



# The Communications and Embedded Products Source Book 2004



**Covering the spectrum  
of Intel communications  
products**



# Communications and Embedded Products Source Book

Welcome to The Intel Communications and Embedded Products Sourcebook—2004, your complete reference guide for Intel's Communications and Embedded products.

As you look through this sourcebook, you will note that all of the sections have been updated to include the latest released products.

As this sourcebook will only be updated once a year, we recommend you look on [www.developer.intel.com](http://www.developer.intel.com) website to get the very latest product information.

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# Embedded Intel® Architecture

Embedded Intel® Architecture (IA) enables embedded system designers to choose from multiple levels of integration, ranging from Intel® processors and chipsets to validated reference designs and highly integrated modular platforms. Whatever level of integration you choose, Intel and its world-class ecosystem provide the building blocks and tools you need to make your embedded solutions *run better, faster and further*:

- Based on emerging industry standards, IA processors are compatible with leading operating systems and supported by a broad third-party ecosystem. Modularity, scalability and standards-based design help customers accelerate time-to-market and reduce cost.
- Embedded Intel® Architecture chipsets provide a reliable platform for high-performance connected embedded applications with the performance, stability, and reliability customers require for embedded computing applications. Intel® chipsets and drivers can help reduce support costs, validation costs, and offer a variety of sell-up opportunities while still providing flexibility and performance at value pricing.
- Embedded IA reference designs and configurations support developers in a variety of market segments including communications, digital security surveillance, interactive clients, storage, learning solutions and print imaging. They may be used off-the-shelf as a market-ready design, or further customized to support additional value-added features.
- Intel provides a wide selection of development kits designed to minimize customers' development efforts and facilitate quick time-to-market. Kits include supporting documents and evaluation software from independent software vendors.
- Intel provides developers with software resources and tools to accelerate the successful development and delivery of IA-based solutions. Intel® Embedded Graphics Drivers specifically target the needs of embedded platform developers, offering an alternative to drivers designed for the desktop and mobile market segments.
- Implementation-ready boards and systems from Intel and third-party vendors are also available to meet your most stringent time-to-market requirements: [www.intel.com/info/eia](http://www.intel.com/info/eia).

## Intel® Xeon™ Processor

The Intel® Xeon™ processor with 512 KB L2 cache and the Low Voltage Intel® Xeon™ processor are the solutions for applications that demand the highest levels of performance in the communications market segment. The Low Voltage Intel Xeon processor has the additional benefit of lower thermal design power, making it ideal for thermally-sensitive, space-constrained environments. Based on the Intel NetBurst® microarchitecture, they feature a 400 MHz and 533MHz system bus, 512KB L2 cache, dual-processor capability, and Hyper-Threading Technology which allows a single physical processor to process two threads of data simultaneously. Support for the Intel Xeon processor with 512 KB L2 cache includes 2.0, 2.4 and 2.8 GHz and 1.6, 2.0 and 2.4 GHz for the Low Voltage Intel Xeon processor.

The Intel Xeon processor with 512 KB L2 cache and the Low Voltage Intel Xeon processor are validated with the Intel® E7500 and the Intel® E7501 chipsets. These chipset designs deliver maximized system bus, memory, and I/O bandwidth to enhance performance, scalability, and end-user productivity.

### INTEL® XEON™ PROCESSOR WITH 512KB L2 CACHE

PRODUCT NUMBER	CORE SPEED (GHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER	VOLTAGE	TCAS	PACKAGE
RK80532KE072512	2.8	533	512K	74.0W	1.5V	75°C	604-pin FC-mPGA-2p
RK80532KE056512	2.4	533	512K	65.0W	1.5V	74°C	604-pin FC-mPGA-2p
RN80532KC041512	2.0	400	512K	58.0W	1.5V	70°C	603-pinINT3

### LOW VOLTAGE INTEL® XEON™ PROCESSOR

PRODUCT NUMBER	CORE SPEED (GHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER	VOLTAGE	TCASE	PACKAGE
RK80532EE056512	2.4	533	512K	40.0W	1.3V	81°C	604-pin FC-mPGA-2p
RK80532EC041512	2.0	400	512K	35.0W	1.3V	83°C	604-pin FC-mPGA-2p
RK80532EC025512	1.6	400	512K	30.0W	1.3V	81°C	604-pin FC-mPGA-2p

## Intel® Pentium® 4 Processor, Intel® Pentium® 4 Processor with Hyper-Threading (HT) Technology, and Intel® Pentium® 4 processor - M

The Intel® Pentium® 4 processor family, with Intel NetBurst® microarchitecture, delivers performance to meet the growing demands of a new generation of leading-edge products, with scalability that helps minimize your total cost-of-ownership. These embedded processors provide the performance headroom needed to meet the heavy application demands of networking, communications and storage appliances, sophisticated interactive clients, industrial automation solutions, digital security surveillance platforms, and imaging devices.

For reliable embedded platform designs, the Intel Pentium 4 processor is validated with the Intel® 845 chipset, the Intel® 845E chipset, the Intel® 845GV chipset, the Intel® 852GME chipset, and the Intel® 875P chipset. The Intel Pentium 4 processor - M is validated with the Intel 845E chipset. The Intel® Pentium® 4 Processor with HT Technology is validated with the Intel 875P chipset. Intel Pentium 4 processor-based platforms include integrated graphics, and support the high-bandwidth I/O performance of USB 2.0 and Gigabit Ethernet networking. Rapid platform development is supported by the latest operating systems, applications and Intel® Architecture development tools, as well as a variety of validated reference designs from Intel. While incorporating Intel's most advanced embedded processor technologies, these processors are software-compatible with previous Intel® Architecture processors.

### INTEL® PENTIUM® 4 PROCESSOR WITH HYPER-THREADING TECHNOLOGY

PRODUCT NUMBER	CORE SPEED (GHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER	VOLTAGE	TCASE	PACKAGE
RK80546PG0801M	3.0	800	1 MB	103W	1.25–1.4V*	5°C–73.5°C	FC-HPGA4 478

\*Variable VID voltage. The Intel Pentium 4 processor with HT Technology ships with different voltage settings. For more detailed information, please refer to our Web site at <http://developer.intel.com/design/intarch/pentium4/pentium4.htm>

### INTEL® PENTIUM® 4 PROCESSOR

PRODUCT NUMBER	CORE SPEED (GHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER	VOLTAGE	TCASE	PACKAGE
RK80532PCE072512	2.8	533	512K	68.4W	1.525V*	5°C–75°C	478 FC-PGA2
RK80532PC064512	2.6	400	512K	62.6W	1.525V*	5°C–72°C	478 FC-PGA2
RK80532PE056512	2.4	533	512K	59.8W	1.525V*	5°C–71°C	478 FC-PGA2
RK80532PC041512	2A	400	512K	54.3W	1.525V*	5°C–69°C	478 FC-PGA2

\*Variable VID maximum voltage

### INTEL® PENTIUM® 4 PROCESSOR - M

PRODUCT NUMBER	CORE SPEED (GHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER	VOLTAGE	TJUNCTION (MAX)	PACKAGE
RH80532GC049512	2.2	400	512K	35.0W	1.3V	100°C	µFC-PGA 478
RH80532GC029512	1.7	400	512K	30.0W	1.3V	100°C	µFC-PGA 478

## Intel® Pentium® M Processor

The Intel® Pentium® M processor is ideal for high-performance, low-power embedded computing, and is designed specifically for communications, transaction terminal, interactive clients, and industrial automation applications. An advanced microarchitecture enables the Pentium M processor to meet embedded computing demands today and in the future. While incorporating new features and improvements, the Intel Pentium M processor remains software-compatible with previous members of the Intel® microprocessor family. It supports uniprocessor designs, and delivers 3.2 GB of data per second into and out of the processor. The Intel Pentium M processor is validated with the Intel E7501 chipset, expanding the processor's platform with a great balance of performance and I/O bandwidth capability for embedded computing segments. This chipset provides up to 4 GB single- or dual-channel DDR200 memory, and features configurable optional Error Correcting Code (ECC) operation.

PRODUCT NUMBER	CORE SPEED (GHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER	VOLTAGE	TJUNCTION	PACKAGE
RH80535GC0251M	1.6	400	1 MB	24.5W	1.484V	100°C	µFC-PGA 478
RJ80535GC0251M	1.6	400	1 MB	24.5W	1.484V	100°C	µFC-PGA 478
RJ80535LC0051M	1.1	400	1 MB	12W	1.180V	100°C	µFC-PGA 478



### Intel® Pentium® III Processor

The Intel® Pentium® III processor is ideal for scalable high-performance applied computing applications. It is validated with multiple chipsets for maximum flexibility and scalability. Combined with the Intel® 840 chipset, the Intel Pentium III processor provides high performance and bandwidth including dual processing support and a second PCI bus. The Intel® 815, Intel® 815E, Intel® 810 and Intel® 810E2 chipsets utilize Intel® Graphics Technology, an integrated graphics platform which provides more stability, higher quality graphics and a reduced OEM bill of materials cost. The Intel® 440BX AGPset supports ECC for the highest data integrity and ISA for legacy I/O. The Intel Pentium III processor with 512K cache is validated with the Intel 815E chipset in uniprocessor mode as well as in dual-processing mode with chipsets from third-party manufacturers.

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER (MAX)	VOLTAGE	TJUNCTION	PACKAGE
RB80526PY600256	600	100	256K	19.6W	1.75V	82°C	370 FC-PGA
RB80526PY700256	700	100	256K	21.9W	1.75V	80°C	370 FC-PGA
RB80526PZ733256	733	133	256K	22.8W	1.75V	80°C	370 FC-PGA
RB80526PY850256	850	100	256K	25.7W	1.75V	80°C	370 FC-PGA
RB80526PZ866256	866	133	256K	26.1W	1.75V	80°C	370 FC-PGA
RB80526PY001256+	1.0GHz	100	256K	29.0W	1.75V	75°C	370 FC-PGA
RB80526PZ001256	1.0GHz	133	256K	29.0W	1.75V	75°C	370 FC-PGA
RK80530KZ012512	1.26GHz	133	512K	29.5W	1.45V	69°C*	370 FC-PGA2

+ For existing embedded applications using the Intel® 440BX chipset only. Drop ship only.  
 \* Tcase, not Tjunction

### Intel® Pentium® III Processor—Low Power

The Intel® Pentium® III processor—Low Power brings the performance of the Pentium III processor to thermally sensitive and space-constrained embedded computing applications. It incorporates Intel’s 0.18-micron manufacturing process, Dual Independent Bus (DIB) architecture and Advanced Transfer Cache, making it ideal for many performance-hungry, thermally sensitive, and space-constrained embedded computing applications such as data communications, telecommunications, industrial automation and transaction terminals.

The Pentium III processor—Low Power also supports MMX™ technology and Internet Streaming SIMD extensions, enabling a more visual experience for the end user and allowing for new applications such as real-time video encoding and speech recognition. Dynamic execution of software instructions within the core processing unit optimizes the workload on the processor, increasing performance. This processor is validated with the Intel® 440BX AGPset and Intel® 440MX PCIset.

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER (MAX)	VOLTAGE	TCASE	PACKAGE
RJ80530KZ933512+	933	133	512K	12.2W	1.15V	0°C–100°C	479 µFC-BGA
RJ80530KZ800512+	800	133	512K	11.2W	1.15V	0°C–100°C	479 UFC-BGA
KC80526GY850256‡	700‡	100	256K	16.1W	1.35V	0°C–100°C	495 BGA
KC80526LY500256	500	100	256K	12.2W	1.35V	0°C–100°C	495 BGA
KC80526NY400256	400	100	256K	10.1W	1.35V	0°C–100°C	495 BGA

+ Supports dual processing when paired with third-party chipsets.  
 ‡ Intel® Pentium® III processor at 850/700 MHz featuring Intel® SpeedStep™ technology (1.6V/1.35V respectively).

### Intel® Pentium® III Processor—Low Power Module

The Intel® Pentium® III processor—Low Power module at 500 MHz provides a scalable solution for existing Intel® Pentium® II processor—Low Power module designs at 266 and 333 MHz, and is the first low-power module to support a 100 MHz system bus. The module includes the Intel Pentium III processor and northbridge of the 440BX AGPset.

## Intel® Pentium® II Processor—Low Power

The Intel® Pentium® II processor—Low Power provides a superior, low-profile, surface-mount solution for applications combining high performance with low power.

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER (MAX)	VOLTAGE	TJUNCTION	PACKAGE
KC80524KX333256	333	66	256K	11.8W	1.6V	0°C–100°C	615 BGA
KC80524KX266256	266	66	256K	9.8W	1.6V	0°C–100°C	615 BGA

## Intel® Celeron® M Processor

The Intel® Celeron® M processor is the next generation of value processors, providing exceptional performance combined with low power. Built on the Intel® 0.13-micron process, it is available at 1.3 GHz, in either µFC-PGA or µFC-BGA packages, with 512 KB of on-die L2 cache. These processors are ideal solutions for communications appliances such as media center appliances, network attached storage, Web pads and other applications with lower power envelopes and BOM requirements. It features a high-performance, low-power core, Advanced Transfer Cache architecture, dynamic execution, and is supported with the Intel® 855GME chipset

PRODUCT NUMBER	CORE SPEED (GHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER (MAX)	VOLTAGE	TJUNCTION	PACKAGE
RJ80535NC013512	1.3	400	512 KB	24.5W	1.356V	0–100°C	479 µFC-BGA
RH80535NC013512	1.3	400	512 KB	24.5W	1.356V	0–100°C	478 µFC-PGA

## Intel® Celeron® Processor

The Intel® Celeron® processor family provides an excellent solution for cost-sensitive applications requiring great performance. It is compatible with Intel® 815E, 815, 810E2 and 810 chipsets; Intel® 82801E C-ICH; Intel 440BX AGPset and 440MX chipset; Intel 815E and 810E2 (1.2 GHz), 845, 845E; 845GV, 852GME, and 875P chipsets (2.0 and 2.5 GHz).

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER (MAX)	VOLTAGE+	TCASE	PACKAGE
RK80532RC060128	2.5 GHz	400	128K	61.0W (TDP)	1.525V	72°C	FC-PGA2 478-pin
RK80532RC041128	2.0 GHz	400	128K	52.8W (TDP)	1.525V	5°C–68°C	FC-PGA2 478-pin
RK80530RY009256	1.2 GHz	100	256K	32.1W	1.5V	70°C	370 FC-PGA2
RB80526PX850128	850	100	128K	26.7W	1.75V	80°C*	370 FC-PGA
RB80526RX733128	733	66	128K	23.6W	1.75V	80°C*	370 FC-PGA
RB80526RX566128	566	66	128K	19.2W	1.75V	90°C*	370 FC-PGA
FV80524RX433128	433	66	128K	24.1W	2.0V	5°C–85°C	370 PPGA
FV80524RX366128	366	66	128K	21.7W	2.0V	5°C–85°C	370 PPGA
FV80524RX300128	300A	66	128K	17.8W	2.0V	5°C–85°C	370 PPGA

\* Max Tjunction

+ Variable VID maximum voltage. The Intel Celeron processor ships with different voltage settings. For detailed product specifications, please refer to <http://developer.intel.com/design/celeron/datashts/251748.htm>

## Intel® Celeron® Processor—Low Power and Ultra Low Voltage

The Intel® Celeron® processor—Low Power and Ultra Low Voltage Intel® Celeron processor provide an exceptional value for thermally sensitive and space-constrained embedded computing applications by combining the optimal balance of cost, performance, and low power. The 400 MHz versions are validated with the Intel 440BX AGPset and Intel 440MX PCIset. The Low Power processor at 300 MHz is validated with the Intel 440MX PCIset. The Ultra Low Voltage processor at 650 MHz is validated with the Intel 440MX PCIset and Intel 815E chipsets.

### INTEL® CELERON® PROCESSOR—LOW POWER

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER (MAX)	VOLTAGE	TCASE	PACKAGE
KC80526LY400A128	400A	100	128K	10.1W	1.35V	0°C–100°C	495 BGA
KC80526LL300128	300	100	128K	5.7W	1.10V	0°C–100°C	495 BGA

**ULTRA LOW VOLTAGE INTEL® CELERON® PROCESSOR**

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	L2 CACHE	THERMAL DESIGN POWER (MAX)	VOLTAGE	TCASE	PACKAGE
RJ80530VY650256	650	100	256K	8.3W	1.10V	0°C–100°C	479 µFC-BGA
RJ80530VY400256	400	100	256K	4.2W	0.95V	0°C–100°C	479 µFC-BGA

**Intel® Pentium® Processor**

The Intel® Pentium® processor is a valuable solution for embedded applications, featuring superscalar architecture, branch prediction, separate code and data caches, a high-performance floating-point unit, enhanced 64-bit data bus, data integrity features, performance monitoring, and execution tracing. Voltage Reduction Technology (VRT) is available with the 133 MHz version resulting in lower power consumption.

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	THERMAL DESIGN POWER (MAX)	VOLTAGE	TCASE	PACKAGE
A8050266166	166	66	14.5W	3.3V	0°C–70°C	296 SPGA
A8050266133	133	66	11.2W	3.3V	0°C–70°C	296 SPGA
A80502CSLM66133	133*	66	7.9W	3.1V	0°C–85°C	296 SPGA
A8050266100	100	66	10.1W	3.3V	0°C–70°C	296 SPGA

\* With Voltage Reduction Technology (VRT)

**Intel® Pentium® Processor with MMX™ Technology and Low-Power Intel® Pentium® Processor with MMX™ Technology**

From point-of-sale (POS) terminals and retail kiosks to advanced networking equipment, Pentium® processors with MMX™ technology enable developers of embedded systems to step up to new levels of performance. To make these designs even easier and more flexible, Intel is making the performance advantages of MMX technology available at a choice of integration levels:

- Longer life cycle support for the 200 MHz and 233 MHz versions
- Low-power Pentium processors with MMX technology at 166 MHz and 266 MHz
- Synchronous DRAM [SDRAM] support with the Intel® 430TX PCIset

**INTEL® PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY**

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	THERMAL DESIGN POWER (MAX)	VOLTAGE	TCASE	PACKAGE
FV8050366233	233	66	17.0W	2.8V	0°C–70°C	296 PPGA
FV8050366200	200	66	15.7W	2.8V	0°C–70°C	296 PPGA

**LOW-POWER INTEL® PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY**

PRODUCT NUMBER	CORE SPEED (MHz)	EXTERNAL BUS SPEED (MHz)	THERMAL DESIGN POWER (MAX)	VOLTAGE	TCASE	PACKAGE
FV80503CSM66166	166	66	4.5W	1.9V	0°C–85°C	296 PPGA
FV80503CSM66266	266	66	7.6W	1.9V	0°C–85°C	296 PPGA
GC80503CSM66166	166	66	4.1W	1.8V	0°C–95°C	352 HL-PBGA
GC80503CSM66266	266	66	7.6W	2.0V	0°C–95°C	352 HL-PBGA
GC80503CS166EXT	166	66	4.1W	1.8V	-40°C–+115°C	352 HL-PBGA

## SL Enhanced Intel486™ Processor Overview

The Intel486™ microprocessors provide 32-bit high performance in increasingly complex application environments. Current customers of the embedded Intel386™ processor can take advantage of the Intel486 processor architecture to extend the performance of their embedded designs.

The Intel® SL Technology featured in the Intel486 processors, allow designers to build intelligent power management capabilities into hardware, making these capabilities independent of application software. Power management becomes an integral part of the system, regardless of what operating system or application is used. Power management is improved because Intel SL Technology protects the power management features from conflicting with other software.

FEATURES	BENEFITS
32-bit address Memory Management Unit (MMU)	<b>High performance and compatibility.</b> The Intel486™ MMU is compatible with the Intel386™ processor MMU
Intel® SL Technology for intelligent power management capabilities <ul style="list-style-type: none"> <li>▪ Static design</li> <li>▪ Automatic on-chip clock control</li> <li>▪ Stop Clock, Stop Grant, Auto Halt Power Down, I/O Restart</li> <li>▪ System Management Mode (SMM)</li> </ul>	<b>Capabilities.</b> Application-independent power management Energy efficiency. Intel SL Technology enables embedded system designs that exceed the Environmental Protection Agency's (EPA) Energy Star program guidelines without compromising performance
Single-cycle instruction execution	<b>Speed and efficiency.</b> Faster execution
On-chip unified code and data cache	<b>Increased performance and efficiency.</b> Reduces external memory fetches and decreases bus traffic
Burst data bus mode	<b>Speed.</b> Supports demanding data-intense applications by enabling fast cache fills
JTAG boundary scan	<b>Diagnostics.</b> Allows for in-system processor diagnostics

## Intel486™ SX Embedded Processor Overview

The embedded Intel486™ SX processor provides high performance to 32-bit, embedded applications that do not require a floating-point unit. The embedded Intel486 SX processor is binary-compatible with the Intel386 and earlier Intel processors. Compared with the Intel386 processor, it provides faster execution of many commonly used instructions.

It also provides the benefits of an integrated, 8-Kbyte, write-through cache for code and data. Its data bus can operate in burst mode, which provides up to 106 Mbps transfers for cache-line fills and instruction prefetches. Two component packages are available: a 196-lead Plastic Quad Flat Pack (PQFP), and a 168-Pin Grid Array (PGA), both available for 5 volt designs. Both products operate at CLK frequencies up to 33 MHz.

## Ultra-Low-Power Intel486™ SX/GX Embedded Processor Overview

The Ultra-Low-Power Intel486™ SX/GX embedded processors were developed specifically for the embedded market. They bring strong performance to low-cost, entry-level, embedded applications, where maximum energy efficiency is a high concern. These low-power technology improvements allow for new packaging options for the Intel486 processor. The Ultra-Low-Power Intel486 SX/GX processors come in the 176 lead Thin Quad Flat Pack (TQFP) package. This is the smallest, lowest profile Intel486 processor in the world. At 25.4 mm x 25.4 mm x 1.5 mm, the 176 lead TQFP package is the same size and thickness as a United States quarter (25¢ coin)!

FEATURES	BENEFITS
Dual Vcc design for standard 3.3V I/O VccP and lower core Vcc	<b>Efficiency.</b> Ideal for battery-powered, portable applications
Digital phase lock loop or DDL for minimum clock start-up time	<b>Maximizes power savings.</b> The DDL takes a maximum of 8 input clock periods (240ns at 33 MHz) to synchronize, approximately 4,000 times faster than a standard Intel486™ processor with PLL design
32-bit external data path in the Ultra-Low-Power Intel486™ SX 16-bit external data path in the Ultra-Low-Power Intel486™ GX	<b>Performance and flexibility.</b> Multiple system design options with true 32-bit architecture
On-chip 8K unified code and data cache	<b>Increased performance and efficiency.</b> Reduces access cycles to external memory
Burst data bus capable of: ▪59 MB/sec transfer at 33 MHz, or DRAMs	<b>Cost reduction.</b> Maintains system throughput with inexpensive DRAMs
176-lead TQFP and product packaging	<b>Compact.</b> Ideal for the most compact designs. This is the smallest, lowest profile Intel486 processor in the world!

### IntelDX2™ and IntelDX4™ Processor Overview

The IntelDX2™ and IntelDX4™ processors bring the highest level of performance in the Intel486 processor family, created by such combined features as speed-multiplying technology, on-chip integration of Level I unified code and data cache, memory management unit with paging, and floating-point unit. The clock-multiplier allows the processor to operate at frequencies higher than the external memory bus. The integer unit uses RISC design techniques to provide single-clock-cycle execution of common instructions and general-purpose registers for manipulating 32-bit addresses and data. The 8K on-chip Write-Through unified cache on the speed-doubled IntelDX2 processor, and the 16K on-chip Write-Back Enhanced unified cache on the speed-tripled IntelDX4 processor maintains the one-clock-per-instruction execution rate. Intel486 processors provide support for multiprocessing systems. Support for multi-level caches reduces bus utilization, allowing multiple Intel486 processors to share a single memory bus. For the highest levels of performance, choose the IntelDX2 and IntelDX4 processors.

FEATURES	BENEFITS
Complete 32-bit RISC-technology integer core and 32-bit external data bus	<b>Performance.</b> For the most data-intensive applications
On-chip floating-point unit	<b>Performance.</b> Highest Intel® x86 integration reduces inter-chip communication
IntelDX2™ processor speed doubling: ▪66 MHz core speed using 33 MHz bus clock at 5V ▪50 MHz core speed using 25 MHz bus clock at 3.3V IntelDX4™ processor speed tripling: ▪100 MHz core speed using 33 MHz bus clock at 3.3V	<b>Performance and flexibility.</b> Multiple frequency choices provide greater flexibility in system designs The IntelDX4 processor supports both speed-doubling and speed-tripling technology
Burst data bus: ▪80Mbps max. burst bus cycle at 25 MHz ▪106Mbps max. burst bus cycle at 33 MHz	<b>Performance.</b> For instruction prefetch and for filling the internal cache

### INTEL486™ PROCESSOR (not all speeds are available in all packages)

PRODUCT	SPEED (MHz)	I/O PINS	SERIAL PORTS	TIMERS/ CTRS	STATIC DESIGN	SYS MGT MODE	A20 GATE	DMA CHAN	WDT	CHIP SELECT	INTERRUPT CLR	DRAM REFRESH	CORE SPEED MULTI	CACHE	BURST DTAT BUS	INPUT LEVELS	VOLTAGE	PACKAGE	TEMP
<b>INTEL486™ PROCESSOR FAMILY</b>																			
80486DX4 32-bit bus	100	0	NO	0	YES	YES	NO	0	NO	0	NO	NO	3X CLK	16Kb, WB	YES	CMOS	3.3V	A168, FC208	C
80486DX2 32-bit bus	50, 66	0	NO	0	YES	YES	NO	0	NO	0	NO	NO	2X CLK	8Kb, WT	YES	CMOS	5.0V-3.3V	A168, SB208	C
80486SX 32-bit bus	33	0	NO	0	YES	YES	NO	0	NO	0	NO	NO	N/A	8Kb, WT	YES	CMOS	5.0V	A168, KU196	C
80486SXF 32-bit bus	33	0	NO	0	YES	YES	NO	0	NO	0	NO	NO	N/A	8Kb, WT	YES	CMOS	3.3V	FA176	C
80486GSF 16-bit bus	33	0	NO	0	YES	YES	NO	0	NO	0	NO	NO	N/A	8Kb, WT	YES	CMOS	3.3V	FA176	C

## Intel386™ Processor Overview

For over 10 years, Intel386 processors have provided the computer industry with reliability and high performance. Initially built as the host CPU for PCs, these processors are still readily available and continue to provide 32-bit processing power for embedded applications. Thanks to the Intel386 processor core design, the new pin-for-pin compatible family enables higher performance, extended temperatures and lower power and voltage capabilities for embedded systems than was previously possible.

FEATURES	BENEFITS
32-bit CPU	<b>Performance.</b> Performance processing at 5 to 10 MIPS
80386 instruction set	<b>Compatibility.</b> Compatibility with all PC applications, development and operating system software
16 MB–4 GB addressability	<b>Expandable.</b> Head room for software growth for future system product enhancements
Protected mode	<b>Security.</b> Ability to develop large, OS-based embedded system; provides restricted access privileges
SL enhanced SMM support	<b>Capabilities.</b> Application-independent power management

## Intel386™ EX Integrated Processor Overview

The Intel386™ EX processor provides high integration and PC compatibility for embedded applications. Intel based the EX on the same static Intel386 processor 32-bit core, and incorporated PC-compatible and traditional embedded peripherals to provide a high-performance, extended temperature, low power, low voltage and an integrated embedded solution.

FEATURES	BENEFITS
PC-compatible peripherals (8254, 8259A, enhanced 8237A)	<b>Portability.</b> Easy portability of application software developed on a PC
16450-compatible serial ports	<b>Compatibility.</b> Standard protocol familiar and well supported within the industry
DMA-supported serial transfers	<b>Efficient.</b> Reduces CPU load
Dynamic bus sizing enables interface to 8- or 16-bit peripherals	<b>Reduces costs.</b> Lowers total system cost
Synchronous serial I/O	<b>Boosts rates.</b> Provides higher data transfer rates (baud rate generator on-chip vs. standard Intel386™ processors)
JTAG boundary scan	<b>Diagnostics.</b> Allows for in-system processor diagnostics

## INTEL386™ PROCESSOR (not all speeds are available in all packages)

PRODUCT	SPEED (MHz)	I/O PINS	SERIAL PORTS	TIMERS/CTRS	STATIC DESIGN	SYS MGT MODE	A20 GATE	ADD SPACE	DMA CHAN	CLK WDT	CLK GEN	PWR OPTIONS	CHIP SELECT	INTERRUPT CTLR	DRAM REFRESH	INPUT LEVELS	VOLTAGE	PACKAGE	TEMP
<b>INTEL386™ PROCESSOR FAMILY</b>																			
80386SX	20, 25, 33	0	NO	0	NO	NO	NO	16M	0	NO	NO	NO	0	NO	NO	TTL	5.0V	NG100	C
80386DX	20, 25, 33	0	NO	0	NO	NO	NO	4G	0	NO	NO	NO	0	NO	NO	TTL	5.0V	A132, NG132	C
80386SXTA	25, 33, 40	0	NO	0	YES	NO	NO	16M	0	NO	NO	NO	0	NO	NO	TTL	5.0V	KU100	C, E
<b>INTEL386™ INTEGRATED PROCESSOR FAMILY</b>																			
80386EXTB	25	24	3	3	YES	YES	YES	64M	2	YES	NO	PD, I	8	YES (8259A)	YES	TTL	3.3V	KU132, FA144	E
80386EXTC	25	24	3	3	YES	YES	YES	64M	2	YES	NO	PD, I	8	YES (8259A)	YES	TTL	5.0V	KU132, FA144	E
80386EXTC	33	24	3	3	YES	YES	YES	64M	2	YES	NO	PD, I	8	YES (8259A)	YES	TTL	5.0V	KU132, FA144	E

### Intel386™ Processor Development Tools

Because the Intel386 processor is a member of the Intel architecture family, the leading architecture used in PCs, a broad range of familiar, low-cost development tools are readily available.

Growth and competition in the PC industry have produced tools that are time-proven and run on the PC, which eliminates the need for expensive workstation-based development tools. For example, the Microsoft\* and Borland\* development tools, used to create more than 50,000 PC applications, can now be used in an embedded environment. For more information about development tools support, refer to the Tools section in this catalog or contact your Intel sales representative or visit our Web site at <http://appzone.intel.com/toolcatalog/>.

### Intel® 186 Processor Overview

For the Intel® 186 standard processor family, the numbers tell the story: more than 10,000 design wins and 100 million units have shipped in its 16 years of production. With the Intel 186 family of products, you can determine the cost and performance requirements for your embedded design and then choose from a wide variety of options: CHMOS, 8- and 16-bit external bus versions and available in commercial/extended temperatures.

The 80C186/188XL family is pin-for-pin compatible with the 80186/188 family and adds an enhanced feature set. The high-performance CHMOS process allows the 80C186/188XL to run at twice the clock rate of the HMOS 80186/188 while consuming less than one-fourth the power.

FEATURES	BENEFITS
16-bit static CPU (XL operating at 25 MHz)	<b>Performance.</b> Performance >1 MIP
8086 instruction set	<b>Development.</b> Use PC for easier software development and debugging
1-MB addressing	<b>Memory.</b> Large address space (for programs and data). Can also use bank switching for > 1 MB
On-chip peripherals	<b>Integration.</b> High x86 integration enables low-cost and low-chip-count designs
8-bit external bus available	<b>Flexibility.</b> Lower memory and system cost
Multiple packaging options 68L (LCC, PLCC, PGA) and 80L (QFP, SQFP)	<b>Packaging.</b> Supports varied system requirements
CMOS inputs and outputs	<b>Noise.</b> Improved noise margins

### Intel® 186 Enhanced Processor Overview

In 1990, Intel designed these processors to meet performance, integration and power consumption needs. Intel created a modular core architecture in order to easily proliferate the family. The 80C18xEX (EA/EB/EC) family features an improved 1.0-micron static core design, and all of the enhanced products run at 25 MHz. In addition, the Ex family products incorporate new features (serial channels, DRAM refresh control and power management) to provide more functionality. The Ex core has also been enhanced to run at 3 volts.

FEATURES	BENEFITS
3-stage power management unit	<b>Power management.</b> Efficient power consumption
3V versions	<b>Low power.</b> Enables portable, battery-powered designs
Watchdog timer (EC only)	<b>High integration.</b> Ensures system integrity in hostile environments
Serial channels (EB/EC only)	<b>Avoid interrupt latency.</b> Facilitates interprocessor communication and modem interface
I/O ports (EB/EC only)	<b>Communication.</b> Ability to communicate externally via standard protocols

**INTEL® 186 PROCESSOR (not all speeds are available in all packages)**

PRODUCT	SPEED (MHz)	I/O PINS	SERIAL PORTS	TIMERS/CTRS	STATIC DESIGN	SYS MGT MODE	A20 GATE	ADD SPACE	DMA CHAN	CLK WDT	CLK GEN	PWR OPTIONS	CHIP SELECT	INTERRUPT CTRL	DRAM REFRESH	INPUT LEVELS	VOLTAGE	PACKAGE	TEMP
<b>INTEL® STANDARD PRODUCT FAMILY</b>																			
80C186XL/188XL	12, 20	0	NO	3	YES	NO	NO	1M	2	NO	YES	PS	13	YES	YES	TTL	5.0V	A68, N68, R68, S80, SB80	C, E
80C186XL/188XL	25	0	NO	3	YES	NO	NO	1M	2	NO	YES	PS	13	YES	YES	TTL	5.0V	A68, N68, R68, S80, SB80	C
<b>INTEL® ENHANCED PRODUCT FAMILY</b>																			
80C186EA/188EA	25	0	NO	3	YES	NO	NO	1M	2	NO	YES	PS, PD, I	13	YES	YES	CMOS	5.0V	N68	C
80C186EA/188EA	13, 20	0	NO	3	YES	NO	NO	1M	2	NO	YES	PS, PD, I	13	YES	YES	CMOS	5.0V	N68	E
80L186EA/188EA	13	0	NO	3	YES	NO	NO	1M	2	NO	YES	PS, PD, I	13	YES	YES	CMOS	3.0V	N68	E
80C186EB/188EB1	25	16	2	3	YES	NO	NO	1M	0	NO	YES	PD, I	10	YES	YES	CMOS	5.0V	N84, S80, SB80	C
80C186EB/188EB	13, 20	16	2	3	YES	NO	NO	1M	0	NO	YES	PD, I	10	YES	YES	CMOS	5.0V	N84, S80, SB80	E
80L186EB/188EB	16	16	2	3	YES	NO	NO	1M	0	NO	YES	PD, I	10	YES	YES	CMOS	3.3V	N84, S80, SB80	C
80L186EB/188EB	13	16	2	3	YES	NO	NO	1M	0	NO	YES	PD, I	10	YES	YES	CMOS	3.0V	N84, S80, SB80	E
80C186EC/188E	25	22	2	3	YES	NO	NO	1M	4	YES	YES	PS, PD, I	10	YES (8259A)	YES	CMOS	5.0V	KU100, CS100, SB100	C
80C186EC/188EC	13, 20	22	2	3	YES	NO	NO	1M	4	YES	YES	PS, PD, I	10	YES (8259A)	YES	CMOS	5.0V	KU100, S100, SB100	E
80L186EC/188EC	16	22	2	3	YES	NO	NO	1M	4	YES	YES	PS, PD, I	10	YES (8259A)	YES	CMOS	3.3V	KU100, S100, SB100	C
80L186EC/188EC	13	22	2	3	YES	NO	NO	1M	4	YES	YES	PS, PD, I	10	YES (8259A)	YES	CMOS	3.0V	KU100, S100, SB100	E

**PACKAGING:**

**A** = Ceramic Pin Grid Array (PGA), **KU** = Plastic Quad Flat Pack (PQFP), **R** = Ceramic Leadless Chip Carrier (LCC), **N** = Plastic Leaded Chip Carrier (PLCC), **NG** = Plastic Quad Flat Pack (PQFP), **S** = Quad Flat Pack (QFP-EIAJ), **SB** = Shrink Quad Flat Pack (SQFP-EIAJ), **FA** = Thin Quad Flat Pack (TQFP), **FC** = Shrink Quad Flat Pack with heat spreader (PQ2 PowerQuad), **X** = SmartDie product

	A	KU	R	N	NG	S	SB	FA	FC
Intel486™ Processor	168ld	196ld						176ld	208ld
Intel386™ Processor	132ld	132ld			100ld, 132ld (DX)			144ld	
Intel186® Processor	68ld	100ld	68ld	68ld, 84ld (EB)		80ld, 100ld (EC)	80ld, 100ld (EC)		

**POWER OPTIONS**

**PD** = Power Down, **PS** = Power Save, **I** = Idle

**TEMPERATURE RANGES: (Degrees Centigrade)**

**C** = Commercial (0°C to +70°C), **E** = Extended (-40°C to +85°C).

Additional product information is always available via the World Wide Web

**Intel® 186 Processor Development Tools**

There are many tools available for developing embedded systems with the Intel 186 product family. In fact, Intel 186 processors are compatible with Intel386 processor development tools and the PC architecture. This compatibility provides access to a wide array of familiar, low-cost development tools.

Growth and competition in the PC industry have produced tools that are time-proven and run on your PC, which eliminates the need for expensive workstation-based development tools. For example, the Microsoft and Borland development tools, used to create more than 50,000 PC applications, can now be used in an embedded environment. For more information about development tools support, refer to the Tools section in this catalog or contact your Intel sales representative or visit our Web site at <http://appzone.intel.com/toolcatalog/>.



**EMBEDDED INTEL® ARCHITECTURE CHIPSETS**

**Intel® 875P Chipset**

The Intel® 875P chipset-based platform delivers performance and high scalability for today’s cutting-edge e-Business and e-Home applications while maintaining a balance of price and performance for embedded computing solutions. It is designed, validated and optimized for Intel Pentium 4 processors with Intel NetBurst® microarchitecture, including the Intel® Pentium® 4 Processor with Hyper-Threading (HT) Technology. The Intel 875P chipset consists of the Intel® 82875P Memory Controller Hub (MCH) and the Intel® 6300ESB I/O Controller Hub (ICH) to provide exceptional graphics bandwidth and support the latest graphics controllers needed to meet the demands of today’s communications and embedded computing market segments. Communication Streaming Architecture (CSA), featuring a Dedicated Network Bus (DNB), enables real Gigabit Ethernet performance by eliminating the PCI bottleneck and providing a direct path to system memory. An optional Intel® 82547 Gigabit Ethernet Controller readily connects to CSA. Advanced packaging technology and industry-leading electrical design innovations deliver long-term system reliability over wide operating conditions.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURE
Intel® 82875P Memory Controller Hub	82875P	1005 FC-BGA	400/533/800 MHz system bus DDR266/333/400 SDRAM with ECC AGP 8X graphics interface CSA network interface
Intel® 6300ESB I/O Controller Hub	FW80001ESB	689 µBGA	PCI 32/33 and PCI-X 64/66 Serial and parallel ATA interfaces USB 2.0 and serial ports AC'97 support Watchdog timer, 37 GPIOs

**Intel® 852GME Chipset**

The Intel® 852GME Chipset for Embedded Computing is an optimized integrated graphics solution featuring low-power design. The 400/533 MHz system bus and integrated 32-bit 3D core at 133 MHz (at 533 MHz system bus) deliver a high-bandwidth connection between the processor and the platform. It supports the Intel® Pentium® 4 and the Intel® Celeron® processors with Intel NetBurst® microarchitecture, and supports up to 2 GB of DDR266/333 system memory, providing the performance and high scalability required for today’s cutting-edge e-Business and e-Home applications. The Intel 852GME chipset is part of Intel’s comprehensive validation process that enables fast deployment of next-generation platforms to maximize competitive advantage while minimizing development risks. It features integrated graphics utilizing Intel® Extreme Graphics 2 technology, enhanced sound quality and AGP 4X support, along with advanced packaging technology and industry-leading electrical design innovations to deliver long-term system reliability over wide operating conditions. Three USB host controllers provide high-performance peripherals with 480 Mbps of bandwidth, while enabling support for up to six USB 2.0 ports. This results in a significant increase over previous integrated 1-4 port hubs at 12 Mbps.

PRODUCT NAME	PRODUCT CODE	PACKAGING	FEATURES
852GME Memory Controller Hub (GMCH)	RG82852GME	732 micro-FC-BGA	DDR266/333 Memory Integrated graphics support 400 MHz or 533 MHz System Bus
I/O Controller Hub 4	FW82801DB	421 micro-BGA	Direct connection to MCH with Intel® Accelerated Hub Architecture Supports 32-bit PCI IDE controllers with ATA/100 Six USB ports with USB 2.0 support AC'97 controller with 20-bit audio support Integrated LAN connect interface

## Intel® 855GME Chipset

The Intel® 855GME Chipset for Embedded Computing is an optimized integrated graphics solution featuring low-power design. A 400 MHz system bus and integrated 32-bit 3D core at 133 MHz, support the Intel® Pentium® M processor and associated microarchitecture and up to 2 GB of DDR333 system memory, providing the performance and high scalability required for today's cutting-edge embedded computing applications. The Intel 855GME chipset is part of Intel's comprehensive validation process that enables fast deployment of next-generation platforms to maximize competitive advantage while minimizing development risks. It features integrated graphics utilizing Intel® Extreme Graphics 2 technology and AGP 4X support, along with advanced packaging technology and industry-leading electrical design innovations to deliver long-term system reliability over wide operating conditions. Three USB host controllers provide high-performance peripherals with 480 Mbps of bandwidth, while enabling support for up to six USB 2.0 ports. Intel® Application Accelerator software provides additional performance over native ATA drivers by improving I/O transfer rates and enabling faster O/S load time, resulting in accelerated boot times. Communication and Network Riser (CNR) offers flexibility in system configuration with a baseline feature set that can be upgraded with an audio card, modem card, or network card. Error Correcting Code (ECC) support is available in integrated graphics mode only.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
855GME Memory Controller Hub (GMCH)	RG82855GME	732 micro-FC-BGA	400 MHz system bus DDR333 Memory Integrated graphics support
I/O Controller Hub 4	FW82801DB	421 micro-BGA	Direct connection to MCH with Intel® Accelerated Hub Architecture Supports 32-bit PCI IDE controllers with ATA/100 Six USB ports with USB 2.0 support AC'97 controller with 20-bit audio support Integrated LAN connect interface

## Intel® 6300ESB I/O Controller Hub

The Intel® 6300ESB I/O Controller Hub (ICH) supports development of next-generation solutions for the communications and general embedded market segments. It is designed for use with the Intel® 875P Memory Controller Hub (MCH) and the Intel® 855GME Graphics Memory Controller Hub (GMCH), providing board designers with a variety of platform options to address price, performance and packaging needs. The Intel 6300ESB ICH can be designed into platforms with processors ranging from the Intel® Pentium® M processor to Intel® Celeron® and Intel® Pentium® 4 processors, in socket 478 packaging. PSB configurations are available at 400 MHz, 533 MHz and 800 MHz. The 6300ESB ICH is a derivative of the Intel® 82801EB (ICH5) and builds upon the ICH5 design by improving bandwidth via PCI-X 64/66 and PCI 32/33 support. It also provides port 60/64 emulation, dual 16500-compatible UARTs for overall BOM cost savings, a two-stage watchdog timer, and 37 GPIOs including four High Drive GPIOs. The Intel 6300ESB ICH and associated drivers help reduce support and validation costs, and offer a variety of sell-up opportunities while still providing flexibility and performance at value pricing. Flexible memory support allows for 200, 266, 333 or 400 MHz DDR SDRAM to be designed in, enabling cost-effective, high-volume memory.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® 6300ESB I/O Controller Hub	FWE6300ESB	689 µBGA	Direct connection to the GMCH via Hublink 1.5 Designed for use with the Intel® 875P MCH and Intel® 855GME GMCH PCI-X 64/66 and PCI 32/33 support Dual integrated UARTS PATA/100 and SATA/150 support Four USB 2.0 ports

### Intel® E7500 and E7501 Chipsets

The Intel® E7500 chipset and E7501 chipset are validated with the Intel Xeon processor with 512 KB L2 Cache and the Low Voltage Intel Xeon processor. This chipset design delivers maximized system bus, memory, and I/O bandwidth to enhance performance, scalability, and end-user productivity. ECC protection, coupled with high data transfer rates, supports I/O segments with greater reliability and faster access to high-speed networks. Four DIMMs per channel (eight DIMMs total) allow a maximum memory configuration of 16 GB. Single or dual DDR200 or DDR266 memory channels are supported for up to 4.3 GB/s of memory bandwidth. Up to three 64-bit PCI/PCI-X Controller Hub 2.0 (P64H2) devices can connect to the MCH, each providing a maximum bandwidth greater than 1 GB/s. Each P64H2 contains two independent 64-bit, 133 MHz PCI-X interfaces and two PCI hot-plug controllers.

#### INTEL® E7500 CHIPSET

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® E7500 Memory Controller Hub (MCH)	RGEE7500PL	1005 FC-BGA	400 MHz System Bus Advanced Platform RASUM, ECC
Integrated Controller Hub (ICH3-S)	FW82801CA	421 BGA	64-bit PCI/PCI-X Controller Hub-2 allows up to 6 PCI-X buses per system
64-bit PCI/PCI-X Controller (P64H2)	RG82870P2	567 FC-BGA	Dual-channel DDR200 memory interface for up to 3.2 GB/s memory bandwidth Uni or dual-processor capable ECC, parity for application critical environments

#### INTEL® E7501 CHIPSET

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® E7501 Memory Controller Hub (MCH)	RGE7501MC	1005 FC-BGA	400/533 MHz System Bus Advanced Platform RASUM
Integrated Controller Hub (ICH3-S)	FW82801CA	421 BGA	64-bit PCI/PCI-X Controller Hub-2 allows up to 6 PCI-X buses per system
64-bit PCI/PCI-X Controller (P64H2)	RG82870P2	567 FC-BGA	Dual-channel DDR266 memory interface for up to 4.3 GB/s memory bandwidth Uni or dual-processor capable ECC, parity for application critical environments

### Intel® 845, Intel® 845E and Intel® 845GV Chipsets

The Intel® 845 chipset family is designed, validated, and optimized for the Intel Pentium 4 processor with Intel NetBurst microarchitecture, using proven and established building blocks. Intel 845 chipset-based platforms extend the capabilities of the Intel Pentium 4 processor with an excellent balance of price and performance for embedded computing segments.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® 82845 Memory Controller Hub (MCH)	RG82845	593 FC-BGA	400 MHz System Bus SDR PC133, 3GB max DDR1600/2100 Memory, 2GB max AGP4X interface enables over 1 GB/s of graphics bandwidth ECC, parity for application critical environments PCI 2.2
Intel® 82845E Memory Controller Hub (MCH)	RG82845E	593 FC-BGA	400/533 MHz System Bus DDR200/266 Memory, 2GB max AGP4X interface enables over 1GB/s of graphics bandwidth ECC, parity for application critical environments PCI 2.2
Intel® 82845GV Memory Controller Hub (GMCH)	RG82845GV	760 FC-BGA	400/533 MHz System Bus SDR PC133, 2GB max DDR200/266/333 Memory, 2GB max; 2 DIMM, No ECC Integrated Intel® Extreme Graphics
I/O Controller Hub 2 (ICH-2) for 845 MCH only	FW82801BA	360 EGBA	Direct connection to Intel 82845 MCH with Intel® Accelerated Hub Architecture Supports 32-bit PCI IDE controllers with ATA/100 Four USB ports, USB 1.1 compliant AC'97 controller with 6-channel sound Integrated LAN connect interface
I/O Controller Hub 4 (ICH-4) for 845E and 845GV only	FW82801DB	421 BGA	Direct connection to Intel 82845E and Intel 82845GV MCH with Intel® Accelerated Hub Architecture Supports 32-bit PCI IDE controllers with ATA/100 Six USB ports with USB 2.0 support AC'97 controller with 6-channel sound Integrated LAN connect interface

## Intel® 82801E C-ICH

The Intel® 82801E C-I/O Controller Hub (ICH) is specifically suited for use within the communications and network appliance market segments. It is designed for use with a variety of Graphics Memory Controller Hubs (GMCHs) providing board designers with outstanding scalability in a single board design. The Intel 82801E C-ICH can be designed into embedded computing platforms with processors that range from the Intel Pentium III to Intel Celeron processors.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® 82801E Communications I/O Controller Hub (C-ICH)	FW82801E	421 BGA	<ul style="list-style-type: none"> <li>Direct connection to the GMCH with Intel® Accelerated Hub Architecture</li> <li>Designed for use with the Intel® 810, Intel® 815E, and Intel® 815 GMCHs</li> <li>Dual Integrated MACs and Dual Integrated UARTs for overall system cost savings</li> <li>Supports 32-bit PCI</li> <li>IDE Controllers with ATA/100</li> <li>Two USB ports</li> </ul>

## Intel® 840 Chipset

The Intel 840 chipset is validated with the Intel Pentium III processor and features support for 100 or 133 MHz system bus speeds, single- or dual-processor configuration, ECC on memory, high memory bandwidth, large memory capacity, AGP 4X, and a second PCI bus (64-bit/66 MHz) for high-performance I/O.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Memory Control Hub (MCH)	FW82840	544 BGA	<ul style="list-style-type: none"> <li>Dual processing capability</li> <li>Dual memory channels for up to 3.2Gbps memory bandwidth</li> <li>16-bit wide implementation of accelerated hub architecture for high-performance concurrent PCI I/O with the P64H</li> <li>AGP 4X port</li> </ul>
I/O Control Hub (ICH)	FW82801AA	241 BGA	<ul style="list-style-type: none"> <li>Direct connection to the MCH with Intel® Accelerated Hub Architecture</li> <li>Supports 32-bit PCI</li> <li>IDE controllers</li> <li>Dual USB ports</li> </ul>
4 MB Firmware Hub*	N82802AB	PLCC	System BIOS and video BIOS
Contact your local Intel field sales representative for product availability			Intel Random Number Generator (RNG) for stronger encryption, digital signing, and security protocols
8 MB Firmware Hub*	E82802AC	TSOP	System BIOS and video BIOS
	N82802AC	PLCC	Intel® Random Number Generator (RNG) for stronger encryption, digital signing, and security protocols
<i>*Must be purchased as separate component</i>			
<b>Optional components of the Intel® 840 chipset:</b>			
64-bit PCI Controller Hub (P64H)	FW82806AA	241 BGA	<ul style="list-style-type: none"> <li>Supports 64-bit PCI slots at speeds of either 33 or 66 MHz</li> <li>Connects directly to MCH using Intel Accelerated Hub Architecture</li> <li>Dedicated path for high-performance I/O</li> </ul>
RDRAM Memory Repeater Hub (MRH-R)	FW82803AA	324 BGA	Converts each memory channel into two for expanded memory capacity

### Intel® 815 and Intel® 815E Chipsets

The Intel 815 and Intel 815E chipsets provide the highest degree of processor scalability supporting the Intel Celeron processor at 566 MHz to the Intel Pentium III processor with 512K cache at 1.26 GHz. The chipsets support processor side bus speeds of 66, 100 and 133 MHz. The Intel 815 and Intel 815E chipsets also provide graphics scalability through the use of Intel® graphics, an add-in Graphics Performance Accelerator (GPA) card, or an add-in AGP 4X card.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Graphics and AGP Memory Controller Hub (GMCH)	FW82815	544 BGA	Intel® Accelerated Hub Architecture 133/100/66 MHz PSB PC133/100 SDRAM, No ECC Integrated scalable graphics Intel® 3D graphics with direct AGP Overall BOM cost savings External AGP port with the option for up to 4 MB of dedicated display cache video memory
I/O Control Hub (ICH) for Intel® 815	FW82801AA	241 BGA	Direct connection to the GMCH with Intel Accelerated Hub Architecture Supports 32-bit PCI IDE Controllers with ATA66 Dual USB ports AC'97 controller with 4 Channel Sound
I/O Control Hub 2 (ICH2) for Intel® 815E	FW82801BA	360 EBGA	Direct connection to the GMCH with Intel Accelerated Hub Architecture Supports 32-bit PCI IDE Controllers with ATA100 Four USB ports AC'97 controller with 6-Channel Sound Integrated MAC
4 MB Firmware Hub* Contact your local Intel field sales representative for product availability	N82802AB	PLCC	System BIOS and video BIOS Intel® Random Number Generator (RNG) for stronger encryption, digital signing, and security protocols
8 MB Firmware Hub*	E82802AC N82802AC	TSOP PLCC	System BIOS and video BIOS Intel Random Number Generator (RNG) for stronger encryption, digital signing, and security protocols

\*Must be purchased as separate component

### Intel® 810 and Intel® 810E2 Chipsets

The Intel 810 chipset provides processor scalability supporting the Intel Celeron processor at 300 MHz to the Intel Pentium III processor at 800 MHz and above, with processor side bus speeds of 66 and 100 MHz. The Intel 810E2 chipset adds support for 133 MHz processor side bus speed. These chipsets optimize system memory arbitration, similar to AGP technology, resulting in a more responsive and cost-effective system. They help reduce overall system cost by integrating graphics into the memory controller.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® 810 Graphics and AGP Memory Controller Hub (GMCH)	FW82810	421 BGA	Intel® Accelerated Hub Architecture 66/100 MHz PSB, PC66/100 SDRAM, No ECC Intel® 3D graphics with Direct AGP Overall BOM cost savings
Intel® 810E2 Graphics and AGP Memory Controller Hub (GMCH)	FW82810E	421 BGA	Intel Accelerated Hub Architecture 66/100 MHz PSB, PC66/100 SDRAM, No ECC Intel 3D graphics with Direct AGP Overall BOM cost savings Optional 4MB of dedicated display cache video memory (100 or 133 MHz)
I/O Control Hub (ICH) for Intel® 810	FW82801AA	241 BGA	Direct connection to the GMCH with Intel Accelerated Hub Architecture Supports 32-bit PCI IDE Controllers with ATA66 Dual USB ports AC'97 controller with 4-channel sound
I/O Control Hub 2 (ICH2) for Intel® 810E2	FW82801BA	360 EBGA	Direct connection to the GMCH with Intel Accelerated Hub Architecture Supports 32-bit PCI IDE Controllers with ATA100 Four USB ports AC'97 controller with 6-channel sound Integrated MAC
4 MB Firmware Hub* Contact your local Intel field sales representative for product availability	N82802AB	PLCC	System BIOS and video BIOS Intel® Random Number Generator (RNG) for stronger encryption, digital signing, and security protocols
8 MB Firmware Hub*	E82802AC N82802AC	TSOP PLCC	System BIOS and video BIOS Intel Random Number Generator (RNG) for stronger encryption, digital signing, and security protocols

\*Must be purchased as separate component

## Intel® 440BX AGPset

The Intel Pentium III processor, Intel Pentium III processor—Low Power, Intel Pentium II processor—Low Power, Intel Celeron processor and Intel Celeron processor—Low Power families are supported by the Intel 440BX AGPset. The system controller provides support for SDRAM, the interface to the PCI bus, and the interface to the AGP port. The PIIX4E provides the PCI to ISA interface, USB support, and many other features necessary to maintain PC compatibility. The Intel 440BX AGPset operates at both 66 and 100 MHz, providing plenty of headroom for future generations of Intel Pentium III and Intel Celeron processors. Both chips in the Intel 440BX AGPset use a BGA package providing improved layout and signal integrity.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® 440BX Northbridge	FW82443BX	1 x 492 BGA	AGPset support, 66/100 MHz SDRAM, 66/100 MHz PSB
Intel® PIIX4E Southbridge	FW82371EB	1 x PIIX4E 324 BGA	USB Support ACPI-compliant power management ECC, parity for application critical environments Concurrent PCI

## Intel® 440MX PCIsset

The Intel 440MX is a low-power, single-component chipset specifically designed to reduce system cost, space and power. The Intel 440MX chipset supports low-power Intel Celeron and Intel Pentium III designs. The Intel 440MX is offered in the small form factor, 492 Ball Grid Array (BGA) package with a typical power dissipation of 2.1W making it an effective solution for fanless applications.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® 440MX	FW82443MX100	492 BGA	Combines the Intel® 440BX AGPset core architecture and PIIX4 southbridge into a single chip Advanced power management features AC'97 link interface based on Intel® AC'97 Specification v 2.1 PC100 SDRAM and ECC 100 MHz PSB

## Intel® PCIssets

The Intel® 430TX PCIsset is a high integration two-chip solution with BGA packaging, which minimizes board real estate requirements while reducing failure points. It closes the power consumption gap and enables new applications by delivering mobile-style power management with the highest performance. The Intel 430TX PCIsset is available in extended temperature range (-40° to +115°C), which enables a complete solution when joined with the 166 MHz lower-power Intel Pentium processor extended temperature version.

The Intel® 430HX PCIsset is a two-chip solution featuring uncompromised EDO memory timings, optimized CPU to PCI performance, additional buffering and arbitration and writeback enhancements. The Intel 430HX PCIsset also supports USB, ECC and parity.

PRODUCT	PRODUCT CODE	PACKAGE	FEATURES
Intel® 430HX Northbridge	FW824391HX	1 X TXC 324 BGA	PCI 2.1, 64 Mbit DRAM, 66 MHz PSB, No ECC
Intel® PIIX3 Southbridge	SB82371SB	1 X PIIX3 208 QFP	L2 cache controller Concurrent PCI USB support ECC, parity for application critical environments
Intel® 430TX Northbridge	FW82439TX	1 X MTXC 324 BGA	PCI 2.1, 66 MHz PSB, SDRAM, No ECC
Intel® PIIX4E Southbridge	FW82371EB	1 X PIIX4E 324 BGA	L2 cache controller Optimized for Pentium® processor with MMX™ technology Dynamic Power Management Architecture SDRAM Support USB Support Concurrent PCI Ultra DMA hard drive protocol

## EMBEDDED INTEL® REFERENCE DESIGNS AND CONFIGURATIONS

Embedded Intel Architecture reference designs support developers in a variety of market segments, including communications, storage, interactive clients, learning solutions, and print imaging. These reference designs may be used off-the-shelf as a market-ready design, or further customized to support additional value-added features. This allows developers to focus technical resources on strategic product innovation and customized applications in order to accelerate time-to-market while reducing the risk of hardware development.

Schematics are available for download at no cost from Intel’s Developer Web site. In addition, Intel’s growing family of reference designs provides these key benefits:

- Accelerated and economical implementation of leading-edge technologies
- Shortened platform selection and design cycle
- Simplified customization with scalable and flexible platforms
- Extended component life cycles and broad software application support

### Reference Designs for Communications

[http://developer.intel.com/platforms/applied/eiacomm/reference\\_configs.htm](http://developer.intel.com/platforms/applied/eiacomm/reference_configs.htm)

Intel provides building blocks that work together in specific configurations to accelerate development of networked storage and other communications applications, including load balancing, network attached storage and storage area networking equipment, network security, Virtual Private Networks, Voice over IP (VoIP), and Web caching. With these proof-of-concept designs, including downloadable schematics, developers can quickly develop boards that scale in processor and I/O performance.

## COMMUNICATIONS APPLIANCE REFERENCE DESIGNS

PRODUCT	PROCESSOR	SPEED	CHIPSET	ETHERNET	CATEGORY
Performance Communications Appliance Intel® E7501	Intel® Pentium® M processor	1.6 GHz	Intel E7501	82546, 82551	Performance
Intel® 845E	Dual Intel® Xeon™ processors or Low Voltage Intel Xeon processors	1.6–2.4 GHz	Intel E7501	82559, 82554GC	Performance
Intel® Communications ICH	Intel® Pentium® 4 processor or Mobile Intel® Pentium® 4 processor-M	1.7–2.4 GHz	Intel 845E	82551QM, 82540EM	Value
Intel® 815E	Intel® Celeron® or Intel® Pentium® III processors	566 MHz–1.26 GHz	Intel® 815E GMCH +82801E C-ICH	82559, 82562ET	Value
Intel® 810	Intel Celeron or Intel Pentium III processor	566–733 MHz	Intel 815E	82559ER, 82562ET	Value
Intel® 815E Entry	Intel Celeron or Intel Pentium III processor	300–700 MHz	Intel 810	82559ER	Value
Intel® 440MX Entry-Level	Ultra Low Voltage Intel Celeron processor	400–650 MHz	Intel 815E	82551ER	Entry
Intel® 440BX Entry-Level	Intel Celeron processor—Low Power	400 MHz	Intel 440MX	82559ER	Entry
	Intel Celeron processor 300A	300 MHz	Intel 440BX/PIIX4E	82559ER	Entry

## INTEL® NETSTRUCTURE™ BOARD REFERENCE DESIGNS

PRODUCT	PROCESSOR	SPEED	CHIPSET	ETHERNET	ETHERNET PORTS
ZT 5524 High Performance	Dual Intel® Pentium® III Processors with 512K L2 Cache	933 MHz	ServerWorks® LE	82546, 82550	Dual Gigabit
ZT 5515 Value	Intel® Pentium® 4 processor-M	1.2 GHz	Intel® 845E	82546	Dual Gigabit

## BLADE REFERENCE CONFIGURATION

PRODUCT	PROCESSOR	SPEED	CHIPSET	ETHERNET	CATEGORY
Intel® 440MX Entry PrPMC	Ultra Low Voltage Intel® Celeron® processor or Intel® Pentium® III processor—Low Power	300–700 MHz	Intel® 440MX	NA	Entry

## Interactive Client Reference Configurations

[http://developer.intel.com/design/intarch/platforms/iaclient/reference\\_configs.htm](http://developer.intel.com/design/intarch/platforms/iaclient/reference_configs.htm)

Interactive Clients are widely used in a variety of market segments including retail, hospitality and other environments where financial, information, or other transactions take place. Applications for interactive clients are evolving from the simple act of processing financial transactions, such as at a cash register or ATM, to becoming an integral part of the business environment. Interactive Clients are now being used to interface to other enterprise resources for business-critical applications such as targeted marketing, Customer Relationship Marketing (CRM), labor management, and employee training. Kiosks and other self-service terminals are being rapidly deployed to provide more customer access points on-premises, or to provide access to goods or services that are not immediately available on-site. Interactive Client development also includes the integration of numerous peripherals a system might use, including network interfaces, audio, LCD touch screens, pole displays, cash drawers, scanners, printers, and other peripherals.

PRODUCT	PROCESSOR	SPEED	CHIPSET	ETHERNET	CATEGORY
Intel® 852 with Intel® Pentium® 4 processor	Intel Pentium 4 processor	2.0 to 2.6 GHz	Intel® 852GME chipset with ICH4	82551QM, 82540EM, 82562EZ	Performance Scalability
Intel® 845E	Intel Pentium 4 processor and Intel® Pentium® 4 Processor-M	Up to 2.53 GHz	Intel 845E	82551	Performance
Intel® 815E	Ultra Low Voltage Intel® Celeron® processor	400–650 MHz	Intel 815E	82551ER	Low-Power
Intel® 815	Intel Pentium III or Intel Celeron processor	566–866 MHz	Intel 815	82562ET	Value
Intel® 810 Embedded Client	Intel Pentium III or Intel Celeron processor	300–850 MHz	Intel 810	82559ER	Value
Intel 810	Intel Pentium III or Intel Celeron processor	566–866 MHz	Intel 810	82562ET	Value

## Intel® Print Imaging Reference Configurations

[http://developer.intel.com/design/intarch/platforms/printimg/reference\\_configs.htm](http://developer.intel.com/design/intarch/platforms/printimg/reference_configs.htm)

Increasing pages per minute and transition to color are driving the need for increased CPU performance and Intel® Print Imaging solutions continue to bring increasing benefit to the enterprise. These high-performance, scalable, and low-power Print Imaging reference configurations offer:

- High performance, high I/O bandwidth and maximum CPU performance, ideal for high I/O bandwidth applications such as high-speed color commercial print solutions.
- Scalability, performance and value, designed for applications such as midrange multi-function units and digital copiers.
- Low power and value, intended for low-power and fanless applications such as entry-level color laser and fast monochrome printers.

PRODUCT	PROCESSOR	SPEED	CHIPSET	ETHERNET	CATEGORY
Intel® E7501	Intel® Xeon™ processor	2.0 GHz	Intel E7501	82551, 82559	High Performance
Intel® 845GV	Intel® Pentium® 4 or Intel® Celeron® processor	2.0 GHz	Intel 845GV	82551, 82559	Scalable
Intel® 845E	Intel Pentium 4 or Intel Celeron processor	1.7–2.2 GHz	Intel 845E	82551, 82559	Scalable
Intel® 815E	Intel® Pentium® III or Intel Celeron processor	1.26 GHz	Intel 815E	82551, 82559	Low Power



## Reference Configuration for Student Learning Station

[http://developer.intel.com/platforms/applied/studentstation/reference\\_config.htm](http://developer.intel.com/platforms/applied/studentstation/reference_config.htm)

Intel Architecture-based processors, chipsets and other components can be used in designs for student learning terminals.

PRODUCT	PROCESSOR	SPEED	CHIPSET	ETHERNET	CATEGORY
Student Computing Station	Intel® Celeron® processor	300A, 366, 433 MHz	Intel® 810	GD 82559	Entry

## Development Kits

Intel provides a wide selection of development kits to support the products on its roadmap. These kits are offered with supporting documents and evaluation software from independent software vendors. Intel’s development kits are designed to minimize the customers’ development efforts and facilitate quick time-to-market.

PRODUCT NUMBER	PRODUCT NAME	PROCESSOR SUPPORT	CHIPSET	PACKAGING	MEMORY
EID875PDEVKIT	Intel® 875P MCH with Intel® 6300ESB ICH Chipset	Intel® Pentium® 4 processor, Intel® Pentium® 4 Processor with Hyper-Threading Technology or Intel® Celeron® processor	Intel 875P MCH and Intel 6300ESB ICH	478 µFC-PGA	Up to 4GB DDR SDRAM at 400/333/266 MHz
EIDPM855FBDVKT	Intel® Pentium® M Processor with Intel® 855GME MCH and Intel 6300ESB ICH Chipset	Intel Pentium M processor at 1.6 GHz	Intel 855GME GMCH and Intel 6300ESB ICH	478 µFC-PGA	200/266/300 MHz DDR SDRAM
EIDPM855HDDVKT	Intel Pentium M Processor with Intel 855GME and Intel® FW82801DB	Intel Pentium M processor at 1.6 GHz	Intel 855GME GMCH	478 µFC-PGA	2GB or 266 MHz DDR SDRAM
EIDPME7501DEVKIT	Intel Pentium M processor with Intel® E7501	Intel Pentium M processor at 1.6 GHz	Intel E7501 chipset	478 µFC-PGA	2 GB or 266 MHz DDR SDRAM
EIDXE7501DEVKIT	Intel E7501 Scalable Performance Board	Dual Low Voltage Intel® Xeon™ processors (1.6 GHz) or Dual Intel Xeon processor (2.4 GHz)	Intel® E7501	Socket 604	256 MB DDR, expandable to 8 GB DDR
EIAP3840DEVKIT	Intel® Pentium® III Processor/Intel® 840	Dual Intel Pentium III processors (866 MHz)	Intel 840 w/MCH, ICH, P64H and FWH	FC-PGA	Dual 64 MB RDRAM RIMMS
EIDP3815BDEVKIT	Intel® 815E Scalable Performance Board	Intel® Celeron® processor (566 MHz) through Intel Pentium III processor (1.26 GHz)	Intel 815/815E	FC-PGA or PC-PGA2	128 MB SDRAM, expandable to 512 MB SDRAM
EIAP3FMBDEVKIT	Intel® 440BX Scalable Performance Board	Intel Pentium III processor (850 MHz)	Intel 440BX AGPset	PC-PGA	32 MB SDRAM
EIACEL18FMBDEVKIT	Intel 440BX Scalable Performance Board	Intel Pentium III processor (850 MHz) or Intel Celeron processor (850 MHz)	Intel 440BX AGPset	PC-PGA	32 MB SDRAM
EIACEL25FMBDEVKIT	Intel 440BX Scalable Performance Board	Intel Pentium III processor (850 MHz) or Intel Celeron processor (433MHz)	Intel 440BX AGPset	PC-PGA	32 MB SDRAM
EIDPLPMXDEVKIT	Intel® 440MX Scalable Low Power Board	Intel Celeron processor—Ultra Low Power (700 MHz) or Intel Pentium III processor—Low Power (500 or 700 MHz)	Intel 440MX AGPset	µPGA	128 MB SDRAM, expandable to 256 MB SDRAM
EID845GVDEVKIT	Intel® 845GV Scalable Performance Board	Intel Celeron processor (2.0 GHz)	Intel 845GV	Socket 478	256 MB DDR, expandable to 2 GB DDR

# Intel® Personal Internet Client Architecture

## Accelerating Wireless Application Development

The convergence of wireless phones and handheld digital devices is advancing daily. To keep pace with this wave of next-generation wireless devices, development of hardware and software must be able to occur along separate paths.

The open architectural framework of the Intel® Personal Internet Client Architecture (Intel® PCA) allows separate development of applications and communication subsystems and speeds development and deployment of wireless Internet devices, applications, and services. It helps enable you to innovate new wireless Internet devices, applications, and services faster than ever before.

## Design Independence

Intel PCA decouples the applications subsystem from the communication subsystem through an open physical and logical bus interface, while providing a link to memory subsystem.

The benefit: you can now drive application development to improve functionality and reduce time-to-market, with independence from communication standards.

## Outstanding Flexibility

Intel PCA framework enables you to design a single platform to support a broad range of products, from cell phones and smart phones to PDAs and automotive clients. Intel PCA supports application compatibility across multiple levels of hardware integration to protect your platform design and software investments.

The benefit: Intel PCA provides consumer and corporate users greater availability of applications, broader deployment of services and networks, and more capable wireless platforms. Applications developers will benefit from shorter development cycles and an open architecture that allows for rapid adaptation of applications across platforms and devices, resulting in faster time-to-market.

It's these benefits that make it easy to understand why Intel PCA has such wide industry support.

## INTEL® PCA PRODUCTS

**Intel PCA Application Processors:** Intel PCA processors, based on the Intel XScale® microarchitecture, deliver advanced integration, leadership multimedia performance and superior power savings for full-featured wireless cell phones, communicators and PDAs.

## INTEL® PXA27X PROCESSOR FAMILY

The Intel® PXA27x processors are the first Intel XScale technology-based processors to include Intel® Wireless MMX™ technology to enable high-performance multimedia acceleration with an industry proven instruction set.

## Building Tomorrow's Handheld Today

Designed from the ground up for wireless clients and incorporating the latest Intel advances in mobile technology, the Intel PXA27x processor family redefines what a wireless handheld can do by incorporating innovative new features while borrowing and enhancing others from the world of the PC. The Intel PXA27x processors are the first Intel XScale technology-based processors to include Intel Wireless MMX technology to enable high-performance multimedia acceleration

with an industry proven instruction set. Another innovative feature is the Intel® Quick Capture Technology which provides one of the industry's most flexible and powerful camera interfaces for capturing digital images and video. And while performance abounds in the Intel PXA27x processor, power consumption is also a critical component. The new capabilities of Wireless Intel SpeedStep® Technology provide a quantum leap forward in low-power operation. Finally, the Intel PXA27x family stacks Intel StrataFlash® memory and low-power SDRAM with the processor for more functionality in a smaller footprint.

### **Advanced Multimedia Capability**

Instead of using additional processors or accelerators that can reduce battery life, Intel Wireless MMX technology provides an advanced set of multimedia instructions that will help bring desktop-like multimedia performance to Intel PXA27x processor-based clients while minimizing the power needed to run rich applications. Intel Wireless MMX technology builds on the Intel® MMX™ technology originally introduced in the Pentium® processor family, enabling the large number of software developers already familiar with these instructions to quickly make their applications such as 2-D and 3-D gaming, streaming MPEG4 video, wireless encryption/decryption, Digital TV reception and voice recognition available for Intel®-based cell phones and PDAs.

### **High-Quality Pictures and Video on a Cell Phone, PDA**

The ability to send and receive digital pictures or video clips has been one of the fastest-growing developments in the cell phone and PDA segments worldwide. Intel Quick Capture Technology, an interface that allows imaging capabilities to be incorporated into phones and PDAs, improves image quality and reduces the overall cost of adding digital image capabilities to mobile devices.

Intel Quick Capture Technology is designed to provide the ability to capture live video and high-quality still images from a wide range of camera sensors in current and future camera-enabled mobile handsets and PDAs. Performing the image processing on the Intel PXA27x processor reduces the need for an external preprocessor, helping save both on cost and power. Intel Quick Capture Technology consists of three primary modes of operation: Quick View mode (providing low-power, real-time previews), Quick Shot mode (providing high-resolution image capture up to 4+ megapixels) and Quick Video mode (providing full-motion, high-quality video capture).

### **Steps to Lowering Power**

First available in the Intel PXA27x processor family, Wireless Intel SpeedStep Technology provides the ability to dynamically adjust the power and performance of the processor based on CPU demand. This can result in a significant decrease in power consumption for wireless handheld devices to increase standby and talk-time.

Wireless Intel SpeedStep Technology advances the capabilities of functions already built into the Intel XScale microarchitecture by incorporating three new low-power states and using advanced Wireless Intel SpeedStep Power Manager Software to intelligently manage the power and performance needs for the end user. The technology is able to change both voltage and frequency on-the-fly, saving additional power while still providing the necessary performance to run rich applications.

## Using Wireless Data Faster

Hooking up application processors to communications products today is a non-standard, high-power, and slow performing prospect. Enter Intel® Mobile Scalable Link (Intel® MSL) a next-generation, scalable, and low-power communications link between application processors and communication processors. This dedicated link was created by Intel to help meet industry requirements for a high-speed interface to supply next-generation clients with data from next-generation networks. Intel MSL supports multiplexed interfaces for data and voice, while supporting up to 14 simultaneous transfers at speeds of up to 416Mbps. The result is quicker development times for faster time-to-market, longer battery life, and improved real-time video telephony and multimedia streaming for clients. Intel MSL will be incorporated into all future Intel® processor products designed for wireless, handheld devices.

## Getting More from Less

In the wireless handheld market segment, space is everything. Customers are demanding thinner, lighter and more flexible handhelds that do not sacrifice features. The challenge is to integrate the features that customers want while simultaneously reducing the size and weight of wireless handheld devices packaging. The Intel PXA27x processor family paves the way toward thinner, lighter designs by stacking variations of Intel® Flash and low-power SDRAM in a space-saving 14x14-mm package. The PXA27x processor family supports the tight space requirements for today's 3G wireless handheld applications while providing scalable solutions for tomorrow's generation of platforms.

## A Trusted Hardware Solution

The Intel PXA27x processor family incorporates the Intel® Wireless Trusted Platform that is designed to provide platform trust and robust security services required for today's wireless devices. Built around the concepts developed by the Trusted Computing Group\* (TCG) industry forum, Intel Wireless Trusted Platform is comprised of hardware and software components that are designed to provide services such as secure boot, secure storage of private information and keys, cryptographic acceleration, and key management support for common security protocols such as Virtual Private Networks (VPN), Secure Sockets Layer (SSL), and Open Mobile Alliance Digital Rights Management (OMA-DRM). The Intel Wireless Trusted Platform also provides the tools to enable OEMs to prevent the reprogramming of International Mobile Equipment Identifiers (IMEI) thus helping reduce handset theft and fraud.

## Development Ecosystem

Intel is a leader in creating comprehensive developer ecosystems for processors. The Intel PXA27x processor family products are code compatible with all ARM\* and Intel XScale technology-based solutions providing an opportunity for developers and manufacturers to maintain their code investments. In addition, the Intel PXA27x family will be supported by the ecosystem of reference platforms compilers, debuggers, code analyzers, codecs, and integrated primitives for performance, graphics and security. In addition, Intel will make available OS board support packages that include drivers and power management software for Linux, Palm\* OS, Symbian\*, Microsoft (CE.Net\*, Smartphone\* and Pocket PC\*) as well as Nucleus\* and SavaJe\*. A number of third-party applications developers are optimizing for Intel Wireless MMX technology today, through Intel's Wireless Competency Center's worldwide. All this provides the manufacturer with one of the most exhaustive choices of software and development hardware in the industry.

## The Intel® PXA27x Applications Processor Advantage

FEATURES	BENEFITS
Intel XScale® Technology	Highly scalable core up to 624 MHz
Secure Solution	The Intel® Wireless Trusted Platform: Security trusted services such as trusted boot, secure storage of private information, and support for security protocols such as VPN, SSL, OMA, IMEI and OMA-DRM
Incredible Multimedia	Familiar Intel® Wireless MMX™ technology instructions designed for high-performance multimedia, 3-D games and advanced video
Advanced Camera Interface	Intel® Quick Capture technology supports 4+ Megapixel cameras for capturing digital images, video and low-power, real-time previews
Enhanced LCD Controller	Dual-Panel LCD up to 24-bit color. Hardware color space conversion with 256 Kbytes of on-chip SRAM for faster video. Two overlays to reduce LCD bandwidth. Integrated with Intel Quick Capture technology to enable fast video preview.
Reduced Power Consumption	Wireless Intel SpeedStep® technology with five low-power modes can change frequency and voltage dynamically. Wireless Intel SpeedStep Power Manager software enables built-in, intelligent power management
Fast Access to Wireless Data	Intel® Mobile Scalable Link provides up to 416 Mbps link between communications and applications processors
Large Peripheral Set	USB Host/Client USB OTG 4-bit SD I/O MMC/SDCard Memory Stick USIM card interface Keypad controller PCMCIA/CF ICP
Memory Interface	100 MHz memory bus supports a variety of 1.8V, 2.5V, 3.0V and 3.3V memory
Less Space	For greater memory density and flexibility Up to 64 Mbytes Intel StrataFlash® Memory 32 Mbytes Intel StrataFlash and 32 Mbytes Low-Power SDRAM

## INTEL® PXA255 PROCESSORS

### Wireless Internet Content at Intel Speed

Mobile and wireless devices simplify our lives, keep us entertained and increase productivity. Each day businesses and individuals rely on them more and more. But, to continue satisfying ever-increasing customer demands to communicate and access information anytime, anywhere, manufacturers need technologies that deliver high performance, flexibility and robust functionality—all in the small-size, low-power framework of portable, battery-powered products. The Intel Personal Internet Client Architecture (Intel PCA) applications processors with Intel XScale technology push handheld device functionality to new heights. With a seven-stage pipeline and faster processing speeds, these microprocessors enable wireless devices to meet the performance demands of Enterprise-class wireless computing and feature-hungry technology consumers. All while Intel's power management capabilities deliver unparalleled operating efficiency. By reducing component count and board space, lowering power consumption, minimizing system costs and shortening time-to-market, Intel PCA applications processors deliver solid competitive advantage and superior handheld devices.

### Intel® PXA255 High-Performance Applications Processor Packing feature-rich devices with multimedia performance.

For advanced devices that run the most impactful mobile applications, the Intel® PXA255 Applications Processor is the answer. This highly integrated, 32-bit RISC processor combines the efficiency of Intel design with the industry-standard ARM\* v.5TE instruction set architecture and the processing power of built-in multimedia capabilities for superior performance and unmatched handheld functionality. This enables increased end-user functionality, the longest battery life and a richer handheld Internet experience. Based on the Intel XScale technology, the Intel PXA255 cost-effectively boosts processing speed and power management for one of the industry's best MIPS/mW ratio. Larger memory caches and gated clocks ensure faster functions with lower power dissipation. And the processing capabilities of the Intel PXA255 enable portable devices to respond faster to optimized operating systems and performance-intensive applications like MP3 audio decode, MPEG4 video decode, speech and handwriting recognition, and Java\* interpretation. From surfing animated Web sites to streaming video to mixing MP3s, the Intel PXA255 delivers processing power for superior performance.

### The Development Framework for Wireless Advancement

Outstanding performance and low power consumption are only the beginning when you develop with the Intel PXA255 applications processor. Our robust software and hardware development environment offers a large library of ARM-compliant applications and tools, as well as an array of wireless operating systems and tool chains to ease application development and system prototyping. The Intel® Integrated Performance Primitives (Intel® IPP) library promises easy access to an array of low-level, cross-platform software algorithms for high-demand communications, signal processing, mathematics and media functions. The Intel IPP's highly optimized implementation helps reduce battery consumption through more efficient CPU execution, enables developers to focus on value-add features, and speeds time-to-market. With the Intel PCA development ecosystem, you have the resources you need to deliver the features your consumers want—efficiently and effectively.

### Intel® Personal Internet Client Architecture The blueprint for next-generation wireless development

With Intel Personal Internet Client Architecture (Intel PCA), the next generation of wireless Internet devices, applications and services are at hand. This open, standards-based architecture separates communication and computing subsystems for parallel development of related wireless devices hardware and software. The scalability of the Intel PCA platform ensures compatibility with leading operating systems and global wireless standards to make porting applications or services across devices and platforms easy and efficient. And with the superior performance of optimized Intel® wireless hardware and software building blocks, Intel makes the promise of a dynamic, multimedia wireless Internet a reality.

The Intel PCA Developer Network offers device manufacturers, service providers and application developers easy access to the applications, tools and services that speed market penetration and encourage consumer adoption of Intel PCA-based products. This Web-based community offers platform and software development kits; programming tools; software building blocks; technical information; marketing program opportunities; community networking; and market exposure to help developers build value in their Intel PCA products, applications and services.

### Intel® PXA255 At-A-Glance:

#### High Performance:

- Low-power, high-performance 32-bit Intel XScale core-based CPU—200, 300, and 400MHz
- ARM Architecture v.5TE compliant and application code compatible with Intel® SA1110 processor for rapid upgrade
- Intel® Super pipelined RISC technology utilizing advanced Intel® 0.18µ process for high core speeds at low power
- Intel® Media Processing Technology including 40-bit accumulator and 16-bit SIMD to enhance audio/video decode performance
- High-performance glue-less burst and page mode interfaces with Synchronous Intel StrataFlash® Memory

#### Low Power:

- Low power and Turbo modes for optimal battery life
- 32 KB data and 32 KB instruction caches
- 2 KB Mini data cache for streaming data
- Support for 2.5 and 3.3V memories

#### I/O Expansion:

- Integrated Memory and PCMCIA/Compact Flash Controller with 100 MHz Memory Bus, 16-bit or 32-bit ROM/Flash/ SRAM (six banks), 16-bit or 32-bit SDRAM, SMROM (four banks), as well as PCMCIA and Compact Flash for added functionality and expandability
- System Control Module includes 17 dedicated general-purpose interruptible I/O ports, real-time clock, watchdog and interval timers, power management controller, interrupt controller, reset controller, and two on-chip oscillators

#### Wireless:

- Peripheral Control Module offers 16-channel configurable DMA controller, integrated LCD controller with unique DMA for fast color screen support, Bluetooth\* I/F, serial ports (IrDA, I<sup>2</sup>C\*, I<sup>2</sup>S\*, AC'97, three UARTs, SPI and SSP), USB end point interface, and MMC/SD Card Support for expandable memory and I/O functionality
- 17x17 mm 256-pin PBGA

### The Intel® PXA255 Applications Processor Advantage

FEATURES	BENEFITS
High-performance, low-power Intel XScale® core at 200, 300 and 400 MHz. Micro-power management including low-power modes and Turbo mode application acceleration	Ideal for high-performance personal digital assistants and wireless communicators
Intel® Media Processing Technology	Optimized audio and video multimedia functionality
Enhanced Memory Controller	Supports lower power 2.5V and 3.3V 32-bit and 16-bit memories as well as glue-less burst and page mode interfaces with Synchronous Intel StrataFlash® Memory
MMC/SD and PCMCIA/CF Card support	Expandable storage and I/O device support
USB Client	Fast host synchronization
1.84 MHz cellular baseband interface	Efficient communications integration
920 Kbs Bluetooth* interface	Broad inter-device communication
Variable latency I/O	Add-on functionality capabilities

## INTEL® PXA26X PROCESSOR FAMILY

An ideal solution for the low-power, space-sensitive cellular phone market segment, the Intel® PXA26x processor family takes portable multimedia processing and integrated memory to breakthrough application performance levels and physical space savings. The Intel PXA26x processor family continues the promise of delivering leadership building blocks based on the Intel Personal Internet Client Architecture (Intel PCA) for the wireless, handheld market segment.

The Intel® PXA261 and Intel® PXA262 processors are the first Intel PCA processors based on Intel's Multiple-Chip Product (MCP) packaging technology. This innovative technology utilizes an Intel XScale technology-based processor with integrated peripherals which are "stacked" in a single package with either 128 Mb (Intel PXA261) or 256 Mb (Intel PXA262) of Intel StrataFlash memory utilizing an internal 16-bit wide memory data bus. This enables higher levels of integration and space savings than previous generations of standalone products.

Based on Intel XScale technology, the Intel PXA26x processor family delivers high performance and low power, while providing processing capabilities that allow wireless handsets to respond quickly to performance-intensive applications like MPEG4 video decode, speech and handwriting recognition, and Java interpretation. Featuring integrated peripherals, the Intel PXA261 and Intel PXA262 processors offer wireless designers expanded functionality, such as an integrated LCD controller with its own Direct Memory Access (DMA) as well as Multi-Media, Secure Digital and CompactFlash (MMC/SD/CF) card support for expandable memory and greater versatility.

A variety of communication ports, including Universal Serial Bus (USB), Infrared (IrDA), I<sup>2</sup>S and AC'97 audio codec interfaces, high-speed Bluetooth\* and Baseband interfaces, Universal Asynchronous Receive and Transmit (UART), and Synchronous Serial Port (SSP) enable fast synchronization and communication with other devices.

Manufactured using Intel's 0.18-micron process technology, the integrated Intel StrataFlash memory offers unprecedented value, performance and reliability, and remains the industry's lowest cost-per-bit NOR Flash memory solution featuring 2-bit-per-cell technology.

The Intel PXA26x processor family uses a small 13x13x1.4 mm package, reducing board space and placement costs by using one integrated component instead of multiple discrete Flash and processor components. The Intel PXA26x processor family also provides enhanced scalability within the same envelope, as all derivative configurations utilize the same package and same ball footprint, eliminating the need to redesign a device's main Printed Circuit Board (PCB).

Complementing the Intel PXA26x processor family is a robust software and hardware development environment. Developers have access to a large library of ARM-compliant applications and tools plus an abundant set of key wireless operating systems and tool chains, including real-time and interactive development systems. Developers can use these resources to build libraries of new feature-rich, industry-leading applications for Intel XScale technology-based products and reduce overall time-to-market.

Finally, Intel delivers Intel Integrated Performance Primitives (Intel IPP) for Intel XScale technology-based processors that helps enable designers to develop applications that can be ported to run on any Intel® processor and the Intel® Flash Data Integrator (Intel® FDI) for Intel StrataFlash Memory which helps designers enable handheld devices to handle the complex features and demands of Internet storage data. This combination allows highly optimized platforms for wireless handheld devices that incorporate all the benefits of Intel PCA.

### Key Applications

- Data-enabled Cellular phones
- Smartphones
- Wireless Communicators



## The Intel® PXA26x Applications Processor Advantage

FEATURES	BENEFITS
Multi-Chip Product Packaging Technology	Helps reduce board size and placement costs by using one component instead of three discrete components
Small package	Features 13x13x1.4 mm package, 0.65 ball pitch, 294 balls
Scalability within same footprint	Reduces design cycles by allowing derivative configurations (from high end to entry level) in the same package and same ball footprint, helping eliminate the need to redesign PCB and allows pin-for-pin drop-in of alternate configurations
High-performance, low-power Intel XScale® core at 200 and 300 MHz	Ideal for wireless devices that require low power and advanced application performance. ARM* v.5TE ISA compliant
Micro-power management	Offers low-power modes and “Turbo mode” application to improve processing acceleration with efficient power consumption
Intel® Media Processing Technology	Helps optimize audio and video multimedia functionality through an integrated 40-bit accumulator
Enhanced Memory Controller	Supports lower power 2.5V to 3.3V 32- and 16-bit memories as well as glue-less burst and page mode interfaces with Synchronous Intel StrataFlash® memory
Storage Card support	Supports industry-standard expandable storage and I/O devices, including Multi-Media, Secure Digital and CompactFlash cards
USB Client	Fast host synchronization with USB host
1.84 MHz cellular baseband interface	Efficient communications integration with cellular baseband
920 Kbs Bluetooth* interface	Broad inter-device communication through industry-standard wireless link
Intel StrataFlash Memory 128 Mb or 256 Mb K3/L30	Utilizes reliable and proven two-bit-per-cell technology. High-performance and high-density Intel® Flash memory. Synchronous burst mode maximizes MIPS

**Intel® PCA Cellular Processors:** Intel PCA Cellular Processors are fully integrated cellular and application processors that are at the heart of an advanced total system solution for today’s GSM/GPRS mobile phones. Intel PCA Cellular Processors deliver leading-class performance, with industry-leading application headroom for voice and computation-intensive data applications.

**Intel® PXA800F Cellular processor:** The Intel PXA800F Cellular Processor is designed for mainstream GSM/GPRS handsets. This high-performance, power-efficient processor integrates Intel XScale technology with Intel® On-Chip Flash memory and Intel® Micro Signal Architecture, jointly developed with Analog Devices, Inc.\*, delivers class-leading performance, with industry-leading headroom to support computation-intensive voice and data applications for mainstream mobile phones.

### Product Highlights

- Full GSM/GPRS Class 12 solution
- High-performance/Low-power Intel XScale technology core, providing class-leading headroom for rich data applications
- Intel Micro Signal Architecture
- Intel On-Chip Flash Memory

**Intel® PXA800F Cellular Processor Features Intel XScale® Technology**

- High-performance, power-efficient processor supports data-intensive applications
- Processor core operates at an adjustable clock frequency up to 312 MHz
- Instruction cache and Data cache memories
- 4 MB integrated Intel On-Chip Flash memory
- 512 KB integrated SRAM
- Memory controller supports synchronous Flash mode, page mode Flash, SRAM, SDRAM, and variable latency
- DMA controller
- Clock units—GSM slow clocking, GSM frame timing, watchdog, RTC
- Supports a wide range of standard interfaces—SIM, UART, USB, I<sup>2</sup>C, SPI, SSP, Digital Audio Interface, MultiMediaCard, Secure Digital Card, Sony Memory Stick, Dallas\* 1-Wire\* Interface, keypad, PWM D/A, JTAG
- Interfaces for Bluetooth, IrDA, GPS and digital camera peripherals
- LCD Controller for up to 120 x 240 display 16-bit color or gray scale

**Intel® Micro Signal Architecture**

- Performs GSM/GPRS baseband signal processing
- Modified Harvard architecture, dual-MAC, deep pipeline, 104 MHz execution clock
- Instruction cache and 64 KB dual-banked data SRAM
- 512 KB integrated Intel On-Chip Flash for field-upgradable signal processing firmware
- Includes microprocessor instructions such as bit manipulation
- Includes cipher and Viterbi accelerators
- Multiple sleep modes and integrated power management minimize power consumption
- Interface support—digital I/Q, voice codec, auxiliary serial port for mixed-signal analog baseband, I<sup>2</sup>S audio codec interface, RF synthesizer serial control interface, JTAG

**Intel® On-Chip Flash Memory**

- Single bit-per-cell NOR Flash stores data and allows code to be executed in place (XIP)
- All the on-chip memory required to run the GSM/GPRS protocol stack
- The entire RTOS and JVM could fit in the on-chip Flash, accelerating performance and reducing power
- Potential to reduce memory latency issues with time-critical applications

**Companion Chips:** Companion chips are highly integrated and power-efficient components that complement the leadership performance of the Intel SA-1110 processor by providing I/O capabilities designed for emerging wireless multimedia applications.

## INTEL® 2700G MULTIMEDIA ACCELERATOR

The Intel® 2700G multimedia accelerator is a companion chip that, when paired with the Intel PXA27x processor family, delivers hardware-accelerated video and graphics for handheld devices.

### Product Highlights

Next-generation communicators and PDAs enable a host of new entertainment-focused usage models such as capturing and sharing pictures or video clips, video playback and interactive gaming. The introduction of VGA color LCDs has improved the user's visual experience for multimedia applications. The Intel 2700G multimedia accelerator is a companion chip that, when paired with the Intel PXA27x processor family, delivers hardware-accelerated video and graphics for handheld devices. The Intel 2700G enables rich 2D and 3D graphics, high-quality video playback and enterprise-worthy dual display without sacrificing battery life.

Intel's multimedia accelerator line features two products that differ in their on-die memory configurations for low power display refresh. The Intel® 2700G3 has 384 KB on-die memory and the Intel® 2700G5 has 704 KB on-die memory and is optimized for VGA resolution display devices.

### DVD-Quality Video Playback

User demands for quality video playback are driving development of color LCDs, cameras, and high-bandwidth connectivity in handhelds. The Intel 2700G is designed to accelerate the leading handheld video formats, including MPEG-2, MPEG-4 and Windows Media Video\*. By working closely with leading ISVs, Intel optimizes top video players so they deliver DVD-quality video playback on the Intel® platform.

### Performance 2D/3D Graphics

Handsets and PDAs have traditionally not offered a gaming experience comparable to the PC user's experience. The Intel 2700G, together with the Intel PXA27x processor family, is designed to enable a new level of 2D graphics and 3D gaming capabilities. Coupled with support for standard 3D APIs such as OpenGL\* ES and JSR-184, software developers will be able to quickly port or create brand-new, near PC-quality games for handheld platforms. In addition, traditional 2D applications such as a graphical user interface will enjoy faster response times, quicker screen refreshes and crisper icons.

### Low Power

Battery life is one of the most important considerations in designing a handheld device. As multimedia capabilities increase, battery life typically decreases. The Intel 2700G multimedia accelerator has been designed from the ground up to work with the Intel PXA27x processor family to provide a balanced approach to performance and power.

Using an advanced low power manufacturing process, the chip is designed for low power in all operating modes, extending battery life for entertainment-oriented applications. The Intel 2700G's highly optimized multimedia capabilities are designed to operate efficiently at extremely low-power. By offloading graphics and video traffic, the Intel 2700G helps to enable the Intel PXA27x processor to handle other types of traffic, such as wireless connectivity and audio content.

Low power display refresh is another power-saving feature in the Intel 2700G. Because handheld devices are typically in display refresh mode frequently during use, it is imperative that the platform provides a very low power display refresh solution. The Intel 2700G3 and Intel 2700G5 have 384 KB and 704 KB on-die memory configurations respectively. These chips are designed to refresh HVGA and VGA resolution displays using significantly less power than solutions refreshing from higher power external memory.

## Performance Dual Display

The Intel 2700G multimedia accelerator helps bring exciting new dual display capabilities to handheld devices. With support for two displays and high resolution images, the Intel 2700G helps to allow business users to connect their handheld devices to a projector and deliver presentations while away from the office. The dual display capabilities also support independent content on separate displays. For the first time, enterprise users will have the unique ability to view presentation notes on their PDA screen while their audience views the presentation on the projector.

## Broad Market Support

The Intel 2700G multimedia accelerator meets the needs of broad market segment applications like telematics, portable media players and industrial tablets. The LCD controller supports displays with resolutions up to 1280x1024 at 16-bit color and advanced display features like partial display refresh.

FEATURES	BENEFITS
<ul style="list-style-type: none"> <li>▪ Robust hardware video decode support for MPEG-2, MPEG-4 and Windows Media Video*</li> <li>▪ Optimized video players</li> </ul>	<ul style="list-style-type: none"> <li>▪ DVD-quality video playback</li> </ul>
<ul style="list-style-type: none"> <li>▪ Graphics acceleration hardware</li> <li>▪ 3D API support</li> <li>▪ Optimized 3D games</li> </ul>	<ul style="list-style-type: none"> <li>▪ Designed to deliver unprecedented handheld gaming experience</li> </ul>
<ul style="list-style-type: none"> <li>▪ On-die memory configuration*</li> <li>▪ Optimization for Intel® PXA27x processor</li> </ul>	<ul style="list-style-type: none"> <li>▪ Balanced system performance and power, extended battery life</li> </ul>
<ul style="list-style-type: none"> <li>▪ Performance dual display architecture</li> <li>▪ Optimized dual display application</li> </ul>	<ul style="list-style-type: none"> <li>▪ Enterprise-worthy dual display</li> </ul>

## STRONGARM\* INTEL® SA-1111

The Intel® SA-1111 companion chip provides integrated technology for full-featured, versatile designs.

### Product Highlights

- Complements the Intel SA-1110 and Intel PXA25x processor's leadership performance/power attributes with advanced I/O capabilities
- Provides a highly integrated solution for emerging wireless multimedia applications
- Provides design flexibility through a wide range of full-function interfaces
- Supported by a rich suite of Intel® and third-party hardware and software development tools

The Intel SA-1111 companion chip, a highly integrated and power-efficient component, complements the leadership performance of the Intel SA-1110 processor by providing key I/O capabilities designed for emerging wireless multimedia applications. The Intel SA-1111 brings a new level of integration to portable wireless devices and enables key attributes such as reduced component count, low power dissipation and high performance. The Intel SA-1111 provides a USB host controller, direct connection to AC-link and I<sup>2</sup>S audio codecs, buffering for one PCMCIA slot and one CF slot, and multiple additional I/O interfaces. A dedicated memory controller can reduce bandwidth demands, to maximize overall system performance. This rich suite of features, combined with a robust development environment, enables manufacturers to bring competitive portable wireless devices to market quickly.

## Support for USB Devices

Featuring a Universal Serial Bus (USB) host controller, the Intel SA-1111 companion chip enables integration with USB-compatible devices and offloads the Intel SA-1110 processor through DMA data transfers. The Intel SA-1111 is compatible with the Open Host Controller Interface (OHCI), Windows\* 95 USBD, and USB Rev 1.1. USB-compliant devices can "plug and play" with portable wireless products that incorporate the Intel SA-1110 processor and Intel SA-1111 companion chip.

## Integrated I/O Interfaces Provide Scalable, Flexible Handheld Designs

To provide maximum design flexibility, reduce design time and lower cost, the Intel SA-1111 companion chip integrates a broad spectrum of I/O interfaces. It incorporates two PS/2 ports, an AC-link, I<sup>2</sup>S and L3 serial ports for audio, an SSP serial data port, two PWM outputs, one PCMCIA interface, one CompactFlash Interface, and general-purpose I/O (GPIO) pins.

The Intel SA-1111 companion chip's SSP serial data port supports National Microwire\*, TI\* Synchronous Serial Protocol (SSP), and Motorola\* Serial Peripheral Interface (SPI) serial protocols, enabling designs incorporating a wide selection of components that require serial communication. PCMCIA and CompactFlash control logic and buffers are integrated within the Intel SA-1111. This eliminates up to 12 external devices, providing a highly integrated, cost-effective and low-power solution for PC companions and vertical handheld applications. Both the USB controller and the serial audio controller make use of DMA to offload the Intel SA-1110 microprocessor, freeing compute resources and bandwidth.

The advanced interfaces and features of the Intel SA-1111 companion chip offer broad flexibility to support multiple cost-effective handheld configurations while minimizing time-to-market constraints. The Intel SA-1111 is packaged in a 256-pin mBGA.

## Low Power Consumption Minimizes Power Requirement

The selective clock-gating feature and three power-down modes (idle, doze and sleep) of the Intel SA-1111 minimize system power requirements. The Intel SA-1111 can power down individual functional blocks that are not in use and power them up quickly when they are needed.

## Development Tools

Intel Integrated Performance Primitives: The Intel Integrated Performance Primitives (IPP) provide a rich and powerful set of general and multimedia signal processing kernels optimized for maximum performance on Intel Personal Internet Client Architecture (PCA) Applications Processors.

## Intel® Integrated Performance Primitives for the Intel® PXA25x and Intel® PXA26x family of Processors, Version 3.0 Beta

The Intel Integrated Performance Primitives (Intel IPP) provides a cross-platform, low-level software interface that abstracts multimedia and signal processing from the Intel Personal Internet Client Architecture (Intel PCA) Processors. Intel IPP includes a broad range of functions for basic software functionality including general signal, image, speech and audio processing, vector manipulation and matrix math, as well as more sophisticated primitives for construction of audio, video and speech codecs such as MP3 (MPEG-1 Audio, Layer 3), MPEG-4, H263, JPEG, GSM-AMR, G723.1 and cryptography (DES, TDES, SHA1, and RSA).

The Intel IPP release 3.0 Beta introduces additional primitives to support the following codecs/applications:

- MPEG4—Encoder (simple Profile)
- AAC—Decoder (Low Complex)
- MP3—Encoder
- JPEG 2000—Encoder/Decoder
- General audio processing—Echo cancellation, VAD
- Rijndael/TDES cryptography application, and more.

With each function highly optimized for the underlying Intel PCA Processors, Intel IPP provides developers with a powerfully simple way to maximize Intel® processor performance without writing assembly code.

### Intel® IPP 3.0 Beta Documentation:

Learn more about the powerful capabilities of Intel IPP.

- Intel Integrated Performance Primitives for the Intel PXA26x and Intel PXA25x family of Processors
- Intel IPP Product Brief
- Intel IPP Case Studies

**To download Intel® IPP, three easy steps are required:**

1. Register for Intel IPP Version 3.0 Beta
2. Check your e-mail. After registering, you will be sent an e-mail with download instructions. If you are a new customer or haven't previously used Intel® Premier Support, you will also receive a second e-mail with your login ID and password information.
3. Follow the instructions to download Intel IPP from our Intel Premier Support Web site.

**Intel® IPP Release Notes:**

- Intel® IPP for Microsoft Pocket PC\* 2002 Release Notes
- Intel® IPP for Linux\* Release Notes

**Intel® Graphics Performance Primitives (Intel® GPP) for the Intel® PXA2xx Family of Processors, Version 1.1 Beta**

The Intel® Graphics Performance Primitives (Intel® GPP) provide a rich and powerful set of 3D graphics functions optimized for the Intel Personal Internet Client Architecture (Intel PCA) Applications Processors. Intel GPP include a broad range of 3D graphics functions including date-type conversion, arithmetic, trigonometric, vector, matrix, and raster primitives.

With each function highly optimized for the underlying Intel PCA Applications Processors, the Intel GPP provide developers a powerfully simple way to maximize Intel processor performance without writing assembly code.

**Intel® GPP V1.1 Beta Documentation:**

- Learn more about the powerful capabilities of Intel GPP.
  - Intel Graphics Performance Primitives for the Intel® PXA2xx Family of Processors Reference Manual

**Intel® GPP V1.1 Beta Library Download:**

- The Intel GPP V1.1 Beta release supports the Microsoft Pocket PC\* 2002 and Microsoft Smartphone\* 2002 operating systems.
  - Intel Graphics Performance Primitives: Installation Package and Release Notes

**INTEL® PCA TECHNOLOGY****Intel XScale® Technology with Intel® Wireless MMX™ Technology**

The trend toward rich multimedia and communications capabilities on mobile devices is growing. End users in the handheld wireless market segment demand multimedia and communication experiences similar to those they enjoy on their desktop—but in a mobile setting. To meet that need, software developers require easy-to-use, general-purpose processor capabilities that provide the performance necessary for rich multimedia. Device manufacturers require that this be accomplished without sacrificing battery power.

Intel® Wireless MMX™ technology is the latest high-performance, low-power, seamless extension to Intel XScale microarchitecture. Intel Wireless MMX technology offers developers a powerful set of new instructions for future Intel Personal Internet Client Architecture (Intel PCA)-based processors that will help enhance the multimedia experience of Intel PCA-based mobile devices. Developed from a solid foundation of Intel® Architecture (IA) technologies, Intel Wireless MMX technology combines the Intel MMX technology instruction set, the integer instructions from Intel® Streaming SIMD Extensions (Intel® SSE) plus several brand-new multimedia acceleration instructions unique to Intel XScale microarchitecture.

This powerful 64-bit Single Instruction Multiple Data (SIMD) architecture gives a performance boost to many applications including motion video, graphics combined with video, image processing, audio synthesis, speech synthesis and compression, telephony, conferencing, 2D graphics, and 3D graphics. Intel Wireless MMX technology brings 43 new instructions to Intel XScale microarchitecture and is enabled by four primary capabilities: Intel® 64-bit Data Pipeline, Intel® Parallel Media Processing, Intel® Media Power On-Demand, and Intel® Multi-Sample Technology. The Intel 64-bit Data

Pipeline is tightly coupled to the Intel XScale microarchitecture pipeline resulting in more efficient and fast data transfers. Intel Parallel Media Processing allows Intel Wireless MMX technology to accelerate many applications, that perform calculations on integer data in a repetitive and sequential manner due to its ability to process 8-bit, 16-bit, and 32-bit data elements in parallel. Intel Wireless MMX instructions can be interleaved with Intel XScale microarchitecture instructions and thanks to Intel Media Power On-Demand Technology, the Intel Wireless MMX technology is only activated when required to execute instructions. Finally, Intel Multi-Sample Technology helps improve multimedia algorithm performance by utilizing the large register file of Intel Wireless MMX to store the many intermediate results required when calculating multiple output values concurrently. This allows Intel Wireless MMX instructions to maximize the use of data fetched from memory to help accelerate audio/video performance and help reduce power consumption.

Intel Wireless MMX technology was defined to be simple. PC software developers who have already utilized Intel MMX technology and Intel SSE will find a familiar programming environment in Intel Wireless MMX technology that will help speed the porting of existing code bases from the Intel Architecture to Intel PCA-based mobile devices. And Intel Wireless MMX technology is general enough to address the needs of a large domain of mobile software applications built from current and future algorithms. Finally, Intel Wireless MMX instructions can be used in applications, codecs, algorithms, and drivers.

## **Intel® Micro Signal Technology:**

### **Product Information**

- In order to address the rapidly expanding market segment for communications and portable computing devices, Analog Devices (ADI) and Intel jointly developed Micro Signal Architecture that incorporates both Digital Signal Processing (DSP) and microcontroller functionality in a single core. The Intel/ADI\* core delivers vast improvements in performance, programmability and power consumption over traditional DSP design.
- Both ADI and Intel will take the Micro Signal Architecture core and separately develop products based on it.
- Intel® Micro Signal Architecture (Intel® MSA) incorporates Digital Signal Processor (DSP) and microcontroller features in a single platform. It combines a highly efficient computational architecture with features more normally seen on microcontrollers, such as optimizations for high-level language programming, memory protection and byte addressing. This results in the ability to execute highly complex DSP tasks and simple control tasks in a single core architecture. Intel MSA is ideal for a variety of battery-powered communications and consumer applications that require high-intensity signal processing on a strict power budget.

## **High Performance, Low Power**

Intel MSA is the first DSP architecture to incorporate Dynamic Power Management (DPM) capabilities, delivering 10 times the normal battery life at one-third peak performance. DPM supports continuous monitoring of the software running on the architecture and enables dynamic adjustments of both the voltage delivered to the core and the frequency at which the core runs (MHz). This results in optimized power consumption and performance for real-time applications.

## **Extended Computing with Intel XScale® Microarchitecture:**

### **Utilizing Intel XScale® Technology**

Smart Displays\* are wireless flat-panel displays that are used as monitors when docked to a base desktop PC, but when detached, become a mobile monitor using 802.11b wireless LAN technology to access information and applications from the desktop PC from anywhere in the home. Smart Displays utilizes the industry-leading performance of Intel XScale technology-based processors and Intel StrataFlash memory.

Some of the top makers of wireless Smart Displays such as AboCom\*, Fujitsu, Lite-On, MSI, Philips\*, Tatung\*, TriGem and ViewSonic\*—have selected Intel XScale technology-based processors to power new products that help enable wireless PC access throughout the home. Smart Displays running on Intel XScale technology are available today in retail from ViewSonic and Philips, with products currently targeted to be released later this year from Fujitsu and TriGem.

## Intel® Telematics Solutions for Emerging Digital Car Products and Services

### ▪ Telematics Design Center

The Intel® Telematics Design Center provides Web-based development and technical support for designing navigation, multimedia, hands-free phone, and other in-car Internet products and applications using Intel XScale technology-based processors.

### ▪ Intel® Wireless Building Blocks for Telematics Product

Intel is supplying new multimedia-capable components for current and next-generation cellular technology, including high-performance, low-power processors, flash memory, chipsets, and software.

## Intel® Portable Media Player

The Portable Media Player (PMP) is a new type of mobile entertainment product pioneered by Intel. PMPs will be small enough to fit in a coat pocket and will allow people to take video, still pictures and music with them anywhere they go—on the plane, train, or bus, to the gym, or hand it to the kids sitting in the back seat of the car during a long drive. Intel®-based PMPs will feature high-quality video playback using an Intel XScale technology-based processor. The different types of media can be transferred to a PMP from a PC or a Personal Video Recorder using a fast Hi-Speed USB 2.0 connection.

**Intel® PCA Developer's Network:** You have an idea for an innovative wireless product. Or you have a development solution that can save other developers time and make you money. You just need the right marketing opportunities and industry connections to make it a success and reduce time-to-market. In today's competitive wireless environment, it's not only a matter of what you know, but whom you know.

Membership in the Intel PCA Developer Network gives you fast access to the resources you need.

The enhanced Intel® PCA Developer Network Solutions Catalog is an extensive database of third-party tools and solutions that help developers identify and connect with the right silicon, hardware designs, board support platforms, independent software vendors, development tools, and manufacturing resources. The new Intel® PCA Developer Network Smart-Match Reference Configuration Tool makes recommendations based on specific application and platform requirements.

As a member of the Intel PCA Developer Network, you are just a click away from a community of fellow developers who can help you cut time-to-market and reach new customers for innovative solutions based on Intel PCA. Your membership opens the door to these exclusive opportunities.



# Embedded PXA Processor Overview

## INTEL® PXA255 PROCESSOR

### Designed for a Wide Range of Embedded Devices

Numerous embedded and portable consumer electronics devices simplify our lives, keep us entertained and increase productivity. Each day businesses and individuals rely on them more and more. But, to continue satisfying ever-increasing customer demands to communicate and access information, manufacturers need technologies that deliver high performance, flexibility and robust functionality—all in the small-size, low-power framework of portable, battery-powered products. The PXA255 application processor with Intel XScale® technology pushes device functionality to new heights. With a seven-stage pipeline and faster processing speeds, these microprocessors enable devices to meet the performance demands of their customers. Coupled with Intel's power management capabilities, the PXA255 delivers unparalleled operating efficiency. By reducing component count and board space, lowering power consumption, minimizing system costs and reducing time-to-market, these applications processors deliver solid competitive advantage and superior devices.

## INTEL® PXA255 HIGH-PERFORMANCE APPLICATIONS PROCESSOR

### Packing feature-rich devices with multimedia performance

For advanced devices that run the most demanding applications, the Intel® PXA255 Applications Processor is the answer. This highly integrated, 32-bit RISC processor combines the efficiency of Intel design with the industry-standard ARM® v.5TE instruction set architecture and the processing power of built-in multimedia capabilities for superior performance and unmatched handheld functionality. This enables increased end-user functionality, the longest battery life and a richer experience. Based on Intel XScale technology, the Intel PXA255 cost-effectively boosts processing speed and power management for one of the industry's best MIPS/mW ratio. Larger memory caches and gated clocks ensure faster functions with lower power dissipation. The processing capabilities of the Intel PXA255 enable portable devices to respond faster to optimized operating systems and performance-intensive applications like MP3 audio decode, MPEG4 video decode, speech and handwriting recognition, and Java® interpretation. From surfing animated Web sites to streaming video to mixing MP3s, the Intel PXA255 delivers processing power for superior performance.

### The Development Ecosystem

Outstanding performance and low power consumption are only the beginning when you develop with the Intel PXA255 applications processor. Our robust software and hardware development environment offers a large library of ARM-compliant applications and tools, as well as an array of operating systems and tool chains to ease application development and system prototyping. The Intel® Integrated Performance Primitives (Intel® IPP) library promises easy access to an array of low-level, cross-platform software algorithms for high-demand communications, signal processing, mathematics and media functions. The Intel IPP's highly optimized implementation helps reduce battery consumption through more efficient CPU execution, enables developers to focus on value-add features, and speeds time-to-market. With the Intel® development ecosystem, you have the resources you need to deliver the features your consumers want—efficiently and effectively.

## Intel® PXA255 At-A-Glance:

### High Performance:

- Low-power, high-performance 32-bit Intel XScale® core-based CPU—200, 300, and 400MHz
- ARM Architecture v.5TE compliant and application code compatible with Intel® SA1110 processor for rapid upgrade
- Intel® Superpipelined RISC Technology utilizing advanced Intel® 0.18μ process for high core speeds at low power
- Intel® Media Processing Technology including 40-bit accumulator and 16-bit SIMD to enhance audio/video decode performance
- High-performance glue-less burst and page mode interfaces with Synchronous Intel StrataFlash® Memory

### Low Power:

- Low power and Turbo modes for optimal battery life
- 32 KB data and 32 KB instruction caches
- 2 KB Mini data cache for streaming data
- Support for 2.5 and 3.3V memories

### I/O Expansion:

- Integrated Memory and PCMCIA/Compact Flash Controller with 100 MHz Memory Bus, 16-bit or 32-bit ROM/Flash/SRAM (six banks), 16-bit or 32-bit SDRAM, SMROM (four banks), as well as PCMCIA and Compact Flash for added functionality and expandability
- System Control Module includes 17 dedicated general-purpose interruptible I/O ports, real-time clock, watchdog and interval timers, power management controller, interrupt controller, reset controller, and two on-chip oscillators

### Portable & User Interface:

- Peripheral Control Module offers 16-channel configurable DMA controller, integrated LCD controller with unique DMA for fast color screen support, Bluetooth\* I/F, serial ports (IrDA, I<sup>2</sup>C\*, I<sup>2</sup>S\*, AC'97, three UARTs, SPI and SSP), USB end point interface, and MMC/SD Card Support for expandable memory and I/O functionality
- 17x17 mm 256-pin PBGA

## The Intel® PXA255 Applications Processor Advantage

FEATURES	BENEFITS
High-performance, low-power Intel XScale® core at 200, 300 and 400 MHz. Micro-power management including low-power modes and Turbo mode application acceleration	Ideal for a wide range of embedded applications
Intel® Media Processing Technology	Optimized audio and video multimedia functionality
Enhanced Memory Controller	Supports lower power 2.5V and 3.3V 32-bit and 16-bit memories as well as glue-less burst and page mode interfaces with Synchronous Intel StrataFlash® Memory
MMC/SD and PCMCIA/CF Card support	Expandable storage and I/O device support
USB Client	Fast host synchronization
1.84 MHz cellular baseband interface	Efficient communications integration
920 Kbs Bluetooth* interface	Broad inter-device communication
Variable latency I/O	Add-on functionality capabilities

**EXTENDED COMPUTING WITH INTEL XSCALE® MICROARCHITECTURE:****Intel® Telematics Solutions for Emerging Digital Car Products and Services****▪ Telematics Design Center**

The Intel® Telematics Design Center provides Web-based development and technical support for designing navigation, multimedia, hands-free phone, and other in-car Internet products and applications using Intel XScale® technology-based processors.

**▪ Intel® Building Blocks for Telematics Product**

Intel is supplying new multimedia-capable components including high-performance, low-power processors, flash memory, chipsets, and software.

**Intel® Portable Media Player**

The Portable Media Player (PMP) is a new type of mobile entertainment product pioneered by Intel. PMPs powered by an Intel XScale® Technology-based PXA255 processor allow users to enjoy their favorite media anywhere, anytime.

Intel®-based PMPs:

- Create an exciting, feature rich and high-quality user experience
- Enable users to enjoy video, still images and music in a device small enough to fit in a coat pocket
- Accommodate the quick transfer of different types of media from a PC or Personal Video Recorder using USB2.0
- Deliver high video performance with low battery consumption

Delivering on its vision for Portable Media Players, Intel is continuously working with numerous consumer electronics industry leaders to further develop the portable media player ecosystem.

# Intel XScale® Microarchitecture

## INTEL XSCALE® MICROARCHITECTURE PRODUCT OVERVIEW

With Intel XScale® microarchitecture, a wide range of Internet applications can be optimized from ultra-low power consumption to high-performance processing. Everything from handheld Internet devices to enterprise Internet infrastructure products can now process rich content at all stages of the Internet.

This new high-performance, ultra-low-power microarchitecture is compliant with the ARM Version 5TE ISA instruction set (excluding the floating-point instruction set). The microarchitecture surrounds the ARM-compliant execution core with the following:

- Instruction and data memory management units
- Instruction, data and mini-data caches
- Write, fill, pend and branch target buffers
- Power management, performance monitoring, debug and JTAG units
- Coprocessor interface
- MAC coprocessor
- Core memory bus

The Intel XScale microarchitecture, when combined with peripherals, provides Applications Specific Standard Products (ASSP) targeted at selected market segments. For example, the microprocessor core can be integrated with an LCD controller, multimedia controllers and an external memory interface. This gives OEMs the ability to develop smaller, more cost-effective handheld devices with long battery life and the performance to run rich multimedia applications. Or the microprocessor core could be surrounded by high-bandwidth PCI interfaces, memory controllers and networking microengines to provide a highly integrated, high-performance I/O or network processor.

Designed with Intel's state-of-the-art 0.18-micron production semiconductor process technology, Intel XScale microarchitecture enables operation of the microprocessor core over a wide range of speed and power, producing industry-leading mW/MIPS performance.

FEATURES	BENEFITS
Intel® Superpipelined RISC Technology	7-stage integer/8-stage memory superpipelined core achieves high speed and ultra-low power
Intel® Dynamic Voltage Management	Dynamic voltage and frequency scaling on-the-fly allows applications to utilize the right blend of performance and power
Intel® Media Processing Technology	Multiply-Accumulate Coprocessor performs two simultaneous 16-bit SIMD multiplies with 40-bit accumulation for efficient media processing
Power Management Unit	Gives power savings via idle, sleep, and quick wake-up modes
128-entry Branch Target Buffer	Keeps pipeline filled with statistically correct branch choices
32 KB Instruction Cache	Keeps local copy of important instructions to enable high performance and low power
32 KB Data Cache	Keeps local copy of important data to enable high performance and low power
2 KB Mini-Data Cache	Avoids “thrashing” of the D-Cache for frequently changing data streams
32-entry Instruction Memory Management Unit	Enables logical-to-physical address translation, access permissions, I-Cache attributes
32-entry Data Memory Management Unit	Enables logical-to-physical address translation, access permissions, D-Cache attributes
4-entry Fill and Pend Buffers	Promotes Core efficiency by allowing non-blocking and “hit-under-miss” operation with Data Caches
Performance Monitoring Unit	Furnishes two 32-bit event counters and one 32-bit cycle counter for analysis of hit rates, etc.
Debug Unit	Uses Hardware Breakpoints and 256-entry Trace History Buffer (for flow change messages) to debug programs
32-bit Coprocessor Interface	Provides high-performance interface between core and coprocessors
64-bit Core Memory Bus with simultaneous 32-bit input path	Gives up to 4.8 Gbps @ 600 MHz bandwidth for internal accesses
8-entry Write Buffer	Allows the Core to continue execution while data is written to memory

### Third-Party Vendor Program

Intel will provide a complete development environment for fast Time-To-Market designs based on the Intel XScale microarchitecture. A number of Third-Party Vendors (TPVs) are enthusiastically supporting this new microarchitecture and will be participating in Intel’s tools support programs for this microprocessor core. The Intel XScale microarchitecture development platforms will include a full set of software development tools and related documentation, including both GNU and ARM-based toolchains.

Cygnus/Red Hat\* and ARM, CAD-UL\*, and Green Hills will be providing compiler, assembler, linker, debugger, and monitor software support for the Intel XScale microarchitecture. There will be a variety of operating system development solutions available for designers, because this next-generation RISC microarchitecture’s balanced power to performance attributes make it applicable across a broad spectrum of application environments.

The Intel XScale microarchitecture will be supported by many operating systems, including those from Accelerated Technology\*, Microsoft, MontaVista\*, Symbian\*, and Wind River\*. Additionally, full hardware debug support will be available from vendors such as ARM, Macraigor Systems\*, and Wind River.

## Intel XScale® Microarchitecture

- Introduced at Intel Developers Forum, August 2000
- Provides industry-leading MIPS/mW performance in an ARM v.5TE-compliant core
- Provides scalability for high performance and low power within a specific application

FEATURES	BENEFITS
ARM* v.5TE-Compliant Core	Compatibility with the broadest range of applications/OSs written for wireless devices
Industry-leading MIPS/mW	High-performance and low-power capabilities
Intel® Dynamic Voltage Management	On-the-fly voltage and frequency scaling
Intel® Media Processing Technology	Core enhancements that enable efficient multimedia processing
Advanced cache architecture	Cache architecture optimized for high performance and low power

## INTEL® XSCALE™ CORE POWER PERFORMANCE

MIPS	50	150	400	600	733	800	1GHz
POWER CONSUMPTION	10mW	40mW	180mW	450mW	640mW	900mW	1.6W

## Intel XScale® Microarchitecture Enhancements over Intel® StrongARM\* Architecture

- ARM v.5TE compliance
- Lower power at the same frequency
  - Intel XScale core = 80mW @ 200 MHz (1.0V)
  - Intel® SA1 core = 400mW @ 206 MHz (1.75V)
- Advanced RISC architecture
  - Intel® Superpipelined Technology
  - Larger caches, advanced cache architecture
  - Dynamic branch prediction
- Enhanced multimedia capabilities
- Extensive debug support/hardware JTAG support
- Intel® 0.18µ leading-edge process
  - Higher performance, lower power
  - More scalable power performance

## Future Intel XScale® Microarchitecture Solutions for many applications

- Internet backbone devices, i.e., Routers, Switches, etc.
- DSLAM Line Cards and Voice access equipment
- Internet Storage RAID/SAN
- PDAs
- Smart phones

# Intel® Flash Memory for Wireless Applications

Today’s wireless developers are faced with the challenge of managing the explosion of emerging data types and designing smaller form factors, all while trying to manage costs. Intel’s innovative flash memory components, high-volume stacked packaging and sophisticated software provide some of the most advanced, cost-effective, single-chip solutions for code execution and data storage. It’s no wonder Intel is the world’s leading supplier of flash memory for wireless cell phones and consumer targeted handheld devices. Discover Intel® Flash memory, the solution of choice for wireless designs.

## **INTEL® STACKED-CHIP SCALE PACKAGING (SCSP) PRODUCTS – NEW LEVELS OF SPACE SAVINGS FOR WIRELESS**

Intel® Stacked-Chip Scale Packaging (Intel® Stacked-CSP) products deliver wireless customers a new generation of memory subsystems by combining high-density Intel StrataFlash® Memory with flexible RAM options for higher levels of integration and space savings.

Intel has developed an extensive portfolio of **Standard Stacked-CSP products** designed to provide the widest range of Flash and RAM product combinations, fast time-to-market, and flexibility to meet your application design requirements. Standard Intel Stacked-CSP products feature x16 and x32 bus widths as well as SRAM, PSRAM, and LP-SDRAM options all in common footprints to allow easy migration for your design.

### **Key Messages:**

- World-Class Silicon
- Packaging Technology Leadership
- Extensive RAM supplier network
- Manufacturing Excellence

<b>FEATURES</b>	<b>BENEFITS</b>
Standard Stacked-CSP Products	<ul style="list-style-type: none"> <li>▪ Provide widest range of Flash + RAM combinations</li> <li>▪ Fast time-to-market</li> <li>▪ Application Flexibility</li> </ul>
Intel® Multi-Level Cell (MLC) Technology	<ul style="list-style-type: none"> <li>▪ Great value and 4th generation of proven reliability</li> </ul>
Low-profile height and small X & Y dimensions from 8 mm x 10 mm	<ul style="list-style-type: none"> <li>▪ Small Intel® Stacked Chip Scale Package/CSP form factor for space- and height-constrained applications</li> </ul>
Standard x16 and x32 Ballouts	<ul style="list-style-type: none"> <li>▪ Enables easy upgrades across Flash and RAM product densities and technologies</li> </ul>
Intel® Ultra-Thin Stacked Chip Scale Package Technology	<ul style="list-style-type: none"> <li>▪ Allows up to 5 die stack</li> <li>▪ Provides low package profile from 0.8 mm to 1.2 mm</li> </ul>

## SCSP COMPONENTS AT A GLANCE: DESIGN-IN PRODUCTS

PRODUCT NAME	PRODUCT COMBINATION	ACCESS TIME (NS)	TEMP RANGE	PACKAGE	BALL COUNT	V <sub>CC</sub> /V <sub>CCQ</sub>	V <sub>PP</sub> /V <sub>PEN</sub>	LEAD/LEAD-FREE
<b>INTEL STRATAFLASH® WIRELESS MEMORY SYSTEM (L18/L30 SCSP)</b>								
<b>LQ 18/30</b>	<b>Code Flash, SRAM, PSRAM (QUAD+ballout)</b>							
48F2000L0	64L18+0	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
48F2000L0	64L30+0	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L
48F3000L0	128L18+0	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L, LF
48F3000L0	128L30+0	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L, LF
48F3300L0	128L18+128L18	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	LF
48F3300L0	128L30+128L30	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L
48F4000L0	256L18+0	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L, LF
48F4000L0	256L30+0	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L, LF
48F4400L0	256L18+256L18	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L, LF
48F4400L0	256L30+256L30	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L
38F3040L0	128L18+32P	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L, LF
38F3040L0	128L30+32P	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L, LF
38F3050L0	128L18+64P (Burst)	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
38F3050L0	128L30+64P	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L
38F3340LL	128L18+128L18+32P	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
38F4050L0	256L18+64P (Burst)	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L, LF
38F3350LL	128L30+128L30+64P	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L
38F3352LL	128L30+128L30+64P+8S	85[25]b[17]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L, LF
38F4055L0	256L30+64P+64P	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
38F4055L0	256L18+64P+64P (Burst)	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
38F4350LL	256L18+128L18+64P (Burst)	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
38F4455LL	256L30+256L30+64P+64P	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
38F4455LL	256L18+256L18+64P+64P (Burst)	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L
<b>LX 18/30</b>								
<b>Code Flash, SRAM, SDRAM (Performance ballouts)</b>								
38F4060L0	256L18+128SD (x16)	85[25]b[14]c	P	LZ	103	1.8V/1.8V	0.9–2.0V or 9V	L
38F4070L0	256L18+256SD (x16)	85[25]b[14]c	P	LZ	137	1.8V/1.8V	0.9–2.0V or 9V	L, LF
38F4462LL	256L18+256L18+128SD +8S	85[25]b[14]c	P	RD	103	1.8V/1.8V	0.9–2.0V or 9V	LF
48F3300L0	128L30+128L30(x32)	85[25]b[17]c	P	RD	137	1.8V/3.0V	0.9–2.0V or 9V	L
48F3300L0	128L18+128L18 (x32)	85[25]b[14]c	P	LZ	137	1.8V/1.8V	0.9–2.0V or 9V	L, LF
48F3300L0	128L30+128L30 (x32)	85[25]b[17]c	P	LZ	137	1.8V/3.0V	0.9–2.0V or 9V	L
48F4400L0	256L18+256L18 (x32)	85[25]b[14]c	P	LZ	137	1.8V/1.8V	0.9–2.0V or 9V	L, LF
48F4400L0	256L30+256L30 (x32)	85[25]b[17]c	P	LZ	137	1.8V/3.0V	0.9–2.0V or 9V	L
38F4360LL	256L18+128L18+128SD (Split Bus)	85[25]b[14]c	P	RD	137	1.8V/1.8V	0.9–2.0V or 9V	L
38F4470LL	256L18+256L18+256SD (Split Bus)	85[25]b[14]c	P	RD	137	1.8V/1.8V	0.9–2.0V or 9V	L
38F3030L0	128L18+16P	85[25]b[14]c	P	RD	44	1.8V/1.8V	0.9–2.0V or 9V	LF
38F2030L0	64L18+16P	85[25]b[14]c	P	RD	44	1.8V/1.8V	0.9–2.0V or 9V	LF
<b>INTEL STRATAFLASH® WIRELESS MEMORY SYSTEM (LV18/LV30 SCSP)</b>								
<b>LVQ 18/30</b>	<b>Code and DataFlash, SRAM, PSRAM (QUAD+ ballout)</b>							
48F4040LV	256L18+256V18	85[25]b[14]c	P	RD	88	1.8V/1.8V	0.9–2.0V or 9V	L, LF
48F4040LV	256L30+256V30	85[25]b[14]c	P	RD	88	1.8V/3.0V	0.9–2.0V or 9V	L
<b>LVX 18/30</b>								
<b>Code and DataFlash, SRAM, SDRAM (Performance ballouts)</b>								
38F4460LV	256L18+256V18+128SD	85[25]b[14]c	P	RD	103	1.8V/1.8V	0.9–2.0V or 9V	LF
48F4444LV	256L18+256L18+256V18+256V18	85[25]b[14]c	P	RD	103	1.8V/1.8V	0.9–2.0V or 9V	L
58F0012LV	256L18+256L18+256V18+128SD	85[25]b[14]c	P	RD	103	1.8V/1.8V	0.9–2.0V or 9V	L

## Wireless Products Legend

## Access Time Footnotes:

- b Page Mode Access  
c Synchronous Burst Mode

## Product Combinations Footnotes:

- P = PSRAM  
S = SRAM  
D = SDRAM

## Temperature Range Footnotes:

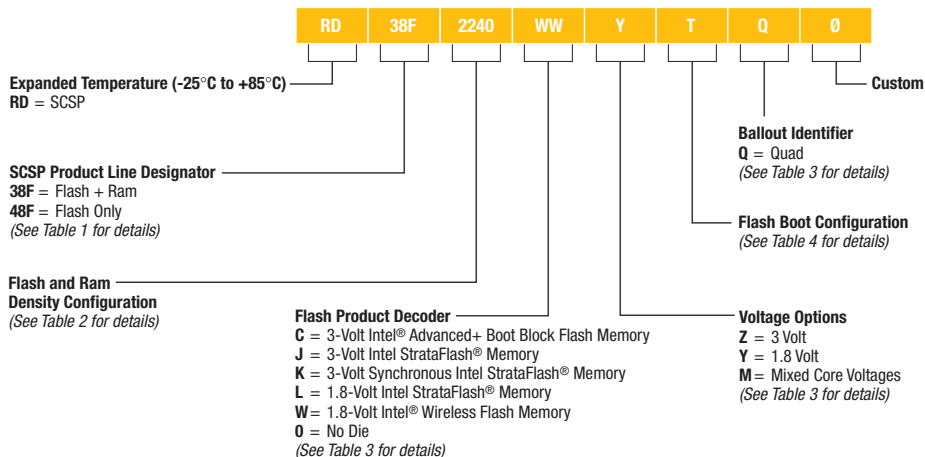
- E = Extended Temperature (-40°C to +85°C)  
P = Expanded Temperature (-25°C to +85°C)

## Package Footnotes:

- GE = 0.75mm VF BGA  
RD = Intel® Stacked Chip Scale Package  
LZ = Intel® UT-Stacked Chip Scale Package

† Access time refers to data component.

## SCSP ORDERING INFORMATION





## Intel® Stacked-SCSP Table References

Density Decoder

Table 1

CODE	FLASH DENSITY	RAM DENSITY
0	No Die	No Die
1	32 Mbit	4 Mbit
2	64 Mbit	8 Mbit
3	128 Mbit	16 Mbit
4	256 Mbit	32 Mbit
5	512 Mbit	64 Mbit
6	1 Gbit	128 Mbit
7	2 Gbit	256 Mbit
8	4 Gbit	512 Mbit
9	8 Gbit	1 Gbit
A	16 Gbit	2 Gbit

Flash Family Decoder

Table 2

CODE	FLASH DENSITY	CORE VOLTAGE
C	Intel® Advanced+ Boot Block Flash Memory	3.0 Volt
J	Intel StrataFlash® Memory	3.0 Volt
K	Intel StrataFlash® Synchronous Memory	3.0 Volt
L	Intel StrataFlash® Wireless Memory	1.8 Volt
LV	Intel StrataFlash® Wireless Memory System	1.8 Volt
W	Intel® Wireless Flash Memory	1.8 Volt
0	No Die	Not Applicable

I/O Voltage Decoder

Table 3

CODE	FLASH I/O VOLTAGE
Z	Flash Family A = 3.0 Volt I/O Flash Family B = 3.0 Volt I/O
Y	Flash Family A = 1.8 Volt I/O Flash Family B = 1.8 Volt I/O
M	Flash Family A = 3.0 Volt I/O Flash Family B = 1.8 Volt I/O
L	Flash Family A = 1.8 Volt I/O Flash Family B = 3.0 Volt I/O

Parameter Configuration Decoder

Table 4

DESIGNATOR	PARAMETER (BOOT) CONFIGURATION	EXPLANATION
B	Bottom	For stacked products comprising two or more Flash die, the F1 die will be the parameter configuration as designated in the product's part number.
T	Top	

*Note: Refer to the specific product datasheet for parameter onfiguration details of the other flash die in the stack (i.e., F2, F3, and so forth).*

D	Dual	For stacked products comprising two Flash die, the F1 and F2 Flash dies are configured as Bottom–Top.
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*Note: Products using the “D” parameter designator are limited to W18/W30 and K18/K30 SCSP envelope line items, and the following individual parts: RD/PF38F4462LLYDB0, RD48F4400L0ZDQ0, RD48F3300L0ZDQ0, RD48F4400LOYDQ0, PF48F4400LOYDN0, PF48F4400L0ZDN0 and RD48F3300LOYDQ0.*

Ballout Decoder

Table 5

CODE	BALLOUT DEFINITION
B	x16D Performance with DRAM
L	“T” ballout
P	Performance x32 ballout
Q	QUAD/+ ballout
S	Sync ballout, original 96-ball version
H	x16 Split Bus
X	Custom ballout; use in conjunction with last character

58Fxxx Product Density Decoder

Table 6

SEQUENCE CODE NO.	FLASH+RAM DIES	EXPLANATION
0012	256L (Bottom)/256L (Bottom)/256V (Top)/128D	Bottom parameter configuration
0012	256L (Top)/256L (Top)/256V (Bottom)/128D	Top parameter configuration
.	.	.
9999	TBD	TBD

*Notes: Flash and RAM die densities are referenced in Mbit, unless noted otherwise. L = Flash Code Segment; V = Flash Data Segment; D = DRAM; P = PSRAM; S = SRAM*

## 1.8 VOLT INTEL STRATAFLASH® WIRELESS MEMORY (L18/L30) – OUR FOURTH-GENERATION INTEL STRATAFLASH® MEMORY

1.8 Volt Intel StrataFlash® Wireless Memory (L18/L30) delivers the combination of wireless performance and Intel StrataFlash memory value that today's wireless handset developers require. L18/L30 is the world's first 1.8V Multi-Level Cell (MLC) device offering wireless designers memory features needed for today's rich wireless applications—high-performance, high-density, and low-power operation. Delivered on Intel's fourth-generation of MLC technology and 0.13 µm process lithography, the L18/L30 enables highly reliable, high-performance, yet cost-effective wireless solutions. L18/L30 gives wireless products the capacity to do more while consuming less power in the process.

### Key Messages

- 1.8 Volt Intel StrataFlash Wireless Memory is the world's first low-power, high-density, multi-level cell flash memory based on 0.13-micron process technology
- 1.8 Volt Intel StrataFlash Wireless Memory is a single chip solution offering high density and performance that today's wireless industry requires for increased data and new graphic-rich applications on today's wireless handhelds
- 1.8 Volt Intel StrataFlash Wireless Memory utilizes Intel's industry-leading stacking technology to obtain densities of up to 1Gb resulting in the industry's lowest-power 1Gb code and data memory solution offered in a single package

### Key Benefits

- First 1.8 Volt MLC device on 0.13 µm process lithography
- Intel's forth-generation MLC architecture offers highly reliable operation
- 64-Mb, 128-Mb, and 256-Mb high-density devices
- Flexible 8 Mb and partitioning allows optimized memory usage
- Dual-mode RWW/E operation for high data throughput
- Burst and page mode support for 54 MHz bus speed allows fast code execution

### 1.8 Volt Intel StrataFlash Wireless Memory is Levels Above and Generations Ahead

## 1.8 VOLT INTEL® WIRELESS FLASH MEMORY (W18/W30) – OUR HIGHEST PERFORMANCE FLASH DEVICE

Intel® 1.8 Volt Wireless Flash memory (W18/W30) is the highest performance memory solution for wireless applications and embedded designs requiring performance or low power.. W18/W30 integrates flexible partition RWW/E architecture with synchronous burst and asynchronous page mode read operations, state-of-the-art security-enabling features and low 1.8V operation. Additionally, the W18/W30 is fully supported by the Intel® Flash Data Integrator (Intel® FDI) software, which enables effective management of code, data, and files in a flash memory device. Intel 1.8 Volt Wireless Flash is Intel's next-generation RWW/E device offering innovative features and revolutionary performance.

### Key Messages

W18/W30 combines four major innovations into one product:

- Flexible partition Read-While-Write/Erase (RWW/E) operation
- Synchronous burst and asynchronous page mode read operations
- 1.8V operations (3.0V I/O option available)
- Enhanced Factory Programming (EFP)

These features make this the ideal RWW/E flash memory solution for next-generation “voice plus data” cellular and wireless applications.

**COMPONENTS AT A GLANCE: DESIGN-IN PRODUCTS**

DENSITY	PRODUCT	ORGANIZATION	ACCESS TIME (ns)	TEMP RANGE	PACKAGE	BALL COUNT	V <sub>CC</sub>	V <sub>PP</sub> /V <sub>PEN</sub>	I/O
<b>WIRELESS MEMORY PRODUCTS—LEADING-EDGE FEATURES FOR WIRELESS CODE EXECUTION AND DATA STORAGE APPLICATIONS</b>									
<b>Intel StrataFlash® Wireless Memory (L18/L30)</b>									
256 Mb	28F256L18a	16M x 16	85[25]b[14]c, 115[30]b[18]c	P	GE	63	1.7–2.0V	0.9–2.0V or 9V	1.7–2.0V
	28F256L30a	16M x 16	85[25]b[17]c, 115[30]b[25]c	P	GE	63	1.7–2.0V	0.9–2.0V or 9V	2.2–3.3V
128 Mb	28F128L18a	8M x 16	85[25]b[14]c, 105[25]b[17]c	P	GE	56	1.7–2.0V	0.9–2.0V or 9V	1.7–2.0V
	28F128L30a	8M x 16	85[25]b[17]c, 110[25]b[20]c	P	GE	56	1.7–2.0V	0.9–2.0V or 9V	2.2–3.3V
64 Mb	28F640L18a	4M x 16	85[25]b[14]c, 105[25]b[17]c	P	GE	56	1.7–2.0V	0.9–2.0V or 9V	1.7–2.0V
	28F640L30a	4M x 16	85[25]b[17]c, 110[25]b[20]c	P	GE	56	1.7–2.0V	0.9–2.0V or 9V	2.2–3.3V
<b>Intel® Wireless Flash Memory (W18/W30)</b>									
128 Mb	28F128W18	8M x 16	65[20]b[11]c, 80[25]b[14]c	E	GE	56	1.7–1.95V	0.9–1.95V or 12V	1.7–2.24V
	28F128W30	8M x 16	70[25]b[20]c, 85[25]b[22]c	E	GE	56	1.7–1.95V	0.9–1.95V or 12V	2.2–3.3V
64 Mb	28F640W18	4M x 16	60[20]b[11]c, 80[25]b[14]c	E	GE	56	1.7–1.95V	0.9–1.95V or 12V	1.7–2.24V
	28F640W30	4M x 16	70[25]b[20]c, 85[25]b[22]c	E	GE	56	1.7–1.95V	0.9–1.95V or 12V	2.2–3.3V
32 Mb	28F320W18	2M x 16	60[20]b[11]c, 80[25]b[18]c	E	GE	56	1.7–1.95V	0.9–1.95V or 12V	1.7–2.24V
	28F320W30	2M x 16	70[25]b[20]c, 85[30]b[20]c	E	GE	56	1.7–1.95V	0.9–1.95V or 12V	2.2–3.3V

**Wireless Products Legend**

**Access Time Footnotes:**

- b Page Mode Access
- c Synchronous Burst Mode

**Product Combinations Footnotes:**

- P = PSRAM
- S = SRAM

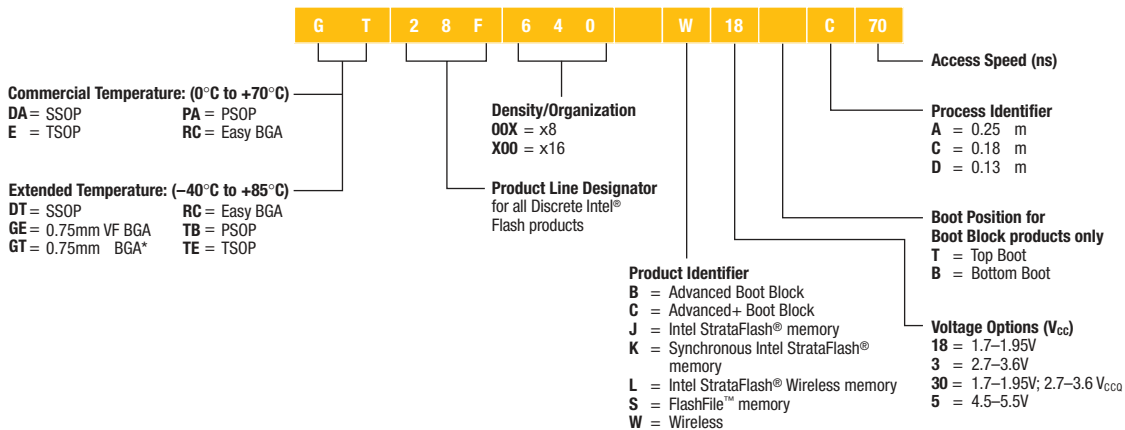
**Temperature Range Footnotes:**

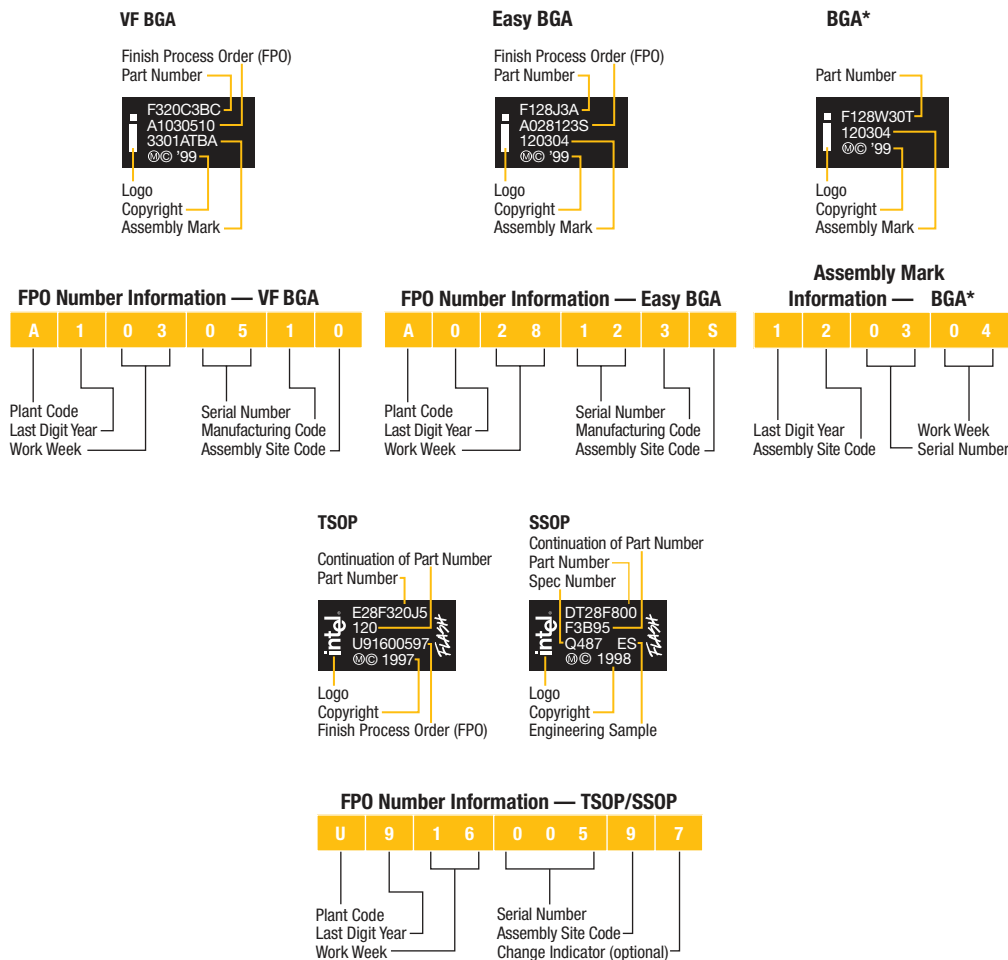
- E = Extended Temperature (-40°C to +85°C)
- P = Expanded Temperature (-25°C to +85°C)

**Package Footnotes:**

- GE = 0.75mm VF BGA
- RD = Intel® Stacked Chip Scale Package
- LZ = Intel® UT-Stacked Chip Scale Package

**ORDERING INFORMATION**





## INTEL® FLASH MEMORY SOFTWARE – FLASH FILE MANAGEMENT FOR YOUR WIRELESS MEMORY SUBSYSTEM

Intel offers a comprehensive line of software solutions, each designed to meet specific system application needs. Intel offers solutions for dynamic XIP code management, data storage, and code+data combined, which make the details of interfacing to flash memory flexible and easy for the system software.

### Intel® Flash Data Integrator (Intel® FDI)–Wireless Advantage

Intel Flash Data Integrator (Intel FDI) is the leading wireless real-time code+data solution that delivers a true XIP advantage to get the most out of Intel Flash memory. Intel FDI manages code, data, and files in flash memory within an open architecture, including support for downloaded Java\* applets, Bluetooth\* file transfers, and voice recognition tags. The Intel FDI architecture allows easy integration into most real-time operating systems.

#### Software Product Highlights:

- Combined with Intel StrataFlash memory, creates a low-cost and compelling package for cellular handset designs
- Built-in support for both software-based and hardware-based read-while-write for data-centric real-time systems
- Simple data storage Application Program Interface (API)
- File Manager provides data storage in the form of ANSI-style files, to simplify software design
- Code Manager provides storage and direct execution (XIP) of Java applets and native code
- Tested, debugged, documented, and easily ported C-source code reduces the time-to-market for OEMs
- Code size is only 60 to 200 Kbytes (depending on feature set)

FEATURES	BENEFITS
File Manager	<ul style="list-style-type: none"> <li>▪ ANSI-style file storage</li> <li>▪ Meta-data support for file name, size, date/time stamp, owner, and permissions</li> <li>▪ Multiple open items for high-performance access</li> <li>▪ Enables easier coordination between software development teams by providing an alternative to numeric data identifiers</li> </ul>
Code Manager	<ul style="list-style-type: none"> <li>▪ Store, update, and delete code segments</li> <li>▪ XIP of code for high performance</li> <li>▪ Enables downloaded software such as Java applets</li> </ul>
Read-While-Write	<ul style="list-style-type: none"> <li>▪ Takes advantage of hardware-based RWW on dual- and multi-partition flash memory devices</li> <li>▪ Software-based RWW enables real-time data management on single-partition flash memory</li> </ul>
Robust power-loss recovery and wear-leveling	<ul style="list-style-type: none"> <li>▪ Recovers most current data when power is lost during writes</li> <li>▪ Ensures better cycling endurance for flash memory</li> </ul>
Royalty-free license when using Intel® Flash devices	<ul style="list-style-type: none"> <li>▪ No incremental product costs</li> </ul>
Comprehensive support for Intel® Flash memory features	<ul style="list-style-type: none"> <li>▪ Compatible with the newest flash memory technology</li> </ul>

**Intel® Persistent Storage Manager (Intel® PSM)—The Ideal Windows\* CE Solution**

Intel® Persistent Storage Manager (Intel® PSM) is the reliable executable storage solution that offers code+data+registry backup in one Intel Flash memory for enterprise Windows\* CE systems. Intel PSM software works in conjunction with the file system in the Microsoft Windows CE (PocketPC and SmartPhone) OS to provide simultaneous access to separate code and file partitions in the same chip. Unlike other data-only storage solutions, the code can be direct executed (XIP), demand-paged, or memory-mapped.

**Software Product Highlights:**

- Enables one of the most efficient memory system architectures in the marketplace for Windows CE
- Combines key memory functions into a single flash memory or bank
- Code Execution manages simultaneous read and write/erase operations
- Data Storage provides Microsoft Windows CE OS-compliant installable file system with power loss protection and wear-leveling
- Registry Backup and Restore enables pre-OS registry restore functions
- Maximizes benefits of Intel StrataFlash memory
- Cost-effective storage
- Reliable system backup
- Less board space, lower component count
- Easily integrated installable file system and device driver
- Pre-OS library file plus file system DLL
- Fully compliant with Microsoft Windows CE .NET operating system, PocketPC, and SmartPhone

FEATURES	BENEFITS
Executable code and data storage in the same chip	<ul style="list-style-type: none"> <li>▪ Efficient use of all memory space in the design</li> <li>▪ Greater design flexibility</li> <li>▪ Reduces power consumption, component count, and required board space</li> <li>▪ Maximizes value of flash memory</li> </ul>
File system with robust power-off recovery	<ul style="list-style-type: none"> <li>▪ Media will not corrupt if power is lost during a file modification</li> <li>▪ Allows Intel StrataFlash® memory to be used as file storage</li> <li>▪ Extends effective erase cycle endurance</li> </ul>
Pre-OS registry recovery and save	<ul style="list-style-type: none"> <li>▪ More reliable and efficient recovery from registry corruption events</li> </ul>

## Intel® Virtual Small Block File Manager (Intel® VFM)—Easy to Integrate

Intel® Virtual Small Block File Manager (Intel® VFM) is the proven, flexible, easy-to-integrate flash file manager for embedded systems. Intel VFM is Intel's Flash software reference code which provides for disk-like sector and file access to Intel Flash. In addition to data storage capability, VFM also accommodates handling code in the same component.

### Software Product Highlights

- Broadbase solution for embedded flash components
- Intel-developed code creates virtual small-block (VSB) sectors in the larger flash erase blocks
- File system sector calls are translated to Intel Flash standard commands
- VSB Flash Media Manager handles flash read/erase/write, wear-leveling, and sector management
- Intel VFM can work as the file manager or with an existing one
- Reserved Blocks allows for integration of code, or other capabilities, with the data storage features of Intel VFM
- Virtual Component support allows for optimal flash array utilization
- Small code size (14–20KB of code and 2–8KB RAM)
- High-performance edit capability
- Robust power-off recovery and media cleanup

FEATURES	BENEFITS
C source code	<ul style="list-style-type: none"> <li>▪ Easy porting to a wide variety of applications</li> <li>▪ Enhancements or changes can be handled by the OEM</li> </ul>
CFI enabled flash routines	<ul style="list-style-type: none"> <li>▪ Supports a wide range of current and future Intel® Flash components</li> </ul>
Complete documentation	<ul style="list-style-type: none"> <li>▪ Porting Guide, User's Guide, Overview, etc., provides quick access to information to understand the code</li> </ul>
Reserved flash region	<ul style="list-style-type: none"> <li>▪ Facilitates code handling in same component with data</li> </ul>
Royalty-free and derivative right license	<ul style="list-style-type: none"> <li>▪ Lower cost</li> <li>▪ Own your own solution</li> </ul>

## Intel® Flash Memory Software

SUPPORTED COMPONENTS	S/W SOLUTIONS		
	Intel® FDI	Intel® VFM	Intel® PSM
<b>Wireless</b>			
L18/L30	■	□	■
LV18/LV30	■	□	■
W18/W30	■	□	
<b>Mainstream</b>			
J3	■	■	■
K3, K18	■	■	■
<b>Basic</b>			
C3, B3	■	□	

- Fully supported and validated
- Code modifications required

If you wish to get Intel® Flash Software, please order a physical copy of the software product's user's guide. Instructions on how to download the software from our Web site will be shipped with the manuals.

## Intel® Flash Memory Documentation

For a complete list and to download available literature, visit our flash memory Web site at:  
<http://developer.intel.com/design/flash>

# Intel® Flash Memory for Embedded Applications

Embedded applications increasingly require rugged, versatile memory solutions. Designers need to accommodate features and functionality, while protecting the end-user's hardware investment. As the world's leading supplier of flash memory, Intel's combination of supply availability, innovative product offerings, high-quality standards, and superior customer support result in embedded memory subsystem solutions unrivaled in the industry. When it comes to embedded memory solutions, reliable high-density, low-cost flash memory from Intel is the answer.

## 3 VOLT INTEL STRATAFLASH® MEMORY (J3 FAMILY) – SECOND-GENERATION INTEL STRATAFLASH® MEMORY ARCHITECTURE

Intel StrataFlash® memory components utilize reliable and proven two-bit-per-cell technology to deliver 2x the memory in 1x the space, offering high-density flash at low cost. Intel StrataFlash memory offers exceptional value and reliability with over four generations of products and 100 million units shipped. Intel StrataFlash Memory (J3) is the best value for mainstream applications requiring both performance and large space for code and data storage. Available in densities up to 256 Mbit (32 Mbyte), J3 is the highest density NOR-based flash component available in high-volume manufacturing today.

On Intel's 0.18-micron technology, J3 sets a new benchmark for fast read speeds by adding both a four and eight word page mode feature. Page mode reads are up to three times faster than asynchronous reads on standard flash memory devices. J3 also offers a high-performance glueless interface to a myriad of processors for various applications (see *CPU to Flash Solution Matrix* at <http://developer.intel.com> for details).

This success of Intel's StrataFlash memory over the past six years has resulted in other flash memory manufacturers producing compatible parts to Intel's J3 product family.

FEATURES	BENEFITS
Intel® MLC Technology	Over six years of leading-edge reliability, performance, and value
32-, 64-, 128-, 256-Mb densities	Lowest cost-per-bit NOR devices
56-lead TSOP package	Over 100 million TSOP packages shipped
64-ball Easy BGA package	Long-term size and footprint capability; 50 percent smaller than 56-lead TSOP
Common Flash Interface (CFI)	Compatibility with future products today
One-Time-Programmable protection registers	64 bits programmed at the factory with a unique ID, and 64 bits can be programmed by the OEM; traceability, license control, and system authentication
Page Mode Interface	Page access mode improves read performance up to 3x
Complete selection of Intel® Flash Management Software	Dramatically reduces the time-to-market for OEMs and is easily ported to OEM's environment.

## INTEL® ADVANCED+ BOOT BLOCK FLASH MEMORY (C3/B3 FAMILY)

The Intel® 3 Volt Advanced+ (C3) and Advanced Boot Block (B3) Flash memory family is the world's first flash memory on the 0.13  $\mu\text{m}$  process lithography—Intel's fifth generation of its successful boot block memory products. Intel's C3 and B3 products are the industry's most widely used flash memory. Designed for a diverse range of applications, the Advanced+ and Advanced Boot Block devices are available in 16- to 64-Mbit densities, with access times up to 70 ns. Packaged offerings include 48-lead TSOP, 48-ball VF BGA, 64-ball Easy BGA, and 8 x 9 matrix Stacked Chip Scale Package. By using the same package configuration, designers can easily migrate from one density to another across five generations of boot block products.

FEATURES	BENEFITS
Intel's 0.13 $\mu\text{m}$ process lithography	<ul style="list-style-type: none"> <li>▪ Ideal solution for next-generation applications</li> </ul>
High performance	<ul style="list-style-type: none"> <li>▪ 70 ns access times @ 2.7–3.6V Vcc operation</li> <li>▪ Full Extended Operating Temperature: -40 °C to +85 °C</li> <li>▪ 12V Vpp fast programming option improves throughput time for lower manufacturing costs</li> </ul>
Full range of easy-to-upgrade, pin-compatible densities	<ul style="list-style-type: none"> <li>▪ 16 Mb, 32-Mb and 64-Mb densities for diverse application needs</li> </ul>
TSOP, VF BGA, Easy BGA and Stacked Chip Scale Packaging	<ul style="list-style-type: none"> <li>▪ Wireless and broad market package offerings</li> <li>▪ Industry-standard JEDEC packaging</li> <li>▪ Proven package reliability</li> <li>▪ VF BGA and Stacked-CSP flash for space-constrained applications</li> <li>▪ Consistent package footprint across densities makes migrations easier</li> </ul>
Instant individual block locking (C3 only) 128-bit fraud protection register (C3 only)	<ul style="list-style-type: none"> <li>▪ Ensures immediate data protection for individual blocks</li> <li>▪ Unique ID and OTP enables fraud protection capabilities</li> </ul>

## 3 VOLT SYNCHRONOUS INTEL STRATAFLASH® MEMORY (K3/K18 FAMILY)

The Synchronous Intel StrataFlash memory product provides a high-performance burst-mode interface and other additional features to the Intel StrataFlash memory family of products. Looking forward, the K3/K18 family of products is expected to only be supported through 2007. For designs requiring support beyond the K3/K18 life cycle, there are currently two choices. For designs that require the performance of a Synchronous interface, focus on the W18/30 products. Information on these products can be found in the “Intel® Flash Memory for Wireless Applications” chapter. For designs requiring higher densities up to 256Mb, refer to the J3 family of products earlier in this chapter.



FEATURES	BENEFITS
Intel® MLC Technology	Over five years of proven reliability, performance, and value
256-Mb, 128-Mb, 64-Mb densities	Industry leading, highest density NOR flash
Page and Burst Mode Interfaces	Page and burst modes improve read performance up to 5x
Complete selection of Intel® Flash management software	Dramatically reduces the time-to-market for OEMs and is easily ported to OEMs' environment
Buffered Enhanced Factory Programming (BEFP)	BEFP speeds up MLC flash programming up to 80 percent for today's beat-rate sensitive manufacturing environments
One-Time-Programmable protection registers	64 bits programmed at the factory with a unique ID, and 2K bits can be programmed by the OEM; traceability, license control, and system authentication
Common Flash Interface (CFI)	Compatibility with future products today
64-ball Easy BGA package	Long-term size and footprint capability; 50 percent smaller than 56-lead TSOP
VF BGA package and Intel® Stacked-CSP	Small packaging for wireless applications

## INTEL® FLASH MEMORY DEVELOPMENT TOOLS

Intel® Flash memory tools reduce product development time and save money by getting your product to the market faster. Intel and third-party vendors worldwide provide a wide range of tools for all stages of the product development cycle. Information and vendor URL links pertaining to these tools are located on the World Wide Web at the Intel® Flash Memory Tools and Software site and in the *Electronic Tools Catalog*. The *Electronic Tools Catalog* contains thousands of tools from more than 200 companies. These tools provide solutions for the definition, design, prototype, and production stages of the product development cycle.

Examples of Intel Flash memory tools range from pre-silicon software models, PCB layout files, Intel® software, programming products, information and services, test accessories, PCB design guidelines, SMT manufacturing tips, and rework equipment. Many other items are available on Intel's Web site, including Chip Scale Package (CSP) information, product information, application notes, datasheets, and online ordering of hard-copy manuals, such as the *Intel® Flash Memory Tools Guide*.

### TOOL HIGHLIGHTS

#### Definition and Design Tools

- IBIS, VHDL, and Verilog software models
- PCB flexible layout and escape routing gerber files
- Schematic symbol files
- Media/file managers, templates, and utility software
- Intel® Flash memory SOFTWAREBuilder
- Intel® Flash memory packaging technology

#### Prototype and Production Tools

- PCB contract manufacturers
- Programming Tools Web page, ([developer.intel.com/design/flash/swtools/tools.htm](http://developer.intel.com/design/flash/swtools/tools.htm)), onboard (JTAG/ATE), off-board, application notes, etc.
- Programmers: engineering, concurrent, gang, and automated
- Programming, prototype, and production sockets and adapters
- Programming and shipping media services
- Tape and reel equipment and services
- SIMM/DIMM manufacturers
- Test accessories
- Rework equipment

FEATURES	BENEFITS
Programming tools, sockets and support	Variety of programming solutions that improve your flash memory programming process by decreasing development times, lowering costs, and improving production capabilities. Intel also works proactively with many programming companies and socket manufacturers to ensure reliable programming hardware and software support is available for Intel® Flash memory products.
Pre-silicon software models (IBIS, VHDL, and Verilog)	Assists the designer in evaluating design functionality and/or electrical characteristics of Intel Flash memory components through software simulation.
PCB flexible layout and escape routing files	Software-based files that allow for multiple Intel Flash memory packages to be designed into a single PCB land pad area or escape routing designs for Intel Flash memory CSPs. Files can be downloaded directly for PCB design.
Media/file managers, templates, and utility software	Software-based files that provide standard schematic symbols, software management functions, low-level flash access routines to help simplify your product development.
Test accessories	Test accessories include a variety of test debug tools usually used in the prototype and production stage of product development. These tools range from vacuum wands and handling procedures to test clip and access fixtures for all Intel Flash Memory packages.
Rework equipment	Reviews rework systems that encompass multiple process steps such as component removal, site redress, solder paste application, split-vision part placement, and reflow oven on the same system.

**COMPONENTS AT A GLANCE: DESIGN-IN PRODUCTS**

DENSITY	PRODUCT	ORGANIZATION	ACCESS TIME (ns)	TEMP RANGE	PACKAGE	NUMBER PINS	V <sub>CC</sub>	V <sub>PP</sub> /V <sub>PEN</sub>	I/O
<b>MAINSTREAM MEMORY PRODUCTS—COST-EFFECTIVE FLASH MEMORY FOR MAINSTREAM CODE EXECUTION AND DATA STORAGE APPLICATIONS</b>									
<b>Intel StrataFlash® Memory (J3)</b>									
256 Mb	28F256J3	32M x 8 or 16M x 16	125[30]b	E	TE/RC	56/64	2.7–3.6V	3V	2.7–3.6V
128 Mb	28F128J3	16M x 8 or 8M x 16	120[25]b	E	TE/RC	56/64	2.7–3.6V	3V	2.7–3.6V
64 Mb	28F64QJ3	8M x 8 or 4M x 16	115[25]b	E	GE/TE/RC	48/56/64	2.7–3.6V	3V	2.7–3.6V
32 Mb	28F32QJ3	4M x 8 or 2M x 16	110[25]b	E	GE/TE/RC	48/56/64	2.7–3.6V	3V	2.7–3.6V
<b>Synchronous Intel StrataFlash® Memory (K3/K18)</b>									
256 Mb	28F256K3	16M x 16	120[25]b[13]c	E	GE/RC	63/64	2.7–3.6V	3V	2.375–3.6V
	28F256K18	16M x 16	120[30]b[15]c	E	GE/RC	63/64	2.7–3.6V	3V	1.65–1.95V
128 Mb	28F128K3	8M x 16	115[25]b[13]c	E	GE/RC	56/64	2.7–3.6V	3V	2.375–3.6V
	28F128K18	8M x 16	115[30]b[15]c	E	GE/RC	56/64	2.7–3.6V	3V	1.65–1.95V
64 Mb	28F64QK3	4M x 16	110[25]b[13]c	E	GE/RC	56/64	2.7–3.6V	3V	2.375–3.6V
	28F64QK18	4M x 16	110[30]b[15]c	E	GE/RC	56/64	2.7–3.6V	3V	1.65–1.95V
<b>BASIC MEMORY PRODUCTS—DEPENDABLE AND MOST WIDELY USED FLASH MEMORY</b>									
<b>Intel® Boot Block Flash Memory (C3, B3)</b>									
64 Mb	28F640C3	4M x 16	80	E	TE, GE/RC	48/64	2.7–3.6V	1.65–3.6V or 12V	1.65–2.5V or 2.7–3.6V
32 Mb	28F320C3	2M x 16	70, 90	E	TE, GE/RC	48/64	2.7–3.6V	1.65–3.6V or 12V	1.65–2.5V or 2.7–3.6V
	28F320B3	2M x 16	70, 90	E	TE, GE	48	2.7–3.6V	2.7–3.6V or 12V	1.65–2.5V or 2.7–3.6V
16 Mb	28F160C3	1M x 16	70, 90	E	TE, GE/RC	48/64	2.7–3.6V	1.65–3.6V or 12V	1.65–2.5V or 2.7–3.6V
	28F160B3	1M x 16	70, 90	E	TE, GE	48	2.7–3.6V	2.7–3.6V or 12V	1.65–2.5V or 2.7–3.6V

\* Speed @ 3.0-3.6V. 3 Volt Boot Block parts are marked with 2.7–3.6V Vcc speeds.

**Embedded Products Legend**

**Access Time Footnotes:**

- b Page Mode Access
- c Synchronous Burst Mode

**Temperature Range Footnotes:**

- C = Commercial Temperature (0°C to +70°C)
- E = Extended Temperature (-40°C to +85°C)
- P = Expanded Temperature (-25°C to +85°C)

**Package Footnotes:**

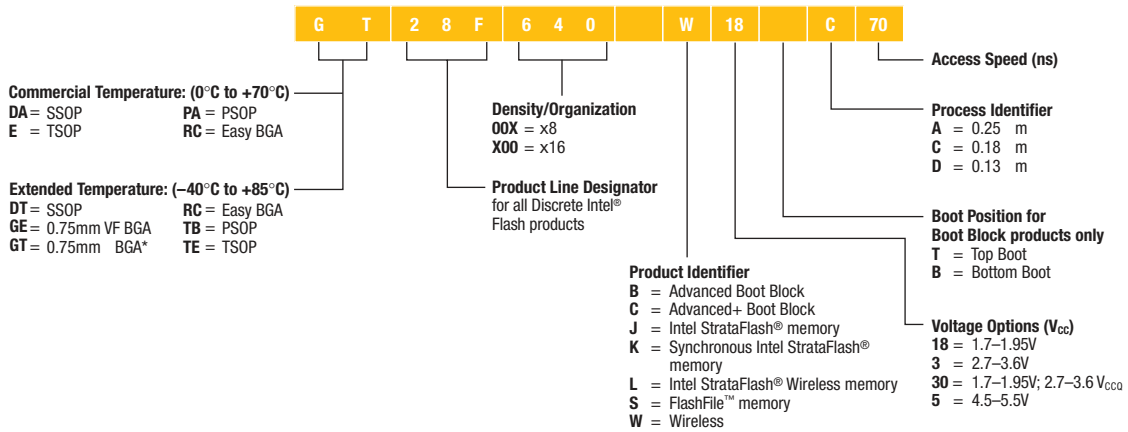
- Commercial Temperature:** (0°C to +70°C)
- DA = SSOP
- E = TSOP
- PA = PSOP
- RC = Easy BGA

**Extended Temperature:** (-40°C to +85°C)

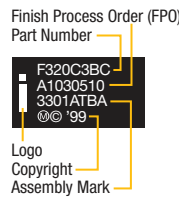
- DT = SSOP
- GE = 0.75mm VF BGA
- RC = Easy BGA
- TB = PSOP
- TE = TSOP

† Temperature range on Intel® Stacked Chip Scale Package/CSP (-25°C to +85°C)

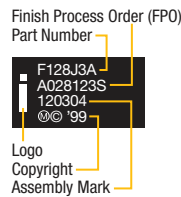
**ORDERING INFORMATION**



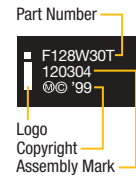
**VF BGA**



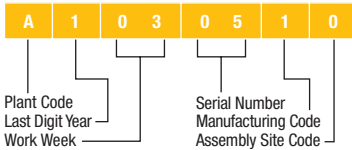
**Easy BGA**



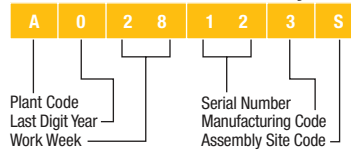
**BGA\***



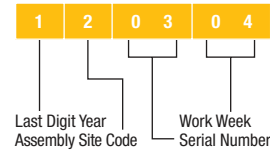
**FPO Number Information — VF BGA**



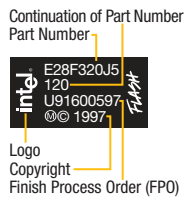
**FPO Number Information — Easy BGA**



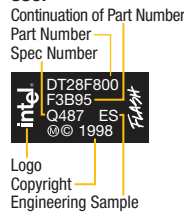
**Assembly Mark Information — BGA\***



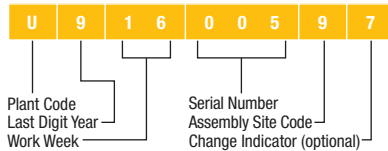
**TSOP**



**SSOP**



**FPO Number Information — TSOP/SSOP**



**Intel® Flash Memory Documentation**

For a complete list and to download available literature, visit our flash memory Web site at:  
<http://developer.intel.com/design/flash>

# Intel® I/O Processors

## INTEL'S I/O PROCESSORS (IOP)

Intel's I/O processor family offers 32-bit microprocessor products that are designed to enable high-performance I/O solutions. These I/O processors have been designed from the ground up optimizing and balancing dataflow in order to deliver the highest I/O throughput possible. Intel's I/O processors range from high-frequency discrete products to fully integrated devices offering all of the required components of a complete I/O solution such as a PCI-X interface or bridge, memory controller, high-performance core, and an XOR engine (for RAID 5 parity generation).

Intel's I/O processor family is specifically designed to increase system-level performance by off-loading many of the I/O tasks traditionally handled by the host processor. From a system-level standpoint, an I/O processor can reduce the utilization of the host CPU by servicing I/O requests and interrupts without host intervention, resulting in a significant increase in overall performance of servers. Intel's I/O processors provide high I/O performance and better system balance, improving scalability and performance. Applications that can best utilize these features include networked storage applications, servers, SAN, NAS, RAID adapter cards, LAN adapter cards, computer telephony devices, networking devices and other I/O-intensive systems. Intel's I/O processors have also found usage in VoIP, iSCSI, Video processing, set-top boxes, control plane processing, medical and others.

### Intel® IOP331 I/O Processor with Intel XScale® Microarchitecture

The Intel® IOP331 is a highly integrated I/O system on a chip for I/O-intensive storage, networking, communications, and embedded applications. The IOP331 features an 800 MHz CPU, high-performance internal bus, dual-ported memory controller, a high-bandwidth PCI-X to PCI-X Bridge, and an improved interrupt controller to provide a high-performance, highly integrated processor solution. Target applications include PCI/PCI-X host-based adapters (RAID cards, iSCSI cards, FC cards, Security/SSL NICs, etc.), control plane and system controller applications utilizing PCI/PCI-X as a system interconnect and/or backplane Virtual Private Network devices, video servers, Network gateways, Network Attached Storage, External Storage Arrays), PCI/PCI-X-based line cards (VoIP, Routers, etc.), and a host of other applications that require a highly integrated, high-performance system on a chip processor.

As Intel's sixth-generation I/O processor, the IOP331 continues to build on Intel's strength in delivering high-performance, low-power Intel XScale® technology processors. The IOP331 is code compatible with the Intel® IOP321 I/O Processor, other Intel XScale core processors, and ARM\*-based devices, simplifying code porting from existing designs. The IOP331 provides ultra-fast memory transactions due to its Double Data Rate (DDR) SDRAM dual-ported memory controller that supports up to 2 GB of DDR 333 MHz memory or 1 GB of DDRII 400 MHz memory. The memory controller supports 32-bit or 64-bit memory subsystems with or without ECC. The IOP331 features a new dual-ported memory controller that provides both a direct port from the CPU to memory (core port) and a port from the ATU/internal bus to memory (internal bus port).

The Intel IOP331 also has made significant improvements to the interrupt controller in order to reduce interrupt latency. The interrupt controller includes an advanced vector generator for both FIQ and IRQ interrupts, delivering the vector directly to the interrupt service routine, saving software overhead. Also included is an interrupt prioritizer that uses a two-bit field for each interrupt source to provide four levels of interrupt priority.

FEATURES	BENEFITS
<ul style="list-style-type: none"> <li>500/667/800 MHz Intel XScale® core</li> <li>Integrated, System on a chip design</li> </ul>	High performance with low power
<b>Dual PCI/PCI-X Interfaces</b> <ul style="list-style-type: none"> <li>Integrated PCI-X Bridge</li> <li>Up to 133 MHz operation</li> <li>2 DMA units with chaining support</li> <li>Support to configure the device from remote PCI host</li> </ul>	PCI-X to PCI-X Bridge integration lowers BOM cost and helps reduce board space
<b>Optimized Memory Controller</b> <ul style="list-style-type: none"> <li>DDR 333 and DDRII 400 with ECC</li> <li>64-, 72-bit memory, and 32-bit mode also supported</li> </ul>	Intel XScale core has direct memory access resulting in much improved performance
<b>Communications</b> <ul style="list-style-type: none"> <li>I<sup>2</sup>C*</li> <li>UARTs</li> <li>16-bit local bus with two chip selects</li> <li>8 GPIO pins</li> </ul>	Integration helps reduce board space and lower BOM cost
<b>Application Accelerator Units in DMA</b> <ul style="list-style-type: none"> <li>RAID5 XOR</li> <li>iSCSI CRC32C</li> </ul>	Application-specific integration in hardware improves RAID5 and iSCSI performance and helps reduce CPU overhead

### Intel XScale® 80219 General-Purpose PCI Processor

The Intel XScale® 80219 general-purpose PCI processor is a single-chip solution that opens the door to cost sensitive, high-performance embedded application use. The 64-bit PCI-X interface is one of several enticing features. The 80219 processor's 64-bit PCI-X interface is fully backward compatible to PCI 2.2 standards enabling easy interface to cheaper PCI components today, and the PCI-X 1.0a compatibility makes it simple to upgrade to PCI-X in the future. The 133 MHz 64-bit PCI-X interface achieves up to 1 GB per second throughput. The internal bus operates at 200 MHz delivering internal bandwidth of up to 1.6 GB/second. The 80219 also features a 200 MHz DDR SDRAM controller with ECC that supports up to 1 GB of 64-bit DDR SDRAM. The 32-bit local bus is programmable at 33, 66 and 100 MHz making it simpler to develop embedded applications requiring a connection to non-PCI peripheral components such as ASICs, Flash memory, or DSPs.

The 80219 is a highly integrated chip with the high performance and bandwidth necessary to serve a wide range of embedded applications such as industrial controllers, low-end networking, set-top boxes, compact PCI, digital surveillance security, vision inspection equipment, personal storage appliances, control plane processing, Voice over Internet Protocol (VoIP) blades and devices, print imaging devices and a host of other applications requiring high performance and low power in a tightly integrated environment.

The 80219 general-purpose PCI processor introduces a powerful combination of integrated features. The 133 MHz PCI-X interface achieves up to 1 Gbyte per second throughput, a two-fold increase over 66 MHz PCI. The internal bus operates at 200 MHz and offers internal bandwidth of up to 1.6 Gbytes/second. The 80219 also features a 200 MHz DDR SDRAM controller with ECC that supports up to 1 Gbyte of 64-bit DDR SDRAM. It also supports 32-bit memory for applications that are more space and cost sensitive. It contains a programmable (33, 66, 100 MHz), 32-bit local bus that is excellent for embedded applications requiring connections to non-PCI peripheral components such as ASICs, flash memory, or DSPs.

FEATURES	BENEFITS
400, 600 MHz Intel XScale® Core	High-performance with low power
Integrated, System-On-A-Chip Design	Smaller packaging for board space cost savings
64-bit PCI 2.2 Interface	Industry Standard I/O Bus allowing flexible inexpensive interconnect
133 MHz PCI-X 1.0a Interface	Easy upgrade to higher speed I/O interconnect
200 MHz DDR SDRAM Bus	Higher memory performance for higher system performance
Up to 1GB memory support	Supports large memory subsystems when necessary
1.6 GB/s Internal Bus	Increases overall design performance
32-bit Local Bus	Excellent for embedded applications requiring non-PCI peripherals such as ASICs, DSPs, or flash
8 GPIOs	
4 SDRAM Output Clocks	Reduces chip count Saves board space
2 Programmable Timers	

### Intel® IOP315 I/O Processor Chipset with Intel XScale® Technology

The Intel® IOP315 chipset—Intel® 80200 processor and Intel® 80314 companion chip—dramatically improves upon the performance of the first-generation I/O processor chipset (Intel® IOP310).

The IOP315 2-chip combo touts a 60 percent performance increase over the previous pair. The performance is scalable with either single or dual core options. Thanks to the Intel XScale microarchitecture, developers of a variety of applications can optimize the needs from ultra-low power of high-performance processing. This new microarchitecture is compliant with the ARM\* Version 5TE instruction set (excludes the floating-point instruction set).

## High-performance companion chip for the Intel® 80200 processor

The Intel® 80314 companion chip for the Intel® 80200 processor provides a rich peripheral set designed for storage and network applications. The Intel 80314 can support either one or two Intel 80200 processors. The Intel 80314 uses an internal switch fabric and supports concurrent transactions from any interface to any other interface. For fast memory transactions, the Intel 80200 processor interface has a dedicated bus to the DDR SDRAM memory controller that allows multiple concurrent outstanding transactions.

The Intel 80314 is especially well suited for high-performance storage applications such as network storage target devices (SAN, iSCSI, NAS) and intelligent network adapter cards (iSCSI, IPv4, IPv6, IPSec). The integrated PCI-X bridge, dual-ported ECC memory, low-latency 1 MB SRAM, high-bandwidth switch fabric and CRC32C and XOR engines make it an ideal choice for these applications. In addition, the Intel 80314 is an excellent solution for embedded and networking applications with its integrated dual-10/100/1000 Mbps MACs and flexible endian support.

FEATURES	BENEFITS
<b>Intel® 80200 Interface</b> <ul style="list-style-type: none"> <li>▪ 100 MHz Request Bus</li> <li>▪ 4-Entry Request Buffer</li> <li>▪ 2.5V I/O generation, 3.3V tolerant (from Intel 80200)</li> <li>▪ Support for single or dual Intel 80200 processors</li> <li>▪ ECC-based bus integrity protection</li> </ul>	High-performance Intel XScale® technology that scales
<b>Dual PCI/PCI-X Interfaces</b> <ul style="list-style-type: none"> <li>▪ Integrated PCI-X bridge</li> <li>▪ 25–133 MHz operation</li> <li>▪ 4 DMA units with chaining support</li> <li>▪ Support to configure the device from remote PCI host</li> <li>▪ CPCI hot-swap support</li> <li>▪ 5V tolerant/3.3V I/O</li> <li>▪ 4 concurrent split transactions</li> <li>▪ Configurable arbitration logic</li> </ul>	PCI-X to PCI-X bridge integration lowers Bill of Material (BOM) cost and helps reduce board space Provides for increased system concurrency
<b>Optimized Memory Controller</b> <ul style="list-style-type: none"> <li>▪ Dual-ported MCU</li> <li>▪ 64- and 72-bit memory</li> <li>▪ 12 GB support, 3 DIMMs</li> </ul>	Dramatically increases core to memory performance
<b>Optional 1 MB of Low-Latency SRAM</b>	Low-latency memory option helps reduce bottlenecks and improve performance
<b>Communications</b> <ul style="list-style-type: none"> <li>▪ 2 GbE MACs</li> <li>▪ 133 MHz, 32-bit local bus with 4-chip selects</li> <li>▪ I<sup>2</sup>C*</li> <li>▪ UARTs</li> <li>▪ 8 GPIO pins</li> </ul>	Integration reduces board space, lowers BOM, and improves performance
<b>Application Accelerator Units in DMA</b> <ul style="list-style-type: none"> <li>▪ RAID5 XOR</li> <li>▪ iSCSI CRC32C</li> </ul>	Storage-specific integration in hardware improves performance and helps reduce CPU overhead



## Intel® IOP321 I/O Processor

The Intel® IOP321 I/O processor is Intel's fifth-generation I/O processor. It is the first I/O processor to integrate an Intel XScale core and a PCI-X interface. Many storage, networking, and embedded applications require fast I/O throughput for optimal performance. The Intel IOP321 is a highly integrated, cost-effective I/O system on a chip that delivers a two-fold performance boost over its predecessor, the Intel® IOP310 I/O processor chipset, in I/O-intensive applications.

The Intel IOP321 is especially well suited to storage applications including RAID (Redundant Array of Independent Disks), HBAs (Host Bus Adapters), and ROMB (RAID on motherboard). Its small package size, high data throughput, and integrated AAU/XOR provide an optimized solution for ROMB applications. In addition, the Intel IOP321 processor is an ideal choice for applications requiring a high-performance I/O subsystem in a tightly-integrated environment.

The Intel IOP321 offers the flexibility to interface with a wide variety of different interconnect technologies, including SCSI, Fibre Channel, SATA, IB, and GBit Ethernet. Utilization of the Intel IOP321 across multiple applications can contribute to cost savings, ease of development, and more effective inventory management.

FEATURES	BENEFITS
400, 600 MHz Intel XScale® Core	High-performance with low power
Integrated, System-On-A-Chip Design	Smaller packaging, board space cost savings
133 MHz PCI-X Interface	Industry-Standard I/O Bus
200 MHz DDR SDRAM Bus	Higher memory performance
Up to 1GB memory support	Two-fold increase in total memory addressability
32 bit Local Bus	Excellent for embedded applications requiring non-PCI-X peripherals such as ASICs, DSPs, or glueless FLASH
8 GPIOs	Reduces chip count
4 SDRAM Output Clocks	Saves board space
2 Programmable Timers	Simplifies design
AAU/XOR	Integrated data protection for RAID; cuts board cost/space

## Intel® IOP303 I/O Processor

The Intel® IOP303 I/O processor, Intel's third-generation I/O processor, provides developers with a fully validated, single-chip solution that can deliver a 25 percent increase over the Intel® i960® RN processor in I/O performance in RAID 0 applications.

While the Intel IOP303 I/O processor is based on the Intel i960 processor core, the chip inaugurates a new naming convention for Intel® I/O processors. The new “Intel® IOP300” series name provides an easier reference for continuing performance increases on Intel's I/O processor roadmap.

The Intel IOP303 I/O processor continues Intel's commitment to strong I/O performance, delivered with high-integration. In addition to its integrated 66 MHz PCI-to-PCI bridge, other enhanced integrated features include a 100 MHz internal bus and 100 MHz SDRAM controller, XOR engine, SDRAM clocks, secondary PCI clocks and eight general-purpose I/O registers, all on a single chip. Compared to the Intel i960 RN I/O processor, maximum accessible memory has been increased from 128 Mbytes to 512 Mbytes of SDRAM. The chip supports both the 5V and 3.3V PCI 2.2 specifications.

FEATURES	BENEFITS
Single chip, integrated I/O processor	<b>Integration.</b> Pre-validated, fast time-to-market solution
66 MHz, 64-bit PCI-to-PCI bridge	<b>Standards.</b> High data bandwidth and PCI compliant
64-bit, 100 MHz internal bus	<b>Data throughput.</b> 800Mbps peak bandwidth for optimum data flow
Two address translation units	<b>ATU.</b> Maps PCI memory space onto the internal bus for high-performance, direct processor access
Three channel DMA controller <ul style="list-style-type: none"> <li>▪ Two channels between primary PCI bus and local memory</li> <li>▪ One channel between secondary PCI bus and local memory</li> </ul>	<b>DMA.</b> Transfers blocks of data between the PCI bus and the local processor memory at a maximum throughput of 528Mbps
Application accelerator unit (integrated hardware XOR engine)	<b>XOR.</b> Supports fast parity generation for applications such as RAID levels 3 and 5
Performance Monitoring Unit (PMU)	<b>Performance tuning.</b> Providing monitoring capabilities of 98 discrete events to assist in fine-tuning applications for maximum performance
Integrated memory controller	<b>Memory.</b> Supports 100 MHz SDRAM, also flash memory
I <sup>2</sup> C* bus interface unit	<b>System management.</b> Supports server management features (temperature control, LCD display)

## I/O PROCESSORS LINE CARD

PRODUCT	CORE SPEED (MHz)	PCI BUS SPEED (MHz)	PCI	CACHE	AAU	PMU	LOCAL BUS	PACKAGE
Intel® 80331M500	500	133(PCI-X)	64-bit PCI-X bridge	32K I cache, 32K D cache	Yes	Yes	16 bit	829L FCBGA
Intel® 80331M667	667	133(PCI-X)	64-bit PCI-X bridge	32K I cache, 32K D cache	Yes	Yes	16 bit	829L FCBGA
Intel® 80331M800	800	133(PCI-X)	64-bit PCI-X bridge	32K I cache, 32K D cache	Yes	Yes	16 bit	829L FCBGA
Intel® 80219M400	400	133(PCI-X)	64-bit PCI-X Interface	32K I cache, 32K D cache	No	Yes	32 bit	544L PBGA
Intel® 80219M600	600	133(PCI-X)	64-bit PCI-X Interface	32K I cache, 32K D cache	No	Yes	32 bit	544L PBGA
Intel® 80314GN	N/A	133(PCI-X)	2 x 64-bit PCI-X Interfaces	N/A	Yes	Yes	32 bit	1027L HSBGA
Intel® 80314GS	N/A	133(PCI-X)	2 x 64-bit PCI-X Interfaces	1MB SRAM	Yes	Yes	32 bit	1027L HSBGA
Intel® 80321M400	400	133(PCI-X)	64-bit PCI-X Interface	32K I cache, 32K D cache	Yes	Yes	32 bit	544L PBGA
Intel® 80321M600	600	133(PCI-X)	64-bit PCI-X Interface	32K I cache, 32K D cache	Yes	Yes	32 bit	544L PBGA
Intel® 80200M200	200	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80200M200T	200	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80200M400*	400	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80200M400T*	400	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80200M600*	600	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80200M600T*	600	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80200M733*	733	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80200M733T*	733	N/A	N/A	32K I cache, 32K D cache	N/A	N/A	No	241L PBGA
Intel® 80303	100	66	64-bit PCI-to-PCI bridge	16K I cache, 4K D cache	Yes	Yes	No	540L PBGA

\*The Intel® 80200Mxxx and Intel® 80312 constitute the “Intel® IOP310 chipset.”

# Network Processors

Intel® network processors combine the high performance and low power consumption of Intel XScale® technology with an easy-to-use programming framework that enables flexible implementation of rich networking services at line rates up to OC-192/10 Gbps. They are designed to meet the specialized packet handling requirements of market segments ranging from customer premises equipment, to access, edge and the core of the network, and up through platforms that support secure content processing.

Network Processors covered in this section are:

- Intel® IXP2850: Network edge security and storage area network applications to OC-192/10 Gbps
- Intel® IXP2800: Network edge and core applications to OC-192/10 Gbps
- Intel® IXP2400: Network access and edge applications to OC-48/2.5 Gbps
- Intel® IXP425: A broad range of home, SME, and embedded networking applications requiring high performance
- Intel® IXP422: Home, SME, and embedded networking applications requiring security
- Intel® IXP421: Home, SME and embedded networking applications requiring voice
- Intel® IXP420: Cost-sensitive home, SME and embedded networking applications

## INTEL® IXP2XXX NETWORK PROCESSOR PRODUCT LINE

### Family Overview

Equipment designed for network edge and core applications requires high levels of processing performance to support value-added network services at line rates up to and including OC-192/10 Gbps. While rapidly adding these new services, network equipment vendors must continue to minimize development time and cost. To support these services and to extend time-in-market network processors must combine performance with highly flexible control of processing resources. In addition, implementation of standards-based interfaces for easy component integration and the ability to leverage software investments by reusing code can dramatically speed time-to-market and lower development costs.

Intel's second-generation network processors, the Intel IXP2400, Intel IXP2800, and Intel IXP2850, use fast and flexible sharing of data and event signals among threads and microengines to manage data-dependent operations among multiple parallel processing stages with low latency. Through this combination of flexible packet processing and fast inter-process communication, Intel delivers rich processing capability at line rates up to and including OC-192/10 Gbps.

The Intel® IXP2XXX network processors deliver this enhanced performance with the programmability designed to speed the deployment of intelligent network services. A centerpiece of Intel® Internet Exchange Architecture (Intel® IXA), Intel's second-generation network processor architecture scales to successive generations of networking products and is supported by a common set of development tools, libraries, and example designs. In combination, the Intel IXP2400, Intel IXP2800, and Intel IXP2850 provide the foundation for a comprehensive development environment that can dramatically accelerate time-to-market, while enabling customers to reuse their investments in software.

### Development Environment

Intel provides a comprehensive development environment that enables customers to rapidly develop applications for the Intel IXP2400, Intel IXP2800, and Intel IXP2850 network processors and migrate existing applications from the Intel® IXP1200 network processor family. The development environment includes the Intel® Internet Exchange Architecture Software Development Kit (Intel® IXA SDK) 3.x, complemented by a choice of hardware development platforms, supporting software and tools, example designs and professional services.

Intel provides developers designing with the Intel® IXP2XXX network processors a choice of advanced development platforms based on their application needs:

- The Intel®IXDP2400 and the Intel® IXDP2800/IXDP2850 Advanced Development Platforms are dual-chip implementations ideal for developing access, edge and metro/core applications up to OC-192/10 GbE line rates.
- The Intel®IXDP2401 and the Intel® IXDP2801/IXDP2851 Advanced Development Platforms are standards-based, PICMG 3.0 Advanced Telecom Computing Architecture\* (AdvancedTCA) compliant single-chip implementations ideal for designing access and edge applications up to OC-48/4 GbE line rates.

These development platforms further enhance the value of the network processors by providing a robust development environment that can dramatically accelerate the development and validation of new products designed for OC-3 to OC-192 line rates. These development platforms can be used in several ways:

- Developers can write code and run simulations in a Windows\*-based PC environment using the graphical workbench and the cycle-accurate simulator, and then use the development platform to verify system functionality before the customer hardware is available.
- Hardware design engineers can reuse schematic source files included in their board design to jump-start their board development effort.
- Developers can validate a design using the base card and mezzanine cards available from Intel, or design and test a custom I/O subsystem using the development platform prior to committing to a full board design.
- With the IXDP2401, IXDP2801 and IXDP2851, developers can add additional AdvancedTCA boards from Intel as well as third parties to prototype more complete systems.
- Developers can design a proprietary switch fabric card, and use an interface on the base card to implement a fabric backplane.

The Intel IXA SDK 3.x enables hardware and software engineering to proceed in parallel. The SDK provides the software team with an easy-to-use graphical simulation environment for developing, debugging, and optimizing a network application at the same time that the hardware team is working on design and prototyping the device. By using the development tools, network building blocks and the Intel® IXA Portability Framework in the SDK, the design team can achieve an unparalleled time-to-market advantage.

Intel IXA SDK 3.x preserves investments in software for the Intel IXP1200 network processor by maintaining the familiar best-in-class Developer's Workbench programming environment and extending it to support the Intel IXP2400, Intel IXP2800, and Intel IXP2850 network processors. Developers who use the Intel® IXA SDK dataplane library, Intel® Microengine C Compiler and the programming framework with the Intel IXP1200 will be able to retarget their code for the Intel IXP2400, Intel IXP2800, and Intel IXP2850 by using the same or similar facilities in SDK 3.x.

Intel IXA SDK 3.x consists of two parts separately packaged and released: Intel IXA SDK Tools 3.x and Intel IXA SDK Software Framework 3.x. Intel IXA SDK Tools 3.x includes microengine (MEv2) development environment and tools used by customers to develop, debug and tune application code that runs on microengines of IXP2XXX network processors. Intel IXA SDK Software Framework 3.x includes software building blocks, framework for combining these building blocks and software pipelines based on these blocks for jump-starting customer application development.

Intel also provides all the tools needed to build challenging products while meeting aggressive development schedules, including example designs and professional software services to enable developers to take advantage of the flexibility offered by Intel® network processors. As a result, developers can reduce the time, effort, and resources required for lower-level, standards-based platform software, and focus on developing new value-adding services and features that differentiate products at the application level.

## INTEL® IXP2850 NETWORK PROCESSOR FOR HIGH-SPEED, SECURE CONTENT PROCESSING IN A SINGLE CHIP

### Product Overview

The newest member of the Intel® second-generation network processor product family, the Intel IXP2850 network processor, delivers high-performance packet and content processing with robust security features in a single platform. By integrating capabilities that have typically required multiple specialized processors, the Intel IXP2850 provides a secure and cost-effective platform that enables a broad range of emerging applications..

### Target Applications

Several current application trends are driving the need for high-performance secure content processing. Global enterprise networks are moving from dedicated connections to virtual private networks. Applications for e-Commerce must support secure Web browsing. Wireless LAN applications have multiple new security standards to support. Distributed storage applications use secure mechanisms for protocol integration and data exchange. In addition, cost efficiencies and performance requirements are fostering a migration of these applications from computing platforms to communications products. These development opportunities include:

- Converged security gateway applications including IPsec and SSL VPN, Stateful Firewall, TCP Offload, IDS/IPS and Virus detection
- Service blades for bulk cryptography and TCP offload in infrastructure switches, routers and appliances
- IPsec/TCP termination and offload functionality in networked storage applications
- Content-aware load balancing in network appliances, such as Web switches, located in front of server farms

FEATURES	BENEFITS
Sixteen integrated programmable 1.4 GHz microengines	Multithreaded dataplane processing elements provide headroom for high-speed packet, content, and secure processing
Two integrated cryptography blocks	Provide hardware acceleration for DES, 3DES, AES, and SHA-1 algorithms. Enables bulk encryption/decryption for IPsec data streams at speeds up to 10 Gbps
Flow-through cryptography architecture processes packets “on the fly”	Minimizes packet reassembly in memory and increases performance
Supports ECB and CBC cipher modes	Provides flexibility to address multiple application environments
Integrated Intel XScale® Core <ul style="list-style-type: none"> <li>▪ 32 Kbyte—Instruction cache</li> <li>▪ 32 Kbyte—Data cache</li> <li>▪ 2 Kbyte—Mini-data cache</li> </ul>	Embedded 32-bit RISC core for IKE, route table maintenance and system-level management functions lowers system cost and saves board space
Support for more than 2 GB of memory	Supports large numbers of security associations for robust performance
PCI 2.2 I/O Interface	Supports industry-standard connection to additional processors to accelerate security functions such as public key exchange
Modular software building blocks for IPsec and TCP	Simplifies product development and speeds time-to-market
Comprehensive development environment: Software SDK and Hardware Development Platform	Improves time-to-market via robust hardware and software development tools
Professional design services	Reduces development risk and time
~2 watts of incremental power for cryptography blocks	Low power consumption reduces system costs
Power Dissipation	~27.5 Watts typical, ~32 Maximum @ 1.4 GHz operation ~19.5 Watts typical, ~25 Maximum @ 1.0 GHz operation ~16.5 Watts typical, ~21 Maximum @ 650 MHz
Software- and pin-compatible with IXP2800	Enables reuse of board designs, reduces development cost, and saves board space

## INTEL® IXP2800 NETWORK PROCESSOR FOR OC-192/10 GBPS NETWORK EDGE AND CORE APPLICATIONS

### Product Overview

The Intel IXP2800 network processor is a member of Intel's second-generation network processor family. Based on the first-generation Intel IXP1200, the Intel IXP2800 is a programmable network processor that integrates a high-performance parallel processing design on a single chip for processing complex algorithms, deep packet inspection, traffic management, and forwarding at wire speed. Its store-and-forward architecture combines a high-performance Intel XScale core with sixteen 32-bit independent multithreaded microengines that cumulatively provide more than 23.1 giga-operations per second. The microengines provide the processing power to perform tasks that traditionally required expensive high-speed ASICs.

### Application Flexibility

The ability of the Intel IXP2800 network processor to support OC-192/10 Gbps line rates makes it the optimal solution for a wide variety of high-performance applications such as Metropolitan Area Network (MAN) switches and routers, Internet edge and core switches and routers, multi-service switches, 10 Gbps enterprise switches and routers designed to meet the requirements of advanced data centers, storage area networks (SAN), and content-aware server off-load/Web switches. The network processor's programmability also makes it the right choice for IPSec and Virtual Private Network (VPN) solutions, and wireless infrastructure equipment. Functionality includes:

- Ethernet/POS/ATM Layer 4 forwarding in core, MAN and edge applications
- Protocol conversion, forwarding and aggregation for multi-service switches, cable headends and DSLAM aggregation
- ATM SARing and forwarding with advanced traffic shaping
- Content-aware load balancing, forwarding, and policing
- Encryption for VPNs and IPSec applications
- GPPS Tunneling Protocol and IPv6 in wireless infrastructure applications
- TCP/IP termination for enterprise data center and SANs
- SSL/TLS acceleration

FEATURES	BENEFITS
16 integrated programmable microengines with 8K instruction program stores	Enhanced second-generation flexible multithreaded RISC processors that can be programmed to deliver intelligent transmit and receive processing, with robust software development environment for rapid product development
Integrated Intel XScale® Core <ul style="list-style-type: none"> <li>▪ 32 Kbyte—Instruction cache</li> <li>▪ 32 Kbyte—Data cache</li> <li>▪ 32 Kbyte—Mini-data cache</li> </ul>	Embedded 32-bit RISC core for high-performance processing of complex algorithms, route table maintenance and system-level management functions. Lowers system cost and saves board space
Two unidirectional 16-bit Low Voltage Differential Signaling (LVDS) data interfaces programmable to be SPI-4 Phase 2 or CSIX	Supports industry-standard interfaces to media and fabric devices, delivering OC-192 and 10Gbps Ethernet performance rates; simplifies design and interface to custom ASIC
Three industry-standard RDRAM interfaces	Memory subsystem to support the network processor store-and-forward processing model
Four industry-standard 32-bit QDR SRAM interfaces	Memory subsystem for look-up tables and access lists
PCI 2.2 I/O Interface	Supports industry-standard connection to system host processors
8-bit asynchronous control interface	Provides control interface for connecting to maintenance port of PHY devices and flash memory
Hardware support for memory access queuing	Simplifies product development and reduces system cost
JTAG support	Improve hardware debug ability
Comprehensive Development Environment: Software SDK and Hardware Development Platform	Improves time-to-market via robust hardware and software development tools
Power Dissipation	~25.5 Watts typical, ~ 30 Maximum @ 1.4 GHz operation ~17.5 Watts typical, ~ 23 Maximum @ 1.0 GHz operation ~16 Watts typical, ~20 Maximum @ 650 MHz
Additional integrated hardware features: <ul style="list-style-type: none"> <li>▪ Hardware Hash Unit (48, 64, and 128 bit)</li> <li>▪ 16-Kbyte Scratchpad Memory</li> <li>▪ Serial UART port for debug</li> <li>▪ Four general-purpose I/O pins</li> <li>▪ Four 32-bit timers</li> </ul>	Simplifies development, reduces development cost and saves board space

**INTEL® IXP2400 NETWORK PROCESSOR FOR OC-48/2.5 GBPS NETWORK ACCESS AND EDGE APPLICATIONS**

**Product Overview**

The Intel IXP2400 network processor is a member of Intel’s second-generation network processor family. It is designed for a wide range of access and edge applications including multi-service switches, routers, broadband access devices, and wireless infrastructure systems. Based on the first-generation Intel IXP1200 network processor, the Intel IXP2400 is a fully programmable network processor that implements a high-performance parallel processing architecture on a single chip for processing complex algorithms, deep packet inspection, traffic management, and forwarding at wire speed. Its store-and-forward architecture combines a high-performance Intel XScale core with eight 32-bit independent multithreaded microengines that cumulatively provide more than 5.4 giga-operations per second. The microengines provide the processing power to perform tasks that traditionally required expensive high-speed ASICs.

## Application Flexibility

The ability of the Intel IXP2400 network processor to support OC-48/2.5 Gbps line rates makes it ideal for a wide variety of high-performance applications such as Wide Area Networking (WAN) multi-service switches, DSLAMs (DSL access multiplexers), CMTS (cable modem termination system) equipment, 2.5G and 3G wireless infrastructure base station controllers and gateways, and Layer 4–7 switches including content-based load balancers, and firewalls. The programmability of the Intel IXP2400 also makes it well suited for VoIP gateways, multi-service access platforms, high-end routers, remote access concentrators, and Virtual Private Network (VPN) gateways. Usage models for the Intel IXP2400 in the target market segments listed above are as follows:

- Aggregation, ATM SARing, traffic shaping, policing, forwarding, and protocol conversion in DSLAM equipment
- Aggregation, forwarding, and protocol conversion in CMTS equipment
- ATM SARing, encryption, and forwarding in base station controllers/radio network controllers
- GTP Tunneling and IPv6 forwarding in wireless infrastructure
- ATM SARing, traffic shaping, policing, protocol conversion, and aggregation for multi-service switches
- Content-aware load balancing, forwarding, and policing

FEATURES	BENEFITS
Eight integrated programmable microengines with 4K instruction program stores	Enhanced second-generation flexible multithreaded RISC processors that can be programmed to deliver intelligent transmit and receive processing, with robust software development environment for rapid product development
Integrated Intel XScale® Core <ul style="list-style-type: none"> <li>▪ 32 Kbyte—Instruction cache</li> <li>▪ 32 Kbyte—Data cache</li> <li>▪ 2 Kbyte—Mini-data cache</li> </ul>	Embedded 32-bit RISC core for high-performance processing of complex algorithms, route table maintenance, and system-level management functions. Lowers system cost and saves board space
Two unidirectional 32-bit media interfaces (Rx and Tx) programmable to be SPI-3, UTOPIA 1/2/3 or CSIX-L1. Each path is configured for 4x8 bit, 2x16 bit, 1x32 bit or combinations of 8 and 16 bit data paths	Supports industry-standard cell and packet interfaces to media and fabric devices delivering 4 Gbps performance rates that can support OC-48 plus fabric encapsulation overhead or 4 x GbE; simplifies design and interface to custom ASIC devices
One industry-standard DDR DRAM interface	Memory subsystem supports the network processor store-and-forward processing model
Two industry-standard QDR SRAM interfaces	Memory subsystem for look-up tables and access lists, or coprocessors (such as CAM/TCAM, IPsec devices). NPF standardized interface for coprocessors
PCI 2.2 64 bit/66 MHz I/O Interface	Supports industry-standard connection to system host processors
Asynchronous control interface supports 8-, 16-, 32-bit slow port devices	Provides control interface for connecting to maintenance port of PHY devices and flash memory
Hardware support for memory access queuing	Simplifies application development and reduces system cost
JTAG support	Improves hardware debug ability
<ul style="list-style-type: none"> <li>▪ Software SDK</li> <li>▪ Hardware Development Platform</li> </ul>	Improves time-to-market via robust hardware and software development tools
Power Dissipation	~13 Watts typical, ~ 16 Maximum @ 600 MHz operation ~9 Watts typical, ~ 12 Maximum @ 400 MHz operation
Additional integrated hardware features: <ul style="list-style-type: none"> <li>▪ Hardware Hash Unit (48, 64, and 128 bit)</li> <li>▪ 16 Kbyte Scratchpad Memory</li> <li>▪ Serial UART port for debug</li> <li>▪ Eight general-purpose I/O pins</li> <li>▪ Four 32-bit timers</li> </ul>	Simplifies development, reduces development cost, and saves board space



## INTEL® IXP4XX NETWORK PROCESSOR PRODUCT LINE

### Family Overview

The Intel® IXP4XX product line is designed to meet the needs of a variety of applications such as high-end residential gateways; small-to-medium enterprise (SME) routers, switches, security devices; wireless access points; industrial control systems, networked printers, and other embedded networked applications. The IXP4XX product line delivers wire-speed performance and sufficient “processing headroom” for manufacturers to add a variety of rich software services to support their applications. These are highly integrated processors that support a variety of WAN and LAN technologies giving customers a common architecture for multiple applications.

The IXP4XX product line meets the requirements of networking applications with a unique distributed architecture that features the performance of the Intel XScale® core and up to three Network Processor Engines (NPEs). The combination of the four high-performance processing elements provides tremendous processing power and enables wire-speed performance at both the LAN and WAN ports. The NPEs are designed to offload many computationally intensive data plane operations from the core. This provides ample processing headroom on the Intel XScale core for developers to add differentiating product features.

The four network processors in the IXP4XX product line are the Intel® IXP425, the Intel® IXP422, the Intel® IXP421, and the Intel® IXP420. The Intel® IXP425 network processor is the most feature rich of these processors, supporting the widest variety of processor speed and connectivity options. The other three network processors offer a subset of the features found on the Intel® IXP425 network processor. For an easy reference of features, see the table following the product descriptions.

### Tools, Applications, and Operating Systems Support Rapid Development

Intel XScale technology includes a broad range of development tools and applications, together with support for multiple operating systems making software development easier. The Intel IXP4XX product line currently supports Wind River® VxWorks®, Microsoft® Windows CE, and the standard Linux® kernel. Third-party products are available for the Intel IXP4XX product line including Wind River Tornado® for VxWorks, and the MontaVista® Linux Professional Edition. Multiple third-party vendors provide application stacks and advanced development environment support.

To help speed time-to-market and reduce development costs, developers have a wide choice of Intel XScale technology-based tools. The Intel IXP4XX network processor may be controlled during debug through a JTAG interface to the processor. The Macraigor® Raven®, Wind River Systems visionPROBE®/visionICE® and EPI® MAJIC®, and other JTAG ICE systems will plug into the JTAG interface through a 20-pin connector.

### Development Platform for Faster Time-to-Market

The Intel® IXDP425 Development Platform is a powerful tool for development and verification of hardware and software for the Intel IXP4XX product line. Using a common development platform across the product line helps reduce costs and speeds development by providing a consistent tools/development environment. Developers can use this flexible and extendable platform to conduct rapid initial chip evaluation, chip performance evaluation, product development and prototyping. Pin compatibility among members of the Intel IXP4XX product line further reduces hardware design complexity.

## INTEL® IXP425 NETWORK PROCESSOR FOR A BROAD RANGE OF HOME, SME, AND EMBEDDED NETWORKING APPLICATIONS

### Product Overview

The Intel IXP425 network processor is a highly integrated, versatile single-chip processor that can be used in a variety of products that need network connectivity and high performance to run their unique software applications. The Intel IXP425 combines integration with support for multiple WAN and LAN technologies in a common architecture designed to meet requirements for high-end gateways, Voice over IP (VoIP) applications, wireless access points, small-to-medium enterprise (SME) routers, switches, security devices, industrial control systems, networked imaging, and other networked embedded applications.

The IXP425 network processor offers the choice of multiple clock speeds at 266, 400, and 533 MHz, with both commercial and extended temperature options. The Intel IXP425 network processor feature set includes a UTOPIA 2 interface, two high-speed serial (HSS) interfaces, high-performance PCI interface, USB controller, two 10/100 Ethernet MACs and an IPsec-enabled network processor engine (NPE) to accelerate cryptography and authentication algorithms.

### Product Highlights

- Member of the Intel IXP4XX network processor product line
- Intel XScale® core at up to 533 MHz provides headroom for customer-defined applications
- Integrated hardware acceleration of popular cryptography algorithms (SHA-1, MD5, DES, 3DES, AES) for secure applications
- DSP software library on the Intel XScale core supports 2–4 voice channels and reduces system cost
- Two high-speed serial (HSS) ports for VoIP SLIC/CODEC or T1/E1
- Two integrated 10/100 Base-T Ethernet MACs with Media Independent Interface (MII) for design flexibility and cost-effective wire-speed performance
- UTOPIA 2 interface with multiple ADSL/G.SHDSL or VDSL support
- 33/66 MHz PCI v2.2 host and option interface for glueless connection of up to four devices
- SDRAM controller supports from 8 to 256 Mbytes of SDRAM memory
- Low system power consumption (1.0–1.5 Watt typical)
- USB version 1.1 device controller
- Two high-speed UARTS support up to 921 Kbaud each
- Sixteen GPIO pins
- 16-bit configurable expansion bus
- Commercial temperature (0° to +70° C) and extended temperature (-40° to +85° C) versions

## INTEL® IXP422 NETWORK PROCESSOR FOR HOME/SME APPLICATIONS REQUIRING SECURITY FEATURES

### Product Overview

The Intel IXP422 network processor is a versatile, single-chip processor that integrates robust security features with the necessary interfaces, wire-speed performance and processing headroom to meet demanding applications including wireless access points, residential gateways, VPN firewall appliances, SME routers and switches, industrial control, networked imaging, and other embedded networked applications.

The Intel IXP422 network processor feature set includes a 266 MHz Intel XScale RISC core, high-performance PCI interface, USB controller, two 10/100 Ethernet MACs and an IPsec-enabled Network Processor Engine (NPE) to accelerate cryptography and authentication algorithms.

### Product Highlights

- Member of the Intel IXP4XX network processor product line
- Intel XScale® core at 266 MHz provides headroom for customer-defined applications
- Integrated hardware acceleration of popular cryptography algorithms (SHA-1, MD5, DES, 3DES, AES) for secure applications
- Two integrated 10/100 Base-T Ethernet MACs with Media Independent Interface (MII) for design flexibility and cost-effective wire-speed performance
- 33/66 MHz PCI v2.2 host and option interface for glueless connection of up to four devices
- SDRAM controller supports from 8 to 256 Mbytes of SDRAM memory
- Low system power consumption (1.0–1.5 Watt typical)
- USB version 1.1 device controller
- Two high-speed UARTS support up to 921 Kbaud each
- Sixteen GPIO pins
- 16-bit configurable expansion bus
- Commercial temperature (0° to +70° C)

## INTEL® IXP421 NETWORK PROCESSOR FOR HOME/SME APPLICATIONS SUPPORTING VOICE OVER IP

### Product Overview

The Intel IXP421 network processor is a versatile single-chip processor that meets the needs of high-performance and cost-sensitive data and Voice over IP (VoIP) applications ranging from residential gateways, Integrated Access Devices (IADs) and small office IP/PBX systems to industrial control, networked imaging, and other embedded networked applications. The Intel IXP421 network processor provides cost-effective implementations that extend the rich performance and features on the Intel IXP425 network processor into targeted market segments.

The Intel IXP421 network processor feature set integrates a 266 MHz Intel XScale RISC core, high-performance PCI interface, USB controller, UTOPIA 2 interface, two high-speed serial HSS and one 10/100 Ethernet MAC. These features provide developers with the processing power, low power consumption, cost-effectiveness and flexibility to address the needs of data plus VoIP applications.

## Product Highlights

- Member of the Intel IXP4XX network processor product line
- Intel XScale® core at 266 MHz provides headroom for customer-defined applications
- DSP software library on Intel XScale core supports 2–4 voice channels and reduces system cost
- Two high-speed serial (HSS) ports for VoIP SLIC/CODEC or T1/E1
- One integrated 10/100 Base-T Ethernet MACs with MII/RMII interface for design flexibility and cost-effective wire-speed performance
- UTOPIA 2 interface supports up to four xDSL PHYs (ADSL, G.SHDSL or VDSL)
- 33/66 MHz PCI v2.2 host and option interface for glueless connection of up to four devices
- SDRAM controller supports from 8 to 256 Mbytes of SDRAM memory
- Low system power consumption (1.0–1.5 Watt typical)
- USB version 1.1 device controller
- Two high-speed UARTS: can support up to 921 Kbaud each, or one UART at 921 Kbaud and one Console UART (230 Kbaud)
- Sixteen GPIO pins
- 16-bit configurable expansion bus
- Commercial temperature (0° to +70° C)

## INTEL® IXP420 NETWORK PROCESSOR FOR HIGHLY COST-SENSITIVE HOME/SME APPLICATIONS

### Product Overview

The Intel IXP420 network processor is a single-chip integrated processor that meets the needs of high-performance and cost-sensitive applications ranging from home gateways, small office/home office (SOHO) routers and wireless access points to industrial control, networked imaging, and other networked embedded applications.

The Intel IXP420 network processor feature set integrates an Intel XScale® core, high-performance PCI interface, USB controller, and two 10/100 Ethernet MACs. This network processor enables cost-effective implementations that extend the processing power, low power consumption and flexibility of the Intel IXP425 network processor into targeted market segments.

### Product Highlights

- Member of the Intel IXP4XX network processor product line
- Intel XScale® core provides headroom for customer-defined applications
- Two integrated 10/100 Base-T Ethernet MACs with MII/RMII interface for design flexibility and cost-effective wire-speed performance
- 33/66 MHz PCI v2.2 host and option interface for glueless connection of up to four devices
- SDRAM controller supports from 8 to 256 Mbytes of SDRAM memory
- Low system power consumption (1.0–1.5 Watt typical)
- USB version 1.1 device controller
- Two high-speed UARTS support up to 921 Kbaud each
- Sixteen GPIO pins
- 16-bit configurable expansion bus
- 266, 400 and 533 MHz Commercial temperature (0° to +70° C)
- 266 MHz extended temperature (-40° to + 85° C)

**SUMMARY OF INTEL® IXP4XX PRODUCT LINE FEATURES**

	INTEL® IXP425	INTEL® IXP422	INTEL® IXP421	INTEL® IXP420
Intel XScale® Core Speed	266/400/533 MHz	266 MHz	266 MHz	266/400/533 MHz
UTOPIA 2	•		•	
GPIO	•	•	•	•
UART 0/1	•	•	•	•
HSS 0	•		•	
HSS 1	•		•	
MII 0	•	•	•	
MII 1	•	•		•
USB	•	•	•	•
PCI	•	•	•	•
Expansion Bus	•	•	•	•
SDRAM	Supports 8–256 MB	Supports 8–256 MB	Supports 8–256 MB	Supports 8–256 MB
AES/DES/DES3	•	•		
SHA-1/MD-5	•	•		
Multi-Channel HDLC	•		•	
VoIP support	2–4 channels		2–4 channels	
Commercial Temperature	•	•	•	•
Extended Temperature	•			•

**Intel® IXP4XX Product Line Ordering Information**

PRODUCT	ORDER NUMBER
Intel® IXP425 Network Processor, 266 MHz CT	FWIXP425BB
Intel® IXP425 Network Processor, 266 MHz ET	GWIXP425BBT
Intel® IXP425 Network Processor, 400 MHz CT	FWIXP425BC
Intel® IXP425 Network Processor, 400 MHz ET	GWIXP425BCT
Intel® IXP425 Network Processor, 533 MHz CT	FWIXP425BD
Intel® IXP425 Network Processor, 533 MHz ET	GWIXP425BDT
Intel® IXP425 Network Processor, 533 MHz CT (Lead Free Eng Samples)	PRIXP425BD
Intel® IXP422 Network Processor, 266 MHz CT	FWIXP422BB
Intel® IXP421 Network Processor, 266 MHz CT	FWIXP421BB
Intel® IXP421 Network Processor, 266 MHz CT (Lead Free Eng Samples)	PRIXP421BB
Intel® IXP420 Network Processor, 266 MHz CT	FWIXP420BB
Intel® IXDP425 Network Processor Development Platform	KIXDP425BD2
Intel® IXDP425 Network Processor Development Platform Voice Module Upgrade Kit	KIXDP425VMU
Intel® IXDP425 Network Processor Development Platform WinCE Upgrade Kit	KIXDP425CEU



# Networking Products

## WORKGROUP AND ENTERPRISE SOLUTIONS

### Ethernet Transceivers

Ethernet transceivers are 10BASE-T Physical Layer (PHY) devices that provide low-cost solutions for desktop and node applications. These industry-standard single-port transceivers implement all required functions of the physical coding sublayer (PCS) and physical media attachment (PMA) sublayers as defined in IEEE 802.3. They provide all the active circuitry to interface 802.3-compliant media access controllers (MACs) and either twisted-pair or coax transmission media.

### Fast Ethernet Transceivers

Fast Ethernet transceivers are 10/100 PHY devices that provide high-performance interface solutions for networks that use equipment running at either 10Mbps or 100Mbps. They support standard CSMA/CD operation or full-duplex operation at 10Mbps or 100Mbps. Available as a single- or multi-port option, they are suited for uses ranging from embedded applications to high-density enterprise switches. Fast Ethernet transceivers provide the active circuitry to interface 802.3-compliant 10/100Mbps MACs and twisted-pair or fiber network media. Line operating conditions are determined using auto-negotiation or parallel detection for legacy systems. The devices implement all required functions of the PCS, PMA, and physical media dependent (PMD) sublayers, with a media independent interface (MII) as defined in IEEE 802.3.

### Gigabit Ethernet Transceivers

1000BASE-T Gigabit Ethernet transceivers are 10/100/1000 PHY devices that provide high-performance interface solutions for 10/100/1000Mbps network equipment. They support standard CSMA/CD operation or full-duplex operation at 10, 100, or 1000Mbps. The single-port device is ideally suited for embedded applications or uplinks on high-performance Ethernet switches. Gigabit Ethernet PHY transceivers provide the active circuitry to interface 802.3-compliant 10/100/1000Mbps MACs and twisted-pair network media. Line operating conditions are determined using auto-negotiation or parallel detection for legacy systems. The 10/100/1000Mbps Ethernet transceiver implements all the required functions of the PCS, PMA, and PMD sublayers, with a Gigabit media independent interface (GMII) as defined in IEEE 802.3.

### Ethernet and Fast Ethernet Repeaters

An Ethernet repeater is a device that repeats a signal received from any port onto all other ports and is, therefore, a shared technology. It is the “hub” that links physically distinct network segments into one logical network. It can also be used to “fan-out” one Ethernet connection to many connections. The family of workgroup and enterprise repeater products includes a variety of cost-effective repeater silicon solutions for managed and unmanaged applications. 10BASE-T solutions are available as four-port devices. 10/100Mbps solutions are available in five-, six-, or eight-port devices. Port density and management options enable these devices to be used in a variety of applications such as small office hubs or home gateways/modems.

### Media Access Controllers

Media Access Controllers (MACs) in a local area network control access to the shared medium by LAN-attached devices. Within a MAC are defined data link layer options which specify the basis on which devices access the shared medium, and the basis on which congestion control is exercised. The first members of the new MAC family, the Intel® IXF1110 Gigabit and Intel® IXF1010 100/1000 Megabit MACs, are the first to use a more robust SPI4-2 interface implementation called “dynamic phase alignment.” Dynamic phase alignment improves data integrity to help ensure 10-Gbps wire-speed performance. These MACs are ideal for solutions in high-end, modular switching applications such as routers and multi-service switches that support LAN and WAN technologies.

## Ethernet Switching Devices

An Ethernet switch is a multi-port device used to relay frames or packets among a set of networks. Multi-layer switch/routers combine the functions of a Layer 2 switch and a router. The Intel® Media Switch Family, including silicon, software, and system building blocks, supports the needs of media-aware networks with advanced quality of service (QoS) capabilities, programmability, and performance at competitive pricing. The Intel Media Switch Software Architecture is a comprehensive package of licensed software tools including APIs and device drivers. Intel partners with other vendors to provide protocol support. A flexible, scalable architecture makes these devices ideal for designs across the entire networking equipment spectrum including: 10/100/1000Mbps standalone switches to the desktop, stackable switches for workgroup aggregation, chassis-based switches for connecting to the enterprise backbone, and routing switches within the data center and network core.

## Intel® Carrier Class Ethernet

Many networking and telecom applications require high-performance Ethernet components capable of operating under harsh environmental conditions. Intel® Carrier Class Ethernet products support operation over the entire extended temperature range while providing features that increase reliability. Each device has an operation lifetime of at least 10 years with less than 100 failures per billion hours. All Intel Carrier Class Ethernet devices will be available a minimum of five years from product introduction.

The Intel Carrier Class Ethernet product portfolio includes solutions for Ethernet physical layer, switching and repeater technologies at a variety of speeds. Intel Carrier Class Ethernet products are ideal for applications where equipment must function reliably in uncontrolled environmental conditions such as base stations, telecom/network switches, factory floor equipment, and industrial computers. Products include the IXE2424EE, LXT9880AGE, LXT914, LXT973, LXT9785, LXT905, and LXT971A/972A.

## NETWORKING PRODUCT LINE SUMMARY

The following table summarizes the networking product application features. For full information refer to the product datasheets.

APPLICATIONS	PART NUMBER	FEATURES
<b>Ethernet Transceivers</b>		
<b>Ethernet Interface Adapter (Universal)</b> <ul style="list-style-type: none"> <li>▪ 10BASE-T hub and switching products</li> <li>▪ 10BASE-T LAN adapter boards for computers/workstations</li> <li>▪ Printer network attachments</li> <li>▪ PCMCIA LAN cards</li> <li>▪ Workstation/graphic terminals</li> <li>▪ PC-PC servers (adapter/motherboard)</li> <li>▪ 10BASE-T interconnects (MAU)</li> <li>▪ Bridges/routers</li> <li>▪ Terminal servers</li> <li>▪ Point-of-sale interfaces</li> </ul>	<b>LXT907A/LXT908</b>	<ul style="list-style-type: none"> <li>▪ Integrated AUI transceivers</li> <li>▪ Integrated 10BASE-T transceivers</li> <li>▪ Improved filters to simplify FCC compliance</li> <li>▪ Integrated Manchester encoder/decoders</li> <li>▪ Automatic/manual AUI/RJ-45 selection</li> <li>▪ Automatic polarity correction</li> <li>▪ Standard and full-duplex Ethernet</li> <li>▪ Power-down mode with tri-stated outputs</li> <li>▪ Four loopback modes</li> <li>▪ Four LED drivers</li> <li>▪ Selectable termination impedance for use with shielded or unshielded twisted-pair (LXT901A only)</li> <li>▪ Signal Quality Error (SQE) disable function for hub and switch applications (LXT907A &amp; LXT908 only)</li> </ul>
<b>Ethernet Interface Adapter (10BASE-T)</b> <ul style="list-style-type: none"> <li>▪ Portable computers</li> <li>▪ PDAs switching hubs</li> <li>▪ Printer adapter cards</li> <li>▪ PCMCIA cards</li> <li>▪ Diagnostic port in telecom</li> </ul>	<b>LXT905</b>	<ul style="list-style-type: none"> <li>▪ 3.3V or 5V operation, power-down mode for battery operation</li> <li>▪ Provides all active circuitry for interfacing 802.3 controllers to a 10BASE-T media</li> <li>▪ Includes Manchester encoder/decoder, reversed polarity detection/correction, integrated filters</li> <li>▪ LED driver, full duplex capability</li> <li>▪ Signal Quality Error (SQE) disable function for hub and switch applications</li> <li>▪ Intel® Carrier Class Ethernet support</li> </ul>



APPLICATIONS	PART NUMBER	FEATURES
<b>Fast Ethernet Transceivers</b>		
<p><b>Fast Ethernet Transceiver</b></p> <ul style="list-style-type: none"> <li>▪ 10/100 NICs</li> <li>▪ 10/100 switches</li> <li>▪ 100BASE-FX NICs and switches</li> </ul>	<b>LXT970A</b>	<ul style="list-style-type: none"> <li>▪ The single RJ-45 port for 10BASE-T and 100BASE-TX simplifies designs, reduces board space and minimizes system cost</li> <li>▪ Baseline Wander Correction delivers consistent, error-free performance</li> <li>▪ Devices perform error free over distances greater than 130 meters of Category 5 cable—far exceeding the IEEE specification of 100 meters</li> <li>▪ Auto-negotiation for 10Mbps or 100Mbps, with full- or half-duplex and parallel detection, provides flexible application support and interoperability with legacy equipment</li> <li>▪ MII operates with either a 3.3V or 5V power supply, allowing the use of low-power MACs</li> <li>▪ 100BASE-FX port provides fiber-optic media support</li> <li>▪ Multiple operating modes for NICs and switches help reduce costs and simplify design cycles</li> <li>▪ Dual operating modes for standard MII and symbol mode MII provide flexible MAC support</li> </ul>
<p><b>Fast Ethernet Transceiver</b></p> <ul style="list-style-type: none"> <li>▪ Combination 10BASE-T/100BASE-TX or 100BASE-FX NICs</li> <li>▪ 10/100 PCMCIA cards</li> <li>▪ Cable modems and set-top boxes</li> </ul>	<b>LXT971A</b>	<ul style="list-style-type: none"> <li>▪ 3.3V operation, low power consumption (350 mW typical), low-power “sleep” mode</li> <li>▪ 10BASE-T and 100BASE-TX using a single RJ-45 connection</li> <li>▪ Supports auto-negotiation and parallel detection</li> <li>▪ MII interface with extended register capability</li> <li>▪ Robust baseline wander correction performance</li> <li>▪ 100BASE-FX fiber-optic capable</li> <li>▪ Standard CSMA/CD or full-duplex operation</li> <li>▪ Configurable via MDIO serial port or hardware control pins</li> <li>▪ Integrated, programmable LED drivers</li> <li>▪ 64-pin PBGA, 64-pin LQFP</li> <li>▪ Intel Carrier Class Ethernet support</li> </ul>
<p><b>Fast Ethernet Transceiver</b></p> <ul style="list-style-type: none"> <li>▪ Combination 10BASE-T/100BASE-TX NICs</li> <li>▪ 10/100 PCMCIA cards</li> <li>▪ Cable modems and set-top boxes</li> </ul>	<b>LXT972A</b>	<ul style="list-style-type: none"> <li>▪ 3.3V operation, low power consumption (350 mW typical)</li> <li>▪ 10BASE-T and 100BASE-TX using a single RJ-45 connection</li> <li>▪ Supports auto-negotiation and parallel detection</li> <li>▪ MII interface with extended register capability</li> <li>▪ Robust baseline wander correction performance</li> <li>▪ Standard CSMA/CD or full-duplex operation</li> <li>▪ Configurable via MDIO serial port or hardware control pins</li> <li>▪ Integrated, programmable LED drivers</li> <li>▪ 64-pin LQFP</li> </ul>
<p><b>Fast Ethernet Transceiver</b></p> <ul style="list-style-type: none"> <li>▪ Building block for telecom backplane systems</li> <li>▪ Internet protocol telephones</li> <li>▪ Twisted pair to fiber converter modules</li> <li>▪ Customer premise equipment</li> </ul>	<b>LXT973</b>	<ul style="list-style-type: none"> <li>▪ Two-port Fast Ethernet PHY</li> <li>▪ 2.5V operation</li> <li>▪ 3.5V operation I/O compatibility</li> <li>▪ Low power consumption (250 mW per port typical)</li> <li>▪ Full two-port MII interface with extended registers</li> <li>▪ Auto MDI/MDIX switch-over capability</li> <li>▪ Status bits for LED generation</li> <li>▪ 100BASE-FX fiber-optic capability on both ports</li> <li>▪ Support for Next Page</li> <li>▪ Integrated termination resistors</li> <li>▪ 100-pin PQFP at commercial and extended temperature</li> </ul>
<p><b>Fast Ethernet Transceiver</b></p> <ul style="list-style-type: none"> <li>▪ Enterprise switches</li> <li>▪ Workgroup switches</li> <li>▪ Storage area networks</li> <li>▪ Multi-port NICs</li> <li>▪ IP telephony switches (LXT9785E)</li> </ul>	<b>LXT9785</b>	<ul style="list-style-type: none"> <li>▪ Eight independent IEEE 802.3-compliant 10BASE-T or 100BASE-TX ports</li> <li>▪ Very low power consumption (250 mW per port, typical)</li> <li>▪ 2.5V operation</li> <li>▪ Multiple interfaces: RMII, SMII, SS-SMII</li> <li>▪ Auto MDI/MDI-X</li> <li>▪ Robust baseline wander correction</li> <li>▪ Auto-negotiation, parallel detection</li> <li>▪ 10/100Mbps full-duplex operation</li> <li>▪ Sectionalization into 1x8 or 2x4 configurations</li> <li>▪ Register compatibility with LXT9781, LXT9782</li> </ul>
	<b>LXT9785E</b>	<ul style="list-style-type: none"> <li>▪ Configurable via MDIO port or external control pins</li> <li>▪ JTAG boundary scan</li> <li>▪ Compatible with 2.5V I/O and 3.3V I/O</li> <li>▪ Integration of input termination resistors</li> <li>▪ Intel® Carrier Class Ethernet support</li> <li>▪ Added DTE discovery, enhanced IP Telephony features</li> </ul>

APPLICATIONS	PART NUMBER	FEATURES
<b>Ethernet Repeaters</b>		
<b>Managed Repeaters</b> <ul style="list-style-type: none"> <li>▪ Stackable and stand alone workgroup hubs</li> <li>▪ Embedded applications for print servers and multi-port routers</li> <li>▪ Remote access SOHO applications</li> </ul>	<b>LXT914</b>	<ul style="list-style-type: none"> <li>▪ Four 10BASE-T ports</li> <li>▪ Reversible AUI port</li> <li>▪ Configuration/status interface</li> <li>▪ Four LED modes</li> <li>▪ Cascadable backplane (no glue logic required)</li> <li>▪ Integrated filters</li> <li>▪ Programmable squelch</li> <li>▪ Intel Carrier Class Ethernet support</li> </ul>
<b>LED Managed Or Unmanaged Repeaters</b> <ul style="list-style-type: none"> <li>▪ “Personal” hubs</li> <li>▪ Stackable and stand alone workgroup hubs</li> <li>▪ Embedded applications for multi-port routers and print servers</li> </ul>	<b>LXT915</b>	<ul style="list-style-type: none"> <li>▪ Four 10BASE-T ports</li> <li>▪ Simple AUI port</li> <li>▪ Four LED modes</li> <li>▪ Cascadable backplane (no glue logic required)</li> <li>▪ Integrated filters</li> <li>▪ Programmable squelch</li> </ul>
<b>Dual Speed 10/100 Repeaters</b> <ul style="list-style-type: none"> <li>▪ Stackable and stand alone workgroup hubs</li> <li>▪ Remote access SOHO applications</li> <li>▪ “Personal” hubs</li> <li>▪ Embedded applications for multi-port routers and print servers</li> <li>▪ Backplane interconnect for central office equipment (LXT9880AGE)</li> </ul>	<b>LXT9860/LXT9880</b>	<ul style="list-style-type: none"> <li>▪ Six- or eight-port 10/100 managed repeater with integrated twisted-pair PHYs including integrated filters</li> <li>▪ Two 10/100 MIIs for bridging</li> <li>▪ Independent segments for 10Mbps and 100Mbps operation</li> <li>▪ Less than 3.4W peak power, 3.3V operation</li> <li>▪ Cascadable inter-repeater backplanes (IRBs), with option for 5V stacking compatibility</li> <li>▪ Hardware assist for RMON and the repeater MIB</li> <li>▪ High-speed SMI</li> <li>▪ Two address-tracking registers per port</li> <li>▪ Source Address matching function</li> <li>▪ Integrated LED drivers with user-selectable modes</li> <li>▪ Available in 208-pin QFP package</li> <li>▪ Commercial temperature range: 0°C–+70°C, ambient</li> </ul>
	<b>LXT9880AGE</b>	<ul style="list-style-type: none"> <li>▪ Added Intel Carrier Class Ethernet support</li> </ul>
	<b>LXT9863/LXT9883</b>	<ul style="list-style-type: none"> <li>▪ Six- or eight-port 10/100 unmanaged repeater with integrated twisted-pair PHYs including integrated filters</li> <li>▪ Two 10/100 MIIs for bridging</li> <li>▪ Independent segments for 10Mbps and 100Mbps operation</li> <li>▪ Less than 3.4W peak power, 3.3V operation</li> <li>▪ Cascadable inter-repeater backplanes (IRBs), with option for 5V stacking compatibility</li> <li>▪ Integrated LED drivers with user-selectable modes</li> <li>▪ Available in 208-pin QFP package</li> <li>▪ Commercial temperature range: 0°C–+70°C, ambient</li> </ul>
<b>Media Access Controllers</b>		
<ul style="list-style-type: none"> <li>▪ High-end switches</li> <li>▪ Multi-service switches</li> <li>▪ High-end routers</li> </ul>	<b>IXF1110/IXF1010</b>	<ul style="list-style-type: none"> <li>▪ Ten-port 100/1000Mbps or 1000Mbps for copper or fiber connectivity</li> <li>▪ SPI4-2 with dynamic phase alignment</li> <li>▪ SPI4-2 supports 400MHz clock</li> <li>▪ 32-bit microprocessor interface</li> <li>▪ Internal 17.0 KB receive FIFO and 4.5 KB transmit FIFO per channel</li> <li>▪ Less than 6W peak power</li> <li>▪ 552 CBGA package</li> <li>▪ Commercial temperature range: 0°C–+70°C, ambient</li> </ul>
<ul style="list-style-type: none"> <li>▪ Multi-service switches, router and aggregation platforms at the service provider and enterprise edge targeting 4 GbE</li> <li>▪ WAN Access and Edge Aggregation systems. DSLAM, CMTS, NG-DLC</li> <li>▪ Wireless Infrastructure such as BTS, BSC, RNC, xGSM, PDSN</li> <li>▪ VPNs; firewall and intrusion detection systems</li> <li>▪ VoIP gateways and web switch appliances</li> <li>▪ OC-48 Layer 4–7 switches and routers</li> </ul>	<b>IXF1104</b>	<ul style="list-style-type: none"> <li>▪ Quad Gigabit Ethernet MAC with SPI3 system interface and interfaces for connectivity to Copper PHYs and Optic modules.</li> <li>▪ Ability to power down individual channels</li> <li>▪ SerDes physical interface for fiber</li> <li>▪ Extended Temp operation for Copper connectivity (-40°C to +85°C)</li> <li>▪ 32-bit MPHY mode</li> <li>▪ 4x8-bit SPHY mode</li> <li>▪ Flexible system interfaces</li> <li>▪ SPI-3 System Interface</li> <li>▪ Allows for dedicated channel per GbE port at 125 MHz</li> <li>▪ GBIC/I<sup>2</sup>C* Controller Interface for optics modules</li> <li>▪ 10Kbyte transmit, 32Kbyte receive FIFOs</li> </ul>

APPLICATIONS	PART NUMBER	FEATURES
<b>Ethernet Switching</b>		
<p><b>Switching Engine</b></p> <ul style="list-style-type: none"> <li>▪ 16–24 port Gigabit Layer 2 workgroup switches</li> <li>▪ 16–24 port Gigabit Layer 2/3/4 workgroup switches</li> <li>▪ Daisy chain or Star stackable 10/100/1000 Layer 2/3/4 switches</li> <li>▪ High-port-count Layer 2/3/4 switch/router solution suitable for stackable and chassis switches (Can be incorporated into stacking solutions with the Intel® Media Switch IXE2424)</li> <li>▪ Cellular switching systems</li> <li>▪ Voice and data integration gateways</li> <li>▪ Edge routers</li> <li>▪ Packet-based video distribution systems</li> </ul>	<b>IXE5416</b>	<ul style="list-style-type: none"> <li>▪ Single chip, 16-port Gigabit switch/router with Layer 2/3/4 support</li> <li>▪ Wire-speed performance across all ports in switching or IP routing modes</li> <li>▪ Advanced traffic prioritization, QoS and bandwidth management</li> <li>▪ Link aggregation</li> <li>▪ Supports VLANs based on IEEE 802.1Q, ports, and protocol</li> <li>▪ Advanced multicast, broadcast, and filtering capabilities</li> <li>▪ Integrated 10/100/1000 Ethernet MACs, packet buffer memory and address look-up table</li> </ul>
<p><b>Switching Engine</b></p> <ul style="list-style-type: none"> <li>▪ 16–24 port Gigabit Layer 2 workgroup switches</li> <li>▪ Daisy chain or Star stackable 10/100/1000 Layer 2 switches</li> <li>▪ High-port-count Layer 2 switch solution suitable for stackable and chassis switches (Can be incorporated into stacking solutions with the Intel Media Switch IXE2424)</li> <li>▪ Cellular switching systems</li> <li>▪ Voice and data integration gateways</li> <li>▪ Edge routers</li> <li>▪ Packet-based video distribution systems</li> </ul>	<b>IXE5216</b>	<ul style="list-style-type: none"> <li>▪ Single chip, 16-port Gigabit switch/router with Layer 2 support</li> <li>▪ Wire-speed performance across all ports</li> <li>▪ Advanced traffic prioritization and QoS</li> <li>▪ Link aggregation</li> <li>▪ Supports VLANs based on IEEE 802.1Q, ports, and protocol</li> <li>▪ Advanced multicast, broadcast, and filtering capabilities</li> <li>▪ Integrated 10/100/1000 Ethernet MACs, packet buffer memory and address look-up table</li> </ul>
<p><b>Switching Engine</b></p> <ul style="list-style-type: none"> <li>▪ 24+4 Layer 2/3/4 workgroup and enterprise switches</li> <li>▪ Cascadable high-port-count Layer 2/3/4 switch/router when using one or all Gigabit ports for cascading</li> <li>▪ Layer 2/3/4 switch/router with Gigabit uplinks and advanced bandwidth management</li> <li>▪ 24+4 MPLS label edge/switch routers</li> <li>▪ Cellular switching systems</li> <li>▪ Voice and data integration gateways</li> <li>▪ Edge routers</li> <li>▪ Packet-based video distribution systems</li> </ul>	<b>IXE2424</b>	<ul style="list-style-type: none"> <li>▪ Single chip, 24-port 10/100 and four-port Gigabit Ethernet Layer 2/3/4 switch/router</li> <li>▪ Wire-speed performance across all ports in switching or IP/MPLS routing modes</li> <li>▪ Advanced traffic prioritization, QoS, DiffServ, WRED, and bandwidth management</li> <li>▪ Link aggregation in any combination of up to eight ports per group</li> <li>▪ Hardware assistance for several L2 and L2/3/4 protocols</li> <li>▪ Supports VLANs based on IEEE 802.1Q, ports, and addresses</li> <li>▪ Advanced multicast, broadcast, and filtering capabilities</li> <li>▪ Support for multiple IP networks on a single port, and multiple ports on the same network</li> <li>▪ Connects to other devices using standard interfaces such as SERDES/GMII, SMII, PCI, I<sup>2</sup>C and SSRAM</li> </ul>
<p><b>Switching Engine</b></p>	<b>IXE2424EE</b>	<ul style="list-style-type: none"> <li>▪ Same as IXE2424</li> <li>▪ Support for industrial temperature range of -40°C to +85°C</li> <li>▪ Intel Carrier Class Ethernet support</li> </ul>
<p><b>Switching Engine</b></p> <ul style="list-style-type: none"> <li>▪ 24+4 Layer 2 workgroup and enterprise switches with advanced bandwidth management</li> <li>▪ Cascadable high-port-count Layer 2 switches when using one or all Gigabit ports for cascading</li> <li>▪ Cellular switching systems</li> <li>▪ Voice and data integration gateways</li> <li>▪ Packet-based video distribution systems</li> </ul>	<b>IXE2426</b>	<ul style="list-style-type: none"> <li>▪ Single chip, 24-port 10/100 and four-port Gigabit Layer 2 Ethernet switch</li> <li>▪ Wire-speed performance across all ports in switching modes</li> <li>▪ Advanced traffic prioritization, QoS and bandwidth management</li> <li>▪ Link aggregation in any combination of up to eight ports per group</li> <li>▪ Hardware assistance for several L2 protocols</li> <li>▪ Supports VLANs based on IEEE 802.1Q, ports, tags, and addresses</li> <li>▪ Low-cost mode of operation</li> <li>▪ Connects to other devices using standard interfaces such as SERDES/GMII, SMII, PCI, I<sup>2</sup>C and SSRAM</li> </ul>

## NETWORKING PRODUCTS LINE CARD

### 10MBPS TRANSCEIVERS<sup>1</sup>

Product	Ports	Interface	Power	Package	Special Features
LXT905	TP	7-pin MAC interface, auto AUI/RJ-45 selection	3.3V or 5V	28 PLCC 32 LQFP	4 LED drivers, Intel® Carrier Class Ethernet support <sup>2</sup>
LXT907	TP & AUI	7-pin MAC interface, auto AUI/RJ-45 selection	5V	44 PLCC	4 LED drivers, SQE disable
LXT907A	TP & AUI	7-pin MAC interface, auto AUI/RJ-45 selection	3.3V	44 PLCC 64 LQFP	4 LED drivers, SQE disable
LXT908	TP & AUI	7-pin MAC interface, auto AUI/RJ-45 selection	3.3V	44 PLCC 64 LQFP	4 LED drivers, extended temperature, SQE disable

### 10/100MBPS TRANSCEIVERS<sup>1</sup>

Product	Ports	Interface	Power	Package	Special Features
LXT970A	TP or fiber	MII, MDIO/MDINT, hardware control	5V, 3.3V 64 PQFP	64 TQFP	5 LED drivers, baseline wander correction
LXT971A	TP or fiber	MII, MDIO/MDINT	3.3V, 2.5V	64 PBGA	3 LED drivers, programmable LEDs, CDE protection, JTAG boundary scan, baseline wander correction, Intel® Carrier Class Ethernet support <sup>2</sup>
LXT972A	TP	MII, MDIO/MDINT, hardware control	3.3V, 2.5V	64 LQFP	3 LED drivers, programmable LEDs, CDE protection, JTAG boundary scan, baseline wander correction, low power consumption
LXT973	2 TP or fiber	Independent MII for each port	2.5V	100 PQFP	Auto MDI/MDIX, CDE tolerance, Intel Carrier Class Ethernet support <sup>2</sup>
LXT9785	8 TP or fiber	RMII/SMII/SS-SMII (2.5V/3.3V)	2.5V	241 PBGA 208 PQFP	Low power, auto MDI/MDIX, MDIO sectionalization, Intel Carrier Class Ethernet support <sup>2</sup>
LXT9785E	8 TP or fiber	RMII/SMII/SS-SMII (2.5V/3.3V)	2.5V	241 PBGA 208 PQFP	Enhanced IP telephony features, auto MDI/MDIX, DTE discovery

#### NOTES

<sup>1</sup> All products offer Energy Saving Mode and support commercial temperature range (0°C to 70°C).

<sup>2</sup> Intel® Carrier Class Ethernet support includes: extended temperature range (-40°C to 85°C), extended lifetime (>10 years of operation), reliability (<100 failures per billion hours over operating life), and extended availability (minimum of five years from product introduction)

### 10MBPS REPEATERS

Product	Ports	Interface	Power	Package	Special Features
LXT914	4 TP & 1 reversible AUI	IRB, SMI, AUI	5V	68 PLCC 100 PQFP	7 LED drivers, 4 LED modes, stackable, status and control, Intel® Carrier Class Ethernet support <sup>2</sup>
LXT915	4 TP & 1 AUI	IRB, AUI	5V	64 PQFP	7 LED drivers, 4 LED indication modes, stackable, unmanaged

### 10/100MBPS REPEATERS

Product	Ports	Interface	Power	Package	Special Features
LXT9860	6 TP	2 IRB (5V tolerant), SMI, 2 MII	3.3V	208 PQFP	SNMP and RMON, stackable, 30 status LEDs, 3 direct drive LEDs (4 selectable modes), 4 segment LEDs, 2 activity graph LEDs
LXT9863	6 TP	2 IRB (5V tolerant), 2 MII	3.3V	208 PQFP	Unmanaged, stackable, 30 status LEDs, 3 direct drive LEDs (4 selectable modes), 4 segment LEDs, 2 activity graph LEDs
LXT9880	8 TP	2 IRB (5V tolerant), SMI, 2 MII	3.3V	208 PQFP	SNMP and RMON, stackable, 30 status LEDs, 3 direct drive LEDs (4 selectable modes), 4 segment LEDs, 2 activity graph LEDs
LXT9880AGE	8 TP	2 IRB (5V tolerant), SMI, 2 MII	3.3V	208 PQFP	SNMP and RMON, stackable, 30 status LEDs, 3 direct drive LEDs (4 selectable modes), 4 segment LEDs, 2 activity graph LEDs, Intel® Carrier Class Ethernet support <sup>2</sup>
LXT9883	8 TP	2 IRB (5V tolerant), 2 MII	3.3V	208 PQFP	Unmanaged, stackable, 30 status LEDs, 3 direct drive LEDs (4 selectable modes), 4 segment LEDs, 2 activity graph LEDs

**100MBPS & 10000MBPS  
MEDIA ACCESS CONTROLLERS**

Product	Ports	Interface	Power	Package	Special Features
IXF1110	10 fiber	SPI4-2, GBIC/SerDes	1.8V, 2.5V	552 CBGA	SPI4-2 with dynamic phase alignment, double data clock, receive FIFO, cost-effective memory architecture
IXF1010	10 TP	SPI4-2, RGMII	1.8V, 2.5V	552 CBGA	SPI4-2 with dynamic phase alignment, double data clock, receive FIFO, cost-effective memory architecture

**INTEL®  
MEDIA SWITCH**

Product	Ports	Interface	Power	Package	Special Features
IXE5416	16 TP or fiber	GMII, TBI, MII	2.5V 3.3V	836 EBGA	16-port Gigabit switching/routing, traffic classification, QoS, filtering, prioritization
IXE5216	16 TP or fiber	GMII, TBI, MII	2.5V 3.3V	836 EBGA	16-port Gigabit switching, traffic classification, QoS, filtering, prioritization
IXE2424	24/4 TP	SERDES/GMII, SMI	1.8V	792 TBGA	24-port 10/100, four-port Gigabit, Layer 2/3/4 switching/routing, integrated 10/100 and Gigabit
IXE2424EE	or fiber	PCI, I <sup>2</sup> C, SSRAM	3.3V		MACs, MPLS, Diffserv, WRED, QoS, VLAN compliance, Intel® Carrier Class Ethernet support <sup>2</sup> (IXE2424EE)
IXE2426	24/4 TP or fiber	SERDES/GMII, SMI, PCI, I <sup>2</sup> C, SSRAM	1.8V 3.3V	792 TBGA	24-port 10/100, four-port Gigabit, Layer 2 switching, integrated 10/100 and Gigabit MACs, VLAN compliance, QoS

**NOTES**

<sup>1</sup> All products offer Energy Saving Mode and support commercial temperature range (0°C to 70°C).

<sup>2</sup> Intel® Carrier Class Ethernet support includes: extended temperature range (-40°C to 85°C), extended lifetime (>10 years of operation), reliability (<100 failures per billion hours over operating life), and extended availability (minimum of five years from product introduction)

**KEY TERMS**

AUI	Attached Unit Interface	RMII	Reduced Media Independent Interface
CDE	Cable Discharge Event	RMON	Remote Monitoring
FX	Fiber Media	SMI	Serial Management Interface
GMII	Gigabit Media Independent Interface	SMII	Serial Media Independent Interface
IRB	Inter-Repeater Backplane	SNMP	Simple Network Management Protocol
MAC	Media Access Controller	TBI	Ten-Bit Interface
MII	Media Independent Interface	TDR	Time Domain Reflectometry
PCI	Peripheral Components Interconnect	TP	Twisted Pair
PHY	OSI Physical Layer device		



# Advanced Ethernet Controllers—PCI Based

## INTEL'S 10/100/1000 ETHERNET CONTROLLERS (MAC/PHY)

### Intel® 82541PI Gigabit Ethernet Controller

The Intel® 82541PI Gigabit Ethernet Controller provides optimized Gigabit networking for PCI designs. This highly efficient controller, with enhanced power management, consumes less than 1.0W of power at Gigabit speeds. When no signal is detected on the wire, the controller reduces power consumption by switching to 100 or 10 and powering down the physical-layer circuitry (PHY). When a signal is detected, the controller automatically negotiates the connection to Gigabit, if available.

The Intel 82541PI Gigabit Ethernet Controller enhances secure manageability and system health monitoring over the LAN with support for IPMI 1.5. For IPMI designs, the onboard SMBus port can pass management traffic through the controller to a management device, such as a Baseboard Management Controller (BMC).

The Intel 82541PI combines Intel's fifth-generation Gigabit MAC design with fully integrated PHY to provide a standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE-TX and 10BASE-T applications. In addition, the controller provides a direct Peripheral Component (PCI) Interconnect designed to be compliant with the PCI 2.3 bus up to 66MHz. Packaged in a 15x15 mm PBGA, the Intel 82541PI Gigabit Ethernet Controller is footprint-compatible with the Intel® 82551QM and Intel® 82551ER Fast Ethernet Controller and Intel® 82562EZ device. Footprint-compatibility, plus Intel® SingleDriver™ technology allow for a flexible Gigabit Ethernet or Fast Ethernet implementation on the same motherboard layout.

### Intel® 82541ER Gigabit Ethernet Controller

The Intel® 82541ER Gigabit Ethernet Controller provides optimized Gigabit networking for PCI designs. This highly efficient controller, with enhanced power management, consumes less than 1.0W of power at Gigabit speeds. When no signal is detected on the wire, the controller reduces power consumption by switching to 100 or 10 and powering down the physical-layer circuitry (PHY). When a signal is detected, the controller automatically negotiates the connection to Gigabit, if available.

The Intel 82541ER combines Intel's fifth-generation Gigabit MAC design with fully integrated PHY to provide a standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE-TX and 10BASE-T applications. In addition, the controller provides a direct Peripheral Component (PCI) Interconnect designed to be compliant with the PCI 2.3 bus up to 66MHz. Packaged in a 15x15 mm PBGA, the Intel 82541ER Gigabit Ethernet Controller is footprint-compatible with the Intel 82551ER and Intel 82562EZ device. Footprint-compatibility allows for a flexible Gigabit Ethernet or Fast Ethernet implementation on the same motherboard layout.

### Intel® 82545GM Gigabit Ethernet Controller

The Intel® 82545GM Gigabit Ethernet Controllers are single, compact components with integrated Gigabit Ethernet MAC and PHY layer functions. Packaged in a 21x21 mm TFBGA, the 82545GM Gigabit Ethernet controller is footprint-compatible with the Intel® 82546GB Dual Port Gigabit Ethernet Controller (same package size, same number and pattern of pins and similar signal layout), allowing for a flexible, single port or dual port, multipurpose design.

The Intel 82545GM integrates Intel's fourth-generation Gigabit MAC design with fully integrated, physical-layer circuitry to provide a standard IEEE 802.3 Ethernet interface for 1000Base-T, 100Base-TX, and 10Base-T applications (802.3, 802.3u, 802.3ab). The controller is capable of transmitting and receiving data at 1000 Mb/s, 100 Mb/s, or 10 Mb/s data rates. For fiber-optic applications, the Intel 82545GM's integrated SERDES supports 1000Base-SX and 1000Base-LX (802.3z). In addition, the controller provides a direct Peripheral Component Interconnect (PCI) 2.2 and PCI-X 1.0a-compliant bus at clock frequencies up to 133 MHz.

The Intel 82545GM Gigabit Ethernet Controller architecture is optimized to deliver both high performance and PCI/PCI-X bus efficiency. Using state logic design with a pipelined DMA Unit and 128 bit wide buses for the fastest performance, the Intel 82545GM controller handles Gigabit Ethernet traffic with low network latency and minimal internal processing overhead. The controller's architecture includes independent transmit and receive queues to limit PCI bus traffic, and a PCI interface that maximizes the use of bursts for efficient bus usage. The Intel 82545GM Gigabit Ethernet Controller prefetches up to 64 packet descriptors in a single burst for efficient PCI bandwidth usage. A 64 KB on-chip packet buffer maintains superior performance as available PCI bandwidth changes. Advanced interrupt moderation hardware manages interrupts generated by the Intel 82545GM controller to further improve system efficiency. In addition, using hardware acceleration, the controller also offloads tasks from the host processor, such as TCP/UDP/IP checksum calculations and TCP segmentation.

The Intel 82545GM Gigabit Ethernet Controller is designed for use in the following applications:

- LAN on Motherboard (LOM) in dense, space-constrained systems such as rack-mounted servers and high-density blade servers
- Communications platform using dual Gigabit Ethernet on the backplane (PICMG 3.1 compliant or 1000BASE-X)
- Internet infrastructure devices with high-speed requirements and limited board real estate, such as switches, routers and load balancers

### **Intel® 82546GB Dual Port Gigabit Ethernet Controller**

The Intel 82546GB Dual Port Gigabit Ethernet Controller incorporates two full Gigabit Ethernet MAC and PHY layer functions and Serializer/ Deserializer (SerDes) on a single, compact component. Packaged in a 21x21 mm PBGA, the 82546GB Dual Port Gigabit Ethernet Controller provides dual port functionality without requiring additional board space for the component.

The Intel 82546GB integrates Intel's fourth-generation Gigabit MAC design, with fully integrated, physical-layer circuitry, to provide two standard IEEE 802.3 Ethernet interfaces for 1000BASE-T, 100BASE-TX, and 10BASE-T applications (802.3, 802.3u, 802.3ab). For Ethernet on the backplane and fiber-optic applications, the Intel 82546GB's two integrated SerDes support 1000BASE-X (802.3z). In addition, the controller provides a single, direct Peripheral Component Interconnect (PCI) 2.3 and PCI-X 1.0a-compliant bus that operates as a single multi-function device on the bus at clock frequencies up to 133MHz.

The Intel 82546GB Gigabit Ethernet Controller architecture is optimized to deliver both high-performance networking and PCI/PCI-X bus efficiency. Using state logic design with a pipelined DMA Unit and 128-bit-wide buses for the fastest performance, the 82546GB controller handles Gigabit Ethernet traffic with low network latency and minimal internal processing overhead. The controller's architecture includes independent transmit and receive queues to limit PCI bus traffic, and a PCI interface that maximizes the use of bursts for efficient bus usage. The Intel 82546GB Gigabit Ethernet Controller prefetches up to 64 packet descriptors in a single burst for efficient PCI bandwidth usage. Two 64KB on-chip packet buffers maintain superior performance as available PCI bandwidth changes. Advanced interrupt moderation hardware manages interrupts generated by the 82546GB controller to further improve system efficiency. In addition, using hardware acceleration, the controller also offloads tasks from the host processor, such as TCP/UDP/IP checksum calculations and TCP segmentation.

The Intel 82546GB Gigabit Ethernet Controller is designed for use in the following applications:

- LAN on Motherboard (LOM) in dense, space-constrained systems such as rack-mounted servers and high-density blade servers
- Communications platform using dual Gigabit Ethernet on the backplane (PICMG 3.1 compliant or 1000BASE-X)
- Internet infrastructure devices with high-speed requirements and limited board real estate, such as switches, routers and load balancers



## Intel® 82547GI Gigabit Ethernet Controller

The Intel® 82547GI Gigabit Ethernet Controller enables full-duplex Gigabit Ethernet performance using the Communication Streaming Architecture (CSA). The Intel 82547GI Gigabit Ethernet Controller bypasses the PCI bus, freeing its bandwidth for other I/O operations, and connects to the dedicated CSA bus on the Memory Control Hubs (MCH) of Intel® 865 and Intel® 875 chipsets for the Intel® Pentium® 4 processor. The CSA port architecture is invisible to both system software and the operating system, allowing conventional “PCI-like” configuration. CSA offers lower memory latency and higher performance than PCI-based controllers, giving the end user a true Gigabit networking experience.

The Intel 82547GI Gigabit Ethernet Controller enhances secure manageability and system health monitoring over the LAN with support for IPMI 1.5. For IPMI designs, the onboard SMBus port can pass management traffic through the controller to a management device, such as a Baseboard Management Controller (BMC) responsible for management functions.

The Intel 82547GI combines Intel’s fifth-generation Gigabit MAC design with fully integrated physical-layer circuitry (PHY) to provide a standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE-TX and 10BASE-T applications. Packaged in a 15x15 mm PBGA, the Intel 82547GI Gigabit Ethernet Controller is footprint-compatible with the Intel 82562EZ device. Footprint-compatibility and Intel SingleDriver technology allow for a flexible Gigabit Ethernet or Fast Ethernet implementation on the same motherboard layout.

## INTEL’S 10/100 ETHERNET CONTROLLERS (MAC/PHY)

### Intel® 82551QM Integrated Fast Ethernet Controller

The Intel® 82551QM Fast Ethernet Multi-function PCI/Cardbus Controller is an evolutionary addition to Intel’s family of Intel® 8255X controllers. It provides excellent performance by offloading TCP, UDP and IP checksums and supports TCP segmentation off-load for operations such as Large Send. It combines a low-power and small package design, which is ideal for power and space-constrained environments. Intel 82551QM enhancements over the Intel® 82559 include improved Bit Error Rate performance, Deep Power-down state power reductions. The Intel 82551QM is pin-compatible with the Intel® 82550 and Intel 82559 Fast Ethernet controllers, and layout-compatible with 82541 Gigabit Ethernet controllers.

### Intel® 82551ER/IT Integrated 10Base-T/100BASE-TX Ethernet Controllers

The Intel® 82551ER integrated 10Base-T/100Base-TX Ethernet Controller is an evolutionary addition to Intel’s family of 8255X controllers. As part of Intel’s fourth generation of fully integrated Fast Ethernet MAC/PHY solutions, the Intel 82551ER is optimized for low-cost, embedded applications. An extended temperature version of the 82551ER product is also available, the Intel® 82551IT which supports an identical feature set and footprint as the 82551ER.

The Intel 82551ER provides excellent performance by offloading TCP, UDP and IP checksums. Its optimized 32-bit interface and efficient scatter-gather bus mastering capabilities enable the Intel 82551ER to perform high-speed data transfers over the PCI bus. This capability accelerates the processing of high-level commands and operations, which lowers CPU utilization. Its architecture enables data to flow efficiently from the bus interface unit to the 3 Kbyte transmit and receive FIFOs, providing the perfect balance between the wire and system bus. In addition, multiple priority queues are provided to augment Quality of Service performance.

The Intel 82551ER is pin-compatible with the Intel® 82559ER Fast Ethernet controller, and layout-compatible with the Intel® 82540 and 82541 Gigabit Ethernet controllers. Intel supported Intel 82551ER drivers run on the standard Intel 82551QM, providing OEMs an upgrade path to the Intel 82551QM for additional features and increased functionality.

## Intel® 82562ET and Intel® 82562EZ 10Base-T/100Base-TX Platform LAN Connect Solution

The Intel® 82562ET and Intel® 82562EZ are highly integrated Platform LAN Connect (PLC) devices combining 10Base-T and 100Base-TX physical layer capabilities, and providing a core ingredient of the enabling solution for the integrated networking connectivity in Intel® I/O Controller Hub (ICH2/3/4/5) based platforms. The Intel 82562ET and Intel 82562EZ support a single interface fully compliant with the IEEE 802.3/802.3u standard. The IEEE 802.3u standard for 100Base-TX defines networking over two pairs of Category 5 unshielded twisted pair cable. The Intel® 82562ET/EZ complies with the IEEE 802.3u Auto-Negotiation (and 100Base-TX) standard and the IEEE 802.3x Full-Duplex Flow Control standard.

The ICH2/3/4/5/6 LAN solution that the Intel 82562ET/EZ enables is a 32-bit PCI device that features enhanced scatter-gather bus mastering capabilities which allows the LAN solution to perform high-speed data transfers over the PCI bus. The bus mastering capabilities enable the LAN solution to process high-level commands and perform multiple operations, thereby offloading communications tasks from the system CPU. Two large transmit and receive FIFOs are also included in the architecture to enhance performance while minimizing the use of system resources. Target applications include but are not limited to LAN on motherboard (LOM) and embedded designs targeted at the value segment and requiring reliable 10/100 LAN capabilities.

### INTEL® ETHERNET CONTROLLER LINE CARD

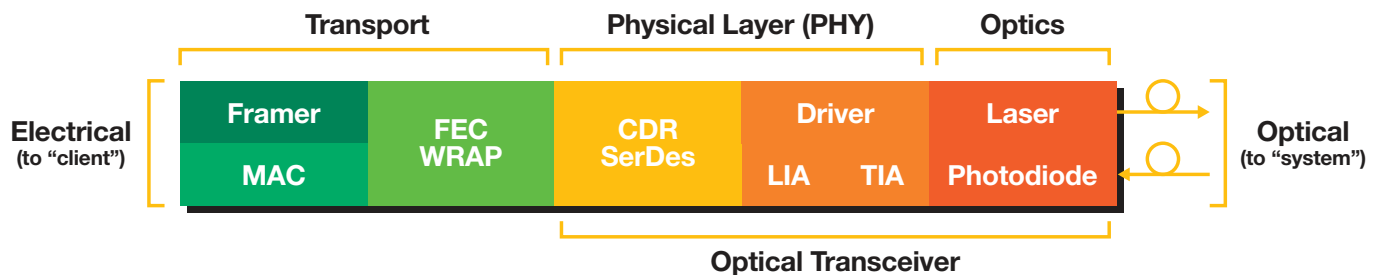
PRODUCT	FUNCTION	MAT'L. MASTER PART NUMBER	BUS	BUS SPEED	INTERFACE PCI BUS	OPERATING TEMP.	VOLTAGE	POWER DISSIPATION	STANDBY POWER MODE	PACKAGE-PINS
<b>10/100/1000 ETHERNET CONTROLLERS</b>										
82547GI	Single port integrated MAC/PHY	855106	CSA	n/a	n/a	0°C–+70°C	1.2, 1.8, 3.3V	~1.0W	105mA @ 3.3V	196 PBGA
82541PI	Single port integrated MAC/PHY	857520	PCI	33/66 MHz	32 bit	0°C–+70°C	1.2, 1.8, 3.3V	~1.0W	45mA @ 3.3V	196 PBGA
82541ER	Single port integrated MAC/PHY	858265	PCI	33/66 MHz	32 bit	0°C–+70°C	1.2, 1.8, 3.3V	~1.0W	45mA @ 3.3V	196 PBGA
82546EB	Dual port integrated MAC/PHY/SerDes	845635	PCI-X/PCI	33/66/133 MHz	32/64 bit	0°C–+55°C	1.5, 2.5, 3.3V	~2.6W	220mA @ 3.3V	364 PBGA
82546GB	Dual port integrated MAC/PHY/SerDes	855352	PCI-X/PCI	33/66/133 MHz	32/64 bit	0°C–+55°C	1.5, 2.5, 3.3V	~2.6W	220mA @ 3.3V	364 PBGA
82545EM	Single port integrated MAC/PHY/SerDes	845633	PCI-X/PCI	33/66/133 MHz	32/64 bit	0°C–+70°C	1.5, 2.5, 3.3V	~1.8W	170mA @ 3.3V	364 TFBGA
82545GM	Single port integrated MAC/PHY/SerDes	855561	PCI-X/PCI	33/66/133 MHz	32/64 bit	0°C–+70°C	1.5, 2.5, 3.3V	~1.5W	125mA @ 3.3V	364 TFBGA
82540EM	Integrated MAC/PHY	845194	PCI	33/66 MHz	32 bit	0°C–+70°C	1.5, 2.5, 3.3V	~1.4W	120mA @ 3.3V	196 TFBGA
<b>10/100 ETHERNET CONTROLLERS</b>										
82551QM	Integrated MAC/PHY	844662	PCI	33 MHz	32 bit	0°C–+85°C	3.3V	~0.5W	n/a	196 PBGA
82551ER	Integrated MAC/PHY	844687	PCI	33 MHz	32 bit	0°C–+85°C	3.3V	~0.5W	n/a	196 PBGA
82551IT	Integrated MAC/PHY	855622	PCI	33 MHz	32 bit	-40°C–+85°C	3.3V	~0.5W	n/a	196 PBGA
82559	Integrated MAC/PHY	822772	PCI	33 MHz	32 bit	0°C–+70°C	3.3V	~0.6W	n/a	196 PBGA
82559ER	Integrated MAC/PHY	825111	PCI	33 MHz	32 bit	0°C–+70°C	3.3V	~0.6W	n/a	196 PBGA
82559ER*	Integrated MAC/PHY	826238	PCI	33 MHz	32 bit	-25°C–+85°C	3.3V	~0.6W	n/a	196 PBGA
<b>10/100 ETHERNET PLATFORM LAN CONNECT (PLC) DEVICES</b>										
82562ET	PLC for ICH2/3/4/5	829706	PLC	n/a	n/a	0°C–+70°C	3.3V	~0.5W	n/a	48 SSOP
82562EZ	PLC for ICH2/3/4/5		PLC	n/a	n/a	0°C–+70°C	3.3V	~0.5W	n/a	196 PBGA

\* expanded temperature version (-25°C–+85°C)

# Optical Products

## PRODUCT OVERVIEW

Intel enables development of a wide range of Optical solutions that help meet demands of carrier equipment manufacturers to accelerate services deployment, reduce cost and ease migration to higher bandwidth. Intel incorporates leading-edge technologies and delivers them through a well-demonstrated, high-volume, low-cost manufacturing.



### Electrical to Optical Conversion (E/O)

The optical transmission system converts the electrical signal into an optical signal. The quality of the transmitted optical signal (i.e., the maximum transmission distance) is highly dependent on the jitter of the serial bit stream. The jitter is the phase noise most commonly caused by the uncertainty or variations in the bit periods. To resolve this, Intel has directed significant effort toward the system and component design, focused at maintaining precise, constant duration of the bit periods in the outgoing data stream.

### Framer/Media Access Controller (MAC)

A SONET/SDH Framer allows for SONET/SDH frame transport by encapsulating electrical data streams into packets or frames, and adding a header with section, line and path overhead bytes. The device can map different kinds of payloads such as ATM, IP, Voice, and Ethernet into the synchronous SONET/SDH frame.

### Forward Error Correction (FEC)/Digital Wrapping

A Forward Error Correction (FEC) transponder device provides coding and decoding functionality for 10Gbps fiber optical transmission, based on the out-of-band FEC scheme recommended by ITU-T G.975. At each receiver, instead of passing on incorrect data, an FEC module recovers the original data and corrects the error. A clean generation of client data travels to the next receiver and the process is repeated. FEC helps to ensure data accuracy across the network and improve network reliability at the highest possible transfer speed over longer distances.

An Optical Digital Wrapper device covers additional functions defined in ITU-T G.709 recommendation, it enables Optical Transport Network (OTN) functionalities and supports synchronous as well as asynchronous mapping schemes.

### Clock and Data Recovery (CDR)

A Clock and Data Recovery (CDR) device converts the analog input signal to a digital bit stream with an associated clock. The clock output from the CDR is used to clock the data on the parallel interface into the next device. The key function block in the CDR is the Phase Locked Loop (PLL), which locks onto the incoming data stream. The phase detector is equipped with a discriminator that evaluates the incoming data signal in the middle of the bit period (the "eye") and determines whether a 1 or a 0 is received. A separate lock detector determines whether the incoming data rate deviates too much from a given frequency. If data input is absent or deviates too much, the external reference clock ensures that the Voltage Controlled Oscillator (VCO) remains in a selectable  $\pm 500$  to  $\pm 2,000$  ppm capture range.

### Serializer/Deserializer (SerDes)

The Deserializer or Demultiplexer (DeMUX) has the purpose of transforming the serial data signal into four parallel data signals at a corresponding lower data rate. If, for example, a 2.488Gbps signal (OC-48) is fed into a 1:4 DeMUX, it will produce four parallel data outputs at 622.08Mbps. This signal then interfaces to the digital processing system. Notice that most of Intel's DeMUX have an integrated Clock and Data Recovery (CDR) device meeting the market segments requirement of small form factor solutions.

In the optical transmission system, the Serializer or Multiplexer (MUX) has the opposite function of the DeMUX. The MUX converts the parallel signal from the processing system into one serial bit stream at a corresponding higher data rate. If, for example, 16 parallel data inputs at 622.08Mbps are led into a 16:1 MUX, the output data will be at 9.95328Gbps (OC-192). The serial signal is amplified before it is passed on to the next building block.

### Optical to Electrical Conversion (O/E)

An optical reception system receives an optical signal and converts it into an electrical signal. The optical receiver can be either a photodiode or an Avalanche Photo Detector (APD) and it converts the optical input to a small electrical current.

### Transimpedance Amplifier (TIA)

A Transimpedance Amplifier (TIA) is placed right after the O/E transducer. It receives the output current from the photodiode and converts it into an electrical voltage. The TIA signal, which varies from a few mV up to 50 mVpp or more, can then be passed to an Automatic Gain Controlled (AGC) amplifier or a Limiting Amplifier (LIA).

### Limiting Amplifier (LIA)

A Limiting Amplifier (LIA) or an Automatic Gain Control amplifier (AGC) follows the TIA. The LIA and AGC have the function of obtaining a signal of sufficient amplitude/power to drive the next building block.

### Laser Diode Driver (LDD)

The Laser Diode Driver (LDD) provides the opposite function of the Transimpedance Amplifier (TIA). The LDD converts the electrical voltage serial signal received from the Multiplexer (MUX) into an electrical current with strictly controlled amplitude.

### Optical Transceiver

Intel® Optical transceivers are subsystems comprised of high-speed optical to electrical conversion, which offers networking OEMs Multi-Source Agreement (MSA)-compliant turnkey solutions for OC-192 and 10GbE interfaces. Potential applications include: Optical switches and routers, add/drop multiplexers, digital cross-connects, Dense Wavelength Division Multiplexing (DWDM) terminals, other WDM and non-WDM metro system equipment, and optical test equipment.

### 10Gbps Framer/MAC/Digital Wrapper

WB4500 SONET/SDH Virtual Concatenation Multi-Protocol OC-48/STM-16, OC-12/STM-4, and OC-3/STM-1 Data Framer

With up to 48 separate logical channels, the Intel® WB4500 SONET/SDH virtual concatenation framer is designed for use in highly channelized telecom and datacom applications in metropolitan area networks and wide area networks. Typical applications include Ethernet over SONET/SDH, RPR, ATM, POS, LAPS, and TDM. This includes systems such as MSPPs, routers, switches, access concentrators, ADMs, and dense wave division multiplexing (DWDM) systems.

There are two system interfaces shown in the Intel WB4500 high-level block diagram: the SPI-3 bus and Telecom Add/Drop bus—combined with a time slot interchange the device can support concurrent TDM and data services in one component.

The line side auxiliary telecom bus can be used to connect low-cost external framers for up to 16 OC-3/STM-1 ports. It can also be used as a mate interface to connect to another Intel WB4500 device enabling a variety of options to solve APS design problems: 1+1, 1:N, BLSR/MS\_SPRing, and UPSR/SNCP.

An example of a complete SONET/SDH system solution based on the Intel WB4500 is shown in the Complete SONET/SDH Solution diagram. The telecom bus add/drop interface is used to connect to a T1/E1 module. The SPI-3 interface connects to an Ethernet services module. On the line side, the auxiliary telecom bus connects to an external framer for a cost effective 1+1 APS solution.

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## IXF19301/19303/19325 Bandwidth Aggregation and Channelizer Devices with Virtual Concatenation

Intel® IXF19301/19303/19325 Bandwidth Aggregation and Channelizer Devices with Virtual Concatenation family of service framer products are highly integrated interface solutions for the transport of multi-service traffic. The various devices are tailored for 10G, 5G and 2.5G applications with or without line and path protection applications.

Intel IXF19301/19303/19325 supports Packet Over SONET (POS), Generic Framing Procedure (GFP), X.85, X.86, Link Access Procedure-SDH (LAPS) and Asynchronous Transfer Mode (ATM) data mapping for up to 64 SONET/SDH virtually or contiguously concatenated containers. The devices support the SPI4 Phase 2 System Interface for easy connection to multi-port MACs, Field Programmable Gate Arrays (FPGAs), or Network Processors.

Intel IXF19301/19303/19325 devices perform section/line overhead termination by implementing a cross-connect allowing the non-blocking transfer of non-concatenated and concatenated payloads between the data and line interfaces. The devices manage both VC-3 to AU-3 and VC-3 to TU-3 container mapping options for flexible SDH configurations.

**IXF19301:** STS-192/STM-64, 10GbE LAN/WAN, x4 STS-48/STM-16, x16 STS-12/STM-4 and STS-3/STM-1 working interface and STS-192/STM-64, x4 STS-48/STM-16 protection interface

**IXF19303:** STS-192/STM-64, x4 STS-48/STM-16, 10GbE LAN/WAN, x16 STS-12/STM-4 and STS-3/STM-1 unprotected, or x2 STS-48/STM-16, x8 STS-12/STM-4 and STS-3/STM-1 protected (1+1; 1:1)

**IXF19325:** x2 STS-48/STM-16, x8 STS-12/STM-4 and STS-3/STM-1 unprotected, or x1 STS-48/STM-16, x4 STS-12/STM-4 and STS-3/STM-1 protected (1+1; 1:1)

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## IXF19302 10Gbps Bandwidth Aggregation and Channelizer Device

The Intel® IXF19302 10-Gbps Bandwidth Aggregation and Channelizer Device service framer is a highly integrated interface solution for the transport of multi-service traffic. The device supports a single STS-192/STM-64, 4 STS-48/STM-16, 16 STS-12/STM-4, 16 STS-3/STM-1 or combination of these via four distinct ports per interface. Intel IXF19302 also provides an aggregation/protection interface for single STS-192/STM-64 or quad STS-48/STM-16. The integrated 10 Gigabit Ethernet Media Access Controller (MAC) allows Wide Area Network (WAN) and Local Area Network (LAN) operations. It supports concatenated and non-concatenated payloads STS-1, STS-Xc (where X = 3, 6, 9, ..., 48) and STS-192c.

Intel IXF19302 supports the mapping/demapping of POS, GFP, X.85, X.86, LAPS and ATM data for up to 64 SONET/SDH virtually or contiguously concatenated payloads/containers. The packets and cells that are mapped/demapped to/from these containers are transferred to/from the next packet device using an SPI-4 Phase 2 system interface. Intel IXF19302 performs section/line OH termination on both interfaces. It also supports higher order VC-4/STS-3 and lower order VC-3/STS-1 path termination on the mapped/demapped SPE/container.

The Intel IXF19302 implements a cross-connect allowing the non-blocking transfer of non-concatenated and concatenated payloads between the Data and Line interfaces. Work and Protect Framers supports Multicast, Add/Drop or configurable for any port to any port protection.

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**IXF18101**      10Gbps Physical Layer Device for STS-192c/STM 64c POS/GFP and 10 Gigabit Ethernet LAN or WAN PHY

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The Intel® IXF18101 is the flagship device in the footprint and register set-compatible IXF1810x family of 10 Gigabit Physical Layer devices.

The IXF18101 is a highly integrated solution for STS-192c/STM 64c and 10 Gigabit Ethernet LAN/WAN port applications, as specified in IEEE 802.3ae. The IXF18101 supports various modes of operation for transport of 10 Gigabit Ethernet, High Level Data Link Control (HDLC) frames, Packet over SONET (POS), or Generic Framing Procedure (GFP) packet formatting. Internal mapping engines provide the required formatting and maintenance of packet data into the STS-192c/STM 64c SONET/SDH frame payload. The device also supports Automatic Protection Switching (APS) in OC192 and 10GbE WAN Modes. A data-over-fiber packet mapping mode is supported for complete flexibility that can be used for test equipment, test functionality verification within a system, or direct data to line mapping.

The GFP mappings are per G. 7041 and can be used for transport of multiplexed data flows of Gigabit Ethernet, FICON, ESCON, Fiber Channel and other protocols.

The 10 Gigabit MAC handles frame encapsulation, verification, flow control, and Remote Monitoring/Simple Network Management Protocol (RMON/SNMP) statistics management, per IEEE 802.3ae standards. The IXF18101 also handles the Physical Coding Sublayer (PCS) and WAN Interface Sublayer (WIS) functions of the 802.3ae 10 Gigabit Ethernet standard.

The PCS hardware handles the 64B/66B encoding/decoding to provide the transition density and balance the 10.3125Gbps stream. The WAN interface sublayer provides the rate matching mechanism for 9.953Gbps rate transport, as well as the STS-192c/STM 64c framing structure used in WAN PHY applications. The GFP mapping engine can be connected directly to Forward Error Correction (FEC) or Optical Transport Networks (OTN) digital wrapper devices for GFP client mapping directly per G.709.

On the System side, it supports the System Parallel Interface-level 4 (SPI-4) Phase 2. On the line side, the IXF18101 supports both the OIF SFI-4 and IEEE 802.3ae XSBI interfaces. An integrated Pseudo Random Bit Sequence (PRBS) packet generator/analyzer for the PCS and WIS blocks (per IEEE 802.3ae clause 49 and 50) is also supported. Various loopback modes for line, system and debug features are provided in the device.

The Intel IXF18101 offers a powerful solution for a variety of 10Gbps line card applications for Core and Metro Routers, Enterprise Routers and Switches, MSPPs, Storage Area Applications, Metro Transport and Dense Wavelength Division Multiplexing (DWDM). The flexibility built into the Intel IXF18101 gives customers the ability to design a software-reconfigurable line card that will support any of the protocols above. Intel provides an Evaluation and Development platform to assist customers with the development of their line cards. And for their Software development, we offer a complete Development platform that includes an Application Program Interface (API) management software, Drivers and Documentation.

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**IXF18102**      10Gbps Physical Layer Device for STS-192c/STM 64c POS/GFP

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The Intel® IXF18102 offers a feature, power and cost optimized solution for STS-192c/STM 64c line card applications for Core and Metro Routers, Enterprise Routers and Switches, MSPPs, Storage Area Applications, Metro Transport and Dense Wavelength Division Multiplexer (DWDM). The Intel IXF18102 is a highly integrated framer solution for STS-192c/STM 64c port applications. The IXF18102 supports various modes of operation for transport of High Level Data Link Control (HDLC) frames, Packet over SONET (POS), or Generic Framing Procedure (GFP) packet formatting. Internal mapping engines provide the required formatting and packet data maintenance into the STS-192c/STM 64c SONET/SDH frame payload. A data-over-fiber packet mapping mode is supported for test equipment and test functionality verification within a system or direct data over fiber applications.

The GFP mapping engine can be connected directly to Forward Error Correction (FEC) or Optical Transport Networks (OTN) digital wrapper devices for GFP client mapping over G.709 OTN Networks. The system interface is 16 bits wide, features 622Mbps–800Mbps Double Data Rate (DDR) clocking and supports the industry-standard System Parallel Interface Level 4 (SPI-4) Phase 2. The SPI-4 Phase 2 interface is Low Voltage Differential Signaling (LVDS), which produces fewer connection concerns than previous 64-bit High-Speed Transport Layer (HSTL) interfaces.

On the line side, the IXF18102 supports the OIF SerDes Framer Interface Level 4 (SFI-4) interface, which is 16 bits wide with 622Mbps data rate. The IXF18102 supports Automatic Protection Switching (APS) for SONET/SDH. Various types of loopbacks such as line remote, line local, system remote as well as system local and Synchronous Payload Envelope (SPE) payload test are supported for general development functionality test and debug.

It is footprint and register set compatible with the IXF18101 device, and therefore offers a feature, cost and power optimized migration path for customers line cards. Since the devices are footprint and register set compatible, customers IP in terms of Software, drivers, and more are protected and can be reused.

For Design development assistance, we offer Hardware Evaluation and Software Development platforms.

## IXF18103 10-Gigabit Ethernet LAN or WAN PHY

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The Intel® IXF18103 is the third device in the IXF1810x family of 10Gbps Physical Layer Devices.

The IXF18103 is a highly integrated solution for 10GbE Local Area Network (LAN) and Wide Area Network (WAN) port applications compliant as per IEEE802.3ae specifications. The IXF18103 supports 10GbE LAN (10.3125Gbps) and WAN (9.953Gbps) applications.

The 10 Gigabit MAC (per IEEE 802.3ae) handles frame encapsulation, verification, 10GbE flow control, and Remote Monitoring/Simple Network Management Protocol (RMON/SNMP) statistics management. The IXF18103 also handles the Physical Coding Sublayer (PCS) and WAN Interface Sublayer (WIS) functions of the IEEE 802.3ae 10 Gigabit Ethernet standard. The PCS hardware handles the 64B/66B encoding/decoding to provide the transition density and balance of the 10.3125Gbps stream. The WIS provides the rate matching mechanism for 9.953Gbps rate transport, as well as the STS-192c/STM 64c framing structure used in WAN PHY applications.

The system interface supports the industry-standard System Parallel Interface Level 4 (SPI-4) Phase 2. This interface is 16 bits wide with 622Mbps–800Mbps Double Data Rate (DDR) clocking. The SPI-4 Phase 2 interface is Low Voltage Differential Signaling (LVDS), which produces fewer connection concerns than previous 64-bit High-Speed Transport Layer (HSTL) interfaces.

On the line side, the IXF18103 supports the IEEE 802.3ae XSBI interfaces. The 16-bit LVDS interface can operate at 622Mbps to support the 10GbE WAN rate of 9.953Gbps, and at 644Mbps to support the 10GbE LAN rate of 10.3125Gbps.

The IXF18103 also supports an integrated Pseudo Random Bit Sequence (PRBS) packet generator/analyzer for the PCS and WIS blocks per IEEE 802.3ae clause 49 and 50. Line remote, line local, system remote, and system local loopbacks are also supported, as well as Synchronous Payload Envelope (SPE) payload test loopbacks for general development functionality test and debug.

The IXF18103 comes with Evaluation and Software Development platforms to assist customers in the development of their line card solutions. Since it is optimized for 10GbE applications, it gives customers the advantage of being able to build cost-optimized, feature rich line cards for these applications without having to pay for features that they may not want.

IXF18103 may be used in combination with Intel® 10Gb LXT16726/27 MUX and CDR DeMUX chips and Intel's TXN18107 XFP optical transceiver for efficient 10GbE LAN/WAN support in enterprise and real estate-sensitive applications.

## IXF18104 10 Gigabit LAN PHY

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The Intel® IXF18104 is a highly integrated solution for 10GbE Local Area Network (LAN) port applications compliant as per IEEE802.3ae specifications. The IXF18104 supports the 10GbE LAN mode of operation for transport of Ethernet frames in LAN (10.3125Gbps) applications.

The 10 Gigabit MAC (per IEEE 802.3ae) handles frame encapsulation, verification, 10GbE flow control, and Remote Monitoring/Simple Network Management Protocol (RMON/SNMP) statistics management. The IXF18104 also handles the Physical Coding Sublayer (PCS) functions of the IEEE 802.3ae 10 Gigabit Ethernet standard. The PCS hardware handles the 64B/66B encoding/decoding to provide the transition density and balance of the 10.3125Gbps stream.

The system interface supports the industry-standard System Parallel Interface Level 4 (SPI-4) Phase 2. This interface is 16 bits wide with 622Mbps–800Mbps Double Data Rate (DDR) clocking. The SPI-4 Phase 2 interface is Low Voltage Differential Signaling (LVDS), which provides the customer with less connection concerns than previous 64-bit High-Speed Transport Layer (HSTL) interfaces. On the line side, the IXF18104 supports the LAN version of the IEEE 802.3ae XSBI interface. The 16-bit LVDS interface operates at 644Mbps to support the 10GbE LAN rate of 10.3125Gbps.

The IXF18104 also supports an integrated Pseudo Random Bit Sequence (PRBS) packet generator/analyzer for the PCS. Line remote, line local, system remote, and system local loopbacks are supported for general development functionality test and debug. The IXF18103 is offered with Evaluation and Software development platforms to assist customers in the development of their line card solutions.

IXF18104 may be used in combination with Intel 10Gb LXT16726/27 MUX and CDR DeMUX chips and Intel's TXN18107 XFP optical transceiver for efficient 10GbE LAN support in enterprise and real estate-sensitive applications.

### 10Gbps Forward Error Correction (FEC/EFEC)

IXF30001      Forward Error Correction Device

IXF30003      Forward Error Correction Device with SONET/SDH Performance Monitor

The Intel® IXF30001 and Intel® IXF30003 are Forward Error Correction (FEC) transponder devices. They provide coding and decoding functionality for use in a 2.5Gbps and 10Gbps fiber optical transmission and systems. Based on the out-of-band FEC scheme recommended by ITU-T G.975, IXF30001 and IXF30003 provide a significant gain in transmission quality. Both devices are intended for use in optical networks running at 2.5Gbps and 10Gbps, especially Dense Wavelength Division Multiplexing (DWDM) systems. Due to the out-of-band nature they do not impose any restrictions to the payload data type. IXF30001 and IXF30003 may be operated as:

- FEC transmitter wrapping and encoding the payload data stream
- FEC receiver unwrapping, decoding and error correcting the received data
- FEC transceiver, or
- Error correcting regenerator
- SONET/performance monitor (IXF30003 only)

With its power consumption below 3.5W the IXF30001 and IXF30003 have excellent power to performance ratio, and small space requirement. The devices open the door to wrapper-based transparent OAM&P of optical networks. Integrated error statistics circuitry and serial Optical Overhead Channels (OCOH) allow complete remote management of an optical network. Both devices can be controlled via an 8-bit processor interface allowing a highly event-driven communication for reducing processor load.

### Forward Error Correction (FEC)/Digital Wrapping

IXF30005      Digital Wrapper 10Gbps OTN

The Intel® IXF30005 is a fully compliant G.709 digital wrapper device that covers most Optical Transport Network (OTN) applications on a single chip. Based on the digital signal wrapping technique defined by ITU-T G.709, the IXF30005 provides all functions required for an OTN system, including transmission protection based on Forward Error Correction (FEC). With integrated FEC error statistics and overhead processing facilities, the Intel IXF30005 is a key component in wrapper-based transparent operation, administration, maintenance and provisioning of optical networks.

The Intel IXF30005 is built on technology developed for the Intel IXF30001, which was the world's first commercially available 10Gbps FEC device in the optical marketplace. Supporting both asynchronous and synchronous mapping schemes, the Intel IXF30005 provides rich OTN framing, mapping and overhead functions on chips, compliant with the ITU-T G.709 standard.

Acting as a direct pin- and software-compatible drop-in replacement for the Intel IXF30001 and IXF30003, the IXF30005 supports G.975 framing, as well as ITU-T G.709. The IXF30005 may be operated as a gateway between existing IXF30001- or IXF30003-based systems and ITU-T G.709-compliant equipment.



With its power consumption of 3.5W the IXF30005 has excellent power to performance ratio, and small space requirements. The device opens the door to digital wrapper OTN applications. Integrated error statistics circuitry and serial Optical Overhead Channels (OCOH) allow complete remote management of an optical network. The devices can be controlled via an 8-bit processor interface allowing a highly event-driven communication for reducing processor load.

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#### IXF30007      10–13Gbps Digital Wrapper with Enhanced Forward Error Correction (FEC) and Variable Overhead Rate

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The Intel® IXF30007 is a fully compliant G.709 digital wrapper device that covers most Optical Transport Network (OTN) applications on a single chip. Built on the technology developed for the Intel IXF30001 (FEC100), the first commercially available 10Gbps FEC device in the market, the IXF30007 is designed for optical transmission applications where the coding gain reached with standard FEC algorithms (ITU-T G.975, ITU-T G.709) is not sufficient. The Intel IXF30007 supports enhanced Forward Error Correction (FEC) using two concatenated RS decoders that provide unparalleled performance and flexibility. The variable FEC overhead allows the adoption of various line rates from 10 to 13Gbps and outperforms any standard FEC already at 10.7Gbps with a net coding gain of 7db. At a line rate of 12.5Gbps it offers approximately 9 dB of net electrical coding gain. It also wraps a 10.3Gbps Ethernet client signal into a 10.7Gbps or higher line rate.

The core FEC technology concatenates two Reed-Solomon codes that are configurable in both error correction capability and block length, delivering a coding gain configuration between zero and 30 percent overhead.

The IXF30007 consists of two completely separated signal paths referred to as north and south paths. While the north path is primarily designed to operate as a line receiver, the south path may be used as a line transmitter. The IXF30007 forms the basis of a single chip transponder application and, using integrated bridges between both paths, may be configured as a regenerator and provide APS support. The Intel IXF30007 provides all basic functions required for an OTN system, and appropriate configuration of the outer code ensures compliance with the digital signal wrapping technique defined by ITU-T G.709. With integrated overhead processing circuitry and different types of payload mapping, the IXF30007 is a key component in wrapper-based transparent operations, administration, maintenance and provisioning of optical networks.

With its low power consumption (less than 3W in a G.709 application and approximately 4W at 12.5Gbps line rate) the IXF30007 has excellent power to performance ratio, and even smaller space requirements than IXF30005. The device opens the door to digital wrapper OTN applications with increased FEC coding gain requirements. Integrated error statistics circuitry and serial Optical Overhead Channels (OCOH) allow remote management of an optical network.

The devices can be controlled via an 8-bit processor interface allowing a highly event-driven communication for reducing processor load.

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#### IXF30009      Optical Transport Processor

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The Intel® IXF30009 Optical Transport Processor is a highly integrated device. As a successor to the Intel IXF30001/IXF30003/IXF30005/IXF30007 devices, the Intel IXF30009 builds on this expertise and is designed to handle most OTN applications on a single chip. It provides strong Forward Error Correction (FEC) performance and support for networking standards such as OTN (G.709v2), SONET/SDH and 10Gigabit Ethernet (10GigE). The IXF30009 features SFI-4-compliant interfaces that can be configured to support either a single 10Gbps signal or four 2.5Gbps tributary signals. It can perform fully transparent asynchronous aggregation of 2.5Gbps tributaries into a 10.7Gbps (OTU2) signal. The device is full duplex and both directions can be configured independently.

The chip can be used as a SONET/SDH framer providing complete section and line termination for one OC-192/STM-64 or four OC-48/STM-16 signals. It can also be operated as a bridge device, transparently transporting any payload over a G.709-compliant network, a network node operating with OTN signals on all interfaces, and as a gateway between asynchronous OTNs interfacing between different carrier networks.

The single-chip integration support for multiple standards makes the Intel IXF30009 the ideal high-integration solution for a wide range of applications including OTN networks, FEC regenerators, multi-service platforms, SONET/SDH Add/Drop multiplexers, submarine and ULH FEC applications, low-cost 10Gbps/2.5Gbps metro and core networks, high-density line cards for 2.5Gbps networks (with four bidirectional ports and 10GigE LAN transport and monitoring).

The variable FEC overhead allows the adoption of various line rates from 10 to 12.5Gbps and outperforms any standard FEC already at 10.7Gbps with a net coding gain of 8.5db. At a line rate of 12.5Gbps it offers over 10dB of net electrical coding gain. It also wraps a 10.3Gbps Ethernet client signal into a 10.7Gbps or higher line rate.

WB1400      1 x STM-4/OC-12 or 4 x STM-1/OC-3 Channelized SONET/SDH Framer

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The Intel® WB1400 1 x STM-4/OC-12 or 4 x STM-1/OC-3 Channelized SONET/SDH Framer is targeted at high-density telecommunications and data communications equipment built for the metropolitan area network (MAN) and access networks, including SONET/SDH ADMs, Switches, Multi-Service Provisioning Platforms (MSPPs) and Access Concentrators used to aggregate end-user traffic transmitted over T1/E1/J1/DS3, wireless, DSL and other transmission pipes.

The Intel WB1400 enables equipment makers to design for either OC-12/STM-4 or 4xOC-3/STM-1 with the same chip. In the OC-3/STM-1 mode, the Intel WB1400 incorporates on-chip Clock and Data Recovery (CDR) which enables connection to small form factor pluggable (SFP) Optics. On the system side, the device offers a triple redundant 4 x 8-bit telecom bus interface at 77.76MHz for backplane connectivity, protection applications, or connection to an add/drop tributary device.

Software compatibility with the Intel® WB15xx/WB1400 product family enables reuse of design for multiple applications. In addition, system designers can develop a single board with different stuffing options applicable for a range of line interface connections. This compatibility enhances equipment manufacturer productivity and reduces design time required for SONET/SDH systems.

WB1500      1 x OC-48/STM-16 or 4 x OC-12/STM-4 Channelized SONET/SDH Framer

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The Intel® WB1500 1 x OC-48/STM-16 or 4 x OC-12/STM-4 Channelized SONET/SDH Framer is targeted at high-density telecommunications and data communications equipment built for the wide area network (WAN) and metropolitan edges of the network, including SONET/SDH ADMs, multi-service routers, switches, access concentrators and dense wavelength division multiplexing (DWDM) systems, used to aggregate large amounts of end user traffic transmitted over T1/E1/J1/DS3, wireless, DSL and other transmission pipes.

The Intel WB1500 is a highly integrated channelized framer and overhead processor that comprehensively addresses both SONET and SDH standards requirements. Compared to competitive devices targeting similar applications, the Intel WB1500 incorporates several unique features such as advanced support for tandem connections, and Intel ALERT™. In the 622 Mbps mode, the Intel WB1500 connects directly to the CDRs eliminating the need for four external MUX/DeMUX devices.

Software compatibility with the Intel WB15xx/WB1400 product family enables reuse of design for multiple applications. In addition, system designers can develop a single board with different stuffing options applicable for a range of line interface connections. This compatibility enhances equipment manufacturer productivity and reduces design time required for SONET/SDH systems.

WB1501      16 x OC-3 Channelized SONET/SDH Framer with Clock and Data Recovery

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The integrated Intel® WB1501 16 x OC-3 Channelized Framer with Clock and Data Recovery (CDR) replaces 4 x OC-3 Framer enabling the design of significantly smaller, more functional optical interfaces. The Intel WB1501 supports sixteen 155Mbps optical ports, channelized down to the STS-1/VC-3 level.

The Intel WB1501 is designed for high-channelization, high density equipment located at the Access and Metropolitan edges of the network, including SONET/SDH ADMs, multi-service routers, switches, access concentrators and DWDM equipment used to aggregate large amounts of end-user traffic transmitted over T1/E1/J1/DS3, wireless, DSL and other transmission pipes. Additionally, with the advent of new high-density optics, the Intel WB1501 eliminates a major barrier to designing higher density optical interface boards.

The Intel WB1501 achieves the industry's highest density at the lowest power dissipation rate and enables equipment makers to build very high-density optical interfaces with drastically reduced power dissipation, a critical advantage in building today's state-of-the-art systems.

Software compatibility with the Intel WB15xx/WB1400 product family enables reuse of design for multiple applications. In addition, system designers can develop a single board with different stuffing options applicable for a range of line interface connections. This compatibility enhances equipment manufacturer productivity and reduces design time required for SONET/SDH systems.

WB1510      2 x STM-4/OC-12 or 2 x STM-1/OC-3 Channelized SONET/SDH Framer

The Intel® WB1510 is the industry's first single-chip 2 x STM-4/OC-12 or 2 x STM-1/OC-3 Channelized SONET/SDH Framer. The device offers equipment makers the flexibility to design 2-fiber line interfaces for ring applications, using a single chip. The 2 x OC-3/STM-1 mode enables systems engineers to design a single line interface card for both OC-12/STM-4 and OC-3/STM-1 rates. The Intel WB1510 is targeted at high density telecommunications and data communications equipment built for the metropolitan area network (MAN) and access networks, including SONET/SDH ADMs, Switches and Multi-Service Provisioning Platforms (MSPPs), and Access Concentrator equipment used to aggregate end-user traffic transmitted over T1/E1/J1/DS3, wireless, DSL and other transmission pipes.

The Intel WB1510 offers a telecom bus interface and full bandwidth cross-connect that enables connections to multiple devices or cards, such as tributary interfaces at the DS1/E1/DS3/E3 or OC-3/STM-1 rates. In the OC-3/STM-1 mode, the WB1510 incorporates on-chip CDR.

Software compatibility with the Intel WB15xx/WB1400 product family enables reuse of design for multiple applications. In addition, system designers can develop a single board with different stuffing options applicable for a range of line interface connections. This compatibility enhances equipment manufacturer productivity and reduces design time required for SONET/SDH systems.

## 10 Gigabit XAUI Transceiver

LXT12102      XAUI to 10G Serial Transceiver

Intel® LXT12102 is a follow-on next-generation product to LXT12101. The device is intended for use in the same applications as LXT12101. With strong integrated features that includes, 8051 microcontroller, multiple ADC and DAC channels, VCSEL driver, Limiting Amplifier, and JTAG, it is an ideal device for optical transceiver modules. LXT12102 uses internal 90nm process technology which enables more than 25 percent power reduction in the B0 version. Similar to LXT12101, it can also be used in the system gasket applications and comes with reference designs.

## 10Gbps Transmitters

GD16585      10Gbps 16:1 Multiplexer (MUX) with Retiming  
GD16589      10.66Gbps 16:1 Multiplexer (MUX) with Retiming

Intel's highly integrated 10Gbps and 10.66Gbps transmitter chips for use in STM 64, OC-192 and out-of-band Forward Error Correction (FEC) applications all incorporate a 16:1 MUX with fully integrated retiming Phase Locked Loop (PLL). The 10Gbps MUX GD16585 and GD16589 include a dynamic phase alignment circuit that provides forward timing for OIF applications or jitter clean up of the reference clock. All the devices exceed the ITU-T and Telcordia jitter requirements.

LXT16707      9.95–10.71Gbps Low-Power 16:1 Multiplexer (MUX)

The Intel® LXT16707 is a highly integrated, high-performance and low-power serializer for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN), Forward Error Correction (FEC/EFEC) applications and 10GbE systems. Manufactured using a SiGe BiCMOS process for an optimal power/performance ratio, the Intel LXT16707 serializer chip helps ensure stable and reliable operation in Telco-class networking equipment.

The Intel LXT16707 transmitter includes a 16:1 MUX and Phase Locked Loop (PLL) circuits. In order to ensure critical timing between clock and data signals going from the framer to the MUX, a 2-bit FIFO has been integrated as support for the

Dynamic Phase Alignment (DPA). The device exceeds ITU-T and Telcordia jitter requirements. The LXT16707 is operated from a single 3.3V power supply and has a power dissipation of 0.75W. It is packaged in a 13x13 mm 132-ball PBGA.

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#### LXT16727 9.95–11.1Gbps Low-Power 16:1 Multiplexer (MUX)

The Intel® LXT16727 is a highly integrated, high-performance and low-power serializer for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN), Forward Error Correction (FEC/EFEC) applications and 10GbE systems.

Manufactured using a SiGe BiCMOS process for optimal power/performance ratio, the Intel LXT16727 serializer chip helps ensure stable and reliable operation in Telco-class networking equipment.

The Intel LXT16727 transmitter includes a 16:1 MUX and Phase Locked Loop (PLL) circuits. In order to ensure critical timing between clock and data signals going from the framer to the MUX, a 9-bit FIFO has been integrated as support for Dynamic Phase Alignment (DPA). Furthermore, the device has three reference clock inputs to fit a wide range of applications (SONET, GbE and OTN) as well as a third integrated PLL for jitter clean-up. The device exceeds the ITU-T and Telcordia jitter requirements. The LXT16727 is operated from a single 3.3V power supply and has a power dissipation of 1.1W. It is packaged in a 13x13 mm or 10x10 mm 132-ball PBGA.

### 10Gbps Receivers

GD16584 10Gbps Clock and Data Recovery (CDR) device with 1:16 Demultiplexer (DeMUX)

GD16588 10.66Gbps Clock and Data Recovery (CDR) device with 1:16 Demultiplexer (DeMUX)

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Intel's highly integrated 10Gbps and 10.66Gbps receivers for use in STM 64, OC-192 and out-of-band Forward Error Correction (FEC) applications all feature a fully integrated Phase Locked Loop (PLL)-based Clock and Data Recovery (CDR) device, along with a 1:16 Demultiplexer (DeMUX). The devices exceed the ITU-T and Telcordia jitter recommendations. Interconnection to 78Mbps framers can be made with the digital support circuits.

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#### LXT16706 9.95–10.71Gbps Low-Power 1:16 Demultiplexer (DeMUX)

The Intel® LXT16706 is a highly integrated, high-performance and low-power deserializer for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN), Forward Error Correction (FEC/EFEC) applications and 10GbE systems.

Manufactured using a SiGe BiCMOS process for an optimal power/performance ratio, the Intel LXT16706 deserializer chip helps ensure stable and reliable operation in Telco-class networking equipment.

The Intel LXT16706 is a DeMUX with an integrated Clock and Data Recovery (CDR) device and a high-quality Limiting Gain Amplifier and is fully compliant with the Optical Interface Forum's SFI-4 recommendation on common electrical interface between framers and Serializer/Deserializer (SerDes) for OC-192/STM 64. The LXT16706 is operated from a dual 1.8V/3.3V power supply and has a power dissipation of 0.75W. It is packaged in a 13 x 13 mm 132-ball PBGA.

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#### LXT16713XC 9.95–11.1Gbps Clock and Data Recovery (CDR)

The Intel® LXT16713XC features an integrated Limiting Amplifier (LIA) with state-of-the-art input sensitivity (better than  $2 \times 2.5\text{mVpp}$  @ BER  $10^{-10}$ ), a Clock and Data Recovery (CDR) unit and a loss of signal/loss of lock circuitry. The device provides a high-performance protocol-agnostic 10Gbps Clock and Data Recovery and Re-timer solution for use in optical line cards and XFP MSA modules for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN) systems with Forward Error Correction (FEC) applications; and submarine systems, 10GbE networks, and 10Gbps Fiber Channel (GFC) and fiber-optic test equipment.

The CDR recovers clock and data, sampling the incoming signal to determine the optimum bit period and coping with dispersions in the fiber that can cause the eye to shrink or deteriorate. The CDR automatically detects the optimum sampling point. The LXT16713 is operated from a single 3.3V power supply and has a power dissipation of 0.5W. It is manufactured using BiCMOS technology and packaged in a 5x6 mm 42-ball PBGA.

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**LXT16713A** 9.95–11.1Gbps Clock and Data Recovery (CDR)

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The Intel® LXT16713A features an integrated Limiting Amplifier (LIA) with state-of-the-art input sensitivity (better than  $2 \times 5 \text{mVpp}$  @ BER  $10^{-10}$ ), a Clock and Data Recovery (CDR) unit and a loss of signal/loss of lock circuitry. The device can be used in XFP modules as a signal conditioner in both Receive and Transmit paths or as an eye opener in optical line cards for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN) systems with Forward Error Correction (FEC) applications; and submarine systems, 10GbE networks, and 10Gbps Fiber Channel (GFC) and fiber-optic test equipment.

The LXT16713A is operated from a single 3.3V power supply and has a power dissipation of 0.5W. It is manufactured using BiCMOS technology and packaged in a 4x4 mm 24-lead QFN.

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**LXT16723** 9.95–11.1Gbps XFP Clock and Data Recovery (CDR)

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The Intel® LXT16723 features an integrated Limiting Amplifier (LIA) with state-of-the-art input sensitivity (better than  $2 \times 5 \text{mVpp}$  @ BER  $10^{-10}$ ), a Clock and Data Recovery (CDR) unit and a loss of signal/loss of lock circuitry. The CDR acts as signal conditioner for either XFP Receive and Transmit paths and conforms to XFI electrical interface as defined in XFP MSA. The device also supports Rx alarms such as LOS and LOCK, and can be used in combination with a micro controller for XFP modules. Furthermore the device can be used as an eye opener in optical line cards for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN) systems with Forward Error Correction (FEC) applications; and submarine systems, 10GbE networks, and 10Gbps Fiber Channel (GFC) and fiber-optic test equipment.

The LXT16723 is operated from a dual 1.8/3.3V power supply and has a power dissipation of 250–350mW. It is manufactured using BiCMOS technology and packaged in a 4x4 mm 24-lead QFN.

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**LXT16726** 9.95–11.1Gbps Low-Power 1:16 Demultiplexer (DeMUX)

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The Intel® LXT16726 is a highly integrated, high-performance and low-power deserializer for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN), Forward Error Correction (FEC/EFEC) applications and 10GbE systems.

Manufactured using a SiGe BiCMOS process for an optimal power/performance ratio, the Intel LXT16726 deserializer chip helps ensure stable and reliable operation in Telco-class networking equipment.

The Intel LXT16726 is a DeMUX with an integrated Clock and Data Recovery (CDR) device and a high-quality Limiting Gain Amplifier and is fully compliant with the Optical Interface Forum's SFI-4 recommendation on common electrical interface between framers and Serializer/Deserializer (SerDes) for OC-192/STM 64. The LXT16726 is operated from a dual 1.8V/3.3V power supply and has a power dissipation of 0.75W. It is packaged in a 13x13 mm or 10x10 mm 132-ball PBGA.

## 10Gbps Transceiver

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**LXT16715** 9.95–11.1Gbps XFP Transceiver

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The Intel® LXT16715 features a bidirectional Clock and Data Recovery Device including integrated Limiting Amplifiers (LIA) with state-of-the-art input sensitivity (better than  $2 \times 5 \text{mVpp}$  @ BER  $10^{-10}$ ). The CDRs acts as signal conditioner for XFP Receive and Transmit paths, supports system and line side loop back and conforms to XFI electrical interface as defined in XFP MSA. The device also supports Rx/Tx alarms such as LOS and LOCK, and can be used in combination with a micro controller for XFP modules. Also the device can be used as an eye opener in optical line cards for SDH STM 64, SONET OC-192, Optical Transport Networking (OTN) systems with Forward Error Correction (FEC) applications; and submarine systems, 10GbE networks, and 10Gbps Fiber Channel (GFC) and fiber-optic test equipment.

The LXT16715 is operated from a dual 1.8/3.3V power supply and has a power dissipation of 500–700mW. It is manufactured using BiCMOS technology and packaged in a 6x6 mm 49-ball BGA.

## 10Gbps Amplifiers

### LXT13002 Limiting Amplifier (LIA) with Loss of Signal (LoS)

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The Intel® LXT13002 Limiting Amplifier (LIA), has up to 10.7Gbps operation, input sensitivity of less than 5mV differential, on-chip DC offset compensation, and a single 1.8V power supply. The device can be used in 10Gbps Ethernet serial LAN, MAN and WAN systems, SONET OC-192, Fibre Channel FC-10, and InfiniBand 1X. The LXT13002 has a programmable loss of signal indicator. The 1.8V supply voltage allows compatibility with 10GbE XFP and XENPAK module specifications, and the low power consumption < 342mW reduces heat generation, enabling implementations within small form factor modules. The low total Root Mean Square (RMS) jitter, typically < 3ps, results in low system jitter at 10Gbps data rates, and the 0.500mV output voltage swing is able to interface with Current Mode Logic (CML). The LXT13002 is available in die form and in 24 MLF package.

### LXT16865 Transimpedance Amplifier (TIA)

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The Intel® LXT16865 is a high gain Transimpedance Amplifier (TIA) providing a differential output swing up to 2x200mVpp and a small signal, single-ended transimpedance gain of 6000Ω. It requires a single power supply of +3.3V and consumes less than 130mW of power. A high optical sensitivity of -20dBm makes LXT16865 the TIA of choice for Metro and Long-Haul applications while LXT14012 is suitable for the Metro/Access and Enterprise market segments. It can support over 2mA input current before overload.

The LXT16865 is tolerant to a photodiode capacitance of 0.2pF, allowing broadband operations with commercial grade photodiodes. They are designed in proven SiGe process and are available in die.

## 10Gbps Drivers

### LXT17001 Laser Driver

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The Intel® LXT17001 is one of three distinct components of the Intel® 10Gbps Physical Medium Dependent (PMD) Chipset. With the expanding demand for data communications, the result is the drive for advancement of high-speed optical networks. The LXT17001 is a low-cost, high-performance laser diode driver IC intended for fiber-optic transmitters operating up to 10.7Gbps. Use of CMOS technology offers an economic solution with considerable power savings compared to traditional 5V bipolar or GaAs parts. The low power consumption reduces heat generation, enabling implementations within small form factor modules, and the low signal overshoot and undershoot <10 percent, creates low jitter and open eye patterns at 10Gbps data rates. The current drive capability is 25mA modulation current into a 50Ω load and is sufficient for biasing and driving most commercial grade Vertical Cavity Surface Emitting Laser (VCSELs). The supply voltages are compatible with preliminary 10GbE XFP and XENPAK module specifications. The LXT17001 is available in die form and 24 MLF package.

### LXT17011 Laser Driver

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The Intel® LXT17011 is a low-cost, high-performance laser diode driver IC intended for fiber-optic transmitters operating over 10 Gbps. Similar in performance to the LXT17001 except that the output of the Intel LXT17011 is an unterminated open drain, allowing the part to drive low impedance lasers with modulation currents up to 50mA. Use of CMOS technology offers an economic solution with considerable power savings compared to traditional 5V bipolar or GaAs parts. The LXT17011 is available in die.

## LXT17031 10Gbps Electro-Absorption Modulator (EAM Driver)

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The LXT17031 is an Electro-Absorption Modulator (EAM) driver that provides an adjustable swing up to 2.5V<sub>pp</sub> into a 50Ω impedance load for data rates up to 10.7Gbps. The LXT17031 requires a single power supply (-5.2V) and features a very low power dissipation rate (0.8W). The LXT17031 EAM driver incorporates a three-stage amplifier: the input amplifier is designed for a wide-dynamic range input signal and provides a duty-cycle control function; the second amplifier prepares the data signal for the output stage; and the output stage enables a DC connection to the modulator and provides high-drive capability and output-voltage swing control. The LXT17031 is used in telecommunication transmission systems, DWDM applications, 10.7Gbps Forward Error Correction and Optical Transport Network transmission and metro and long-haul transmitters. The LXT17031 is available in die and QFN32 package.

## 10Gbps Optical Transceivers

### TXN132201/5/7 Small Form Factor 10Gbps Optical Transceivers

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The Intel® TXN132201/5/7 Small Form Factor 10Gbps Optical Transceivers are designed to provide an interface between the photonic physical layer and the electrical layer in 10Gbps network applications. The TXN13320 transceiver family provides an optical transmitter and receiver pair integrated with an electrical Multiplexer (MUX) and Demultiplexer (DeMUX). The module multiplexes/demultiplexes 16 channels from a differential Low-Voltage Differential Signal (LVDS) parallel data bus into a serial optical signal running at line rates from 9.953 to 10.709Gbps. An integrated micro-controller provides robust control and monitoring of the module through an I<sup>2</sup>C interface on the 300-pin Berg\* MEG-Array connector.

The transmitter contains a cooled 1310nm Distributed Feedback (DFB) laser or a cooled 1550nm Electro-absorption Modulated Laser (EML) with integrated laser-driver, launched into a single-mode optical fiber pigtail. The receiver includes a PIN photodiode and transimpedance amplifier, which operate over both the 1.3μm and 1.5μm bands.

The TXN13220 transceiver family can be configured to supply a single- or dual-rate SONET/SDH, SONET+ Forward Error Correction (FEC) or 10Gb Ethernet interface, with optional clock jitter filtering. The module satisfies link distances from 0 to 40km with future variants extending to 80km in reach. The transceiver is assembled in a Multi-Source Agreement (MSA)-compatible package that is a maximum size of 3.0" Lx2.2" Wx0.63" H.

The Intel TXN13220 family of transceivers is designed to be compliant with Telcordia GR-253 requirements for OC-192 SONET interfaces and draft 5.0 of IEEE 802.3ae, 10GBASE-L and 10GBASE-E 10Gb Ethernet specifications. The TXN13220 family is also fully compliant to the 300-pin MSA for 10 Gigabit transponders and I<sup>2</sup>C reference document for 300-pin MSA transponders.

### TXN13600 10Gbps C-Band Tunable Optical Transceiver for DWDM Networks

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The Intel® TXN13600 Tunable Optical Transceiver is a full C-band tunable 10Gbps transceiver for DWDM network applications. By allowing customers to tune the transceiver to any one of the ITU grid channels, the Intel TXN13600 transceiver makes it possible to cover the 80-channel C-band with a single transceiver, eliminating the requirement to carry 80 different transceivers for each of the required wavelengths.

The Intel TXN13600 Tunable Optical Transceiver provides a compliant interface between the photonic physical layer and the electrical section layer. The module includes an optical transmitter and receiver pair integrated with electrical MUX/DeMUX functions. When matched with Intel's other transceiver, Framer and FEC products, Intel provides the complete solution for many line card designs.

Designed to meet the link budget and distance requirements of metro and long-haul networks, the highly integrated Intel TXN13600 module includes a Lithium Niobate Mach-Zehnder modulator, microcontroller, MUX (9bit FIFO)/DeMUX, Clock and Data Recovery (CDR) unit, jitter filter, APD and PIN receiver options, and a temperature-tuned external cavity laser into a 4.1" Lx3.5" Wx0.53" H form factor device with only 11W of maximum power dissipation. Additional product features include SBS suppression ("dithering"), multi-rate capability (SONET/SDH, Ethernet, and Forward Error Correction), zero chirped (+/-1200ps/nm dispersion) and negative chirped (+1600ps/nm dispersion) modulator options, and a transmit output power of up to +5.5dBm.

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**TXN17201/9** 10Gbps Optical Transceiver, compliant with XPAK MSA

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The Intel® TXN17201/9 10Gbps optical transceiver is XPAK PCI form factor compatible, hot-pluggable module designed for use in data-center applications in Local Area and Storage Area Networks.

The device is a 10GBASE-SR multi-mode transceiver operating at 10.3Gbps for Ethernet applications, and includes Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA), and Physical Medium Dependent (PMD) functions. The transmitter section decodes four 8B/10B-encoded channels at 3.125Mbps from an XAUI parallel data bus, performs 64B/66B scrambling, and multiplexes the result into a 10.3Gbps Ethernet rate optical signal.

The receiver section demultiplexes a single 10 Gbps optical signal and converts it to four channels of XAUI. The receiver includes a photodiode, transimpedance amplifier, clock recovery decision circuit and demultiplexer, and operates over the 850nm band.

The TXN17201 transceiver is assembled in an XPAK Multi-Source Agreement (MSA)-compatible 2.74" Lx1.557" Wx0.465" H module. The heat sink is designed for 45°C ambient temperature with 100 linear feet per minute airflow. The electrical interface is through an XPAK MSA-compliant 70-pin board edge connector, with optical connections made using standard LC optical connectors. The transceiver is intended for link spans up to 300 m, and uses an 850 nm Vertical Cavity Surface Emitting Laser (VCSEL). An IEEE802.3ae and XPAK MSA-compliant Management Data Interface (MDIO) are also included.

The Intel® TXN17209 10Gbps XPAK optical transceiver operating at 10.5Gbps for Fibre Channel applications is also available.

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**TXN174XX** 10Gbps Optical Transceiver, compliant with XENPAK MSA

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The Intel® TXN174XX 10Gbps Optical Transceiver is XENPAK compliant and designed to provide a IEEE802.3ae 10.3Gbps interface between the photonic physical layer and the electrical section layer. The module comprises an optical transmitter and receiver pair integrated with XAUI to Serial conversion. PCS, PMA and PMD functions are included. The transmitter section decodes four 8B/10B encoded channels at 3.125Mbps from a XAUI parallel data bus, performs 64B/66B scrambling and multiplexes the result into a 10.3125Gbps optical signal launched into a single-mode optical fiber pigtail.

The receiver section demultiplexes a single 10.3125Gbps optical signal and performs opposite decoding before it converts back to 4 channels of 3.125Mbps XAUI. The receiver includes a photodiode, Transimpedance Amplifier (TIA), Clock and Data Recovery (CDR) device, decision circuit, and DeMUX. An IEEE802.3ae and XENPAK MSA-compliant Management Data Interface (MDIO) is included.

The optical transceiver is assembled in a Multi-Source Agreement (MSA)-compatible 4.5" Lx1.4" Wx0.7" H package. The heat sinking was designed for 55°C ambient temperature/200 linear feet per minute airflow. Alternative heat sinking options are also available. The XAUI interface connection is made using a XENPAK MSA-compliant 70-pin board edge connector. Optical connections are made with standard SC-UPC optical connectors.

The 10GBASE-SR transceiver is intended for link spans up to 300m, and uses a 850nm vertical cavity surface emitting laser (VCSEL) source.

The 10GBASE-LR transceiver is intended for link spans up to 10km, and uses a 1.3µm distributed feedback (DFB) laser source. The 10GBASE-ER transceiver is intended for link spans up to 40km, and uses a 1.5µm externally modulated (EML) laser source.

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**TXN17431** CX4 Electrical Transceiver, compliant with XENPAK MSA

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The Intel® TXN17431 CX4 Electrical Transceiver is a XENPAK compliant form factor module designed for link distances of 15m over 24 American Wire Guide (AWG) InfiniBand\* cable. It complies with the latest IEEE CX4 specification, as drafted in 802.3ak\_D5. Intel TXN17431 has an adjustable transmit de-emphasis that enables a transmit function that fits within the template defined in 802.3ak. In addition, the built-in receive equalization provides a robust link for 15 m. In case of proprietary links, an additional transmit pre-emphasis can be chosen in order to either drive longer distances of 24 AWG cable or utilize an inferior but more flexible 28 AWG cable.



Intel TXN17431 interfaces with standard InfiniBand cables using a 4X (8-signal pair) electrical connector. The connector is a shielded structure for low cross-talk. This electrical mating interface is compliant to the standards—InfiniBand, 10GFC, Serial ATA 2, and SAS. With the XENPAK-compliant 70-pin connector, the Intel TXN17431 can be readily plugged into the existing optical slots in a line card application with no further changes required to the existing system board designs. This ready-to-use function provides a way to quickly evaluate the CX4 modules in a real system environment.

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#### TXN18107 10Gbps Optical Transceiver, compliant with XFP MSA

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The Intel® TXN18107 10Gbps Optical Transceiver is XFP compliant and provides an interface between the photonic physical layer and the electrical section layer in high-density data-center applications, local area networks (LANs) and storage area networks (SANs). This small form factor, hot-pluggable transceiver provides excellent optical performance in the challenging thermal environment of multi-port switch line cards and other high port-density applications including server network interface cards, storage host bus adapters, LAN switches, SAN switches and storage array interfaces.

The Intel TXN18107 transceiver will operate at any bit rate from 9.95 to 10.51875Gbps. It is compliant with IEEE 802.3ae draft 5.0 10GBASE-LR, operating at 10.312Gbps for Ethernet applications and 10GFC draft 3.0 1200-SM-LL-L, operating at 10.51875Gbps for Fibre Channel applications.

The transceiver includes an optical transmitter and receiver pair integrated with clock and data recovery (CDR) integrated circuits. The transceiver also includes an XFP MSA-compliant, 2-wire digital management and diagnostic interface. Assembled in a compact MSA-compliant form factor, the transceiver is 0.722"x0.453"x3.071" and is designed to be compliant with draft 5.0 of IEEE 802.3ae and 10GFC draft 3.0 specifications.

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#### TXN3101 4/2/1Gbps Small Form Factor (SFF) Optical Transceivers

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The Intel® TXN3101 4/2/1Gbps Small Form Factor (SFF) Optical Transceivers provide high performance integrated duplex data links for bidirectional communication over multimode optical fiber. This module is designed for high-speed Fibre Channel data links at 4.25Gbps (4X Fibre Channel rate). With the rate select pin, the module is also rate agile and can work at the 1X and 2X Fibre Channel rates (1.0625Gbps and 2.125Gbps) and the Gigabit Ethernet rate (1.25Gbps).

The Intel TXN3101 optical transceiver is provided with a LC receptacle compatible with the industry standard LC optical connector. The SFF 850nm transceivers use a single 3.3V supply and are assembled in a compact MSA-compliant form factor package, 0.53"x0.386"x1.92". This optoelectronic transceiver module is a class 1 laser product compliant with FDA Radiation Performance Standards, 21 CFR Subchapter J. This component is also class 1 laser compliant according to International Safety Standard IEC-825-1.

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#### TXN3111 4/2/1Gbps Small Form Factor Pluggable (SFP) Optical Transceivers

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The Intel® TXN3111 4/2/1Gbps Small Form Factor Pluggable (SFP) Optical Transceivers provide high performance integrated duplex data links for bi-directional communication over multimode optical fiber. This module is designed for high-speed Fibre Channel data links at 4.25Gbps (4X Fibre Channel rate). With the rate select pin, the module is also rate agile and can work at the 1X and 2X Fibre Channel rates (1.0625Gbps and 2.125Gbps) and the Gigabit Ethernet rate (1.25Gbps).

The TXN3111 optical transceiver is provided with a LC receptacle compatible with the industry standard LC optical connector. The SFF 850nm transceivers use a single 3.3V supply and are assembled in a compact MSA-compliant form factor package, 0.58"x0.445"x2.22". This optoelectronic transceiver module is a class 1 laser product compliant with FDA Radiation Performance Standards, 21 CFR Subchapter J. This component is also class 1 laser compliant according to International Safety Standard IEC-825-1.

## TTX11500 Full C-Band Tunable Laser

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The Intel® TTX11500 Full C-Band Tunable Laser is the ideal solution for DWDM optical transceivers and DWDM discrete linecard designs. Full C-band tunable lasers alleviate inventory and sparing costs in high channel-count DWDM systems by allowing a single device to replace multiple single-channel lasers tuned to individual wavelengths on the ITU grid. Full C-band tunable lasers also enable new system functionality such as hot backup and dynamic provisioning in addition to next-generation applications of optical regeneration and wavelength conversion.

The Intel® C-band tunable laser design consists of a cooled external cavity diode laser (ECDL) within a 30-pin butterfly package. The ECDL uses an etalon-based, thermally actuated, widely tunable filter to achieve single mode operation at selectable wavelengths. The tunable laser contains no moving parts and shares many design elements of standard distributed feedback lasers (DFBs).

The laser has excellent optical performance, including low RIN, high SMSR, narrow line width and superior wavelength accuracy over operating conditions and lifetime allowing the product to meet all the stringent requirements of today's high-channel-count long-haul and metro DWDM systems.

The Intel TTX11500 is designed to be implemented in modules and line card solutions with the Intel TTX11500 electronics reference design. This allows full control and monitoring of the laser via a LVTTTL RS-232 serial interface including the ability to tune to any channel within the C-band (off-grid tuning optional). The laser reference design also accommodates features such as frequency dithering for SBS suppression and TxTRACE tone signaling, as implemented in the Intel TXN11500 electronics reference design.

## 2.5Gbps Framer/Digital Wrapper/Bandwidth Management

### IXF6048 Cell Packet Framer

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The Intel® IXF6048 and IXF6012 multi-speed SONET/SDH cell packet framers are distinguished by a unique architecture that enables OEMs to design high-performance IP/ATM transport equipment. The IXF6048 and IXF6012 can store entire packets of different lengths, ATM cells or a combination of IP packets and ATM cells on the same payload, while enabling optimal equipment processing. This capability is the result of a large on-chip FIFO (up to 16Kbytes), and allows carriers to provide a much greater level of Quality of Service (QoS).

The IXF6048 supports various channel types such as one OC-48, or four OC-12s and the IXF6012 supports various channel types such as one OC-12 or four OC-3s. The IXF6012 is pin-to-pin compatible with the IXF6048, enabling OEMs to build highly flexible equipment that can be easily upgraded as the network grows. This flexibility also helps extend the life and versatility of equipment, and helps reduce replacement costs. Intel's software support, including device drivers and a Graphical User Interface (GUI), enables OEMs to quickly implement both the IXF6048 and IXF6012. In addition, equipment becomes easily adaptable for different speeds via software that changes the configuration. With an extremely configurable design that carries both ATM and IP, the IXF6048 and IXF6012 cell/packet framers simplify and accelerate the transporting of data through today's multi-protocol network, and help speed time-to-market.

### IXF30025 Digital Wrapper 2.5Gbps Optical Transport Network (OTN)

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The Intel® IXF30025 is a fully compliant G.709 digital wrapper device that covers most Optical Transport Network (OTN) applications on a single chip. The device is targeted for 2.5Gbps OTN applications. Based on the digital signal wrapping technique defined by ITU-T G.709, the IXF30025 provides all functions required for a 2.5Gbps OTN system, including transmission protection based on Forward Error Correction (FEC). With integrated FEC error statistics and overhead processing facilities, the Intel IXF30025 is a key component in wrapper-based transparent operation, administration, maintenance and provisioning of optical networks.

The Intel IXF30025 is built on technology developed for the Intel® IXF30005 Digital Wrapper for 10Gbps. Acting as a direct pin- and software-compatible drop-in replacement for the Intel® IXF30001 the Intel IXF30025 supports G.975 framing, as well as ITU-T G.709 OTU-1 framing. The IXF30025 may be operated as a gateway between existing IXF30001-based

systems and ITU-T G.709-compliant equipment. With its power consumption of 2W the IXF30025 has excellent power to performance ratio, and small space requirements. The device opens the door to digital wrapper OTN applications. Integrated error statistics circuitry and serial Optical Overhead Channels (OCOH) allow complete remote management of an optical network. The devices can be controlled via an 8-bit processor interface allowing a highly event driven communication for reducing processor load.

IXF25300      2.5G SONET/SDH Framer with STS-1 and VT/TU Pointer Processor and AU/TU Cross Connect, Stackable to 10Gbps

The Intel® IXF25300 2.5G SONET/SDH Framer with STS-1 and VT/TU Pointer Processor and AU/TU Cross Connect, Stackable to 10Gbps provides a complete high and low order bandwidth management solution in Metro and Access networks for Multi-Service Provisioning Platforms (MSPPs), Add/Drop Multiplexers (ADM), Edge Boxes, Core Switches, and Cross Connects using modular stackable fabric that allows multiple product platforms, sizes, and architectures within a single chip. The Intel IXF25300 is compliant with Bellcore GR-253, ANSI T1.105, ETSI ETS 300 417, ITU-T G.707, G.783, G.784, G.806 and G.826 requirements.

The Intel IXF25300 supports up to STM-16/OC-48 worth of bandwidth with any valid combination of STM-16/OC-48, STM-4/OC-12 and STM-1/OC-3 interfaces. The device integrates all common ADM functions into a single chip to allow single card ADM/MSPP development with linear scalability from 2.5Gbps to 10Gbps. It combines framing, high order and low order processing into the same package. It also contains a single stage non-blocking AU/TU cross connect and provides separate controls for AU and TU switch configurations. The Intel IXF25300 supports SD/SF on VC-4 to VT-1.5 VC-12 to allow for faster UPSR/SNCP ring closure. Low power dissipation of 7W and a compact 31mmx31mm package enable flexible design and improved time-to-market.

### 2.5Gbps Multi-rate Serializer/Deserializer (SerDes) Chipsets

GD16556      Multi-rate Clock and Data Recovery (CDR) device with 1:16 Demultiplexer (DeMUX) and Digital Wrapping  
 GD16557      Multi-rate 16:1 Multiplexer (MUX) with Digital Wrapping  
 LXT16596      Multi-rate Clock and Data Recovery (CDR) device with 1:4 Demultiplexer (DeMUX) and Digital Wrapping  
 LXT16597      Multi-rate 4:1 Multiplexer (MUX) with Digital Wrapping

The Intel® LXT16596/LXT16597 and GD16556/GD16557 are high-performance multi-rate transponder chipsets designed for interconnecting a 2.5Gbps line interface to a custom CMOS ASIC or FPGA. The fully integrated on-chip Phase Locked Loops (PLLs) on LXT16597 eliminate critical clock/data timing relations and feature the unique dynamic phase-alignment between ASIC and Multiplexer (MUX). The chipsets are compatible with multiple line rates up to OC-48/STM 16. Switching between the bit rates is possible on the fly through select pins. The receivers have an input Limiting Amplifier (LIA), Clock and Data Recovery (CDR) device, Loss of Signal (LOS), and DeMUX and support digital wrapping. The transmitters are equipped with a MUX and jitter attenuator. All devices support up to 7 percent increased line rate. They comprise integrated programmable clock dividers for digital wrapping for Forward Error Correction (FEC) applications. Fractions available are 32/31, 16/15, and 15/14.

### 2.5Gbps Transmitters

GD16553      4:1 Multiplexer (MUX) with Bypass Capability and Laser Driver

The Intel® GD16553 is a high-performance 2.5Gbps 4:1 Multiplexer (MUX) with on-chip Phase Locked Loop (PLL) and high current laser driver designed for use in SDH STM 16 or SONET OC-48 fiber-optic communication systems. The optional bypass capability allows direct 2.5Gbps input to the laser driver. The on-chip PLL synthesizer ensures the 2.5GHz clock for retiming of the high-speed serial output. The PLL is locked to the external reference clock. The on-chip LC type VCO ensures low jitter generation of less than 5 mUIRMS. For 78Mbps interface, see our digital support circuits. The GD16553 has a 4-bit ECL system interface and a supply voltage of -5.2V.

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**LXT16653**      4:1 Multiplexer (MUX)

The Intel® LXT16653 is a high-performance monolithic integrated Multiplexer (MUX) and clock generator device applicable for optical communication systems including SONET OC-48 and OC-12. It uses an external reference clock for accurate clock generation. The Phase Locked Loop (PLL) filter is external for flexible design, giving an excellent low jitter clock source. The device features VCO, PLL, Clock Divider, MUX, and Phase Nulling Clocking Scheme.

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**GD16523**      Multi-rate 16:1 Multiplexer (MUX)

The Intel® GD16523 are high-performance 2.5Gbps 16:1 multiplexers with on-chip VCO and Phase Locked Loop (PLL) system, designed for SDH STM 16 and SONET OC-48 transmission systems. The GD16523 is a low-power multi-rate transmitter with double PLL featuring forward clocking, FIFO and loopback functionality. The GD16523 can also be configured for dynamic phase alignment. All the transmitters are manufactured in a Silicon Bipolar process and exceed the ITU-T and Telcordia jitter recommendations.

### 2.5Gbps Receivers

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**GD16543**      Clock and Data Recovery (CDR) device with 1:4 Demultiplexer (DeMUX)

The Intel® GD16543 receiver features a 1:4 Demultiplexer (DeMUX) with input Limiting Amplifier (LIA) and Clock Data and Recovery (CDR). It is designed for SDH STM 16 and SONET OC-48 transmission systems. The 622MHz output clock is maintained within 500ppm tolerance even in absence of data. The device meets the ITU-T and Telcordia jitter recommendations. For 78Mbps interface, see our digital support circuits.

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**LXT16642**      Clock and Data Recovery (CDR) device with 1:4 Demultiplexer (DeMUX)

The Intel® LXT16642 is a high-performance monolithic integrated Clock and Data Recovery (CDR) device with onboard 1:4 Demultiplexer (DeMUX), applicable for optical communication systems including SONET OC-48 and OC-12.

It uses an external reference clock for fast acquisition. The Phase Locked Loop (PLL) filter is external for flexible design, giving an excellent low jitter clock source. The low power, small physical form factor and the high integration, makes the device ideal for module, Dense Wavelength Division Multiplexing (DWDM) and backplane applications, as well as solutions with aggregation points for OC-48 (quad) to OC-192.

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**GD16524**      Multi-rate Clock and Data Recovery (CDR) device with 1:16 Demultiplexer (DeMUX) with Limiting Amplifier (LIA)

The Intel® GD16524 are high-performance 2.5Gbps receiver devices applicable for SDH STM 16 and SONET OC-48 applications. The devices all comprise a Phase Locked Loop (PLL)-based Clock and Data Recovery (CDR) device with all circuits needed for fast acquisition and lock to the incoming data. The integrated 1:16 Demultiplexer (DeMUX) ensures a simple and universal interface to the next device. All three devices have a wide tuning range conforming to standard SONET/SDH speed and Forward Error Correction (FEC) requirements.

GD16524 is a 3.3V multi-rate transmitter designed for standard SONET/SDH rate and Gigabit Ethernet. GD16524 features high-speed serial loopback input, peak detection for signal level monitoring and AGC control as well as consecutive identical bit sequence and BER detection. All the devices conform to ITU-T and Telcordia jitter requirements over supply and temperature ranges.

GD16522	Multi-rate 1:1 Clock and Data Recovery (CDR) device with Limiting Amplifier (LIA) and Loss of Signal (LOS)
GD16546B	1:1 Clock and Data Recovery (CDR) device with Limiting Amplifier (LIA)
GD16547	1:1 Clock and Data Recovery (CDR) device with Limiting Amplifier (LIA)

The Intel® GD16522, Intel® GD16546B and Intel® GD16547 are complete 2.5Gbps Clock and Data Recovery (CDR) receivers with on-chip Limiting Amplifier (LIA). Device specifications for both jitter transfer, jitter tolerance and jitter generation exceed the ITU-T and Telcordia recommendations simultaneously over supply and temperature, allowing the CDR to be used as a regenerator in SONET/SDH systems. All the 1:1 CDRs have a wide tuning range enabling both standard SONET/SDH speed and Forward Error Correction (FEC) application. The GD16522 is multi-rate STM 1/4/16 and SONET OC-3/12/48 ideal for high-density applications. It features a consecutive identical bit sequence and BER detection.

### 2.5Gbps Drivers

GD16578	Laser Modulator Driver with Retiming
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The Intel® GD16578 is a 2.5Gbps Retiming Laser Modulator Driver designed to provide a controllable drive current for optical modulators. Even at the maximum modulation current of 200 mA the device still provides an excellent eye diagram up to 4Gbps, making it a good price-performance solution for 2.5Gbps transmission. The GD16578 can drive external loads with a characteristic impedance of 25Ω.

GD16521	Any Rate Laser Driver with Retiming (25Ω)
GD16561	Any Rate Laser Driver with Retiming (50Ω)
GD16571	Any Rate Laser Driver with Retiming (25Ω)

Together with our 16:1 multiplexers, the Retiming Laser Drivers form a low jitter, low-power and cost optimized 2.5Gbps solution for your SDH or SONET system. The retiming laser drivers have the best eye diagrams in the industry across the full modulation current range. This allows for a large variety of laser diodes.

GD16573A	Any Rate Laser Driver (25Ω)
GD16575A	Any Rate Laser Driver (50Ω)

The Intel® GD16573A and Intel® GD16575A Laser Drivers are a cost optimized, low-power solution for your 2.5Gbps SDH or SONET transmission system. Both are suitable for Electro-Absorption, Direct Modulated and WDM lasers, the GD16573A being designed to drive a 25W load and the GD16575A a 50W load.

### 2.5Gbps Amplifiers

GD16511	General-Purpose Limiting Amplifier (LIA)
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The Intel® GD16511 is a wide bandwidth Limiting Amplifier (LIA) designed for SDH STM 16 and SONET OC-48 optical communication systems as well as instrumentation and datacom applications up to 3.125Gbps. The GD16511 has been measured together with a 2.5Gbps Clock and Data Recovery (CDR) circuit, and error-free operation has been measured down to below 3mVpp input signal (10<sup>-9</sup> BER). The amplifier accepts input signals to above 1Vpp. The GD16511 has ECL system interface and a supply voltage of -5V.

### 622 or Quad 155Mbps Framer

IXF6012	POS/ATM Framer
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See IXF6048.

## 155Mbps Receivers/Transmitters

GD16591A Multi-rate 8:1/4:1/2:1 Multiplexer (MUX)

GD16592A Multi-rate Clock and Data Recovery (CDR) device with 1:8/1:4/1:2 Demultiplexer (MUX)

The Intel® GD16591A/GD16592A is a low-power transmitter/receiver chipset designed for multi-rate line interfaces such as STM 4/OC-12, STM 1/OC-3 and PDH E4. The GD16591A comprises an 8:1/4:1/2:1 Multiplexer (MUX) and an optional forward/counter clocking scheme. The GD16592A comprises an input Limiting Amplifier (LIA), Clock and Data Recovery (CDR) device and 1:8/1:4/1:2 Demultiplexer (DeMUX). Both devices offer loopback for local and remote loopback test modes. The devices exceed the ITU-T/Belcore jitter recommendations.

GD16360 Dual Transceiver with Cable Equalizer

The Intel® GD16360 is a fully dual transmit/receive IC for E4/STM 1/OC-3 operation designed for low cost and volume production. It provides conversion between LVPECL signals and the G.703 line interface featuring two channels, each with a cable equalizer and Loss of Signal (LOS) detection on the receive side and a cable driver on the transmit side.

LXT6155 SDH SONET/ATM Transceiver

The Intel® LXT6155 is a 155Mbps (OC-3/STM 1/STS-3/3c) high-speed, fully integrated transceiver that supports fiber and coax transmission on the same chip. Implemented using Intel's proven mixed-signal design expertise in 3.3V CMOS technology, it has a small footprint, enabling consumption of 650mW of power (typical) and allowing the integration of multiple OC-3s on the same board.

## 155Mbps Mapper

IXF6151 28 T1/E1 Mapper

The Intel® IXF6151 28 T1/E1 Mapper is a universal voice and data communication solution for high-bandwidth access that maps both T1 and E1 signals over SONET/SDH networks. The flexible, universal design of the IXF6151 enables OEMs to build one solution that meets the requirements of both SONET and SDH networks and provides interoperability between the two infrastructures. The IXF6151 allows T1 signals to be carried in an SDH network, further enhancing flexibility.

## 155Mbps Receivers

GD16362A Clock Date and Recovery (CDR) CMI Decoder with Equalizer and LOS

GD16368B CMI Decoder with 1:8/1:4/1:2 Demultiplexer (DeMUX)

The Intel® GD16362A and Intel® GD16368B receivers are Clock and Data Recovery devices with CMI to NRZ decoders designed for reception of PDH, SDH, and SONET signals at 140 and 155Mbps. The 78/70 or 17/19MHz reference clock enable programmable selection between PDH (E4) and STM 1/OC-3 board configurations for maximum flexibility. The GD16362A additionally features on-chip true LOS detection (G.775) and an equalizer capable of recovering signals after more than 25dB (78MHz) cable attenuation. Both devices meet G.751, G.823, and G.825 requirements for jitter tolerance and jitter transfer. The devices are designed for low cost and volume production using BiCMOS technology.

## 155Mbps Transmitters

GD16361A	CMI Encoder with Cable Driver
GD16367B	8:1/4:1/2:1 Multiplexer (MUX) with CMI Encoder

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The Intel® GD16361A and Intel® GD16367B transmitters are retiming CMI encoders designed for cable transmission of PDH, SDH, and SONET signals at 140 and 155Mbps. Both devices meet ITU-T G.751, G.823, and G.825 recommendations for jitter tolerance and jitter generation and G.703 for 140 and 155Mbps CMI interface (return loss and transmit power). The devices are designed for low cost and volume production using BiCMOS technology.

## Digital Support Circuits

GD16590	General-Purpose Multi-frequency Clock Synthesizer
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The Intel® GD16590 is a 3.3V high-speed multi-rate clock synthesizer, with three selectable reference clock inputs and six output clocks at fixed rates from 38.88 to 1.244MHz, intended for clock distribution in SONET/SDH applications by using the internal Voltage Control Oscillator (VCO). The device can also be used with an external VCXO. The GD16590 features an integrated Phase Locked Loop (PLL) with on-chip low noise VCO. Selectable subdivided output clocks without phase skew. It exceeds the ITU-T and Telcordia jitter requirements and is available in a 48-pin TQFP package (7x7 mm). GD16590 is a general-purpose PLL intended for jitter clean-up, phase compensation and frequency synthesis application in high-speed digital systems.

LXT16598	Multi-frequency Clock Synthesizer
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The Intel® LXT16598 is a 3.3V generic high-speed multi-rate clock synthesizer consisting of a Phase Frequency Comparator and a wide-tune range Voltage Control Oscillator (VCO). The device supports up to three external VCXOs/VCXOs (Voltage Control Saw/Crystal Oscillator). The LXT16598 features an integrated Phase Locked Loop (PLL) with on-chip low noise VCO. Four selectable subdivided output clocks without phase skew at programmable rates from 9.00 to 809MHz, suitable for Forward Error Correction (FEC) operations in 2.5Gbps and 10Gbps applications. It exceeds the ITU-T and Telcordia jitter requirements and is available in a 48-pin QFN package (7x7 mm). The LXT16598 is a general-purpose PLL intended for FEC gear-box as a one chip solution for synchronous clocking designs in FEC applications, jitter clean-up, phase compensation and frequency synthesis application in high-speed digital systems.

GD16333	4:32 Demultiplexer (DeMUX)
GD16334	32:4 Multiplexer (MUX)

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Our digital support circuits are cascadable quad multiplexers and demultiplexers designed to interface high-speed primary Multiplexer/Demultiplexer (MUX/DeMUX) devices at 622Mbps and low-speed CMOS framers at 78Mbps. Each device contains circuitry for control and synchronization of an array of slave devices. The devices are composed of four identical MUX/DeMUX blocks with a common clock and synchronization block. Combined with our 10Gbps transmitter and receiver chipsets, these interface devices provide a simple and complete solution for SDH and SONET system designs.

## OPTICAL PRODUCTS OVERVIEW

SYSTEM	PART NUMBER	FUNCTION	APPLICATION
OC-192/10GbE	IXF18101	10Gbps Physical Layer Device for STS-192c/STM 64c POS/GFP and 10GbE LAN and WAN	Core and Metro Routers, Enterprise Routers and Switches, MSPPs, Storage Area Applications, Metro Transport and DWDM
OC-192	IXF18102	10Gbps Physical Layer Device for STS-192c/STM 64c POS/GFP	Core and Metro Routers, Enterprise Routers and Switches, MSPPs, Storage Area Applications, Metro Transport and DWDM
10GbE	IXF18103	10Gigabit Ethernet LAN or WAN PHY	Core and Metro Routers, Enterprise Routers and Switches, MSPPs, Storage Area Applications, Metro Transport and DWDM
10GbE	IXF18104	10Gigabit Ethernet LAN PHY	Core and Metro Routers, Enterprise Routers and Switches, MSPPs, Storage Area Applications, Metro Transport and DWDM
OC-192	IXF30001	G.975 10.7Gbps Forward Error Correction Device ~6dB gain	DWDM equipment, FEC regenerators, long-haul networks, Cross Connects
OC-192	IXF30003	G.975 10.7Gbps Forward Error Correction Device with Performance Monitoring ~6dB gain	DWDM equipment, FEC regenerators, long-haul networks, SONET/SDH performance monitoring
OTN	IXF30005	G.709 10.7Gbps Digital Wrapper and Forward Error Correction Device	DWDM equipment, OTN Optical Transport Networks, FEC regenerators, submarine/ULH network SONET/SDH performance monitoring
OTN	IXF30007	G.709 10–13Gbps Digital Wrapper with Enhanced FEC up to 9dB net electrical coding gain	DWDM equipment, OTN Optical Transport Networks, FEC regenerators, submarine/ULH network SONET/SDH performance monitoring, ultra long haul and submarine networks
OTN/10GbE	IXF30009	G.709 10.7Gbps Optical Transport Processor and Ultra Forward Error Correction 10dB net electrical coding gain	OTN Optical Transport Network, FEC regenerators, SONET/SDH add/drop multiplexers, submarine and ULH FEC applications, metro and core networks, 10GE LAN transport and monitoring, multi-services switches, Cross Connects
OTN	IXF30025	G.709 2.66 Gbps Digital Wrapper and Forward Error Correction Device	DWDM equipment, OTN Optical Transport Network, IP transport equipment, gigabit and terabit routers, ATM Switches, Layer 3 switches, multi-services switches, Cross Connects ~6dB gain
OC-3 to OC-48	IXF25300	SONET/SDH Framer, STS-1, VT/TU Pointer Processing	MSPP, ADM, Edge Box, Core Switch, Cross Connects
OC-12/OC-3	WB1400	SONET/SDH Framer	ADM, Switches, MSPP, Access Concentrators, STM-1, STM-4
OC-12/OC-3	WB1500	SONET/SDH Framer	ADM, Switches, MSPP, Access Concentrators, STM-1, STM-4
OC-12/OC-3	WB1501	SONET/SDH Framer	ADM, Switches, MSPP, Access Concentrators, STM-1, STM-4
OC-12/OC-3	WB1510	SONET/SDH Framer w/CDR	ADM, Switches, MSPP, Access Concentrators, STM-1, STM-4
OC-48/OC-12	WB4500	SONET/SDH Framer	Ethernet over SONET, RPR, ATM, POS, LAPS, TDM
OC-3 to OC-192	IXF193XX	Bandwidth aggregation and channelizer, virtual concatenation	POS, GFP, X.86, X.85, ATM, LAPS
OC-3 to OC-192	IXF19302	Bandwidth aggregation and channelizer	POS, GFP, X.86, X.85, ATM, LAPS
OC-192	LXT12102	XAUI to 10G Serial Transceiver	XENPAK/XPAK/X2 MSA, XAUI-to-10G serial line card (XFP)
OC-192	LXT13002	10G L/A W/LOS	OC-192, 10G Transceivers, FC-10, 10 Gbps Ethernet Serial LAN, MAN, WAN Systems
OC-192	LXT16588	10.66Gbps CDR with 1:16 DeMUX	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16589	10.66Gbps 16:1 MUX with Retiming	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16706	9.95Gbps–10.7G CDR with 1:16 DeMUX	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16707	9.95Gbps–10.7G 16:1 MUX with Retiming and 2-bit FIFO	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16713	9.95Gbps–11.1Gbps Clock and Data Recovery	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16713A	9.95Gbps–11.1Gbps Clock and Data Recovery	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16726	9.95Gbps–11.1Gbps CDR with 1:16 DeMUX	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16727	9.95Gbps–10.7G 16:1 MUX with Retiming and 9-bit FIFO	STM 64, OC-192 and out-of-band FEC applications
OC-192	LXT16715	10G XFP Transceiver, CDR	OC-192, STM64, OTN, FEC, Submarine Systems, GFC, fiber-optical test equipment, 10GbE
OC-192	LXT16723	10 Gbps 1:1 CDR	OC-192, STM64, OTN, FEC, Submarine Systems, GFC, fiber-optical test equipment, 10GbE
OC-192	LXT16865	10G High Gain T/A	STM64, OC-192, DWDM, FEC, OTN
OC-192	LXT17001	Low Current Laser Driver	VSCEL Driver for 10GbE and OC-192
OC-192	LXT17011	High Current Laser Driver	Laser Driver for 10GbE and OC-192
OC-192	LXT17031	10Gbps Electro-Absorption Modulator (EAM) Driver	STM 64, OC-192, DWDM, FEC, OTN



OPERATING SPEED	POWER SUPPLY	OPERATING TEMPERATURES (TCASE)	SYSTEM INTERFACE	POWER CONSUMPTION	PACKAGE
10/10.3Gbps	1.2/1.8/2.5V; 3.3V I/O tolerant	-40°C to +85°C	LVDS	5.2W	672 UBGA
10Gbps	1.2/1.8/2.5V; 3.3V I/O tolerant	-40°C to +85°C	LVDS	4.7W	672 UBGA
10.3Gbps	1.2/1.8/2.5V; 3.3V I/O tolerant	-40°C to +85°C	LVDS	5.2W	672 UBGA
10.3Gbps	1.2/1.8/2.5V; 3.3V I/O tolerant	-40°C to +85°C	LVDS	4.7W	672 UBGA
10.7Gbps	1.8V, 2.5V, 3.3V	-40°C to +85°C	622, 666 LVDS	3.5W max	576 TBGA
10.7Gbps	1.8V, 2.5V, 3.3V	-40°C to +85°C	622, 666 LVDS	3.5W max	576 TBGA
10.7Gbps	1.8V, 2.5V, 3.3V	-40°C to +85°C	622, 669 Mbps LVDS	3.1W typical	576 TBGA
up to 12.5 Gbps	1.5V, 2.5V, 3.3V	-40°C to +85°C	622, 669 Mbps LVDS	4W	420 TBGA 35x35 mm
up to 12.5 Gbps	1.5V, 2.5V, 3.3V	-40°C to +85°C	622, 669 Mbps LVDS	TBD	868 TBGA
2.7Gbps	2.5V; 3V I/O tolerant	-40°C to +85°C	155, 166 LVDS	2W	576 TBGA
2.5Gbpt to 10Gbps		-40°C to +85°C	155 LVDS, 622 LVDS	3.4W	
2.5Gbps	1.5V, 2.5V, 3.3V	-40°C to +85°C	.25µ CMOS	3.4V	648-Pin PBGA
2.5Gbps	1.5V, 2.5V, 3.3V	-40°C to +85°C	.25µ CMOS	3.4V	648-Pin PBGA
2.5Gbps	1.5V, 2.5V, 3.3V	-40°C to +85°C	.25µ CMOS	3.4V	648-Pin PBGA
2.5Gbps	1.5V, 2.5V, 3.3V	-40°C to +85°C	.25µ CMOS	3.4V	648-Pin PBGA
2.5Gbps	1.5V	-40°C to +85°C	.14µ CMOS	3.5V	850-Pin PBGA
10Gbps, 5Gbps, 2.5Gbps					1150-Pin UBGA
10Gbps					1150-Pin UBGA
10.3Gbps	1.2V Core Supply	0°C to +70°C	XAUI	1.9–2.2W	192-pin BGA
10.7Gbps	1.8V/3.3V	-40°C to +85°C	NA	-342mW	Die/MLF32
10.7Gbps	+3.3V	0°C to +70°C	LVDS	3.4W	132-pin BGA
10.7Gbps	+3.3V	0°C to +70°C	LVDS	3.4W	132-pin BGA
10–10.7Gbps	1.8/3.3V	-40°C to +85°C	LVDS	0.75W	132-pin BGA
10–10.7Gbps	3.3V	-40°C to +85°C	LVDS	0.75W	132-pin BGA
10–10.7Gbps	3.3V	0°C to +85°C	CML	0.4–0.5W	42-ball PBGA
10–10.7Gbps	3.3V	0°C to +85°C	CML	0.4–0.5W	24-pin QFN
10–10.7Gbps	1.8/3.3V	-40°C to +85°C	LVDS	0.75W	132-pin BGA
10–10.7Gbps	3.3V	-40°C to +85°C	LVDS	1.1W	132-pin BGA
9.95–11.1Gbps	1.8V/3.3V	0°C to +85°C	CML	650–700mW	49-ball BGA
9.96–11.1Gbps	1.8V/3.3V	0°C to +85°C	CML	325–350mW	24-pin QFN
10.7Gbps	+3.3V	0°C to +85°C	Serial	-130mW	Die
10Gbps	-1.8V Core Supply	-40°C to +85°C	NA	500mW	Die
10Gbps	-1.8V Core Supply	-40°C to +85°C	NA	500mW	Die
10.7Gbps	-5.2V	-40°C to +85°C	CML	0.8W	Die/QFN32

## OPTICAL PRODUCTS OVERVIEW

SYSTEM	PART NUMBER	FUNCTION	APPLICATION
OC-48	GD16511	General-purpose Limiting Amplifier	STM 16/OC-48, 4x3.125Gbps for 10Gb Ethernet WDM PHY modules
OC-48	GD16521	Any Rate Laser Driver with Retiming (25Ω)	SDH STM 16, SONET OC-48
OC-48	GD16522	Multi-rate 1:1 CDR with Limiting Amplifier and LOS	SDH STM 16, SONET OC-48
OC-48	GD16523	Multi-rate 16:1 MUX	SDH STM 16, SONET OC-48
OC-48	GD16524	Multi-rate CDR with 1:16 DeMUX with Limiting Amplifier	SDH STM 16, SONET OC-48
OC-48	GD16543	CDR with 1:4 DeMUX	SDH STM 16, SONET OC-48
OC-48	GD16546B	1:1 CDR with Limiting Amplifier	SDH STM 16, SONET OC-48
OC-48	GD16547	1:1 CDR with Limiting Amplifier	SDH STM 16, SONET OC-48
OC-12	IXF6012	Multi-speed OC-12, x4 OC-3/1 SONET/SDH ATM/POS Overhead Terminator	ATM Switches, Layer 3 switches, multi-services switches, gigabit and terabit routers, DWDM equipment, IP transport equipment, LAN/WAN interfaces, DSLAMs, Central Office, Cross Connect, Digital Loop Carrier
OC-12	GD16591A	Multi-rate 8:1/4:1/2:1 MUX	STM 4/OC-12, STM 1/OC-3, PDH E4
OC-12	GD16592A	Multi-rate CDR with 1:8/1:4/1:2 DeMUX	SDH STM 16, SONET OC-48
OC-3	LXT6155	155Mbps SONET/SDH/ATM Transceiver drives Fiber or Coax	Multi-services switches, DSLAMs, Gateways, Central Office Switch, Cross Connects, Digital Loop Carrier, 3G Mobile Switch Centers
OC-3	GD16361A	CMI Encoder with Cable Driver	PDH, SDH and SONET at 140 and 155Mbps
OC-3	GD16362A	CDR CMI Decoder with Equalizer and LOS	PDH, SDH and SONET at 140 and 155Mbps
OC-3	GD16367B	8:1/4:1/2:1 MUX with CMI Encoder	PDH, SDH and SONET at 140 and 155Mbps
OC-3	GD16368B	CMI Decoder with 1:8/1:4/1:2 DeMUX	PDH, SDH and SONET at 140 and 155Mbps
OC-3	LXT6151	28T1/21E1 VT/TU SONET/SDH Mapper	PDH, SDH and SONET at 140 and 155Mbps
Various	GD16333	4:32 DeMUX	SONET/SDH
Various	GD16334	32:4 MUX	SONET/SDH
Various	GD16360	Dual Transceiver with cable Equalizer, LOS detection and Cable Driver	Multi-services switches, ADMs, Central Office Switch, Cross Connects, Digital Loop Carrier, 3G Mobile Switch Centers
Various	GD16590	General-Purpose Multi-frequency Clock Synthesizer	E4/STM 1/OC-3

OPERATING SPEED	POWER SUPPLY	OPERATING TEMPERATURES (TCASE)	SYSTEM INTERFACE	POWER CONSUMPTION	PACKAGE
3.5Gbps	+3.3V	-40°C to +85°C	CML	0.13W	32-pin TQFP
2.7GHz	+3.3V	-40°C to +95°C	CML/LVPECL	0.6W+bias+mod	48-pin TQFP
2.7GHz	+3.3V	-40°C to +85°C		0.6W	48-pin TQFP
2.7GHz	+3.3V	-40°C to +85°C	LVPECL	0.8W	100-pin TQFP
2.7GHz	+3.3V	-40°C to +85°C	LVPECL	0.8W	100-pin TQFP
2.7GHz	-5.2V	0°C to +85°C	LVPECL	1.1W	48-pin TQFP
2.7GHz	-5.2V	-5°C to +95°C		1.0W	48-pin TQFP
2.7GHz	-5.2V	-5°C to +95°C		1.0W	48-pin TQFP
2.7GHz	-5.2V	-40°C to +85°C	Utopia 1,2,3/POS Utopia 1,2,3	0.8W max	600 PBGA
622MHz	+3.3V	-25°C to +85°C		0.40W	48-pin TQFP
622Mbps, 155Mbps, 55Mbps	3.3V; 5V tolerant I/O	-25°C to +85°C		0.45W	48-pin TQFP
622Mbps	3.3V, 5V tolerant I/O	0°C to +75°C	155 Serial PECL or CMI, 8-bit parallel	760mW typical	64 LQFP
155Mbps	+3.3V, +5.0V	-40°C to +85°C	LVPECL	0.5W	28-pin SSOP
155Mbps	+3.3V, +5.0V	-40°C to +85°C	LVPECL	0.5W	28-pin SSOP
155Mbps	+3.3V, +5.0V	-40°C to +85°C	CMOS	0.4W	52-pin PQFP
155Mbps	3.3V	0°C to +75°C	CMOS	0.6W	52-pin PQFP
155Mbps	+3.3V, +5.0V		T1/E1 NRZ serial Data, Telecom Bus for STS 3/STM 1 Multiplexing		256 PBGA
622MHz	5.0V	-5°C to +85°C	TTL	1.0W	100-pin QFP
800MHz		0°C to +70°C	TTL	1.3W	100-pin QFP
55Mbps	3.3V, 5V tolerant I/O	5°C to +85°C	LVPECL	0.50W	48-pin TQFP
1244MHz	+3.3V	0°C to +70°C	TTL	1.0W	100-pin QFP



# Intel® Telecom Products

## INTEL® TELECOM PRODUCTS INTRODUCTION

Intel, the world's largest chipmaker, is also a leading manufacturer of computer, networking and communications products. Intel® communications systems products offer developers, service providers, resellers and communications system owners what they need to succeed in the new world of converged voice and data communications. This includes a broad family of building blocks, a global network of solutions providers, and comprehensive support and consulting services.

Ranging from silicon to server software, Intel® building blocks meet the converged communications needs of environments as diverse as enterprise organizations and service providers. These building blocks include voice, fax, conferencing and speech technologies; telephone and IP network interfaces; PBX integration products; carrier-class, board systems-level products, platforms, transmission products; and more. Intel® communications building blocks enable new, converged Web services including Internet voice browsing, Web-enabled contact centers and true unified messaging.

For more information on these products, visit <http://www.intel.com/products/index>.

## SILICON TRANSMISSION PRODUCTS

### T1/E1/J1 Transmission Solutions

T1/E1/J1 technology is the standard in the telecommunications industry, providing the foundation from which DSL, PDH, SDH, and ATM technologies deliver narrowband and broadband applications using the existing infrastructure. For an industry facing a wide variety of WAN access choices in the coming years, T1/E1/J1 will remain the transport channel of choice because of its availability, backward compatibility, and cost-effectiveness. The T1/E1/J1 product group consists of the following families: (1) Analog Front Ends (AFE), (2) Short Haul T1/E1/J1 Line Interface Units (LIU), (3) Long Haul T1/E1/J1 Line Interface Units and (4) T1/E1/J1 framers.

### Digital Subscriber Line (DSL) Solutions

DSL technologies are transport mechanisms for delivering high-bandwidth digital data services over twisted-pair copper wires—the cabling now in place between telephone companies' central offices and subscribers. HDSL2 is the latest advancement in symmetric DSL technology delivering 1.544Mbps (DS-1/T1) data rates up to 12,000 feet on a single twisted pair.

## SILICON TRANSMISSION PRODUCT LINE SUMMARY

The following table summarizes the networking product application features. For full information refer to the product datasheets.

APPLICATIONS	PART NUMBER	FEATURES
<b>Integrated T1/E1/J1 Short Haul Line Interface Units</b>		
<ul style="list-style-type: none"> <li>▪ E1 Digital Cross Connects</li> <li>▪ SDH E1 Tributary Interfaces</li> <li>▪ Public Switching Trunk Line Interfaces</li> <li>▪ Microwave Transmission Systems</li> <li>▪ Access Systems</li> <li>▪ Add Drop Multiplexers (ADM)</li> </ul>	<b>LXT380</b>	<ul style="list-style-type: none"> <li>▪ Octal E1 Short Haul transceiver per ITU G.703</li> <li>▪ Single rail supply voltage of 3.3V with 5V I/O capability</li> <li>▪ Hitless Protection Switching (HPS) for 1 to 1 protection without relays</li> <li>▪ Low power consumption of &lt;100 mW per channel (typical)</li> <li>▪ 75Ω/120Ω TX operation without component changes</li> <li>▪ Driver short circuit current limiter (&lt;50 mA RMS)</li> <li>▪ Transmit return loss exceeds ETSI ETS 300166</li> <li>▪ Selectable optional transmit pulse shape PLL</li> <li>▪ Optional per channel clock recovery</li> <li>▪ Optional HDB3 line encoder/decoder</li> <li>▪ On-chip secondary driver short circuit monitoring circuit</li> <li>▪ Provides protected monitoring points per ITU G.772</li> <li>▪ Analog/digital and remote loopback testing function</li> <li>▪ LOS per ITU G.775 and ETS 300 233 (selectable)</li> <li>▪ Optional 8-bit parallel or 4 wire serial control interface</li> <li>▪ JTAG Boundary Scan test port per IEEE 1149.4</li> <li>▪ Small footprint 144-pin LQFP and 160-pin BGA</li> <li>▪ Host mode (parallel or serial) and Hardware mode</li> </ul>
<ul style="list-style-type: none"> <li>▪ SDH E1 tributary interfaces</li> <li>▪ Public switching trunk line interfaces</li> <li>▪ Digital Access Cross Connects (DAC)</li> <li>▪ Channel banks</li> <li>▪ Microwave transmission systems</li> </ul> <p>Tools = LXT380, LXT384 Design Assistant</p>	<b>LXT381</b>	<ul style="list-style-type: none"> <li>▪ Single rail 3.3V supply with 5V tolerant inputs</li> <li>▪ Hitless Protection Switching (HPS) for 1 to 1 protection without relays</li> <li>▪ Low power consumption of &lt;100 mW per channel (typical)</li> <li>▪ 75Ω/120Ω TX operation without component changes</li> <li>▪ Fast output driver tri-stability</li> <li>▪ Transmit return loss exceeds ETSI ETS 300166</li> <li>▪ LOS per ITU G.775</li> <li>▪ JTAG Boundary Scan test port per IEEE 1149.1</li> <li>▪ 144-pin LQFP and 160-pin BGA Packages</li> <li>▪ Hardware mode only</li> </ul>
<ul style="list-style-type: none"> <li>▪ SONET/SDH Tributary Interfaces</li> <li>▪ Digital Cross Connects</li> <li>▪ Public/Private Switching Trunk Line Interfaces</li> <li>▪ Microwave Transmission Systems</li> <li>▪ T1-T3, E1-E3 MUX</li> <li>▪ Access Systems</li> </ul>	<b>LXT384</b>	<ul style="list-style-type: none"> <li>▪ Single rail 3.3V supply with 5V tolerant inputs</li> <li>▪ Low power consumption of 150 mW per channel (typical)</li> <li>▪ Hitless Protection Switching (HPS) for 1 to 1 protection without relays</li> <li>▪ Superior crystal-less jitter attenuator</li> <li>▪ Meets ETSI CTR12/13, ITU G.736, G.742, G.823 and AT&amp;T Pub 62411 specifications</li> <li>▪ Optimized for SONET/SDH applications, meets ITU G.783 mapping jitter specification</li> <li>▪ Constant throughput delay jitter attenuator</li> <li>▪ HDB3, B8ZS, or AMI line encoder/decoder</li> <li>▪ Provides protected monitoring points per ITU G.772</li> <li>▪ Analog/digital and remote loopback testing functions</li> <li>▪ LOS per ITU G.775, ETS 300 233 and T1.231</li> <li>▪ 8-bit parallel or 4 wire serial control interface</li> <li>▪ Hardware and Software control modes</li> <li>▪ JTAG Boundary Scan test port per IEEE 1149.1</li> <li>▪ 160-pin PBGA and 144-pin LQFP</li> </ul>
	<b>LXT386</b>	<ul style="list-style-type: none"> <li>▪ 4 Channel Version of LXT384</li> </ul>
	<b>LXT388</b>	<ul style="list-style-type: none"> <li>▪ 2 Channel Version of LXT384</li> <li>▪ Driver Performance Monitor (DPM)</li> <li>▪ Tx and Rx Jitter Attenuator</li> <li>▪ 100-pin LQFP</li> </ul>

APPLICATIONS	PART NUMBER	FEATURES
<b>Switched 56/DDS</b>		
<b>Frame Relay DDS and SW/56 DSUs</b> <ul style="list-style-type: none"> <li>▪ Leased-line DDS</li> <li>▪ Internet Service Provider (ISP) Equipment</li> <li>▪ Frame Relay Access Devices (FRAD)</li> </ul>	<b>LXT400</b>	<ul style="list-style-type: none"> <li>▪ Fully integrated all-rate extended range transceiver</li> <li>▪ Receive equalizer filter can handle up to 40 dB at rates below 56 Kbps, and up to 49 dB at 56 Kbps and 72 Kbps</li> </ul>
<b>T1/E1/J1 Long Haul Line Interface Units</b>		
<b>Access Systems</b> <ul style="list-style-type: none"> <li>▪ ISDN Primary Rate Interface (ISDN PRI)</li> <li>▪ CSU/NTU interface to T1 Service</li> <li>▪ Wireless Base Station interface</li> <li>▪ T1 LAN/WAN bridge/routers</li> <li>▪ T1 Mux; Channel Banks</li> <li>▪ Digital Loop Carrier—Subscriber Carrier Systems</li> </ul>	<b>LXT360/LXT361</b>	<ul style="list-style-type: none"> <li>▪ Fully integrated transceivers for Long or Short Haul T1 or E1 interfaces</li> <li>▪ Crystal-less digital jitter attenuation: Select either transmit or receive path, no crystal or high-speed external clock required</li> <li>▪ Meet or exceed specifications in ANSI T1.403 and T1.408; ITU I.431, G.703, G.736, G.775 and G.823; ETSI300-166 and 300-233; and AT&amp;T Pub 62411</li> <li>▪ Support 75Ω (E1 coax), 100Ω (T1 twisted-pair) and 120Ω (E1 twisted-pair) applications</li> <li>▪ Selectable receiver sensitivity—Fully restores the received signal after transmission through a cable with attenuation of either 0 to 26 dB, or 0 to 36 dB @772 kHz and 0 to 43 dB @ 1024 kHz</li> <li>▪ Five Pulse Equalization Settings for T1 Short Haul applications</li> <li>▪ Four Line Build-Outs for T1 Long Haul applications from 0 dB to -22.5 dB</li> <li>▪ Transmit/receive performance monitors with Driver Fail Monitor Open and Loss of Signal outputs</li> <li>▪ Selectable unipolar or bipolar data I/O and B8ZS/HDB3 encoding/decoding</li> <li>▪ Line attenuation indication output in 2.9 dB steps</li> <li>▪ QRSS generator/detector for testing or monitoring</li> <li>▪ Output short circuit current limit protection</li> <li>▪ Local, remote and analog loopback, plus in-band network loopback generation and detection</li> <li>▪ Multiple-register serial interface for microprocessor control</li> <li>▪ Available in 28-pin PLCC, and 44-pin PQFP packages</li> </ul>
<b>OC3/STM-1 Line Card</b>		
<b>155 Mbps Transceiver</b>	<b>LXT6155</b>	<ul style="list-style-type: none"> <li>▪ 155Mbps (OC-3/STM 1/STS-3/3c) high-speed, fully integrated transceiver that supports fiber and coax transmission on the same chip. Implemented using Intel's proven mixed-signal design expertise in 3.3V CMOS technology, it has a small footprint, enabling consumption of 650mW of power (typical) and allowing the integration of multiple OC-3s on the same board.</li> </ul>
<b>155Mbps Mapper</b>	<b>IXF6151</b>	<ul style="list-style-type: none"> <li>▪ Universal voice and data communication solution for high-bandwidth access that maps both T1 and E1 signals over SONET/SDH networks. The flexible, universal design of the IXF6151 enables OEMs to build one solution that meets the requirements of both SONET and SDH networks and provides interoperability between the two infrastructures. The IXF6151 allows T1 signals to be carried in an SDH network, further enhancing flexibility.</li> </ul>
<b>T1/E1/J1 Framers</b>		
<ul style="list-style-type: none"> <li>▪ Voice and ATM Gateways</li> <li>▪ T1/E1/J1 Access</li> <li>▪ IMAPs</li> <li>▪ Integrated Access Devices (IAD)</li> <li>▪ Inverse Multiplexing over ATM (IMA) cards</li> <li>▪ Wireless Base Stations</li> <li>▪ Frame Relay Access Devices</li> </ul>	<b>IXF3204</b> <b>IXF3208</b>	<ul style="list-style-type: none"> <li>▪ Quad and Octal T1/E1/J1 Framer with Intel® On-Chip Performance Report Messaging (Intel® PRM). IXF3204/08 has independent channel control and 24 HDLCs (V5.1 and 5.2, GR-303 support for DLCs). Extensive BERTs, and counters for Intel PRM. T1/E1/J1 framer with Intel PRM and API and GUI speeds design and or saves license fees. Single BOM for world markets. Available in 256 PBGA (17x17 mm).</li> </ul>

**T1/E1/J1 TRANSMISSION LINE CARD – SHORT HAUL LINE INTERFACE UNITS**

DEVICE	TYPE	NETWORK PORTS	LINE RATE	POWER SUPPLY	JITTER ATTENUATOR	JA ARCHITECTURE	HPS	JTAG	μP INTERFACE	PACKAGE
LXT350	SH LIU	1	T1/E1/J1	5V	Tx or Rx	Crystal-less			Serial	28 PLCC/44 QFP
LXT351	SH LIU	1	T1/E1/J1	5V	Tx or Rx	Crystal-less			Parallel	28 PLCC/44 QFP
LXT380	SH LIU	8	E1	3.3V			Yes	Yes	Serial/Parallel	144 LQFP/160 BGA
LXT381	SH AFE	8	E1	3.3V			Yes	Yes	Serial/Parallel	144 LQFP/160 BGA
LXT384	SH LIU	8	T1/E1/J1	3.3V	Tx or Rx	Crystal-less	Yes	Yes	Serial/Parallel	144 LQFP/160 BGA
LXT386	SH LIU	4	T1/E1/J1	3.3V	Tx or Rx	Crystal-less	Yes	Yes	Serial/Parallel	100 LQFP/160 BGA
LXT388	SH LIU	2	T1/E1/J1	3.3V	Tx and Rx	Crystal-less	Yes	Yes	Serial/Parallel	100 LQFP

**T1/E1/J1 TRANSMISSION LINE CARD – LONG HAUL LINE INTERFACE UNITS**

DEVICE	TYPE	NETWORK PORTS	LINE RATE	POWER SUPPLY	JITTER ATTENUATOR	JA ARCHITECTURE	HPS	JTAG	μP INTERFACE	PACKAGE
LXT360	LH/SH LIU	1	T1/E1	5V	Tx or Rx	Crystal-less			Serial	28 PLCC/44 QFP
LXT361	LH/SH LIU	1	T1/E1	5V	Tx or Rx	Crystal-less			Parallel	28 PLCC/44 QFP

**T1/E1/J1 TRANSMISSION LINE CARD – FRAMERS**

DEVICE	TYPE	NETWORK PORTS	LINE RATE	POWER SUPPLY	SPECIAL FEATURES	JTAG	μP INTERFACE	PACKAGE
IXF3204	framer	4	T1/E1/J1	3.3V	PRM	Yes	Serial	256 PBGA
IXF3208	framer	8	T1/E1/J1	3.3V	nPRM	Yes	Serial	256 PBGA

**OC3/STN-1 LINE CARD**

SYSTEM	PART NUMBER	FUNCTION	APPLICATION
OC-3	LXT6155	155Mbps SONET/SDH/ATM Transceiver drives Fiber or Coax	Multi-services switches, DSLAMs, Gateways, Central Office Switch, Cross Connects, Digital Loop Carrier, 3G Mobile Switch Centers
OC-3	LXT6151	28T1/21E1 VT/TU SONET/SDH Mapper	PDH, SDH and SONET at 140 and 155Mbps



APPLICATIONS	PART NUMBER	FEATURES
<b>Digital Subscriber Line Products</b>		
<b>HDSL</b> <ul style="list-style-type: none"> <li>▪ T1 or E1 (2-pair) and fractional T1 or E1 transport</li> <li>▪ Digital pair-gain</li> <li>▪ Wireless base stations to switch interfaces</li> <li>▪ Campus and private networking</li> <li>▪ High-speed digital modems</li> </ul>	<b>SK70704/SK70706</b>	<ul style="list-style-type: none"> <li>▪ HDSL chipset for 784 Kbps data transmission</li> <li>▪ Fully-integrated analog core chip</li> <li>▪ Integrated activation/start-up</li> <li>▪ Optimized for one-pair operation</li> </ul>
	<b>SK70704/SK70707 or SK70708</b>	<ul style="list-style-type: none"> <li>▪ HDSL chipset for 1168 Kbps data transmission</li> <li>▪ Fully-integrated analog core chip</li> <li>▪ Integrated activation/start-up</li> <li>▪ Optimized for one-pair operation</li> </ul>
<b>Multi-Rate DSL</b> <ul style="list-style-type: none"> <li>▪ High-speed residential Internet access</li> <li>▪ Extended range fractional T1/E1 transport</li> <li>▪ 4-, 6-, 8- or 12-channel digital pair-gain</li> <li>▪ Wireless base station to switch access</li> <li>▪ WAN access for LAN routers</li> </ul>	<b>SK70720/SK70721</b>	<ul style="list-style-type: none"> <li>▪ Chipset configurable to 272, 400, 528, and 784 Kbps data transmission</li> <li>▪ Fully integrated analog core chip</li> <li>▪ Supports transparent repeater applications without an external processor or glue-logic</li> <li>▪ Supports processor directed rate selection driven by receive signal level and noise margin</li> <li>▪ Continuously adaptive echo canceller and equalizers perform to changing noise and line characteristics</li> </ul>
	<b>SK70721/SK70725 or SK70725A</b>	<ul style="list-style-type: none"> <li>▪ Fully integrated, 2-chip transceiver</li> <li>▪ Supports 272–1,168 Kbps data transmission</li> <li>▪ Integrated line drivers, filters and analog echo canceller reduce the number of external components</li> <li>▪ Multiple framing modes: Transparent, T1 standard, E1 standard</li> <li>▪ Independent transmit and receive clocks for minimum delay</li> <li>▪ Tolerance for extended signal interruptions</li> <li>▪ Single +5V supply</li> <li>▪ Typical power dissipation less than 500 mW</li> <li>▪ Supports processor directed rate selection driven by receive signal level and noise margin</li> <li>▪ Continuously adaptive echo canceller and equalizers maintain excellent transmission performance with changing noise and line characteristics</li> </ul>
	<b>LXP730</b>	<ul style="list-style-type: none"> <li>▪ Complements the SK70725/25A/21</li> <li>▪ Synchronization of external data streams to the DSL</li> <li>▪ Multiplexing and demultiplexing of independent data streams</li> <li>▪ Loopback of data at DSL interface in both directions</li> <li>▪ Creation, insertion, and recovery of the MDSL Overhead (MOH)</li> <li>▪ Supports two input/output data streams simultaneously</li> <li>▪ Supports systems with point-to-point architectures</li> </ul>
<b>HDSL2</b> <ul style="list-style-type: none"> <li>▪ Single pair T1 transport systems</li> <li>▪ Multichannel digital pair-gain systems</li> <li>▪ WAN access for LAN routers and switches</li> <li>▪ Integrated access devices (IAD)</li> <li>▪ Wireless access systems</li> </ul>	<b>SK7074x</b>	
	<b>SK70740/41/42</b>	
	<b>SK70740/44</b>	

**DIGITAL SUBSCRIBER LINE (DSL) PRODUCTS LINE CARD**

HDSL CHIPSET		MULTI-RATE DSL (MDSL) CHIPSET					HDSL2 CHIPSET
ACC HDX Framer	SK70704 SK70706	SK70704 SK70707	SK70704 SK70708	SK70720 SK70721	SK70725 SK70721 LXP730	SK70725A SK70721 LXP730	SK70740 SK70741 SK70742 SK70744
Description	T1 HDSL Chipset	E1 HDSL Chipset	E1 HDSL Chipset	Multi-Rate DSL DSL Data Pump Chipset (w/Microinterruption)	Enhanced Multi-Rate DSL Data Pump Chipset	Enhanced Multi-Rate DSL Data Pump Chipset	HDSL2 Chipset
Speed (Kbps)	784 Kbps	1168 Kbps	1168 Kbps	272 Kbps–784 Kbps	272 Kbps–1168 Kbps	272 Kbps–1168 Kbps	1552 Kbps
Reference Clock (MHz)	12.544 MHz	18.688 MHz	18.688 MHz	Variable	Variable	Variable	21.5 MHz
Power Supply (Volts)	5V	5V	5V	5V	5V	5V	2.5V, 3.3V, 5V
Power Consumption/port (Watts)	<1.0W	<1.2W	<1.2W	<1.2W	<1.2W	<1.2W	<1.8W
Integrated Line Driver	•	•	•	•	•	•	
Microprocessor Interface	•	•	•	•	•	•	•
Ext. Temp -40°C to +85°C	•	•	•	•	•	•	•

**SUPPORTED STANDARDS**

ETSI		•	•		•	•	
ANSI	•			•	•	•	•
ITU	•	•	•	•	•	•	

**SUPPORTED LINE CODING**

2B1Q	•	•	•	•	•	•	
TCPAM							•

**APPLICATIONS**

T1 (2 Pair)	•			•	•	•	
T1 (1 Pair)							•
Fractional T1	•				•	•	•
E1 (2 Pair)		•	•				
Fractional E1		•	•				
N Channel Digital Pair-Gain		•	•	•	•	•	•
Wireless Base Station to Switch Interface	•	•	•	•	•	•	•
Campus and Private Networking	•	•	•	•	•	•	•
High-Speed Digital Modems	•	•	•	•	•	•	•
WAN Access for LAN Routers and Switches	•	•	•	•	•	•	•

**PACKAGES**

ACC	28 PLCC	28 PLCC	28 PLCC	44 PLCC	44 PLCC	44 PLCC	64 QFP
HDX	44 PLCC	68 PLCC	44 PLCC	28 PLCC	28 PLCC	28 PLCC	64 QFP, 100 QFP
Framer					64 LQFP	64 LQFP	64 QFP

# Telecom Boards and Platforms

## INTEL® NETSTRUCTURE™ COMPUTE BOARDS AND PLATFORMS

[developer.intel.com/design/network/products/cbp/index.htm](http://developer.intel.com/design/network/products/cbp/index.htm)

Intel provides modular building blocks for the telecommunications market segment. Based on industry standards, including AdvancedTCA\* and CompactPCI\*, Intel boards and platforms offer carrier-grade, high-density computing solutions featuring high availability, hot-swappable components and computer telephony capabilities. Components are designed to be NEBS-3/ETSI-compliant and feature IPMI v1.5-based management.

Intel® NetStructure™ solutions empower development of differentiated, reliable, Intelligent Network (IN) services for the converged IP network. The Intel® embedded processor roadmap is built on performance scalability to ensure an extended product life cycle, while standards-based hardware and software building blocks support efficient and cost-effective time-to-market.

### Complete Development Solutions

Intel provides technical and sales support for customers designing with Intel® NetStructure boards, platforms, and components. This support includes value-add operating system support with device drivers for Redundant System Slot (RSS) applications, system management features and functionality, hot swap, and BIOS innovations.

In addition, when faced with complex design issues in a tight timeframe, look to the Intel® Communications Alliance members for complete, standards-based development solutions to help you move products to market on YOUR schedule. Discover ready-to-buy boards and platforms based on embedded Intel® Architecture that can save you development time and money, allowing you to focus resources on value-add functionality. You'll realize the benefits of price, flexibility and scalability for a variety of embedded, communications, and networking applications.

[www.intel.com/info/eia](http://www.intel.com/info/eia)

### Intel® NetStructure™ Boards and Platforms: Designed for AdvancedTCA\* Specifications

Intel is meeting the diverse design challenges of system developers in the areas of availability, density, price, performance and support for service applications with AdvancedTCA-compliant boards and platforms. Based on the PICMG\* 3.x specification, this open, board-based, carrier-grade architecture can achieve levels of backplane interconnect bandwidth, performance and flexibility not previously possible in standards-based products.

#### ADVANCEDTCA COMPLIANT PROCESSOR BOARDS

PRODUCT NUMBER	PRODUCT NAME	PROCESSOR	SPEED	CHIPSET	MEMORY	CHASSIS COMPATIBILITY	ETHERNET SUPPORT
MPCBL0001F03/F04	High-Performance Single Board Computer	Low Voltage Intel® Xeon™ processor	2.0 GHz with Fibre Channel	Intel® E7501 chipset	Up to 4 GB DDR 266 ECC SDRAM	MPCHC0001 ATCA 14U Chassis	2x 1000/100/10 to the backplane
MPCBL0001N03/N04	High-Performance Single Board Computer	Low Voltage Intel® Xeon™ processor	2.0 GHz without Fibre Channel	Intel® E7501 chipset	Up to 4 GB DDR 266 ECC SDRAM	MPCHC0001 ATCA 14U Chassis	2x 1000/100/10 to the backplane

#### ADVANCEDTCA COMPLIANT PLATFORMS



PRODUCT NUMBER	PRODUCT NAME	TOTAL SLOTS	POWER	FANS	HEIGHT	DEDICATED CHASSIS MANAGEMENT SLOTS
MPCHC0001	14U Shelf	14	200W/slot	6	24.4" (621mm)	2

#### ADVANCEDTCA COMPLIANT PLATFORM COMPONENTS

PRODUCT NUMBER	PRODUCT NAME	COMPATIBILITY	SIZE	FEATURES
MPCMM0001	Chassis Management Module	MPCBL0001F03/F04 SBC MPCBL0001N03/N04 SBC MPCH0001 14U Shelf	177mm x 300mm x 4 HP	Monitors chassis resources and environmental conditions; provides instrumentation for health metrics and alerting. Defines interface between platform hardware and system software.

## Intel® NetStructure™ Boards and Platforms: Designed for CompactPCI\* Specifications

The PICMG 2.16 specification-compliant family of products provides OEM equipment designers with CompactPCI standards-based, building-block solutions for carrier-grade telecom and Internet applications, with support for switched Ethernet communications across the system backplane. Solutions include hot-swap, high availability and multicomputing capabilities ranging from low-cost processor boards to fully integrated systems for mission-critical applications. Modular, scalable, off-the-shelf platforms and components, and support for major operating systems and real-time software, speed application development. A generous set of onboard embedded features address the system integration and reliability requirements of OEM system builders. These building blocks are designed to interoperate within the entire Intel® NetStructure™ family of packet switched backplane products, and with third-party building blocks meeting the PICMG 2.16 specification.

FEATURES	BENEFITS
Standards-based, open architecture	<ul style="list-style-type: none"> <li>• Interoperable between multiple vendors' systems, giving customers more flexibility</li> <li>• Efficient and economical integration to support faster time-to-market</li> <li>• Custom configurable</li> <li>• Allows customers to focus on core competencies</li> </ul>
Embedded  file support	<ul style="list-style-type: none"> <li>• Continuous Intel Architecture (IA) roadmap provides future security</li> </ul>
High density	<ul style="list-style-type: none"> <li>• Reduces overall cost of equipment space and minimizes system volume</li> </ul>
Low power/thermals	<ul style="list-style-type: none"> <li>• Provides superior thermal characteristics</li> </ul>
Modular boards are active FRUs to enhance serviceability	<ul style="list-style-type: none"> <li>• Can easily be replaced in the field in under five minutes without disrupting other system components</li> </ul>
RSS capabilities, provided by redundant power supplies, CPUs, hard drives, etc., support hot-swappable boards	<ul style="list-style-type: none"> <li>• High availability with 99.999 percent uptime</li> </ul>
IPMI  ment enables full management of all IPMI-based SBCs and peripherals in a platform	<ul style="list-style-type: none"> <li>• Allows operators to remotely monitor system health, individual sensor data, FRU data, and exert power-up/down control</li> </ul>

## COMPACTPCI COMPLIANT 6U PROCESSOR BOARDS


### Intel® NetStructure™ MPCBL5525 High Performance Processor Board

Designed for carrier-grade telecom and Internet applications requiring exceptional processing power from a single slot, this board offers configurable high availability, I/O expansion, 66 MHz CompactPCI bridging features and utilizes a split-transaction, deferred reply protocol. The 400 MHz processor side bus uses Source Synchronous Transfer (SST) of address and data to improve performance by transferring data four times per bus clock (4X data transfer rate, as in AGP 4X).

### Intel® NetStructure™ ZT 5524 High Performance System Master Processor Board

This high-performance processor board is designed for telecom and Internet applications requiring exceptional computing bandwidth, speed, and processing power. A 64-bit PCI bridge and high-speed CompactPCI bus drive up-to-seven peripheral boards at 33 MHz, or four at 66 MHz. The ZT 5524 board supports 2 GB ECC SDRAM, 4 MB onboard flash and onboard video.

### Intel® NetStructure™ ZT 5504 System Master Processor Board

This high-value Intel Pentium III processor-based board is designed for telecommunications and Internet applications requiring completely integrated processing solutions for increased performance and system reliability. It can also operate in a CompactPCI peripheral slot as a standalone single board computer (SBC). The board features a 100 MHz FSB with 64-bit/33 MHz CompactPCI bus interface, 512 MB or 1 GB ECC SDRAM, 4 MB onboard Flash and onboard video 

### Intel® NetStructure™ ZT 5515 Compute Processor Board

This Intel® Pentium® 4 processor-based board inherits the high reliability and robust physical characteristics of CompactPCI without a CompactPCI bus. Use of Intel's Gigabit ethernet technology for both dataplane and control-plane communication provides excellent price performance. The board features 1 GB ECC SDRAM, 16 MB onboard Flash, and onboard video.

#### COMPACTPCI\*-COMPLIANT PROCESSOR BOARDS

PRODUCT NUMBER	PRODUCT NAME	PROCESSOR	CHIPSET	COMPACTPCI* BUS INTERFACE	MEMORY	MANAGEMENT	CHASSIS COMPATIBILITY	EXTENDED OS SUPPORT	REFERENCE DESIGN AVAILABLE
MPCBL5525	High Performance Processor Board	Intel® Pentium® M processor, 1.6 GHz	Intel® E7501 chipset	64-bit, 33 MHz	DDR 200 SDRAM with ECC	IPMI-based BMC	ZT 5091, ZT 5088, ZT 5085, MPCHC5089D	Windows® XP, Windows® 2000, Windows NT® 4.0, Red Hat® Linux® 8.0, VxWorks®, MontaVista CGL*	No
ZT 5524	High Performance System Master Processor Board	Single or Dual Intel® Pentium® III processors, 933 MHz	ServerWorks® LE chipset	64-bit, 33/66 MHz	512 MB and 1 GB PC133 SDRAM	IPMI-based BMC	ZT 5090, ZT 5085, ZT 5088	Red Hat Linux, VxWorks, Windows 2000	Yes
ZT 5515	Compute Processor Board	Intel® Pentium® 4 Processor – M, 1.2 GHz	Intel® 845E chipset	No cPCI Bus Interface	256 MB, 512 MB, 1 GB and 1 GB+ ECC DDR SDRAM	IPMI-based BMC	ZT 5090, ZT 5085, ZT 5088	Red Hat Linux, VxWorks, Windows® 2000	Yes
ZT 5504	System Master Processor Board	Intel Pentium III processor— Low Power, 1.0 GHz (BGA2)	Intel® 440GX	64-bit/33 MHz	512 MB and 1 GB ECC SDRAM	IPMI-based BMC	ZT 5090, ZT 5085, ZT 5088	Red Hat Linux, VxWorks, Windows® 2000	No

#### COMPACTPCI\*-COMPLIANT PLATFORMS

These telecom building blocks from Intel provide OEM equipment designers with standards-based development solutions built on the PICMG 2.16 specification. In addition to high availability features, Intel® NetStructure™ platforms are highly modular, scalable, and extremely serviceable. Ethernet signals are routed across the midplane without the use of cables, saving time in set-up, maintenance and repair, and minimizing the thermal challenges of traditional cabling methods. Chassis management modules enable customers to manage multiple SBCs and conduct chassis diagnostics remotely for enhanced system reliability. Hot-swappable system components provide built-in redundancy to simplify replacement and minimize service time. Platforms include AC/DC power and are designed to the NEBS/ETSI and IPMI v1.5 standards.

### The Intel® NetStructure™ ZT 5085 12U Redundant Host Packet Switched Platform

This platform features a PICMG 2.16-compatible midplane to support redundant-host architecture for I/O-intensive applications, providing OEM equipment designers with a carrier-grade, standards based, high availability computing platform. It supports five-nines (99.999%) availability with built-in redundancy for active system components including Ethernet switches, chassis management modules, power supplies and fan trays.

### Intel® NetStructure™ ZT 5088 12U General Purpose Packet Switched Platform

This extremely flexible, high-availability platform is configurable for both compute-intensive and I/O-intensive applications, providing OEM equipment designers with carrier-grade, standards-based solutions. This high-capacity CompactPCI platform features innovative power and cooling. The ZT 5088 supports five-nines (99.999%) availability with built-in redundancy for active system components including Ethernet switches, chassis management modules, power supplies and fan trays.

### Intel® NetStructure™ ZT 5090 4U General Purpose Packet Switched Platform

This high-density CompactPCI platform features seven node slots and one integrated layer 2/3 Ethernet switch slot, transversely mounted in a 4U enclosure, making it ideal for carrier-grade telecom and Internet applications. Backplane interconnect speeds are user-definable and scalable from 10 Mbps to 2000 Mbps per node slot, allowing customers to start with a lower-cost, lower-speed set of components and upgrade as needed.



## Intel® NetStructure MPCHC5091 4U General Purpose Packet Switched Platform

This high density CompactPCI platform features seven node slots and one integrated layer 2/3 Ethernet switch slot, transversely mounted in a 4U enclosure, making it ideal for carrier-grade telecom and Internet applications.

## Intel® NetStructure™ MPCHC5089DC 12U General Purpose Packet Switched Platform

This extremely flexible platform is well-suited for the exacting requirements of modular communications infrastructure applications. It is designed for customers who demand high availability and low maintenance, but at the same time want to maximize processing density while minimizing hardware footprint and cost. It features built-in redundancy for active system components including Ethernet switches, chassis management modules, power supplies and fan trays.

### COMPACTPCI\*-COMPLIANT PLATFORMS

PRODUCT NUMBER	PRODUCT NAME	TOTAL SLOTS	SBC SLOTS (POWER/SLOT)	BUS SEGMENTATION	H.110 SUPPORT	TOTAL POWER	CHASSIS MANAGEMENT
ZT 5085	12U Redundant Host Packet Switched Platform	21*	2 (50W)	Two 64-bit, 33 MHz PCI segments (8,8) or (16)	12 slots	250W (N+N, N=4 redundancy)	2 modules included
ZT 5088	12U General Purpose Packet Switched Platform	21*	4 (50W)	Four 64-bit/66 MHz PCI segments (5,4,5,4) or (9,9)	None	250W (N+N, N=4 redundancy)	2 modules included
ZT 5090	4U General Purpose Packet Switched Platform	8**	2 (45W)	Two 32-bit/33 MHz or 64-bit/66 MHz PCI segments (4,3)	Peripheral slots on each segment; 5 total	250W (N+N, N=2)	1 module included
MPCHC5091	4U General Purpose Packet Switched Platform	8	7 (45W)	One 32/64-bit 33 MHz PCI segment	One segment, 6 total peripheral slots	Two 250W power supplies, AC or DC (N+1 support with optional third power supply)	1 dedicated chassis management slot (Optional CMM)
MPCHC5089DC	12U General Purpose Packet Switched Platform	21 6U slots†	Up to 50W per node slot	No CompactPCI bus	None	350W (N+N, N+4 redundancy)	2 modules included

\* Includes two dedicated Ethernet slots

\*\* Includes one dedicated Ethernet slot

† Includes 18 node slots, two fabric slots and two 3U chassis management slots

### COMPACTPCI\* COMPLIANT PLATFORM COMPONENTS

PRODUCT NUMBER	PRODUCT NAME	COMPATIBILITY	SIZE	FEATURES
ZT 4807	Rear-Panel Transition Board	ZT 5090 platform, ZT 5504 SBC	6U x 4HP	Routes all cabling out the back of a system; provides access to a secondary IDE channel, Com1 and 2 serial ports and a floppy disk drive
ZT 4901	I/O Mezzanine Expansion Card	ZT 5524 SBC, ZT 5090 platform	6U x 4HP	Provides two PMC sites, a dual optical Fibre Channel interface, and CompactPCI bridging at 33 or 66 MHz
ZT 6303	250W Hot Swap AC Power Supply	ZT 5090 platform	3U x 8HP x 160 mm	Extra high current density allows unit to deliver up to 40 amperes on either the +5 or +3.3 volt outputs at 50°C. This highly dense, hot swap, redundant supply is ideally suited for telecommunications, industrial automation and a variety of embedded computer applications
ZT 7102	Chassis Management Module	ZT 5090, ZT 5085 and ZT 5088 platforms	3U x 4HP	Reliable, comprehensive, standards-based management, utilizing the IPMI standard within a unique star topology to support very high-level management applications
ZT 8101	10/100 Ethernet Switch	ZT 5090 platform, ZT 5504 SBC	6U x 4HP	Easy-to-use browser/Web-based management console; routes and switches at full wire speed utilizing non-blocking architecture with sophisticated multicast protocols to limit unnecessary traffic; provides in-chassis switch fabric to operate in a redundant configuration
ZT 8102 ZT 8102HA	Ethernet Switch	ZT 5515 SBC, ZT 5085 and ZT 5088 platforms	6U x 4HP	Available in either a basic Layer 3 version (ZT 8102) or enhanced Layer 3 version (ZT 8102HA) with high-availability software stack and additional routing capabilities; 16 Gigabit Ethernet ports and Layer 3 routing capabilities; hardware-based wire speed L2 switching and L3 routing
ZT 96080	IDE CompactFlash* Carrier	ZT 5504, ZT 5515 and ZT 5524 SBCs	N/A	Drop-in storage alternative to a 2.5" IDE hard disk drive; allows customer to select preferred amount of CompactFlash

# Telecom Boards

## Intel offers a range of media processing b7

The Intel® Dialogic® System Release 5.1.1 Feature Pack 1 for Windows\* (SR 5.1.1 FP1), available from Intel, supports these new telecom products: Intel® Dialogic® DMV160LP Combined Media Board, Intel® Dialogic® CPI/400BRI PCI Fax Board, and the Intel® Dialogic® DISI16R2 and Intel® Dialogic® DISI24R2 switching boards. SR 5.1.1 FP1 also provides support for the following board enhancements: Intel® Dialogic® DI0408LSAR2, Intel® Dialogic® DI0408LSAR2EU, and Intel® Dialogic® DISI32R2 switching boards; Intel® NetStructure™ DM/IP IP boards; Intel® NetStructure™ DM/V combined media boards; and all products and features supported in the previous SR 5.1.1 release.

## Combined Media Processing Boards

### LOW-DENSITY COMBINED MEDIA PRODUCTS

#### DM3 Voice Processing and Analog Interface

Part of the next-generation of analog PCI boards, the Intel® Dialogic® DMV160LP Combined Media Board is a 16-port, PCI-based voice processing and analog interface board offering the enhanced capabilities a competitive communications market segment demands. Ideal for advanced computer telephony (CT)-based communications applications requiring multimedia resources, this high-performance, scalable board offers a rich set of advanced features and support for digital signal processing (DSP) technology and signal processing algorithms.

#### Resource with Analog Interface (JCT Boards)

The Intel® Dialogic® JCT boards are low-density products that provide a robust media feature set including voice processing, speech recognition, and fax capabilities. These boards with Spring Ware technology are available for the PCI form factor and are for developers seeking to rapidly build and globally deploy small to midrange enterprise solutions. The boards can be scaled from one to eight boards in a PC chassis for building systems up to 96 ports and provide a CT Bus connector, allowing for interoperability with other CT Bus/SCbus-compatible boards. Intel Dialogic JCT boards provide the ideal platform for today's unified messaging, voice mail, IVR, and contact center applications.

## Low-Density Analog Product Line Summary

The following table summarizes the low-density analog product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/mediaprocessing.htm>.

### DM3 VOICE PROCESSING AND ANALOG INTERFACE BOARD

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® DMV160LP</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Voice mail/voice messaging</li> <li>▪ IVR</li> <li>▪ Contact center</li> <li>▪ Dictation</li> </ul>	<b>DMV160LP</b>	<ul style="list-style-type: none"> <li>▪ 16 channels of voice processing</li> <li>▪ 16 analog loop start network interfaces</li> <li>▪ DM3 architecture</li> <li>▪ R4 API for media control</li> <li>▪ Supports simultaneous voice, fax, and Intel® Dialogic® Continuous Speech Processing Technology</li> <li>▪ Full-size, universal PCI form factor</li> <li>▪ Worldwide approvals in progress</li> <li>▪ DTMF detection</li> <li>▪ Call progress analysis</li> <li>▪ Advanced low bit rate coders, including TrueSpeech*</li> <li>▪ Up to eight boards per chassis</li> <li>▪ Support for Windows NT*, Windows* 2000, and Windows* XP operating systems</li> <li>▪ Four ports onboard DSP-based fax</li> <li>▪ H.100 connector (H.100 TDM Bus support)</li> <li>▪ CT Bus compatible (with SCbus support)</li> <li>▪ Global Call* support</li> <li>▪ Transaction record</li> </ul>

### RESOURCE WITH ANALOG INTERFACE (JCT BOARDS)

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® D/41JCT-LS</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Voice/fax mail</li> <li>▪ Voice portal</li> <li>▪ IVR</li> <li>▪ Contact center and e-Business</li> <li>▪ Dictation</li> <li>▪ Speech-enabled auto-attendant</li> </ul>	<b>D41JCTLS</b>	<ul style="list-style-type: none"> <li>▪ Four channels of enhanced voice (voice and speech recognition)</li> <li>▪ Four channels of fax</li> <li>▪ Four channels of analog loop start network interfaces</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ R4 API for media control</li> <li>▪ Up to eight boards per system</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis ensures reliability</li> <li>▪ A-law or <math>\mu</math>-law voice coding at dynamically selectable data rates</li> <li>▪ GSM and G.726 coding algorithms for support of Voice Profile for Internet Mail (VPIM) standard</li> <li>▪ Software development kits for Windows NT*, Windows* 2000, and Linux* operating systems yield faster time-to-market</li> <li>▪ Worldwide approvals for cost-effective expansion to serve global market segments</li> </ul>
<b>Intel® Dialogic® VFX/41JCT-LS</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Voice/fax mail</li> <li>▪ Voice portal</li> <li>▪ IVR</li> <li>▪ Contact center and e-Business</li> <li>▪ Fax-on-demand</li> </ul>	<b>VFX41JCTLS</b>	<ul style="list-style-type: none"> <li>▪ Four channels of enhanced voice (voice and speech recognition)</li> <li>▪ Four channels of analog loop start network interfaces</li> <li>▪ Same features and benefits as D/41JCT-LS plus four channels of enhanced fax capabilities</li> <li>▪ ITU-T T.4 Group III fax (T.4 and T.30) and ETSI NET/30 for send and receive operations</li> <li>▪ V.17 transmission (14.4 Kbps) for sending and receiving faxes</li> <li>▪ Software development kits for Windows NT, Windows 2000, and Linux operating systems yield faster time-to-market</li> </ul>
<b>Intel® Dialogic® D/120JCT-LS</b>	<b>D120JCTLS</b>	<ul style="list-style-type: none"> <li>▪ 12 channels of enhanced voice (voice, speech recognition)</li> <li>▪ 4 channels of fax</li> <li>▪ 12 channels of analog loop start network interfaces</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Same features and benefits as D/41JCT-LS</li> </ul>



# Voice Boards

## VOICE BOARDS

### Voice with Analog Interface

Low-density voice resource boards offer from four to 16 resources of voice processing and four to 16 channels of loop-start network interfaces on a single board. The four-channel products are half-size boards with no SCbus or CT Bus support and are available for the ISA and PCI form factors. The 16-channel product is an ISA board with SCbus support. All of these boards with Spring Ware technology are for small to midrange enterprise developers who require high-end features such as automatic gain control (AGC), caller ID, global dial pulse detection (GDPD), and international approvals. The boards can be scaled from one to 16 boards in a PC chassis for building systems up to 256 ports (depending on specific product and application limitations) and provide the ideal platform for today's unified messaging, voice mail, interactive voice response (IVR), and contact center applications.

### Low-Density Single Media Product Line Summary

The following table summarizes the low-density analog product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/mediaprocessing.htm>

## VOICE AND ANALOG LOOP-START INTERFACE BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® DIALOG/4</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Voice mail</li> <li>▪ Interactive voice response (IVR)</li> <li>▪ Contact center</li> </ul>	<b>DIALOG4</b>	<ul style="list-style-type: none"> <li>▪ Up to four channels of voice</li> <li>▪ Four analog loop start network interfaces</li> <li>▪ Half-size, ISA form factor</li> <li>▪ R4 API for media control</li> <li>▪ Voice coding at dynamically selectable data rates</li> <li>▪ DTMF detection and cut-through</li> <li>▪ AGC support</li> <li>▪ Up to 16 boards per chassis = 64 channels</li> <li>▪ Internationally approved</li> <li>▪ Software development kits for Windows NT*, Windows* 2000, and Linux* operating systems yield faster time-to-market</li> </ul>
<b>Intel® Dialogic® D/4PCI</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Voice mail</li> <li>▪ IVR</li> <li>▪ Contact center</li> </ul>	<b>D4PCI</b>	<ul style="list-style-type: none"> <li>▪ Four channels of voice</li> <li>▪ Four analog loop start network interfaces</li> <li>▪ Half-size, PCI form factor</li> <li>▪ R4 API for media control</li> <li>▪ Supports caller ID for intelligent call handling</li> <li>▪ Supports global dial pulse detection</li> <li>▪ Internationally approved</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis ensures reliability</li> <li>▪ TAPI/WAVE support</li> <li>▪ Up to 16 boards per chassis = 64 channels</li> <li>▪ Software development kits for Windows NT, Windows 2000, and Linux operating systems yield faster time-to-market</li> </ul>
<b>Intel® Dialogic® D/4PCIU</b>	<b>D4PCIU</b>	<ul style="list-style-type: none"> <li>▪ Same features and benefits as D/4PCI with universal connectivity (support for 3.3V and 5V signaling environments) with Intel® Dialogic® System Release V5.1 SP1 or higher</li> <li>▪ G.726 and GSM coders</li> </ul>

## VOICE AND ANALOG LOOP-START INTERFACE BOARDS (continued)

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® D/4PCIUF</b>	<b>D4PCIUF</b>	<ul style="list-style-type: none"> <li>Same features and benefits as D/4PCIU AND up to four channels of basic, DSP-based fax</li> </ul>
<b>Intel® Dialogic® D/160SC-LS</b> <ul style="list-style-type: none"> <li>Unified messaging</li> <li>Voice mail</li> <li>IVR</li> <li>Contact center</li> </ul>	<b>D160SCLSREV3</b>	<ul style="list-style-type: none"> <li>Up to 16 channels of voice</li> <li>16 loop-start telephone line interfaces</li> <li>ISA form factor</li> <li>R4 API for media control</li> <li>Voice coding at dynamically selectable data rates</li> <li>DTMF detection and cut-through</li> <li>AGC support</li> <li>Caller ID capability</li> <li>Up to 16 boards per chassis = 256 channels (may be limited by application)</li> <li>Software development kits for Windows NT*, Windows* 2000, Linux, and MS-DOS operating systems yield faster time-to-market</li> </ul>

## VOICE WITH DIGITAL PRI INTERFACE

### DM/V Voice Series

Intel® NetStructure™ DM/V voice boards are media platforms for developers looking to rapidly build and globally deploy high-density media server solutions for the enterprise and public networks. The boards are available with four digital PRI interfaces in addition to voice processing in either PCI or CompactPCI\* form factors.

### High-Density Single Media Product Line Summary

The following table summarizes the high-density single media product features. For more information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/mediaprocessing.htm>

## DM/V VOICE BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DM/V480-4T1-PCI</b>	<b>DMV4804T1PCIU</b>	<ul style="list-style-type: none"> <li>48–120 channels of basic voice</li> <li>Four digital network interfaces</li> <li>PCI or CompactPCI* form factor</li> <li>H.100 and H.110 compliant</li> <li>Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>Tone signaling</li> <li>Call progress analysis</li> <li>1200+ ports per chassis</li> <li>Software development kits for Windows NT*, Windows* 2000, and Linux* operating systems yield faster time-to-market</li> <li>R4 API for media control</li> <li>Unified call control access through Global Call* interface provides worldwide application portability and shortens development time</li> </ul>
<b>Intel® NetStructure™ DM/V480-4T1-CPCI</b>	<b>DMV4804T1CPCI</b>	
<b>Intel® NetStructure™ DM/V600-4E1-PCI</b>	<b>DMV6004E1PCIU</b>	
<b>Intel® NetStructure™ DM/V600-4E1-CPCI</b>	<b>DMV6004E1CPCI</b>	
<b>Intel® NetStructure™ DM/V960-4T1-PCI</b>	<b>DMV9604T1PCIU</b>	
<b>Intel® NetStructure™ DM/V960-4T1-CPCI</b>	<b>DMV9604T1CPCI</b>	
<b>Intel® NetStructure™ DM/V1200-4E1-PCI</b>	<b>DMV12004E1PCIU</b>	
<b>Intel® NetStructure™ DM/V1200-4E1-CPCI</b>	<b>DMV12004E1CPCI</b>	
<ul style="list-style-type: none"> <li>Messaging and enhanced services</li> <li>Contact center and e-Business</li> <li>PC-PBX</li> <li>Switching and call completion</li> <li>Prepaid/debit card</li> <li>Gateway switch</li> </ul>		

## HIGH-DENSITY COMBINED MEDIA PRODUCTS

### Resource Only (DM/V-B and DM/V-A Multifunction Resource Series)

When combined with a board containing digital network interfaces—such as the Intel® NetStructure™ DM/N or DM/T Digital Telephony Interface Board—Intel® NetStructure™ DM/V-B and DM/V-A combined media boards provide a powerful media platform for developers looking to rapidly build and globally deploy high-density media server solutions for the enterprise and public network market segments. The DM/V-A boards provide a rich solution with a robust media feature set and between 120 and 240 channels of media—including voice processing, speech recognition and conferencing, or fax capabilities—in either universal PCI or CompactPCI form factors. The DM/V-B boards build upon the features of the DM/V-A boards by adding universal media loads that offer simultaneous voice processing, speech recognition, fax, and conferencing; improved media densities (120 to 576 channels); and the ability to select three different types of conferencing media. Currently available in a universal PCI form factor, DM/V-B boards are supported by Intel® Dialogic® System Release Software 6.0 PCI for Windows\* (SR 6.0 PCI for Windows).

### Resource Only (JCT Shared Resource Series)

When combined with a board containing digital network interfaces—such as the Intel NetStructure DM/N or DM/T Digital Telephony Interface Board—the Intel® Dialogic® JCT combined media boards enable media platforms for developers looking to rapidly build high-density media server solutions for enterprise and service provider networks. The JCT boards support up to 32 channels of media including voice processing, fax capabilities, or—with SR6.0 PCI for Windows—speech recognition, in a universal PCI form factor.

### Resource with Onboard PRI Interface(s) (DM/V-B and DM/V-A Combined Media Boards)

Intel NetStructure DM/V-B and DM/V-A combined media boards are powerful media platforms for developers looking to rapidly build and globally deploy high-density media server solutions for the enterprise and public networks. The DM/V-A boards are available with either two or four digital PRI interfaces in either universal PCI or CompactPCI form factors and offer a rich solution with a robust media feature set that includes voice processing, speech recognition, and with the dual span boards, conferencing capabilities. The DM/V-B boards build upon the features of the DM/V-A boards by adding software-selectable T-1/E-1 interfaces; a universal media load that offers simultaneous voice processing, speech recognition, fax, and conferencing; improved media densities; the ability to mix select protocols; and the ability to select three different types of conferencing media. Currently available in a universal PCI form factor, DM/V-B boards are supported by SR6.0 PCI for Windows.

### Resource with Onboard PRI Interface(s) (JCT Single- and Dual-Span Boards)

Intel® Dialogic® JCT single- and dual-span combined media boards enable media platforms for developers looking to rapidly build high-density media server solutions for enterprise and service provider networks. Available with either one or two digital PRI interface(s) in a universal PCI form factor, the boards provide a media-rich environment that supports multiple media such as voice processing and in select instances, speech recognition or fax.

## High-Density Combined Media Product Line Summary

The following table summarizes the high-density combined media product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/mediaprocessing.htm>.

### DM/V-B COMBINED MEDIA BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DMV3600BP</b> <i>(Currently supported only on SR6.0 PCI for Windows)</i> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Color ring-back</li> <li>▪ Voice portal</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Audio conferencing server</li> <li>▪ Web conferencing</li> <li>▪ Fax server</li> <li>▪ Fax broadcast</li> </ul>	<b>DMV3600BP</b>	<ul style="list-style-type: none"> <li>▪ 360 channels of basic voice, or</li> <li>▪ 160–576 channels of conferencing, or</li> <li>▪ 120+ channels of simultaneous voice, speech recognition, conferencing, and fax (universal media load)</li> <li>▪ Three different levels and densities of conferencing to choose from</li> <li>▪ Select media loads with enhanced EC (up to 64ms echo tail length)</li> <li>▪ PCI form factor</li> <li>▪ H.100 compliant</li> <li>▪ Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis</li> <li>▪ 1200+ ports per chassis</li> <li>▪ Software development kits for Windows* 2000, Windows* 2003, Windows* XP and Linux* operating systems yield faster time-to-market</li> <li>▪ R4 API for media control</li> </ul>

### DM/V-A COMBINED MEDIA BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DM/V2400A-PCI</b> <b>Intel® NetStructure™ DM/V2400A-CPCI</b> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Color ring-back</li> <li>▪ Voice portal</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Audio conferencing server</li> <li>▪ Web conferencing</li> <li>▪ Fax server</li> <li>▪ Fax broadcast</li> </ul>	<b>DMV2400APCIU</b> <b>DMV2400ACPCI</b>	<ul style="list-style-type: none"> <li>▪ 240 channels of basic voice, or</li> <li>▪ 120-240 channels of conferencing, or</li> <li>▪ 120 channels of simultaneous voice and speech recognition, and 60–120 channels of conferencing, or</li> <li>▪ 120 channels of voice and speech recognition and 12–15 channels of fax</li> <li>▪ PCI or CompactPCI* form factor</li> <li>▪ H.100 and H.110 compliant</li> <li>▪ Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis</li> <li>▪ 1200+ ports per chassis</li> <li>▪ Software development kits that can include Windows NT*, Windows* 2000, Windows* 2003, Windows* XP and Linux* (depending on the specific system release) operating systems yield faster time-to-market</li> <li>▪ R4 API for media control</li> </ul>

**JCT COMBINED MEDIA BOARDS**

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® D/160JCT</b> <b>Intel® Dialogic® D/320JCT</b> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Voice Portal</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Fax server</li> <li>▪ Fax broadcast</li> </ul>	<b>D160JCT</b> <b>D320JCT</b>	<ul style="list-style-type: none"> <li>▪ 16 and 32 channels of voice, speech recognition or fax (speech recognition currently only on SR6.0 PCI for Windows)</li> <li>▪ PCI form factor</li> <li>▪ H.100 compliant</li> <li>▪ Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis</li> <li>▪ Up to six boards per chassis</li> <li>▪ Software development kits that can include Windows NT*, Windows* 2000, Windows* 2003, Windows* XP and Linux* (depending on the specific system release) operating systems yield faster time-to-market</li> <li>▪ R4 API for media control</li> </ul>

**DM/V-B COMBINED MEDIA BOARDS**

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DMV600BTEP</b> <i>(Currently supported only on SR6.0 PCI for Windows)</i> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Color ring-back</li> <li>▪ Voice portal</li> <li>▪ Contact center and e-Business I</li> <li>▪ PC-PBX</li> <li>▪ Audio conferencing server</li> <li>▪ Web conferencing</li> <li>▪ Switching and call completion</li> <li>▪ Prepaid/debit card</li> <li>▪ Gateway switch</li> <li>▪ Fax server</li> <li>▪ Fax broadcast</li> </ul>	<b>DMV600BTEP</b>	<ul style="list-style-type: none"> <li>▪ 60+ channels of simultaneous voice, speech recognition, conferencing, and fax (universal media load)</li> <li>▪ Two software-selectable digital network interfaces</li> <li>▪ Select media loads with enhanced EC (up to 64ms echo tail length)</li> <li>▪ PCI form factor</li> <li>▪ H.100 compliant</li> <li>▪ Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis</li> <li>▪ 1200+ ports per chassis</li> <li>▪ Software development kits for Windows* 2000, Windows* 2003, Windows* XP and Linux* operating systems yield faster time-to-market</li> <li>▪ R4 API for media control</li> <li>▪ Unified call control access through Global Call* interface provides worldwide application portability and shortens development time</li> <li>▪ Ability to mix select protocols for each span</li> </ul>
<b>Intel® NetStructure™ DMV1200BTEP</b> <i>(Currently supported only on SR6.0 PCI for Windows)</i> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Color ring-back</li> <li>▪ Voice portal</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Audio conferencing server</li> <li>▪ Web conferencing</li> <li>▪ Switching and call completion</li> <li>▪ Prepaid/debit card</li> <li>▪ Gateway switch</li> <li>▪ Fax server</li> <li>▪ Fax broadcast</li> </ul>	<b>DMV1200BTEP</b>	<ul style="list-style-type: none"> <li>▪ 120+ channels of simultaneous voice, speech recognition, conferencing, and fax (universal media load)</li> <li>▪ Four software-selectable digital network interfaces</li> <li>▪ Select media loads with enhanced EC (up to 64ms echo tail length)</li> <li>▪ PCI form factor</li> <li>▪ H.100 compliant</li> <li>▪ Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis</li> <li>▪ 1200+ ports per chassis</li> <li>▪ Software development kits for Windows 2000, Windows 2003, Windows XP and Linux operating systems yield faster time-to-market</li> <li>▪ R4 API for media control</li> <li>▪ Unified call control access through Global Call interface provides worldwide application portability and shortens development time</li> <li>▪ Ability to mix select protocols for each span</li> </ul>

## DM/V-A COMBINED MEDIA BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DM/V480A-2T1-PCI</b> <b>Intel® NetStructure™ DM/V480A-2T1-CPCI</b> <b>Intel® NetStructure™ DM/V600A-2E1-PCI</b> <b>Intel® NetStructure™ DM/V600A-2E1-CPCI</b> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Color ring-back</li> <li>▪ Voice portal</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Audio conferencing server</li> <li>▪ Web conferencing</li> <li>▪ Switching and call completion</li> <li>▪ Prepaid/debit card</li> <li>▪ Gateway switch</li> </ul>	<b>DMV480A2T1PCI</b> <b>DMV480A2T1CPCI</b> <b>DMV600A2E1PCI</b> <b>DMV600A2E1CPCI</b>	<ul style="list-style-type: none"> <li>• 48 and 60 channels of simultaneous voice and speech recognition, and 60 channels of conferencing</li> <li>• Two digital network interfaces</li> <li>• PCI or CompactPCI* form factor</li> <li>• H.100 and H.110 compliant</li> <li>• Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>• Tone signaling</li> <li>• Call progress analysis</li> <li>• 1200+ ports per chassis</li> <li>• Software development kits that can include Windows NT*, Windows* 2000, Windows* 2003, Windows* XP and Linux* (depending on the specific system release) operating systems yield faster time-to-market</li> <li>• R4 API for media control</li> <li>• Unified call control access through Global Call interface provides worldwide application portability and shortens development time</li> </ul>
<b>Intel® NetStructure™ DM/V960A-4T1-PCI</b> <b>Intel® NetStructure™ DM/V960A-4T1-CPCI</b> <b>Intel® NetStructure™ DM/V1200A-4E1-PCI</b> <b>Intel® NetStructure™ DM/V1200A-4E1-CPCI</b> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Color ring-back</li> <li>▪ Voice portal</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Switching and call completion</li> <li>▪ Prepaid/debit card</li> <li>▪ Gateway switch</li> </ul>	<b>DMV960A4T1PCI</b> <b>DMV960A4T1CPCI</b> <b>DMV1200A4E1PCI</b> <b>DMV1200A4E1CPCI</b>	<ul style="list-style-type: none"> <li>• 96 and 120 channels of voice and speech recognition</li> <li>• Four digital network interfaces</li> <li>• PCI or CompactPCI form factor</li> <li>• H.100 and H.110 compliant</li> <li>• Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>• Tone signaling</li> <li>• Call progress analysis</li> <li>• 1200+ ports per chassis</li> <li>• Software development kits that can include Windows NT, Windows 2000, Windows 2003, Windows XP and Linux (depending on the specific system release) operating systems yield faster time-to-market</li> <li>• R4 API for media control</li> <li>• Unified call control access through Global Call interface provides worldwide application portability and shortens development time</li> </ul>

**JCT SINGLE- AND DUAL-SPAN BOARDS**

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<p><b>Intel® Dialogic® D/240JCT-T1</b>  <b>Intel® Dialogic® D/480JCT-1T1</b>  <b>Intel® Dialogic® D/300JCT-E1-75</b>  <b>Intel® Dialogic® D/300JCT-E1-120</b>  <b>Intel® Dialogic® D/600JCT-1E1-75</b>  <b>Intel® Dialogic® D/600JCT-1E1-120</b></p> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Voice portal</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Switching and call completion</li> <li>▪ Prepaid/debit card</li> <li>▪ Gateway switch</li> <li>▪ Fax server</li> <li>▪ Fax broadcast</li> </ul>	<p><b>D240JCTT1R2U</b>  <b>D480JCT1T1U</b>  <b>D300JCTE175R2U</b>  <b>D300JCTE1120R2U</b>  <b>D600JCT1E175U</b>  <b>D600JCT1E1120U</b></p>	<ul style="list-style-type: none"> <li>▪ 24 and 30 channels of voice, speech recognition or fax</li> <li>▪ One digital network interface</li> <li>▪ PCI form factor</li> <li>▪ H.100 compliant</li> <li>▪ Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis</li> <li>▪ Up to 16 boards per chassis</li> <li>▪ Software development kits that can include Windows NT*, Windows* 2000, Windows* 2003, Windows* XP and Linux* (depending on the specific system release) operating systems yield faster time-to-market</li> <li>▪ R4 API for media control</li> <li>▪ Unified call control access through Global Call* interface provides worldwide application portability and shortens development time</li> </ul>
<p><b>Intel® Dialogic® D/480JCT-2T1</b>  <b>Intel® Dialogic® D/600JCT-2E1-75</b>  <b>Intel® Dialogic® D/600JCT-2E1-120</b></p> <ul style="list-style-type: none"> <li>▪ Messaging and enhanced services</li> <li>▪ Wireless and fixed-line short message service (SMS)</li> <li>▪ Contact center and e-Business</li> <li>▪ PC-PBX</li> <li>▪ Switching and call completion</li> <li>▪ Prepaid/debit card</li> <li>▪ Gateway switch</li> </ul>	<p><b>D480JCT2T1R2U</b>  <b>D600JCT2E175R2U</b>  <b>D600JCT2E1120R2U</b></p>	<ul style="list-style-type: none"> <li>▪ 48 and 60 channels of voice, speech recognition or fax</li> <li>▪ Two digital network interfaces</li> <li>▪ PCI form factor</li> <li>▪ H.100 compliant</li> <li>▪ Universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ Tone signaling</li> <li>▪ Call progress analysis</li> <li>▪ Up to 10 boards per chassis</li> <li>▪ Software development kits that can include Windows NT, Windows 2000, Windows 2003, Windows XP and Linux (depending on the specific system release) operating systems yield faster time-to-market</li> <li>▪ R4 API for media control</li> <li>▪ Unified call control access through Global Call interface provides worldwide application portability and shortens development time</li> </ul>

# Fax Boards

## LOW-DENSITY FAX PRODUCTS

### Intel® Dialogic® CPi/200-B2 and CPi/400-B2 Fax Boards

The Intel® Dialogic® CPi/200-B2 and CPi/400-B2 fax boards are ideal solutions for computer-based fax installations requiring PCI compatibility and V.34 fast transmission mode. Designed to optimize network-based fax servers and customized applications, they have two (CPi/200-B2 PCI board) or four (CPi/400-B2 PCI board) telephone line interface circuits approved for direct connection to analog loop-start lines. An onboard switch can be set to a unique board number for each board within a multi-board configuration. Install multiple CPi/200-B2 or CPi/400-B2 PCI boards in a single PC chassis to create cost-effective systems scalable up to 16 ports.

### Intel® Dialogic® CPi/400BRI PCI Fax Board

The Intel® Dialogic® CPi/400BRI PCI fax board is a single-slot, medium-density fax board that supports four ports of feature-rich fax capabilities plus two integrated, onboard, digital BRI network interfaces.

The CPi/400BRI PCI four-port ISDN BRI fax board was developed to meet the fax needs of countries widely using ISDN BRI as the preferred communications network such as European countries and Australia, Japan, New Zealand, and South Africa. This flexible, scalable solution incorporates computer-based fax into the ISDN environment, with a universal PCI form factor for maximum compatibility with the latest servers.

### Low-Density Fax Product Line Summary

The following table summarizes the low-density fax product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/mediaprocessing.htm#fb>.

## CPI/200-B2 AND CPI/400-B2 FAX BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® CPi/200-B2</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax server</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>CPI200B2</b>	<ul style="list-style-type: none"> <li>▪ Two fax resources</li> <li>▪ PCI form factor</li> <li>▪ Onboard, on-the-fly MH, MR, MMR compressions</li> <li>▪ API support for the GDK/GRT</li> <li>▪ Simultaneous V.34 transmission (33.6 Kbps), both transmit and receive</li> <li>▪ Up to four boards per chassis = up to eight channels</li> </ul>
<b>Intel® Dialogic® CPi/400-B2</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax server</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>CPI400B2</b>	<ul style="list-style-type: none"> <li>▪ Four fax resources</li> <li>▪ PCI form factor</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ API support for the GDK/GRT</li> <li>▪ Simultaneous V.34 transmission (33.6 Kbps), both transmit and receive</li> <li>▪ Up to four boards per chassis = up to 16 channels</li> </ul>



## INTEL® DIALOGIC® CPI/400BRI PCI FAX BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® CPI/400BRI PCI</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax server</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>CPI400BRIPCI</b>	<ul style="list-style-type: none"> <li>▪ Four fax resources</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ ISDN BRI network interface</li> <li>▪ API support for the GDK/GRT</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ TBR3 compliant</li> <li>▪ ITU T.30, T.4, T.6 compliance</li> </ul>

## HIGH-DENSITY FAX PRODUCTS

### Fax Resource Only (DM/F Fax Boards)

These fax resource products offer 24 or 30 resources of full-featured fax on a single board. This includes the Intel® NetStructure™ DM/F240-PCIU, Intel® NetStructure™ DM/F240-CPCI, Intel® NetStructure™ DM/F300-PCIU, and Intel® NetStructure™ DM/F300-CPCI fax boards. The products are available for the PCI or CompactPCI\* form factor. These boards give fax-intensive applications robust processing power and messaging flexibility. Users can make the most of a span of either 24 or 30 ports of feature-rich fax capabilities on a single board, deploying fewer boards per chassis and, ultimately, fewer and smaller chassis overall. This lowers the cost of ownership and enables more end users to deploy CT applications. Up to eight DM/F fax boards (up to 196 or 240 ports of fax) can be combined in a single chassis.

*As an alternative, developers can choose the Intel® Dialogic® CPi/2400-PCIU and Intel® Dialogic® CPi/3000-PCIU fax resource only boards, which are programmed through the legacy Gamma Link API only.*

### Fax Resource with Onboard PRI Interface (High-Density Fax Boards)

The high-density, single-slot hardware Intel® NetStructure™ DM/F240-1T1-PCIU and Intel® NetStructure™ DM/F300-1E1-PCIU fax boards are high-capacity fax boards that are useful for large-scale deployments of fax-enabled applications. The boards let users make the best use of a span of either 24 or 30 ports of feature-rich fax capabilities, plus an integrated network interface, on a single board. The increased resource density on the DM/F240-1T1-PCIU and DM/F300-1E1-PCIU fax boards lowers per-port costs, since customers can deploy fewer boards per chassis, and, ultimately, fewer and smaller chassis overall. Up to eight DM/F fax boards (up to 196 or 240 ports of fax) can be combined in a single chassis.

*As an alternative, developers can choose the Intel® Dialogic® CPi/2400-1T1-PCIU and Intel® Dialogic® CPi/3000-1E1-PCIU fax boards, which are programmed through the legacy Gamma Link API only.*

### Fax and Voice Resource with Onboard PRI Interface (DM3 VFN Boards)

The Intel® NetStructure™ DMVF240-1T1-PCIU and Intel® NetStructure™ DMVF300-1E1-PCIU fax boards provide a highly integrated platform with 24 or 30 universal ports of voice, fax, and digital network interface. Offering a universal set of voice, fax, tone resources, and network interface in a 1:1:1:1 ratio, available on any call at any time, these boards are ideal for developers looking to provide cost-effective, highly scalable, high-density communications applications that require multimedia in a single PCI slot. Create high-density, multimedia solutions that support from 24 to 192 T-1 or 30 to 240 E-1 channels per chassis.

## High-Density Fax Product Line Summary

The following table summarizes the high-density fax product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/mediaprocessing.htm#fb>

### FAX RESOURCE ONLY BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DM/F240-PCIU</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMF240PCIU</b>	<ul style="list-style-type: none"> <li>▪ 24 fax resources</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ R4 API</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 196 channels</li> <li>▪ Windows* and Linux* operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>
<b>Intel® NetStructure™ DM/F300-PCIU</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMF300PCIU</b>	<ul style="list-style-type: none"> <li>▪ 30 fax resources</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ R4 API</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 240 channels</li> <li>▪ Windows and Linux operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>
<b>Intel® NetStructure™ DM/F240-CPCI</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMF240CPCI</b>	<ul style="list-style-type: none"> <li>▪ 24 fax resources</li> <li>▪ CompactPCI* form factor</li> <li>▪ R4 API</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 196 channels</li> <li>▪ Windows and Linux operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>
<b>Intel® NetStructure™ DM/F300-CPCI</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMF300CPCI</b>	<ul style="list-style-type: none"> <li>▪ 30 fax resources</li> <li>▪ CompactPCI form factor</li> <li>▪ R4 API</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 240 channels</li> <li>▪ Windows and Linux operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>

## FAX RESOURCE WITH ONBOARD PRI INTERFACE BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DM/F240-1T1-PCIU</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMF2401T1PCIU</b>	<ul style="list-style-type: none"> <li>▪ 24 fax resources</li> <li>▪ Onboard T-1 network interface (ISDN, T-1 CAS)</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ R4 API for fax, Global Call* for call control</li> <li>▪ Fully exportable fax resources</li> <li>▪ Onboard on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 196 channels</li> <li>▪ Windows* and Linux* operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>
<b>Intel® NetStructure™ DM/F300-1E1-PCIU</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMF3001E1PCIU</b>	<ul style="list-style-type: none"> <li>▪ 30 fax resources</li> <li>▪ Onboard E-1 network interface (ISDN, R2 MF)</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ R4 API for fax, Global Call for call control</li> <li>▪ Fully exportable fax resources</li> <li>▪ Onboard on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 240 channels</li> <li>▪ Windows and Linux operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>

## FAX AND VOICE RESOURCE WITH ONBOARD PRI INTERFACE BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DMVF240-1T1-PCIU</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Voice response servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMVF2401T1PCIU</b>	<ul style="list-style-type: none"> <li>▪ 24 fax resources and 24 voice resources</li> <li>▪ Play voice, record voice prompts</li> <li>▪ Onboard T-1 network interface (ISDN, T-1 CAS)</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ R4 API for fax and voice, Global Call* for call control</li> <li>▪ Fully exportable fax and voice resources</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 196 channels</li> <li>▪ Windows and Linux operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>
<b>Intel® NetStructure™ DMVF300-1E1-PCIU</b> <ul style="list-style-type: none"> <li>▪ Unified messaging</li> <li>▪ Fax servers</li> <li>▪ Voice response servers</li> <li>▪ Fax-on-demand</li> <li>▪ Fax broadcast</li> </ul>	<b>DMVF3001E1PCIU</b>	<ul style="list-style-type: none"> <li>▪ 30 fax resources and 30 voice resources</li> <li>▪ Play voice, record voice prompts</li> <li>▪ Onboard E-1 network interface (ISDN, R2 MF)</li> <li>▪ PCI form factor, universal connectivity (support for 3.3V and 5V signaling environments)</li> <li>▪ R4 API for fax and voice, Global Call for call control</li> <li>▪ Fully exportable fax and voice resources</li> <li>▪ Onboard, on-the-fly MH, MR, and MMR compression</li> <li>▪ Error Correction Mechanism (ECM)</li> <li>▪ V.17 transmission (14.4 Kbps)</li> <li>▪ Up to eight boards per chassis = 240 channels</li> <li>▪ Windows* and Linux* operating system support</li> <li>▪ All features available on all channels, regardless of load</li> <li>▪ ITU T.30, T.4 compliance</li> </ul>

# Digital Telephony Interface Boards

## INTEL® NETSTRUCTURE™ DMN160TEC DIGITAL TELEPHONY INTERFACE BOARD

The Intel® NetStructure™ DMN160TEC Digital Telephony Interface Board is a high-density, digital telephone interface on a CompactPCI\* form factor. Supporting up to 480 ports and 16 spans, the board is programmable as T-1, E-1, or a mix of both (in units of four) and fully compatible with other CompactPCI media processing and IP resource boards available from Intel.

The DMN160TEC board offers developers a single, flexible product that supports worldwide network interfaces. Programmable on the fly, it effectively lets solutions scale as system requirements grow. The DMN160TEC board is H.110 compliant and supports the switching of voice paths over CT Bus time slots to use resources on other boards. High density and multiple features mean fewer boards and a smaller chassis, which helps developers keep up with the growing demands placed on next-generation platforms.

### Digital Telephony Interface Product Line Summary

The following table summarizes the digital telephony interface product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/signaling.htm#dtib>.

## DMN AND DMT DIGITAL TELEPHONY INTERFACE BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ DMN160TEC</b> <ul style="list-style-type: none"> <li>▪ Switching/call completion</li> <li>▪ Network contact center</li> <li>▪ Prepaid/debit card</li> <li>▪ Gateway switch</li> </ul>	<b>DMN160TEC</b>	<ul style="list-style-type: none"> <li>▪ 16 software-selectable T-1 or E-1 digital network interfaces (groups of four)</li> <li>▪ CompactPCI* form factor</li> <li>▪ H.110 compliant</li> <li>▪ Onboard law conversion</li> <li>▪ Ability to simultaneously run multiple ISDN protocols</li> <li>▪ Software development kits for Windows* 2000 and Linux* operating systems yield faster time-to-market</li> <li>▪ Unified call control access through Global Call* interface provides worldwide application portability and shortens development time</li> </ul>

# IP Boards

## DM/IP BOARDS

Intel® NetStructure™ DM/IP boards offer a standards-based software and hardware development platform for building IP-based communications servers for the next-generation enterprise and service provider Ethernet network. Intel® DM/IP boards feature 24 to 60 ports per slot of both public network and Internet connectivity, plus onboard voice and fax processing. The DM/IP boards readily scale to support 480-port call completion applications such as access gateways and IP-PBXs and media server applications such as unified messaging, interactive voice response (IVR), customer relationship management (CRM).

DM/IP boards offers many optimized, low-bandwidth vocoder algorithms for transmitting high-quality audio over an IP network including ITU-T G.711, G.723.1, G.729a, ITU GSM, and real-time fax over IP (ITU T.38). These algorithms use a variety of coding techniques, bit rates, and frame sizes to compress audio for managing data network bandwidth. The wide algorithm support of the boards provides the ability to deploy IP-based applications globally, tailoring them to specific network bandwidth and voice quality requirements.

DM/IP boards offer improved quality of service (QoS) performance over IP networks. Threshold alarms alert an application when network QoS parameters (jitter, latency, and packet loss) deteriorate below user-administered levels. These alarms help to improve traffic engineering, allowing more efficient use of IP networks. They also enable dynamic decision-making, which lets IP calls be rerouted onto the PSTN in the event of network congestion. IP packets carrying real-time voice and fax can be routed with higher priority by setting IP Precedence bits.

The boards feature a flexible approach to IP call control, letting a developer choose from any of the call control stacks supported by H.323, MGCP, and SIP, or providing the ability to develop or port another by offering call control management that resides on the server host instead of being embedded on the board. Support for standard signaling protocols enables the DM/IP boards to interoperate with a wide range of popular IP phones including Microsoft NetMeeting\* and the PingTel\* Phone. DM/IP boards also work seamlessly with terminals that are compliant with H.323, MGCP, H.248, and SIP. With the introduction of a SIP-based phone client on Windows XP desktop software, DM/IP boards enables fast, cost-effective deployment of IP phone service in the enterprise.

In addition to these leading IP voice networking features, DM/IP boards also provide a true universal port solution with a robust media feature set including voice processing and fax capabilities. These boards also support an extensive suite of PSTN digital network interfaces and globally approved signaling protocols all in a single PCI or CompactPCI\* slot. All of these features combined make Intel NetStructure DM/IP boards among the most powerful media processing platforms bridging legacy networks and communications solutions to the next-generation Internet.

### DM/IP IP Board Product Line Summary

The following table summarizes the DM/IP board product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/signaling.htm#ipb>

## DM/IP IP BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™</b> <b>DM/IP241-1T1-PCI-100BT</b> <ul style="list-style-type: none"> <li>▪ IP-based unified messaging</li> <li>▪ Interactive voice response (IVR) services</li> <li>▪ Web CRM centers and help desks</li> <li>▪ Debit/calling card applications</li> <li>▪ Voice portals</li> <li>▪ Fax over Internet Protocol (FoIP)</li> <li>▪ Access gateway</li> <li>▪ IP PBX</li> </ul>	<b>DMIP241T1P100</b>	<ul style="list-style-type: none"> <li>▪ Up to 24 voice resources</li> <li>▪ Full-size, PCI form factor</li> <li>▪ Vocoder: G.723.1, G.729a, G.711, GSM</li> <li>▪ T.38 real-time FoIP</li> <li>▪ Host-based call control</li> <li>▪ R4 and Global Call* control APIs</li> <li>▪ QoS: IP Precedence/Type of Service (TOS)</li> </ul>

**Intel® NetStructure™****DM/IP301-1E1-PCI-100BT**

- IP-based unified messaging
- IVR services
- Web CRM centers and help desks
- Debit/calling card applications
- Voice portals
- Fax over Internet Protocol (FoIP)
- Access gateway
- IP PBX

**Intel® NetStructure™****DM/IP481-2T1-PCI-100BT****Intel® NetStructure™****DM/IP481-2T1-CPCI-100BT**

- IP-based unified messaging
- Web CRM centers and help desks
- Debit/calling card applications
- Voice portals
- FoIP
- Access gateway
- IP PBX

**Intel® NetStructure™****DM/IP601-2E1-PCI-100BT****Intel® NetStructure™****DM/IP601-2E1-CPCI-100BT**

- IP-based unified messaging
- IVR services
- Web CRM centers and help desks
- Debit/calling card applications
- Voice portals
- FoIP
- Internet gateways for toll bypass (Voice and Fax over IP)
- Access gateway
- IP PBX

**Intel® NetStructure™****DM/IP601-CPCI-100BT**

- IP-based unified messaging
- IVR services
- Web CRM centers and help desks
- Debit/calling card applications
- Voice portals
- FoIP
- Internet gateways for toll bypass (Voice and Fax over IP)
- Access gateway
- IP PBX

**DMIP301E1P100**

- Up to 30 voice resources
- Full-size, PCI form factor
- Vocoders: G.723.1, G.729a, G.711, GSMs
- T.38 real-time FOIP
- Host-based call control
- R4 and Global Call control APIs
- QoS: IP Precedence/TOS

**DMIP4812T1P100****DMIP4812T1C100**

- Up to 48 voice resources
- Full-size, PCI and CompactPCI\* form factors
- Vocoders: G.723.1, G.729a, G.711, GSM
- T.38 real-time FOIP
- IVR services
- R4 and Global Call control APIs
- Host-based call control
- QoS: IP Precedence/TOS
- CompactPCI high availability

**DMIP6012E1P100****DMIP6012E1C100**

- Up to 60 voice resources
- Full-size, PCI and CompactPCI form factors
- Vocoders: G.723.1, G.729a, G.711, GSM
- T.38 real-time FOIP
- Host-based call control
- R4 API
- QoS: IP Precedence/TOS

**DMIP601C100BT**

- Up to 60 voice resources
- Full-size, CompactPCI form factor
- Vocoders: G.723.1, G.729a, G.711, GSM
- T.38 real-time FOIP
- Host-based call control
- R4 API
- G.711 multicast
- QoS: IP Precedence/TOS
- CompactPCI high availability
- Conferencing

## IPT PRODUCTS

### Intel® NetStructure™ IPT Boards

Intel® NetStructure™ IPT boards are among the industry's highest-density standards-based VoIP interface boards for developing scalable, carrier-grade IP telephony gateways and media servers. There are four IPT models, differentiated by the number and type of IP channels per PC slot.

- IPT1200C—120 channels of any coder
- IPT4800C—480 channels of any coder
- IPT6720C—672 channels of any coder
- IPT2400C—240 channels of any coder

IPT boards are optimized to deliver the most popular IP-based solutions for the public network and the enterprise. They easily scale to support thousands of channels in media gateway, media server, IP-PBX, and IP contact center solutions. Offering the choice of between 120 and 672 channels per slot, IPT boards interoperate in a broad suite of PSTN signaling and media processing boards for developing open systems solutions.

Intel NetStructure IPT boards offer many optimized, low-bandwidth vocoder algorithms for transmitting audio over an IP network, including ITU-T G.711, G.723.1+a, and G.729a+b. These algorithms use a variety of coding techniques, bit rates, and frame sizes to compress audio for managing data network bandwidth. Frame sizes as small as 5 ms are supported for some of the highest voice-quality IP telephony available on the market today. The wide algorithm support lets developers deploy IP-based applications for the diverse requirements of the modular network.

Besides powerful transcoding capabilities, other standard features include high-performance echo cancellation up to 64 ms, RFC-2833 support for tone detection and pass-through capabilities, and T.38 fax relay support for developing high-performance solutions. In addition, the boards support high quality of service through quality monitoring (QM) features including IP precedence for setting traffic priority, voice activity detection (VAD) and silence suppression for reducing the number of packets in a link and lower bandwidth utilization, packet loss recovery, and jitter buffer management compensating for latency (resulting in high voice quality). Intel NetStructure IPT boards let developers deploy competitive, feature rich, carrier-grade IP telephony solutions.

### IPT Boards Product Line Summary

The following table summarizes the IPT board product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/signaling.htm#ipb>

## IPT BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ IPT1200C</b>	<b>IPT1200C</b>	<ul style="list-style-type: none"> <li>▪ Choice of 120-, 240-, 480-, and 672-port low-bit-rate vocoder port configurations</li> <li>▪ Broad choice of vocoders (G.711, G.723.1+a, G.729a+b)</li> <li>▪ SIP, H.323, MGCP, MEGACO signaling</li> <li>▪ H.110-compliant 8 MHz CT Bus</li> <li>▪ Dual 1000BaseT, 100BaseTX network interface</li> <li>▪ Windows NT*/Windows* 2000 operating system compatible</li> <li>▪ Global Call* API for call control</li> <li>▪ CompactPCI* form factor</li> </ul>
<b>Intel® NetStructure™ IPT2400C</b>	<b>IPT2400C</b>	
<b>Intel® NetStructure™ IPT4800C</b>	<b>IPT4800C</b>	
<b>Intel® NetStructure™ IPT6720C</b>	<b>IPT6720C</b>	
<ul style="list-style-type: none"> <li>▪ IP media gateway and media servers</li> <li>▪ IP-enabled contact centers</li> <li>▪ Enhanced service platforms</li> <li>▪ IP-enabled voice portals</li> </ul>		

# Call Logging Boards

Intel offers a wide breadth of products in the call logging and contact center market segments. The Intel® Dialogic® line-tapping boards are for digital- and analog-based enterprises in the call recording industry. By providing a high-impedance line tap of stations and/or trunks, these PCI- and ISA-compatible boards provide transparent access to specific call information. They provide for voice recording in environments where logging is required by law or is desired to reduce liability and resolve disputes. Developers can create medium to large quality assurance (QA) and call logging systems with a powerful set of features and functionalities including low-bit-rate coders. Quality and stability help to make Intel a vendor of choice for call logging and QA hardware.

## Analog HiZ Line-Tapping Board

The Intel® Dialogic® DMV160LPHiZ Line-Tapping Board contains a rich set of advanced features, including digital signal processing (DSP) technology and signal processing algorithms for building the core of any computer telephony (CT) call logging system. The DMV160LPHiZ board provides 16 channels of call processing interfaces in a single PC slot. A unique dual-processor architecture comprised of DSPs and a general-purpose microprocessor handles all telephony signaling and performs all DTMF (touchtone) and audio/voice signal-processing tasks. The DMV160LPHiZ board connects to 16 analog telephone channels, detects touchtones, and digitizes, compresses, and records voice signals.

Use the DMV160LPHiZ board to develop sophisticated, multifunction CT systems incorporating capabilities such as voice processing, speech recognition, and text-to-speech (TTS).

## Digital Station Set HiZ Line-Tapping Board

Intel® Dialogic® DSLT/162CT-U-HiZ Line-Tapping Board is a 16-port high-impedance line-tap PCI board for digital station sets that records up to 128 simultaneous conversations via separate DSPs and provides voice and digital telephone display data. Highly scalable, this board can access and record all digital agent lines regardless of the contact center's size.

This digital set line-tapping (DSLТ) board provides quality assurance for the call recording industry by providing constant line access to proprietary PBX digital agent telephones and capturing information essential to the effective management of large contact centers. The DSLT board is an internal, PC-based solution that provides a physical tap of an agent's telephone, capturing the required information and providing access to the necessary call information. While the link is transparent to the parties involved in the connection, it permits extraction of signaling/protocol information from the network interface. The DSLT board is strictly a passive device monitoring existing connections between the PBX and the digital telephone set. The board uses a transparent, electrical coupling to the link that connects the telephone to the PBX. No PBX conference bridge resources are required.

Compatible with Avaya\* (formerly Lucent\*), NEC\*, Nortel\*, and Siemens\* PBXs, the DSLT board provides 16 ports, with a maximum of 128 ports per chassis. The DSLT Software Development Kit (SDK), available for Windows NT\* and Windows\* 2000 operating systems, includes advanced diagnostic and field troubleshooting capabilities.

## Digital T-1 HiZ Line-Tapping Board

The Intel® Dialogic® DM/V480-2T1-PCI-HiZ Line-Tapping Board provides a powerful set of features that developers can use to create quality assurance and call logging systems. Offered in a single-slot PCI format, this digital HiZ board provides 48 ports of call recording capability for two T-1 (1.544 Mb/s) digital interfaces.

Powerful DSPs provide a rich set of voice processing features, including various rates of voice compression, recording, telephony tone signaling, and reliable DTMF detection. The digital T-1 HiZ board is based on the DM3 architecture, which provides an environment that accelerates application development and provides a path for future growth. Software development kits (SDK) are available for Windows NT and Windows 2000 operating systems. This digital T-1 HiZ board is accompanied by software that monitors trunk signaling to determine the moment a call is setup, connected, and disconnected. This information is then used to determine when to start recording the call, as well as collect Automatic Number Identification (ANI) and Dialed Number Identification Service (DNIS). ISDN signaling is supported.



Voice processing features, downloaded to the onboard DSPs at power up, let the digital T-1 HiZ board record voice messages from the calling and called parties. Messages can be stored using G.711  $\mu$ -law or A-law PCM, at a rate of 64 Kb/s, as is used by the public telephone network. To reduce storage requirements, voice-coding algorithms can compress recordings to 24 Kb/s or 32 Kb/s, using adaptive differential pulse code modulation (ADPCM). Other standards-based low-bit-rate coders like G.276 for VPIM-compliant applications and GSM for unified messaging applications are also available.

### Digital E-1 HiZ Line-Tapping Board

The Intel® Dialogic® DM/V600-2E1-PCI-HiZ Line-Tapping Board provides a powerful set of features that developers can use to create quality assurance and call logging systems. Offered in a single-slot PCI format, this digital HiZ board provides 60 ports of call recording capability for two E-1 (2.048 Mb/s) digital interfaces.

Powerful DSPs provide a rich set of voice processing features, including various rates of voice compression, recording, telephony tone signaling, and reliable DTMF detection. The digital E-1 HiZ board is based on the DM3 architecture, which provides an environment that accelerates application development and provides a path for future growth. SDKs are available for Windows NT and Windows 2000 operating systems.

Voice processing features, downloaded to the onboard DSPs at power up, let the digital E-1 HiZ board record voice messages from the calling and called parties. Messages can be stored using G.711  $\mu$ -law or A-law PCM, at a rate of 64 Kb/s, as is used by the public telephone network. To reduce storage requirements, voice-coding algorithms can compress recordings to 24 Kb/s or 32 Kb/s, using ADPCM. Other standards-based low-bit-rate coders like G.276 for VPIM-compliant applications and GSM for unified messaging applications are also available.

### Call Logging Product Line Summary

The following table summarizes the call logging product application features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/signaling.htm#tbl>

#### CALL LOGGING BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® DSLT/162CT-U-HIZ</b> <b>Digital Station Set HiZ line tap</b> <ul style="list-style-type: none"> <li>Contact center/quality assurance</li> <li>Call logging/recording environments</li> </ul>	<b>DSL162CTUHIZ</b>	<b>DSL key features</b> <ul style="list-style-type: none"> <li>Taps proprietary digital PBX station sets</li> <li>16 ports</li> <li>PCI form factor</li> <li>128 ports per chassis</li> <li>Records up to 128 simultaneous conversations</li> <li>H.100 compatible</li> <li>Windows NT*/Windows* 2000 operating system compatible</li> <li>Drivers available in the Intel® Dialogic® System Release Software</li> </ul>
<b>Intel® Dialogic® DM/V480-2E1-PCI-HIZ</b> <b>Intel® Dialogic® DM/V600-2E1-PCI-HIZ</b> <b>Digital T-1 HiZ line tap board</b> <b>Digital E-1 HiZ line tap board</b> <ul style="list-style-type: none"> <li>Contact center/quality assurance</li> <li>Call logging/recording environments</li> </ul>	<b>DMV480T1PCIHIZ</b> <b>DMV6002E1PCIHIZ</b>	<b>T-1/E-1 key features</b> <ul style="list-style-type: none"> <li>48 T-1 or 60 E1 ports per board</li> <li>Universal PCI form factor</li> <li>Built on DM3 media stream architecture</li> <li>Signal monitoring</li> <li>Dual interface—two digital network interfaces for each digital trunk tapped</li> <li>Audio interface detects call progress and DTMF tones for host application</li> <li>H.100 compatible</li> <li>Global tone detection</li> <li>R4 API</li> <li>Call logging API with GUI</li> </ul>
<b>Intel® Dialogic® DMV160LPHIZ</b> <b>Analog HiZ line tap board</b> <ul style="list-style-type: none"> <li>Contact center/quality assurance</li> <li>Call logging/recording environments</li> </ul>	<b>DMV160LPHIZ</b>	<ul style="list-style-type: none"> <li>16 ports of voice processing and 16 ports analog high-impedance interface</li> <li>PCI form factor</li> <li>Downloadable signal and call processing firmware</li> <li>Onboard DSP</li> <li>H.100 compatible</li> </ul>

# PBX Integration Boards

Private branch exchange (PBX) integration boards let developers of voice mail, unified messaging, auto-attendant, and interactive voice response (IVR) solutions build sophisticated enterprise applications that maximize the advanced digital features of the PBX such as calling party identification; called party identification; message waiting lamp control; and fast, reliable transfers.

PBX integration boards are considered premium integration products and used when an application requires more sophisticated call control and call information than normally available through an analog connection. These advanced features are sometimes collectively referred to as “digital features.” The term “integration” describes any method for connecting an application to a PBX or key telephone system (KTS), but is most often used when referring specifically to a product that offers advanced digital features.

These digital features are available without expensive upgrades to existing PBX equipment, since PBX integration boards use the same interface to the PBX as a digital telephone—a concept known as “emulation.” PBX integration boards emulate, or behave like, a digital telephone, thereby letting the boards provide advanced call control capabilities to an application through an application programming interface (API).

## Intel® Dialogic® DSE PBX Integration Boards

Intel® Dialogic® DSE PBX Integration boards offer advanced digital connectivity for popular PBXs in 8-, 12-, and 16-port configurations for unified and Internet-ready call, voice, and fax processing applications in medium to large enterprises and contact centers. The boards provide up to 16 ports of digital access to the PBX by emulating the powerful digital display telephones used by attendants and ACD/contact center supervisors and agents.

The DSE board provides application developers with a high-level interface to digital PBXs through digital telephone emulation, as well as the ability for media processing using H.100-compatible voice processing hardware. The Intel Dialogic DSE PBX integration board runs on Windows NT\* and Windows\* 2000 operating systems and offers support for Microsoft Telephony API\* (TAPI), the industry standard for computer-telephony integration (CTI) interfaces. TAPI support means the Intel Dialogic DSE PBX integration board works readily with a large number of existing applications, significantly reducing development time.

## Intel® Dialogic® D/82JCT-U-PCI-UNIV PBX Integration Board

The Intel® Dialogic® D/82JCT-U-PCI-UNIV PBX integration board offers advanced digital connectivity to many popular PBXs for unified and Internet-ready call, voice, and fax processing applications in small to medium-sized enterprises. Featuring programmable soft-ports capable of supporting voice, fax, call handling, and host-based speech technologies, this board reduces the cost of ownership for systems requiring multimedia functionality. By choosing the D/82JCT-U-PCI-UNIV board for enterprise applications, developers eliminate the complexities associated with analog or T-1 integration, as well as costly investments in proprietary CTI links.

## Intel® Dialogic® D/42JCT-U PBX Integration Board

The Intel® Dialogic® D/42JCT-U PBX integration board offers advanced digital connectivity to many popular PBXs for unified and Internet-ready call, voice, and fax processing applications in small to medium-sized enterprises. Featuring programmable soft-ports capable of supporting voice, fax, call handling, and host-based speech technologies, this board reduces the cost of ownership for systems requiring multimedia functionality. By choosing the D/42JCT-U board for enterprise applications, developers eliminate the complexities associated with analog or T-1 integration, as well as costly investments in proprietary CTI links.

## PBX Integration Board Product Line Summary

The following table summarizes the PBX integration board product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/signaling.htm#pbxib>.

### DSE PBX INTEGRATION BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® DL300908</b> <b>Intel® Dialogic® DL300912</b> <b>Intel® Dialogic® DL300916</b> <ul style="list-style-type: none"> <li>▪ Voice mail/voice messaging</li> <li>▪ Unified messaging</li> <li>▪ Auto attendant</li> <li>▪ Interactive voice response (IVR)</li> <li>▪ Interactive media response (IMR)</li> </ul>	<b>DL300908</b> <b>DL300912</b> <b>DL300916</b>	<ul style="list-style-type: none"> <li>▪ 8, 12, and 16 digital interface ports</li> <li>▪ Supports Avaya* (Definity), NEC* (NEAX*), Nortel* (Meridian-1), and Siemens* (Hicom*) PBXs</li> <li>▪ PCI long form factor</li> <li>▪ Field expandable (DL300908 and DL300912)</li> </ul>
<b>Intel® Dialogic® DL300708</b> <b>Intel® Dialogic® DL300712</b> <b>Intel® Dialogic® DL300716</b> <ul style="list-style-type: none"> <li>▪ Voice mail/voice messaging</li> <li>▪ Unified messaging</li> <li>▪ Auto attendant</li> <li>▪ Interactive voice response (IVR)</li> <li>▪ Interactive media response (IMR)</li> </ul>	<b>DL300708</b> <b>DL300712</b> <b>DL300716</b>	<ul style="list-style-type: none"> <li>▪ 8, 12, and 16 digital interface ports</li> <li>▪ Supports Mitel* (SX200, SX2000) PBXs</li> <li>▪ PCI long form factor</li> <li>▪ H.100 compatible</li> <li>▪ Field expandable (DL300708 and DL300712)</li> </ul>
<b>Intel® Dialogic® DL300208</b> <b>Intel® Dialogic® DL300212</b> <b>Intel® Dialogic® DL300216</b> <ul style="list-style-type: none"> <li>▪ Voice mail/voice messaging</li> <li>▪ Unified messaging</li> <li>▪ Auto attendant</li> <li>▪ Interactive voice response (IVR)</li> <li>▪ Interactive media response (IMR)</li> </ul>	<b>DL300208</b> <b>DL300212</b> <b>DL300216</b>	<ul style="list-style-type: none"> <li>▪ 8, 12, and 16 digital interface ports</li> <li>▪ Supports Siemens (ROLM) PBXs</li> <li>▪ PCI long form factor</li> <li>▪ H.100 compatible</li> <li>▪ Field expandable (DL300208 and DL300212)</li> </ul>

### JCT PBX INTEGRATION BOARDS

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® D/82JCT-U</b> <ul style="list-style-type: none"> <li>▪ Voice mail/voice messaging</li> <li>▪ Unified messaging</li> <li>▪ Auto attendant</li> <li>▪ Interactive voice response (IVR)</li> <li>▪ Interactive media response (IMR)</li> </ul>	<b>D82JCTUPCIUNIV</b>	<ul style="list-style-type: none"> <li>▪ Eight digital interfaces plus eight media processing channels</li> <li>▪ Four digital interfaces plus four media processing channels</li> <li>▪ Supports Avaya* (Definity), Mitel* (SX200, SX2000, SX50), Nortel* (Meridian-1 and NorStar), Siemens* (Hicom* 150/300, ROLM* CBX 9005, 9006, 9751), and NEC (NEAX* 2400/2000, Electra Professional*, Electra Elite*) PBXs</li> <li>▪ Supports G.711, OKI linear, GSM, and G.726 voice coders</li> <li>▪ Two channels of fax per card, sharable across CT Bus</li> <li>▪ DTMF tone generation and detection</li> <li>▪ Support for continuous speech processing</li> <li>▪ Pitch corrected speed control on playback</li> <li>▪ Universal PCI support—with System Release 5.1 or higher</li> <li>▪ H.100 compatible</li> </ul>
<b>Intel® Dialogic® D/42JCT-U</b>	<b>D42JCTU</b>	<ul style="list-style-type: none"> <li>▪ Four digital interfaces plus four media processing channels</li> <li>▪ Supports Avaya (Definity), Mitel (SX200, SX2000, SX50), Nortel (Meridian-1 and NorStar), Siemens (Hicom 150/300, ROLM CBX 9005, 9006, 9751), and NEC (NEAX* 2400/2000, Electra Professional, Electra Elite) PBXs</li> <li>▪ Supports G.711, OKI linear, GSM, and G.726 voice coders</li> <li>▪ One channel of fax per card, sharable across CT Bus</li> <li>▪ DTMF tone generation and detection</li> <li>▪ Support for Intel® Dialogic® Continuous Speech Processing Technology</li> <li>▪ Pitch-corrected speed control on playback</li> <li>▪ PCI long form factor</li> <li>▪ H.100 compatible</li> </ul>

# SS7 Boards

Signaling System 7 (SS7) is the signaling system that forms the backbone of the international telecommunications network. Intel offers a complete family of SS7 products ranging from boards to gateways, scalable from 64 to more than 16,000 ports. These products are used for call control/call routing, wireless/wireline messaging, and intelligent network applications.

For more information on SS7 gateway products, refer to the Signaling Gateway section.

## Intel® NetStructure™ SS7 Boards

These E-1/T-1/V.35 SS7 intelligent interface boards, along with SS7 protocol software, give direct, high-performance access to the worldwide telecommunications network. SS7 boards from Intel provide the platform for call control, wireless applications, and Intelligent Networking (IN) in CompactPCI\*, PCI, and ISA form factors. The onboard processor runs a full range of protocols, from MTP up to ISUP, SCCP, TCAP, GSM-MAP, IS41-MAP, INAP, and CAP, independent from the host. The boards also include H.100/H.110/SCbus interfaces for interworking with other standards-based boards in a system. The boards include runtime support for many local variants, as well as the major ANSI and ITU versions. The latest addition to the product family, the Intel® NetStructure™ SS7HDP Board, is a high-density, high-performance board that lets developers create cost-effective, high-density, carrier-grade communications solutions requiring advanced SS7 performance.

## SS7 Board Summary

The following table summarizes the SS7 board application features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/signaling.htm#ss7b>

### Applications that can be enabled using Intel® SS7 Products include:

- Color ring-back tone (CRBT)
- Location-based services (LBS)
- Short Message Services (SMS)
- Prepaid calling
- Voice portals
- Interactive voice response (IVR) and voice mail systems
- Intelligent networking/IP long-haul

## SS7 BOARDS

PRODUCTS AND APPLICATIONS	FORM FACTOR	ITEM MARKET NAME	KEY FEATURES
Intel® NetStructure™ SS7HDP	PCI	SS7HDPD4TE	<ul style="list-style-type: none"> <li>▪ 16 or 64 links per board</li> <li>▪ Onboard process runs protocols independent of host</li> <li>▪ Common API between boards</li> <li>▪ Two, four, or eight E-1/T-1 digital network interfaces per board</li> <li>▪ Onboard processor runs protocols independent of host</li> <li>▪ Support for MTP, ISUP, TUP, BT-IUP, SCCP, TCAP, GSM-MAP, IS41-MAP, INAP, CAP, and many local variants including ANSI and ITU/ETSI</li> <li>▪ Three or four SS7 links per board</li> <li>▪ Common API between boards</li> </ul>
Intel® NetStructure™ SPC12S	PCI	SS7SPC12S	
Intel® NetStructure™ SPC14	PCI	SS7SPC14	
Intel® NetStructure™ SCPM8	CompactPCI*	SS7CPM8	
Intel® NetStructure™ SCPR8RJ	CompactPCI	SS7CPR8RJ	
Intel® NetStructure™ PCCS62E	ISA	SS7PCCS62E	
Intel® NetStructure™ PCCS62EU	ISA	SS7PCCS62EU	
Intel® NetStructure™ PCCS62T	ISA	SS7PCCS62T	
Intel® NetStructure™ PCCS62TH	ISA	SS7PCCS62TH	
Intel® NetStructure™ PCCS62EUH	ISA	SS7PCCS62EUH	
Intel® NetStructure™ PCCS62EBH	ISA	SS7PCCS62EBH	
Intel® NetStructure™ PCCS62SEB	ISA	SS7PCCS62SEB	
Intel® NetStructure™ PCCS62ST	ISA	SS7PCCS62ST	

# Station Interface Boards

These integrated, multifunction telephony boards are designed specifically for small to medium-sized enterprise applications including server-based private branch exchanges (PBXs) and contact centers. Equipped with a rich mix of telephone station interfaces and media processing resources, the DI boards help developers and resellers create more efficient and complete system solutions that offer increased functionality at a lower cost to end users. These are some of the overall benefits of this product line.

- Optimized for converged communications switching applications
- Lower system cost through higher densities
- Wide range of resources integrated onboard
- Easy to add system features and enhancements
- Built-in service reliability and availability

## STATION INTERFACE PRODUCTS

### Intel® Dialogic® DI0408LSAR2 Switching Board

The Intel® Dialogic® DI0408LSAR2 board is a single-slot, richly-configured trunk and station interface board designed for small to mid-sized server-based PBX or contact centers starting at four loop-start analog interfaces and eight station interfaces on a single board. Reliable and cost-effective, the DI0408LSAR2 board offers an optimized combination of interfaces and resources for enterprise switching applications. Build a 4-trunk, 8-station converged communications system in a single PCI slot with one DI0408LSAR2 board. Add up to eight integrated boards from Intel or other Intel® boards to support virtually any small to medium-sized enterprise switching application.

### Intel® Dialogic® DISI16R2, DISI24R2, and DISI32R2 Switching Boards

The Intel® Dialogic® DISI16R2, DISI24R2, and DISI32R2 switching boards connect analog telephone devices directly to converged communications platforms to create affordable, small to mid-sized, server-based PBX telemarketing systems and contact centers. Highly reliable and cost-effective, these integrated station interface products offer an optimized mix of analog station interfaces and resources for building highly scalable systems.

The DISI16R2, DISI24R2, and DISI32R2 boards are full-size, single-slot PCI boards based on DM3 architecture that provide 16, 24, or 32 station interfaces, respectively. They include conferencing, voice play/record, tone detection and generation, and caller ID capabilities. The DM3 architecture provides access to independent, high-performance, firmware-based network protocol and media processing resources that can be operated and integrated on compatible hardware platforms.

## Station Interface Product Line Summary

The following table summarizes the station interface board application features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/switching.htm#cssivb>

### STATION INTERFACE BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® Dialogic® DI0408LSAR2</b> <b>Intel® Dialogic® DI0408LSAR2EU</b> <b>Intel® Dialogic® DI0408LSAR2I</b> <b>Intel® Dialogic® DI0408LSAR2EUI</b> <ul style="list-style-type: none"> <li>▪ Server-based PBX</li> <li>▪ Customer contact center</li> </ul>	<b>DI0408LSAR2</b> <b>DI0408LSAR2EU</b> <b>DI0408LSAR2I</b> <b>DI0408LSAR2EUI</b>	<ul style="list-style-type: none"> <li>▪ Four loop-start trunk connections with call control</li> <li>▪ Eight analog station interfaces with call control</li> <li>▪ Full-size, PCI form factor</li> <li>▪ Fail-over of four trunks to four stations</li> <li>▪ Eight voice play and record</li> <li>▪ Full complement of tone detection and generation</li> <li>▪ Nine-party conference resources</li> <li>▪ Two fax resources per board</li> <li>▪ Four CSP resources</li> <li>▪ On-hook and off-hook caller ID generation (FSK)</li> <li>▪ Message Waiting Indicator Control (FSK)</li> <li>▪ Music on-hold audio port</li> <li>▪ Support for Windows NT* , Windows* 2000, and Windows* XP operating systems</li> <li>▪ Uses Global Call*, MSI, and R4 APIs</li> <li>▪ CT Bus H.100 compliant</li> <li>▪ Phone support, 2500 sets; caller ID phones; international complex impedance phones</li> <li>▪ International approvals</li> <li>▪ DI0408LSAR2, DI0408LSAR2EU require external telephony power supply (MSISCGLOBALPWR)</li> <li>▪ DI0408LSAR2I, DI0408LSAR2EUI require internal telephony power supply (DIINTPPS)</li> </ul>
<b>Intel® Dialogic® DISI16R2</b> <b>Intel® Dialogic® DISI24R2</b> <b>Intel® Dialogic® DISI32R2</b> <ul style="list-style-type: none"> <li>▪ Automatic call distributor (ACD)</li> <li>▪ Server-based PBX</li> <li>▪ Customer service</li> <li>▪ Teleconferencing/conferencing bridge</li> <li>▪ Inbound and outbound telemarketing</li> </ul>	<b>DISI16R2</b> <b>DISI24R2</b> <b>DISI32R2</b>	<ul style="list-style-type: none"> <li>▪ Full-size, PCI form factor</li> <li>▪ 16, 24, or 32 analog station interfaces with call control, caller ID generation</li> <li>▪ Full complement of dedicated voice play and record</li> <li>▪ Full complement of dedicated tone detections and generation</li> <li>▪ 16 parties of conferencing with echo cancellation</li> <li>▪ On-hook and off-hook caller ID generation (FSK)</li> <li>▪ Message Waiting Indicator Control (FSK)</li> <li>▪ Music on-hold audio port</li> <li>▪ Support for Windows NT, Windows 2000, and Windows XP operating systems</li> <li>▪ Uses Global Call, MSI, and R4 APIs</li> <li>▪ CT Bus H.100 compliant</li> <li>▪ International approvals</li> <li>▪ Requires external power supply (MSISCGLOBALPWR)</li> </ul>

## HIGH-DENSITY STATION INTERFACE PRODUCTS

The high-density station interface (HDSI) solution from Intel provides an open-architecture platform for converged communication systems that integrates large-scale switching and voice processing resources under a single hardware and software architecture. The HDSI solution is offered in both PCI and CompactPCI\* configurations, which provide some of the industry's highest densities plus analog station connectivity in a single computer chassis slot.

### High-Density Station Interface

The HDSI solution offered by Intel is an assembly consisting of either an Intel® NetStructure™ HDSI-PCIU board with H.100-compliant CT Bus connectivity or an HDSI-CompactPCI\* board assembly (including a CompactPCI baseboard and a rear I/O module) with H.110-compliant CT Bus connectivity, connected to an external station interface box (SIB). The CT Bus provides switching between trunks and stations and also allows expansion for additional network and resource boards from Intel. Using just one computer chassis slot, this solution can support up to 120 stations with tone detection and generation, and frequency shift key (FSK) caller ID transmission.

### High-Density Station Interface Product Line Summary

The following table summarizes the HDSI product features. For additional information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/boards/switching.htm#sib>.

## HIGH-DENSITY STATION INTERFACE BOARDS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
Intel® NetStructure™ HDSI/480PCIU	HDSI480PCIU	<ul style="list-style-type: none"> <li>▪ Connectivity to 48, 72, 96, or 120 analog stations</li> <li>▪ Programmable ringing with automatic ring trip requires no additional external circuitry</li> <li>▪ Station status event detection allows collection of call traffic statistics via the application for cost-effective management of call setup and call termination</li> <li>▪ Programmable gain provides station volume control from the application and enables matching line levels from different devices</li> <li>▪ Supports programmable notification tones for metering time expired</li> <li>▪ Full complement of dedicated voice resources (not on HDSI 1200)</li> <li>▪ Provides unobtrusive monitoring of connections</li> <li>▪ Provides battery feed to phone (termination) sets</li> <li>▪ C language application program interfaces (APIs) for Windows NT*, Windows* 2000, and Windows* XP operating systems</li> <li>▪ Onboard DTMF detection recognizes tones generated by phones connected to the stations</li> <li>▪ Onboard tone generation provides for generating PBX-like tones to the stations such as dial tone, ring back, and busy</li> <li>▪ Programmable cadence allows selection of ring cadence options</li> <li>▪ Onboard FSK generation allows the transmission of Caller ID to Class, type caller ID phones, as well as the ability to turn on and off message waiting indicators</li> </ul>
Intel® NetStructure™ HDSI/480PCIJP	HDSI480PCIJP	
Intel® NetStructure™ HDSI/720PCIU	HDSI720PCIU	
Intel® NetStructure™ HDSI/720PCIJP	HDSI720PCIJP	
Intel® NetStructure™ HDSI/960PCIU	HDSI960PCIU	
Intel® NetStructure™ HDSI/960PCIJP	HDSI960PCIJP	
Intel® NetStructure™ HDSI/1200PCIU	HDSI1200PCIU	
Intel® NetStructure™ HDSI/1200PCIJP	HDSI1200PCIJP	
Intel® NetStructure™ HDSI/480CPCI	HDSI480CPCI	
Intel® NetStructure™ HDSI/720CPCI	HDSI720CPCI	
Intel® NetStructure™ HDSI/960CPCI	HDSI960CPCI	
Intel® NetStructure™ HDSI/1200CPCI	HDSI1200CPCI	
<ul style="list-style-type: none"> <li>▪ Inbound and outbound telemarketing</li> <li>▪ PBX/key systems</li> <li>▪ Operator services, such as billing automation, directory assistance, and intercept treatments</li> <li>▪ Automatic call distribution (ACD)</li> <li>▪ Local information services</li> </ul>		

# Telecom Platforms

Intel offers open, modular product platforms that can provide a solid foundation on which communications OEMs can build large- or small-scale converged communications systems for both the enterprise and the public network market segments.

Gateway products from Intel include the Intel® NetStructure™ PBX-IP Media Gateway, offering enterprises a phased migration to IP networking, and the Elite Gateway\* which lets enterprises eliminate toll calls between offices by adding voice to existing wide area networks (WANs). In general, use the PBX-IP Media Gateway to connect to digital PBXs or drive digital phones and the Elite Gateway to connect to analog trunk interfaces or drive analog phones.

## Media Gateways

### INTEL® NETSTRUCTURE™ PBX-IP MEDIA GATEWAY

The Intel NetStructure PBX-IP Media Gateway allows a well-planned, phased migration to an IP network, making it a smart solution for enterprises not yet ready (or willing) to completely abandon their investment in legacy PBX equipment. This building block from Intel provides a simple, cost-effective transition to voice and data convergence for enterprises with PBXs. Connected externally, it offers an IP solution that works with current legacy equipment. It supports H.323 or SIP-based applications running on network servers, remote terminals, or other devices.

Connected between a PBX or a digital handset and a LAN, WAN, or managed packet network, the Intel NetStructure PBX-IP Media Gateway converts proprietary digital PBX messages into a format suitable for transmission over standard IP networks. With a PBX, the gateway is used for emulation; with a digital handset, the gateway is used for phone driving. Each gateway unit contains eight digital PBX (emulating) or digital station interfaces (phone driving) and a 10/100 BaseT Ethernet connection for connecting to a LAN.

### PBX-IP Media Gateway Product Line Summary

The following table summarizes the PBX-IP media gateway product features. For more information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/gsp/index.htm#gateways>

### PBX-IP MEDIA GATEWAY PRODUCT LINE

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ PIMG80PBXDNI</b> <b>Intel® NetStructure™ PIMG80PBXMTLDNI</b> <b>Intel® NetStructure™ PIMG80LS</b> <ul style="list-style-type: none"> <li>▪ IP-enabled PBX network</li> <li>▪ Voice over Internet Protocol (VoIP) extension to branch offices</li> <li>▪ Centralized VoIP applications servers including IP-based voice mail and unified messaging</li> <li>▪ Teleworking/telecommuting</li> </ul>	<b>PIMG80PBXDNI</b> <b>PIMG80PBXMTLDNI</b> <b>PMIG80LS</b>	<b>Emulating</b> <ul style="list-style-type: none"> <li>▪ Eight ports per unit. Stack multiple units for higher densities.</li> <li>▪ PBX compatibility: Mitel* (PIMG80PBXMTLDNI), Avaya*, NEC*, Nortel*, Siemens* (PMIG80PBXDNI) various analog (PIMG80LS)</li> <li>▪ 10/100 BaseT Ethernet LAN port</li> <li>▪ Supports H.323 or Session Initiated Protocol (SIP) VoIP standards</li> <li>▪ Administration through Web, telenet, or local serial port</li> <li>▪ Appliance packaging (approximately 10 in x 10 in x 2 in [25 cm x 25 cm x 5 cm])</li> </ul>
<b>Intel® NetStructure™ PIMG80PBXDSI</b>	<b>PIMG80PBXDSI</b>	<b>Phone driving</b> <ul style="list-style-type: none"> <li>▪ Eight ports per unit. Stack multiple units for higher system densities.</li> <li>▪ Handset compatibility: Avaya, NEC, Siemens (PIMG80PBXDSI)</li> <li>▪ 10/100 BaseT Ethernet LAN port</li> <li>▪ Support H.323 or SIP VoIP standards</li> <li>▪ Administration through Web, telenet, or local serial port</li> <li>▪ Appliance packaging (approximately 10 in x 10 in x 2 in [25 cm x 25 cm x 5 cm])</li> </ul>



**ELITE GATEWAY\***

The Elite Gateway is a cost-effective and reliable way to place voice and fax calls over an IP network. Service providers and enterprises can both use the gateway to cut costs. The gateway is equipped with remote management capabilities. Modules are provided for analog trunks or analog telephones.

**Elite Gateway\* Product Line Summary**

The following table summarizes the Elite Gateway product features. For more information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/gsp/index.htm#gateways>

**ELITE GATEWAY\* PRODUCT LINE**

PRODUCT AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Elite Gateway*</b> <ul style="list-style-type: none"> <li>▪ xSP service provision for enterprises</li> <li>▪ E-Business data center</li> <li>▪ Enterprise voice intranet</li> <li>▪ Web-enabled contact center</li> <li>▪ Click-to-connect business</li> <li>▪ Web-enabled auto-attendant</li> <li>▪ IP-based PBX</li> </ul>	<b>E8044PORTFXO</b> <b>E804S4PORTFXS</b> <b>E8088PORTFXO</b> <b>E808S8PORTFXS</b> <b>E808X4PTFXOFXS</b> <b>FXS4PORTBLADE</b> <b>FXO4PORTBLADE</b> <b>ELITE4PORTENM</b> <b>E4PORT2FXS2FXO</b> <b>EDESKTOP4FXO</b> <b>EDESKTOP4FXS</b> <b>EDESKTOP2FXS</b>	<ul style="list-style-type: none"> <li>▪ 1U rack-mountable with four ports per module (up to two modules per chassis) or desktop appliance with two or four ports</li> <li>▪ 10/100 BaseT Ethernet LAN port</li> <li>▪ Analog loop-start trunk or analog telephone station interfaces (FXS, FXO and E&amp;M)</li> <li>▪ Supports H.323 VoIP standard</li> <li>▪ Supports T.38 fax transmission</li> <li>▪ Built-in dial plan</li> <li>▪ Web browser, Telnet, or RS-232 for administration</li> </ul>

# Signaling Gateways

Signaling System 7 (SS7) is the signaling system that forms the backbone of the international telecommunications network. Intel offers a complete family of SS7 products ranging from boards to servers that scale from 64 to more than 16,000 ports. These products are used for call control, signaling, wireless messaging, and intelligent network applications. For more information on SS7 server products, refer to the SS7 Boards section.

## SS7 SERVER PRODUCTS

### Intel® NetStructure™ SIU131 and SIU231 SS7 Signaling Gateways

The Intel® NetStructure™ SIU131 and SIU231 signaling gateways are cost-effective and highly reliable SS7 servers that provide straightforward ways to build intelligent network entities such as Service Control Points (SCP) and Intelligent Peripherals (IP) using standard computing platforms.

### Intel® NetStructure™ SIU520 Signaling Gateway

The Intel® NetStructure™ SIU520 Signaling Gateway provides SS7 connectivity for multi-chassis call control, wireless, or Intelligent Networking (IN) applications. A message-based protocol application programming interface (API), compatible with other SIU systems and with Intel® NetStructure™ SS7 boards, is presented over IP to application hosts. SIU520 unit can run a wide range of SS7 protocols and local variants, enabling worldwide deployment in a variety of applications.

### Intel® NetStructure™ Digital Signaling Converter

This multifunction, multi-protocol intelligent “black-box” device accepts SS7 or ISDN signal inputs and outputs another SS7 or ISDN signal. With a simple configuration and capable of fitting into your existing network, Intel NetStructure Digital Signaling Converters let ISDN or previously incompatible SS7 equipment to be interconnected with public network systems.

### Intel® NetStructure™ SG430 SS7 Signaling Gateway

Interfacing to both SS7 and IP networks, the Intel® NetStructure™ SG430 SS7 Signaling Gateway lets SS7 information be carried to and from IP-based applications such as softswitches and mobile network elements. This signaling gateway bridges IP networks, ISDN equipment, and SS7 equipment. It is a key enabler for building IP-based telecommunications service nodes such as VAD platforms or wireless location/messaging services. It is also used to SS7-enable voice systems, giving access to the power and flexibility of the core telecommunications network.

## SS7 Server Product Line Summary

The following table summarizes the SS7 server product features. For more information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/gsp/index.htm#sg>.

### SS7 SERVERS

PRODUCTS AND APPLICATIONS	ITEM MARKET NAME	KEY FEATURES
<b>Intel® NetStructure™ SIU131</b> <b>Intel® NetStructure™ SIU231</b> <ul style="list-style-type: none"> <li>▪ Mobile short messaging/location-based services</li> <li>▪ IP telephony gateways</li> <li>▪ Intelligent Networking SCP</li> <li>▪ IP-based application service provider</li> <li>▪ Multi-chassis service platforms</li> <li>▪ VAD/IVR and voice mail systems</li> </ul>	<b>SIU131</b> <b>SIU231</b>	<ul style="list-style-type: none"> <li>▪ Support for MTP, ISUP, TUP, BT-IUP, SCCP, TCAP, GSM-MAP, IS41-MAP, INAP, CAP, and many local variants including ANSI and ITU/ETSI</li> <li>▪ Multiple interface formats—E-1/T-1/V.35</li> <li>▪ Fault-resilient load-sharing configurations</li> <li>▪ Common API with boards for applications scalability</li> <li>▪ API over TCP/IP interface to up to 32 applications hosts</li> </ul>
<b>Intel® NetStructure™ SIU520</b> <ul style="list-style-type: none"> <li>▪ SS7 service node creation, including</li> <li>▪ Wireless nodes—short message service center (SMSC), home register (HLR), roaming gateways</li> <li>▪ Wireless short messaging service (SMS) platforms/gateways</li> <li>▪ Intelligent Networking (IN) service control point (SCP), Internet protocol (IP)</li> <li>▪ Voice-activated dialing (VAD), voice portal, interactive voice response (IVR), or voice mail systems</li> </ul>	<b>SIU520</b>	<ul style="list-style-type: none"> <li>▪ Traffic rates up to 800 TCAP transactions per second, or 450 ISUP or TUP calls per second</li> <li>▪ Up to 12 SS7 signaling links in 12 link sets</li> <li>▪ Intel® 2U carrier-grade NEBS-3/ETSI carrier-grade server location</li> <li>▪ Dual fault-resilient configurations</li> </ul>
<b>Intel® NetStructure™ DSC110</b> <b>Intel® NetStructure™ DSC210</b> <b>Intel® NetStructure™ DSC310</b> <ul style="list-style-type: none"> <li>▪ Rapid deployment of ISDN equipment</li> <li>▪ Interconnection of incompatible SS7 equipment</li> <li>▪ Advanced network inter-working</li> </ul>	<b>DSC110</b> <b>DSC210</b> <b>DSC310</b>	<ul style="list-style-type: none"> <li>▪ Support for ANSI/ITU ISP, TUP, BT-IUP and other local variants</li> <li>▪ Conversion to/from all supported SS7 variants</li> <li>▪ Conversion to/from ISDN and DPNSS</li> <li>▪ Parameter manipulation to bridge incompatible networks</li> </ul>
<b>Intel® NetStructure™ SG430 Signaling Gateway</b> <ul style="list-style-type: none"> <li>▪ Mobile short messaging/location-based services</li> <li>▪ Distributed switch</li> <li>▪ SS7 long haul and offload</li> <li>▪ GPRS integration</li> <li>▪ 2G-to-3G inter-working</li> <li>▪ IP telephony gateways</li> <li>▪ Intelligent Networking SCP</li> <li>▪ IP-based application service provider</li> </ul>	<b>SG430</b>	<ul style="list-style-type: none"> <li>▪ SS7-to-IP inter-working using open standards</li> <li>▪ Simultaneous support for multiple SS7 variants—ANSI/ITU/ETSI/JAPAN</li> <li>▪ Multiple interface formats—E-1/T-1/V.35</li> <li>▪ Supports connectivity to SIGTRAN-compatible application servers</li> <li>▪ Enables multi-host distributed application server systems</li> <li>▪ STP-like operation</li> <li>▪ Fault-resilient configurations</li> <li>▪ High-performance in 2U form factor</li> <li>▪ SS7/SIGTRAN application server software also available</li> </ul>

# Media Servers

## MEDIA SERVER PRODUCTS

### Voice Portal Reference Assemblies from Intel

Voice portal reference assemblies from Intel are packaged, integrated hardware platforms application developers can use to build hardened solutions for rapidly-expanding e-Business and speech-enabled voice portal solutions. It brings together the power of Intel® server technology with Intel® Dialogic® telephony interface boards in an integrated server platform.

The voice portal reference assemblies are comprised of three major, logical components: the Intel® Server Board SE7500WV2, a hardened chassis that provides a rugged platform for building flexible voice portal solutions; Intel® Dialogic® telephony interface boards; and Intel® Dialogic® Continuous Speech Processing Technology, software that consists of a new library of functions, device drivers, firmware, and technical documentation to help create leading-edge ASR applications.

### Voice Portal Reference Assemblies Product Line Summary

The following table summarizes the voice portal reference assemblies' product features. For more information, refer to the product datasheet index at <http://www.intel.com/design/network/products/telecom/gsp/index.htm#servers>

## VOICE PORTAL REFERENCE ASSEMBLIES

PRODUCTS AND APPLICATIONS	KEY FEATURES
<p><b>Voice Portal Reference System</b></p> <ul style="list-style-type: none"> <li>▪ Voice-assisted dialing</li> <li>▪ Speech-enabled interactive voice response (IVR)</li> <li>▪ Unified messaging</li> <li>▪ Voice mail server</li> <li>▪ Customer care/contact center</li> <li>▪ Operator services (collect, calling card, and prepaid)</li> <li>▪ And many others</li> </ul>	<ul style="list-style-type: none"> <li>▪ Supports one or two Intel® Xeon™ processors—up to 2.2 GHz (512 KB L2 cache)</li> <li>▪ Two integrated Intel® PRO/100+ Server Adapters (Intel® 82550PM controller)</li> <li>▪ Triple Peer PCI buses</li> <li>▪ Integrated ATI* Rage* XL video controller with 8 MB of video memory</li> <li>▪ Supports up to 6 GB of PC133 ECC SDRAM memory with six DIMM sockets</li> <li>▪ Validated on Windows* and Linux* operating systems</li> </ul>

The following are the descriptions and Item Market Names for the latest releases.

ITEM MARKET NAME	DESCRIPTION
VPWIN2KE1S75	Windows* 2000 Professional, 1 Gig, 30 ports
VP12WIN2KT1S	Windows 2000 Professional, 1 Gig, 48 ports
VP12WIN2KT1D	Windows 2000 Professional, 1 Gig, 96 ports
VP12WIN2KE1D	Windows 2000 Professional, 1 Gig, 120 ports
VP22WIN2KT1	Windows 2000 Professional, 2 Gig, 192 ports
VP22WIN2KE1	Windows 2000 Professional, 2 Gig, 240 ports
PFSR22003960	Windows 2000 Professional, 4 Gig, 288 ports
PFMULWIN196	Windows 2000 Professional, 2 Gig, 96 ports, NEBS compliant
PFMULWIN11200	Windows 2000 Professional, 2 Gig, 120 ports, NEBS compliant
PFLANWIN296	Windows 2000 Professional, 4 Gig, 192 ports, NEBS compliant
PFLANWIN211200	Windows 2000 Professional, 4 Gig, 240 ports, NEBS compliant
PF13W41T1	Windows 2000 Server, 1 Gig, 4 ports
PF13W41EURO	Windows 2000 Server, 1 Gig, 4 ports
PF13W4802T1	Windows 2000 Server, 2 Gig, 48 ports
PF13W964T1	Windows 2000 Server, 1 Gig, 96 ports
PF13W964T12G	Windows 2000 Server, 2 Gig, 96 ports
PF13W12E1	Windows 2000 Server, 1 Gig, 120 ports
PF13W12004E1	Windows 2000 Server, 2 Gig, 120 ports
PF23W1GB	Windows 2000 Server, 1 Gig, 28 ports
PF23W1GBE1	Windows 2000 Server, 1 Gig, 34 ports

# Telecom Software

Telecom software from Intel helps developers rapidly build robust, feature-rich, custom converged communications and modular network solutions by managing the applications and the low-level hardware and software development tasks.

Intel® Dialogic® System Release software and software development kits (SDKs) include device drivers, application programming interfaces (APIs), and utilities for Intel® telecom boards and related products. A variety of development tools—including the Intel® NetMerge™ CT Application Development Environment—help developers shorten development cycles and deliver products to market faster.

## Intel® NetMerge™ Call Processing Software

Intel® NetMerge™ Call Processing Software V6.0 is computer telephony (CT) call control server software capable of connecting a wide range of telephone switches to a variety of data processing environments. The software's client/server technology supports industry-standard hardware, operating systems, network services, and call control programming interfaces such as C, C++, Java\*, TAPI, and ActiveX\*, letting application developers easily integrate more intelligent call control features into their existing business applications.

For original equipment manufacturers (OEMs), independent software vendors (ISVs), application developers, and integrators looking to expand their reach into the contact center market segment, Intel NetMerge Call Processing Software provides the ability to:

- Add telephony features to their customers' existing business applications
- Expand their businesses by providing current—and new—customers with ways to enhance their existing contact centers
- Integrate new features and functionality into legacy systems while maintaining their customer's investment in existing equipment and infrastructure
- Support new communication environments such as IP with minimal changes to the application.

## Intel® NetMerge™ Call Processing Software Components

In addition to Intel NetMerge Call Processing Software, Intel offers several software components that can assist you in developing or CTI-enabling business applications. Each of the following Intel NetMerge Call Processing Software components provides complex functions from which computer-telephone integration (CTI) applications can be built. In many cases, these components can be used to provide CTI capabilities in an existing business application without having to CTI-enable the application.

- Intel® NetMerge™ Enhanced SDK provides an intuitive higher-level telephony programming interface that shields developers from many of the variations of different telephone switches.
- Intel® NetMerge™ Call Information Manager manages call-related data as the call is routed through the enterprise.
- Intel® NetMerge™ Call Monitoring Manager brings real-time call monitoring functionality to your applications. The call monitoring manager simplifies call monitoring for large numbers of telephony devices, easily integrating with business applications.
- Intel® NetMerge™ Call Routing Manager handles the technical aspects of call routing applications. Just add the business logic.
- CSTA Switch Simulator emulate a CSTA-compliant switch environment, including devices such as telephones, trunks and ACD queues.

## Call Processing Software Product Line Summary

The following table summarizes the Intel NetMerge Call Processing Software product features. For more information, refer to the product datasheet index at <http://www.intel.com/network/csp/products/ctconnect/family.htm>

### CALL PROCESSING SOFTWARE PRODUCT LINE

PRODUCT AND APPLICATIONS	KEY FEATURES
<b>Intel® NetMerge™ Call Processing Software</b> <ul style="list-style-type: none"> <li>▪ Customer relationship management (CRM)/e-CRM</li> <li>▪ Call recording and quality management</li> <li>▪ Contact center workforce management</li> <li>▪ Contact center</li> <li>▪ Help desk</li> <li>▪ Interactive voice response (IVR)</li> <li>▪ Screen pop</li> </ul>	<ul style="list-style-type: none"> <li>▪ Runs under Windows NT*, Windows* 2000, and Windows* XP operating systems</li> <li>▪ Includes client APIs for Microsoft Windows* 95, Windows* 98, Windows 2000, Windows NT*, Windows XP, Hewlett-Packard HP-UX*, and Compaq Tru64 UNIX*, and OpenVMS* operating systems</li> <li>▪ Supports call control programming interfaces such as C, C++, Java*, TAPI, and ActiveX*</li> <li>▪ Support for Computer Supported Telecommunications Application (CSTA) Phase III protocol</li> </ul>

The following are the descriptions and Item Market Names for the latest releases.

ITEM MARKET NAME	DESCRIPTION
CPSV6ENTWINPPK	CPS V6.0 Enterprise License for Windows* PP key
CPSV6ENTWINUSB	CPS V6.0 Enterprise License for Windows USB key
CPSV6FULLWINPPK	CPS V6.0 Full License for Windows PP key
CPSV6FULLWINUSB	CPS V6.0 Full License for Windows USB key
CPSV6LOWWINPPK	CPS V6.0 Low License for Windows PP key
CPSV6LOWWINUSB	CPS V6.0 Low License for Windows USB key
CPSV6MIDWINPPK	CPS V6.0 Mid License for Windows PP key
CPSV6MIDWINUSB	CPS V6.0 Mid License for Windows USB key
CPSV6MONWINPPK	CPS V6.0 Monitor License for Windows PP key
CPSV6MONWINUSB	CPS V6.0 Monitor License for Windows USB key
CPSV6PROUPG	CPS V6.0 Product Upgrade License for Windows
CTCESDKSUBSRV	Enhanced Software Development Kit
CTCCMPCALFKIT	Version 3 for COMPUCALL, Full Sys Prod. for Windows NT*
CTCFULLSUNKIT	CT Connect V5.0 Full Sys. for SOLARIS
CTCCIMUNLDVKIT	Call Information MGR V3.5 Single Site, Unlimited Devices
CTCCIM25KIT	Call Information MGR V3.5, Single Site, 25 devices
CTCCIM30MS25DEV	Call Information MGR V3.5, Multisite, 25 devices
CTCCIMUPDKIT	Call Information MGR V3.5 Update kit
CTCCIMUDMSITEKT	Call Information MGR V3.5 Multisite, Unlimited Devices
CTCOMPLV30MONNT	Version 3 for COMPUCALL, monitor for Windows NT
CTCCRMGR	Call Routing Manager
CSTAASSIMFORNT	CSTA Switch Simulator V1.0 Prod. for Windows NT
NCCSV1.1WINPPK	Network Call Control Software V1.1 for Windows PP key
NCCSV1.1WINUSB	Network Call Control Software V1.1 for Windows USB key
NECGATEWAYV20NT	NEC Gateway* V2.0 Product for Windows NT

## Intel® NetMerge™ Call Manager

Intel® NetMerge™ Call Manager is software that works in conjunction with the Microsoft Speech Server\*, providing management and control over Intel® Dialogic® telephony resources. Through a set of application programming interface (API) functions, the call manager enables applications built using Microsoft speech tools to control and monitor calls and apply speech resources. The call manager sets up and maintains connections with voice browsers, making it possible to monitor a device in order to make or receive calls, control events, distribute incoming calls across available ("ready") browsers, and place outbound calls on available device resources. The call manager:

- Maps outbound call requests from a Speech Application Language Tag (SALT) interpreter to available channels on the Intel Dialogic telephony board. The number of channels available depends on the type of telephony board you install.
- Maps call control signaling events from the switch into CSTA XML messages that can be understood by the SALT interpreter.
- Maps CSTA XML messages from the SALT interpreter into telephony requests that can be sent to the switch.
- Handles media processing, such as recording audio.

Each Intel NetMerge Call Manager package includes a single CD containing:

- Intel NetMerge Call Manager Software
- Intel Dialogic System Release Software
- Global Call Software
- Runtime license for Intel® NetMerge™ Call Manager and Intel® Dialogic® System Release software

*Note: Customers do not have to purchase the Intel Dialogic System Release Software.*

Also available is an entry-level, single-span bundle that includes one Intel® NetStructure™ DMV480A-2T1-PCI Combined Media Board and a 24-port Intel NetMerge Call Manager licensed software package. Packaging standard, off-the-shelf DM3 telephony hardware with 24 ports of call manager software provides developers with a single span of telephony at a reduced price.

## Call Manager Software

The following table summarizes the Intel NetMerge Call Manager Software product features. For additional information, refer to the product datasheet index at <http://www.intel.com/network/csp/products/8661web.htm>

### CALL PROCESSING SOFTWARE PRODUCT LINE

PRODUCT AND APPLICATIONS	KEY FEATURES
Intel® NetMerge™ Call Manager is the enabling media and telephony control component of these application areas: <ul style="list-style-type: none"> <li>▪ Speech-enabling existing IVR and contact center applications</li> <li>▪ Self-help Web services for customer service</li> <li>▪ Customer relationship management</li> </ul>	<ul style="list-style-type: none"> <li>▪ Runs under Windows* 2003 Server</li> <li>▪ Supports Microsoft Speech Server* (SALT)</li> <li>▪ Modular design</li> <li>▪ Manages low-level telephony events, messages, and media</li> <li>▪ Support a variety of telephony boards and protocols</li> </ul>

The following are the descriptions and Item Market Names for the latest releases.

ITEM MARKET NAME	DESCRIPTION
NMCALMGR4PTPKG	Intel® Call Manager 4 port licensed software kit and other associated Intel® software components
NMCALMGR16PTPKG	Intel Call Manager 16 port licensed software kit and other associated Intel software components
NMCALMGR24PTPKG	Intel Call Manager 24 port licensed software kit and other associated Intel software components
NMCALMGR48PTPKG	Intel Call Manager 48 port licensed software kit and other associated Intel software components
NMCALMGR96PTPKG	Intel Call Manager 96 port licensed software kit and other associated Intel software components
KDMVACM24PT	Single-Span Bundle: Intel® DMV480A-2T1 board, Intel Call Manager 24 port license, and other associated Intel software components



# Development Tools

## INTEL® NETMERGE™ CT APPLICATION DEVELOPMENT ENVIRONMENT

The Intel® NetMerge™ CT Application Development Environment is a set of development tools and runtime environments that help shorten time-to-market and to revenue by helping developers build robust, portable computer telephony (CT) applications quickly and easily.

This product reduces the need to write directly to a telephony device's API in C or C++. Because of its underlying architecture, Intel NetMerge CT Application Development Environment eliminates the need for developers to learn new telephony hardware, APIs, and protocols. The Intel NetMerge CT Application Development Environment architecture provides an abstraction layer that sits on top of telephony device APIs and performs low-level CT tasks, saving time that developers can better use to focus on building innovative applications.

Intel NetMerge CT Application Development Environment offers the flexibility of programming in different environments: either a CT-specific environment or a Windows environment. Both interfaces provide access to the many benefits of the underlying architecture. The Intel NetMerge CT Application Development Environment's application development (AD) language is a CT-specific scripting language that includes a flowcharter and a debugger. Also available are AD ActiveX\* objects, which incorporate directly into a Windows visual programming environment such as Visual Basic\* and provide CT-specific development functions. Intel® NetStructure™ Host Media Processing software is now supported under Intel NetMerge CT Application Development Environment Version 8.2 SP2.

### CT Application Development Environment Product Line Summary

The following table summarizes the CT Application Development Environment product features. For more information, refer to the product datasheet index at [http://www.intel.com/network/csp/products/indx\\_aet.htm#tools](http://www.intel.com/network/csp/products/indx_aet.htm#tools). A complimentary evaluation version is available for download at <http://www.intel.com/network/csp/products/ctade/evalsw.htm>.

## CT APPLICATION DEVELOPMENT ENVIRONMENT PRODUCT LINE

APPLICATIONS	KEY FEATURES
<p><b>CT Application Development Environment</b></p> <ul style="list-style-type: none"> <li>▪ Voice portal</li> <li>▪ Voice messaging and unified messaging</li> <li>▪ Voice-activated dialing (VAD)</li> <li>▪ Text-to-speech e-mail</li> <li>▪ Speech-enabled interactive voice response (IVR)</li> <li>▪ Contact center</li> <li>▪ Customer relationship management (CRM)</li> <li>▪ Fax-on-demand</li> <li>▪ Debit card</li> <li>▪ Host Media Processing (supported under V8.2 SP2)</li> <li>▪ Voice over IP—DM/IP boards</li> <li>▪ ISDN—Basic Rate Interface (BRI)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Provides native support for speech recognition engines including Microsoft* SAPI, Nuance*, Phillips* SpeechPearl*, and SpeechWorks*</li> <li>▪ Designed/tested for Windows NT* and Windows* 2000 operating systems</li> <li>▪ Transparent support for R4 and Global Call* APIs</li> <li>▪ Available for System Release 5.1</li> <li>▪ Supports 15 languages including Cantonese, Dutch, English, French, Mandarin, and Spanish</li> <li>▪ Supports regional language differences such as British and American English, and Latin American and Castilian Spanish</li> </ul>

### CT Application Development Environment

The following are the descriptions and Item Market Names for the latest releases.

ITEM MARKET NAME	DESCRIPTION
CTADE0PROGKEY	0 port, programmable key
CTADE0PRGKEYUSB	0 port, programmable key USB
CTADE2DEVKEY	Version 8.2, 2-port development kit
CTADE2RT	2-port, Runtime hardware key

ITEM MARKET NAME	DESCRIPTION
CTADE4RT	4-port, RunTime hardware key
CTADE8RT	8-port, RunTime hardware key
CTADE12RT	12-port, RunTime hardware key
CTADE16RT	16-port, RunTime hardware key
CTADE24RT	24-port, RunTime hardware key
CTADE24DEVKEY	Version 8.2, 24-port development kit
CTADE30RT	30-port, RunTime hardware key
CTADE30DEVKEY	Version 8.2, 30-port development kit
CTADE48RT	48-port, RunTime hardware key
CTADE60RT	60-port, RunTime hardware key
CTADE64RT	64-port, RunTime hardware key
CTADE72RT	72-port, RunTime hardware key
CTADE96RT	96-port, RunTime hardware key
CTADE120RT	120-port, RunTime hardware key
CTADE128RT	128-port, RunTime hardware key
CTADE192RT	192-port, RunTime hardware key
CTADE240RT	240-port, RunTime hardware key
CTADE256RT	256-port, RunTime hardware key
CTADE2DEVKEYUSB	Version 8.2, 2-port development kit USB
CTADE2RTUSB	2-port, RunTime hardware key USB
CTADE4RTUSB	4-port, RunTime hardware key USB
CTADE8RTUSB	8-port, RunTime hardware key USB
CTADE12RTUSB	12-port, RunTime hardware key USB
CTADE16RTUSB	16-port, RunTime hardware key USB
CTADE24RTUSB	24-port, RunTime hardware key USB
CTADE24DEVKEYUSB	Version 8.2, 24-port development kit USB
CTADE30RTUSB	30-port, RunTime hardware key USB
CTADE30DEVKEYUSB	Version 8.2, 30-port development kit USB
CTADE48RTUSB	48-port, RunTime hardware key USB
CTADE60RTUSB	60-port, RunTime hardware key USB
CTADE64RTUSB	64-port, RunTime hardware key USB
CTADE72RTUSB	72-port, RunTime hardware key USB
CTADE96RTUSB	96-port, RunTime hardware key USB
CTADE120RTUSB	120-port, RunTime hardware key USB
CTADE128RTUSB	128-port, RunTime hardware key USB
CTADE192RTUSB	192-port, RunTime hardware key USB
CTADE240RTUSB	240-port, RunTime hardware key USB
CTADE256RTUSB	256-port, RunTime hardware key USB

# Telecom System Software

## INTEL® DIALOGIC® SYSTEM RELEASE SOFTWARE

Intel® Dialogic® System Release Software is a collection of software components used to build and operate solutions that use the latest features of Intel® Dialogic® and Intel® NetStructure™ board products. This includes host software, downloadable firmware, software development tools (SDKs), and management utilities. The software has a high level of interoperability and typically includes significant infrastructure enhancements. It is designed for broad distribution with a complete uninstall/install required.

### Intel® Dialogic® System Release 6.0 PCI for Windows\*

The Intel® Dialogic® System Release 6.0 PCI for Windows\* (Intel® Dialogic® SR 6.0 PCI for Windows) enables higher-density solutions with increased usability and flexibility that use Intel® Dialogic® and Intel® NetStructure™ boards. This release supports new and enhanced telecom products from Intel, along with major enhancements to existing capabilities. This release provides support for the new Intel® NetStructure™ DMV600BTEP, DMV1200BTEP, and DMV3600BP combined media boards and the Intel Dialogic DMV160LPHIZ high-impedance board.

Intel® Dialogic® Continuous Speech Processing Technology (which enables high-quality speech recognition), Global Call\* (which provides a uniform call control interface), and the IP Media Library (which controls media on IP devices), all have new capabilities enabling more robust solutions. Intel® Dialogic® SR 6.0 PCI for Windows\* adds support for the Windows 2003 operating system in addition to supporting the Windows XP and Windows 2000 operating systems.

### Intel® Dialogic® System Release 6.0 CompactPCI\* for Windows\* and Linux\*

The Intel® Dialogic® System Release 6.0 CompactPCI\* for Windows and Linux\* is a telco-ready release that includes support for the high-density product line featuring the Intel® NetStructure™ IPT boards, the Intel® NetStructure™ DMN160TEC Network Interface Board, and the Intel® NetStructure™ DM/V-A combined media and high-density station interface (HDSI) boards.

Intel Dialogic SR 6.0 CompactPCI supports high availability features such as peripheral hot swap (PHS) and warm redundant system slot (RSS), full SNMP support, fault management (detection, diagnosis, isolation, recovery, and repair), remote management, faster system download and initialization, and more. Intel® Dialogic® Continuous Speech Processing (Intel® Dialogic® CSP) and conferencing software modules can be implemented and scaled to hundreds of speech—and audio conferencing—enabled ports and still deliver high-quality speech recognition and conferencing effectively. By adding these capabilities, Intel provides OEMs with the building blocks they need to deliver robust carrier-grade solutions that use less hardware resources and space, resulting in decreased development, deployment, and operating costs.

### Intel® Dialogic® System Release 5.1.1 FP1 for Windows\*

The Intel® Dialogic® System Release 5.1.1 Feature Pack 1 for Windows (Intel® Dialogic® SR 5.1.1 FP1) adds support for Windows XP Professional, as well as support for all products and features supported in previous Intel Dialogic SR 5.x releases. New products supported include the new Intel® Dialogic® DMV160LP Combined Media Board, Intel® Dialogic® CPI/400BRI PCI Fax Board, and the new Intel® Dialogic® DISI16R2, DISI24R2, and DISI32R2 switching boards. Intel Dialogic SR 5.1.1 FP1 also includes newly-enhanced features for some current board products including the Intel® Dialogic® DI0408LSA Switching Board and the new Intel® Dialogic® DI0408LSAR2 Switching Board.

### **Intel® Dialogic® System Release 5.1.1 for Windows\***

The Intel® Dialogic® System Release 5.1.1 for Windows (Intel® Dialogic® SR 5.1.1) includes supports for the “A” series quad-pan and resource boards, dual-span boards, the high impedance (HiZ) boards from Intel, and the Intel® NetStructure™ High-Density Station Interface boards. All Intel® Dialogic® SR 5.0 and Intel® Dialogic® SR 5.01 supported products and features are also supported in Intel® Dialogic® SR 5.1.1.

### **Intel® Dialogic® System Release 5.1 Feature Pack 1 for Linux\***

The Intel® Dialogic® System Release 5.1 Feature Pack 1 for Linux (Intel® Dialogic® SR 5.1 FP1 for Linux) supports Red Hat\* 7.2 and 7.3 and introduces support for several new features and the new Intel® Dialogic® D/4PCIU voice boards. Intel® Dialogic® SR 5.1 FP1 enhances the IP capabilities by adding support for host-based call control on DM/IP boards, adding IP Media Library support of RFC 2833 and T.38 fax, and Global Call API support for H.323 and SIP protocol stacks.

In addition to supporting all previous features and products from Intel Dialogic SR 5.1 for Linux, this release includes support for universal PCI versions of the DM/F and DM/VF boards.

### **Intel® Dialogic® System Release 5.1 for Linux\***

The Intel® Dialogic® System Release 5.1 for Linux (Intel Dialogic SR 5.1) supports the Red Hat 7.1 and 7.2 operating systems, the high-density DM3-based boards, and the entire portfolio of communications boards and all the features found in the Intel Dialogic System Release 5.0 and Intel Dialogic System Release 5.01.

Highlighted in this release are the Intel® Dialogic® DM/V-A boards with enhanced voice processing features and protocols, the DM/IP (100BaseT) boards, and the Intel® NetStructure™ DM/VF integrated T-1/E-1 voice and fax processing products. High availability and high-performance features required for carrier-grade telco, service provider, and large enterprise solutions are also included. Intel Dialogic SR 5.1 also supports lower-density communications building blocks from Intel on Linux platforms for building cost-effective solutions such as interactive voice response (IVR) and messaging for cost-sensitive market segments.

Telcos and high-end service providers require highly available systems to sustain their revenue goals and to minimize their total cost of ownership. Intel Dialogic SR 5.1 for Linux enables solutions using the CompactPCI form factor supporting peripheral hot-swap, SNMP support, on-demand diagnostics, single-board start/stop operation, firmware tracing, faster system download and initialization, and more. Intel Dialogic Continuous Speech Processing Technology and conferencing software modules can be implemented and scaled to hundreds of speech- and audio-conferencing-enabled ports and still deliver high-quality speech recognition and effective conferencing. By adding these capabilities, Intel provides OEMs with the building blocks they need to deliver robust, carrier-grade solutions that use fewer hardware resources and less space, resulting in decreased development, deployment, and operating costs.

## System Release Software Product Line Summary

The following table summarizes the system release software product features. For additional information, refer to the product datasheet index at [http://www.intel.com/network/csp/products/indx\\_aet.htm#srs](http://www.intel.com/network/csp/products/indx_aet.htm#srs)

### SYSTEM RELEASE SOFTWARE

PRODUCT	KEY FEATURES
<b>Intel® Dialogic® System Release 6.0 PCI for Windows*</b>	<ul style="list-style-type: none"> <li>▪ Runs under Windows* 2003, Windows* XP, and Windows* 2000</li> <li>▪ Supports the Intel® NetStructure™ DMV600BTEP, DMV1200BTEP, and DMV3600BP combined media boards</li> <li>▪ Supports the Intel Dialogic DMV160LPHIZ high-impedance board</li> <li>▪ Echo cancellation to 64 mSec support on Intel NetStructure combined media boards</li> <li>▪ Global Call* API support for Call Progress Analysis, call transfer, call hold and retrieve on DM3 boards, and access to SIP message information fields</li> <li>▪ IP Media Library API support for RFC 2833 and T.38 fax</li> <li>▪ Learn Mode and Tone Set API support on Intel NetStructure boards</li> <li>▪ Enhancements to configuration, administration, and diagnostic software make it easier to install, configure, and manage</li> </ul>
<b>Intel® Dialogic® System Release 6.0 CompactPCI* for Windows</b>	<ul style="list-style-type: none"> <li>▪ Runs under Windows 2000</li> <li>▪ Supports standards-based basic peripheral hot-swap (PHS)—PICMG* 2.12 and warm redundant system slot (RSS)</li> <li>▪ Increased fault management (FM) for detection, diagnosis, isolation, recovery, and repair</li> <li>▪ SNMP support that also includes standard DS1 and ISDN MIB (2495) and MIB-II</li> <li>▪ Clocking API and daemon provides clock management (fallback) eliminating system failure from clock faults</li> <li>▪ Command line interface (CLI) for the operation of all boards (start, stop, remove, and diagnose)</li> <li>▪ Locking CompactPCI board ejectors guards against accidental board removal</li> </ul>
<b>Intel® Dialogic® System Release 6.0 CompactPCI for Linux*</b>	<ul style="list-style-type: none"> <li>▪ Runs under Red Hat* 7.3 Linux operating system, offering quick out-of-the-box installation and configuration</li> <li>▪ Same features and products supported as V6.0 for Windows</li> </ul>
<b>Intel® Dialogic® System Release 5.1.1 FP1 for Windows</b>	<ul style="list-style-type: none"> <li>▪ Runs under Windows NT*, Windows 2000, and Windows XP operating systems</li> <li>▪ Same products and features as Intel Dialogic SR 5.1.1 for Windows, plus additional product support and features</li> <li>▪ New products supported—Intel Dialogic DMV160LP Combined Media Board, Intel Dialogic CPi/400-BRI PCI Fax Board, and Rev 2 DI products</li> </ul>
<b>Intel® Dialogic® System Release 5.1.1 for Windows</b>	<ul style="list-style-type: none"> <li>▪ Runs under Windows NT and Windows 2000 operating systems</li> <li>▪ Same products and features as Intel Dialogic SR 5.1 for Windows, plus additional product support and features</li> <li>▪ Enhanced IP Link, expanded fax support, improved high availability</li> </ul>
<b>Intel® Dialogic® System Release 5.1 FP1 for Linux</b>	<ul style="list-style-type: none"> <li>▪ Runs under Red Hat 7.2 and 7.23 operating systems</li> <li>▪ Supports the Intel Dialogic D/4PCIU voice board</li> <li>▪ Host-based H.323 and SIP IP call control</li> <li>▪ Universal PCI versions of Intel NetStructure DM/F and DM/VF boards</li> <li>▪ Global Call API support for H.323 and SIP Protocol stacks</li> <li>▪ IP Media Library support for RFC 2833 and T.38 fax</li> </ul>

**SYSTEM RELEASE SOFTWARE (continued)**

PRODUCT	KEY FEATURES
<b>Intel® Dialogic® System Release 5.1 for Linux*</b>	<ul style="list-style-type: none"> <li>▪ Runs under Red Hat* 7.1 and 7.2 operating systems</li> <li>▪ Quad-span and resource “A” series boards can support up to 120 channels of conferencing in a single slot</li> <li>▪ Dual-span, quad-span, and resource “A” series boards provide up to 120 channels of continuous speech processing, conferencing, or other media processing features</li> <li>▪ HDSI boards provide support for up to 120 analog station devices</li> <li>▪ DM3 voice, fax, and network interface in a single PCI slot offering 24 (T-1) or 30 (E-1) universal ports of voice, tone, fax processing, and network interface available on any call at any time in a 1:1:1:1 ratio</li> <li>▪ DM/IP boards let VoIP calls be connected from the platform to the SCbus</li> <li>▪ Increased high-availability features for carrier-grade solutions, including CompactPCI* peripheral hot-swap (like-for-like replacement)</li> <li>▪ Interactive diagnostics for DM3 technology (POST on-demand)</li> <li>▪ Detects and repairs firmware faults</li> <li>▪ Improved system initialization time</li> </ul>

**System Release Software**

The following are the descriptions and Item Market Names for the latest releases.

ITEM MARKET NAME	DESCRIPTION
SR511WIN	Intel® Dialogic® System Release 5.1.1 for Windows*
SR511WINSPI	Intel® Dialogic® System Release 5.1.1 Service Pack for Windows
SR511WINFP1	Intel® Dialogic® System Release 5.1.1 Feature Pack 1 for Windows
SR51LINUX	Intel® Dialogic® System Release 5.1 for Linux*
SR51LINUXSPI	Intel® Dialogic® System Release 5.1 Service Pack for Linux
SR51LINUXFP1	Intel® Dialogic® System Release 5.1 Feature Pack 1 for Linux
SR60CPCIWIN	Intel® Dialogic® System Release 6.0 for CompactPCI* for Windows
SR60CPCILINUX	Intel® Dialogic® System Release 6.0 for CompactPCI for Linux
SR60PCIWIN	Intel® Dialogic® System Release 6.0 PCI for Windows

# Host Media Processing Software

## INTEL® NETSTRUCTURE™ HOST MEDIA PROCESSING SOFTWARE RELEASE 1.1 FEATURE PACK 1 FOR THE WINDOWS\* OPERATING SYSTEM

Intel® NetStructure™ Host Media Processing (Intel® NetStructure™ HMP) Software performs media processing tasks on general-purpose servers based on Intel® architecture (IA) without the use of specialized hardware. The software provides media services that can be used to build flexible, scalable, and cost-effective next-generation IP media servers.

When installed on a system, the software looks to the customer application like an Intel® telecom board with DM3 architecture, but all media processing takes place on the host processor. To help customers accelerate their time-to-market and migrate their existing applications to IP, the software also supports two direct APIs: R4 for media processing and Global Call\* for call control. Release 1.1 uses a built-in network interface card (NIC) to provide IP connectivity. It also supports the industry-standard H.323 and Session Initiation Protocol (SIP) protocols for call control, and call transfers using the H.450.2 supplementary services protocol.

### Host Media Processing Software Product Summary

The following table summarizes the Host Media Processing product features. For additional information, refer to the product datasheet index at <http://www.intel.com/network/csp/products/8762web.htm>.

## HOST MEDIA PROCESSING SOFTWARE PRODUCT LINE

PRODUCT AND APPLICATIONS	KEY FEATURES
<b>Intel® NetStructure™ Host Media Processing Software Release 1.1 &amp; Release 1.1 Feature Pack 1</b>	<ul style="list-style-type: none"> <li>▪ Supports computing platforms with Intel® Celeron®, Intel® Pentium® III, Intel® Pentium® 4, and Intel® Xeon™ processors with ability to scale up to 120 media processing channels per system</li> <li>▪ Compliant with the ITU H.323 specification for call control</li> <li>▪ Supports voice record/play with automatic gain control and volume control in a variety of file formats including OKI ADPCM, linear A-law and <math>\mu</math>-law PCM, and Wave</li> <li>▪ Supports streaming media over RTP using a G.711 voice coder with choice of packet size (10 ms, 20 ms, and 30 ms) and RFC-2833 DTMF packets</li> <li>▪ Uses built-in Ethernet card for network connectivity</li> <li>▪ Compliant with the ITU H.323 and H.450.2 specifications and IETF SIP for call control</li> <li>▪ IP multicast support</li> <li>▪ Provides a mechanism for integration with any third-party call control or connection control over IP stack</li> <li>▪ Supports streaming media over RTP using the G.711, G.723.a, G.729a, G.729b voice coders</li> <li>▪ Supports the Global Call* and R4 APIs</li> <li>▪ Includes administration tools such as configuration manager and SNMP software</li> <li>▪ Supports voice record/play with AGC control and volume control</li> <li>▪ Detects and generates standard in-band DTMF and user-defined tones</li> <li>▪ Full conferencing features include scalability with a maximum of 120 parties per system</li> <li>▪ Quality of service (QoS) threshold alarms and packet loss reduction</li> <li>▪ T.38 fax termination support</li> <li>▪ Supports Intel® Dialogic® Continuous Speech Processing Technology</li> <li>▪ Supports Windows* 2000, XP, 2003 Server operating systems</li> </ul>
<ul style="list-style-type: none"> <li>▪ Voice mail and messaging</li> <li>▪ IVR and announcements</li> <li>▪ Conferencing server</li> <li>▪ Unified messaging</li> </ul>	

## Intel® NetStructure™ Host Media Processing Software Release 1.1 for the Windows\* Operating System

The following are the Item Market Names and descriptions for the latest releases.

ITEM MARKET NAME	DESCRIPTION
DMIPS10C11W	Conferencing—Includes advanced features such as coach/pupil mode, tone clamping, and active talker notification (one conferencing port)
DMIPS10E11W	Enhanced RTP—Adds the capability of streaming voice over RTP using the G.723.1, G.729a, and G.729b coders to the RTP G.711 resource. Add on top of the RTP G.711 resource (one port of transcoding)
DMIPS10F11W	T.38 fax termination—T.38 fax termination (over UDP) (one port of fax)
DMIPS10I11W	IP call control—Provides call control stacks for the H.323 with H.450.2 supplementary services, and SIP protocols, with Global Call* API support. Can only be used together with the RTP G.711 resource (one port of IP call control)
DMIPS10R11W	RTP G.711—Provides the capability of streaming digitized voice over RTP using the G.711 coder with 10 ms, 20 ms, and 30 ms frames. Required for each RTP session (one RTP stream)
DMIPS10S11W	Speech integration—Integrates host media processing with speech engines for ASR and TTS support by using the continuous speech processing APIs. Add on top of the voice resource (one port of speech)
DMIPS10V11W	Voice—Play with volume control, record with AGC, DTMF, user-defined tone detection and generation, including RFC 2833 and H.245 UII (one port of voice)



# Bridge Products

## TRANSPARENT PCI-TO-PCI BRIDGES

Intel's family of second-generation Transparent PCI-to-PCI bridge chips provides essential building blocks for extending PCI bus capabilities and delivering higher performance for data-intensive applications. With their secondary PCI buses, the Intel® 2115x family enables designers to increase the number of supported PCI slots in x86, Intel® Pentium® processor, PowerPC\* Alpha\*, and other system architectures, and to design multi-component PCI adapter cards with an independent bus on the card.

For improved performance, Intel's second-generation Transparent PCI-to-PCI bridges are designed for compliance with 2.3 of the PCI Local Bus Specification. In addition, these second-generation bridge products feature support for delayed transactions and have deeper buffers than earlier-generation bridges designed for PCI Revision 2.0. They are compliant with the Advanced Configuration Power Interface (ACPI) and PCI Bus Power Management Specification.

### FEATURES

- Proven PCI technology for extending PCI bus capabilities

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- Compliant with ACPI (Advanced Configuration Power Interface) the Power-Management Interface specification

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- Compliant with PCI (Peripheral Component Interface Specification) Rev. 2.3

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- Increases the number of PCI slots that can be supported in a system and multi-device and multi-function add-in card designs

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- Available in 33 MHz and 66 MHz and 32-bit or 64-bit bus architectures

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- Support for delayed transactions and an advanced buffer architecture

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- JTAG interface and general I/O pins for embedded device designs (see line card)

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- 64-bit PCI bus provides the high bandwidth manufacturers need to deliver high-performance servers and workstations for data-intensive applications

## TRANSPARENT PCI-TO-PCI BRIDGES

BASE PART NUMBER	REVISION	MANUFACTURER PART NUMBER	MAT'L. MASTER PART NUMBER	PROCESS TECH	PRIMARY SPEED	INTERFACE PCI BUS	SECONDARY SPEED	INTERFACE PCI BUS	OTHER JTAG	PRODUCT GPIO	FEATURES PACKAGE	POWER MGMT
21152	BB		835912	854	33 MHz	32 bit	33 MHz	32 bit	No	No	160 PQFP	Yes
21154	AE		821305	854	33 MHz	64 bit	33 MHz	64 bit	Yes	Yes	304 PQFP	Yes
	BE		821308	854	66 MHz	64 bit	66 MHz	64 bit	Yes	Yes	304 PQFP	Yes

Process Technology Key: 854  
Intel® 0.35 micron (854.6)

Customer Technical Questions: 1-800-628-8686  
support@mailbox.intel.com

# PCI-X Bridge Products

## TRANSPARENT PCI-X BRIDGE

Intel's newest member of the PCI discrete bridge chip family is a transparent bridge for the latest, *eXtended* version of PCI architecture—PCI-X. PCI-X provides significantly increased I/O throughput over standard 33MHz and 66MHz PCI modes. Operating at a maximum 133MHz clock frequency, the 64-bit BW31154 provides throughput of up to 1GB/sec—twice the max throughput of 64-bit, 66MHz PCI. It also runs at 66MHz and 100MHz PCI-X frequencies, and also can be operated seamlessly in standard 33MHz or 66MHz PCI speeds for complete compatibility with legacy PCI devices and frequency isolated systems or modules. With the 31154's 10 secondary PCI clocks and other advanced, second-generation PCI-X bridge features, design engineers can readily develop high slot and/or high-density device attach applications in PCI or cPCI form factors for motherboards, add-in cards, backplanes or embedded platforms.

For improved performance, Intel's Transparent PCI-X bridge is designed for compliance with 1.0b of the PCI-X Local Bus Specification. In addition, the highly capable and flexible 31154 features a dynamic 8KB transaction buffer, 5V tolerance for legacy PCI devices, an opaque memory mode (for semi-transparent operation), cPCI hot swap capability and asynchronous clock frequency support.

### FEATURES

Latest PCI-X technology for extending PCI and PCI-X bus capabilities

Compliant with ACPI (Advanced Configuration Power Interface) the Power-Management Interface specification

Compliant with the PCI SIG's PCI-X v 1.0b specification

Increases the number of PCI slots that can be supported in a system or backplane, as well as increasing the number of devices (multi-function and/or multi-device) in add-in cards and HBAs

64-bit bridge supporting 33 MHz and 66 MHz PCI; and 66MHz, 100MHz and 133MHz PCI-X architectures and speeds; in any arrangement between primary and secondary bus segments

Support for PCI-X split transaction protocol and asynchronous clock frequency (25MHz – 133MHz)

JTAG interface and general I/O pins for embedded device designs (see line card)

64-bit PCI/PCI-X bus provides the high-bandwidth hardware vendors need for high-performance enterprise-class desktops and servers, embedded platforms, backplanes and add-in cards.

## TRANSPARENT PCI-TO-PCI BRIDGES

BASE PART NUMBER	REVISION	MANUFACTURER PART NUMBER	MAT'L. MASTER PART NUMBER	PROCESS TECH	PRIMARY SPEED	INTERFACE PCI BUS	SECONDARY SPEED	INTERFACE PCI BUS	OTHER JTAG	PRODUCT GPIO	FEATURES PACKAGE	POWER MGMT
BW31154			857381	859	133MHz	64-bit	133MHz	64-bit	Yes	Yes	421BGA	Yes
Process Technology Key:		859 0.18 micron										

## NON-TRANSPARENT PCI-TO-PCI BRIDGES

Intel's 21555 non-transparent PCI-to-PCI bridge chips enable add-in card vendors to deliver high-performance, intelligent I/O cards and embedded products that previously were not possible. Designed specifically for applications where a processor is used behind a PCI-to-PCI bridge, the chip provides a clean architecture for creating a product with multiple processor domains.

The non-transparent PCI-to-PCI bridge chip provides designers of intelligent controllers and embedded systems with a solution capable of resolving resource conflicts between a PCI-based host system and a PCI-based subsystem. This gives a local processor maximum flexibility in mapping and managing subsystem resources. In addition, this non-transparent bridge product is fully compliant with Revision 2.3 of the PCI specification including delayed transactions. It also features cPCI hot swap capability.

### FEATURES

Independent address spaces and asynchronous clocks deliver unparalleled application flexibility

64-bit primary and secondary bus interfaces deliver high performance for data-intensive applications

Compliant with PCI (Peripheral Component Interface Specification) Rev. 2.3

Secondary bus arbitration support for up to nine bus master devices

Evaluation Design Kit speeds time-to-market

Available in 33 MHz and 66 MHz bus speed

## NON-TRANSPARENT PCI-TO-PCI BRIDGES

BASE PART NUMBER	REVISION	MANUFACTURER PART NUMBER	MAT'L. MASTER PART NUMBER	PROCESS TECH	PRIMARY SPEED	INTERFACE PCI BUS	SECONDARY SPEED	INTERFACE PCI BUS	OTHER JTAG	PRODUCT GPIO	FEATURES PACKAGE	POWER MGMT
21555	A	Intel	848191	854	33 MHz	64 bit	33 MHz	64 bit	Yes	Yes	304 PBGA	Yes
	BB	Intel	848192	854	66 MHz	64 bit	66 MHz	64 bit	Yes	Yes	304 PBGA	Yes
Process Technology Key:		854 Intel® 0.35 micron (854.6)										

Customer Technical Questions: 1-800-628-8686  
support@mailbox.intel.com

## PCI-X SERIAL ATA HOST DISK CONTROLLER

Intel's 31244 PCI-X Serial ATA Host Disk controller is a 4-port, 1.5Gbps Host Controller backwards compatible with Parallel ATA software and drivers. Using the 31244 host Serial ATA controller, system and storage vendors can provide high-performance, low-cost disk controller and RAID 0, 1 and 10 capability on motherboards, storage/RAID cards or external disk/storage subsystems for DAS, SAN or NAS solutions. Designed with features such as Direct Port Access (independent, concurrent port control) and dedicated DMA channel for each port, the 31244 PCI-X Serial ATA host disk controller takes the inherent advantages of PCI-X and Serial ATA 150MBs (per port) architectures even further with sophisticated features and enterprise extensions to SATA I—such as LED, enhanced voltage, drive hot plug and powerful Serial ATA (native) Command Queuing support. In addition, the 31244 controller is backwards compatible with PCI 33MHz and 66MHz speeds (32-bit or 64-bit bus modes), as well as supporting PCI-X 66MHz, 100MHz and 133MHz in 64-bit mode.

### FEATURES

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Four Serial ATA channels/ports at 1.5Gbps (150MBs) each

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PCI-X 1.0a-compliant 64-bit bus width running at 133, 100 or 66MHz speeds; backwards compatible with 32-bit or 64-bit PCI v 2.3 running at 33 or 66MHz speeds

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Direct Port Access (DPA mode or Master/Master) control over each Serial ATA port

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Dedicated DMA channel for each Serial ATA port

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Parallel ATA mode (Master/Slave) support

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Serial ATA Command Queuing with support for up to 32 queue pairs

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RAID 0, 1, 10 (including boot support and pre-O/S utility)

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Supports hot-plug Serial ATA hard disk drives

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Activity LED support for each driver, or one LED for the system

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Enhanced voltage support for storage/HDD backplane applications

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DPA Mode software drivers for Windows\* 2000, Windows XP and Windows CE .NET; and Linux\* Redhat 8.0

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NOTE: In addition, a Host Bus Adapter (HBA) card and Customer Reference Board (CRB) are available.

# MCS<sup>®</sup> 96 Microcontrollers

## A POWERFUL FOUNDATION

The Intel<sup>®</sup> MCS<sup>®</sup> 96 microcontroller family of products are popular for 16-bit embedded microcontrollers. The 8XC196 products are found in a variety of embedded applications. The high-performance register-to-register architecture is well suited for complex real-time control applications such as industrial controllers, automation, printers, pattern recognition and motor control. Our broad portfolio of 8XC196 microcontroller products has been designed to meet your varying peripheral, memory size, addressability, serial communications and performance requirements.

The 8XC196 family shares a common core architecture which is register based. This register-based architecture eliminates the accumulator bottleneck seen in most other microcontroller families and enables fast context switching. All devices have bit, byte, word and some 32-bit operations. The table below summarizes the capture and generation of high-speed signals on the HSIO and EPA.

OPERATION	16 MHz	20 MHz	25 MHz	50 MHz
HSI (High-speed input)	1.125 us	900 ns		
HSO (High-speed output)	1 us	800 ns		
EPA (Event processor array)	250 ns	200 ns	160 ns	80 ns

The 8XC196 Bus Controller features programmable wait-state generation, 8- or 16-bit bus width, and features a HOLD/HLDA protocol for multiprocessor applications. The 8XC196NP/NU have dynamically selectable multiplexed/demultiplexed bus and a chip select unit.

The MCS 96 microcontroller product family has three distinct product lines. The most recent products form the EPA (Event Processor Array) family. This family of devices has the advanced peripherals which include a flexible input/output system and the EPA module itself. The HSIO family consists of devices that have the High-Speed Input/Output subsystem. The Motor Control family is comprised of devices that support motor control applications. This last family also uses the EPA system for I/O control.

The majority of the MCS96 microcontrollers product family is offered with on-chip EPROM (size vary) and some have on-chip CAN 2.0. The advanced 88CO196EC microcontroller offers high level of integration with on chip Flash (256Kbyte) and CAN 2.0.

FEATURES COMMON TO ALL MCS® 96 PRODUCTS	BENEFITS
16-bit CPU	<b>High performance.</b> Up to 50 MHz
On-chip memory	<b>Low cost.</b> Cost-effective solution
Register-to-register architecture	<b>Efficient.</b> More compact code than accumulator-based architecture, which allows more efficient use of memory (no accumulator bottleneck for any operations/computations) <b>Unlimited usage.</b> Minimum of 232 registers can be directly addressed at any time
Three operand instructions	<b>Create efficient code.</b> Reduces data memory usage
Bus controller features programmable wait-state generation and bus widths	<b>Economical.</b> Efficient usage of wide variety of memory and 8- or 16-bit peripheral devices
Flat addressability of large register files	<b>Fewer barriers.</b> Avoids artificial limitation and barriers of segmented files
Three distinct product lines: <ul style="list-style-type: none"> <li>▪ event processor array (EPA)</li> <li>▪ high-speed input/output (HSIO)</li> <li>▪ motion control (MC)</li> </ul>	<b>Advanced.</b> Peripherals include configurable input/output ports and modular event processor array structure <b>Speed.</b> Devices with high-speed input FIFO and output system <b>Waveform.</b> Uses waveform generator and event processor array system for input/output

### MCS® 96 Microcontroller Family—High-Speed Input/Output

Intel designed the HSIO family for applications that require high-speed input and output and closed-loop event control. These devices can lock events in the high-speed output unit (CAM), which allows you to repeat events with no software overhead. The HSIO family comprises the 8X196KB, 8XC196KC, 8XC196KD and 88CO196EC.

The CHMOS version (denoted with a “C,” i.e., 8XC196) is code- and peripheral-compatible with the obsolete NMOS products. The HSIO allows interrupt servicing in the background with minimal CPU overhead and reduces external components for temperature control, strain gauge and motion detection, providing an attractive solution for applications that need accurate timing for multiple events.

FEATURES FOUND ON HSIO PRODUCTS	BENEFITS
Register-to-register architecture; up to 1,000-byte register RAM and up to 32K internal OTPROM	<b>Efficient.</b> No accumulator bottleneck, fast context switching
1.4 uSec 16x16 multiply, 2.4 uSec 32/16 divide	<b>Speed.</b> Good math performance for fast and compact calculation loops
8-channel, 8- or 10-bit A/D converter	<b>Fewer components.</b> Reduces external components requirement by integrating A/D functionality on chip
8- or 16-bit external bus	<b>Performance.</b> Optimal memory interfacing
Full-duplex serial port	<b>Tracking.</b> Versatile event tracking
Pulse-width-modulated output	<b>Less overhead.</b> Reduces processor overhead
High-speed I/O subsystem	<b>Timing.</b> For accurate timing of multiple events
Peripheral transition server on KC and KD	<b>Less overhead.</b> Reduces CPU overhead during interrupt servicing
Integrated Flash and CAN on 88CO196EC	<b>Integration.</b> Attractive solution where CAN and/or Flash memory is required, enabling easy upgrade for current 96 users based on the same architecture

## MCS® 96 Microcontroller Family—Motor Control

Intel's Motor Control family provides efficient three-phase AC induction motors, DC brushless motors and inverter applications. The product line features the 8XC196MC, 8XC196MD and 8XC196MH. The 8XC196MC/MD/MH have a unique three-phase waveform generator that enables precise and efficient motor control. All include standard microcontroller peripherals so the same chip can also handle additional functions such as front-panel control. These products are ideal single-chip solutions for reducing system cost. Motor control can also be possible through software using 88CO196EC microcontroller.

FEATURES FOUND ON MC PRODUCTS	BENEFITS
Register-to-register architecture	<b>Efficient.</b> No accumulator bottleneck, fast context switching
Three-phase PWM waveform generator	<b>Ease of operation.</b> Simplifies software and hardware requirements
Up to 12-channel EPA	<b>Timing.</b> High-resolution timing of multiple events
Peripheral transaction server (PTS)	<b>Less overhead.</b> Reduces CPU overhead required to service interrupts
Up to 14-channel A/D converter	<b>Efficiency.</b> Monitors multiple analog signals
16-bit watchdog timer	<b>Reliability.</b> Increases reliability of system
488 MC/MD and 744 MH byte register file, high-performance CPU	<b>Speed.</b> Provides fast context switching, fast instruction execution
On-chip ROM/OTPROM 16K MC/MD and 32K MH	<b>Storage.</b> Available for code and data storage
Frequency generator (MD only)	<b>Applications.</b> For infrared (remote) functionality
Two serial ports (MH only)	<b>Applications.</b> For increased communication capability

## MCS® 96 Microcontroller Family—Event Processor Array (EPA)

The EPA family of devices is ideal for complex, real-time control applications that require a flexible input/output system and yield a finer granularity in timing measurement. EPA products include the 8XC196NT, 8XC196NP, 80C196NU and 80C196EA is the newest addition to this family, operating at 40 MHz and is integrated with a large number of peripherals and 4K of data RAM. The 80C196EA's demultiplexed address/data bus with three chip select outputs make it easier to design low-cost memory solutions. The 88CO196EC is the newest addition to this family, operating at 40MHz and is highly integrated with on-chip 256K Flash and CAN 2.0.

FEATURES FOUND ON EPA PRODUCTS	BENEFITS
Register-to-register architecture	<b>Speed.</b> Fast context switching and compact calculation loops
High-speed capture/compare EPA channels	<b>Precision.</b> Precision event capture, output compare
Peripheral transaction server	<b>Less overhead.</b> Reduces system overhead to service interrupts
Optional ROM on chip when codes are stable; NP is ROM or CPU-only, NU is CPU-only	<b>Solutions.</b> Provides single-chip solutions
Up to 1,000-byte-register RAM	<b>Performance.</b> Fast data manipulation with register space
Up to 31 prioritized interrupt sources	<b>Flexibility.</b> Handles a variety of commands
NP/NU feature dynamic demux/mux address/data bus and chip	<b>Performance.</b> Fast external memory access using commodity or unit with six chip select pins; NP supports 3V operation low-cost memory devices; allows for glueless memory interface; NU provides a clock-doubled performance increase over all MCS® 96 microcontroller devices and approximately twice the performance of the C196NP
Integrated Flash and CAN on 88CO196EC	<b>Integration.</b> Attractive solution where can and/or Flash memory is required, enabling easy upgrade for current 96 users based on the same architecture

## MCS® 96 Microcontroller Family—Integrated CAN 2.0 88CO196EC Microcontroller

The Intel® 88CO196EC contains a highly integrated set of functions, including the CAN2.0 in-vehicle networking protocol, plus an SDU, stack monitor, 16-channel A/D converter, and an enhanced EPA. With the SDU, designers can set a hardware breakpoint for debugging purposes, plus read and write code RAM as well as program the Flash memory through a high-speed, dedicated serial link. The stack monitor detects stack overflow and underflow conditions and invokes a non-maskable interrupt if the stack pointer crosses a user defined boundary. The enhanced EPA, capable of transmitting and receiving Pulse Width Modulation (PWM) signals, handles high-speed input and output events with reduced overhead and trigger A/D conversions. The 16-channel, 8- or 10-bit A/D converter, with an individual register for each channel, supports an auto-scan mode and consumes no CPU overhead.

## MCS® 296 Microcontroller—Advanced 16-Bit Controller with DSP Capability

Intel's MCS® 296 microcontroller is the latest addition to the Intel MCS 96 microcontroller family. The 80296SA is performance enhanced compared to the 8XC196NP and 8XC196NU controllers. The 80296SA is designed to be binary-code compatible with the 8XC196NP/NU products, and can be directly dropped into an 8XC196NP/NU socket with an immediate boost to system performance.

The 80296SA exhibits improved math performance over previous architectures making it suitable for embedded digital signal processing and feedback control systems. The 80296SA can perform at 12.5 DSP MIPS and 16 general-purpose MIPS. The 80296SA has 512 bytes of register RAM and 2 Kbytes of code/data RAM and utilizes the same peripherals as the 8XC196NP/NU. Additionally, like the 8XC196NU, the 80296SA includes a phase-lock loop. With this peripheral, an external clock drives the device at one-half or one-quarter the maximum internal clock frequency allowing the system to use low-frequency external clock or oscillators while maintaining the maximum internal operating frequency. Enhancements to the chip select unit, the interrupts, and the timers are also implemented. The MCS 96 windowing scheme was enhanced in the 80296SA to include the windowing of some external memory locations for direct addressing, thus improving the overall efficiency of external memory instructions.

FEATURES	BENEFITS
50 MHz Operation	<b>Speed.</b> Higher performance
Binary-code compatible with Intel's 8XC196NU/NP	<b>Cost.</b> Protect existing software investment microcontrollers
Pipelined architecture/reduced execution states	<b>Faster.</b> Up to five times faster than the 8XC196KC20
6 Mbyte of address space	<b>Memory headroom.</b> More memory headroom for high-level language compilation
2 Kbytes code/data RAM	<b>High-speed code memory.</b> More space to store data
40-bit accumulator	<b>Added signal processing capability.</b> Multiply and accumulate executes in 80 ns using 40-bit hardware accumulator. Useful in signal processing and feedback control system
512 bytes register RAM	<b>Fast data manipulation.</b> Within register space

## MCS® 296 Microcontroller Development Tools

The Intel MCS 296 controller is complemented by an extensive set of hardware and software tools from Intel and leading third-party development tool vendors. Software development is supported by ANSI C compiler, assembler, linker/locator, debugger, and simulators from Tasking, IAR, and ChipTools. Hardware design and debug is supported by In-Circuit Emulators from Nohau\*.

Product evaluation is facilitated using Intel's 296SA Eval Kit. This kit includes a board, debug monitor, and evaluation copies of third-party software development tools to facilitate code development and execution.



## MCS® 96 Microcontroller Development Tools

The Intel MCS 96 microcontroller product family is supported by a variety of development tools, and evaluation boards.

Complete sets of development tools and C compilers are available from third-party vendors. Third-party vendors also support development tools for in-circuit emulation. For more information about development tools support, contact your Intel sales representative or visit the Web site at: <http://appzone.intel.com/toolcatalog/>

## MCS® 96 Microcontroller family—CAN Product family

Intel has developed a complete product family that supports the Controller Area Network (CAN) protocol. Intel offers the CAN capability as either a standalone communications controller or integrated onto high-performance 16-bit Microcontroller. CAN is a development of Robert Bosch GmbH and was designed specifically for high-speed in-vehicle networking. CAN is widely accepted in automotive applications and supports high-speed networking standards such as DeviceNet\* and SDS\*, that are used in industrial control and factory automation. CAN utilizes a multi-master bus configuration for the transfer of communication objects between nodes of the network.

All members of the Intel® CAN product family utilize the features of the 82527-standalone communications controller and are software compatible. They all support the standard and extended message identifier CAN specification 2.0 part B.

## CAN—Standalone Communications Controller—82527

The 82527 serial communications controller, which is a joint development of Robert Bosch GmbH and the Intel Corporation, is a highly integrated device that performs serial communication according to the CAN protocol. It features advanced message filtering, I/O port reconstruction, and storage for 15 message objects and multiple CPU interface options.

FEATURES	BENEFITS
CAN specification 2.0	Capable of transmitting, receiving, and performing message filtering on extended message frames
Programmable global mask	Allows users to globally mask any identifier bits of the incoming message.
Two 8-bit bidirectional I/O Ports	Two 8-bit I/O ports for communication with external peripherals/CPU, allowing two-way communications
Flexible CPU Interface	Ability to directly interface with many different CPUs
Programmable message objects of 8-byte data length	Message object can be configured as either transmit or receive

## CAN—16-bit Microcontroller with Integrated CAN

Intel has combined the 82527 CAN protocol controller with the industry-standard MCS® 96 16-bit Microcontroller architecture on one chip. The result is a family of integrated Microcontrollers well suited for a variety of real-time event control applications that require high-speed networking. Integrating CAN on the CPU decreases printed circuit board area, allows faster access to CAN messages and reduces overall system cost. All members of the MCS 96 family have bit, byte, word and some 32-bit operations. The 87C196CA and 87C196CB microcontrollers with integrated CAN provide an upgrade path for the members of the 87C196Kx/87C196Jx families.

### 16-bit Microcontroller with Integrated CAN-TN87C196CA

TN87C196CA has a similar memory and peripheral set similar to the 87C196JT including 32Kbytes of on-chip OTPROM, 1Kbytes of on-ship register RAM and 256 bytes of code RAM. This product is suited for applications requiring real-time event control such as anti-lock braking systems, 4-cylinder engine control and programmable logic controllers.

FEATURES	BENEFITS
Integrated CAN 2.0	Built-in CAN 2.0 capability, reducing overall application cost
6 high-speed capture/compare EPAs	High-resolution timing of multiple events
Up to 38 I/O ports	High interface potential with external peripherals
Full duplex synchronous serial I/O port (SSIO)	Enables communication with other SSIO-equipped peripherals
Configurable 8- or 16-bit external bus	Works with various external peripherals vs. just 8 or 16-bit peripherals

### 16-bit Microcontroller with Integrated CAN-TN87C196CB

TN87C196CB is a highly integrated superset of the 87C196CA. It contains all 87C196CA features, and additional memory, more I/O capability, user-selectable 4X PLL clock multiplier and additional features.

The 87C196CB provides a compatible upgrade path for the 87C196CA applications, such as 4 or 6 cylinder engine control, integrated vehicle dynamics, programmable logic controllers and motor controls.

FEATURES	BENEFITS
Integrated CAN 2.0	Built-in CAN 2.0 capability, reducing overall application cost
Up to 56 I/O port Pins	Extremely high interface potential with external peripherals
1 Mbytes external addressing	More memory headroom for high-level language compilation
4X PLL Clock multiplier	Greater flexibility in choosing an external clocking source
56 Kbytes on-chip OTPROM	Highest internal memory available for all Intel® 16-bit controllers
1.5 Kbytes on-chip register RAM	Fast data manipulation with register space

**MCS® 96 MICROCONTROLLER LINE CARD**

PRODUCT	SPEED (MHz)	ROM/OTPROM	REGISTER RAM	CODE RAM	I/O PINS	I/O TYPE	SERIAL PORTS	ANALOG INPUT CHANNELS	ADDRESS SPACE	PKG	TEMP	KEY FEATURES
<b>HSIO FAMILY</b>												
8XC196KB	16	168K	232	NO	48	HSIO	1	8	64K	N-68, S-80	C, E, A	Low-cost entry level, suitable for replacing NMOS 8X9X
8XC196KC20	20	16K	488	NO	48	HSIO	1	8	64K	N-68, S-80, SB-80	C, E, A	16K OTPROM, 488-byte RAM 3-PWM, PTS
8XC196KD/	16, 20	32K	1000	NO	48	HSIO	1	8	64K	N-68, S-80, SB-80	C, E, A	32K OTPROM, 1000-byte RAM Version of KC
8XC196KD20 Timer Counters = 2; Once Test Mode = Yes; Process = CMOS												
<b>MOTION CONTROL FAMILY</b>												
8XC196MC	16	16K	488	NO	53	8 EPA	PTS MODE	13	64K	N-84, S-80, U-64	E	PTS, PWM, 3-Phase Waveform Generator
8XC196MD	16	16K	488	NO	64	12 EPA	PTS MODE	14	64K	N-84, S-80	E	MC Enhancement with Frequency Generator
8XC196MH	16	32K	744	NO	52	6 EPA	2	8	64K	N-84, S-80, U-64	E	Enhanced 3-Phase Waveform Generator with 32K EPROM
Timer Counters = 2; Once Test Mode = Yes; Process = CMOS												
<b>EPA Family</b>												
87C196CA	20	32K	1000	256	44	6 EPA	2	6	64K	N-68	E	Integrated CAN 2.0 controller
87C196CB	20	56K	1.5K	512	56	10 EPA	2	8	1M	N-84	E	Integrated CAN 2.0, 1 MB linear address range, 2K RAM
88C0196EC	40	0	1.26Kb	275	59	15 EPA	3	16	2 MB	NG-132	C,E	Integrated CAN 2.0, 256 Kbytes on chip Flash
8XC196NP	25	4K	1000	NO	32	4 EPA	1	0	1 MB	S-100, SB-100	C	1 MB Linear Address Range, Low Power, 6 Chip select, 3 PWMs, Demux bus
8XL196NP	14	4K	1000	NO	32	4 EPA	1	0	1 MB	S-100, SB-100	C	3V at 14 MHz version of 8XC196NP
8XC196NT	20	32K	1000	512	56	10 EPA	2	4	1 MB	N-68	C, E	High performance and highly integrated controller with 1 MB Address Range
80C196NU	40, 50	0	1000	NO	33, 32	4 EPA	1	0	1 MB	S-100, SB-100	C	1 MB Linear Address Range, 6 Chip Selects, 3 PWMs, Demux bus
80C196EA	40	0	1K	3K	83	17 EPA	3	16	2M	S-160	C	Highly integrated NU-core Controller with Serial Debug Unit
Timer Counters = 2, except 83C196EA = 4; Once Test Mode = Yes; Process = CMOS												

**MCS® 296 PROCESSOR LINE CARD**

PRODUCT	SPEED (MHz)	ROM/OTPROM	REGISTER RAM	CODE RAM	I/O PINS	I/O TYPE	SERIAL PORTS	ANALOG INPUT CHANNELS	ADDRESS SPACE	PKG	TEMP	KEY FEATURES
<b>MCS® 296 Microprocessor Line card</b>												
80296SA	40, 50	0	512	2K	32	4 EPA	1	0	6M	S-100	C	6 MB Linear Address Range, 6 Chip selects, 3 PWM, 40-bit Hardware Accumulator
Timer Counters = 2; Once Test Mode = Yes; Process = CMOS												

**82527 CAN STANDALONE LINE CARD**

PRODUCT	CAN VERSION	I/O PORTS	BIT RATE	MESSAGE OBJECTS	GLOBAL MASK	PROGRAM CLOCKOUT	CPU INTERFACE	PACKAGE	TEMPERATURE
82527	2	Two 8-bit Ports	Up to 1 Mbit	14 (one with programmable mask)	Yes	Yes	8-bit MUX, 16-Bit MUX 8-bit Non-MUX (sync/asynch)	44ld PLCC	E
Packages: C = 48L Ceramic DIP N = 68L PLCC N-52 = 52L PLCC N-68 = 68L PLCC N-84 = 84L PLCC P = 68L Plastic DIP R = 68L Ceramic LCC S = 80L QFP (EIAJ) S-100 = 100L QFP SB-100 = 100L SQFP U = 64L Shrink DIP Temperature Ranges: C = Commercial (0 to 70 degrees C) E = Extended (-40 to 85 degrees C) A = Automotive (-40 to 125 degrees C) To receive more information on Intel's Automotive Products, call (800) 548-4725 and ask for document #272452-01, "The Winning Formula Automotive Brochure."									

# MCS<sup>®</sup> 251 Microcontrollers

## THE NEXT-GENERATION MICROCONTROLLERS

Using advanced modular design techniques, Intel launched the next generation of its 8-bit (80c51) architecture—MCS<sup>®</sup> 251 microcontroller. The MCS 251 microcontroller delivers significantly higher performance of minimum five times simply by recompiling your existing MCS<sup>®</sup> 51 code, and offers a host of other enhanced features including an increase in memory mix and addressing, low power and noise, efficient high-level language support, an enhanced instruction set and other integrated features.

Most importantly, the new architecture maintains binary code and pin compatibility with existing MCS 51 microcontrollers. The MCS 251 microcontrollers will deliver even greater performance through its enhanced and optimized 251 instruction set with no hardware changes to your existing MCS 51 microcontroller application.

FEATURES	8XC251SA/SB/SP/SQ 8XC251TB/TQ BENEFITS
New core architecture	<ul style="list-style-type: none"> <li>▪ Up to 15X performance increase using new MCS 251 microcontroller instructions</li> <li>▪ Significantly reduce RFI</li> <li>▪ Increase efficiency and support of C language programming</li> </ul>
Binary code and pin compatible with MCS 51 microcontroller	<ul style="list-style-type: none"> <li>▪ Hardware investment protected</li> <li>▪ Reduce development time with backward-compatible MCS<sup>®</sup> 51 microcontroller instruction set</li> </ul>
8 Kbytes/16 Kbytes on-chip	<ul style="list-style-type: none"> <li>▪ Flexibility in using different memory options in development and ROM/OTPROM or ROMless version production</li> </ul>
Programmable Counter Array (PCA) supports <ul style="list-style-type: none"> <li>▪ High-speed output</li> <li>▪ Real-time capture and compare</li> <li>▪ PWM</li> </ul>	<ul style="list-style-type: none"> <li>▪ Flexibility and performance enhancement in real-time control applications such as:               <ul style="list-style-type: none"> <li>- Measurement of duty cycle, phase difference and frequency</li> <li>- Real-time interrupt generation and output toggling</li> <li>- Adjustable duty cycle generation</li> </ul> </li> </ul>
Hardware watchdog timer	<ul style="list-style-type: none"> <li>▪ Increased system reliability</li> </ul>
Page mode configuration	<ul style="list-style-type: none"> <li>▪ Increases the performance for external instruction fetch by 2X</li> </ul>
Programmable wait-states (0–3) external wait-pin capability	<ul style="list-style-type: none"> <li>▪ Flexibility in external memory and peripheral interface configuration and</li> <li>▪ Allows the use of either fast or slow memory</li> </ul>
Support seven interrupt sources, each with four interrupt priority levels	<ul style="list-style-type: none"> <li>▪ Increased flexibility for event control applications</li> </ul>
256 Kbytes external memory space	<ul style="list-style-type: none"> <li>▪ Increased capability and flexibility to handle large software requirements</li> </ul>
512/1 Kbyte on-chip RAM	<ul style="list-style-type: none"> <li>▪ Increased internal memory capacity for data manipulation and C language support</li> </ul>

## MCS® 251 Microcontrollers

Intel® 8XC251SA/SB/SP/SQ and Intel® 8XC251TB/TQ microcontrollers provide the performance upgrade path to existing MCS 51 microcontroller with the New Instruction Pipeline, 16-bit internal code fetch and page mode capability giving a performance edge over other microcontrollers. It also has an interface provision for slower external peripherals through its unique configurable wait-states and external wait-pin capability. This significantly reduces RFI design consideration. It also has the ability to execute C code efficiently and coupled with larger RAM size options to enable complex applications thus shortening applications design and qualification time.

The Intel 8XC251TB/TQ is based on the MCS 251 microcontroller architecture and has ALL of the Intel 8XC251SA/SB/SP/SQ peripheral features plus a second programmable serial I/O port (UART). In addition, the Intel 8XC251TB/TQ microcontroller can perform up to 24 MHz frequency and maintains pin and code compatibility with MCS 51/151/251 microcontrollers. Similar with the Intel 8XC251SA/SB/SP/SQ, the Intel 8XC251TB/TQ has 512 bytes or 1 Kbyte of on-chip data RAM options, 8 Kbytes and 16 Kbytes of on-chip ROM or ROMless options, and is available in 44LD PLCC and 40LD PDIP package options.

The Intel 8XC251TB/TQ and Intel 8XC251SA/SB/SP/SQ microcontrollers are an ideal performance upgrade path for all existing MCS 51 microcontroller applications. The high-performance architecture and the advanced features available in the Intel 8XC251TB/TQ and Intel 8XC251SA/SB/SP/SQ also make them ideally suited for applications requiring complex data manipulation functions and real-time control capability such as printers, copiers, scanners, CD-ROM drives, tape drives, POS terminals, modems, digital phones, cellular/wireless handsets and line cards.

## Development Tools and Programming Tools

Intel offers design engineers a variety of hardware and software development tools from some of the industry's leading tools suppliers. High performance, Windows\*-based software, full featured, real-time emulators along with flexible, fully integrated device programming support is available from many of the familiar suppliers currently supporting the MCS 51 microcontroller architecture.

High-performance Windows-based development tools are also available from BSO/Tasking, Franklin/Keil and Production Languages Corporation (PLC). These high-quality tools include ANSI C Compilers, Macro Assemblers, Source Level Debuggers, Object Librarians, Linker/Locators and Instruction Simulators. Full-featured, real-time emulators featuring DOS\* or Windows-based user interface and a variety of host hardware interfaces are offered by Metalink Corporation\* and Nohau Corporation. Flexible, fully integrated device programming support for advanced designs is available from BP Microsystems\*, Data I/O\*, Needham\*, SMS Mikrocomputer-Systeme GmbH\*, and System General Corporation\*.

## MCS® 251 MICROCONTROLLER LINE CARD

PRODUCT	ROM/ EPROM (BYTES)	REGISTER RAM (BYTES)	TIMER/ COUNTERS	SERIAL PORT	ANALOG INPUT CHANNELS	I/O PINS	SPEED (MHz)	PROCESS	PACKAGE	SECURITY	TEMP	KEY FEATURES
87C251SA	8K	1K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS® 251 Architecture, PCA, H/W WDT
87C251SB	16K	1K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
87C251SP	8K	512K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
87C251SQ	16K	512K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
83C251SA	8K	1K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
87C251SA, ROM												
83C251SB	16K	1K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
87C251SB, ROM												
83C251SP	8K	512K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
87C251SP, ROM												
83C251SQ	16K	512K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
87C251SQ, ROM												
80C251SB	ROMless	1K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
80C251SQ	ROMless	512K	3	1	0	32	16	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
83C251TB	16K	1K	3	2	0	32	24	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
83C251TQ	16K	512K	3	2	0	32	24	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
80C251TB	ROMless	1K	3	2	0	32	24	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT
80C251TQ	ROMless	512K	3	2	0	32	24	CHMOS	P, N, TN, TP	L3	C, E	High-Performance MCS 251 Architecture, PCA, H/W WDT

**PACKAGE OPTIONS:**

**D** = 40LD CerDIP, **Ku** = 100LD QFP (Quad Flat Pack), **N** = 44LD PLCC, **N1** = 68LD PLCC, **P** = 40LD PDIP, **P1** = 48LD PDIP, **S** = 44LD QFP (Quad Flat Pack), **Sb** = 100LD SQFP (Shrink Quad Flat Pack), **X** = SmartDie® Product, **P** = 40 Lead Plastic Dual Inline Package at commercial temp, **N** = 44 Lead Plastic Chip Carrier at commercial temp, **TN** = 44 Lead Plastic Chip Carrier at express temp, **TP** = 40 Lead Plastic Dual Inline Package at express temp

**TEMPERATURE RANGES:**

**C** = Commercial (0°C to +70°C), **E** = Extended (-40°C to +85°C), **A** = Automotive (-40°C to +125°C). To receive more information on Intel's Automotive Products, call (800) 548-4725 and ask for document #272452-01, "The Winning Formula Automotive Brochure." **Speed** (MHz): \* = commercial temperature range only.

**Security:** L1 = 1 Lock Bit, L2 = 2 Lock Bits, L3 = 3 Lock Bits, P = Protection

**NOMENCLATURE:**

83C51xx = Mask ROM, 80C5x = Mask ROM, 87C51xx,ROM = FEPROM, 87C5x,ROM = FEPROM, 87C51,ROM = Factory Program ROM

Where available, order Factory Programmed ROM (FEPROM)

Additional product information is always available at <http://developer.intel.com/design/mcs51/>

# MCS<sup>®</sup> 51 Microcontrollers

## THE ORIGINAL 8-BIT MICROCONTROLLERS

Intel's 8-bit MCS<sup>®</sup> 51 microcontroller family consists of CHMOS versions of the original NMOS 8-bit microcontrollers. The MCS 51 microcontroller architecture is optimized for control-oriented applications and provides a variety of fast addressing modes for accessing the internal RAM facilitates byte processing and numerical operations on small data structures. The instruction set provides an extremely useful spread of 8-bit arithmetic instructions, including multiply and divide instructions, logical instructions as well as extensive on-chip support for 1-bit variables as a separate data type, allowing direct bit manipulation and testing in control and logic systems that require Boolean processing.

Intel offers a wide variety of MCS 51 controllers with different levels of on-chip peripherals and memory. The MCS 51 microcontroller family includes versions with on-chip EPROM, One-Time Programmable (OTP) and ROM memory, as well as CPU-only microcontrollers. Intel's proven CHMOS technology provides lower power, higher integration and higher performance for the MCS 51 product line.

FEATURES COMMON TO ALL MCS <sup>®</sup> 51 PRODUCTS	BENEFITS
8-bit CPU optimized for event control	<b>Efficient.</b> Event control design
Boolean processing	<b>Ease.</b> Simple bit manipulation <b>Flexibility.</b> Enables single-chip designs
On-chip peripherals (timer/counters, serial ports, I/O ports, PCA, etc.)	<b>Integration.</b> High integration enables low-cost and low-chip-count designs
Extensive software and hardware programming support	<b>Easy to use.</b> Simplifies your design cycle

## MCS<sup>®</sup> 51 Microcontroller Family—Classic

Intel's 8-bit MCS 51 Classic family is a leading choice for embedded control. Intel offers a wide variety of on-chip memory in both EPROM and ROM options, as well as CPU-only microcontrollers. Intel's proven CHMOS technology provides lower power, higher integration and higher performance.

FEATURES FOUND ON MCS <sup>®</sup> 51 CLASSIC PRODUCTS	BENEFITS
8-bit CPU optimized for event control	<b>Efficient.</b> Event control design
Boolean processing	<b>Ease.</b> Simple bit manipulation
On-chip memory (up to 32K)	<b>Solutions.</b> Enables single-chip designs
On-chip peripherals (timer/counters, serial ports, PCA, etc.)	<b>High integration.</b> Enables low-cost and I/O ports, low-chip-count designs

## MCS<sup>®</sup> 51 Microcontrollers—Expanded RAM

The 8XC51RA/RB/RC provides additional on-chip RAM from 256 to 512 bytes, making these products ideal if your application requires large on-chip data storage. The Expanded RAM family is peripheral-compatible with the 8XC51FX product line.

FEATURES FOUND ON MCS <sup>®</sup> 51 EXPANDED RAM PRODUCTS	BENEFITS
Expanded internal RAM (512 byte) size	<b>Synergy.</b> More working space on chip, breaks the 256-byte limitation
Dedicated hardware watchdog timer	<b>Control.</b> Improved system integrity control
Functionally compatible with other MCS <sup>®</sup> 51 microcontrollers	<b>Compatibility.</b> Easy migration of existing designs
On-chip peripherals (timer/counters, serial ports, I/O ports, etc.)	<b>High integration.</b> Enables low-cost and low-chip-count designs

## MCS® 51 Microcontroller Development Tools

Complete sets of development utilities and C compilers are available through third-party vendors. Many third-party vendors also provide in-circuit emulator development tools. For more information about development tools support, log on to <http://developer.intel.com/design/mcs51>, or contact your Intel sales representative.

### MCS® 51 CLASSIC FAMILY MICROCONTROLLER LINE CARD

PRODUCT	ROM/ EPROM (BYTES)	REGISTER RAM (BYTES)	TIMER/ COUNTERS	SERIAL PORT	ANALOG INPUT CHANNELS	I/O PINS	SPEED (MHz)	PROCESS	PACKAGE	SECURITY	TEMP	KEY FEATURES
80C31BH	ROMless	128	2	1	0	32	16, 24	CHMOS	D, N, P, S	N/A	C, E	Power Save Modes
80C51BH	4K ROM	128	2	1	0	32	12, 16, 24	CHMOS	N, P, S	P	C, E	Power Save Modes
87C51	4K EPROM/OTP	128	2	1	0	32	16, 24	CHMOS	D, N, P, S	L3	C, E	Three-Level Memory Lock
80C32	ROMless	256	3	1	0	32	16, 24	CHMOS	N, P, S	N/A	C, E	Up-Down Timer/Counter
80C52	8K ROM	256	3	1	0	32	12, 16, 24	CHMOS	N, P, S	L1	C, E	Up-Down Timer/Counter
87C52	8K EPROM/OTP	256	3	1	0	32	16, 24	CHMOS	D, N, P, S	L3	C, E	Up-Down Timer/Counter
87C58, ROM	32K ROM	256	3	1	0	32	12, 16, 24, 33	CHMOS	N, P, S	L1	C, E	Up-Down Timer/Counter
87C58	32K EPROM/OTP	256	3	1	0	32	16, 24, 33	CHMOS	D, N, P, S	L3	C, E	Up-Down Timer/Counter
80C51FA	ROMless	256	3	1	0	32	16, 24, 33	CHMOS	D, N, P, S	N/A	C, E	Programmable Counter Array (PCA), Prog. Clock Out
83C51FA	8K ROM	256	3	1	0	32	12, 16, 24	CHMOS	N, P, S	L1	C, E, A	Programmable Counter Array (PCA), Prog. Clock Out
87C51FA	8K EPROM/OTP	256	3	1	0	32	16, 24, 33	CHMOS	D, N, P, S	L3	C, E, A	Programmable Counter Array (PCA), Prog. Clock Out
87C51FB, ROM	16K ROM	256	3	1	0	32	12, 16, 24, 33	CHMOS	N, P, S	L1	C, E, A	Programmable Counter Array (PCA), Prog. Clock Out
87C51FB	16K EPROM/OTP	256	3	1	0	32	16, 24, 33	CHMOS	D, N, P, S	L3	C, E, A	Programmable Counter Array (PCA) Prog. Clock Out
87C51FC, ROM	32K ROM	256	3	1	0	32	12, 16, 24, 33	CHMOS	D, N, P, S	L1	C, E, A	Programmable Counter Array (PCA), Prog. Clock Out
87C51FC	32K EPROM/OTP	256	3	1	0	32	16, 24, 33	CHMOS	D, N, P, S	L3	C, E, A	Programmable Counter Array (PCA), Prog. Clock Out

### MCS® 51 EXPANDED RAM FAMILY LINE CARD

PRODUCT	ROM/ EPROM (BYTES)	REGISTER RAM (BYTES)	TIMER/ COUNTERS	SERIAL PORT	ANALOG INPUT CHANNELS	I/O PINS	SPEED (MHz)	PROCESS	PACKAGE	SECURITY	TEMP	KEY FEATURES
80C51RA	ROMless	512	3	1	0	32	16, 24	CHMOS	N, P, S	N/A	C, E	Expanded RAM, Prog. Clock out, H/W WDT
87C51RA, ROM												
87C51RA	8K OTP	512	3	1	0	32	16, 24	CHMOS	N, P, S	L3	C, E	Expanded RAM, Prog. Clock out, H/W WDT
87C51RB, ROM												
87C51RB	16K OTP	512	3	1	0	32	16, 24	CHMOS	N, P, S	L3	C, E	Expanded RAM, Prog. Clock out, H/W WDT
87C51RC, ROM												
87C51RC	32K OTP	512	3	1	0	32	16, 24	CHMOS	N, P, S	L3	C, E	Expanded RAM, Prog. Clock out, H/W WDT

#### PACKAGE OPTIONS:

**D** = 40LD CerDIP, **Ku** = 100LD QFP (Quad Flat Pack), **N** = 44LD PLCC, **N1** = 68LD PLCC, **P** = 40LD PDIP, **P1** = 48LD PDIP, **S** = 44LD QFP (Quad Flat Pack), **Sb** = 100LD SQFP (Shrink Quad Flat Pack), **X** = SmartDie®: Product, **P** = 40 Lead Plastic Dual Inline Package at commercial temp, **N** = 44 Lead Plastic Chip Carrier at commercial temp, **TN** = 44 Lead Plastic Chip Carrier at express temp, **TP** = 40 Lead Plastic Dual Inline Package at express temp

#### TEMPERATURE RANGES:

**C** = Commercial (0°C to +70°C), **E** = Extended (-40°C to +85°C), **A** = Automotive (-40°C to +125°C). To receive more information on Intel's Automotive Products, call (800) 548-4725 and ask for document #272452-01, "The Winning Formula Automotive Brochure." **Speed** (MHz): \* = commercial temperature range only.

**Security:** L1 = 1 Lock Bit, L2 = 2 Lock Bits, L3 = 3 Lock Bits, P = Protection

#### NOMENCLATURE:

83C51xx = Mask ROM, 80C5x = Mask ROM, 87C51xx,ROM = FEPROM, 87C5x,ROM = FEPROM, 87C51,ROM = Factory Program ROM

Where available, order Factory Programmed ROM (FPRM)

Additional product information is always available at <http://developer.intel.com/design/mcs51/>



# Interconnect Devices

## PRODUCT OVERVIEW

The Intel® Interconnect Devices provide a combination of flexible integration options, functionality and reliability that helps ensure optimum system-level performance and customer satisfaction.

- Intel® PC Card (PCMCIA) controllers provide a flexible, compact, and reliable solution for software transport, memory upgrade and peripheral connectivity in communications devices and embedded systems.
- Serial Controllers are I/O data communication devices for network applications.
- Parallel Controllers are IEEE 1284-compatible parallel I/O data communication products for peripheral applications.
- WAN Controllers enable leased line, dial-up and packet-based WAN connections for a broad range of communications applications.

PRODUCTS	CONTROLLER CATEGORY	OPERATING TEMPERATURE	PACKAGE	EVALUATION KIT	DESCRIPTION
DZPD6710VCB	PC Card/PCMCIA	Commercial (0°C to +70°C)	LQFP 144 pin	PDK6710ADM12	ISA to PC Card Single-slot
SPD6722QCCE	PC Card/PCMCIA	Commercial (0°C to +70°C)	MQFP 208 pin	PDK6722ADM16	ISA to PC Card Dual-slot
SPD6729QCE	PC Card/PCMCIA	Commercial (0°C to +70°C)	MQFP 208 pin	PDK6729ADM14	PCI to PC Card Dual-slot
SCD140010QCJ	Serial	Commercial (0°C to +70°C)	MQFP 100 pin	CDK1400JAT01A	4 async serial channels at 230.4 Kbps or 3 serial ports and 1 parallel port
SCD186510QCB	Serial	Commercial (0°C to +70°C)	MQFP 100 pin	CDK1865BAT01A	8 async serial channels at 115.2 Kbps
SCD128310QCE	Parallel	Commercial (0°C to +70°C)	MQFP 100 pin	CDK1284EAT02A	IEEE 1284
SCD128410QCE	Parallel	Commercial (0°C to +70°C)	MQFP 100 pin	CDK1284EAT02A	IEEE 1284, 2 serial channels at 115.2 Kbps
SCD240110QCM	WAN	Commercial (0°C to +70°C)	MQFP 100 pin	CDK2401MAT03B	4 async/sync serial channels at 134.4 Kbps
SCD248110QCD	WAN	Commercial (0°C to +70°C)	MQFP 100 pin	CDK2481DAT03B	4 async/sync serial channels at 230.4 Kbps

### PC Card (PCMCIA) Applications

- Routers, bridges, network switches
- Printers
- Test equipment
- Portable handheld systems
- Remote access servers
- Terminal servers
- POS terminals
- Video conferencing using Zoom Video
- DSLAMs (digital subscriber line access multiplexers)
- Vending machines
- Integrated access devices
- PBXs
- Set-top, Internet boxes
- Navigation systems

### Serial Controller Applications

- General-purpose, multi-channel serial communications
- Remote access servers
- Terminal servers
- POS terminals
- Multiport async cards

**Parallel Controller Applications**

- Printers
- Scanners
- Copiers
- Backup systems
- Industrial control systems
- Multi-function devices
- Set-top boxes with printer port

**WAN Controller Applications**

- Branch office routers
- Remote access servers
- Terminal servers
- Protocol converters

# Software

## SOFTWARE FOR EID PRODUCTS

Embedded Intel® Architecture (EIA) system software support is a key platform building block. Software building blocks from Intel such as the Intel® Embedded Computing Firmware Library eases development of EIA designs for faster time-to-market. Enabling software such as device drivers help deliver maximum performance for the advanced features offered on EIA silicon.

### Intel® Embedded Computing Firmware Library

The high rate of technology evolution makes it critical to get to market quickly with innovative, high-performance, connected devices. These sophisticated systems must also meet increasingly demanding application requirements and tighter budget controls. Developers regularly face challenges that threaten their ability to meet schedule, feature, and cost goals. One large challenge is in the area of system initialization. Many applied computing platforms don't require the full set of features provided in a standard PC BIOS. The problem is that developing initialization code is difficult and time-consuming. Intel Embedded Computing Firmware Library can help.

Intel Embedded Computing Firmware Library provides a set of libraries and tools that perform core level initialization of the processor, chipset and memory. Intel Embedded Computing Firmware Library lets developers implement only the components they need, resulting in faster boot times and a smaller memory footprint. In addition, Intel Embedded Computing Firmware Library can significantly reduce the time and cost associated with developing and validating system initialization modules.

Currently, Intel Embedded Computing Firmware Library provides support for component-level initialization of the Intel® Pentium® III, Intel® Pentium® II and Intel® Celeron® processors, SDRAM, the Intel® 440BX AGPset, Intel® 440MX chipset, Intel® 815 and Intel® 815E chipsets and the Intel® E7500 chipset. It presents a simple, clean, 32-bit API consistent with common embedded programming practices regardless which Intel® processor or chipset is being utilized. Figure 1 shows the Intel Embedded Computing Firmware Library version 2 architecture. The API provides an abstraction of the processor and chipset so that if these components change, the developer is no longer required to update any of the "additional initialization code" that may have been developed. Instead, the developer downloads only the version of Intel Embedded Computing Firmware Library supporting the Intel processor and chipset selected for the new design.

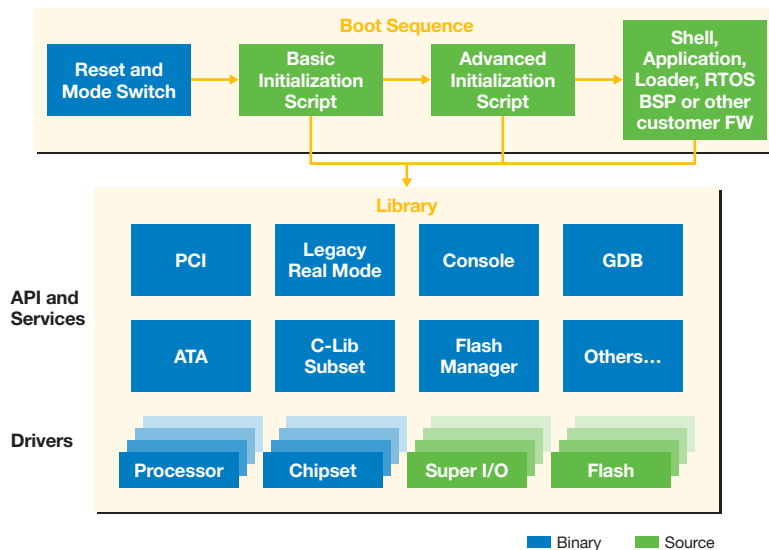


Figure 1: Intel® Embedded Computing Firmware Library Block Diagram

Intel Embedded Computing Firmware Library has the following features:

- Memory and memory controller initialization
- Processor cache initialization, configuration and control
- Initialization of multi-processor system including Hyper-Threading processors
- Installation of processor updates
- Querying of hardware configuration (e.g., installed memory, cache size, etc.)
- PCI enumeration and resource allocation
- Support for PCI expansion ROMs enabling video initialization, PXE boot, SCSI boot, etc.
- IDE initialization and I/O
- Subset of C library
- Support for common OS boot loaders
- GNU debugger (GDB) stub with serial interface which enables early dynamic system test execution, remote debugging of system boot & hardware
- Basic initialization of most components on selected super I/O chips
- Easily extensible subset of real-mode interrupts (i.e., BIOS services)
- System management mode support
- Interrupt handling
- Local and remote consoles with user-extensible, command line shell
- Update boot flash via serial port using YMODEM

### Enabling Software

Enabling software consists of software and tools used to realize maximum performance from Embedded Intel Architecture (EIA) processors and of software, typically referred to as device drivers, used to deliver maximum performance from the features provided by the EIA chipsets.

### Processor Enabling Software

Processor enabling software consists of software tools and utilities used to optimize the application software and operating systems which are targeted to run on a platform with an EIA processor. The following steps may be taken in order to fully optimize any software product for EIA processors:

1. Incorporate Intel® Performance Libraries in the software source code to take advantage of the special processor features. See <http://developer.intel.com/software/products/perflib/> for additional details.
2. Use Intel® Compilers (now with embedded extentions) to compile the software source code to take advantage of special processor instruction sets, such as SSE2. See <http://developer.intel.com/software/products/compilers/> for additional details.
3. Use Intel® VTune™ Performance Analyzers to optimize the software source code flow such that the resultant compiled binary performs significantly better. See <http://developer.intel.com/software/products/vtune/> for additional details.
4. Use Intel’s Threading Tools to add parallelism to software if it is targeted for a Multi-Processing system or for a processor which supports Hyper-Threading Technology. See <http://developer.intel.com/software/products/threadool.htm> for additional details.

These steps apply to any software designated for a platform with an EIA processor, including operating systems. For example, the Intel Compilers may be used to compile the Linux\* operating system kernel in place of the standard Gnu C Compiler for improved performance.

Table 1 identifies the operating systems that have specific processor feature support available.

**TABLE 1 PROCESSOR FEATURES SUPPORTED PER OPERATING SYSTEM**

Major Processor Features	Microsoft Windows NT* 4.0	Microsoft Windows* 98SE	Microsoft Windows* 2000	Microsoft Windows* XP	Microsoft Windows NT* Embedded	Microsoft Windows* XP Embedded	Microsoft Windows* CE 3.0	Microsoft Windows* CE .NET	Linux* 2.4.19	Windows* VxWorks 5.x	QNX* Neutrino v6
Hyper-Threading Technology (Intel® Pentium® 4 Processor feature)	N	N	Y <sup>1</sup>	Y <sup>1</sup>	N	Y <sup>1</sup>	N	N	Y	Y <sup>2</sup>	N
Physical Address Extension (36-bit addressing)	N	N	Y <sup>3</sup>	Y <sup>3</sup>	N	Y <sup>3</sup>	N	N	Y <sup>4</sup>	N	N <sup>5</sup>

<sup>1</sup> See <http://www.microsoft.com/windows2000/server/evaluation/performance/reports/hyperthread.asp> for more information

<sup>2</sup> Hyper-Threading Technology supported as loosely coupled asynchronous multiprocessing design.

<sup>3</sup> See <http://www.microsoft.com/hwdev/platform/server/PAE/default.asp> for more information

<sup>4</sup> See <http://www.intel.com/idf/us/fall2002/presentations/DES124PS.pdf> for more information

<sup>5</sup> Neutrino v6.2.1 provides support for PAE with an explicit model – apps/drivers can access >4G but kernel does not manage this space

### Chipset Enabling Software (Device Drivers)

The device drivers for the EIA chipsets and components improve performance and expose features, such as USB 2.0, ATA/100, or Gigabit LAN. Typically each operating system vendor will provide, with the distribution of their operating system, a set of “native” device drivers which support many of the standard features available on the EIA chipsets which were common at the time of the OS release. For example, Microsoft Windows\* 2000 provides native drivers for the integrated graphics available on the Intel 815 Chipset, while Microsoft Windows NT\* 4.0 will use the default native VGA drivers. In addition, Intel offers the Intel® Embedded Graphics Driver for the Intel® 815/815E, 845GV, 852GME, and 855GME Chipsets which may be installed on either Microsoft Windows XP, eXP, 2000, NT 4.0, CE .NET, and Linux replacing the native drivers and providing enhanced performance and features.

In some cases driver updates are available from the operating system vendor while in other cases updates are only available from Intel. This section is intended to clarify what device drivers are available for the chipsets which are on EIA Division's roadmap and where updates may be found. In addition, some references are included for Intel® Network Adapters. Due to the large variety of operating systems used in embedded markets, only a limited listing is provided.

The paragraphs below describe where the drivers for each operating system are typically found; after that there are tables which describe the drivers available for each supported EIA Division chipset.

## Microsoft\* Operating Systems

The Microsoft operating systems typically have native device driver support for all Intel® chipsets and components up to the time that the operating systems are released. In a few cases, Microsoft will provide Service Packs or may offer Microsoft Windows Updates which include updated drivers that have support for newer features. For example, Windows 2000 was released before USB 2.0 products were widely available. Microsoft has since provided a Service Pack for Windows 2000 that will include drivers for USB 2.0 support. On the other hand, Windows NT 4.0 was released prior to USB 1.1 product availability. Microsoft does not currently, and will not ever, provide any Service Packs that provide USB 1.1 support for Windows NT 4.0.

The embedded versions of the Microsoft operating systems, such as Microsoft Windows XP embedded and Microsoft Windows NT embedded, will typically use the same device driver binary as the standard desktop version of the operating system. The primary difference is the method of installation of the driver binary; with a desktop operating system, an install method, such as Plug and Play, is normally used to find and install on initial boot the appropriate drivers for the hardware features that are present on the platform, while for the embedded operating systems, the OEM customer will use a development environment to include the device driver binary as part of an operating system image built prior to initial boot of the target platform. Because of this, different support files are required for the embedded operating system development environment. However, out of the box, the same level of device driver support will be available from Microsoft for both the desktop version and the embedded version of the operating system. For example, Windows NT 4.0 does not have support for USB 1.1, and Windows NT embedded also does not have support for USB 1.1.

One distinct exception to the native Intel chipset device driver support under the Microsoft operating systems is the Microsoft Windows CE operating system. There are very few native device drivers available for specific EIA components, and only the most rudimentary support is available for generic services, such as IDE and USB.

**TABLE 2 MICROSOFT\* OPERATING SYSTEM DEVICE DRIVER RESOURCES**

ITEM	DESCRIPTION	LOCATION	APPLICABLE MICROSOFT OS*
Microsoft* Updates	Microsoft supplied updates, such as Service Packs and patches, to operating system which may include updated or new native device drivers	<a href="http://windowsupdate.microsoft.com">http://windowsupdate.microsoft.com</a>	Desktop Only <sup>6</sup>
Intel® Network Adapter Drivers	Updates and overwrites the Microsoft-supplied native device drivers for Intel Network Adapters with newer and more advanced features.	<a href="http://support.intel.com/support/network/index.htm">http://support.intel.com/support/network/index.htm</a>	All
Intel® Chipset Software Installation Utility	Installs chipset INF file which describes to the operating system the capabilities of the chipset such that the correct native drivers are loaded.	<a href="http://support.intel.com/support/chipsets/">http://support.intel.com/support/chipsets/</a>	Desktop only <sup>7</sup>
Intel® Application Accelerator	Performance software package for Intel® desktop PCs which provides improved IDE hard drive support for Windows* operating systems, including 48-bit LBA (137+ GB) drive support.	<a href="http://support.intel.com/support/chipsets/">http://support.intel.com/support/chipsets/</a>	All except Windows* CE <sup>8</sup>
Intel® 810, Intel® 815, and Intel® 845GV chipsets graphics drivers	Updates and overwrites the Microsoft-supplied native device drivers, if present, for the internal graphics of these chipsets.	<a href="http://support.intel.com/support/graphics/intel815/">http://support.intel.com/support/graphics/intel815/</a> and <a href="http://support.intel.com/support/graphics/intel810/">http://support.intel.com/support/graphics/intel810/</a> and <a href="http://support.intel.com/support/graphics/intel845g/">http://support.intel.com/support/graphics/intel845g/</a>	Desktop only <sup>9</sup>
Intel® InfiniBand* Architecture resource	Information and tools for developing device drivers for the Intel InfiniBand Architecture.	<a href="http://www.intel.com/technology/infiniband/index.htm">http://www.intel.com/technology/infiniband/index.htm</a>	All
USB 1.1 drivers	Drivers which add generic USB support for the operating system	<a href="http://www.bsquare.com/products/devtools/usbin40/">http://www.bsquare.com/products/devtools/usbin40/</a>	Windows NT* 4.0 and Windows* NT Embedded
USB 2.0 drivers	Drivers which add USB 2.0 support for Windows 2000 and Windows XP only	<a href="http://www.microsoft.com/WindowsXP/pro/downloads/servicepacks/sp1/default.asp">http://www.microsoft.com/WindowsXP/pro/downloads/servicepacks/sp1/default.asp</a> or <a href="http://www.microsoft.com/windows2000/downloads/servicepacks/sp3/default.asp">http://www.microsoft.com/windows2000/downloads/servicepacks/sp3/default.asp</a>	Windows 2000, Windows XP, and Windows XP Embedded

<sup>6</sup> For the embedded operating systems, a new package must be obtained from Microsoft or a Microsoft partner.

<sup>7</sup> For the embedded operating systems, the Intel® Chipset Software Installation Utility is not used because the developer of the embedded image may choose the specific drivers the operating system will use when developing the OS image.

<sup>8</sup> IAA may be installed normally after the Embedded XP or Embedded NT image is created; there are no Embedded components for either of these operating systems.

<sup>9</sup> For Microsoft\* Windows CE 3.0 and Windows CE .NET, device drivers can be found on FDBL, under Applied Computing -> Products -> Chipsets -> [choose chipset] -> Software.

## Linux\* Operating System

The Linux operating system is available in source code form free of charge from <http://www.kernel.org>. The current kernel distribution includes complete support for the majority of the EIA chipsets, with additional support for newer chipsets being added with each new release. Many of the basic device drivers are typically provided with the kernel, and necessary modifications can be made through a source code patch; audio drivers and X server drivers are drivers which are available separately.

Linux vendors, such as Red Hat\*, Agilent\*, MontaVista\*, and LynuxWorks\*, will adopt the standard Linux kernel distribution, make their own modifications, and then redistribute through their own channels. Therefore, their redistribution will have the same EIA devices supported as the Linux kernel they have adopted.

The EIA Division works with the Linux kernel development team to incorporate the support for new features and functionality of EIA chipsets into new kernel distributions when possible; if additional features and functionality is required, Intel FAE/FSE should forward request to the EID Driver Software contact.

**TABLE 3 LINUX\* OPERATING SYSTEM DEVICE DRIVER RESOURCES**

ITEM	DESCRIPTION	LOCATION
Official Linux* kernel distribution Intel® Network Adapter Drivers	Complete source for the Linux operating system which supports a large number of EIA devices Intel®-supplied network drivers for the Linux operating system. Note that the kernel distribution does already have Intel network driver support; these drivers are an alternative. Includes Intel® PRO/100, Intel® PRO/1000, and Intel® PRO/Wireless adapters.	<a href="http://www.kernel.org/">http://www.kernel.org/</a> <a href="http://support.intel.com/support/network/index.htm">http://support.intel.com/support/network/index.htm</a>
Xfree86	Most popular open-source X Window System which runs on Linux; support provided for EIA integrated graphics chipsets.	<a href="http://www.xfree86.org/">http://www.xfree86.org/</a>
Audio driver project	Project to provide extensive audio support for the Linux operating system, including support for the EIA chipsets which have integrated AC'97 controllers.	<a href="http://www.alsa-project.org">http://www.alsa-project.org</a>
USB Project	Effort to enhance USB support for the Linux kernel; USB 2.0 support has been rolled into the standard Linux kernel distribution 2.4.19 and later	<a href="http://www.linux-usb.org/">http://www.linux-usb.org/</a>
Gnu C Compiler (GCC) 3.1	Updated compiler provided with Linux kernel distribution; this version provides some Intel® Pentium® 4 processor optimizations.	<a href="http://gcc.gnu.org">http://gcc.gnu.org</a>
Intel® InfiniBand* Architecture resource	Information and tools for developing device drivers for the Intel InfiniBand Architecture	<a href="http://www.intel.com/technology/infiniband/index.htm">http://www.intel.com/technology/infiniband/index.htm</a>

## Other Real Time Operating Systems (RTOSs)

Other operating systems that are typically used in embedded applications are WindRiver\* VxWorks and QNX\* Neutrino. For Intel® devices, these vendors will develop and support the device drivers on their own.

## Other Embedded Operating Systems

There are a large number of other operating systems that are used in embedded applications. The EIA Division does not typically provide driver support for any of these other operating systems. Two of the most popular operating systems which support EIA chipsets include WindRiver VxWorks and QNX Neutrino. For Intel devices, these vendors will develop and support the device drivers individually.

**TABLE 4 OTHER EMBEDDED OPERATING SYSTEM DEVICE DRIVER RESOURCES**

ITEM	DESCRIPTION	LOCATION
WindRiver* VxWorks v5.x	Most widely adopted real-time operating system in the embedded industry, according to WindRiver.	<a href="http://www.windriver.com/products/html/vxwks5x.html">http://www.windriver.com/products/html/vxwks5x.html</a>
QNX* Neutrino v6	The QNX RTOS provides a powerful, massively scalable, reliable foundation for embedded systems, according to QNX.	<a href="http://www.qnx.com/products/os/rtos6.html">http://www.qnx.com/products/os/rtos6.html</a>
Intel® Network Adapter Drivers	Intel provided distribution of network drivers for the Intel® 82559ER Ethernet component which includes WindRiver-provided VxWorks drivers.	<a href="http://developer.intel.com/design/network/products/lan/controllers/82559er.htm">http://developer.intel.com/design/network/products/lan/controllers/82559er.htm</a>

**INTEL® EMBEDDED CHIPSET DEVICE DRIVER SUPPORT MATRIX**

The following tables describe the device driver support provided for the associated Intel® Embedded Chipsets. The tables are presented in the following order:

- Table 5 Intel® E7500 and Intel® E7501 Chipset—ICH3 south bridge (RGEE7500PL/RGE7501MC + FW82801CA + RG82870P2)
- Table 6 Intel® 845GV Chipset—ICH4 south bridge (RG82845GV + FW82801DB)
- Table 7 Intel® 845E Chipset—ICH4 south bridge (RG82845E + FW82801DB)
- Table 8 Intel® 845 Chipset—ICH2 south bridge (RG82845 + FW82801BA)
- Table 9 Intel® 815E and Intel® 810E2 Chipsets—ICH2 south bridge (FW82815E/FW82810E + FW82801BA)
- Table 10 Intel® 840 Chipset—ICH south bridge (FW82840 + FW82801AA)
- Table 11 Intel® 815E and Intel® 810E2 Chipsets—CICH south bridge (FW82815E/FW82810E + FW82801E)  
(the CICH south bridge is not natively supported by any of the Microsoft operating systems. Check FDBL for the Microsoft OS drivers)
- Table 12 Intel® 815 and Intel® 810 Chipsets—ICH south bridge (FW82815/FW82810 + FW82801AA)
- Table 13 Intel® 440BX Chipset—PIIX4E south bridge (FW82443BX + FW82371EB)
- Table 14 Intel® 440MX Chipset—Integrated south bridge, PIIX4E compatible (FW82443MX100)
- Table 15 Intel® 430TX Chipset—PIIX4 south bridge (FW82439TX + FW82371EB)
- Table 16 Intel® 430HX Chipset—PIIX3 south bridge (FW82439HX + SB82371SB)
- Table 17 Intel® Network Adapters

Each table provides a list of highlighted features for the chipset, and the support available for each OS. For the best performance, it may be necessary to get the most recent drivers available from the sources provided in the operating system sections above.



**TABLE 5 INTEL® E7500 AND INTEL® E7501 CHIPSET – ICH3 SOUTH BRIDGE (RGE7500PL/RGE7501MC + FW82801CA + RG82870P2)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
3x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	Y
3x USB 2.0	N	N	Y <sup>11</sup>	Y <sup>11</sup>	N	Y <sup>11</sup>	N	N	Y	N	N
2x IDE ATA/100	Y <sup>12</sup>	Y <sup>12</sup>	Y	Y	ATA/66	Y	PIO	PIO	Y	Y	Y
1x Integrated LAN	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AC'97 2.2	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y

**TABLE 6 INTEL® 845GV CHIPSET – ICH4 SOUTH BRIDGE (RG82845GV + FW82801DB)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
3x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	Y
3x USB 2.0	N	N	Y <sup>11</sup>	Y <sup>11</sup>	N	Y <sup>11</sup>	N	N	Y	N	N
2x IDE ATA/100	Y <sup>12</sup>	Y <sup>12</sup>	Y	Y <sup>13</sup>	ATA/66	Y <sup>14</sup>	PIO	PIO	Y	Y	Y
1x Integrated LAN	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AC'97 2.2	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
<b>Integrated Graphics:</b>											
Resolution to 1600x1200, color depth to 24bpp	Y	Y	Y	Y	N	N	N	N	Y <sup>15</sup>	N	N
Accelerated 2D features	Y	Y	Y	Y	N	N	N	N	Y	N	N
Accelerated 3D features	Y	Y	Y	Y	N	N	N	N	N	N	N
Accelerated video features	Y	Y	Y	Y	N	N	N	N	Y	N	N
DVO encoder support (includes TV-Out, TMDS, and LVDS devices)	Y	Y	Y	Y	N	N	N	N	N	N	N

<sup>10</sup> USB 1.1 support available separately from third-party vendors

<sup>11</sup> USB 2.0 support available in a Microsoft Windows Update release

<sup>12</sup> ATA/100 and 48-bit LBA (137+ GB) drive support provided in Intel® Application Accelerator utility

<sup>13</sup> 48-bit LBA (137+ GB) drive support provided in Intel® Application Accelerator utility; also will be enabled as part of Service Pack 1

<sup>14</sup> 48-bit LBA (137+ GB) drive support will be enabled as part of Service Pack 1

<sup>15</sup> Advanced graphics features supported in XFree86 4.2

**TABLE 7 INTEL® 845E CHIPSET – ICH4 SOUTH BRIDGE (RG82845E + FW82801DB)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
3x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	Y
3x USB 2.0	N	N	Y <sup>11</sup>	Y <sup>11</sup>	N	Y <sup>11</sup>	N	N	Y	N	N
2x IDE ATA/100	Y <sup>12</sup>	Y <sup>12</sup>	Y	Y <sup>13</sup>	ATA/66	Y <sup>14</sup>	PIO	PIO	Y	Y	Y
1x Integrated LAN	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AC'97 2.2	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y

**TABLE 8 INTEL® 845 CHIPSET – ICH2 SOUTH BRIDGE (RG82845 + FW82801BA)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
3x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	Y
2x IDE ATA/100	Y <sup>12</sup>	Y <sup>12</sup>	Y	Y	ATA/66	Y	PIO	PIO	Y	Y	Y
1x Integrated LAN	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AC'97 2.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y

<sup>10</sup> USB 1.1 support available separately from third-party vendors<sup>11</sup> USB 2.0 support available in a Microsoft Windows Update release<sup>12</sup> ATA/100 and 48-bit LBA (137+ GB) drive support provided in Intel® Application Accelerator utility<sup>13</sup> 48-bit LBA (137+ GB) drive support provided in Intel® Application Accelerator utility; also will be enabled as part of Service Pack 1<sup>14</sup> 48-bit LBA (137+ GB) drive support will be enabled as part of Service Pack 1

**TABLE 9 INTEL® 815E AND INTEL® 810E2 CHIPSETS – ICH2 SOUTH BRIDGE (FW82815E/FW82810E + FW82801BA)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
2x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	Y
2x IDE ATA/66	Y	Y	Y	Y	Y	Y	PIO	PIO	Y	Y	Y
AC'97 2.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y

**TABLE 10 INTEL® 840 CHIPSET – ICH SOUTH BRIDGE (FW82840 + FW82801AA)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
2x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	Y
2x IDE ATA/100	Y <sup>12</sup>	Y <sup>12</sup>	Y	Y	ATA/66	Y	PIO	PIO	Y	Y	Y
1x Integrated LAN	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AC'97 2.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
<b>Integrated Graphics:</b>											
Resolution to 1600x1200, color depth to 24bpp	Y	Y	Y	Y	Y	Y	Y	Y	Y <sup>15</sup>	Y <sup>16</sup>	Y <sup>17</sup>
Accelerated 2D features	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Accelerated 3D features	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Accelerated video features	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
DVO encoder support (includes TV-Out, TMDS, and LVDS devices)	Y	Y	Y	Y	Y	Y	Y <sup>18</sup>	Y <sup>18</sup>	Y <sup>19</sup>	N	N

<sup>10</sup> USB 1.1 support available separately from third-party vendors  
<sup>12</sup> ATA/100 and 48-bit LBA (137+ GB) drive support provided in Intel® Application Accelerator utility  
<sup>15</sup> Advanced graphics features supported in XFree86 4.2  
<sup>16</sup> Advanced graphics features supported in WindML  
<sup>17</sup> Advanced graphics features supported in Photon® MicroGUI  
<sup>18</sup> Limited to Chromtel® CH700x and Silicon Image® 154/164  
<sup>19</sup> Limited to Chromtel® CH7007

**TABLE 11 INTEL® 815E AND INTEL® 810E2 CHIPSETS – CICH SOUTH BRIDGE (FW82815E/FW82810E + FW82801E)<sup>20</sup>**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
2x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	N
2x IDE ATA/100	ATA/66	ATA/66	Y	Y	ATA/66	Y	PIO	PIO	Y	Y	N
2x Integrated LAN	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
<b>Integrated Graphics:</b>											
Resolution to 1600x1200, color depth to 24bpp	Y	Y	Y	Y	Y	Y	Y	Y	Y <sup>15</sup>	Y <sup>16</sup>	Y <sup>17</sup>
Accelerated 2D features	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Accelerated 3D features	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Accelerated video features	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
DVO encoder support (includes TV-Out, TMDS, and LVDS devices)	Y	Y	Y	Y	Y	Y	Y <sup>18</sup>	Y <sup>18</sup>	Y <sup>18</sup>	N	N

**TABLE 12 INTEL® 815 AND INTEL® 810 CHIPSETS – ICH SOUTH BRIDGE (FW82815/FW82810 + FW82801AA)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
2x USB 1.1	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	1x	1x	Y	Y	Y
2x IDE ATA/66	Y	Y	Y	Y	Y	Y	PIO	PIO	Y	Y	Y
AC'97 2.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
<b>Integrated Graphics:</b>											
Resolution to 1600x1200, color depth to 24bpp	Y	Y	Y	Y	Y	Y	Y	Y	Y <sup>15</sup>	Y <sup>16</sup>	Y <sup>17</sup>
Accelerated 2D features	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Accelerated 3D features	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Accelerated video features	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
DVO encoder support (includes TV-Out, TMDS, and LVDS devices)	Y	Y	Y	Y	Y	Y	Y <sup>18</sup>	Y <sup>18</sup>	Y <sup>18</sup>	N	N

<sup>10</sup> USB 1.1 support available separately from third-party vendors<sup>15</sup> Advanced graphics features supported in XFree86 4.2<sup>16</sup> Advanced graphics features supported in WindML<sup>17</sup> Advanced graphics features supported in Photon® MicroGUI<sup>18</sup> Limited to Chronitel® CH700x and Silicon Image® 154/164<sup>19</sup> Limited to Chronitel® CH7007<sup>20</sup> For the Microsoft OS driver support, check on FDBL at Applied Computing -> Products -> Chipsets -> Havasupai -> Software.

**TABLE 13 INTEL® 440BX CHIPSET – PIIX4E SOUTH BRIDGE (FW82443BX + FW82371EB)**

Major Chipset Functions	Microsoft Windows NT* 4.0	Microsoft Windows* 98SE	Microsoft Windows* 2000	Microsoft Windows* XP	Microsoft Windows NT* Embedded	Microsoft Windows* XP Embedded	Microsoft Windows* CE 3.0	Microsoft Windows* CE .NET	Linux* 2.4.19	Windriver* VxWorks 5.x	QNX* Neutrino v6
1x USB 1.0	N <sup>0</sup>	Y	Y	Y	N <sup>0</sup>	Y	Y	Y	Y	Y	Y
2x IDE ATA/33	Y	Y	Y	Y	Y	Y	PIO	PIO	Y	Y	Y

**TABLE 14 INTEL® 440MX CHIPSET – INTEGRATED SOUTH BRIDGE, PIIX4E COMPATIBLE (FW82443MX100)**

Major Chipset Functions	Microsoft Windows NT* 4.0	Microsoft Windows* 98SE	Microsoft Windows* 2000	Microsoft Windows* XP	Microsoft Windows NT* Embedded	Microsoft Windows* XP Embedded	Microsoft Windows* CE 3.0	Microsoft Windows* CE .NET	Linux* 2.4.19	Windriver* VxWorks 5.x	QNX* Neutrino v6
1x USB 1.0	N <sup>0</sup>	Y	Y	Y	N <sup>0</sup>	Y	Y	Y	Y	Y	Y
1x IDE ATA/33	Y	Y	Y	Y	Y	Y	PIO	PIO	Y	Y	Y
AC'97 2.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y

**TABLE 15 INTEL® 430TX CHIPSET – PIIX4 SOUTH BRIDGE (FW82439TX + FW82371EB)**

Major Chipset Functions	Microsoft Windows NT* 4.0	Microsoft Windows* 98SE	Microsoft Windows* 2000	Microsoft Windows* XP	Microsoft Windows NT* Embedded	Microsoft Windows* XP Embedded	Microsoft Windows* CE 3.0	Microsoft Windows* CE .NET	Linux* 2.4.19	Windriver* VxWorks 5.x	QNX* Neutrino v6
1x USB 1.0	N <sup>0</sup>	Y	Y	Y	N <sup>0</sup>	Y	Y	Y	Y	Y	Y
2x Ultra DMA/33	Y	Y	Y	Y	Y	Y	PIO	PIO	Y	Y	Y

<sup>00</sup> USB 1.1 support available separately from third-party vendors

**TABLE 16 INTEL® 430HX CHIPSET – PIIX3 SOUTH BRIDGE (FW82439HX + SB82371SB)**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
1x USB 1.0	N <sup>10</sup>	Y	Y	Y	N <sup>10</sup>	Y	Y	Y	Y	Y	Y
2x Bus Master IDE	Y	Y	Y	Y	Y	Y	PIO	PIO	Y	Y	Y

**TABLE 17 INTEL® NETWORK ADAPTERS**

Major Chipset Functions	Microsoft Windows NT® 4.0	Microsoft Windows® 98SE	Microsoft Windows® 2000	Microsoft Windows® XP	Microsoft Windows NT® Embedded	Microsoft Windows® XP Embedded	Microsoft Windows® CE 3.0	Microsoft Windows® CE .NET	Linux® 2.4.19	Windriver® VxWorks 5.x	QNX® Neutrino v6
Intel® PRO/1000 (includes 82544)	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Intel® PRO/100 Adapters (includes 82557, 82558, 82559, 82550)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Intel® PRO/Wireless Adapters <sup>21</sup> (includes 802.11a and 802.11b adapters)	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N

<sup>10</sup> USB 1.1 support available separately from third-party vendors

<sup>21</sup> Some Wireless adapters are not supported by all operating systems; check supported operating systems at <http://support.intel.com/support/network/wireless/31485.htm>.

# Communications and Embedded Developer's Networks



A community of communications and embedded developers and solution providers

## Intel® Communications Alliance

The Intel® Communications Alliance is a community of communications and embedded developers and solutions providers who share a vision of the convergence of communications and embedded computing technologies. Members of the Intel Communications Alliance include operating systems and tools providers, software providers, hardware providers and integrators. These companies share a commitment to accelerating the convergence of computing and communications based on Intel® technologies, products and services. By networking, building new relationships and working together, members of the Intel Communications Alliance have the opportunity to deliver innovative solutions, in less time at lower cost, and pass these competitive benefits on to their customers. Intel works with community members, providing underlying communications and computing technologies and driving the industry-standard specifications needed for greater choice, stability and opportunities for market segment growth.

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- Communications and computing technologies and industry initiatives
- Solutions development and co-marketing assistance
- Standards leadership

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Membership in the Intel® PCA Developer Network provides application developers, device manufacturers, development tools vendors, and service providers with technical data, marketing support, marketing exposure, marketing opportunities, and industry connections they need to accelerate the innovation and marketing of wireless Internet solutions.

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- Now it is easier to make the industry connections you need through the Intel PCA Developer Network Company Directory.
- The new and enhanced Intel® PCA Developer Network Solutions Catalog provides even faster access to Intel® PCA building blocks, third-party tools, and software.
- Intel PCA Development Support and Technical Support pages deliver the data you need.
- The Intel® PCA Developer Network Newsletter keeps you informed on the latest Intel® PCA wireless solutions.

### Benefits

PCA Developer Network provides access to critical product and software tool information to enable members to bring solutions to the market. Members become part of community to share valuable information to help accelerate the development of wireless solutions. Intel PCA Developer Network provides members the following benefits:

- Advance information
- Access to development tools and platforms
- Software building blocks for applications
- Application and technical support
- Marketing assistance and cooperative marketing opportunities
- Networking and matchmaking opportunities
- Joining the community is easy. Register today at no cost and accelerate your innovation. Please see link:

<http://developer.intel.com/pca/developernetwork/about.htm>

<http://www.intel.com/pca>



# Development Tools and Support

## COMPREHENSIVE SUPPORT FOR EMBEDDED PRODUCTS

Intel is proud of the wide variety of hardware and software development tools available to support you in all phases of the development cycle. Some of the industry's leading tools suppliers are providing high-performance Windows\*-based software; full-featured, real-time emulators; along with flexible, fully integrated device programming support for Intel's embedded products. We are committed to providing the tools and support needed to speed the learning curve and reduce design time. The pages that follow list our tool vendors and contact information, including World Wide Web addresses. Feel free to contact them directly, browse their home site, or look up their tool fact sheets on Intel's Web-based Electronic Tools Catalog at: <http://appzone.intel.com/toolcatalog/>.

### MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Hardware Support

MCS® 196/296 MICROCONTROLLERS	MCS® 51/251 MICROCONTROLLERS	80X86 AND PENTIUM® PROCESSORS	PENTIUM® II, PENTIUM® III AND CELERON® PROCESSORS	PENTIUM® 4 AND XEON™ PROCESSORS
<i>Supports both 196 &amp; 296 Microcontrollers</i>				
<b>ACCESSORIES/ADAPTERS</b>				
Emulation Technology, Inc.	Emulation Technology, Inc. Tribal Microsystems	Adapter Technologies, Inc. Emulation Technology, Inc. Hitex Development Tools GmbH	American Arium Intel Corp.	American Arium Intel Corp.
<b>EMULATORS</b>				
Dr. Krohn & Stiller Huntsville Microsystems Lauterbach Datentechnik GmbH Nohau Corp. Phyton Signum Systems	CEIBO, Inc. ChipTools, Inc. Dr. Krohn & Stiller Emulation Technology, Inc. Agilent Hi-Lo Systems Research HiTech Equipment Corp. Hitex Development Tools GmbH## Huntsville Microsystems ISystems Lauterbach Datentechnik GmbH MetaLink Corp., Inc. Nohau Corp. Signum Systems Tribal Microsystems Mitectek International	American Arium CEIBO, Inc. Hewlett-Packard Company Hitex Development Tools GmbH Microtek International Signum Systems Softaid, Inc. Sophia Systems	Agilent American Arium Applied Microsystems Corp. Microtek International	American Arium
<b>EVALUATION BOARDS AND KITS</b>				
Intel Corp. The Dearborn Group	HiTech Equipment Corp. Intel Corp.	Intel Corp.	Intel Corp.	Intel Corp.
<b>HARDWARE ACCESSORIES—MEMORY &amp; STORAGE</b>				
Forte Design Systems	ITT Cannon Newnex Forte Design Systems	Adtron Corp. AnnaSoft Datalight, Inc. Intel Corp. M-Systems Inc. Microsoft Corp. Phoenix Technologies Syquest Technology	Adtron Corp. AnnaSoft Datalight, Inc. Intel Corp. M-Systems Inc. Microsoft Corp. Phoenix Technologies Syquest Technology	Adtron Corp. AnnaSoft Datalight, Inc. Intel Corp. M-Systems Inc. Microsoft Corp. Phoenix Technologies Syquest Technology
<b>LOGIC/BUS ANALYZERS</b>				
Agilent	Agilent	DLI Digital Logic Instruments GmbH Hewlett-Packard Company Agilent Tektronix, Inc.	Agilent Tektronix, Inc.	Agilent Tektronix, Inc.
<b>PC/104 MODULES</b>				
		Adtron Corp. Ampro Computers, Inc. EEPD Imagenation Corp. Jumptec Motion Engineering, Inc.	Adtron Corp. Ampro Computers, Inc. EEPD Jumptec	

## MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Hardware Support (continued)

MCS® 196/296 MICROCONTROLLERS	MCS® 51/251 MICROCONTROLLERS	80X86 AND PENTIUM® PROCESSORS	PENTIUM® II, PENTIUM® III AND CELERON® PROCESSORS	PENTIUM® 4 AND XEON™ PROCESSORS
<i>Supports both 196 &amp; 296 Microcontrollers</i>				
<b>SINGLE BOARD COMPUTING</b>				
		Advantech American Predator Corp. Ampro Computers, Inc. Carlo Gavazzi Cell Computing Concurrent Technologies Diversified Technology Force Computers HiTech Equipment Corp. I-Bus ICS Advent Itox Jumptec Kontron Micro Industries Microbus Motion Engineering, Inc. Motorola Computer Group Pep Modular Computers Portwell RadiSys Corp. SBS Technologies Trenton Technology VMIC WinSystems	Advantech American Predator Corp. Ampro Computers, Inc. Carlo Gavazzi Cell Computing Concurrent Technologies Diversified Technology Force Computers I-Bus Itox Jumptec Kontron Micro Industries Microbus Motorola Computer Group Pep Modular Computers Portwell RadiSys Corp. SBS Technologies Trenton Technology VMIC WinSystems	Advantech Diversified Technology Force Computers Kontron Nexcom Portwell RadiSys Corp. Trenton Technology
<b>SUPPORT COMPONENTS</b>				
		Intel Corp. National Semiconductor Vadem	Intel Corp. National Semiconductor Vadem	

## MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Hardware Support

i960® PROCESSORS	STRONGARM® PROCESSORS	INTEL® XSCALE™ TECHNOLOGY	INTEL® IXA NETWORK PROCESSORS
<i>Supports I/O Processors</i>		<i>80200/80312 PXA210/PXA250</i>	<i>IXP 220/225/425 IXP 1200/2400/2800</i>
<b>ACCESSORIES/ADAPTERS</b>			
Cyclone Microsystems, Inc. Emulation Technology, Inc. Intel Corp. PLX Technology, Inc. SKY Computers, Inc.			
<b>EMULATORS</b>			
Corelis, Inc. Spectrum Digital, Inc.	Applied Microsystems Corp. ARM, Ltd. Sophia Systems	ARM, Ltd. Embedded Performance, Inc. Lauterbach Datentechnik, GmbH Macraigor Systems LLC Sophia Systems Wind River Systems, Inc.	Applied Microsystems Corp. ARM, Ltd. Embedded Performance, Inc. Lauterbach Datentechnik, GmbH Macraigor Systems LLC Sophia Systems Wind River Systems, Inc.
<b>EVALUATION BOARDS AND KITS</b>			
CompuLab Cyclone Microsystems, Inc. Intel Corp.	Acorn Systems China Business Services Cogent Computer Systems, Inc. GDA Technologies	ADI Engineering Cyclone Microsystems, Inc. Intel Corp. Wind River Systems, Inc.	Intel Corp. RadiSys Corp.
<b>HARDWARE ACCESSORIES—MEMORY AND STORAGE</b>			
Emulation Technology, Inc.			
<b>LOGIC/BUS ANALYZERS</b>			
Agilent DLI Digital Logic Instrument GmbH	Tektronix, Inc.	Agilent Corelis, Inc. Tektronix, Inc.	Agilent New Wave PDG Tektronix, Inc.

**MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Hardware Support**

(continued)

i960 <sup>®</sup> PROCESSORS	STRONGARM <sup>*</sup> PROCESSORS	INTEL <sup>®</sup> XSCALE <sup>™</sup> TECHNOLOGY	INTEL <sup>®</sup> IXA NETWORK PROCESSORS
Supports I/O Processors		80200/80312 PXA210/PXA250	IXP 220/225/425 IXP 1200/2400/2800
<b>PC/104 MODULES</b>			
<b>SINGLE BOARD COMPUTING</b>			
Cyclone Microsystems, Inc.	Accelent Systems, Inc. ADS	ADI Engineering Cyclone Microsystems, Inc.	Force Computers Kontron RadiSys Corp.
<b>SUPPORT COMPONENTS</b>			
Applied Micro Circuits Corp. Galileo Technology, Inc. Intel Corp. V3 Semiconductor		ADI Engineering	

**MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Software Support**

MCS <sup>®</sup> 196/296 MICROCONTROLLERS	MCS <sup>®</sup> 51/251 MICROCONTROLLERS	80X86 AND PENTIUM <sup>®</sup> PROCESSORS	PENTIUM <sup>®</sup> II, PENTIUM <sup>®</sup> III AND CELERON <sup>®</sup> PROCESSORS	PENTIUM <sup>®</sup> 4 AND XEON <sup>™</sup> PROCESSORS
<b>ASSEMBLERS &amp; COMPILERS, LINKERS/LOCATORS</b>				
IAR Systems Phyton, Inc. Tasking	Avocet Systems, Inc. IAR Systems Intel Corp. Keil Elektronik GmbH* Micro Computer Control Corp. Tasking.	Borland International CAD-UL, Inc. Red Hat DDC-I, Inc. Intel Corp. GNU MetaWare, Inc. Metrowerks Microsoft Corp. Rational Software Corp. Thomson Software Products	CAD-UL, Inc. Red Hat Intel Corp. GNU Microsoft Corp.	Red Hat Intel Corp. GNU Microsoft Corp.
<b>BIOS</b>				
		American Megatrends, Inc. AnnaSoft Award Software International, Inc. General Software, Inc. Insyde Software Phoenix Technologies	American Megatrends, Inc. Award Software International, Inc. General Software, Inc. Insyde Software Phoenix Technologies	American Megatrends, Inc. Award Software International, Inc. General Software, Inc. Insyde Software Phoenix Technologies
<b>BOARD TESTERS</b>				
		Antron/Psilogic International Test Technologies	Antron/Psilogic International Test Technologies	Antron/Psilogic International Test Technologies
<b>DEBUGGERS</b>				
ChipTools, Inc. IAR Systems Intel Corp. Tasking Universal Cross-Assemblers	ChipTools, Inc.	AnnaSoft CAD-UL, Inc. Concurrent Sciences, Inc. Embedded Power Corp. Micro Digital, Inc. Microsoft Corp. Paradigm Systems	CAD-UL, Inc. Red Hat GNU Microsoft Corp.	Red Hat GNU Microsoft Corp.
<b>DEVELOPMENT SOFTWARE</b>				
Chip Tools, Inc. IAR Systems Phyton, Inc. Tasking	Avocet Systems	Cogent Real-Time Systems, Inc. Intel Corp. Intrinsyc Software, Inc. Log Point Technologies, Inc.	Cogent Real-Time Systems, Inc. Intel Corp. Intrinsyc Software, Inc.	Cogent Real-Time Systems, Inc. Intel Corp. Intrinsyc Software, Inc.
<b>FUZZY LOGIC SOFTWARE</b>				
Apronix Inform Syndesis				

## MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Software Support (continued)

MCS® 196/296 MICROCONTROLLERS	MCS® 51/251 MICROCONTROLLERS	80X86 & PENTIUM® PROCESSORS	PENTIUM® II, PENTIUM® III AND CELERON® PROCESSORS	PENTIUM® 4 AND XEON™ PROCESSORS
<b>OPERATING SYSTEMS AND REAL-TIME EXTENSIONS</b>				
CMX Company Embedded Systems Products, Inc. IAR Systems	CMX Company Embedded Systems Products, Inc. Signum Systems	Accelerated Technology, Inc. AnnaSoft DataLight, Inc. Embedded Systems Products, Inc. IBM Software Group—OEM Sales Industrial Programming, Inc. Integrated Systems, Inc. JMI Software Systems, Inc. KADAK Products Ltd. LinuxWorks Micro Digital, Inc. Microsoft Corp. Microtec Microware Systems Corp. On Time Marketing Phar Lap Software, Inc. QNX Software Systems Ltd. RadiSys Corp. U.S. Software VenturCom, Inc. Wind River Systems, Inc.	LinuxWorks Microsoft Corp. MontaVista Software QNX Software Systems, Ltd. VenturCom, Inc. Wind River Systems, Inc.	LinuxWorks Microsoft Corp. MontaVista Software QNX Software Systems, Ltd. VenturCom, Inc. Wind River Systems, Inc.
<b>PROGRAMMERS</b>				
Advin Systems, Inc. BP Microsystems, Inc. Data I/O Corp. Needham's Electronics Phyton, Inc. SMS Microcomputer Systeme GmbH Stag Programmers Ltd. System General Corp. (US) Tribal Microsystems	Advin Systems, Inc. BP Microsystems, Inc. CEIBO, Inc. Data I/O Corp. Needham's Electronics Phyton, Inc. SMS Microcomputer Systeme GmbH System General Corp. (US) Tribal Microsystems Zorchip Corporation			
<b>MODELING/SIMULATION</b>				
Chip Tools, Inc. Chronology Corp.		Synopsys, Inc.	Synopsys, Inc.	Synopsys, Inc.
<b>SOFTWARE MODEM</b>				
<b>SOFTWARE TEST/VERIFICATION</b>				
		Applied Microsystems Corp.	Applied Microsystems Corp.	Applied Microsystems Corp.
<b>VOICE RECOGNITION</b>				

## MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Software Support

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<b>ASSEMBLERS &amp; COMPILERS, LINKERS/LOCATORS</b>			
Green Hills Software, Inc. Intel Corp. Irvine Compiler Corp.	ARM, Ltd. Red Hat GNU Green Hills Software, Inc. MetaWare, Inc.	ARM, Ltd. GNU Green Hills Software, Inc. Intel Corp. LinuxWorks MontaVista Red Hat Wind River Systems, Inc.	ARM, Ltd. GNU Green Hills Software, Inc. Intel Corp. LinuxWorks MontaVista Red Hat Wind River Systems, Inc.
<b>BIOS</b>			
<b>BOARD TESTERS</b>			
Corelis, Inc. International Test Technologies		Corelis, Inc.	

**MICROCONTROLLERS, NETWORK AND MICROPROCESSORS – Software Support**

(continued)

i960® PROCESSORS	STRONGARM* PROCESSORS	INTEL® XSCALE™ TECHNOLOGY	INTEL® IXA NETWORK PROCESSORS
<b>DEBUGGERS</b>			
Accelerated Technology, Inc. ARM, Ltd. Green Hills Software, Inc. Integrated Systems, Inc. Intel Corp. Real-Time Innovations, Inc.	ARM, Ltd. Red Hat GNU Green Hills Software, Inc. MetaWare, Inc.	ARM, Ltd. Green Hills Software, Inc. Red Hat LinuxWorks MontaVista Wind River Systems, Inc.	ARM, Ltd. Green Hills Software, Inc. Intel Corp. LinuxWorks MontaVista RadiSys Corp. Red Hat Wind River Systems, Inc.
<b>DEVELOPMENT SOFTWARE</b>			
Green Hills Software, Inc. Intel Corp. Wind River Systems, Inc.	ARM, Ltd. Red Hat GNU Green Hills Software, Inc. MetaWare, Inc.	ARM, Ltd. Accelerated Technology, Inc. Green Hills Software, Inc. Red Hat Wind River Systems, Inc.	Consystant Intel Corp. MontaVista RadiSys Corp. Teja Technologies Wind River Systems, Inc.
<b>FUZZY LOGIC SOFTWARE</b>			
<b>OPERATING SYSTEMS AND REAL-TIME EXTENSIONS</b>			
Accelerated Technology, Inc. JMI Software Systems, Inc. KADAK Products Ltd. NSI Com Wind River Systems, Inc.	Accelerated Technology, Inc. CMX Company Embedded Systems Products, Inc. Express Logic, Inc. Integrated Systems, Inc. JMI Software Systems, Inc. KADAK Products Ltd. Lucent Technologies, Inc. LinuxWorks Mentor Graphics Corp. Microsoft Corp. Microware Systems Corp. MontaVista Net BSD Perihelion Distributed Software Ltd. Sun Microsystems, Inc. Symbian U.S. Software Wind River Systems, Inc.	Accelerated Technology, Inc. OSE Systems Express Logic, Inc. LinuxWorks MontaVista Microware Systems, Corp. QNX Software Red Hat Wind River Systems, Inc.	Accelerated Technology, Inc. LinuxWorks MontaVista OSE Systems QNX Software RadiSys Corp. Wind River Systems, Inc.
<b>PROGRAMMERS</b>			
<b>MODELING/SIMULATION</b>			
Integrated Systems, Inc. Synopsys	Applied Microsystems Corp. ARM, Ltd. Corelis Inc. Summit	ARM, Ltd. Red Hat VaST Systems Technology	Intel Corp.
<b>SOFTWARE MODEM</b>			
	Atacom PC Tel Surf		
<b>SOFTWARE TEST/VERIFICATION</b>			
<b>SOFTWARE TEST/VERIFICATION</b>			
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