



Product Brief

Intel® IXP421 Network Processor

Embedded Computing

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Product Overview

This versatile, single-chip processor meets the needs of high-performance, 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 and networked imaging applications. The Intel® IXP421 network processor is a member of the Intel® IXP4XX product line of network processors providing cost-effective implementations that extend the rich performance and features of the Intel® IXP425 network processor into targeted market segments.

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

The Intel IXP421 network processor is part of Intel® Internet Exchange Architecture (Intel® IXA), a packet processing architecture that provides a foundation for software portability across multiple generations of network processors. Intel IXA is based on Intel XScale technology, the Intel IXA portability framework and programmable microengines.

Product Highlights

- Member of the Intel IXP4XX product line of network processors for residential and small-to-medium enterprise (SME) applications
- Intel XScale processor at 266 MHz provides headroom for customer-defined applications
- Intel® Infrastructure DSP Solution on Intel XScale processor supports two to four voice channels and reduces system cost
- Two HSS interfaces for VoIP SLIC/CODEC or T1/E1
- One integrated 10/100 Base-T Ethernet MAC 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 eight to 256 Mbytes of SDRAM memory
- Average consumption of 1.5W to a maximum of 1.9W
- USB version 1.1 device controller
- Two high-speed UARTs can be configured to support speed from 1200 baud to 921 Kbaud each
- Sixteen GPIO pins
- 16-bit expansion bus allows easy glueless connection to peripheral devices
- 266 MHz commercial temperature (0° to 70° C)

Common Architecture throughout Intel® IXP4XX Product Line of Network Processors Supports Application Flexibility

The Intel IXP4XX product line of network processors feature a distributed processing architecture that speeds development for a range of applications. Each processor combines a high-performance Intel XScale processor with additional Network Processor Engines (NPEs) to achieve wire-speed packet processing performance while running instruction streams in parallel.

The Intel XScale processor is fully compatible with the ARM® V5T Thumb instructions set and V5E DSP extensions. Designed on the Intel® 0.18-micron process technology, it delivers a high MIPS/power consumption ratio and provides ample processing headroom for value-added software features.

Two NPEs in the Intel IXP421 network processor are designed to complement the Intel XScale processor for many computation-intensively intensive data plane operations. These tasks include IP header inspection and modification, packet filtering, packet error checking, checksum computation and flag insertion and removal. The NPE architecture includes an ALU, self-contained internal data memory and an extensive list of I/O interfaces, together with hardware acceleration elements. The hardware acceleration elements associated with an NPE targets a set of networking applications. Each hardware

acceleration element is designed to increase the speed of a specific networking task that would otherwise take many MIPS to complete by a standalone processor.

Each NPE can handle Layer 2 and, in some cases, Layer 3 packets. For example, the WAN/Voice NPE has one UTOPIA 2 interface and two HSS interfaces to handle AAL (1/2/5) segmentation and reassembly (SAR) functions. The MII/RMII interface is attached to Ethernet NPE A and is capable of handling 100 Mbps, full-duplex Ethernet packet filtering. The extensive hardware capabilities of the NPEs are under the control of microcoded algorithms that are accessed via application programming interfaces (APIs) released as a software library with the processor. Customer applications configure and interact with the NPEs through the high-performance API layer running on the Intel XScale processor. Sample "codelets" demonstrate how to use each service or function provided by the processor library and the underlying hardware.

Broad Range of LAN/WAN Capabilities

The Intel IXP421 network processor supports a wide range of broadband and LAN access solutions through its multiple integrated interfaces. The UTOPIA 2 interface supports up to four xDSL PHYs (ADSL, G.SHDSL or VDSL). The PCI 2.2 host and option interface provides the flexibility to directly connect devices including 802.11x chips, PCMCIA controllers, Ethernet MACs, and cable MAC/PHYs. The network processor also fea-

tures two HSS interfaces that can serve as high-speed ports for direct connection to T1/E1 framers or to industry-standard SLIC/CODECS.

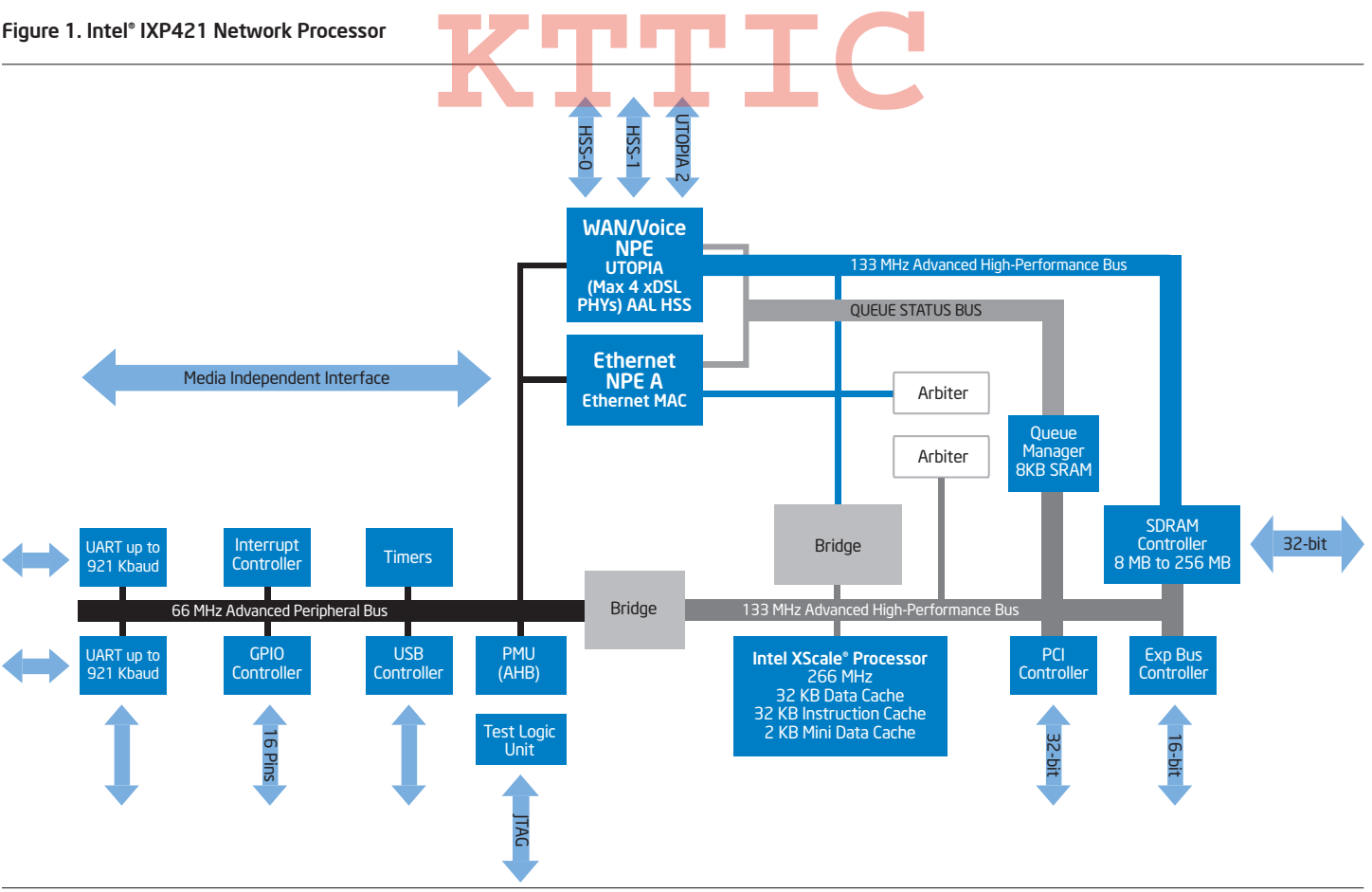
Highly-integrated Data and Voice Functionality

On-chip integration of data and voice functions saves the cost of implementing separate devices and supports easier integration with other hardware. Intel XScale microarchitecture includes integrated multiply and accumulate functions that enable multimedia processing without the need for external hardware. In a voice application, it can perform a wide variety of speech coding and telephony algorithms without the need for an external DSP chip. To further reduce the total chip count, the processor integrates an SDRAM controller, interrupt controller, GPIO port, UART, watchdog timer and general-purpose timers. The processor features USB version 1.1-device controller and achieves direct connection to flash memory through its expansion bus interface. By integrating this functionality, Intel is reducing the total solution chip count and cost for many types of applications.

Intel® Infrastructure DSP Solution Eliminates Need for External DSP Chip

The Intel IXP421 network processor includes a powerful DSP software library along with rich and powerful general and multimedia signal processing kernels, optimized for maximum performance on the Intel XScale processor. This enables voice-processing algorithms on the processor for

Figure 1. Intel® IXP421 Network Processor



port counts in the 1-voice interface to 4-voice interface range. The ability to implement voice compression algorithms on the processor is enabled by:

- Raw performance (up to 266 MHz clock speed)
- Additional multiply instructions with a 40-bit accumulator added to the processor
- Large cache sizes contained on the processor

The Intel XScale processor operates at very high speeds and very low power consumption for processing algorithms including G.711 and G.729a/b. The multiply and accumulate extensions were added for multimedia processing applications and can help accelerate voice-processing algorithms. These DSP extensions were added to those supplied directly with the ARM instruction set. Also, the large caches contained in the Intel XScale processor make it possible to lock down a complete algorithm in local memory, and the efficient cache design allows dynamic use of fast memory without extra cycle cost. Intel provides optimized software that will make it easy to implement these algorithms on the Intel XScale micro-architecture. This removes the requirement for external DSPs in low voice port-count designs and helps to reduce overall system cost.

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. The Intel IXP421 network processor currently supports Wind River* VxWorks* and the standard Linux* kernel. Associated third-party products are available for the Intel IXP4XX product line of network processors including Wind River* Workbench for VxWorks and the MontaVista* Linux* Professional Edition. Multiple third-party vendors also 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 IXP421 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* systems will plug into the JTAG interface through a 20-pin connector.

Reference Platform for Faster Time-to-Market

The Intel® IXDPG425 Network Gateway Reference Platform is a multi-service gateway, turn-key solution, allowing developers to adopt and modify platform design and quickly develop a desired solution, thus significantly reducing time-to-market. It also demonstrates the scalability and processing power of the Intel IXP425 network processor in supporting a wide range of residential gateway applications. Pin compatibility among members of the Intel IXP4XX product line further reduces hardware design complexity.

The reference platform includes the Intel IXP425 network processor at 533 MHz, SDRAM memory, flash, a four-port Ethernet switch for LAN, an additional Ethernet port for WAN, four telephone line interfaces, a mini-PCI interface to connect to a 802.11 WLAN, an ADSL mezzanine card interface, two USB 2.0 host ports and power-regulator devices.

Intel Advantage

Intel is a leading supplier of communications building blocks, adding value at many levels of integration. Along with a strong ecosystem of hardware and software vendors, including members of the Intel® Communications Alliance (intel.com/go/ica), Intel helps developers cost-effectively meet design challenges and shorten time-to-market.

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