Product Brief

Intel® IXP425 Network Processor

Embedded Computing

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Product Overview

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

This network processor offers a choice of multiple clock speeds at 266, 400, and 533 MHz, with both commercial and extended temperature options. Its feature set includes a UTOPIA 2 interface, two 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 product line of network processors for enterprise, small-to-medium enterprise (SME), residential and other networking applications
- Intel XScale® processor 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 protected applications
- DSP software library on the Intel XScale processor supports two to four voice channels and reduces system cost
- Two high-speed serial (HSS) interfaces 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
- Average consumption of 1.5W to a minimum 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
- 266/400/533 MHz commercial (0°C to 70°C)
- 266/400/533 MHz extended temperature (-40°C to +85°C) versions

Common Intel® IXP4XX Product Line Architecture for Application Flexibility

All network processors in the Intel IXP4XX product line have a unique distributed processing architecture that speeds development for a range of applications. Each combines a high-performance Intel XScale processor with additional NPEs to achieve wire-speed packet processing performance.

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

The three NPEs in the Intel IXP425 network processor complement the Intel XScale processor for many computationally intensive data plane operations, including 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 that target a set of networking applications. Each hardware acceleration element increases the speed of a specific networking task that would otherwise take many MIPS to complete by a standalone RISC 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, enabling it to handle AAL (1/2/5) segmentation and reassembly (SAR) functions. A MII interface is attached to both the Ethernet NPE A and the Ethernet NPE B, and these NPEs are each

capable of handling 100 Mbps, full duplex Ethernet packet filtering. Ethernet NPE B also has three hardware acceleration elements to accelerate VPN related tasks such as (DES), (AES) and hashing at speeds up to 70 Mbps. 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 IXP425 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, and cable MAC/PHYs. The network processor also features two HSS interfaces for direct connection to T1/E1 framers or to industry-standard SLIC/CODECS.

Highly-integrated Data and Voice Functionality

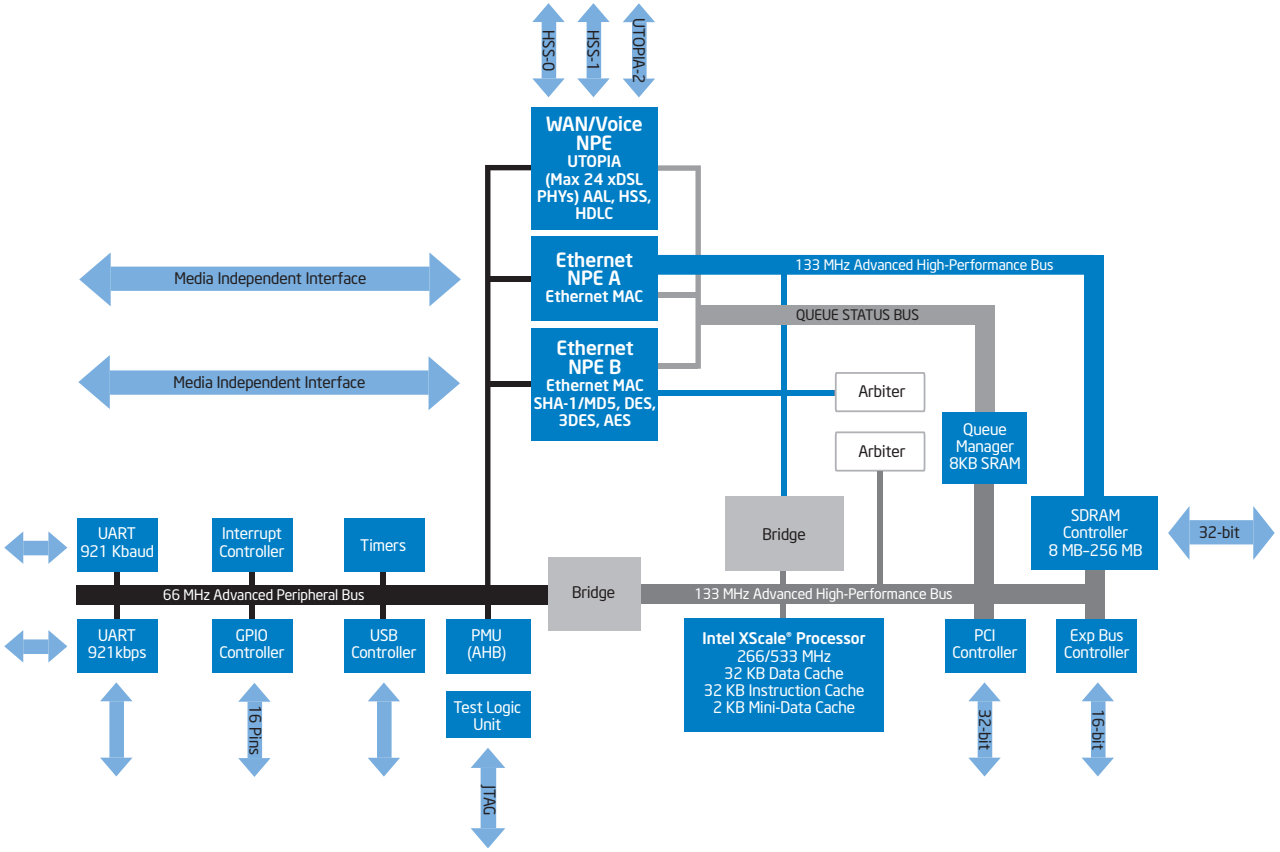
On-chip integration of data and voice functions saves the cost of implementing separate devices and supports easier integration with other hardware. The Intel XScale processor includes integrated multiply and accumulate functions that enable multimedia processing without the need for external hardware. In a voice application, the processor 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 a SDRAM controller, interrupt controller, GPIO port, UARTs, 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 IXP425 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 the network processor to implement voice-processing algorithms on the Intel XScale processor for port counts in the one-voice interface to four-voice interface range. The ability to implement voice compression algorithms on the core is enabled by:

- The raw performance of the Intel XScale processor (up to 266 MHz clock speed)
- Additional multiply instructions with a 40-bit accumulator added to the processor
- The large cache sizes contained on the processor

Figure 1. Intel® IXP425 Network Processor



The Intel XScale processor operates at very high speeds for processing algorithms including G.711 and G.729a/b at very low power consumption. 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 is developing optimized libraries that will make it easy to implement these algorithms on the Intel XScale processor. This removes the requirement for external DSPs in low voice port-count designs and helps to reduce overall system cost.

Integrated Security Hardware Acceleration Elements

The Intel IXP425 network processor provides integrated hardware acceleration for security applications. It implements DES, 3DES and AES data encryption algorithms, in addition to SHA-1 and MD5 authentication algorithms, typically used in applications such as VPNs. 802.11 and 802.11a/b/g wireless applications also benefit from the network processor's ability to accelerate RC4-based WEP services and AES-CCM mode operations.

The Intel IXP425 network processor silicon contains the following cryptography hardware accelaration elements:

- DES (64-bit block cipher size, 56-bit key)
- 3 DES (64-bit block cipher size, 3 keys—56 bit each)
- An authentication hardware acceleration element with support for the following authentication algorithms:
  —HMAC-SHA-1
  —HMAC-MD5
- AES containing a 128-bit block cipher size with key sizes of 128, 192, or 256 bits

Using the NPE for dedicated hardware acceleration enables the processing of cryptography and authentication algorithms to be offloaded from the Intel XScale processor. The processor API calls allow the cryptography and authentication elements to be used by any interface within the network processor. This provides maximum flexibility for all interfaces, especially when dealing with security issues over wireless. The high-performance architecture of the Intel IXP425 network processor can support bulk encryption/decryption rates of up to 70 Mbps for DES, 3DES and AES algorithms.

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 IXP425 network processor currently supports Wind River* VxWorks* and the standard Linux* kernel. Associated third-party products are available for the 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® IXP425 network processor may be controlled during debug through a JTAG interface to the processor. The Macraigor* Raven*, Wind River Systems visionPROBE*/visionICE*, EPI* MAJIC* and other JTAG ICE 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 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.

Intel Access

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