



Intel® IXP42X Product Line of Network Processors

With ETHERNET Powerlink Controlled Node

The networked factory floor enables the adoption of systems for remote monitoring, long-distance support, diagnostic services and the integration of in-plant systems with the enterprise. The need for flexible connectivity solutions and high network bandwidth is driving a fundamental shift away from legacy industrial bus architectures and communications protocols to industry standards and commercial off-the shelf (COTS) solutions. Standards-based interconnect technologies and communications protocols, especially Ethernet, enable simpler and more cost-effective integration of network elements and applications, from the enterprise to the factory floor.

The Intel® IXP42X product line of network processors with ETHERNET Powerlink (EPL) software helps manufacturers of industrial control and automation devices bridge between real-time Ethernet on the factory floor and standard Ethernet IT networks in the connected enterprise.

Challenge: Bridging Ethernet-to-EPL

Communication between the office and the factory floor is simplified by using a uniform network structure. Ethernet in the industrial environment will allow functionality which is not possible with existing proprietary industrial buses. However, standard Ethernet does have some characteristics that limit its suitability in the industrial environment. Collisions between packets, in addition to non-predictable queuing-delays, prevent the use of standard Ethernet in deterministic systems.

While different real-time Ethernet solutions are available or under development, EPL, the real-time protocol solution managed by the open vendor and user group EPSG (ETHERNET Powerlink Standardization Group), is the only deterministic data communication protocol that is fully conformant with Ethernet networking standards.

EPL takes the standard approach of IEEE 802.3 Ethernet with a mixed polling and time-slicing mechanism to transfer time-critical data within extremely short and precise isochronous cycles. In addition, EPL provides configurable timing to synchronize networked nodes with high precision while asynchronously transmitting data that is less time-critical. EPL is the ideal solution for meeting the timing demands of typical high performance industrial applications, such as automation and motion control. Current implementations have reached 200 μ s cycle-time with a timing deviation (jitter) less than 1 μ s. It has long since graduated from being a prototype and is being used by many companies in full production.

Intel® IXP42X Network Processors: Bridging Ethernet to EPL

The Intel® IXP42X product line of network processors combines Intel XScale® technology with a variety of built-in communications features to support the requirements of industrial control and automation and provides the ideal network processing solution for implementing EPL. The high-performance Intel XScale core provides processing headroom to flexibly support a broad range of applications while minimizing power consumption.

Integration of multiple 10/100 Ethernet interfaces and built-in acceleration for EPL on the processor's programmable Network Processor Engines (NPE) reduces overall system cost and simplifies the design of Ethernet to EPL gateways. The NPEs are RISC processors surrounded by multiple co-processor components. The co-processors provide specific hardware services including Ethernet processing, MAC interfaces, and cryptographic processing. Running EPL on one NPE enables the network processor to concurrently run standard Ethernet and security on the other. By enabling the use of off-the-shelf building blocks, the Intel IXP42X product line can provide manufacturers with a significant time-to-market advantage compared to solutions based on proprietary ASICs.

The architecture of the Intel IXP42X product line is particularly suited to EPL. The processor's EPL enabled NPE performs packet processing and classification. The Queue Manager facilitates service type queuing, and the Intel XScale core provides the processing platform for networking solutions and other associated software.

EPL Software Release

As shown in Figure 1, the Intel EPL software release consists of software components specific to the Intel IXP42X product line of network processors. Together with an EPL driver and EPL stack, the software release enables rapid integration of EPL functionality with basic Ethernet services in a common platform.

- NPE microcode consists of one or more loadable and executable NPE instruction files that implement NPE functionality behind the software library. These instruction files are incorporated into the software library at build time.

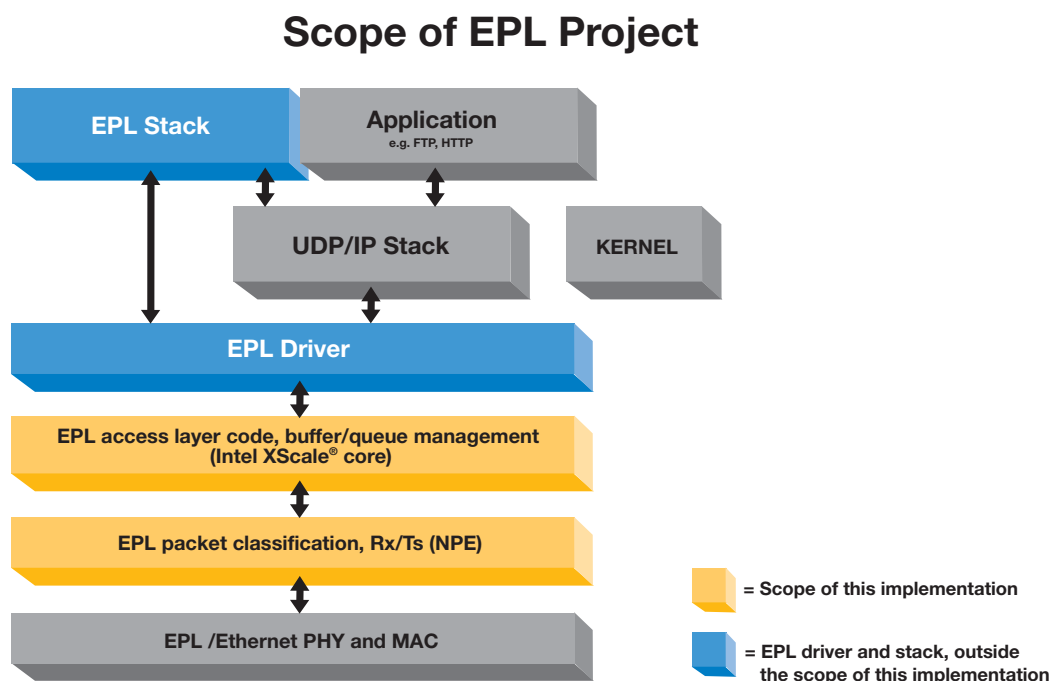
The library includes a NPE downloader component that provides NPE code version selection and downloading services. The software release contains the NPE microcode image for EPL that can be downloaded to the NPE for EPL related services.

- The EPL access layer component provides a framework of APIs to interface with the EPL microcode image running on NPE B of the Intel IXP42X network processor. This layer consists of a set of software components that can be used to configure, control, and communicate with the hardware. Services include selection of the port for EPL operation, configuration of the EPL node ID, choice of basic Ethernet or EPL mode, and transmission and reception of Ethernet and EPL frames.

EPL Software Feature Summary

- Support for EPL Controlled Node (CN)
- Optional configuration of one Ethernet interface for EPL CN
- CN operation in basic Ethernet and EPL mode
- Configuration of unicast and multicast address and EPL ID for the node
- Multicast address listening for frames from the MN and other CNs: SoC, SoA, Poll Response, Asynchronous Send
- EPL ID to validate packets destined for CN
- Transmission and reception of isochronous and asynchronous data
- Max frame size: 1536 bytes
- NPE based classification of EPL frames on the receive path as SoC, PReq, SoA, NMT Request Invite, Ident Request, Status Request, and Unspecified Invite
- NPE based transmission of prepared response frames within the specified time-slot
- Maximum latency between the received frame (last bit in) and the transmitted frame (first bit out) of less than 8 μ s.

Figure 1: The Intel® EPL software implementation consists of NPE microcode for packet classification and an EPL access layer interface. Full implementation requires an EPL driver and an EPL stack.



Development Platform

The Intel® IXDP425 Network Processor Development Platform helps minimize development costs and speeds development by providing a consistent development environment.

Developers can use this flexible and extendable platform to conduct rapid initial chip evaluation, performance evaluation, product development, and prototyping. Pin compatibility among members of the Intel® IXP42X product line reduces hardware design complexity.

Support for Rapid Development

Intel XScale technology is supported by a broad range of development tools and is compatible with multiple operating systems. The Intel EPL software implementation product line is currently supported on the Linux* operating system.

Summary

Communication between the office and the factory floor is simplified by using a uniform, standards-based network structure. Real-time Ethernet in the industrial environment enables functionality which is not possible with existing

proprietary industrial buses. The Intel IXP42X product line of network processors with EPL software enables manufacturers to implement solutions to bridge between real-time and standard Ethernet in the connected enterprise.

The highly integrated, single-chip design of the Intel IXP42X product line of network processors provides a unique combination of performance, reliability, and flexibility to bridge between Ethernet and EPL on a single platform.

Intel Advantage: A Commitment to Industrial Control and Automation

Intel provides highly integrated, standards-based silicon solutions that can help manufacturers rapidly develop and deliver products for industrial control and automation in the connected enterprise. Intel® communications building blocks reflect years of Ethernet networking expertise, including providing the hardware and software building blocks for modular network solutions. Through continuous innovations in connectivity and processing in the network, Intel is delivering a wide choice of solutions that enable faster time-to-market, longer time-in-market, and increased revenue opportunities.

Intel Access

Developer's Site:	developer.intel.com
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