

Advanced Switching Technology

Tech Brief



Advanced Switching Overview

The Advanced Switching Interconnect (ASI) is a switching-interconnect technology, that combines the advanced features of existing proprietary fabrics with industry standard technology and design practices developed by the Advanced Switching Interconnect Special Interest Group (ASI SIG™). As an extension of PCI Express* (PCIe) technology, ASI benefits from multiple levels of re-use from PCIe (directly via Serdes & SW transparency and indirectly via architectural compatibility and industry familiarity with PCIe) including the ability to re-use PCIe based development tools, components and boards. ASI is uniquely positioned within the industry to draft off the industries tremendous adoption of PCIe while providing the critical features required in demanding switch fabric architectures. Key attributes of ASI include: peer-to-peer communications, multiple levels of Quality of Service (QoS), multiple hosts & address spaces, several data movement engines and protocol agnostic tunneling. Targeted for "in-the-chassis" switching between boards, ASI is expected to also be used in some chip-to-chip and chassis-to-chassis applications and has seen widespread support from a variety of companies providing IP, FPGA, Tool, Silicon, Software, Board and carrier/enterprise grade internet infrastructure products.

Advantages and Benefits

Advanced Switching provides a much richer feature set to users of commodity interconnect technologies, enabling significant uplift in capabilities while maintaining industry standard sourcing and pricing models. Users of proprietary fabric technology will benefit from the broad infrastructure support for ASI, moving them from a limited and expensive universe of providers and products to a growing and vibrant ecosystem of vendors competing in providing silicon, design services, design, test and operating software, and supporting system level hardware (chassis, cabling, connectors, etc).

This standardized switch fabric will transform the design process, enabling a modular approach and common platforms across product lines and industries, greatly reducing time to market and development budgets. This modularity and the ability to handle multiple protocols on the same interconnect will accelerate innovation and the trend toward converged computing and communications solutions.

By offering PCI transparency (via Protocol Interface 8 [PI-8]), broad scalability and flexibility, Advanced Switching will enable designers to differentiate products through incremental advancements while

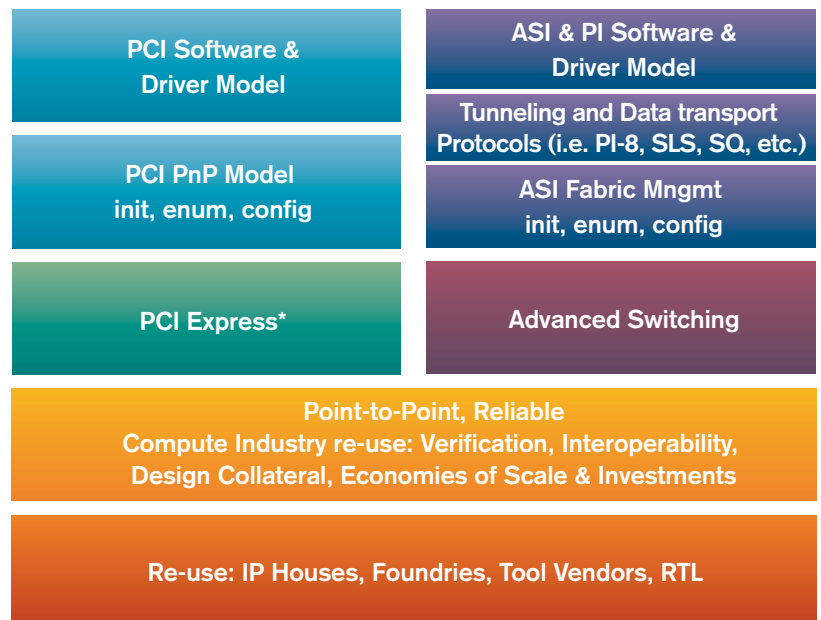
allowing re-use of existing infrastructure. Through encapsulation of any upper level protocols such as Ethernet, Fiber Channel or ATM, Advanced Switching can provide for significantly less complex designs by eliminating the need for protocol conversion while preserving software investment.

"We expect the market will ultimately shift to merchant fabrics using the Advanced Switching (ASI) protocol to enable standard backplanes. We believe most next-generation fabrics will adopt this standard protocol, with the first such products sampling in 2005."

*-The Linley Group, "A Guide to Switch Fabrics
—3rd Edition"*

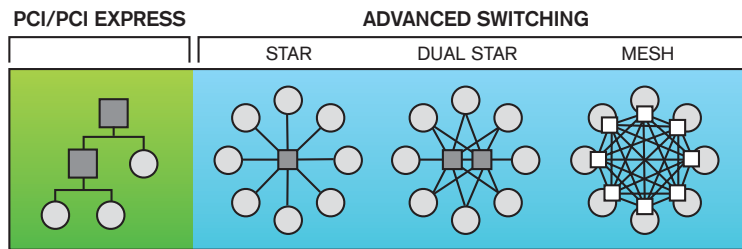
Features

Advanced Switching overlays the physical and link layers of PCI Express with an optimized transaction layer, providing a rich set of features and capabilities. By sharing the same physical and link layers of PCI Express, Advanced Switching can re-use the IP, tools, foundry and services from the high volume PCI Express ecosystem.



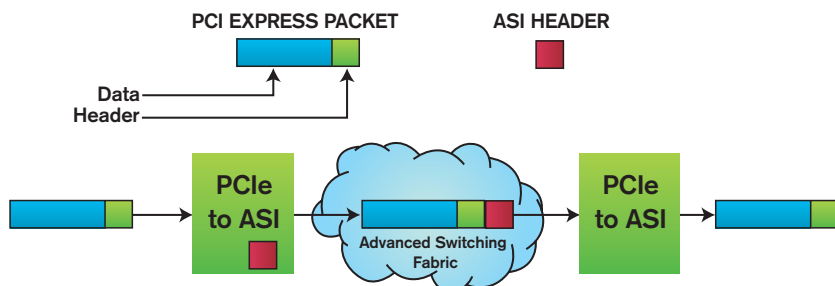
*other names and brands may be claimed as property of others

The ASI transaction layer provides source-based path routing versus the memory mapped routing of PCI Express. By eliminating the hierarchical structure of memory mapped routing, flexible topologies can be constructed such as star, dual-star, and full mesh. The path routing mechanism additionally provides for inherent security mechanisms via the unique route 'signature'.



Protocol Tunneling

Advanced Switching encapsulates data packets and attaches a header that routes it through the fabric regardless of the packet format. The header contains a PI (protocol interface) field that is used at the packet destination to determine the packet's format. Thus any protocol can be routed through an ASI network. PCIe packets are a particularly important format to system developers where ASI will serve as a central switch fabric connecting PCIe endpoints. PI -8 allows multiple PCIe enabled CPUs to transparently connect to multiple PCIe enabled I/O nodes through the ASI fabric using PCIe plug and play software.



Advanced Switching Applications

Advanced Switching is designed to provide the functionality of the proprietary interconnects that have been at the core of storage, communications, and embedded computing systems. Target applications for ASI include the following:

- Bladed computing
- Embedded computers (e.g. medical imaging, military command and control)
- Communications edge/access/metro equipment
- Communications routers
- Enterprise and high performance (e.g. video) storage routers and arrays

ASI is an appropriate technology wherever advanced fabric features are required. It works with any protocol and is particularly well suited to extend PCI Express based designs. It has strong advantages over proprietary and niche fabric technologies because of its broad industry support and maturing eco-system of products that support a wealth of cost-effective, innovative solutions.

Physical Layer Features

- Identical to PCI Express
- Link aggregation with support for 1X, 2X, 4X, 8X, 12X, 16X, and 32X
- Polarity inversion and lane reversal
- Scrambling and 8B/10B encoding

Link Layer Features

- Reuse from PCI Express
- Reliable delivery with 32-bit CRC and retry on error, optional end-to-end CRC
- Credit based flow control

Transport Layer Features

- supports load/store, queue based messaging and RDMA data movement models
- Peer-to-peer communications
- Support for any topology
- Encapsulate any packet or cell protocol
- Multiple native data transport mechanisms
- Multicast routing
- Low latency and jitter
- Robust QoS supporting 20 VCs and 8 TC's
- Advanced flow control mechanisms

"Currently, we believe many in the industry are eyeing this future based around the development of [sic] Advanced Switching . . . to eventually become the common backplane interconnect standard for future datacom and telecom infrastructure designs."

-Sean Lavey, IDC

About the ASI SIG

The Advanced Switching Interconnect SIG (ASI SIG) is a non-profit collaborative trade organization tasked with developing and supporting a switched interconnect and data fabric interface specification for communications, storage and embedded equipment, termed Advanced Switching Interconnect (ASI), based on the PCI Express architecture. In addition to ongoing technical development of the specification, the member companies help to define, develop and market ASI. The overall tasks performed by the members of the SIG include establishing broad industry awareness, ongoing technical development, and the enablement of rapid industry adoption through training programs, ecosystem development, and interoperability and compliance testing. The board of directors includes Agere, Alcatel, Huawei, IDT, Intel, Siemens, Vitesse and Xilinx. More information can be found at www.asi-sig.org.