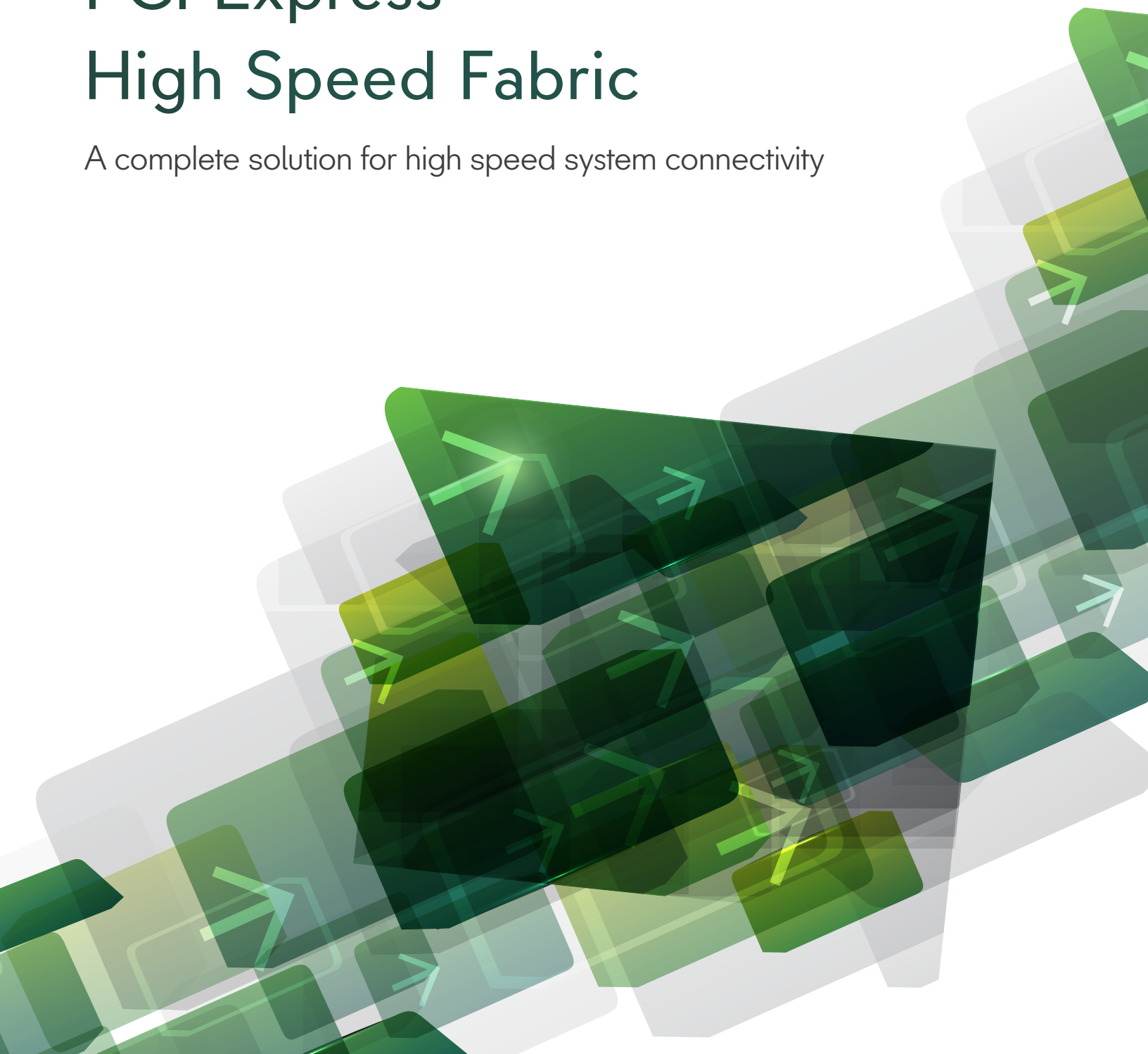
Dolphin

INTERCONNECT SOLUTIONS

# PCI Express High Speed Fabric

A complete solution for high speed system connectivity



# Introduction

Maximizing application performance is a combination of processing, communication, and software. PCIe Fabrics combine all three elements. A PCIe Fabric connects Processors, I/O devices, FPGAs and GPUs into an intelligent fabric. This fabric connects devices through flexible cabling or fixed backplanes. PCIe Fabrics main goal is to eliminate system communication bottlenecks, allowing applications to reach their potential. To accomplish this, PCIe Fabrics deliver the lowest latency possible, combined with high data rates.

Dolphin's PCIe Fabric solution consists of standard computer networking hardware and eXpressWare™ PCIe software. Our standard form factor boards and switches reduce time to market, enabling customers to rapidly develop and deploy PCIe Fabric solutions for data centers and embedded systems. eXpressWare™ software enables reuse of existing applications and development of new exciting applications, both with better response times and data accessibility. eXpressWare™ SuperSocket™ and IPoPCIe software ensures quick application deployment by not requiring any application modifications. Application tuning is available with our low level SISCI shared memory API that delivers maximum performance.

The PCI Express standard's continued performance improvements and low cost infrastructure is ideal for application and system development. The current PCI Express solutions are at 128 GT/s. The PCIe road map extends speeds to 256 GT/s and 512 GT/s, while still maintaining backward compatibility. Standard PCIe commercial components are used by Dolphin as a road map to high performance hardware. Dolphin's solution exploits the PCI Express infrastructure to deliver next generation systems with maxim application performance. Our easy to implement and deploy solution gives customers the choice of changing or not changing their existing applications, but still taking advantage of PCI Express performance.

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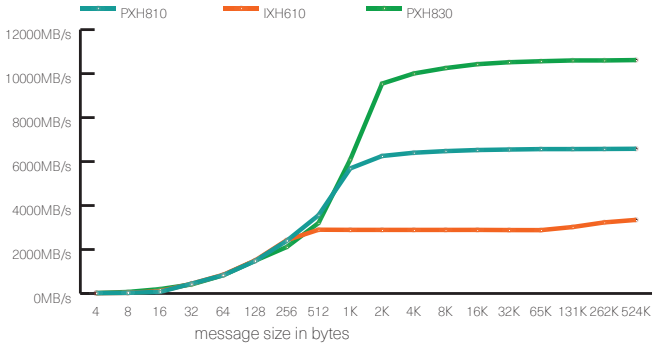
# Why PCI Express ?

## Performance

PCI Express solutions deliver outstanding performance compared to other interconnects in latency and throughput. When compared to standard 10 Gb/s Ethernet, PCI Express latency is 1/10 the measured latency. This lower latency is achieved without special tuning or complex optimization schemes. Current solutions offer latencies starting at 540 nanoseconds memory to memory access.

In addition, Dolphin takes advantage of PCI Express high throughput. Our current Gen 3 x16 implementations achieve data rates exceeding 11 GB/s. Dolphin's eXpresWare™ software infrastructure allows customers to easily upgrade to next generation PCI Express with doubling bandwidth. No software changes are required. These products still maintain the low latency characteristic of PCI Express. An investment in low latency high performance Dolphin products yields dividends today and into the future.




PCIe Throughput

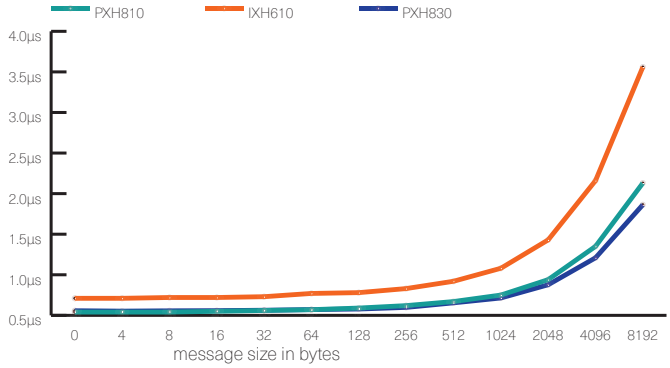



Figure 1: PCIe Latency

## Eliminate Software Bottlenecks

Dolphin's eXpressWare™ Software is aimed at performance critical applications. Advanced performance improving software, such as the SISCI API, removes traditional network bottlenecks. Sockets, IP, and custom shared memory applications utilize the low latency PIO and DMA operations within PCI Express to improve performance and reduce system overhead.

Software components include SuperSockets Sockets API, an optimized IPoPCIe driver for IP applications, SmartIO software for I/O optimization, and the SISCI shared memory API. Dolphin's SuperSockets software delivers latencies around 1 µs and throughput at 65 Gb/s. The SISCI API offers further application optimization by using remote memory segments and multi-cast/ reflective memory operations. Customers benefit from even lower latencies with the SISCI API in the range of 0.54 µs latency with higher throughput of over 11 GB/s. SmartIO software is used for peer to peer communication and moving devices between systems with device lending.

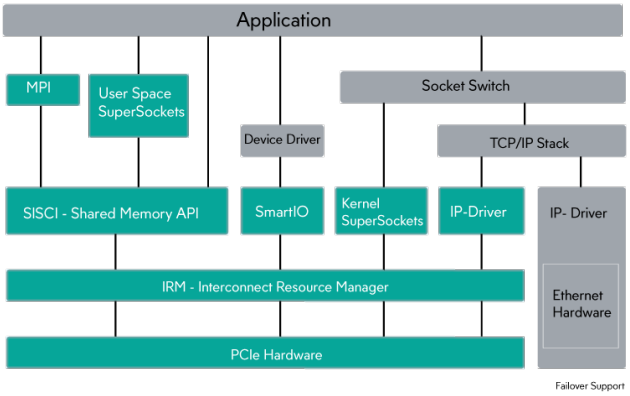



Figure 2: Dolphin eXpressWare™ Software Stack

## Key Applications

- Financial Trading Applications
- High Availability Systems
- Real Time Simulators
- Databases and Clustered Databases
- Network File Systems
- High Speed Storage
- Video Information Distribution
- Virtual Reality Systems
- Range and Telemetry Systems
- Medical Equipment
- Distributed Sensor-to-Processor Systems
- High Speed Video Systems
- Distributed Shared Memory Systems

## Robust Features

- Lowest host to host latency and low jitter with 0.54µs for fast connections and data movement
- DMA capabilities to move large amounts of data between nodes with low system overhead and low latency. Application to application transfers exceeding 11 GB/s throughput.
- Management software to enable and disable connection and fail over to other connections
- Direct access to local and remote memory, hardware based uni- and multi-cast capabilities
- Set up and manage PCIe peer to peer device transfers
- High speed sockets and TCP/IP application support
- Ease installation and plug and play migration using standard network interfaces

## High Performance Hardware

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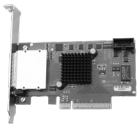
|  | Low profile PCIe Gen 2 and Gen 3 adapter cards provide high data rate transfers over standard cabling. These interface cards are used in standard servers and PCs deployed in high performance low latency applications. These cards incorporate standard iPass connectors and SFF-8644 connectors. They support both copper and fiber optic cabling, along with transparent and non-transparent bridging (NTB) operations. |
|  | XMC Adapters bring PCIe data rates and advanced connection features to embedded computers supporting standard XMC slots, VPX, VME or cPCI carrier boards. PCIe adapters expand the capabilities of embedded systems by enabling very low latency, high throughput cabled expansion and clustering. Standard PCs can easily connect to embedded systems using both XMC and host adapters. |
|  | PCI Express Gen 3 switch boxes scale out PCIe Fabrics. Both transparent and non-transparent devices link to a PCIe switch, increasing both I/O and processing capacity. These low latency switches scale systems while maintaining high throughput. |

# PCIe Applications

## SmartIO Technology

### Remote Peer-to-Peer

PCIe peer-to-peer communication (P2P) is a part of the PCI Express specification and enables regular PCIe devices to establish direct data transfers without the use of main memory as a temporary storage or the CPU for data movement as illustrated in figure 3. This significantly reduces communication latency. PCIe Fabrics expand on this capability by enabling remote systems to establish P2P communication. Intel Phi, GPUs, FPGA, specialized data grabbers can exploit remote P2P communication to reduce latency and communication overhead.

The SISCI API supports this functionality and provides a simplified way to setup and manage remote peer-to-peer transfers. SISCI software enables applications to use PIO or DMA operations to move data directly to and from local or remote PCIe devices.

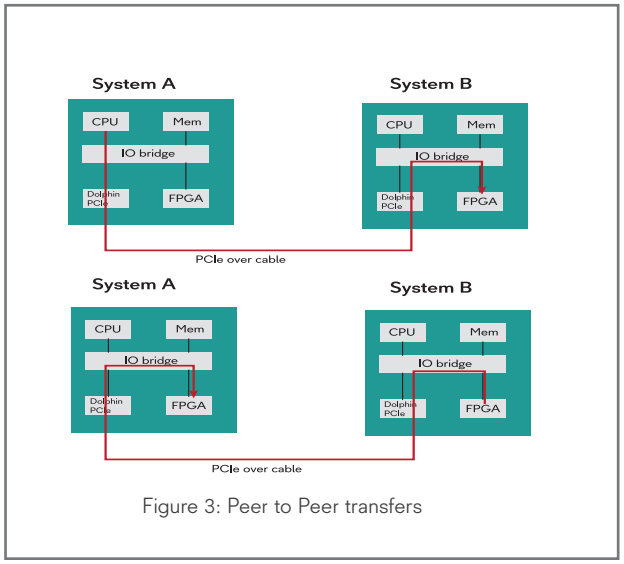



Figure 3: Peer to Peer transfers

### PCIe Device Lending Software

PCIe Device Lending offers a flexible way to enable PCIe IO devices (NVMes, FPGAs, GPUs etc) to be accessed within a PCIe Fabric. Devices can be borrowed over the PCIe Fabric without any software overhead at PCIe speeds. Device Lending is a simple way to reconfigure systems and reallocate resources. GPUs, NVMe drives or FPGAs can be added or removed without having to be physically installed in a system on the fabric. The result is a flexible simple method of creating a pool of devices that maximizes usage. Since this solution uses standard PCIe, it doesn't add any software overhead to the communication path. Standard PCIe transactions are used between the systems. Dolphins eXpressWare software manages the connection and is responsible for setting up the PCIe Non-Transparent Bridge (NTB) mappings.

Two types of functions are implemented with device lending. These are the lending function and the borrowing function as outlined in figure 4. Lending involves making devices available on the fabric for temporary access. These PCIe devices are still located within the lending system. The borrowing function can lookup available devices. Devices can then be temporarily borrowed. When use of the device is completed, the device can be released and borrowed by other systems on the fabric or returned for local use.

Device lending also enables a SR-IOV device to be shared as a MR-IOV device. SR-IOV functions can be borrowed by any system in the PCIe Fabric. Thereby enabling the device to be shared by multiple systems. This maximizes the use of SR-IOV devices such as 100 Gbit Ethernet cards.

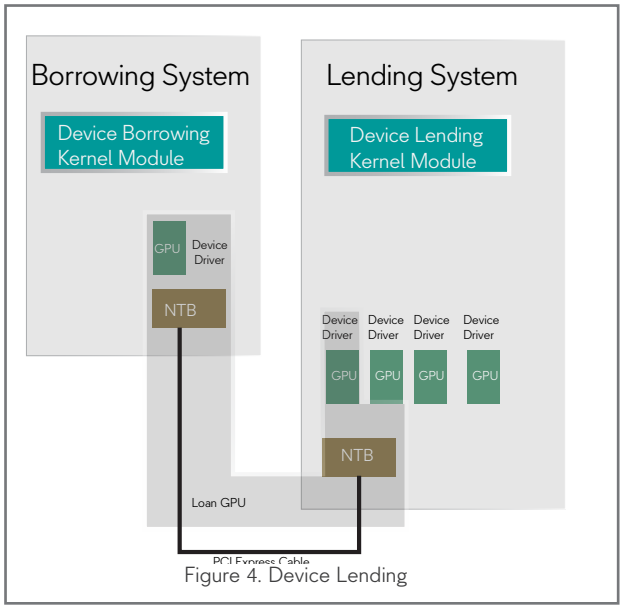



Figure 4. Device Lending

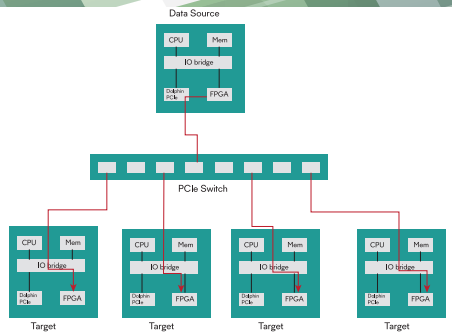
# Reflective Memory / Multi-cast

Dolphin's reflective memory or multi-cast solution reinterprets traditional reflective memory offerings. Traditional Reflective Memory solutions, which have been on the market for many years, implement a slow ring based topology. Dolphin's reflective memory solution uses a modern high speed switched architecture that delivers lower latency and higher throughput.

Dolphin's PCIe switched architecture employs multi-cast as a key element of our reflective memory solution. A single bus write transaction is sent to multiple remote targets or in PCI Express technical terms multi-cast capability enables a single Transaction Layer Packet (TLP) to be forwarded to multiple destinations. PCI Express multi-cast results in a lower latency and higher bandwidth reflective memory solution. Dolphin benchmarks show end-to-end latencies as low as 0.99µs and over 6000 MB/s data flow at the application level. These performance levels solve many real time, distributed computing requirements.

Dolphin combines PCI Express multi-cast with the eXpressWare™ SISCI (Software Infrastructure for Shared-memory Cluster Interconnect) API to allow customers to easily implement applications that directly access and utilize PCIe multi-cast. Applications can be built without the need to write device drivers or spend time studying PCIe chipset specifications.

Another main difference in Dolphin's reflective memory solution is the use of cached main system memory to store data. Cached main memory provides a significant performance and cost benefit. Remote interrupts or polling signal the arrival of data from a remote node. Polling is very fast since the memory segments are normal cached main memory and consume no memory bandwidth. The CPU polls for changes in its local cache. When new data arrives from the remote node, the I/O system automatically invalidates the cache and the new value is cached.




In addition, FPGA and GPU applications can implement this reflective memory mechanism. The SISCI API configures and enables GPUs, FPGAs, or any PCIe master device to send data directly to remote memory through the multi-cast mechanism, avoiding the need to first store the data in local memory. Data is written directly from a FPGA to multiple end points for processing or data movement. FPGAs can also receive data from multiple end points.

Reflective memory solutions are known for their simplicity, just read and write into a shared distributed memory. Our high-performance fabric increases simplicity with easy installation and setup. The SISCI Developers Kit includes tools to speed development and setup of your reflective memory system. Once setup, your application simply reads and writes to remote memory.

## Features

- High-performance, ultra low-latency switched 64 GT/s and 40 GT/s data rates
- Gen 3 x8 performance up to 6000 MB/s data throughput
- Gen 2 x8 performance up to 2886 MB/s data throughput
- FPGA, GPU support
- Hardware based multi-cast
- Configurable shared memory regions
- Fiber-Optic and copper cabling support
- Scalable switched architecture
- SISCI API support
- PCIe host adapters
- Expandable switch solutions

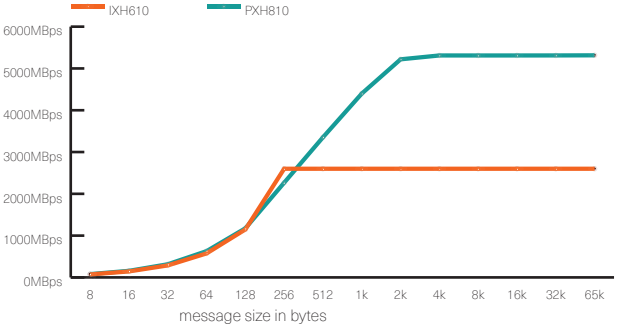
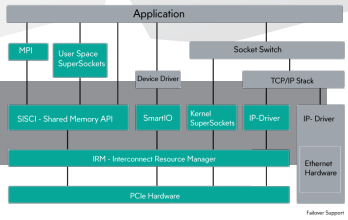



figure 5: Reflective Memory Throughput

# eXpressWare™ Software

## PCI Express Software Suite




eXpressWare™ software enables developers to easily migrate applications to PCIe Fabrics. eXpressWare's™ complete software infrastructure enables networking applications to communicate using standard PCIe over cables and backplanes. Several interfaces and APIs are supported including standard TCP/IP networking - IPoPCIe driver, a low level direct remote memory access API – SISCI shared memory API and a sockets API -SuperSockets™. Each API has its benefits and can be selected based on application requirements.

The SISCI API enables customers to fully exploit the PCIe programming model without having to spend months developing device drivers. The API offers a C programming API for shared / remote memory access, including reflective memory/multi-cast functionality, peer to peer memory transfers and RDMA capabilities. The SISCI API supports direct FPGA to FPGA, GPU to GPU, or any combination of communication with FPGA, CPUs, GPUs or memory over PCIe.

SuperSockets™ enables networked applications to benefit from a low latency, high throughput PCIe Fabric without any modifications. With SuperSockets™, a PCIe Fabric can replace local Ethernet networks. The combination of Dolphin's PCIe host adapters and switches with SuperSockets™ delivers maximum application performance without necessitating application changes. SuperSockets™ is a unique implementation of the Berkeley Sockets API that capitalizes on the PCIe transport to transparently achieve performance gains for existing socket-based network applications. Both Linux and Windows operating systems are supported, so new and existing applications can easily be deployed on future high performance PCIe Fabrics.

Dolphin's performance optimized TCP IP driver for PCIe (IPoPCIe) provides a fast and transparent way for any networked applications to dramatically improve network throughput. The software is highly optimized to reduce system load (e.g. system interrupts) and uses both PIO and RDMA operations to implement the most efficient transfer of all message sizes. The major benefits are plug and play, much higher bandwidth, and lower latency than network technologies like 10Gb/s Ethernet. The IPoPCIe driver is targeted for non-sockets applications and functions that require high throughput.

- PCIe Gen 1,2,3 support
- Address based Multi-cast / reflective memory
- Point to point and switched fabric support
  - Scalable to 126 nodes
- Operating systems
  - Windows, Linux, VxWorks, RTX
- Low latency direct memory transfers
- Accelerated Loopback support
- Peer to peer transfers
- UDP and TCP support
- UDP multi-cast
- Cascading of switches
- FPGA and GPU direct memory transfers
- Low latency direct memory transfers
- PCIe chipset support
  - Microsemi, Broadcom /PLX, IDT, ntel NTB
- Cross O/S low latency data transfers
- Sockets Support
  - Berkeley Sockets, WinSock 2
- Fabric manager

## Specifications

| | |
|---|---|
| Supported APIs | SISCI API<br>Berkley Sockets API<br>Microsoft WinSock2/LSP support<br>TCP/IP |
| Application Performance | 0.54 microsecond latency (application to application)<br>Above 11 GB/s throughput |
| Supported Components | Microsemi<br>Broadcom/PLX<br>IDT<br>Intel NTB enabled servers |
| PCI Express | Base Specification 1.x, 2.x, 3.x<br>Link widths 1-16 lanes |
| Topologies | Switch/ point to point/ mesh |

| | |
|---|---|
| Supported Platforms | x86<br>ARM 32 bit and 64 bit<br>PowerPC |
| eXpressWare™ Packages | eXpressWare™ for Linux<br>eXpressWare™ for Windows<br>eXpressWare™ for RTX<br>eXpressWare™ for VxWorks |
| Dolphin Software | SuperSockets for Windows<br>SuperSockets for Linux<br>IPoPCIe driver<br>SISCI API<br>IRM- Interconnect Resource Manager<br>PCIe Fabric Manager |

# eXpressWare™ Software

## IPoPCIe IP over PCIe

Dolphin's performance optimized TCP IP driver for PCIe (IPoPCIe) is targeted at non-sockets applications that require high throughput along with plug and play. This fast and transparent network driver dramatically improves network throughput. The software is highly optimized to reduce system load (e.g. system interrupts) and uses both PIO and RDMA operations to implement the most efficient transfers of all message sizes. IPoPCIe offers much higher bandwidth and lower latency than standard network technologies like 40 GbE. Figure 4 illustrates the performance with Gen2 and Gen3 PCIe cards.

At the hardware level, the TCP/IP driver provides a very low latency connection. Yet, operating system networking protocols typically introduce a significant delay for safe networking (required for non-reliable networks like Ethernet). The IPoPCIe driver still implements these networking protocols increasing latency. User space applications seeking the lowest possible network latency should utilize the Dolphin SuperSockets™ technology. The IPoPCIe driver will typically provide 5-6 times better throughput than 10G Ethernet.

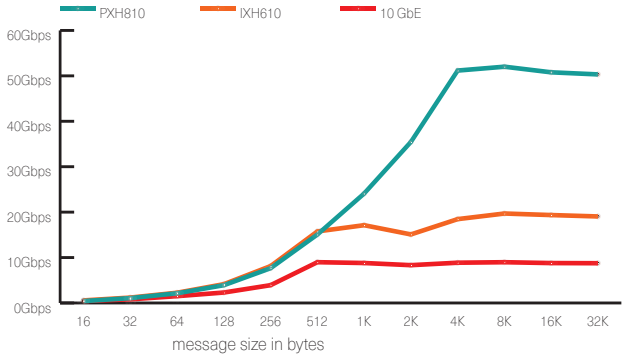



Figure 6: TCP/IP Throughput

## Features

- All networked, users space and kernel space applications are supported.
- 100% compliant with Linux Socket library, Berkeley Socket API and Windows WinSock2.
- No OS patches or application modifications required. Just install and run
- Routing between networks
- ARP support
- Both TCP and UDP supported. (UDP multi-cast/broadcast is not supported yet using Linux, but SuperSockets for Linux supports UDP multi-cast)
- Supports hot-pluggable links for high availability operation
- Easy to install

## IPoPCIe Uses

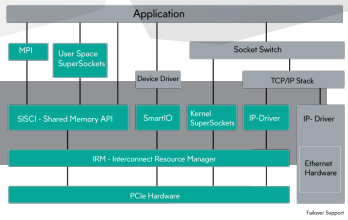
The optimized TCP/IP driver is recommended for applications like

Windows

- Microsoft Hyper-V live migration
- Network file sharing (map network drive)
- Applications that require UDP (not support by SuperSockets yet).

Linux:

- General networking
- NFS
- Cluster file systems not supported by SuperSockets
- iSCSI




# eXpressWare™ Software

## SISCI Low Level API

Dolphin's Software Infrastructure Shared-Memory Cluster Interconnect (SISCI) API makes developing PCI Express Fabric applications faster and easier. The SISCI API is a well established API for shared memory environments. In PCI Express multiprocessing architectures, the SISCI API enables PCIe based applications to use distributed resources such as CPUs, I/O, and memory. The resulting applications feature reduced system latency and increased data throughput.

For processor to processor communication, PCI Express supports both CPU driven programmed IO (PIO) and Direct Memory Access (DMA) as transports through non-transparent bridges (NTB). Dolphin's SISCI API utilizes these components in creating a development and runtime environment for systems seeking maximum performance. This very deterministic environment featuring low latency and low jitter is ideal for traditional high performance applications like real time simulators, reflective memory applications, high availability servers with fast fail-over, and high speed trading applications.

The SISCI API supports data transfers between applications and processes running in an SMP environment as well as between independent servers. SISCI's capabilities include managing and triggering of application specific local and remote interrupts, along with catching and managing events generated by the underlying PCIe system (such as a cable being unplugged). The SISCI API makes extensive use of the "resource" concept. Resources are items such as virtual devices, memory segments, and DMA queues.

The API removes the need to understand and manage low level PCIe chip registers. At the application level, developers utilize these resources without sacrificing performance. Programming features include allocating memory segments, mapping local and remote memory segments into addressable program space, and data management and transfer with DMA. The SISCI API improves overall system performance and availability with advanced caching techniques, data checking for data transfer errors, and data error correction.

## Features

- Shared memory API
- PCI Express Peer to Peer support
- Replicated/reflective memory support
- Distributed shared memory and DMA support
- Low latency messaging API
- Interrupt management
- Direct memory reads and writes
- Windows, RTX, VxWorks, and Linux support
- Supports data transfers between all supported OS and platforms.
- Caching and error checking support
- Events and callbacks
- Example code available

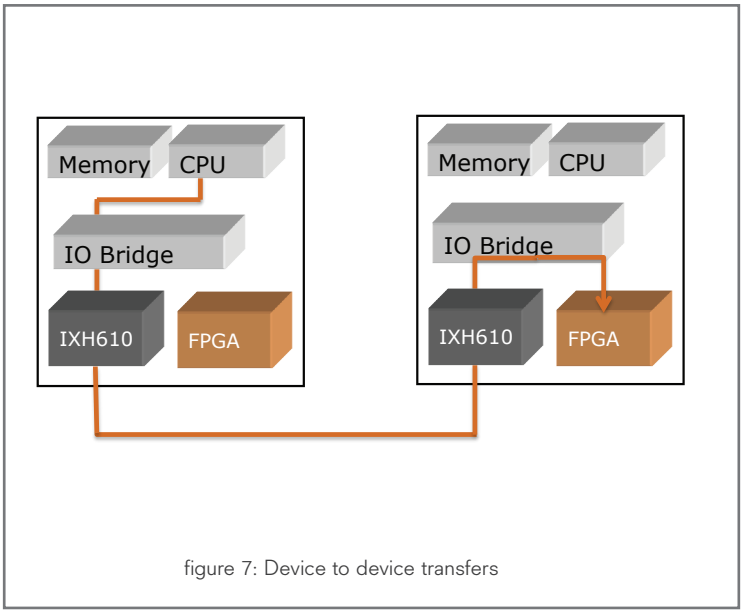



figure 7: Device to device transfers

# eXpressWare™ Software

## Why use SISCI?

The SISCI software and underlying drivers simplify the process of building shared memory based applications. For PCIe based application development, the API utilizes PCI Express non-transparent bridging to maximum application performance. The shared memory API drivers allocate memory segments on the local node and make this memory available to other nodes. The local node then connects to memory segments on remote nodes.

Once available, a memory segment is accessed in two ways, either mapped into the address space of your process and accessed as a normal memory access, e.g. via pointer operations, or use the DMA engine in the PCIe chipset to transfer data. Figure 6 illustrates both data transfer options.

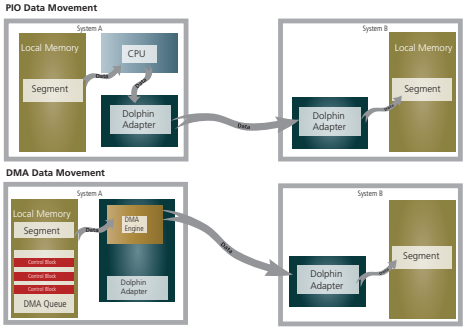



figure 8: SISCI data movement model

Mapping the remote address space and using PIO may be appropriate for control messages and data transfers up to e.g. 1k bytes, since the processor moves the data with very low latency. PIO optimizes small write transfers by requiring no memory lock down, data may already exist in the CPU cache, and the actual transfer is just a single CPU instruction – a write posted store instruction. A DMA implementations saves CPU cycles for larger transfers, enabling overlapped data transfers and computations. DMA has a higher setup cost so latencies usually increase slightly because of the time required to lock down memory and setup the DMA engine and interrupt completion time. However, more data transfers joined and sent together to the PCIe switch in order amortizes the overhead.

The built in resource management enables multiple concurrent SISCI programs and other users of the PCIe Fabric to coexist and operate independent of each other. The SISCI API is available in user space and a similar API is available in kernel space. Itatiaes occhui fachi, niciam

## SISCI Performance

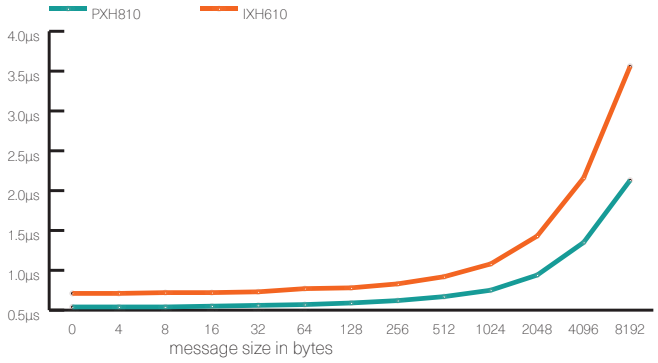



Figure 7: PXH and IXH latency

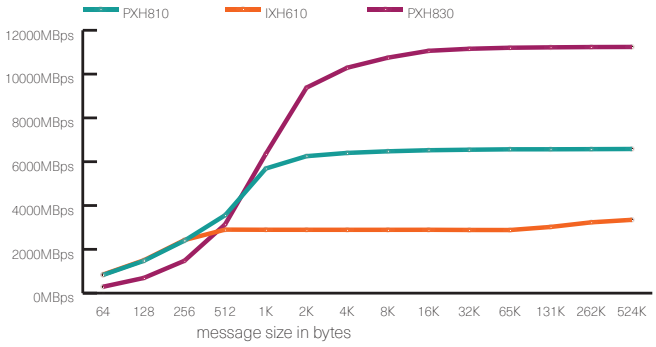
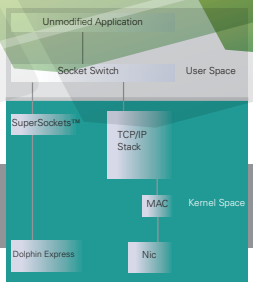



Figure 8: SISCI PIO/DMA Throughput

The SISCI API provides applications direct access to the low latency messaging enabled by PCI Express. Dolphin SISCI benchmarks show latencies as low as 0.54µs. The chart on Figure 7 show the latency at various message sizes. The SISCI API enables high throughput applications. This high performance API takes advantage of the PCI Express hardware performance to deliver over 11 GB/s for Gen 3 and 3500 MB/s for Gen 2 of real application data throughput. Figure 8 shows the throughput at various message sizes using Dolphin IXH and PXH host adapters




# eXpressWare™ Software

## SuperSockets™

PCI Express can replace local Ethernet networks with a high speed low latency network. SuperSockets is a unique implementation of the Berkeley Sockets API. With SuperSockets , network applications transparently capitalize on the PCIe transport to achieve performance gains.

Dolphin PCIe hardware and the SuperSockets software support the most demanding sockets based applications with an ultra-low latency, high-bandwidth, low overhead, and highly available platform. New and existing Linux and Windows applications require no modification to be deployed on Dolphin's high-performance platform.

Traditional implementations of TCP sockets require two major CPU consuming tasks: data copy between application buffers and NIC buffers along with TCP transport handling (segmentation, reassembly, check summing, timers, acknowledgments, etc). These operations turn into performance bottlenecks as I/O interconnect speeds increase. SuperSockets eliminates the protocol stack bottlenecks, delivering superior latency performance. Our ultra-low latency remote memory access mechanism is based on a combination of PIO (Programmed IO) for short transfers and DMA (Direct Memory Access) for longer transfers, allowing both control and data messages to experience performance improvements.

SuperSockets is unique in its support for PIO. PIO has clear advantages for short messages, such as control messages for simulations systems. Transfers complete through a single CPU store operation that moves data from CPU registers into remote system memory. In most cases, SuperSockets data transfers complete before alternative technologies start their RDMA transfer.

In addition to PIO, SuperSockets implements a high-speed loopback device for accelerating local system sockets communication. This reduces local sockets latency to a minimum. For SMP systems, loopback performance is increased 10 times.

SuperSockets comes with built in high availability, providing instantaneous switching during system or network errors. If the PCI Express® Fabric fails, socket communication transfers to the regular network stack. The Linux version supports an instant fail- over and fail-forward mechanism between the PCIe and regular network.

## Features

- Windows and Linux support
- Full support for socket inheritance/duplication
- Includes local loopback socket acceleration up to 10 times faster than standard Linux and Windows
- No OS patches or application modifications required
- Easy to install with no application modifications
- Linux to Windows connectivity available soon

### Linux Specific Features

- TCP, UDP, and UDP multi-cast support
- Supports both user space and kernel space applications
- Compliant with Linux Kernel Socket library and Berkeley Sockets
- Transparent fail-over to Ethernet if high speed connection fails and falls back when problem is corrected

### Windows Specific Features

- TCP support , UDP and UDP multi-cast being implemented
- Supports user space applications
- Compliant with WinSock2 API
- Fail-over to Ethernet if high speed connection is not available at start-up

# eXpressWare™ Software

## How Does SuperSockets™ Work?

To divert socket communication without touching the application, the sockets API functions must be intercepted. This is done differently in Windows and Linux environments.

Dolphin SuperSockets on Linux differs from regular sockets only in the address family. SuperSockets implement an AF_INET compliant socket transport called AF_SSOCK. The Linux LD_PRELOAD functionality is used to preload the standard sockets library with a special SuperSockets library that intercepts the socket () call and replaces the AF_INET address family with AF_SSOCK. All other sockets calls follow the usual code path. Target addresses within the PCI Express Fabric are accelerated by the SuperSockets module.

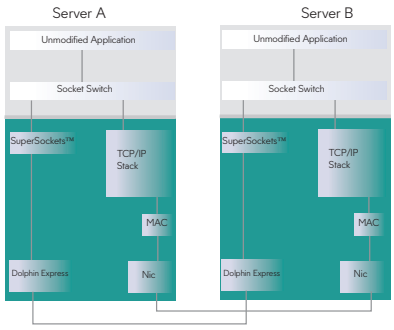



figure 9: SuperSockets™ vs. Ethernet data model

For Windows applications or services, a Layered Service Provider(LPS) module is installed and automatically configured. The LSP accelerates socket transfers initiated by AF_INET or AF_INET6, SOCK_STREAM endpoints. The SuperSockets stack provides a proxy application called dis_ssocks_run.exe that enables specific programs to use the PCI Express path. By default, the LSP is a pass-through module for all applications: the network traffic passes through the NDIS stack.

The network acceleration over PCI Express occurs when the interconnect topology is fully functional, the client and server programs are launched under the proxy application's control and both sides use the standard Winsock2 API calls. At runtime, a native socket is created and used for initial connection establishment. Therefore, all connections are subject to typical network administrative policies.

The supported transfer modes are blocking, non-blocking, overlapped, asynchronous window and network events. The Service Provider balances the CPU consumption based on the traffic pattern. Dedicated operating system performance counters are additionally provided.

## SuperSockets™ Performance

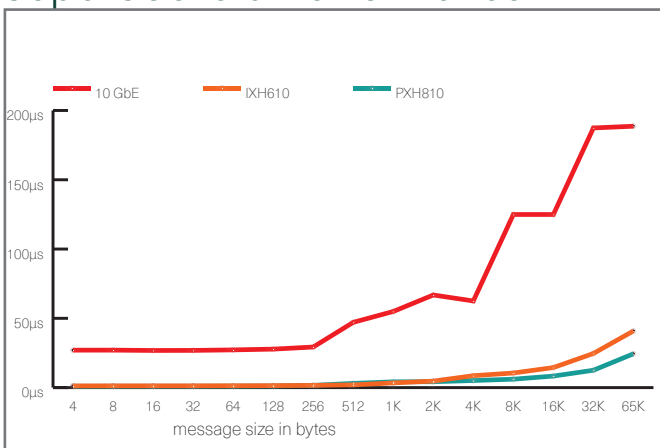



Figure 10: SuperSockets™ latency

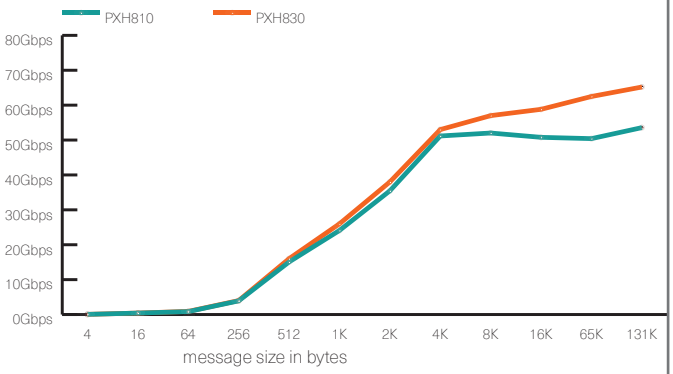



Figure11: SuperSockets™ Throughput

SuperSockets is optimized for high throughput, low latency communication by reducing system resource and interrupt usage in data transfers. The latency chart above shows performance results using PCI Express vs 10 Gigabit Ethernet. The socket ping-pong test shows the half RTT (Round Trip Time). The minimum latency for Dolphin SuperSockets is under 1 microseconds. SuperSockets also delivers high throughput with over 53 Gb/s of data throughput with our Gen3 PXH810 product.

# PCIe NTB Adapters

Dolphin's PCI Express NTB Host Adapter are high performance cabled interface to external processor subsystems. Based on standard PCI Express bridging architectures, the host adapters include advanced features for non-transparent bridging (NTB) and clock isolation.

These host adapter combine high performance with an application to application latency starting at sub-1 microsecond. They support both Remote Direct Memory Access (RDMA) and Programmed IO (PIO) transfers, effectively supporting both large and small data packets. RDMA transfers result in efficient larger packet transfers and processor off-load. PIO transfers optimize small packet transfers at the lowest latency. The combination of RDMA and PIO creates a highly potent data transfer system.

All PCIe NTB adapters support our eXpressWare™ software suite which takes advantage of PCI Express' RDMA and PIO data transfer scheme. eXpressWare™ software delivers a complete deployment environment for customized and standardized applications. The suite includes a Shared-Memory Cluster Interconnect (SISCI) API as well as a TCP/IP driver and SuperSockets software. The SISCI API is a robust and powerful shared memory programming environment.

The optimized TCP/IP driver and SuperSockets™ software remove traditional networking bottlenecks, allowing standard IP and sockets applications to take advantage of the high-performance PCI Express interconnect without modification. The overall framework is designed for rapid development of inter-processor communication systems.

Our host adapters are carefully designed for maximum cable length. They supports copper cables at various lengths at full PCI Express speeds. Fiber optics are available on some models to extend cable distances up to 100 meters.

All NTB adapter cards come with a full license to the Dolphin eXpressWare software.

## Features

- PCI Express compliant
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- RDMA support through PIO and DMA
- Copper and fiber-optic cable connections
- Full host clock isolation. Supports hosts running both CFC and SSC
- Non-transparent bridging to cabled PCI Express systems
- Low Profile PCIe form factor
- EEPROM for custom system configuration
- Link status LEDs through face plate

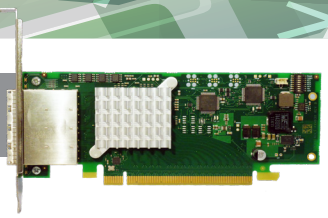
## Specifications

| | |
|---|---|
| Dolphin Software | SuperSockets Berkley Sockets API<br>Microsoft WinSock2 /LSP support<br>IPoPCIe driver<br>SISCI API<br>Device Lending and SmartIO -(excludes IX products) |
| PCIe Bracket | Full height plate mounted<br>Half height plate included |
| Configuration | DIP-switch<br>NTB /Long cable /short cable /safe boot |
| Regulatory | CE Mark<br>FCC Class A<br>UL94V-0 compliant<br>RoHS Compliant |

| | |
|---|---|
| Operating Systems supported | Windows, RTX, Linux, VxWorks |
| Operating Environment | Operating Temperature: 0°C - 55°C (32°F - 131°F)<br>Operating Temperature with AOC: 0°C - 45°C (32°F - 113°F)<br>Air Flow: 150 LFM<br><br>Operating Temperature: 0°C - 50°C (32°F - 122°F)<br>Air Flow: ~0 LFM<br><br>Relative Humidity: 5% - 95% (non- condensing) |

# PCIe NTB Adapters

## PXH830 Gen 3 PCIe NTB Adapter



## Features

- PCI Express Gen3 compliant - 8.0 GT/s per lane
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Quad SFF-8644 connector
  - » PCI Express 3.0 cables
  - » MiniSAS -HD cables
- Four x4 Gen3 PCI Express cable ports that can be configured as:
- One - x16 PCI Express port
- Two - x8 PCI Express ports
- Two NTB ports
- Copper and fiber-optic cable support

## Specifications

| | |
|---|---|
| Link Speeds | 32 GT/s per port /128 GT/s |
| Application Performance | 0.54 microsecond latency (application to application)<br><130 nanoseconds cut through latency port to port |
| Active Components | Broadcom/PLX Gen 3 PCIe Switch with DMA |
| PCI Express | Base Specification 3 |
| Topologies | Point to point or 3 node Mesh Topology |
| Cable Connections | Quad SFF-8644 connector<br>PCIe 3.0 and MiniSAS HD cables<br>Copper cables, 0.5 - 9 meters<br>Fiber Optic -100 meters |

| | |
|---|---|
| Power Consumption | 10 Watts (typical, 14 Watts worst case ) + 800 miliwatts (typical) pr connected x4 AOC |
| Mechanical Dimensions | Low profile, Half Length - 68.90 mm (2.731 inches) x 167.65 mm (6.600 inches) |
| Product Codes | PXH830 PCIe Fabric Adapter |

## Cluster connections

When used for multi-processor connections, the PXH830 adapter is capable of connecting up to three nodes at Gen3 x8 without a switch as shown in figure 1 2 or two nodes at Gen3 x16. Each port is 32 GT/s. Two ports create a 64 GT/s x8 link. Four port create a 128 GT/s x16 link. All ports have latencies as low as 0.54 microseconds. The PXH830 supports any system with a standard x16 PCIe slot.

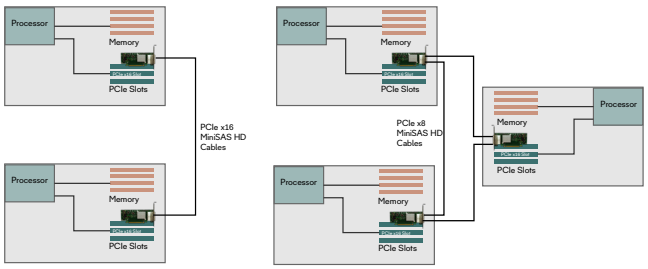



Figure 12: Switchless PXH830 Configurations

## Performance

Each connection supports 32 GT/s with a maximum of 128 GT/s. Figure 13 illustrates the latency at various packet sizes. The bottom axis are packet sizes the side axis is latency in microseconds. PXH830 latencies are as low as 0.54 microseconds.

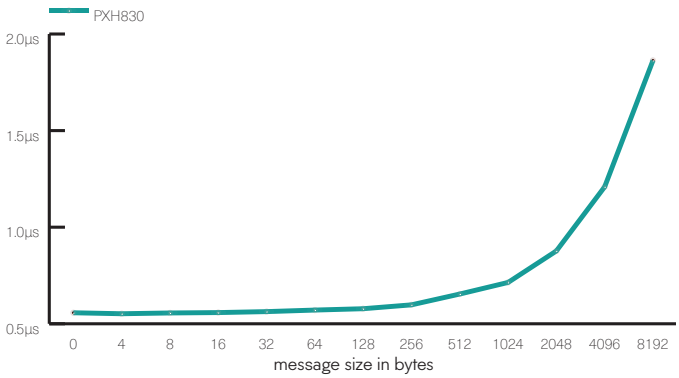
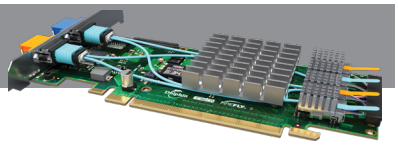



Figure 13: PXH830 Latency

# PCIe NTB Adapters



## PXH840 Gen 3 PCIe NTB Adapter

### Features

- PCI Express Gen3 compliant - 8.0 GT/s per lane
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Samtec FireFly Fiber optic
- Four x4 Gen3 PCI Express cable ports that can be configured as:
- One - x16 PCI Express port
- Two - x8 PCI Express ports
- Two NTB ports
- fiber-optic cable only

### Specifications

| | |
|---|---|
| Link Speeds | 32 GT/s per port /128 GT/s |
| Application Performance | 0.54 microsecond latency (application to application)<br><130 nanoseconds cut through latency port to port |
| Active Components | Broadcom/PLX Gen 3 PCIe Switch with DMA |
| PCI Express | Base Specification 3 |
| Topologies | Point to point or 3 node Mesh Topology |
| Cable Connections | Samtec FireFly Transceivers<br>Fiber Optic -100 meters |
| Power Consumption | 10 Watts (typical, 14 Watts worst case ) + 800 miliwatts (typical) pr connected x4 AOC |
| Mechanical Dimensions | Low profile, Half Length - 68.90 mm (2.731 inches) x 167.65 mm (6.600 inches) |
| Product Codes | PXH840 PCIe Fabric Adapter |

### Cluster connections

When used for multi-processor connections, the PXH830 adapter is capable of connecting up to three nodes at Gen3 x8 without a switch as shown in figure 1 2 or two nodes at Gen3 x16. Each port is 32 GT/s. Two ports create a 64 GT/s x8 link. Four port create a 128 GT/s x16 link. All ports have latencies as low as 0.54 microseconds. The PXH830 supports any system with a standard x16 PCIe slot.

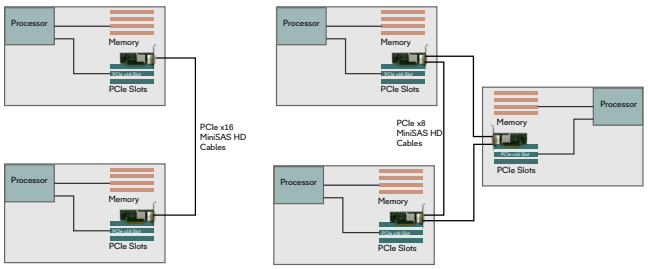



Figure 14: Switchless PXH830 Configurations

### Performance

Each connection supports 32 GT/s with a maximum of 128 GT/s. Figure 15 illustrates the latency at various packet sizes. The bottom axis are packet sizes the side axis is latency in microseconds. PXH830 latencies are as low as 0.54 microseconds.

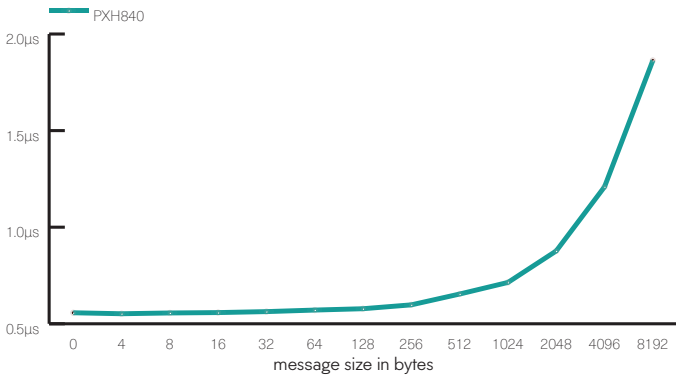



Figure 15: PXH840 Latency

# PCIe NTB Adapters

## MXH830 Gen 3 PCIe NTB Adapter

### Features

- PCI Express Gen3 - 8.0 GT/s per lane
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Quad SFF-8644 connector
  - » PCI Express 3.0 cables
  - » MiniSAS -HD cables
- RDMA support through PIO and System DMA
- Copper and fiber-optic cable support
- <170ns - Cut Through latency
- MXH830 supports the following port configurations
  - » One - x16 PCIe port
  - » Two - x8 PCIe ports
  - » Four - x4 PCIe ports
- MXH830 can be configured into a 5 node cluster using 4 x4 ports to each host or a 3 node cluster using x8 connections,or a two node x16 connection
- Combined with the MXS824 can scale to up to 64 or128 nodes

### Specifications

| | |
|---|---|
| Link Speeds | 32GT/s per port / 128 GT/s total |
| Application Performance | ~500ns latency (application to application)<br>Above 10 Gbytes/s throughput |
| Active Components | Microsemi Switchtec PFX Switch |
| PCI Express | Base Specification 3.1<br>Cable Specification 3.0 ( preliminary)<br>Card Electromechanical Specification 3.0 |
| Topologies | Two nodes direct cable<br>Three to five nodes mesh topology<br>Switched Topology with MXS824 |
| Cut-Through Latency | <170ns |
| Cable Connections | SFF-8644 connector for copper / fiber cables<br>Supports 4 - x4/ 2 - x8 or 1 - x16 connections<br>PCIe 3.0 copper and MiniSAS-HD copper / fiber up to 9m with copper, 100m with fiber |
| Power Consumption | 12 Volt: Max 19.6 Watts<br>12 Volt: Max 24 Watts including AOC<br>+3.3 Volt: Not connected<br>+3.3 Volt AUX: Max 1 Watt |
| Mechanical Dimensions | Low profile - 69.2 mm ( 2.7 inches) x 168.2 mm (6.6 inches) |
| Product Codes | MXH830 Host NTB Adapter |

### Cluster connections

When used for multi-processor connections, the MXH830 adapter is capable of connecting up to 5 nodes at Gen3 x4 without a switch as shown in figure 1 6 or three nodes at Gen3 x8 and 2 nodes at Gen3 x16. Each port is 32 GT/s. Two ports create a 64 GT/s x8 link. Four port create a 128 GT/s x16 link. The MXH830 supports any system with a standard x16 PCIe slot.

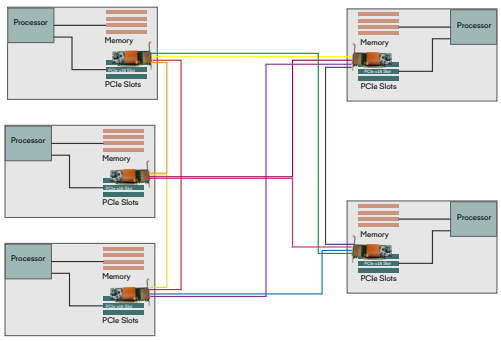
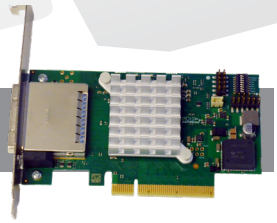



Figure 16: Five node MXH830 cluster

[1] System DMA is only available with select systems

# PCIe NTB Adapters



## PXH810 Gen 3 PCIe NTB Adapter

### Features

- Gen 3 64 GT/s
- PCI Express Gen3 compliant - 8.0 GT/s per lane
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- PCIe iPass Connectors
- One x8 PCIe port
- RDMA support through PIO and DMA
- Non-transparent bridging
- Copper connection up to 5 meters
- Fiber-optic cable connection up to 100 meters
- Clock isolation, full CFC and SSC support
- Non-transparent bridging to cabled PCIe systems
- Low Profile PCIe form factor
- EEPROM for custom system configuration
- Link status LEDs through face plate

### Specifications

| | |
|---|---|
| Link Speeds | 64 GT/s |
| Application Performance | 0.54 microsecond latency (application to application)<br>6595 MB/s throughput |
| Active Components | PLX PCI Express Switch |
| PCI Express | Base Specification 3 |
| Topologies | Switch/ point to point |
| Cable Connections | x8 iPass copper cable, fiber optic cable support<br>Supports x8 to x4 transition cables |
| Power Consumption | 12 watts |

| | |
|---|---|
| Mechanical Dimensions | Low profile - 68.90 mm ( 2.731 inches) x<br>120 mm (6.600 inches) |
| Mounting Plates | Full height plate installed<br>Half height plate included with board |
| Operating Systems supported | Windows, RTX, Linux, VxWorks |
| Product Codes | PXH810 Host NTB Adapter |

### Cluster and I/O connections

The PXH810 adapter delivers extremely high throughput. This is demonstrated by using the SISCI API. The PXH810 PCIe hardware performance delivers over 6500 MB/s of real application data throughput for high performance communication. Figure 17 shows the throughput at various message sizes using the PXH810 Gen 3 host adapters.

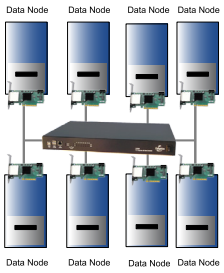



figure 17: Eight node PXH810 cluster

### Performance

When used for inter-host connections, the PXH810 adapter is capable of node to node connections or connections through a IXS600 Switch as shown in figure 18. Each connection supports 64 GT/s with latencies as low as 0.54 microseconds. Designed for x8 PCIe Systems, the PXH810 supports any system with a standard x8 or x16 PCIe slot. Gen3 operation requires a system that supports Gen3 PCI Express.

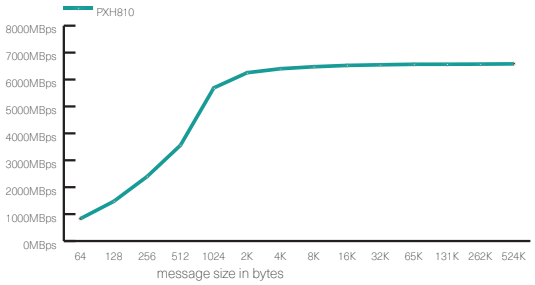



figure 18: PXH810 Throughput

# PCIe NTB Adapters

## IXH610 Gen2 PCIe Host Adapters

### Features

- PCI Express 2.1 compliant - 5.0 GT/s per lane
- x8 PCI Express port - 40 GT/s
- Link compliant with Gen1 and Gen2 PCI Express
- Support Gen1, Gen2, and Gen3 PCIe Slots
- PCI Express External Cabling Specification
- PCI Express x8 iPass Connectors
- Copper cables - up to 7 meters
- Non-transparent bridging to cabled PCIe systems

### Specifications

| | |
|---|---|
| Link Speeds | 40 GT/s |
| Application Performance | 0.74 ms latency (application to application)<br>3,500 MB/s Throughput |
| PCI Express | Base Specification 2.1 |
| Topologies | Point to point, Switched |
| Cable Connections | x8 iPass copper cable support<br>Supports x8 to x4 transition cables |
| Power Consumption | 7 watts |

| | |
|---|---|
| Mechanical Dimensions | PCI Express Card Electromechanical Specification 2.0 |
| Operating Environment | Operating Temperature: -10°C -60°C<br>Relative Humidity: 5% -95% non-condensing |
| User Configuration Modes | Transparent Host<br>Target adapter<br>Non-transparent Host(NTB) |
| Product Codes | IXH610 - Host / NTB Adapter |

### Cluster connections

When used for clustered connections, the IXH610 adapter is capable of node to node connections or connections through a IXS600 Switch as shown in figure 19. Adding industrial systems is done by connecting to the IXH620 XMC adapter. Each connection supports 40 GT/s with latencies as low as 0.74 microseconds. Designed for x8 PCIe Systems, the IXH610 supports any system with a standard x8 or x16 PCIe slot. The IXH631 uses MiniSAS HD connectors to create up to a 5 node cluster without a switch.


Figure 19: Eight node PCI Express Cluster

# PCIe Hardware

## IXH620 Gen2 PCIe XMC Host Adapter

### Features

- PCI Express 2.1 compliant - 5.0 GT/s per lane
- x8 PCIe port - 40 GT/s
- VITA 42.0-2005, ANSI/VITA 42.3-2006 compliant
- PCI Express External Cabling Specification
- PCIe x8 iPass Connectors
- Copper cable connections up to 7 meters copper connection
- Non-transparent bridging to cabled PCI Express systems
- Short XMC form factor
- XMC P15 connector

### Specifications

| | |
|---|---|
| Link Speeds | 40 GT/s |
| Application Performance | 0.74 microsecond latency (application to application) |
| Specifications | PCI Express Base Specification 2.1<br>VITA 42.0-2005, ANSI/VITA 42.3-2006 |
| Topologies | Point to point, Switched |
| Cable Connections | x8 iPass copper cable support<br>Supports x8 to x4 transition cables |
| Power Consumption | 7 watts |
| Mechanical Dimensions | XMC Short form factor |
| Operating Environment | Operating Temperature: 0°C -55°C<br>Relative Humidity: 5% -95% non-condensing |
| User Configuration Modes | Non-transparent(NTB) |
| Product Codes | IXH620 Host /Target / NTB adapter |

### Host to host connections

The IXH620 connects single board computers or systems running a distributed processing environment. Industrial or military customers requiring redundancy or increased compute resources use the IXH620 by itself or in conjunction with the IXS600 switch. Figure 20 illustrates connecting two single board computers with the IXH620. Fast data transfers are enabled through Dolphin's shared memory mechanism.


Figure 20: two node connection with XMC adapter

# PCIe Host/ Target Adapters

## PCIe Host/Target Adapters

Dolphin's PCIe Host/Target Adapters are high performance cabled interface to external IO subsystems. All transparent host and target adapters provide standard features for transparent bridging (TB), along with host and clock isolation.

Various host/target adapters can be configured to support various connection configurations including switched or point to point. They are designed to support various applications including GPU farms, test and measurement equipment, medical equipment, and storage subsystem. Each adapter is configurable as either a host adapter or target adapter using an on-board DIP-Switch to select between host and target operations.

These adapters support various cabling specification including iPass or the new PCI Sig 3.0 specification. Some adapter can also be used with a standard MiniSAS-HD cable when the Dolphin card is both the host and target adapter. Our new Gen3 adapters supports the new CMI functionality when used with a PCIe 3.0 cable and can therefore connect to a CMI compliant PCIe target device.

The adapters are carefully designed for maximum cable length. Some boards support copper cables up to 9 meters at full PCI Express Gen3 speed. Fiber optics extends this distance to 100 meters.

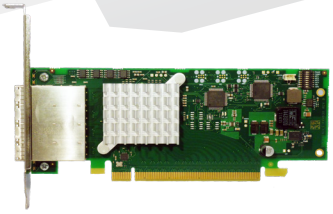
## Features

- PCI Express compliant
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Copper and fiber-optic cable connections
- Full host clock isolation. Supports hosts running both CFC and SSC
- Low Profile PCIe form factor and XMC form factors
- EEPROM for custom system configuration
- Link status LEDs through face plate

## Specifications

| | |
|---|---|
| PCIe Bracket | Full height plate mounted<br>Half height plate included |
| Configuration | DIP-switch<br>Host /Target /Long cable /short cable /safe boot |
| Regulatory | CE Mark<br>FCC Class A<br>UL94V-0 compliant<br>RoHS Compliant |
| Operating Systems supported | All |

| | |
|---|---|
| Operating Environment | Operating Temperature: 0°C - 55°C (32°F - 131°F)<br>Operating Temperature with AOC: 0°C - 45°C (32°F - 113°F)<br>Air Flow: 150 LFM<br><br>Operating Temperature: 0°C - 50°C (32°F - 122°F)<br>Air Flow: ~0 LFM<br><br>Relative Humidity: 5% - 95% (non- condensing) |



# PXH832 Gen 3 Host/Target Adapter

## Features

- PCI Express Gen3 compliant - 8.0 GT/s per lane
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Host and target operation
- Quad SFF-8644 connector
  - » PCI Express 3.0 cables
  - » MiniSAS -HD cables
- Four x4 Gen3 PCI Express cable ports that can be configured as:
  - » One - x16 PCI Express port
  - » Two - x8 PCI Express ports
- Copper and fiber-optic cable connectors
- Full host clock isolation. Supports hosts running both CFC and SSC
- Low Profile, half length PCIe form factor
- EEPROM for custom system configuration
- Link status LEDs through face plate

## Specifications

| | |
|---|---|
| Link Speeds | 32 GT/s per port / 128 GT/s |
| Application Performance | <130 nanoseconds cut through latency port to port |
| Active Components | Broadcom /PLX Gen 3 PCIe Switch |
| PCI Express | Base Specification 3 |
| Topologies | Transparent Host/Target up to 4 devices |
| Cable Connections | Quad SFF-8644 connector<br>PCIe 3.0 and MiniSAS HD cables<br>copper cables, 0.5 - 9 meters<br>Fiber Optic -100 meters |

| | |
|---|---|
| Power Consumption | 10 Watts (typical, 14 Watts worst case ) + 800 miliwatts (typical) pr connected x4 AOC |
| Mechanical Dimensions | Low profile, Half Length - 68.90 mm (2.731 inches) x 167.65 mm (6.600 inches) |
| PCIe Bracket | Full height plate mounted<br>Half height plate included |
| Product Codes | PXH832 Host/Target Adapter |

## Topology Support

The PXH832 adapter is capable of being configured as a host or a target adapter. Figure 21 illustrates the some of the various topologies supported by the PXH832. It can support up to 4 PCIe expansion units without an external switch. As a host adapter, the PXH832 connects to PCIe targets via PCIe 3.0 cables. It can connect to other PXH832 boards as a target or a custom target adapters. The PXH832 can be configured as a x16, x8, or x4 connection.

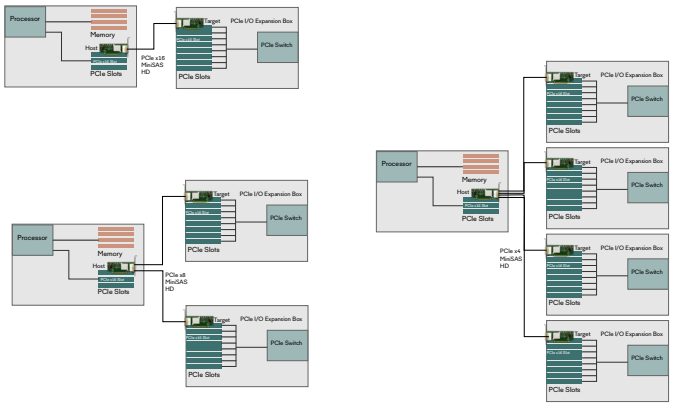
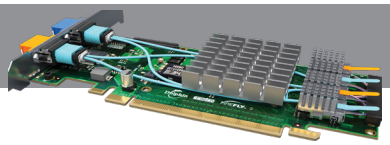



Figure 21: PXH832 Transparent Topology

# PCIe Host/ Target Adapters



## PXH842 Gen 3 PCIe Host/ Target Adapter

### Features

- PCI Express Gen3 compliant - 8.0 GT/s per lane
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Host and target operation
- Samtec FireFly Connections
- Four x4 Gen3 PCI Express cable ports that can be configured as:
  - One - x16 PCI Express port
  - Two - x8 PCI Express ports
  - Four - x4 PCI Express ports
- Fiber-optic cable connectins only
- Full host clock isolation. Supports hosts running both CFC and SSC
- Low Profile, half length PCIe form factor

### Specifications

| | |
|---|---|
| Link Speeds | 32 GT/s per port /128 GT/s |
| Application Performance | 0.54 microsecond latency (application to application)<br><130 nanoseconds cut through latency port to port |
| Active Components | Broadcom/PLX Gen 3 PCIe Switch with DMA |
| PCI Express | Base Specification 3 |
| Topologies | Point to point or 3 node Mesh Topology |
| Cable Connections | Samtec FireFly Transceivers<br>Fiber Optic -100 meters |
| Power Consumption | 10 Watts (typical, 14 Watts worst case ) + 800 milliwatts (typical) pr connected x4 AOC |
| Mechanical Dimensions | Low profile, Half Length - 68.90 mm (2.731 inches) x 167.65 mm (6.600 inches) |
| Product Codes | PXH842 PCIe Host/Target Adapter |

### Topology Support

The PXH842 adapter is capable of being configured as a host or a target adapter. Figure 22 illustrates the various configurations supported by the PXH842. It can support up to 4 PCIe expansion units without an external switch. As a host adapter, the PXH842 connects to PCIe targets via MPO cables to Samtec Fiberfly transceivers. It can connect to other PXH842 boards as a target or a custom target adapters. The PXH842 can be configured as a x16, x8, or x4 connection.

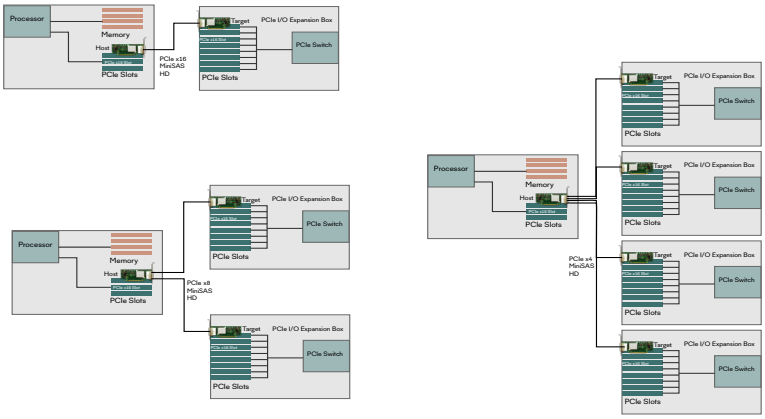



Figure 22: PXH842 Switchless Transparent Topology

# MXH832 Gen 3 Host/Target Adapter

## Features

- PCI Express Gen3 compliant - 8.0 GT/s per lane
- Microsemi PFX 32 lane switch
- Link compliant with Gen 1, Gen 2, and Gen 3 PCIe
- Host and target operation
- Quad SFF-8644 connector
  - » PCI Express 3.0 cables
  - » MiniSAS-HD cables
- Copper and fiber-optic cables
- MXH832 supports the following port configurations
  - » One - x16 PCIe port
  - » Two - x8 PCIe ports
  - » Four - x4 PCIe ports
- Full host Clock isolation support. Automatic support for host running CFC or SSC.

## Specifications

| | |
|---|---|
| Link Speeds | 32 GT/s per port / 128 GT/s |
| Application Performance | 170 nanoseconds cut through latency port to port |
| Active Components | Microsemi PFX Gen 3 PCIe Switch |
| PCI Express | Base Specification 3.1<br>Cable Specification 3.0 ( preliminary)<br>Card Electromechanical Specification 3.0 |
| Topologies | Transparent Host/Target up to 4 devices |
| Cable Connections | SFF-8644 connector for copper / fiber cables<br>Supports 4 - x4/ 2 - x8 or 1 - x16 connections<br>PCIe 3.0 copper and MiniSAS-HD copper / fiber<br>Distance - up to 9m with copper, 100m with fiber |
| Power Consumption | 12 Volt: Max 19.6 Watts<br>12 Volt: Max 24 Watts including AOC<br>+3.3 Volt: Not connected<br>+3.3 Volt AUX: Max 1 Watt |
| Mechanical Dimensions | Low profile, Half Length - 69.2 mm (2.7 inches) x 168.2 mm (6.6 inches) |
| PCIe Bracket | Full height plate mounted<br>Half height plate included |
| Regulatory (pending) | CE Mark<br>FCC Class A<br>UL94V-0 compliant<br>RoHS Compliant |
| Operating Environment | Operating Temperature: 0°C - 55°C (32°F - 131°F)<br>Air Flow: 150 LFM<br>Relative Humidity: 5% - 95% (non- condensing) |
| Configuration | DIP-switch<br>Host / Target / x4,x8,x16 link / Safe Boot / Edge Clock Select |
| Product Codes | MXH832 Host/Target Adapter |

## Topology Support

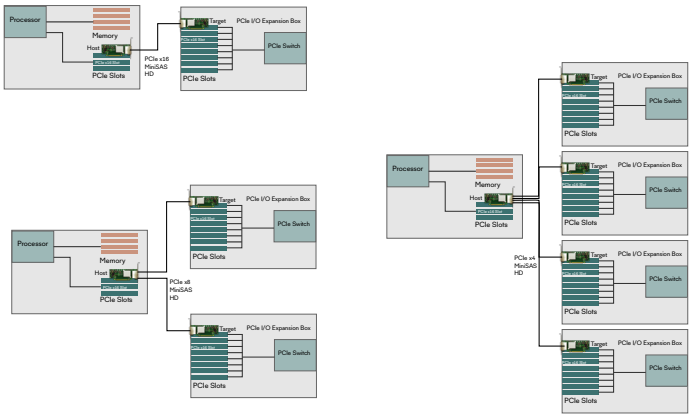



Figure 23:MXH832 I/O Expansion Configurations

# PCIe Host/ Target Adapters

## PXH812 Gen 3 Host/Target Adapter

### Features

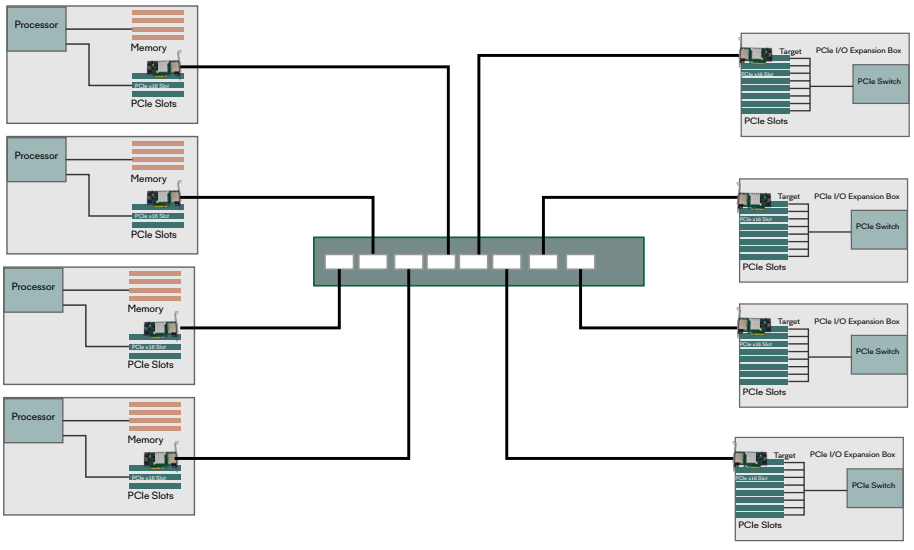
- PCI Express Gen3 compliant - 8.0 GT/s per lane
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Host and target operation
- PCI Express iPass cables
- One x8 Gen3 PCI Express cable port that can be configured as:
- Copper and fiber-optic cable connectors
- Full host clock isolation. Supports hosts running both CFC and SSC
- Low Profile, half length PCIe form factor
- EEPROM for custom system configuration
- Link status LEDs through face plate

### Specifications

| | |
|---|---|
| Link Speeds | 64 GT/s |
| Cut through latency | 138 nanoseconds |
| Active Components | Broadcom (PLX/Avago) PCIe Switch |
| PCI Express | Base Specification 3 |
| Topologies | Switch/ point to point |
| Cable Connections | x8 iPass copper cable, fiber optic cable support<br>Supports x8 to x4 transition cables |
| Power Consumption | 3.3 Volt 12 watts |
| Mechanical Dimensions | Low profile - 68.90 mm ( 2.731 inches) x<br>120 mm (6.600 inches) |

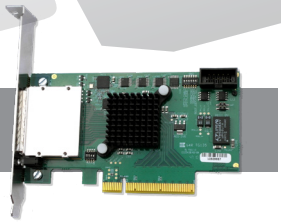
| | |
|---|---|
| Operating Environment | Operating Temperature: 0°C -55°C<br>Relative Humidity: 5% -95% non-condensing |
| Usage Modes | Transparent Host/Target |
| Configuration | Dip-switch configurable<br>host / target |
| Mounting Plates | Full height plate installed<br>Half height plate included with board |
| Product Codes | PXH812 Host/ Target Adapter |

### Topology Support




Figuure 24: I/O Expansion with PXH812

# PCIe Host/ Target Adapters



## IXH611 Gen2 PCIe Host/Target Adapters

### Features

- PCI Express 2.1 compliant - 5.0 GT/s per lane
- x8 PCI Express port - 40 GT/s
- Link compliant with Gen1 and Gen2 PCI Express
- Support Gen1, Gen2, and Gen3 PCIe Slots
- PCI Express x8 iPass Connectors
- Copper cables - up to 7 meters
- Transparent bridging to cabled I/O devices
- Low Profile PCIe form factor

### Specifications

| | |
|---|---|
| Link Speeds | 40 GT/s |
| PCI Express | Base Specification 2.1 |
| Topologies | Point to point, Switched |
| Cable Connections | x8 iPass copper cable support<br>Supports x8 to x4 transition cables |
| Power Consumption | 7 watts |
| Mechanical Dimensions | PCI Express Card Electromechanical Specification 2.0 |

| | |
|---|---|
| Operating Environment | Operating Temperature: -10°C -60°C<br>Relative Humidity: 5% -95% non-condensing |
| User Configuration Modes | Transparent Host<br>Target adapter<br>Non-transparent Host(NTB) |
| Product Codes | IXH611 - Host/Target Adapter |

### Remote I/O Connections

The IXH611 functions as a high quality transparent connection to remote PCIe I/O subsystems. These subsystems include test equipment, I/O expansion systems, specialized equipment, and storage systems. The IXH611 is specially designed for higher signal quality and support for spread spectrum clocking. The IXH611 is used as a target adapter in I/O expansion applications.


Figure 25: I/O expansion with PCI Express

# PCIe Host/ Target Adapters

## IXH620 Gen2 PCIe XMC Host Adapter

### Features

- PCI Express 2.1 compliant - 5.0 GT/s per lane
- x8 PCIe port - 40 GT/s
- Link compliant with Gen1 PCI Express
- VITA 42.0-2005, ANSI/VITA 42.3-2006 compliant
- PCI Express External Cabling Specification
- PCIe x8 iPass Connectors
- Copper cable connections up to 7 meters copper connections
- Clock isolation support
- Transparent bridging to cabled I/O devices
- Short XMC form factor
- EEPROM for custom system configuration
- XMC P15 connector

## Specifications

| | |
|---|---|
| Link Speeds | 40 GT/s |
| Application Performance | 0.74 microsecond latency (application to application) |
| Specifications | PCI Express Base Specification 2.1<br>VITA 42.0-2005, ANSI/VITA 42.3-2006 |
| Topologies | Point to point, Switched |
| Cable Connections | x8 iPass copper cable support<br>Supports x8 to x4 transition cables |
| Power Consumption | 7 watts |
| Mechanical Dimensions | XMC Short form factor |

| | |
|---|---|
| Operating Environment | Operating Temperature: 0°C -55°C<br>Relative Humidity: 5% -95% non-condensing |
| User Configuration Modes | Transparent/non-transparent(NTB) |
| Regulatory | CE Mark<br>EN 55022,EN 55024-A1&A2, EN 61000-6-2<br>FCC Class A<br>UL94V-0 compliant<br>RoHS Compliant |
| Product Codes | IXH620 Host /Target / NTB adapter |

## Remote I/O subsystems

To extend the I/O capabilities of an XMC enabled system, the IXH620 supports host adapter or target adapter configurations. Industrial and Military customers requiring increased I/O bandwidth for graphics, processing, or data collection can add IXH620 enabled XMC carrier cards and chassis. Figure 26 illustrates connecting a standard server to and XMC enabled chassis to attach additional XMC cards for test system or increased functionality.


Figure 26: connect embedded equipment to hosts

# PCIe Switch Boxes

## PCIe External Switch Boxes

Dolphin PCI Express switch boxes provide low latency, highly efficient switching for high performance applications. These powerful switch products enable I/O scaling and inter-processor communication by combining transparent and non-transparent bridging capabilities with Dolphin's eXpressWare software and clustering technology. Users can connect multiple PCI Express end points or create a highly efficient compute cluster with PCs, servers, or SBCs with XMC sites.

Dolphin's switch boxes work as the switching element within Dolphin's product line. Each switch port delivers maximum bandwidth to each device while maintaining backwards compatibility with Gen1 and Gen2 components. Dolphin products utilizes standard cable connectors such as iPass and MiniSAS HD as well as PCIe 3.0 cables. They support both copper or fiber-optic cabling. Customer can link multiple standardized PCI Express products such as PXI chassis, storage, and I/O expansion units.

For Non Transparent Bridging (NTB) or clustering applications, the switch-boxes integrate with PCI Express Host Adapters or XMC Adapter. The total NTB solution solves many of the problems related to PCI Express operations, such as power sequencing and standard software. Dolphin customers avoid the severe power-on requirements normally associated with PCI Express. Hosts, cables, and the switch can be hot-swapped and power cycled in any sequence for real plug and play.

Switch-boxes can be partitioned into several virtually independent partitions, e.g. mixing NTB and Transparent functionality on separate ports.

Dolphin switch boxes support our eXpressWare comprehensive software suite. They provide a scalable solution for financial computing, simulation, Military, and enterprise business applications.

## Features

- Fiber-optic and copper cable support
- Link compliant with Gen1, Gen2, and Gen3 PCIe
- Copper and fiber-optic cable connections
- Transparent and Non Transparent support
- Hot Plug PCI Express cabling support in NTB mode
- Built in management processor
- Boot configuration and user data support for cluster and system configuration
- 19 Inch 1U rack mountable chassis
- Front and rear operational status and alert LEDs
- Redundant Fans

## Topologies

Dolphin Switches are key element in Dolphin's inter-processor connectivity strategy. Industrial, military, or enterprise customer can create diverse multiprocessing configurations. The hybrid configuration illustrated shows single board computers and data nodes connected through the switch. The IXH610 host adapter and IXH620 XMC adapter are used to connect to different compute nodes.

Increasing the number of I/O components in a system is accomplished by using a switch with PCIe I/O expansion boxes. Figure 27 illustrates the IXS600 connecting 7 additional I/O expansion boxes. These boxes can accommodate components such as sensors, graphics, co-processors, video capture cards, and other I/O devices.

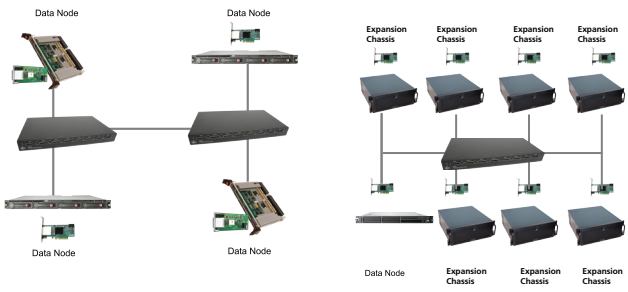



Figure 27: I/O and hybrid configuration

# PCIe Switch Boxes

## MXS824 Gen3 PCIe Switch

### Features

- 24 PCI Express Gen3 x4 ports
- 32 GT/s per port
- SFF-8644 Connectors
- NTB or Transparent Use
- PCIe 3.0 or MiniSAS-HD cables
- Hot plug cabling support
- 19 inch 1U rack mountable
- Redundant Fans
- Port Status LEDs
- Copper and Fiber-optic cables
- Ethernet based management and monitoring

### Specifications

| | |
|---|---|
| Link Speeds | 32 GT/s per port |
| Application Performance | 170ns port latency |
| Active Components | Microsemi Switchtec PCIe Gen3 Switch |
| PCI Express | Base Specification 3.1 |
| Ports | 24 - x4 non-blocking 32 GT/s ports |
| Cable connections | x4 MiniSAS-HD cable Connnections<br>Copper cables- up to 5 meters at Gen3 speed<br>Fiber- Optic cable support- up to 100 meters |
| Management | Rj45 and USB management ports<br>Operational status and alert LEDs |
| Power | Auto-sensing power supply<br>110 - 240 V AC 50-60Hz<br>Power consumption : Max 80 Watts |
| Mechanical | 1U, 19 inch rackmountable chassis<br>440mm (W) x 300mm (D) x 45mm( H)<br>Redundant Fans |
| User Configuration Modes | Transparent/non-transparent(NTB) |

| | |
|---|---|
| Operating Environment | Operating Temperature: 0°C -55°C<br>Relative Humidity: 5% -95% non-condensing |
| Storage Environment | Storage Temperature: -25°C - 70°C<br>Relative Humidity: 10% - 95% (non- condensing) |
| Software | SuperSockets™ Berkley Sockets API<br>Microsoft WinSock2/LSP support<br>SISCI API<br>TCP/IP Driver |
| Pending Safety test | IEC 60950-1:2005 (Second Edition), Am 1: 2009<br>EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011<br>A CB test certificate is available upon request. |
| Regulatory | CE Mark<br>EN 55022,EN 55024-A1&A2, EN 61000-6-2<br>FCC Class A<br>UL94V-0 compliant<br>RoHS |
| Product Codes | IXS60 |

## Scalability

The MXS824 support up to 24 end points at x4 PCIe speeds. The switch can be configured as x4 or x8 or x16 ports. At these speeds, it can support 24, 12,or 6 end points. Ultimately, multiple MXS824s can be connected to scale out to 64 end points or higher.

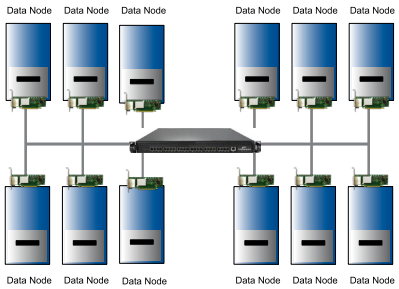



Figure28: Scalability of switches

# PCIe Switch Boxes

## IXS600 Gen3 PCIe Switch

### Features

- PCI Express 3.0 compliant -8.0 GT/s per lane
- Eight PCI Express Gen3 x8 ports
- PCI Express x8 iPass Connectors
- Auto-training to lower lane widths
- Supports x4 lanes with a transition cable
- Link compliant with Gen1 and Gen2 PCI Express
- Transparent and Non Transparent support
- PCI Express External Cabling Specification

### Specifications

| | |
|---|---|
| Link Speeds | 64 GT/s per port |
| Application Performance | 6595 MB/s application data rate<br>200ns port latency |
| Ports | 8 - x8 non-blocking 64 GT/s ports |
| Cable connections | x8 iPass copper cables |
| Management | Ethernet management port<br>Operational status and alert LEDs |
| Power | Auto-sensing power supply<br>110 - 240 V AC 50-60Hz<br>Power consumption : Max 80 Watts |
| Mechanical | 1U, 19 inch rackmountable chassis<br>440mm (W) x 300mm (D) x 45mm( H)<br>Redundant Fans |

| | |
|---|---|
| User Configuration Modes | Transparent/non-transparent(NTB) |
| Operating Environment | Operating Temperature: 0°C -55°C<br>Relative Humidity: 5% -95% non-condensing |
| Regulatory | CE Mark<br>EN 55022,EN 55024-A1&A2, EN 61000-6-2<br>FCC Class A<br>UL94V-0 compliant<br>RoHS |
| Product Codes | IXS600 Gen3 100 Mhz |

### Scalability

Scalability is achieved by connecting multiple switches. Multiple IXS600 switches are used for larger reflective memory applications or creating larger processing clusters.

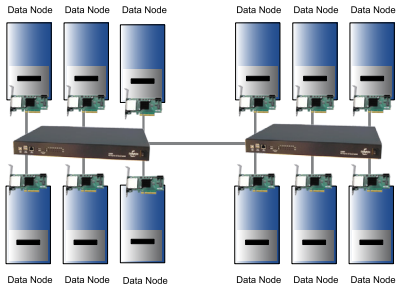



Figure29: Scalability of switches

# Hardware Comparison - PCIe Gen 3 with SFF-8644 Connector

| Feature | PXH830 | PXH832 | MXH830 | MXH832 |
|---|---|---|---|---|
| Use | NTB | Transparent Host/ Target | NTB | Transparent Host/ Target |
| Form factor | Short/ Low profile PCIe | Short/ Low profile PCIe | Short/ Low profile PCIe | Short/ Low profile PCIe |
| PCIe max connection speed | x16 Gen3 | x16 Gen3 | x16 Gen3 | x16 Gen3 |
| NTB | Yes | No | Yes | No |
| Transparent Target | No | Yes | No | Yes |
| Transparent Host | No | Yes | No | Yes |
| Clocking | 100Mhz | 100MHz | 100Mhz | 100MHz |
| Max copper cable length | 9 Meter | 9 Meter | 9 Meter | 9 Meter |
| Fiber support | 100 Meter | 100 Meter | 100 Meter | 100 Meter |
| Switch support | MXS824 | MXS824 | MXS824 | MXS824 |
| Scalability | 3 nodes without switch 64/128 nodes with switch | 1-4 expansion without switch | 5 nodes without switch 64/128 nodes with switch | 1-4 expansion without switch |
| Number of reflective memory segments | 4(16) | N/A | 4 (16) | N/A |
| Max PIO Performance | 10.2 GB/s | N/A | | N/A |
| Max DMA Performance | 11 GB/s | N/A | | N/A |
| Scipp latency back to back | 0.54 µs | N/A | | N/A |
| Scipp latency switch | 0.71 µs | N/A | | N/A |

# Hardware Comparison - PCIe Gen 2/3 with iPass Connector

| Feature | PXH810 | PXH812 | IXH610/IXH611 | IXH620 |
|---|---|---|---|---|
| Use | NTB | Transparent Host/ Target | NTB/ Transparent Host/ Target | NTB/ Transparent Host/Target |
| Form factor | Short/ Low profile PCIe | Short/ Low profile PCIe | Short/ Low profile PCIe | Short XMC |
| PCIe max connection speed | x8 Gen3 | x8 Gen3 | x8 Gen2 | x8 Gen2 |
| NTB | Yes | No | Yes | Yes |
| Transparent Target | No | Yes | IXH610-No<br>IXH611-Yes | Yes |
| Transparent Host | No | Yes | Yes | Yes |
| Clocking | 100Mhz | 100MHz | 100MHz | 100MHz |
| Max copper cable length | 5 Meter | 5 Meter | 7 Meter | 7 Meter |
| Fiber support | 100 Meter | 100 Meter | No | No |
| Switch support | IXS600 | IXS600 | IXS600 | IXS600 |
| Scalability NTB, general use | 14 nodes | N/A | 20 nodes | 20 nodes |
| Scalability Reflective memory functionality only | 14 nodes | N/A | 56 nodes | 56 nodes |
| Transparent scalability | 256 bus numbers | 256 bus numbers | 256 bus numbers | 256 bus numbers |
| Maximum reflective memory segment size | 2 GB | N/A | 2 GB | 2 GB |
| Number of reflective memory segments | 4 (16) | N/A | 4 | 4 |
| Total reflective memory size | 4 x 2 GB | N/A | 4 x 2 GB | 4 x 2 GB |
| Max PIO Performance | 5312 MB/s | N/A | 2950 MB/s | 2950 MB/s |
| Max DMA Performance | 6695 MB/s | N/A | 3500 MB/s | 3500 MB/s |
| Scipp latency back to back | 0.54 µs | N/A | 0.74 µs | 0.74 µs |
| Scipp latency switch | 0.71 µs | N/A | 0.9 µs | 0.9 µs |

# Hardware Comparison - PCIe Switch Boxes

| Feature | MXS824 PCIe Switch | IXS600 PCIe Switch |
|---|---|---|
| PCIe | Gen3 | Gen3 |
| Link Speed | 32 GTps/s per x4 | 64 GTps/s per x8 |
| Port Latency | 170ns | 200ns |
| Active Components | Microsemi Switchtec® PCI Express Gen3 Switch | IDT PCI Express Gen3 Switch |
| PCI Express | Base Specification 3.1 | Base Specification 3.0 |
| Ports | 24 - x4 non blocking PCIe Gen3 ports | 8 - x8 Non blocking PCIe Gen3 ports |
| Port configurations | Flexible port configurations - E.g 24 -x4, 12 -x8, 6 - x16 ports or 2x16+2x+12x4 | 8- x8 ports |
| Operating Modes | NTB and Transparent | NTB and Transparent |
| Connector Type | SFF-8644 | iPass |
| Cable Connections | x4 MiniSAS HD or PCIe 3.0 cable connections | x8 - iPass Cable connections |
| Cable Types | Copper cables - up to 5 meters at Gen3 speeds Fiber-Optic cables - up to 100 meters at Gen3 speeds | Copper Cables - up to 5 meter at Gen3 speeds |
| Dimensions | 1U 19 inch rack mount | 1U 19 inch rack mount |
| Power consumption | Auto-sensing power supply 110-240v AC 50- 60 Hz | Auto-sensing power supply 110-240v AC 50- 60 Hz |
| Additional ports | 1 Ethernet Management Port, 1 USB port for firmware, 1 SD-card slot | 1 Ethernet Management Port, 1 USB port for firmware |
| Power management | Advanced power management - hibernation, wake via Ethernet | N/A |

# Product Comparison Charts

## Software Comparison

| Feature | SISCI | SuperSockets | IPoPCIe Driver |
|---|---|---|---|
| Linux Platform Support<br><br>Kernel 2.6 - 4.x | x86, x86_64<br>ARM 32/64.<br>PPC<br>NVidia Tegra | x86, x86_64<br>ARM 64<br>PPC | x86, x86_64<br>ARM 64<br>PPC |
| Windows Vista, 7, 10, Server 2008-2016 Platform Support | x86, x86_64 | x86, x86_64 | x86, x86_64 |
| RTX Platform Support | x86, x86_64 | No | No |
| VxWorks 6.9 , 7.0 | x86, x86_64<br>PPC | No | No |
| Latency | 0.54 µs Linux | 0.98 µs Linux | 5.6 µs Linux |
| Max Bandwidth | 11 GB/s Linux | 65 Gb/s | 65 Gb/s |
| Reflective Memory Support | Yes | N/A | N/A |
| Address based Multi-cast support | Yes | N/A | N/A |
| TCP Support | N/A | Yes | Yes |
| UDP Support | N/A | Linux -Yes<br>Windows - No | Yes |
| UDP Multi-cast Support | N/A | Linux -Yes<br>Windows - under development | Linux -under development<br>Windows - Yes |
| Application modifications required | Yes | No | No |
| Cross O/S and Platform data transfer support | All | User space Linux / Windows | No |
| Peer to Peer Transfers support | Yes | N/A | N/A |
| Accelerated Loopback Support | Yes | Yes | No |
| Open Source code available | Yes | No | No |
| Licensing of software available | Yes | Yes | Yes |
| Chipset support | Microsemi<br>Broadcom/PLX<br>IDT<br>Intel NTB | Microsemi<br>Broadcom/PLX<br>IDT<br>Intel NTB | Microsemi<br>Broadcom/PLX<br>IDT<br>Intel NTB |

Dolphin Interconnect Solutions has been a global provider of ultra-low latency, high-bandwidth computer interconnect solutions for high speed real-time systems, clustered databases, general networking, web services and industrial applications for more than 25 years. For more information, please visit www.dolphinics.com.

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