PCI Technology Overview

February 2003
Agenda

- History and Industry Involvement

- Technology Information
  - Conventional PCI
  - PCI-X
    - 1.0
    - 2.0
  - PCI Express
  - Other

- Digi Products in PCI/PCI-X environments

- Q & A
Q: What does “PCI” mean anyway?

A: _Peripheral Component Interconnect_
PCI-SIG

- PCI Special Interest Group
- Industry organization formed in 1992
- Over 900 members
- Promotes PCI as an industry-wide standard
- Full ownership and management of the PCI specifications
- Maintains the PCI specifications and forward-compatibility of all PCI revisions
PCI Technology

- Conventional PCI
  - Initial PCI 1.0 proposal by Intel in 1991
  - Introduced by PCI-SIG as PCI 2.0 in 1993
  - Version 2.1 approved in 1995
  - Recent version 2.3 approved in March 2002

- PCI-X
  - Version 1.0 approved in September 1999
  - Version 2.0 approved in July 2002

- PCI Express
  - Formerly known as 3GIO
  - Version 1.0 approved in July 2002
Conventional PCI

- Plug-and-Play Functionality

- Standard PCI is 32 bit and operates at 33 MHz
  - Throughput 133 MB/sec

- PCI 2.1 introduced
  - Universal PCI cards supporting both 3.3V and 5V
  - 64 Bit slots and 66 MHz capability
    - 32-Bit throughput @ 66 MHz: 266 MB/sec
    - 64-Bit throughput @ 66 MHz: 532 MB/sec

- PCI 2.3 system no longer supports 5V-only adapters
  - 3.3V and Universal PCI products are still fully supported!
32-Bit vs 64-Bit Slots/Boards

- **5V 32-Bit Slot**
- **3.3V 32-Bit Slot**
- **3.3V 64-Bit Slot**
- **5V 64-Bit Slot**

32-Bit PCI boards can be used in 64-bit slots!
PCI-X 1.0

- Based on existing PCI architecture

- 64-Bit slots with support for 3.3V and Universal PCI
  - No support for 5V-only boards!

- Fully backwards-compatible
  - Conventional 33/66 MHz PCI adapters can be used in PCI-X slots
  - PCI-X adapters can be used in conventional PCI slots

- Provides two speed grades: 66 MHz and 133 MHz
  - The slowest board dictates the maximum speed on a particular bus!

- Targeted at high-end data networking and storage network applications
PCI-X 2.0

- Based on PCI-X 1.0
  - Still fully backwards-compatible

- Introduces ECC (Error Correction Codes) mechanism to improve robustness and data integrity

- Provides two additional speed grades
  - PCI-X 266: 266 MHz (2.13 GB/sec)
  - PCI-X 533: 533 MHz (4.26 GB/sec)

- Bandwidth sufficient to support new breed of cutting-edge technologies
  - 10 Gigabit Ethernet / Fiber Channel
  - 4X / 12X InfiniBand
PCI / PCI-X Performance vs Demand

Source: PCI-SIG
PCI-X Speed Limitations

- PCI-X supports point-to-point and multi-drop loads

- Highest speed grades are supported exclusively with point-to-point loads
  - PCI-X 133
  - PCI-X 266
  - PCI-X 533

- Two PCI-X 133 loads operate at 100 MHz

- Four loads operate at a maximum of 66 MHz

- OEMs can build connector-less systems with multiple loads utilizing high speed grades
PCI-X Speed Limitations

- Maximum speed: 133 / 266 / 533 MHz
- Maximum speed: 100 MHz
- Maximum speed: 66 MHz
PCI-X Speed Limitations

Example: Dell PowerEdge 2600 w/Intel E7500 Chipset

- Bus 1: PCI-X 133 MHz, 1 Slot each
- Bus 2: PCI-X 100 MHz, 2 Slots each
- Bus 3: PCI-X 100 MHz, 2 Slots each
- Bus 4: PCI 33 MHz, 1 Slot
- Bus 5: PCI 33 MHz

Specifications:
- Two 64-Bit 133 MHz PCI-X Slots
- Four 64-Bit 100 MHz PCI-X Slots
- One 32-Bit 33 MHz PCI Slot

1. 1 PCI-X Slot @ 133 MHz
2. 1 PCI-X Slot @ 133 MHz
3. 2 PCI-X Slots @ 100 MHz
4. 2 PCI-X Slots @ 100 MHz
5. 1 PCI Slot @ 33 MHz

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The Future of PCI-X

- PCI-X 3.0 specification in development
  - Expected to become available in late 2004

- Backwards-compatible with PCI-X 1.0 / 2.0

- PCI-X 1066 will provide 1066 MHz data rate with 8.5 GB/sec bandwidth

- First application for PCI-X 1066 are 40 Gigabit Ethernet adapters with bandwidth requirements of 8 Gigabytes per second!

- Investigations of PCI-X 2133 are underway
PCI-X Roadmap

Source: PCI-SIG

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
PCI Express

- High-speed point-to-point architecture that is essentially a serialized, packetized version of PCI
- General purpose serial I/O bus for chip-to-chip communication, USB 2.0 / IEEE 1349b interconnects, and high-end graphics ▶ viable AGP replacement
- Bandwidth 4 Gigabit/second full duplex per lane
  - Up to 32 separate lanes ▶ 128 Gigabit/second
- Software-compatible with PCI device driver model
- Expected to coexist with and not displace technologies like PCI-X in the foreseeable future
Buzzworthy

- **InfiniBand**
  - Backed by Intel, Sun, Dell, HP and others
  - Connects servers with remote storage and networking devices, and other servers with throughput rates of 2.5 Gigabit/second (1x) to 10 Gigabit/second (4x)
  - Will also be used inside servers for inter-processor communication (IPC) in parallel clusters

- **HyperTransport**
  - Promoted by AMD, Cisco, Sun and others
  - Advanced high-speed, high-performance, point-to-point link for integrated circuits
  - System interconnect with peak bandwidth of 12.8GB/sec

- **RapidIO**
  - Promoted by IBM, Motorola and others
  - Allows chip-to-chip and board-to-board communications at performance levels scaling to ten Gigabits per second
  - Targeted at embedded world
Q: Does Digi provide PCI-X products?
A: No.

Q: Are Digi products supported in PCI-X systems?
A: Absolutely.*

* All Universal PCI and 3.3V products
Digi and PCI-X

- Extension of the PCI standard providing improved speed, bandwidth, and more efficient bus transaction processing
- PCI-X supports both 3.3V-only and Universal PCI boards
- PCI-X does not support 5V-only PCI boards

▶ All of Digi’s Universal PCI adapters work in PCI-X systems!

- PCI-X systems allow the use of both PCI and PCI-X cards on the same bus, but the slowest PCI card dictates the bus speed

▶ PCI-X performance degradation can be easily avoided by separating Digi Universal PCI adapters (33 MHz/32-Bit) and high-performance PCI-X adapters using different PCI-X bus segments!
Avoiding Performance Degradation

Example: Dell PowerEdge 2600 w/Intel E7500 Chipset

Specifications

- Five independent PCI/PCI-X bus interfaces that can be used to group adapters by speed/type to avoid any performance degradation of PCI-X system components!

- Two 64-Bit 133 MHz PCI-X Slots
- Four 64-Bit 100 MHz PCI-X Slots
- One 32-Bit 33 MHz PCI Slot

Bus 1
1 PCI-X Slot @ 133 MHz

Bus 2
1 PCI-X Slot @ 133 MHz

Bus 3
2 PCI-X Slots @ 100 MHz

Bus 4
2 PCI-X Slots @ 100 MHz

Bus 5
1 PCI Slot @ 33 MHz
Digi and Conventional PCI

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- Digi’s Universal PCI adapters can be used in all conventional PCI systems!
- Digi’s Universal PCI adapters are 32-Bit and operate at 33 MHz!
- Digi Universal PCI adapters can be used in 64-bit PCI slots!
- Same PCI-X performance / bus segmentation approach!
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