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

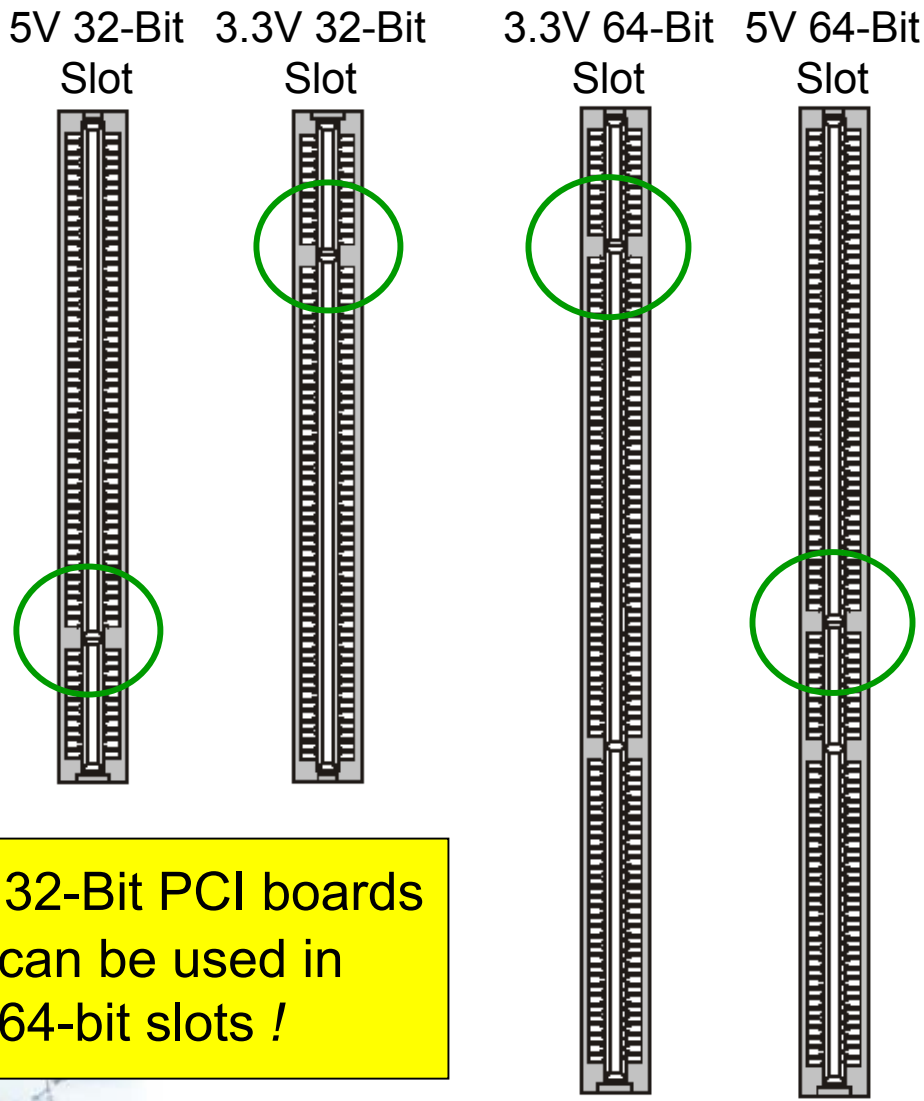
PCI Technology

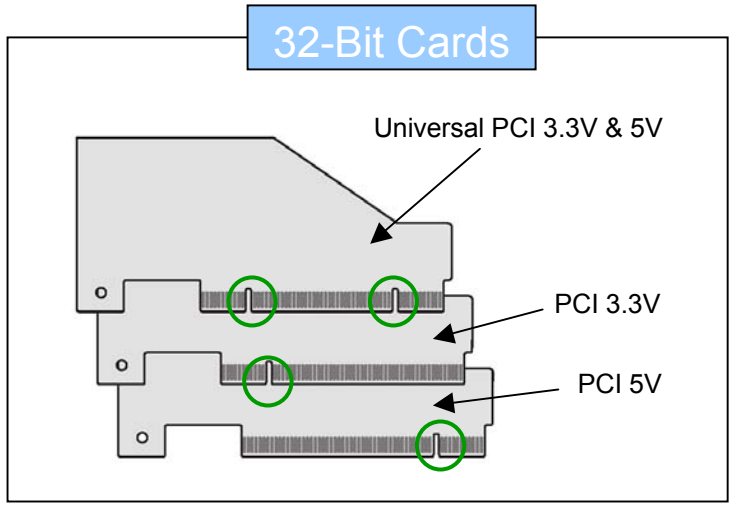
- Conventional PCI
  - Initial PCI 1.0 proposal by Intel in 1991
  - Introduced by PCI-SIG as PCI 2.0 in 1993
  - Version 2.1 approved in 1995
  - Recent version 2.3 approved in March 2002
- PCI-X
  - Version 1.0 approved in September 1999
  - Version 2.0 approved in July 2002
- PCI Express
  - Formerly known as 3GIO
  - Version 1.0 approved in July 2002

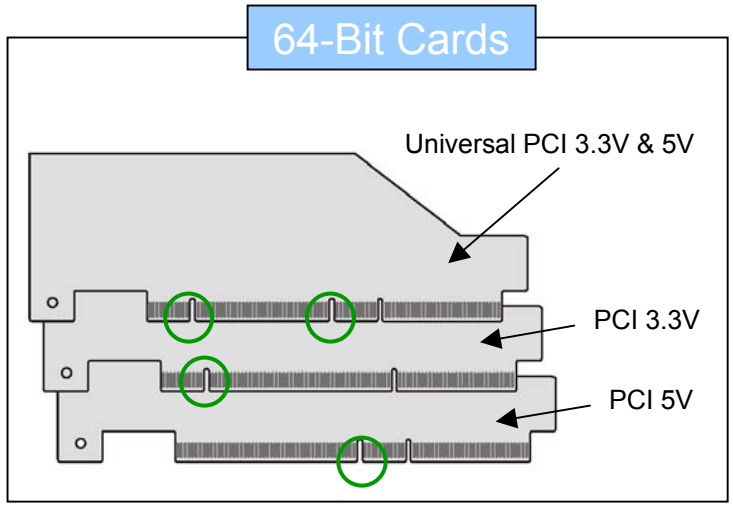
Conventional PCI

- 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







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

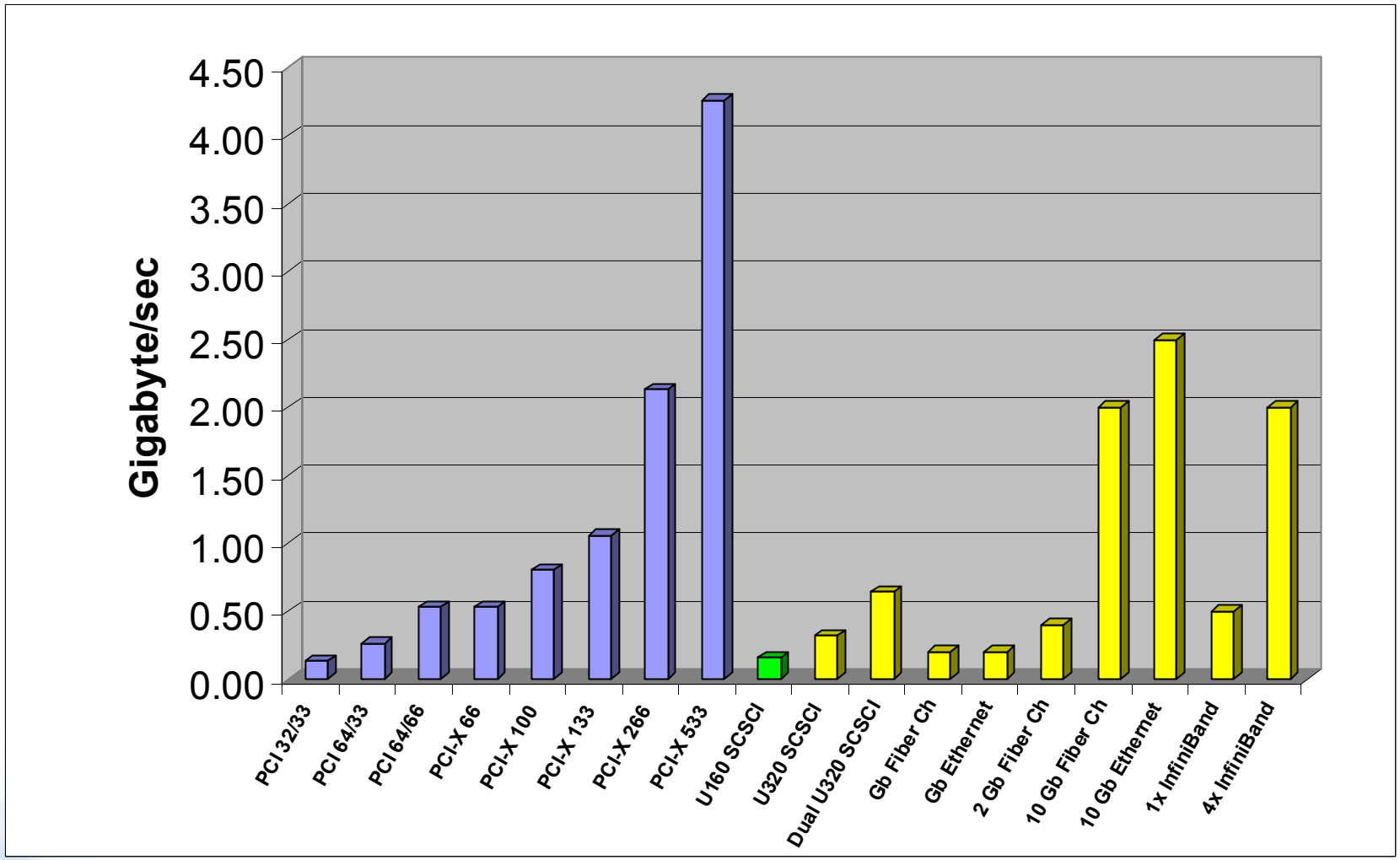
PCI-X 1.0

- 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

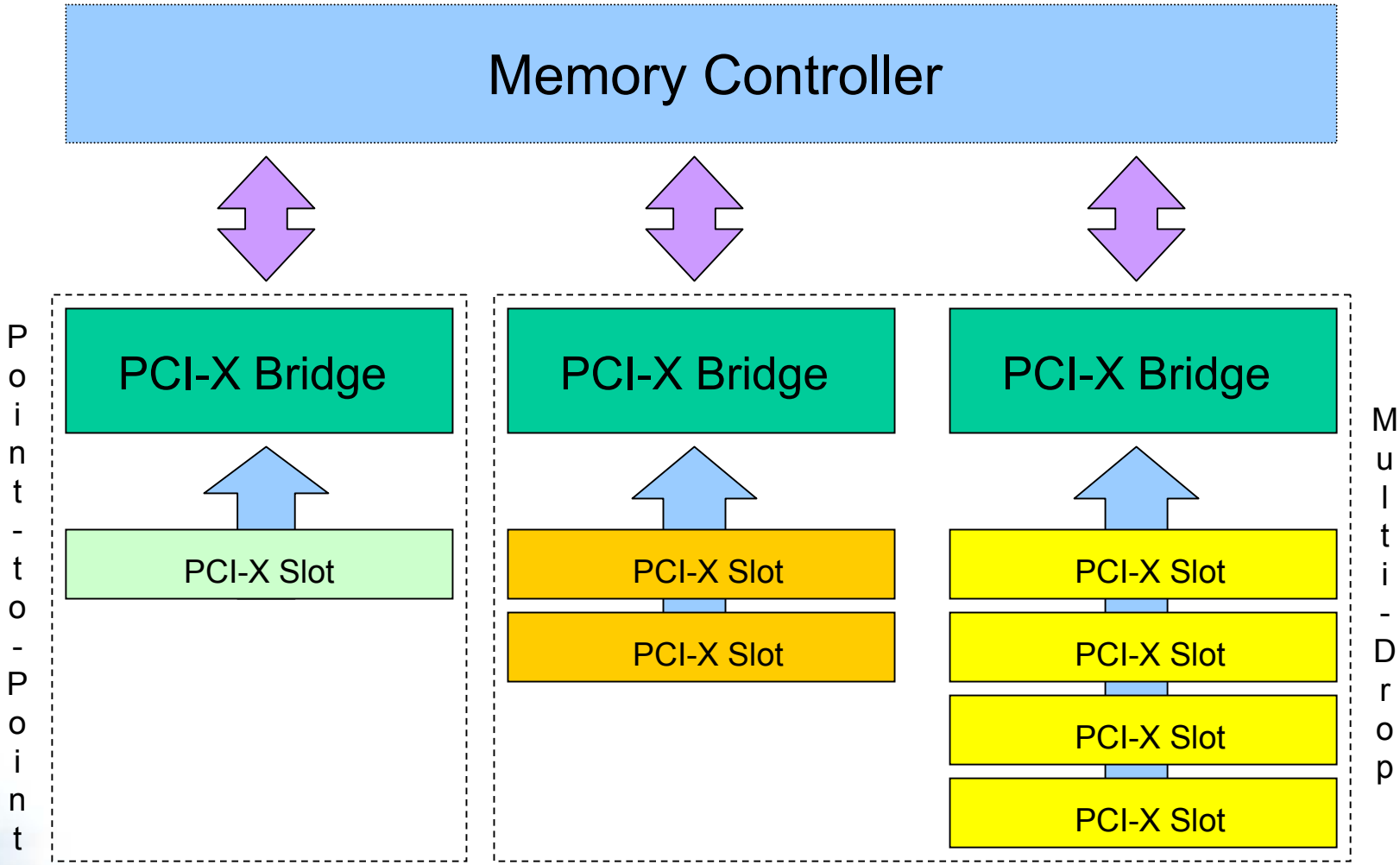


Source: PCI-SIG

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

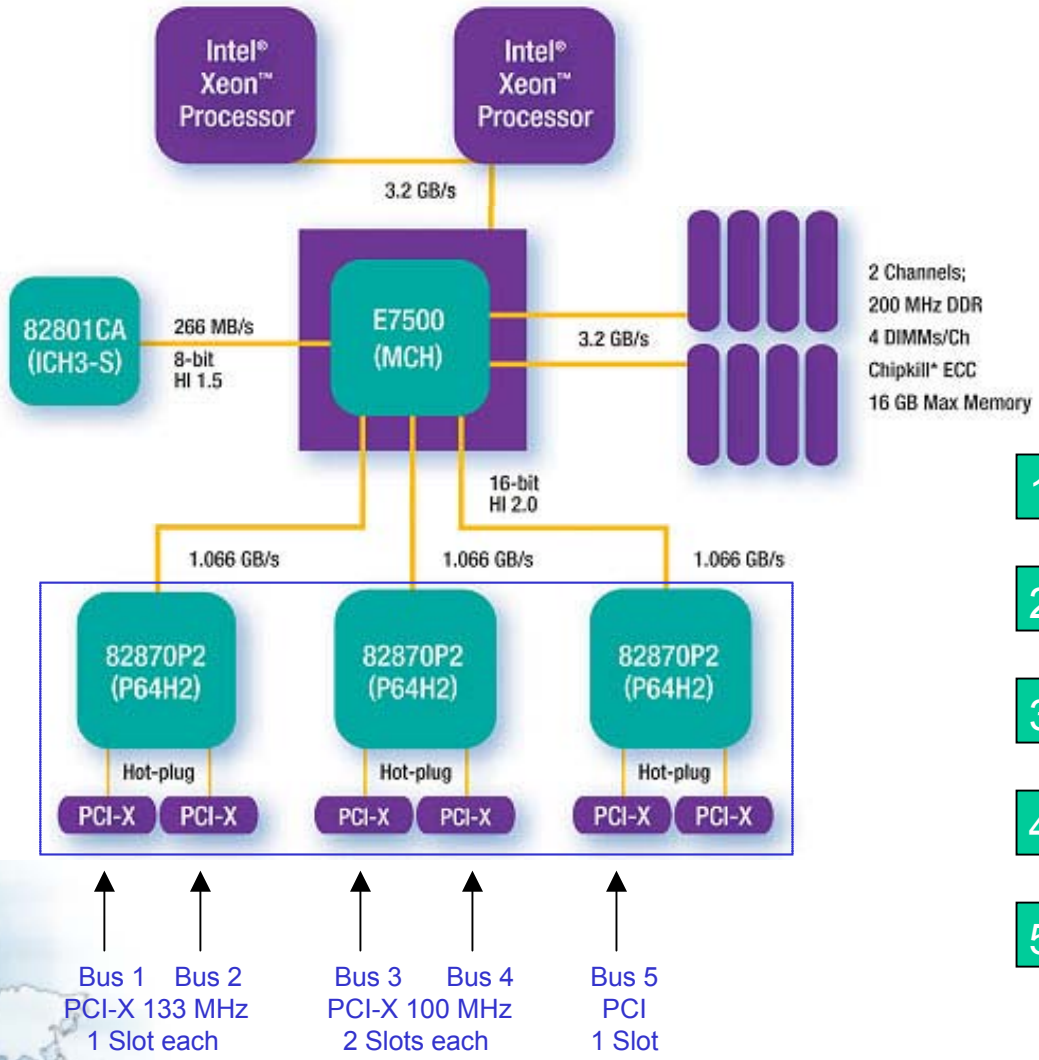
PCI-X Speed Limitations



- 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



Specifications

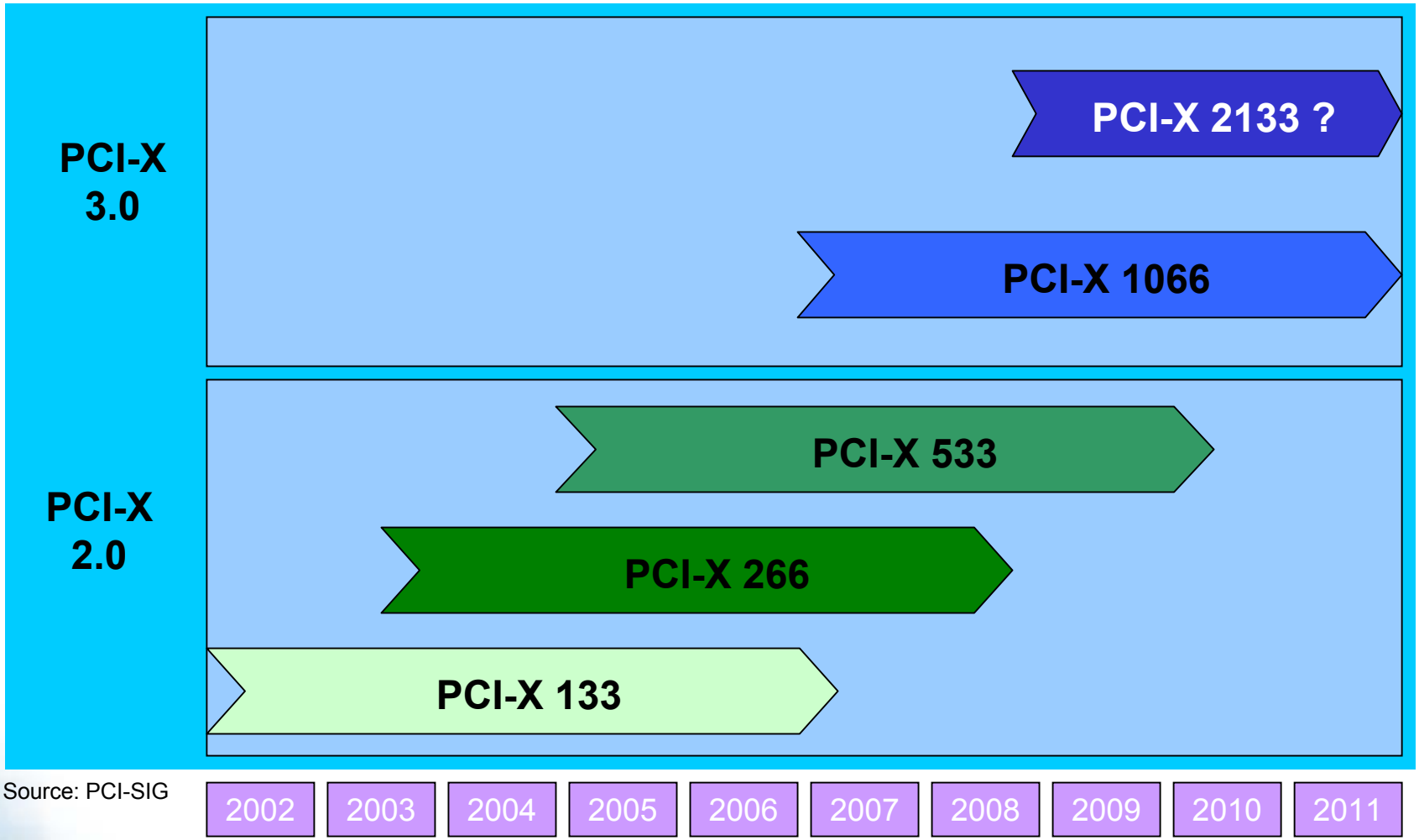
Two 64-Bit 133 MHz PCI-X Slots
Four 64-Bit 100 MHz PCI-X Slots
One 32-Bit 33 MHz PCI Slot

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

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

PCI Express

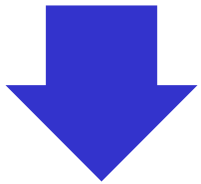
- High-speed point-to-point architecture that is essentially a serialized, packetized version of PCI
- General purpose serial I/O bus for chip-to-chip communication, USB 2.0 / IEEE 1349b interconnects, and high-end graphics ▶ viable AGP replacement
- Bandwidth 4 Gigabit/second full duplex per lane
  - 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.

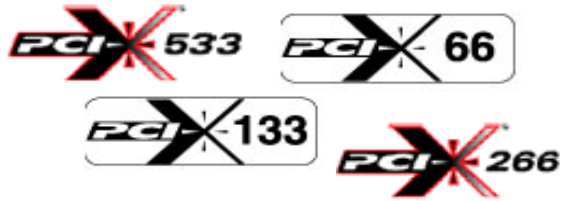


Q: Are Digi products supported in PCI-X systems ?

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

- 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 *!*

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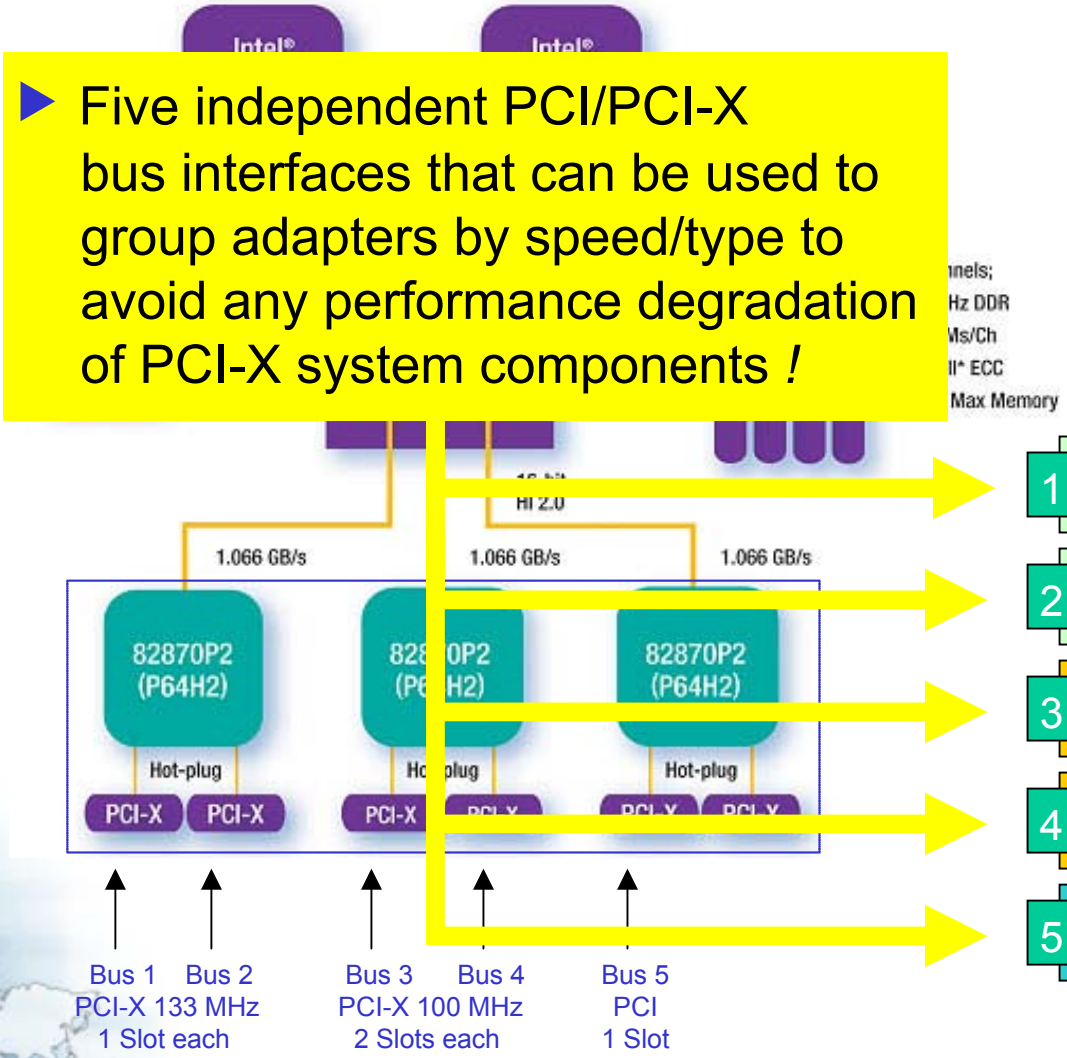

1. 1 PCI-X Slot @ 133 MHz
2. 1 PCI-X Slot @ 133 MHz
3. 2 PCI-X Slots @ 100 MHz
4. 2 PCI-X Slots @ 100 MHz
5. 1 PCI Slot @ 33 MHz

Digi and Conventional PCI

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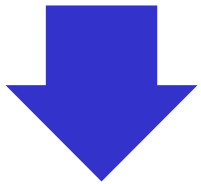
- Digi's Universal PCI adapters can be used in all conventional PCI systems *!*
- Digi's Universal PCI adapters are 32-Bit and operate at 33 MHz *!*
- Digi Universal PCI adapters can be used in 64-bit PCI slots *!*
- Same PCI-X performance / bus segmentation approach *!*

Q: Does Digi provide PCI-X products ?

A: No.



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