Ateneo de Manila University

Buses and the PCI bus

William Emmanuel S. Yu and Wilfred Tupaz Jr.
14 February 2001
http://cersa.admu.edu.ph/
william.s.yu@ieee.org
Section I

Buses
Bus

★ internal system components, including the processor, cache, memory, expansion cards and storage devices communicate via these buses
★ serves as the primary connection interface between these devices
Types of Buses

★ Processor Bus

★ is the highest-level bus that the chipset uses to send information to and from the processor

★ Cache Bus

★ higher-level architectures, such as those used by the Pentium Pro and Pentium II/III, employ a dedicated bus for accessing the system cache

★ is sometimes called a backside bus

★ conventional processors using fifth-generation motherboards and chipsets have the cache connected to the standard memory bus.
★ Memory Bus

★ sometimes called the Front Side Bus (FSB)
★ is a second-level system bus that connects the memory subsystem to the chipset and the processor
★ in some systems the processor and memory buses are basically the same thing.

★ Local I/O Bus

★ data bus that connects directly, or almost directly, to the microprocessor and performance critical expansion devices
★ local buses can support only a few devices, but provide very fast throughput
★ most PCs contain either the PCI bus or the ISA bus
Section II

Local I/O Bus
Industry Standard Architecture (ISA)

★ bus architecture used in the IBM PC/XT and PC/AT

★ the AT version of the bus is called the AT bus and became a de facto industry standard

★ being replaced by the faster PCI bus, however most PCs still contain ISA slots for slower devices

★ normally, configure expansion boards with DIP switches and jumpers

★ in 1993, Intel and Microsoft introduced a new version of the ISA specification called Plug and Play ISA that allows the operating system to configure such devices
Video Electronics Standards Association (VESA)

- first local bus to gain popularity
- introduced in 1992
- created to address video-related issues in personal computers
- to improve video performance in PCs
- 32-bit bus which is in a way a direct extension of the 486 processor/memory bus
- normally runs at 33 MHz, although higher speeds are possible on some systems
Accelerated Graphics Port (AGP)

- called a port instead of a bus because it only connects two devices
- answers the need for increased bandwidth between the main processor and the video subsystem
- simpler, faster, dedicated interface between the main processor subsystem and the video processor
Peripheral Component Interconnect (PCI)

- a local bus standard developed by Intel Corporation and other industry leaders in 1993
- not processor dependent
- included in most modern PCs including the Macintosh Computers
- intended to replace the ISA bus
## Comparison

<table>
<thead>
<tr>
<th></th>
<th>ISA</th>
<th>EISA</th>
<th>VL-BUS</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Path Width</strong></td>
<td>8/16</td>
<td>32</td>
<td>32/64</td>
<td>32/64</td>
</tr>
<tr>
<td><strong>Data Bus Speed (MHz)</strong></td>
<td>5.33/8.33</td>
<td>8.33</td>
<td>33/50</td>
<td>33/50</td>
</tr>
<tr>
<td><strong>Data Transfer Rates (MB/sec)</strong></td>
<td>5.33/8.33</td>
<td>33</td>
<td>132/264</td>
<td>132/264</td>
</tr>
<tr>
<td><strong>Data Rates Implemented (MB/sec)</strong></td>
<td>5.33/8.33</td>
<td>33</td>
<td>132</td>
<td>132</td>
</tr>
<tr>
<td><strong>Number of Slots</strong></td>
<td>0-8</td>
<td>0-8</td>
<td>0-2</td>
<td>0-4</td>
</tr>
<tr>
<td><strong>Bus Masters Supported</strong></td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Data/Address Parity</strong></td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Sync, Channel Checks</strong></td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Card ID/Auto Configuration</strong></td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Works with ISA/EISA</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Section III

PCI
PCI

★ is a 64-bit bus usually implemented as a 32-bit bus for maximum compatibility
★ runs at clock speeds of 33 or 66MHz
★ provides improved performance over ISA and VESA buses
★ intended to provide I/O bandwidth for high speed peripheral devices
PCI Workings

★ PCI is not a true local bus
★ occupies an intermediate level between the CPU local bus and a standard expansion bus
★ isolated from the CPU local bus by a PCI bridge/controller
  ★ CPU can writes data to PCI peripherals, such as a hard drive
  ★ PCI bridge/controller can immediately store the data in its buffer
★ CPU go on to its next operation rather than waiting for the transfer to complete
★ The buffer then feeds the data to the peripheral at the most efficient rate possible
Diagram
Advantages of PCI

★ Burst Mode
★ the PCI bus can transfer information in a burst mode, where after an initial address is provided multiple sets of data can be transmitted in a row

★ Bus Mastering
★ intelligent devices that, when attached to a system bus, can gain control of the bus and perform tasks independent of the CPU

★ High Bandwidth Options
★ The PCI bus specification version 2.1 calls for expandability to 64 bits and 66 MHz speed; if implemented this would quadruple bandwidth over the current design
Advantages of PCI

★ Plug and Play
  ★ there is not need to setup jumper settings

★ Synchronous/Asynchronous Speed Settings
  ★ depending on the chipset and motherboard the speed settings of the PCI bus can be modified
Asynchronous Setup

- speed of the PCI bus can be set independently of the memory bus speed
- normally controlled through jumpers on the motherboard, or BIOS settings
Synchronous Setup

- the PCI bus runs at half the memory bus speed
- example: since the memory bus is usually 66, 100, 133 MHz, the PCI bus would run at 33, 50, 66.5 MHz respectively.
Bonus Section

Overclocking
Overclocking

★ it refers to changing the settings of a computer system so that the hardware runs at a faster speed than the manufacturer rated it for

★ is also sometimes called pushing or speed margining

★ usually performed by modifying the multiplier rating setting via motherboard jumpers or bios settings to change either the FSB speed or the clock multiplier

★ system bus on a PC that uses synchronous PCI will cause PCI peripherals to be overclocked as well, often leading to system stability problems
Two Ways of Overclocking

★ modifying the clock multiplier will only improved CPU speed and not the other components and thus no real performance improvement just added wait states
★ modifying the FSB however also has corresponding changes to the other system components
Risks and Tips

★ ensure that all overclocked figures are within manufacturer specification and tolerable ranges

★ some notes are that PCI bus runs as one half the FSB and AGP runs at two-thirds the FSB and the microprocessor runs as clock multiplier times the FSB.
Section IV

Conclusions