

Computer Organization and Architecture

كلية التربية للعلوم الصرفة / جامعة ديالى

Lecture 11

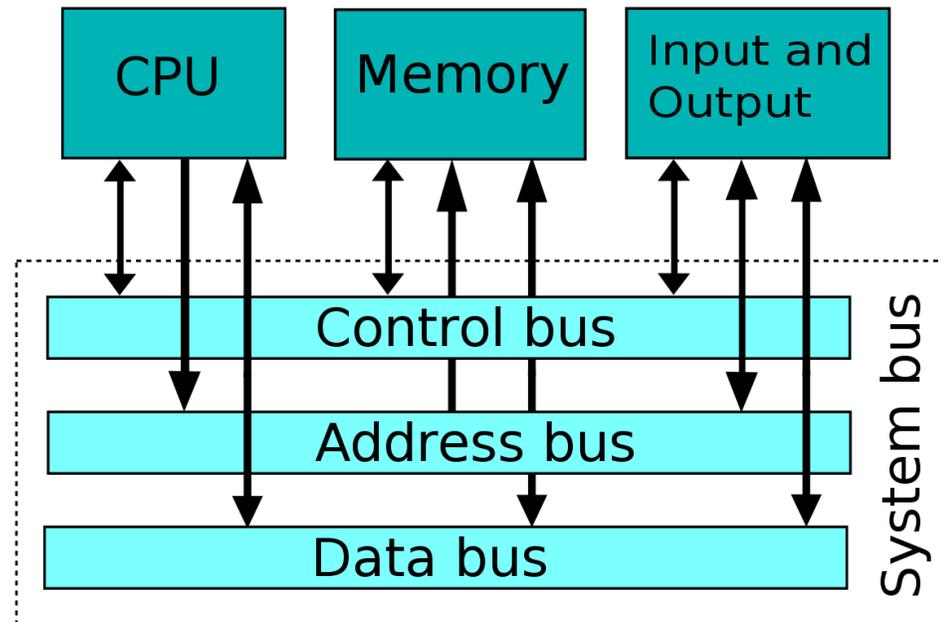
System Buses



Types of Computer Buses | Meaning, Components, Functions, Structure, Topology

A computer bus is also known as a local bus, data bus or address bus, a bus is a link between components or devices linked to a computer.

A bus, for instance, carries data through the motherboard between a CPU (Central Processing Unit) and the system memory.



What is a computer bus?

A bus is a communication system in computer architecture that transfers data between components inside a computer, or between computers.

The following are a few points to describe a computer bus:-

A bus is a group of lines/wires which carry computer signals.

A bus is the means of shared transmission.

Lines are assigned for providing descriptive names. — carries a single electrical signal, e.g. 1-bit memory address, data bits series, or timing control that turns the device on or off.

Data can be transferred from one computer system location to another (between different I / O modules, memory, and CPU).

The bus is not only cable but also hardware (bus architecture), protocol, program, and bus controller.

What are the different components of a bus?

Each bus possesses three distinct communication channels.

Following are the three components of a bus: –

The address bus, a one-way pathway that allows information to pass in one direction only, carries information about where data is stored in memory.

The data bus is a two-way pathway carrying the actual data (information) to and from the main memory.

The control bus holds the control and timing signals needed to coordinate all of the computer's activities.

Functions of a computer bus

Below are a few of the functions in a computer bus:-

Data sharing – All types of buses used in network transfer data between the connected computer peripherals. The buses either transfer or send data in serial or parallel transfer method. This allows 1, 2, 4, or even 8 bytes of data to be exchanged at a time. (A Byte is an 8-bit group). Buses are classified according to how many bits they can move simultaneously, meaning we have 8-bit, 16-bit, 32-bit, or even 64-bit buses.

Addressing – A bus has address lines that suit the processors. This allows us to transfer data to or from different locations in the memory.

Power – A bus supplies the power to various connected peripherals.

Structure and Topologies of Computer buses

Lines are grouped as mentioned below –

Power line provides electrical power to the components connected

Data lines carrying data or instructions between modules of the system

Address lines indicate the recipient of the bus data

Control lines control the synchronization and operation of the bus and the modules linked to the bus

What are the different types of computer buses?

Computers normally have two bus types:-

System bus – This is the bus that connects the CPU to the motherboard's main memory. The system bus is also known as a front-side bus, a memory bus, a local bus, or a host bus.

A number of I / O Buses, (I / O is an input/output acronym) connecting various peripheral devices to the CPU. These devices connect to the system bus through a 'bridge' implemented on the chipset of the processors. Other I / O bus names include "expansion bus," "external bus" or "host bus"

ISA – Industry Standard Architecture

The Industry Standard Architecture (ISA) bus is still one of the oldest buses in service today.

Although it has been replaced by faster buses, ISA still has a lot of legacy devices that connect to it such as cash registers, CNC machines, and barcode scanners.

Since being expanded to 16 bits in 1984, ISA remains largely unchanged. Additional high-speed buses were added to avoid performance problems.



EISA – Extended Industry Standard Architecture

An upgrade to ISA is Extended Industry Standard Architecture or EISA. This doubled the data channels from 16 to 32 and allowed the bus to be used by more than one CPU.

Although deeper than the ISA slot, it is the same width that lets older devices connect to it.

When you compare the pins on an ISA to an EISA card (the gold portion of the card that goes into the slot), you can find that the EISA pins are longer and thinner. That is a quick way to decide if you have an ISA or an EISA card.



MCA – Micro Channel Architecture

IBM developed this bus as a substitute for ISA when they designed the PS/2 PC which was launched in 1987.

The bus provided some technological improvements over the ISA bus. The MCA, for example, ran at a speed of 10MHz faster and supported either 16-bit or 32-bit data.

One advantage of MCA was that the plug-in cards were configurable software; that means they needed minimal user input during configuration



VESA – Video Electronics Standards Association

The Video Electronics Standards Association (VESA) Local bus was created to divide the load and allow the ISA bus to handle interrupts, and the I / O port (input/output) and the VL bus to work with Direct Memory Access (DMA) and I / O memory.

This was only a temporary solution, due to its size and other considerations. The PCI bus was easy to overtake the VL bus.

A VESA card has a range of additional pins and is longer than the ISA or EISA cards.

It was created in the early '90s and has a 32-bit bus and was a temporary fix designed to help boost ISA 's performance.

PCI – Peripheral Component Interconnect

The PCI bus was developed to solve ISA and VL-bus related issues. PCI has a 32-bit data path and will run at half the speed of the system memory bus.

One of its enhancements was to provide connected computers with direct access to machine memory. That increased computer efficiency while reducing the CPU 's capacity for interference.

Today's computers mostly have PCI slots. PCI is considered a hybrid between ISA and VL-Bus that provides direct access to the connected devices system memory.

This uses a bridge to connect to the front side bus and CPU and is able to provide higher performance while reducing the potential for CPU interference.

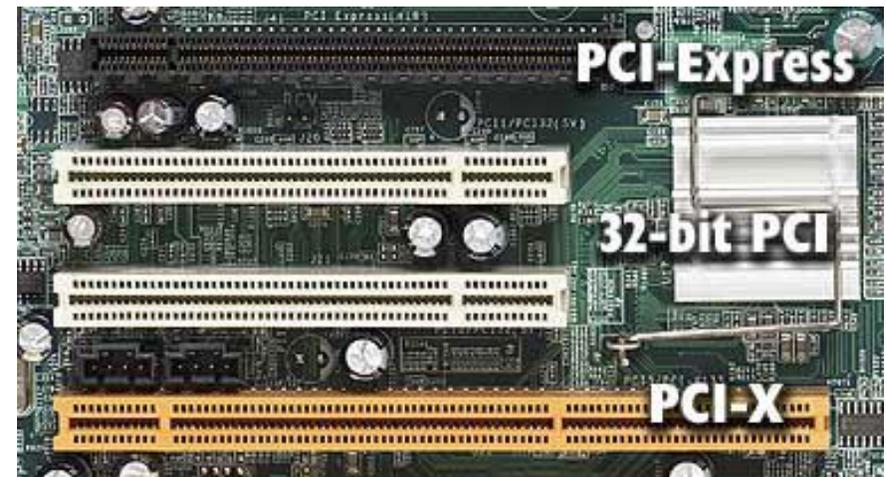


PCI Express (PCI-X)

The most recent added slot is PCI Express (PCIe). It was designed to replace the AGP and PCI bus. It has a 64-bit data path and 133 MHz base speed but incorporating full-duplex architecture was the main performance enhancement.

That allowed the card to run in both directions at full speed simultaneously. PCI Express slots run at 1X, 4X, 8X, and 16X providing PCI with the highest transfer speed of any form of a slot. The multiplier specifies the maximum rate of transfer.

PCI Express is compatible backward, allowing a 1X card to fit into a 16X slot.



PCI Express (PCI-X)

PCMCIA – Personal Computer Memory Card Industry Association (Also called PC bus)

The Personal Computer Memory Card Industry Association was established to give the laptop computers a standard bus.

But it is used in small computers, essentially.

AGP – Accelerated Graphics Port

The Accelerated Graphics Bus (AGP) was designed to accommodate the computers' increased graphics needs. It has a data path that is 32 bits long and runs at maximum bus speed.

This doubled the PCI bandwidth and reduced the need to share the bus with other components. This means that AGP operates at 66 MHz on a regular motherboard, instead of the 33 MHz of the PCI bus.

AGP has a base speed of 66 MHz that doubles PCI speed. You can also get slots that run at speeds 2X, 4X, and 8X.

It also uses special signaling to allow twice as much data to be transmitted at the same clock speed over the port.



SCSI – Small Computer Systems Interface.

Small Computer System Interface is a standard parallel interface used for attaching peripheral devices to a computer by Apple Macintosh computers, PCs, and Unix systems.



Most common types of computer buses

Most of the listed buses are no longer used or not frequently used today.

Below is a list of the buses that are the most popular ones:-

ESATA and SATA– Hard Drives and Disk Drives computer.

PCIe – Video Cards and Computer Expansion Cards.

USB – Peripherals to a computer.

Thunderbolt – Peripherals that are connected via a USB-C cable.