



Advanced: Busses

Review

Previously, you learned that:

The **bus** is how the computer communicates between components. It is composed of 2 things:

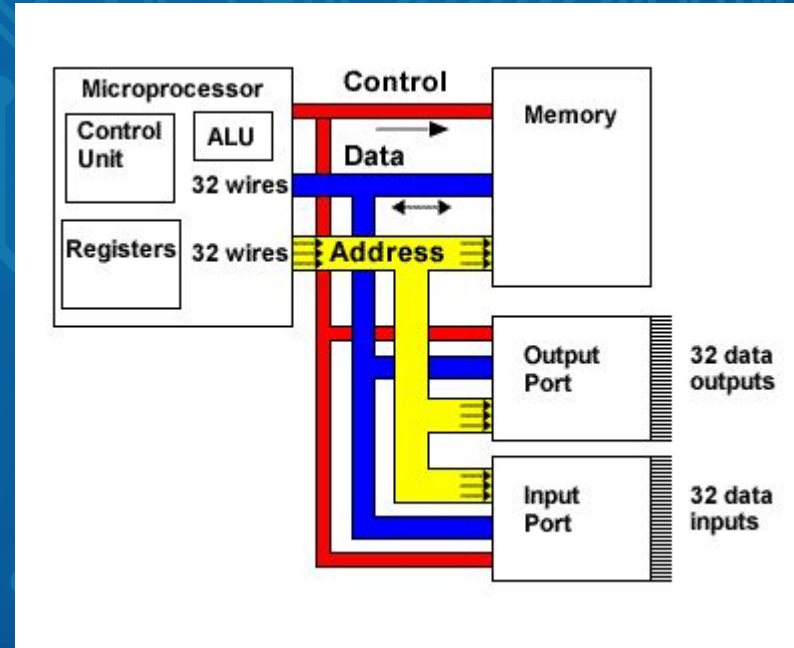
1. A language for communication, called a **communication protocol**.
2. The **physical wiring, printed circuits and connectors** in a motherboard.

The Tip of the Iceberg

Busses come in several different varieties:

Here we see that the CPU (labelled as microprocessor) has 3 different busses on its own:

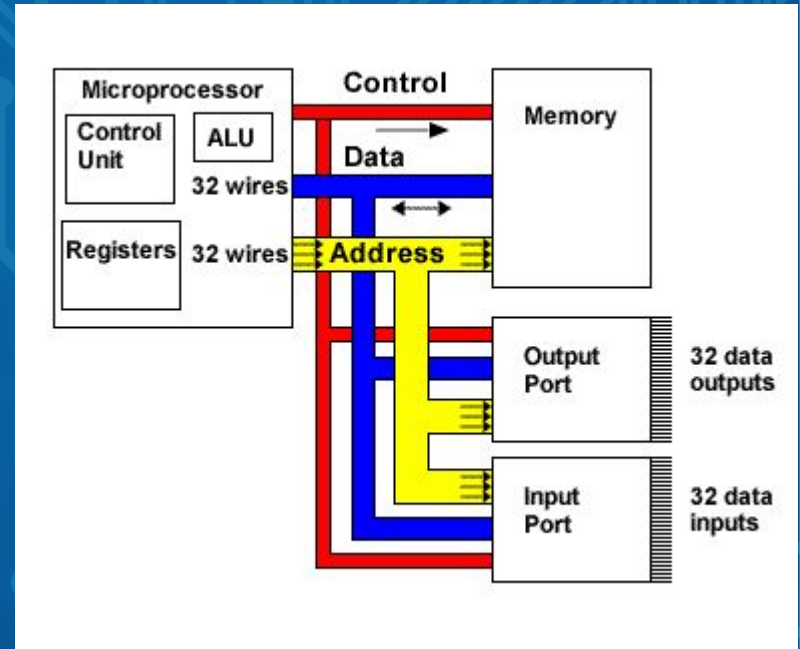
1. **Control** Bus
2. **Data** Bus
3. **Address** Bus



Bus Type

In this diagram, we call the group of wires a bus, but it is important to note that each individual wire here is itself a bus.

So the address bus is a parallel composed of 32 **parallel** busses.



Control Bus

The command bus carries the instruction type (i.e. read/write) to be performed, and the success/failure reply (called a **Status**). It is also responsible for the following things:

- **Interrupt Requests** (IRQ) - Some hardware (like keyboard/mouse, NIC, etc.) can interrupt the current program to have data processed.
- **System Clock Control** - Delivers internal timing information to components within the computer.

Data Bus

The data bus is responsible for transferring the data that is to be processed.

So, if the command bus wants to write a chunk of data, that data is solely passed using the data bus.

Address Bus

The address bus is responsible for signalling the location in memory. This location is known as a **physical** address.

Physical addresses are usually shown to users as hexadecimal numbers in the form 0x01234567 for 32 bit machines, or 0x0123456789ABCDEF in 64 bit machines.

So 32 bit machine can address about 32 GB of memory in 4,294,967,295 distinct locations. Each location is 1 byte.

64 Bit Machines

The possible addresses for 64 bit machines are a little bigger. With 16 hex digits, that's 64 binary digits, so:

- 18,446,744,073,709,551,616 distinct memory locations

Questions and Exercises

Watch '<https://www.youtube.com/watch?v=aBCaCrC3z0k>' and answer the following:

1. What is the role of a computer BUS?

Transferring data, addresses, and control signals between the CPU, memory, storage, and peripherals

2. What are the 3 parts of a BUS?

Data bus, address bus, and control bus

3. A 32 bit bus can transfer how many bytes of data at a time?

4 bytes of data at a time

4. What role does the address BUS play?

Carries memory addresses to specify data locations

Questions and Exercises

6. The Control BUS is usually made up of 4 types of wires. List and describe them.

1. **Read/Write Control:** Signals whether the operation is reading from or writing to memory or an I/O device.
2. **Interrupt Request (IRQ):** Signals that a device needs attention from the CPU.
3. **Clock Signals:** Synchronizes data transfers by providing timing information.
4. **Reset:** Resets the system or a component to its initial state.

7. How is Serial transmission different from parallel?

5. **Serial transmission sends data one bit at a time, while parallel sends multiple bits simultaneously**

8. What is clock skew in parallel data transmission?

6. **Clock skew is the timing difference between the clocks of different parallel transmission lines, causing data misalignment**

9. Where is Serial used more today than parallel data transmission across BUS lines?

7. **Serial is used more today in USB, HDMI, and Ethernet connections due to its simplicity and higher data transfer rates over longer distances**

Questions and Exercises

10. Why does the PCI express data transmission use pairs of lines to send serial data?

1. PCI Express uses pairs of lines to improve signal integrity and reduce electromagnetic interference, allowing faster and more reliable serial data transmission

11. How are PCIx1 and PCEx16 express slots different?

2. PCIe x1 has 1 lane for data transfer, while PCIe x16 has 16 lanes, allowing faster data transfer and supporting high-performance devices like graphics cards

12. What is the role of a buffer in data transmission?

3. Stores data to manage differences in data transfer rates between sender and receiver

13. How are IDE, SCSI and SATA buses related?

4. IDE, SCSI, and SATA are different types of data buses used for connecting storage devices, with SATA being the most modern and fastest

14. What is an expansion card?

5. Adds functionality to a computer, such as graphics, sound, or network capabilities

15. What is a crystal oscillator used for in these cards?

6. It provides a stable clock signal to synchronize operations and maintain timing accuracy in expansion cards