

# Interconnecting CPUs in a multiprocessor system

Serial interconnect between devices in a system simplifies the physical aspect of device communication. Fewer wires are needed in a cable between boards. Fewer traces are needed on circuit boards. This reduces the exposure to signal degradation from electrical noise coupling into the communication path. Disk drives have moved from a parallel to serial interface (SATA) for this reason.

Serial signalling can be implemented with a clock (synchronous) or without a clock (asynchronous). Synchronous serial interfaces can be faster than asynchronous interfaces, but have the disadvantage of being susceptible to spurious clock transitions caused by noise.

## Synchronous Interfaces

**I<sup>2</sup>C Specification** (46 pages. Phillips patent)

[http://www.semiconductors.philips.com/acrobat\\_download/literature/9398/39340011.pdf](http://www.semiconductors.philips.com/acrobat_download/literature/9398/39340011.pdf)

Summary - <http://www.embedded.com/story/OEG20010718S0073>

Defines the physical interconnect.

Open drain with pullup resistor.

400pF max bus load. Includes device input capacitance and wiring capacitance.

PCB trace over a ground plane is about 0.5pF/inch.

Flat cable (ribbon cable) capacitance is about 1.0pF/inch.

There is no error detection.

Common devices are 400kbit/sec or 100kbit/sec.

**CAN Specification** (73 pages. Bosch patent)

<http://www.semiconductors.bosch.de/pdf/can2spec.pdf>

License: <http://www.semiconductors.bosch.de/en/20/can/2-license.asp>

Requires HW support in microprocessors.

**SPI Specification** (no document. Motorola design)

Comparison with I<sup>2</sup>C:

<http://www.embedded.com/story/OEG20020124S0116>

Can be bit banded.

## Asynchronous Interfaces

### Universal Asynchronous Receiver Transmitter (UART)

<http://en.wikipedia.org/wiki/UART>

Common physical interconnects:

- direct – logic level connection of the shift register input and output between two devices
- RS232 - +3v is a zero bit, -3v is a one bit. [http://en.wikipedia.org/wiki/RS\\_232#Voltage\\_levels](http://en.wikipedia.org/wiki/RS_232#Voltage_levels)  
signal levels can be between 3 to 15 volts.
- RS422 – differential signalling with a single transmitter and one or more receivers.  
[http://en.wikipedia.org/wiki/RS\\_422](http://en.wikipedia.org/wiki/RS_422)
- RS485 – differential signalling with multiple transmitters. [http://en.wikipedia.org/wiki/RS\\_485](http://en.wikipedia.org/wiki/RS_485)

Using an asynchronous interface with differential signalling provides the most robust communication path in electrically noisy environments. 10/100/1000 baseT ethernet does this.

Communication between devices will require a protocol.

SNAP Specification (27 pages)

<http://www.hth.com/filelibrary/pdf/snap.pdf>

Physical - <http://en.wikipedia.org/wiki/RS-485>

This is easily implemented on a wide range of hardware.

Relevant reading:

<http://www.epanorama.net/links/serialbus.html>

Microcontroller Interfaces

<http://www.ucpros.com/work%20samples/Microcontroller%20Communication%20Interfaces%201.htm>

<http://www.ucpros.com/work%20samples/Microcontroller%20Communication%20Interfaces%202.htm>

<http://www.ucpros.com/work%20samples/Microcontroller%20Communication%20Interfaces%203.htm>

Other standards:

Read about fieldbusses -

<http://en.wikipedia.org/wiki/Fieldbus>

<http://www.profibus.com/pb/technology/description/>