

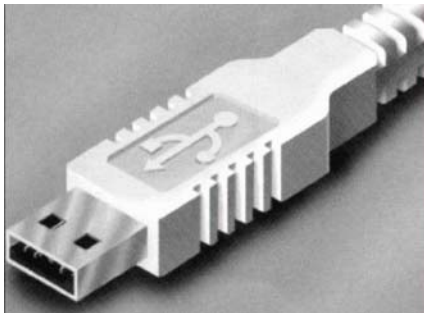
## **USB2 Specification**

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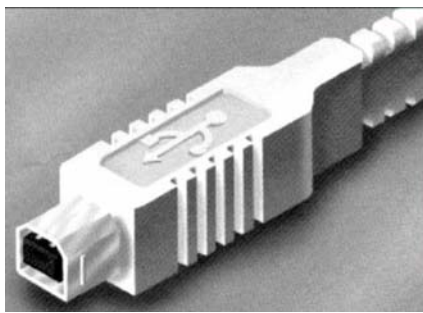
- Reference:  
<http://www.usb.org/developers/docs/>
- Asynchronous Communication
- 4-wire connector
  - 2 wires for power
  - 1 twisted pair for signal
- Hosts and devices

## **USB2 Connectors**

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Host connector



Device connector

## **USB2 Speeds**

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- Three speeds are supported
  - High speed: 480 Mbps  $\pm$ 0.05% (500 ppm)
  - Full speed: 12 Mbps  $\pm$ 0.25% (2500 ppm)
  - Low speed: 1.5 Mbps  $\pm$ 1.5% (15,000 ppm)

## **USB2 Data Encoding**

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- Two levels are used
  - High state is called J
  - Low state is called K
- Idle is represented by a high (J) state
- Packets start with a sync pattern
  - High speed: 15 KJ pairs followed by 2 K's
  - Other speeds: 3 KJ pairs followed by 2 K's
- NRZI:
  - 1 represented by no change in level
  - 0 represented by a change in level
- Bit stuffing used for synchronization
  - a 0 is inserted after 6 consecutive 1's
  - guarantees a transition at least every 7 bit times

## USB2 Packets

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- Starts with 8-bit PID field including
  - 4-bit packet type
  - 4-bit checksum (one's complement of packet type)
- Types of packets:
  - Token: contains address information
  - Data
  - Handshake
  - Special
- Addresses are 7 bits
- Data fields up to 1024 bytes
- All fields other than PID are checked with a CRC
  - Data packet CRC generator:  $X^{16} + X^{15} + X^2 + 1$