COL216
Computer Architecture

Input/Output – 5

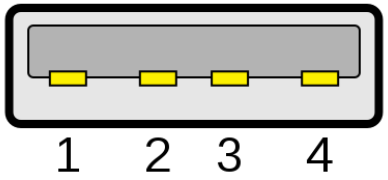
USB

28th March 2022

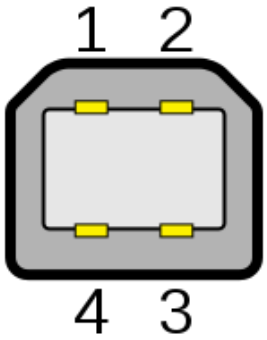
USB : Universal Serial Bus

- Introduced in mid-90's
- Used for a huge variety of devices
- Replaced earlier serial and parallel ports
- Much higher speed than RS232 etc
- Packet oriented, not character oriented
- Clock is recovered from data
- Differential signalling (D+ and D-)
- Upto 127 devices through hubs, each with up to 16 IN and 16 OUT end points

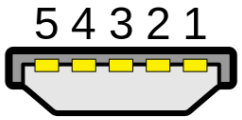
USB connectors



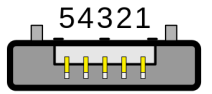
Type A



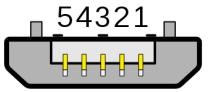
Type B



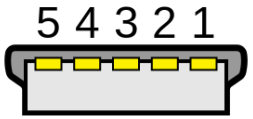
Mini-A



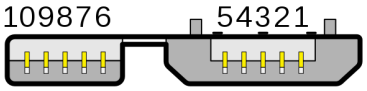
Micro-A



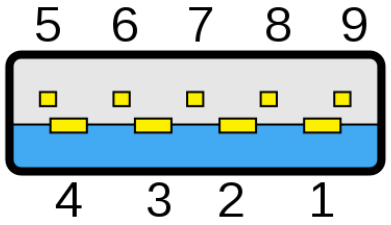
Micro-B



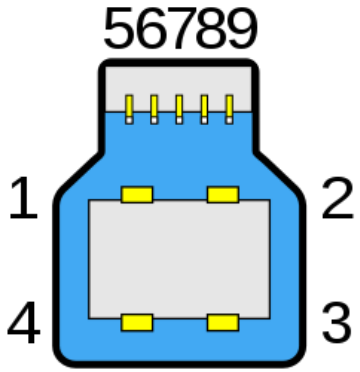
Mini-B



Micro-B SuperSpeed



Type A SuperSpeed



Type B SuperSpeed

Type-C

source : wikipedia

USB speed, levels

- USB 1.0 Low Speed 1.5 Mb/s
- USB 1.0 Full Speed 12 Mb/s
- USB 2.0 High Speed 480 Mb/s
- USB 3.0 Super Speed 5 Gb/s
- USB 3.1 Super Speed+ 10 Gb/s
- USB 3.2 Super Speed+ 20 Gb/s
- USB 4 forthcoming

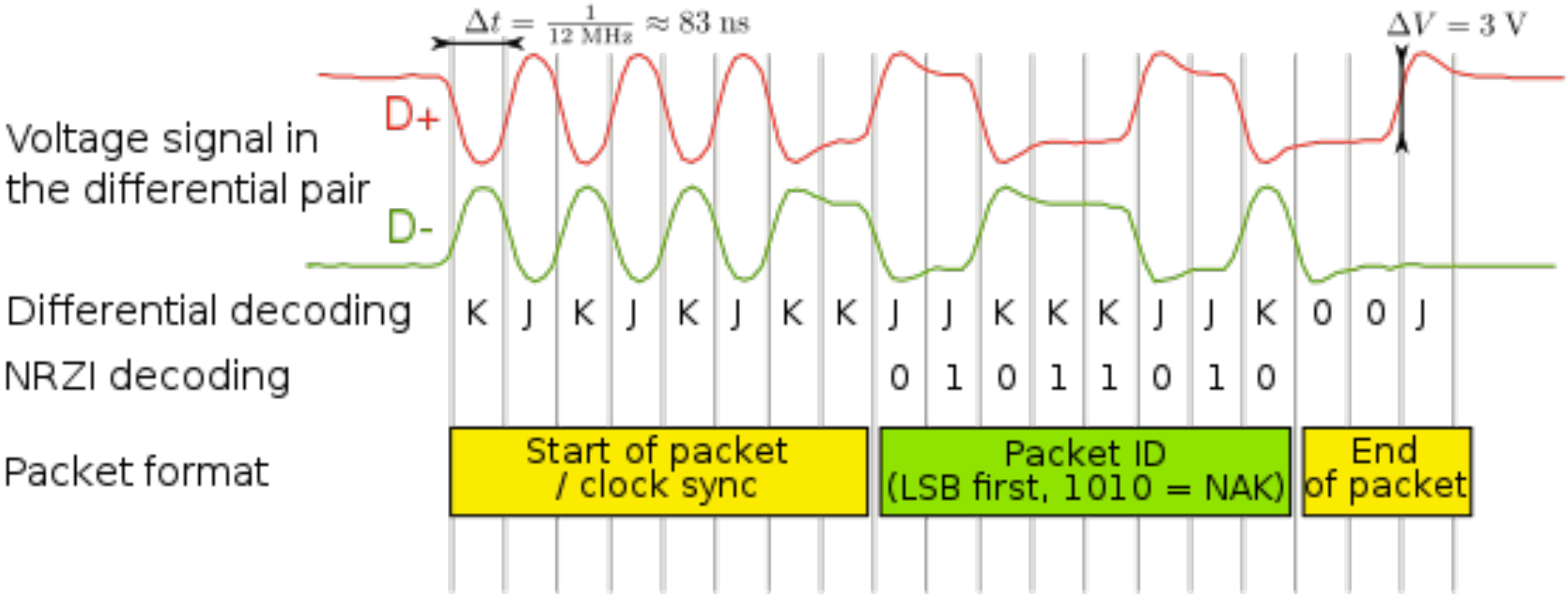
LS, FS : 0.0 to 0.3 V 2.8 to 3.6 V

HS, SS : -10 to 10 mV 360 to 440mV

What D+,D- patterns can indicate

- Device found detached
- Device wakes up host
- Host and device idling
- Start of packet
- End of Packet
- Reset device to a known state
- Power down device
- Host wakes up device
- Host wants device to stay awake
- Device wants to wake up

USB NAK packet



source : wikipedia

Packet IDs

- Token packets
  - SPLIT: Split transaction
  - PING
  - OUT, IN: Address for data transfer
  - SOF: start of frame marker
  - SETUP: Device management
- Handshake packets
  - ACK: Packet accepted
  - NAK: Packet not accepted, retransmit
  - NYET: Data not ready yet
  - STALL: Transfer impossible, do recovery
- DATA0, DATA1 etc: data packet