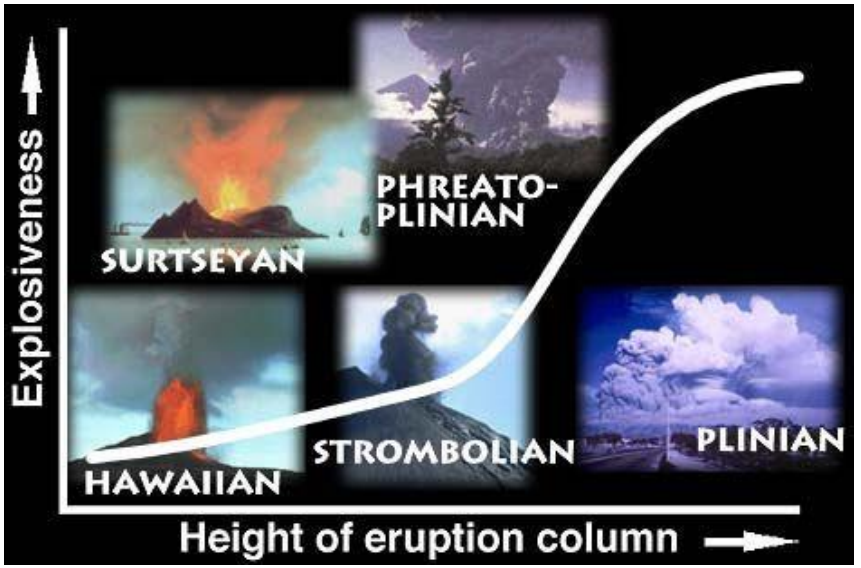
Universal Serial Bus

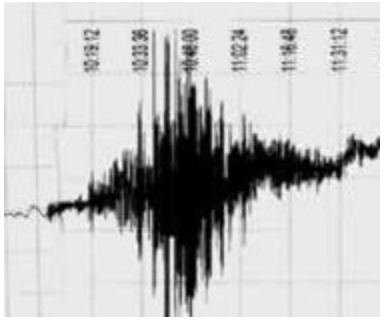
- Teknik Antarmuka Komputer -

Eka Maulana
Universitas Brawijaya

Interface Background

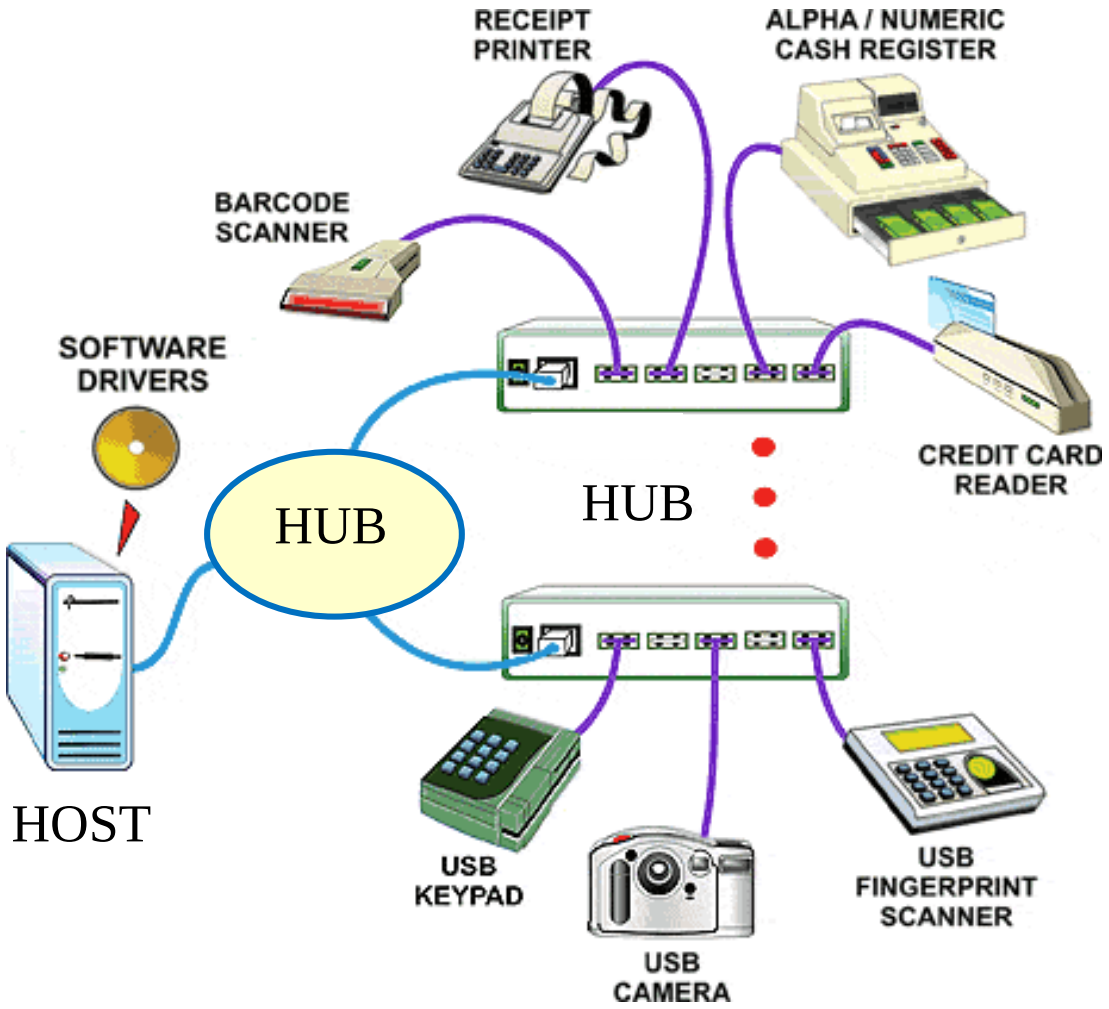


Monitoring



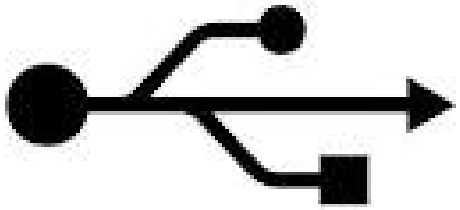
USB Overview

- HOST
- HUB
- DEVICEs (127 max)



USB Progress

- USB 1.0
  - Low Speed (1.5 Mbps)
  - Full Speed (12 Mbps)
- USB 2.0
  - High Speed (480 Mbps)
- USB 3.0
  - Super Speed (5 Gbps)

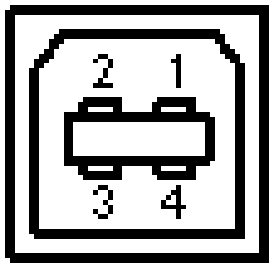


Spesifikasi

- Sinyal: 5 volt DC
- max. voltage: 5 V (± 5%)
- max. current: 500-900 mA
- Cable: 4 wires (8 wires for superspeed)
- Protocol: Serial
- Connector: Unique
- Designer: Compaq, DEC, IBM, Intel, Microsoft, NEC and Nortel

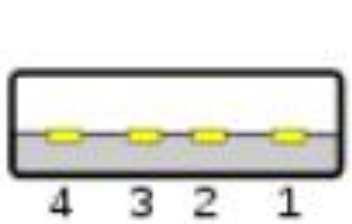
Hardware Specification **(PIN OUT)**

A type
(to Host)

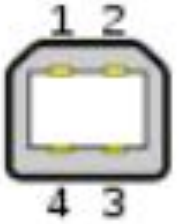


B type
(to Device)

Pin	Name	Cable color	Description
1	VBUS	Red	+5 V
2	D−	White	Data −
3	D+	Green	Data +
4	GND	Black	Ground



Type A



Type B

Mini-A

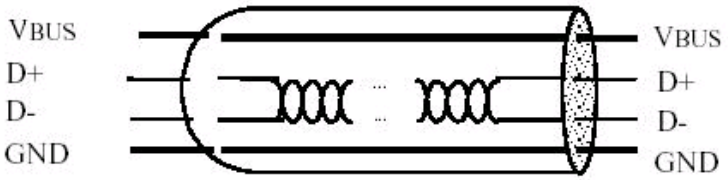
Mini-B

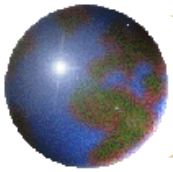
Micro-A

Micro-B

Connector

D+/D- Twisted Pair



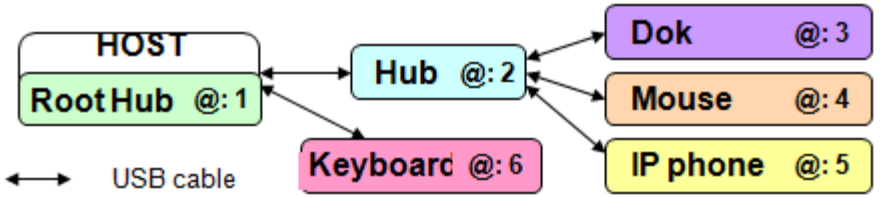


The Transaction Protocol is Host Based

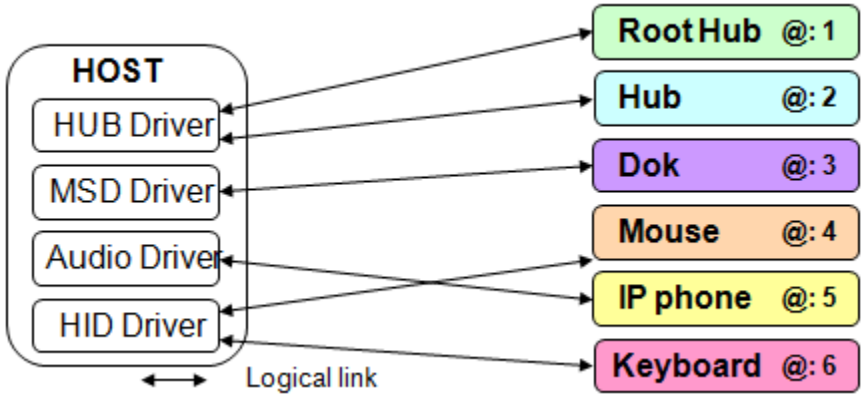
- Host based token polling
  - Data from host-to-function and function-to-host
  - Host handles most of the protocol complexity
  - Peripheral design is simple and low-cost
- Robustness
  - Handshake to acknowledge data transfer and flow control
  - Very low raw physical bit error rate ($< 10^{-10}$)
  - CRC protection plus hardware retry option
  - Data toggle Sequence bits
- Bounded transfer characteristics
  - Data transfer bandwidth and latency prenegociated
  - Flow control for peripheral buffer management
- No asynchronous message/interrupt from the peripheral

USB Topology

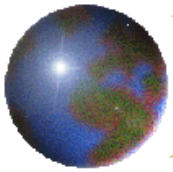
- A unique device address is assigned to each USB device
- Physical tiered start network:



- Logical network:



- Each device sees all traffic generated by the host
- A device does not see data sent by another peripheral



USB Transfer

- A device has several endpoints
- Each endpoint is assigned to a logical pipe with the host
- Each pipe is characterized by:
  - Device address
  - Endpoint number
  - Transfer type
- Transfer type:

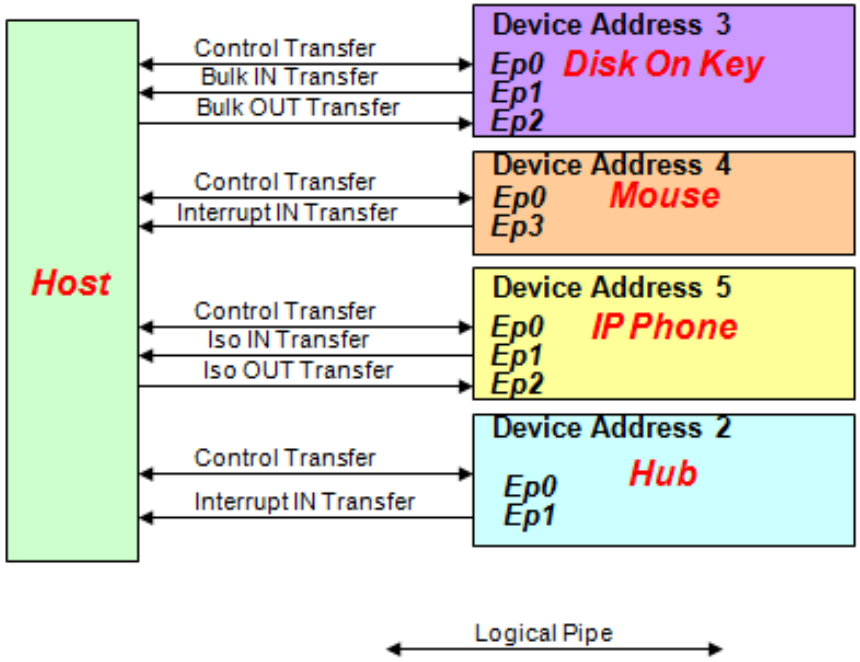
Type	*Direction*	*Packets per frame*	*Max Packet Size*
Control	Bidir	Several	64 Bytes
Bulk	Unidir	Several	64 Bytes
Isochronous	Unidir	One	1024 Bytes
Interrupt	Unidir	One max	64 Bytes

  - Control: configuration/command/status type communication
  - Bulk: large amounts of data at highly variable times
  - Isochronous: constant-rate, error tolerant transfers
  - Interrupt: send or receive data infrequently but with bounded service periods

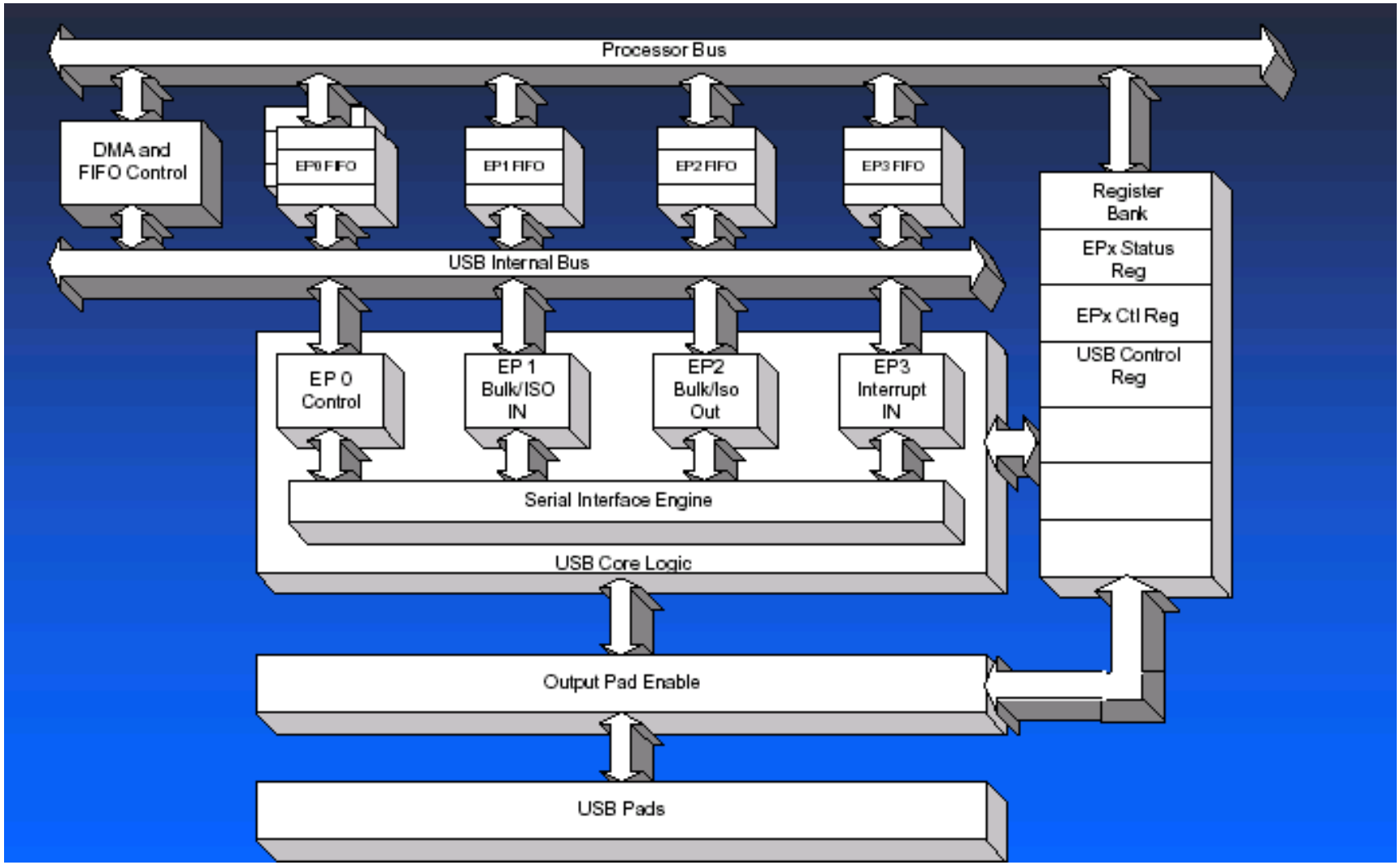
USB Pipe

- Device address is affected by the host
- Endpoint configuration depends on the device implementation
- Time multiplexing of transfer is under host control

Transfer	F/S	Bulk	ADDR	ENDP	Bytes Transferred
20	S	OUT	2	1	31
21	S	IN	2	2	36
22	S	IN	2	2	13
23	S	OUT	2	1	31



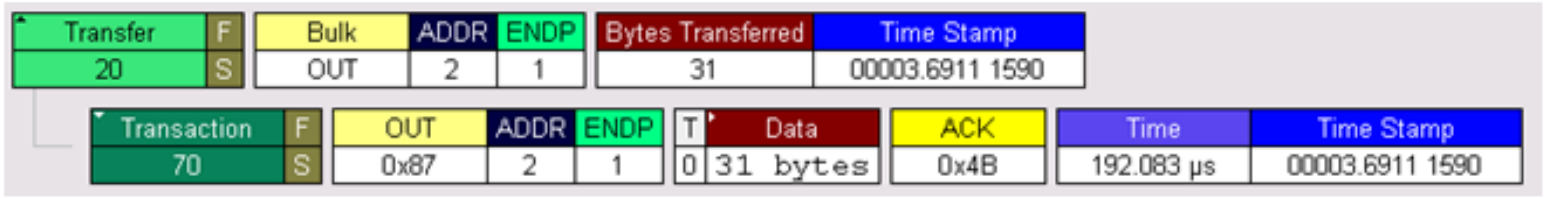
USB Controller



USB transactions

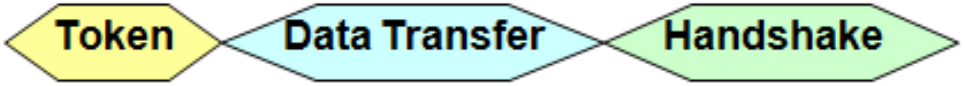
- A transfer is composed of one or several transactions
- Example of control transfer (several transactions)

- Example of bulk transfer (one transaction)

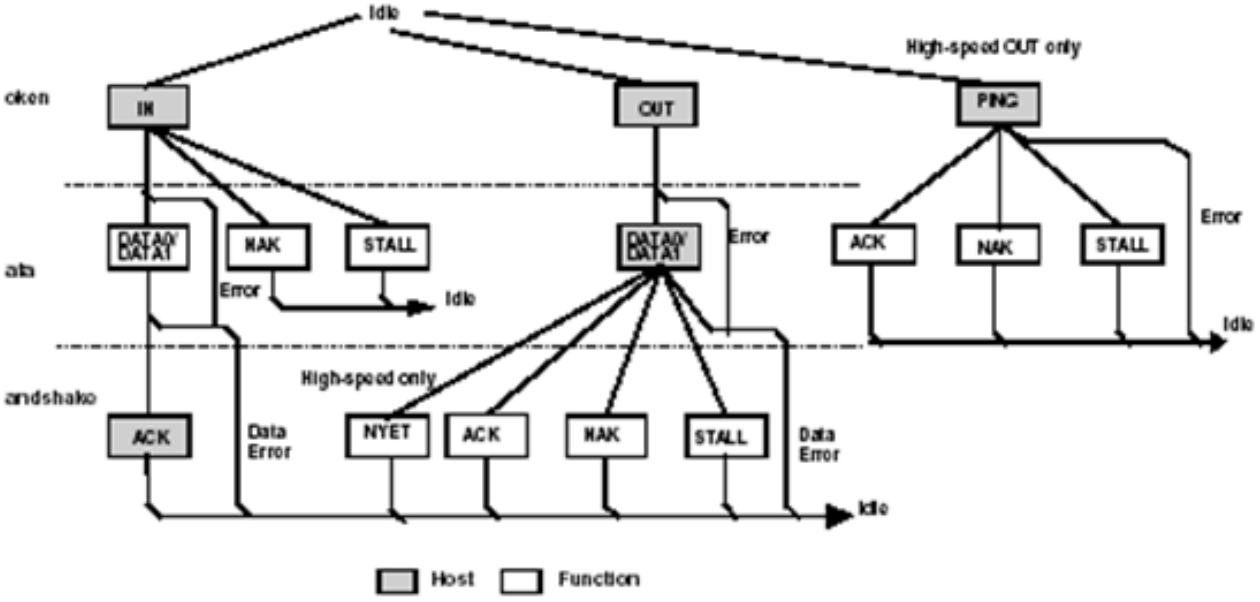


USB Transactions (1)

- **A transaction is made of 3 packets**
  - Token: device address, endpoint number, transfer type
  - Data : data to be sent
  - Handshake: acknowledge

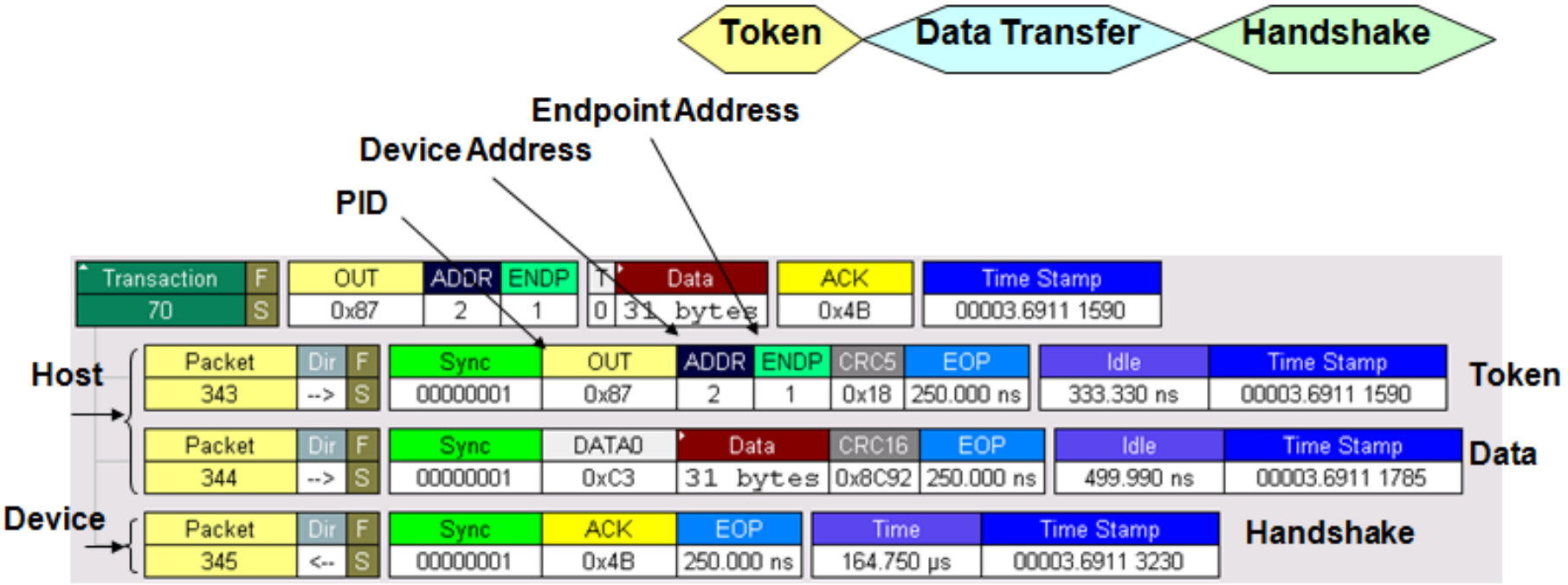


- **Example of bulk transaction:**



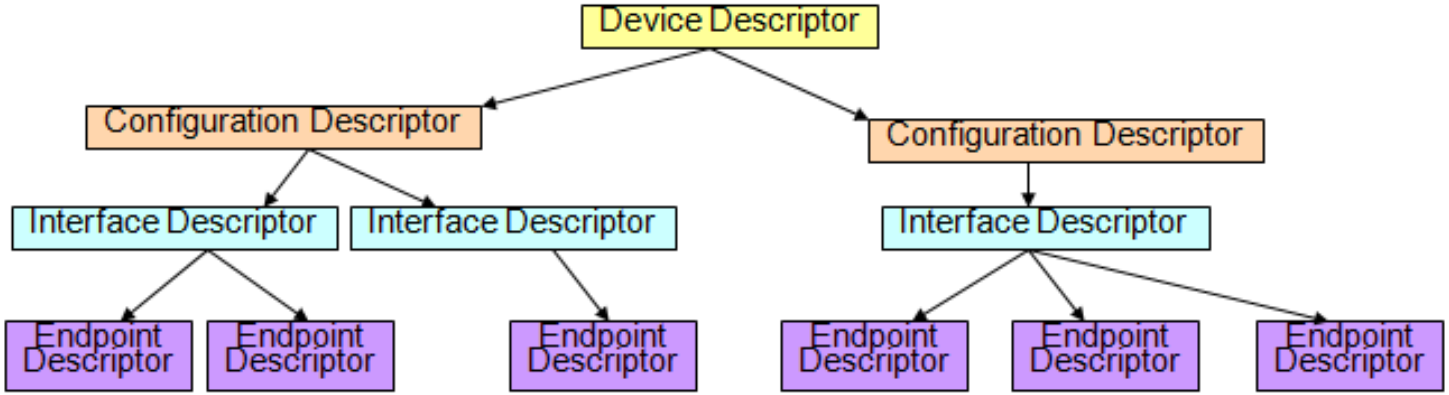
USB Transactions (2)

- **Example of bulk OUT transaction:**



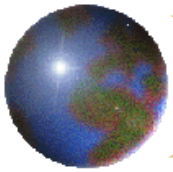
Device descriptor

- The USB Host stacks uses the descriptor retrieved from the device to find the corresponding driver.
- Windows looks for a matching Vendor ID/Product ID in its .inf library
- If not found, it will search for a matching class driver
- If not found then it will request the user to insert a CD to install the corresponding driver



USB class drivers

- Building on top of the USB specifications, there are Device Class Specifications from the Device Working Group
- Matching device class requirements allow use of standard host class drivers provided by Windows or Linux
- Each class driver specifies the endpoint configurations required
- Existing class drivers:
  - Audio class (speakers, …)
  - HID (keyboard, mouse, …)
  - Mass Storage (disk on key)
  - Printer class
  - Smart Card CCID
  - Communication Data Class



tugas

- CRC (penjelasan, jenis, prosedur)
- Data toogle squence (NRZI)