

Data Flow Model of USB 3.0

Presented By:
Tania Malik

Agenda

- Basic Definitions
- Data Flow Model of USB
- SuperSpeed Packets
- Basic Transactions
- Difference from USB 2.0

Basic Definitions:

- Device Endpoints
- Pipes
 - Stream Pipes
 - Message Pipes
- Packets
- Burst Transaction
- Streaming
- Polling

Device Endpoints

- Uniquely identifiable portion of USB
- Use for Communication flow b/w Host and device
- Simplex connection, support data in one direction
- Logical device is composed of collection of independent endpoints
- End point has unique – device- determined identifier called end point number.
- End pint descriptor { Device address, Endpoint No, Direction}
- End point characteristics(Max packet size, Burst Size, Transfer type, direction, bus access frequency)

Device Endpoints

- Two types of endpoints
- **Endpoint zero**
 - Default endpoint, use both input, output endpoint
 - Use to provide access to device' configuration information and allow generic USB status and control access.
- **Non-endpoint zero**
 - Additional endpoints required for implementation
 - In an unknown state before being configured and not accessible.

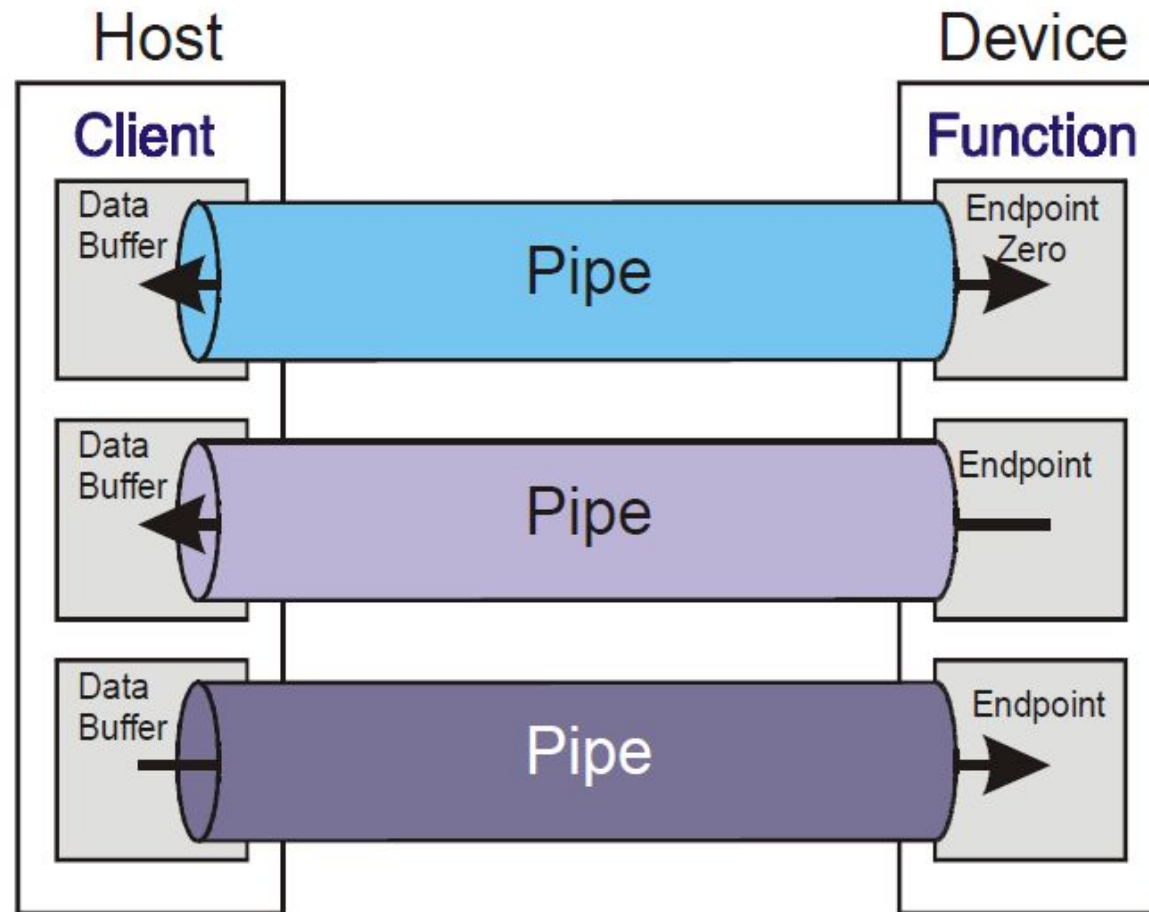
Pipes

- Association b/w endpoint and software
- Are able to move data b/w host and device
- Pipe consist of two endpoints with endpoint zero is called default control pipe
- Default control pipe also used by device specific software



- Two type of Pipes
 - Stream Pipes
 - Message pipes

Pipes communication



Pipe types

1. **Stream Pipes**

- No USB- required structure
- Unidirectional
- Data transfer is in sequential order
- Is bounded to a single device endpoint No. in appropriate direction.
- Support bulk, isochronous, interrupt transfer type

2. **Message Pipes**

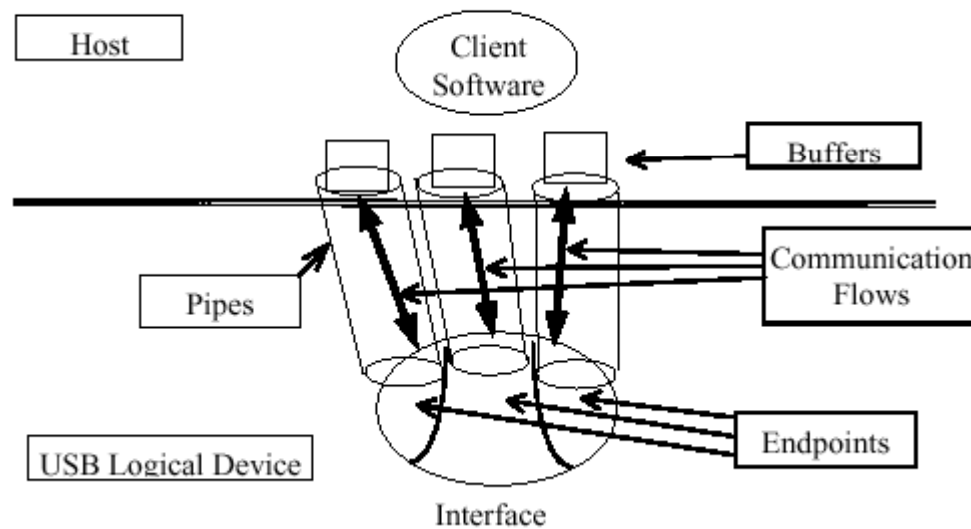
- Has USB defined structure
- Bidirectional
- Default control pipe is always a message pipe
- Device can service only a single message request at a time per message pipe
- Support control transfer type

Basic Definitions cont.

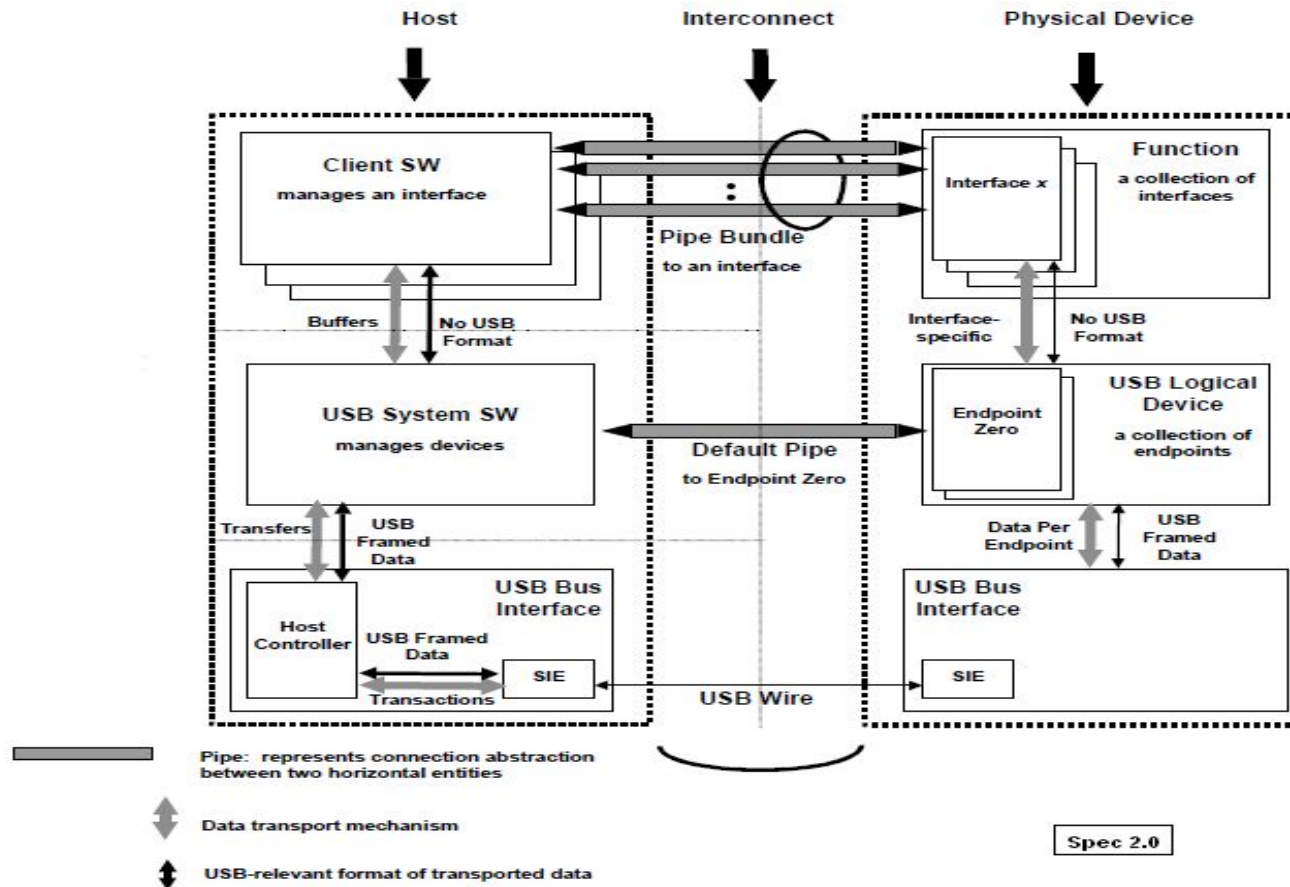
- **Packets**
 - Sequence of data bytes with specific control sequence.
- **Burst Transaction**
 - Allow host to continuously send or receive data
 - No of packets send/ receive without intermediate ACK packet reported by device .
- **Streaming**
 - Transmission of digital audio or video, or the listening and viewing of such data without first storing it.
 - Require some mechanism for establishing a channel b/w sender and receiver.
- **Polling**
 - A polling model is a system of multiple queues accessed by a single server in cyclic order.

USB Communication Flow

- Concepts of endpoints, pipes, transfer types are same as USB 2.0.



USB communication Flow



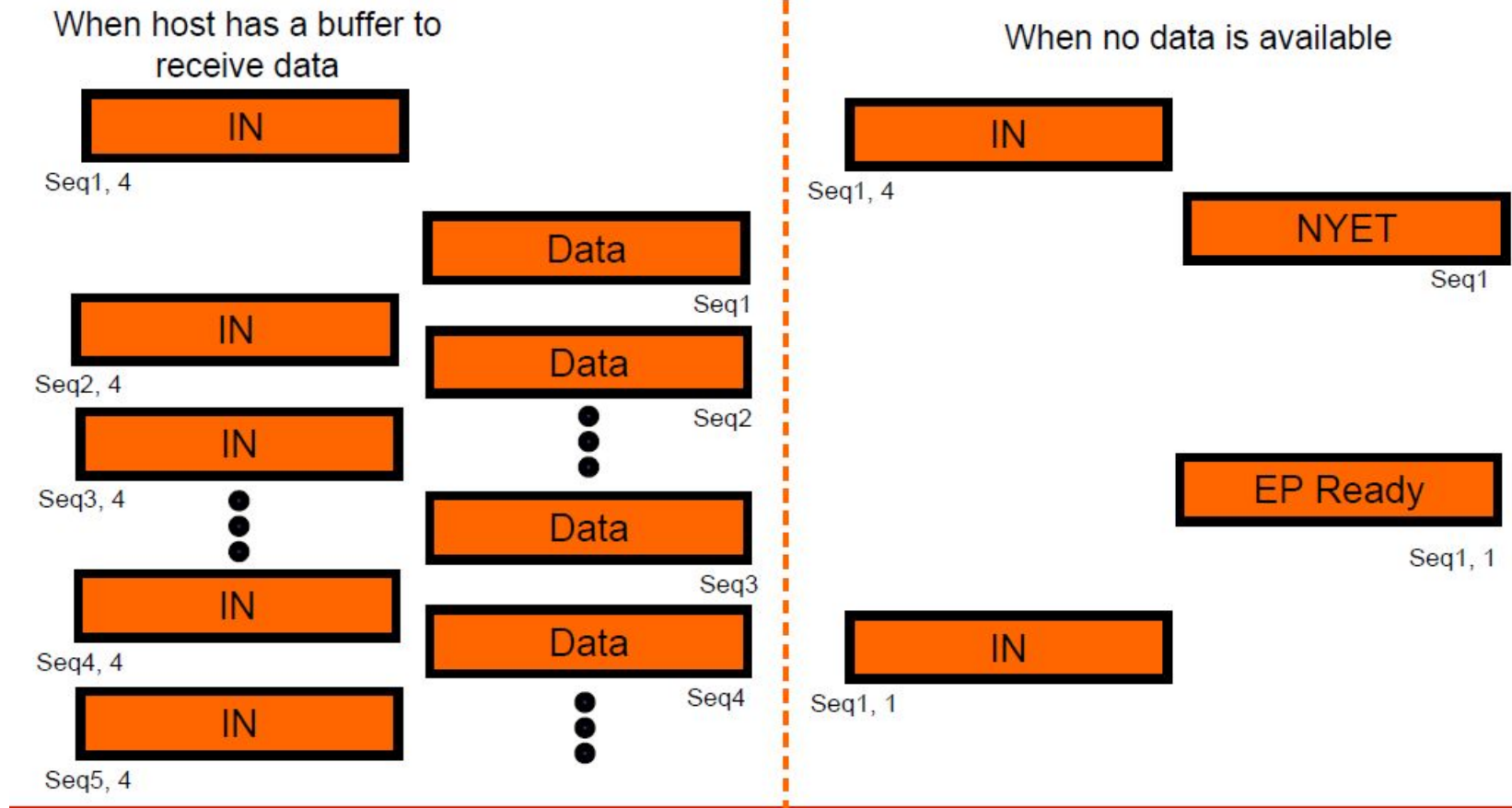
How to transfer and what transfer?

- **Transfer types**
 - Control Transfer
 - Isochronous Transfer
 - Interrupt Transfer
 - Bulk transfer
- **Transfer unit**
 - Packet
 - SuperSpeed packets start with 16 byte header, 16- bit CRC
 - Most packets contain routing information (routing String) and device address triple.
 - Routing string is use to direct packets on directed path

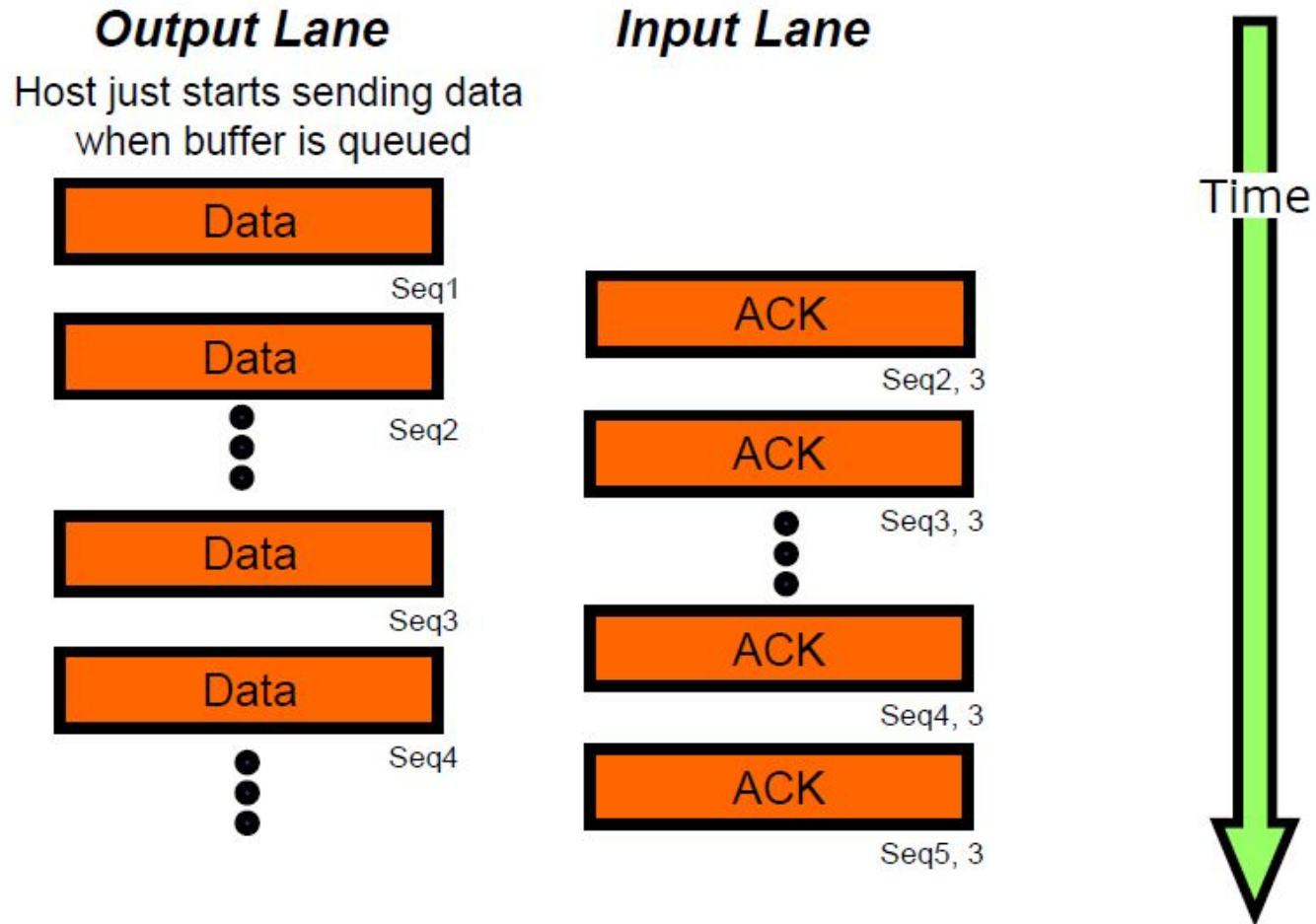
SuperSpeed packets types

- **Link Management Packets**
 - Traverses only the pair of directly connecting ports
 - Use to manage that link
- **Transaction packet**
 - Traverse all links in the path directly connecting the host and a device
 - Use to control the flow of data packets, configure device and hub.
- **Data Packet**
 - Traverse all links in the path directly connecting the host and a device
 - Consist of two parts
 - Data Packet Header (DPH) Similar to TP
 - Data Packet Payload (DPP) Data Block
- **Isochronous Timestamp Packet**
 - Multicast packet sent by host to all active links

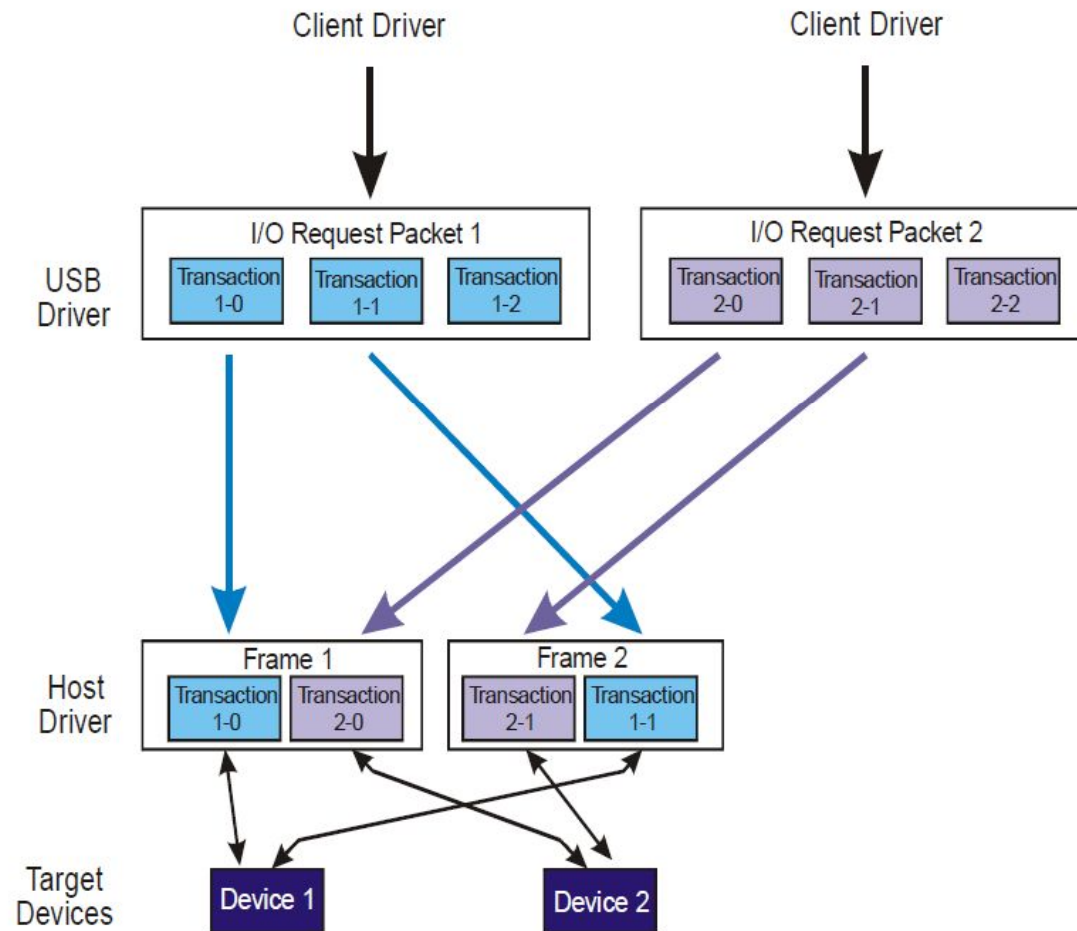
Basic In Transfer



Basic Out Transfer



USB Transaction



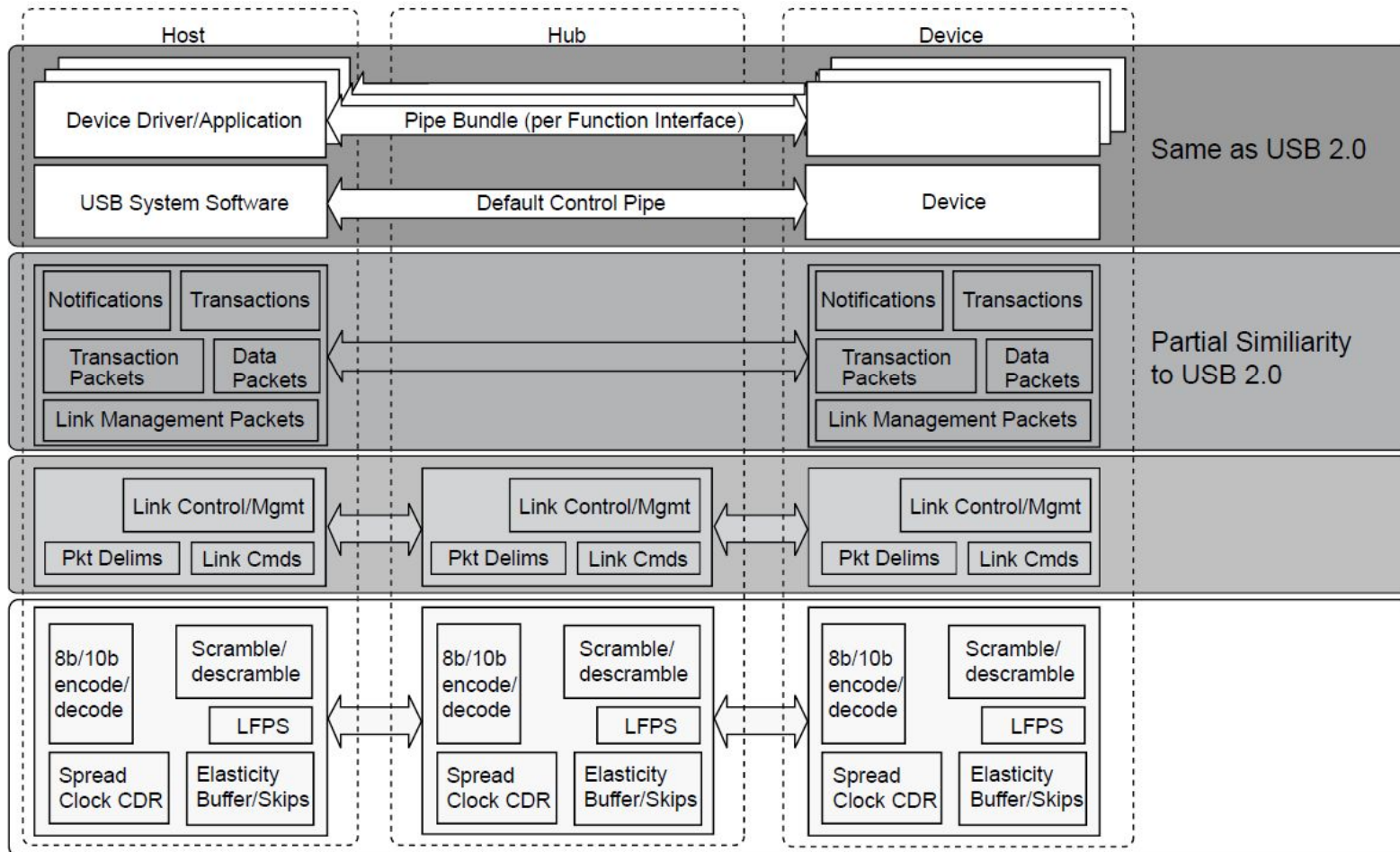
Comparison b/w 2.0 and SuperSpeed

SuperSpeed	USB 2.0
Dual-simplex, unicast protocol	Half-duplex, broadcast protocol
Uses asynchronous notification (NRDY, ERDY)	Uses polling mechanism
Supports streaming for bulk transfers	Does not support streaming
Supports continuous bursting	Does not support bursting
For OUT, token is integrated into data	OUT is three separate parts (Token, Data, and Handshake)
For IN, token is replaced by Handshake	IN is three separate parts (Token, Data, Handshake)
Splits error detection, recovery and flow control functionality between protocol layer and link layer	Protocol layer manages error detection, recovery, and flow control functionality

Conclusion

- SuperSpeed data flow model retains the familiar concepts and mechanisms for endpoints, pipes, and transfer types.
- Only difference is when endpoint in Super Speed is busy it returns a NRDY response and send ERADY notification when want to serve again.
- SuperSpeed support streaming for bulk transfer.

Conclusion cont.



Questions

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Answers