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Engineering 304, Microprocessor Interfacing
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Answers for the questions below can be found in the *Universal Serial Bus Specification* Revision 2.0 (also known as the "USB Standard"). The standard is available in hard-copy via the reserve collection at the Dordt Library. It is also available for free downloading from the Web. (A link is given on the Canvas homework page for this course.)

For each question below, provide an answer that is as complete as possible subject to the constraint that it is **less than 100 words.**

What is an **Isochronous Transfer**? (Section 5.6)
Format – The USB has not content structure for data on communication pipes.
Direction – Isochronous pipe is uni-directional and has an endpoint identifier. If bi-directional is needed then must have two pipes.
Packet – an isochronous pipe specifies the maximum size data payload that it can transmit or receive. The maximum data payload size 1023 bytes for each full-speed endpoint.
Bus Access – full-speed and high-speed devices. A host must not issue more than 1 transaction in a (micro)frame for an isochronous endpoint
Data Sequences – the protocol is optimized by assuming transfers normally succeed. It does not send back a received response.

What is a **Bulk Transfer**? (Section 5.8)
Format – The USB has not content structure for data on communication pipes.
Direction – Is a stream pipe flowing into or out of host. If bi-directional is needed then must have two pipes.
Packet – an isochronous pipe specifies the maximum size data payload that it can transmit or receive. The maximum data payload size 512 bytes for each high-speed endpoint.
Bus Access – full-speed and high-speed devices. If there are bulk transfers pending for multiple endpoints, bulk transfers for the different endpoints are selected by fair access policy, Host Controller implementation-dependent.
Data Sequence – toggle bits are toggled upon successful transaction.

How many **microframes** are there in a **frame**? (Section 8.4.3.1)
It is defined that for high-speed microframes with 125 microsec frame time. It defines a full-speed 1 ms frame time by Start of Frame. If desired, a high-speed device can locally determine a particular microframe "number" by detecting the SOF that had a different frame number than the previous SOF and treating that as the zeroth microframe. The next seven SOFs with the same frame number can be treated as microframes 1 through 7.
The maximum can be 8 times a microframe in a frame depending on when the Start of Frame is for that packet.

What is **Bus Enumeration**? (Section 9.1.2)
When a USB device is attached to or removed from the USB, the host uses a process known as bus enumeration to identify and manage the device state changes necessary. This happens in stages:
1. **When connected it informs Hub of status change pipe. Power-up.**
2. **Host uses query in hub**
3. **Wait 100 ms for stability and address**
4. **Reset port to enable default address. Pulls < 100 mA.**
5. **Host assigns unique address**
6. **Device descriptor is accessed for max data payload.**
7. **Host reads configuration information, takes most of time.**
8. **Host assigns a configuration value.**

What is **Dynamic Attachment and Removal**? (Section 9.2.1)
The hub where USB is attached must report any change in the status of the port. Host enables hub port to device upon detection and also resets the device and port. A reset USB characteristics are: It responds to the default USB address, It is no configured, It is not initially suspended. When a device is removed from a hub port, it disables the port where the device was attached and notifies the host of removal.