



SuperSpeed USB Framework

Rahman Ismail

Chair – Protocol Workgroup
Intel Corporation



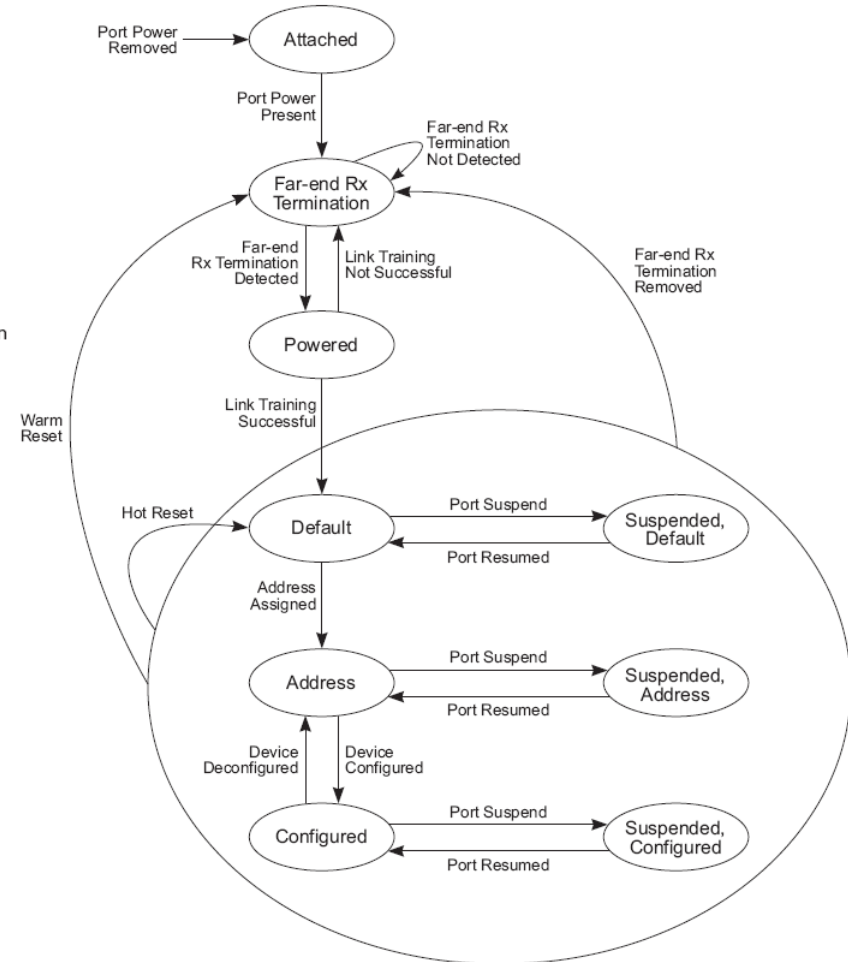
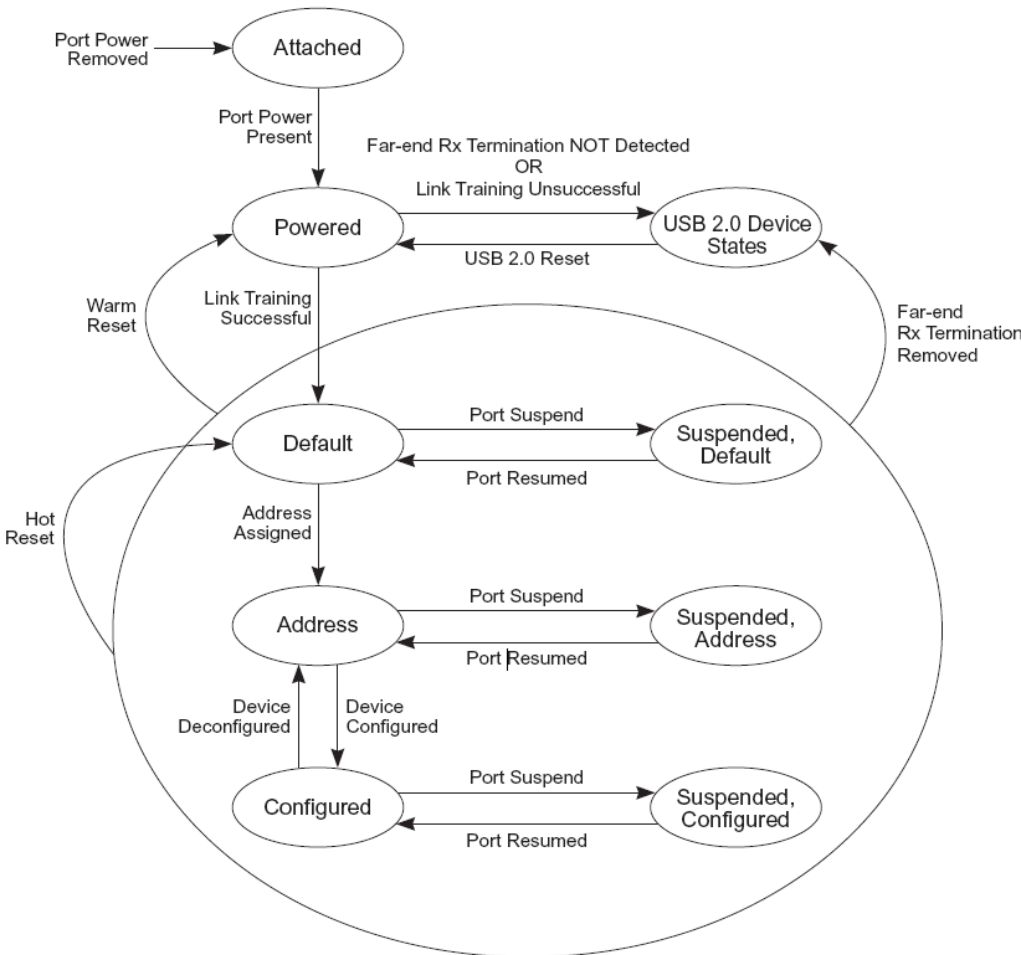
Agenda

- **Device States**
- Basic Framework
- New for SuperSpeed USB
 - Summary of Device Requests
 - Summary of Framework Descriptors
 - Summary of Device Notifications
 - Streams

Device States



- USB 2.0 Device state model is preserved



Bus Enumeration

Differences from USB 2.0



- The hub informs the host of a port change event
 - The device is already reset and in the Default state
- In SuperSpeed mode the device can draw up to 150mA from V_{BUS}
- Once addressed
 - The host sets the system exit latency
 - The host the isochronous delay



Agenda

- Device States
- **Basic Framework**
- New for SuperSpeed USB
 - Summary of Device Requests
 - Summary of Framework Descriptors
 - Summary of Device Notifications
 - Streams

Basic Framework



- USB 2.0 Standard Requests and Descriptors are utilized in SuperSpeed USB
- New requests and descriptors added to support SuperSpeed USB requirements
 - Extensions provide future extensibility as well

Basic Framework Summary



Device States	Same as USB 2.0	
Requests	Modified	Clear Feature, Set Feature, Get Status
	New	Set Iscoh Delay, Set System Exit Latency
Descriptors	Modified	Device, Device Qualifier, Configuration, Endpoint
	New	BOS, USB 3.0 Device Capability, Endpoint Companion
Device Notifications	All New	



Agenda

- Device States
- Basic Framework
- **New for SuperSpeed USB**
 - **Summary of Device Requests**
 - Summary of Framework Descriptors
 - Summary of Device Notifications
 - Streams

Device Requests Extensions

Set/Clear Feature



bmRequest X0000000B	bRequest Set/Clear Feature	wValue Feature Selector	wIndex Zero	wLength zero	Data
-------------------------------	---	--------------------------------------	-----------------------	------------------------	-------------

- Set/Clear Feature
 - Backward compatible with USB 2.0
 - Isolates all SuperSpeed features from USB 2.0 features
 - Deprecated device level Remote Wake
- New standard feature selectors
 - U1_ENABLE
 - U2_ENABLE
 - LTM_ENABLE

U1_ENABLE	Enable Initiating U1 Entry
U2_ENABLE	Enable Initiating U2 Entry
LTM_ENABLE	Enable Latency Tolerance Messages

Interface Requests Extensions

Set/Clear Feature



bmRequest X0000000B	bRequest Set/Clear Feature	wValue Feature Selector	wIndex Zero	wLength zero	Data
-------------------------------	---	--------------------------------------	-----------------------	------------------------	-------------

- FUNCTION_SUSPEND is the only valid feature selector
- Upper byte of wIndex describes the Suspend Options

Bit	Description
0	0 Normal Operation 1 Low Power Suspend State
1	0 Function Remote Wake Disabled (Default) 1 Function Remote Wake Enabled
2-7	Reserved

- Lower byte of wIndex identifies the Interface number
- Device level Remote Wake enable/disable is NOT used



Get Status Request Extension

bmRequest 100000XXB	bRequest Get Status	wValue Zero	wIndex Zero	wLength Two	Data Status
-------------------------------	----------------------------------	-----------------------	-----------------------	-----------------------	-----------------------

- Backward compatible with USB 2.0
- Status returned for requests targeted at the Device level

D7	D6	D5	D4	D3	D2	D1	D0
Reserved (Reset to Zero)			LTM Enable	U2 Enable	U1 Enable	Remote Wakeup	Self-Powered
D15	D14	D13	D12	D11	D10	D7	D8
Reserved (Reset to Zero)							

U-083

- Remote Wakeup field is reserved and not used by SuperSpeed devices
- U1/U2 and LTM are enabled/disabled using Set/Clear Feature Requests

Get Status Request Extension (Cont.)



bmRequest 100000XXB	bRequest Get Status	wValue Zero	wIndex Zero	wLength Two	Data Status
-------------------------------	----------------------------------	-----------------------	-----------------------	-----------------------	-----------------------

- Status returned for requests targeted at the Interface level

D7	D6	D5	D4	D3	D2	D1	D0
Reserved (Reset to Zero)						Function Remote Wakeup	Function Remote Wake Capable
D15	D14	D13	D12	D11	D10	D7	D8
Reserved (Reset to Zero)							

U-084

- Valid information returned ONLY by the first interface in a function
- Bit 0: Reports whether the function supports Remote Wakeup
- Bit 1: Returns whether the function is enabled for Remote Wake
- SetFeature is used to Enable/Disable Remote Wake



New Device Requests

- Set Isochronous Delay

bmRequest 0000000B	bRequest SET ISOCH DELAY	wValue Delay in ns	wIndex Zero	wLength Zero	Data None
------------------------------	---------------------------------------	------------------------------	-----------------------	------------------------	---------------------

- The wValue field specifies a delay from 0 to 65535 nanoseconds
- Average time for a packet to traverse the links to the device

- Set System Exit Latency

bmRequest 0000000B	bRequest SET SEL	wValue Zero	wIndex Zero	wLength Six	Data Exit Latency Values
------------------------------	----------------------------	-----------------------	-----------------------	-----------------------	--

Offset	Name	Meaning
0	U1SEL	Time in μ s for U1 System Exit Latency
1	U1PEL	Time in μ s for U1 Device to Host Exit Latency
2	U2SEL	Time in μ s for U2 System Exit Latency
4	U2PEL	Time in μ s for U2 Device to Host Exit Latency



Agenda

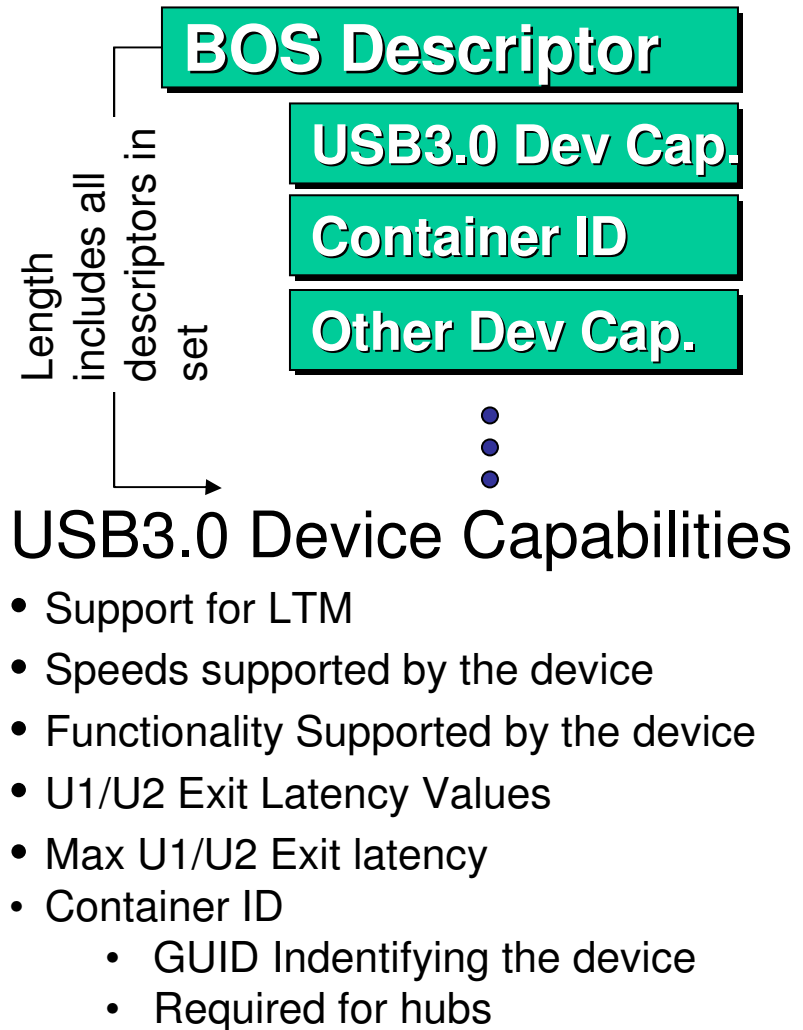
- Device States
- Basic Framework
- **New for SuperSpeed USB**
 - Summary of Device Requests
 - **Summary of Framework Descriptors**
 - Summary of Device Notifications
 - Streams

Descriptor Modifications

Device Level



- Device Descriptor
 - bMaxPacketSize0 09H
 - bcdUSB 0300H
- Configuration Descriptor
 - bMaxPower expressed in 8-mA units
- New BOS Descriptor for Device-level Extensions
 - Accessed via separate request
 - Extensible container model like Configurations

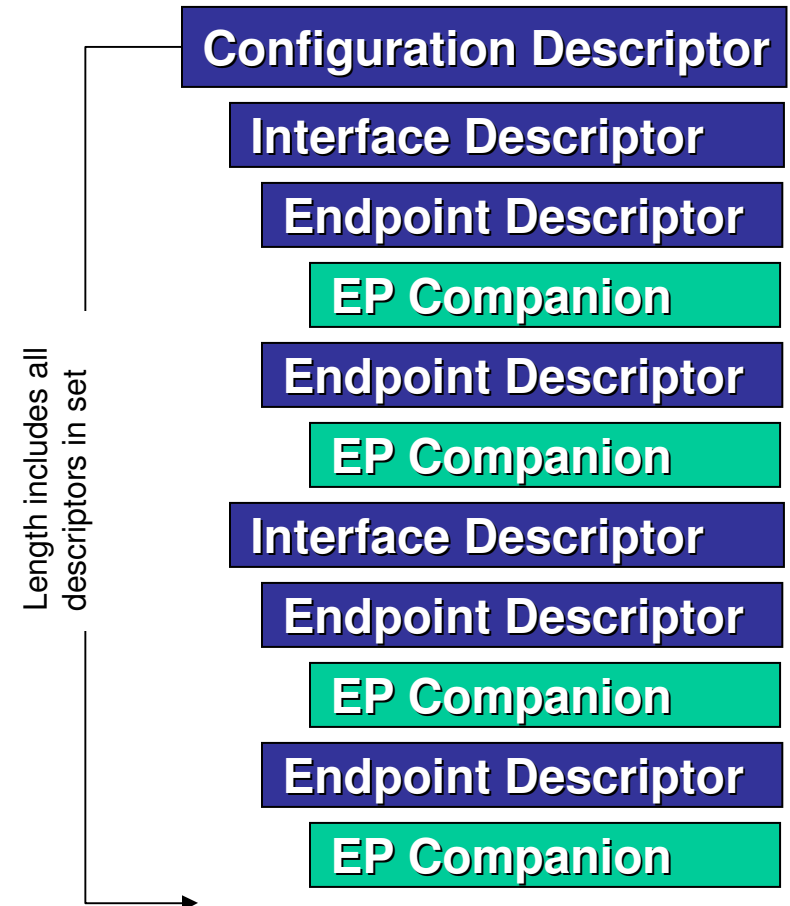


Descriptor Modifications

New Endpoint Companion



- wMaxPacketSize value fixed
 - 1K
 - Except for Iso and Interrupt endpoints
- New Interrupt Endpoint Feature
 - Notification only
- Every Endpoint descriptor has an Endpoint Companion descriptor in every configuration set
- Endpoint companions must follow the endpoint they are associated with
- Endpoint companions carry new endpoint capabilities for USB 3.0
 - Max Burst and Mult
 - Stream Capability
 - Bytes per interval



Descriptor Modifications



When operating at Non-SuperSpeed

- Device Qualifier must return a value of 0300H in the bcdUSB field
- All SuperSpeed device must support LPM
 - Must return a BOS Descriptor with the USB 2.0 EXTENSION capability
- Function level suspend/remote wake is not supported
 - Uses the standard USB 2.0 device mechanism



Agenda

- Device States
- Basic Framework
- **New for SuperSpeed USB**
 - Summary of Device Requests
 - Summary of Framework Descriptors
 - **Summary of Device Notifications**
 - Streams

Device Notifications



- Can only be transmitted by a device

31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0																																
Device Address										Reserved																Type						DWORD 0
Notification Type Specific																				Notification Type				SubType								DWORD 1
Notification Type Specific																																DWORD 2
Link Control Word																CRC-16																DWORD 3

U-105

- Three Types of Device Notifications
 - Function Wake
 - Latency Tolerance Message
 - Bus Interval Adjustment Message
- ERdy is an endpoint specific device notification

Summary



- Extends the USB 2.0 Framework to support SuperSpeed USB
- USB 2.0 defined device state preserved
- Support for function level suspend
- New device level capabilities descriptor
- New endpoint companion descriptor
- Device Notifications added to framework