Errata for “USB Revision 2.0 April 27, 2000” as of 12/7/2000

Check the http://www.usb.org website for the latest errata.

Chapter 5

Reversed Values in Transaction Overhead Tables:

Background: The tables in chapter 5 showing high-speed transaction overheads have typographical errors where the interpacket gap and minimum bus turnaround time values were reversed. No functional impact.

Change: p. 43, table 5-3 & p. 45, table 5-5 and p. 51, table 5-8: change “…8 bit interpacket gap, 88 bit min bus…” to “…88 bit interpacket gap, 8 bit min bus…”.

Table 5-3. High-speed Control Transfer Limits

	Protocol Overhead (173 bytes)	(Based on 480 Mb/s and 88 bit interpacket gap, 8~~8~~ bit min bus turnaround, 32 bit sync, 8 bit EOP: (9x4 SYNC bytes, 9 PID bytes, 6 EP/ADDR+CRC,6 CRC16, 8 Setup data, 9x(1+11) byte interpacket delay (EOP, etc.))				
	Data Payload	**Max Bandwidth (bytes/second)**	**Microframe Bandwidth per Transfer**	**Max Transfers**	**Bytes Remaining**	**Bytes/ Microframe Useful Data**
	1	344000	2%	43	18	43
	2	672000	2%	42	150	84
	4	1344000	2%	42	66	168
	8	2624000	2%	41	79	328
	16	4992000	3%	39	129	624
	32	9216000	3%	36	120	1152
	64	15872000	3%	31	153	1984
Max		60000000				7500

Table 5-8. High-speed Interrupt Transaction Limits

Protocol Overhead	(Based on 480 Mb/s and 88 bit interpacket gap, 88 bit min bus turnaround, 32 bit sync, 8 bit EOP: (3x4 SYNC bytes, 3 PID bytes, 2 EP/ADDR+CRC bytes, 2 CRC16 and a 3x(1+11) byte interpacket delay(EOP, etc.))

	Data Payload	**Max Bandwidth (bytes/second)**	**Microframe Bandwidth per Transfer**	**Max Transfers**	**Bytes Remaining**	**Bytes/ Microframe Useful Data**
	1	1064000	1%	133	52	133
	2	2096000	1%	131	33	262
	4	4064000	1%	127	7	508
	8	7616000	1%	119	3	952
	16	13440000	1%	105	45	1680
	32	22016000	1%	86	18	2752
	64	32256000	2%	63	3	4032
	128	40960000	2%	40	180	5120
	256	49152000	4%	24	36	6144
	512	53248000	8%	13	129	6656
	1024	49152000	14%	6	1026	6144
	2048	49152000	28%	3	1191	6144
	3072	49152000	42%	2	1246	6144
Max		60000000				7500

Table5-5. High-speed Isochronous Transaction Limits

	Protocol Overhead		(Based on 480 Mb/s and 88 bit interpacket gap, 88 bit min bus turnaround, 32 bit sync, 8 bit EOP: (2x4 SYNC bytes, 2 PID bytes, 2 EP/ADDR+addr+CRC5, 2 CRC16, and a 2x(1+11)) byte interpacket delay (EOP, etc.))			
	Data Payload	**Max Bandwidth (bytes/second)**	**Microframe Bandwidth per Transfer**	**Max Transfers**	**Bytes Remaining**	**Bytes/ MicroFrame Useful Data**
	1	1536000	1%	192	12	192
	2	2992000	1%	187	20	374
	4	5696000	1%	178	24	712
	8	10432000	1%	163	2	1304
	16	17664000	1%	138	48	2208
	32	27392000	1%	107	10	3424
	64	37376000	1%	73	54	4672
	128	46080000	2%	45	30	5760
	256	51200000	4%	25	150	6400
	512	53248000	7%	13	350	6656
	1024	57344000	14%	7	66	7168
	2048	49152000	28%	3	1242	6144
	3072	49152000	41%	2	1280	6144
Max		60000000				7500

Chapter 7

Issue with Test_SE0_NAK Behavior:

Background: While in test mode Test_SE0_NAK, upstream facing ports "must respond to any IN token packet with a NAK handshake (only if the packet CRC is determined to be correct) within the normal device response time." The question has been raised as to the meaning of "any IN token" and whether a device must NAK even if the packet is not directed to the device or directed to any endpoint on that device. If it must, a device placed in this test mode will NAK even when an IN token is directed to another devices, such as a mouse or keyboard, resulting in possible problems for other devices connected to the bus during compliance testing. At this point, there are probably implementations that interpret the spec both ways, so this erratum expands the spec to allow either interpretation. This will have to be dealt with in compliance testing. There will be no impact on non-test-mode operation.

Change: p. 169, section 7.1.20, 1st bullet, 3rd sentence: Change complete sentence to: "In addition, while in this mode, upstream facing ports (and only upstream facing ports) must respond to any IN token packet directed to the device (with an endpoint number supported by the device), and optionally to any IN token packet which is not directed to the device or optionally with any endpoint number, with a NAK handshake (only if the packet CRC is determined to be correct) within the normal device response time. Note: This means that the host should send test packets to a device under test with the device's current address and endpoint number zero to ensure that the device will respond."

7.1.20 Test Mode Support

To facilitate compliance testing, host controllers, hubs, and high-speed capable functions must support the following test modes:

- Test mode Test_SE0_NAK: Upon command, a port's transceiver must enter the high-speed receive mode and remain in that mode until the exit action is taken. This enables the testing of output impedance, low level output voltage, and loading characteristics. ~~In addition, while in this mode, upstream facing ports (and only upstream facing ports) must respond to any IN token packet with a NAK handshake (only if the packet CRC is determined to be correct) within the normal allowed device response time.~~ In addition, while in this mode, upstream facing ports (and only upstream facing ports) must respond to any IN token packet directed to the device (with an endpoint number supported by the device), and optionally to any IN token packet which is not directed to the device or optionally with any endpoint number, with a NAK handshake (only if the packet CRC is determined to be correct) within the normal device response time. Note: This means that the host should send test packets to a device under test with the device's current address and endpoint number zero to ensure that the device will respond. This enables testing of the device squelch level circuitry and, additionally, provides a general purpose stimulus/response test for basic functional testing.

Issue with Test_Force_Enable Behavior:

Background: The question has been raised as to the meaning of the language that says "…the disconnect bit can be polled while varying the loading on the port, allowing the disconnect detection threshold voltage to be measured." Some implementations have allowed the port to exit the test mode and return to the disconnected port state when the disconnect threshold is exceeded. Others have let the port stay in the test mode and allowed the bit to be "live". This erratum allows either behavior. There will be no impact on non-test-mode operation.

Change: p. 170, section 7.1.20, bullet on Test_Force_Enable: Add sentence at end of paragraph, "Disconnect detection is optionally allowed to exit test_mode and return the port to the disconnected port state."

- Test mode Test_Force_Enable: Upon command, downstream facing hub ports (and only downstream facing hub ports) must be enabled in high-speed mode, even if there is no device attached. Packets arriving at the hub's upstream facing port must be repeated on the port which is in this test mode. This enables testing of the hub's disconnect detection; the disconnect detect bit can be polled while varying the loading on the port, allowing the disconnect detection threshold voltage to be measured. Disconnect detection is optionally allowed to exit test_mode and return the port to the disconnected port state.

Issue with Test_Packet behavior:

Background: The question has been raised as to the minimum inter-packet gap allowed for an upstream facing port in test mode Test_Packet. The spec states that "The inter-packet timing must be no less than the minimum allowable inter-packet gap as defined in Section 7.1.18 and no greater than 125us." Unfortunately, an upstream facing port never sends back-to-back packets, so this parameter is actually not defined. Since an upstream facing port may send a packet in response to an incoming packet after a minimum of 8 bit times, some designers have interpreted this to mean the minimum inter-packet gap in the test mode should be 8 bit times. This erratum allows this interpretation. It will meet the needs of compliance testing, and there will be no impact on non-test-mode operation.

Change: p. 170, section 7.1.20, bullet on Test_Packet: Add sentence at end of paragraph, "For an upstream facing port, the inter-packet timing must be no less than 8 bit times."

- Test mode Test_Packet: Upon command, a port must repetitively transmit the following test packet until the exit action is taken. This enables the testing of rise and fall times, eye patterns, jitter, and any other dynamic waveform specifications.

  The test packet is made up by concatenating the following strings. (Note: For J/K NRZI data, and for NRZ data, the bit on the left is the first one transmitted. "S" indicates that a bit stuff occurs, which inserts an "extra" NRZI data bit. "* N" is used to indicate N occurrences of a string of bits or symbols.)

•

NRZI Symbols (Fields)	**NRZ Bit Strings**	**Number of NRZ Bits**
{KJ * 15}, KK (SYNC)	{00000000 * 3}, 00000001	32
KKJKJKKK (DATA0 PID)	11000011	8
JKJKJKJK * 9	00000000 * 9	72
JJKKJJKK * 8	01010101 * 8	64
JJJJKKKK * 8	01110111 * 8	64
JJJJJJJKKKKKKK * 8	0, {111111S *15}, 111111	97
JJJJJJJK * 8	S, 111111S, {0111111S * 7}	55
{JKKKKKKK * 10}, JK	00111111, {S0111111 * 9}, S0	72
JJJKKKJJKKKKJKKK (CRC16)	0110110101110011	16
JJJJJJJJ (EOP)	01111111	8

A port in Test_Packet mode must send this packet repetitively. The inter-packet timing must be no less than the minimum allowable inter-packet gap as defined in Section 7.1.18 and no greater than 125 μs. For an upstream facing port, the inter-packet timing must be no less than 8 bit times.

Issue with TDR Loading Specification:

Background: On page 144, Section 7.1.6.2, 4th paragraph, there is a sentence which reads “No single excursion, however, may exceed the Through limits for more than twice the TDR rise time (400 ps).” This is confusing, since the TDR risetime is required to be 400 ps, not 200 ps. This erratum clarifies the language. There is no negative impact caused by this clarification.

Change: Change the sentence to read “No single excursion, however, may exceed the Through limits for more than twice the TDR rise time (twice the 400 ps risetime is 800 ps).”

No single excursion, however, may exceed the Through limits for more than twice the TDR rise time (twice the 400 ps risetime is 800 ps).~~No single excursion, however, may exceed the Through limits for more than twice the TDR rise time (400 ps).~~

Chapter 8

Issue with Some PING STALL Response Omissions:

Background: The PING protocol state machines and "railroad diagrams" show (correctly) that STALL is an allowed response to PING. However, two sentences in the spec do not explicitly mention STALL. This change should cause no functional impact since the more explicit and detailed figures show the full set of allowed responses. Any potential impact is limited to bulk OUT and control endpoints in high-speed devices.

Change: p. 217, section 8.5.1, 4th paragraph, last sentence: change "… a NAK or an ACK handshake." to "…. a NAK, STALL or an ACK handshake."

The host controller queries the high-speed device endpoint with a PING special token. The PING special token packet is a normal token packet as shown in Figure 8-5. The endpoint either responds to the PING with a NAK, STALL, or ~~an~~ ACK handshake.

Change: p. 219, section 8.5.1.1, 3rd paragraph, change "…. the allowed ACK, NAK or an NYET handshakes for the PING mechanism." to "…. the allowed ACK, NAK, STALL or an NYET handshakes for the PING mechanism."

Figure 8-27 shows the host controller state machine for the interactions and transitions between PING and OUT/DATA tokens and the allowed ACK, NAK, STALL, or ~~an~~ NYET handshakes for the PING mechanism.

Clarifying PING Related OUT NAK Responses:

Background: The PING protocol tries to limit NAK responses to OUT transactions. However, a description in the spec suggests that NAK responses to PING transactions are unusual, (which it not true). This change should cause no functional impact since the other descriptions of PING more clearly identify that PING can be NAK'd "forever". Any potential impact is limited to bulk OUT and control endpoints in high-speed devices.

Change: p. 218, section 8.5.1.1, 2nd paragraph, 1st sentence: change "A NAK response is expected to be an unusual occurrence." to "A NAK response to an OUT is expected to be an unusual occurrence."
p. 218, section 8.5.1.1, 2nd paragraph, 3rd sentence: change "…allowed to NAK…" to "… allowed to NAK an OUT…"

A NAK response to an OUT is expected to be an unusual occurrence. A high-speed bulk/control endpoint must specify its maximum NAK rate in its endpoint descriptor. The endpoint is allowed to NAK an OUT at most one time each *bInterval* period. A NAK suggests that the endpoint responded to a previous OUT or PING with an inappropriate handshake, or that the endpoint transitioned into a state where it (temporarily) could not accept data. An endpoint can use a *bInterval* of zero to indicate that it never NAKs. An endpoint must always be able to accept a PING from the host, even if it never NAKs.

Incorrect Figure 8-27 (Host High-speed Bulk OUT/Control Ping State Machine):

Background: The Host High-speed Bulk OUT/Control Ping State Machine figure was incorrectly cut and pasted from the draft specification (where it was correct). The current (incorrect) figure is a total duplicate of figure 8-32. Any potential impact is limited to bulk OUT and control endpoints in high-speed devices.

Change: p. 218: Replace incorrect Figure 8-27 with below:

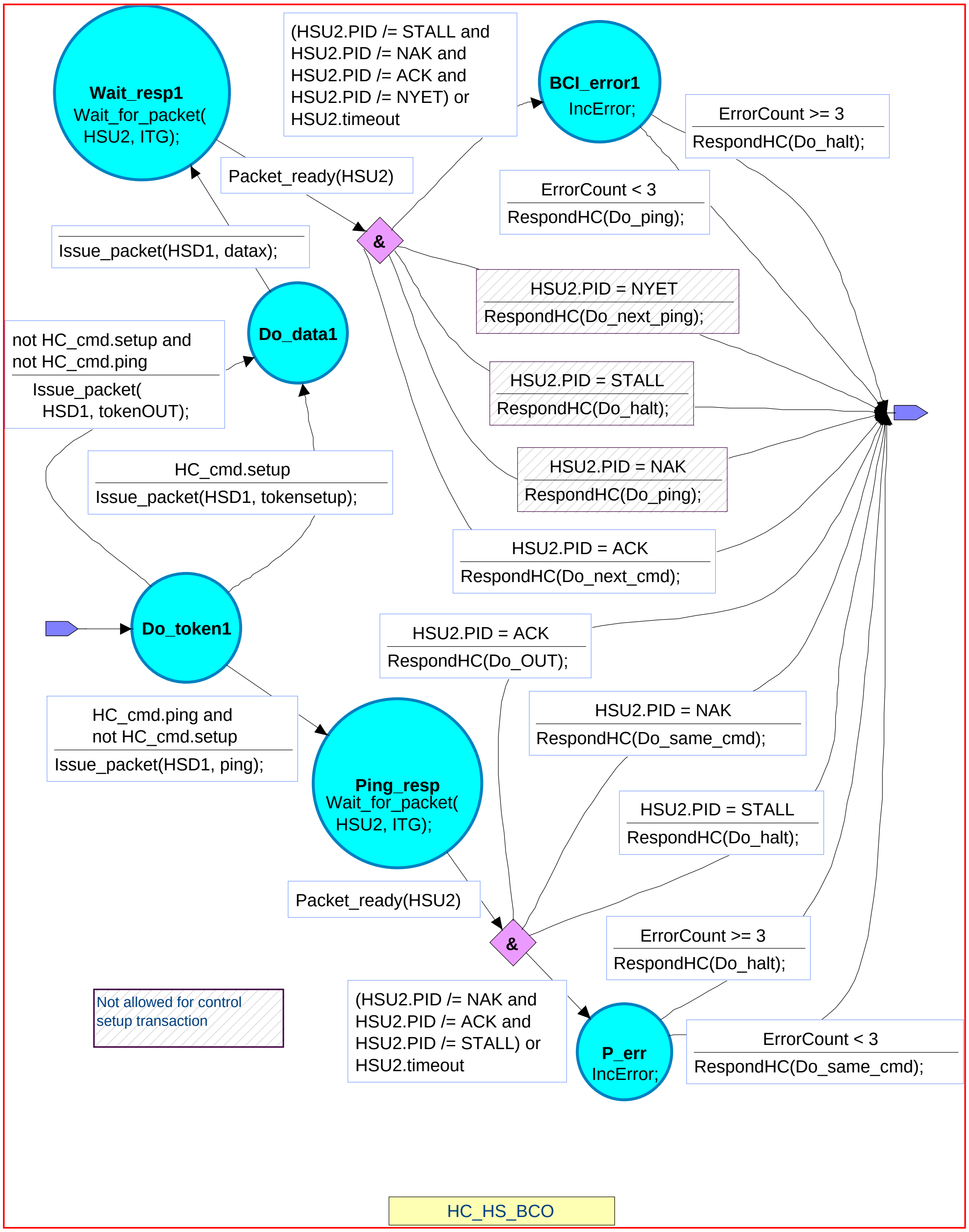


Figure 8-27. Host High-speed Bulk OUT/Control Ping State Machine

Clarifying Figure Title for Figure 8-31 & 8-32:

Background: The titles on figures 8-31 and 8-32 are misleading. The current titles suggest that the figure is uniformly applicable for all speeds, bulk/control/interrupt OUT transactions, (which is not true). No functional impact.

Change: p.222, figure 8-31: caption should be “FS Bulk, FS/LS Control, or HS/FS/LS Interrupt OUT Transaction Host State Machine”

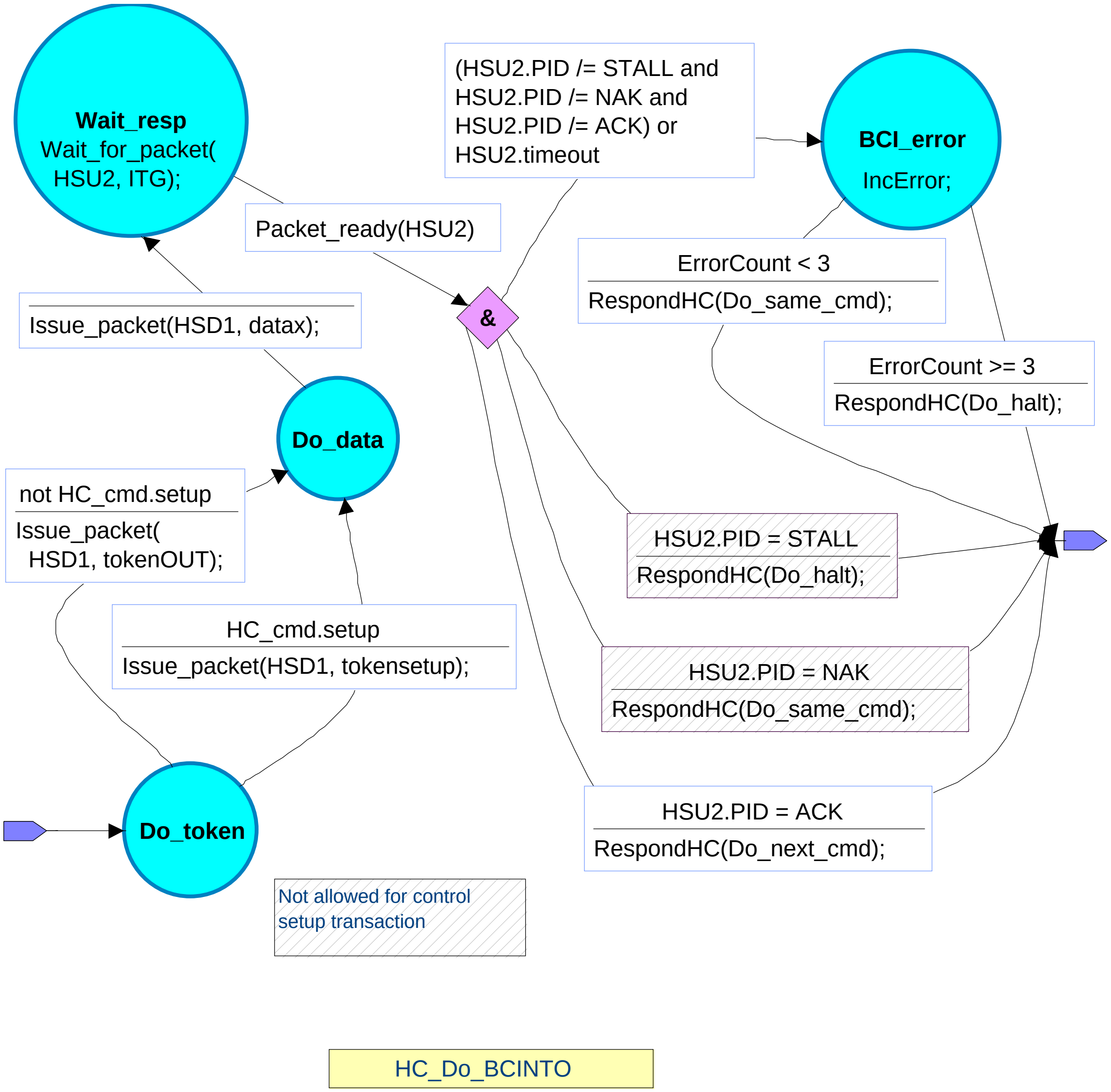


Figure 8-31. FS Bulk, FS/LS~~/~~ Control, or HS/FS/LS Interrupt~~/~~ OUT Transaction Host State Machine

Change: p. 223, figure 8-32: caption should be “FS Bulk, FS/LS Control, or HS/FS/LS Interrupt OUT Transaction Device State Machine”.

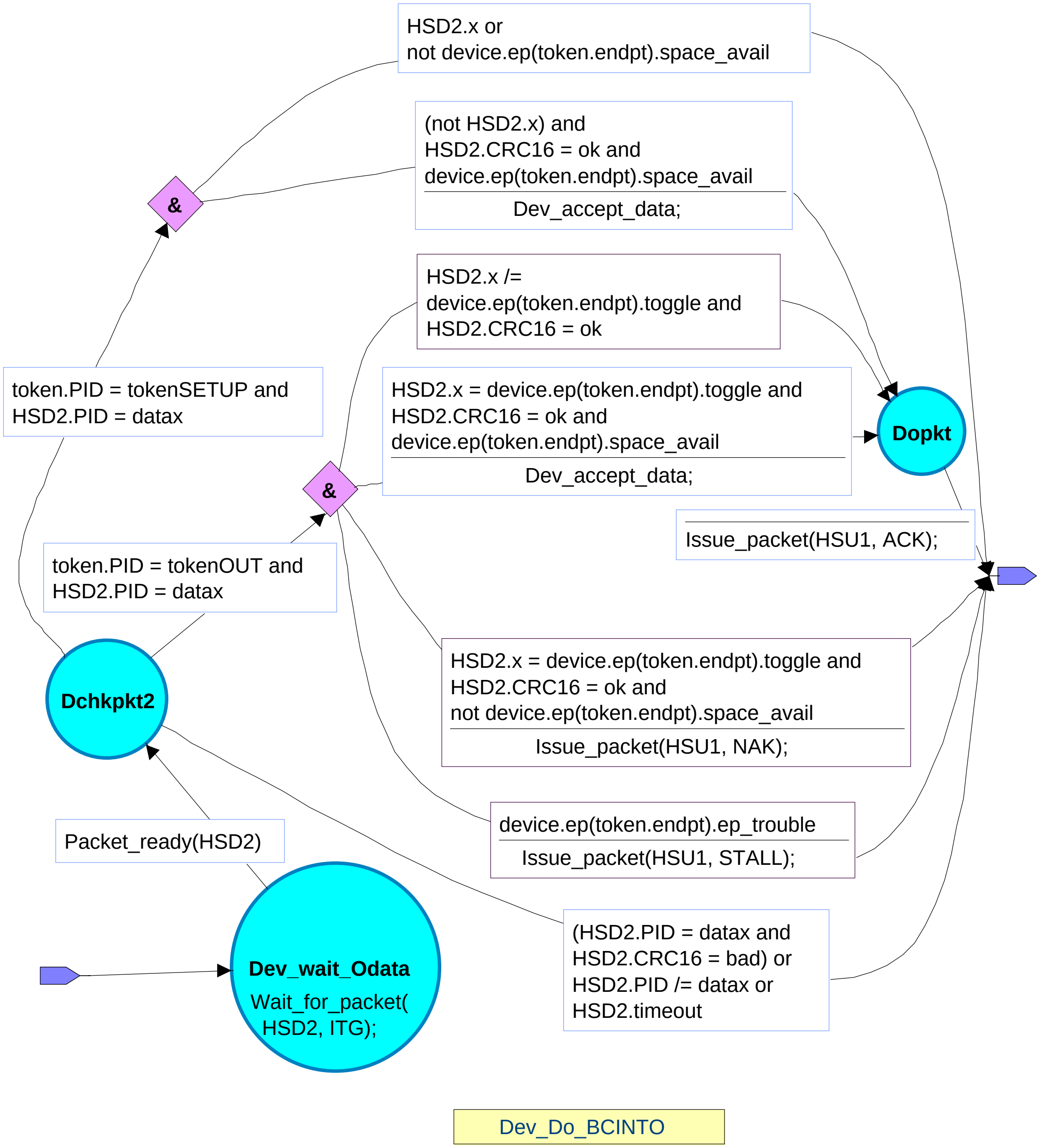


Figure 8-32. FS Bulk, ~~/~~FS/LS Control, ~~/~~or HS/FS/LS Interrupt OUT Transaction Device State Machine

Clarifying No Data PID Sequencing for Interrupt:

Background: Typographical error in the description of high-speed, high-bandwidth endpoints suggests that data PID sequencing is used for both isochronous and interrupt endpoints. Data PID sequencing is only applicable to isochronous endpoints. Also a reference to chapter 5 is incorrect. No functional impact.

Change: p. 232, last paragraph, first sentence: strike "… and interrupt…". 2nd sentence change reference from Section 5.9.1 to 5.9.2.

High-speed, high-bandwidth isochronous~~ and interrupt~~ endpoints support a similar but different data synchronization technique called data PID sequencing. That technique is used instead of data toggle synchronization. Section 5.9.~~1~~2 defines data PID sequencing.

Chapter 9

Background: The table summarizing the standard device requests doesn't reflect the test selector value for SET_FEATURE. This value is correctly described in other places in the spec. Also, the tabular representation of the test selector in the SET_FEATURE definition has the sub-columns reversed (incorrectly) while the text precisely (correctly) defines the organization. No functional impact.

Change: p. 250, table 9-3, row for "SET_FEATURE": change column for wIndex into two sub-columns; left sub-column has current text, new right sub-column has "Test Selector" to correspond with Test_mode support.

Table 9-3. Standard Device Requests

bmRequestType	bRequest	wValue	wIndex		wLength	Data
00000000B 00000001B 00000010B	CLEAR_FEATURE	Feature Selector	Zero Interface Endpoint		Zero	None
10000000B	GET_CONFIGURATION	Zero	Zero		One	Configuration Value
10000000B	GET_DESCRIPTOR	Descriptor Type and Descriptor Index	Zero or Language ID		Descriptor Length	Descriptor
10000001B	GET_INTERFACE	Zero	Interface		One	Alternate Interface
10000000B 10000001B 10000010B	GET_STATUS	Zero	Zero Interface Endpoint		Two	Device, Interface, or Endpoint Status
00000000B	SET_ADDRESS	Device Address	Zero		Zero	None
00000000B	SET_CONFIGURATION	Configuration Value	Zero		Zero	None
00000000B	SET_DESCRIPTOR	Descriptor Type and Descriptor Index	Zero or Language ID		Descriptor Length	Descriptor
00000000B 00000001B 00000010B	SET_FEATURE	Feature Selector	Zero Interface Endpoint	Test Selector	Zero	None
00000001B	SET_INTERFACE	Alternate Setting	Interface		Zero	None
10000010B	SYNCH_FRAME	Zero	Endpoint		Two	Frame Number

Change: p. 258, Section 9.4.9: the figure field wIndex reverses the “Test Selector” and “Zero Interface Endpoint” columns to more accurately reflect the order of bitfields described in the text.

9.4.9 Set Feature

This request is used to set or enable a specific feature.

bmRequestType	bRequest	wValue	wIndex		wLength	Data
00000000B 00000001B 00000010B	SET_FEATURE	Feature Selector	Zero Interface Endpoint~~Test Selector~~	Test Selector~~Zero Interface Endpoint~~	Zero	None

Chapter 11

Incorrect Cross Reference:

Background: Wrong cross reference was made for full speed microframe timer ranges. No functional impact.

Change: p. 300, section 11.2.1, 2nd paragraph, last sentence: Replace reference to “Table 11-2” with reference to “Table 11-1”.

11.2.1 High-speed Microframe Timer Range

The range for a microframe timer must be from 59904 to 60096 high-speed bits.
The nominal microframe interval is 60000 high-speed bit times. The hub microframe timer range specified above is 60000 +/- 96 high-speed bit times in order to accommodate host accuracy, hub accuracy, repeater jittter, and hub quantization. The +/-96 full-speed bit time variation is calculated in ~~Table 11-2~~Table 11-1.

Typographical Error in Full Speed EOF1/EOF Timing Reference:

Background: A reference to EOF1 was incorrectly used instead of EOF2 in describing the EOF points of full speed frames. Other figures clearly show the required relationships of EOF1 and EOF2. No functional impact.

Change: p. 305, section 11.2.5.2, first sentence: Replace text ”…, the EOF1 point is 10 bit times before EOF and EOF1 is …” with “.., the EOF2 point is 10 bit times before EOF and EOF1 is …”.

11.2.5.2 Full-speed EOF1 and EOF2 Timing Points

When the hub operates as a full-/low-speed repeater, the EOF~~1~~2 point is 10 bit times before EOF and EOF1 is 32 bit times before EOF as shown in Figure 11-8.

Illegally Specified bInterval Values for Hub Class Descriptors:

Background: In section 11.23.1, the hub descriptors have several typographical errors. These errors were introduced when the descriptors were copied from the USB 1.1 specification. Most of the errors have an illegal USB2.0 value (FFH) for the bInterval of the hub polling period. This was the correct value for USB1.x hubs. One descriptor incorrectly repeats the same bAlternateSetting value for two different AlternateSettings. The changes allow both previous USB1.1 allowed values and compliant USB2.0 values to avoid silicon changes to hub designs in progress. The change only impacts USB2.0 hubs.

Change: p. 410, in the other_speed endpoint descriptor for the status change endpoint: the bInterval value should be 0CH (i.e. $2^{(12-1)}$ or 256ms). The current value of FFH in the specification is a holdover from the USB 1.1 for full-speed and is an illegal value for high-speed. Similarly, the endpoint descriptors for the status change endpoints on pages 411, 412, 415 and 416 should be changed to 0CH. The expectation is that compliance testing will accept values in the range of 0CH to 10H (12-16) or FFH for some time with an eventual convergence on the value of 0CH for long term compliance.
p. 410, in the hub descriptor other speed interface descriptor for multiple TT hub case (i.e. 2nd interface descriptor on page): the bAlternateSetting should be set to 1 (not 0).

11.23.1 Standard Descriptors for Hub Class

The hub class pre-defines certain fields in standard USB descriptors. Other fields are either implementation-dependent or not applicable to this class.

A hub returns different descriptors based on whether it is operating at high-speed or full-/low-speed. A hub can report three different sets of the descriptors: one descriptor set for full-/low-speed operation and two sets for high-speed operation.

A hub operating at full-/low-speed has a device descriptor with a bDeviceProtocol field set to zero(0) and an interface descriptor with a bInterfaceProtocol field set to zero(0). The rest of the descriptors are the same for all speeds.

A hub operating at high-speed can have one of two TT organizations: single TT or multiple TT. All hubs must support the single TT organization. A multiple TT hub has an additional interface descriptor (with a corresponding endpoint descriptor). The first set of descriptors shown below must be provided by all hubs. A hub that has a single TT must set the bDeviceProtocol field of the device descriptor to one(1) and the interface descriptor bInterfaceProtocol field set to 0.

A multiple TT hub must set the bDeviceProtocol field of the device descriptor to two (2). The first interface descriptor has the bInterfaceProtocol field set to one(1). Such a hub also has a second interface descriptor where the bInterfaceProtocol is set to two(2). When the hub is configured with an interface protocol of one(1), it will operate as a single TT organized hub. When the hub is configured with an interface protocol of two(2), it will operate as a multiple TT organized hub. The TT organization must not be changed while the hub has full-/low-speed transactions in progress.

Note: For the descriptors and fields shown below, the bits in a field are organized in a little-endian fashion; that is, bit location 0 is the least significant bit and bit location 7 is the most significant bit of a byte value.

Full-/Low-speed Operating Hub

Device Descriptor (full-speed information):

bLength	12H
bDescriptorType	1
bcdUSB	0200H
bDeviceClass	HUB_CLASSCODE (09H)
bDeviceSubClass	0
bDeviceProtocol	0
bMaxPacketSize0	64
bNumConfigurations	1

Device_Qualifier Descriptor (high-speed information):

bLength	0AH
bDescriptorType	6
bcdUSB	200H
bDeviceClass	HUB_CLASSCODE (09H)
bDeviceSubClass	0
bDeviceProtocol	1 (for single TT) or 2 (for multiple TT)
bMaxPacketSize0	64
bNumConfigurations	1

Configuration Descriptor (full-speed information):

bLength	09H
bDescriptorType	2
wTotalLength	N
bNumInterfaces	1
bConfigurationValue	X
iConfiguration	Y
bmAttributes	Z
bMaxPower	The maximum amount of bus power the hub will consume in full-/low-speed configuration

Interface Descriptor:

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	0
iInterface	i

Endpoint Descriptor (for Status Change Endpoint):

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	FFH (Maximum allowable interval)

Other_Speed_Configuration Descriptor (High-speed information):

bLength	09H
bDescriptorType	7
wTotalLength	N
bNumInterfaces	1 (for single TT) or 2 (for multiple TT)
bConfigurationValue	X
iConfiguration	Y
bmAttributes	Z
bMaxPower	The maximum amount of bus power the hub will consume in high-speed configuration

Interface Descriptor:

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	0 (for single TT) 1 (for multiple TT)
iInterface	i

Endpoint Descriptor (for Status Change Endpoint):

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	0CH~~FFH~~ (Maximum allowable interval)

Interface Descriptor (present if multiple TT hub):

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	~~0~~1
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	2
iInterface	i

Endpoint Descriptor (present if multiple TT hub):

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	0CH~~FFH~~ (Maximum allowable interval)

High-speed Operating Hub with Single TT

Device Descriptor (High-speed information):

bLength	12H
bDescriptorType	1
bcdUSB	200H
bDeviceClass	HUB_CLASSCODE (09H)
bDeviceSubClass	0
bDeviceProtocol	1
bMaxPacketSize0	64
bNumConfigurations	1

Device_Qualifier Descriptor (full-speed information):

bLength	0AH
bDescriptorType	6
bcdUSB	200H
bDeviceClass	HUB_CLASSCODE (09H)
bDeviceSubClass	0
bDeviceProtocol	0
bMaxPacketSize0	64
bNumConfigurations	1

Configuration Descriptor (high-speed information):

bLength	09H
bDescriptorType	2
wTotalLength	N
bNumInterfaces	1
bConfigurationValue	X
iConfiguration	Y
bmAttributes	Z
bMaxPower	The maximum amount of bus power the hub will consume in this configuration

Interface Descriptor:

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	0 (single TT)
iInterface	i

Endpoint Descriptor (for Status Change Endpoint):

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	0CH~~FFH~~ (Maximum allowable interval)

Other_Speed_Configuration Descriptor (full-speed information):

bLength	09H
bDescriptorType	7
wTotalLength	N
bNumInterfaces	1
bConfigurationValue	X
iConfiguration	Y
bmAttributes	Z
bMaxPower	The maximum amount of bus power the hub will consume in high-speed configuration

Interface Descriptor:

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	0
iInterface	i

Endpoint Descriptor (for Status Change Endpoint):

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	FFH (Maximum allowable interval)

High-speed Operating Hub with Multiple TTs

Device Descriptor (High-speed information):

bLength	12H
bDescriptorType	1
bcdUSB	200H
bDeviceClass	HUB_CLASSCODE (09H)
bDeviceSubClass	0
bDeviceProtocol	2 (multiple TTs)
bMaxPacketSize0	64
bNumConfigurations	1

Device_Qualifier Descriptor (full-speed information):

bLength	0AH
bDescriptorType	6
bcdUSB	200H
bDeviceClass	HUB_CLASSCODE (09H)
bDeviceSubClass	0
bDeviceProtocol	0
bMaxPacketSize0	64
bNumConfigurations	1

Configuration Descriptor (high-speed information):

bLength	09H
bDescriptorType	2
wTotalLength	N
bNumInterfaces	1
bConfigurationValue	X
iConfiguration	Y
bmAttributes	Z
bMaxPower	The maximum amount of bus power the hub will consume in this configuration

Interface Descriptor:

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	1 (single TT)
iInterface	i

Endpoint Descriptor (for Status Change Endpoint):

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	0CH~~FFH~~ (Maximum allowable interval)

Interface Descriptor:

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	1
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	2 (multiple TTs)
iInterface	i

Endpoint Descriptor:

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	0CH~~FFH~~ (Maximum allowable interval)

Other_Speed_Configuration Descriptor (full-speed information):

bLength	09H
bDescriptorType	7
wTotalLength	N
bNumInterfaces	1
bConfigurationValue	X
iConfiguration	Y
bmAttributes	Z
bMaxPower	The maximum amount of bus power the hub will consume in high-speed configuration

Interface Descriptor:

bLength	09H
bDescriptorType	4
bInterfaceNumber	0
bAlternateSetting	0
bNumEndpoints	1
bInterfaceClass	HUB_CLASSCODE (09H)
bInterfaceSubClass	0
bInterfaceProtocol	0
iInterface	i

Endpoint Descriptor (for Status Change Endpoint):

bLength	07H
bDescriptorType	5
bEndpointAddress	Implementation-dependent; Bit 7: Direction = In(1)
bmAttributes	Transfer Type = Interrupt (00000011B)
wMaxPacketSize	Implementation-dependent
bInterval	FFH (Maximum allowable interval)

The hub class driver retrieves a device configuration from the USB System Software using the GetDescriptor() device request. The only endpoint descriptor that is returned by the GetDescriptor() request is the Status Change endpoint descriptor.

Inconsistency in ClearPortFeature Descriptions:

Background: The description of ClearPortFeature is inconsistent in some places in the spec. The description of the PORT_INDICATOR in section 11.24.2.7.1.10 is correct, but the state machine figure (11-11) omits a label for ClearPortFeature and the description of the ClearPortFeature request incorrectly specifies an explicit indicator value, where there is no value that would be meaningful. Also, the PORT_INDICATOR is not explicitly listed for SetPortFeature as a case for having the MSB of wIndex set to zero. This change only impacts hubs that provide port indicator control.

Change: p. 317, figure 11-11: Add "or ClearPortFeature(PORT_INDICATOR, indicator_selector = n/a)" to the label on the transition from Manual mode to Automatic mode.

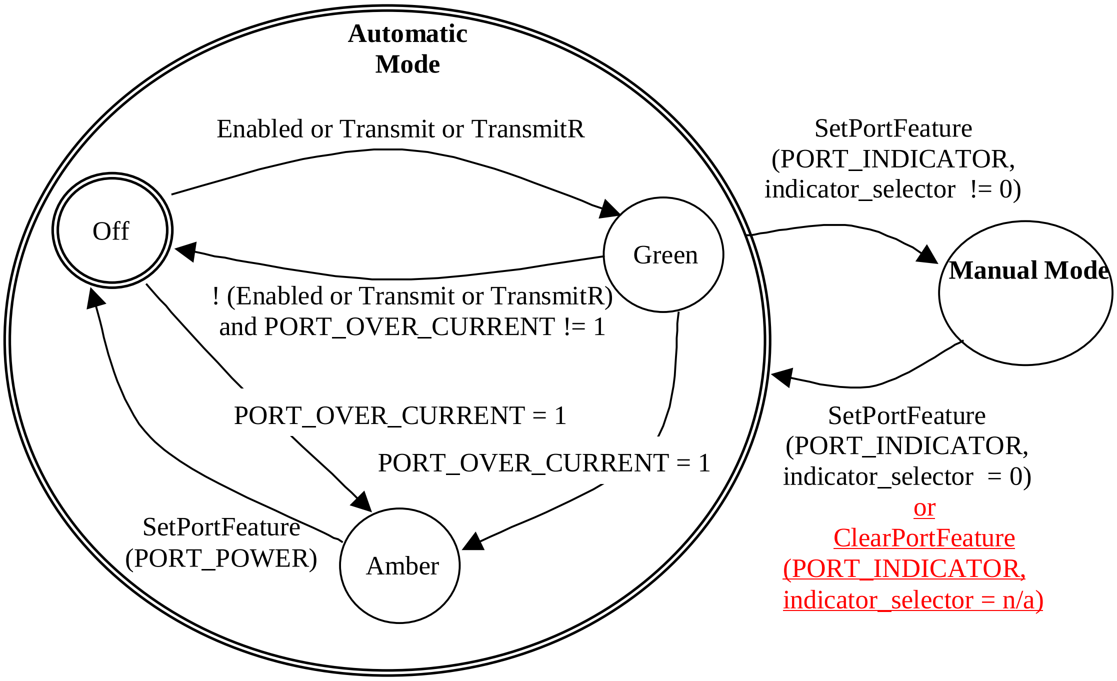

Automatic Mode
Enabled or Transmit or TransmitR
Off
Green
! (Enabled or Transmit or TransmitR) and PORT_OVER_CURRENT != 1
PORT_OVER_CURRENT = 1
PORT_OVER_CURRENT = 1
SetPortFeature (PORT_POWER)
Amber
SetPortFeature (PORT_INDICATOR, indicator_selector != 0)
Manual Mode
SetPortFeature (PORT_INDICATOR, indicator_selector = 0)
or
ClearPortFeature (PORT_INDICATOR, indicator_selector = n/a)

Figure11-11. Port Indicator State Diagram

Change: p. 423, 3rd paragraph before section 11.24.2.3: replace the sentence beginning "The selector field…" with the sentences "Clearing the PORT_INDICATOR causes a transition of the port indicator state machine back to automatic mode (see Figure 11-11). The indicator_selector field is ignored for ClearPortFeature."

Clearing the PORT_ENABLE feature causes the port to be placed in the Disabled state. If the port is in the Powered-off state, the hub should treat this request as a functional no-operation.

Clearing the PORT_POWER feature causes the port to be placed in the Powered-off state and may, subject to the constraints due to the hub's method of power switching, result in power being removed from the port. Refer to Section 11.11 on rules for how this request is used with ports that are gang-powered.

~~The selector field identifies the port indicator selector when clearing a port indicator.~~ Clearing the PORT_INDICATOR causes a transition of the port indicator state machine back to automatic mode (see Figure 11-11). The indicator selector field is ignored for the ClearPortFeature. The selector field is in bits 15..8 of the *wIndex* field.

It is a Request Error if *wValue* is not a feature selector listed in Table 11-17, if *wIndex* specifies a port that does not exist, or if *wLength* is not as specified above. It is not an error for this request to try to clear a feature that is already cleared (hub should treat as a functional no-operation).

If the hub is not configured, the hub's response to this request is undefined.

Change: p. 435, 1st paragraph: add "… or PORT_INDICATOR." to end of the last sentence.

11.24.2.13 Set Port Feature

This request sets a value reported in the port status.

bmRequestType	bRequest	wValue	wIndex		wLength	Data
00100011B	SET_ FEATURE	Feature Selector	Selector	Port	Zero	None

The port number must be a valid port number for that hub, greater than zero. The port number is in the least significant byte (bits 7..0) of the *wIndex* field. The most significant byte of *wIndex* is zero, except when the feature selector is PORT_TEST or PORT_INDICATOR.

Clarifying Standard Hub Class Requests:

Background: GET_/SET_INTERFACE requests to the hub in the summary hub class request table do not currently indicate that they are required for multiple TT hub implementations. Since the hub descriptors report alternate interfaces and other descriptions indicate how these interfaces are used, these commands are clearly required.
This change only impacts hubs that support multiple TTs.

Change: p. 419, table 11-14: change Hub Response descriptions for GET_INTERFACE and SET_INTERFACE from "Undefined…." to "Standard for multiple TT hub operating at high-speed."

Table 11-14. Hub Responses to Standard Device Requests

bRequest	Hub Response
CLEAR_FEATURE	Standard
GET_CONFIGURATION	Standard
GET_DESCRIPTOR	Standard
GET_INTERFACE	~~Undefined. Hubs are allow to support only one interface.~~Standard for multiple TT hub operating at high-speed.
GET_STATUS	Standard
SET_ADDRESS	Standard
SET_CONFIGURATION	Standard
SET_DESCRIPTOR	Optional
SET_FEATURE	Standard
SET_INTERFACE	~~Undefined. Hubs are allow to support only one interface.~~Standard for multiple TT hub operating at high-speed.
SYNCH_FRAME	Undefined. Hubs are not allowed to have isochronous endpoints.

Minor Typographical Errors:

Background: No functional changes.

Change: p. 426, section 11.24.2.7, 2nd paragraph after figure: change “refer to Table 11-20” to “refer to Table 11-22”

11.24.2.7 Get Port Status

This request returns the current port status and the current value of the port status change bits.

bmRequestType	bRequest	wValue	wIndex	wLength	Data
10100011B	GET_STATUS	Zero	Port	Four	Port Status and Change Status

The port number must be a valid port number for that hub, greater than zero.

The first word of data contains *wPortStatus* (refer to). The second word of data contains *wPortChange* (refer to ~~Table 11-20~~Table 11-22).

Change: p. 427, table 11-21, row for bit 10: change name from "High-speed Device Attached" to "Full- or High-speed Device Attached".

Table 11-21. Port Status Field, *wPortStatus*

Bit	Description
0	**Current Connect Status:** (PORT_CONNECTION) This field reflects whether or not a device is currently connected to this port. 0 = No device is present. 1 = A device is present on this port.
1	**Port Enabled/Disabled:** (PORT_ENABLE) Ports can be enabled by the USB System Software only. Ports can be disabled by either a fault condition (disconnect event or other fault condition) or by the USB System Software. 0 = Port is disabled. 1 = Port is enabled.
2	**Suspend:** (PORT_SUSPEND) This field indicates whether or not the device on this port is suspended. Setting this field causes the device to suspend by not propagating bus traffic downstream. This field may be reset by a request or by resume signaling from the device attached to the port. 0 = Not suspended. 1 = Suspended or resuming.
3	**Over-current:** (PORT_OVER_CURRENT) If the hub reports over-current conditions on a per-port basis, this field will indicate that the current drain on the port exceeds the specified maximum. For more details, see Section 7.2.1.2.1. 0 = All no over-current condition exists on this port. 1 = An over-current condition exists on this port.
4	**Reset**: (PORT_RESET) This field is set when the host wishes to reset the attached device. It remains set until the reset signaling is turned off by the hub. 0 = Reset signaling not asserted. 1 = Reset signaling asserted.
5-7	**Reserved** These bits return 0 when read.
8	**Port Power:** (PORT_POWER) This field reflects a port's logical, power control state. Because hubs can implement different methods of port power switching, this field may or may not represent whether power is applied to the port. The device descriptor reports the type of power switching implemented by the hub. 0 = This port is in the Powered-off state. 1 = This port is not in the Powered-off state.
9	**Low- Speed Device Attached:** (PORT_LOW_SPEED) This is relevant only if a device is attached. 0 = Full-speed or High-speed device attached to this port (determined by bit 10). 1 = Low-speed device attached to this port.
10	**Full- or High-speed Device Attached:** (PORT_HIGH_SPEED) This is relevant only if a device is attached. 0 = Full-speed device attached to this port. 1 = High-speed device attached to this port.
11	**Port Test Mode** : (PORT_TEST) This field reflects the status of the port's test mode. Software uses the SetPortFeature() and ClearPortFeature() requests to manipulate the port test mode. 0 = This port is not in the Port Test Mode. 1 = This port is in Port Test Mode.
12	**Port Indicator Control**: (PORT_INDICATOR) This field is set to reflect software control of the port indicator. For more details see Sections 11.5.3, 11.24.2.7.1.10, and 11.24. 0 = Port indicator displays default colors. 1 = Port indicator displays software controlled color.
13-15	**Reserved** These bits return 0 when read.

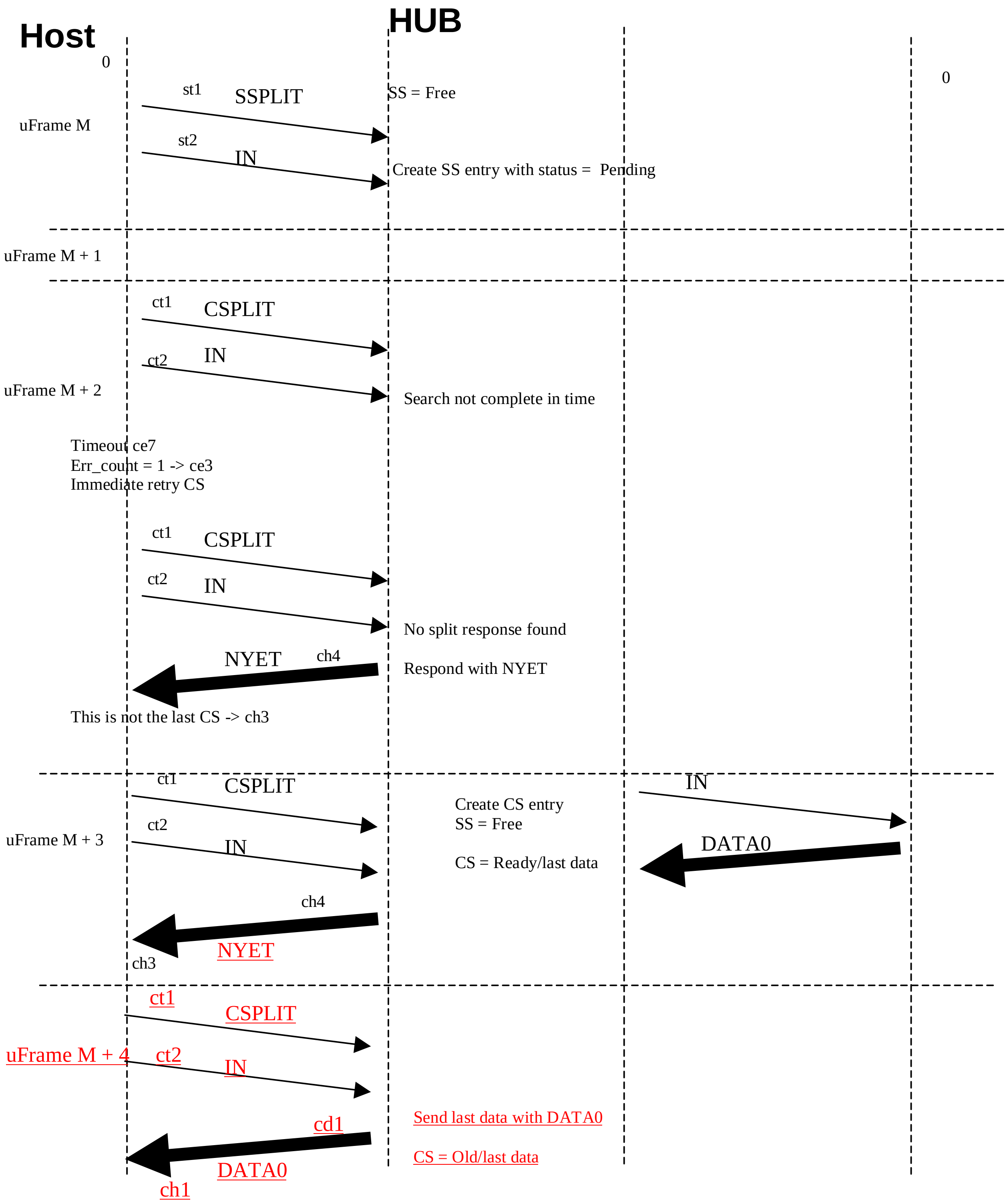
Chapter Appendix A

Missing Information in Example Split Transactions:

Background: One of the split transaction examples is missing some labels and a final complete split transaction. No functional impact.

Change: p. 553, example 12 “HS CS too early…”: Add “NYET” label on final arrow from Hub to Host. Add new uframe M+4 with HS transaction arrows: 1) host to hub: “CSPLIT” and “IN” arrows, 2) hub to host “data” arrow.

12) HS CS too early (full-speed data not available yet)


Host
HUB
0
0
uFrame M
st1
SSPLIT
SS = Free
st2
IN
Create SS entry with status = Pending
uFrame M + 1
ct1
CSPLIT
ct2
IN
uFrame M + 2
Search not complete in time
Timeout ce7
Err_count = 1 -> ce3
Immediate retry CS
ct1
CSPLIT
ct2
IN
No split response found
NYET
ch4
Respond with NYET
This is not the last CS -> ch3
ct1
CSPLIT
IN
Create CS entry
SS = Free
ct2
uFrame M + 3
IN
DATA0
CS = Ready/last data
ch4
NYET
ch3
ct1
CSPLIT
uFrame M + 4
ct2
IN
Send last data with DATA0
cd1
CS = Old/last data
DATA0
ch1