



HACKING THE USB WORLD WITH FACEDANCER

STANDARDIZATION AND DEVICE CLASSES



these two devices have a lot in common,
even if only one of them looks like a weird alien egg

- send motion updates at regular intervals
- report the status of a few buttons



left: image credit HP
right: image credit UHURU, Inc.

these two devices have a lot in common,
even if only one of them looks like a weird alien egg

- send motion updates at regular intervals
- report the status of a few buttons



Q: Should these devices really need custom drivers?

A: No! *But wait... how do we do that?*

left: image credit HP

right: image credit UHURU, Inc.

STANDARD DEVICE CLASSES

these two devices have a lot in common,
even if only one of them looks like a weird alien egg

- send motion updates at regular intervals
- report the status of a few buttons



Q: Should these devices really need custom drivers?

A: No! *But wait... how do we do that?*

left: image credit HP

right: image credit UHURU, Inc.

STANDARD DEVICE CLASSES

Not an exhaustive list.

Class Number	Name	Standardized in...
0x1	Audio	Device Class Specification
0x2	Communications Device (CDC)	Device Class Specification
0x3	Human Interface Device (HID)	Device Class Specification
0x6	Still Image Capture	Device Class Specification
0x7	Printer	Device Class Specification
0x8	Mass Storage (UMS)	Device Class Specification
0x9	USB Hub	USB core specifications
0xE	Video Capture	Device Class Specification

Full Speed device @ 15 (0x14200000):	Composite device: "USB Receiver"
▶ Port Information:	0x001a
▶ Number Of Endpoints (includes EP0):	
▶ Device Descriptor	
▼ Configuration Descriptor (current config):	"RQR36.00_B0005"
▶ Length (and contents):	59
Number of Interfaces:	2
Configuration Value:	1
Attributes:	0xA0 (bus-powered, remote wakeup)
MaxPower:	98 mA
▶ Interface #0 - HID/Boot Interface	
▼ Interface #1 - HID	
Alternate Setting	0
Number of Endpoints	1
Interface Class:	3 (HID)
Interface Subclass:	0
Interface Protocol:	0
▼ HID Descriptor	
Descriptor Version Number:	0x0111
Country Code:	0
Descriptor Count:	1
▼ Descriptor 1	
Type:	0x22 (Report Descriptor)
▶ Length (and contents):	98
▶ Parsed Report Descriptor:	
▶ Endpoint 0x82 - Interrupt Input	

HID DEVICES

All diagrams from the USB 2.0 specification.

HID DEVICES

▼ HID Descriptor	
Descriptor Version Number:	0x0111
Country Code:	0
Descriptor Count:	1
▼ Descriptor 1	
Type:	0x22 (Report Descriptor)
▶ Length (and contents):	98
▼ Parsed Report Descriptor:	
Usage Page	(Vendor defined 0)
▼ Usage 1 (0x1)	
Collection (Application)	
ReportID.....	(16)
Report Size.....	(8)
Report Count.....	(6)
Logical Minimum.....	(0)
Logical Maximum.....	(255)
Usage 1 (0x1)	
Input.....	(Data, Array, Absolute)
Usage 1 (0x1)	
Output.....	(Data, Array, Absolute, No Wrap, Linear, Preferred State, N
End Collection	
Usage Page	(Vendor defined 0)
▼ Usage 2 (0x2)	
Collection (Application)	
ReportID.....	(17)
Report Size.....	(8)
Report Count.....	(19)
Logical Minimum.....	(0)
Logical Maximum.....	(255)
Usage 2 (0x2)	
Input.....	(Data, Array, Absolute)
Usage 2 (0x2)	
Output.....	(Data, Array, Absolute, No Wrap, Linear, Preferred State, N
End Collection	
Usage Page	(Vendor defined 1)
▼ Usage 1 (0x1)	
Collection (Application)	
ReportID.....	(6)

MASS STORAGE

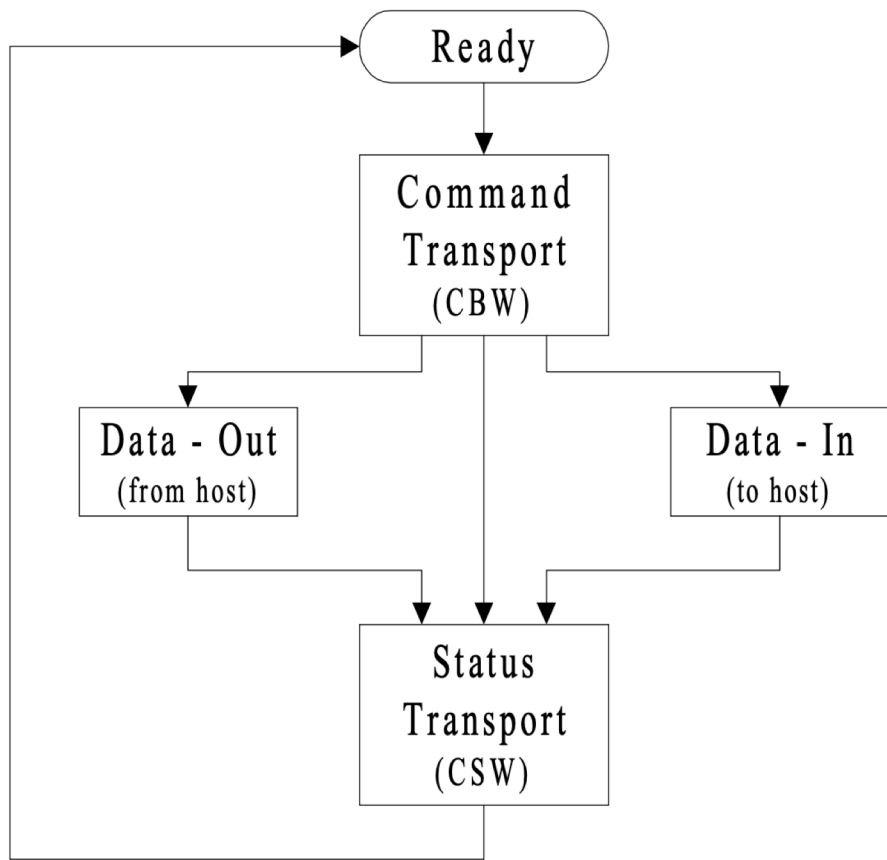


Figure 1 - Command/Data/Status Flow

Table 5.1 - Command Block Wrapper

bit Byte	7	6	5	4	3	2	1	0
0-3	<i>dCBWSignature</i>							
4-7	<i>dCBWTag</i>							
8-11 (08h-0Bh)	<i>dCBWDataTransferLength</i>							
12 (0Ch)	<i>bmCBWFlags</i>							
13 (0Dh)	Reserved (0)				<i>bCBWLUN</i>			
14 (0Eh)	Reserved (0)			<i>bCBWCBLength</i>				
15-30 (0Fh-1Eh)	<i>CBWCB</i>							

Table 5.2 - Command Status Wrapper

Byte	bit	7	6	5	4	3	2	1	0
0-3		<i>dCSWSignature</i>							
4-7		<i>dCSWTag</i>							
8-11 (8-Bh)		<i>dCSWDataResidue</i>							
12 (Ch)		<i>bCSWStatus</i>							

All diagrams from the Bulk Only Device Class Definition (DCD)..

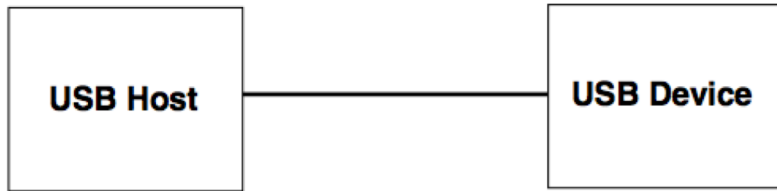
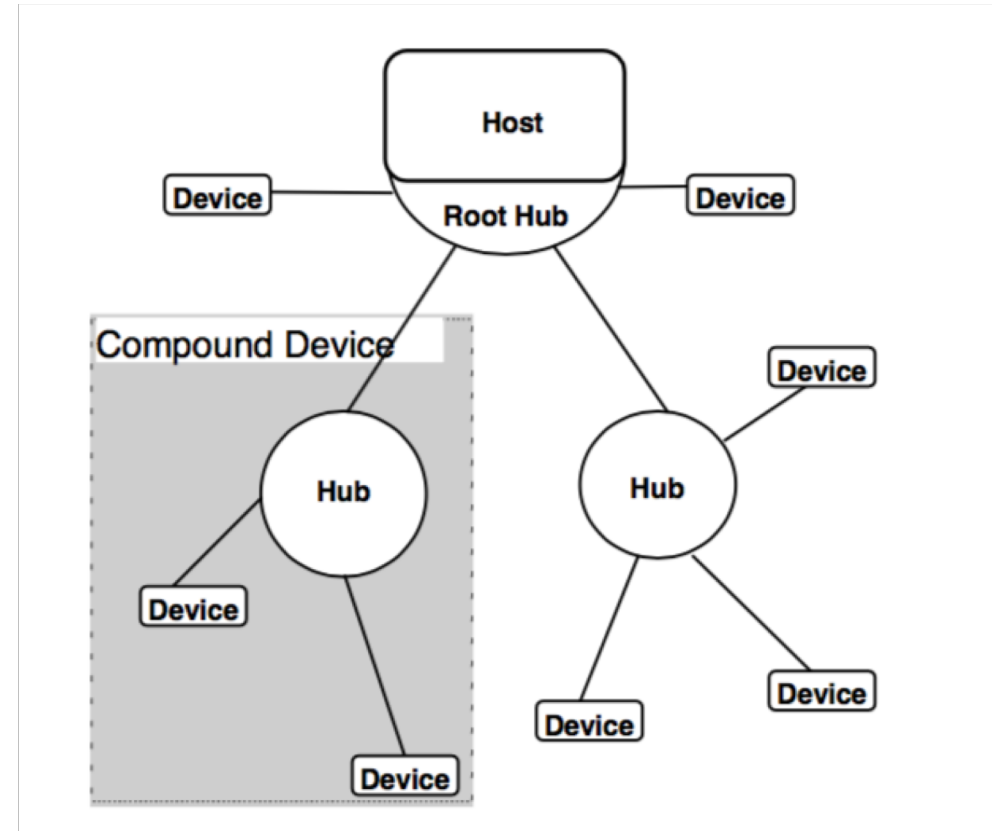


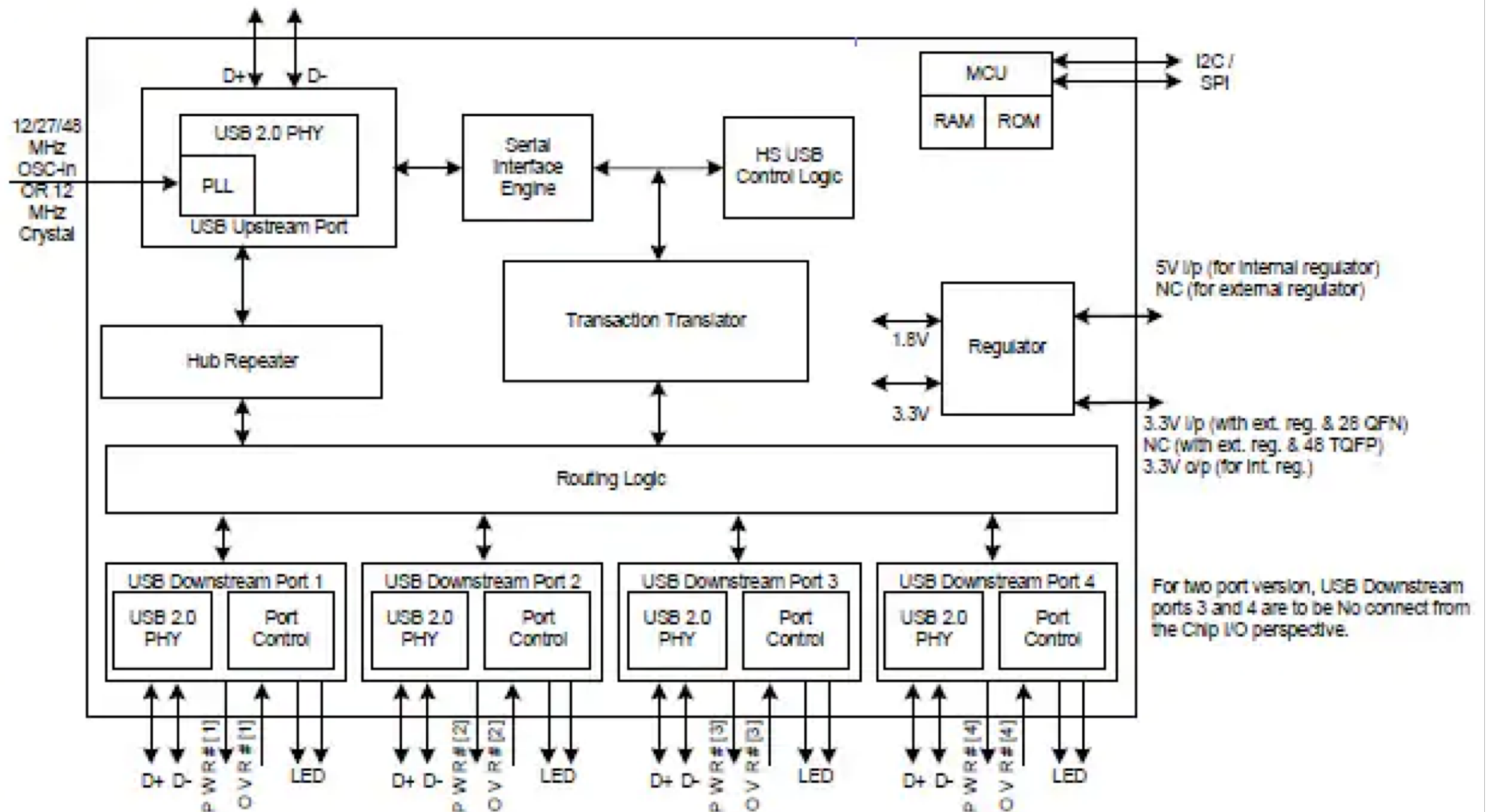
Figure 5-1. Simple USB Host/Device View



USB HUBS

All diagrams from the USB 2.0 specification.

Block Diagram – CY7C6563X



USB HUBS

Diagram courtesy Cypress, Inc.

Block Diagram – CY7C6563X

The block diagram illustrates the internal architecture of the CY7C6563X chip. Key components and their connections include:

- Crystal:** 12/27/48 MHz OSC-in OR 12 MHz Crystal.
- USB Upstream Port:** Contains a PLL and USB 2.0 PHY, connected to D+ and D- lines.
- Serial Interface Engine:** Connects the USB Upstream Port to the HS USB Control Logic.
- HS USB Control Logic:** Manages high-speed USB data flow.
- Transaction Translator:** Facilitates communication between the upstream and downstream ports.
- Hub Repeater:** Manages the USB hub functionality.
- Routing Logic:** Central logic block that routes data between the upstream and downstream ports.
- USB Downstream Ports:** Four ports (1, 2, 3, 4) each containing a USB 2.0 PHY and Port Control, connected to D+, D-, V+, and V- lines, and an LED.
- MCU:** Microcontroller Unit containing RAM and ROM, connected to I2C/SPI.
- Regulator:** Provides 1.8V and 3.3V power rails, connected to 5V (up for internal regulator, NC for external) and 3.3V (up for internal regulator, NC for external).

For two port version, USB Downstream ports 3 and 4 are to be No connect from the Chip I/O perspective.

USB HUBS

Diagram courtesy Cypress, Inc.

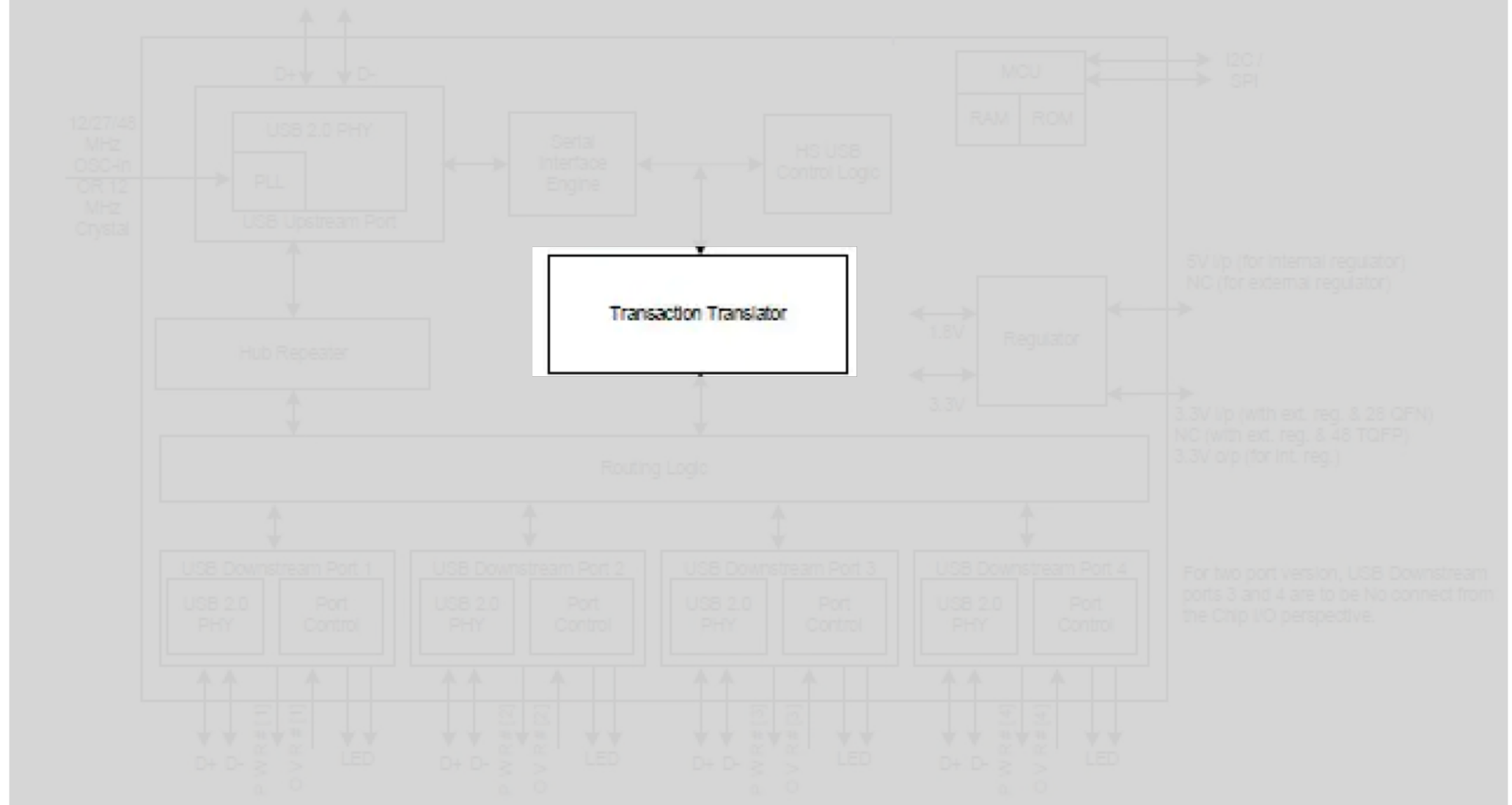
Block Diagram – CY7C6563X



USB HUBS

Diagram courtesy Cypress, Inc.

Block Diagram – CY7C6563X



USB HUBS

Diagram courtesy Cypress, Inc.