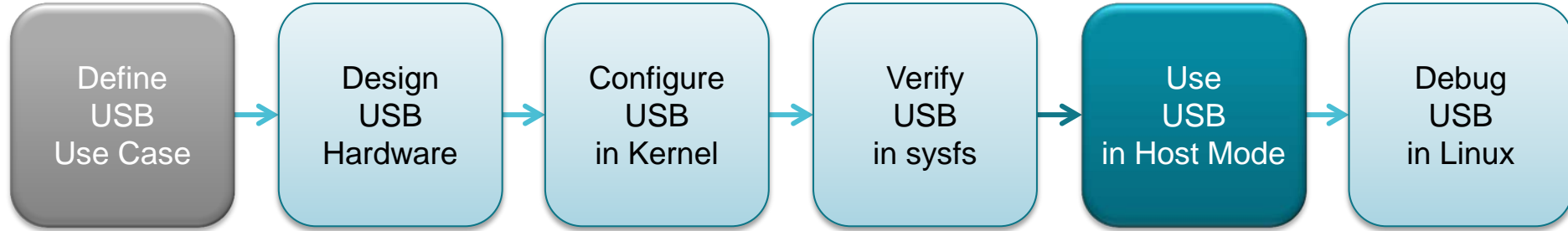


# USB System Design in Sitara Devices Using Linux

**[Part 5]: Use USB in Host Mode**

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# Agenda



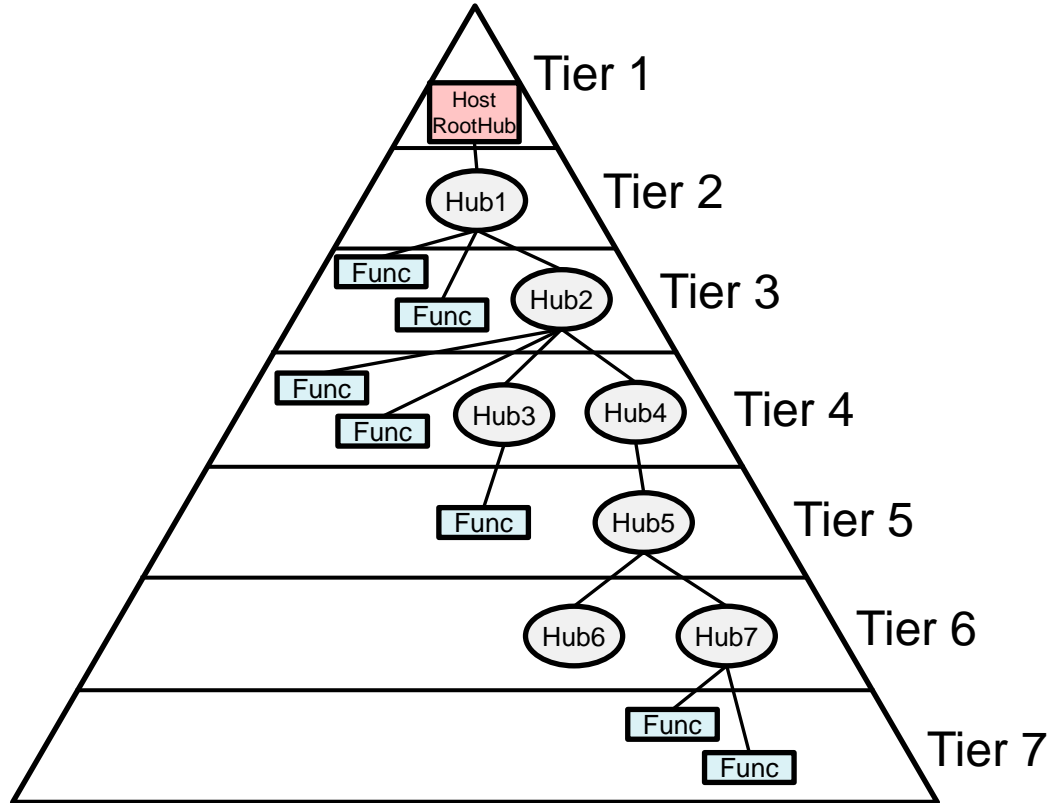
- Overview of USB host mode
- USB terminology: USB topology, VID:PID, device enumeration
- USB in Kernel boot log
- Hub enumeration log
- Device enumeration log: Thumb drive, webcam, Ethernet dongle
- Examining enumerated devices

# USB host mode overview

- USB host mode:  
Presented as a USB host port, like that on a PC
- Should be easy to use:
  - Enumeration is transparent to end users
  - Presents the function of enumerated USB devices to the same as non-USB devices:
    - Thumb drive → /dev/sda
    - Webcam → /dev/video0
    - USB Ethernet dongle → eth0
    - USB UART dongle → /dev/ttyUSB0
    - ...

# USB topology overview

- Tiered star topology:
  - Hubs
  - Max of 7 tiers
  - 5 hub tiers
  - No hubs on Tier 7
- Point-to-point communication



# USB identification: VID/PID

- The VID:PID combination identifies USB devices:
  - Each is a 16-bit number
  - Embedded in USB products
  - Communicated to the USB host during enumeration
- For example: **1d6b:0002**

VID (Vendor ID)  
assigned by  
USB-IF

PID (Product ID)  
assigned by  
the manufacturer

# USB device enumeration

- Activity that detects and identifies attached/detached USB devices:
  - When USB device is attached
    - Detects device speed
    - Assigns device an unique address
    - Queries device functions/capabilities
  - When USB device is detached
    - Disables the port to which the USB device has been attached
    - Updates local topological information
- Enumeration process:
  - Electrical enumeration
  - Software enumeration:
    - By USB core drivers
    - By USB class drivers

# AM335x MUSB log in kernel boot

```
[ 28.082168] 47401300.usb-phy supply vcc not found, using dummy regulator
[ 28.225364] usbcore: registered new interface driver usbfs
[ 28.266910] 47401b00.usb-phy supply vcc not found, using dummy regulator
[ 28.452639] usbcore: registered new interface driver hub
[ 28.551803] usbcore: registered new device driver usb
[ 28.907803] musb-hdrc musb-hdrc.0: MUSB HDRC host driver
[ 28.907849] musb-hdrc musb-hdrc.0: new USB bus registered, assigned bus number 1
[ 28.909102] hub 1-0:1.0: USB hub found
[ 28.909505] hub 1-0:1.0: 1 port detected
[ 29.041987] musb-hdrc musb-hdrc.1: MUSB HDRC host driver
[ 29.042029] musb-hdrc musb-hdrc.1: new USB bus registered, assigned bus number 2
[ 29.079753] hub 2-0:1.0: USB hub found
[ 29.079810] hub 2-0:1.0: 1 port detected
```

# lsusb to check USB buses

We can also use **lsusb** command to check the USB buses are ready:

If ready:

```
root@am335x-evm:~# lsusb
```

```
Bus 002 Device 001: ID 1d6b:0002 Linux Foundation
```

```
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation
```

If not:

```
root@am335x-evm:~# lsusb
```

```
unable to initialize libusb: -99
```



# AM57x DWC3/xHCI log in kernel boot

```
[ 7.631914] usbcore: registered new interface driver hub
[ 7.638051] usbcore: registered new device driver usb
[ 7.682830] xhci-hcd xhci-hcd.0.auto: xHCI Host Controller
[ 7.689423] xhci-hcd xhci-hcd.0.auto: new USB bus registered, assigned bus number 1
[ 7.716336] usb usb1: New USB device found, idVendor=1d6b, idProduct=0002
[ 7.723256] usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 7.730854] usb usb1: Product: xHCI Host Controller
[ 7.736031] usb usb1: Manufacturer: Linux 4.9.78-02452-gb7f5aa5c64de xhci-hcd
[ 7.743301] usb usb1: SerialNumber: xhci-hcd.0.auto
[ 7.749929] hub 1-0:1.0: USB hub found
[ 7.754527] hub 1-0:1.0: 1 port detected
[ 7.759857] xhci-hcd xhci-hcd.0.auto: xHCI Host Controller
[ 7.766353] xhci-hcd xhci-hcd.0.auto: new USB bus registered, assigned bus number 2
[ 7.782883] usb usb2: New USB device found, idVendor=1d6b, idProduct=0003
[ 7.790067] usb usb2: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 7.797541] usb usb2: Product: xHCI Host Controller
[ 7.803148] usb usb2: Manufacturer: Linux 4.9.78-02452-gb7f5aa5c64de xhci-hcd
[ 7.803154] usb usb2: SerialNumber: xhci-hcd.0.auto
[ 7.810708] hub 2-0:1.0: USB hub found
[ 7.810738] hub 2-0:1.0: 1 port detected
```

# USB high-speed hub enumeration log example

```
[258711.393109] usb 3-1: new high-speed USB device number 2 using xhci-hcd
[258711.564538] usb 3-1: New USB device found, idVendor=2109, idProduct=2812
[258711.571358] usb 3-1: New USB device strings: Mfr=1, Product=2, SerialNumber=0
[258711.578634] usb 3-1: Product: USB2.0 Hub
[258711.583814] usb 3-1: Manufacturer: VIA Labs, Inc.
[258711.595408] hub 3-1:1.0: USB hub found
[258711.599410] hub 3-1:1.0: 4 ports detected
```

# USB high-speed hub enumeration log example

```
[258711.393109] usb 3-1: new high-speed USB device number 2 using xhci-hcd
[258711.564538] usb 3-1: New USB device found, idVendor=2109, idProduct=2812
[258711.571358] usb 3-1: New USB device strings: Mfr=1, Product=2, SerialNumber=0
[258711.578634] usb 3-1: Product: USB2.0 Hub
[258711.583814] usb 3-1: Manufacturer: VIA Labs, Inc.
[258711.595408] hub 3-1:1.0: USB hub found
[258711.599410] hub 3-1:1.0: 4 ports detected
```

```
root@am57xx-evm:~# lsusb -t
```

```
/: Bus 04.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 5000M
/: Bus 03.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 480M
   |__ Port 1: Dev 2, If 0, Class=Hub, Driver=hub/4p, 480M
/: Bus 02.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 5000M
/: Bus 01.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 480M
```

# USB super-speed hub enumeration log example

```
[259442.473217] usb 2-1: new SuperSpeed USB device number 2 using xhci-hcd
[259442.735361] usb 2-1: New USB device found, idVendor=2109, idProduct=0812
[259442.742178] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=0
[259442.750706] usb 2-1: Product: USB3.0 Hub
[259442.756484] usb 2-1: Manufacturer: VIA Labs, Inc.
[259442.775304] hub 2-1:1.0: USB hub found
[259442.779437] hub 2-1:1.0: 4 ports detected
[259442.873117] usb 1-1: new high-speed USB device number 2 using xhci-hcd
[259443.044540] usb 1-1: New USB device found, idVendor=2109, idProduct=2812
[259443.051358] usb 1-1: New USB device strings: Mfr=1, Product=2, SerialNumber=0
[259443.059890] usb 1-1: Product: USB2.0 Hub
[259443.065678] usb 1-1: Manufacturer: VIA Labs, Inc.
[259443.079339] hub 1-1:1.0: USB hub found
[259443.083399] hub 1-1:1.0: 4 ports detected
```

# USB thumb drive enumeration log example

```
[ 203.903495] usb 2-1.4: new SuperSpeed USB device number 3 using xhci-hcd
[ 204.055499] usb 2-1.4: New USB device found, idVendor=13fe, idProduct=5500
[ 204.062404] usb 2-1.4: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 204.069769] usb 2-1.4: Product: Silicon-Power32G
[ 204.074421] usb 2-1.4: Manufacturer: UFD 3.0
[ 204.078706] usb 2-1.4: SerialNumber: P1601315070B65BF8EA9BA78
[ 204.129321] usb-storage 2-1.4:1.0: USB Mass Storage device detected
[ 204.136008] scsi host0: usb-storage 2-1.4:1.0
[ 204.140671] usbcore: registered new interface driver usb-storage
[ 205.204613] scsi 0:0:0:0: Direct-Access      UFD 3.0  Silicon-Power32G PMAP PQ: 0 ANSI: 6
[ 205.904591] sd 0:0:0:0: [sda] 60604416 512-byte logical blocks: (31.0 GB/28.9 GiB)
[ 205.912349] sd 0:0:0:0: [sda] Write Protect is off
[ 205.917442] sd 0:0:0:0: [sda] No Caching mode page found
[ 205.922833] sd 0:0:0:0: [sda] Assuming drive cache: write through
[ 205.933794] sd 0:0:0:0: [sda] Attached SCSI removable disk
```

USB Core Enumeration

USB Class Enumeration

# USB webcam enumeration log example

```
[ 250.653459] usb 1-1.3: new high-speed USB device number 3 using xhci-hcd
[ 250.934827] usb 1-1.3: New USB device found, idVendor=046d, idProduct=0990
[ 250.941735] usb 1-1.3: New USB device strings: Mfr=0, Product=0, SerialNumber=2
[ 250.950295] usb 1-1.3: SerialNumber: 4C5A2E43
-----
[ 251.015055] media: Linux media interface: v0.10
[ 251.039935] Linux video capture interface: v2.00
[ 251.061589] uvcvideo: Found UVC 1.00 device <unnamed> (046d:0990)
[ 251.173811] input: UVC Camera (046d:0990) as /devices/platform/44000000.ocp/48880000.omap_dwc3_
1/48890000.usb/xhci-hcd.0.auto/usb1/1-1/1-1.3/1-1.3:1.0/input/input1
[ 251.189716] usbcore: registered new interface driver uvcvideo
[ 251.195518] USB Video Class driver (1.1.1)
[ 251.598395] usb 1-1.3: Warning! Unlikely big volume range (=3072), cval->res is probably wrong.
[ 251.607155] usb 1-1.3: [5] FU [Mic Capture Volume] ch = 1, val = 4608/7680/1
[ 251.617012] usbcore: registered new interface driver snd-usb-audio
```

USB Core Enumeration

USB Class Enumeration

# USB ethernet dongle enumeration log example

```
[ 8551.173489] usb 2-1.1: new SuperSpeed USB device number 4 using xhci-hcd
[ 8551.204067] usb 2-1.1: New USB device found, idVendor=0bda, idProduct=8153
[ 8551.210972] usb 2-1.1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 8551.219543] usb 2-1.1: Product: USB 10/100/1000 LAN
[ 8551.225069] usb 2-1.1: Manufacturer: Realtek
[ 8551.229358] usb 2-1.1: SerialNumber: 00E01E8100AF


---


[ 8551.285065] usbcore: registered new interface driver r8152
[ 8551.297324] usbcore: registered new interface driver cdc_ether
[ 8551.406628] usb 2-1.1: reset SuperSpeed USB device number 4 using xhci-hcd
[ 8551.535831] r8152 2-1.1:1.0 eth2: v1.08.9
```

USB Core Enumeration

USB Class Enumeration

# lsusb command

```
root@am57xx-evm:~# lsusb
```

```
Bus 002 Device 003: ID 13fe:5500 Kingston Technology Company Inc.
```

```
Bus 002 Device 004: ID 0bda:8153 Realtek Semiconductor Corp.
```

```
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation
```

```
Bus 001 Device 003: ID 046d:0990 Logitech, Inc. QuickCam Pro 9000
```

```
Bus 001 Device 002: ID 2109:2812 VIA Labs, Inc. VL812 Hub
```

```
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation
```

```
Bus 002 Device 002: ID 2109:0812 VIA Labs, Inc. VL812 Hub
```

```
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation
```

```
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation
```



# “lsusb -t” command

```
root@am57xx-evm:~# lsusb -t
```

```
/: Bus 04.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 5000M
/: Bus 03.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 480M
/: Bus 02.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 5000M
  |__ Port 1: Dev 2, If 0, Class=Hub, Driver=hub/4p, 5000M
    |__ Port 1: Dev 4, If 0, Class=Vendor Specific Class, Driver=r8152, 5000M
    |__ Port 4: Dev 3, If 0, Class=Mass Storage, Driver=usb-storage, 5000M
/: Bus 01.Port 1: Dev 1, Class=root_hub, Driver=xhci-hcd/1p, 480M
  |__ Port 1: Dev 2, If 0, Class=Hub, Driver=hub/4p, 480M
    |__ Port 3: Dev 3, If 0, Class=Video, Driver=uvcvideo, 480M
    |__ Port 3: Dev 3, If 1, Class=Video, Driver=uvcvideo, 480M
    |__ Port 3: Dev 3, If 2, Class=Audio, Driver=snd-usb-audio, 480M
    |__ Port 3: Dev 3, If 3, Class=Audio, Driver=snd-usb-audio, 480M
```

# “lsusb -v” command

```
root@am57xx-evm:~# lsusb -v -d 13fe:5500
```

```
Bus 002 Device 003: ID 13fe:5500 Kingston Technology Company Inc.
```

```
Device Descriptor:
```

```
  bLength                18
  bDescriptorType        1
  bcdUSB                  3.10
  bDeviceClass            0
  bDeviceSubClass        0
  bDeviceProtocol        0
  bMaxPacketSize0       9
  idVendor                0x13fe Kingston Technology Company Inc.
  idProduct              0x5500
  bcdDevice              1.00
  iManufacturer          1 UFD 3.0
  iProduct               2 Silicon-Power32G
  iSerial                3 P1601315070B65BF8EA9BA78
  bNumConfigurations    1
```

```
Configuration Descriptor:
```

```
  bLength                9
```

```
...
```

# For more information

- For questions about this training, refer to the E2E Community Forums at <http://e2e.ti.com>



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