USB System Design in Sitara Devices Using Linux

[Part 2]: Configure MUSB in Linux Kernel
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Agenda

- Overview of Kernel USB stack
- MUSB driver structure
- MUSB kernel config options
- MUSB device tree binding
Kernel USB stack

Kernel Function Drivers (SCSI, Network, HID, UART, V4L2...)

USB Class Drivers
(Host Mode)

USB Gadget Drivers
(Device Mode)

USB Core Drivers

USB Controller Drivers

PHY Drivers

Platform Glue Drivers

DMA Drivers

Extcon Drivers

USB Subsystem (controller, PHY)
MUSB host mode driver structure

- USB Class Drivers
- USB Core Drivers
- MUSB Controller Drivers
  - MUSB Core
  - MUSB Host
  - MUSB DMA
- USB PHY Drivers
- AM335x Glue Driver
- OMAPL138 Glue Driver
- CPPI41 DMA Driver

USB Subsystem (controller, PHY)
MUSB kernel config options

- USB Class
- USB Gadget
- USB Core
- MUSB Controller
- MUSB Glue
- USB PHY
- CPPI41 DMA (optional)
USB class driver kernel config

- USB device classes:
  - Identifies the functionality of a USB device
  - For example: UAC (Audio), MSC (Mass Storage)
  - Each class has an ID defined by USB-IF

- Kernel config options for USB classes are not in a centralized place; Under each kernel function module

- Kernel defconfig has all/most class options enabled:
  - tisdk_am335x-evm_defconfig
  - tisdk omapl138-lcdk_defconfig
USB gadget driver kernel config

Options are all located under
Device Drivers -->
USB support -->
USB Gadget Support
USB core kernel config

Config Option Symbol:
CONFIG_USB_SUPPORT
CONFIG_USB
MUSB controller kernel config

Config Option Symbol:
- CONFIG_USB_MUSB_HDRC
- CONFIG_USB_MUSB_DUAL_ROLE
AM335x MUSB glue kernel config

Config Option Symbol: CONFIG_USB_MUSB_DSPS
AM335x USB PHY kernel config

Config Option Symbol:

CONFIG_NOP_USB_XCEIV
CONFIG_AM335X_PHY_USB
OMAPL-138 MUSB glue kernel config

Config Option Symbol: CONFIG_USB_MUSB_DA8XX
OMAPL-138 USB PHY kernel config

Config Option Symbol:
CONFIG_NOP_USB_XCEIV
CPPI41 DMA Engine kernel config

Config Option Symbol:
CONFIG_DMADEVICES
CONFIG_TI_CPPI41
CPPI41 DMA MUSB kernel config

Config Option Symbol:
CONFIG_USB_TI_CPPI41_DMA
PIO mode MUSB kernel config

Config Option Symbol: CONFIG_MUSB PIO ONLY
Kernel defconfig

 Kernel defconfig which has MUSB config options enabled:

<table>
<thead>
<tr>
<th></th>
<th>AM335x</th>
<th>OMAPL-138</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor SDK Kernel</td>
<td>tisdk_am335x-evm_defconfig</td>
<td>tisdk_omapl138-lcdk_defconfig</td>
</tr>
<tr>
<td>Community Kernel</td>
<td>omap2plus_defconfig</td>
<td>davinci_all_defconfig</td>
</tr>
</tbody>
</table>

* Use the defconfig as the base of the config, then fine tune for your project.
AM335x MUSB device tree binding

- USB-related DT nodes are defined in *am33xx.dtsi*
  - *am33xx.dtsi*: AM335x SoC DT definition

- USB node **status** property:
  - In *am33xx.dtsi*, default is set to “disabled”.
  - Set to “okay” in board DT file to enable the node.

- USB port **dr_mode** property:
  - In *am33xx.dtsi*, default is set to “otg” (dual-role).
  - Override it in the board DT file for non-OTG mode:
    - Host-only mode: **dr_mode** = “host”
    - Device-only mode: **dr_mode** = “peripheral”

```plaintext
am335x-bone-common.dtsi:

&usb {
  status = "okay";
};
&usb_ctrl_mod {
  status = "okay";
};
&usb0_phy {
  status = "okay";
};
&usb1_phy {
  status = "okay";
};
&usb0 {
  status = "okay";
  dr_mode = "peripheral";
};
&usb1 {
  status = "okay";
  dr_mode = "host";
};
&cppl41dma {
  status = "okay";
};
```
OMAP-L138 MUSB device tree binding

- USB-related DT nodes are defined in `da850.dtsi`
  - `da850.dtsi`: OMAP-L138 SoC DT definition

- USB node `status` property:
  - In `da850.dtsi`, default is set to “disabled”.
  - Exception: `cppi41dma` default is set to “okay” already
  - Set to “okay” in board DT file to enable the node

- USB port `dr_mode` property:
  - In `da850.dtsi`, default is set to “otg” (dual-role).
  - Override it in the board DT file for non-OTG mode:
    - Host-only mode: `dr_mode = “host”`
    - Device-only mode: `dr_mode = “peripheral”`

---

```c
Da850-lcdk.dts:

&usb_phy {
    status = "okay";
};

&usb0 {
    status = "okay";
};
```
MUSB in fullspeed-only config

- MUSB works in high-speed by default.
- How to limit MUSB to full-speed only?
- Configure it in board DT file:
  ```
  maximum-speed = "full-speed"
  ```
- The two MUSB modules can work on different maximum-speed independently.

```c
&usb0 {
  status = "okay";
  dr_mode = "peripheral";
  maximum-speed = "full-speed"
};

&usb1 {
  status = "okay";
  dr_mode = "host";
  maximum-speed = "full-speed"
};
```
For more information

- MUSB Linux Driver Configuration: 
- AM335x MUSB Linux Porting Guide
- AM335x MUSB DT Bindings Kernel Documentation
- OMAPL-138 MUSB DT Bindings Kernel Documentation
- USB Generic DT Bindings Kernel Documentation
- For questions about this training, refer to the E2E Community Forums at
  http://e2e.ti.com