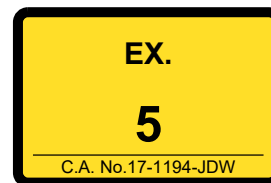


Digital iPod Out OTG Solution Dual Role USB HUB



Unwired Technology
October 23, 2013

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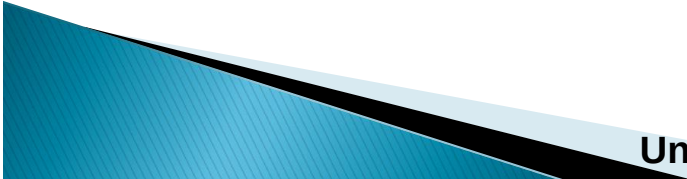
ATTORNEYS' EYES ONLY

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EX. 5 - Page 1 of 16

APTIV_00000297

Agenda

- ▶ Overview of Standard Linux USB SW Architecture
 - Overview of Enumeration, Role Reversal and Gadget data flows
- ▶ Overview of Unwired Linux USB SW Architecture
 - Overview of Enumeration, Role Reversal and Gadget data flows
- ▶ Overview of Unwired Dual Role USB HUB HW



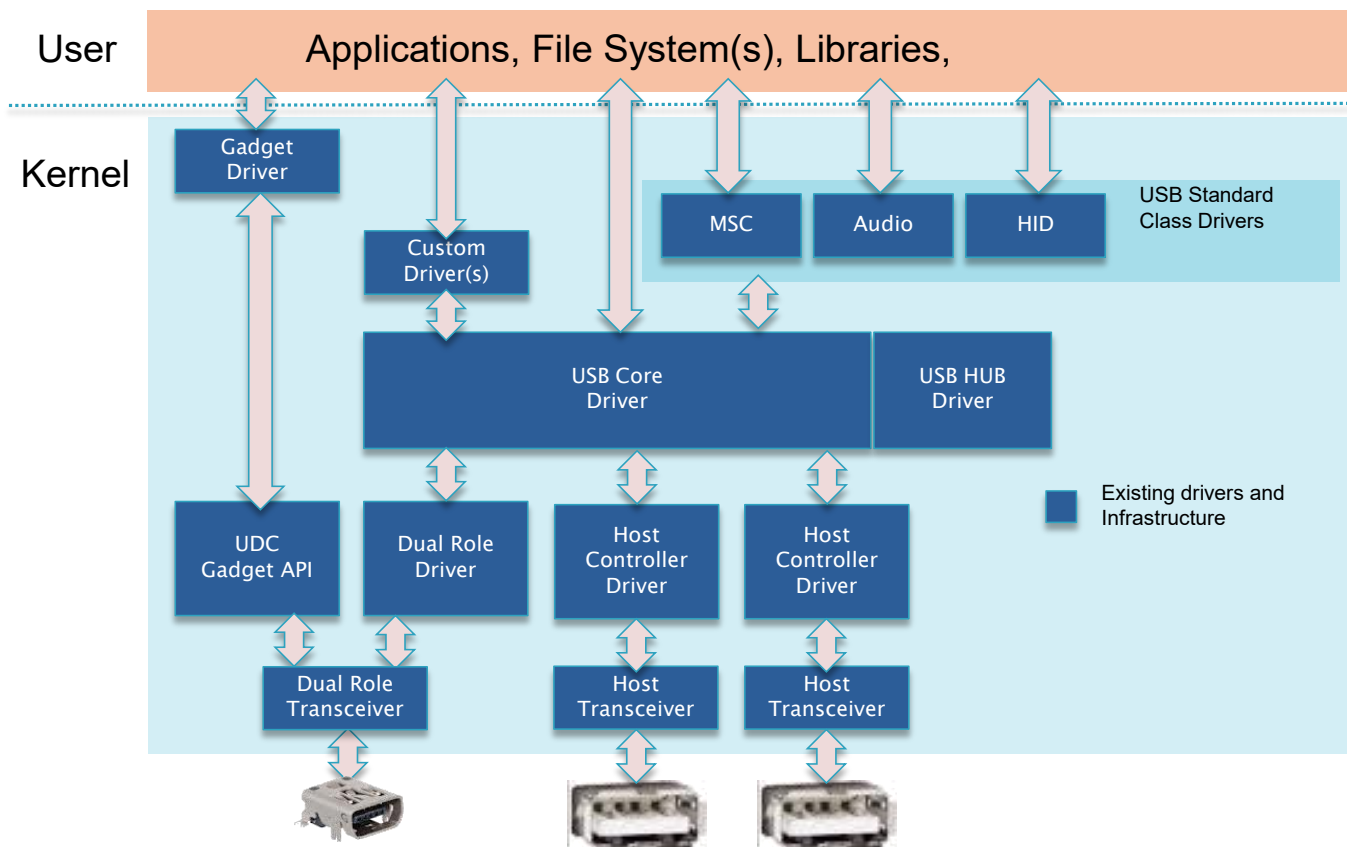
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ATTORNEYS' EYES ONLY

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EX. 5 - Page 2 of 16

APTIV_00000298

Linux USB Host / Gadget Software Architecture (Standard)



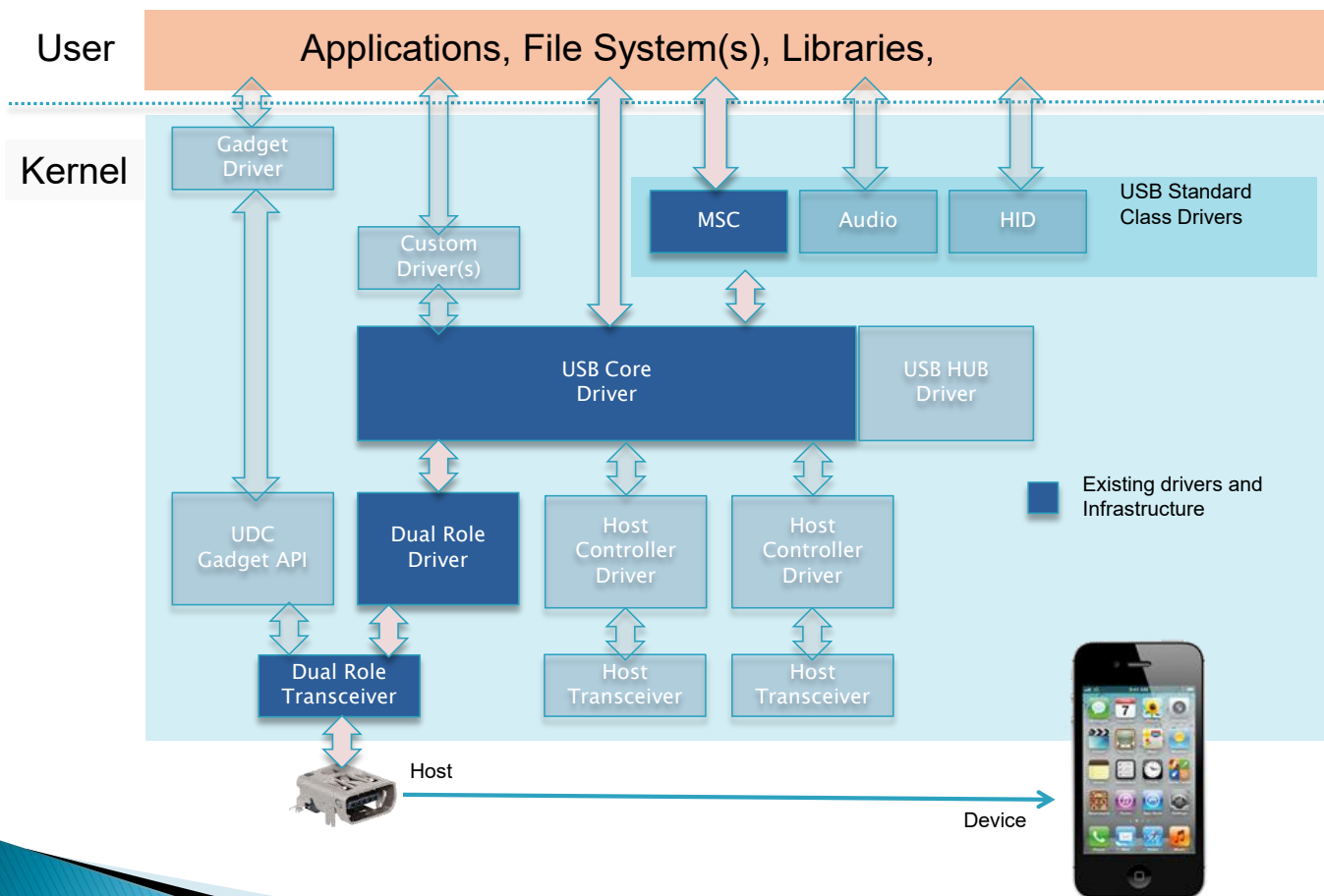
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EX. 5 - Page 3 of 16

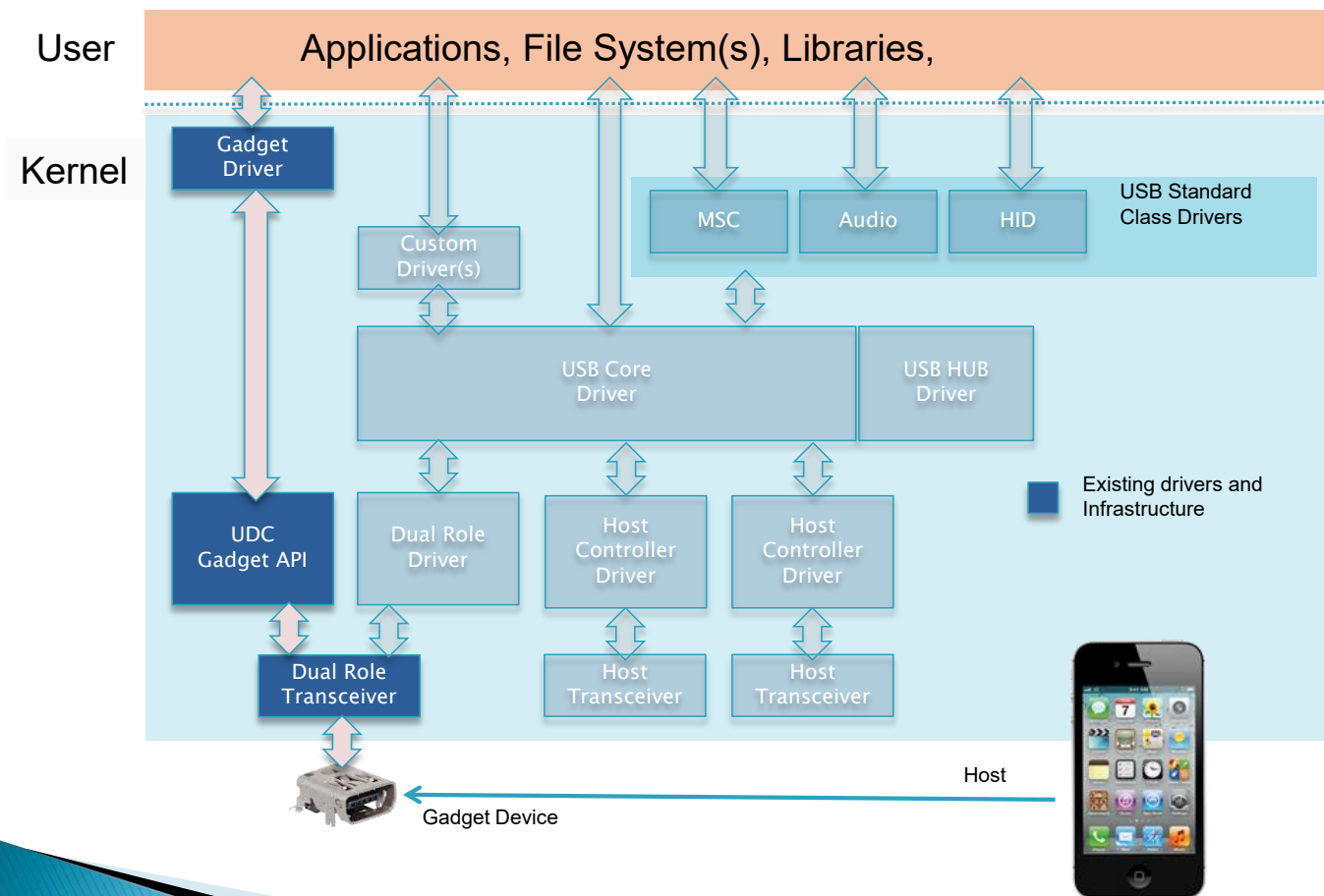
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Linux USB Host / Gadget Software Architecture (Host)



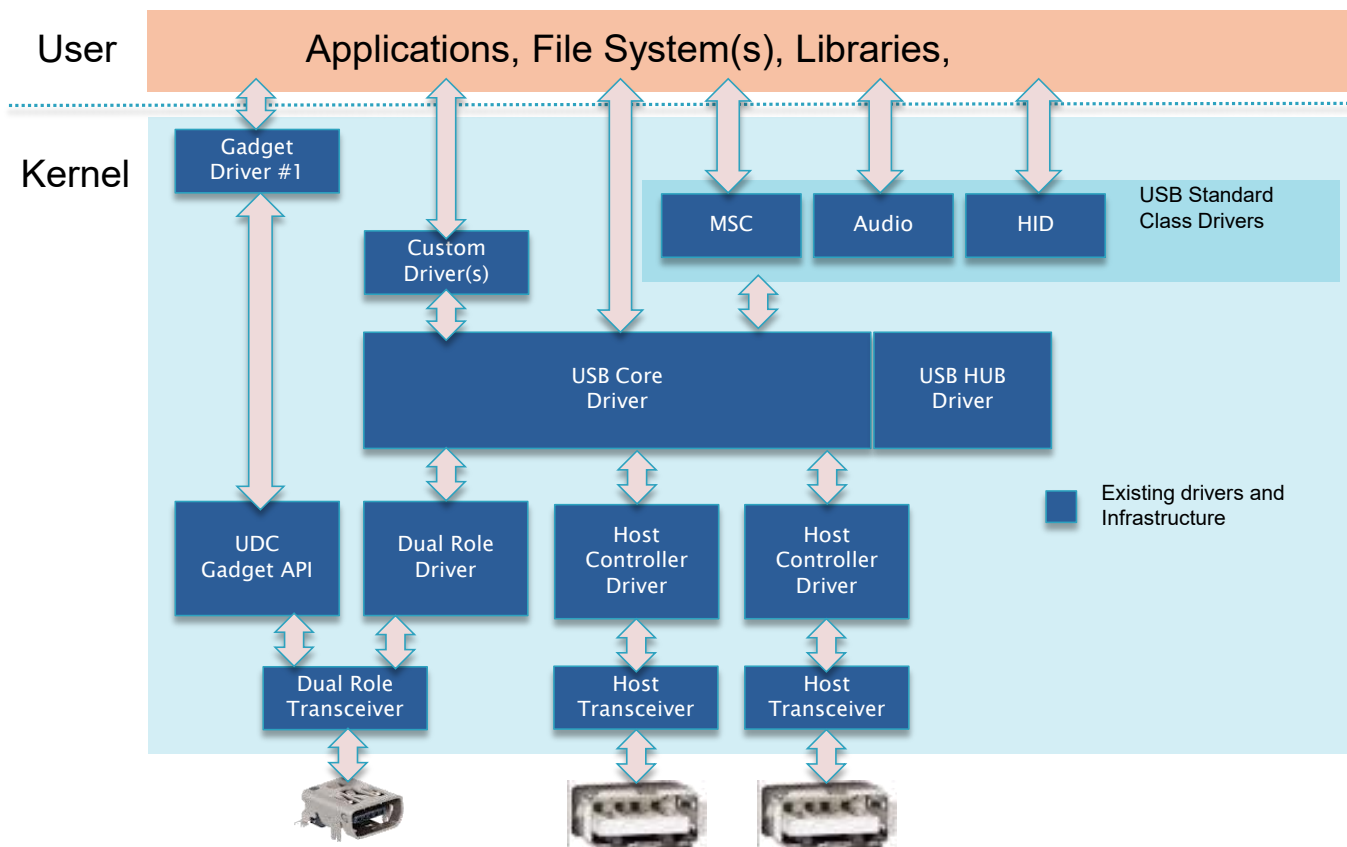
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Linux USB Host / Gadget Software Architecture (Gadget)



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Linux USB Host / Gadget Software Architecture (Standard)



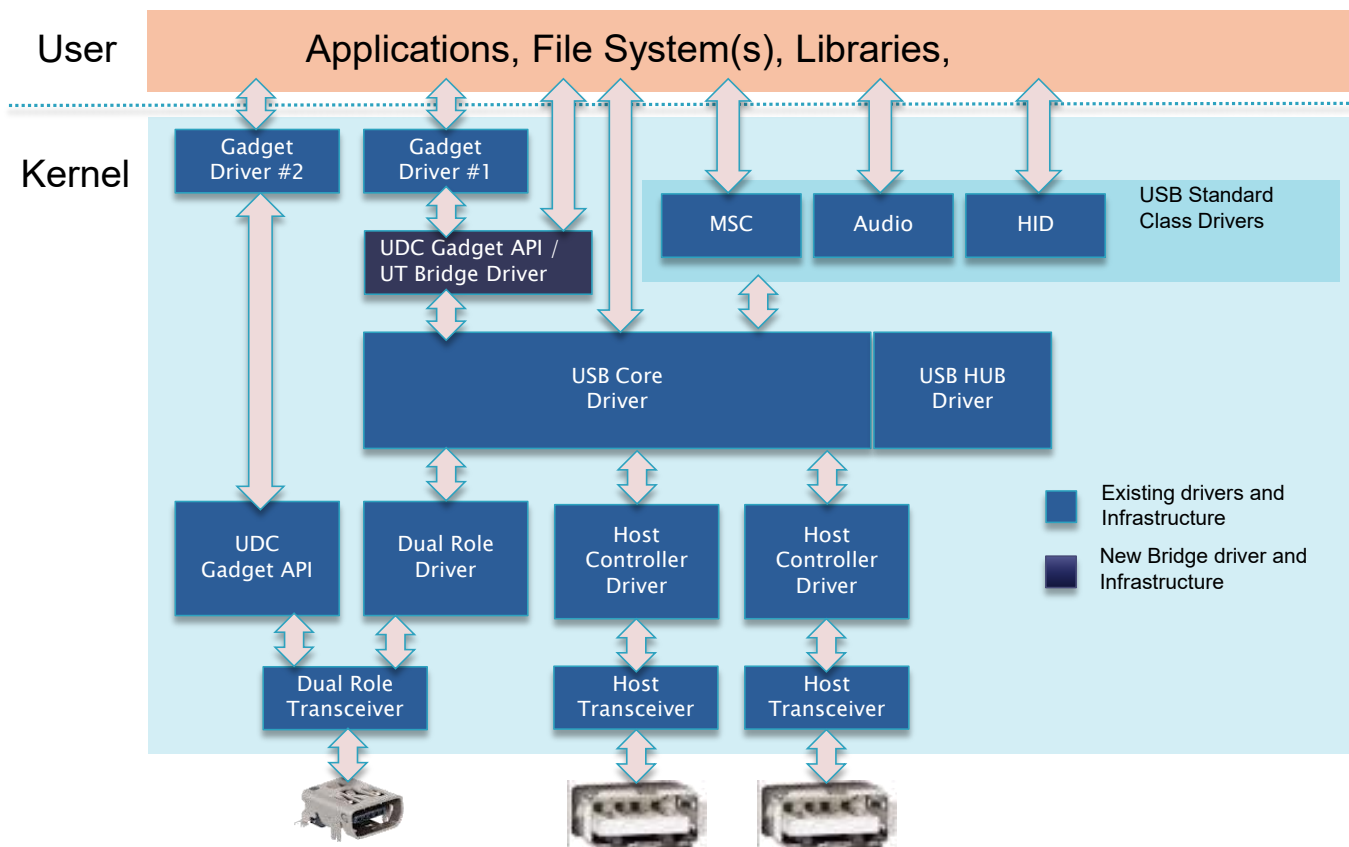
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DELPHI_0000024.6
EX. 5 - Page 6 of 16

APTIV_00000302

Linux USB Host / Gadget Software Architecture (Unwired)



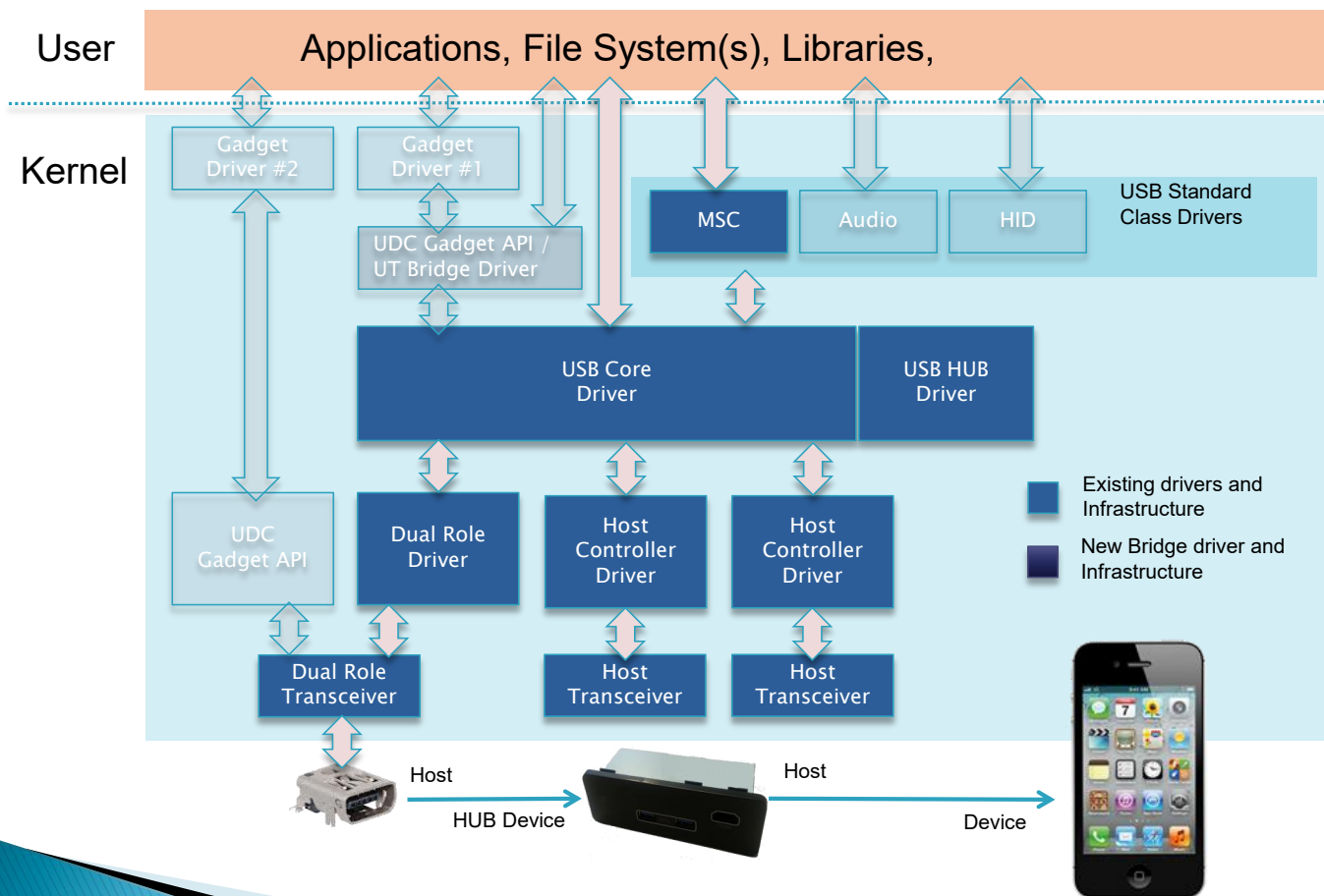
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ATTORNEYS' EYES ONLY

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EX. 5 - Page 7 of 16

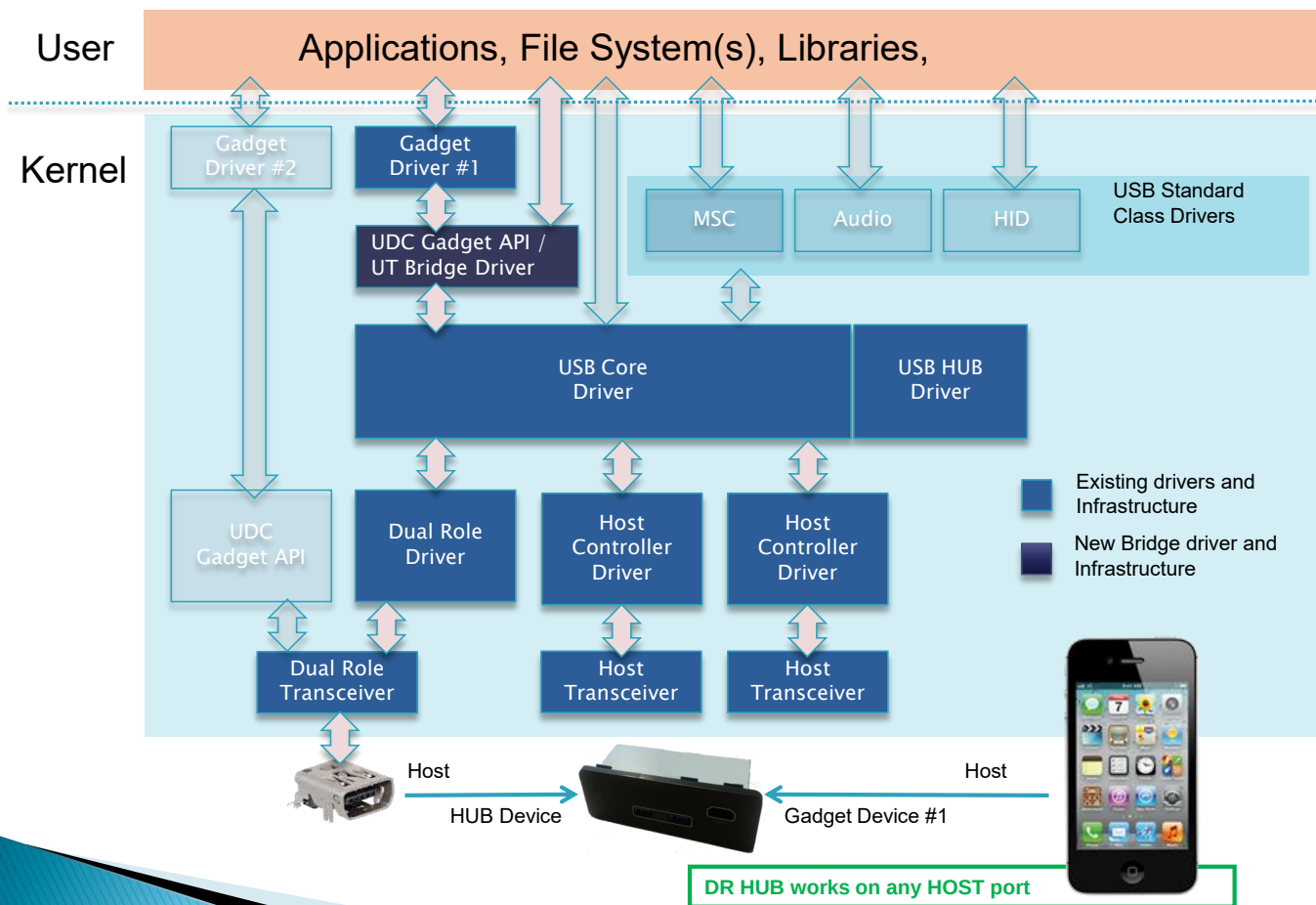
APTIV_00000303

Linux USB Host / Gadget Software Architecture (Host)



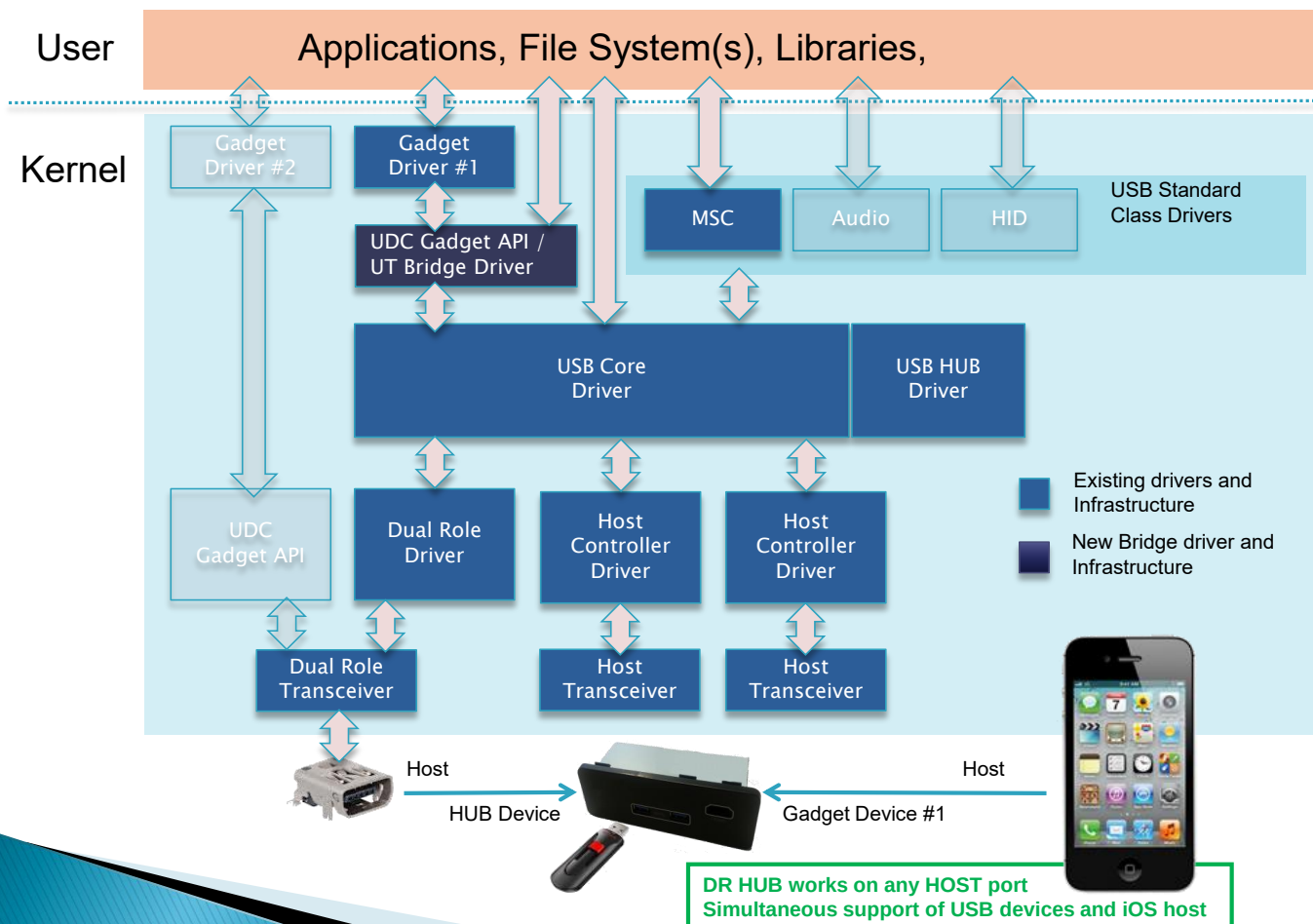
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Linux USB Host / Gadget Software Architecture (Gadget)



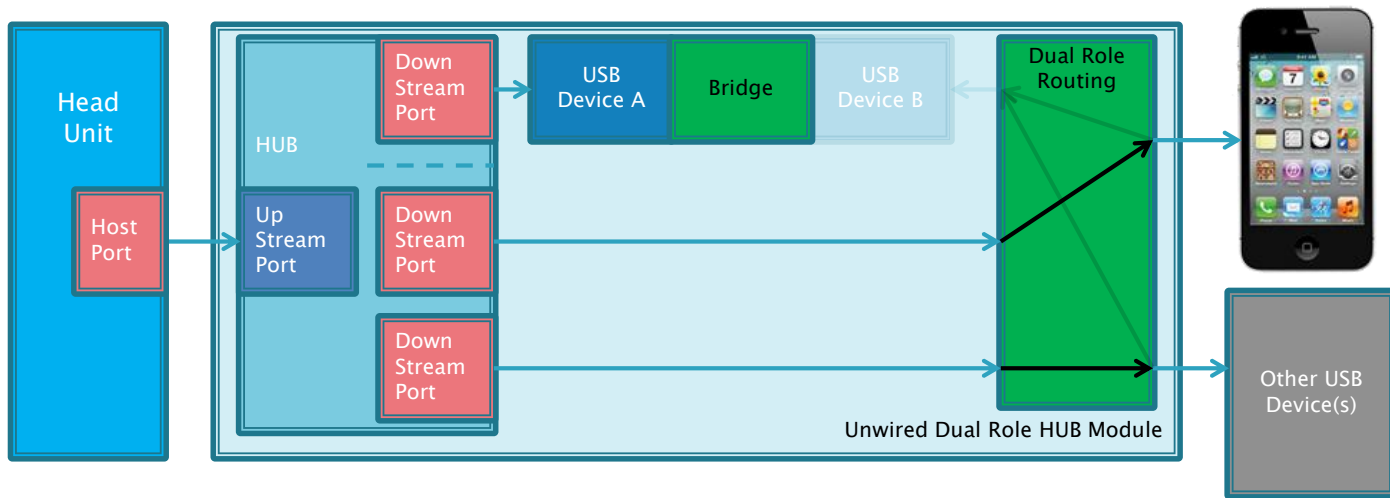
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Linux USB Host / Gadget Software Architecture (Gadget)



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Dual Role HUB Concept



Description :

- At power up Head Unit detects a USB hub and a custom device (Bridge)
- Head Unit will load custom driver for the Bridge device supplied by Unwired
- Bridge driver has ability to control routing of any downstream port of the hub to either the Bridge or straight to the hub
- USB port routing is direct to the Hub for initial connection as a normal USB device.

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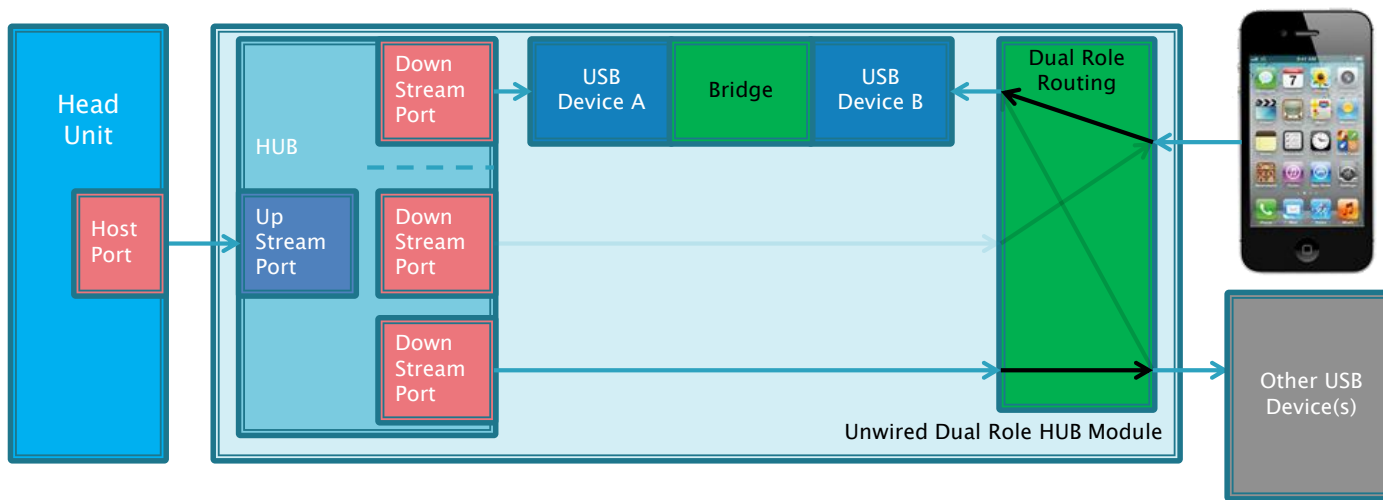
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EX. 5 - Page 11 of 16

Dual Role HUB Concept

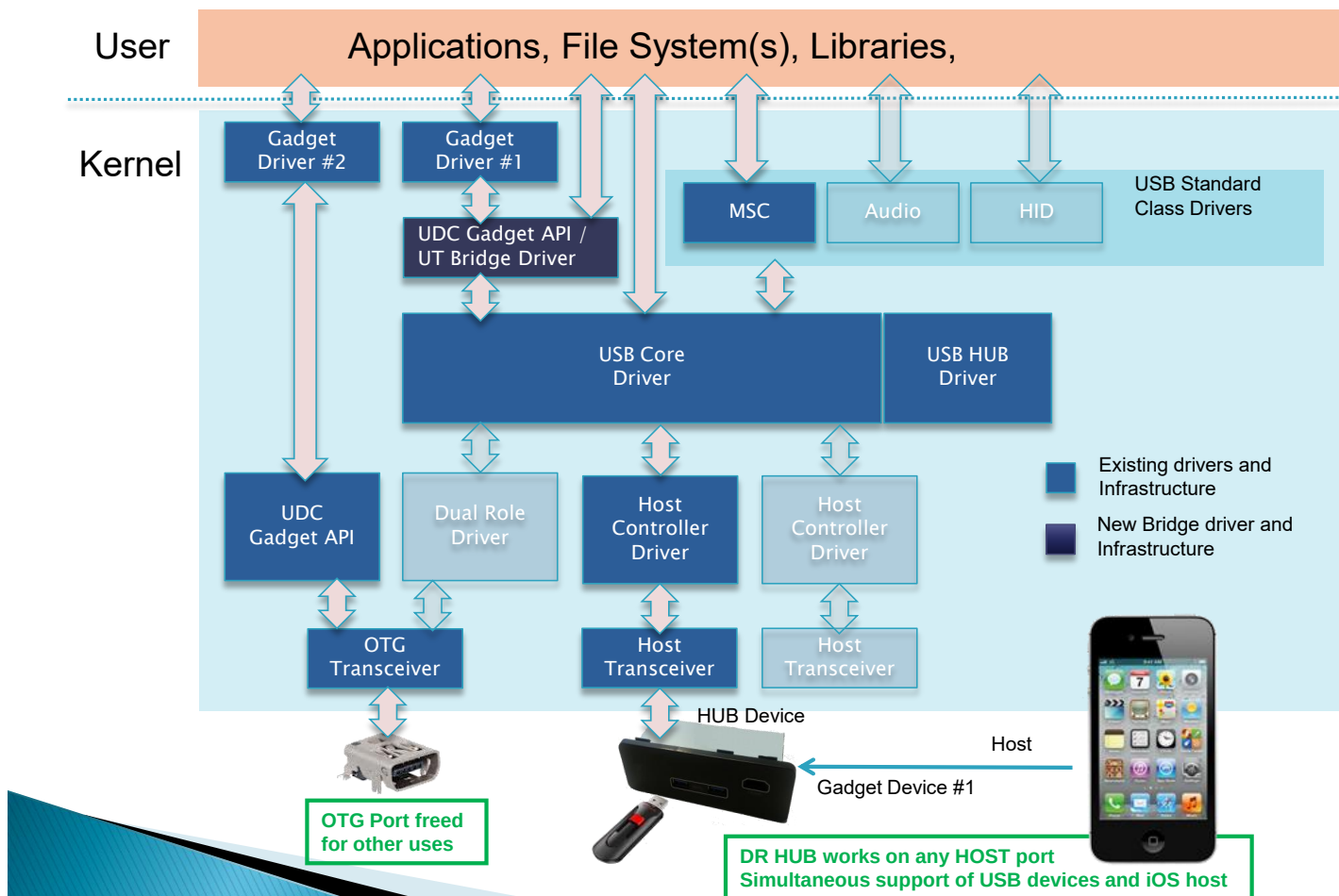


Description :

- Upon connection to Apple device the head unit will authenticate and then command the Bridge driver to role reverse resulting in the Apple device to be routed to the Bridge
 - Module contains a single Bridge
 - Either user accessible port may be role reversed and connected to the bridge
- When the iOS device is in host mode it will transfer data to Device B and Device B will transfer it to Device A.
- The Bridge driver in the head unit will read the data from endpoints in device A and pass it to a gadget driver

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Linux USB Host / Gadget Software Architecture (Unwired)



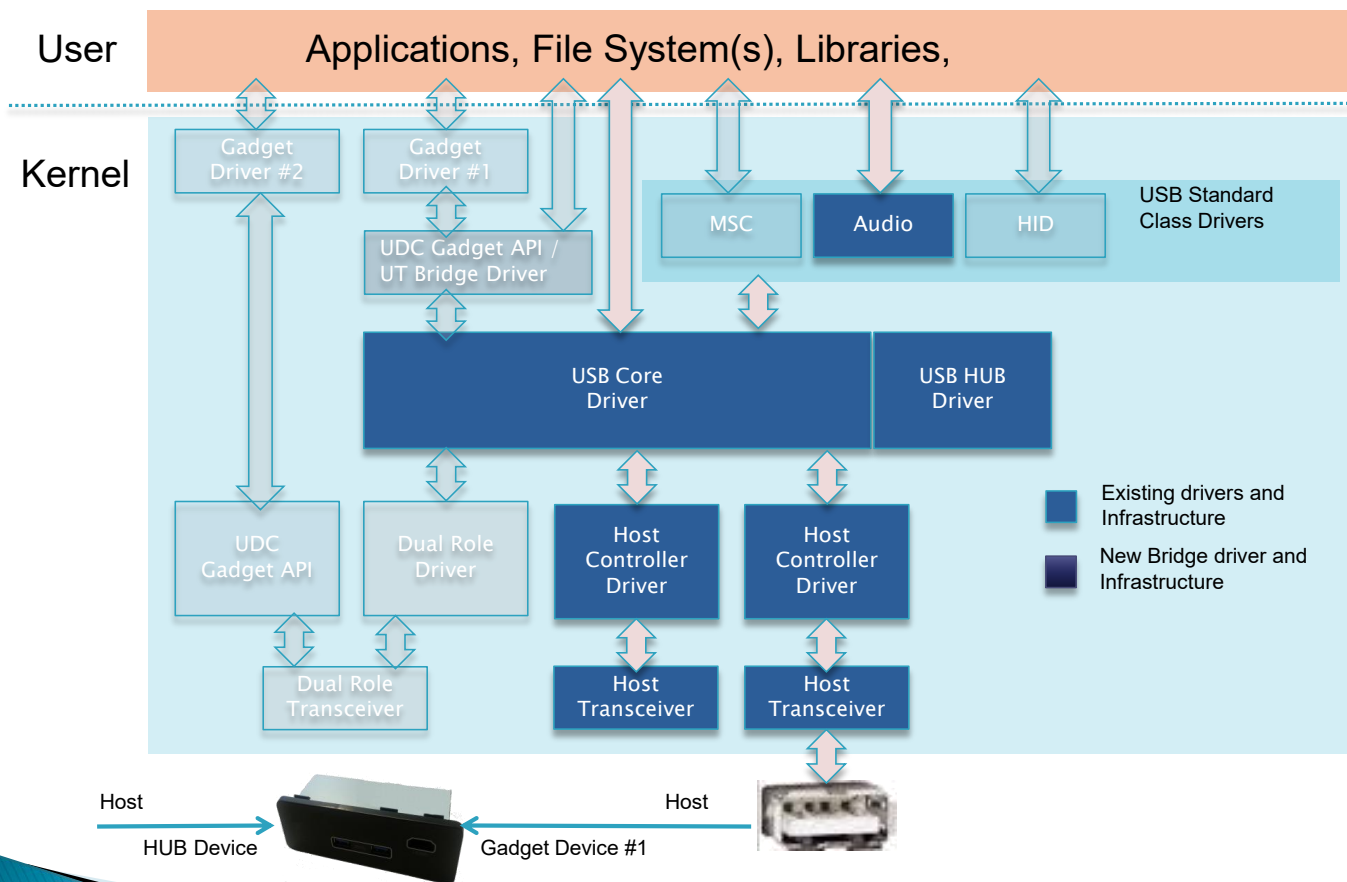
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Dual Role HUB Development Status

- **Initial HW development timeline based upon lead customer**
 - Form factor HW for lead customer available to OS providers only
 - Target for SW development Hubs (FPGA) 11/22/2013
 - Target for GM Form factor Hubs (ASIC) April 2014
- **Linux Driver available as Beta**
 - Based on Kernel 3.8 / 3.10
 - GPL based kernel driver
 - Requires SLA (to enforce driving feedback into mainline)
 - Tested using two Ubuntu PC's connected to hub as Host and Gadget
 - Gadget 0
 - NCM Gadget
 - USB Audio Gadget
 - ACM Serial Gadget

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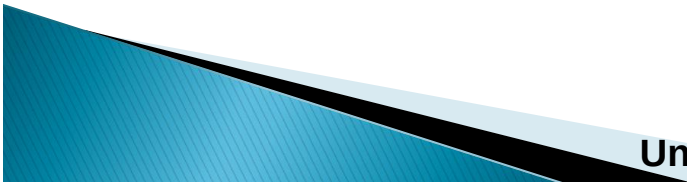
Linux USB Host on DR Port Example



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Dual Role HUB & Driver Recap

- **Enables Role Reversal of devices connected via USB Hubs**
 - Role Reversal can be managed in User space and/or in Kernel.
- **Works with Any USB Host capable port**
 - Does not require a Dual Role port on the host
- **Integrates with existing Kernel with minimal changes.**
 - Bridge data transfer can be managed in User space and/or in Kernel
- **Allows re-using or optimization of existing Linux gadget driver's**
 - Standard UDC/Gadget API Interface exposed via Unwired Bridge Driver
 - Optional Direct Interface exposed via Bridge Driver



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EX. 5 - Page 16 of 16

APTIV_00000312