

USB4™ on Windows

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Presentation Agenda

- Support for USB4™ on Windows
 - Goals
 - Introduction to Software Connection Manager (CM)
 - Software Architecture
- Support for Firmware Update
- Pre-boot support
 - Software CM in pre-boot
 - Switching between SW & FW CM
 - Mapping Host Interface to tunneled ports
- Security
- Requirements and Validation
- Timelines
- Q & A

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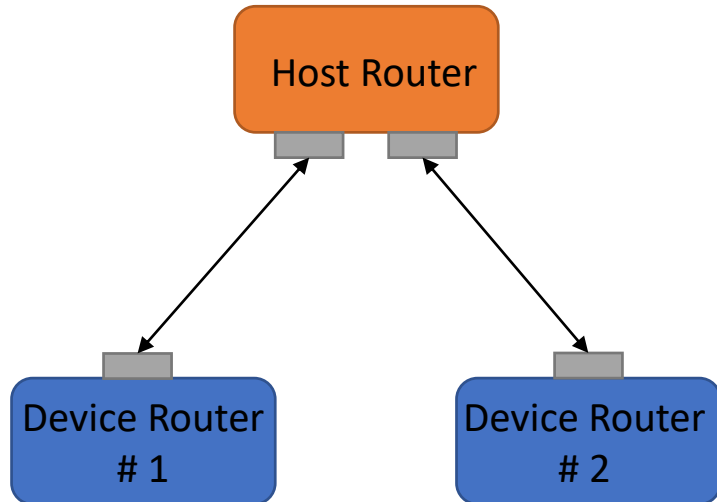
Support for USB4™ on Windows

- Goals
 - Software based connection manager on Windows
 - Avoid fragmentation with different FW based CM implementations in the market
 - Interoperability with all USB4 spec compliant host and device routers
 - Provide compatibility to existing Thunderbolt™ 3 peripherals
 - Thunderbolt 3 host routers will continue to use Firmware based connection manager
 - Support firmware update without requiring third-party software
 - Allow OS and User policies to manage the USB4 bandwidth among different devices/protocols
 - No changes required in USB class/client drivers, PCI function drivers or graphics drivers to work over USB4
 - Leverage IOMMU & DMA remapping for protection against physical DMA attacks

Software based Connection Manager in Windows

- Advantages vs FW based CM
 - Avoid fragmentation
 - Better interoperability
 - Ease of update
 - Apply OS/User defined security policies
 - Bandwidth management
 - Power coordination among different protocol stacks

Software Architecture



- Windows SW CM =
 - Host Router Driver (HRD) instance
 - Device Router Driver (DRD) instance(s)
- HRD – Manages the host interface,
 - Provides hardware services to other DRDs
- DRD – Manages an instance of device router
- Power dependencies to be met in software
 - During sleep/suspend
 - During resume
 - _DSD/DVSEC

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Support for Firmware Update

- **Goal:** Eliminate the need for third party software
- Firmware payload published as Extension INFs through Windows Update
- **Protocol**
 - USB3 channel will use Component Firmware Update ([CFU](https://github.com/microsoft/CFU))
 - <https://github.com/microsoft/CFU>
 - USB4 – In Progress
 - USB4 defined exchanges or CFU
- **Host Routers**
 - UEFI based capsule updates for integrated host routers
 - Inbox supported mechanism (USB4™ channel only – described below)
- **Device Routers**
 - USB3 channel targeted at the integrated USB hub
 - Works in USB3/ Thunderbolt™ 3 modes as well
 - Native USB4 channel targeted at the device router

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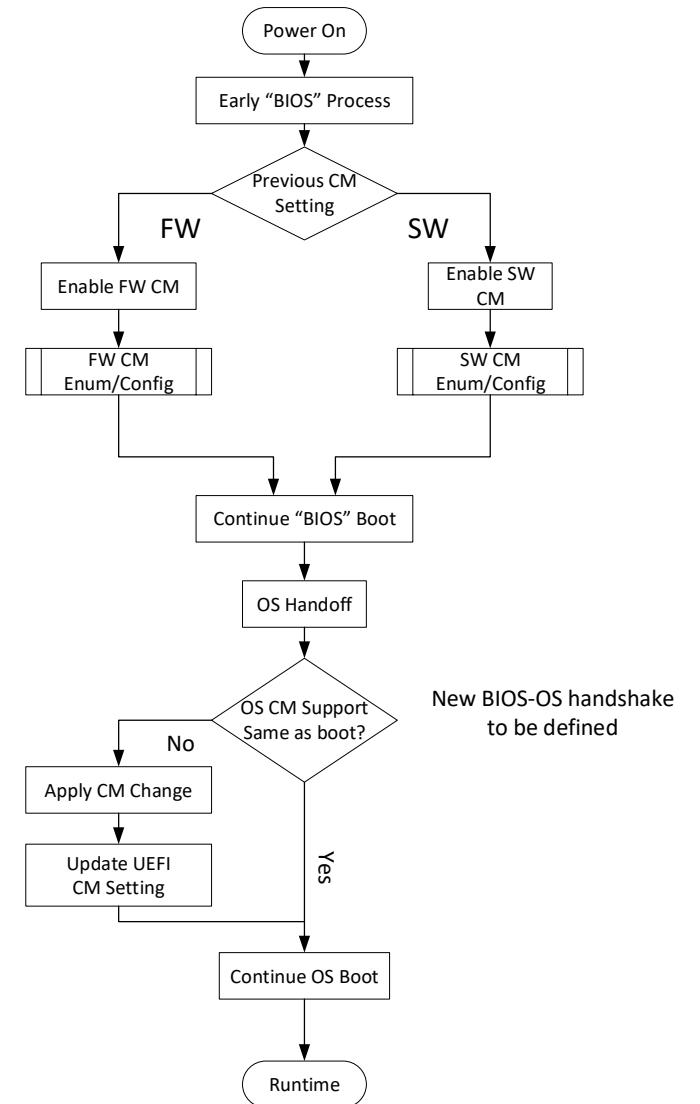
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SW based CM in pre-boot environment

- Executed in DXE phase. Loads prior to UEFI native protocol drivers.
 - No SMI triggered entry points.
 - Fixed execution time
 - First come first serve BW allocation scheme
- Capabilities
 - Will support USB, PCI & DP tunneling and Thunderbolt™ 3 peripherals
 - No support for USB4™ power management, hot plug & xDomain communication
- Hand-off
 - HW state is preserved during BIOS to OS hand-off of CM – No metadata is passed

Switching between SW & FW CM

- Need to support FW CM for Legacy OS
- New BIOS-OS handshake to be defined in ACPI to allow auto switch between SW & FW CM
 - OS to use this handshake to indicate support for SW CM
- Switching is an expensive operation and is expected only during an OS upgrade/downgrade scenario
- Platform may choose to not give control to requesting OS, resulting in FW mode only



Mapping Host interface to tunneled ports

- Use the `_DSD` (Device Specific Data) as defined by ACPI with the Device Properties UUID for defining the mapping properties of tunneled ports
- Required to establish power relation between Host Interface and the tunneled ports that it controls
- PCIe DVSEC (Designated Vendor specific capability) will be used instead of `_DSD` for defining this mapping on add-in USB4 cards.

```
//_DSD sample (Subject to change)

Scope (\_SB.PCI0)
{
    Device (NHI0) { } //Host interface instance

    Device (DSB0) //Tunneled PCIe port instance
    {
        Name (_DSD, Package () {
            ToUUID("daffd814-6eba-4d8c-8a91-bc9bbf4aa301"), //Device Properties UUID
            Package () {
                Package () { "usb4-host-interface", \_SB.PCI0.NHI0 },
                Package () { "usb4-port-number", PortInstance#},
            }
        })
    }
    Device (...) //Potentially extend to DP and USB tunneled ports
    {
        Name (_DSD, Package () {
            ToUUID("daffd814-6eba-4d8c-8a91-bc9bbf4aa301"), //Device Properties UUID
            Package () {
                Package () { "usb4-host-interface", \_SB.PCI0.NHI0 },
                Package () { "usb4-port-number", PortInstance#},
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        })
    }
}
}
```

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Security

- Microsoft and Intel support “Kernel DMA protection” feature on the latest Thunderbolt™ 3 enabled systems.
 - This feature leverages the IOMMU & DMA remapping to sandbox external devices.
 - DMA remapping provides hardware support for isolation of device accesses to system memory.
 - Will apply for systems that turn on PCI tunneling
- Intel platforms also enable Pre-boot DMAR support for end-to-end protection in BIOS and OS.
- Plan to extend this feature for USB4™ enabled systems
 - Option for end user to disable PCI tunneling through a BIOS/platform setting that will be communicated to OS.

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Windows Certification Requirements

- Goals
 - Consistent and reliable user experience with USB4™ hosts and peripherals
 - Windows platforms support the full USB4 feature set by default
 - Requires features that may be optional in the specification
 - System integration is consistent with the Windows SW CM Architecture
- Timeline
 - Published in preview (more coming in November)
 - 6+ months of review
 - Enforcement will align with the release of the USB4 SW CM in the OS
- Requirements
 - <https://aka.ms/ProposedReqs>
 - [Microsoft Collaborate partner portal](#)

Windows Certification Requirements (Continued)

- PCIe Tunneling
- DisplayPort Alt-mode
- Thunderbolt™ 3 Compatibility
- Uniform Port Capabilities
- D3 Cold Support
- Kernel DMA Protection
- _DSD or DVSEC
- BIOS Handoff
- Host Router Reset Support
- Flattening Portal Bridge (FPB)

Validation tools from Microsoft

USB4™ Switch

- 1:2 programmable switch
- Supports USB4, Thunderbolt™ 3 , USB3, PD, and Alt-Modes
- Integrates with HLK and other test tools and scripts
- Automates connect/disconnect, for stress testing, switching peripherals, etc.



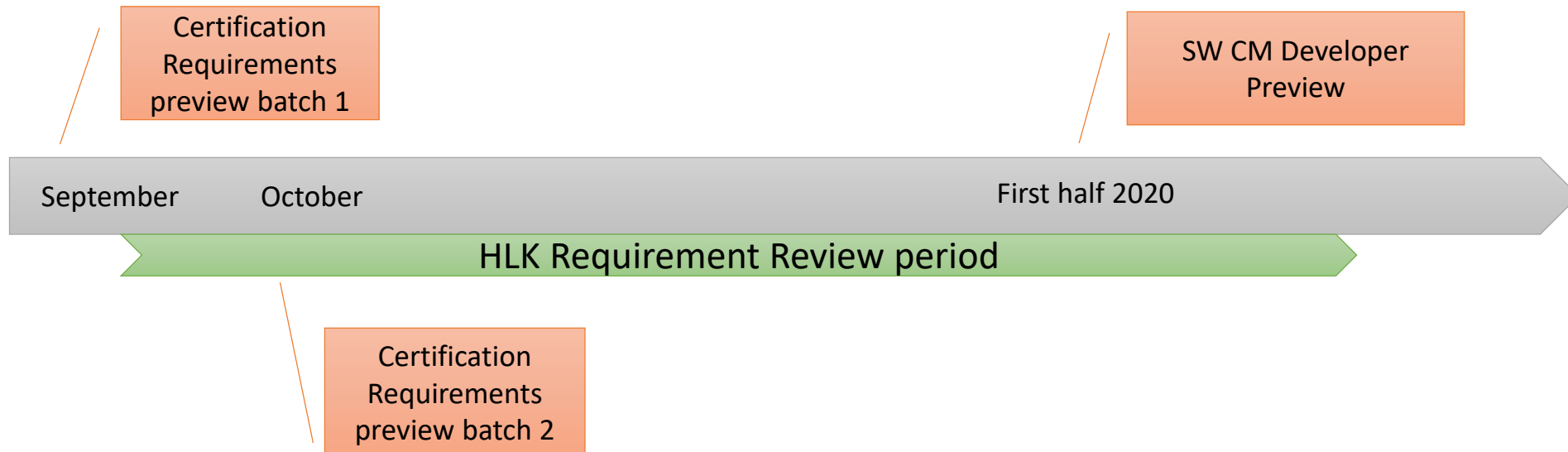
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Timelines

- Certification Requirements – preview batch 1 available now
- Certification Requirements – preview batch 2 available October 2019
- Certification Requirements – preview batch 3 available now
- Requirement review open through the first half of 2020
- SW CM Developer Preview available in the first half of 2020



Q&A
