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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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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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.

https://aka.ms/USB4Switch
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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