USB4™ Compliance and Certification

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USB Developer Days 2019 – Taipei, Taiwan November 20, 2019



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Presentation Agenda

- Overview
- Compliance Development
- USB4[™] Testing
- Certification Process
- Summary & Questions

Presentation Agenda

• Overview

- Introduction
- Benefits of Certification
- Certification Categories
- Required Testing
- Compliance Timeline
- Compliance Development
- USB4[™] Testing
- Certification Process
- Summary & Questions

Introduction

• Goals:

- High Quality Certified USB4 Products
- Stable, Repeatable, Well Documented Tests
- Instantly Available Testing
 - Qualified Test Houses
- Minimize Test Equipment Costs
 - Avoid Expensive Equipment As Possible

• Approach

- Build on USB 3.x Compliance Program Infrastructure
 - Extend and Reuse USBCV
 - Extend Compliance Device Infrastructure
 - Extend and Reuse Test Services Infrastructure
- Engage with Test Equipment Vendors
- Complex technology \rightarrow enhanced testing

Use BKMs from USB and Thunderbolt[™] compliance

Benefits of Certification

- Guarantees interoperability
- Add value, assurance of quality
- Help with debug/troubleshooting
- New product categories get access to PIL and subject matter experts
- Logo and Icon Usage



USB4™ Certification Categories

	CERTIFIED USB20 Gbps	CERTIFIED USB40 Gbps
USB4 Host	\checkmark	\checkmark
USB4 Hub	Not Allowed	\checkmark
USB4-Based Dock	Not Allowed	\checkmark
USB4 Peripheral Device	\checkmark	\checkmark
USB4 Active Cable	\checkmark	\checkmark
USB4 Passive Cable	\checkmark	\checkmark

- USB PD Compliance
- USB Type-C[®] Compliance
- USB 2.0 Compliance
- USB 3.2 Compliance
- USB4[™] Compliance



- USB PD Compliance
- USB Type-C[®] Compliance
- USB 2.0 Compliance
- USB 3.2 Compliance
- USB4[™] Compliance



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- USB Type-C[®] Compliance
- USB 2.0 Compliance
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- USB4[™] Compliance



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- USB 3.2 Compliance
- USB4[™] Compliance



- USB PD Compliance
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- USB 2.0 Compliance
- USB 3.2 Compliance
- USB4[™] Compliance

- USB PD Compliance
- USB Type-C[®] Compliance
- USB 2.0 Compliance
- USB 3.2 Compliance
- USB4[™] Compliance
 - Tunneling
 - TBT3-Compatibility

Required Testing - USB4 Hosts

- USB PD Compliance
- USB Type-C[®] Compliance
- USB 2.0 Compliance
- USB 3.2 Compliance
- USB4[™] Compliance
 - DP and USB3 Tunneling
 - If supported:
 - PCIe Tunneling
 - TBT3-Compatibility

Required Testing - USB4 Peripheral Devices

- USB PD Compliance
- USB Type-C[®] Compliance
- USB 2.0 Compliance
- USB 3.2 Compliance
 - If supported
- USB4[™] Compliance
 - If supported:
 - DP Tunneling
 - USB3 Tunneling
 - PCIe Tunneling
 - TBT3-Compatibility

If support DP or PCIe tunneling, must support equivalent USB function (if available)

Equivalent USB Function

- A USB4 device must expose an equivalent USB function on USB 3.x or USB 2.0 (if it exists) when connected to a host that does not support the required USB4 capabilities
- If an equivalent USB function does not exist, the USB4 device must Billboard (USB 2.0)

USB4 Compliance Timeline

Presentation Agenda

- Overview
- Compliance Development
 - CTS Development
 - Compliance Process
 - Test Coverage
- USB4 [™] Testing
- Certification Process
- Summary & Questions

Everything Starts with the Specification...

Universal Serial Bus 4 (USB4[™]) Specification

Apple Inc.	
Rewlett-Packard Inc.	
Intel Corporation	
Microsoft Corporation	
Renesas Corporation	
STMicroelectronics	
Texas Instruments	

Version 1.0

August, 2019

Design to specification not compliance tests!!!

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Compliance Test Specification (CTS) Development

Compliance Process Overview

Compliance Test Specs

Compliance Test Specs

Interprets

•Spec Requirements

Defines

Test Assertions •Specific Test Requirements Test Algorithms

Test H/W & S/W

Validates

Test Criteria •Compliance •Interoperability Workshops Test Houses PASS FAIL

<u>Clear Test Output</u> <u>Maps</u> Directly to Test Spec

Predictable Path To Compliance

Test Coverage

- Compliance is not a replacement for validation
- Tests attempt to approximate:
 - Common and corner cases
 - Error and non-error cases
 - Implementation variations across different hosts
- Not testing cases of bad SW
 - For example, cases where Connection Manager configures Router incorrectly or sends unexpected packet

Presentation Agenda

- Overview
- Compliance Development
- USB4[™] Testing
 - USB4[™] Test Matrix
 - Thunderbolt[™] 3 Compatibility Testing
 - Test Tools
- Certification Process
- Summary & Questions

Silicon vs. End Product

Physical component that gets integrated into product

Product that end user can go buy

USB4™ Test Matrix

	Host Silicon	Host End Product	Dock Silicon	Dock End Product	Hub Silicon	Hub End Product	Device Silicon	Device End Product
Electrical	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Logical Layer	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
Protocol	\checkmark	x	\checkmark	x	\checkmark	x	\checkmark	x
ТМU	\checkmark	x	\checkmark	x	\checkmark	x	\checkmark	x
H2H Tunneling	\checkmark	\checkmark	x	x	x	x	x	x
USB3 Tunneling	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	If Supported	If Supported
DP Tunneling	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	If Supported	If Supported
PCIe Tunneling	If Supported	If Supported	\checkmark	\checkmark	\checkmark	\checkmark	If Supported	If Supported
USB4 Interop	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark
TBT3- Compatability	If Supported	If Supported	\checkmark	\checkmark	✓ (DFP only)	✓ (DFP only)	If Supported	If Supported

USB4™ Test Matrix

USB4™ Test Suite Summary

USB4™ Test Tools

- Electrical Test Tools
 - Test Fixtures
 - Real Time Scope
 - Pattern Generator
 - Network Analyzer
 - Signal Generator
- USB4 Exerciser
 - Logical layer testing
 - Generate error cases
- USB4 Analyzer
 - Primarily used for protocol and tunneling testing

- Clock Signal Analyzer
 - TMU Testing
- USB4 Compliance Device
 - Generates loopback USB4 traffic
- USB4CV
 - Primary SW test tool
 - Builds on existing USB CV
 - Will be available to download on USB.org
 - First gen works on Win10, x64, PCIe-based host

Example USB4CV Output

🗟 USB 4 Command Verifier	-	_ >	(=	USB4 Chapter 5 [Transport Tests] × +		1	×
Select Test Sute				← → C (G)		۵	1
US84 Chapter 11 tests (PCIe Tunneling) D1 US84 Chapter 11 tests (PCIe Tunneling) H1 US84 Chapter 12 tests (Pois (Pois) H1 US84 Chapter 5 tests (Transport) D1 US84 Chapter 5 tests (Transport) D1 US84 Chapter 5 tests (Transport) D1 US84 Chapter 5 tests (Configuration) D1 US84 Chapter 5 tests (Configuration) D1	Port 7 type Host Interface Adapter Port Post response as expected Verifying port 8 of 13 Read from port configuration space Verifying port type and expected response (Read response/ERR_ADDR) Port stype PCIe Downstream Adapter Port Port response as expected	^	N L R	NUMBER OF TESTS: 1 LOG NAME: USB4 Chapter 5 [Transport Tests] Host With Compliant Device - 2019-08-28 10-21-41 RESULT: passed			•
USB4 Chapter 5 tests (Configuration) 03	Verifying port 9 of 13 Read from port configuration space						
Select Test Mode	Verifying port type and expected response (Read response/ERR_ADDR) Port 9 type PCIe Downstream Adapter Port		I				
Complance Test Prompt for Less Parameters Prompt for Less Parameters	Pot response as expected. Vertying pot 10 of 13 Read from pot configuration space		1 1	INFO Test log initialized. INFO Log Level: Normal INFO User Input module initialized			
Test Parced and Test Faled	Vertying port type and expected response (Nead response/EHH_ADUH) Port 10 type DP OUT Adapter Port		F	Port Enumeration Test Par	sed		
Select Test Right-click on tests for more information USB4 Chapter 5 [Transport Tests] Host With Compilant Device	Verfying port 11 of 13 Read from port configuration space Verfying port 11 yee and expected response (Read response/ERR_ADDR) Port imponse as expected. Verfying port 12 of 13 Read from port configuration space Verfying port 12 of 13 Port imponse as expected. Verfying port 13 of 13 Read from port configuration space Verfying port 14 of 14 Port mempories as expected. Verfying upstream port 7 Upstream port Verfied Stop time: Weid Aug 28 10:21:47 2019 Duration: 3 seconds. Stopping Test [Ford Enxameration Test: Number of : Fails (0): Aborts (0): Warnings (0)] TEST SUITE SUMMARY: [Fails (0): Aborts (0): Warnings (0)] TEST SUITE SUMMARY: [Fails (0): Aborts (0): Warnings (0)]		*************************	<pre>INFO Start time: Ned Aug 28 10:21:44 2019 INFO Disable-Enable OFP Lanes INFO Enumerating host RUT INFO Enumerating compliant Router INFO Retrieve RUT data INFO Starting Port Iterations INFO Verifying port 1 of 13 INFO Read from port configuration space INFO Port 1 type USB4 Port INFO Port response as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port 1 type USB4 Port INFO Read from port configuration space INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port response as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port 2 type USB4 Port INFO Port 2 type USB4 Port INFO Port response as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port sponse as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port 3 type USB4 Port INFO Port asponse as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port asponse as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port asponse as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port response as expected. INFO Verifying port 4 of 13 INFO Read from port configuration space INFO Port response as expected. INFO Verifying port type and expected response (Read response/ERR_ADOR) INFO Port response as expected. INFO Verifying port 5 of 13 INFO Read from port configuration space INFO Port response as expected. INFO Verifying port 5 of 13 INFO Read from port configuration space INFO Read from port configuration space INFO Read from port type and expected response (Read response/ERR_ADOR) INFO Read from port type and expected response (</pre>	Passed e (Read response/ERR_ADOR) e (Read response/ERR_ADOR) e (Read response/ERR_ADOR)		
Run Launch Report Viewer Open Reports Directory	Update Display	Ext	II I	INFO Port 5 type DP IN Adapter Port INFO Port response as expected.			

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 - Process Overview
 - Pre-Certification Requirements
 - Test Venues
- Summary & Questions

USB4 Certification Process Overview

- 1. Pass USB 2, USB 3.2, USB PD, and USB Type-C[®] compliance tests
- 2. Complete USB4[™] Pre-Certification testing and requirements
- 3. Submit product for certification
- 4. Perform USB4 Compliance testing at test lab
- 5. Send test results to USB-IF
- 6. Get notification from USB-IF with status (pass or fail)

Pre-Certification Testing and Requirements

- Generate Vendor Info File (VIF)
- Show that used certified components
 - Certified Connector
 - Certified Silicon (if end product)
- Run subset of USB4[™] compliance tests and produce logs

Will be posted on www.USB.org

USB4™ Test Venues

Independent Test Labs (ITLs)

Product integration Lab (PIL)

Workshops (eventually ...)

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- Summary & Questions
 - Key Takeaways
 - Q&A

Key Takeaways

- ★ It's a lot of testing !!!
- ★ Certify in layers need to use certified USB components
- ★ USB4[™] Compliance follows compliance BKMs
- ★ Perform in your own lab as part of validation

Time for Q&A

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