

USB4™ Compliance and Certification

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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

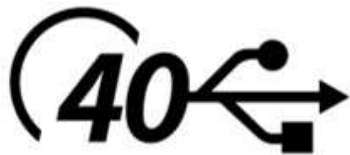
- **Approach**

- 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 → enhanced testing



Use BKM's 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

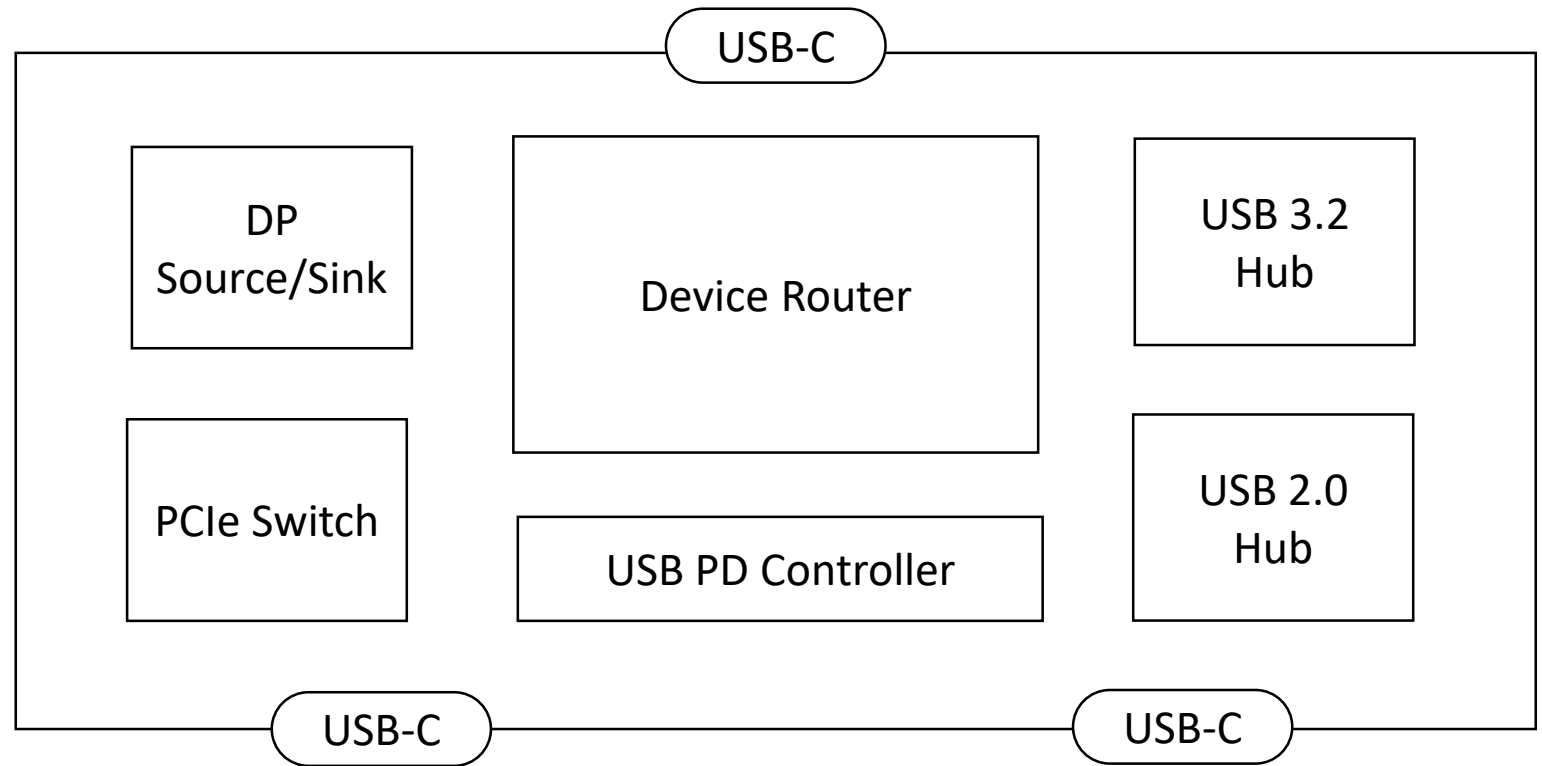


USB4™ Certification Categories

		
USB4 Host	✓	✓
USB4 Hub	Not Allowed	✓
USB4-Based Dock	Not Allowed	✓
USB4 Peripheral Device	✓	✓
USB4 Active Cable	✓	✓
USB4 Passive Cable	✓	✓

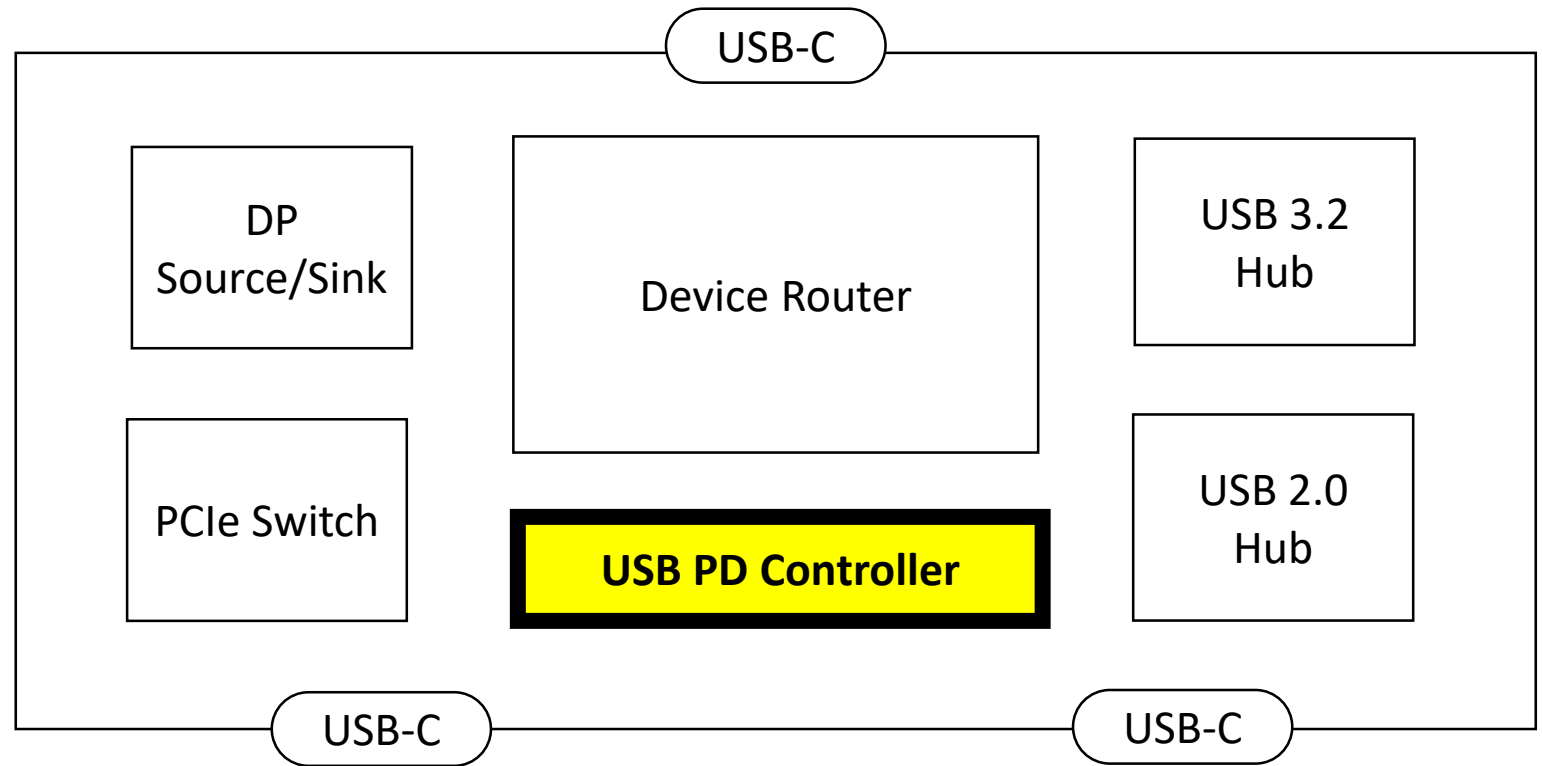
Required Testing – USB4 Hubs/Docks

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



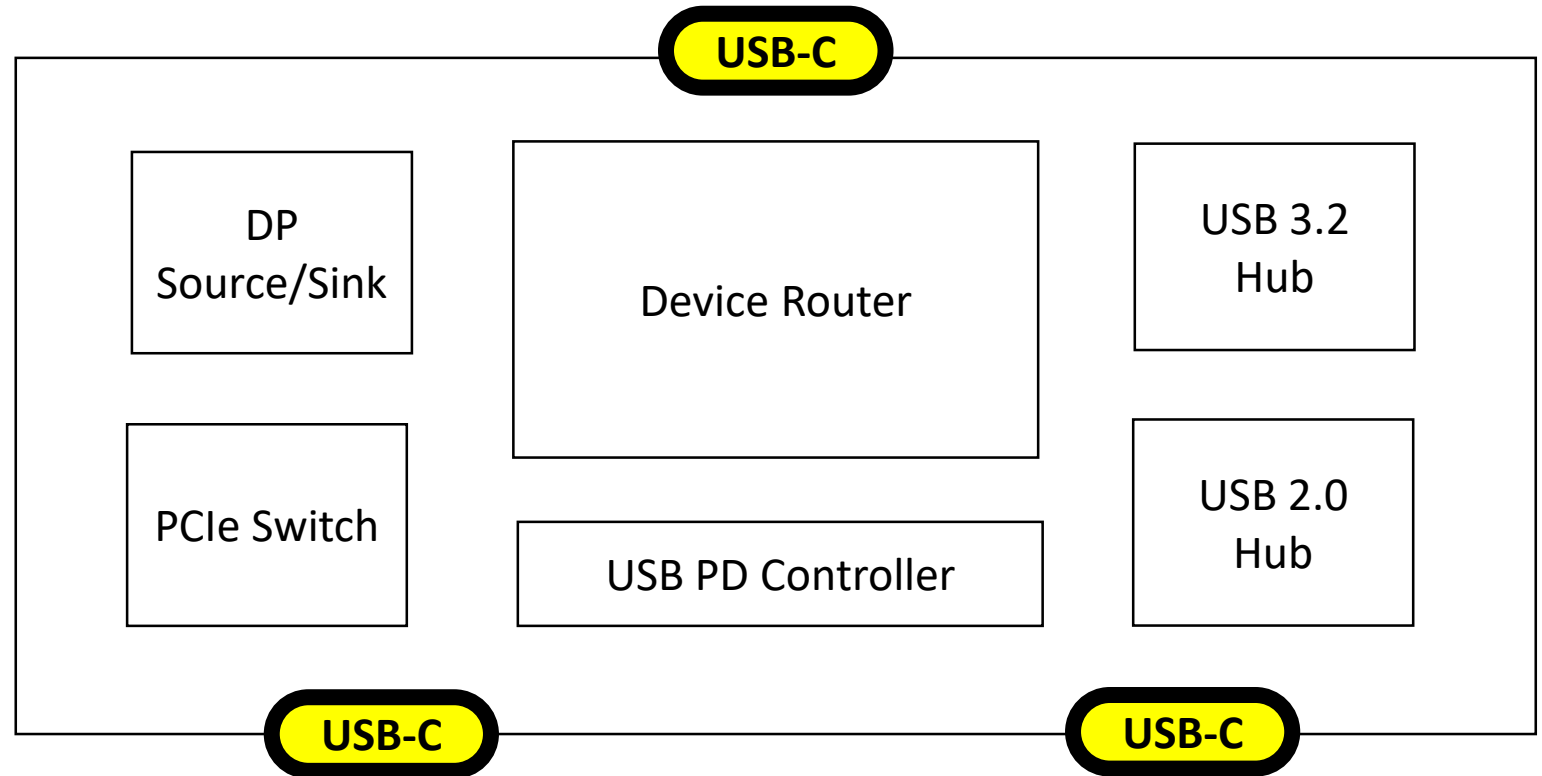
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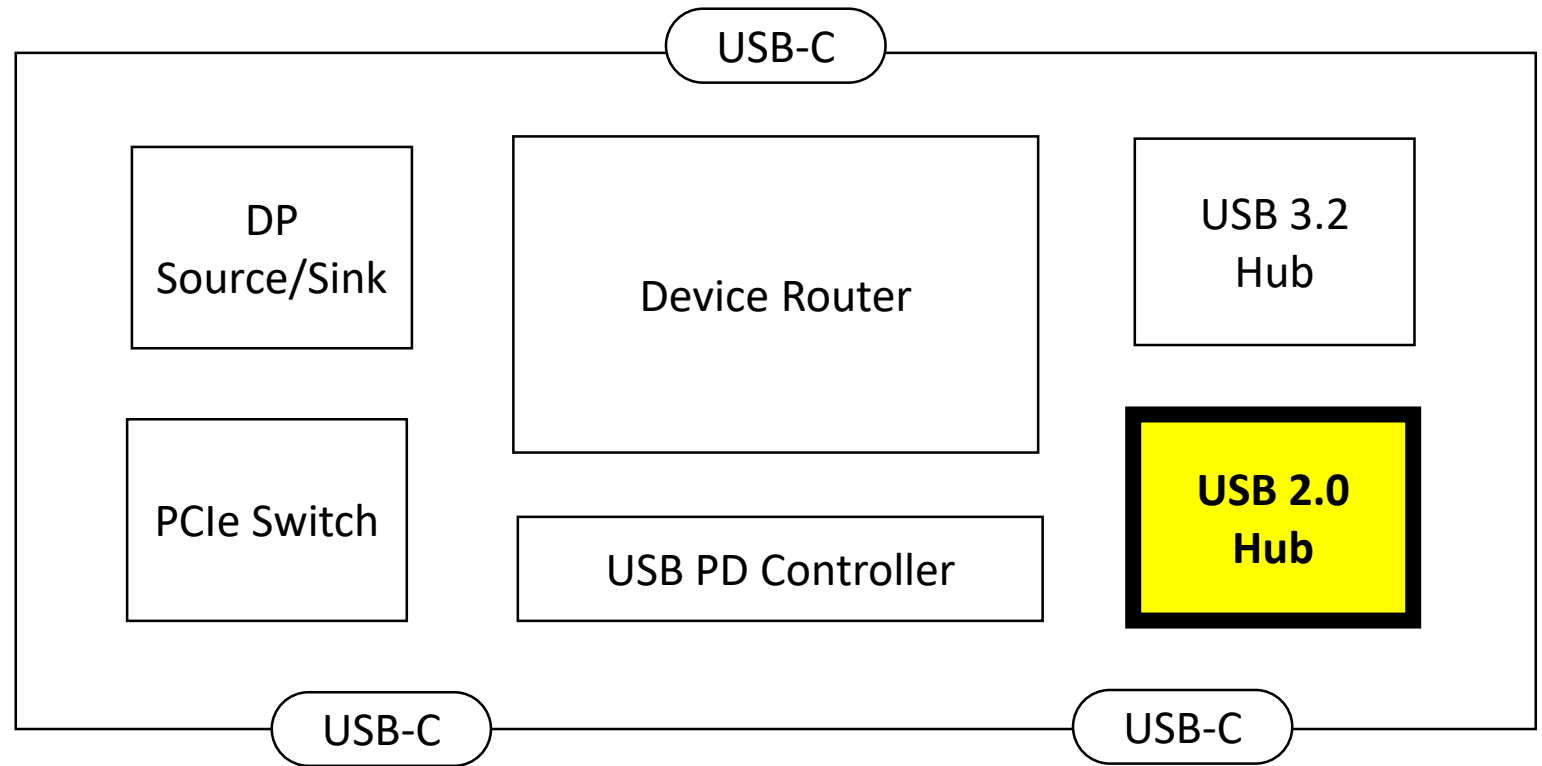
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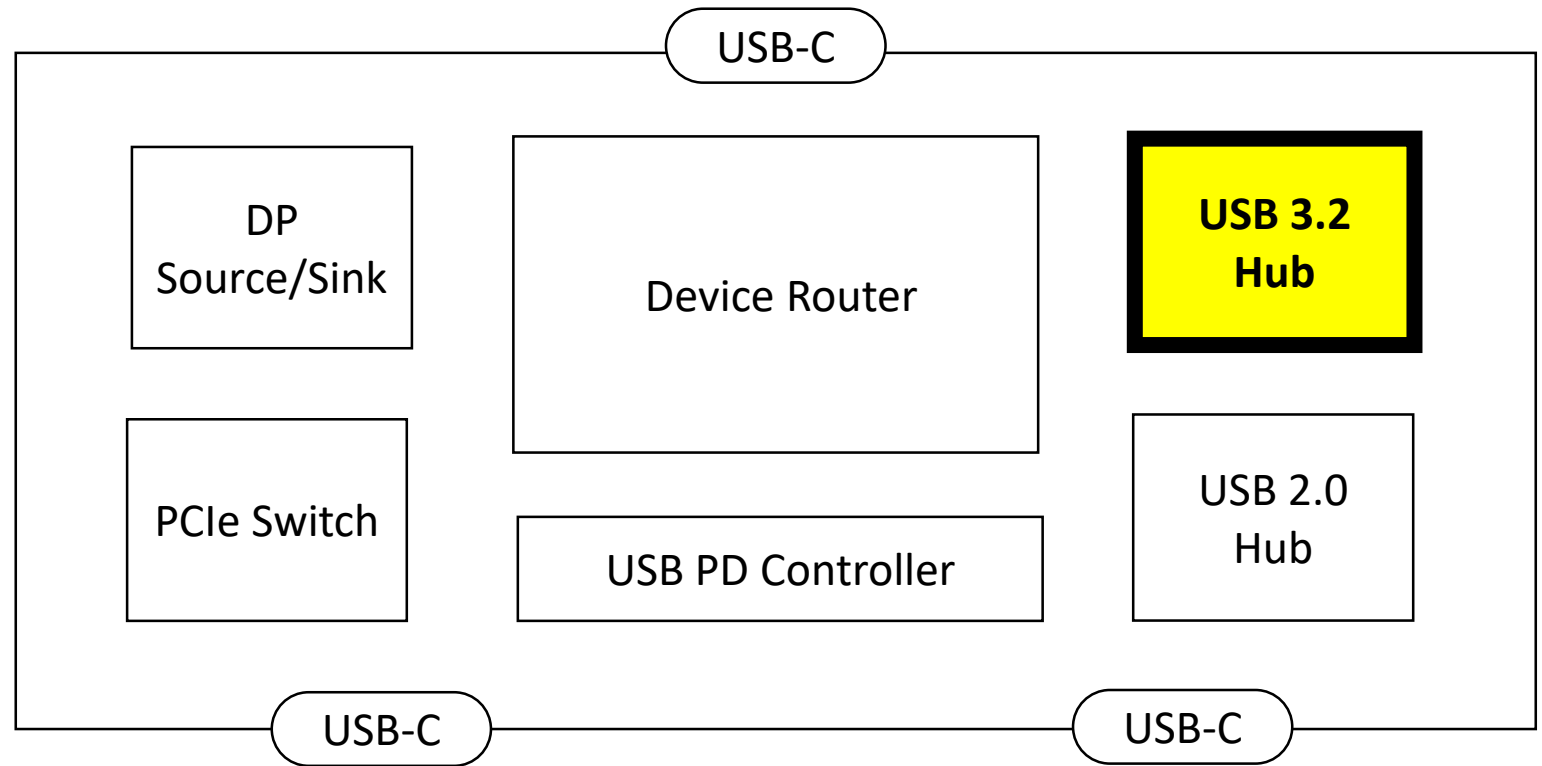
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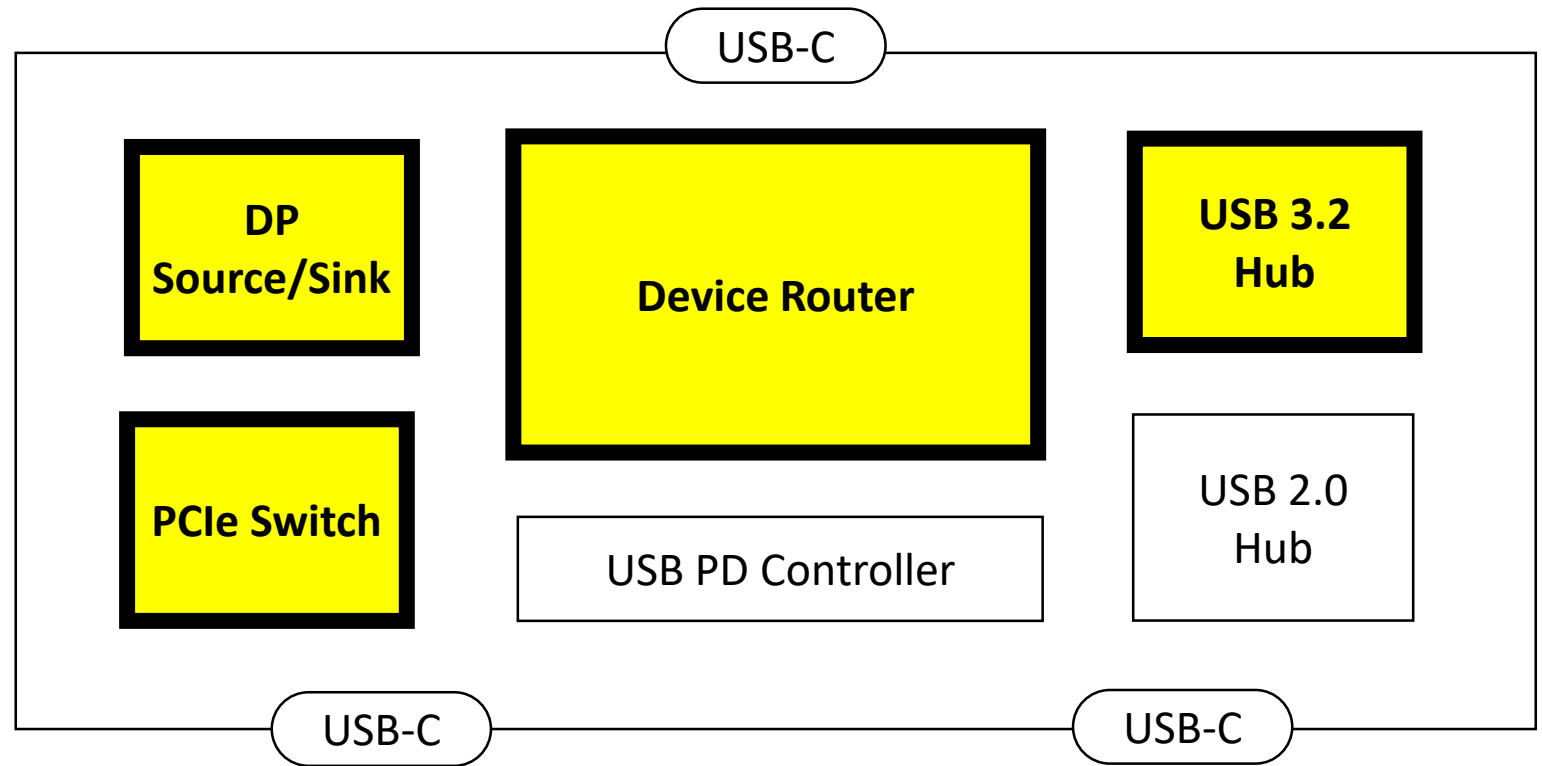
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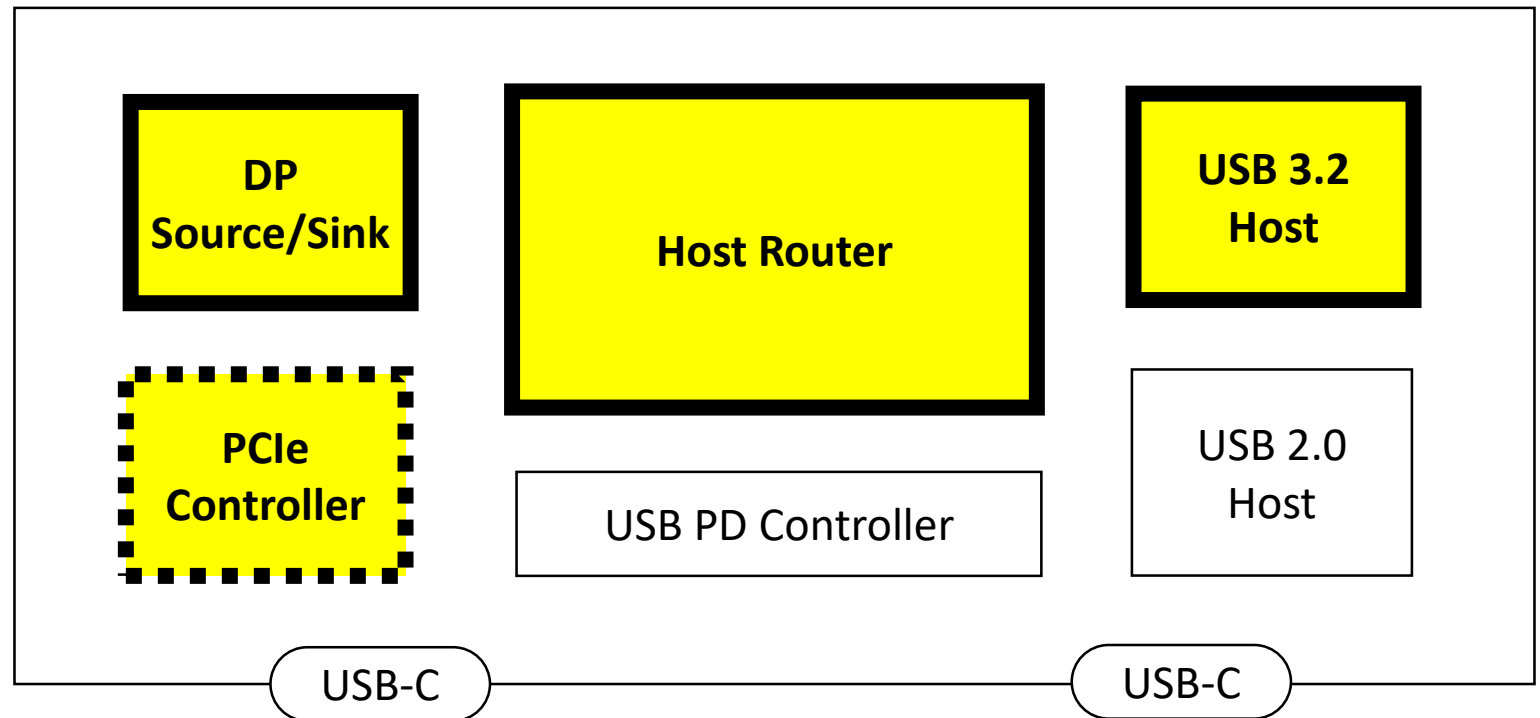
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- **USB4™ Compliance**
 - **Tunneling**
 - **TBT3-Compatibility**



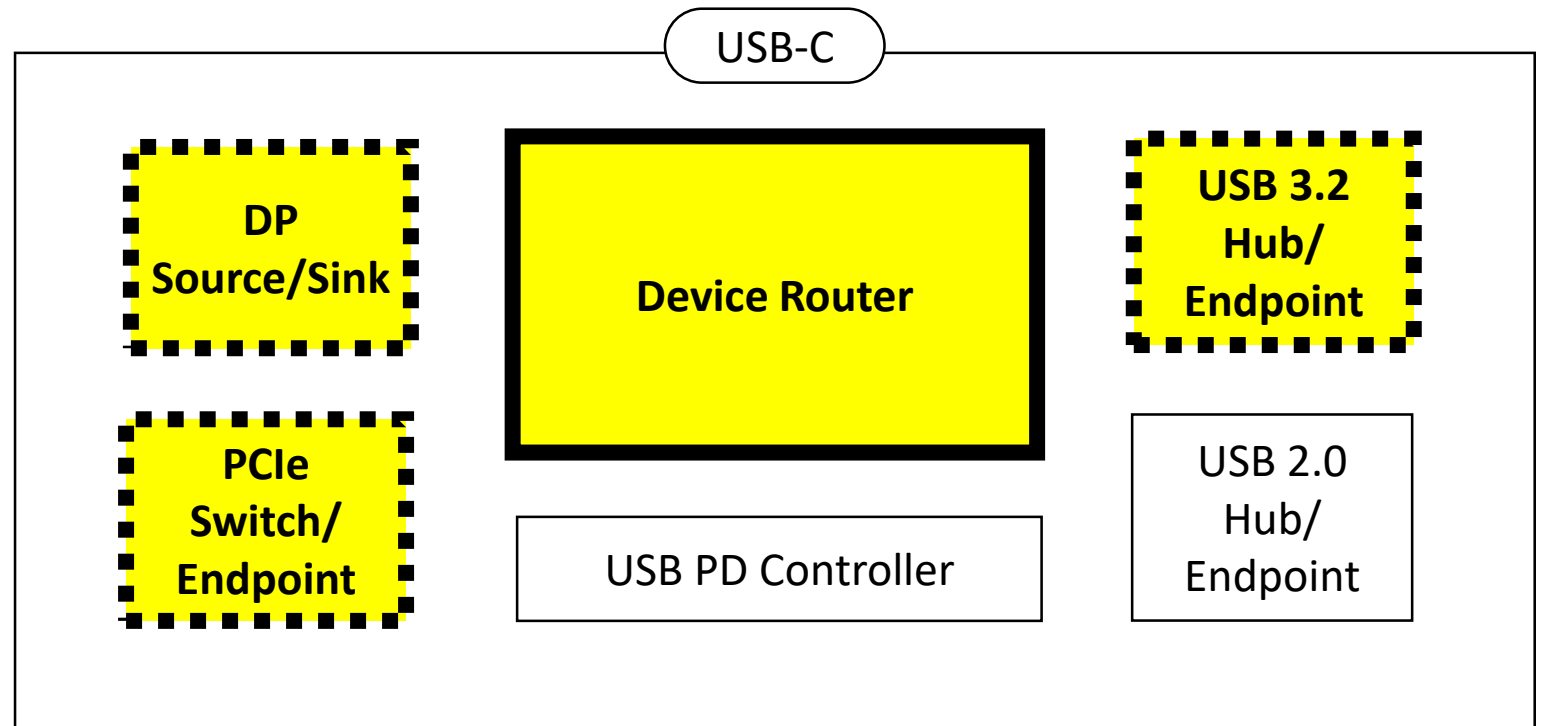
Required Testing - USB4 Hosts

- 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

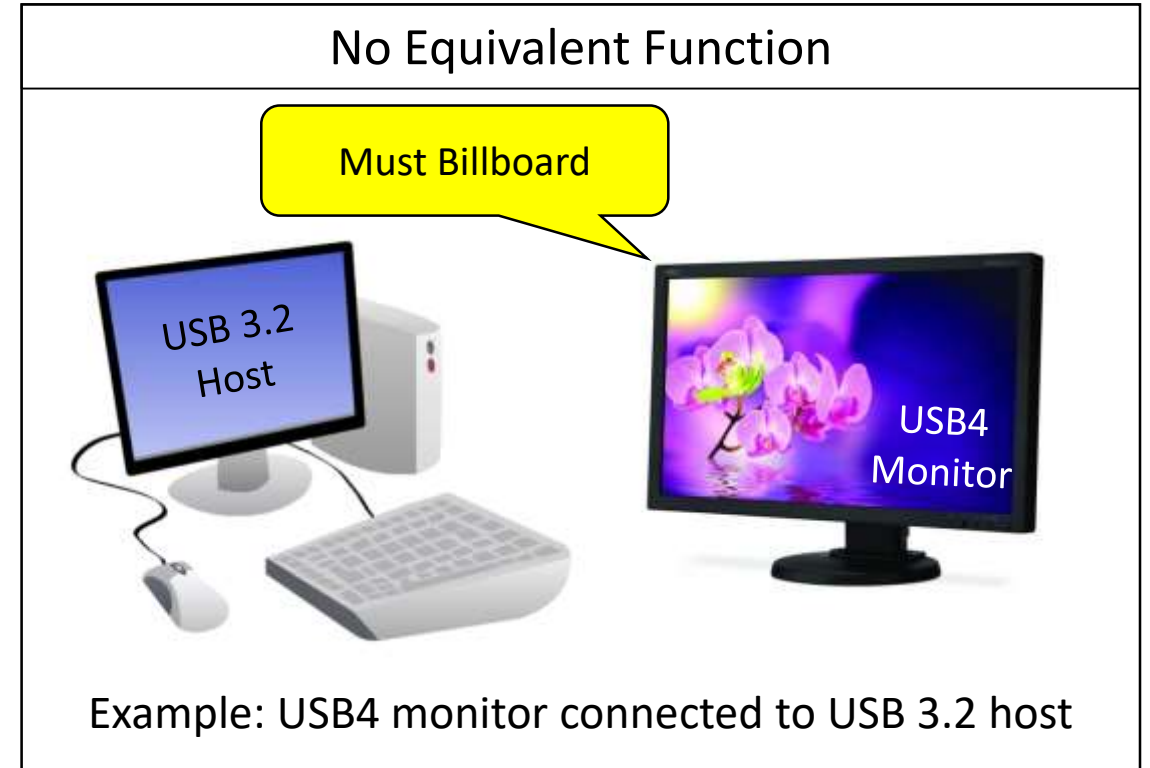
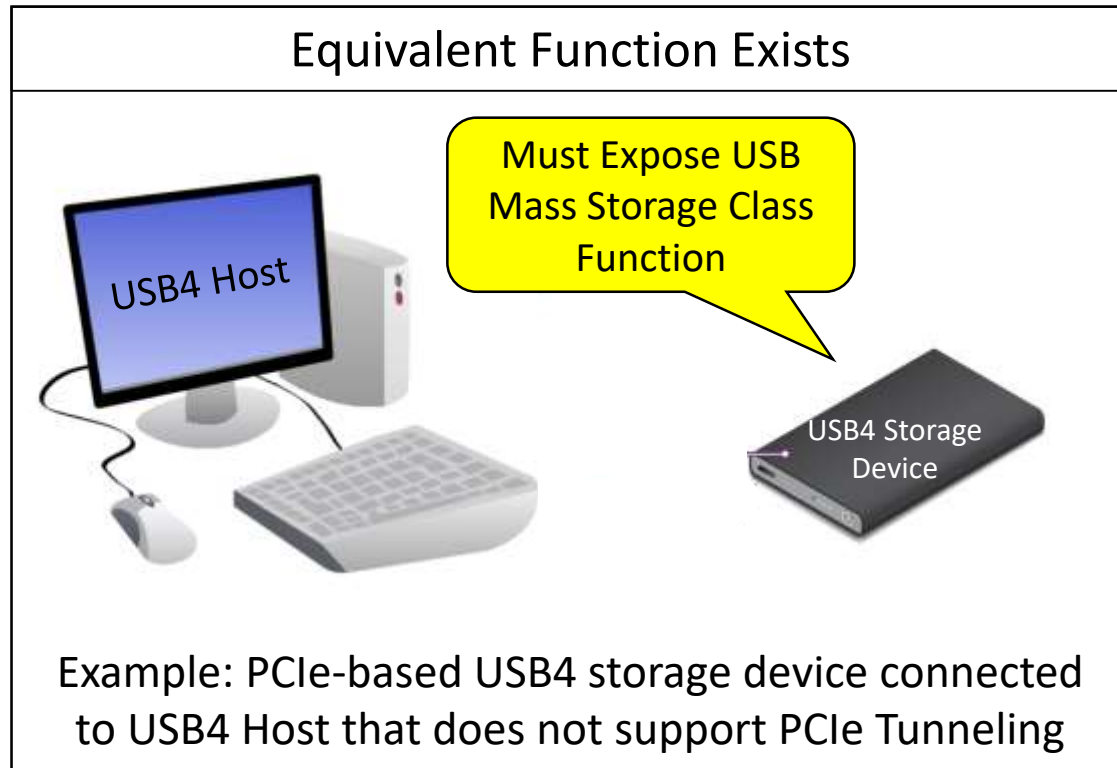
- USB PD Compliance
- USB Type-C® Compliance
- USB 2.0 Compliance
- **USB 3.2 Compliance**
 - If supported
- **USB4™ Compliance**
 - If supported:
 - DP Tunneling
 - USB3 Tunneling
 - PCIe Tunneling
 - TBT3-Compatibility



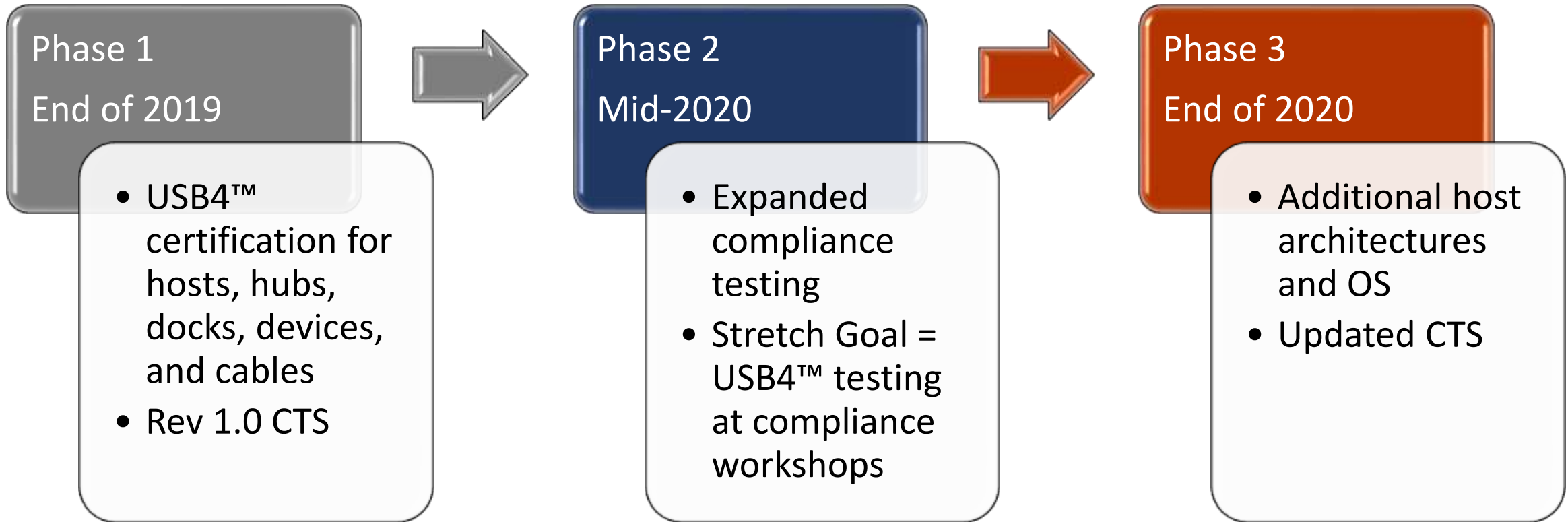
If support DP or PCIe tunneling, must support equivalent USB function (if available)

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

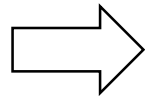
- Overview
- **Compliance Development**
 - **CTS Development**
 - **Compliance Process**
 - **Test Coverage**
- USB4™ Testing
- Certification Process
- Summary & Questions

Everything Starts with the Specification...



Compliance Test Specification (CTS) Development

USB4™
Spec



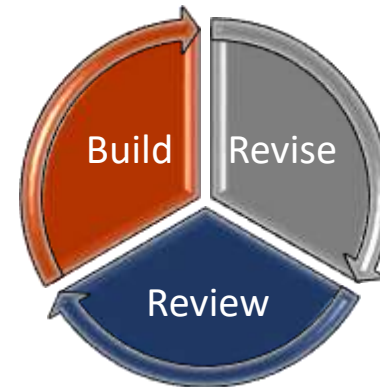
1) Generate Assertions

4.1.1.2.4 AT and RT Transaction Rules		
4.1.1.2.4#1	NT	A transmitter shall not abort an AT Transaction or an RT Transaction after the STX Symbol is sent.
4.1.1.2.4#2	TD 4.3	When a receiver receives two or more leading DLE symbols it shall discard the extra leading DLE symbols and process the received LT Transaction as if only one leading DLE symbol was received

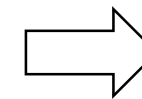
2) Assertion Disposition

6. Immediately after sending the DLE symbols, send the AUT a Write Command with the following:
 - a. *Target* = Register 9 (Metadata)
 - b. *Length* = 4
 - c. *Command Data* = FFFF FFFFh
7. Wait for a Write Response from the AUT
8. Send the AUT a Read Command with the following:
 - d. *Target* = Register 9 (Metadata)
 - e. *Length* = 4
9. Verify that the contents of Register 9 are the same as previously written (FFFF FFFFh) (4.1.1.2.4#2)

3) Write Tests and Map Assertions

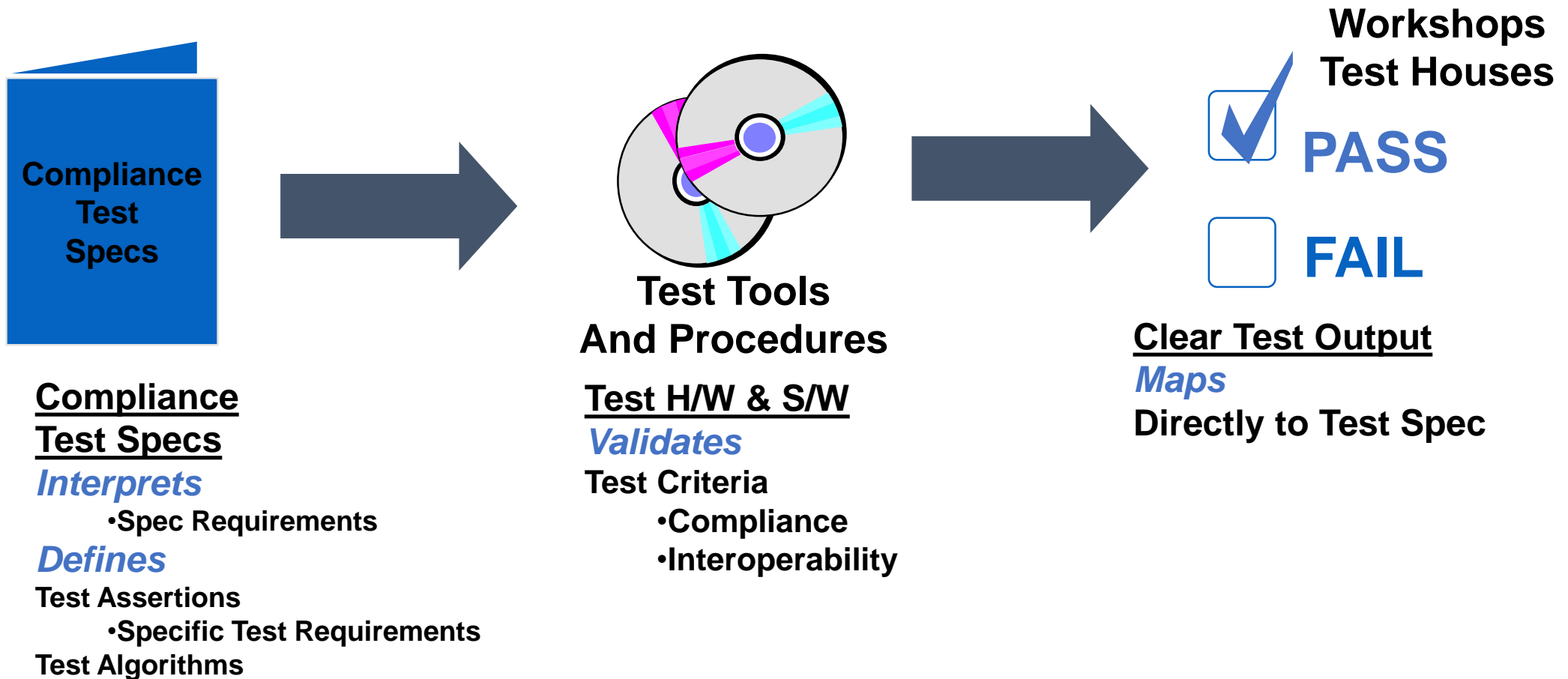


4) Review, Revise, and Build



USB4™
CTS

Compliance Process Overview



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
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Silicon vs. End Product

Silicon



Physical component that gets integrated into product

End 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	✓	✓	✓	✓	✓	✓	✓	✓
Logical Layer	✓	✓	✓	✓	✓	✓	✓	✓
Protocol	✓	✗	✓	✗	✓	✗	✓	✗
TMU	✓	✗	✓	✗	✓	✗	✓	✗
H2H Tunneling	✓	✓	✗	✗	✗	✗	✗	✗
USB3 Tunneling	✓	✓	✓	✓	✓	✓	If Supported	If Supported
DP Tunneling	✓	✓	✓	✓	✓	✓	If Supported	If Supported
PCIe Tunneling	If Supported	If Supported	✓	✓	✓	✓	If Supported	If Supported
USB4 Interop	✓	✓	✓	✓	✓	✓	✓	✓
TBT3-Compatibility	If Supported	If Supported	✓	✓	✓ (DFP only)	✓ (DFP only)	If Supported	If Supported

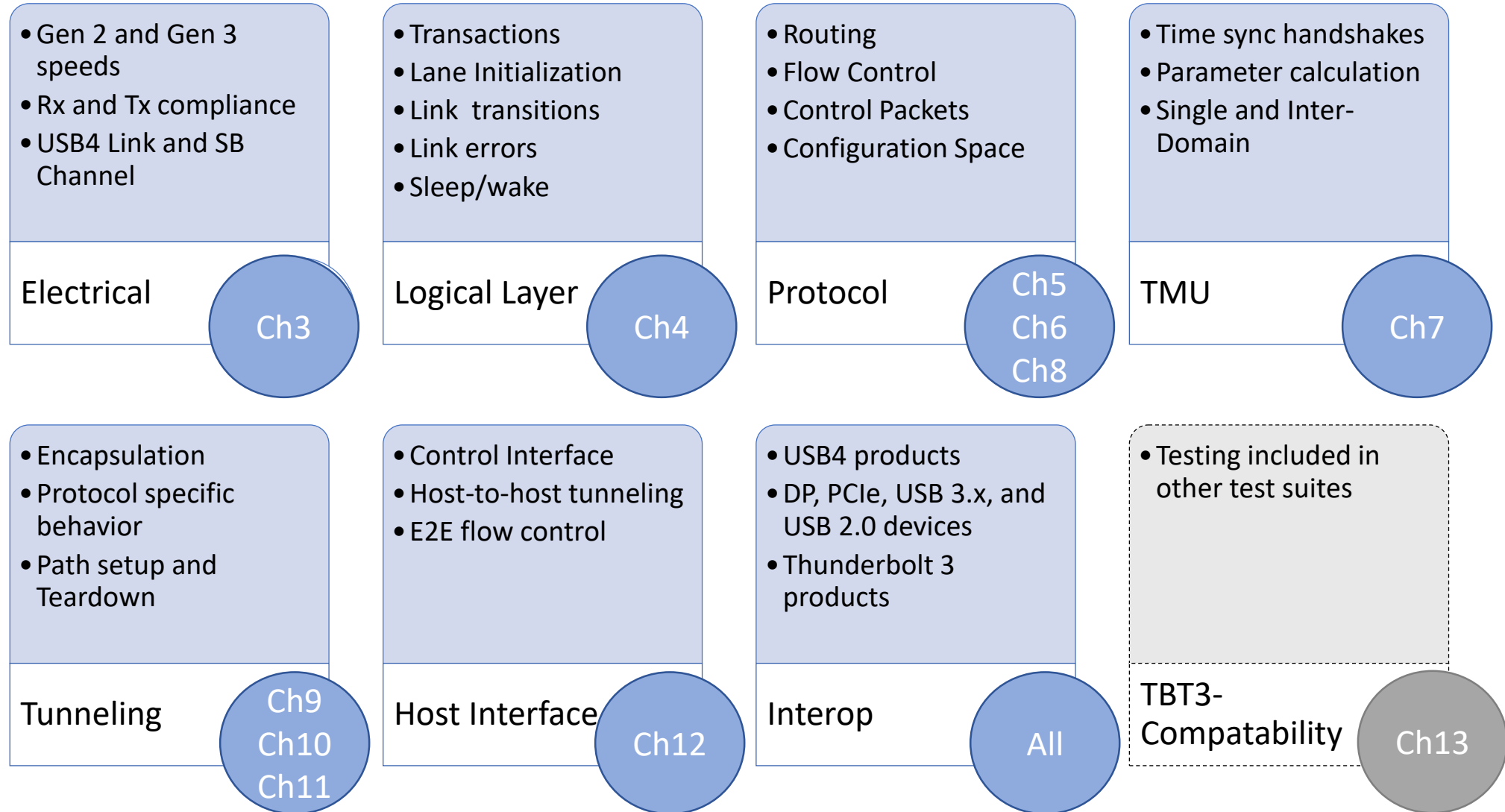
USB4™ Test Matrix

	Host Silicon	Host End Product	Dock Silicon	Dock End Product	Hub Silicon	Hub End Product	Device Silicon	Device End Product
Electrical	✓	✓					✓	✓
Logical Layer	✓	✓					✓	✓
Protocol	✓							✗
TMU	✓							✗
H2H Tunneling	✓							
USB3 Tunneling	✓							If Supported
DP Tunneling	✓							If Supported
PCIe Tunneling	If Supported							If Supported
USB4 Interop	✓	✓					✓	✓
TBT3-Compatibility	If Supported	If Supported		✓		✓ (DFP only)	If Supported	If Supported

Takeaways:

1. There is a lot of testing!
2. End product testing is a subset
3. If a feature is supported, it is tested
4. If a feature is not supported, look for graceful fallback

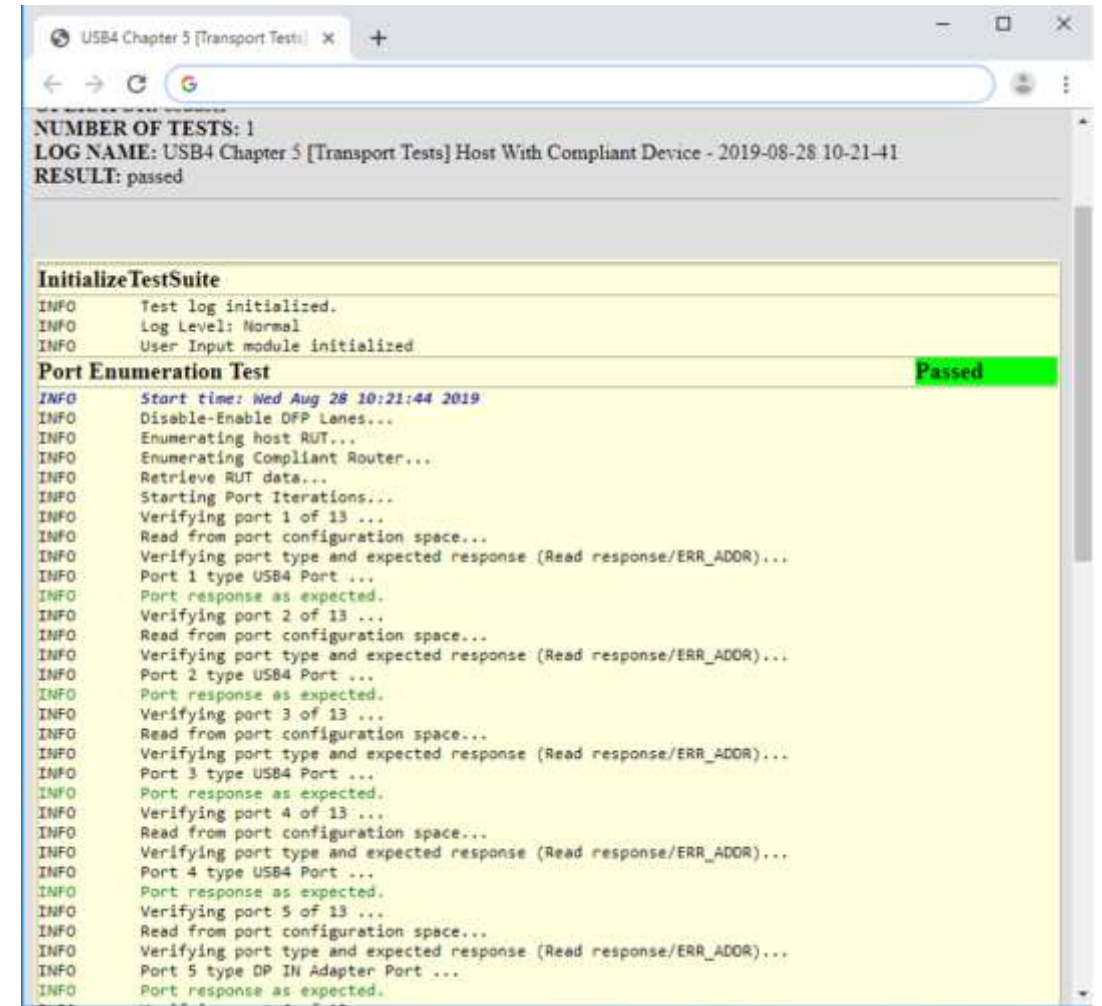
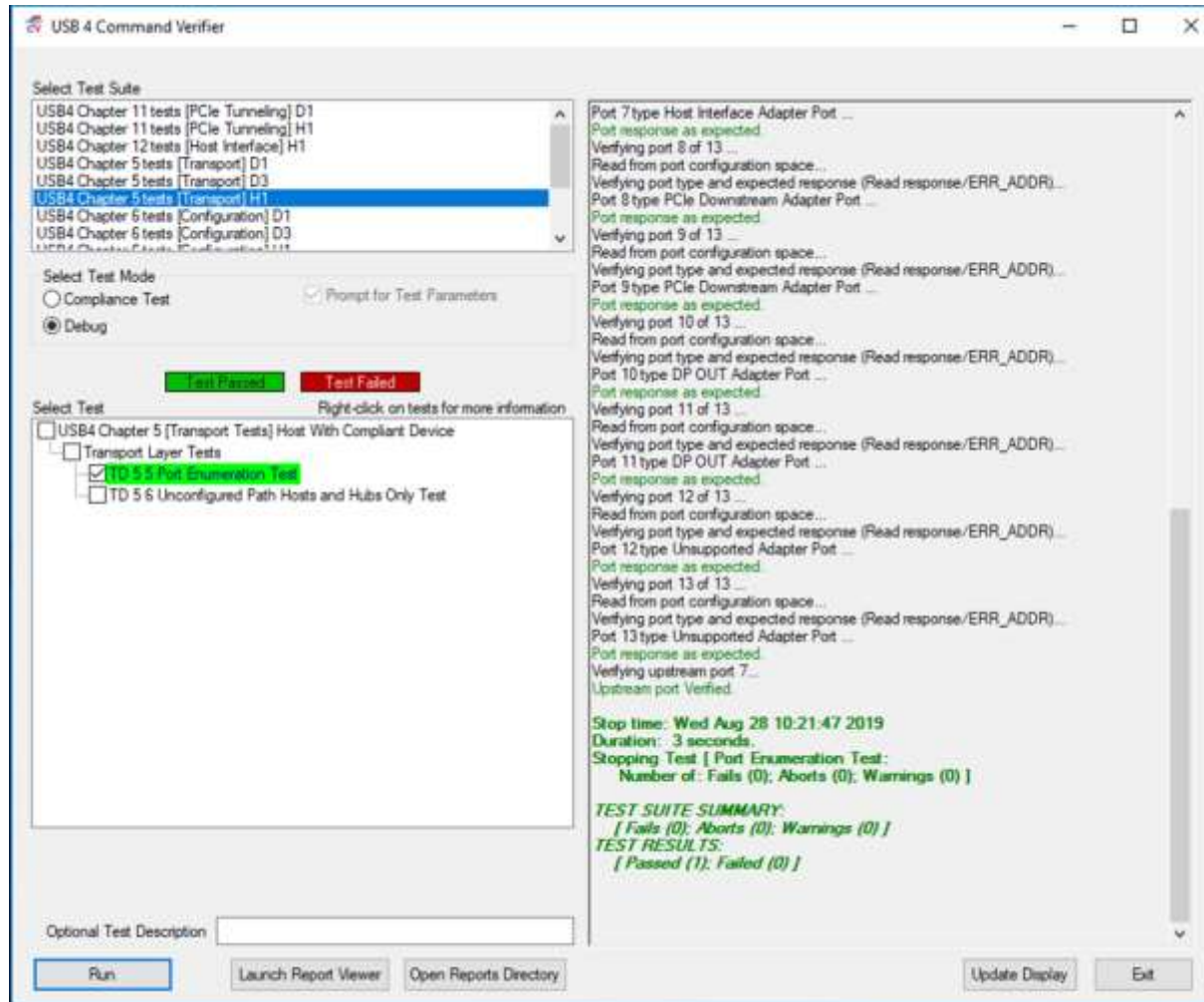
USB4™ Test Suite Summary



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



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 - **Process Overview**
 - **Pre-Certification Requirements**
 - **Test Venues**
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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 BKM's
- ★ Perform in your own lab as part of validation

Time for Q&A
