VESA – DisplayPort Technology and Compliance Program Update

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Dec 10, 2014

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Agenda

- VESA Overview
- DP 1.3
- DP Alt Mode on USB Type-C Overview
- Summary

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About VESA

- 25 years of standardization
- Vision: continual growth in technical standards development

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DisplayPort Today

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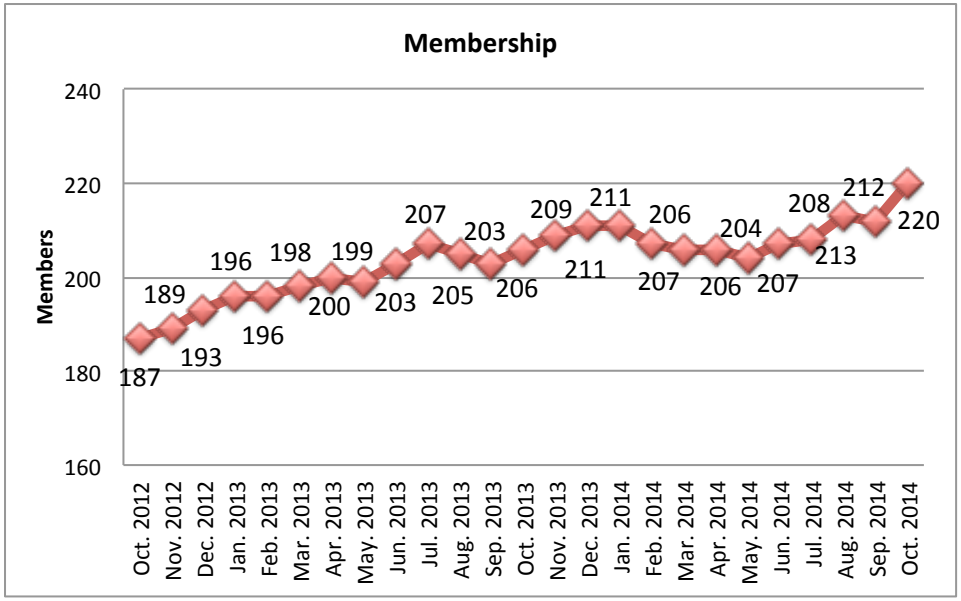
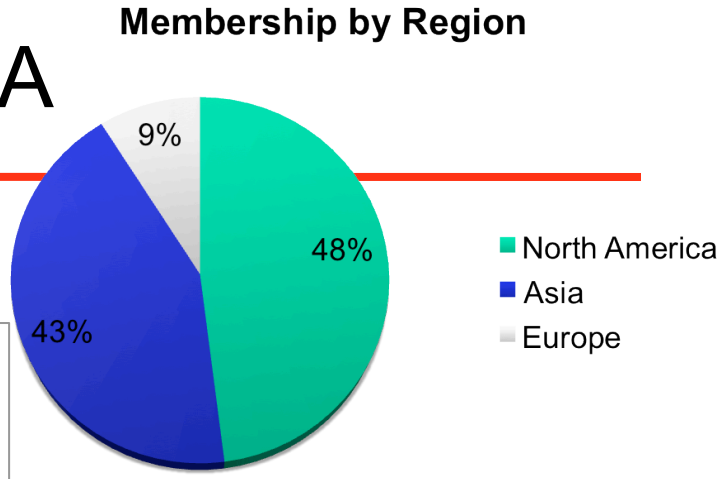
About VESA

- Global industry alliance with more than 220 member companies





VESA Membership Continues to Grow!

Mission to develop, promote and support ecosystem of vendors and certified interoperable products for the electronics industry

Facilitate DisplayPort standards development, publication and compliance testing, as well as promotion and marketing

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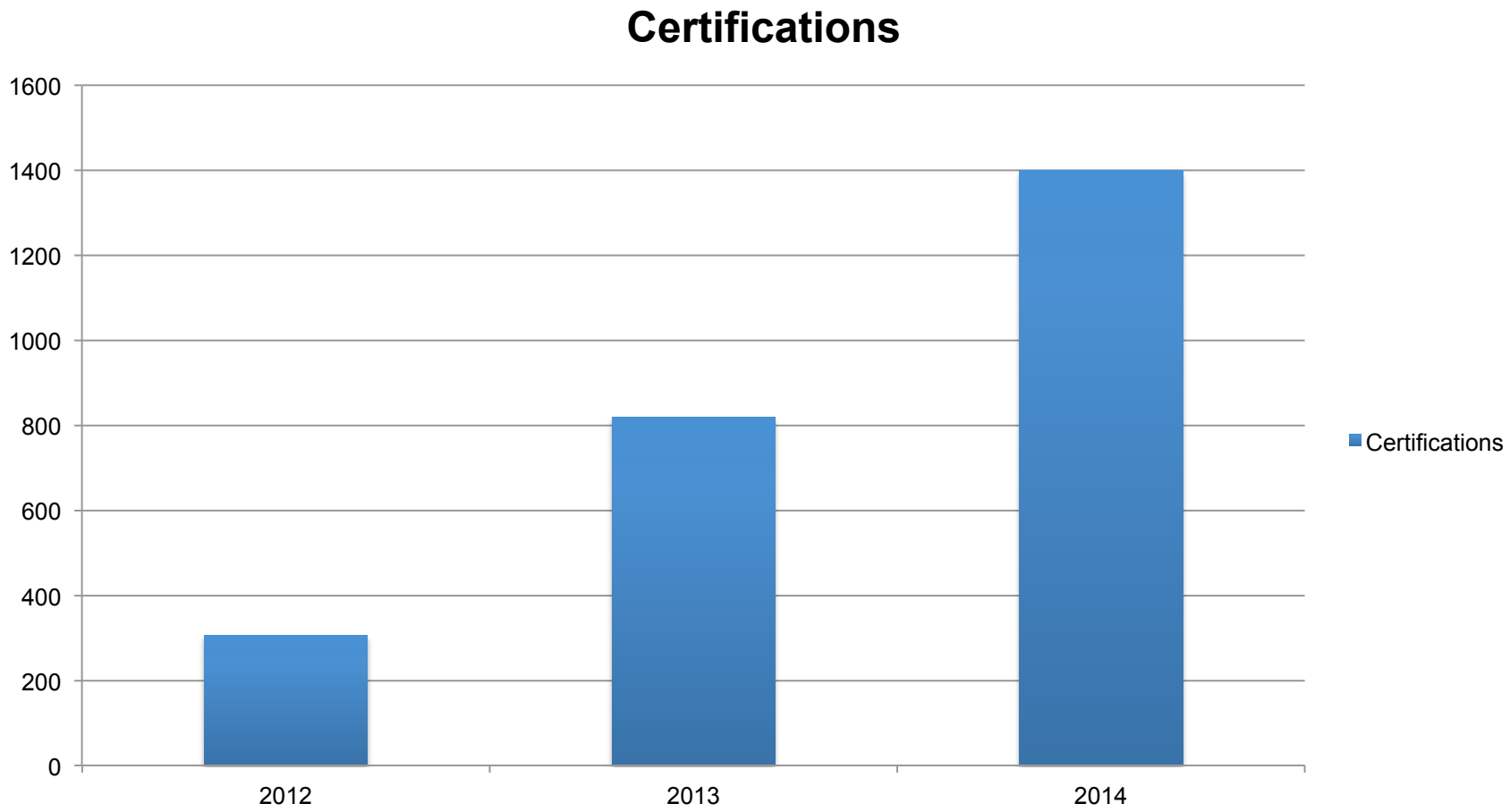
VESA Certifications



Total Products Certified over the last three years

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Certification Requirements Update

NEW: Effective January 15, 2015

- all authorized test centers and self test labs will be required to perform *Link Layer Extension Set 1* compliance testing for formal certification as described in the VESA DisplayPort Link Layer Compliance Test Specification: Extension Set 1.

Link Layer Extension Set 1 test requirements are detailed in the compliance test specification "DP Link CTS 1.2 Ext. Set 1 r1.1" available at www.vesa.org under the member downloads section.

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Plug Tests

- PlugTests have significant value to member companies. Particularly as new capabilities and products are deployed.
- VESA plans to host three PlugTests in 2015.

Objectives of 2015 Plugtests

- Demonstrate and improve Traditional Interoperability
  - Particularly important for new product capabilities
- Test DP 1.3 and DP Alt Mode over USB Type-C as devices become available
- Verify Test Equipment Correlation
- Proposed locations:
  - 2 in US
    - 1st Scheduled March 23, 2015 Embassy Suites Milpitas
  - 1 in Asia

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8

DisplayPort 1.3 Summary

- The VESA DisplayPort Standard, Version 1.3, was released on Sept 15, 2014
- Replaces DisplayPort Version 1.2a for new designs
- Backward compatible, offers new optional features
- Compliance tests expected 1st Half of 2015

Summary of Main New Features for DP 1.3

- 50% Increase in video data transfer rate
  - supports higher resolutions
  - deeper colors
  - higher display refresh rates
- Further optimized for use on shared interfaces including DP Alt Mode on USB Type-C or DockPort
- "Living Room Friendly" features added to enhance applicability for consumer displays including digital televisions

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DP 1.3 Link Rate Increase

DP Version Introduction	Link Rate Name	Bit rate	Max Resolution Support (24 bpp, 60Hz Refresh, 4:4:4 format)	Max Resolution Support (24 bpp, 60Hz Refresh, 4:2:0 format)
DP 1.0	RBR	1.62 Gbps	1920x1080	Not supported
	HBR	2.7 Gbps	2560x1600	Not supported
DP 1.2	HBR2	5.4 Gbps	4K x 2K	Not supported
DP 1.3	HBR3	8.1 Gbps	5K x 3K	8K x 4K

Total useable data transfer rate for DP 1.3 = 25.92 Gbps

8.1 Gbps link rate, per lane
x 0.8 to account for 8b/10b transport coding overhead
x 4 maximum number of available lanes
25.92 Gbps total usable data transfer rate

Example Display Support using HBR3 Link Rate

HBR3 enables the following display resolution through a single DisplayPort connection, without the use of compression:

- 5K x 3K (pixel resolution of 5120 x 2880) with 60Hz refresh, 24 bit color
- Enhanced 4K UHD display, with these example enhancements:
  - 120Hz refresh and 24 bit color
  - 96Hz refresh and 30 bit color

Note: The examples above assume the support of HBR3 by both the video source and display, and the use of VESA monitor timing. All examples assume the standard 4:4:4 display pixel format.

Example Display Applications for HBR3 Link Rate (Continued)

Using the DisplayPort Multi-Stream feature, HBR3 can enable the following example display configurations, without the use of compression:

- Two 4K UHD (3840 x 2160) displays
- Up to Four 2560 x 1600 displays
- Up to Seven 1080p or 1920 x 1200 displays
- One 4K UHD display with up to Two 2560 x 1600 displays

Optimization for Shared Interface Use

- Numerous specification enhancements to simplify the use of DisplayPort as an ingredient in the following interface examples:
  - The USB Type-C connector, using the DisplayPort Alt Mode
  - VESA DockPort Standard
  - VESA Mobility DisplayPort Standard (MyDP)
  - VESA Embedded DisplayPort Standard (eDP)
  - ThunderBolt
  - Future wireless interfaces

- Example enhancements to DP 1.3:
  - Improved link training to accommodate more varied and complex video transport topologies, along with the higher link rate of HBR3
  - The addition of link-trainable repeaters to increase performance and reliability across complex topologies (such as docking station + Hub + active cable)
  - Unified device register set to simplify implementation and allow devices to support various interface types

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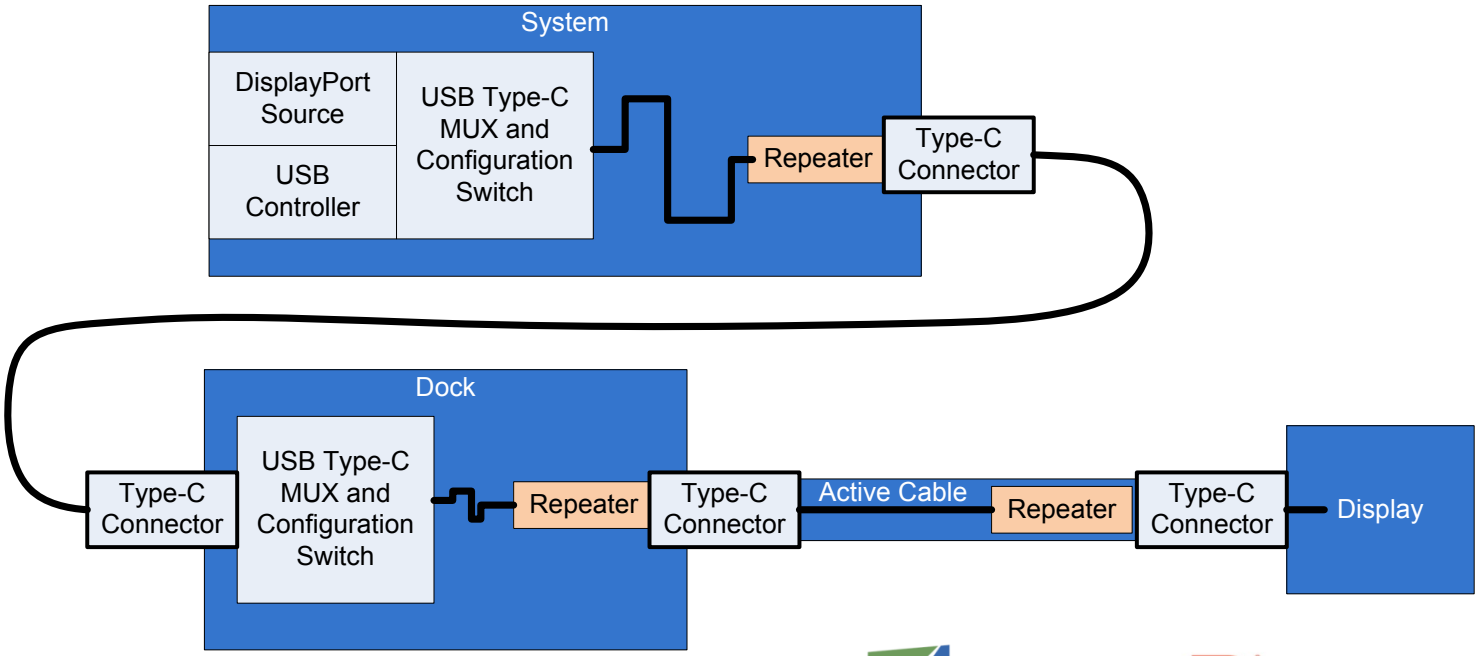
Example Link Trainable Repeater Application

- Used to overcome signal loss in complex signal distribution topologies
- Can be applied to active cables
- For each physical interface segment, link training results in signal transmitter and receiver adjustments to optimize signal performance
- This unique video interface feature yields a higher interface data rate with increased reliability and lower error rate



Other New Features

- New definition for Branch Device using SST (Single Stream Transport mode)
  - Enables different link configurations between the upstream facing and downstream facing ports, such as 2 HBR2 links in, and 4 HBR links out
  - Simplifies the implementation of docking stations, those with USB Type-C receptacles supporting DisplayPort Alternate Mode
- Support of RAW pixel format to support high-performance camera sensors

DisplayPort 1.3 Continues to Support Other Features that are Unique to DisplayPort

- Support of multiple monitors using Multi-Stream
- Support of high-definition audio formats
- Support of Adaptive Sync
- Support of protocol converters to VGA, DVI, or HDMI
- Low voltage, AC coupled interface compatible with sub-micron process geometry, simplifying integration
- Data scrambling and fixed link rates simplify EMI and RFI mitigation
- **Royalty free standard** available to VESA members

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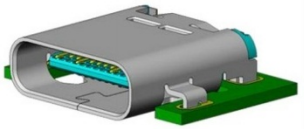
Expected DisplayPort 1.3 Deployment

- General availability of devices supporting new features such as HBR3 or 4:2:0 is expected in 2016.
- DP 1.3 is expected to be enabled in both native DP devices and devices using the USB Type-C interface with the DisplayPort Alternate Mode
- DisplayPort-to-HDMI 2.0 converters are expected in 2015. May require a firmware update for existing DP 1.2a systems.
- DP 1.3 CTS development has begun

DP Alt Mode on USB Type-C Overview and Certification

VESA DisplayPort Alt Mode on USB Type-C Summary

- The *VESA DisplayPort Alt Mode Standard, Version 1*, was released on Sept 22, 2014
- Enables the use of the USB Type-C interface for DisplayPort



- Alternate Mode functional extension of the USB Type-C interface
- Developed in liaison with the USB 3.0 Promoter Group

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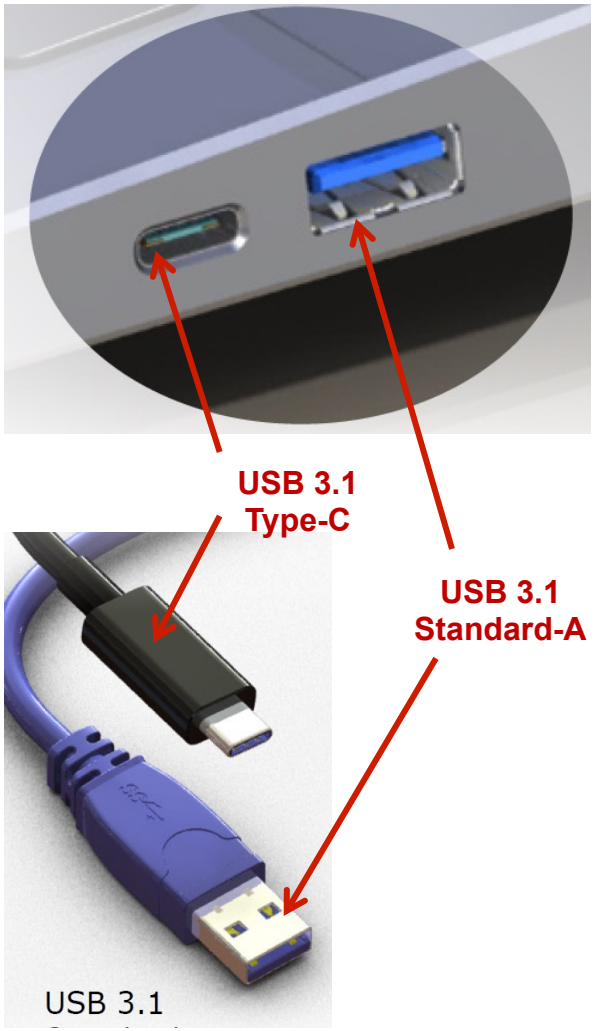
Introduction of USB Type-C

USB Type-C information is provided as an informative overview only, please refer to the USB Type-C Cable and Connector Specification available at www.usb.org for more information

- New generation of USB connector developed to serve the market for next 20 years
- Thin profile suitable for both ultra portable devices and larger devices
- Reversible plug orientation & cable direction
  - USB 3.1 Gen 2 (10Gbps)
  - USB Power delivery, up to 100 watts
  - Supports DisplayPort Alternate Mode

USB Type-C will be the only interface you will need

- *High speed, secure data*
- *Display connection*
- *System Power*



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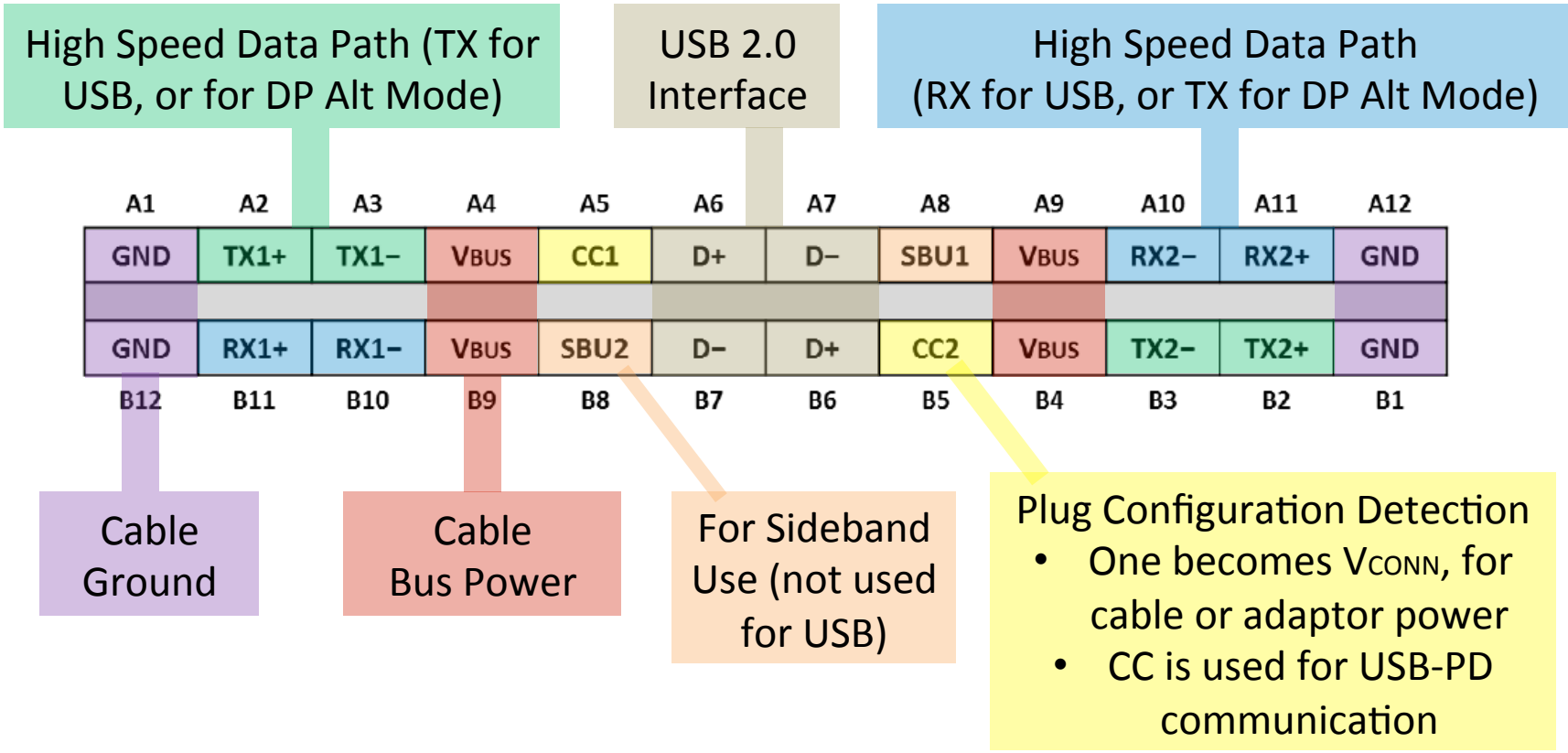
USB Type-C Receptacle Pins

Below is a diagram of the pins defined for system or device receptacle



USB Type-C Connector Pin Mating

Receptacle configuration

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND
GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

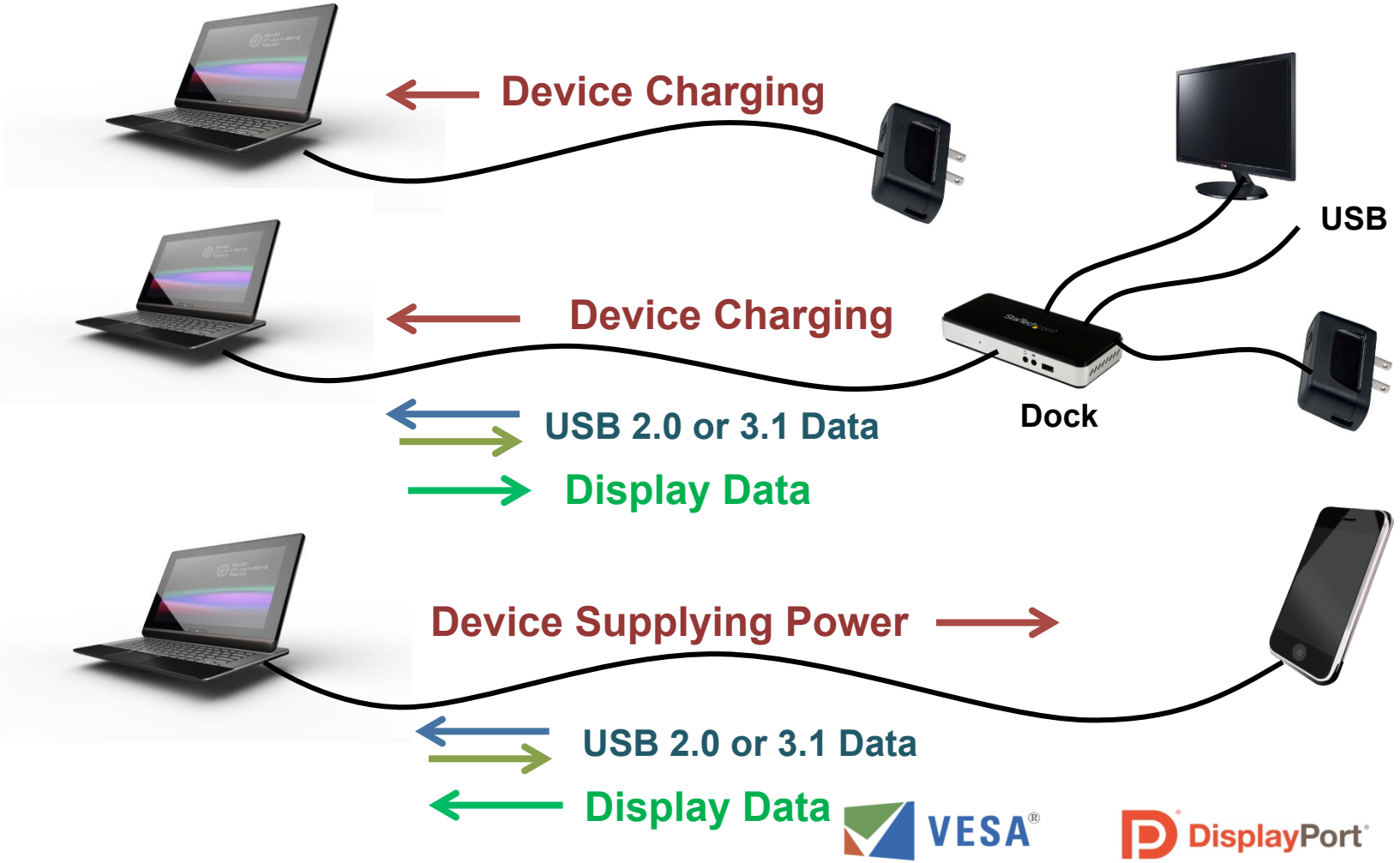
Plug configuration (for cable, or other plug-in device)

A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2−	VBUS	SBU1	D−	D+	CC	VBUS	TX1−	TX1+	GND
GND	TX2+	TX2−	VBUS	VCONN			SBU2	VBUS	RX1−	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

- **Plug can inserted into receptacle in either orientation (can rotate 180 degrees)**
- **Device with receptacle is responsible detecting orientation and routing proper signals to receptacle pins as needed**

Example USB Type-C Configurations

Either end can serve as USB Host, USB-PD Power Consumer, and DisplayPort Video Source (these services are orthogonal to each other)



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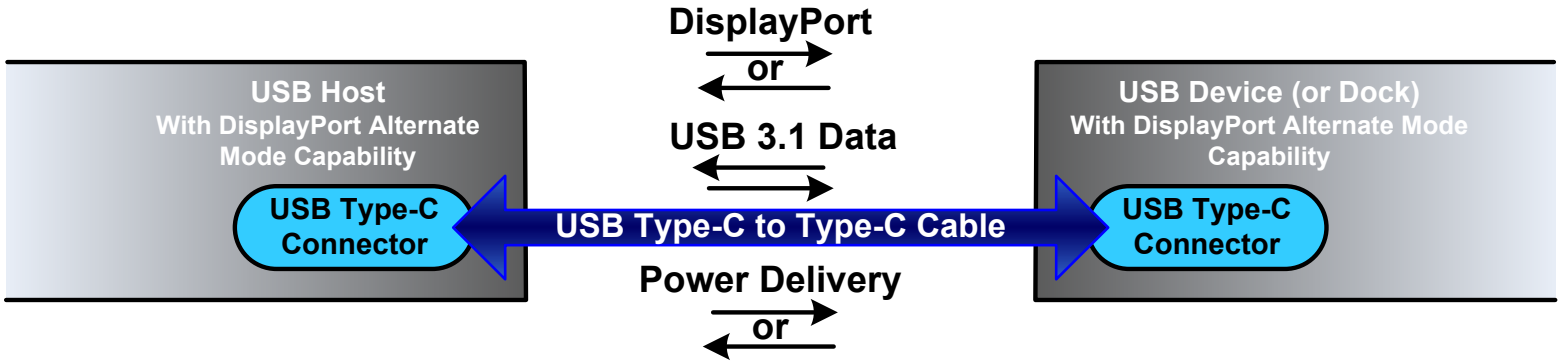
USB Type-C Connector Function Extension

DisplayPort Alternate Mode



- A passive Full Feature USB Type-C to Type-C cable can carry up to four DisplayPort lanes
  - This will offer the same performance and feature capability as a standard DisplayPort connection
  - This will also allow DisplayPort data rates to increase in the future, since the USB Type-C connector has very high data rate capability
- DisplayPort can be combined with USB 3.1 operation over the same USB Type-C cable
  - Implemented with two high speed pairs for DP (using two lane DP operation), and two high speed pairs for USB (USB 3.1 only uses two high speed lanes for normal operation)
  - Useful for docking stations or hubs, or for adding docking station functionality to a display
- USB 2.0 and USB Power Delivery is available in all configurations
  - Because USB 2.0 and USB Power Delivery use dedicated wires in the USB Type-C cable, both of these services are always available, even when using all four USB Type-C high speed pairs for DisplayPort

DP Alt Mode Terminology

- Terminology was needed to describe port capabilities independent of port connector type
  - Downstream facing port (DFP)
  - Upstream facing port (UFP)
  - DisplayPort function (_D)
  - USB C function (_U)

"Connector type" "port direction"_"function"

Ex. DisplayPort DFP_D

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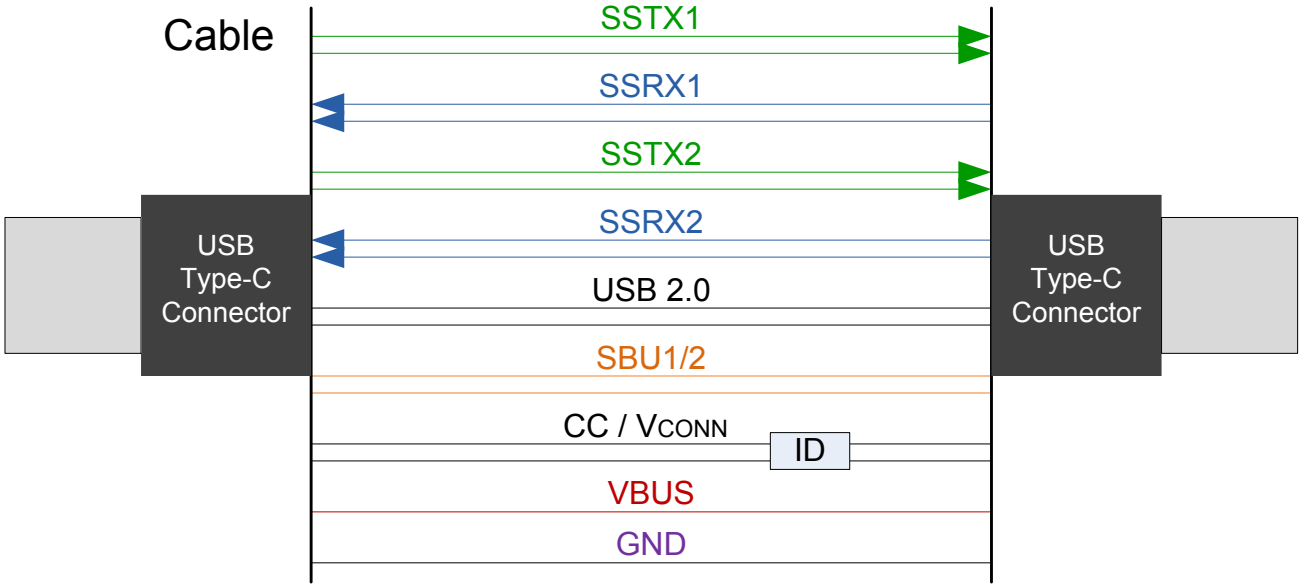
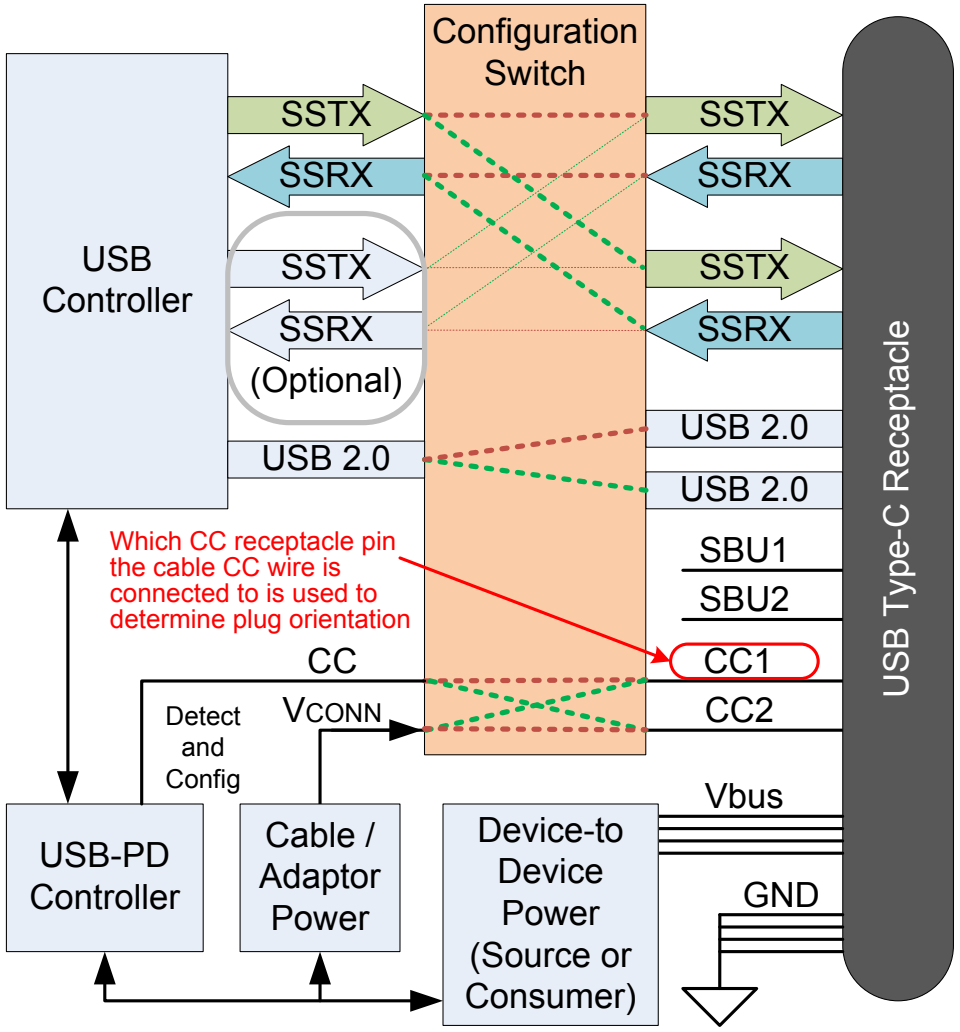
Type-C to Type-C Full Feature Passive Cable



- This will be a common, widely available cable for USB Type-C applications, and it will support the DisplayPort Alt Mode
- Full Feature Type-C cables and certain adapters have an electronic ID that can be read by USB-PD protocol to determine capability
- Passive cables up to 1m are designed to support SS Gen 2 (10 Gbps)
- Passible cable up to 2m are designed support SS Gen 1 (5 Gbps)

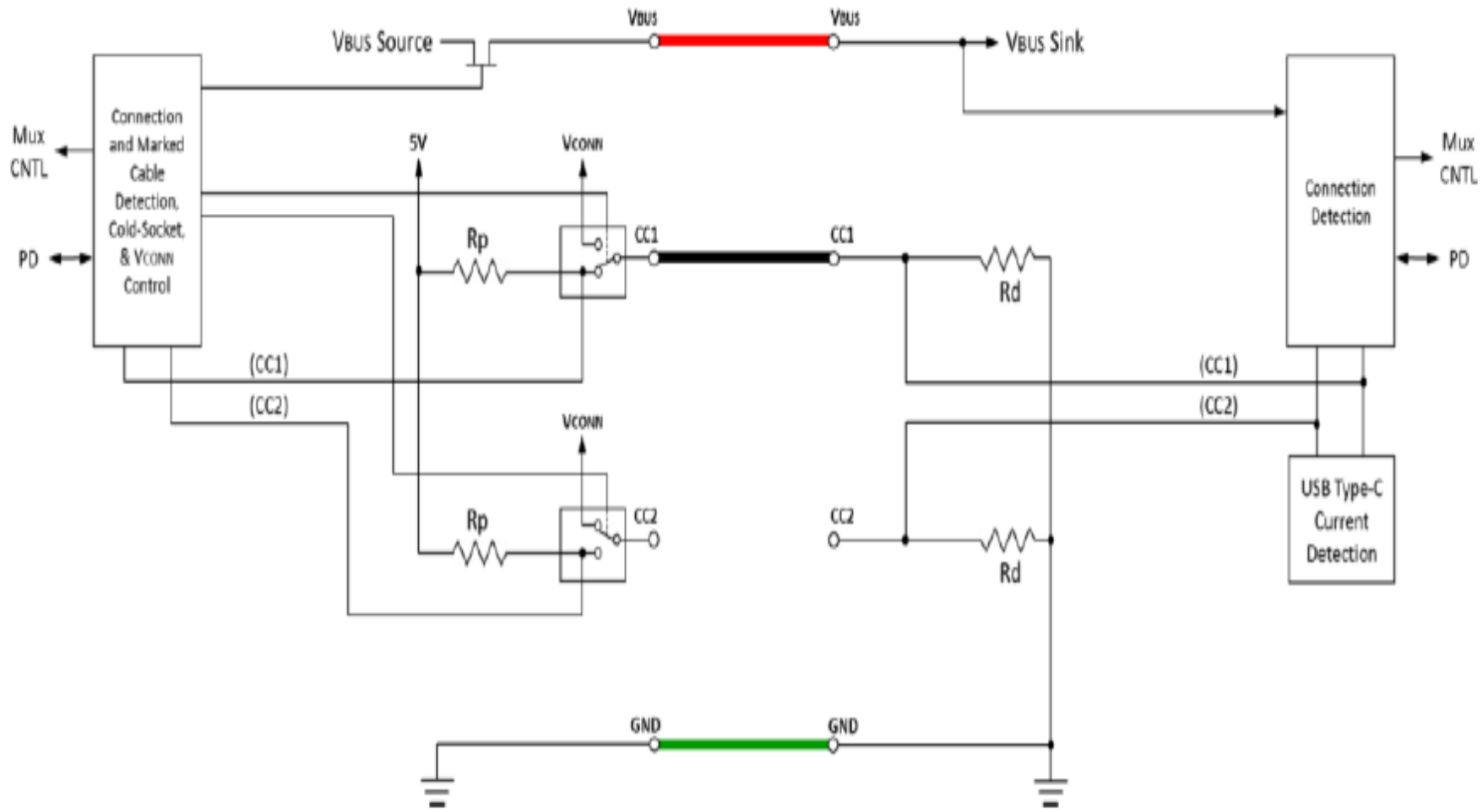
USB Type-C Plug Orientation Reversing is Supported by a Connector PHY Switch



- Example for USB Type-C receptacle that supports USB modes only
- A similar switch is needed at the Device end
- Switch can be integrated with USB function

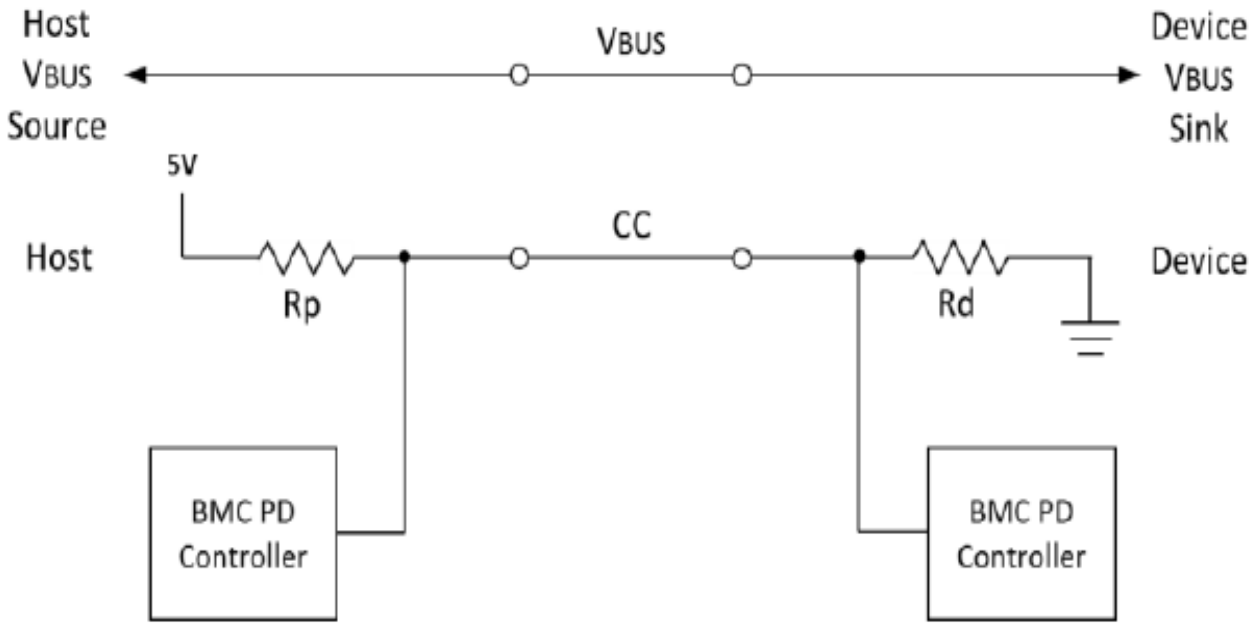
Switching mechanism

- Rp (pullup resistor) and Rd (pulldown resistors) on CC1/CC2 determine polarity

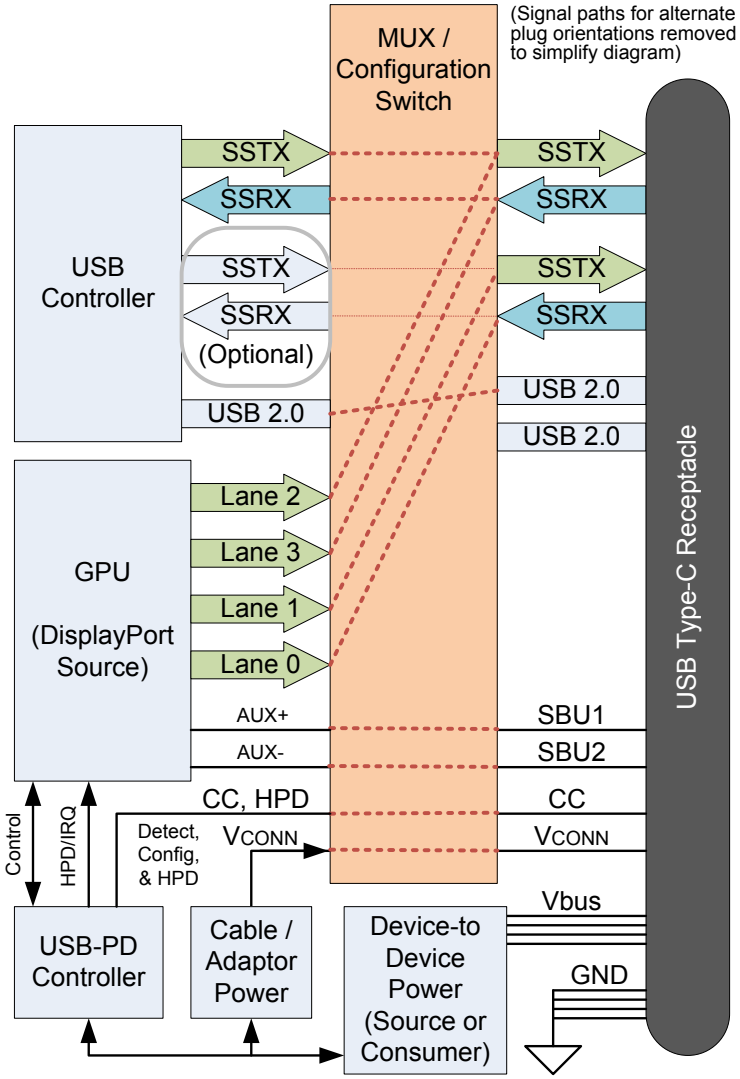


Power Contract/Alt mode detection

- BMC controllers negotiate power and Alt Modes
- Vbus for legacy devices



USB Type-C Connector PHY Switch for Supporting DisplayPort Alternate Mode



- Example for interface that supports USB and DisplayPort Alternate Mode
- Similar switch needed at the Device end
- Switch can be integrated along with the USB and DisplayPort functions

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Supported cable types

- USB C to USB C
- USB C to DP
- USB C to Protocol converter
- USB C to Dockport

- USB C to DP cables must include logic to support USB PD and DP connection detect protocols.
- Protocol converters must support some optional features in DP 1.3 specification

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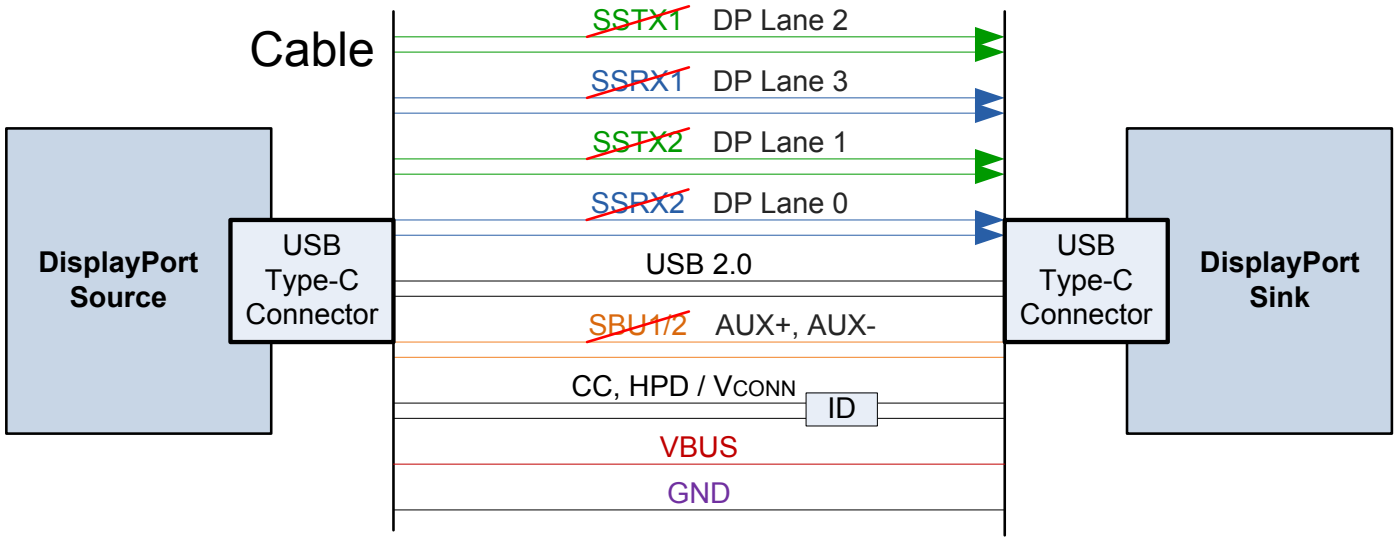
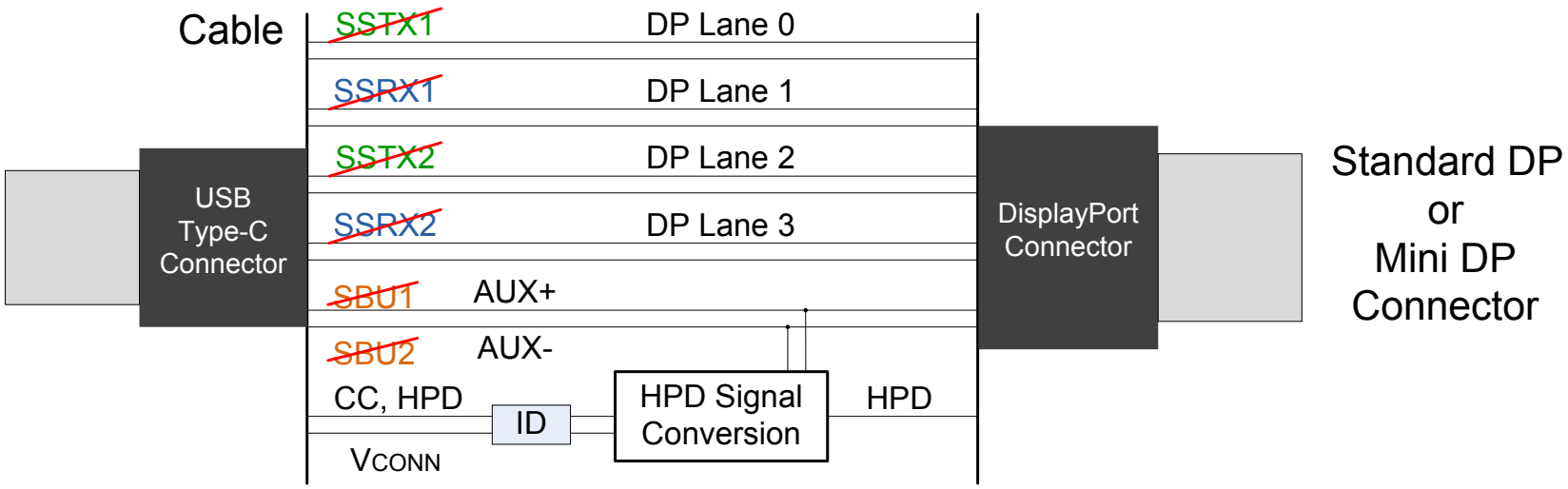
DisplayPort Over a USB Type-C to Type-C Full Feature Passive Cable

Please refer to the VESA DisplayPort Alt Mode on USB Type-C Standard for more information



- Utilizes optional DisplayPort Alt Mode capability of USB Type-C connector
- DisplayPort can use all four high speed lanes to deliver full DisplayPort performance
- The DisplayPort AUX Channel uses the SBU pins
- The DisplayPort HPD / IRQ is transmitted over the CC pin using the USB-PC protocol
- USB 2.0 and USB Power Delivery always available

USB Type-C to DisplayPort Adapter Cable



- Utilizes optional DisplayPort Alt Mode capability of USB Type-C connector
- Cable is reversible, works in either direction; four lanes of DisplayPort
- Supports legacy DisplayPort Source and Sink Devices
- Detected by USB Type-C enabled device that supports DP Alt Mode
- No support for USB or other alt modes
  - These features are not supported by legacy DisplayPort devices

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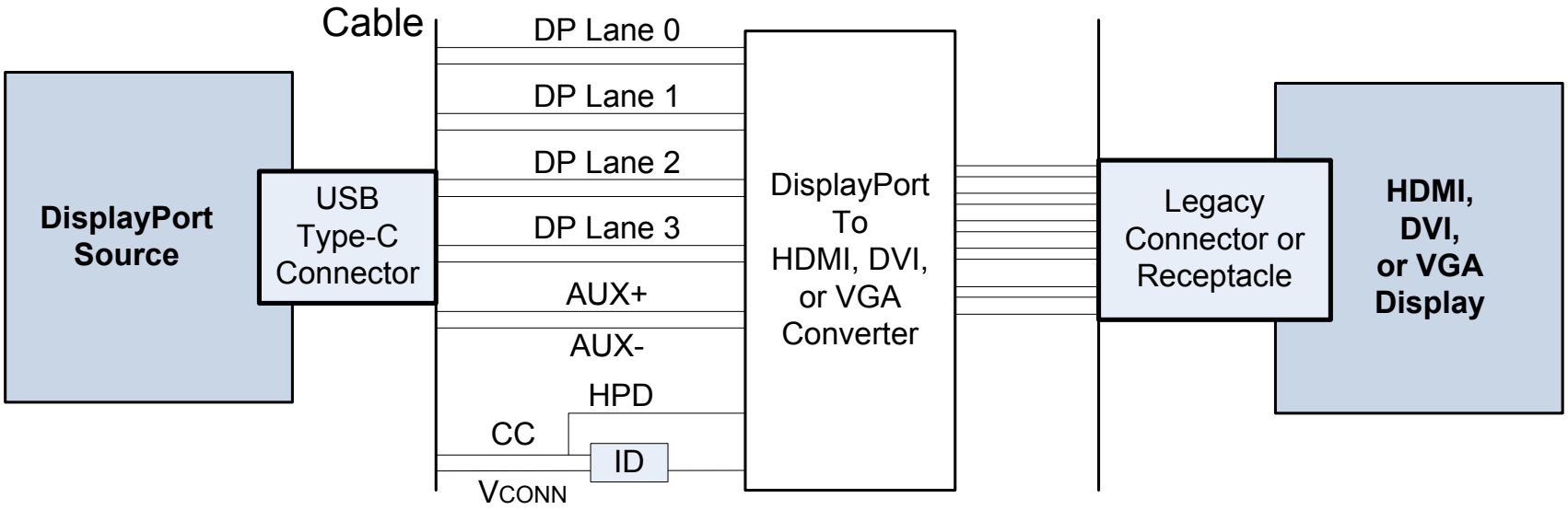
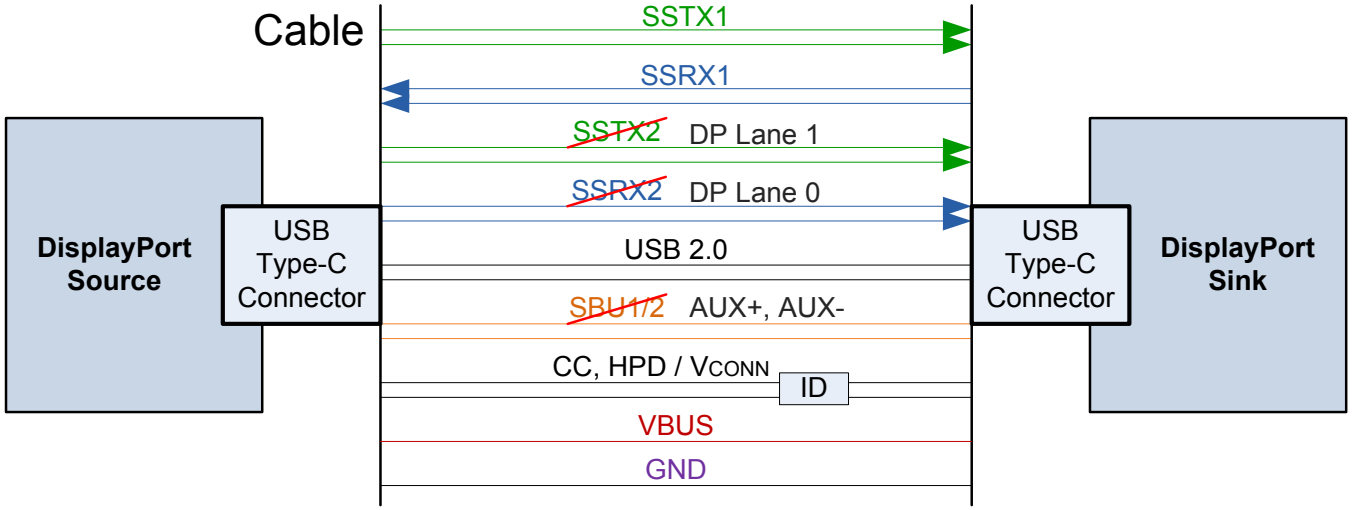
USB Type-C to HDMI, DVI and VGA Adapter Cables / Cable Adapters



- Utilizes DisplayPort Alt Mode capability of USB Type-C connector
- Adapter Cable: USB Type-C plug on one end, legacy plug on other end
- Adapter: USB Type-C plug on one end, legacy receptacle on other end
- USB Type-C will NOT support DisplayPort Dual Mode (DP++)
- USB Type-C to HDMI Converters will support HDMI 2.0 and CEC

DisplayPort and USB 3.1 over a Type-C to Type-C Full Feature Passive Cable

Configuration for Docking Stations



- Utilizes DisplayPort Alt Mode capability of USB Type-C connector
- DisplayPort uses two high speed lanes
  - For DP 1.2a (HBR2), this provides support for 2560x1600 or 2 each 1080p displays
  - For DP 1.3 (HBR3), this will provide support of 4K UHD (3840 x 2160)
- Two high speed lanes used for USB 3.1
- USB 2.0 and USB Power Delivery always available
- DP lane count and USB speed selection is use case determined

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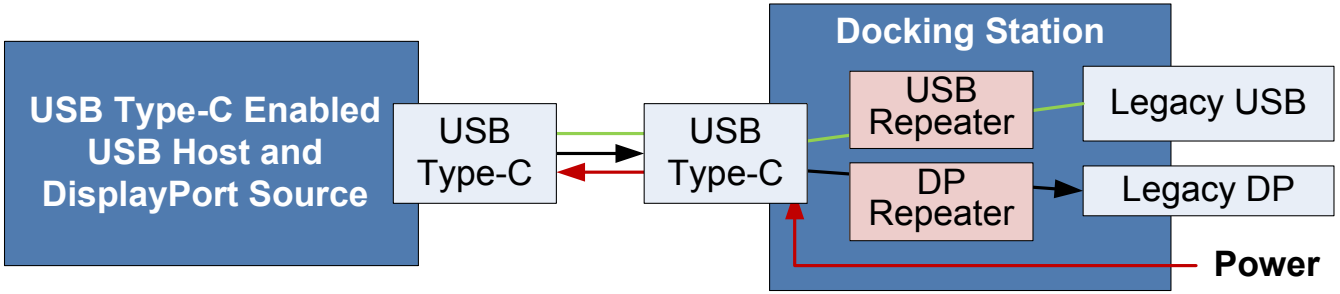
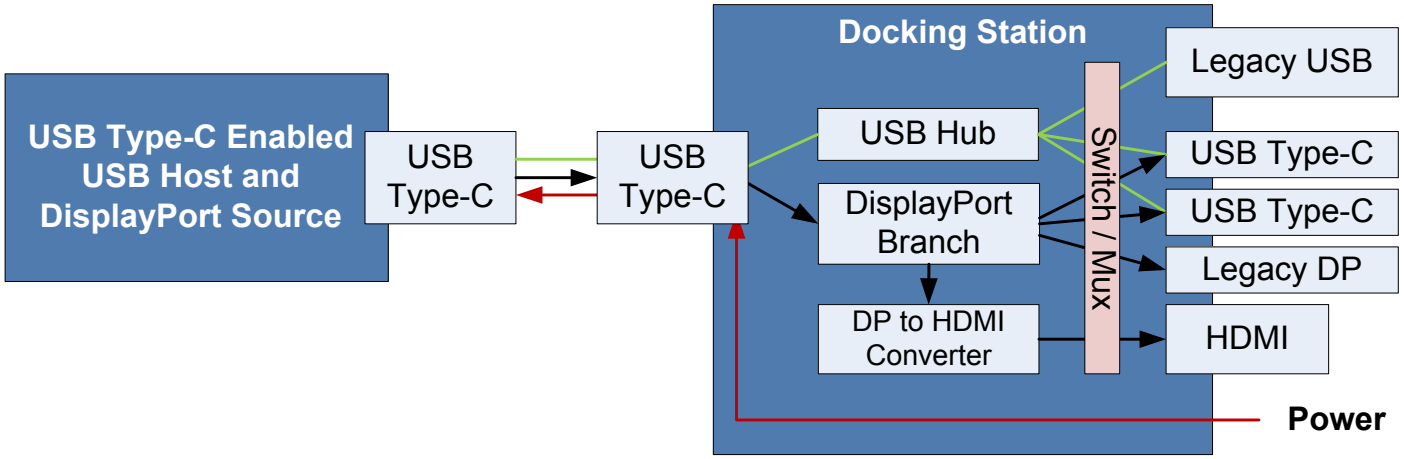
Example Docking Configurations using the USB Type-C DisplayPort Alternate Mode

Simple Docking Configuration



More Complex Docking Configuration



DisplayPort Alternate Mode
Compliance Test Plan

- VESA will develop and publish the DP Alternate Mode compliance test in coordination with the USB-IF
- Compliance test specification work has begun.
- The objective is to enable compliance testing for USB Type-C, and the DP Alt Mode for USB Type-C, at the same ATCs enabling the use of a single test station

Summary

- DP 1.3 provides over 50% increase in performance among other improvements
- DisplayPort Alt Mode over USB Type-C facilitates technology coverage in portable products
- DP Alt Mode CTS will be available mid 2015
- 3 Plug Tests in 2015

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39

QUESTIONS?