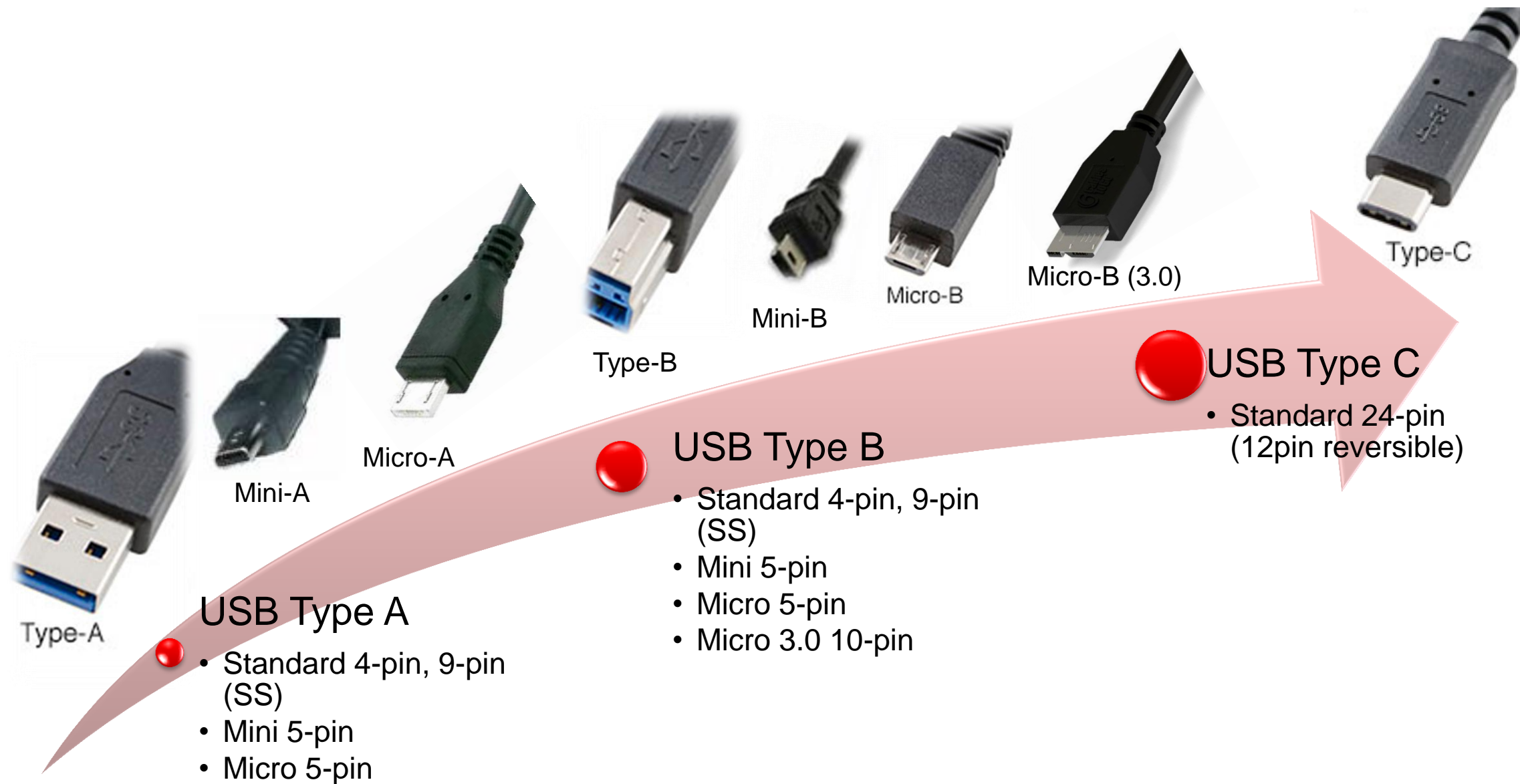


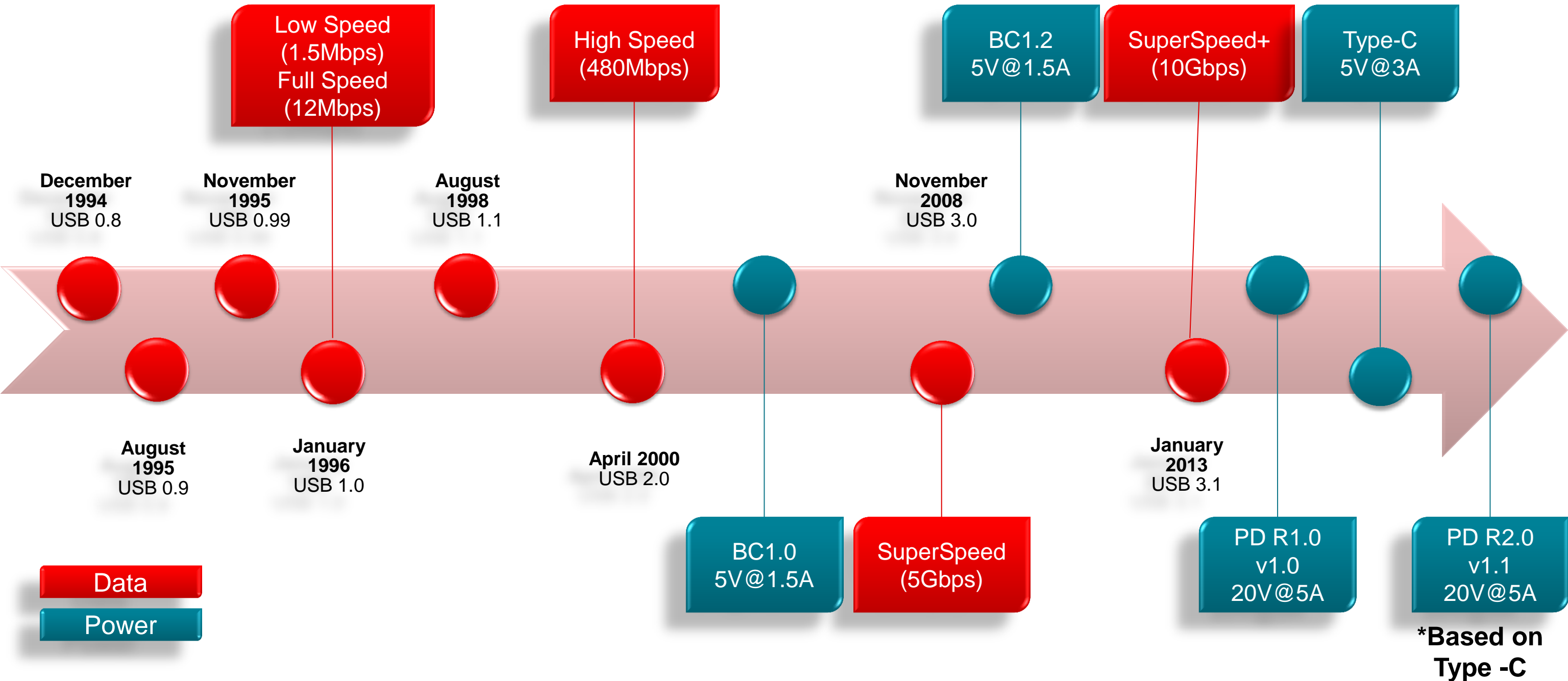
USB Type-C Overview

Mark Pearson, FAE, TI – Bloomington, MN Sales Office

Evolution of USB connectors



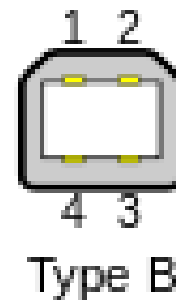
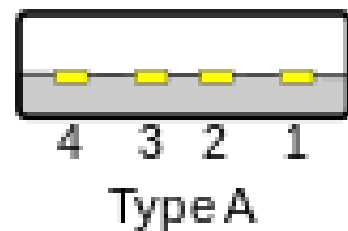
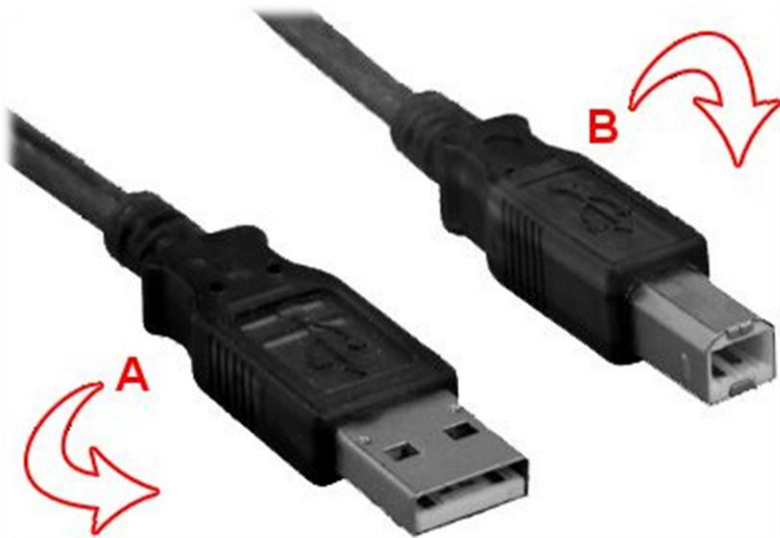
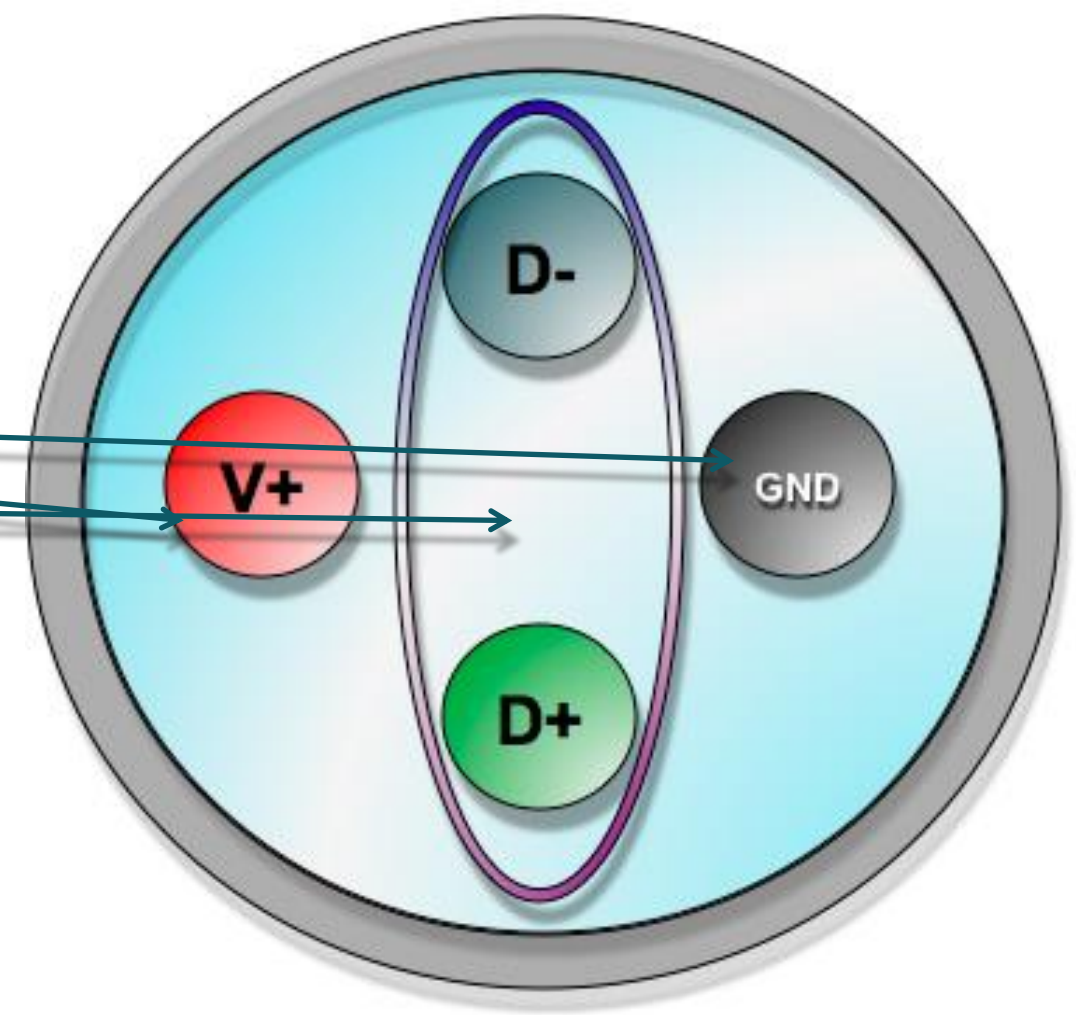
Evolution of USB Speed & Power



In the Beginning USB 2.0 Cable

The “original” USB has just four electrical contacts

- 5V PWR (VBUS) and GND
- D+ and D- Data busses
- USB 2.0 was First connector to combine both Data and Power!



USB 2.0 has been a great workhorse, but:

- Connectors are clumsy
- Different connectors at either end for Host/Device
- Not easy to find the right cable with the right two connectors
- Limited data speeds and connectivity

USB 2.0: Battery Charging (BC) 1.2

USB 2.0 Port Types	Description
Standard Downstream Port (SDP)	<ul style="list-style-type: none">• Typically found in desktop and laptop computers.• Maximum load current:<ul style="list-style-type: none">• 2.5mA suspended,• 100mA connected (and not suspended)• 500mA (max) with specific configuration• Recognized when the USB data lines, D+ and D-, are separately grounded through 15kΩ, and then is enumerated (in order to be USB compliant)
Charging Downstream Port (CDP)	<ul style="list-style-type: none">• Newer, higher current USB port for PCs, laptops, and other hardware.• Current can be supplied before enumeration, up to 1.5A*• Hardware handshake on the D+ and D- lines recognizes device plugged into a CDP
Dedicated Charging Port (DCP)	<ul style="list-style-type: none">• Charging occurs without any digital communication.• Only supplies up to 1.5A*• A short exists between D+ to D-

*Proprietary Charging will require 2.1A-2.4A!

USB Type-C Introduction

Why Type-C?

- What does it provide for users?
 - Broad application in integration of standards
 - MHL, Display Port, USB, Thunderbolt
 - High Speed and Performance
 - Backwards compatible with previous speeds (legacy support)
 - High Power
 - 100W capable
 - Power direction is reversible
 - Reversible / Flip-able connector
 - eWaste – path to single universal plug / further reduction of cabling
 - i.e. Monitor needs no adapter
- Why does it matter for infotainment?
 - Displays are becoming better → need connectors to be capable!

USB Type-C™ Terms

Term	Description
Alternate Mode	Operation defined by a vendor or standards organization that is associated with a SVID assigned by the USB-IF. Entry and exit into and from an Alternate Mode is controlled by the USB PD .
CC	<u>Configuration Channel</u> (CC) used in the discovery, configuration and management of connections across a USB Type-C cable.
DFP	<u>Downstream Facing Port</u> , specifically associated with the flow of data in a USB connection. Typically the ports on a host or the ports on a hub to which devices are connected. In its initial state, the DFP sources V_{BUS} and VCONN, and supports data. A charge-only DFP port only sources V_{BUS} .
DRD (<u>Dual-Role-Data</u>)	The acronym used in this specification to refer to a USB port that can operate as either a DFP (Host) or UFP (Device). The role that the port initially takes is determined by the port's power role at attach. A Source port takes on the data role of a DFP and a Sink port takes on the data role of a UFP. The port's data role may be changed dynamically using USB PD Data Role Swap .
DRP (<u>Dual-Role-Power</u>)	The acronym used in this specification to refer to a USB port that can operate as either a Source or a Sink. The role that the port offers may be fixed to either a Source or Sink or may alternate between the two port states. Initially when operating as a Source, the port will also take on the data role of a DFP and when operating as a Sink, the port will also take on the data role of a UFP. The port's power role may be changed dynamically using USB PD Power Role Swap .
SBU	Sideband Use. (For Alternate Mode)
Sink	Port asserting Rd on CC and when attached is consuming power from V_{BUS} ; most commonly a Device.
Source	Port asserting Rp on CC and when attached is providing power over V_{BUS} ; most commonly a Host or Hub DFP.
UFP	<u>Upstream Facing Port</u> , specifically associated with the flow of data in a USB connection. The port on a device or a hub that connects to a host or the DFP of a hub. In its initial state, the UFP sinks V_{BUS} and supports data.

What is USB Type-C?

USB Type C is a new receptacle, plug, and cable standard that is compatible with existing USB interfaces:

- First connector supporting power, data and video!
- Connector:
 - Small form factor connectors
 - Flip-able connectors and reversible cable that gives a more user friendly experience
- Data Rate:
 - Supports USB 3.1 (10Gbps)
 - Supports “Alternate Modes” through the same port
- Power:
 - New USB Type-C Current (5V / 1.5A / 3A)
 - Supports USB PD (up to 100W)

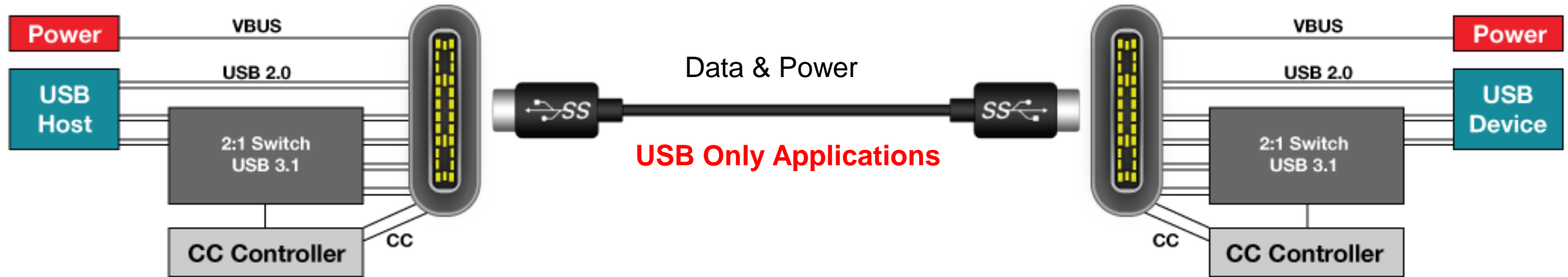


USB Type-C: the voltage is fixed while current is scalable

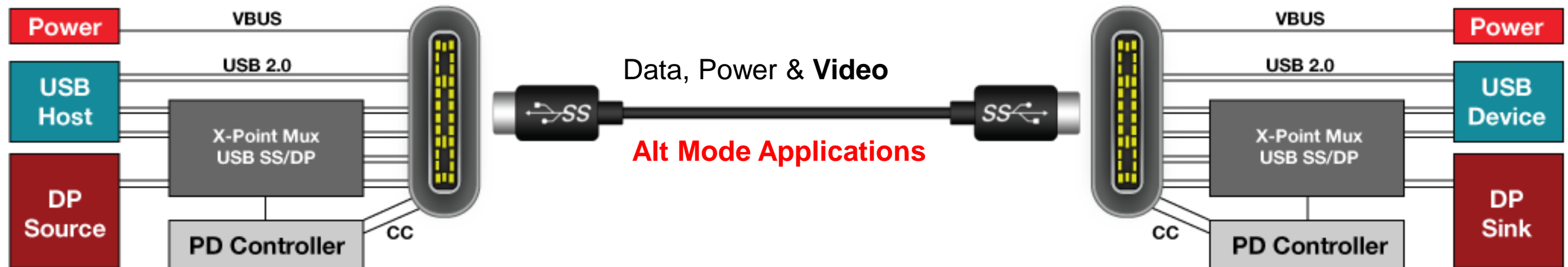
USB PD: the wattage is fixed while the voltage and current are scalable

USB Type-C is a Physical Interface

Supports USB 2.0 or USB 3.1 or DisplayPort video or other protocols



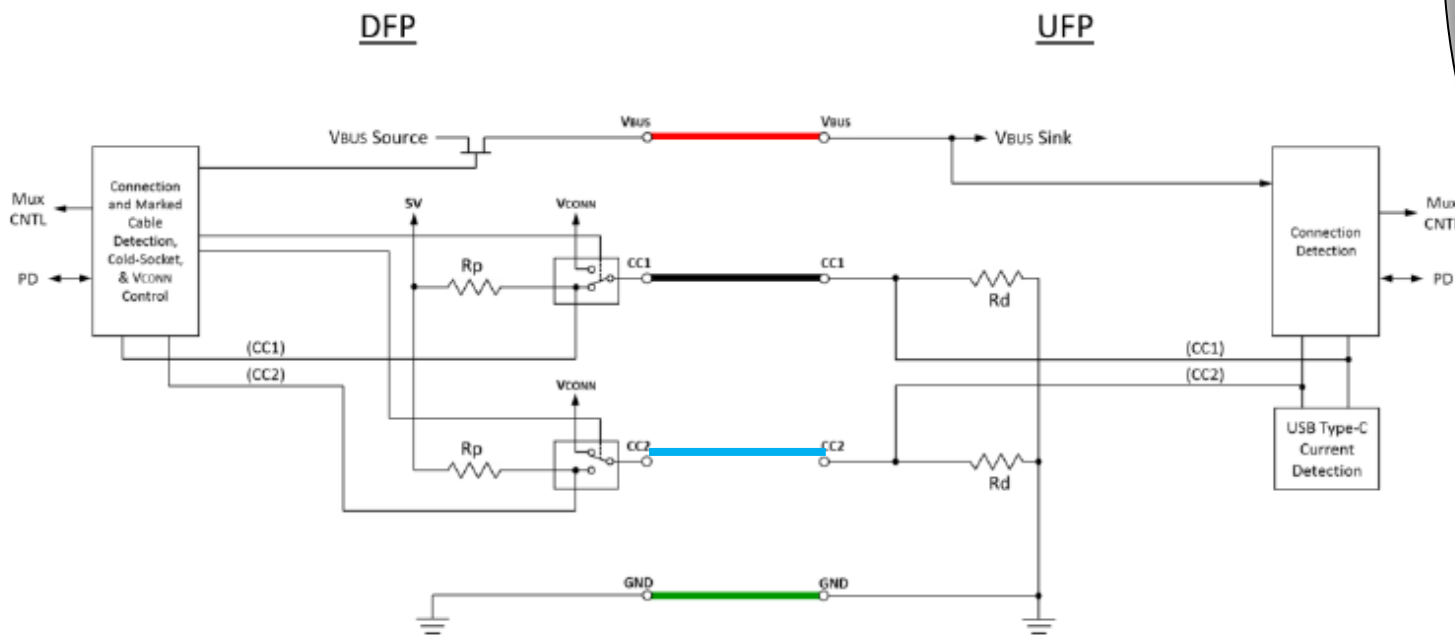
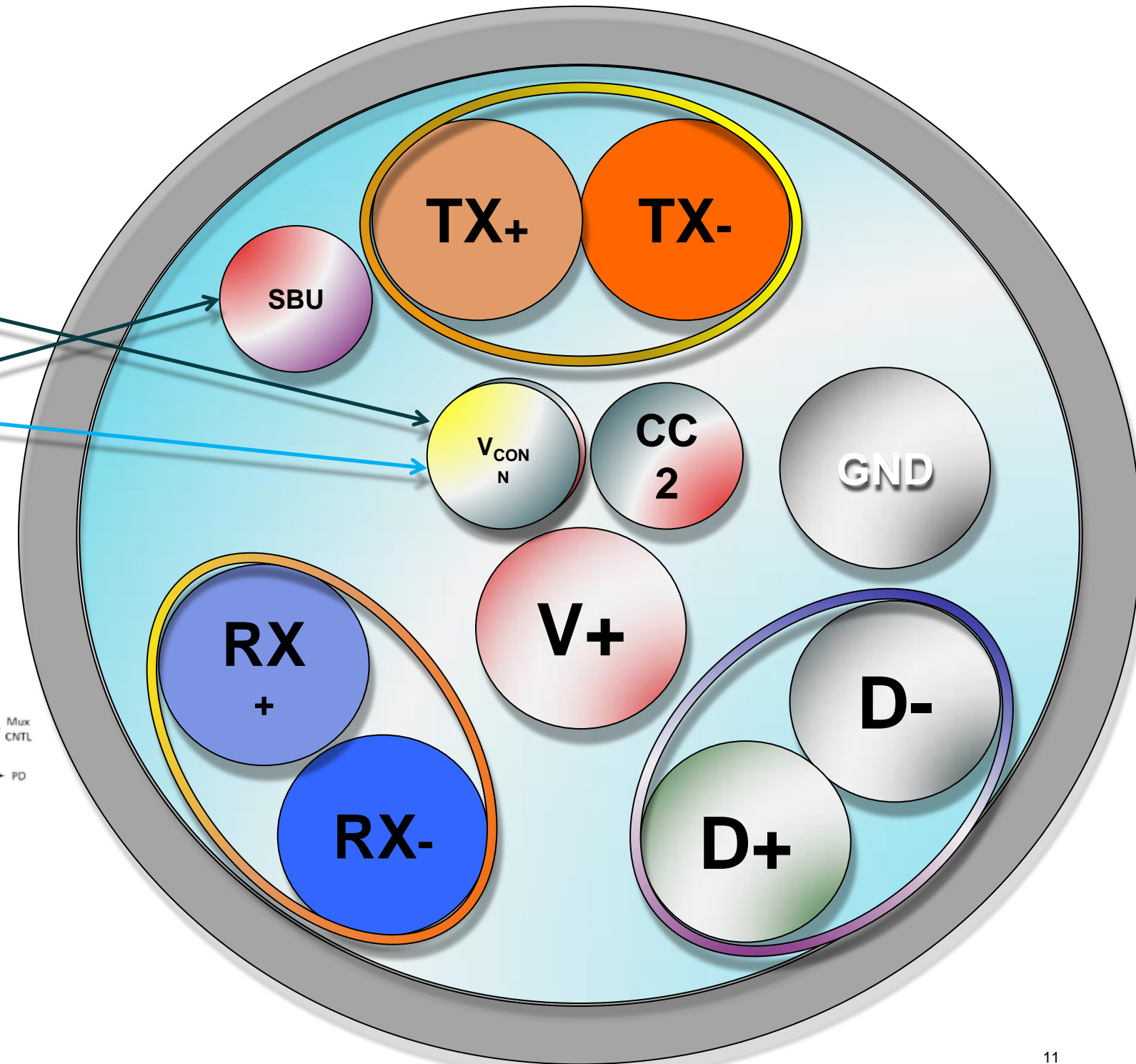
USB Type-C is a connector/cable interface, not a new speed
USB2, USB3.1 and Alt Mode function (DP video) can co-exist



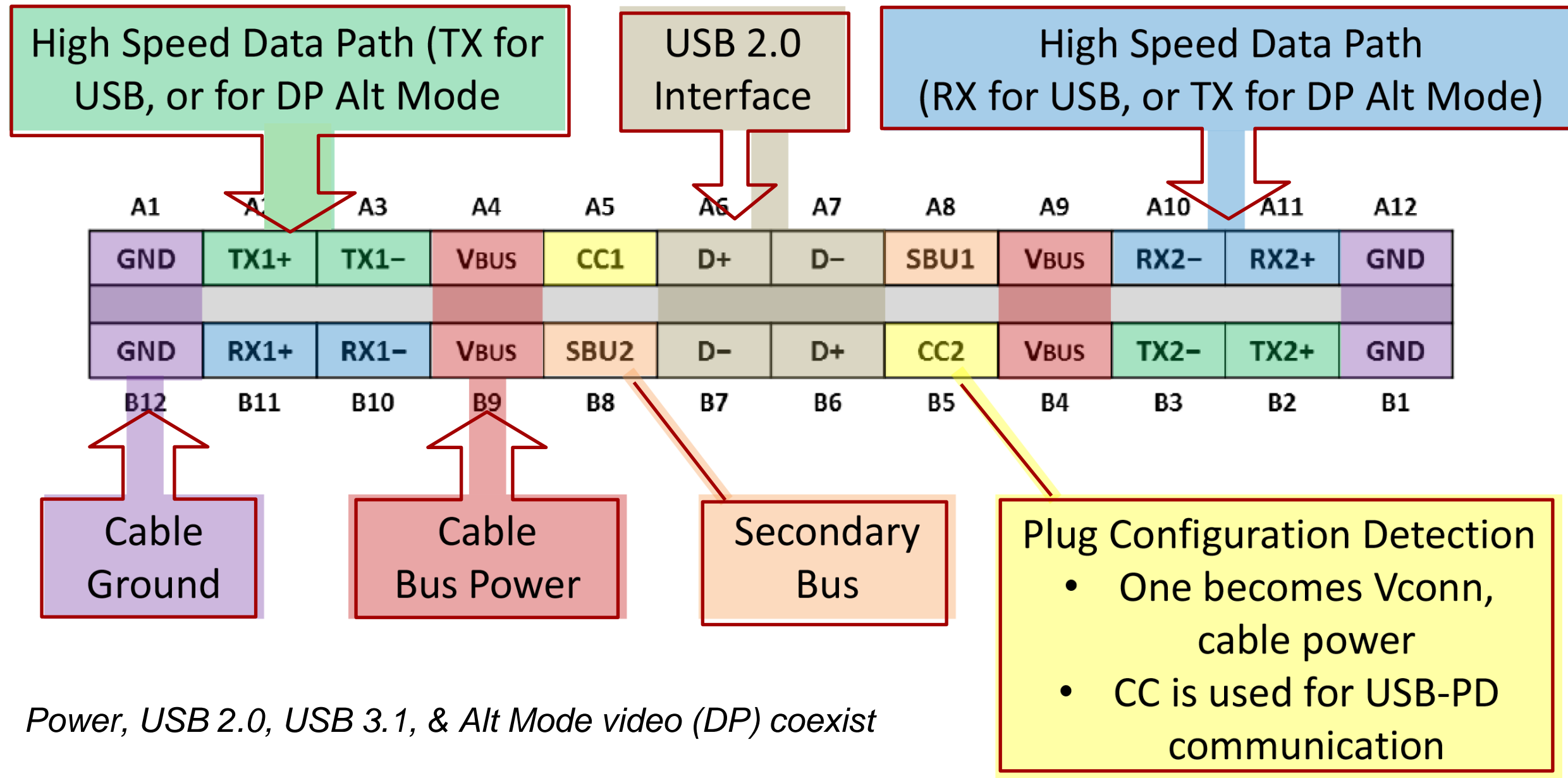
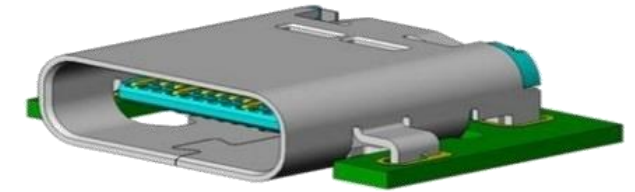
USB Type-C Cable

USB Type C Added

- CC (Configuration Channel)
 - **Mandatory! This is what makes Type C work!**
- V_{CONN} Support (optional)
- SBU (Side Band Unit- Optional)



What is Type-C: Type-C Pins



Power, USB 2.0, USB 3.1, & Alt Mode video (DP) coexist

Source: <http://arstechnica.com/gadgets/2015/01/usb-3-1-and-type-c-the-only-stuff-at-ces-that-everyone-is-going-to-use/>

USB Type-C Connectors

USB Type-C removes the need for different plug/receptacle types for host and devices.

- The Type-C connector replaces both Type-A and Type-B connectors
 - Reversible/Flip-able – Orientation Agnostic
- A host-to-device logical relationship is maintained via the configuration channel (CC).
- USB Hosts and Devices can now be either providers or consumers of Data (DRD)
- With USB PD Hosts and devices can now be either providers or consumers of power (DRP)
- Enhances flexibility and ease of use

Review:

- All USB Type-C ports operate in one of three data modes:
 - Host mode: the port can only be host
 - Device mode: the port can only be device
 - Dual role mode: the port can be either host or device
- Port types:
 - DFP (Downstream Facing Port): host
 - UFP (Upstream Facing Port): device
 - DRP (Dual Role Port): host or device
- Valid DFP-to-UFP connections
 - The table below describes valid DFP-to-UFP connections
 - Host to Host or Device to Device have no functions

	Host-mode port	Device-mode port	Dual-role port
Host-mode port	No Function	Works	Works
Device-mode port	Works	No Function	Works
Dual-role port	Works	Works	Works*

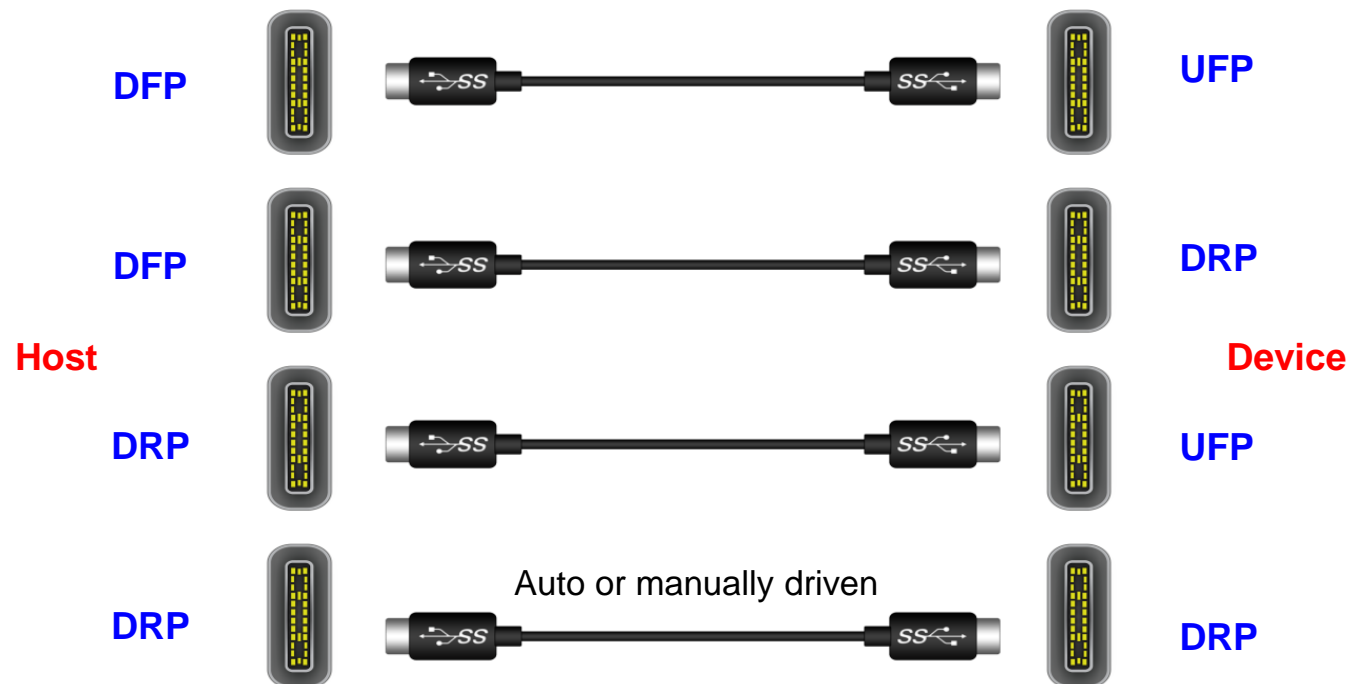
*This may be automatic or manually driven

USB Type-C Connectors and Cables

Option for cheaper implementation and backward compatibility






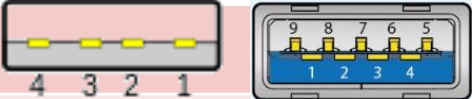


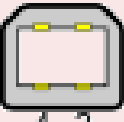

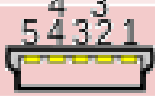

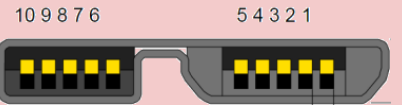

- Two cable/plug options: **Full-Featured** (USB 3.1 & USB 2.0), and **USB 2.0**
- Cables supporting USB 3.1 or Alt Mode must be electronically marked
- Standard (full-featured & USB 2.0) cables support 3A current – electronically marked cable can support up to 5A



USB Type-C to Legacy Standard A/B, Mini/micro B cable options

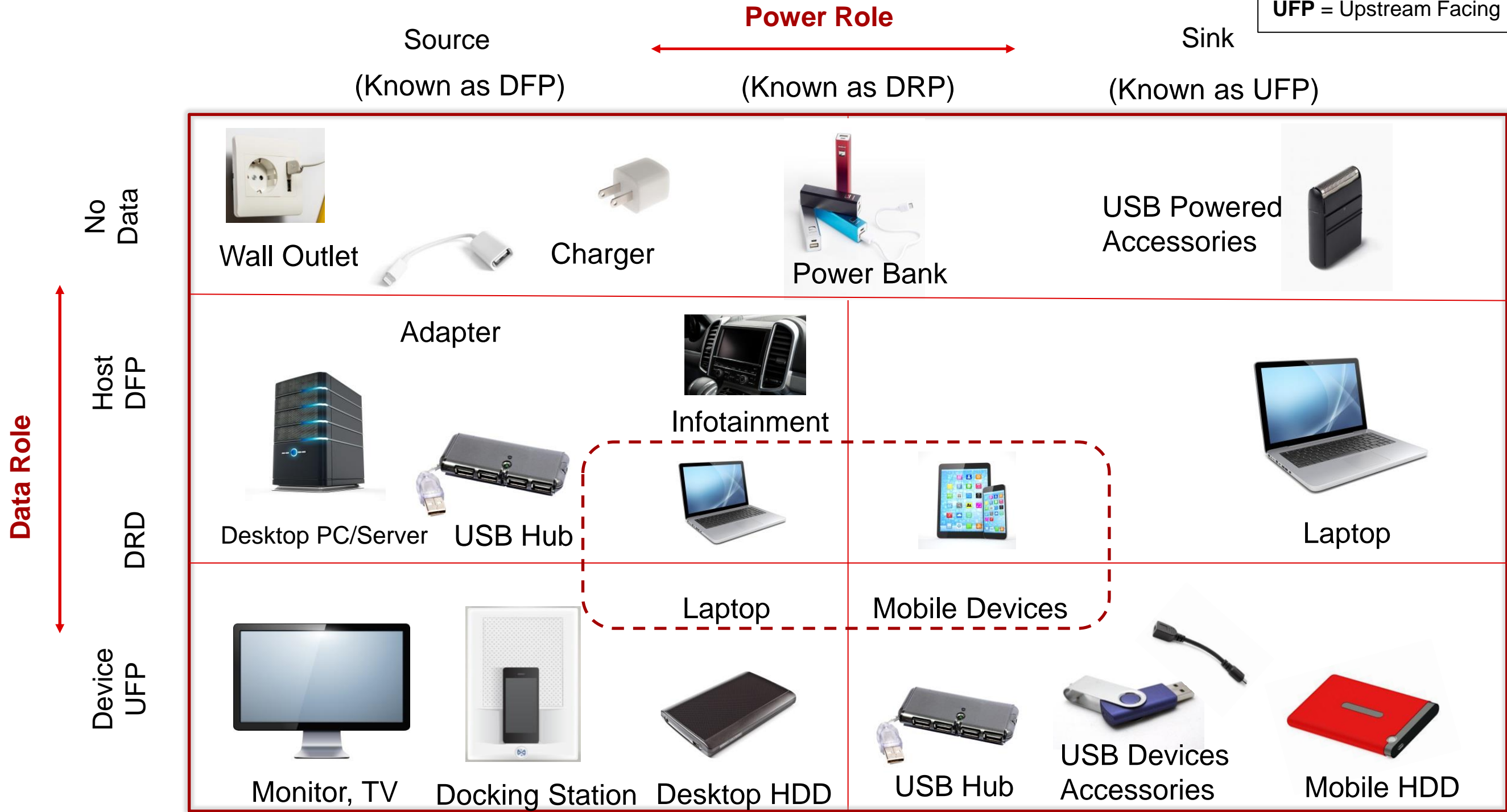
- USB Type-C to USB 3.1 Standard-A
- USB Type-C to USB 2.0 Standard-A
- USB Type-C to USB 3.1 Standard-B
- USB Type-C to USB 2.0 Standard-B
- USB Type-C to USB 2.0 mini-B
- USB Type-C to USB 3.1 micro-B
- USB Type-C to USB 2.0 micro-B

USB Capabilities by Cable Type & Standard

Type	USB 2.0 (480Mbps) 	USB 3.0 (5 Gbps) 	USB 3.1 (10Gbps) 	OTG	Pins Supported
Std A	✓	✓	✗	✗	D±, Vbus± 
Mini A	✓	✗	✗	✓	D±, Vbus±, ID 
Micro A	✓	✗	✗	✓	D±, Vbus±, ID 
Std B	✓	✓	✗	✗	D±, Vbus±  
Mini B	✓	✗	✗	✓	D±, Vbus±, ID 
Micro B	✓	✗	✗	✓	D±, Vbus±, ID 
Micro-B 3.0	✓	✓	✗	✓	D±, Vbus±, ID Tx±, Rx± 
Type-C	✓	✓	✓	✓	D±, Vbus±, CC1/CC2 SBU1/SBU2, Tx1±, Rx1±, Tx2±, Rx2± 

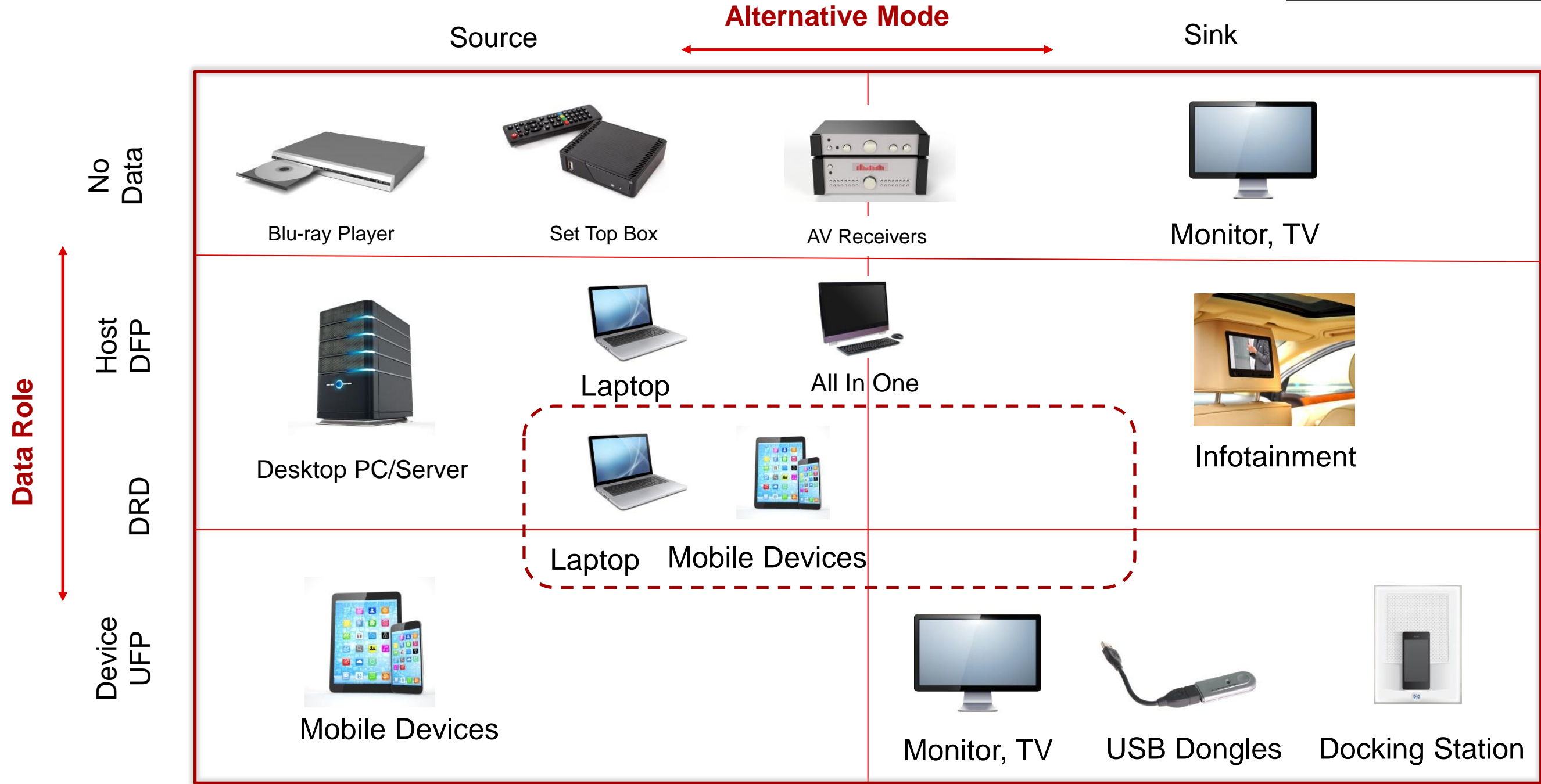
USB Type-C Ecosystems – Power & Data

DFP = Downstream Facing Port
DRD = Dual-Role-Data (DFP or UFP)
DRP = Dual-Role-Power (Source or Sink)
UFP = Upstream Facing Port



USB Type-C Ecosystems – Data & Video

DFP = Downstream Facing Port
DRD = Dual-Role-Data (DFP or UFP)
DRP = Dual-Role-Power (Source or Sink)
UFP = Upstream Facing Port



USB Type-C Power Modes

Flexible and Modular Power Delivery Methods



USB Type-C can be used to deliver power via a number of different protocols:

Precedence	Mode of Operation	Nominal Voltage	Maximum Current
Highest	USB PD	Up to 20 V	Up to 5 A
	USB Type-C current @ 3A	5 V	3 A
	USB Type-C current @ 1.5A	5 V	1.5 A
	USB BC1.2	5 V	Up to 1.5 A
	USB 3.1		900 mA
Lowest	USB 2.0		500 mA



Port Power Roles

Following the introduction of USB PD, port power roles are now defined separately from the port data roles.

- **Provider:** device can only provide power
- **Consumer:** device can only receive power
- **Consumer provider:** the device can act as either a consumer or provider. This is only possible for devices that support USB PD

Capable of delivering up to 100W over one USB Type-C port!

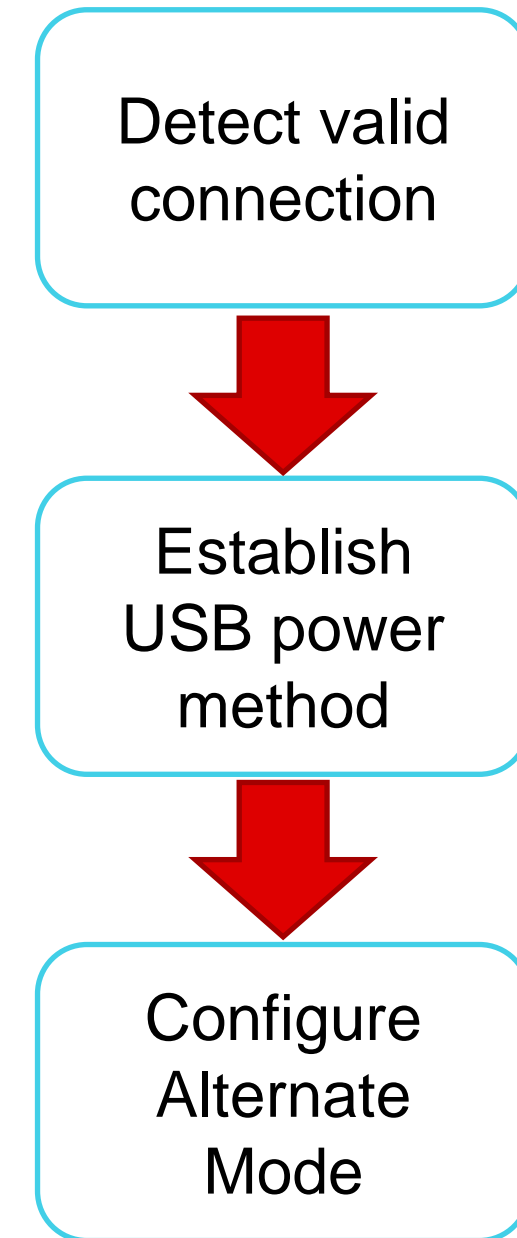
Configuration Channel

Providing the flexibility of Type-C

Functionally the Configuration Channel (CC) is used to serve the following purposes:

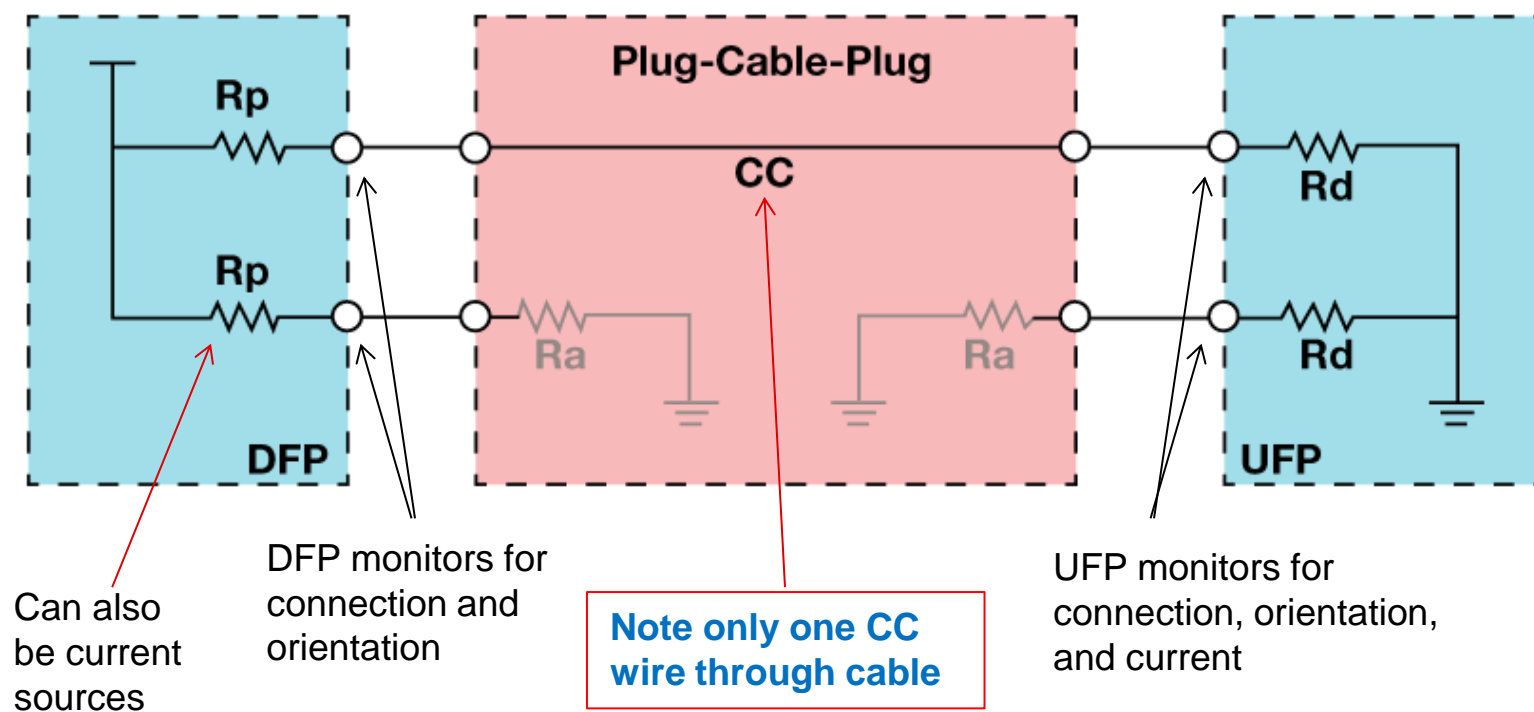
- Detect connect of USB ports,
- Resolve cable orientation and twist connections to establish USB data bus routing
- Establish DFP and UFP roles between two connected ports
 - Could be two DRP ports!
- Discover and configure power: USB Type-C current modes or USB Power Delivery
- Discovery and configuration of optional Alternate and Accessory modes

Typical CC flow for DFP to UFP configuration:



USB Type-C Configuration Channel

Simple way to accommodate flip-able, symmetrical & reversible cable



Type-C Data Roles:

- Downstream Facing Port (**DFP**) - Host
- Upstream Facing Port (**UFP**) - Device
- Dual Role Port (Dual role data **DRD** & Dual role power **DRP**) - switch between DFP and UFP

Type-C Power Roles:

- **Source** - a provider of power when connected
- **Sink** - a consumer of power when connected

Simple resistor divider network between host and device

- DFP pulls-up the CC pin with R_p
- UFP pulls-down the CC pin with R_d
- DRD/P alternates between DFP and UFP

One CC wire in the cable

- DFP(UFP) can detect attachment of UFP (DFP) if active CC line has a R_d (R_p) on the other side
- DFP/UFP can detect plug orientation by monitoring which CC line is active
- DFP uses different R_p (or current source) values to advertise its current provider capability. **USB default, 1.5A or 3A**

Data & power roles

- By default DFP (host) is power source and UFP (device) is power sink
- USB PD can be used to change these roles

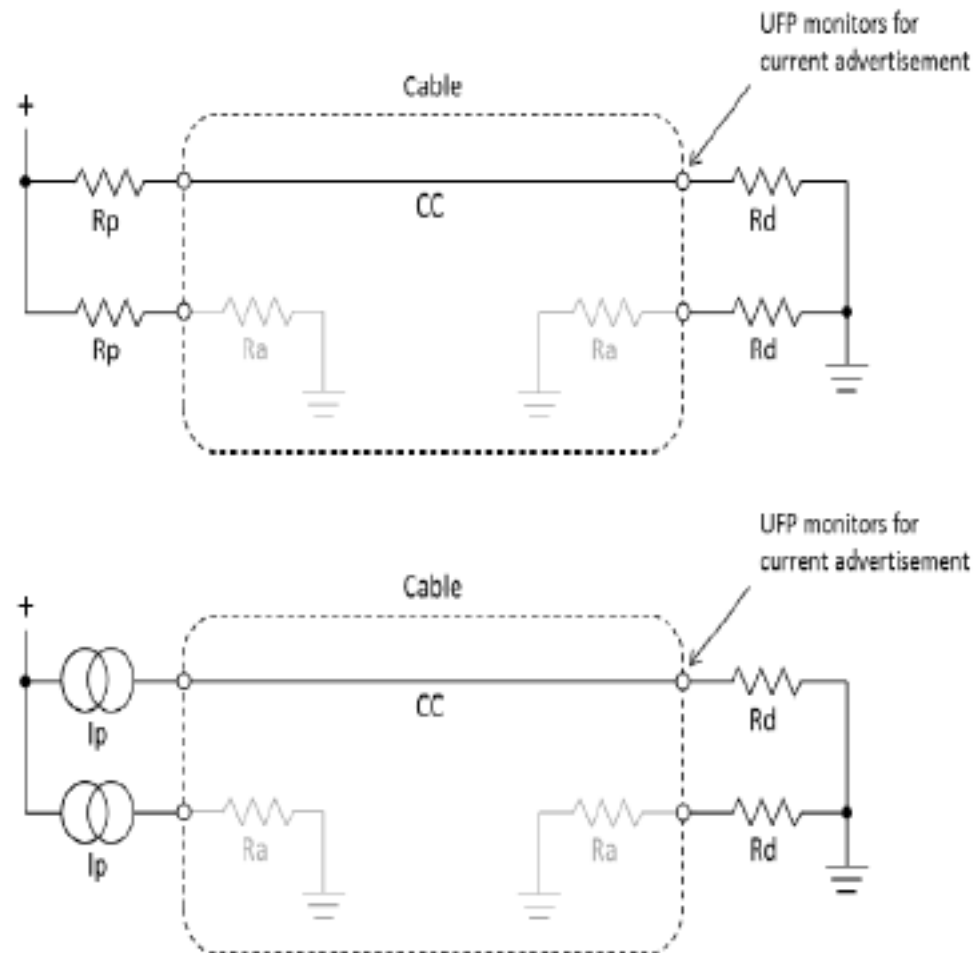
VCONN power

- DFP provides VCONN power (1W minimum) at the unused CC pin for electronics inside cable
- Cable installs pull-down resistor R_a to request VCONN power

USB Type C current detection

DFP uses CC detection to determine the connection

- Voltage mode detection: R_p in DFP and R_d in UFP
- Current mode detection: current source in DFP and R_d in UFP

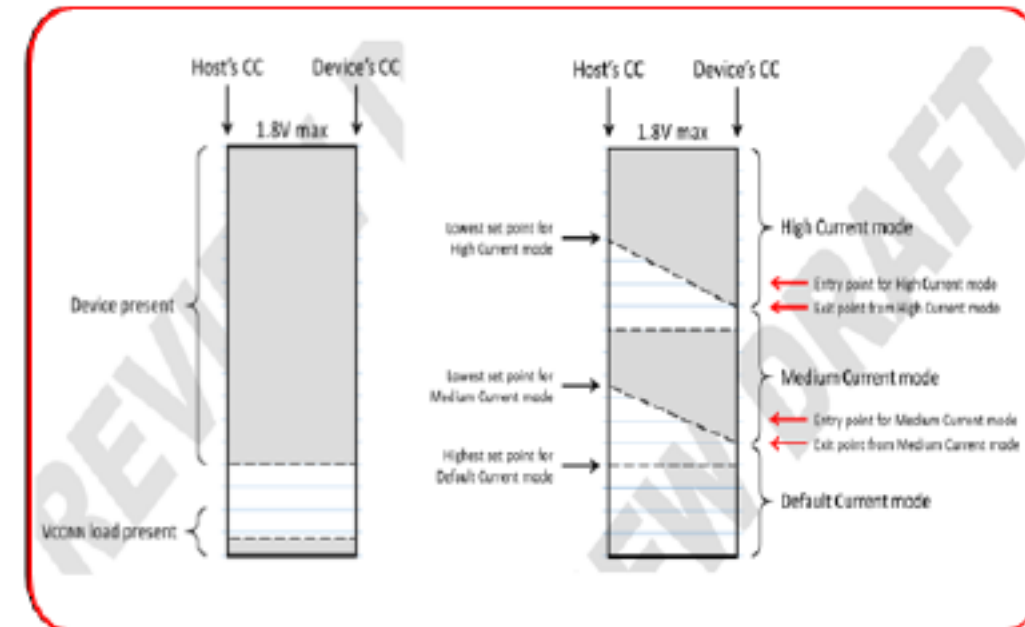


When CC voltage is lower than 1.8V

- Device is present

USB Type-C current

- CC voltage is between 1.21-1.31V: High current mode and the port supports 5V/3A
- CC voltage is between 0.65 – 0.75V: Medium current mode and the port supports 5V/1.5A
- Otherwise: default current mode, 5V/500mA

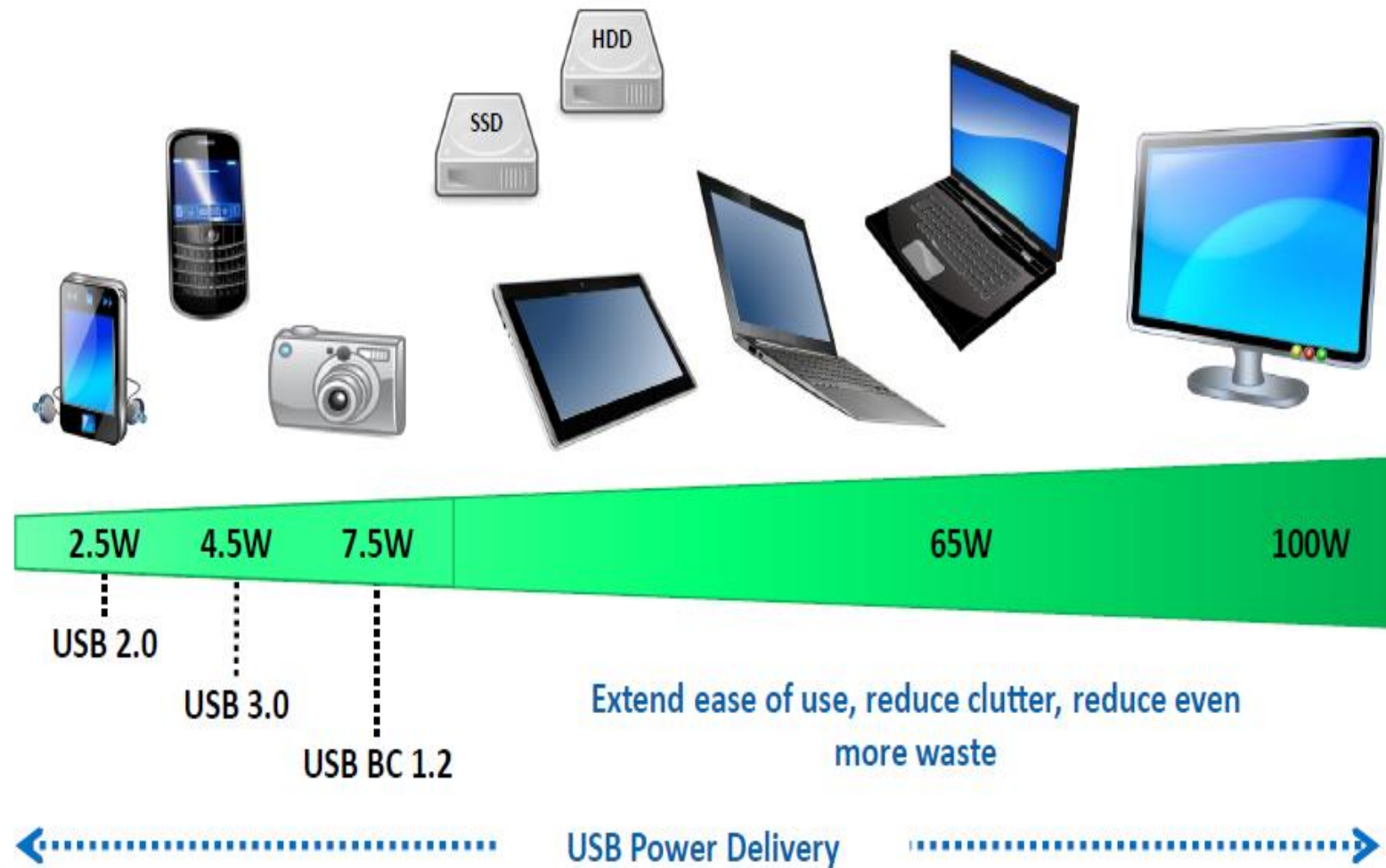


What is USB Type-C Power Delivery? (USB Type-C, PD)

USB Type-C Power Delivery (PD)

USB PD is a Protocol that allows power control signaling:

- Enables both lower and higher power transfer than previous USB protocols
- USB PD over Type-C communicates over dedicated wiring (CC)
- USB PD over Type-A communicates over VBUS (was not adopted by industry)
 - Qualcomm's QC is not an Industry standard



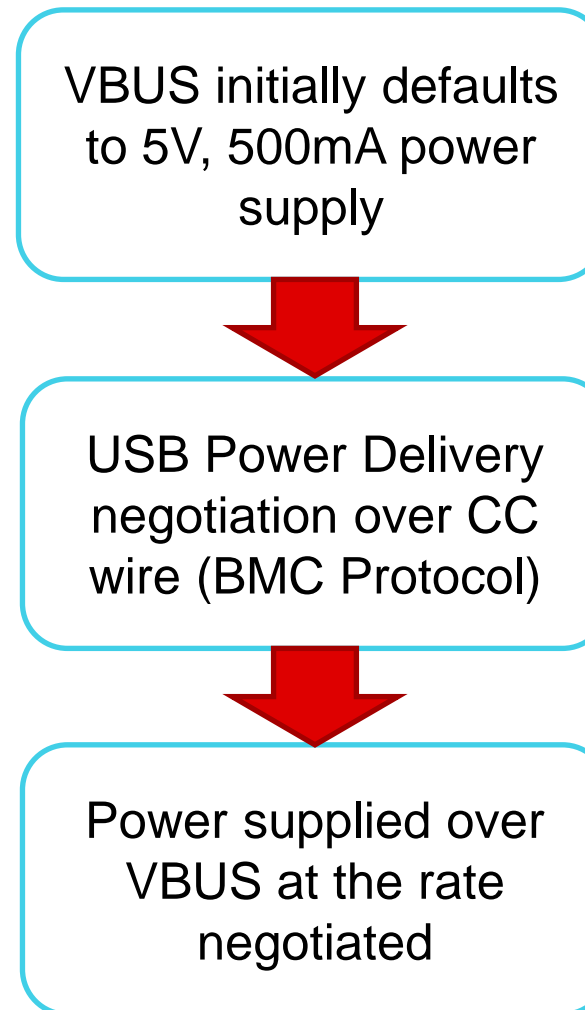
Provider is capable of delivering up to 100W over one USB Type-C port!

USB PD Features

Why use USB PD?

- Up to 100W power over USB cable
- Enables Alternate Modes
- Dead battery and lost power detection
- Allows DFP to UFP or UFP to DFP supply.
- Allows DFP to optimize power management across multiple peripherals
- Intelligent and flexible management of power
- DFP has cold socket to conserve power
- Co-existence with legacy USB products

Typical PD flow



USB Power Delivery (PD)

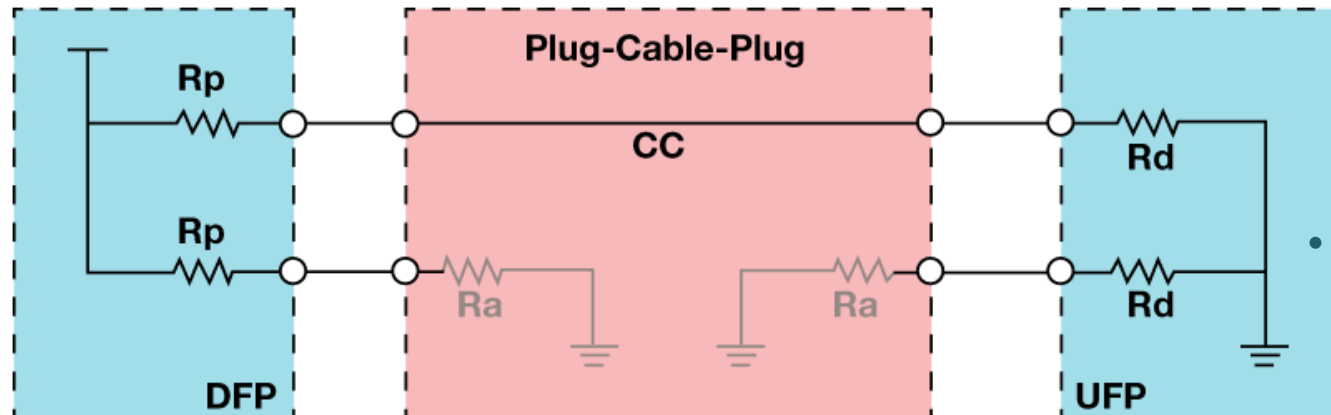
Extends USB Type-C capability – more power, Alt Mode: video & more

What is USB PD?

- USB PD is a single wire communication protocol over CC lines
- A negotiation method to extend USB Type-C interface capability for more power, alt mode and flexibility
- Both ends must support certain extended feature(s) for an successful PD contract

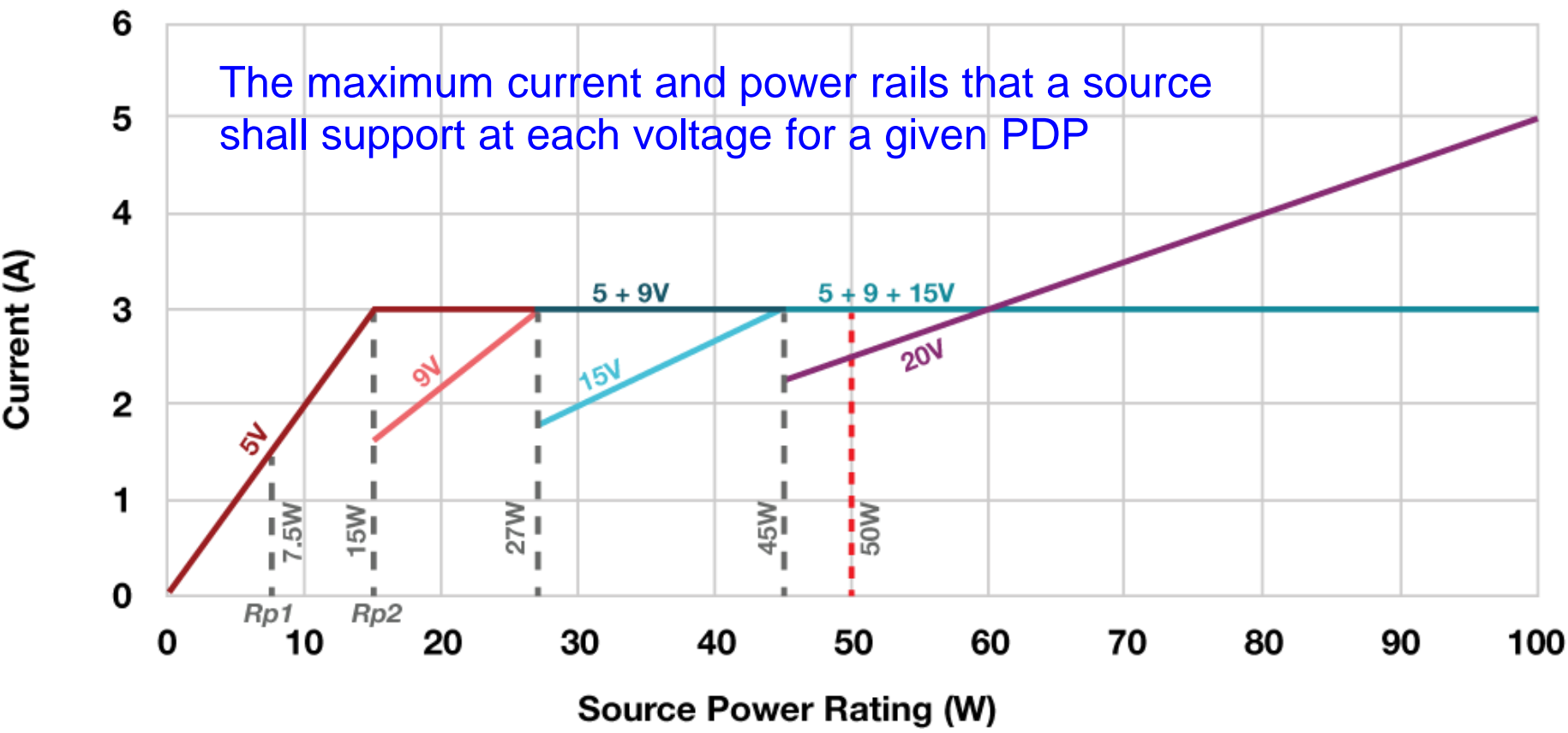
Why USB PD?

- **Extended Power**
 - USB Type-C provides up to 15W (5V/3A) power through VBUS with simple resistor divider network
 - USB PD must be used to extend the power delivery beyond 5V/3A
 - PD can negotiate power up to 100W (20V/5A) – faster charging
 - PD can also negotiate >1W of VCONN power up to 6W
- **Alternate Mode**
 - USB PD must be used for any Alt mode
 - Through PD Alt Mode negotiation USB Type-C interface can be used for non-USB use cases
 - SS differential pairs and SBU lines are available for Alt Mode use
 - USB2 must be preserved when in Alt Mode
- **Role Flexibility**
 - By default Host/DFP is power source and Device/UFP is power sink
 - USB PD must be used to decouple the data/power roles



USB PD Power Profiles

Ensures orderly inter-operability



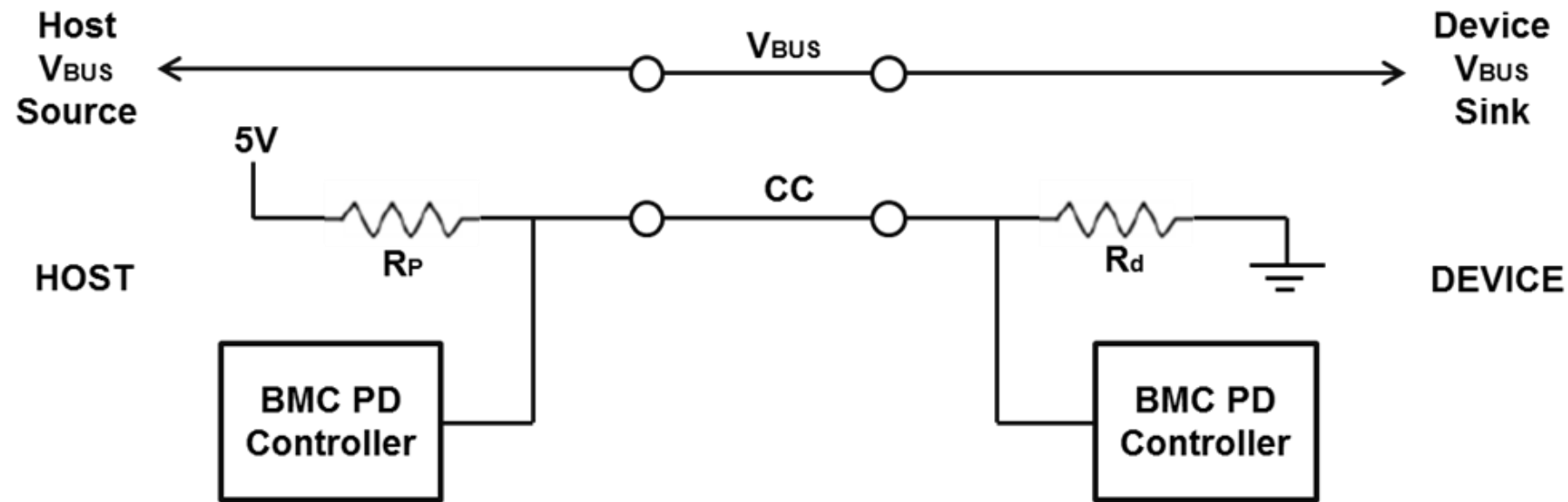
Source Power Rules

- Ensure the PD Power (PDP) of an adapter specified in watts explicitly defines the voltage and currents at each voltage the adapter supports
- Ensure that adapters with large PDP are always capable of providing the power to devices designed for use with adapters with smaller PDP
- Enable an ecosystem of adapters that are interoperable with the devices in the ecosystem

PDP (W)	Current at 5 V(A)	Current at 9 V(A)	Current at 15 V(A)	Current at 20 V(A)
$0.5 \leq x \leq 15$	$x \div 5$			
$15 < x \leq 27$	3	$x \div 9$		
$27 < x \leq 45$	3	3	$x \div 15$	
$45 < x \leq 60$	3	3	3	$x \div 20$
$60 < x \leq 100$	3	3	3	$x \div 20^1$

¹ Requires a 5A cable.

USB PD over Type-C



- USB PD negotiated via Bi-phase Mark Coded (BMC) communication over CC wire
- Type-C cable and connectors capable of up to 100W delivery profile.
- Cheaper, smaller solution vs over Type-A/B as there is no need to Isolate VBUS
- Supports consumers, providers, consumer providers, complex power policies etc.

Typical PD flow

VBUS initially defaults to 5V, 500mA power supply



USB Power Delivery negotiation over CC wire (BMC Protocol)



Power supplied over VBUS at the rate negotiated

Electronically Marked Cable

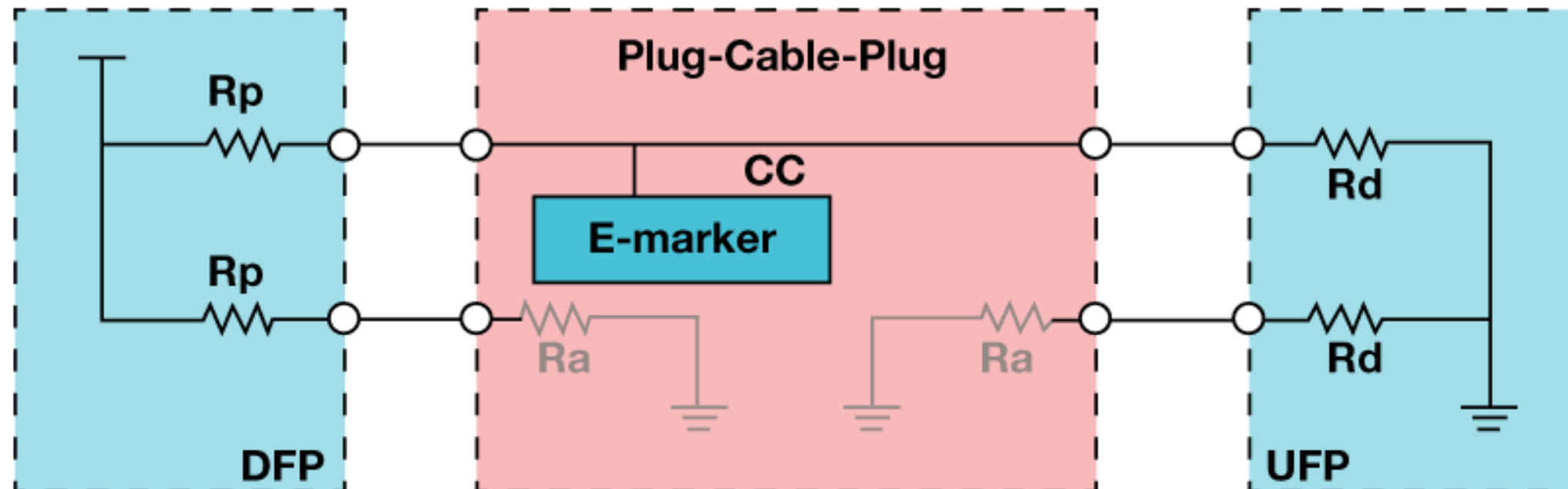
Making USB Type-C interface ubiquitous

What is E-marker ?

- Simple USB PD controller inside a cable
- Responds to USB PD commands from DFP/source
- Provide cable characteristics such as current carrying capability, performance, vendor identification etc.
- Typically powered by VCONN

When E-marker is needed?

- USB Type-C cable supporting more than 3A current
- USB Type-C full featured cable with USB 3.1 or alternate mode signaling

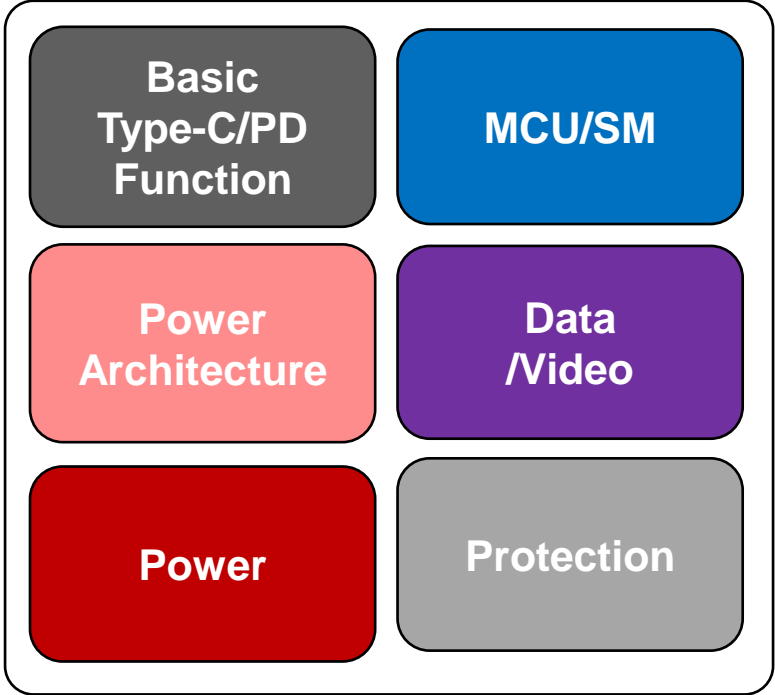
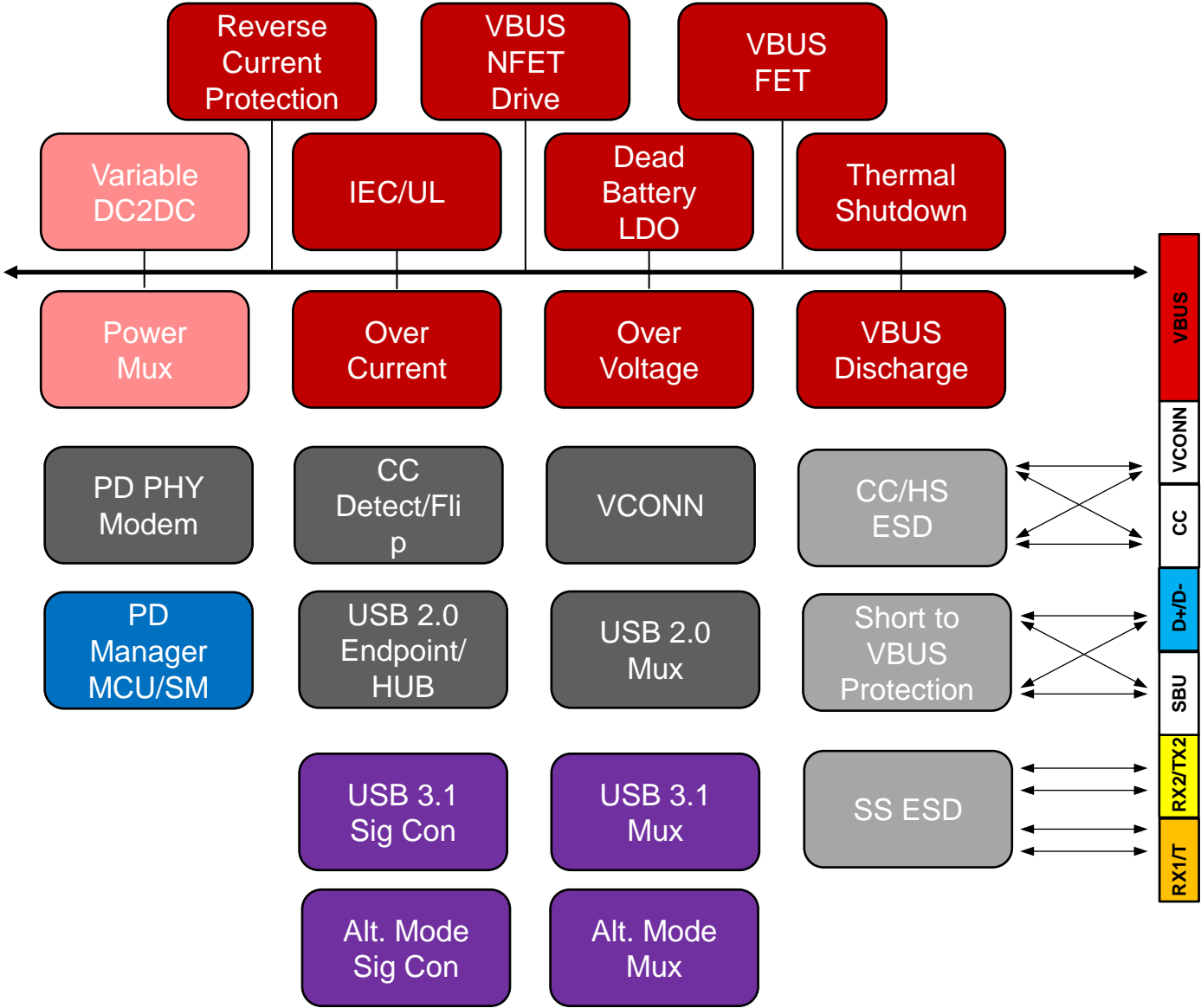


Features through USB Type-C Interface

Do we need PD?

Function	PD Needed?
USB 2.0 data	No
USB 2.0 & 3.1 data	No
<15W power	No
BC 1.2 power	No
Analog Audio	No
>15W power	Yes
Alt Mode (such as DP Video)	Yes
Power/data role swap	Yes
Cable identification	Yes
Active cable support	Yes

USB Type-C and PD Functions

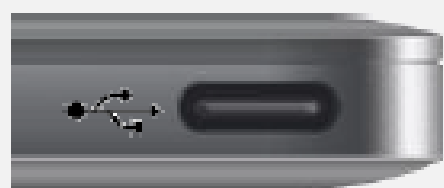


Legend

Different systems/applications will require different sets of these blocks

Type-C and PD Visual Recognition

USB 2.0
480 Mb/s



PD Enabled



USB 3.1
5 Gb/s



PD Enabled



USB 3.1
10 Gb/s



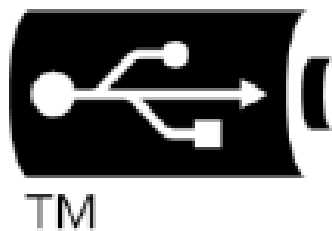
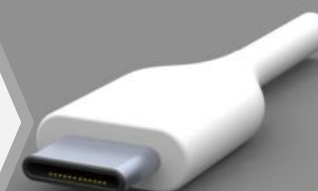
PD Enabled



DisplayPort*
Multi-Function
5 (or) 10 Gb/s



PD Enabled



USB Type-C 'Alternate Mode'

USB Type-C Alternate Mode

Extends beyond USB data

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	V _{CONN}			SBU2	VBUS	RX1-	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

What is Alt Mode?

- Alternate use of USB Type-C interface for non-USB functions
- USB2 must be preserved
- USB PD must be used to negotiate an alternate mode
- **Definition:** Operation defined by a vendor or standards organization that is associated with a SVID assigned by the USB-IF. Entry and exit into and from an Alternate Mode is controlled by the USB PD Structured VDM Enter Mode and Exit Mode commands

Example of Alt Modes

- DisplayPort (DP)
- Thunderbolt
- PCI Express
- MHL
- HDMI (in work for dongle/cable)

Can you create your own alternate mode?

- Option 1: create an official alternate mode approved by USB-IF (will be given an SID, Standard ID)
- Option 2: Get a VID from USB-IF and create a non-official alternate mode (you must own both sides of the system for this to work)

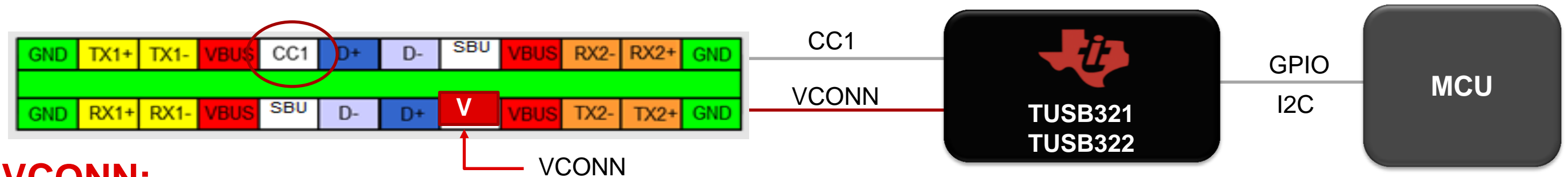


TEXAS INSTRUMENTS

Configuration Channel & VCONN

Enable the flexibility of USB Type-C

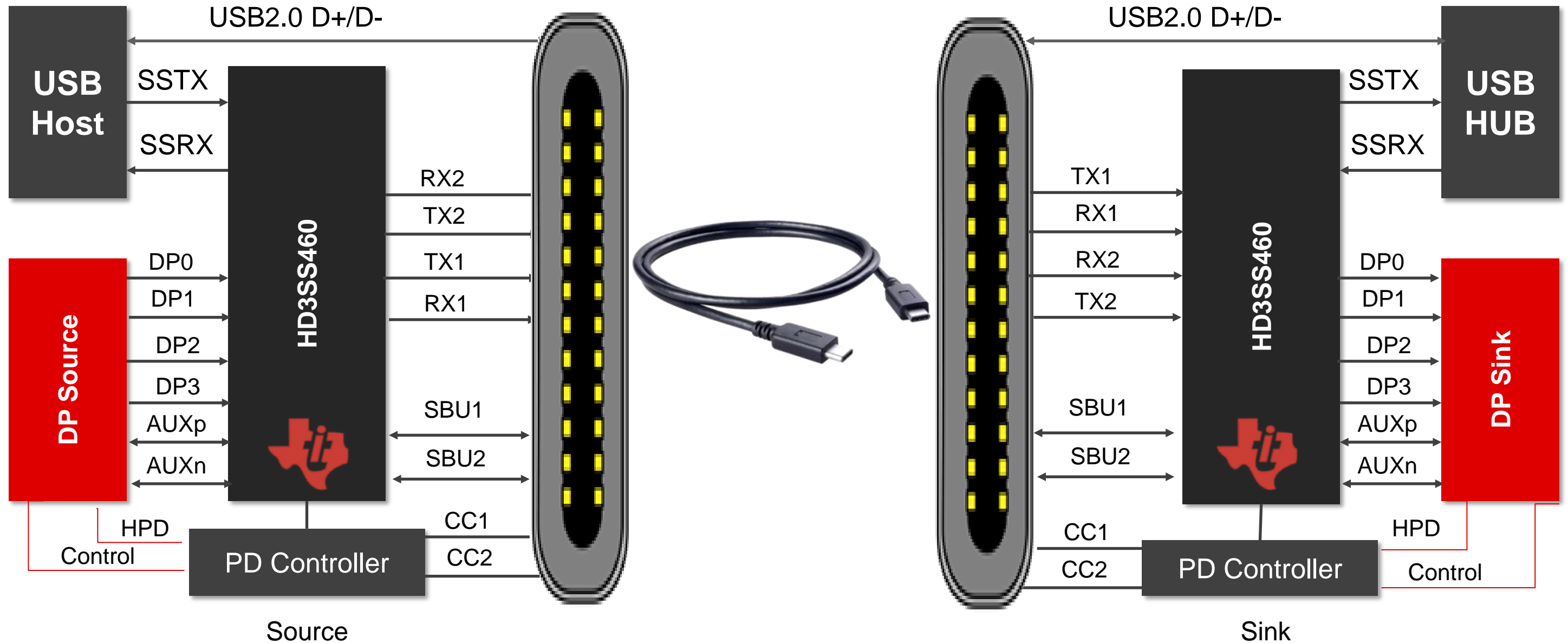
Typical CC flow for DFP to UFP configuration:



VCONN:

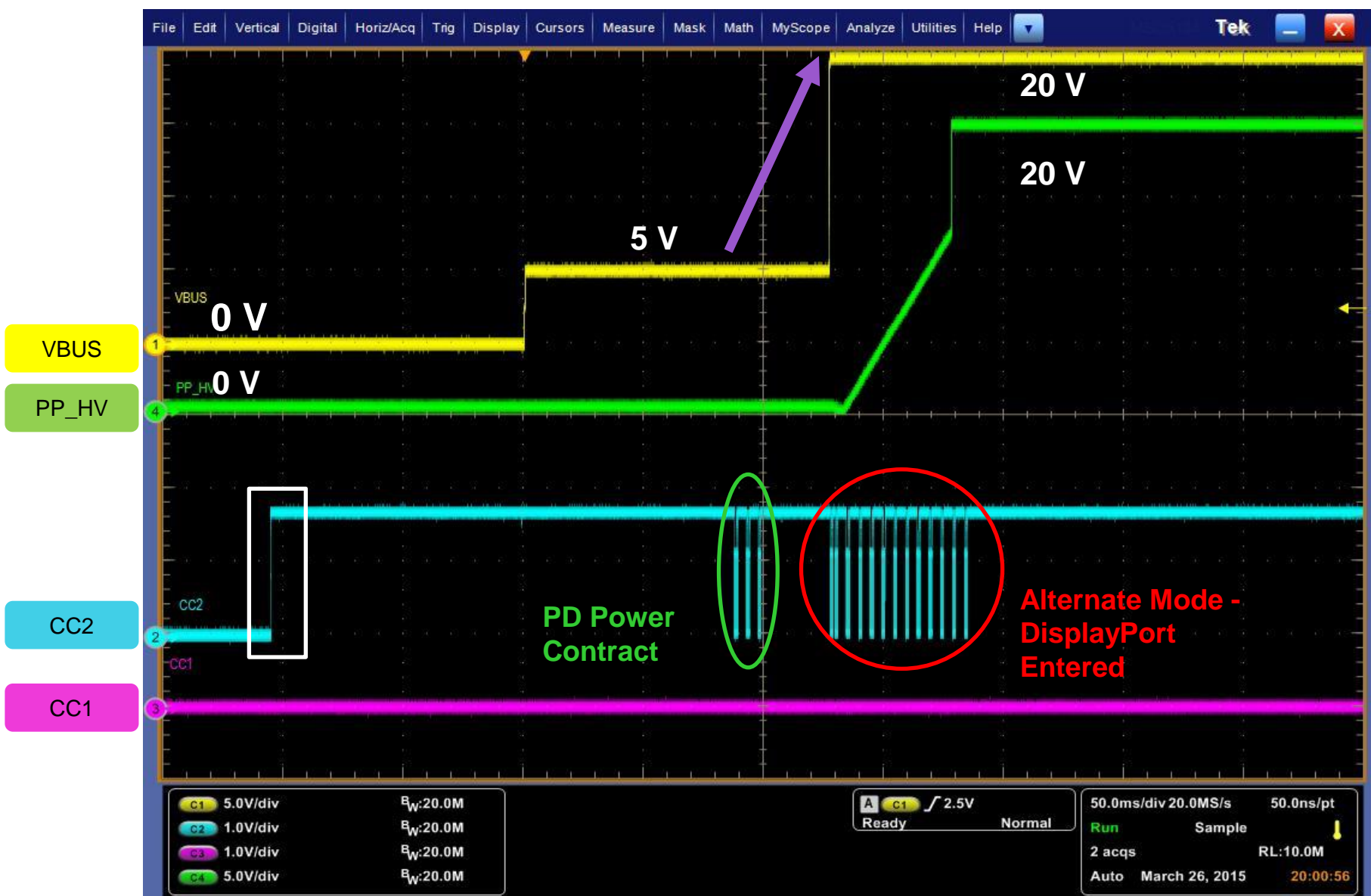
When one of the CC pins is used for connecting between the DFP and UFP, the other CC pin can be used to supply power to an active cable. The name of this power rail is VCONN. When the DFP CC detect the pull-down resistor, the CC pin will be switched from pull-up to VCONN. The VCONN will supply 4.75~5.5v and output power 1Watt

Alternate Mode Application: DP over Type-C



USB PD Alternate Mode Negotiation

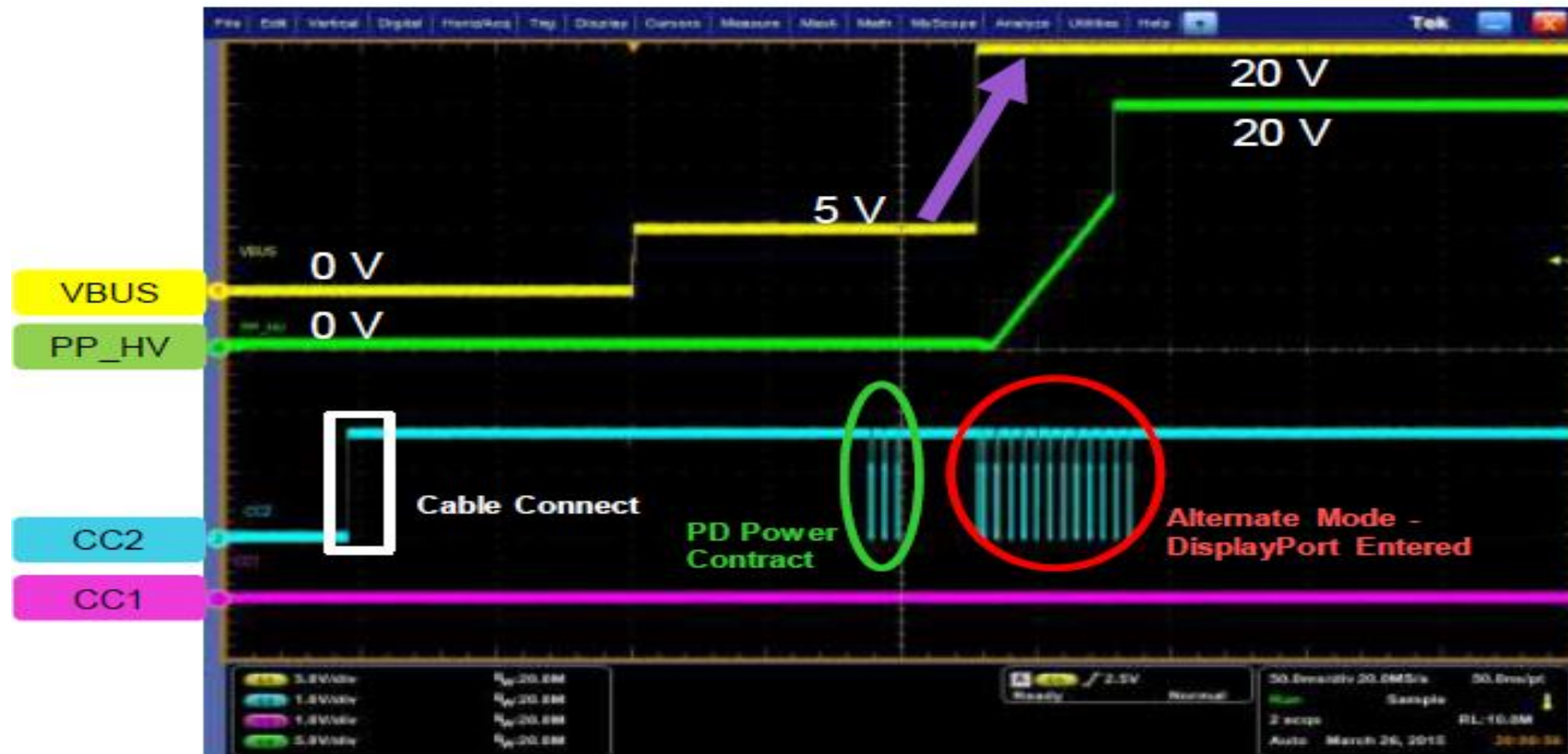
Scope Trace between a Dock and Notebook establishing a USB PD Contract



USB Power Delivery Analyzer with PD Controller Firmware
(A Dock acting as a DFP/Source & Notebook acting as the UFP/Sink)

Source Capabilities (Fixed 5V 3A, Fixed 20V 3A)		OUT
➡ Source Capabilities packet (Fixed 5V 3A, Fixed 20V 3A)		OUT
✓ GoodCrc packet		IN
➡ Request (Object 2 = Fixed 20V 3A, Requested 3A, Maximum 3A) > Accepted		IN
➡ Request (Object 2 = Fixed 20V 3A, Requested 3A, Maximum 3A)		IN
➡ Accept		OUT
➡ PsRdy		OUT
➡ PsRdy packet		OUT
✓ GoodCrc packet		IN
➡ Discover Identity > Ack (Undefined)		OUT
➡ Discover Identity		OUT
➡ Discover Identity Ack (Undefined)		IN
➡ Discover SVIDs > Ack (0xFF01)		OUT
➡ Discover SVIDs		OUT
➡ Discover SVIDs Ack (0xFF01)		IN
➡ Discover Modes (SVID = 0xFF01) > Ack (0x001C0045)		OUT
➡ Discover Modes (SVID = 0xFF01)		OUT
➡ Discover Modes (SVID = 0xFF01) Ack (0x001C0045)		IN
➡ Enter Mode (SVID = 0xFF01, Mode = 1) > Ack		OUT
➡ Enter Mode (SVID = 0xFF01, Mode = 1)		OUT
➡ Enter Mode (SVID = 0xFF01, Mode = 1) Ack		IN
➡ SVID Specific Command (0x10) > Ack		OUT
➡ SVID Specific Command (0x10)		OUT
➡ SVID Specific Command (0x10) Ack		IN
➡ SVID Specific Command (0x11) > Ack		OUT
➡ SVID Specific Command (0x11)		OUT
➡ SVID Specific Command (0x11) Ack		IN

Alternate Modes Require PD



USB Billboard - *Orderly and frustration free experience for end users*

- USB2 device container that reports back when a device fails to enter an Alt Mode
- Required for monitor, dock etc. applications
- Ensures when a host system is connected to a non compatible device/sink, end-user gets an warning
- This is not a PD function, rather host reads through USB2

- USB PD negotiates both power and alt mode contracts through active CC line
- If Alt mode contract fails certain sink devices are required to offer USB Billboard

DisplayPort as USB Type-C Alternate Mode

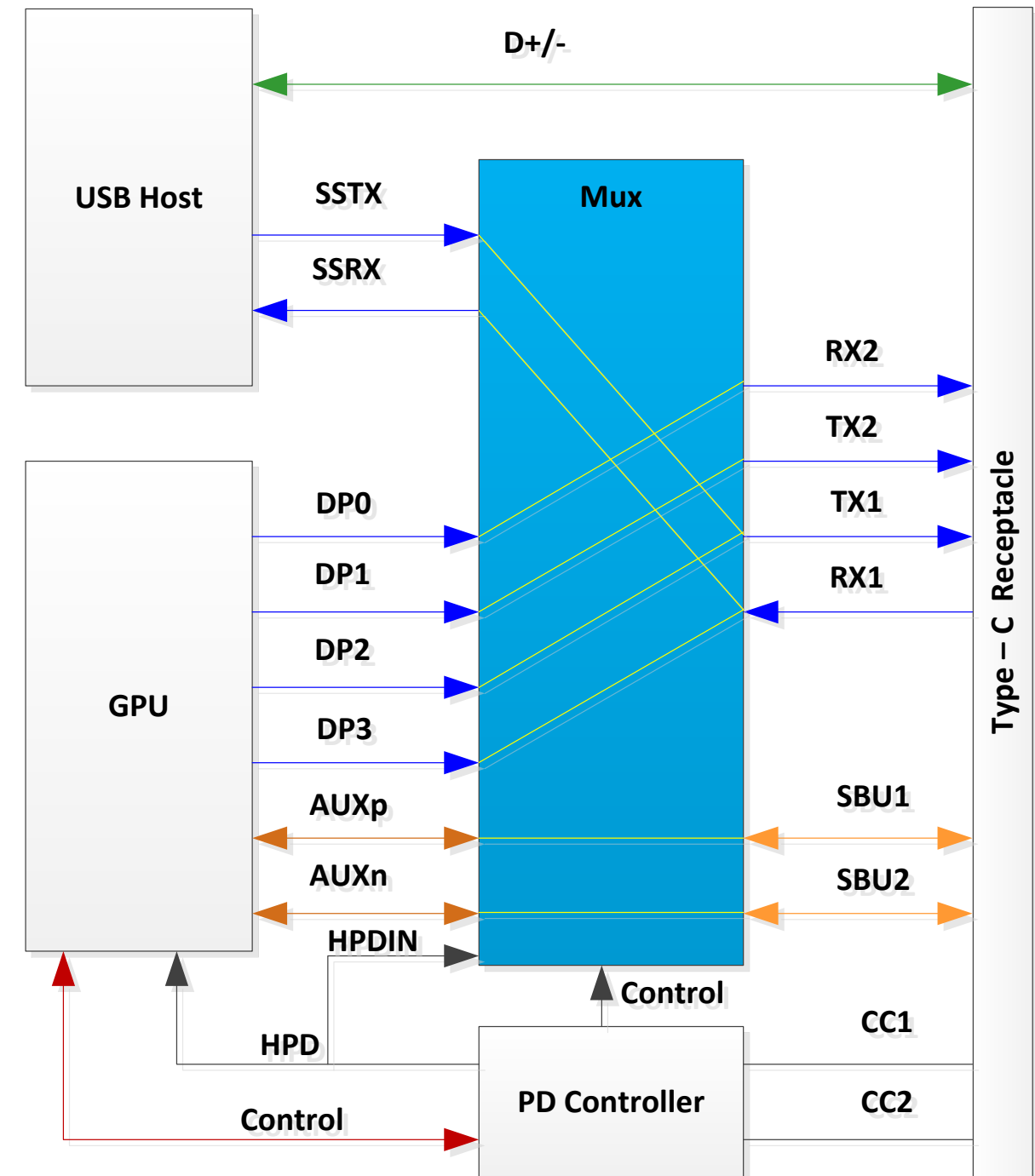
Bringing high resolution video

Need for signal Muxes

- Selection of active USB SS signals depending on plug orientation
- Merging of Alt Mode signals into SS signal pairs
- Flexibility of SS signal versus Alt Mode signals
- Signal Mux can be a physical device (most use case today) or done inside a processor (supporting both USB and Alt Mode through same pins)

DisplayPort as Alt Mode

- DisplayPort is most popular Alt mode today supporting high resolution video
- Signal mux allows following options for system depending on application need:
 - USB SS RX/TX only
 - USB SS RX/TX & 2 lanes of DP video
 - 4 lanes of DP video
- DP AUX signals use SBU1 and SBU2 signal pins
- DP HPD signal is embedded into USB PD message



More Information

- USB Type-C Specifications
 - <http://www.usb.org/developers/usbtpec/>
- USB PD Specifications
 - <http://www.usb.org/developers/powerdelivery/>
- USB 3.1 Specifications
 - <http://www.usb.org/developers/docs/>
- USB Billboard Specifications
 - http://www.usb.org/developers/docs/devclass_docs/
- TI Type-C page
 - <http://www.ti.com/llds/ti/interface/usb-type-c-overview.page>
- TI E2E Online Community
 - e2e.ti.com

USB Resources

TEXAS INSTRUMENTS Everything Search Login / Register

Products Applications & designs Tools & software Support & training Sample & buy About TI


TI Home > Power Management > USB Power and Charging Port Controllers

Power Management

Overview Products Featured products Tools & software Technical documents

Overview for USB Power and Charging Port Controllers

USB Power Switch and Charge Port Controllers fall into one of five well defined categories. For ease of end equipment safety testing these switches are recognized as Solid State Overcurrent Protection Devices by UL 2367, as shown below.



USB Power and Charging Port Controllers

Fixed Current Limit Switch

Fixed I_{LIMIT} switches are in products everywhere. Over 100 TI USB Power Switches means you are likely using one now.

[Product search](#)

Precision Adjustable Limit Switch

Devices with accurate, adjustable current limits and low resistance for demanding system requirements.

[Product search](#)

USB Charging Port Controllers

Protection and usb dataline handshaking enables charging for all popular handheld devices.

[Product search](#)

Switch with Boost Converter

Switches with a boost/buck to create compliant 5-V USB Power from 1.8 to 5.25-V sources.

[Product search](#)

Switch with LDO

Typically with 4 ports of control these integrated switches have an internal LDO to provide power to a USB hub.

[Product search](#)

www.ti.com/usbpowerswitches

TEXAS INSTRUMENTS Search through millions of questions and answers Login / Register

TI E2E Community > Support forums Blogs Groups Videos

Power Management More

Welcome to the Power Management Section of the TI E2E Support Community. Ask questions, share knowledge, explore ideas, and help solve problems with fellow engineers. To post a question, click on the forum tab then "+ New".

AC/DC and Isolated DC/DC Power

Battery Management

Digital Power

Gallium Nitride (GaN) solutions

LCD/OLED Display Bias Solutions

LED Driver

Linear Regulators

Load Switches and Power Path Protection

NextFET™ Power MOSFETs

Non-Isolated DC/DC

PMIC

Power Interface

Power Modules

Sequencers

SIMPLE SWITCHER®

Supervisor and Reset IC

Voltage References

Wireless Power

Forums

Announcements

FAQ

Files

Show All E2E Forums

Options

Think it. Design it. Engineer it.

Load Switches and Power Path Forum

www.e2e.ti.com

USB Power Switch and Charging Controller Selector Guide

TEXAS INSTRUMENTS

Table of Contents

- 1 & 2 Channel 4.5 - 5.5 V Fixed I_{LIMIT} USB Switches1
- 1 & 2 Channel 2.7 - 5.5 V Fixed I_{LIMIT} USB Switches2
- 3 & 4 Channel 2.7 - 5.5 V Fixed I_{LIMIT} USB Switches2
- Precision Adjustable I_{LIMIT} USB Switches3
- USB Charging Port Controllers3
- USB Switches with Internal Boost Converter3
- A Brief Explanation of USB Charging Handshakes4

1&2 Channels, 4.5 - 5.5 V USB Switches

Channels	Rated Current Amps	Enable Polarity	Output Discharge	SOIC	MSOP DGN PowerPAD™	MSOP DGN	SOT-23	SOP DRC
1	0.5	L	Y	Value Parts in Red			TPS2041CDBV	
		H	Y				TPS2051CDBV	
	1	L	Y		TPS2061CDGN		TPS2061CDBV	
		H	Y		TPS2065CDGN-2		TPS2065CDBV-2	
	1.5	L	Y		TPS2068CDGN		TPS2068CDBV	
		H	Y		TPS2069CDGN-2			
2	0.5	L	Y		TPS2090CDGN	TPS2090CDGK		
		H	Y		TPS2091CDGN	TPS2091CDGK		
	1	L	Y	TPS2062CD	TPS2062CDGN			TPS2062CDB-2
		H	Y	TPS2066CD	TPS2066CDGN			
	1.5	L	Y		TPS2069CDGN-2			
		H	Y		TPS2068CDGN			
2	1.5	L	Y		TPS2064CDGN-2			TPS2064CDB-2
		H	Y					TPS2064CDB-2

Most TI USB Switches are recognized by UL under UL2367. Please consult datasheet for latest status.

www.ti.com/usbpowerswitches 2015

<http://www.ti.com/lit/slyt509>

UNIVERSAL SERIAL BUS


Universal Serial Bus

Google™ Custom Search Search

About USB-IF Channel Press Developers Members Products

USB Developer Days

September 27-28, 2016 | Houston
October 19-20, 2016 | Hong Kong



Learn about the latest in USB technology!

Instant, No Hassle Connections

Universal Serial Bus (USB) connects more than computers and peripherals. It has the power to connect you with a whole new world of PC experiences.

USB is your instant connection to the fun of digital photography or the limitless creative possibilities of digital imaging. You can use USB to connect with other people through the power of PC-telephony and video conferencing. Once you've tried USB, we think you'll grow quite attached to it!

USB-IF Announces a New Certified USB Charger Logo and Compliance Program [More information](#)

Site sponsored by USB Implementers Forum, Inc., creators of USB technology. [About Us](#) | [Privacy Statement](#)

[VTM Group](#) | [KAVI](#)® where .orgs work

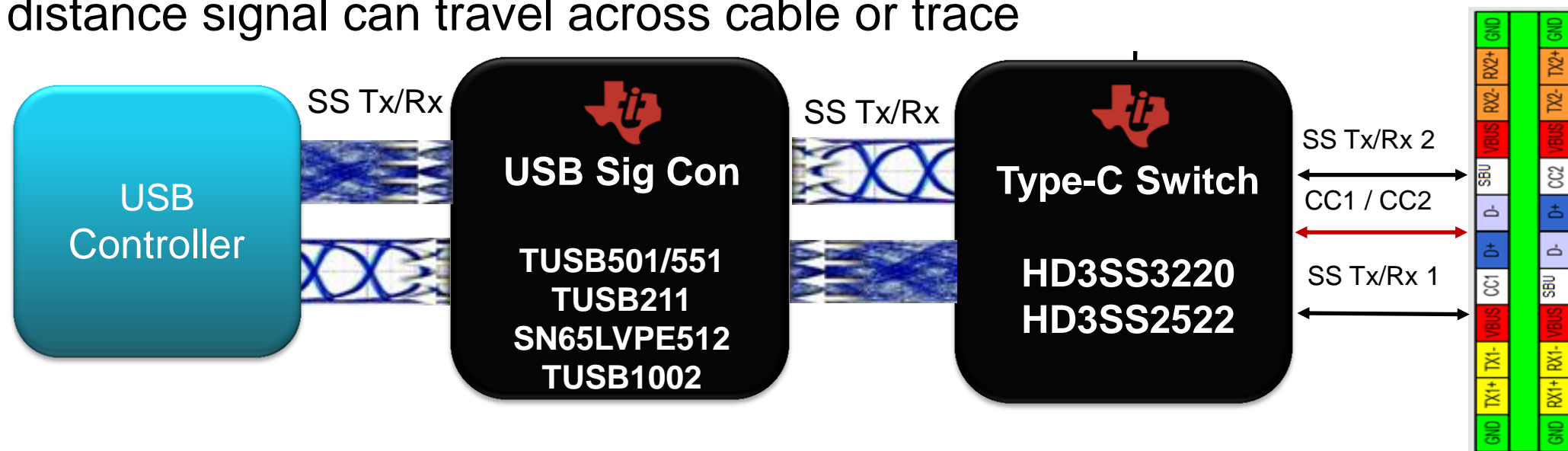
<http://www.usb.org>

Improve USB Type-C Signal Quality using Signal Conditioner

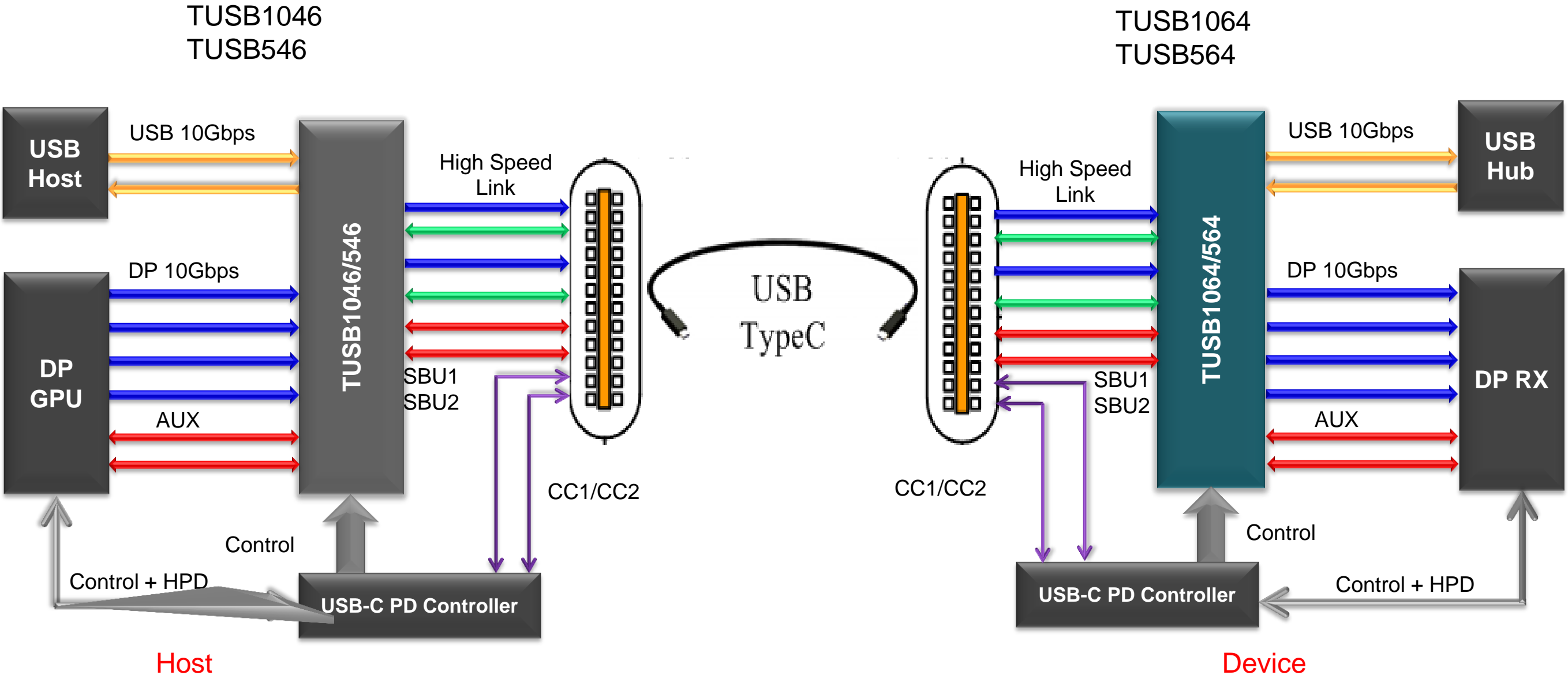
Gigabit signals are subject to signal integrity degradation due to long trace, cross connectors, long cable and capacitance lines

Signal Conditioners enables Type-C solution

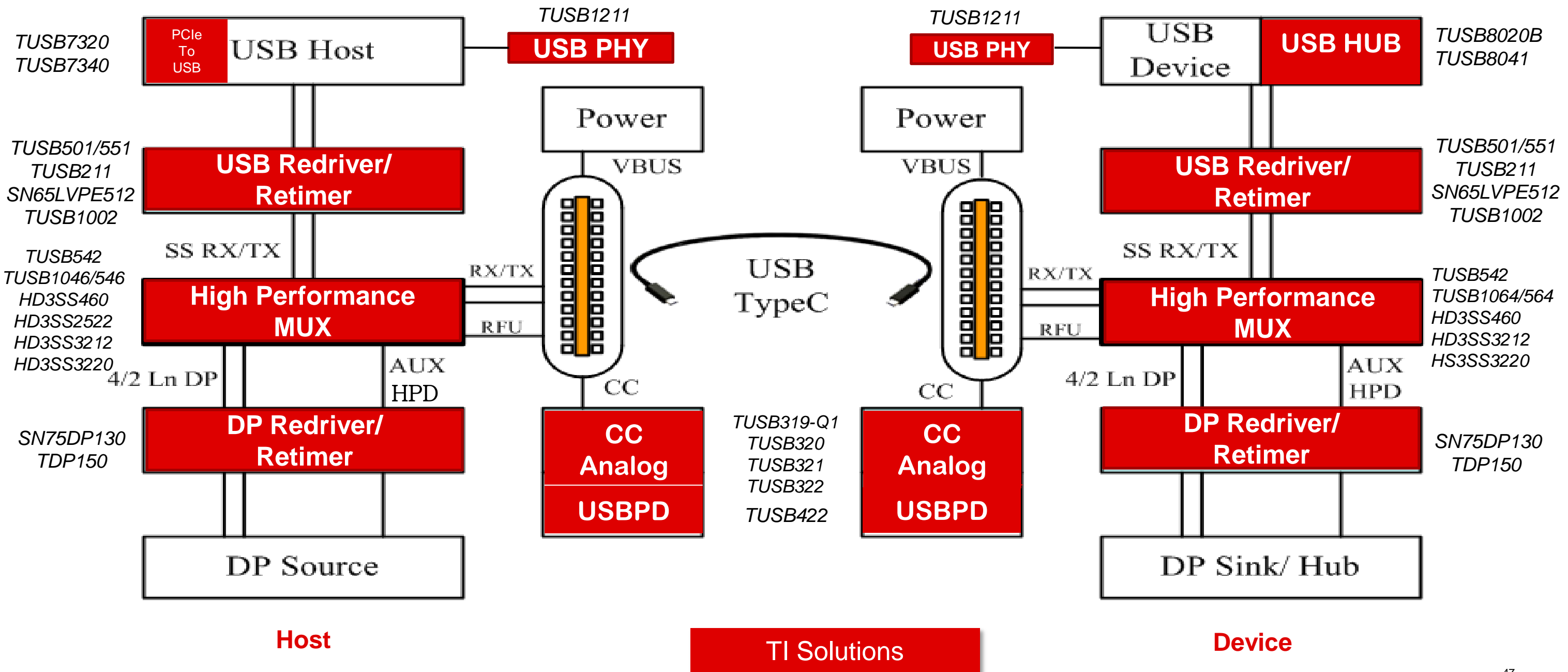
- Improve signal quality, maintain signal integrity over long trace or cable
- Enable design flexibility and improve system performance, help pass compliance
- Enable broad range of interoperability
- Extend distance signal can travel across cable or trace



Re-driver Solutions for USB Type-C Alt Mode



TI Solutions for USB Type-C



Thank You!



©Copyright 2017 Texas Instruments Incorporated. All rights reserved.

This material is provided strictly “as-is,” for informational purposes only, and without any warranty.
Use of this material is subject to TI’s **Terms of Use**, viewable at TI.com