Engineer Note 44

USB C Technical Note

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Contents

USB-C Technical Guide

Summary info:

(for those who need a quick overview but may not want to get into it)

Power Delivery – Application Note:
When you connect a USB-C cable, a chip within the cable will tell the device what capabilities the cable can support. However, only the data from the first cable will be reported.

This data may include:

- Alt Mode Support
- USB Data Rate
- Power Delivery
- Pin Orientation (not from chip but from resistance measurement)

As an installer our primary concern is overload.

If the first cable is rated to 100W, it will tell the transmitting device to output 100W.
However, if an extension cable is added which only supports 60W this could present a fire hazard.

Installer Rules:

When using an USB-C cable (0.5-10m standard or active):

- Do not use a USB-C coupler or an extender USB-C cable (male to female cable).
- The site cable is the input cable on the tabletop. (AV device direct to client laptop)

When the above rules are broken:

If an extension or coupler used, it will work, but in only one orientation of the USB-C connector.

Any extensions must be power rated equally or higher than the original cable.

USB-Connectors

The **USB A/B** connector and its variants are designed for use only as a carrier of USB data and/or power delivery.

A **USB A/B** connection uses 9 pins and **USB-C** uses 24 Pins. Both connections utilize USB 3.2 Gen X connections to transmit data. The key difference is the number of USB lanes and the allocation of lanes to transmit data.

As a result of its success as an adopted standard for the transportation of USB 3 data and the connectors technical ability to support competing protocols. USB-C has become the one stop connector for all your charging, data transfer, video transport, and audio needs. Devices and cables may support one or all these services with no visual indication of performance.

No assumptions can be made about what is being transported though a given cable. We must now understand the connection between the devices using manufacturer information and cables which we can identify and verify its performance capabilities.

This change to USB-C with ever higher bandwidth protocol support is not without its challenges. As data rates increase, cable lengths decrease or become exponentially difficult to manufacture at reasonable lengths with hybrid cables.

USB-C Utilises **up to four super speed lanes**. Only **two lanes** can be used for traditional USB 3 use however the full **four lanes** can be utilized for **video** transmission.

Each lane can support 10Gbps resulting in a fully capable extension device requiring upwards of 40Gbps of data transfer. At present the only method to achieve this is with hybrid USB-C cables.

USB A/B Connector

A legacy USB 2.0 connection is maintained for backward compatibility. Two USB 3.2 Gen X Super Speed lanes are available but the allocation of these lanes is fixed to one transmit and one receive.

As such USB data rates are limited to either USB 3.2 Gen 1x1 (5 Gbps) or USB 3.2 Gen 2x1 (10 Gbps)

The below table shows the pinout for USB 3.2 A/B connectors:

USB 3 A/B Pinout	
Pin	Signal
1	Power +5V
2+3	Legacy USB 2 Pair
4	Ground Power
5+6	Super Speed Lane 1 Pair
7	Ground Signal
8+9	Super Speed Lane 2 Pair

Note:

- If USB A - Lane 1 Rx and Lane 2 TX
- If USB B - Lane 1 TX and Lane 2 RX

USB-C Connector

USB-C is a reversible connector. However, the pins that connect when physically rotated are different.

To facilitate the re-routing of signals dependent on the orientation of the connector, a resistor with-in the first cable provides orientation information.

Once orientation is determined - it assigns the four super speed lanes correctly. (According to the rotation of the connector.)

As a result of this:

Any extensions or couplers from a USB-C connection will only work when connected to the user device in one orientation (or 50% of the time). As such, any time we use a USB-C cable from an AV device to the table, the cable should be presented all the way to the table connection. (AV device direct to client laptop)

We cannot run a 7m cable to the floor with a short 2m patch lead like we can with HDMI.

The length limit for a standard USB-C cable is 1.8m. However, active/hybrid cables can be up to approximately 20m.

The USB-C connector as previously mentioned can support protocols beyond USB 3. A list of these protocols is included below:

Protocols with USB-C connector and USB 3 cable

- USB 2
- USB 3 - All Varieties
- DisplayPort - Alt Mode
- Thunderbolt 3 - Alt Mode

Protocols with USB-C connector and its own proprietary cable

- USB 4 - Superspeed 20
- USB 4 - Superspeed 40
- Thunderbolt 3
- Thunderbolt 4

Of these protocols, DisplayPort alt mode with the use of USB 2 or 3 depending on lane configuration is the most widely adopted. The below list highlights the key features available with a USB 3 connection and a USB-C connector.

A USB-C USB 3 Gen X connection can support:

- USB 2.0 legacy connection
- Four Super Speed Lanes.
- Super Speed Data Protocol– USB3.2 Gen X / USB 4/ Thunderbolt 3 & 4 / PCI-e
- Power delivery up to 240W
- Alternative mode operation – DisplayPort
- Side Band Channel – Used within Alternative mode

E-Marker requirement for USB-C Cables:

E-Marker Chips provide information about the capabilities of the cable. E-Markers are required in the following conditions:

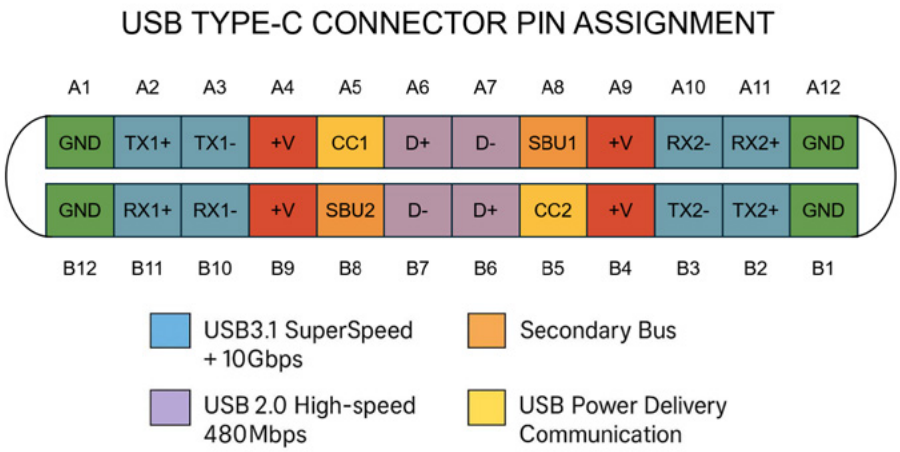
- USB3, USB4 and Thunderbolt connection.
- Where USB 2 cables are used E-Markers must be used when exceeding 60W.
- All hybrid cables

E-Markers are recommended for 60W cables although not required.

The E-Marker Chip provides the following Information:

- **Power and current:** The maximum supported current and voltage
- **Data transfer:** The type of USB signal and data transfer speed
- **Cable length:** The length of the cable
- **Vendor and product ID:** The vendor and product ID of the cable
- **Alternate mode:** Whether the cable supports alternate mode

This image shows all the pins within a USB-C receptacle and its function.



The four Super Speed lanes can be semi flexibly routed dependent upon the data protocol / Alt Mode in use.

The below table shows the pinout for USB-C connectors:

USB 3 C Pinout	
Pin	Signal
A1+A12+B12+A12	Ground for Power Delivery
A4+A9+B9+B4	Vbus Power Delivery +5V-48V
A5+B5	CC USB Power Delivery Communication
A8+B8	Secondary Bus - Side Band Use
A6+A7/B7+B6	USB 2 Pair (Rotation Dependent A or B Pair)
A2+A3	Super Speed Lane 1 Pair
A10+A11	Super Speed Lane 2 Pair
B11+B10	Super Speed Lane 3 Pair
B3+B2	Super Speed Lane 4 Pair

Note:

USB-C receptacles have USB 2 pins wired on both A6+A7 and B7+B6 to allow for connection to the USB-C plug which is wired only on A6+A7 being mounted in either orientation.

Sideband Channel - A8+B8

This is a low bandwidth channel used for communication of signals like EDID or CEC in Display Port or HDMI Alternative modes

Configuration Channel (CC) - A5 + B5

One CC pin is connected to establish the orientation of the connection. The other CC pin is repurposed as a Vconn to power the E-Marker Chip within the cable

Additional Cable Information:

Although 24 pins are available within the USB-C connector, only 18 wires are utilised.

- Two pins within the plug are used for USB 2 as opposed to four on the receptacle to allow for reversing the connection.
- Four VBus Power pins are used with two physical cables for power delivery.
- Four Ground pins are used with two physical cables for power return ground.

USB-C Charging

As power requirements increase, both current and voltage supply varies.

The below table shows the relationship between power draw and current/voltage.

Power Up to	Voltage	Current
≤ 15 W	5V	< 3A
27W	9V	5A
45W	15V	5A
60W	20V	5A
100W	20V	5A
140W	28V	5A
180W	36V	5A
240W	48V	5A

USB-Charging Terminology:

- USB-Charging up to 100W is Standard Power Range (SPR)
- USB-Charging between 100W and 240W is Extended Power Range (EPR)

USB 3 – Data Rates & Lanes

Confusingly the name of USB 3 protocols has changed multiple times. As such, some hardware manufacturers may not have updated the terminology to support these changes.

USB 3 utilises a new naming convention which aims to simplify the data rate which can be achieved. USB data rates vary based on the version of USB they are transmitting, and the number of lanes which are utilised.

USB 3 comprises of two variants, Gen 1 (5Gbps) and Gen 2 (10 Gbps).
When used in conjunction with the following connectors, additional lanes can be used to increase transfer speed.

- USB A/B connectors – 2 Lanes
- USB-C connectors - 4 Lanes

*Please note that although 4 lanes are available USB 3, Gen 1 & 2 only utilise up to 2 lanes for data transfer. USB 4 will use these additional lanes for data transfer.

USB Gen A x B

A = Generation
B = Num lanes used

Name	Naming Convention	Signal	Cable Length
USB 2.0	High Speed USB	480Mbps	5m
USB 3.2 Gen 1x1	USB 3.0	5 Gbps	3m
	USB 31. Gen 1		
	USB 3.2 Gen 1 x 1		
	Super Speed		
	Super Speed 5		
USB 3.2 Gen 1 x 2	USB 3.1 Gen 2	10 Gbps	3m
	Super Speed +		
	Super Speed 10		
USB 3.2 Gen 2 x 1	USB 3.2 Gen 2 x 1	10 Gbps	3m
USB 3.2 Gen 2 x 2	USB 3.2	20 Gbps	3m
	Super Speed 20		
USB 4 Gen 2 x 2		10 Gbps	0.8m
USB 4 Gen 3 x 2		20 Gbps	0.8m

USB Real Use Data Rates and Connector Support

Name	Signal	Encoding	Rate*	Connector
USB 2.0	480Mbps			USB A/B/C
USB 3.2 Gen 1x1	5 Gbps	8b/10b	4 Gbps	USB A/B/C
USB 3.2 Gen 1 x 2	10 Gbps	8b/10b	8 Gbps	USB A/B/C
USB 3.2 Gen 2 x 1	10 Gbps	128b/132b	9.7 Gbps	USB A/B/C
USB 3.2 Gen 2 x 2	20 Gbps	128b/132b	19.4 Gbps	USB-C
USB 4 Gen 2 x 2	10 Gbps	128b/132b	19.4 Gbps	USB-C
USB 4 Gen 3 x 2	20 Gbps	128b/132b	38.8 Gbps	USB-C

Encoding Note:

Rate* with Encoding Overhead

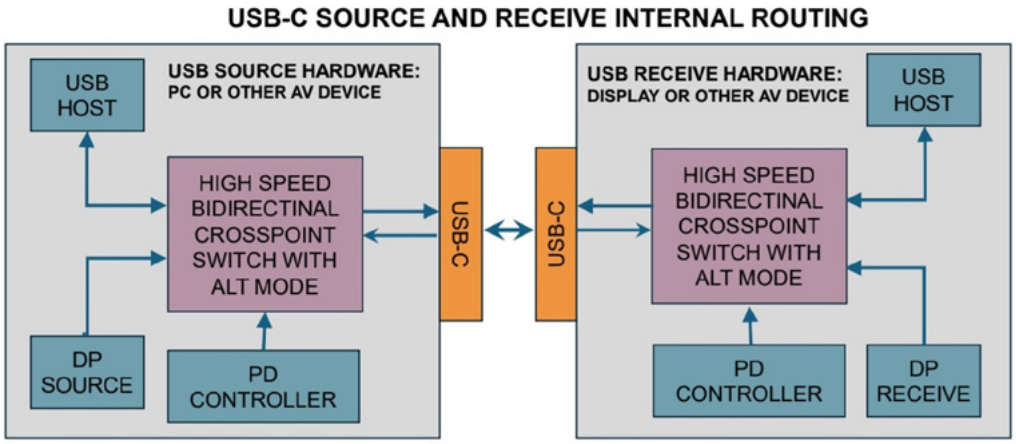
Between 8b/10b and 128b/132B, a large increase in signal transmission rate with encoding overhead is achieved.

8b/10b adds two bits per 8 bits of data, whereas 128b/132b adds only 4bits per 128 bits of data. This larger encoding block sees transfer overhead reduce from 20% to just 3%.

What is USB3 alt mode video?

Alt mode video is when two or four of the super speed lanes on the USB-C connection are used to transmit native video data. For a device to support alt mode video, a multiplexer must exist on the USB side which interfaces multiple signal types within the device to the USB-C connection. This multiplexer allows a direct connection between the GPU and the end device.

Once a connection link has been established it can determine what signals to route and what lane allocation to make.



The above information shows an example of a typical USB-C Multiplex Chip and how it allows multiple interfaces to interact with a single port.

There are several types for Alt mode video available for USB 3. these are listed below:

- DisplayPort 2 Lane Alt Mode
- DisplayPort 4 Lane Alt Mode
- HDMI Alt Mode
- Thunderbolt 3 Alt Mode
- MHL Alt Mode
- Virtual Link Alt Mode

DisplayPort alt mode video is the most popular USB-C alternative mode connection.

As of 2025 AV integration we are likely to only use DisplayPort Alternative Mode.
Alternatively Display Link may be used but this does not use any alt mode in addition to standard USB 2/3 transmission.

Where a USB-C dock is fitted with a HDMI output and a USB 3 connection, this will be a DisplayPort Alternative Mode link as HDMI Alt Mode cannot support USB3.

DisplayPort Alt Mode Video

USB-C 3.2 Gen2x2 can support up to DisplayPort up to 1.4 and HDCP 2.3.

Although a USB lane is designed to run 10Gbps, typically only 8.1Gbps per lane is certified by a specific cable designed to meet Alt Mode video as this is the bandwidth requirement for HBR3/8.1 to achieve DisplayPort 1.4 compliance.

Alt mode video is a method of transporting true DisplayPort or HDMI Signals in its native form. As a result of this, no compression of video bandwidth is achieved like other platforms of video transmission such as HDBT/AVOIP or SMPTE2110.

To fit this data rate onto a USB-C bus the video signal must be transmitted over multiple lanes. No provision for compression is made within USB4 so the issue is here to stay.

This high bandwidth makes long cables difficult and expensive to produce.

DisplayPort 4 lane alt mode video

All four lanes of the USB-C cable transmit DisplayPort video.

The benefit of this is to support twice the resolution or frame rate of 2 lane alt mode video at the expense of USB 3 connectivity (USB 2 speeds will still be available via the legacy USB 2 pins)

This is the primary choice when two 4k outputs from a single USB-C cable is required.
*However the devices and cables would also need to support MST

DisplayPort 2 lane alt mode video

Two Lanes of the USB-C cable transmit DisplayPort video and the other two transmit USB 3 Data.

This is the primary choice when a single 4K/30 Video output is required but BYOD connectivity is needed as the USB 3 Lanes can provide camera and audio over USB.

HDMI Alt Mode:

HDMI Alt mode video can be used to display 4K HDMI video signals. HDMI Alt Mode video requires the use of all four superspeed lanes. By using all four lanes of bandwidth HDMI Alt Mode will support the full range of HDMI 1.4b features alongside USB2 Functionality:

- USB 2 Speed only
- Resolutions up to 4K
- Surround sound
- Audio Return Channel (ARC)
- 3D (4K and HD)
- HDMI Ethernet Channel (HEC)
- Consumer Electronic Control (CEC)
- Deep Color, x.v.Color, and content types
- High Bandwidth Digital Content Protection (HDCP 1.4 and HDCP 2.2)

What is Multi Stream Transport (MST)?

Multi Stream Transport allows a single USB-C connection to display multiple monitors either by use of an MST device or hub.

MST has been available with DisplayPort for some time, and since USB 3 Alt Mode uses DisplayPort video over the USB-C connection it supports MST in the same way.

This used to be popular with HD displays, however with the introduction of 4K monitors this is less usable due to bandwidth limitations.

Typically, the only time MST and USB-C will be used is with 4 lane Alt mode video. However, many source devices don't support this and as such is not recommended for end user inputs.

Also, when part of an installed solution it may be more beneficial to distribute HDMI/DisplayPort signals natively rather than by USB-C.

MHL Alt Mode

Mobile High Definition Link (MHL) Alternate Mode will support MHL audio/video in addition to USB 3.1 Gen 1 or Gen 2 data.

- 4K 60fps over a single lane
- 8K 60fps over four lanes
- Immersive audio (such as Dolby Atmos®, Dolby Digital, DTS:X™, etc.)
- USB 2.0 and USB 3.1 Gen 1 or Gen 2

Typically this is found only in consumer displays or consumer AV receiver products.

Virtual Link (VR) Alt Mode – Discontinued

Originally designed for use within Virtual reality applications

This version of Alt mode USB is unlike all other types of USB 3 Alt Mode video transports.

This connection utilised 6 super speed lanes as opposed to the four lanes typically available. This is achieved by using all four USB 2 Pins as opposed to just two of them and repurposing them to two lanes of USB 3.0. As such the cables for Virtual Link will be different to that of standard USB-C USB 3 cables with Alt mode video Support.

The primary reason that Virtual Link has gone to such lengths to obtain six super speed lanes is to allow 4K 60Hz video over 4 Lane DisplayPort Alt mode video. Whilst providing sufficient data transfer and power for a VR headset on a single cable.

Thunderbolt 3

Thunderbolt 3 uses the USB-C connector but can be used to transport data in any of the below modes.

- USB Only Mode
- DisplayPort Only Mode
- DisplayPort and USB Multi-Function Mode
- Thunderbolt Mode

Every Thunderbolt 3 peripheral must include two ports. The Thunderbolt 3 interface within a computer is interfaced by 4x PCI-E Lanes. Where two ports are in use this PCI-e bandwidth is shared between ports.

When bandwidth requirements exceed the maximum link speed due to the use of multiple protocols the bandwidth of the PCI-E link will be reduced to maintain signal integrity of continuous links.

USB Only Mode

In USB only mode, a Thunderbolt port behaves exactly like a USB3 port and supports USB 2.0,3.0 and 3.1 signals as a point-to-point link.

DisplayPort Only Mode

Just like USB3 uses a multiplexer chip to route a GPU connection directly to the USB-C connection Thunderbolt ports operate in the same way.

Thunderbolt 3 supports four lane DisplayPort 1.1 or 1.2a alt mode video with a maximum link speed of 4x 5.4Gbps (HBR2). Thunderbolt manages to transmit all four HBR2 lanes through two super speed lanes on the USB-C connection.

This DisplayPort link can support one 4K 60Hz video stream.

DisplayPort and USB Multi-Function Mode

Within this mode, one super speed lane is allocated to DisplayPort and one to USB 3.1.
This uses a 5.4Gbps HBR2 version of DisplayPort 2 Lane Alt mode video which Thunderbolt transmits over a single superspeed lane.

This DisplayPort link can support one QHD 60Hz video stream.

Thunderbolt Mode

When both device and cable connected support Thunderbolt, the devices can operate in Thunderbolt mode. This uses all four super speed lanes of the USB-C connector to achieve two lanes for transmit and two lanes for receive. These two RX/TX lanes are multiplexed together as an aggregated data link or data bus. What makes Thunderbolt 3 so powerful is its ability to transmit multiple different protocols over this link without the need for physical isolation like USB3.

Like USB data, Thunderbolt 3 offers two speed variants. 20Gbps and 40Gbps (10 or 20Gbps individual links respectively).

A list of the protocols which can be transmitted over this Thunderbolt 3 bus is given below:

- USB2
- USB 3.0, 3.1
- DisplayPort 1.1 & 1.2a
- PCI-E 3.0
- Power / Charging up to 100W

DisplayPort 1.2a and Thunderbolt 3.

You may have noticed that USB3 DisplayPort Alt mode supports DisplayPort 1.4 whilst Thunderbolt 3 is limited to 1.2a. This may be less of a downside than it appears on the surface.

Whilst Display port 1.4 allows the transport of HBR3 with 8.1Gbps transport per lane. DisplayPort 1.2a allows only HBR2 with 5.4Gbps transport. When operated in four lane display port mode, DP 1.4 allows a maximum data rate (not bandwidth) of 25.9Gbps compared to 17.28Gbps with 1.2a.

The maximum resolutions available with DP 1.4 are 8k 30Hz or 4K 120Hz whereas DP 1.2a is limited to 4K 60Hz.

A single USB-C connector using USB3 DisplayPort 1.4 4 lane Alternative mode can make use of MST to serve two 4K 60Hz displays.

Whilst Thunderbolt 3 can use only DisplayPort 1.2a to deliver a single 4K 60Hz, because Thunderbolt 3 isn't limited by lanes but by bandwidth, two Instances of DisplayPort 1.2a can be transmitted across a single Thunderbolt 3 40Gbps link.

As such, both protocols devices can support two displays at 4K 60Hz.

With Thunderbolt, the displays, cables and source device would all need to support Thunderbolt 3.

With USB-C a USB-C MST hub would be required and the USB-C cable and host device would need to support MST and DisplayPort 4 Lane Alt Mode video for USB-C.

Thunderbolt Chain and Networking:

Thunderbolt devices can be linked in a daisy chain (link from one device to another), up to a maximum of 6 devices. This is dependent on every connection being a full Thunderbolt link, operating in Thunderbolt mode. If any of these devices are connected in USB or DisplayPort mode, the chain is broken at this point.

The maximum bandwidth of the chain is limited by each segments bandwidth capability. In some instances, multiple Thunderbolt connections will be required due to this bandwidth limitation.

One additional feature of Thunderbolt 3 is that the Thunderbolt interface operates as a virtual ethernet adapter. This allows the PCI-e interface within Thunderbolt 3 to transfer network traffic with speeds greater than 10Gbs to connected Thunderbolt devices.

This can prove beneficial for network drive storage solutions for broadcast video recording due to the need for high data rate recording whilst centrally locating media for remote management/post production.

Thunderbolt 3 Minimum Specification issues

Although Thunderbolt 3 supports all the above functionality, there are a few issues with Thunderbolt 3 which cause significant compatibility issues.

These issues are primarily caused by the minimum specification requirements shown in the table below:

	Thunderbolt 3 Maximum	Thunderbolt 3 Minimum
Total bandwidth	40 Gbps	20 Gbps
Minimum bandwidth available for data transfer	32 Gbps	16 Gbps
Display	Two 4K or One 8K Display	One 4K Display

Additional issues with Thunderbolt 3:

Unreliable compute wake through Thunderbolt peripherals. (EG, KVM via dock)

As a result of this, dual screen 4K display with Thunderbolt 3 is not always supported. A key issue with this is laptop support for Thunderbolt 3 which will often only support a single display. As a result of this we cannot rely or design a Thunderbolt 3 solution based on dual screen video transport. Where dual screen is required both AV hardware and end user devices should be Thunderbolt 4.

Thunderbolt 4

Thunderbolt 4 is the same protocol as Thunderbolt 3 with some minor refinements to provide greater compatibility and reliability.

The minimum performance of Thunderbolt 4 is equal to the maximum requirements of Thunderbolt 3. This removes ambiguity over Thunderbolt 3 which has variants in data link speed and display support.

Thunderbolt 4 has a security layer which limits access to memory to that only required for the specific peripheral. Without this, the whole PCI-e lane is accessible due to its non-typical method of access and high-speed connection provides security concerns both high in bandwidth and non-typically protected methods of access.

The Thunderbolt 4 specification is fully compliant with USB4. An easy rule to follow is that a USB4 device in a Thunderbolt 4 port will operate correctly. A Thunderbolt 4 device in a USB4 port will have limited functionality.

Every Thunderbolt 4 peripheral must include four ports. Beyond this, the Thunderbolt 4 interface within a computer is interfaced by 4x PCI-e lanes. Where two ports are in use this PCI-e bandwidth is shared between ports.

When bandwidth requirements exceed the maximum link speed due to the use of multiple protocols the bandwidth of the PCI-e link will be reduced to maintain signal integrity of continuous links.

USB 4

USB 4 is built on the Thunderbolt 3 standard after Intel made the standard available for use without licencing.

As a result of this USB 4 is the same as Thunderbolt 3 and shares its issues with minimum specification.

The other primary consideration with USB 4 and Thunderbolt 3 is that manufacturers can self-certify compliance with the standard whilst Thunderbolt 3 compliance requires certification via Intel. This can result in products on the market which may or not meet the specification. Compounded with the issue that there is such varying performance between minimum and maximum specification it is very difficult to guarantee hardware compatibility.

The compromise with USB 4 is that it will only support DisplayPort 1.2a like Thunderbolt 3 as opposed to DisplayPort 1.4. This may be resolved in time.

Cables and Devices

Thunderbolt 3, 4 and USB 4 cable lengths and identification:

Please note that active cables are required for lengths greater than 0.5m for Thunderbolt 3 and 0.8m for USB4.

Docks and Compatibility

USB-C docks which can support Thunderbolt 3 or Thunderbolt 4 often require driver installation for operation and are not driverless like USB. As such is it recommended to use docks which can be Thunderbolt disabled within the BIOS.

Pro AV docks can be a good solution to minimise these impacts.

Some USB-C docks have built in GPU's for laptops without Alt Mode video support. Some of these will require drivers and some will support the display link standard.

Display Link

Display Link is a USB GPU platform where the GPU sits within the dock and the connected device only sends video data for updated pixels.

This requires the display link software to be installed on the source device but allows the use of 4K displays from low bandwidth computers without much issue as most of the time static or non-moving content is displayed.

Display Link Is not an ideal solution for moving video.

USB 3.1 Long Range Extenders:

Many USB 3.1 extender RX/TX units exist for the transmission of USB A/B single lane USB3. As they do not natively support four superspeed lanes required for USB-C they cannot support the use of Alt mode video in any variety.

These USB 3 extenders use a single Cat7 / Fibre cable to create point to point link.
Typically, these can support standard USB 3.1 A/B speeds with duplex lane single 5Gbps data rate.
Since 10Gbps USB extenders are not available at present, long range USB-C extenders with multiple aggregated links to achieve 40Gbps for full USB-C extension are a distant reality.

Lack of Extender solutions for Alt Mode Video

Compared to long distance HDMI/DisplayPort transport mediums like HDBT/DM which uses a 10G data link to transport 18Gbps of data, Alt mode video supports no data compression like HDBT/DM which uses DSC/PAN. There is no provision to include this into USB4 either. As such full data rate must be achieved by utilising multiple lanes.

At present no four lane USB3.2 Gen 2 over structured cabling solutions exist for long distance USB-C connections. These devices would also require support for Alt Mode video to facilitate video transport.

At present these requirements are achieved through existing AVOIP, HDBT/DM or SDI solutions.

Adding USB-C to PCs without Alt mode Support:

Adding alternative mode to PCs which don't natively support it or additional inputs to high performance PCs for applications such as V-MIX, can prove challenging.

If this is a requirement for your project, please see this reference guide:
https://dancharblog.wordpress.com/2020/07/20/add-usb-c-with-dp-alt-mode-to-your-desktop-pc/

Notes:

Apple M1 USB-C dual screen is not possible due to a limitation within the M1 Chip.

Protocols with USB-connector with a USB 3 cable

- USB 2
- USB 3 - All varieties
- DisplayPort - Alt Mode
- Thunderbolt 3 - Alt Mode

Protocol with USB-C connector with its own proprietary cable

- USB 4 - Superspeed 20Gbps
- USB 4 - Superspeed 40Gbps
- Thunderbolt 3 – 20Gbps
- Thunderbolt 3 – 40Gbps
- Thunderbolt 4

Adding USB-C to PCs without Alt mode support:

Useful Links:

https://www.ti.com/lit/an/slaaem9/slaaem9.pdf

About the author:

Samuel Williams MInstSCVE is a specialist in integrated audiovisual system design, with a focus on complex systems that are simple to operate, maintain, and adapt over time, alongside a strong interest in electroacoustics.

With over 15 years' experience across system design engineering, consultancy, and an early career in live events, his work centres on delivering dependable solutions that maximise both user and operator experience through clarity of design, technical robustness, and an understanding of real-world operational constraints.

He holds an MSc in Applied Acoustics from the University of Derby and a Diploma in Acoustics and Noise Control from the Institute of Acoustics.

Media Powerhouse is a systems integration, events, and creative print business delivering integrated audiovisual systems across the UK and Europe.

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