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DisplayPort Alternate Mode for USB Type-C Announced - Video, Power, & Data All Over Type-C

by [Ryan Smith](#) on September 22, 2014 9:01 AM EST

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USB Type-C With DisplayPort Alternate Mode

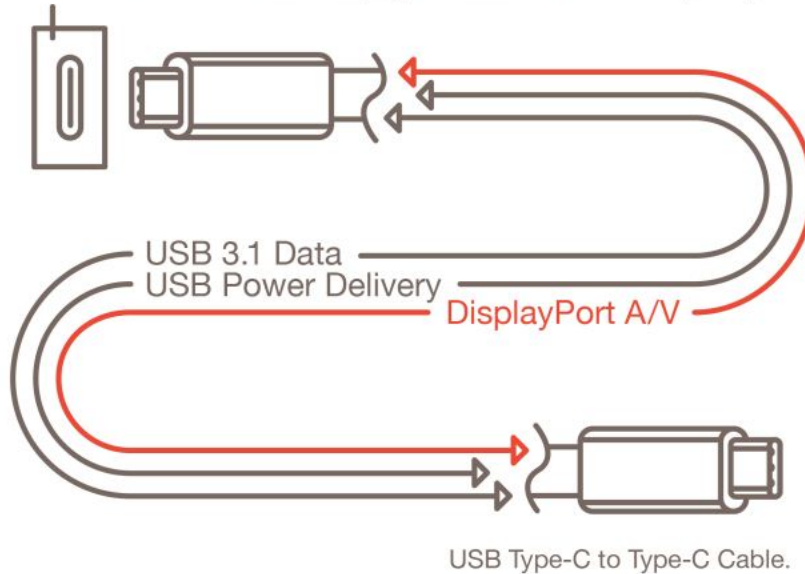
Earlier this month the USB Implementers Forum announced the new [USB Power Delivery 2.0 specification](#). Long awaited, the Power Deliver 2.0 specification defined new standards for power delivery to allow Type-C USB ports to supply devices with much greater amounts of power than the previous standard allowed, now up to 5A at 5V, 12V, and 20V, for a maximum power delivery of 100W. However also buried in that specification was an interesting, if cryptic announcement regarding USB Alternate Modes, which would allow for different (non-USB) signals to be carried over [USB Type-C connector](#). At the time the specification simply theorized just what protocols could be carried over Type-C as an alternate mode, but today we finally know what the first alternate mode will be: DisplayPort.

Today the VESA is announcing that they are publishing the “DisplayPort Alternate Mode on USB Type-C Connector Standard.” Working in conjunction with the USB-IF, the DP Alt Mode standard will allow standard USB Type-C connectors and cables to carry native DisplayPort signals. This is designed to open up a number of possibilities for connecting monitors, computers, docking stations, and other devices with DisplayPort video while also leveraging USB’s other data and power capabilities. With USB 3.1 and Type-C the USB-IF was looking to create a single cable that could carry everything, and now that DisplayPort can be muxed over



USB Type-C With DisplayPort Alternate Mode

USB Host or Device with DisplayPort Alternate Mode Capability.



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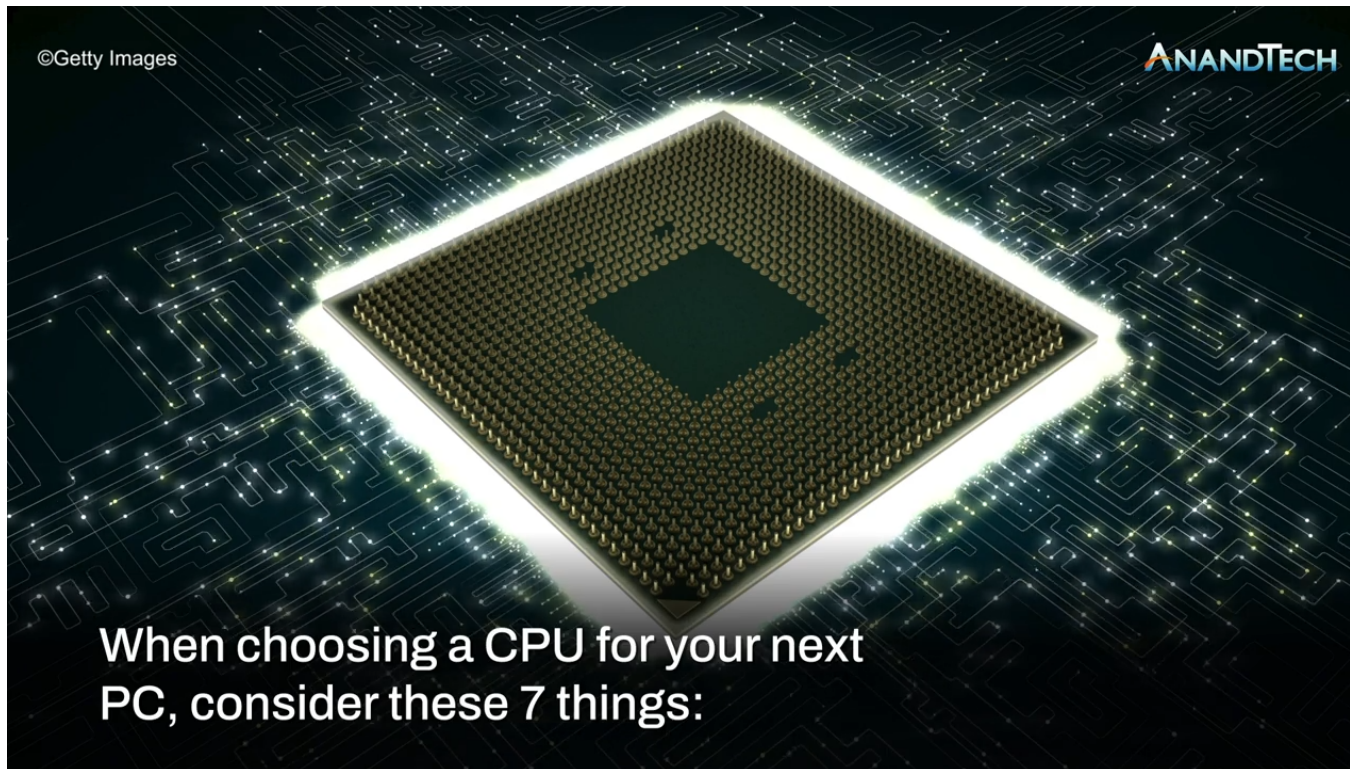
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the Alt Mode specification, DP Alt Mode will then in turn be allowed to take over some of these lanes – one, two, or all four – and run DisplayPort signaling over them in place of USB Superspeed signaling. By doing so a Type-C cable is then able to carry native DisplayPort video alongside its other signals, and from a hardware standpoint this is little different than a native DisplayPort connector/cable pair.



have some very rough numbers to play with

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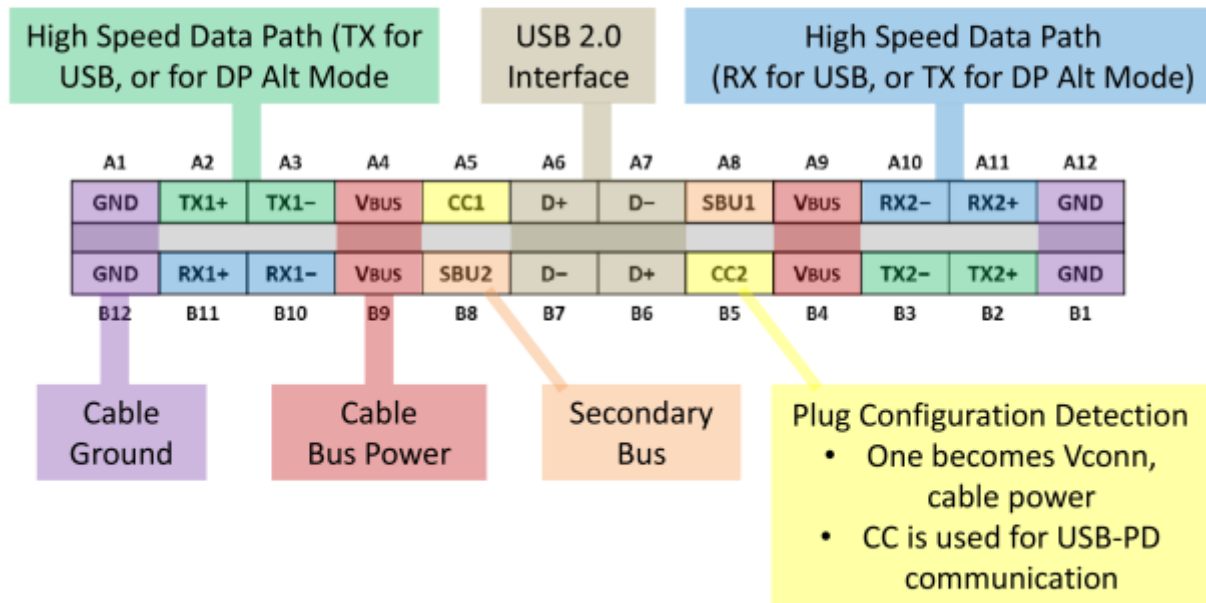
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USB Type-C Receptacle Pins

Pins defined for system or device receptacle



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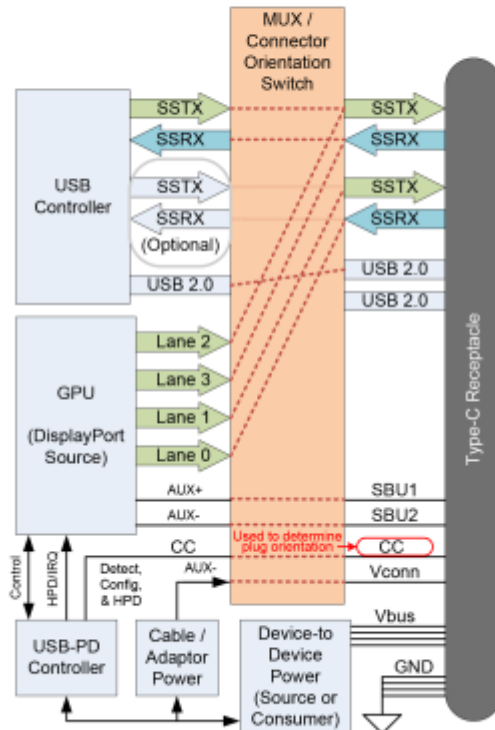
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From a hardware perspective this will be a simple mux. USB alternate modes do not encapsulate other protocols (ala Thunderbolt) but instead allocate lanes to those other signals as necessary, with muxes at either end handling the switching to determine what signals are on what lanes and where they need to come from or go. Internally USB handles this matter via the CC sense pins, which are responsible for determining cable orientation. Alongside determining orientation, these pins will also transmit a Standard IDentification



USB Type-C Device Switch for DisplayPort Alternate Mode Support



- Example for interface that supports USB and DisplayPort Alternate Mode Only
- Similar switch needed at the Device end

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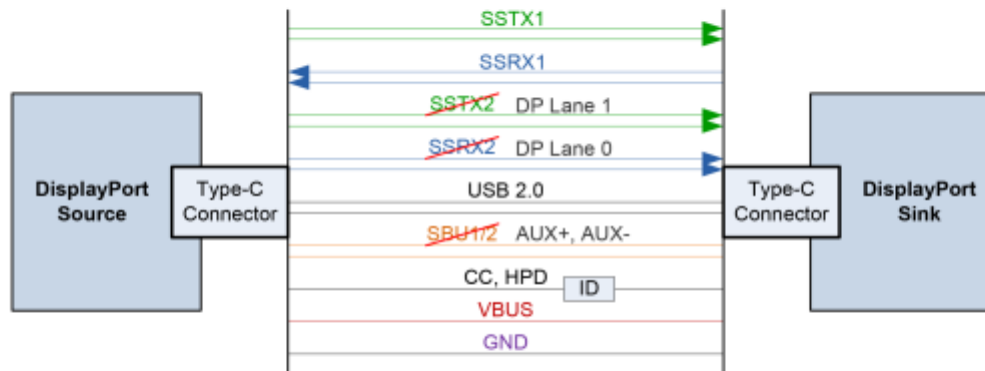
Along with utilizing USB lanes for DP lanes, the DP Alt Mode standard also includes provisions for reconfiguring the Type-C secondary bus (SBU) to carry the DisplayPort AUX channel. This half-duplex channel is normally used by DisplayPort devices to carry additional non-video data such as audio, EDID, HDCP, touchscreen data, MST topology data, and more. Somewhat perversely in this case, the AUX channel has even been used to carry USB data, which dutifully enough would still be supported here for backwards

with all of the regular DisplayPort features a Type-C cable also carries the standard USB 2.0 interface and USB power, which always coexist alongside alt mode. So even in these configurations Type-C allows dedicated high power and USB 2.0 functionality, something the DisplayPort physical layer itself is not capable of. And of course when using a less-than-full configuration, 2-3 of those lanes on the Type-C cable then can be left to running USB Superspeed signaling, allowing USB 3.1 data to be carried alongside the narrower DisplayPort signal.

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

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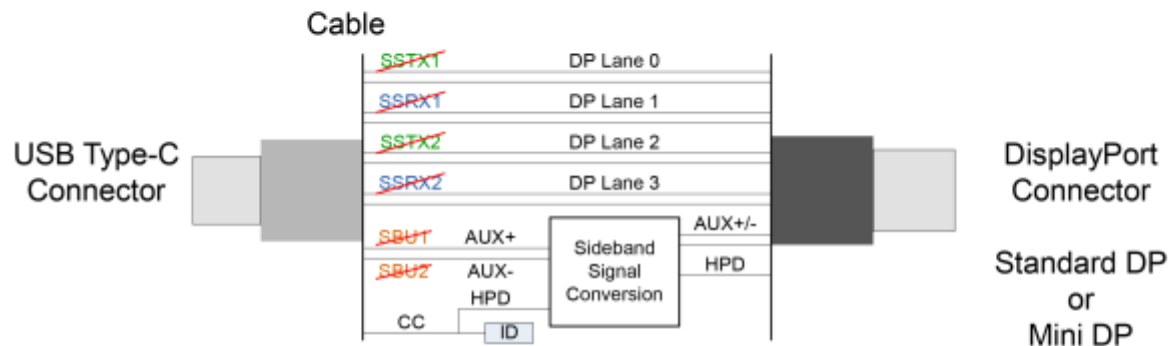
Configuration for Docking Stations



- 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

side Type-C ports can be used for the sink (displays) as well as the source (computers), so one could have a display connected to a source entirely over Type-C. Otherwise simple Type-C to DisplayPort cables can be constructed which from the perspective of a DisplayPort sink would be identical to a real DisplayPort cable, with the cable wired to expose just the DisplayPort signals to the sink. Or since these cables will be bidirectional, a legacy DisplayPort source could be connected to a Type-C sink just as well.

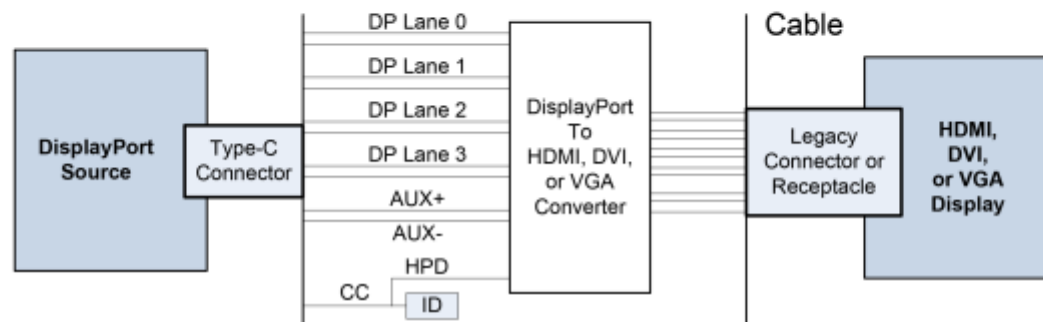
USB Type-C to DisplayPort Adapter Cable



- Cable is reversible, works in either direction; four lanes of DisplayPort
- Supports legacy DisplayPort Source and Sink Devices
- Detected by 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

HDMI 2.0 cables (and **only** HDMI 2.0, no 1.4) to make Type-C ports usable with HDMI devices. In fact the only major DisplayPort feature that won't work over a Type-C connector is Dual-Mode DisplayPort (aka DP++), which is responsible for enabling passive DisplayPort adapters. So while adapters work over Type-C, all of them will need to be active adapters.

USB Type-C to Legacy Mode Adapter Cables / Cable Adapters



- Utilizes DisplayPort Alt Mode capability of Type-C connector
- Adapter Cable: Type-C plug on one end, legacy plug on other end
- Cable Adapter: Type-C plug on one end, legacy receptacle on other end
- HDMI Adapter Cable takes advantage of new HDMI “direct connect Source” provision
- USB Type-C will NOT support DisplayPort Dual Mode (DP++)
- All certified Type-C to HDMI Converters will support HDMI 2.0

length DisplayPort 1.2's HBR2 mode can be used. Meanwhile DP Alt Mode is currently only defined to work on passive USB cables, with the VESA seemingly picking their words carefully on the use of "currently."

The Ecosystem & The Future

Because of the flexibility offered through the DP Alt Mode, the VESA and USB-IF have a wide range of options and ideas for how to make use of this functionality, with these ideas ultimately converging on a USB/DisplayPort ecosystem. With the ability to carry video data over USB, this allows for devices that make use of both in a fashion similar to Thunderbolt or DockPort, but with the greater advantage of the closer cooperation of the USB-IF and the superior Type-C physical layer.

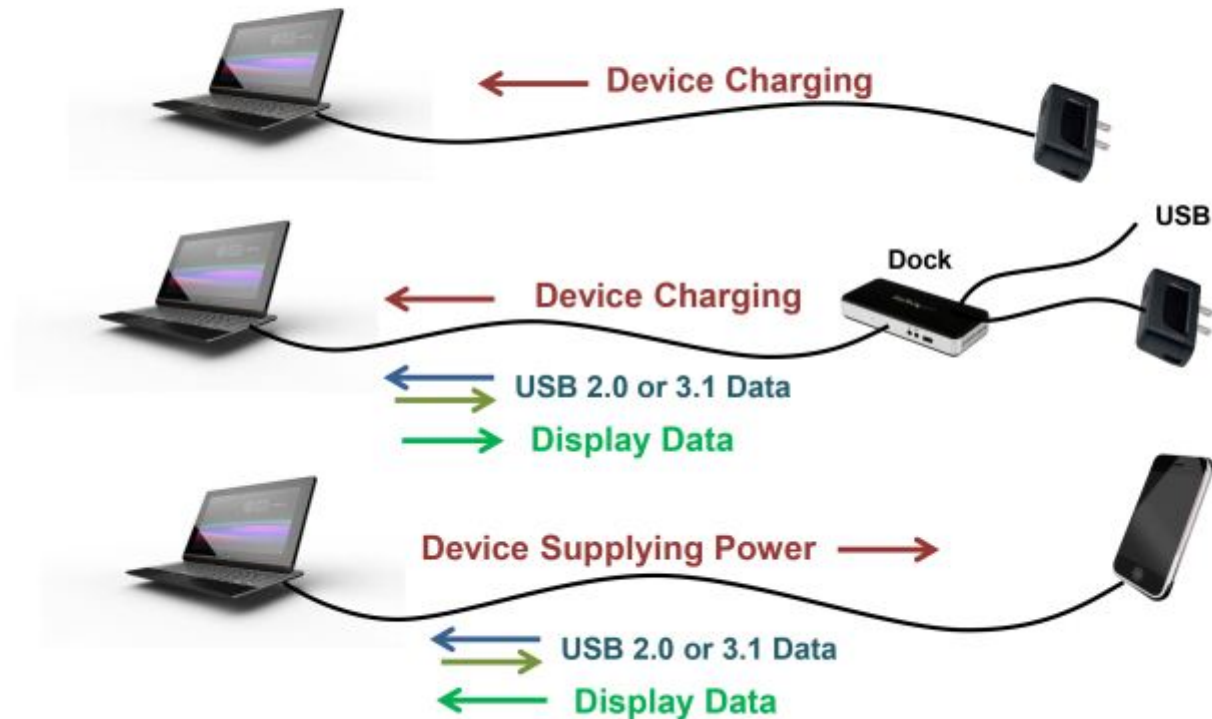
At its most basic level, DP Alt Mode means that device manufacturers would no longer need to put dedicated display ports (whether DisplayPort, VGA, or HDMI) on their devices, and could instead fill out their devices entirely with USB ports for all digital I/O. This would be a massive boon to Ultrabooks and tablets, where the former only has a limited amount of space for ports and the latter frequently only has one port at all. To that end there will even be a forthcoming identification mark (similar to DP++) that will be used to identify Type-C ports that are DP Alt Mode capable, to help consumers identify which ports they can plug their displays into. The MUX concept is rather simple for hardware but I do get the impression that devices with multiple Type-C ports will only enable it on a fraction of their ports, hence the need for a logo for consumers to identify these ports. But we'll have to see what shipping devices are like.

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Example USB Type-C Configurations

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



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More broadly, this could be used to enable single-cable connectivity for laptops and tablets, with a single Type-C cable providing power to the laptop/tablet while also carrying input, audio, video, additional USB data, and more. This would be very similar to the [Thunderbolt Display](#) concept, except Type-C would be able to be a true single cable solution since it can carry the high-wattage power that Thunderbolt can't. And since Type-C can carry DisplayPort 1.3 HBR3, this means that even when driving a 4K@60Hz display there will still be 2

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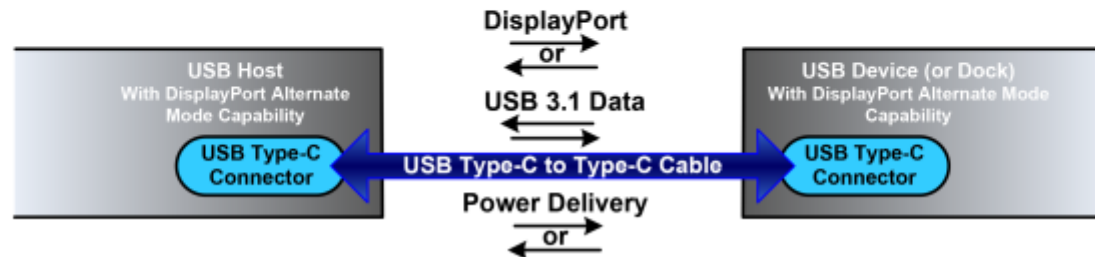
Speaking of which, this does mean that USB via DP Alt Mode will more directly be competing with other standards such as Thunderbolt at DockPort. Thunderbolt development will of course be an ongoing project for Intel, however for [DockPort](#) this is basically the end of the road. The standard, originally developed by AMD and TI before being adopted by the VESA, will continue on as-is and will continue to be supported over the DisplayPort physical layer as before. However it's clear from today's announcement that DisplayPort over USB has beaten USB over DisplayPort as the preferred multi-signal cabling solution, leaving DockPort with a limited duration on the market.

It's interesting to note though that part of the reason DP Alt Mode is happening – and why it's going to surpass DockPort – is because of the Type-C physical layer. In designing the Type-C connector and cabling, the USB-IF has specific intentions of having the Type-C connector live for a decade or more, just like USB Type-A/B before it. That means they've done quite a bit of work to future-proof the connector, including plenty of pins with an eye on supporting speeds greater than 10Gbps in the future.



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
 - Will initially offer the same capability as a standard DisplayPort connection
 - Will allow DisplayPort data rates to increase in the future, since the USB Type-C connector uses newer technology
- DisplayPort can be combined with USB 3.1 Operation
 - Two high speed pairs for DP (two lane operation), and two high speed pairs for USB
 - Useful for docking stations (or adding docking station functionality to a display)
- USB 2.0 is available in all configurations

For that reason the possibility is on the table of ditching the DisplayPort physical layer entirely and relying solely on Type-C. Now to be clear this is just an option the technology enables, but for a number of reasons it would be an attractive option for the VESA. As it stands the DisplayPort physical layer tops out at 8.1Gbps per lane for HBR3, meanwhile Superspeed+ over Type-C tops out at 10Gbps per lane with the design goal of further bandwidth increases. As the complexity and development costs of higher external buses goes up, one

the DP Alt Mode ecosystem needs to take off for the kinds of mobile devices it's designed for, and only then would anyone be thinking about replacing the DisplayPort physical layer entirely.

Wrapping things up, the VESA tells us that they are going to hit the ground running on DP Alt Mode and are seeing quite a bit of excitement from manufacturers. The VESA is expecting the first DP Alt Mode capable devices to appear in 2015, which is the same year Type-C ports begin appearing on devices as well. So if everything goes according to schedule, we should see the first DP Alt Mode devices in just over a year.

The all-in-one cable concept has been a long time coming, and after DockPort and Thunderbolt stumbling the market does look ripe for DP Alt Mode. So long as the execution is there, the manufacturers are willing to use it, and device compatibility lives up to the promises. Getting video over USB is the ultimate Trojan horse – unlike mDP, USB is already everywhere and will continue to be – so this may very well be the X factor needed to see widespread adoption where other standards have struggled.

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[savagemike](#) - Monday, September 22, 2014 - [link](#)

Now THAT'S a universal bus.

Seriously though - this looks pretty cool. Even beyond the different daisy chaining configurations it will be nice to just have one cable to hook stuff together if this works out.

Need to connect your printer, scanner, mobile device, monitor - use this cable.

Need to charge your whatever - use this cable.

Cable gone bad and giving you a bad day? It's OK because all the other cables you have are the same kind of cable. Just use one of them.

It's a glorious, glorious vision of the future.

[SniPerfidy](#) - Monday, September 22, 2014 - [link](#)

Well said.

[Minion4Hire](#) - Monday, September 22, 2014 - [link](#)

I wish I could upvote you, because I would upvote you so hard.

This really is the cabling revolution we need. Getting rid of cables entirely is unrealistic (at least until battery technology advances by huge leaps and bounds) but minimizing and simplifying the cables that we use on a regular basis would be a massive improvement.

[Zertzable](#) - Monday, September 22, 2014 - [link](#)



It also couldn't handle power transfer... THIS is what the mobile industry has needed for years and what will possibly mark the return of the dock model and laptops/mobile more frequently devices connected to full size/peripherals and displays at home.

There is absolutely a demand for this, it just hasn't been very easy (the average consumer looking at a power cable, USB hub, display cable, etc just gives up). I know Mac users young and old that bought iMacs even tho they had MBP already because they wanted something larger at home.

It'll be interesting to see whether Apple ignores this spec and plows forward with Thunderbolt for a while or wether they adopt it fast. Personally speaking I have no big need for it as I still have a desktop, but it'd make a future Surface Pro A LOT more interesting.

Byte - Tuesday, September 23, 2014 - link

We need this NOW! I'm trying to hook up 4 monitors and i need a freakin different cable for every one! The stupid radeon has DVI, HDMI, MiniDP. So not only do i need regular cables, i need to wach out for this Mini plug crap. WTF! I had to just stick one in the VGA of the intel integrated and called it a day.

SirKnobsworth - Tuesday, September 23, 2014 - link

Check the specs of your video card, but DisplayPort (including mini DP) can support multi-stream transport, meaning that with a MST hub you might be able to connect more than one monitor to just that one port.

Impulses - Monday, September 22, 2014 - link

What are the chances we'll see Type C on 2015 phones? I know it's still not necessary from a voltage or data rate standpoint, but it'd definitely help drive the adoption rate quickly AND Samsung has already been implementing USB 3.0 on recent models... The quicker Type C starts becoming commonplace the more likely it'll be to realize it's fill potential, even if we don't see things like these alt modes for 2 years.

JCP2014 - Monday, September 22, 2014 - link

Great question, I'm wondering the same thing. Idk if 2015 flagships might be too early to have this. If I had to bet I'd say no, because it's a process that starts with the SOC, and it has to be USB 3.1 compatible. It's possible that SOC makers have already started preparing for this to be in next year's SOCs, but that would be the only hope of it being in phones next year.



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