Conspicuous Convergence

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It's an old story. For years, we've been hearing about how technology is "converging" to a single standard. We've been told that one day everything will happen "in the cloud" and that the only wires we'll need are the AC mains that carry power into the building. Sitting in a conference room trying to connect 21st century mobile devices to fixed AV assets with 20th century connections, one might be forgiven for being skeptical. Sometimes the failure of convergence to manifest in a form that aligns with our expectations results in a temporary technological blind spot. The closer we are to the confluence, the harder it is to see the details.

USB Type-C connector – photograph by J. Cornwall

It's time to take a good, careful look around. We are very close to a new, conspicuous convergence in mobility and technology. It's coming to a smartphone, tablet or laptop near you. Its journey started more than two decades ago. From its humble beginnings as a path for keyboards and printers to connect to a PC, Universal Serial Bus (USB) has grown to become more than just a universal serial connection port. It's also now a universal battery charger and a universal data port. And USB is quickly becoming a universal gateway for interoperability. According to Jeff Ravencraft, president of the USB Implementers Forum (USB-IF), the non-profit industry standards organization is "unwavering in our mission to solidify USB Type-C as the single cable of the future."

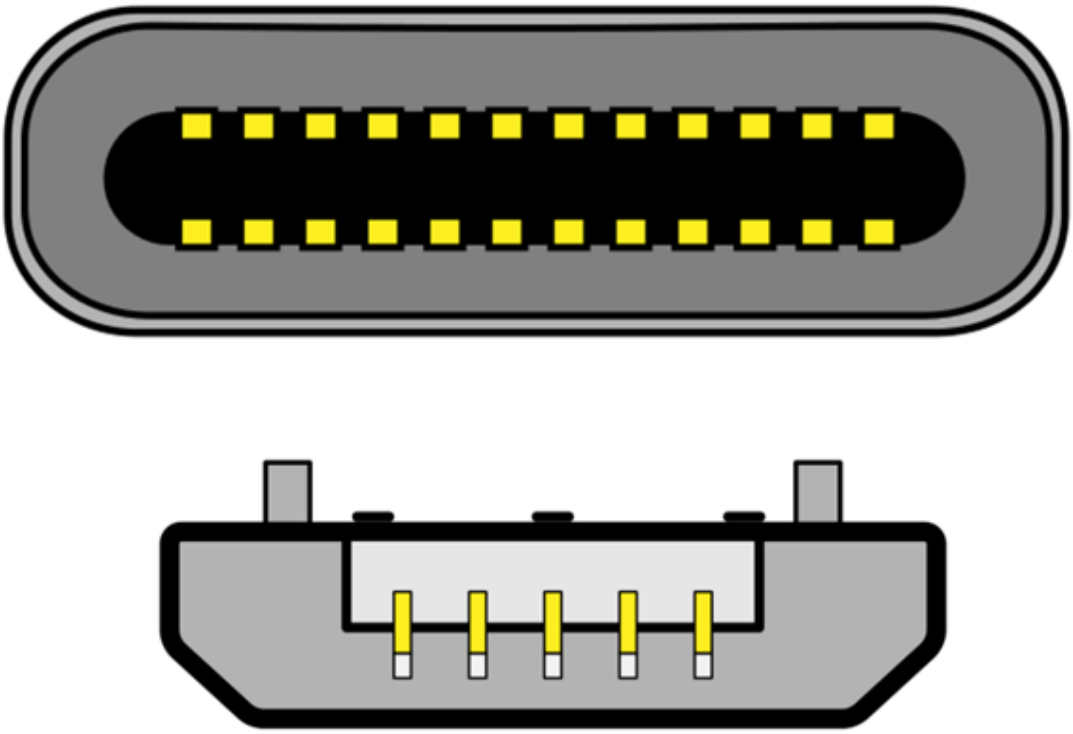
USB Type-C is having an impact on technology far greater than its modestly-sized, innocent-looking plug would have you believe. Barely larger than the ubiquitous USB micro type-B connection found on a preponderance of the world's cell phones and tablets, the new Type-C connection boasts a fourfold

increase in conductor density, a fortyfold increase in power handling, and a doubling of maximum data transfer rates. It is, by any relevant measure, a tour de force of telecommunications potential.

USB Type-C & micro Type-B connector comparison – photograph by J. Cornwall

Let's break down the features and capabilities of this powerful signal link by starting with its colossal connection count. The USB plug to which you've become accustomed, USB 2.0, contains just four wires; a differential pair for data and a pair for the voltage bus and ground. The micro Type-B connection on a smartphone adds an additional pathway for the USB OtG (On the Go) link. If you dabble in large files or advanced features, you might have a USB 3.0 pathway. This uses the established two pairs, and adds another two. USB 2.0 supports a maximum data transfer rate of 480MB/s. USB 3.0 (now defined as USB 3.1 Gen 1) can increase that number by a factor of ten, to 5GB/s. In comparison, the link between your Blue Ray DVD player and the display in your living room is probably rated to handle 10.2GB/s. For more than twenty years we've limped along with a connection on our mobile devices that isn't fast enough to support full-motion high-definition video. Any yet for ten of those twenty years, we've come to think of as HDTV as a de rigueur level of performance.

USB Type-C supports USB 3.1 Gen 2 performance. This gives the Type-C connection the potential for that whopping 10GB/s throughput enjoyed by the most advanced HDMI links. But even that is only a fraction of the story. The Type-C connector increases the pathway count to 24 pins, making possible a level of connectivity performance never seen before in mobile devices. All the pins mentioned above are included, along with an additional four shielded-twisted pairs that support a near-magical Alternate Mode.



In this illustration, the upper connector is USB Type-C and the lower is USB Micro Type-B as found on many smartphones and other mobile devices.

Alternate modes are optional USB Type-C features. Devices are not required to support any specific Alternate Mode. The system uses a series of embedded e-marker and billboard chipsets, which allow the technology to determine the feature set in use during a connection. This will take intuitive connectivity one step closer to reality for users who are less concerned with the technology deployed, and more concerned with leveraging the device's content. There are four Alternate Mode specification currently in use, and more are almost certainly on the way.

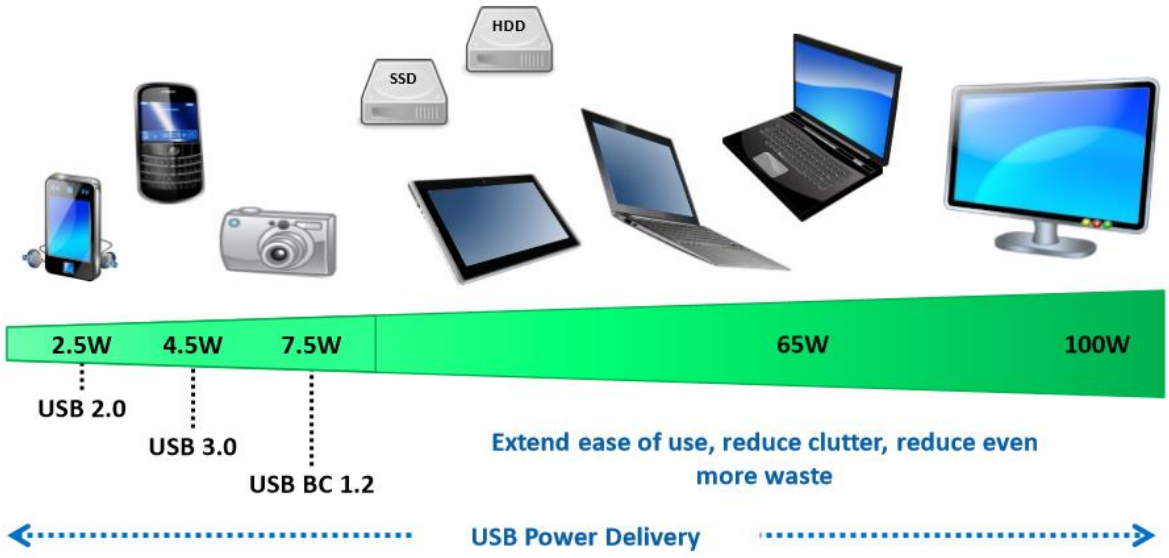
The most important Alternate Mode, and the only one natively supported by all standard USB Type-C connectors and cables, is DisplayPort Alternate Mode. Devices with this feature can connect to a DisplayPort equipped monitor or signal switcher/selector by using a passive USB Type-C to DisplayPort cable. This allows a smartphone, tablet or laptop to use a single powerful connection for both charging and AV connectivity supporting up to a 2160 by 3840 4K UHD image! This is precisely the configuration used in both the astonishingly powerful Apple MacBook and the hot new ZenPad 8000 tablet from Asus.

Additional Alternate Mode specifications include Mobile High Definition Link (MHL) Alternate Mode (announced in 2014), Thunderbolt 3 Alternate Mode (announced in June 2015) and HDMI Alternate

Mode (announced in September 2016). Even more serial protocols, such as PCIe and Base-T Ethernet, may join the roster soon.

C2G USB-C to DisplayPort adapter model 29481

The Video Electronics Standards Association (VESA) attributes a large percentage of the growth of DisplayPort connectivity to the rapid rise in inter-device compatibility made possible by the USB Type-C technology. Bill Lempesis, executive director of VESA, said "DisplayPort's Alternate Mode USB-C extension, which we introduced in September 2014, delivers full DisplayPort audio/video performance (driving 4K and higher resolution), SuperSpeed USB data and up to 100 watts of power—all over a single cable. Consumer electronics manufacturers are just now ramping up the use of USB-C on their products, which further accelerates the adoption of DisplayPort as the A/V standard of choice for driving 4K and higher resolution from PCs on down to mobile devices."



USB Type-C also supports a new level of desktop power options. Known as “power profiles”, the Type-C standard allows for 6 discrete configurations. The existing USB 2.0 system supports up to 5 volts and 500 mA of power for a maximum of 2.5 watts of power delivery while operational. That system also allows as much as 10 watts for charging, but not while actively transferring data over the USB link. This configuration remains the default profile to ensure full backwards compatibility with existing devices.

In the future USB Type-C will support profiles that deliver as much as 20 volts and 5 amps of current, or 100 watts of power. This is enough to power a large desktop monitor, or charge a battery in just a fraction of the time we’ve come to expect. The new Google Pixel cell phone, which is equipped with USB Type-C, claims to gain up to 7 hours of operational charge in just a scant 15 minutes of charging time!

USB Type-C is having a major impact on system design because of its flexible, powerful nature. It’s a connector that unifies AV, data and power over a single versatile port with a uniquely compact profile. USB Type-C adoption by manufacturers and the market is the fastest in the history of USB standards, which has a pretty impressive track record of adoption. In the world of digital convergence where the information technology, telecommunications, consumer electronics and content industries are all pushing towards a single, convenient and powerful connection, the rise of USB Type-C really is a conspicuous convergence!