

FCi Basics

USB Technology Explained

Amphenol
COMMUNICATIONS SOLUTIONS

USB Implementers Forum, Inc. (USB-IF)

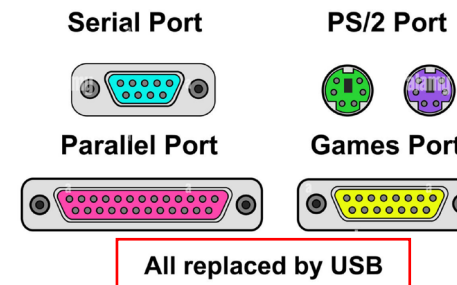
- a non-profit corporation founded by a group of companies (Intel, IBM, HP, Microsoft etc...)
- developed the Universal Serial Bus specification in 1996











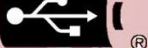








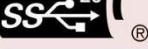




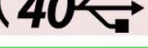

USB Was Designed To Standardize The Connection Of Computer Peripherals

- Replaced Serial and Parallel Ports
- Eliminated The Need For Separate Power Supplies For Devices
- Allows For “Hot Swapping”
- Connect Up To 127 “Devices”
- Allows The Flow Of Information Into AND Out Of A Computer (Host)

USB
Enabling Connections™



USB Specification Road map

Revision	Issue Date	Brand Name	Bits/sec	Package Logo	Port & Cable Logo	USB-C® Trident Charging Logo
USB 1.0	Jan 1996	Low Speed Full Speed	1.5 Mbps 12 Mbps			
USB 1.1	Aug 1998	Full Speed With updated	1.5 Mbps 12 Mbps			
USB 2.0	April 2000	High Speed	480 Mbps			
USB 3.0 USB 3.2 Gen 1x1	Nov 12, 2008	SuperSpeed USB 5Gbps	5 Gbps			
USB 3.1 USB 3.2 Gen 2x1	July 26, 2013	SuperSpeed USB 10Gbps	10 Gbps			
USB 3.2 USB 3.2 Gen 2x2	Sep 22, 2017	SuperSpeed USB 20Gbps	20 Gbps			
USB4 USB4 Gen 2x2	Sep 3, 2019	USB4™ 20Gbps	20 Gbps			
USB4 USB4 Gen 3x2	Sep 3, 2019	USB4™ 40Gbps	40 Gbps			

USB 3.x was
re-named twice

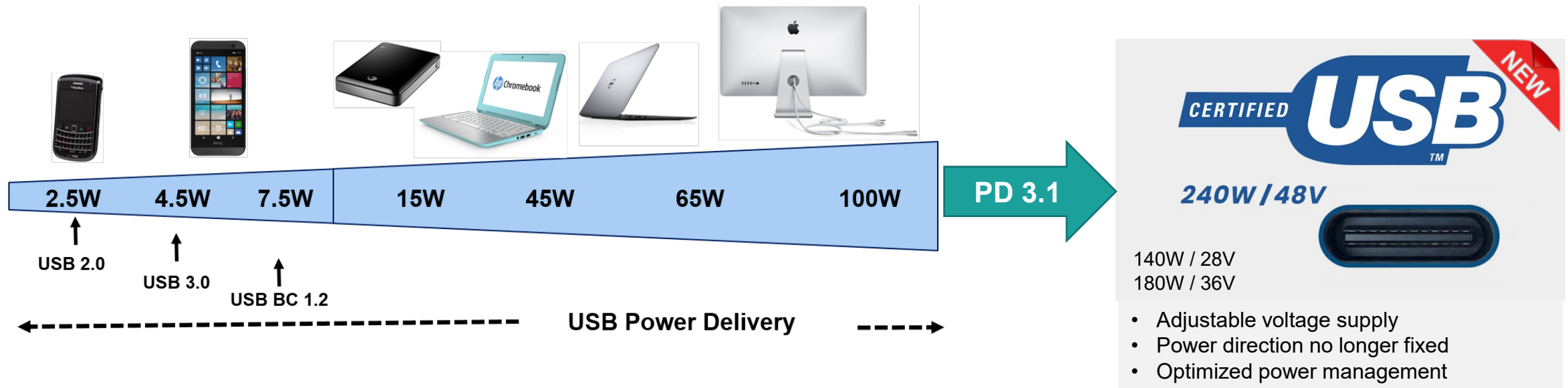
Original Name	1st time re-name when USB 3.1 (10Gbps) was published	2nd time re-name when USB 3.2 20Gbps was published	Data Speed
USB 3.0	USB 3.1 Gen1	USB 3.2 Gen1	5Gbps
USB 3.1	USB 3.1 Gen2	USB 3.2 Gen2	10Gbps
USB 3.2	USB 3.1 Gen2x2	USB 3.2 Gen2x2	20Gbps

USB Power Delivery (USB PD)

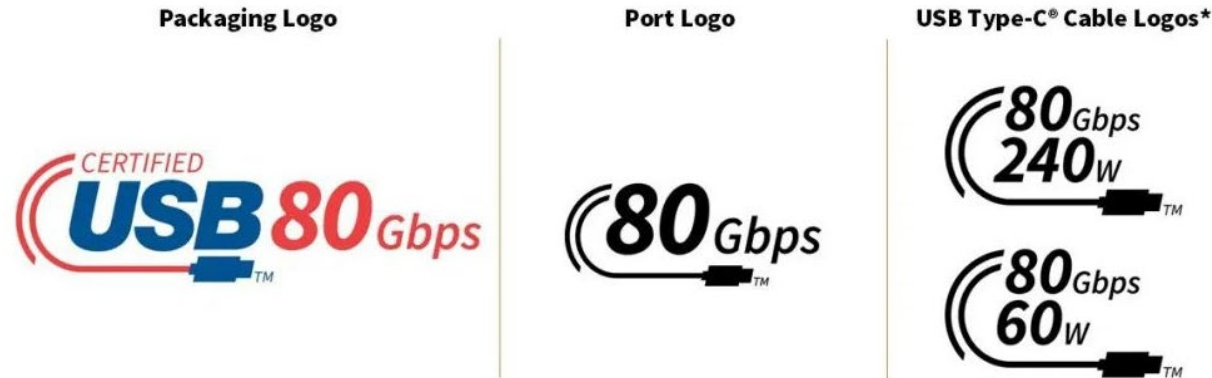
USB has evolved from a data interface capable of supplying limited power to a primary provider of power with a data interface

USB power standards

Specification	Current	Voltage	Power (max.)
Low-power device	100 mA	5 V	0.50 W
Low-power SuperSpeed (USB 3.0) device	150 mA	5 V	0.75 W
High-power device	500 mA ^[a]	5 V	2.5 W
High-power SuperSpeed (USB 3.0) device	900 mA ^[b]	5 V	4.5 W
Multi-lane SuperSpeed (USB 3.2 Gen x2) device	1.5 A ^[c]	5 V	7.5 W
Battery Charging (BC) 1.2	1.5 A	5 V	7.5 W
USB-C	1.5 A	5 V	7.5 W
	3 A	5 V	15 W
Power Delivery 1.0/2.0/3.0 Type-C	5 A ^[d]	20 V	100 W
Power Delivery 3.1 Type-C	5 A ^[d]	48 V ^[e]	240 W



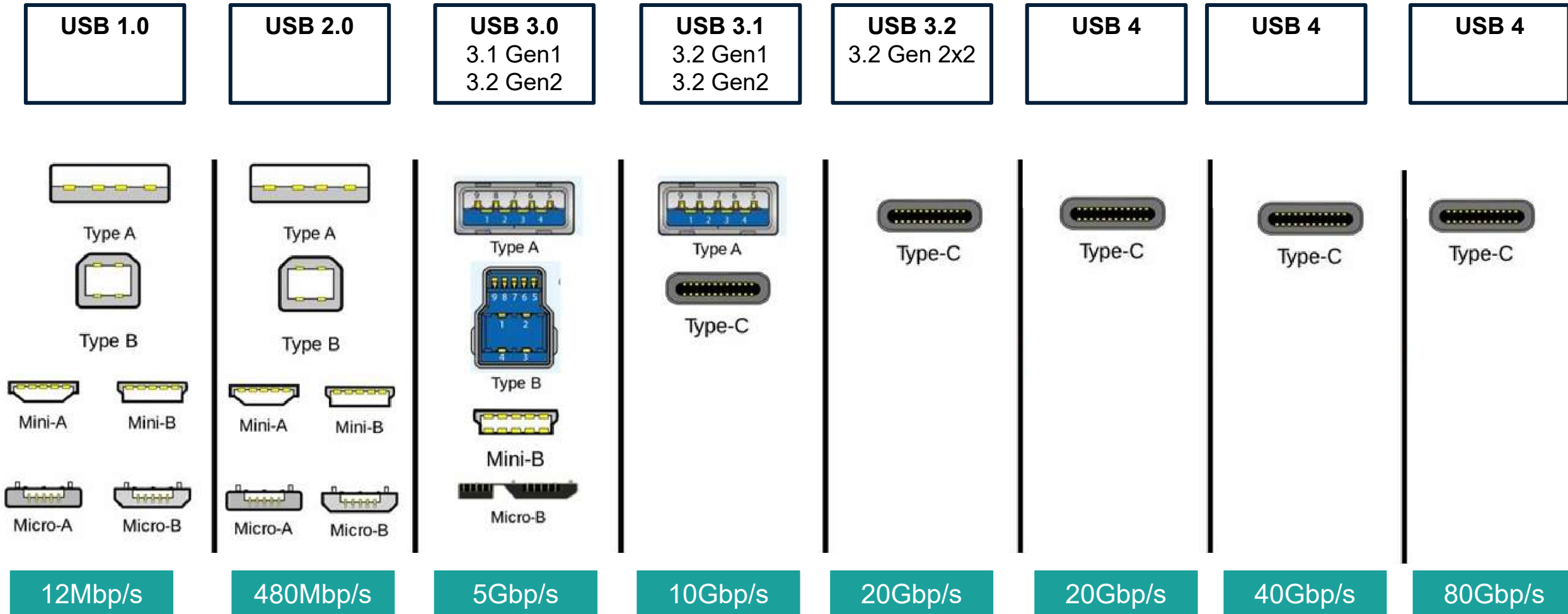
What's new of USB4® Version 2.0



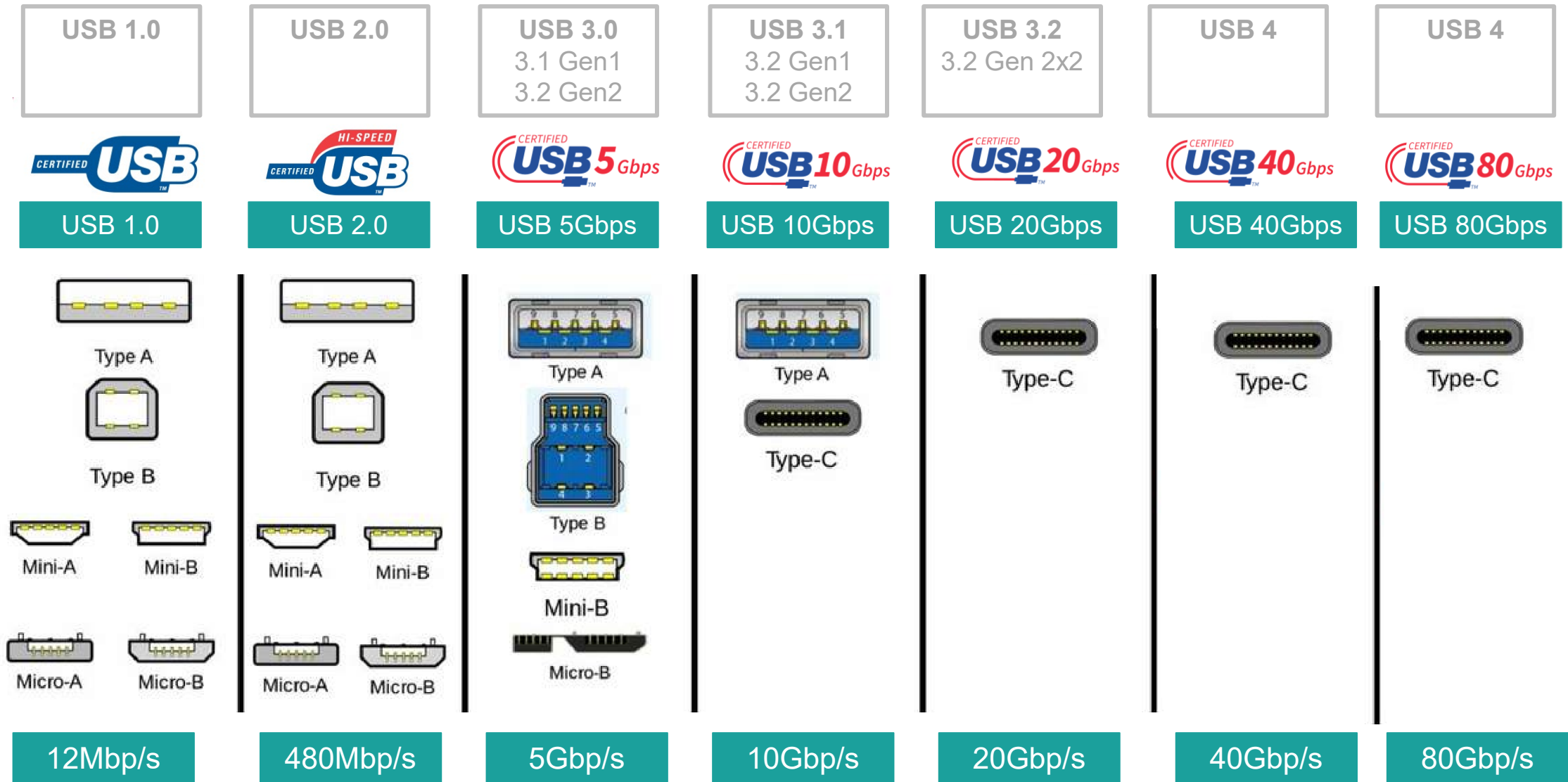
packaging, port and cable logo's.....

- **In October 2022**, USB-IF released the USB4® Version 2.0 specification, a major update to enable up to 80 Gbps of data performance over the USB Type-C® cable and connector
- Key characteristics of the updated USB4 solution include:
 - a new physical layer architecture
 - using existing 40 Gbps USB Type-C passive cables and newly-defined 80 Gbps USB Type-C active cables
 - Updates to data and display protocols to better use the increase in available bandwidth
 - USB data architecture updates now enable USB tunneling to exceed 20 Gbps.
 - Updated to align with the latest versions of the DisplayPort and PCIe specifications
 - Backward compatibility with USB4 Version 1.0, USB 3.2, USB 2.0 and Thunderbolt™ 3.

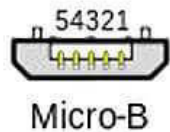
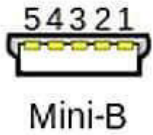
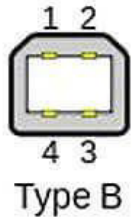
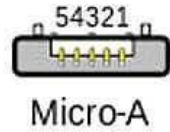
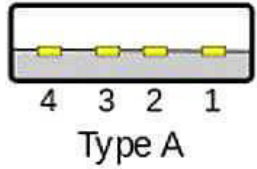
USB Interface and Data Speed Evolution (and re-naming)



USB Interface and Data Speed Evolution (and re-naming)



USB 2.0 series



Pin#	Signal name
1	VBUS
2	D-
3	D+
4	GND

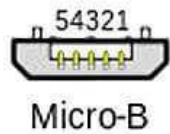
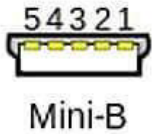
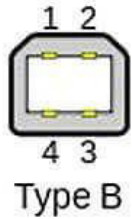
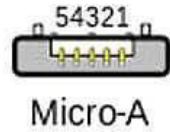
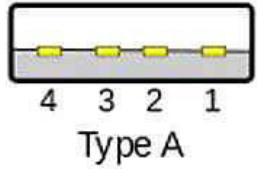
Pin#	Signal name
1	GND
2	USB OTG Address bus
3	D+
4	D-
5	VBUS



USB On The Go

USB Pinout Development

USB 2.0 series

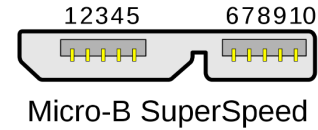
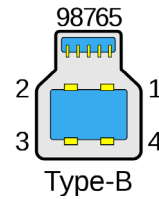
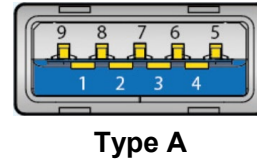


Pin#	Signal name
1	VBUS
2	D-
3	D+
4	GND

Pin#	Signal name
1	GND
2	USB OTG Address bus
3	D+
4	D-
5	VBUS

USB On The Go

USB 5Gbps series

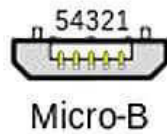
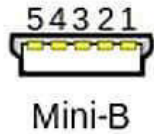
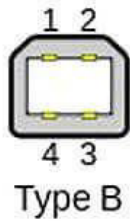
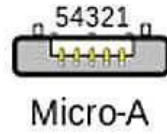
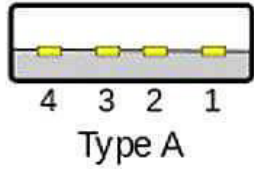


Pin#	Signal name
1	VBUS
2	D-
3	D+
4	GND
5	StdA_SSRX-
6	StdA_SSRX+
7	GND_DRAIN
8	StdA_SSTX-
9	StdA_SSTX+

High Speed

USB Pinout Development

USB 2.0 series

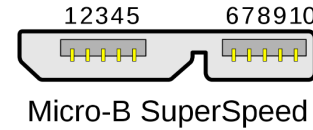
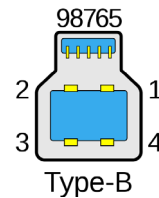
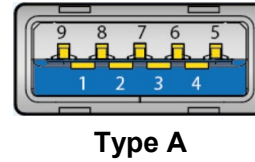


Pin#	Signal name
1	VBUS
2	D-
3	D+
4	GND

Pin#	Signal name
1	GND
2	USB OTG Address bus
3	D+
4	D-
5	VBUS

USB On The Go

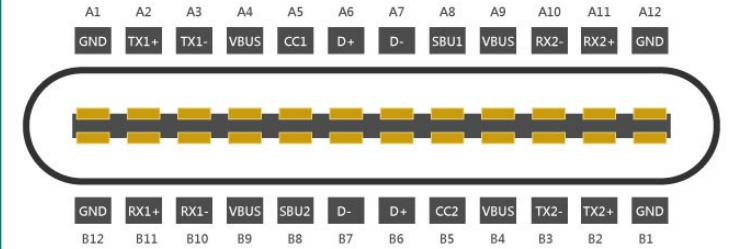
USB 3.x series



Pin#	Signal name
1	VBUS
2	D-
3	D+
4	GND
5	StdA_SSRX-
6	StdA_SSRX+
7	GND_DRAIN
8	StdA_SSTX-
9	StdA_SSTX+

High Speed

USB Type C




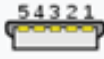





















Pin#	Signal name	Pin#	Signal name
A1	GND	B1	GND
A2	TX1+	B2	TX2+
A3	TX1-	B3	TX2-
A4	VBUS	B4	VBUS
A5	CC1	B5	CC2
A6	D+	B6	D+
A7	D-	B7	D-
A8	SBU1	B8	SBU2
A9	VBUS	B9	VBUS
A10	RX2-	B10	RX1-
A11	RX2+	B11	RX1+
A12	GND	B12	GND

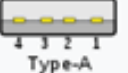





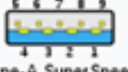










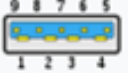
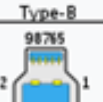


Side Band Use to transport other high speed protocols

Higher Speed, Reverse Mating

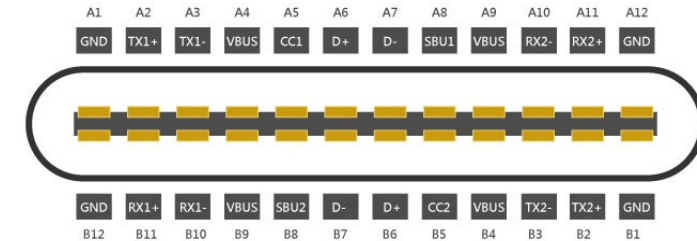
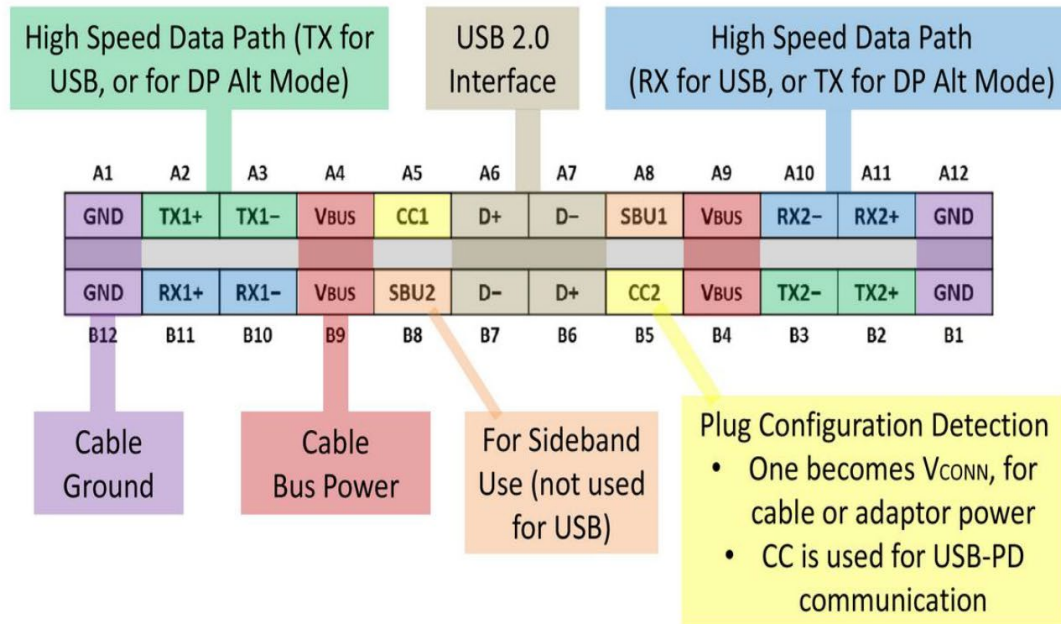
USB Interface Types

Revision		Type-A	Type-B	Type-C	Mini-A	Mini-B	Mini-AB	Micro-A	Micro-B	Micro-AB
Plug	2	 Type-A	 Type-B	Not existed	 Mini-A	 Mini-B	Not existed	 Micro-A	 Micro-B	Not existed
	3.2	 Type-A SuperSpeed	 Type-B SuperSpeed		Deprecated	Deprecated		Deprecated	 Micro-B SuperSpeed	 Deprecated
Receptacle	2	 Type-A	 Type-B	Not existed	 Mini-A	 Mini-B	 Mini-AB	Not existed	 Micro-B	 Micro-AB
	3.2	 Type-A SuperSpeed	 Type-B SuperSpeed	 Type-C	Deprecated	Deprecated	Deprecated		 Micro-B SuperSpeed	 Deprecated
Application		PC	Scanner Printer	Laptop PC tablet	Portable Device		Universal interface for microA, & B only	Cell phone Tablet		Universal interface for microA, & B only

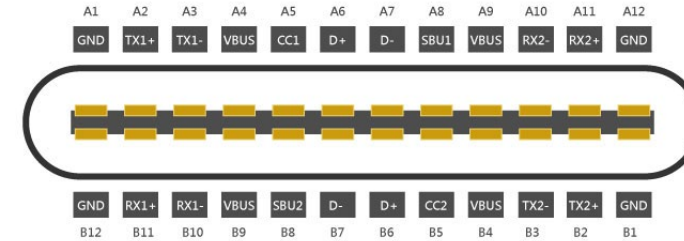
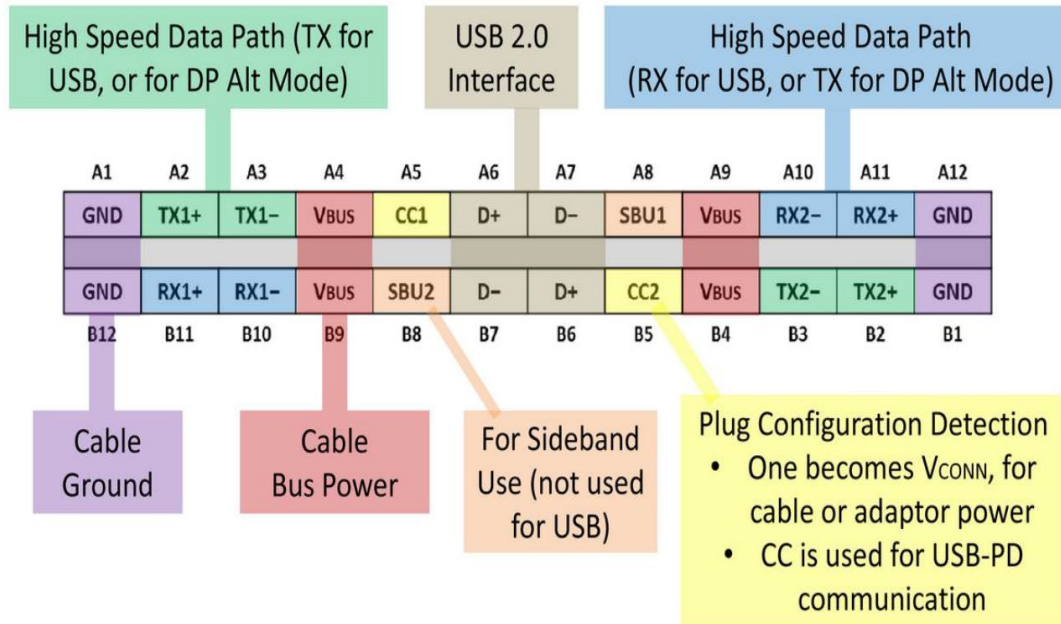
USB Interface Types

Revision		Type-A	Type-B	Type-C	Mini-A	Mini-B	Mini-AB	Micro-A	Micro-B	Micro-AB
Plug	2	 Type-A	 Type-B	Not existed	 Mini-A	 Mini-B	Not existed	 Micro-A	 Micro-B	Not existed
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Receptacle	2	 Type-A	 Type-B	Not existed	 Mini-A	 Mini-B	 Mini-AB	Not existed	 Micro-B	 Micro-AB
	3.2	 Type-A SuperSpeed	 Type-B SuperSpeed	 Type-C	Deprecated	Deprecated	Deprecated		 Micro-B SuperSpeed	Deprecated
Application		PC	Scanner Printer	Laptop PC tablet	Portable Device		Universal interface for microA, & B only	Cell phone tablet	Universal interface for microA, & B only	
		mature		growth	decline			mature	decline	

USB Type C Pinout



USB Type C Pinout – 4 Main Versions

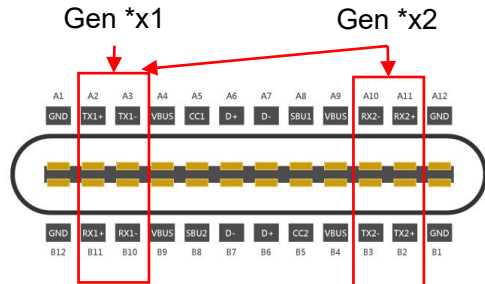


24 positions

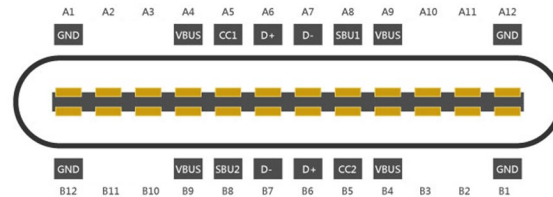
16 positions

14 positions

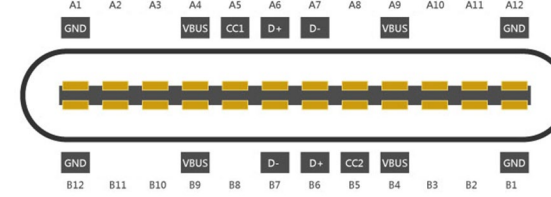
6 positions



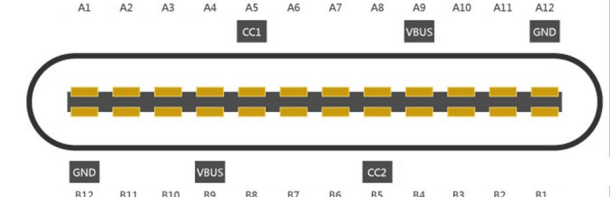
USB 80Gb/s
Full capability of USB-C



USB 2.0
4 pairs of high speed differential signal pins removed

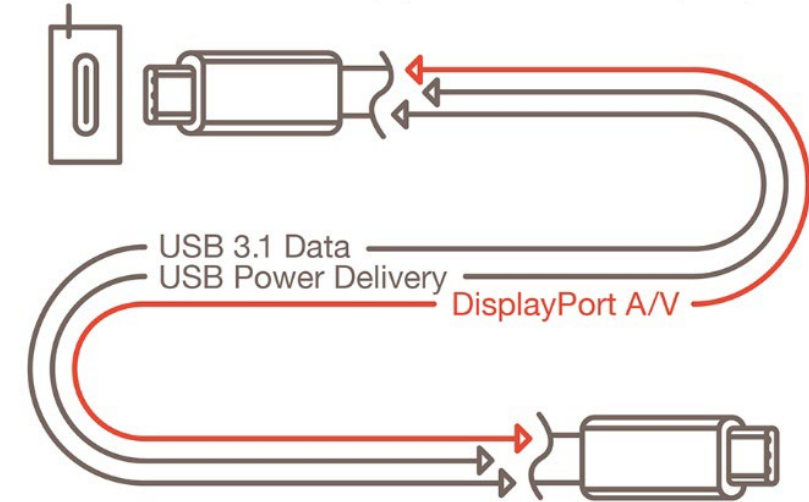
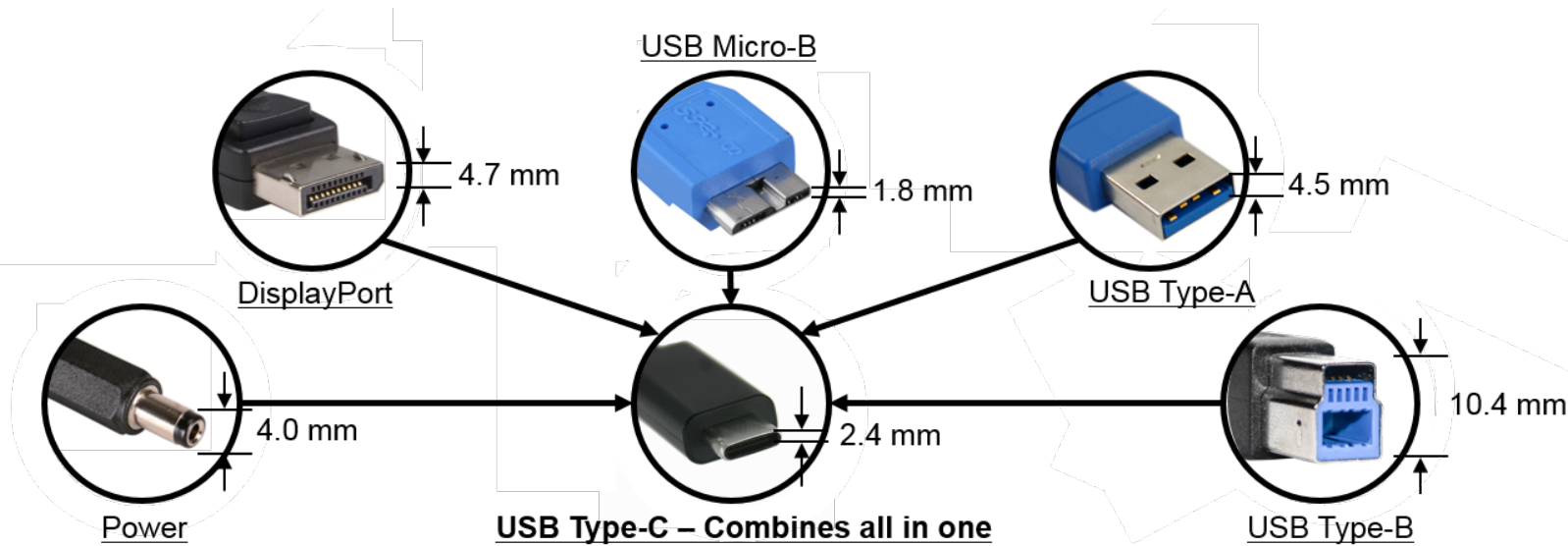


USB 2.0
If alternate mode is not deeded

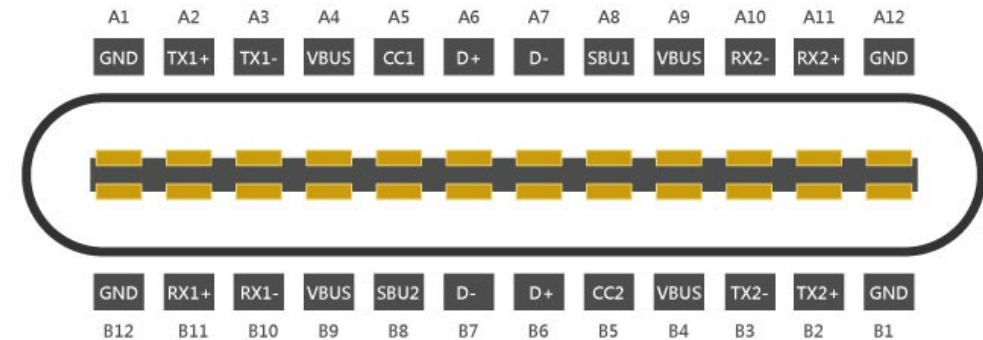


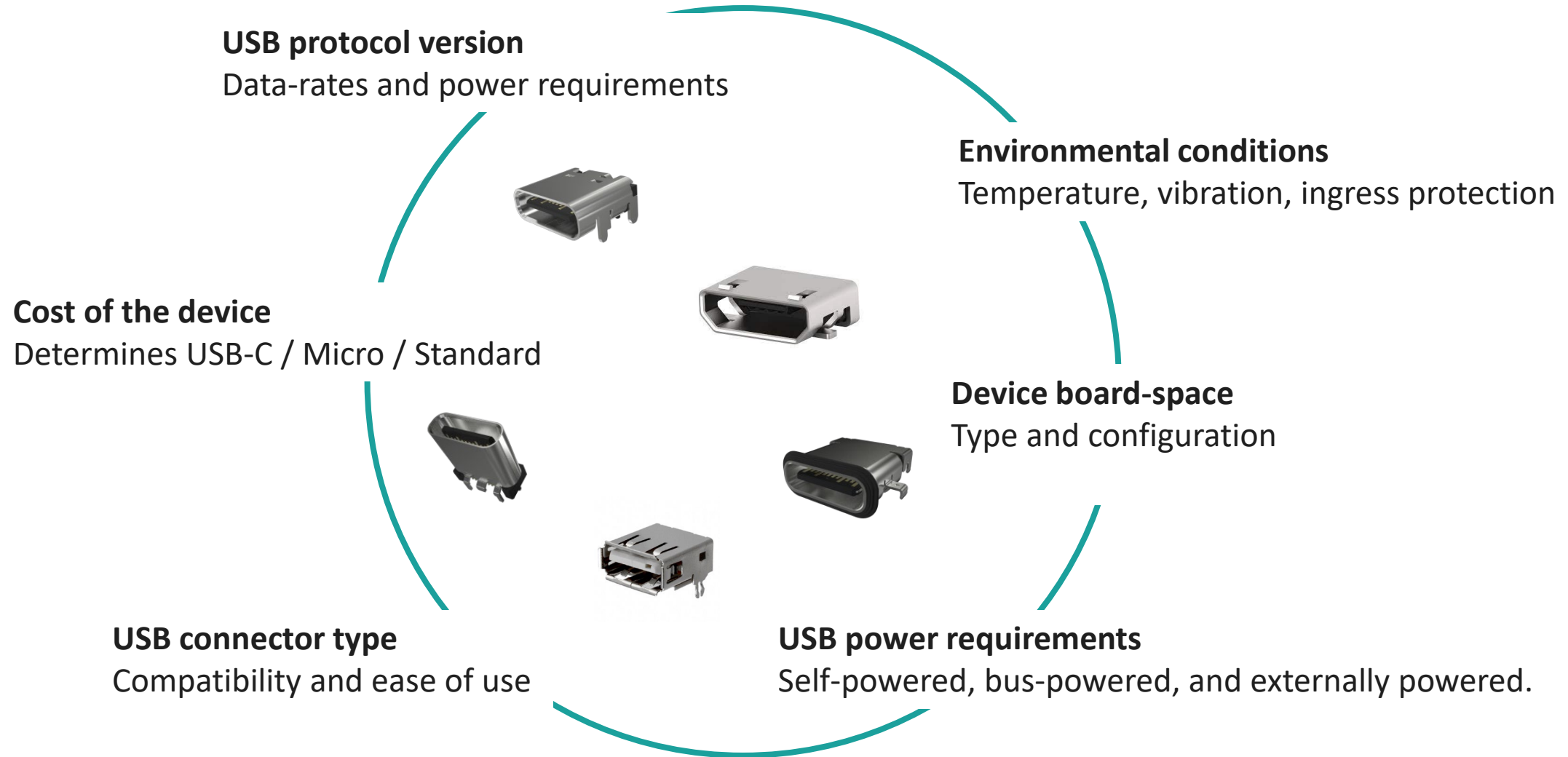
Charging only
No data transmission

USB C Advantages

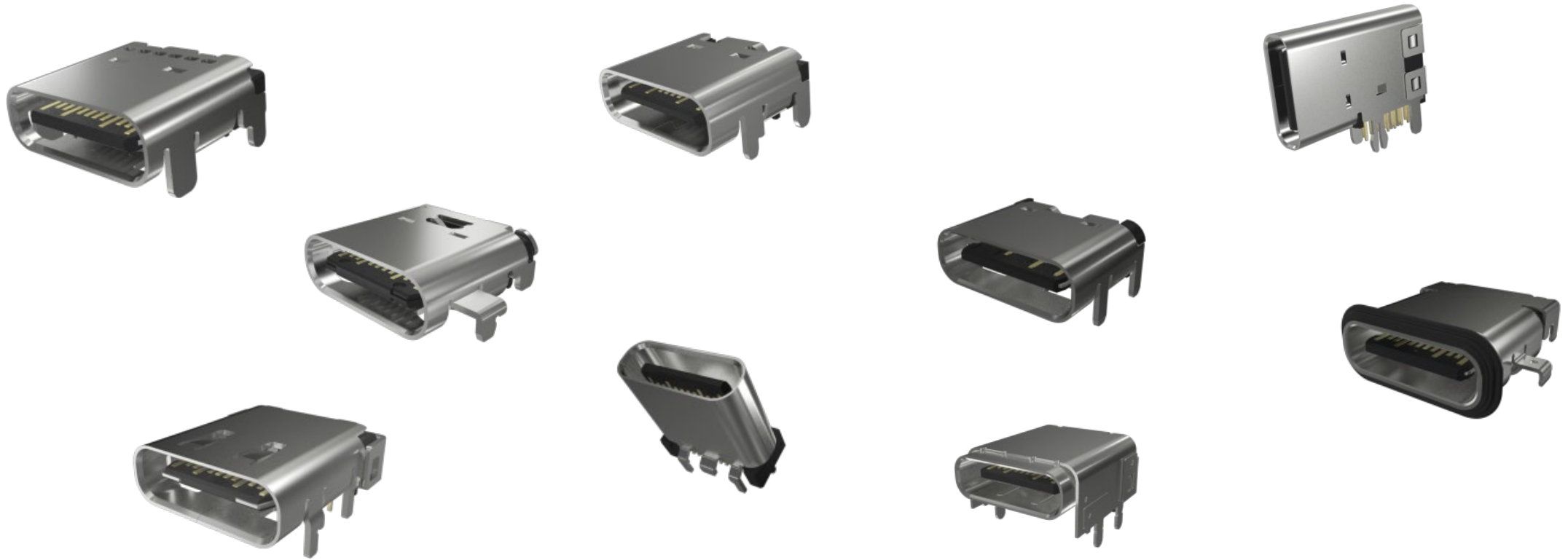


- Blind mate / reverse mate
- Up to 5A current rating, support 240W max power delivery
- Data transmission up to 80Gbps.
- Charging interface for various electric products via PD protocol
- Enhanced anti-EMI and RFI mitigation performance
- Optional integrated DisplayPort, HDMI (side band)





USB C Connectors...



.... come in various shapes and configurations...

Features and Benefits of USB Type C - Right Angle

Support 5.0A/100W power delivery and up to 20 Gbps data rates

Enables fast charging and high-speed data transfer

Spring shell friction design

Provides higher un-mating force to prevent unintentional cable release

Soldering pins Hybrid

- Provides higher retention force
- Enables easy inspecting
- Eases supplementary soldering on SMT pins

Metal shell

Provides robustness to the connector and better EMI shielding performance

Mid-plate design enhance the tongue strength

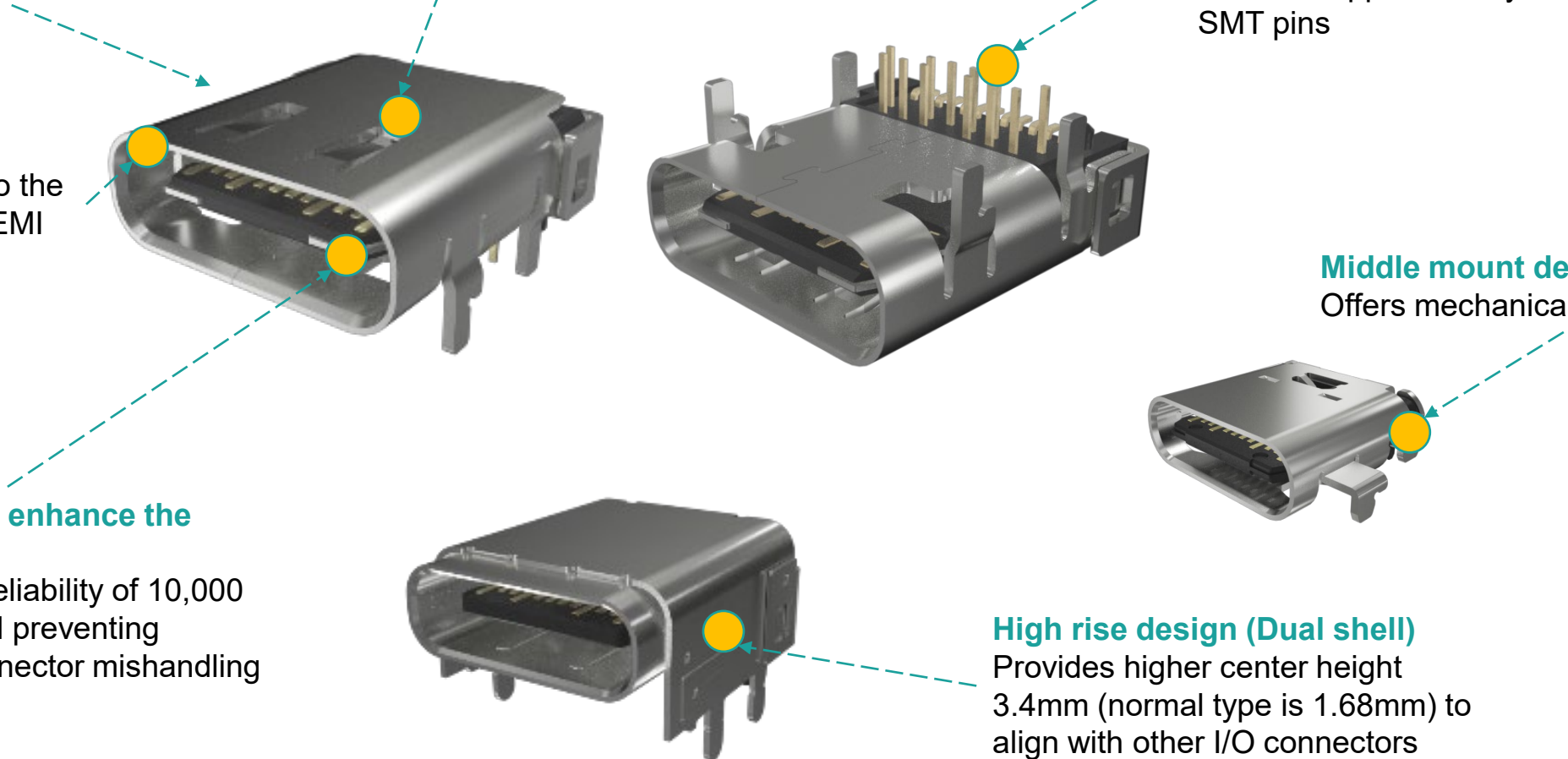
Supporting high reliability of 10,000 mating cycles and preventing damage from connector mishandling

Middle mount design

Offers mechanical design flexibility

High rise design (Dual shell)

Provides higher center height 3.4mm (normal type is 1.68mm) to align with other I/O connectors



Features and Benefits of USB Type C – Vertical, Right Angle, IP67

Vertical type

Offers mechanical design flexibility

Flexible height design

Two height options of 9.25&10.4mm to provide customer mechanical design flexibility

Plastic housing holder and shell stopper

Provide robust design to prevent plug over insertion

Upright type

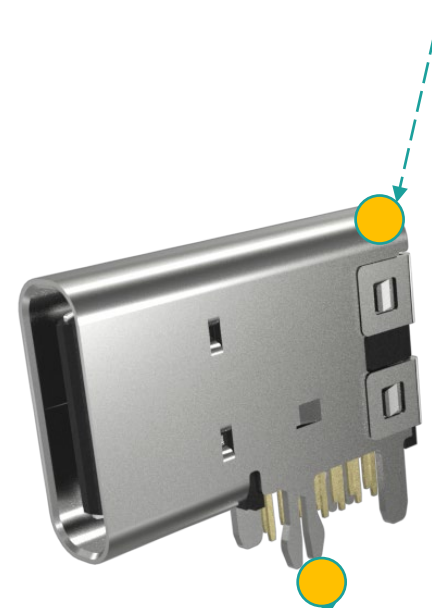
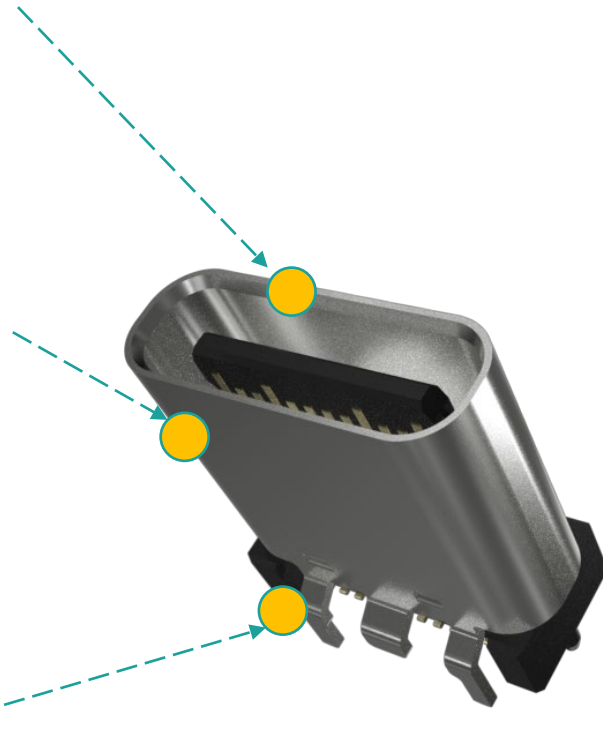
Offers mechanical design flexibility

Shell peg hook design

Provides retention force during soldering process to avoid uplift

Silicon molded seal ring

Excellent temperature resistance and protection against dust and water ingress (IP67)



Amphenol Typical Offering on USB Type C connectors

**USB Type-C
Surface Mount**

10152803



**USB Type-C
Middle Mount**

10137064



**USB Type-C
16Pin SMT**

10155435



**USB Type-C
6Pin Charging**

10164359



**USB Type-C
14Pin Upright**

10151348



**USB Type-C
Hybrid Mount**

10159872



**USB Type-C
Vertical SMT**

10157529



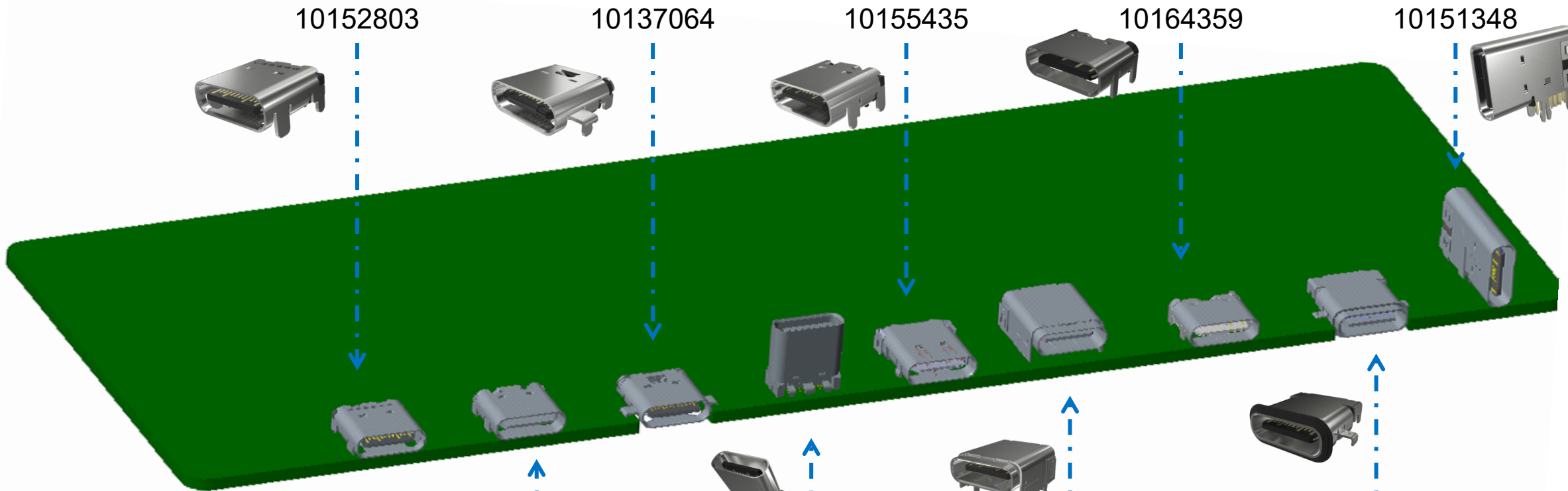
**USB Type-C
SMT High rise**

10163259



**USB Type-C
24Pin Waterproof**

10164986



USB Type-C Cable Typical product and application

USB 2.0 Type A to C

< 15W Power charging &
480Mbps data transmission



USB3.2 Type C to C

< 100W PD fast charging &
<20Gbps data transmission



USB4/Thunderbolt Type C to C

Up to 240W PD fast charging &
Up to 40Gbps data transmission



Product and Application - USB 2.0 A to C for Consumer



A Male – C Male
10165793-Z0100YWLF

Products



C Male – C Male
10165794-Z0100YWLF



Set top box

Applications



Blue tooth earphone



E-cig



Smart phone



Blue tooth speaker



A Male – C Female
Custom

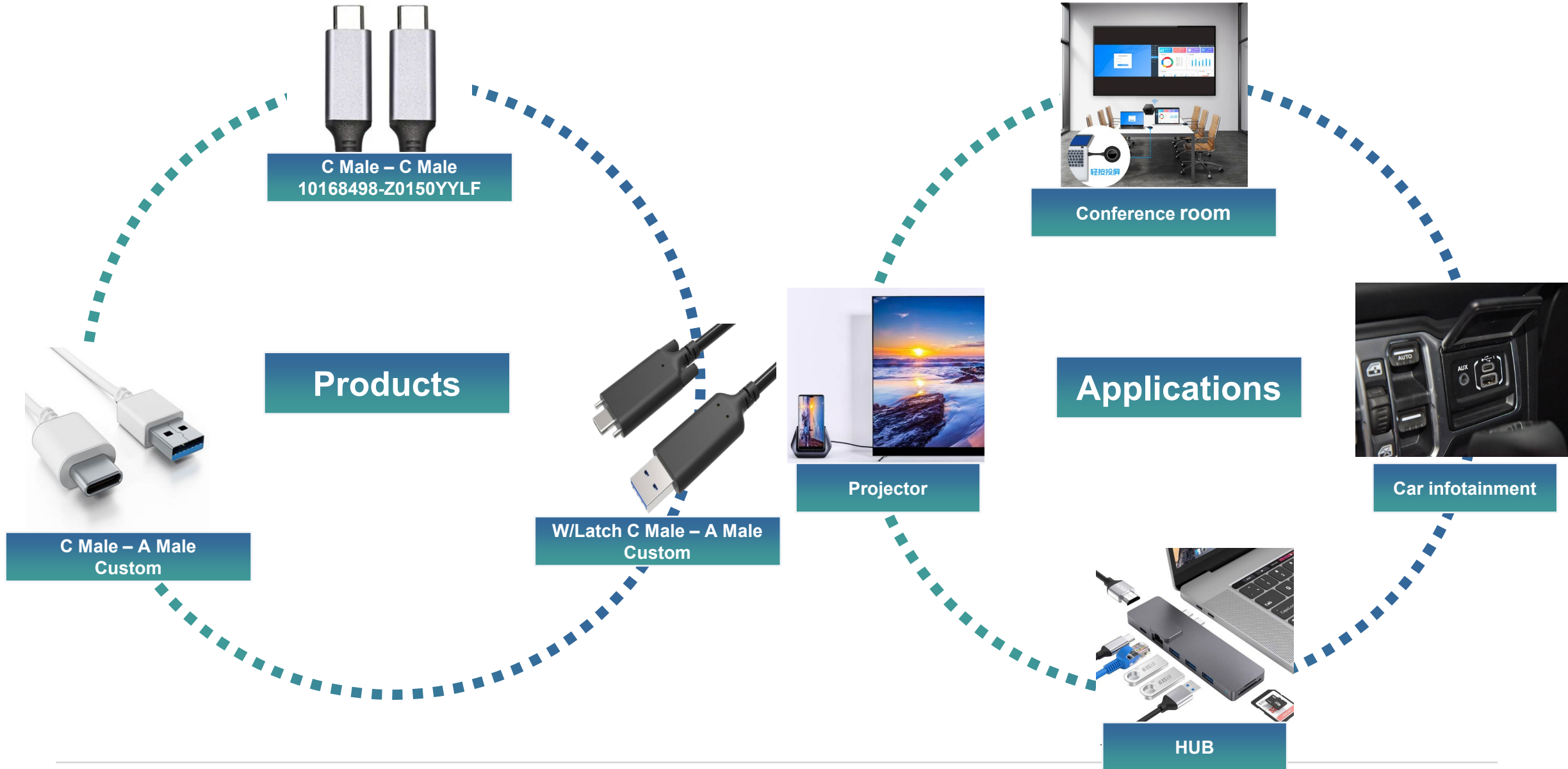


Adapter
A Male- C Female
10170593-0011LF

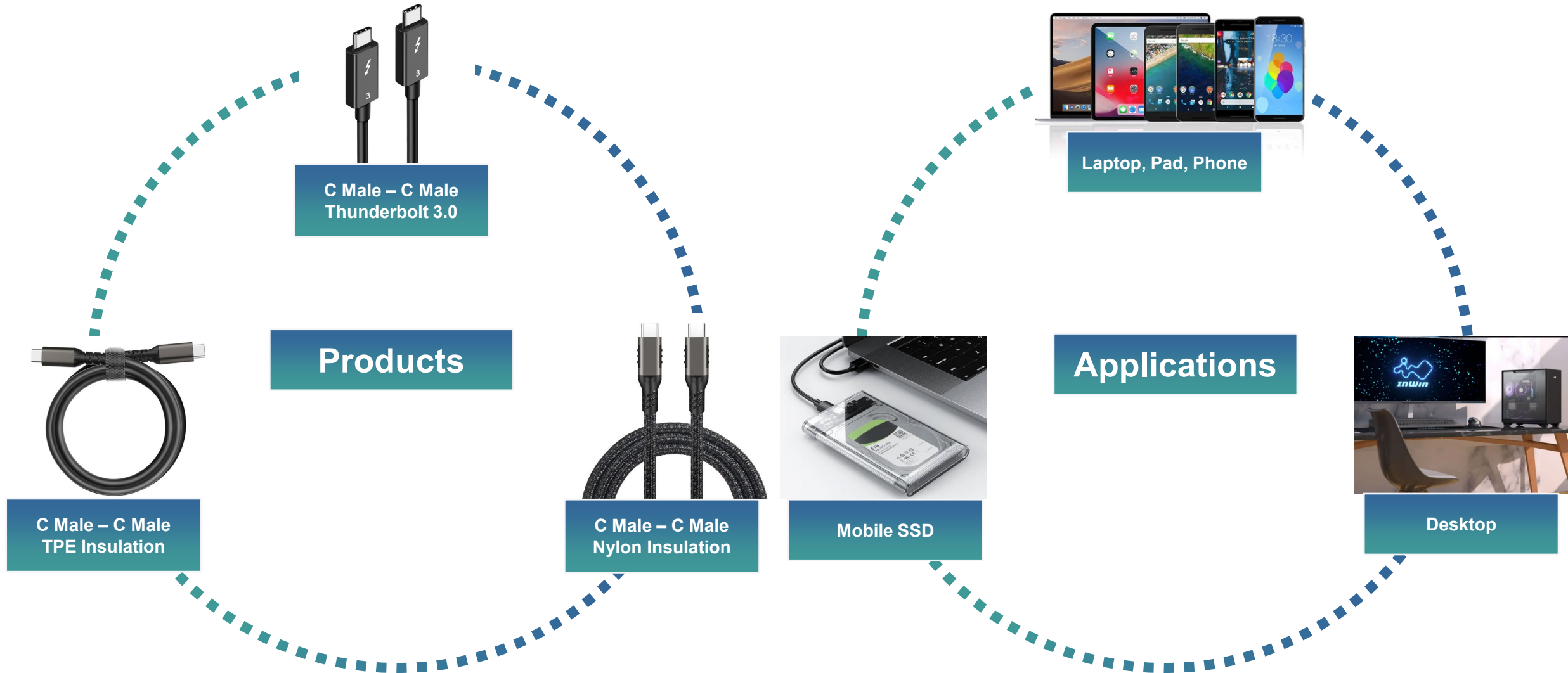


C Male - 3.5 Female
Custom

Product and application – USB 3.2 Gen 1 & 2 5G/10Gbps



Product and application – USB 3.2 Gen 2*2 20Gbps



Target Applications: Ruggedized Handhelds



Computing



Measurement



Point of Sale



Medical



interface cables



charging cables



Don't forget the cables!!!

Target Applications: Automation, VR, Drones...



Smart Home



AV/VR devices



Drones

.... ANY smaller electronic device requiring a power and/or data connection!!



[More USB Type C info can be found at Mouser's website!](#)

Thank You

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COMMUNICATIONS SOLUTIONS