USB - Universal Serial Bus

Introduction

USB is the short form of Universal Serial Bus. It is a standard technology that allows electronic devices to communicate, connect, and transfer data and power with each other. USB ports are used in computers, smartphones, gaming consoles, and other gadgets. It easily transfers data among devices (files from a flash drive to a PC) and supplies power. USBs are useful to connect peripherals like keyboards, mice, printers, external hard drives, etc. and is the replacement version of older ports like serial, parallel, PS/2, and so on.

USB was invented by an Indian-American Ajay Bhatt in 1995, an Intel employee at the time. He led a team from seven companies, Compaq, DEC, IBM, Intel, Nortel, Microsoft, and NEC, to develop the USB standard. In January 2025, He was honored with the Padma Shri, India's fourth-highest civilian award, by the Government of India.

USBs are often referred by their connector types, generation versions, and power delivery technology standard. Connectory Types are by the design influencing data transfer speeds, power delivery, and device compatibility. USBs have evolved through several generation versions offering increased data transfer speeds and power capabilities. And, USB Power Delivery is a fast-charging technology standard adopted by different USB versions.

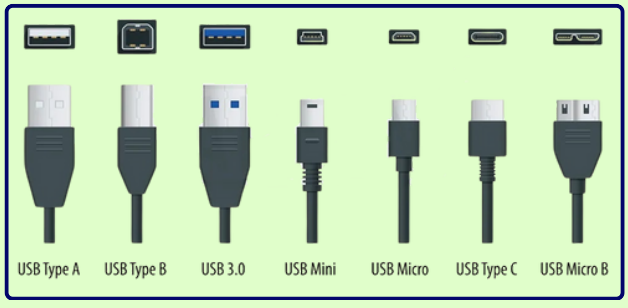
USB Connector Types

The connector design evolved over a period of time in connecting various devices. Here are various USB types...

1. USB-A: It is a connector type used across multiple USB versions and is a standard Flat Rectangular Connector. Used for laptops, desktop computers, gaming consoles, and chargers. USB Type-A is compatible with USB versions from 1.0 through 3.2.

2. USB-B: It is a Square-shaped connector, often used for printers, scanners, and external hard drives. Now, rarely used due to newer alternatives. Compatible with USB 1.0 through 3.1 Gen 1.

3. USB-C: This is the most popular connector type. It has a reversible design, meaning no wrong way to plug it in. It supports fast data transfer & power delivery. It is used in modern laptops, smartphones, tablets, and gaming consoles. Type-C is compatible with USB 2.0 through the latest USB4 v2.0.



USB Connector Types

4. USB-Mini: It is smaller than USB-B, used in older cameras, MP3 players, and game controllers. It has been replaced by micro-USB. It is compatible with USB 2.0 and USB 2.0 OTG.

5. USB-Micro: This is compact, widely used for Android smartphones, wireless headphones, and portable devices. There is also a variant Micro-B. However, it has been phased out by Type-C. It is compatible with USB 2.0, USB 2.0 OTG, and USB 3.0.

6. Lightning: It is an Apple's proprietary connector like micro-USB. Used in iPhones, iPads, and AirPods.

USB Versions

Evolution of USB Versions is defined by the Data Speed and Power Specifications. Here is a table to depict the same...

USB Version	Speed	Max Power (Standard)
USB 1.0	1.5 Mbps	2.5W (5V, 0.5A)
USB 1.1	12 Mbps	2.5W
USB 2.0	480 Mbps	2.5W (5V, 0.5A)
USB 3.0, 3.1 Gen 1	5 Gbps	4.5W (5V, 0.9A)
USB 3.1 Gen 2	10 Gbps	4.5W (5V, 0.9A)
USB 3.2 Gen 2x2	20 Gbps	4.5W (5V, 0.9A)
USB4	Up to 40 Gbps	Depends on implementation
USB4 v2.0	Up to 80 Gbps	Depends on implementation

USB Power Delivery

USB Power Delivery (USB PD) as power negotiation standard is adopted to deliver much higher power over USB. Implemented in USB-C. Increasingly used in phones, tablets, laptops, monitors, and more. Not all Type-C cables support USB PD, though. Here are USB PD standards...

PD Version	Release	Max Power	Voltage Levels
USB PD 1.0	2012	10W–100W	5V, 12V, 20V
USB PD 2.0	2014	100W	5V–20V @ 5A
USB PD 3.0	2016	100W	Same as PD 2.0 + PPS
USB PD 3.1	2021	240W	New levels: 28V, 36V, 48V

Conclusion

As the technology evolves, USB version 4 is transforming and shaping how we power, connect, and transfer data across devices. USB4 v2.0 is already giving a speed up to 80 Gbps and is expected to grow further. That would enable quicker file transfers, smoother video streaming, and better performance for high-end applications.

With improving Power Delivery support, USB Type-C is able to go up to 240 Watts. This enables charging laptops, monitors, and even some household appliances. Type-C is such a success, even Governments are mandating that standard for all devices to reduce e-waste. It helps less clutter and fewer cables due to compatibility with more devices.