A Complete Guide on the Evolution of USB Ports to Dongle Connectivity

The Era of RS-232 and Legacy Communication Jacks

Before the USB port debuted, communication interfaces were often large, cumbersome, and specialized. RS-232 is one of the earliest standards for serial communication, used in the 1970s and '80s for connecting computers to peripheral devices such as modems. With its distinct 9 or 25-pin connector, RS-232 was functional but limiting.

Its limited speed, typically 115,200 bps, became a bottleneck for data-intensive devices like printers, scanners, and digital cameras. Other legacy communication jacks, such as parallel ports, VGA, and PS/2 connectors, also had a similar story. While they served their purpose, they became outdated as the demand for data speeds, simplicity, and versatility grew.

In 1996, a consortium of technology companies such as Intel, Microsoft, and IBM introduced the Universal Serial Bus (USB). The goal was to create a universal, easy-to-use interface to replace the cables and connectors for peripherals, such as printers, cameras, and storage devices.

The introduction of USB brought several advantages: higher data transfer speeds, plug-and-play functionality, and the ability to power devices through the same connection.

The USB port's design was compact, and its ability to transmit data and power through a single cable made it an instant hit. This flexibility allowed the USB standard to grow rapidly.

Soon, USB ports appeared on every device — from desktop computers to laptops, gaming consoles, and even smartphones. For the first time, we had a single connector that could handle different devices.

USB 1.1 introduced data transfer speeds of 12 Mbps (100x faster than RS-232). Later versions like USB 2.0 (480 Mbps), USB 3.0 (5 Gbps), and USB 3.1/3.2 (up to 20 Gbps) offered even better performance. It paved the way for high-bandwidth applications like video streaming and fast file transfers.

The Rise of Net Setters: Cellular Connectivity at Your Fingertips

In the early 2000s, a new phenomenon began to take shape: the net setter, a USB device that provided internet connectivity. They were used to connect laptops and desktops to the internet via 3G or 4G networks, especially in areas where traditional broadband infrastructure was lacking. Netsetters revolutionized mobile connectivity, transforming any laptop or computer into a mobile internet device. As the mobile networks evolved, so did these devices, stepping up from the initial 3G models to the more advanced 4G LTE versions. This adoption of USB-based cellular modems was a game changer, laying the groundwork for more sophisticated connectivity solutions.

Dongles: A New Era of Portable Connectivity

The next phase saw the rise of dongles, delivering plug-and-play functionality while adding specialized capabilities and bridging different connectivity standards. Early 2000s USB cellular modems, limited to 2G at 384 Kbps and drawing over 500 mA, have evolved from card-sized to thumb-sized devices with multi-core processors, encryption, and edge computing. Modern dongles are 1/10th the power per bit, with some models using energy harvesting to extend battery life in remote deployments by up to 400%. Supporting Wi-Fi, Bluetooth, GPS, and **IoT applications**, dongles empower retrofits and network integration without full system overhauls, meeting the expanding demands of the IoT ecosystem.

Dongles and IoT: The Retrofit Solution for Legacy Applications

Dongles have become vital in IoT by letting manufacturers retrofit existing products with modern communication technologies like Wi-Fi, Bluetooth, or **4G/5G**, avoiding costly redesigns. A simple plug-and-play dongle can upgrade, for example, a legacy factory machine to connect with the cloud and support smart operations. This ability to add wireless capabilities without major hardware changes has helped companies quickly modernize and integrate even traditional systems into today's IoT networks.

The Competitive Edge of Dongles

1. Retrofitting Legacy Equipment

- Dongles add Wi-Fi, Bluetooth, or cellular (3G/4G/5G) to older industrial machines without internal changes, enabling data transfer for cloud-based remote monitoring and predictive maintenance.

Example: Attaching a cellular dongle to legacy PLCs transforms traditional manufacturing lines into smart factories.

2. Rapid Prototyping and Development

- Dongles let us quickly switch between LTE, NB-IoT, Cat-M1, or Wi-Fi, simplifying prototyping without redesigning hardware.

Example: IoT startups can test devices on multiple carriers and regions by swapping dongles.

3. Geographic Expansion and Roaming

- Multi-network dongles provide global connectivity across diverse cellular bands, avoiding hardware redesign for new markets.

Example: Asset tracking solutions use LTE dongles for seamless cross-border operations.

4. Temporary Connectivity Requirements

- Plug-and-play dongles offer instant connectivity in places lacking fixed internet, ideal for temporary or remote setups.

Example: Pop-up events or remote sites can use cellular dongles for short-term IoT communication.

5. Adding New Features to Existing Products

- Dongles expand products with features like GPS or Bluetooth without reworking hardware, extending product life.

Example: Adding GPS-enabled dongles to vehicles for fleet tracking or medical devices for remote monitoring.

6. Modular Design and Future Proofing

- Using dongles, future-proof products by allowing easy upgrades to new network technologies, like 5G or 6G, via modular ports.

Example: Smart meters with USB ports can swap dongles to adopt new connectivity standards.

Conclusion

From RS-232 to USB, and from netsetters to IoT dongles, the evolution of communication interfaces shows how innovation shapes our connected world. Today's dongles, with their compact and versatile design, stand at the forefront, enabling IoT growth with rapid prototyping, international scalability, enhanced security, and minimal hardware redesign. These cost-effective tools empower OEMs, ODMs, and engineers to future-proof solutions and stay competitive in a changing market.