TREND PAPER

EMERGING TRENDS IN ELECTRONICS

MINIATURIZATION, NEW DATA TRANSMISSION CONNECTION STANDARDS, UBIQUITOUS IoT AND 5G DEMOCRATIZATION

FISCHER CONNECTORS AUTHORS

Stuart Doe
Principal Solutions Architect

Marine Bouduban
High-Speed Connectivity Solutions Architect

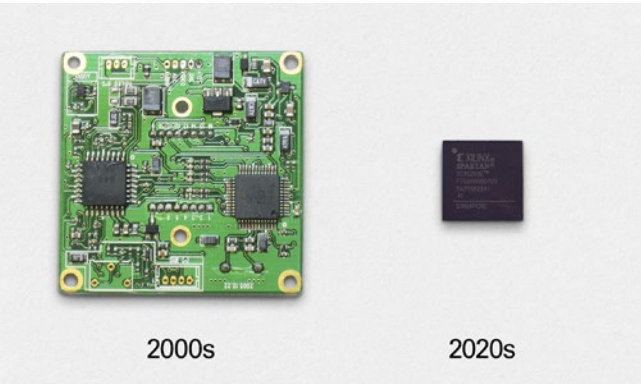
In a world of ever-increasing global consumption fueled by the immense thirst for electronic technology and information transmission, we find ourselves in a critical situation with the world supply of electronic components drying up. Demand for electronic devices has risen sharply due to the Covid-19 outbreaks which forced the entire world to work in isolation, driving the unprecedent need for Integrated circuits (IC). Whilst development has been keeping pace during this crisis, we expect more from our devices!

In parallel to this, the concurrent rollout of 5G has been providing increased connectivity, enabling a new generation of users to access the Internet of Things (IoT) with enhanced capabilities. Cameras and optical systems have risen to unprecedented levels, with higher quality video – 4K and even 8K now being commonplace.

As the tension between demand and supply rises, the world of electronics keeps evolving and the impact of its evolution will need to be watched closely in this volatile context. Let us focus on the nature of these changes – which current and future trends are worth looking out for?

MINIATURIZATION

Electronics never stagnates – processing power (gates in IC devices) is growing as new fabrication plants deliver even smaller devices with improved processing capabilities per square millimeter. The global shortage has led to technological investments in Fab plants globally, not only to increase capacity and reduce reliance on overseas manufacturing supply chains but also to bring technological advancement. Despite all this chaos, opportunities and progress have emerged. Taiwan Semiconductor Manufacturing Company (TSMC) is investing USD 12 billion (typically cost) in setting up a new Fab plant in Phoenix, Arizona, which will pioneer the manufacturing of sub 5 nanometer chips in 2024. This constant progress is defined by Moore's Law, i.e., 'the observation that the number of transistors in a dense integrated circuit (IC) doubles about every two years.'



Progressive miniaturization of electronics delivers whole circuits now embedded into one single device, boosting full "system on chip" capabilities.

Therefore, devices will become smaller and more capable with the introduction of "System on Chip", which speeds up the design of systems and core building blocks of electronics, enabling prototypes to be developed and put into production more quickly. System on Chip also encourages the current trend towards highly capable hardware-agnostic devices which are then controlled via software. A typical example is a Software Defined Radio (SDR). For military-based users, this paradigm shift in technological hardware development offers significant advantages to the soldier. As communications networks and military radios shrink in Size, Weight and Power (SWaP), the increased bandwidth provided by these connectivity systems allow soldiers greater situational awareness of both themselves and their environment, thereby reducing the cognitive burden and allowing informed decisions to be executed. Ultimately reducing the weight of electronics also allows them to carry increased provisions – food!

The advance of miniaturization has also been welcomed by the global fitness market. A whole host of "wearable devices" from Global Positioning Systems (GPS), heart rate, repetition rate and foot strike sensors, intelligent garments and shoes, the list is endless – including even conductive thread! The main obstacle to the acceptance of such electronics is their interoperability and connectivity with other systems and networks. Even early adopters need to see the value in interoperable systems along with the storage and security of such data.

EMERGENCE OF NEW DATA TRANSMISSION CONNECTION STANDARDS

With so many devices/handsets and so many communication protocols, we expect to see some selection based on the need for higher transmission speed connections with low latency.

Video protocols are evolving to match the increasing resolution and larger frame rate needed to reach real-time applications. We see, for example, the emergence of high-performance coaxial transmission with 12G SDI, or ever faster HDMI with HDMI 2.1. Connectivity has never been so critical.

Similarly, we also observe a multiplication of protocols supporting IP networking, completing the standard ethernet offer. A typical example is Single Pair Ethernet, which aims to bring ethernet to new applications, where it was previously inconceivable due to space and architecture constraints.

On the connection front of USB, USB-C is a great example of the above-mentioned selection process. On top of unifying many communication standards within one (i.e., HDMI, Display Port, USB) form factor and supporting power transmission, USB-C enables larger transmission speed, up to 40 Gbps (USB 4). The combination of these two factors makes USB-C the new champion, with other connections slowly losing the battle, the striking example being Apple's Lightning.

Increased data transmission and new standards are emerging, such as Single Pair Ethernet (SPE).

The wireless world follows the same evolution, with Bluetooth chip manufacturers offering higher data rate products over short range up to 2 Mbps (Nordic). The evolution of Wi-FI towards Wi-Fi 6/6e is no exception, as this new version enables even higher throughput, even in densely populated areas.

IoT AND 5G: FASTER, FURTHER, AND MORE ROBUSTLY!

The well-known statement that '5G is the ultimate enabler for IoT' has never been truer, and our thirst for data is ever increasing. Use of AI is a typical example of cloud processing capability over 5G. The emergence of new technological capabilities together with the democratization of existing ones paves the way for an ever more ubiquitous IoT. Here, we review three essential aspects in this wave of 5G democratization: interoperability, increased bandwidths and private networks.

Interoperability is key for seamless and high performance IoT. Many efforts have been dedicated to making it more accessible and mainstream. An example is the wider deployment of Open Radio Access Networks (Open RAN or O-RAN). These non-proprietary RAN are characterized by a disaggregation of software and hardware which makes them all the more modular.

Another major trend in the context of interoperable mobile communication is embedded SIM-cards, or e-SIMs, permanently mounted into a device. Their integration requires less space than traditional SIM cards, making them accessible to new devices. In addition, they have been designed to support interoperability from the outset. On the one hand, their specifications (data format and security system) are standardized with that in mind. Conversely, they are fully rewritable and can be adapted to various mobile network operators (MNO).

As we have already seen, the demand for data is increasing at a breathtaking rate. To meet this demand, experts are striving to perfect the exploitation of 5G frequency bands. 5G uses the so-called low-band and mid-band (FR1, < 7 GHz), together with the very trendy high-band (FR2, > 24 GHz), also called "mmWave technology". The use of the latter already constitutes a huge push in the quest to meet bandwidth demand. The checkmate, however, comes when these various bands are combined in a process called carrier aggregation.

On top of interoperability and increased bandwidth capacity, unlocking the full power of 5G for applications outside mobile communication requires another pillar: private 5G networks. Across markets and applications, enterprises are more and more in need of highly efficient, reliable and secure wireless networks. In terms of efficiency, there is no match for 5G and its unbeatable low latency. However, for a company to base its critical operations on a network shared with others constitutes a huge risk. Firstly, the company does not have control over the management of the network. Secondly, bandwidth availability might fluctuate, compromising reliability. Thirdly, a shared network is at an increased risk of security breaches.

5G has introduced higher global bandwidths and increased access to cloud-based processing, e.g. AI, facial recognition, etc.

As a consequence, alternatives to public 5G networks were necessary for the emergence of small revolutions such as Industry 4.0 (largely enabled by the Industrial Internet of Things, IIoT), AR/VR or widespread robotics. Private 5G networks were born as an answer to that conundrum. Organizations build their own networks and can do this according to two models that involve very different financial outlays. The first is large-scale deployment, with the purchase of significant hardware and allocation of large teams to manage it. The second is purely cloud native, and is paid for per usage, in an "as-a-service" setting. This second model gives access to private 5G networks and their benefits to smaller companies – the user has the final say.

CONCLUSION

From these trends, we gather that tomorrow's world will be largely enabled by advances in electronics in its broadest sense, encompassing two main aspects:

- Firstly, electronics moves at a variable but progressive rate of change, often leapfrogging when enabled by significant progress in adjacent fields of technology, e.g., the introduction of 5G and the services that it has enabled.

- Secondly, as previously mentioned, industrial problems of supply have impacted these adjacent fields of technology, which are critical and equally important to the success of the electronics industry as a whole. The analogy of a chess board is useful in explaining that each piece moves forward, yet you need all the correct pieces to win the game and see truly inspiring changes in the electronics industry. Post-crisis, we are now on the cusp of these breakthroughs.

Watch this space!

ABOUT FISCHER CONNECTORS

Founded in 1954, Fischer Connectors designs, develops and deploys end-to-end interconnect solutions for ecosystems requiring local transfer and management of data, signals and power. Its tailored electronic solutions, connectors and cable assemblies are trusted globally for their reliability in demanding environments.

The company is part of the Swiss-headquartered technology group Conextivity. With nearly 600 people worldwide, four R&D centers, six manufacturing sites and two business activities (Fischer Connectors and Wearin'), Conextivity Group offers high-performance connectivity solutions that manage power and data flows seamlessly from sensors and devices to the cloud and AI, enabling the emergence of new and scalable ecosystems.