What Time Sensitive Networking Is Trying to Accomplish

Today's networks are complex and not readily interoperable.

Held each year in Las Vegas, the Consumer Electronics Show (CES) is often a showcase for new and upcoming technologies. The original compact disc, the HD TV, and the first Xbox gaming console were all unveiled at different versions of this event. In more recent years, CES has been dominated by products and concepts associated with wearable tech, connected cars, and especially, the emerging Internet of Things (IoT).

While the IoT is widely viewed as a consumer phenomenon—one that encompasses ubiquitous wireless connectivity as well as IP-enabled home appliances, among other *things*—much of its development is driven by the evolving requirements of industry. Sectors such as manufacturing, pro audio, video, and transportation/automotive are still pushing for standards that would help unlock the potential of an industrial Internet of Things, which holds the promise of bringing field devices, enterprise IT applications, and cloud infrastructures closer together.

These industries' concerted efforts have already produced solutions and specifications such as Bluetooth® mesh networking, IEEE 802.11ah HaLow Wi-Fi, and 802.1 audio video bridging. The first two are most likely to find their ways into the many consumer-facing devices on display at CES, but the third, now being succeeded by time sensitive networking (TSN) through various updates to 802.1 and 802.3, could make an even bigger impact through its role in automation and control systems.

What Would Time Sensitive Networking Replace in the Industrial Internet of Things?

One aspect of TSN that deserves a bit more attention is what exactly—in terms of network designs, protocols, models, etc.—it is designed to replace.

TSN: Time Sensitive Networking

Figure 1. TSN will support the generous bandwidth, IT security provisions and low latency requirements of IIoT applications. Most of all, it will ensure the performance of real-time traffic even on Ethernet networks handling many different types of data.

Multiple layers and the Purdue Enterprise Reference Architecture

An early 2016 report from National Instruments, recently highlighted by *engingeering.com*, revealed the IIoT status quo that TSN's proponents are trying to change.[1] More specifically, current industrial network architectures feature multiple layers, each of which is optimized for a specific set of tasks and bound by its own particular levels of latency, bandwidth, and quality of service. This setup ensures that mixed traffic across the network is properly handled, but it is not ideal for interoperability between systems—a key IIoT requirement.

Today's industrial networks are full of complexity and noninteroperability.

Todd Walter of National Instruments, who is also the industrial segment chair at the AVnu Alliance, further explained that many plants continue to follow the Purdue Enterprise Reference Architecture, a 1990s era model for multilayer networks.[2] PERA is designed to cover everything under the enterprise control banner, from physical processes up to logistics systems.

A textbook example would be an architecture in which Level 0 was I/O from sensors, with safety instrumented systems at Level 1 and PLC/RTU IP communications at Level 1.5.[3] Higher up would be enterprise resource planning (Level 4) and file servers (Level 5). In the real world, PERA-oriented architectures rely on diverse collections protocols, including legacy fieldbuses, alongside Ethernet solutions to address these individual layers.

Fieldbus and Ethernet in PERA

For example, complex and highly demanding motion control applications are often still split into islands of automation, that is, multiple networks including fieldbus and Ethernet solutions. Sets of machines supporting such applications will need to have stopping precision, position retention, and the ability to withstand harsh environments, yet might utilize a range of technologies to meet these requirements. Proprietary networks may be used to distribute motion, working alongside PROFIBUS® and ControlNet® to communicate with frequency drives and Ethernet to deliver information to users. Such a setup means that many different supporting tools and training procedures are in play at any time.

Getting back to Walter's point about PERA, this mix of technologies—that is, fieldbus, Ethernet, and the respective hardware and software ecosystems that support them—is feasible, but out of step with the interoperability and economy that enterprises are coming to expect from the IIoT. Capitalizing on the IIoT opportunity may require, at the very least, standard networking infrastructures, additional bandwidth, and the ability to remotely and securely access edge devices. TSN is well positioned to deliver all of these capabilities.

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It is an expansion of AVB, which was originally designed to synchronize critical pro AV streams. When the automotive industry decided to introduce AVB into some cars, the scope of the project expanded, and with AVB itself having lagged behind proprietary competitor Dante, TSN became a sensible evolution for the widespread efforts to create interoperable deterministic networking. Features such as converged QoS, bandwidth reservation, and the use of the IEEE 1588 precision time protocol are highlights of TSN, but there is also its appealing compatibility with standard Ethernet infrastructure.

"By using standard Ethernet components, TSN can integrate seamlessly with existing brownfield applications and standard IT traffic to improve ease of use," Walter explained in an article for *Design World*.[2] "In addition, TSN inherits many features of existing Ethernet, such as HTTP interfaces and Web services, which enable the remote diagnostics, visualization and repair features common in IoT systems."

Moving Time Sensitive Networking Forward

As the level of industry activity at events like CES and Integrated Systems Europe 2016 (at which AVnu Alliance presented) demonstrate, the IoT and IIoT are becoming central concerns to organizations across the globe.[4] While work on the original AVB began more than a decade ago, its latest leap forward as TSN is arriving at an opportune moment when the IIoT is really coming into focus.

TSN will support the generous bandwidth, IT security provisions, and low latency requirements of IIoT applications. Most of all, it will help ensure the performance of real-time traffic even on Ethernet networks handling many different types of data. It will be able to find a home in a variety of challenging industrial environments, including autonomous cars, traffic control networks, wind farms, power plants, and control systems. However, it is just getting started and it will face key hurdles in supplanting current network architectures that have been in place for years or even decades.

The first portions of the finalized TSN standard, along with references from vendors, began in 2016. From there, TSN-certified products and services should eventually begin arriving in automation systems to remake network architectures for the IIoT.

References

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