New IEEE 802.3™ Standards Provide Platforms for the Next Ethernet Innovations

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Pragmatic, market-driven standardization continually expands the low-cost foundation on which Ethernet innovation takes place, across the technology's sprawling horizon of use cases.

Standards development through the IEEE 802.3™ Ethernet Working Group for decades has helped support the creation of more varied and powerful solutions at a better cost structure. Because they do not have to solve the same, shared problems again and again, companies across the always-growing Ethernet application space instead differentiate themselves by way of the innovation that they provide on top of the standards-based foundation.

Two IEEE 802.3 standards approved and published in 2020 are the newest illustrations of this dynamic in action in different areas of Ethernet networking.

IEEE 802.3ca™, *IEEE Standard for Ethernet Amendment 9: Physical Layer Specifications and Management Parameters for 25 Gb/s and 50 Gb/s Passive Optical Networks*, is intended to support the rollout of the next generation of business and residential fiber-to-the-premise services.

IEEE 802.3ch™, *IEEE Standard for Ethernet--Amendment 8:Physical Layer Specifications and Management Parameters for 2.5 Gb/s, 5 Gb/s, and 10 Gb/s Automotive Electrical Ethernet*, is designed to accommodate the next evolution of in-vehicle networks.

Unleashing Next-generation Business and Residential Services

No service provider wants to be in a situation where they cannot deliver what their customers desire. At the same time, service providers stay under relentless pressure to reduce footprint of network equipment, simplify service upgrades and cut network-upgrade and fiber-deployment costs.

That range of market needs led to development of IEEE 802.3ca. The standard, published in July 2020, supports efficient and cost-effective extension of both existing and new Ethernet passive optical networks (EPONs) to multiple channels of 25 Gigabits per second (Gb/s).

EPONs often are the "last-mile" network infrastructure connecting service providers with their internet, voice and digital-TV customers. The new IEEE standard defines methods for symmetric (same bandwidth speeds delivered downstream and upstream) and asymmetric (different speeds in the two directions) services over EPON connections of at least 20 kilometers.

The standard is intended to allow access network operators to evolve their networks by gradually deploying faster and faster customer-side devices without any downtime to existing customers. These new access networks are able to concurrently support links operating at downstream/upstream rates of 25/10 Gb/s, 25/25 Gb/s, 50/10 Gb/s, 50/25 Gb/s, and 50/50 Gb/s, while coexisting and maintaining compatibility with the previously standardized 10 Gb/s EPON equipment that they have commonly deployed today. The standard is relevant for connections over existing optical fiber already in the ground, as well as new fiber that a network operator might yet deploy.

This point illustrates the pragmatic, achievable balance in standards development that the IEEE 802.3 working group strives for—the task force that developed IEEE 802.3ca was committed to achieving a completely new level of service but not relying on technology for which the industry would need to wait 15 years for the appearance in the marketplace of economically feasible, real-world solutions.

For example, instead of defining a 50 Gb/s solution using a single wavelength and thereby pushing the limits of technical and economic feasibility, IEEE 802.3ca defines a novel method for bonding together multiple wavelengths at 25 Gb/s to deliver the unprecedented performance of 50 Gb/s symmetric peak capacity. This allows original equipment manufacturer (OEM) suppliers to roll out products aligned with the standard sooner rather than later. As a result, concrete innovation is freed to move forward.

Supporting Automotive Networking Evolution

The global automotive industry is amid transition from legacy, purpose-built networks to Ethernet for support of autonomous driving and other applications such as advanced driver assistance systems (ADAS).

IEEE 802.3ch was developed to fill a void for support of data rates greater than 1 Gb/s in automotive Ethernet environments. The standard, published in June 2020, adds physical-layer specifications and management parameters for 2.5 Gb/s, 5 Gb/s and 10 Gb/s operation on a single balanced pair of conductors.

The IEEE 802.3 working group's dedicated efforts in automotive Ethernet began in 2012. That work over the years since has yielded standards addressing the requirements that characterize this industry:

- There is always a need for more (speed and/or bandwidth).
- Automotive's long design cycles require the ability to upgrade without a complete redesign.
- Designs that allow components to be added as needed are preferable because of cost sensitivity throughout the industry.

The higher-speed connectivity defined in IEEE 802.3ch is intended to serve as the in-vehicle network backbones for top-level transport of various slower-speed data, as well as to support transmission of high-resolution, high-frame-rate, uncompressed video from the cameras on which ADAS and autonomous driving rely.

These machine-vision capabilities entail transfer and processing of a tremendous volume of images and other raw data from sources across the vehicle. When something is in the road, the ADAS system must figure out what the obstruction is and what kind of action it's going to take. For example, is the obstruction a plastic bag or an animal? And, depending on that answer, is the ADAS system going to warn the driver or signal the vehicle's steering or brakes to take some automated response?

Moving Forward

New standardized capabilities drive technological innovations, and new technological innovations expose the need for new standardized capabilities.

For example, the IEEE 1904™ Access Networks Working Group, which has always worked in close conjunction with IEEE 802.3, has launched a project to build on the capabilities of IEEE 802.3ca and provide EPON operators with compatible system-level specifications covering equipment management, traffic engineering, and quality of service (QoS) mechanisms.

The work around Ethernet networks for the automotive industry continues, as well. A follow-up project to IEEE 802.3ch is underway to support the automotive industry's ongoing shift from their traditional domain-based electronic architectures to zonal architectures relying on Ethernet links for fully autonomous operation.

There is always new work to be done in raising the world's standards, and IEEE SA work is globally open to everyone. You are invited to engage and make a meaningful impact for the benefit of humanity.

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