How Two New Standards Can Help Ethernet Achieve Higher Speeds and Reach Longer Distances

IEEE 802.3cp and IEEE 802.3ct Aim for Faster and Longer-Distance Ethernet Services

Over the past few decades the world has made great strides in building a powerful, pervasive, and resilient networking infrastructure, a task that has been given new urgency in recent years by the exponential growth in bandwidth demands. The importance of network connectivity was only fully highlighted by the COVID-19 pandemic. That's when we began to rely on digital networking much more intensely than ever before, for the online services that enable many parts of our lives.

Ethernet technology is vital to our online capabilities. A family of wired networking technologies introduced commercially in 1980, Ethernet has continually grown and evolved to address many new applications and has become by far the dominant networking technology upon which the world depends.

Wired networks might seem to be an anachronism today, given the wireless capabilities of products such as laptops, Wi-Fi routers, and streaming devices. The reality, however, is that behind ~~every~~ many wireless networks there is a wired network that enables it. That's because before digital information gets to a phone, it must travel from a base station to the cellular broadcast tower. And before a Wi-Fi® router can broadcast a signal to a television, that signal has to get from the ~~cable operator~~video service provider's facility to the home. These tasks ~~are~~ can be handled by wired Ethernet networks based on the IEEE 802.3 standards family, which enable effective, reliable, and inexpensive performance.

IEEE 802.3 Ethernet Standards

The IEEE 802.3™ Ethernet Working Group has developed more than 75 standards over the years addressing various Ethernet user requirements and technical issues, helping to make Ethernet one of the most widely used networking technologies ever invented. IEEE 802.3 is part of a diverse family ~~collection~~ of specifications developed by the IEEE Computer Society's IEEE 802 LAN/MAN Standards Committee ~~standards known as IEEE 802~~ which develops ~~addresses~~ a broad array of technical networking standards~~connectivity protocols and applications, developed by~~. IEEE 802 LMSC is comprised of thousands of technical experts diligently developing the collection over more than 40 years.

Two newly published IEEE 802.3 standards continue that progress, by addressing specific industry needs for higher speeds and longer reach. More specifically, the standards define new specifications for the integrated circuits known as PHYs, which control the transmission of data across the physical layers of Ethernet networks.

Faster and More Efficient Bidirectional Data Transmission

The IEEE 802.3cp™, Standard for Ethernet Amendment 14: Bidirectional 10 Gb/s, 25 Gb/s, and 50 Gb/s Optical Access PHYs, addresses the need for higher speeds and greater efficiency in the delivery of point-to-multipoint broadband services, such as from a cable company or other service provider to a cluster of homes, cell towers, or a large business.

This so-called access market has traditionally made use of passive optical networks (PONs), where one fiber serves a cluster of users. But for larger groups of users, this sharing limits data transmission speeds. Dedicated bidirectional single-fiber links are an attractive solution for this application, because one fiber per customer can be used to both send/receive data, via a wavelength division duplexing technique.

This not only makes faster data rates possible, it also simplifies network field operations because only one connection must be made to a fiber, resulting in fewer points of potential failure.

IEEE 802.3cp defines network physical layer specifications and management parameters for PHYs that can enable symmetric bidirectional operation at data rates of 10 Gb/s, 25 Gb/s, and 50 Gb/s over a single strand of single-mode optical fiber at least 10 km long.

This standard also enables operators to achieve key overall network requirements: a bit error rate (BER) of $\leq 10^{-12}$ at the service interface; optional energy-efficient operation; and silent-start operation, to avoid misconnected optics jamming the network.

100 Gb/s Ethernet Performance at Reaches Longer Than 10 km

The IEEE 802.3ct™, Standard for Ethernet - Amendment: Physical Layers and Management Parameters for 100 Gb/s Operation over DWDM (dense wavelength division multiplexing) systems, meanwhile, addresses the needs of multiple system operators (MSOs) and cable distribution networks, and mobile backhaul networks, where reaches up to ~80 km are required, or where lack of fiber availability drives the need to use one fiber to transmit multiple instances of Ethernet. The IEEE 802.3ct standard will enable up to 48 wavelengths on a single fiber, with each wavelength supporting transmission of a separate 100 Gb/s Ethernet data stream.

This standard will enable MSOs, cable companies, and telephone companies to distribute data-intensive content over longer distances, even encompassing small metropolitan areas, reducing costs, and providing users with more economic and reliable high-speed service.

The development of this standard was driven by requests from industry to define PHYs and protocols for 100 Gb/s single-channel Ethernet operation in a DWDM system that are consistent and completely integrated with existing IEEE 802.3 Ethernet specifications. (DWDM modulation increases bandwidth over existing fiber networks by combining and transmitting multiple signals simultaneously at different wavelengths on the same fiber.)

The 802.3ct Task Force shared knowledge with ITU-T Study Group 15 from the International Telecommunications Union during the formulation of the standard, to ensure that there will be compatibility with another DWDM-based networking standard that the group is developing.

Get Involved in IEEE 802

The work around Ethernet networking continues. Another project IEEE P802.3cw is currently in development, and is focused on 400 Gb/s Ethernet transmission across DWDM systems, targeting the networking needs of hyperscale data centers. This effort will enable up

to 64 wavelengths on a single fiber, with each wavelength supporting transmission of a separate 400 Gb/s Ethernet data stream.

Standards development at IEEE Standards Association (IEEE SA) is open to anyone as an individual or on behalf of your organization. You are invited to participate and contribute to raising the world's standards in technological connectivity.

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