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WHITE PAPER

Evolution of Data Center Networking Technology — IP and Beyond

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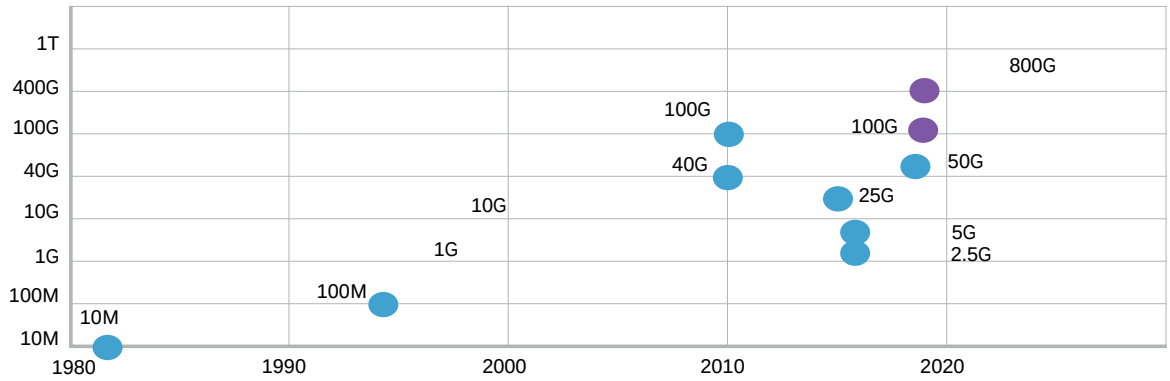
Introduction

Ethernet is ubiquitous—it is the core technology that defines the Internet and serves to connect the world in ways that people could not imagine even one generation ago. HPC clusters are working on solving the most challenging problems facing humanity—and cloud computing is the service hosting many of the application workloads struggling with these questions. While alternative network infrastructure within datacenters often facilitates low latency, high-speed communication, they are often limited in reach to within a single facility. Additionally, there is often a prohibitive cost to building multiple fabrics and cloud providers that occupy multiple locations need to move data and even perform inter-process communication between locations. For these needs, Ethernet SoCs supporting up to 800 GbE or even beyond play a critical role and companies who can aggregate, route, and deliver this traffic with minimal latency will thrive—presenting a way to leverage massively scale-out and long-haul high-speed communication critical to multi-site high performance computing, machine learning and data analytics.

This white paper explains the Ethernet standards' evolution over the years from supporting home networking to now enabling hyperscale and cloud data center networking. The paper also highlights the need for a more comprehensive Ethernet solution beyond IP that SoC designers demand for 100G to 800G SoCs.

The Ethernet Standard and Other Critical Elements

Ethernet initially became a reality in 1972 at Xerox's Palo Alto Research Center when Bob Metcalf and Dave Boggs were challenged to share the world's first laser printer with hundreds of workstations. Inspired by a packet radio network used to communicate among the Hawaiian Islands (ALOHANet), the concept of a Carrier Sense Multiple Access protocol for Collision Detection (CSMA/CD) was developed to define the Media Access Control (MAC) layer of the Ethernet protocol. Below the MAC layer, a passive coaxial cable was used to propagate electromagnetic waves (packets) and an outstanding 3 Mbit/s Ethernet network was achieved. While this remained internal for several years until the commercialization of the Ethernet protocol in 1979. After four years of work, the IEEE approved the first standard for n CSMA/CD Ethernet communication over 10Base5 (aka "thicknet") at a rate of 10 Mbps. Challenging to use, this cabling method required a hole to be bored through the cable jacket and outer braid to the center core and installation of a "vampire tap" to connect each machine. The development of the Ethernet physical layer steadily improved both usability and speed over the next three decades until there was a literal explosion of standards to address different market segments and applications. Figure 1 illustrates the Ethernet PHY standard evolutions throughout the years.


1T
400G
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1980
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2020
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40G
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25G
100G
50G
800G
5G
2.5G

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