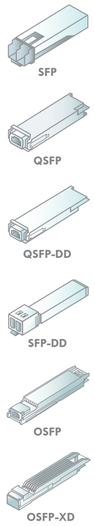
LATEST INTERFACES AND NOMENCLATURE

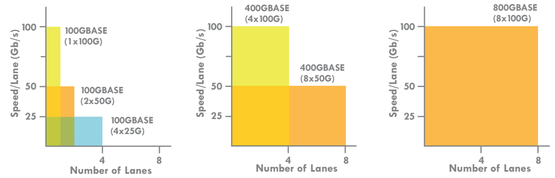
	Backplane	Twinax Cable	15-40m(OT) Single Twisted Pair	>100m (OT) Single Twisted Pair	100m (IT) Twisted Pair (2/4 Pair)	MMF	500m PSM4	2km SMF	10km SMF	20km SMF	40km SMF	80km SMF	Electrical Interface	Pluggable Module
10BASE–	T1S		T1S	T1L	T									
100BASE–			T1	T1L	T									
1000BASE–			T1		T									SFP
2.5GBASE–	KX		T1		T									SFP
5GBASE–	KR		T1		T									SFP
10GBASE–			T1		T	SR			-BR10-D/U LR	-BR20-D/U	-BR40-D/U ER			SFP
25GBASE–	KR1 KR	CR1 CR/CR-S	T1		T (30m)	SR			LR EPON -BR10-D/U	EPON -BR20-D/U	ER -BR40-D/U		25GAUI	SFP
40GBASE–	KR4	CR4			T (30m)	SR4/eSR4	PSM4	FR	LR4		ER4		XLAUI XLPPI	QSFP
50GBASE–	KR2 KR	CR2 CR				SR		FR	EPON LR -BR10-D/U	EPON -BR20-D/U	ER -BR40-D/U		LAUI-2/50GAUI-2 50GAUI-1	SFP/QSFP
100GBASE–	KR4 KR2 KR1	CR10 CR4 CR2 CR1				SR10 SR4 SR2 VR1 SR1	PSM4 DR	CWDM4 FR1	LR4 4WDM-10 LR1	4WDM-20	ER4/ 4WDM-40	ZR	CAUI-10 CPPI CAUI-4/100GAUI-4 100GAUI-2 100GAUI-1	SFP/SFP-DD QSFP/QSFP-DD OSFP
200GBASE–	KR4 KR2	CR4 CR2 CR1				SR4 VR2 SR2	DR4 DR1	FR4 FR1	LR4		ER4		200GAUI-4 200GAUI-2 200GAUI-1	QSFP/QSFP-DD SFP-DD
400GBASE–	KR4	CR4 CR2				SR16 SR8/SR4.2 VR4 SR4	DR4 DR2 DR2-2	FR8 FR4 DR4-2	LR8 LR4-6 400G-LR4-10		ER8	ZR	400GAUI-16 400GAUI-8 400GAUI-4 400GAUI-2	QSFP/QSFP-DD OSFP
800GBASE-	ETC-KR8 KR8	ETC-CR8 CR8 CR4				VR4.2 SR4.2 VR8 SR8	DR8 DR4	DR8-2 DR4-2 FR4	TBD		TBD		800GAUI-8 800GAUI-4	
1.6TBASE-		CR8				VR8.2 SR8.2	DR8	DR8-2					1.6TAUI-16 1.6TAUI-8	QSFP/QSFP-DD OSFP/OSFP-XD



Gray Text = IEEE Standard Red Text = In Task Force Green Text = In Study Group

Blue Text = Non-IEEE standard but complies to IEEE electrical interfaces * Note: As of publication, subject to change

FATTER PIPES



Total throughput (data rate) may be achieved in three general ways, and combinations of them:

1 Aggregating multiple lanes **2 Increasing the per lane bit rate**

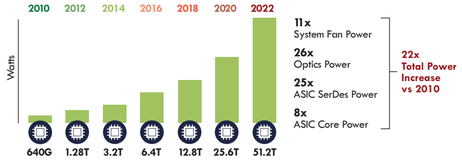
3 Increasing the bits transferred per sample (Baud)

After data rate/lane is chosen, the number of lanes in a link determines the speed. See chart on how multiple lanes can be used to generate similar speeds.

SUSTAINABILITY

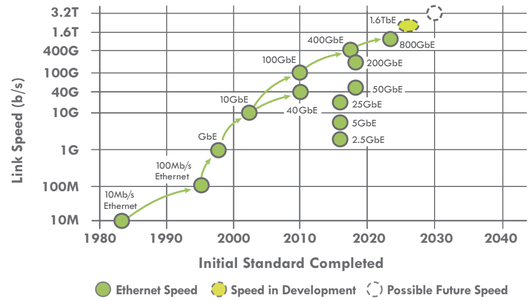
Relentless Advancement

80x Bandwidth Increase over 12 Years

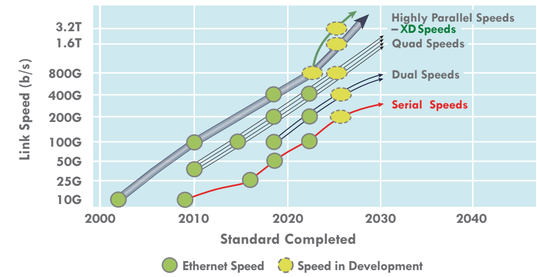


Most major companies now have sustainability pledges requiring better energy efficiency. Ethernet is part of the problem (it uses power) and part of the solution (enabling more efficient facilities). Data centers account for about 1-1.5% of global electricity use. When we look at the power used by the IT equipment, the proportion used by the network has been steadily increasing. For the networking industry, power is the key problem to solve. The challenge for Ethernet is to improve the energy efficiency by reducing the picojoules per bit with new technologies.

ETHERNET SPEEDS



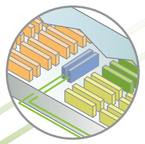
PATH TO SINGLE LANE



Homes use Ethernet to connect personal computers, printers, streaming video services, wireless access points, security cameras and many more devices. Power over Ethernet enables data and power to be delivered over one cable.

Enterprises use wired and wireless Ethernet to connect hundreds or thousands of devices together over Local Area Networks (LANs). Most LANs use BASE-T connectivity, but large buildings, campuses, entertainment venues (sports stadiums and arenas) use multi-mode and single-mode fiber too.

Automotive Ethernet offers a standard based in-vehicle connectivity to systems such as ADAS, infotainment, telematics, etc. over a single twisted pair cable. An Ethernet-based communication network is a key infrastructure element for functions like autonomous driving and the connected car.



Hyperscale Data Centers deploy tens or hundreds of thousands of homogeneous servers across warehouse scale data centers in pods.

ETHERNET ECOSYSTEM

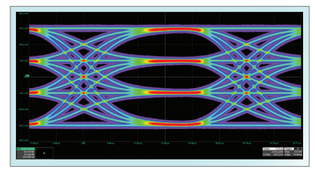
As streams turn into rivers and flow into the ocean, small Ethernet links flow into large Ethernet links and flow into the Internet. The Internet is formed at Internet Exchange Points (IXPs) that are spread around the world. The IXPs connect Telecommunications Companies, Cable companies, Providers and Content Delivery Networks over Ethernet in their data centers.

The Internet Exchange Point (IXP) is where the Internet is made when various networks are interconnected via Ethernet. Co-location facilities are usually near the IXP so that they have excellent access to the Internet and long-haul connections. 5G's next-generation network architecture is changing our connected world. It has the potential to support thousands of new applications in both industrial and consumer segments, and with speeds and throughput exponentially higher than current networks, the possibilities for 5G appear to be almost limitless.

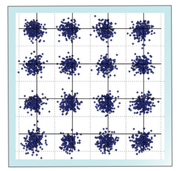
Server Racks
Ethernet Switch And Router Racks
Patch Panels
Storage Racks
Storage Network Equipment
Transport Equipment
Telecom Networks
Cable Networks

ETHERNET SPEEDS
10–100M
1–5G
10G
25–50G
100–200G
400G

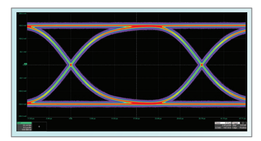
SIGNALING METHODS



PAM4



Coherent



NRZ

Signaling for higher lane rates has transitioned from non-return-to-zero (NRZ) used for 25Gb/s per lane to four level Pulse-Amplitude Modulation (PAM4) for 50 Gb/s per lane and above. Coherent signaling uses inphase and quadrature modulation for 100Gb/s per lane and above.

OPTICAL EVOLUTION