2018 Roadmap Graphics – Side 1

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February 27| 2018

NEXT ETHERNET ERA

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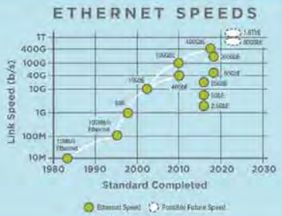
2018 ETHERNET ROADMAP

THE PAST, PRESENT AND FUTURE OF ETHERNET



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ethernet alliance
www.ethernetalliance.org
Designed by Scott Kipp and John D'Ambrosia

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$9.95

INTEROPERABILITY AND CERTIFICATION

The Ethernet Alliance is committed to leading the charge to instilling industry confidence in Ethernet standards through its multivendor interoperability demonstrations and plugfests. Our PoE Certification Program takes this mission to the next level!

Our industry-defined PoE Certification Test Plan is based on the Ethernet PoE standard, and products passing this test will be granted the Ethernet Alliance PoE Certification Logo. This logo will provide instant recognition for products that based on the IEEE 802.3 PoE standard, and provide confidence in the multi-vendor interoperability of those products bearing it. The logos will also provide clear guidance on which devices will work with each other.

The first generation of the program certifies Type 1 and Type 2 products that use 2-Pair of wires. The second generation of the program will tackle the forthcoming IEEE 802.3bt PoE standard. This table explains the capabilities of the Types.

PoE Types and Classes	2-Pair PoE+ - Type 2 / 2-Pair PoE – Type 1				4-Pair PoE in Standardization			
Class	0	1	2	3	4	5	6	7	8
PSE Power (W)	15.4	4	7	15.4	30	45	60	75	90
PD Power (W)	13	3.84	6.49	13	25.5	40	51	62	71.3
	4-Pair PoE–Type 3					4-Pair PoE Type 4			

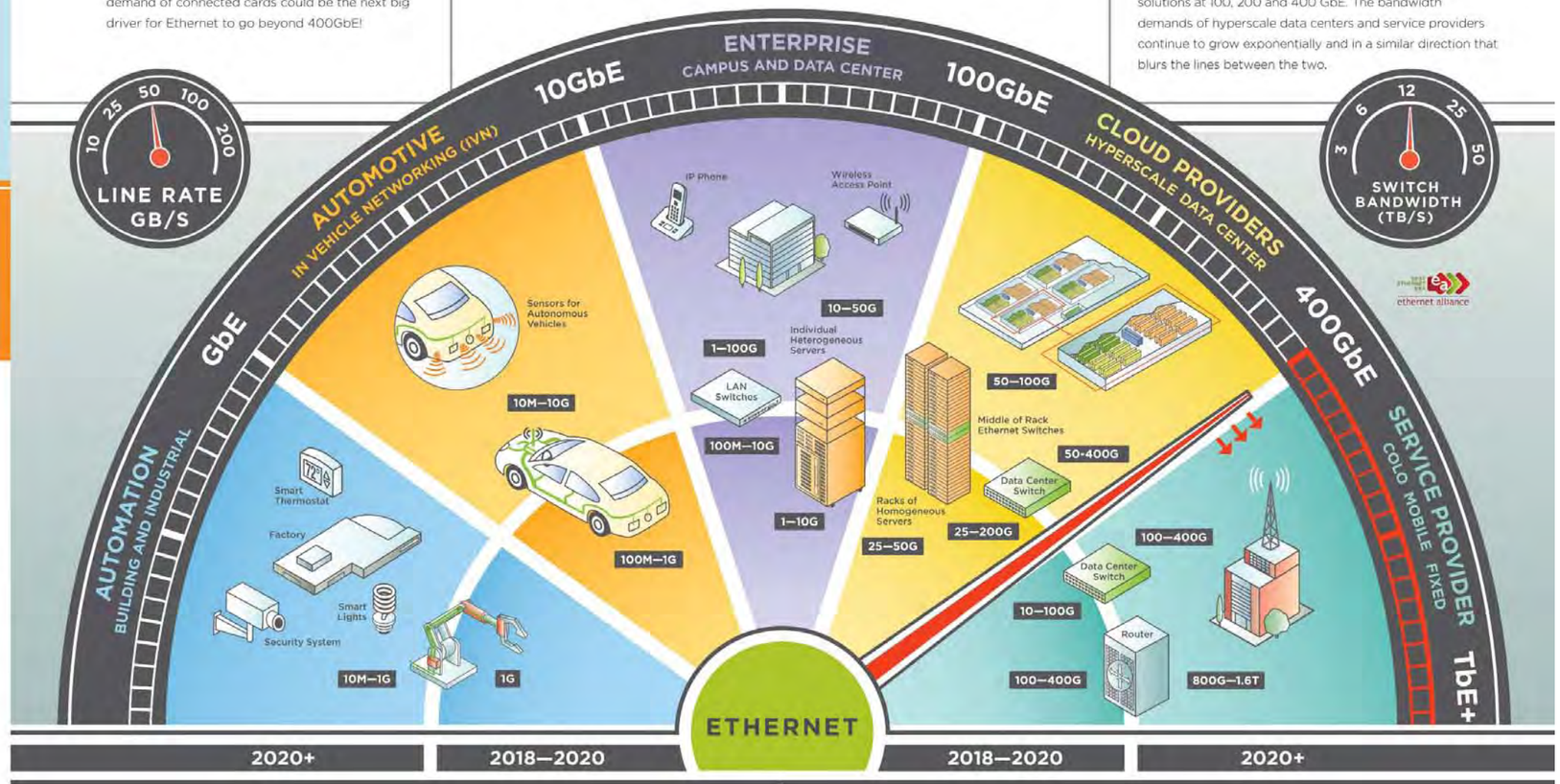
EA Certified™
https://ethernetalliance.org/poecert/

ETHERNET APPLICATIONS

AUTOMOTIVE Ethernet is one of Ethernet's latest success stories. Forecasts predict up to 500 million ports of Ethernet will ship in 119 million vehicles by 2019. Ethernet links within cars provide data and power to reduce the cost and weight in vehicles while providing economies of scale and interoperability. And the bandwidth demand of connected cards could be the next big driver for Ethernet to go beyond 400GbE!

ENTERPRISE and Campus applications drive the bulk of Ethernet port shipments with hundreds of millions of ports shipping per year. Ethernet's roots are in enterprise local area networks (LANs) where the entire Ethernet family, including the BASE-T products, can be found. LANs are rich in copper where over 70 Billion meters of cable have been deployed over the past 15 years. Enterprise data centers are very cost sensitive and most servers deploy GbE and 10GbE.

CLOUD PROVIDERS were the first to adopt 10GbE servers on a large scale in 2010 for hyperscale data centers. With voracious appetites for east-west traffic, hyperscale servers have moved to 25GbE today and will move to 50GbE by the end of 2018. Unique networking architectures within these warehouse scale data centers have driven multiple multimode and single-mode fiber solutions at 100, 200 and 400 GbE. The bandwidth demands of hyperscale data centers and service providers continue to grow exponentially and in a similar direction that blurs the lines between the two.



BUILDING AND INDUSTRIAL applications highlight the need for lower speed Ethernet solutions in harsh environments. The Ethernet community is working to define a single standard for 10 Mb/s operation plus power delivery over a single twisted pair. This will consolidate a landscape of multiple legacy protocols, driving the promise of Ethernet's multi-level interoperability to new heights for these spaces, as 2019 forecasts point to 165 million ports per year.

SERVICE PROVIDERS have driven higher speed Ethernet solutions for decades. Router connections, client side optics for optical transport networks (OTN) equipment, and wireless backhaul have continually pushed Ethernet to higher rates and distances to meet the demands for wireless connectivity. And with global demand by consumers for video, this shows no signs of changing.

EA CERTIFIED & PSE Logo™, is a trademark and certification mark of The Ethernet Alliance in the United States and other countries. Unauthorized use strictly prohibited.

To get a PDF version of the roadmap and to find out more about the roadmap, please go to: **www.ethernetalliance.org/roadmap/**

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	4-Pair PoE–Type 3					4-Pair PoE Type 4			

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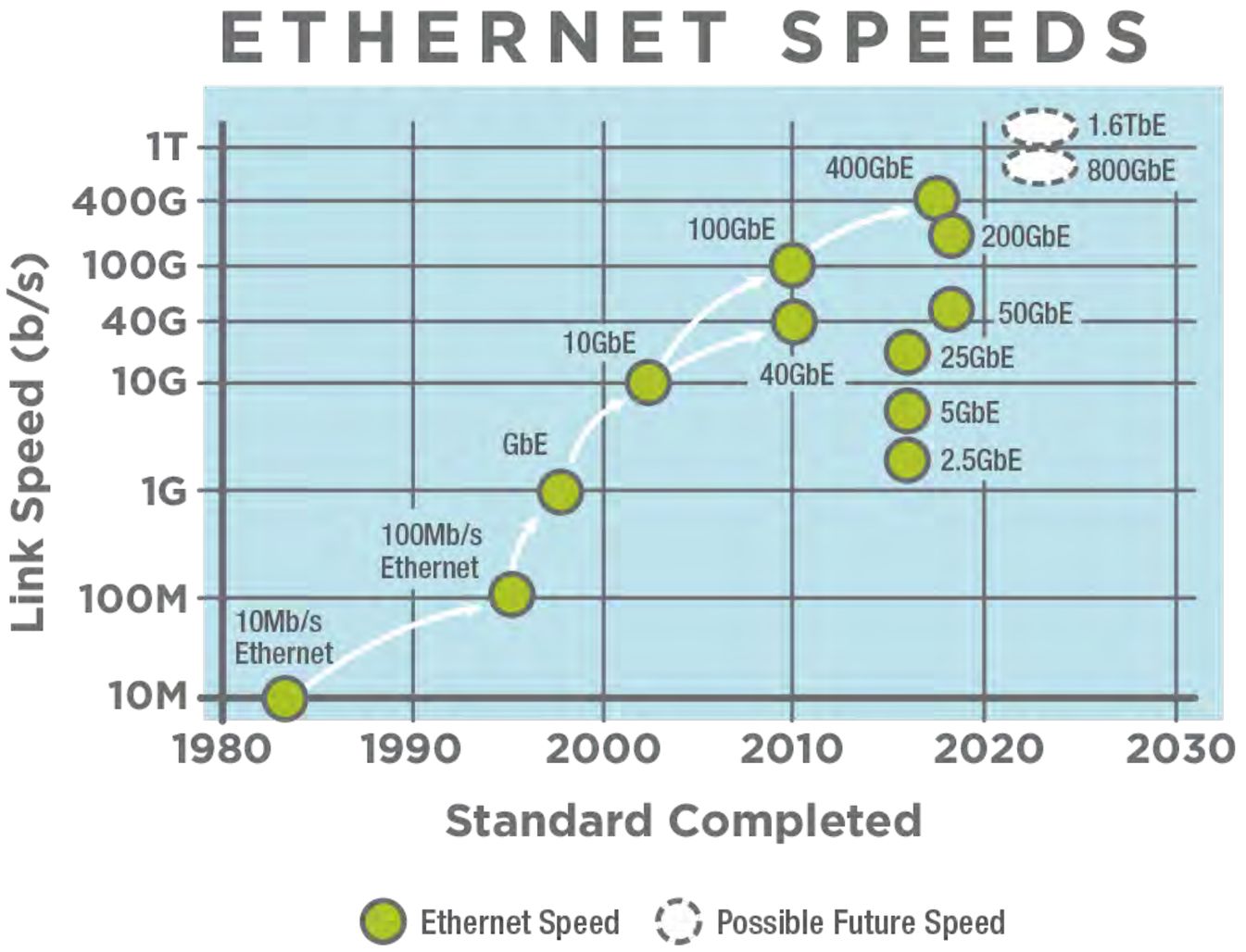

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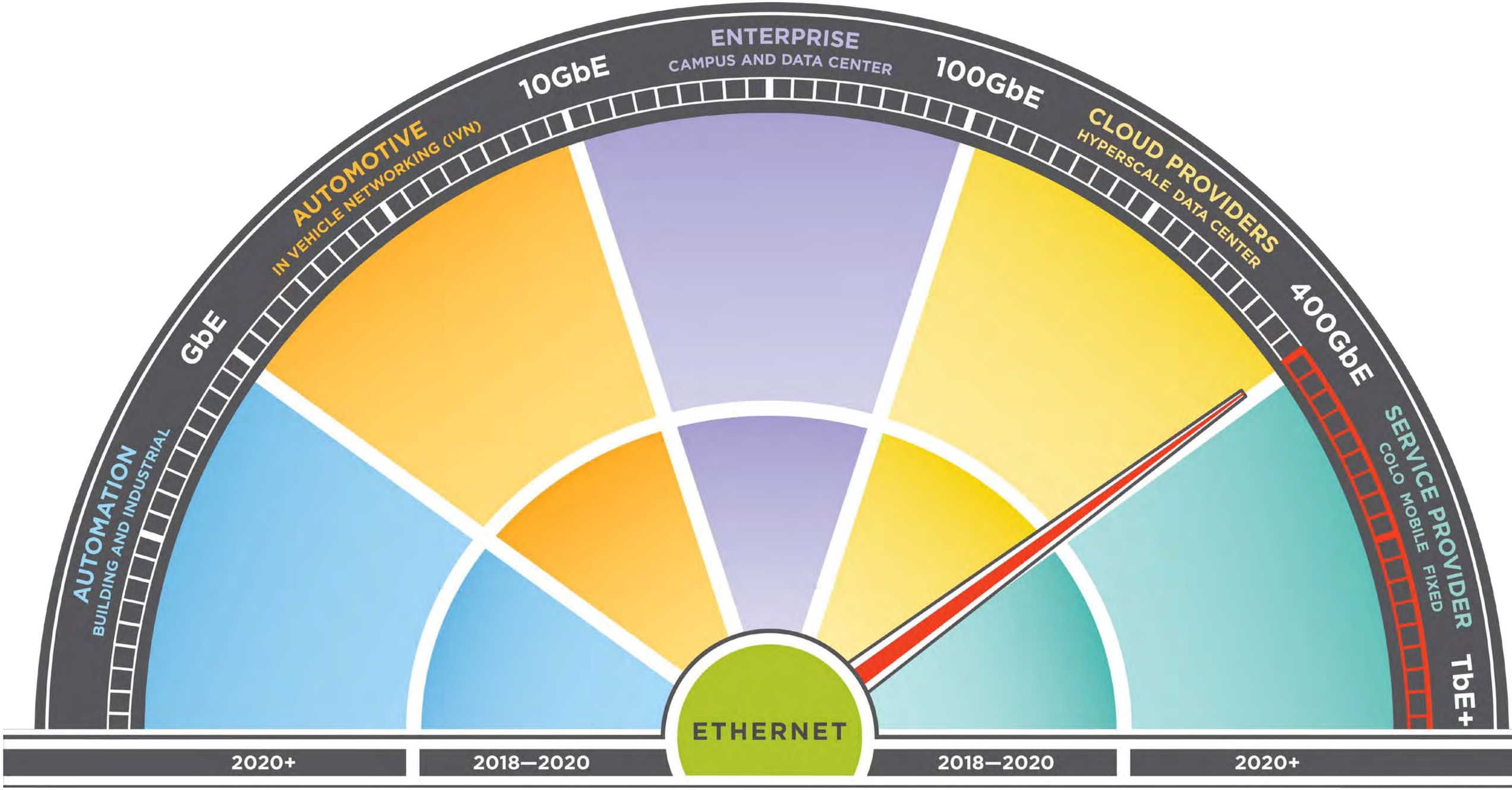
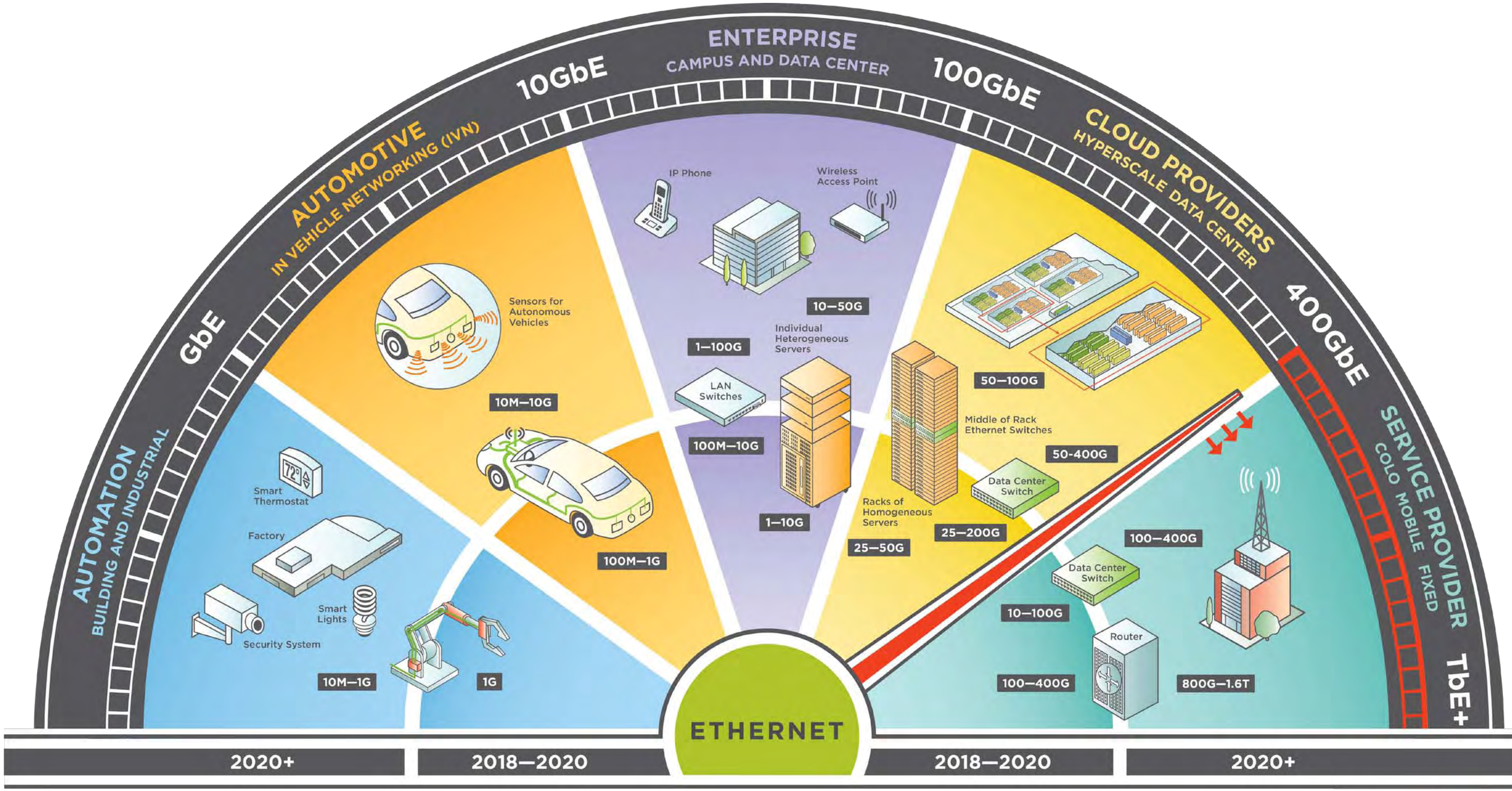
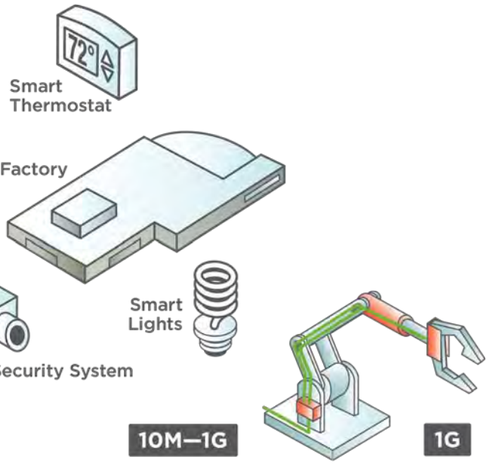
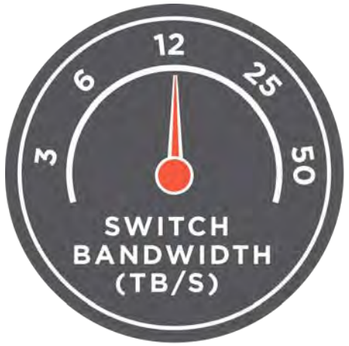

AUTOMATION
BUILDING AND INDUSTRIAL
GbE
AUTOMOTIVE
IN VEHICLE NETWORKING (IVN)
10GbE
ENTERPRISE
CAMPUS AND DATA CENTER
100GbE
CLOUD PROVIDERS
HYPERSCALE DATA CENTER
400GbE
SERVICE PROVIDER
COLO MOBILE FIXED
TbE+
ETHERNET
2020+
2018—2020
2018—2020
2020+

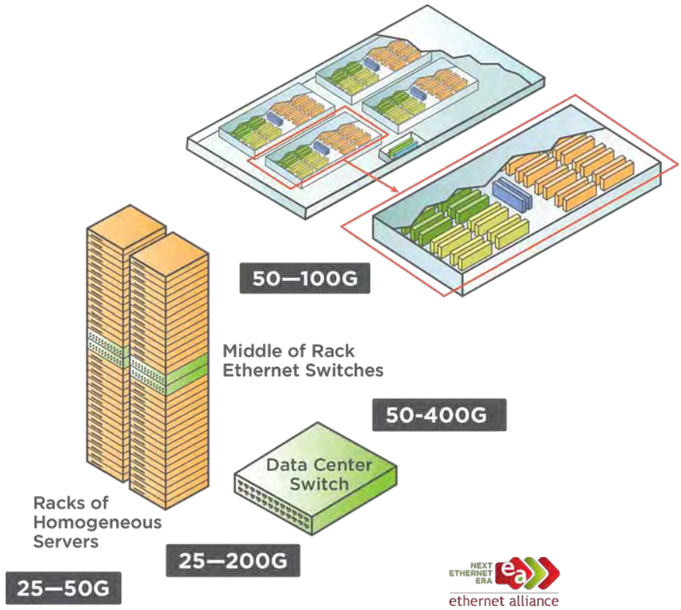


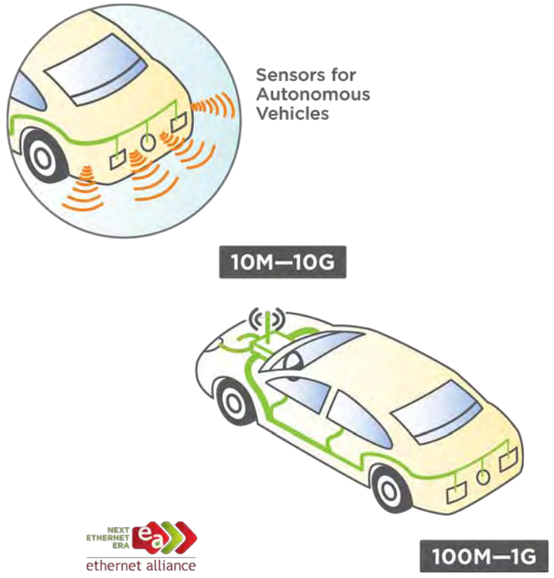
NEXT ETHERNET ERA

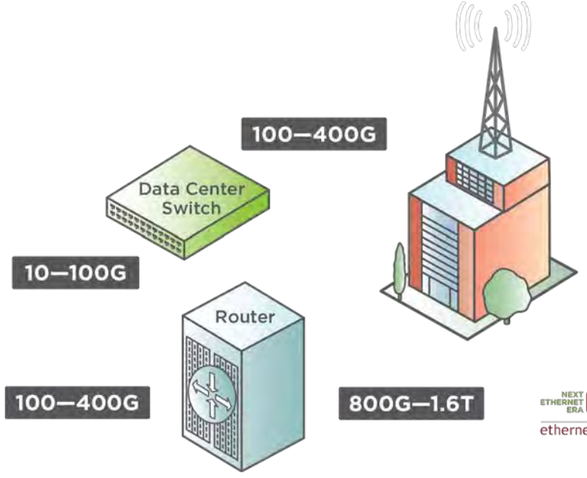

72°
Smart Thermostat
Factory
Smart Lights
Security System
10M—1G
1G

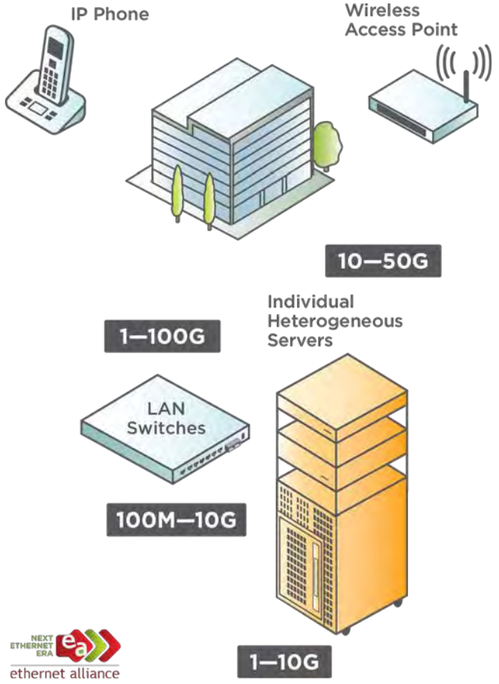

3
6
12
25
50
SWITCH BANDWIDTH (TB/S)

10
25
50
100
200
LINE RATE GB/S


50—100G
Middle of Rack Ethernet Switches
50-400G
Data Center Switch
Racks of Homogeneous Servers
25—200G
25—50G


Sensors for Autonomous Vehicles
10M—10G
100M—1G


100—400G
Data Center Switch
10—100G
Router
100—400G
800G—1.6T


IP Phone
Wireless Access Point
10—50G
1—100G
Individual Heterogeneous Servers
LAN Switches
100M—10G
1—10G

Exit Text

Thank You

2018 Roadmap Graphics – Side 2

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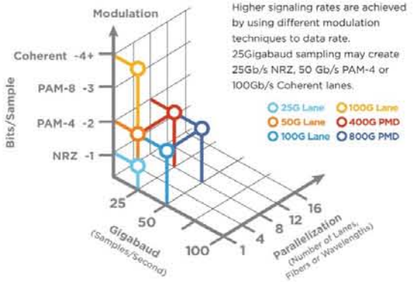
EMERGING INTERFACES AND NOMENCLATURE

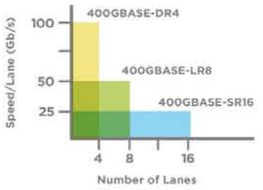
	Electrical Interface	Backplane	Twinax Cable	Twisted Pair (1 Pair)	Twisted Pair (4 Pair)	MMF	500m PSM4	2km SMF	10km SMF	40km SMF	80km SMF
10BASE-		T1S?		T1S/T1L							
100BASE-				T1							
1000BASE-				T1	T						
2.5GBASE-		KX		T1S?	T						
5GBASE-		KR		T1S?	T						
10GBASE-				T1S?	T						
25GBASE-	25GAUI	KR	CR/CR-S		T	SR			LR	ER	
40GBASE-	XLAUI	KR4	CR4		T	SR4/eSR4	PSM4	FR	LR4	ER4	
50GBASE-	LAUI-2/50GAUI-2 50GAUI-1	KR	CR			SR		FR	LR	ER	
100GBASE-	CAUI/10 CAUI-4/100GAUI-4 100GAUI-2 100GAUI-1	KR4 KR2 KR1	CR10 CR4 CR2 CR1			SR10 SR4 SR2	PSM4 DR	10X10 CWDM4 CLR4 100G-FR	LR4 4WDM-10 100G-LR	ER4 4WDM-40 ?	?
200GBASE-	200GAUI-4 200GAUI-2	KR4 KR2	CR4 CR2			SR4	DR4	FR4	LR4	?	?
400GBASE-	400GAUI-16 400GAUI-8 400GAUI-4	KR4	CR4			SR16	DR4	FR8 400G-FR4	LR8 ?	?	?

Gray Text = IEEE Standard Red Text = In Standardization Green Text = In Study Group
Blue Text = Non-IEEE standard but complies to IEEE electrical interfaces

HOW TO GO FASTER



Higher signaling rates are achieved by using different modulation techniques to data rate. 25Gigabaud sampling may create 25Gb/s NRZ, 50 Gb/s PAM-4 or 100Gb/s Coherent lanes.

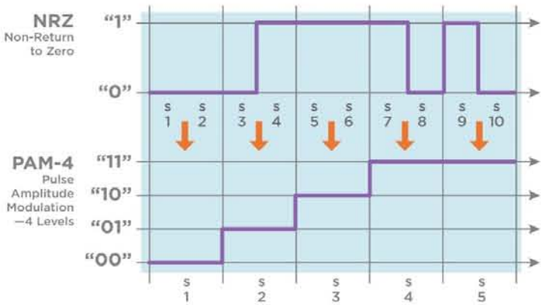


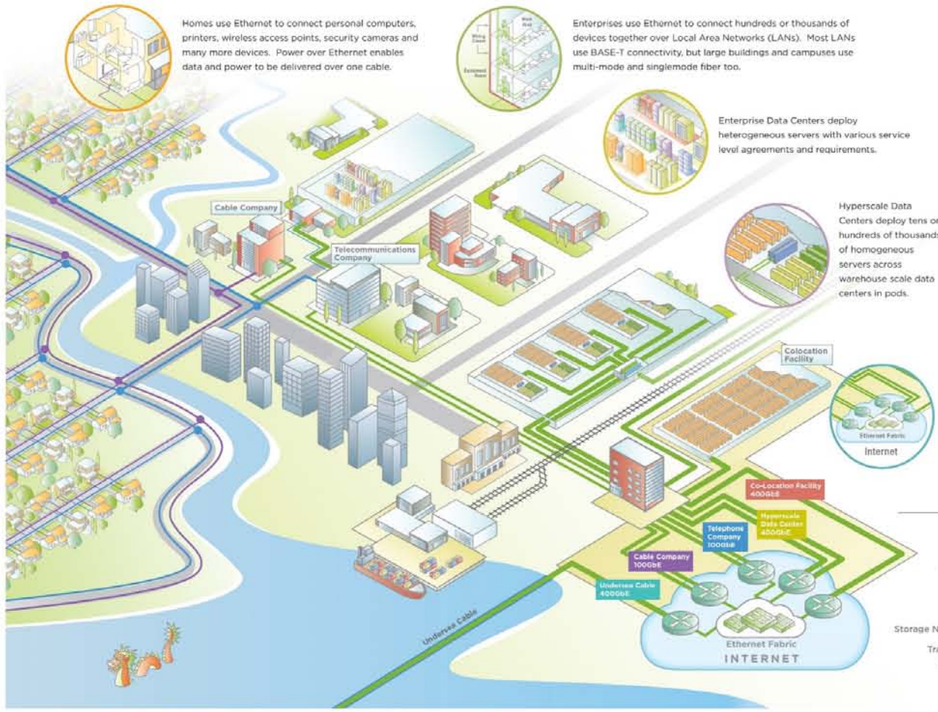
After the data rate/lane is chosen, the number of lanes in a link determines the speed. This chart shows how 4, 8 or 16 lanes can be used to generate 400GbE links.

TO TERABIT SPEEDS

SIGNALING METHODS

Most high speed Ethernet signaling has been Non Return to Zero (NRZ), but Pulse Amplitude Modulation 4 Level (PAM-4) signaling delivers twice as many bits per sample.





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, Cloud Providers, Content Delivery Networks and over Ethernet in their data centers

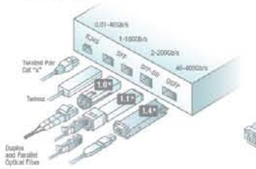
The Internet Exchange Point (IXP) is where the Internet is made when various networks are interconnected via Ethernet. Co-location facilities are usually near the IXP so that they have excellent access to the Internet and long haul connections.

FORM FACTORS

This diagram shows the most common form factors used in Ethernet ports. Hundreds of millions of RJ45 ports are sold a year while tens of millions of SFP and millions of QSFP ports ship a year.

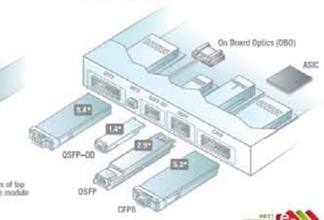
This diagram shows new form factors initially designed for 100GbE and 400GbE Ethernet ports. All have 4 or 8 lanes and the OBO has up to 16 lanes. The power consumption of the modules is proportional to the surface area of the module.

1–4 Lane Interfaces



*Square inches of top surface of the module

4–16 Lane Interfaces



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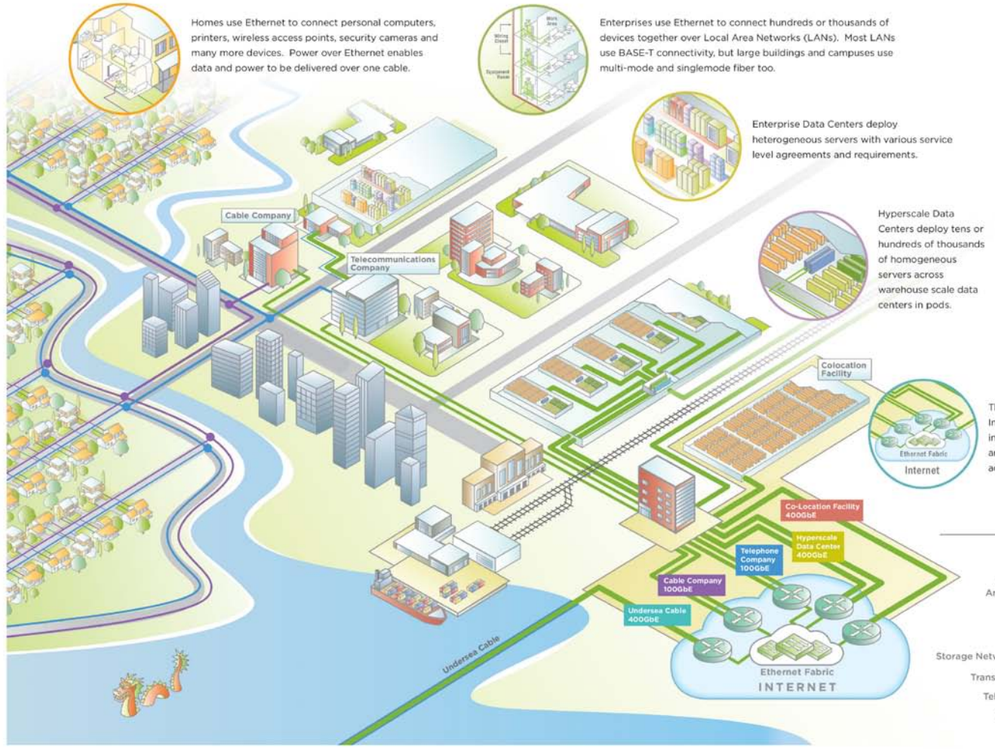

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ETHERNET ECOSYSTEM

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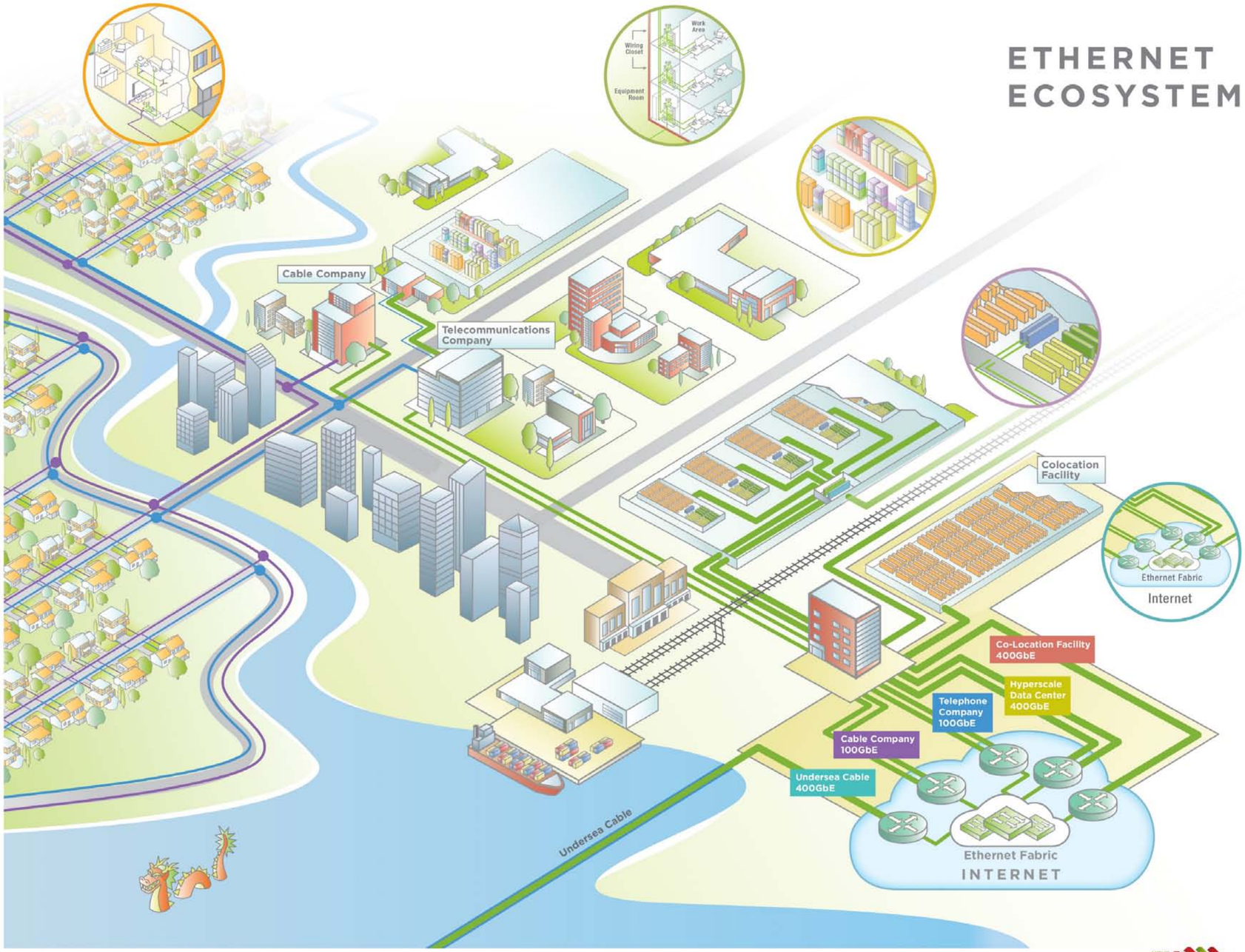

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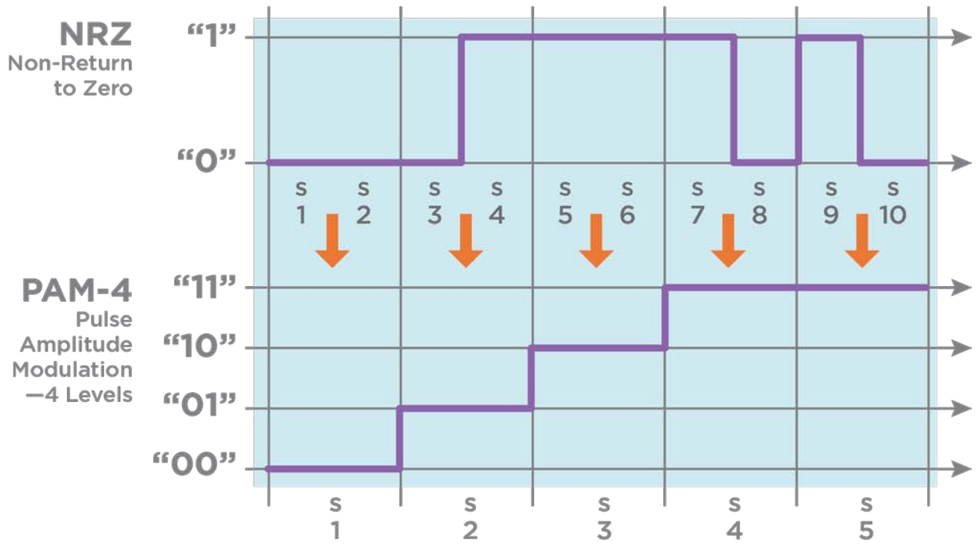

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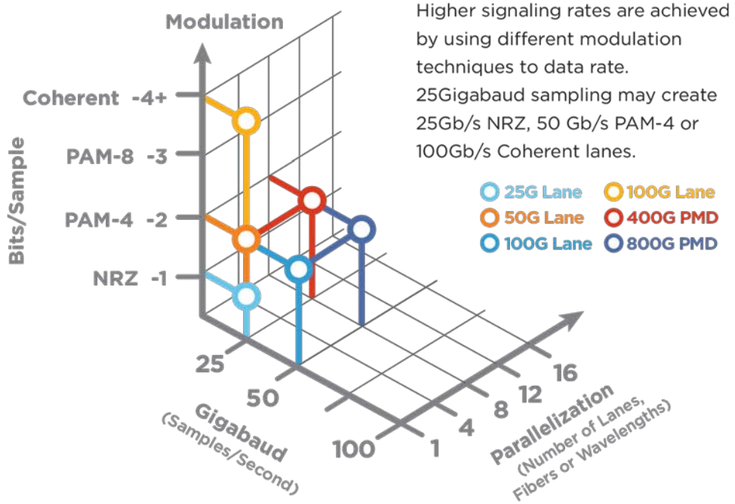
HOW TO GO FASTER



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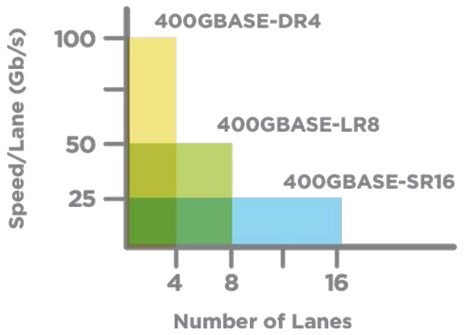

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100BASE–				T1							
1000BASE–				T1	T						
2.5GBASE–		KX		T1S?	T						
5GBASE–		KR		T1S?	T						
10GBASE–				T1S?	T						
25GBASE–	25GAUI	KR	CR/CR-S		T	SR			LR	ER	
40GBASE–	XLAUI	KR4	CR4		T	SR4/eSR4	PSM4	FR	LR4	ER4	
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100GBASE–	CAUI/10 CAUI-4/100GAUI-4 100GAUI-2 100GAUI-1	 KR4 KR2 KR1	CR10 CR4 CR2 CR1			SR10 SR4 SR2	 PSM4 DR	10X10 CWDM4 CLR4 100G-FR	 LR4 4WDM-10 100G-LR	 ER4 4WDM-40 ?	 ?
200GBASE–	200GAUI-4 200GAUI-2	KR4 KR2	CR4 CR2			SR4	DR4	FR4	LR4	?	?
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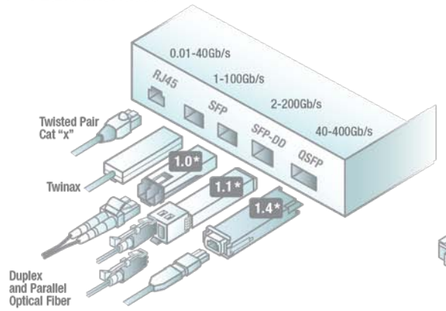
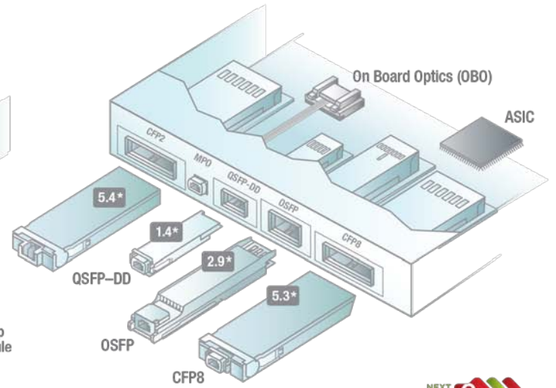


*Square inches of top surface of the module

4-16 Lane Interfaces



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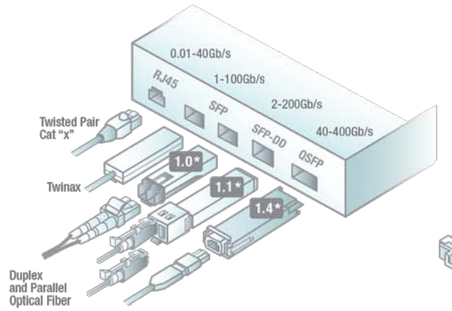
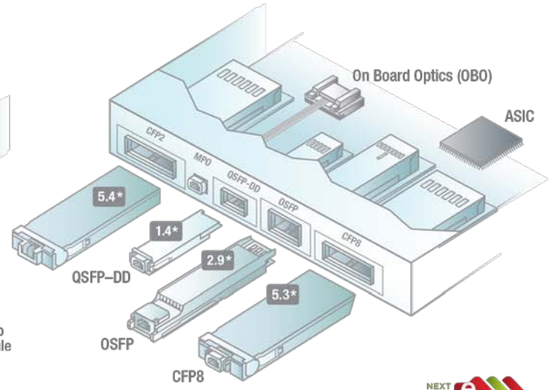
FORM FACTORS

1–4 Lane Interfaces



*Square inches of top surface of the module

4-16 Lane Interfaces



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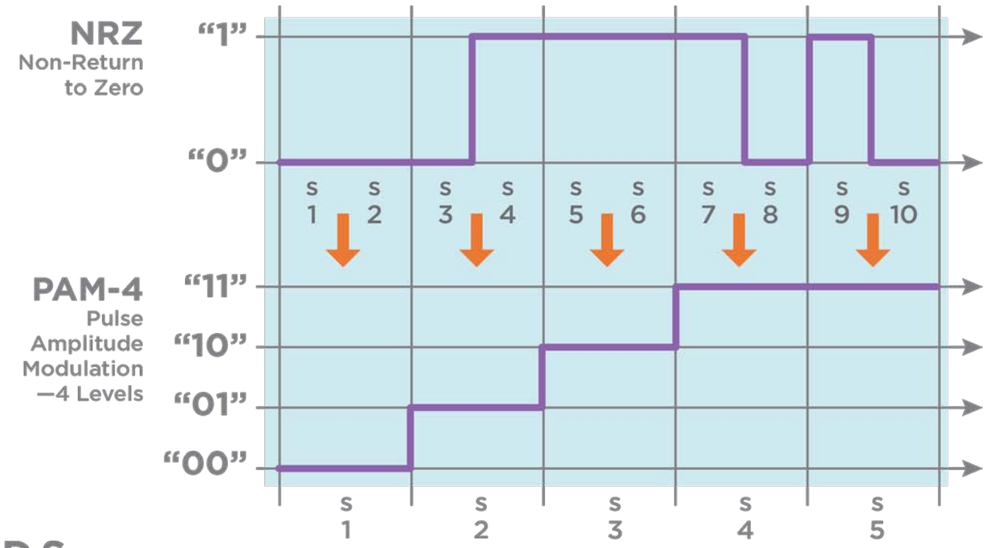
SIGNALING METHODS



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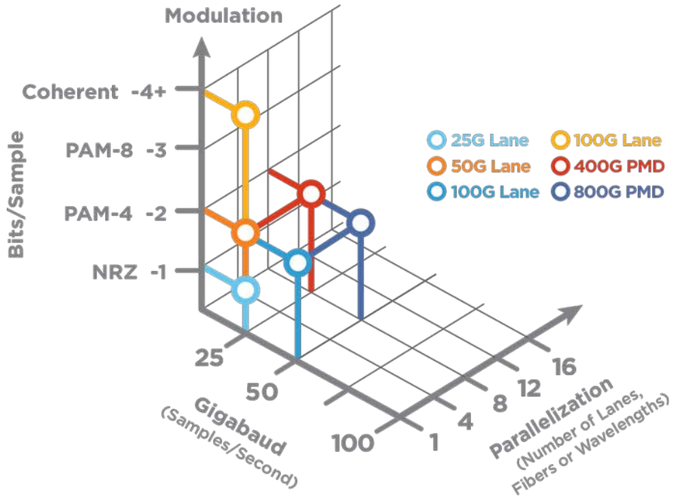
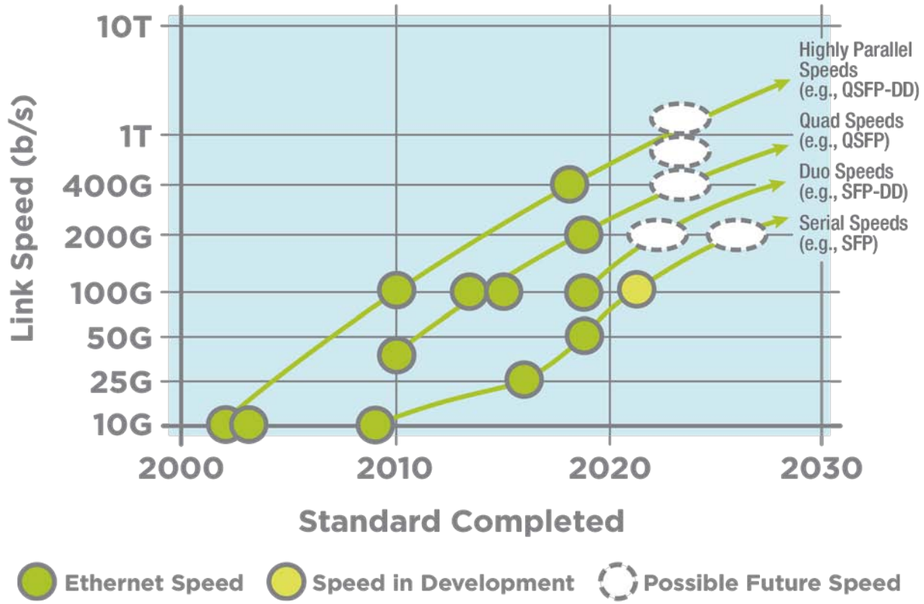
HOW TO GO FASTER



TO TERABIT SPEEDS



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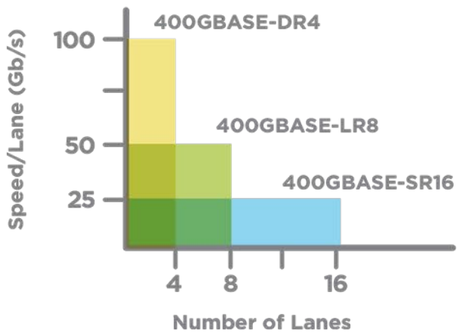
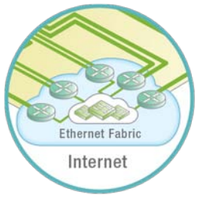
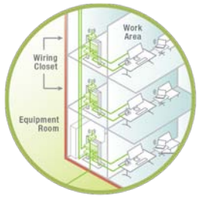
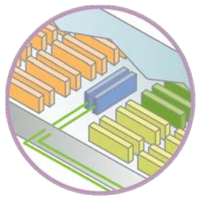


NEXT ETHERNET ERA ethernet alliance


Ethernet Fabric
Internet


Work Area
Wiring Closet
Equipment Room



Exit Text

Thank You