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Experience. Outcomes.

HKNOG
Hong Kong Network Operators' Group

25GE, 50GE, 400GE

What's With All These "New" Ethernet Rates?

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APAC CTO & Strategic Business Development

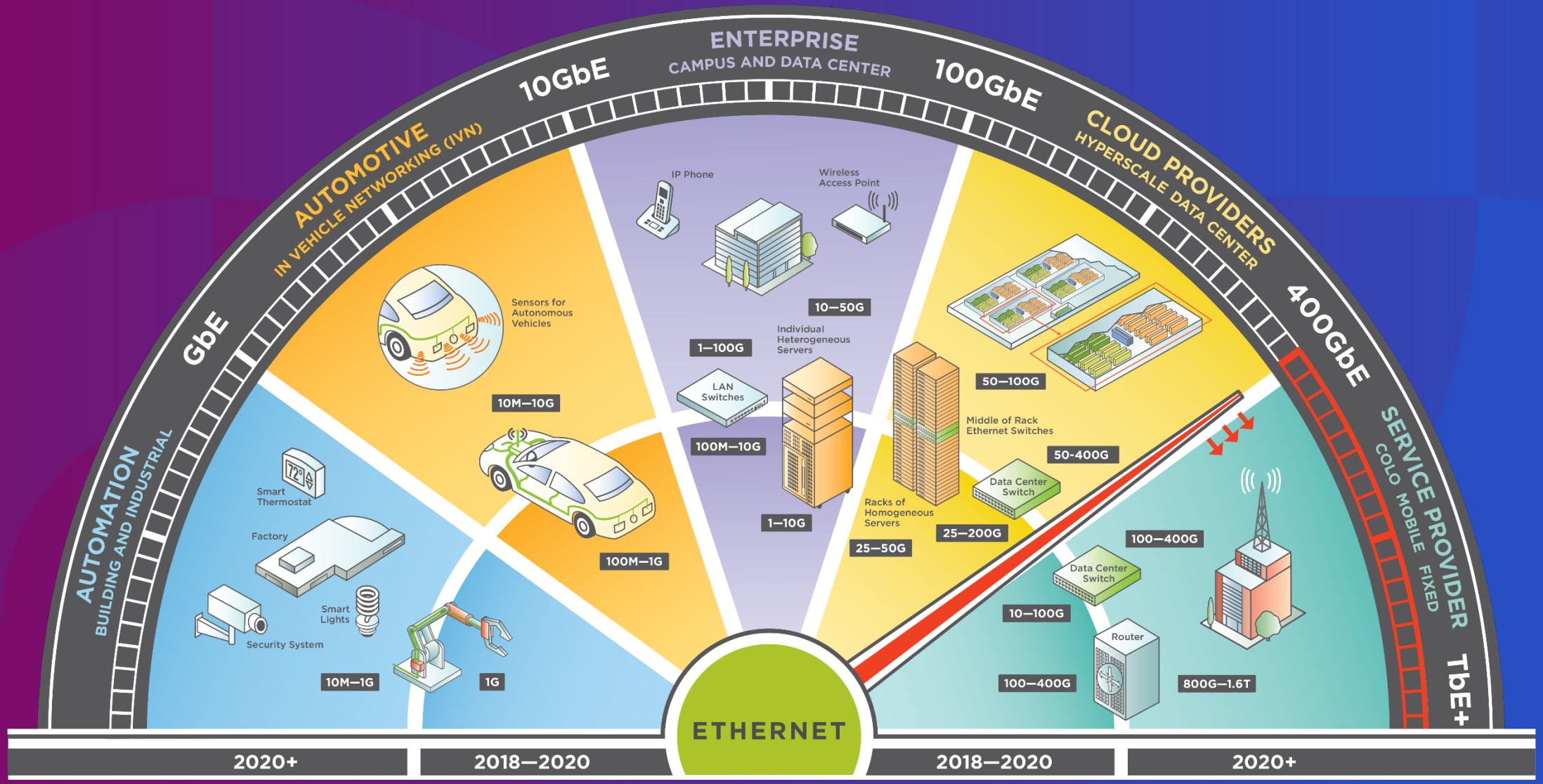
March 2019

AGENDA

1. Key Drivers for new Ethernet rates
2. Adapting to Optics
3. Where to Next?

About Us

Ever Expanding Applications Space for Ethernet



Source: Ethernet Alliance, 2018

Why “25 is the new 10…. 50 is the new 40”

1. **Performance**
   - Within Data Centres
     - Server performance grown well beyond single 10G interface
     - Storage getting faster thanks to SSDs
   - Within Metro WANs
     - Aggregation capacities moving from 10G → 100G… Driving Access points to evolve from 1G →10G, and 10G → 25G
2. **Costs**
     - Less expensive to use a single 25G interface than 2 x 10G or 1 x 40G (4 of 10G lanes)
     - Significantly reduce Ethernet switches required

“ 25G provides higher throughput through lane capacity expansion instead of lane aggregation

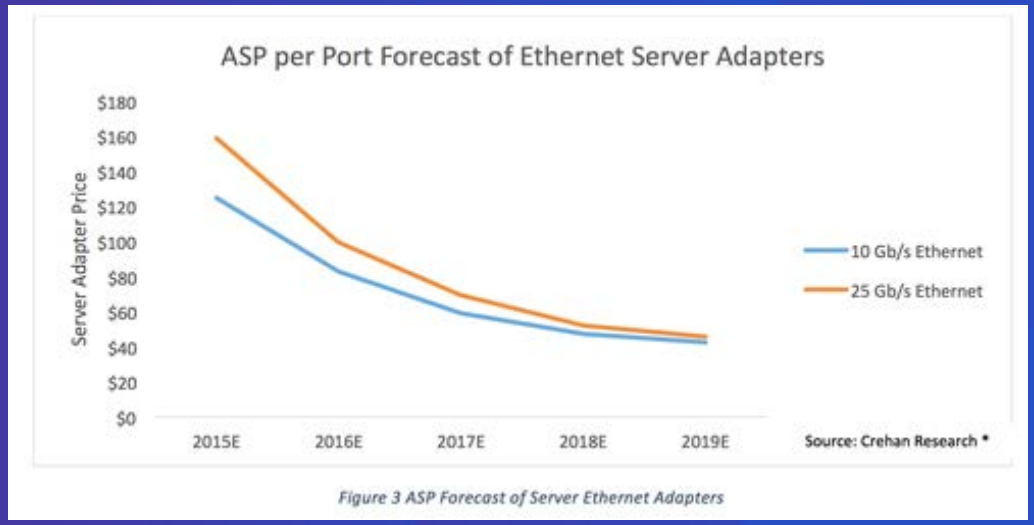


Figure 3 ASP Forecast of Server Ethernet Adapters

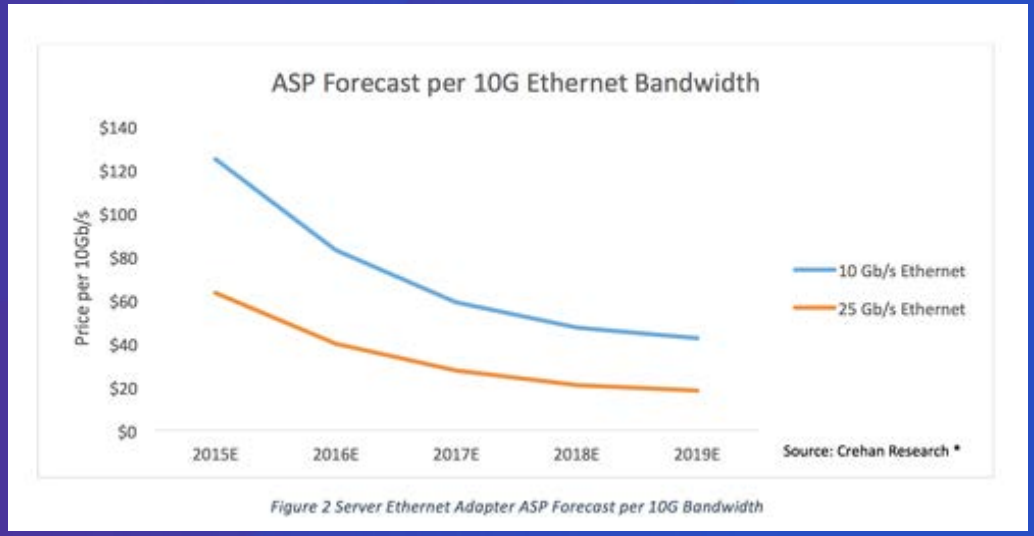
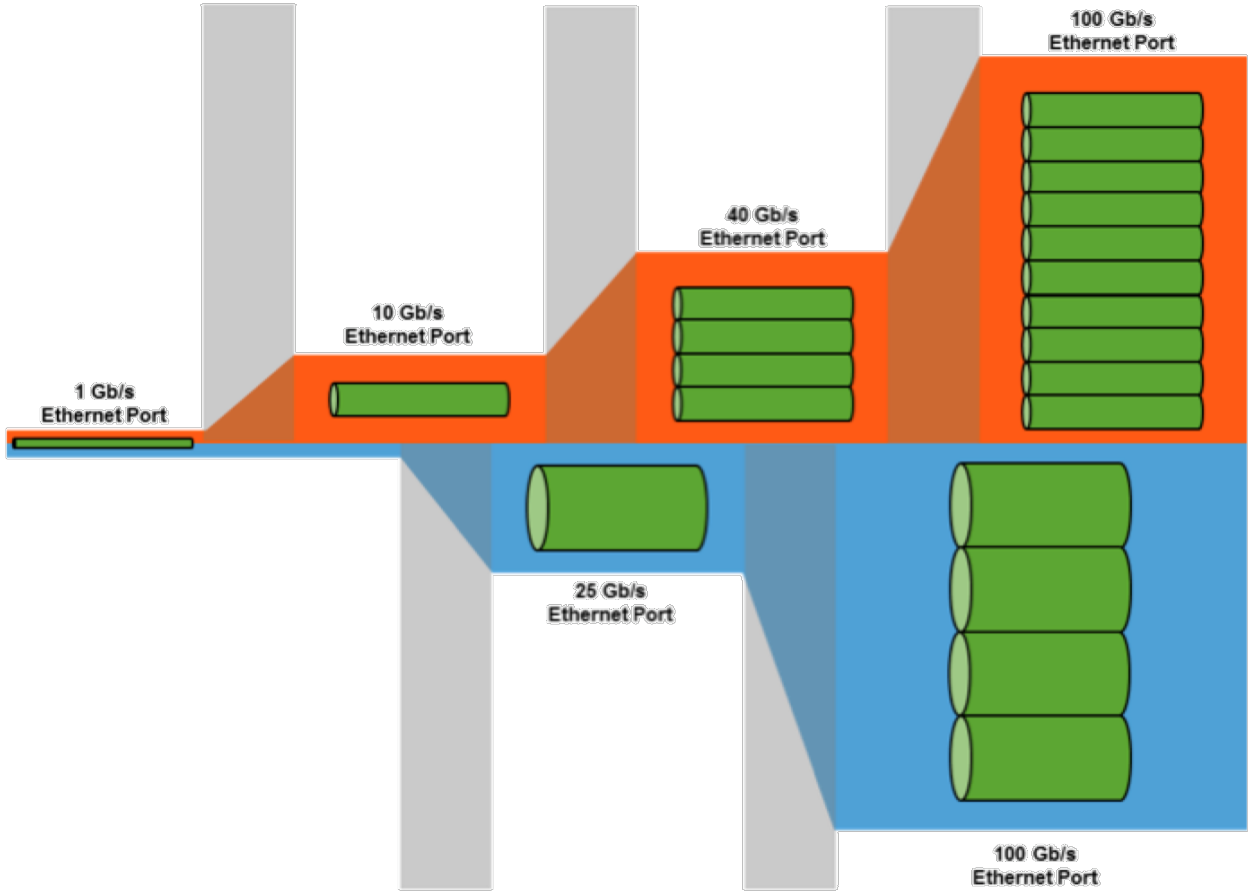


Figure 2 Server Ethernet Adapter ASP Forecast per 10G Bandwidth

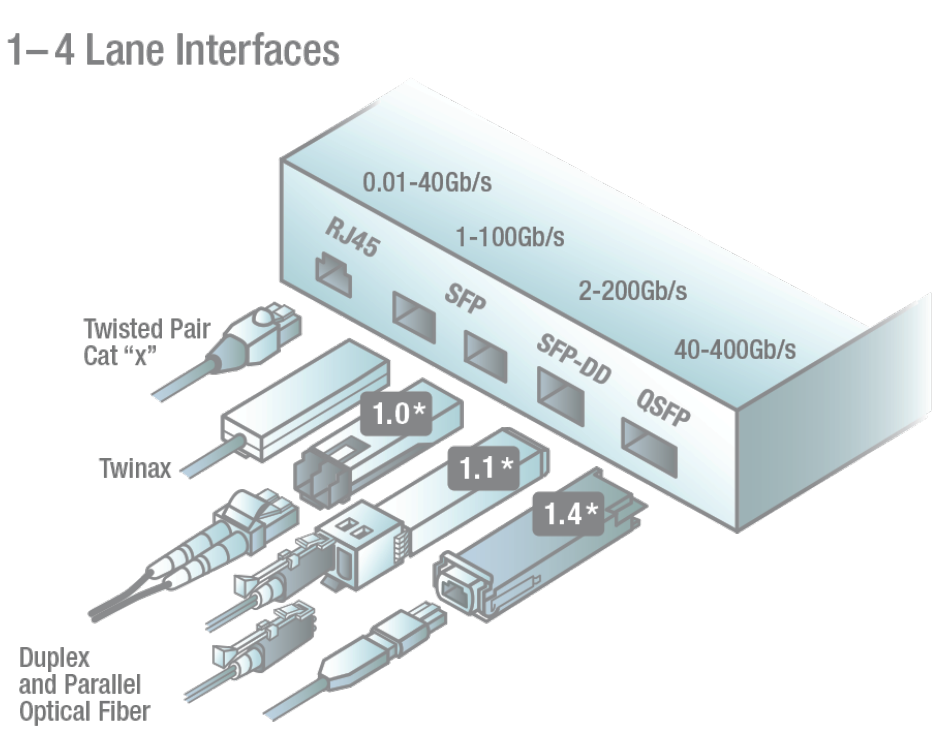
25G Ethernet Consortium

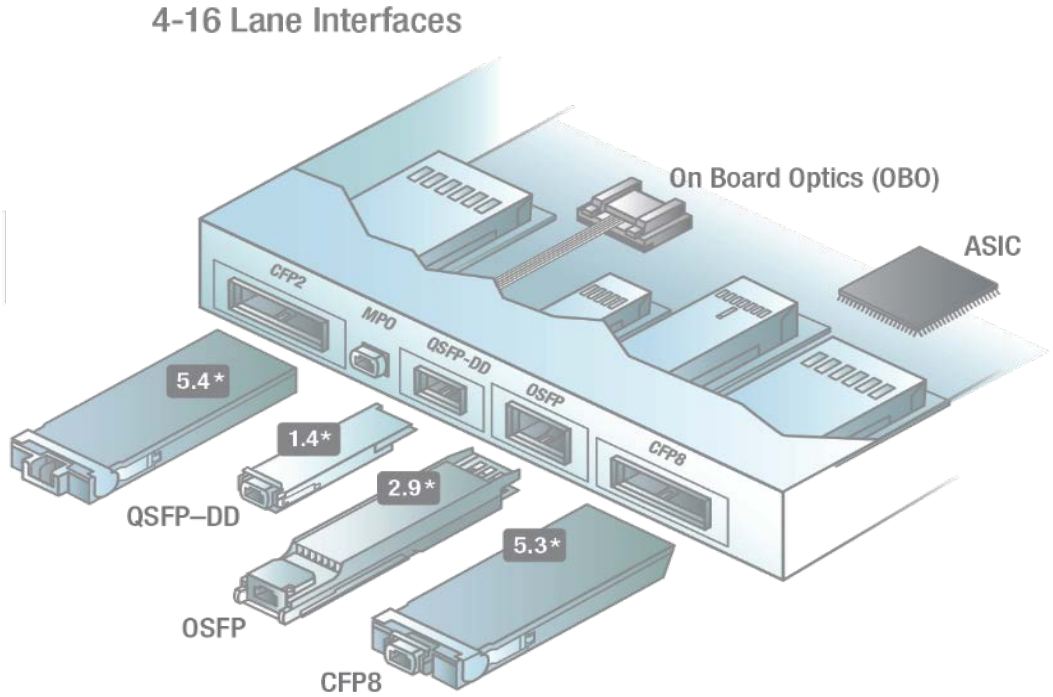
- **IEEE 802.3 Task Force formed in 2014**
  - To support the specification of single-lane **25-Gbit/s Ethernet** and dual-lane **50-Gbit/s Ethernet** technology
  - Specification draft was completed in September 2015

- **The IEEE 802.3by (25Gb/s) standard**
  - Uses technology defined for 100 Gigabit Ethernet implemented as four 25-Gbit/s lanes (IEEE 802.3bj)
  - The IEEE 802.3by standard several single-lane variations



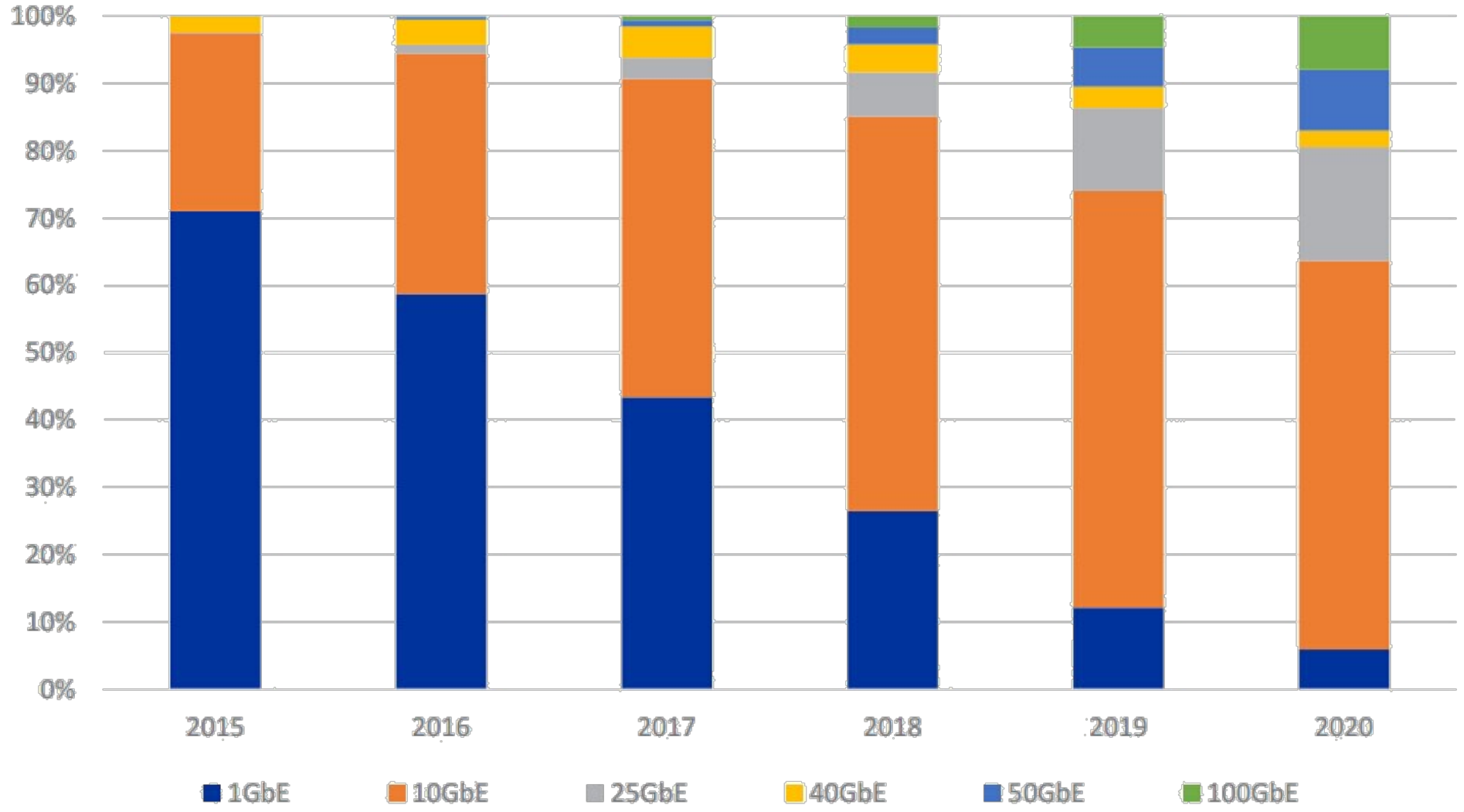
Evolving Ethernet Interface Plug Form Factors





Source: Ethernet Alliance, 2018

Expected Market Uptake



Source: IEEE ComSoc, 2018

Evolving to an End-End Programmable Infrastructure for Efficiencies and Agility

Flexible services

Flexible client/gray interfaces **(FlexE)**

Flexible transport (ROADM,OTR, POTS, FlexO)

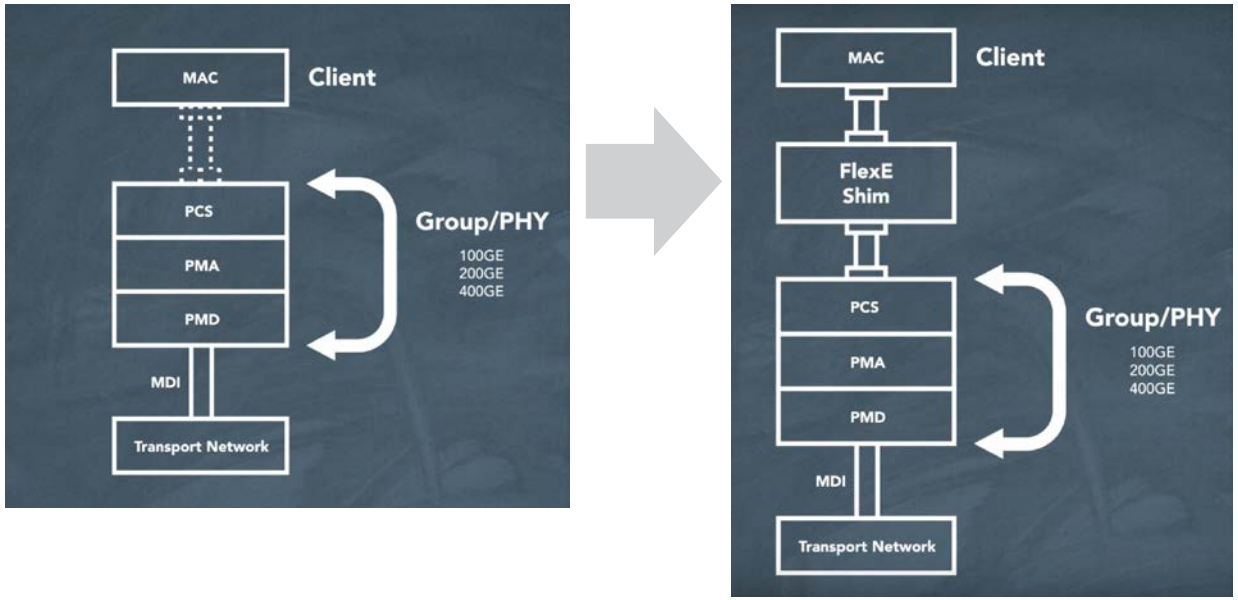
Flexible DWDM line interfaces (Flexible grid)

Programmable Infrastructure

The Industry is moving to **flexible rate transport** for network efficiency, spectrum optimization & cloud consumption model

What is Flex Ethernet (FlexE)?

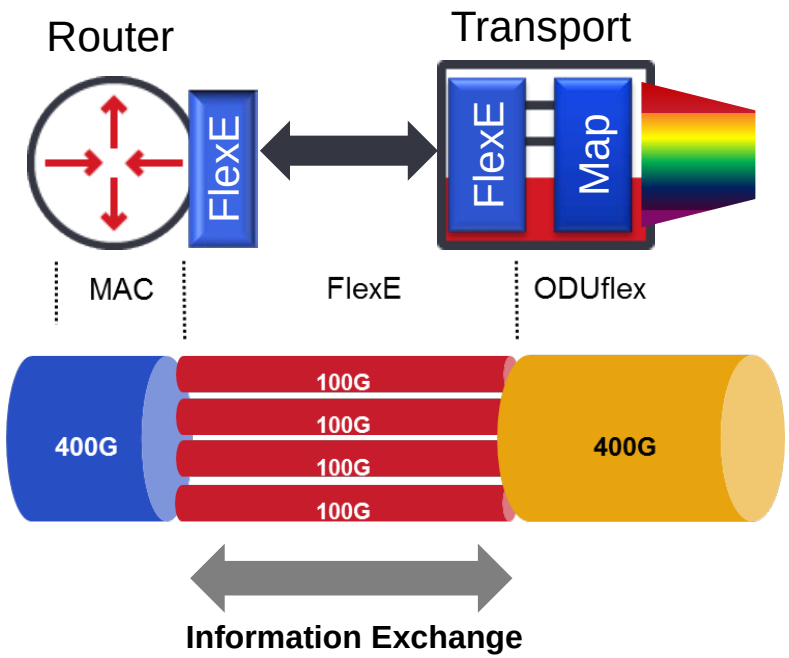
- **FlexE is an OIF Implementation Agreement**
  - OIF-FLEXE-01.0, 2.0
- **FlexE provides a generic mechanism for supporting a variety of Ethernet MAC rates**
  - 10G, 40G, nx25G from physical interfaces that may or may not correspond to any existing Ethernet PHY rate
- **Introduces a new TDM frame structure to the existing IEEE defined PCS**
  - New shim between the Ethernet MAC/RS and PCS
  - Enhances current Ethernet “Layer 1” capabilities
  - Using existing 66b and ordered set structures from the Ethernet PCS



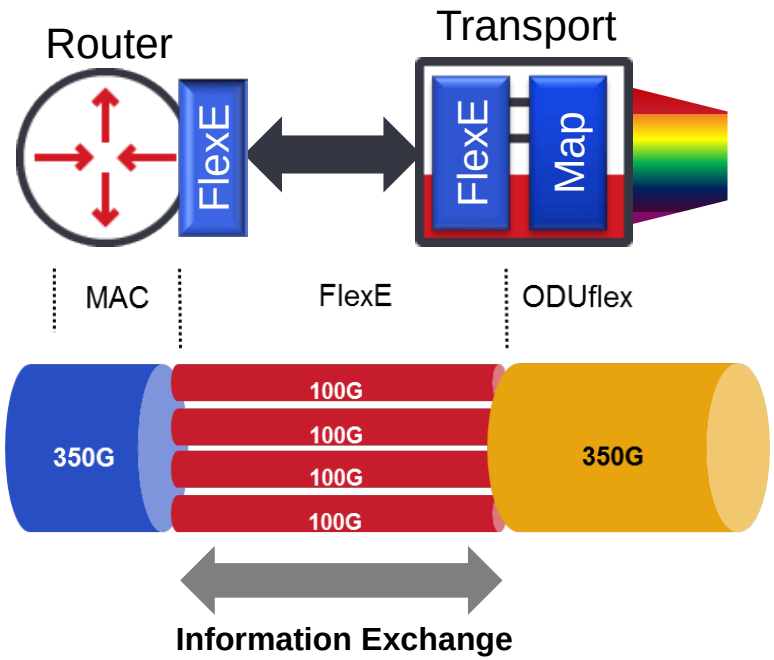
- **Current FlexE proposals for using IEEE standard client rates**
  - 10G, 25G, 40G, 100G, 200G (future), 400G (future)
- **Current FlexE proposals for supported group rates**
  - 100G, 200G (future), 400G (future)

FlexE Application Use Case Examples

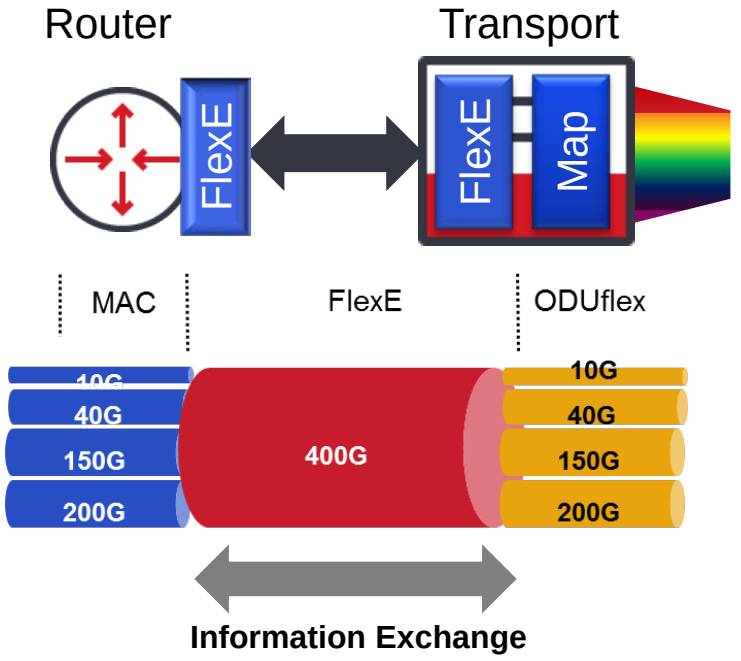
Bonding



Sub-Rating

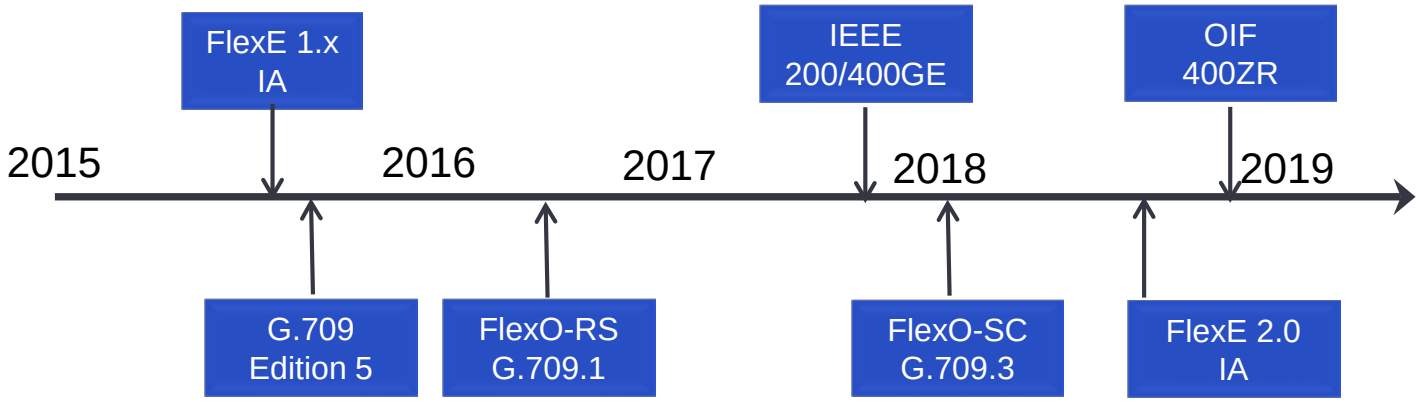


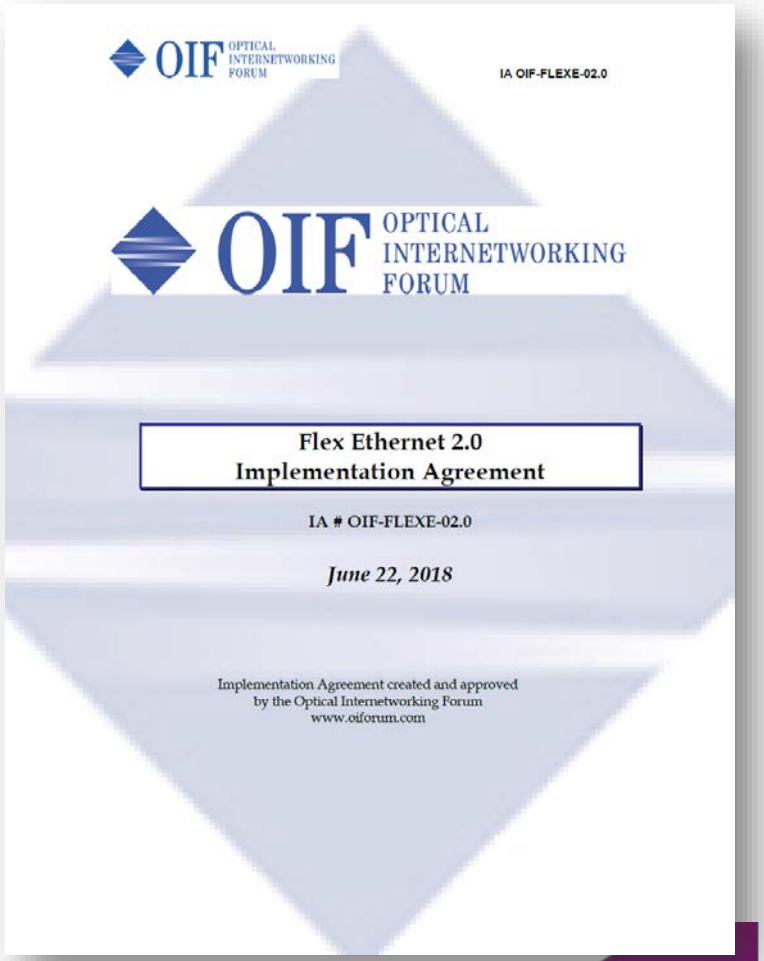
Channelization



Standards Status

- **OIF FlexE IA**
  - IA 1.0 completed Jan 2016
  - IA 2.0 completed June 2018
  - IA 2.1 launched Dec 2018





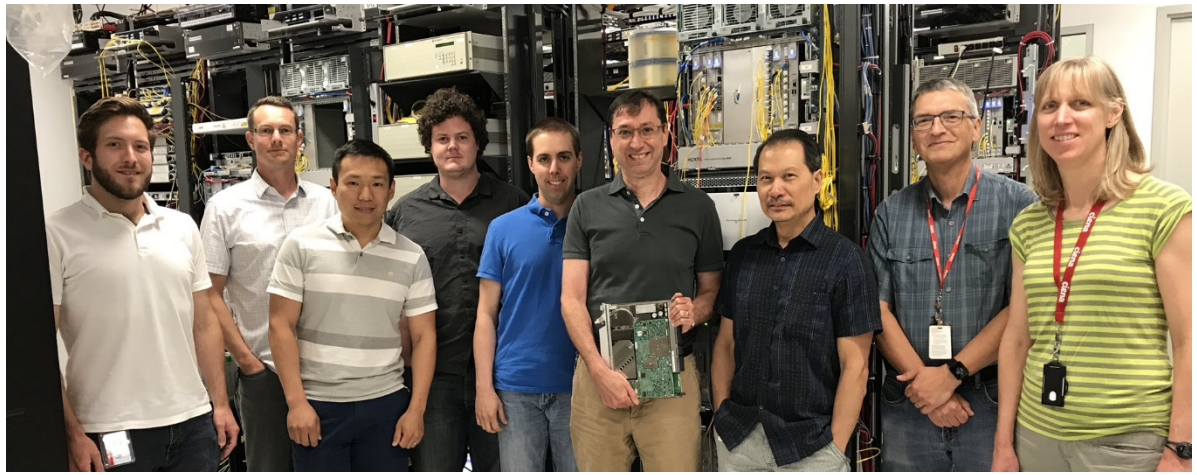
Ciena & 400GE in the Real-World

"Introducing **400GbE** is a natural next step. Customer demands have shifted to faster speeds, more video-centric content and cloud integration

-- Roman Pacewicz, chief product officer, AT&T Business.

8 September 2017

Ciena R&D Team with the Industry's first 400GbE Transponder



DALLAS, September 08, 2017

share

AT&T Completes Industry-Leading 400 Gb Ethernet Testing, Establishing A Future Network Blueprint for Service Providers and Businesses

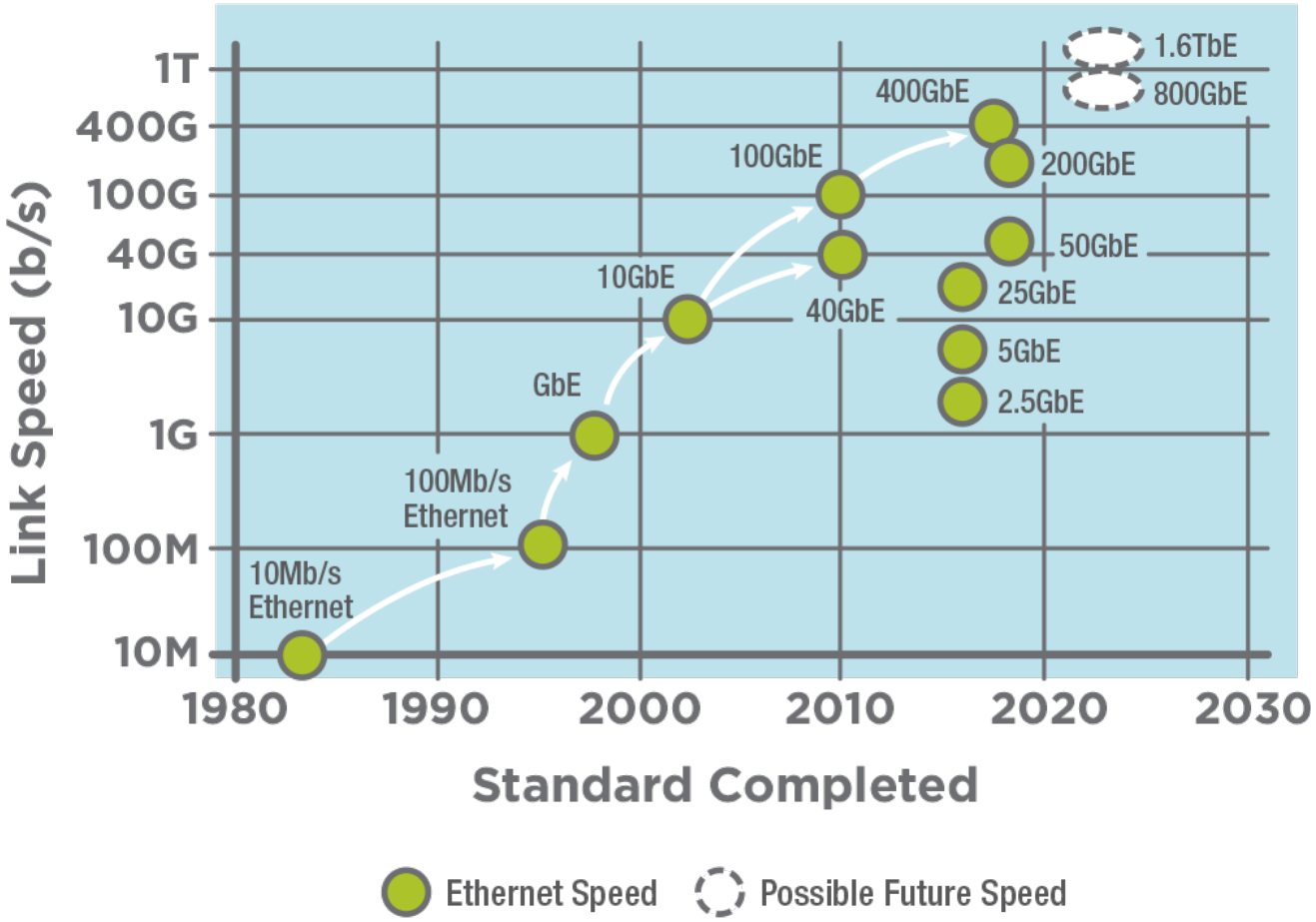
Aligned with IEEE's Anticipated Ratification of the New 400 Gb Ethernet Industry Standard

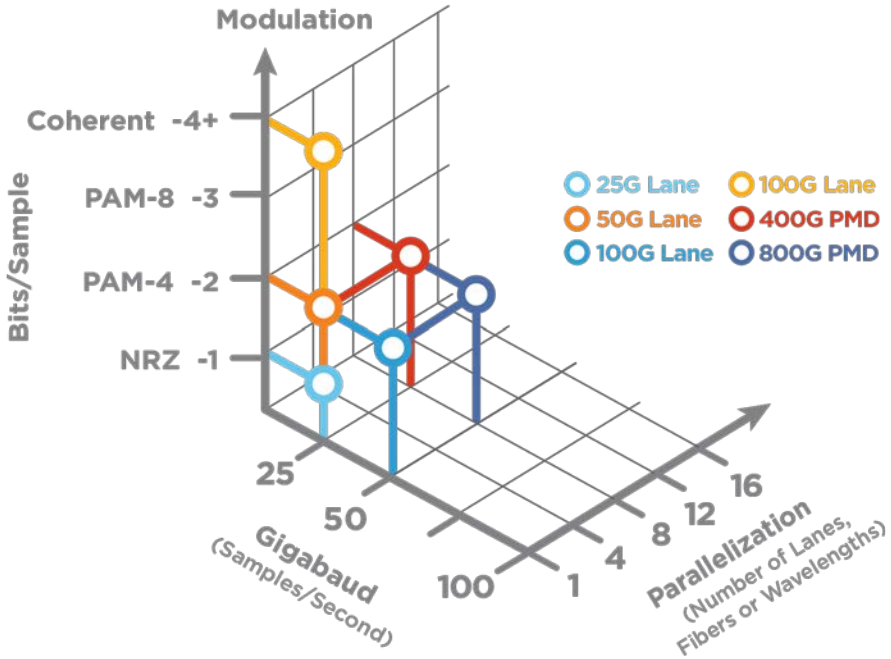
AT&T* successfully completed testing a single-wavelength 400 gigabit Ethernet (GbE) data speed across its production network. This was the final phase of our multi-step trial. This trial of an IEEE standards-based 400 GbE end-to-end circuit demonstrates our intent to lead the industry in providing next-generation speeds – helping transform the way our customers do business.

"Introducing 400 GbE is a natural next step. Customer demands have shifted to faster speeds, more video-centric content and cloud integration," said Roman Pacewicz, chief product officer, AT&T Business. "We consistently provide top-quality services to businesses and are proud to pave the way for this industry innovation."

...

Where to Next?





Source: Ethernet Alliance, 2018

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