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Ethernet Alliance Technology Roadmap

The Roadmap Subcommittee
Version 3.0

Disclaimer

The views expressed in this presentation are the views of the Roadmap Subcommittee and the Ethernet Alliance.

Agenda

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- Speeds, Media and Distance
- BASE-T Speedmap
- Access Roadmap
- PoE Roadmap
- Backplane Roadmap
- 40GbE Roadmap
- 100GbE Roadmap

Media Types

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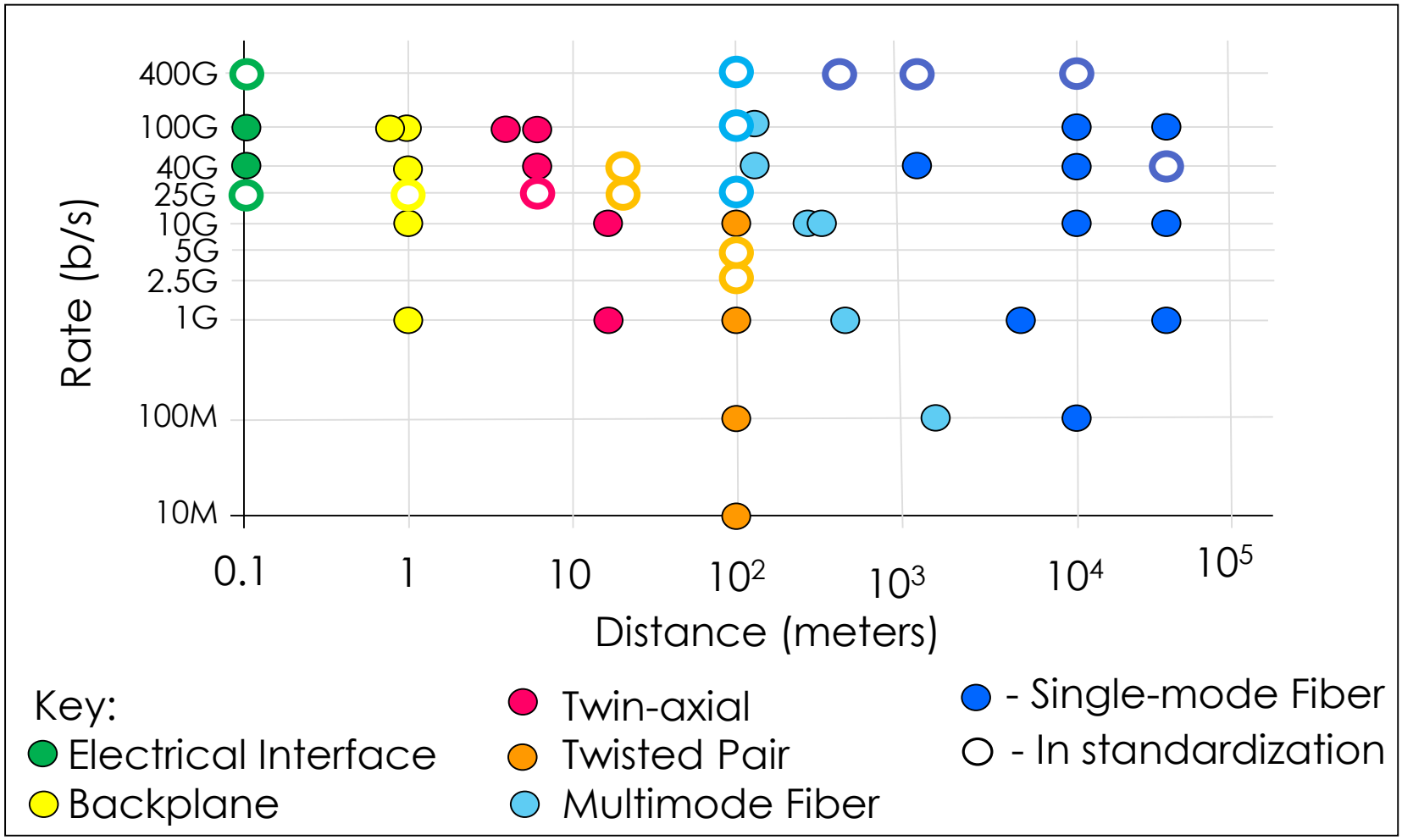
- Ethernet operates over a number of technologies defined by IEEE 802.3 including:
  - Backplanes
  - Copper cables
  - Multimode fiber
  - Single-mode fiber
- The roadmaps, reach and speed for each of these technologies is different and will be discussed in this presentation

Distance vs Speed



*This is for traditional applications of Ethernet (enterprises, data centers, etc.) but not all emerging applications.

Ethernet Speedmap

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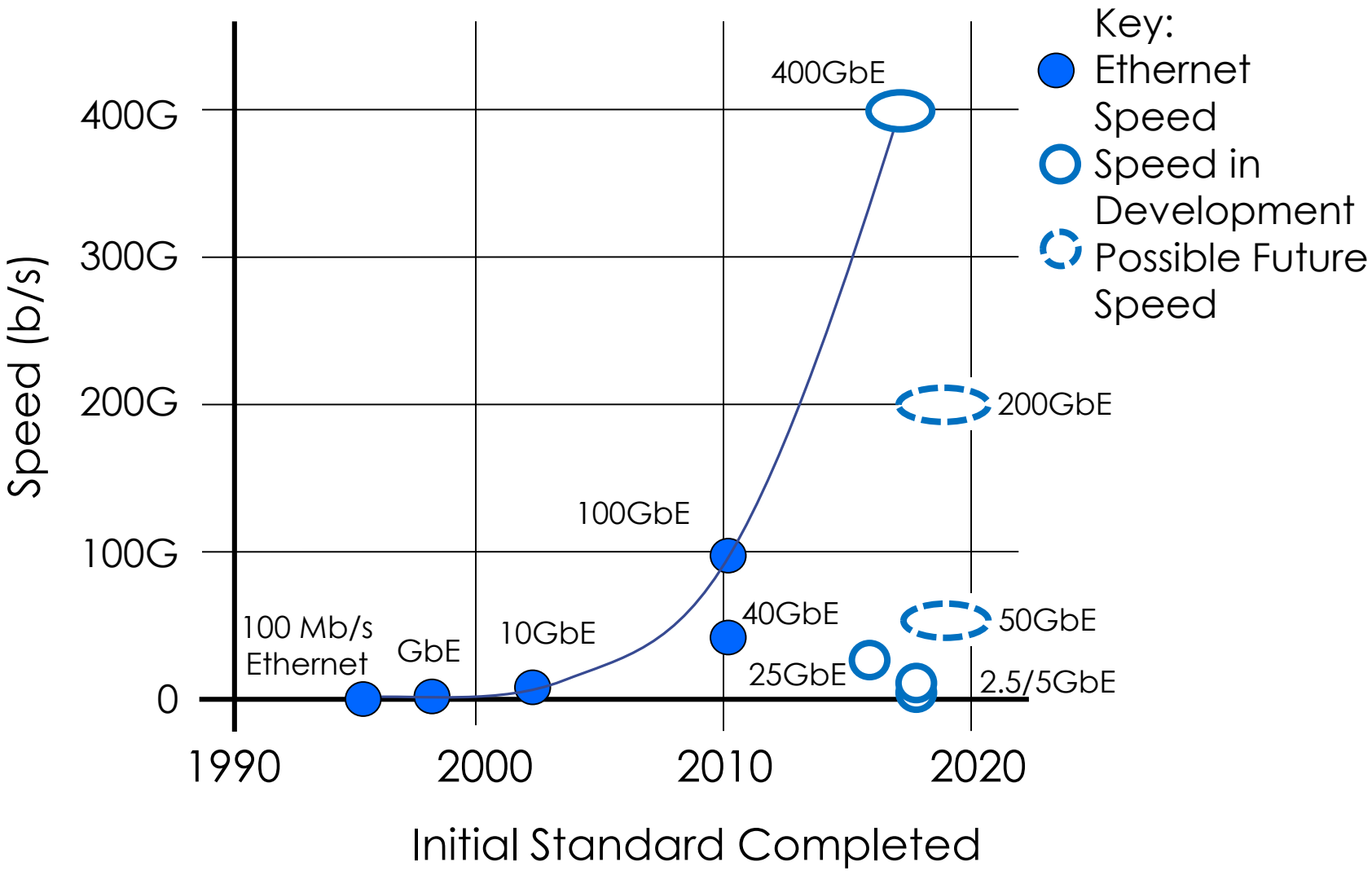
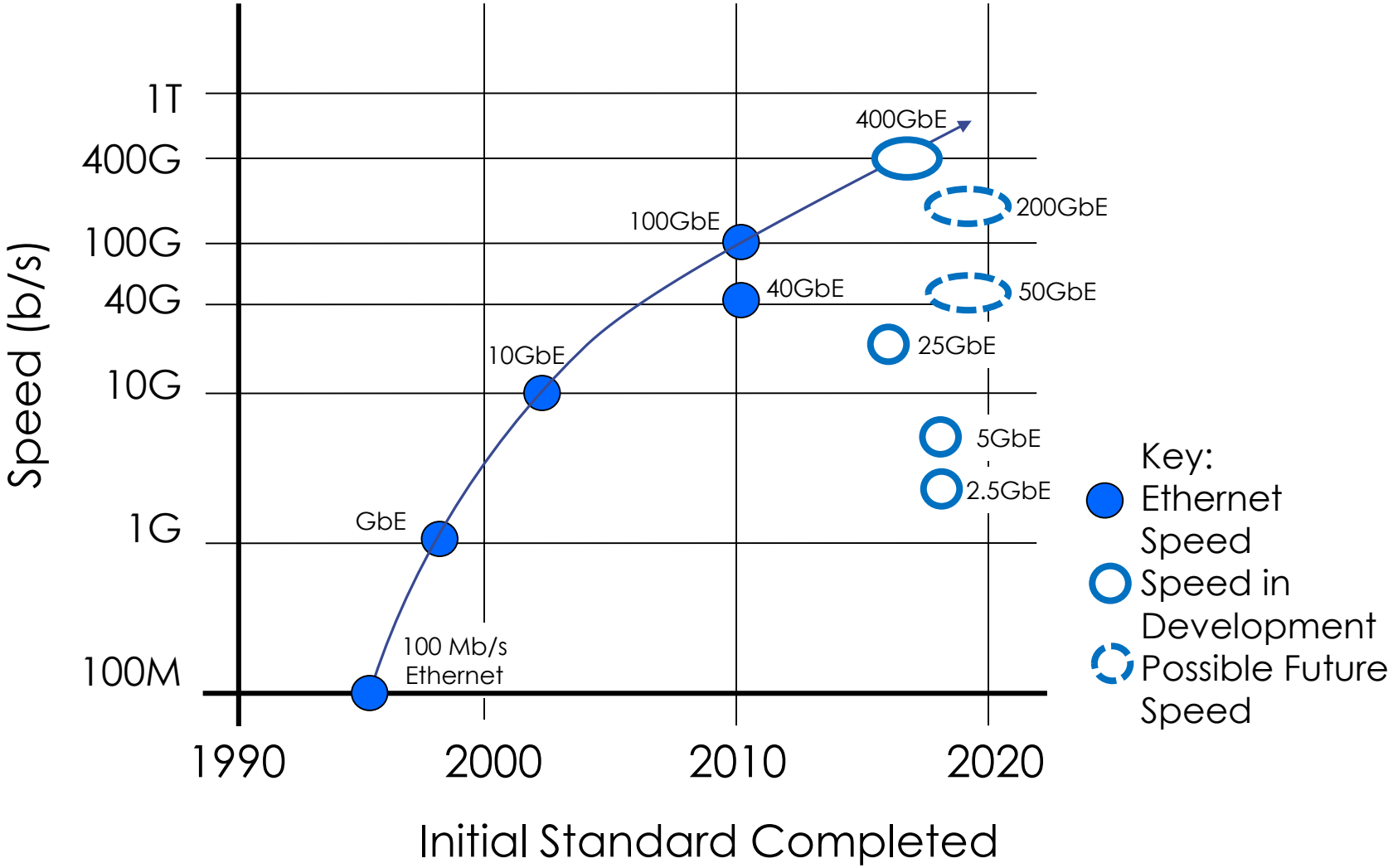
Name	Date Initial Standard Ratified
10Mb/s Ethernet	1983
100Mb/s Ethernet	1995
Gigabit Ethernet	1998
2.5 Gigabit Ethernet	2017 (est)***
5 Gigabit Ethernet	2017 (est)***
10 Gigabit Ethernet	2002
25 Gigabit Ethernet	2016 (est)*
40 Gigabit Ethernet	2010
50 Gigabit Ethernet	2018-2020(est)^
100 Gigabit Ethernet	2010
200 Gigabit Ethernet	2018-2020(est)^
400 Gigabit Ethernet	2017 (est)**

*Estimated on a 2-year standardization process that started with the CFI in July 2014
**Estimated on a 4-year standardization process that started with the CFI in March 2013
***Estimated on a 3-year standardization process that started with the CFI in November 2014
^ Estimates for a possible standardization process that starts with CFI in 2015 or 2016

Ethernet Speeds - Linear



Ethernet Speeds – Log



BASE-T Speedmap

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Name	Reach	Twisted Pair Medium	Date Standard Ratified
10BASE-T	100 m	Cat 3	1990
100BASE-TX	100 m	Cat 5	1995
1000BASE-T	100 m	Cat 5e	1999
2.5GBASE-T	100m	Cat 5e	2016 (est)**
5GBASE-T	100m	Cat 5e/6?	2016(est)**
10GBASE-T	100 m	Cat 6_A	2006
25GBASE-T	30m	Cat 8	2016 (est)*
40GBASE-T	30 m	Cat 8	2016 (est.)*

*Estimated on a 3-year standardization process that started with the CFI in March 2013 and Task Force schedule
**Estimated on a 2-year standardization process that started with the CFI in November 2014

Access Roadmap

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- This chart shows the various speeds of Access technology that needs to be confirmed by the Access Networks Subcommittee

Name	Speed	Date Standard Ratified
GEPON	1 Gb/s	2004
10GEPON	10 Gb/s symmetric 10 Gb/s & 1 Gb/s asymmetric	2009
Extended EPON	1 Gb/s 10 Gb/s symmetric 10 Gb/s & 1 Gb/s asymmetric	2013
EPoC	up to 10 Gb/s	2015 (est.)

* Red text means the standard is in development

PoE Roadmap

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Name	Power from Power Sourcing Equipment (PSE)	Date Standard Ratified
PoE	15.4W	2003
PoE+	30W	2009
4 Pair PoE	60-99W	2015 (est.)
1 Pair Power over Data Lines	TBD	2015 (est.)

Name	Power at Powered Device (PD)	Date Standard Ratified
PoE	13W	2003
PoE+	25.5W	2009
4 Pair PoE	<60-99W	2015 (est.)
1 Pair Power over Data Lines	TBD	2015 (est.)

* Red text means the standard is in development

Backplane Roadmap

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PMD Name	Reach or Loss Budget	# of Lanes	Date Standard Ratified
1000BASE-KX	1 m	1	2007
10GBASE-KX4	1m	4	2007
10GBASE-KR	1 m	1	2007
25GBASE-KR	35dB @ 12.9GHz	1	2016 (est.)*
40GBASE-KR4	1m	4	2010
100GBASE-KR4	35dB @ 12.9GHz	4	2014
100GBASE-KP4	33dB @ 7GHz	4	2014

*Estimated on a 2-year standardization process that started with the CFI in July 2014

40GbE Port Roadmap

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- Physical Medium Dependent Sublayers for 40GbE

PMD Name	Electrical Interface to Optical Module	Reach	Medium	Date Standard Ratified
40GBASE-CR4	Not Applicable	7 m	Twinax	2010
40GBASE-SR4	XLAUI / XLPPI	100/150 m	OM3/OM4	2010
40GBASE-LR4	XLAUI / XLPPI	10 km	OS1/OS2	2010
40GBASE-FR	XLAUI	2 km	OS1/OS2	2011
40GBASE-ER4	XLAUI	40 km	OS1/OS2	2015 (est.)
40GBASE-T	Not Applicable	30 m	Cat 8	2016 (est.)

* Red text means the standard is in development

100GbE Port Roadmap

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- Physical Medium Dependent Sublayers for 100GbE

PMD Name	Electrical Interface to Optical Module	Reach	Medium	Date Standard Ratified
100GBASE-CR10	N/A	7 m	Twinax	2010
100GBASE-SR10	CAUI-10	100/150 m	OM3/OM4	2010
100GBASE-LR4	CAUI-10	10 km	OS1/OS2	2010
100GBASE-ER4	CAUI-10	40 km	OS1/OS2	2010
100GBASE-CR4	N/A	5 m	Twinax	2014
100GBASE-SR4	CAUI-4	70/100 m	OM3/OM4	2015 (est.)
100GBASE-LR4	CAUI-4	10 km	OS1/OS2	2015 (est.)

400GbE Reach Objectives

The 400GbE Task Force has the following reach objectives that are subject to Working Group Approval:

- At least 100 m over MMF
- At least 500 m over SMF
- At least 2 km over SMF
- At least 10km over SMF

- For information on IEEE 802.3 projects, visit:

http://www.ieee802.org/3/

Summary

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- Ethernet continues to improve with new standards and products that expand the Ethernet ecosystem
- Market demands are diversifying and new standards will be developed as they are needed
  - 2.5/5/25/40GBASE-T
  - 25GbE
  - 50GbE/200GbE
  - 400GbE
- The Ethernet Alliance helps them progress