

Ethernet Alliance Technology Exploration Forum 2014 “The Rate Debate”



Session 1: Data Center Speeds
Ethernet Alliance Roadmap Introduction
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Roadmap Subcommittee Vice-Chair
President of Ethernet Alliance

October 16, 2013



This presentation has been developed within the Ethernet Alliance, and is intended to educate and promote the exchange of information. Opinions expressed during this presentation are the views of the presenters, and should not be considered the views or positions of the Ethernet Alliance



Ethernet Alliance Roadmap

Find more at:

www.ethernetalliance.org/subcommittees/roadmapping-subcommittee/

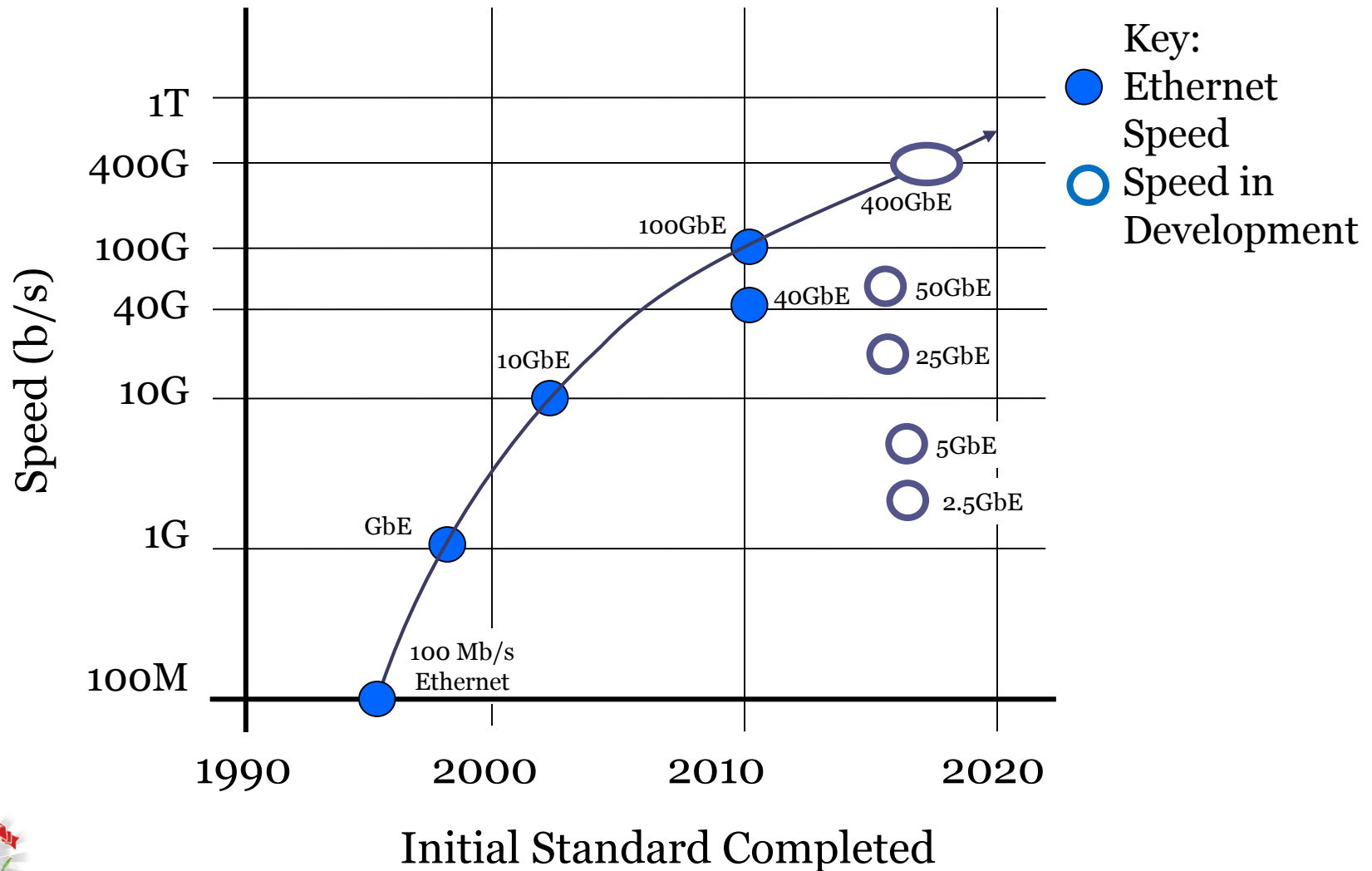
| Name | Speed | Date Initial Standard Ratified |
|----------------------|----------|--------------------------------|
| 10Mb/s Ethernet | 10 Mb/s | 1983 |
| 100Mb/s Ethernet | 100Mb/s | 1995 |
| Gigabit Ethernet | 1 Gb/s | 1998 |
| 10 Gigabit Ethernet | 10 Gb/s | 2002 |
| 25 Gigabit Ethernet | 25Gb/s | 2016 (est)* |
| 40 Gigabit Ethernet | 40 Gb/s | 2010 |
| 100 Gigabit Ethernet | 100 Gb/s | 2010 |
| 400 Gigabit Ethernet | 400 Gb/s | 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

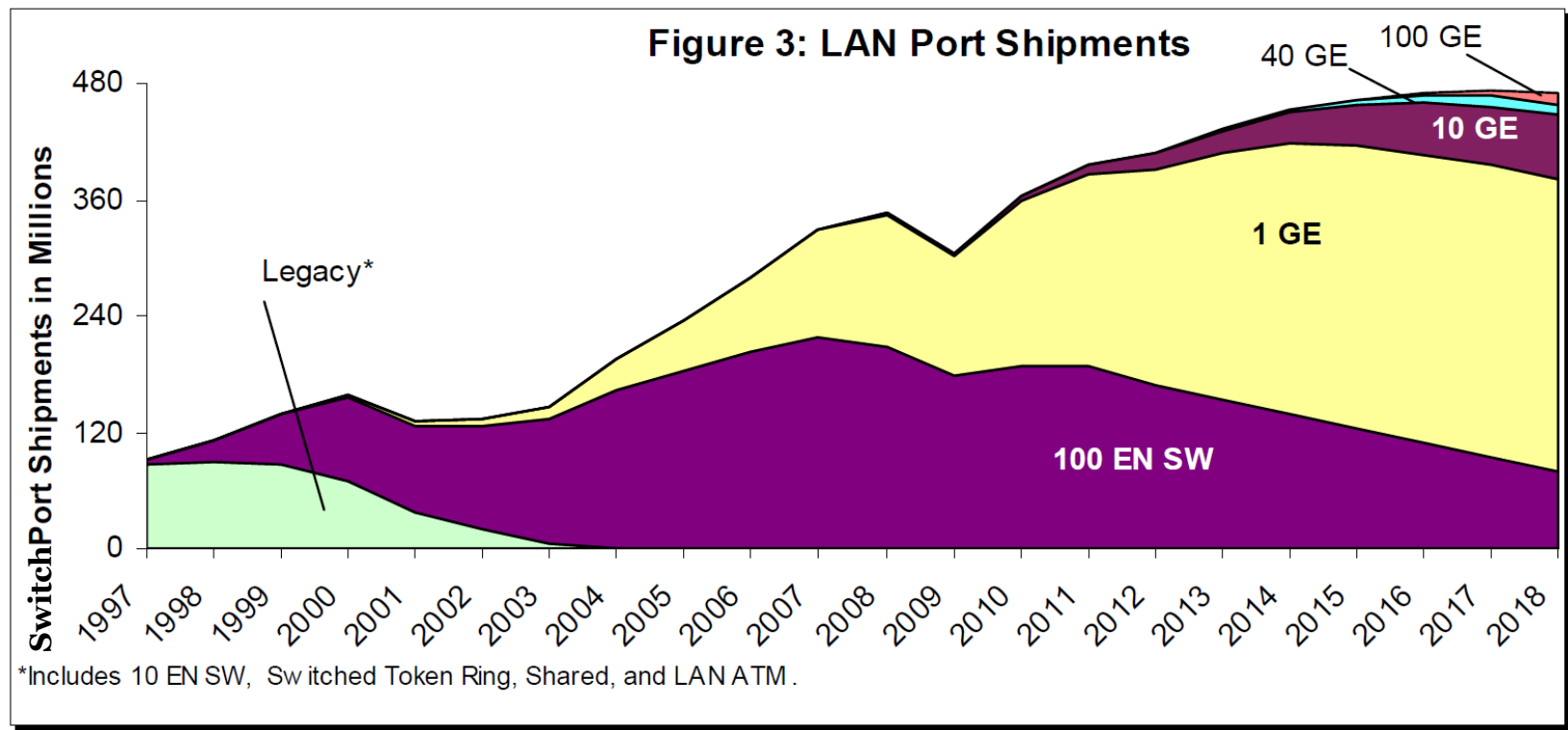


Ethernet Speeds - Log



Switch Ports Shipped

Low cost connectivity more important than speed for most applications (PCs, Voice over IP phones, cameras)



Source: Dell'Oro Ethernet Switch Layer 2+3 Report, July 2014



>1B Ports Shipped in 2014!

Over **7 Billion Ethernet** ports shipped in last decade!

| | Ethernet Switch Ports ¹ | Router Ports ² | Controllers and Adapters ³ | PoE Devices ⁴ | Access Ports ⁵ | Total |
|-------------|------------------------------------|---------------------------|---------------------------------------|--------------------------|---------------------------|-------------|
| 2004 | 195M | 1.2M | 110M* | 8.9M | 62M | 377M |
| 2014 | 452M | 1.8M | 294M | 98M | 129M | 974M |

Probably another 100M ports on widgets, TVs and other equipment in 2014.

With Internet of things and vehicular applications expected to ship 100s of Millions of ports by the end of the decade, Ethernet will surpass **1.5B Ports/year** by 2020.

1. Dell'Oro Ethernet Switch Layer 2+3 Report, July 2014
2. Dell'Oro Routers Report, July 2014
3. Dell'Oro Controller and Adapter Report, January 2012
4. Based on PoE switch ports from Dell'Oro Ethernet Switch Layer 2+3 Report, July 2014
5. Dell'Oro Access Five Year Forecast, July 2014

* 2006 values since 2004 values weren't available

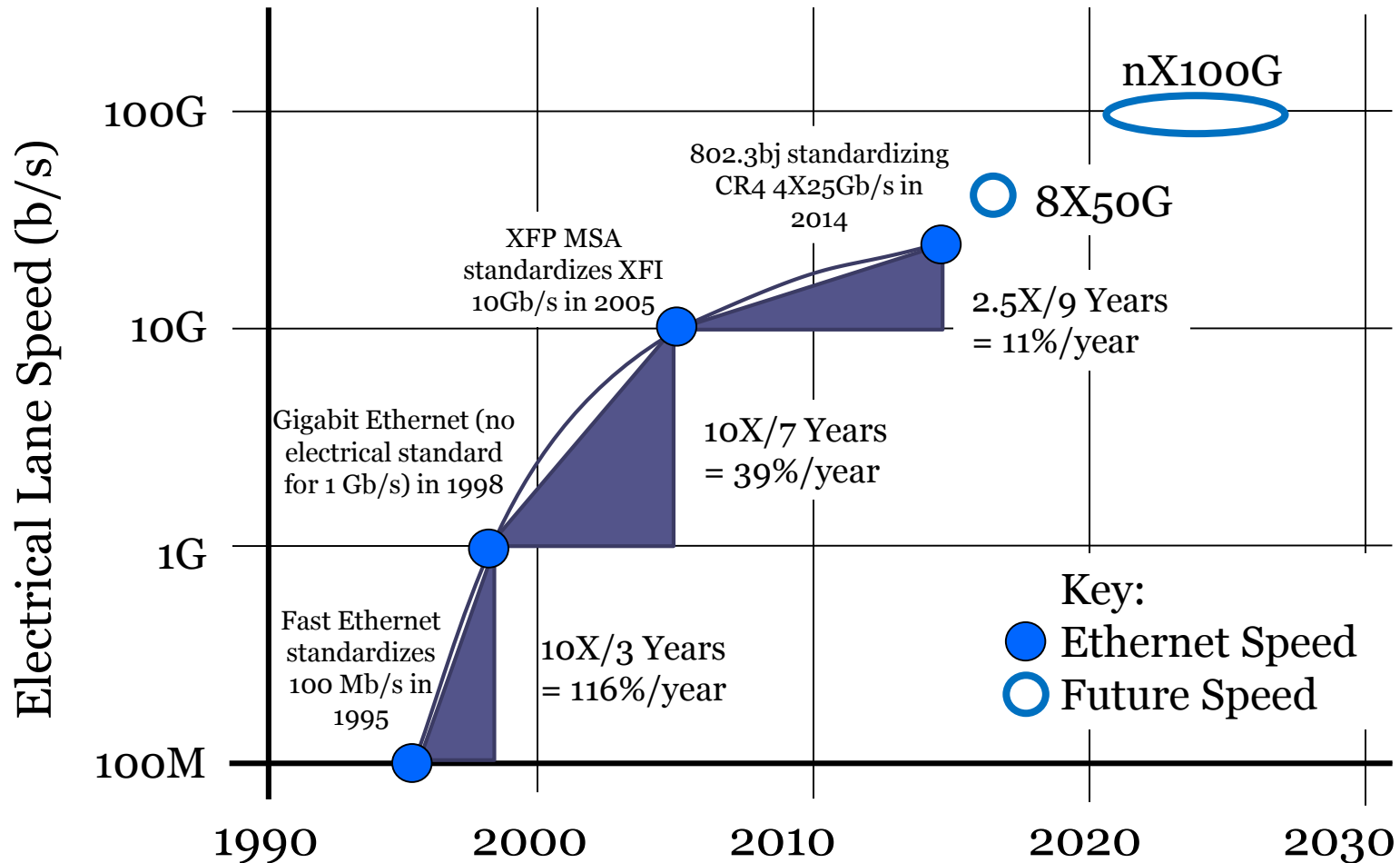


Why Lower Speeds?

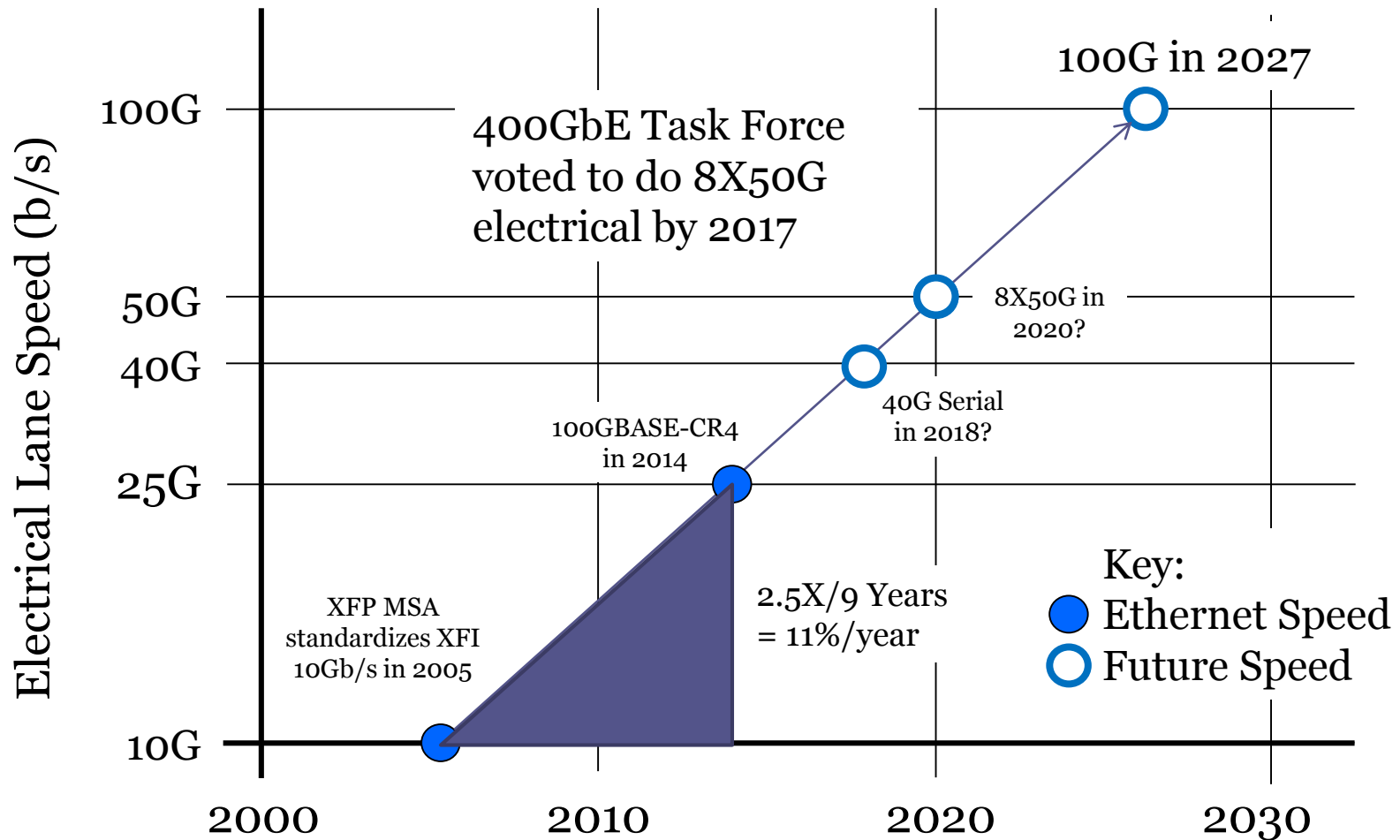
- Installed base of CAT5E cabling in campus driving 2.5/5GBASE-T with new applications
 - 10GBASE-T doesn't support 100m of CAT5E
- Low cost/bit of SFP+ compared to QSFP+
 - Serial lanes lower cost than parallel lanes
 - 1X40GbE SFP+ should deliver good bandwidth/\$ compared with 40GbE QSFP+ (4X10G)
- 40GBASE-T looks very challenging, but 25GBASE-T looks easier
- 100GbE still prohibitively expensive for many users

Electrical Interface Speeds

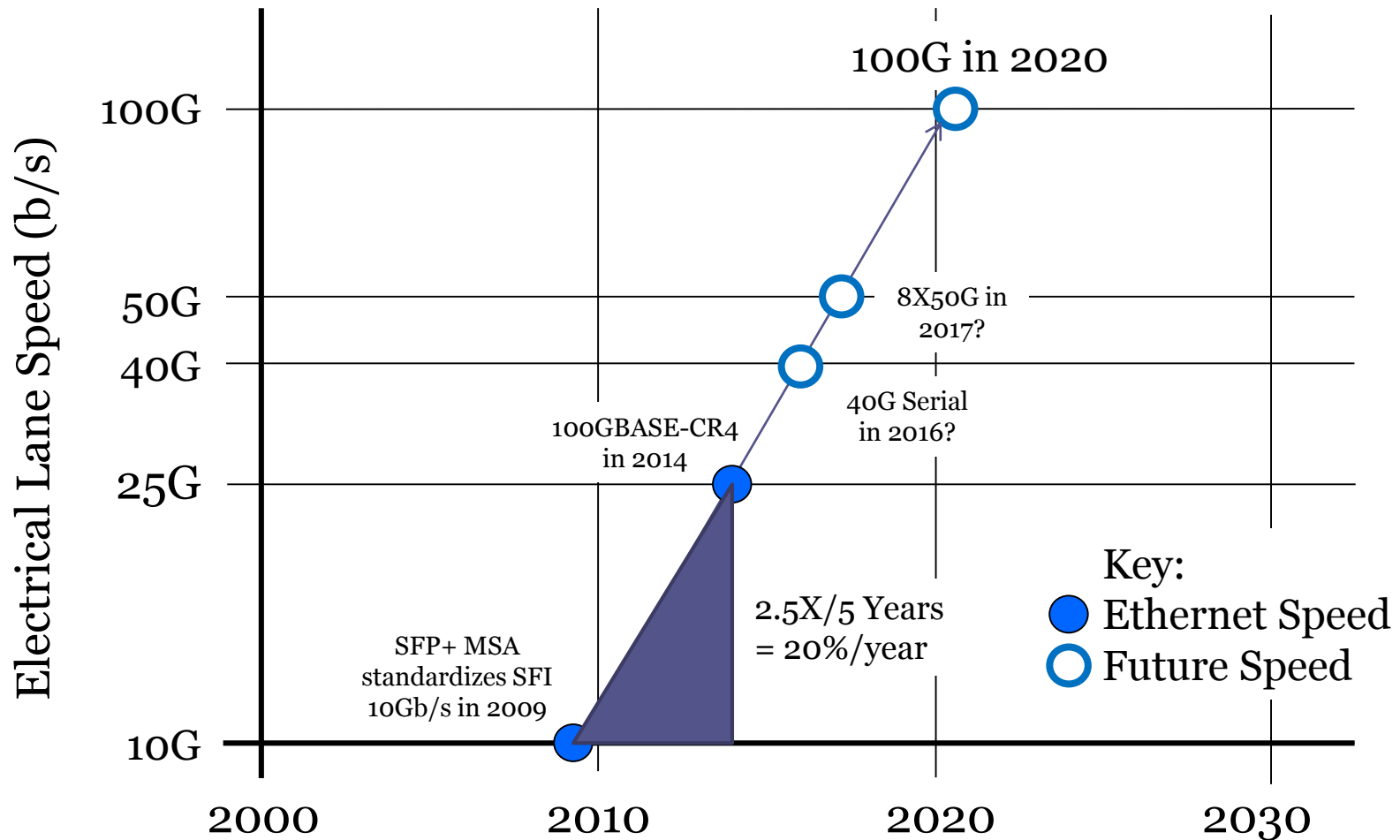
When will the next speeds arrive?



11% CAGR is Fairly Slow



20% CAGR is Great!

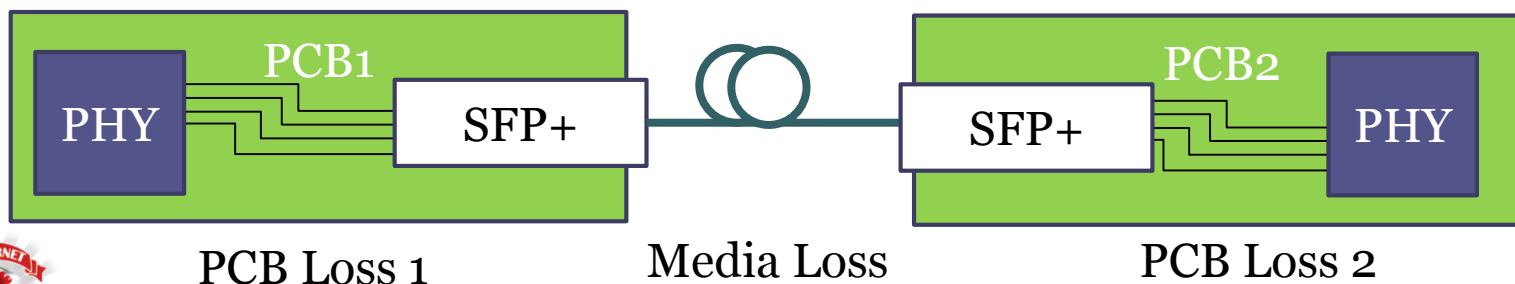


How far will 40G and 50G Serial go?

- Bandwidth Length Product depends on Media

| Speed | Reach with PCB Loss =10dB | MMF Reach (OM3) | BASE-T Cable Distance |
|-------|---------------------------|-----------------|-----------------------|
| 1G | 20-36" on FR4 | 550m (OM2) | 100m on CAT5 |
| 10G | 10-15" on Nelco4000 | 300m | 100m on CAT6A |
| 25G | 4-6" on MEGTRON6 | 70m | ?? |
| 40G | ?? 2"? | ? | 30m on CAT8 |
| 50G | ??? | ?? | ?? |

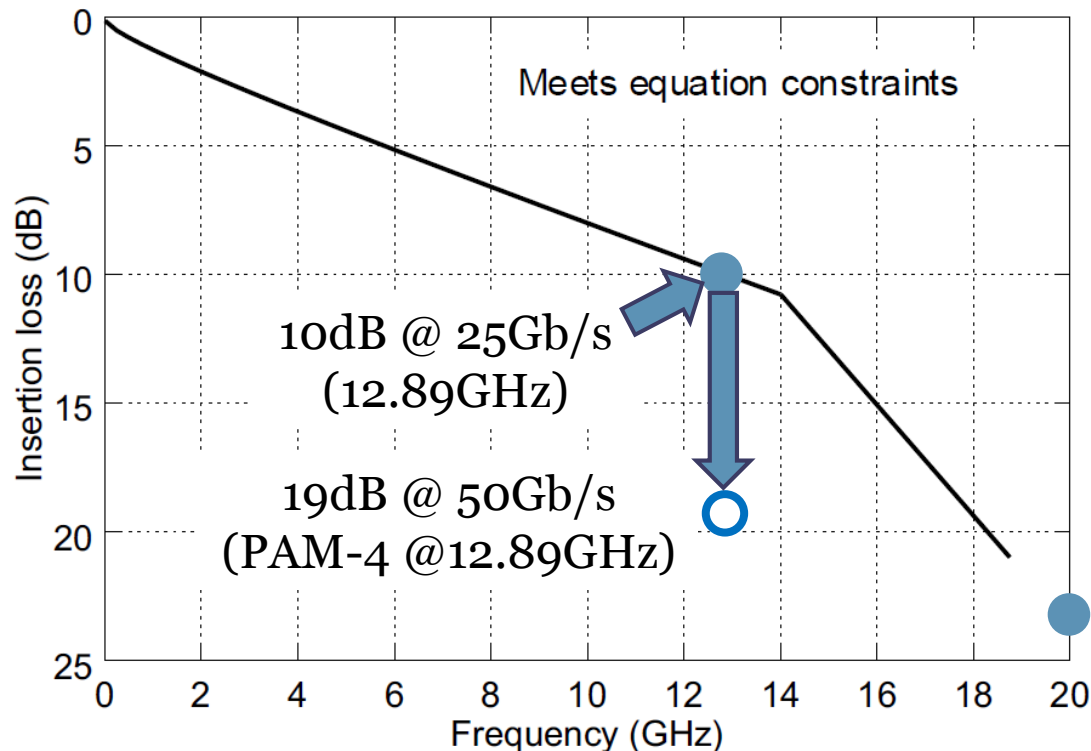
One example of an Ethernet Link



Faster is Much Harder

- Higher speeds equal higher loss and power or shorter distances

CAUI-4 Chip to Module Insertion Loss



50Gb/s is off the chart
unless advanced
modulation is used
(12.89GHz with PAM-4)

When will we get
100Gb/s signaling?

>20dB @ 40Gb/s
(20GHz)

Why 25G Now?

- Best cost/Gbps soon
- Technology is ready
 - ASICs are port limited, so need more Gb/s/port



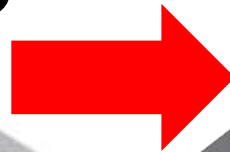
640Gb/s

64 Ports
of 10G in 2009



64 10GbE port ASIC enables
48 SFP+ and 4 QSFP+
640Gb/s of Throughput

5X in
5 Years



3.2 Tb/s

128 Ports
of 25G in 2015



128 25GbE port ASIC enables
32 QSFP+
3.2 Tb/s of Throughput

5X The Calories

McDonald's
Hamburger
-250 calories



Burger King's
Triple Whopper with
Cheese
-1250 calories



1000X the Storage in 10 Years

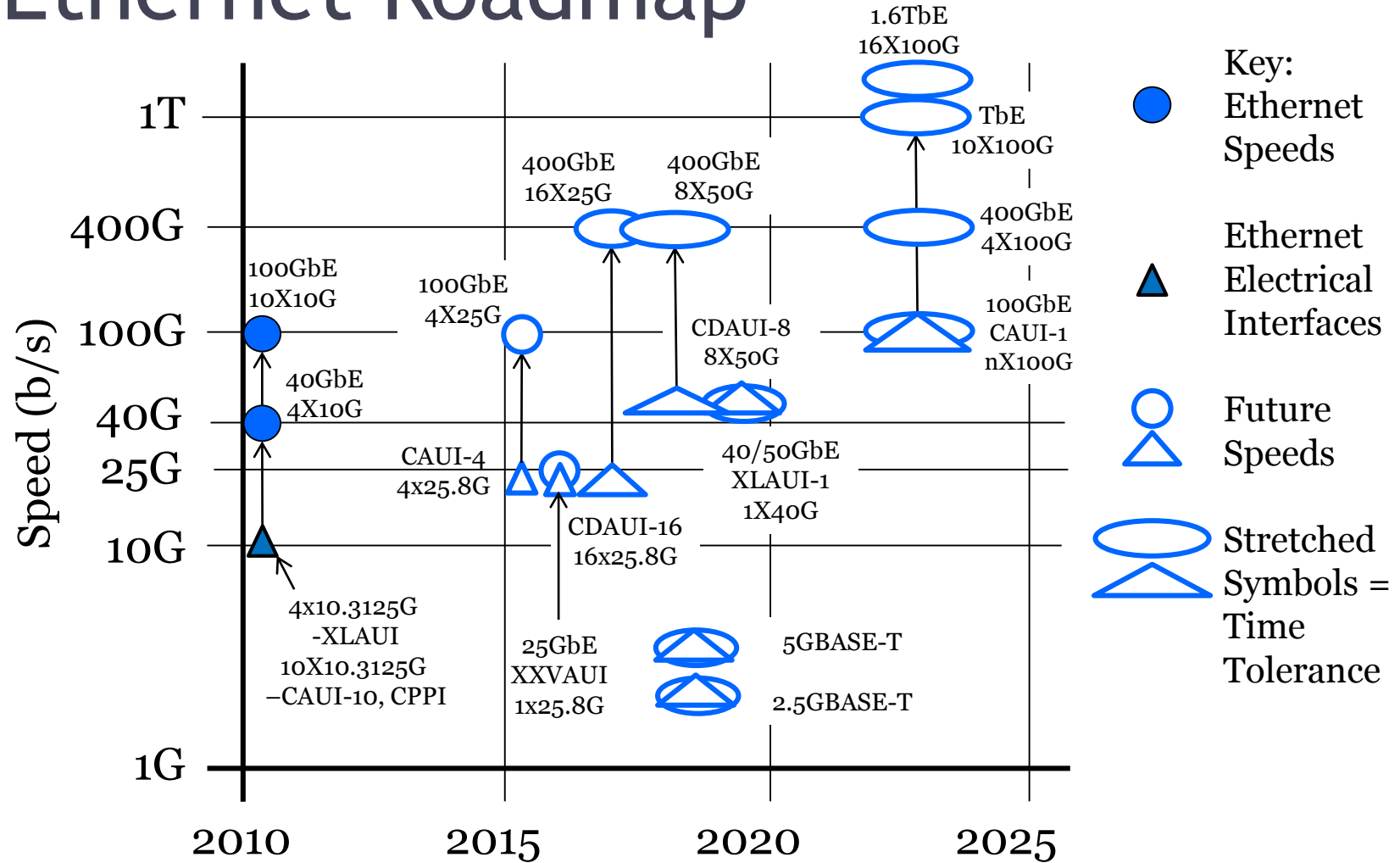
2003
512MB



2014
512GB!



Ethernet Roadmap



Where's the Debate?

- When should we standardize 40GbE and/or 50GbE SFP+?
 - Will it be NRZ or PAM-4 or ?
- Should we standardize 2X50G 100GbE?
- When can we standardize 100GbE Serial in SFP+?
 - 4X100GbE QSFP112 should combine to 400GbE
- 400GbE has many options:
 - Should 8X50G Electrical Interface be NRZ or PAM-4
 - Should optics be 8X50G or 4X100G λ and what encoding (NRZ, PAM-4, DMT)?
- Many BASE-T questions to be discussed later...

Session 1: Data Center Speeds

| Time | Topic | Speaker(s) |
|---------|--|---|
| 9:10am | <i>Ethernet Alliance Roadmap Introduction</i> | Scott Kipp, Ethernet Alliance President (Brocade) |
| 9:30am | <i>Networking Data Rates inside the Data Centers</i> | Alan Weckel, Dell'Oro Group |
| 9:50am | <i>Server Diversity: Why One Speed Is No Longer Enough</i> | Dave Chalupsky, Intel |
| 10:10am | <i>Implications of the Next Signaling Rate on Ethernet Speeds</i> | Kapil Shrikhande, Dell |
| 10:30am | <i>Switch Perspective</i> | Rob Stone, Broadcom |
| 10:50am | <i>Break</i> | |
| 11:05am | <i>Discussion on Sessions</i> | Scott Kipp, Ethernet Alliance President (Brocade) |



