

“Beyond 10km” Optics Strawman (CFI) “The Need”

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IEEE 802.3 New Ethernet Applications Ad Hoc

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Introduction

- This presentation will focus on “The Need” of a strawman / starting point for a CFI Proposal on “Beyond 10km Optics.”

Reminder – Objective for a CFI Consensus Meeting

- To measure the interest in starting a study group to address Beyond 10 km Optical PMDs
- We don't need to
 - Fully explore the problem
 - Debate strengths and weaknesses of solutions
 - Choose any one solution
 - Create PAR or five criteria
 - Create a standard or specification
- Anyone in the room may speak / vote
- RESPECT... give it, get it

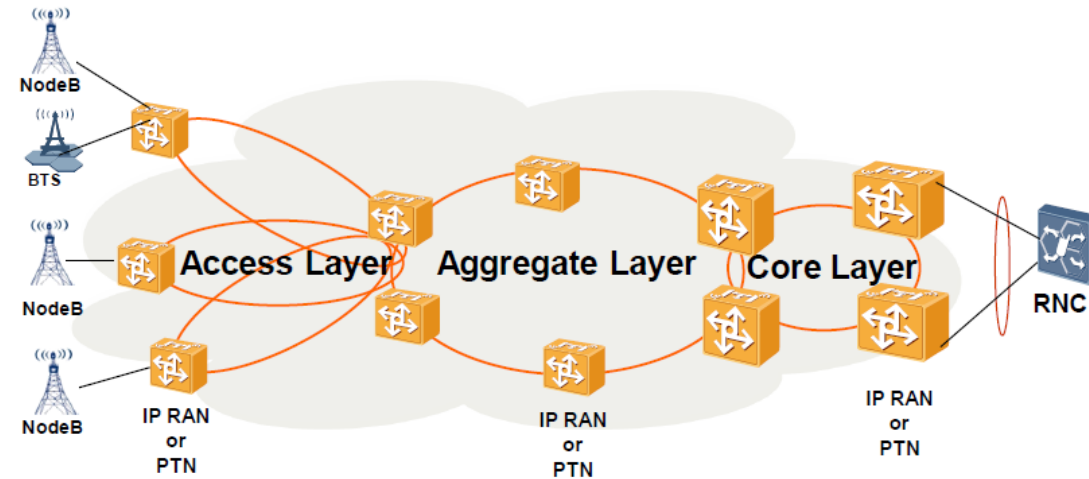
“The Need for Optical PMDs Beyond 10km”

The Need for Optics Beyond 10km Reach

- Data presented to data has highlighted
 - 50GbE – campus / metro interconnect (wang_ecdc_01_0716) – offers 2x speed increase over 25GbE
 - Mobile Backhaul Networks 200GE & 400GE for metro transport aggregation layer network (zhao_ecdc_01_0716)
 - 4G / 5G
 - Inter-building Usage (>10km, 40km, 80km)
 - Example – MSK-IX (dambrosia_ecdc_01_0516)
 - Example - Metro Data Center Interconnect (booth_ecdc_01_0716)

Example - Mobile Backhaul Networks

40km Reach in Mobile Backhaul Network



- In [huang_ecdc_01_0716](#) and observation from shipment in Carrier network, 40km volume is increasing

Statistics for 10GE & 100GE Modules used in PTN, as of June, 2016				
Transmission Distance	<2km	10km	40km	80km
10GE distribution	0.28%	44.46%	44.05%	11.20%
100GE distribution (more than 15K modules)	0	56.43%	34.59%	8.97%

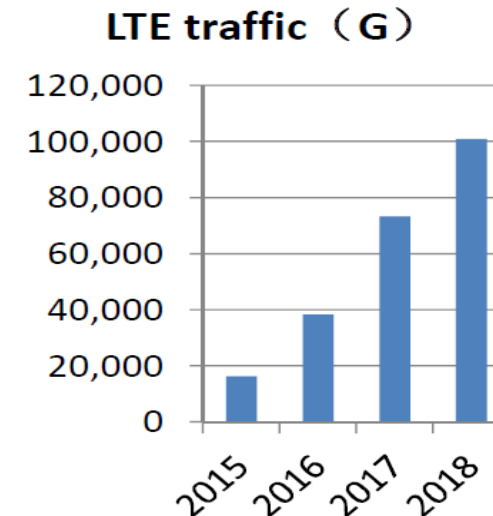
Carrier Input

Present status and forecast

- According to our survey, long distance module is a mandatory requirement for us

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- According to the increase of LTE traffic, as LTE backhaul network, PTN will face 4~5 times traffic in 2017 or 2018.
- Then we will have to use 400GE interface in the same scenario and take the same percentage with 100GE and 10GE.
- In 2018~2019, we expected the requirement for 400GE ER modules will be more than 10K.



Source: Huang/ Cheng, China Mobile, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/huang_ecdc_01_0716.pdf

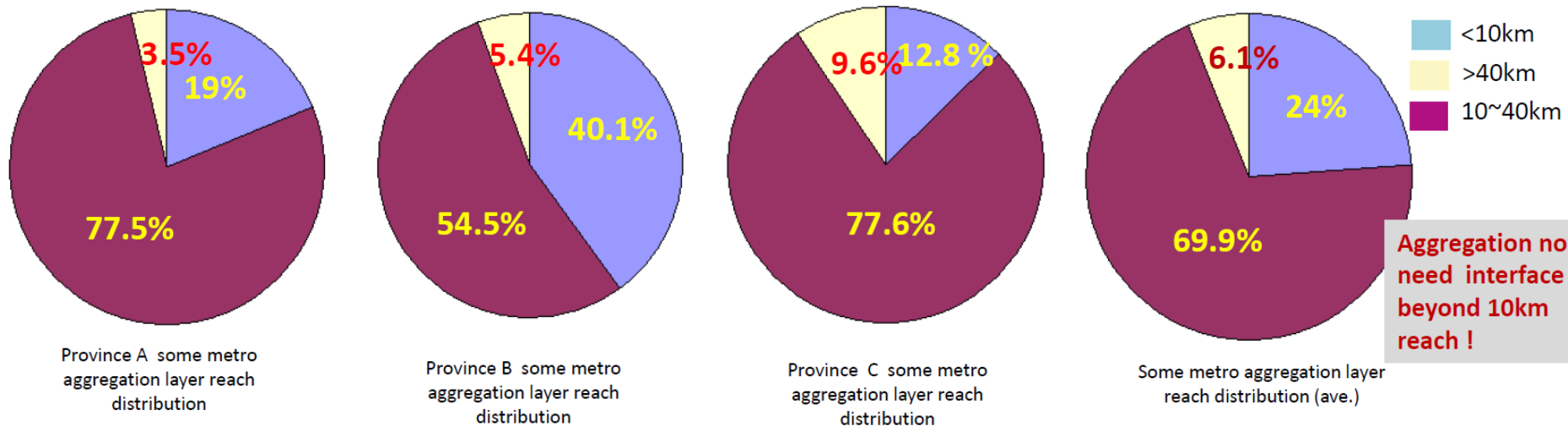
Carrier Input – Reach Targets

CAICT 中国信通院

Aggregation node distance from actual networks

As metro core usually use WDM/OTN to extend reach distance of Ethernet interface, therefore current aggregation layer transmission distance is crucial to the future higher bitrate interface, such as 200GE and 400GE, etc.

Furthermore, each metro network may has its own distribution characteristic of reach distance, and some metro aggregation layer node distance from actual networks in China are investigated, and these nodes would has the requirement to deploy link capability more than 10GE.



Source: Wenyu Zhao, CAICT
http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/zhao_ecdc_01_0716.pdf

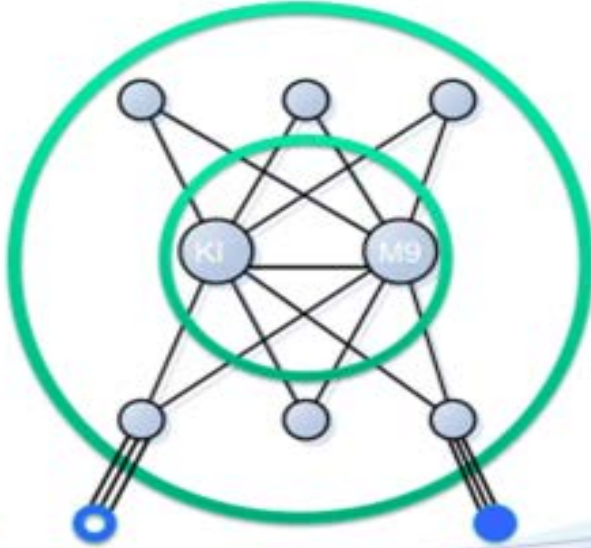
IEEE 802.3 NG-ECDC Ad Hoc, July, 2016, San Diego

Example - Inter-Building Connections

Industry Discussions- MSK-IX

Double Core Specifics

- MLAG interaction between KI & M9 (~40km distance)
- Passive 10G DWDM solution between core, predictable network size
- Smooth migration from old equipment to a new one
- Ring-topology concept:
 - Tier 0 – connect core to each other,
 - Tier 1 – core datacenters and switches,
 - Tier 2 – edge datacenters.
- Current capacity between several Tier1 switches and Core: 640Gbps (n x 10G) with Future plans 100G+ links between them.
- **Need solution for 100G+ optical transceivers between Core & Tier1 up to 40 km**



MSK-IX

Courtesy: Alexander Ilin, MSK-IX

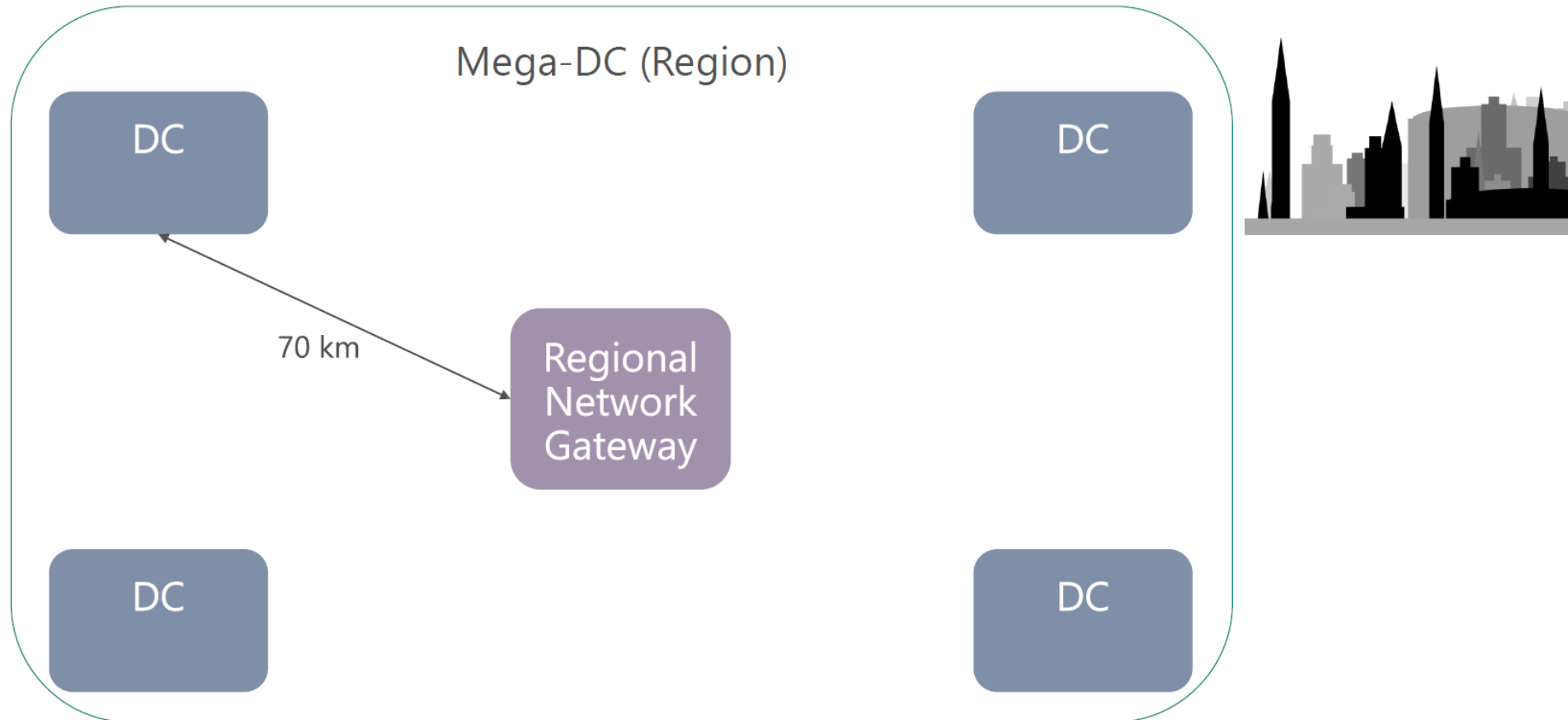
IEEE 802.3 NG ECDC Ad Hoc, IEEE 802.3 May 2016 Interim, Whistler, BC, Canada

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Source: John D'Ambrosia, Futurewei, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_05/dambrosia_ecdc_01_0516.pdf

Example - Regional Data Center Architecture

Mega Data Center Architecture v2.0



Source: Brad Booth, Microsoft, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/booth_ecdc_01_0716.pdf

Summary – Observed Reaches

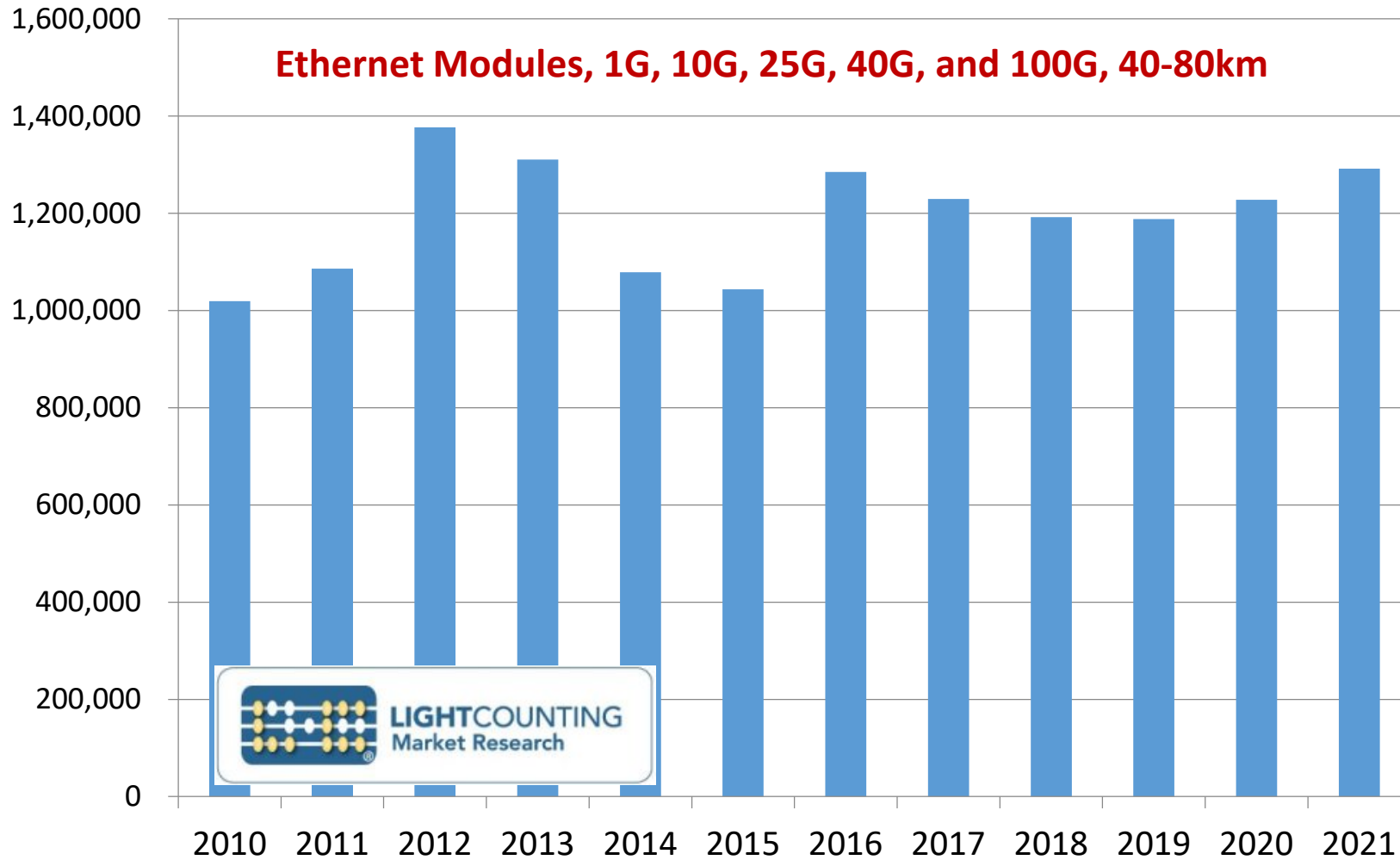
Source		<2km	10km	40km	>40km	80km
China Mobile *	10GbE	0.3%	44.5%	44.1%	-	11.2%
	100GbE	0	56.4%	34.6%	-	9.0%
CAICT Aggregation Nodes **	Province A	-	19.0%	77.5%	3.5%	-
(200GbE / 400GbE)	Province B	-	40.1%	54.5%	5.4%	-
	Province C	-	12.8%	77.6%	12.8%	-
	Province D	-	24%	69.9%	6.1%	-
LightCounting	10 GbE	- ***	93%	5.4%	-	1.6%
	10 GbE Telecom	0	76%	17%	-	7%

* - Source: Huang/ Cheng, China Mobile, http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/huang_ecdc_01_0716.pdf

** - Source: Wenyu Zhao, CAICT < http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/zhao_ecdc_01_0716.pdf

*** - 10GLR “Subspec” volume not included for this analysis

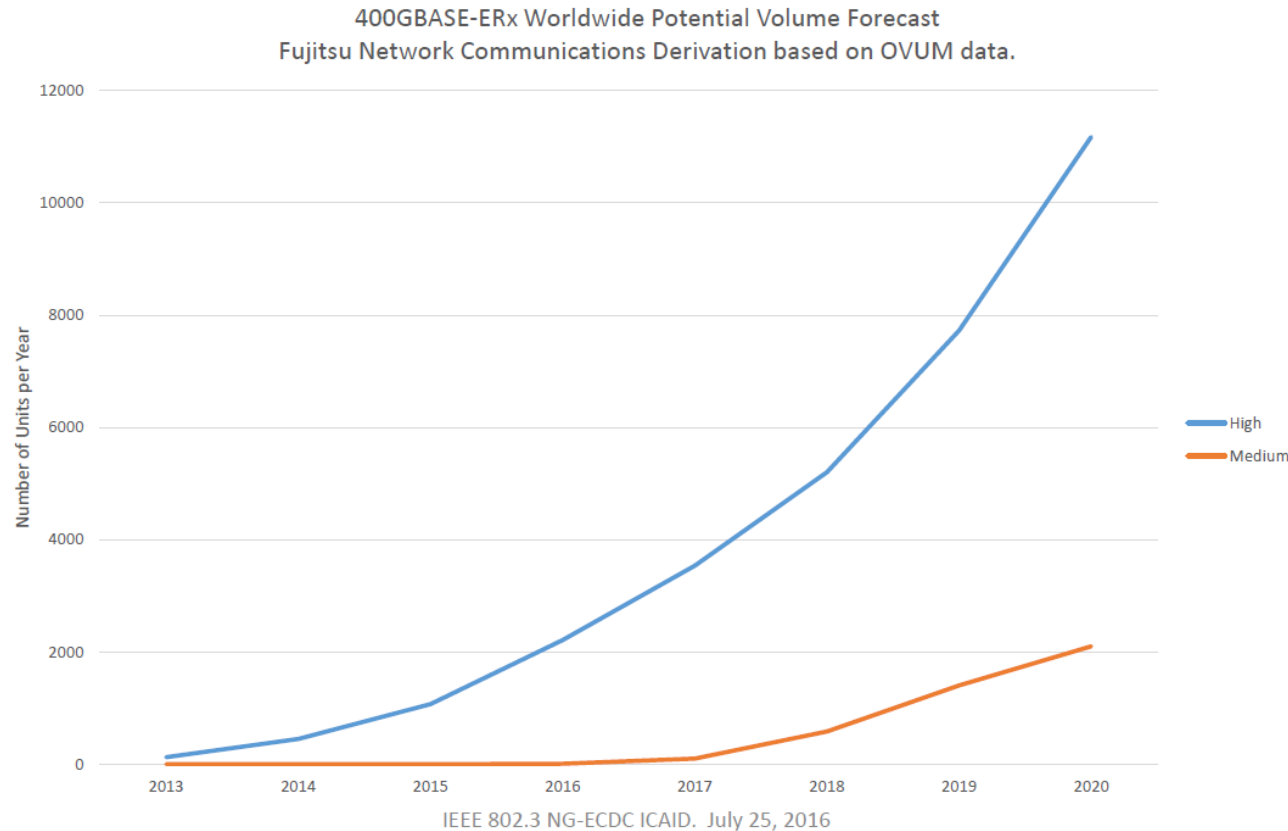
Extended Reach Ethernet Modules



- For 100GbE, 40km, LightCounting projects a market that will roughly triple in value from 2017 to 2021.
- SONET 40-80km shipments represent another half-million units in 2016. SONET is transitioning to Ethernet.
- 1 / 2.5 / 10 Gb/s DWDM / CWDM 40km & 80km optics will exceed 1M units this year and growing
- Totals are for merchant supplier shipments. Captive supply could add another half-million units.
- Data courtesy of LightCounting

Forecast -400GBASE-ERx

Broad Market Forecast



- This is not a data center volume application
- However, current forecast is to an approximate estimate of completion of a standard, assuming near future CFI

Source: Tom McDermott, Fujitsu,
http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/mcdermott_ecdc_01_0716.pdf

Observations

- Large use of “40km and beyond solutions” over multiple rates
- When reviewing market numbers – one needs to consider overlap of applications and volumes “blurring” the market need
 - LightCounting total versus telecom need (5.4% versus 17%)
- Data provided to date targeting telecom suggest their networks leverage highly leverage 40km solutions

- True reach distributions, however, are not known.
 - Reach based on PMD type?

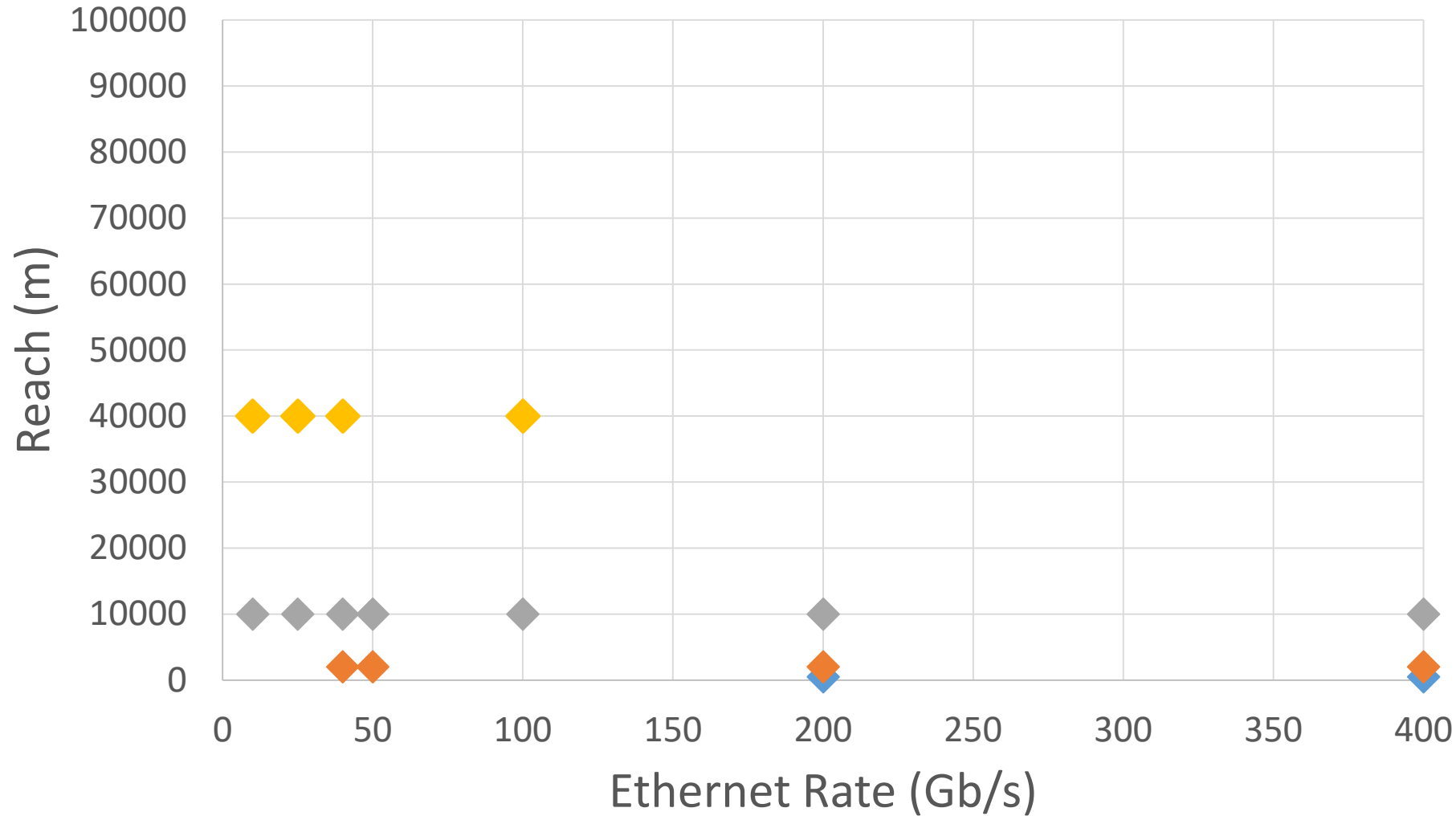
The Optical Landscape

State of IEEE 802.3 Ethernet P2P SMF Standards

		10GbE	25GbE	40GbE	50GbE	100GbE	200GbE	400GbE
500m	10G	-	-	-	-	-	-	-
	25G	-	-	-	-	-	-	-
	50G	-	-	-	-	-	4X50G	-
	100G	-	-	-	-	1X100G	-	4X100G
2km	10G	-	-	-	-	-	-	-
	25G	-	-	-	-	-	-	-
	40G	-	-	1X40G	-	-	-	-
	50G	-	-	-	1X50G	-	4X50G	8X50G
	100G	-	-	-	-	-	-	-
10km	10G	1X10G	-	4X10G	-	-	-	-
	25G	-	1X25G	-	-	4X25G	-	-
	50G	-	-	-	1X50G	-	4X50G	8X50G
	100G	-	-	-	-	-	-	-
40km	10G	1X10G	-	4X10G	-	-	-	-
	25G	-	1X25G	-	-	4X25G	-	-
	50G	-	-	-	-	-	-	-
	100G	-	-	-	-	-	-	-

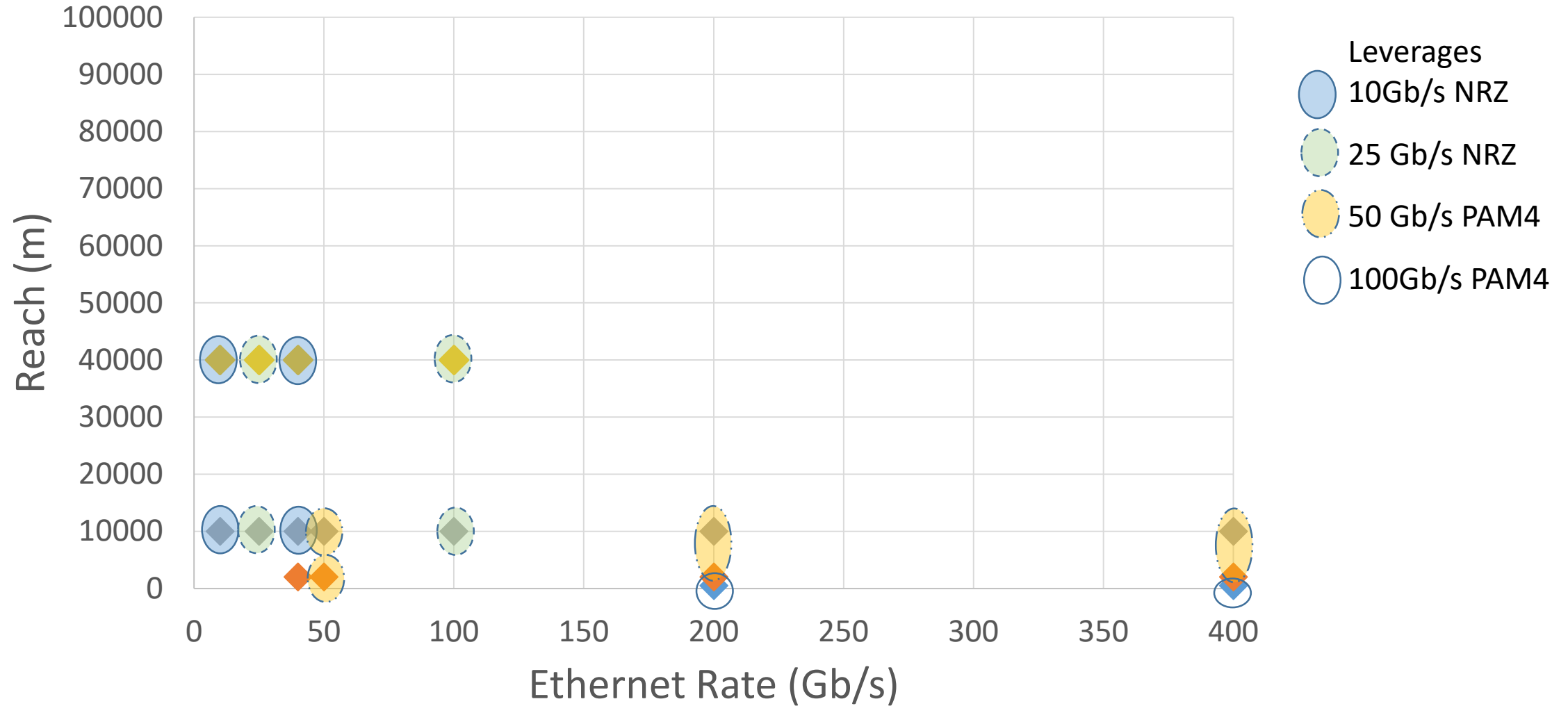
Note Standard in development

IEEE 802.3 Ethernet P2P Standards



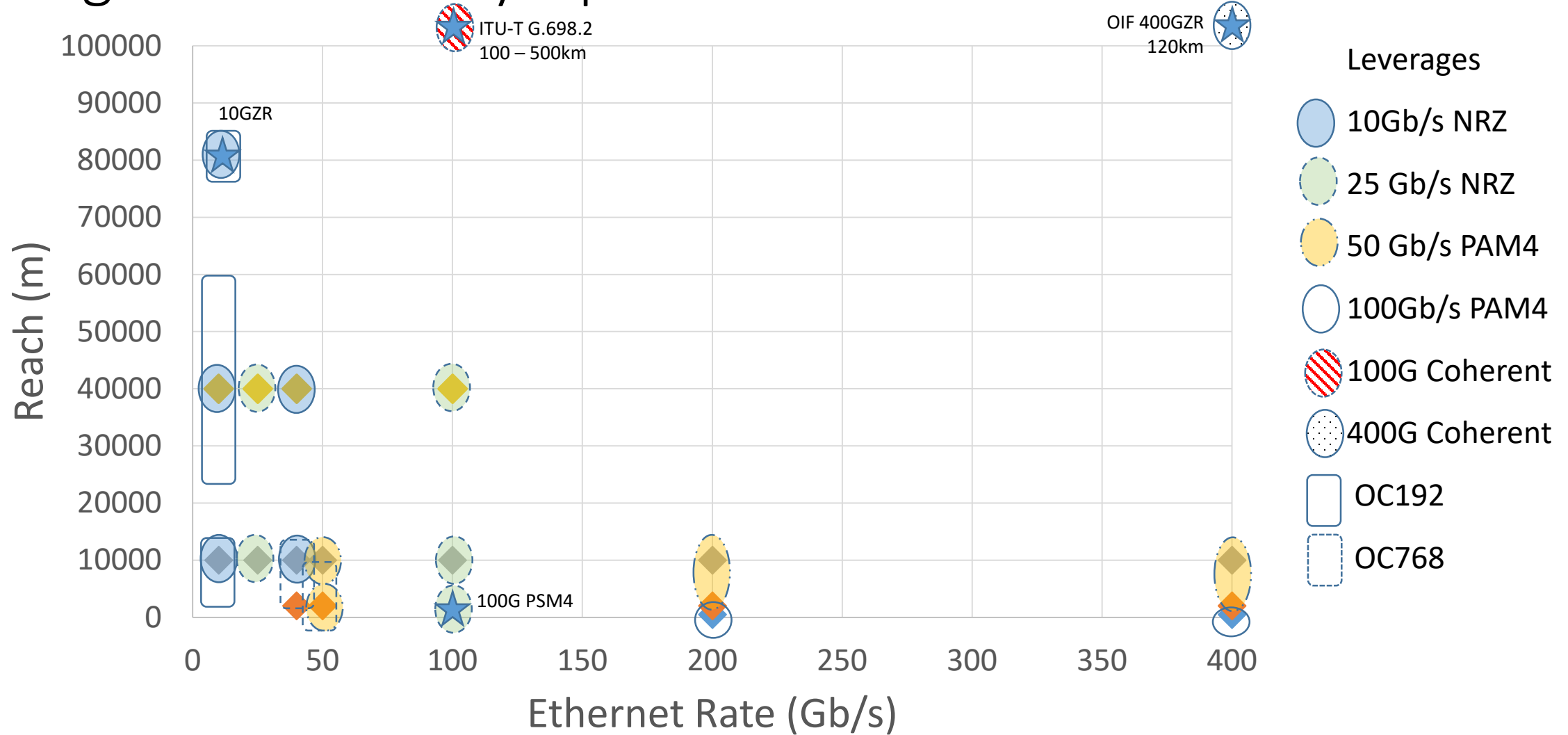
Note - All Ethernet SMF standards $\geq 10\text{GbE}$ (completed or in progress) shown.

IEEE 802.3 Ethernet P2P Standards Leveraging Technology



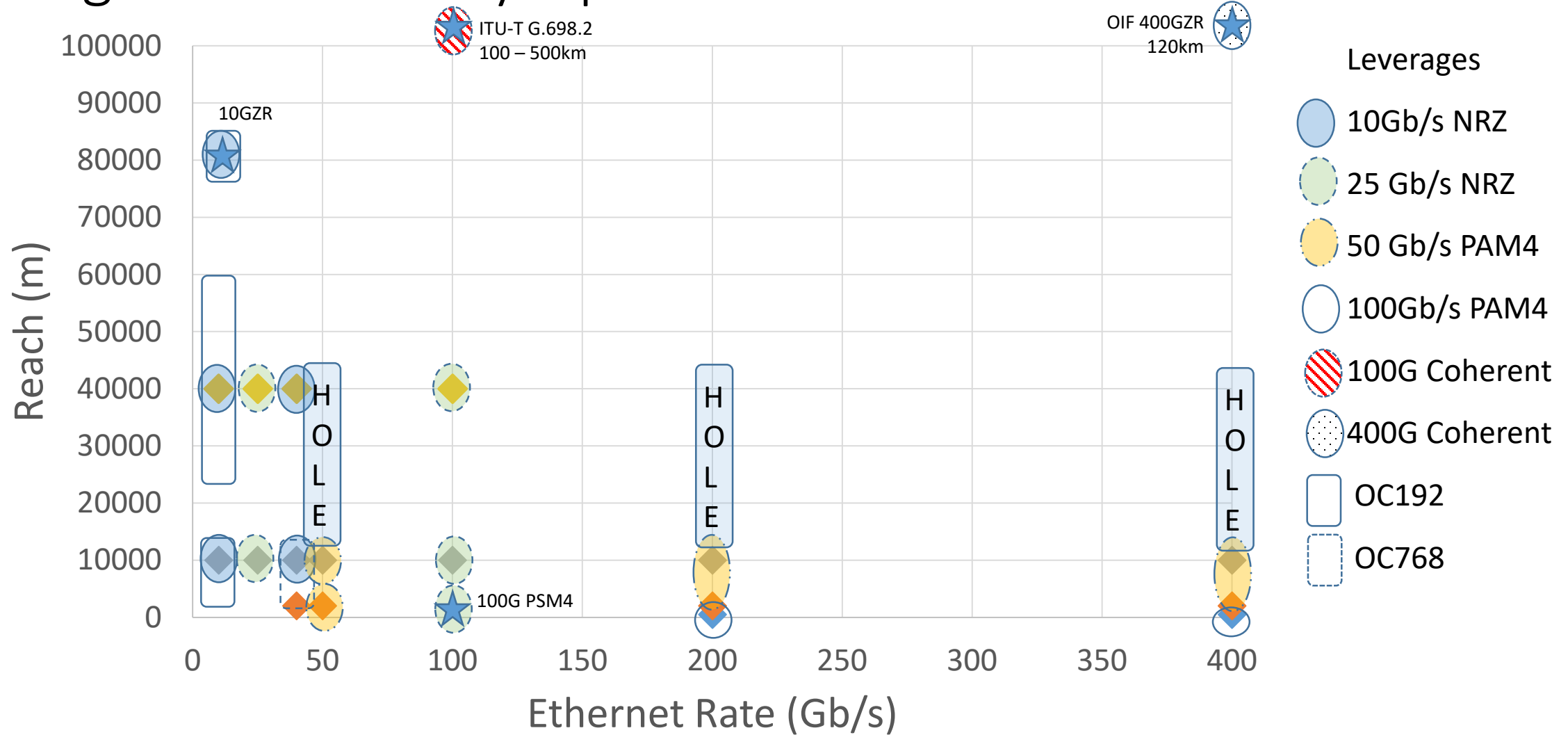
Note - All Ethernet SMF standards ≥ 10 GbE (completed or in progress) shown.

Adding Other Industry Optical Standards and Solutions



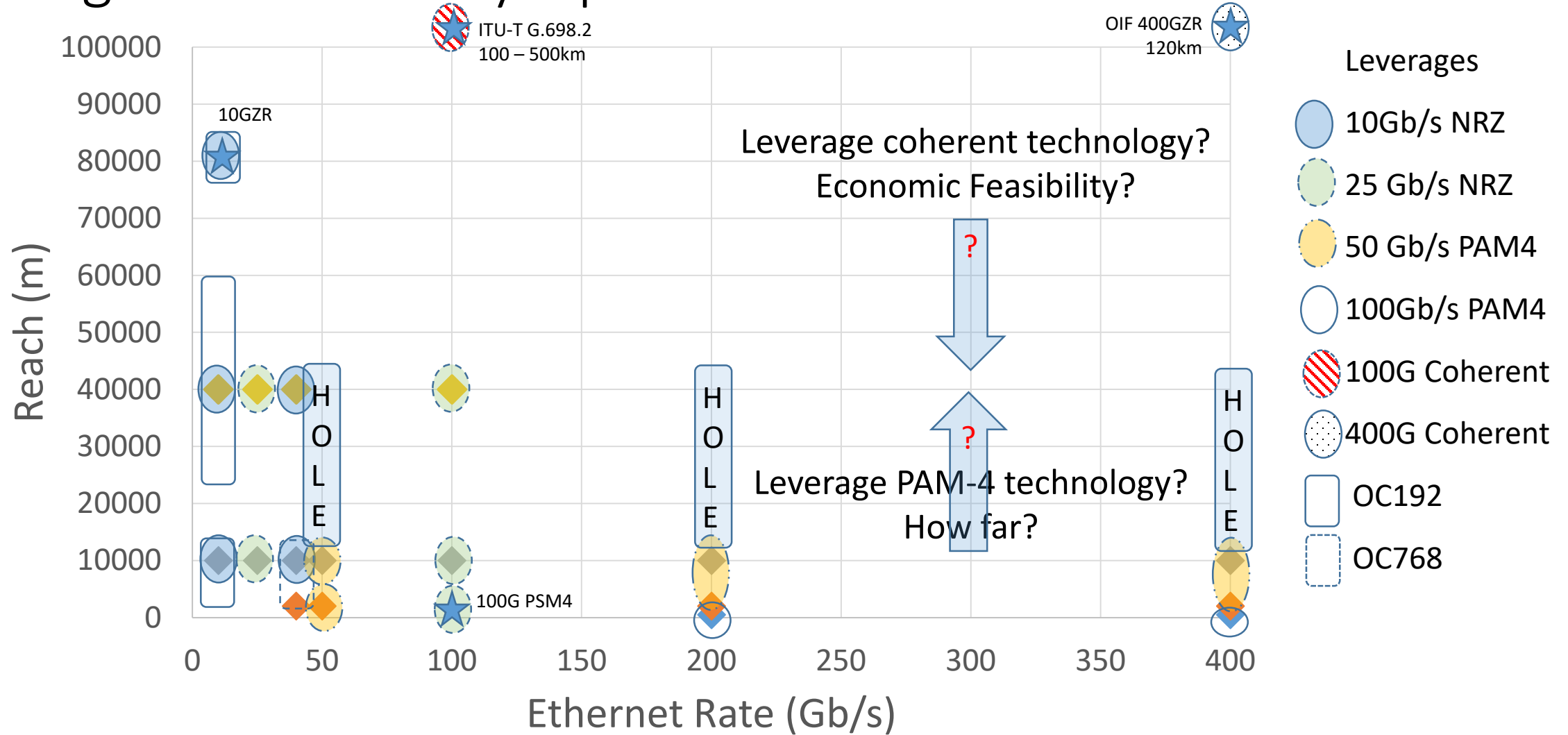
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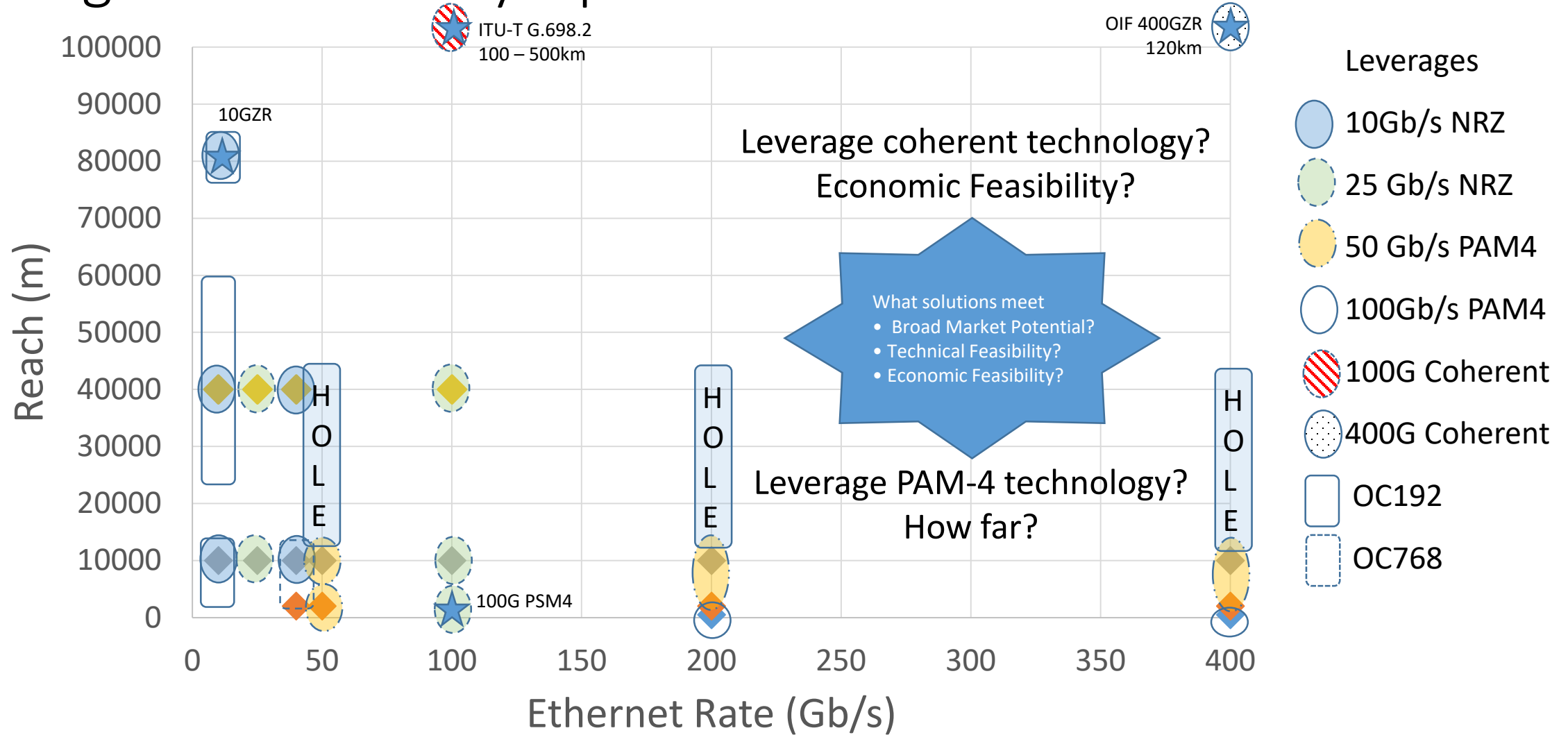
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Summary

- Extended reach beyond 10km has demonstrated multiple number of applications
- “Extended Reach” means different things to different applications
 - The 802.3 Ethernet Family – up to 40km
 - The Industry – Beyond 40km to 120km to 100’s of kms
 - Emerging carrier applications are deploying or considering Ethernet based solutions
- Currently – hole above 10km for 50Gb/s, 200Gb/s, and 400Gb/s
- Different perceptions of “Extended Reach” has different cost targets
- Different perceptions on how far 50 Gb/s PAM-4 can be leveraged

Recommendation

- A Study Group should be formed to “STUDY” the “>10 km SMF Optical PMD” topic
- Key Potential Topics for a Study Group
 - What is the real reach requirement(s) beyond 10km?
 - 40km (the historical Ethernet reach objective)?
 - Is there a single or multiple targets?
 - Can a 50 Gb/s PAM4 based solution meet the broad market potential, technical feasibility, and economic feasibility of target or targets?
 - Can a coherent based solution meet the broad market potential, technical feasibility, and economic feasibility of target or targets?
- The decision to start a project should be based on the findings of the Study Group