HUBER+SUHNER

The future of 100G, 400G, 400+G & 800Gig optics. - It's Confused!

Agenda

1. Overview transmission standards

2. IEEE and MSA groups

3. 800G standards

4. 400G SR

5. Reach > 10km

6. Conclusion

H+S Cube Optics – Overview

H+S CUBO is a leading provider of active and passive WDM components to OEMs AND optical transport solutions for metro networks to Carriers.

	Passive	Active
Outdoor		
Indoor		
Components Sub-Systems		

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Transmission standards 2017
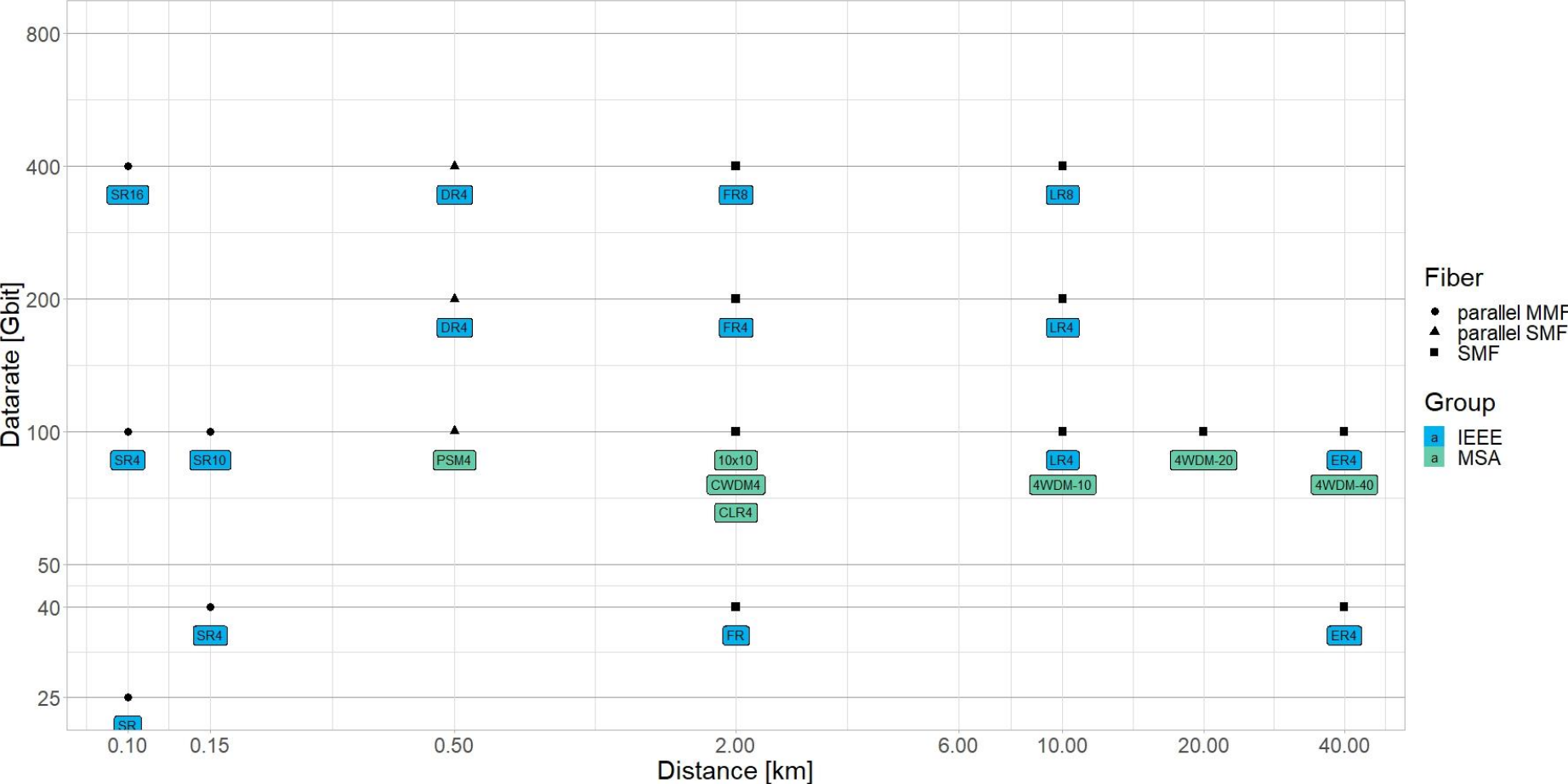
Standards ZZm:

- ZZ: Range class or standard shortcut
- m: Number of fibers or wavelengths

- IEEE most important group
- MSA for applications not covered by IEEE

Transmission standards Q4 2020

Standards ZZm:

- ZZ: Range class or standard shortcut
- m: Number of fibers or wavelengths
- .2: Bidirectional
- -X: Range in kilometers

- First 800G MSA
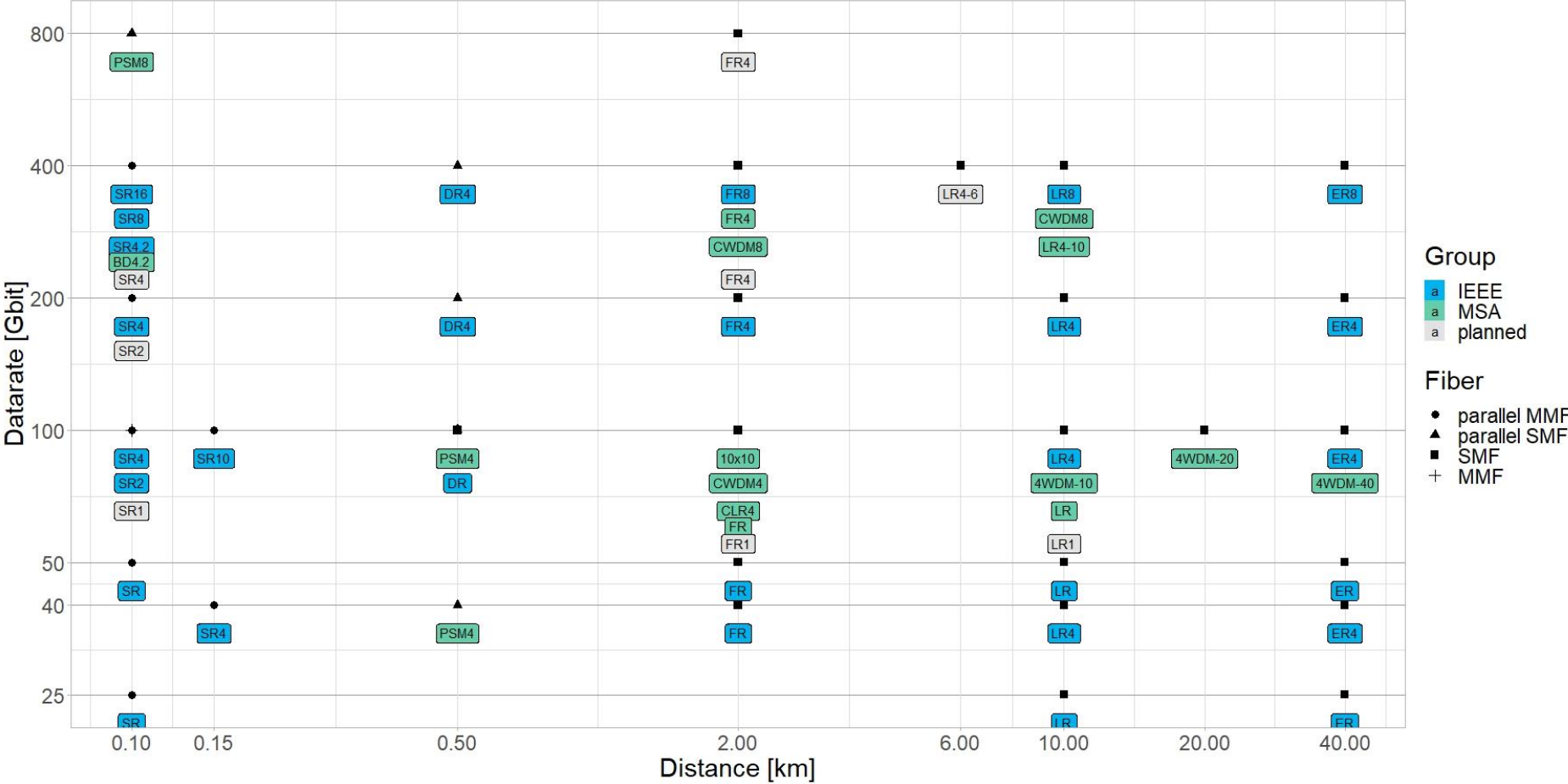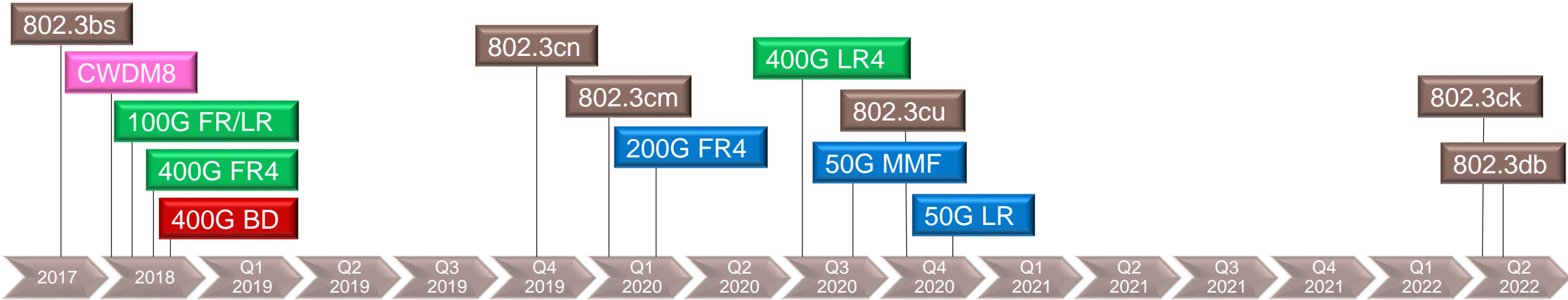- MSAs also for applications already covered by IEEE

IEEE and MSA Groups

802.3bs

CWDM8

100G FR/LR

400G FR4

400G BD

802.3cn

802.3cm

200G FR4

400G LR4

802.3cu

50G MMF

50G LR

802.3ck

802.3db

| 2017 | 2018 | Q1 2019 | Q2 2019 | Q3 2019 | Q4 2019 | Q1 2020 | Q2 2020 | Q3 2020 | Q4 2020 | Q1 2021 | Q2 2021 | Q3 2021 | Q4 2021 | Q1 2022 | Q2 2022 |

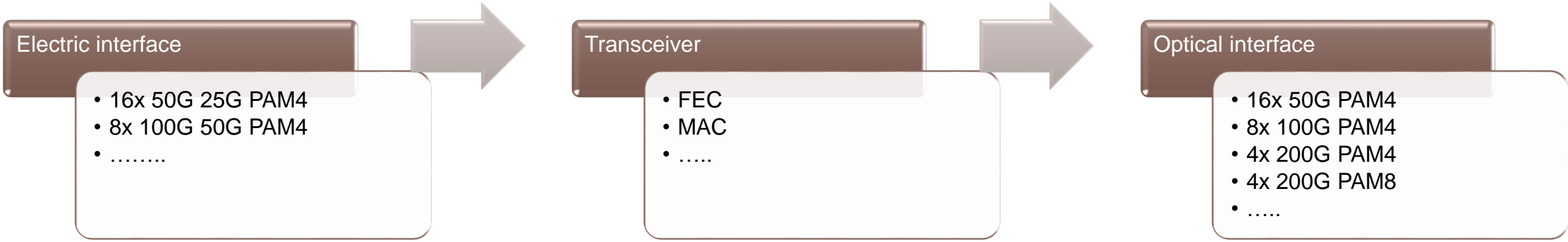| **IEEE**	**400G Bidi group**	**100G Lambda group**	**Open Eye MSA**	**CWDM8 MSA group**
• 802.3bs: 400G-SR16, FR8,DR4,LR8,200G,…. • 802.3cn: 400G-ER8,…. • 802.3cm: 400G-SR8, 400G SR4.2……. • 802.3cu: 100G-FR, 400G-FR4, 400G-LR4-6 • 802.3ck: Electrical interface 100G per lane • 802.3db: 100G-SR, 200G-SR2, 400G-SR4	• Bidirectional parallel MMF fibers • 400G-BD4.2	• 100G per lambda transmission standards • 100G FR/LR • 400G LR4 • 400G FR4	• 50G per lambda reducing power consumption, cost and latency • 200G-FR4 • 50G-LR • 50G-MMF • Standards for 100G per lambda planned	• 50G per lambda NRZ • 400G-CWDM8-2 • 400G-CWDM8-10

800G standards

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Electric interface
- 16x 50G 25G PAM4
- 8x 100G 50G PAM4
- ……..

Transceiver
- FEC
- MAC
- …..

Optical interface
- 16x 50G PAM4
- 8x 100G PAM4
- 4x 200G PAM4
- 4x 200G PAM8
- …..

Ethernet Technology Consortium

- 800G specification
- April 2020
- No definition for optical interface
- Defining MAC und PCS
- Based on 2x400G PCS

800G Pluggable

- 800G-PSM8
- August 2020
- Parallel SM fiber
- 100G per lane
- 100m reach
- PCS refers to 802.3bs

800G Pluggable

- 800G-FR4
- In standardization
- 200G per lane
- PAM4 or higher order PAM

MSA Groups and promoters

100G Lambda	Open Eye MSA	CWDM8 MSA	800G Pluggable	Ethernet Consortium
Alibaba Group	AOI	AOI	Huawei	Arista
AOI	CIG	Hisense	Fujitsu	Broadcom
Arista	Juniper	Nokia	AOI	Google
Hisilicon	Molex	Rockley	CIG	Milano
II-VI	Macom	Intel	Hisense	Microsoft
Cisco	LuxshareICT	Accton	Accelink	
intel	Semtech	H3C	Baidu	
Juniper	…..	…..	…..	
…..				

400G SR

802.3bs → **Bidi** → 802.3cm → 802.3db

SR16

SR4.2 | SR8

SR4

25G NRZ

25G PAM4

50G PAM4

CFP8

QSFP-DD

QSFP-DD **800**
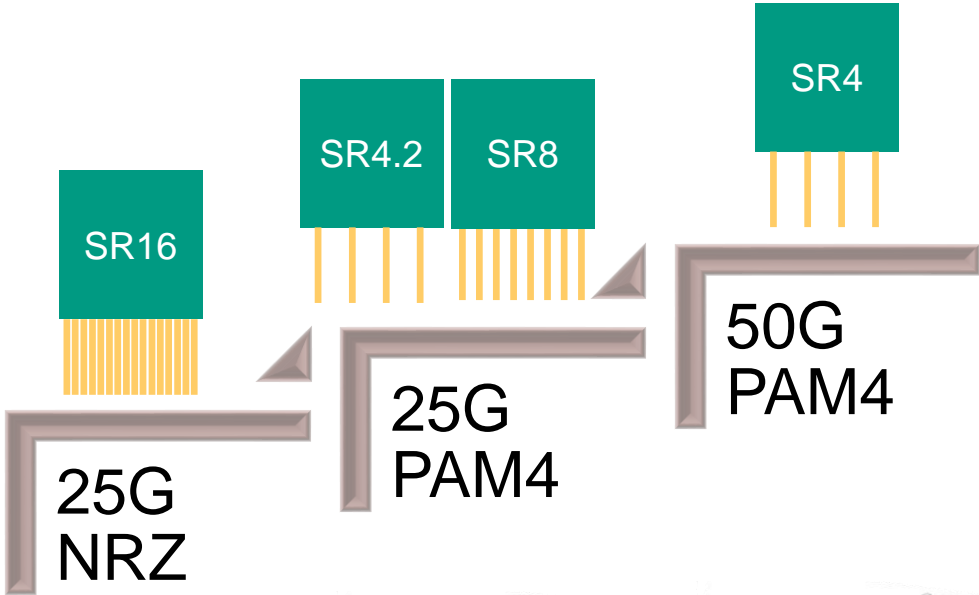
MPO-32
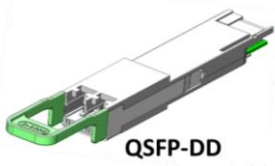
MPO-16
MPO-12

MPO-12

SR4.2 /BD4.2 concept

PD

Laser
Laser
Laser
Laser

MUX
MLX/

MUX/
DEMUX

MUX/
DEMUX
MLX/

Laser
Laser
Laser

PD
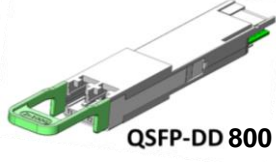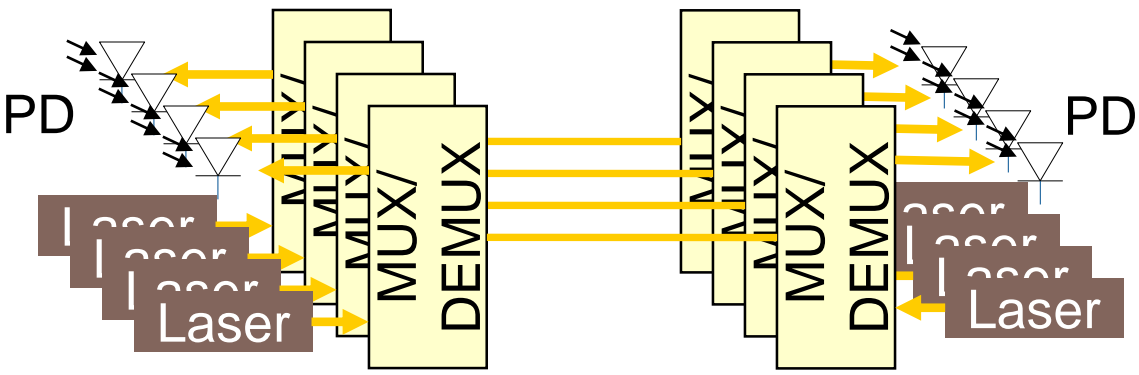
- SR4.2 and BD4.2 similar standards
- More complex optics but lower speed per lane

Reach > 10km

| 400G-ER8	400ZR	Open ZR+	IEEE
Q4 2019	Q1 2020	Q3 2020	**802.3cw** • 400Gb/s DWDM 80km • June 2022
IEEE	OIF	Open ZR+ MSA group	
400G	400G	Multirate(100-400)	
Direct detect	Coherent	Coherent	
8 λ LAN-WDM	1 λ DWDM	1 λ DWDM	**802.3ct** • 100Gbit/s DWDM 80km • September 2021
>17dB link budget	11 dB link budget	2 dB link budget	
30-40km[a]	80-120km[b]	80-1040km (400G)[c]	
No amplifier	With and without amplifier	With amplifier	

- a 40km is engineered link, link budget can be critical for worst case fiber

- b link without amplifier is engineered link with reduced range

- c range higher for lower data rate up to 5840km (100G)

Conclusion

Direct detect vs. coherent
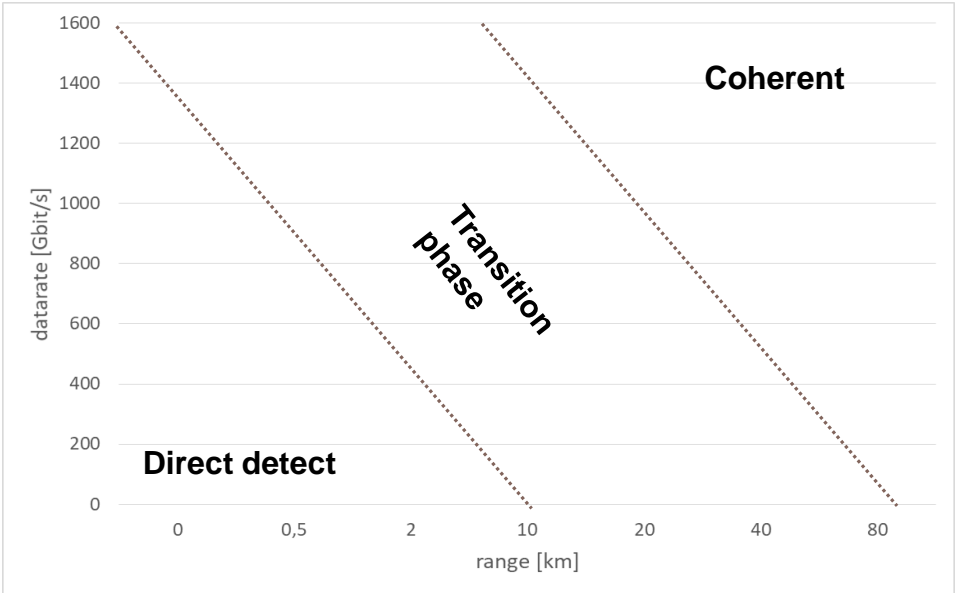
Data rate per lane direct detect standards
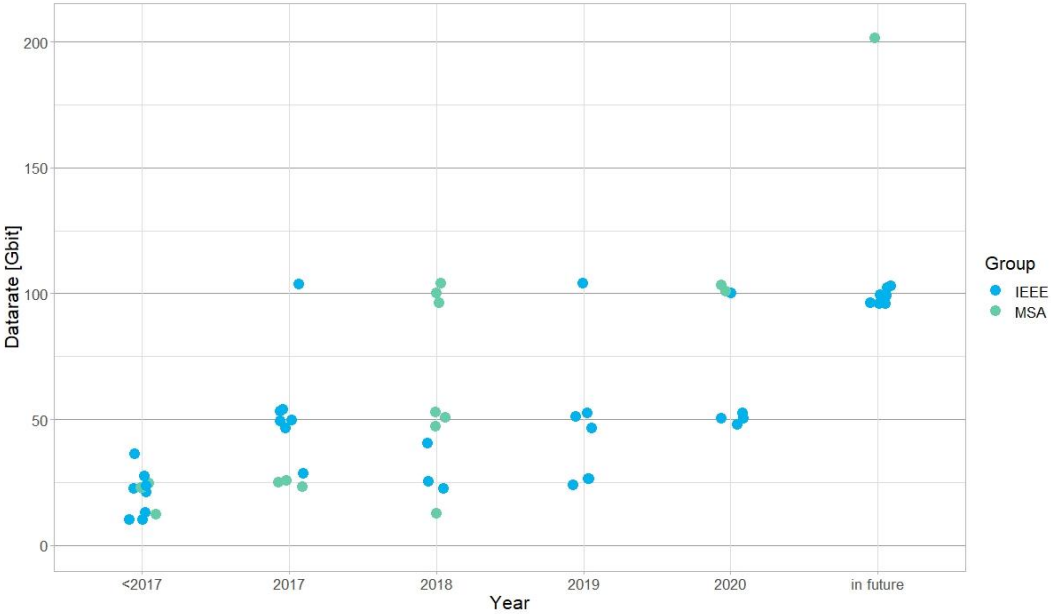
- With 400ZR coherent will move near to datacenter
- Direct detect still has lower power consumption and is competitive > 2km

- 100G per lambda is mostly used in future standards
- 800G pluggable is already targeting 200G per lane

Sources

- IEEE 802.3
  https://www.ieee802.org/3/

- 800G pluggable
  https://www.800gmsa.com/

- Ethernet Technology Consortium
  https://ethernettechnologyconsortium.org/

- Open Eye MSA
  https://www.openeye-msa.org/

- 100G Lambda MSA
  https://100glambda.com/

- CWDM8 MSA
  https://www.cwdm8-msa.org/

- 400ZR
  https://www.oiforum.com/

- Open ZR+
  https://www.openzrplus.org/

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Connecting – today and beyond