



400G Introduction

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Agenda

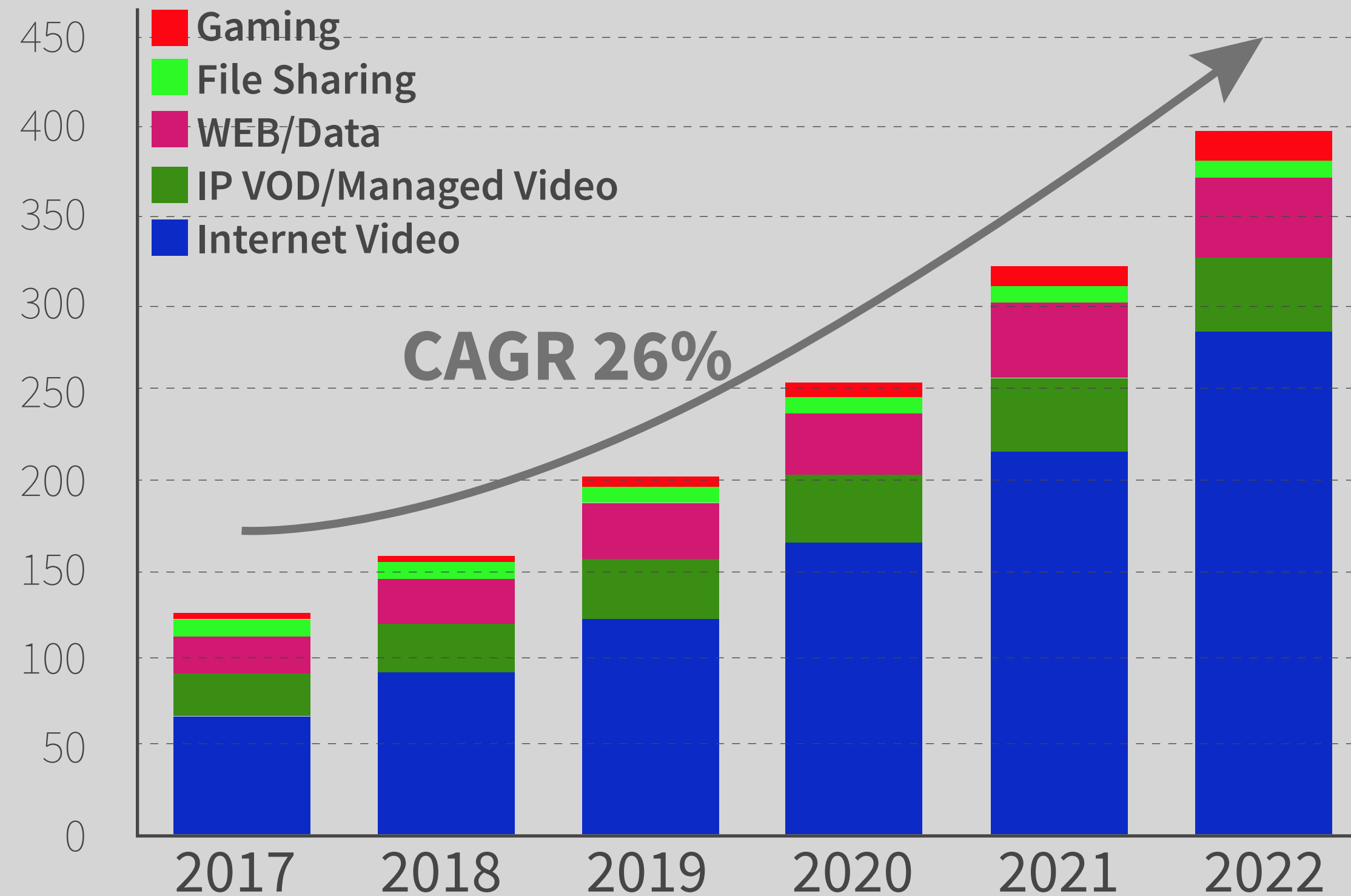
- # Internet traffic & COVID-19
- # Evolution towards 400G
- # 400G Transceiver Types
- # 400G Transceiver Form Factors
- # PAM4 Modulation
- # EDGE 400G QSFP-DD
- # EDGE 400G Compatibility



#Internet Traffic grows **faster then ever**

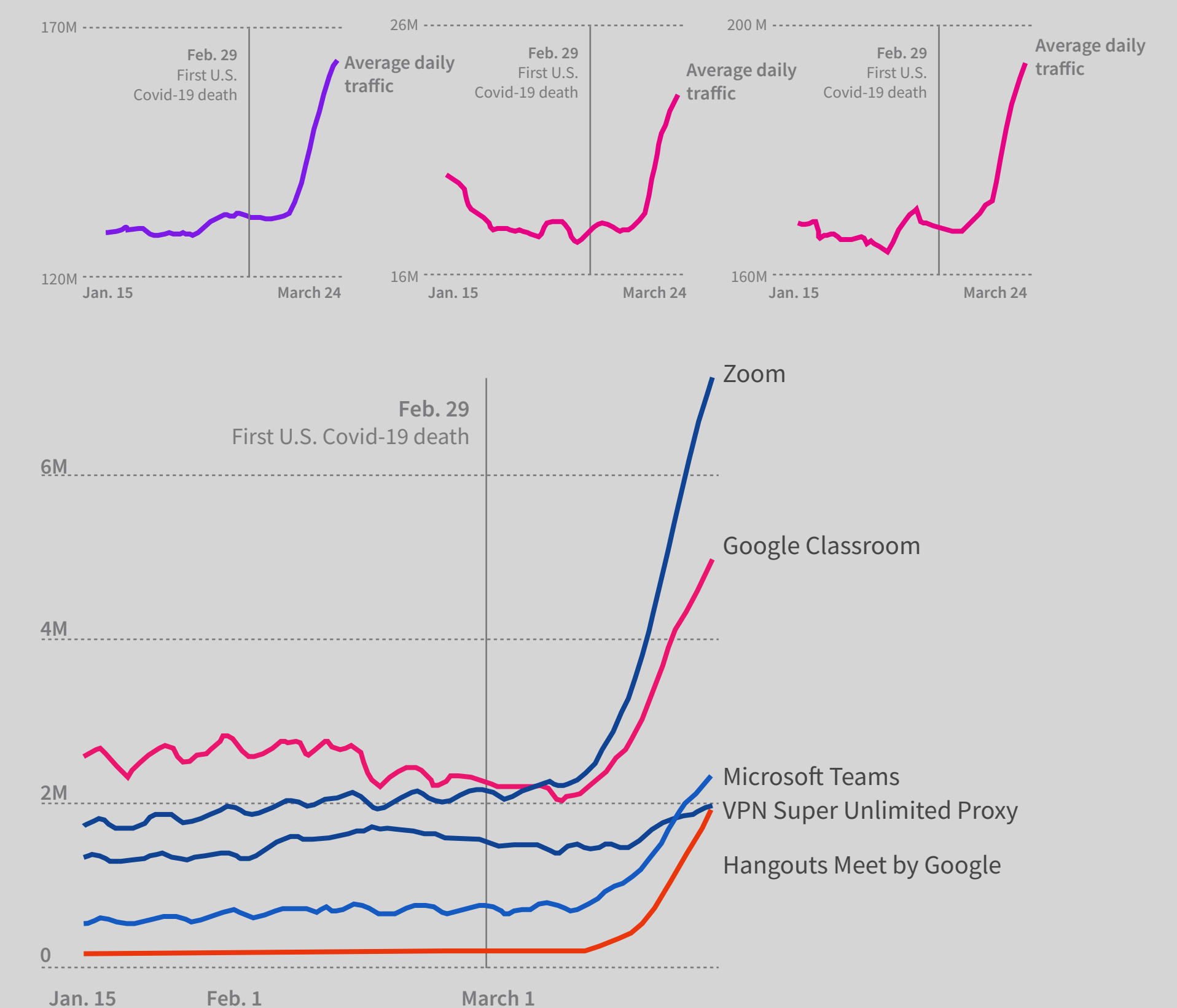
Cisco Projections 2017

Source: Cisco VNI Global IP Traffic Forecast 2017-2022



But COVID-19 changed it all

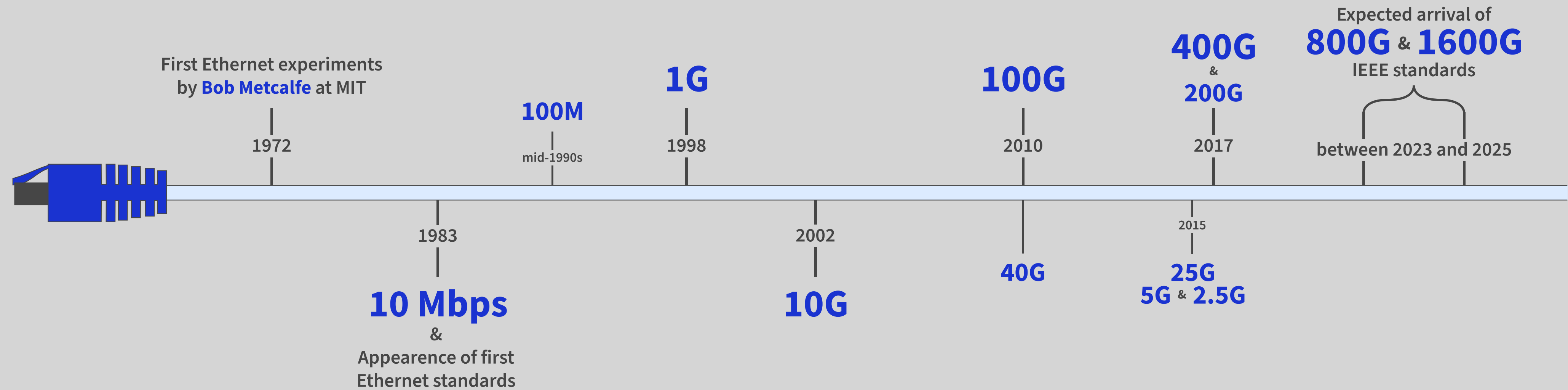
Source: The New York Times



COVID-19 Changed User Behavior...**Maybe Forever?**

Global traffic estimates are radically changed by COVID-19, but when it's finally over, user habits will remain changed. It will lead to much faster growth of traffic as anticipated moments ago;

#Evolution towards 400G



400G - 400 billion bits of information traveling through an optical fiber every second is a latest IEEE ratified standard for **Ethernet**, where Ethernet since its inception in Year 1983 has become most popular networking technology in the world.

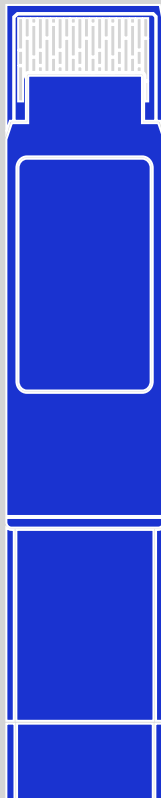


#400G Transceiver Types

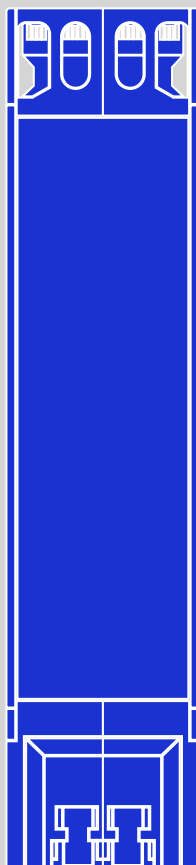
Industry Name	Media Type	Max Distance	Data rate	Wavelength	Connectors	Optical Signal	Standard
400GBASE-SR8	Multi-Mode Fiber	100m (OM4)	425 Gbps	8x850nm	MTP/MPO 16	8x50G PAM4 per lane	IEEE 802.3bs
400GBASE-DR4	Single-Mode Fiber	500m	425 Gbps	4x1310nm PSM	MTP/MPO 12	4x100G PAM4 per lane	IEEE 802.3bs
400GBASE-DR4+	Single-Mode Fiber	2km	425 Gbps	4x1310nm PSM	MTP/MPO 12	4x100G PAM4 per lane	IEEE 802.3bs
400GBASE-FR4	Single-Mode Fiber	2km	425 Gbps	CWDM4 1271/1291/1311/1331nm	Double LC	4x100G PAM4 per lane	100G Lambda MSA
400GBASE-LR4	Single-Mode Fiber	10km	425 Gbps	CWDM4 1271/1291/1311/1331nm	Double LC	4x100G PAM4 per lane	100G Lambda MSA
400GBASE-LR8	Single-Mode Fiber	10km	425 Gbps	LWDM8 1273/1277/1282/1286/1295/1300/1304/1309nm	Double LC	8x50G PAM4 per lane	IEEE 802.3bs
400GBASE-ER4 Lite	Single-Mode Fiber	40km	425 Gbps	LWDM4 1295/1300/1304/1309nm	Double LC	4x100G PAM4 per lane	IEEE 802.3bs

#400G Transceiver Form Factors

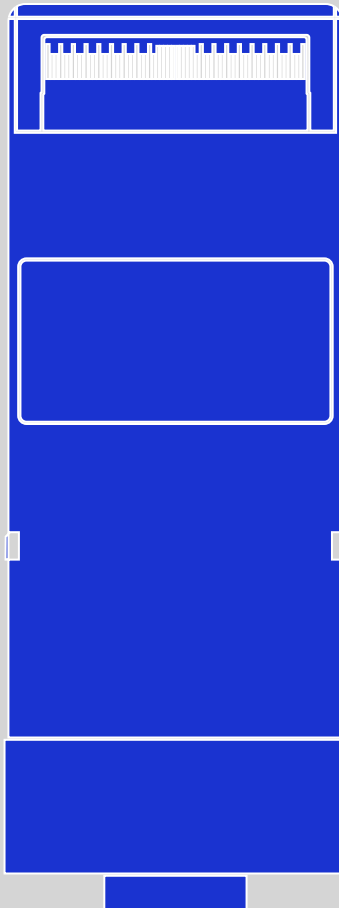
QSFP-DD



OSFP



CFP8

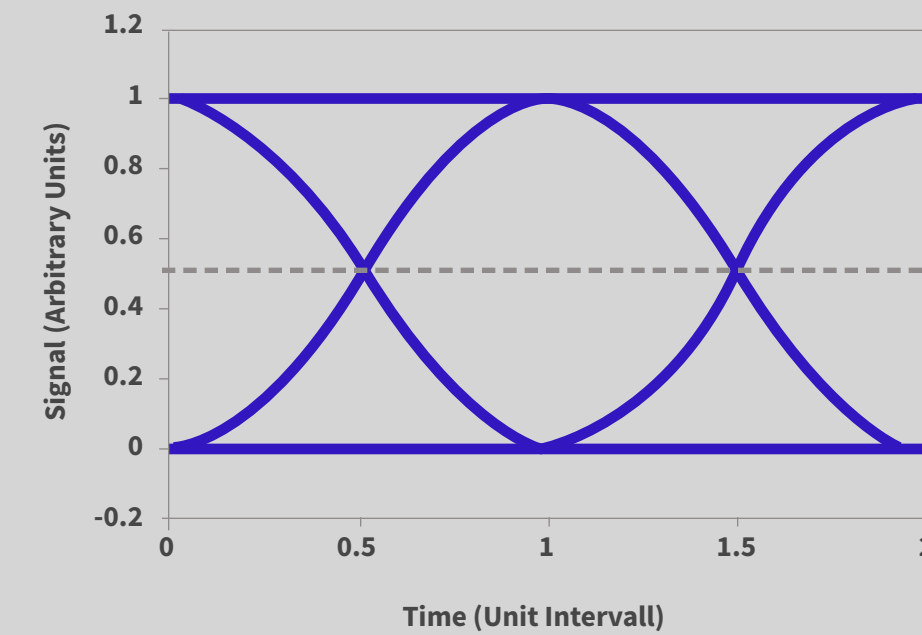
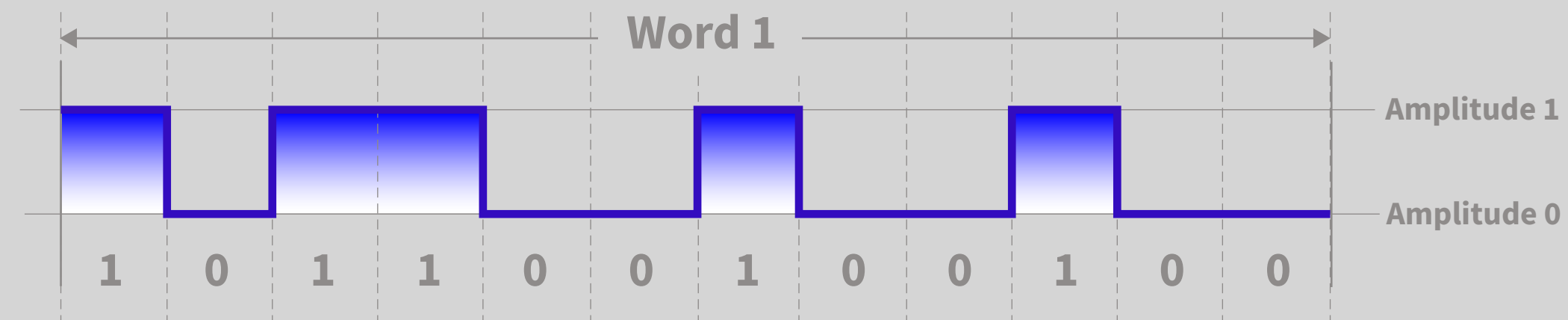


Dimensions	18.35mm× 8.5mm x 89.4mm	22.58 mm × 13mm x100.4	40 mm × 9.5 mm × 102 mm
Port Density 1U	36	32	16
Power Consumption	≤12W	≤15W	≤28W
Future to 800G	No	Yes	Yes
Backwards to QSFP	Yes	With Adapter	No
Alliance	QSFP-DD MSA	OSFP MSA	CFP MSA

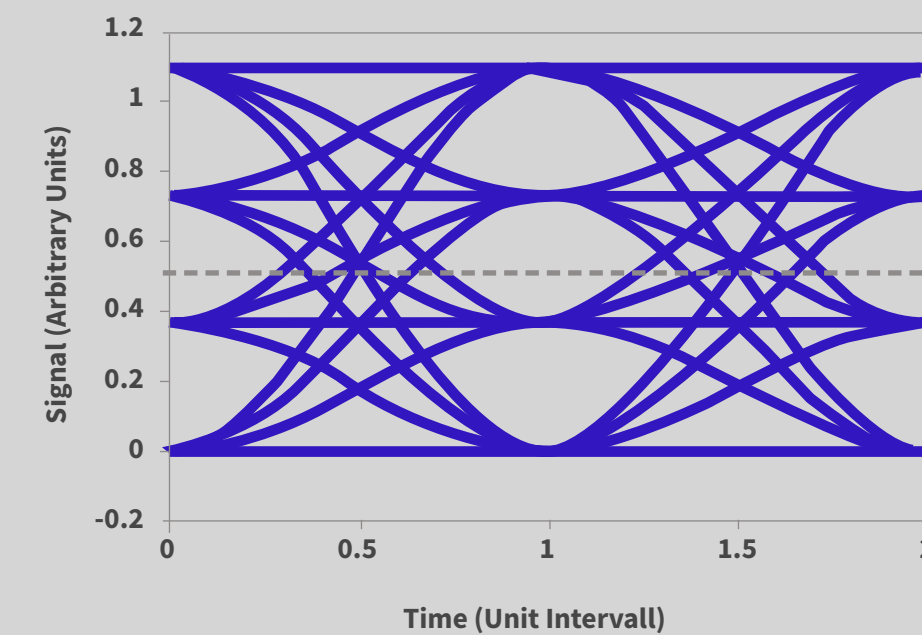
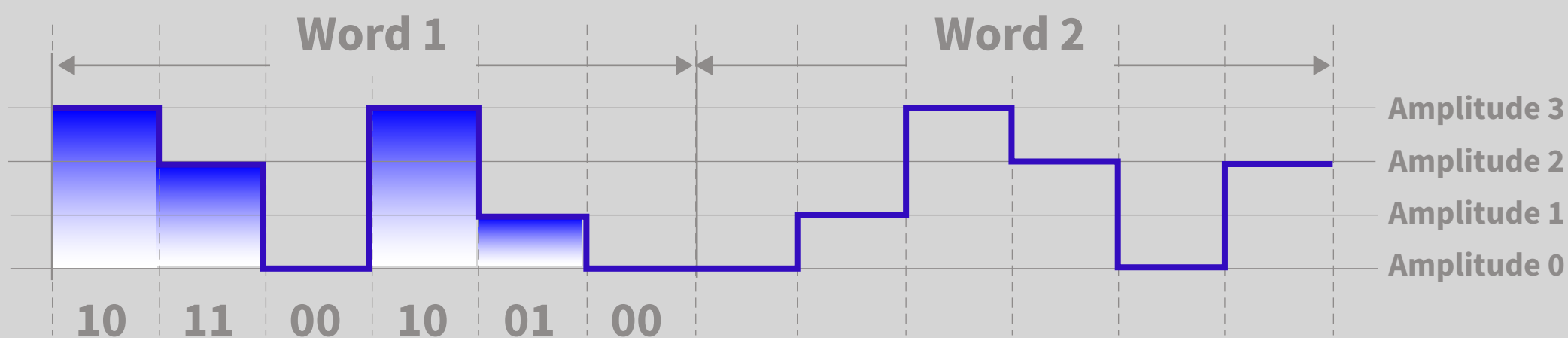
QSFP-DD - has the smallest power consumption, size, has great port density per 1U and is backwards compatible with QSFP, therefore it has high chance of becoming most widely used form factor for 400G Ethernet applications.

#PAM4 Modulation

Existing 1-100G Optical Transceivers use NRZ (Not Return to Zero) Encoding:



Existing 400G Optical Transceivers use PAM4 (Pulse Amplitude Modulation 4) Encoding:



PAM4

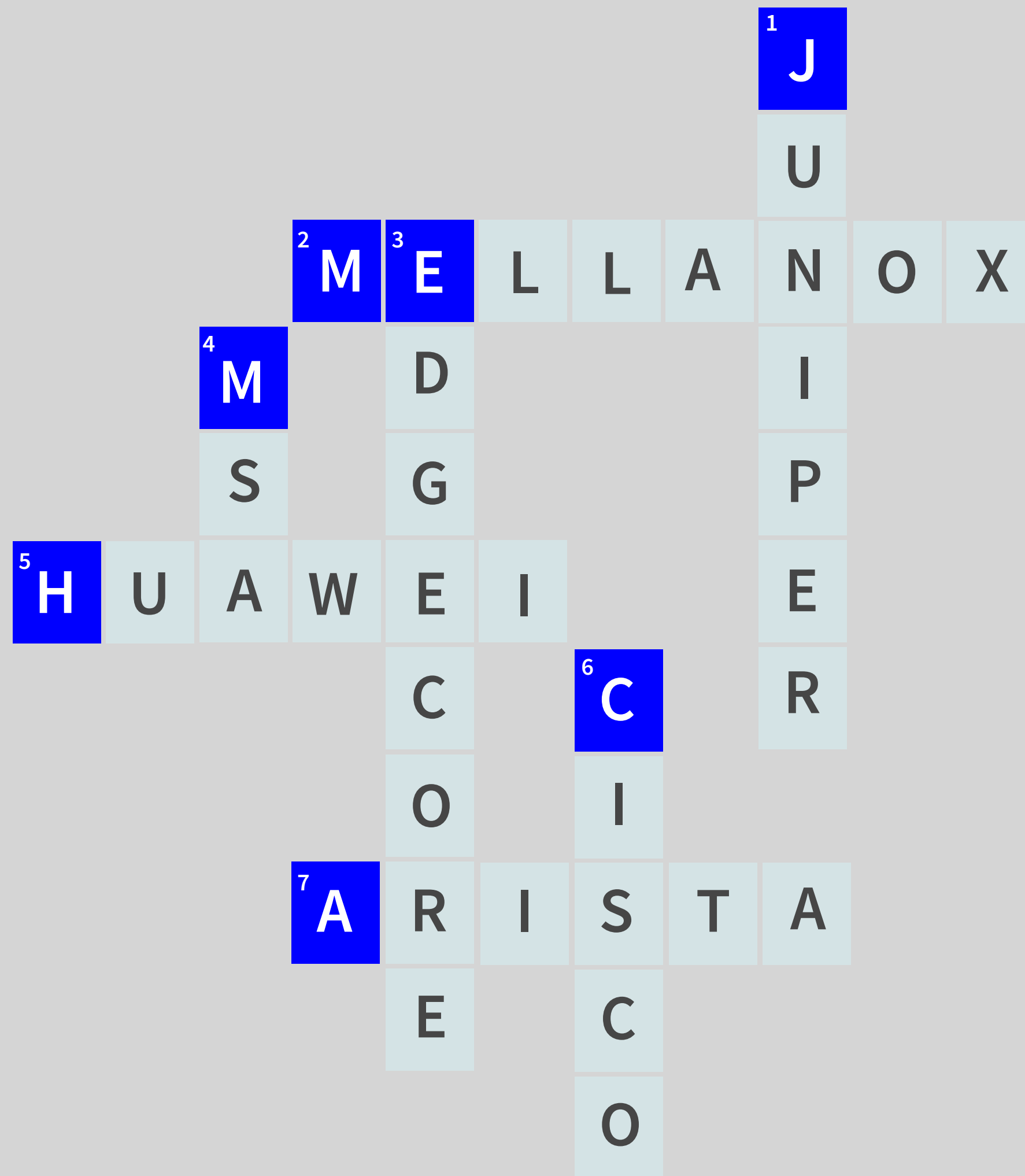
- ✚ Allows duplicate line information throughput (twice number of bits in same timeframe)
- ✚ Increases SNR (Signal-Noise Ratio) by -9.54 dB (Link Budget Penalty)
- ✚ Higher requirements for link quality, Clock stability and receiver quality

#EDGE 400G QSFP-DD



Product Code	400G-QSFP-DD-100	400G-QSFP-DD-500	400G-QSFP-DD-2	400G-QSFP-DD-2.1	400G-QSFP-DD-11	400G-QSFP-DD-40
Industry Name	400GBASE-SR8	400GBASE-DR4	400GBASE-DR4+	400GBASE-FR4	400GBASE-LR4	400GBASE-ER4 Lite
Tx/Rx Wavelength	850nm	4x1310nm PSM4	4x1310nm PSM4	1271/1291/1311/1331nm	1271/1291/1311/1331nm	1295/1300/1304/1309nm
Laser	VSCEL	EML	EML	EML	EML	EML
Modulation	PAM4	PAM4	PAM4	PAM4	PAM4	PAM4
Fiber Type	Multi-Mode Fiber (MMF)	Single-Mode Fiber (SMF)	Single-Mode Fiber (SMF)	Single-Mode Fiber (SMF)	Single-Mode Fiber (SMF)	Single-Mode Fiber (SMF)
Connectors	MTP/MPO-16	MTP/MPO-12	MTP/MPO-12	Double LC	Double LC	Double LC
Optical Budget	1.9 dB	3 dB	4 dB	4 dB	6.3 dB	18 dB
Max Distance	100m (OM4)	500m	2km	2km	10km	40km
Data Rate	425 Gbps	425 Gbps	425 Gbps	425 Gbps	425 Gbps	425 Gbps
FEC	Supported	Supported	Supported	Supported	Supported	Supported
DDM	Supported	Supported	Supported	Supported	Supported	Supported
Power Consumption	≤10W	≤12W	≤12W	≤12W	≤12W	≤12W
Temperature	Standard 0°-70°C	Standard 0°-70°C	Standard 0°-70°C	Standard 0°-70°C	Standard 0°-70°C	Standard 0°-70°C
For Latest Price	Click Here	Click Here	Click Here	Click Here	Click Here	Click Here

#EDGE 400G Compatibility



100% Compatible

With major brands such as Cisco, Arista, Juniper, Mellanox, Huawei, Edgecore & MSA*.

** As allways - all new technologies we recommend small scale tests before big implementations;*



Thank You!
edgeoptic.com