

Data Center Essentials Cabling to Last

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Data Consumption is increasing...

50 billion

DEVICES CONNECTED TO INTERNET IN
2020

Cisco

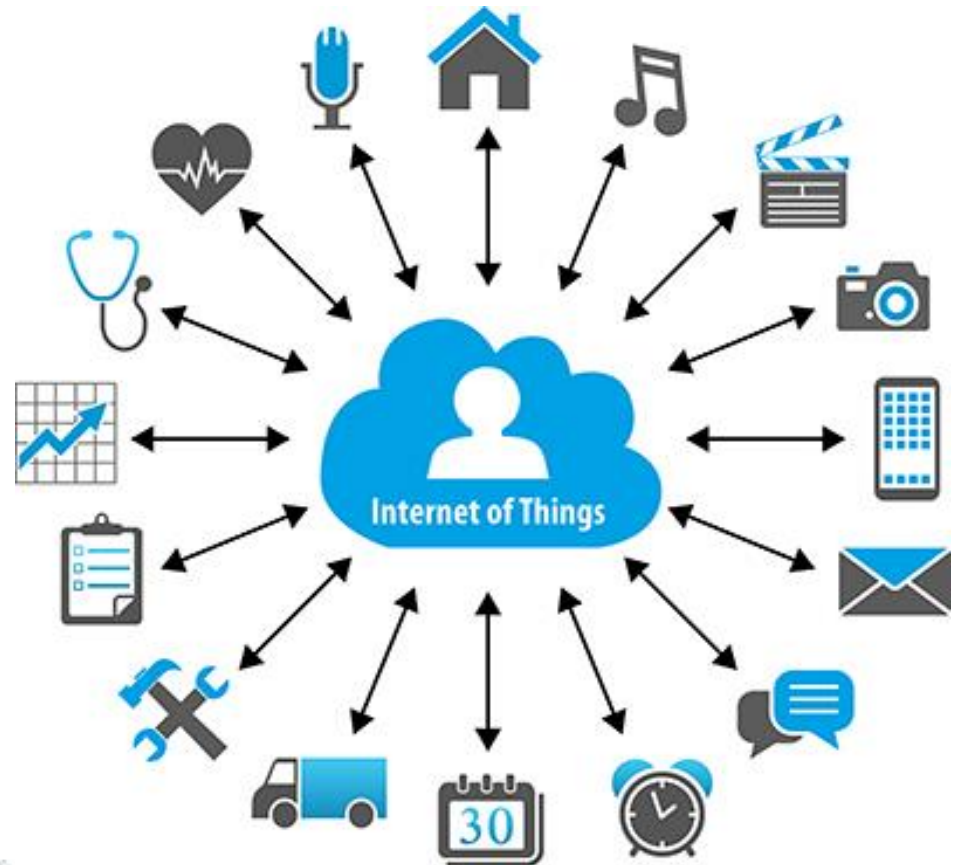
400 Zettabytes

IOT DATA GENERATION IN
2018

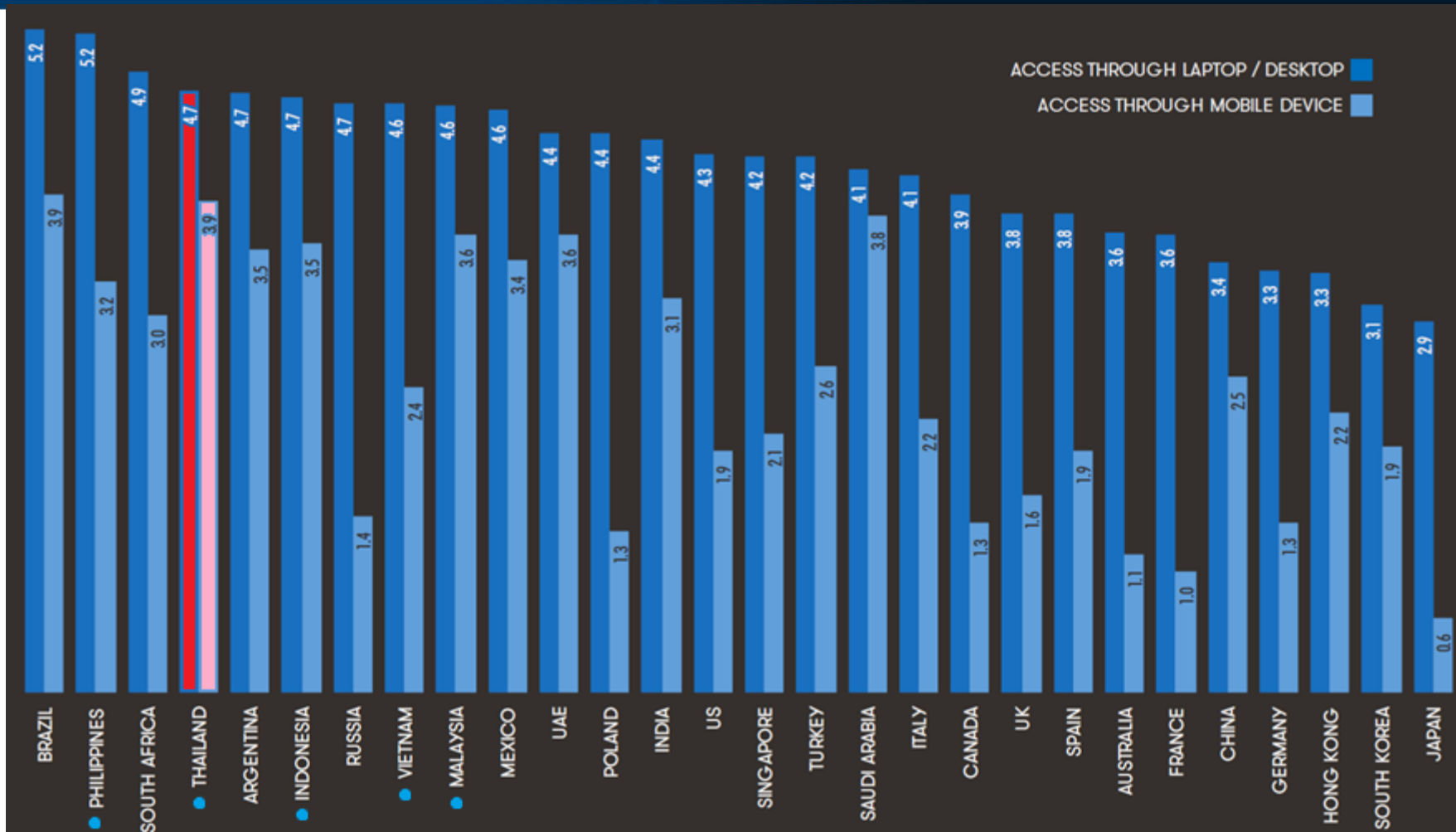
1 zettabyte



1 trillion
gigabytes



People's behavior is changing...



And the Data Center Market won't stop growing...

US\$ 359
million
by 2020

Research and Markets

Data Center market size in Southeast Asia

(revenue from IT equipment, power management systems, cooling solutions, general construction, racks, security and DCIM).



20.17%
CAGR

Research and Markets

Projected growth during the period
2016-2020 for SEA DC Market.



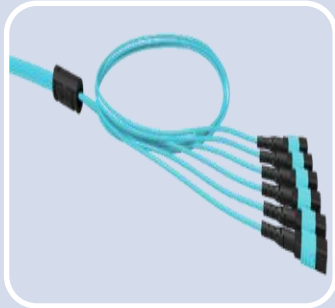
We'll need powerful networks



Data Centers



What to expect from networks



High Density



Modularity



Scalability



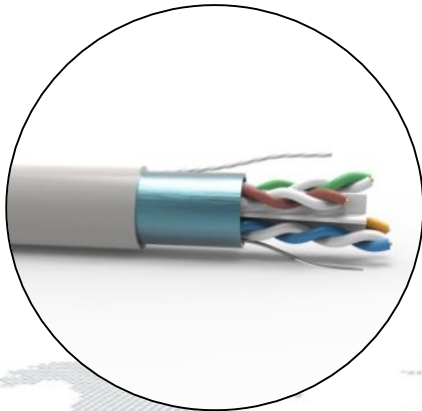
Performance

What to expect from networks

Optical Systems



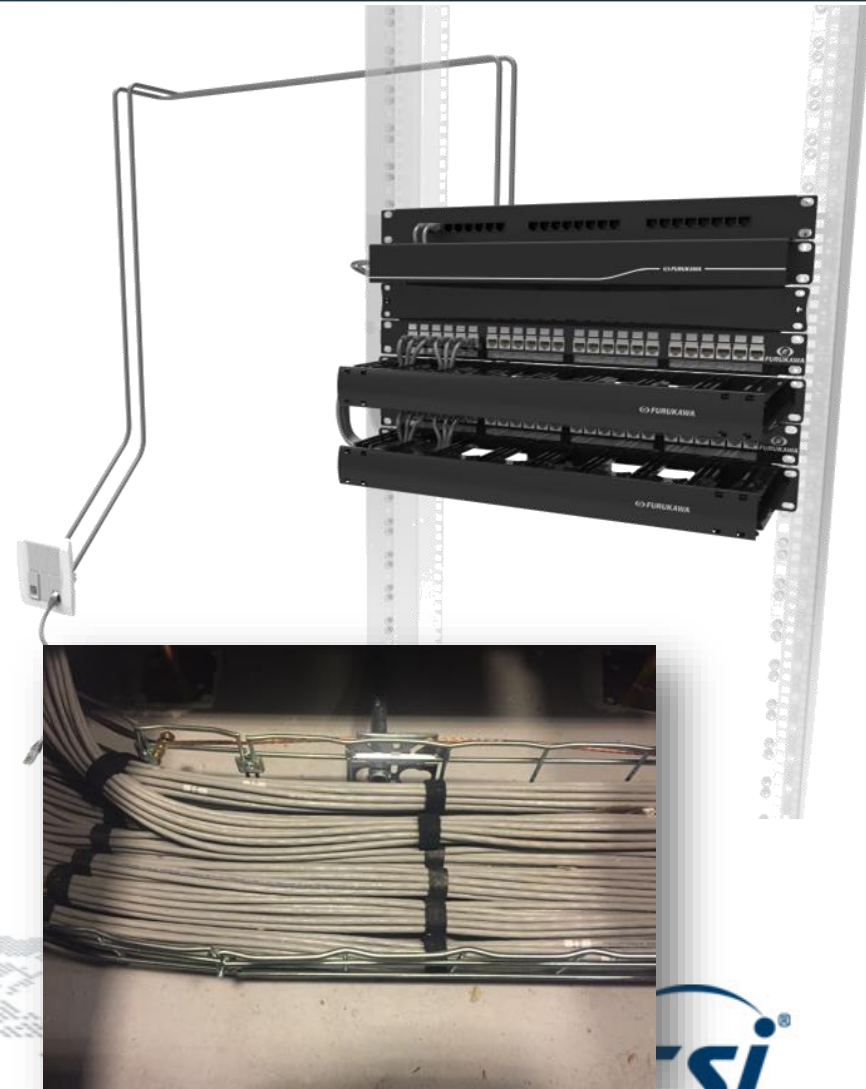
Copper Systems



Network Infrastructure

Data Center Solution – Copper Systems

- Categories 6, 6A and 8 (TIA-568-C.2-1, Jul.2016)
2.0 GHz, 30m and 2-connector channel, with a maximum permanent link of 24m;
- **Shielded** and Unshielded options;
- Different flame rate options (**LSZH**).



Data Center Solution – Copper Systems



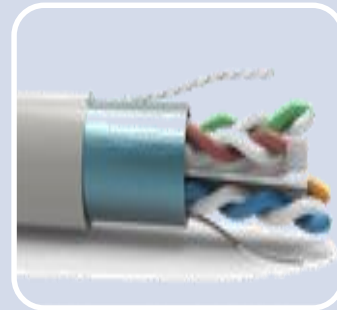
High Density



Modularity



Scalability



Performance

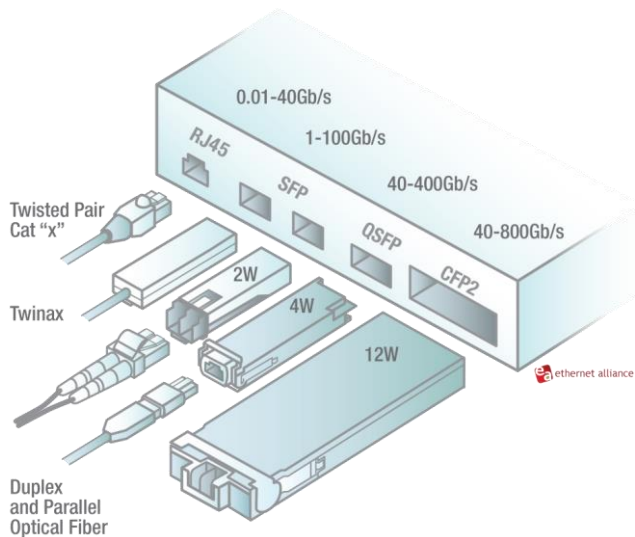
Data Center Solution – Copper Systems



ROADMAP 25/40GBASE –T

- **25 GBASE-T (IEEE 802.3by)**
- **40 GBASE-T (IEEE 802.3bq)**
 - Category 8
 - 30 m channel maximum length
- **100 GbE: without specification for Copper Channel**

Roadmap Ethernet



ETHERNET INTERFACES AND NOMENCLATURE

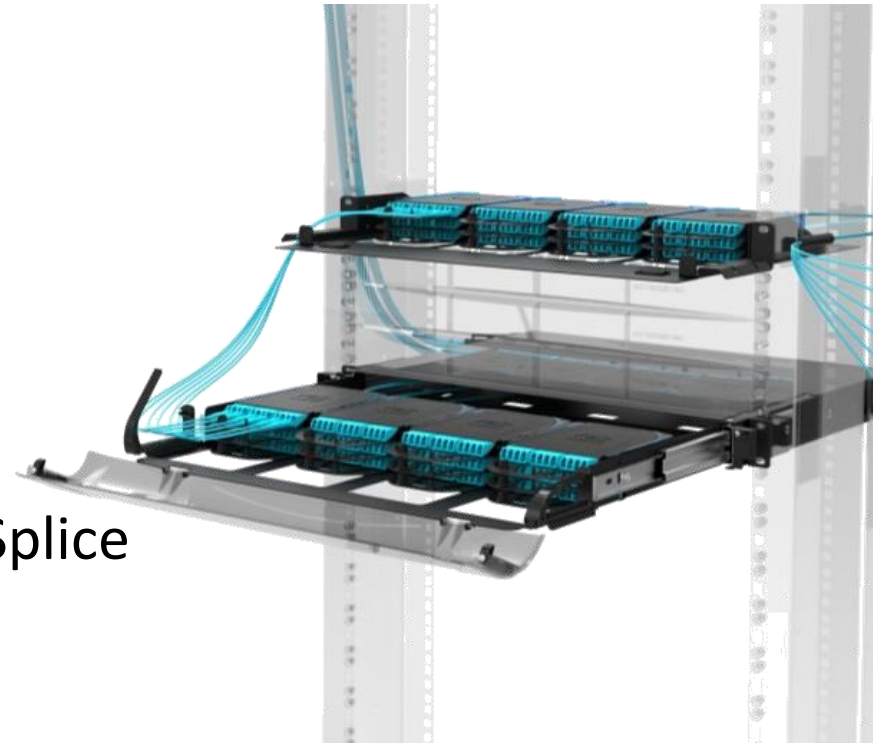
	Electrical Interface	Backplane	Twinax Cable	Twisted Pairs	MMF	Parallel SMF	2km SMF	10km SMF	40km SMF
10BASE-				T					
100BASE-				TX	FX			LX	
1000BASE-		KX	CX	T	SX			LX	
2.5GBASE-		KX		T					
5GBASE-		KR		T					
10GBASE-	SFI, XFI XSBI, XAUI	KX4, KR	CX4 SFP+DAC	T	SR			LR	ER
25GBASE-	25GAUI	KR	CR	T	SR			LR	ER
40GBASE-	XLAUI	KR4	CR4	T	SR4		FR	LR4	ER4
50GBASE-	50GAUI 50GAUI-2	KR, KR2	CR, CR2		SR		FR	LR	
100GBASE-	CAUI10 CAUI4 100GAUI-2	KR4, KR2	CR10, CR4, CR2		SR10 SR4 SR2	PSM4 DR	10X10 CWDM4 CLR4	LR4 10X10	ER4 10X10
200GBASE-	200GAUI-4 200GAUI-8	KR4	CR4		SR4	DR4	FR4	LR4	
400GBASE-	400GAUI-16 400GAUI-8				SR16	DR4	FR8	LR8	

Gray Text = IEEE Standard Red Text = In Standardization
Blue Text = Non-IEEE standard but complies to IEEE electrical interfaces

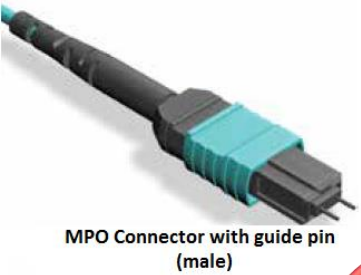


Data Center Solution – Optical Systems

- Singlemode, OM3, OM4 and OM5
(TIA 568.3-D, Oct.2016)
- LC and MPO connectors
(TIA/EIA-604, FOCIS 10 and FOSIS 5)
- **Pre Terminated** Systems or Fusion Splice Systems;
- Different flame rate options (**LSZH**).



Data Center Solution – Optical Systems

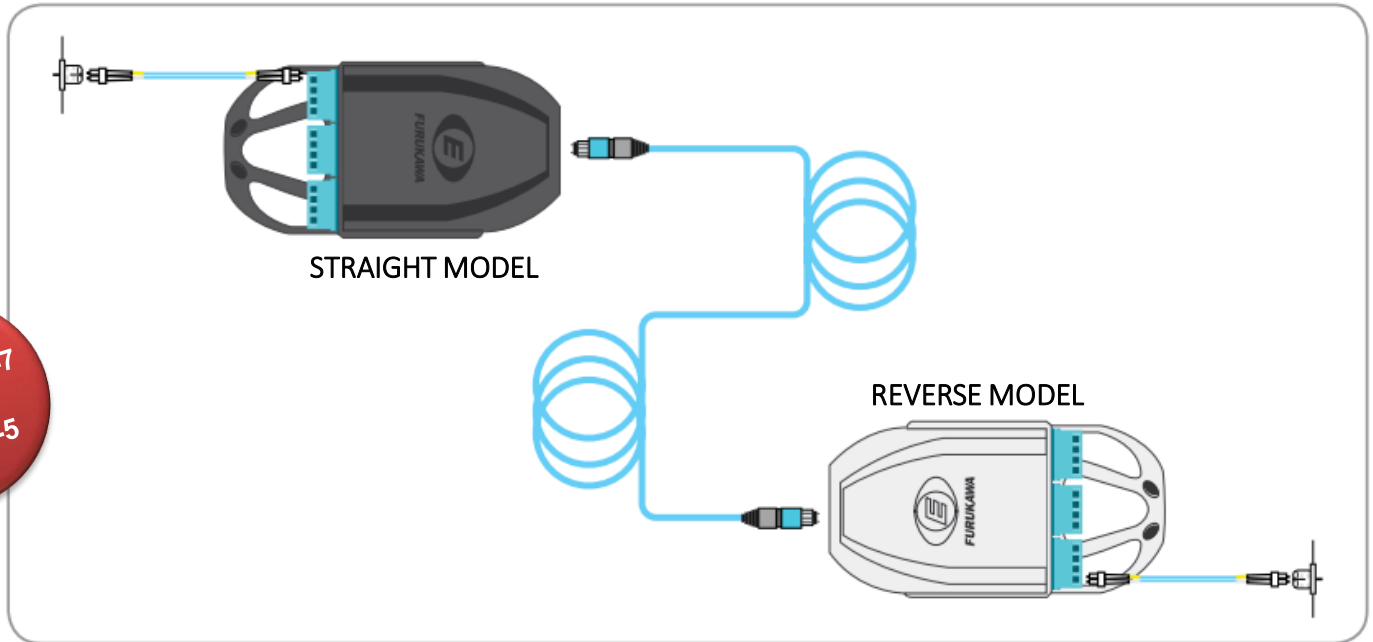


MPO Connector with guide pin (male)



MPO Connector without guide pin (female)

IEC-61754-7
and
TIA-604-5



Polarity for arrays

Near / Far End	Fiber sequence (viewing the array connector plug end face with key up)											
Near	1	2	3	4	5	6	7	8	9	10	11	12
Far	12	11	10	9	8	7	6	5	4	3	2	1



Figure 11 – Type-B:1-1 array patch cord and array cable (key-up to key-up)

End	Fiber sequence (viewing the array connector plug end-face with key up)											
2-row plug, top row	1	2	3	4	5	6	7	8	9	10	11	12
2-row plug, bottom row	1	2	3	4	5	6	7	8	9	10	11	12
1-row plugs	12	11	10	9	8	7	6	5	4	3	2	1

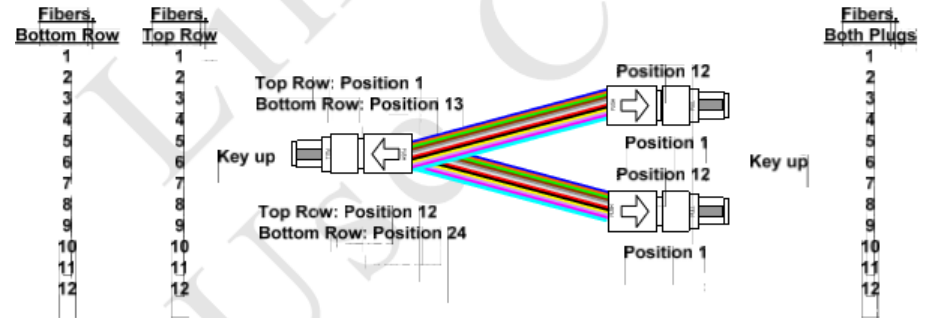


Figure 12 – Type-B:2-1 array patch cord (key-up to key-up)

(TIA 568.3-D, Oct.2016)

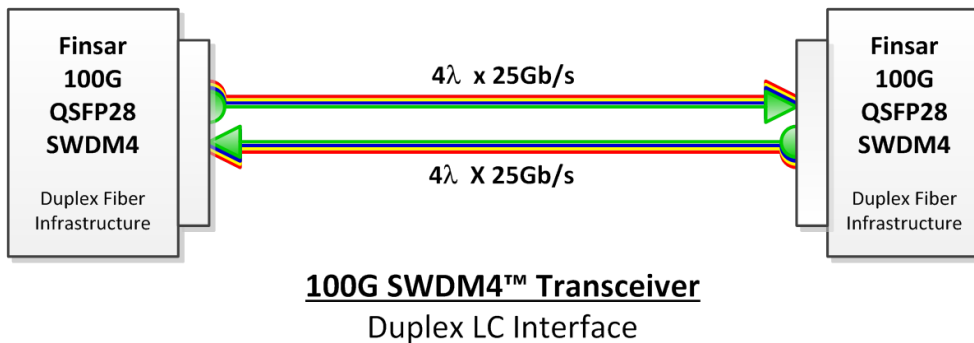
WBMMF (OM5)



Optical fiber type (cabled fiber type) ¹	Wavelength (nm)	Maximum attenuation (dB/km)	Minimum overfilled modal bandwidth-length product (MHz.km) ²	Minimum effective modal bandwidth-length product (MHz.km) ²
850 nm Laser-Optimized 50/125 μ m Multimode TIA 492AAAC (OM3)	850 1300	3.0 1.5	1500 500	2000 Not Required
850 nm Laser-Optimized 50/125 μ m Multimode TIA 492AAD (OM4)	850 1300	3.0 1.5	3500 500	4700 Not Required
Wideband Laser-Optimized 50/125 μm Multimode TIA 492AAAE	850 953 1300	3.0 2.3 1.5	3500 1850 500	4700 2470 Not Required
Single-mode Indoor-Outdoor TIA 492CAAB	1310 1383 1550	0.5 0.5 0.5	N/A N/A N/A	N/A N/A N/A
Single-mode Inside Plant TIA 492CAAB	1310 1383 1550	1.0 1.0 1.0	N/A N/A N/A	N/A N/A N/A
Single-mode Outside Plant TIA 492CAAB (OS2) ³	1310 1383 1550	0.4 0.4 0.4	N/A N/A N/A	N/A N/A N/A

WBMMF (OM5)

SWDM - Short Wavelength Division Multiplexing



1 Links 100G with LC duplex

2 Links 400G with 8 fibers.

3 Power dissipation – Low ~ 1,5 W

Multiple channels and a pair of MM- OM5 Optical Fibers:
40 Gbps = $4 \times \lambda$ 10Gbps **100 Gbps = $4 \times \lambda$ 25Gbps**

Application evolution over multimode and the impact of WBMMF on fiber plant

Transmission	40GbE Tx Rx	100GbE Tx Rx	400GbE Tx Rx
10G parallel lanes			N/A
25G parallel lanes	N/A		
10G or 25G with WDM and/or parallel lanes			

Note: Multiple lines represent parallel lanes and line with multiple colors represents WDM (multiple wavelengths within same lane).

Channel Attenuation

Application	OM2	OM3	OM4 and OM5
Ethernet 10GBASE-LX4	2.0 dB / 300m	2.0 dB / 300m	2.0 dB / 300m
Ethernet 25GBASE-SR	-	1.8 dB / 70m	1.9 dB / 100m
Ethernet 40GBASE-SR4	-	1.9 dB / 100m	1.5* dB / 150m
Ethernet 100GBASE-SR4	-	1.8 dB / 70m	1.9 dB / 100m
Ethernet 100GBASE-SR10	-	1.9 dB / 100m	1.5* dB / 150m

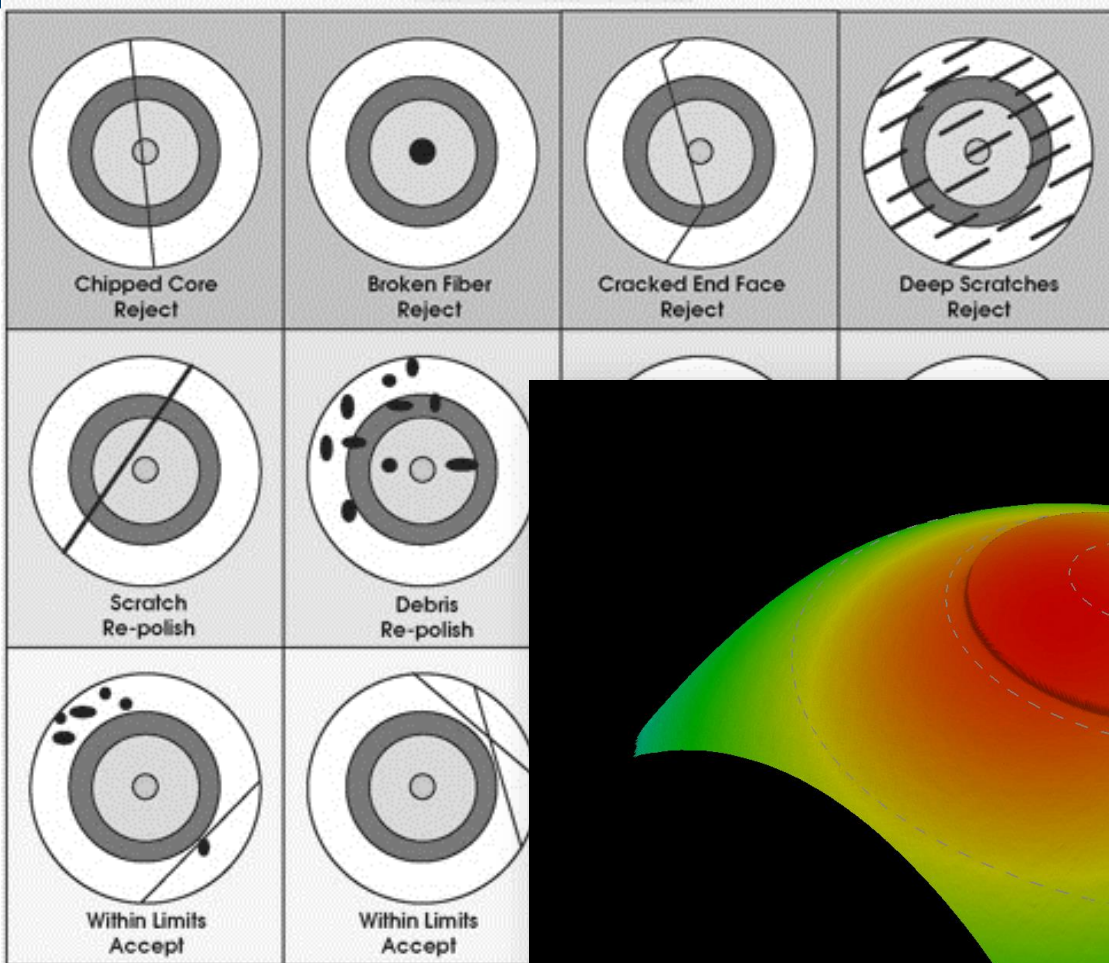
*1.0 dB total connection and splice loss allowance per IEEE 802.3.

Channel Attenuation

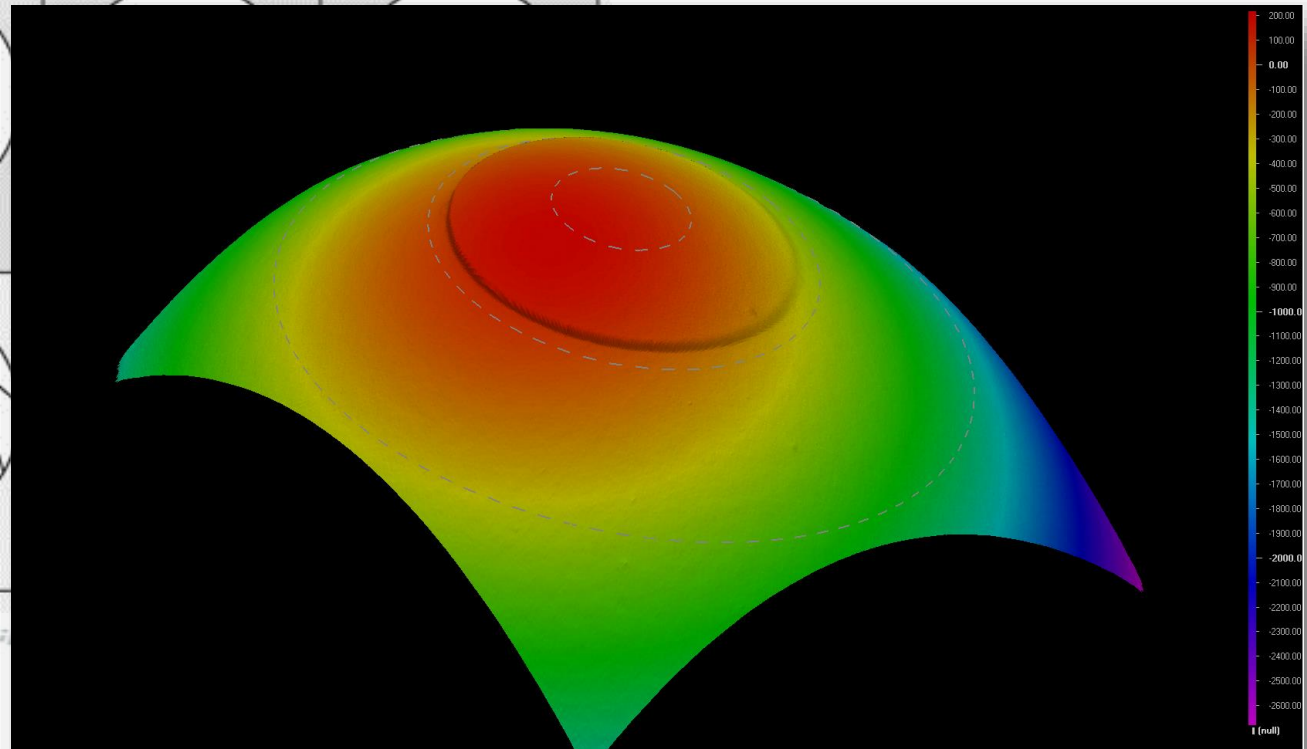


TIA-569
Pathways &
Spaces

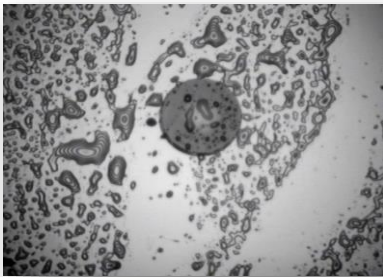
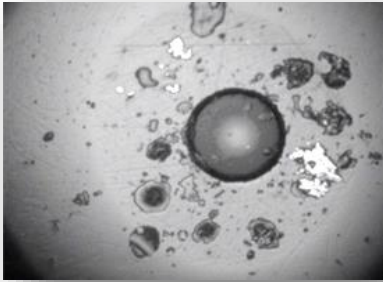
Channel Attenuation



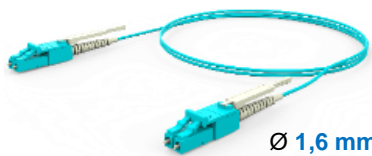
IEC 61300-3-47



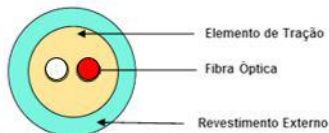
Channel Attenuation



Other helpful features

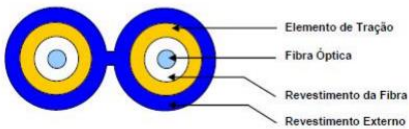


Ø 1,6 mm
e IL < 0,15 dB
**PC DUPLEX UNIBOOT
LOW LOSS**



Elemento de Tração
Fibra Óptica
Revestimento Externo

UNIBOOT Patch Cords

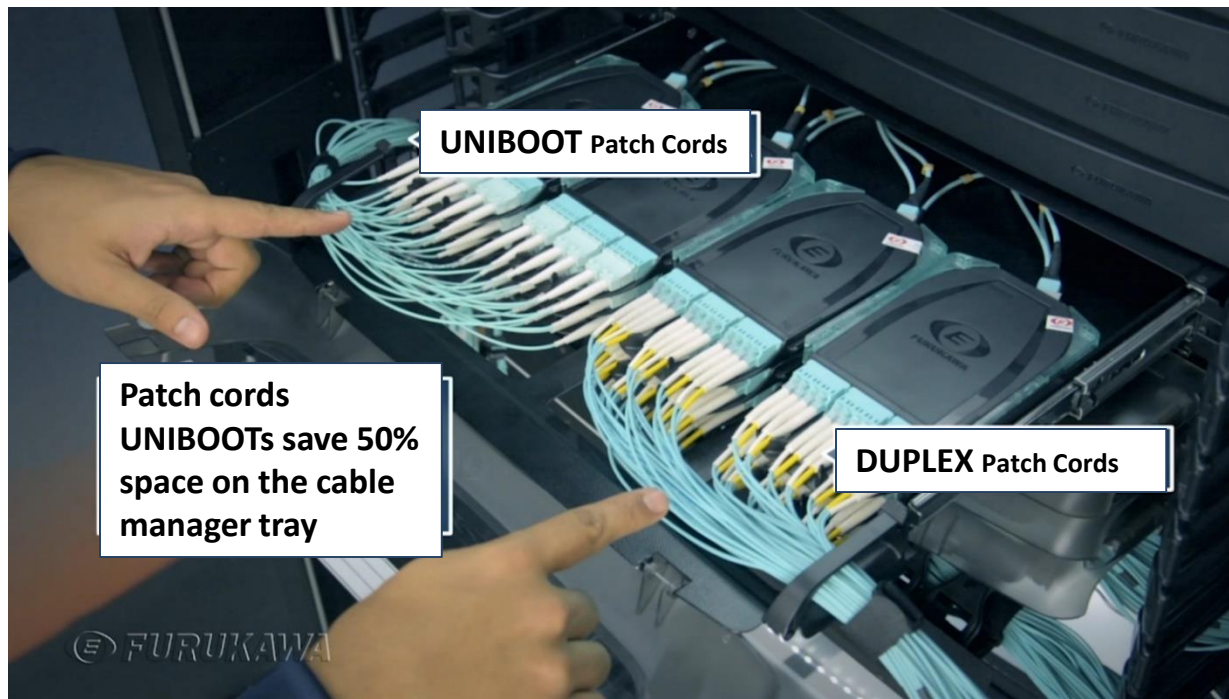


Elemento de Tração
Fibra Óptica
Revestimento da Fibra
Revestimento Externo

DUPLEX Patch Cords



FURUKAWA CABLING SYSTEM



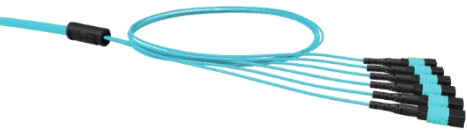
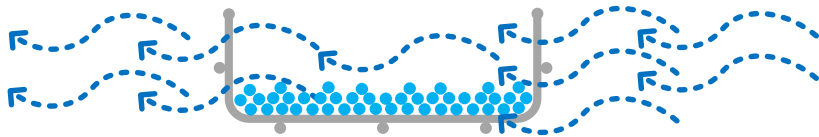
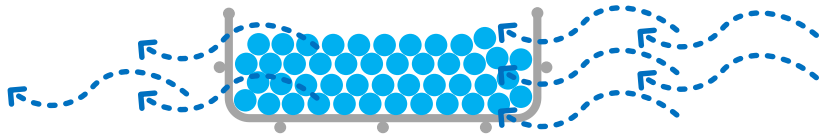
UNIBOOT Patch Cords

Patch cords
UNIBOOTs save 50%
space on the cable
manager tray

DUPLEX Patch Cords



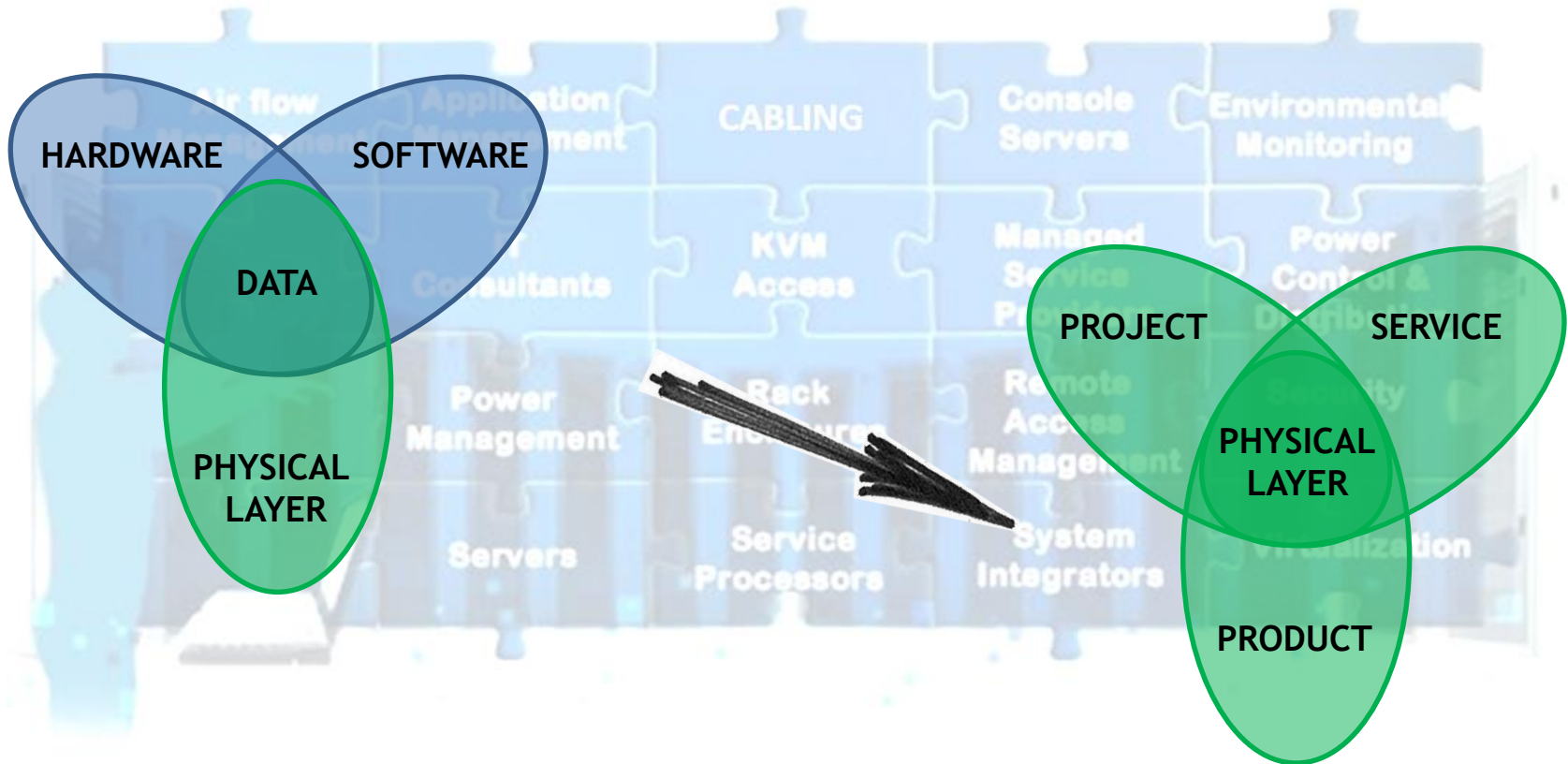
Other helpful features



Ø 13 mm
SERVICE CABLE 144FO

- Energy and Cooling systems compete for space with Cabling system.
- Integrated projects allow optimization of available space under technical floor and computer room.
- Optical cables that combine higher fiber count with smaller diameter reduce space and weight occupation.

Other helpful features



Importance of Cabling



Importance of Cabling



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