



Data Center Copper Cabling up to 40GBase-T

Presenter:

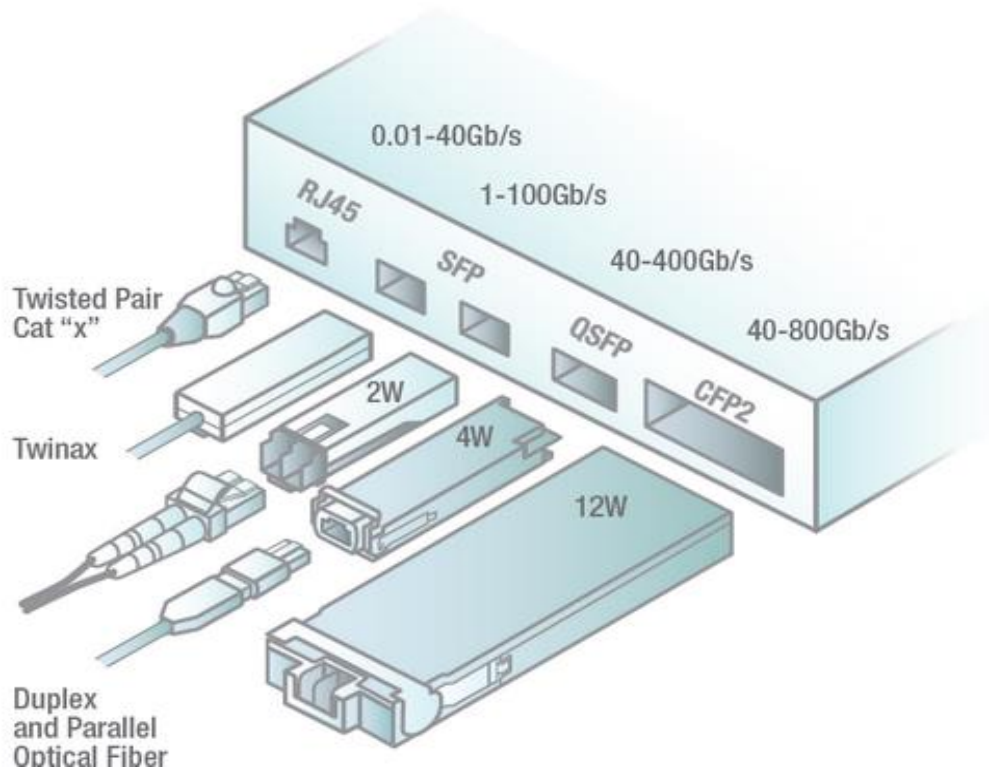
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Data Centre Expert, Datwyler



40GbE Alternatives

1. Fiber Optic: LC duplex (BiDi, SWDM), parallel (MTP/MPO)
2. Active Optical Cable (AOC)
3. Twinax Direct Attached Copper (DAC)
4. Twisted Pair Copper Class I link with RJ45 Interface (Cat 8.1)



Comparison in 40GbE Cabling

Method of Connection	OM4 Duplex (BiDi)	OM5 Duplex (SWDM)	OM4 Parallel (MTP)	OM4 AOC	Twinax DAC	Class I with RJ45
Connecting Interface	QSFP+ LC	QSFP+ LC	QSFP+ MTP	QSFP+	Twin-axial Plug	RJ45
Transceiver Price	US\$300	Coming, will be more costly than BiDi	US\$49	Not sold separately	No required	Not required
Link Cabling Price		OM4/5 cable is US\$ xx/m		US\$130 (5m)	US\$70 (5m)	US\$ x/m
Switch Price/port	\$\$\$\$	\$\$\$\$\$\$	\$\$\$	\$\$\$\$	\$\$\$	\$
Port Energy Consumption	All transceivers are active components to convert between optical & electrical signals				Some power loss at QSFP+ plugs	Entirely passive
Link Distance	150m	150m	350m	100m	7m	30m
Backward compatible with lower GbE	Yes	No	Yes	No	No	Yes
IEEE Standard Compliance	No	No	Yes	No	Yes	Yes
Structured Cabling System?	Yes	Yes	Yes	No	No	Yes
Use Case in DC	Core-Aggregation-Access, Spine-Leaf, Fat Tree				Top of Rack	EoR, MoR, ToR



ISO/IEC 11801 -1 Channel

Class I and Class II

- ISO/IEC 11801 General Cabling for Customer Premises is being restructured including substantial updates. It is going to be published as edition 3 in Q4 2017:
 - 11801-1 Generic Cabling for Customer Premises
 - 11801-2 Office Premises
 - 11801-3 Industrial premises
 - 11801-4 single-tenant homes
 - 11801-5 Data Centres
 - 11801-6 Distributed Building Services
- Class I and Class II cabling has been added
- Components Cat 8.1 and Cat 8.2 have been added in support of Class I and Class II Channel



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Supported application by Category 8 Cabling

- IEEE 802.3bq 25G/40GBASE-T published 8 September 2016
 - Defines minimum transmission characteristics for the application on a twisted pair channel
- ANSI/TIA-568-C.2-1 published 30 June 2016
 - Defines Category 8 Channels and Permanent Links
- ANSI/TIA-1152-A published 10 November 2016
 - Defines tester measurement and accuracy requirements for Category 8
- ISO/IEC Standards expected in 2017
 - ISO/IEC 11801-99-1 Class I/II Channels and Permanent Links
 - IEC 61935-1 Ed 5.0 tester measurement and accuracy requirements



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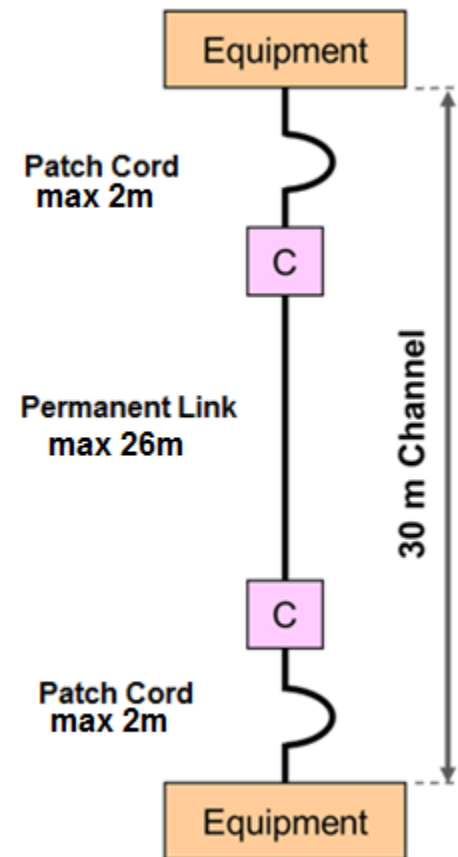
IEEE 802.3bq (25G/40GBASE-T)

Goals 25G/40GBASE-T

1. To eliminate length restriction of Twinax (7 m)
2. To increase energy efficiency
3. To cut cost.

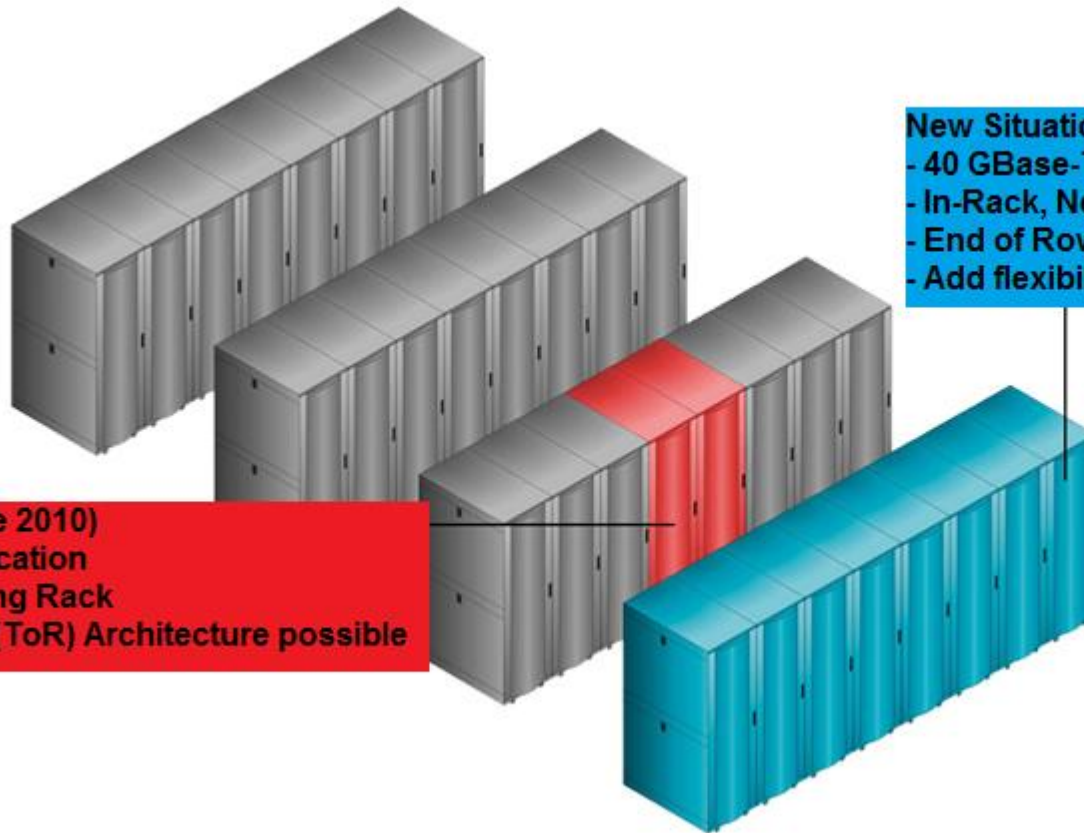
Topology of 25/40G Channel

1. Server to Switch up to 30 m, with 2 connectors
 - EoR (End of Row), MoR (Middle of Row)
2. Direct patch: up to 10 m length
 - ToR (Top of Rack)



NextGBASE-T Application

25G/40GBASE-T in Data Center (Server-to-Switch)



Today Situation (since 2010)

- 40 GBase-CR4 Application
- In-Rack, Neighbouring Rack
- Only at Top of Rack (ToR) Architecture possible

New Situation (2016)

- 40 GBase-T Application
- In-Rack, Neighbouring Rack
- End of Row (EoR), Middle of Row (MoR)
- Add flexibility of network architecture



NextGBASE-T Application overview DC cabling design

Channel in Row

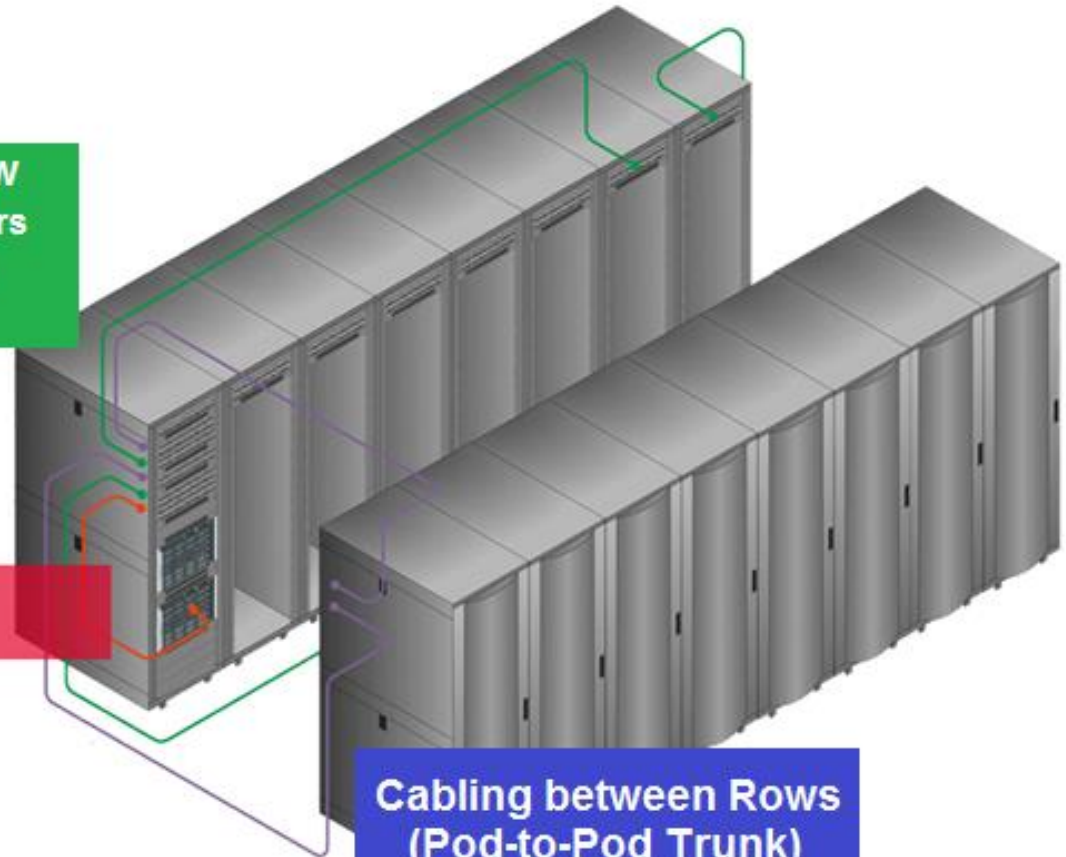
- upto 2 connectors
- Cu twisted pairs
- EoR, MoR

Switch Port Trunks

- Cabling of Equipment
- Cu twisted pairs
- Outlet to plug Trunk

Cabling between Rows (Pod-to-Pod Trunk)

- Cu Twisted Pairs
- FO (>30m)





Copper Twisted Pair Standards

Comparison: TIA vs IEC

Freq MHz	TIA Permanent Link, Channel & Component	IEC Components	IEC Permanent Link & Channel	Cable Construction	Equipment Interface	Speed bps (IEEE)	Length	
							Permanent Link	Channel
100	Cat5e	Cat5e	Class D	Unshielded	RJ45	100	90m	100m
250	Cat6	Cat6	Class E	Unshielded, Shielded	RJ45	1G	90m	100m
500	Cat6A	Cat6A	Class E _A		RJ45	10G	90m	100m
600	Not recognized	Cat7	Class F	S/FTP, F/FTP	Not on equipment	10G	90m	100m
1000	Not recognized	Cat7A	Class F _A	S/FTP	Not on equipment	10G	90m	100m
2000	Cat8	Cat8.1	Class I	S/FTP S/UTP	RJ45	40G	24m	30m
2000	Cat8	Cat8.2	Class II	S/FTP	Not Compatible with RJ45	40G	24m	30m





Permanent Link & Channel: IEC Class vs TIA Cat


 ISO/IEC CLC 	
Components	Links/Channels
	Class A
	Class B
	Class C
Category 5	Class D
Category 6	Class E
Category 6 _A	Class E _A
Category 7	Class F
Category 7 _A	Class F _A
Category 8.1	Class I
Category 8.2	Class II

 ANSI/TIA	
Components	Links/Channels
Category 3	Category 3
Category 5	Category 5
Category 6	Category 6
Category 6A	Category 6A
Category 8	Category 8



Connection Category: IEC vs TIA

 ISO/IEC CLC 							
Modular Plug/cord	Modular Connector Category						
	5	6	6 _A	7	7 _A	8.1	8.2
Category 5	5						
Category 6		6					
Category 6 _A			6 _A				
Category 7				7			
Category 7 _A					7 _A		
Category 8.1						8.1	
Category 8.2							8.2
	Connection Category						

 ANSI/TIA					
Modular Plug/cord	Modular Connector Category				
	3	5	6 _A	6 _A	8
Category 3	3				
Category 5		5			
Category 6			6		
Category 6 _A				6 _A	
Category 8					8
	Connection Category				

Cables and connections of different Categories may be mixed within a channel, however the resultant cabling performance will be determined by the Category of the lowest performing component.

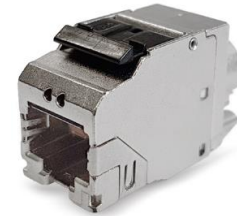


ISO/IEC 11801 Class I Channel

Cat 8.1

- ISO/IEC 11801-1 describes the Class I Channel:

- Connector Type: **RJ45**
 - backwards compatible to Cat 6_A, 6 and 5e
- Frequency range: **2000 MHz** (20 x Frequency range of Cat 5e!)
- Cable Type: screened only; S/UTP or S/FTP set-up
- Channel configuration:
 - max. **26 m with max. 2 connectors and max 2 x 2 m patch cord**
OR
 - max. **10m patch cord only** (“direct patch”)
- Environment to be used: Data Center
- Extrapolated limit lines from Class E_A



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ISO/IEC 11801 Class II Channel

Cat 8.2

- ISO/IEC 11801-1 describes the Class II Channel:

- Connector Type: **ARJ45 or TERA™**

- backwards compatible to Cat 7_A and 7



- Frequency range: **2000 MHz** (20 x Frequency range of Cat 5e!)

- Cable Type: screened only; S/UTP or S/FTP set-up

- Channel configuration:

- max. **26 m with max. 2 connectors and max 2 x 2 m patch cord**
OR

- max. **10m patch cord only** (“direct patch”)

- Environment to be used: Data Center

- Extrapolated limit lines from Class F_A



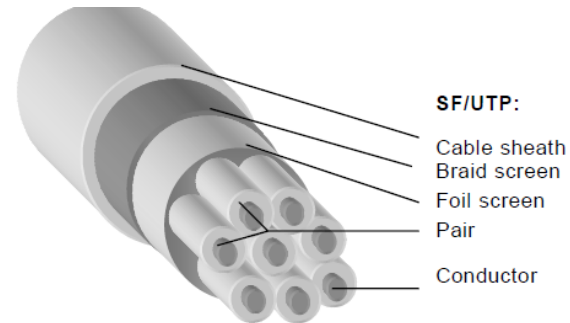
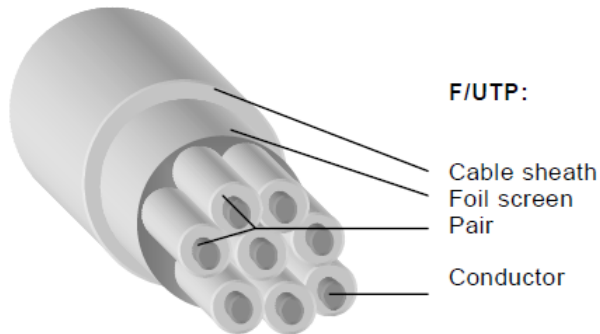
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ISO/IEC 11801 Class I & II Channel

- Cable Designs in support of Cat 8, Class I

- overall screen
- no individual pair screen



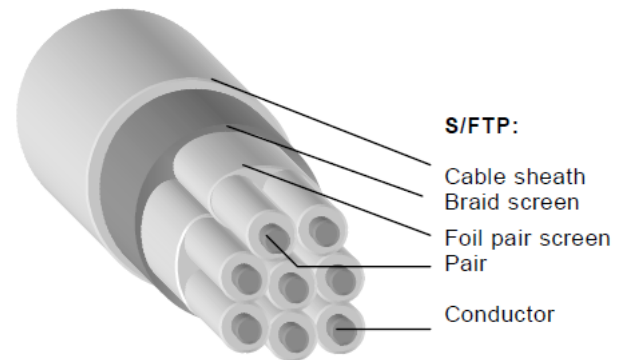
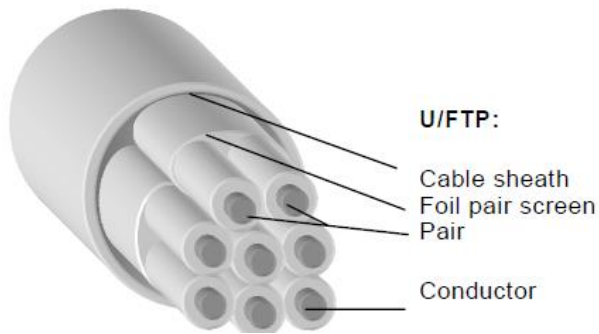
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ISO/IEC 11801 Class I & II Channel

- Cable Designs in support of Cat 8, Class I and Class II

- overall screen (recommended)
- individual pair screen



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Performance Testing Class I



- Field Tester Requirements:

- Accuracy Level

- Level 2G

- Test Frequency:

- 2000 MHz

- Test Sets

- Permanent Link Class I

- Channel Class Class I



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Performance Testing Class I



Cable ID: M-Cat.8.1 24m PL ISO

Date / Time: 03/15/2017 02:36:27 PM

Headroom 4.4 dB (NEXT 36-45)

Test Limit: ISO11801 PL Class I

Cable Type: Dätwyler Cat 8.2 CU 8203

NVP: 72.7%

Software Version: V5.0 Build 3

Limits Version: V5.0

Calibration Start Date:

Main (Module): 03/02/2017

Remote (Module): 03/02/2017

Test Summary: PASS

Model: DSX-8000

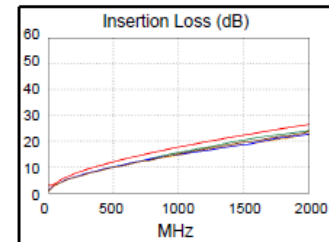
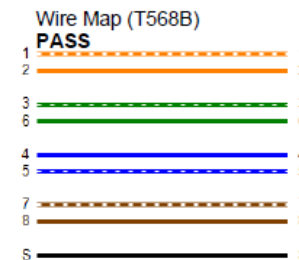
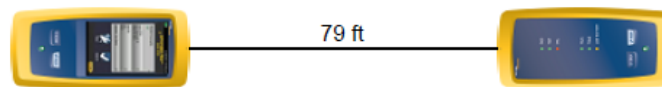
Main S/N: 1652170

Remote S/N: 1652216

Main Adapter: DSX-PLA804

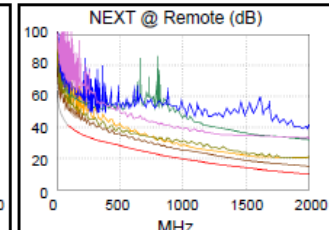
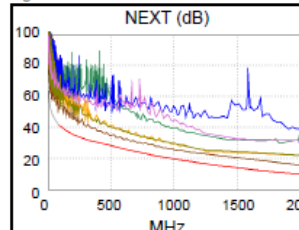
Remote Adapter: DSX-PLA804

Length (ft)	[Pair 12]	79
Prop. Delay (ns), Limit 147	[Pair 45]	113
Delay Skew (ns), Limit 14	[Pair 45]	3
Resistance (ohms), Limit 6.00	[Pair 45]	3.49
Resist. Unbal. (ohms), Limit 0.150	[Pair 78]	0.006
Resist. P2P Unbal. (ohms), Limit 0.120	[Pair 45-78]	0.008
Insertion Loss Margin (dB)	[Pair 36]	2.2
Frequency (MHz)	[Pair 36]	2000.0
Limit (dB)	[Pair 36]	26.5



Worst Case Margin Worst Case Value

	MAIN	SR	MAIN	SR
PASS				
Worst Pair	36-45	36-45	36-45	36-45
NEXT (dB)	5.2	4.4	6.2	5.3
Freq. (MHz)	1652.	1586.	2000.	2000.
Limit (dB)	12.5	13.1	9.6	9.6
Worst Pair	36	36	36	36
PS NEXT (dB)	5.4	4.8	7.5	6.1
Freq. (MHz)	1460.	1584.	2000.	1980.
Limit (dB)	11.3	10.1	6.6	6.8



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Thank you



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