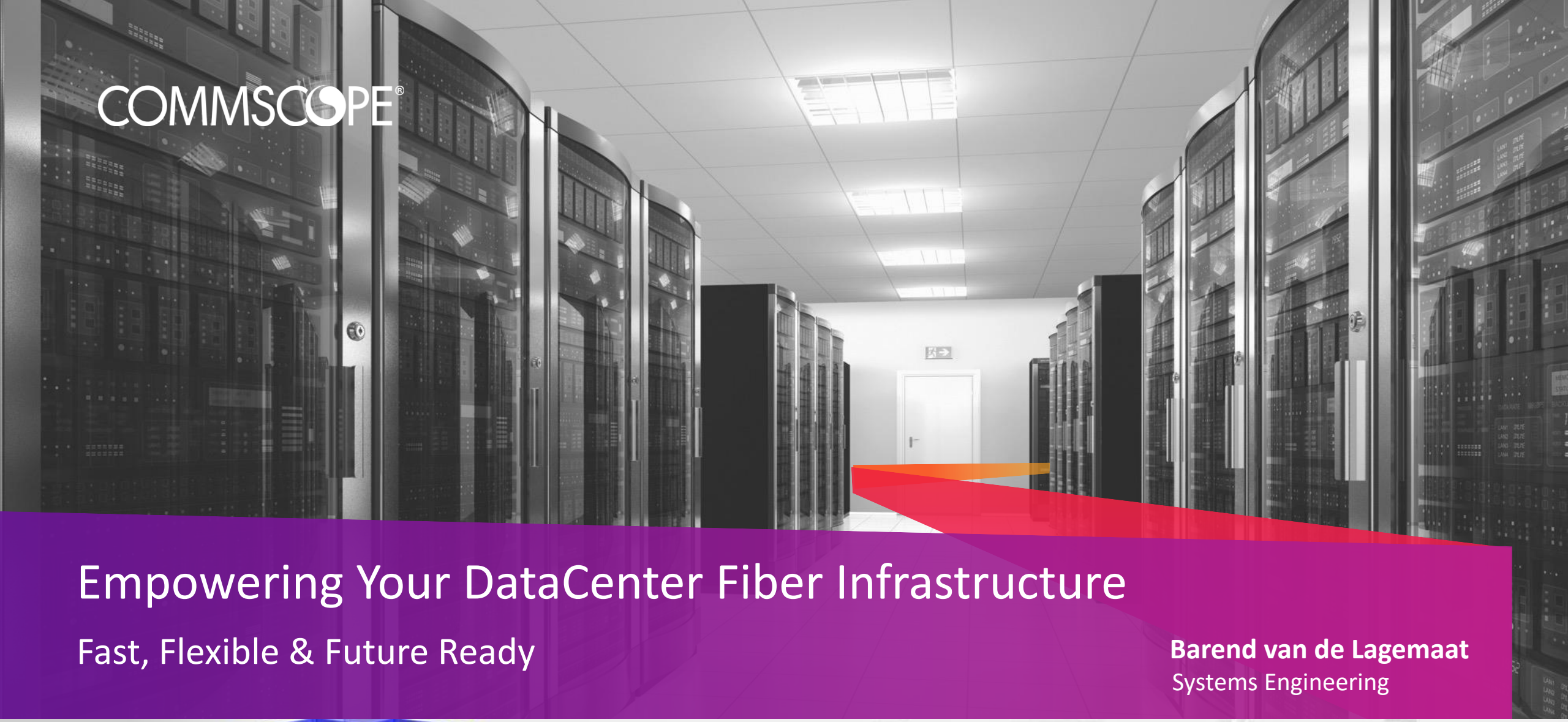

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Empowering Your DataCenter Fiber Infrastructure

Fast, Flexible & Future Ready

Barend van de Lagemaat
Systems Engineering

FHI IT INFRA
IT INFRA
HET KENNISEVENT OVER COMPUTERRUIMTES, DATACENTERS EN CLOUD COMPUTING
16 november 2023
1931 Congrescentrum 's-Hertogenbosch

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Network, Intelligent Cellular & Security Solutions

Connectivity & Cable Solutions

Outdoor Wireless Networks

Home Networks

Access Network Solutions

Connecting The Future

$8.5B
revenue (2021)

30K
employees

15K
patents

$800M
R&D Investment

Global
R&D, manufacturing & distribution

10K
global partners

Committed
to environmental & social sustainability

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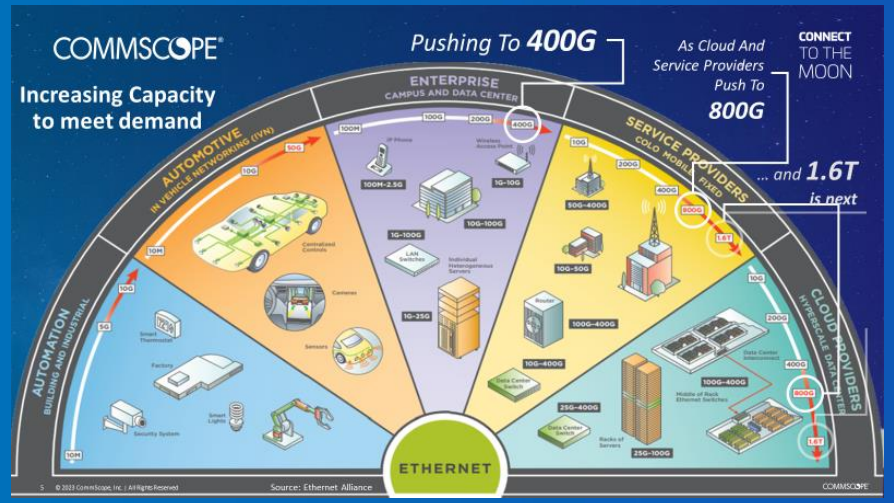
Common DC Infrastructure Considerations – Relevant to ALL Data Centers

Upgradeability

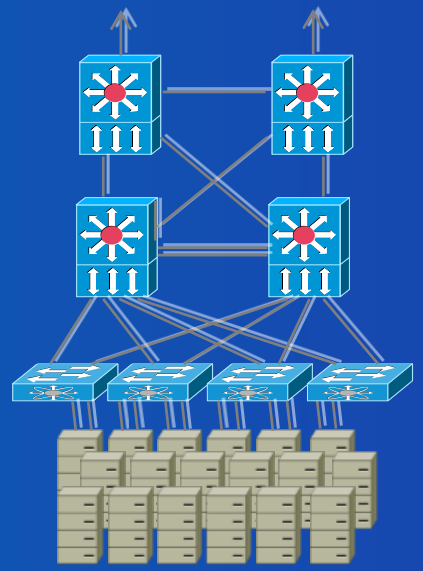
Flexibility

Scalability

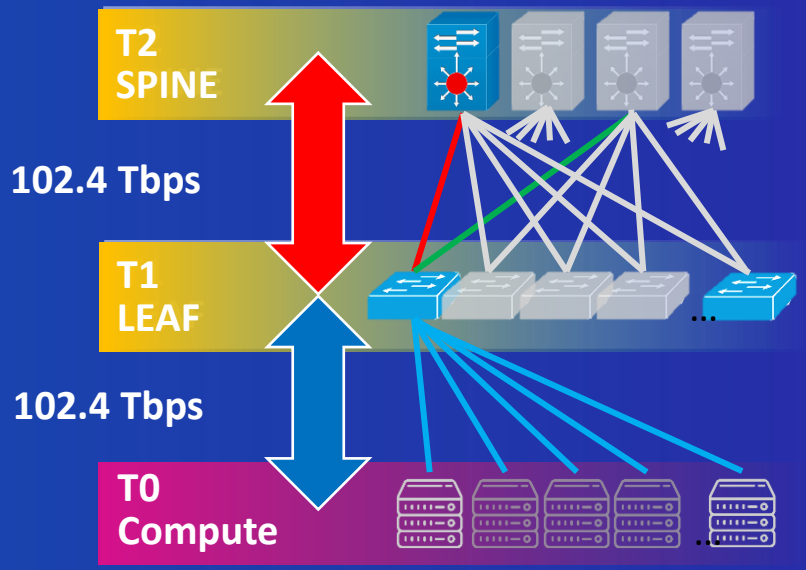
Balancing Capacity vs Cost



New Technology Impact on Architecture



Size and Speed of Deployment



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Mode	Data Rate	Lane Speed	Standard or MSA	PMD	Fiber Count	Connectors	Reach OM4/5 - SM
Multimode	100G	100G	802.3db	100G-VR1	2	LC	30/50m
	100G	100G	802.3db	100G-SR1	2	LC	70/100m
	400G	100G	802.3db	400G-VR4	8	MPO8, MPO8 APC	30/50m
	400G	100G	802.3db	400G-SR4	8	MPO8, MPO8 APC	70/100m
	800G	100G	Terabit BiDi MSA	800G-VR4.2	8	MPO8, MPO8 APC	30/50m
	800G	100G	Terabit BiDi MSA	800G-SR4.2	8	MPO8, MPO8 APC	70/100m
	800G	100G	802.3df	800G-VR8	16	MPO16 APC	30/50m
	800G	100G	802.3df	800G-SR8	16	MPO16 APC	70/100m
	1.6T	100G	Terabit BiDi MSA	1.6T-VR8.2	16	MPO16 APC	30/50m
	1.6T	100G	Terabit BiDi MSA	1.6T-SR8.2	16	MPO16 APC	70/100m
Singlemode	200G	200G	802.3dj	200G-DR1	2	LC	500m
	200G	200G	802.3dj	200G-FR1	2	LC	2km
	400G	200G	802.3dj	400G-DR2	4	2xLC, 2xSN, 2xMDC	500m
	800G	200G	802.3dj	800G-FR4	2	LC	2km
	800G	200G	802.3dj	800G-LR4	2	LC	10km
	800G	200G	802.3dj	800G-DR4	8	MPO8 APC	500m
	800G	100G	802.3dj	800G-DR4-2	8	MPO8 APC	2km
	800G	100G	802.3dj	800G-DR8	16	MPO16, 2xMPO8 APC	500m
	800G	100G	802.3dj	800G-DR8-2	16	MPO16, 2xMPO8 APC	2km
	1.6T	200G	802.3dj	1.6T-DR8	16	MPO16, 2xMPO8 APC	500m
	1.6T	200G	802.3dj	1.6T-DR8-w	16	MPO16, 2xMPO8 APC	2km

VR (MM)	Very Short Reach	50m
SR (MM)	Short Reach	100-150m
DR (SM)	Data Center Reach	500m
FR (SM)	Fiber Reach	2 km
LR (SM)	Long Reach	2-10km
ER (SM)	Extended Reach	10-40km

Publication dates

- 802.3db – 2022
- Terabit BiDi MSA – 2023
- 802.3df – 2024
- 802.3dj – 2026

Overview of Next Generation Applications

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Mode	Data Rate	Lane Speed	Standard or MSA	PMD	Fiber Count
Multimode	100G	100G	802.3db	100G-VR1	2
	100G	100G	802.3db	100G-SR1	2
	400G	100G	802.3db	400G-VR4	8
	400G	100G	802.3db	400G-SR4	8
	800G	100G	Terabit BiDi MSA	800G-VR4.2	8
	800G	100G	Terabit BiDi MSA	800G-SR4.2	8
	800G	100G	802.3df	800G-VR8	16
	800G	100G	802.3df	800G-SR8	16
	1.6T	100G	Terabit BiDi MSA	1.6T-VR8.2	16
	1.6T	100G	Terabit BiDi MSA	1.6T-SR8.2	16
e	200G	200G	802.3dj	200G-DR1	2
	200G	200G	802.3dj	200G-FR1	2
	400G	200G	802.3dj	400G-DR2	4
	800G	200G	802.3dj	800G-FR4	2

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MPO8 patchcord

MPO adapter pack

MPO8-MPO8 trunk (pinned)

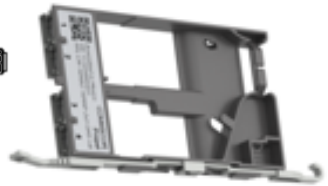
MPO adapter pack

MPO8 patchcord

40GBase-SR4 to 40GBase-SR4
100GBase-SR4 to 100GBase-SR4
400GBase-SR4.2 to 400GBase-SR4.2
800GBase-SR4.2 to 800GBase-SR4.2

MPO8 patchcord

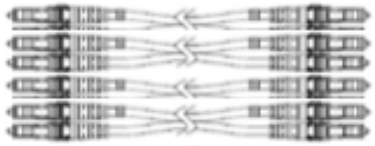
MPO adapter pack



MPO8-MPO8 trunk (pinned)

PO8 - LC DM

LC Uniboot



40GBase-SR4 to 4x10GBase-SR
100GBase-SR4 to 4x25GBase-SR

MPO8 Connectivity

High Bandwidth Break Out

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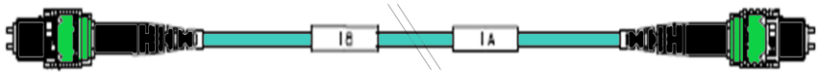
MPO16 patchcord
(Non-pinned)

MPO16 adapter pack

MPO16-MPO16 trunk (pinned)



MPO16 adapter pack

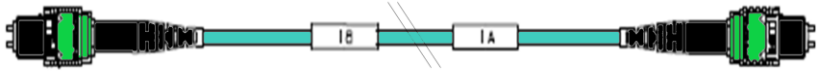
MPO16 patchcord
(Non-pinned)

400GBase-SR8 to 400GBase-SR8
800GBase-SR8 to 800GBase-SR8
800GBase-VR8 to 800GBase-VR8

MPO16 patchcord

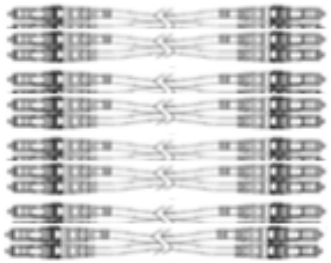
MPO16 adapter pack

MPO16-MPO16 trunk (pinned)



MPO16-LC DM

LC Uniboot



400GBase-SR8 to 8x50GBase-SR
800GBase-VR8 to 8x100GBase-VR
800GBase-SR8 to 8x100GBase-SR

MPO16 Connectivity

High Bandwidth Break Out

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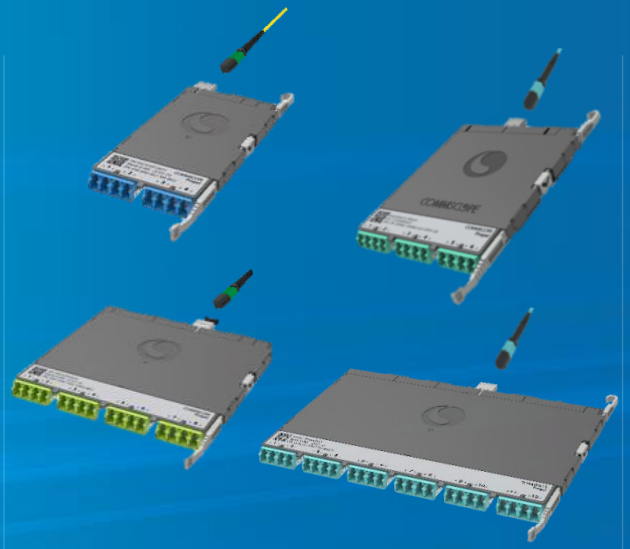
Propel™

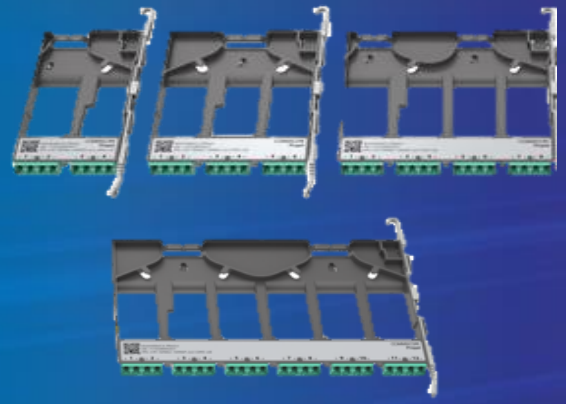
Panels

- 1, 2, & 4RU
- 48 Duplex LC/MPO per RU Standard Density
- 72 Duplex LC/MPO per RU High Density
- 144 SN per RU – Double Duplex Density



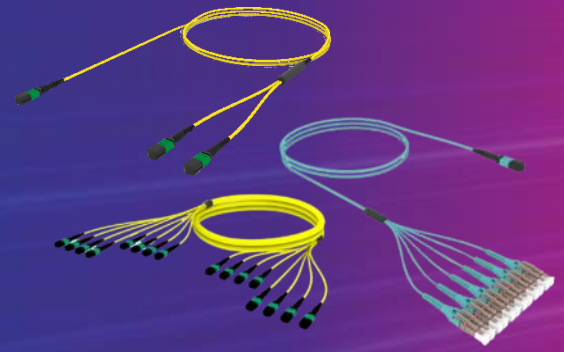
Modules

- MM: LC, MPO8/12/16/24
- SM: LC, SN, MPO8/12/16
- MM & SM : MPO Conversion Modules



Adapter, splice Packs

- LC, SN, MPO8, 12, 24 & MPO16



Cable Assemblies

- MPO8, MPO12, MPO16, MPO24 Based Trunks
- Duplex LC Uniboot & SN Patch and Array cable assemblies

Designed with applications and future in mind
Updated extension of High Speed Migration

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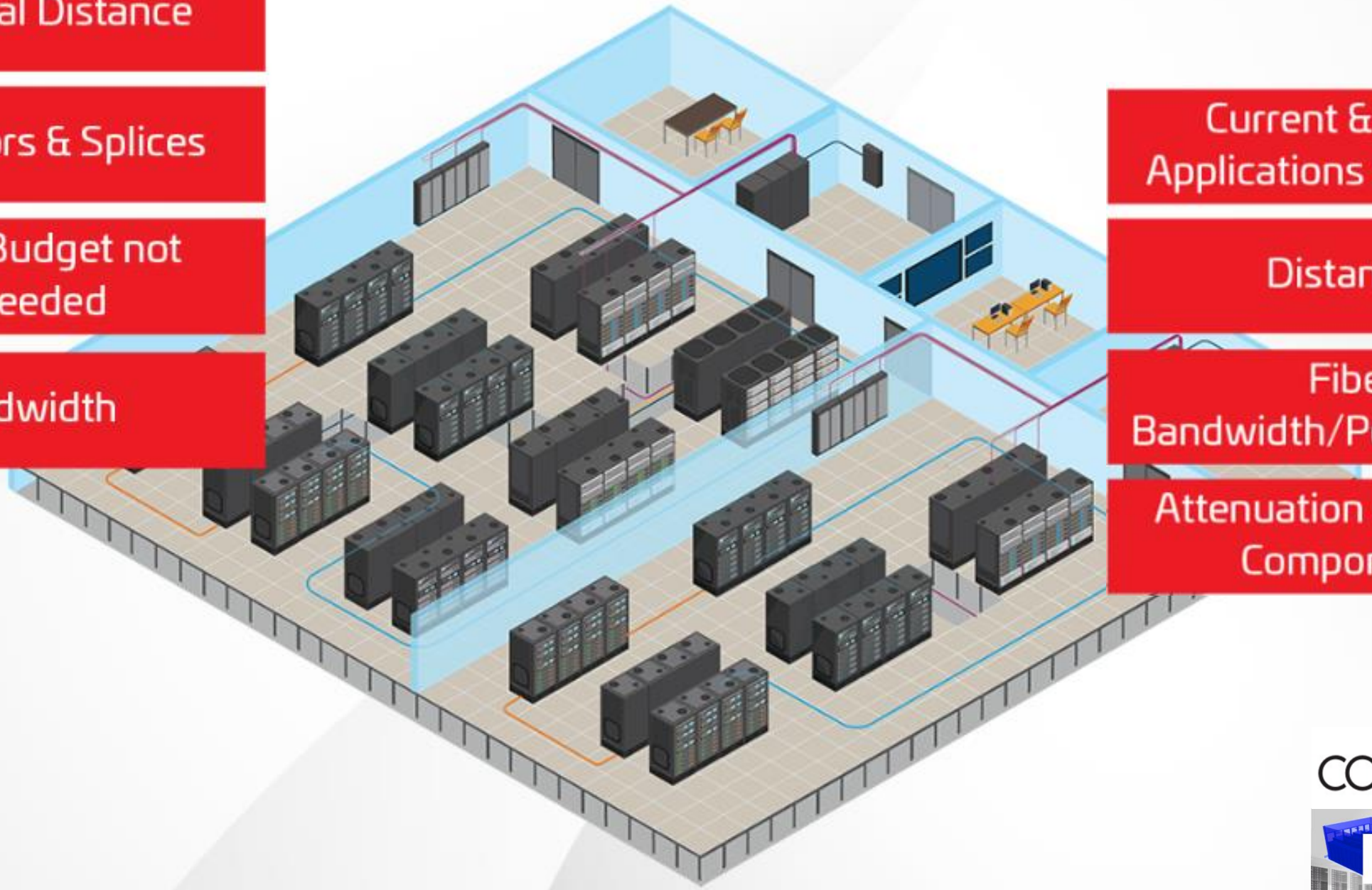
Additional Distance

Connectors & Splices

Power Budget not Exceeded

Bandwidth



Current & Future Applications Supported

Distances

Fiber Bandwidth/Performance

Attenuation of Cable & Components

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	Maximum Channel Insertion Loss (dB)			
IEEE 802.3 Ethernet Application	1G	10G	100G	400G
Fiber Type				
OM4 multi mode	3.56	2.6	1.9	1.9
OS2 single mode	4.56	6.2	6.3	3.0*

	Maximum Channel Insertion Loss (dB)				
Fiber Channel Application	2G	4G	8G	16G	32G
Fiber Type					
OM4 multi mode	3.31	2.95	2.2	1 .95	1 .87
OS2 single mode	7.8	7.8	6.4	6.4	6.21

Application Power Budget

* 400GBASE-DR4

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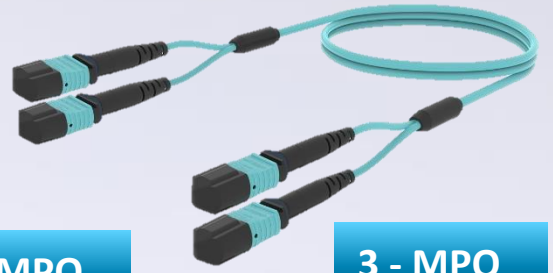

Trunk Cabling

2 - MPO

3 - MPO

MPO-LC modules

1 - LC

4 - LC

Patch Cords

Optical Loss: Manual Calculation Example ISO STANDARD Values

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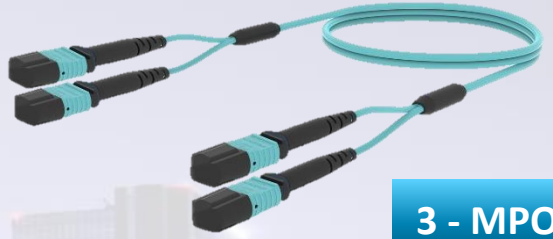
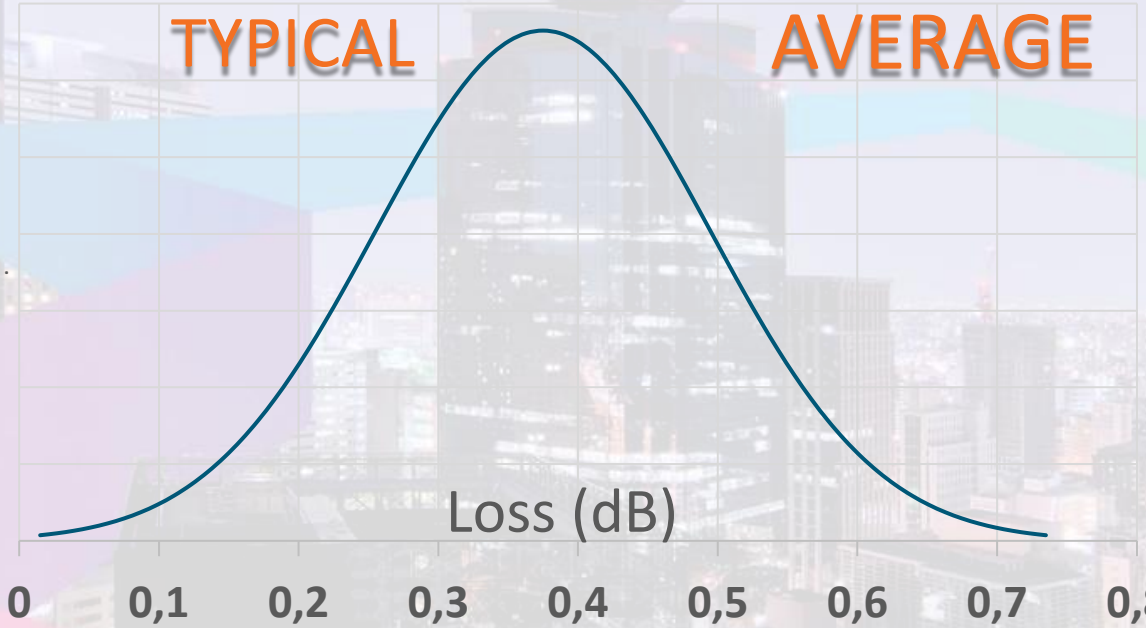
1 - LC

2 - MPO



3 - MPO

4 - LC



Optical Loss : Best – Worst – Average - Typical

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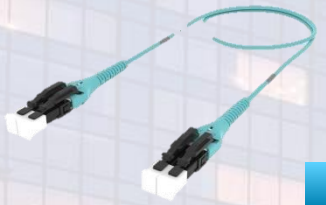
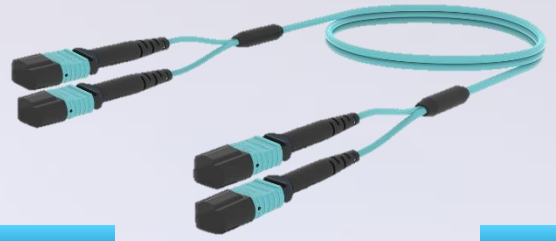
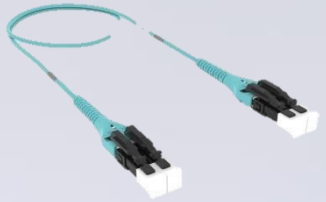


1 - LC

2 - MPO



3 - MPO



4 - LC

ALLOWED STANDARD CONNECTOR LOSS	Up to 0,75 dB per connector
Each LC to MPO Module = 2 connections	0,75 dB x 2 = 1,5 dB
2 x LC - MPO Module	2 x 1,5 dB = 3,0 dB
Cable Loss = 3,5 dB/km	(100m) = 0,35 dB
LINK Loss Connectivity & Cable	= 3,35 dB

Optical Loss Calculation for Multimode Standards

ISO

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Application Power Budget – **Standard** Limits

IEEE 802.3 Ethernet Application	Maximum Channel Insertion Loss (dB)			
	1G	~~10G~~	~~100G~~	~~400G~~
Fiber Type				
OM4	3.56	2.6	1.9	1.9
OS2	4.56	6.2	6.3	3.0*

Fiber Channel Application	Maximum Channel Insertion Loss (dB)				
	~~2G~~	~~4G~~	~~8G~~	~~16G~~	~~32G~~
Fiber Type					
OM4	3.31	2.95	2.2	1 .95	1 .87
OS2	7.8	7.8	6.4	6.4	6.21

* 400GBASE-DR4

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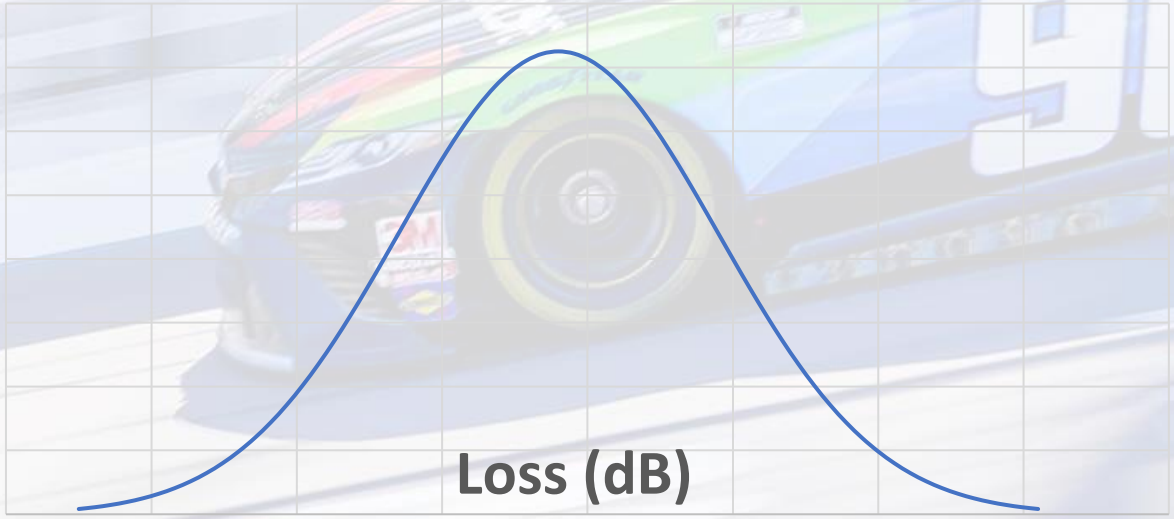
2 - MPO

1 - LC

Ultra Low Loss MPO Module

3 - MPO



4 - LC

Optical Loss : Best – Worst for Ultra Low Loss CommScope

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Published CommScope® MAX Attenuation		
ULL LC - MPO Module = 2 connections	= 0,35 dB	
2 x LC - MPO Module	2 x 0,35 dB =	0,7 dB
OM5 Cable Loss = 3,0 dB/km		= 0,30 dB
LINK Loss Connectivity & Cable		= 1,00 dB

Optical Loss Manual Calculation – Multimode OM5 Example CommScope Values

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Application Power Budget – CommScope Limits

IEEE 802.3 Ethernet Application	Maximum Channel Insertion Loss (dB)			
	1G	10G	100G	400G
Fiber Type				
OM4	3.56	2.6	1.9	1.9
OS2	4.56	6.2	6.3	3.0*

Fiber Channel Application	Maximum Channel Insertion Loss (dB)				
	2G	4G	8G	16G	32G
Fiber Type					
OM4	3.31	2.95	2.2	1 .95	1 .87
OS2	7.8	7.8	6.4	6.4	6.21

* 400GBASE-DR4

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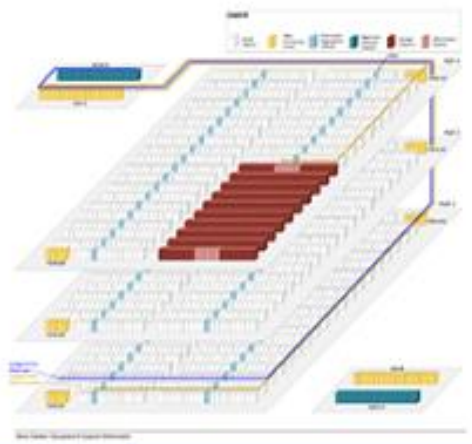
Design

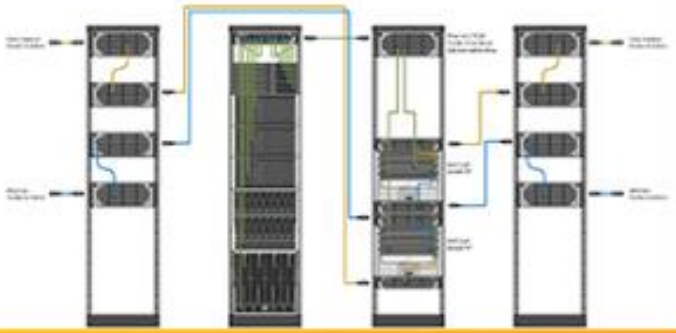


Model

Validate

1000BASE-SX	✓	1000 m	4G FC 850 nm	✓	400 m
1000BASE-LX	✓	600 m	8G FC 850 nm	✓	260 m
10GBASE-S	✓	490 m	16G FC 850 nm	✓	170 m
25GBASE-S	✓	120 m	32G FC 850 nm	✓	120 m
40GBASE-SR4	✓	175 m	128G FC 850 nm	✓	105 m
40GBASE-eSR4	✓	490 m			
40GBASE-CSR4	✓	400 m			
40GBiDi	✓	150 m			
40G-SWDM4	✓	460 m			
100GBASE-SR4	✓	120 m			
100G-SWDM4	✓	150 m			

Install



Test

Register

Applications Assurance & The Converging Data Center

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Design Tools

Ultra Low Loss Fiber Performance Calculator

Calculate link or channel loss and determine the supported applications and max lengths for the configuration. The configuration and results can be exported as PDF.

Cable Selection

- ○ LazrSPEED OM5 WB
- ● LazrSPEED 550 OM4
- ○ TeraSPEED SM

Cable Attributes

Cable Length: 100 ● meters ○ feet

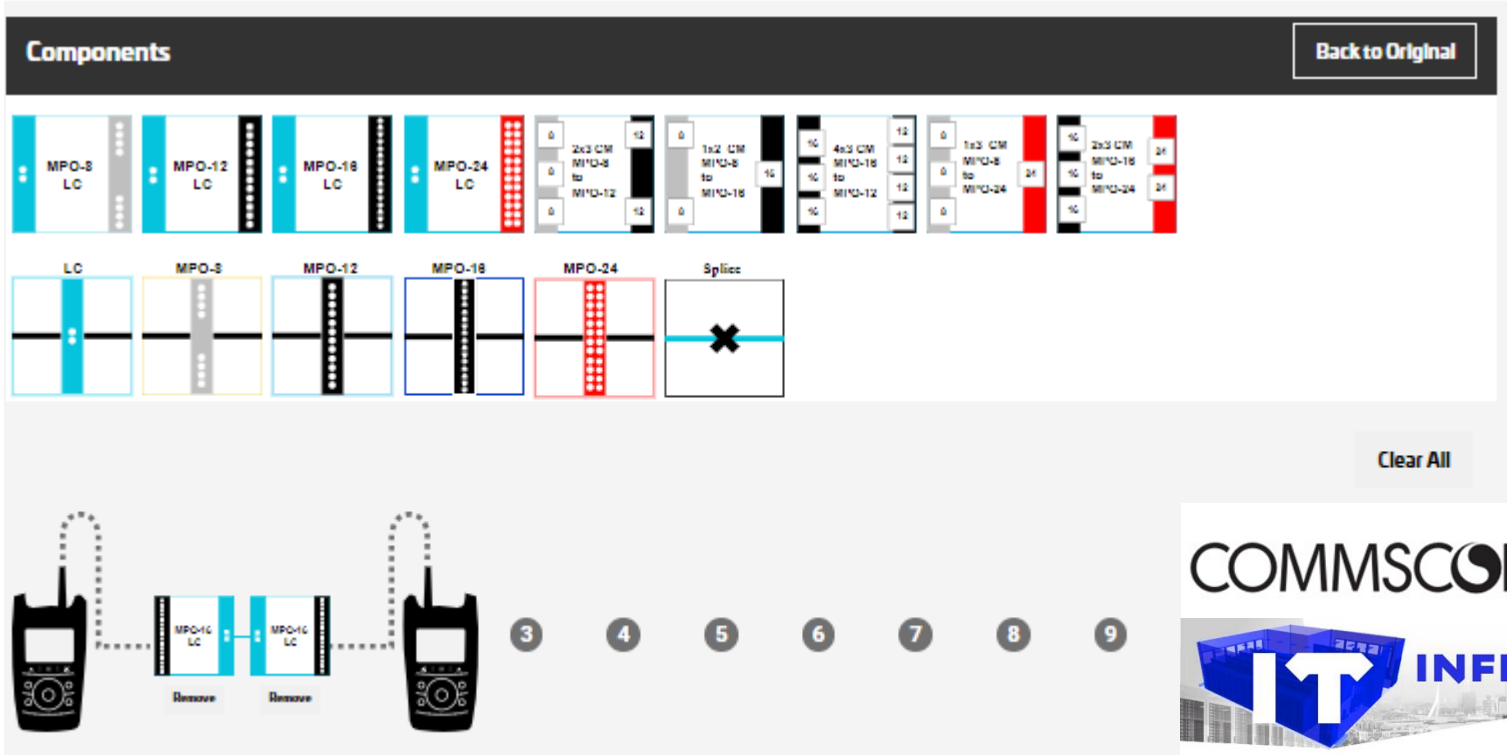
Uncertainty Value: 0.25 dB

Loss Calculations

850 nm Loss	1.15	dB
1300 nm Loss	0.95	dB

Export

You can also select components to configure connections below and add the field configuration below it. The components will show connections between units and will calculate loss based on the units and length selected and inputed.



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Design Tools

Ultra Low Loss Fiber Performance Calculator

Cable Selection

- (●) LazrSPEED OM5 WB
- ( ) LazrSPEED 550 OM4
- ( ) TeraSPEED SM

Cable Attributes

Cable Length: 100 (●) meters ( ) feet

Uncertainty Value: 0.25 dB

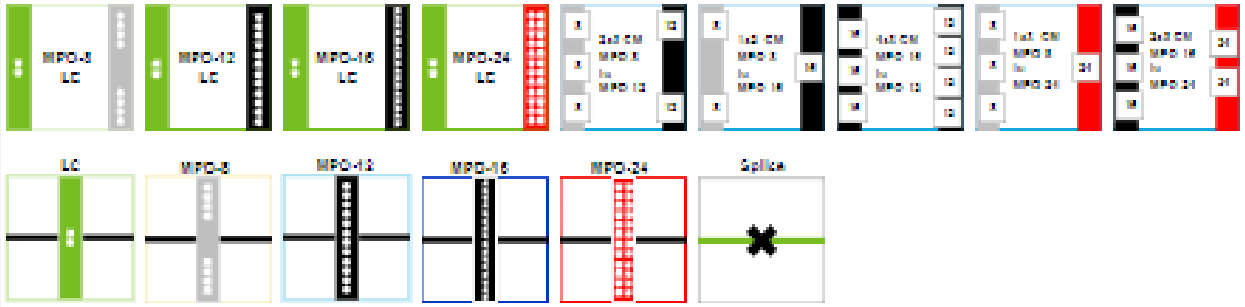
Loss Calculations

850 nm Loss	1.61	dB
1300 nm Loss	1.41	dB

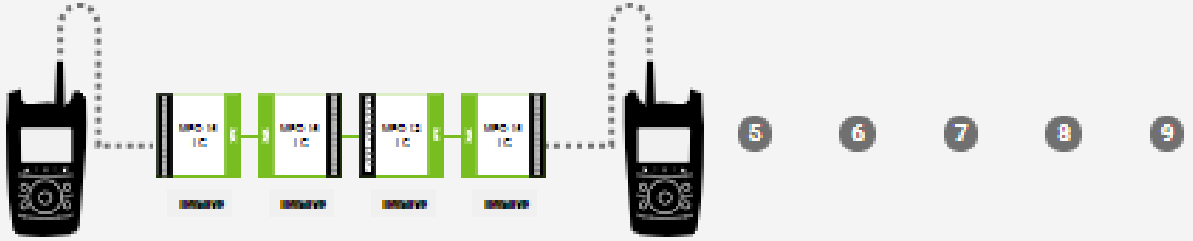
Export

You can also select components to configure connections below and add the field configuration below it. The components will show connections between units and will calculate loss based on the units and length selected and inputed.

Components — Back to Original



Clear All



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OM4 vs OM5

MultiMode Applications Chart

Compatible applications available for your selected configuration.

Legend

- Application supported. Distance within Limits.
- Application supported but link too long.

Application	Max Length(m)
100G-VR	50
200G-VR2	50
400G-VR4	50
800G-VR8	50
800G-VR4.2	50
1.6T-VR8.2	50
8GFC MM	290
16GFC MM	195
32GFC MM	130
64GFC-SW	100
128GFC-SW4	110
256GFC-SW	100

Application	Max Length(m)
25G-SR	130
100G-SR4	130
50G-SR	105
100G-SR2	105
200G-SR4	105
400G-SR8	105
100G-SR	100
200G-SR2	100
400G-SR4	100
800G-SR8	100
10G-S	500

Application	Max Length(m)
40G-CSR4	400
40G-SR4	200
40G-eSR4	500
40G-SWDM4	350
40G-BiDi	155
100G-BiDi	105
100G-SWDM4	105
400G-SR4.2	105
800G-SR4.2	70
1.6T-SR8.2	70

MultiMode Applications Chart

Compatible applications available for your selected configuration.

Legend

- Application supported. Distance within Limits.
- Application supported but link too long.

Application	Max Length(m)
100G-VR	50
200G-VR2	50
400G-VR4	50
800G-VR8	50
800G-VR4.2	70
1.6T-VR8.2	70
8GFC MM	290
16GFC MM	195
32GFC MM	130
64GFC-SW	100
128GFC-SW4	110
256GFC-SW	100

Application	Max Length(m)
25G-SR	130
100G-SR4	130
50G-SR	105
100G-SR2	105
200G-SR4	105
400G-SR8	105
100G-SR	100
200G-SR2	100
400G-SR4	100
800G-SR8	100
10G-S	500

Application	Max Length(m)
40G-CSR4	400
40G-SR4	200
40G-eSR4	500
40G-SWDM4	460
40G-BiDi	200
100G-BiDi	150
100G-SWDM4	150
400G-SR4.2	150
800G-SR4.2	100
1.6T-SR8.2	100

Ultra Low Loss Fiber Performance Calculator Application Support CommScope

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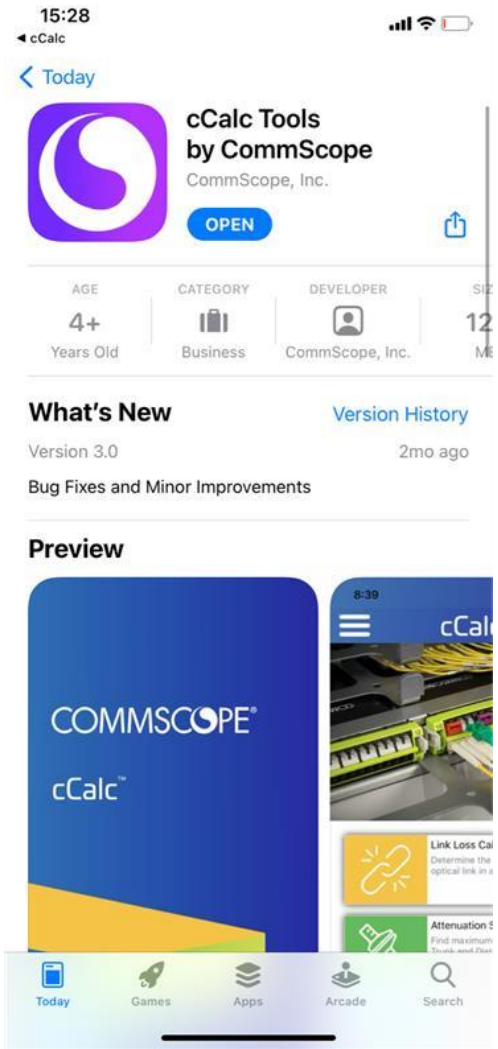

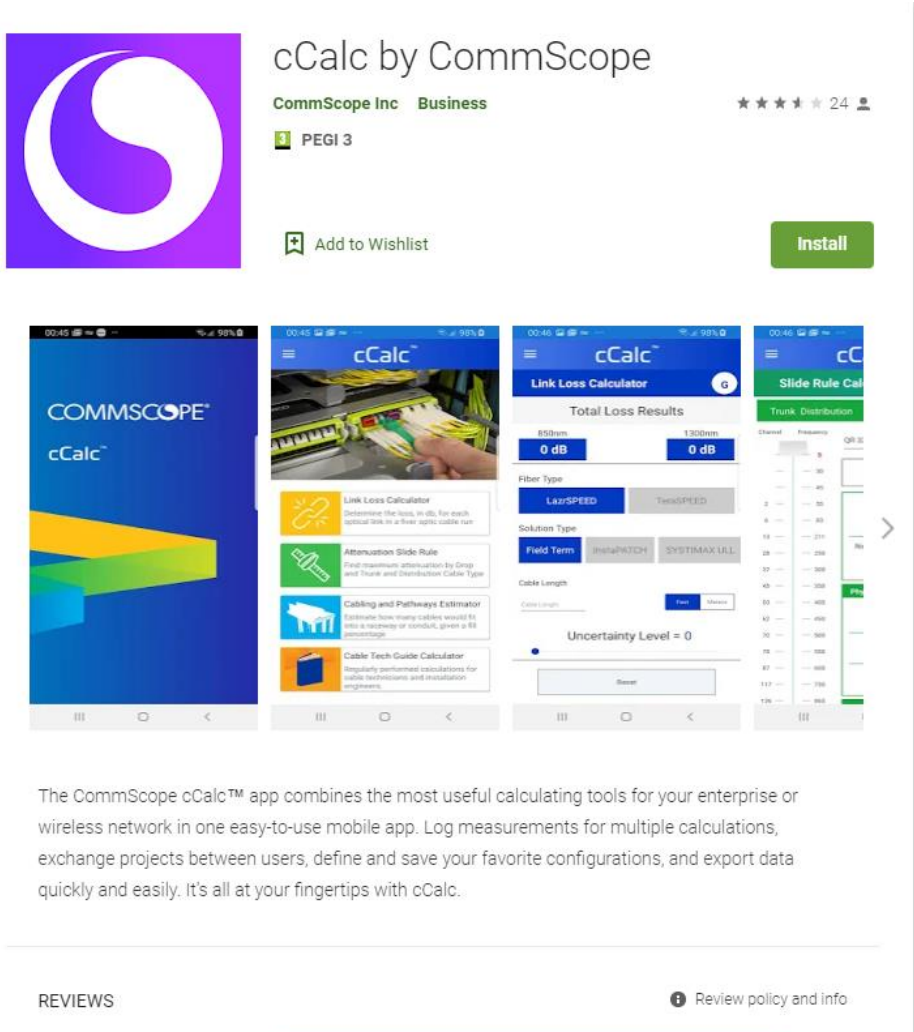

There is an APP for it

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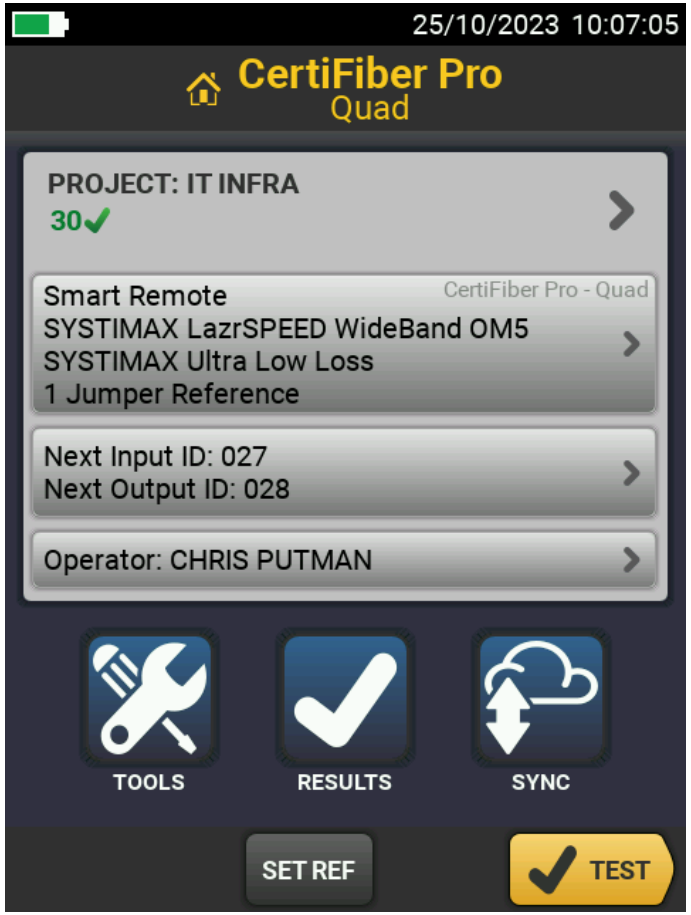
Choose Fiber Type as normal

Choose Test Limit : Vendor-CommScope

Choose Type of Cabling :

- preterm or spliced
- amounts of connectors/splices
- 1/2/3 jumper referencing



Link Loss Calculator and Fluke Versiv / LinkWare

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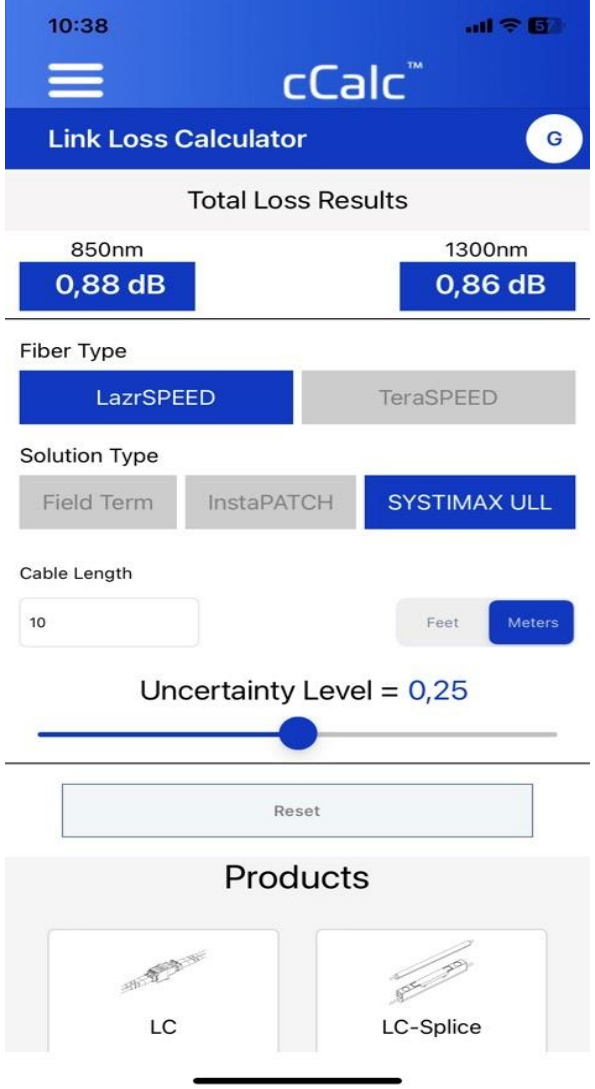

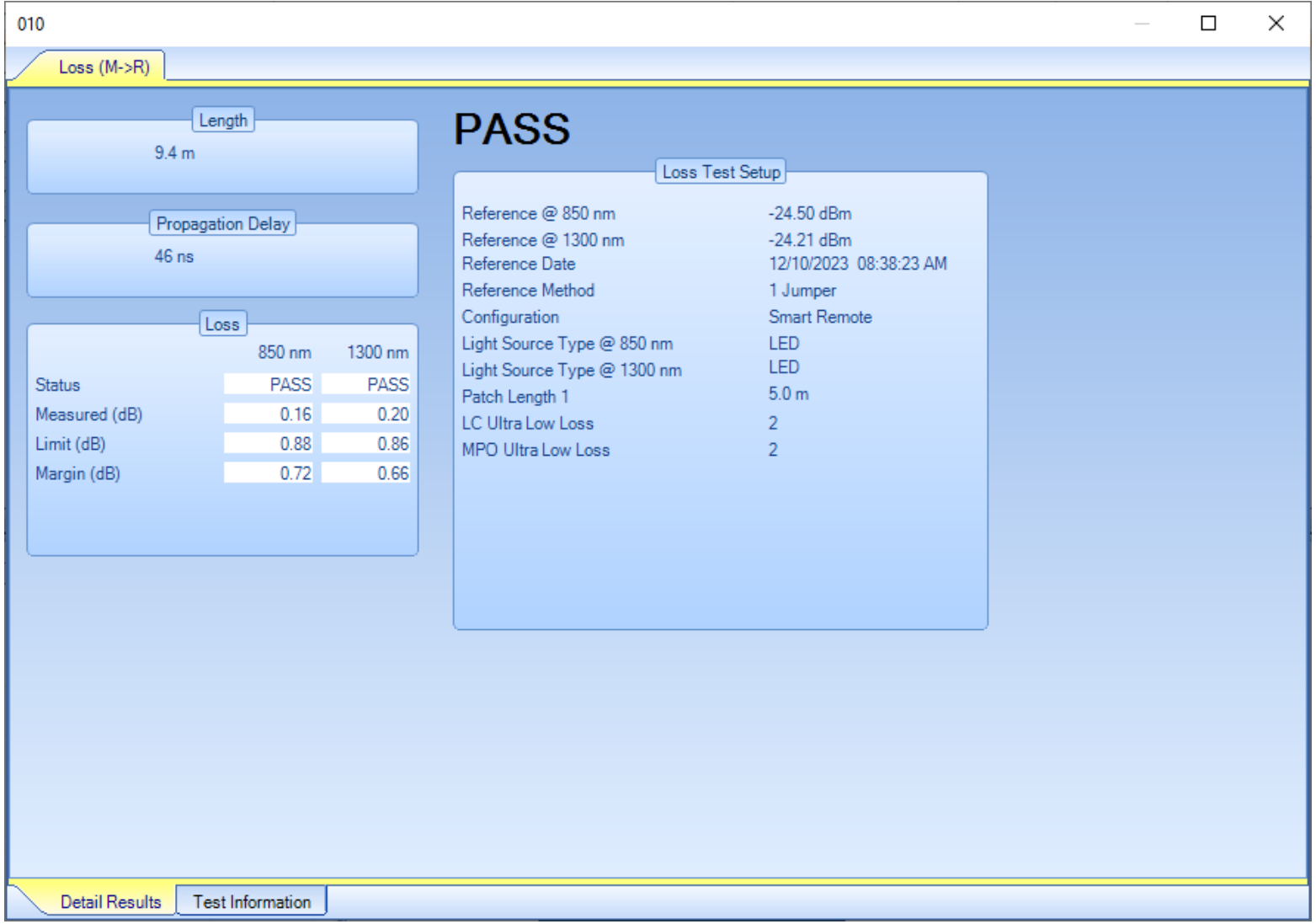

Limits in the Fluke tester provided in the cCalc APP

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Why should DC Customers Care ?

Application performance and support is the end goal

- **Customers should choose the test limit that provides guarantees for the applications they plan to use in the datacenter.**

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Why should DC Customers Care ?

Application performance and support is the end goal

- If the end goal is to support customer applications, then they should utilize a manufacturer that actually guarantees those applications.
- While using industry standards as a baseline might work in some instances, it will not guarantee the support of their applications
- CommScope's 25-year performance and application Assurance Warranty takes a holistic approach to design, model, validate, build, install and test. This ensures optimum application support for both current and future applications.

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See you at stand no. 8

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