LEVITON

Demystifying ENTERPRISE FIBER NETWORKS

New options, best practices, and smart choices for less complexity and more flexibility.

Adrian Young
Leviton Network Solutions

2018 BICSI WINTER
CONFERENCE & EXHIBITION
Orlando, FL | February 4-8

In This Session

- Multimode fiber types
- How many fibers do I need for my application?
- Future IEEE and non IEEE applications
  - Will my existing fiber plant support these?
- Connector choices
- MPO trunk cables and conversion cassettes

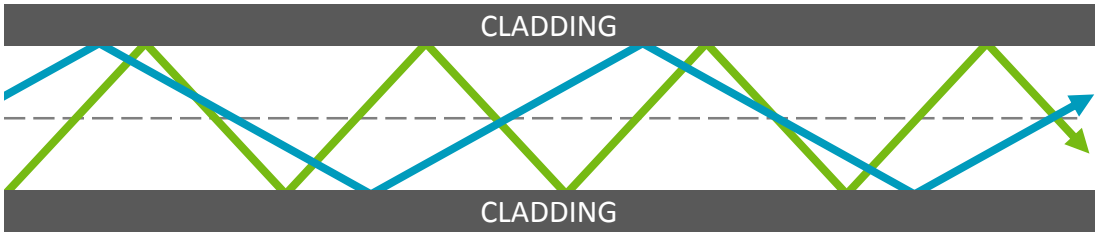
Fiber Types

Distance Matters

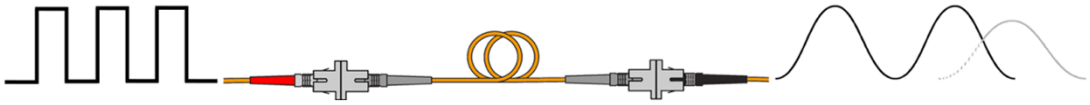
Which Multimode Fiber Do You Have or Choose?

Designation	Modal Bandwidth @ 850 nm (MHz.km)
OM1	200
OM2	500
OM3	2,000
OM4	4,700
OM5	4,700

- With multimode, there are many modes (paths) of light
- The modes travel down the cable at different speeds



- A pulse of light will spread as it travels down the cable
- The longer the fiber, the more spreading (dispersion)



Which Multimode Fiber Do You Have or Choose?


Duplex LC


Duplex LC

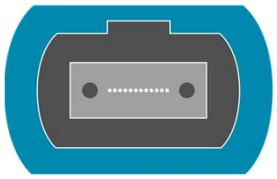

MPO


MPO

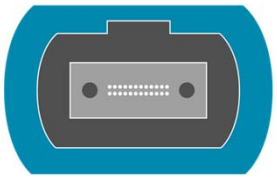
Designation	Modal Bandwidth @ 850 nm (MHz.km)	1000BASE-SX		10GBASE-SR		40GBASE-SR4		100GBASE-SR4	
		Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet
—	160	225	738	26	85	—	—	—	—
OM1	200	275	902	33	82				
OM2	500	550	1,808	82	269				
OM3	2,000	860	2,822	300	984	100	328	100	328
OM4	4,700	860	2,822	400	1,312	150	492	150	492
OM5									

The MPO Connector

- Also referred to as MTP
  - MTP is a registered trademark of US Conec
  - MTPs are compliant with IEC Standard 61754-7 and TIA 604-5 – Type MPO
  - Typically provides better performance than standard MPOs



12 Fiber



24 Fiber

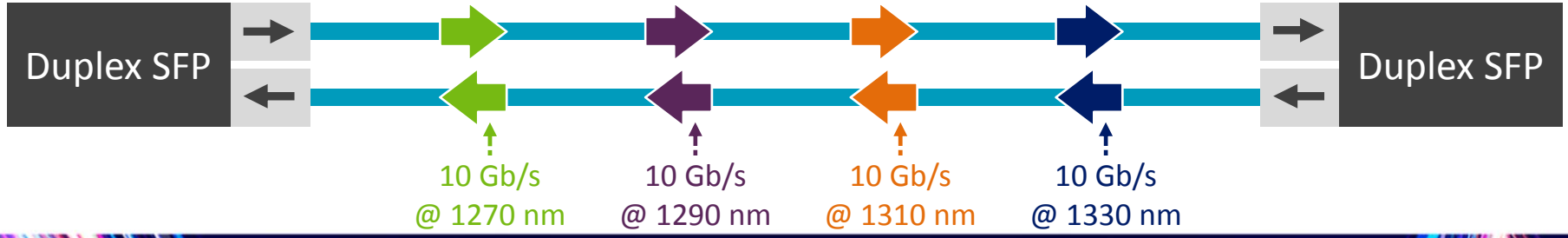
MTPs trunk cables can support traditional LC duplex transceivers with the addition of breakout cassettes

Do I Have To Replace My Links With MPO?

- There are 40 Gb/s solutions than run over duplex links today
- Cisco QSFP-40G-SR-BD
  - 30 m over OM2, 100 m over OM3, 150 m over OM4
  - Transmits and receives on the same fiber using two wavelengths

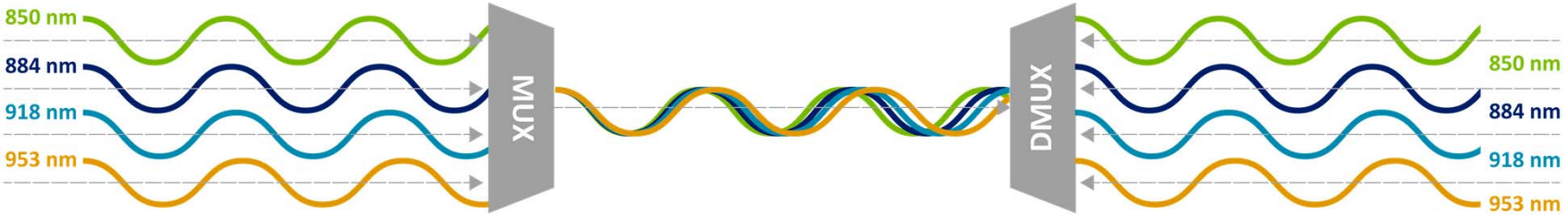
Do I Have To Replace My Links With MPO?

- There are 40 Gb/s solutions than run over duplex links today
- Arista QSFP-40G-UNIV
  - 150 m over OM3/OM4, transmitting on four wavelengths

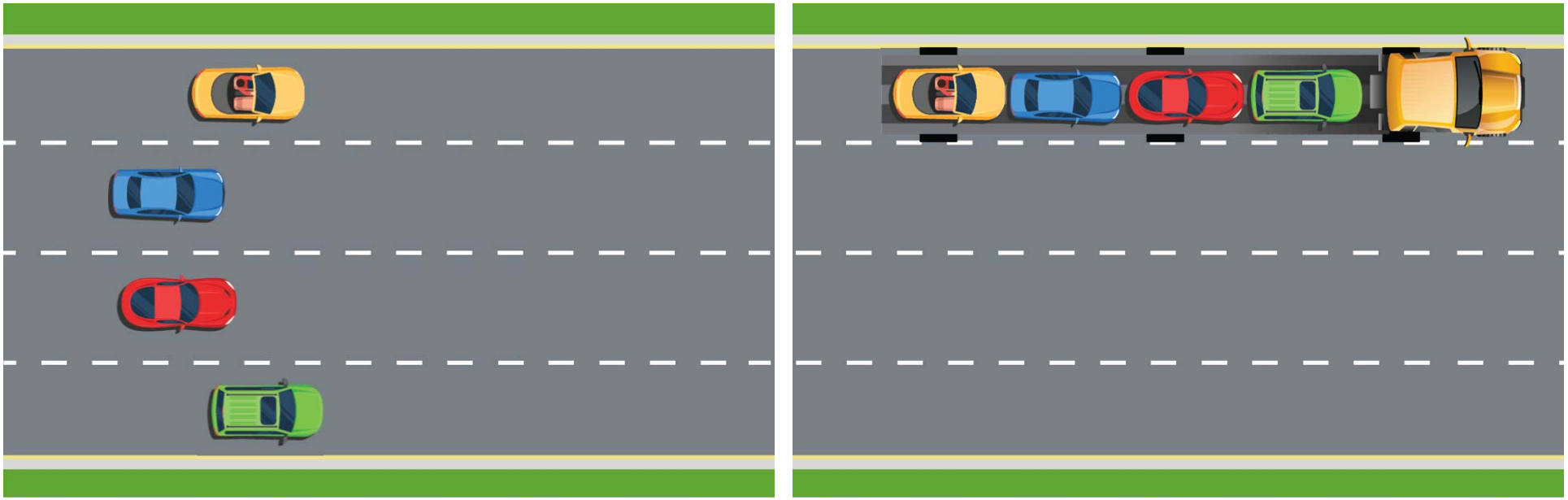


Short Wave Division Multiplexing (SWDM)

- Transmitting four wavelengths on a single multimode fiber



SR4 vs. SWDM

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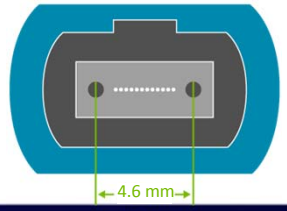
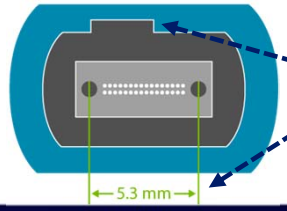
Future Multimode IEEE Ethernet Applications

Application	OM3		OM4		OM5		Fiber Count	Connector Type
	Meters	Feet	Meters	Feet	Meters	Feet		
50GBASE-SR	70	230	100	328	100	328	2	LC
100GBASE-SR2							4	MPO[1]
200GBASE-SR4							8	MPO[1]
400GBASE-SR16							32	MPO[2]

MPO[1]
12 Fiber

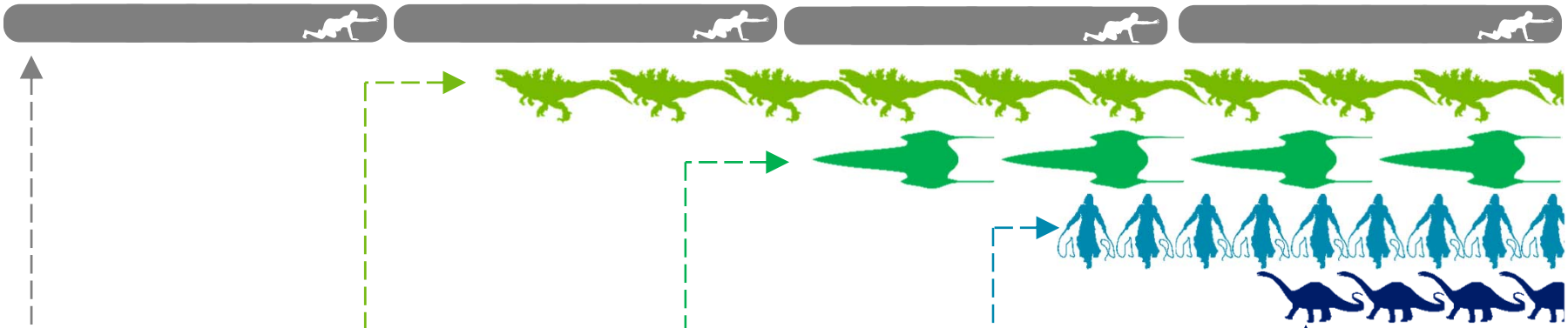


MPO[2]
32 Fiber



Offset Key
Pins further apart

Reduction in Supported Lengths (Multimode)



1994 100 Mb/s

2,000 m (6561 ft.)

4x the length of Andy's tunnel to freedom, *The Shawshank Redemption*

1998 1000 Mb/s

550 m (1805 ft.)

9.2x the length of Godzilla, *Godzilla*

2002 10 Gb/s

300 m (984 ft.)

3.95x the length of the Naboo Starship, *Star Wars: Episode II – Attack of the Clones*

2010 40 Gb/s

150 m (492 ft.)

8.8x the width of Whiplash's wingspan and whips, *Ironman 2*

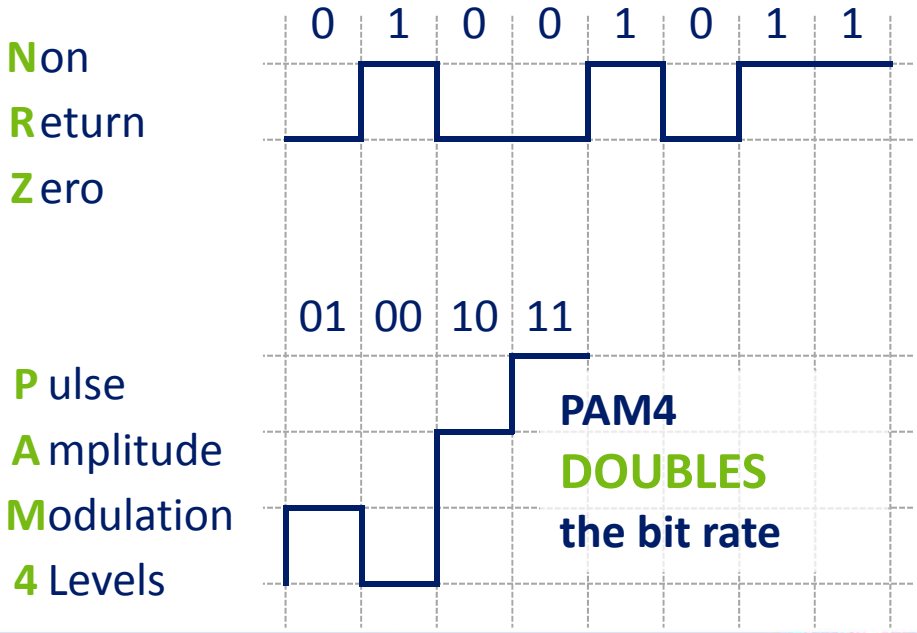
2015 100 Gb/s

100 m (328 ft.)

3.6x the length of an Apatosaurus, *Jurassic World*

Future Single-Mode IEEE Ethernet Applications

- 50GBASE-FR (Duplex)
  - 2 km, using PAM4
- 50GBASE-LR (Duplex)
  - 10 km, using PAM4
- 100GBASE-DR (Duplex)
  - 500 m, using PAM4
- 200GBASE-DR4 (Duplex)
  - 2 km, using PAM4



Future Single-Mode IEEE Ethernet Applications

Application	OS1/OS2		PAM4	WDM	Fiber Count	Connector Type
	Meters	Feet				
50GBASE-FR	2,000	6,561	Yes	No	2	LC
50GBASE-LR	10,000	32,736	Yes	No	2	LC
100GBASE-DR	500	1,640	Yes	No	2	LC
200GBASE-DR4	500	1,640	Yes	No	8	MPO
200GBASE-FR4	2,000	6,561	Yes	4	2	LC
200GBASE-LR4	10,000	32,736	Yes	4	2	LC
400GBASE-FR8	2,000	6,561	Yes	8	2	LC
400GBASE-LR8	10,000	32,736	Yes	8	2	LC

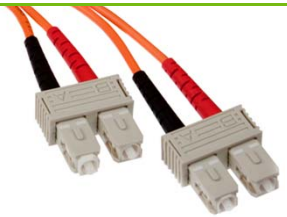
Connector Options

Termination Options

Transceiver Fiber Interfaces

Most common SC, LC, and MPO

1000BASE-SX GBIC
(SC)



1000BASE-SX SFP
(LC)

10GBASE-SR SFP
(LC)

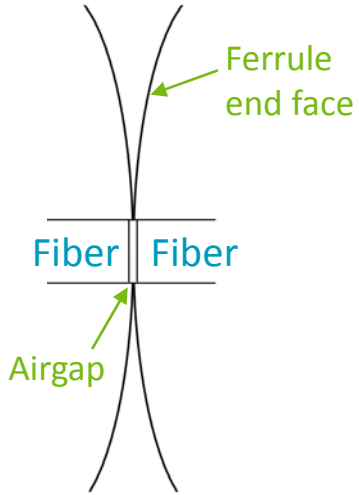
40GBASE-SR4 QSFP+
(MPO)

SC/LC Termination Options

- Field Polish
  - Ideal for smaller installations
  - Craft sensitive
  - Labor costs a consideration
  - Consumables
    - Polishing paper
  - Concerns meeting updated TIA single-mode return loss (reflectance) requirements

Return Loss (Reflectance)

- This is the reflection of light back into the transceiver
- Most common cause is the airgap between connectors
  - Polishing the ceramic end face results in an undercut
  - When two connectors are mated, there is small airgap between them
  - Bigger the airgap: Worse the return loss (reflectance)
- With higher speeds, now a concern in the enterprise

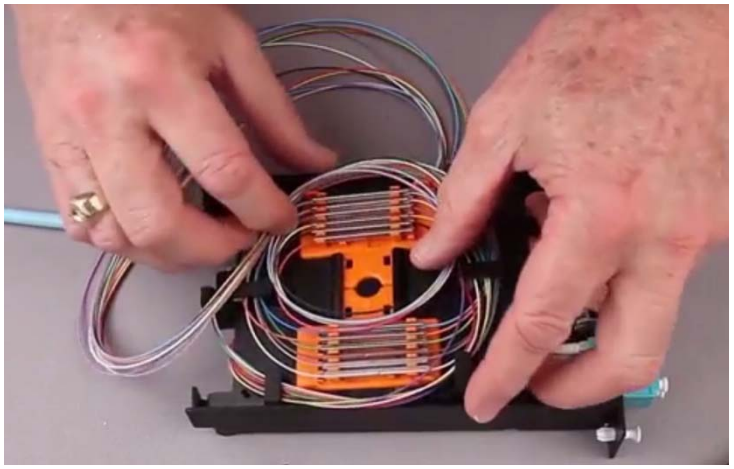


SC/LC Termination Options

- Mechanical
  - Faster termination than field polish
  - Less craft sensitive
  - Factory polished end faces
  - Consumables
    - Better insertion loss
    - Better return loss (reflectance)
  - Less consumables
    - No polishing papers
  - Precision cleaver required

SC/LC Termination Options

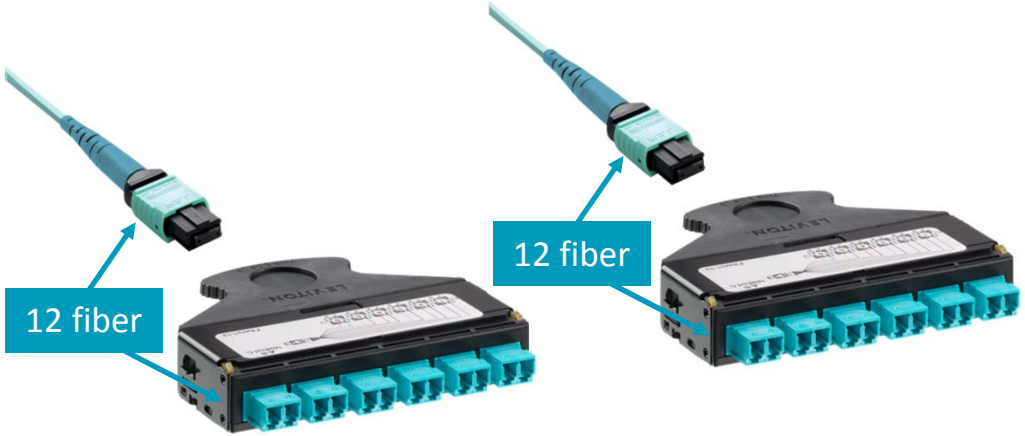
- Pigtail – Fusion Splice
  - Factory polished connectors
    - Excellent insertion/return loss
  - Precision cleaver and splicer required



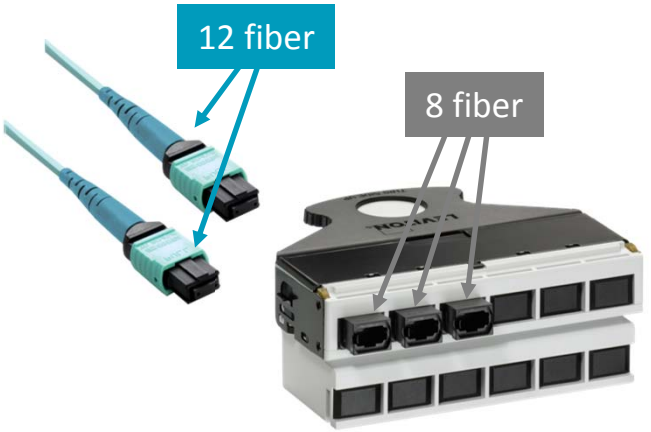
  - Skill in dressing splice trays

MPO Trunks Offer Flexibility

With an MPO trunk cable, you get to choose interface connector



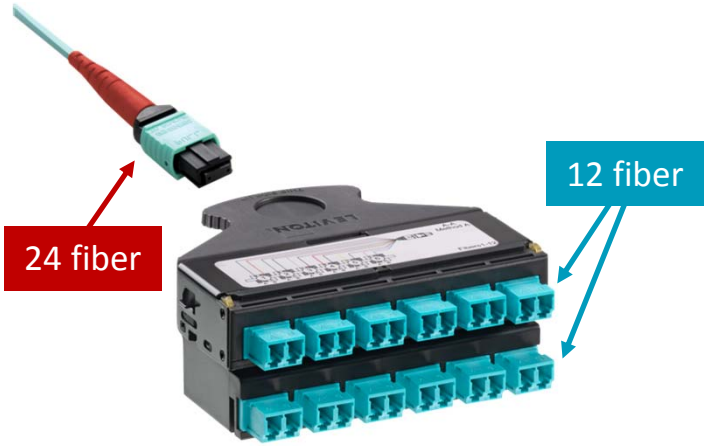
1000BASE-SX or 10GBASE-SR



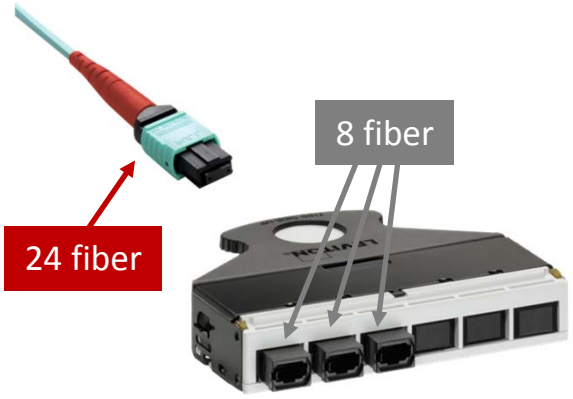
40GBASE-SR4, 100GBASE-SR4, or 200GBASE-SR4

MPO Trunks Offer Flexibility

With an MPO trunk cable, you get to choose interface connector

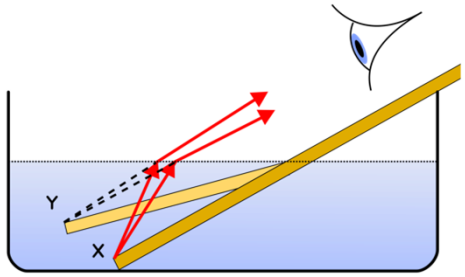


1000BASE-SX or 10GBASE-SR



40GBASE-SR4, 100GBASE-SR4, or 200GBASE-SR4

Minimizing Return Loss (Reflectance)



- Put an 8 degree angle on the end face
- Any reflected light is forced into the cladding
- Angled Physical Contact connector (APC)
- APC connector housing is green
  - Avoids mixing PC and APC connectors

- Concatenated links (many connections) can result in optical return loss issues if return loss (reflectance) is not controlled
- IEEE 802.3cd (in progress) specifying discrete reflectance

Takeaways

- Supported distances on multimode continue to decrease
- Proprietary technologies to reuse existing duplex links now available
- OM5 offers an advantage over OM4/3 only for SWDM technologies
- MPO trunk cables offer flexibility – for those who cannot decide
- 24-fiber multimode MPO cables cover you from 100 Mb/s to 100 Gb/s
- Field polished single-mode connectors may not support ≥100 Gb/s
- Concatenated singlemode links may benefit from APC connectors

Thank You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