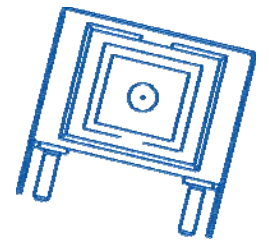


COTSWORKS™

⊕ ⊕ ⊕ ⊕ ⊕ ⊕ ⊕ ⊕ *From Off The Shelf...To In Design* ⊕ ⊕ ⊕ ⊕ ⊕ ⊕ ⊕ ⊕



Beyond Multimode Duplex FOHEC 2010



Rugged Fiber Optic Components
For Harsh Environments

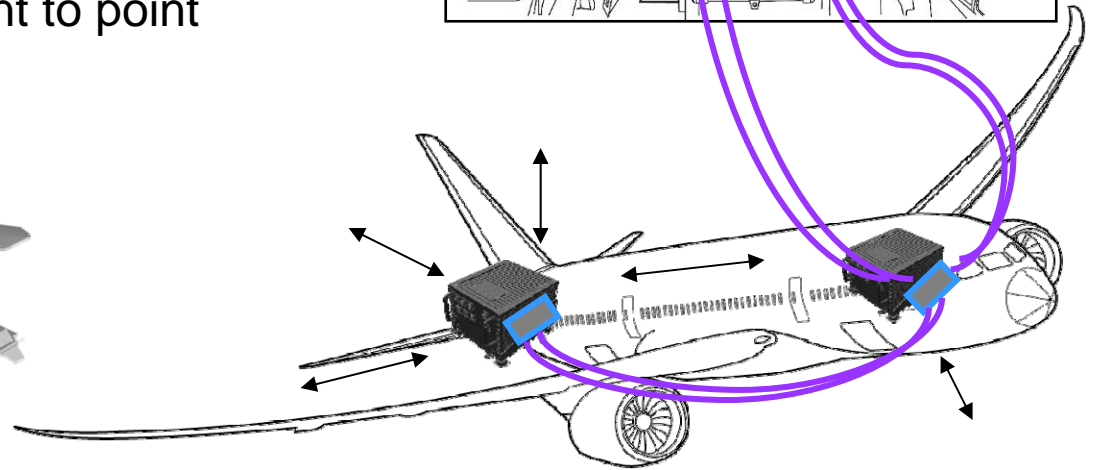
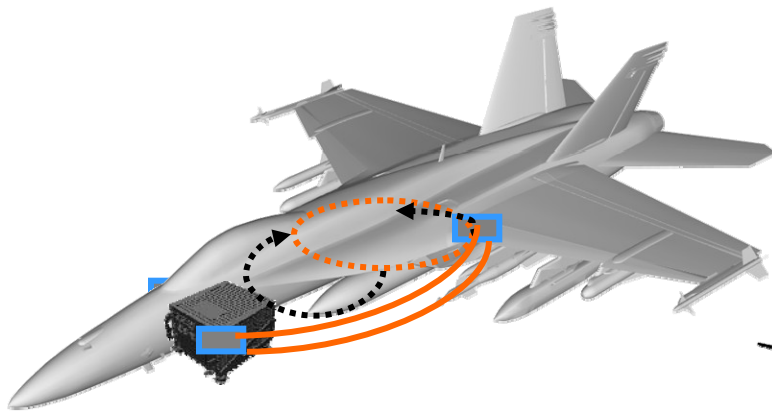
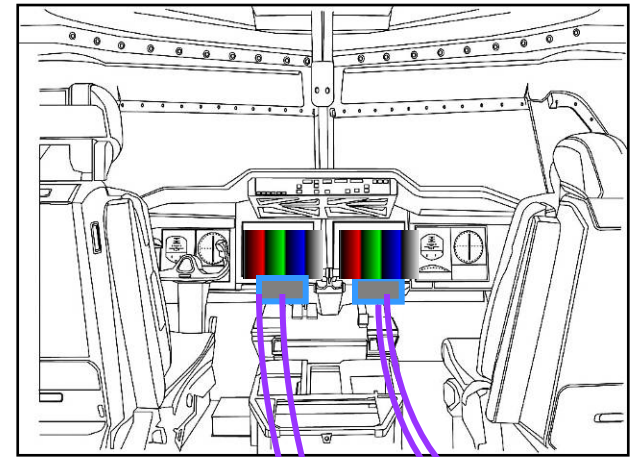


Rugged Fiber Optics = Expensive

- Rugged fiber networks in aircraft and vehicles is often multimode cable based
- Network costs are high due to cable, connector, and installation costs
- Actives are often in safe area using COTS parts which hides network costs
- Telecomm industry uses single fiber networking; datacomm happy with duplex
- Time to look at multimode single fiber to reduce costs and complexity in rugged fiber use

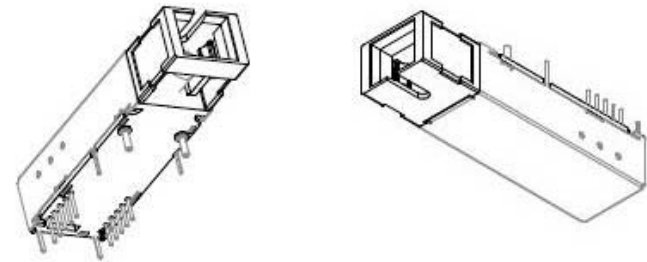
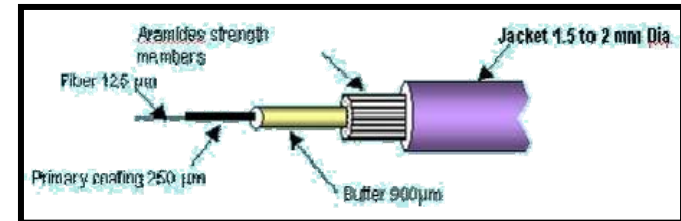
Sample Aerospace Fiber Network

- Command/control systems and video links
 - Redundant flight deck screens to LRUs
 - LRUs to core systems, sensors, or cameras
 - In-Flight Entertainment
- Fiber optic cabling needed for composite fiber aircraft to solve EMI issues
- ADFX and Ethernet, ARINC 818 and Fibre Channel protocols, XAUI point to point



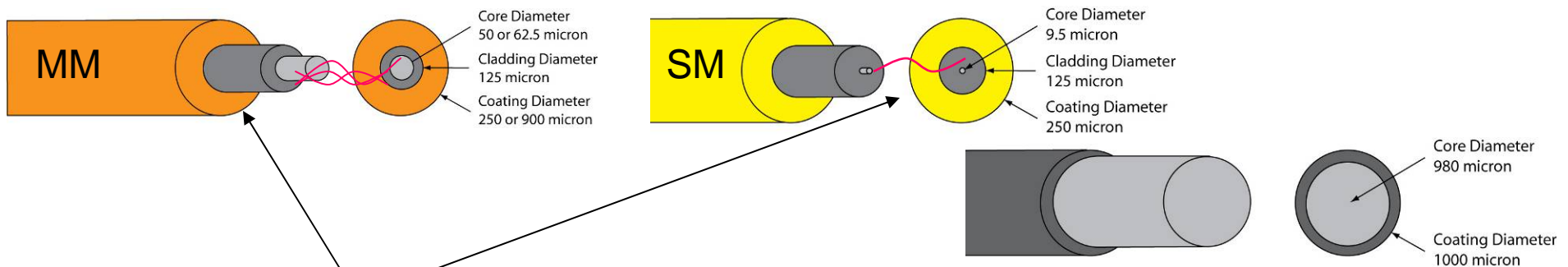
Fiber Optic Network Building Blocks

- Cabling/Passives in physical plant
- Connectors in between systems
- Optical transceivers in network equipment



Fiber Optics Cable Types

- Optical Fiber is a very thin and flexible glass tube
- It is made of two parts: core where light travels and cladding which keeps light in the core
- A buffer and jacket provide further protection and marking
- Primarily two kinds: Multimode (MM), Single Mode (SM);
 - MM is short haul, short wavelength, datacomm: orange jacket
 - SM is long haul, long wavelength, data/telecomm: yellow jacket
 - POF is used for very short distances, audio, mostly slow data

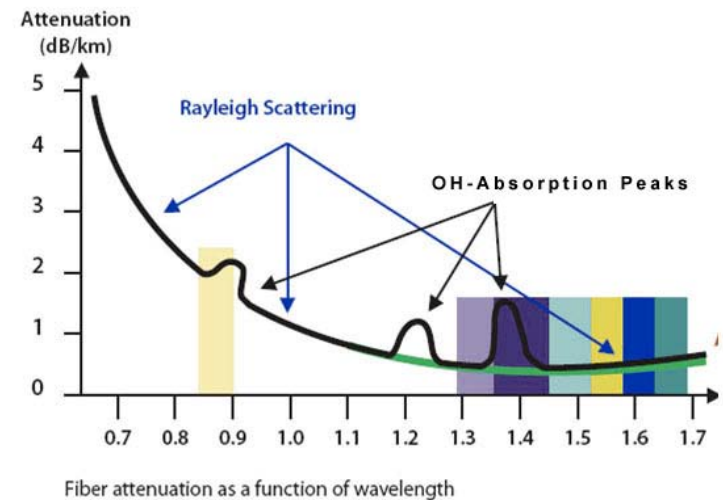


“Mode” of light in the path
More modes = lower cost components but shorter distances since modes begin to disburse

POF’s large core makes termination and installation easy but has very high loss

Understanding Wavelengths

- Light is measured in wavelength, or distance of *peak to peak*
- Wavelengths used in are invisible to our eye, 850 to 1550nm
- Light is absorbed or lost as it travels along the fiber or thru connectors
- NOTE: the wavelength is related to the type of laser used, which is also related to the type of cable (MM vs. SM)
- The Intl. Tele. Union defines ranges for interoperation

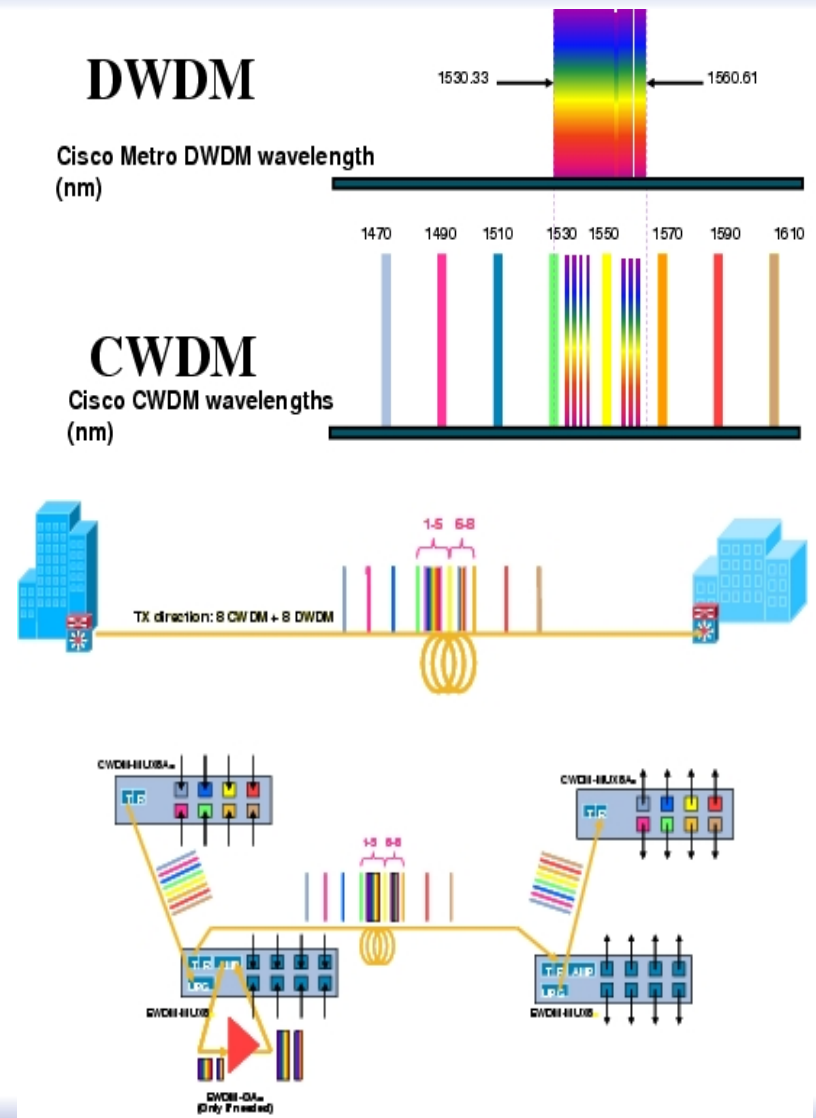


820-880 nm (1st window)	S Band 1460-1530 nm
O Band 1260-1360 nm (2nd window)	C Band 1530-1565 nm
E Band 1360-1460 nm	L Band 1565-1625 nm
	U Band 1625-1675 nm

Standard (ITU) ranges

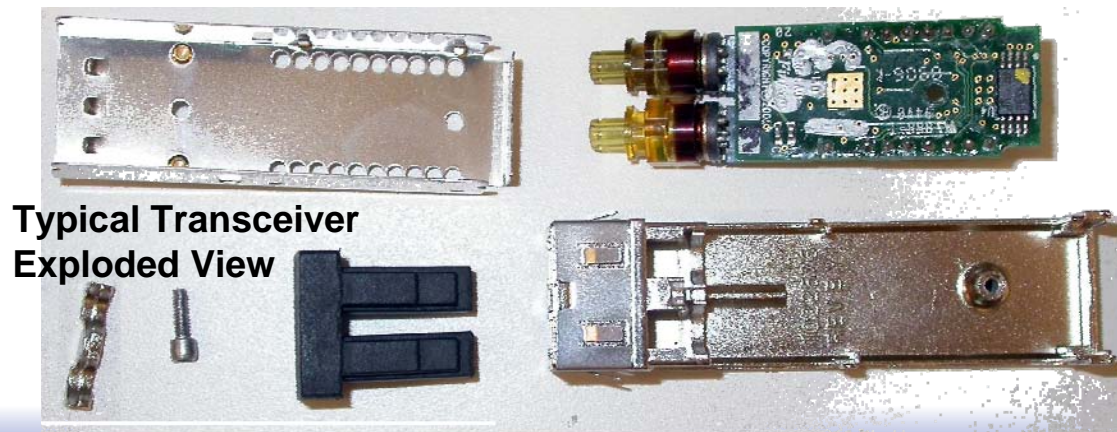
WDM Networking

- WDM Networking reduces fiber cable needs
 - One fiber carries 64 channels, at 10G...or now 128 at 40G
 - Most MANs are CWDM with DWDM for long haul
- Enterprise and Data Centers use WDM to increase cost effectiveness of leased fiber
- Five years ago, you needed a PhD to do WDM, today you need pluggables
- All Single Mode based

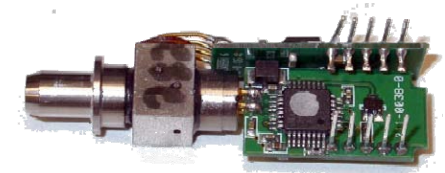


Optical Transceivers Explained

- There are three types of Lasers that vary by cost, power, and beam profile
 - LEDs for FDDI, MM cable, wide beam, low power
 - VCSELs, LAN, MM cable, smaller beam, high power
 - FP/DFB lasers, WAN, SM cable, direct beam, very high power
- Transmitter Optical Sub Assemblies (LASERs) are packaged with leads and a lens (TOSA)
- Receiver Optical Sub Assemblies are packaged with leads (ROSA)
- A circuit board contains the logic to drive the two components
- A case houses the connector and shields the circuits



**Typical Transceiver
Exploded View**



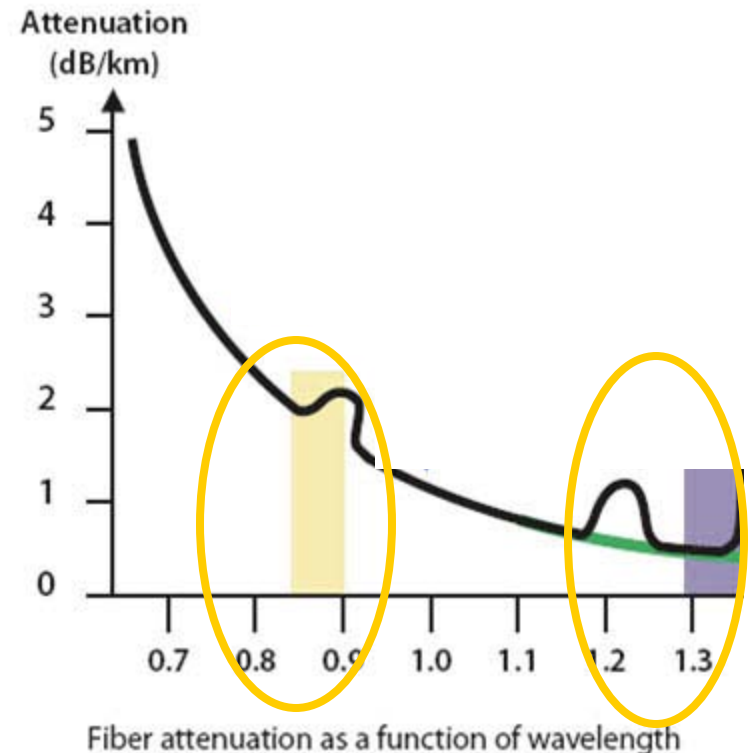
**Single Fiber
Transceivers
use a *BOSA***

Laser Types

- VCSEL
 - High modulation
 - Coherent light
 - Good coupling
 - Circular beam
 - Low threshold current
 - Low power
 - On silicon test
 - Array capable
 - Ultra reliable
 - Reliable temp. performance and control
- LED
 - Low bandwidth
 - Wide optical path
 - Low coupling
- Edge Laser
 - High bandwidth
 - High heat
 - Alignment needed
 - Long reach
 - Good temp. tolerance but temp dependence

Multimode WDM

- Focus on 8xx and 13xx range, wavelengths compatible with MM
- LX 4 standard defined 4 wavelengths at 1310
 - Used for early 10G
 - Integrated lasers and filters in one module
- HD/SDI transceiver used four wavelengths at 8xx
 - Not cost effective vs. multiple MM fibers in one bundle
 - Consumer approach (HDTV)



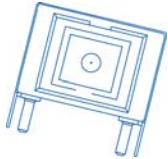
Elusive Multimode Single Fiber

- VCSEL based product
 - On silicon test at multiple wavelengths
 - Multimode fiber compatible including use of industry standard fiber sources/meters/training
 - Lowest cost possible for lasers, cable plant
- Non-standard
 - Creation of new filters for combining light and detecting light

“Single Ray”

- 8xx centered single fiber transceiver
- 10 Mb to 10Gbps
- Industrial or Military temperature operation
- Upgrade to existing cable networks without running new fiber
- Substantial lower cost, weight, install, service costs in aerospace
- Standard multimode or large core compatible

Contacting Us



www.cotsworks.com

info@cotsworks.com

749 Miner Road
Highland Heights, OH 44143
440-446-8800 Phone
440-815-2204 Fax

Cotsworks.blogspot.com

- Direct contact to design, component, mechanical, and reliability engineers to production
- Distributor in Europe



Laser 2000:
Nordics, UK, Germany