NEPTUNE UNDERSEA NETWORK

We are seeking an optical transport switch which will perform the following function:

Multiplex 8 x 1000BT copper Ethernet sessions to one 1550nm optical channel. (We may consder 100BT at this time)
Drive the optical channel past 150km with margin
Fiber would typically be submarine grade SMF28E such as Corning with:
Loss=0.19 dB / Km CD=17 ps/km.nm CD slope .007 ps/nm^{2}km

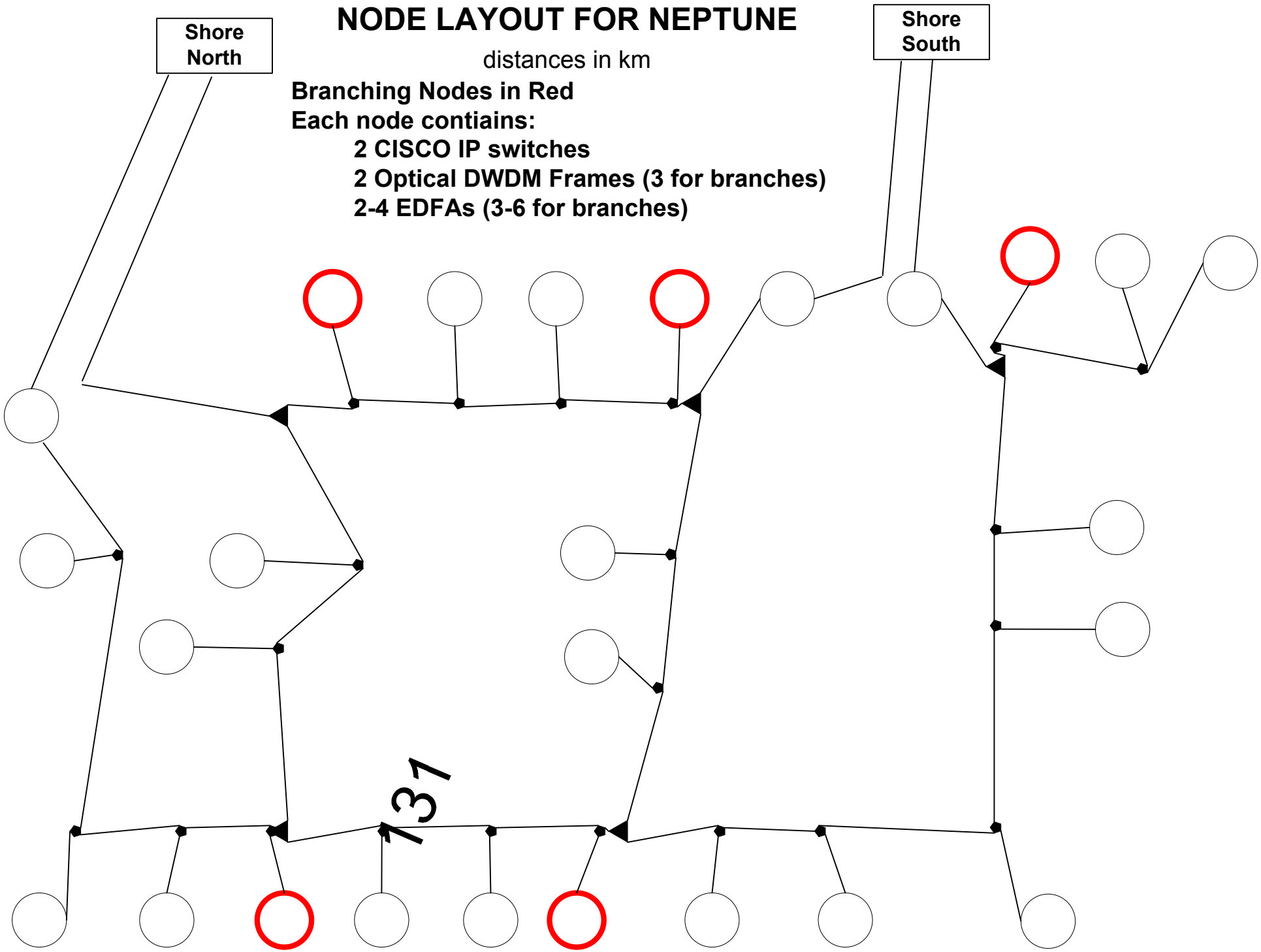
Our chief concerns are:

Size - We must enclose the devices in titanum enclosures to be deployed from a ship. Weight is an issue here. Devices which could be packaged in a 12" diameter drum are preferred
Power Consumption-Power is supplied via long undersea cables with limited current carrying capacity. Devices under 50 wats are preferred.
Reliability - We are hoping for continuous operation over 25 years. All equipment must have a published FIT or MTBF rating.

Present best match is:

Dimensions for mux/transponder frame: 19" x 3.5" x 7"
Power for mux transponder frame: 15 watts
Dimensions for EDFA: 2" x 8" x 8"
Power for EDFA: >23 watts at end-of-life

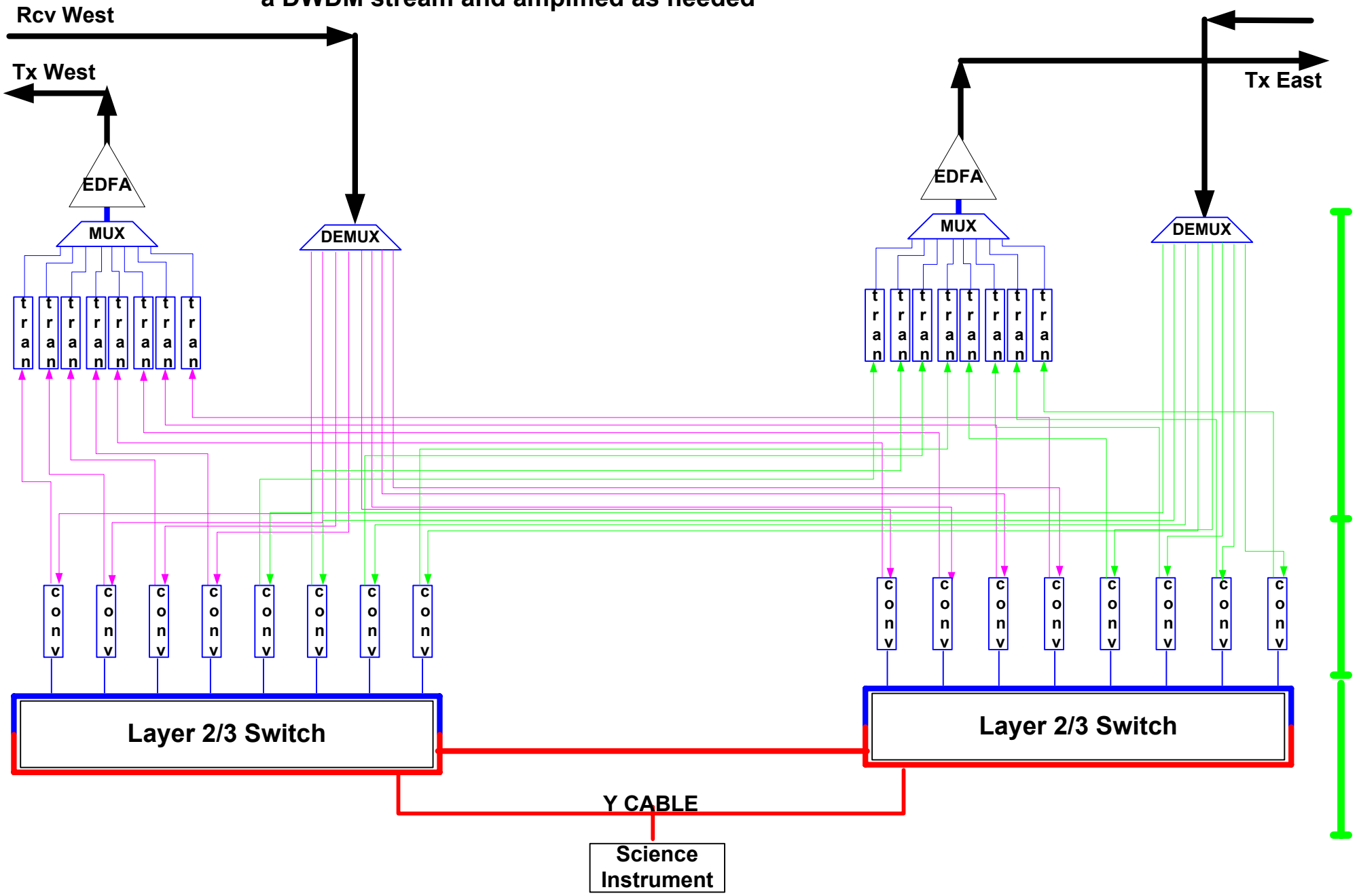
We are seeking devices with that meet or exceed these qualifications.

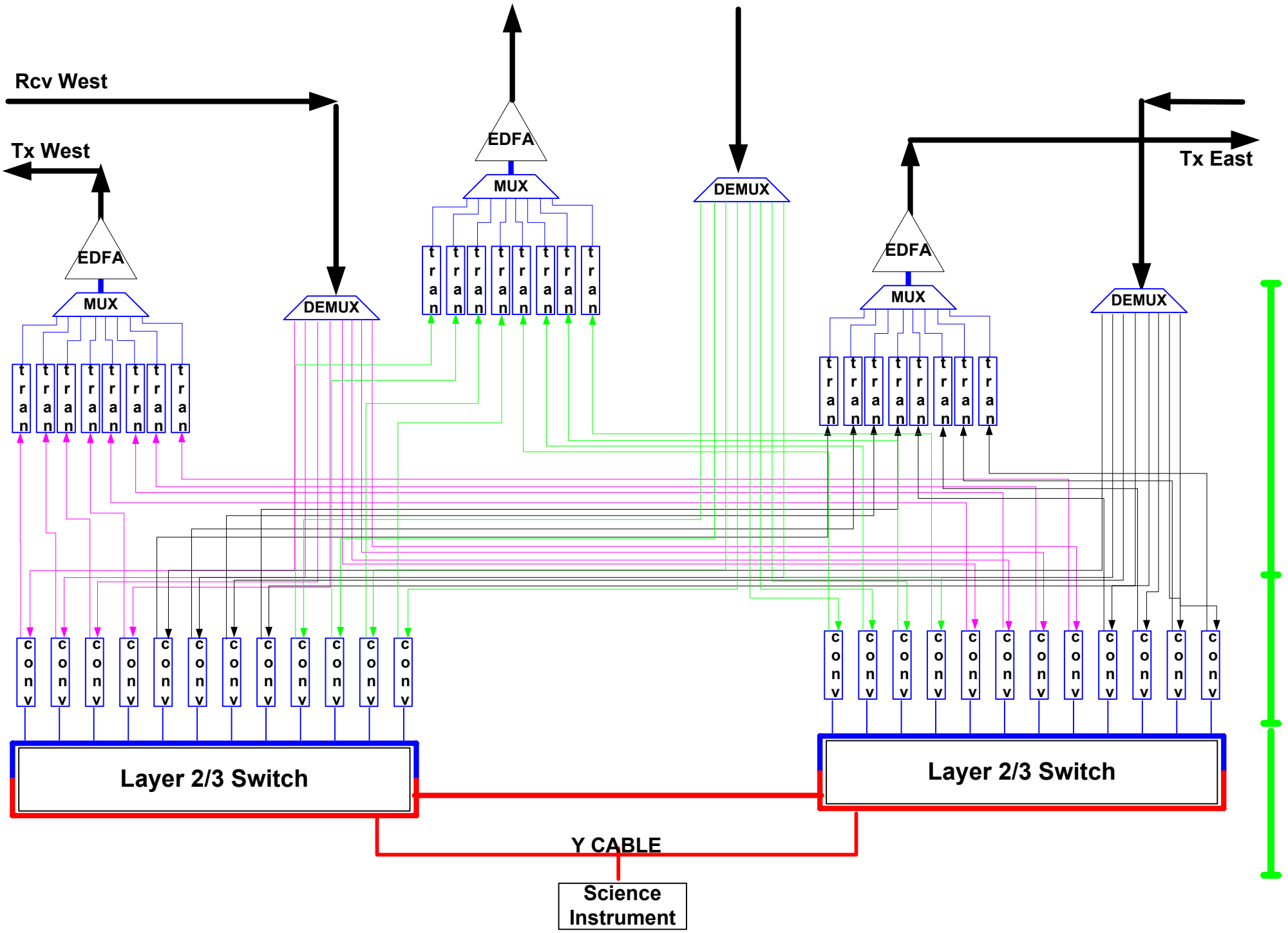

NODE LAYOUT FOR NEPTUNE
distances in km
Branching Nodes in Red
Each node contiains:
2 CISCO IP switches
2 Optical DWDM Frames (3 for branches)
2-4 EDFAs (3-6 for branches)
Shore North
Shore South
131

Science Node Internal Architecture (2-way)

8 DWDM channels are demuxed from the East and feed via 1GbE optical-electrical converters to an IP switch.

8 IP 1GbE ethernet signals are fed to electrical-optical converter, muxed into a DWDM stream and amplified as needed



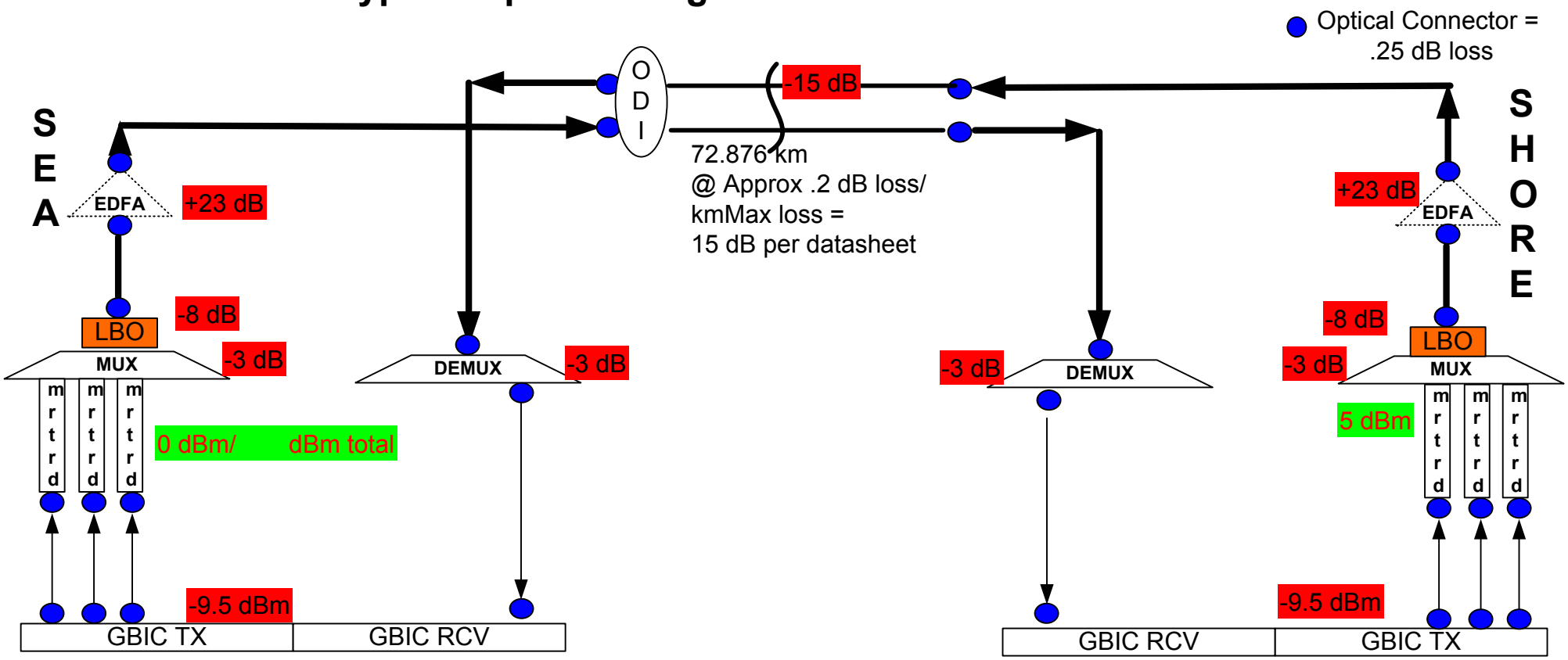

Branching Science Node Internal Architecture (3-way)
Rcv West
Tx West
Tx East
EDFA
MUX
DEMUX
EDFA
MUX
DEMUX
EDFA
MUX
DEMUX
tran
conv
Layer 2/3 Switch
Layer 2/3 Switch
Y CABLE
Science Instrument

Some Important Optical Specs using Network Electronics Optics with CISCO SPFs

Device	Sensitivity dBm	Overload dBm	Damage dBm	Output dBm
NE MRTRD 1550 transponder	-20	-3	-1	-0 (1mW)
NE MRTR 1310 transponder	-25			-7.5
NE MRTR enhancd	-3 to -19			6 (4mW)
LX SFP (GBIC)	-3 to -19			-3 to -9.5
1EC28 EDFA		-6		23 (gain)

Device	Loss dB
NE Mux/Demux	-3 per side - 2*3/
MARS 73 km Cable	-15

Typical Optical Budget w/EDFAs - 73km run



NOTES: 1-1AEC28 EDFA limited to -6dBm input. -8 dB LBO used to adjust input.Gain is 17dB
2-Receive Sensitivity: LX GBIC = -19 dBm MR-TR= -25 dbM
3-MRTRD provides 0 dBm=1mW input. All 3 inject 3mW =~5 dBm

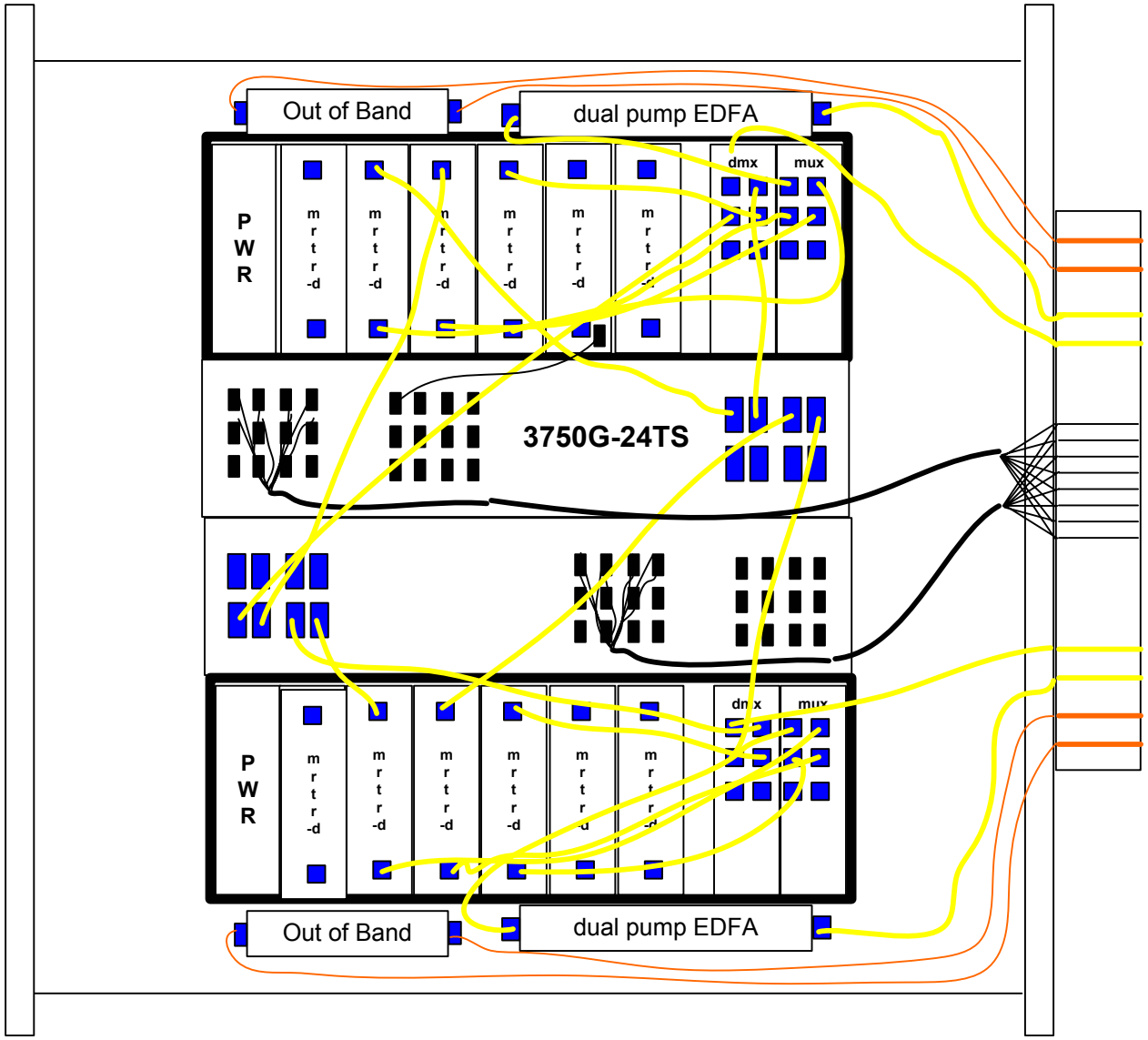
Power for *one* added wavelength starting at sea tx GBIC thru shore rcv GBIC
0 -3 -8 +(2*-.25) +23 +(2*-.25) -15 +(2*-.25) -3 +(2*-.25) = **-9dBm**

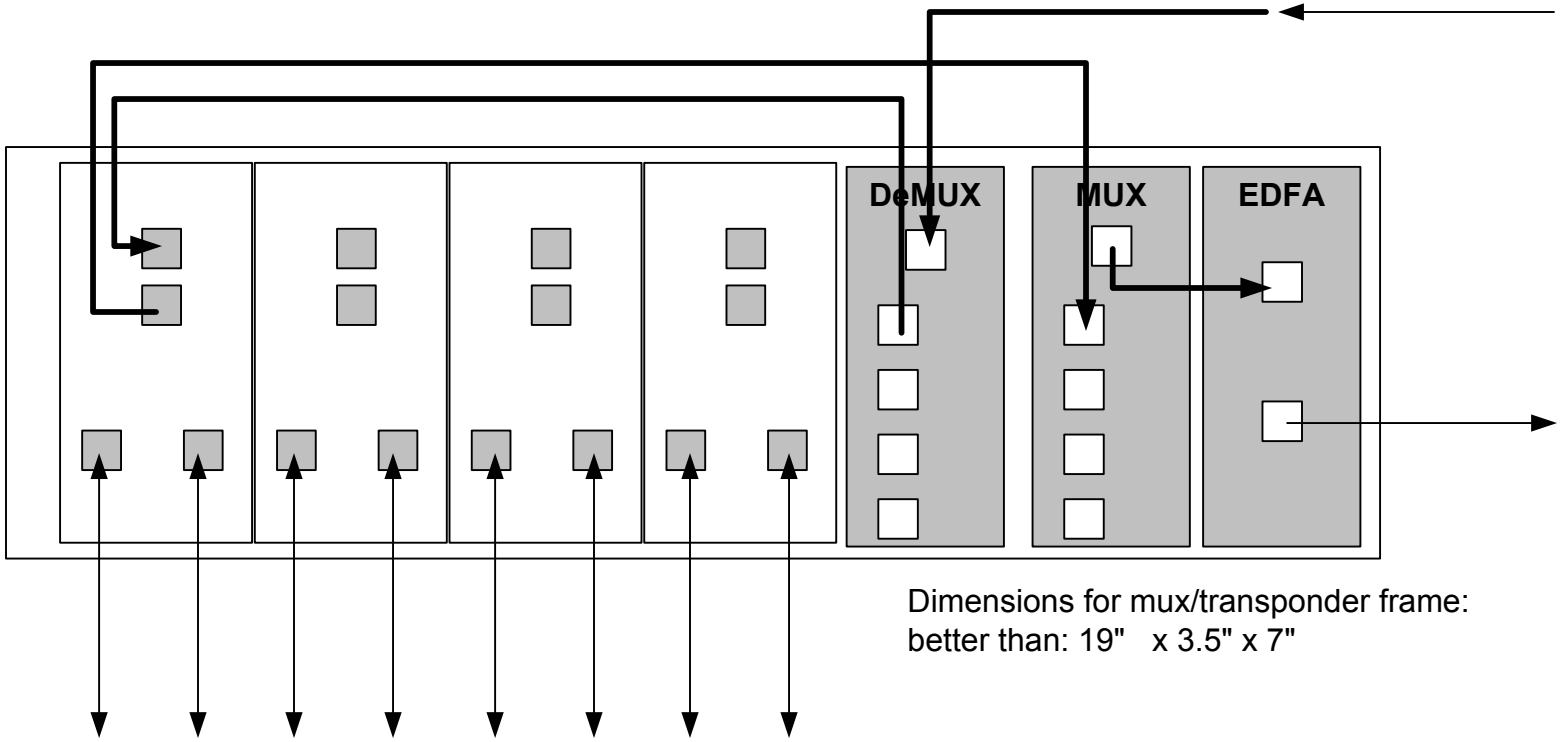
Adding aging allowance of -.01 dB/ km/ 30 years = -0.73 dB and design margin of -3 dB
Power of wavelength at shore rcv GBIC = **-12.73 dB**

Example of packaging in oceanographic titanium enclosure. Diameter is important.

Outer devices are optical Mux & transponder assemblies

Innert devices are electronic IP switches





Dimensions for mux/transponder frame:
better than: 19" x 3.5" x 7"

IDEALIZED OPTICAL FRAME

4 DWDM 2.5 Gb channels carrying 2 x 1GbE signals are demuxed transponders converting to electrical.