Atacama
Large
Millimeter
Array

Fibre Optic Links for IF DTS
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A description of the fibre optic link design & component functionality

Back End Preliminary Design Review, 2002 April 24-25, Granada, Spain

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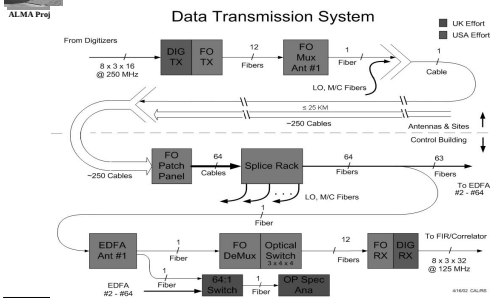
Overview of the fibre optic links for IF DTS



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Power Budget for link

Network Elements	Fibre distance km	+switch +amp Loss dB	+switch No amp Loss dB	distance dependant loss db
Laser Output (dBm)		0	0	
Splice		-0.1	-0.1	
Connector		-0.1	-0.1	
WDM combiner + connectors		-7.5	-7.5	
Splice		-0.1	-0.1	
array cable in trench 1 splice/2km	25	-7.5	-7.5	0.3
Splice		-0.1	-0.1	
Patch panel connectors		-0.2	-0.2	
Input into Amplifier (connectorised)		-15.6	-15.6	
Amplifier Output (dBm) (connectorised)		8	-15.6	
WDM demux + connectors		-7.5	-7.5	
Splice		-0.1	-0.1	
Switch + connectors		-7.5	-7.5	
Splice		-0.1	-0.1	
Connector		-0.1	-0.1	
Margin		-6	-6	
Receiver sensitivity		[illegible]	19.04	
Power Budget		3.74	-17.86	

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Notes on the design

- Ref: ALMA Project Book Chapter 9. Section 9.4
- Parameters considered
  - Attenuation, *~37dB (including 6dB margin)*
  - Dispersion, *2dB Power Penalty*
  - Modulator extinction ratio, *1dB Power Penalty*
  - Polarisation Mode Dispersion, *negligible*
  - Polarisation Dependent loss, *3dB Power Penalty*
  - Cross Talk, *1dB Power Penalty*
  - Non-Linear effects, *negligible.*

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Notes on the Design

- Fibre Choice
  - Standard Single Mode fibre, G.652
- Transmitter choice
  - Integrated EA Modulated package (upto 80km transmission)
- Total Attenuation, dispersion & polarisation mode dispersion are a function of link length. Design dependent on link length

Safety

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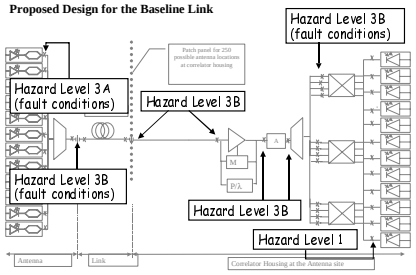
Proposed Design for the Baseline Link



Safety

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- Controlled access to optical system.
  - Interlocked cabinets on laser emitting equipment
  - Locked doors on fibre enclosures
  - Automatic shutdown in the event of a fibre break
  - Labelling
  - Training
  - Documentation

Functional Description of the Modules

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- Optical Multiplexer & Monitor Module
- Optical Fibre Amplifier Module
- Optical Demultiplexer & Switch Module
- Patch Panel

Optical Multiplexer & Monitor Module

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- 12 wavelengths will be multiplexed onto a single fibre
- 200GHz channel spacing, Athermal device, -25dB adjacent crosstalk.
- Failure mode in the transmitter could cause hazardous conditions.
- Over power monitor connected to a -20dB coupler at the output of the Mux provides ‘keep alive’ signals to transmitter boards.

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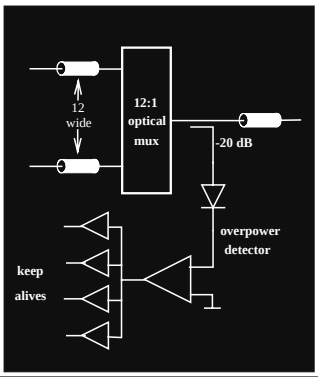

Optical Fibre Amplifier

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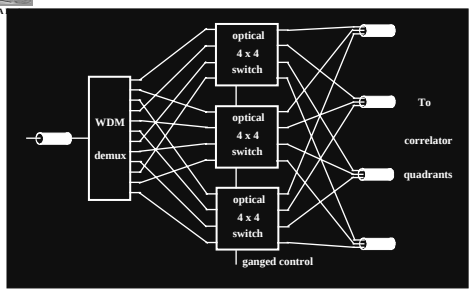
- Used to compensate for loss in optical components.
- Single pump unit suitable for DWDM applications
- 20dB gain, NF < 6dB, maximum output +17dBm (total)
- Hazardous output protected by automatic shutdown.

Optical Demultiplexer & Switch Module



Optical Demultiplexer & Switch Module

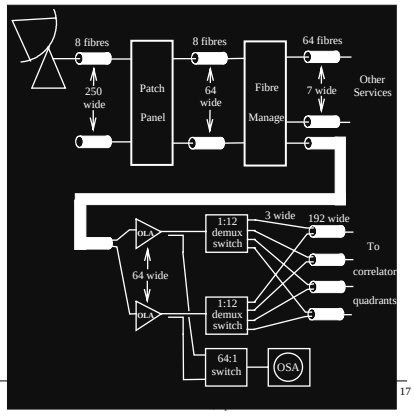
- DWDM Multiplexer separates the 12 wavelengths onto individual fibres.
- 4 x 4 optical matrix switch allows three wavelengths, representing an polarisation pair to be switched to the correlator quadrants
- They can be switched in any manner, including, for example, the same triple to all 4 quadrants.

Optical Demultiplexer Switch Discussion Questions

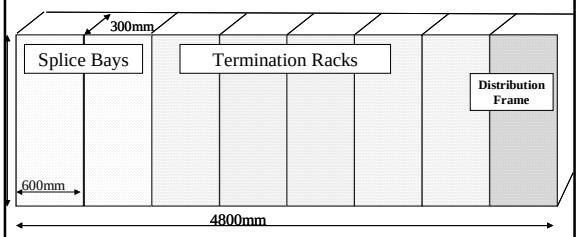
- Minimum $1.5Million price tag.
- Can be reduced by up to 50% when the requirements are reduced.
- Is the functionality worth the price?

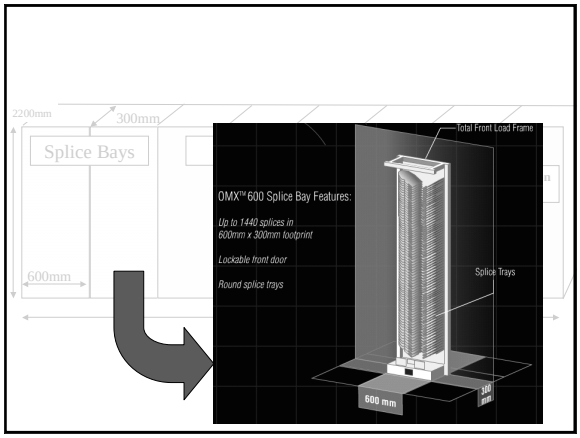
Patch Panel

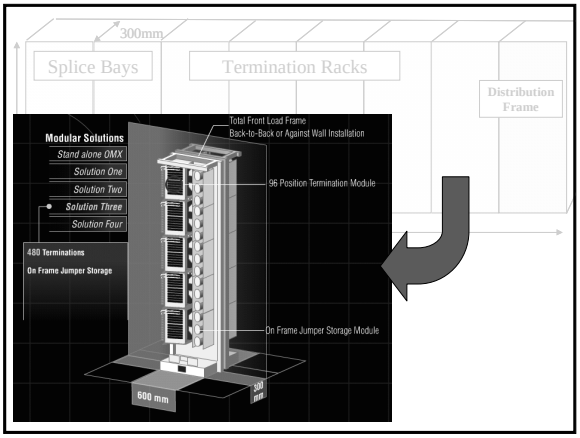
- Connects 64 ‘live’ antenna pads to the 64 sets of terminal equipment.
- Choice of 250 locations for the 64 antenna, each with an 8 fibre cable.
- Results 2,000 splices & a big headache!

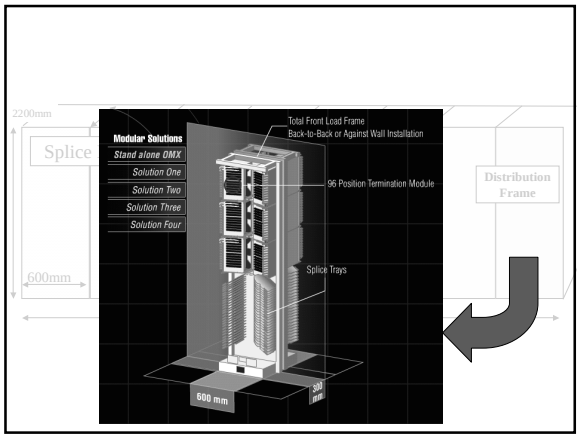


Patch Panel









Patch Panel Discussion Questions

- Is the proposed wiring diagram suitable for other applications?
- Input from other interested groups

Conclusions & Questions

- Design :
  - standard single mode fibre
  - optical fibre amplifiers
  - 200GHz DWDM channel spacing
- Potentially hazardous, safety precautions should be taken.
- Optical switch is expensive & lossy – confirm requirements
- Patch panel is complex – input from other groups