

Barriers to WDM Deployment on Military Platforms

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**DARPA/MTO
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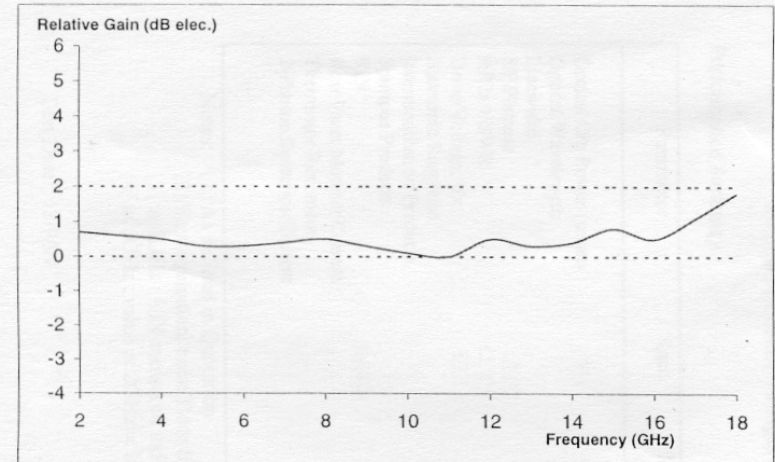
Militarized (Flight-Qualified) 18 GHz Single-Mode Transmitters

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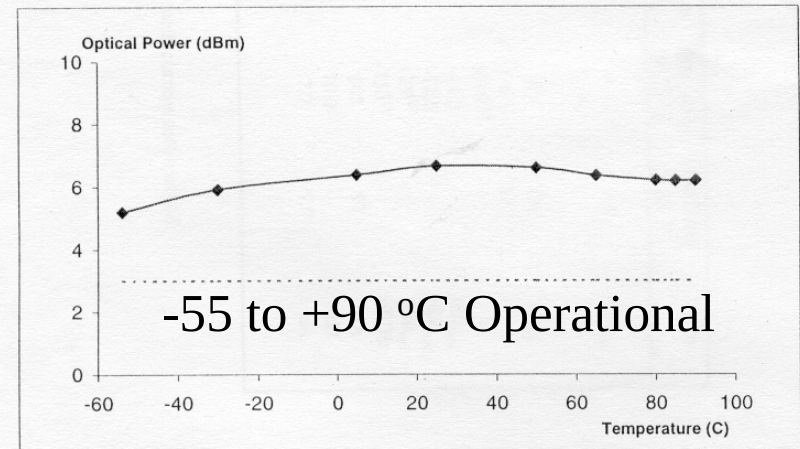


Mature, Military Hardware for Point-to-Point Applications

RF Flatness over Frequency @ 90C

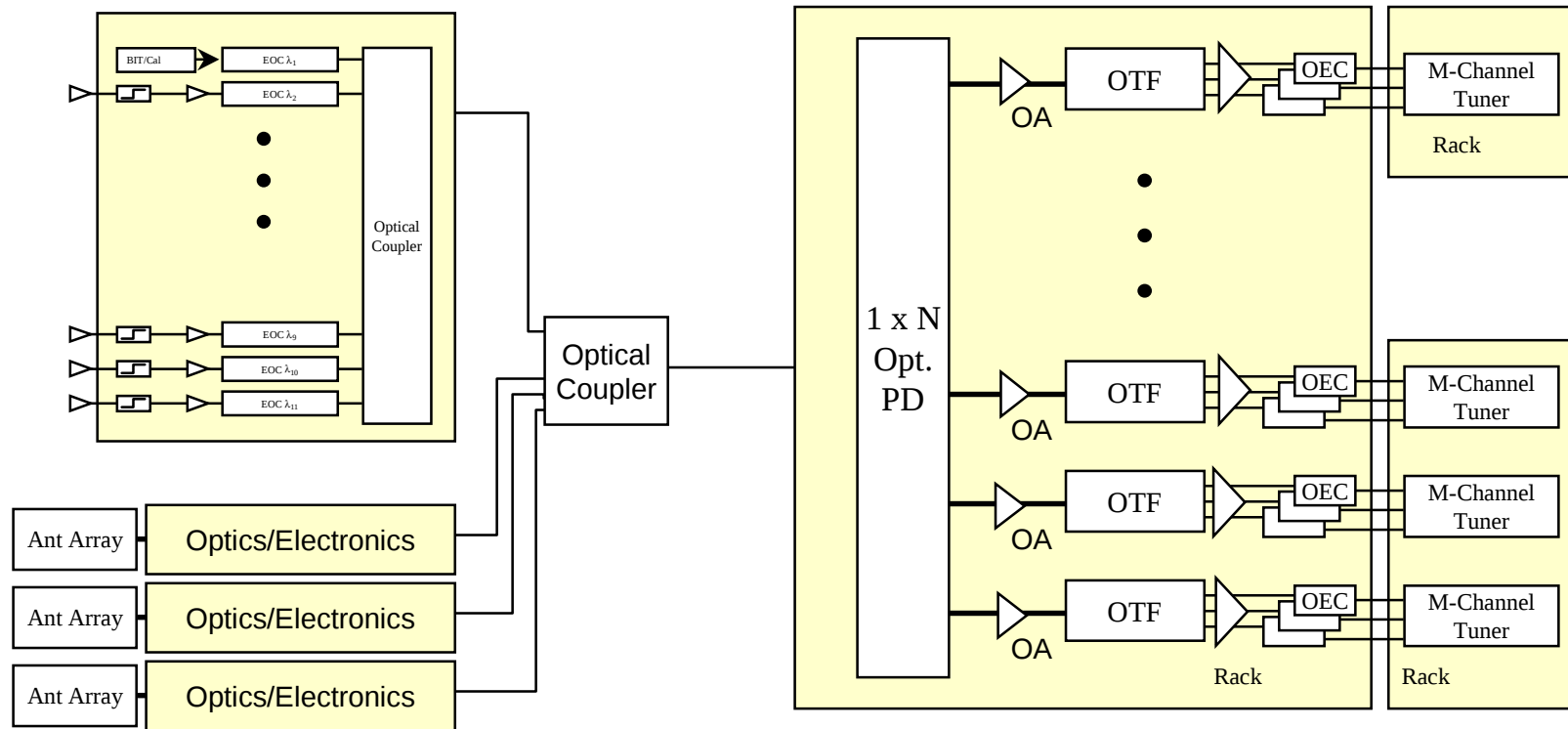


Mean Optical Output Power vs. Temperature



Generic WDM for Non-Blocking, Full Broadcast Antenna Selection

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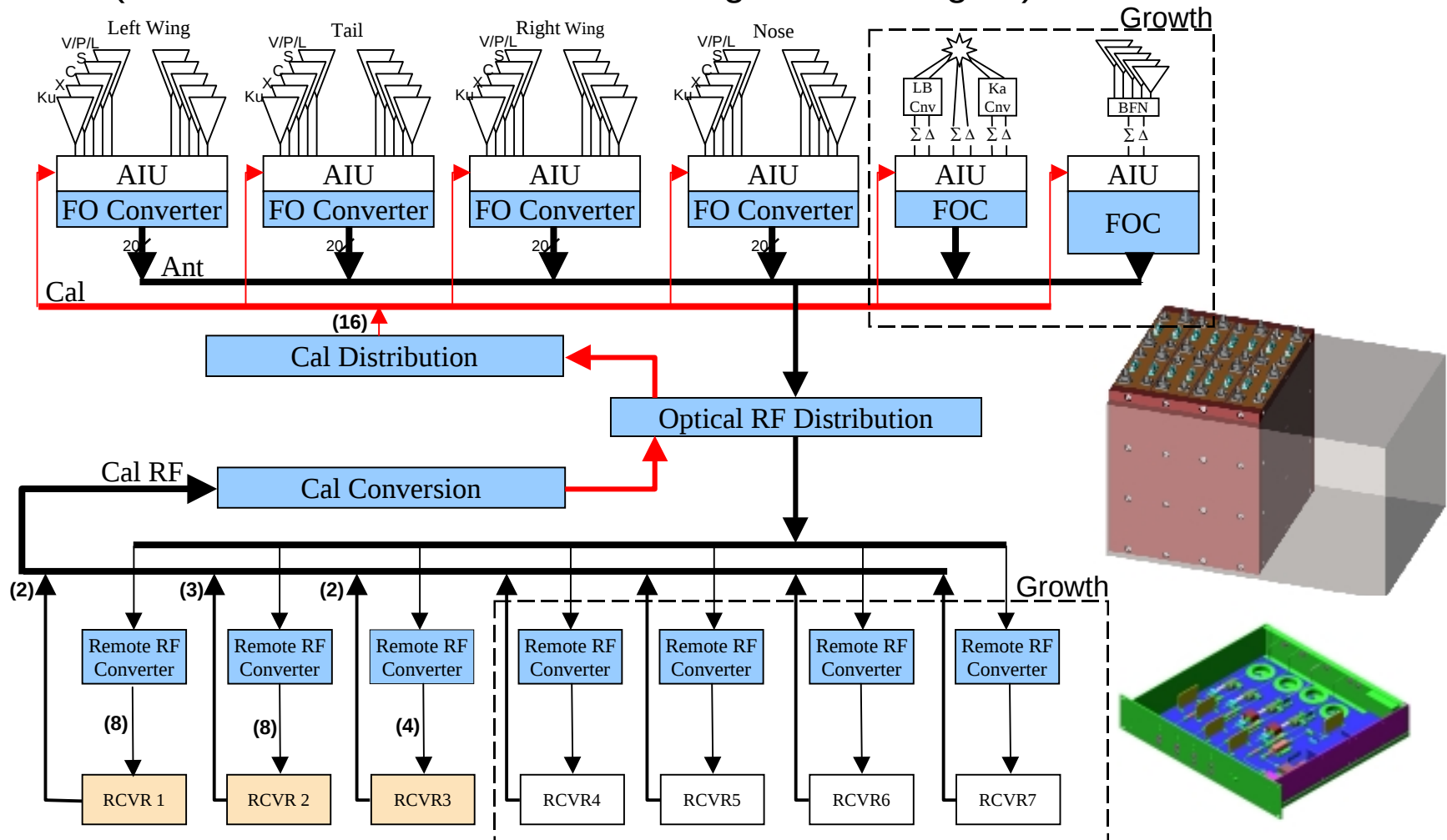
WDM Fiber Network Replacing Conventional RF Cabling, Optical Power Divider (PD) and Optical Tunable Filters (OTF) Replacing Conventional RF Switch; All Antenna Signals Available at Each Receiver

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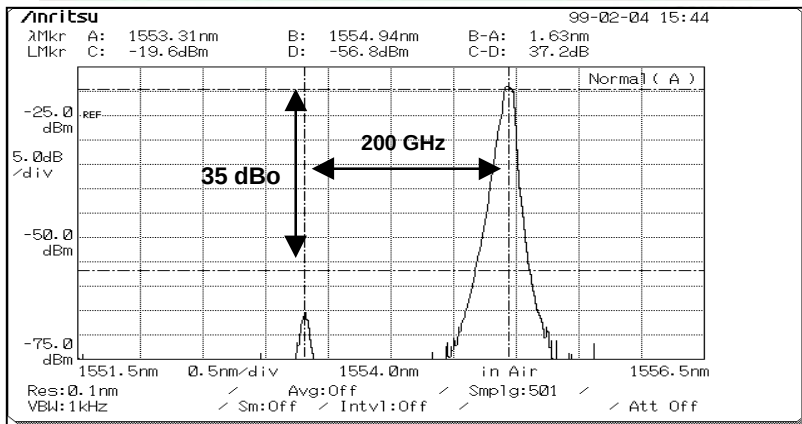
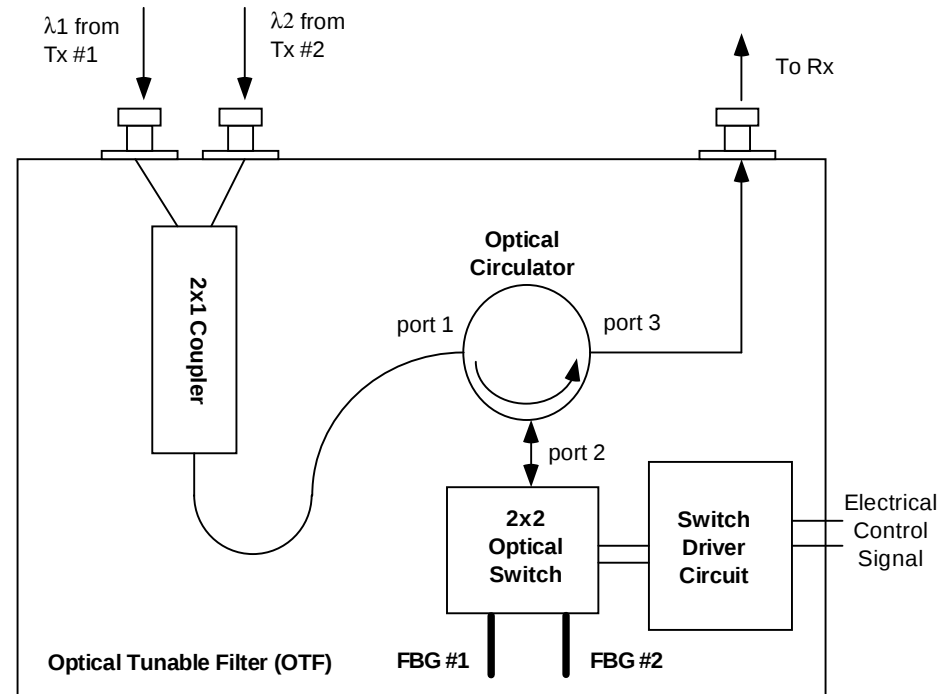
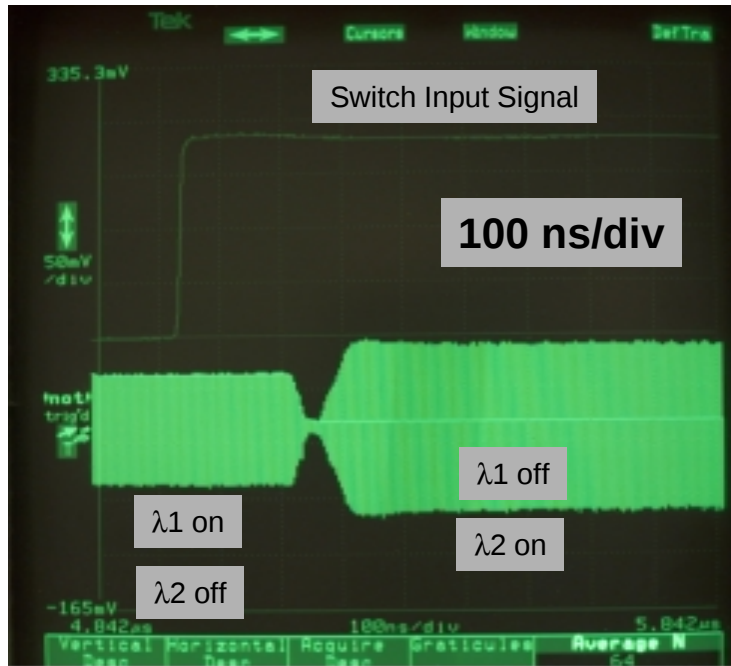
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Current Analog 18 GHz Link WDM System

(80 Antennas to 16 Receivers using 4 Wavelengths)

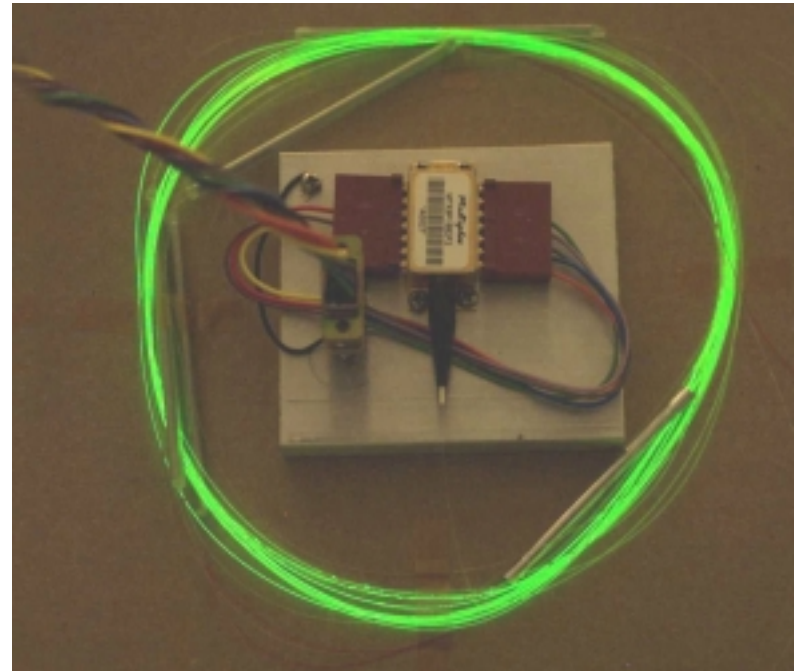
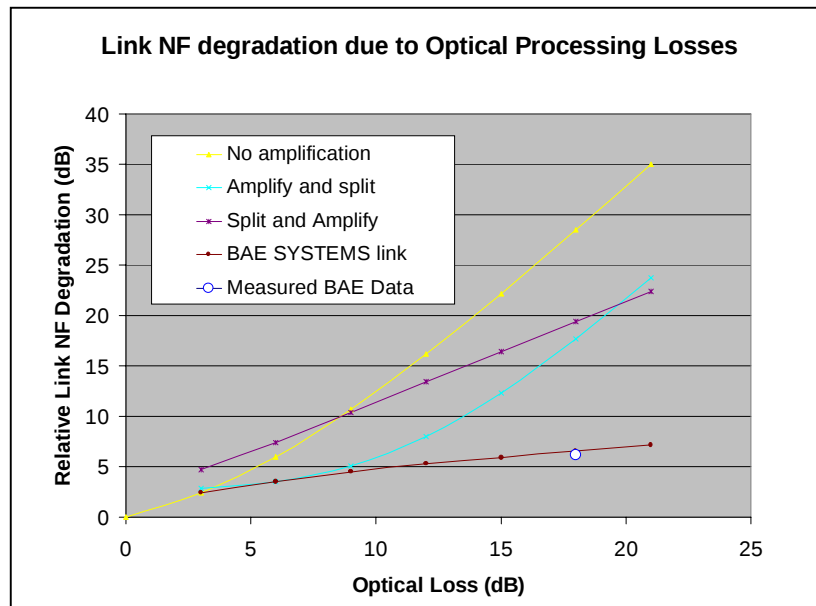


Dual Channel (10.1 and 10.5 GHz) Switching (Optical Tunable Filter)



Switching Speed ~80 ns
RF Crosstalk <-76 dBc
RF Bandwidth 18 GHz
Insertion Loss ~8 dBc

Low Noise Optically Amplified Microwave Links



BAE SYSTEMS has developed proprietary technology to reduce the noise figure ($RIN \sim -157$ dB/Hz) of fiber optic microwave links with high optical processing losses due to WDM, switching, and other distribution components.

Desparately Needed Developments to Enable Replacement of RF Switches

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- **Low Insertion Loss, High-Speed Switches**
 - 10 ms SONET Switching is Too Slow for Military Applications
 - $<10 \mu\text{s}$ is Typical Requirement ($<100 \text{ ns}$ for High POI Appl.)
 - Narrow Bandwidth (FP), High-Speed Switches Don't Help!!
- **Low-RIN EDFAs**
 - WDM Requires Muxing and Demuxing Multiple Channels
 - EDFAs **ALWAYS** Degrade Analog Link Performance
 - EDFA RIN Must be Reduced Below -155 dB/Hz
- **High Crosstalk Suppression Between WDM Channels (Optical Switches for Tunable λ Filtering)**
 - Easy for Narrowband RF Signals ($<1 \text{ GHz}$)
 - Difficult for 18 GHz and Higher Sidebands
 - Fiber Bragg Gratings are the Only Demonstrated Technology to Achieve $> 35 \text{ dBo}$ Crosstalk Suppression for 18 GHz Sidebands
- **High-Power WDM DFB Arrays**
 - $>40 \text{ mW/Channel}$ @ $\text{RIN} < -160 \text{ dB/Hz}$, $< 1 \text{ MHz}$ Linewidth