Barriers to WDM Deployment on Military Platforms

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REVIEW OF THIS MATERIAL DOES NOT IMPLY DEPARTMENT OF DEFENSE ENDORSEMENT OF FACTUAL ACCURACY OR OPINION
# Barriers to WDM Deployment on Military Platforms

**DARPA/MTO, WDM for Military Platforms Workshop** held in McLean, VA on April 18-19, 2000, The original document contains color images.
Militarized (Flight-Qualified) 18 GHz Single-Mode Transmitters

Mature, Military Hardware for Point-to-Point Applications

-55 to +90 °C Operational
Generic WDM for Non-Blocking, Full Broadcast Antenna Selection

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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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)

Switch Input Signal

100 ns/div

\( \lambda_1 \) on
\( \lambda_2 \) off
\( \lambda_1 \) off
\( \lambda_2 \) on

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

Switching (Optical Tunable Filter)

To Rx

\( \lambda_1 \) from Tx #1
\( \lambda_2 \) from Tx #2

2x1 Coupler

Optical Circulator

2x2 Optical Switch

FBG #1
FBG #2

Optical Tunable Filter (OTF)

Switch Driver Circuit

Electrical Control Signal

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BAE SYSTEMS has developed proprietary technology to reduce the noise figure (RIN ~ -157 dB/Hz) of fiber optic microwave links with high optical processing losses due to WDM, switching, and other distribution components.
Desperately Needed Developments to Enable Replacement of RF Switches

- **Low Insertion Loss, High-Speed Switches**
  - 10 ms SONET Switching is Too Slow for Military Applications
  - <10 μs is Typical Requirement (<100 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 GHz)
  - Difficult for 18 GHz and Higher Sidebands
    - Fiber Bragg Gratings are the Only Demonstrated Technology to Achieve > 35 dBo Crosstalk Suppression for 18 GHz Sidebands

- **High-Power WDM DFB Arrays**
  - >40 mW/Channel @ RIN <-160 dB/Hz, < 1 MHz Linewidth