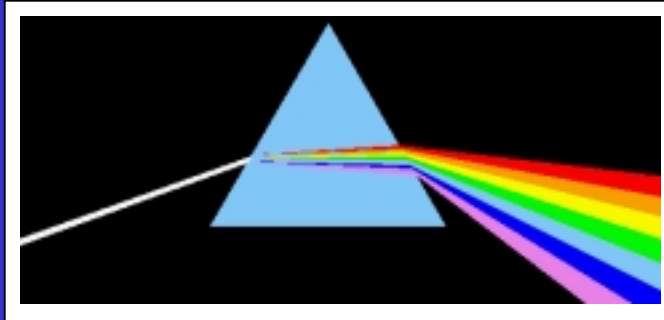
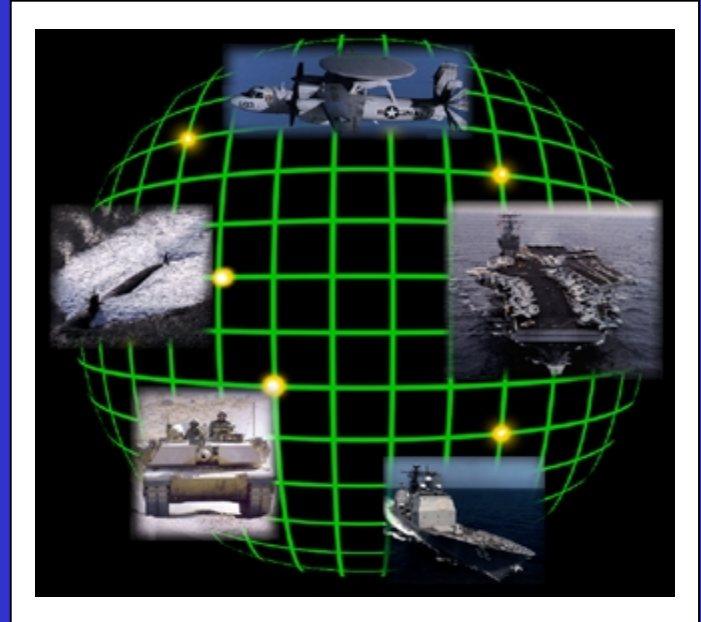




Wavelength Division Multiplexing (WDM) Technology for Naval Air Applications



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Naval Air Systems Command

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Aerospace Photonics

- Despite Significant Commercial and DARPA Funding of WDM Technology, the Technology Has Yet to Impact Naval Aerospace Platforms.
- Affordability, Environmental Compatibility, and Technology Readiness Level Remain Impediments.
- Directed Technology Maturation at the Component, Packaging, and System Level Are Required.
- Broad Application to fighter, transport, ASW, AEW, VSTOL, UAV/UCAV, Rotary Wing, and Space Platforms.
- Many Common Issues with FTTH and FTTD



AEROSPACE PLATFORM INTERCONNECTS

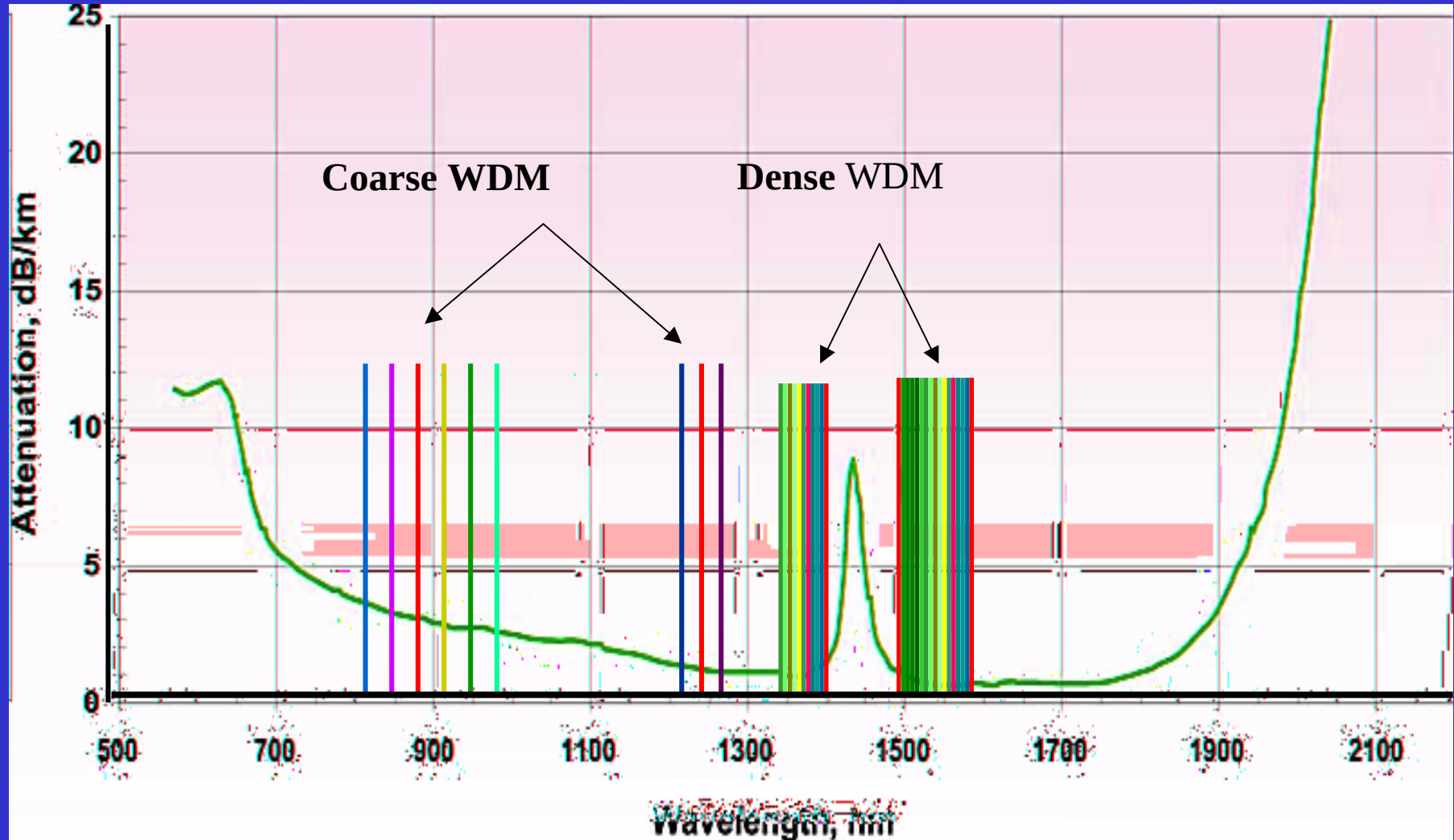
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PLATFORM/SYSTEM		FIBER SIZE								CABLE CONSTRUCTION				CONNNECTORS							
		100/140/172 - GI	100/140/170 - GI	62.5/125 - GI	200/208 HCS - SI	100/140 -GI (NON-POLYIMIDE)	200/300 - G(EUROPE)	200/280 - SI(EUROPE)	Single Mode	SIMPLEX	CIRCULAR MULTI - CABLE	RIBBON	BLOWN	SMA	HA	ST	Lensed	38999 TYPE	SPECIAL	MT	
USA	F-22	X									X							X			
	RAH-66	X									X							X			
	F/A 18	X									X							X			
	F/A 18 E/F	X							X		X							X			
	FOIS	X								X								X			
	AV-8B	X								X	X							X			
	F15 Towed Decoy T45								X	X	X								X		
	C-130	X		X							X					X		X			
	AWACS (707)			X						X						X					
	BOEING 777 SSF	X									X						X	X			
SPACE	SATELLITE		X			X				X	X			X				X	X		
NON-US	EUROFIGHTER Data bus							X		X				X	X						
	HF 9000 SYSTEM				X		X	X		X				X							
	EUROFIGHTER towed decoy								X	X											
	SKS600							X		X								X			
	AIRSHIP SEA HARRIER						X			X				X				X			
	RAF-ALe							X		X											
	MIRAGE 2000																				
	TIARA							X		X											
	EH101 Mk3							X													
	Merlin							X													
	CHINOOK HC Mk3							X													
	E-3D SENTRY							X							X						
	SEA KING Mk3a							X													
	NIMROD 2000			X						X						X					
	LYNX (Export)						X	X		X				X							
	Gripen																				
	EUROCOPTER							X													
	A340/600 Taxi Aid			X										X							
A340/500 JES			X							X						X	X				

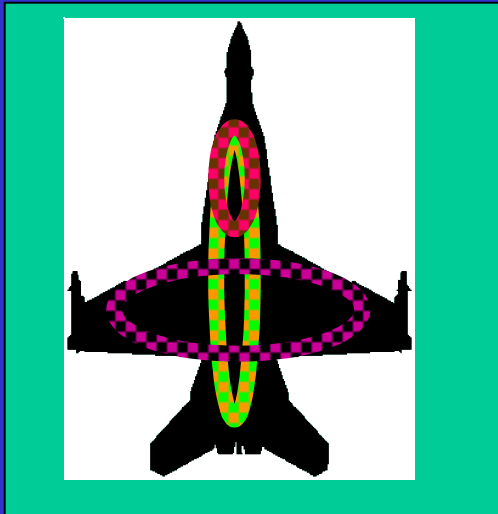


WDM Spectrum and Wavelength Selection

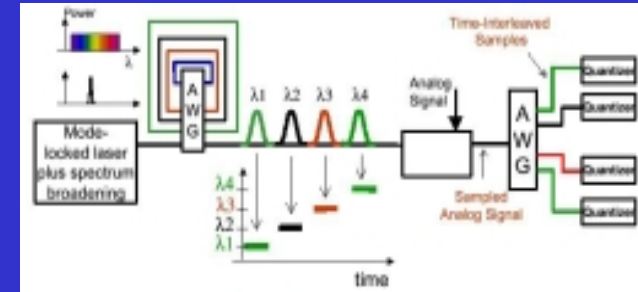




Potential WDM Applications

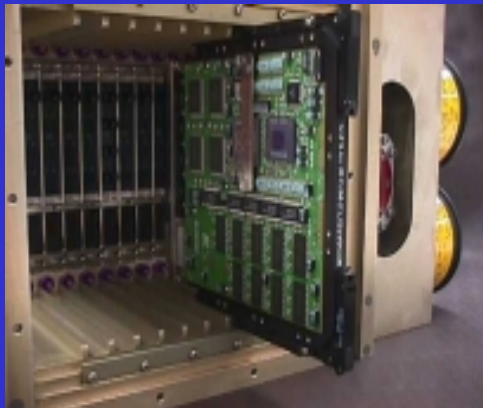


Free Space Interconnects

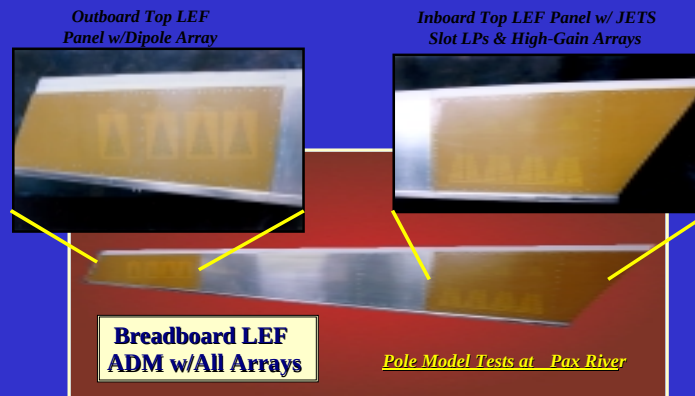


True Time Delay
A/D Conversion

Networks for Aircraft/
UAV Avionics & VMS



Computer Interconnects



Smart Skins/Structures
Interconnect and
Diagnostics

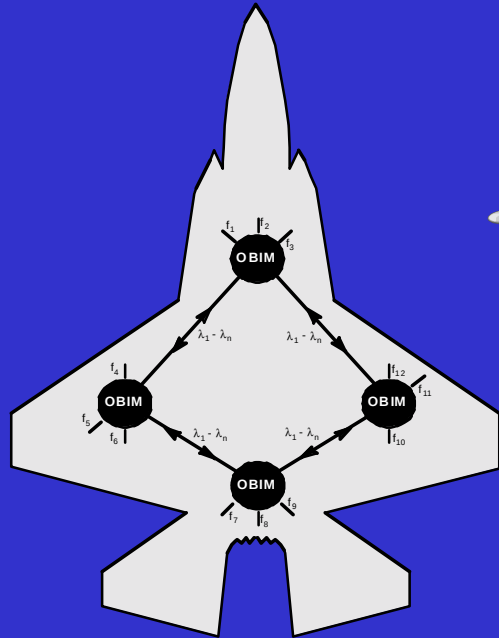


Missile and Decoy
Interfaces



Current NAVAIR WDM Developments

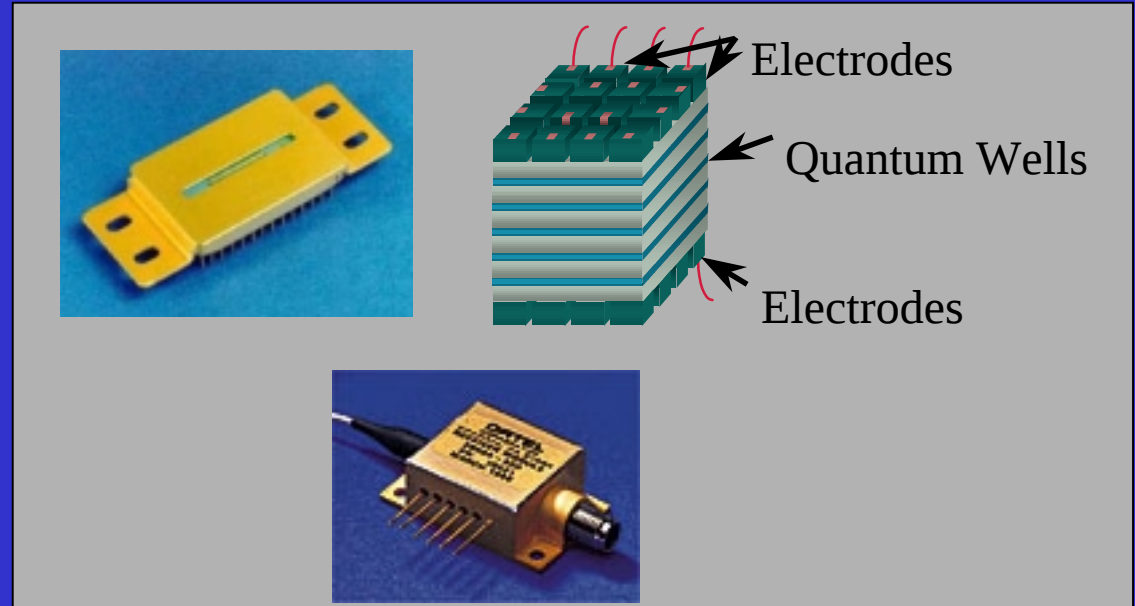
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FAST WDM/SCM
Network Development



P-3 "Hairy Buffalo" Demonstration



Broadband Component Developments⁶



Required Component Maturation

- High Density Single Mode Cable Plant
 - Small Footprint Single Channel and Array Connectors
 - Rugged Ribbon and Single Channel Cables
 - Installation and Maintenance Tools and Test Equipment
- Optical Backplane Technology
 - Media and Connectors
- Tunable and Multi-Wavelength Lasers & Filters
 - Broad Spectrum for Coarse and Dense WDM
 - Efficient Pump Lasers for all Bands
 - Rapid Continuously Tunable Lasers and Filters



Required Component Maturation

- Planar Wavelength Selective Couplers and Array Waveguides
- Affordable Compact Fiber, Glass, and Waveguide Amplification - Multi-Band/Broadband.
- Broadband “Smart Pixel” Detectors.
- High Speed Modulators and “All Optical” Switching
- Embedded Structural Diagnostics
 - Bragg Grating and Fabry Perot Micro-sensors
 - Integrated WDM Sensor Interface



Packaging/Connector Issues

- Prefer Hermetic, Connectorized, Low profile Device and Component Packages.
- Non-TE cooling preferred.
- Transceivers Should include Built-in-Test Features
 - Power Monitors
 - Simple Threshold Logic
 - Switching Capability
- Small Footprint Ferrules and Connector Backshells
- Designed to withstand Temperature, Shock, Vibration



SYSTEM DEMONSTRATIONS

- BROADBAND MIXED SIGNAL WDM/SCM NETWORK WITH MULTI-CHANNEL DIGITAL, RF, AND FLIGHT CRITICAL DATA
- VCSEL BASED TRANSMISSION OF PARALLEL DATA VIA WDM IN AN OPTICAL BACKPLANE INTERCONNECT
- MIL-STD 1760 WDM MULTI-CHANNEL WEAPONS DATA LINK
- FREE SPACE SMART STRUCTURE SENSOR NETWORK
- WDM BASED A/D AND TRUE TIME DELAY IN BROADBAND AIRBORNE PHASED ARRAY



Summary

- Internet is driving Commercial WDM Technology
- Aerospace Environment is the Challenge
- COTS Components Must be Designed, Packaged or Screened to Operate in this Harsh Environment
- Affordability Remains an Issue with Low Volume
- Systems Requirements are still unique:
 - Latency, Determinism, Throughput, RF Frequency Bands, Fault Tolerance, System and Structural Health Monitoring.
- WDM is a High Payoff Technology