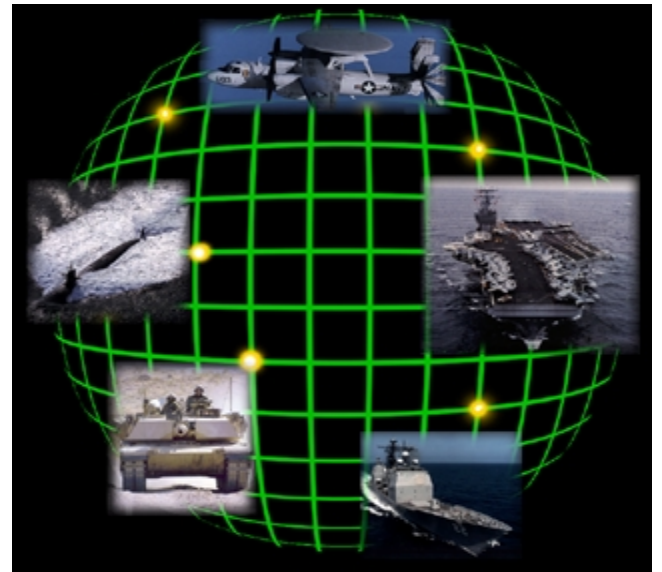




Wavelength Division Multiplexing (WDM) Technology for Naval Air Applications



Drew Glista
glistaas@navair.navy.mil

Naval Air Systems Command

Patuxent River, MD
301-342-2046

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 18 APR 2000		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Wavelength division Multiplexing (WDM) Technology for Naval Air Applications				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Air Systems Command Patuxent River, MD				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES DARPA/MTO, WDM for Military Platforms Workshop held in McLean, VA on April 18-19, 2000, The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 13	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



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

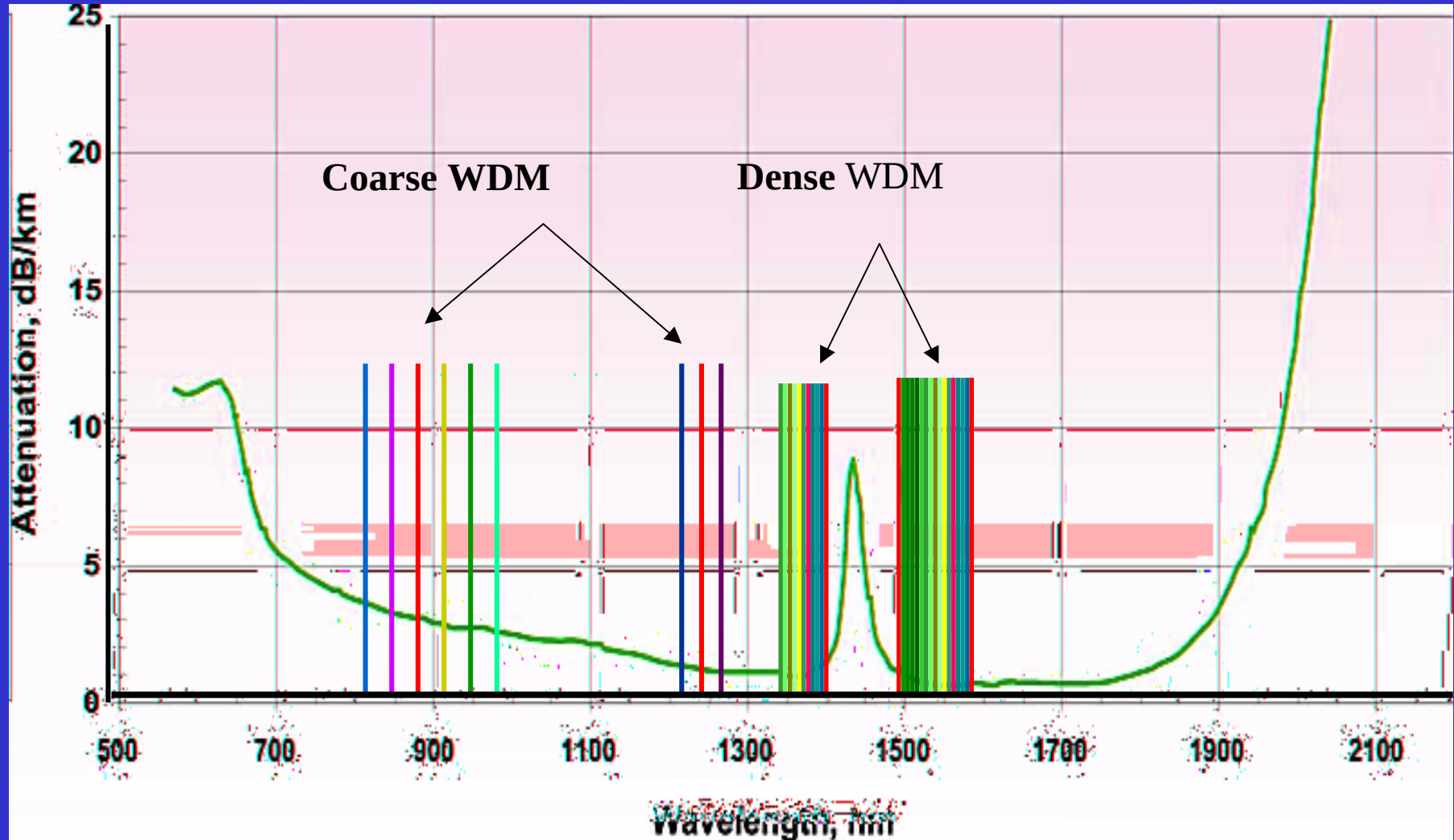


APPROVED FOR PUBLIC RELEASE, DISTRIBUTION UNLIMITED

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-AL							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				

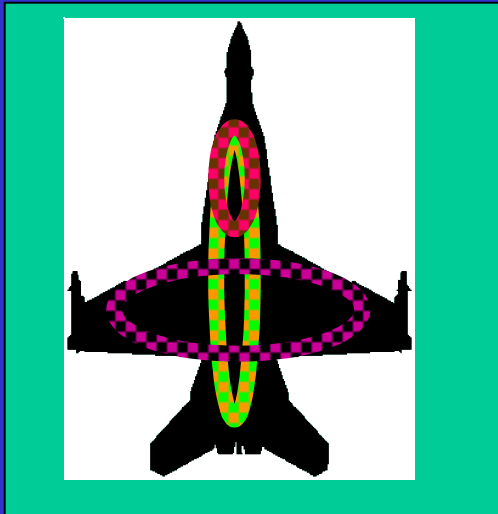


WDM Spectrum and Wavelength Selection

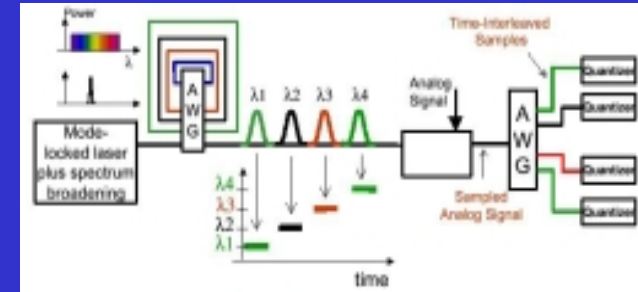




Potential WDM Applications

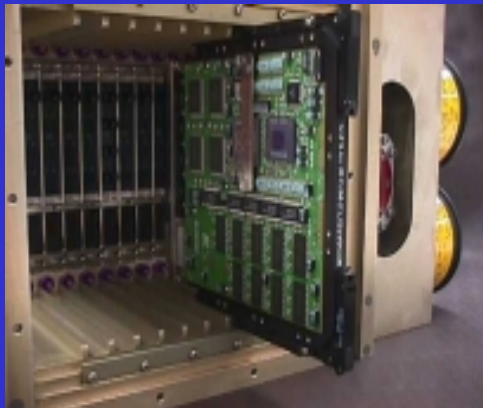


Free Space Interconnects

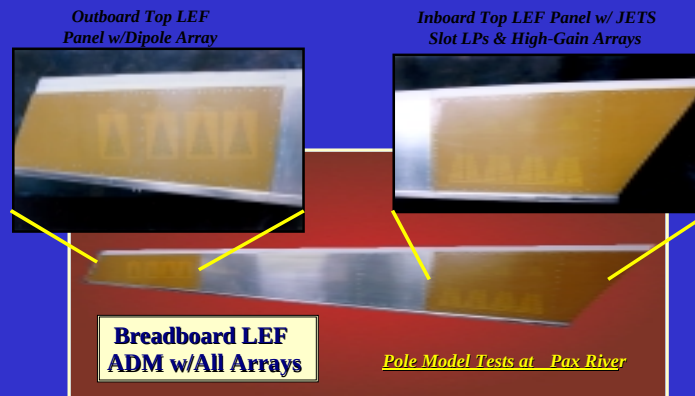


True Time Delay
A/D Conversion

Networks for Aircraft/
UAV Avionics & VMS



Computer Interconnects



Smart Skins/Structures
Interconnect and
Diagnostics

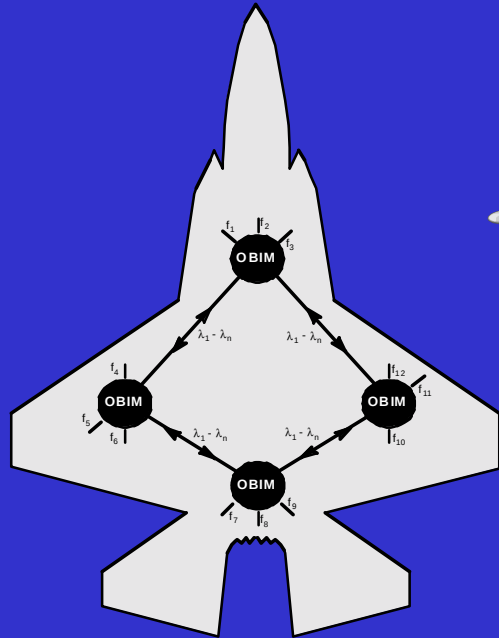


Missile and Decoy
Interfaces



Current NAVAIR WDM Developments

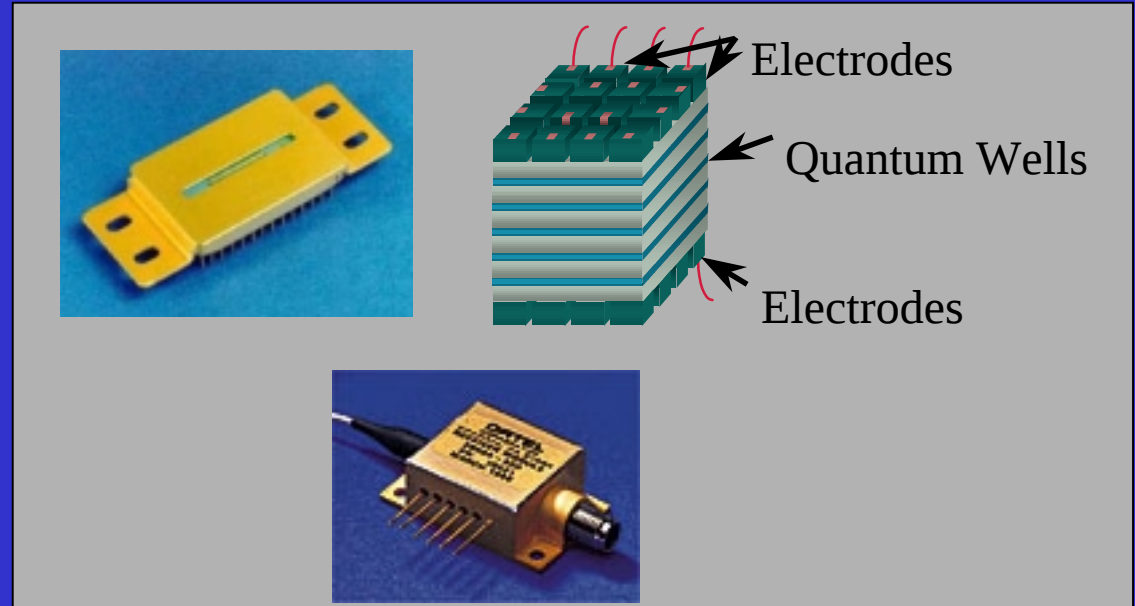
APPROVED FOR PUBLIC RELEASE, DISTRIBUTION UNLIMITED



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