AFRL Sensors Directorate

At

Rome Research Site, Rome, NY

Briefing to BRAC Commissioner Lloyd W. Newton

22 June 2005

Mr. Joe Sciabica

Mr. Bill Baldygo

Mr. Rick Shaughnessy

Sensors Directorate

Air Force Research Laboratory

Outline

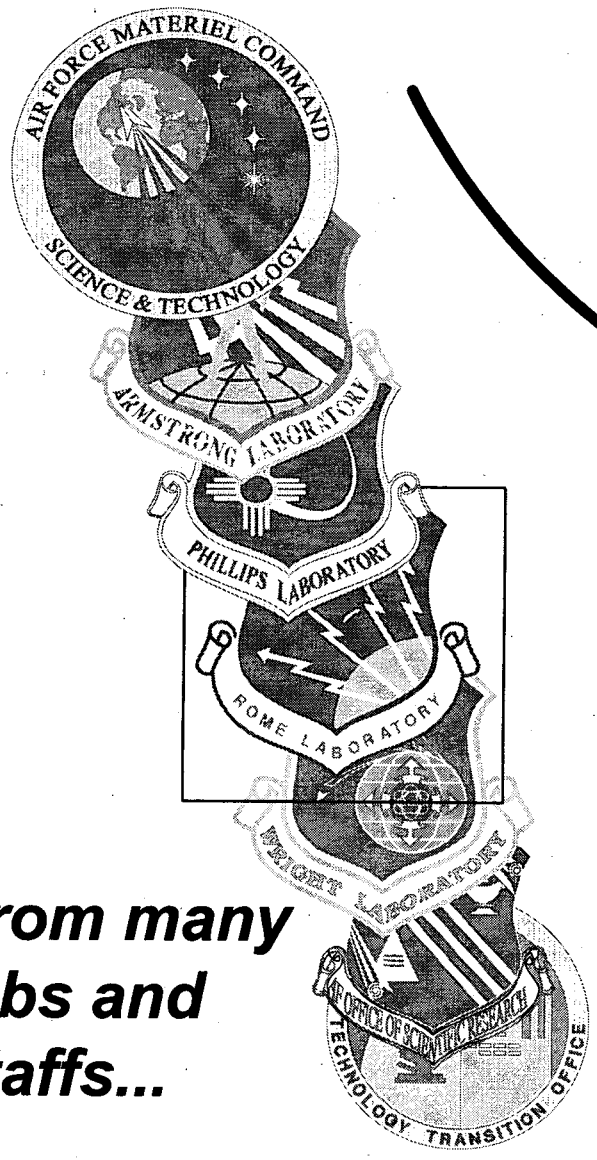
- AFRL Sensors Directorate Overview
  - Mr. Joe Sciabica
- AFRL/SN Rome Research Site
  - Mission
  - People
  - Accomplishments
- Requirements/Considerations for SN RRS Relocation
  - BRAC Recommendations for SN RRS
  - Facilities
  - Sites
  - Classified Infrastructure
- Discussion and Q&A

DoD BRAC Recommendations

- Realign Rome Laboratory, NY, by relocating the Sensor Directorate to Wright Patterson Air Force Base, OH, and consolidating it with the Air Force Research Laboratory, Sensor Directorate at Wright Patterson Air Force Base, OH.
- Justification: This recommendation realigns and consolidates portions of the Air Force and Army Research Laboratories to provide greater synergy across technical disciplines and functions. It does this by consolidating geographically separate units of the Air Force and Army Research Laboratories.

Source: Department of Defense Base Closure and Realignment Report, Volume I, Part 2 of 2; Detailed Recommendations, Section 10 Recommendations-Technical Joint Cross-Service Group; May 2005, p. Tech-22.

Air Force Research Laboratory



From many labs and staffs...

...To the Air Force's Single Laboratory

AFRL Stand-Up 1997

- Consolidated All Sensors Work Performed at the Former Wright Laboratory and Rome Laboratory into the New Air Force Research Laboratory (AFRL) Sensors Directorate (SN) Headquartered at WPAFB

- Diverse Sensor Research Facilities, Capabilities, and Technical Disciplines at WPAFB, Hanscom AFB and Rome Site Were Combined to Provide a Completely Synergistic Sensor Research Capability

AFRL Stand-Up

Strategic Technical Differentiation

Wright Research Site – WPAFB, OH

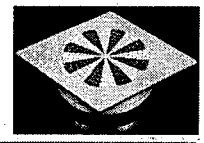
Electronic Warfare

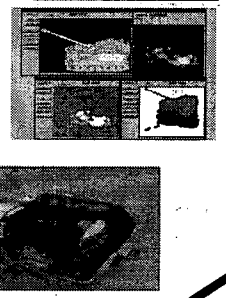
Electro-Optical Sensors

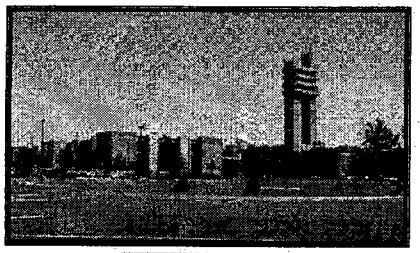
Automatic Target Recognition

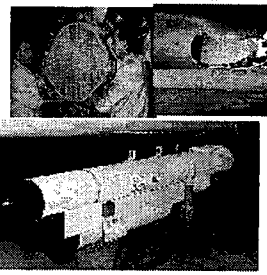
RF and EO Components

Sensor Fusion







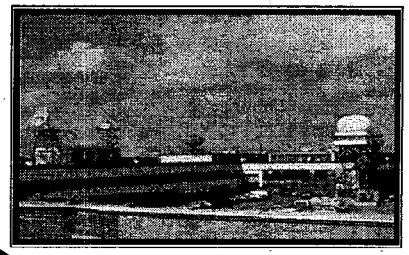


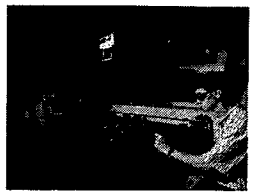
Rome Research Site – Rome, NY

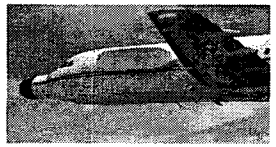
Surveillance Radar

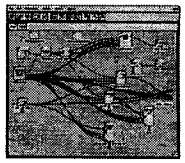
Radar Signal Processing

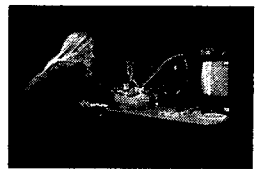
Photonic Components







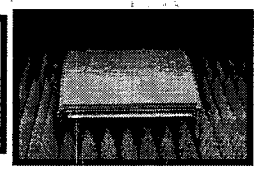


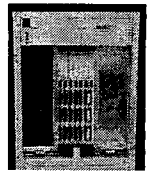


Hanscom Research Site – Hanscom AFB, MA

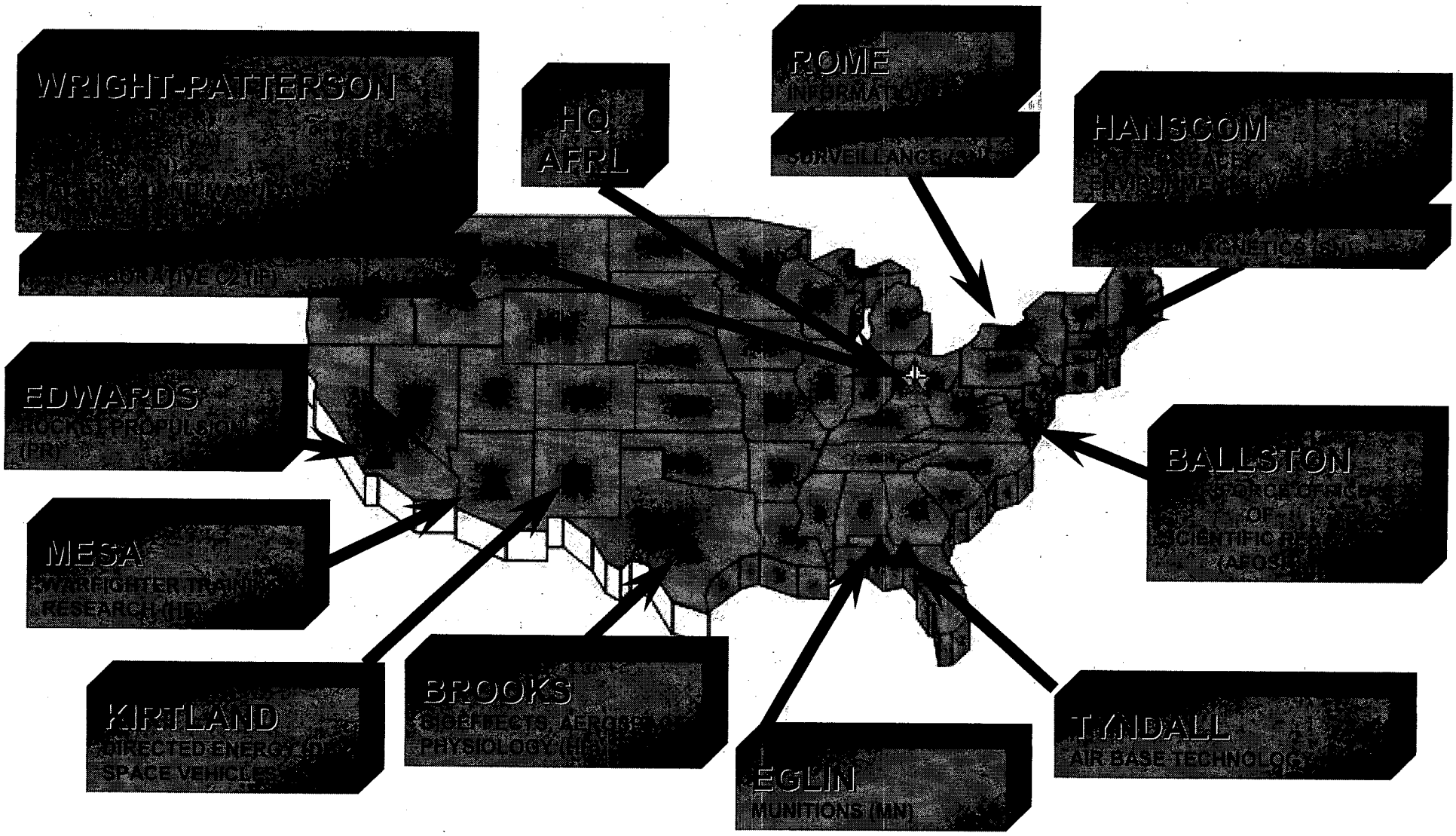
Antennas

Phenomenology

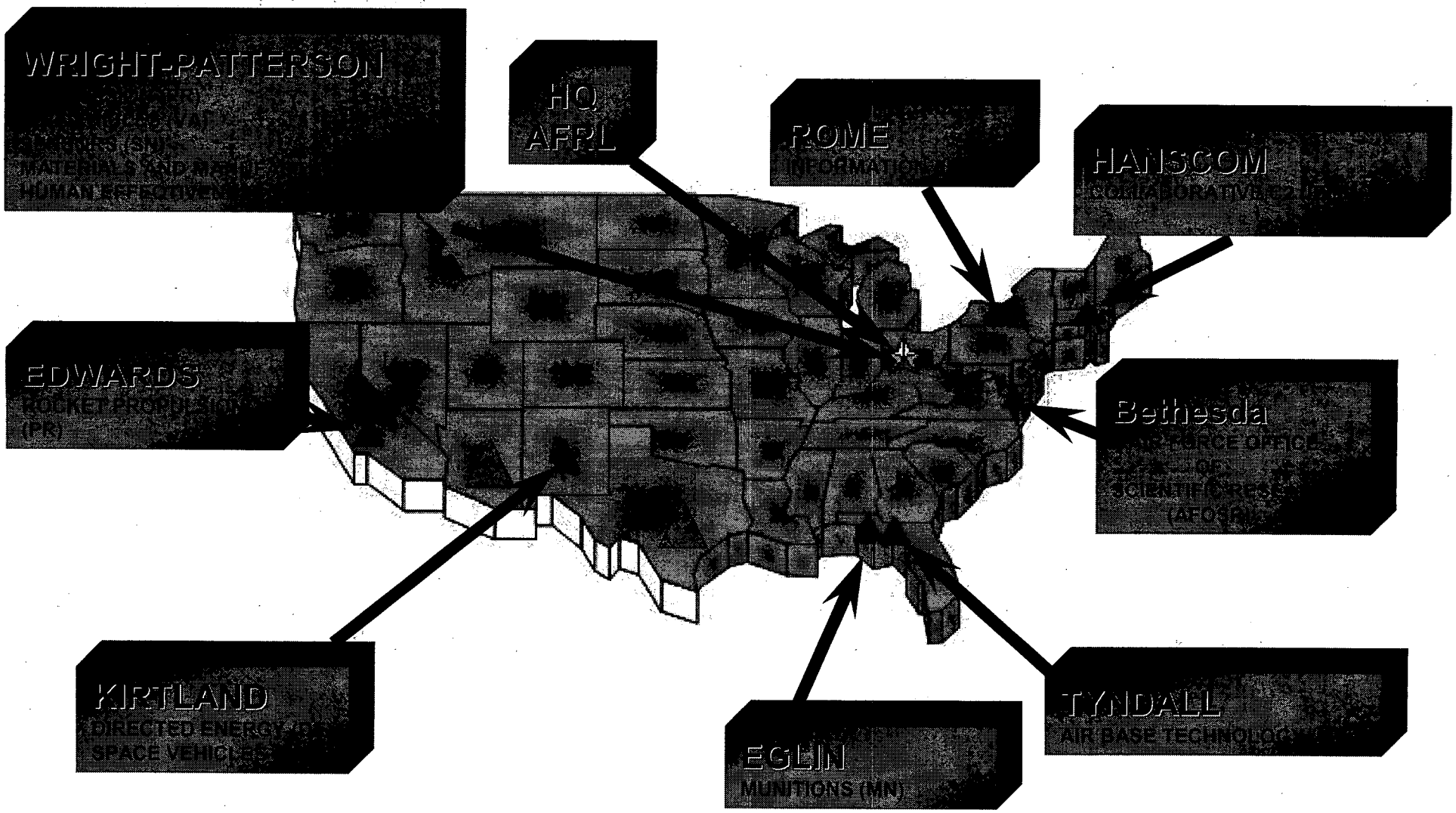




AFRL Major Sites



BRAC IMPACT


WRIGHT-PATTERSON
HQ AFRL
ROME
HANSCOM
EDWARDS
ROCKET PROPULSION (PR)
Bethesda
KIRTLAND
DIRECTED ENERGY
SPACE VEHICLES
EGLIN
MUNITIONS (MN)
TYNDALL
AIR BASE TECHNOLOGY

Sensors Directorate

Our Mission

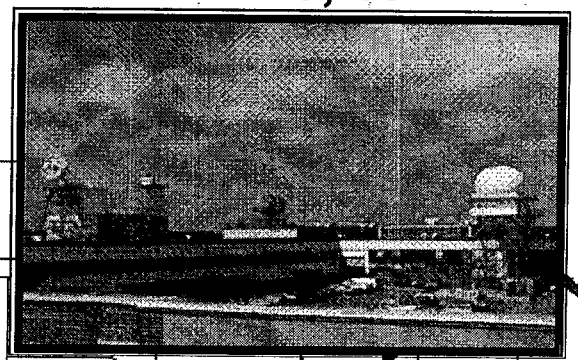
To lead the discovery, development, and integration of affordable sensor and countermeasure technologies for our warfighters.

Our Vision

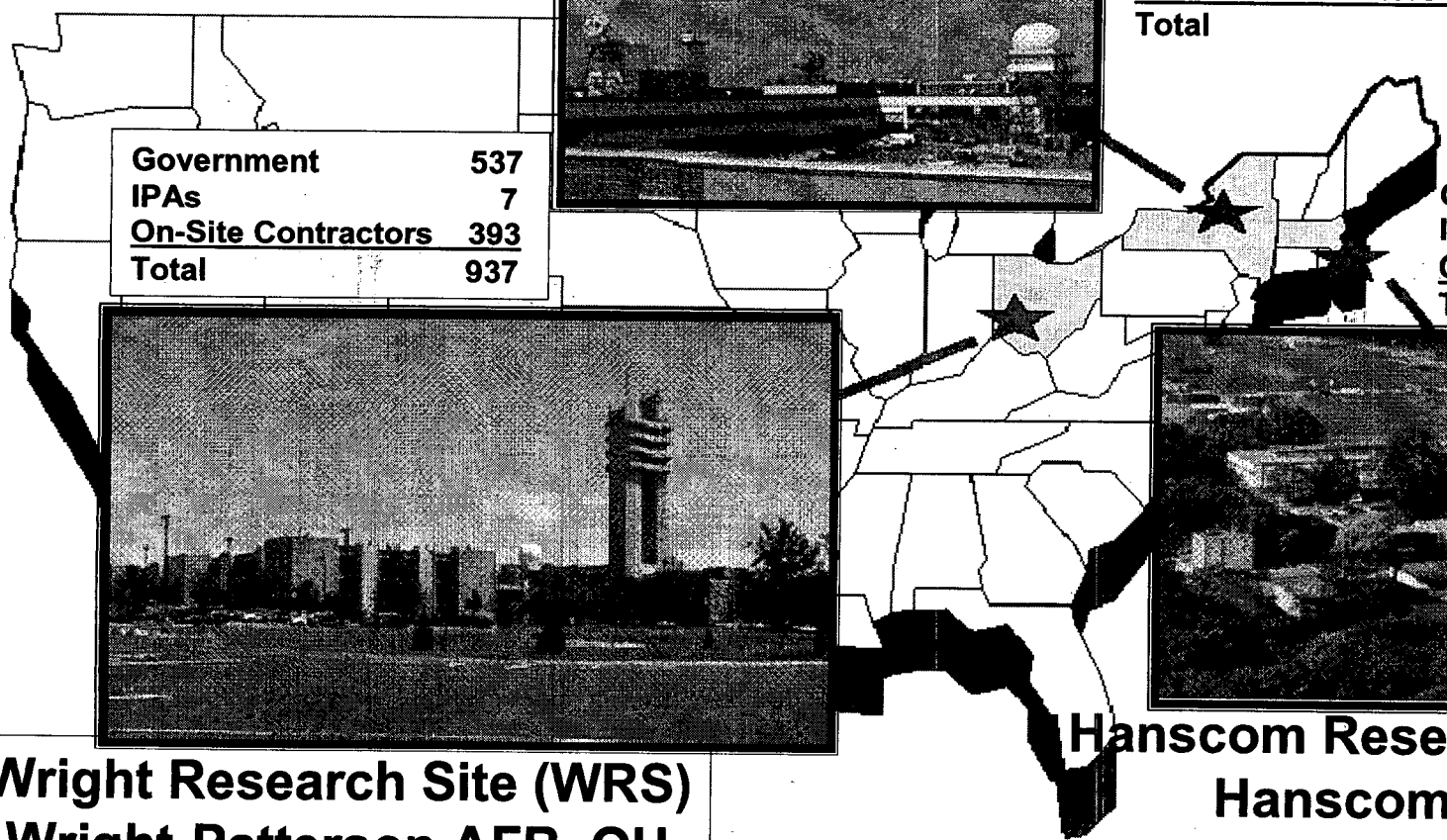
Sensor and countermeasure technology enabling complete freedom of air and space operations for our warfighters, no sanctuary for our adversaries, and homeland security.

Sensors Directorate Locations

Rome Research Site (RRS)
Rome,NY



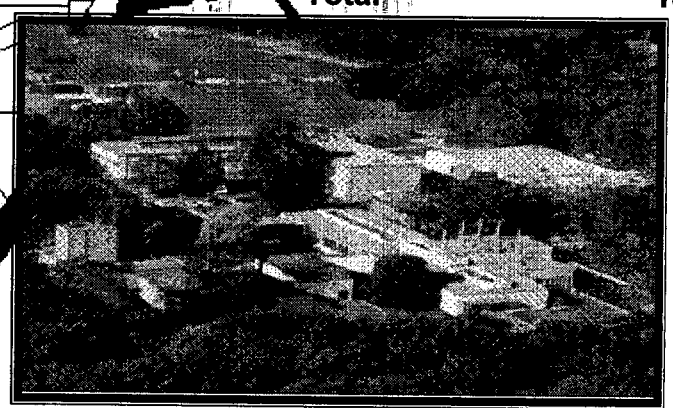
Government	82
IPAs	3
On-Site Contractors	25
Total	110



Government	537
IPAs	7
On-Site Contractors	393
Total	937

Wright Research Site (WRS)
Wright-Patterson AFB, OH

Government	110
IPAs	2
On-Site Contractors	73
Total	185



Hanscom Research Site (HRS)
Hanscom AFB, MA

Sensors Directorate

CORP. INFORMATION
MR. R. KUTTER

ORG. DEVELOPMENT
DR. D. SASARAK

DIRECTOR
MR. J. SCIABICA

DEPUTY DIRECTOR
COL G. HOPPER

CHIEF SCIENTIST
DR. M. WICKS (Act'g)

INTEGRATION & OPERATIONS
(SNO) MR. D. TOMLINSON

FINANCIAL MANAGEMENT
(SNF) MS. C. VAN VOORHIS

CONTRACTING
(SNK) MS. D. SUCHECKI

SECURITY
(SNY) MS. K. CATALANO

AEROSPACE COMPONENTS & SUBSYSTEMS TECHNOLOGY
(SND)
MR. T. KASTLE

ELECTROMAGNETIC TECHNOLOGY
(SNH)
DR. R. PAYNE

RF SENSOR TECHNOLOGY
(SNR)
MR. W. MOORE

EO SENSOR TECHNOLOGY
(SNJ)
COL R. GAUDETTE

SENSOR AUTOMATIC TARGET RECOGNITION (ATR) TECHNOLOGY
(SNA)
DR. M. BRYANT

SIGNATURE TECHNOLOGY OFFICE
(SNS)
MR. W. CUZICK

SENSOR APPLICATIONS & DEMONSTRATIONS
(SNZ)
MR. E. MARTINSEK

ANTI-TAMPER – SOFTWARE PROTECTION INITIATIVE OFFICE
(SNT)
MR. J. HUGHES

Collaboration with Other AFRL Directorates

INFORMATION
- Communications, Apertures & Components
- Spaced Based Radar
- ATR/Combat ID/Info Fusion/Exploitation
- Targets Under Trees
- Time Critical Targeting
- Collaborative Engineering Environment
- Laser Communication

SPACE VEHICLES
- Anti-Jam GPS
- Space Based Radar
- Rad Hard Electronics
- Hyperspectral Imaging
- Satellite Survivability
- Auto Target Recognition

AIR VEHICLES
- SensorCraft UAV
- Conformal Apertures
- Computational Electromagnetics
- Small / Micro UAVs
- UCAV

PROPULSION
- SensorCraft UAV

HUMAN EFFECTIVENESS
- SensorCraft UAV
- Time Critical Targeting
- Laser Warning & Protection
- Targets Under Trees

DIRECTED ENERGY
- Infrared Countermeasures
- PING
- MEDUSA
- Horizon-Limited Laser Radar
- RV Discrimination
- See Through Clouds
- Acquisition, Tracking & Pointing for Laser Weapons

MUNITIONS
- Anti-Jam GPS
- Small / Micro UAVs
- RF Components
- Focal Plane Arrays
- Auto Target Recognition
- Laser Radar
- Targets Under Trees

MATERIALS
- III-V Components
- RF Polymers
- SensorCraft UAV
- Laser Warning & Protection

AFOSR
- Waveform Diversity
- Electromagnetics
- Electronic Materials & Devices
- Auto Target Recognition

Collaborations

Sensors Directorate has >100 collaborations with external organizations

"Collaborators" provide:

- Technical skills
- Resources
- Warfighter needs

[redacted]

Local Collaborations

Academia

Binghamton Univ.
Univ. of Buffalo
Clarkson Univ.
Colgate Univ.
Cornell Univ.
Rensselaer Polytechnic Institute
Rochester Institute of Technology
SUNY Institute of Technology
Syracuse Univ.
Utica College

Local Contractors

Automated Resource Management Associates
Black River Systems Company
Computer Sciences Corp.
ITT Industries
L-3 Communications
Capraro Technologies, Inc.
PAR Technology (Gov. Systems)
Research Associates for Defense Conversion
Syracuse Research Corporation
Northrop Grumman IT

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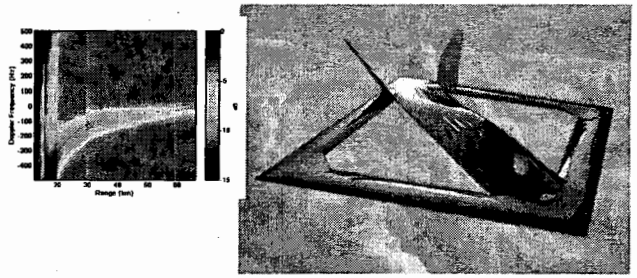
  - BRAC Recommendations for SN RRS
  - Facilities
  - Sites
  - Classified Infrastructure
- Discussion and Q&A
  - All

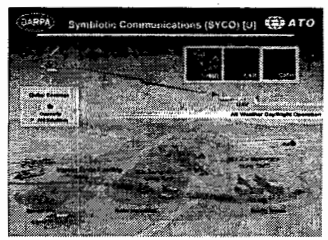
Sensors Directorate at RRS

Who We Are – What We Contribute

- Nationally Recognized Experts in:
  - Radar Technology and Applications
  - Advanced Waveforms and Signal Processing
  - Photonics Subsystems & Components



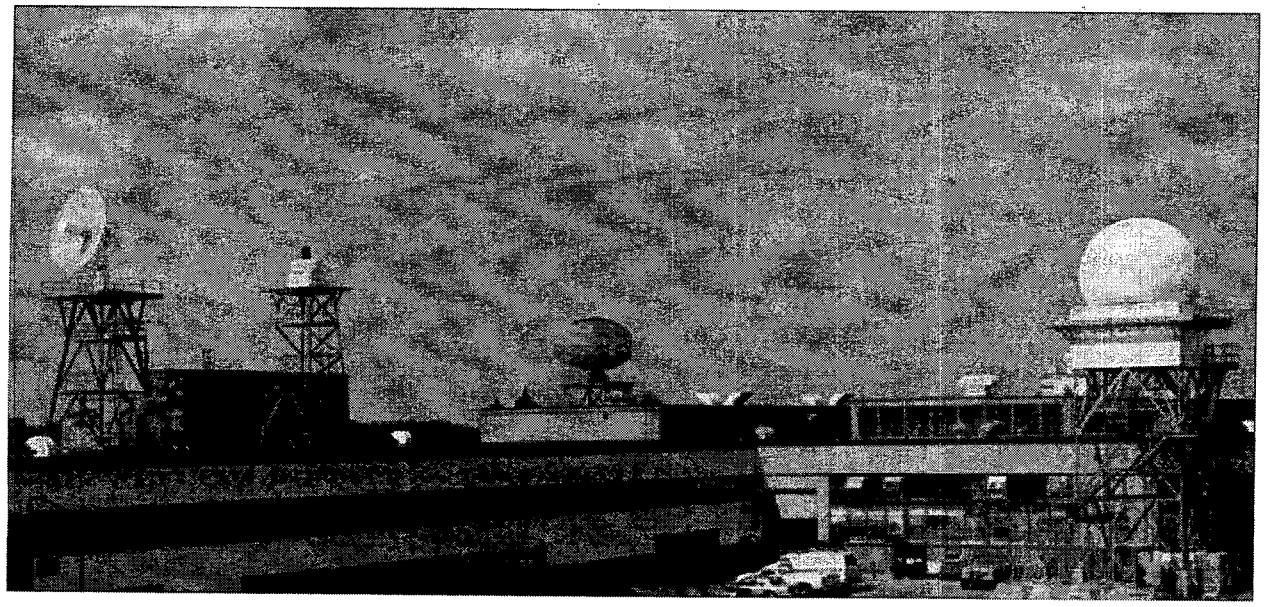
- Provide Key Sensors Technologies and Applications Enabling Superior Warfighting Capability:
  - Detecting & Tracking Difficult Threats in Difficult Environments
  - FOPEN, GPEN, BPEN
  - LO Targets, Dismounts, Slow Movers
  - Severe Clutter, Jamming & Interference

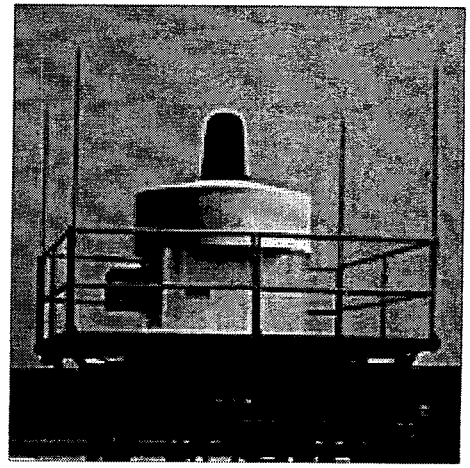


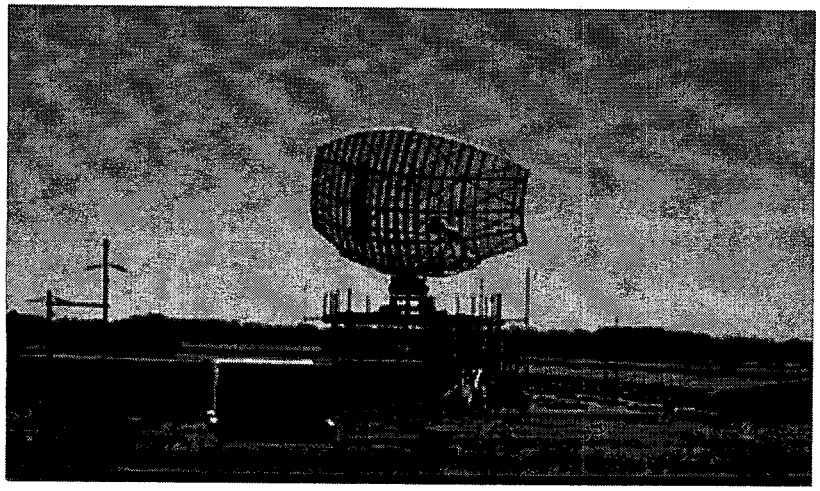
- Protect National Security by Ensuring U.S. Lead in Military Critical Technologies:
  - Bistatics/Multistatic Radar
  - Space-Based Radar
  - Multi-Dimensional Adaptive Processing
- Key Users Come to Us!
  - AF SPOs, NSA, NRO, DHS, DARPA

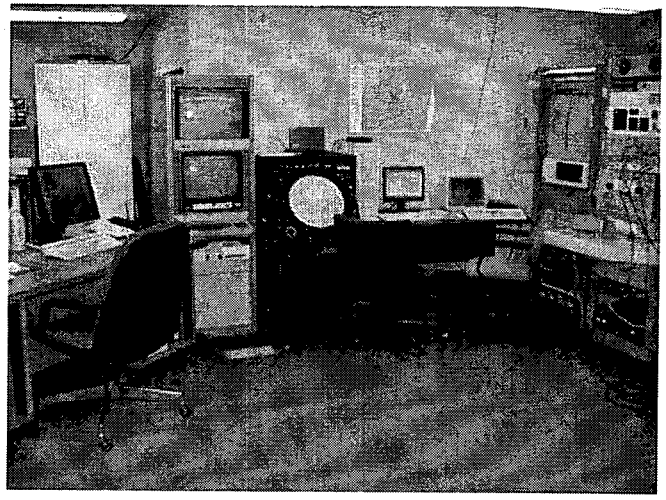
AFRL Surveillance Facility

Rome Research Site

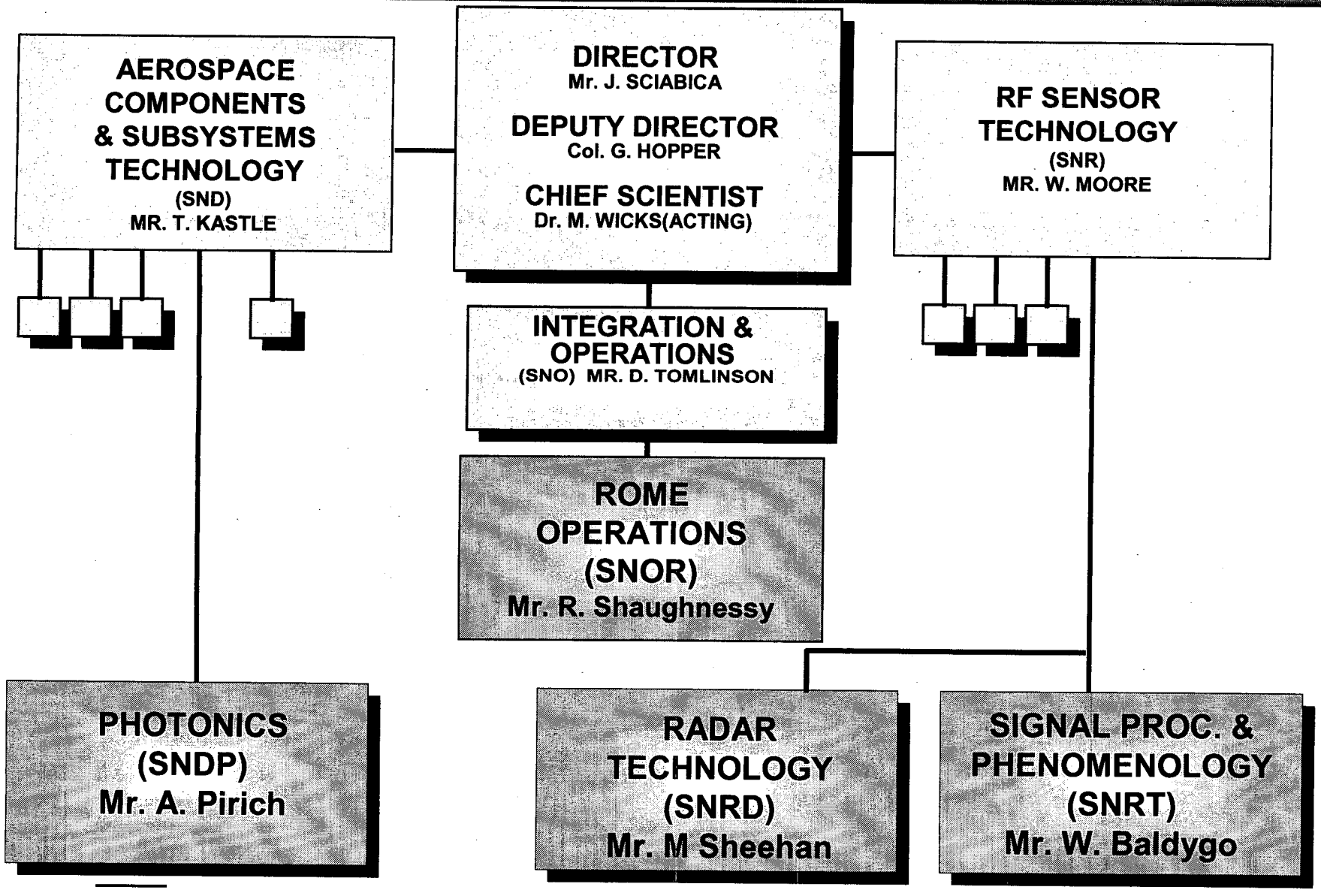








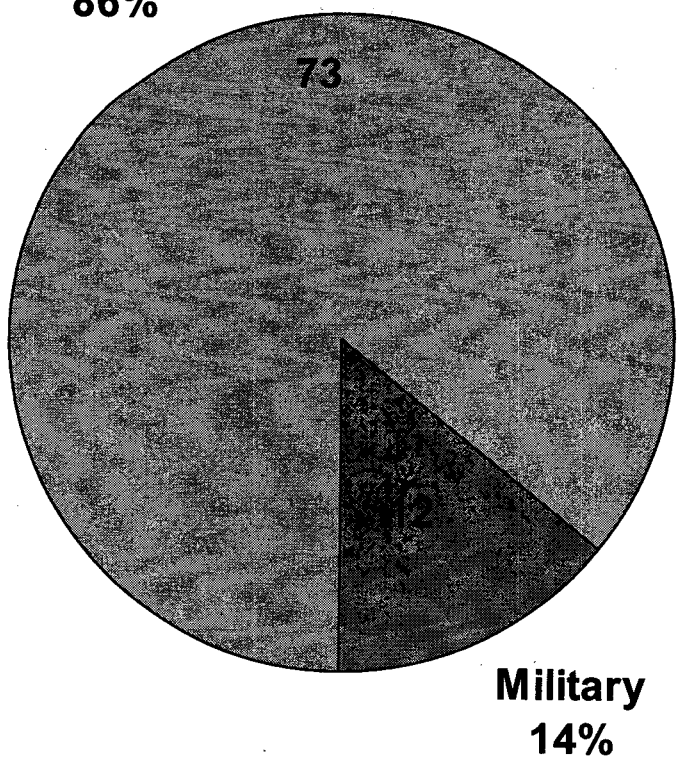
Sensors Directorate @ Rome



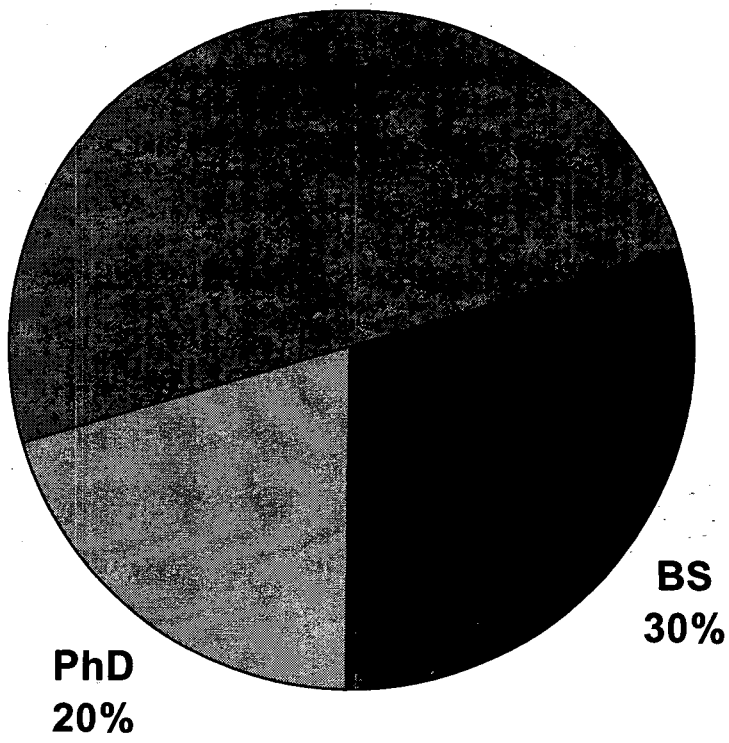
Personnel - Rome Site

GOVERNMENT	85
ONSITE CONTRACTORS	25
Total	110

SN/RRS (85)



Academic Degree(S&E Only)



People - Our Most Valuable Resource

- Acting Chief Scientist, AFRL/SN
- Three AFRL Fellows
- Five IEEE Fellows; Three Section Chairs Including Current Chair
- One SPIE Fellow
- Three Sensor Directorate Level Award Winners Including Last Two "Veiled Award" Winners
- IEEE National Radar Conference Host 1997 & 2006
- Annual Tri-Service Radar Symposium Air Force Co-chair
- Association Of Old Crows Section Conference Chair
- TTRDP Experiments Chair
- TTCP SEN-TP-3 Lead
- AFRL/DARPA KASSPER Workshop Chair
- NATO SET-071 Panel Member
- Annual Tri-Service Waveform Diversity Workshop
- Annual AFRL STAR Workshop

5 IEEE Fellows

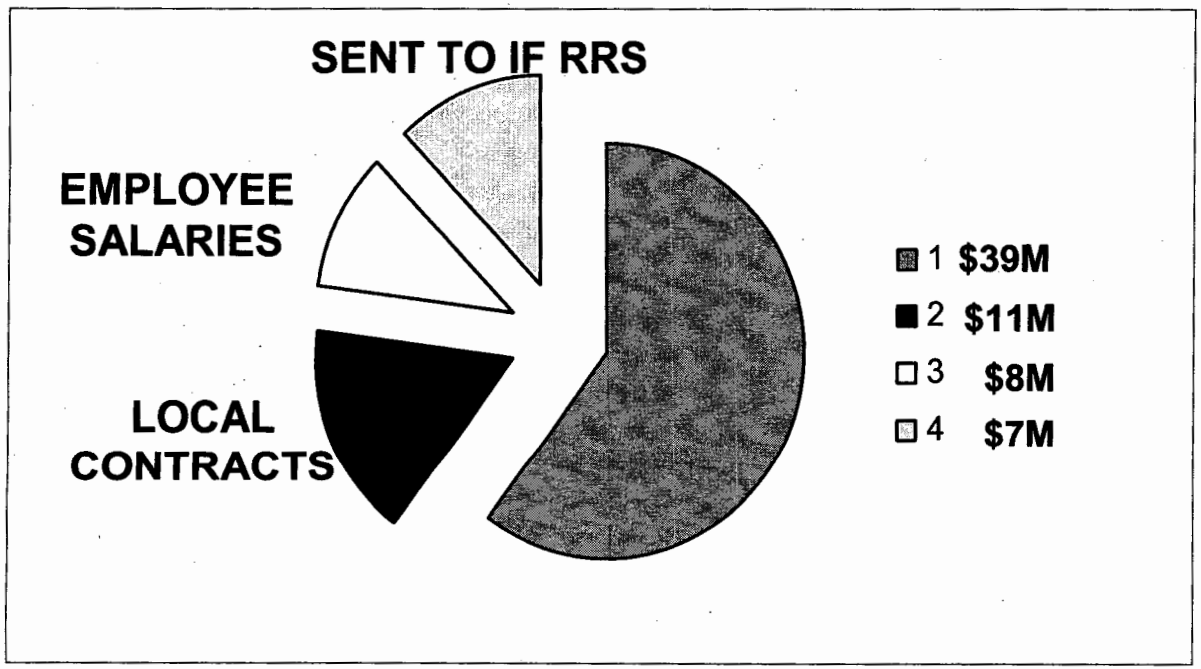
3 AFRL Fellows

1 SPIE Fellow

> 200 Conference Papers

NATIONAL TECHNICAL RECOGNITION

Sensors Rome
Local Area Financial Impact



SN RRS Income	
AF	$ 30.5 M
Customer	$ 34.5 M
Sensors Total*	$ 65.0 M

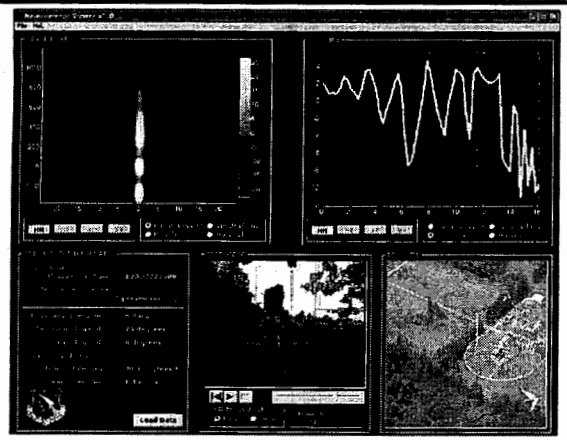
SN RRS OUTGO	
SN RRS Contracts OUTSIDE LOCAL AREA	$ 39M
SN RRS Contracts INSIDE LOCAL AREA	$ 11M
SN RRS SENT TO IF RRS	7M
EMPLOYEE SALARIES	8M

SN RRS Military Value

- **FOREST**—Detect Small Vehicles/Dismounted Troops
- **FOPEN**—Foliage Penetration (Aspect Sensitive RCS of Mil/Civ Vehicles)
- **STRUCTURALLY-INTEGRATED CONFORMAL ARRAY**—End-Fire Array Technology
- **BAO**—Battle Field Air Operations
- **TTRDP-RADARSAT**—Bistatic GMTI from Space Illuminator
- **ISBR**—Integrated Space Based Radar
- **SYCO**—Symbiotic Communications System
- **INTELLIGENCE COMMUNITY SUPPORT**
- **KNOWLEDGE AIDED SIGNAL PROCESSING**
- **OPTICAL SIGNAL PROCESSING**

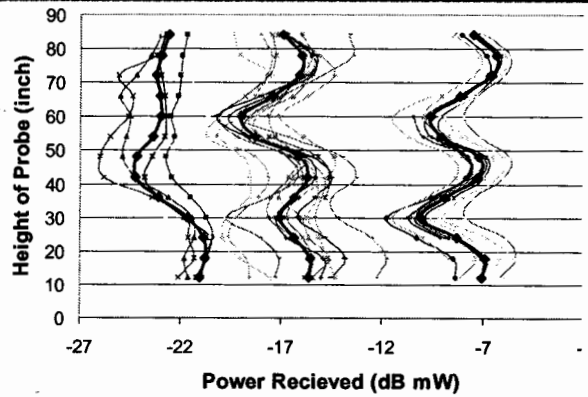
FOREST Data Collection (Stockbridge)

Objective: Analyze the Backscattering Behavior of a Moving Target in a Forest Environment



The GUI presents radar data analysis in a user friendly environment.

Choreographed Paths thru woods



Attenuation and Fading Statistics of Propagation within a Forest Environment

Knowledge of these scattering and fading statistics will lead to the development of more accurate target models and, in turn, for improved radar detection and signal processing techniques

Elevation probing used to analyze attenuation and multipath statistics

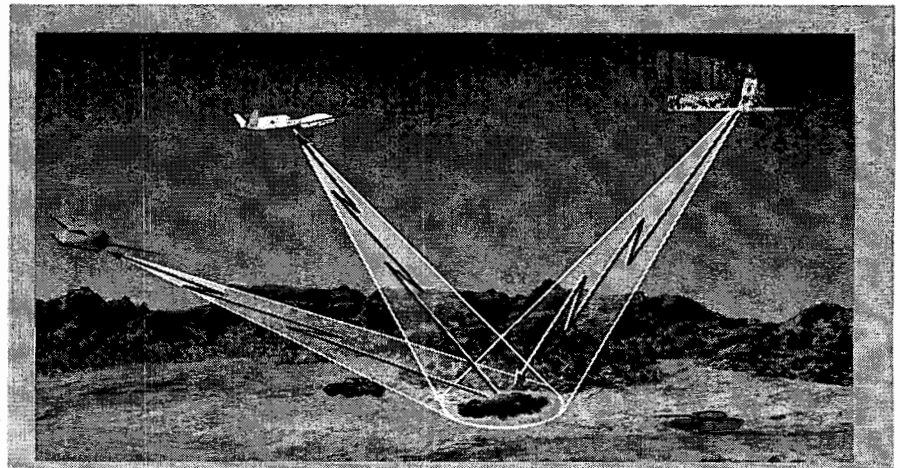
Troops Disbanding from Vehicles

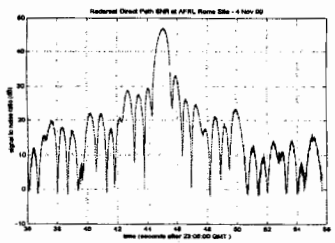
Provides Measurements and Ground Truth for Evaluation of Theoretical Models and Simulation.

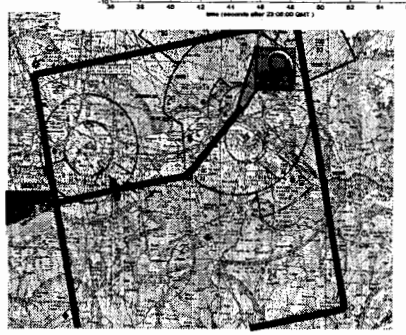
RadarSat I/II Experimentation

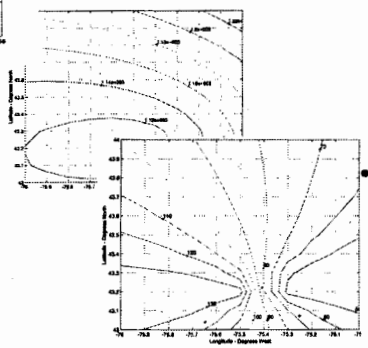
Accomplishments:

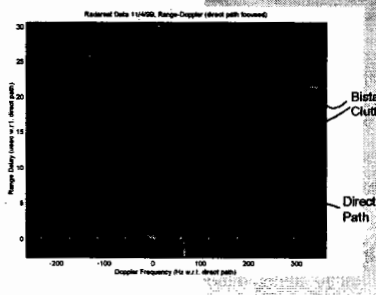
- Collected Multichannel Airborne Radar Data to Evaluate SBR GMTI Concepts
- Passive/Covert Radar Function
- Conducted Airborne GMTI Experiment
  - 5 Nov 2000 at CFB Petawawa
  - Fall 2004 at Ft. Drum
- Planning For Transportable Receiver Experiments
  - Clutter Phenomenology
  - Waveform Diversity

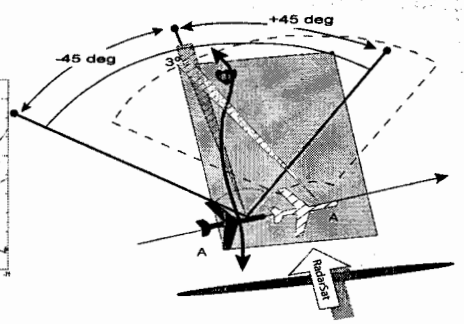




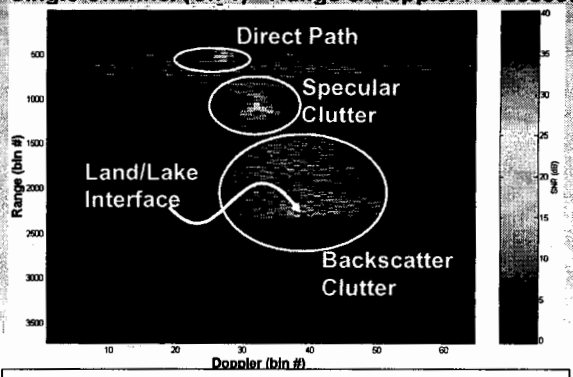








• Single Channel (Ch 1) - Range & Doppler Processed



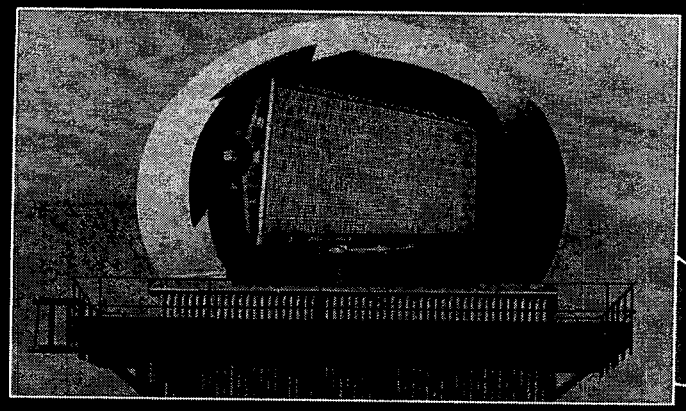
Clutter Range/Doppler Distribution is Reasonable

Optical Signal Processing

RADAR TEST BED FOR ANTI-JAMMING OPTICAL BEAMFORMING (AJOB) SIGNAL PROCESSOR TEST

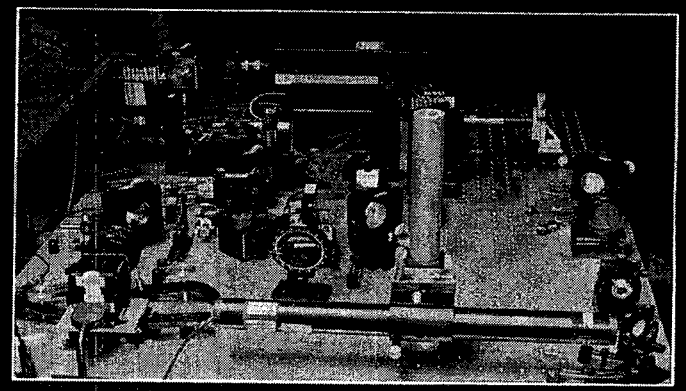
(1) STAND-OFF JAMMERS

- ONE FILLS RECEIVERS WITH BARRAGE NOISE
- OTHER ANTENNA TRANSMITS A SIMULATED TARGET



(2) ECCM RADAR

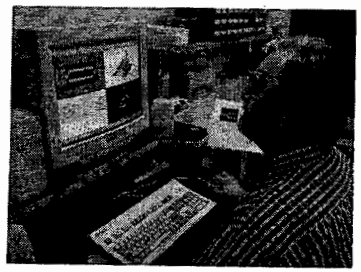
RECEIVES SIGNAL(S) FOR OPTICAL PROCESSING



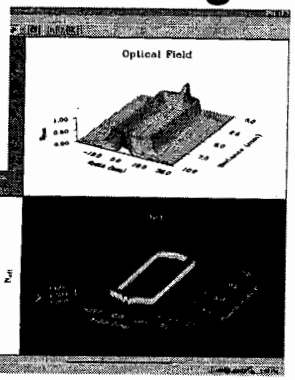
(3) OPTICAL SIGNAL PROCESSOR

PERFORMS JAMMER CANCELLATION & PULLS THE TARGET OUT OF THE NOISE

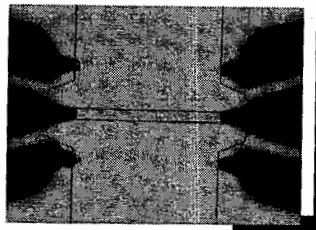
AFRL/SNDP In-House Capabilities

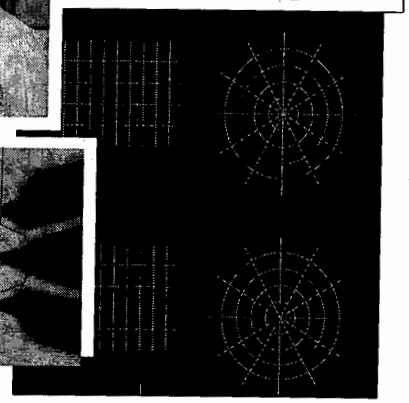


Optical Modeling

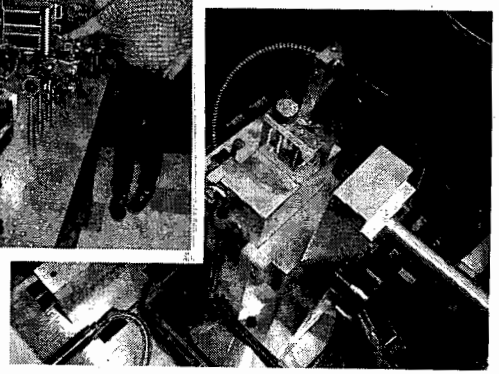


Electrical Modeling

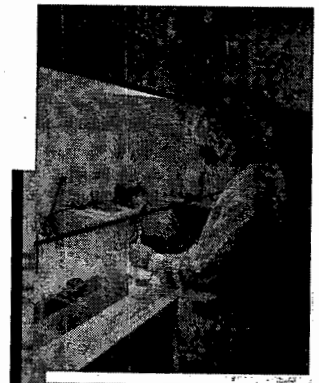


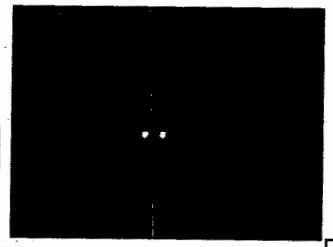


Materials for Processing

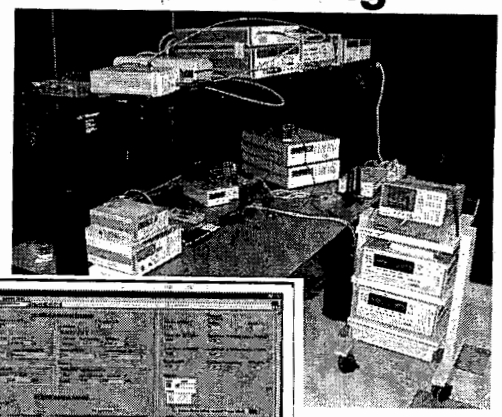


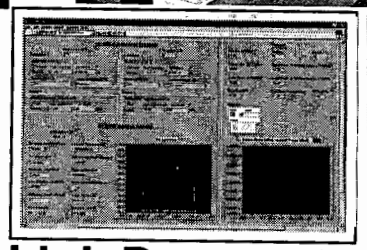
Electro-Optical Material Characterization





Electro-Optical Device Fabrication





RF Link Demonstration And Component Evaluation

Sensors-Rome Engineers Support to Joint Warfighter Community at Ft Drum

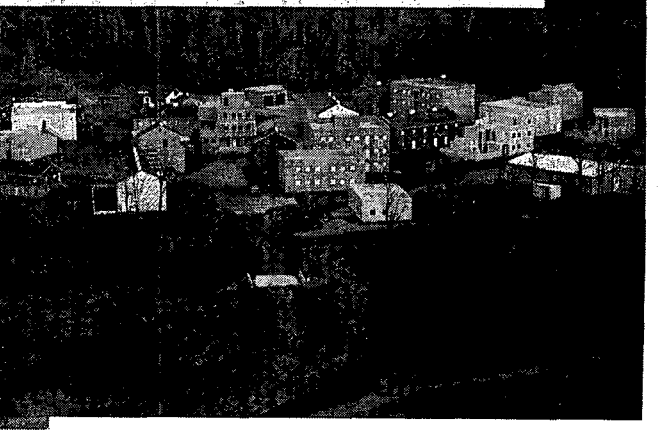
- Baseline FOPEN Test System
- Improve Target & Clutter Models
- Detect & Track Slow Moving Targets
- Wheeled & Tracked, In & Out of Trees

- **Collect Doppler Signature Data on Slow-Moving Ground Targets, Extract RCS**
  - **Develop First-Order Statistics; i.e., Mean Value & Variation About the Mean**
  - **Function of: Aspect Angle, Polarization, Frequency, Target Type & Depression Angle**
  - **Examine Time Correlation Properties; Collect Environment Clutter Data**

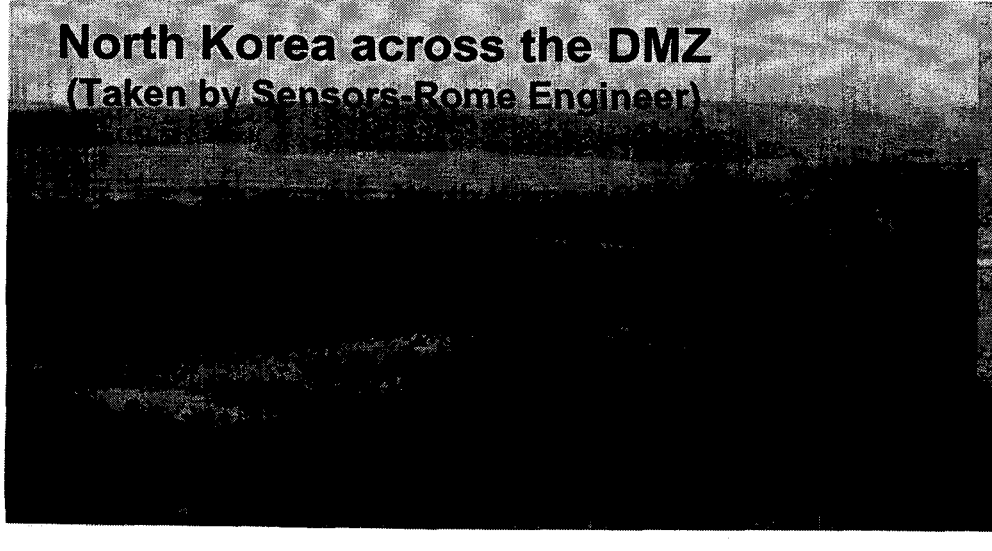
Intelligence Community Efforts at Ft Drum, NY in Support of the *War on Terror* and Reconnaissance of N. Korea

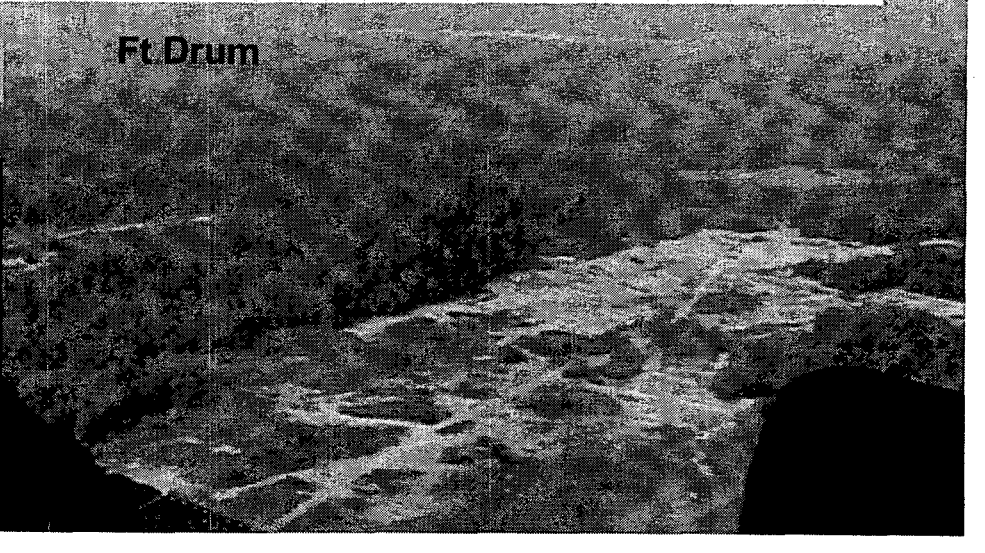
(Due to Agreements In-place and Proximity to Sensors-Rome)

Developing New Methods to Locate Terrorist Bombs in Urban Settings



Developing New Methods to Perform Reconnaissance on N. Korean Troops





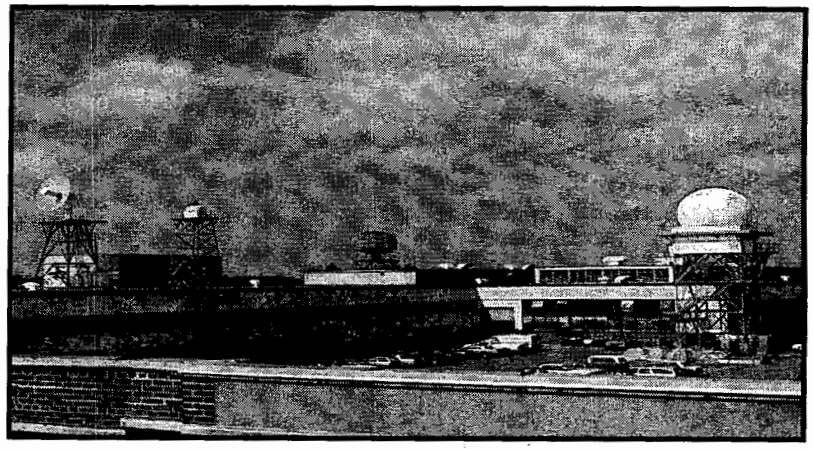
Outline

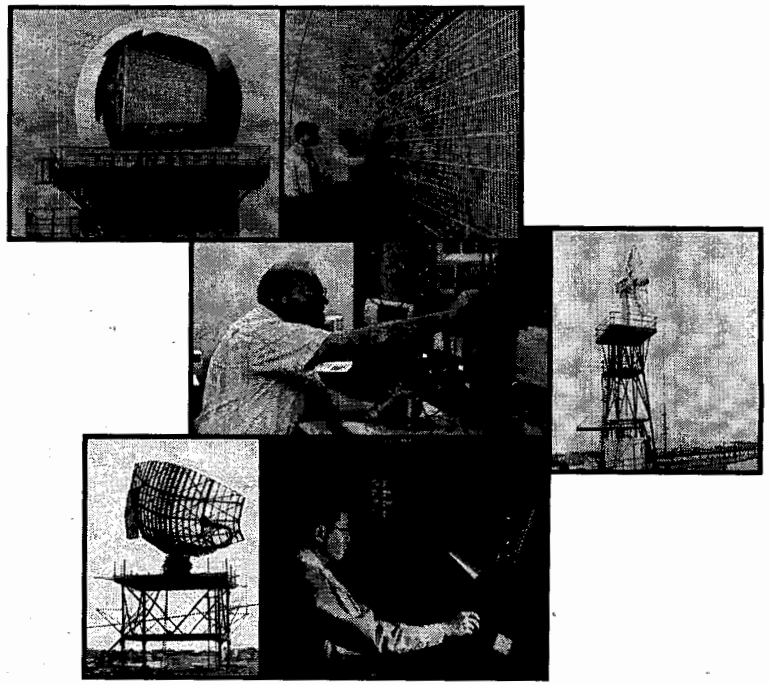
- AFRL Sensors Directorate Overview
  - Mr. Joe Sciabica
- AFRL/SN Rome Research Site
  - Mission
  - People
  - Accomplishments
- Requirements/Considerations for SN RRS Relocation
  - BRAC Recommendations for SN RRS
  - Facilities
  - Sites
  - Classified Infrastructure
- Discussion and Q&A
  - All

Relocation Requirements

Surveillance Facility

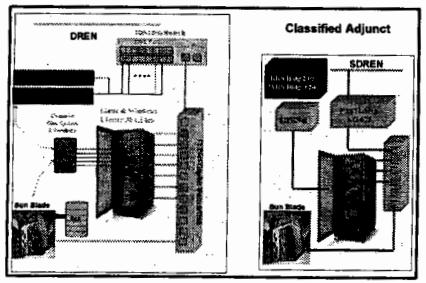
- 4 Sensor Systems; 3 active and 1 passive
- High-Fidelity Data Acquisition
- Complex, experimental radar testbeds
- Re-configurable nature makes them world-unique
- Towers, antennas, transmitters, instrumentation, frequency allocation/authorization

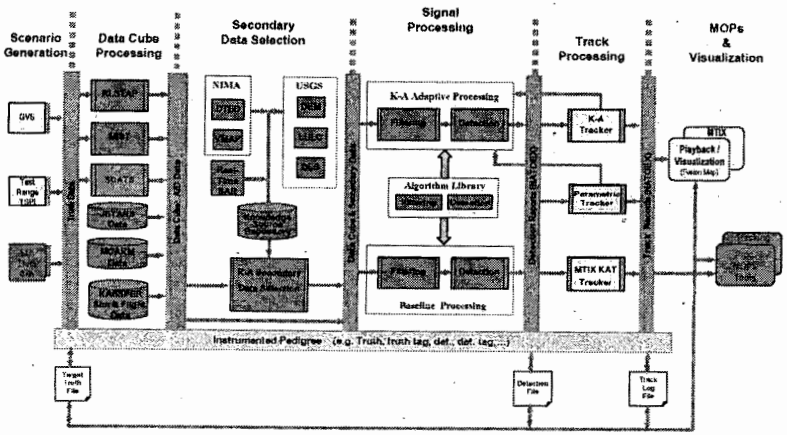


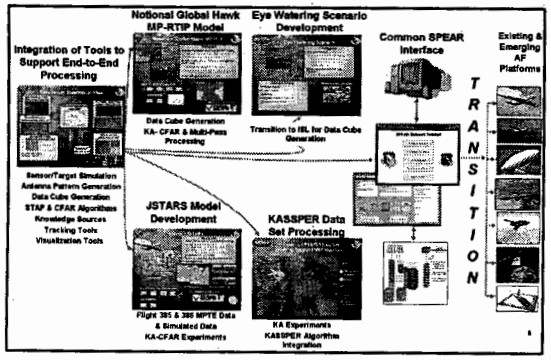


Relocation Requirements

SPEAR Facility







- Unique Testbed for developing, evaluating and demonstrating advanced sensor concepts and signal processing algorithms to <u>Accelerate Transition to the Warfighter.</u>
- Multi-level Secure Environment
  - Open Storage
- SIPRNET and SDREN connectivity to other DoD, AF, and FFRDC Organizations
- 1600 ft^2 Classified Processing

Remote Site Synergy

Remote Site Capabilities - Newport, Stockbridge & Ft. Drum

- Quiet RF Environment for Antenna Testing, RCS Measurements
  - FOPEN Radar Meas.
  - FOREST Demo
  - Conformal Array Testing
- At Ft. Drum developed, tested and demonstrated core technology for BAO Kit
- Diverse Joint Service Target Sets - Tanks, Trucks, Tracked Wheel Vehicles and F-16s

Relocation Requirements

Vaults – SCI and SAP

- 2 SAP Facilities & 1 SCI Facility
  - Storage Containers
  - Computers, Telephones and VTC
  - Workspace and Conference Area
  - SPEAR Testbed Replicated in SCI area
  - GWAN (SCI Computer Network)

BRAC COBRA Run Accuracy

- Technical Joint Cross-Service Group (TJCSG) Directed Use of Field Certified Data from AF Concerning Contractors Cost – 3 May 2005

- COBRA Data Standard for Contractor Reductions
  - Apply 15% Reduction Against All Contractor Personnel
  - Show $200K Miscellaneous Recurring Savings for Each Contractor Eliminated
  - Certified Data FY03: 82 Gov't Employees; 31 Contractors (32_tech_04277_ftes_funding_fo.xls) = Total 113 FTEs

- COBRA Run 5 May 2005 Assumed Reduction of 64 Contractors from Rome and Miscellaneous Recurring Savings of $200K per reduced contractor equaling $12.8M Savings/year
  - Data Standard Should Have Used 4 Contractors vs. 64
  - Results in $36M Total Savings Discrepancy FY2009-2011

- Will AF/DoD Realize Consolidation Savings?
  - COBRA for SN RRS Needs to be re-run Using Correct # Contractors and 15% Reduction

Summary

- World-Class Expertise in Surveillance Radar Technology & Radar Signal Processing Technology
  - Personnel Depth (Ph.D.'s, Fellows)
  - Refereed Publications
  - Patent Applications & Awards
- Numerous Accomplishments Supporting Customers & Partners:
  - Technical Staff Name-Requested by High-Profile Customers/Partners
- Extensive Relationships to Leverage R&D Investment
- Synergy between SNDP/SNRT/SNRD
- Importance of Facilities/Capabilities to Sensors Directorate Mission
- Important to Recreate these Capabilities at WPAFB to Support Recommended Move

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