MISSION:
To explore, prototype, and demonstrate high-impact, game changing technologies that enable the Air Force and Nation to maintain its superior technical advantage.

VISION:
To lead the Air Force and Nation in command, control, communications, computers, and intelligence (C4I) and cyber science, technology, research and development.

ROME = C⁴I & Cyber
AFRL Mission & Vision

MISSION: Leading the discovery, development, and integration of affordable warfighting technologies for our air, space, and cyberspace forces.

VISION: We defend America by unleashing the power of innovative air and space technology.
Information Technologies Touch Every AFRL Directorate
A Rich Heritage of Legendary Technology

- Surveillance Radar
- PAVE Mover
- Airborne Digital Map System
- IR Camera for B-52
- Advanced Planning System
- Moving Target Indicators Experiment
- Single Pass AirDrop
- Selective Cyber Operations Technology Integration
- Cyber Situational Awareness
- NSDC

Rome Air Development Center
Established 1951 – 1991

- Intelligence Data Handling Systems
- Skylab Tracking
- SEM-E Modules For the F-22
- Software Programmable Radio (forerunner of JTRS)
- CONDOR Supercomputer
- WebTAS

Rome Laboratory

- DARPA’s agent for ARPANET
- Research Facility Newport & Stockbridge
- Track & ID Fusion Algorithms for AWACS
- Off-Board Data On J-STARS
- DCGS

AF Research Lab Information Directorate
Established 1997 – Present

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Early Years of Research

- Minicard Intelligence Data Handling System
- First Communication Satellite Echo 1
- ARPA Network RADC
- Micro-Electro-Mechanical Systems (MEMS)
- Cognitive Assistant That Learns and Organizes (CALO)
- John F. Dove Laser Technology

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Information Directorate Facilities

65 Acre Campus, 30 Laboratories & Facilities, And 882,000 Sq Ft Floor Space
Information Directorate Facilities

Machine Intelligence for ISR Laboratory
Situation Awareness Laboratory
Cyber Experimentation Environment (CEE)
Audio Processing Lab
Operational Information Management Lab
Integrated Intelligence Innovation Facility (IIF)
Secure Embedded High Performance Computing
Small Unmanned Aerial System Experimental Capability (SUAS-EC)
Command and Control Technology Center (C2TC)
High Performance Computing Facility
Advanced Computing Applications Laboratory
Quantum Information Science Facility
Quantum Communications Laboratory
Nanotechnology & Computational Intelligence Laboratory
Corporate Collateral Facility (CCF)
Cyber Integration & Transition Environment
K5 Laboratory
Corporate Research and Development Server Facility (CRDSF)
Microwave and Optical Communication Range
RF Technology Center
Cyber Operations Technology Facility (COTF)
Network-Centric Integration & Interoperability Facility (NCIIF)
Command and Control Concept Center (C2CC)

Newport Remote Research Site
Stockbridge Remote Research Site
Newport Research Site

Far Field, Elevated Outdoor Antenna Test Range

- 78 Acres
- 360 Degree Pattern Measurement
- Established in 1972
- Ideal Geography
- Essential Measurements of the F-35 Aircraft Antenna Patterns
- Inflatable Reflector Antennas for SOCOM
- 15 Commercial Test Agreements - 1 Pending

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Stockbridge Research Site
RF and Small UAS Experimental Facility

- 300 Acre Flexible Test Site, Varying In Relative Distance, Topology And Foliage Density
- Heavy-duty Turntable With A 200’ High Arched Measurement Probe – Large Aircraft And Vehicle Capable
- 120’ Walkup Tower For LOS And Optical Links
- Controllable Contested Environment
- All Weather, Full Season, Configurable RF Capability
- C4ISR, Cyber, Spectrum, Networking
- Flexible Frequency Authorizations
- SUAS Airfield
- Fixed Wing And VTOL Platforms
- Trained Flight Personnel
- Experiment, Management And Control Facility
- Flexible Laboratory Space
- Operations And Control Room

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Quantum Information Science

**RI Goal: Demonstrate Quantum Network**

- Nodes consist of arrays of trapped ions
- Entanglement mapping for long distance transmission over conventional channel
- Photon-based qubits provide interconnect and processing “on the fly”
Open Innovation Environment | *Agility + Innovation + Partnerships*

An agile and transformative ecosystem at AFRL/RI, connecting global technology leaders to collaborate and solve complex Air Force computing challenges.

Linking researchers from government, industry, and academia, to share the best and brightest people, ideas, and facilities.

**Discovery Lab Outside the Fence for High Risk, High Impact Problem Solving**

- Open Campus Facility Within Walking Distance Of AFRL Campus
- Hard And Soft Lab Space
- Collaboration Space
- Event Space
- One Facility For Outreach
- Co-located Partners, Offices, Labs, Event Center
- Basic Research Hub For C4I And Cyber

**S-UAS Testing | Quantum Facilities | Neuromorphic Computing Facilities**
Information Directorate Core Technical Competencies (CTC)

Putting The Right Information Into The Right Hands At The Right Time

Leveraging And Shaping The Cyber Domain To The Nation’s Advantage

Communications

Command & Control

Intelligence

Cyber

Computers

RI CTC: Connectivity & Dissemination (CAD)

RI CTC: Autonomy, C2, & Decision Support (AC2)

RI CTC: Processing & Exploitation (PEX)

RI CTC: Cyber S&T (CYB)

Mastering Complexity of Multi-domain Command & Control

Exploiting Computing and Algorithms to Transform Big Data Into Information

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Connectivity and Dissemination (CAD) CTC Highlights

Android Tactical Assault Kit
- ATAK is an Android based application with advanced collaborative geo-spatial sharing, and communication capabilities
- AFRL First “One Click” Nonexclusive License Application in Federal Government
- Over 100 licenses issues to date

SecureView
- Secure access to multiple independent levels of security classification on one consolidated workstation
- Provides customers with security and protection against data exfiltration
- Intuitive user interface that requires minimal training

Aerial Layer Networking
- Provide multi-faceted AF networks by developing agile, adaptable, programmable, resilient and secure capabilities for the Aerial Layer Network
- Flexible, ad-hoc autonomous networking, multiple levels of security on single aerial network
- Tactical Data Link Network SA & Management

Next Gen Software Defined RF
- Provide affordable, dynamic, software-defined Radio Frequency (SDRF) capabilities for on-demand communications, dynamically adjusted for threat conditions
- Affordable secure multi-mission waveforms for A2/AD environment
- 5X reduction in platform integration cost by enabling flexible adaptation to existing apertures

Putting The Right Information Into The Right Hands At The Right Time

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Cyber Science and Technology (CYB) CTC Highlights

MUAS
- Enhancing emerging baseline capabilities countering small COTS Unmanned Aircraft Systems (sUAS) by demonstrating prototypes in a relevant environment
- Openness and modularity allow for collaborative R&D ensuring rapid capability transition

Asymmetric Cyber Warfare (ACW)
- Identify, map and understand the newest forms of digital data in order to maximize the intelligence value and produce actionable information
- Develop software applications and methods to automatically map networked sensors and provide visualization of the network activity

Lightweight Blockchain
- Develop communication approaches that will survive highly contested/fragmented networks
- Enables creation of distributed “un-censorable” websites and command and control systems
- Demonstrated on cheap commodity hardware (Raspberry Pi $30)

Communication Network Access Program
- Multi-function transmit/receive capability to integrate EW / Cyber / Comm missions into a common radio platform
- Software-defined, reprogrammable radio frequency technology across wide frequency ranges
- High-precision, compact timing sources for high-resolution geolocation and triangulation of targets

Leveraging And Shaping The Cyber Domain To The Nation’s Advantage

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Agile Condor / Blue Raven
• Brain-Inspired, Intelligent Computing For Deploying Artificial Intelligence and Machine Learning Capabilities
• Low SWaP High Performance Ruggedized Embedded Computing
• Disruptive performance, scalable architecture, big data analytics

Quantum Information Science
• Provide ultra-secure quantum communication by establishing memory-based quantum network nodes, adapting the photon-based interconnects using integrated circuits
• Ability to perform quantum information processing between and within network nodes – can be extended to realize distributed quantum computing

Actionable Intelligence Discovery and Exploitation (AIDE)
• Uses the power of machine learning to provide the right intelligence to the right personnel at the right time
• Capture the Knowledge of our Analysts
• Shift the Burden from Airman to AI

Advanced Text Exploitation Assistant (ATEA)
• Automates the handling and exploitation of intelligence message traffic to help identify actors, activities, and actor networks, aggregating information across large volumes of textual data
• Automated extraction models for entities, events, and relations
Autonomy, Command & Control and Decision Support (AC2) CTC Highlights

Multi-Domain Command and Control (MDC2)
• Create multiple, complex dilemmas for an adversary composed of non-kinetic & kinetic effects at overwhelming speed & scale
• Master C2 complexity through dynamic orchestration & distribution of situational awareness, decision-making, & force direction
• Harness machine intelligence to exponentially increase human capacity for command & control

StreamlinedML
• Develop a comprehensive machine learning framework tailored for Air Force and Department of Defense data and applications
• Increasing access to advanced learning capabilities supporting analysis of diverse data types, reasoning about the environment, and advanced decision support

Joint Effects Operations
• Develop and demonstrate capabilities that enable improved and faster decision making for multi-domain command and control
• Rapid multi-domain mission understanding, planning & assessment

Adaptive Cyber Command & Control (ACC2)
• Provide precise and predictable cyber effects estimates to ensure operational planners present viable cyber assets to combatant commanders considering multi-domain options
• Shorten time to integrate cyber operations into multi-domain operations plans

Mastering Complexity of Multi-domain Command & Control

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Machine Learning: **Key Drivers**

- Situational Awareness & Understanding
- Cyber/Space Operations
- Contested Operations
- Multi-Domain Command & Control

Leverage & Adapt  
Formulate & Lead

**AI/ML Execution Strategy:** *From foundational discovery to capability delivery*

**DISCOVERY**  
Solving Unique Hard AI, Autonomy, & ML Problems for AF/DoD

- QUANTUM IS
- AGILE CONDOR POD
- Embedded Conventional & Neuromorphic Computing

**ENGAGE**  
AF/DoD, Academic, & Commercial Research Communities

- Google
- UC Berkeley
- Stanford University
- Carnegie Mellon University

**DEVELOP**  
Develop: AF/DoD pipeline for fast-tracking AI/ML capabilities to AF applications and data

- MDC2
- flyleaf

**DELIVER**  
State-of-the-art capabilities to the warfighter

- ATAK
- OA DCGS

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NINJA Counter-Small UAS System

**CHALLENGE:** COTS Small Unmanned Aerial Systems (sUAS) have become ubiquitous due to their low cost and ease of use. They now present a very real threat.

Ninja provides link specific cyber detection and defeat of sUAS

- Precise, affordable, and agile solution to combat the threat
- Implemented an open system architecture leveraging crowd sourced algorithms
- Integrated with AFRLs Android Tactical Assault Kit for added functionality
- Proven in numerous operational domains for a multitude of customers
- Fielding to all AF installations to begin in FY19
- Works in concert with layered defense construct and is desired first engagement option
- Government wide interest from FAA, DOJ, DHS, DOI, and international partners

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Android Team Awareness Kit

The United States Air Force Research Laboratory (AFRL) Information Directorate seeks industry partners to license and commercialize the Android Team Awareness Kit.

ATAK is an Android based application with advanced collaborative geo-spatial sharing, and communication capabilities.

"One Click" License
AFRL First "One Click" Nonexclusive License Application in Federal Government

http://techlinkcenter.org/summaries/atak

Over 100 Signed Licenses!

Game Changing Technologies
PARTNERING WITH ACADEMIA AND INDUSTRY
126 Academic Partnerships | Contracts, Grants, Cooperative Agreements, Educational Partnership Agreements, Cooperative R&D Agreements, Information Institute & Visiting Researchers

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Basic Research

II Visiting Faculty Research Program (VFRP) AFOSR Summer Faculty Fellowship Program (SFFP)

The Information Directorate collaborates with universities on research in key areas that can help our nation secure its cyberspace. Some of our advertised research topics include:

• Cyber Agility Research and Applications
• Multi-Domain Mission Assurance
• Cognitive RF Spectrum Mutability
• Computational Trust in Cross-Domain Information Sharing
• Neuromorphic Computing
• Application of Game Theory and Mechanism Design to Cyber Security
• Optimized Machine Learning in Large-Scale Complex Systems
• Trusted Software-Intensive Systems Engineering
• Secure Processing Systems

Research topics can be viewed at the VFRP and SFFP web sites:

http://www.wpafb.af.mil/Welcome/Fact-Sheets/Display/Article/836756/
http://afsffp.sysplus.com/

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Information Directorate Summer Internships

http://www.wpafb.af.mil/afrl/ri/

- Summer Internship Program
- Advanced Course in Engineering (ACE) Internship Program
- Information Institute Visiting Faculty Research Program (VFRP)
Industry Opportunities

Broad Agency Announcement

• Using Open-Open BAAs (unique to RI Directorate)
• Establishes innovative open solicitation for agile requirements
• Topics published on FedBizOpps
• Topics tailored to solving critical AFRL technology needs
• Uses 2-step (white paper / proposal) process that saves vendor time and money
• Expedites obligation process (~90 days)
• Centrally managed Contracting Officer
• Currently 44 Open BAAs within RI
World Class Talent
Future Starts Here | Government Career Classifications

- Electronics Engineering
- Computer Science
- Computer Engineering
- Physics
- Mathematics
- Operations Research
- General Engineering
- Mechanical Engineering
- Materials Engineering
- Civil Engineering
- Environmental Engineering
- Industrial Engineering
- Maintenance Mechanic & Fabrication

- Telecommunications
- Safety & Occupational Health Management
- Human Resources Management
- Logistics Management
- Architecture
- Business Administration
- Financial Management
- Patent Attorney & Legal Services
- Cartography
- Contracting
- Police

Total Government Staffing – 816
Total Directorate Staffing – 1,227

- Military Professional Staff
  - (13)
- Contractor Professional Staff
  - (83)
- Civilian Scientist & Engineers
  - (384)
- Contractor Scientist & Engineers
  - (328)
- Civilian Professional Staff
  - (367)
- Students (Including II)
  - (112)
- Visiting Professors
  - (62)

Source: AFRL/RIB as of 31JAN20

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Developing Next Generation of Cybersecurity and Information Technology Warriors

Advanced Course in Engineering (ACE)

- Complete immersion in the cyber security discipline thorough intense coursework and training exercises applying the art of cyber warfare in a multi-domain operational scenario
- 10 week, resident professional development educational course targeting ROTC undergraduates, civilians, active duty and international officers
- Transforms top cadets into original thinkers, problem solvers, and technical leaders

Program History

- Graduated 464 interns since being founded in 2003
  - Composed of 264 Air Force, 3 Navy, 4 Army, 38 UK, 4 AU, and 151 Civilians
  - Retained 65% of ACE graduates in the Air Force
- Contributed 25% of the AF CNODP class over the last 5 years
  - Over 30% of ACE 17D graduates attend CNODP or WIC
- Deployed 2019 ACE R&D projects to the 57th IAS, NSA Red Team, and RED FLAG 19-3

Machine Learning Boot Camp

- Developing and executing intensive “boot camps” on machine learning for AF civilian and military scientists and engineers and acquisition leaders to build the workforce we need.
- 22 S&Es attended 10 week curriculum in Fall 2019
Information Technology Governmental Collaboration

**USAFA**
- AFMC
- AFSOC
- AFSPC
- ANG
- 24th & 25th AF
- AMC
- ACC
- AFLCMC
- SAF
- SMC
- ...

**ACADEMIA**
- 90+ grants
- Information Institute – 80+ members
- 130+ EPAs
- Visiting Faculty Research Program
- Research Fellowships
- STEM
- Centers of Excellence
- ...

**JOINT COMMUNITY**
- STRATCOM
- TRANSCOM
- NORTHCOM
- CYBERCOM
- CENTCOM
- Army
- Navy
- Marines
- ...

**INTEL COMMUNITY**
- DIA
- CIA
- IARPA
- NSA
- NRO
- NGA
- NASIC
- ...

**INDUSTRY**
- 200+ contractual partners
- IR&D
- 60+ CRADAs
- SBIR/STTR
- ...

**INTERNATIONAL**
- PAs
- TTCP
- NATO
- EOARD
- AOARD
- ...

**OTHER DoD**
- DARPA
- DTRA
- Cyber COI
- C4I COI
- ...

**OTHERS**
- FBI
- FFRDCs
- NASA
- DHS
- DoE Labs
- ...

as of 14 Jan 19

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Coming soon

SUNY & AFRL
Quantum Warrior Challenge
Questions