NextGen Interagency Experimentation Hub

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MITRE Innovation Program

NextGen: Next Generation Air Transportation System

Vision

Connecting the research labs of NextGen mission partners…

NASA

DoD

CAASD
IDEA Lab
C2C *Labs*
Command & Control Center

FEMA

FAA

…to enable interagency exploration of NextGen advanced concepts.

C2C: Command and Control Center
CAASD: Center for Advanced Aviation System Development
DoD: Department of Defense
FAA: Federal Aviation Administration
FEMA: Federal Emergency Management Agency
IDEA: Integration Demonstration and Experimentation for Aeronautics
NASA: National Aeronautics and Space Administration

Interagency Experimentation Cases:

Need to exchange info across many domains & boundaries

Hijacked Aircraft

FAA
NAVCANADA
NORTHCOM
TSA
FBI
Airlines

UAS in Hurricane Response

FAA
FEMA
DoD
CBP
NASA
NOAA

Pandemic Flu Response

FAA
CBP
CDC
HHS

CBP: Customs and Border Protection
CDC: Center for Disease Control
FBI: Federal Bureau of Investigation
HHS: Health and Human Services
NOAA: National Oceanic and Atmospheric Administration
NORTHCOM: United States Northern Command
TSA: Transportation Security Administration

Photography credits for Figures 1 and 3: Uncooperative Aircraft -- http://www.istockphoto.com, File #14519644; Hurricane Response -- http://www.istockphoto.com, File #2121743; Pandemic Flu Response -- Public Domain photo courtesy of CDC/James Gathany.

Challenges

- **Classified DoD and DHS partner labs are isolated within secure domains**
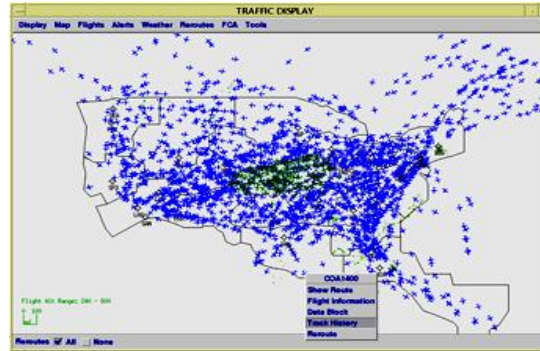

DoD

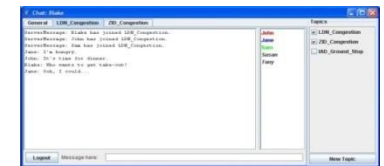- **Firewalls block connectivity with external unclassified partner labs**

IDEA Lab

Labs

FAA

NASA

FEMA

DHS: Department of Homeland Security

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What Data Should Flow?

Common data types in aviation-related experimentation

Aircraft Position Updates

Flight Plans

VoIP*
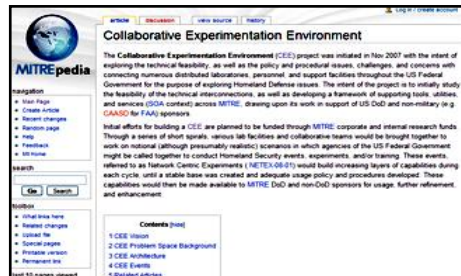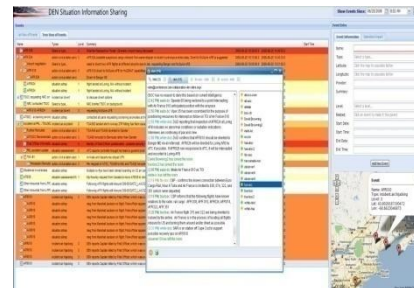

Web Pages

Critical Events/Intel

Email, Chat

*VoIP: Voice over Internet Protocol

✓ **cross-firewall**   ✓ **cross-domain**

Technologies We Explored

- ■ *Cross Domain network/guard options*

Unclassified Lab   **Classified Lab**
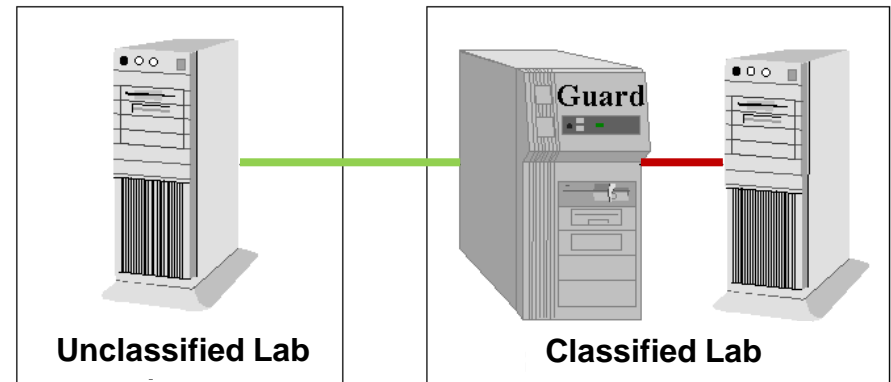
- ■ *Cross Firewall data exchange strategies*
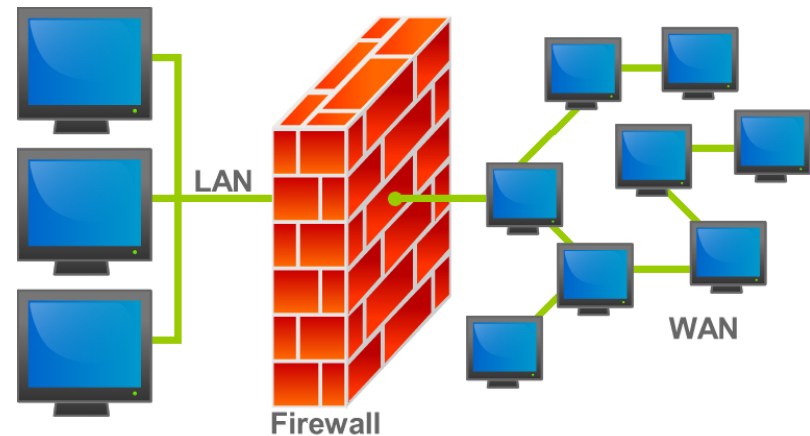
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Cross-Firewall Services
Why?

- **The basic requirement:**

  - **Provide MITRE with an environment that enables MITRE's sponsors to *participate from remote locations* during experiments.**

- **Benefits:**

  - ***Eliminate the need for sponsors to travel* to MITRE, reducing costs and resource allocation issues;**

  - **Enable sponsors to participate *using their own systems, tools, and proprietary/sensitive datasets* from their own labs.**

  - **Facilitate *mobile participation* in experiments**

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Cross-Firewall Services
Current Design

Firewall

Firewall(s)

IDEA Lab

GRAIL

Data Server

MII

MITRE

Data Server

Web Server

Chat Server

Email Server

VoIP Server

General Support System (GSS)

External Labs

VoIP Server

MITRE
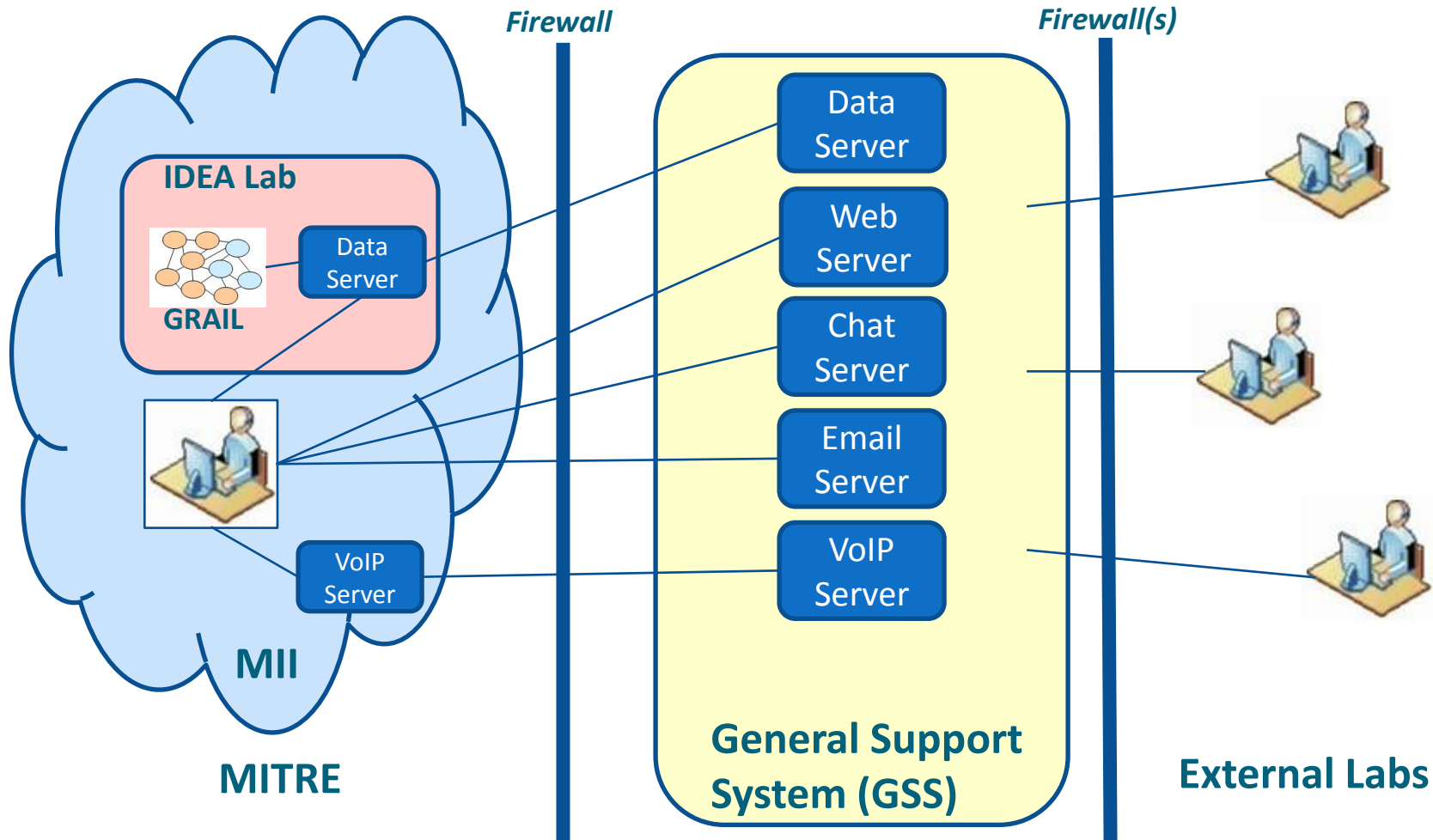
Cross-Firewall Services
Design Notes

- **Data**
  - ActiveMQ server provides Java Message Service (JMS) publish/subscribe capability
- **Web**
  - Representational State Transfer (REST)
  - Support for web portals, mobile devices
- **Chat**
  - Openfire server
- **Email**
  - Zimbra server
- **VoIP**
  - Asterisk servers; h/w or s/w phone clients

Service solutions were chosen based on their ability to meet performance and data management needs (as proven in previous internal experiments).

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Highlight: Web Messaging Support for Web Portals & Mobile Devices

- **Goal: make data available in new ways for emerging user needs**
  - **Expand to support new stakeholders/realms**
  - **Deliver services and data to users on nontraditional platforms**

- **Approach:**
  - **Support web portals and mobile devices by providing additional data formats and protocols**
    - **JSON and AJAX useful for web services which can be consumed by mobile devices**
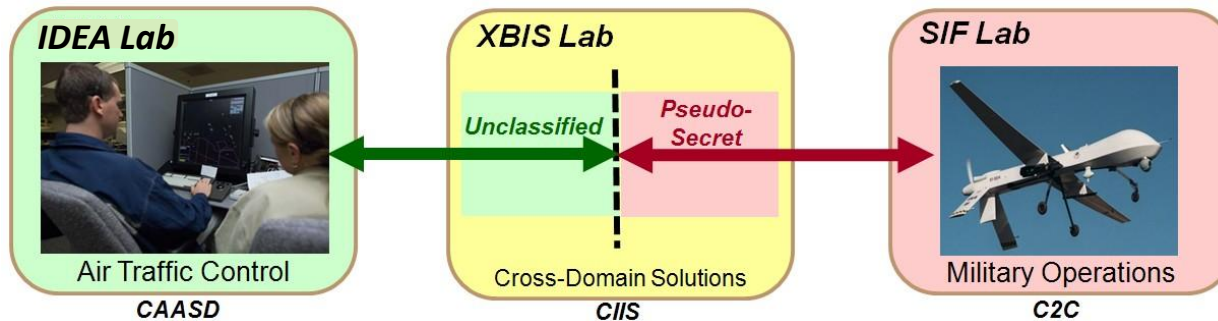

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JSON: JavaScript Object Notation
AJAX: Asynchronous JavaScript and XML

Cross-Domain Service
Why?

- **Allow classified DoD R&D Labs to participate in aviation experiments with IDEA Lab**

  - **Missions environments: uncooperative aircraft, UAS in controlled airspace, etc.**

  - **IDEA Lab provides the simulated air traffic data and air traffic controller stations**

  - **Military service and other agency labs run simulations of their aircraft, UASs, and sensors, and man their own C2 stations**

  - ***Data that are actually exchanged between labs are unclassified and non-sensitive***

UAS: Unmanned Air System

Cross-Domain Solutions
Setup & Testing in Multi-Lab Testbed

IDEA Lab
Air Traffic Control
CAASD

XBIS Lab
Unclassified
Pseudo-Secret
Cross-Domain Solutions
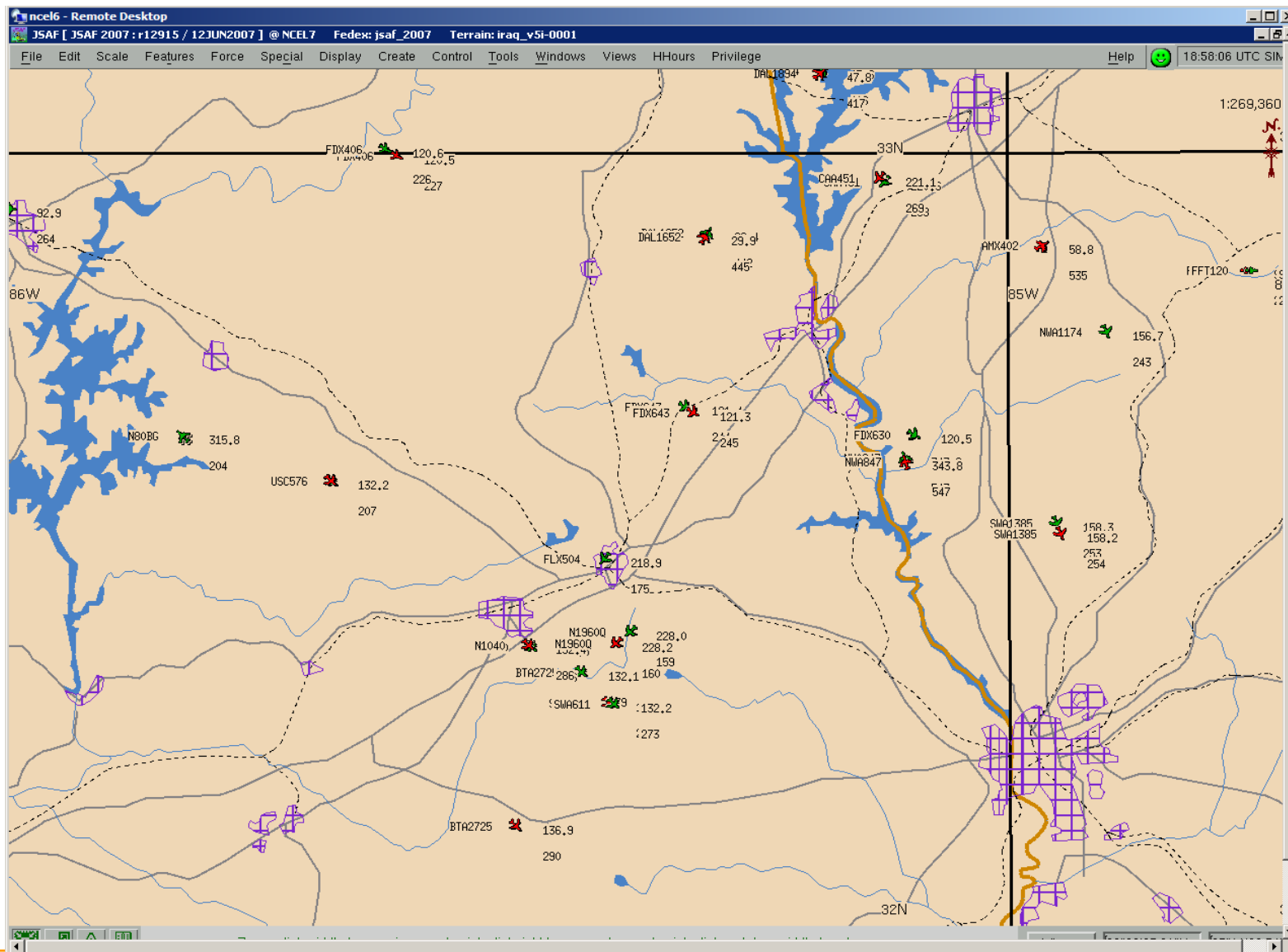CIIS

SIF Lab
Military Operations
C2C

■ **Established data connectivity among labs**

■ **With Raytheon Trusted Computer Solutions (RTCS), installed and exercised SimShield**

– Latency results favorable

– Usability issues acceptable

Message Latency* (sec)

Number of Aircraft
200   1000   2000   4000

■ **Worked with Lockheed Martin (LM) to configure and pre-test Radiant Mercury (RM) with Rialto at LM Colorado Springs location**

– Currently in testing in XBIS Lab
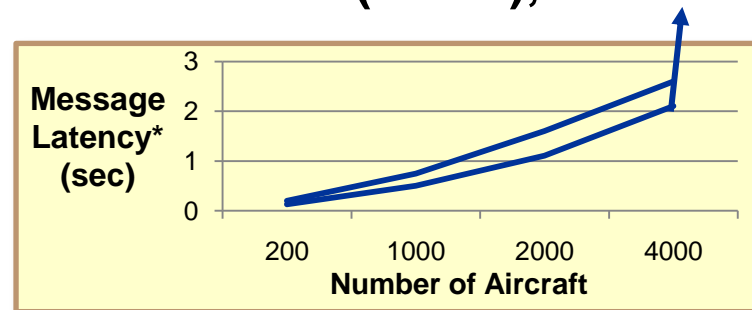
* NOTE: These latencies include not only SimShield latency but also high-side network and middleware latencies

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XBIS: Cross Boundary Information Sharing
SIF: Simulation Interoperability Facility
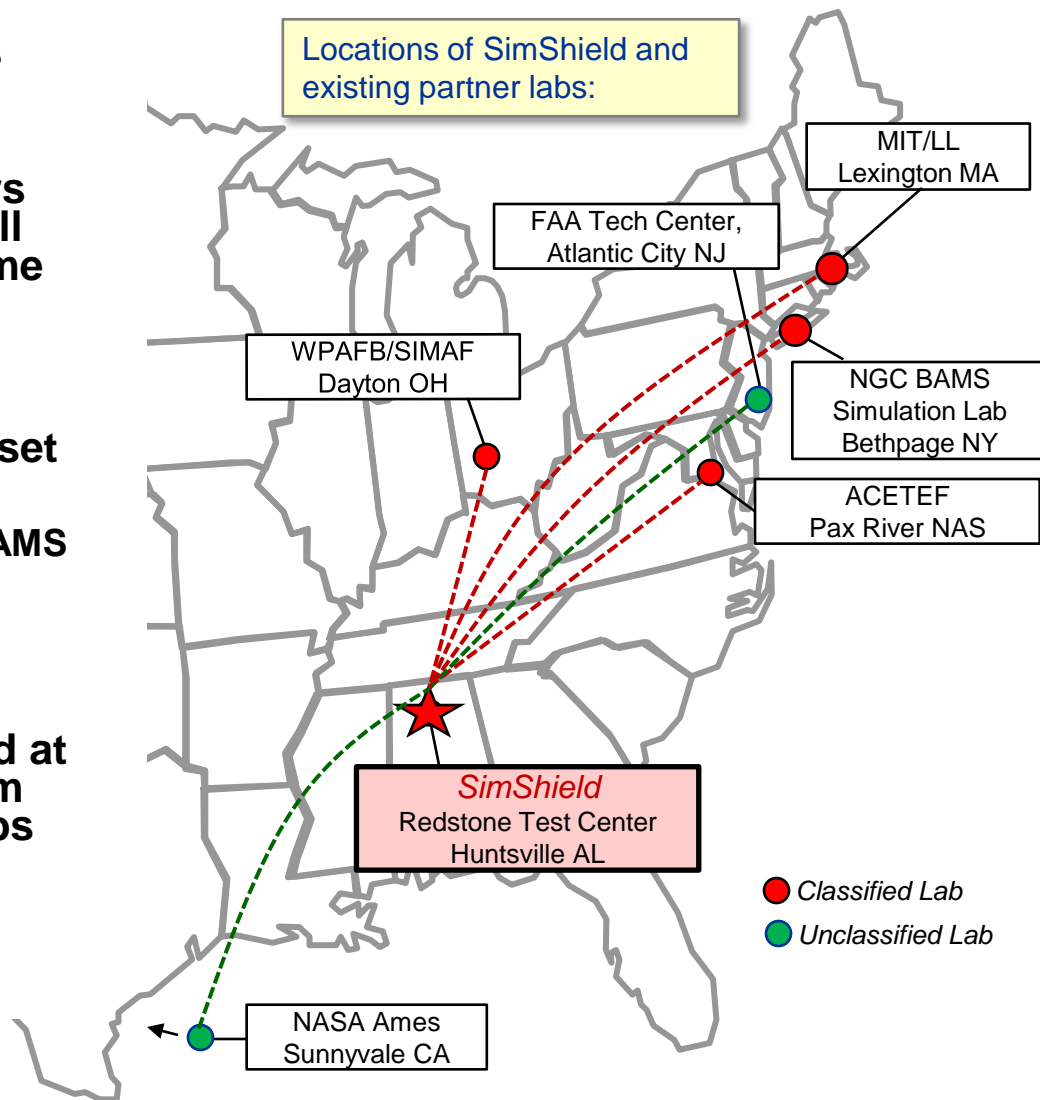CIIS: Center for Integrated Intelligence Systems

Cross-Domain Solutions
Performance Testing

Cross Domain Service
Implementation

- **Problem: cross domain solutions (CDSs) are expensive and take a long time to approve/deploy**

- **Redstone Test Center (RTC) offers _reuse_ of their SimShield at a small fraction of the cost & approval time**
  - **Classified side of SimShield on S-DREN connects to many DoD research labs**

- **Rulesets in RTC's SimShield are set for UAS experimentation**
  - **Existing connections to Navy's BAMS simulation lab and partners**

- **Once MITRE DREN/S-DREN connectivity is established, this SimShield enables cross domain connectivity between labs located at MITRE (IDEA Lab, NCEL) and from MITRE Labs to remote partner labs (CEIF, AFRL, …)**

Locations of SimShield and existing partner labs:

MIT/LL Lexington MA

FAA Tech Center, Atlantic City NJ

WPAFB/SIMAF Dayton OH

NGC BAMS Simulation Lab Bethpage NY

ACETEF Pax River NAS

SimShield Redstone Test Center Huntsville AL

NASA Ames Sunnyvale CA

🔴 *Classified Lab*
🟢 *Unclassified Lab*

ACETEF: Air Combat Environment Test and Evaluation Facility
AFRL: Air Force Research Laboratory
BAMS: Broad Area Maritime Surveillance
CEIF: C2 Enterprise Integration Facility
JMETC: Joint Mission Environment Test Capability
MIT/LL: Massachusetts Institute of Technology/Lincoln Labs
NAS: Naval Air Station
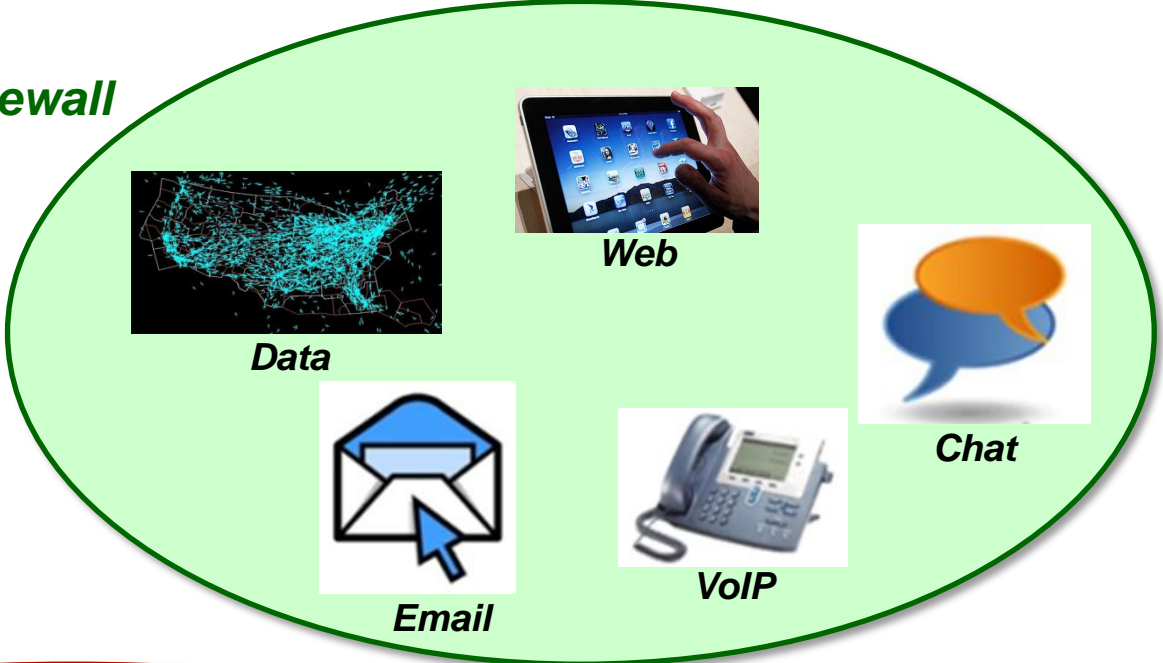NCEL: Naval C4I Experimentation Laboratory

NGC: Northrup Grumman Corporation
S-DREN: Secure Defense Research and Engineering Network
SIMAF: Simulation and Analysis Facility
WPAFB: Wright Patterson Air Force Base

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NextGen Interagency Experimentation Hub

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Cross Firewall Services

Data

Web

Email

VoIP

Chat

Cross Domain Service

Redstone Test Center

IDEA Lab

Unclassified   *Classified*

Military R&D Labs

DREN   *SDREN*

SimShield CDS

← **Simulated Aircraft Data** →