



# Redstone Test Center – Weapon Centric Cyber Developmental Test Capability

## National Cyber Summit – June 2019

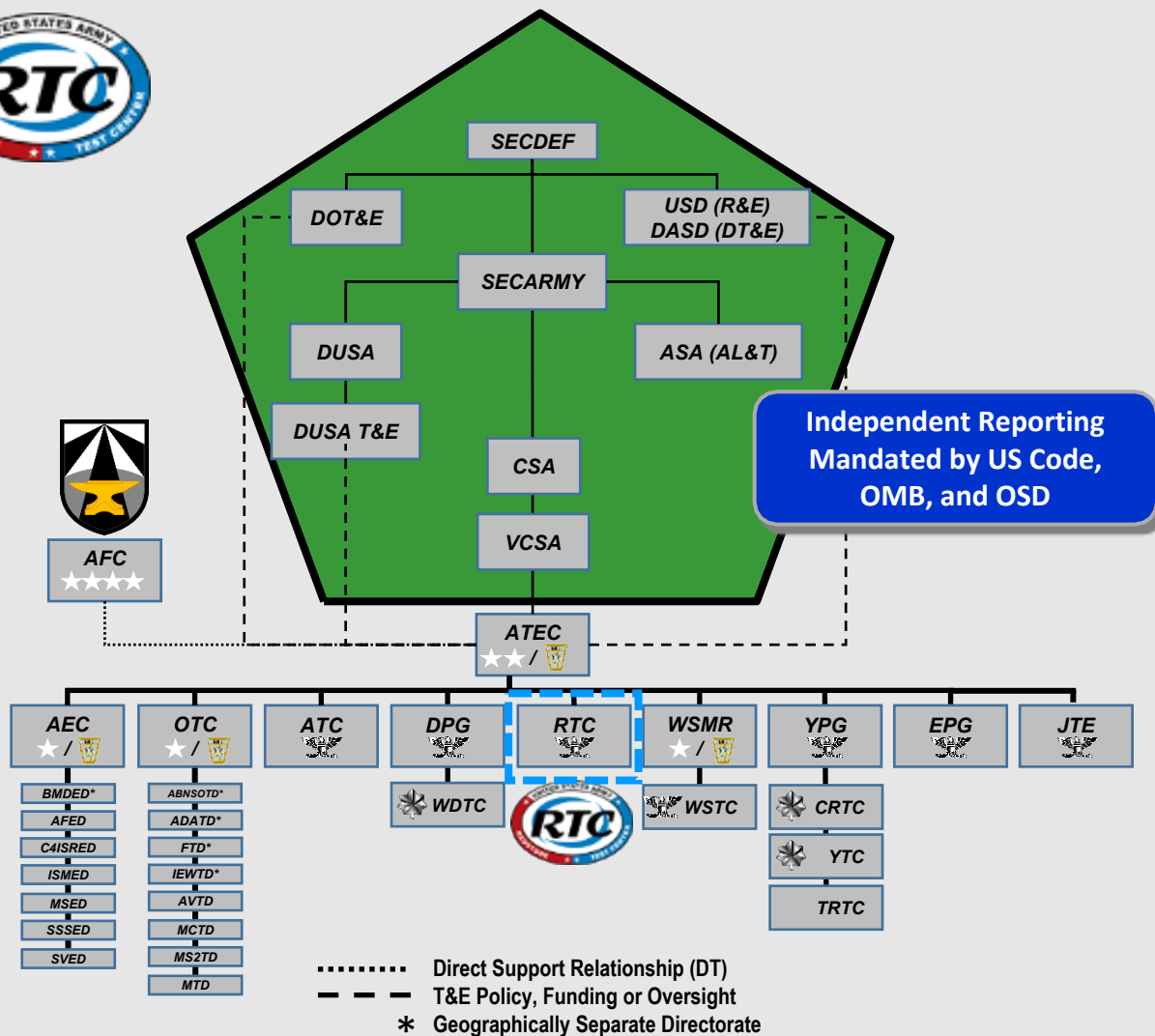
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Distribution Statement: Approved for Public Release

The Overall Classification of this Briefing is:  
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# RTC – The Big Picture



**Operational Test Agency: Army is the only service which unifies developmental testing, operational testing, and independent evaluation under a single Command (ATEC)**

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- General Orders No. 13, Signed CSA 16 Oct 06
- LAW (Section 139, Title 10, U.S. Code)
  - Establish Office of Director, Operational Test and Evaluation
  - Requires annual report to Congress for oversight systems
- LAW (Section 2366, Title 10, U.S. Code)
  - Live Fire Test & Evaluation (LFT&E)
    - Requires survivability testing of major systems meant to protect their occupants
    - Requires lethality testing of munitions
    - Requires a LFT&E test report to congressional defense committees
- LAW (Section 2399, Title 10, U.S. Code)
  - Defense Appropriations Act
    - Requires independent Initial Operational Test & Evaluation (IOT&E) before proceeding beyond low-rate initial production (LRIP) for all major defense acquisition programs
    - Three qualifications - production or production-like materiel; typical users; realistic conditions
    - Limits system contractor involvement in IOTE
- LAW (Section 2400, Title 10, U.S. Code)
  - Low-Rate Initial Production (LRIP)
    - Quantities for IOTE are established by the DOT&E for oversight systems, and by OTAs for others

# RTC Unique Capabilities

## Aircraft Flight Testing

- Test Pilot School Trained:
  - ✓20+ XPs (DAC/MIL)
  - ✓10+ Flight Test Engineers (FTEs)
- Flight Quality and Engine and Aircraft Performance
  - **Structural and Rotary Dynamics**
- Aircraft Survivability
- Aircraft Icing - Natural & Artificial
- Aviation Systems Test & Integration Lab (AvSTIL)

## Environmental

- Internationally Recognized Experts: **Dynamics, Climatics & E3**
- Contributing authors: MIL-STDs, TOPs/ITOPs, STANAGs
- One-of-a-Kind Large Capacity 6DOF Motion Replication
- Unique Acoustic & Vibro-Acoustic Chamber w/Realistic 6DOF motion
- Over 40 Environmental Chambers



## Missiles

- Mobile & Fixed TM Ground Stations
- Advanced Optical & Radar Target Tracking
- Liquid, Solid & Hybrid Rocket Motor Testing
- Warhead and Small Rocket Testing
- Custom Surveillance Test Vans
- Missile Seeker and AUR HWIL Facilities

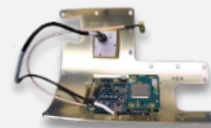


- **Indicates Technical Experimental Developer Army Civilian**

**Highly Educated World Renowned Expertise**

## Instrumentation

- Aviation and Missile Custom Instrumentation, Telemetry and Ground Viewing
  - **Rapid Custom Test Instrumentation Development** to Support Unique Customer Requirements
- Test Set Design/Build/Field to Support Systems Life-Cycle Sustainment
  - **Extreme Miniaturization of Instrumentation/ASIC**
- Custom Design/Build TM kits and FTSs for R&D and Fielded Systems
- Custom Precision TSPI Systems

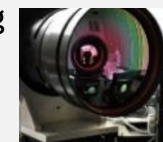


## Advanced T&E Methods

- **Distributed Test and Modeling & Simulation**
- Internationally Recognized Network & Simulation Architecture Expertise
- Leaders in Live-Virtual-Constructive Distributed Environment (LVC-DE) for System of System Testing
  - **Scalable Tactical Emulated Network** and LVC-DE Combine to Support System-of-Systems Testing in a Realistic Net-Enabled Battlefield
- **Advanced Materials Analysis** of Metallic and Composite Structures

## Sensors

- Open Air Sensor Testing
- EO/IR, LASER, Visible, Hyperspectral and Acoustic Laboratories
- Captive Carry & Ground Based Sensor Testing
- Stabilized Electro-Optical Airborne Instrumentation Platform (SEAIP)



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# Cybersecurity Vulnerability & Assessment Test Environment (CVATE)

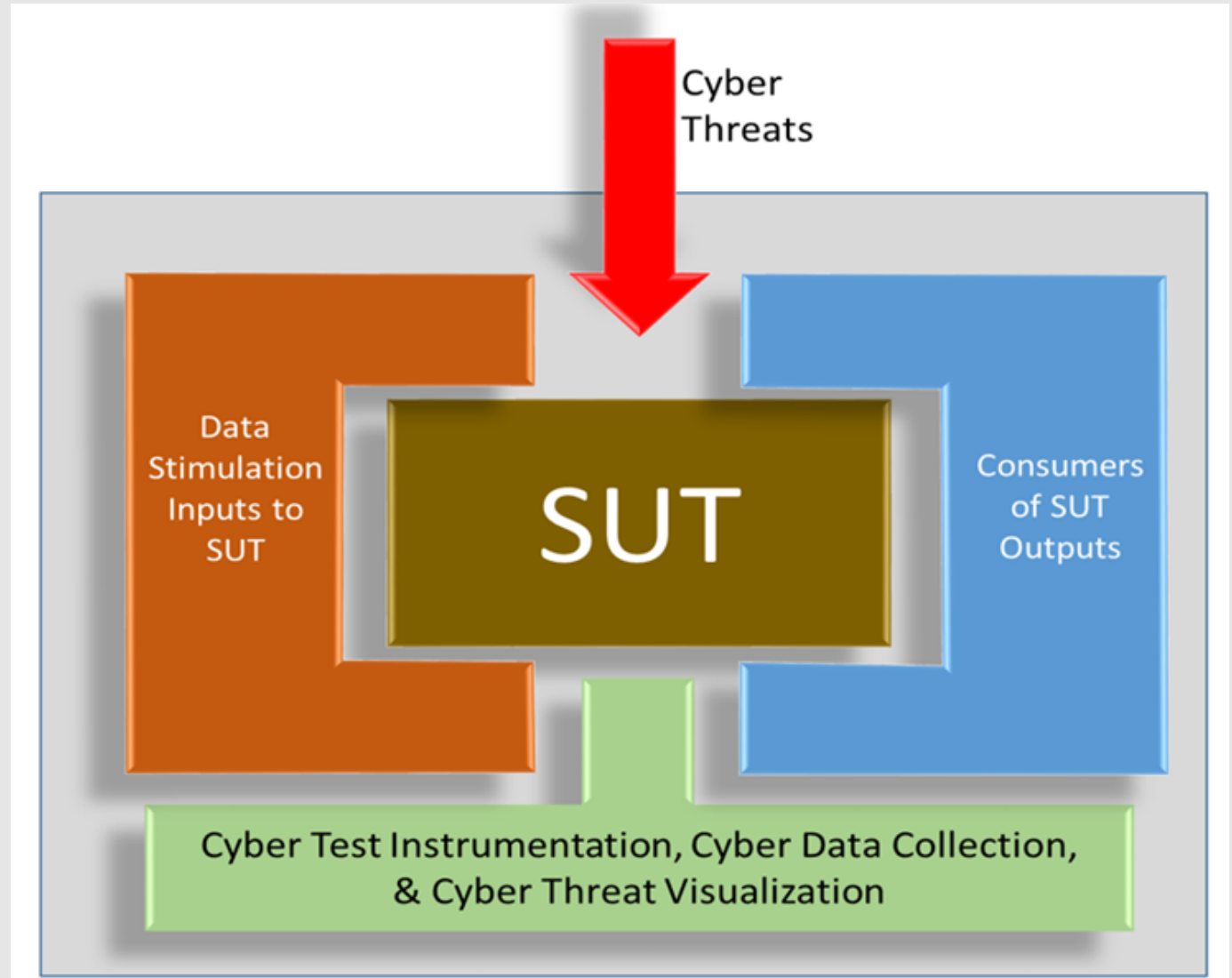
CVATE – Prototype RTC Cyber Developmental Test Capability

- Leverage weapon expertise and capability
- Enterprise approach – Template for ATEC DT
- Partnerships – TSMO, PMs, PEOs, Intel, AF
- Risk/Threat based cyber testing
- Shift Left – Risk Reduction
- KSAs, Processes, Technical Capability
- Spin-off – Cyber Test Division

- OTA Contract – Awarded in June 2018

**TRIDEUM**

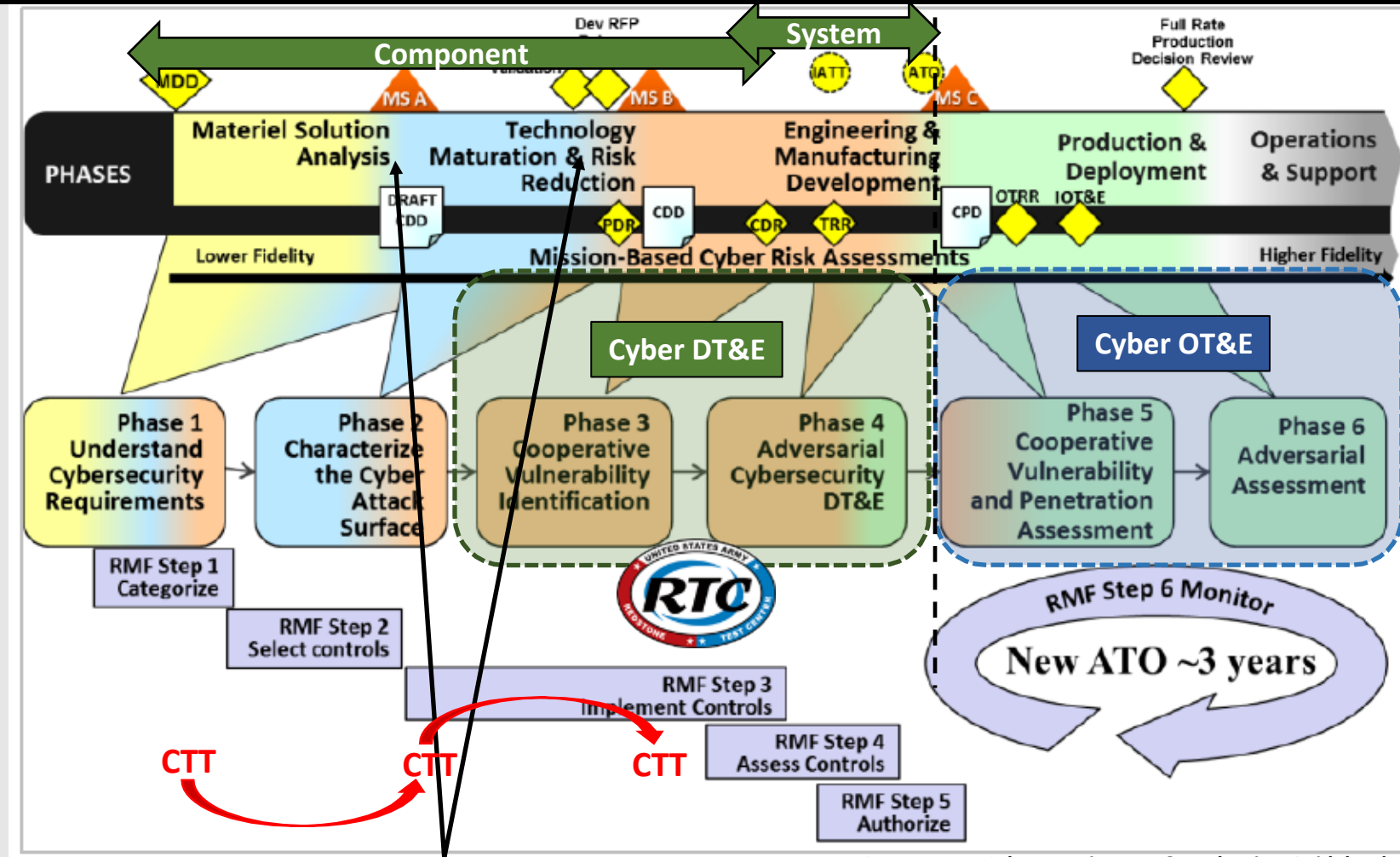
- Trideum contract partners:



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# DoD Cyber Testing Requirements

- > RTC Strategic Engagement in the Cyber Test Process.
  - Cyber DT&E – RTC summary of efforts.
    - Cyber Table Top Tool – T&E rigor in planning.
    - Component cyber test capability – prove the design early.
    - System level cyber test capability – immerse the item in an operationally relevant environment.
    - System of System – mission impact.
- > We contend that...
  - There are opportunities to dramatically improve upon formal/minimum testing requirements.
  - RMF is mostly compliance-based; the critical need for weapon systems is threat-based cyber testing.
  - Shifting vulnerability/risk discovery left will benefit the entire community.



Source: DoD Cybersecurity Test & Evaluation Guidebook

The best chance to set the conditions for a cyber resilient weapon system is HERE.

Solutions?

- 1) Shift Left – test earlier. Get it right from the outset.
- 2) Improve cyber testing capabilities so that Phase 3-6 testing is less disruptive.

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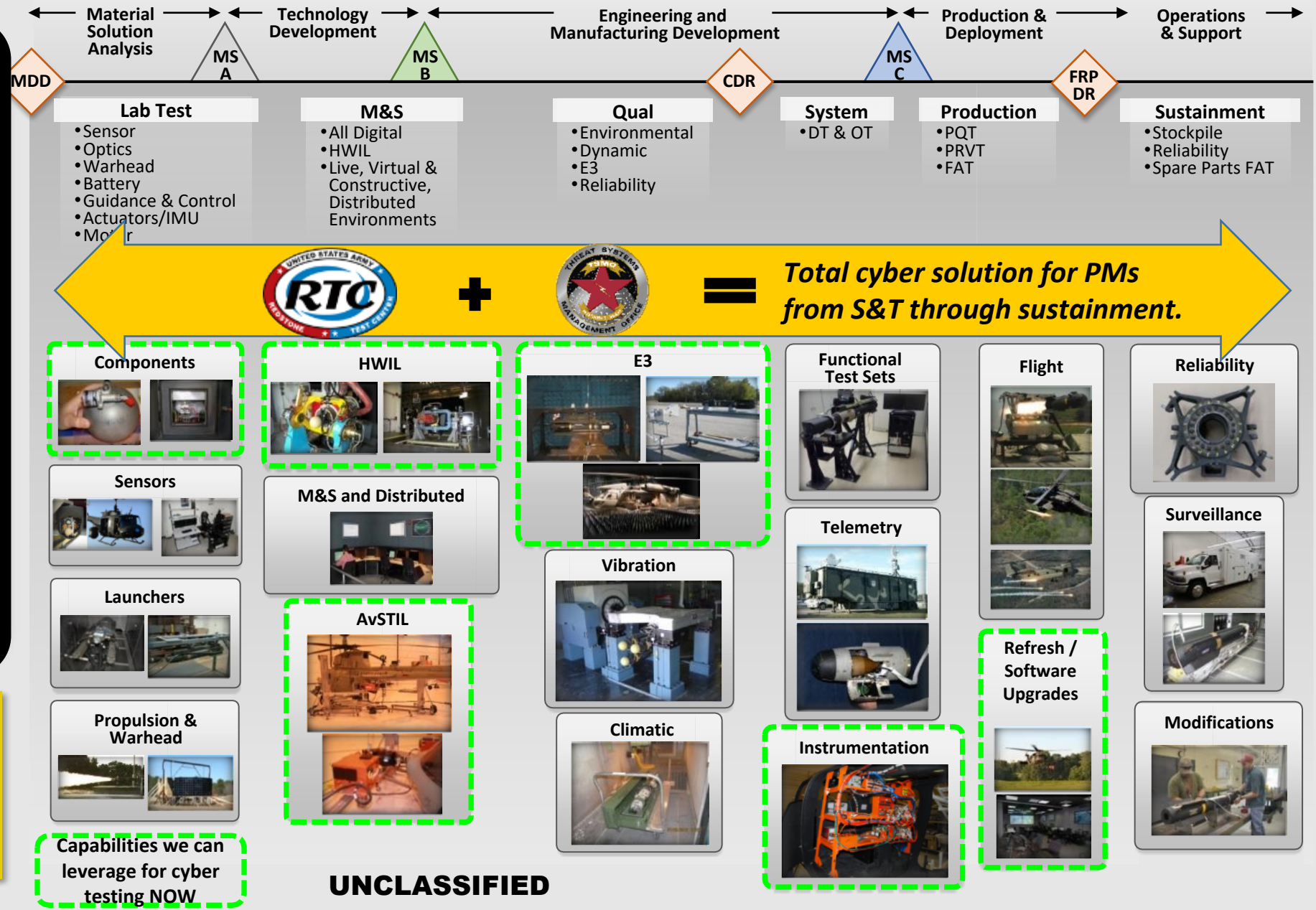


# RTC Aviation, Missile & Sensor Life-Cycle <sup>Cyber</sup> Test Capabilities

## Key Points

- > Component Level Testing – Use a standard threat framework to validate OEM design. Treat cyber like we do environmental, dynamic, and EMI.
- > System level - Leverage existing T&E instrumentation, HWIL capability, distributed test capabilities, and M&S to create an operationally relevant cyber test environment.
- > Cyber DT across the entire life-cycle.
- > Enterprise solution – Apply capability at each Test Center.

**RTC provides weapon-centric cyber testing in an operationally relevant environment – T&E rigor, decision quality data, & prioritized focus on mission critical vulnerabilities.**



# Cyber Table Top (CTT) – *Identifying Real Mission Risks*

## Cyber Table Top (CTT)

- > The CTT is a widely-adopted form of Mission Based Cyber Risk Assessment (MBCRA).
- > Informs system design, DT&E, and ATO – *should* be used periodically as the system or threat environment evolves.
- > We can't defend or test everything. A well-executed CTT produces prioritized, mission-focused cyber test objectives.

**Bringing T&E  
Rigor to Cyber  
Testing**

*Risk based cyber “war-gaming” to prioritize potential vulnerabilities*

### Expertise

- Large concentration of trained CTT facilitators.
- Decades of engineering experience testing Army weapon systems.
- Wealth of cybersecurity expertise.
- Substantial experience leading and supporting CTTs.

### Tools

- RTC is developing an automated CTT tool to improve the efficiency & effectiveness of the CTT process.
- Support from OSD CTT lead; interest from testing community.

### Relationships

- RTC is well-connected – strong relationships with TSMO, TRMC, CCDC Aviation & Missile, PEOs/PMs, academia, private industry, etc.

### Facilities

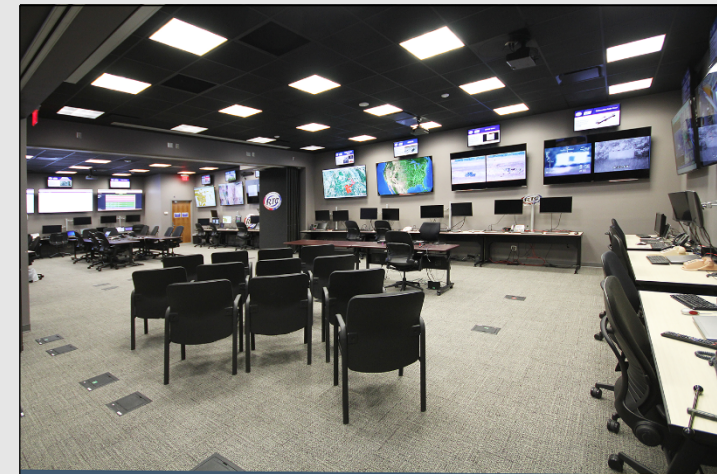
- Leveraging existing world class aviation, missile, and sensor test capabilities
- Distributed Test Control Center (DTCC): world-class, state-of-the-art test facility (up to SECRET).

The screenshot displays a software interface for a Cyber Table Top (CTT) tool. It features a sidebar with navigation options like 'File', 'Facilitator', 'Control', 'Facilitator', 'Team member', 'Team leader', and 'Analysis Team'. The main window is titled 'CTT Tool' and contains a 'Risk Matrix' table. The table has columns for 'Mission 1' and 'Mission 2', and rows for 'Very Low', 'Low', 'Moderate', 'High', and 'Very High'. The cells are color-coded: green for 'Very Low', yellow for 'Low', orange for 'Moderate', red for 'High', and dark red for 'Very High'. Below the table, there are buttons for 'Export' and 'Print'.

	Mission 1	Mission 2
Very Low	Very Low	Low
Low	Low	Moderate
Moderate	Moderate	High
High	High	Very High
Very High	Very High	Very High

Prototype CTT Tool

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Distributed Test Control Center (DTCC)

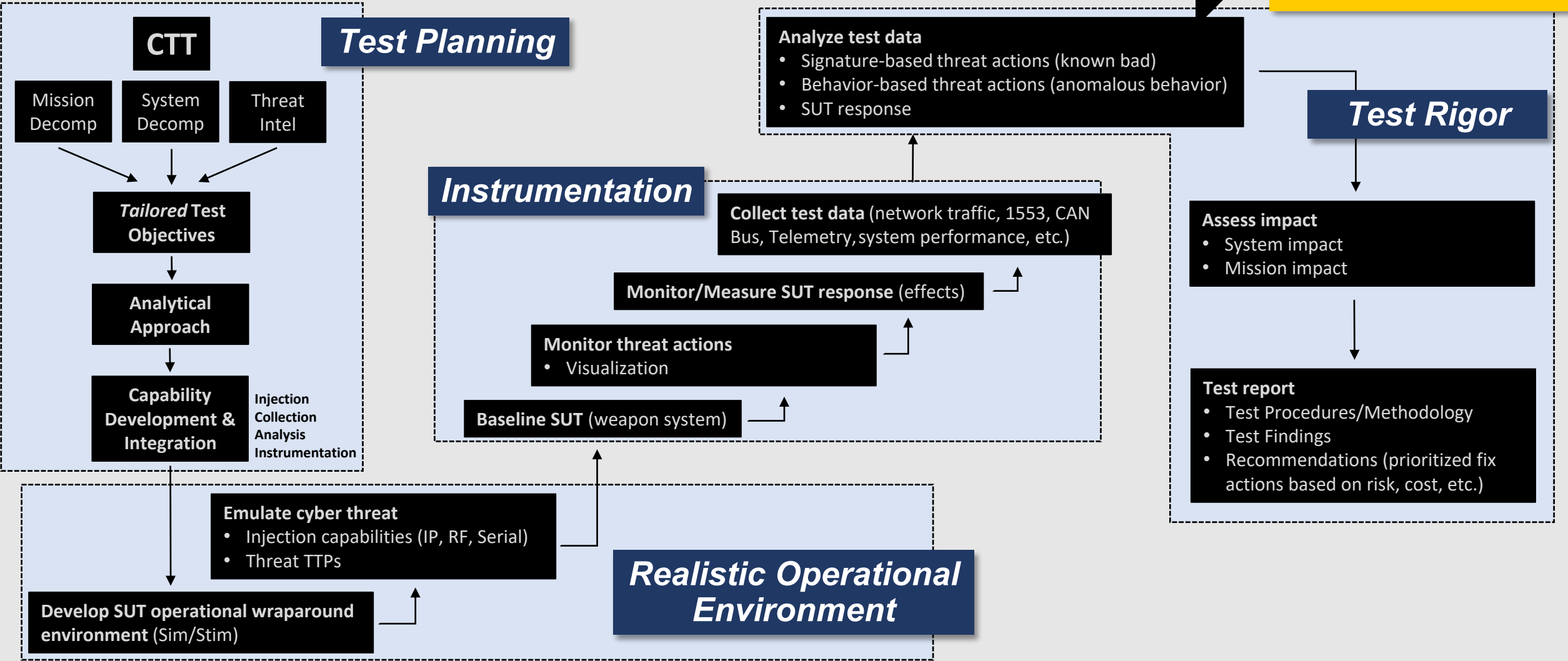
# RTC Cyber Testing Process

Understand the  
Mission | SUT | Threat

Understand the Data

Understand the Impact

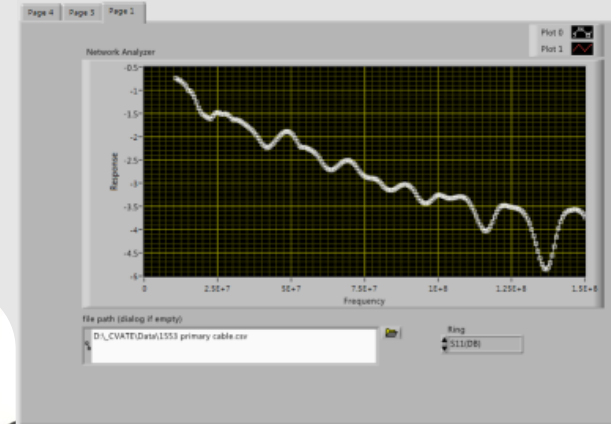
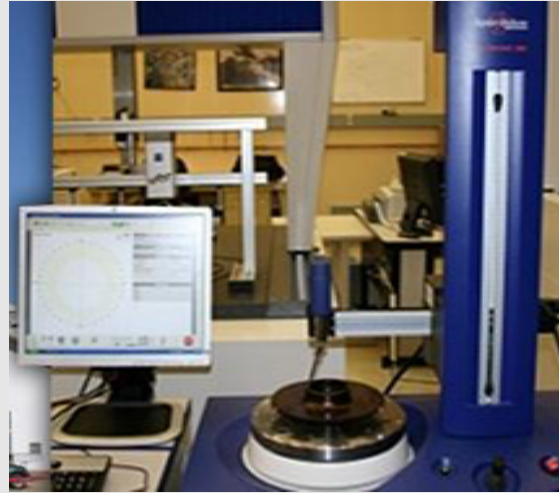
*Decision quality data with  
prioritized focus on mission  
critical vulnerabilities.*





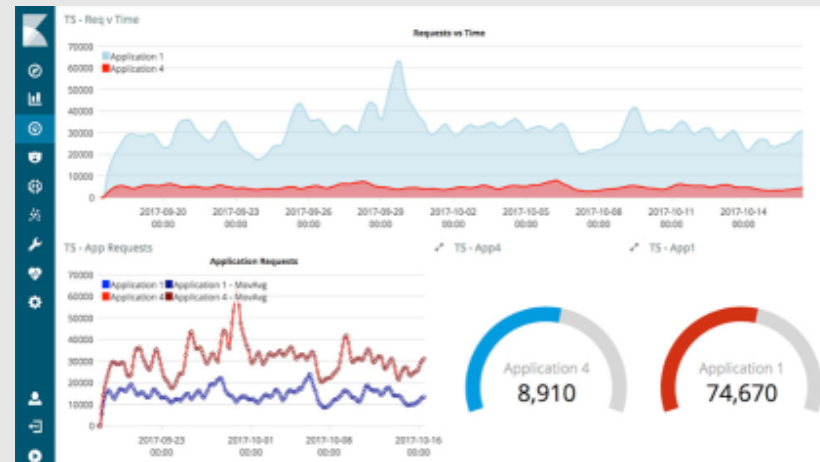
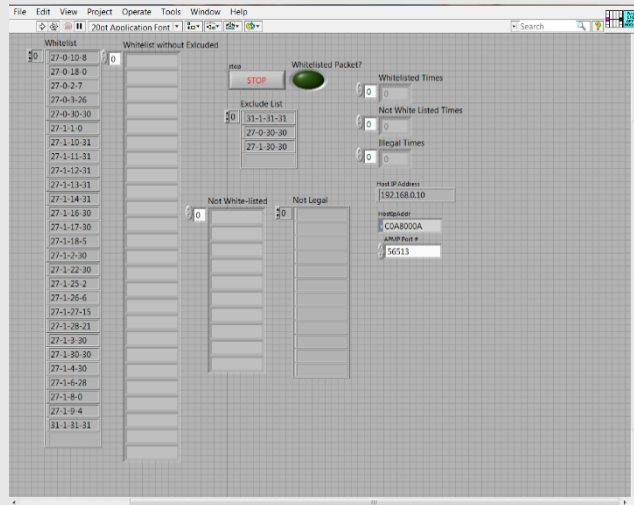
# Component-Level Cyber DT: Proving the Cyber Design

The RTC is leveraging world-class technical expertise, decades of test experience, and a large collection of existing instrumentation capabilities to develop highly-unique, mission-focused cyber testing capabilities for aviation and missile systems.



Time-Domain Reflectometer (TDR) application to detect unauthorized physical modifications (e.g. adding a rogue device).

Custom whitelist application to detect unexpected/unauthorized communications on the MIL-STD-1553 bus.

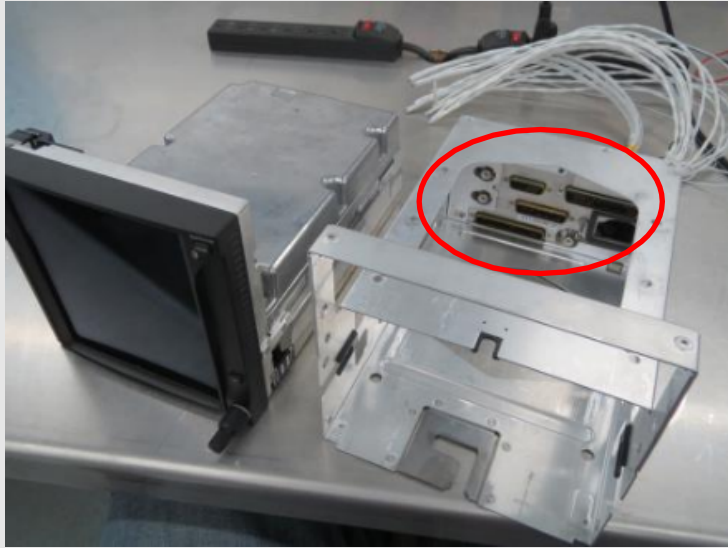


Kibana time series analysis utility

Developing methods to leverage powerful COTS/GOTS cybersecurity tools to identify malicious/anomalous activity in weapon systems.

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# Component-Level Cyber Developmental Test: GTN 750 Nav Unit



Numerous Interface Bus Targets

## COTS Cyber Challenges

- Numerous Attack Surfaces
- COTS availability to adversaries
- Supply chain
- Integration with military systems

## GTN-750 Nav Unit - COTS Customs Border Patrol UH-60



Highly Configurable User Interface



Aircraft Interactions

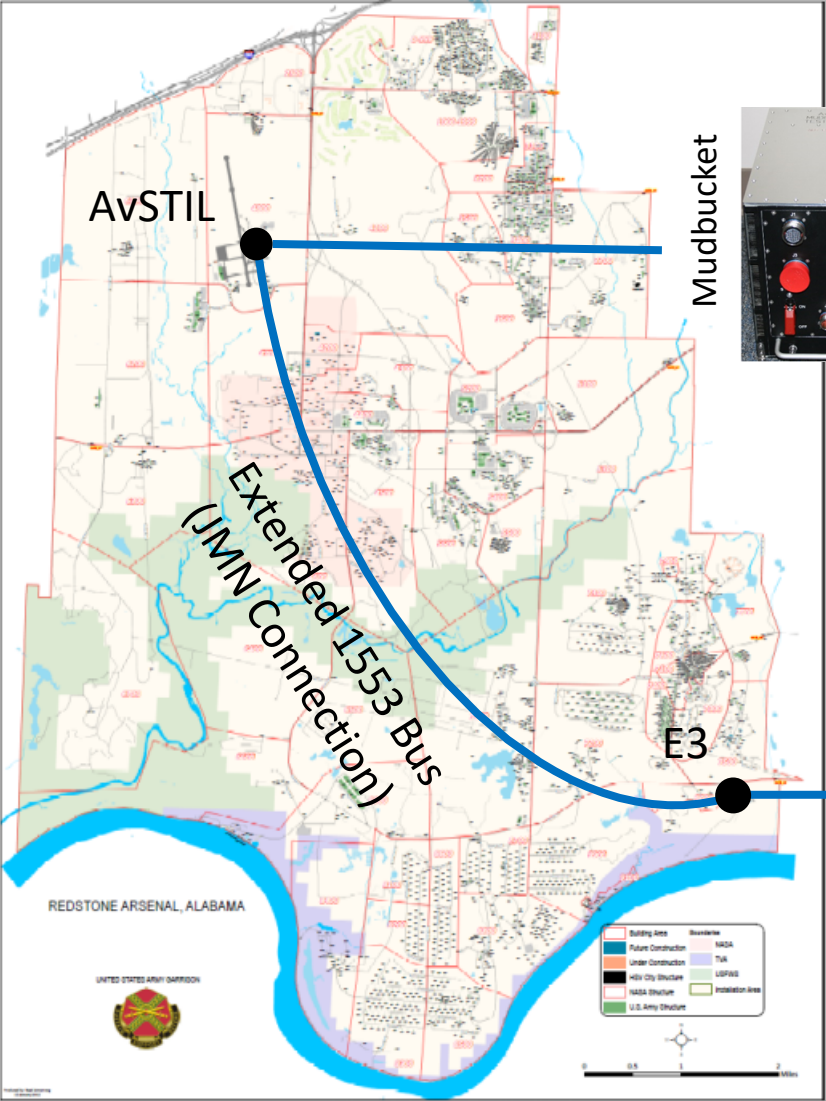


Touch Screen Access

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# Identification, Friend or Foe (IFF) Testing – Cyber EM Affects



Aircraft in RTC Cyber Lab

Distributed Test

AvSTIL  
Command/Control

AvSTIL Data Monitoring

Transponder in E3 Anechoic Chamber



APX-123  
Transponder



RF

Mode 5  
Transmitter  
(SBIR)

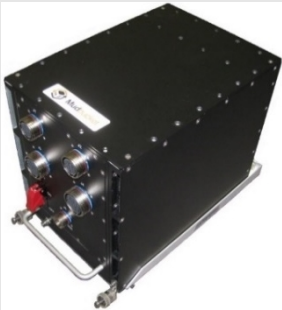
Normal  
Interrogation  
Setup

Abnormal  
Interrogation  
Setup

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# Weapon System Cyber Test Lab (WsCTL)

(SUT Immersion -> Mission Impact)



Mudbucket (MDBCTT)  
Data Collection/Injection  
Simulated Flight



Flight Data Recorders  
Data Collection / Playback



Complete System Under Test (SUT)



AN/PLM-4 Radar Stimulator  
"Bell Ringer"



Distributed Test Control Center (DTCC)  
- M&S Operational Wrap-Around



Anechoic Chamber

Collaborating Facilities

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# Discussion

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