SEAL and SIMEX

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SEAL

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SEAL Floorplan

1. Reception
2. Observation
3. Theater
4. Dismount
5. DevLab

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MITRE's Simulation, Experimentation and Analytics Lab (SEAL)

- **INTEGRATED.** SEAL provides integral reception, observation, command center, and technical control areas, and fully equipped red/white cells.
- **RECONFIGURABLE.** SEAL's data wall consists of forty-five 55-inch, high-definition displays, which may be dynamically repositioned throughout the lab space.
- **SECURE.** SEAL employs a zero-client computing infrastructure with multilevel 6.25 Gbps KVM switch that enables operations up to Secret.
- **CONNECTED.** SEAL provides connectivity to key internal (MITRE MII, NERVE) and external (DREN, SDREN) networks.

Opened in 2016, The Simulation, Experimentation and Analytics Lab (SEAL) is operated by the Modeling and Analysis Innovation Center, in close coordination with MITRE's Enterprise Information Technology and Lab Services centers.

SEAL is a corporate resource, specializing in human interaction with models, simulations, data and visualization at scale.

Applications include: wargaming, experimentation, training, mission rehearsal, test and evaluation, facilitated analytics and decision making, research and applications in immersive technologies and large-scale visualization.

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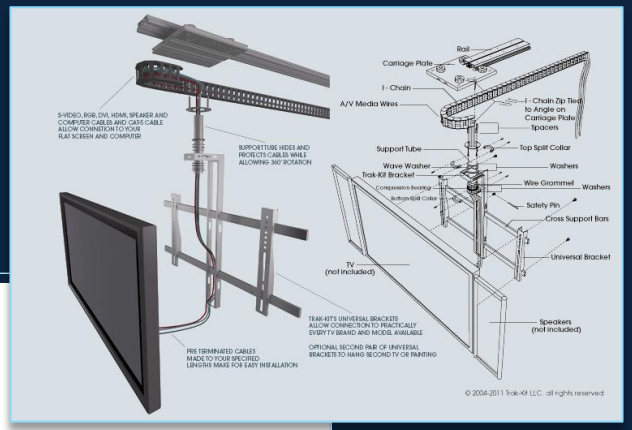
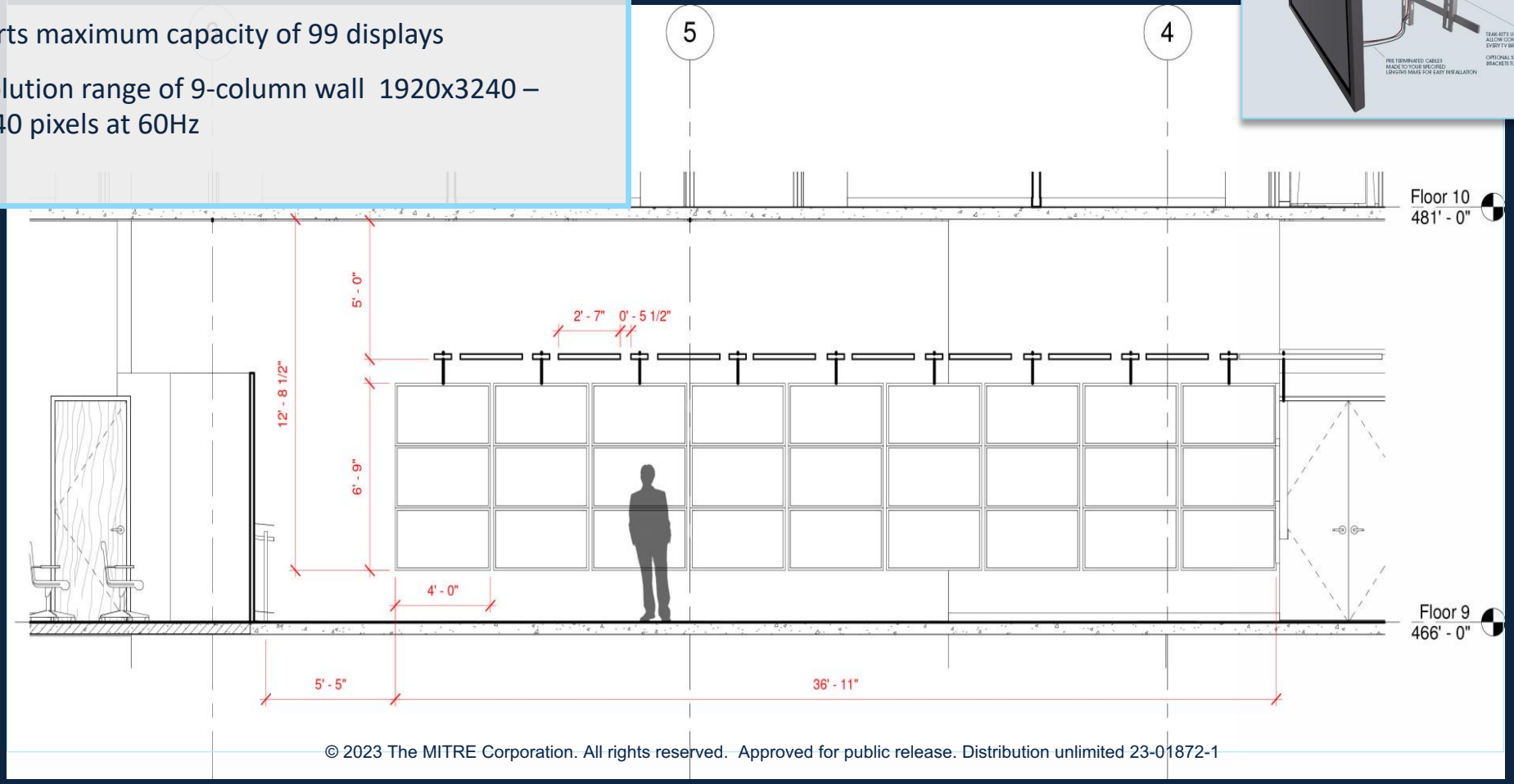
- Ceiling-mounted track supports array movable “display columns”
- Smart servos provide automated movement for columns
- Track programming supports “pre-sets” for column configurations;
- Each “display column” consists of three 55” Planar low-voltage LCD displays
- Lab supports maximum capacity of 99 displays
- Video resolution range of 9-column wall 1920x3240 – 17280x3240 pixels at 60Hz

www.trak-kit.com





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SIMEX

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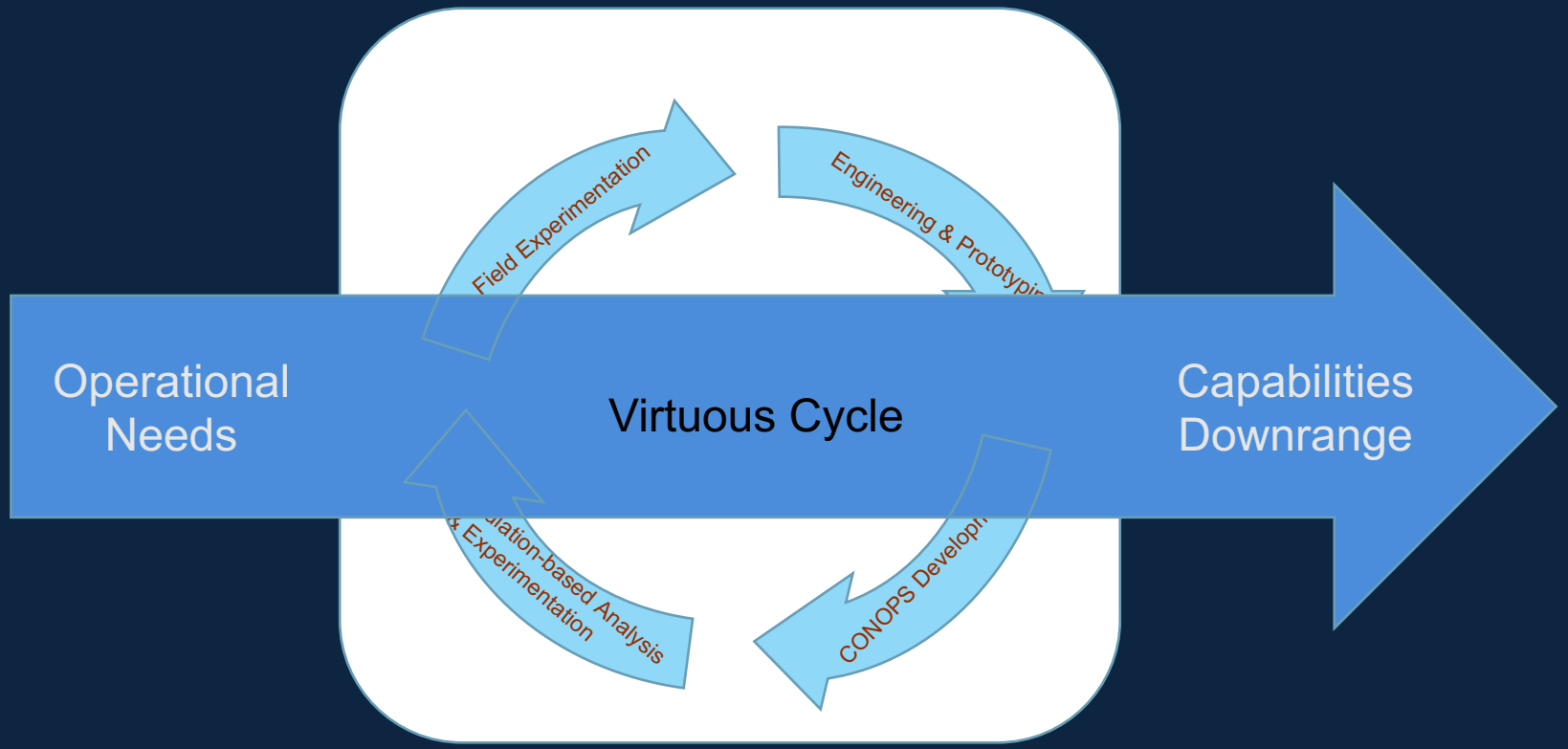
An Approach to Capability Development

- Understand the operator, operational environment, operations, and technology, techniques, tactics, procedures
- Propose CONOPS
- Evolve/Test CONOPS
  - Modeling and Simulation
  - Human-in-the-loop experimentation
  - Prototyping
- Test Live
  - Surrogate Systems
  - Actual Systems
- Deploy
- Train
- Gather Operator Feedback



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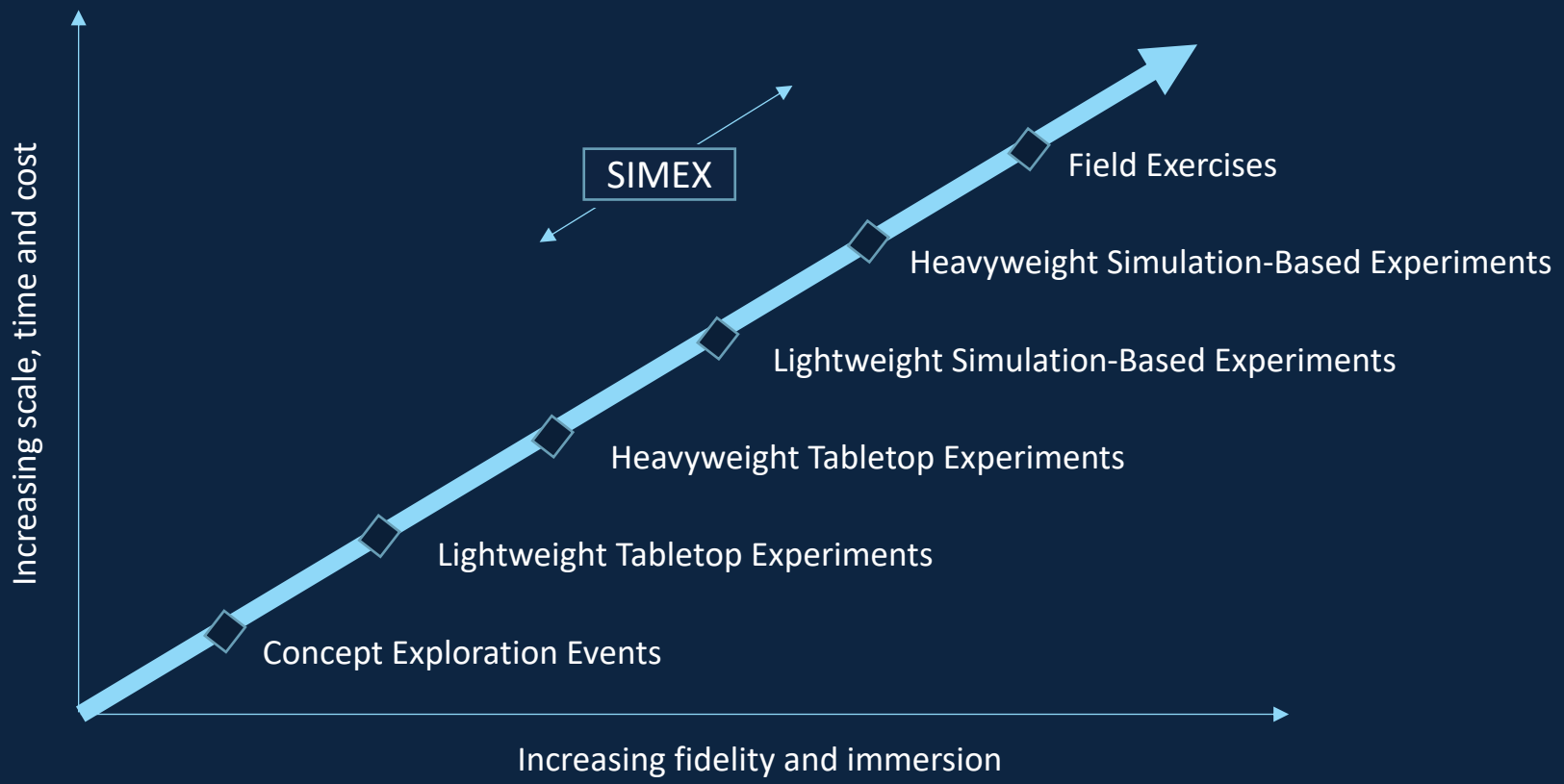
MITRE Experimentation Flagship: SIMEX



A flagship of MITRE's experimentation offerings are SIMEXs supported through our OSD-sponsored National Security Experimentation Lab (NSEL). Since its inception in 2002, NSEL has conducted over 80 SIMEXs.

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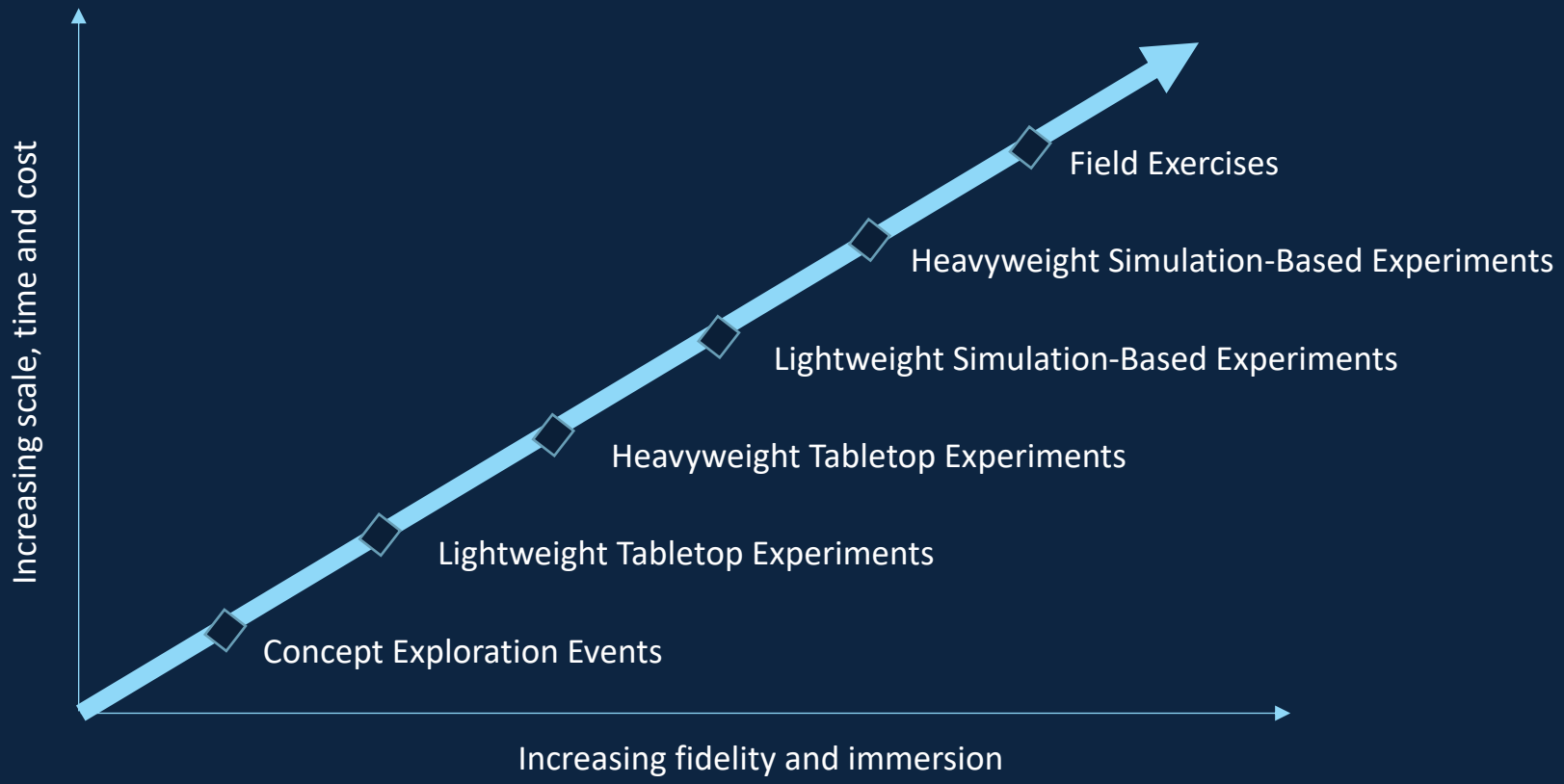
MITRE Framework for Human-in-the-Loop Experimentation



- **Discovery experiments** involve introducing novel systems, concepts, organizational structures, technologies, or other elements to a setting where their use can be observed and catalogued.
- **Hypothesis testing experiments** are the classic type used by scholars to advance knowledge by seeking to falsify specific hypotheses (specifically if…then statements) or discover their limiting conditions.
- **Demonstration experiments** in which known truth is recreated, are analogous to the experiments conducted in a high school, where students follow instructions that help them prove to themselves that the laws of chemistry and physics operate as the underlying theories predict.

We base our framework on the work of Alberts and Hayes who describe a spectrum of experimentation and varying experimental objectives.

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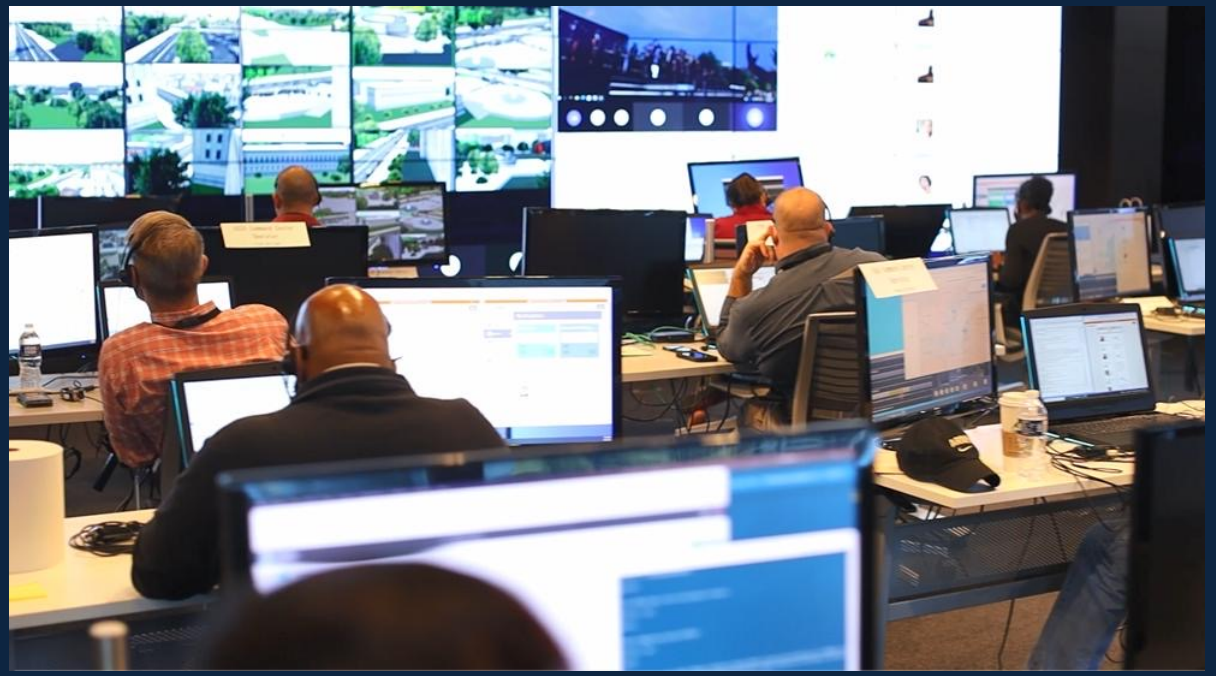
SIMEX Immersive Experimentation Environment Configuration #1: SEAL Operations Center



SIMULATED ENVIRONMENT

REAL AND SURROGATE MISSION SYSTEMS

REAL OPERATORS

- Multiple levels of classification
- Centralized or distributed
- Few-to-tens of operators
- Few-to-tens of design points
- Fixed or variable threat behaviors
- Discovery, hypothesis testing, demonstration, mission rehearsal
- Area to regional scale simulated environment (10 – 10^4 simulated entities)

Foster interoperability. Evolve concept of operations (CONOPS) and tactics, techniques and procedures (TTPs)

- How will the addition of a new technology/platform/system impact operations?
- How will new roles/missions/stakeholders be coordinated?
- How do our processes hold up under increased pace of scale and threat?

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SIMEX Immersive Experimentation Environment Configuration #2: Virtual Reality Environments

- Apply evolving VR technology (Oculus/Meta, HP, HTC)
- Nearfield immersion
- Bio sensing
- Complement SEAL command center capabilities

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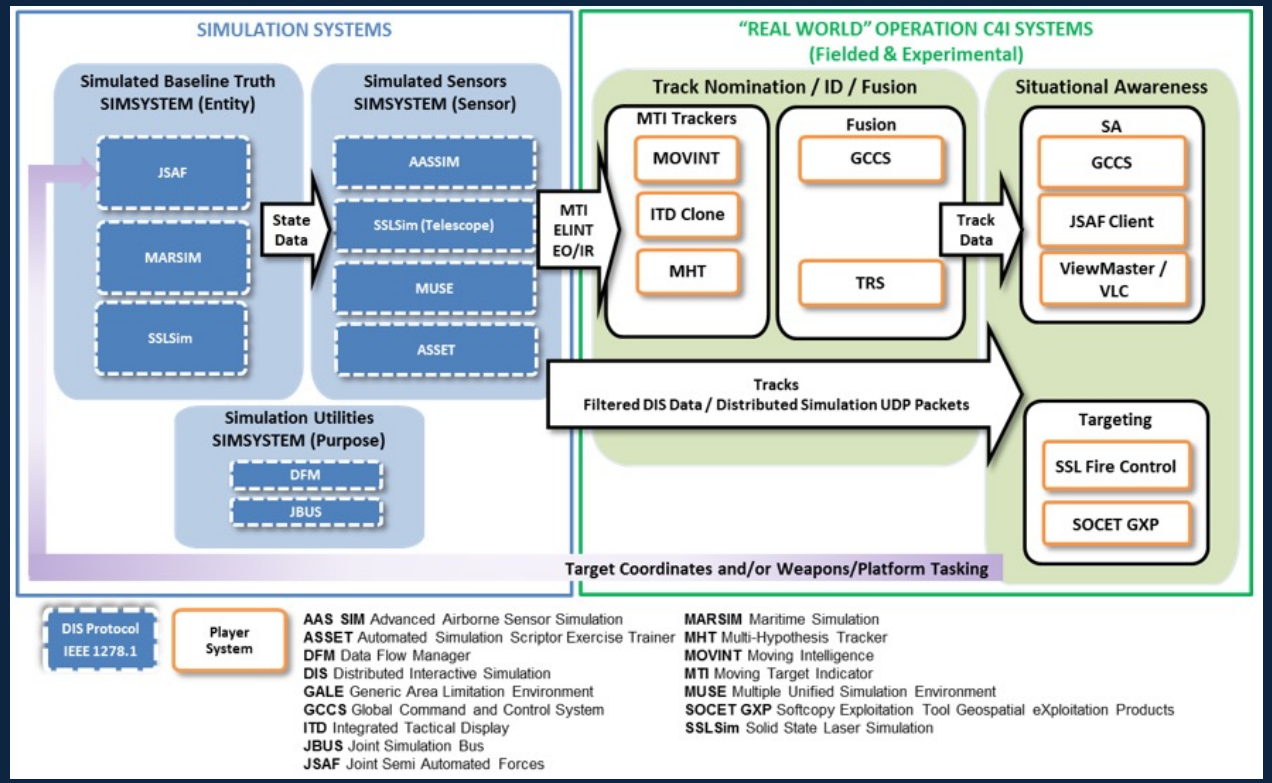
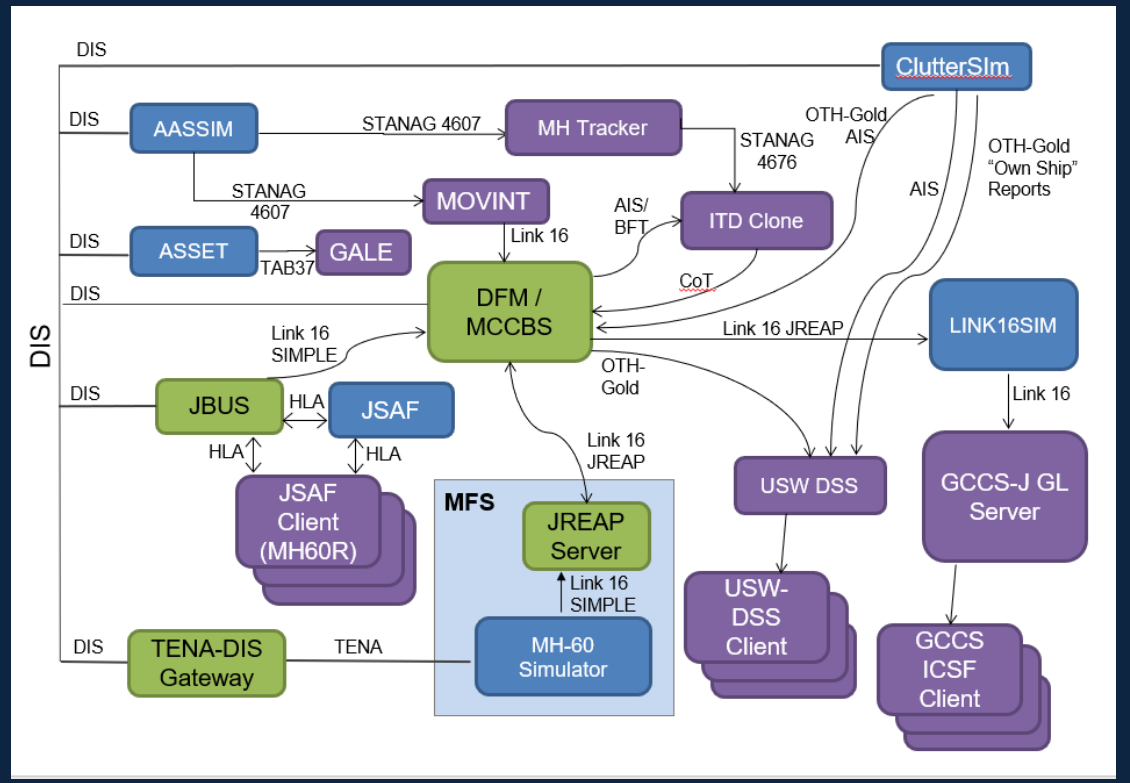
Simulations, C4I Systems, and Tools are Integrated using Multiple Interoperability Mechanisms



Sample architecture from an SSL SIMEX



Sample Data Flow Diagram from a USW SIMEX

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Distributed Experimentation Support

COCOMs

Industry Labs

SDREN

JMETC/JSN

SECRET

DREN

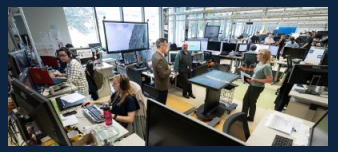
UNCLASSIFIED

Govt Labs

SEAL/NSEL

SMII

SECRET



MITRE Labs

NSEL and SEAL provide support for distributed experimentation at unclassified and Secret. Infrastructure and support for experimentation at TS and SCI are under development for 2024-2026.

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SIMEX Process

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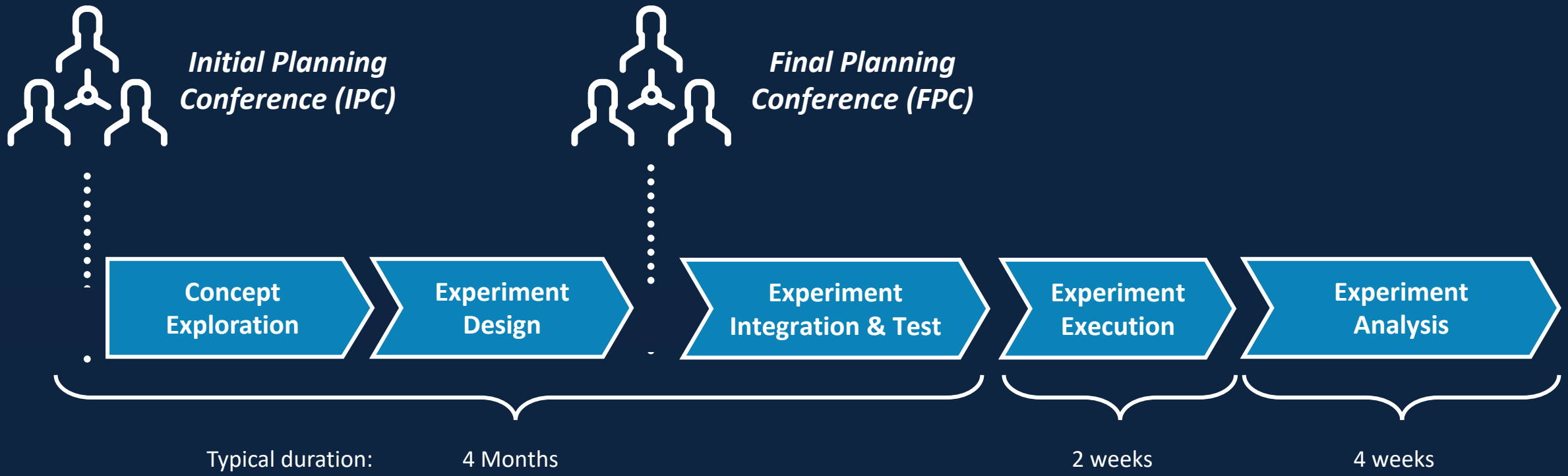
SIMEX Systems Engineering Framework

Through two decades of experience, we have developed an effective and reliable systems engineering methodology tailorable to the needs of the sponsor.



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SIMEX Sponsor Responsibilities

Active sponsor and stakeholder engagement throughout the process is key to a successful SIMEX

Participate in Planning Conferences

Provide C3/sensor/weapon technical parameters as able

Guide Scenario Development

Evolve CONOPS and TTP

Review Proposed C4ISR Environment

Provide Operators for the SIMEX (Red and Blue Cells)

Review Post-SIMEX Briefing/Report

Tailor results to influence CONOPS/TTP and Acquisition

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SIMEX Infrastructure

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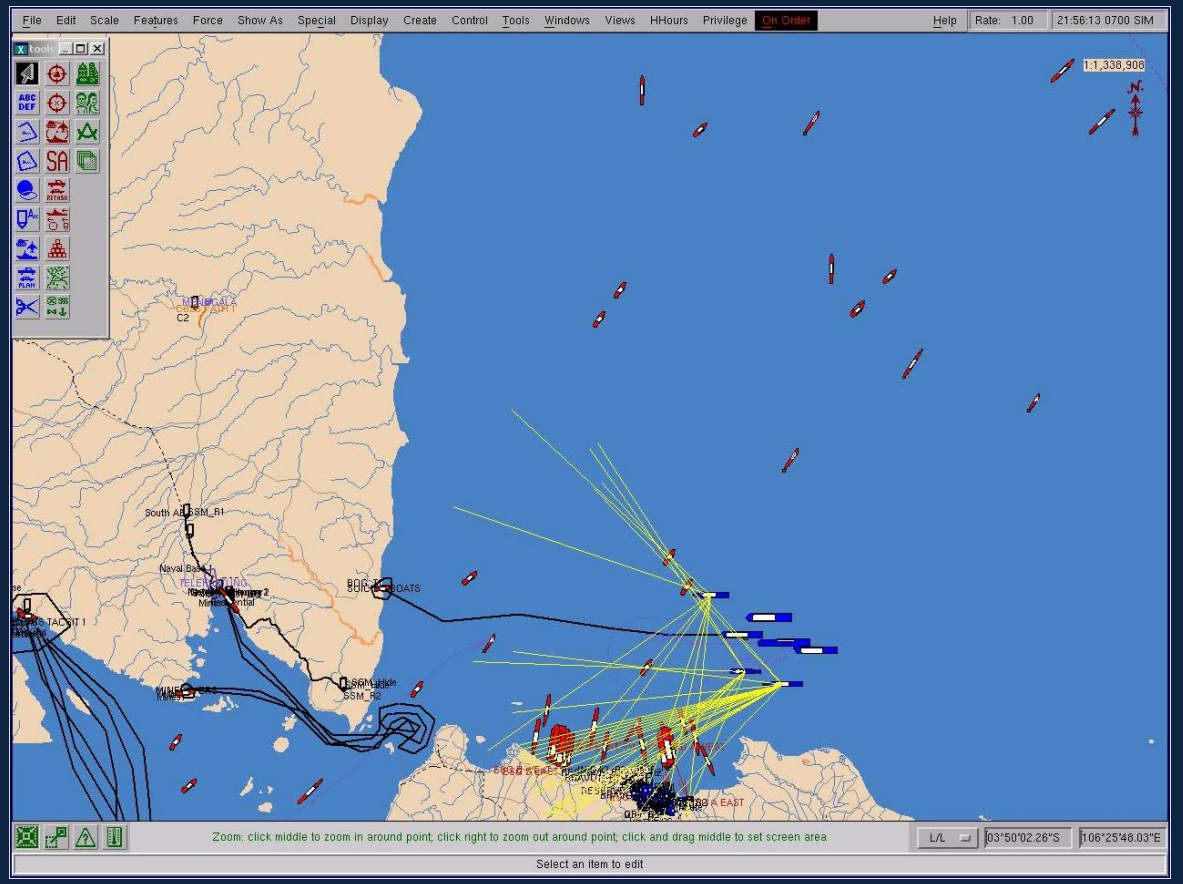
Simulation Example: Joint Semi-Automated Forces (JSAF)

- Entity-level simulation
  - Realistic synthetic environment for simulation execution
  - Simulated entities
    - Platform: Air, Ground, Surface, Sub-surface
    - Life Form: IC, Civilians
    - Weapons & Munitions
- Synthetic environment representing real world terrain
  - Synthetic forces interact with terrain
- Scenario: Simulation of Behavior
  - Detailed entity-level tasking
  - Automated reaction to critical events
    - Detonations, Detections, Fires
  - Unattended
    - Scenarios pre-planned
  - Operator-in-the-loop
    - Dynamic scenario changes



* JSAF provided and Supported by: Naval Warfare Development Command (NWDC)

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Simulation Example: UNITY3D Simulations

SIMEX employs Unity3D, a performance-oriented COTS software development environment with an emphasis on visualization and first-person human interaction.

- Capable of simulating land, sea, and air platforms to varying levels of fidelity
- Capability to integrate real-world terrain data from various sources.
- Support for the latest graphics processors, display, and input technologies
- Support for the Oculus Rift Virtual Reality headset
- Growing base of available COTS, GOTS, and Free 3D Models, Behaviors, and Code aids in modular design and rapid development
- Network Capability
- Direct support of various programming languages
- Cross platform support including desktop, mobile, and web-based clients

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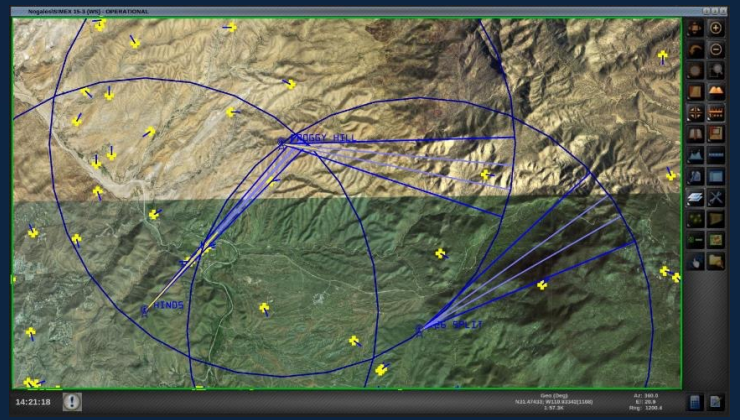
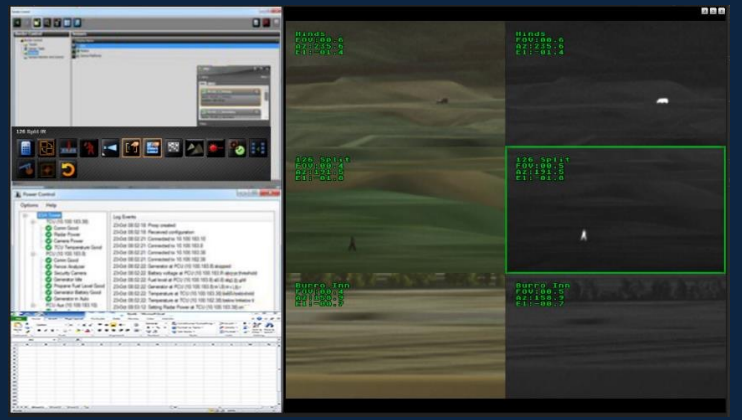
Operator Systems: UNITY Emulation

- Represents the three monitors of an actual sensor system
- Operators can control multiple sensors
  - Pan/Zoom
  - Slew to a track or location
  - Investigate and classify Items of Interest
- Up to 10 simultaneous video feeds
- Uses real-world parameters for lifelike control and visual representation





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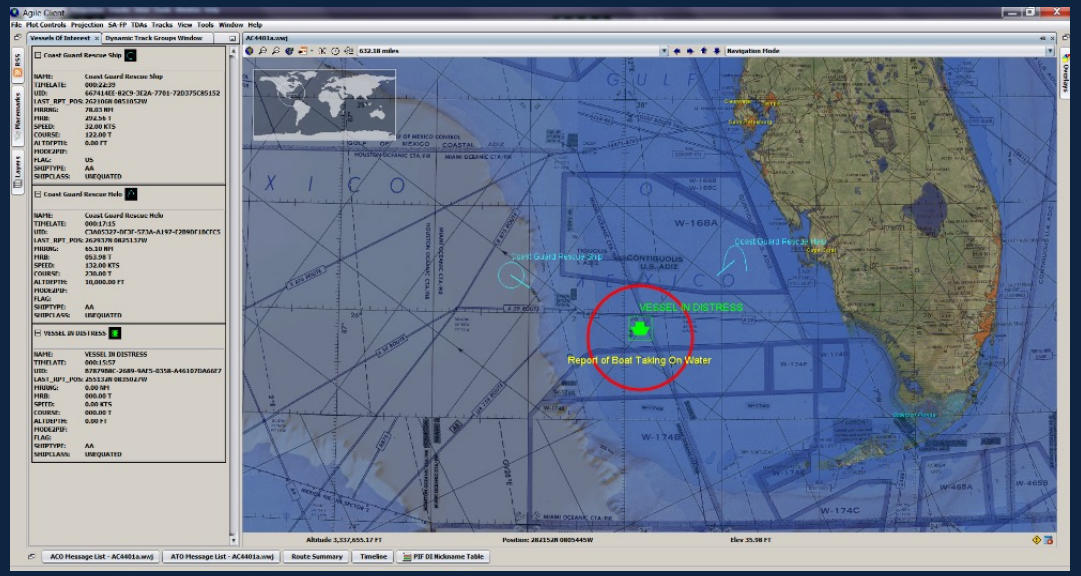
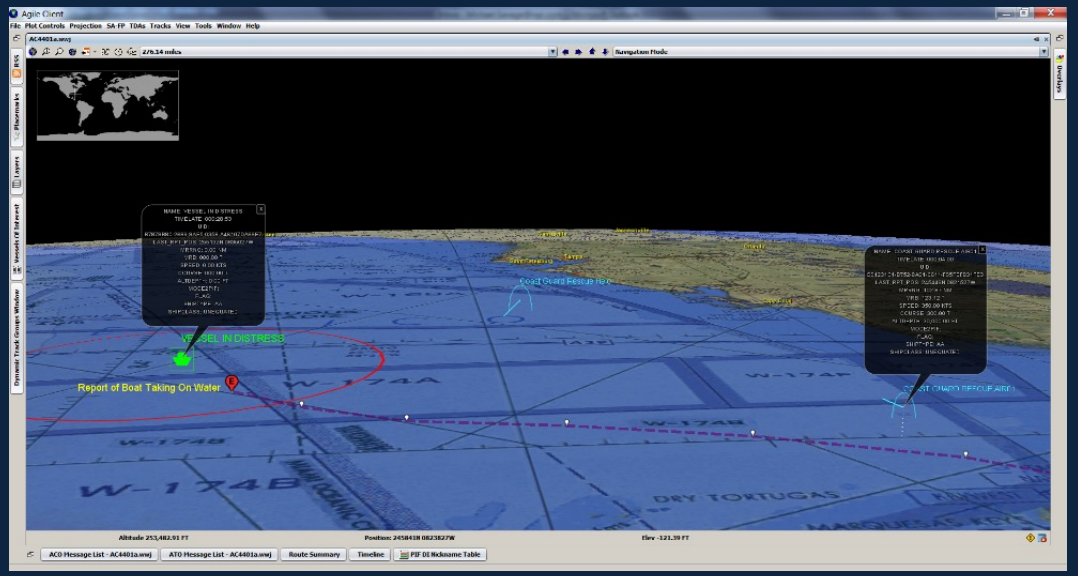
Operator Systems: Global Command and Control System (GCCS)

- GCCS-J Global 6
  - Suite of critical war fighting capabilities to present an integrated, near real-time picture of the battlespace
  - Track Management System (TMS) server in NSEL is master track database providing COP data to GCCS clients
  - COP Sync service provides tracks to external GCCS services
- Agile Client
  - PC/Windows client to GCCS
  - 3D rendering of C2 tactical graphics
    - NASA World Wind
  - Track management functions





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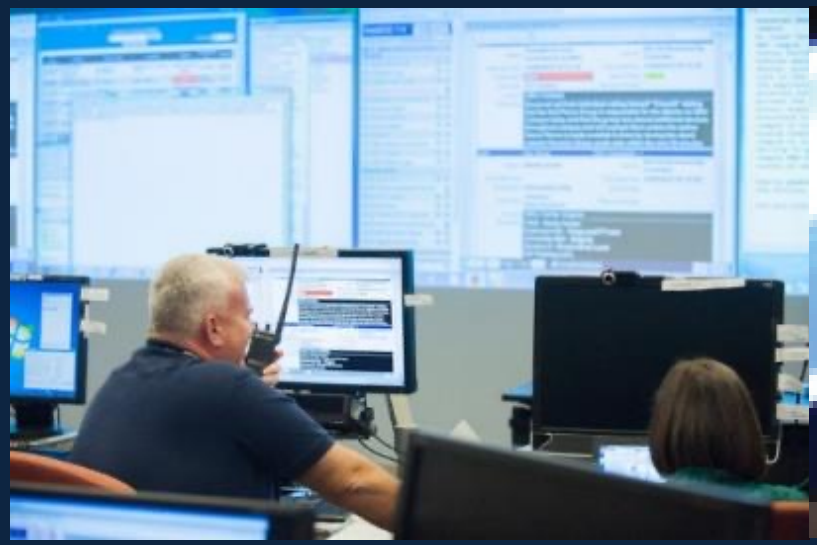
MITRE Experimentation: A Differentiating Capability

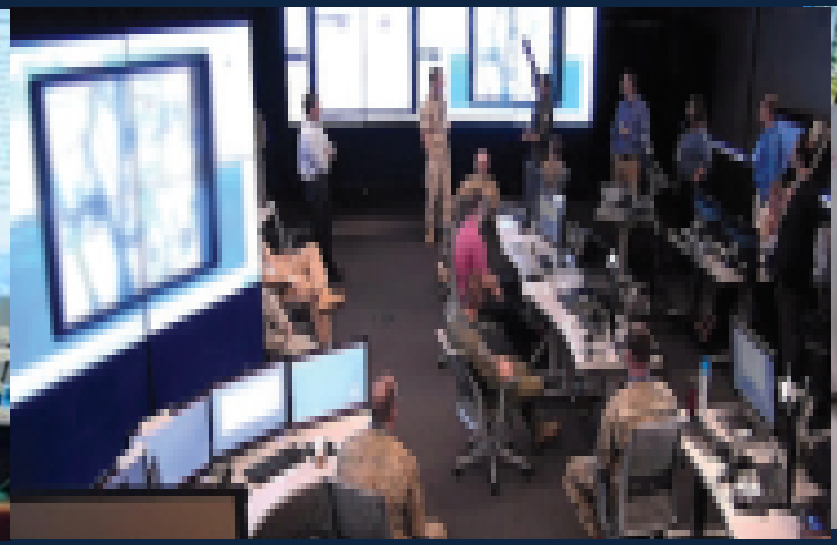
An even playing field to industry and Government for distributed experimentation

State-of-the-art venues for tabletop exercises, wargames and command center experimentation

Capabilities for emulating current and future C4I, Sensor and Weapon systems in realistic scenarios

A cost-effective mechanism for risk reduction events leading up to live demonstrations and exercises





For questions about MITRE experimentation, contact experimentation@mitre.org

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BACKUP MATERIAL

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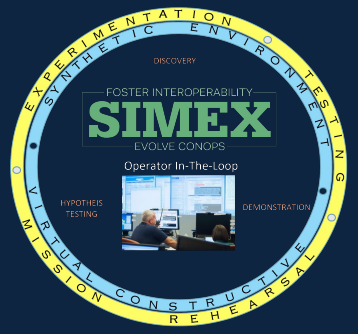

MITRE SIMEX

Key Characteristics

- Virtual/Constructive environment
- Multiple levels of classification
- Centralized or distributed
- Few-to-tens of operators
- Few-to-tens of design points
- Fixed or variable threat behaviors
- Discovery, hypothesis testing, demonstration, mission rehearsal
- Area to regional scale simulated environment (10 – 10^4 simulated entities)

Topics

- UAS/c-UAS
- Autonomy/swarming
- JADC2
- NSW/SSGN Ops
- Time Critical Targeting
- ISR Mgt
- Navy Laser
- Maritime Domain Awareness
- Contested Logistics
- Irregular Warfare
- Census Ops
- Border Security
- School Safety
- Tax Fraud

Core Sims

- JSAF
- AFSIM
- OneSAF
- ClutterSim

Mission Systems Emulations

- MEDUSA
- MINOTAUR
- FAAD-C2
- L-MADIS
- ATAK
- THAAD
- MAFIA
- ADSI
- GCCS
- In consideration
  - C2BMC
  - BC3
  - IBCS
  - AEGIS
  - Patriot

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