AT THE HEART OF THE MISSION

NDIA

1919 2019

UPDATED 3.19.19

2019 CYBER-AUGMENTED OPERATIONS TECHNICAL SYMPOSIUM

Operationalizing the Technical Advantage

March 26 – 27 | Austin, TX | NDIA.org/CAOSpring

AGENDA

TUESDAY, MARCH 26

7:00 am – 4:45 pm

REGISTRATION
ZLOTNIK BALLROOM PREFUNCTION

7:00 – 8:00 am

NETWORKING CONTINENTAL BREAKFAST
ZLOTNIK BALLROOM PREFUNCTION

8:00 – 8:15 am

WELCOME REMARKS
ZLOTNIK BALLROOM 4

Lt Gen Robert Elder, USAF (Ret)
Chair, NDIA Cyber-Augmented Operations Division

8:15 – 9:00 am

KEYNOTE SPEAKER
ZLOTNIK BALLROOM 4

COL Stoney Trent, USA
Chief of Operations, Joint Artificial Intelligence Center (JAIC)

9:00 – 10:00 am

DATA ANALYTICS & ALGORITHMS PANEL
ZLOTNIK BALLROOM 4

Brig Gen J.O. McFalls III, USAF (Ret)
Senior Consultant, U.S. Cyber Command (J9)
Moderator

COL Benjamin Ring, USA
Chief, J9 Applied Research & Development Division, U.S. Cyber Command (USCYBERCOM)

Dr. Katie Liszewski
Data Scientist, Battelle Memorial Institute

Keith Riser
Team Lead, Identity Intelligence Team, C5ISR Center, Information & Intelligence Warfare Directorate, U.S. Army Combat Capabilities Development Center (DEVCOM)

10:00 – 10:30 am

NETWORKING BREAK
ZLOTNIK BALLROOM PREFUNCTION

10:30 – 11:30 am

ARTIFICIAL INTELLIGENCE PANEL

ZLOTNIK BALLROOM 4

COL Stoney Trent, USA
Chief of Operations, Joint Artificial Intelligence Center (JAIC)
Moderator

Dr. Elisha Peterson
Chief Scientist, Analytic Capabilities Group, Johns Hopkins University Applied Physics Laboratory (JHU-APL)

Syeed Mansur
President and CEO, SENTRANA

COL Benjamin Ring, USA
Chief, J9 Applied Research & Development Division, U.S. Cyber Command (USCYBERCOM)

Mark Ashford
Data Manager Support, Air Force Agency for Modeling and Simulation, Huntington Ingalls Industries

11:30 am – 12:30 pm

DECISION SUPPORT SYSTEMS PANEL

ZLOTNIK BALLROOM 4

Jeff Moulton
President and CEO, Stephenson Technologies Corporations (STC)
Moderator

Bryan Bartels
Chief, Future Ops, Joint Air Component Coordination Element for U.S. Air Force Global Strike Command (AFGSC) in coordination with USSTRATCOM

Chris MacDonald
Senior Director, Global Analytics Business Development

Derrick Franceschini
Senior Scientist, Cole Engineering Services, Inc.

Nathan Dawn
Weapon Systems Team Program Analyst, A5/8, Department of the Air Force

12:30 – 1:30 pm

LUNCH & NETWORK PROTECTION PANEL

ZLOTNIK BALLROOMS 4, 5 & 6

Dr. Greg Wettstein
Principal Engineer, IDfusion
Moderator

John Grosen
Chief Information Officer, IDfusion

James Cole
Director of Architecture & Engineering, Intel Corporation

Albert Taglieri
Cadet, U.S. Air Force Academy

Victor Lee
Cadet, U.S. Air Force Academy

1:30 – 2:15 pm

KEYNOTE SPEAKER

ZLOTNIK BALLROOM 4

Robert Butler
Senior Vice President, Critical Infrastructure Protection Operations, AECOM Management Services

2:15 – 3:15 pm

VIRTUAL TRAINING SYSTEMS PANEL

ZLOTNIK BALLROOM 4

Keenan Skelly
Vice President, Global Partnerships & Security Evangelist, Circadence
Moderator

Dr. John Surdu
Senior Scientist, Cole Engineering Services, Inc.

Dr. Omar Hasan
Chief Architect, Dignitas Technologies

Maj Gen Howard Baker, USAF (Ret)
Vice President, Worldwide Federal Aerospace and Defense, PTC

Ambrose Kam
Chief Engineer/Fellow, Rotary & Mission Systems Cyber Innovation, Lockheed Martin Corporation

Lt Col Warren Carroll, USAFR
Operations, Plans and Requirements Lead, U.S. Air Force Global Strike Command (AFGSC)

3:15 – 3:45 pm

NETWORKING BREAK

ZLOTNIK BALLROOM PREFUNCTION

3:45 – 4:45 pm

AGILE SPECTRUM APPLICATIONS PANEL

ZLOTNIK BALLROOM 4

Lizy Paul
Director, Strategy & Business Development, Data Links & Communication Systems, Collins Aerospace
Moderator

Dorie Famalette
Deputy for Product Manager Waveforms, PEO C3T, U.S. Army

John Wentworth
Lead Engineer for Product Manager Waveforms, PEO C3T, U.S. Army

William Cave
President and CEO, Prediction Systems, Inc.

Dr. Nancy Grady
Chief Data Scientist, Cyber Operations, SAIC

Dr. Doug Thornton
Cyber Scientist, Battelle

5:00 – 6:00 pm

NETWORKING RECEPTION

ZLOTNIK BALLROOM PREFUNCTION

WEDNESDAY, MARCH 27

7:00 am – 3:45 pm

REGISTRATION
ZLOTNIK BALLROOM PREFUNCTION

7:00 – 8:00 am

NETWORKING CONTINENTAL BREAKFAST
ZLOTNIK BALLROOM PREFUNCTION

8:00 – 8:15 am

ADMIN REMARKS
ZLOTNIK BALLROOM 4

Lt Gen Robert Elder, USAF (Ret)
Chair, NDIA Cyber-Augmented Operations Division

8:15 – 9:00 am

KEYNOTE SPEAKER
ZLOTNIK BALLROOM 4

Steve Gray
Chief Executive Officer, Asteri Networks

9:00 – 10:00 am

AUGMENTED REALITY PANEL
ZLOTNIK BALLROOM 4

Jason Ingalls
Founder and CEO, Ingalls Information Security
Moderator

Seana Murray
Program Manager, Microsoft Corporation

John Parsons
Augmented Reality Sales Representative, Federal Aerospace and Defense

Joshua Burns
Simulations Engineer & Augmented Reality SME, Honeywell

Brandi Pickett
Risk Management Consultant, Ingalls Information Security

10:00 – 10:30 am

NETWORKING BREAK
ZLOTNIK BALLROOM PREFUNCTION

10:30 – 11:30 am

PHYSICAL SYSTEM REPLICATION/DIGITAL TWIN PANEL

ZLOTNIK BALLROOM 4

Lt Gen Robert Elder, USAF (Ret)
Chair, NDIA Cyber-Augmented Operations Division
Moderator

William Cave
President and CEO, Prediction Systems, Inc.

Parker Wiksell
Cyber Scientist, Battelle

Dr. John Kelly
President, Model Software Corporation

11:30 am –12:30 pm

NETWORKING LUNCH

ZLOTNIK BALLROOMS 5 & 6

12:30 – 1:15 pm

KEYNOTE SPEAKER

ZLOTNIK BALLROOM 4

COL Paul Craft, USA
Director of Operations, Joint Forces Headquarters, Department of Defense Information Networks (JFHQ-DODIN)
Invited

1:15 – 2:15 pm

MACHINE LEARNING APPLICATIONS PANEL

ZLOTNIK BALLROOM 4

Maj Gen David Senty, USAF (Ret)
Vice Chair, NDIA Cyber-Augmented Operations Division
Moderator

Chris MacDonald
Senior Director, Global Analytics Business Development

Ambrose Kam
Chief Engineer/Fellow, Rotary & Mission Systems Cyber Innovation, Lockheed Martin Corporation

Eddie Green
Director,Special Projects/Intelligence, OccamSec

2:15 – 2:45 pm

NETWORKING BREAK

ZLOTNIK BALLROOM PREFUNCTION

2:45 – 3:45 pm

AFWERX INITIATIVES & UPDATES PANEL

ZLOTNIK BALLROOM 4

Col Alan Rock, USAF
Reserve Advisor to the Commander, U.S. Air Force Global Strike Command (AFGSC)
Moderator

Col Craig Leavitt, USAF (Ret)
Strategist, National Security Air and Space Programs, National Defense University (NDU)
Invited

Matthew Scott
Austin Director, AFWERX

Jeff Gilmore
Data Scientist, Defense Innovation Unit (DIU)

Lt Col Eric Frahm, USAF
Austin Lead, Chief Product Officer, Air Education and Training Command (AETC)

3:45 – 4:00 pm

CLOSING REMARKS

ZLOTNIK BALLROOM 4

Lt Gen Robert Elder, USAF (Ret)
Chair, NDIA Cyber-Augmented Operations Division

The NDIA has a policy of strict compliance with federal and state antitrust laws. The antitrust laws prohibit competitors from engaging in actions that could result in an unreasonable restraint of trade. Consequently, NDIA members must avoid discussing certain topics when they are together at formal association membership, board, committee, and other meetings and in informal contacts with other industry members: prices, fees, rates, profit margins, or other terms or conditions of sale (including allowances, credit terms, and warranties); allocation of markets or customers or division of territories; or refusals to deal with or boycotts of suppliers, customers or other third parties, or topics that may lead participants not to deal with a particular supplier, customer or third party.

JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

Cyber AI

Cyber-Augmented Operations Technical Symposium

March 2019

Elisha Peterson
elisha.peterson@jhuapl.edu
Chief Scientist & Lead for Cyber AI, Analytic Capabilities Group
Johns Hopkins University Applied Physics Laboratory

Summary

- How do we leverage AI/ML (and visualization) to make operators more effective

Effective Analytics

Ask the Right Questions

↓

Use the Right Data

↓

Apply the Right Tools/Techniques

↓

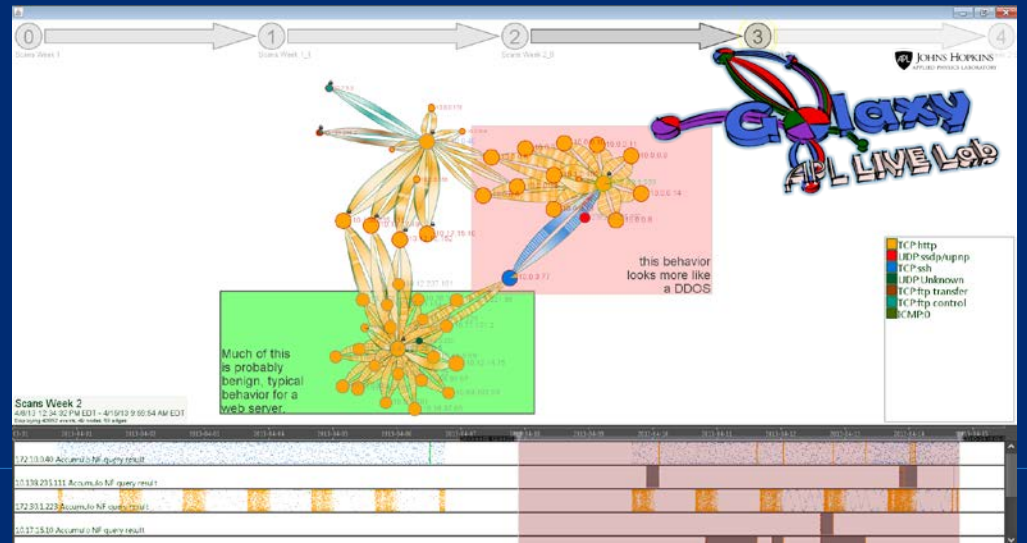
Apply Answers to the Right Situation

↓

Ensure Value to Operators

Ask the Right Questions

- Visualize data to better understand context, find new anomalies
- Train data scientists in cyber, e.g. by embedding with operators/exercises/etc.
- Be more specific
  - *Not “what netflow is malicious” but “when do these clients open an unusual port?”*
- Be more comprehensive
  - *Not “do any bad hosts talk to my web server?” but “what are the set of all allowed/expected flows for this web server?”*

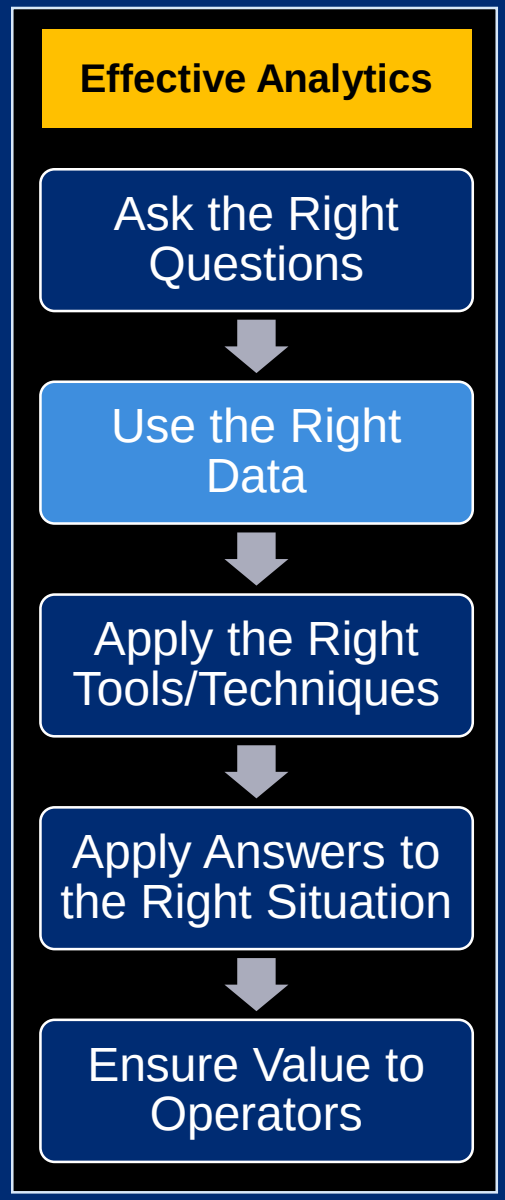


Effective Analytics

1. Ask the Right Questions
2. Use the Right Data
3. Apply the Right Tools/Techniques
4. Apply Answers to the Right Situation
5. Ensure Value to Operators

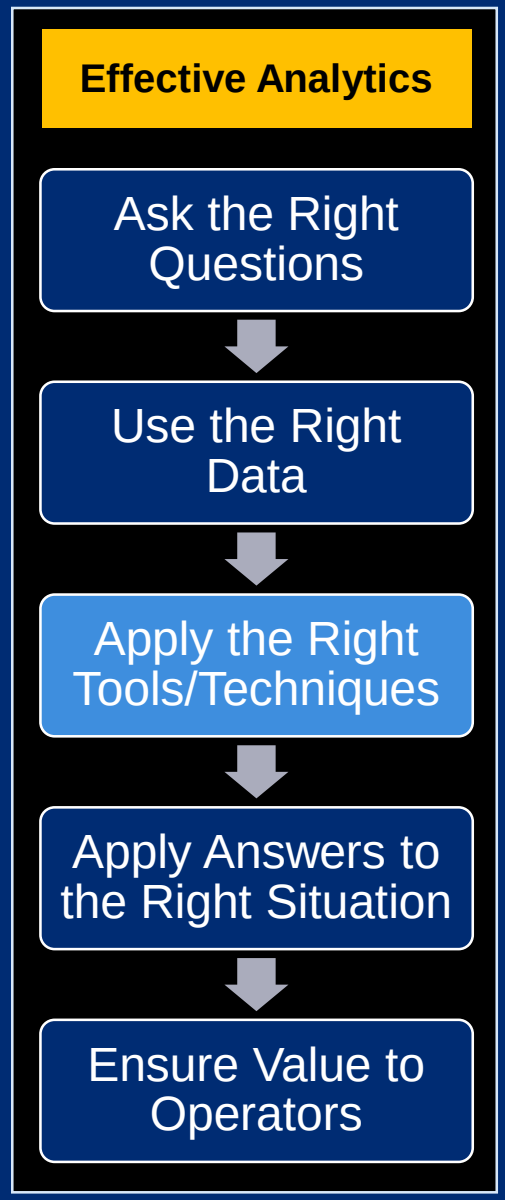
Use the Right Data

- Need good labeled data
  - 1999 DARPA Intrusion dataset – flawed, out of date, dozens of papers
- Need more than just netflow
  - Collect from multiple locations for cross-site correlation
  - Collect from multiple types for corroboration/ground truth
- Repeatable experimentation platforms?



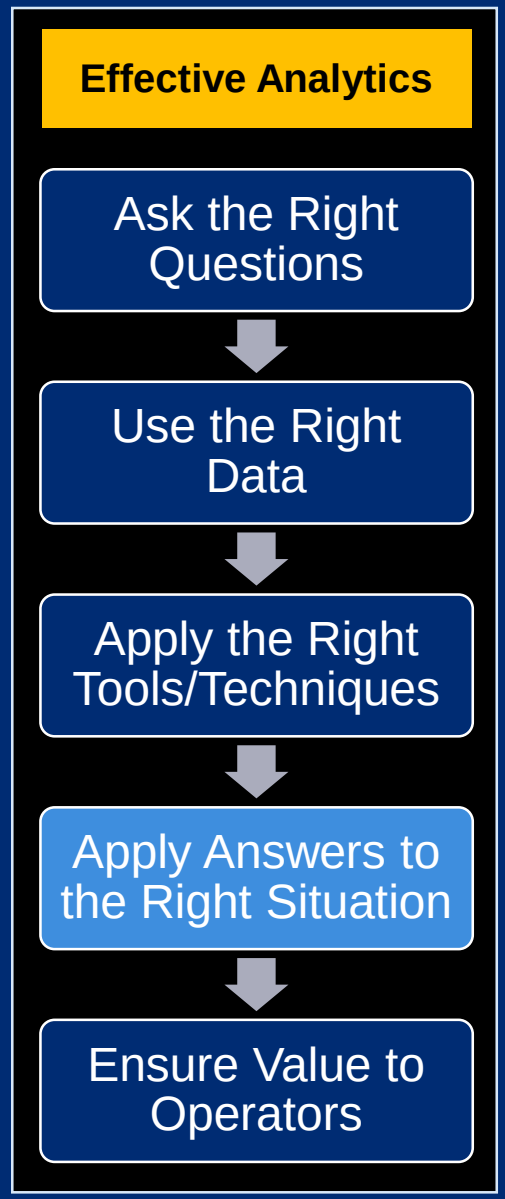
Apply the Right Tools/Techniques

- What is the simplest technique that will work?
- Techniques that work well in one domain may not work well with cyber
  - Deep learning is not “one size fits all”
- Feature Engineering / Domain Understanding
  - Add statistics for packet sizes/times within a flow
  - Model connections between (ip+proto+port) rather than ip’s
- Incorporate modeling, e.g. attack graphs



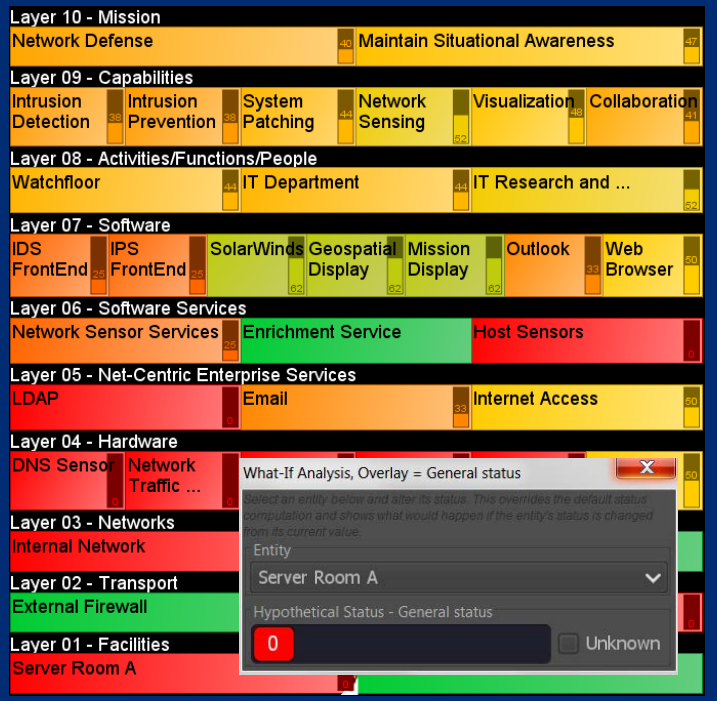
Apply Answers to the Right Situation

- Context matters: enterprise networks, research networks, university networks, ICS/SCADA networks, other constrained networks
- Need more research on transferability of models



Ensure Value to Operators (Users)

- Who is the user?
  - *analyst? defensive/offensive ops? decision-maker? developer? data scientist?*
- Analysts
  - Need low false positives
  - Need context, especially with alerts
- Decision-makers
  - Tools like Dagger can help decision-makers understand impact and prioritize resources
- Data scientists
  - AI to make analytic development faster?



Effective Analytics

Ask the Right Questions

↓

Use the Right Data

↓

Apply the Right Tools/Techniques

↓

Apply Answers to the Right Situation

↓

Ensure Value to Operators

Application Areas Where AI Is Likely to Help

- **Anomaly Detection**
- **Cyber Key Terrain Mapping**
- **Automated Data Science**
- **Planning & Executing Cyber Ops**

- **Currently helping** – malware analysis, spam detection, DNS queries, …

Challenge #1: Establish Cyber CTF

- Common Task Framework
  - Requires **public** data sets, automated evaluation/metrics, and a competition
  - Establishes feedback loop for constantly improving models and techniques
  - Always leads to declining error rates
- What would a CTF for cyber look like?
  - Define classes based on both host roles (web, DNS, enterprise client, etc.) and traffic (web, scanning, video, data exfiltration, etc.)
  - Models must grapple with cyber semantics to be successful
  - Goal becomes “out of all this traffic, what is understood and what is not understood”

Challenge #2: Automated Network Characterization

- From an observed set of data, define the rules that govern that data
  - Subnets, firewalls, servers, applications, etc.
- Difficulty varies by network type: constrained, enterprise, research
- Immediate value for alerting on constrained networks
- Immediate value for CPTs understanding an unfamiliar environment

**also known as "key cyber terrain mapping"*

JOHNS HOPKINS

APPLIED PHYSICS LABORATORY

Application Areas Where AI Is Likely to Help

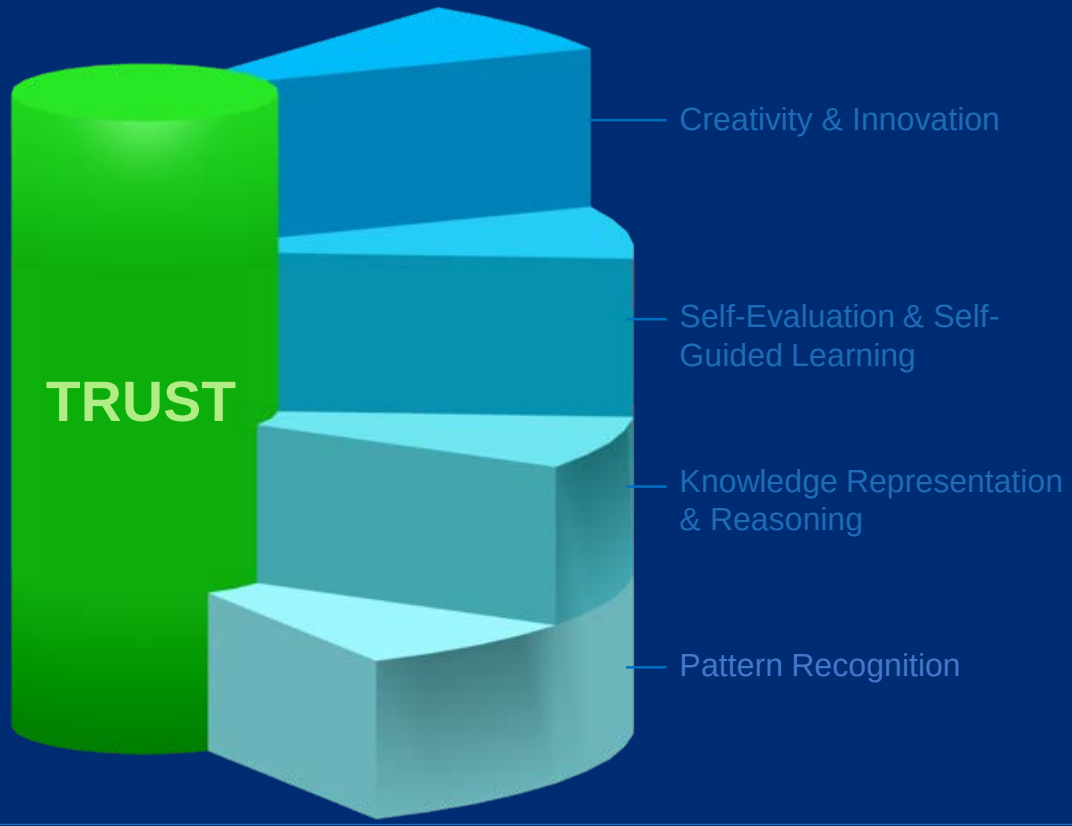
- **Anomaly Detection** – finding unknowns, combinations of techniques, zero days
  - Likely adds less value for known attacks when strong signatures are available
- **Analytic Assistance** – automated enrichment, query expansion, information aggregation, correlation
- **Cyber Key Terrain Mapping** – automated network discovery, mapping to mission
- **Automated Data Science** – developing, testing, deploying, maintaining ML and other analytics models in production; enabling end-users to harness the power of ML
- **Planning & Executing Cyber Ops** – human/machine teaming for planning, analysis, COA selection, rapid employment of defenses and effects in cyberspace

- **Currently helping** – malware analysis, spam detection, DNS queries, …

Intelligent Sensing Vision

Autonomously understand the world as a trusted partner to the symbiosis of humans and other AIs

Perceive • Decide • Act • Team



Reasoning

Ability to deal with the unexpected

Headquarters U.S. Air Force

Integrity - Service - Excellence

Operational Training Infrastructure (OTI)

Augmented Intelligence to support OTI Ecosystem

U.S. AIR FORCE

SAF/PA Release: 2019-0189

Must Transform

We can't get there from here!

- **Some challenges/areas to consider:**
  - **Aging workforce; GS civilian leaders need updated competencies for the future**
  - **Obsolescence; Different underlying hardware/software configurations**
  - **Baselines managed individually by platform**
  - **Attrition Workforce – subjective succession planning**
  - **Current fleet of simulators were never designed to work together**

https://research.newamericaneconomy.org/report/sizing-up-the-gap-in-our-supply-of-stem-workers/

"The United States has a persistent and dramatic shortage of STEM workers—a problem that worsened considerably during the first half of the decade."

U.S. AIR FORCE

Augment

- What can be accomplished with Augmented Intelligence?
  - Using Deep Learning Technologies
- Initial focus is on "smart automation" that demonstrates the "art of the possible"
- Data Architecture
  - AF Chief Data Officer symposium
    - Data Lake
      - Kylo
    - AF Chief Data Officer Data Service Strategy
      - Set-up data service
      - Set-up deep learning

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Augment-2

- Initial Use Case : Augment Data Engineering Job function
  - Facilitate Loading the Data from Pilot Training Next Program (PTN)
    - Establish heuristics that facilitate automation
    - Smart Automation
      - Sense
      - Neural Networks (AI Agent)
      - Act
- Potential Use Cases
  - ETL (Extract-Transform-Load) that collect metadata
  - Smoke test to facilitate regression testing of simulation capabilities to ensure Composability and Interoperability

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Conclusion

- Use Augmented Intelligence to address STEM shortage in AF M&S
- Focus on Smart Automation Demo
- Utilize the AF Chief Data Officer data lake architecture
- Follow the AF Chief Data Officer Data Services Strategy

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References

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CAPITALIZING ON DIGITAL TRANSFORMATION

Chris MacDonald
Head of Global Analytics CoE

March 2019

ptc

THE TIME TO TRANSFORM IS NOW

PHYSICAL

DIGITAL

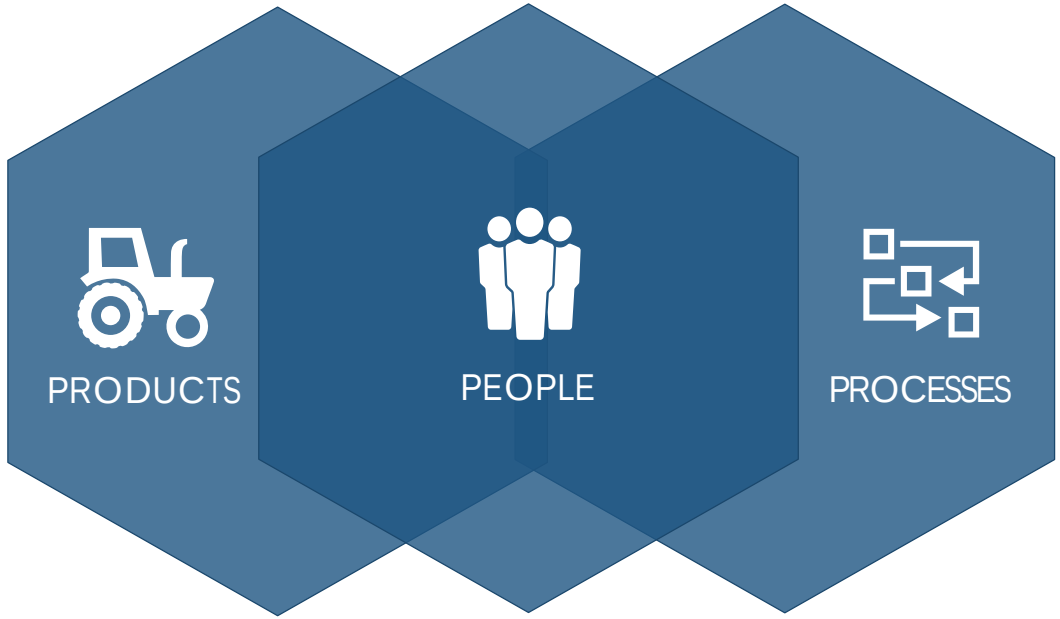
Digital Transformation is the means by which industrial companies capitalize on **PHYSICAL DIGITAL** convergence

CONVERGENCE ACROSS PRODUCTS, PROCESSES, AND PEOPLE

UNIQUE PERSPECTIVE AND RECOGNIZED AUTHORITY

DRIVE BUSINESS OUTCOMES

Smart Connected Products Drive Critical Product and Service Differentiation



Smart Connected Processes Enable Breakthroughs in Operational Effectiveness

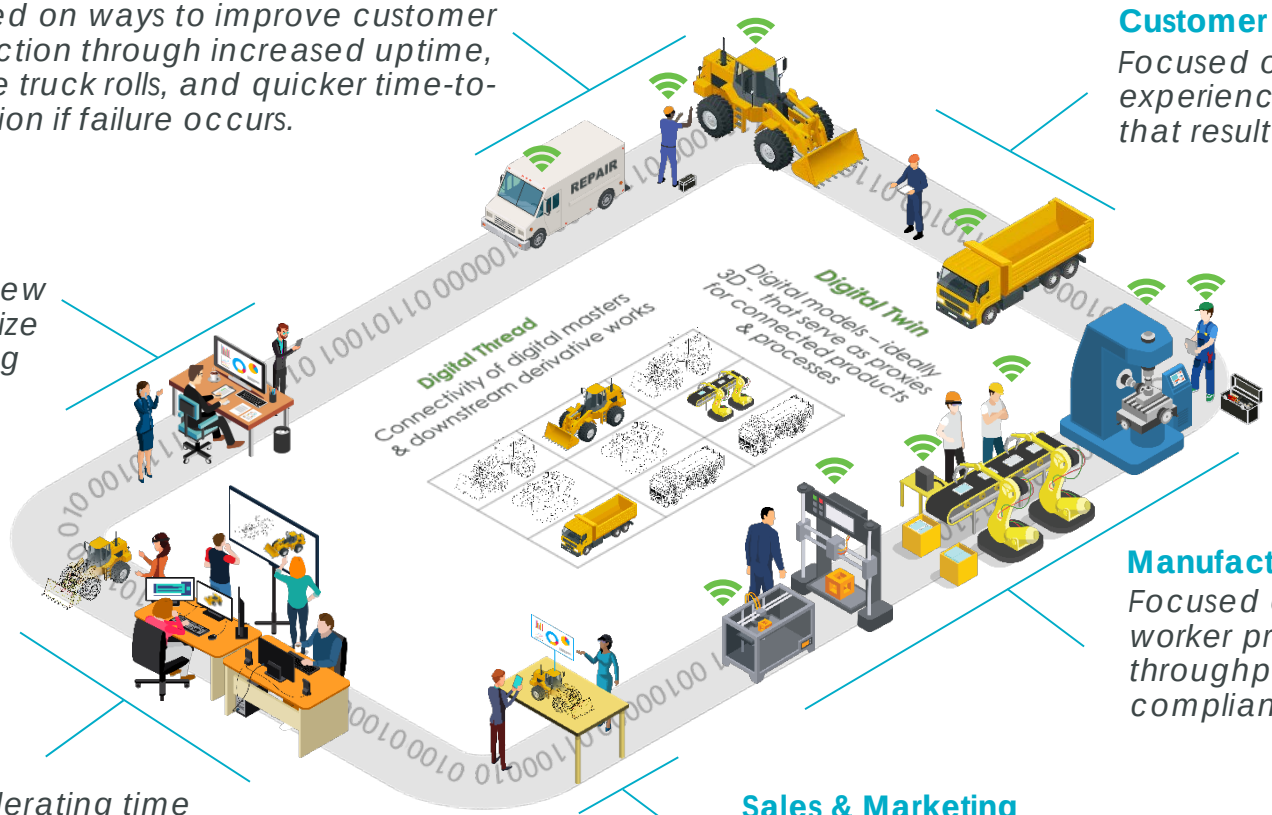
Smart Connected People Makes Workforce Productivity and Quality Soar

UNLEASH OPPORTUNITIES ACROSS THE ENTERPRISE

Customer Service
Focused on ways to improve customer satisfaction through increased uptime, reduce truck rolls, and quicker time-to-resolution if failure occurs.

Customer Operations
Focused on breakthrough digital experiences (like training and self-service) that result in value-added services

Corporate/CXO
Focused on ways to create new business models and modernize the workforce while increasing shareholder value



Manufacturing & Supply Chain
Focused on optimized plant and worker productivity which increases throughput, production quality, compliance and worker safety.

Engineering
Focused on accelerating time to market with optimized designs, real-time simulation and virtual collaboration which will close the loop from design to production

Sales & Marketing
Focused on giving "Voice of the Product" for customer usage and consumable replenishment while providing engaging demo experiences with 3D holograms.

PRODUCTS | PEOPLE | PROCESSES

VIA MARKET-PROVEN INDUSTRIAL SOLUTIONS

Service Optimization
Improve customer success, reduce service, and deliver new value via product performance and world class service

Product & Service Innovation
Develop new products, services, and business models that enable differentiation and new revenue opportunities

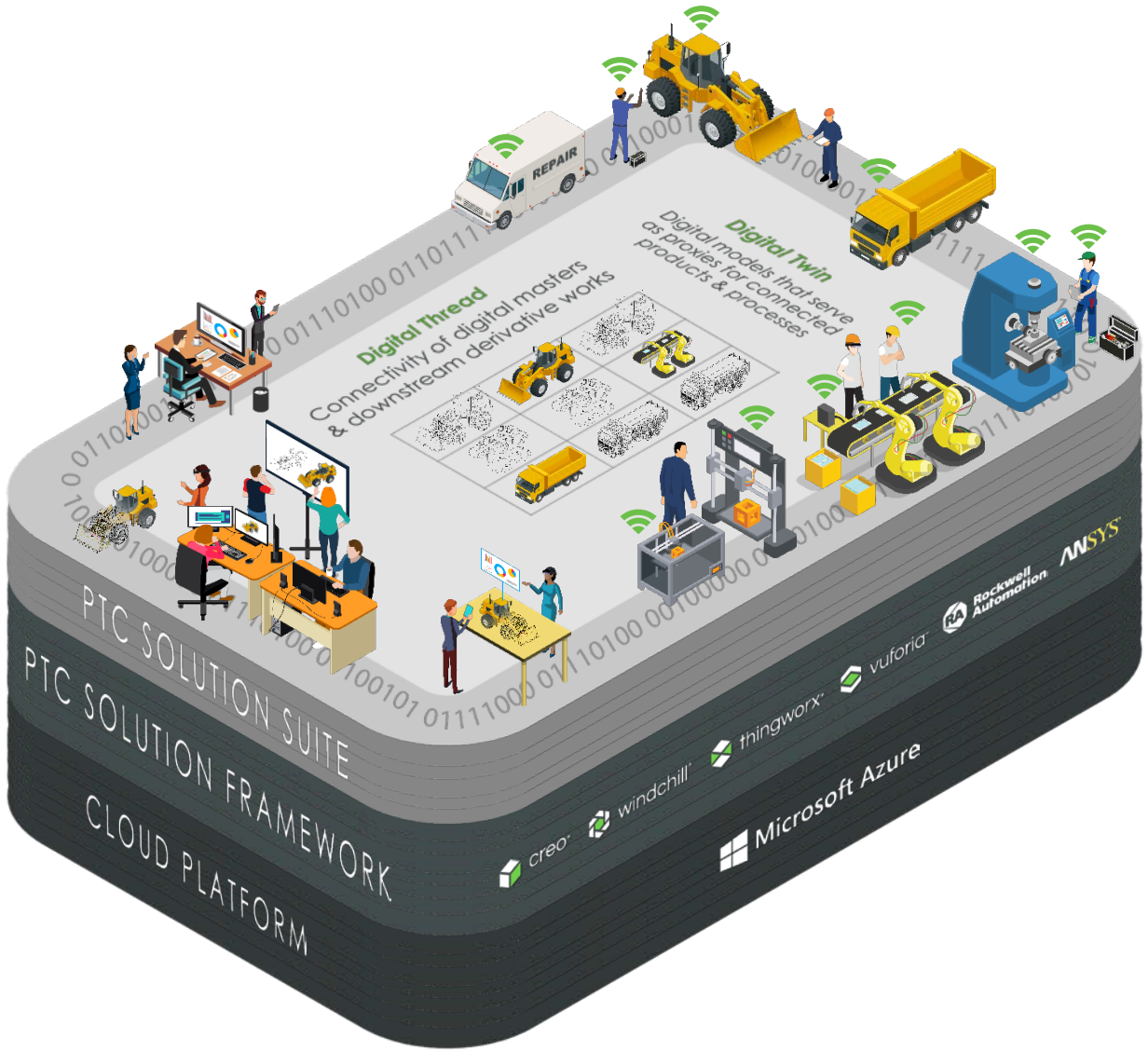
Manufacturing Efficiency
Improve operational efficiency, reduce manufacturing costs, accelerate time to market, and ensure quality & compliance

Engineering Excellence
Seamless data and model centric workflow that enables data driven decisions throughout the design and manufacturing process

Sales & Marketing Experiences
Virtual product demonstrations, product companions, “voice of the product” feedback, and augmented experiences

PRODUCTS | PEOPLE | PROCESSES

DIGITAL TRANSFORMATION SOLUTION SUITE

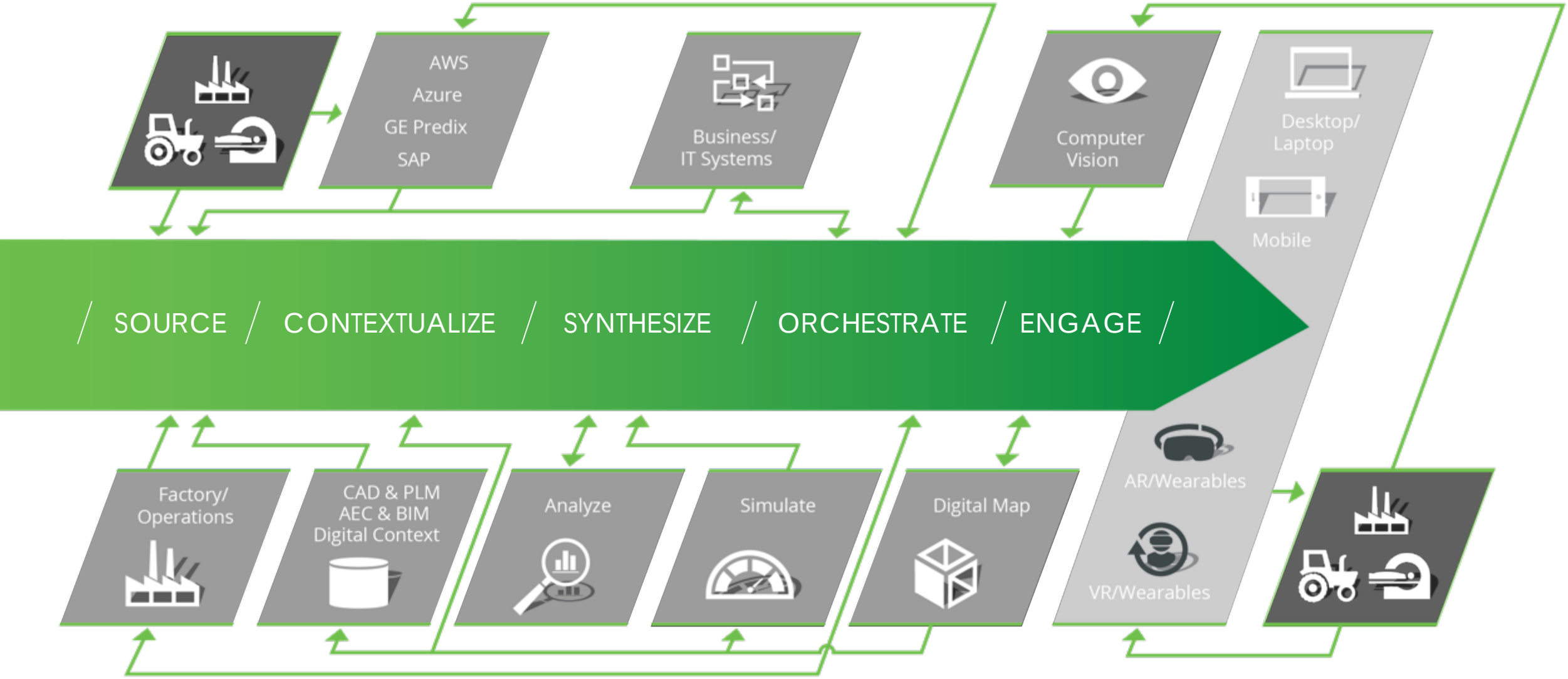


POWER OF PTC'S SOLUTION FRAMEWORK

ptc

3D PLATFORM	PRODUCT LIFECYCLE PLATFORM	INDUSTRIAL ORCHESTRATION PLATFORM	EXPERIENCE PLATFORM
Associative 3D Modeling	Requirements Management	IT & OT Data Acquisition	Object Recognition & Tracking
Generative Design	Content Management	Contextualization	Spatial Recognition & Tracking
IOT-Connected 3D Digital Twin	Project Collaboration, Governance & Workflow	Data Analytics & Visualization	Experience Authoring
3D Work Instructions	BOM Management	Business Process Flow	Expertise Capture
Configured Digital Mockup	Change & Configuration Management/Digital Thread	UX Composition	Logical Procedure Guidance
3D Spatial & Object Capture	Product Variability Management	Domain-specific Logic Composition	Ad Hoc Collaborative Experiences
Design for Additive Manufacturing	Manufacturing Process Management	Domain-specific Data Models Composition	HMI / Experience of Things
Multi-CAD Collaboration	Service Process Management	Industrial Protocol Translation	Multi-Platform Device Support
Real-time Simulation	Quality Management	Digital Content Management & Remote Access	Content Management
creo	windchill	thingworx	vuforia

INDUSTRIAL INNOVATION PLATFORM



Model

Digitize via scan, photo, or video

TURNING POSSIBILITY INTO REALITY

- PTC uniquely provides industrial companies with:
  - Deep industrial domain expertise that provides a starting point
  - Technology framework that enables agility and scale
  - OOTB solutions that allows customers to configure not code
- With PTC, and its partner ecosystem, manufacturers can capitalize on the promise of digital transformation today


ptc

Embedding Simulation Into Mission Command Systems

Dr. John R. Surdu, COL (ret.)

Senior Scientist

Cole Engineering Services, Inc.

Objective

Embed simulation INTO a fielded mission command suite to support operations, embedded training, and war gaming.

- **Course of Action Analysis:** Run a constructive simulation with little or no human intervention to simulated several friendly and enemy courses of action many times and report useful metrics to aid in commander's decision making. Requires a simulation that can run much faster than real time.
- **Planning Support:** Simulating the plan even as it is being created to identify risks and opportunities.
- **Mission Execution Monitoring:** Running the simulation in real time to slightly faster, racing ahead from time to time, comparing the planned state of the operation to the actual state of the operation, raising a flag when things seem to be going awry, and running the simulation much faster than real time to determine if any differences between planned and actual impact to the outcome of the operation.
- **Embedded Training:** Operators create plans in the MC system and then run them seamless in the embedded simulation to stimulate command and control processes.
- **War gaming:** The employment of simulated military resources in operations, either exploring the effects of warfare or testing strategies without actual combat.
- **Learning Simulations:** Enabling simulations to monitor the real operation, update their parameters, and become better predictors over time.

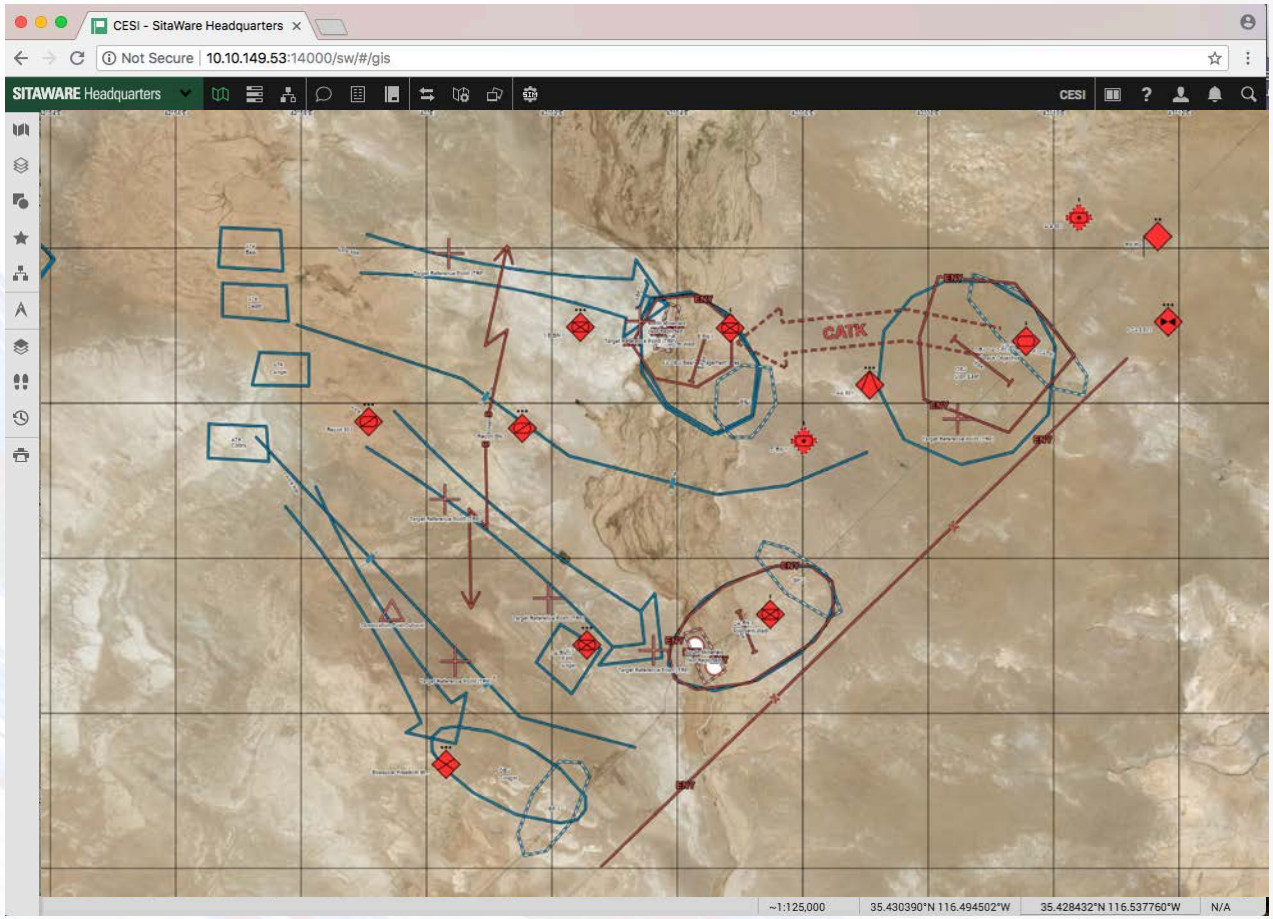
Challenge

- In military operations, COA is facilitated by “wargaming.” This is currently a manual process in which the staff looks at each stage of a COA, using an action-reaction-counteraction paradigm.
- Wargaming, though a formal part of doctrine, is only a semi-formal process, subject to the bias, experience, fatigue, and competence of the participants.
- The purpose of integrating a simulation to support COA analysis is to mitigate the human factors and provide more rigorous assessment of each COA.

- **We have a generation of officers that are used to CONOPS and directed COAs who do not have experience with conducting COA analysis.**

How it Works

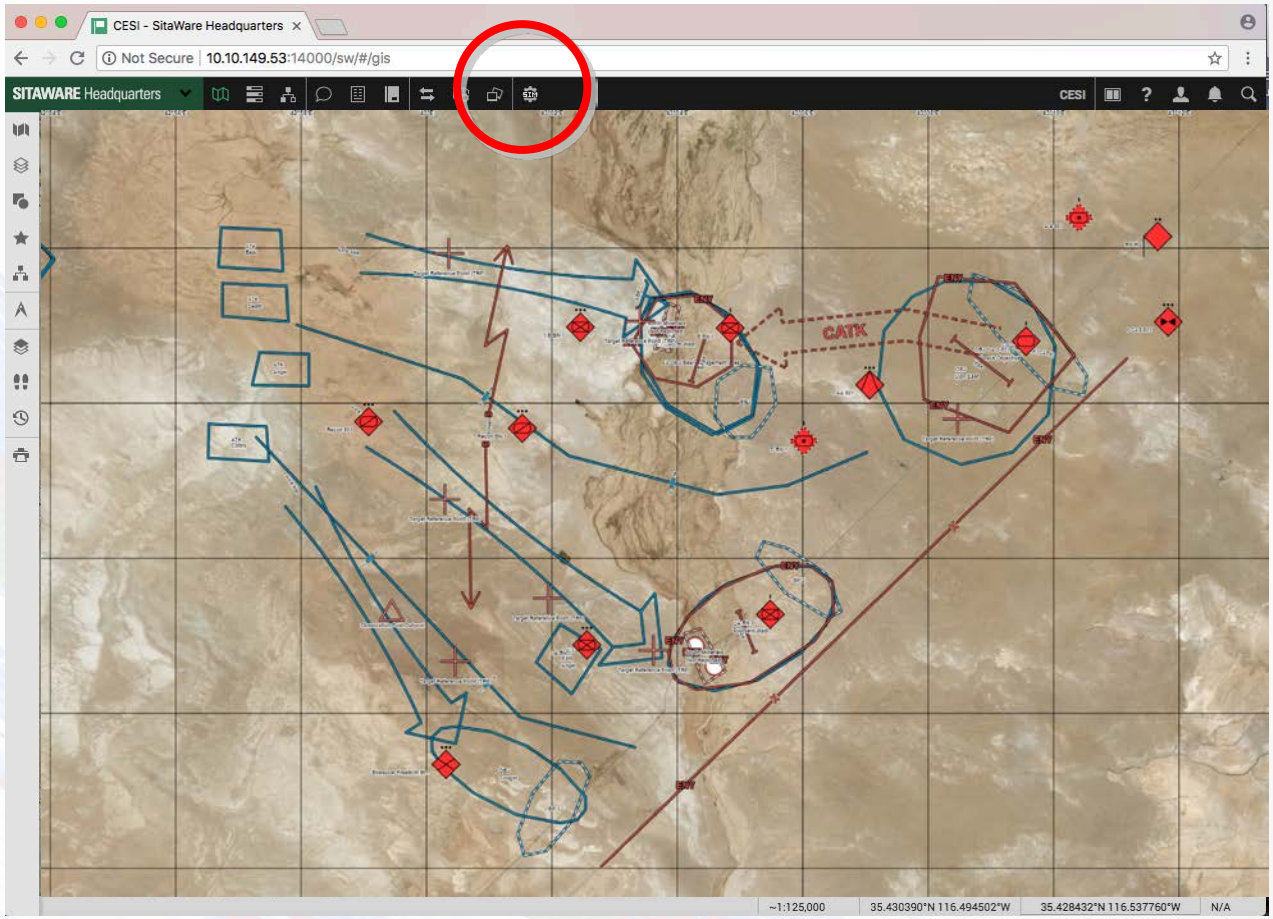
- Develop plan using native SitaWare planning capability.
- Used Operation Tiger Claw scenario from Maneuver Center of Excellence.
- No special planning tools to learn.



CESI
Cole Engineering Services, Inc.

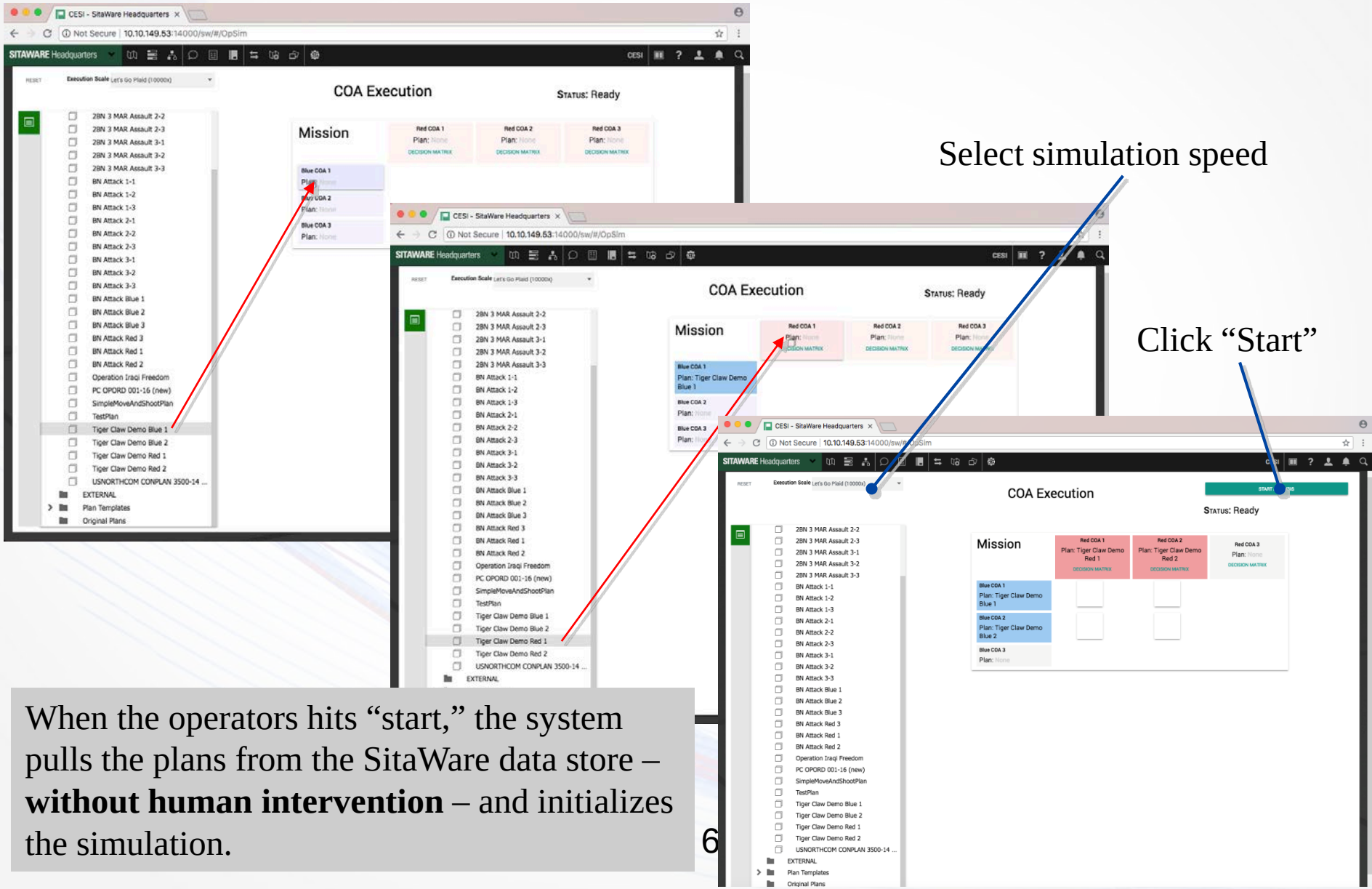
How it Works

First interaction with the simulation is merely to click on the icon in the tool ribbon.



CESI
Cole Engineering Services, Inc.

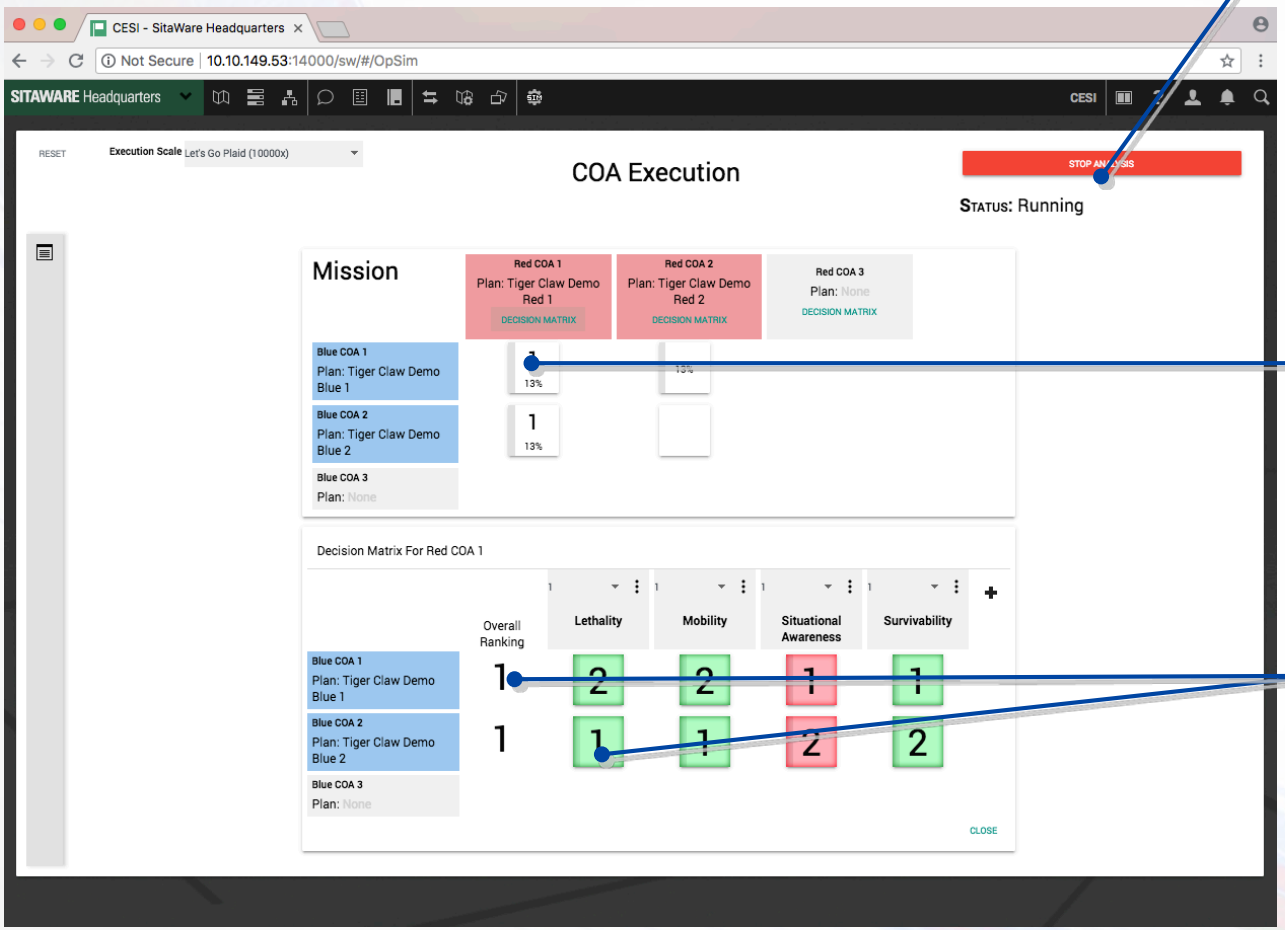
Drag, Drop, and Start



When the operators hits “start,” the system pulls the plans from the SitaWare data store – **without human intervention** – and initializes the simulation.

Intermediate Results

Simulation starts



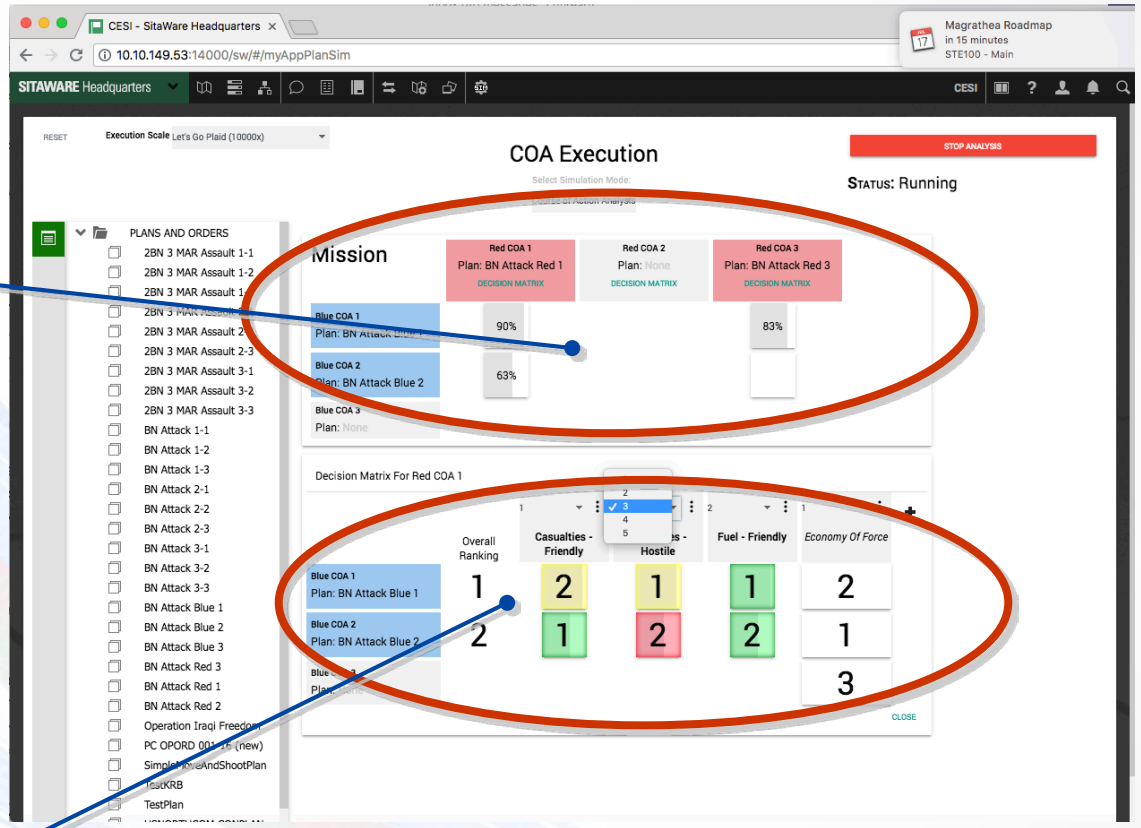
Simulation progress

Running estimate of how the COA is stacking up against a particular Red COA

Exploring Simulation RESULTS

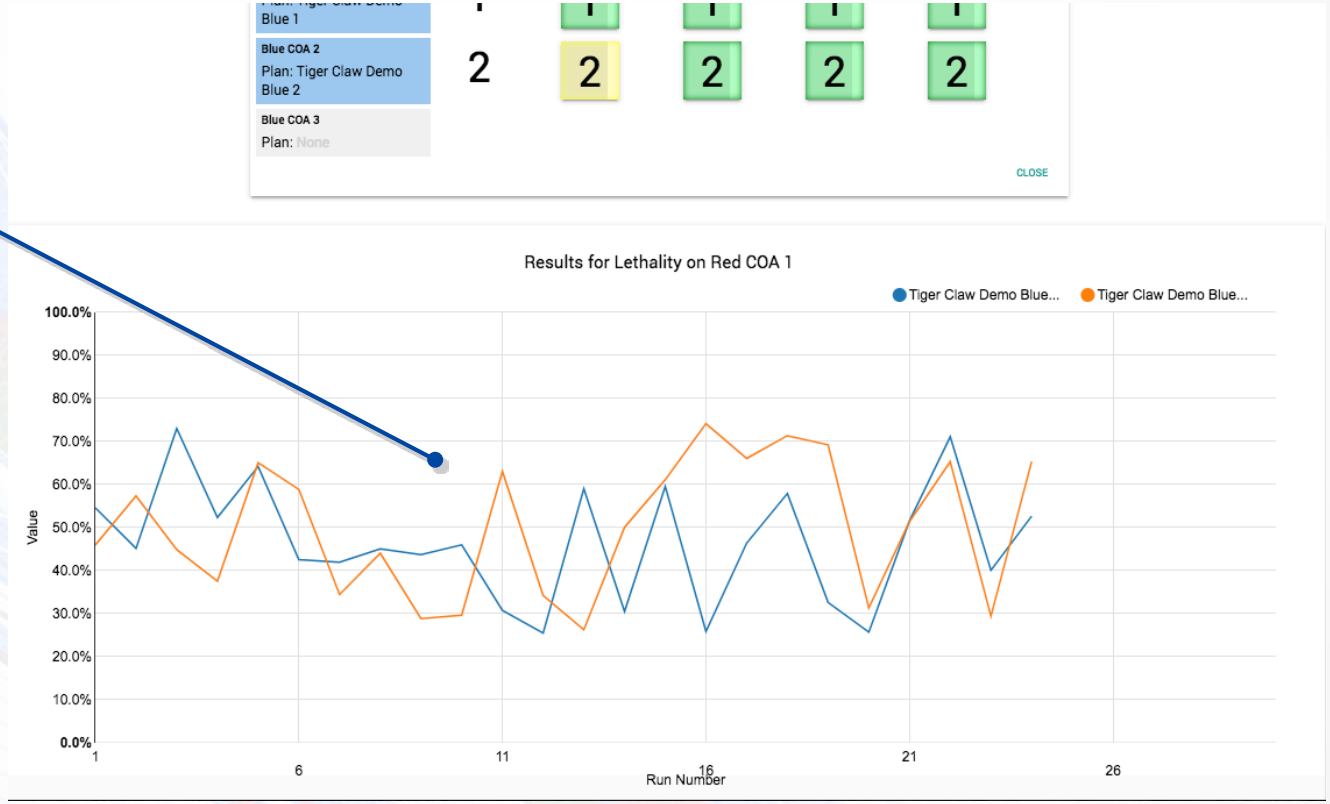
Progress and results rollup matrix

Traditional matrix that compares Blue COA performance against Red COAs.



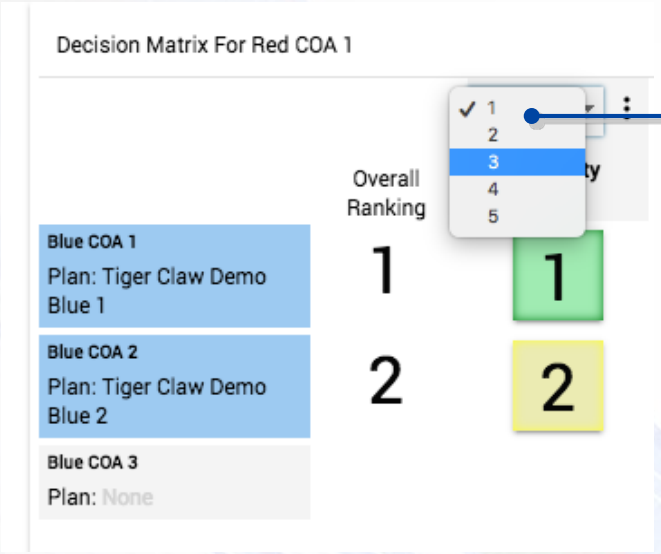
Deeper Dive

Results are reported by simulation run.

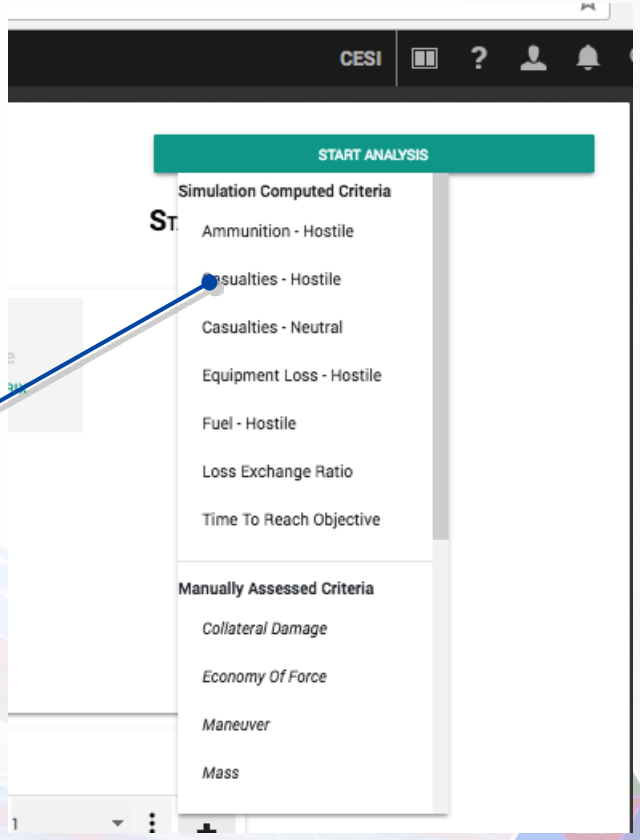


Each pairing of Red and Blue COAs is simulated many times to generate statistically-significant results.

Adjusting Weights

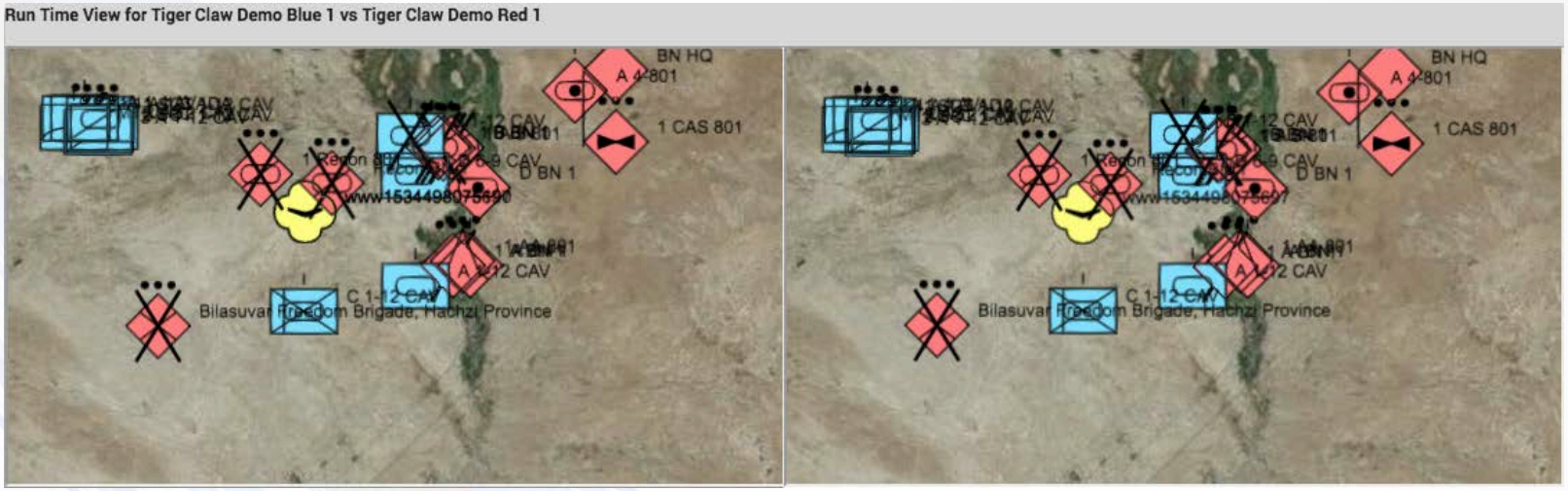


Staff can adjust weights of evaluation criteria.



- Staff can select from a broad set of objective and subjective evaluation criteria.
- Staff manually assess the subjective criteria.

Viewing the Simulation as it Executes



The mission command operator need not know how to operate the simulation. This view allows the operator to view the execution of the COA to gain insight.

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Note:

The operator never sees the simulation.

Just simulation RESULTS.

The correct approach is to HIDE complexity from the users, not add complexity.

Summary

- Many use cases for embedded simulation in mission command systems.
  - Course of Action Analysis
  - Planning Support
  - Mission Execution Monitoring
  - Embedded Training
  - War gaming
  - Learning Simulations
- We implemented this with three simulations: OneSAF, MTWS, and OpSim (purpose-built simulation).

Embedded Live, Force-on-Force Training for Infantry Soldiers

Dr. John R. Surdu, COL (ret.)

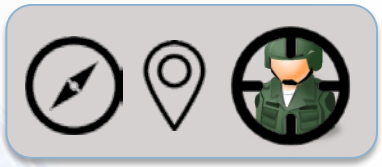
Senior Scientist

Cole Engineering Services, Inc.

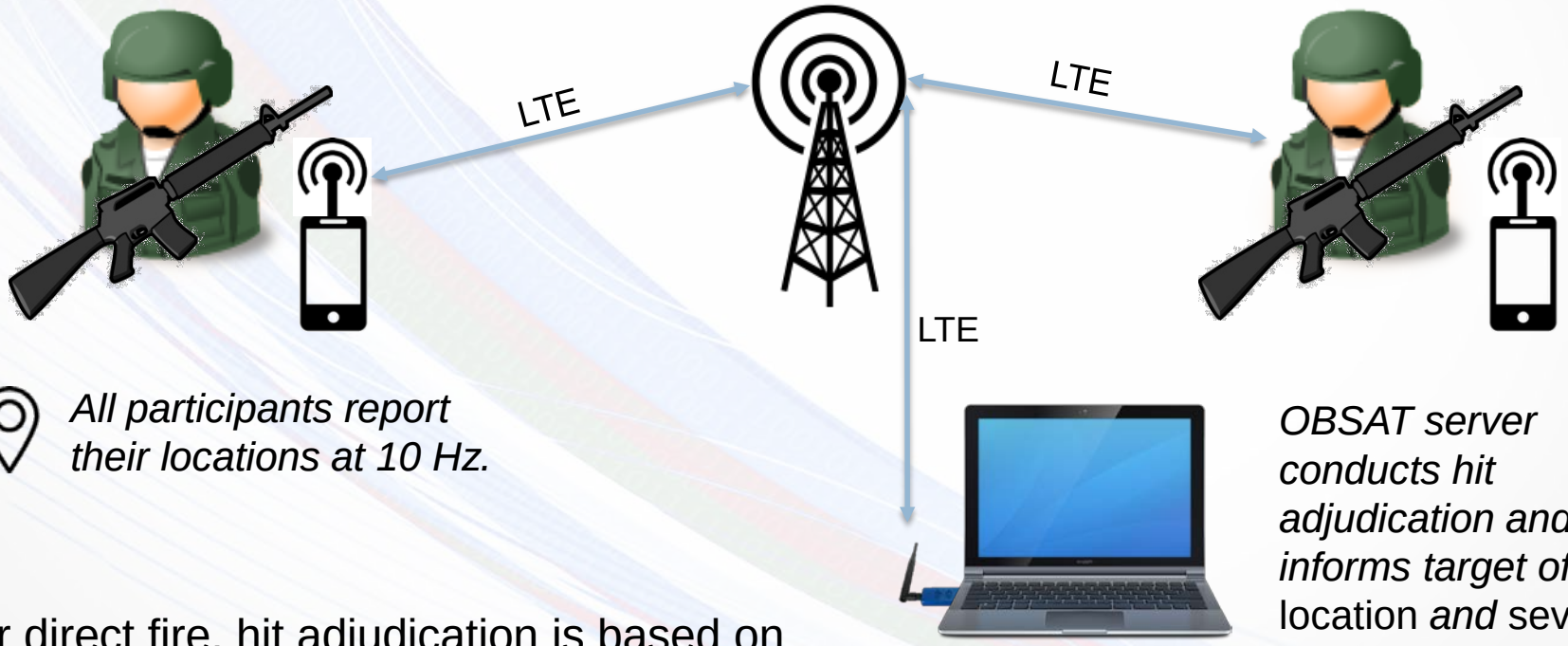
Motivation

- Negative training associated with laser engagement systems (e.g., MILES):
  - Cannot lead moving targets
  - Cannot fire through foliage
  - Cannot properly elevate rifle based on range
  - Cannot represent grenade launchers
  - Cannot fire “non line of site”
- Create a technology that improves live, force-on-force training.
  - Eliminate the negative training
  - Reduce additional equipment needed for live, force-on-force training
  - Provide an expeditionary and deployable capability soon, not in twenty years
  - Be AR/MR “ready”
- This work pointed the way to a technology solution that would **eliminate the negative training associated with MILES-type systems** while providing additional capabilities

Overall OBSAT Patent-Pending Process



When a shot is fired, the orientation of the weapon, location of the shooter, and processed sight picture is transmitted to the OBSAT server.



All participants report their locations at 10 Hz.

OBSAT server conducts hit adjudication and informs target of location *and* severity *of wounds.*

For direct fire, hit adjudication is based on the sight picture, *not* geometric pairing.

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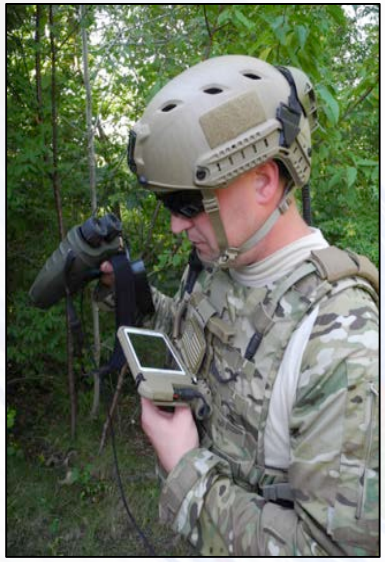
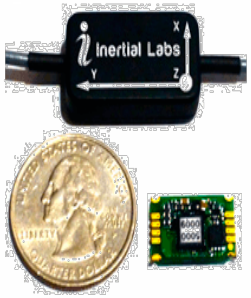
Minimal Appended Equipment



- Human Systems Integration, Inc. wearable USB hub, smart phone, player software, and smart phone enclosure.
- *Surrogate* for Nett Warrior device.

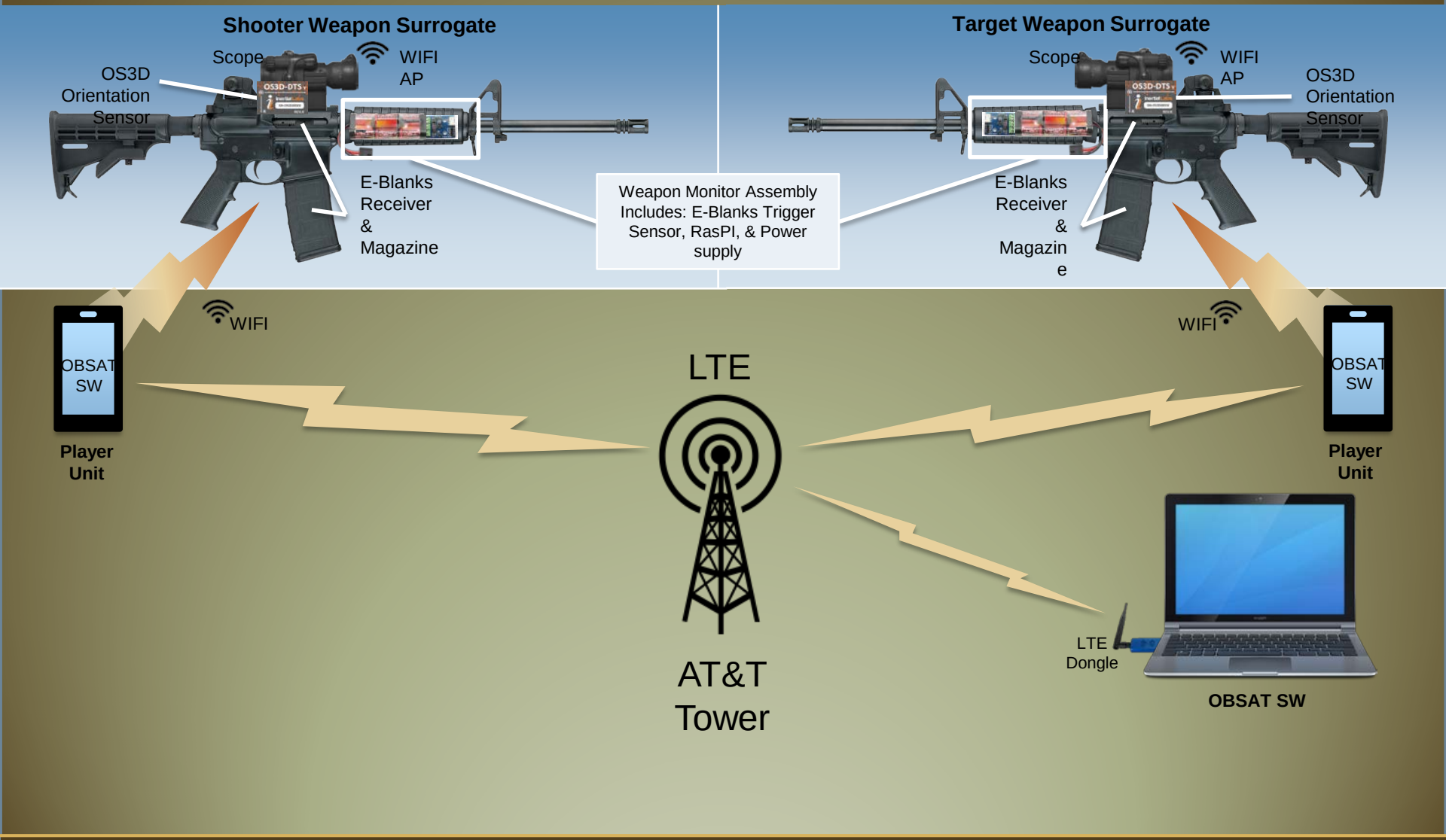


- A single Inertial Labs OS3DM sensor mounted to Picatinny Rail on rifle or scope.
- Will be embedded in next-generation digital scopes and/or IVAS.

- AtN commercial digital daylight or thermal scope.
- *Surrogate* for next-generation digital scopes under development.

- AR-15 or M-4.
- Detect bolt cycling via E-blanks analog output.

OBSAT Small Arms System Configuration



OBSAT server being replaced by a CTIA OBSAT Gateway, but the overall architecture remains the same.

Hardening and Simplifying

Before

- Weapon tethered to Player
- Airsoft rifle
- Note 1 phone
- Lots of wires
- Image processing on the server

After

- Weapon untethered from Player
- AR-15 with eBlanks
- Note 8 phone + Raspberry PI
- Fewer wires
- Image processing on phone / player unit

This simplification and making the software more robust took six months.

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Ongoing Efforts

- Create a library of representative images
- Train a computer vision image classifier to identify the target in the sight picture
- Working with Google to leverage most advanced computer vision tools available
- Develop, prototype, integrate, and test the orientation sensor with optical correction

Stinger System Overview

- All participants report location to CTIA through a gateway.
- OBSAT CTIA Gateway subscribes to aircraft PLI.
- Shooter tracks targets and sends position and orientation to OBSAT CTIA Gateway.
- OBSAT CTIA Gateway determines friend or foe and reports to shooter's Player Unit.
- Player Unit displays correct tone.
- When the shooter fires, the player unit determines if the shooter properly tracked and super-elevated.
- The OBSAT CTIA gateway determines hit or miss.

Targets with no MILES gear report their location.

LTE Network

LTE

LTE

Soldier Worn Player Unit (Net Warrior Surrogate)

Wi-Fi

Optional instructor Operator Station

OBSAT CTIA Gateway

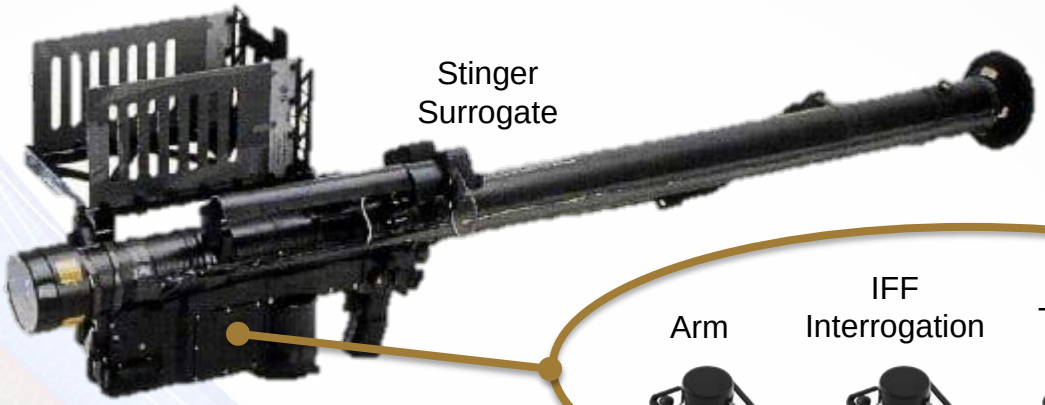
Ethernet

CTIA

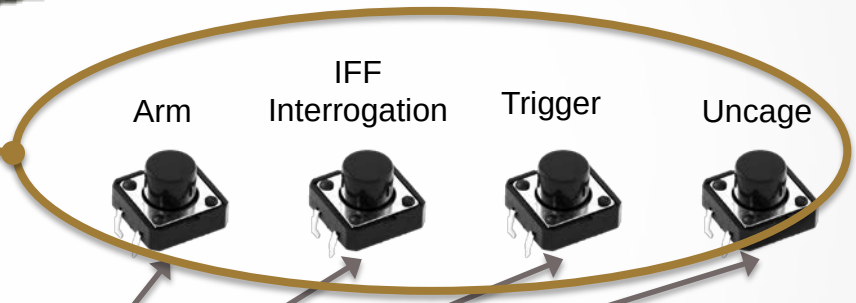
Stinger System Overview

(Player Unit and Stinger Surrogate)

Instructor Operator Station (IOS) (Optional)



Stinger Surrogate



Wi-Fi

Thermal Scope

Player Unit

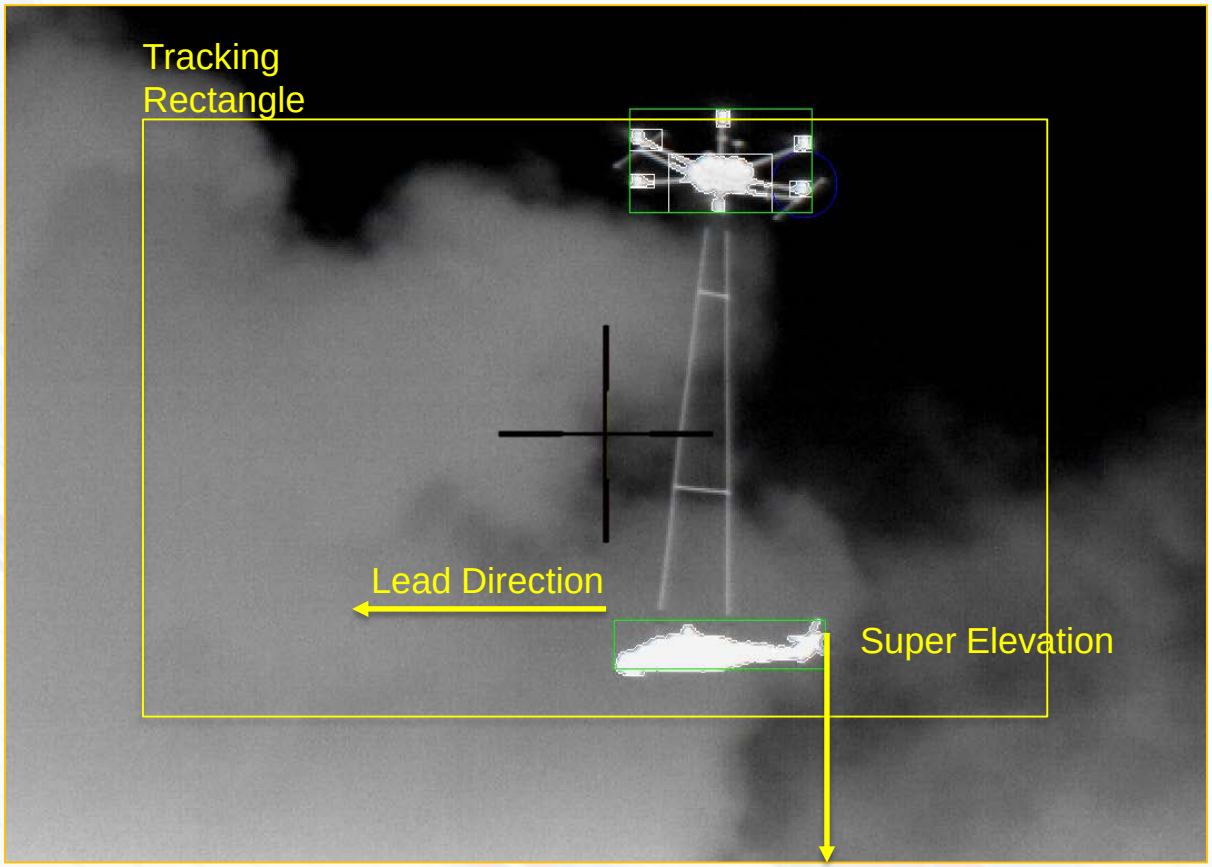
Wi-Fi

Wi-Fi

Raspberry PI Zero

Inertial Labs OS3D Orientation Sensor

Stinger Image Processing



Summary

- OBSAT Technology mitigates or eliminates negative training associated with laser engagement systems.
  - M-16
  - M-203
- OBSAT Technology is MR/AR ready.
- OBSAT Technology reduces need for appended equipment, thereby reducing training distractors and maintenance tail.
- Further maturation is required to get the technology ready for prime time.

Improvements in Image Processing

Old Image Processing Model				
Trials		Predicted		
		No	Yes	
Actual	No	**50**	0	50
	Yes	56	**114**	171
		106	114	

Accuracy = (114+50) / 220 = 75%

New Image Processing Model(1)				
Trials		Predicted		
		No	Yes	
Actual	No	**34**	28	62
	Yes	28	**131**	159
		62	159	

Accuracy = (34+131) / 200 = 75%

Notes of issues we are seeing:

- *Running side profile*
- *Side profiles*
- *Trouble with Peggy*

New Image Processing Model(2)				
Trials		Predicted		
		No	Yes	
Actual	No	**50**	11	61
	Yes	4	**155**	159
		54	166	

Accuracy = (54+166) / 200 = **93%**

Accuracy = (True Positives + True Negatives) / Total Trials

Image Synthesis Currently Problematic

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – SOLDIER CENTER

Cyber Augmented Operations Technical Symposium 2019: CyberBOSS Overview

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Simulation and Training Technology Center (STTC)

CYBERBOSS OBJECTIVES

Broker Cyber Actions and Effects Across LVC&G Systems

- Adjudicate cyber effects between federates to enable fair-fight concepts

Use a Services Approach to Develop a Cyber Terrain Ecosystem

- Open and Transparent – easy to see what is happening internally
- Flexible and Extensible – adaptable to future needs and/or third party extension

Define Common Data Model for Cyber Events

- Leverage existing models (e.g. COATS)
- Incorporate cyber-specific information (e.g. intentions, cyber-attacks, and cyber control)

Correlate Cyber Terrain between Synthetic Battlespaces

- Common device representation across federated LVC&G simulations and/or cyber ranges (e.g. CyberCENTS)

CENTRAL CONTROL AND ROUTING OF CYBER EFFECTS

CyberMaster | Cyber Role Player | Cyber Common Operating Picture (COP) | Cyber AAR | Cyber Exercise Creation Tools

Cyber Simulation Operator

Cyber Training GUIs

Metova Federal is a CyberBOSS team member

Metova CyberCENTS

Cyber Range Operator

Range Training Tools ↔ Other Cyber Ranges

CyberBOSS

- Common cyber effects definition
- Cyber event control strategy
- Cyber actor lists
- Cyber objects and infrastructure definitions
- Information message routing

CyberBOSS Interface Framework (CIF)

COBWebS — OneSAF (CyberBOSS Interface Framework)

COBWebS — JLCCTC (CyberBOSS Interface Framework)

Others (CyberBOSS Interface Framework)

Existing Simulation Systems

Live Simulation Systems

Synthetic Simulation Systems — COBWebS

Tactical Internet

Operational Devices

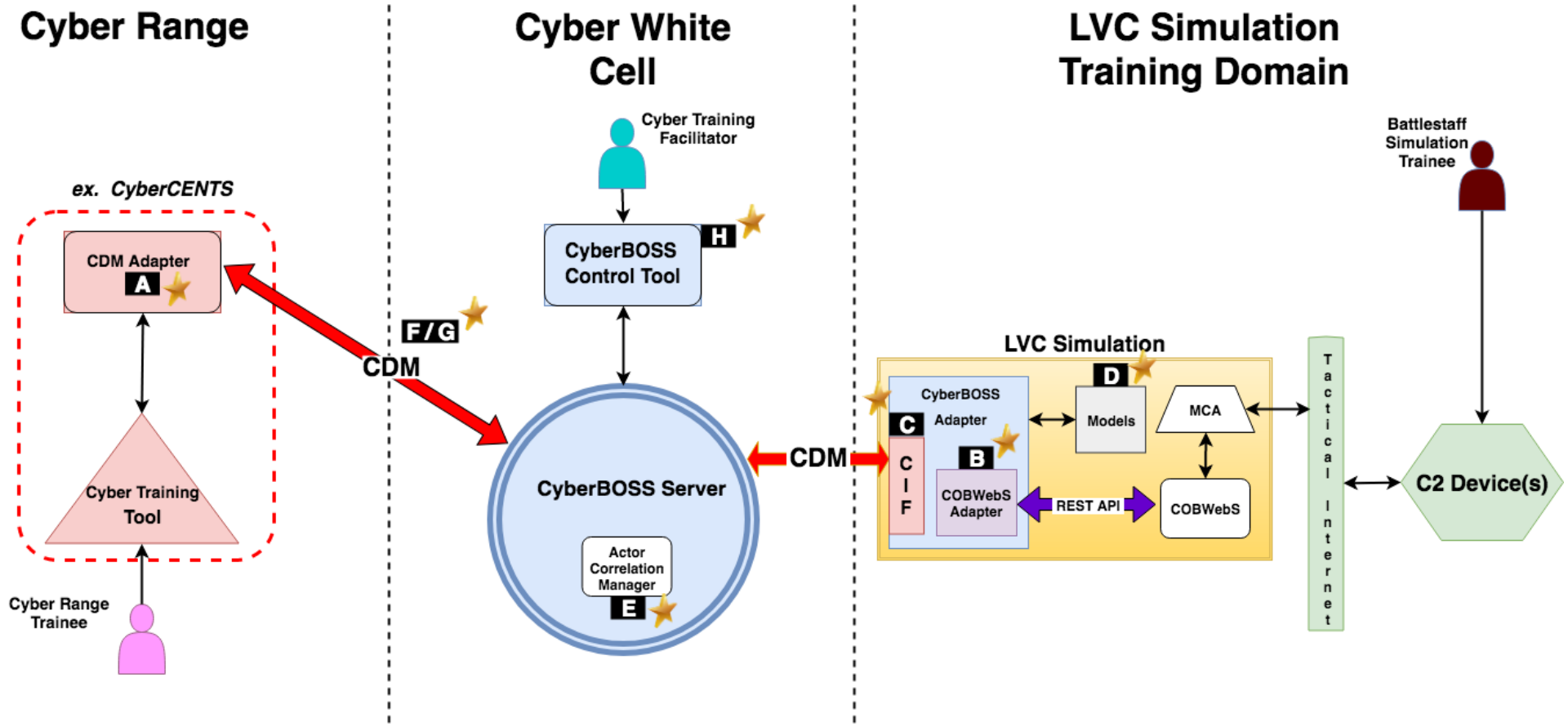
Cyber Effects Models

ICATS

TA / Battle Command Staff

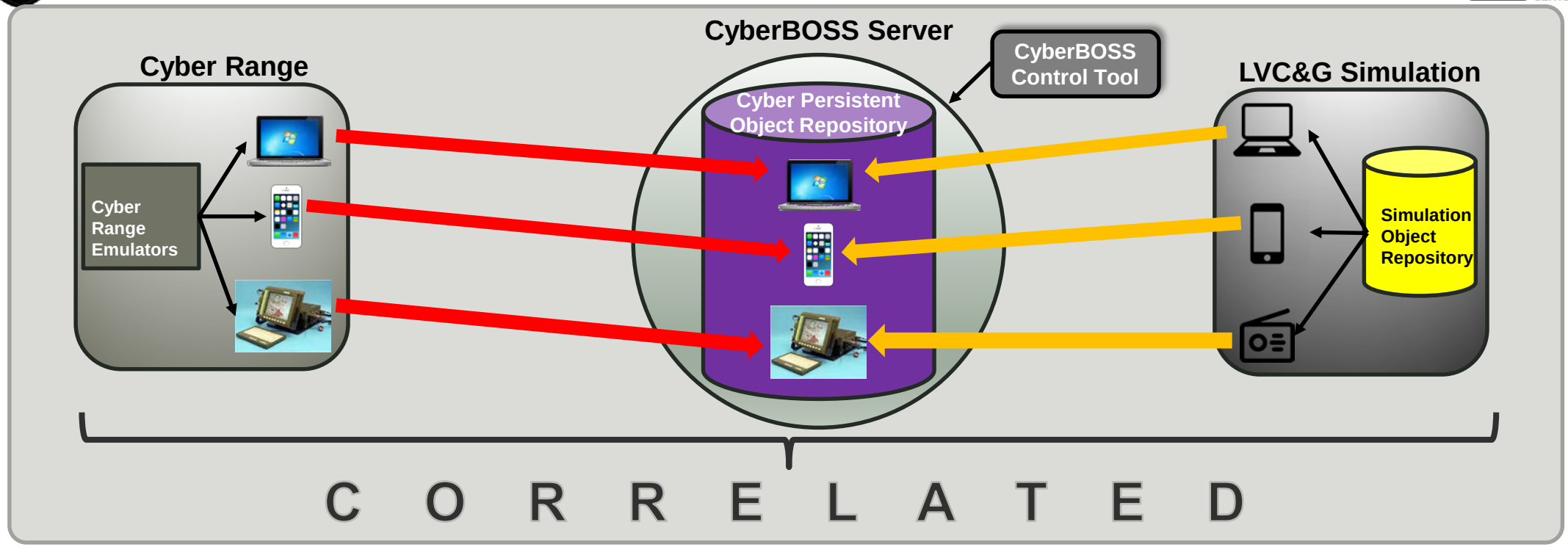
The CIF provides a client oriented perspective of the services and data in the CyberBOSS ecosystem

ARCHITECTURE COMPONENTS



A. Cyber Range Adapter
B. COBWebS Adapter
C. CyberBOSS Interface Framework (CIF)
D. Cyber Modeling Enhancements (OneSAF)
E. Correlation Management Services
F. CDM Data Model Enhancements
G. CDM Documentation Generator
H. Control Tool Enhancements

DEVICE CORRELATION



Disjoint Representation of Devices between CyberBOSS Federates

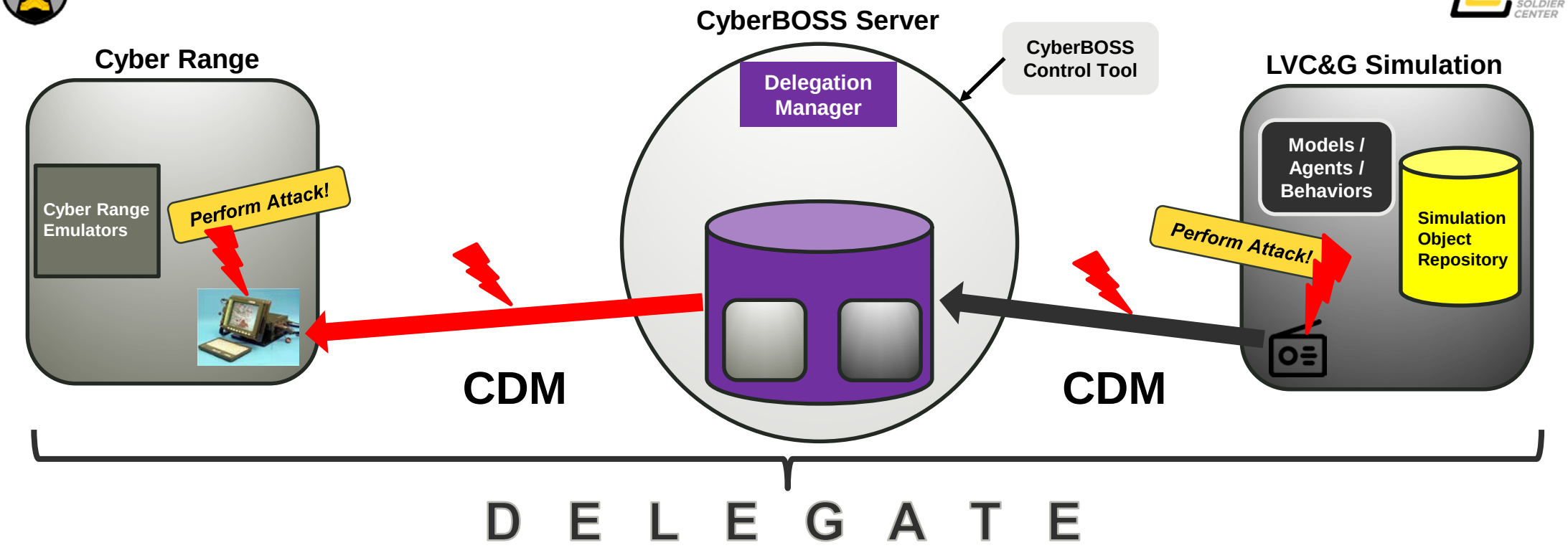
- Simulations use different information to refer to the same device
  - Cyber range represents operating system & version information
  - LVC&G simulation provides location information (tied to owning entity)

CyberBOSS Server Correlates Device Information between Federates

- Adjudicates information from all federates
  - Supports bridging device effects between the connected applications

Correlate Devices between Federates

CYBER EVENT DELEGATION



Harness Correlated Object Representation to Delegate Requests

- E.g. Issue task in LVC&G simulation, but delegate to federate with a higher fidelity representation

Adjudication / Routing Capability in CyberBOSS Server

- Actions are directed to the domain where they are best suited
- E.g. Cyber attacks should route to a cyber range if it is part of the federate

Route Cyber Events between Federates

QUESTIONS?

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CCDC – Soldier Center
Simulation & Training Technology Center (STTC)

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BACKUP SLIDES

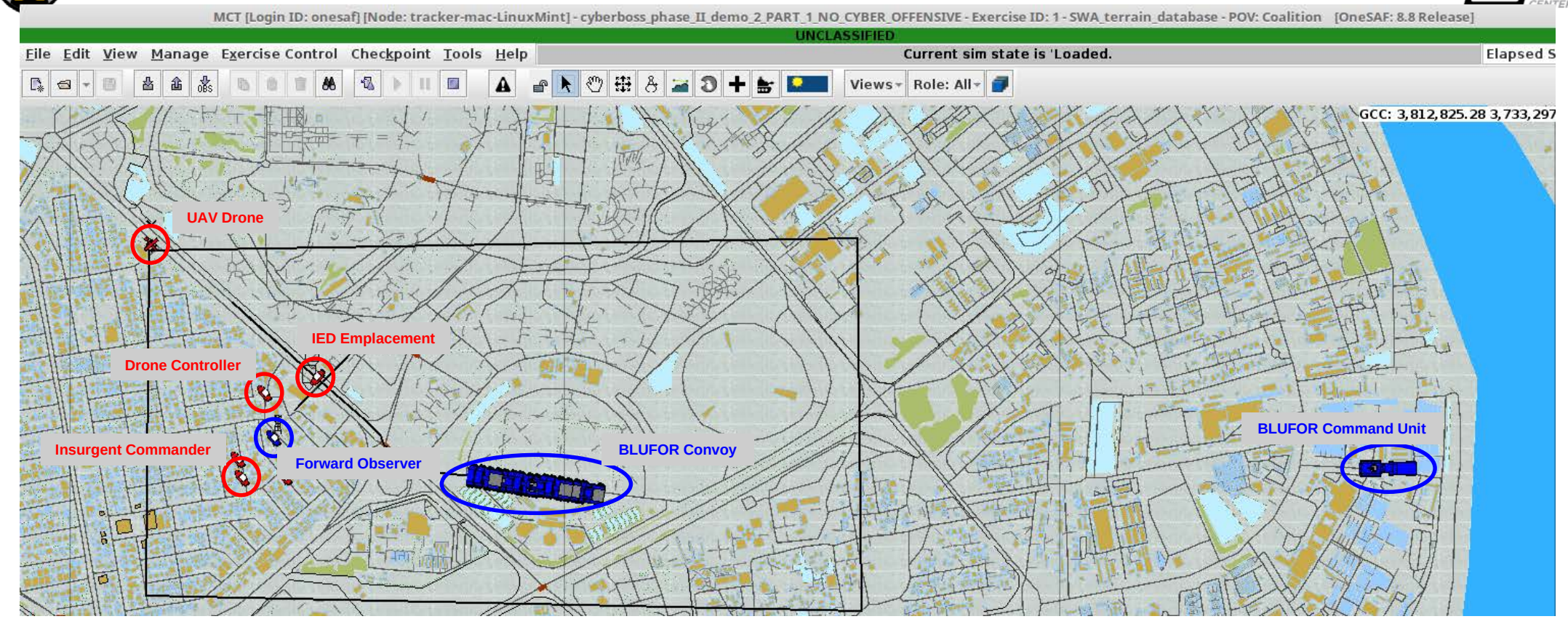
DEMO OBJECTIVES

- Incorporate cross-domain communication with CyberBOSS as a broker
  - Reconnaissance & Attack operations interoperate over disjoint applications (LVC & Cyber Range)
  - Demonstrate connections to the Cyber Range.
- Develop more complex scenarios that support offensive cyber training
- Extend Cyber Data Model (CDM) expression to support more robust client integration.
- Prototype the CyberBOSS Interface Framework (CIF) as a standardized client API / connection paradigm
  - Extend OneSAF to show vision of how a compliant cyber simulation would interface with CyberBOSS
    - Utilize Prototype CIF client adapter (within OneSAF)
    - Build ODM, Modeling & Agent infrastructures (following OneSAF development paradigm)
- Demonstrate COBWebS REST API integration

Scenario Description *Part 1*:

NO Offensive Cyber Attack

DEMO PART 1: *NO* CYBER OFFENSIVE

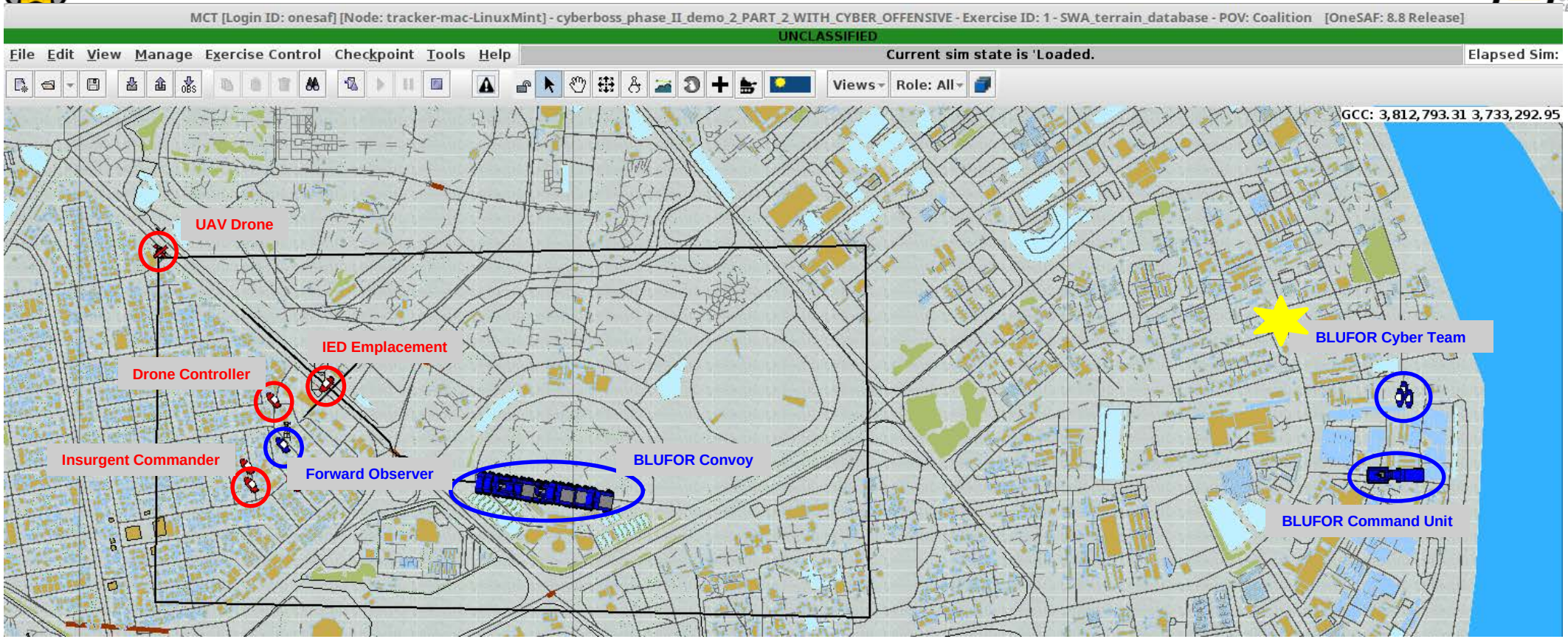


- **Part 1: *No* BLUFOR Cyber Offensive**
  - BLUFOR convoy traveling down route in urban environment
  - OPFOR insurgents situated in WiFi cafes, using a drone to surveil convoy activity
  - Commander instructs movement of Convoy, unaware of Insurgency coordinated IED attack
    - DoS on BLUFOR Commander's Tactical Device
    - Demonstrates extension of COBWebS into more complex training scenarios
  - BLUFOR Forward Observer attempts to relay impending attack to Commander, but message fails
  - Convoy moves through area, IED detonated with BLUFOR casualties

Scenario Description *Part 2*:

WITH Offensive Cyber Attack

DEMO PART 2: *WITH* CYBER OFFENSIVE



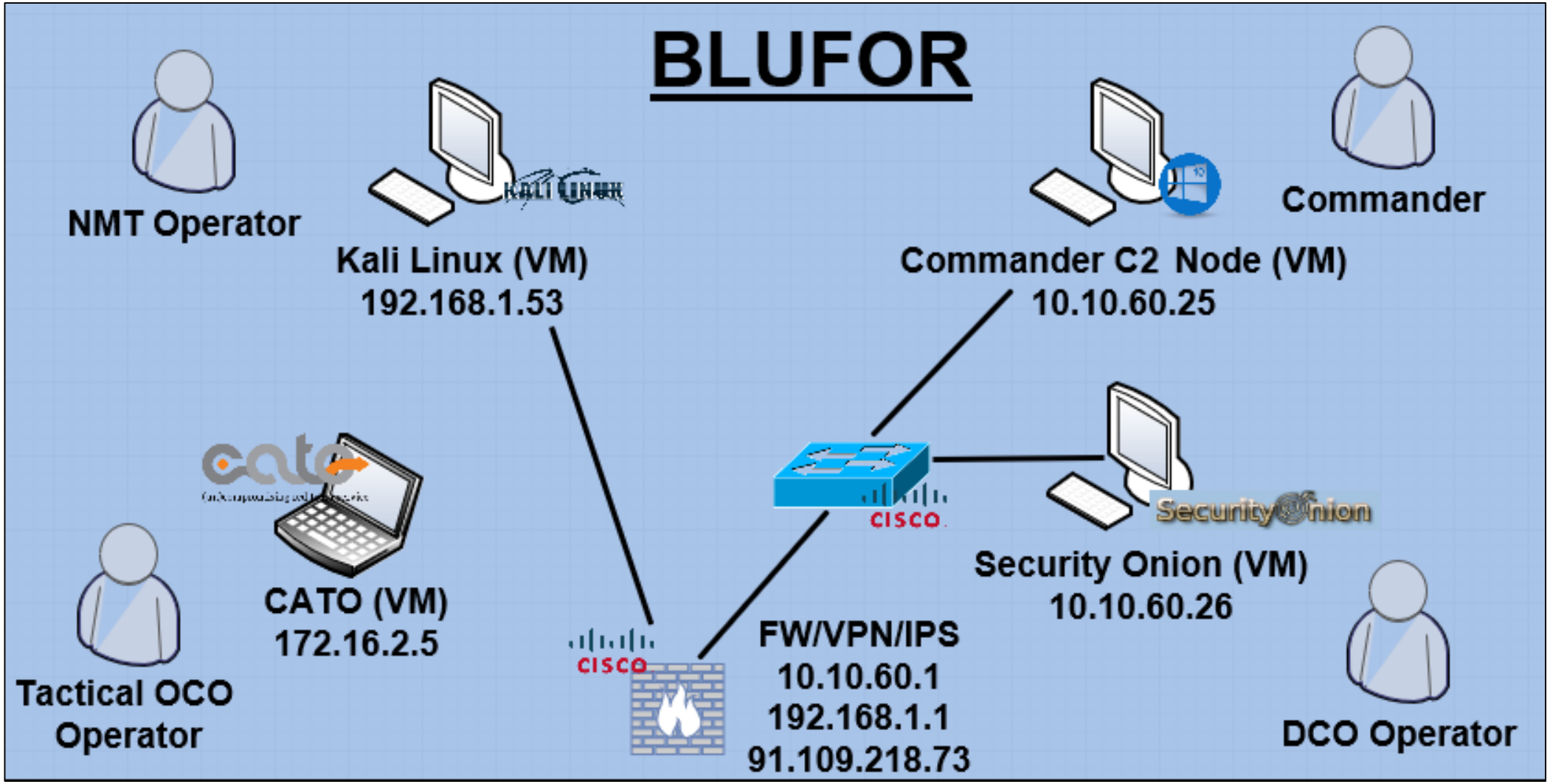
Part 2: *With* BLUFOR Cyber Offensive

- BLUFOR commander mitigates active attack on internal network & by ordering cyber reconnaissance
  - Obtains ability to hack into OPFOR controlling devices for drone & IED detonator
- BLUFOR commander orders cyber attack on the OPFOR devices
- OPFOR loses communication with the drone and can no longer surveil the BLUFOR convoy
- OPFOR cannot initiate IED
- BLUFOR convoy moves through area unharmed.

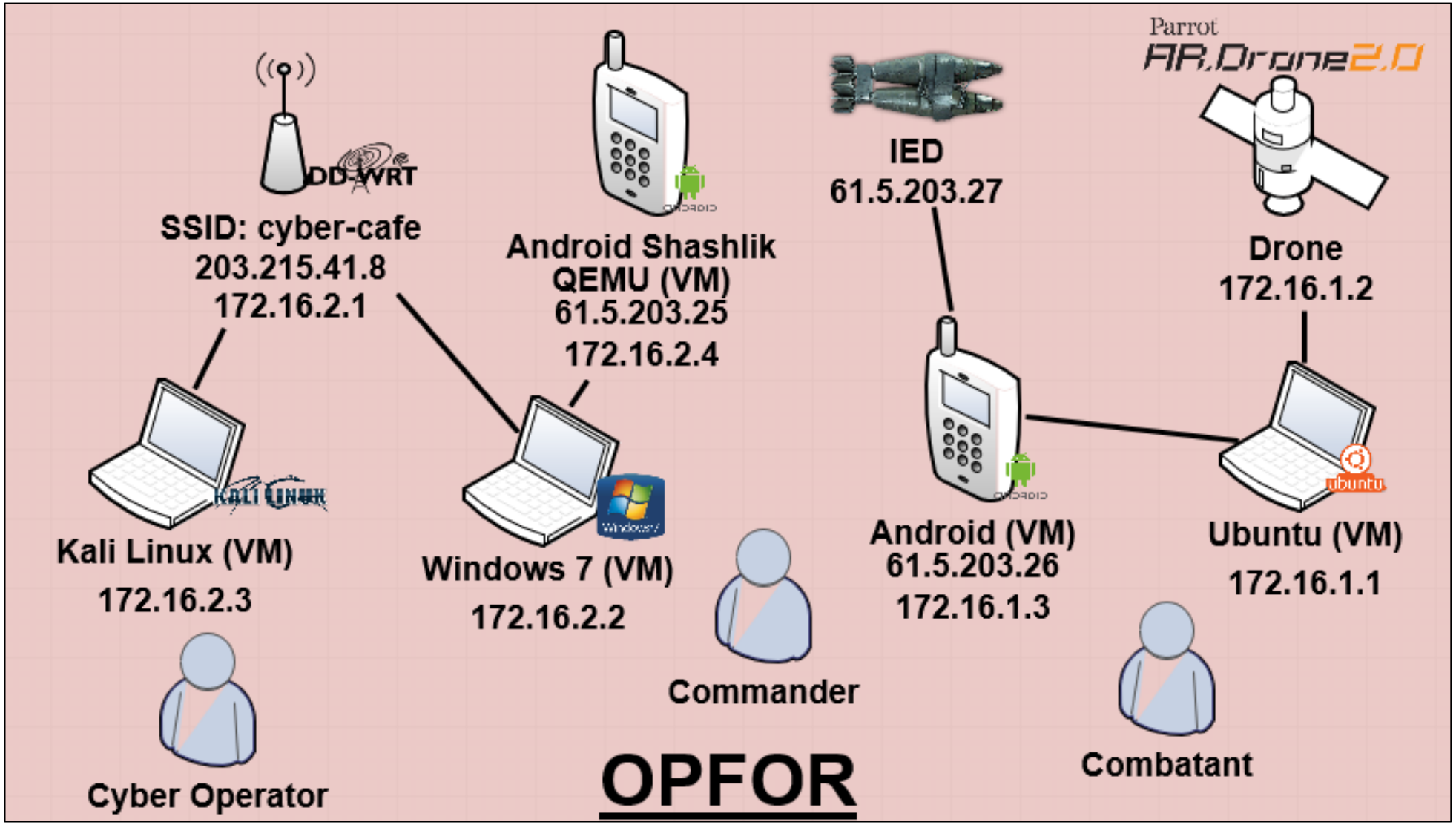
KEY OBJECTIVES

- Demonstrate interoperability of cyber range and constructive simulation systems to provide cyber training.
- Demonstrate modeling of BLUFOR offensive cyber operations
- Demonstrate collaborative training between Maneuver & Cyber Team

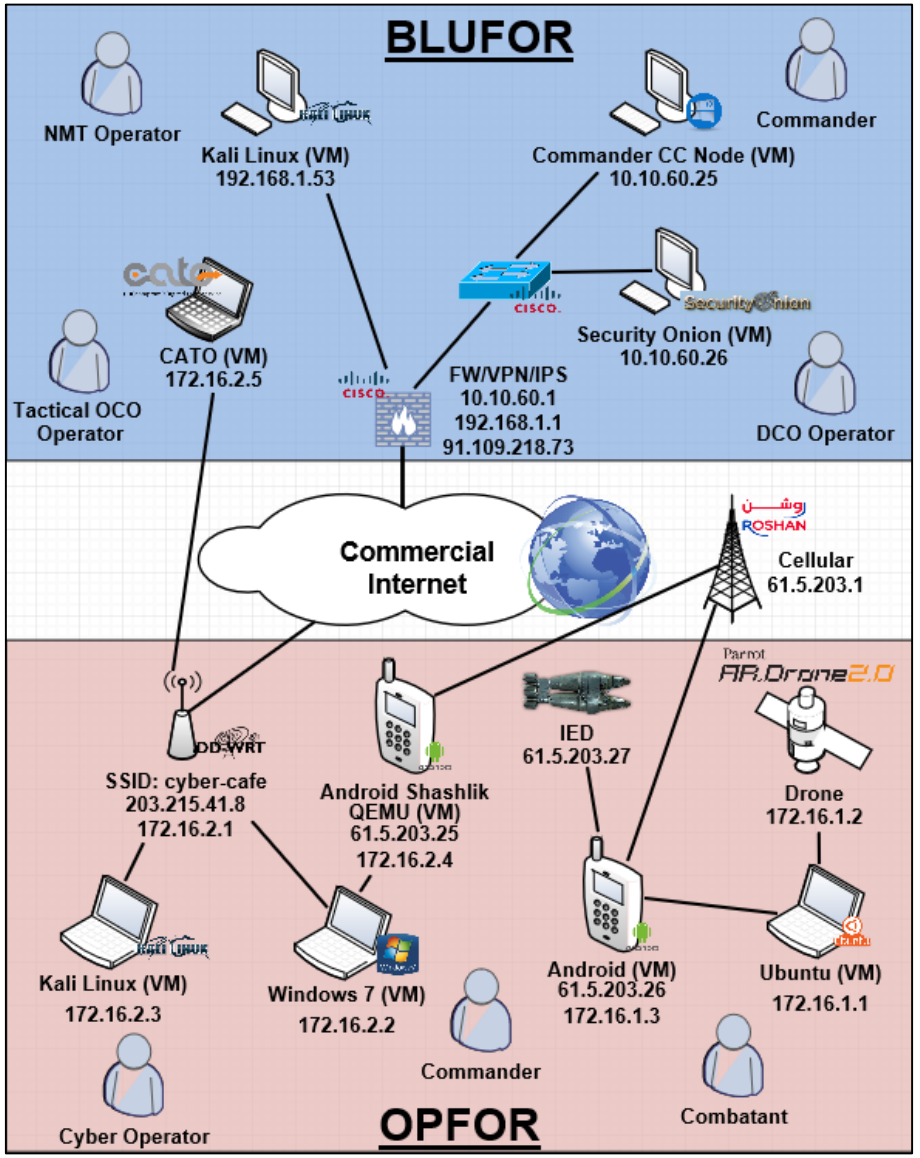
DEMO PART 2: BLUFOR CYBER ENTITIES



DEMO PART 2: OPFOR CYBER ENTITIES



DEMO PART 2: CYBER BATTLESPACE



Cyber Virtual Training

NDIA CYBER AUGMENTED OPERATIONS SYMPOSIUM

26 March 2019

Ambrose Kam

ambrose.kam@lmco.com

Cyber Innovations

Ambrose Kam

- **Over 24 yrs in Modeling & Simulation (M&S) and Operations Analysis (OA) with broad expertise in communications, networking, mission planning, renewable energy, radar, cyber, etc.**
- **Pioneer in applying M&S and OA techniques to cyber threat analysis.**
- **MIT Fellow in Systems Design & Management since 2002**
- **LM Fellow in Cyber**
- **2017 Asian American Engineer of the Year (AAEOY)**
- **Published over 30 research papers on a variety of subjects; guest lecturer @ MIT and Georgia Tech; industry internship sponsor/project lead on research projects with military academies**
- **MEng from Cornell; Dual Master's Degree from MIT (Systems Engineering & Management) Bachelor of Science from University at Buffalo**

Cyber Virtual Training in a Multi-Domain Op (MDO) Environment)

Real-Time Simulation-Based Operator-in-the-Loop

https://www.lockheedmartin.com/en-us/news/features/2016/webt-navy-area-51.html

Lockheed Martin Image

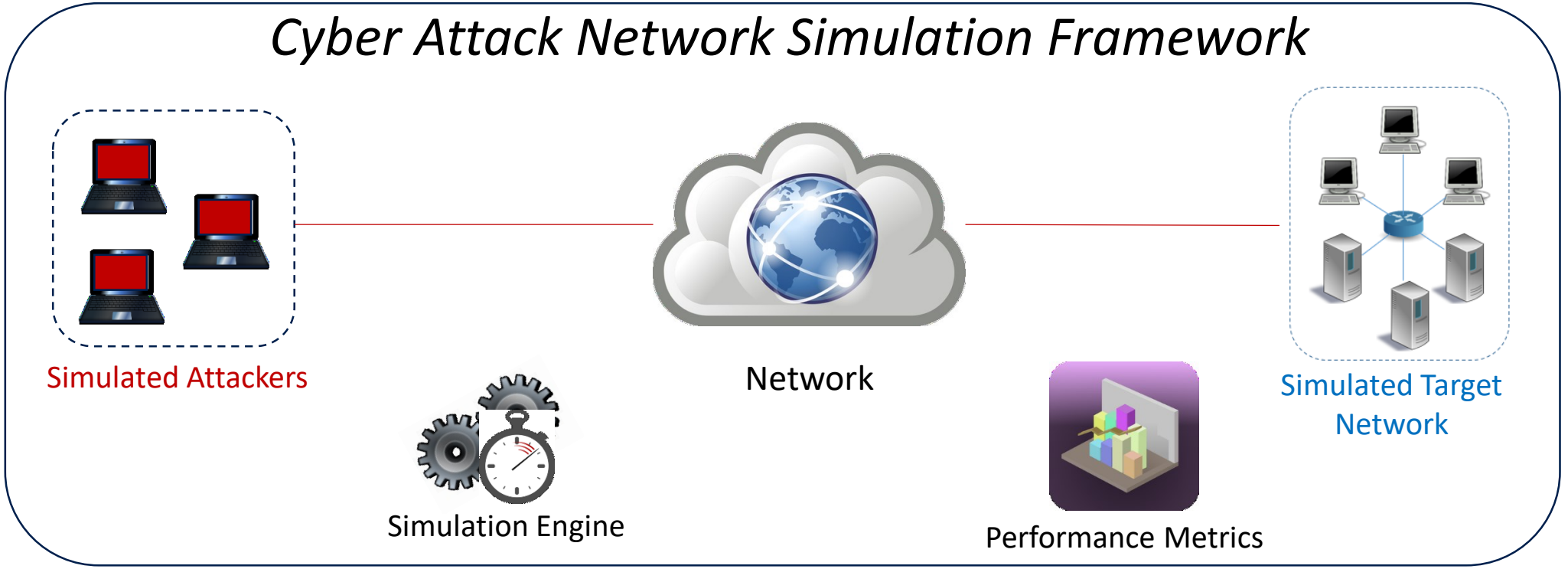
Motivations

- Objectives
  - Develop an operator-in-the-loop capability to support a wargaming environment; the goal is to determine how EW/Cyber TTPs affects mission effectiveness for both Red/Blue teams

- Problem Statement
  - Multi-domain Operations (MDO) is a big challenge; EW/Cyber will only make MDO more complicated given the quick advancement of the EW/Cyber techniques. Recent conflicts in Georgia and Ukraine showed how EW/Cyber can compliment traditional weaponry. US cannot afford to be left behind.

**Disclaimers: The example shown in this presentation is unclassified; it is not intended to represent any domestic or foreign systems/platforms.*

What is Cyber Attack Network Simulation (CANS)?

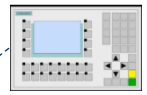


Lockheed Martin Image

The Cyber Attack Network Simulator (CANS) is a discrete event simulation that allows analysts to study the effect of various cyber events against a model of a planned or operational network system.

CANS models cyber events and their impacts to a system

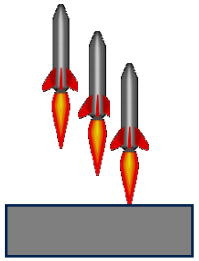
CANS Example



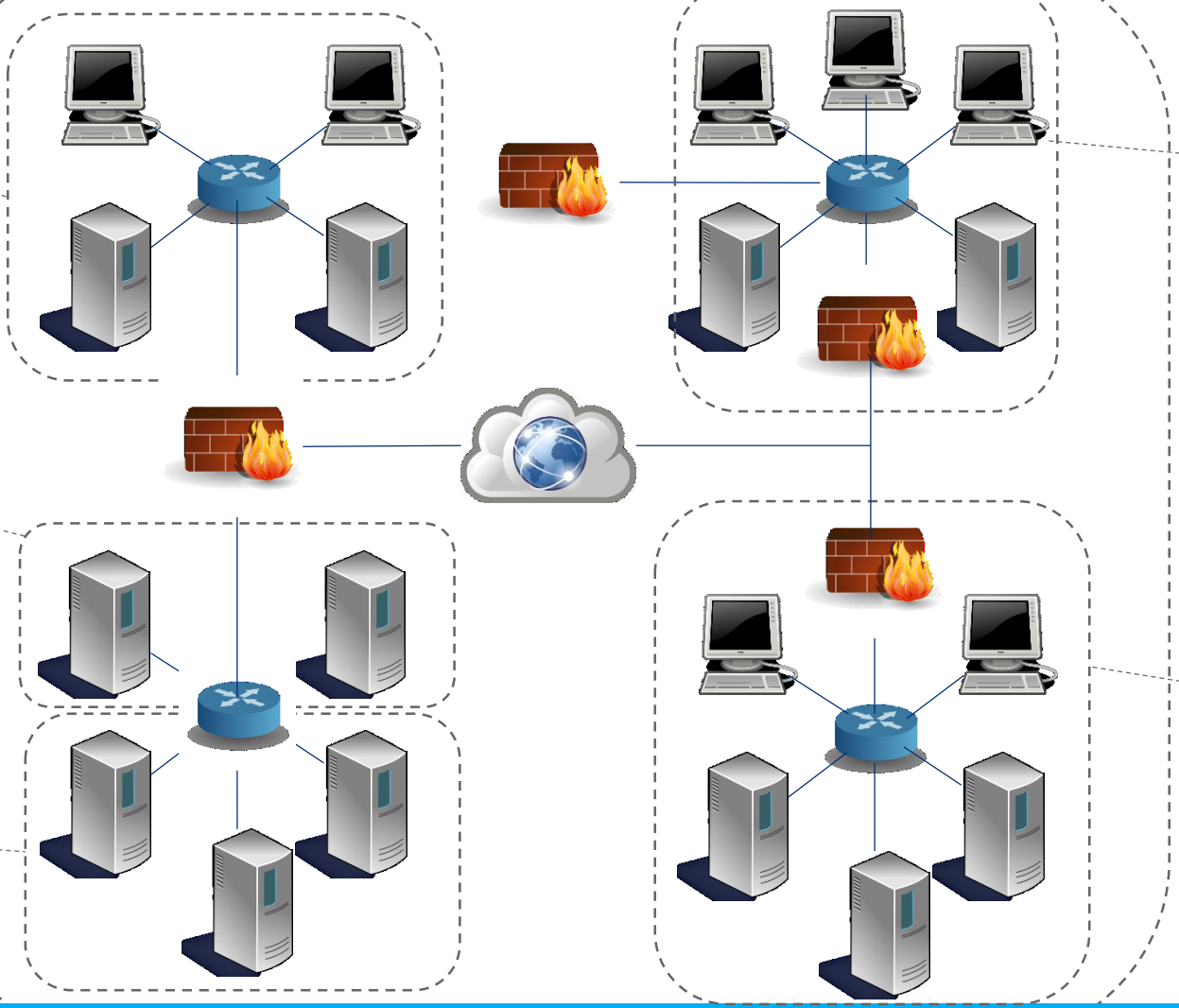
Operator Consoles

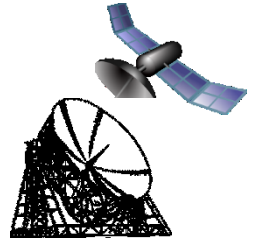
Destroyer

Sensor Systems



Weapon Systems





Satellite / Ground Station

Fighter Plane

CANS System Models are Highly Modular

What is AFSIM?

- Advanced Framework for Simulation, Integration & Modeling
- Government Owned object-oriented C++ library
- Discrete Event Simulation
- Can run at, faster and slower than real time
  - Can be Human-in-the-loop

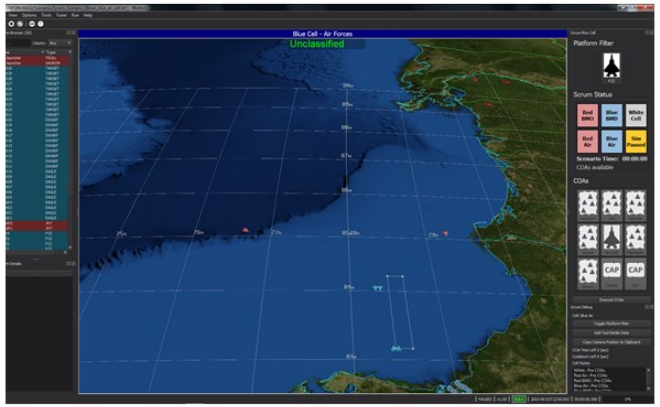
The intent of AFSIM is not to provide all encompassing models, but rather to provide the framework for incorporating the necessary models*

***from AFRL**

AFSIM Warlock Operator Interface

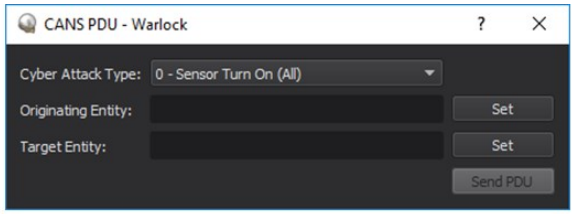
Courtesy of IST

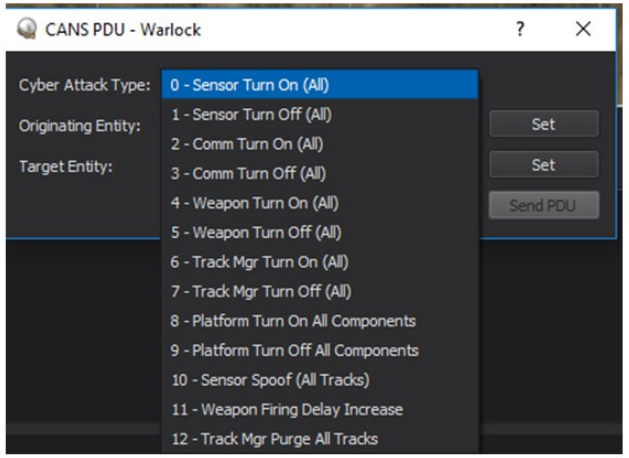
Distributed Operator Stations



Blue Cell Player

Courtesy of IST

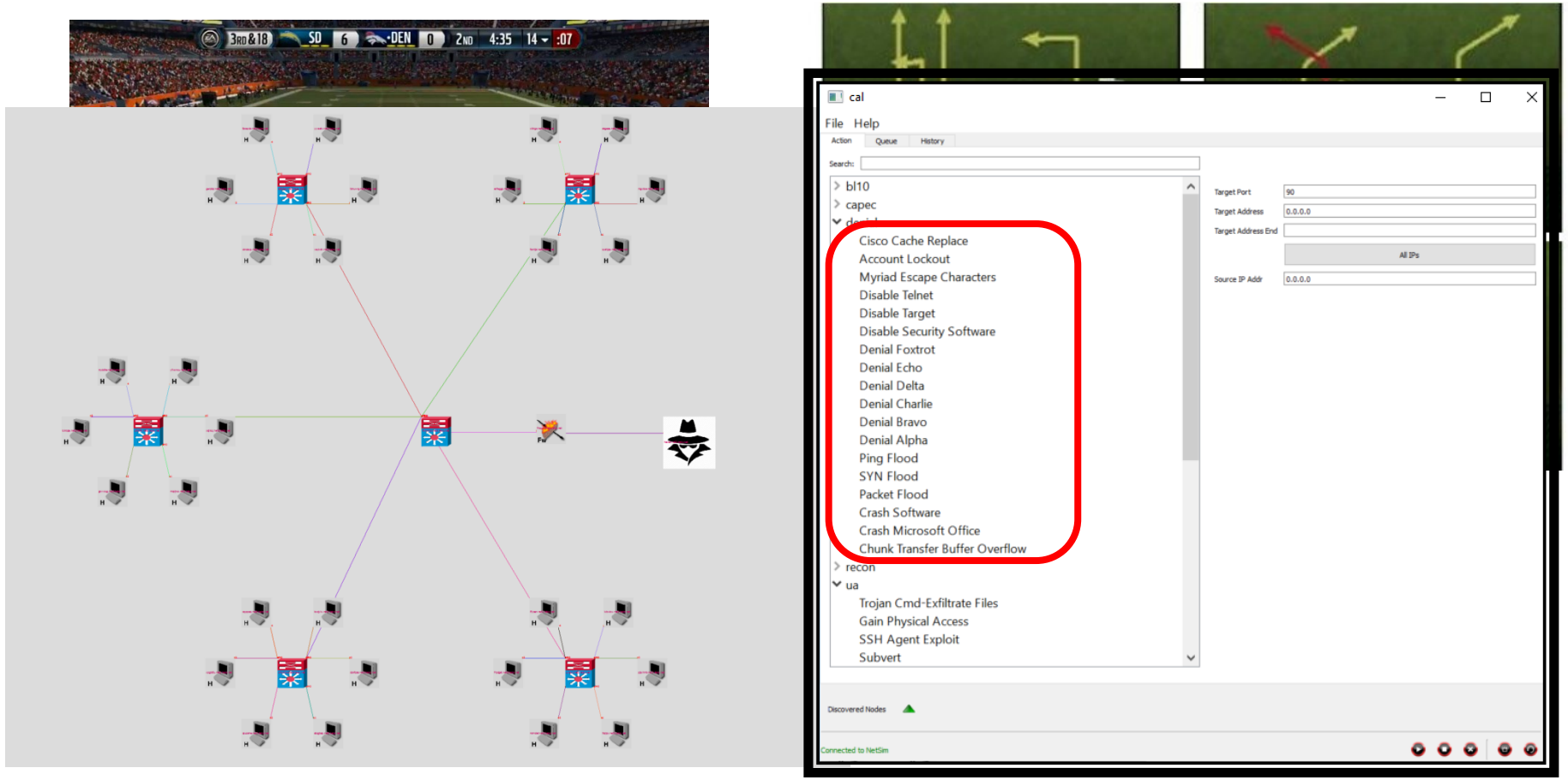


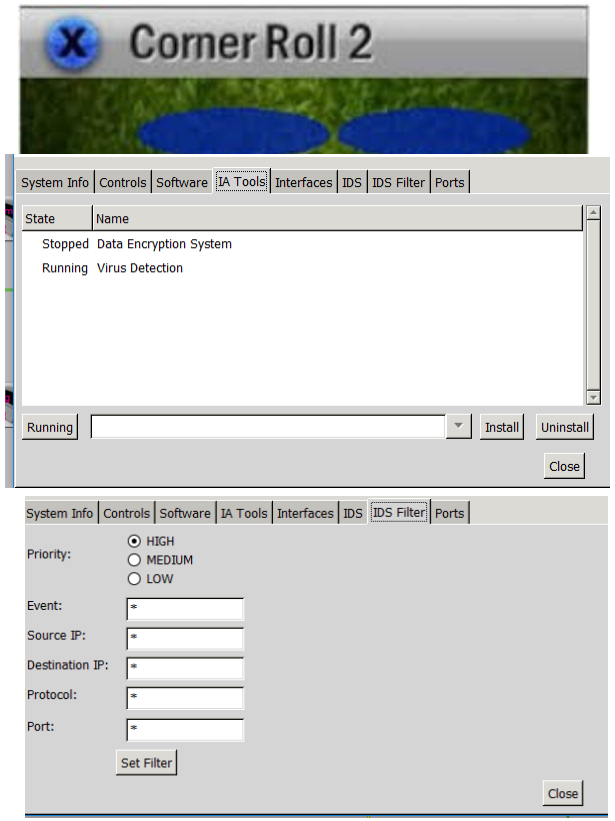


CANS/AFSIM DIS

Lockheed Martin Image

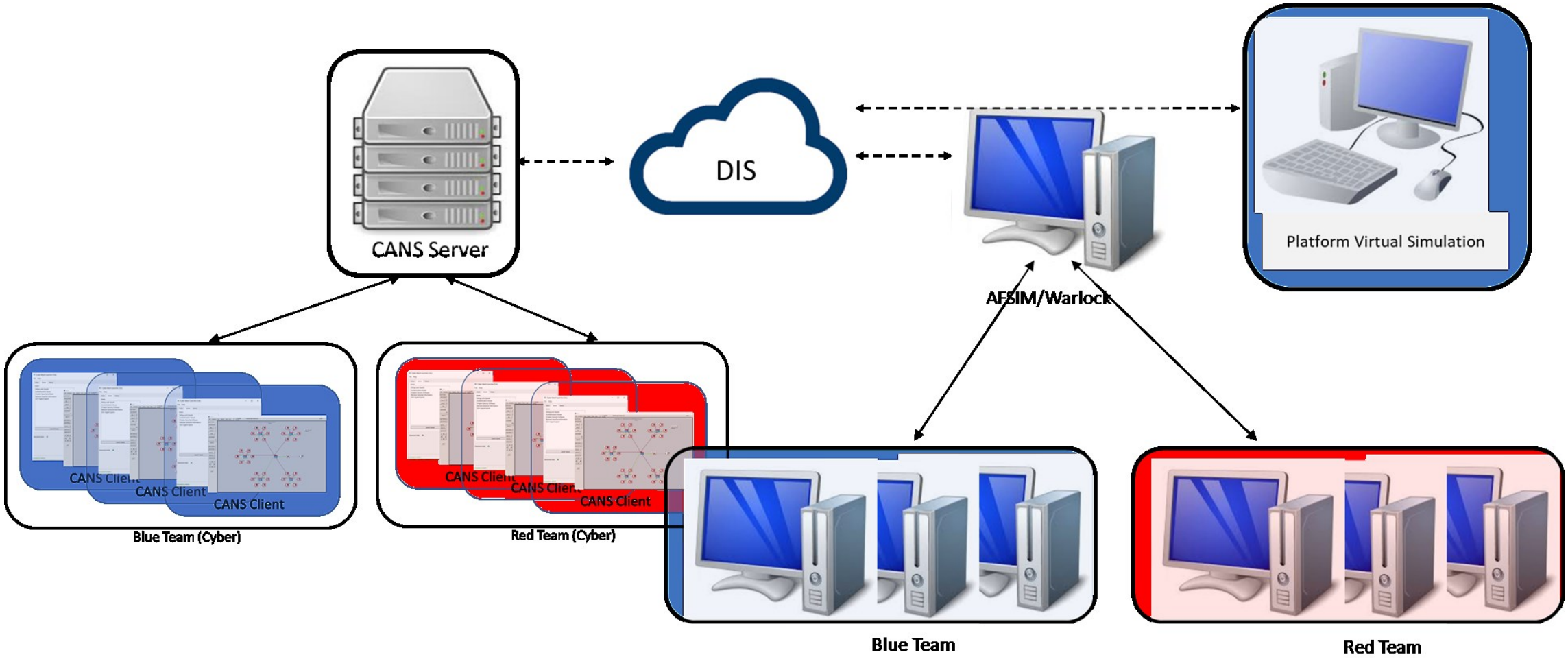
EW/Cyber Wargaming: A Madden Football Analogy





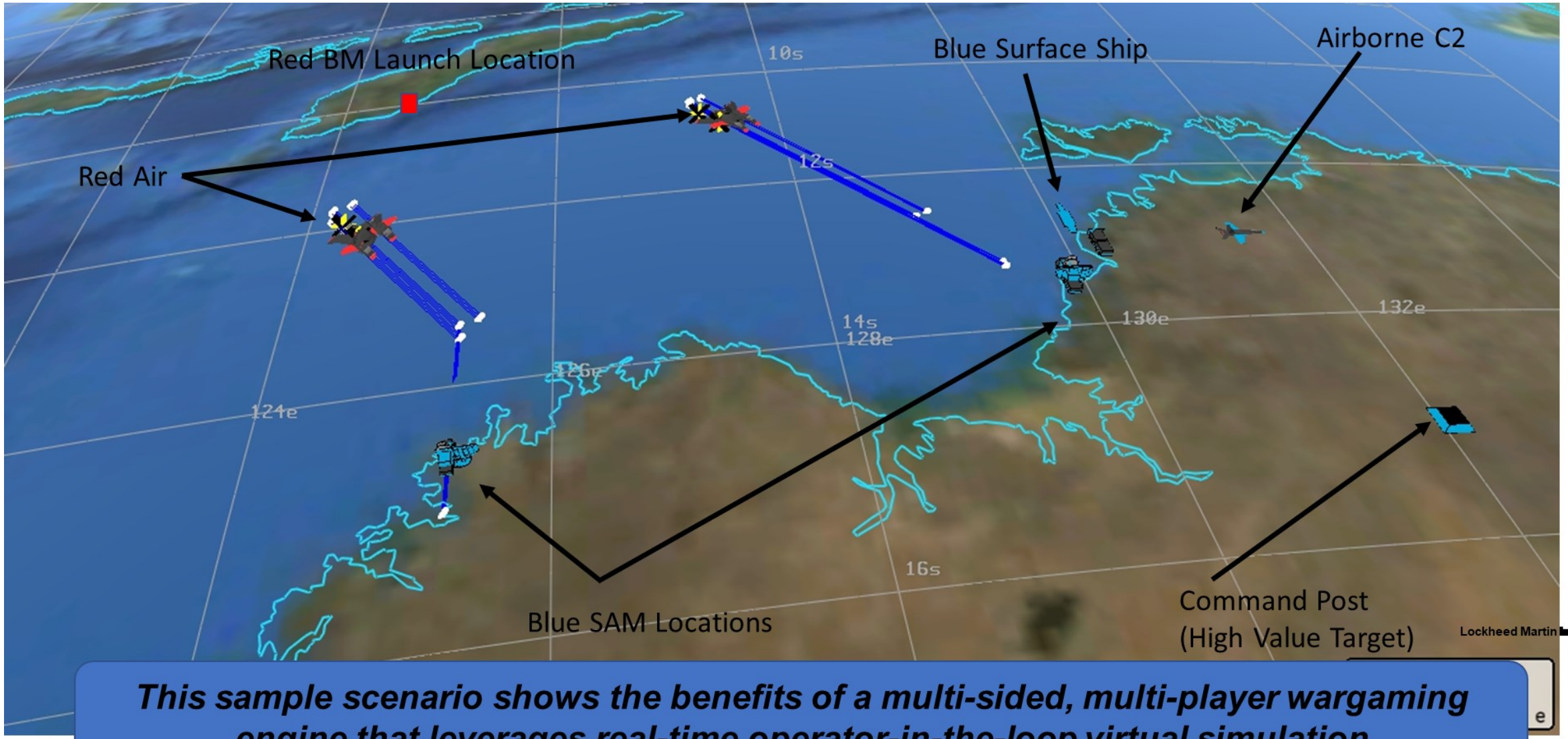
Lockheed Martin Image

CANS/AFSIM Software Architecture



Lockheed Martin Image

MDO Scenario OV-1



This sample scenario shows the benefits of a multi-sided, multi-player wargaming engine that leverages real-time operator-in-the-loop virtual simulation

Conclusion

- CANS/AFSIM Multi-Domain Wargaming Framework
  - Low Cost, Real-Time, Operator-in-the-Loop Wargaming Engine
  - Flexible scenario implementations to expose operational & capability gaps
  - Experiment with new Tactics, Techniques and Procedures (TTP)
  - Large variety of EW/Cyber exploits (offensive/defensive)

- Future Work
  - UCI messaging to bring in tactical systems
  - Mission planning tool integration
  - Artificial Intelligence, machine learning and optimization via AFSIM plug-ins

Questions?

The SPECTRUM ENERGY BATTLE

March 2019

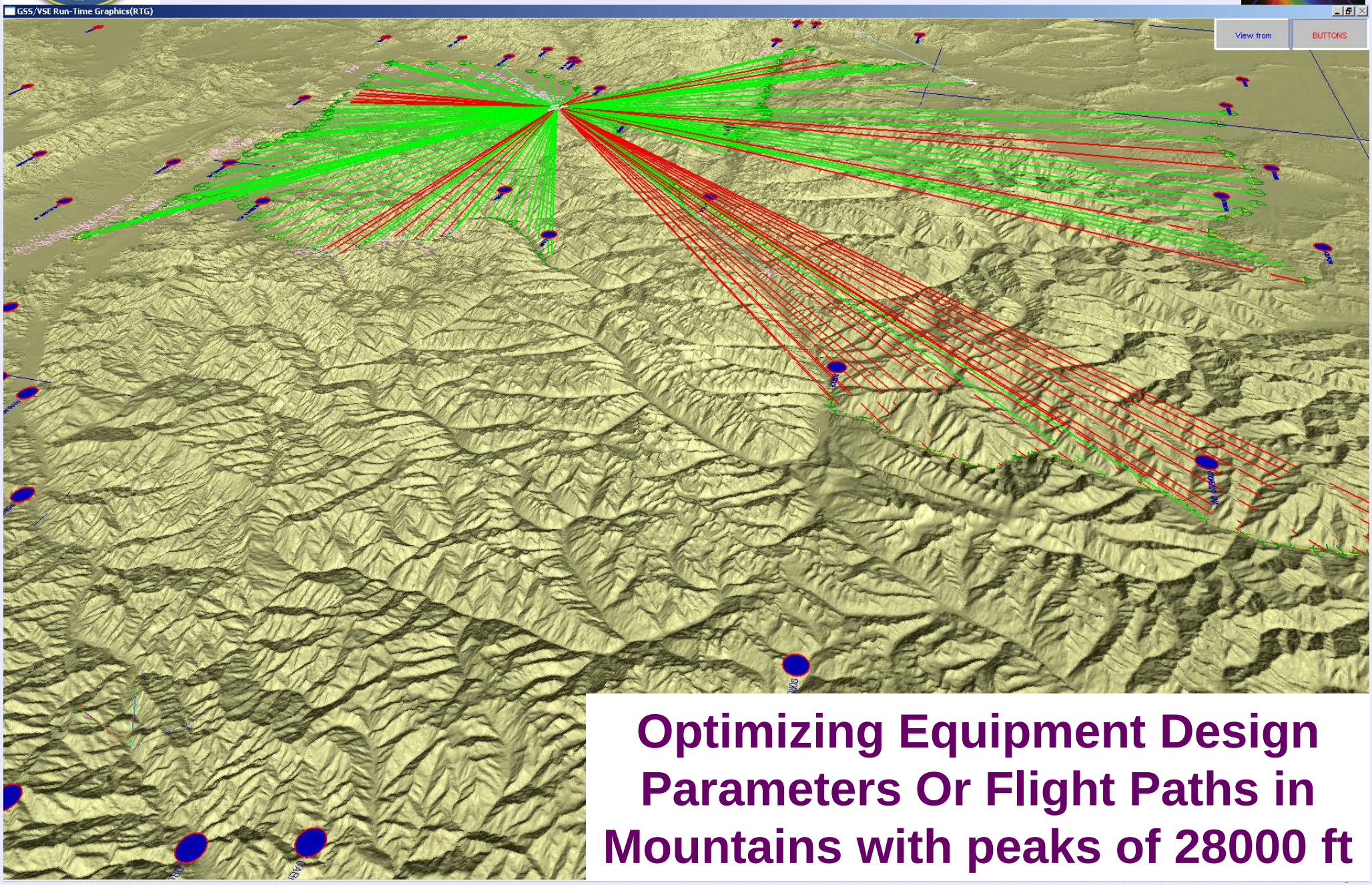
UNCLASSIFIED

The PSI
AI – AJ RADIO
Part 1

January 2019

UNCLASSIFIED

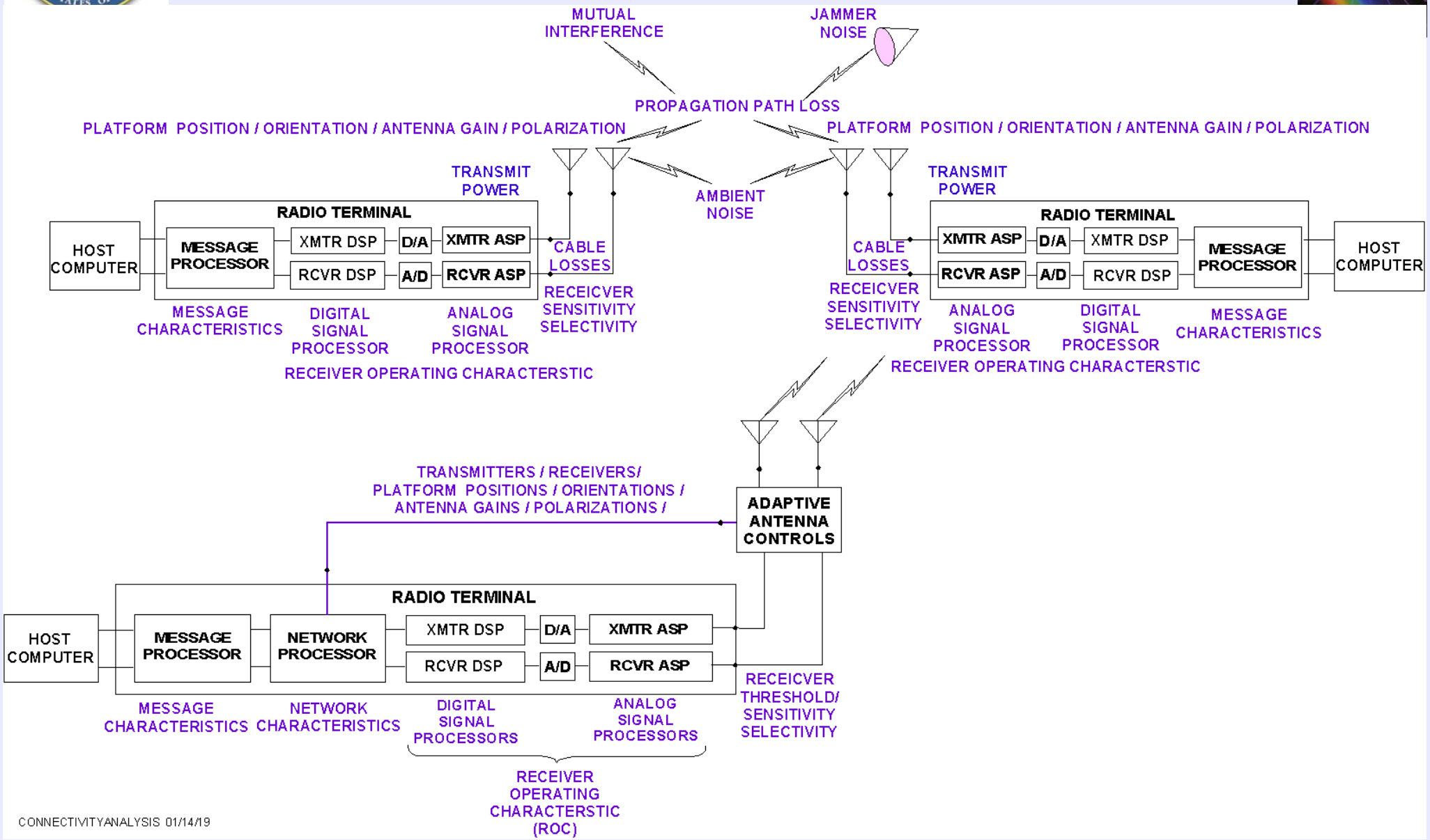
EXAMPLE REQUIREMENTS



Optimizing Equipment Design Parameters Or Flight Paths in Mountains with peaks of 28000 ft

DETERMINING CONNECTIVITY:

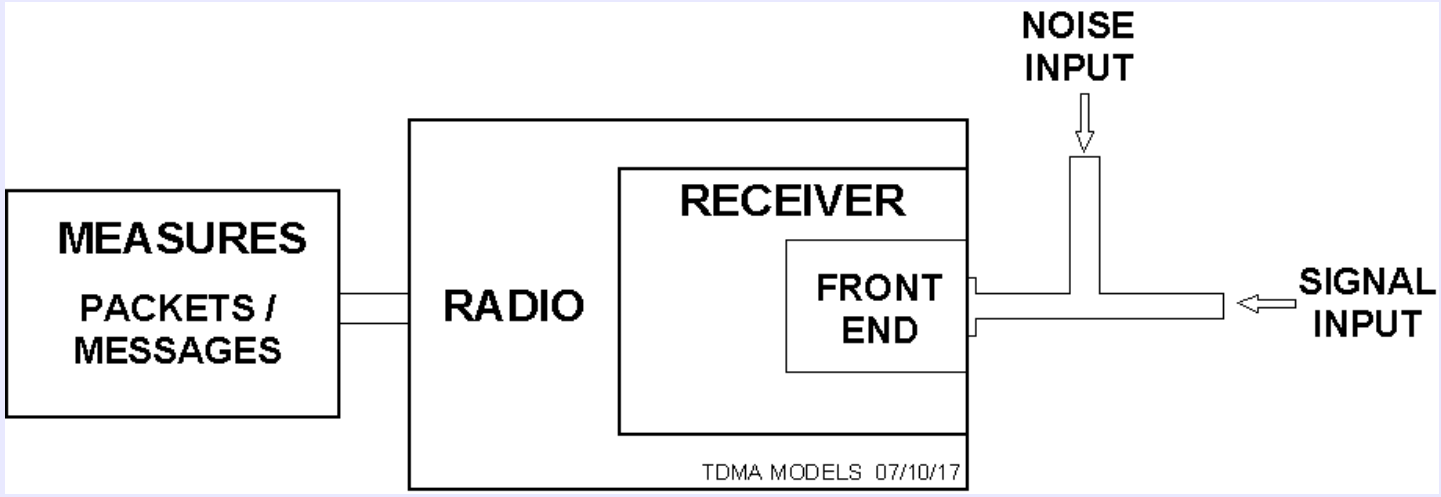
MODELS MUST ACCOUNT FOR MANY FACTORS



DEPENDS UPON: SIGNAL PROCESSING, POWER, ANTENNAS, PROPAGATION PATH LOSS, NOISE & OTHER FACTORS

Current Operational Considerations

Determining Connectivity (examples):

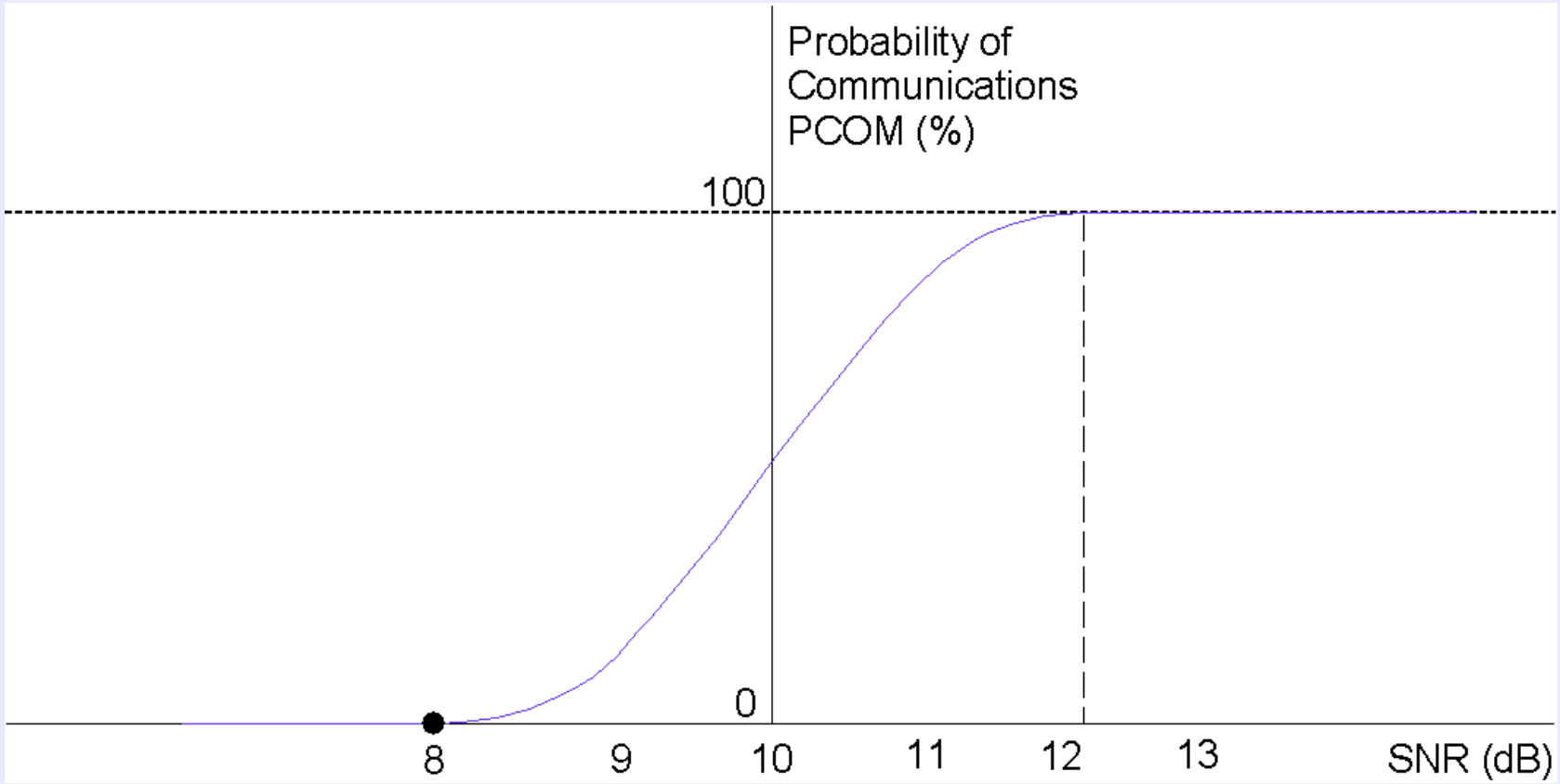


Measuring the Receiver Operating Characteristic (ROC)

(Could have multiple ROCS depending on the design.)

Current Operational Considerations

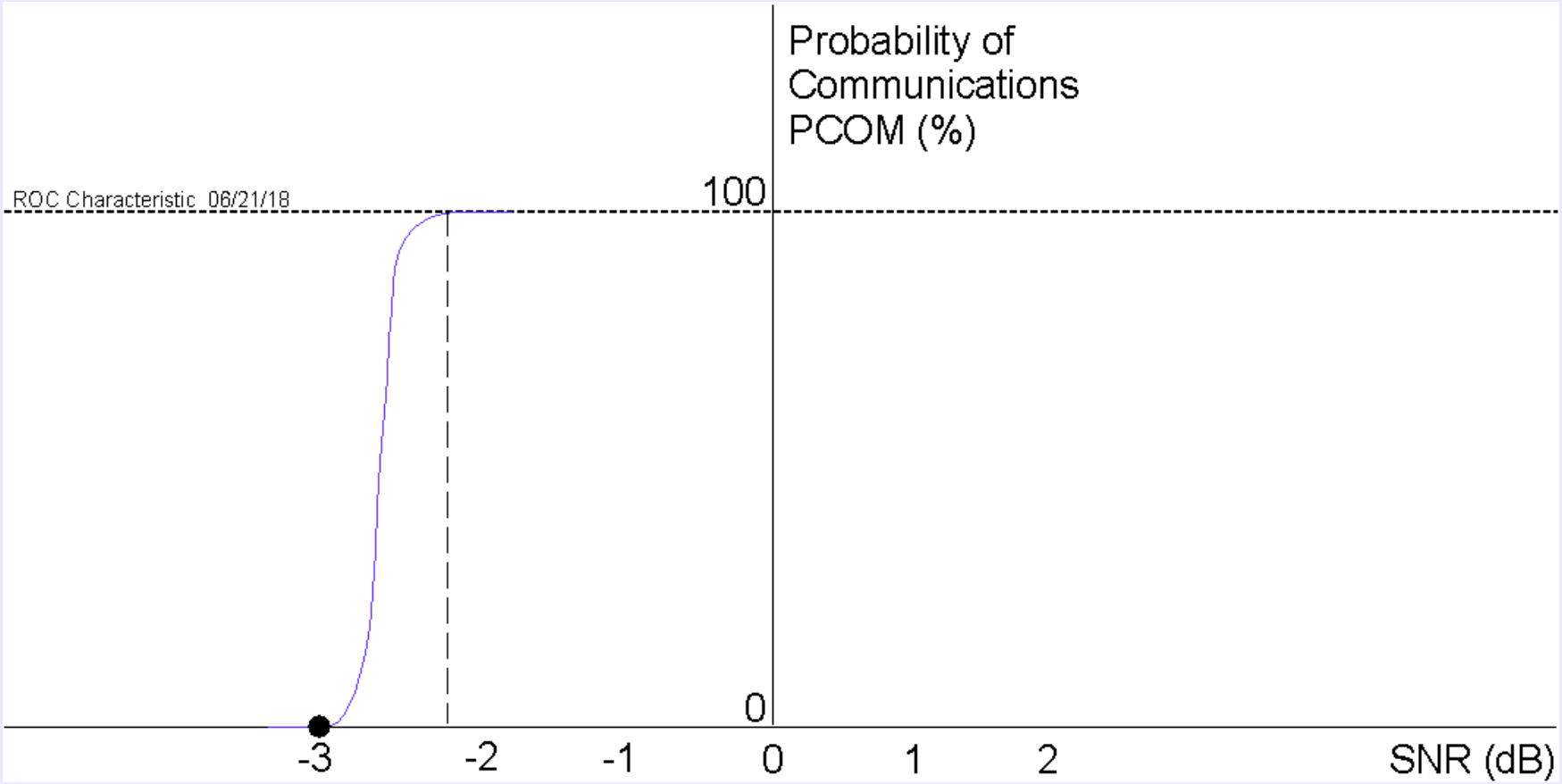
Determining Connectivity (examples):



Receiver Operating Characteristic (ROC)
- for a Soft Decision Receiver (Less DSP)

Current Operational Considerations

Determining Connectivity (examples):



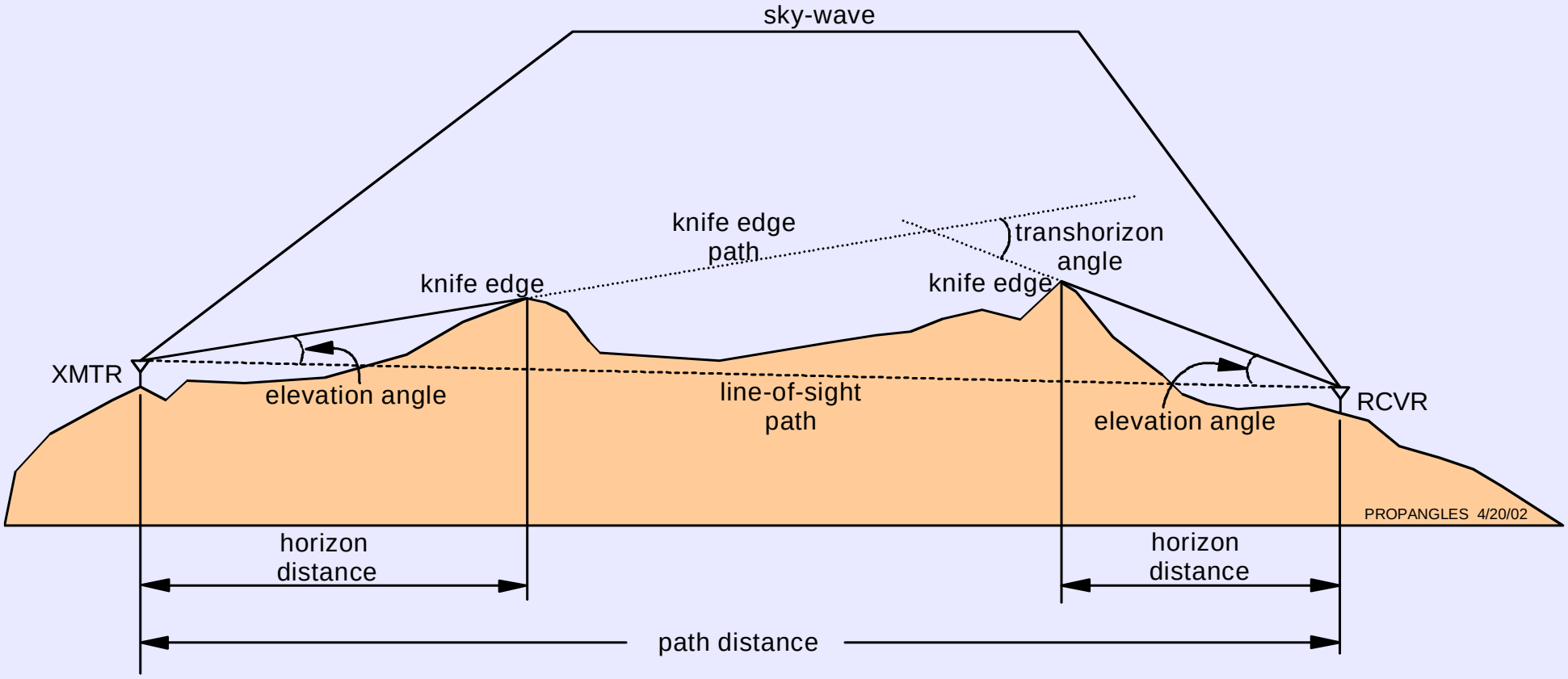
Receiver Operating Characteristic (ROC)

- for a Hard Decision Receiver - (More DSP)

- and Much improved SNR - (Better ASP)

EXAMPLE REQUIREMENTS

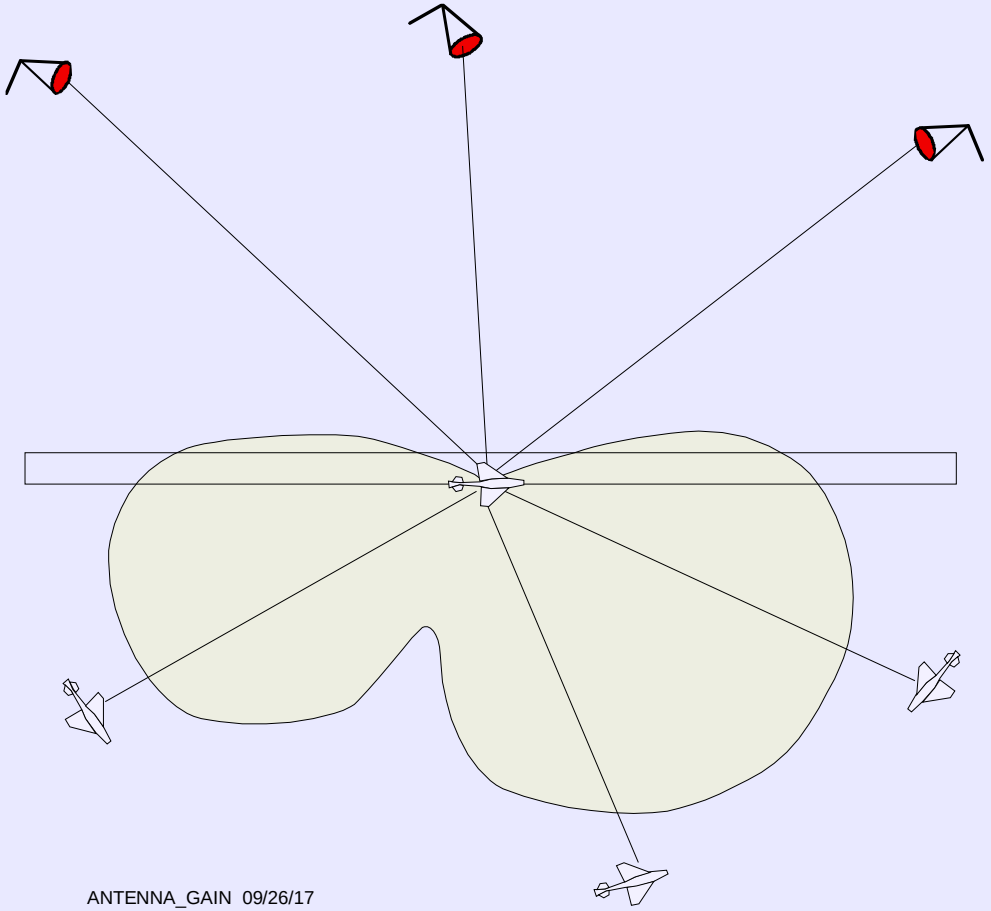
ACCURACY OF PROPAGATION PATH LOSS DEPENDS UPON: DISTANCE, ANTENNAS, TERRAIN, & OTHER FACTORS



CONNECTIVITY IS *NOT SIMPLY LINE-OF-SIGHT (LOS) !*

EXAMPLE REQUIREMENTS

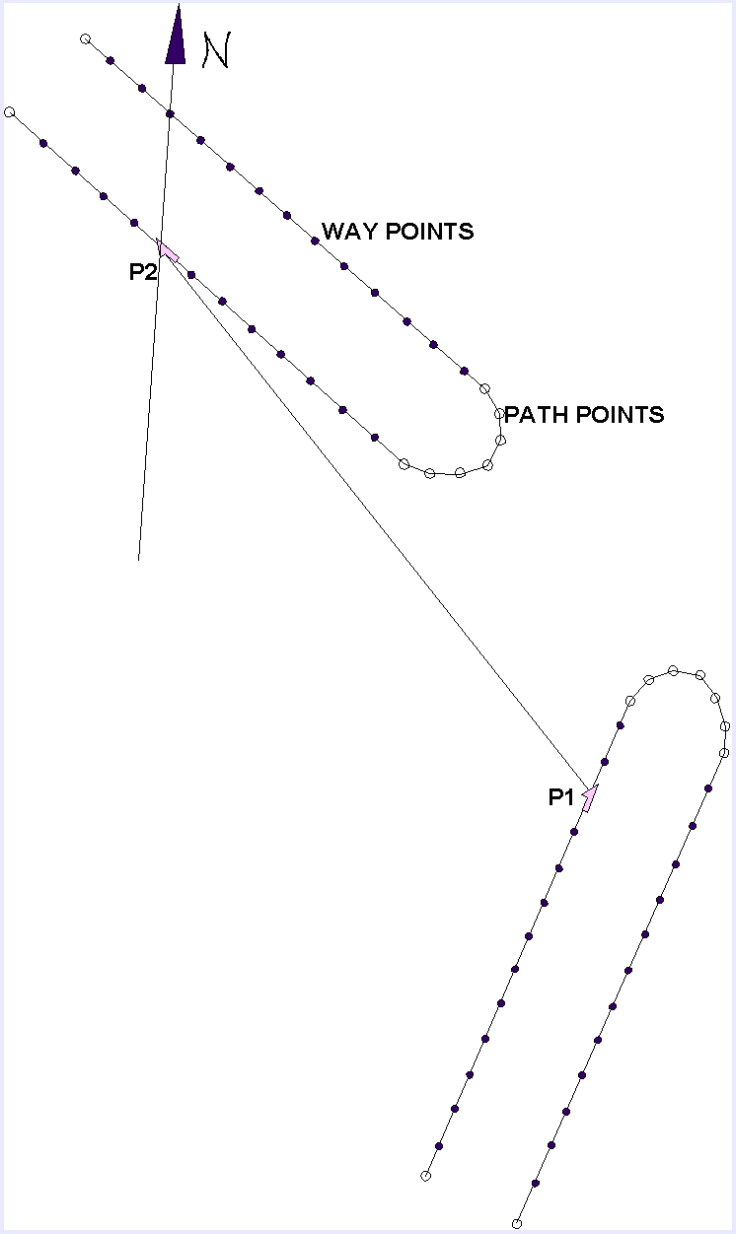
SIGNAL AT FRONT END OF RECEIVER CAN BE ENHANCED BY ANTENNA DESIGN, BOTH ON THE TRANSMITTER AND RECEIVER;



SMART ANTENNAS CAN ADAPT TO THEIR ENVIRONMENT

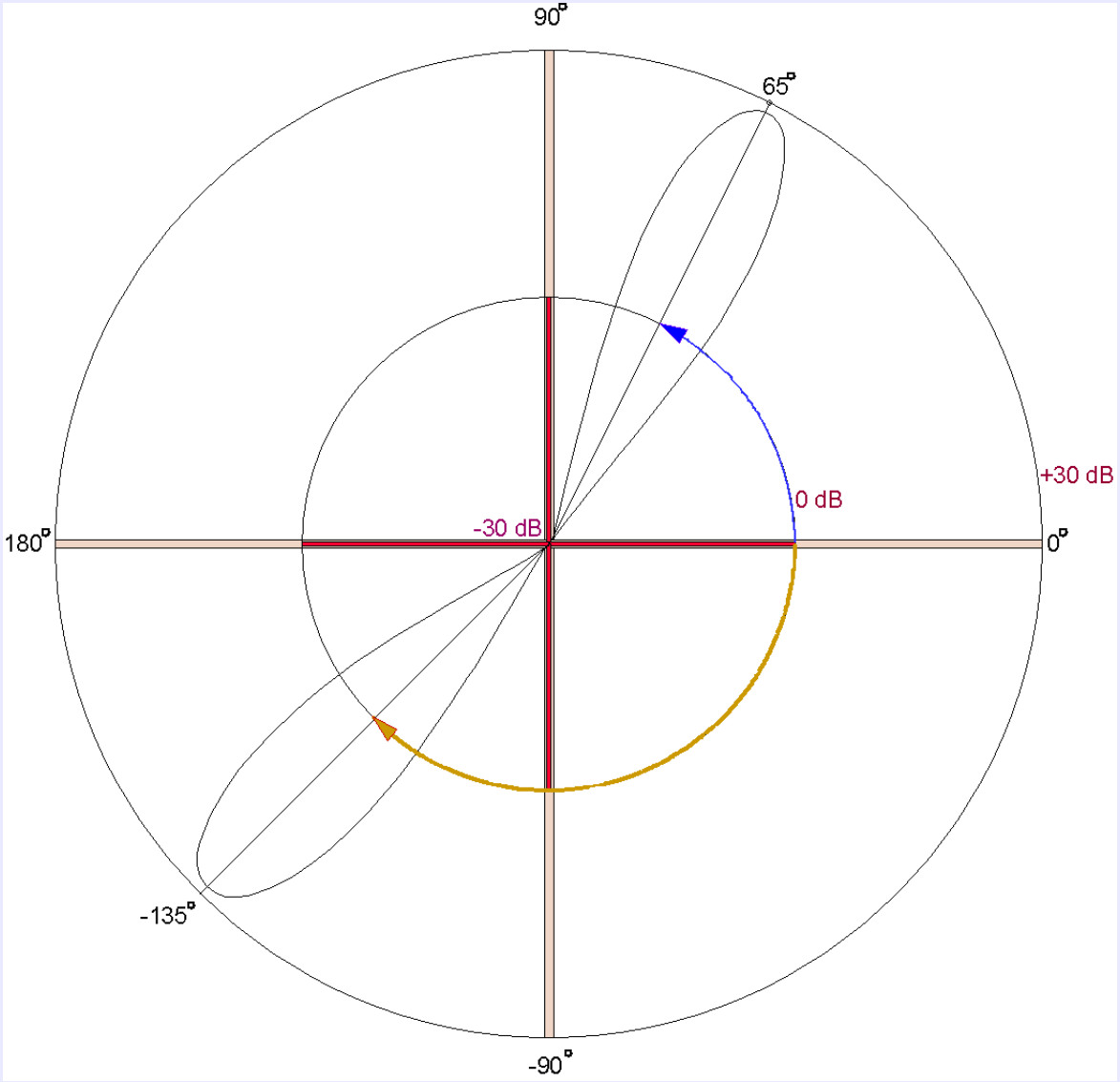
EXAMPLE REQUIREMENTS

SIGNAL AT FRONT END OF RECEIVER CAN BE ENHANCED BY ANTENNA DESIGN, BOTH AT THE TRANSMITTER AND THE RECEIVER;



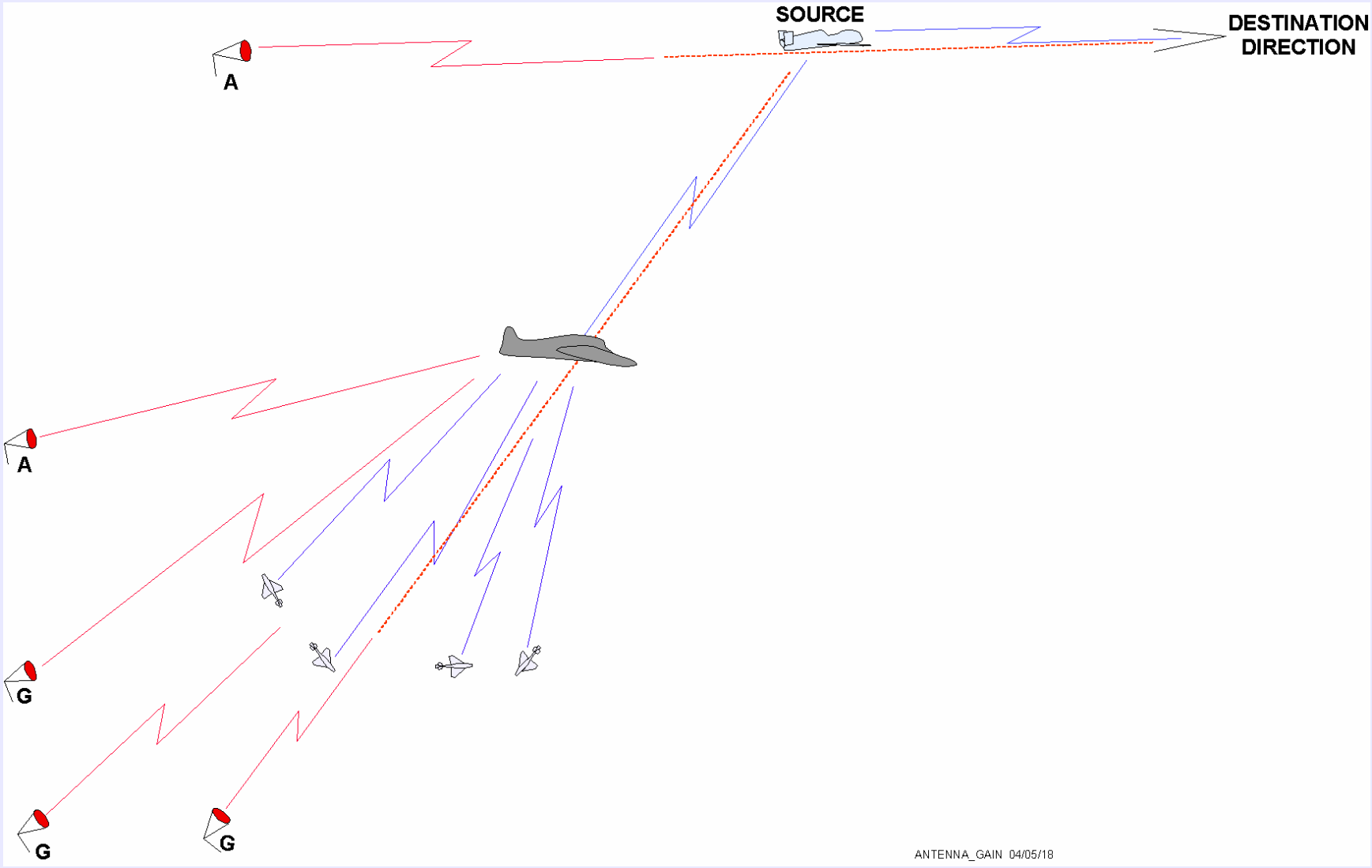
SMART ANTENNAS CAN ADAPT TO THEIR ENVIRONMENT

Current Operational Considerations



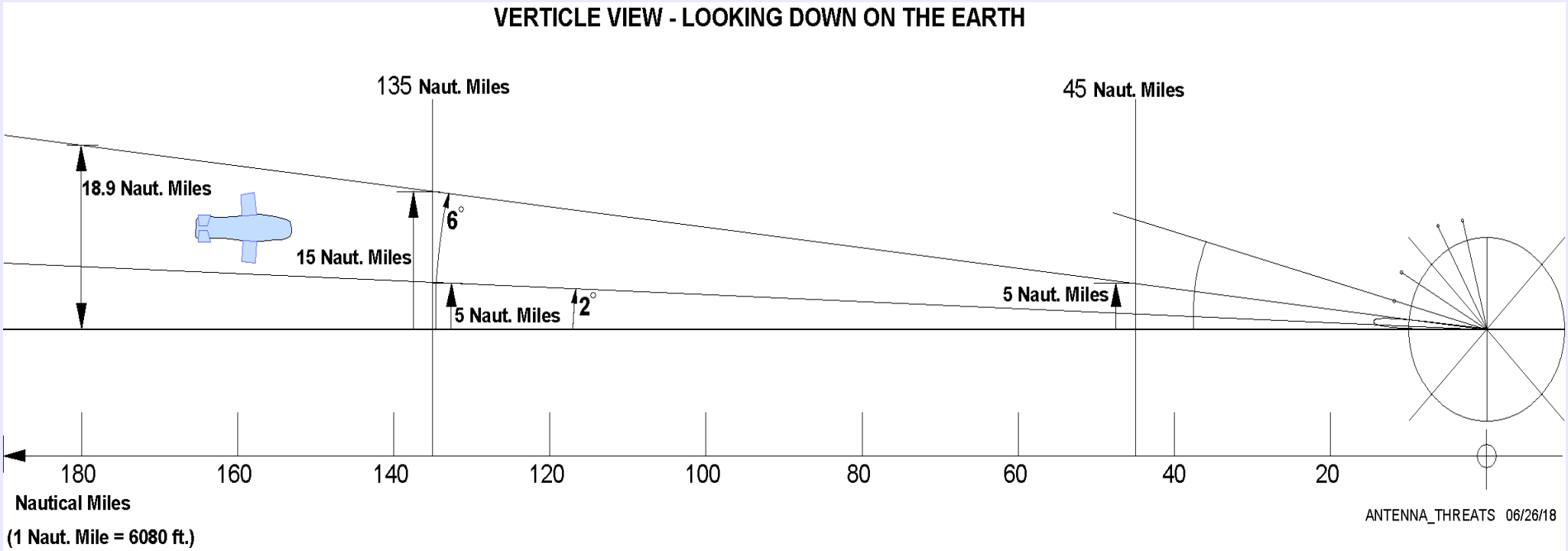
Determining Connectivity – Example Factors:

Current Operational Considerations



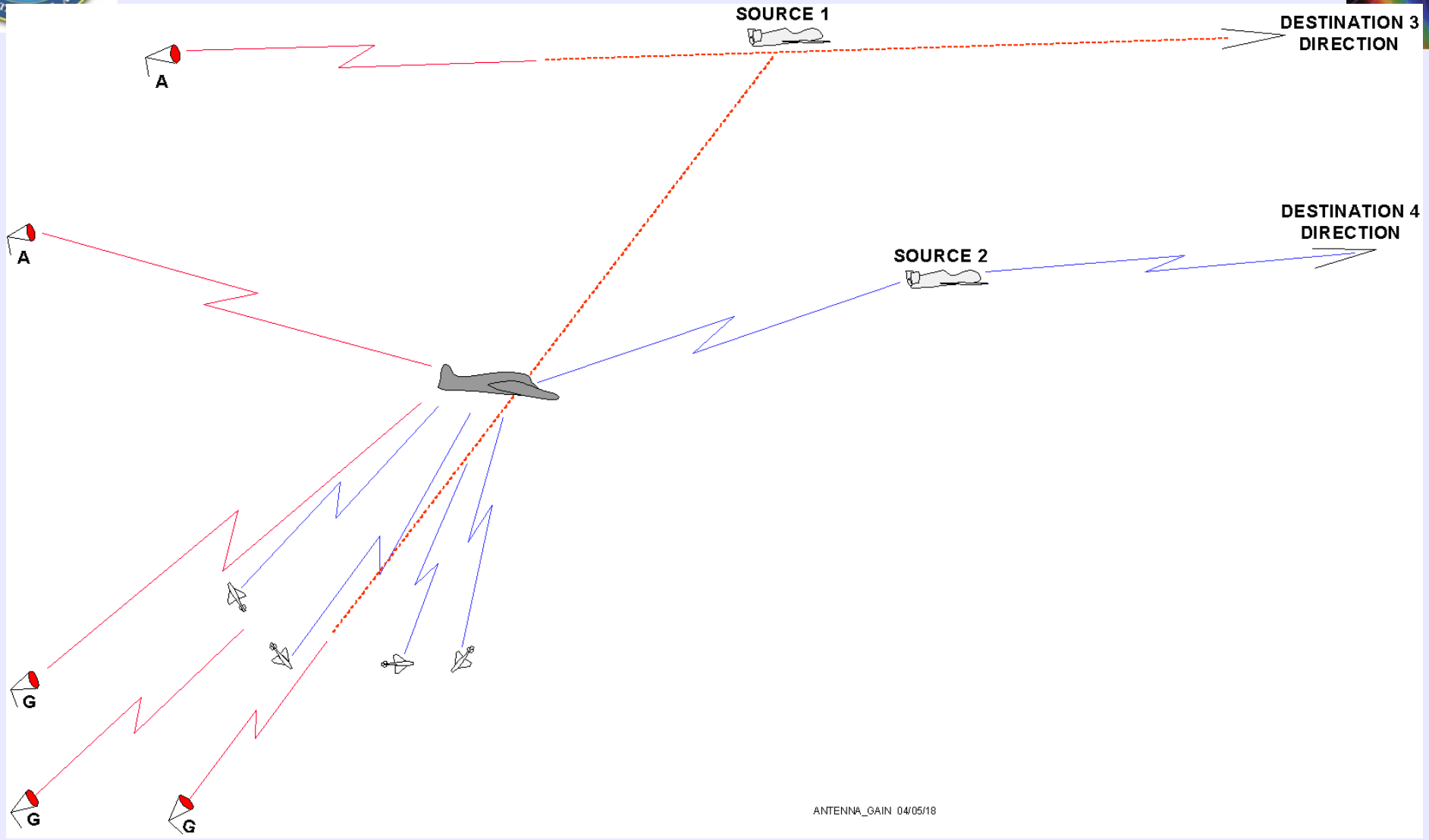
Determining Connectivity – Example Factors:

Current Operational Considerations



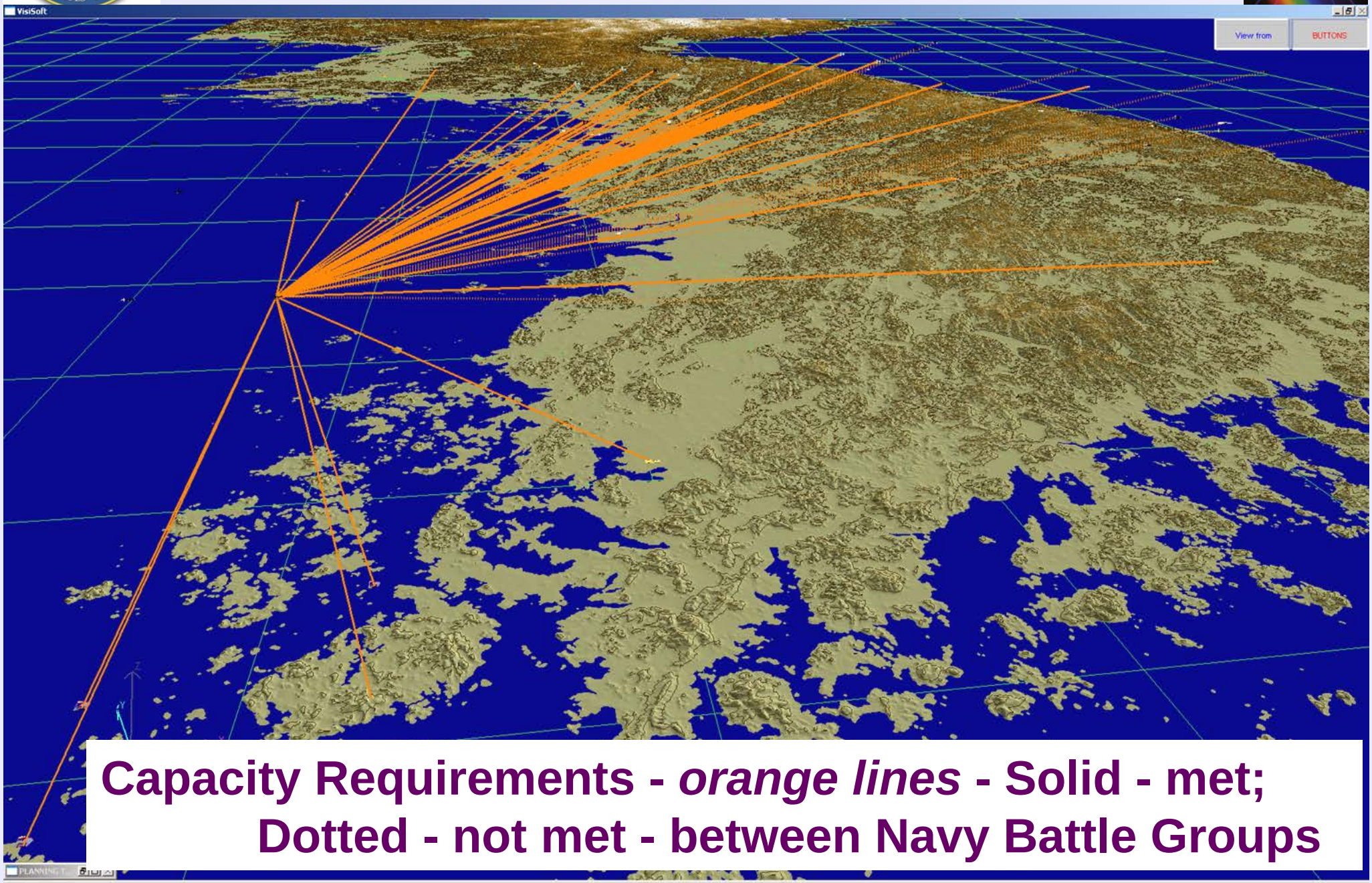
Determining Connectivity – Example Factors:

Current Operational Considerations



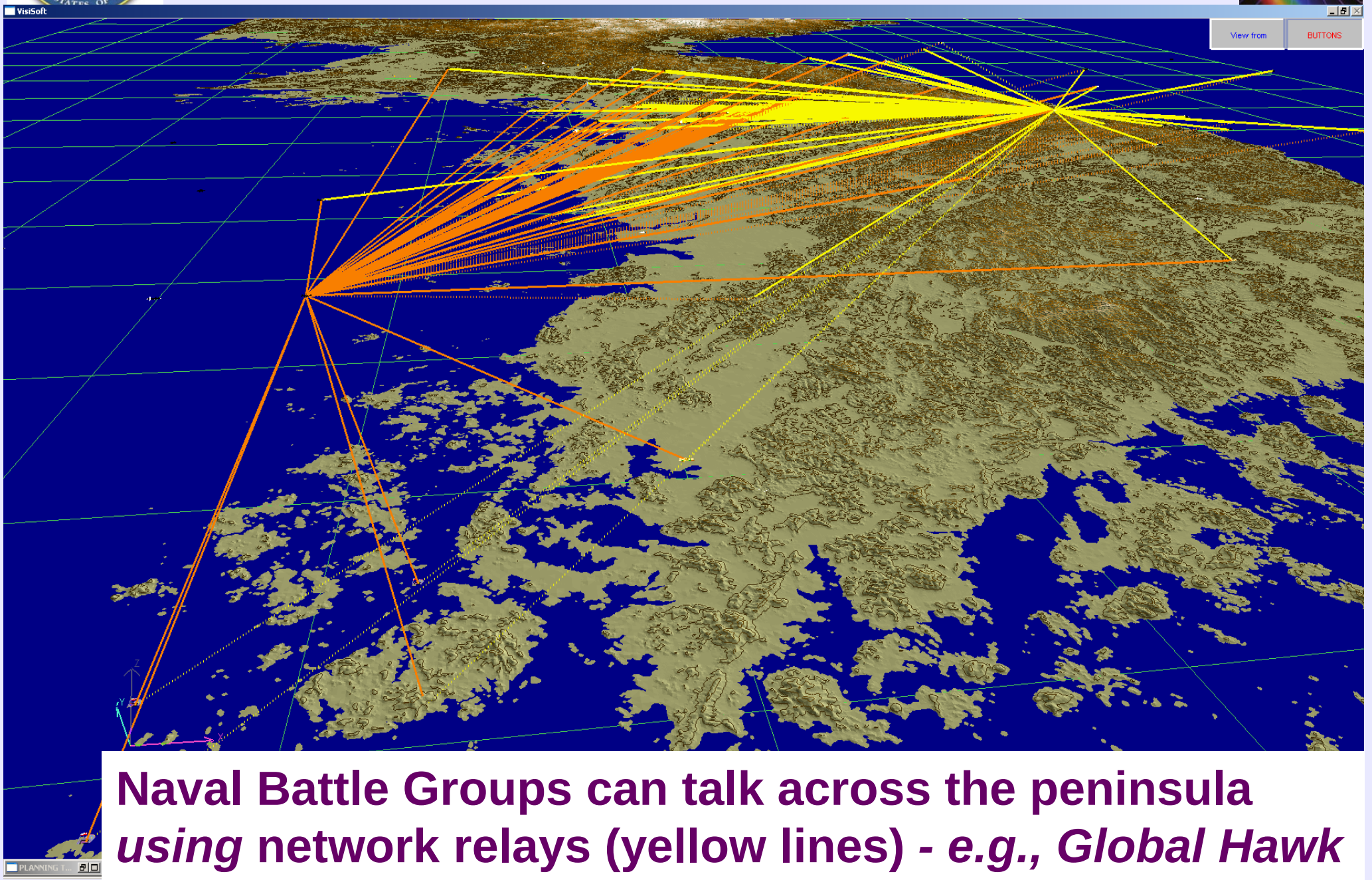
Ensuring Connectivity Requirements are met Using a NETWORK

EXAMPLE REQUIREMENTS



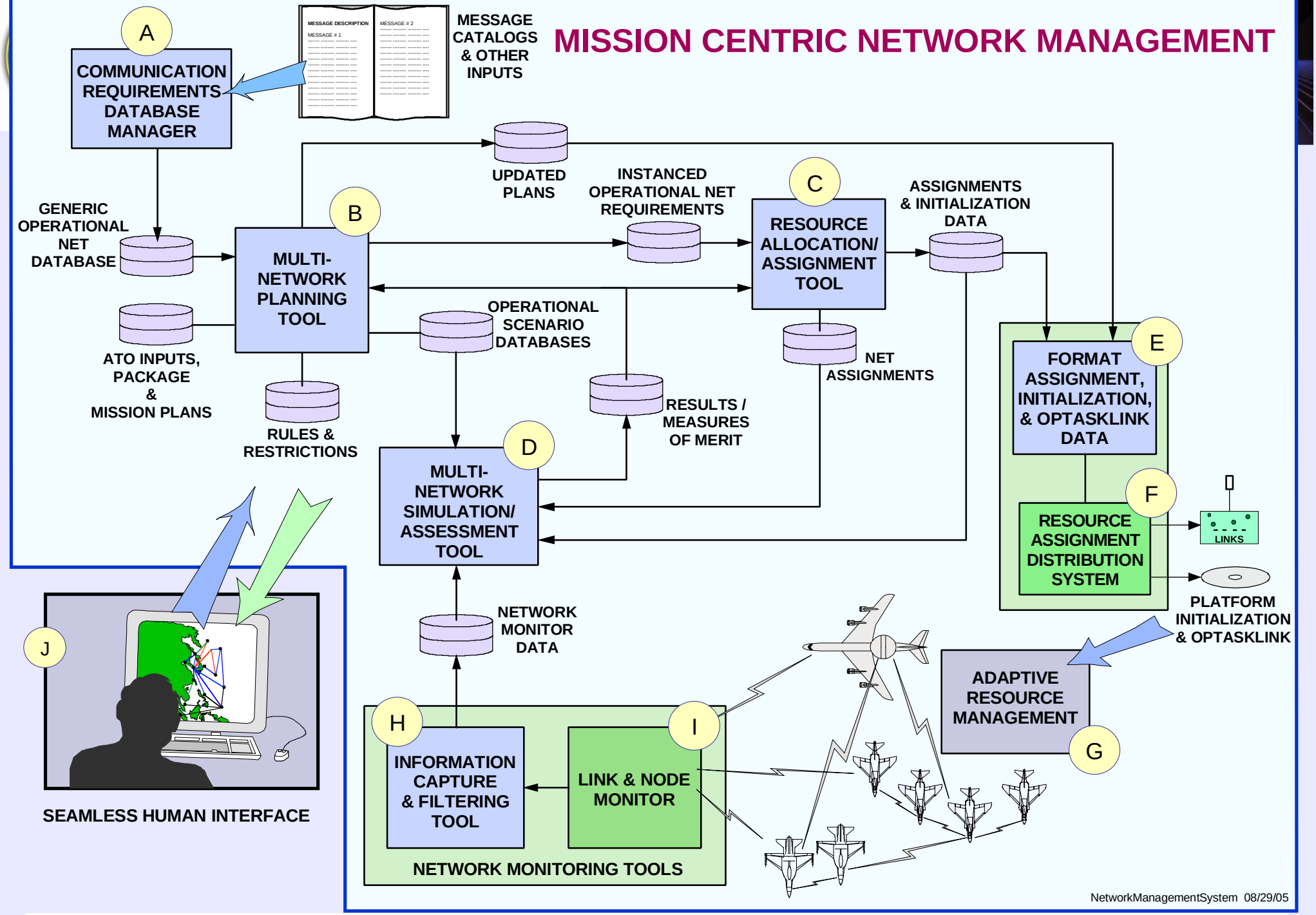
Capacity Requirements - *orange lines* - Solid - met;
Dotted - not met - between Navy Battle Groups

EXAMPLE REQUIREMENTS



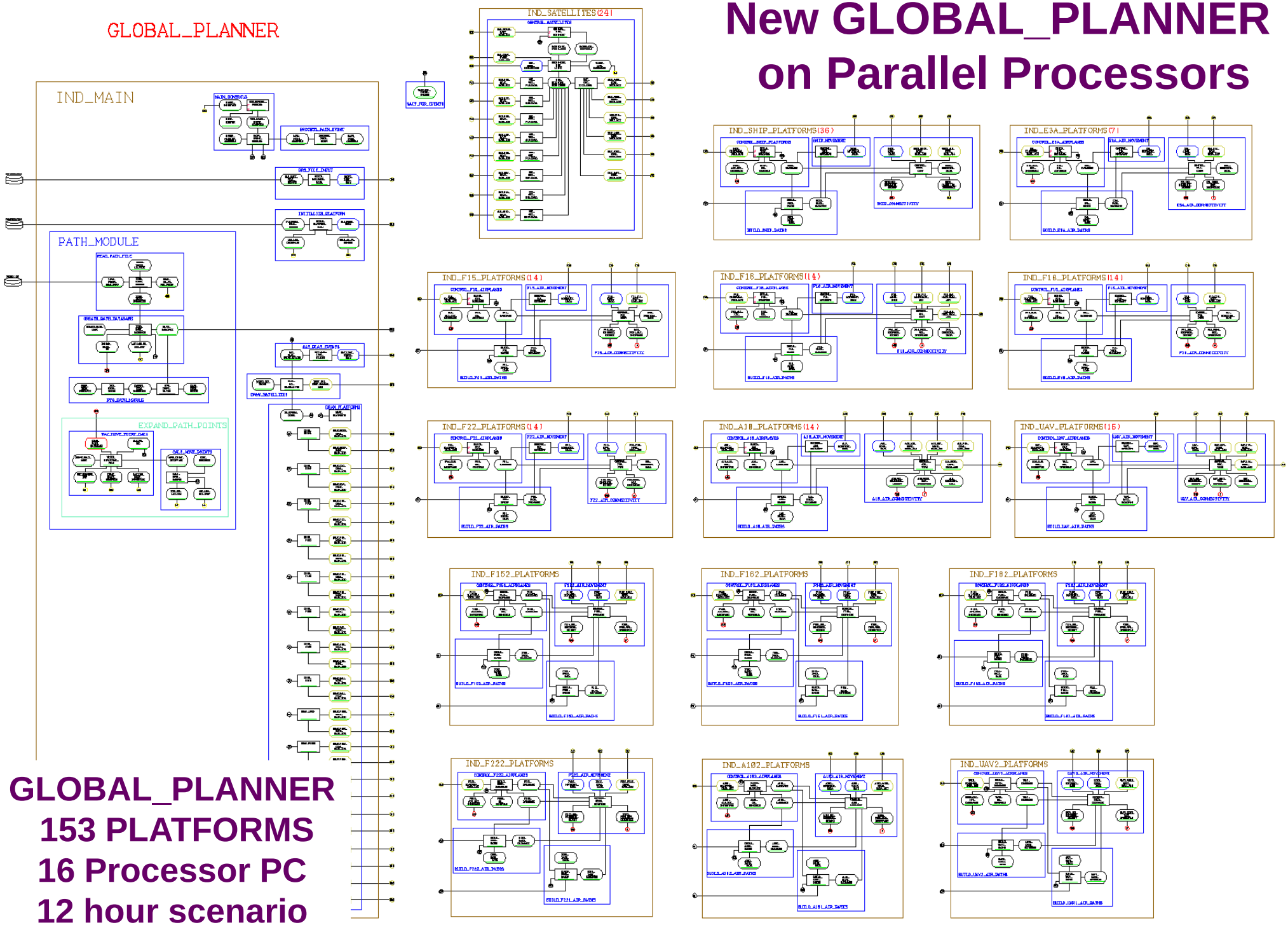
Naval Battle Groups can talk across the peninsula *using* network relays (yellow lines) - *e.g., Global Hawk*

MISSION CENTRIC NETWORK MANAGEMENT



THIS REQUIRES A NETWORK MANAGEMENT SYSTEM

New GLOBAL_PLANNER on Parallel Processors



GLOBAL_PLANNER
153 PLATFORMS
16 Processor PC
12 hour scenario
2.31 seconds

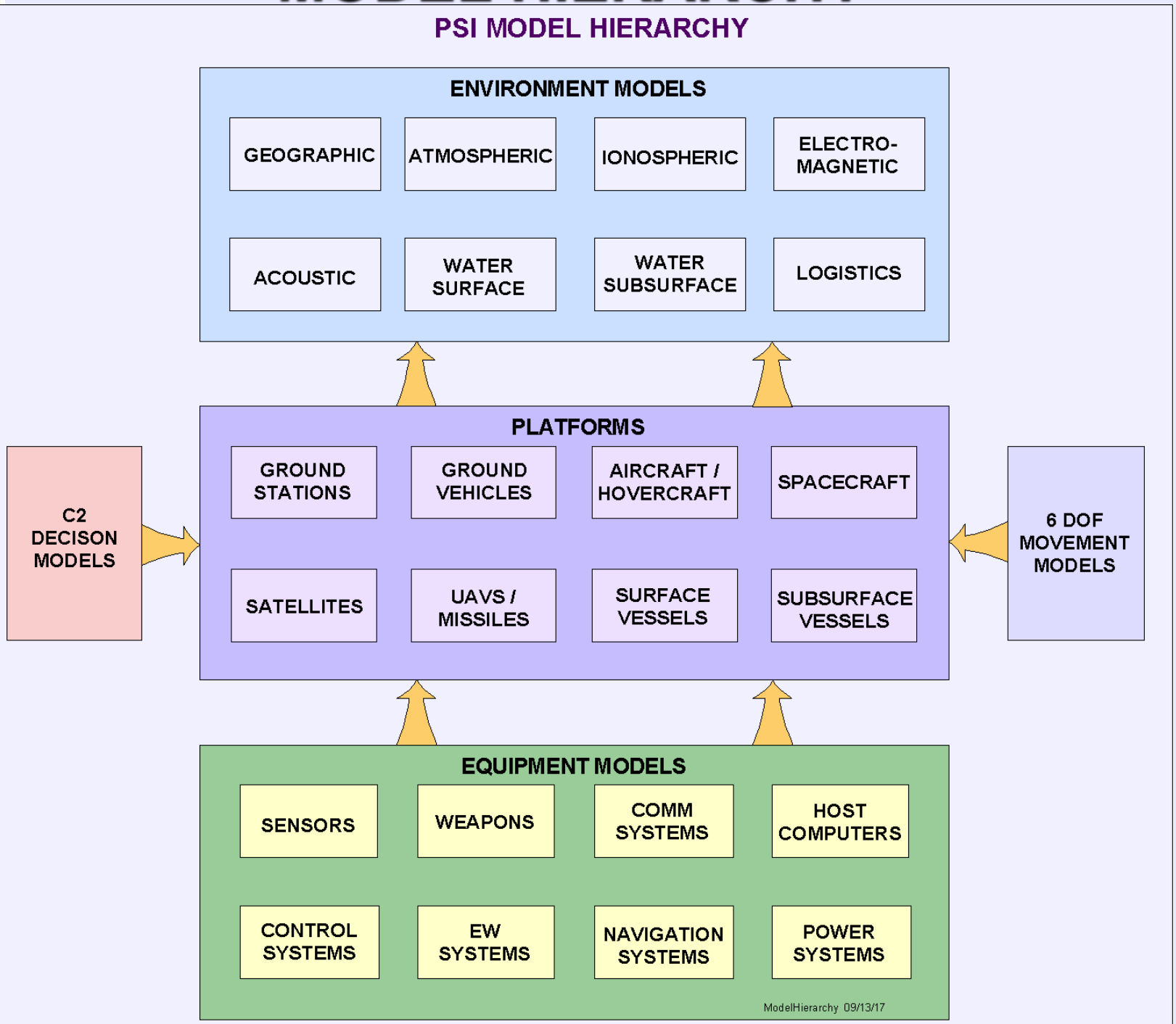
Example Operational Considerations

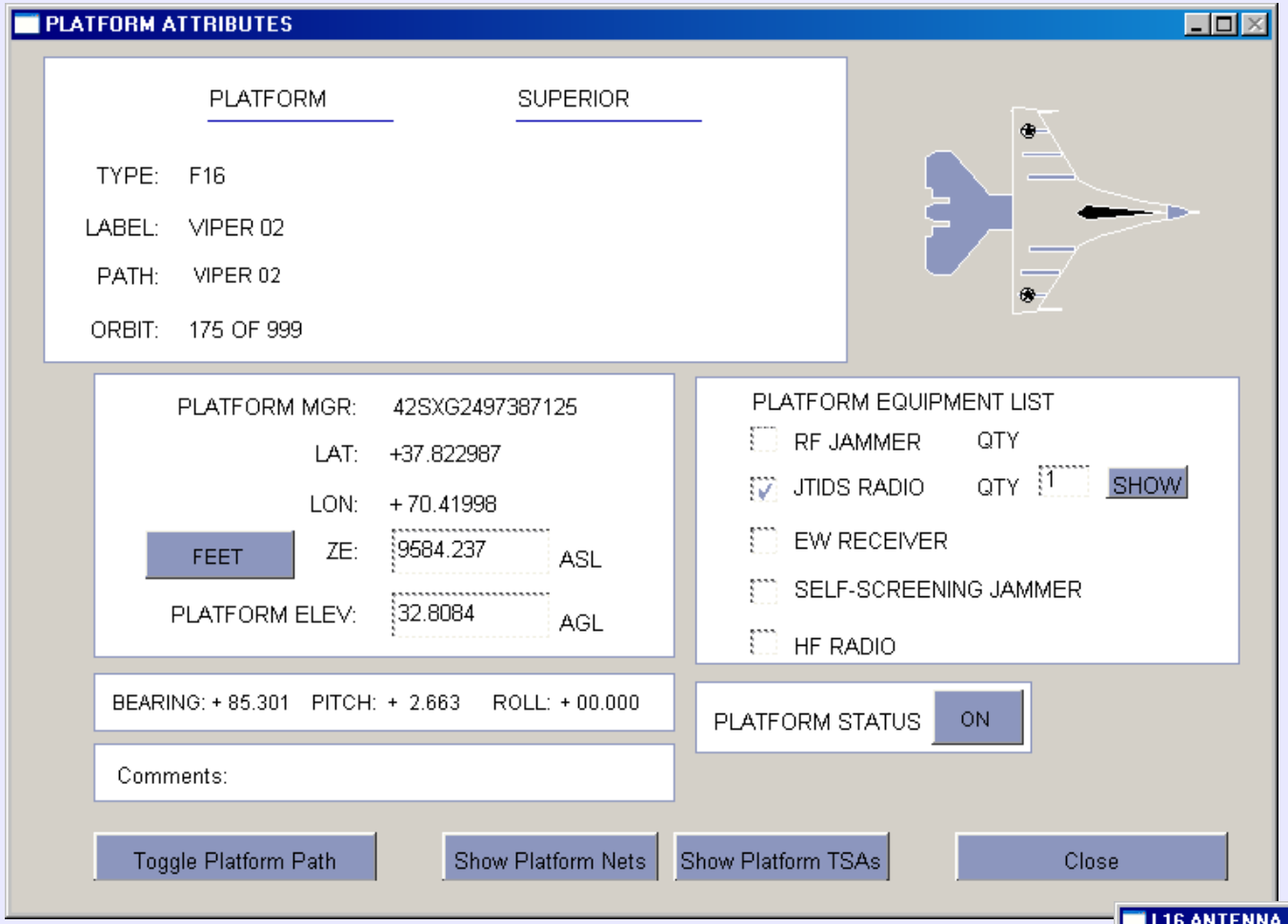
Jammer Power: 10000 Watts, UAV Power: 1000 Watts, ROC: -15 dB														
	U1	U2	U3	U4	U5	U6L	PE	AW	RJ	R1	R2	R3	SH	Total
U1		100%	30%	30%	100%	70%								66%
U2	100%		0%	0%	100%	15%								43%
U3	100%	100%		100%	100%	100%								100%
U4	100%	100%	100%		100%	100%								100%
U5	100%	100%	100%	52%		100%								90%
U6L	100%	100%	100%	100%	100%		0%	0%	0%	0%				56%
PE						100%		100%	100%	100%	52%	0%		75%
AW						100%	100%		100%	100%	100%	0%		83%
RJ						100%	100%	100%		100%	100%	0%		83%
R1						100%	100%	100%	74%					94%
R2							100%	100%	100%			100%	0%	80%
R3							0%	0%	0%		100%		100%	40%
SH											0%	100%		50%
Total	100%	100%	66%	56%	100%	87%	67%	67%	62%	75%	70%	40%	50%	74%

Jammer Power: 10000 Watts, UAV Power: 1000 Watts, ROC: -25 dB														
	U1	U2	U3	U4	U5	U6L	PE	AW	RJ	R1	R2	R3	SH	Total
U1		100%	100%	100%	100%	100%								100%
U2	100%		100%	100%	100%	100%								100%
U3	100%	100%		100%	100%	100%								100%
U4	100%	100%	100%		100%	100%								100%
U5	100%	100%	100%	100%		100%								100%
U6L	100%	100%	100%	100%	100%		0%	0%	0%	33%				59%
PE						100%		100%	100%	100%	100%	0%		83%
AW						100%	100%		100%	100%	100%	0%		83%
RJ						100%	100%	100%		100%	100%	0%		83%
R1						100%	100%	100%	100%					100%
R2							100%	100%	100%			100%	0%	80%
R3							0%	0%	0%		100%		100%	40%
SH											0%	100%		50%
Total	100%	100%	100%	100%	100%	100%	67%	67%	67%	83%	80%	40%	50%	83%

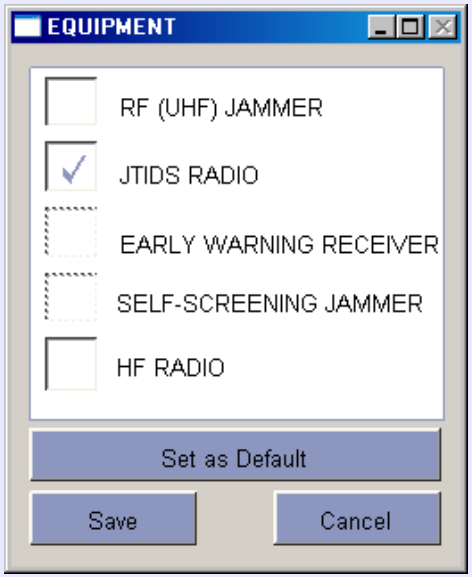
Parametric Analysis of % Connectivity

MODEL HIERARCHY

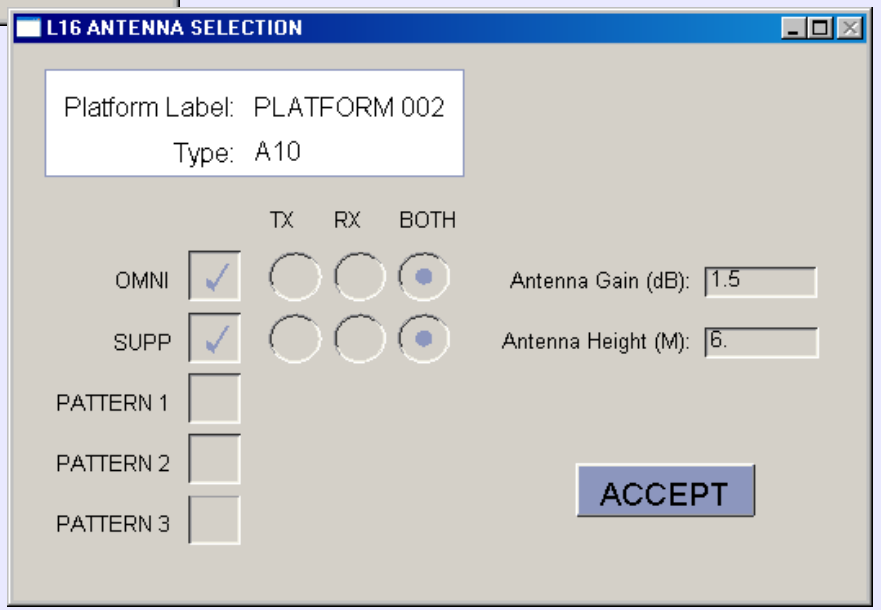




Automatic Development of Simulations



Selecting Models & Parameters



PREDICTION SYSTEMS, INC.

PREDICTION & CONTROL SYSTEMS ENGINEERS

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Spring Lake, NJ 07762

Telephone: (732) 449-6800
Fax: (732) 449-0897

Web Site: www.predictsys.com
E-Mail: psi@predictsys.com

2019 Cyber-Augmented Operations Division Spring Conference

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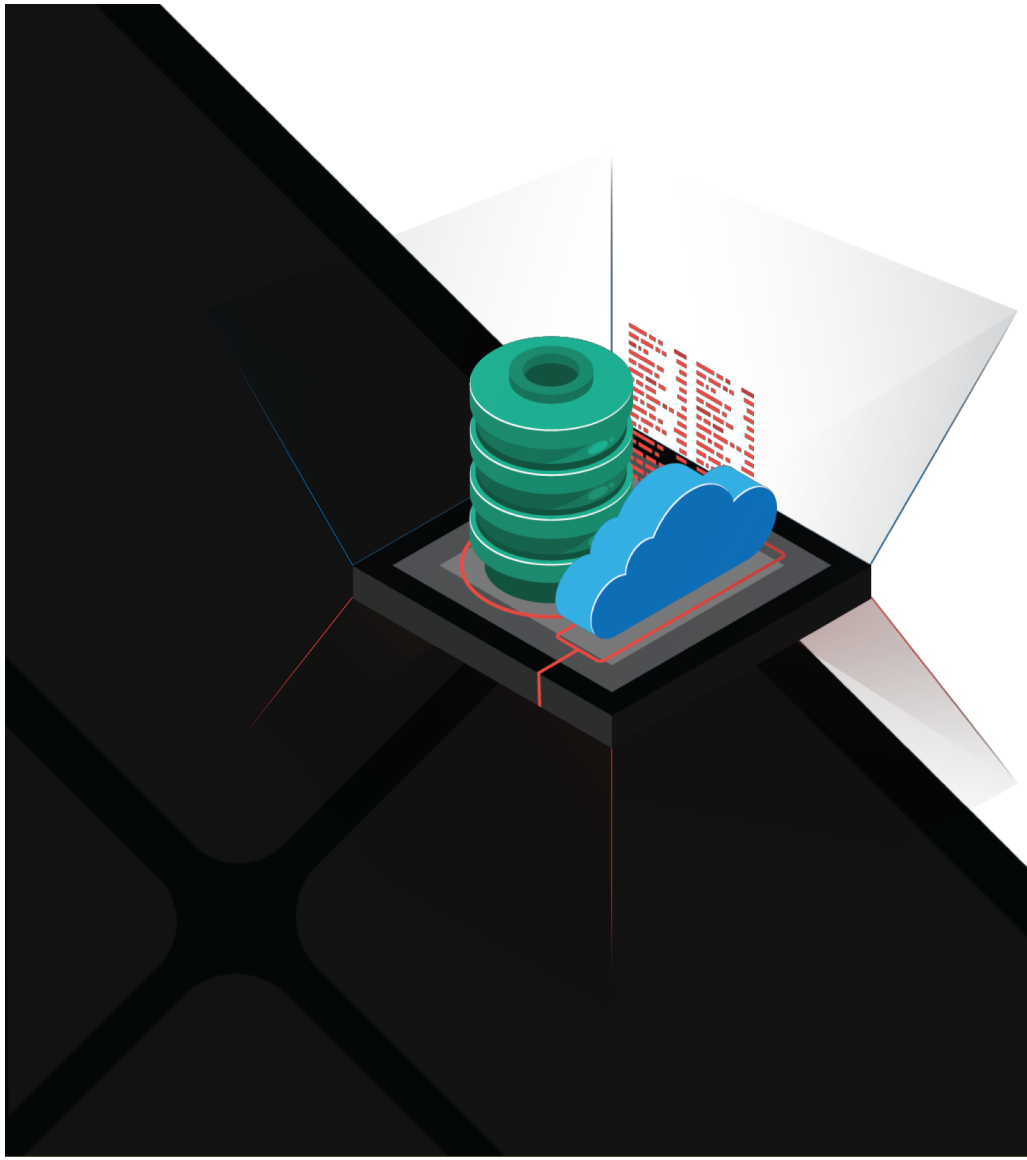


Using Data Analytics to Optimize Content Effectiveness

Steve Gray's Career

Mathematician & Computer Scientist

Developed graphical displays and C&C systems for the Strategic Defense Initiative.

Heavy Iron Studios Founder (sold to THQ)

Steve's *Lord of the Rings* games at Electronic Arts generated >US$1B at retail

Head of Production Tencent Games China 2009 – 2017

2017 revenue $15.6B

Under Steve, market share grew from 15% to 65%

Asteri Founder & CEO

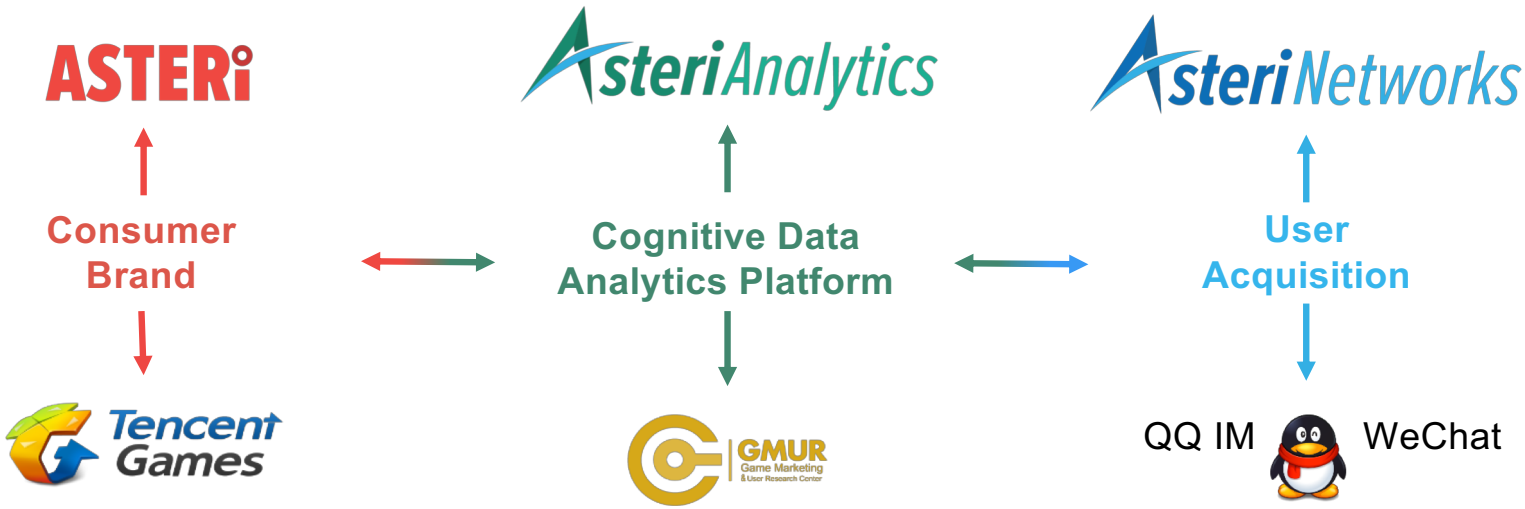

AIR FORCE GLOBAL STRIKE COMMAND
cyber innovation center
Collaboration • Research • Technology
CITY OF SHREVEPORT
UNION • JUSTICE • CONFIDENCE
LOUISIANA

How Did This Work At Tencent?

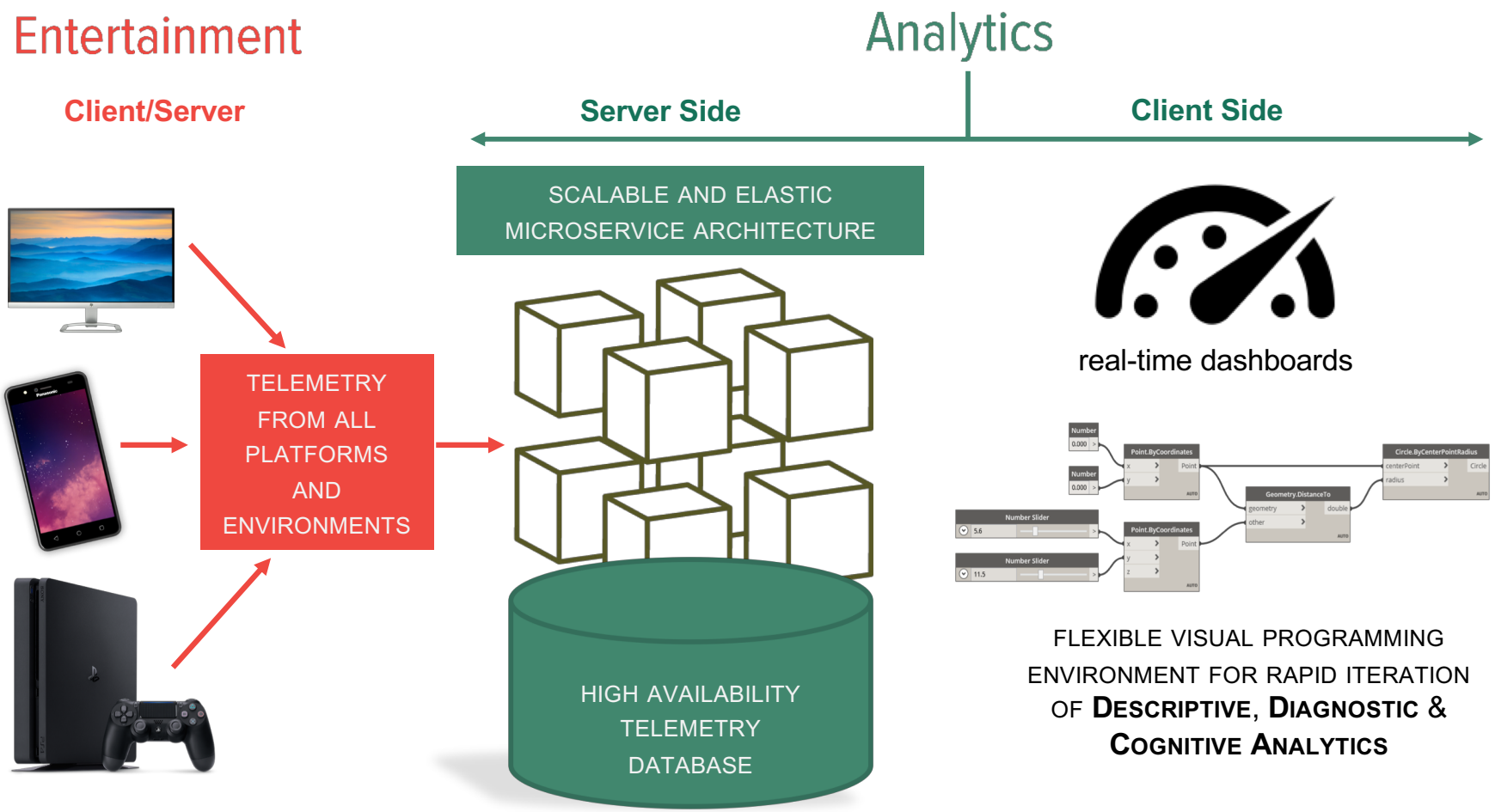
Steve Gray was the principal architect of Tencent Games' data-driven IP development, publishing and operations method which drove Tencent's China market share from 15% to **65%**.

Asteri's solution combines web, mobile and social media platforms to provide a zero cost customer acquisition solution.

Our revolutionary data analytics platform enables the reliable development, publishing & operation of online entertainment.



Predictive Audience Analytics™ Platform



Business Level Metrics

Key Performance Indicators (KPI) are needed to maximize success.
KPIs apply to all businesses but Apps have specific metrics.

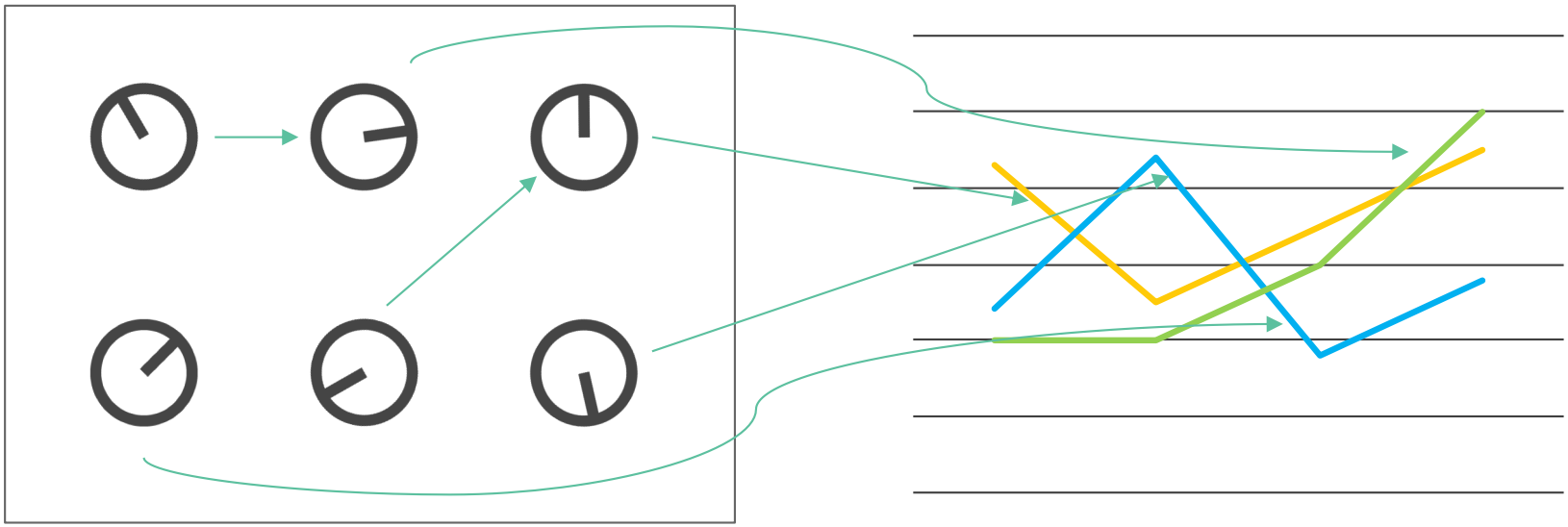
BUSINESS LEVEL	GAMES	CUSTOMER SERVICE	C2C COMMERCE
MUV Monthly Unique Viewers	Average Daily Play Time	User Inquiries	Potential sales initiated
MAU Monthly Average Users	Games per Session	Quits without final results	Click through rate
DAU Daily Average Users	Player Attach Rate	Time on hold	Closed sales
PCU Peak Concurrent Users	Revenue per Player	Staff interaction time	Average transaction size
ACU Average Concurrent Users	Revenue per day	Staff interaction percent	Average monthly transactions
Weekly Return Rate		Ticket escalation percent	Abandoned shopping carts
Monthly Return Rate			

Connecting Telemetry to Business Level Metrics

Think of Applications as having many knobs which are connected to both each other and to KPIs.

Some of the knobs are known, some you need to discover.

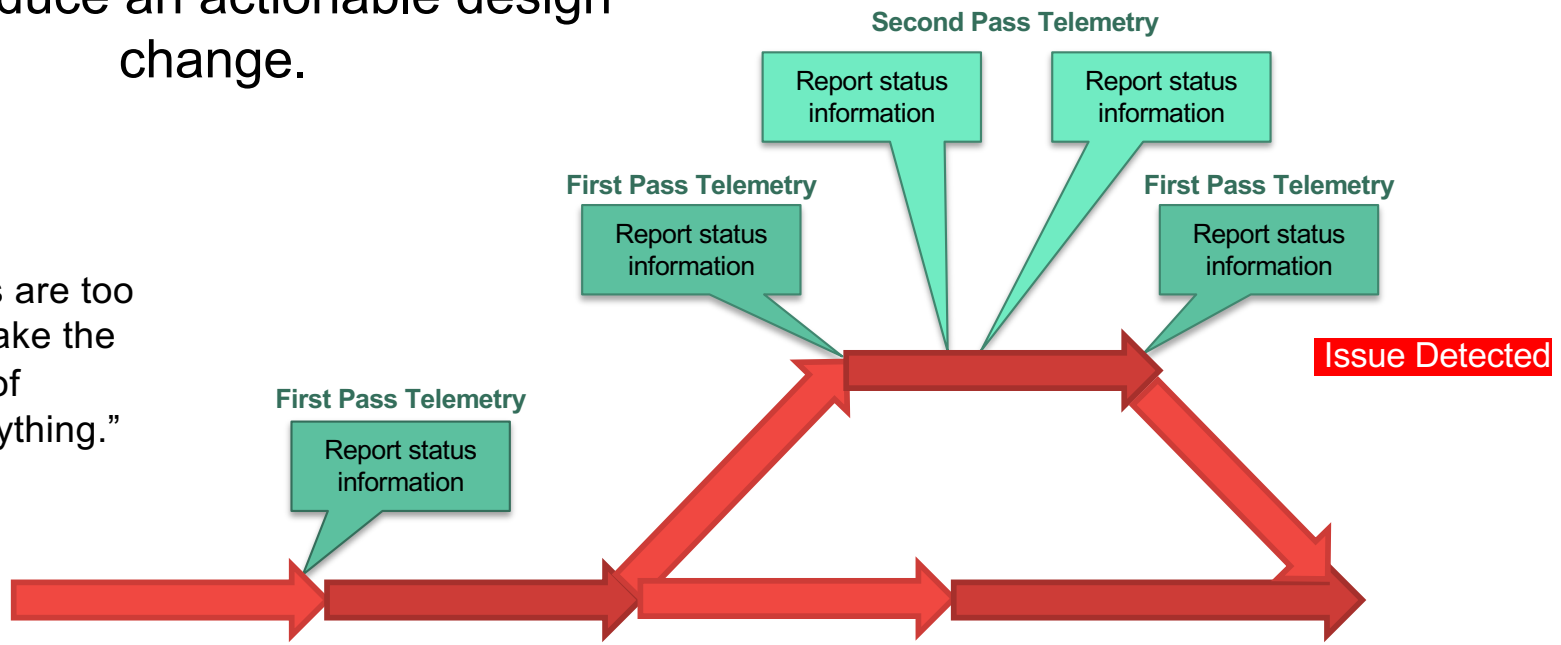
Once you how they are connected to KPIs, you can turn them in the right direction to drive those Business Level Metrics to success.



Using Iterative Refinement to Produce Actionable Results

Multiple passes are required to pin-point the exact nature of a problem and produce an actionable design change.

Most Applications are too complicated to take the approach of "instrument everything."

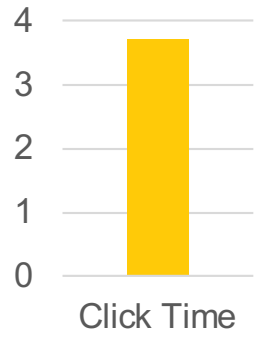


Case Study: “Next” Button Placement In Asteri Analytics

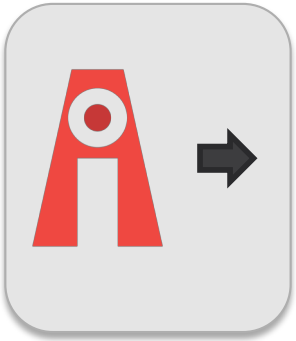
At Asteri we believe in taking our own medicine, so we used our Analytics to test two different configurations of the “Next” button on our image testing website.

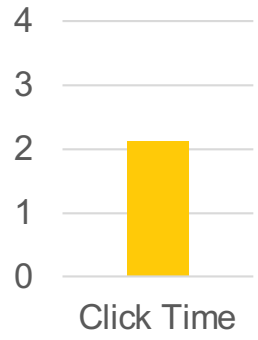
We measure a user’s engagement in an image by measuring the amount of time they spend looking at it.

However we discovered there is a *2nd influence on time.*



It doesn’t matter what image you show, or how engaged the user is, by moving the “Next” button from the bottom to the right side consistently reduces the average click time by about 1.6 seconds.





This is how the Asteri Data Analytics Platform is used to *optimize* User Experience.

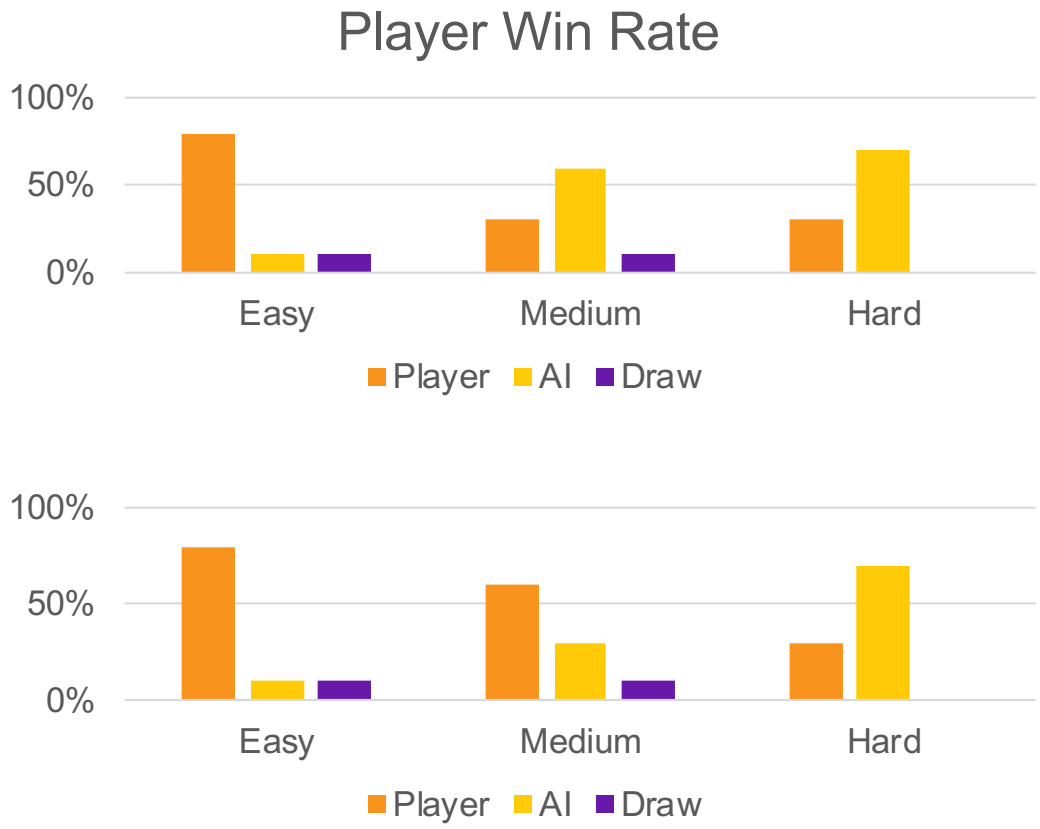
Case Study: Tuning AI in the Otrio* Game

While set on ***Easy*** the AI loses most of the time – which is good.

However on ***Medium*** the game is definitely too difficult.

We feel on *Medium* the Player should win a bit more than half the time.

By collecting data in real time, we can use the Asteri Data Analytics Platform to quickly tune the AI while watching the changes in the Player Win Rate until we achieve our target result.



* Otrio is a mobile game being developed by Asteri in partnership with Spin Master, Ltd.

Use Cases for Predictive Audience Analytics™

Asteri's HQ in historic downtown Shreveport, our close relationship with the locally based BRF InterTech Innovation Accelerator, as well as our proximity to Barksdale AFB make these logical projects for us.

Build a **Permanent Change of Station (PCS) app** that automates the process by providing checklists & tracking fully instrumented to optimize the App and the PCS process.

Partner with **training & simulation companies** to instrument and optimize the learning process and cockpit configurations.

Track **candidates' interest & abilities**, use the data in an attribution system to optimize a multi-platform media recruitment campaign.

Predictive Audience Analytics™ is a SaaS Platform

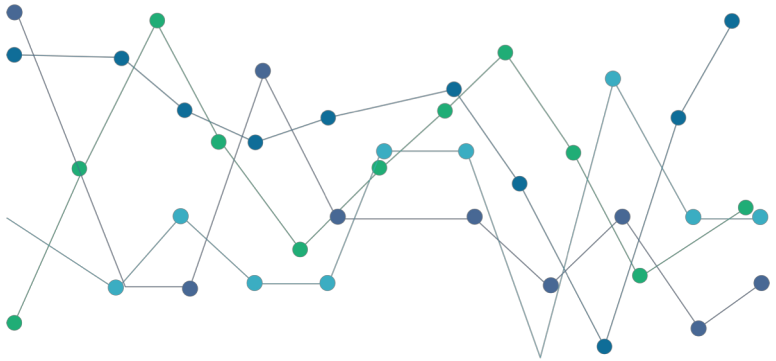
Software-as-a-Service Platform

- It is designed to be integrated into any application.
- Asteri's Analytics division can provide subcontracting services to help with integration and create all necessary analysis and reporting systems.

How can we use Data Analytics to effect **Positive Change** in Social Norms and Structures?

Tracking Positive Social Behavior (PSB)

Data Mining combined with Natural Language Processing
allows us to build an accurate profile of a User's interests and behavior.

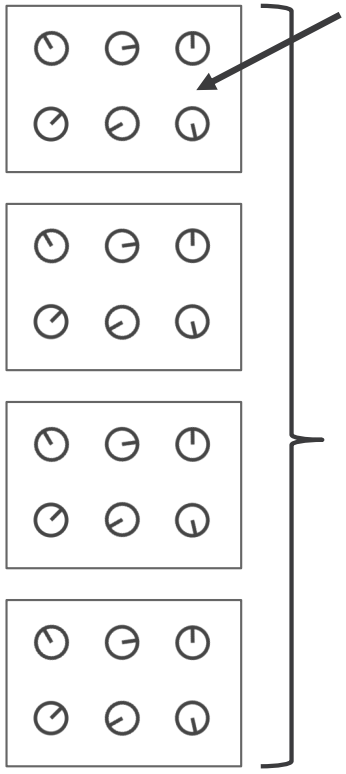


PSB Index

Positive Social Behavior Index

How Asteri uses Intra- and Inter-Media Optimization

- **CREATE**
- **DEPLOY**
- **ANALYIZE**
- **OPTIMIZE**
- **ITERATE**



Intra-Media Optimization

Use Asteri's Predictive Audience Analytics platform to optimize engagement and build PSB effect within each piece of content.

Inter-Media Optimization

Track PSB effects across all content, to find the most effective interactive and linear entertainment for mobile, console and PC.

Local Content is Critical

Asteri's Analytics helps target and refine linear and interactive content, but it is not a replacement for creativity.

To reach at-risk individuals and build PSB we must work closely with artists of all types from local cultures.

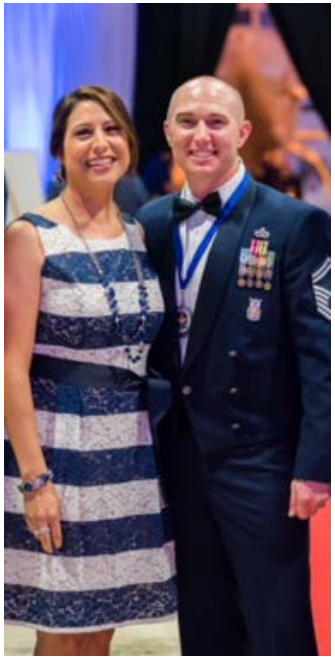
Our Founders' history in the entertainment industry has forged relationships with creative artists around the world.

There is a real opportunity to use ***Asteri's iterative optimization*** to create online content that can promote ***Positive Social Behavior***

Contact Steve Gray
steve@asteri.io

About Me

CISSP® Certified Information Systems Security Professional



CERTIFIED AUTHORIZATION CAP® PROFESSIONAL

INGALLS INFORMATION SECURITY

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Future of Cyber Tools

"We are going to have to be able to take information from any platform, any sensor, and connect it at the strategic, operational, and tactical levels to bring effects anywhere on the planet, and I've got to be able to do that in fifteen minutes or less."

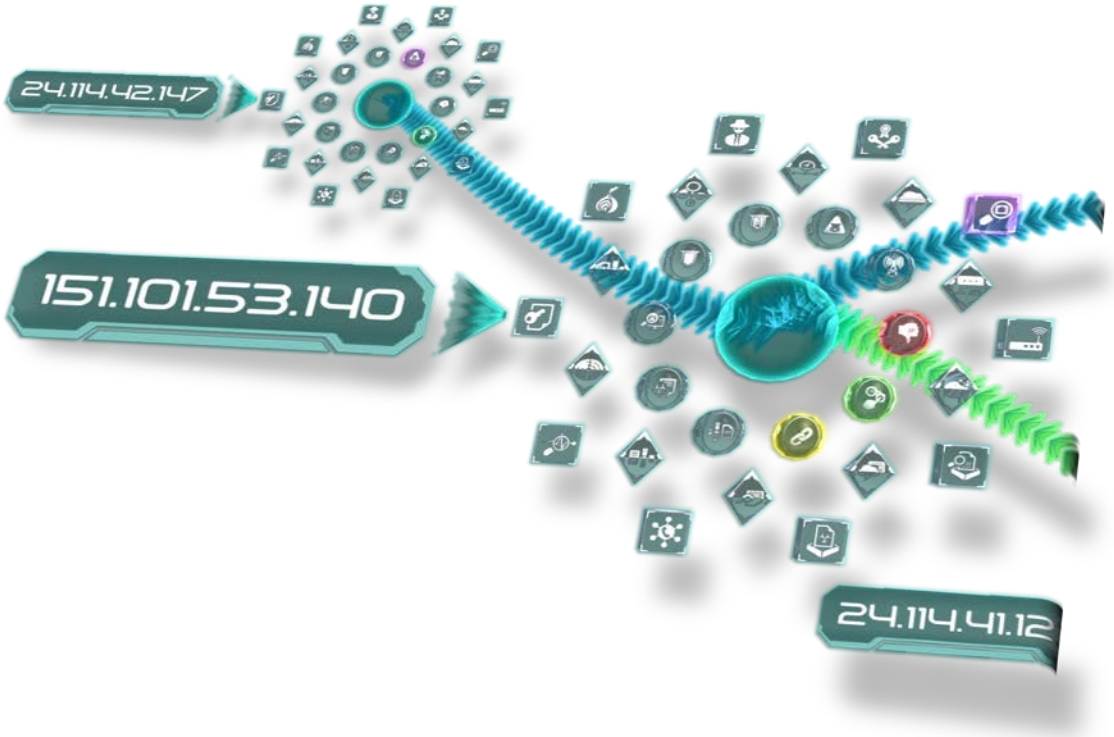
General Steven Wilson, VCSAF
Wright Dialogue with Industry
Dayton, Ohio, 18 July 2018

Solve Limiting Factors

Go From This:

	ClientIP	ClientPort	Duration	Filesize
200"""	10.10.1.253	50505	224 seconds	3510
200"""	10.10.1.253	52125	8 seconds	3653
200"""	10.10.1.253	51218	15 seconds	4680
200"""	10.10.1.253	63264	11 seconds	8048
200"""	10.10.1.253	62725	5 seconds	8048
200"""	10.10.1.253	62268	6 seconds	6694
200"""	10.10.1.253	62223	6 seconds	4295
200"""	10.10.1.253	64513	4 seconds	8048
	10.10.1.253	62000	4 seconds	804

To This (in 3D):



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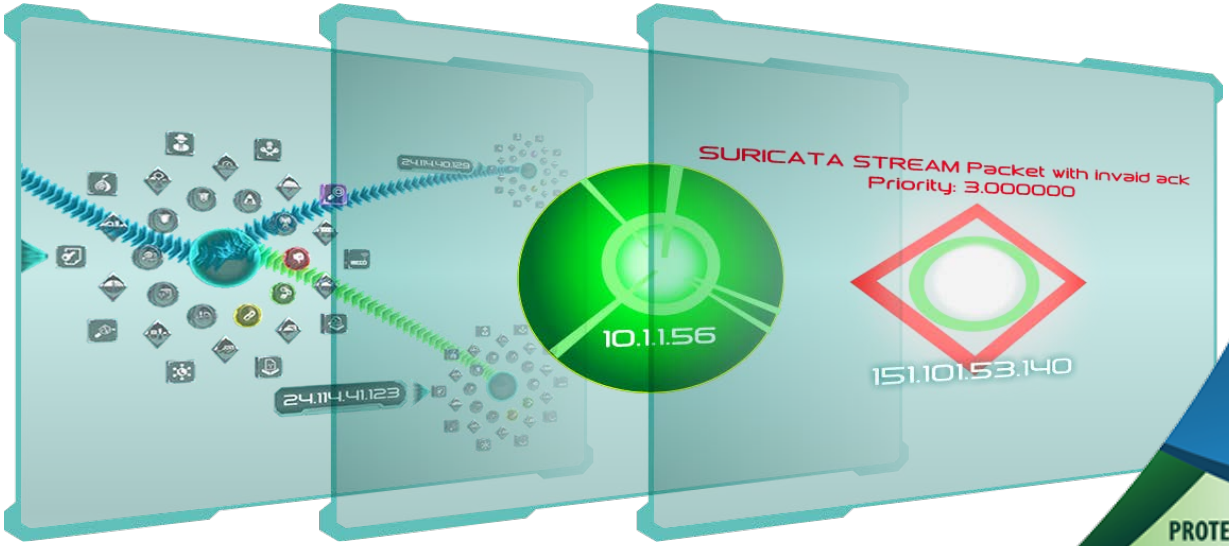
Visualize Cybersecurity Data

- Data should have depth of focus:
  - General overview, metrics, and simple relationships can be thought of as a backdrop
  - Relevant information such as search results are better focused and delineated from the background
  - Critical data is presented in a way that is easily consumable
  - Ability to manipulate how data is displayed



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Augmented Reality

Augmented Reality overlays your vision with computer rendered graphics.

- This allows for many possibilities:
  - Share a single 3D visualization among a group of people (around a conference table, for example)
  - Provide briefings with substantive content in real-time
  - Training, auditing, and other group tasks

Source: getmeta.com

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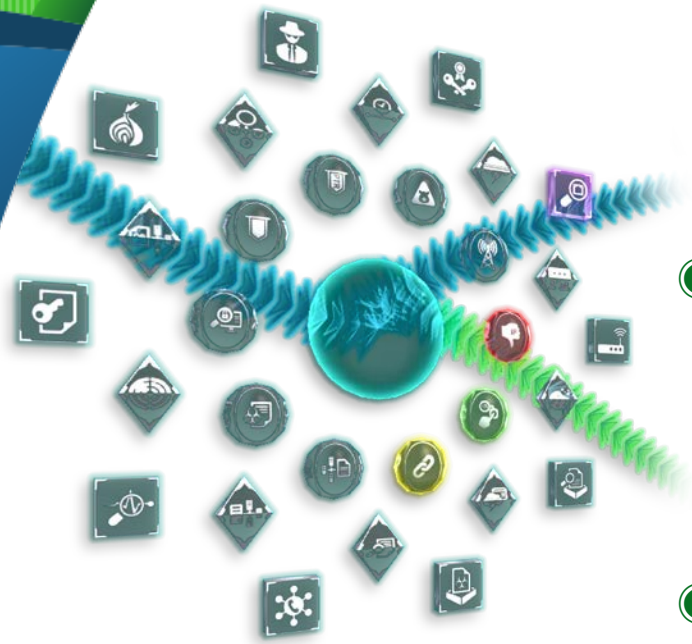
Metadata: The Visualization Engine



- Using metadata allows us to:
  - Create situational awareness of the environment
  - Understand basic relationships clearly (client-server, proxy, etc.)
  - Identify patterns
  - Position interesting data to gain context
- Getting metadata is fairly easy:
  - Network events are captured in flow records, IDS, etc.
  - Access logs provide event metadata
  - Endpoint applications
- Storing/retrieving metadata is a challenge with lots of options:
  - NoSQL database clusters provide fast storage and search
  - Hadoop and other analytics platforms

Integrate and Optimize Cyber Ops

- Data visualization allows us to:
  - Provide orders of magnitude of more data in a relationship model
  - Create situational awareness of network states quickly
  - Alert and Identify abnormalities or patterns (draw the user's attention)
  - Reference additional information and overlay it in a given situation
    - Example: systems classified as handling PII, PHI, PCI data can be identified among systems with IDS alerts
- Analyst are able to:
  - Identify intrusions faster
  - Map them out faster
  - Provide Remediation teams with detailed information to clean up intrusions in shorter amounts of time and with less Risk
- Additionally, this technology is able to:
  - Serve as a training aid for entry-level analysts
  - Provide leaders with situational awareness, attacker pathway, and a breach map when dealing with Incident Response

Viewpoint - Objectives

- Allow modeling of security events that have occurred and intrusions that are discovered
- Defenders can cover more network area per Analyst
- Lower the technical barriers of analyst training
- Discuss security events among multi-discipline teams
- https://youtu.be/Lcw30z8I6Ck

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Questions?

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501-515-1026

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PHYSICAL SYSTEM REPLICATION

DIGITAL TWIN

March 2019

UNCLASSIFIED

CAD for Prediction & Control Systems

MEASURABLE APPLICATION GOALS:

- Provide an order of magnitude reduction in the time & cost to develop models, simulations & systems;
- Provide 4 to 6 orders of magnitude improvement in simulation/system run-time speed
  -- while cutting costs by orders of magnitude;
- Allow application experts to design, build, and test systems directly;
- Allow newcomers to a project to quickly learn and understand complex systems.

Example Application: Use of Autonomous Vehicles with Network Facilities to achieve High A/J Margins

TAKING PROPER MEASURMENTS:

The principle Measure is the Speed Multiplier - SM:

$$SM = Ts / Tp$$

where Ts is Time to run on a Single Processor - Fast
and Tp is Time to run on a Parallel Processor

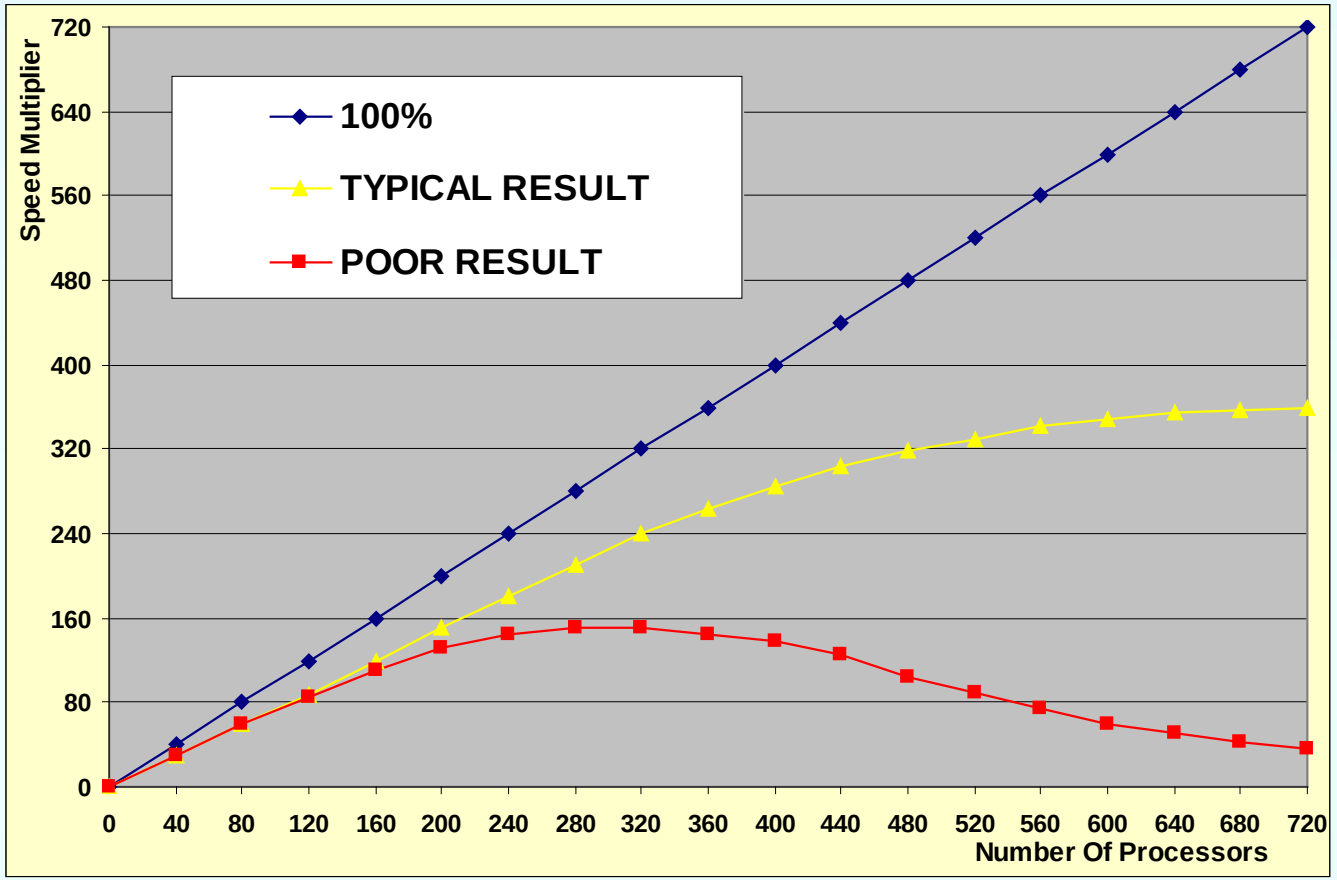
Depending upon the application
– this may be difficult to measure

The critical Measure is Processor Utilization Efficiency:

$$PUE = SM / Np$$

where SM is the Speed Multiplier
and Np is the Number of Parallel Processors

CAD for Prediction & Control Systems



The difference in speeds above is due to the Processor Utilization Efficiency (PUE)

VisiSoft PUEs can be above 95%

Von Neumann's

Instruction Set Architecture

- the ISA for Single Processors

must be extended by VSI's

Application Space Architecture

- the ASA - for Parallel Processors

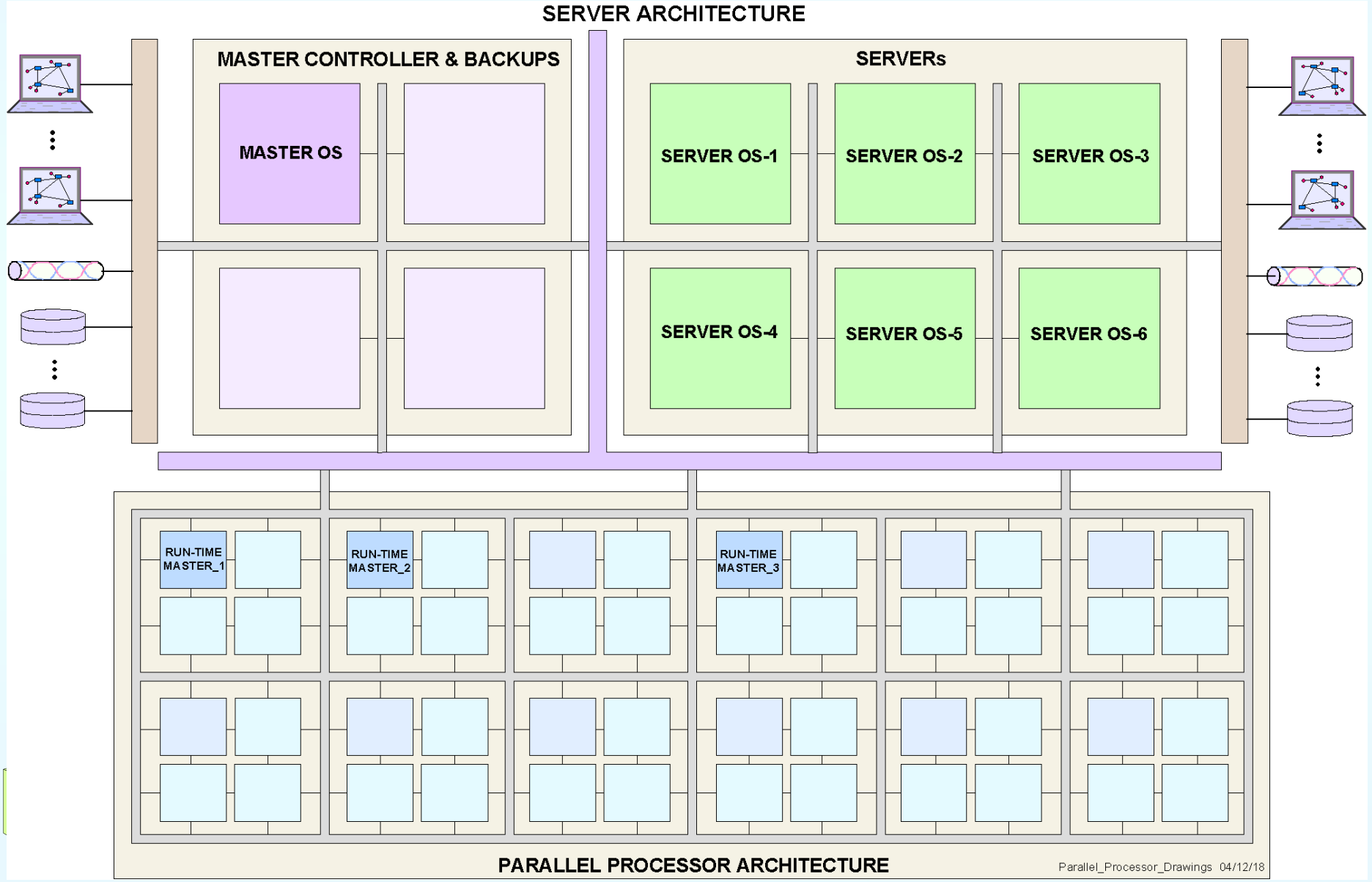
CAD for Prediction & Control Systems

REPRESENTATIVE PARALLEL APPLICATIONS:

- Adaptive Control of Large Groups of Autonomous Moving Platforms
- Human Body Organ simulation
- Human Brain – Artificial Intelligence modeling
- Global Climate prediction
- Currency Market prediction
- Chemical - Molecular structure simulation
- Scanning, sorting, and correlating massive databases (Big Data)
- Weather prediction in mountainous terrain
- Power distribution simulation
- Electro-magnetic wave simulation
- Global HF power transmission
- Global Military Planning - Multiple moving platform simulation

THESE ARE NOT SERVER REQUIREMENTS!

And: - Servers Are Not Parallel Processors
- A Multi-Tasking OS is Not a Parallel OS



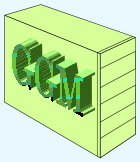
CAD for Prediction & Control Systems

SOFTWARE IS AN EXTENSION OF MATHEMATICS:

- Must pick the “Best Spaces” to represent the problem;
- The Best Spaces provide independence (Kalman);
- They simplify the algorithms;
- Simple algorithms run much faster;
- Simple algorithms are much easier to understand;
- Newcomers to a project quickly learn the software

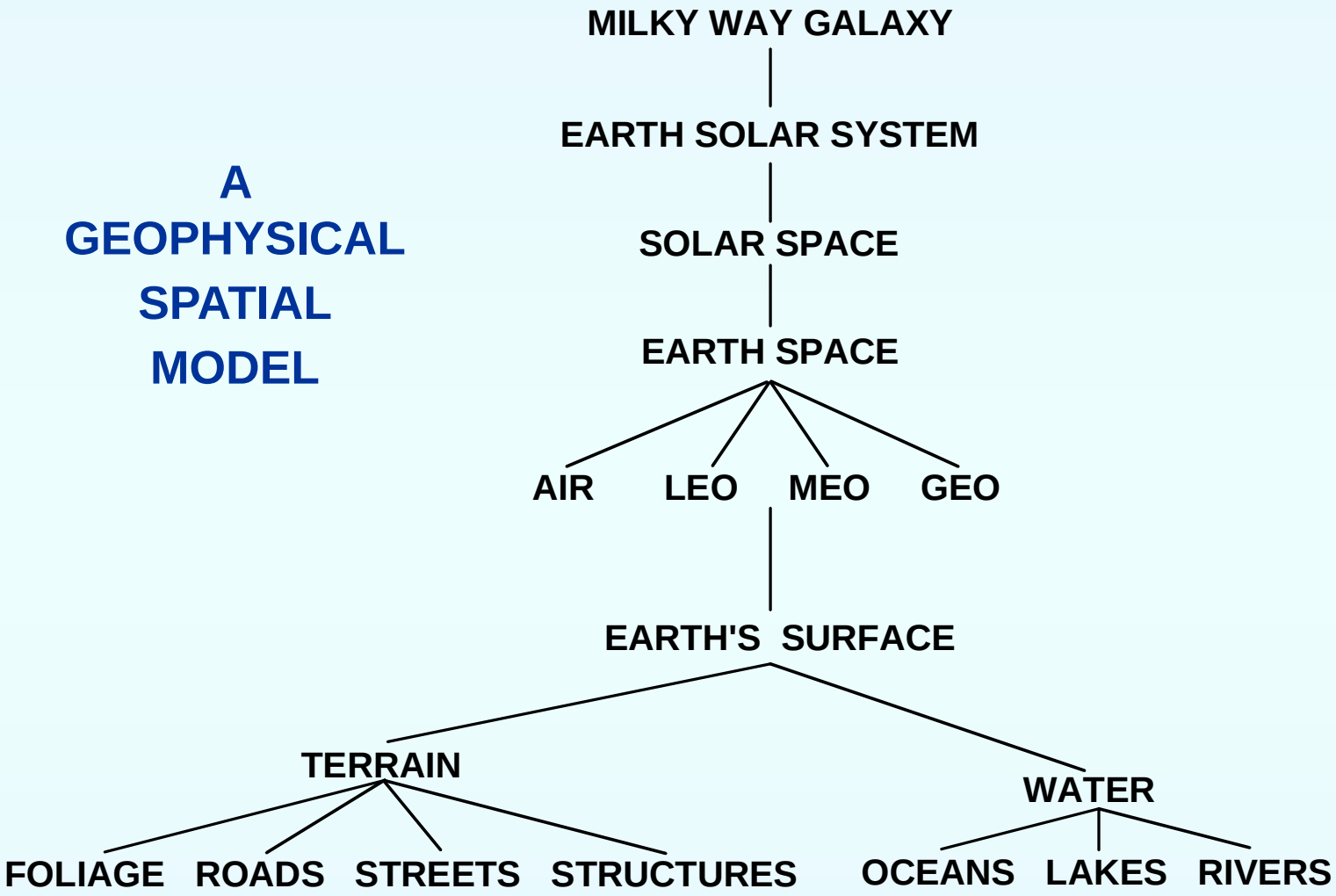
Also, What is a “Software Module” ?
And, What is “Software Architecture” ?

These terms are used throughout the literature – *undefined!*



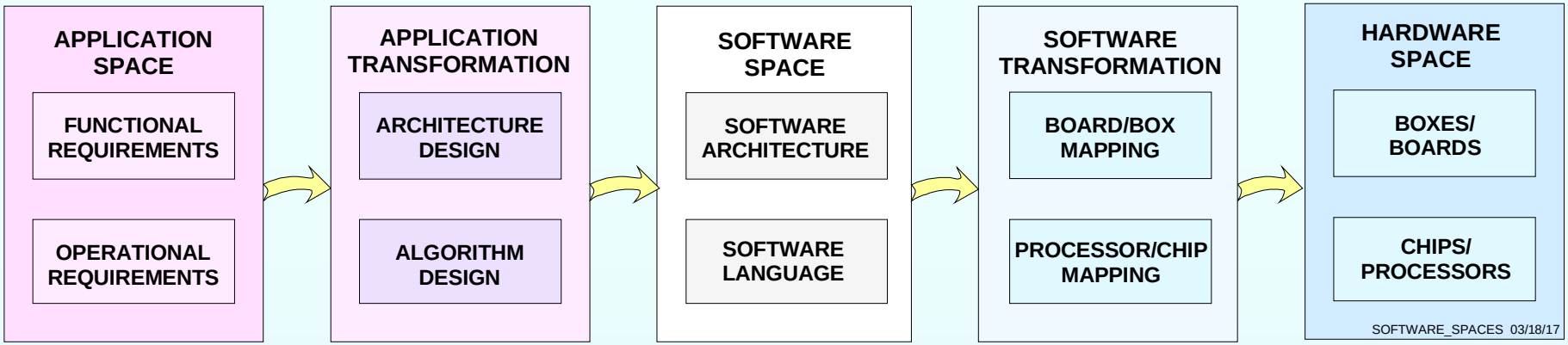
EXAMPLE OF A MODEL SPACE HIERARCHY

A GEOPHYSICAL SPATIAL MODEL



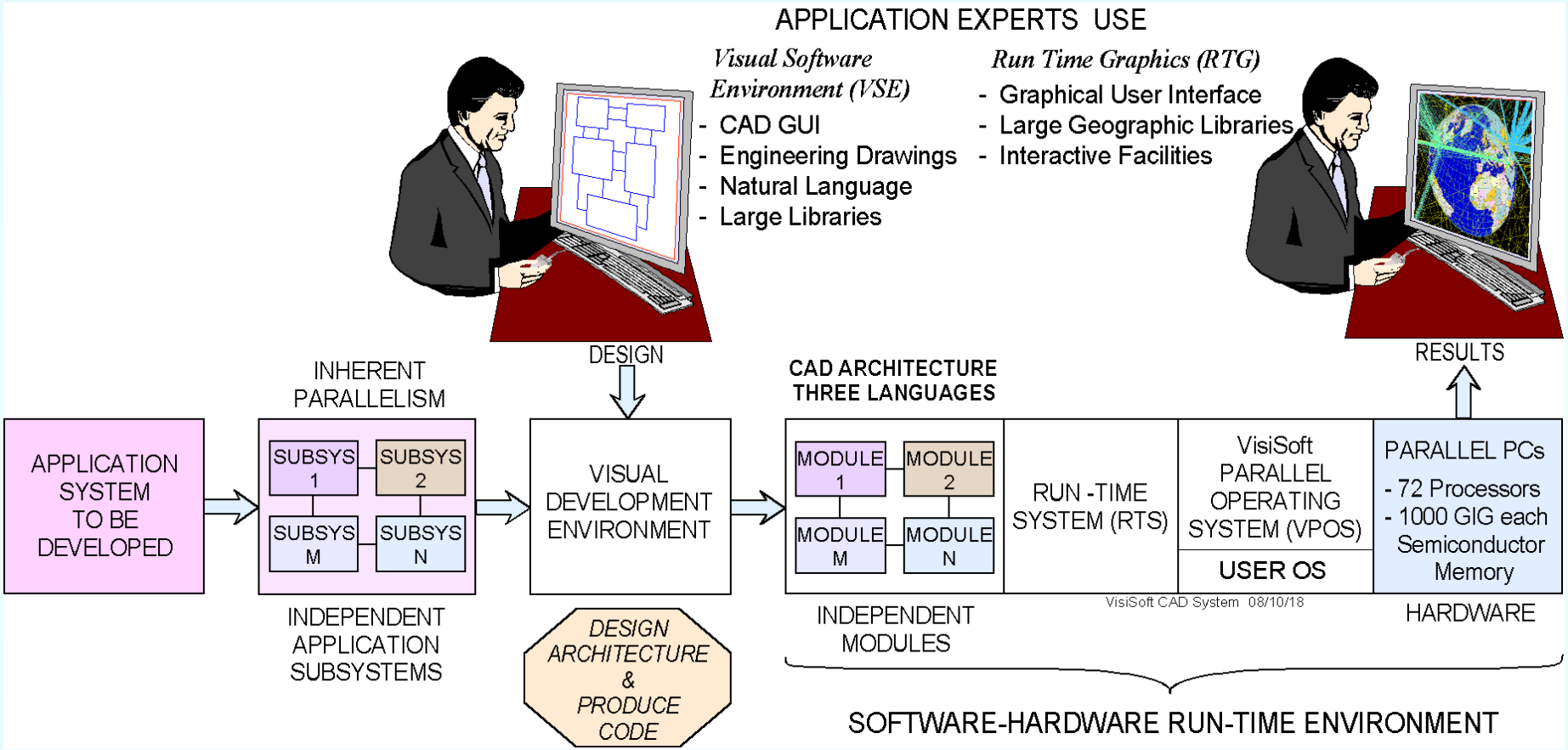
SUCH MODELS SUPPORT HETEROGENEOUS HIERARCHIES WITH ACCURACIES DOWN TO 1.1 CM

Spaces for Translation of Application Requirements into Software Requirements & then into Hardware Requirements



Defining the: Application Space Architecture (the ASA)

CAD for Prediction & Control Systems



Visual Software Engineering Using A CAD System For Building Real-Time Control Systems

CAD for Prediction & Control Systems

a RESOURCE

-

Contains Hierarchical Data Structures To Easily Map Complex Spaces

```
RESOURCE: TRANSCEIVER                    INSTANCES: TRANSMITTER
                                                    RECEIVER

GENERAL_PARAMETERS
    1  TRANSMITTER_POWER          REAL   INITIAL_VALUE 100
    1  RECEIVER_THRESHOLD         REAL   INITIAL_VALUE 120

RADIO
    1  TRANSCEIVER                STATUS TRANSMITTING
                                         RECEIVING
                                         IDLE
                                         OFF
    1  LOCATION
       2  X_POSITION             REAL
       2  Y_POSITION             REAL
       2  ELEVATION              REAL
    1  ANTENNA_HEIGHT             REAL
    1  ANTENNA_GAIN               REAL

RECEIVER_CONNECTIVITY_VECTOR
    1  POWER_AT_RECEIVER          REAL
    1  TOTAL_NOISE_POWER          REAL
    1  CONNECTIVITY_MATRIX
       2  PROPAGATION_LOSSES
          3  TERRAIN_LOSS         REAL
          3  FOLIAGE_LOSS         REAL
          3  TOTAL_LOSS           REAL
       2  SIGNAL_POWER           REAL
       2  SIGNAL_TO_NOISE_RATIO  REAL
       2  LINK_DELAY             REAL
       2  LINK                   STATUS GOOD
                                         FAIR
                                         POOR

TRANSCEIVER_RULES
    1  TRANSCEIVER_PROCESS        RULES  GOOD_RECEPTION
                                         CONFLICTING_RECEPTION
                                         CONFLICTING_BROADCAST
```

A Space / Data Structure

CAD for Prediction & Control Systems

a PROCESS

-

Contains Hierarchical Rule Structures That Support One-in One-out Independent Control Structures (Mills)

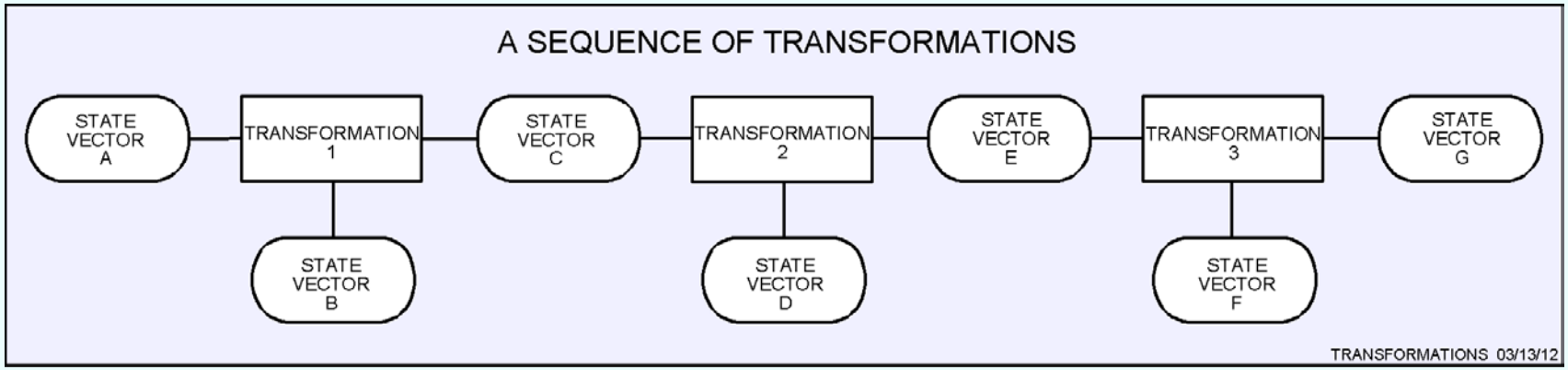
```
PROCESS: RECEPTION                    RESOURCES: TRANSCEIVER
INSTANCES: TRANSMITTER                           MESSAGE_FORMATS
           RECEIVER                              TRANSMITTER_OUTPUT
```

```
START_RECEPTION
    IF TRANSCEIVER IS IDLE
        EXECUTE GOOD_RECEPTION
    ELSE IF TRANSCEIVER IS RECEIVING
        EXECUTE CONFLICTING_RECEPTION
    ELSE IF TRANSCEIVER IS TRANSMITTING
        EXECUTE CONFLICTING_BROADCAST .

GOOD_RECEPTION
    IF SIGNAL_TO_NOISE_RATIO IS GREATER THAN RECEIVER_THRESHOLD
        SET TRANSCEIVER  TO RECEIVING
        ADD SIGNAL_POWER TO TOTAL POWER_AT_RECEIVER .
        CALL DECODE_MESSAGE .

    IF  MESSAGE TYPE IS FORMAT_A
    AND SYNC_CODE    IS VALID
    AND LAST_SYMBOL  IS A TERMINATOR
         EXECUTE SEND_ACKNOWLEDGEMENT .

CONFLICTING_RECEPTION
    IF POWER_AT_RECEIVER IS GREATER THAN SIGNAL_POWER
         SCHEDULE ABORT_RECEIVE NOW .

CONFLICTING_BROADCAST
    CANCEL END_RECEIVE NOW
    SCHEDULE START_RECEIVE IN EXPON(0.83) MILLISECONDS
        WITH PRIORITY 80

SEND_ACKNOWLEDGEMENT
    MOVE ACKNOWLEDGEMENT TO TRANSMIT_MESSAGE_BUFFER
    IF DESTINATION IS BROADCAST
        SEARCH LINK_CONNECTIVITY_VECTOR OVER RECEIVER
             EXECUTING TRANSMISSION
                  WHEN LINK IS GOOD
    ELSE EXECUTE TRANSMISSION .

TRANSMISSION
    SCHEDULE LINK_RECEPTION
        IN LINK_DELAY MICROSECONDS
            USING TRANSMITTER, RECEIVER
```

A Transformation / Rule Structure

PREDICTION & CONTROL SYSTEMS ENGINEERS

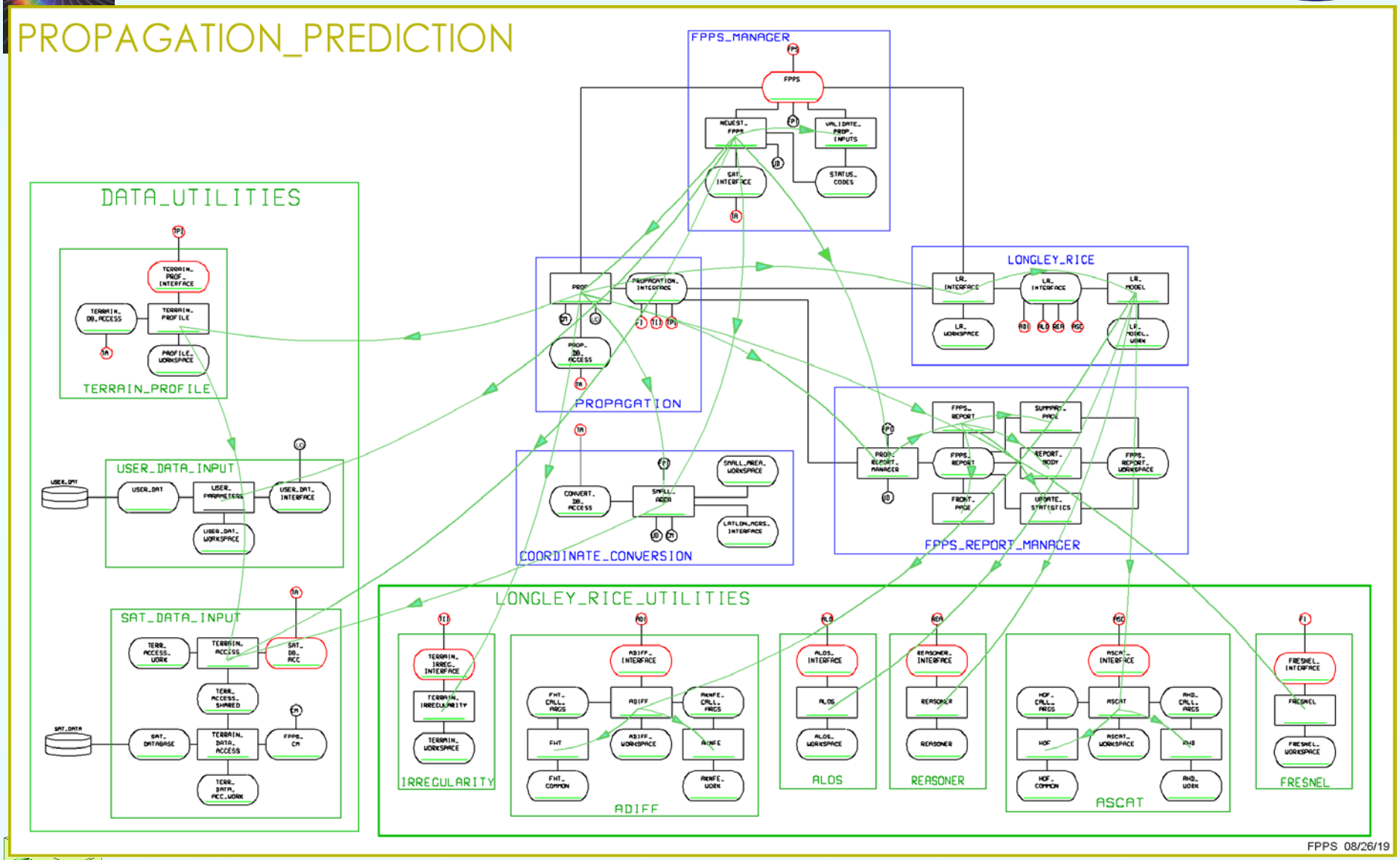
Spaces for Translation of Application Requirements into Software & Hardware



Connecting Resources & Processes to Create a Sequence of Transformations

- *Mathematically Defining a Module*

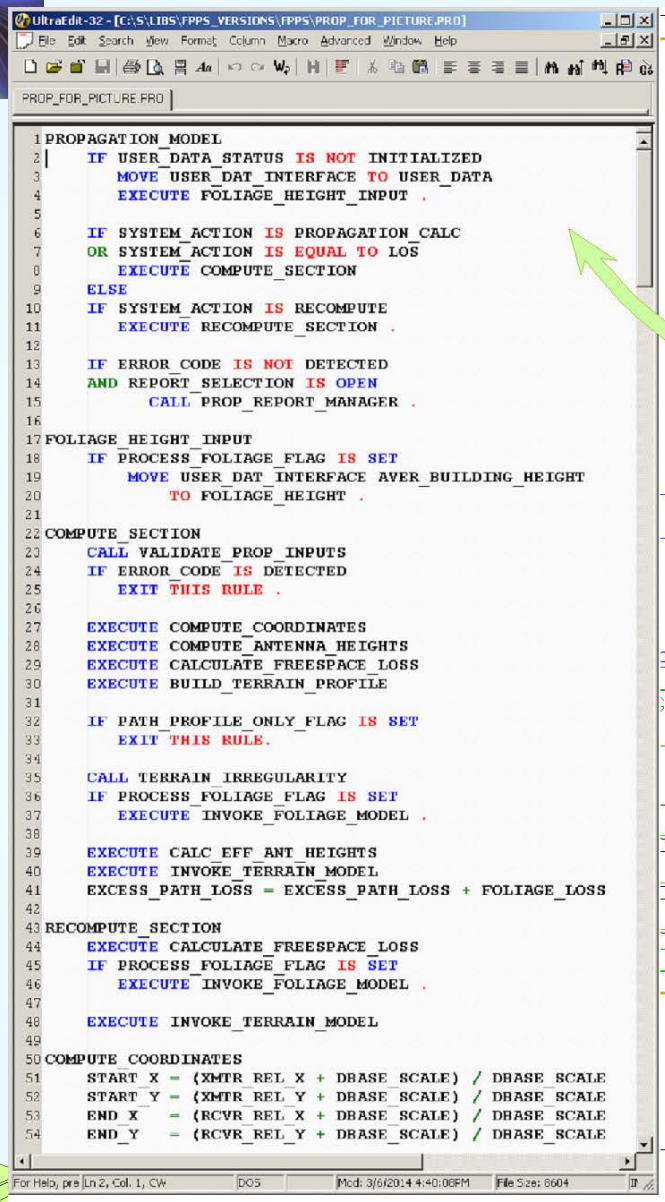
CAD for Prediction & Control Systems

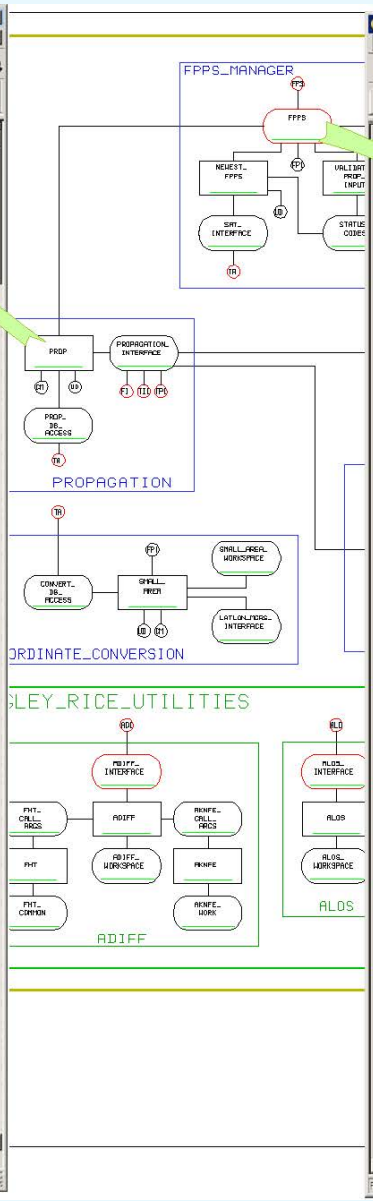


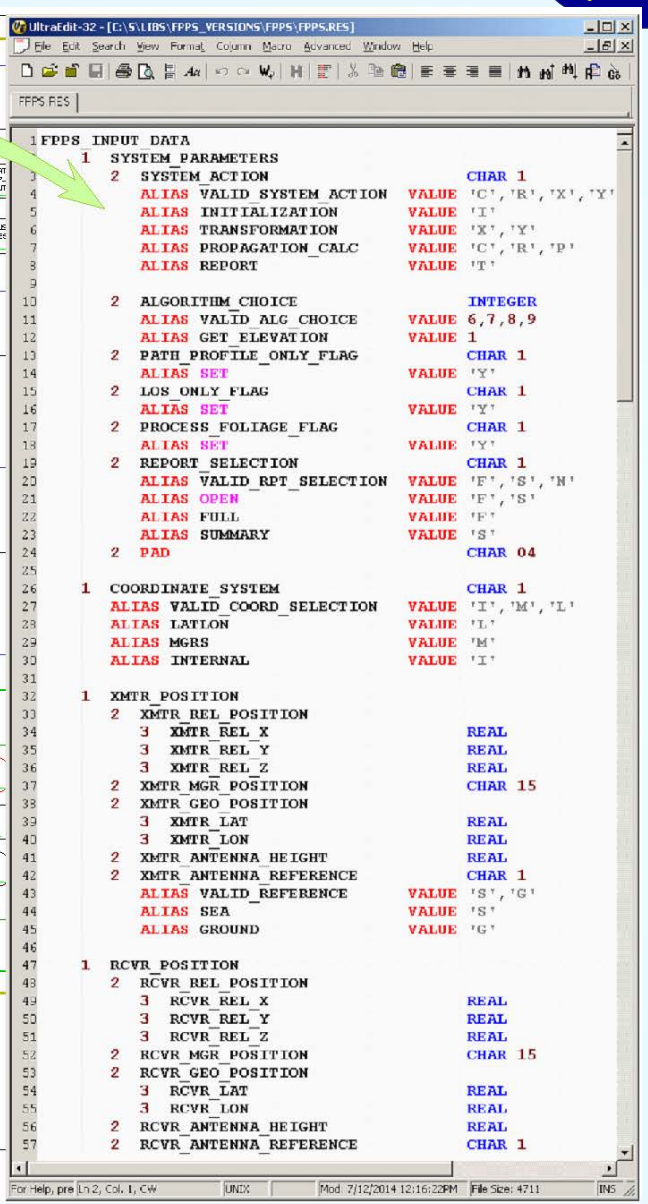
An Architecture - a Hierarchy of Modules

PREDICTION & CONTROL SYSTEMS ENGINEERS

CAD for Prediction & Control Systems





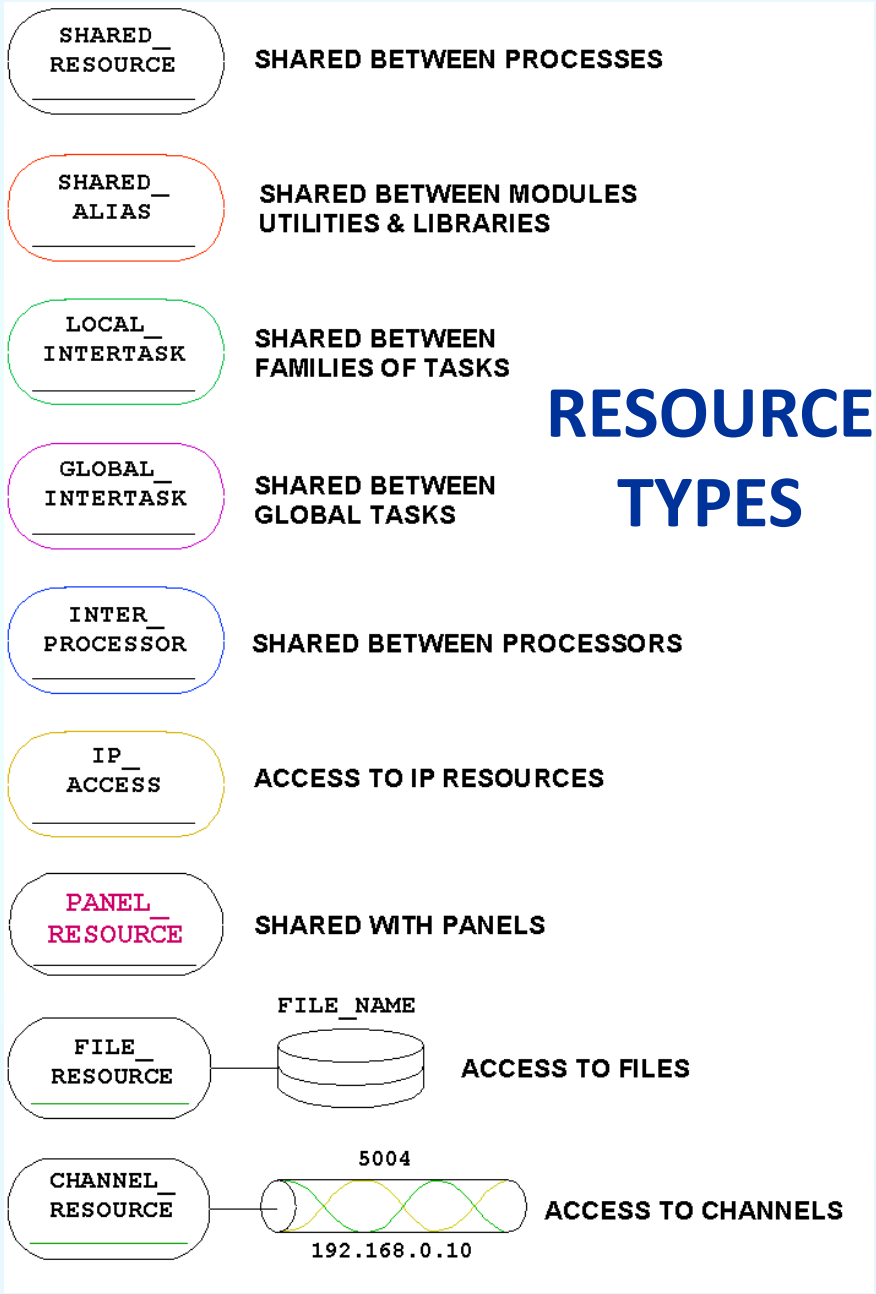


Double Click To Edit The Code

PREDICTION & CONTROL SYSTEMS ENGINEERS

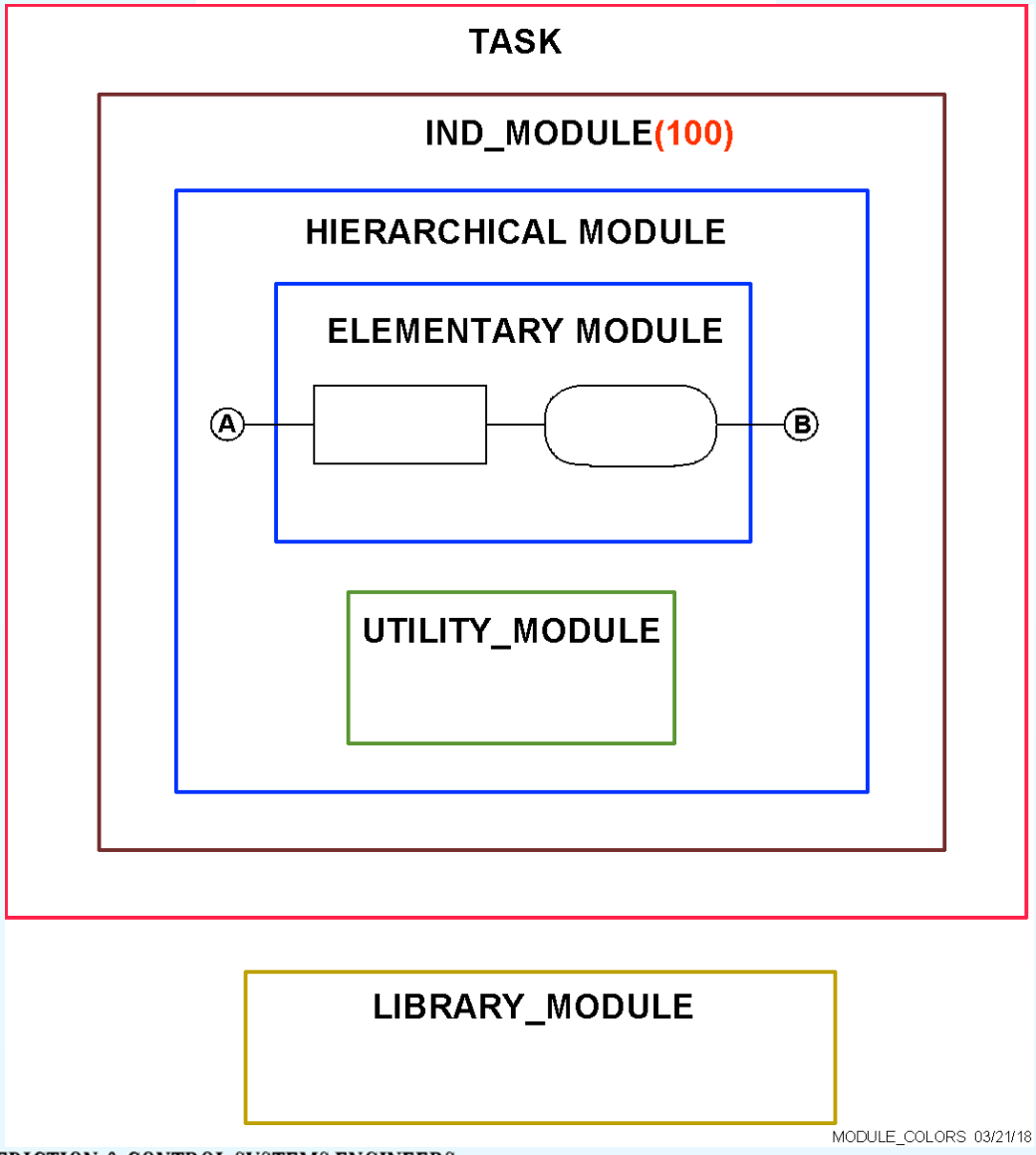
CAD for Prediction & Control Systems

RESOURCE TYPES ARE CRITICAL TO SHARING DATA & MAPPING MODULES ONTO PARALLEL PROCESSORS



MODULE TYPES

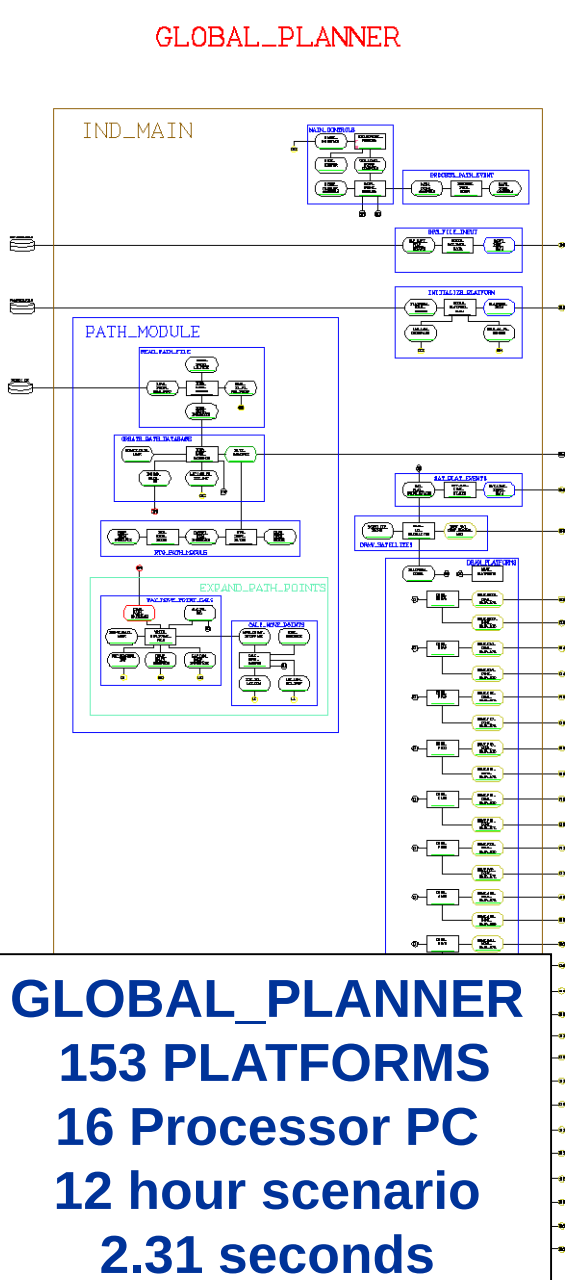
MODULE TYPES ARE CRITICAL TO *INDEPENDENCE* & ARCHITECTURAL MAPPING OF MODULES ONTO PARALLEL PROCESSORS

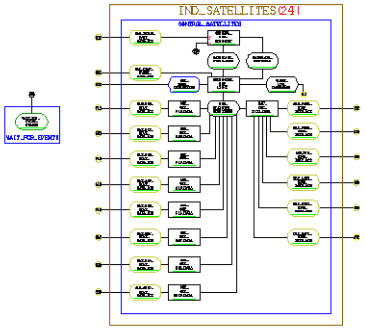


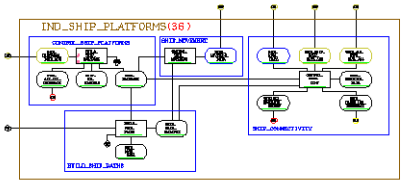
MODULE_COLORS 03/21/18

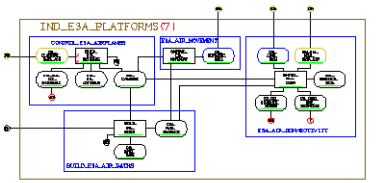
CAD for Prediction & Control Systems

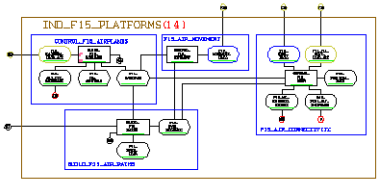
A Parallel Processor Simulation Architecture

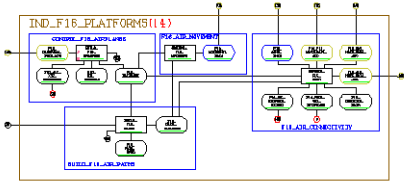


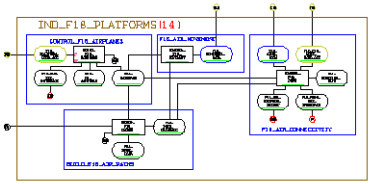


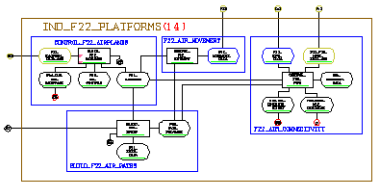


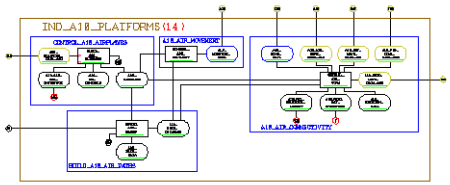


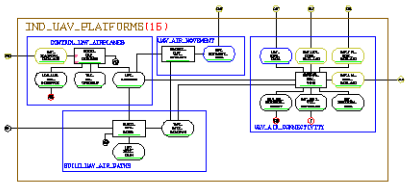


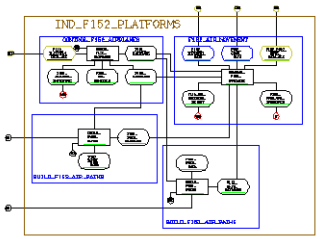


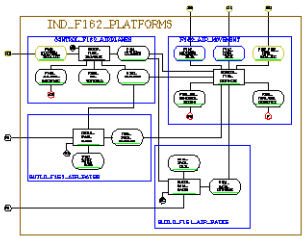


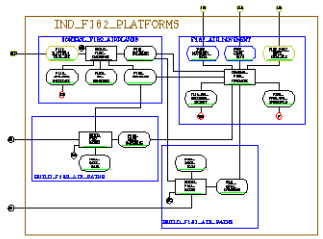


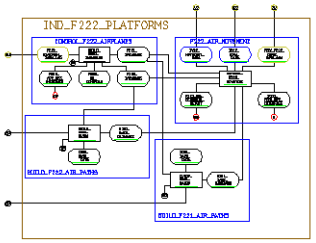


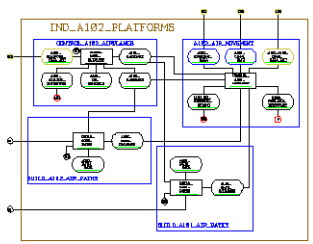


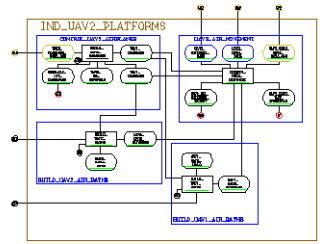










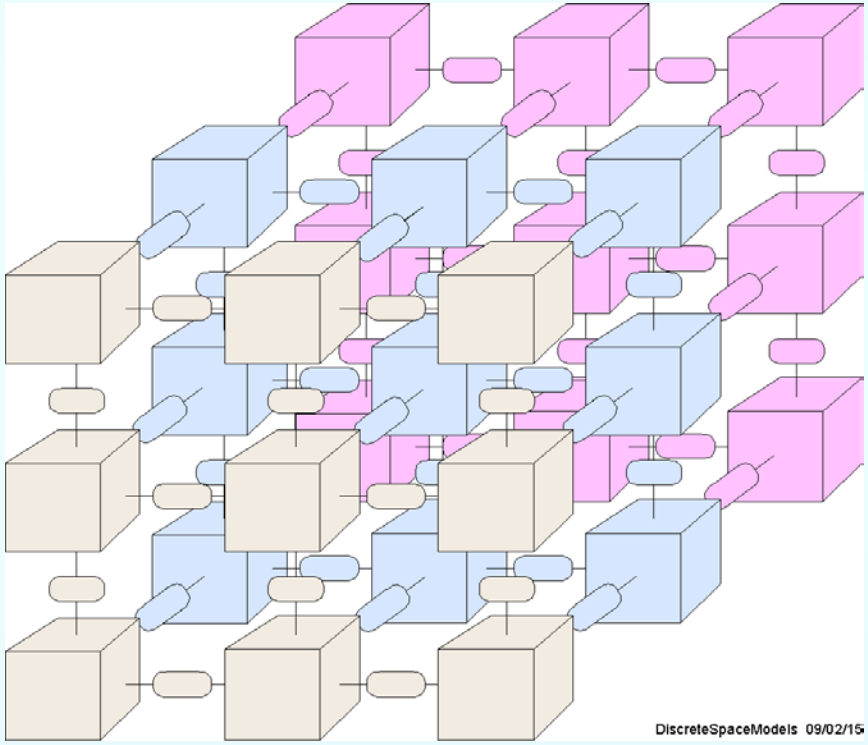


GLOBAL_PLANNER
153 PLATFORMS
16 Processor PC
12 hour scenario
2.31 seconds

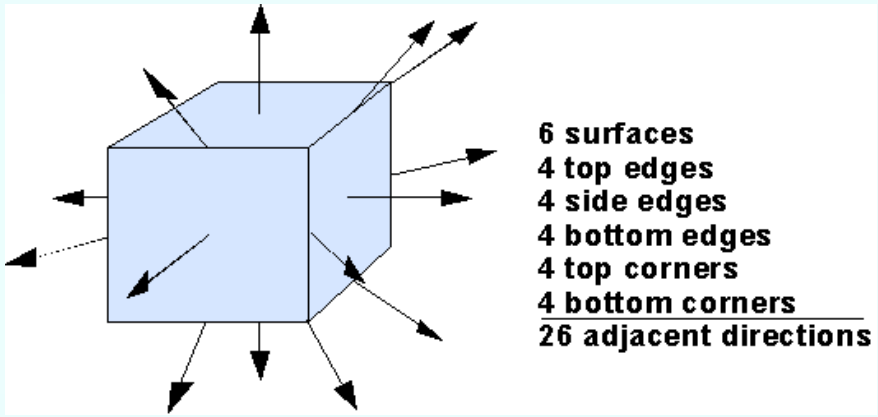
BACKUP SLIDES

Most Physical Systems Can Be Modeled Using 3-Dimensional Cells

A 3-D matrix of cells



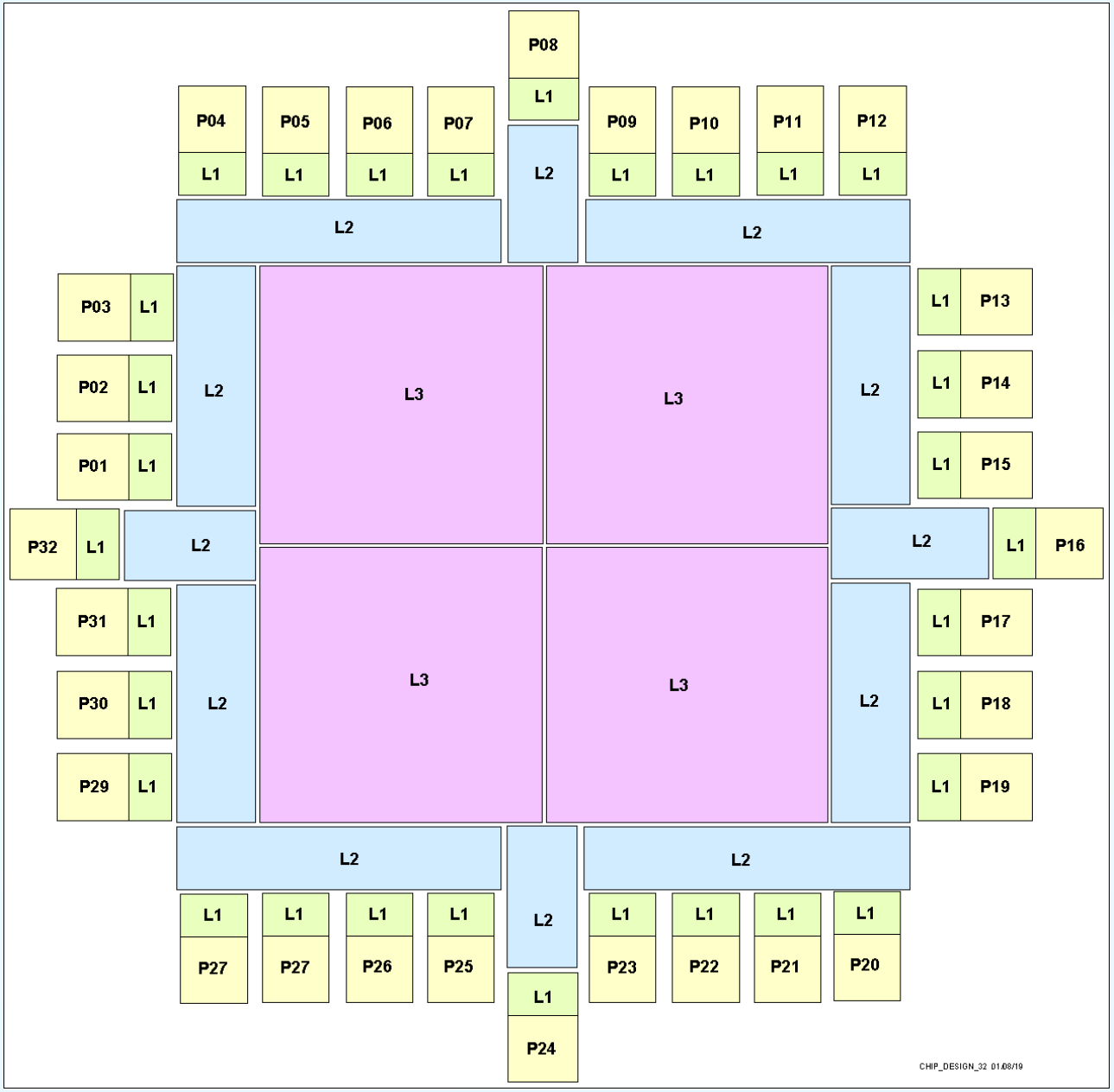
A single resource is shared between the adjacent face of each major cell



Each cell may contain huge numbers of minor sub-cells

Cells need only interface with adjacent neighbors!

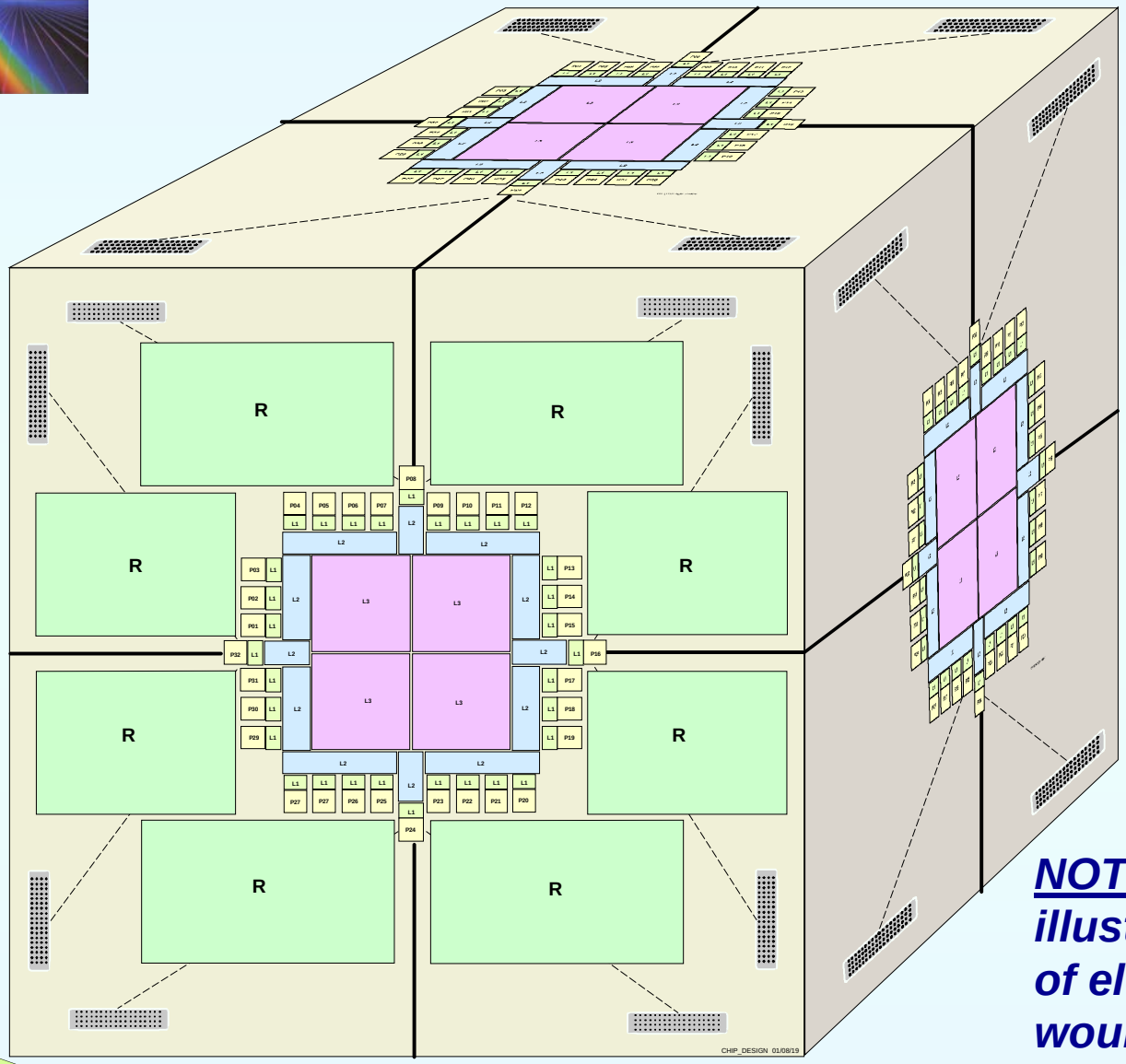
CAD for Prediction & Control Systems



Start with the basic Chip design

- Greatly Simplified

CAD for Prediction & Control Systems



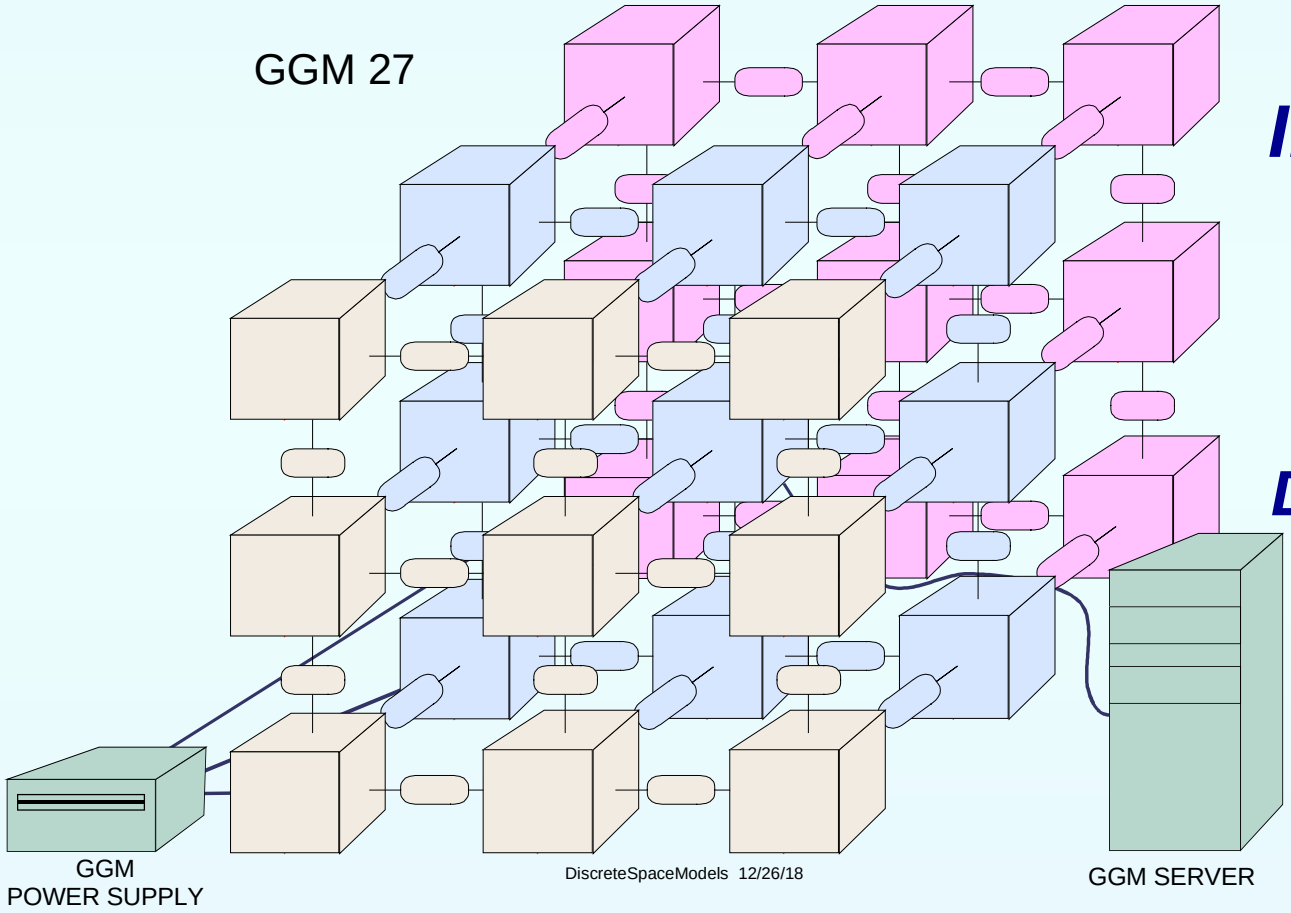
Then use the 3-D Box Design - with all DMA Channels

NOTE: ***This drawing only illustrates relative placement of elements - not where they would reside! For example, chips will be located on the inside of the boards.***

CAD for Prediction & Control Systems

BASED ON THE:

APPLICATION SPACE ARCHITECTURE

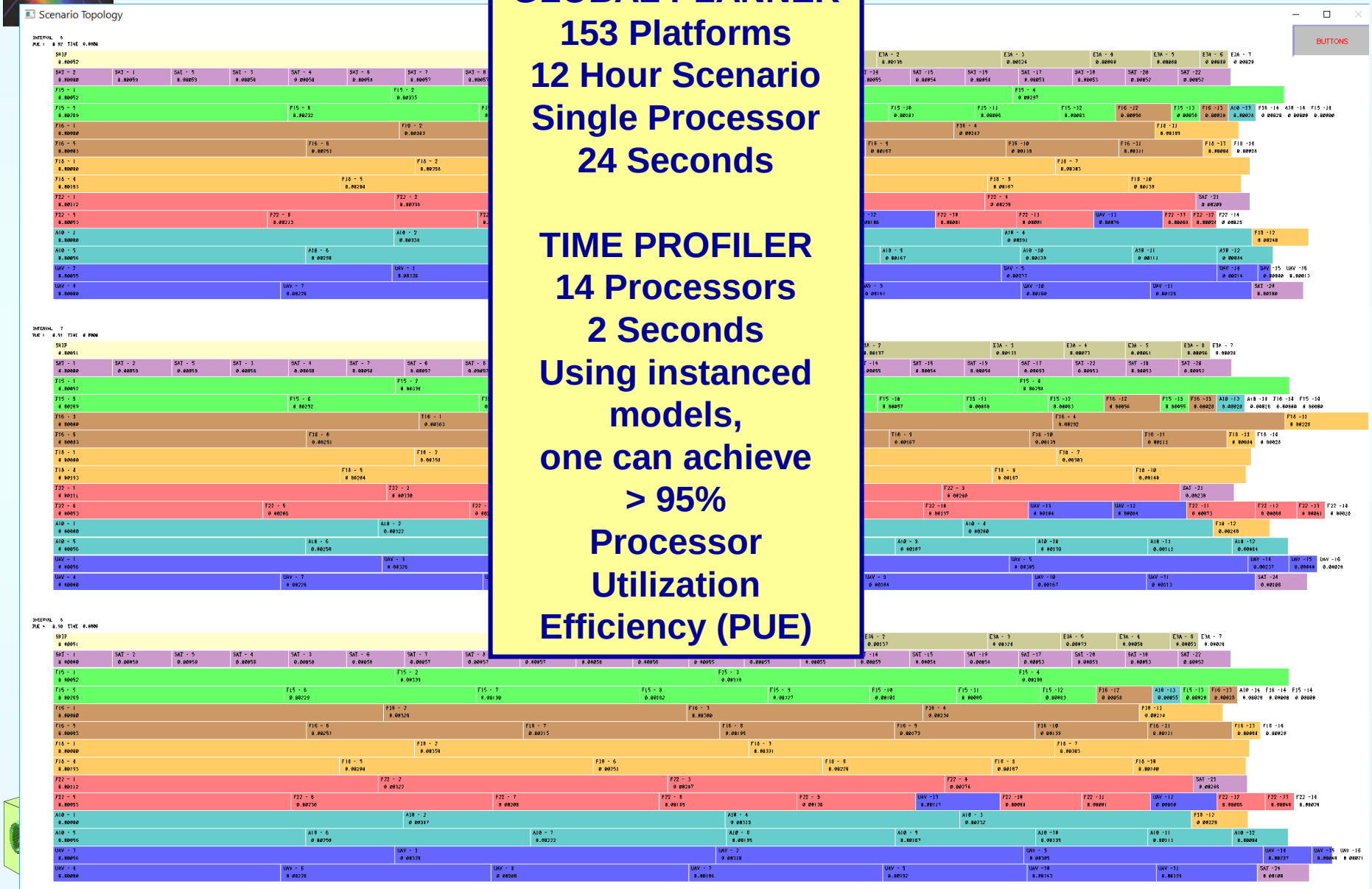


Just Interconnect the boxes
- In 3-D
- With all DMA Channels

CAD for Prediction & Control Systems

GLOBAL PLANNER
153 Platforms
12 Hour Scenario
Single Processor
24 Seconds

TIME PROFILER
14 Processors
2 Seconds
Using instanced models,
one can achieve
> 95%
Processor Utilization Efficiency (PUE)



CAD for Prediction & Control Systems

Consider a comparison of Green Gene Machines with other Parallel Processors

Green Gene Machine	Number of Processors	Power (KW) Consumed	Equivalent* Processors	Power (KW) Consumed
Green Gene 1	32	0.6	3200	12
Green Gene 2	64	0.8	7000	25
Green Gene 3	128	1.2	16000	60
Green Gene 01	192	4.0	50,000	188
Green Gene 04	768	16.0	400,000	1,500
Green Gene 09	1728	36.0	1,600,000	6,000
Green Gene 27	5184	108.0	5,000,000	18,750

Then just look at the energy savings from the reduced number of processors

*Equivalent Processor differences depend upon applications

PREDICTION SYSTEMS, INC.

PREDICTION & CONTROL SYSTEMS ENGINEERS

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Spring Lake, NJ 07762

Telephone: (732) 449-6800
Fax: (732) 449-0897

Web Site: www.predictsys.com
E-Mail: psi@predictsys.com

Functional Monitoring & Diagnosis (FMD)

John J Kelly, PhD
Model Software Corporation
www.ModelSoftware.com

Model Software

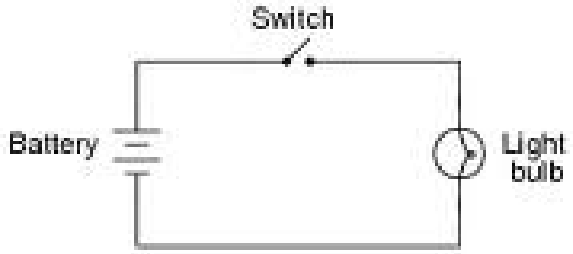
Requirement

- Current tools for Monitoring & Diagnosis have major limitations
  - Poor Effectiveness
    - False Positives
    - False Negatives
    - Tuning makes one better at the expense of the other
  - Poor Coverage
    - Detect anomalies
    - Diagnose/Isolate them correctly
  - Expensive
    - Not affordable to achieve high coverage
    - Not affordable to maintain as the monitored system evolves

Strategy

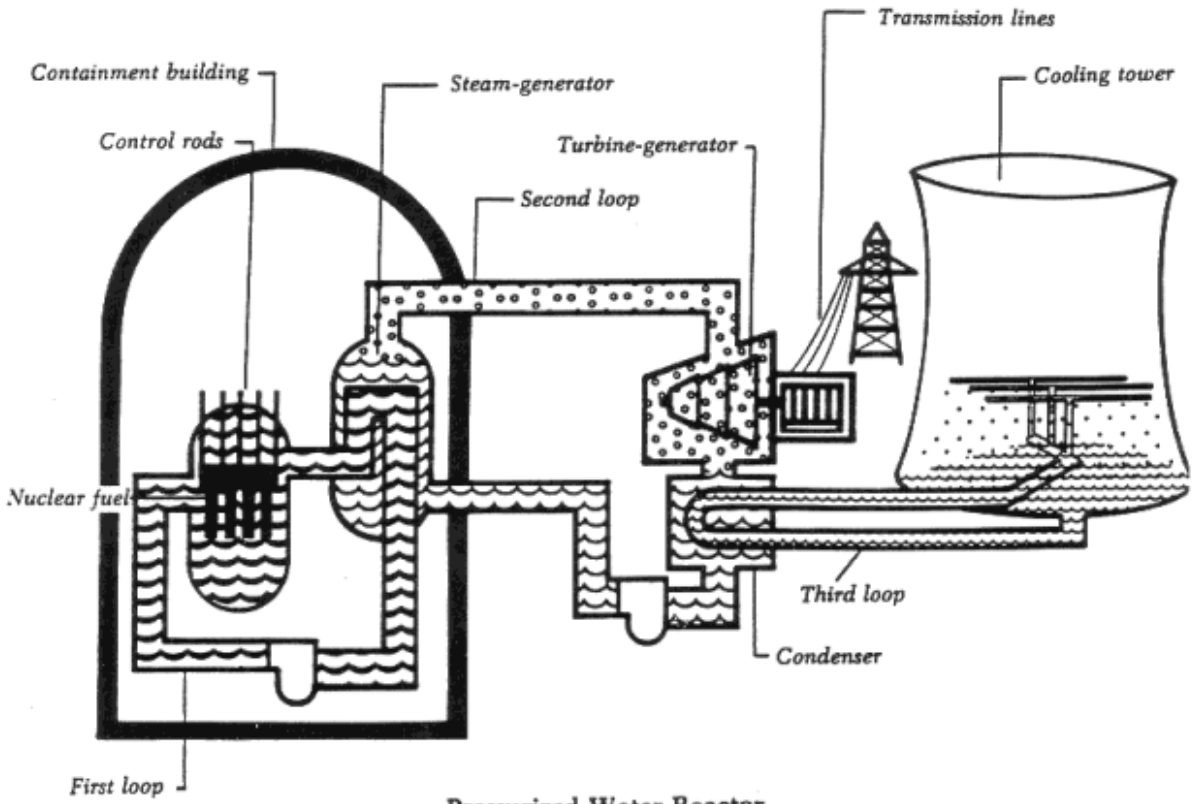
- Empirical
  - EG Machine Learning, Neural Nets
  - Easily discovers patterns from data sets
  - But:
    - Many patterns are trivial
    - Most patterns are not predictive
  - Contact with the real world is always problemattic
- Models
  - Non-trivial patterns that are testably predictive are called models
  - Desire to fully exploit the entire operational math model of the system
    - Highly scalable
      - Even as big as a nuclear power plant (1k-10k sensors)

Simplified Example: System & Model



Luminance = c * Power
Power = Voltage * Current
Voltage = Current *Resistance
Resistance = {if S=closed, R1}
{if S=open, ~infinite}
R1 = {if bulb=nominal, 1 ohm}
Voltage = {if battery=nominal, 1.5 volts}

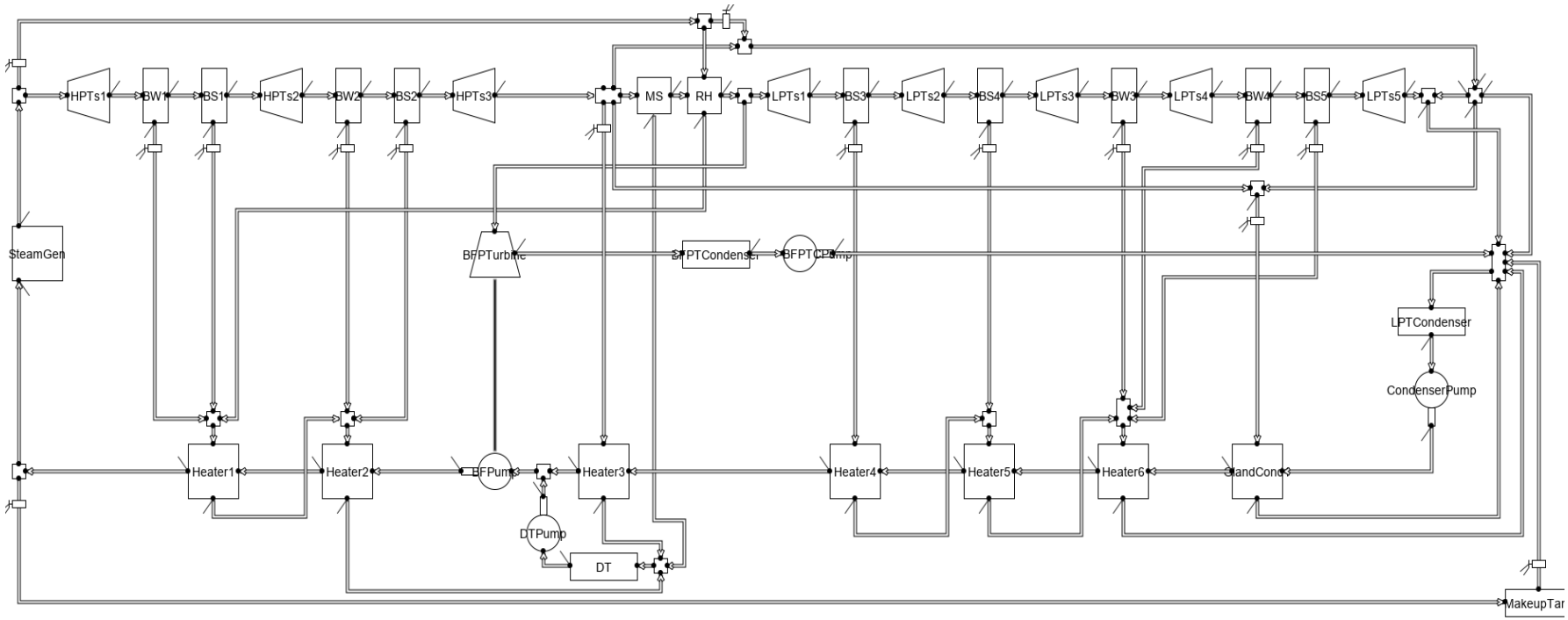
Nuclear Power Plant (Pressurized Water Reactor)



Pressurized Water Reactor

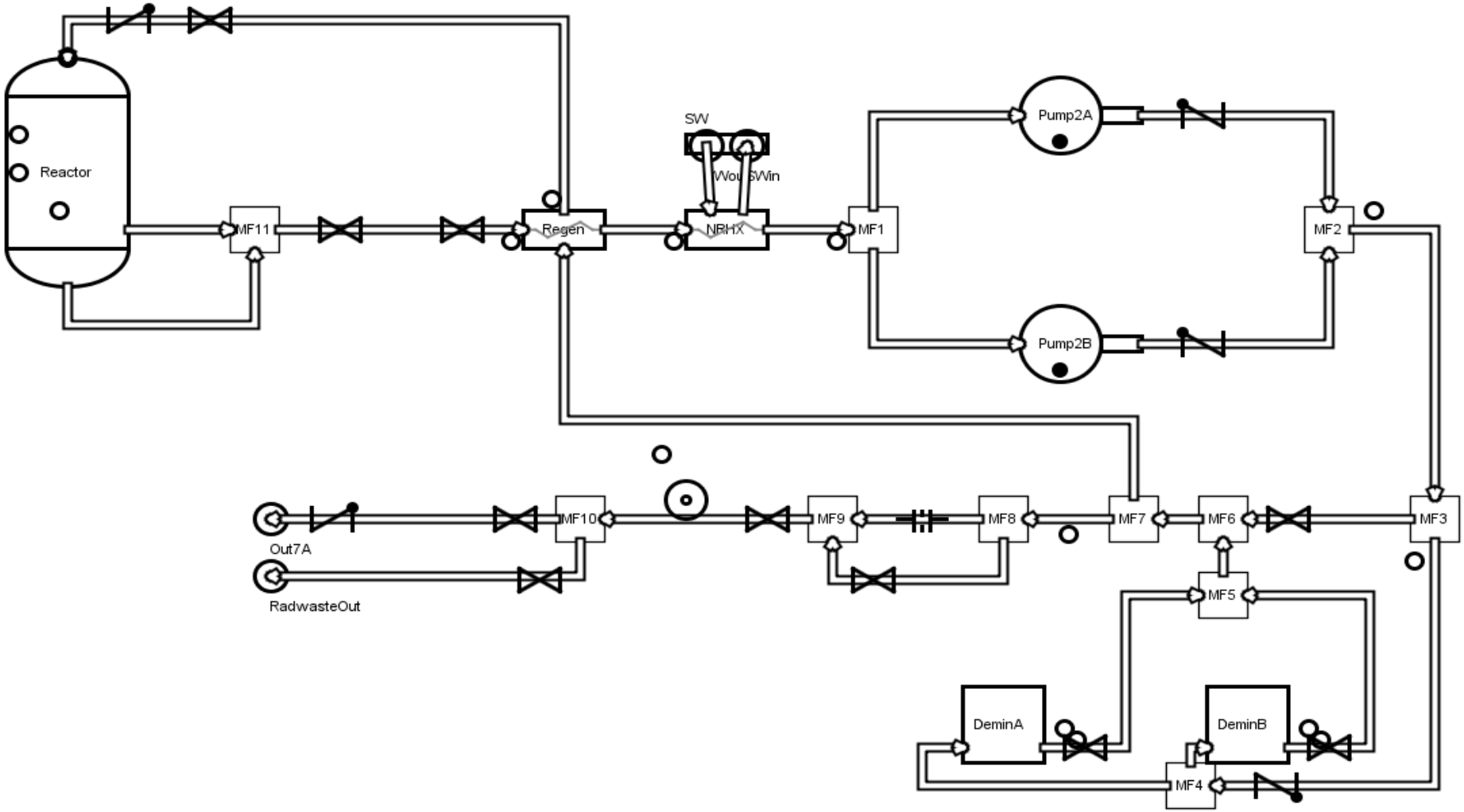
Model Software

Nuclear Power Plant (PWR) – Balance of Plant (BoP)



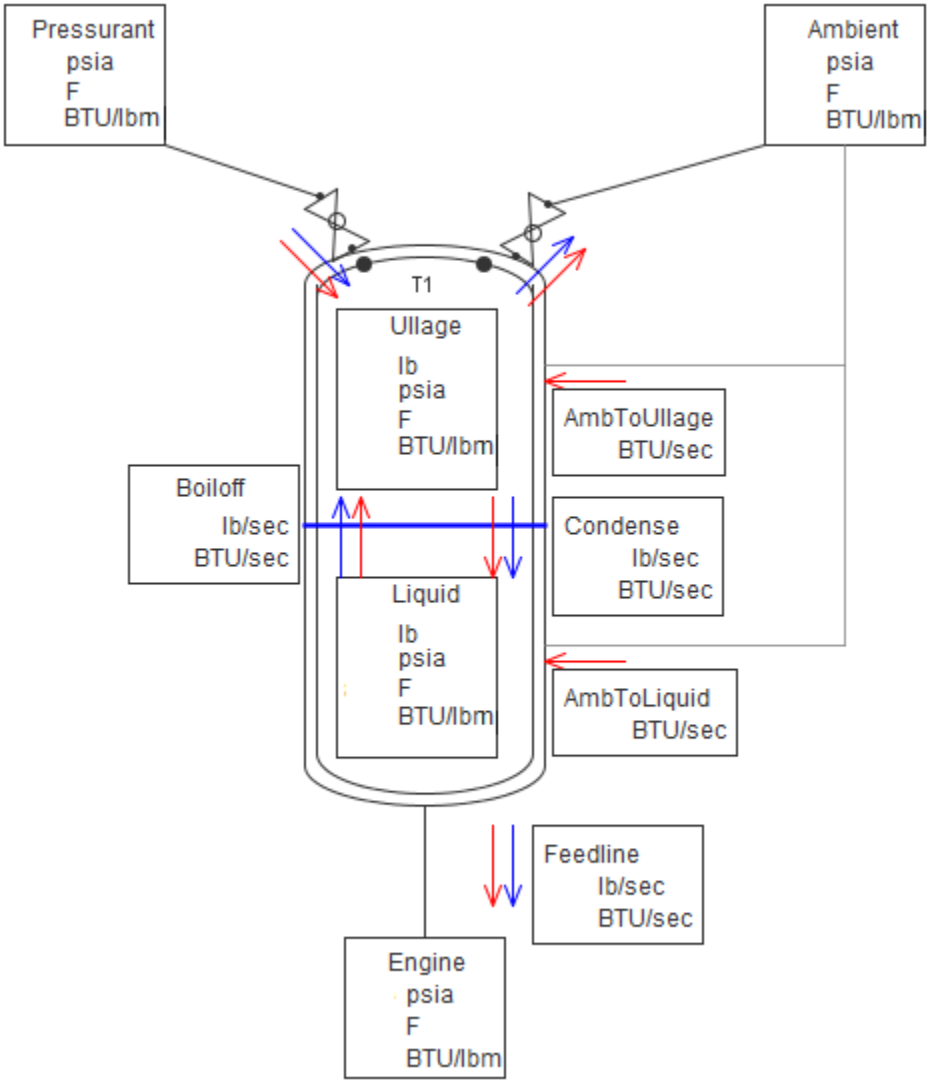
Model Software

Nuclear Power Plant (Pressurized Water Reactor)
Reactor Water Cleanup System



Model Software

Rocket Engine Propellant

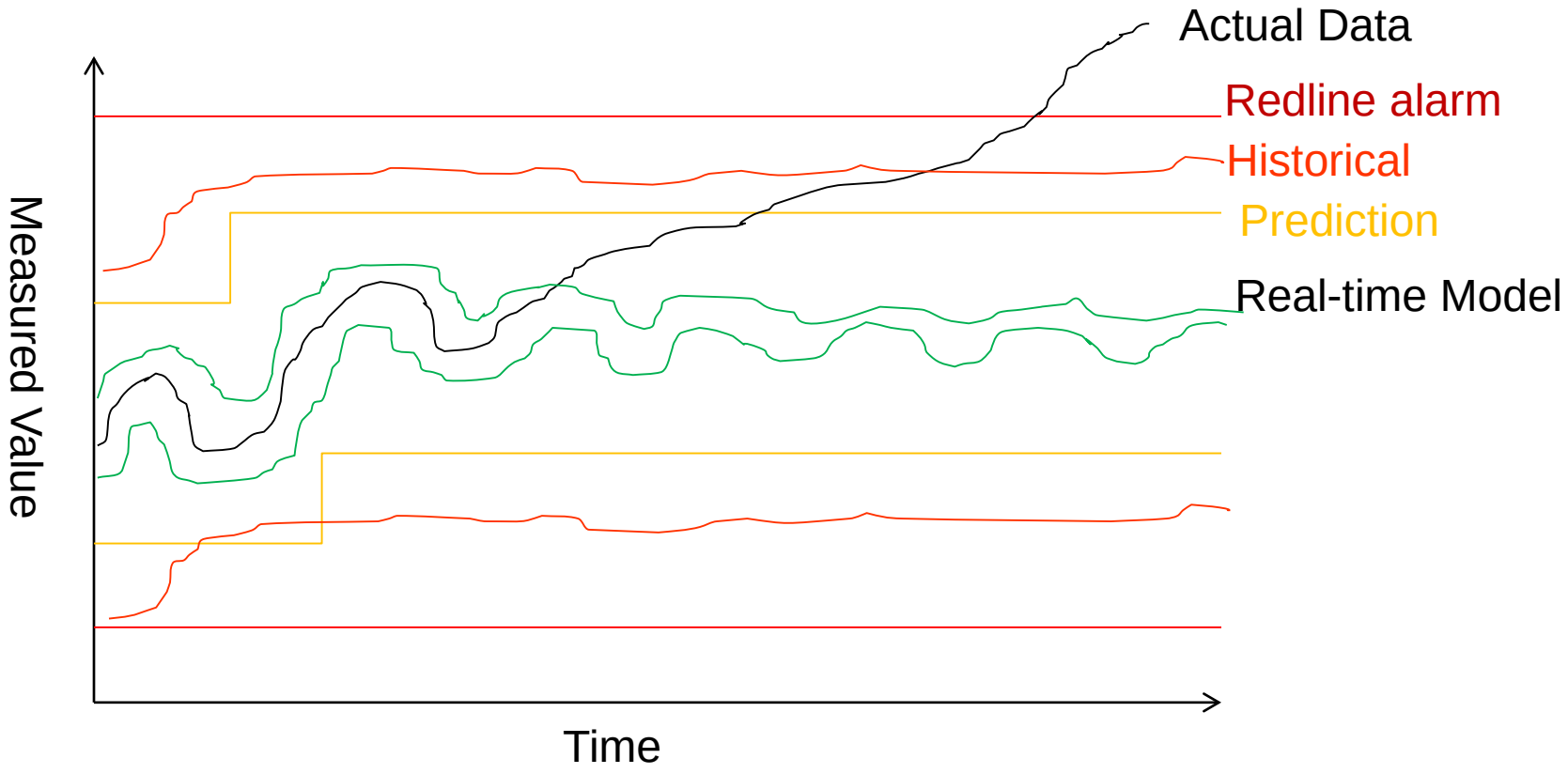


Model Software

Benefits

- Labor
  - Use existing process engineers
    - Not “AI experts”
  - Affordable to both set up & maintain as the target system evolves
- Effective
  - Minimize False Positives
  - Minimize False Negatives
  - Diagnostic limitations
    - Typically result from the limitations of the sensor suite
    - Not the software or the model

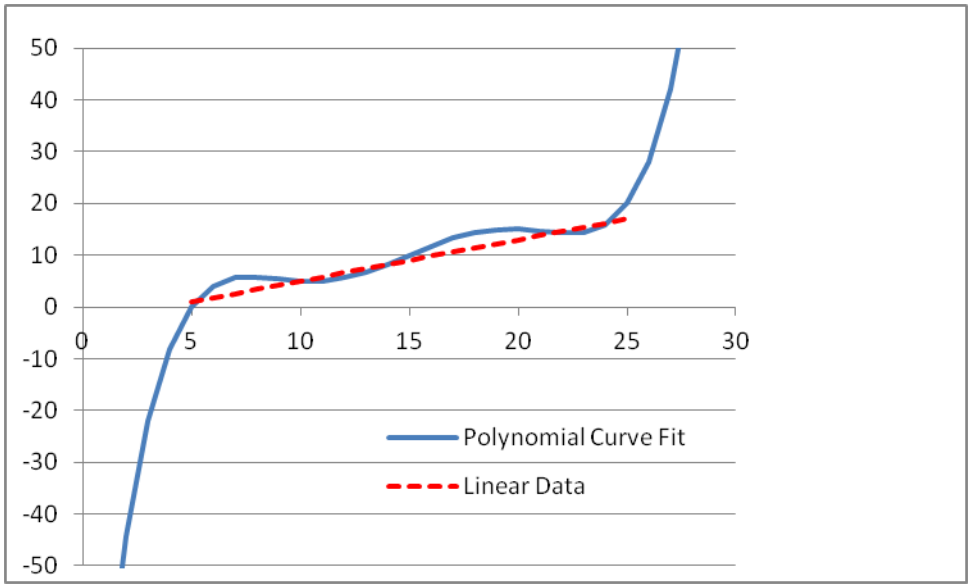
Real-time Detection of Failure



• Using an operating model enables detecting failures earlier than they might otherwise be detected, affording more time to manage them

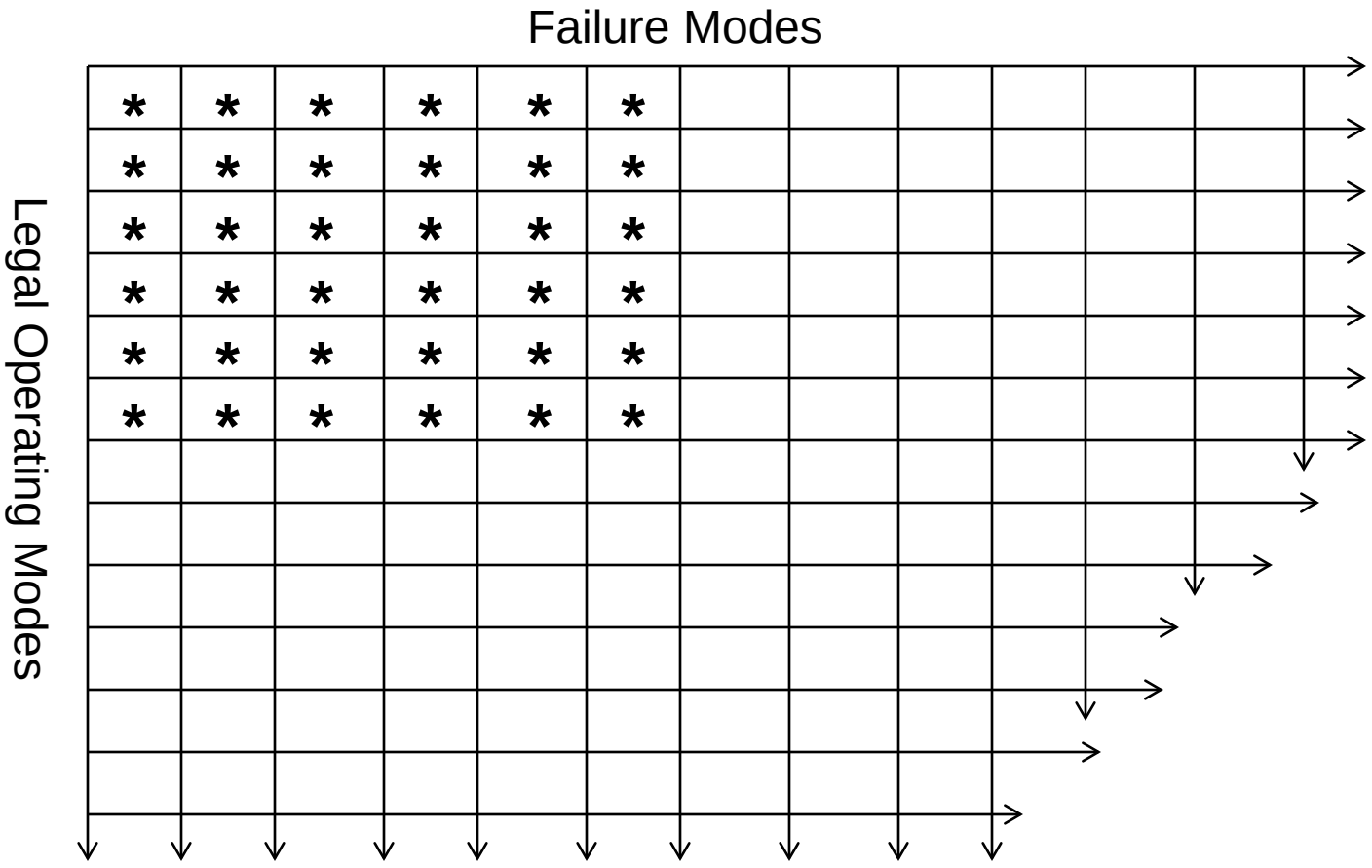
Model Software

Existing Technologies: Empirical



- Goodness of Fit (Overfitting)
  - Curve-fitting tools are notorious for fitting high-order polynomials to low-order phenomenon, such as for log and square-root functions, or even just simple linear equations that are slightly obscured by noise.
  - While by adding enough high-order terms, there can eventually be a fit, to some criteria, within the data domain of the exemplars, but as soon as the equations are used outside the range of the training exemplars the fit can be extremely bad

Combinatorial Space of Symptoms



* Defined symptom-fault relation

Model Software

Technicians & Engineers

- The empirical techniques are comparable to using technicians to diagnose equipment
  - Most all the time the technician immediately knows what is wrong – because he has seen it before in actual practice or in training
  - The balance of the time the technician struggles because he doesn't know how to diagnose from first principles
- An engineer can diagnose anything if he has a schematic and some time
  - He is well-versed in the first principles and in reasoning about models
- The downside to using engineers is that they must be kept on call and they do require some time to think about the problem
- FMD software performs essentially the same analysis that an engineer would perform
  - But it is practical to keep the FMD software online 24/7
  - It is able to perform the analysis in less than a second

Technique Summary

	Handcode	Empirical	Models
Availability of	Expert/Model	Data	Model
Goodness of Fit	Varies	Overfit	As good as it gets
Combinatorics	Limited	Limited	Virtually unlimited
Reliability	Good	Limited	Best
Range of Scenarios	Considered scenarios	Scenarios in exemplar set	Limited only by # of elements in Model