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*Customer Success Is Our Mission*

# FORCEnet Science and Technology Needs with Potential Solutions

**Presentation to ICCRTS**

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**De Vere University Arms**

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# FORCEnet Operations

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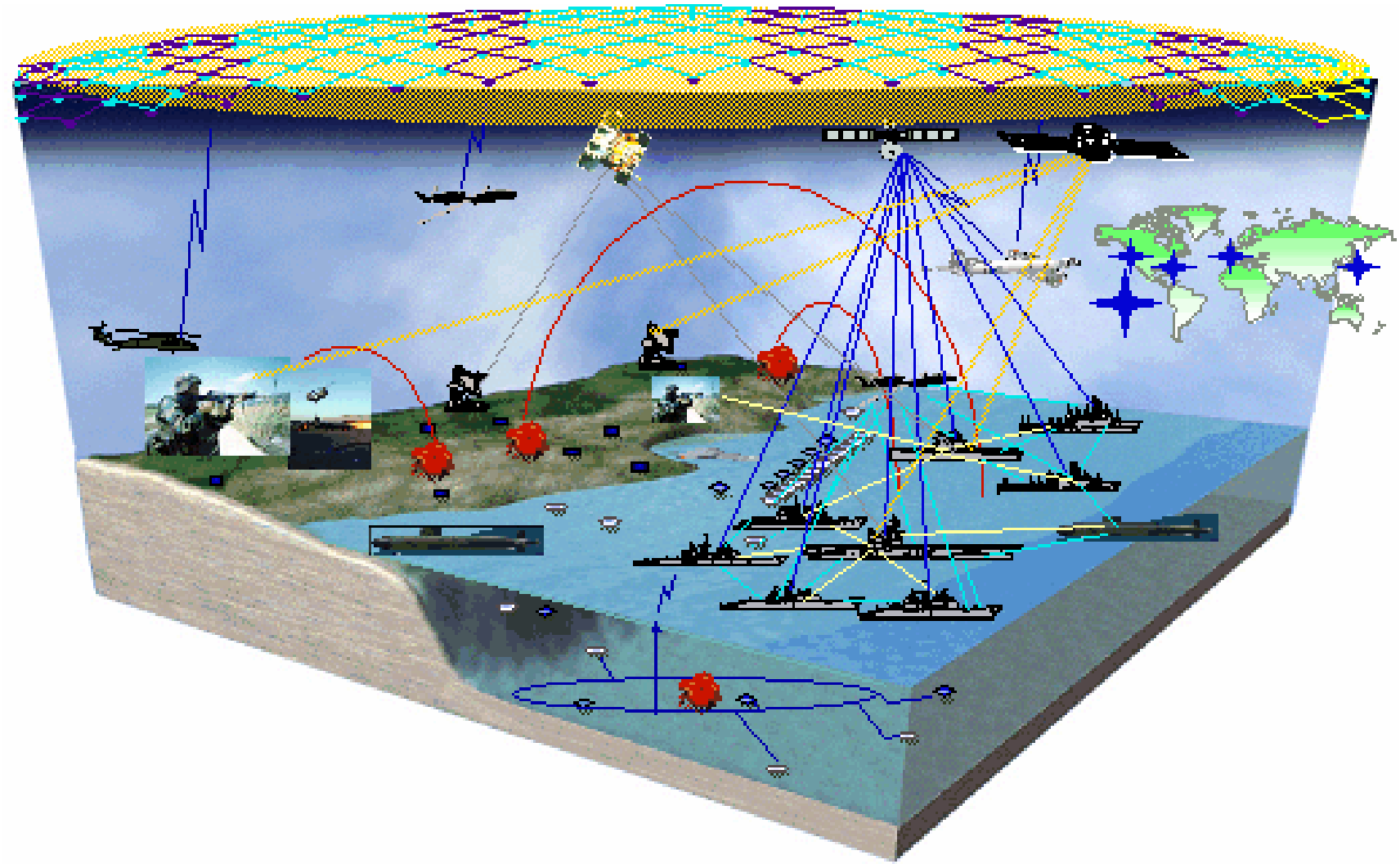

# National Research Council of the National Academies FORCEnet Study Team

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# FORCEnet Information Infrastructure Capabilities

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- Reliable wideband mobile communications
- Information management (including Common Operational Picture [COP])
- Situation awareness and understanding
- Persistent Intelligence Surveillance and Reconnaissance, ISR
- Information assurance
- Modeling and simulation
- Dynamic composability and collaboration
- Supporting the disadvantaged user-personnel, platform or sensor

http://www.nap.edu/catalog/11456.html

Blue, Orange are addressed in this paper

# FORCEnet- A Functional Concept for the 21st Century- CNO, 2005-Required Capabilities

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1. Provide robust, reliable communications to all nodes, based on the varying information requirements and capabilities of those nodes
2. Provide reliable, accurate and timely location, identity and status information on all friendly forces, units, activities and entities/individuals
3. Provide reliable, accurate and timely location, identification, tracking and engagement information on environmental, neutral and hostile elements, activities, events, sites, platforms and individuals
4. Store, catalogue and retrieve all information produced by any node on the network in a comprehensive, standard,repository so that the information is readily accessible to all nodes and compatible with the forms required by any nodes, within security restrictions
5. Process, sort, analyze, evaluate, and synthesize large amounts of disparate information while still providing direct access to raw data as required.
6. Provide each decision maker the ability to depict situational information in a tailorable, user-defined, shareable, primarily visual representation

# FORCEnet- A Functional Concept for the 21st Century- CNO, 2005-Required Capabilities

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7. Provide distributed groups of decision makers the ability to cooperate in the performance of common command and control activities by means of a collaborative work environment.
8. Automate lower-order command and control sub-processes and to use intelligent agents and automated decision aids to assist people in performing higher-order subprocesses, such as gaining situational awareness and devising concepts of operations.
9. Provide information assurance
10. Function in multiple security domains and multiple security levels within a domain and manage access dynamically
11. Interoperate with command and control systems of very different type and level of sophistication
12. Allow individual nodes to function while temporarily disconnected from the network
13. Automatically and adaptively monitor and manage the functioning of the command and control system to ensure effective and efficient operation and to diagnose problems and make repairs as needed.
14. Incorporate new capabilities into the system quickly without causing undue disruption to the performance of the system
15. Provide the decision makers the ability to make and implement good decisions quickly under conditions of uncertainty, friction, time, pressure, and other stresses

# Information Management

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## Data Overload means *Information Camouflaged*


**World War I:**
**30 wpm**
Field Phone

**World War II:**
**60 wpm**
Radio

**Vietnam:**
**100 wpm**
SATCOM

**Gulf War:**
**192,000 wpm**
Networked Computers

**War in 2010:**
**1.5 trillion wpm**
Wideband Datalinks

**We can transmit the entire Library of Congress each minute**

**wpm - words per minute**

*From General Buck Rogers Brief to NDIA*

# Information Management Technical Challenges

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- Trust
- Contamination
- Utility
- GIG Task, Push, Process and Use (TPPU) and Only Handle Information Once (OHIO)
- Metrics
- Pedigree
- Models to capture and share knowledge of phenomenology and sources to guide human interpretation

# JOINT INTEGRATED AIR DEFENSE

***Joint Theater Context- Information Management***

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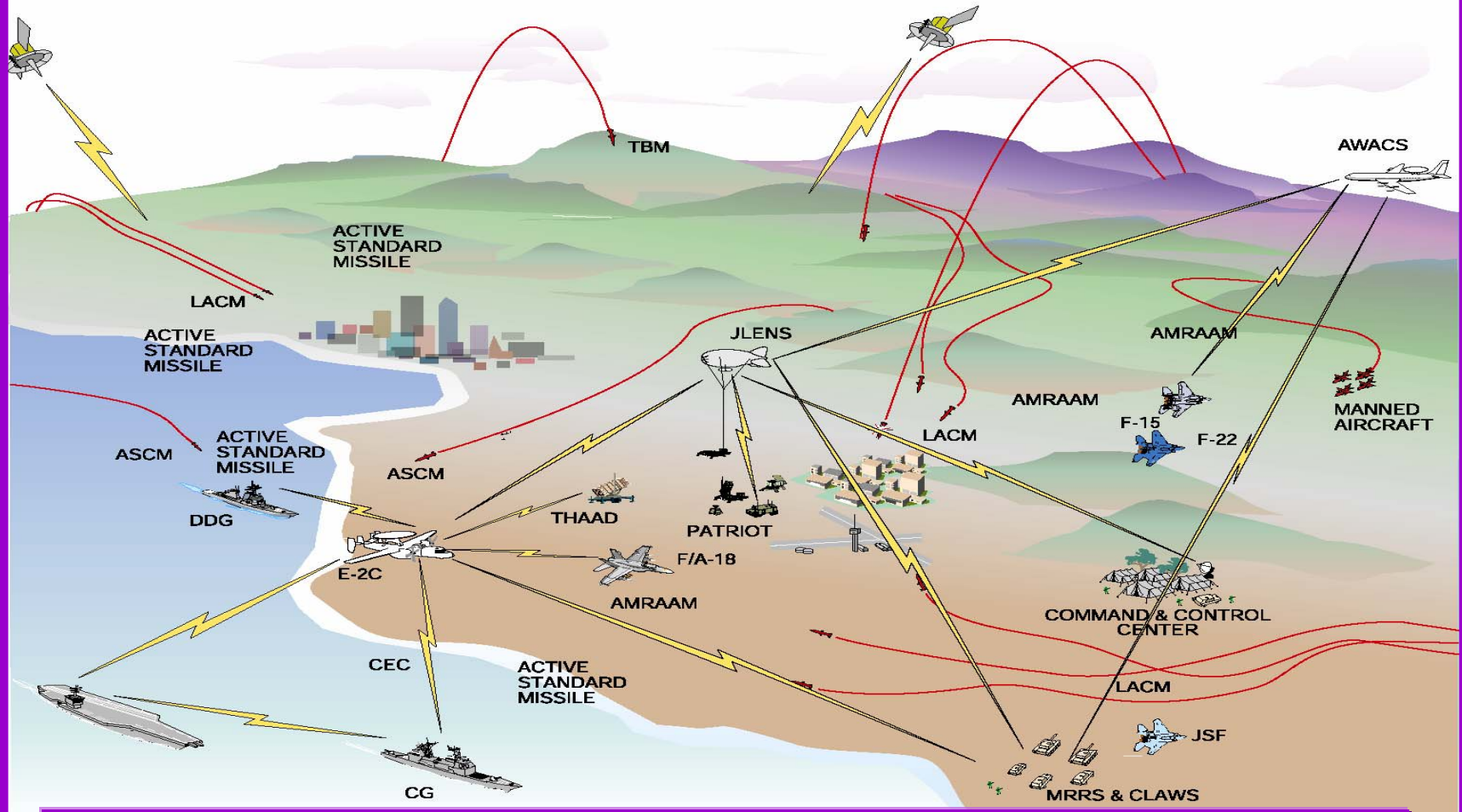
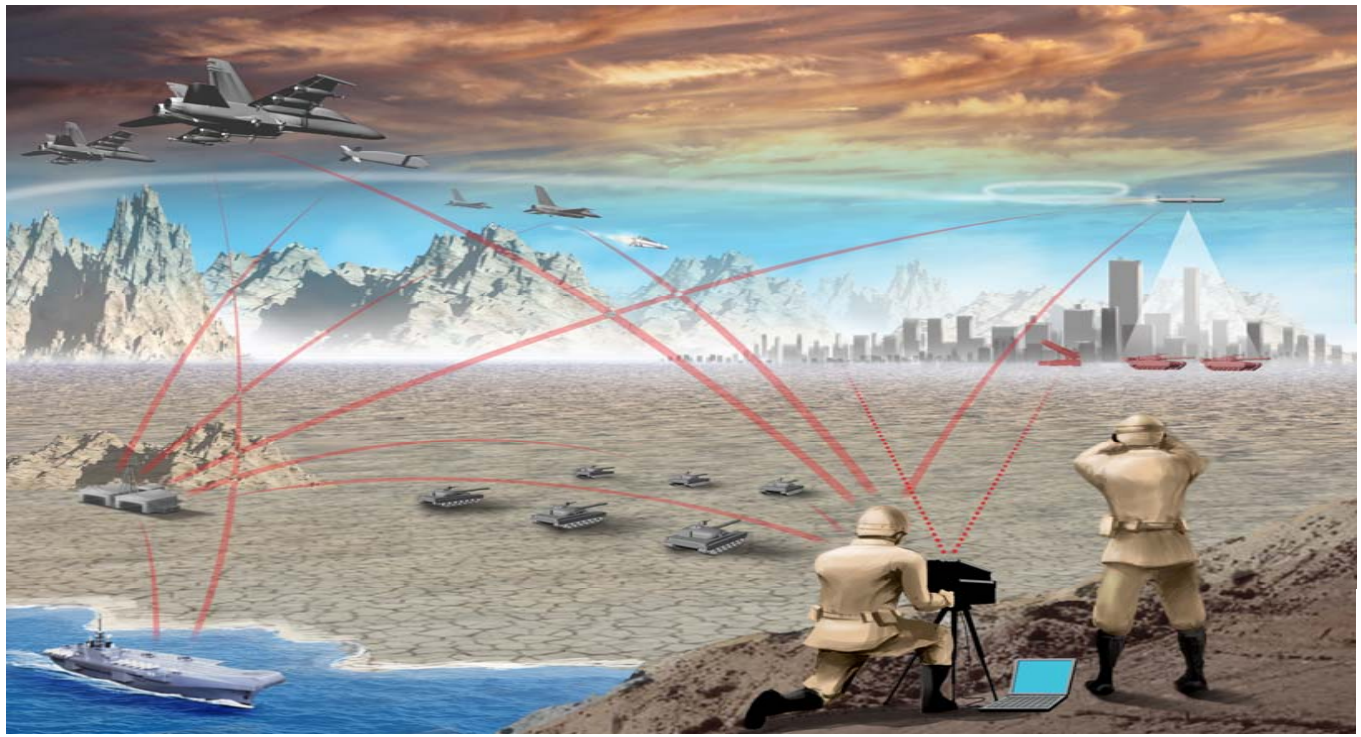



## JOINT INTEGRATED KILL CHAIN

# Situation Awareness and Persistent ISR



# Situational Awareness Technical Challenges

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- Inference engines
- Knowledge management
- Large scale relational and control frameworks
- Human-machine collaboration
- Cognitive modeling
- Dynamic “What If?” Analysis

# Persistent ISR Technical Challenges

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- Persistent sensing
- Pervasive sensing
- C2 of platforms and sensors to meet dynamic operational and tactical needs
- Dynamic planning and replanning of sensor modality and coverage
- Distributed autonomous networks
- Automation to support Net-Centric Warfare
- Dynamic netted sensors

# Strike Netted Effects Network

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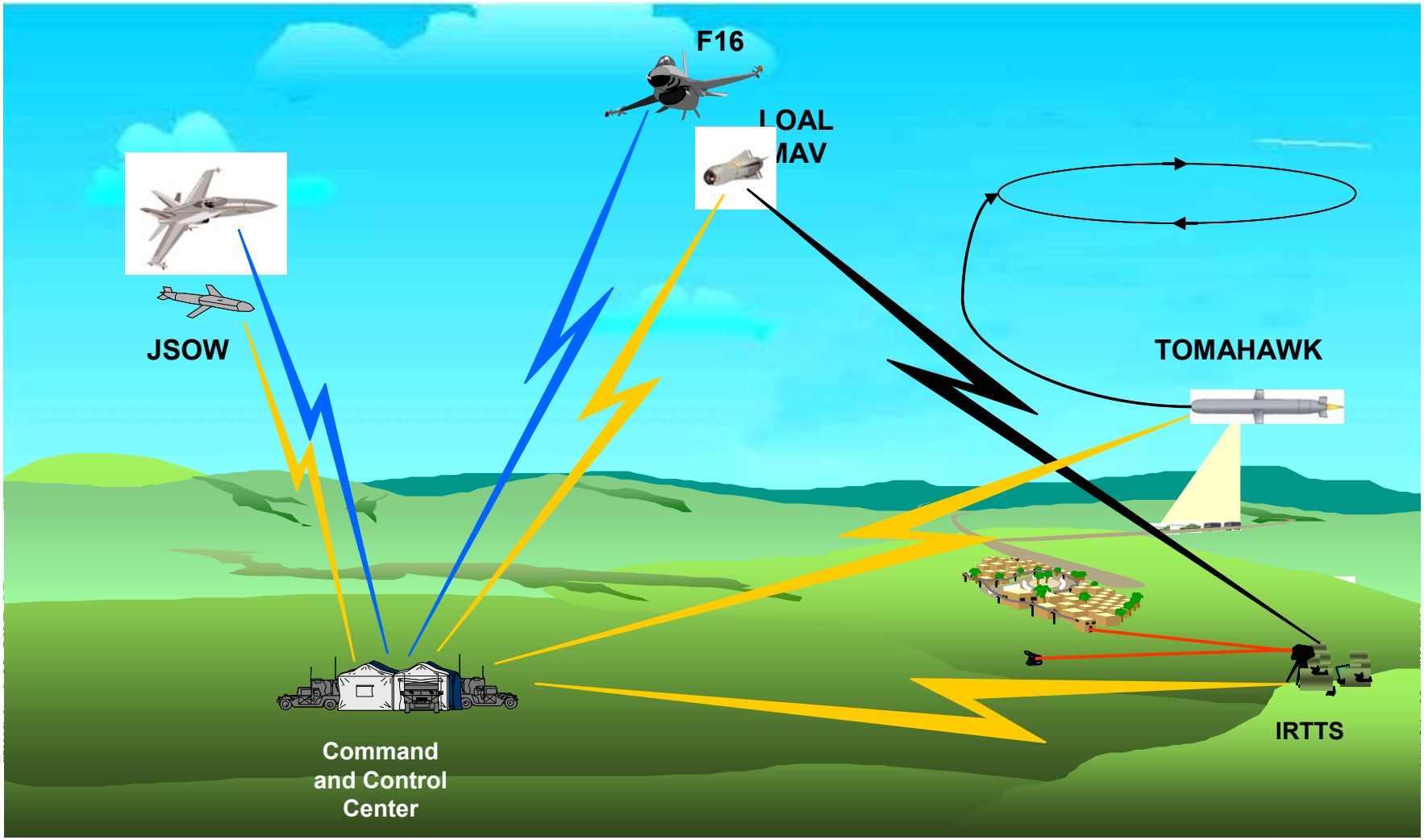

# Information Assurance Technical Challenges

- Automated network analysis / monitoring
- Dynamic balancing of protection levels, including policy adaptation, with sharing needed to maintain mission effectiveness
- Trustworthiness of software systems
- Intrusion detection
- Identify insider threats
- Metrics

# CHAIN – Part of the Solution for IA

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## Compartmented High Assurance Information Network (CHAIN)


***Supports Homeland Defense Agency, Coalition and Joint Interoperability Information Assurance Requirements***

**Security Enhancements**

- Designed to comply with DCID 6/3
- Context-sensitive content filtering
- Mandatory and discretionary access control
- Audit data collection and automatic analysis
- In-transit and at-rest data protection

# Composability Technical Challenges

## Composeable Warfighting

**Interoperable**
*Across technologies and systems*

**Composeable**
*Systems, Organizations, Processes and Procedure*

**Plug and Play**
*Add, subtract platforms, sensors, weapons, warriors h/w, download s/w; reusable*

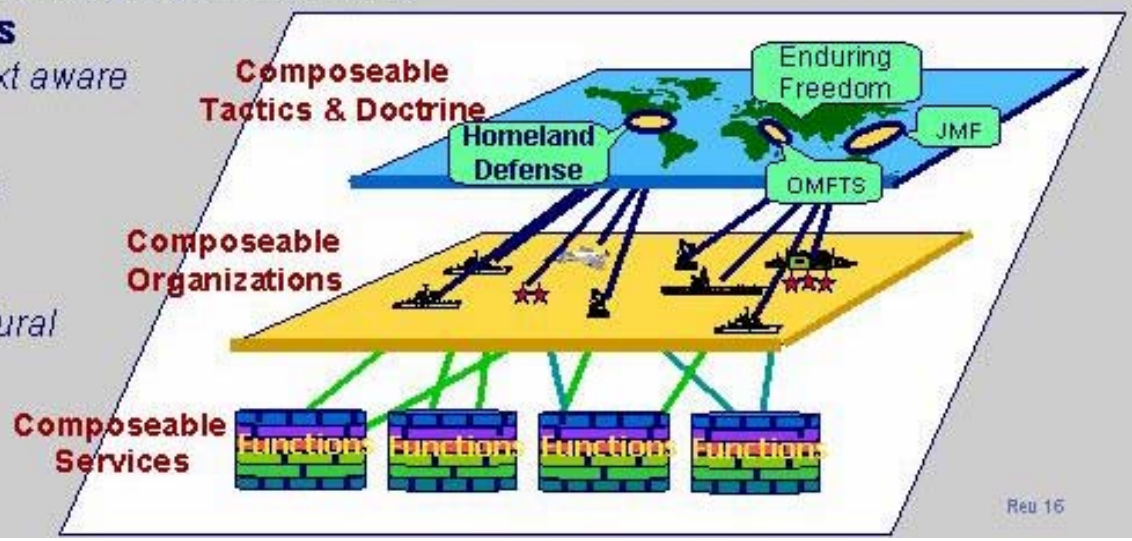
**Distributed**
*Ubiquitous, virtual sources, virtual systems, virtual spaces, virtual presence*

**Adaptive**
*To new missions, technologies, environments*

**Sentient Applications**
*Self-learning, context aware*

**Secure**
*I/O Protected, MLS, Tailorable*

**Intuitive**
*Low/no training, natural*



# Part of the Solution-Tying It All Together Net Enabled Operations

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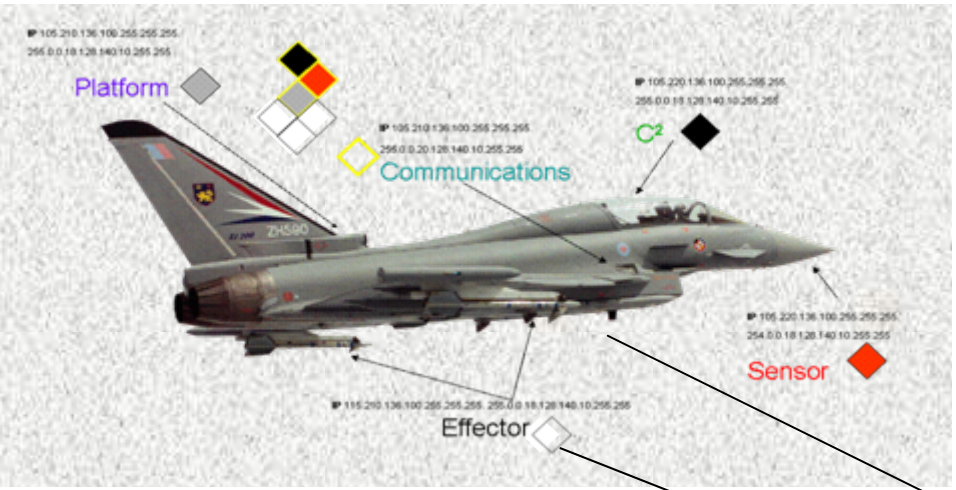
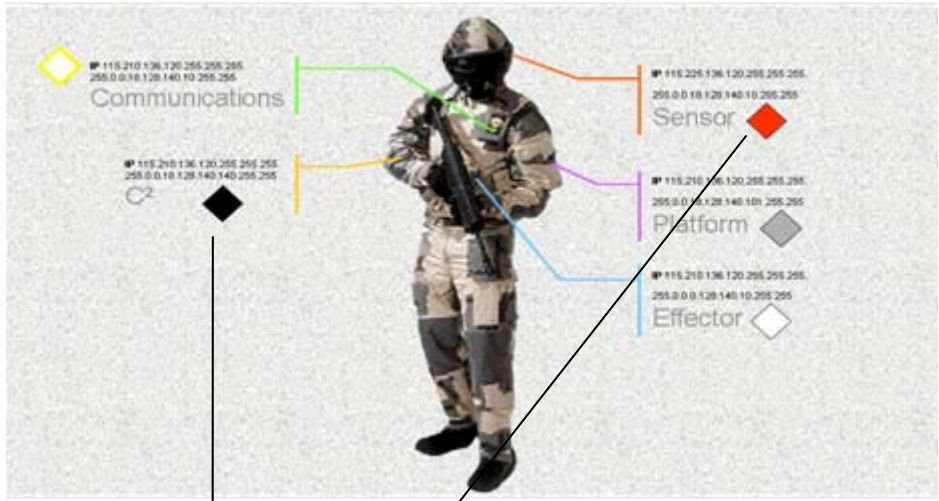
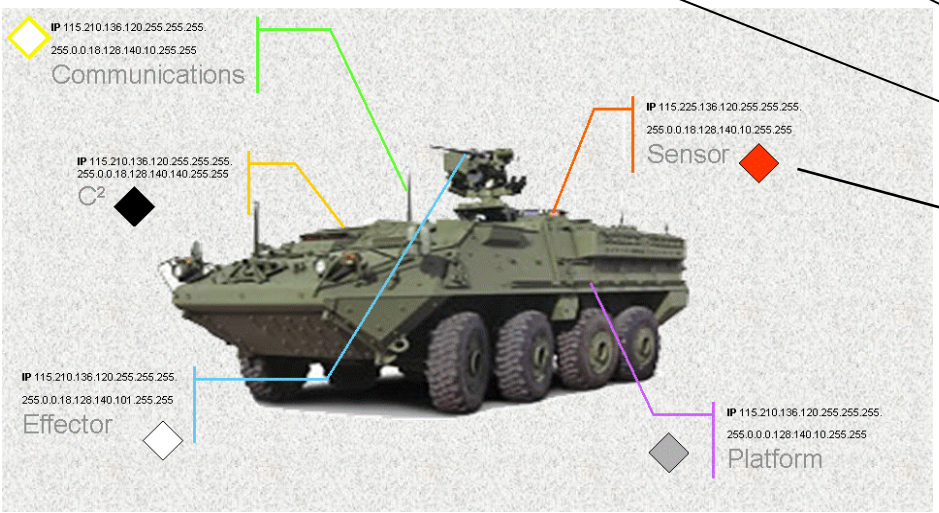
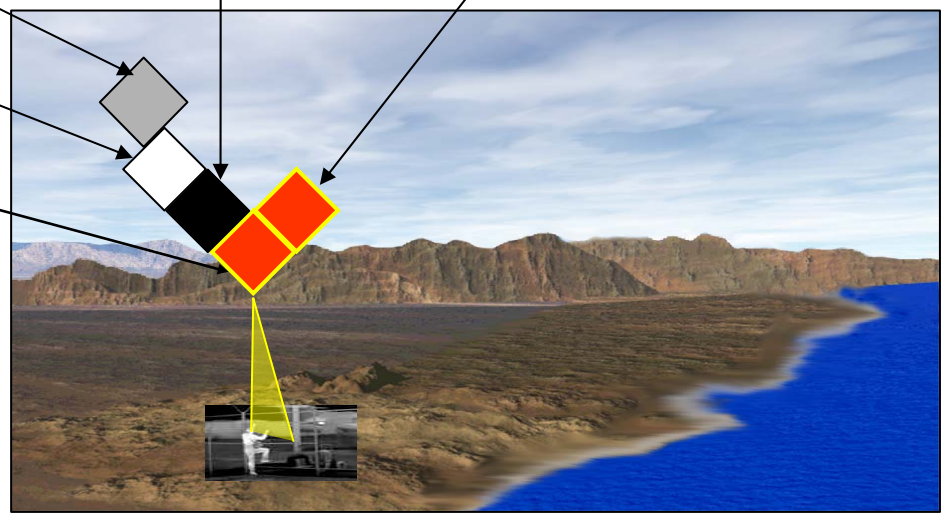


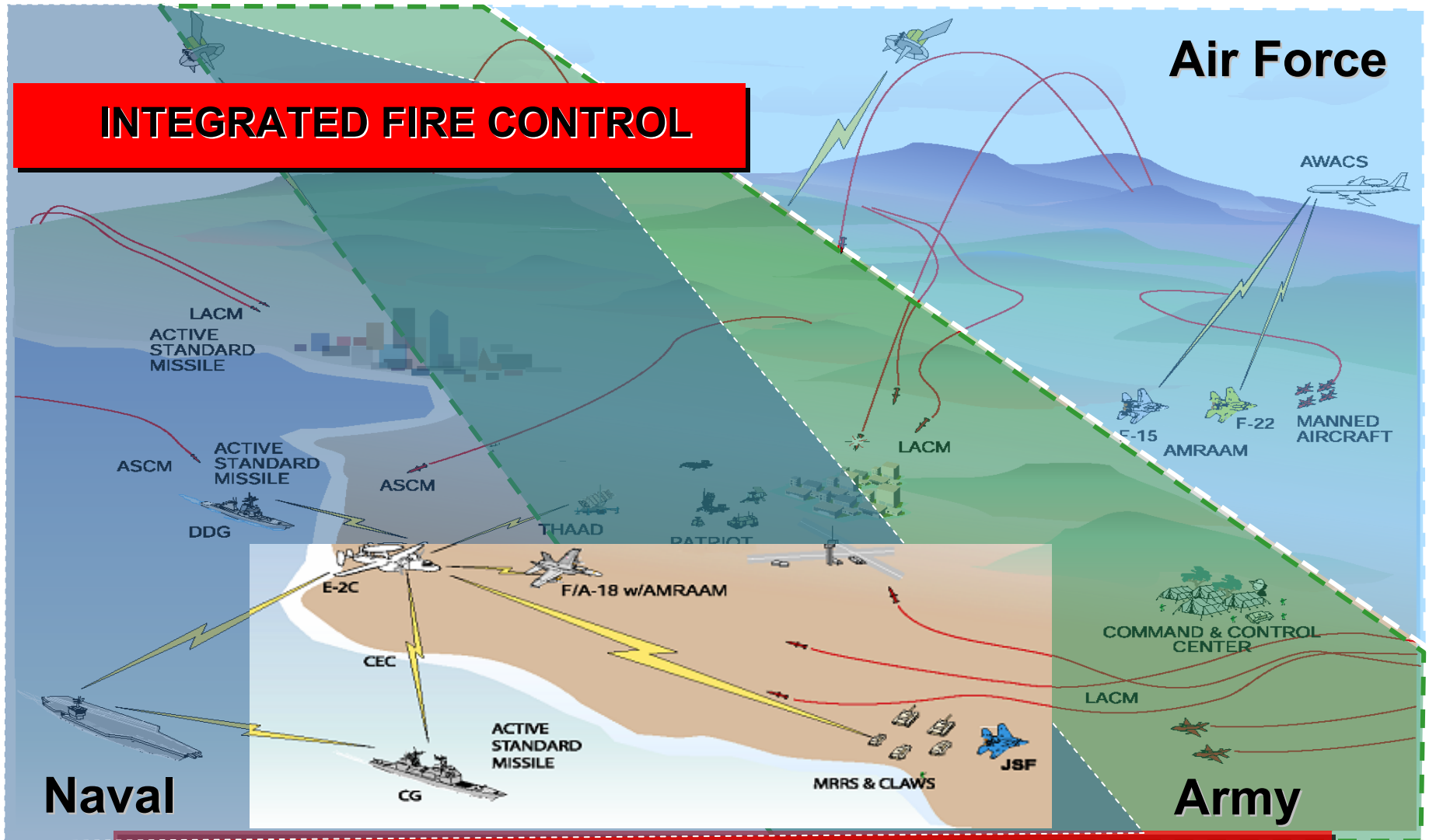



**Internet analogy – every Effector, Sensor, C2 & Platform has an IP address**

# FUTURE AIR DEFENSE TRANSFORMATION



# FORCEnet and Net Enabled Capabilities S&T Concerns

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- There are critical Science and Technology, S&T, capabilities
  – Key to FORCEnet and NEC success
- The S&T issues must be aggressively understood and resolved

- If we do not resolve these S&T issues, Net Enabled Capabilities and Net Centric Operations will not be successful

# Backup

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# Prioritizing S&T Recommendations-example

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- Critical to Navy and no one else is working in this area
- Critical to the Navy but others are working this area
- Enhances performance but not required
- Near-term
- Mid-term
- Long-term

# S&T Sensitivity Table

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| FORCEnet Information Infrastructure | Navy Priority | S&T Experimentation | Ongoing ONR | Comments | Priority (scores) |
|---|---|---|---|---|---|
| Critical to Navy and No One Else Working | | Critical to Navy But Others Working | | Enhanced Performance Fn II, Nice to Have but Not Required | |
| 1. Communications | | | | | |
| (a) Links/Antenna √ | | N | Partial | Issue for ships and submarines | H |
| (b) QOS/Monitor | √ | N | Partial | | H |
| (c) Protocols/STD √ | | N | Partial | | H |
| (d) U.W. Communications √ | | L | Partial | Speed and depth issues, optical communications | H |
| (e) Satellite Relay Alternative | √ | L | √ | | |
| (f) Optical Communications Marine Layer | | √ | L | √ | |
| (g) Apertures—Disadvantaged Users | | √ | M | ? | |
| | | | | | |
| 2. Information Management | | | | | |
| (a) Ontology √ | | N | Partial | | H |
| (b) Information Services | √ | N | Partial | | H |
| (c) Sensor Resource Management | | √ | M | | |
| (d) Distributed Fusion √ | | N | Partial | Includes underwater issues | )H |
| (e) User Defined Visualization | | √ | N | | H |
| (f) Enterprise Monitor | √ | M | | | |
| | | | | | |
| 3. Situation Awareness | | | | | |
| (a) Contextual Reasoning | √ | M | Partial | | |
| (b) Knowledge Bases | √ | M | Partial | | |
| (c) Interactive Hypothesis Management | | √ | L | ? | |
| (d) Cognitive Interface | | √ | L | Partial | |

# S&T Sensitivity Table-continued

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4. Information Assurance | | | | | | | |
| (a) Metrics/Monitoring | | √ | | M | Partial | | |
| (b) Sharing enabler/Balance | | | √ | L | | | |
| (c) Software Trustworthiness | | √ | | M | √ | | |
| (d) Power Sources | | √ | | M | √ | | |
| | | | | | | | |
| 5. Modeling and Simulation | | | | | | | |
| (a) Scaling | √ | | M | | | | |
| (b) Systems Engineering | | √ | | M | | | |
| (c) What If Analysis | | | √ | L | | | |
| | | | | | | | |
| 6. Composability/Collaboration | | | | | | | |
| (a) Mission Management | | | √ | L | | | |
| (b) Readiness Monitor | | √ | | M | | | |
| (c) Manpower and Training | | | √ | L | ? | | |
| (d) Collaboration communications | (4) | √ | | M | Partial | Automation in unreliable | |
| | | | | | | | |
| 7. Disadvantaged Users | | | | | | | |
| (a) HMI | √ | | M | Partial | | | |
| (b) Customized Information | | √ | | M | Partial | | |
| (c) Aperture Size/Weight | √ | | | M | ? | Small ships, U.W. - platforms | H |
| (d) Power Sources | | √ | | M | | | |
| | | | | | | | |
| 8. Persistent ISR | | | | | | | |
| (a) Automated Adaptive Sensor Control | | | √ | | L | Partial | |
| (b) Manpower Reduction | | √ | | M | Partial | | |
| (c) Netted Sensors sensors/vehicles | √ | | | M | Partial | e.g., sonobuoys and UW | H |

NOTE: N = Near term; M = Mid Term; L = Long Term; and H = High Priority. A list of acronyms is

# High Priority FORCEnet S&T-

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- 1.a. The capability in link and antenna technologies to provide increased data rates and beam agility.
- 2.d. Distributed, heterogeneous, real time level 1 data fusion.
- 2.e. User defined visualization and automation for decision support
- 1.b Insufficient quality of service and network monitoring, control, and reconfiguration to provide the necessary availability and latency for priority traffic.
- 7.c. The size and weight of antenna apertures too large for routine use by disadvantaged (especially dismounted) users.
- 8.c. Small, networked sensors for wide area, inexpensive alerting in difficult/denied areas.
- 2.a. Ontology consistency to enable automated machine collaboration across communities of interest.
- 2.b. Information services to enable management of information content/quality.
- 1.c. Necessary protocols in standard use to support the mobility, disruption, and information assurance robustness that will be needed in the future FORCEnet.
- 1.d. Reliable communications technologies to reach underwater vehicles at speed and depth.

# S&T Recommendations

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- **Continue to develop prototypes that demonstrate solutions to the antenna blockage problem, such as wide-band multi-beam arrays, and alternative relays**
- **Aggressively seek technologies that will permit connecting to disadvantaged uses such as small vessels, marine vehicles, and dismounted marines**

# S&T Recommendations - 2

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- MANET routing over multiple alternate paths
- QoS management and monitoring
- Network protection and recovery
- Information assurance
- Connectivity to dismounted units with smaller size and weight antenna apertures
- Small netted sensors for wide area, inexpensive alerting in difficult denied areas
- Information management in the naval context to permit full exploitation of network-centric enterprise services, increasing its investments in ontologies of naval operations, information services, distributed level 2 through 4 fusion, and user-defined visualization
- Investigate other shortfalls in long-term strategic investments

# FEDERATED AIR DEFENSE

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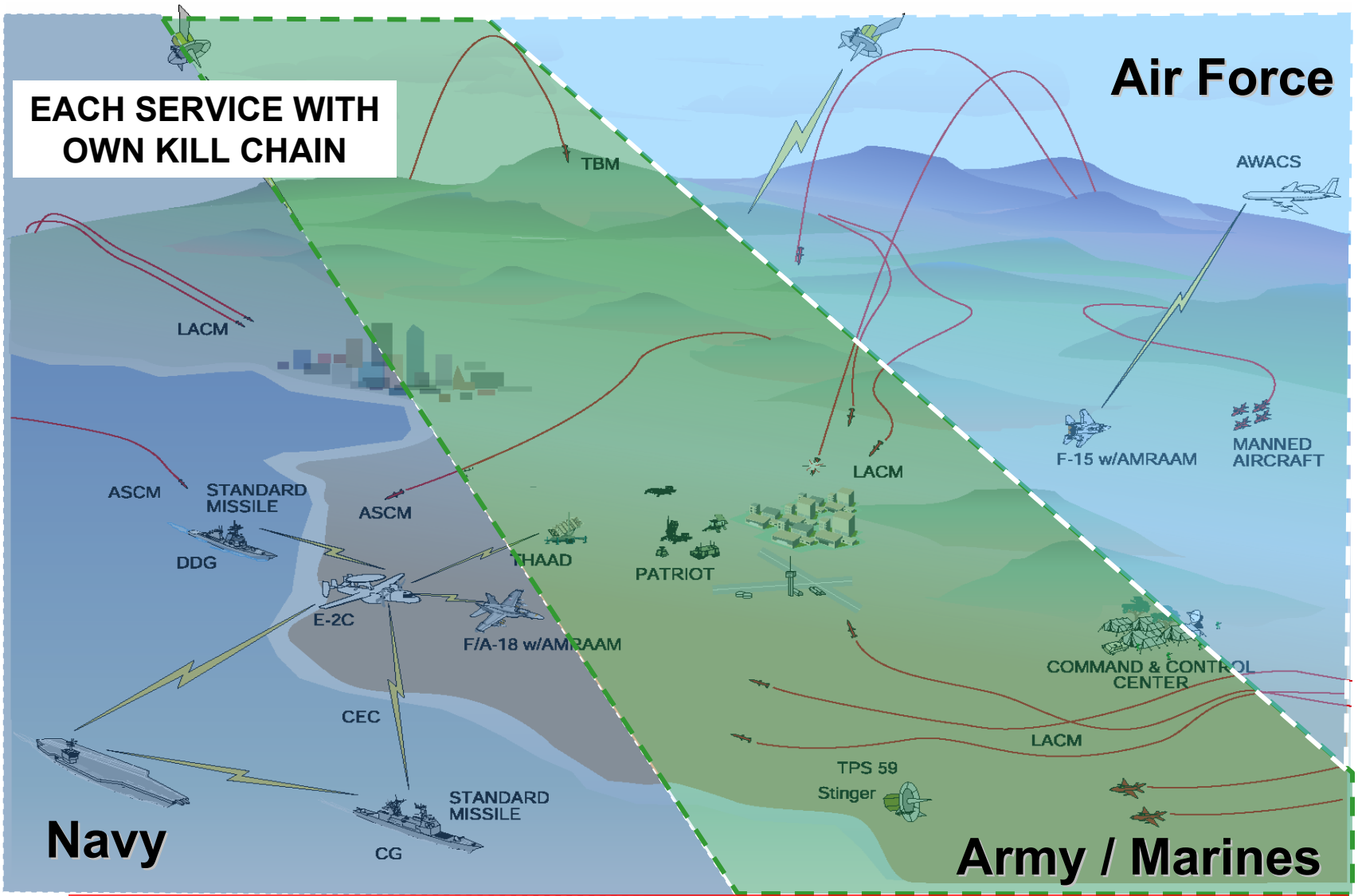


**FIRE CONTROL IS NOT INTEGRATED**

# TOMORROW'S NAVY AIR DEFENSE

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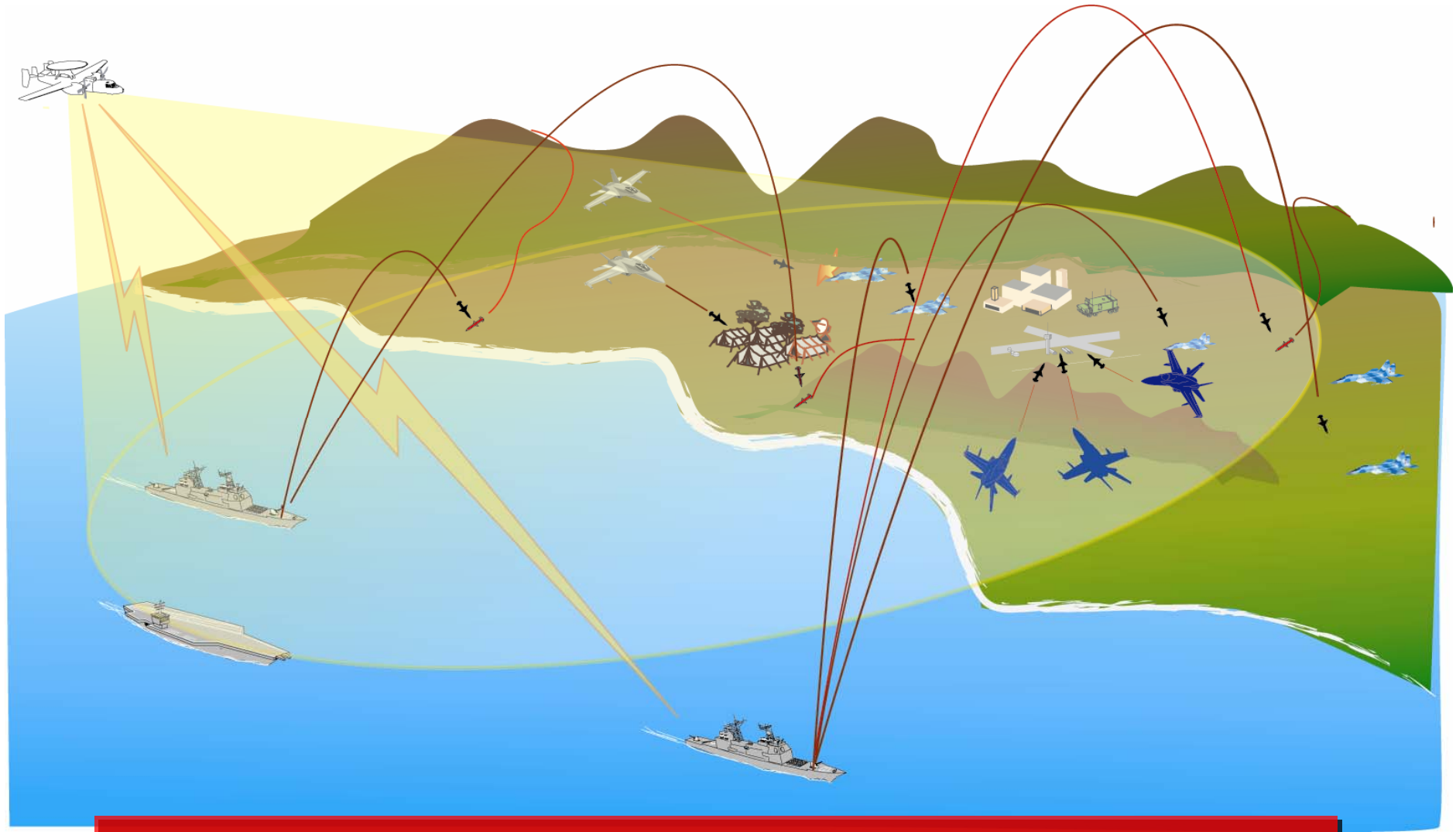

**OFFENSIVE POSTURE WITH MORE STRIKE**

# Communications and Networking Modeling and Simulation Center of Excellence

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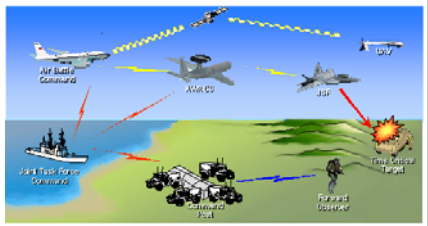
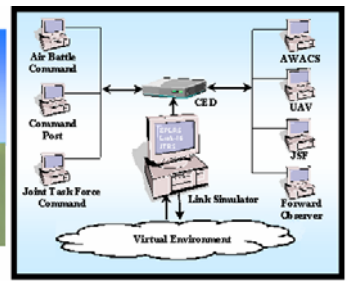
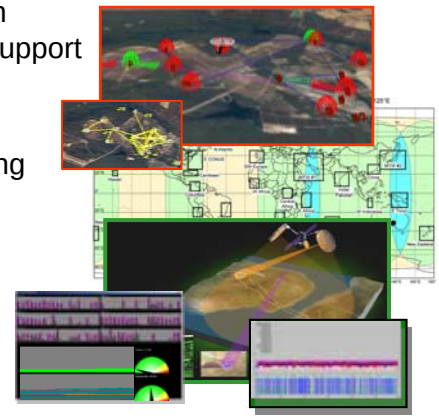
**Innovative Technologies:**
Integrating a Simulated Communications Environment into man-in-the-loop and hardware-in-the-loop simulation and integration environments to accurately represent the effects of communications and networking protocols. Flexible design allows for use throughout all phases of system development and test.



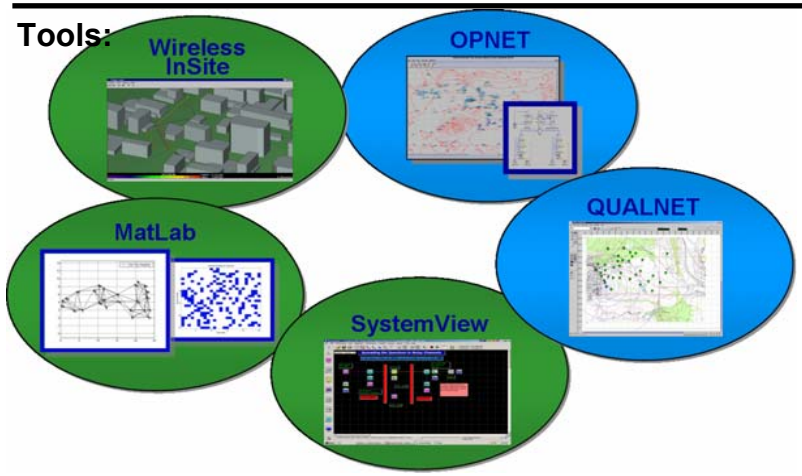



**Team Overview:**
- "Center of Excellence" for tactical communications and networking Modeling and Simulation
- Over $1M in hardware and software to support modeling and simulation activities

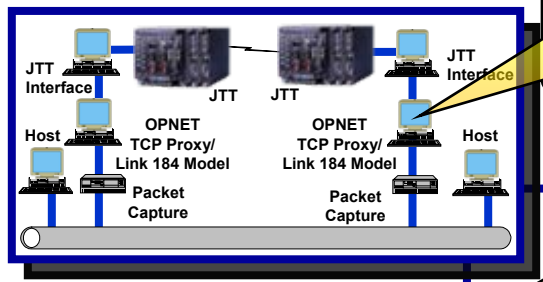
**Strengths:**
- Advanced networking protocol prototyping and development
- Communication system performance evaluation and analysis
- 2-D and 3-D visualization and animation
- Integration of communication effects in distributed simulation environments
- Development of HLA compliant models



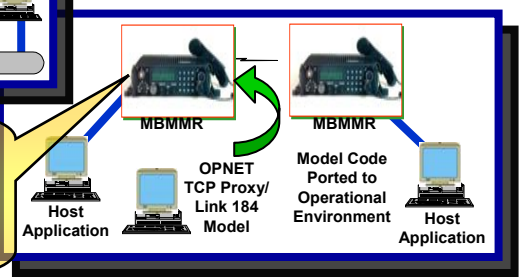
**Tools:**




**Rapid Prototyping:**




**Integrating detailed OPNET models into hardware test/integration environments supports early evaluation of protocol performance.**

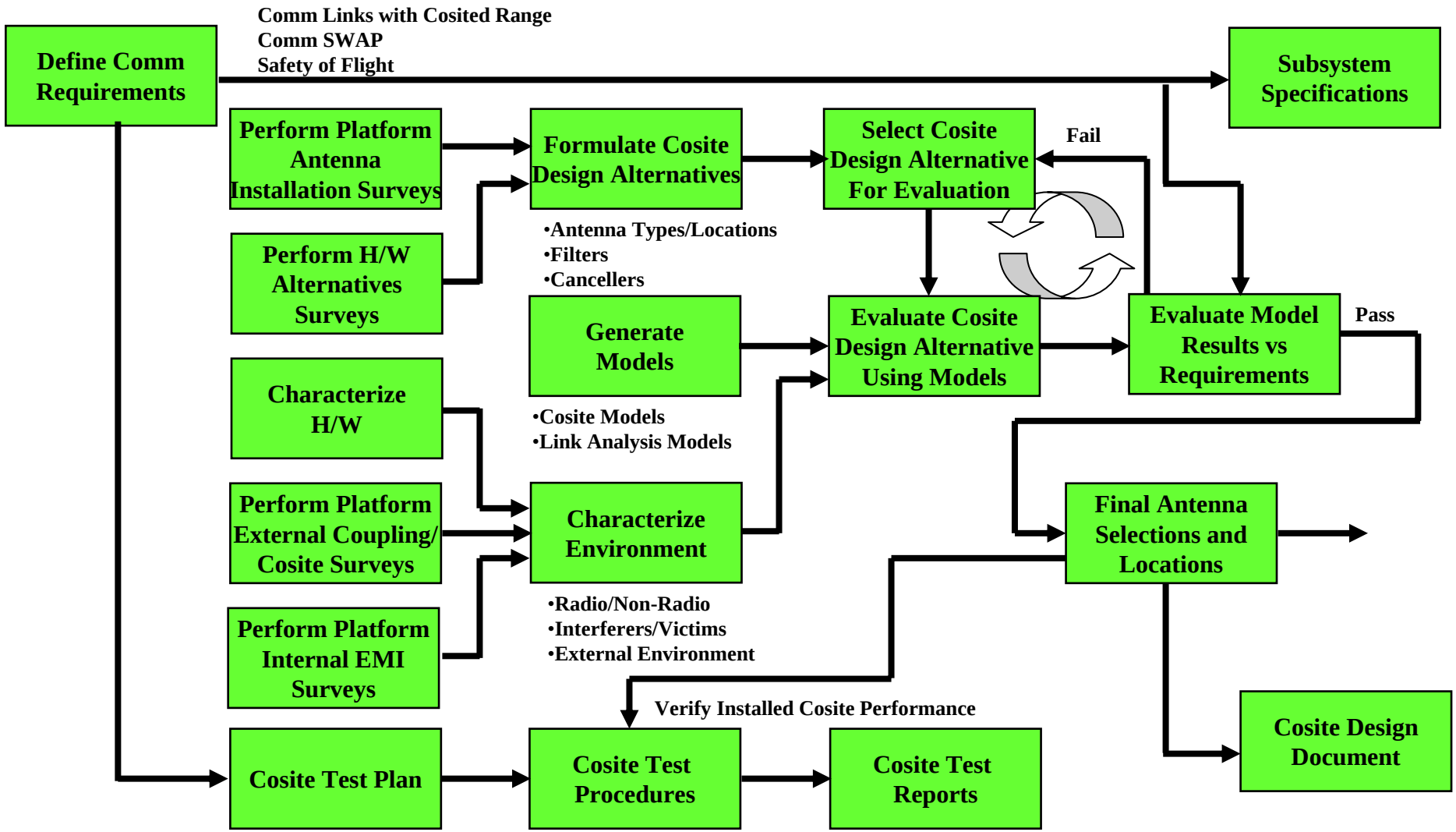



**Directly porting protocol models from the simulation environment into target hardware to minimize risk in developing SCA compliant protocols.**

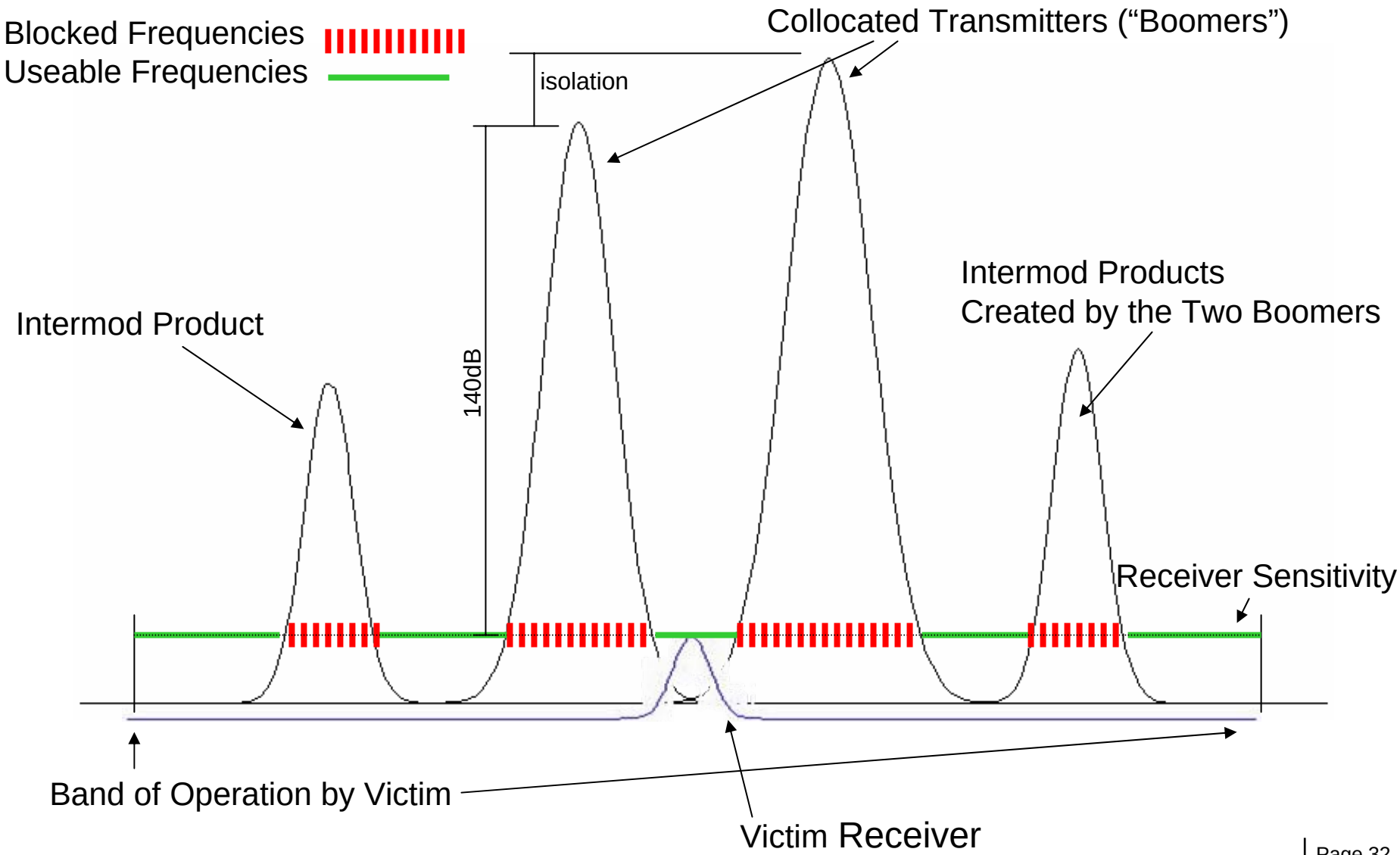
# Communications Technical Challenges

- Communication links and apertures
- Network quality of service
- Resource management
- Automated networking in a dynamic, mobile environment

# The Process: Cosite System Design Flow



# M&S provides a Solution for Communications



# Disadvantaged Users Technical Challenges

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- Weight and space
- Information overload
- Limited communications and processing
- Limited power sources

# Disadvantaged User

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REUTERS/Caren Firouz

# Part of the Solution

- ★ Warfighter's life is better
  - More communications capability in a small package
  - 1 piece of gear does the work of many
  - Robust waveforms → get the message through
  - Reduces "blue on blue" events

- ★ Warfighter is more effective
  - Provides more information → voice, data and situational awareness
  - Connects to local and wide area networks
  - Puts powerful sensors at soldier's disposal
  - Supports urban warfighting operations through networking