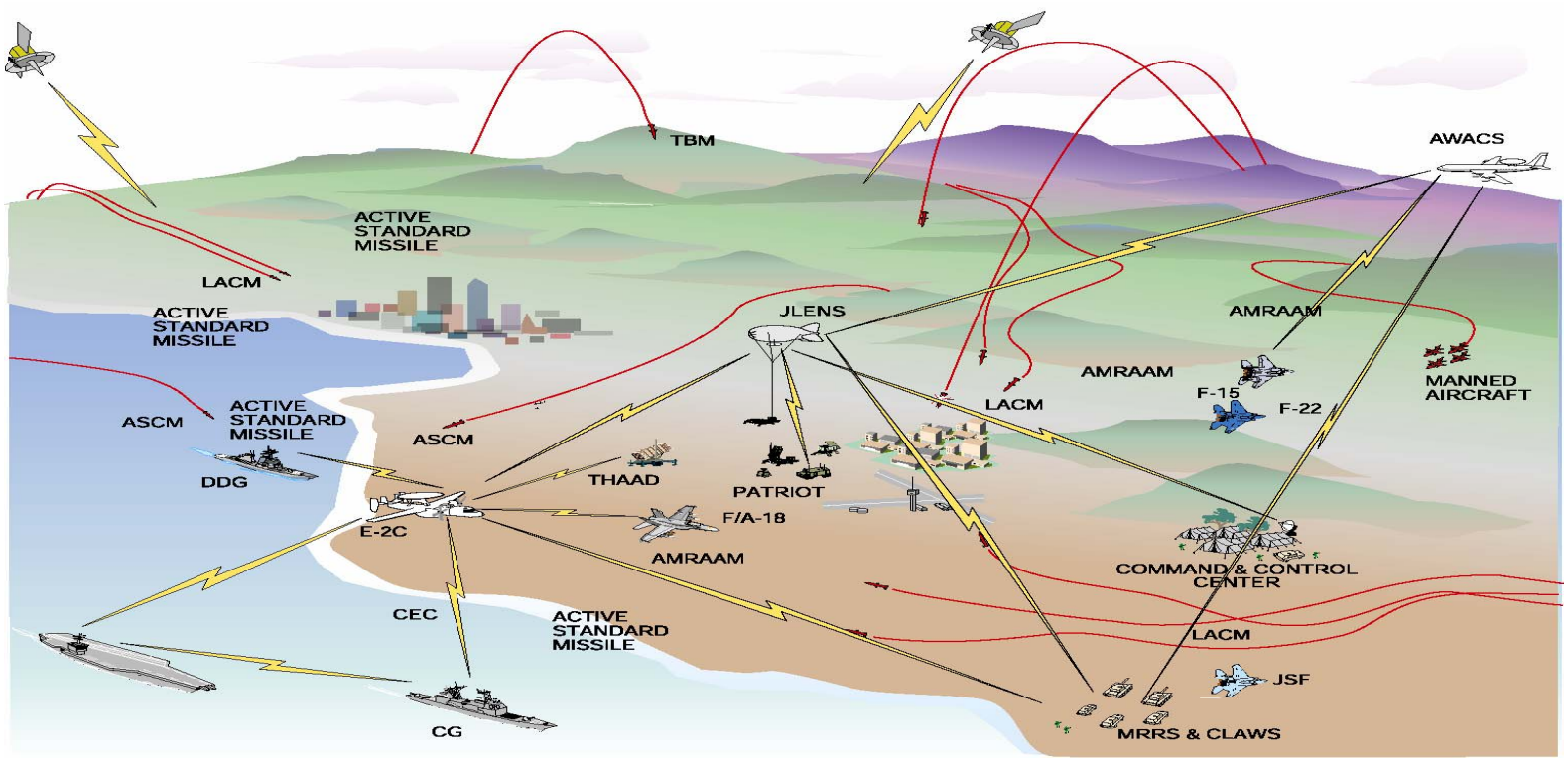
Raytheon

Customer Success Is Our Mission



CCRTS C2 Plenary Panel

June, 2006

Jude E. Franklin, Ph. D.

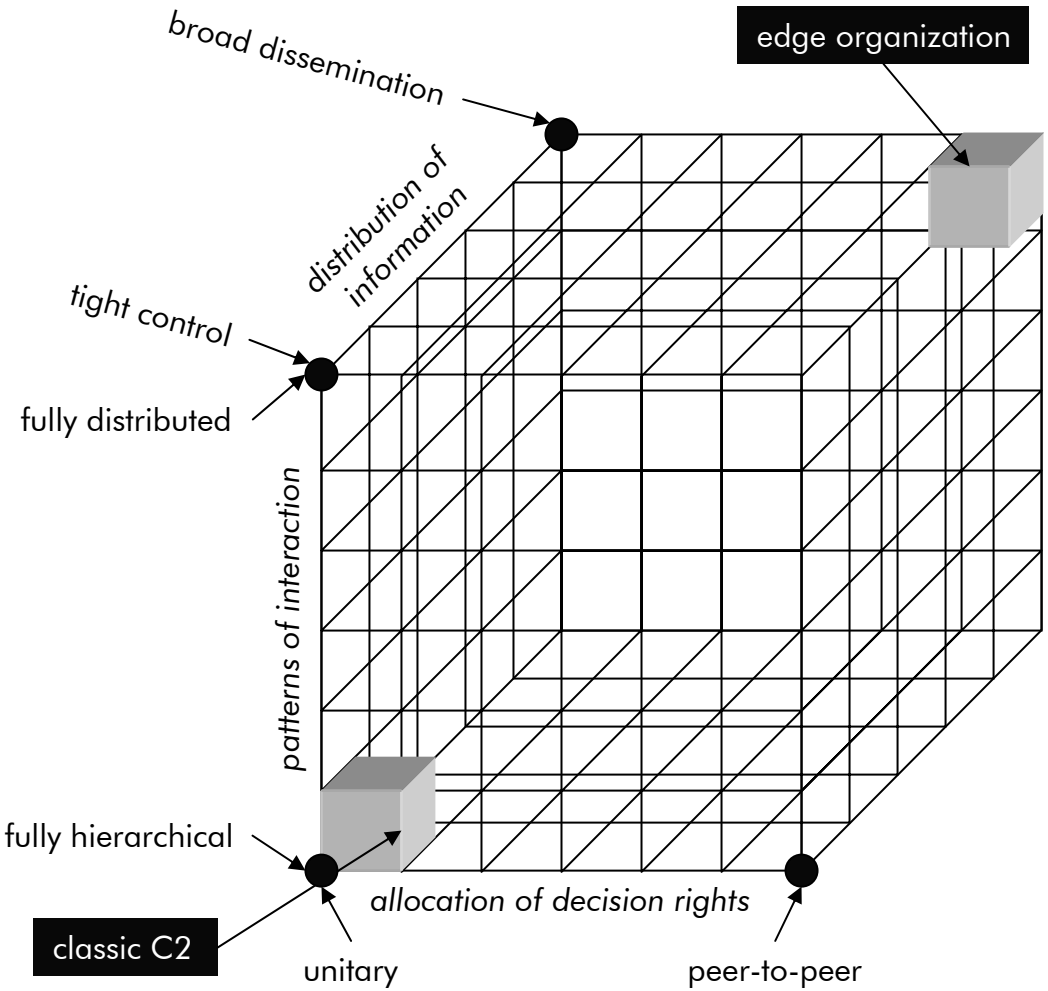
TD, Raytheon NCS C2 Systems

Raytheon TD 06-0008

Understanding Command and Control

- Net Centric Operations
- Interactions Among Entities
- Information and Knowledge Sharing
- Shared Awareness
- Collective Sensemaking
- Collaboration
- Planning
- Resource Allocation
- Commanders Intent
- C2 Approach Space
  - Allocation of Decisions
  - Patterns of Interactions
  - Distribution of Interactions

C2 Approach Space- Alberts and Hayes



FORCEnet Information Infrastructure Capabilities* related to C2

Raytheon
Network Centric Systems

- 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
- Supporting the disadvantaged user-personnel, platform or sensor

Chief of Naval Operations 15 FORCEnet Capabilities

*National Academy of Science FORCEnet Study

Information Management

Raytheon
Network Centric Systems

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

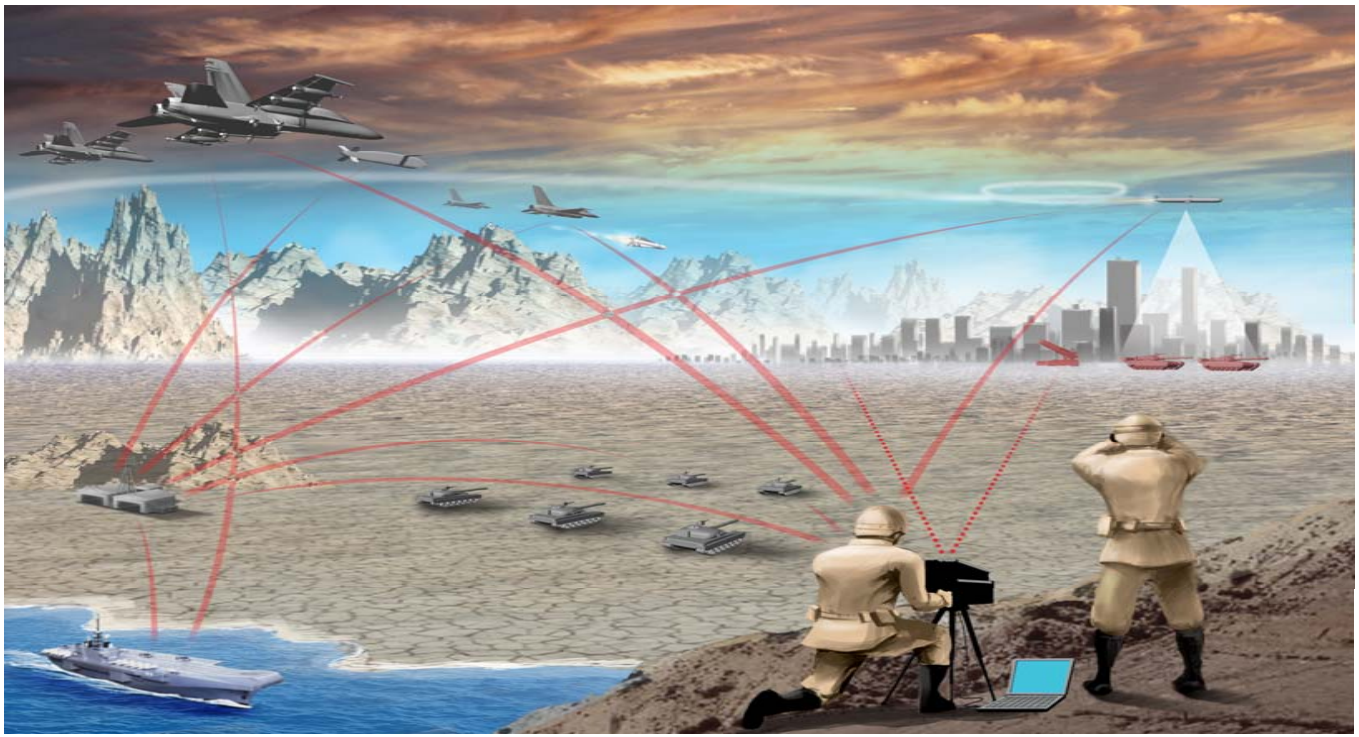
We can transmit the entire

Library of Congress each minute

wpm - words per minute

From General Buck Rogers Brief to NDIA

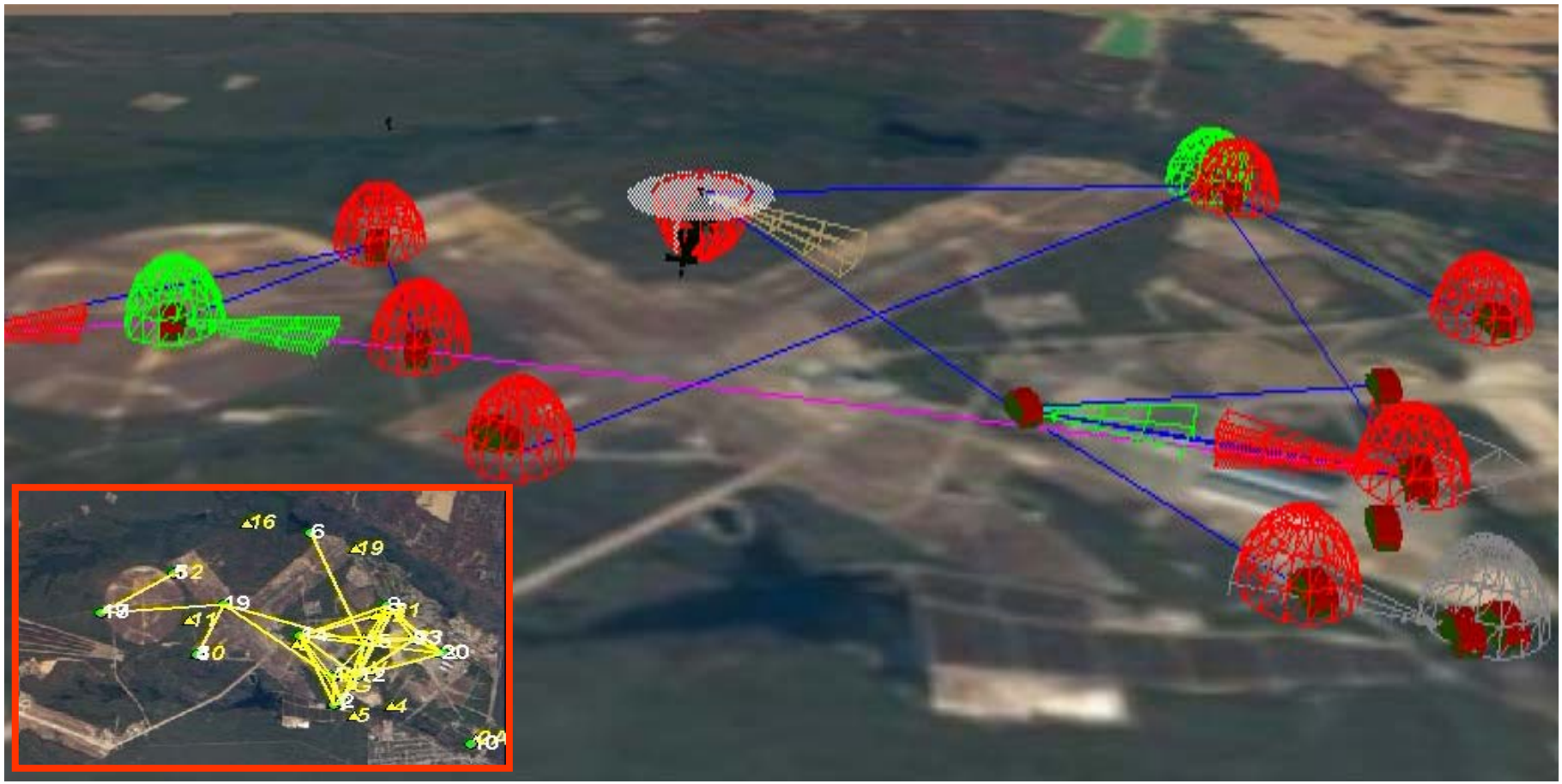
Situation Awareness and Persistent ISR



M&S and Analysis Outputs

Raytheon
Network Centric Systems

- 2-D and 3-D animations of connectivity in a mobile ad-hoc tactical network



Animations allow the designers and implementers to “see reality.”

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

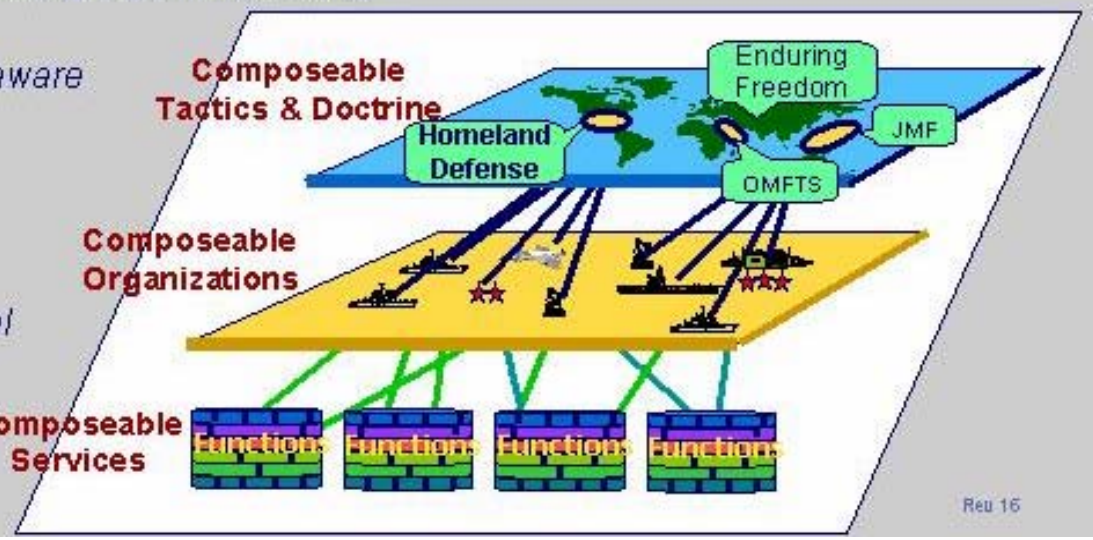
Distributed
Ubiquitous, virtual sources, virtual systems, virtual spaces, virtual presence

Adaptive
To new missions, technologies, environments

Sentient Applications
Self-learning, context aware

Secure
I/O Protected, MLS, Tailorable

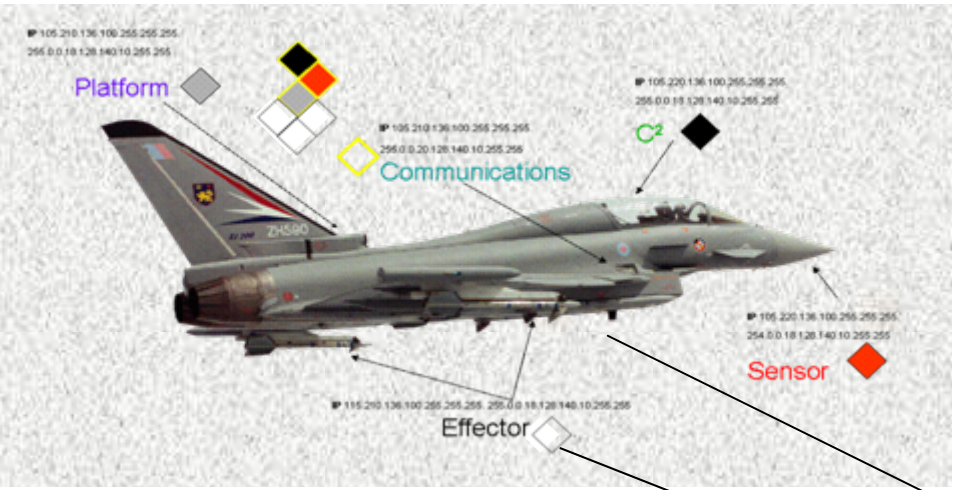
Intuitive
Low/no training, natural

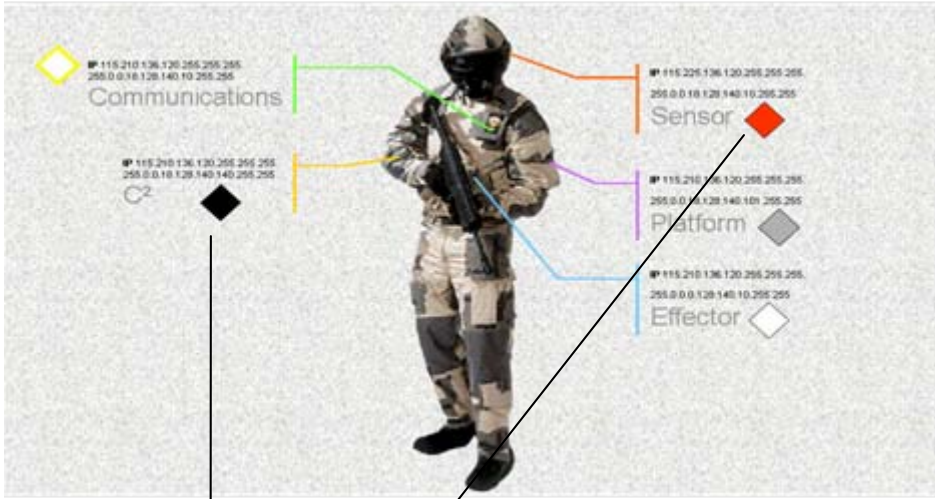


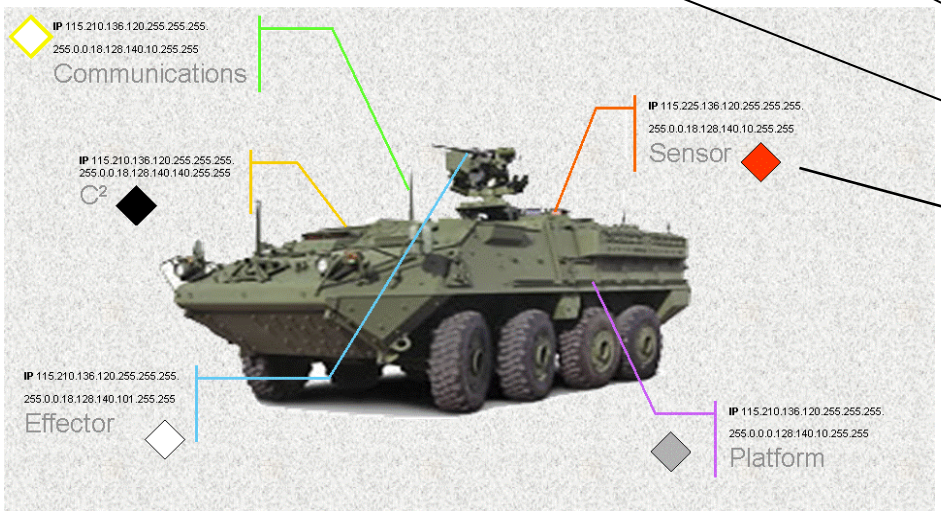
Backup

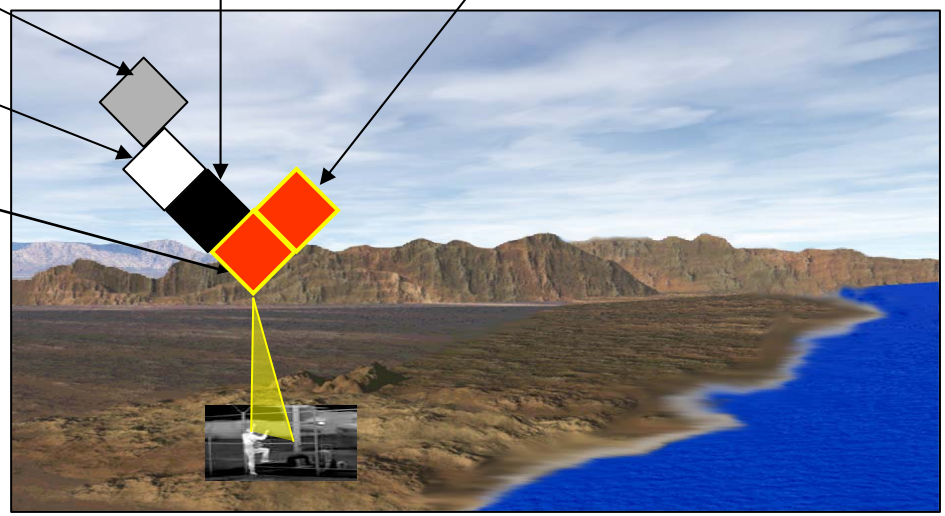
Tying It All Together – Net Enabled Capability

Raytheon
Network Centric Systems







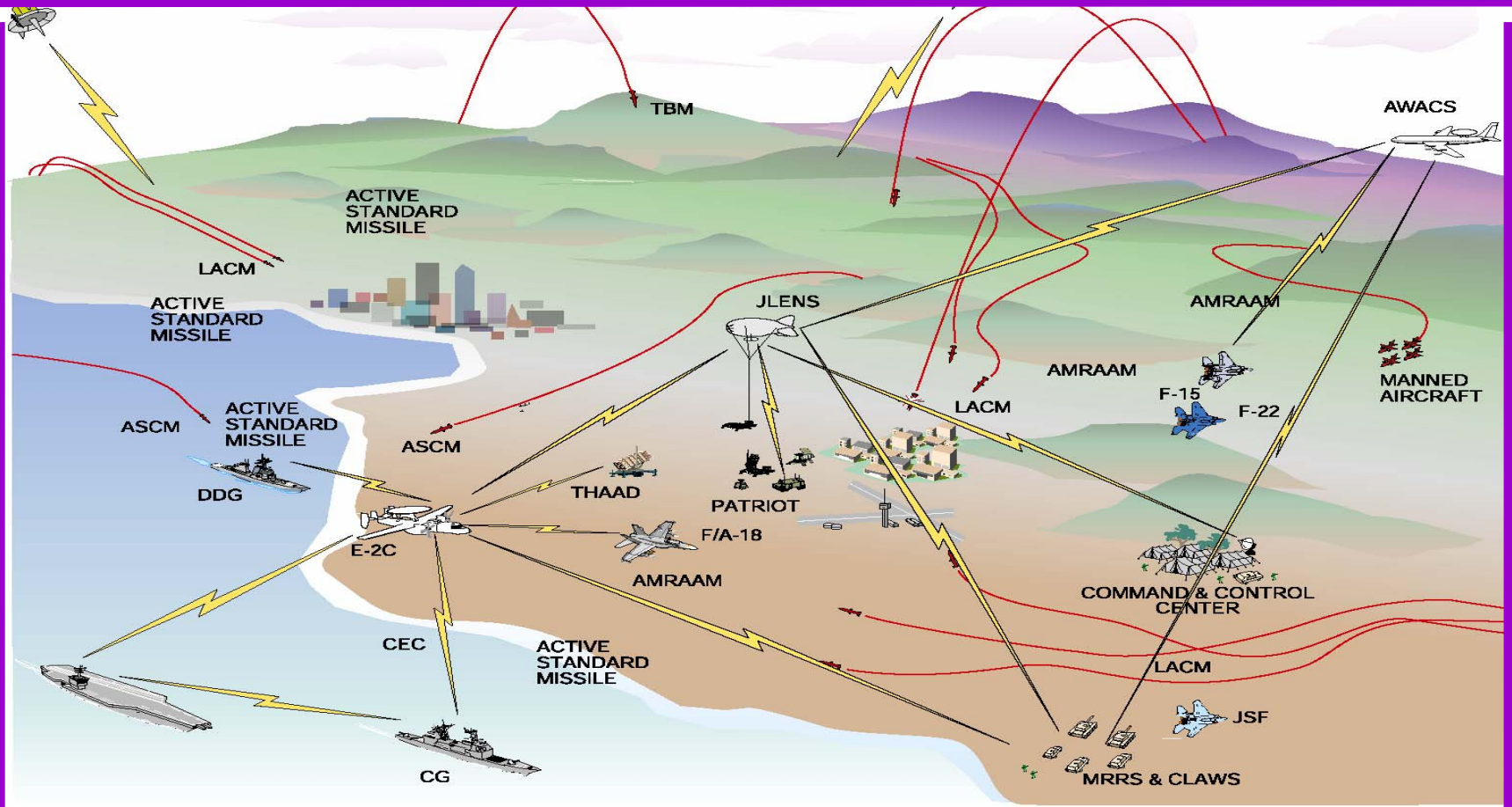


Internet analogy – every Effector, Sensor, C2 & Platform has an IP address

JOINT INTEGRATED AIR DEFENSE

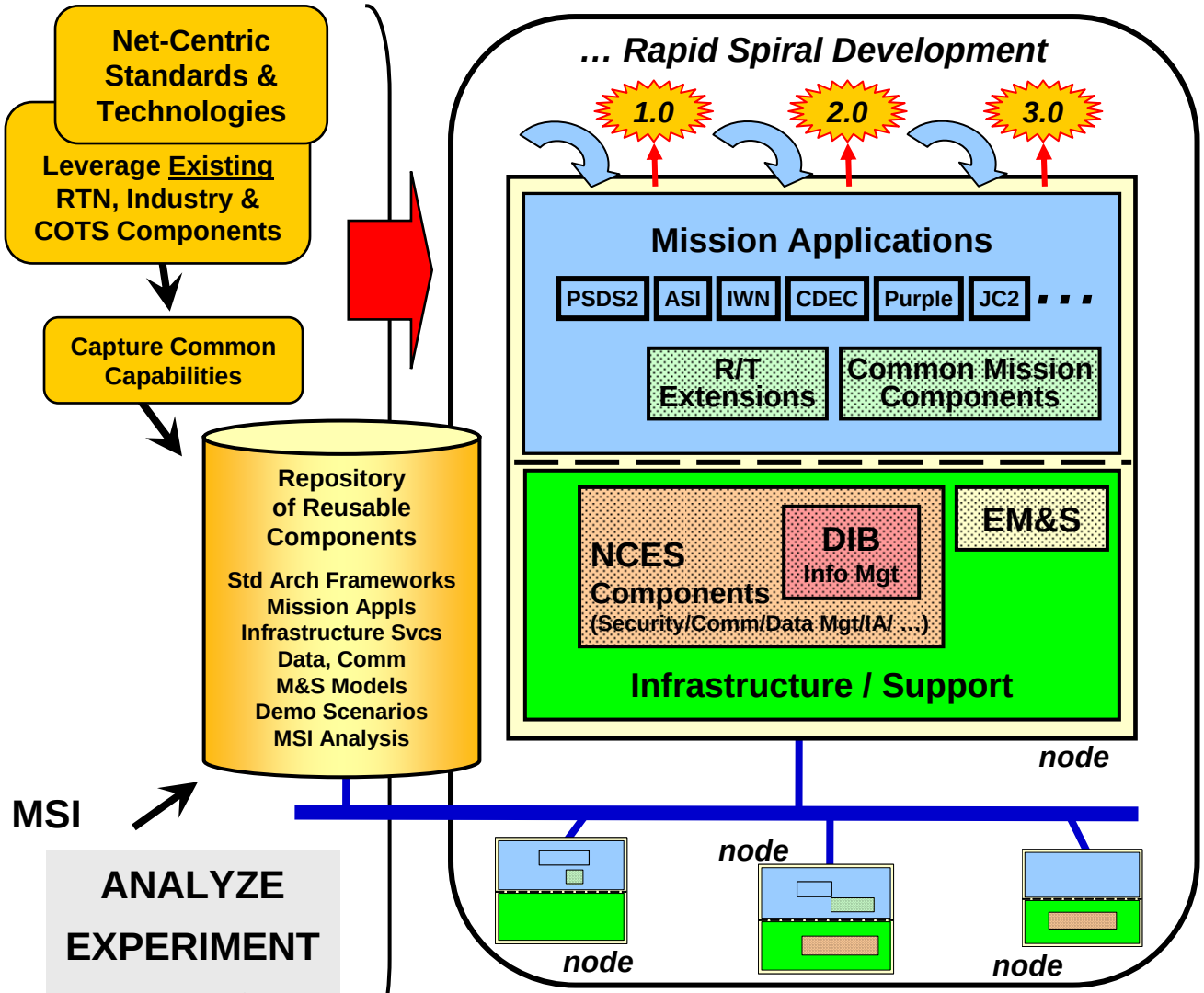
Joint Theater Context

Raytheon
Network Centric Systems



JOINT INTEGRATED KILL CHAIN

A Standard "Open" Net-Centric Environment



Environment

- *Accelerates* System Integration
- Enables *Rapid Prototype Demos*
- Supports *Rapid Solutions* Acquisition processes
- Provides Common Framework of Architectures, M&S, Technology, and Critical Skills

Achieving 50%+ Reduction in Demo Costs, and 15%+ Reduction in System Development Costs

Existing (Common) Capability

Enterprise Net-Centric Integration Capability

National Research Council of the National Academies FORCEnet Study Team

Raytheon
Network Centric Systems

- Rich Ivanetich, IDA
- Bruce Wald, former Assoc TD, NRL
- Robert Brammer, NGIT
- Joseph Cipriano, LMIT
- Admiral Archie Clemins, Caribou Technologies
- Chip Elliott, BBN
- Joel Engel, Former IBM Fellow
- Jude Franklin, Raytheon
- John Hanley, IDA
- Kerrie Holley, IBM Global Services
- Ken Jordan, SAIC
- Otto Kessler, MITRE
- Jerry Krill, JHU APL
- Ann Miller, U. Missouri-Rolla
- RADM Bill Morris
- RADM Richard Nibe
- LTG. John Rhodes
- Daniel Siewiorek, CMU
- Ed Smith, Boeing
- Mike Zyda, USC

High Priority FORCEnet S&T-

- 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

- **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 continued

- 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

Information Management Recommendations

Raytheon
Network Centric Systems

- Develop technology for distributed real time processing and heterogeneous fusion
- Develop technology for automated resource allocation driven by current operational situation understanding
- Identify and formulate ontology frameworks for consistent data usage across the network enterprise
- Identify and implement information services that assure consistent IM processes across the network enterprise

Situation Awareness and Understanding Recommendations

Raytheon
Network Centric Systems

- Investigate inferencing techniques necessary to relate objects and events to their environment and to units, activities, and behaviors
- Develop a relational and control framework for managing a broad range of knowledge representations, hypotheses, assertions, etc.
- Develop automated techniques for information capture, representation, authoring, and validation
- Integrate human and machine capabilities for hypothesis management — balancing machine capability for handling numerical scale problems with human ability for intuition

Persistent ISR Recommendations

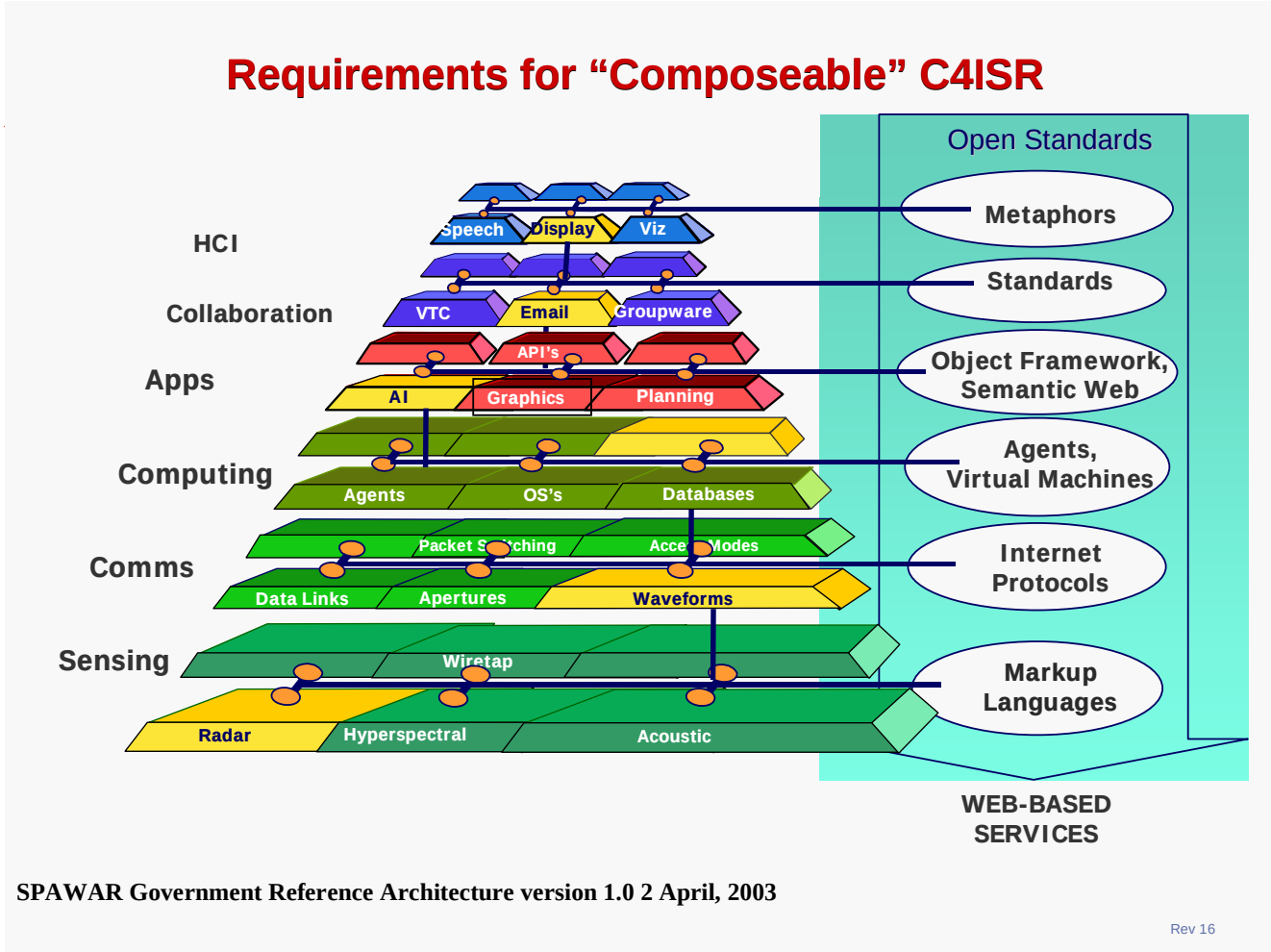
- **Investigate in netted sensor technology for wide area alerting of asymmetric targets / activity**
- **Investigate automated sensor management to adjudicate sensing needs across mission goals, and for sensing responsiveness to dynamic battlespace needs**
- **Investigate machine to machine collaboration for remote operations**

M&S Recommendations

- **Coordinate with other relevant research and development activities across the Defense Department, industry, academia, and the commercial sector:**
  - **Modeling and simulation to support large-scale systems engineering**
  - **Adversarial analysis models and simulations**

Dynamic Composability

Raytheon
Network Centric Systems



Composability / Collaborations Recommendations

Raytheon
Network Centric Systems

- **The committee recommends that ONR in concert with CFFC, NWDC, and appropriate laboratory organizations commit to a long term co-evolutionary process, which involves laboratory and field experiments, to evolve the required technical components with naval tactics and procedures and personnel implications**
  - **Investigate complex resource management (allocation and coordination) issues**
  - **Investigate automated collaboration tools necessary to facilitate interactions and problem solving between humans, between machines, and between humans and machines (the effort should also address issues associated with the variable reliability of the naval communications)**

Information Management Technical Challenges

Raytheon
Network Centric Systems

- Trust
- Contamination
- Utility
- GIG Task, Post, 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

Situational Awareness and Persistent ISR Technical Challenges

Raytheon
Network Centric Systems

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

M&S Technical Challenges

- Analysis of asymmetric threat and urban warfare
- Analysis of networks and network dependent systems
  - Prior to operational deployment
- Analysis of Net Centric Operations / Warfare
- Training and personnel
- M&S toolsets