



An Extended Enterprise Architecture for a Network- Enabled, Effects-based Approach for National Park Protection – Transitioning Military Paradigms



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Introduction to US National Parks

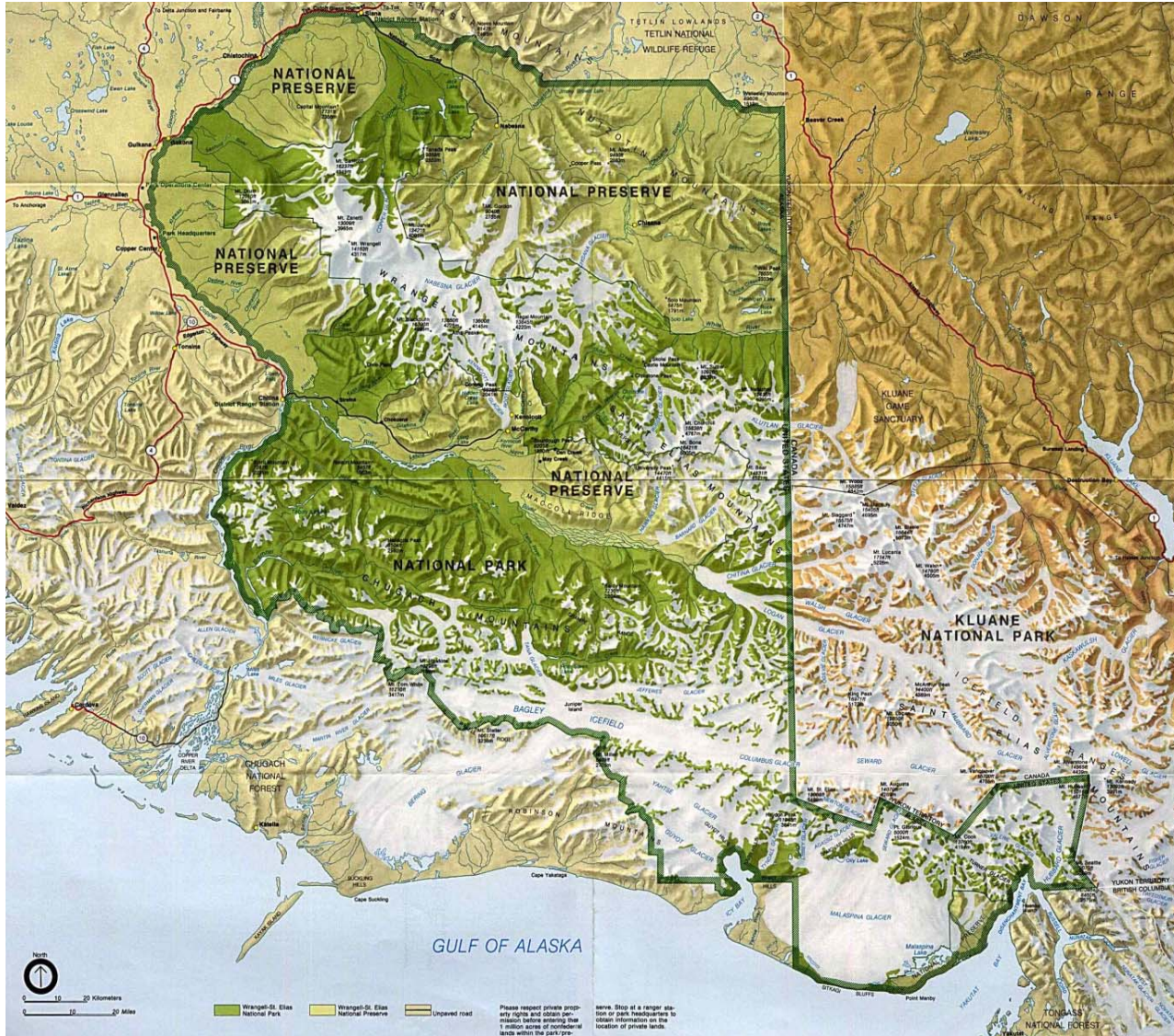
- National Park system represents over 80 million acres of public land over all 48 contiguous states plus AL, HI, American Samoa, Guam, Puerto Rico, U.S. Virgin Islands
- National Park Service (NPS) as part of their *Natural Resource Challenge* must maintain the eco-system integrity of approximately 270 parks with significant natural resources
- Major problems exist
 - Climate changes, animal/fish population cycle variations, invasive species introduction, cultural affects of indigenous peoples, natural disasters, oil spills, land development, tourism, criminal enterprises...
 - 75 – 80% of marijuana grown outdoors is on state or federal land
- According to the *National Park Service Action Plan* for preserving natural resources, a focused methodology is necessary to achieve this challenge

National Resource Inventory and Monitoring Program Goals

- 1. Natural resource inventories completed for regional and national summaries**
- 2. Long-term monitoring programs placed to monitor ecosystem status and trends over time**
- 3. Decision support geographic information systems & other tools to aid identification of alternative management actions, trade-offs, and evaluation of outcomes**
- 4. Integrated natural resources inventory and monitoring integrated with park planning, operation and maintenance, visitor protection, and interpretation activities**
- 5. Cooperation with other federal and state agencies to share resources, achieve common goals, and avoid unnecessary duplication of effort and expense**

Numbers 2, 3, 4, and to Some Extent 5 Will be Addressed

Wrangell-St. Elias National Park and Preserve (WRST)



- **Consists of 13.2 million acres that includes a coastal region of approximately 1.9 million acres and four mountain ranges**
- **Largest national park in the U.S. and contains the continent's largest assemblage of glaciers and mountain peaks above 16,000 feet**

Monitoring Varied Geography and Terrain



Mountains above Nabesna Glacier



Hubbard Glacier over Disenchantment Bay



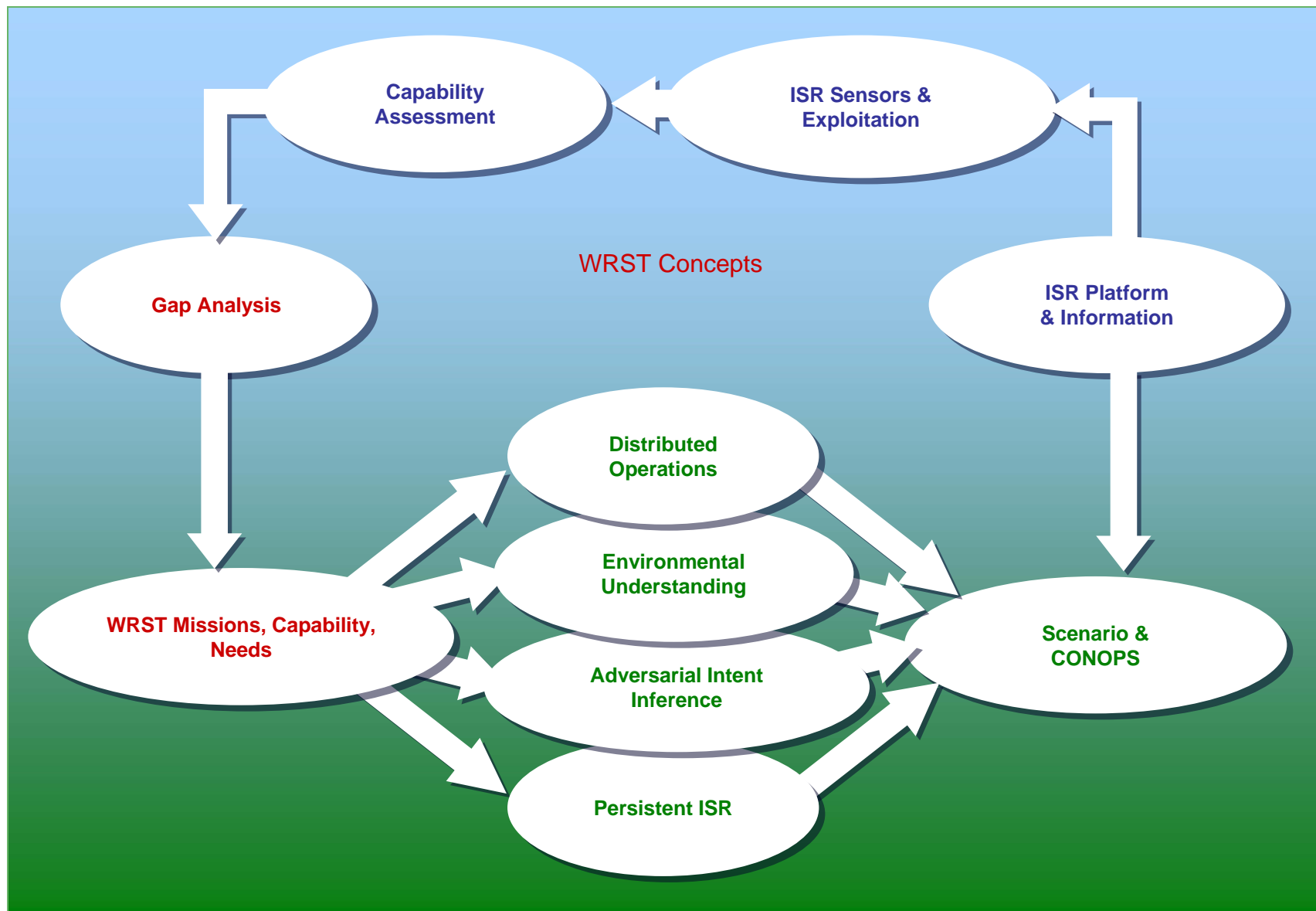
Chitina Valley's Broad Spruce Forest

Defining the Enterprise

- Available sensor information for observing the environment
- Intelligence information (Human intelligence, e.g. knowledge of criminal enterprises)
- Sensor and source control (local vs. national vs. strategic assets)
- Normal maritime traffic and maritime domain awareness (MDA)
- Known techniques, tactics, and procedures (TTP) of poachers and other miscreants
- Adversary intent and capabilities
- Weather events
- Geologic events and changes
- Ecological events (sewage and oil spills, etc.)
- Normal and abnormal cycles in animal and plant populations
- Cultural affects of indigenous peoples
- Fishing practices (destructive, subsistence, and otherwise)
- Effects of run-off, sedimentation, waste water, and marine and agricultural debris
- Ocean variations (temperature, salinity, etc.) over distance and time
- Invasive species (plant and animal) introduction and spread
- Natural and man-made disasters (forest fires, earthquakes, etc.)
- Tourism
- Coast Guard presence and capabilities
- Enforcement and policing capabilities
- Legal and regulatory agencies and policies (e.g. USC Title 50)

Leads to Defining the Landscape of the Problem Space

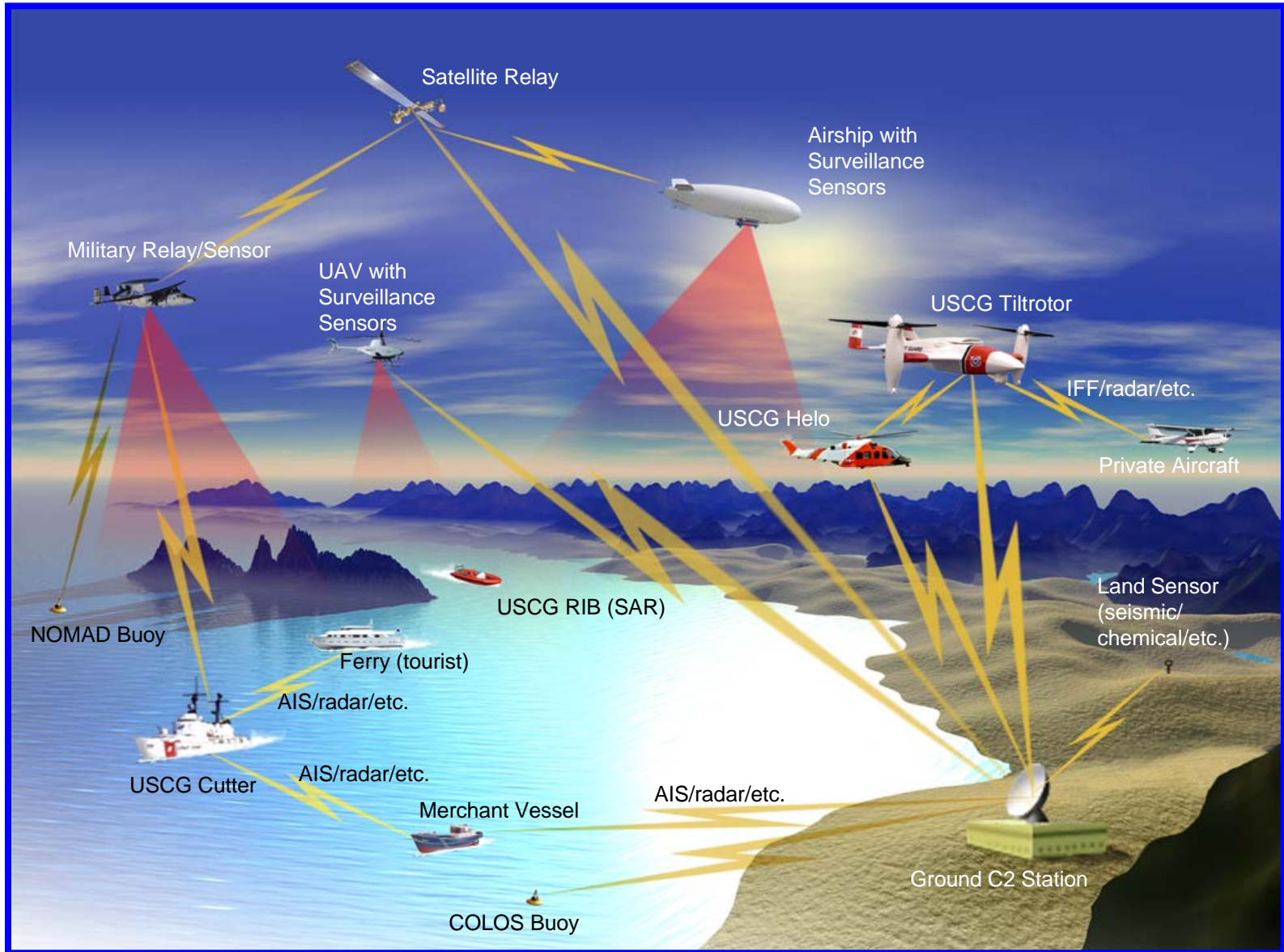
Modified DARPA Strategic Plan for ISR



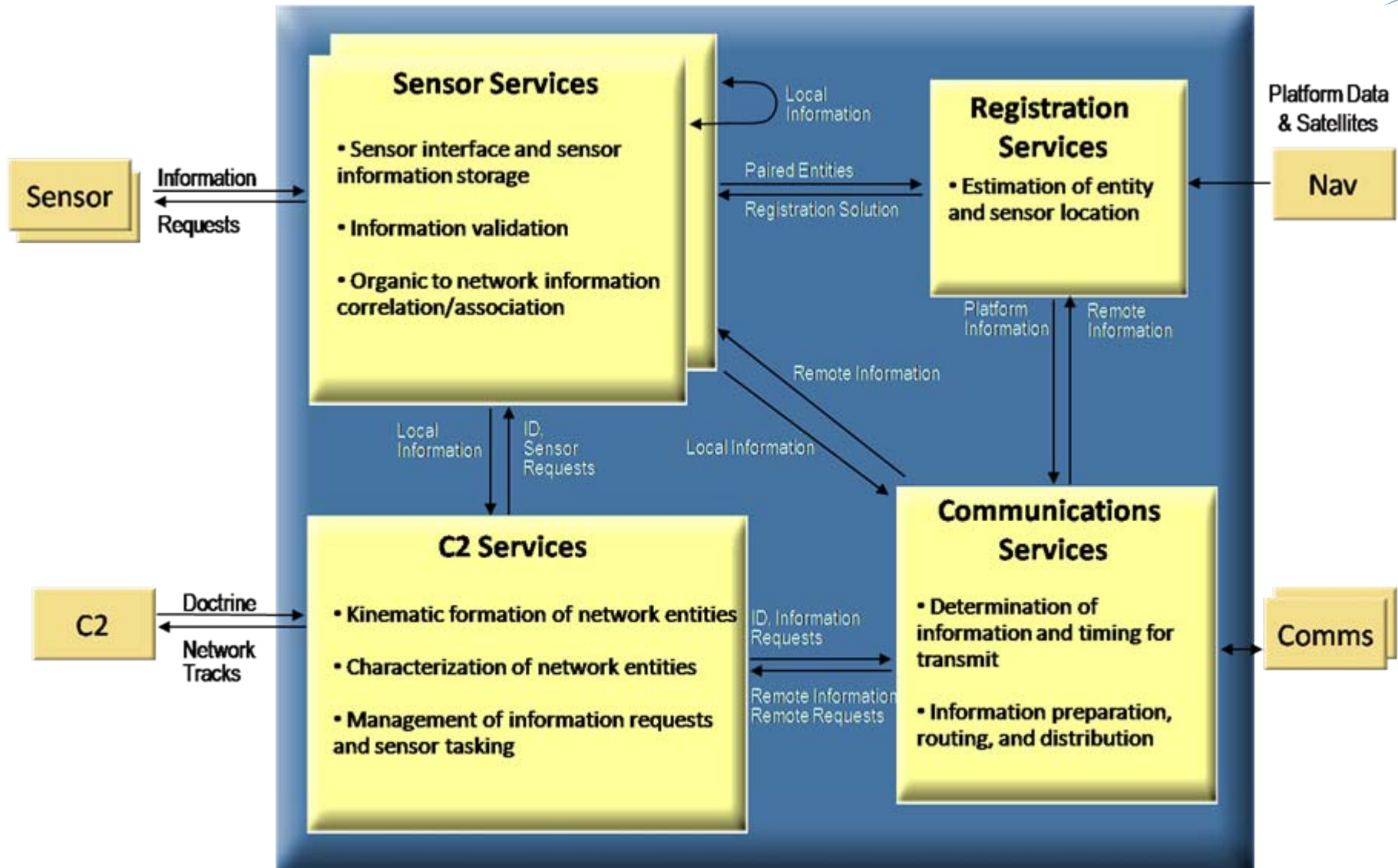
Actionable Info Defines Enterprise Architecture

- **Persistent ISR for a contiguous operational picture:**
UAV, Autonomous Underwater Vehicles (AUV), satellite tracking, Infra-red (IR), imaging, chemical and biological plume detection/tracking, Automatic Identification Systems (AIS), Vessel Monitoring System (VMS), Aerostats, terrestrial/maritime radar, sonar, sonobuoys, Coastal Oceanographic Line-of-Sight (COLOS) and NOMAD buoys, C2 system inputs, etc.
- **Adversarial understanding and intent inferencing:**
Sea bird poaching, timber harvesting, illegal fishing operations, drug and human trafficking patterns, illegal diving/archeological operations, etc.
- **Environmental understanding:**
NOAA weather reports, Lloyds maritime databases, tidal information, dynamic water temperature and salinity zone maps, port identification, littoral/land entry barriers, forest cover, fish spawning cycles, migratory bird movements, NOAA prohibited fishing areas, tourist destinations, chemical spills, wastewater release points, commercial maritime vessel traffic patterns, large public events, etc.
- **Coordination and prioritization of distributed operations:**
Asset availability and dynamic tasking, resource allocation, environmental tempo, multiple user objectives, network centric operations, synoptic assessment, command authority, multi-level security, mission precedence, communication routing and bandwidth availability, etc.

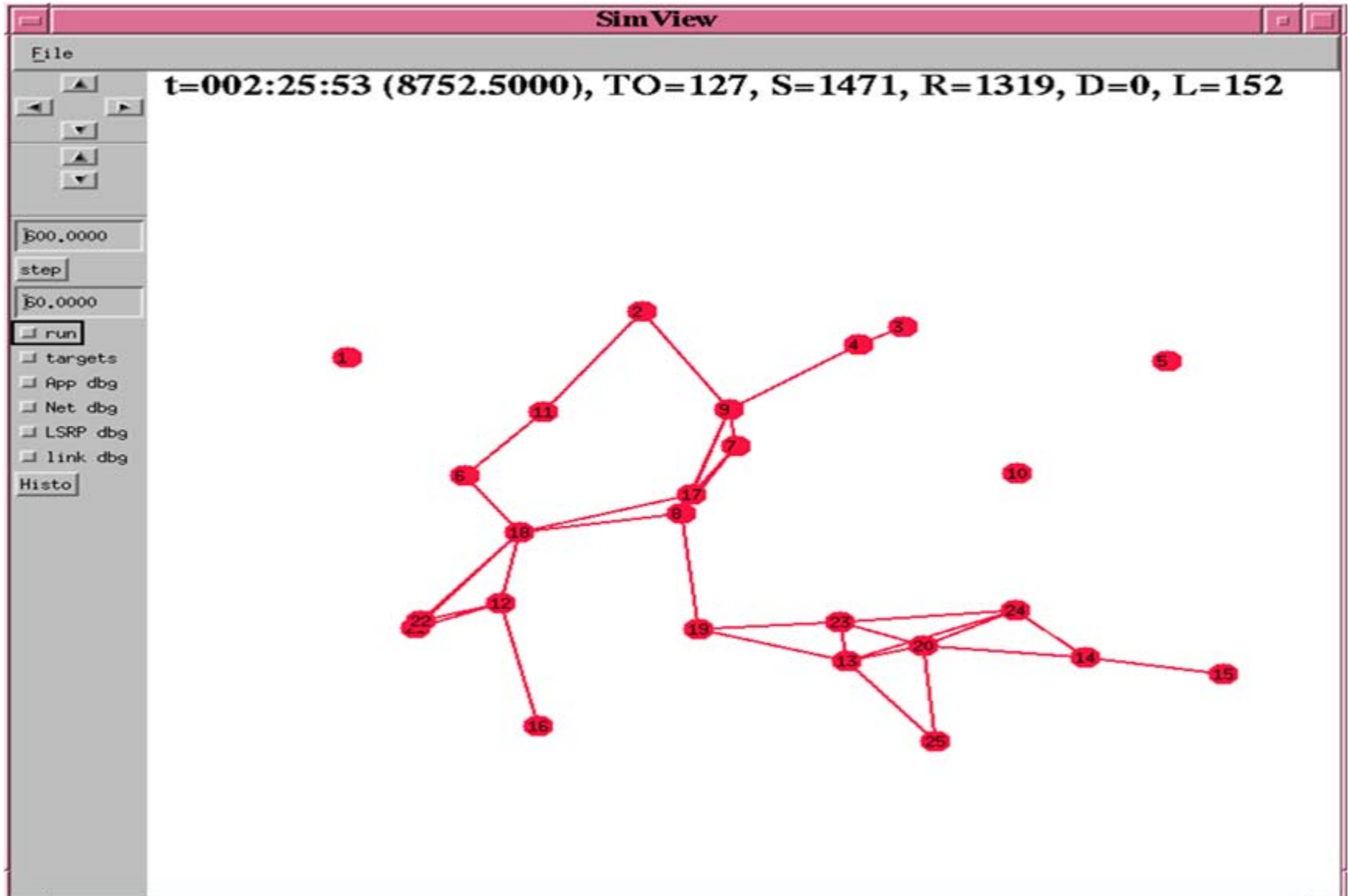
Net-Centric View for Monitoring the WRST



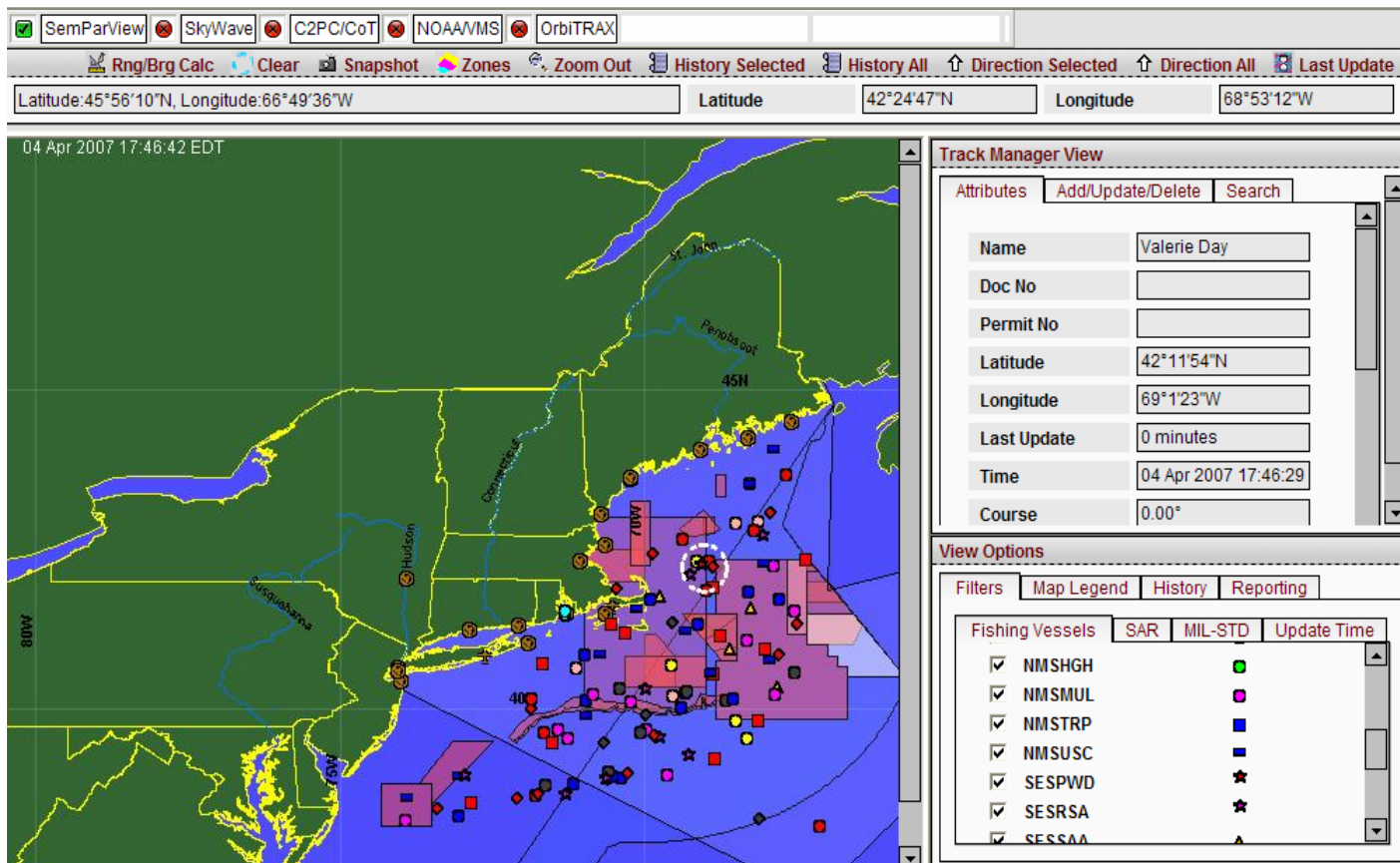
NCE Based Functional Architecture



Example Network Topology



A Start – SemPar View



Future Inputs???

- DHS feeds
- DEA info
- NICC wildfire fighting support
- FAA aircraft data
- Lloyds maritime data
- NOAA weather
- Other???

- Web-based application for creating and sharing information across a network
- Generates a tactical situational awareness picture for multi-mission applications – fisheries monitoring, commercial maritime traffic identification, law enforcement, etc.
- Ingests multiple data sources (e.g. AIS self-identification information, radar, NOAA VMS fisheries data and feeds from UCSG sources) and combine the inputs to display a single situational awareness picture of events

Conclusions

- ***Propose a network-enabled effects-based approach married with a well defined extended enterprise architecture for WRST (and national parks in general) monitoring***
 - **Long-term monitoring programs**
 - **Decision support geographic information systems and other field data tools**
 - **Natural resources inventory and monitoring programs integrated with park systems**
 - **Cooperation with other federal and state agencies**
- **This is accomplished through transitioning military paradigms of**
 - **Distributed operations**
 - **Environmental understanding**
 - **Adversarial intent inferencing**
 - **Persistent ISR**