Systems Engineering and Capability Portfolio Management (JNO Approach)

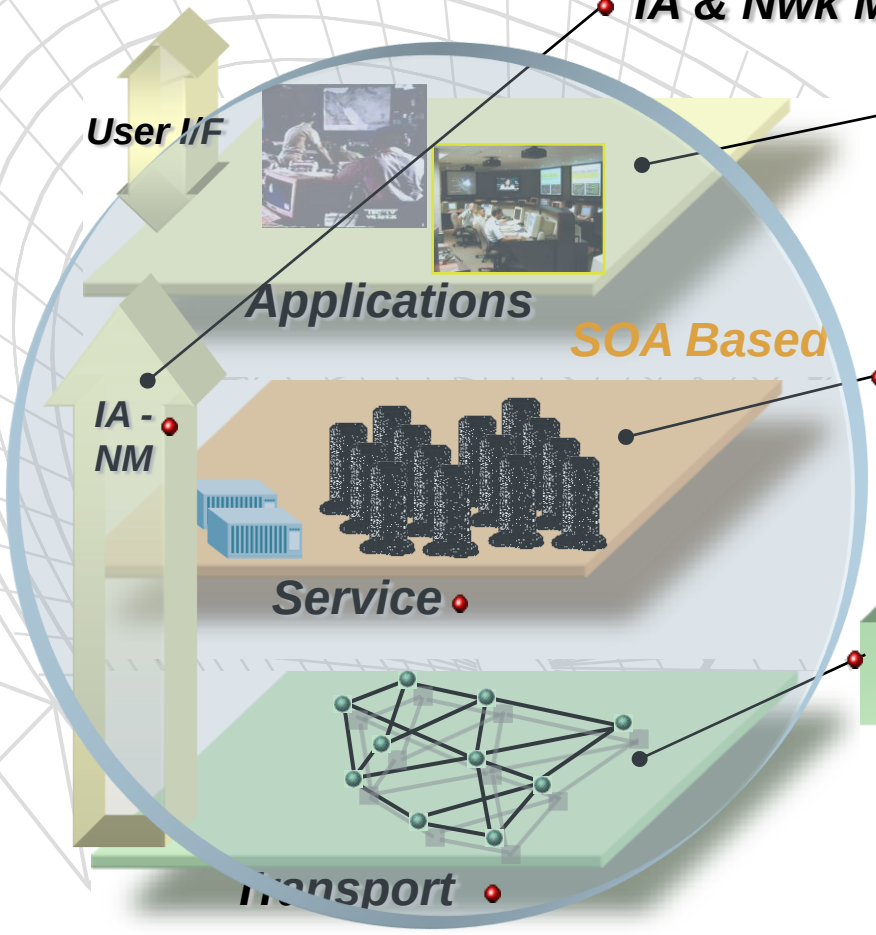
21 October 2008

NDIA Systems Engineering Conference

People throughout the trusted, dependable and ubiquitous network are empowered by their ability to access information and recognized for the inputs they provide.

Build, Populate, Protect

Information & the GIG - Layered Perspective



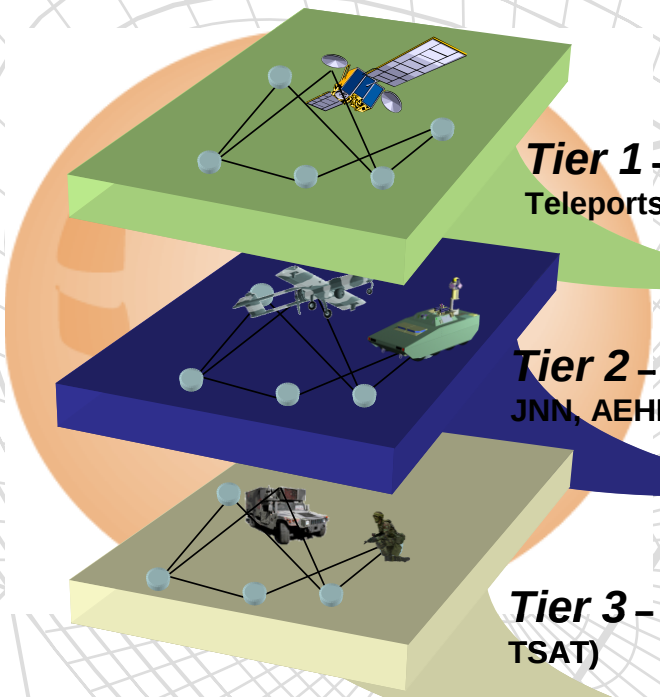
- ✓ Loosely coupled applications based upon SOA/SLA
- ✓ Enabled applications are highly adaptive and flexible

- ✓ Defined data strategy – attributes set by applications
- ✓ XML driven by DoD directives
- ✓ SOA enterprise environment with managed services

- ✓ IP based with QoS established by applications
- ✓ Multi-media for highly available communications

Assured information (data) access is the critical concept – the user sets the information access requirements

Global Information Grid (GIG) Transport Tiers



Tier 1 **– Backbone (DISN-NG, WGS, Teleports, Comm SatCom, JNN)**

Tier 2 **– Intermediate (WIN-T, JTRS, WGS, JNN, AEHF, NMT, HC3, FAB-T, TSAT)**

Tier 3 **– Edge (JTRS, MUOS, HC3, NMT, TSAT)**

Major commercial equipments

Tactical equipment mix

Mostly military with some commercial equipment mix

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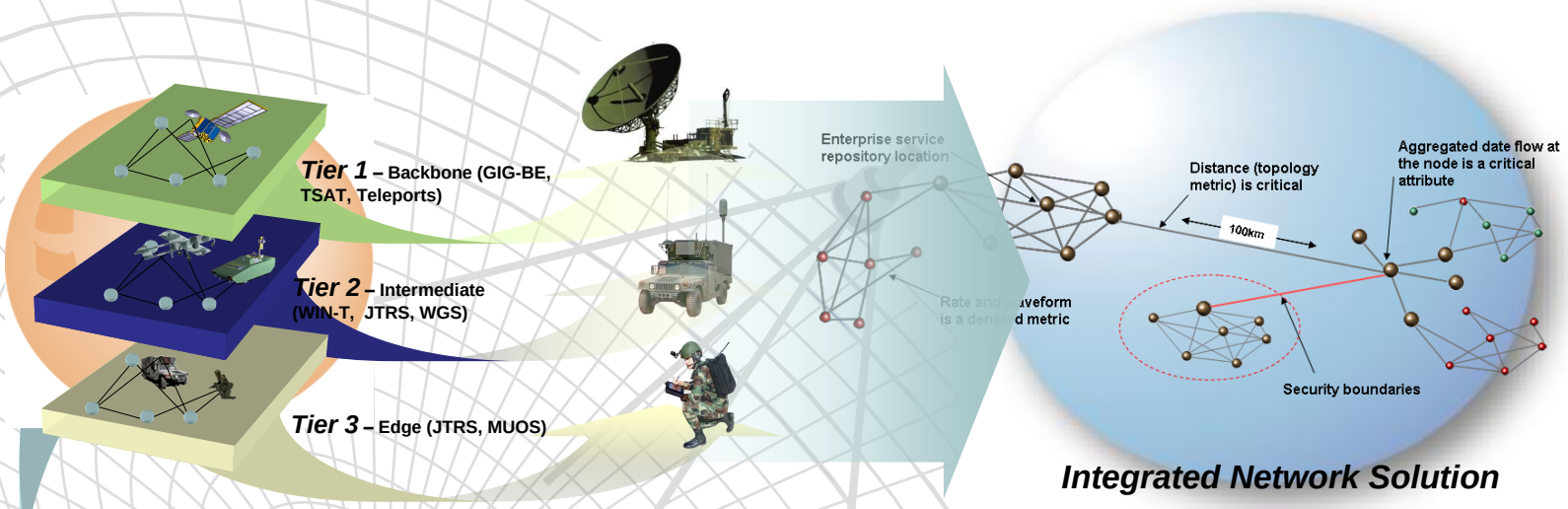
- **GIG is an IP unified network having a BLACK routing and switching basis – tiered in many respects as commercial networks; with cost significantly increasing towards the edge**

Incomplete Network Solution - Losing Sight of the Network

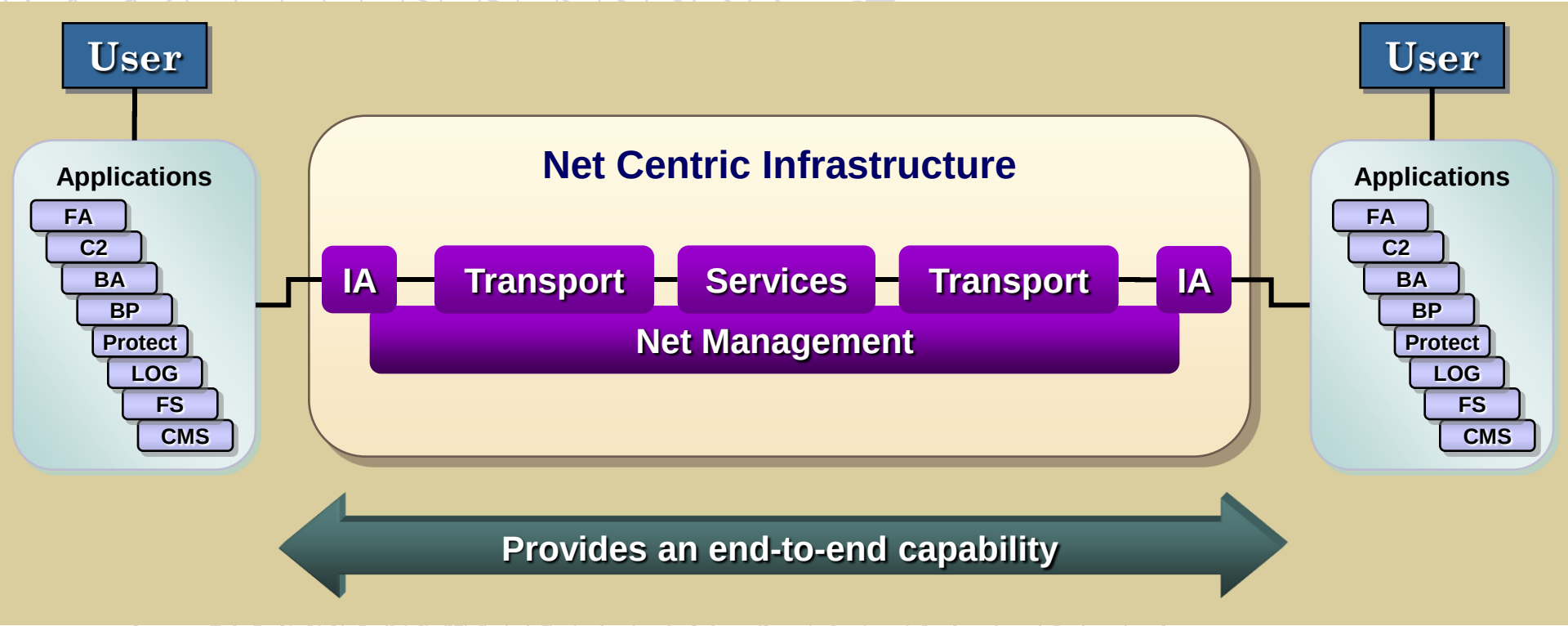
Network Topology Relationships



- Understanding the entire network is critical so to not compromise a cost and warfighter effective solution (Interoperability)
- Forcing the core and tactical edge networks to be addressed an integrated structure
- Network and Enterprise programs are NOT independent
- Network is part of the GIG – requires relationship to the services and applications, BUT information (data) is the critical element
- Interoperability with more than a single Service element or a partial force – total force including the all Services and coalition forces

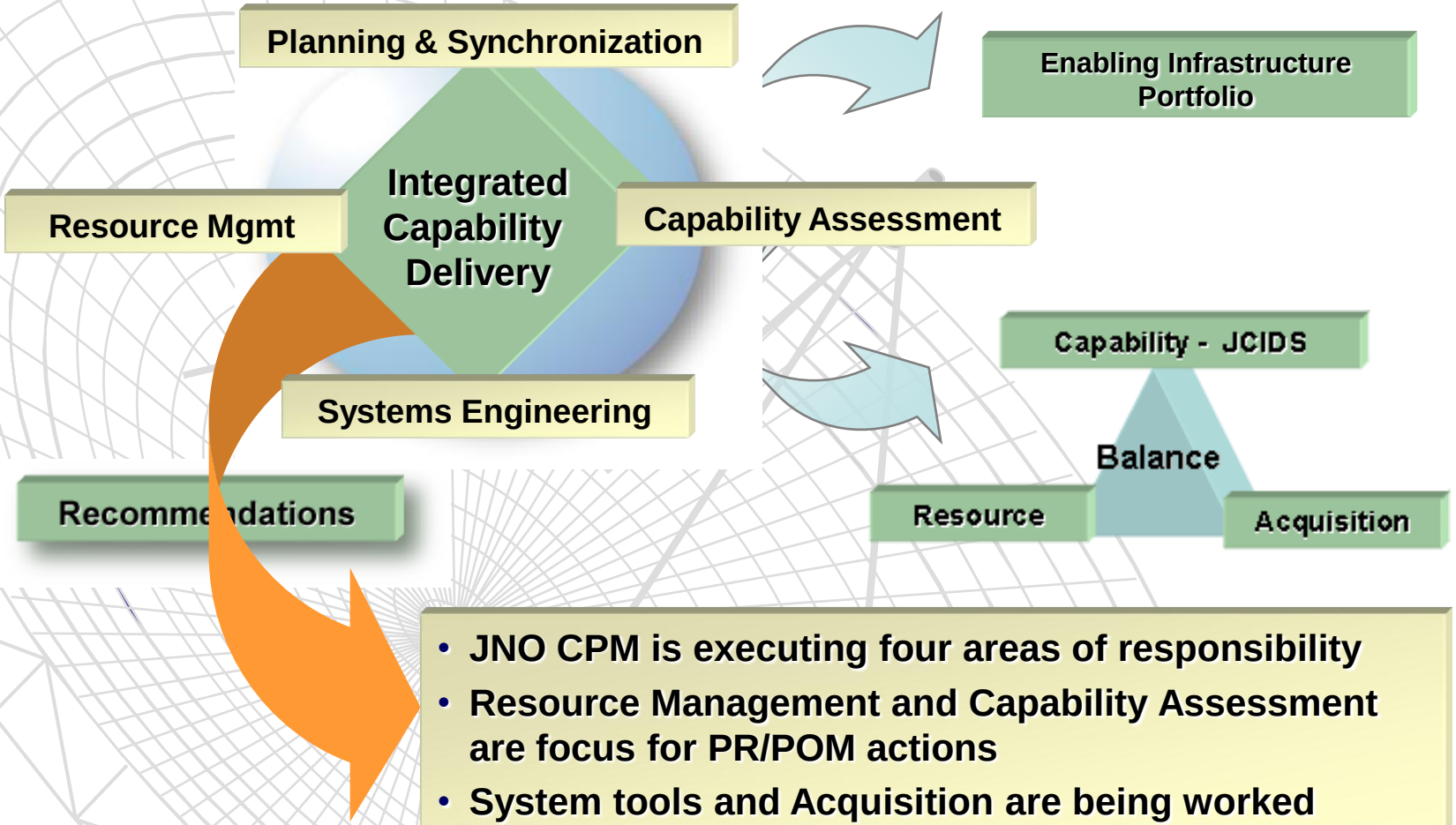
Mission

Conduct portfolio management of enabling programs and capabilities--develop material and non-material solutions to ensure timely, synchronized, and integrated delivery of Net-Centric capabilities



NC portfolio is an enabling infrastructure for other Capability Portfolios

JNO (NC) CPM Roles & Responsibilities



- JNO CPM is executing four areas of responsibility
- Resource Management and Capability Assessment are focus for PR/POM actions
- System tools and Acquisition are being worked

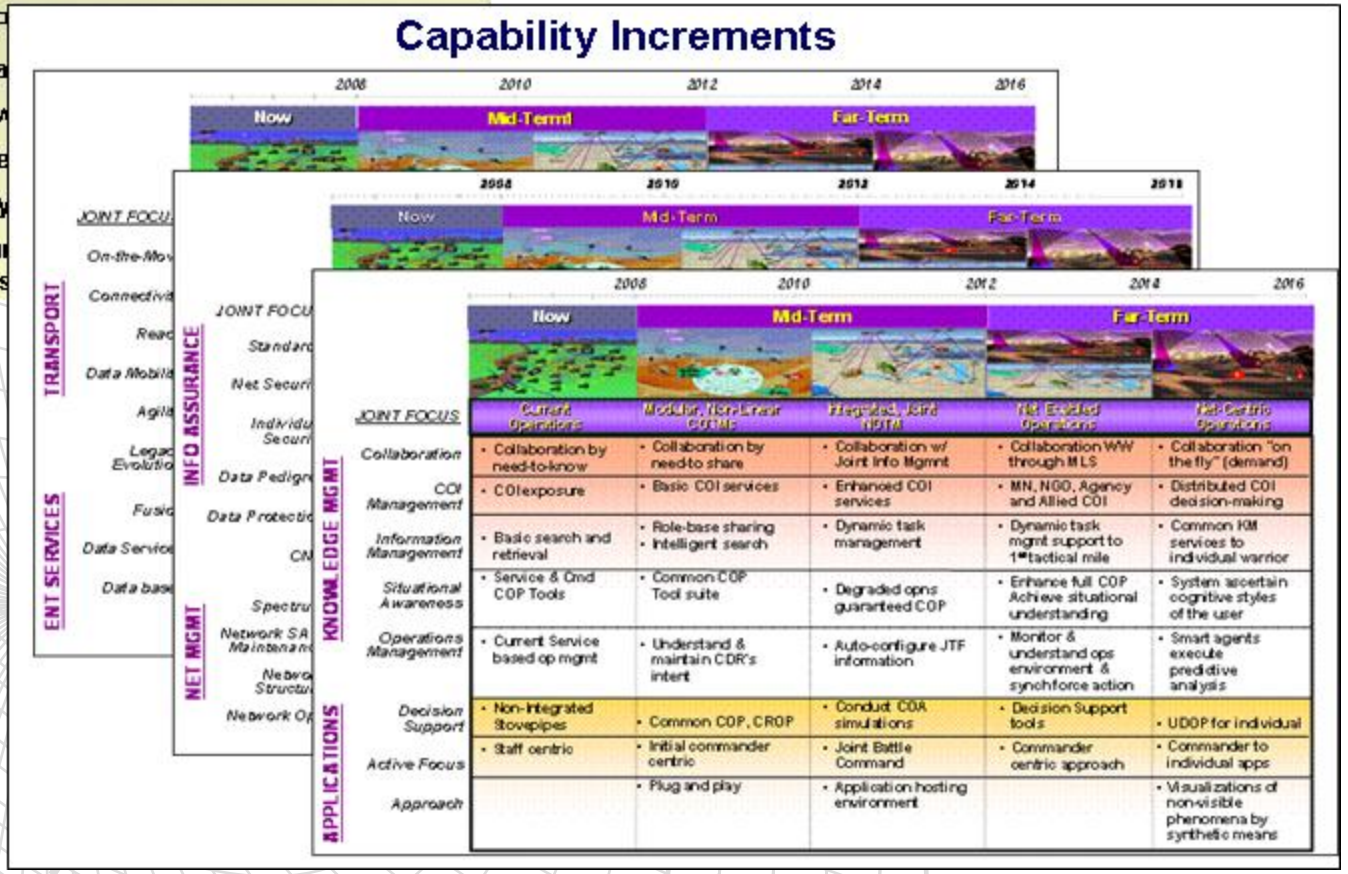
Use JNO portfolio management to improve synchronization, interoperability & integration -- balance cost, schedule, & performance (risk) across the portfolio

Capability Increments

JNO Tier 2 Area	Strategic Interest Summary (QDR, SPG, JPG)	Warfighter Needs (JNOS WarF, CGA, IPLs, JUONs, NCOE JCD, Ops Plans)
Network Managem		
Knowledg Managem		
Informati Transpor		
Enterpris Services		
Informati Assuranc		

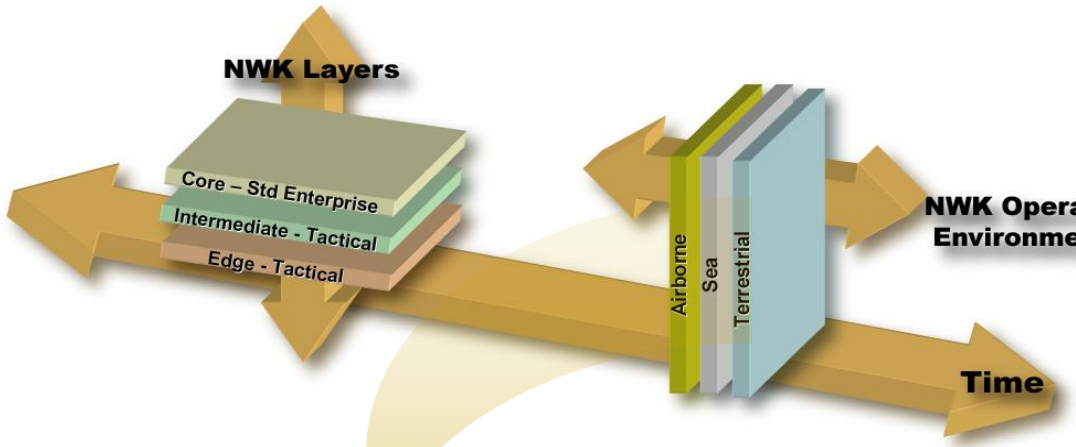
Goals

- Balance portfolio based on a P
- Provide ability to collaborate a
- Provide a highly available netw
- Provide ability to identify/store
- Protect integrity of data and sy
- Ensure integrated infrastructu resource (network, spectrum, s

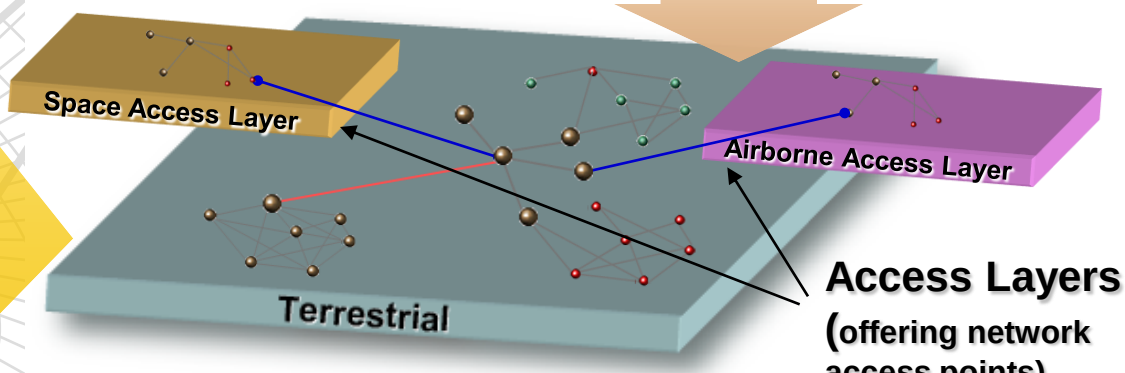


- **Defines Near-, Mid-, and Far-Term capability deliveries**
- **Capability Increments will be approved via the FCB and SWarF**

Network Architecture Perspectives



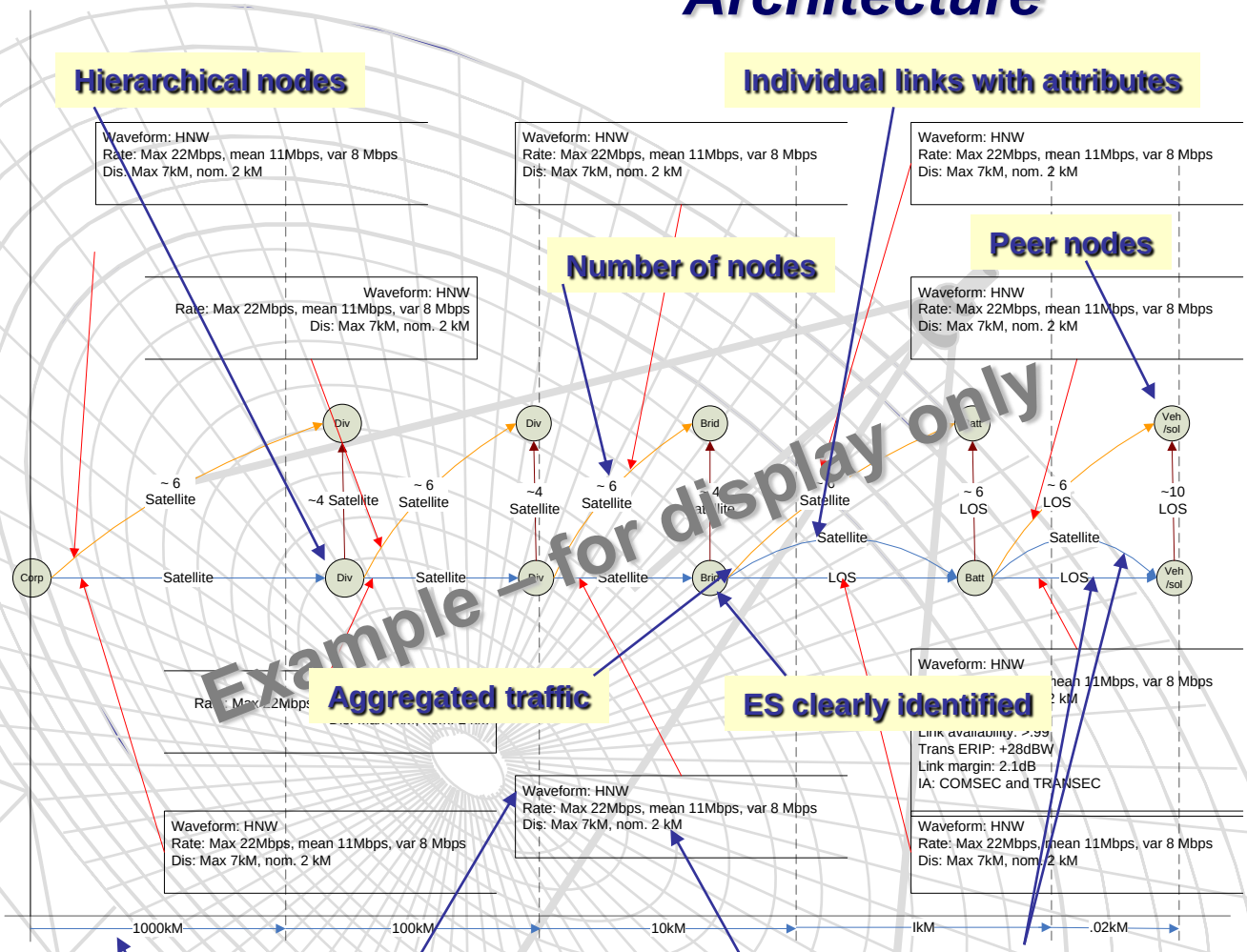
- Network perspective
  - Network elements including services which support the terrestrial warfighter
  - Depict the supporting GIG Network elements required capabilities



Access Layers (offering network access points)

- Understanding the network framework (architecture topology) is essential to determining the ability to meet the warfighter capability demands and optimizing the investment
- The space and airborne access layers are not necessary networks but offer the networks an alternate media means not available within the nwk physical domain

The Characteristics of a Terrestrial Tactical Network Architecture



Terrestrial NWK

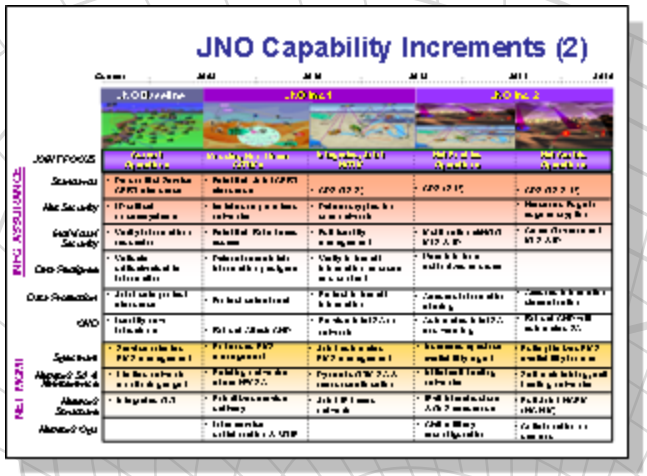
- Network is hierarchical in structure
- Distance is critical with hierarch topology
- Diversity is key
- Space is an extension of terrestrial

Airborne Nwk

- Distance is in terms of near and far
- Diversity is important
- C2 nodes with ES are critical
- Position in air space relative to permissive environment is key

NC

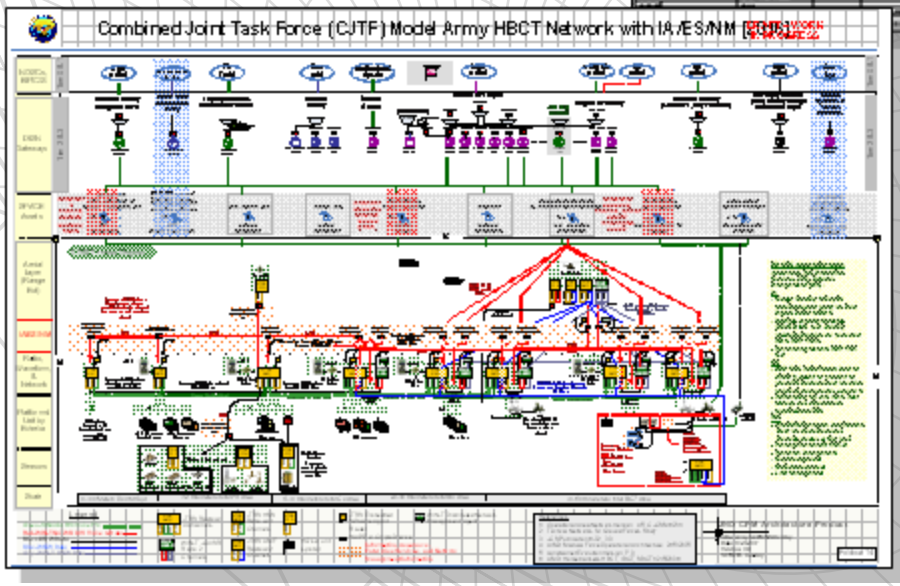
Assessment and Framework



Capability Delivery Increments (CDI): **Describes desired Capability Delivery over time**

- **Derived from JROC-approved sources (JIC, JCD)**
- **Parsed into evolutionary Increments of capability**

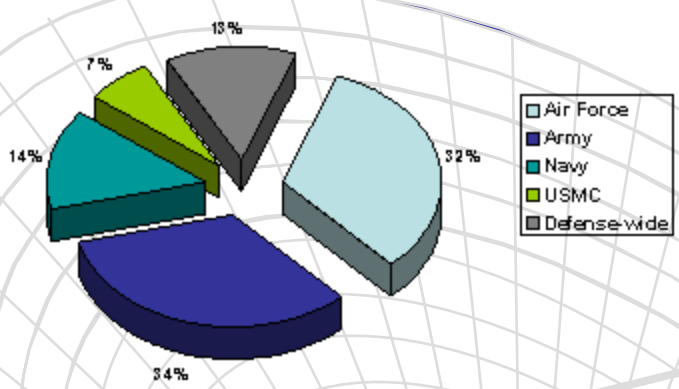
Quantified CDI w/Metrics: **enables the technical analysis of the portfolio**



Architecture Views: **Describe the POR capability available**

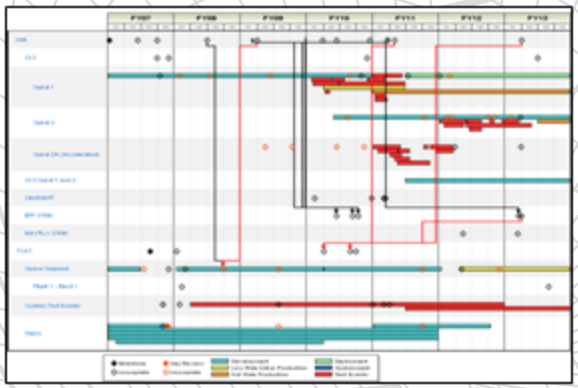
- **Derived from JCIDS documents**
- **Overlays of ES, NM, IA**
- **Assembled into evolutionary architectures by Increments**

Specific Assessment and Analysis Aspects



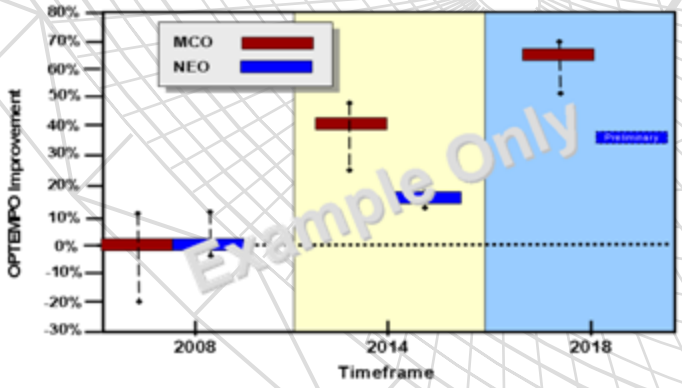
Portfolio Financial Profile: **boundary and baseline for resource analysis and optimization**

- **286 Program Elements (whole or partial)**
- **$160B total over FY08-13 (RDT&E+Proc+O&M)**



Integrated Master Schedule: **analysis of program, interdependencies, and synchronization issues**

- **Provides support to:**
  - **Architecture Development**
  - **Program and cross portfolio analysis**
  - **POM focus teams**



Ops Impact Analysis: **quantifies impact of portfolio changes on ops effectiveness**

- **OPTEMPO**
- **Lethality**
- **Survivability**

Balancing the Portfolio – Resource Process

Strategic interests & warfighter capabilities

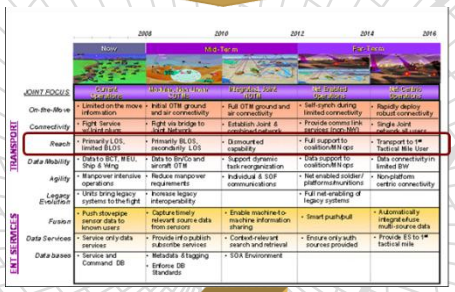
JNO Tier 2 Area	Strategic Interest Summary (GDIP, JFPG, JPG)	Warfighter Needs (JNOS Warff, CGA, IPLs, JUONs, NCOE JCD, Ops Plans)
Network Management		• Spectrum Access Mitigant • Interoperability • Infrastructure Allocation
Knowledge Management		
Information Transport		
Enterprise Services		
Information Assurance		

Goals

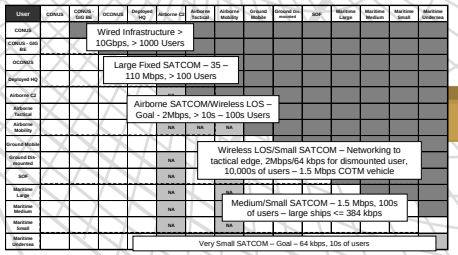
Goals

- Balance portfolio based on a Prioritized Capability Mix
- Provide ability to collaborate and share situational awareness
- Provide a highly available network extending to the first tactical mile
- Provide ability to identify/store/share/exchange data/information
- Protect integrity of data and systems
- Ensure integrated infrastructure situational awareness to enable efficient resource (network, spectrum, services) management

Capability increments



Quantitative capability increments



Application Demand

BA, JC2, other Portfolios

New Demand

Assess Quantified Capabilities

Disconnects

Focus

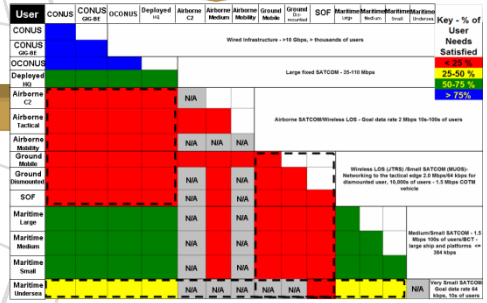
Demand

Resourced

Balanced Portfolio

External Balance

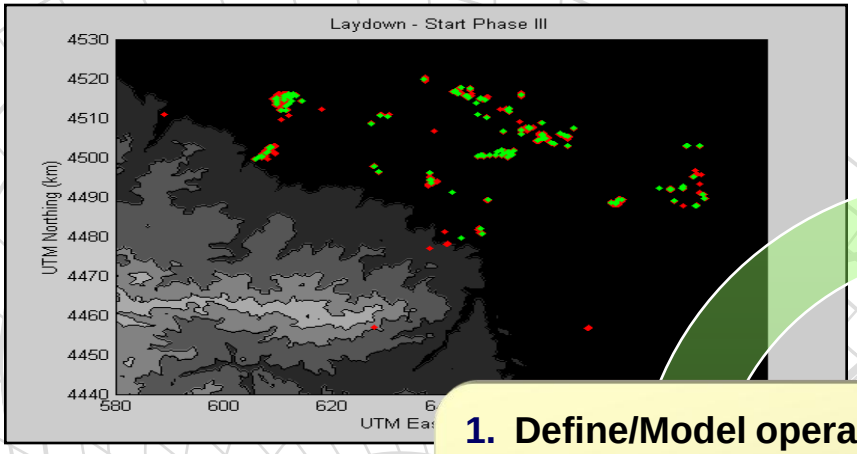
Program capability increments

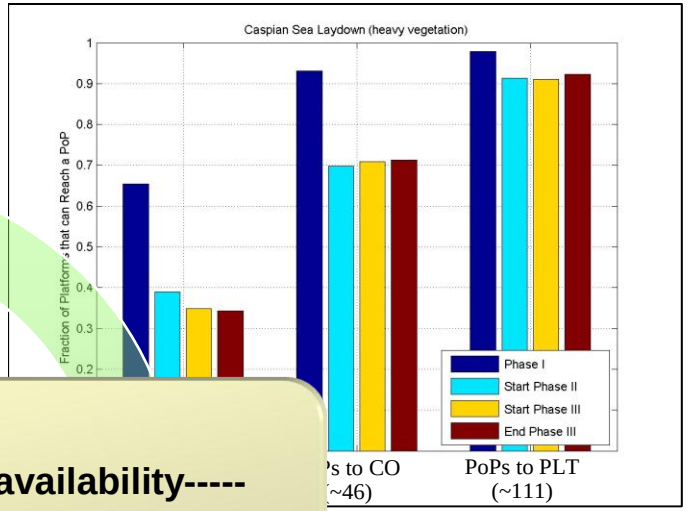


NC

Analysis Example

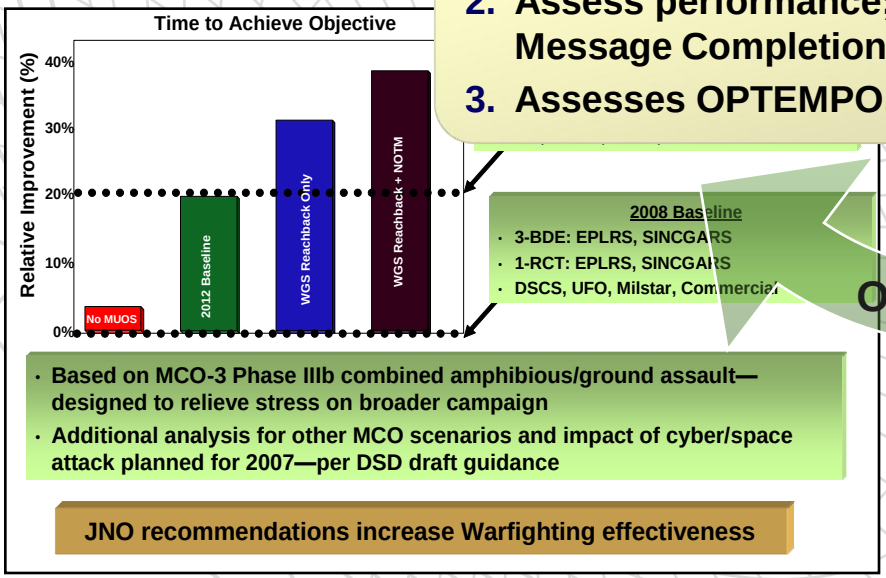
-- # of BDE SATCOM terminals required to connect the edge --





Technical

1. **Define/Model operational vignettes**
2. **Assess performance; connectivity, availability----- Message Completion Rate (MCR)**
3. **Assesses OPTEMPO, Lethality, Survivability**



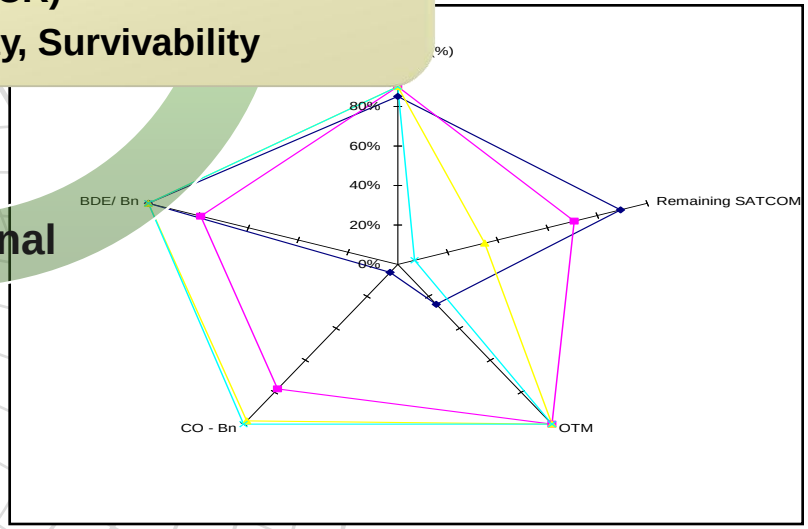
2008 Baseline

- 3-BDE: EPLRS, SINCGARS
- 1-RCT: EPLRS, SINCGARS
- DSCS, UFO, Milstar, Commercial

Operational

- **Based on MCO-3 Phase IIIb combined amphibious/ground assault—designed to relieve stress on broader campaign**
- **Additional analysis for other MCO scenarios and impact of cyber/space attack planned for 2007—per DSD draft guidance**

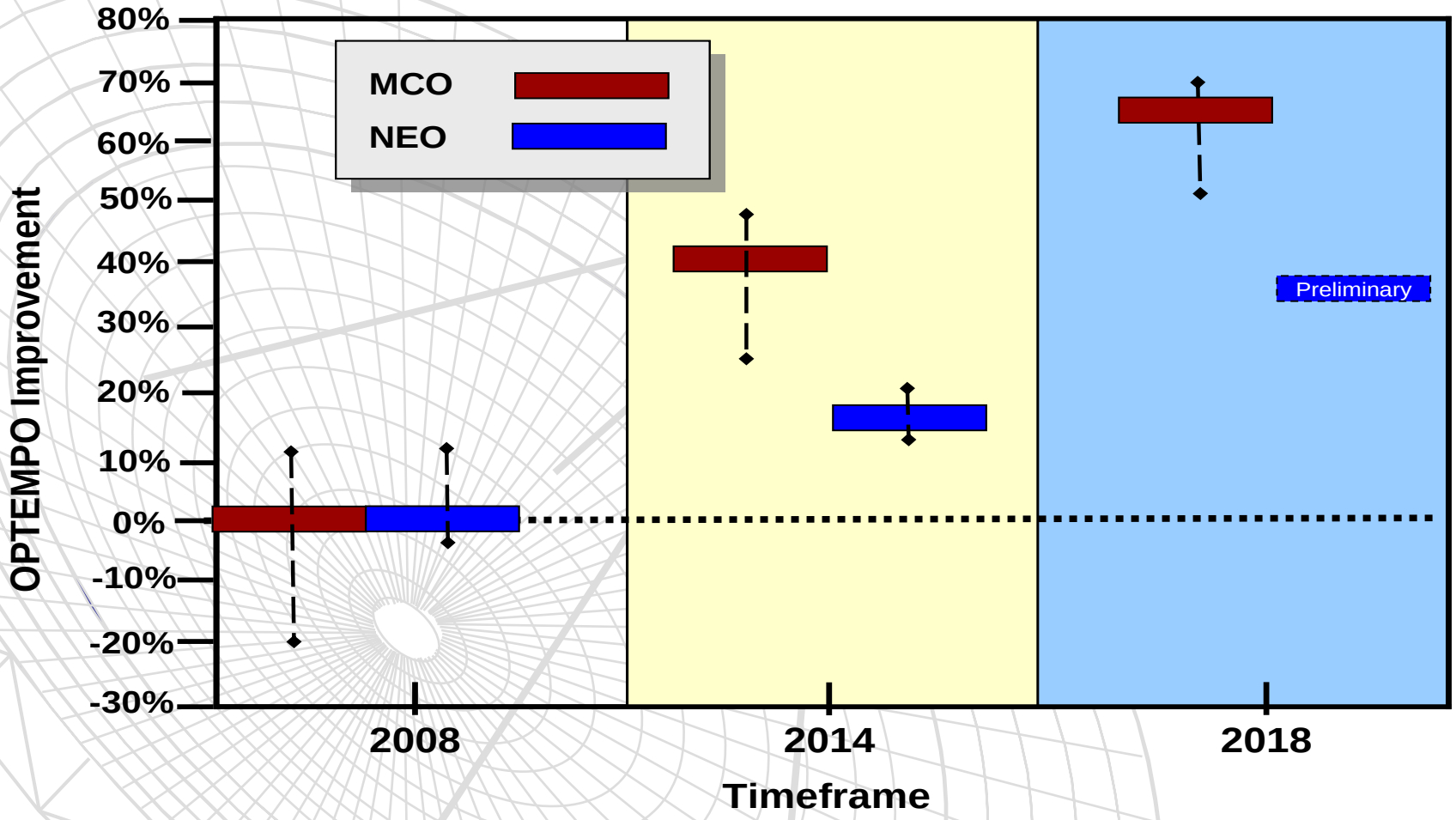
JNO recommendations increase Warfighting effectiveness



Connectivity, Message Completion Rate, OPTEMPO, Lethality and Survivability

Ops Impact Analysis Results

Benign Threat Environment

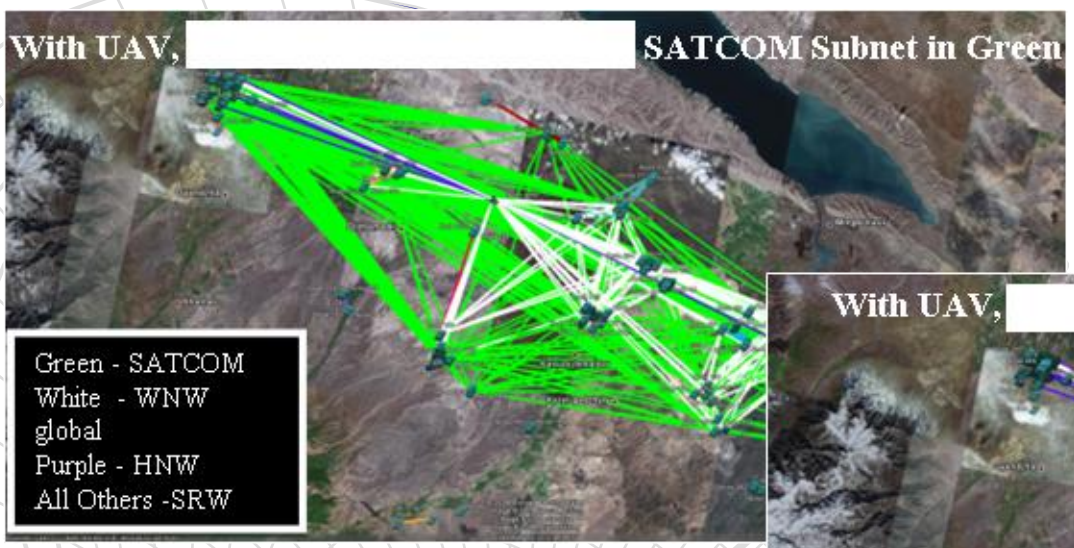


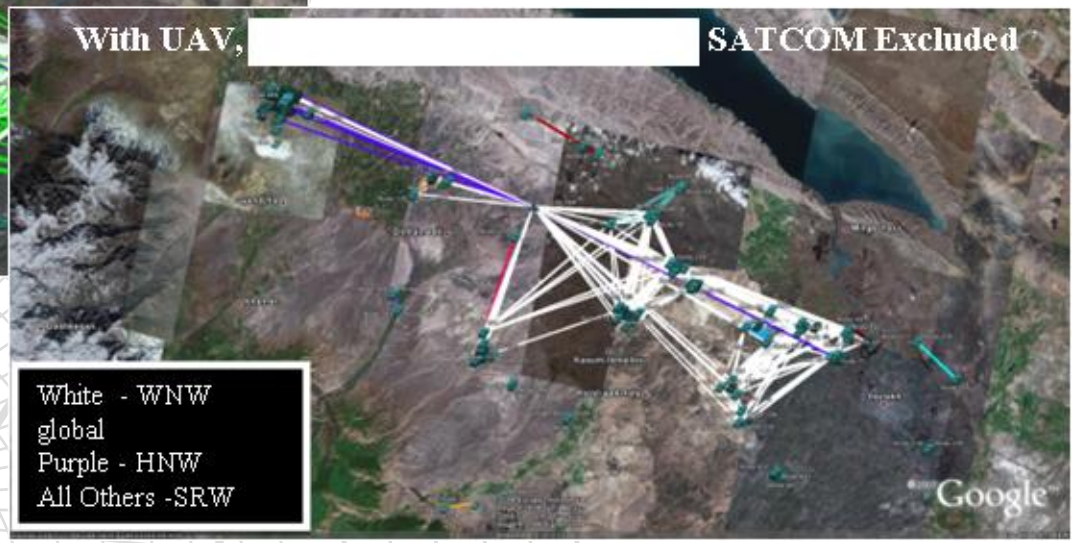
- Network equipped forces have significantly improved OPTEMPO
- Good Situational Awareness (SA) & Battle Command (BC) result in predictable outcome

MCO: Major Combat Operation
NEO: Non-Combat Evacuation Operation

Network Performance Analysis

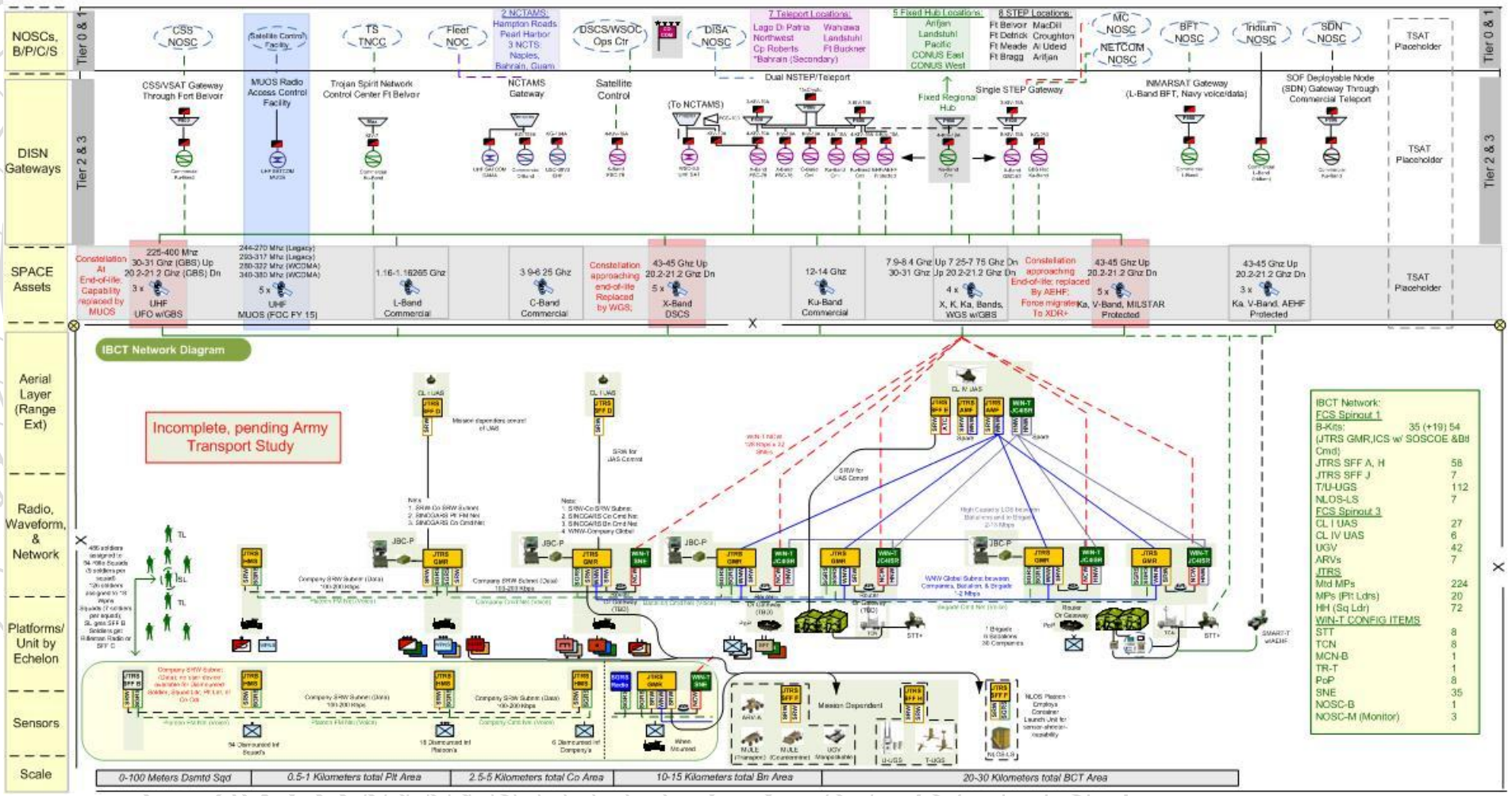
(CERDEC Tool)





- **Allows quick turnaround studies with numerous excursions feasible**
- **Provides Message Completion Rates and other Network characteristics**
- **Used as feeder to higher fidelity models (e.g., OPNET) and provides means of visualizing / analyzing high fidelity models**

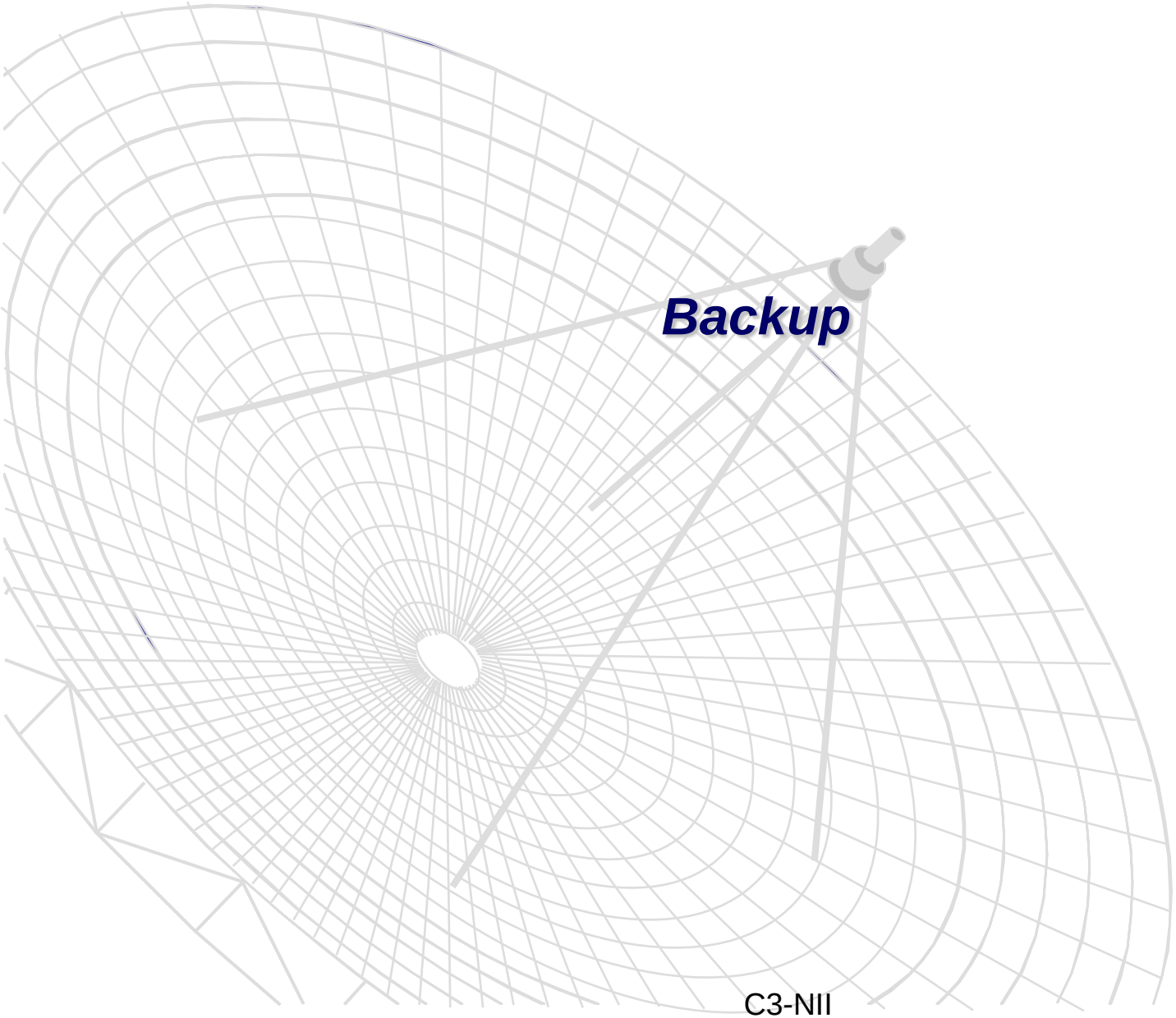
Example Army IBCT Network



Expanded View of JTRS-WIN-T Connectivity by Waveform with Aerial Layer Applied and FCS Spinout Items From Soldier to Brigade Main

Summary

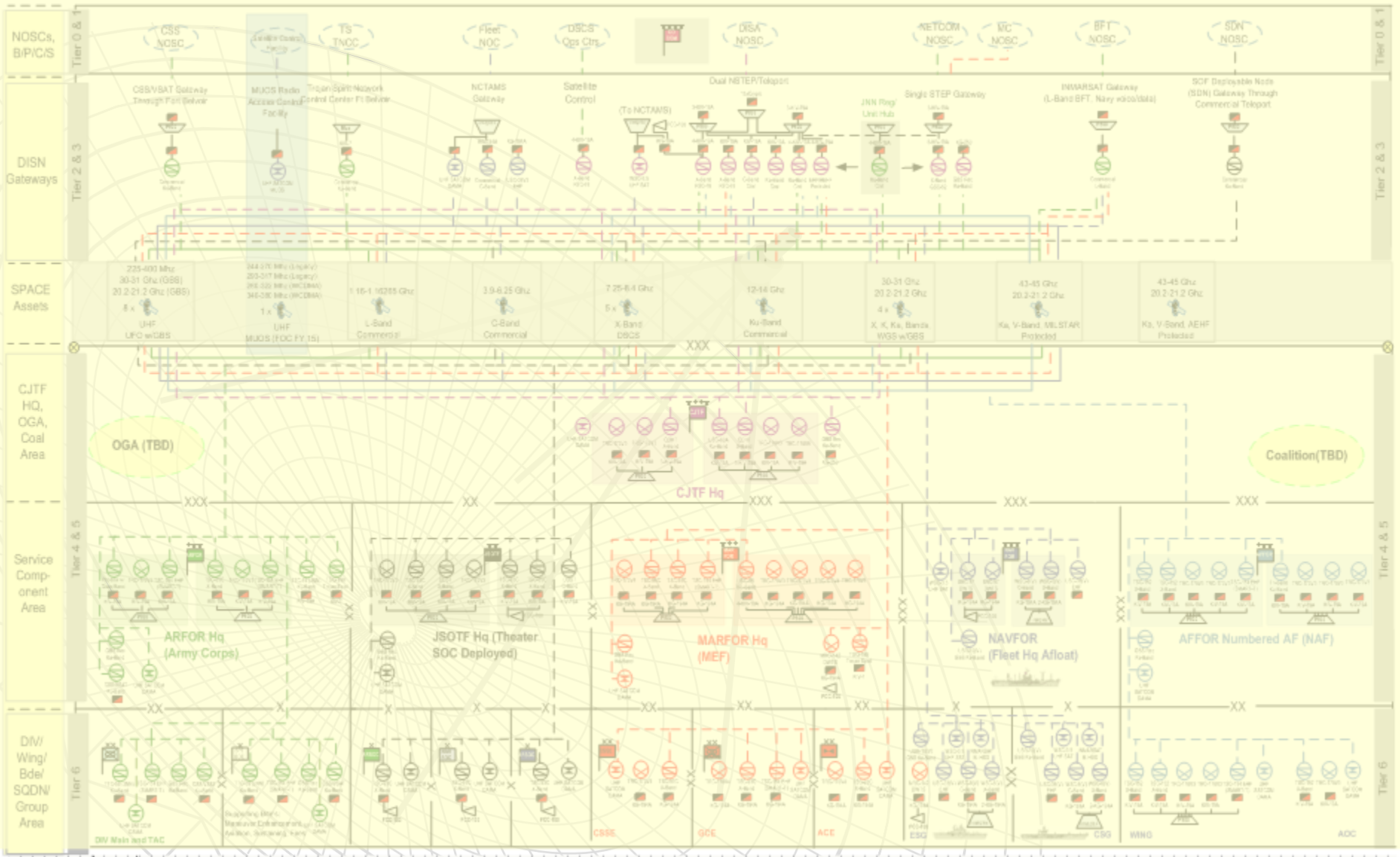
- NC Portfolio balances the three building processes – capabilities, acquisition and resources
- NC Portfolio employs a Systems Engineering based portfolio management approach
  - Achieves a quantitative analytical position based upon warfigther based capability increments
  - Places the capabilities into a network topology architectural framework which is used to offer contextual structure to the capability implementations
  - Quantitative demand and supply concepts are used to evaluate the gaps and overlaps in capabilities
- Implementation / program solutions developed from the evaluation assessment are used to determine the right investments
- Continual analytical assessments for the three building processes is done using a combination of network topology architectures, QCDI, and modeling tools
  - Network and enterprise services performance are evaluated quantitatively
  - Specific metrics include OPTEMPO, lethality and survivability derived from operational models / scenarios



Backup

Combined Joint Task Force (CJTF) Model [2012]

DRAFT – WORK IN PROGRESS



Legend

- Purple-Joint
- Green-Army
- Red-Marine
- Dark Blue-Navy
- Light Blue-Air Force
- Black-Special Operations

LOS/Tropo Radio System
Wideband Satellite Terminal
Narrowband Satellite Terminal

Multiplexers

Satellite

Major HQs

Crypto Hardware

Note: LOS lines were not drawn to reduce clutter

References:

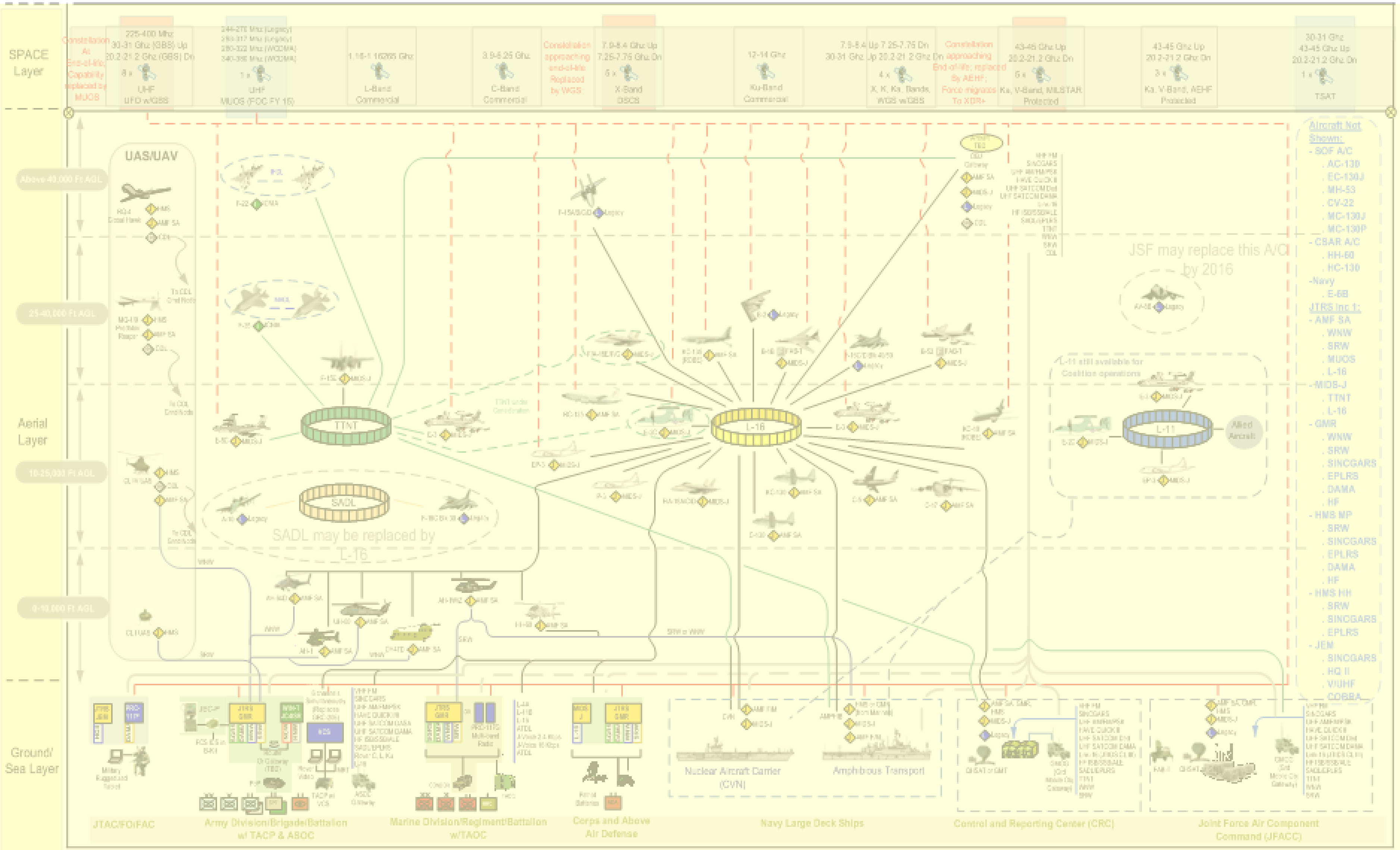
1. Operational Area Network Version 4.5, CJCSM 6231
2. Tactical Networks for Ground Forces Study
3. JCS Publication 6-02, 3.0
4. AMD Modular Force Operational Architecture 2/15/2006
5. Landwarnet Evolution Version 7.0
6. AMD Horseblankets HBCT, IBCT, SBCT 12/5/2006

JNO CPM Architecture Product

Title: CJTF Top Level Architecture
Date: 5/31/2007
Version: 0.7
R. Conway

Combined Joint Task Force (CJTF) Model Joint Airborne Network [2016]

DRAFT – WORK IN PROGRESS



Legend

- Black-L-16 Data Link
- Red-NB/WB SATCOM
- Gray-IP JAN Backbone LOS
- Blue-SRW/WNW LOS
- Green-TTNT LOS

Note: To minimize clutter, all connectivity lines are not shown.

References:

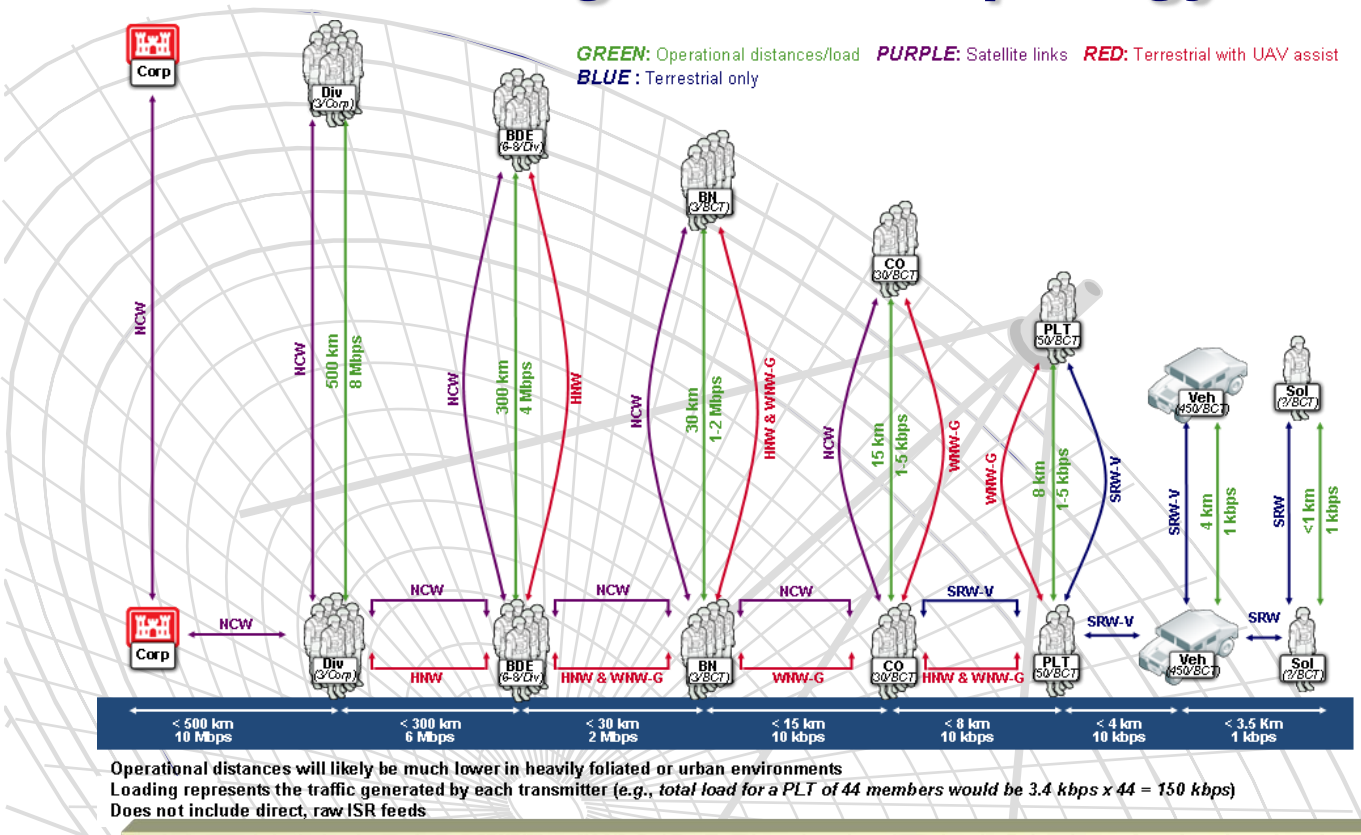
1. Deployable Comms Concept of Employment, Sep 2005
2. JAOC OV 2/3
3. AOC Wpns Sys, USQ-163 ISP, 31 July 2006
4. TDC Presentation, February 2007
5. Air Force Doctrine Document (AFDD) 2, 17 Feb 2000
6. Tactical Wireless Joint Network (TWJN) v.1, 30 Apr 2007
7. Objective Gateway CONOPS Ver 1, 25 May 2006
8. TRD, ASOC Gateway Ver 0, 30 April 2007
9. Air Force Roadmap 2006-2025, June 2006
10. Joint Terminal Engineering Office, NS4R, SATCOM Systems Roadmap, Spring (07), PB 08
11. OPNAV N88 Capability Case Analysis (CCA), Oct 2007

JNO CPM Architecture Product

Title: Joint Airborne Network 2016
Date: 10/27/2007
Version: 0.9
MITRE/R. Conway

Foldout 27

High Level Topology View



Operational distances will likely be much lower in heavily foliated or urban environments
Loading represents the traffic generated by each transmitter (*e.g., total load for a PLT of 44 members would be 3.4 kbps x 44 = 150 kbps*)
Does not include direct, raw ISR feeds

- Architectural structure sets the assessment and analysis context
- The network topology offers analysis of the links, ES and IA aspects

Terrestrial Network

- Network is hierarchical in structure
- Distance is critical with hierarch topology (node-to-node – peer-to-peer)
- Link diversity is critical
- Space and UAVs are an extension of terrestrial – these are access points (or layers)
- Significant work is need to insure the right balance exists between LOS, space and UAV
- Throughout the implementation consideration: performance, cost, schedule and risk need careful assessment

JNO Increments to Focus Team Solutions

	JNO Baseline (2004)	Transition 1 (2008)	JNO Incr 1 (2010)	Transition 2 (2012)	JNO Incr 2 (2014–2016)
JOINT FOCUS	Current Operations	Modular, Non-Linear, COTM	Integrated, Joint, COTM-NOTM	Net-enabled Operations	Net-Centric Operations
TRANSPORT	• Fight Service with Joint Plugs • Limited on the move data • Manpower intensive • Primarily LOS, limited BLOS • Data to Brigade, MEU, Ship, Wing	• Fight via bridge to Joint network • Increase legacy interoperability • Initial OTM ground and air connectivity • Reduced manpower • Primarily BLOS, secondarily LOS • Data to Bn/Co level	• Joint / combined network • Full on the move ground and air • Operate in Austere Environment • Support dynamic task reorganization • Dismounted capability	• Net-enabled soldier/ platforms/munitions • Self synchronization during limited connectivity • Fully support Joint/coalition/MN operations • Provide comms link services (non-NW)	• One Network • Transport to 1st Tactical Mile user • Guaranteed delivery of data • No longer platform-centric • Global data access • Enhanced CES
ENTERPRISE SERVICES	• Best Effort Routing; bridged voice • Svc command DB • Push stovepipe sensor data	• Initial CES • Metadata & tagging • Federated Portals • Enforce DB standards	• SOA environment • Enhanced COI formation • Machine-to-machine info sharing	• Full integration of all CES (joint/service) • Service coreography to dynamic tasks • Smart push/pull	• Automatically integrate/fuse multi-source data • ES to Tactical edge
INFORMATION ASSURANCE	• De-conflict Service CERT org stds • Joint data protection standards	• Isolate compromised • Joint CERT standards • Role-based access • Robust CND; detection & response to attacks	• CDS (TS-S) • Protected & assured in-transit • Identity management • COI Security	• Multi-national MLS • CDS (S-U) • Assured sharing	• Hardened edge-to-edge encryption • Assured info dissemination • CDS (TS-S-U)

Pre-decisional draft

Components

— Time →

GDF, PDM, Directed

Focus Teams

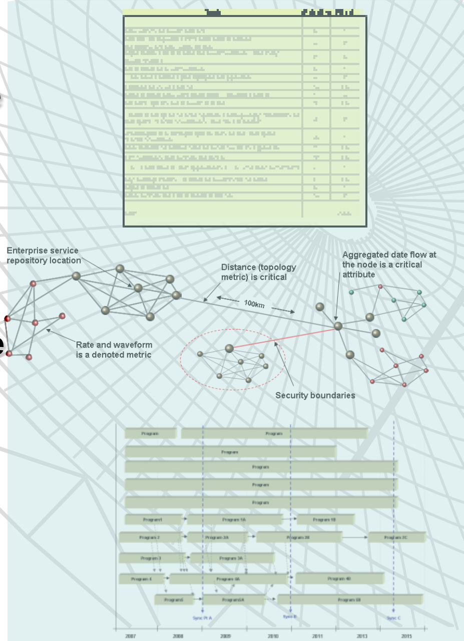
Gaps / Over Laps

Quantitative Capabilities

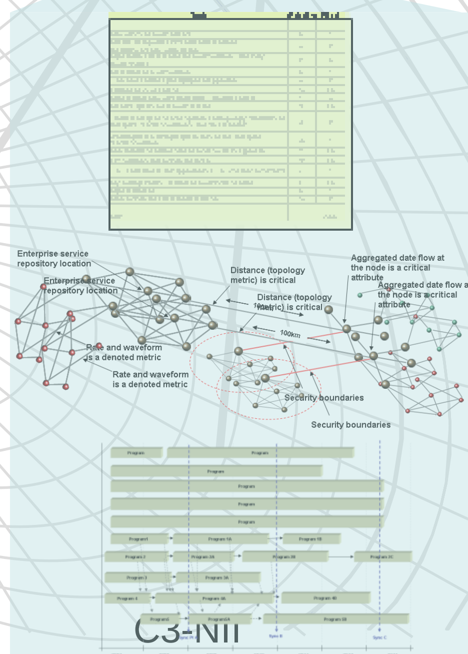
Network Architecture

Integrated Schedule

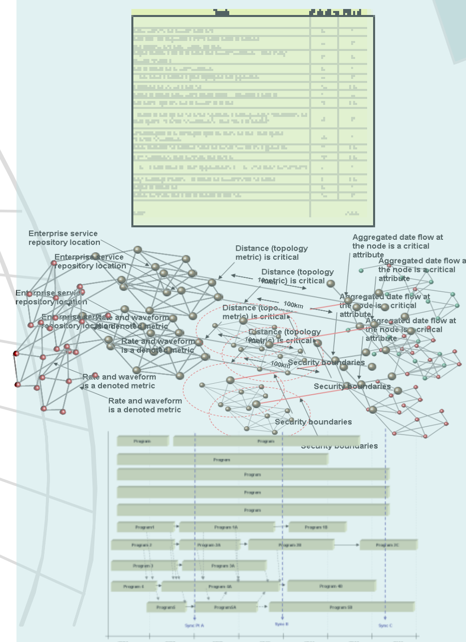
Near Term



Mid Term

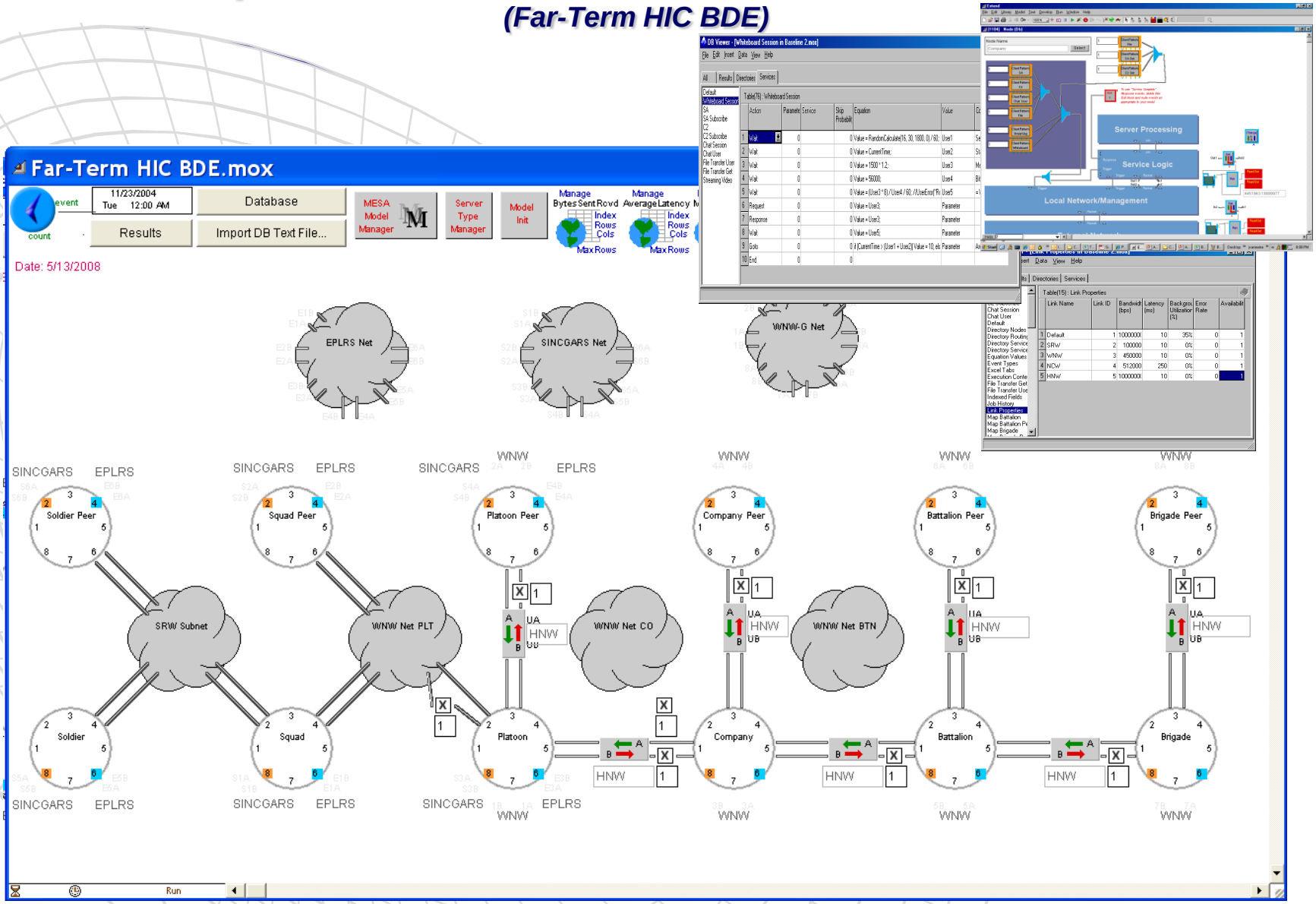


Far Term

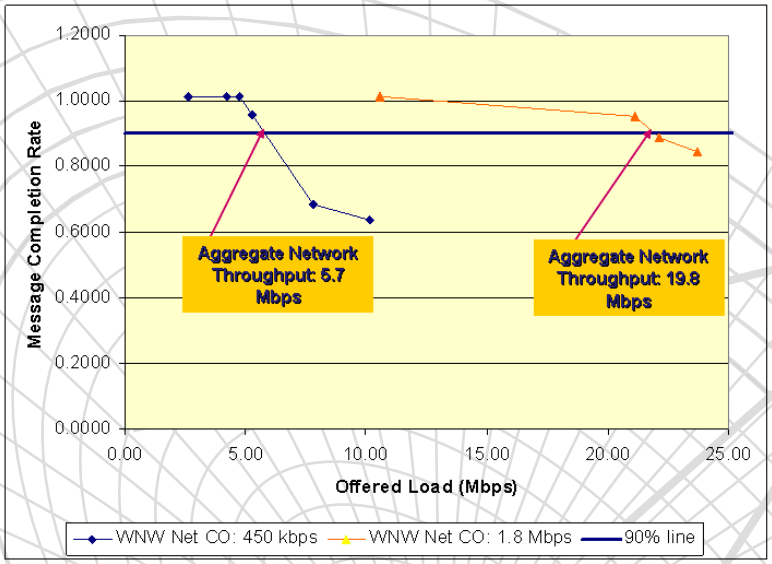


Simplified Traffic Network Model Structure

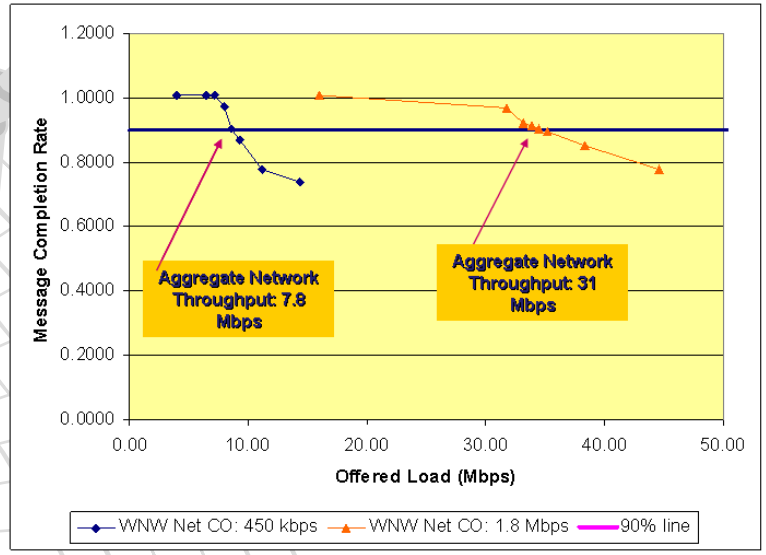
(Far-Term HIC BDE)



ES Network Location –Throughput and Cost



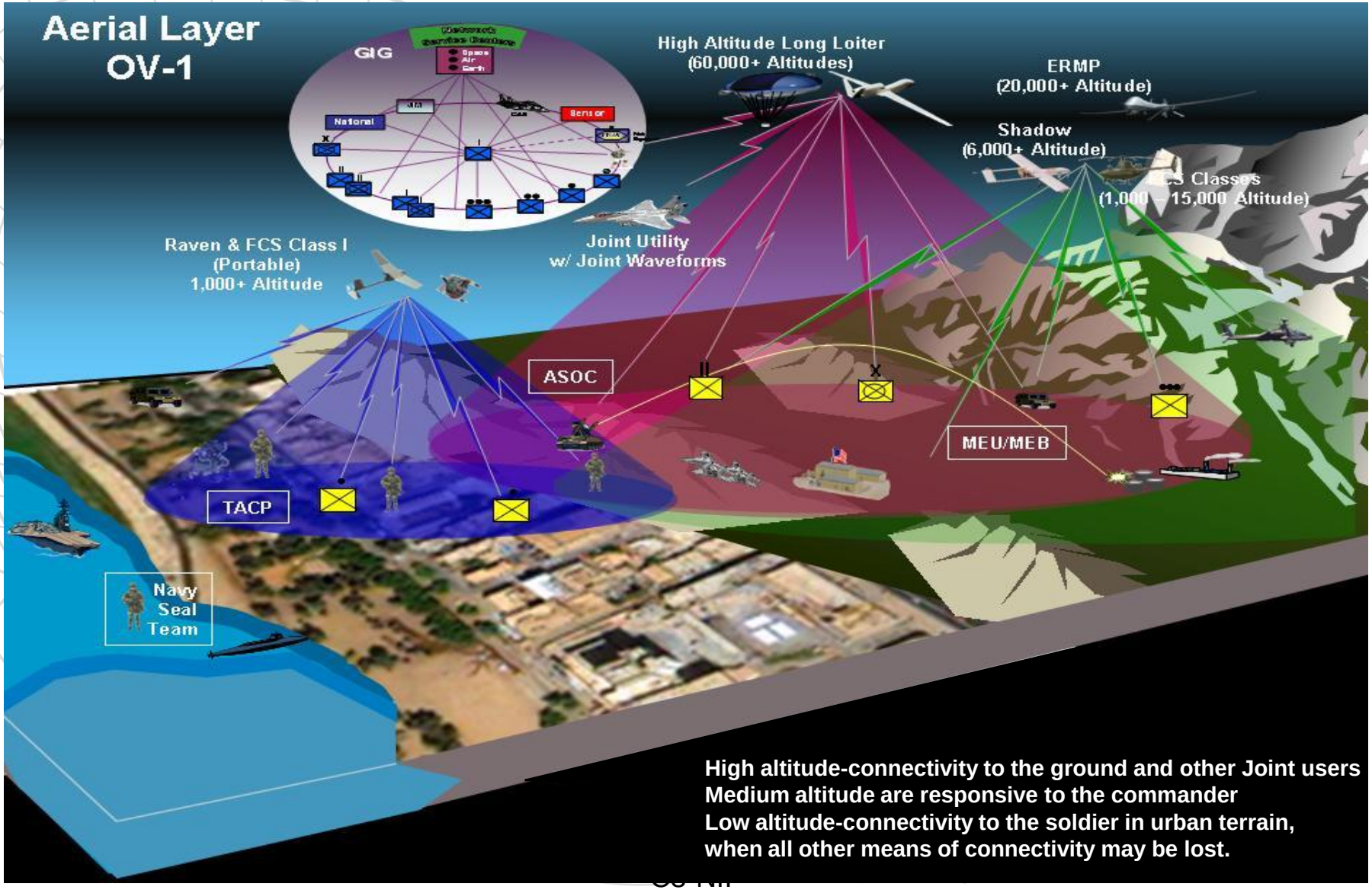
Configuration 1: Total throughput achievable versus message completion rate for the mid-term, high-intensity conflict configuration with Enterprise Servers at the BDE level



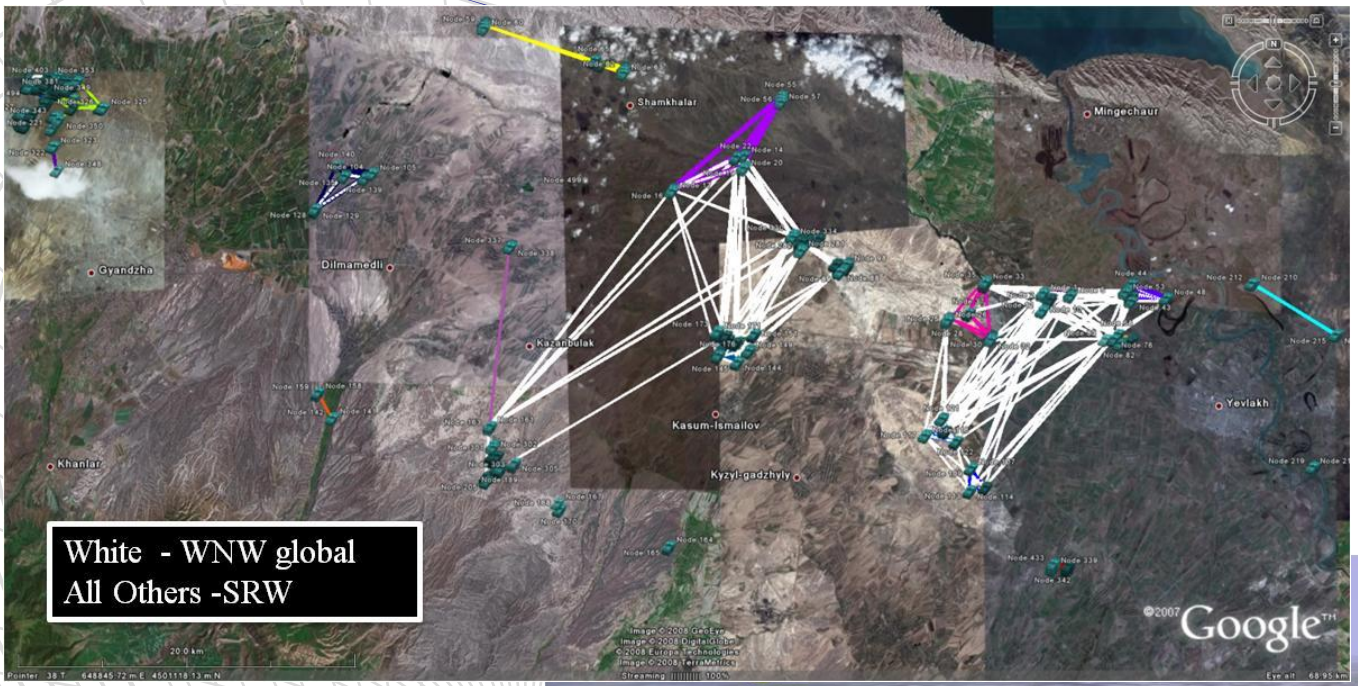
Configuration 2: Total throughput achievable as a function of offered traffic load for the far-term, high-intensity conflict configuration with Enterprise Servers at the CO level

- The location of the ES may have potentially significant effects on the network performance and more importantly on the effective network throughput
- The balance of ES cost vs the lower level network cost is an important aspect which is being currently assessed

Operational View – OV-1 (U)

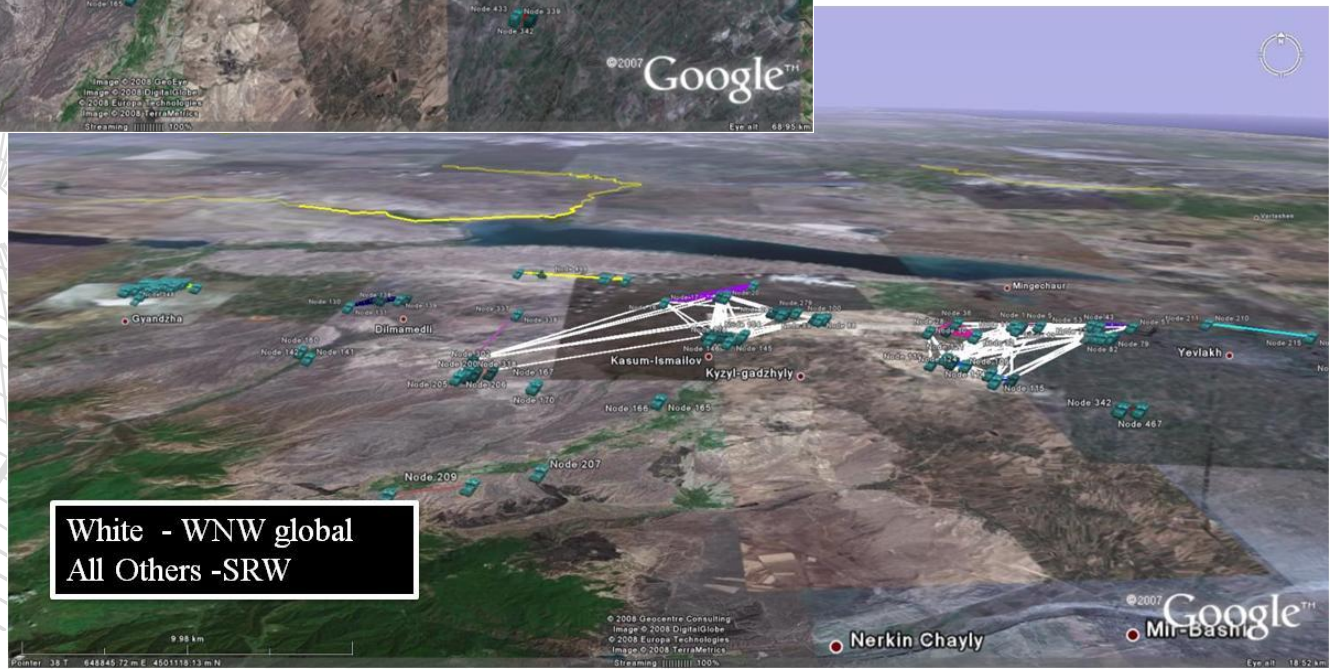


Without Satellite Connectivity



Standard View

Slant View

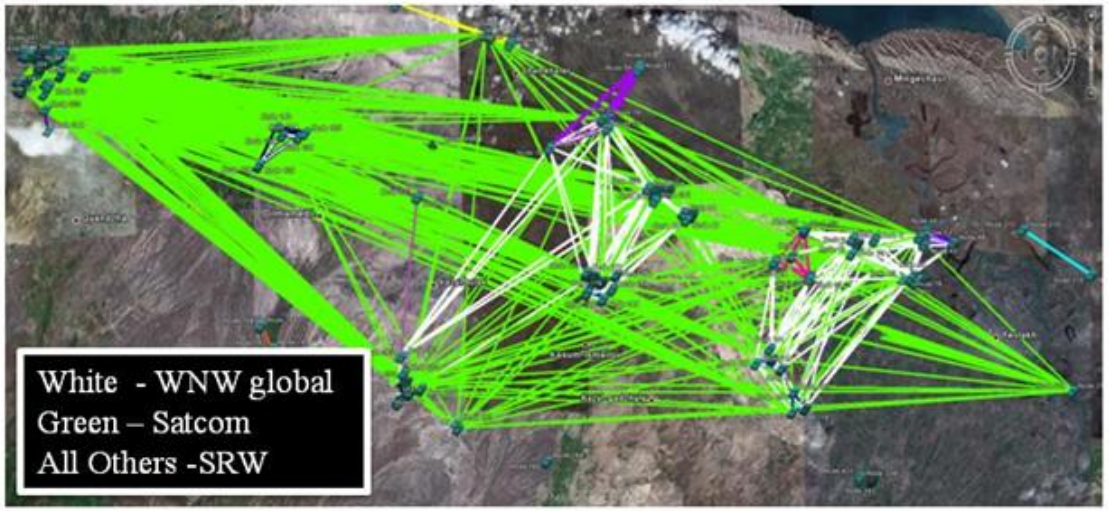


Network Topology

- SRW subnets are tightly clumped, good connectivity.
- Global WNW subnet connects some SRW subnets but is fragmented.
- SATCOM terminal in each SRW subnet connects those without Global WNW connectivity.

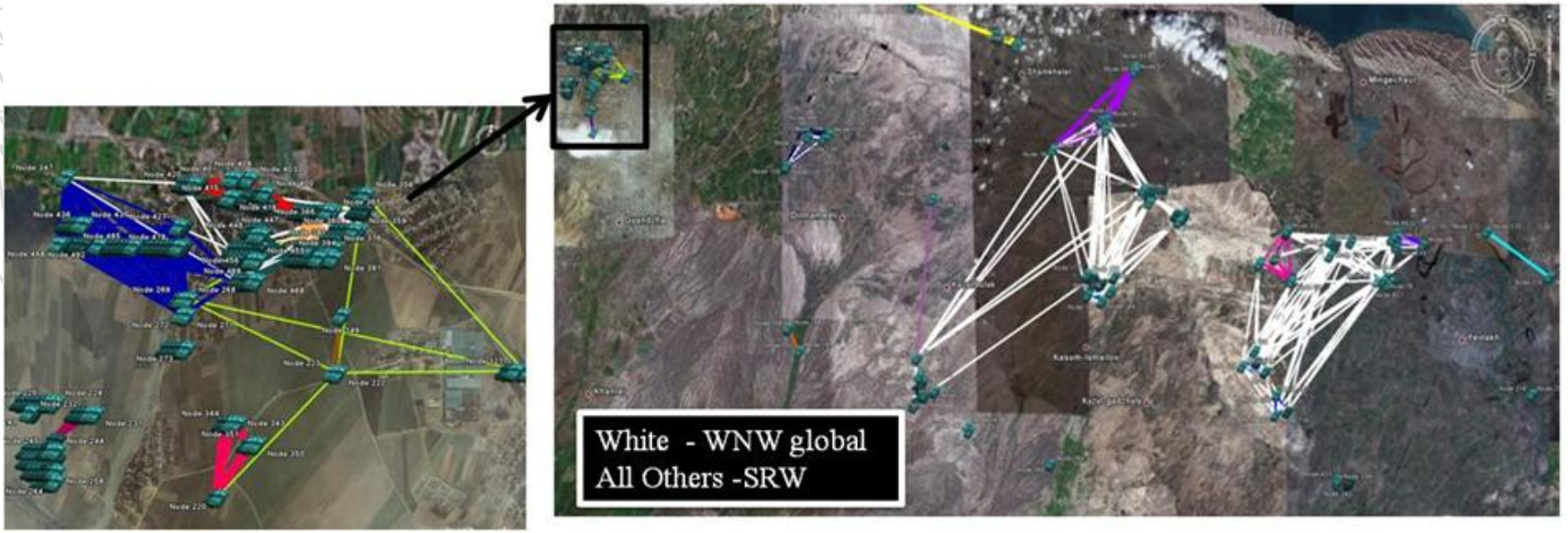
TNGF BCT

SATCOM Subnet in Green)



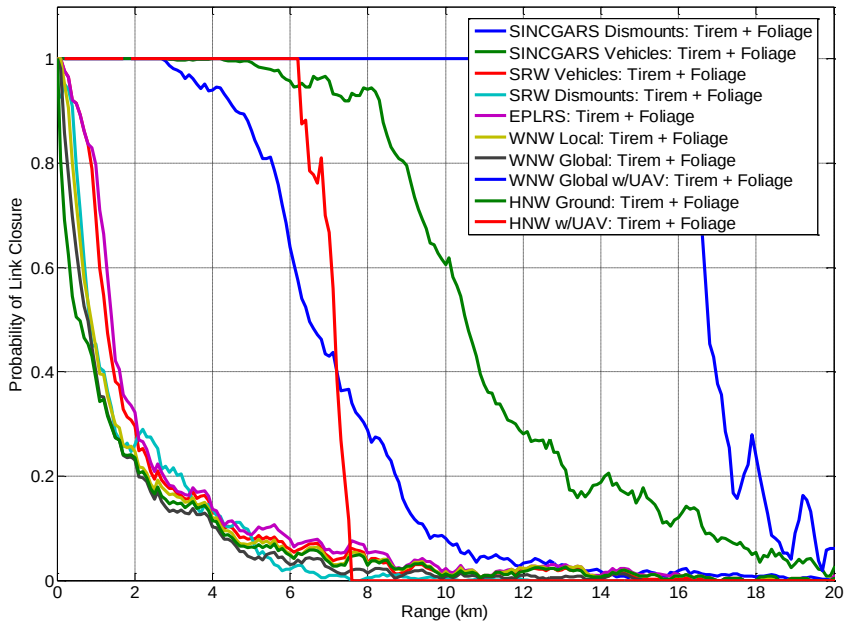
TNGF BCT

SATCOM Excluded)

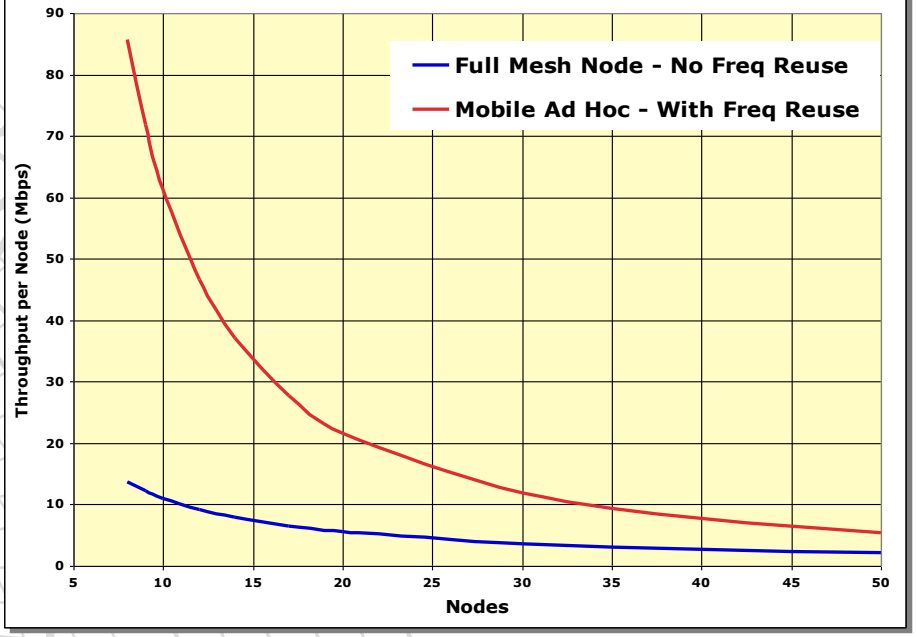


Range and Capacity Analysis

Waveform/Radio Range Performance



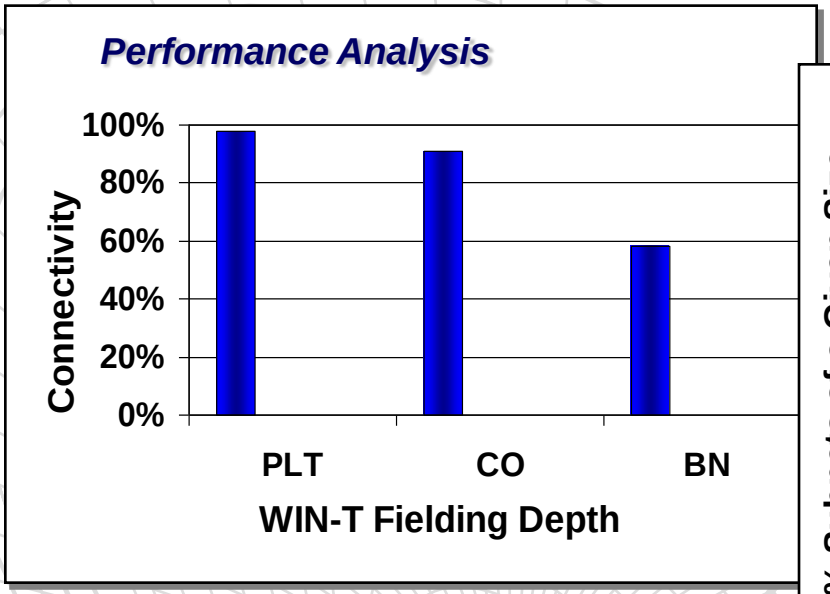
HNW Link Capacity Performance

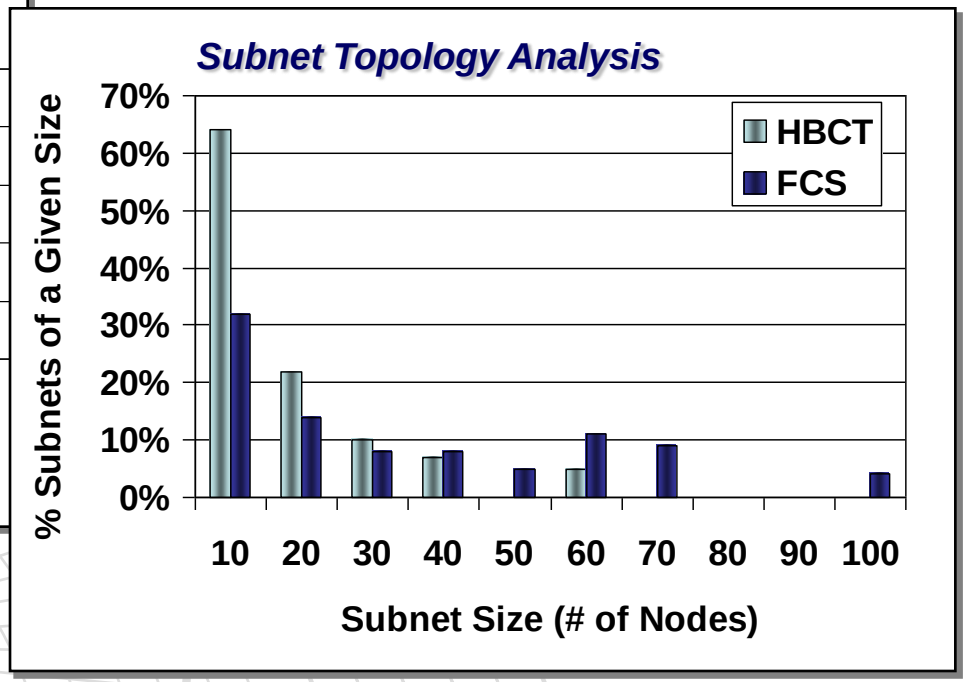


- **Compute link closer and capacity for given network laydown, terrain, and vegetation**
- **Waveform performance analysis feeds Network performance analysis**

NOTES
Masts are 7 meters for HNW
UAVs at low altitude (FCS CL IV altitude used in PM FCS BCT analyses)
Assume 80-90% confidence

Representative Results





- WIN-T connects Ad Hoc subnets into an integrated network
- More than 70% of mobile AD Hoc networks are less than 30 nodes
- Reorganization of subnets may allow all to fall below 50 nodes