Next Generation Wireless Communications (NGWC) for Logistics Applications

Project Brief to VADM Rondeau, Deputy Commander, USTRANSCOM
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NGWC Overview

- **Vision**
  - On the net-centric, geographically and operationally distributed battlefield of tomorrow, the Joint War Fighter will have, at his disposal, a complete, accurate, and current view of the status of equipment, supplies, and materials across the entire spectrum of military logistics.

- **Objective**
  - Demonstrate global, near-real-time, asset visibility through the development of a suite of devices that harness the capabilities of existing and future communications technologies throughout the distribution pipeline and on the battlefield.

- **Approach**
  - Develop with an open architecture, standards-based methodology.
  - Develop and integrate mesh network technology as the base communications technology.
  - Develop interfaces between mesh network and existing backhaul communications capabilities available throughout the DoD Distribution Enterprise.

- **Anticipated Outcomes**
  - Enable Distribution Enterprise enhanced Asset Visibility with minimal infrastructure.
  - Enable critical alert data transmission from platforms back into the U.S. Army STAMISs (prognostics).
NGWC Collaborative Team

- USTRANSCOM
- SDDC
- U. S. Army ODCS G4
- LIA
- PM J-AIT
- PM MTS
- PM DWTS
- CASCOM
- CENTCOM J4
- AMC
- CERDEC
- DLA
- DoD AIT
- OSD (ATL)
- U. S. Navy AIT
- U. S. Air Force AIT
- U. S. Marine Corps AIT

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Program Requirements

- **Documentation**
  - Distribution Process Owner (USTRANSCOM J5/4)
    - Satellite Tracking Requirements Workshop (April 2006)
  - DoD AIT CONOPS for Supply and Distribution Operations (11 Jun 2007)
  - Army AIT ORD
  - Modular Force Logistics Concept (MFLC)
  - Distribution Operations for the Future Modular Force - Concept Capability Plan (CCP)

- **Operational Needs**
  - CENTCOM J4
  - Joint Special Operations Logistics Directorate
  - HQDA G-44(D)
  - HQDA G-46/CIO
  - HQDA G-44(M/S)
  - Other Services

- **Functional Requirements Table**
  - Directing the technical solution for NGWC
## USTRANSCOM Requirements Workshop

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>Integrated Now</th>
<th>Planned Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite Connectivity</td>
<td>Yes (Iridium)</td>
<td>Will investigate others</td>
</tr>
<tr>
<td>In-the-box Visibility</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Track Container separate from Conveyance</td>
<td>Yes (via mesh or SatCom)</td>
<td>Mesh Enabled</td>
</tr>
<tr>
<td>Global Coverage</td>
<td>Yes (Iridium)</td>
<td></td>
</tr>
<tr>
<td>Programmable to change reporting frequency</td>
<td>Yes</td>
<td>Many, including door contact</td>
</tr>
<tr>
<td>Sensors: Temp, Light, Intrusion</td>
<td>Yes (temp, humidity, light)</td>
<td></td>
</tr>
<tr>
<td>Interoperable with aRFID</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Link with RF-ITV Server</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Geo-Fencing Capability</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Leverage Current Infrastructure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Encryption</td>
<td>Yes (Commercial Grade)</td>
<td>Yes (DoD Compliant)</td>
</tr>
<tr>
<td>HERO and HERP certified</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Use improved methods of internal power</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Replaceable Battery</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Transmit Battery Status</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Ideal form factors: size, weight, shape</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be permanently fixed to Govt Container</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>IA Compliance</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

NGWC satisfies 11 now!  
18 Specific Requirements Identified  
Remaining 7 planned for development!
Assessment of Asset Visibility Technology

Active RFID Infrastructure
- Provides 'Where it Was' visibility
- Nodal capability
- Requires Fixed Infrastructure
- Deployable (Takes time)
- Costly (Set up & maintain)
- CLS in Battle Space
- Closed Architecture

Movement Tracking System + (MTS+)
- Many capabilities for operator
- Satellite connectivity to RF-ITV Server
- MTS+ serves as aRFID interrogator
- 'Good Enough' Fielding Limitations (Cost)

Commercial SatCom/Cellular Capabilities
- Stove-piped solutions
- No coordinated effort to link systems
- Locally and regionally procured
- Various methods of interface to RF-ITV
- Commercial Applications w/feed to various STAMIS

NGWC
- Integrated Capabilities Solution (embraces existing and emerging tracking solutions)
- Global, 'Near-Real-Time', on-demand
- Enables Distribution 'Total Asset Visibility' (location, identification, condition)
- Wireless Mesh Network Solution to connect assets across the enterprise
- Multiple Paths to RF-ITV and Logistics C2 Systems

‘Fragmented’

‘Good Enough’ Fielding

STRATEGIC LIFT

Military Distribution
- CONUS DCs
- POE
- POD
- OCONUS DCs
- SSA
- UNIT

Commercial Distribution
- Factory

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Existing/Available Connectivity to the NIPRNet

Interfaces

CAISI  DoD IT  MTS  SatCom  Cellular

NGWC Mesh Network

Interfaces

Navy  Army  DLA  OSD  Joint  Air Force  USMC

AIT Enabled Business Processes

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Information Assurance (IA)

- Resolving IA issues is integral to the design of the mesh network and the system architecture
  - IA requirements are driving the mesh design
  - DIACAP process has been initiated
  - Objective is a full Certification and Accreditation (C&A) package
  - Collaborating with U. S. Army NetCom for design requirements
  - Continue to brief proposed solution at the PM J-AIT hosted RF-ITV System Security Architecture Working Group

- Technical Approach (High Level)
  - All RF transmission will be encrypted
  - Tags transmit only in the presence of active authenticated sinks
  - User can silence mesh emissions

- Issues/Concerns
  - Mitigate consequences of multiple-service IA requirements compliance
NGWC Flexibility

User Defined Requirement

Available Technologies
- aRFID
- GPS
- COMMS
- MESH
- RADIO

Integration
- IA
- GPS
- MESH
- RADIO

Optimal Device Configuration
- NGWC Device

Capability Tailored to Enable Specific Business Process
- Open Architecture
- Standards-Based
- Scalable Solution

LOGISTICS
DATA
REQUIREMENT

CAPABILITY

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# NGWC Mesh Data Interface

<table>
<thead>
<tr>
<th>PRIMARY MESH SINK NODES (Externally Powered)</th>
<th>MESH INTERFACE</th>
<th>BACKHAUL COMMUNICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAISI Wireless w/CSS VSAT</td>
<td>Authorized computer clients on CAISI network</td>
<td>CSS VSAT or other means used by CAISI Network to gain Internet Access</td>
</tr>
<tr>
<td>Movement Tracking System (MTS)</td>
<td>MTS Laptop Computer on vehicle</td>
<td>MTS onboard SatCom capability</td>
</tr>
<tr>
<td>DoD Computer Systems w/access to NIRPNet</td>
<td>DoD Computers</td>
<td>The existing and available internet capability</td>
</tr>
<tr>
<td>NGWC Gateway Device</td>
<td>NGWC Gateway Device</td>
<td>Internal Iridium Modem</td>
</tr>
<tr>
<td>Commercial Tracking Solutions</td>
<td>Various commercial cellular and SatCom tracking systems</td>
<td>Various Cellular/SatCom capabilities</td>
</tr>
</tbody>
</table>

Data interfaces between existing backhaul communication systems and DoD RF-ITV Server

ITV/TAV Customers
Mesh Technology Overview

- **Mesh Network Technology (explained)**
  - A network of nodes that communicate with and among other nodes
  - Nodes maintain communications, finding the most efficient route back to a sink node.
  - Sink nodes are nodes that have access to a backhaul communications capability
  - Mesh can be implemented using any of the 802.n Wireless network technologies
  - Must match characteristics of the 802.n wireless technology with the business process and functional requirements to determine the optimal wireless technology for integration into the NGWC mesh network

- **Existing Mesh Network Technology**
  - Most existing mesh is static mesh network technology
    - Facility automation networks
    - Manufacturing/Industrial mesh networks
  - Adhoc Mesh Networks are gaining interest within the development community

- **NGWC Mesh Characteristics**
  - Adhoc - the ability to form a mesh network randomly, as nodes are detected
  - Self healing/self forming - nodes can join and leave the network seamlessly
  - Battery Powered - limiting factor for most 802.n wireless network technologies
  - IA Compliant - must comply with wireless and IA policy in order to access NIPRNet
  - Mesh architecture must adhere to the principles of the OSI model
  - NGWC Mesh solution will be 'pseudo-adhoc mesh network'
Mesh Network Technology

Adhoc formation of a network routing tag data back to an authenticated sink node with access to the NIPRNet.

Two nodes within the network are physically moved, resulting in the reconfiguration of the adhoc network so that tag data can find a route back to the sink node.
Mesh Applications to Warehousing

NGWC Enabled Warehouse Pallet

NGWC Enabled Container

NGWC Enabled DoD Computer

WAREHOUSE OPERATIONS

Blue Grass Army Depot
Sierra Army Depot
Anniston Army Depot
DLA Operations

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Mesh Applications to Convoy Operations

NGWC Enabled Container

NGWC Enabled Vehicle

MTS+ Enabled Vehicle

Tactical Battle Space
OCONUS Host Nation 3PL
Tactical Convoy Operations
Strategic Movement Control/Coordination

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Mesh Applications to Container Yard Operations

- NGWC Enabled Warehouse Pallet
- NGWC Enabled Container
- NGWC Enabled Forklift
- NGWC Sink Node

SDDC Port Operations
Aviation Terminal Operations
SSA Operations
Container Trans-load Operations
Capstone Demonstration (18-20 Apr 2007)

- Demonstration Scenarios
  - Early Entry
  - Initial Logistics Enclave Buildup
  - Convoy Operations
  - Supply Support Activity (SSA) Operations
  - Last Tactical Mile (LTM)

- Technology Enablers
  - SatCom (Iridium)
  - GPS
  - aRFID
  - Sensors
  - Adhoc Mesh Network Technology
  - CAISI Wireless Interface
NGWC Business Case

- **NGWC as a ‘Gap Filling’ Technology Enabler (Current Focus)**
  - Real-time tracking & condition monitoring in the operational/tactical battle space
    - Early entry, highly mobile, volatile operational environments
    - Austere Environments
    - Host Nation/3PL supported operations
    - Vehicle/Convoy ops
    - Real-time monitoring of life-limited assets
  - Real-time automatic, dynamic, container/463L pallet locating and monitoring
    - POE/POD Operations (Surface and Air)
    - Supply Support Activity Operations
    - Visibility outside instrumented logistics operations nodes

- **NGWC as a ‘Process Binding’ Technology Enabler (Future Focus)**
  - Automatically and dynamically tracks containers with conveyances
  - Automatically and dynamically provides warehouse material visibility
  - Integrates supply & distribution processes at the pallet level and above.
  - End-Item condition alert data transmission off platforms (CLOE Enabler for non-C2-enabled platforms)
  - Enables visibility of operational resources to support DoD Logistics Processes
Way Ahead

- **USTRANSCOM Focus**
  - Demonstrate near-real-time tracking and condition monitoring of DoD assets in the CENTCOM AOR (Date and location TBD)
    - Porting Device Management Center (DMC) capability behind DoD Firewall in advance of an operational test (In progress)
    - Working with USTC Staff to develop use cases for mesh design
  - NGWC Project was selected for Phase II consideration of the USTRANSCOM FY09 RDT&E Request for Proposals
  - USTRANSCOM Focused Demonstration Opportunities
    - Air/Surface Port Operations
    - JLOTS
    - CENTCOM AOR
    - Segments of the Distribution Pipeline

- **Mesh/IA Development**
  - Spiral development - guided by ‘functional requirements' and 'use cases'
  - Collaboration and Demonstration Opportunities
    - Army Materiel Command (AMC)
    - U. S. Air Force
    - U. S. Marine Corps
    - U. S. Navy Medical
    - U. S. Army Medical
    - Joint Munitions Command
Conclusion

- There is a requirement, DoD-Wide, for an enhanced level of asset visibility throughout the Distribution Enterprise.

- The key enabler to attaining this increased level of asset visibility is a communications network that will pass logistics data from any number of logistics business processes.

- Mobile Ad hoc Wireless Mesh Networking is the targeted communications technology that forms the foundation for the NGWC concept of ‘infrastructure free’ enhanced asset visibility across the distribution enterprise.

- LIA will continue to foster collaboration within, among, and across agencies and services to arrive at a single, integrated solution to enable total asset visibility “DoD Wide”.