DoD applications of LTE: Lessons Learned for Public Safety
Agenda

• DoD Tactical Wireless Programs
  – Technology Development Areas
    • Deployables
    • Mobility
    • Security
    • Training Ranges (Internet of Things)

• Requirement themes

• Applicability to Public Safety
WIN-T4-Tier Architecture and Connectivity

- Long Term

Space Layer
Reach & Reachback
- Iridium

Airborne Layer
Reach
- DSCS
- Milstar/AEHF
- WGS
- Commercial Ku
- ER/MP w. WCP
- Phoenix
- TCN
- JGN

Ground Layer
- SMART-T
- JNN
- TR-T
- PCD
- PoP/SNE
- SMART-T
- WIN-X
- NOSC
- TCN
- JGN
- STT
- MCN-B

Access Waveforms
- 802.11
- 802.16
- WNW
- SRW
- EPLRS

External Systems
- SATCOM
- Air to Ground
- Ground to Ground
- 4G Wireless
- 802.11g WiFi
- Cable Connections
- Marine Corps
- Lower Ti

WIN-T Provided

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WIN-T Platforms
- i.e. Deployable Solutions
WIN-T Inc 2
- Enables Commercial Users Devices

Today

Regional Hub Supports
FDMA and NWC

NCW or FDMA

NCW provides BLOS Communications
ATH and OTM

TR-T provides
HNR range extension

HNW provides LOS Communications
ATH and OTM

SWLAN provides wireless Connectivity to user’s laptops

LAW connects Commanders vehicles To TCN

Command CNR Net or SRW

Inc 2 already provides 4G WiMax for Secure LAW clients at BN and above

Inc 2 already provides WiFi for SecNet 54 clients at BN and above

Add WiFi access for COTS clients

Add Cellular Core Network to one or more nodes

Add 3G/4G Cellular Base Stations at CO and above for COTS Devices

Future

Regional Hub Supports
FDMA and NWC

NCW or FDMA

NCW provides BLOS Communications
ATH and OTM

TR-T provides
HNR range extension

HNW provides LOS Communications
ATH and OTM

SWLAN provides wireless Connectivity to user’s laptops

SWLAN provides LOS Communications
ATH and OTM

LAW connects Commanders vehicles To TCN

Command CNR Net or SRW

3G/4G/LTE Handheld Cellular

Command CNR Net or SRW

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WIN-T SUMMARY

- WIN-T works – Inc 1 is 100% fielded and deployed since 2005
- Inc 2 authorized for Full Rate Production in June 2015
- Inc 2 fielding since 2012
- Inc 3 serves as the key technology development engine, including Network Management

Tactical, ad-hoc, self-forming, self-healing networks behave very differently than static networks

- Inc 2 is a game changer
Fort Dix CRADA Network Integration - Real World Testing

- 802.11 Backhaul (3KM)
- Tactical Data Center
- Fort Dix
- LTE
- LTE
- LTE
- LTE
- GPS
- 802.11
- Mobile Computer
- Commanders Vehicle #2
- Commanders Vehicle #1
- GPS
- 802.11
- WiFi Hand-Helds
- ODU
- Ka SATCOM
- ODU

AFCO International
Emerging Technology Forum
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AWIN Concept: LTE + Fortress Mesh

Internet of Things Model

AWIN
Army Test and Evaluation Command (ATEC)
Wireless Test and Evaluation Network (AWIN)

LTE + Fortress
on 100’ Tower

FTREN
DREN

LITE

Overarching LTE Network for Real-Time (5-9’s) Health and Status
(Data Collector Heartbeat, Vehicle BFT, Staff C2)

15 Mile Radius

Staff C2

SDREN

DataOps

AWIN NetOps

Staff C2

High Capacity Surge Area on 30’ Tower (CP / TCN)
PTP Backhaul/Mobile Mesh

Mobile Collection Suite

3 Mile Radius

Mobile Collection Suite

Staff C2

Fiber

High Capacity Fortress PTP

Staff C2

Staff C2

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Tactical Technology Themes
Developed LTE Tactical Themes

- **LTE Components**
  - Distributed Core Network, VCN Geographic Redundancy and S1-Flex
  - Frequency Agility (400MHz – 6 GHz), interchangeable RF heads, Dual and Quad Band ENB
  - Decreased SWaP+C with every release
  - 4Rx Capability to Improve coverage and throughput
  - Enhanced Maximum Throughput
  - Developed Radio-Aware-Routing functionality for interoperability with multi-radio networks (WIN-T)

- **Mobility (Distributed, Hierarchical, Geographical Network Architecture Roaming)**
  - Self-Organizing Networks (SON)
  - MOCN Capability (multi-operator core network) (WIN-T Requirement)

- **Connectivity**
  - Support 256 UEs (WIN-T Requirement)
  - Secure QoS Capability (outside of tunnel)
  - WIN-T CSfC Interoperability Verified (MACE and WIN-T Suites)

- **Improved (simplified) Network Management GUI**
LTE Virtual Core Network (VCN)

- Designed for deployability and small fixed networks; very small and light for vehicle and manpack integration
- Supports all GD eNodeB options
  - VCN (1u COTS server, supports up to 30 eNodeBs, 2,000 users)
  - can be deployed as eNodeB only with S1 backhaul to fixed core
- Supports single or multi-site systems
- Network of networks
  - Individual systems can be connected together
  - Range further extendable via mesh Wi-Fi connection
  - Remote or local HSS
  - Just add power and internet connection
  - Available as software-only and on qualified hardware platforms
**Use Case**
- Support moderate-sized teams operating in larger area of responsibility for sustained periods (days)
- Support for planned exercises, large extended crisis scenes, wildfire base camps
- Supports and bridges a variety of modes: LTE, LMR, satellite communications

**Broadband Cell on Wheels Spec**
- 700MHz LTE (BC14) – other bands available
- 1 or 3 sector eNodeB architecture
- VCN with Evolved packet core
- VCN redundancy (Distributed Networking)
- WiFi and Mesh radio bridge extensions
- On Board switch/router and App Server
- 120’ 106’, 60’, or 30’ mast options
- IDU for IP over SATCOM
- Diesel power, light tow
- Multiple “add-on” options
  - Surveillance, SATCOM, Security, Renewable Energy, microwave
### Architecture of Deployable Solutions

- One size does not fit all

<table>
<thead>
<tr>
<th>Aerial Payloads</th>
<th>Enable LTE coverage over a wide area of responsibility, with relay/backhaul to existing FirstNet infrastructure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Command Network Nodes (Large Scale Disasters, Hurricanes, Floods)</td>
<td>Major network platform with high bandwidth SATCOM uplinks, hosting an LTE Core for large areas without FirstNet coverage. Example: major disasters calling for National Guard involvement, could include WIN-T platforms outfitted with &quot;FirstNet Kits&quot;; serving as Command Network Nodes.</td>
</tr>
<tr>
<td>Larger Teams in Planned or Sustained Areas of Operations (Planned Events, Disaster Response/Recovery, or larger Wildfire (Type 1/2) response teams)</td>
<td>Large area of responsibility and high numbers of users requiring coverage from trailers or light trucks that are capable of serving dozens or hundreds of responders.</td>
</tr>
<tr>
<td>Small Teams of Officers in Remote Location (Search and Rescue, Response to Remote 911, Small Wildfire (Type 3/4) team)</td>
<td>Small teams served by portable equipment in a transit case or mounted in light vehicles.</td>
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<tr>
<td>Single Patrol Officer in Remote Location (Remote County Police, Park Ranger, Border Agent)</td>
<td>Man-portable (backpack) nodes that offer communications and reach-back. At this level, size, weight, power and ease of use are critical to ensure the user can transport the system in remote areas. Note: these solutions may include non-LTE elements like MiFi/SATCOM (i.e.: Secure Commercial Roaming / Backhaul).</td>
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</table>
Large Deployable Variations

- Cell on Light Truck (CoLT)
- Double/Single Axle
- Rapid Deployable Mast
- Tower on Wheels (ToW)
- Aerostat
Secure QoS Architecture defined in order to facilitate provision of sophisticated QoS mechanisms without cross security domain interfaces.
Secure QoS Capabilities

- Multiple Dedicated bearers
  - Non-GBR bearers (created at call setup)
    - Up to 4 bearers
    - Configurable QCI to match service
  - GBR bearer (triggered by traffic flow)
    - Triggered by traffic flow matching filter parameters
    - ARP priority and precedence mechanism
    - Rate implied by trigger (e.g., optimized for voice codec)
    - Inactivity timer triggered tear down

Example QoS Mapping

- QoS capability maintained with all traffic in end-to-end CSFv tunnel(s)
- QoS mapping based upon DSCP tags

<table>
<thead>
<tr>
<th>Traffic Class</th>
<th>Example Traffic</th>
<th>Precedence within Traffic Class</th>
<th>Possible DSCP Value</th>
<th>Implied QCI priority</th>
<th>ARP priority</th>
<th>Pre-empt cap</th>
<th>Pre-empt vul</th>
<th>GBR rate</th>
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<tbody>
<tr>
<td>Network Control</td>
<td>Critical Network Control</td>
<td>111000</td>
<td>56</td>
<td>5</td>
<td>Y</td>
<td>Y</td>
<td>Non-GBR</td>
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<tr>
<td>High Priority</td>
<td>Flash</td>
<td>101910</td>
<td>42</td>
<td>1</td>
<td>Y</td>
<td>N</td>
<td>Voice codec rate.</td>
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<td>Combat Net Voice</td>
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Public Safety Applications And Adaptations
Experience Built on Key Public Safety and Military Programs
True Global Initiative

New York City WIN
MAGNET – Multi-Agency Govt Network

ADCOM911
Adams County, CO, U.S
LTE Equipment

Qinetiq and DSTL for UK MOD
LTE system for Deployable System Experiments

Armasuisse for Swiss Army
LTE system for Deployable System Experiments

PSCR Testing at NIST
For FirstNET
LTE Performance and Interoperability

UAE Signal Corps trial for national network
LTE for fixed and deployable infrastructure

Indian Army and Singapore Armed Forces
LTE for deployables

Qatar MOI
First LTE PSBN
Range of devices
Trialed deployables

Public Safety Canada
CIRTEC
PSCR Equiv.

Spanish Army and German Army
LTE for fixed and mobile ad-hoc networks

General Dynamics Proprietary

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Public Safety Deployable Solutions
- Vehicular Network System
• **USE CASE**
  - Customer Built CoLT (Cell on light Truck) meeting agency mission operation needs
  - Support moderate-sized teams operating in larger area of responsibility for sustained periods (days)
  - Planned exercises, large extended crisis scenes, wildfire base camps
  - Supports and bridges a variety of modes: LTE, LMR, satellite communications
  - Can be configured for incident command and mutual aid scenarios
Scenario: Next Generation Border Security

New Capabilities

- Real Time Situational Awareness Apps
- Enhanced Mission Effectiveness
- Inter-Agency Interoperability

SoNM LTE Public Safety Network

Mobile Video Surveillance

Portable Surveillance

Unattended Ground Sensors

Enhanced Mission Effectiveness
Next Generation Border Security
- Enabling Technologies

- Airborne
- UAV
- CBP Agents
- LMR – Voice
- LTE – Data/Voice
- Field Intelligence Center
- Remote Video Surveillance System
- Integrated Fixed Towers
- Mobile Video Surveillance System
- Unattended Ground Sensors
In Summary

• US DoD Tactical Networks are heavily invested in broadband and mobility
• Public Safety can learn from “early adopter” Defense programs and Development
• Military Technology will find it’s way into Public Safety Solutions
  – Deployables
  – Mobility
  – Security
  – QoS
  – Applications

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