

DoD applications of LTE: Lessons Learned for Public Safety



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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





WIN-T Platforms - i.e. Deployable Solutions



TCN & VWP OTM

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WIN-T Inc 2 -Enables Commercial Users Devices



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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

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Fort Dix CRADA Network Integration - Real World Testing



Comparing Technology Forum AWIN Concept: LTE + Fortress Mesh Internet of Things Model





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

LTE and Mesh Wireless Deployable Networks



- 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



General Dynamics Small-Cell Man Portable eNodeB and Laptop hosted VCN



General Dynamics eNodeBs Mounted on PSCR's "Cell on Wheels"



Dual Carrier 700 MHz/2.5 GHz "Cell on Wheels"

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



106 ft "Tower on Wheels"

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Architecture of Deployable Solutions

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- One size does not fit all

Aerial Payloads – Enable LTE coverage over a wide area of responsibility, with relay/backhaul to existing FirstNet infrastructure.





Large Deployable Variations



Cell on Light Truck (CoLT)



Double/Single Axle



Rapid Deployable Mast



Tower on Wheels (ToW)

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GENERAL DYNAMICS PROPRIETARY



Secure QoS Architecture



• Secure QoS architecture defined in order to facilitate provision of sophisticated QoS mechanisms without cross security domain interfaces

Secure QoS Capabilities

MME 51-c-56a HSS PDN 511 eNodeB SGW CSFC VPN server PGW CSfC Double Tunnel Default EPC bearer Security domain boundary QoS capability maintained with all traffic in Dedicated Non-GBR EPS bearer Dedicated Non-GBR EPS bearer end-to-end CSFc tunnel(s) Dedicated Non-GBR EPS bearer QoS mapping based upon DSCP tags Dedicated Non-GBR EPS bearer Example QoS Mapping Dedicated GBR EPS bearer (triggered)

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

Traffic Class	Example Traffic	Precedence within Traffic Class	Binary	Decimal	IETF Label	QCI	Implied QCI priority	ARP priority	Pre- empt cap	Pre- empt xul	GBR rate	
Network Control	Critical Network Control		111000	56		5	1	15	Y	Y	Non-GBR	
Higl Tel Cor	High Priority Telephony	Flash	101010	42		1	2	1	Y	N		
		Immediate	Note 1					2	Y	Y		
	Combat Net	High	Note 1			1	2	3	×	N		
		Medium	Note 1					4	×	N		
	voice	Low	Note 1					5	Y	N	Voice codec	
Inelastic											rate.	

Possible DSCP Value



Public Safety Applications And Adaptations

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New York City WIN

MAGNET – Multi-Agency Govt Network



ADCOM911 Adams County, CO, U.S LTE Equipment

QinetiQ

Qinetig 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



First LTE PSBN Range of devices

Trialed deployables



Indian Army and Singapore Armed Forces

LTE for deployables



Public Safetv Canada CIRTEC

PSCR Equiv.



German Army

LTE for fixed and mobile ad-hoc networks

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Public Safety Deployable Solutions - Vehicular Network System



Broadband Mobile Command Post



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ehicle Configured with a 513, 2013 Kansas City, MO

Scenario: Next Generation Border Security

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Next Generation Border Security

- Enabling Technologies





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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