U.S. ARMY SIGNAL CENTER OF EXCELLENCE

Army Cellular Capability Development Strategy

Vision for the Future of Army Mobile Computing

Accelerated Capabilities Division (ACD)
Capabilities Development Integration Directorate (CDID)
U.S. Army Signal Center of Excellence (SIGCoE)
Fort Gordon, Georgia

16 August 2011

Today the Army requires more capabilities in mobile communications and the ability to connect Soldiers to the network. This void must be filled by an affordable solution. The development of cellular technologies in support of both garrison and tactical operations is such a solution. To meet this challenge, we must invest in these modern communication abilities to bring a relatively low-cost, efficient solution. Additionally, we must expand and resource properly our education and training to support the installation and maintenance of these systems in garrison and in a tactical environment. We must also resource the use of handhelds and tablets as training support devices in our educational institutions, from Basic Training up through Leader Training and Education. To fund these initiatives, we must find trade-offs and conduct a comprehensive Cost Benefit Analysis (CBA) to determine the feasibility of this plan. This CBA must closely analyze the current, As-Is state against our cellular-based model in order to determine the most cost-effective way ahead. Finally, we must foster a cultural progression that supports expansion of these technological advancements into our workspace.

The Vision

2/69 Armor is ordered to attack OBJECTIVE LIONS to destroy enemy forces and secure critical river crossings for follow-on forces. Using smartphones with translator apps, Human Intelligence (HUMINT) teams receive information on a possible location of enemy forces and transmit it encrypted to the battalion Command Post (CP) over the mobile cellular network. The S2 confirms the report with Joint Surveillance Target Attack Radar System (JSTARS) feeds and then sends screen captures to the Battalion Commander, LTC Townsend. Routed through his Warfighter Information Network-Tactical (WIN-T) Soldier Network Extension (SNE) equipment to a mobile cellular node while en route to the objective, LTC Townsend receives imagery of the JSTARS feed on his cellular handheld showing a potential enemy assembly area. Using his smartphone, Townsend sends a secure chat message requesting Unmanned Aircraft Systems (UAS) imagery of the location for confirmation. A Brigade Combat Team (BCT) Shadow UAS provides near real-time full motion video to the commander's handheld device. He then conducts a net call with his subordinate leaders using his smartphone, informing them of the enemy's disposition, conduct real-time collaboration with white-board capability, issue a Fragmentary Order (FRAGO), and conduct hasty back briefs for the attack. With the capability to see live video, the unit is able to identify the best avenue of approach and destroy the enemy formation with no friendly losses. Searching captured enemy combatants, the unit quickly sends biometrics and pictures of captured documents back to the G2 for analysis.

From the tactical edge of this futuristic battlefield, Soldiers will connect from their handheld smartphones with the command post through the use of cellular equipped UAS; vehicle mounted cellular node; the commander's WIN-T Point of Presence (PoP); or, if in range of a CP, through the cellular node that is integrated with WIN-T. These Soldiers will have unprecedented access to applications, voice, video and data services anywhere on the battlefield. Our leaders will be much better armed for success when, at their fingertips, they have ready access to doctrine, Tactics, Techniques, and Procedures (TTPs), unit Standing Operating Procedures (SOPs), training simulators, automated tools to support their mission, detailed data on every Soldier and the equipment they are assigned, Mission Essential Task List (METL) tasks, hand receipts, study guides, and data warehouses across the Army. Whether a Soldier is a logistician tracking critical repair parts, a medic calling for Medical Evacuation (MEDEVAC), a lawyer conducting case analysis, a helicopter repairman logging maintenance reports, a Signal Noncommissioned Officer (NCO) managing spectrum, a Company Intelligence Support Team (COIST) Analyst conducting sensitive site exploitation, or a Infantryman viewing UAS feed of an objective, Army cellular capabilities will support all phases of full spectrum military operations. ***The ultimate goal for Army cellular is to support a Soldier as he first enters service by issuing him a phone, email address, and telephone number that remains assigned to him throughout his military career.*** This system would be operational in both garrison and tactical environments. If the smartphone device is lost or captured, the system will immediately detect the anomaly and disable any use of the device by unauthorized personnel. Further, the system will continue to track the location of the lost device through its embedded Position Location Information (PLI)-enabled capabilities, allowing the command to actively retrieve the device.

1. **Background**

a. Army Operational Needs Statements (ONS) and Quick Reaction Capabilities (QRC), as directed by the ISR Task Force, Department of the Army and TRADOC have identified the need for adaptation of commercial cellular and wireless technologies to fulfill existing gaps and requirements. Demonstrations and experimentation by the Intel community and the Army Experimentation Task Force (AETF) at Fort Bliss have shown how quickly Soldiers can adapt to this new technology as well as demonstrating the value added in the areas of Intel gathering, situational awareness, mission command, and communications[1]. Smartphones that support Situational Awareness/Command and Control (SA/C2)-focused applications will be able to provide Soldiers with superior tactical and operational advantages on the battlefield. These Commercial, Off The Shelf (COTS)-based devices and corresponding cellular networks will also support multiple missions, such as Forward Operating Base (FOB) perimeter and border security, ISR and wireless video surveillance, Reconnaissance, Surveillance, and Target Acquisition (RSTA), Force Protection, Logistics, disaster recovery and continuity of operations.

b. The advanced capabilities available through cellular technologies are substantial: untethering leaders from CPs, enhancing mobile communications capabilities, connecting Soldiers to the network with access to mission critical data, and providing a seamless network capability that is achievable through the implementation of an Army cellular network. Furthermore, we believe the necessary equipment and sustainment could be acquired through cost avoidance strategies. Currently, the Army G-3 LandWarNet (LWN) Division is working to generate solutions for the Command, Control, Communications, Computers, Combat Systems, Intelligence, Surveillance, and Reconnaissance (C5ISR) Operational Needs Statement (ONS)[2]. Army G2 is bringing Relevant ISR to The Edge (RITE)[3]. Throughout the Army, efforts are being made to develop a cellular solution to solve operational requirements[4].

---

[1] Michael A. Vane, "Leveraging Technology to Maximize Soldier Training and Performance," 1 April 2011, 9 April 2011 <http://www.army.mil/-news/2011/04/01/54252-leveraging-technology-to-maximize-soldier-training-and-performance/index.html>.

[2] U.S. Army, "2011 Posture Statement – C5ISR Operational Needs Statement," 2011, Washington, D.C., 9 April 2011 <https://secureweb2.hqda.pentagon.mil/VDAS_ArmyPostureStatement/2011/information_papers/PostedDocument.asp?id=259>.

[3] Michael A. Vane, Robert M. Toguchi, "Achieving Excellence in Small-Unit Performance," *Military Review*, May-June 2010, 9 April 2011 <http://usacac.army.mil/CAC2/MilitaryReview/Archives/English/MilitaryReview_20100630_art011.pdf>.

[4] The Defense Advanced Research Projects Agency (DARPA) is taking commercial smartphone capabilities into Operation Enduring Freedom (OEF) this year. XVIII ABN Corps is asking to experiment with smartphones in theater. 1CAV is asking to take a network solution into OEF. 5th Signal Command has deployed a cellular network on Bagram as a means of extending unclassified Defense Switched Network (DSN) services. The Signal Center of Excellence (SIGCoE) has deployed a proof of concept network at Fort Bliss that brings spectrum agility and affordability. They have also stood up a small cell whose focus is app development and training. Joint Battle

c. To meet these challenges, industry Research and Development (R&D) investments offer greater capabilities at lower cost. Cellular technologies can then reduce infrastructure cost and more effectively deliver training at our Posts, Camps, and Stations. These technologies will fill critical gaps in the tactical communications capabilities we currently provide our war fighting formations. However, the Army needs to develop a single developmental line of operation strategy.

d. This vision for cellular capabilities is not without issues. Vulnerabilities exist that continue to challenge security managers. To combat these vulnerabilities, various Department of Defense Directives specify the need to have consistent, defense-in-depth approach to Information Assurance (IA) for any type of network[5]. It is outside the scope and classification of this document to discuss specific vulnerabilities and attack vectors that must be overcome; however, we must continue to work with the National Security Agency (NSA) and DARPA to ensure proper and full implementation of Suite B-type encryption as well as other advanced cyber-defense technologies in all aspects of our future cellular-enhanced network.

e. This paper contains the storyline, objectives, and metrics for the implementation of Army cellular and mobile computing capabilities. We will discuss the wireless services' requirements and goals at Posts, Camps, and Stations as well as those needed in a tactical environment. The goals are impressive – a paperless society where desktop computers are rarely used. Soldiers will be issued a handheld device upon entry into the Army with a telephone number and email address that follows them throughout their career. The handheld device would also support the educational tenets found in the Army Learning Concept (ALC) 2015: lifelong learning; direct learner engagement; adaptive Soldiers and Leaders; relevant and rigorous training and education; and, networked technology[6].

Command – Platform (JBC-P) is currently building a handheld capability. Special Operations Command (SOCOM) has had similar initiatives, and Soldiers in the field are beginning to write tactical apps, like the captain in Afghanistan who built an app to aid navigation, calls for fires and calls for MEDEVAC.

[5] DOD Directive 8100.2, "Use of Commercial Wireless Devices, Services, and Technologies in the Department of Defense (DoD) Global Information Grid (GIG)," DOD Directive 8500.1, "Information Assurance (IA)," and DOD Instruction 8500.2, "Information Assurance Implementation" are somewhat dated documents; however, they do provide a good foundation to begin discussions on wireless vulnerabilities and required IA/cyber countermeasures and protective postures.

[6] U.S. Army TRADOC, *The U.S. Army Learning Concept 2015,* 2010, 9 April 2011, <http://www-tradoc.army.mil/tpubs/pams/tp525-8-2.pdf>.

2. **Purpose**

a. Today, there are several cellular developments affecting the Central Command (CENTCOM) Area of Responsibility (AOR).[7] There are also numerous Programs of Record (POR) and non-POR handheld solutions in development[8]. The Army lacks a unified strategy to develop commercial wireless capabilities and lags behind commercial network capabilities. Through vehicles like the C5ISR ONS, the Warfighter has already identified the need for such a capability[9]; and in many cases, units are developing solutions outside the normal process. We must meet this challenge and develop a robust cellular strategy to address the needs of the Warfighter.

b. In the past three years, hundreds of thousands of smartphone applications (apps) have been developed in the commercial market. AETF's sampling of apps clearly showed that Soldiers already possess the ability to quickly grasp the concept and put apps to practical use in tactical operations. The apps tested were mainly in support of maneuver operations; however, other fields--such as medical and logistics--have identified areas where Army apps would improve mission execution. Apps will provide instant access to a wide range of training material and help create an agile, adaptive Soldier able to access, manage, integrate, evaluate and create information. Always-connected Soldiers will become part of a community of experts, allowing them to better master the technological survival skills that will be required of future Soldiers. Specialized apps will increase digital competence, usage, and transformation. Additionally, the SIGCoE will work to develop reusable, certified frameworks that other app developers can insert into their code, providing reliable and durable functionality. With volumes of reusable, approved code available, Army app developers will be able to create applications that can be more quickly certified.

c. Therefore, the Army must move to an integrated strategy in order to:

(1) Ensure an effective, cost saving expenditure of resources, while eliminating redundancies and developing a solution that meets Warfighter needs.

(2) Develop dynamic, secure smartphone software applications (apps) to provide ease of use and enhancements to Soldier use of handhelds or tablets.

(3) Connect the mobile and dismounted Soldier to the network through an integrated solution.

---

[7] RITE 3G, MANTECH, MONAX, UltraWave, and a product from the National Geospatial-Intelligence Agency.

[8] JBC-P, NetWarrior, Medical Command (MEDCOM), Fire Center, RITE 3G, Joint Tactical Radio System (JTRS), WIN-T, and Connecting Soldiers to Digital Applications (CSDA).

[9] U.S. Army, "2011 Posture Statement – C5ISR Operational Needs Statement," 2011, Washington, D.C., 9 April 2011 <https://secureweb2.hqda.pentagon.mil/VDAS_ArmyPostureStatement/2011/information_papers/PostedDocument.asp?id=259>.

(4) Develop cellular technologies that can deliver high throughput at a low cost in a scalable, easy to deploy, easy to operate network architecture.

(5) Exploit emerging cellular/broadband technologies and leverage commercial communications infrastructure for units both in garrison and while operationally deployed.

(6) Initiate phased insertion of commercial wireless technologies, interoperable with tactical networks, and complementary to programs of record, with legs to future (WIN-T, JBC-P, Nett Warrior, and JTRS).

(7) Implement an Army unified communications strategy, designed to enhance garrison/mobile networks through efficiencies in delivery and routing of voice, video, data through network convergence.

3. **Cellular-Capable Operations**

a. The speed that information travels throughout an operational environment requires the Solider to access networked data sources and capabilities that far exceed legacy voice-capable radios. The more mission-related information a Soldier possesses, the better he will perform. Available cellular technologies will provide Soldiers access through the network to information databases. Future apps can be created to support mobile command and control, biometrics collection, sensitive site exploitation, call for fire, MEDEVAC, spectrum management, network management, logistics tracking, and sensor automated reporting. Handhelds can be acquired at a fraction of the cost of legacy and future programmed radios. Our enemies today use cellular capabilities for everything from C2 to detonating roadside Improvised Explosive Devices (IEDs)[10]. Lessons learned from Iraq and Afghanistan and documents like the C5ISR ONS accentuate the need to connect the individual Soldier to network resources at the extreme tactical edge. The implementation of an Army tactical cellular development strategy will connect the Soldier to critical data sources while either mobile or dismounted, achieve cost-avoidance in limiting the need to upgrade legacy radios, identify potential cost savings by reducing the acquisition of currently planned radios, take advantage of industry R&D dollars already spent in developing added capability, and fill critical gaps in current mobile communications capabilities.

b. Through further analysis we must identify where legacy radios are being used that could be replaced by cellular devices to provide equal or even better capabilities than what Soldiers have today. As an example, JTRS is not planned to be fielded to every echelon and we are already seeing an increased need for un-tethered situational awareness and more advanced communications than "push-to-talk" communications. Smartphones and similar devices will fill this existing and emerging gap. Additionally, Army tactical cellular network capabilities will also fill network transport requirements for a number of acquisition program requirements and other emerging program requirements. As examples, the JBC-P and NetWarrior programs are developing handhelds without a clear path to what transport capability will be provided. With sufficient area coverage, cellular would be a relatively low-cost, small form-factor solution.

c. There is significant debate across the Army as to what capabilities an Army tactical cellular network should possess. Ultimately it comes down to area coverage, throughput, and affordability. A cellular network cannot simply be an additional network. It must provide savings by replacing redundant capabilities, fill gaps in mobile communications capabilities while connecting the Soldier to the network. See Appendix A for more information.

d. Any system built today must show efficient use of the electro-magnetic spectrum. We will work with the National Telecommunications and Information Administration (NTIA), as required, to allow use of spectrum for these new capabilities according to U.S. government guidelines and regulations[11]. Further, we will work with NTIA to support their ongoing efforts to

---

[10] U.S. Army, *FM 3-21.8 – The Infantry Rifle Platoon and Squad,* March 2007, 9 April 2011, <https://rdl.train.army.mil/soldierPortal/atia/adlsc/view/public/23583-1/FM/3-21.8/appi.htm>.

[11] NTIA, "Spectrum Primer: Who Regulates Spectrum," 30 April 2011, <http://www.ntia.doc.gov/osmhome/roosa4.html>.

ensure advanced technologies are properly used and that "performs cutting-edge telecommunications research and engineering, including resolving technical telecommunications issues for the federal government and private sector."[12] Dynamic Spectrum Access (DSA) and cognitive capabilities must be considered in the development of Army cellular capabilities[13]. With the number of fixed and mobile cellular nodes seen operating within a BCT's operational environment, the required frequency deconfliction for traditional, fixed-frequency, commercial systems will be a monumental task for our BCT spectrum managers. After all, deployable commercial systems are based on technologies built for fixed, non-mobile tower systems employed by commercial service providers. Army mobile cell nodes must be cognitive; that is, these nodes must be capable of sensing its surrounding spectrum environment in order to determine what is transmitting on which frequencies. Through the use of DSA, the nodes must then be able to determine what frequencies are available for transmission. This process needs to be completely automatic, without operator involvement. The technology to do so must be resident in both the handheld and the mobile cellular nodes. In garrison, any Army cellular solution requires spectrum flexibility in order to access COTS smartphones while operating with frequencies not used by the commercial service providers. These providers pay billions of dollars to lease spectrum to support their network requirements. This commercial spectrum is in such great demand that a threat exists whereby traditional military spectrum could be leased to the commercial market. This threat could mean that military posts, camps, and stations would not have free access to commercial spectrum.

e. Smartphones are ubiquitous[14]. Our Soldiers have grown up with this technology and can readily implement it in a garrison environment to improve training and execute daily administrative requirements. We believe a complete cost benefit analysis will show the Army can provide this capability more effectively and efficiently than leasing the service from commercial providers. By providing Army cellular network and services in the garrison, we project that significant savings could be found through a phased replacement of current radio communications, reduction in fixed infrastructure, and cost avoidance in providing cellular capabilities to the individual Soldier.

f. Soldiers today require mobile connectivity to data resources to accomplish their daily mission. Everything from training and maintenance to tracking medical appointments and accessing individual Soldier records can be accomplished through a smartphone. CSDA pilot

---

[12] NTIA, "Spectrum Primer: National Telecommunications and Information Administration," 30 April 2011, <http://www.ntia.doc.gov/osmhome/roosa8.html>.

[13] Carlos M. Gutierrez, *Federal Strategic Spectrum Plan,* March 2008, 30 April 2011, <http://www.ntia.doc.gov/reports/2008/FederalStrategicSpectrumPlan2008.pdf>.

[14] Research in Motion (RIM) released the first BlackBerry in 2002. By 2005, many commanders and primary staff officers in the Army had a government provided BlackBerry. By 2009, BlackBerry subscribers exceeded 32 million. By January 2010, over 42 percent of US consumers reported owning a smartphone. Smartphones are used today for everything from messaging, on-line banking, and entertainment to video conferencing, market research, and locating the nearest restaurant.

programs have greatly helped identify the need and have successfully demonstrated where the use of smartphone technologies have improved education and training by increasing ‘hands on’ training time, reduced maintenance costs, improved test scores, and helped manage more productive use of Soldiers’ time.

g. Finally, the cost to scale the capability across the Army must be affordable. Through numerous market surveys, we have found deployable cellular nodes ranging from $14K for small, very limited capability up to $450K for greater capacity and throughput. The technology to meet Army requirements is available in the lower half of this range. Systems being viewed for niche requirements in support of OEF cost $10 million per battalion and are not affordable when scaled across the entire Army. Considering technologies available now and in the near-future, individual cellular nodes should not exceed $75K. Additionally, no need exists for a fully ruggedized handheld solution. Commercial phone cases provide adequate protection for the average user. By minimizing costs, a damaged handheld could simply be replaced as Class IX, expendable. To ensure the technology we employ remains relevant, units should be funded with a lifecycle budget for cell phones but not restricted by today’s slow and lengthy acquisition process.

4. Recommended Strategy for Cellular Development to Support Operations

We recommend the following way ahead/fielding strategy for Army cellular capabilities:

a. Conduct a comprehensive Cost Benefit Analysis (CBA) to determine the potential value of developing an Army garrison cellular or wireless network. The screening criteria and cellular tenets are described in Appendix B. Appendix C outlines the potential for cost savings expected from a CBA.

b. Identify a single Program Executive Office (PEO) and Project Manager (PM) to unify materiel acquisition efforts and develop an Army tactical cellular solution. However, in the area of app development and management, we do not yet recommend identification of a single PEO/PM team to unify materiel efforts here.

c. Install a proof of concept cellular network at Fort Bliss in coordination with Network Enterprise Technology Command (NETCOM). We recommend Fort Bliss not only because of its Brigade Modernization Command (BMC) mission but also to support the thousands of data collectors who evaluate Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) solutions in support of BMC exercises. It would provide services for the commands and Soldiers in support of their daily administrative and training mission, both on the main installation and the areas used for training. Current commercial systems are inadequate in providing coverage throughout these areas. Also, such an Army cellular network will provide both a data exchange network and a safety/tracking network for data collectors.

d. Field deployable cellular capabilities to the BMC at Fort Bliss, TX in a phased approach over a three year period, beginning in FY2012. One large node is envisioned for the brigade Tactical Operations Center (TOC) or FOB ($75K) with seven smaller nodes for the brigade Tactical (TAC) CP and six battalions ($60K each) for a total cost of approximately $435K. An additional $200K will be required for the purchase of approximately 500 smartphones with $100K for sustainment . Total Rough Order of Magnitude (ROM) is $735K. Additionally, field one company of the 86th ESB, Fort Bliss. This unit will be reorganized in accordance with the Signal FAA and provide WIN-T capabilities to company-level of the AETF. One company can support 24 CPs. Recommend fielding 24 cellular nodes to the 86th for a cost of $1.44 million. This will better inform the Program Objective Memorandum (POM) process as to what density should be provided in the future. Additionally, this fielding will inform the Army on where cellular capabilities can replace other radios such as Single Channel Ground and Airborne Radio System (SINCGARS) and prevent required radio upgrades.

e. Field six nodes to UASs at a total ROM of $250K in FY2013. Also, field one Corps (2 nodes), one Div (3 nodes), and five BCTs (45 nodes) IAW Capability Set Fielding 13/14 at a ROM of $3M. Finally, determine what number of SINCGARS can be retired early and better determine which other planned radio purchases can be reduced or eliminated.

f. Field additional nodes and smartphones as required through FY2014: the need for 25 cellular nodes is estimated to provide adequate coverage to Fort Bliss and the White Sands

training areas. ROM cost would be $1.9M for 25 cellular nodes (onetime cost), $500K for network operations and maintenance (annual cost) for a total of $2.4M. Recommend this proof of concept be phased as follows:

(1) In FY2012, install 9 cellular nodes to cover the Fort Bliss and White Sands training areas for the BMC. With estimated operations and maintenance cost, ROM is $900K.

(2) In FY2013, install 8 cellular nodes to cover the BMC garrison area and northeast Fort Bliss. With estimated operations and maintenance cost, ROM is $750K.

(3) In FY2014, expand the network to remaining garrison areas. With estimated operations and maintenance cost, ROM is $750K.

(4) Additional cost for smartphones for Soldiers' use are approx $300 per phone or $30K per 100.

5. **Conclusion**

Current operations clearly show a need for improved mobile communications capabilities connecting the individual Soldier, operating at the tactical edge, to the network in order to access critical voice, video, and data network resources. COTS wireless and cellular technologies have matured to the point that tactical employment is now both feasible and affordable. Army investment in cellular technologies will give commanders scalable options for employing their network capabilities in the generating force at posts, camps, and stations, as well as the operating force, in support of all phases of Joint operations. The development of this capability will fill current capability gaps while technologies continue to be developed for Army programs such as JTRS. Further, this will fill gaps in Army units that are not scheduled to receive JTRS but require a similar capability at a relatively lower cost. Additionally, we will realize near-term cost-avoidance by upgrading fewer legacy radios. Army cellular capabilities will reduce training, administrative functions, and facilitate tactical operations by connecting Soldiers to the network with a technology that they are fully familiar. Further integration with combat net radios and WIN-T will maximize Warfighter communications capabilities in support of full spectrum operations. This capability will not only thicken the tactical network but also extend the network to lower echelons, both mounted and dismounted. The ability for Army Posts, Camps, and Stations to take advantage of cellular technologies will support soldier training requirements and provide extended network services and coverage.

Significant work has been done, through the CSDA and other projects, determining the value COTS cellular networks and handheld devices would bring in support of military operations and in further developing these capabilities. It is now time to unify these efforts in the implementation of a unified Army cellular development strategy. By executing this strategy we will provide an affordable, critical network resource from garrison motor pools to the tactical edge, enabling our Soldiers to better accomplish their missions.

Appendix A

Critical Tactical Cellular Capabilities Required

a. Area coverage: Area coverage is a matter of line of site and density where mobile cellular nodes will be an important capability in extending cellular to the tactical edge. Experimentation and information available through industry shows the average line of site coverage in open terrain for cellular networks is three to five miles.

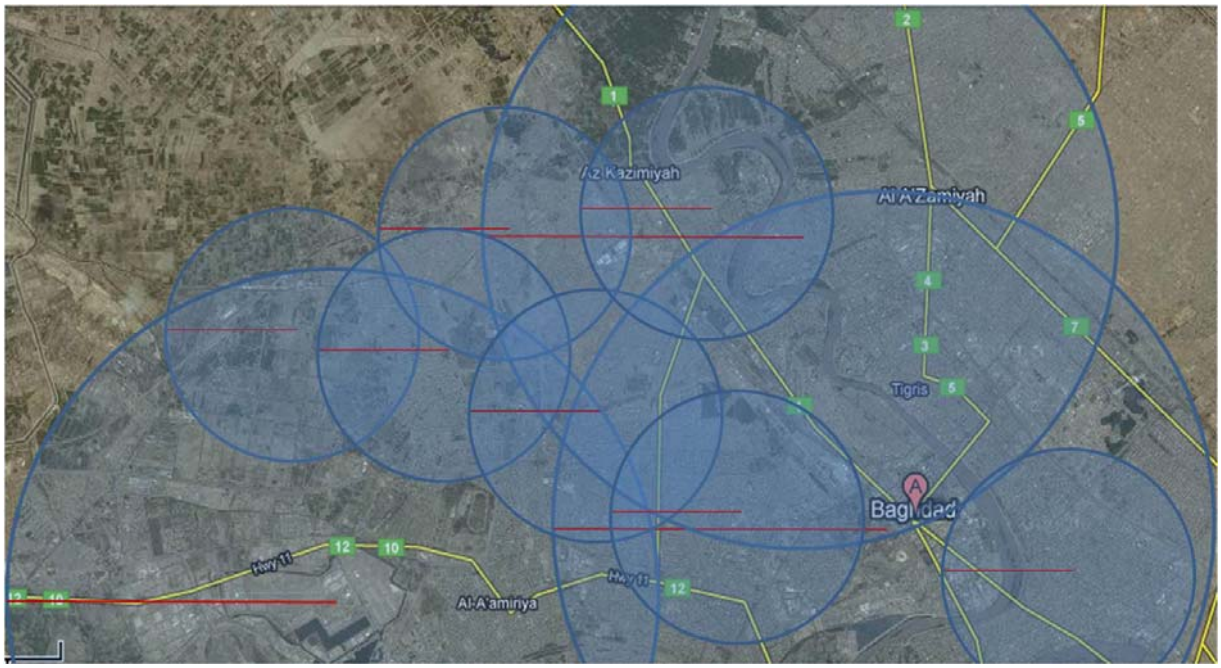

Figure 1 – Potential Cellular Coverage

Figure 1 is based on a deployment of two Division cellular nodes, two BCT nodes, and six battalion nodes deployed in an urban environment with the blue circles depicting probable ranges of cellular transmission. Although ranges of 3-5 miles on a 100 foot antenna and 7-10 miles from an Aerostat have been demonstrated, this diagram uses 2 miles and 5 miles as planning ranges in an urban area. When planning cellular network topologies, the overlapping coverage of two or more cell nodes prevents shadowing effects; dead spaced caused by buildings or terrain in between the user and transmitting cellular antenna/tower. To gain the maximum coverage of a BCT's operational environment, cellular nodes must be fielded organic to BCT and battalion CPs. This will enable the operation of cellular nodes by trained Signal Soldiers in conjunction with the operation of WIN-T nodes and will enable the use of WIN-T as backhaul for interconnecting cellular nodes. Given the assumption that not every company or platoon requires their own cellular node and to gain the greatest efficiencies, cellular capabilities will be pooled IAW the Signal Functional Area Assessment (FAA)-recommended Expeditionary Signal Battalion (ESB) redesign. ESBs will be tasked to provide cellular nodes to command posts without organic WIN-T and can go down to the company or platoon level, as required. This will ensure sufficient Signal trained Soldiers are available to operate the nodes and Install, Operate, and Maintain (IO&M) these tactical cellular nodes at the right place and time across

the area of operations. As depicted in Figure 1, with the deployment of cell nodes down to battalion-level CPs, the network does not cover every inch of ground of a BCTs operational environment. Because of the limited density of cellular nodes or availability of site security, sufficient overlapping coverage to prevent the effects of shadowing will not always be achievable with organic assets. The same issue exists with FM radio Retransmission Stations (RETRANS) and any other form of line of site radio depending on the radio. The use of commercial infrastructure may fill some gaps but there will be areas of dead space. ESB provided mobile nodes at the company CP along with low-cost, vehicular mounted, mobile cellular nodes integrated with the mobile capabilities of WIN-T Increment 2 will reduce gaps and provide on the move capabilities to the Warfighter. Cellular nodes installed in an aerial layer will reduce coverage gaps and extend the network to the tactical edge. Small cellular nodes that meet Shared Wireless Access Protocol (SWAP) requirements must be installed on UASs to either provide a persistent capability with the use of long-loiter systems like today's Battlefield Airborne Communication Node (BACN) or a surge capability through the use of Shadow or other platforms.

b. Throughput: The amount of bandwidth available to the end-user device will determine the success of the network. The average application developed for military use will be a low bandwidth consuming program with small packets of information being exchanged. However, the need for dismounted Soldiers to receive large-file downloads and potentially streaming video feeds must be considered. We must be able to share bandwidth. This means a system that advertises a node provides 14.4 Mbps down and 7 Mbps up, shares that capacity with all users on the node. If there are ten users, each could expect to receive about 1.4 Mbps. If there are 40 users, each would expect to receive 360 kilobits per second. The minimum data throughput to the handheld must be between one and two megabits per second to ensure an adequate quality of service is provided.

c. Affordability: The development of Army cellular capabilities cannot cost the Army any additional manpower. Simple user interfaces and management tools enable ease of use in installing and managing cellular nodes. Industry has demonstrated cellular nodes that only have an on/off switch and are remotely managed so as to significantly reduce manpower and training requirements for the majority of the intended operators.

Appendix B

Screening Criteria for a Cellular Development CBA

In FY2011, we must conduct a full CBA to proper analyze the various courses of action (COAs) for Army cellular development. Prior to analyzing the various COAs under any CBA, we must first use the following screening criteria to determine the best solution set within the proposed cellular capabilities model:

a. ***Must be affordable*** – Current fiscal constraints and the probability of future constrained budgets has determined affordability as the number one criteria in any system development. When scaled to an Army-wide solution, individual cellular nodes that cost $300K - $400K or solutions that cost $10 million per battalion are unaffordable. Leasing services from commercial carriers is also an unaffordable option. We must halt the experimenting with $300K nodes and move forward with a cost efficient solution that is $75K or less per node.

b. ***Must provide spectrum agility to the handheld*** – When the host nation or commercial interests will not allow access to traditional cellular frequency spectrum or the spectrum is degraded due to electronic counter measures, the Army system must be able to operate in other than commercial frequency bands. It is counterproductive for the Army to build a network system and then have Army units arrive in a theater of operation and be told that the new network system can't be turned on. Unfortunately, this is not an unrealistic scenario. Additionally, with the extraordinary growth of emitters on today's battlefield, the Army can no longer afford to build systems that rely on fixed, dedicated frequencies. Using technologies available today, the Army can achieve spectrum agility through the development of network systems that expand the frequency capability through dynamic spectrum access/cognitive radio capability.

c. ***Must leverage commercial infrastructure when available and when the commander deems the level of risk is acceptable*** – The Army has been using cell phones on the battlefield for ten years. An individual sitting at a cellular network management terminal can easily gather PLI data, deny service, or conduct other disruptive operations. The commander on the ground must determine when the requirement for Soldiers to access the network through commercial infrastructure outweighs any residual risk. An Army solution must not only consider handsets accessing commercial infrastructure but we must also have the ability to interface it with our military network nodes in order to efficiently take advantage of available commercial network transport. When commercial infrastructure is not available, we must be prepared to fill the network gaps with Army systems.

d. ***Must provide various levels of security*** – An Army cellular capability must be accredited to transmit most categories of data; but in the near term, this capability should focus on two categories: unclassified and secret and below. Further, we must not classify it as Type 1 security; but, we should execute NSA Suite B – software encrypted solutions. With the advances in computing power of smartphones, NSA's drive for a secure handheld solution, and the emphasis within industry to get a certified solution, a handheld solution that is capable of processing secret and below data is fully achievable in the near future. In order to move

forward, the Army should build towards an unclassified standard today and ensure it easily integrates Suite B solutions when they become available. Using standardized source code revolving around the Advanced Encryption Standard (AES)-256 bit standard would provide suitable software-based security for mobile capabilities.

e. ***Must be interoperable with Army networks*** – Ultimately any Army cellular system must use the Army's common network as its means for backhaul transport. It is inefficient and unaffordable to design systems that require stand alone networks to transfer data throughout the theater. Mobile and fixed cellular nodes will use WIN-T as the means to interconnect between dispersed locations.

f. ***Must be integrated with the Army's unified Network Operations (NetOps) tools*** – Part of the vision of Increment 3 of WIN-T is to develop a single integrated set of NetOps tools to manage the Army's networks[15]. The development of an Army cellular network and its management must evolve to a suite of unified NetOps tools to ensure Army networks are operated and managed effectively and efficiently.

[15] Greg Wagner, "Army Ready with Next Generation of Network Operations," *Army Communicator,* Summer 2008, 9 April 2011, <http://www.signal.army.mil/ocos/ac/Edition,%20Summer/Summer%2008.pdf>.

Appendix C

Potential for cost savings

There are a number of areas that will require further study for potential Army cost savings in both garrison and tactical application of an Army cellular solution. These areas are briefly discussed below:

a. Partial replacement of SINCGARS. Required Communications Security (COMSEC) upgrades are required for all SINCGARS radios in the near future. The ROM cost for this upgrade is $10K per radio. SINCGARS radios that support a majority of our combat support and combat service support units and SINCGARS supporting FOB operations could be replaced by a cellular handheld capability. With 450K SINCGARS radios in the Army inventory, if we replace 25 percent with cellular handhelds, this would be a cost avoidance savings of roughly $1.13 billion.

b. Replacement of Land Mobile Radios (LMR) and preventing the installation of fixed infrastructure on deployed FOBs will save millions of dollars a year in contingency funds.

c. Significant Army resources are expended on establishing company to Corps-level, tactical command posts. Besides the manpower required for the installation, the Army has invested nearly $300 million in cable, wire, switches, and phones. This fixed infrastructure also ties commanders and Soldiers to the CP facilities; that is, when they aren't in the CP they are disconnected from the network. With a 10 percent reduction in fixed infrastructure, there would be a savings of $30 million in replacement cost over the next 3-5 years.

d. Although the design and cost for communications support at the company command post-level is not complete, the implementation of an Army cellular capability would significantly reduce the equipment, training, and cost necessary.

e. The average CONUS cost for voice and text only cell phone is $500 per year and $1,200 per year for BlackBerry service. The cost for a voice/text cell phone in Iraq averaged about $900 a year. Millions of dollars could be converted from commercially leased services to offset the cost of developing Army cellular capabilities.

f. A detailed, garrison cost benefit analysis must be done to identify solid cost savings in implementing a cellular solution. It is anticipated cost efficiencies will be identified through the reduction in infrastructure by replacing or preventing future installations of the majority of desk phones and Local Area Network (LAN) wiring while providing a capability to our Soldiers that isn't currently available. Additional savings will be recognized in the replacement of trunking radio and emergency response systems applied across the Army at our posts, camps, and stations.