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Directorate of Logistics and Engineering (J4)
White Paper

Leveraging Internet of Things (IoT) Technology to Improve Theater Posture and Sustainment: *Smarthub*

“This increasingly complex security environment is defined by rapid technological change, challenges from adversaries in every operating domain”

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Forward

This paper presents an innovative concept for United States Central Command to exponentially improve Base Operating Support (BOS), Operations & Maintenance (O&M) costs, capacity, capabilities and management at overseas enduring locations through the establishment of an experimental *SmartHub* – a multi-functional distribution hub that leverages Internet of Things (IoT) technologies and integrates innovation initiatives from across the Department of Defense (DoD). It further provides a transformational approach to partnering with designated host nations at joint and/or combined operating locations.

USCENTCOM is at an inflection point relative to how we set the Theater Posture. The realities of trans-regional, multi-domain, 21st Century warfare and increasingly constrained resources are driving DoD to change how we establish and run enduring locations. The Combatant Commands (CCMDs) must overcome these challenges to successfully meet assigned mission sets and simultaneously support SECDEF priorities, Globally Integrated Operations, and sustain distributed operations.

A confluence of four dynamics compel the CCMDs and Service partners to change the way we operate, manage, and resource enduring locations.

- **Boxer's Stance:** The 2018 National Defense Strategy (NDS) and the 2018 National Military Strategy (NMS) initiated a global reallocation of resources aligned to mission priorities. The NDS directs investment prioritization for distributed logistics and maintenance; innovative operational concepts to anticipate the implications of new technologies on the battlefield; and rigorously define the problems anticipated in future conflict. Accordingly, achieving the "Boxer's Stance" articulated in the NMS requires a change to how we approach enduring posture.
- **Base Operations:** SECDEF directed the Services to apply institutional installation knowledge to overseas enduring bases to assess current methodologies, identify best practices and develop recommendations for efficient installation operations. In 2017, the Deputy SECDEF directed the Services to manage CCMD enduring locations in the same manner as other worldwide enduring locations and to transition base development investment from Overseas Contingency Operations (OCO) to Service base budgets beginning in FY20.
- **Posture Resourcing:** The transition of funding enduring requirements associated with forward presence that supports contingency response from OCO to Service base budgets requires a more sustainable, resilient approach. CCMD enduring posture requirements must be aligned with the Service POM cycles.
- **Economy of Force:** DoD designation of *Economy of Force* theaters relative to NDS priorities, and commensurate significant reductions in MILCON and Operational Support funding, as well as directed capacity reductions for ongoing

contingency operations starting in FY20, requires a more sustained approach to optimize constrained resources.

NDS priorities demand that CCMDs be more effective and efficient; posturing to support assigned missions, future contingencies and emerging Dynamic Force Employment (DFE) responsibilities. Difficult choices must be made on where to position capabilities that require the Services to invest in infrastructure to ensure operational and sustainment resiliency in a network-contested environment. Integration of partners' requirements, capabilities and resource contributions to meet common interests must be leveraged. And, we must maintain the ability to rapidly reintroduce forces into the theater, aggregate, bed down, sustain, and potentially employ them to address future contingencies.

Across the nation, a network of cities share emerging technologies and best practices, and leverage the IoT to address a wide spectrum of challenges, improve effectiveness of support, conserve resources and drive down operating costs. These cities leverage commonly available technology and access ecosystem innovation to improve support for citizens. This network, Smart Cities, proactively addresses many similar challenges that the Department faces with respect to enduring locations.

In light of the dynamics impacting future posture, USCENTCOM will pursue the establishment of a *SmartHub*; a joint, multi-functional sustainment and logistics distribution hub to leverage IoT and Smart Cities' best practices. This proposed pilot will evaluate the benefits of a portfolio of IoT solutions, and provide a test bed for emerging technologies and innovation in an overseas environment; and integration with host nation partners. Lessons learned from this pilot will inform future investment decisions, strengthen partner nation capabilities and shape policy guidance to improve enterprise-wide agility for other enduring locations across the Department.

SmartHub is envisioned as a pathway to achieve four primary objectives:

- Provide a transformational platform for the integration and operationalization of DoD innovation initiatives to improve our enduring bases and export best practices across DoD;
- Leverage IoT and Smart Cities technologies with defense applications to exponentially improve base management and operations;
- Inform the development of new Terms of Reference, authorities and funding approaches that sustain Base Operating Support;
- Partner on a combined venture with a lead Service and a host nation to mutually achieve better posture.



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Introduction

The 2018 National Military Strategy (NMS) is directly aligned with the 2018 National Defense Strategy (NDS) and focuses on great power competition. The central theme of the 2018 NMS prescribes the need for the joint force to assume a metaphorical boxer's stance – with the strength, agility, endurance, resilience, flexibility and awareness required to fight and win against any potential adversary despite the uncertainty of knowing when, where, or under what conditions the next fight will occur. Use of the “Boxer's Stance” suggests a rapidly adaptable, globally integrated set of capabilities that can be dynamically employed to shape the strategic environment.

To meet the objectives outlined in the 2018 NMS, CENTCOM will pursue additional lines of effort to counter adverse great power competition and Violent Extremist Organizations to support U.S. security interests and alliances relative to that competition and mission set. CENTCOM must also ensure an effective posture to address future contingencies and essential Security Cooperation activities with significantly reduced resources.

Mitigating the risk associated with the 2018 NDS directed resource prioritization and a smaller force presence around the globe, will be essential for all elements of DoD (CCMDs, Services and its supporting Defense Agencies). From a joint logistics and engineering perspective, designing a concept for a “smart capability” to support 21st Century Warfare by deploying and leveraging proven IoT solutions, like Smart Cities technologies, is one way to enable the joint force, allies and partners to better build and manage our enduring locations and support distributed operations in a contested environment.

This paper articulates a broad concept to improve Lead Service provided Base Operating Support (BOS), reduce O&M costs, increase capabilities, and enhance management at overseas enduring locations through the establishment of an experimental *SmartHub* – a joint, multi-functional logistics distribution hub that leverages IoT, civilian Smart Cities Technologies, and integrates innovation initiatives from across the DoD and commercial industry. It will also provide a transformational approach to partnering with a designated host nation at a combined enduring location. Enabled through IoT solutions, the *SmartHub* concept will serve as a force multiplier by harnessing the power of the digitally connected battlefield resulting in a measureable reduction in mission risk and increased operational reach, enabled by agile and resilient logistics.

The *SmartHub* will integrate planning to ensure that critical munitions, Prepositioned War Reserve Materiel (PWRM), force enablers needed for Joint Reception, Staging and Onward Movement (JRSO) of combat forces, Operational Contract Support, Energy Production, Operational Project Stocks and interagency supply sources are optimally postured and managed to support assigned missions in multi-domain operations.

In 21st Century Warfare, real-time access to data will be the primary enabler for CCMDs and Services to support emerging DFE deployment requirements. Historically, military success has been predicated on gaining sea and air dominance, then building an

elaborate basing posture to support operations. This WWII operating construct satisfied demand requirements using historical consumption factors with no access to real-time demand data. The evolution of increased standoff capabilities challenges the joint force's ability to develop an overseas, forward presence posture supported by long lines of communication. Offsetting the adversary's growing advantage requires a paradigm shift for DoD to have the ability to acquire and process consumption data in real time.

Expanding Russian and Chinese global presence and continued improvement of Iran's Anti-Access and Area Denial (A2/AD) weapon systems and refinement of swarm tactics will stress U.S. military superiority. The emphasis of adversarial weapons systems that stress innovation, as well as precision and extended range weapons indicate that future conflicts will be significantly different than those of the past. War in the 21st Century will be characterized by "sensor-rich militaries of peer states and proxies employing precision-guided munitions on highly lethal battlefields that can restrict Joint Force freedom of maneuver and action."¹ As described in multi-domain operations framework, "America's adversaries have demonstrated capabilities that deny access to theaters...and negate freedom of action at the operational and tactical levels."²

To succeed in this environment, CCMDs must posture to sustain operations without the relative security provided in past conflicts. In future conflicts, CCMDs will not have the luxury of having massive amounts of logistics supporting them and will continue to compete in a very limited resource environment against other priorities. CENTCOM's lines of communication will not be contiguous, and the enemy will attack support areas and capabilities with precision fires to degrade sustainment activities. Leveraging available technology provides a pathway for CENTCOM to succeed in this new operating environment, and make possible a "Boxer's Stance" within the resource realities of the National Defense Strategy.

Challenge

Based on the 2018 NDS, CCMDs and Services must reassess their current approach to planning, programming, developing and maintaining posture, while evolving to support the designated national priorities with significantly less resources. To facilitate improved resiliency, increased operational reach and reduced operational risk, CENTCOM and its subordinate organizations must harness the power of IoT solutions to implement the five key focus areas of the NDS (See Appendix 1):

- Resilient and agile logistics
- Forward force maneuver and sustainment resilience
- Advanced autonomous systems
- Dynamic force posture, employment and sustainment
- Reorganization to leverage innovation and new technologies in a network contested environment

¹ Multi-Domain Battle: Combined Arms for the 21st Century, www.arcic.army.mil/App_Documents/Multi_Domain_Battle.pdf

² U.S. Army Training Doctrine Command. "Multi-Domain Battle: Evolution of Combined Arms for the 21st Century 2025-2040", Dec 2017, tradoc.army.mil/MultiDomainBattle/docs/MDB_Evolution21st.pdf

Vision

Establish an experimental *SmartHub* pilot that closely aligns with the Military Services' *Base of the Future* initiatives, and integrates the various service innovation efforts to form a IoT driven, joint, multi-functional, multi-modal distribution and sustainment operating location.

Pilot

Transform an enduring OCONUS location into a theater logistics distribution hub that leverages a wide range of IoT solutions, informed by U.S. Smart Cities lessons learned and Services' innovation programs to enhance capacity through analytics. Innovation is key to addressing challenges facing USCENTCOM in supporting a 21ST Century Warfare scheme of maneuver with an agile and resilient logistics capability as envisioned by the objectives of the NDS. Amplifying information on U.S. Smart Cities Technologies is located in appendices 2 and 3.

Potential benefits of this pilot *SmartHub* include:

- Exponential improvement of Lead Service provided Base Operating Support (BOS),
- Reduction of O&M costs,
- Increased distribution and sustainment capabilities
- Enhanced management at overseas enduring locations.
- Establish a transformational approach to partnering with a designated host nation at joint/combined enduring locations
- Demonstrate Service/DoD innovation initiatives such as future net zero operational constructs (waste, water, energy).

Investments in energy technologies should be prioritized according to the same standard as any other Department decision to invest in basic research and technology development, namely: their direct contribution to achieve the Department's primary missions; potential return on investment; protection of US national security interests; and contribution to enhancing readiness and combat effectiveness while reducing the vulnerability of our service members in battle. We should also take full advantage of private sector innovations that can provide military advantages.

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The *SmartHub* will provide a pathway to four primary objectives:

- Leverage IoT solutions with defense applications to exponentially improve base management and operations.
- Provide a transformational platform for the integration and operationalization of DoD innovation initiatives to improve our enduring bases and export best practices across the theater.
- Partnering on a combined venture with a host nation to mutually achieve better posture and force projection, and generate a template for other CCMDs.
- Inform the development of new Terms of Reference, authorities and funding approaches that improve Base Operating Support.

Cost of Doing Nothing

The *SmartHub* concept is envisioned as one way to improve wartime capabilities and logistics capacity. This will cost money in the short term and a cost benefit analysis is typically not sufficiently convincing to justify upfront heavy financial investment. So it's important to ascertain the cost of doing nothing as in "What will the cost be without *SmartHub* implementation?" This valuation concept is becoming more prevalent in infrastructure discussions because it highlights opportunity costs that may be less tangible, but could ultimately lead to a higher price, and higher risk to force and mission, if action is not taken. Including this opportunity cost considers factors such as:

- Our competition is not standing still – great power adversaries and allies across the world are taking risks and investing in much of the technology described above which could easily lead to a competitive advantage.
- Playing catchup to an adversary will cost more than incremental investment now and may not be possible if they garner time to mature and develop an innovative concept that precludes a US strategic advantage on the battlefield.
- The impacts of a fully realized *SmartHub* could lead to more significant cost savings than estimated – the process of implementation and change will uncover inefficiencies and lead to new solutions that would not otherwise be realized.
- Preventive measures are cheaper than repairing damage due to a lack of action. Infrastructure improvements as well as improvements to logistics and distribution network now are less expensive than reacting to damage from an adversary's actions or even catastrophic weather events.

Thus "doing nothing" may not require an immediate investment, but definitely has long term consequences and possible grave implications. Additionally, establishing a *SmartHub* now, as a pilot in an overseas CCMD AOR, will provide an excellent test bed to determine the best mix of new technology and focused infrastructure requirements. By implementing IoT solutions and Smart Cities Technologies now in multiple environments, against multiple threats, and in readily changing security environments

means that any solution applied (i.e., physical, structural, policy) can be tested and vetted quickly. The solutions and the processes for applying them can then be more rapidly implemented, when they are needed.

Way Forward

In coordination with the select CCMD Science & Technology Offices, we will engage the Services, Combat Support Agencies, academia and the commercial sector with clear statements of work/requirements/capabilities to develop a pipeline of potential technology solutions for addressing operational gaps and logistics vulnerabilities.

We will review IoT solutions and successful Smart Cities initiatives, evaluate CONUS prototype locations, and determine a lead Service to establish a *SmartHub* in an OCONUS AOR. This will require close host nation coordination for the establishment of a pilot site to evaluate prospective technology solutions. These efforts will inform the USCENTCOM Theater Posture Plan (TPP) and the Commander's Integrated Priority List which will facilitate and enable the establishment of permanent *SmartHubs*.

Internally, USCENTCOM will:

- Socialize this concept through the USCENTCOM J4 Joint Strategic Support Boards (JSSB);
- Socialize this concept with OSD-OE and the Joint Logistics Enterprise (JLEnt);
- Develop a series of articles providing the J4's vision for a *SmartHub* in support of Distributed Operations in a contested environment;
- Partner with IoT and Smart Cities experts to determine potential ROIs and recommendations;
- Inform Science & Technology (S&T) nominations (Capability Gaps);
- Conduct KLEs with the Access Working Group and a designated Host Nation;
- Conduct KLEs with the Services to determine what is within the realm of the possible;
- Brief the Logistic Functional Capabilities Board (FCB-LOG) in the Joint Capabilities Integration and Development System (JCIDS) Process.

Externally, USCENTCOM will require support from OSD to realize this concept in the form of:

- Identify available authorities and funding sources to establish a *SmartHub*;
- Engagement with commercial industry and the private sector to harvest civilian Smart Cities best practices and recruit sponsors;
- Integration of Service innovation efforts;
- Integration with Science and Technology priorities across DoD;
- Development of Mission Metrics and LOEs;
- Master Planning;
- Energy Supportability Analyses and Resilience Planning;
- Fuel Savings Performance Contracting (goal is net zero operating cost);
- Global Energy Market Analysis and Energy Readiness Reporting;
- Distributed Operations;

- Distribution of Lessons Learned and harvested best practices (to include eventual DOTMLPF-P change recommendations).

Implementation Activities

- Partner with OSD to leverage and optimize on-going innovation opportunities across the DoD as we advance the *SmartHub* concept for the Department.
- Determine authority and funding requirements.
- Identify and target a single OCONUS operating location for concept validation and testing. The location should benefit both U.S. and host nation interests, support bilateral defense requirements and serve to facilitate public and private sector science and technology to drive greater economic innovation and diversification.
- Conduct gap analysis between existing large logistics distribution hubs and *SmartHub capabilities*; identify current strengths and areas for improvement.
- Stakeholder engagement and best practice research - Conduct research based on industry trends and best practices that may inform the direction of the plan. Explore possibility of partnering with a host nation MOD and HN innovation initiatives to advance that partner's national innovation objectives by using a military base as a test bed/proof of principle.
- Explore partnering opportunities with the private sector and academia; potential for Public-Private Partnerships (offsets Department capacity shortfalls).
- Identify key initiatives and develop Lines of Effort (LOE).
- Develop analytical metrics to determine best practices and ROI; an analytical tool used to illustrate the potential impact an initiative may have on both the key stakeholders and business drivers. Also provides a quantitative process for prioritizing initiatives.
- Designate a Lead Service for the selected test site.
- Develop a Plan of Action and Milestones (POAM) to track activities and milestones.
- Discuss Contracting options.
- Develop an Implementation Plan in collaboration with key stakeholders.
- Determine authority and funding requirements.
- Evaluate risk associated with SmartHub Lines of Effort, with specific attention to understanding cyber risk, and establish comprehensive risk mitigation plan.

Conclusion

The 2018 NDS foresees ongoing advances in artificial intelligence, machine learning, IoT and other evolving technologies "will change society and, ultimately, the character of war."³ To preserve and expand our military advantage and enable acquisition reform, we must pursue applications of advancing technologies boldly while ensuring a strong commitment to military ethics. A new approach is required to increase the speed and

³ Office of the Sec of Defense, Unclassified synopsis of the classified 2018 National Defense Strategy, pp 3

agility necessary to deliver integrated, artificial intelligence enabled capabilities and to adapt USCENTCOM's posture, and sustain operations and activities in the AOR.

To preserve our advantage, CENTCOM, in close coordination with stakeholders and partners, will establish an experimental *SmartHub* that closely aligns with the Services' *Base of the Future* initiatives and integrates the various Service innovation efforts to form a joint multi-modal distribution and sustainment operating location. The results will inform CENTCOM efforts to transform our theater posture and logistics support framework.

A *SmartHub* employs technologies—artificial intelligence, the IoT, machine automation and robotics, advanced manufacturing and predictive and prescriptive data analytics to improve the quality and speed of its information management functions and services. It can significantly improve enduring location posture, logistics distribution and sustainment operations. Employed collectively, these technologies collect and process mega-data that enables more effective and efficient operations and decisions.

Acknowledging the promise of innovative technologies can sometimes be oversold or plain wrong, an optimal balance of IoT solutions, host nation partnering and existing Service innovation initiatives can collectively bring the *SmartHub* concept to reality [with reduced risk] and offer significant advantages for our military installations.

Application to DOTMLPF-P

Specific DOTMLPF-P applications remain TBD based on approval of the *SmartHub* concept and subsequent execution. The USCENTCOM staff will present the *SmartHub* concept proposal to the FCB-LOG for consideration and assistance in aligning the concept with DOTMLPF-P considerations for Joint Logistics. Additionally, Lessons Learned from the *SmartHub* will be captured and shared via the FCB-LOG.

A key deliverable from the *SmartHub* initiative will be a Science and Technology Roadmap for transitioning reliance on legacy long Lines of Communications and supply chains, including the hub & spoke distribution process, to a *SmartHub* logistics capability. This capability will utilize an IoT solution set that complies with NDS goals of developing an *Agile & Resilient Logistics* capability, and will support distributed operations in a contested environment.

This roadmap should be used to inform DOTMLPF-P applications.

SmartHub best practices will inform policy that guides military construction requirements, Lead Service Base Operating Support (BOS) guidance, autonomous distribution systems, advanced manufacturing and base management.

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Appendix 1: NDS Focus Areas

- Resilient and agile logistics: The U.S. will prioritize prepositioned forward stocks and munitions, strategic mobility assets, partner and allied support, as well as non-commercially dependent distributed logistics and maintenance to ensure logistics sustainment while under persistent multi-domain attack.
- Forward force maneuver and posture resilience: We must prioritize ground, air, sea and space forces that can deploy, survive, operate, maneuver and regenerate in all domains while under attack.
- Advanced autonomous systems: The DoD will invest broadly in military application of autonomy, artificial intelligence and machine learning, including rapid application of commercial breakthroughs, to gain competitive military advantages.
- Dynamic force posture and employment: Force posture and employment must be adaptable to account for the uncertainty that exists in the changing global strategic environment.
- Reorganizing for Innovation: Modernization is not defined solely by hardware; it requires change in the ways we organize and employ forces. We must anticipate the implications of new technologies on the battlefield, rigorously define the military problems anticipated in future conflict and foster a culture of experimentation and calculated risk-taking.

Appendix 2: Smart Cities Overview

Smart Cities technologies led by the explosion of IoT solutions to the commercial marketplace has enabled older U.S. cities like Pittsburgh to completely transform themselves resulting in a more resilient community.

Although the Services are aggressively pursuing Smart Cities' best practices, there is no globally recognized definition of a "Smart City/base," which adds to the complexity of adoption by the military municipalities. Although early Smart City initiatives were largely driven by technology, cities must shift to a requirements-driven approach and capture unique military requirements in the evolving definitions.

The IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

End-to-end IoT solutions empower smart industries, smart living and smart enterprises and deliver connected experiences by connecting assets, operations/logistics and services. These tools allow data analytics to identify, assess, mitigate and/or accept energy and other related risks to critical assets/infrastructure. This facilitates data driven decisions instead of opinion based ones. The next generation of *SmartHubs* will include Uber style solutions for increasing the efficiency of the JLEnT. Based on real time user information, *SmartHubs* will manage bed down requirements through secure AirBnB-like applications.

A smart base approach should leverage technology and IoT to improve services and be driven by the base needs rather than technology. The full potential of connected devices, with an increasing array of technology choices, may be difficult for military base leadership to navigate.

As defined by the LSNetwork, Smart City solutions fall into six-broad categories to transform the urban landscape:

- **Infrastructure:** This line of effort provides multiple Smart Hub opportunities. COCOMs require IoT solution to measurably reducing mission risk while increasing operational reach resulting in a more resilient posture in support of 21st Century Warfare. Improve resiliency is specifically important to Economy of Force (EoF) theaters in the era of improved Ballistic Missiles.

Smart lighting is an example of an important solution that will be implemented in theater wide infrastructure. While smart lighting might sound trivial at first glance, it's worth noting that lighting alone consumes 19% of the world's total electricity.

Efficient energy production is another focus area. We must look to Reusable energy, micro-grid power generation and Small Modular Reactors. These will all lead to the

ability to mass combat power rapidly by quickly transitioning a location from warm to hot status. All COCOMs, but especially EoF ones will require a dynamic, rapidly deployable portfolio of energy sources that support the objectives of the NDS, specifically DFE SmartHub serves as an incubator for future BCT and MEU portable technology.

Enhanced Force Protection will also benefit from Smart Cities technologies. The ability to quickly detect, respond and neutralize threats will make our installations more resilient.

COCOM **Posture** will leverage “**Connected**” Forces to “**Smart**” infrastructure capable of supporting DFE. Furthermore, leveraging IoT solutions will serve, once established, as an offset to resource reductions and constraints leveled against COCOMs in support of the NDS directed Service readiness. SmartHub concept explains how COCOMs can reimagine support to 21st Century Warfare through the deployment IoT solutions.

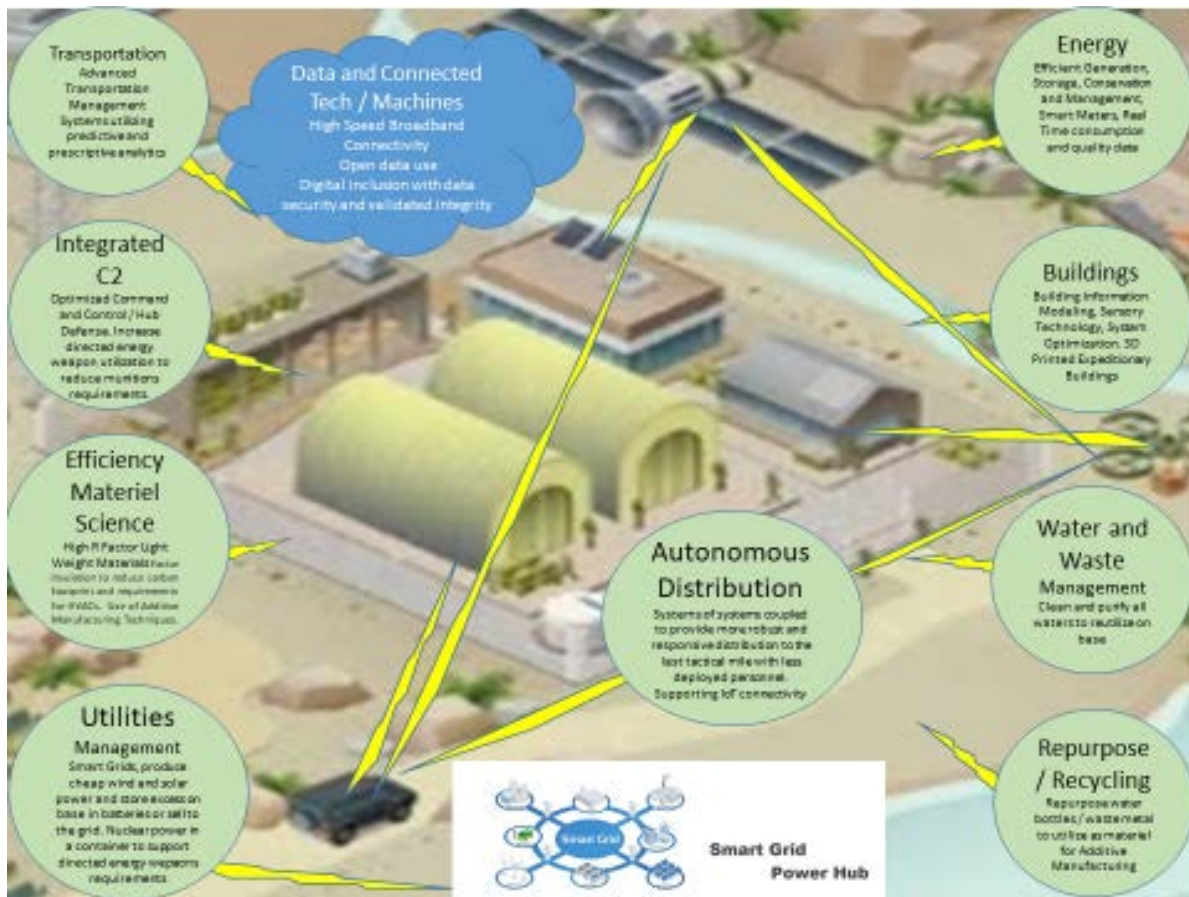
- **Buildings:** Heating/cooling, energy usage, lighting and ventilation will be managed and optimized by technology. Solar panels will be integrated into building design, replacing traditional materials. Fire detection and extinguishing is tailored to individual rooms. We will require tools which enable ‘smart city’ implementation to current and future base camp master planning for energy, water & waste management that is deployable and simple to use and maintain.
- **Utilities:** Smart grids (used for energy consumption monitoring and management), water leakage detection and water potability monitoring are some Smart City aspects on the utilities side. Demand reduction technologies/techniques for non-critical energy users will allow for overall reduction in fossil fuel generated energy. COCOM forces rely on WWII fuel and power distribution network that increases risk to the mission. Long logistics distribution Lines of Communication represent vulnerability for adversaries to exploit. We must look to scalable/reliable/sustainable energy solutions, to include renewable, which provide assured power during peak demands, while reducing reliance on host nation power and/or delivered fossil fuels. This will lead us to tactical micro-grids to provide resilient and reliable power to small-to-medium locations.
- **Transport:** Intelligent, adaptive distribution routes will be implemented, while charging stations through the installation will power EVs. Autonomous Distribution will be integrated as practical. Investments will prioritize prepositioned forward stocks and munitions, strategic mobility assets, partner and allied support, as well as non-commercially dependent distributed logistics and maintenance to ensure logistics sustainment while under persistent multi-domain attack. We will look to reduce our footprint and transportation requirement using Additive Manufacturing/3D Printing and other technologies as they advance.
- **Environment:** Air pollution control, renewable energy and waste management solutions will make for greener cities. Rooftop or side vegetation will be integrated

into building designs, to help with insulation, provide oxygen and absorb CO2. All these improvements will, in turn, develop a stronger, more cost effective Ecosystem.

- **Life:** There will be installation wide secure Wi-Fi for unclassified network use. Real-time updates will provide installation managers information on traffic, security, and other building maintenance issues. This technology will drive the need for next generation information technology (IT) support staff that are digitally fluent and enabled. They must be fully capable of managing and interpreting large volumes of disparate data to support the dynamic nature of 21st Century Warfare. Through artificial intelligence (AI) and algorithms, they will be able to anticipate and predict requirements, further supporting the increasing dynamic nature of future warfare.

To be fully successful at this endeavor Services and COCOMs must become digitally and technologically agile. The reference to digital agility infers the ability to develop systems and processes to respond quickly to dynamic conditions. The reference to technological agility refers to incorporating emerging trends in additive manufacturing capability to reduce supply stock and logistics distribution requirements. **Smart Logistics** is an evolving technology that includes data-driven software platforms that automate the management of shipping (i.e. Transportation Management Systems or TMS) and storage (i.e. Warehouse Management Systems or WMS). Key adjacent platforms include fleet management along with supply chain management (SCM). Key data inputs to these systems come increasingly from connected sensors and vehicles that use GPS-enabled telematics platforms to track the exact whereabouts of goods (or drivers and field service workers of all kinds). Of course, given the massive volume of data that logistics represents, there's plenty of need for big data analytics, which increasingly means machine learning and AI). The Department's vision is to bundle big data analytics with AI to provide a predictive capability that will result in an increased level of agility. Smart Logistics will ultimately lead to an overall data driven transformation of the Department's sustainment posture.

Figure 1 visualizes the conceptual components of a smart city and provides example technology solutions for each.



Appendix 3: Smart Cities Technology Objectives

1. Copying successful e-solutions from the participating regions, supported by academics and with the involvement of Component Commands and Base Operating Support Integrators.
2. Build a methodological model that will assist base commanders to transfer international good e-practice.
3. Develop e-services based in all partner regions, thus mainstreaming this approach.
4. Build generic localized, personalized and pro-active e-services that will be implemented in the whole partnership on behalf of service members and base operating agencies.
5. Jointly redesign and redefine back and front offices in order to build smarter and transparent base command and control.
6. Build an e-service platform with the potential to be shared across a COCOM's AOR back to Service and Defense Agency providers, in the domain of service-delivery, wireless services and take-up.
7. Co-design unclassified, NIPR mobile services aimed at efficiency, cost-saving and participation with attention for e-inclusion.
8. Bring decision makers and good practice owners together in E-Basing Academies and international seminars.
9. Define methodologies for user involvement, profiling customers and identifying needs; test methodologies to transfer these needs in appropriate services; and test techniques to fit the right channel to the specific services and customers thereby setting a framework for a higher level of e-services in a COCOM's AOR.
10. Build a strong network of researchers supporting the co-design of pilots.
11. Develop practical indicators and management instruments to survey and guarantee e-service delivery.
12. Work together in the domain of interface standardization in close collaboration with CONUS and host nation administrations.
13. Coordinate the activities of Smart Cities with the national architecture projects in CONUS and in host nations.
14. Raise the e-services bar by implementing similar e-services across the participating regions, thereby inspiring other regions and facilitating mainstreaming.
15. Jointly develop service contact centers for SMEs.
16. Jointly pilot new service channels, blue tooth services for public transport, online forms in mobile phones and wireless city services.
17. Improve the citizen services.
18. Improve infrastructure and services.
19. Housing and basic sanitation facilities for all.
20. Reduce congestion on roads.
21. Reduce air pollution and resource depletion.
22. Boost local economy, promote interactions and ensure security.

23. The ability to effectively and efficiently manage rapid urbanization will become essential.
24. Bases need to reach, achieve and maintain the essential objectives of economic, social, environmental and financial sustainability.
25. Significantly reduce emissions (CO₂, greenhouse gases.)
26. Significantly reduce energy consumption. Long-term objective: reaching close-to-zero energy standards in new and existing buildings by 2025.
27. Significantly increase the use of renewable sources of energy (e.g. in public buildings.)
28. Raising awareness in the wider public about responsible use of resources (energy, water.)
29. Giving service members (from consumers to prosumers) an active role by providing opportunities for actively controlling additional areas of daily life.
30. Promoting multi-modal transport systems by improving the public transport network, enhancing networking between individual transport carriers and significantly reducing individual motorized transport.
31. Positioning our military bases as a model expeditionary environmental city and as a leading site for research and technological development with international and industry partners.