

Modified Design Hardware and Wireless Sensors Networks for Designing Future Combat System

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Abstract: Future combat system (FCS) is a network, which connects eighteen individual weapon scheme connected with the soldier all the way through the network. Supporting the soldier with real time situational awareness and cooperative operability among forces to entire a mission successfully with low mortality rate is the fundamental thought, there by enabling the soldier to see first, understand first and take action decisively. Since, most of the system operates in remote environment with battery support, power consumption is a serious issue. System with many nodal points has to be encrypted strictly to prevent the network from attacks (simply hacking). In this paper, an analysis was made on use of instruments with less power consumption, particularly custom design hardware and wireless sensors or sensors to tackle this difficulty.

Keywords: Future combat system, Wireless sensor network, Cluster integration.

1. Introduction

This is our time to change our basic strategy from the 20th century, cold war model that relied on massive logistics buildup, heavy brigades, sequential operations, linear warfare and intelligence gained by direct observation/contact. FCS supports us against the current irregular warfare by providing light, agile Brigade Combat Teams with a small logistics foot print that is networked and capable of conducting simultaneous operations to directly attack the enemy centers of control and exploits the intelligence gained via remote reconnaissance and surveillance systems.

BCT is the network which will allow every FCS system from unmanned vehicles to precision weapons to share the information and work together. The network will offer decision-making not just at the brigade level, but all the way down to the battalion and company levels. The FCS allows the army to achieve greater situational awareness, improved survivability, lethality, efficiency and joint operability. On today's battlefield, the availability of real-time

information is vital for success.

FCS technology will allow the soldiers to see first and understand first: from a position far away. Systems such as the Unattended Ground Sensor (UGS), Unmanned Ground Vehicles (UGVs) and Unmanned Aerial Vehicles (UAVs) will provide information about the enemy's position in individual buildings and neighborhoods, as well as over the bunkers. Wireless sensors can be used in case of unattended war environments.

This information will be fed into the network and immediately shared with brigade, battalion and company commanders, even to the platoon leaders. This networked surveillance increases the reliability of information and reduces tactical risk to the soldiers. In short, FCS provides enhanced situational awareness. On today's battlefield, precision weapons are necessary to defeat enemies who are often mixed with civilian populations or hidden in restrictive terrain such as mountainous regions. FCS systems such as the Mounted Combat System (MCS), Non-Line of Sight-Cannon (NLOS-C) and Non-Line of Sight-Mortar (NLOS-M) combined with FCS's unmanned systems and the soldiers, provide the ability to destroy enemy and increase the ability to identify targets and to engage with precision munitions that reduce the risk of collateral damage. On today's battlefield, soldiers in complex environments are at risk within vehicles, due to the enemy's use of Improvised Explosive Devices (IEDs), Rocket-Propelled Grenades (RPGs) and Anti-Tank Missiles. As the soldiers move into complex terrain (urban areas) where the enemy is well hidden and traditional fighting vehicles are largely ineffective. Figure 1 shows the protocol stack in a wireless sensor network [1].

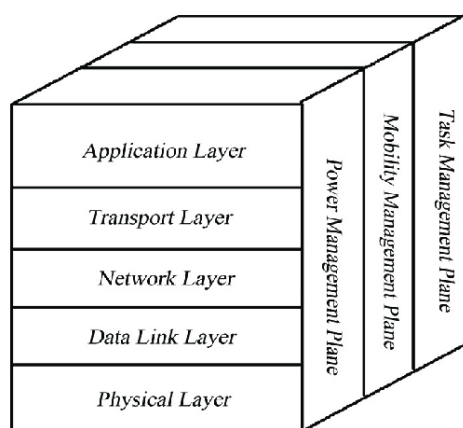


Figure 1. Protocol stack in a wireless sensor network

2. Network Articulation

The Army's FCS (BCT) network allows the FCS Family-of-Systems to operate as a system-of-systems in which the capabilities of all the systems are greater than the sum of its parts. The network enables the infantry soldiers to better understand and dominate the future battlefield at greater level. The network consists of five layers, when combined provides very high speed data flow within the network [2]-[3]. The FCS network possesses the adaptability and management functionality required to maintain standard services, while the FCS (BCT) fights on a rapidly shifting battle space giving them the advantage to see first, understand first, act first and finish decisively.

2.1. Standards Layer

The Standards Layer is the foundation of the network. It provides the governance for which the other layers are shaped and formed. The FCS (BCT) network conforms to the standards documentation to ensure that the net-centric attributes like flexibility and adaptability on distributed computing environment. Information needs, information timeliness, information source and networked capabilities provide enhanced guidance to ensure the technical exchange of information and end-to-end operational effectiveness. Uniform standard allows inter operability with other networks.

2.2. Communication

The FCS (BCT) Family-of-Systems is connected to the command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) network by a multilayered transport layer with extremerange, capability and dependability. The primary function of the transport layer is to provide secure and reliable data transfer over complex terrain. The network supports advanced functions like integrated network managementcapability, information assurance and information dissemination management to ensure dissemination of critical information among sensors, processors and war fighters both within and external to the FCS (BCT)- equipped organization.

2.3. Services Layer

Heart of FCS (BCT) network is the Services Layer, commonly referred to as System-of-Systems Common Operating Environment (SOSCOE) which supports multi mission-critical applications both independently and simultaneously. It is designed so that, at any specific instant, one can incorporate only the components that are needed for that particular instant. It enables advanced integration of separate software packages, independent of their location, connectivity mechanism and the technology used for developing them.

2.4. Applications Layer

The Applications Layer is responsible for providing the integrated ability to assess, plan and execute the network-centric mission operations by using a common interface and a set of non-overlapping functional services that provides the full range of FCS (BCT) war-fighter capabilities. This layer combines ten software packages to enable full interaction, integration and interoperability between the systems with no hardware, software or information bank. It also allows cross Battlefield Functional Area (BFA) problem-solving, decision aiding, adaptable doctrine, tactics, techniques and procedures, reconfiguration of roles and levels of automation during execution development, the basic efficiencies promotion, technology refresh and insertion.

2.5. Platforms Layer

The Sensors and Platforms Layer is comprised of a distributed and networked array of multi-spectral sensors that provides the FCS (BCT) with the ability to-see first. Intelligence, Surveillance and Reconnaissance (ISR) sensors are integrated onto all manned ground vehicles, all unmanned ground vehicles and all four classes of unmanned aerial vehicles within the FCS (BCT). To provide war fighters with current, accurate and actionable

information, the data from the various distributed ISR and other external sensor as sets are subjected to complex data processing, filtering, correlation, aided target recognition and fusion. The 18 networked systems consist of eight manned ground vehicles, three unmanned ground vehicles, four unmanned aerial vehicles and three specialized devices.

2.6. Soldier as a System

All Soldiers in the Brigade Combat Team (BCT) are part of the Soldier as a System (SaaS) overarching requirement that encompasses everything the soldier wears, carries and consumes to include unit radios, crew served weapons and unit specific equipment in the execution of tasks and the duties [4]-[5]. All soldiers systems will be treated as an integrated System of Systems (SoS). The soldier, as defined by Soldier as a System (SaaS) meets the need to perk up the current capability of all the soldiers, regardless of Military Occupational Specialty (MOS) to carry out army warrior tasks and functions more proficiently and effectively. Soldier as a System (SaaS) establishes a base line for core soldier requirements and establishes the foundation for specific or mission unique soldier programs (Ground, Mounted and Air). It presents a fully integrated modular soldier that provides a balance of tasks and mission equipment in support of the soldier team: the current and the future force. FCS also enhances the SaaS with additional benefits like joint embedded training: allowing the soldier to train anywhere, at any time, including enroute to the battlefield.

3. Issues in Design

(1) One of the somber issues is the lifetime of the battery. Longer the lifetime of the battery, longer is the life of the soldier. Since the soldiers depend only on the system to identify and eliminate threats which affects his survivability, long lasting fast rechargeable batteries are required. One solution for this issue is to replace the sensors with wireless sensors with novel distributed clustering algorithms embedded in it.

(2) It is very tricky to establish communication relays near the battlefield, as it becomes a target to enemy forces. If reliable communication could not be established, soldier can't obtain real-time war picture. For real-time situational awareness, secure and reliable communication is the foremost criterion. More the number of node points, more is the possibility for hacking and as a result providing reliable communication link in non-line of sight is a severe issue. The problem could be overcome by clustering all the nodes in distributed manner.

(3) When the battle field has to cover wider area, signal strength becomes weaker and this paves a way for losing the collected information. This creates a SNR problem that has to be taken into account. This can be eliminated completely by increasing the number of nodes in the network.

4. Conclusion

Supporting the soldier with real time situational awareness and cooperative operability among forces to entire a mission successfully with low mortality rate is the fundamental thought, thereby enabling the soldier to see first, understand first and take action decisively. Fusing the data collected from dissimilar reconnaissance vehicle, unattended ground sensors, unmanned aerial vehicles and live assets has to be made successfully. System of system

common operating environment (SOSCOE) supports the system, providing reusable software design for platform and battle command application via low bandwidth network. After the comprehensive study on the problems and issues concerning FCS, two foremost criterions have to be accounted principally: battery lifetime and reliable communication over disrupted terrains.

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