RFID EFFORTS SUPPORT SEAMLESS ASSET TRACKING FOR THE 21ST CENTURY ARMY

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ABSTRACT

RFID tagging and tracking efforts at ORNL can be used to provide the Army with continuous knowledge of the location and status of every asset. This will provide commanders the assurance they need to verify logistics and to plan and sustain missions.

Several RFID-related technologies must experience technological advances in order to meet the requirements of a seamless total asset visibility (TAV) architecture. This TAV architecture must dovetail with the command, control, communications, computer, intelligence, surveillance and reconnaissance (C4ISR) architecture that will provide continuous situational awareness of the FCS battlefield. Therefore, these architectures must utilize compatible technologies, system-of-systems engineering and common information standards including many that are currently emerging.

1. INTRODUCTION

The long-term vision of program managers for the Defense Logistics Agency (DLA), other military entities such as the Army's Future Combat Systems (FCS) and commercial ventures is to have total asset visibility (TAV) for all of their resources as shown in Figure 1. That is, they need to have actionable information available to them at all times about the location, quantity and state of their material assets and personnel. Researchers at ORNL have recently been performing testing and evaluation support for DLA; R&D support for DLA, Department of Energy (DOE) and other customers; and system integration analysis for FCS in the area of radio-frequency identification (RFID) tagging and tracking.

In order to realize the ultimate goals of TAV, several key technology areas must mature and must be integrated:

- geo-spatial locating systems
- communication technologies
- common information protocols
- time distribution
- universally unique product identifiers
- association of data sheets (or manifests) and histories with the unique product identifiers
- sensor and sensor communication technologies
- total system integration and testing

In each of these areas, technologies are emerging and standard practices are evolving that make TAV a possibility in the near future. Various programs at ORNL are focused on advancing these efforts and integrating them into a seamless TAV infrastructure which will be discussed in Sections 2 and 3.

2. TAV ARCHITECTURES

TAV Scenario

The long-term vision for TAV may best be described by discussing a hypothetical scenario using the systems shown in Figure 1. On one of the vehicles supporting an overseas battle, a weapon system is starting to demonstrate degraded performance. The vehicle's manifest is programmed with information that the weapon system needs to be fixed and this information is up-linked to the commander via the C4ISR infrastructure.

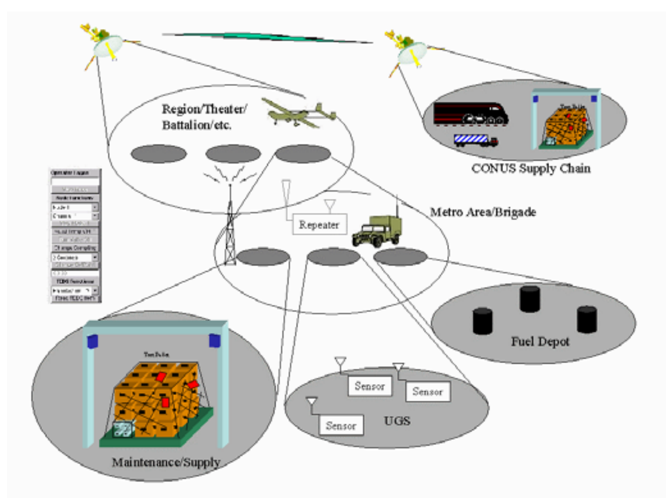

Figure 1. TAV Vision

The message goes out to logistics support entities which are able to send queries back through the C4ISR networks requesting specific model numbers and histories of components on the degraded weapon system. Once the need has been established, the logistics entities then send out requests for the necessary replacement parts. By having real-time location data on all of these assets, the logistics entities can demand emergency shipping and maintenance scheduling such that all the parts and technicians arrive at the maintenance area near the battlefield. Thus, the vehicle can be removed from the battle for a minimum amount of time, repaired and returned to the battle.

Architecture Development

The above scenario becomes a reality if all assets are "tagged" with a unique identifier when they are manufactured, an updateable database about the features of the asset is associated with this identifier, and the asset enters a communication grid that can communicate periodically with the tag.

One key element in realizing this scenario is the development of a communication architecture that brings together all of the necessary technologies in a seamless fashion. We must have common protocols, layer definitions and interface definitions that allow various technologies to support TAV.

3. DEVELOPMENT EFFORTS AT ORNL

Geo-spatial locating functionality focuses on determining and communicating the exact location of an asset to the appropriate decision maker. Efforts at ORNL involve advancing GPS complement technologies as well as helping to evolve the real-time locating systems (RTLS) standards. These efforts involve advancing passive, semi-passive and active RFID tag technologies.

Communication advances include utilizing an in-house patent-pending hybrid spread-spectrum (direct-sequence/frequency-hopping) transmission technique and designing multi-band tags that can operate in any part of the world.

The common information protocol development involves participation in several standards' committees and exercising protocols established for generic communications where appropriate.

Time distribution efforts involve integrating clock signature analysis techniques developed by a commercial partner and the inclusion of IEEE 1588 protocols.

Unique identification of individual assets and the association of pertinent data and histories has involved leveraging the activities of the Auto-ID Center as well as the sensor communication efforts embodied in the IEEE 1451 standards.

There are several ongoing hardware programs at ORNL that involve combining sensors and communication electronics in miniaturized low-power packages. These efforts include measuring and transmitting temperature using a single ASIC, measuring blood perfusion in an implant and transmitting the data to a receiver outside the body, combining chemical "sniffer" sensors with RF communication electronics and combining 6-D position sensing with hybrid spread spectrum communications. The combination of these programs can lead to an infrastructure that provides the health, status and location of soldiers and platforms.

A system integration and verification test was performed to establish the effectiveness of tracking assets via RFID intelligent tags through the DoD supply chain. In order to validate supporting technologies and how to use them, the DLA Advanced HAZMAT Rapid Identification, Sorting, and Tracking (AHRIST) Phase II project team conducted four series of RFID intelligent tag product validation tests. In Figure 2, the results of readings of a pallet of aerosol cans are shown. The color green denotes that the RFID tag was identified and read completely, yellow represents that the tag was identified but not read fully and the color red means that the tag was not identified.

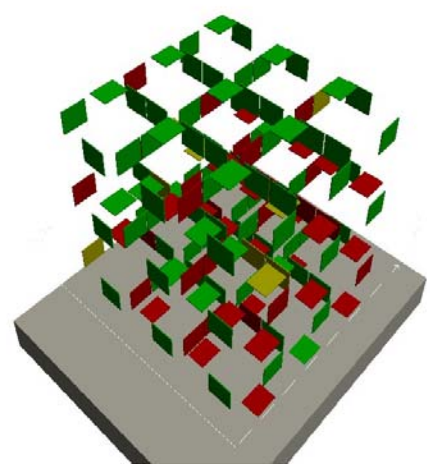

Figure 2. Package Tags Accessed by Portal Reader

CONCLUSIONS

The vision of global TAV will be achievable in the near future. Some of the programs and findings presented in this paper are important in accomplishing that vision. Specifically, standards involvement and forward-looking architecture development will ensure that future technology improvements move us toward that vision.