TAV Why Total Asset Visibility? What is it anyway?

by Michael J. Hammons, CEO ARGO Tracker and Greg Chisholm, Senior Software Engineer for ARGO Tracker

The United States Military is undergoing a fundamental transformation. This transformation is driven by the need for rapid deployment and troop sustainment for the duration of that deployment. Required is a military logistics system that can ensure correct, timely, cost effective, and repeatable deployment performance to rapidly emerging hotspots. That is, military logisticians are being challenged to perform deployments with short notice respective to who, what, where, and when.

Total Asset Visibility (TAV) is a goal for transforming the Department of Defense (DOD) logistics supply chain and is enabled by automatic identification technology (AIT), the name given to devices that can be used at nodes in the logistics supply chain to provide data (see References 1-4 and Figure 1).

Radio Frequency Identification (RFID) is a technology that enables logisticians to identify, categorize, and locate assets. This enabling technology has been termed in the DOD as Intransit Visibility (ITV)[5]. RFID technology is key to the DOD's Logistics Transformation efforts—efforts to enable the Focused Logistics concept and the JSC JV 2020 plan.[1,6].

TAV is enabled by RFID[1-4].Current use of active and passive RFID provide visibility at portals to distribution centers and at transportation nodes. However, such usage fails to instrument movement between depots/distribution centers, ports of embarkation/debarkation, and theater-depots/distribution centers. For TAV to be successful, methods for visualizing the movement of material throughout the entire deployment must be used (e.g., an ITV technology such as RFID). Such technologies provide identification information coupled with location and security/integrity information. Under this environment, TAV communications are optimized to use a combination of satellites and local cellular networks.

An additional method that will aid in optimizing the DOD Supply Chain and that provides a means for incorporating TAV into the existing logistics scheme is referred to as a nested structure (see Figure 2) of sensors and supply-chain manifests to enable complete visualization of all segments of the DOD supply chain[5]. Such an integration/incorporation requires seamless compatibility with the existing information infrastructure.

The pages ahead will discuss how technologies such as GPS and global, wireless communications can be deployed throughout the DOD supply chain to ensure Total Asset Visibility—a visibility that is essential to improving management and security of the DOD supply chain.

BACKGROUND

The existing DOD supply-chain infrastructure supports gathering RFID data at portals, e.g., where assets enter or leave facilities (see Figure 1). Because identification data is unavailable during transportation of assets (i.e., an information gap exists respective to the entirety of the supply chain), this article offers a solution to plugging the information gap associated with transportation phas-

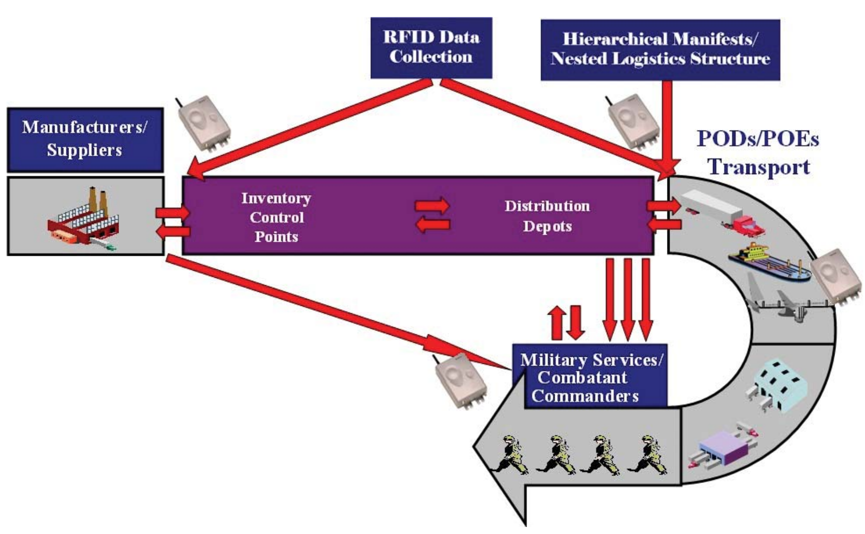

Fig. 1 – TAV Encompasses the Entirety of the DoD Supply Chain

Flash memory is incorporated for data storage, which may be used to accumulate data from external/internal data sources during periods of shipment when communications are reduced to preserve battery life.

es while meshing into the existing information infrastructure.

TAV is dependent on communication and location technology to provide visibility into the transportation phases of logistics supply chains, e.g., between Manufacturers, Depots/Distribution Centers, Ports of Embarkation/Debarkation, Theater Depots/Distribution Centers, and Customers—whether via land, sea, or air (see Figure 1).

Depending on location (i.e., CONUS, in-theater, and all points in between), combined satellite and cellular communication capabilities offer the ability for optimized communications. This optimization depends on a strategy to ensure that the appropriate communications capability is used as required—based on cost considerations. However, it must be noted that this strategy needs to be configurable to accommodate alternate optimization strategies.

TAV devices need to incorporate dual technologies for determination and reporting of position information. Conceptually, GPS provides the primary location information; however, when GPS information is unavailable, the INU continues to provide location information (from the last known GPS latitude/longitude).

TAV enables DOD supply chain security and integrity through the use of additional sensors to monitor critical parameters such as temperature, shock, and intrusion.

Devices that support TAV incorporate both internal and external power sources. Flash memory is incorporated for data storage, which may be used to accumulate data from external/internal data sources during periods of shipment when communications are reduced to preserve battery life.

Figure 3 depicts a TAV architecture. The primary components of this architecture are the main micro-processor, memory, and interfaces. Low-power, System-on-Chips (SOCs) are selected for the main processor (e.g., the MIPS-compatible Alchemy AU-1000 family). Such SOCs provide the capability for communications with diverse, peripheral equipment, e.g, cellular modem, satellite modem, GPS, and data acquisition (e.g., INU and sensors). Additional external connectivity is provided for Flash Memory, Extended RAM memory, and USB devices. With respect to memory, 64 MB of RAM plus 64MB flash memory provides sufficient scratch memory for computational support plus sufficient non-volatile memory for storage of essential data in the event of a power outage.

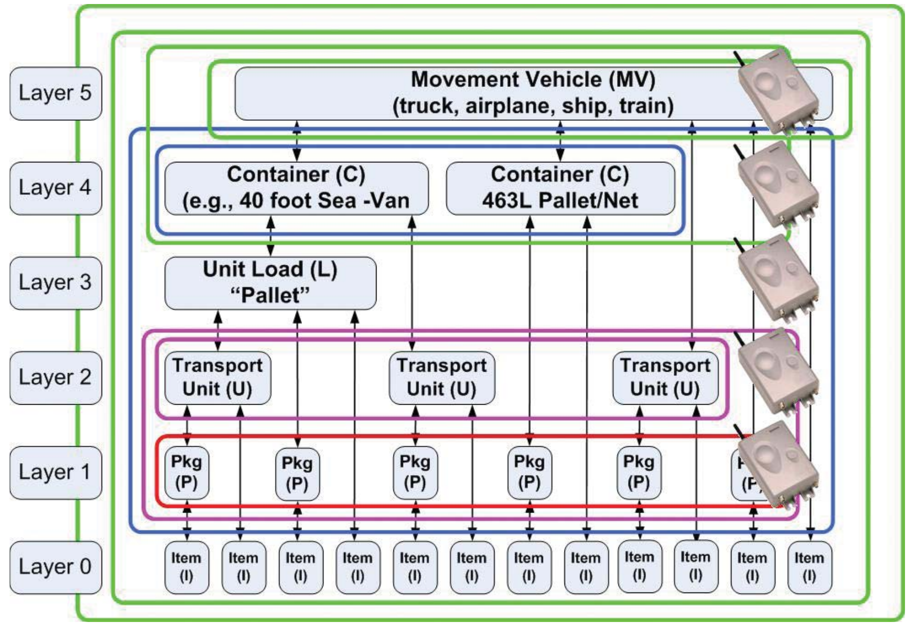

Fig. 2 – Nested Logistics Structure

Power consumption is the bane of TAV units. Communications consume the majority of power and must be optimized to extend battery life. For example, international shipments begin in the proximity of cellular communications, traverse large expanses where cellular communications are unavailable, and culminate within the proximity of cellular networks. This suggests that a combination of cellular and satellite communications are necessary to enable communication over the complete transportation path.

Because cellular modems are more power efficient than their satellite cousins—consuming on the order of twice the power, TAV devices are able to use both cellular and satellite modems and are optimized to conserve power by selecting the optimal communications path. Once the optimal connection is established, a secure session (via SSH) is established to ensure that the integrity and security of the data communications is linked to a secure source.

GPS technology provides the primary source of position information for TAV devices. Ultra-sensitive GPS receivers (e.g., signal capture at -151 dbm [inside a building or container]). However, reception of GPS signals is unavailable in certain situations (usually referred to as "tunneling", i.e., in an urban cavern or when signal reception is jammed or weakened).

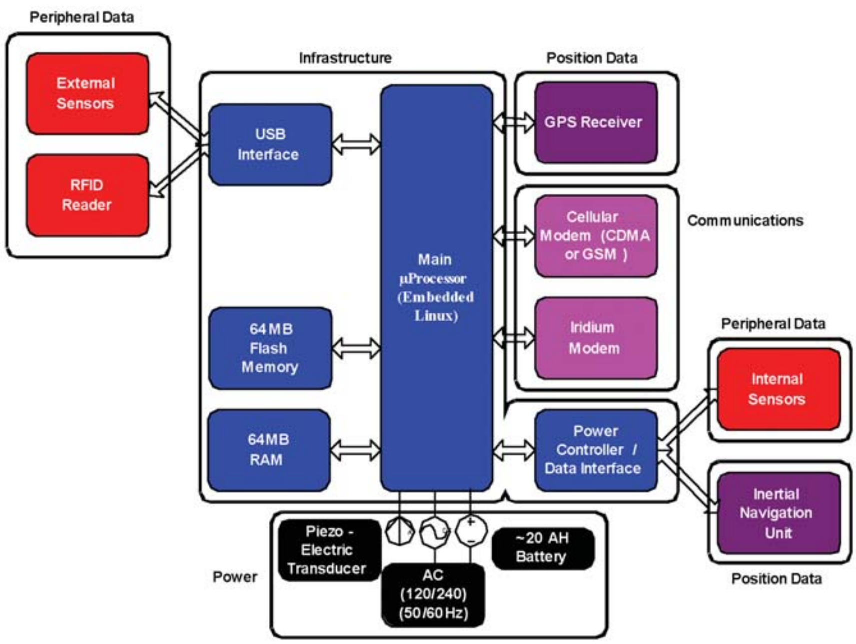

Fig. 3 – TAV Architecture

Power consumption is the bane of TAV units. Communications consume the majority of power and must be optimized to extend battery life.

TAV devices provide a backup means for determining position information. Such devices are based on Inertial Navigation Unit (INU) technology. INU technology was developed and used for air and naval navigation. Solid-state technology enables the use of three-axis accelerometers to provide location data in the event of loss or disruption of GPS signal. For TAV devices, the latest GPS location is used as a seed for the INU position determination.

Data is accepted from two sources, i.e., internal and external. Internal sensors provide voltage, current, temperature, and inertial navigation data.

A wide variety of external sensors utilize the USB interface and all data is transmitted to a secure source.

Many TAV applications are associated with a vibrating environment. Because of this, and because communication devices have such voracious power consumption appetites, vibrations of sufficient strength and frequency may be exploited to provide power to either charge or diminish the depletion of batteries. Pizeoelectric charging subsystems offer the perfect solution to this situational environment. In the absence of pizeoelectric power conversion capability, there exists a more standard alternative—transport vehicle power. Transport vehicle power offers power management certainty when few other certainties exist—especially in multi-theater, conflict environments. Transport vehicle power provides an excellent 'tap' resource for the extension of battery life.

Naturally, there must be a means for recharging a battery when alternating current is available, i.e., 120/240Volt alternating at 50/60 Hertz.

SUMMARY AND CONCLUSION

Active/Passive RFID provides visibility into a supply chain—a visibility that is essential to improving management of the DOD supply chain. However, such visibility is limited by the ability to read tags at portals (e.g., at the exit of a manufacturing facility, at the entrance/exit of Depots/Distribution Centers, etc.). TAV complements this ability and provides visibility into all transport phases of the supply chain—including intercontinental transport.

TAV can be integrated into the instrumentation of the supply chain in support at any/all the upper levels in a nested, logistics structure (See Figure 2). Conceptually, the TAV device carries a payload of data (i.e., a representation of the accumulation of RFID tags at the package level, or an accumulation of manifests associated with any combination of layers above level 2). This data can be communicated on a schedule, on an internal trigger (e.g., associated with a location or a security/integrity violation), or on demand (using OTA capabilities).

TAV is not a pipe-dream; it is available today and provides exquisite visibility that is currently unavailable. TAV is customizable to create optimal configurations that match a myriad of configurations. ***DTJ***

Michael Hammons is CEO for ARGO Tracker Corporation. Greg Chisholm is a senior software engineer for ARGO Tracker Corporation located in Tucson, Arizona. He has over 100 articles in refereed journals/publications. ARGO Tracker is a provider of highly customizable, real-time asset tracking solutions that supports the militaries forward deployment of tactical assets.