Ubiquitous Military Supplies Model based on Sensor Network

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Abstract Information technology has brought revolutionary changes in society and is causing digital reforms in military setup as well. Logistics innovation is being promoted so that they can support the military campaigns and provide needed supplies to the right place and at the right time. Such information and knowledge can be best obtained through experience or a battle but this may cause a considerable loss, even including causalities. Moreover, munitions system and military strategies in modern times are for possible battles in the future rather than for solving problems at present. This paper uses the definition in a narrow sense to do research on the efficient military distribution system that adopts a ubiquitous sensor network and collects information through an RFID tag. Ubiquitous technology would provide the army logistics with a new method to upgrade a war game and acquire better results.

Keyword: Sensor Network, Ubiquitous, RFID

1. Introduction

Information technology has brought revolutionary changes in society and is causing digital reforms in military setup as well. The U.S. Army, the forerunner of the military distribution system that utilizes high-technology, made plans in detail by predicting the operation of the army according to varied military campaigns, making all out efforts to prepare for the future. The U.S. Army is developing a system that it can dispatch the a brigade within 96 hours, a division in 120 hours, and 5 divisions within 30 days to any place in the world. Furthermore, logistics innovation is being promoted so that they can support the military campaigns and provide needed supplies to the right place and at the right time. Such information and knowledge can be best obtained through experience or a battle but this may cause a considerable loss, even including causalities. Moreover, munitions system and military strategies in modern times are for possible battles in the future rather than for solving problems at present. So it is almost impossible to experiment, evaluate, or analyze them in an actual battle. Hence, obtaining knowledge of a war in an indirect way such as a war game is important.

This provides an opportunity that soldiers can have a victory without destruction, bloodshed, and fear of defeat. Participants in a war game not just observe the situations taking place under the simulated combat but take an active attitude in order to have deep understanding and evaluation of a war. So it can be said that a war game offers more effective learning opportunity.

In a broad sense, a war game defined by Defense and Strategic University means “all sorts of simulated military operations including a field maneuver of an actual military unit, a maneuver for proficient activities of a commander and a staff officer, a map exercise such as strategy discussion and judgment in mind, thinking process used for analysis of the enemy force and friendly force, a simulated operation by quantitative means and methods, and so on.” In a narrow sense, however, a war game means “a simulated military operation that carries out with certain rules, procedures, and resources an actual or imaginary combat condition which can’t be experimented due to many dangers.” This document uses the definition in a narrow sense to do research on the efficient military distribution system that adopts a ubiquitous sensor network and collects information through an RFID tag. The systematic distribution methods would allow the simulated military operations to be done more promptly and accurately.

2. Ubiquitous Environment

2.1 Ubiquitous Sensor Network

Sensor Network is the information management that detects the condition of an item (the temperature, humidity, degree of contamination, a crevice, etc.) by attaching an RFID tag to it and sends the information to the network. Ultimately, all the objects are endowed with computing and communication abilities regardless of time, places, where, net-works, devices, and services. In order to realize USN, various RFID tags that offer sensor information should be developed as well as sensing functions so as to build networks among them.

USN is a technology that enables communication through various broadband networks regardless of wired/wireless and telecommunication broadcasting. The technology is available anytime and anywhere through varying telecommunication devices such as a desktop computer, a mobile PC, a mobile phone, a PDA, a car navigation terminal, and information appliances. The number of terminals given an ID by IPv6 is on the rise, allowing users to connect to networks anytime. Since it is a barrier-free interface, people of all ages, even the disabled can use without any difficulty.

To materialize the technology the RFID systems as a means of an input/output de-vice and networks as information exchange should be developed. The RFID system consists of a tag, a reader, Savant, ONS, and middleware including PML. Being connected to the Internet networks, the system can offer application services. Some of the relevant technologies are a tag-related technology, an RFID reader, middleware of a sensor, computing and network technology.

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USN is composed of a tag (a sensor) attached to an antenna which is installed on a reader. This reader is connected to in-formation networks while the tag and reader communicate through an electric wave. It is powered by a built-in energy source or radio waves received. When a reader transmits radio waves through a tag, the tag uses the electric waves as an energy source. In turn, the activated tag sends its information to the reader. Accord-ing to the energy source, tags is divided into active and passive types. A passive tag gets energy from the electric waves that a reader sends while an active tag has its own battery. The reader transmits collected information to Savant server and then ONS locates PML where the information exists so that it can obtain specific information of an item [1], [2].

2.2 Radio Frequency IDentification

RFID is, the Main Technology of USN. The frequency range of an RFID tag is usually 125 KHz and 13.56 MHz, which are used for a traffic card or admission control within short distances. As 900MHz and 2.4GHz are used, the available distance becomes longer and prices, inexpensive. As a result, the technology has been introduced to various areas such distribution, logistics, the environment, transportation, and so on. Besides, more sensing abilities are added and its use is extended to medical/security/national defense areas. Technology of developing a chip, an antenna, and packaging is critical to lowering the prices to 5 cents or below and making it have a small size as well as advanced functions. In future a tag will be integrated with a super cheap price (1 cent or below), a wireless chip/sensor, and a simple function. Table.1 depicts the characteristics of an RFID by its frequency range. An RFID reader can read 100 tags per a second by adopting tag anti-collision algorithms but the technology aims at reading several hundreds. Since the use of mixed frequency range (13.56MHz, 900MHz, and 2.4GHz) is expected, a multi-frequency/multi-protocol reader should be developed. Currently, the sensing distance and accuracy of an RFID reader appears to be limited by the function of an antenna as well as surrounding circumstances. In order to enhance the sensor function, therefore, arrangement of 2~4 antennas is used. Beam-forming antennas, which control beams by responding to the environments, will be applied in the future. Research should be done on tag anti-collision also. There must be identifier code system that gives a tag identification numbers according to regions, for the technology will employ electric tags using identification schemes to identify an object. Related technologies are EPC(96bit) system developed by EAN and UCC, which leads international distribution standardization, and u-ID(126bit) system by Japan. Meanwhile, IPv6 of 128bit is being promoted for the Internet address system, indicating that providers need to scale up global efforts to establish code system standardization. The U.S. government is seeking to utilize RFID technology to reduce costs and enhance services. According to the GAO report in U.S., 13 of 24 federal bodies are using the RFID or planning to apply the technology. The rest has no plan regarding the technology yet. The GAO report on 'Information protection-RFID technology for federal government' was written out at the request of members of the House of Representatives. GAO surveyed various organizations including Department of State, Department of Defense, Department of Energy, Department of Homeland Security, Department of Health, Department of Labor, and federal bodies including EPA. In addition, Department of Treasury/Transportation, General Affairs Department, NASA, and SSA were surveyed also. According to the report, the governmental organizations are using or planning to use RFID technology in the areas of transportation, keeping track of a ship, freight, document, air service, a patrol of a border, immigration management, electric screening, and so on. Due to the convenience and cost-reduction efficiency of the technology, they are most likely to extend the application of the technology. However, there are problems to be solved before the application. The report reveals lack of standards on multi-operation and compatibility as well as privacy issues.

Still, RFID technology is arousing more interests in Europe as it is applied to retail sale, transportation, medicine, livestock management. Frost & Sullivan, an IT consulting company, estimates that Europe will spend more than 5 billion euro on RFID-related hardware, software, and services in 2007. The market that links retail sale with the government will lead to trend, and transportation and manufacturing industry too. Yet, Frost & Sullivan comments that the high price is the greatest obstacle to the distribution of RFID technology and thus the providers should try to offer realistic prices. Though Frost & Sullivan admitted it would take some time until the providers achieve the price, they also maintained that the RFID prices had already gone down. Regarding mobile communications providers, it argues that RFID technology would raise their profits per a subscriber. Frost & Sullivan continues to say that the providers may not see special business opportunities or large profits from RFID projects before 2007 but they still need to prepare for future business by developing strategies [2], [3], [4].

3. The Military Supplies system for using RFID

3.1 Military Supplies

Military supplies are classified according to the number of pieces, nature (expendables and non-expendables), unit prices (high and low), and so on. Of the various standards, classification based on their kinds is used most common. So let's take a close look at the way supplies are classified into Class.1-Class.10 according to their usage and nature[5], [6].

[Table 1] Classification Class Ⅰ-Class Ⅹ

Class	Items	Remarks
1	Food	Meals ready to eat
2	General supplies, tying materials, parts of a gun, clothing and individual outfits	
3	Oil, hard coal, an antifreeze solution, chemicals	
4	Construction materials, timbers	Cement, paint
5	Munitions	Including Explosives
6	Individual stuffs	PX goods
7	Finished goods (equipment)	
8	Medical devices/supplies	Medicines, medical devices/ equipment parts to repair
9	Parts/accessories to repair	An engine, a tire
10	Materials for service of public welfare	Farming tools

Military supplies are also divided by their functions such as fire power, movement, special weaponry,

telecommunication, and electronics, aviation and shipping, general equipment, supplies, munitions, and medical supplies (9 categories in total).

[Table 2] Classification by functions

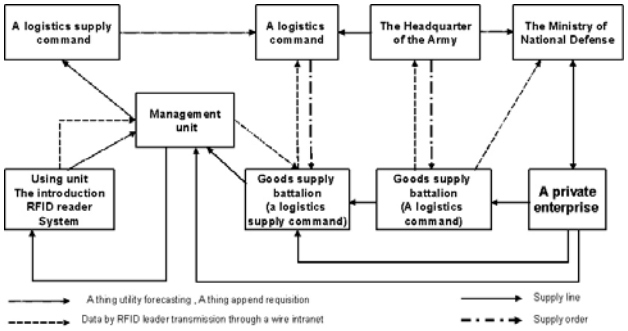
Functions	Class	Scope
Fire power	7,9	Equipment of fire power Parts to repair maintenance materials
Movement	7,9	Vehicles and trailers Part to repair and maintenance materials Part for a vehicle with variousequipment
Special weaponry	7,9	Equipment designated by special weapons Parts to repair
Telecommunication & Electronics	2,7,9	Telecommunications devices Computation equipment and expendables High price software barcode system
Aviation and shipping	7,9	An airplane, a ship, and the equipment Parts to repair
General equipment	7,9	Construction /power supply /river-crossing /duty support equipment Parts to repair
Supplies	2,3	Chemicals, an antifreeze solution, heating/cooking equipment Clothing, individual outfits, a tent, a tool, expendables
Goods	1,3,4	Stable/subsidiary food Oil and hard coal Construction/engineering work
Munitions	5	Munitions for fire power equipment Various explosives
Medical supplies	8	Medical devices and their parts Medicines, sanitary / medical devices / materials

4. Logistics System

ROKA logistics system is divided by the enterprises' delivery types. First, supplies could be directly sent to both a supply unit and a military unit that needs the articles. Or they could be delivered to a logistics supply command and then to a military unit which needs the articles. With respect to expendables, a unit can make a request for them while it reports the status of non-expendables every quarter to expect the demand.

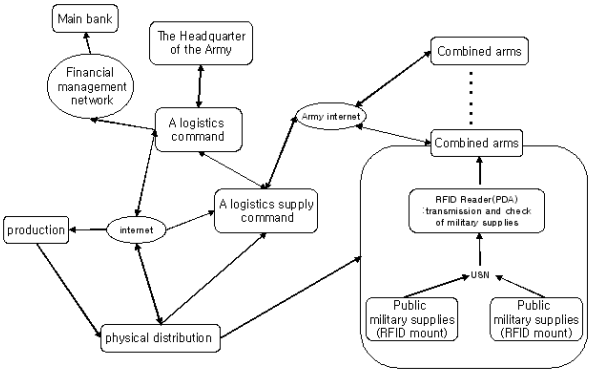
Such system may require longer time, for the logistics supply command takes charge of the distribution but allows accuracy of an itemized statement and real-time service. In the above mentioned logistics system a quarterly report replaces a request and a channel of logistics supply collects the reports. The flow of supplies is direct delivery from an enterprise to a unit but administrative procedures are done by a sup-port unit, creating inconsistency. And supplies are divided by their use and kinds in the system.

Introduction of RFID technology to the logistics system as depicted in Figure 1 can prevent waste of a budget and other resources by prompt delivery and accurate management of supplies. In addition, though a division promises to offer required supplies when they are not in stock, the request in not made in an automatic manner so that the supplies appear to be depleted unless the official in charge of logistics system ask for the articles. Unlike officials in higher divisions, military units do not know about the schedule when the supplies are delivered. Because there's no automatic system among a division, a logistics supply command, and a logistics command, it's hard to receive needed supplies even when they are in stock.



(Fig.1) Logistic System by RFID Technology

But the introduction of RFID technology can solve the problem, providing a network for the Ministry of National Defense, the Logistics Command, a logistics supply command, and the other relevant organizations so that they can supply articles based on accurate data. A RFID reader attached to a PDA can be applied to a military operation also.



(Fig.2) Logistics System by USN

The data of materials and human resources, employing RFID technology, can be used as operation data of a war game. There is a variety of kinds of a war game and The U.S. Navy defines it as a simulation of a military operation involving two or more forces who depict an actual or assumed situation. At present, such a war game is operated to understand efficient operation of air power in Korea. And the data obtained by RFID technology can extend the simulated military operations to the whole army.

5. Conclusion

The logistics system of ROKA is divided by the way of delivery: direct delivery from an enterprise to both a support unit and a unit that needs supplies and the deliver to a logistics supply command which sends the supplies to a military unit. Concerning expendables, a unit can make a request, but it makes a report of non-expendables to expect the demand. The logistics system may have an advantage of responding each situation but also causes waste of time and a budget.

To address the problem this document took a look at the logistics system using RFID technology. But the document has its limitations, for use of RFID in a logistics

system has yet to be developed and there're not sufficient data to prove the effect of the system. Though large-scale logistics companies are active in adopting RFID system, the analysis of the effect should be done in the near future. RFID technology is becoming a new system for automatic management of physical distribution. And it would provide the army logistics with a new method to control manufacturing, delivery, and human resources in real time.

Army logistics system has employed high technology and this document analyzed the system of physical distribution in order to apply the data to military operations. RFID and USN discussed herein can be introduced to the logistics system and they will serve to provide data for a war game. Still, this document has its limitations because the use of RFID in a logistics system is in a development stage yet and there're not sufficient data to prove its effect in logistics system. Though large-scale logistics companies are active in adopting RFID system, the analysis of its effect should be carried out in the near future. RFID technology is becoming a new system for automatic management of physical distribution. And it would provide the army logistics with a new method to upgrade a war game and acquire better results.

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