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"Video Integration in Friendly Force Tracking systems: SIMACOP-FFT, a field experience"

Topic 5

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Abstract

Friendly Force Tracking Systems (FFTS) are the lowest echelon command and control information systems (C2IS) in any army command and control architecture. Their initial goal is to provide near real-time information about own troops position. However, in foreseeable current empty battlefields as well as in asymmetric confrontations at least two extra functionalities are required: 1) sensor integration capabilities and 2) extra features allowing traditional C2 functions over small units with high mobility, possibly from battalion level downwards dismounted soldier. SIMACOP, developed by Technical University of Valencia, provides upon a FFT system basic C2 functionalities previously stated: threat, alarm and ORBAT management; overlaying and tactical chat messaging as well as sensor integration, with special focus on video. System has been successfully evaluated by Spanish Army and has been used as a basic tool for manoeuvres carried by Spanish Army 8th Light Cavalry Regiment and the Signal Brigade. In this work the fielded experience of the system at such realistic scenarios is shown demonstrating its C2 capabilities far beyond from being a simple FFT system. Precisely, 'sensor-on-network' concept has been demonstrated by means of video-server integration, implementing the "Post and smart pull" communication paradigm. Gaining access to video information from any sensor at any C2 post, bears to a sensible enhancement in agility and mission effectiveness.

Keywords: Command and Control, positioning, tactical communications, sensor integration, FFT field trials.

1. Introduction

Generally, command and control systems of land armies have as main goal the generation of the Common Operational Picture (COP) at large unit level, i.e. Battalion and above. Blue Force Tracking is a United States military term used to denote a GPS-enabled system that provides military commanders and forces with location information about friendly (and despite its name, also about hostile) military forces, currently it has evolved to a Friendly Force Tracking as an equivalent term.

FFT systems consist of a computer, used to display location information, a satellite terminal and satellite antenna, used to transmit location and other military data, a positioning system usually GPS but in a near future others like GALILEO (to determine its own position), command-and-control software (to send and receive orders, and many other battlefield support functions), and mapping software, usually in the form of a GIS, that plots the FFT device on a map. The system displays the location of the host vehicle on the computer's terrain-map display, along with the locations of other platforms (friendly in blue, and enemy in red) in their respective locations. FFT can also be used to send and receive text and imagery messages, and FFT has a mechanism for reporting the locations of enemy forces and other battlefield conditions (for example, the location of mine fields, battlefield obstacles, bridges that are damaged, etc.).

However, in most current conflicts, including peacekeeping missions, the majority of operations are performed by small units: companies, platoons, or even squads. It is relevant to highlight, in the framework of asymmetric conflicts, urban warfare or antiterrorist operations.

Additionally, in peace-keeping and humanitarian operations, command and control functions have to be executed over small units, even individuals, belonging to different COIs, e.g. military, civilian or NGO. Usually belonging to different nationalities and holding different training and doctrine levels.

In this kind of operations, for command and control is mandatory to have a global vision of the situation (Situational Awareness) by means of sharing each unit situation perception or even from individuals (Individual Awareness). From the perception sharing (Shared Awareness), collaboration between units is achieved; larger agility and an improved efficiency in the accomplishment of the mission.

In these scenarios, in order to get an improved and enriched SA, the person on command has to “see with his own eyes” the situation to make the adequate

tactical decisions. To perform this action, acquisition and fusion of multimedia information, coming from several sensors, and among this multimedia information the most relevant is video streaming.

Within a classification of command and control systems, three large levels could be distinguished:

- Large units command and control systems, brigade and above.
- Small units command and control systems, battalion and below. Usually these systems are known as Battlefield Management Systems (BMS)
- Friendly Force Tracking (FFT) systems, which allow automatic positioning of units over a GIS, by receiving their position over the corresponding tactical networks.

To avoid systems redundancy there is a clear convergence between BMS and FFT systems, mainly: automatic positioning of units should be accompanied by command and control tools, e.g. threats management, alarms management, sharing of information over dynamic objects in the battlefield, configuration and reconfiguration of ad-hoc units during mission time, messaging and planning.

Some good examples of systems located in the border of BMS and FFT are: FBCB2 (Force XXI Battle Command Brigade and Below) from the US Army, in which also is based NATO IFTS used in Afghanistan, and also French EADS Imp@ct. To make command decisions easier at all layers, real time availability of networked sensors information, following the NATO NEC (Network Enabled Capability) concept is a must. Access to video and telemetry information from an UAV or from independent cameras or terrestrial vehicles is a fundamental goal of modern C4ISR systems, preferably integrated in the FFT/BMS

The rest of the paper is structured as follows: second section describes SIMACOP as an FFT system useful for small unit command and control, describing its main capabilities and options. The third section will describe two field trials experiences in which the FFT system was used so as its capability of

integrating video sensors. The paper will finish with the conclusions and future work.

2. SIMACOP: An FFT System for Small Units Command and Control

SIMACOP stands for *Sistema de Información para MAndo y COntrol de Pequeñas unidades*, in English “Small Units Command and Control Information System”. In its FFT version, command and control functions are performed from battalion level to individual soldier, including the following:

- Alarms
- Threats inclusion and broadcasting.
- Short messaging in tactical chat format.
- Ortophotos marking and broadcasting.
- ORBAT generation.
- Units filtering.
- NFFI interoperability and with Spanish Army command and control IS (SIMACET) via COE.

Interoperability capability with SIMACET has been provided and it is an option that has to be highlighted because it is an interesting feature that lacks these large command and control tool of the Spanish Army. It is performed by means of COE 1.0 and COE 2.0. It allows the representation of units with a size smaller than battalion over the main command and control tool of the Spanish Army, after an adequate filtering.

On the other hand, SIMACOP-FFT has integrated the communication capability with other FFT from allied countries by means of NATO NFFI (NATO Friendly Force Information) standard, in its IP1, IP2 y SIP3 versions. This capability has been extensively tested in CWID exercises with all NATO countries involved.

The systems allows sensors integration associated to an individual unit, and possible access to other units if transmission means have enough bandwidth available. Integrated sensors are:

- Video and infrared sensors.
- Telemetric binoculars.

- Deployable wireless sensor networks to detect presence (acoustic, seismic and infrared) and also temperature.

Figure 1. SIMACOP-FFT application interfaces.

Regarding communication networks, SIMACOP-FFT includes communication modules, allowing interaction with tactical communication means currently in use in the Spanish Army.

- VHF PR4G version 3 and version 2 radios
- HF Harris 5800 radios
- X-band military satellite means: TLB, TLX and SoTM (Satcom on the move)
- Personal Combat Radios ITT Spearnet (used by COMFUT, the Spanish Future Soldier Program)

SIMACOP-FFT has been developed to use regular civilian communications means. These means are frequently used in military and coordinated missions in which confidentiality is not an issue:

- L-band global coverage satellites: Inmarsat, Iridium and Thuraya.
- Tetrapol

- UMTS/GPRS
- WiFi and WiMAX

Finally it is important to highlight the friendly HMI, with all the functionalities easily accessible by means of a tactile screen, even with gloves and vehicles in movement. Versions for PC, tablet PC and PDA have been developed, and they run over different operating systems. This kind of HMI is broadly used in all kind of tactical applications.

Figure 2. SIMACOP running over a PC a) and over a PDA b)

Within the Military Community, there is a need for a user friendly FFT and Situational Awareness system that can provide information to and from troops quickly and reliably. A system like this would provide greater visibility of assets, access to information for decision makers in rear-areas, and a trustworthy communication link to troops on the ground. Military users in particular face a significant risk when operating in environments with low visibility of other units. In particular, friendly units have an increased incidence of fratricide due to lack of SA. Minimizing the risk to troops, and increasing the amount of real-time battlefield intelligence depends on the operator's ability to have easy access to a SA system that is readily available in any situation. System scalability is needed in order to reach users in rear-areas, vehicles, and dismounted

situations, and data needs to be compatible with legacy Command and Control (C2) applications. SIMACOP-FFT provides all this, and it is implemented using COTS technology.

3. Field trials

The system has been tested and evaluated in its early stages by the Spanish Army, in the Spanish CWID (Coalition Warrior Interoperability Demonstration) 2006 event. Later, during 2006, new interoperability tests were performed in the 20007 and 2008 NATO CWID events in Lillehammer (Norway) with the French FFT systems (Imp@ct and Maestro) so as with the German, Italian, Norwegian and Romanian FFT systems. Regarding non-national FFT systems SIMACOP-FFT also was tested with the LTIS system developed by NATO NC3A.

Moreover, the system supported the exercise performed in CWID 2008 on the Spanish side, allowing the NFFI interoperability of a virtual Spanish battalion provided by Spain to the corresponding NRF of the exercise.

The viability of the system to be used in an operative environment was evaluated by the Spanish Army branch in charge of ICT systems (JCISAT), in April 2008, in a deployment of nearly twenty vehicles, working in scenarios with a combination of VHF, HF and global coverage satellites.

However, as fundamental field trials we have to highlight two main exercises performed by the Spanish Army:

- Support to the LIVEX exercise performed by the 8th Light Cavalry Regiment “Lusitania”, in May 2008 in the manoeuvres area of Chinchilla (Albacete).
- The scenario implemented by the Signal Brigade of the Spanish Army in Marines (Valencia) during the Practical CIS training (EPCIS).

LIVEX Exercise

This exercise was performed by the 8th Light Cavalry Regiment “Lusitania”, with all the available material. This fact allowed the research team to evaluate the capabilities of the FFT system on the field in a simulated environment as similar

as possible to real operations. The unit was simulating a peace-keeping simulation in Middle East. The main conclusions extracted from this first trial were:

- SIMACOP-FFT capability to operate in highly dynamical units, with little support of computer and communication specialists and a high facility of installation, maintenance and use.
- Fast acquisition by the cavalry personnel of the potentialities and capabilities of the system, i.e. usability
- Appreciable reduction in voice communication by the teams involved in the exercise to provide positioning and situation reports, so as to provide command orders. This is due to the FFT system command and control capabilities. In other words the FFT system provide to the command elements and the operating units, a shared perception of the situation, making auto-synchronization possible and definitively the reduction in the flow of reporting messages and orders, upwards and downwards respectively in the hierarchical structure of the unit.

The following figure provides a clear understanding of the use of the DDT system. It can be seen for the same tactical situation the traditional way of conducting operations using a map and sticks and the capabilities of the FFT system with a computer screen.

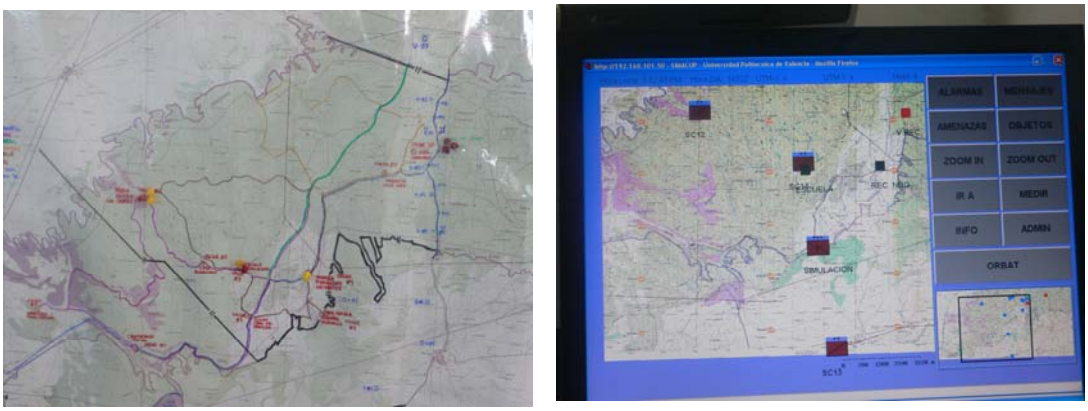

Figure 3. Tradicional performance of an exercise a) and b) SIMACOP-FFT screenshot with the same tactical situation

EPCIS scenario

EPCIS, is a training exercise performed by the Signal Brigade of the Spanish Army every year. This exercise is highly interesting because all communications means of the Spanish Army are tested at the same time, and different scenarios in which communications are a key component are simulated. Currently the Signal Brigade provides communication support to the Spanish units deployed in Lebanon (UNIFIL) and in Afghanistan (NATO ISAF). Scenarios based on operations in these two countries with different communications means were simulated and over the communications structure SIMACOP-FFT was successfully tested.

The main goal of the SIMACOP-FFT scenarios carried out during EPCIS, was the evaluation of two concepts:

- Use viability of the FFT system in operations zone (Afghanistan and Lebanon) and support for remote command and control of them from Spain.
- The management and integration capability of visual sensors (video) within the FFT system in real operations, specifically video streaming information coming from UAVs (Unmmaned Air Vehicles), like the Spanish MoD UAV SIVA.

First goal was fully successful, and it was possible to test the working capability of the FFT system over different combined transmission means (HF, VHF, military and global geostationary satellites), so as the replication between command post of the FFT information from the operations zone to the main command post in Spain by means of X band satellite means currently in use in the Spanish army: TLB and TLX terminals.

Regarding the second objective, the viability of the NEC concept “sensor within the network” was fully and successfully tested. Traditionally, each sensor on the battlefield is associated to the weapons platform that makes use of it. Nevertheless, in the command and control NEC concept, sensors, making use of the high connectivity degree provided by the network in use, are no longer linked to a individual platform, and are available to any system that needs and

wants to make use of them in each instant in time. This information management paradigm is known as “post and smart pull”.

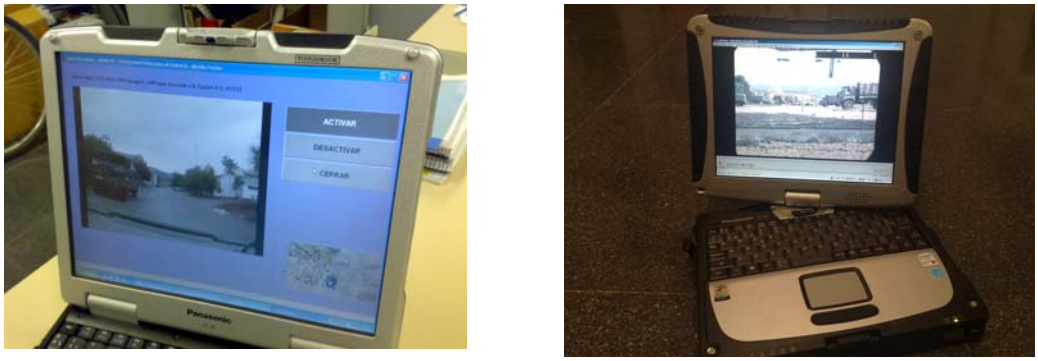

Figure 4. SIMACOP FFT Video integration: video from a vehicular SOTM a) and video from a SIVA UAV b)

During the exercise the concept viability was successfully tested due to the FFT capability for integrating different kind of sensors. A video flow received from the SIVA UAV (Spanish Army UAV), could be seen simultaneously in the advanced command post in the operations zone (e.g. Lebanon); in the command post in Spain and in a vehicle in movement equipped with the corresponding FFT terminal. The latter is really which would need the images and the telemetry captured from the UAV, even when this vehicle is connected to a subnet different to the one of the SIVA land control station.

4. Conclusions

SIMACOP system Developer at UPV, and used as FFT, offers more capabilities a part of localization and navigation. Acting as a real small units command and control system, with an additional benefit of a reduced complexity and cost if compared with the most popular BMS on the market.

One of the key design concepts of the system, is its capability of using any communication mean (HF, VHF, satellite,…), besides its full software conception. This design makes the system fully independent of the hardware (platform and transmission mean) over it would work.

SIMACOP FFT provides new features for the most different tactical situations (moving vehicles, dismounted soldiers, …). On the other hand, the capability of integrating sensors, video and telemetry, allow the development of the most advanced NEC concepts over SIMACOP.

Field trials have proved its capability to operate in highly dynamical units, with little support of computer and communication specialists and an appreciable reduction in voice communication to provide positioning and situation reports, so as to provide command orders. At the same time the FFT system provides the management and integration capability of visual sensors (video) in real operations, specifically video streaming information coming from UAV and other tactical sensors. Summarizing the FFT system provide to the command elements and the operating units, a shared perception of the situation, making auto-synchronization possible and definitively the reduction in the flow of reporting messages and orders, upwards and downwards respectively in the hierarchical structure of the unit.

The field experience explained in this paper proofs the operability and maturity of the system, comparable or even improving similar systems from different countries in several components and capabilities. Currently the system has been acquired by the Spanish Army and is going to be used in different operations and countries.

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