



UNIVERSIDAD
POLITÉCNICA
DE VALENCIA



UNIVERSIDAD POLITÉCNICA de VALENCIA



Prof. Manuel Esteve

Distributed Real Time Systems Lab



COMMAND AND CONTROL INFORMATION SYSTEMS FOR SMALL UNITS: *SIMACOP*, A RESEARCH SYSTEM TO TEST NEW CONCEPTS

11th ICCRTS



Motivation



- SIMACOP is an experimental C4ISR multimedia system developed by the Real Time Distributed Systems Lab which belongs to the Communications Department, UPV, Spain.
- Starting point: the majority of current C2 systems have been defined for big units (e.g. Battalion size and bigger). However the modern conflicts and current operations demand C2 systems for smaller units such as squads and platoons.
- Peacekeeping operations, antiterrorist operations, and in general asymmetric operations demand to obtain the adequate shared awareness among small units involved in the operation, generating the adequate mission COP.



Motivation



- It would be extremely useful a command and control tool which:
 - Allows obtaining the COP at platoon and squad level.
 - Virtually locating friend, neutral and enemy units over an operations theatre cartographic database with the suitable scalability at each level.
 - Facilitates command and control decisions to platoon and squad level, from one or from many tactical command and control post, forward or rear.
 - Allows *self-synchronization* among platoons, *shared awareness based*.
 - Acquires individualized data from troop units, which therefore will act as sensors and actors simultaneously.



Motivation



- To develop all these objectives, we will start from two premises:
 - Availability of a combat network capable of delivering digital data with the appropriated bandwidth: WIFI and WIMAX technologies are currently the most appropriated for this goal although it would be important to take into account security and coverage issues.
 - Automated information acquisition for COP generation: this process must be performed transparently to the troop units, that is, without their intervention in the information elaboration process and without interfering in their tasks.



Motivation



- **The best option to obtain the adequate SA, would be:**
 - 1) Knowledge of units and individual elements exact location at the operations theatre, by means of a GPS device carried by every individual element.
 - 2) Multimedia information gathering, mainly video, from every individual element to “see through his own eyes”. Therefore, every individual element must carry a video or infrared camera.
 - 3) Moreover, and taking into account the high value of the elements involved, it would be helpful to be able to collect from them biomedical information such as ECG or body temperature, at least. This kind of information would be obtained through biometric sensors allocated on each individual element.
 - 4) Transmission and fusion of gathered data to the C2IS application in the command post through the combat network.



SIMACOP Functional description



- SIMACOP is a small unit's C4ISR multimedia system based in COTS technologies, with multimedia streaming and fusion capabilities, including high quality video streaming.
- The system consists of various C2 nodes connected among them and to individual troops elements with sensor/actuator functionality, by means of a wide capacity (tenths of Mbps) wireless data network, based in IEEE 802.11 WiFi standard in the current functional prototype.
- Integrated Sensors:
 - 1) GPS
 - 2) High quality video streaming MPEG-4
 - 3) Biometrics: ECG, temperature



SIMACOP Functional description



- **Functional approach of the system main issues (I):**
 - Each individual member (squad leader and troop individuals) carries a SBC (Single Board Computer) which fuses data obtained from different sensors (video or infrared camera, GPS, biosensors, enemy and neutral units location identifiers) which fuses and generates a unique information stream per individual element.
 - First level C2 application generates the COP at platoon level since it receives data streams from squads that constitute the platoon. The connection of this platoon command and control post with different squads is done by means of a wireless data network. The C2 application is executed on a militarised laptop with wireless connection.
 - The squad commander is equipped with a tablet PC where the squad soldiers GPS position is shown on a operation theatre GIS.



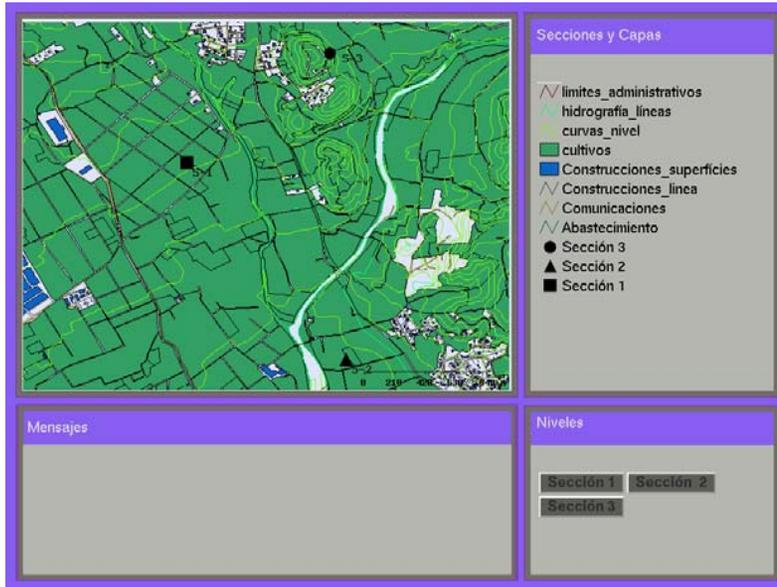
SIMACOP Functional description



- **Functional approach of the system main issues (II) :**
 - C2 node can receive and fuse streams from other non-human sensor sources such as managed aerial vehicles (helicopter flying over operations theatre) or non managed (UAV) or fixed sensors distributed in the operations field (cameras with streaming capacity, presence sensors, etc).
 - A platoon/squad level C2 node can operate isolated, in auto synchronized way with other C2 nodes involved in the mission, or under the hierarchy of a higher level C2 post that coordinates several platoon/squad level C2 nodes.
 - The command orders are transmitted via voice through the combat radio network. The integration of VoIP in the system is a future research line.
 - Capacity of interoperability with SIMACET© and other C2IS associated to the NATO interconexion system level 5 due to the use of C2IEDM.



SIMACOP Functional description



Platoon level screen



Platoon/Squad level screen



SIMACOP Functional description



Unidades de Tropa y Capas

- limites_administrativos
- hidrografia_lineas
- curvas_nivel
- cultivos
- Construcciones_superficies
- Construcciones_linea
- Comunicaciones
- Abastecimiento
- Jefe de Pelotón
- Unidad de Tropa 7
- Unidad de Tropa 6
- Unidad de Tropa 5
- Unidad de Tropa 4
- Unidad de Tropa 3
- Unidad de Tropa 2
- Unidad de Tropa 1

Mensajes

Niveles

JP UT 1 UT 2 UT 3
UT 4 UT 5 UT 6 UT 7
Sección Secciones

Squad level screen



Identificación Unidad de Tropa

Carvajal Rodrigo, Federico Jesus

Situación Pelotón

09:14:27 Sec-1 UT-1

Constantes Vitales

Temperatura: 25 C
Pulso : 92

JP UT 1 UT 2 UT 3
UT 4 UT 5 UT 6 UT 7
Sección Secciones

Troop unit level screen



Potential benefits



- The system incorporates the most advanced concepts in the current C2IS development:
 - Agility. Command and control adaptability to a variety of dynamic scenarios.
 - Information power in the mission border (*Power to the Edge*). In the above cited missions, it is required a powerful information system at the operations theatre, directly interacting with enemy forces.
 - Self-synchronization. It is based on the shared reality perception (Situational Awareness) of mission involved units and, to be efficient, requires clear starting orders, effectiveness in the low echelon commanders, complete shared information regarding the tactical scenario and mutual trust among units. SIMACOP considers all these aspects.



Development state

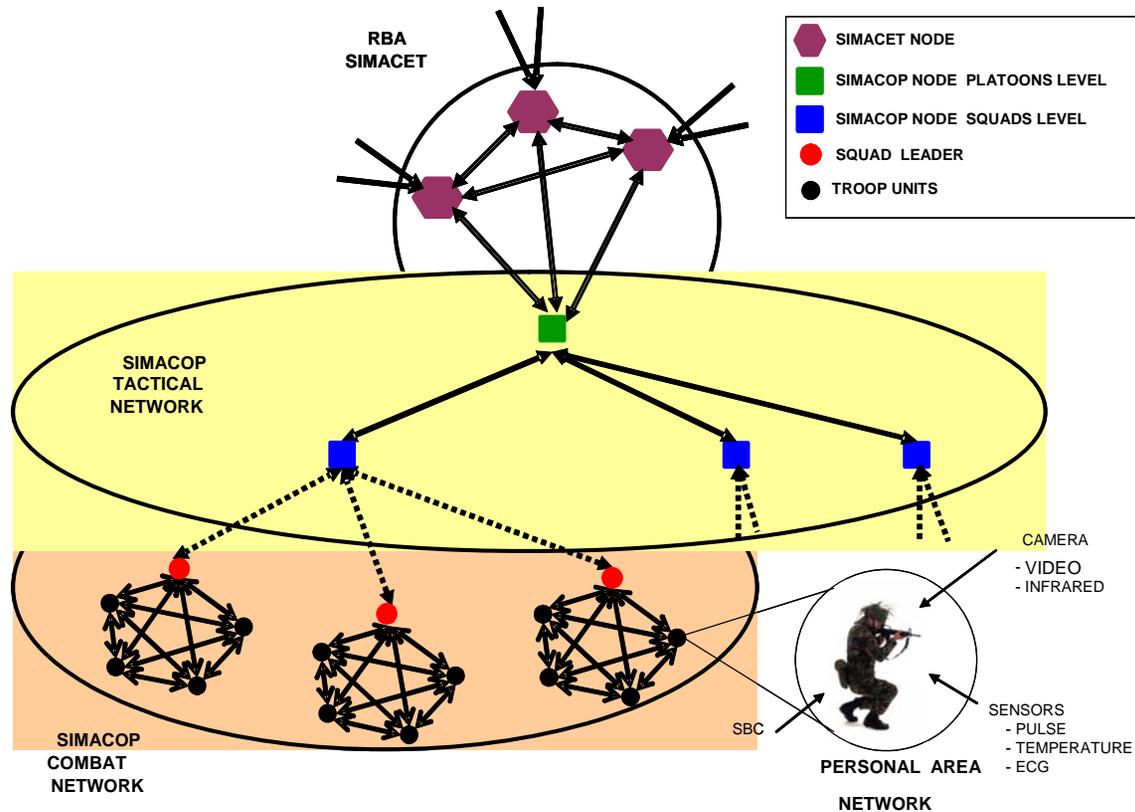


- Currently, there is a completely developed stable prototype that includes all the features described before
- Next steps in development are:
 - IEEE 802.16 WiMax connectivity.
 - Automatic designation and localization of neutral and enemy forces.
 - Simultaneous camera playback at the C2 node.
 - Incorporation of security mechanisms for wireless communications.
 - Incorporation of VoIP techniques for the vocal communications.



SIMACOP Technical description

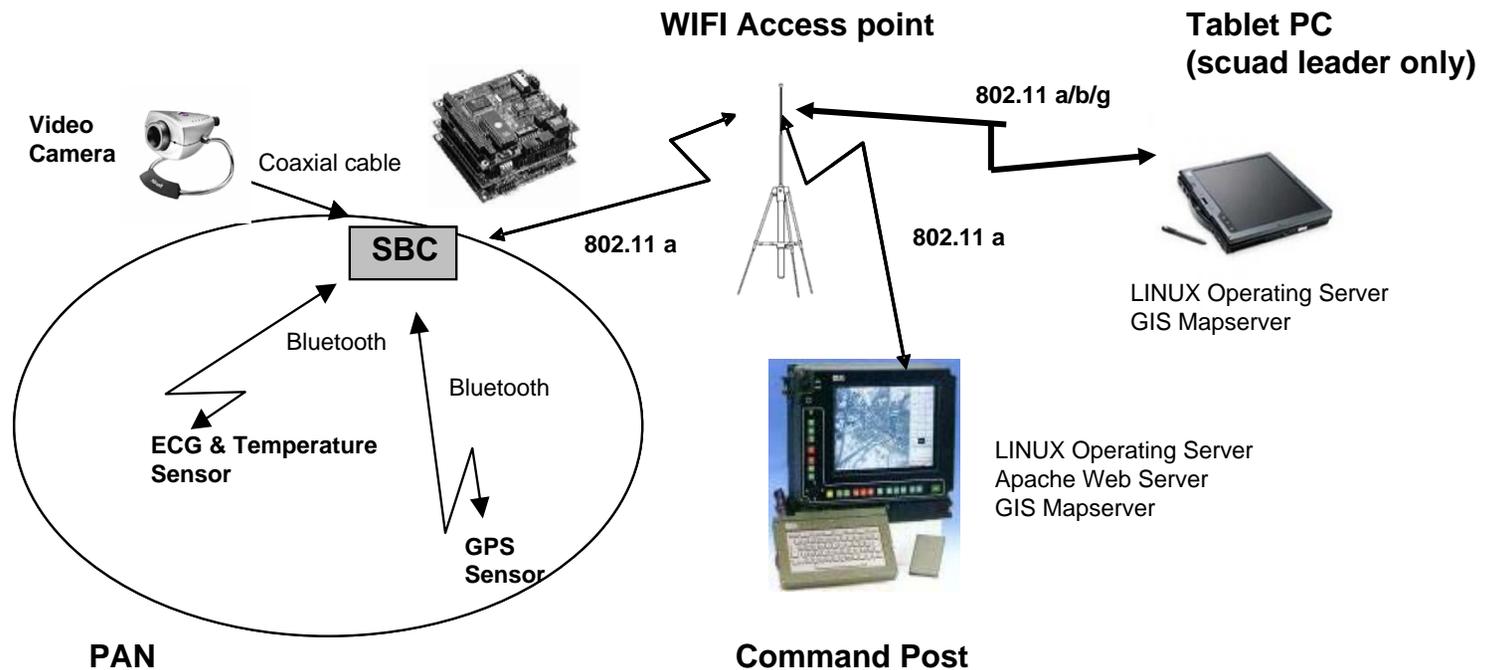
- System architecture:



SIMACOP Technical description



- COTS technologies used:



Field experience



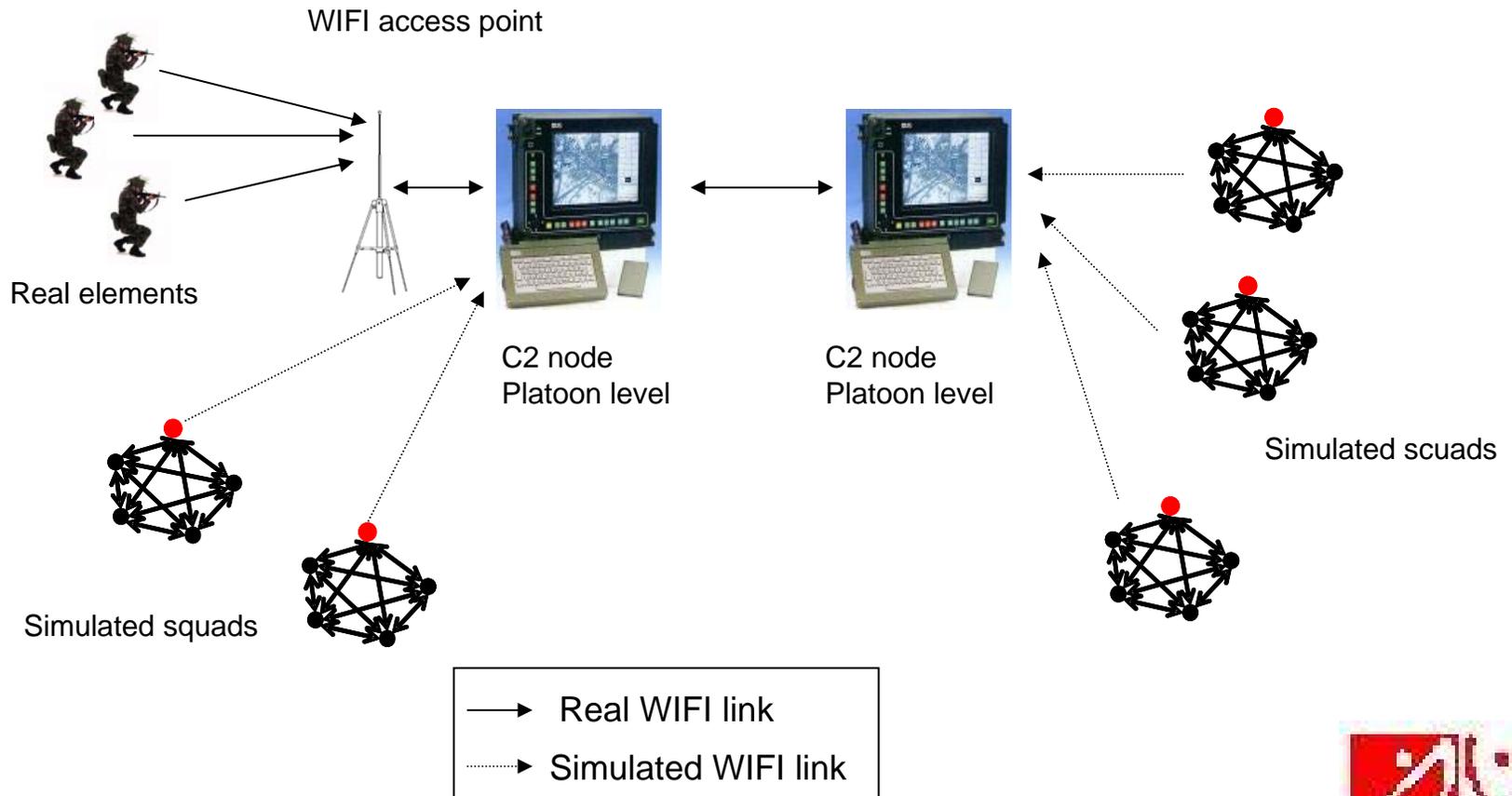
- SIMACOP was selected for the Coalition Warrior Interoperability Demonstration (CWID) 2006. The demonstration was performed in the Spanish Army Signal Brigade General Almirante base manoeuvre field last May 3rd, 2006.
- CWID 2006 demonstration components:
 - Two section/squad C2 nodes with its own WIFI access point for connecting with its squads and a WIFI bridge for connecting with other C2 nodes.
 - One platoon level node with two WIFI bridges to connect with the lower level C2 nodes.
 - C2 nodes deployment including their network equipment (laptops, access points and bridges) in two vehicles equipped with electric supply facilities.
 - A military squad composed by 3 individual elements with complete equipment SBC with WIFI link, GPS, video camera in the helmet and biometric sensors.
 - The rest of the demonstration elements were simulated.



Field experience



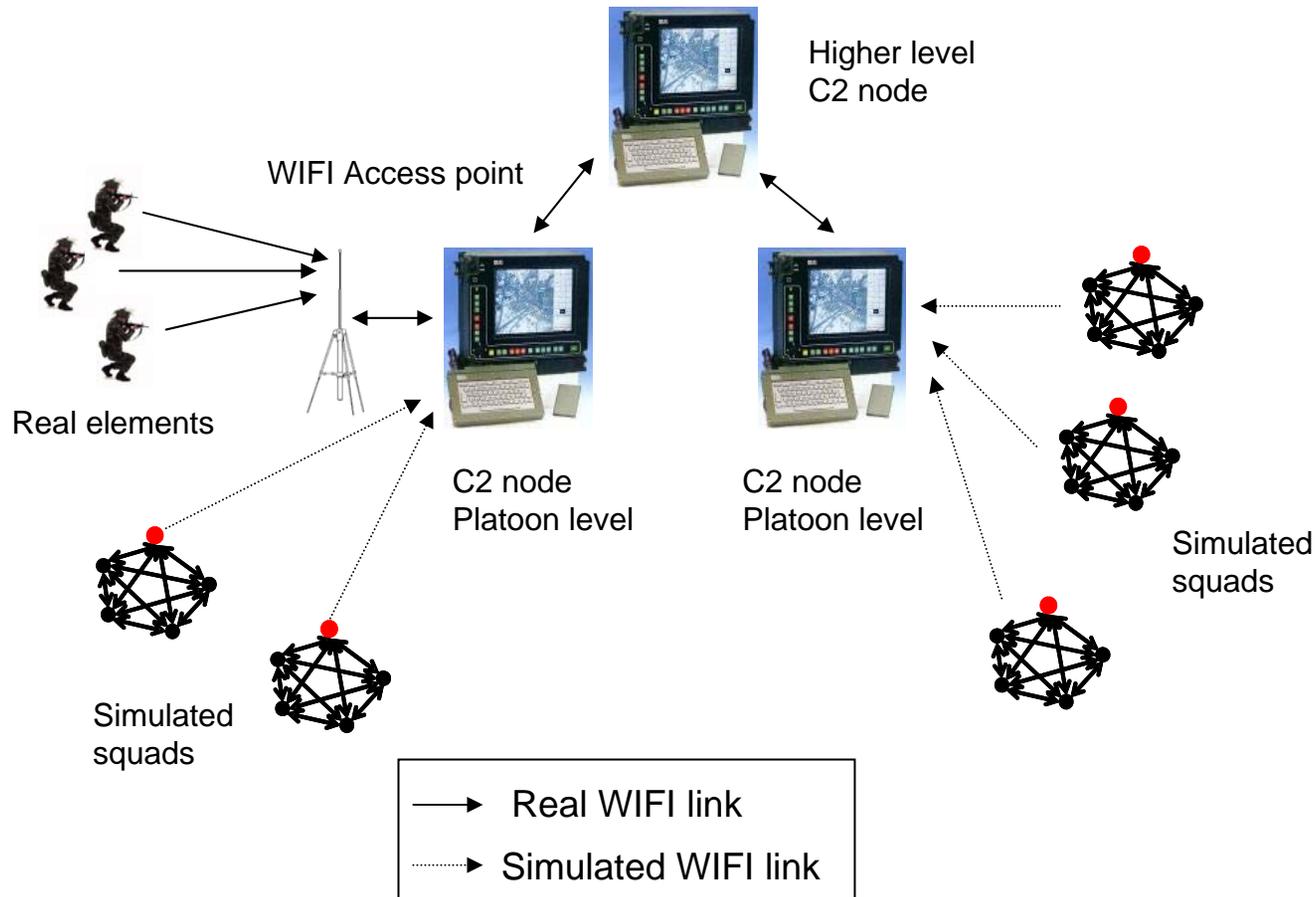
- SIMACOP: Autosynchronized working mode:



Field experience



- SIMACOP: Hierarchical working mode



Field experience



Field experience



- During the demonstration were evaluated the following aspects:
 - The system functional feasibility
 - The WIFI coverage under real operational conditions
 - The lost rate in the WIFI network.
 - Video quality subjective evaluation
 - An overall system operability subjective probe



Field experience



- Some numeric results from this evaluation are:

(0 worst, 5 best)

Video quality at command post	4.5
Situational awareness improvement at command post	4
Decision support improvement	4.5
Application usability	4.5



Future work and conclusions



- Regarding future work, the technical improvements which allow the system to research on new command and control concepts for small units are the following:
 - The use WIMAX wireless technology for giving support to the tactical network. This support could be extended to the combat network when equipment compliant with IEEE 802.16e standard was available with mobility support.
 - To introduce vocal communications based on VoIP which will be directly supported on the tactical and combat networks.
 - To introduce a system for enemy and neutral units automatic designation
 - To introduce an automatic system for positioning own forces (Blue Force Tracking), with indoor positioning capabilities for complementing GPS information.



Future work and conclusions



- SIMACOP advantages which contribute to the use doctrine of C2 systems can be summarized as follows:
 - Through SIMACOP the COP is obtained up to squad level, and also to several platoons level.
 - The auto synchronization among different squads of the same platoon and also among platoons is facilitated by SIMACOP.
 - All information from individual troop units is gathered in an automatic way without interruption of their actions.
 - High quality video inclusion allows the use of the system not only in reconnaissance missions but also in intelligence operations since it allows the identification of targets and situations, in an accurate way and in real time, from a secure and well equipped rear command post





mesteve@dcom.upv.es

