Body Area Networks in Defence Applications

BodyNet Workshop
Oslo – September 24th - 26th, 2012

THALES

◆ **Network Enabled Capability** (NEC) suggests a new and technology-focused concept for fighting future wars and conflicts;

◆ The networked force is the combination of various stand alone computer systems, weapon platforms and people forming an integrated organization that allow military personnel to come together and communicate in ways previously unknown;

◆ NEC is about effective linking or networking of knowledgeable entities that are geographically or hierarchically dispersed.

◆ The networking of knowledgeable entities enables them to share information and collaborate to develop shared awareness and also to collaborate with one another to achieve a degree of self-synchronization.

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◆ The net result is increased combat power due to effective sharing of information among war-fighting platforms;

◆ Some of the reported military advantages of NEC operations include the following:

  ○ Networked forces can be formed with smaller-sized units;

  ○ Networked forces can fight using new tactics because networking allows soldiers to keep track of each other and be connected even if geographically distant;

  ○ The sensor-to-shooter time is reduced. Using NEC systems, soldiers in the field have the capability to conduct an "on-site analysis" of raw intelligence from sensor displays, rather than waiting for return analysis reports to arrive back from other supporting units.

◆ NEC is highly dependant on the ability of geographically dispersed forces to create a high level of mutual battlefield awareness.

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- **Geographically Dispersed Force** are no longer geographically constrained;

- **Knowledgeable Force**: military forces will share a battlefield's situational awareness and the understanding of commanders' intents.

- **Effective Linking** among Battlefield Entities generates synergies and the ability to adapt dynamically to the situation.

- The NEC based evolution of **soldier systems** has led to Soldier Personal Area Networks (PAN) as the soldier is becoming more and more the centre point of the modern warfare;

- **Technological advances** make available a huge number of sensors and peripherals that can be used to provide useful information to the higher hierarchical levels.

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◆ **Body Area Networks** will add new capabilities for NEC support related either to individual level or squad level;

◆ At **individual level** the soldier could benefit from this technology because, using appropriate sensors distributed on its body, vital and health parameters can be monitored and sent to a central unit or device;

◆ At **squad level**, new capabilities could be added using spatial distribution of sensors and their interoperability;

◆ Soldier squads (equipped with PDA, cameras , …) should be able to provide C2 chain with sensors and localization information;

◆ The soldier network will need to integrate several custom and COTS peripherals that comply with different international standards.

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Operational Effectiveness strictly related to configuration modularity.

NEED FOR:

- ◆ **Study Standard Interfaces**

- ◆ **Standard Protocols and DM**

- ◆ **CONEMP/CONUSE**

- ◆ **Holistic Approach**

- ◆ **Equipment Integration**

- ◆ **Ergonomy**

- ◆ **Modularity**

- ◆ **Plug & Play**

- ◆ **and …**

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◆ Technological advances in IP standards, communication means, computational platforms and situational awareness SW make available a huge number of sensors and peripherals.

◆ Effective use by networked soldiers in order to improve perception of the battlefield and share information with his comrades and higher echelons is still an area for improvement.

◆ The situational awareness of the soldier can be drastically improved through distributed and cooperative sensor networks with wearable sensors.

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◆ Identification of current and future **sensors** for the soldier PAN: to wear, to carry, to use for ambient interaction;

◆ Study, search and **adaptation** of COTS technologies and products for the Physical Layer (wired, wireless, fabric and body conductivity);

◆ Investigation of **optimum merging** of the above different network technologies in order to build a soldier PAN that is at the same time scalable and able to host a plurality of network peripherals;

◆ Design of physical and logical network architectures that ensure the **connectivity** to the soldier radio through a PAD (Personal Application Device) preserving the current valuable peripherals and complying with future operational requirements and new devices.

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◆ The soldier PAN must be considered as a Multi-Network Platform that must address several problems:

  ⦾ Interaction and Interference of the BAN with other equipments carried by the soldier;

  ⦾ Communication of **heterogeneous** devices (sensors) at different protocol stacks layers.

  ⦾ Lack of standardization at network/subnetwork level;

 ⦾ Lack of "decision-making" Integrated Application Level.

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The set of equipments and devices carried by the soldier make up a multi network.

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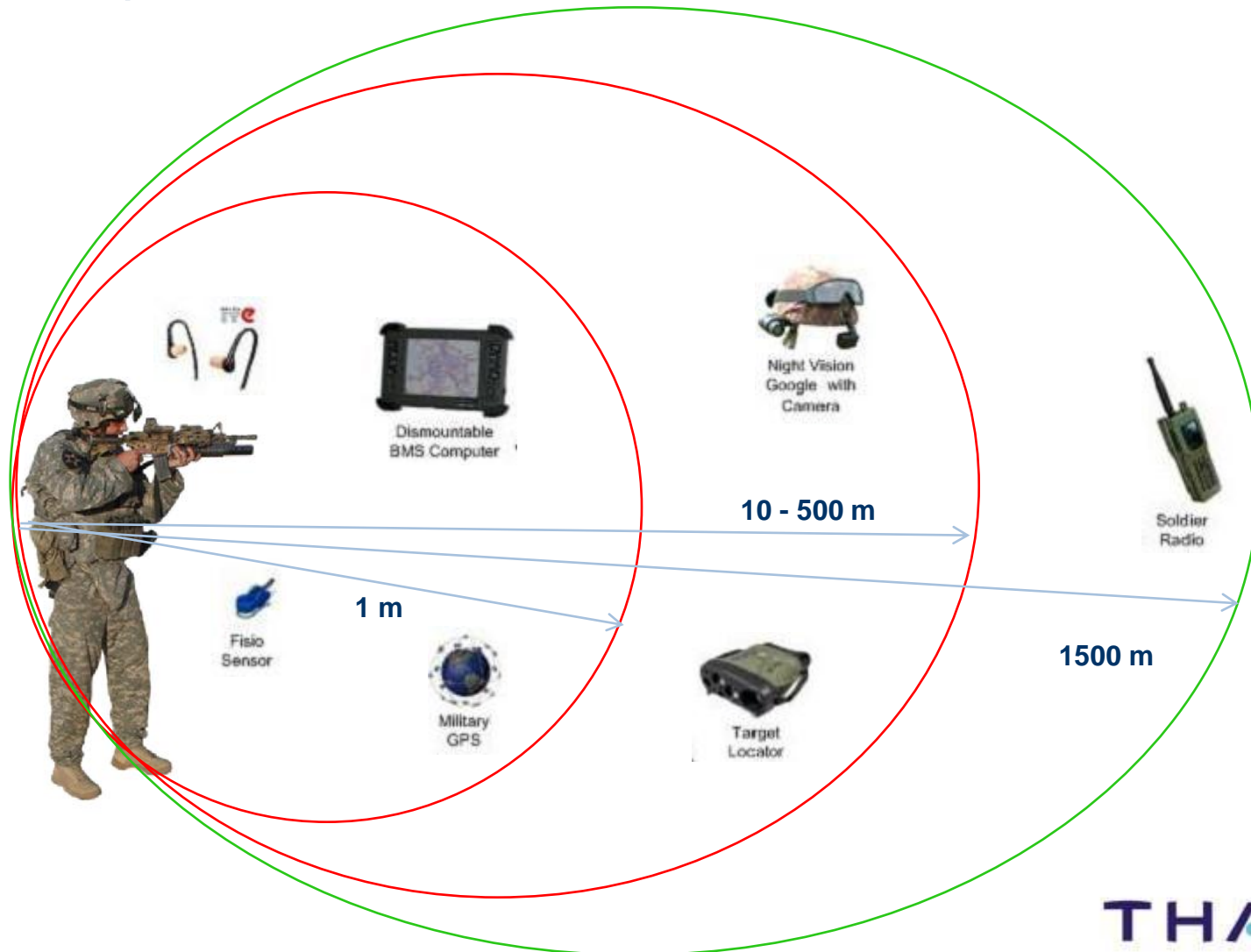
◆ The situational awareness of the soldier through distributed and cooperative sensor networks with wearable sensors can be drastically increased.

◆ There are three applications that could benefit from Body Area Networks in Defence Applications;

- Define ways to locate soldiers in indoor/urban scenarios;

- Define ways to apply audio based sniper detection for networked soldiers;

- Define ways to generate a 3D audio sound reconstruction which gives the soldier immediate perception of the relative position of the speaker.

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◆ Indoor localization of soldiers is essential in modern combat operations;

◆ GPS (and Galileo) are not (or hardly) exploitable;

◆ A combination of complementary techniques could be used:

- ◉ Ultra Wide Band waveform (high precision, short medium range);

- ◉ Accelerometer (medium precision/ accumulating error);

- ◉ GPS (OR Galileo) (long range/low precision.
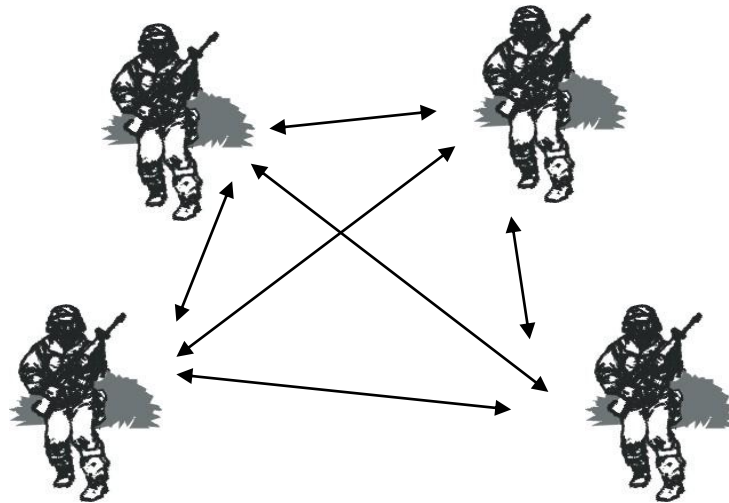
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OPERATIONAL UNITS : SQUAD AND PLATOON
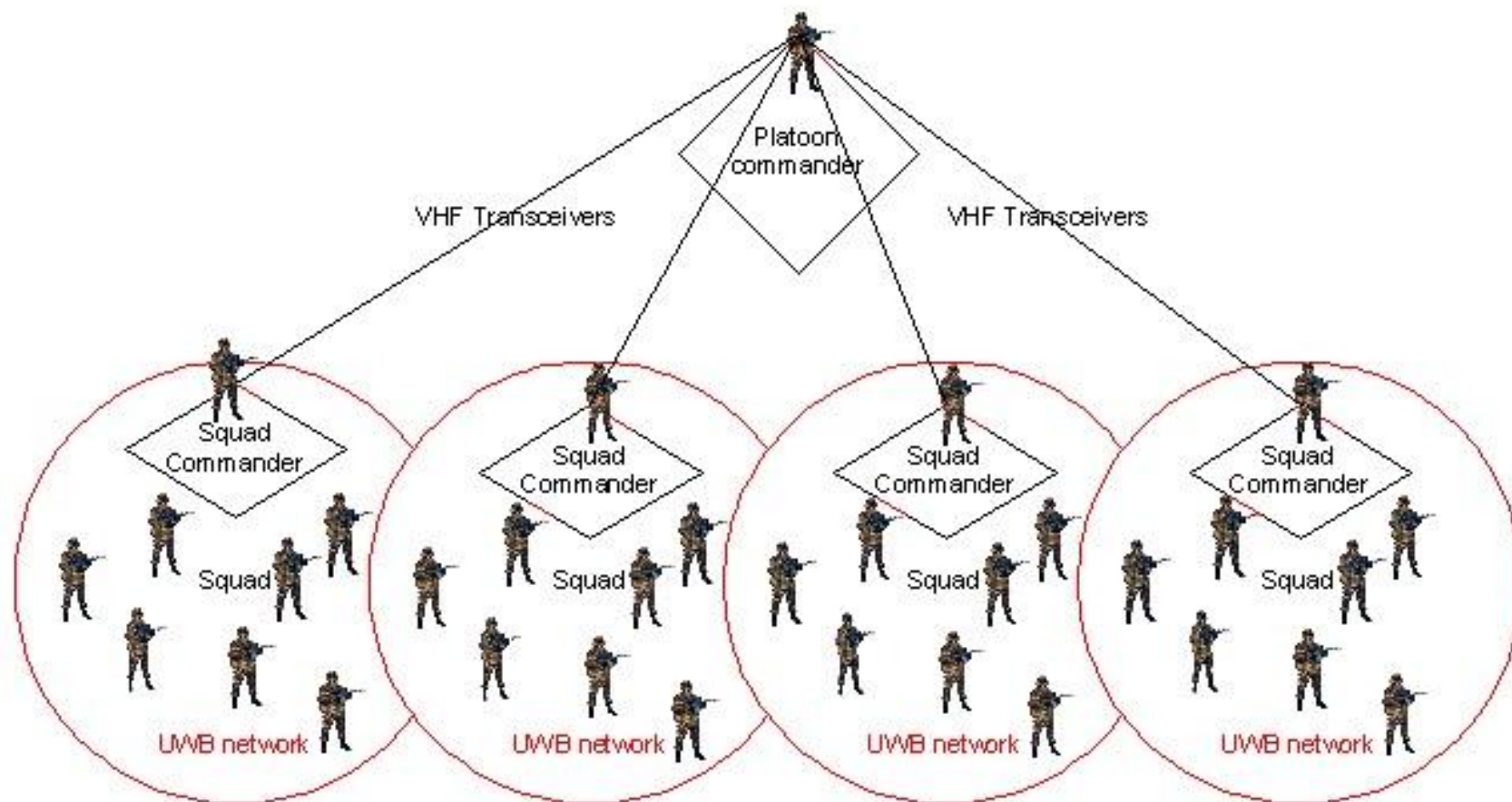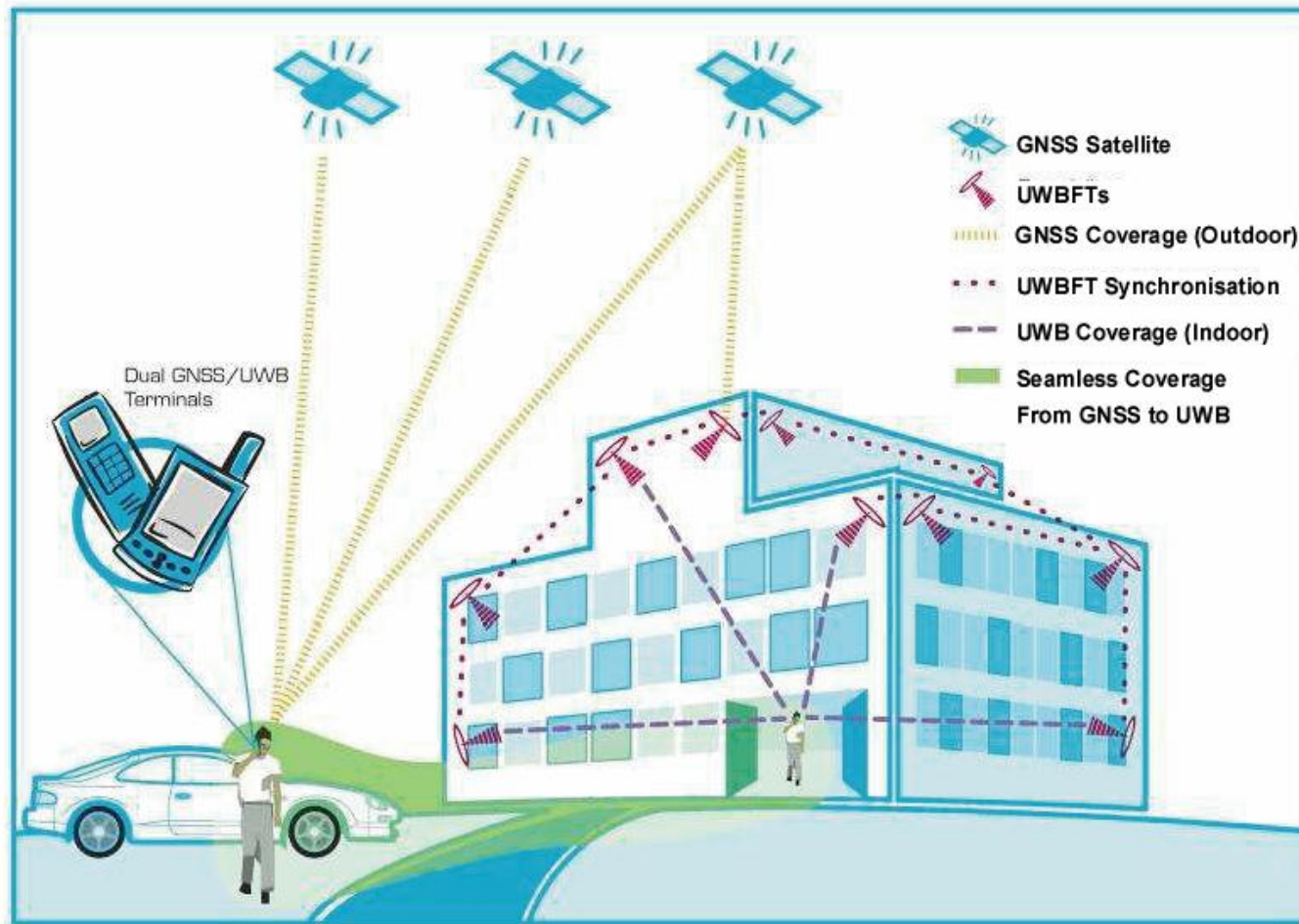
- Precision of the order of 1 meter in 3d ;

- Range : up to 100 meter (indoor), 1000 meter in LOS.

- Distributed and cooperatative localization;

- Fusion of positioning sensors to provide a robust and accurate localization system with seamless indoor and outdoor coverage;

- The soldier is a mobile inherent sensor platform and the sensor to be utilized for sniper detection is microphones;

- Thus the soldier squad may be considered as a large dynamic distributed microphone array;

- This microphone array may be used for precise detection of snipers and other noise sources of tactical interest.

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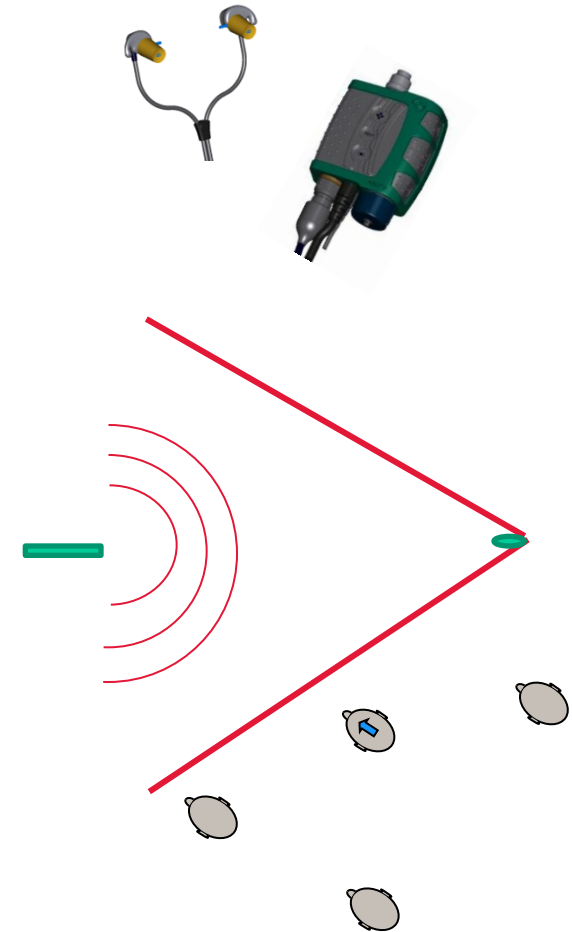
- High precision in sniper positioning requires knowledge of exact microphone (soldier) positioning and synchronized timing.

- Given position and time, fast and precise audio data processing algorithms must be developed.

- An efficient display/presentation solution must be developed.

- A high degree of redundancy is expected and must be exploited.

- Differentiation between sound sources and reflections will be a challenge.

- The dynamic nature of the array might be a challenge.

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- The idea is to synthesize a 3D sound environment in the radio communication headset to ease the communication process between individual members of small groups in high noise situations;

- By adding directional clues to the headset sound reproduction, a near to natural aural communication may be achieved;

- The directional clues needed for the 3D sound synthesis will comprise relative position between the members in the group as well as relative head direction.

SPEAKER

WPAN

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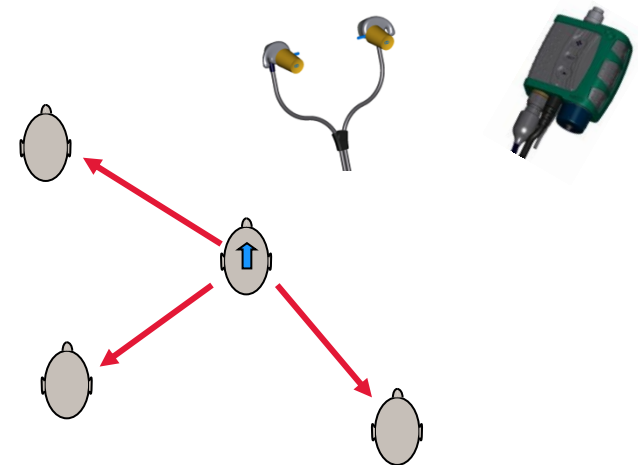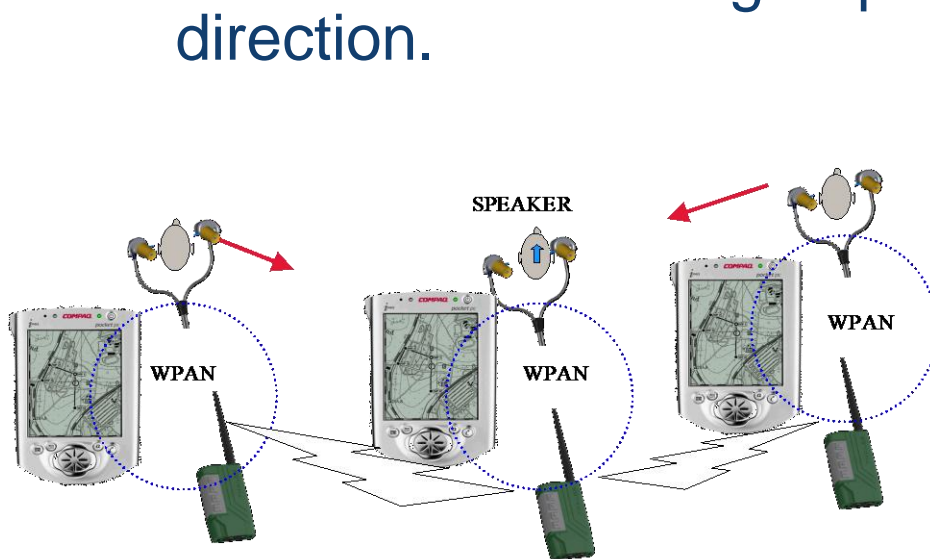
- The directional information needed can be extracted from the Soldier PAN and off- the-shelf sensors;

- The reproduction of spatial information in the headset will be based on development and use of Head Related Transfer Functions (HRTFs);

- Effective real time algorithms for the integration of directional parameters and HRTFs must be developed;

- Critical parameters and algorithms for obtaining an out-of-the-head impression must be developed;

- Exploit the best representation of 3D sound, which is perceived by the soldier as a substantial Improvement to the situational awareness on the battlefield.

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END OF PRESENTATION

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