

# WHERE2: **W**ireless **H**ybrid **E**nhanced **M**obile **R**adio **E**stimators – Phase 2

*Positioning information is inherently linked to all mobile devices. WHERE2 exploits the synergies of positioning information in wireless communication systems to improve wireless communications and positioning capabilities.*

## At A Glance: WHERE2

**Wireless Hybrid Enhanced Mobile  
Wireless Estimators – Phase 2**



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**EC Contribution:** 5,257M€

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## Main Objectives

WHERE2 develops new cooperative positioning and communications technologies based on mobile radio networks.

Exploiting network cooperation and mobile terminal cooperation by P2P links, position and motion information of mobile terminals can be accurately estimated. This information can be used to optimize both a radio access network itself and procedures which support cooperation among these networks. The key top level objectives of the project are:

### Positioning:

Enable **indoor** terminal location with an accuracy at least **equivalent to that of outdoor GPS**, by combining and extending **distributed techniques** into the highly dynamic heterogeneous and cooperative scenario.

### Communications:

**Quantify geo-location-based cooperation gain** in wireless communications in terms of throughput, reliability, power consumption, complexity and security.

### Realization:

Develop integrated hardware platform to **confirm performance and feasibility of cooperative positioning and communications algorithms by trials.**

## Technical Approach

The research work in WHERE2 focuses on four work packages (WPs) to investigate the performance of potential future mobile radio systems in indoor areas. These WPs are

- WP1: Scenarios, relevant **channel models** and market feedback
- WP2: **Heterogeneous context-aware cooperative positioning**
- WP3: **Geo-location aided cooperation** for future wireless networks
- WP4: **Heterogeneous Test Bed for Location and Communications**

*Exploiting  
network  
cooperation by  
P2P links to  
estimate position  
and motion  
information of  
mobile terminals  
to optimize the  
network itself.*

**Future mobile radio systems**, 4G in particular, are expected to operate in **heterogeneous communication systems** to fulfil the need of a **ubiquitous access** and they will **include the ability to position the terminal** to strengthen this in every environment.

WP1 is split into three tasks. In task 1-1 the system parameter and the framework of the scenarios are defined that are the base for all research activities. In task 1-2 the wireless channel is characterized to **define a coherent multi-link heterogeneous channel model for communication and positioning investigations** in WP2-WP4. In task 1-3 a **continuous feedback from the industry partners about standardisation activities** and information about operator strategies is exploited to incorporate an instantaneous feedback about changes in the real market.

In WP2 various aspects to position a mobile in a **distributed cooperative heterogeneous communication system via mobile radio links** and **inertial sensors** are investigated. A strong link to WP1 and a clear focus on **realistic conditions** in the hardware, e.g. **complexity, latency, asynchronous air-interfaces**, etc., allow to implement the best suited algorithms for the **selected hardware platforms for integration** in WP4.

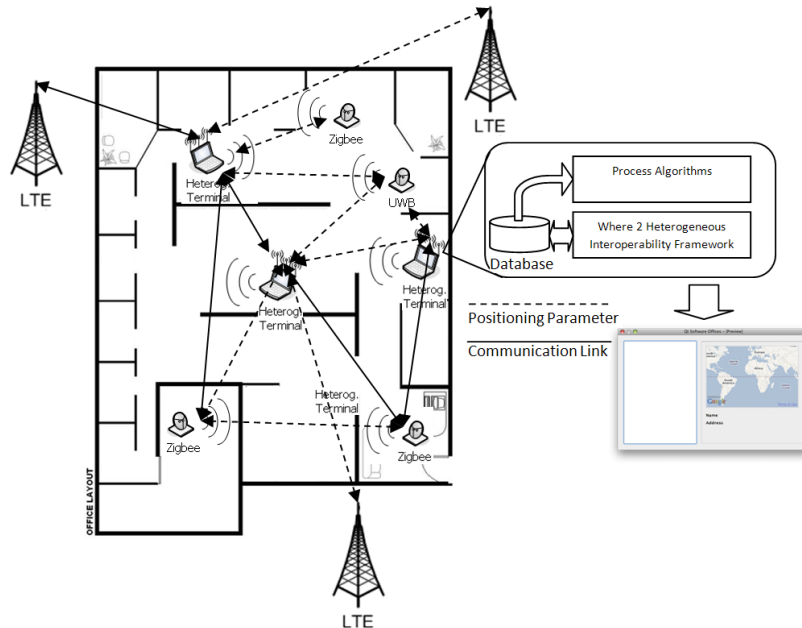
In WP3 **geo-aided communication** is investigated for **coordinated, cooperated and cognitive radio networks**. Here the **degree of reduced cooperation** in the network **defines the different foci of the tasks**: Starting with task 3-1 for **coordinated radio networks**, continuing with task 3-2 with **cooperative mobile radios** and finally in task 3-3 a **cognitive network**, where no cooperation between the licensed and the non-licensed network exists. The investigations are performed on the PHY layer as well as on the protocol layer of the underlying communication systems. A **combination of different radio platforms will be integrated** in WP4 to **show cooperative**

**positioning and communications for an indoor scenario**. This integration is fed by the implementation and validation of multiple algorithms. Finally, these **algorithms** will be **realized in trials**.

## Expected Impact

### Next-generation mobile radio technologies

WHERE2 investigates future mobile radio technologies under a combined approach, which considers both communications and positioning requirements. On the one hand this approach will allow identifying potential synergies between communications and positioning. On the other hand it provides solutions for optimising those. Investigations will indicate how already standardised systems like 3GPP LTE, WiMAX, etc. can be evolved using WHERE2 technology in terms of their positioning and cooperation capabilities in order to improve both communications and positioning QoS metrics.



### Cognitive radio and network technologies

WHERE2 aims to provide knowledge about the communications infrastructure in the neighbourhood of mobile terminals. This supports cognitive approaches by **a-priori knowledge of available RANs** and consequently reducing spectrum sensing effort. Dynamic routing will enable **decentralised (P2P) communication** beyond the radio horizon of mobile devices. This enables **RANs to dynamically adapt their cell sizes** according to network traffic resulting in increased cell breathing capabilities.

### Novel radio network architectures

WHERE2 will develop **architectures** for **heterogeneous RANs** in order to **enable and improve cooperative positioning** and P2P communications in dynamic RAN topologies. Through the consideration of position and movement information, network architectures, which deploy **short range P2P communications** and **femtocells** for increasing network throughput, are applicable even for highly mobile users.