AIRNET

Airport Network for Mobiles Surveillance & Alerting

Information Society Technologies

Project n°507888

AIRNET

(Airport Network

for Mobiles Surveillance & Alerting)

D5.1: Publishable Final Activity Report

Instrument: STREP (Specific Targeted Research Project)

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Project Coordinator Organisation	M3 SYSTEMS 1, rue des Oiseaux 31410 LAVERNOSE-LACASSE (France)	

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ACRONYMS

<u>NOTE</u>: the term "onboard system" in the present document designates the part of the AIRNET system which is located in the vehicles (also called "mobiles"). The aircraft are out of scope of the AIRNET project and are not equipped with any AIRNET system. It is only foreseen that the AIRNET system is compatible with an ATC (Air Traffic Control) system, which enables to retrieve the aircraft positions and inject them into the AIRNET system.

AIRNET	Airport Network for Mobiles Surveillance & Alerting
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCO	Air Traffic COntroller
ATM	Air Traffic Management
AOO	Airport Operation Officer
CNU	Communication & Navigation Unit
DL	Document List
DSS	Decision Support System
EC	European Commission
EGNOS	European Geostationary Navigation Overlay Service
EQ	Equipment
GeoDW	Geographical Data Warehouse
GH	Ground Handling
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HMI	Human Machine Interface
HW	Hardware
KOM	Kick-Off Meeting
MoM	Minutes of Meeting
PM	Progress Meeting
QoS	Quality of Service
R/T	Radio Telephony
SDSS	Spatial Decision Support System
SW	Software
TETRA	Terrestrial Trunked Radio
TN	Technical Note
UHF	Ultra High Frequency
VDL-4	VHF Data Link Mode 4
VHF	Very High Frequency
WBS	Work Breakdown Structure
WP	Work Package
WPD	Work Package Description
Glossary	

GLOSSARY

This section provides the explanation of terms required for a correct understanding of the present document. Most of the following explanations are drawn from the A-SMGCS manual [ICAO-A-SMGCS], the ICAO Annex 14 [ICAO Annex 14] or the EUROCAE MASPS for A-SMGCS [EUROCAE-MASPS], in that case it is indicated in the definition. [ICAO-A-SMGCS] definitions are used as a first option. In general, other definitions are only used where there is no ICAO definition. If not, it is explained why another definition is preferred to the ICAO one.

Advanced Surface Movement Guidance and Control Systems (A-SMGCS)

[ICAO-A-SMGCS] definition

Systems providing routing, guidance, surveillance and control to aircraft and affected vehicles in order to maintain movement rates under all local weather conditions within the Aerodrome Visibility Operational Level (AVOL) whilst maintaining the required level of safety.

Airport authority

[ICAO-A-SMGCS] definition

The person(s) responsible for the operational management of the airport.

Airport Driving Licence

(Oporto Airport Vehicle Circulation and Safety Rules)

Document issued by the Airport Authority, to be renewed periodically, recognizing that a specific driver is qualified to operate a vehicle on airside.

Airport Vehicle Access Permit

(Oporto Airport Vehicle Circulation and Safety Rules)

Document issued by the Airport Authority, to be renewed periodically, recognizing that a specific vehicle grants all technical conditions to be operated on airside.

Airside

[ICAO-A-SMGCS] definition

The movement area of an airport, adjacent terrain and buildings or portion thereof, access to which is controlled.

Alert

[ICAO-A-SMGCS] definition

An indication of an existing or pending situation during aerodrome operations, or an indication of abnormal A-SMGCS operation, that requires attention/action.

Alert Situation

[EUROCAE-MASPS]*definition*

Any situation relating to aerodrome operations which has been defined as requiring particular attention or action.

Apron

[ICAO Annex 14] *and* [ICAO-A-SMGCS]*definition*

A defined area on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

Conflict

[ICAO-A-SMGCS]*definition*

A situation when there is a possibility of a collision between aircraft and/or vehicles.

Control

[ICAO-A-SMGCS] *definition*

Application of measures to prevent collisions, runway incursions and to ensure safe, expeditious and efficient movement.

Cooperative mobile

"Cooperative target" [EUROCAE-MASPS] *definition in which "target" is replaced by "mobile" (see mobile definition)*

Mobile which is equipped with systems capable of automatically and continuously providing information including its Identity to the A-SMGCS.

Note: as several cooperative surveillance technologies exist, a mobile is cooperative on an aerodrome only if the mobile and the aerodrome are equipped with cooperative surveillance technologies which are interoperable.

Guidance

[ICAO-A-SMGCS]*definition*

Facilities, information and advice necessary to provide continuous, unambiguous and reliable information to pilots of aircraft and drivers of vehicles to keep their aircraft or vehicles on the surfaces and assigned routes intended for their use.

Identification

[ICAO-A-SMGCS]*definition*

The correlation of a known aerodrome movement call sign with the displayed target of that mobile on the display of the surveillance system.

Incursion

[ICAO-A-SMGCS]*definition*

The unauthorized entry by an aircraft, vehicle or obstacle into the defined protected areas surrounding an active runway, taxiway or apron.

Intruder

Any mobile which is detected in a specific airport area into which it is not allowed to enter.

Manoeuvring area

[ICAO Annex 14] *and* [ICAO-A-SMGCS]*definition*

That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons.

Mobile

A mobile is either an aircraft or a vehicle.

Note : when referring to an aircraft or a vehicle, and not another obstacle, the term "Mobile" will be preferred to "Target". The term "Target" will only be used when considering an image of a mobile or other obstacle displayed on a surveillance screen.

Movement area

[ICAO-A-SMGCS]*definition*

That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and apron(s).

Non-Cooperative mobile

"Non-cooperative target" [EUROCAE-MASPS] *definition in which "target" is replaced by "mobile" (see mobile definition)*

Mobile which is not equipped with systems capable of automatically and continuously providing information including its Identity to the A-SMGCS.

Protection area

A protection area is a virtual volume around a runway, a restricted area or a mobile. This protection area is used to detect an alert situation. For instance, an alert situation is detected when a mobile is on a runway and one or more mobiles enter the runway protection area.

Restricted Area

Aerodrome area where the presence of mobiles (aircraft or vehicle) is permanently or temporarily forbidden, because it may affect the operation of aircraft during landing, take-off, taxi, parking and push back operations.

Road

[ICAO Annex 14] *definition*

An established surface route on a movement area meant for exclusive use of vehicles.

Road-holding position

[ICAO Annex 14] *definition*

A designated position at which vehicles may be required to hold.

Roadway

(Oporto Airport Vehicle Circulation and Safety Rules)

An established surface route on a movement area meant for exclusive use of vehicles, not interfering with taxiways.

Route

[ICAO-A-SMGCS] *definition*

A track from a defined start point to a defined endpoint on the movement area.

Routing

[ICAO-A-SMGCS] *definition*

The planning and assignment of a route to individual aircraft and vehicles to provide safe, expeditious and efficient movement from its current position to its intended position.

Runway

[ICAO Annex 14] *definition*

A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

Runway-holding position

[ICAO Annex 14] *definition*

A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/MLS critical/sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless ortherwise authorized by the aerodrome control tower.

Runway Incursion

EUROCONTROL Runway Incursion Task Force definition

The unintended presence of an aircraft, vehicle or person on the runway or runway strip.

Service Road

(Oporto Airport Vehicle Circulation and Safety Rules)

An established surface route on a movement area, crossing a taxiway, meant for exclusive use of vehicles.

Stand

[ICAO-A-SMGCS] *definition*

A stand is a designated area on an apron intended to be used for the parking of an aircraft.

Surveillance

[ICAO-A-SMGCS] *definition*

A function of the system which provides identification and accurate positional information on aircraft, vehicles and obstacles within the required area.

Taxiway

[ICAO Annex 14] *definition*

A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another, including:

a) ***Aircraft stand taxilane*** – A portion of an apron designated as taxiway and intended to provide access to aircraft stands only;

b) ***Apron taxiway*** – A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron;

c) ***Rapid exit taxiway*** – A taxiway connected to a runway at an acute angle and designed to allow landing airplanes to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times.

1 Introduction

1.1 Purpose and scope of the document

This document constitutes the deliverable D5.1 “Publishable Final Activity Report”. This deliverable is a contractual document delivered to the European Commission after the project completion.

1.2 Structure of the document

The structure of the present document is the following:

- Section 2 presents the state of the art, the project objectives, the project study logic & schedule, and the consortium composition
- Section 3 presents the main achievements of Phase 1 of the project (Operational Requirements)
- Section 4 presents the main achievements of Phase 2 of the project (Detailed Specifications & Development)
- Section 5 presents the main achievements of Phase 3 of the project (Platform Operations)
- Section 6 presents the main achievements in terms of dissemination
- Section 8 presents the conclusions

1.3 Applicable and reference documents

1.3.1 *Applicable documents*

AD1 Contract n°FP6-507888, AIRNET (Airport Network for Mobiles Surveillance and Alerting), Commission of the European Communities, Directorate General Information Society, Information Society Technologies, Specific Targeted Research Project (STREP), 22 December 2003.

AD2 Annex I to AIRNET contract, Description of Work, 17 September 2003.

AD3 Annex II to AIRNET contract, General conditions, 23 October 2003.

AD4 Consortium Agreement for Specific Targeted Research or Innovation Projects under the Sixth Framework Programme of the European Community (2002-2006) for the Project called "AIRNET" (507888) – Version 1.0 of 16 December 2003 and its amendment 1 of 5 February 2004.

1.3.2 *Reference documents*

RD1 [ICAO-A-SMGCS]: ICAO European Manual on Advanced Surface Movement Control and Guidance Systems (A-SMGCS) AOPG, Final Draft, Nov 2001.

RD2 [ICAO Annex 14]: ICAO Annex 14, Volume I, Chapter 8.

RD3 [EUROCAE-MASPS]: EUROCAE WG-41, MASPS for A-SMGCS, Edition ED-87A, January 2001.

RD4 [EUROCAE MOPS]: EUROCAE MOPS issue 0.10 for SMR for use in A-SMGCS.

2 Project objectives

2.1 State of the art

From the ground surface movements point of view, an airport layout can be broken down into the three following segments:

- **Manoeuvring area**: composed by runways and taxiways, this area is under control of Air Traffic Control (ATC) authorities. A limited number of vehicles, together with aircraft, are operating in this area, and ground control ensures safety by maintaining adequate separation between the mobiles.
- **Apron area**: mainly composed by parking areas, it is under joint responsibility of airport operators and ATC authorities. A large number of vehicles are operating around the aircraft to support various activities: passengers transfer, goods handling, aircraft servicing, security, etc.
- **Public area**: corresponding to the arrival and departure halls, it is the interface of the airport with a variety of ground transportation means.

A schematic representation of manoeuvring / apron area is depicted in Figure 2-2-1:

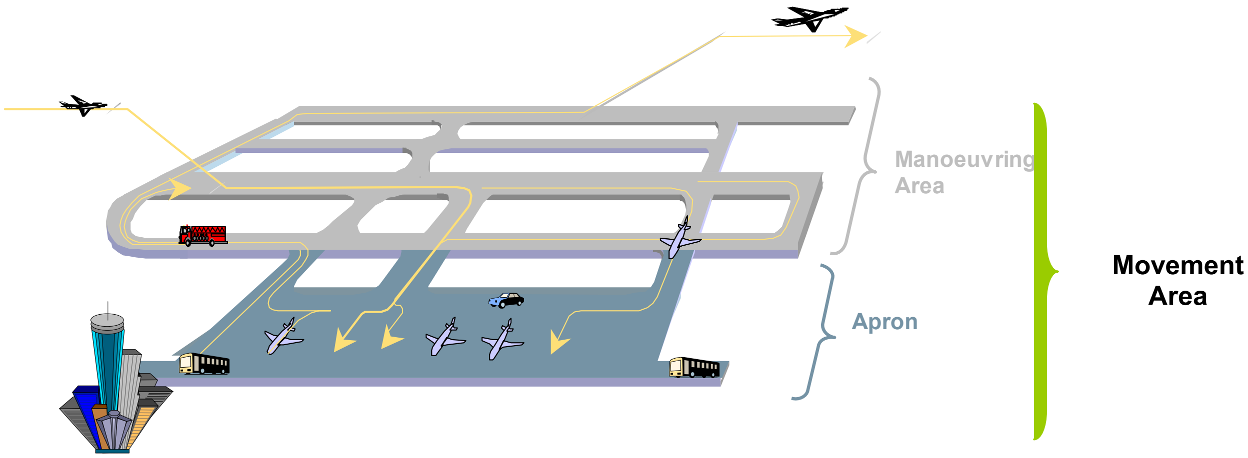

Figure 2-2-1: Airport Schematic Layout

As illustrated in Figure 2-2-2: Airport Areas Inter-dependence below, the different airport areas are inter-dependent and involve several types of stakeholders.

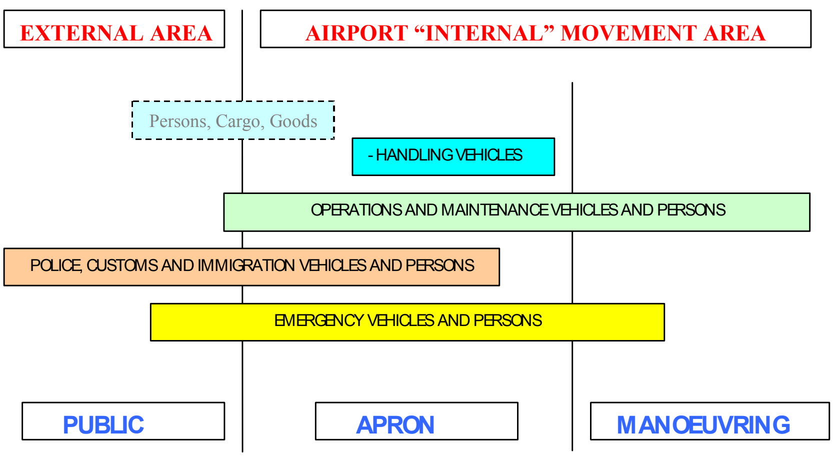

Figure 2-2-2: Airport Areas Inter-dependence

Note that AIRNET is not limited to the Manoeuvring Area, but concerns the movement area and the peripheral roads.

Existing surveillance systems dedicated to the manoeuvring area are using procedures primarily based on the "see and be seen" principle, to maintain separation between aircraft and/or vehicles. These systems have demonstrated their weaknesses (in particular in low visibility conditions) and the risk of runway incursion has become one of the major issues in the safety of air transport.

Furthermore, the management of the different airport segments is performed independently, and stakeholders involved in the decision-making process have a limited knowledge of the overall traffic situation. In particular, there is no integrated management of the vehicle movements at airport level. This lack of coordination, in crisis situation (bad meteorological conditions, traffic overload, etc.), may lead to severe dysfunction of the airport.

Therefore, the safety of vehicles on the airport areas and the efficiency of the movements of these vehicles are more and more seen as major issues by airport operators, since the continuous and steady growth of air traffic implies an increase in the number of vehicles that provide services to aircrafts. This is why it is well recognized today that there is a need for new systems (**A-SMGCS: Advanced Surfaced Movement Guidance and Control System**) to satisfy the airports demand. The A-SMGCS recommendations edited by **Eurocontrol** aim at improving the management of ground surface movements and to improve airport surveillance in the manoeuvring area. In addition, it is also necessary to improve the coordination between airport stakeholders, by better sharing of the information.

There are now A-SMGCS systems available and implemented at large airports, however these systems are based in ground radars, multilateration and present some frequency constraints when a large number of vehicles are equipped.

The AIRNET project implements a low cost A-SMGCS solution.

2.2 Project objectives

In this perspective, the high-level objectives of **AIRNET** (***AIR****port* ***NET****work for Mobiles Surveillance & Alerting*) were to:

- **Improve airport users safety on all the areas of the airport**, by providing essential and reliable information to relevant airport stakeholders. In particular, AIRNET enabled to prevent airport ground movement safety hazards due to vehicles, by means of an automated control tool capable of:
  - Detecting runway incursions and incursions into dangerous or restricted areas
  - Providing alarms indications both to the end-users and vehicle drivers
- **Improve the efficiency of operations**, by providing services to airport operators to optimise the flows of vehicles on the apron area. In particular, AIRNET enabled to prevent airport congestion in crisis situation by means of a decision making tool allowing to:
  - Monitor the vehicles resources utilisation
  - Optimise the allocation of vehicle resources, according to flight schedule modifications and to meteorological condition changes

The safety and efficiency objectives of AIRNET project require as a first step to monitor all vehicles in manoeuvring area, apron and in the peripheral roads. The actors involved were numerous and are described in detail in the next sections. Therefore, for both high-level objectives, a "shared situation awareness" at airport level needed to be provided, as illustrated in Figure 2-3 hereafter.

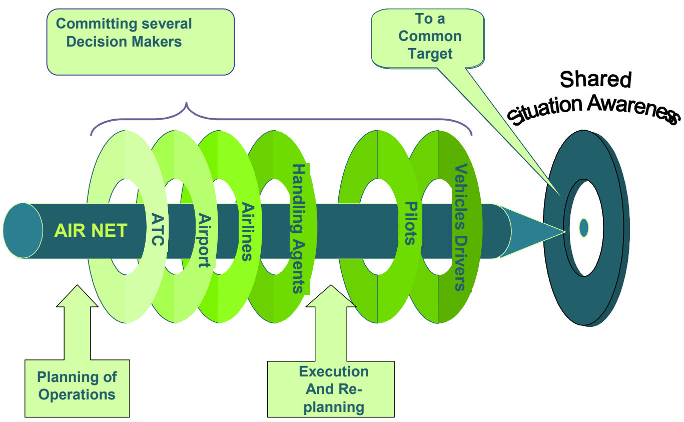

Figure 2-3 : AIRNET : Towards a shared situation awareness

The detailed objectives of the AIRNET project were to:

- **prototype an EGNOS low-cost platform for the surveillance, control and management of airport vehicles** (catering, baggage, fuel, maintenance, firemen, police, customs, etc.). This platform will be based on the **EGNOS** satellite navigation system for providing the position of the vehicles with the required high-level of integrity. It will implement the recommendations of EUROCONTROL for **A-SMGCS** (Advanced Surface Movement Guidance and Control systems).

  This platform is composed of several key components:

  - interactive Human-Machine Interfaces (HMIs) for the drivers of the vehicles and the end-users on the ground, to display the situation to drivers & ground operators and to allow operational interaction between the ground operators and the drivers.
  - communication networks:
    - communication network interoperable with aircraft, to allow situation awareness both on the vehicle side and the aircraft side
    - innovative communication networks (wireless technologies), for communication between the ground and the vehicle (position, identity, alerts, instructions, etc.)
    - runway safety functions, to process the surrounding situation of a mobile and to elaborate alarms to the driver in emergency situations
    - congestion control functions, to assess the overall situation and to plan the allocation of airport resources, based on spatial analysis

The architecture and development of this platform relied on a detailed analysis of operational and functional requirements, based on the A-SMGCS recommendations from Eurocontrol.

- **deploy this prototype at Oporto airport (mid-size airport, Portugal) for an extensive validation campaign.** The low-cost of the AIRNET infrastructure make AIRNET attractive to small and medium size airports.

It is to be noted that the AIRNET project was based on a **strong involvement of the end-users**, in order to ensure the adequate capture of user needs, constraints and requirements capture, and above all, the adequation of the system design with the users' needs. The end-users were involved in the project as **experts** (for the collection of user requirements) and as **actors** during the validation campaign (field-trials), in order to provide the essential return of experience & operational feedback.

Eventually, it is to be noted that, thanks to the involvement of end-users, the AIRNET partners had a good knowledge and understanding of current **European legislations** related with air transport, as well as a good knowledge of the **operational methods** and **procedures** currently used by the end-users. In addition, the AIRNET partners were in direct contact with EUROCONTROL, in order to guarantee the compatibility of AIRNET with A-SMGCS requirements under development. Regarding innovative communication networks, the AIRNET partners have included technologies currently under evaluation and standardisation (e.g. Wi-Fi) for use in operational systems in air transport.

2.3 Project study logic & schedule

The AIRNET project was organised around three main phases:

- **Phase 1 (Operational Requirements)**, which aimed at defining the services provided by the AIRNET system to the end-users, and the AIRNET platform. This phase was related to WP1 activities.
- **Phase 2 (Detailed Specifications & Development)**, which aims at developing & testing in parallel the Runway Safety and Congestion Control components. This phase was related with WP 2 and 3 activities. This phase was broken down into two sub-phases:
  - **Phase 2.A** (Detailed Specifications of the Runway Safety and Congestion Control components)
  - **Phase 2.B** (Development & Test of the components developed in Phase 2.A)

- **Phase 3 (Platform Operations)**, which aimed at demonstrating the AIRNET services using the AIRNET prototype deployed in Porto airport. This phase was related to WP4 activities.

These three phases were organised around two general supporting work-packages: WP0 for Consortium Management, WP5 for Project Conclusions & Exploitation. The figure hereafter depicts the study logic and the dependencies between the AIRNET work-packages:

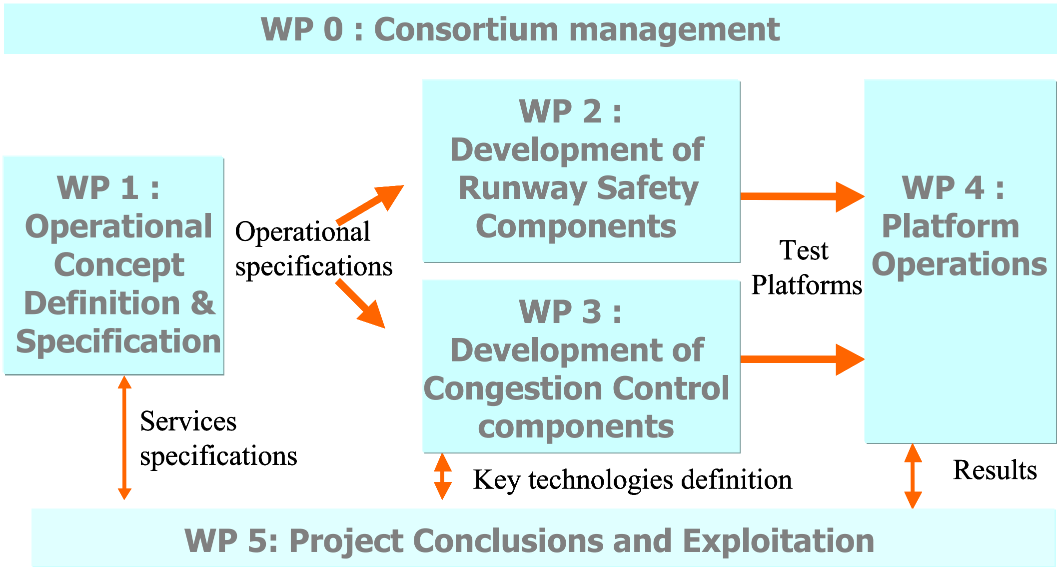

Figure 2-4: AIRNET study logic

- WP1 included the definition of operational services (WP1.1), operational scenarios (WP1.2), system architecture (WP1.3), as well as the cost-benefit analysis (WP1.4). In this WP, the specifications of the system (i.e. identification of the different components of the system) were defined : they were used as a basis for the detailed specifications produced in WP2 and WP3.
- WP2 & WP3 were realised in parallel, based on the results of WP1, covering respectively the development & validation of the runway safety and congestion control hardware and software components. These work-packages were decomposed in several tasks (refered to as WP2.x and WP3.x), covering each component of the system. These tasks aimed at:
  - Producing the detailed specifications of each component of the system identified in WP1.
  - Developing each component of the system, based on the detailed specifications.
  - Testing and validating each component independently.
- WP4 was realised at the end of WP2 & WP3. The different components of the system, which had been developed and validated in WP2 & 3, were integrated in Porto airport at the beginning of WP4. Then the validation activities were performed, using the integrated system.
- All along the project, WP5 dealt with the two following issues:
  - Project conclusions, which were finalised at the end of WP4.
  - Project dissemination activities, which included the project Web site, abstracts and presentations.

The project work-breakdown structure is depicted in the figure hereafter:

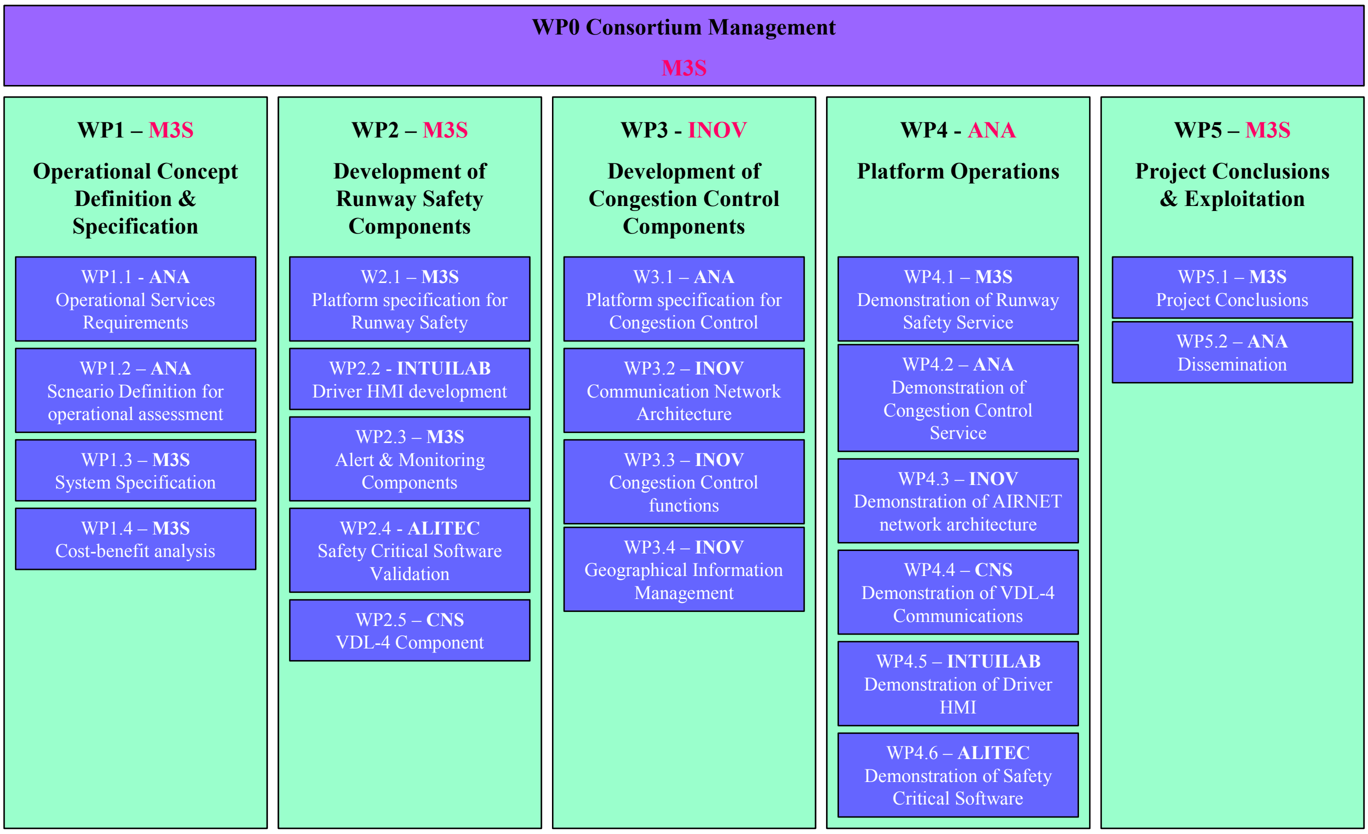

Figure 2-5: AIRNET Work Breakdown Structure

The table herebelow presents the detailed objectives of the different phases of the project:

Phase	Detailed objectives
Phase 1 (operational requirements)	The objective of this phase was to define the AIRNET operational requirements. The tasks performed are: - definition of the AIRNET services - specification of the AIRNET services, in terms of operational requirements - definition of the functional specifications, based on the operational requirements defined previously - definition of the system architecture
Phase 2.A (detailed specifications)	The objective of this phase was to produce the detailed specifications of each equipment (hardware) and each software module which are to be developed under the project. These detailed specifications were produced based on the results of the Phase 1, and especially the services and operational requirements. These detailed specifications contain, for each equipment and software module: - module/equipment requirements (identification & analysis of applicable requirements from TN1.1, identification of module/equipment requirements, traceability matrix) - architectural design - interfaces definition - detailed specification of the module/equipment
Phase 2.B (development)	The objectives of this phase, based on the detailed specifications produced in the Phase 2.A, were: - Detailed design of each equipment & software module - Development, unit tests & verification of the software modules and hardware components - System integration tasks, for both the onboard and the ground systems: integration of all onboard & ground SW modules and equipment During Phase 2.B, the integration of the onboard system and ground system was performed in parallel, by means of several intermediate "pre-integration" meetings which were held regularly. This enabled to obtain, at the end of Phase 2, the AIRNET onboard and ground system were validated, and integrated separately, thus paving the way for smooth integration of the whole AIRNET system at the beginning of Phase 3.
Phase 3 (platform operations)	The objective of this last phase of the project was to deploy the AIRNET system in Porto airport for an extensive validation campaign, which has demonstrated the operational concept. 4 airport vehicles were equipped, and used to test the AIRNET system in fully operational conditions (2 "Follow-Me" vehicles, one vehicle

Phase	Detailed objectives
	from the maintenance and another vehicle from the birds). - 2 vehicles were equipped with the AIRNET CNU and CDMA450 (AIRNET 04: Birds Kia, AIRNET 05: Follow-Me Strakar) - 2 vehicles were equipped with the AIRNET Tablet PC and Wi-Fi (AIRNET 01: Maintenance Polo, AIRNET 03: Follow-Me Polo) For this validation campaign, a new generation of WiFi network (802.11a) was specifically deployed at Porto airport, taking into account airport implementation requirements and airport operational constraints. This network implemented in particular a centralised roaming control, thus reducing handover times. In adition, the CDMA network, initially not foreseen, was used as the technology developed and the project adapted itself to test a possible future network. Moreover, the AIRNET ground system was interconnected to the Porto Airport Operational Management System (AOMS), which takes into account the IATA and ICAO applicable references. The data provided by the AOMS (aircraft arrival/departure times, parking stand number, etc.) were used by AIRNET for the decision support process. This was a step towards a fully integrated A-SMGCS system. This last phase of the project started after completion of the previous phase 2.B.

Table 2-1 : Detailed objectives of each project phase

The figure hereafter presents the detailed schedule of the AIRNET project.

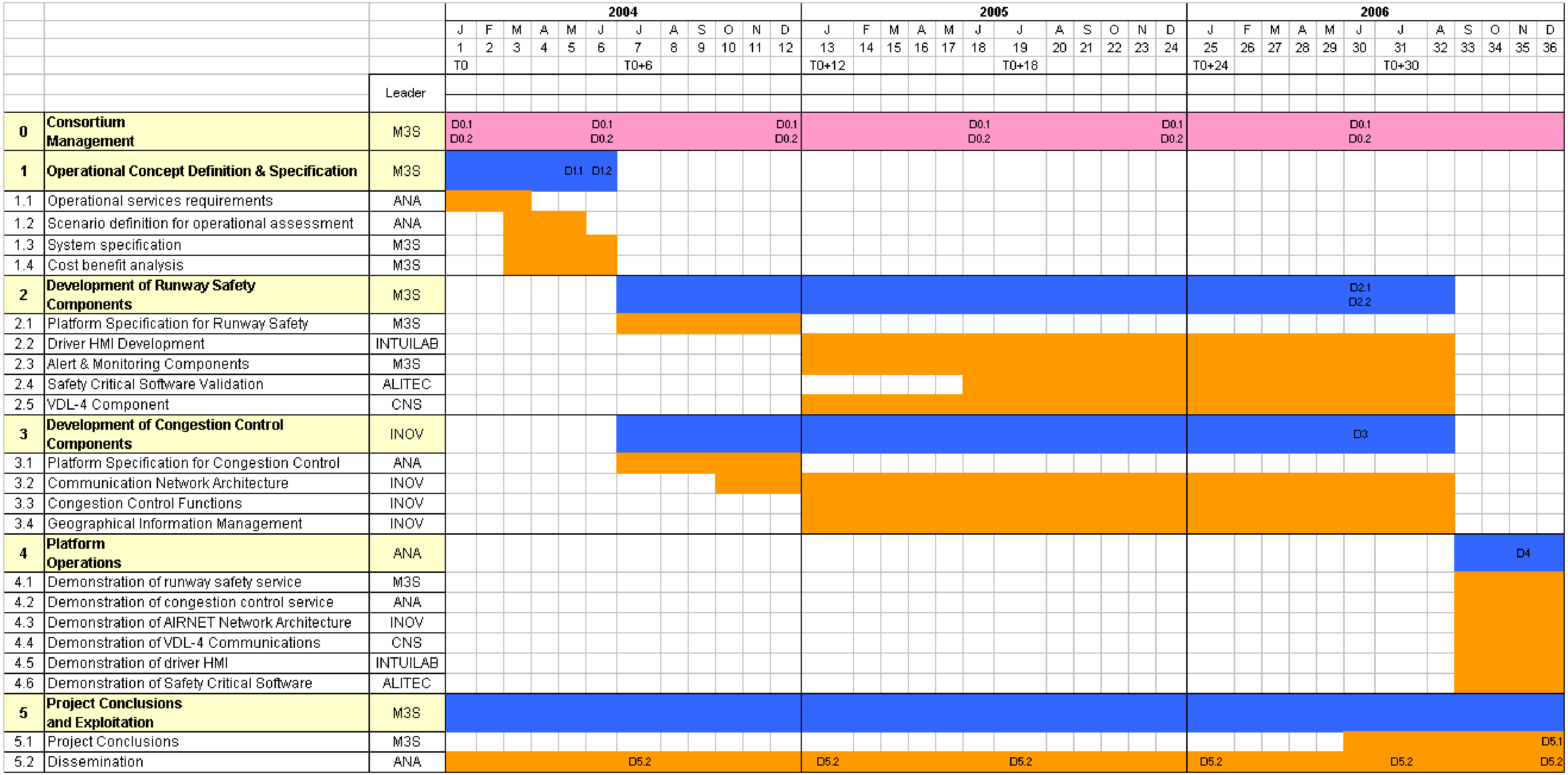

Figure 2-6 : AIRNET project schedule

2.4 Consortium composition

The AIRNET project was a STREP funded by the European Commission under the 6th Framework Programme, first call of the IST priority (Information Society Technologies), strategic objective 2.3.1.10 « e-Safety for Road & Air Transport ». The duration of the project was 36 months and it started on 1 January 2004. The project was realised by a consortium lead by M3 Systems (coordinator) and built around the following partners:

- Institutions:
  - **ANA** - Aeroportos de Portugal: end-user airport
  - **INESC-INOV** (Portugal): research laboratory specialised in information technology, telecommunications and networks
- SMEs:
  - **M3 Systems (France) : project coordinator**
  - **INTUILAB (France)**
  - **ALITEC (France)**
  - **CNS SYSTEMS AB (Sweden)**

2.5 Project logo, contact details and public Web site

AIRNET

Airport Network
for Mobiles
Surveillance & Alerting

More information (project public Website):

http://www.airnet-project.com

Coordinator contact details:

Name: PRESUTTO, Franck

Organisation: M3 SYSTEMS

Tel: +33-56-2231085

Email:presutto@m3systems.net

3 Main achievements of Phase 1 (Operational Requirements)

Over Phase 1, the following activities were performed:

- Definition of AIRNET actors, with their associated needs and roles
- Description of the AIRNET services
- Operational specification of the AIRNET services
- Functional specification of the AIRNET services (functional architecture and data model)
- System architecture

A brief summary of the AIRNET actors and services is presented hereafter.

The methodology used for the production of these specifications is presented in section 3.1, which enables to demonstrate the adherence to international airport standards.

3.1 Methodology

This section presents the methodology which has been used for the production of the AIRNET operational & functional specifications, which enables to demonstrate the adherence to standards:

- A-SMGCS manual [ICAO-A-SMGCS],
- ICAO Annex 14 [ICAO Annex 14]
- EUROCAE MASPS for A-SMGCS [EUROCAE-MASPS]

3.1.1 Introduction

The operational users on one hand and the system designers (engineers) on the other hand have different points of view and do not talk often the same "language".

It is important to recognise that users have an "external view of the system". For them key questions are: what do I get from the system?, in which conditions ?... A user elaborates concepts, often based on the experience, to express what is expected from the system. Therefore, he is only concerned with the external view of the system (how to interface, which environment, what are the limits,). For a user, the system itself is a black box.

On the contrary the engineers are concerned about the "internal building blocks" of the system and they need to elaborate a logical representation of the system taking into account the users demands (i.e. operational requirements). The internal organisation of the system can be described by means of "functions" (also called building blocks or components). Functions are still abstract entities but they can be expressed in technical terms and they are part of a hierarchical breakdown of the system. This hierarchical breakdown implies that, depending on the complexity, functions may be refined into sub-functions and that interfaces between functions and sub-functions are clearly specified.

There is a need for a generic methodology capable to support the capture of user needs and to translate them into an engineer view. From a methodological point of view, it is proposed to define 3 levels of requirements for an A-SMGCS system:

- Operational or Service level
- Functional level
- Architectural level

3.1.2 Operational level

At the operational level, the A-SMGCS system is seen as a black box providing services to users. This black box interacts with the users but also with its environment and other external systems. At this level, the requirement analysis allows to define the operational requirements from a user point of view and to identify the environmental constraints and the interfaces with external systems.

The operational requirements related to System Design, Evolution, Operational Range, Responsibilities, Interfaces and Environmental Constraints are listed as "General Principles", while the operational requirements specific to AIRNET services are listed in specific sections. These operational requirements are broken down into the following categories:

Operational Requirements Categories	Definitions	Abbreviations Op_
Services requirements	They define the services to be provided to the users	Serv
Operational range	These requirements define the operational range covered by the systems, they fix the operational limits of the system	Range
Responsibilities	Requirements related to assignment of responsibilities when using A-SMGCS	Resp
Interfaces	Requirements related to interfaces between A-SMGCS and users or other systems	If
Performances	These requirements define the performances to be fulfilled by A-SMGCS at an operational level	Perf
Monitoring	Requirements related to monitoring of A-SMGCS equipment, Quality of Service, Performances…	Mon
Environmental constraints	Requirements related to interference between A-SMGCS and its environment	Env
Design	They are not “pure” operational requirements but more general principles on system design	Ds
System evolution	They are not “pure” operational requirements but more general principles on future evolutions of the system	Evo

Table 1: Categories of Operational Requirements

3.1.3 Functional level

At the functional level, the analysis of operational requirements allows to define the internal building blocks of the A-SMGCS system, which is seen as an interaction of different functions. The operational requirements are mapped onto the functional framework, to get a first engineering view of the system architecture to be developed. In particular interfaces with users are refined and if possible expressed in more technical terms.

Consistency and completeness of the functional representation of the system is assessed with respect to operational requirements. At this stage the functional framework is an efficient tool for communication between ATM Operational experts and engineering experts. The building of the functional framework provides a reference for A-SMGCS instances; it allows the definition of test cases and validation exercises. In addition, it facilitates the comparison between validation results obtained at different evaluation platforms.

Therefore are listed the functional requirements for the AIRNET system. The functions that AIRNET shall perform have been defined on the basis and through close examination of operational requirements. These functions are independent from each other and linked by data flows. The description of the different functions and the links between each function represent the functional architecture of AIRNET which is presented in the following sections.

The operational requirements have been allocated to each function which implies that each function is specified by a list of **functional requirements** which have been derived from the operational requirements and which could thus be considered as the children of operational requirements.

It could be noted that the operational requirements related to Design, Operational Range and Evolution which apply to each function are not allocated, and considered as "general principles" requirements.

In the same way, operational requirements, dealing with constraints from AIRNET environment, are not allocated to AIRNET functions because they do not refer to the functional specification but more to the technical characteristics of the AIRNET equipment.

3.1.4 Traceability along the process

As shown in the following figure, the different levels of requirements have relationships as if they are part of a same family.

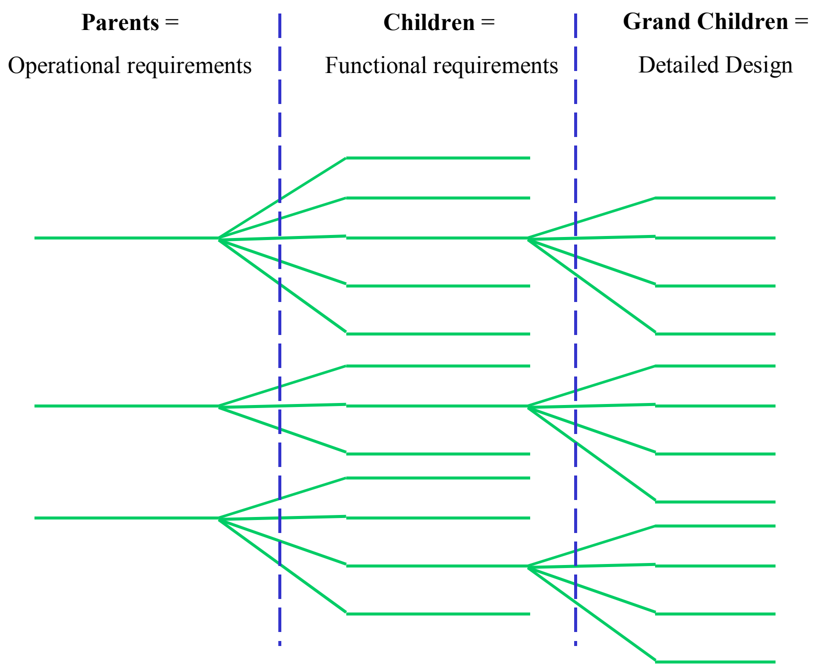

Figure 3-1 Operational and Functional requirements

It is possible to consider that operational requirements are the core specification. They are the starting point (the parents) from which are derived functional requirements which can be considered as "children requirements". Finally, the functional requirements are used to derive detailed design requirements that can be seen as "grand children" of the operational requirements.

There is a strong relationship between the operational requirement and the functional one: the operational requirement is the parent and the functional one is the child. It is important to trace this dependence between the operational and functional requirements for several reasons.

Firstly, during the project life cycle, the requirements will evolve. For instance, if an operational requirement is modified, it will impact its child requirements. So, it will be necessary to also update the child requirements in order to keep a consistent specification.

Secondly, the traceability between the requirements will be used during the validation of the A-SMGCS. For instance, when testing a specific function, all the functional requirements applying to this function are checked. If the function is not consistent with one of these functional requirements, it will be concluded that the parent(s) operational requirement(s) are not fulfilled by the A-SMGCS.

3.2 AIRNET actors & services

3.2.1 AIRNET actors

AIRNET Services will help actors to improve safety for the airport movements on the manoeuvring and apron areas of vehicles. The AIRNET actors are:

- The **ATCO**: the role of the Air Traffic Controller is to manage aircrafts[1] and vehicles movements in the manoeuvring area with respect to safety requirements and planning constraints
- The **AOO**: the role of the Airport Operation Officer is the management of the apron area (allocation of parking areas to aircraft), the surveillance and control of all vehicle movements (according to Airport Traffic Rules), in order to have an optimised management of assistance to aircraft and granting all required safety conditions for each specific visibility condition (Normal or Low visibility conditions)
- The **GH manager**: the role of Ground Handling managers is to manage and optimise their fleet of vehicle, according to the required ground handling assistance to aircraft, respecting Airport Traffic Rules published by the Airport Authority
- The **vehicle drivers**: the role of the driver is to drive his vehicle following ATCO instructions and clearances provided by R/T, when circulating in the manoeuvring area. Vehicle drivers can be decomposed into four main categories:
    - **Follow-me and rescue and fire-fighting vehicles**
    - **Airport vehicles** (Maintenance, Support)
    - **Handling vehicles**
    - **Governmental Services vehicles**

Within the scope of AIRNET, the aircrafts will not be equipped, although they will be simulated (simulation tests will be made using vehicles with “aircraft” labels and priority rules).

In this perspective, the present cost-benefit analysis aims at evaluating the profitability of the AIRNET project for each actor operating on the airport platform. The

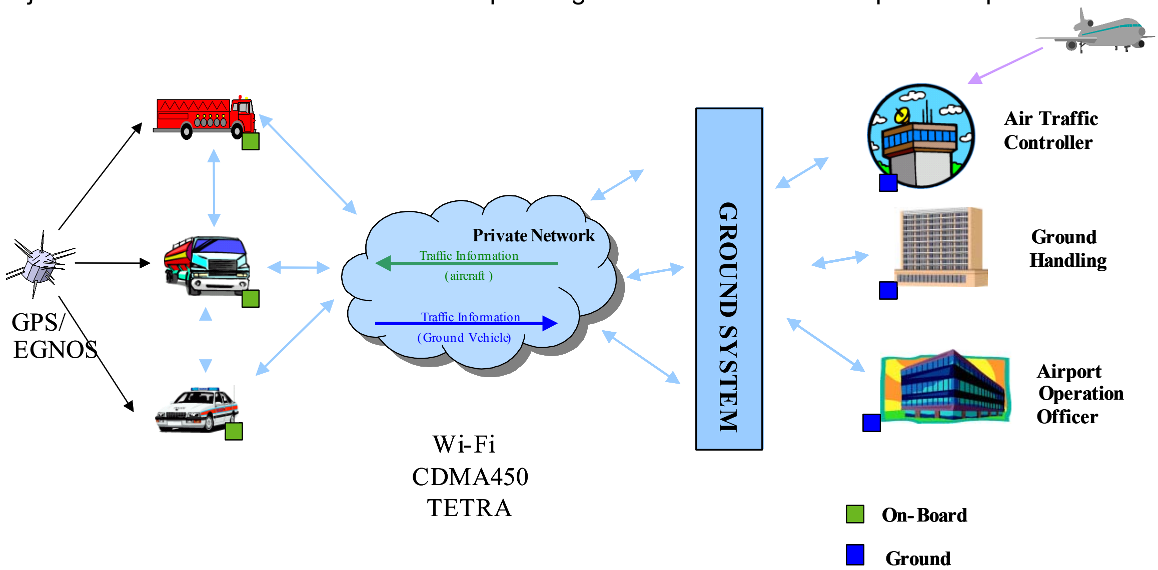

Figure 3-2 hereafter identifies the AIRNET system scenario, for the Ground and the On-Board users.

[1] Although described here the role of ATCO, the AIRNET project does not consider equipping Aircrafts.

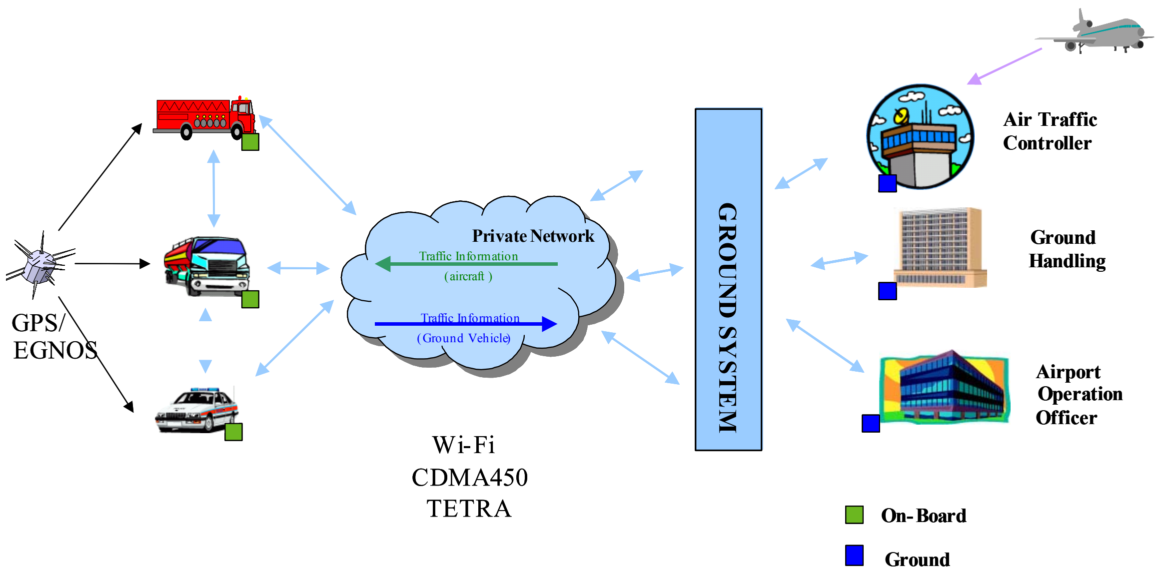

Figure 3-2: AIRNET Implementation Scenario at the Airport

3.2.2 AIRNET services

The AIRNET services will focus on the safety and efficiency of ground movements in the different airport areas. In terms of end-users the following services have been defined:

- **Surveillance service**
  - providing ATCO (on manoeuvring area) with traffic information and traffic context[2]
  - providing other actors with a situation awareness service on all areas of the airport (traffic information and traffic context),
- **Control service**
  - for ATCO (on manoeuvring area) providing conflict/infringement alerts,
  - for other actors (on all areas of the airport) providing a situation control service (including conflict /infringements alerts),
- **Guidance service** on all airport area providing the drivers with its vehicle position and traffic context on a moving map of the airport[3],
- **Decision support service** aims to provide situation assessment and proposition of solutions to optimise the vehicles resources for apron area (AOO, GH, drivers).

Depending on the product versions and configurations, all or a part of the services described above can be provided by AIRNET solution.

3.3 AIRNET Architecture

In order to provide the proposed services to the previously identified actors, the following key enablers have been identified:

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2 Within the scope of AIRNET the Aircrafts will not be equipped. Therefore no information to pilots will be provided through the AIRNET system, at this phase. Later if the aircrafts are provided with certain equipments (squitter Mode-S or VDL-4) the information could be integrated in AIRNET through the ATC system since the AIRNET is fully compatible with ATN (Aeronautical Telecommunications Network) recommendations and all data transferred between systems are processed in ASTERIX format.

3 The vehicle position does not contemplate aircrafts, although later on it could be integrated in AIRNET (please see Footnote Nº 3)

- **Human Machine Interfaces** (HMI) on both embedded and ground equipments that provide services to actors
- Vehicles positioning using **satellite navigation capabilities** (GPS and European augmentation EGNOS) so that location of all airport actors is published with a good level of accuracy and integrity
- Data exchange between vehicles and ground system through **a set of airport wireless communication networks**
- **Processing capabilities for software applications** that provide services to both drivers and ground users (ATCO, AOO, GH)

The AIRNET system architecture includes the following main components:

- The **wireless networks** allow the data exchange between mobiles and ground system covering both the Manoeuvring area and the Apron area
- The **On-Board System** in each vehicle. It includes the position sensor (GPS and EGNOS augmentation) and vehicle driver HMI. It interfaces to AIRNET wireless networks and manages the software applications, which provide the AIRNET services
- The **Ground System** is composed by processing facilities to elaborate overall situation and services, a ground HMI to interface with ground actors (ATCO, AOO, GH) and communication means to exchange data with vehicles

Since the AIRNET system has to be able to operate with a single wireless network (in one given specific area), it must fulfil all the AIRNET communication requirements. However several networks, depending on airport area, will be used in order to demonstrate different precise objectives.

The multiple network approach brings different possible solutions (that demonstrate different objectives):

- The first one uses the TETRA network technology and demonstrates the ability of the AIRNET system to be mapped on an ever-deployed airport network. This network, although available at the Oporto Airport it was discarded for the AIRNET solution due to its low performance capabilities, as justified in TN4.3, section 6.3
- The second one uses the CDMA network technology available at the Oporto airport and demonstrates the adaptability of the AIRNET system. This network technology was not for foreseen in the contractual Technical Annex, but its availability at the airport justifies its inclusion instead of the UHF network
- The last one uses the Wi-Fi network technology and demonstrates the ability of exploiting innovative networks

Although initially foreseen, the private network (UHF) was not deployed for the Oporto Platform Prototype, as justified in TN 2.13_GS, section and already justified in the first annual AIRNET revision meeting.

The implementation of a VDL-4 network aims at demonstrating the ability of the AIRNET system to be compliant with one aeronautical network (the ADS-B). The technology used in AIRNET is the VDL-4, but other technologies like Mode-S could be used for this purpose.

The following figure provides the detailed architecture including data flow between the entities:

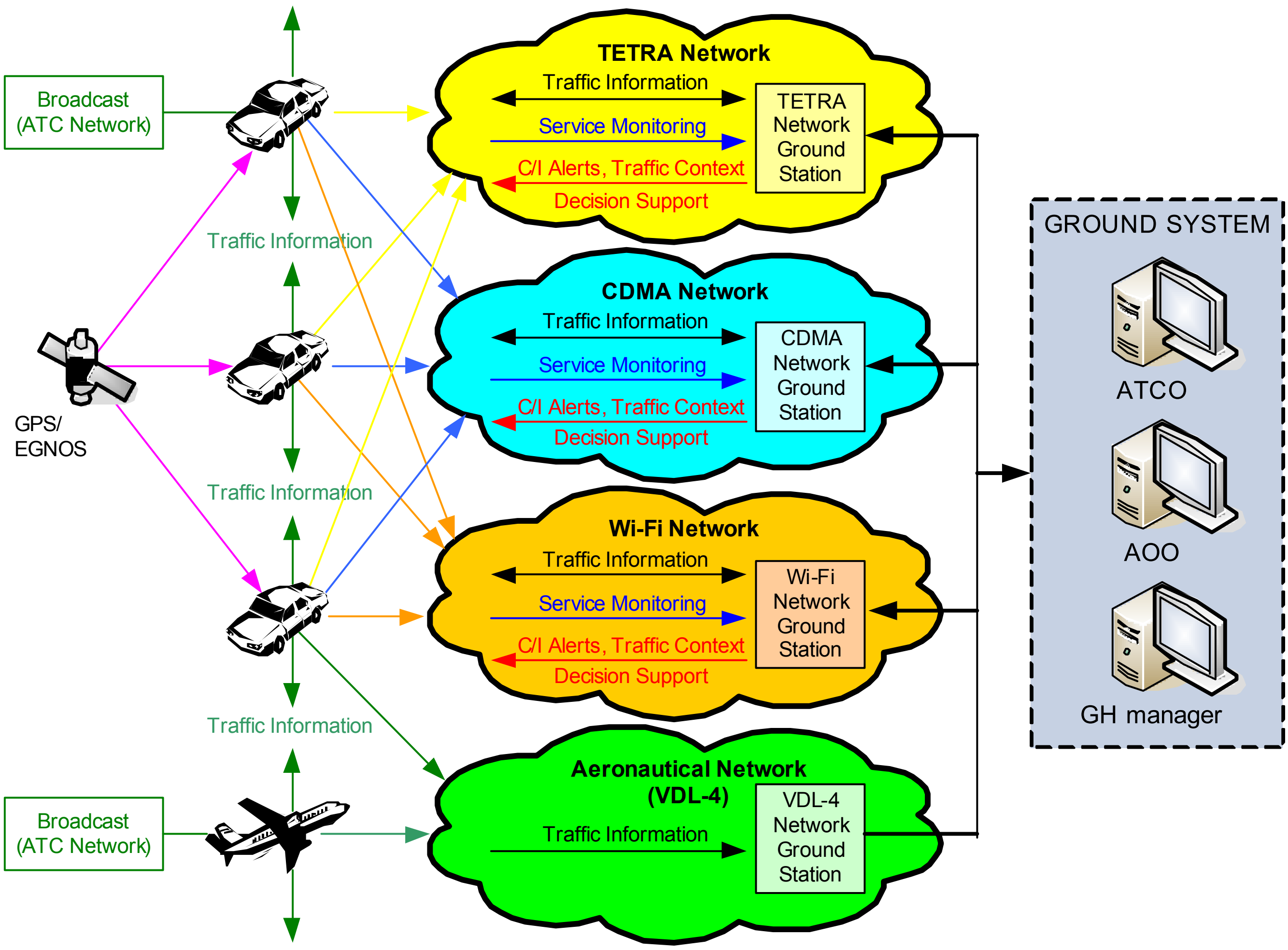


Figure 3-3-3: AIRNET Detailed Architecture & Interfaces

Aircraft information is not broadcasted in the AIRNET system but could be received through ATC system.

As described in the given detailed architecture, the AIRNET system consists in providing multiple services to users (such as ATCO, AOO, GH and drivers). These services are provided through several wirelesses communication mediums: innovative networks (Wi-Fi 801.11a 2G - private, CDMA 450 - public) as well as existing networks (Tetra and Aeronautical Network – VDL-4).

3.3.1 Communication Networks

The use of wireless communication technologies to build mobile communication networks is a major issue for AIRNET project. These communication technologies will need to provide the quality of service required by the airport operations:

- **Real time traffic situation**
- **Interoperability with civil aviation communications**: the AIRNET system was developed taking into consideration the possibility to implement interfaces so the aircraft has to be in the loop for vehicles in the manoeuvring area (**aeronautical data links**)
- **No interference with existing installations**: an airport is equipped with many different ground beacons and radar
- **High integrity**: the false alarm and the miss-detection rate to the ground user (ATCO, AOO, GH) and to vehicle drivers has to be very low to improve safety
- **High peak loads in crisis situation**: the number of mobiles involved in ground situation may vary a lot in crisis situations

- **Low cost per vehicle**: in order to implement the proposed concept, all vehicles have to be equipped with a transponder therefore the low costs per unit is a key driver for a successful implementation in airport operations

Since the AIRNET system has to be able to operate with a single communication network, it must fulfil all the AIRNET communication requirements. However several networks, depending on system configuration, will be implemented in order to demonstrate different precise objectives.

The network approach brings to three different possible solutions (demonstrate different objectives):

- The first one uses a CDMA network. This CDMA network is under the reponsibility of a public network operator and is presently deployed at the Porto airport.
- The second one uses the TETRA network technology and demonstrates the ability of the AIRNET system to be mapped on an ever-deployed airport network
- The last one uses the Wi-Fi network technology and demonstrates the ability of exploiting innovative networks

However, in addition to the chosen network, the implementation of a VDL-4 network aims at demonstrating the ability of the AIRNET system to be compliant with one aeronautical network.

The several networks implemented at ASC provide the following functions:

- Transfers the Traffic Information between vehicles and ground station (if no other communication medium used):
  - Broadcasts position from each vehicle to all other vehicles and ground station
  - Broadcasts position of other mobiles (identified by surface radar or other non-cooperative system) from ground station to all vehicles. This feature was not implemented in the scope of AIRNET
  - Broadcasts messages from the Ground to the vehicles
- Transfers Conflict/Infringement Alerts, Traffic Context and Decision Support information from ground station to vehicles
- Transfers On-Board Systems Status from vehicles to ground station
- Messages Transfers (including “Panic Button”) from vehicles to ground.

Note: The Public TETRA and CDMA networks do not support broadcast service, this functionality is performed by the Ground System.

3.3.2 AIRNET On-Board System

The On-board system is composed of:

- CNU Computer
- Satellite navigation capabilities through the GPS/EGNOS receiver
- Communication radio equipment (TETRA, CDMA, Wi-Fi, VDL-4) / Data exchange capabilities through a set of airport wireless communication networks:
  - The **TETRA network** transponder
  - The **CDMA network** transponder
  - The **Wi-Fi network** transponder
  - The **VDL-4 network** transceiver
- An On-board Display System providing the proposed services to the vehicle's driver

The integration of all these equipments into a single On-board system and the management of their inter-connections imply the presence of a **Communication and Navigation Unit** (CNU).

Although initially foreseen, for the Oporto Platform to integrate in each CNU different wireless network it only supports one network (2 CNU’s with CDMA 450 and 2 tablet PC’s with Wi-Fi).

In addition to these equipments some functional software modules have been implemented to provide the user with the AIRNET services:

- Provide Traffic Information software module
- Provide Traffic Context software module
- Conflicts/Infringements Detection software module
- Service Monitoring software module
- Decision Support software module

The following figure provides the On-board system architecture:

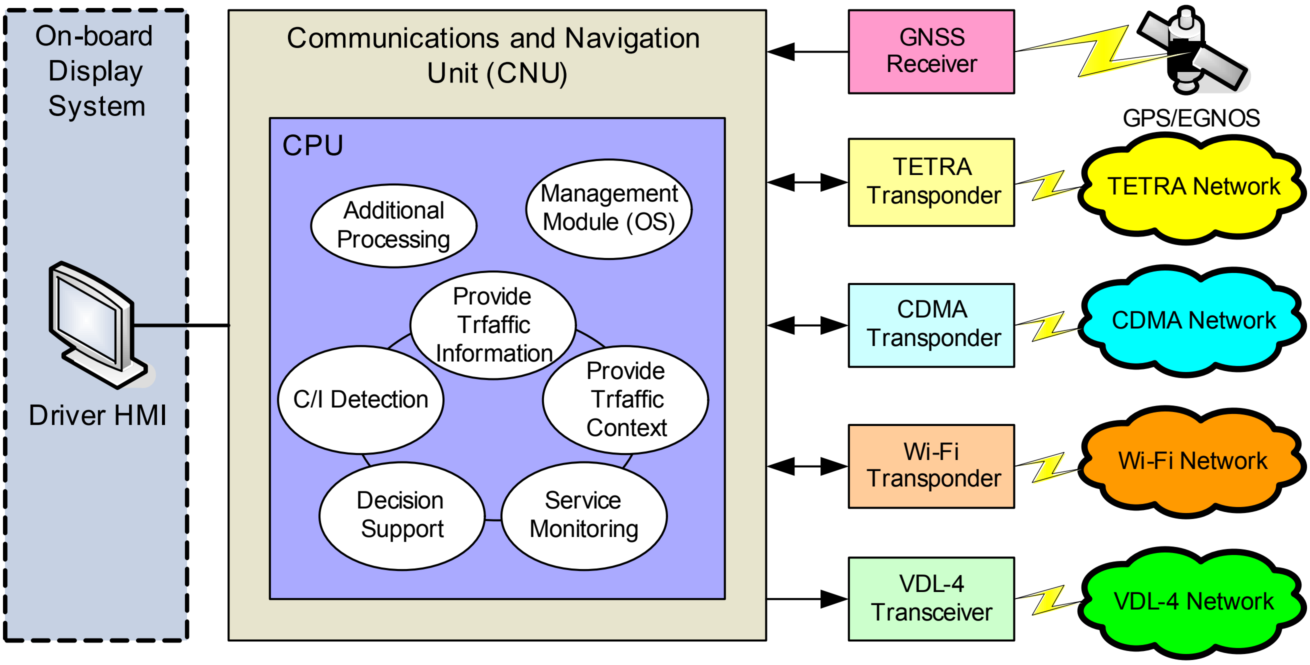


Figure 3-3-4: AIRNET On-Board System Architecture

3.3.3 AIRNET Ground System

As presented in the architecture overview, for the Ground System it was implemented the same set of airport wireless communication networks as to the On-board system:

- The **TETRA network** ground station (public)
- The **CDMA network** ground station (public)
- The **Wi-Fi network** ground station (private)
- The **VDL-4 network** ground station

As referred only CDMA and Wi-Fi networks were integrated in the On-Board equipment, so although TETRA and VDL-4 are present at the Oporto airport they were not used for system validation.

It also provides the proposed services to all the ground operators through Ground Human Machine Interface.

The concerned ground operators are the following ones (Section 3.2):

- The Air traffic Controllers (**ATCO**)
- The Airport Operation Officer (**AOO**)
- The Ground Handling managers (**GH**)

The integration of all these equipments and the processing of the information to provide services to the users imply the presence of a **Ground Processing System**.

This Ground processing system will implement the following functional software modules:

- Provide Traffic Information software module

- Provide Traffic Context software module
- Conflicts/Infringements Detection software module
- Service Monitoring software module
- Decision Support software module
- Human Machine Interface software module
- Operational Data Gateway software module

The ground system architecture is illustrated here below:

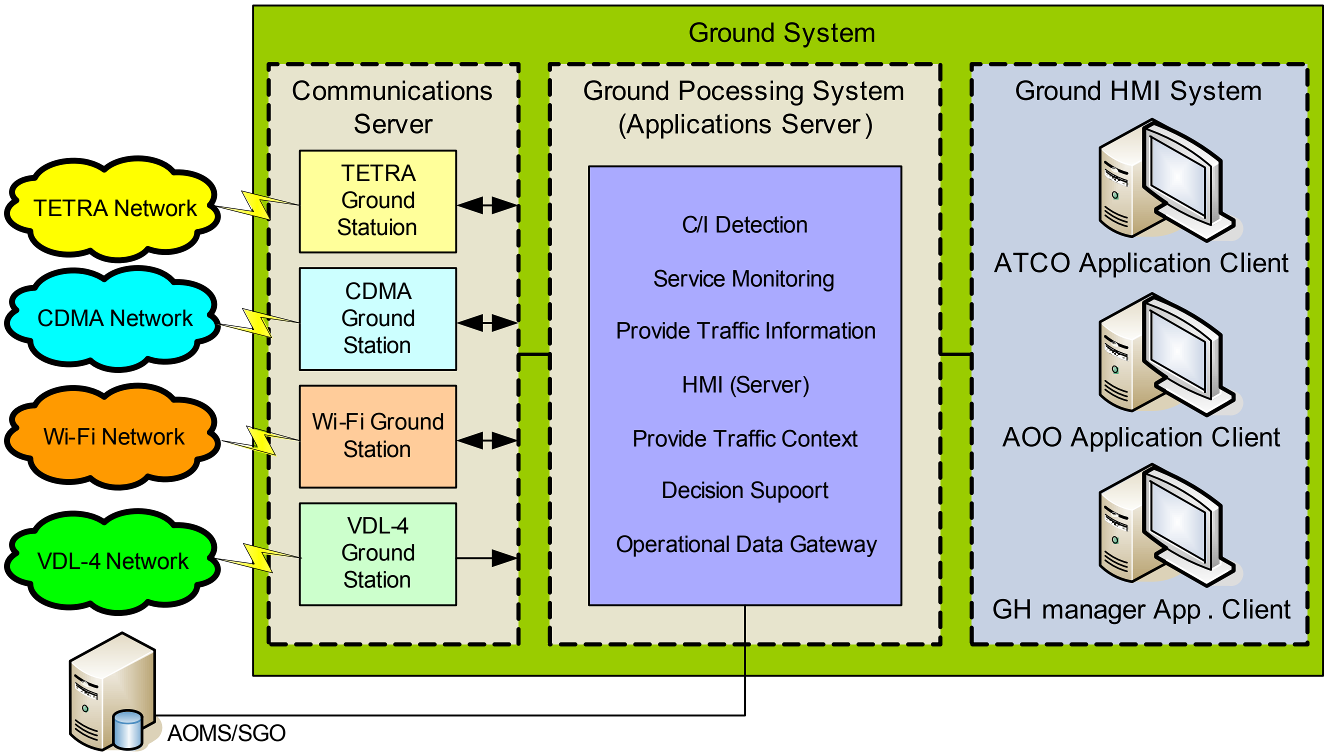


Figure 3-3-5: AIRNET Ground System Architecture

3.3.4 Exclusion of aircraft

As indicated in Annex I to the Contract, it is not the objective of AIRNET to equip aircraft. Our hypothesis is that, in the future, aircraft will be already equipped with an ATC communication network (VDL-4 or other), in order to be able to broadcast their position (ADS-B concept). In this context, the objective of AIRNET is to equip each vehicle so that it is capable of receiving :

- The position of the other vehicles (thanks to the wireless networks identified in WP3.2)
- The position of the aircraft (thanks to the ATC network)

This will enable to make vehicles cooperative with each other and with aircraft, but no aircraft will be equipped with ATC network transponders in AIRNET. The objective of AIRNET is only to enable the compatibility between the vehicles and the aircraft, by means of the ATC communication network. This is why one of the main issues of AIRNET will be to test the interface between vehicles and aircraft traffic.

In addition, regarding the choice of the VDL-4 network, as indicated previously, our objective is to guarantee the compatibility between the AIRNET system and the ATC network used by aircraft. As a consequence, when we submitted the proposal to EC, we had to make **an hypothesis as regards the choice of a candidate ATC network** (and this hypothesis is reflected in Annex I). We have proposed to equip vehicles with VDL-4 components, because it seemed to be a **serious candidate for the ATC communication network**, when we submitted the proposal, for the following reasons :

- VDL-4 is standardised by ICAO, EUROCAE and ETSI.

- VDL-4 technology can be used for more services than the acquisition of position of aircraft and vehicles, due to the data link protocol

However, there are some other candidate networks, such as Mode S. Since the project started, specific attention has been placed on the analysis of other ATC communication protocols (compatibility with ATN SARPS), always keeping in mind the compliance with the requirements and standards applicable for A-SMGCS. Therefore, it is quite probable that the operational system, which will be developed in the future (based on the results of the AIRNET project), might implement interfaces to other ATC networks, such as Mode S. But this is out of scope of the AIRNET project.

As a conclusion, the following items summarise the two issues mentioned here above. These items perfectly reflect the project objectives as indicated in Annex I and D0.1 (Project Development Plan) and TN1.3 (AIRNET Architecture Document) :

- no aircraft will be equipped with a VDL-4 transponder
- since there is no VDL-4 ground station in Porto, and given that the cost of acquisition of such a ground station is relatively high and out of scope of the project, we have decided to use a VDL-4 transponder on the ground (acting as a ground station).

In addition, it is to be noted that the AIRNET project partners recognised the importance of taking into consideration in AIRNET real-time aircraft information : information about flights will be retrieved from the Porto Airport Operational Management System (AOMS). This AOMS system is interconnected with the Air Traffic Control system, and will be integrated in AIRNET : although this feature is not foreseen in the contract, ANA decided to develop the needed modules and interfaces and INOV will include them in the Decision Support system, with no additional cost for the project. Furthermore, in the future operational system, these additional features will also allow small and medium size airports to integrate aircraft position detected by special sensors, thus avoiding the installation of ADS-B or ground radars or even the implementation of Mode S or VDL-4 transponders.

4 Main achievements of Phase 2 (Detailed Specifications & Development)

4.1 Phase 2.A (Detailed Specifications)

4.1.1 Objectives

The objective of this Phase 2.A was to produce the detailed specifications of each hardware component and each software module to be developed under the project:

- On-board system :
    - hardware components
    - software modules
    - communication drivers between hardware components and communication networks components
- Ground system :
    - hardware components
    - software modules
    - communication drivers between hardware components and communication networks components
- Communications networks (panorama and comparison of existing technologies, choice of technologies)

4.1.2 Approach

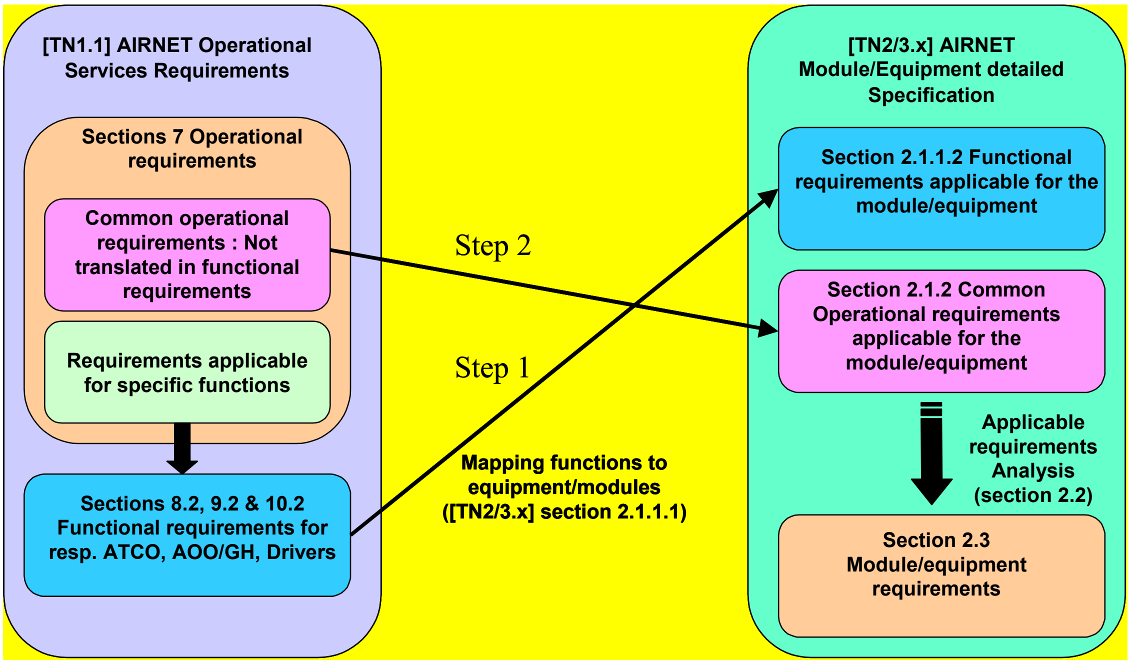
The same harmonised approach was followed for the production of all the detailed specifications produced during Phase 2.A. This enabled to ensure that all the detailed specifications produced are homogeneous, and use the same template, approach and methodology. **This harmonisation was very important, in order to ensure a good coordination of the different developments (HW & SW) to be performed over the next Phase 2.B**.

The approach followed for the detailed specifications is presented hereafter. Each of the detailed specifications is broken down into 4 main sections:

- module/equipment requirements (identification & analysis of applicable requirements, identification of module/equipment requirements, traceability matrix)
- architectural design
- interfaces definition
- detailed specification of the module/equipment

For the elaboration of the module/equipment requirements, the following 5-step approach was followed:

- **STEP 1- APPLICABLE FUNCTIONAL REQUIREMENTS** : the objective of this step was to identify from AIRNET Operational Services Requirements, the functional requirements which could directly or indirectly impact the module/equipment to be specified.
- **STEP 2- APPLICABLE OPERATIONAL REQUIREMENTS** : some operational requirements have not been translated into functional requirements in the AIRNET Operational Services Requirements, since they were general principles or for instance performance requirements, which are applicable to the modules/equipments. The objective of this step was to identify these applicable operational requirements.



- **<u>STEP 3- REQUIREMENTS ANALYSIS.</u>** The objective of this step was to analyse in detail from the module/equipment viewpoint, the applicable functional & operational requirements identified in Steps 1 & 2 (e.g. analyse the consequences of the applicability of a requirement, etc.).
- **<u>STEP 4- MODULE/EQUIPMENT REQUIREMENTS.</u>** The objective of this step was to derive, from Steps 1, 2 and 3, the specific requirements for the module/equipment to be specified.
- **<u>STEP 5 : TRACEABILITY MATRIX.</u>** The module/equipment requirements defined in Step 4 are the children of applicable functional and operational requirements. This is illustrated in a traceability matrix, which is of utmost importance for the project since it will be used at the end of the tests to conclude for each operational requirement whether it is fulfilled or not. Although this matrix has already been produced as a reference for each TN, it has to be revised and updated during the development phase.

4.2 Phase 2.B (Development)

4.2.1 Main achievements

The main achievements of the project over Phase 2.B are the following:

- **The completion of the development of each equipment & software module (ground and onboard)**:
    - hardware components (including communication network components)
    - software modules
    - communication drivers between hardware components and communication networks components

  These development tasks have used as a basis detailed specifications for each equipment & software module that were produced in Phase 2.A.
- **The production of the Conception Manual** for each equipment and software module. This Conception Manual is a “readable” document, which follows the detailed specifications produced in Phase 2.A, and which explains the choices of implementations as well as the possible changes with respect to the detailed specifications that were produced in Phase 2.A. This document will enable a developer to come back to the developed source code a few months or years after the end of the project, and to fully understand the software architecture and behaviour: this document will thus facilitate the modification of the software modules developed in AIRNET, if such modifications are needed before the end of the project.

It is to be noted that these Conception Manuals were not initially contained in the list of contractual deliverables contained in Annex I to the Contract. The project partners have decided to produce these

Conception Manuals for each equipment and software module in order to be compliant with the specific development methodology that has been followed by the partners over the project. This methodology is presented in section 4.2.3 of the present document.

- **The production of the Design Document** for each software module. This document contains, for each software module, a precise description of the SW module (functions/classes, parameters, data structures, etc) and concerns only software maintenance.
- The production of a **common Interface Control Document (ICD)**, which contains and centralizes all the data structures and inputs/outputs of each software module/hardware equipment of the system. This document was agreed by all partners and was used as a basis for the developments.
- **The execution & completion of the tests & validation (unit tests) for each equipment and software module**. These tests have been performed following a specific test plan for each equipment and software module, and which is presented in the Conception Manual for each equipment and software module.
- **Completion of the integration of the onboard and ground systems**.

The table hereafter presents the list of all the equipment and software modules for which the development has been completed over the reporting period.

4.2.2 Regular technical meetings

Several technical working meetings were organised over Phase 2.B, in order to enable the technical teams of M3S, INOV, INTUILAB, which are in charge of developing the main equipment and software modules, to work together on development tasks, software debugging and system integration. These regular meetings, by enabling the technical teams to exchange very fast on problems identified, enabled them to work much more efficiently than if they had been working separately. Therefore, these meetings proved to be very fruitful.

The objectives of these technical meetings for the technical teams were:

- to define precisely and agree on the **interfaces** between each software module and each hardware equipment of the system. This was achieved through the common ICD (Interface Control Document), which contained all the data structures and inputs/outputs of each software module/hardware equipment of the AIRNET system. This document was produced with inputs from all partners and was agreed by all partners. It was used as a basis for the development of of software modules and hardware equipment in Phase 2.B.
- to agree on **common software development principles & methods**.
- to perform software **debugging**.
- to start the **integration of the onboard and ground systems** as early as possible, in order to solve all potential problems early, thus enabling a smooth final integration at the end of Phase 2.B.

4.2.3 Specific software development & documentation methodology

It was agreed by all partners in charge of developing technical components of the system to adopt a common harmonised methodology for software development and documentation in Phase 2.B. This methodology was followed by the partners during the whole reporting period, and enables to ensure that all the equipment and software modules of the project, which are developed by different partners, are developed using the same rules and standards. This enables a smooth system integration.

This methodology was based on the following elements:

- Use of a **common coding standard** for the development of the different software modules : this standard ECSS-E40b has been produced by the European Space Agency, and is usually used for “small” software projects in the space domain.
- Use of a **common configuration management tool** for the management of the different source codes developed by the different partners (“CVS server”).
- Use of a **common template for the production of the Conception Manual for each equipment and software module**. The contents of the common template for the Conception Manual is the following :
    - Modifications of Architecture/Interface/Activity Diagrams

- Description of any additional functionalities
- Description of any non-operational functionalities:
  - Initialisation
  - Maintenance
  - Off-line functions
- Detailed description of SW architecture
  - Threads
  - Pipes,…
- User Manual : configuration, parameters, etc.

- Use of a **common tool for producing the Detailed Design document for each software module**. This document (HTML format) will be automatically generated by a common tool used by all partners (DOXYGEN tool), and only concerns software maintenance.
- Use of a **common methodology for the tests to be performed on each equipment and software module**: a test plan has been be elaborated for each module/equipment, and has been be included in the Conception Manual. This test plan contains:
  - Definition of several tests ("unit test cases") for each module/equipment requirement
  - Definition of the pass/fail criteria for each test
  - Execution of each unit test case, before integration, in order to validate each "standalone" module (the pass/fail criteria used for software modules/equipment validation are included)
  - Unit test report (checklist of the results of the unit test cases)
- Use of a **common Interface Control Document (ICD)**, which contains and centralizes all the interfaces of the AIRNET system (both external and internal interfaces)

This common methodology is illustrated by the figure hereafter.

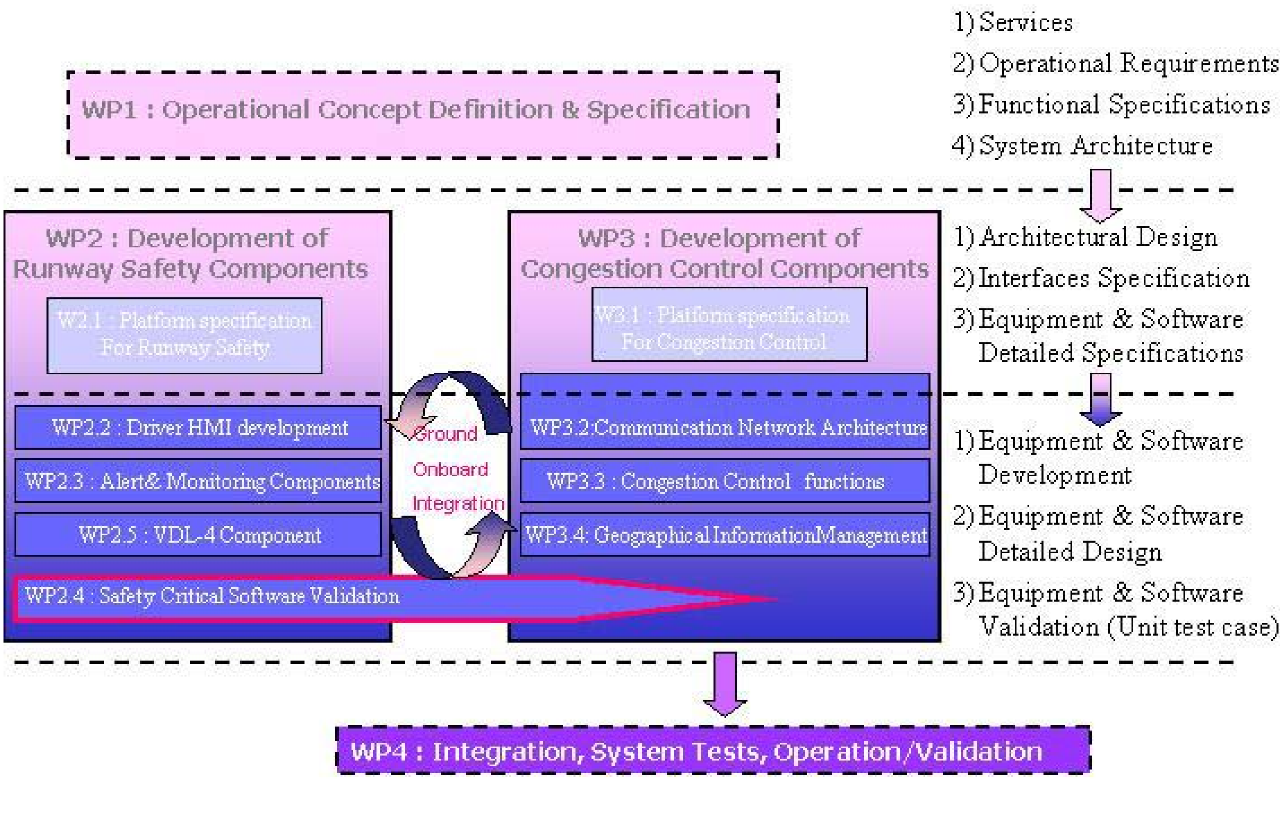


Figure 4-1: Development methodology

4.2.4 System integration methodology

During the different validation campaigns performed on Porto airport and in the different laboratories of partners, the AIRNET system performances, the deviations and the potential improvements were reported by the different partners. A specific table (Excel sheet) was used to report unexpected systems behaviours, to associate actions and schedule, and to provide the current status.

This table was regularly updated (at least each month) by M3S, taking into account new potential issues identified and technical team progresses.

In the following page, a part of this table has been inserted in order to illustrate the way issues have been reported and managed.

Action Item ID / Problem ID	Reported by	Problem context	Action Item description / Proposition of solution	Actionee	Due date	Obs/status
PB_07 Recovery of onboard system after loss of EGNOS position	I. Rebelo (cf. email 11 April 06)	*If EGNOS coverage is lost (vehicle near the terminal building) the CNU doesn't recover the position information when the EGNOS coverage is recovered (with the vehicle in open field).*	This is very surprising: actually, during the January meeting in Porto, this situation was tested and it was successfully proven that the onboard system automatically recovers when the EGNOS position is recovered following an EGNOS loss of position (e.g.	M3S	30 June	To be tested during test campaign in Porto
PB_08 Slow map display on Ground HMI	I. Rebelo (cf. email 11 April 06)	*The Ground HMI map display takes too much time.*	Yes, this was already observed during the January meeting in Porto. **Cf. Action AI-08 (26/01/06)**	INOV	19 May	SOLVED to be checked during tests at Lisbon (Week 25)
PB_09 Ground HMI stability problems	I. Rebelo (cf. email 11 April 06)	*There are some display stability problems: gaps of information and information updates missing.*	To be investigated by INOV/M3S	INOV/M3S	19 May	To be tested and debugged. Will be solved with new software releases

Figure 4-2 : Illustration of the table for system integration tasks

5 Main achievements of Phase 3 (Platform Operations)

5.1 Overview

The objective of this last phase of the project was to deploy the AIRNET system in Porto airport in order to perform an extensive validation campaign of the AIRNET system. The objectives of this validation campaign were to:

- Validate the AIRNET system in operational conditions.
- Validate that the implemented AIRNET demonstrator respected the international norms and required operational criteria in terms of performance: realibility, safety and response times

This validation campaign took place in Porto airport over a 4-month period from October to December 2006. During this campaign, 4 airport vehicles were equipped and used to test the AIRNET system:

- 2 vehicles were equipped with the AIRNET CNU and CDMA450 (AIRNET 04: Birds Kia, AIRNET 05: Follow-Me Strakar)
- 2 vehicles were equipped with the AIRNET Tablet PC and Wi-Fi (AIRNET 01: Maintenance Polo, AIRNET 03: Follow-Me Polo)

The validation was performed step-by-step, based on the limited configuration deployed at Oporto airport, intending to demonstrate that the services provided by the AIRNET system complied with the operational requirements of the different airport actors.

Figure 5-1 : Oporto airport (Portugal)

For this validation, only the communication wireless technologies with better performance (Wi-Fi and CDMA) were implemented in the operational scenarios. During the various tests performed for the validation, it was not possible to perform tests in low visibility operations, since they never occurred. Nevertheless the tests were performed during day and night conditions.

Corrective rollback evaluations and components optimisation were performed during the tests. Several iterations were made, evolving operational people to experiment, evaluate and provide feedback to improve the solution implemented.

The Validation of the AIRNET system was based on the results of the operational validation in each of the following sub-sets:

- Validation of the Runway Safety Service

- Validation of the Congestion Control Service
- Validation for the Communication Network
- Validation of the VDL-4 network
- Validation of the Driver HMI

With the exception of VDL4, all the foreseen tests were performed by Porto operational and technical staff independently from the AIRNET partners, that developed the different hardware and software components of the AIRNET system. The Porto airport has only one runway 17-35, as presented in the photo below.

5.2 Description of the AIRNET Platform used for the validation campaign

As depicted by the pictures hereafter, the AIRNET prototypes implemented at the Oporto airport includes:

- **On-Board equipment:**
    - 2 vehicles equipped with CNU and CDMA450 (AIRNET 04 - Birds Kia and 05 – Follow-Me Strakar)
    - 2 vehicles equipped with tablet PC and Wi-Fi (AIRNET 01 - Maintenance Polo and 03 – Follow-Me Polo)
    - Driver HMI

  The onboard equipment for the 5th vehicle (AIRNET 02) was not integrated due to a CNU failure.

- **Communication Networks:**
    - CDMA 450 Network (all airside coverage)
    - Wi-Fi 801.11a –2nd Generation (airside partly covered)
    - Tetra Network (available on Ground but not used in vehicles for the AIRNET demonstration)
    - VDL4 – one ground station and one transceiver not integrated in the AIRNET platform.
- **Ground Station:**
    - Communications server + Applications server + Ground HMI
    - Airport Operational Management Systems (not part of the AIRNET system but made available by ANA)

Figure 5-2 : Vehicles equipped with AIRNET onboard system (1)

Figure 5-3 : Vehicles equipped with AIRNET onboard system (2)

Figure 5-4 : AIRNET ground system deployed at Oporto

Figure 5-5 : WiFi network deployed at Oporto airport

5.3 Identified limitations

The platform, as implemented, being an R&D solution presents some limitations that didn't allow a continuous operation bringing some difficulties to the operational validation.

From the problems identified, the ones considered most important in operational terms were:

- The ground service monitoring module crashes sometimes during switch on/off procedure and after some time of continuous work of the system, what obliges to restart the system
- Switch on/off of vehicles is a complex procedure that obliges the intervention of maintenance each time the operational staff wants to connect the system. This problem was minimized with the delivery by M3S in 6th November 2006 of the description "Use of the AIRNET on-board system: switch ON/OFF procedure". As it is compulsory to do the CNU and tablet PC manual switch-off each time the vehicle is switched-off, the Operational staff had to perform specific trials, as the validation in normal operational conditions was not possible.

During validation of the demonstrator the following issues of minor importance were also detected:

- Sometimes the 'Switch on' procedure fails in all vehicles; most of the times it is correct;
- After 'Switch off' procedure the vehicle does not disappear from the GHMI;
- In the DHMI, when a vehicles is moving sometimes the positions of the others vehicles are fixed although, they are also moving;
- The Runway incursion without clearance alarm sometime is not correctly displayed on one of the vehicles (AIRNET 3);
- Messages transmitted to a vehicle in movement are not always displayed when the vehicle stops;
- In the DHMI the flight company icons were not displayed;
- The tasks hours displayed in the DHMI are one hour different from the Database and GHMI hours;
- The Tasks names in the DHMI do not match to the tasks in the Database and in the GHMI.

5.4 Results of the Tests Performed in Operational Environment

5.4.1 *Validation tests*

In the following subsections are presented the results of the tests that were performed in operational conditions during the validation campaign.

- Runway Safety Service Tests
- Congestion Control Service Tests
- Communication Networks Tests
- Driver HMI Tests

For each type of tests, the tests results have been grouped in three different categories:

- **Positive and innovative aspects of AIRNET**, taking into consideration the future deployment of the solution in operational environment, are highlighted for the different services tested and evaluated.
- **Issues for an industrial solution**: some aspects that need to be corrected when passing from a demonstrator prototype to an industrial solution.
- **Further developments**, that could improve even more the features of AIRNET.

5.4.1.1 Runway Safety Service Tests

From the operational tests performed the following aspects were highlighted:

- **Positive and Innovative Aspects**
  - Vehicles position precision and accuracy

    - Most of the time an HPL less than 7,5m (normally 1-2m) was achieved
    - The EGNOS signal availability most of the time
    - Velocity information quite accurate.
  - Position precision adequate for A-SMGCS operation.

- **Issues for an industrial solution**
  - Alarms identified have to be implemented (only runway incursion alarm available)
  - Runway incursion alert should be red.
  - The limit of the safety areas should be displayed on the DHMI map like in the GHMI.
  - Dynamic update of geographical information in case of LVO/NVO has to be implemented.
  - AIRNET system 'Switch on-off' should be done automatically with vehicle 'Turn on-off'.
  - AIRNET system 'Switch on' should be improved (in the demonstrator takes too much time - 3 to 4 min.)
- **Further developments**
  - EGNOS signal coverage in shadow areas (near the buildings, beneath the fingers, inside the tunnels and terminals)

5.4.1.2 Congestion Control Service Tests

From the operational tests performed the following aspects were highlighted:

- **Positive and Innovative Aspects**
  - Position precision adequate for A-SMGCS operation.
  - Ground HMI layouts adequate for different type of actors.
  - On-line interface with AOMS (flight plans information, task allocation, drivers and cars id) which allows to provide the following data provided by Decision Support system:
    - Airport layout: geographical representation of various airport areas (TWY, RWY…)
    - Reference points: holding points, stop bars (and other airfield lighting), RWY thresholds…
    - Fixed Obstacles
  - The use of ASTERIX format allowing the data fusion with existent A-SMGCS Systems, based in radar and multilateration.
- **Issues for an industrial solution**
  - All Alarms concerning vehicles have to be implemented (only runway incursion alarm available)
  - Panic alert message has to be improved
  - Additional data already identified in Airnet specifications has to be implemented:
    - RWY and TWY status (open / closed), the reason a runway or taxiway is closed;
    - Other data (e.g. meteorological conditions)
  - The vehicles have to be displayed, on DHMI and GHMI, immediately after 'Switch-on'.
- **Further developments**
  - System monitoring status to be full implemented
  - Replay and simulation facilities to be available

- Dynamic update of geographical information in case of LVO/NVO needs to be implemented.
- GIS information needs to be improved according with ED 119 (recommended since end of 2005).

5.4.1.3 Communication Network Tests

From the operational tests performed the following aspects were highlighted:

- **Positive and Innovative Aspects**
  - System ability to work with different network technologies
  - The validation of a low cost private wireless network to be used in the airside of an airport to support operational systems in conformity with A-SMGCS (Wi-Fi 2nd generation)
  - CDMA network can be used as a back-up network.
- **Further developments**
  - Wi-Fi network coverage of the wireless network chosen has to be extended to all airport areas including the shadow areas, if all AIRNET services are to be implemented.

5.4.1.4 Driver HMI Tests

From the operational tests performed the following aspects were highlighted:

- **Positive and Innovative Aspects**
  - A clean and neat image during night and low visibility conditions.
  - User friendly interface
  - Layout suitable for the drivers of different actors
- **Issues for an industrial solution**
  - During the day is very difficult to see the information displayed.
- **Further developments**
  - DHMI without touch screen needs to be implemented.

5.5 The operational use of Wireless Communications Networks

Currently there are three deployed wireless networks as part of the AIRNET platform in the Porto airport: TETRA, CDMA450 and WiFi (802.11a) besides the aeronautical VDL-4 network, which is only used for compatibility tests with an aeronautical network. Tests on the use of these networks to support the AIRNET services have already been done.

The TETRA network covers the entire air side of the airport (apron area, maneuvering area and peripheral roads), and most of the airport staff vehicles were already equipped beforehand with TETRA for voice and short message communications. Results of the data transmission tests in the TETRA network within the AIRNET platform show a limited performance for the AIRNET services.

The CDMA network also covers the complete air side of the airport area, using a CDMA Telemodem Z010 inside the vehicles. The airport area is covered in CDMA/1xRTT, and one half of that area is also covered with CDMA/EVDO.

The Wi-Fi (IEEE 802.11a) network deployment also assures the complete coverage of the air side of the Porto airport. The increased transmit power allowed for IEEE 802.11a allowed this goal to be achieved with only 17 APs, which are also able to provide coverage redundancy (see figure).

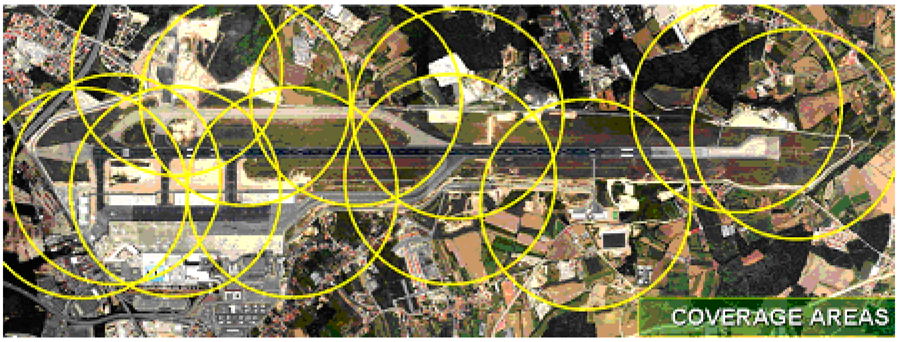


Figure 5-5 : WiFi network coverage at Oporto airport

Network performance tests were conducted. The latter show that the Wi-Fi network is currently the only one that fully respects AIRNET delay and packet loss requirements. The security features included in the chosen Wi-Fi network area are also adequate for its use in an airport environment. However, CDMA performance allows its use as backup network, and its role tends to improve as more of the area of the Porto airport gains EV-DO coverage. However, the higher data rate of Wi-Fi allows it to provide a wider range of new applications in this environment and being a private network completely controlled by the airport authority brings an extra added value for AIRNET. The tests conducted for TETRA showed that its performance is low for the majority of AIRNET services.

5.6 Conclusions

This section presents the conclusions of the validation campaign performed in Porto over the period from October to December 2006.

From the Operational perspective, from the AIRNET demonstrator it was possible to conclude that, if improvements suggested in the previous section are implemented, the solution is suitable for:

- A-SMGCS services (surveillance, guidance and control) for vehicles, not only in the maneuvering area, but in all movement area and peripheral roads.
- The implementation of decision support services important for situation assessment and proposition of solutions to optimise operational performance through better management of the resources (human, vehicles and equipment) that are affected to aircrafts on each stand, allowing an efficient fleet management in the apron area and peripheral roads. The following main types of information can be provided:
    - Aircraft real time information (i.e. ETA, ATA, ETD, ATD, stand, aircraft type, origin, destination, passengers gate, conveyor belt, etc.)
    - Text messages with the drivers instructions
    - Airport historical data (former conflict, infringements…), with all movements of vehicles on the airport
    - Vehicle status information, position and task allocation and completion indicator and information about vehicles and drivers (ID…)
    - Driver status information, information about the driver (license validity, infractions, …)
- Operations as a safety net, anticipating potential conflicts and preventing hazards resulting from vehicle driver operational errors or deviations:
    - Detecting and providing conflict/infringement alert on the maneuvering area:
        - on taxiway: e.g. vehicle entering or crossing taxiway while aircraft is taxing;
        - vehicle not stopping at the Roll holding position
        - vehicle going behind Road holding position
        - restricted areas incursions caused by vehicles: critical and sensitive areas established for radio navigation aids
        - Incursions to emergency areas (i.e. access roads to the runway for emergency vehicles)

    - Runway strip or the protection area needed for the precision approach and landing aid in use, whichever is the most restrictive
    - Closed runway or taxiway
    - Taxiway strips

- Implementing a full A-SMGCS system through the integration of AIRNET with the data fusion unit of an ATC A-SMGCS System base in radar and multilateration for aircrafts, surveillance, guidance, control and routing services
- Implementing different types of wireless networks allowing different capabilities of data exchange between mobiles and ground system, covering both the Manoeuvring area and the Apron area. The evaluation of the several networks could contribute to the AIRNET implementation in different airports using existing infra-structure, or aiding to choose the most adequate one, depending on the available budget and services to be supported
- Innovative solutions based in EGNOS/Galileo positioning system and low cost wireless networks, compliant with the standards and recommendations of ICAO and EUROCONTROL and ITU (International Telecommunications Union) and ETSI (European Telecommunications Standard Institute)
- Implementing low cost modular solutions either on small aerodromes or on large airports, in this case integrated with an A-SMGCS for surveillance, guidance, control and routing of Aircrafts
- Developing a unique solution integrating different aspects concerning Safety and Fleet Management
- Developing Geo-referenced information according to ICAO and Eurocontrol/ WGS- 84 Rules and applicable in any other project using EGNOS and Galileo applications for airport operational areas. The way in which the geographical information was created can be replicated and used in other projects:
    - Obtained through the airport available cartography, originally referenced on Lisbon's Hayford-Gauss Datum System for the Air-field Handbook.
    - Cartography accuracy confirmed by external audit, that also validated its transformation to WGS-84 System.
    - Innovative feature of contemplating all aeronautical protection surfaces geo-referenced according to the existing "Standards", and prepared in collaboration with the Air Traffic Control Services
    - Cartography stratified in thematic layers, therefore it is ready for easy inclusion of another sort of information, such as: new aeronautic data, obstruction of aerial navigation, covered facilities, etc.
    - It has the aptitude to be visualized in 3D, although it is only designed for planimetric data processing.
- The design of AIRNET solution can be customized for Ground Handling services:
    - Specific and dedicated information according to the GH manager needs. Only his/her own fleet AC's information to perform his/her task, and the Handling driver needs only information about the A/C he/she is handling
- the development of other Galileo applications for aeronautical environment or for other transport modes, based in GNSS applications.

Additionally the stepwise methodology and approach taken in the AIRNET project, can be easily followed in other projects. If the same methodology, as the used in the AIRNET, is used in other projects for the implementation phase, it will be easy to identify and track the related user requirements and to assess their impact on the system, thus allowing to minimize the implementation risks.

The major phases/step analysis were:

- Identification of airport actors (stakeholders)
- Definition of actors' roles and needs

- Characterization of vehicles operations
- Definition of airport areas characteristics
- Identification of required interfaces with operational systems
- Service prototyping: from operational to functional requirements. This step allows an an easy mapping between operational requirements, functional requirements and tests (used over previous reporting periods)
- Production of detailed specifications for all hardware components and software modules to be developed under the project

6 Conclusions of the Public Demonstration (Porto, 13 December 2006)

A Public Demonstration of the AIRNET system was organised on 13 December 2006 in Porto airport, in presence of representatives of the European Commission, Eurocontrol, European airports, European industry key players. The objective of this Public Demonstration were to:

- Present the main results & achievements of the AIRNET project
- Make a demonstration of the AIRNET system in operational conditions, by providing the participants with the opportunity to witness the actual performance of the AIRNET solution installed and working in operational vehicles.
- Obtain feedback from participants & discuss with them on how to pave the way for the operational use of the AIRNET solution. In particular, this event enabled to validate the AIRNET solution for multiple end-users from the aeronautical sector (other airports and other users).

6.1 Organisation

6.1.1 Participants

This Public Demonstration gathered over 100 persons from several European entities and the participants had the possibility to observe the AIRNET solution installed in the vehicles and in operational conditions. This event had a big interest from the Portuguese mass media that published several articles. The participants to this major communication event were the following :

- European Commission
- Project participants: M3 SYSTEMS, ANA, INOV, CNS, INTUILAB
- Airport authorities:
  - ANA Aeroportos de Portgal:
    - airports of Faro, Lisbon, Porto
    - DIA [Direcção de Infra-estruturas Aeronauticas]
    - DIMO [Direcção de Imobiliário]
    - DJUCON [Direcção de Serviços]
    - DSTE [Direcção de Serviços Técnicos
  - Frankfurt airport (Fraport, Germany)
- Airport ground movements
  - CLA – Catering
  - PORTWAY
- Industry :
  - Aircraft manufacturers: Airbus France (France)
  - Efacec (Portugal)
  - Skysoft (Portugal)
  - Portugal Telecom Inovação (Portugal)
- Others :
  - CNES - Centre National d'Études Spatiales (France)
  - Portuguese Agency of Innovation (Portugal)
  - Alcatel Lucent (Portugal)

    - Alfândega (Portugal)
    - Hitec Marketing (Austria)
- Transport :
    - ASCAS - Associação de Sociedades Concessionárias de Auto-Estradas SCUT
    - METRO DO PORTO (Portugal)
- Software
    - EDINFOR
    - Edisoft (Portugal)
    - ESRI Portugal (Portugal)
- Research & education institutes :
    - INAC - Instituto Nacional de Aviação Civil (Portugal)
    - INOV (Portugal)
    - Institute of Flight Guidance Braunschweig (Germany)
    - ISEC - Instituto Superior de Educação e Ciências
    - Saarland University (Germany)

The table hereafter presents the participants list:

EMPRESA	NOME	CARGO
Agência de Inovação	Bibiana Dantas	
AIRBUS - França	Marcel Garcia	
Alcatel Transports Solutions	Blanche Moreno	Key Account Manager
Alcatel-Lucent	Gaspar Veiga	Director - Key account Manager
Alfândega | Porto	Fernando Franco	
Alfândega | Porto	Maria Paula Soares	
ANA - Aeroporto de Faro	Duarte Alves	Coord. Área Safety
ANA - Aeroporto de Faro	Francisco Gomes	Gestor de Segurança
ANA - Aeroporto de Lisboa	Albano Pinto	
ANA - Aeroporto de Lisboa	Américo Marques	
ANA - Aeroporto de Lisboa	António Ribeiro	
ANA - Aeroporto de Lisboa	Armindo Barata	
ANA - Aeroporto de Lisboa	Fausto Matias	
ANA - Aeroporto de Lisboa	Helena Marques	
ANA - Aeroporto de Lisboa	João Nunes	
ANA - Aeroporto de Lisboa	João Reis	
ANA - Aeroporto de Lisboa	Jorge Barreira	
ANA - Aeroporto de Lisboa	José Luis Rabaçal	
ANA - Aeroporto de Lisboa	Mário Cabrita	
ANA - Aeroporto de Lisboa	Paulo Medo	
ANA - Aeroporto de Lisboa	Ruas Fialho	
ANA - Aeroporto de Lisboa	Rui Gordinho	
ANA - Aeroporto de Lisboa	Rui Jesus	
ANA - Aeroporto de Lisboa	Sérgio Miranda	
ANA - Aeroporto de Lisboa	Sérgio Ribeiro	
ANA - Aeroporto do Porto	Alvaro Leite	
ANA - Aeroporto do Porto	Anabela Costa	
ANA - Aeroporto do Porto	António Loureiro	
ANA - Aeroporto do Porto	António Pinho	
ANA - Aeroporto do Porto	Arlindo F. Brito	
ANA - Aeroporto do Porto	Armando Sá Pereira	
ANA - Aeroporto do Porto	Carlos Vicente de Carvalho Finteiro	Oficial de Operações Aeroportuárias
ANA - Aeroporto do Porto	Eduardo Vasconcelos	
ANA - Aeroporto do Porto	Emiliano Cardoso	
ANA - Aeroporto do Porto	Fernando Rocha	
ANA - Aeroporto do Porto	Fernando Vieira	Director
ANA - Aeroporto do Porto	Joaquim Carvalho	
ANA - Aeroporto do Porto	Joaquim Queirós	

ANA - Aeroporto do Porto	José Alberto Ramos	
ANA - Aeroporto do Porto	José Maria Silva	
ANA - Aeroporto do Porto	José Sardo Pereira	
ANA - Aeroporto do Porto	Luciana Marinho	
ANA - Aeroporto do Porto	Manuel Oliveira Tavares	
ANA - Aeroporto do Porto	Maria Aduzinda	
ANA - Aeroporto do Porto	Maria da Glória Oliveira	
ANA - Aeroporto do Porto	Maria do Rosário Fernandes	
ANA - Aeroporto do Porto	Maria Efigénia Pinto	
ANA - Aeroporto do Porto	Nuno Lima	
ANA - Aeroporto do Porto	Paula Pinheiro	
ANA - Aeroporto do Porto	Paulo Oliveira	
ANA - Aeroporto do Porto	Rui Alves	
ANA - Aeroporto do Porto	Rui Amaral	
ANA - Aeroporto do Porto	Rui Maia	
ANA - Aeroporto do Porto	Sérgio Martins	
ANA - Aeroporto do Porto	Zulmira Marques	
ANA - Aeroportos de Portugal	João António Ruas Fialho, Eng.	
ANA - Aeroportos dos Açores	Mota Borges, Dr.	
ANA - CSP [Centro de Serviços Partilhados]	Nuno Ferreira, Dr.	
ANA - DAA [Direcção dos Aeroportos dos Açores]		
ANA - DAO [Direcção de Auditoria]	Joana Gamboa, Eng.	DAO
ANA - DAO [Direcção de Auditoria]	José A. R. Pereira	
ANA - DAO [Direcção de Auditoria]	Ludovina Simões, Drª	Directora
ANA - DAO [Direcção de Auditoria]	Vitor Almeida	
ANA - DAO [Direcção de Auditoria]	Vitor Delgado Maria	
ANA - DFIN [Direcção Financeira]	Daniel Moita	
ANA - DIA [Direcção de Infra-estruturas Aeronauticas]	João Leal, Arqt.	Director
ANA - DIA [Direcção de Infra-estruturas Aeronauticas]	Marisa Guerreiro, Arqtª	Chefe de Projecto
ANA - DIA [Direcção de Infra-estruturas Aeronauticas]	Menezes Gonçalves, Eng.	Gestor de Cliente
ANA - DIA [Direcção de Infra-estruturas Aeronauticas]	Nuno Carmo, eng.	
ANA - DIMO [Direcção de Imobiliário]	Pedro Beja Neves, Dr.	Director
ANA - DJUCON [Direcção de Serviços]	Francisco Sebastian, Dr.	Director
ANA - DSTE [Direcção de Serviços Técnicos]	Gualdim de Carvalho, Eng.	
ANA - DSTE [Direcção de Serviços Técnicos]	Ivo Silva, Cmdt.	Director
ANA - DSTE [Direcção de Serviços Técnicos]	Luis Canha e Sá, Dr.	
ANA - DSTE [Direcção de Serviços Técnicos]	Pedro Reis	
ANA - DSTE [Direcção de Serviços Técnicos]	Vitor Figueiredo, Eng.	

ANA - DSTIC	Isabel Rebelo, Eng.	
ANA - Serviços Centrais	Maria de Lurdes Duque	
ANAM	Sónia Fernandez	Chefe do Serviço de Operações Aeroportuárias
ASCAS - Associação de Sociedades Concessionárias de Auto-Estradas SCUT	José Luis Silva Louro	Consultor de Temática Rodoviária
Autodesk	Jorge Horta, Eng.	Director Autodesk Portugal
CLA - Catering	Fernando Costa	Gerente
CLA - Catering	Miguel Teixeira	Director
CNES - Centre Nacional D'Études Spatiales	Marc Jeannot	Navigation System Engenieer
EDINFOR	Gonçalo Lança, Dr.	Gestor de Cliente
EDINFOR	José Quádrio Alves, Dr.	Gestor de Desenvolvimento de Negócio
Edisoft	Nuno Gomes	
Efacec	José Sousa	Comercial Manager
Efacec	Paulo Paixão	Unidade de Negócio de Telecomunicações
Efacec	Pedro Moreira da Silva	
Efacec	Cipriano Lomba	Director
ESRI Portugal	José Luis Raimundo	Consultor
EU Comission	Irmgard Heiber	Scientific Admin.
EU Comission - DG Tren	Halle Sven	
Fraport	Michael Huhnold	Head S. Development
Fraport	Thorsten Astheimer	Senior Project Manager
Goundforce	José Cruz	Director Geral Carga
Hitec Marketing	Andrea Kurz	Senior Researcher
INAC - Instituto Nacional de Aviação Civil	Artur Manuel Correia Travassos Ventura, Eng.	Director de Infraestruturas e Navegação Aerea
INAC - Instituto Nacional de Aviação Civil	Luis Coimbra, Eng.	Management Board of Galileo Authority
INAC - Instituto Nacional de Aviação Civil	Rui Sérgio Martins Bingre do Amaral	Chefe do Departamento de Infraestruturas Aeroportuárias
INOV	Augusto Casaca, Prof.	Professor
INOV	Fernando Moreira, Eng.	Presidente
INOV	Luis Fernandes	Project Managaer
INOV	Mário Serafim Nunes	vogal do CA
INOV	Carlos Palminha, Eng.	
INOV	Gabriel Pestana, Eng.	
INOV	João Lageira, Eng.	
INOV	Tiago Rocha da Silva, Eng.	Director
Institute of Flight Guidance Braunschweig	Christoph Schamand	Research Assistent
Institute of Flight Guidance Braunschweig	Eike Christian Rewald	Research Assistent
Integra - Dinamarca	Zoltan Gati	

Intergraph	João Pedro Fernandes	Technical Supervisor
Intergraph	João Santos	Eng. Civil Depart. Comercial
INTUILAB	Alban Hermet	UI Designer
INTUILAB	Stephane Valles	Project Manager
ISEC - Instituto Superior de Educação e Ciências	Miguel Centeno Moreira	Director do Departamento de Ciências e Tecnologias
ISR - Coimbra	Rui Rocha	Professor
M3 Systems	Berne Sebastien	Technical Diector
M3 Systems	Marc Pollina	President
M3 Systems	Mathieu Romain	
METRO DO PORTO	Nuno Ortigão, Dr.	Director da Rede de Exploração
NAER	Maria de Fátima Rodrigues, Drª	
PH	Hugo Dias	Director Geral
Portugal Telecom Inovação	José Machado, Eng.	
Portugal Telecom Inovação	José Miguel Santos, Eng.	
Portugal Telecom Inovação	Leopoldo Magalhães, Eng.	
PORTWAY	António Baptista	
PORTWAY	Artur Anjo	
PORTWAY	José Manuel Santos, Dr.	Administrador
PORTWAY	José Tomás Baganha, Dr.	Director Executivo
Saarland University	Gao Haibin, Dr.	
Skysort	José Freitas, Eng.	
Tracevia	José Coutinho, Eng.	
	Maria Carlota Sales Henriques	Advisor

Table 6-1 : List of participants to the Public Demonstration on 13 December 2006

6.1.2 *Agenda*

The figure hereafter presents the agenda of the Public Demonstration.

As reflected by the agenda presented hereabove, several presentations were made:

- Presentation of the AIRNET project: objectives, work-breakdown structure, schedule, main achievements
- Presentation of the AIRNET onboard system
- Presentation of the AIRNET Driver Human-Machine Interface
- Presentation of the AIRNET Ground System
- Presentation of the AIRNET Wireless Communication Networks implemented in the project
- Presentation of the AIRNET Operational Validation Campaign realised over the period from October to December 2006
- Presentation of the operational feedback & return of experience obtained from the end-users

Concerning the demonstrations in the vehicles, participants were invited to :

- Go in the vehicles and observe the behaviour of the AIRNET onboard system & Driver Human-Machine Interface in operational conditions. In particular, they could observe the movement of the vehicle on the airport map, as well as the runway incursion alert.
- Observe the behaviour of the AIRNET ground system & Ground Human-Machine Interface at the same time as the vehicles were moving on the airport surface (they could in particular observe the runway incursion alert & the movement of the vehicles).

6.1.3 ANA evaluation

ANA's opinion on the AIRNET public presentation is very positive. Despite the fact that the Public presentation was done in a period near Christmas, where usually there are travelling restrictions either due to the period but also resulting from budget limitations. Indeed the audience was much larger and demonstrating a deep interest in the solution.

Indeed there were representatives from different countries related with aeronautical sector (airports and air navigation), namely, regulators (civil aviation and telecommunications), Portuguese governmental institutions (connected with innovation, road, rail and maritime transports), public transports, private entities, scientific institutions (universities and investigation organisations) and industry.

The audience experienced the solution working in real time environment and fully integrated with the Airport operational systems.

The fact that the solution was integrated and fully interconnected with existing systems (Airport Local Area Network, Operational Management, Flight information and Airport Central Time Systems) and not as a dedicated and stand-alone demonstrator of the AIRNET solution was one of the major success factors that lead the participants to request further details about the solution and the possibility to be adapted to their own scenarios.

Concerning ANA as an entity responsible for the management of 7 airports and with management contracts for Madeira (Funchal and Porto Santo) and Macau airports it was relevant the interest showed by the airport and handlers operational staff.

After the public demonstration several enquiries were made to ANA from national and foreign airports and also from public transport authorities and especially from the industry.

7 Main achievements in terms of dissemination

7.1 Objectives

The objective of the tasks to be performed over the reporting period under WP5.2 was to contribute to the dissemination of AIRNET project & results, in order to raise public participation and awareness.

7.2 Main achievements

In order to achieve the objectives, over the project, the different partners of the AIRNET consortium have performed several dissemination actions, which are presented in the Table 7-1 hereafter.

Over the project, ANA and M3S have put a strong effort in disseminating the project results in two main events related with aviation specific business area. Namely the following dissemination actions took place in:

- **9th ACI Europe technical and Operational Safety Committee**, where most of the major European Airport representatives were present. The ACI (Arports Council International) is the only worldwide professional association of airport operators. ACI EUROPE represents some 400 airports in 45 European countries. Member airports handle 90% of commercial air traffic in Europe, welcoming over a billion passengers each year. ANA, in straight cooperation with ANA Director of Technical Services, made a presentation of the AIRNET project, focusing on the A-SMGCS concept and application to the Oporto airport. The main participants were Eurocontrol, ACI, and University of Cranfield. In addition, the following airports/companies were present :
    - Major European Airports : BAA Heathrow Airport, ADP, Aeroports de Paris French Civil Aviation, Frankfurt Fraport AG, Amsterdam Airport Shiphol, Copenhagen Airports A/S, Avinor AS (Norwegen Airports), Luftfartsverket (Swedish Airports & Stockholm-Arlanda Airport), AENA Aeropuertos Espanoles y Navegacion Aerea (Spanish Airports).
    - Medium Size Airports: Vienna Airports, Unique Flughafen Zurich AG, Aeroporti de Roma, Prague Ruzyne/Chech, Airports Authority, ANA-Aeroportos de Portugal, Munich International Airport, Riga Airport.
    - Small/Local Airports: G. Marconi Di Bologna Airport, Flughafen Frankfurt Hahn GMBH, Marseille-Provence, ADV German Airports Association, Riga International Airport;
    - Other entities: Cranfield University, EUROCONTROL, ACI Europe.
- **JISSA (Journées Internationales sur les Senseurs et Systèmes de Surveillance Aéroportuaire)** where two presentations of AIRNET were performed by M3 SYSTEMS and INOV to an airport specialised community: airports authorities, DG TREN of the European Commission, industry.

  The audiences in these two main events showed their interest in AIRNET project, raising several questions about the project, its objectives and its follow-up.

In addition, ANA and M3S focused the dissemination activities in the presentation of AIRNET system and services to potential users, since the aeronautical community is giving a strong emphasis to the A-SMGCS systems. In this context, the following dissemination actions were thus performed:

- M3S and ANA made a presentation of AIRNET during the **INSTILUX workshop (Advanced Surface Movement Guidance and Control Systems Workshop in Luxembourg)**, which addressed at all aspects of A-SMGCS, with particular emphasis on implementation progress and experience. The presentations includes the A-SMGCS levels I and II procedures and the European Action Plan for the Prevention of Runway Incursions. The guest speakers represented all areas of Airport Operations and many presentations focused on lessons learned from airports worldwide. The target population was ATCOs, Pilots and Airport Operations personnel.
- ANA was invited and participated in the initiative of "**Dia do Espaço**" (**Space Day**), promoted by the **GRICES** (**Cabinet for International Relationships of Science and Upper Teaching, which depends from the Minister of Science, Technology and Upper Teaching**), that took place on 26 November 2005 in Lisbon (Knowledge Museum/Pavilion). This participation aimed

at promoting the AIRNET project and the other on-going innovation projects related with Space / Galileo System. In particular, leaflets and presentations were available for the visitors.

The recent modernization of Francisco Sá Carneiro Airport in Oporto, allowed the construction of a modern technological platform, in the most diverse support systems to the airport's operation and exploration. This has allowed this airport to become a privileged stage to demonstrate and test technological innovations at an international scale. ANA was present in the exhibition with stand promoting the AIRNET project, where the visitors showed their interest in AIRNET project, raising several questions about the project, its objectives and its follow-up regarding the EGNOS and Galileo system deployment.

- M3S participated to the **4th EUROCONTROL Innovative Research Exhibition (INO)** in Brétigny. In particular, M3S animated the AIRNET stand during this event, and presented the AIRNET services (with illustration videos, particularly useful for dissemination & training purposes). M3S also made a presentation of the Driver HMI.
- INOV presented the following AIRNET papers at international conferences:

  i)A.Casaca, F.Presutto, I.Rebelo, G.Pestana and A.Grilo, An Airport Network for Mobiles Surveillance, Proceedings of the 16th International Conference on Computer Communication, ISBN 7-121-00308-2, pp. 1703 – 1708, Beijing, China, September 2004.

  ii)A.Grilo, M.Nunes, A.Casaca, F.Presutto, I.Rebelo, Communication Network Architecture for Mobiles Surveillance in an Airport Environment, Joint International Symposium on Sensors and Systems for Airport Surveillance Proceedings (CDROM), Paris, França, June 2005.

  iii) António M. Grilo, Romain Mathieu, Christian Axelsson, Mário M. Nunes, Integration of Wireless Technologies in an Advanced Surface Movement Guidance and Control System Network, 2005 IST Mobile and Wireless Communication Summit, Dresden, Germany, June 2005.

  iv) G.Pestana, M.M.Silva, A.Casaca, J.Nunes, An Airport Decision Support System for Mobiles Surveillance and Alerting, 4th International ACM Workshop on Data Engineering for Wireless Mobile Access Proceedings (CDROM), Baltimore, USA, Junho 2005.

  v) A.Casaca, T.Silva, A.Grilo, M.Nunes, F.Presutto and I.Rebelo, The Use of Wireless Networks for the Surveillance and Control of Vehicles in an Airport Environment, Proceedings of the 11th IFIP Personal Wireless Communications Conference, Lecture Notes on Computer Science, Springer, ISBN-10 3-540-45174-9, pp.483-493, Albacete, Spain, September 2006.

There also two other papers currently submitted, respectively to a journal and to an international conference.

During the 1st semester of 2006, ANA continued the strategy to disseminate the AIRNET solution aimed at specific airport users and aeronautical community, with the strong support of M"s. The main dissemination actions were:

- Portuguese Road Congress (Gamma, AIRNET & SAFEDRIVE), 5-7 April 2006, Lisbon (Partner: ANA: Isabel Rebelo, made a presentation to the Portuguese entities and major key players in the Roads Sector)
- 10 th Meeting of Technical and Operational Safety Committee, 21st April 2006 ACI Europe (Riga) (Partner: ANA: Ivo Silva, held contacts and and invited Marc Pollina from M3S to make a presentation of the AIRNET solution being developed at Oporto, at this ACI Conference)
- "Galileo A European Project of Global Lengthening", Galileo at Airports, Conference Galileo promoted by APLA - 22nd June 2006, Lisbon (Partner: ANA, Isabel Rebelo made a Presentation and maintained contacts focusing on the specific Galileo Applications integrated in the AIRNET solution)
- "Airport Operations and Security", a course ministered by ANA to a group of Chinese Airport Specialists (30th June 2006, Lisbon) (Partner: ANA, Isabel Rebelo presented the AIRNET solution which was very well accepted by the Chinese Airport Specialists that demonstrated interest in implementing a solution of this kind.

Besides, the AIRNET ongoing activities and results have been published via various media publications and conferences, as shown in the table hereafter. This task included dissemination in scientific and application related journals, as well as in scientific and application related conferences.

The AIRNET Web site, developed by ANA, available since November 2004 at www.airnet-project.com, has been periodically updated including most dissemination materials, all deliverables (contractual and internal) as well as minutes of meetings. This Web site is two-fold (private/public area):

- The public area of the Web site enables to promote and disseminate useful information on AIRNET & related topics, to download project public deliverables, to link to other useful Web sites, to contact project participants and to get information on forthcoming project events or related external events.
- The private area of the Web site is only accessible to project partners. It is dedicated to specific activities: transfer of specific documents, project private deliverables, progress reports, presentations, project templates, cost forms, etc.

All the presentations and material used for the dissemination actions mentioned hereabove have been placed on the AIRNET Web site.

ANA and M3S have also prepared material for a ICT new web site common with other projects of the 6th framework programme (SafeAirport, Ismael) in order to establish a common portal and join activities for dissemination actions.

7.3 Coordination with other projects

At the occasion of the In-Depth Clustering Meeting organised by the European Commission in Brussels on 9 November 2004, preliminary contacts were made with the following FP6-IST on-going projects related to airport safety :

- ISMAEL (Intelligent Surveillance and Management Functions for Airfield Applications Based on Low Cost Magnetic Field Detectors), contract n°IST-2002-507774
- SAFE AIRPORT (Development of an Innovative Acoustic System for the Improvement of Co-operative Air Traffic Management), contract n°IST-2002-507008

Following these preliminary contacts, it was agreed with ISMAEL and SAFE AIRPORTS coordinators to establish further synergies and connections with AIRNET in the first semester of 2005.

Following the first Clustering Meeting, the following actions were performed by M3S and ANA :

- A second Airport Safety Cluster Meeting was held in Brussels at the European Commission on 5 and 6 April 2005, with the objective of presenting the projects to each other and identifying and exploring opportunities for cooperation and benefit from the experiences of each other project and knowledge. In this meeting, the following actions were agreed and are under implementation :
    - Crosslinks were established on each project Web site towards the other project Web sites
    - A common Web portal (www.airport-safety-cluster.com) was established and contain the synergies identified between the three projects. The contents of this Web portal is the following :
        - Background :
            - short description of each project (AIRNET, ISMAEL, SAFE AIRPORT) and crosslinks to each project Web site
            - rationale for the Cluster initiative
        - Short description of the objectives for the initiative
- Another meeting was held at M3S premises on 24 May 2005, with the objective to derive a common action plan for dissemination and to define a precise collaboration strategy. .It was also agreed during this meeting to prepare a Coordination Action to be submitted to EC in the frame of the Aeronautics & Space call (deadline 13 July 2005). However, the feedback from EC on the opportunity of submitting this proposal in the Aeronautics & Space call, was rather negative. Consequently, it was agreed by all partners to postpone the Coordination Action and try to find a more suitable EC call for proposals.

- The common Web portal has been established by ISMAEL partner at the end of December 2005, including inputs and detailed information about AIRNET provided by the AIRNET partners. The collaboration between the three projects will continue as much as possible, tajing into account the fact that no funding was available for these actions.

In addition, contacts were initiated with the CAATS FP6 project. Actually, AIRNET was selected as a target project for interaction with CAATS. A member of the CAATS team thus came to Porto during the AIRNET integration meeting in January 2006, in order to have an insight on the AIRNET system and the live end-user tests: during these tests, operational specialists of ANA were involved in AIRNET answers to inquiries of CAATS. INTUILAB also reviewed the CAATS Human Factors Best Practice Manual. The objective is to tailor the CAATS HF Best Practice Manual to AIRNET needs in particular. It was agreed by M3S, ANA, INTUILAB and representatives of the CAATS project to perform in 2006 a Human Factors case study on the AIRNET system. As such, the study will be of benefit to AIRNET in terms of providing an input in Human Factors key elements currently not fully covered by AIRNET.

7.4 Other Dissemination Actions

ANA accepts to organize a file with major technical and scientific articles, press releases and a list of seminars and conferences were the AIRNET project and solution was presented.

As the Public presentation was most welcome by the audience and specialized entities in general (national and international), questions regarding scientific papers and publications are still being raised and also many press releases and news are being published.

Therefore t cope with this request and to provide a better material to EC, ANA decides to prepare a paper and an electronic version of AIRNET Project dissemination material

This material will have a special editing procedure and due to that will only be available during April.

ANA accepts also to maintain AIRNET website available until mid of March 2008. This site will be updated with dissemination material connected to AIRNET.

Event	Dissemination level	Location	Date	Partners involved	Actions from partners	Dissemination material used
Presentation of AIRNET in local newspaper in Toulouse ("La Dépêche")	Local	Toulouse (France)	March 2004	M3S	Presentation of AIRNET	Word document available on AIRNET Web site (« 2004_03_XX_Article La Dépêche.doc »)
Diffusion of the AIRNET Summary to Portuguese Innovation Organisations (ADI – Agência de Inovação; POSI- Plano Operacional Sociedade de Informação)	National	Portugal	1st semester 2004	ANA	Diffusion of AIRNET summary	Available on AIRNET Web site
National Conference « SMEs and FP6 : dream, reality or nightmare ? » Organised by French Ministry of Economy, Finance & Industry	National	Paris (France)	1 April 2004	M3S	M3S : presentation of AIRNET objectives & partners, FP6 experience	Powerpoint presentation available on AIRNET Web site (" M3 Systems_Atelier IST_Bercy_01-04-04.ppt")
ITS *(Intelligent Transport Systems)* International Congress of Budapest in the stand of the European Commission	International	Budapest (Hungary)	24-26 May 2004	M3S & ANA	Diffusion of AIRNET by M3S and ANA	Powerpoint presentation available on AIRNET Web site ("2004-05-24-26_AIRNET_IST Conf_Budapest.ppt")
Galileo Conference	International	Budapest (Hungary)	27-28 May 2004	M3S & ANA	Presentation of AIRNET by M3S and ANA to the 1st Galileo conference enlarged to the new member states, where ongoing relevant EGNOS/GALILEO projects financed by ESA and already under development in the new member states were presented	Available on AIRNET Web site
Portuguese Seminar about university and Regional Development, during a special day about Engineering, Airports and Society	National	Beja (Portugal)	9 June 2004	ANA & INOV	R&D Projects in Oporto Airport (Portugal) – ANA Wireless Communications Architecture in AIRNET Project- INOV Simulation Scenarios, Control of vehicles and communications in Airports – Project Airnet Study case – INOV	Available on AIRNET Web site

Event	Dissemination level	Location	Date	Partners involved	Actions from partners	Dissemination material used
16th International Conference on Computer Communication (ICCC'04)	International	Beijing (China)	September 2004	INOV	A.Casaca, F.Presutto, I.Rebelo, G.Pestana and A.Grilo, An Airport Network for Mobiles Surveillance, Proceedings of the, ISBN 7-121-00308-2, pp. 1703 – 1708, Beijing, China, September 2004	Available on AIRNET Web site
Presentation of AIRNET and Innovation projects in ANA's corporate magazine for clients and companies in Portugal ("Revista Ana Aeroportos, Setembro-Outubro)	National	Lisbon (Portugal)	September/ October 2004	ANA	Presentation of AIRNET and other innovative projects at ANA-Aeroportos	Article presentation available on AIRNET Web site ("ASCnoticias03-04.pdf")
European Commission brochure for FP5 & FP6 Environment projects	International	Brussels (Belgium)	October 2004	M3S & ANA	This brochure will present all FP5 and FP6 Environment projects, and is aimed at being largely disseminated through all the major events related to ICT for Environmental Risk Management and GMES.	Available on AIRNET Web site
Presentation of AIRNET in local magazine for companies in the Midi-Pyrénées region ("Entreprises Midi-Pyrénées")	Local	Midi-Pyrénées region (France)	October 2004	M3S	Presentation of AIRNET	JPEG file available on AIRNET Web site ("2004_10_XX_Entreprises Midi-Pyrénées.jpg")
5th Conference Portuguese Association of Information Systems	International	Lisbon (Portugal)	3-5 November 2004	INOV	Presentation about E-Safety Airport and Road Systems	Available on AIRNET Web site
ICT for Transport Clustering Meeting	International	Brussels (Belgium)	8 November 2004	M3S & ANA	Presentation of AIRNET in meeting related to the "eSafety for road and air transport" Strategic Objective of the IST programme. Objectives of meeting : 1 - explore & set-up complementarities & synergies among current and future R&D activities for this Strategic Objective. 2- Establish fruitful	Available on AIRNET Web site

Event	Dissemination level	Location	Date	Partners involved	Actions from partners	Dissemination material used
					contacts with active actors in the domain and to anticipate the future priorities supported through the IST programme	
AIRNET official Web site	Web site	N.A.	8 November 2004	M3S & ANA	Official release of AIRNET official Web site	www.airnet-project.com
In-Depth Clustering Meeting	International meeting	Brussels (Belgium, EC)	9 November 2004	M3S & ANA	Establishing synergies with other on-going projects (ISMAEL and SAFE AIRPORT)	Powerpoint presentation + available on AIRNET Web site
Contacts with different EC-funded projects	N.A.	N.A.	November 2004	ANA	Establishing synergies with EC-funded projects	N.A.
3rd EUROCONTROL Innovative Research Workshop, 9-10 December 2004	International	Bretigny (France)	9 December 2004	M3S & ANA	M3S made available a stand for the workshop	N.A.
AIRNET presentation at the Intermodality workshop, 15 th February 2005, Lisbon (Portugal)	International	Lisbon (Portugal)	15 February 2005	ANA	I.Rebelo, A. Pinho. A Loureiro, made an AIRNET presentation with emphasis on the safety enhancement features	Available on AIRNET Web site
Article published in the CNES Mag (information magazine of CNES, French National Space Agency)Edition n°25 of March 2005	National	France	March 2005	M3S	Article prepared by M3S regarding “Les Véhicules Aéroportuaires Localisés par Satellite” published in CNES Mag (information magazine of CNES, French National Space Agency) Edition n°25 of March 2005	Available on AIRNET Web site
"ACI Europe Technical & Operational Safety Committee" - AIRNET AIRport NETwork for Mobiles Surveillance and Alerting Presentation	International	Funchal – Madeira (Portugal)	31 March - 1 April 2005	ANA	I. Rebelo (ANA) made an AIRNET presentation in the ACI Europe Technical & Operational Safety Committee" - AIRNET AIRport NETwork for Mobiles Surveillance and Alerting Presentation	Available on AIRNET Web site
European Commission brochure for FP5 & FP6 Environment projects	International	Brussels (Belgium)	April 2005	M3S & ANA	This brochure will present all FP5 and FP6 Environment projects, and is aimed at being largely disseminated through all the major events.	Available on AIRNET Web site

Event	Dissemination level	Location	Date	Partners involved	Actions from partners	Dissemination material used
Airport Safety Clustering Meeting	International meeting	Brussels (Belgium, EC)	4-5 April 2005	M3S, ANA, INOV	Establishing synergies with other on-going projects (ISMAEL and SAFE AIRPORT)	N.A.
Dissemination action at the Portuguese Ministry of Transports	National	Lisbon (Portugal)	18 May 2005	ANA	I. Rebelo (ANA) made a presentation and wrote an article for the Transports Workshop held at the Portuguese ministry of transports. The article and the presentation were made available, at the Ministry site.	Available on AIRNET Web site
Airport Clustering Meeting	N.A.	N.A.	24 May 2005	M3S, ANA	Establishing synergies with ISMAEL and SAFE-AIRPORT projects and defining a common work-plan	N.A.
ITS (Intelligent Transport Systems) International Congress Hannover, in the stand of the European Commission	International	Hannover (Germany)	June 2005	INOV	INOV made an AIRNET presentation at the ITS at the Crossroads of European Transports	Available on AIRNET Web site
4th International ACM Workshop on Data Engineering for Wireless and Mobile Access MobiDE 2005 (in conjunction with SIGMODE/PODS 2005)	International	Baltimore (USA)	June 2005	INOV	Gabriel Pestana (INOV), made a presentation of AIRNET project as “An Airport Decision Support System for Mobiles Surveillance & Alerting”	Available on AIRNET Web site
2005 IST Mobile and Wireless Communications Summit Integration of Wireless Technologies in na Advanced Surface Movement Guidance and Control System Network	International	Dresden (Germany)	June 2005	INOV	Mário S. Nunes (INOV) made a presentation regarding the Integration of Wireless Technologies in an Advanced Surface Movement Guidance and Control System Network, applied in the AIRNET project	Available on AIRNET Web site
JISSA (JOURNEES INTERNATIONALES SUR LES SENSEURS ET SYSTEMES DE SURVEILLANCE AEROPORTUAIRE)	International	France	June 2005	M3S & INOV	Two presentations of the AIRNET have been done: One presenting AIRNET concept as a low-cost A-SMGCS System for small and medium sized airports and	Available on AIRNET Web site

Event	Dissemination level	Location	Date	Partners involved	Actions from partners	Dissemination material used
					another in the context of the Communication Network Architecture for Mobiles Surveillance in an Airport Environment framework. Additionally an article was prepared to be published.	
Artcile published on Cordis Web site, in the "Aviation Feature IST results" section	International	N.A.	18 July 2005	M3S	M3S answered to an interview held by a journalist contracted by EC to prepare the article to be published on Cordis Web site. This article was prepared in coordination with the ISMAEL and SAFE AIRPORT projects. This article was published at the following URL: http://istresults.cordis.lu/index.cfm?section=news&tpl=article&BrowsingType=Features&id=77794	Article available on AIRNET Web site
Presentation of AIRNET main achievements over the year 2005	International	Brussels (Belgium)	19 July 2005	M3S	M3S prepared a presentation of the main achievements of AIRNET over the year 2005. This presentation was used by EC to disseminate about the results of IST funded projects.	Presentation available on AIRNET Web site
INSTILUX [APT-ASMGCS] Advanced Surface Movement Guidance and Control Systems Workshop in Luxembourg	International	Luxembourg	24-25 October 2005	M3S, ANA	M3S and ANA made a presentation of AIRNET during this worksop, which addressed at all aspects of A-SMGCS, with particular emphasis on implementation progress and experience. The presentations includes the A-SMGCS levels I and II procedures and the European Action Plan for the Prevention of Runway Incursions.	Presentation available on AIRNET Web site

Event	Dissemination level	Location	Date	Partners involved	Actions from partners	Dissemination material used
					The guest speakers represented all areas of Airport Operations and many presentations focused on lessons learned from airports worldwide. Audience: the target population was ATCOs, Pilots and Airport Operations personnel.	
"Cycle de conférences de l'Institut National Polytechnique de Toulouse" INPT – Salle du Sénéchal	Local & regional	Toulouse (France)	27 October 2005	M3S	M3S made a presentation of the AIRNET objectives and outcomes during this event, which gathered scientists from Toulouse University. This presentation raised considerable interest in the project, mainly related to the connection with EGNOS and Galileo system.	Presentation available on AIRNET Web site
2nd Space Forum promote by GRICES	National (with several international personalities)	Lisbon (Knowledge Museum)	26 November 2005	ANA	ANA was present with a stand, where presentations and leaflets from the Innovation projects were available. ANA explained the project to the Portuguese Science Minister and to the ESA General manager.	Stand, leaflets and presentation
4th EUROCONTROL Innovative Research Exhibition (INO)	International	Eurocontrol Brétigny	9 December 2005	M3S	M3S organised the AIRNET stand during this event, and presented in particular the AIRNET services (with illustration videos, particularly useful for dissemination & training purposes). M3S also made a presentation of the Driver HMI.	Presentation available on AIRNET Web site
Portuguese Road Congress (Gamma, AIRNET & SAFEDRIVE),	National	Lisbon	5-7 April 2006	ANA	ANA: Isabel Rebelo, made a presentation to the Portuguese entities and major key players in [illegible]	Presentation available on AIRNET Web site

Event	Dissemination level	Location	Date	Partners involved	Actions from partners	Dissemination material used
					the Roads Sector)	
10 th Meeting of Technical and Operational Safety Committee, ACI Europe (Riga)	International	Riga	21st April 2006	ANA, M3S	Ivo Silva, held contacts and made a presentation of the AIRNET solution being developed at Oporto at the ACI Conference	Leaflets and presentation
"Galileo A European Project of Global Lengthening", Galileo at Airports, Conference Galileo promoted by APLA -	International	Lisbon	22nd June 2006	ANA	ANA maintained contacts and focused on the specific Galileo Applications integrated in the AIRNET solution	Leaflets and presentation
"Airport Operations and Security", a course ministered by ANA to a group of Chinese Airport Specialists	International	Lisbon	30th June 2006	ANA	ANA, Isabel Rebelo presented the AIRNET solution which was very well accepted by the Chinese Airport Specialists that demonstrated in implementing a solution of this kind.	Presentation available on AIRNET Web site
Personal Wireless Communications Conference 2006	International	Albacete, Spain	September 2006	INOV	Presentation of paper	Paper in LNCS proceedings
AIRNET Public Demonstration	International	Porto	13 December 2006	M3S, ANA, INOV, CNS, INTUILAB	Presentation & demonstration of the AIRNET system to a broad audience (Eurocontrol, ICAO, EC)	Presentations will be made available on AIRNET Web site
Different articles related to AIRNET	International	Internet	http://www.ueaf.net/actualites/fis_292.html http://www.innovations-report.de/html/berichte/verkehr_logistik/bericht-46792.html http://www.clickpress.com/releases/Detailed/2707005cp.shtml http://www.pressbox.co.uk/cgibin/links/search.cgi?t=av&d=1&query=airnet&catid=&search.x=41&search.y=10			

Table 7-1: Dissemination actions performed over the project

8 Conclusions

8.1 Conclusions

The AIRNET demonstrator validates the most innovative features of the project.

The different actors of the airport (ATCO, AOO, GH) considered the AIRNET solution valid to airport operations and a good implementation of the A-SMGCS concept. AIRNET includes also additional features besides those specified in A-SMGCS which clearly contributes for the efficiency of airport services.

Although there are still some issues to be developed in the demonstrator, which naturally occur in a R&D demonstrator, they are identified and can be solved through further work when evolving into an industrial solution.

As a result of the project experience and on going standardization some further improvements are also suggested for operational solution.

The AIRNET project was an excellent project for the several partners to acquire know-how, that enabled them to further develop the AIRNET concept in other applications and developing further features and functionalities. Indeed, the AIRNET project served as a valuable instrument for all partners for developing industrial solutions by themselves or under other contracts or projects funded by local authorities and governments or even through European Programmes.

Also the scientific papers produced and disseminated in several conferences and technological forums, have been raising public awareness for safer and more efficient applications using the concepts developed under the AIRNET project.

8.2 Future actions

FRANCK this section should be filled-in by all partners of the consortium. If they do not expect to do anything this should be mentioned.

8.2.1 M3S

~~*8.2.2 SAFE DRIVE project*~~

With the know-how acquired in the AIRNET project, M3S is developing under French funding system two projects:

- Clesta
- SafeDrive

Clesta Project:

SafeDrive Project:

Franck I think you should refer to the solution developed under the French innovation agency. Remember that INTUILAB is not a partner in the SafeDrive/Eureka Consortium (so please be careful in the description because D5.1 is a PUBLIC Deliverable to be made available in the web site) We should avoid mixing projects!!!!!

~~The project partners M3S, ANA, INOV & INTUILAB are currently realising the SAFE DRIVE project. This project, which is funded by the respective French & Portuguese Agencies of Innovation through a EUREKA process, aims at developing the industrial prototype, on the basis of the results achieved in the frame of the AIRNET project. In particular, the SAFE DRIVE solution is intended to be deployed in several small & medium-size airports in Europe.~~

SAFE DRIVE is a low cost and adaptive solution, which will enable to improve the safety and efficiency of airport vehicle operations

The architecture of the SAFE DRIVE system is based on:

- Vehicle Units equipped with an innovative HMI display, a dedicated EGNOS navigator
- Bi-directionnal data link capabilities (UHF, Wi-Fi) between vehicles and user ground stations
- User Ground Stations providing access and display of vehicle information in real time

The compatibility with ICAO and Eurocontrol standards ensures an easy interface between SAFE DRIVE and A-SMGCS systems.

Figure 8-1 : SAFE DRIVE vehicles equipment

Based on EGNOS and GALILEO in the future, SAFE DRIVE provides the vehicle positioning together with a confidence indicator (integrity). SAFE DRIVE will enable :

- Safe navigation of vehicles on the airport surface in any visibility conditions
- Better situational awareness for drivers and reduction of conflict and collision risks

- Improved control of vehicle movements
- Better task coordination and optimised fleet control for ground supervisors and managers

Figure 8-2 : SAFE DRIVE User Ground Station

8.2.3 ANA

ANA, using the know-how acquired with the AIRNET project is developing and implementing a pilot project for the Lisbon Airport, focusing on the Ground System and Communication components of AIRNET solution. This pilot project, takes into account the operational feedback and recommendations from the operational staff (from the different airports that participated in the public presentation and handling agents) and has to be obviously configured according with the requirements of Lisbon Airport. Also European standards and recommendations emerging during the AIRNET development will also be taken into consideration.

The solution for the Lisbon Airport, will use for the on-board equipment based on, off the shelf, EGNOS receiver devices.

ANA will promote the pilot solution deployed for the Lisbon airport when accepted in operational environment to other airports under ANA's management.

Eventual agreements for solution commercialisation with the industry will be analysed in a later step.

8.2.4 INOV

8.2.5 INTUILAB

8.2.6 CNS

8.2.7 ALITEC