AIRNET
AIRport NETwork for Mobiles Surveillance and Alerting

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AIRNET : AIRport NETwork for Mobiles Surveillance & Alerting

STREP (Specific Targeted Research Project) funded by the European Commission in FP6 :

- Strategic objective 2.3.1.10 «e-Safety for Road & Air Transport »
- Duration : 36 months,
  Start date : 1 January 2004
- Budget : 2, 67 M€
- 1st call of the IST priority
  (Information Society Technologies)
CONSORTIUM

• Coordinator: M3 SYSTEMS (SME, France)
• INSTITUTIONS:
  • ANA Aeroportos de Portugal: end-user airport
  • INESC-INOV (Portugal): research laboratory specialised in telecom and networks
• SMEs:
  • INTUILAB (France)
  • ALITEC (France)
  • CNS SYSTEMS AB (Sweden)
Project objectives

• Specify & prototype an innovative EGNOS low-cost modular platform for advanced operational services on the airport movement area:
  – Improve safety on the airport movement area
  – Improve efficiency of operations & airport capacity

• Target: small & medium size airports

• Context: A-SMGCS (Advanced Surface Movement Guidance & Control System) ➔ ICAO & Eurocontrol standards

• Operational validation campaign in potential user airport (2006): Porto
The continuous and steady growth of air traffic leads to an escalating number of accidents & incidents on surface movements:

- "Bad meteorological conditions or low visibility (LV): airport stakeholders have little or no knowledge of ground surface traffic
- Emergency situations: surveillance, control and management of vehicles are critical
  ➔ Risks of collisions & incursions into dangerous & restricted areas (e.g. runway)
  ➔ Congestion of airport areas in Europe

Current Situation

- Use of RT com. In the procedures for ground movements & contacts with ATC
- "See and be seen" principle for surveillance & control
AIRNET actors

Vehicle drivers:

Manoeuvering area

Service

Firemen

Follow me

Works

Various

Fleet handlers

Luggage

Passengers

Fuel

Support

Maintenance

IV CONGRESSO RODOVIÁRIO PORTUGUÊS
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COMPONENTS

EGNOS
Navigators

Central
Data
Processing

Wireless
Networks

Services

• Air Traffic Controller
• Airport Operations Officer
• Ground Handling

• Vehicle Driver
VEHICLE NAVIGATOR

Communication & Navigation Unit (CNU)

CPU
- Specific Treatments
- C/I Detection
- Decision Support
- Service Monitoring
- Provide Traffic Information
- Provide Traffic Context

Management Module (OS)

Onboard Display System

Driver HMI

Wi-Fi

Private Network transponder

Traffic Information
- Service Monitoring
- Traffic Context
- C/I Alerts
- Decision Support

Private Network

GPS/EGNOS Receiver

Vehicle parameters
- (position, speed, time)

GPS/EGNOS

Wi-Fi Transponder

Traffic Information
- Service Monitoring
- Traffic Context
- C/I Alerts
- Decision Support

Wi-Fi Network

TETRA Transponder

Traffic Information
- Service Monitoring
- Traffic Context
- C/I Alerts
- Decision Support

TETRA Network

ATC Network Transponder (VDL4)

Traffic Information

ATC Network VDL4

Interfaces

Vehicular Navigator

Decision Support

Traffic Information

C/I Alerts

Service Monitoring

Traffic Context
GROUND SYSTEM

Ground Processing System

- Service Monitoring
- Decision Support
- Provide Traffic Context
- C/I Detection
- Provide Traffic Information

Interfaces

Ground HMI System

- Air Traffic Controller
- Airport Operation Officer
- Ground Handling

Interfaces

Private Network

Traffic Information
Service Monitoring
Traffic Context
C/I Alerts
Congestion Control Info

Private Network Ground Station

Wi-Fi Network

Traffic Information
Service Monitoring
Traffic Context
C/I Alerts
Congestion Control Info

Wi-Fi Ground Station

TETRA Network

Traffic Information
Service Monitoring
Traffic Context
C/I Alerts
Congestion Control Info

TETRA Ground Station

ATC Network (VDL4)

Traffic Information

ATC Network Ground Station (VDL4)
KEY ENABLERS

– POSITIONNING SENSOR: satellite navigation capabilities (EGNOS) for accuracy and integrity

– USER INTERFACE: Dedicated Human Machine Interfaces (HMI) on-board and ground

– AERODROME GEOGRAPHICAL DATA BASE: real time processing and update, recording of all movements

– WIRELESS NETWORK: Data exchange between vehicles and ground system, several candidate technologies exist

– SERVICES MONITORING AND INTEGRITY: algorithms to monitor end-to-end quality of services
Why EGNOS/GALILEO?

Safety services require continuity of service and integrity

- Global coverage
- Provides the position of any mobile with the required accuracy: 7.5 m (ICAO A-SMGCS manual)
- Provides integrity information (Protection level and Alert Limit) which is essential for critical applications as A-SMGCS
- Availability
- Minimum equipment for mobiles (GNSS receiver), and ground infrastructure
Illustration of Surveillance service to driver

- Display of vehicle position on airport map
- This service provided by the Provide Traffic Information (PTI) and the Provide Traffic Context (PTC) software modules
Illustration of Control service to driver

- Alerts in case of conflict/infringement (runway incursion, panic alert, overspeed)
  
  This service is provided by the Conflict/Infringement Detection (CID) module
Illustration of Decision support service to driver

- Knowledge of real-time information about destination aircraft
- Reception from ground stakeholders of text messages & instructions
- Transmission of information to ground stakeholders about task completion

This service is provided by Decision Support (DS) software module
Illustration of Surveillance service to ground stakeholders

- **Knowledge of traffic situation:**
  - Position, ID, speed, heading of all mobiles (vehicles+aircraft)
  - Airport layout, reference points, restricted areas, fixed obstacles, stands, apron, roads (emergency, peripheral, service)
  - Dynamic information:
    - Runway & taxiway status (open/closed)
    - Dynamic obstacles

- **Supervision of a specific fleet (filtering according to type, position, ...)**

→ This service is provided by the Provide Traffic Information (PTI) and the Provide Traffic Context software modules
• Detection of conflicts/infringements:
  
  – *collisions* between vehicles and aircraft on ground (e.g. vehicle entering runway when aircraft arriving)

  – incursion of non-authorised vehicles into restricted & forbidden areas (e.g. runway incursion)

⇒ This service is provided by the Conflicts/Infringements Detection (CID) software module
Results of implementation & Integration Tests

**Ground HMI GIS-Geographical Information**

Information available on GHMI - Geo-referenced according to ICAO and Eurocontrol/WGS-84 Rules.

- 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 visualised in 3D, although it is only designed for planimetric data processing.

In conclusion, from now on it is available the Geographic Information of ASC operational areas, which can be used in any project.
WP3.4 – Geographical and Spatial Information System
AIRNET Network Architecture at the Oporto Airport

- AOMS
- AS (Aplication Server)
- Aplication Client (ATC/AOO/GH)
- CS (Communication Server)
- CDMA
- Modem CDMA450
- CNU
- CNU + Wi-Fi card
- TETRA
- VDL4
- Airnet WiFi VLAN
- CNU + VDL4
- CNU + Wi-Fi card
- Airnet WiFi VLAN
- Airnet Interconnection VLAN
- Airport LAN
- CDMA
- Modem TETRA
- CNU
- CNU + Wi-Fi card
- CNU + Wi-Fi card
- CNU + Wi-Fi card
Wi-Fi Deployment at the Oporto Airport

**Wi-Fi Implementation at Oporto**

First worldwide installation of a 2\textsuperscript{nd} generation, 802.11a Wi-Fi network
Wi-Fi AP Deployment at the Oporto Airport

Coverage Areas
CDMA Implementation at Oporto
Utilization of another wireless innovative network (CDMA 450)
Implementation & Integration Tests

- **Francisco Sá Carneiro Airport (January 2006, Porto):**
  - For the first time, the AIRNET system was deployed on the airport:
    - Installation of AIRNET ground system in Porto airport
    - Three vehicles were equipped with AIRNET onboard system

- For each AIRNET service (surveillance, control, etc.), a set of **scenarios** had been defined before the meeting. For each scenario, the following items have been defined:
  - Objectives of scenario
  - Pre-requisites
  - Scenario description
Results of implementation & Integration Tests

- Vehicles equipped with AIRNET onboard system:
Results of implementation & Integration Tests

Surveillance Service
Positioning Precision - EGNOS

• The Position accuracy is one of the the AIRNET key features already demonstrated at the Oporto Airport

  - *It was possible to verify that the EGNOS can be a positioning system to be used for A-SMGCS (Position, Speed, Alarms, …)*

• The information displayed in the label will be improved.
Results of implementation & Integration Tests

Driver-HMI – Quality of the information displayed (clear and neat)

Contrast of the information seeing in the monitor in real environment (good perception independent of luminosity conditions).

Alarm exhibited in the display: OWN TI MISSING (Traffic information missing). the information showed is related with the vehicles and aircrafts in movement.
Results of implementation & Integration Tests

Conflict Infringement Service - SAFETY

• Detail of a near infringement situation of a vehicle in the critical area of the glide path antenna, performed at night
• Detail of a vehicle driving off-road
Results of implementation & Integration Tests

Control Services

Alarms/Alerts in case of conflict/infringement (runway incursion Alerts)

• The incursion made by one vehicle (ID: 2) in the critical area of the Runway was processed and displayed with success.
  - The entering and going out of the vehicle from the Critical Areas is registered and shown in the bottom box of the screen.
Results of implementation & Integration Tests

Ground HMI

Decision Support and geographical information capability
AIRNET ... 
A « SAFETY » & 
DECISION SUPPORT SYSTEM
FOR ALL TRANSPORT MEANS
Possible extension of AIRNET outside the airport

- TECHNOLOGY TRANSFER FROM AIRPORT DOMAIN TO ROAD DOMAIN (SAFETY):

  - Wireless networks
  - Operational Management Systems (Transport Control Centers, Traffic Control Centers)
  - Navigation Signal
  - GNSS Navigator

→ New services provided to the drivers:
  - To improve safety & avoid accidents
  - Based on the situation awareness and responsibility of drivers
  - Adapted to the variety of drivers profiles (leisure, business, commuters, police, firemen, etc.)
Basic requirements for AIRNET implementation

- GIS information and wireless communications coverage from all the concerned area
- Vehicles equipped with GNSS receivers

➔ Also applicable to:
  - Other airports
  - Logistics platforms
  - Traffic in general
Possible extension of AIRNET outside the airport

- Possible connections to operational management systems of end-users:
  - Transport control center (e.g. “Direction Départementale de l’Equipement” in France)
  - Traffic Control Centers
  - Operational centers of emergency end-users (police, firemen, medical emergency, Civil Security)
  - Car manufactures
Proposed 2 steps approach:

Step 1: extension from the airside of an airport to all the surrounding areas and to a limited set of users
- Transport operators (passengers, cargo & dangerous goods)
- Emergency and Civil Security entities (for the implementation of restricted scenarios)

Step 2: extension to all vehicles

AIRNET: An EGNOS based safety system that could integrate solutions already deployed for all kinds of transports.
Possible extension of AIRNET outside the airport

• Approach similar to AIRNET:
  – Based on existing technological infrastructures:
    • Galileo for geo-positioning of vehicles
    • Wireless networks (e.g. UMTS) for communication between vehicles and ground
    • Using dedicated Human-Machine Interfaces for both the ground and onboard
  – Using the same type of partnership with end-users:
    • Car manufacturers
    • Transport & Traffic Entities
    • Emergency users (police, firemen, emergency …)
  – Validation/Proof of concept using only a limited number of vehicles, thus paving the way for operational deployment
  – Integration with other CE Projects with demonstrators in east countries.
Possible extension of AIRNET outside the airport

AN EGNOS LOW COST INTEGRATED SAFETY SYSTEM

FOR ALL TYPES OF MOBILES
http//www.airnet-project.com

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