MOBNET Presentation to Inachus Group

(MOBile NETwork for people's location in natural and man-made disasters)

Project Framework

- **Kick-off** — **January 2016**
- **Duration** — **26 months**
- **Customer GSA** — **EC/H2020 Galileo SME Call 2015**

Eduarda Blomenhofer
NavPos Systems GmbH
Freiburg, Nov. 9th, 2016

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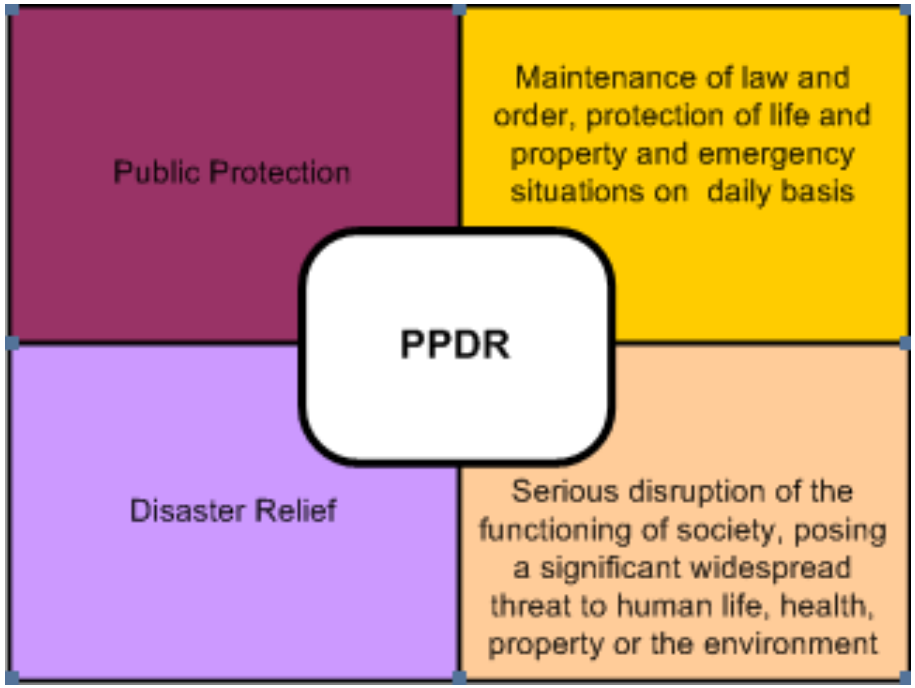
MOBNET Scope

- Public Protection & Disaster Relief Service
- Levels of Operation:
  - Level 1: Everyday Incidents
  - Level 2: Major Events
  - Level 3: Natural and Man-made disasters
- Focus on Rescue Systems Operation
- Different performance criteria depending of Mission type
- Project prototype to cover 2 km area mission



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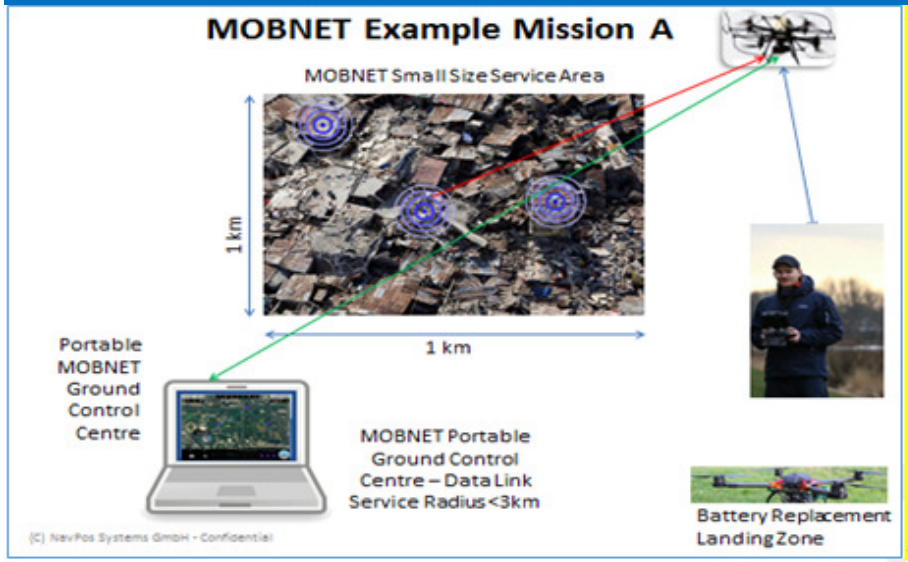
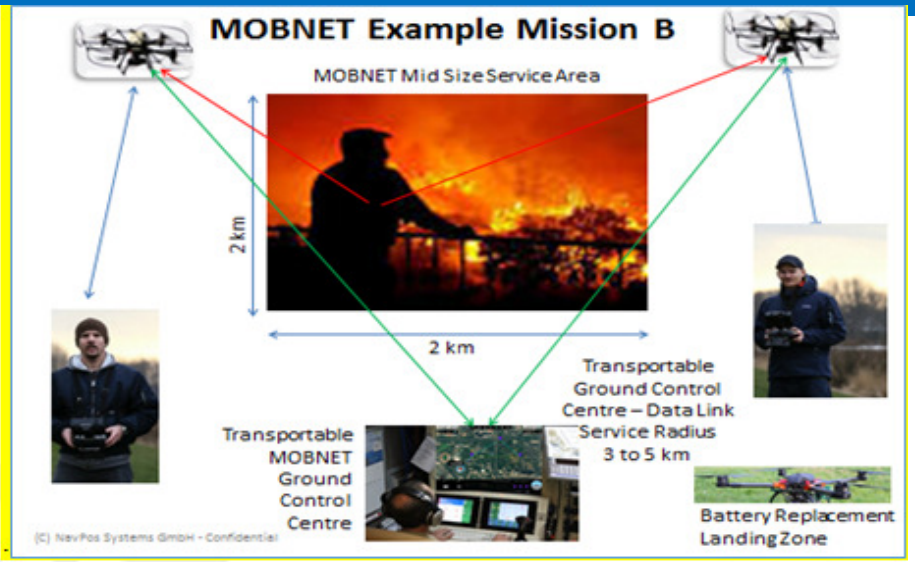
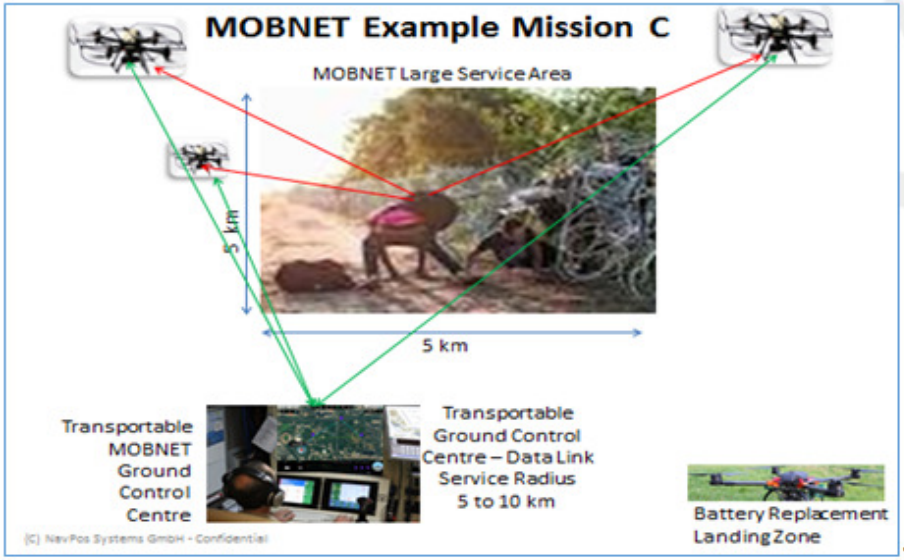
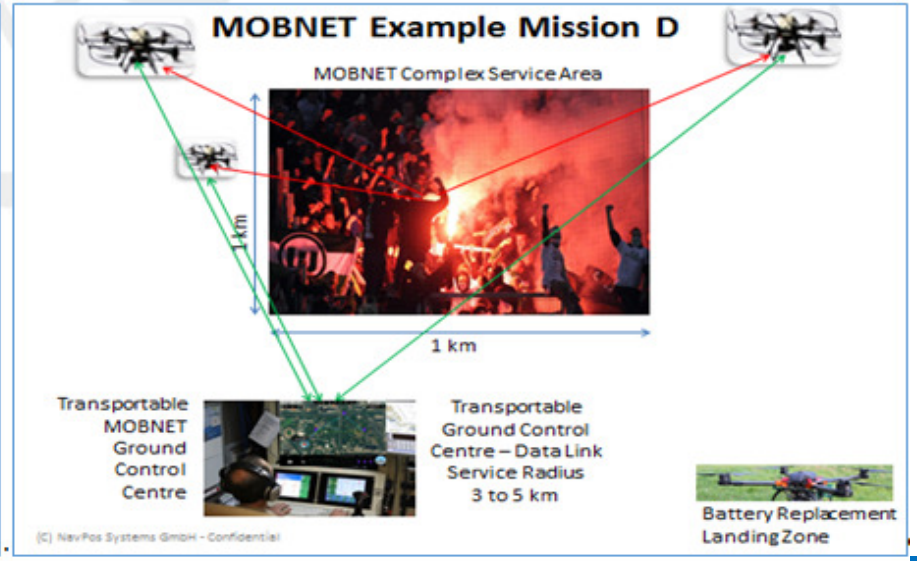
MOBNET Example Missions and Use Cases

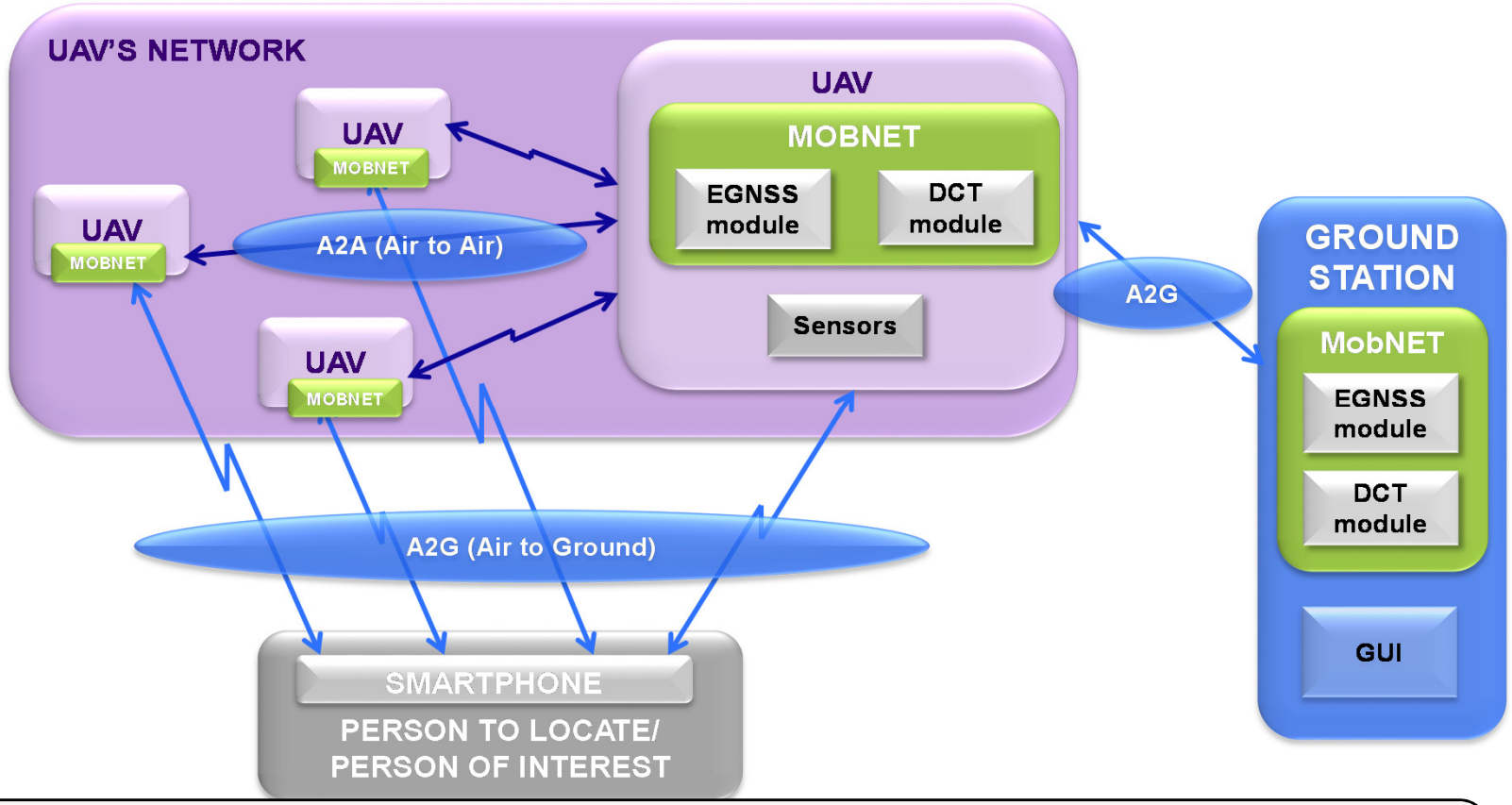








MOBNET System Architecture



Basic Idea and Concept:
Combine precise GNSS positioning and timing with GSM signal ranging on a drone to locate mobile phones

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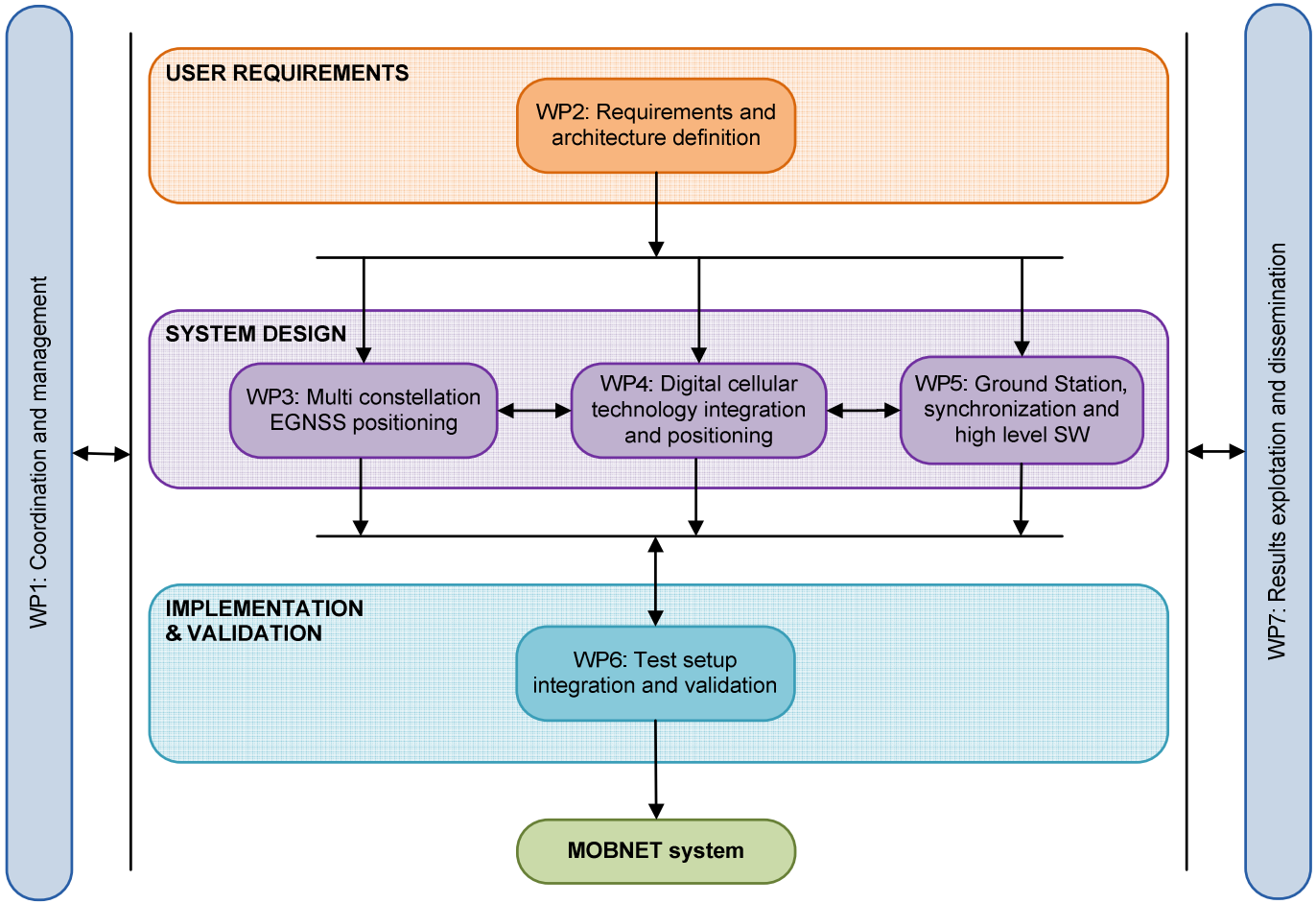
MOBNET Study Team and Main Tasks

- Orbital (Spain)
  - Study Coordinator
  - Datalink Module
- CEIT (Spain)
  - Digital Communication Terminal (DCT) Module
- Main School of Fire (SGSP, Poland)
  - MOBNET Use Cases, Applications and Trials
- Delft Dynamics (Netherlands)
  - Drone Manufactorer
- NavPos Systems (Germany)
  - EGNSS Navigation and Timing Module



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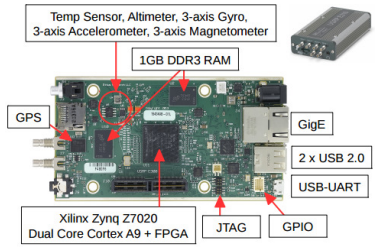
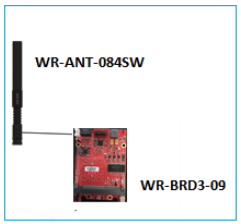
MOBNET Subsystems

- **Drone(s)**
  - **Drone platform**
  - **Drone operator**

- **Payload(s)**
  - **DCT Module**
  - **EGNSS Module**
  - **Datalink**



- **Ground Station**
  - **Mission Computer and Visualization**
  - **EGNSS Ground Station**
  - **Datalink**



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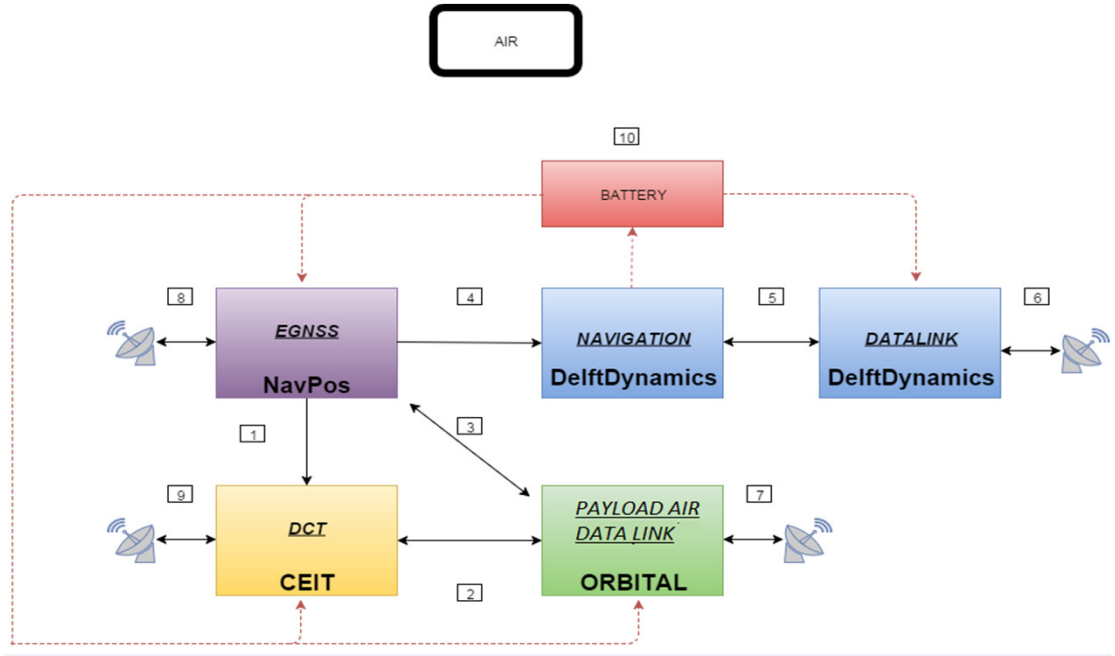
MOBNET Architecture (I)



- **MOBNET Drone(s) equipped with three airborne payload systems:**
  - **EGNSS system for accurate ranging**
  - **DCT system for GSM detection and main onboard processing**
  - **Payload Datalink for communications with Ground Segment**

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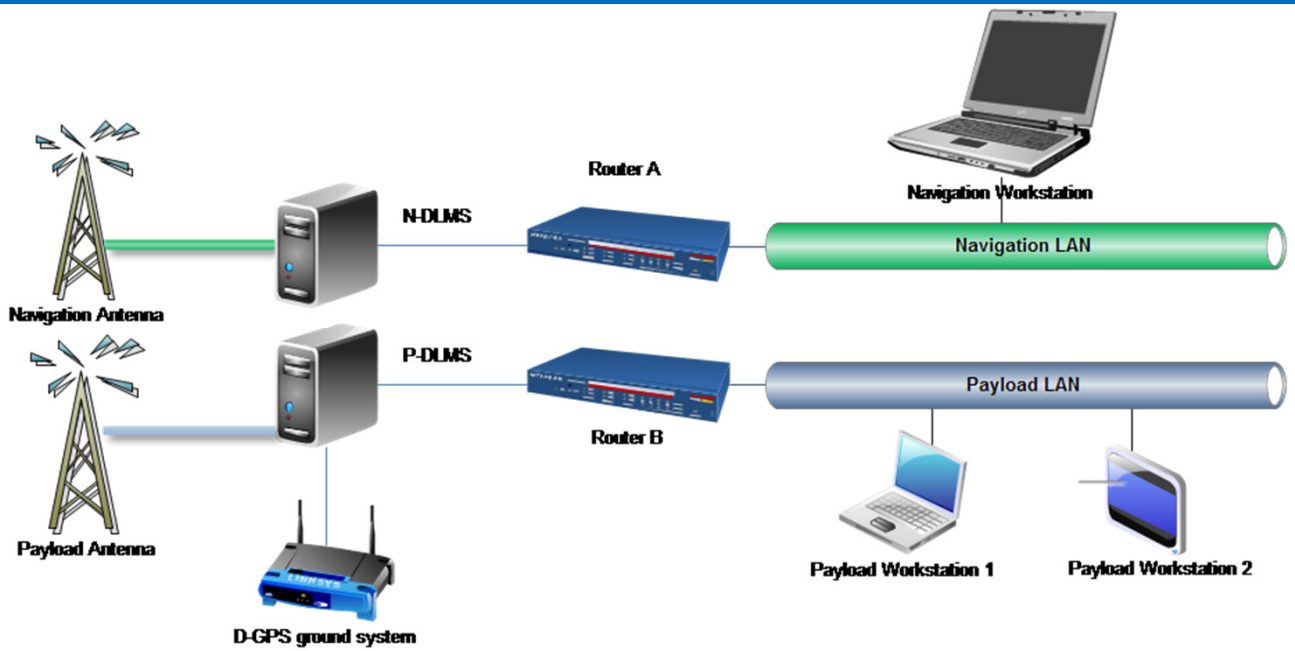
MOBNET Architecture (II)



- **MOBNET Ground Segment:**
  - **D-GNSS system enables augmentation data to airborne systems**
  - **Segregated Navigation chain to operate any kind of Drone(s)**
  - **Payload Datalink provides seamless Layer-2 interface to Air**
  - **MOBNET mission software system (Payload data exploitation)**

WP2.1 User Requirements vs. MOBNET Error Budget

MOBNET Positioning Error Contributers:

- **EGNSS PVT Accuracy**
  - Depending on EGNSS solution m (Stand-alone) to dm (D-GNSS) to cm (RTK) – level
- **PPS Accuracy**
  - +/-10ns x c equals +/-3m
- **DCT Ranging Accuracy**
  - Noise and bias ?

Source:
MOBNET Questionaire User Responses

Inaccuracy	Responses:	
	[-]	[%]
<1 m	1	1%
1 - 2 m	14	21%
2 - 5 m	23	34%
<10 m	23	34%
Other	0	0%
n.a.	6	9%
Total:	67	100%

MOBNET Position Accuracy Objective:
~ +/- 2m to 10m to fulfill most Users Rqmts

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Challenge: Provision of ~10ns PPS timing accuracy on a drone!

- „Cheap“ GPS Timing Receivers and even low cost GPS chip set manufacturer spec‘s claim to provide pps timing accuracy better 20ns, but
  - Typically this is realized at a static position with known or averaged GPS position
  - 20ns is specified as a „typical“ accuracy which means it is not reliable
  - Low cost GPS Chip sets show larger than 100ns inaccuracies and drifts to 400ns
- Multi-Constellation mix could degrade timing accuracy
- Significant price differences from single frequency & single constellation GPS Rx&Antenna to multi-frequency & multi-constellation GNSS Rx&Antenna
- Development Approach
  - Investigation of professional GNSS receiver market for best candidates (e.g. Septentrio, Novatel, Trimble, …)
  - Trade-off between requirements and architectures to identify best solution(s) considering performance/cost ratio
  - Anticipate EGNSS module solution(s) development

NavPos MOBNET EGNSS Module Design Objectives:
Submeter-Positioning and <10ns PPS Time over 10km Drone Range

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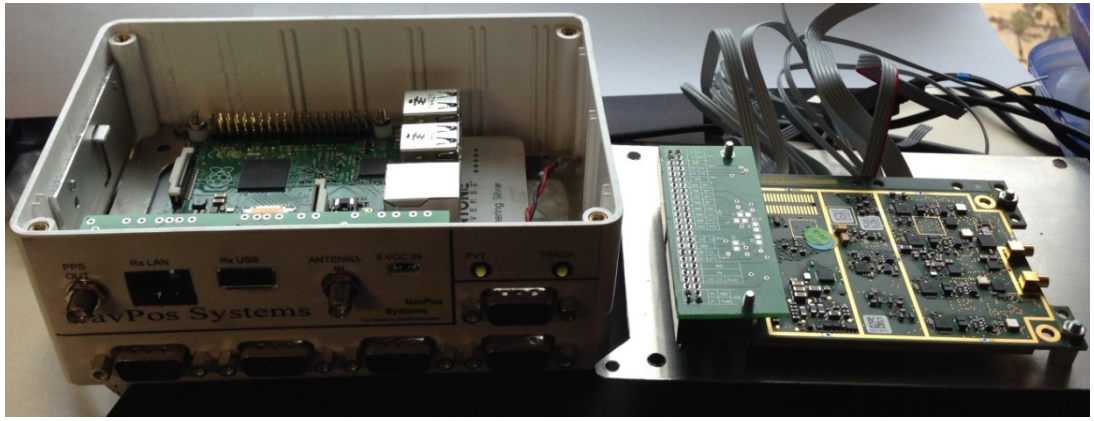
EGNSS Payload Module Prototype

- **Functions**
  - Provides PVT and PPS time synchronization
  - GNSS PVT and raw data recording
- **Features**
  - 544 Channels GNSS Rx
  - Supported signals: GPS (L1, L2, L5), GLONASS (L1,L2,L3), Galileo (E1, E5ab, AltBoc, E6), BeiDou (B1, B2, B3), IRNSS (L5), QZSS (L1,L2,L5) (Galileo, Beidou, IRNSS, E6/B3
  - Supports standalone and D-GNSS operations
  - Embedded GNSS Antenna
- **Performance**
  - PPS Timing Acc. ~10ns
  - Standalone H1.2m V1.9 m
  - DGNSS H0.4m V0.9m
  - Option: RTK for cm-Accuracy
  - Several hours operations on battery



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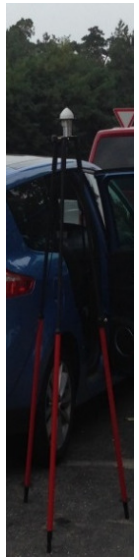
EGNSS Ground Station Prototype

- **Functions**
  - **Generates DGNSS Corrections**
  - **GNSS raw data recording**
  - **Multiple drones (return) PVT track data recording using Terminalserver**
- **1 day Autonomous Operations using its embedded Powerbank**
- **Frontpanel**



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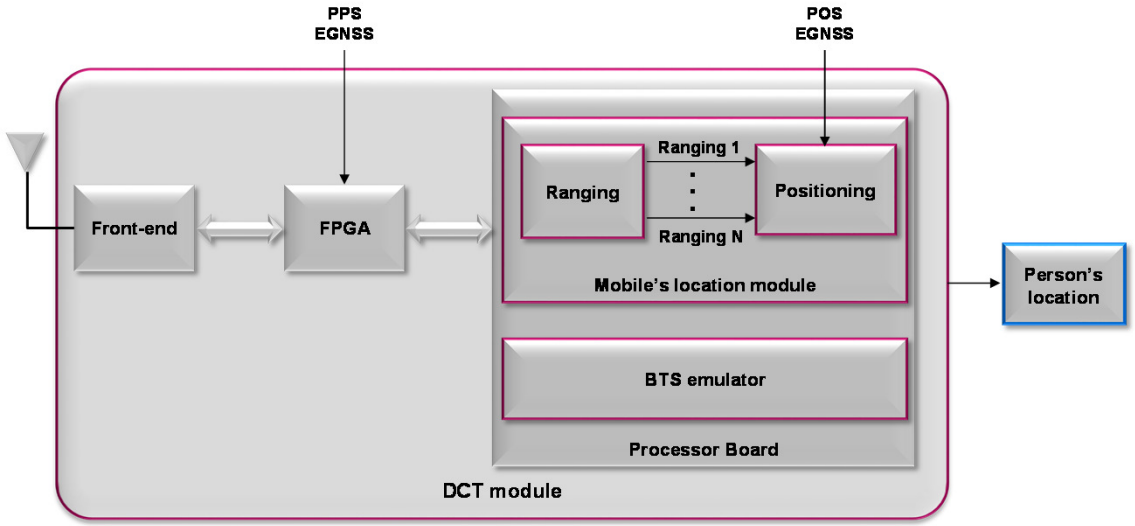
DCT subsystem

- **Airborne system acting as GSM base station to detect cell phones.**
- **Real-time, FPGA-based processing system which generates MOBNET payload data (victims position estimates).**
- **Interface with airborne GNSS for PPS signal**



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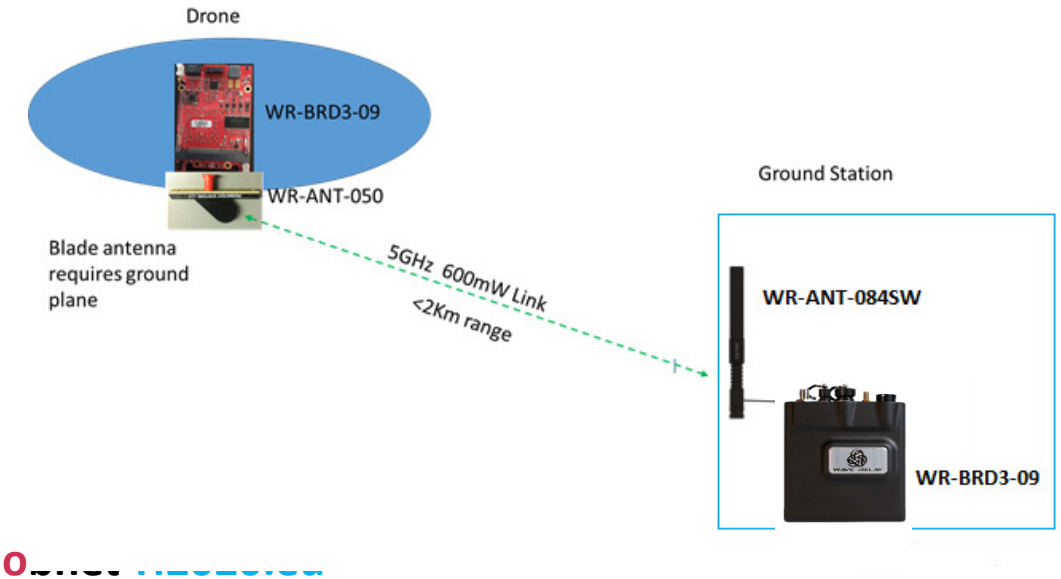
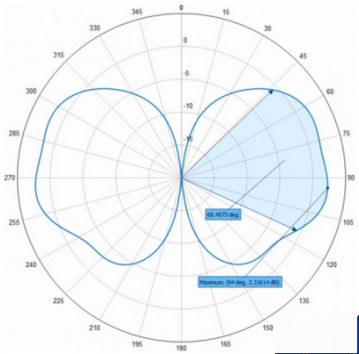
Payload Datalink subsystem

- **Present in both Air and Ground Segments.**
- **Seamless Layer-2 integration between Airborne DCT payload datastream and Ground Payload Network.**



Requirement	data
Distance to cover with datalink	2km
Frequency Range	5.8 GHz band
Throughput	<2Mbps
Weight	<150 g
Connectors	Ethernet, RS-232
Radio-Link type	LOS – Point to point

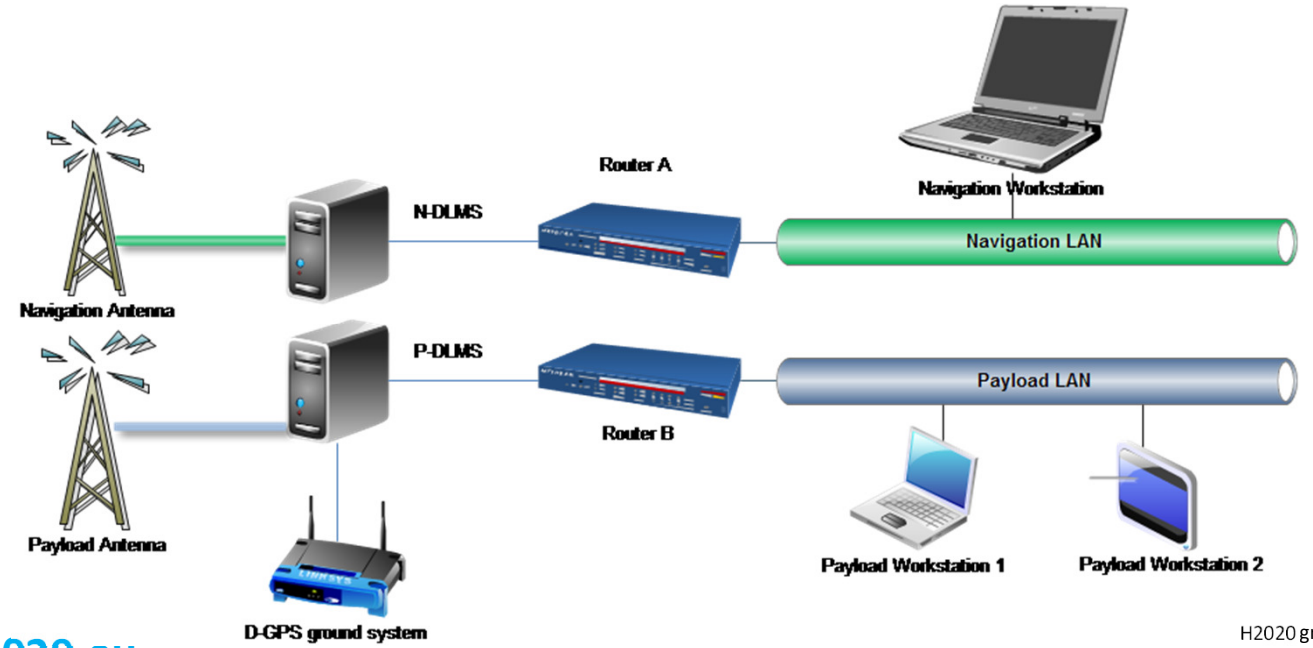


Drone subsystem

- **MOBNET prototype based on Quadcopter RH4 aircraft.**
  - Empty weight: 2900 grams
  - Maximum TOW: 5600 grams
  - Payload capacity: 1000-1500 grams
  - Battery weight: 1200-1700 grams
  - Endurance: 15-25 minutes.

Ground Station

- **Flexible, compact UAV ground control station suitable for MOBNET operation.**
- **Segregation between Navigation and Payload chains.**
- **Mission data Operation, Exploitation and Recording.**
- **D-GNSS integrated in Payload chain.**



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Conclusions

- **MOBNET Project and Development well on track**
- **First prototypes of subsystem modules available**
- **Next step System Integration and further Software Development**
- **Trials in Poland planned for Q4 2017**

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