High Precision GNSS Module for Google’s ARA platform

Giovanni A. Vecchione
giovanni-arturo.vecchione@deimos-space.com
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1. Deimos introduction

2. Galileo ARA Module

3. Business case and Japan opportunities
• ELECNOR DEIMOS is the technology company of the ELECNOR Group, operating in: Aerospace, Defence, Transport, Energy, Environment, etc.

• **Space is our core business and niche of expertise**

• Continuous growth since our creation in year 2001

• Turnover 2013 – 35 M€

• Staff: 300 Engineers
• **ELECNEOR DEIMOS** is a relevant player in the European Space Market:
  - More than **500 contracts** awarded for ESA, EC, NASA(JPL) and other agencies
  - More than **60 satellites** includes already technology from DEIMOS

• **Company present in all the Space Segments:** launchers, space, ground, operations and user segment

• **Relevant Involvement in the Majority of ESA Missions**

• **Involvement in all Phases of a Space Mission**
GNSS References

- **Galileo**: DEIMOS is responsible for three critical elements of Galileo Ground Segment:
  - MGF: Message Generation Facility
  - MSF: Mission Support Facility (Reference Orbits and Clocks)
  - RDG: system simulator
  Furthermore DEIMOS has been involved:
  - RAMS Analysis at System Level
  - Navigation and Integrity Concept Definition and Implementation
  - Test User Segment Receiver
  - ISVV of the Galileo Payload

- **EGNOS V3**: DEIMOS is responsible for the performances and definition of the Data Processing Segment of EGNOS V3:
  - Navigation and Integrity Concept Definition
  - RAMS Analysis
  - System Performance Simulation and Service Volume Simulation

- **GNSS Evolutions**: new integrity concepts (RAIMS), Inter-satellite links, Autonomous Satellite Navigation, Real Time Orbit Determination, etc
• **Competences:**
  
  – System Engineering (e.g. architecture, interfaces, etc)
  – GNSS algorithms and performances (e.g. navigation, integrity, safety, simulation tools)
  – GNSS receivers (e.g. signal processing, performance analysis, user receiver algorithms, hybridisation, etc)
  – GNSS applications (e.g. Nav/Com integration, advanced navigation solutions, etc)
  – Development of Ground Segment Systems involving complex algorithms, and critical and real time software systems (e.g. GSWS, DO-178B, in DAL-B and DAL-C)

• **Tools and products**
  
  – GNSS System performance simulation
  – GNSS Performance Analysis SW
  – GNSS Processing Chain (Galileo & EGNOS)
  – GNSS Test Bed, for processing chain validation
  – GNSS Receiver
State-of-the art product suite for R&D professionals

Hardware for real-time hard data
GRIP (GNSS Receiver Prototype Builder)

GRIP (GNSS Receiver Prototype Builder) is the hardware part of the GRANADA family of tools, allowing to implement and study receiver algorithms and system designs one step further on real hardware.

- REAL TIME DATA
  - FOPA based flexible receiver with access to hardware registers via Modbus protocol.

- MULTIPLE SIGNALS
  - Supports GPS L1/L5 and Galileo E1/E5a/E5b - All 1500 signals.

- BUILD YOUR OWN
  - For education, R&D, testing and receiver development, allowing to build your own receivers and algorithms.

http://granada.deimos-space.com/

- Strong investment in R&D & product development in GNSS
- More than 15 projects led under ESA, EC, GSA and national programs
- Award winning concepts and patents
**GNSS R:** a bi-static radar, in which the instrument simultaneously acquires both the direct and reflected signals from the GNSS satellites.

DEIMOS has developed the **SARGO** instrument and system for determining the water characteristics through the analysis of reflected signals on the water surface. SARGO works with both **GPS** and **Galileo**, including E5. The receiver is flexible and could be easily adapted to **QZSS**.
Under H2020 Galileo-2014-1 call, COREGAL project under the lead of DEIMOS Engenharia aims at developing a low cost unmanned aerial platform and service for biomass mapping.

A first of a kind combined Position+Reflectometry (P+R) Galileo receiver is developed as main sensor for platform positioning and biomass estimation, the latter using reflected Global Navigation Satellite Systems (GNSS) signals (also called GNSS-R) that propagate through tree canopies, branches and leafs.
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Google kept ATAP department after selling MOTOROLA.
A working phone was presented in April.
A market test is foreseen at the end of this year.
Advantages

- A modular phone is flexible, open new possibilities for innovative hw modules.
- Apart from the low cost market a high end user can be foreseen, searching for different or very special characteristics of its phone.
- Special and innovative modules are under development: certainly not targeted for mass market but there is a great interest around this kind of applications for high end smart phones.
Size of phones now is linked to form factor more than electronic components
Hundreds of tons of e-waste, people change their phones every 1.5-2 years
Different platforms, same concept

The core is simply a mechanical backplane with a common bus
Different users, different needs

Advantages

• A modular phone is flexible
• Adapt your phone to your needs
• Special and innovative modules are under development, not only “classic” ones
Galileo for ARA

- Concept: High Precision Galileo E5 receiver module for mobile phones
- Initial implementation: Project ARA
  - Creates a structural frame that holds smartphone modules of the owner's choice.
  - First smartphone based on this concept is foreseen in the end 2015.
  - Great distribution channel through ARA Module Market
- ARA is the best channel for implementing the idea and bring it to commercial success
• Cost effective high precision for professional applications

• **Prototype specifications:**
  - Base-Band Processing Core (DSP)
  - Dual-input (e.g. dual-frequency, dual-antenna)
  - 16-channels (HW) with 5 correlator pairs each
  - Support for GPS L1 and L5 and Galileo E1, E5a/E5b, E5 and E6 signals’ modulations (BPSK, BOC, CBOC, AltBOC)
  - Access to internal observables and configuration parameters via Matlab and PCIe
  - Interfaces: PCIe, Ethernet, CAN, UART, JTAG, GPIO
AltBOC modulation allows unprecedented performances

- High multipath resilience and low tracking noise, ideal for harsh environments (e.g. urban environments, close to tree canopies and other objects)
- Expected navigation accuracies down to 20 cm based on Galileo E5 signals
Why E5? What Performances?

- AltBOC
  - E5a
  - E5b
  - L5
  - 1176.45 MHz
  - 1191.795 MHz
  - 1207.14 MHz
  - 1227 MHz

- E6
  - 1278.75 MHz

- E1
  - 1575.42 MHz
  - L1

- ~30 cm
- • ~10 m
GALARA main components

RF Front-end

DSP (FPGA / ASIC)

Antenna

The receiver is under patenting process

Market
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• **GALARA is a two phase project**
  - Consolidation and miniaturization of the prototype via FPGA, implementation of QZSS capabilities is possible
  - Development of an ASIC based receiver.

• **Business Approach**
  - GALARA initiative could introduce higher precision at lower cost
  - Easy Smartphone based interface
  - Developers communities are involved into the process
Conclusion

• **Major companies are investing in modular devices (Google, ZTE, Puzzlephone, Fairphone, Intel).** First ARA to hit the market in 2015, market test in Puerto Rico

• Great interest from people (908,000 supporters from Thunderclap, several design awards won by Dave Hakkens Phoneblocks)

• Galileo E5 on a simple device can boost the adoption of GNSS EU technologies

• **The receiver is flexible: it is possible to implement QZSS**

• Complex modulations improves multipath

• **New technology for users = new application developed**

• **GALARA is the first step to enable high precision at a lower cost into a small package**
KEEP CALM AND ASK ME QUESTIONS