SBAS/EGNSS as an Industry Driver

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ir. Peter A. GROGNARD
Founder & CEO, Septentrio
Vice Chairman, Galileo Services
Septentrio Company Introduction

- Europe’s leading manufacturer of professional GNSS receivers and recognized world leader for Galileo receiver development

- Privately-held company with headquarters in the heart of Europe, and offices in Los Angeles and Beijing. Majority owner of Altus Positioning Systems – www.altus-ps.com

- Representations in India: Bengaluru / New Delhi

MISSION

Design, develop & commercialize High-end OEM satellite navigation products
Based on the Company’s proprietary satellite navigation technology
Galileo Services

The Key Player in GNSS Applications and Services
For Further Information

- Galileo Services Website:
  www.galileo-services.org

- Galileo Services Permanent Representative:
  - Axelle POMIES
  - Phone: +33 1 53 66 11 11
  - Fax: +33 1 53 66 11 00
  - E-mail: axelle.pomies@galileo-services.org
Septentrio: a respected, recognized brand

wind blowing from the North...

the seven stars in Ursa Major (Big Dipper)

points to Polaris (Northern Star)

- Logo:

- Product names consistent: PolaRx & AsteRx
Septentrio Core Activities

- **Custom-Engineering** of Advanced GNSS Receivers
  - Undisputed world leader in Galileo receiver technology

- **Sales** of GNSS receivers for industrial applications, requiring high-precision position & time information
  - Measurement: survey and scientific
  - Machine control: agriculture, construction, mining
  - Maritime: dredging, off-shore
  - Navigation: aeronautical, rail...
Septentrio and EGNSS:
A Unique Track Record since 1998
A Long Legacy of Modernizing GNSS Rx

- First EGNOS reception in late 1999
- First L2C reception in 2003
  - Ideal rehearsal for Galileo
- First Beidou reception in 2008
  - First Beidou PVT in Jan 2013
- Important improvements realized: more complex signal acquisition and tracking – opened promise for professional applications requiring precision & integrity
World’s first Galileo signals with Septentrio

Lift-off mass: 600 kg
Power demand: 700 W
Stowed Dimensions: 1.3 m x 1.8 m x 1.65 m

Launched Dec 28, 2005

GIOVE-A

Septentrio GETR

First Galileo SIS received Jan 12, 2006

GSTB-V2 / A
GSTB-V2 / B

The GALILEO GSTB-V2 Satellites

World’s first Galileo signals with Septentrio
Septentrio Galileo Sensor Station Network
Strategic contribution to Galileo Program

- Prime Contractor to European Space Agency for Test User Segment – production of Test User Receivers

- Only receiver manufacturer that has contributed to pre-launch testing & verification of all Galileo satellites
Two Septentrio-First Historic Galileo Milestones

Tracking World’s First Open Galileo Signal with Septentrio GETR Receiver

Succesfull Tracking of World’s First Galileo Security Signal with Septentrio TUR-P Receiver on February 14, 2012
**Multi-system/Multi-Frequency Essential**

- **Multi-Systems**: GPS + Galileo + GLONASS + Beidou
  - More satellites => (almost) always a PVT
  - With two fully deployed systems: 95% availability; only 50% with GPS alone
  - Availability critical in professional and safety-of-life applications

- **Multi-Frequency**:  
  - Until May 1, 2000, Selective Availability largest error
  - Today: ionospheric errors most important - can only be compensated in real-time by receiving signals on several frequencies: L1/L2/L5

- EGNOS and its error correction asked as early as 2002
Sales of Professional Receivers for Various Industrial Applications
Existing Septentrioe Complete Product Offering

- **AiRx2**
  - Aviation
- **AsteRx2/3**
  - Science
- **AsteRx**
- **AiRx2**
  - Governmental
- **AiRx2**
  - Prof-MarNav
- **AiRx2**
  - TUR-P
- **AiRx2**
  - Mach Ctl
- **AiRx2**
  - MarSurvey
- **AiRx2**
  - Survey

- **HH/911**
- **LBS**
- **Car Nav** (incl HH, Mar, ...)
- **Tracking**
- **Timing**

- **Precision**: 10m, m, dm, cm, mm

- **Reliability**

PROFESSIONAL MARKET

February 28, 2013

© Septentrio Satellite Navigation
Current Product Portfolio

Product Portfolio

Reference Receivers: PolaRx
- PolaRx4
- PolaRx4TR
- PolaRxS

Rover Receivers: AsteRx
- AsteRx2e
- AsteRx2eL
- AsteRx2eH
- AsteRx3
- AsteRx-m
- AsteRx-i

Aviation Receivers: AiRx
- AiRx2

Multi-constellation reference station and scientific receivers
Compact, low power, high-update rate receivers for mobile applications
Certifiable Receivers for SoL applications in aviation
Applications

Automation & robotics

Machine control

Marine survey & Engineering

Land & Aerial survey
The first commercial case for EGNOS; explicitly asked by customer:

- Error correction
- System w/o DGPS
- Roughly 0.5m with high availability
- System to be as robust and simple as possible
Improving efficiency in container harbour operation

Automatic logging of pick-up and drop-off points for containers linked to central yard-management SW to reduce human error

- Accuracy
- Reliability
- Safety

Implementation in Deurganck terminal with 44 straddle carriers resulted in 0 “lost” containers
UAVs

- AsteRx for UAV
- PolaRxeH/@ for landing platform
- EGNOS for autonomous error correction

- AsteRx-m: smallest and coolest GPS/GLO L1/L2
The AiRx family

- AiRx2 : dual-frequency BETA-3 receiver
  - 16 channels GPS L1 C/A code/carrier
  - 4 channels L1 SBAS
  - In-the-field upgrade paths for GPS L5 and Galileo
  - DO229 / DO-160 /DO178 level B /DO254 level A
  - RAIM and pRAIM
  - Fault Detection/Exclusion
Precision Agriculture

- Required Precision Crop-Dependent – EGNOS great!
- RTK - Precision Agriculture
Machine control

- Construction
- Dredging
- Excavation

PolaRx2eH : dual-antenna dual-frequency receiver combined with RTK for high-precision (cm-level) and stable machine control
- Interfaces with machine control programs eg Prolec and CarlsonSW
PolaRx4 Multi-GNSS reference station

- Signals support
  - GPS L1, L2, L5
  - GLO L1, L2, L3 RF ready
  - GAL E1/E5a/E5b/E5ab (including AltBOC)
  - COMPASS Ready
  - Real all in view (4 constellations x 12 sats, all signal)
  - SBAS

- Advanced Interference Mitigation (digital, in-band)
  - Integrated spectrum analysis
  - Notch filtering

- 100Hz Measurement output
- Clock Steering + Disciplined Ref out (VCTCXO)
- Special time transfer variant PolaRx4TR
PolaRxS Scintillation monitor

- Multi-frequency multi-constellation receiver dedicated to ionospheric monitoring and space weather applications.
- Key features:
  - Triple frequency GPS, GLO, GAL
  - Up to 100Hz MEAS output (signal phase + intensity)
  - Lock+ for tracking high dynamics
  - Ultra-low phase noise oscillator (OCXO)
  - Modern connectivity (IP, GUI, webservice)
- Power <4W
- Dedicated logging tool generating ISMR log file (backward compatible with old GSV4004)
Recalculate position solutions offline with different assumptions

Based on receiver positioning algorithms

Post-processing: Measure without base station, then calculate offline

SDK for integration in 3rd party applications