Next generation GNSS Technology

GNSS Receiver with an open Interface

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Overview

- Project description, idea and motivation
- Project partner
- Working packages navXperience
- User interviews and online survey
- Board architecture
- Our two GNSS board developments
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Name of the project: GOOSE

GOOSE – **GNSS Receiver with an open Software standardized interface**

The Project is government-funded from the ministry of economics and supported from DLR

### GNSS boards small cutting

<table>
<thead>
<tr>
<th>Channels</th>
<th>ComNav K508</th>
<th>Datagrid DGRx-GNSS</th>
<th>Javad TR-G3T</th>
<th>Novatel OEM 638</th>
<th>Trimble BD920</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNSS Systems</td>
<td>GPS L1, L2, L5, Glonass L1, L2, Beidou all</td>
<td>GPS L1, L2, L2, L5</td>
<td>GPS all Glonass all Galileo E1</td>
<td>GPS all Glonass all Galileo all Beidou all</td>
<td>GPS L1, L2, Glonass L1, L2, Galileo Yes? Beidou B1, B2</td>
</tr>
<tr>
<td>Max Satellites</td>
<td>60</td>
<td>30 or more</td>
<td>all</td>
<td>120</td>
<td>44</td>
</tr>
<tr>
<td>Size (mm)</td>
<td>100x60x12</td>
<td>90x60x12</td>
<td>57x88x12</td>
<td>125x85x14</td>
<td>51x42x7</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>42g</td>
<td>50g</td>
<td>47g</td>
<td>37g</td>
<td>25g</td>
</tr>
<tr>
<td>Accuracy</td>
<td>5 mm + 1ppm &lt; 1 cm</td>
<td>3 mm + 0.5 ppm</td>
<td>4 mm + 1 ppm</td>
<td>1 mm + 0.1 ppm</td>
<td></td>
</tr>
<tr>
<td>Ports</td>
<td>4</td>
<td>3</td>
<td>12</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Baud rate (bps)</td>
<td>921.600</td>
<td>115.200</td>
<td>460.800</td>
<td>921.600</td>
<td>460.200</td>
</tr>
<tr>
<td>Temperature</td>
<td>-40 to 85°C</td>
<td>-40 to +85°C</td>
<td>-35 to +75°C</td>
<td>-40 to 85°C</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>Power</td>
<td>1.8 Watt</td>
<td>1.5 Watt</td>
<td>3.4 Watt</td>
<td>2.8 Watt</td>
<td>1.3 Watt</td>
</tr>
</tbody>
</table>
Idea and Motivation

- Today the software (firmware) of all GNSS boards manufactures is not open
- Nobody can’t use his own RTK engine directly on the board
- Only the manufactures know how they calculate the tracking loops etc.
- No developer can use the complete raw data from the satellites
- If you develop special solution you always need a extra computer
- Our Idea: Open Firmware, Open Software interface, what do you want more

Project partner and rules

- Fraunhofer IIS
  Leader and carriers of technology
- navXperience
  Founder, market research and software design
- der Bundeswehr Universität München
  First user and RTK software developing
Joseph Fraunhofer
eponym of the
Fraunhofer Gesellschaft

Born 6th of March 1787 and died 7th of June 1826
German optician and scientist,
founder of the Fraunhofer lines
Manufacture of telescopes
and optical instruments

The Fraunhofer-Gesellschaft in Figures

- Founded in Munich in 1949
- 60 institutes across Germany with a total staff of 20,000
- Five Fraunhofer Centers in the USA
- Representative offices and senior advisors in Asia, the Middle East and Moscow
- Total budget € 1.8 billion with € 1.5 billion of income generated from contract research
GNSS Developments short overview

- Galileo Testbed GATE: L1/E5/E6 Frontends & Baseband Processing
- Flexible GNSS Frontend (80 MHz bandwidth)
- Multi-frequency GPS/GLONASS/GALILEO receivers and development platforms (ASIC development)
- Beamforming monitoring receivers
- ASIC design of GNSS receivers and components
- Galileo PRS applications
- 3G+C Antenna design transfer in a patent

UniBW München

- Founded in 1970 from the defense secretary Helmut Schmidt
- First students in the year 1973
- Today around 3,000 students in Munich
- 95% of the officer cadet study in 20 different fields
- From the beginning of GPS the UniBW research in GNSS technology
navXperience

- Founded in 2009 from Hubert Schmitz and Dirk Kowalewski
- GNSS Antennas for all constellations and all L-Band GNSS signals
- GNSS antennas for all solutions (reference stations, mobile solutions, maritime, machine control, agriculture and defense) with high accuracy

Several navXperience Projects

Contract over 1,500 3G+C mobile antennas for the engineer corps of the US Army from 2014 to 2019

Developing for the SAC a GNSS antenna including the S-Band signals for the IRNSS

Delivering the GNSS antennas for a digger machine control system of the MTS company from Germany
Working packages navXperience

- Costumer survey
- Define the specification of the Goose board
- Competition analysis
- Prepare the product specifications
- Working together with FhG IIS at the operating system
- Controlling the results

Interviews
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Online survey

- Over 80% low power and over 50% small size

Oneline survey

- Over 50% needs serial and USB ports
GPS, GLONASS and Galileo have the same significance

Architecture
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Architecture

- Sensor Fusion (Loosely Coupled)
- Input (i.e. RTCM)
- Output (i.e. RTCM, NMEA)
- PVT (Tightly Coupled)
- Tracking Loops (Ultratightly Coupled)
- Pseudo Ranges
- Receiver Management
- Jammer/Interferer Detection

HAL
- Sensor Control
- HW-Event-Detector
- Acquisition Control
- FFT

HW
- Sensors
- Channels
- Measurement Unit
- Acquisition Unit
- Sample Buffer

Developer and reference station board

- PCIe interface
- Integration in a PC
- Also working alone
- GPS, GLONASS, Galileo, Beidou and all other L-Band signals
User GNSS board

- Same architecture as the developer board and the same characteristic
- Smaller
- A GNSS developer can be absolutely sure, that his programming software works with same properties on both boards

Only a sample, not the real board

Thank you very much for your attention

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