Review of navigation systems by Russian manufacturers, trends and prospects

GLONASS/ GPS/ GALILEO technologies and equipment

Valery Babakov
The global market of navigation equipment

Total GNSS Shipments by Segment, millions

CAGR = 27.4%

CAGR = 37.5%
The global market of navigation equipment

Total GNSS Revenue by Segment, $ Billions

- CAGR = 27.4%
- CAGR = 28.5%
- CAGR = 20.0%

[Bar chart showing Total GNSS Revenue by Segment for the years 2005 to 2013]
The global market of navigation equipment

GNSS ASIC/ChipSet Market forecast

Source: ABI Research, Semiconductor Applications Markets report, 2009
Major drivers of further development of GNSS equipment

- GPS system modernization and development of new navigation signals
- The complete launch of GLONASS system and development of new navigation signals
- The introduction of the European GALILEO and Chinese COMPASS systems
- Implementing of the most advanced microelectronic technologies for new chip-sets, lower equipment prices even for improved performance
- Continuous development of GNSS position and navigation based services and their introduction in various areas of human activities
- The advantages of multi-system receivers over GPS only receivers
The main advantages of GLONASS / GPS equipment

- higher accuracy of combined navigation solutions
- higher availability of navigation signal in urban canyons and other areas with limited satellites visibility
- increased noise immunity from industrial or intentional interference
- free choice between GLONASS and GPS in case of limited availability of either system signals
Russian navigation equipment market

Factors slowing down Russian navigation market development before 2008

- legislative restrictions until 2007 (restrictions of identifying coordinates with accuracy of less than 30m)
- unsatisfactory cartography of most of the Russian territory
- containment of GPS-only navigation in regulated market segments for security reasons until the complete launch of GLONASS
- Insufficient public awareness of opportunities and advantages of navigation technologies
- Absence of unified standards and certification methods for navigation receivers
- Absence of state purchases stimulating market development
Russian navigation equipment market

Major drivers of Russian navigation market in the next 3-5 years

- Federal program “GLONASS” activities:
  - Complete restoration of the GLONASS constellation
  - Cartography activities
  - Development of regulations and rules for navigation equipment and services for public transportation
- Increasing range of navigation equipment and services, resulting in increased application opportunities
- Lower prices for GPS/GLONASS navigation receivers (competitive with GPS-only equipment)
- State purchase programs for various ministries, departments and regions
- Growing public awareness of advantages and opportunities
**Russian navigation equipment market**

**Possible scenarios**

**Total navigation equipment & services sales in Russia, $ Millions**

<table>
<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2012</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>175</td>
<td>6700</td>
<td>8800</td>
</tr>
</tbody>
</table>

**Total World navigation equipment & services sales, $ billions**

<table>
<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2012</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
<td>220</td>
<td>275</td>
</tr>
</tbody>
</table>

**Probable scenario**

Total navigation market in Russia in 2014 is likely to be of the same share of the global market as the Russia’s GDP share in the world’s GDP, that is 3.2%.

**Conservative scenario**

Russian navigation market share only 0.9% of the global market.

**Conclusion**

Russian navigation market in 2014 will be $ 2.5 – 9 Billion.
Market development areas of navigation equipment

- Chip-sets and OEM modules for various applications, including consumer electronics
- Navigation equipment for maritime, aviation, automotive and rail applications
- Geodesic equipment
- DGNSS equipment
- Mass-market equipment (PND navigators, trackers, communicators)
- Safety of Live and Military equipment
- GPS/GLONASS/GALILEO signal simulators
GLONASS State program

Sub-program 2
«Development and industrialization of navigation equipment for civil application»

State customers
Ministry of industries and trade of the Russian Federation, the Federal Space Agency

Aims of the sub-program
Development and industrialization of modern navigation equipment for public customers, as well as development and production of basic electronic components for mass-market navigation equipment

The main tasks of the sub-program
1. Development of state-of-the-art electronic components
2. Development of competitive navigation equipment and systems
3. Introduction of modern mass production technologies
4. Modernization of navigation equipment production facilities
Developers of navigation equipment and systems
- "RIRV"
- "VNIIRA"
- "MKB «Kompas»"
- "Tranzas"
- "RNII KP"
- "NII KP"
- "AFK «Systema»"
- "KB NAVIS"
- "Igevskiy radiozavod"
- "M2M telematika"

Developers and manufacturers of chip-sets and basic modules of navigation receivers
- "RIRV"
- "NII MA & factory «Micron»"
- "SPIRIT Telecom"
- "KB NAVIS"
- "NTC «Module»"
- "NIIMA «PROGRESS»"

Authorities – GNSS services customers
- ROSPROMTORG

Manufacturers of navigation equipment
- "Factory «Navigator»"
- "RIRV"
- "Concern PVO «Almaz–Antey»"
- "RNII KP"
- "NII KP"
- "MKB «Kompas»"
- "VNIIRA"
- "Tranzas"
- "KB Navis"
- "Igevskiy radiozavod"
- "AFK «Systema»"
OEM-receiver modules

OEM receiver for military equipment
RNPI (14C850)
Highly dynamical objects, special purpose navigation receiver
«KB NAVIS»

OEM modules for civil application

GNSS OEM receiver
for civil aircrafts
«KB NAVIS»

CH-4706
the small-sized navigation receiver
«KB NAVIS»

NAVIOR-24
the precision navigation receiver for time synchronization
«KB NAVIS»

MNP-M3
the small-sized navigation receiver
«IRZ»
OEM-receiver modules

OEM modules for civil application

1K-161

DuoStar-2000

1K-181

GeoC-1

«RIRV»

«SPIRIT Telecom»

«RIRV»

«GeoStar Navigation»

OEM modules for civil application

OEM receiver modules

OEM modules for civil application
Maritime equipment

Aqua-Board-12 «RIRV»

Integration «RIRV»

UAIS T103 «Tranzas»

Farvater «Radio Complex»
Aviation equipment

- BPSN-2
  «KB NAVIS»
- BPSN-2-01
  «KB NAVIS»
- CH-4312
  «KB NAVIS»
- BMC
  «VNIIRA Navigator»
- A-737
  MKB «Kompas»
- ABRIS
  «Tranzas»
In-car navigation and fleet management equipment

Over 40 manufacturers of autotrackers and mobile terminals

Avto-K «RIRV»

Glospace SGK-70 «NII KP»

CH-4711 «KB NAVIS»

Companies logos and images related to in-car navigation and fleet management equipment.
Equipment for Rail application

Satellite communication and navigation equipment
«Airokosmichesky Technology»

Emergency warnings to train crew, in train communication. The equipment increases train security and service levels.

Complex locomotive equipment
«IRZ»

Insures higher security for trains, prevention of accidents and pre-accident emergency situations on the railway.
Geodesic equipment

GEO 161 «RIRV»

RESEARCH «RIRV»

Briz-GP «KB NAVIS»

Briz-KM-GS «KB NAVIS»

Geodesic control and correction station «RIRV»
Differential service equipment

**CH-3500MK**
Differential GLONASS/GPS reference station
«KB NAVIS»

**CH-4901**
Beacon receiver
«KB NAVIS»

**CH-3500MKA**
Differential GLONASS/GPS reference station
«KB NAVIS»
Military and special purpose equipment

Maritime receivers

14C812
Navigation receiver for submarine
«Briz-PL»
«KB NAVIS»

14C815
DGPS/DGLONASS Navigation receiver «Briz-KD»
«KB NAVIS»

14C852
Maritime Navigation receiver with electronic map «Briz-KM-K»
«KB NAVIS»

14C854
Radionavigation goniometric complex for maritime application «Briz-KM-RNK MP»
«KB NAVIS»
Military and special purpose equipment

Information-navigation system

«Termotech»

Universal navigation receiver «Briz-KM-U»

«KB NAVIS»

14C851

Radionavigation goniometric complex for artillery

«Briz-KM-RNK BRAV&MP»

«KB NAVIS»

14C857
**Military and special purpose equipment**

**Individual navigation receivers**

14C853

Personal navigation receiver. Can be used individually and as part of in vehicle navigation system «Briz-KM-I»

«KB NAVIS»

14C858

Personal navigation receiver «Briz-KM-RV»

«KB NAVIS»

Grot-M

Personal navigation receiver «RNII KP»

NPI2

Personal navigation receiver «Кompas»
GNSS signal simulators

«KB NAVIS»

GPS/GLONASS/GALILEO/SBAS signal simulator CH-3803M

Designed in 2005

Navigation signals:
- GLONASS L1, L2 (C/A, P)
- GPS L1, L2, L5 (C/A, CM+CL, I5+Q5)
- SBAS L1 (C/A)
- GALILEO E1-L1-E2 (OS, SoL)

Number of simulation channels:
- 32 multi-system universal channel

Modeled objects – carriers of navigation receivers
- The number of objects: 1…3
- Modeled object movements – any with 6 degrees of freedom
- The object dynamics: 0…12 000 m/s, 0…500 m/s²

Certified as measuring instrument for navigation receivers
Signal simulator system CH-3805
Designed in 2007 (development project «Simulator» within Program «GLONASS»)

Navigation signals:
- GLONASS L1, L2 (C/A, P)
- GPS L1, L2, L5 (C/A, CM+CL, I5+Q5)
- SBAS L1 (C/A)
- GALILEO E1-L1-E2, E5a, E5b (OS, SoL)

Number of simulation channels:
- 48 multi-system universal channel

Modeled objects – carriers of navigation receivers
- The number of objects: 1…3
- Modeled object movements – any with 6 degrees of freedom
- The object dynamics: 0…12 000 m/s, 0…500 m/s²

Special shielded chamber for receiver sensitivity measurements
GPS/GALILEO Signal simulator

CH-3806

Developed in 2006 within «GIRASOL» project (ESA)

Navigation signals:
- GPS L1, L2, L5 (C/A, CM+CL, I5+Q5)
- SBAS L1 (C/A)
- GALILEO E1-L1-E2, E5a, E5b
  (OS, SoL, AltBoc)

Number of simulation channels:
- 48 multi-system universal channel

Modeled objects – carriers of navigation receivers
- The number of objects: 1…3
- Modeled object movements – any with 6 degrees of freedom
- The object dynamic: 0…12 000 m/s, 0…500 m/s²
The main tasks of Russian industries in GLONASS introduction

- Support of complete GLONASS satellite constellation
- Providing of GLONASS metrological parameters in terms of accuracy, integrity and reliability
- Developing of new GLONASS/GPS chip-sets and OEM receivers using the most advanced microelectronic technologies
- Developing of mass-market equipment competitive with GPS-only systems in terms of price and performance
- Mass production of GLONASS/GPS equipment for different consumer applications
Areas of development

Multifunctional small-size computers

PND

Communicators and smart-phones

Personal trackers
New NAVIS NV08C GPS/GLONASS/GALILEO receiver
«KB NAVIS»

Applications:
- mobile telecommunication devices
- mobile telecommunication systems
- personal navigation systems
- security and monitoring systems
- fleet management systems
- portable telecommunicators and media players

For various mobile navigation and communication devices

Experimental samples are under production
### New NAVIS NV08C GPS/GLONASS/GALILEO receiver «KB NAVIS»

<table>
<thead>
<tr>
<th>Supported GNSS</th>
<th>GPS/GLONASS/GALILEO/SBAS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of tracking channels</strong></td>
<td>32</td>
</tr>
<tr>
<td><strong>Chipset</strong></td>
<td>NV08CA, NV08CD&lt;br&gt;(0.13 µm RF CMOS, 90 nm CMOS)</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>Position – 2.5 m, Height - 3 m&lt;br&gt;Time – 50 ns</td>
</tr>
<tr>
<td><strong>Max. update rate</strong></td>
<td>10 Hz</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>-189 dBW (A-GNSS)</td>
</tr>
<tr>
<td><strong>Acquisition, average</strong></td>
<td>cold start - 30 s&lt;br&gt;hot start - 1 s</td>
</tr>
<tr>
<td><strong>Power consumption</strong></td>
<td>20 mW time-to-time fix @ 1s&lt;br&gt;&lt;150 mW tracking and navigation</td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td>USB 2.0, UART, SPI, GPIO, 1 PPS</td>
</tr>
<tr>
<td><strong>Communication protocols</strong></td>
<td>NMEA-0183, BINR, RTCM SC-104 V2.2</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>9<em>11</em>2 mm</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>1 g</td>
</tr>
<tr>
<td><strong>Operating temperature range</strong></td>
<td>-30…+70</td>
</tr>
<tr>
<td><strong>Unite price @ mass production</strong></td>
<td>&lt; 15 $</td>
</tr>
</tbody>
</table>
New NAVIS NV08C GPS/GLONASS/GALILEO receiver
«KB NAVIS»

The main development stages and milestones

- MPW lots of chipset ASICs NV08CA, NV08CD – October, 2009
- Qualification test of NV08C MCM and OEM receiver – March, 2010
- Series production start – first lot of 500K pcs – June, 2010
Contact information:  

Association «GLONASS/GNSS-FORUM»  

JSC Research Design Lab NAVIS («KB NAVIS»)  
Address for correspondence: 127411, Moscow, POB 11  
Headquarter: Dmitrovskoe shosse 157, Bld. 5  
Tel (007-495) 665-61-48  
Fax (007-495) 665-61-49  
E-mail: navis@navis.ru  
http://www.navis.ru