Commerce to Consumers: GPS Technology Market Update

Steve Koenig
Director, Industry Analysis
Consumer Electronics Association
About CEA

• Mission:
  – Grow the consumer electronics industry
• More than 2,000 member companies
• Market research, legislative advocacy, technology standards
• Producer of the International CES®
The European GNSS Agency (GSA)

The GSA is the European Union Community Agency formed to accomplish specific tasks related to European GNSS programmes.
GPS/GNSS Verticals

Military

Commercial

Consumer (Devices and LBS)
SURVEYING
Surveying – Global Market Building

Shipments of GNSS devices by region

<table>
<thead>
<tr>
<th>Year</th>
<th>EU27</th>
<th>North America</th>
<th>Rest of the World</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
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<td>80</td>
<td>110</td>
</tr>
<tr>
<td>2013</td>
<td>50</td>
<td>100</td>
<td>120</td>
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<tr>
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<td>60</td>
<td>120</td>
<td>140</td>
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<tr>
<td>2015</td>
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<td>200</td>
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<td>2019</td>
<td>110</td>
<td>220</td>
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<tr>
<td>2020</td>
<td>120</td>
<td>240</td>
<td>260</td>
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<td>2021</td>
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<td>260</td>
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</tr>
<tr>
<td>2022</td>
<td>140</td>
<td>280</td>
<td>300</td>
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Global Market Size (est.)

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Shipments (000s)</td>
<td>200</td>
<td>320</td>
</tr>
<tr>
<td>Installed Base (000s)</td>
<td>550</td>
<td>1,150</td>
</tr>
</tbody>
</table>

Surveying – Global Market

Installed base of GNSS devices by region

Key Manufacturers

- Ashtech
- Deere & Co
- Hemisphere
- Javad
- Laid
- Leica
- North Surveying
- Novatel
- Pentax
- Pulse Electronics
- Septentrio
- Topcon
- Trimble
- Yageo Corporation
AGRICULTURE
Future Farms: Automatic Steering / VRT Common

Shipments of GNSS devices by region

<table>
<thead>
<tr>
<th>Year</th>
<th>EU27</th>
<th>North America</th>
<th>Rest of the World</th>
<th>GNSS penetration</th>
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<td>10</td>
<td>90</td>
<td>90</td>
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<tr>
<td>2013</td>
<td>15</td>
<td>135</td>
<td>135</td>
<td>15%</td>
</tr>
<tr>
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<td>20</td>
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<td>25</td>
<td>225</td>
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<td>40%</td>
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<td>375</td>
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<tr>
<td>2022</td>
<td>60</td>
<td>400</td>
<td>400</td>
<td>60%</td>
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Global Market Size (est.)

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Shipments (000s)</td>
<td>220</td>
<td>610</td>
</tr>
<tr>
<td>Installed Base (000s)</td>
<td>950</td>
<td>2,650</td>
</tr>
</tbody>
</table>
Precision Farming – Global Market

Installed base of GNSS devices by region

Key Manufacturers

- Hexagon
- Deere & Co
- Topcon
- AGCO Corp

AVIATION
GNSS Aviation: High Degree of Penetration

Shipments of GNSS devices by segment

Global Market Size (est.)

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Shipments (000s)</td>
<td>260</td>
<td>340</td>
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<tr>
<td>Installed Base (000s)</td>
<td>975</td>
<td>1,325</td>
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</tbody>
</table>

Aviation - Global Market

Installed base of GNSS devices by region

Key Manufacturers

- Honeywell
- Garmin
- Rockwell Collins
- Thales Avionics
- Universal


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RAIL
GNSS Rail: Low Volumes / Penetration

Shipments of GNSS devices by application

<table>
<thead>
<tr>
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<th>Global Market Size (est.)</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
<td>2020</td>
<td></td>
</tr>
<tr>
<td>Annual Shipments (000s)</td>
<td>15</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Installed Base (000s)</td>
<td>53</td>
<td>270</td>
<td></td>
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</tbody>
</table>

GNSS Rail – Global Market

Installed base of GNSS devices by region

Growing support for critical safety functions
USA = Positive Train Control

Key Manufacturers

- Furuno
- Leica
- Omnicom
- Trimble

- CSR-SIRF
- Japan Radio Co.
- U-Blox
- Septentrio


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MARITIME
Global Maritime GNSS: Safety First

Shipments of GNSS devices by application

Global Market Size (est.)

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Shipments (000s)</td>
<td>117</td>
<td>158</td>
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<tr>
<td>Installed Base (000s)</td>
<td>725</td>
<td>1,050</td>
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</table>

Maritime – Global Market

Installed base of GNSS devices by region

Key Manufacturers

- Furuno
- Japan Radio
- Laird
- Leica
- Novetel
- Pulse
- Trimble

ROADS (VEHICLES)
Road GNSS: New Applications on the Horizon

Shipments of GNSS devices by application

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Market Size (est.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Shipments (M)</td>
<td>58</td>
<td>102</td>
</tr>
<tr>
<td>Installed Base (M)</td>
<td>240</td>
<td>440</td>
</tr>
</tbody>
</table>

Road GNSS – Global Market

Installed base of GNSS devices by region

Key Manufacturers

- Broadcom
- CSR-SiRF
- Furuno
- Japan Radio Co.
- Mediatek
- Pulse Electronics
- Qualcomm
- ST Micro
- U-Blox


Units (millions)
Recalculating the Opportunity
Shipments of GNSS devices by application

U.S. PND Market Trend

Unit Shipments (000s)

HH Penetration:

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Units (000s)</td>
<td>300</td>
<td>550</td>
<td>707</td>
<td>2,284</td>
<td>8,751</td>
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<td>13,684</td>
<td>12,315</td>
<td>9,325</td>
<td>7,274</td>
<td>6,182</td>
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</tbody>
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Source: CEA
GPS: In-Vehicle Navigation/Safety

U.S. household penetration rate climbing

Source: CEA
Autonomous Vehicles

Street Legal Testing in:

- California Republic
- Michigan
- Nevada
LBS (CONSUMERS)
LBS Device Universe Expanding

Global Market Size (est.)

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Shipments (M)</td>
<td>1,200</td>
<td>2,200</td>
</tr>
<tr>
<td>Installed Base (B)</td>
<td>2.6</td>
<td>5.6</td>
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LBS GNSS – Global Market

Installed base of GNSS devices by region

Key Manufacturers

- Broadcom
- CSR-SiRF
- Fujitsu Ltd.
- Intel
- Mediatek
- Qualcomm
- Skytraq
- STM
- Texas Instruments
- U-Blox

U.S. Wireless Handset Volume Trend
(Shipments in 000s)

Cumulative Smartphone Units = 660 million

Source: CEA
U.S. Tablet Volumes / Forecast

Shipments in 000s

Cumulative Shipments = 274 million

Source: CEA
U.S. Trends in HH Penetration for Mobile Devices

Source: CEA
LBS: Gaining Momentum

Key Trends

More Use Cases

Connectivity, Sensors, Ecosystem

Accuracy, Power Management, Cost

Apps

Devices

Smartphones

Technology

GNSS, Wi-Fi, etc.
CE Mega-Trend: Sensorification

• Chorus of sensors in CE

• **GPS** and **Connectivity** are crucial
Raw Outputs from Sensors
...not that interesting!

Accelerometer

GPS - GNSS

Gyroscope
It’s All About Context

• The “magic” is made in software
• Combining inputs from various sensors adds context
• CES is full of companies finding new uses for sensors
• Basic applications of sensors are old news
  – Complex algorithms determine context and meaning of inputs
GNSS LBS: Innovation

An all-new, super fun way to check in

Beautiful Sunday bike ride with Zack and Laura

See which of your friends are hanging out nearby

East River Park

Right here 500 feet

Andrew
Ace bar
Adam
Ace Bar

A short walk away 1.0 miles

Nina
Black Crescent
Nick
Lower East Side
Lauren
Lower East Side

See what your friends are up for tonight

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GNSS LBS: Disruption

The closest driver is approximately 1 min away

800 Market St

Set pickup location

Travis
Will arrive in 1 minute

Call Driver
## Global GNSS Market Summary

### Unit Shipments (000s)

<table>
<thead>
<tr>
<th>GNSS Market</th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey</td>
<td>200</td>
<td>320</td>
</tr>
<tr>
<td>Agriculture</td>
<td>220</td>
<td>610</td>
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<td>Aviation</td>
<td>260</td>
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<td>Rail</td>
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<td>Maritime</td>
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<tr>
<td>Road</td>
<td>58,000</td>
<td>102,000</td>
</tr>
<tr>
<td>LBS</td>
<td>1,200,000</td>
<td>2,200,000</td>
</tr>
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</table>

Cumulative Global GNSS Revenues 2012-2022

Summary

• Location is more important than ever.
• GPS/GNSS is an enabling technology for innovation and disruption.
• Consumer market (Road, LBS) represents biggest opportunity.
• Precision verticals have room to grow – especially in emerging markets.