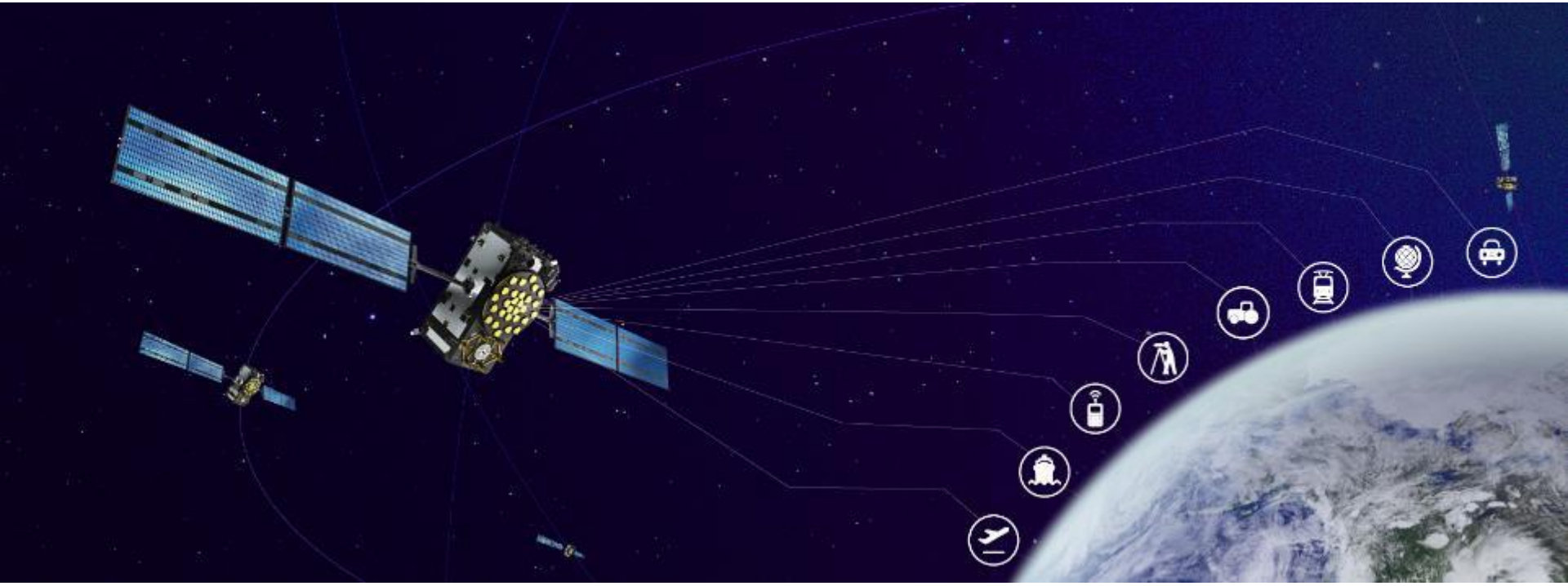


European Global Navigation Satellite Systems Agency

GALILEO EGNOS
NAVIGATION SOLUTIONS
POWERED BY EUROPE

European GNSS Agency, main GNSS market trends and opportunities

Market opportunities for Galileo and EGNOS in Portugal

Gian Gherardo Calini, Head of Market Development

21 September 2017, Lisbon

GSA in a nutshell

Mission:

Gateway to Services

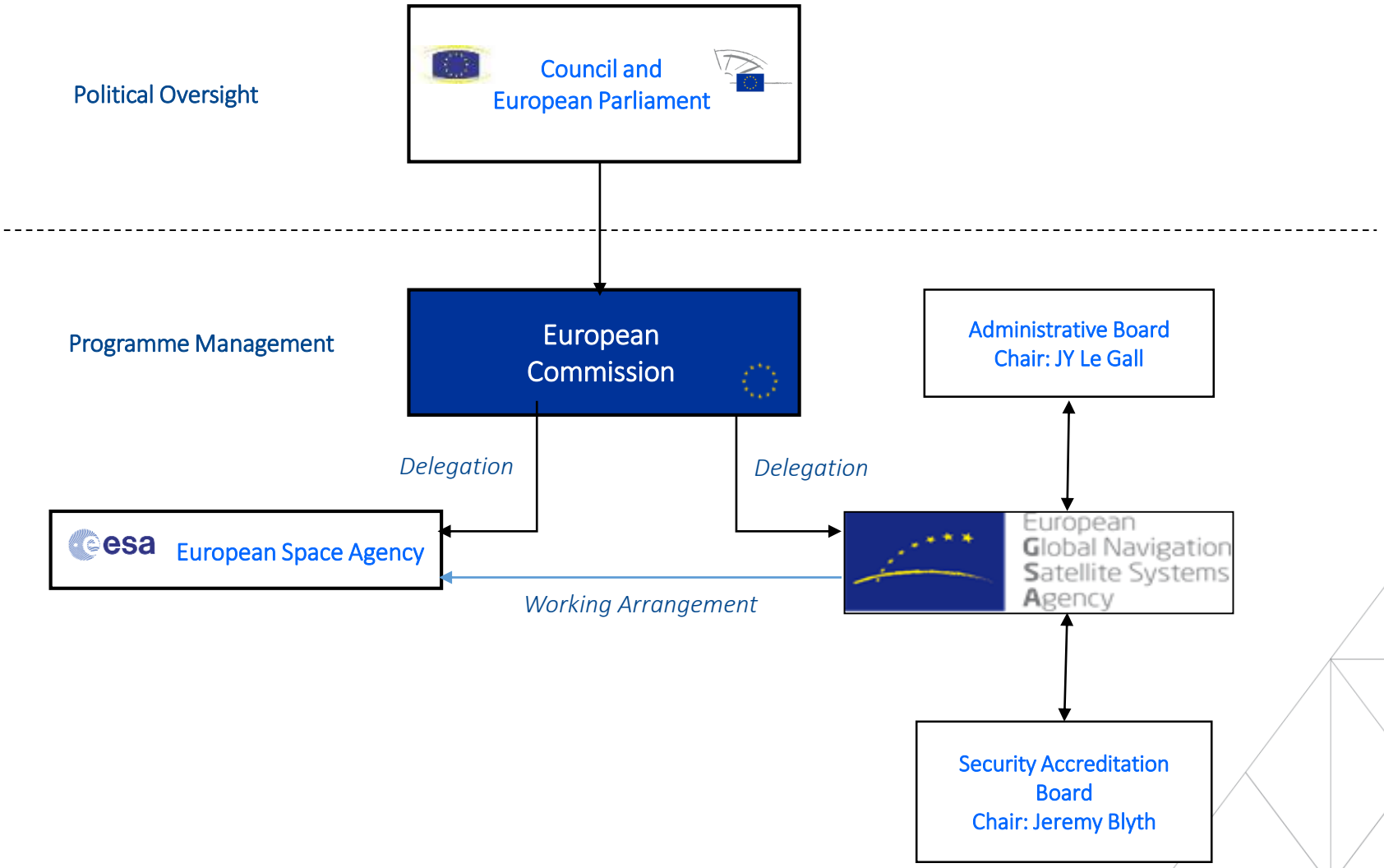
- Galileo & EGNOS Operations and Service Provision
- E-GNSS Market Development (applications and receivers)

Gatekeeper of security

- Security Accreditation
- Operation of Galileo Security Monitoring Centre, governmental service (PRS) activities

Resourcing:

GSA governance summary



“Three main pillars” integrated approach towards E-GNSS adoption…

DOWNSTREAM VALUE CHAIN

MARKET SEGMENTS

- Road
- LBS
- Aviation
- Rail
- Maritime
- Agriculture
- Surveying & Mapping
- Timing & Synchronization
- Governmental

Bodies influencing the market	Navigation Signal Providers	Chipset, receiver	Devices	Content & Apps	Service providers

Understand **market and user needs and satisfaction**

User Satisfaction

Stimulate

DEMAND & ADOPTION

- EGNSS added Value
- Cooperate with receivers and apps developers
- Roadmaps with stakeholders
- Support EC policies

Support EU

COMPETITIVE OFFER

of Services, applications

and receivers

Fundamental Elements

E-GNSS USER ADOPTION

EU PUBLIC BENEFITS

EXAMPLES

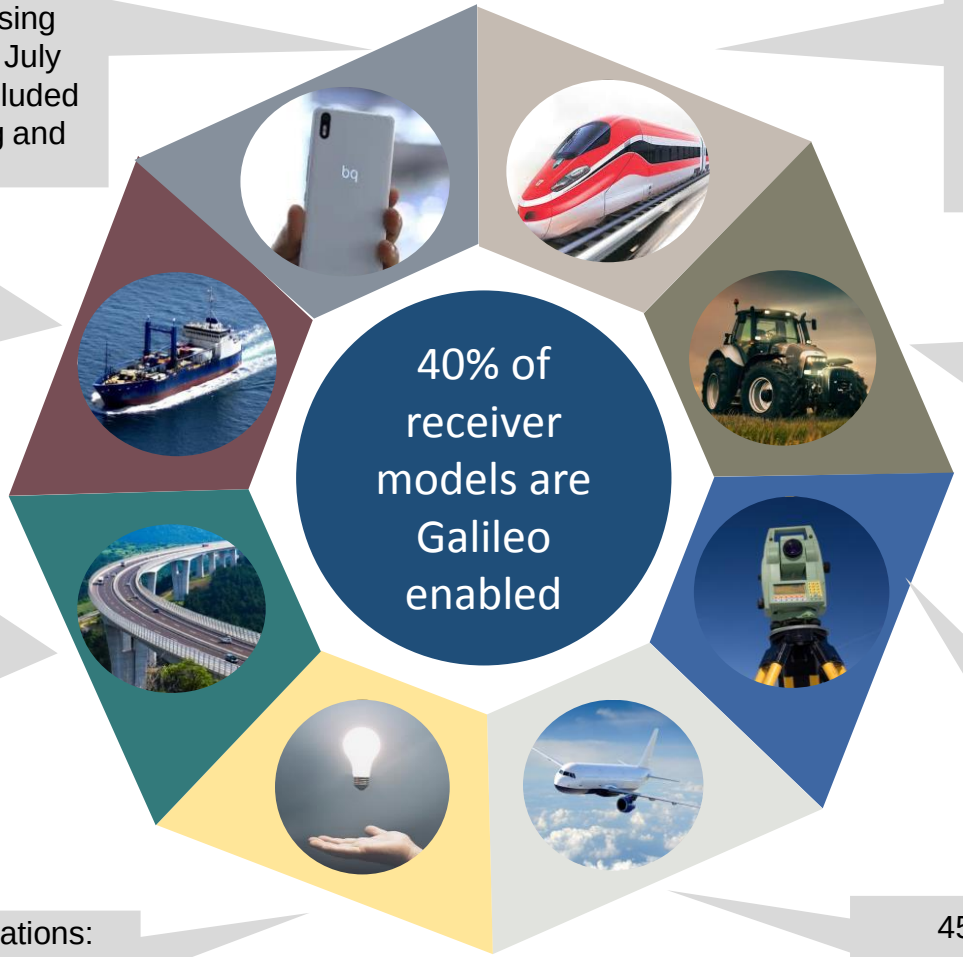
…bringing concrete results

BQ Aquaris X5 Plus, the first European smartphone using Galileo, was launched in July 2016. Today, Galileo is included also in Huawei, Samsung and Apple models

Galileo and EGNOS have been included in the European Railway Traffic Management System MoU in view of expected operational and safety benefits

Galileo recognized by the International Maritime Organization as a *"World Wide Radio Navigation System"* for the use in regulated domains

EGNOS leadership with 72% of farmers using GNSS, thanks to partnerships with tractor manufacturers actively promoting EGNOS affordable accuracy



Road tolling: EGNOS already implemented in 4 European schemes

Regulated applications: eCall and Digital Tachograph regulations using Galileo and EGNOS

EGNOS integrated in literally all newly sold handheld mapping devices Galileo growing presence in Surveying

R&D FP7 and H2020 applications:
60 products developed
19 patents granted
142 prototypes ready

450 EGNOS based approach procedures in 244 airports in 23 EU countries

Market and Technology monitoring support our integrated approach

Available for download on GSA website

The first edition of the ***GNSS Technology Report*** was issued on 2016 providing an in-depth analysis of 3 GNSS macrosegments:

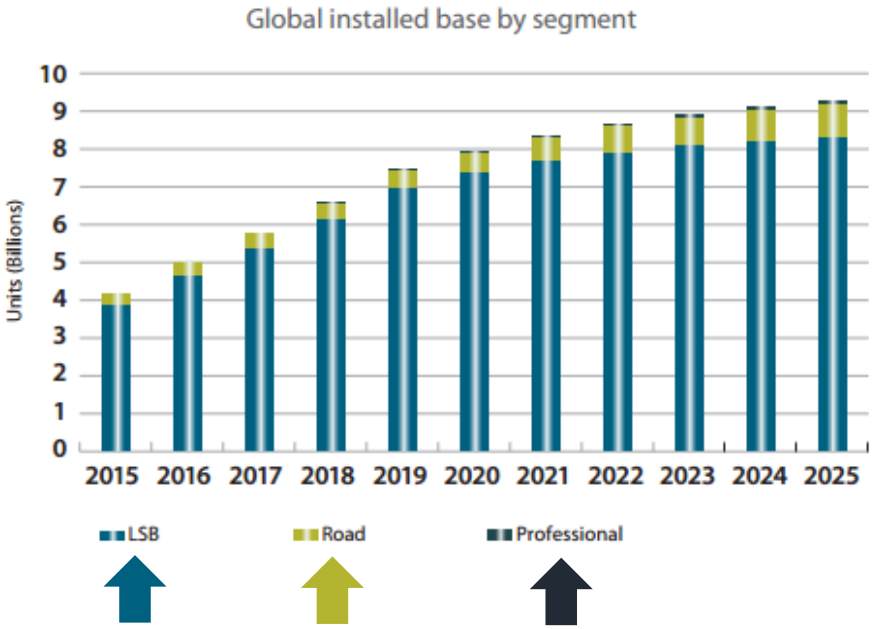
- *Mass market solutions*
- *Transport safety and liability-critical solutions*
- *High precision, timing and asset management solutions*

Available for download on GSA website

GNSS Market Report 5 was released in 2017, main enhancements are:

- *Expanded session on "macro trends"*
- *Addition of segment-specific "user perspectives"*
- *The E-GNSS added value per segment*

The global GNSS installed base will reach 8bln devices in 2020, meaning more opportunities…



Smartphones account for almost 80% of the global installed base of GNSS devices, being the most popular platform to support mobile "LBS"

Thanks to In-Vehicle System and eCall markets the number of devices used for "Road" applications is set to grow substantially, with a CAGR of 11.4%

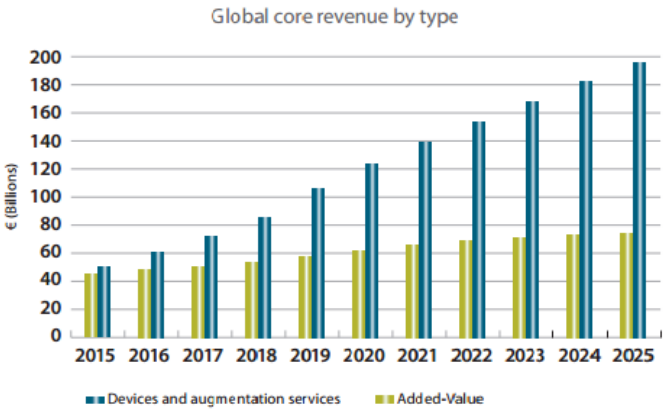
Fostered by a maturing regulatory environment, the drones market is set to account for over 70% of the installed base of "Professional" segments in 2025

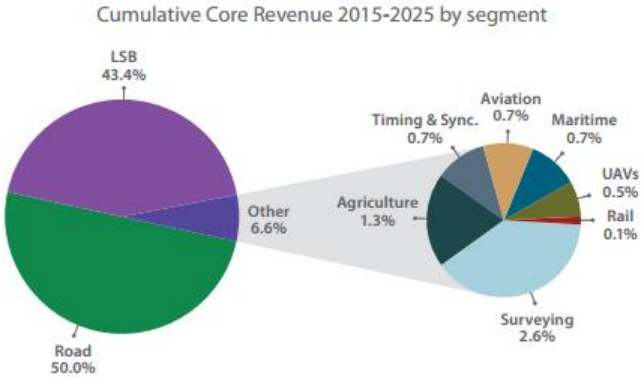
…especially for innovative added-value services providers, opening the door to SMEs and start-ups

Added-value services are set to witness skyrocketing growth of 20% annually*

All services that create an added value to users by leveraging on GNSS technology

Road and LBS dominate the core revenues representing together more than 93% of the market*





* In the period 2015-2020

The market growth is the result of major developments where E-GNSS plays a key role

E-GNSS contributes to a **rapidly diversifying range** of **technologies** and **applications**

Internet of Things

- Locating objects
- Synchronising networks

Big Data

- Geo-referencing data

mHealth

- Disability assistance
- Patient monitoring

Augmented Reality

- Link between surrounding reality and digital objects

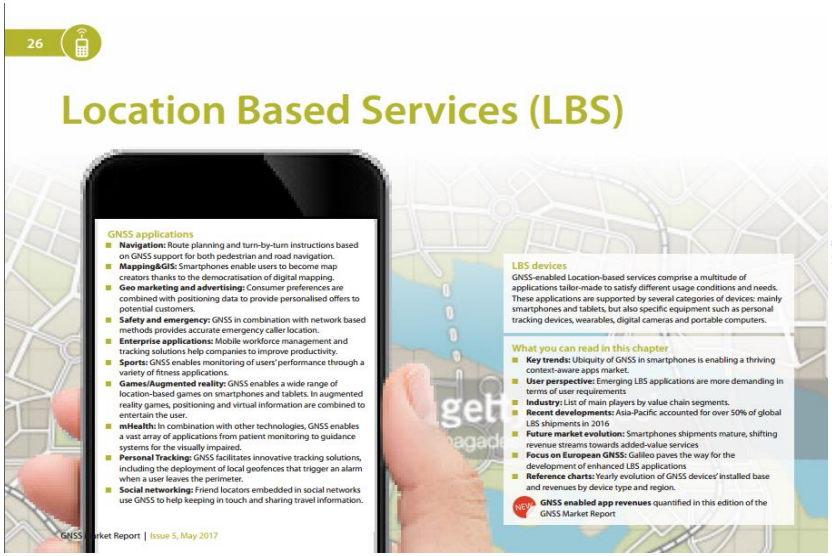
Smart Cities

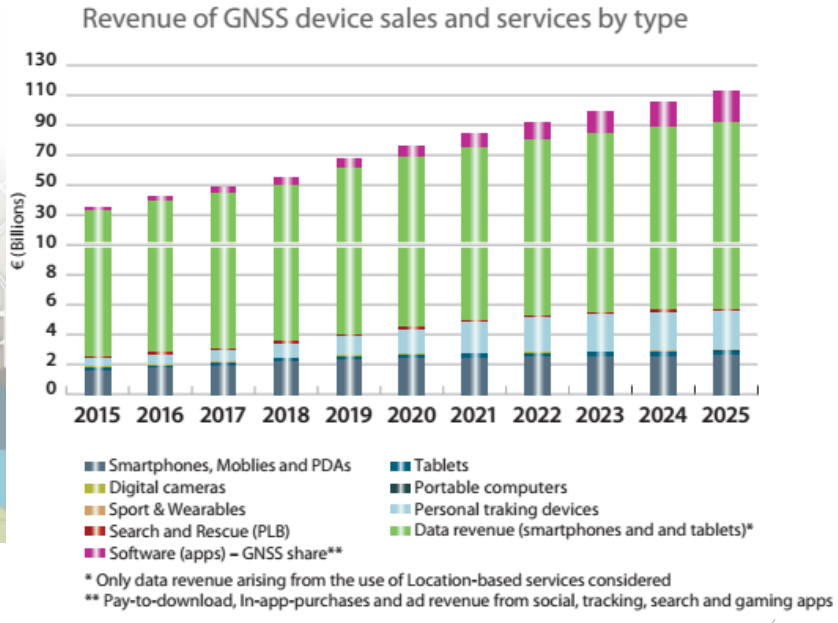
- Supporting infrastructure design and mobility

Multimodal Logistics

- Asset monitoring
- Theft risk reduction

Smartphones shipments reach maturity, shifting revenues towards value-added services

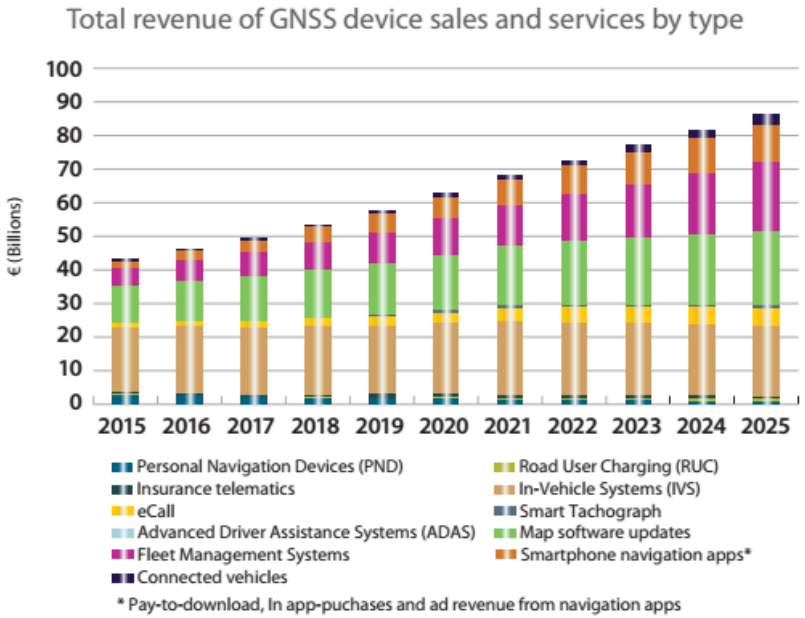




Key market trends:

- Over 90% of context-aware smartphone apps now rely on GNSS and first Galileo smartphones hit the market
- Availability of GNSS raw measurements on smartphones opens new possibilities for app developers

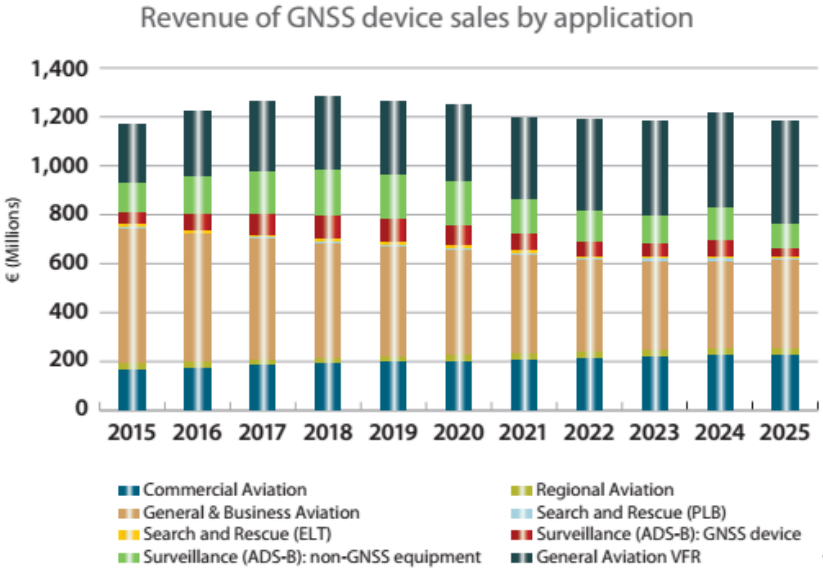
Revenues from eCall will increase, boosted by the mandatory installation in all new vehicles



Key market trends:

- GNSS, together with other technologies, is a key answer to Autonomous Vehicles' need of accurate positioning combined with reliability of localisation
- Business models continue evolving, with OEMs pushing towards the ownership of GNSS sensors and aftermarket companies increasingly specialising in data collection and elaboration

Visual Flight Rules applications will lead the market in the years to come



Key market trends:

- The aviation market continues to grow worldwide with reliance on GNSS increasing
- Rotorcraft operations are currently rapidly expanding their use of SBAS

* VFR: Visual Flight Rules

By 2025, sales of recreational navigation units will represent 57% of total maritime GNSS market value

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Maritime

GNSS applications

According to the distinction provided by IMO Resolution A.915(22), **GNSS applications** can be split into navigation and positioning:

Navigation

- **Sea**
  SOLAS vessels: All passenger ships, cargo ships larger than 500 gross tonnage or larger than 300 tons if engaged on international voyages are regulated and rely heavily on GNSS to support navigation activities. At least 3 devices are typically fitted on vessels for redundancy reasons.
  Non-SOLAS vessels: GNSS-based systems for maritime navigation are widespread not only across commercial, but also recreational vessels. They are used both for overseas and high traffic areas.
- **Inland Waterways (IWW):** GNSS is used to ensure safe navigation also in inland waterways (rivers, canals, lakes and estuaries).

Positioning

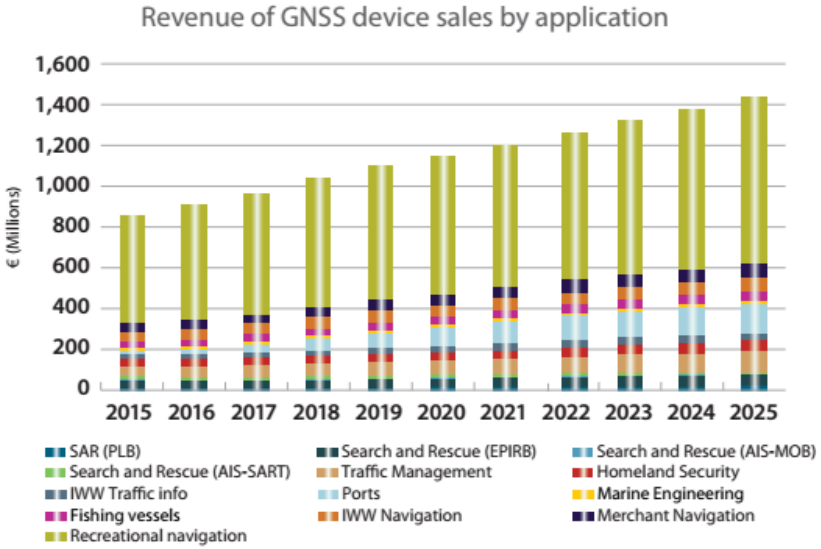
- **Traffic management and surveillance:** These activities are supported by GNSS-based systems including **Automatic Identification System (AIS) and Long-Range Identification and Tracking (LRIT)** both in sea and inland waters.
- **Search and Rescue** is the search for and provision of aid to people in distress or danger. Different types of devices can make use of GNSS positioning:
  - In the frame of the Cospas-Sarsat programme, ship and person-registered beacons, i.e. **Emergency Position Indicating Radio Beacons (EPIRBs)** and **Personal Locator Beacons (PLBs)** transmit, once activated, the necessary information for rescue to authorities via satellite communication;
  - When activated, **AIS Search and Rescue Transponders (AIS-SART)** and **AIS Man Overboard (AIS-MOB)** devices continuously transmit an alert message including ID number and GNSS-based location, which triggers an alarm on all AIS equipped vessels within Very High Frequency (VHF) range.
- **Fishing vessel control:** GNSS positioning enables Vessel Monitoring Systems to check the position of fishing vessels, as well as the time spent in international and foreign waters, protected marine areas, etc.
- **Port operations:** Transit progress, docking and loading-unloading operations are monitored through GNSS-based technologies.
- **Marine engineering:** GNSS is used to support marine construction activities (e.g. cable and pipeline laying).

What you can read in this chapter

- **Key trends:** Multi-constellation GNSS is becoming the go-to solution for a wide range of maritime applications.
- **User perspective:** GNSS offers significant benefits to both the direct users and beyond.
- **Industry:** List of main players by value chain segments.
- **Recent developments:** Maritime GNSS shipments witness a year-to-year growth, with recreational navigation dominating the segment.
- **Future market evolution:** In a connected maritime environment, GNSS is a key enabler for both traditional and innovative shipping operations.
- **Focus on European GNSS:** EGNSS set to be a key differentiator in the maritime domain with special focus on Navigation and SAR applications.
- **Reference charts:** Yearly evolution of GNSS devices' installed base and revenues by by application and region.

NEW **AIS-SARTs and AIS-MOBs** quantified in this edition of the GNSS Market Report.

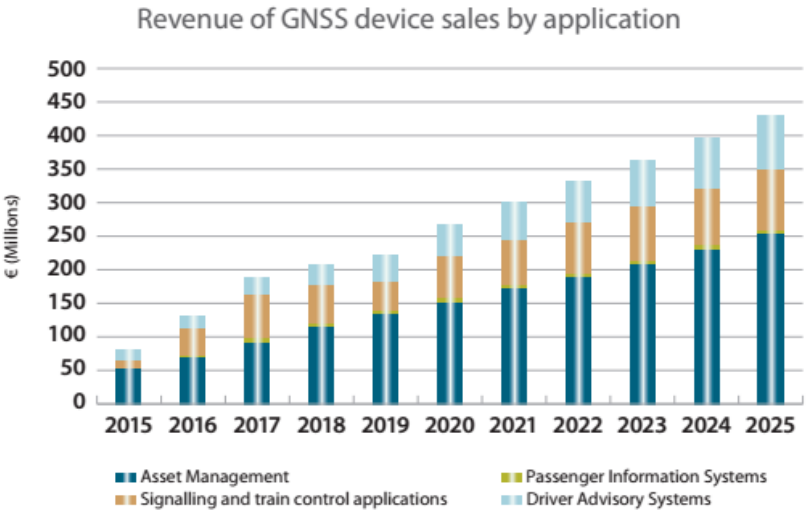
GNSS Market Report



Key market trends:

- Multi-constellation GNSS is becoming the go-to solution for a wide range of maritime applications
- SAR beacon manufacturers are preparing for multi-constellation GNSS, opening the path for Galileo penetration in all type of SAR beacons

Asset management applications will continue driving the revenues in the rail market segment



Key market trends:

- GNSS is becoming a generic system widely used in non-safety relevant applications
- GNSS begins to be implemented also for safety relevant applications with different maturity depending on the region, e.g. in India, China and the Middle East

Automatic steering applications increasingly adopted by farmers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Agriculture

GNSS applications

Precision agriculture is the application of different technologies and solutions to manage the variability of agricultural production, in order to improve crop yield and reduce environmental impact. Key GNSS enabled applications include:

- **Farm machinery guidance** uses GNSS positioning to assist drivers in following the optimal path thanks to a digital display, thus minimising risks of overlaps.
- **Automatic steering** completely takes over steering of the farm equipment from the driver allowing the operator to engage in core agricultural tasks.
- **Variable rate application** combines GNSS positioning with information from other sensors and digital maps to distribute the right amount of agrichemicals.
- **Yield monitoring** enables site-specific monitoring of harvest, combining the output of a yield sensor with GNSS positioning of the harvester.
- **Biomass monitoring** enables site-specific monitoring of biomass in an agricultural field, providing up-to-date information on crop development.
- **Soil condition monitoring** enables updates of soil moisture levels, fertility or diseases to optimise their management. GNSS positioning and software applications identify the exact position of the soil samples sent to laboratories. Data from soil sampling is used in VRT application maps.
- **Livestock tracking and virtual fencing** use a GNSS-enabled portable equipment to track animals behaviour, leveraging tracking and virtual fencing.
- **Forest management** makes use of GNSS positioning for different forestry tasks such as identification and mapping of damage and areas under stress, location of clear-cut areas, sample plots and roads.

Agri-logistic applications help farmers to increase efficiency and to comply with number of regulations and new standards:

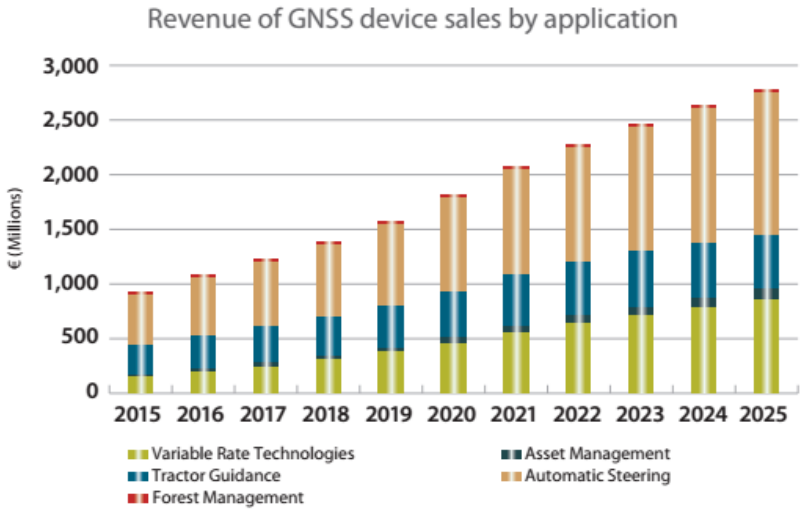
- **Farm machinery monitoring and asset management** use real-time GNSS information for monitoring the location and mechanical status of equipment and to manage work flows efficiently.
- **Geo-traceability** enhances the effectiveness of food, animal and product traceability by using transponders on animals and vehicle GNSS trackers, as well as by geo-referencing location and size of land parcels.
- **Field definition** is the activity of measuring precisely the boundaries and the size of agricultural fields. In the EU, GNSS-based operations using EGNOS and Galileo support a system of area-based subsidies for farmers within the Common Agricultural Policy (CAP).

What you can read in this chapter

- **Key trends:** GNSS stimulates integrated farm management's uptake, as new applications take off.
- **User perspective:** Interoperability and ease of use are key requirements of precision farmers.
- **Industry:** List of main players by value chain segments.
- **Recent developments:** Precision agriculture solutions registered growth across applications.
- **Future market evolution:** Growth of emerging markets will further push adoption of GNSS.
- **Focus on European GNSS:** EGNSS to foster the further adoption of precision agriculture.
- **Reference charts:** Yearly evolution of GNSS devices' installed base and revenues by application and region.

NEW **Forest Management** quantified in this edition of the GNSS Market Report

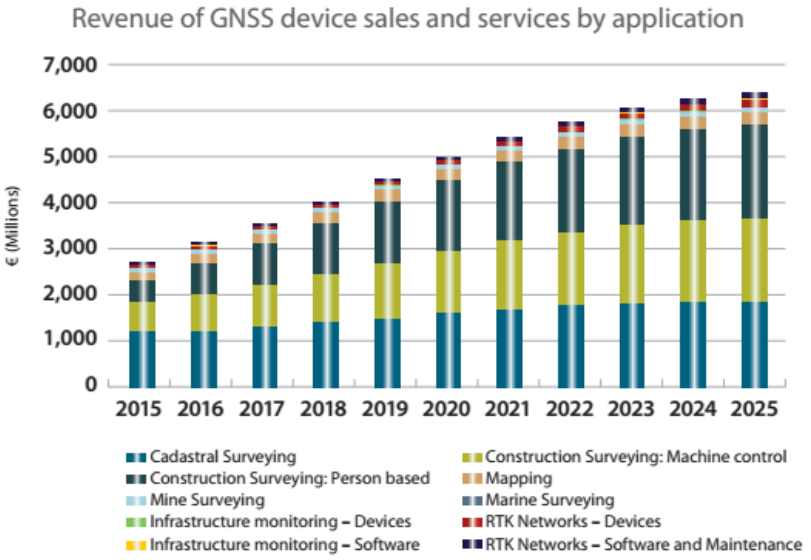
GNSS Market Report | Issue 5, May 2017



Key market trends:

- GNSS applications are used across all phases of the agricultural life cycle and represent a key enabler for the integrated farm management comprehensive concept
- IoT has been the source of new and more productive ways to farm, owing to the use of easy-to-install and affordable sensors

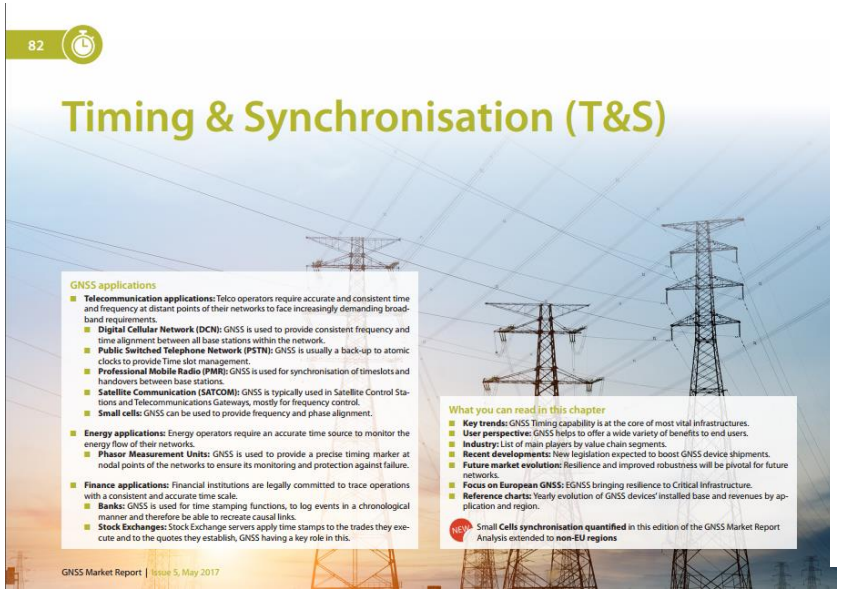
The strong development of the construction sector will drive the growth of the GNSS surveying market

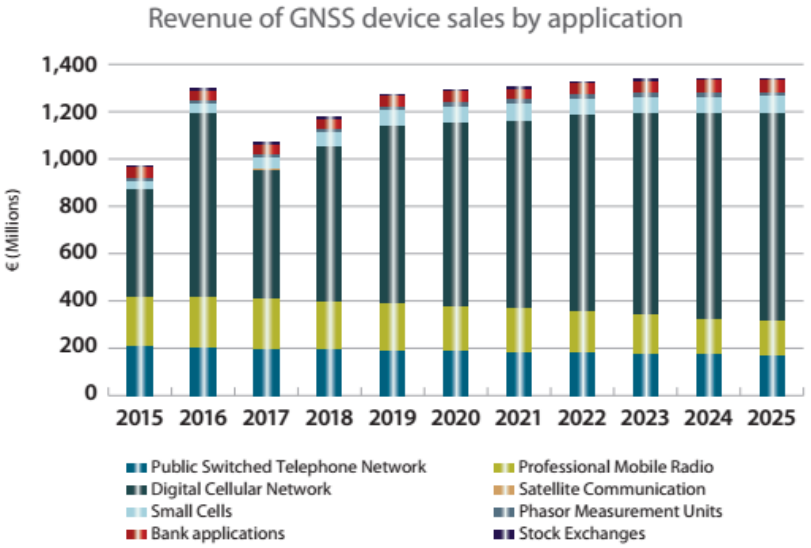


Key market trends:

- Incumbent manufacturers are focusing on customers services and assistance to counterbalance Asian manufactures' aggressive pricing strategies
- Multi-constellation and dual frequency is a reality for professional users today, triple frequency and PPP solutions are gaining grounds now and in the coming years

The T&S market is expected to reach €1.3 bln in 2020





Key market trends:

- Expansion of telecom networks (e.g. Small Cells, 4G, 5G) makes GNSS more and more essential, driving future shipments
- The T&S community is facing many challenges linked to an increased need for resilience, reliability and security, supported by an evolution of the regulation

GSA tangibly supports EU players in reaping the market opportunities

Horizon 2020 aims to foster adoption of Galileo and EGNOS mostly via content and application development.
It supports the integration of services into devices and their commercialisation

Around **100 €mln** budget in first 3 calls

Fundamental Elements

Fundamental Elements projects focus on fostering the development of innovative Galileo- and EGNOS-enabled receivers, antennas and chipsets technologies.
It aims to realize products that address user needs in priority market segments

€75.5 M for non-PRS projects

http://www.gsa.europa.eu/r-d/gnss-r-d-programmes

Galileo officially moved from a testing phase to the provision of live services

Galileo goes live

Initial Services are the first step towards full operational capability and reflects Europe's achievement to satisfy evolving user needs leveraging E-GNSS signals with better performance

Upgrading devices

Already today, leading GNSS companies representing more than 95% of the GNSS chipset market produce Galileo-ready chips

www.useGalileo.eu

Users can keep track of Galileo-enabled devices in the different market segments and be informed as soon as new ones become available

Linking space to user needs

How to get in touch:

GSA Newsletter

GNSS YouTube Channel

GSA Twitter - @EU_GNSS
EGNOS Twitter - @EGNOSPortal

European GNSS Agency LinkedIn Page
GNSS Market, Research & Development

GNSS Facebook page

GNSS Slideshare Page (presentations)

www.GSA.europa.eu

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HORIZON 2020

E-GNSS USER ADOPTION

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Our integrated approach has shown to be effective bringing concrete results

EXAMPLES

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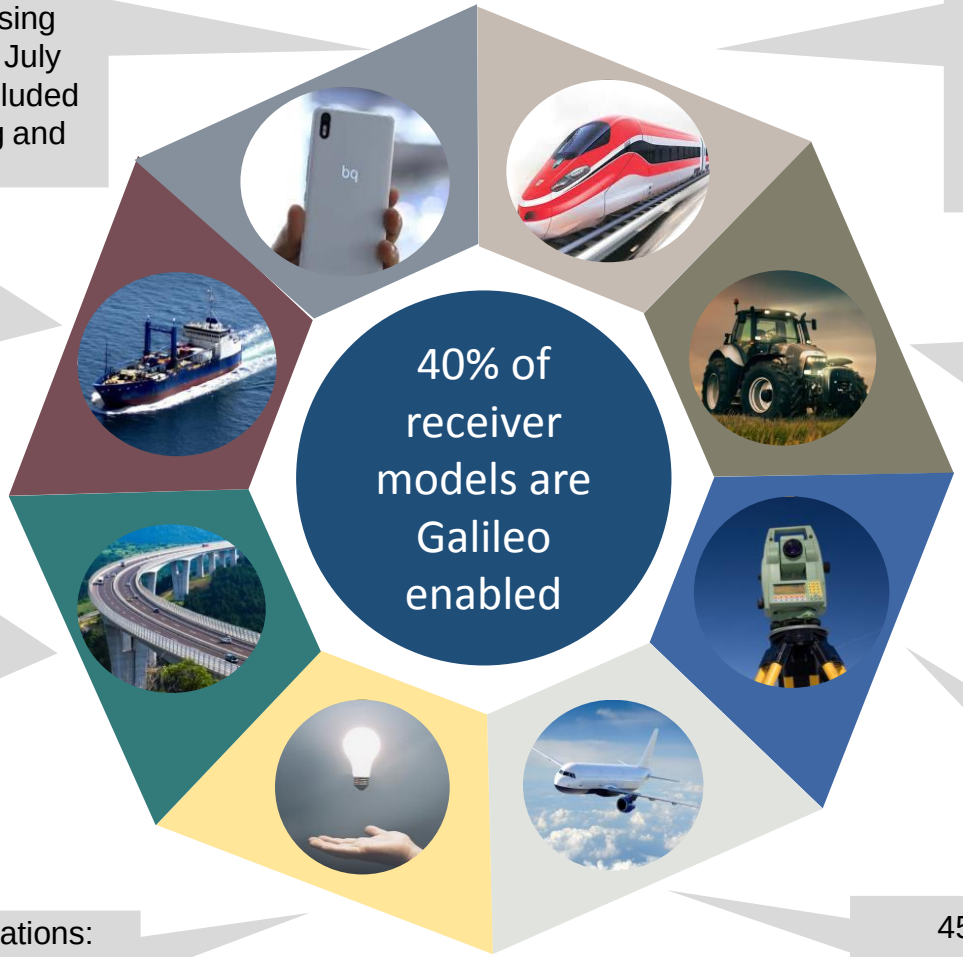

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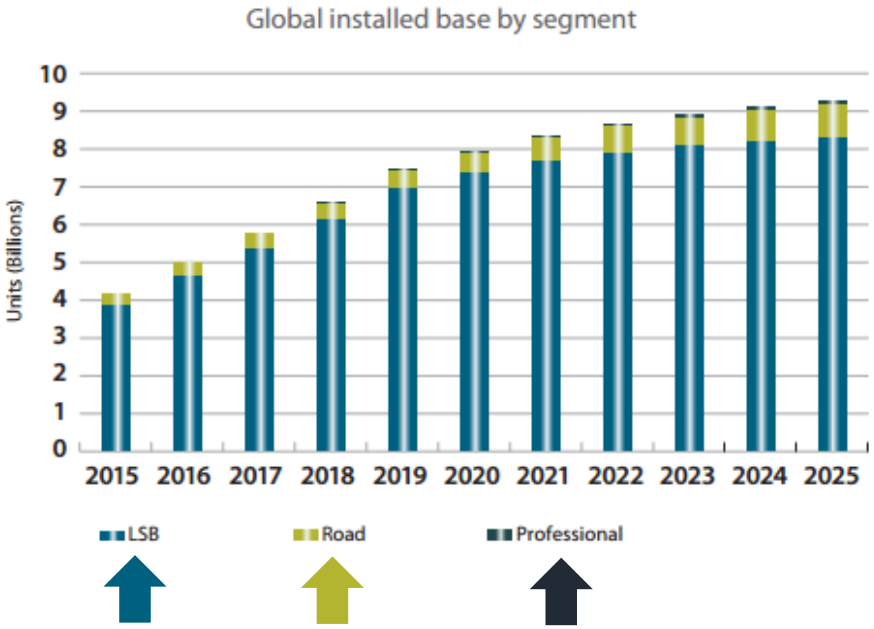

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