GLOBAL GNSS MARKET AND BUSINESS OPPORTUNITIES

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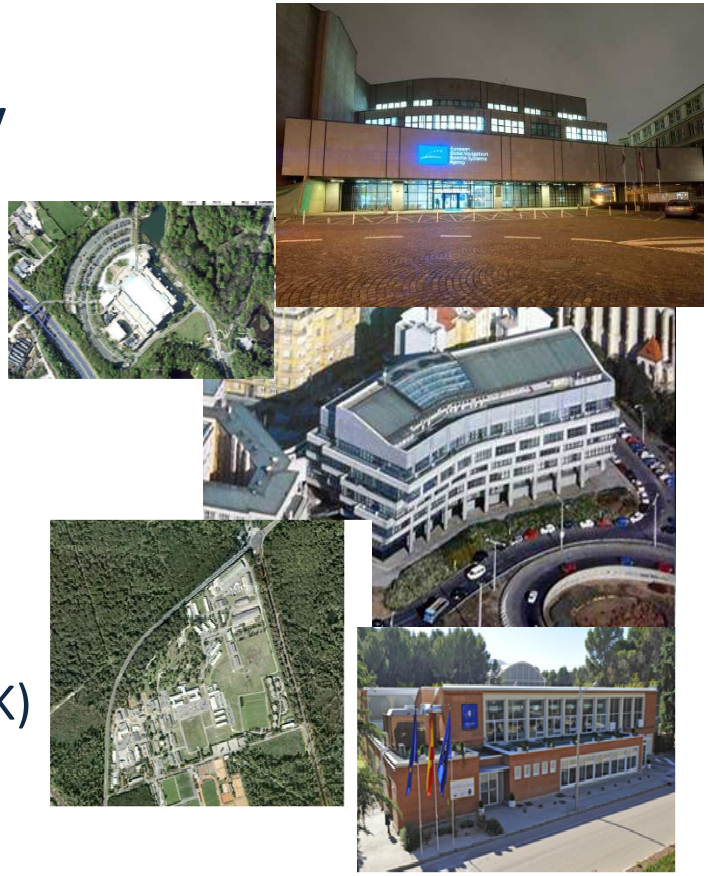
This presentation can be interpreted only together with the oral comments accompanying it

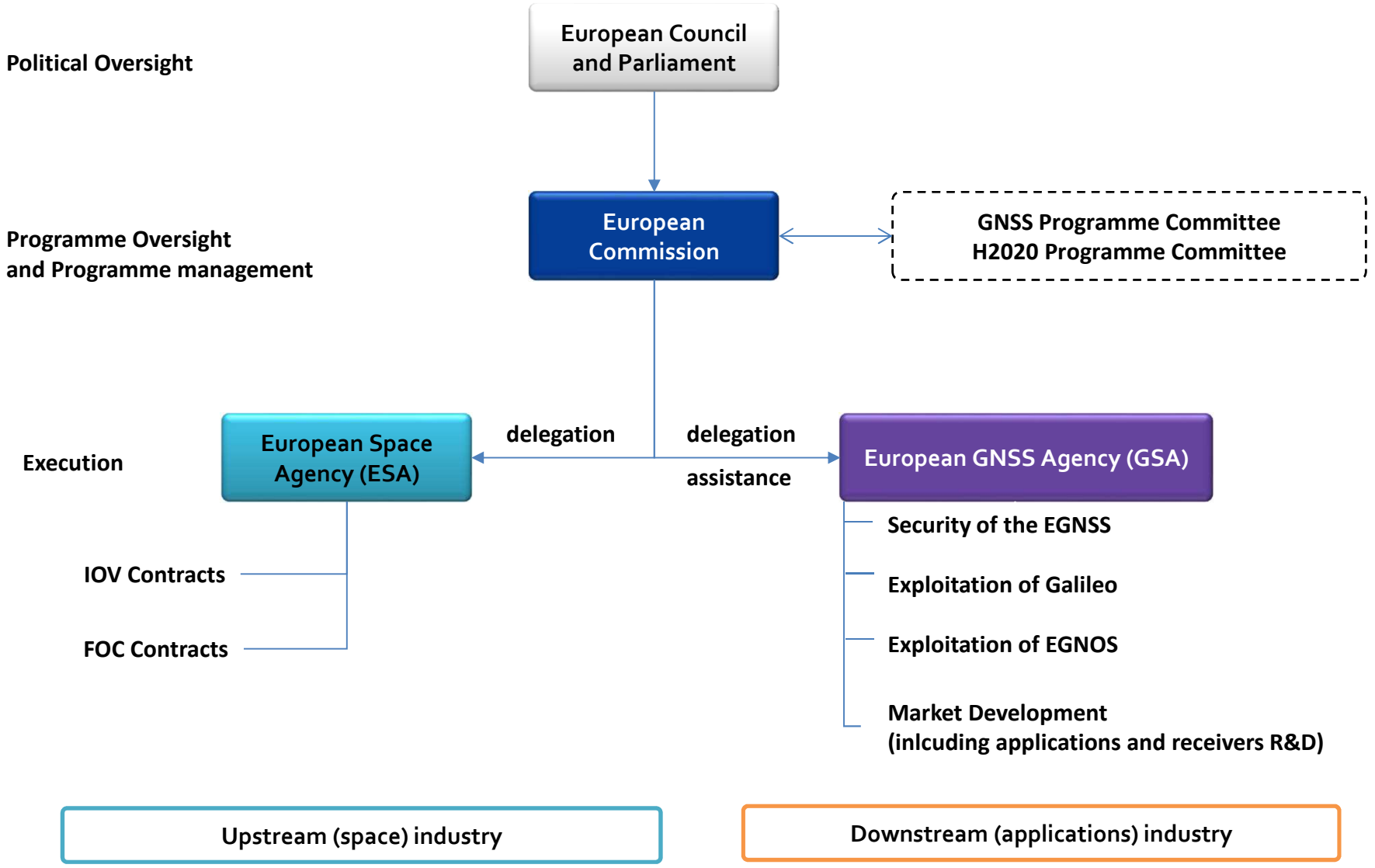
Who we are?

The European GNSS Agency (GSA):

- Public European Union Agency
- Staff: **132**
- Nationalities: **21**
- Headquarters: **Prague**
  (Czech Republic)
- Other Locations:
  St Germain en Laye (France), Swanwick (UK)
  Torrejon (Spain)



Within Galileo programme, GSA is in charge of market uptake, system security and exploitation



The European GNSS Programmes: EGNOS and Galileo

Galileo

- European Global Navigation Satellite System (GNSS)
- Fully compatible with US GPS*
- Open service free of charge and delivering dual frequencies
- Constellation currently in deployment

EGNOS

- Satellite Based Augmentation System (SBAS)
- Measures and improves GPS performance
- Sends corrections to users via satellites or terrestrial links (EDAS)
- European coverage (but under extension in other regions)

'It's there, use it'

*GPS: Global Positioning System

GSA Market Development is supporting the adoption of Galileo and EGNOS

MARKET SEGMENTS

- Road
- Aviation
- Maritime
- Rail
- LBS
- Agriculture
- Mapping
- Timing
- Governmental

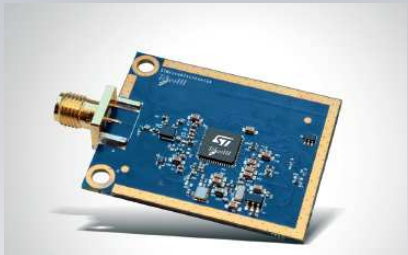
DOWNSTREAM VALUE CHAIN

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

UNDERSTANDING MARKET AND USERS

STIMULATING DEMAND and ADOPTION

cooperating with **receivers manufacturers**



SUPPORTING COMPETITIVE OFFER

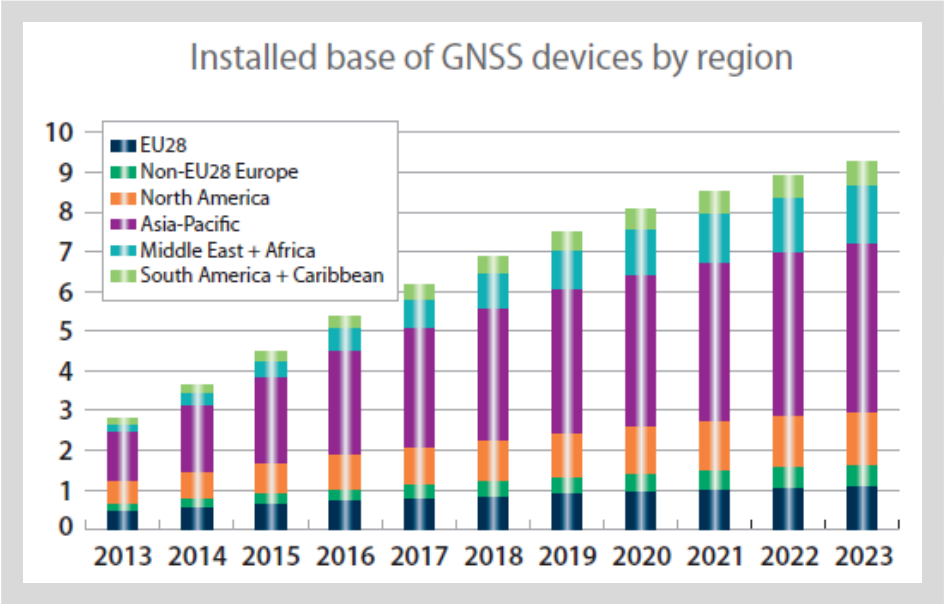
of EU services and applications

Fundamental Elements

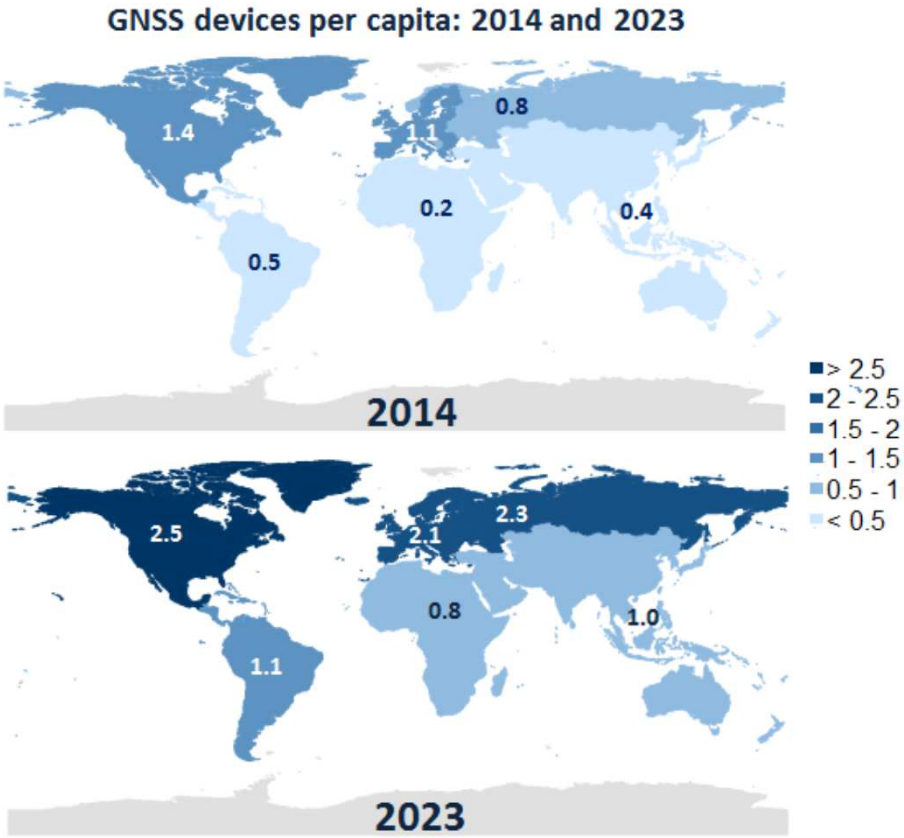
E-GNSS USER ADOPTION

EU SOCIO-ECONOMIC BENEFITS

A 4 billion GNSS devices global market, expected to further grow in the future both in volume…



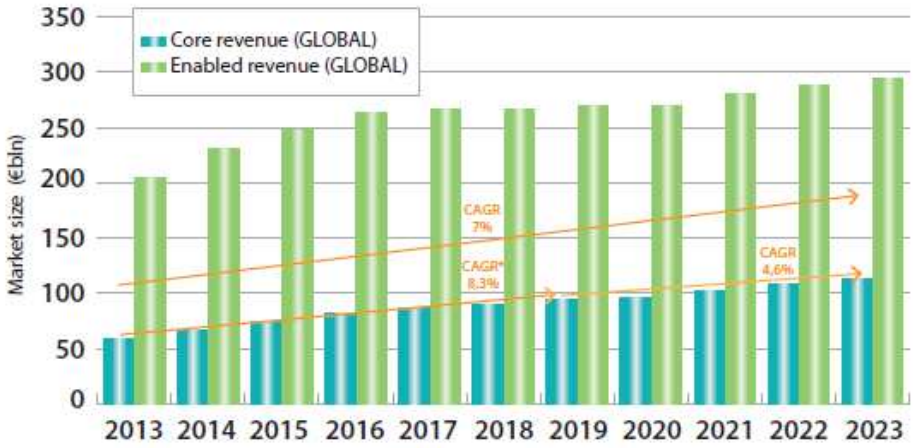
Installed base of GNSS devices will triple by 2023



Growth will be observed in all regions, led by Asia-Pacific

…and revenues, driven by mass market segments

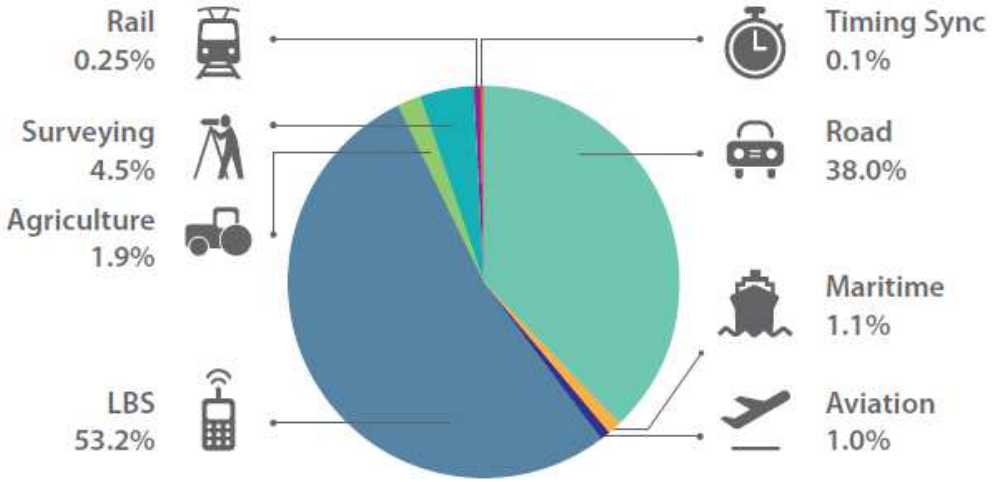
Global GNSS market size (€bln)



* CAGR: Compound Annual Growth Rate

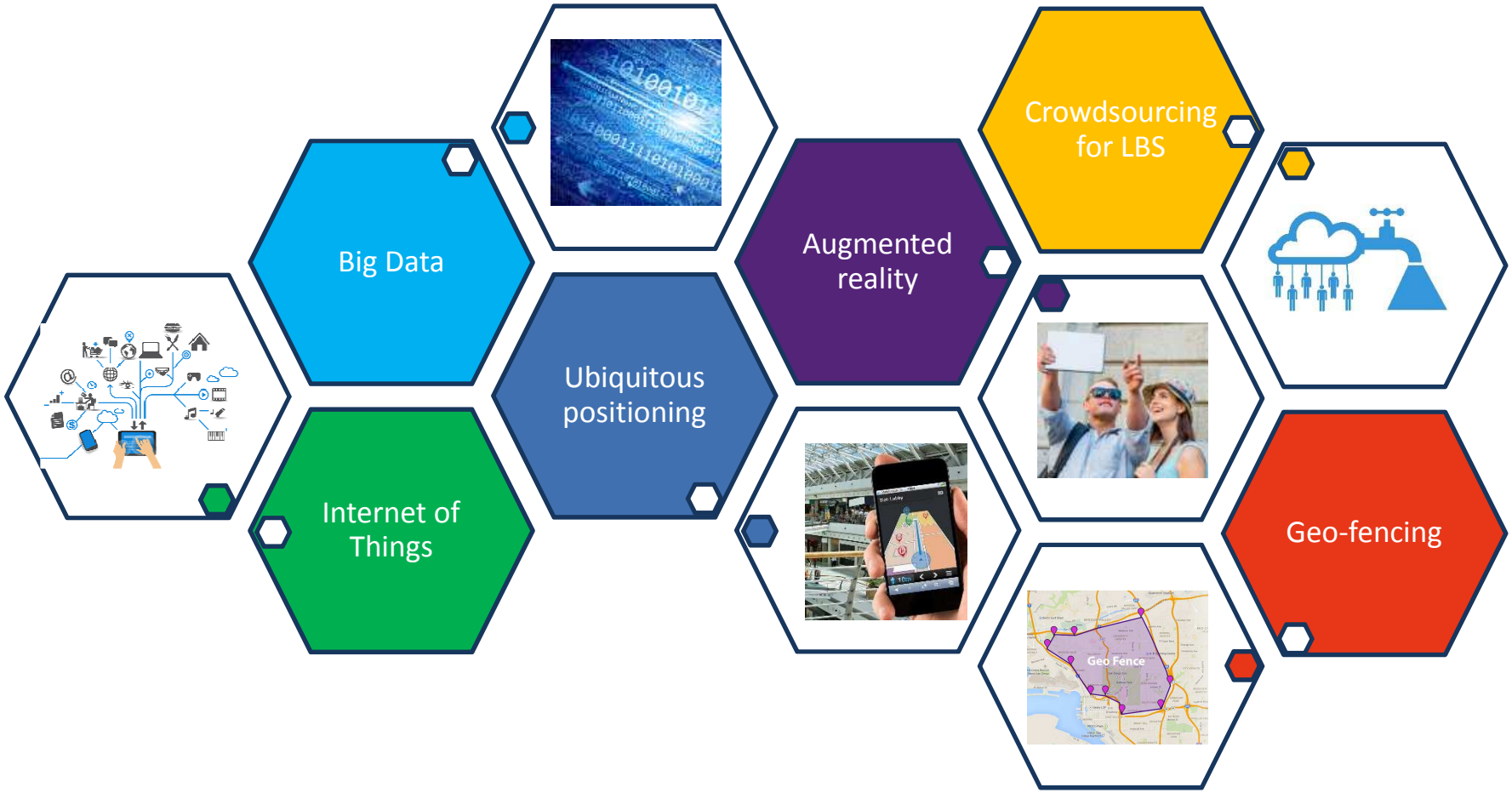
Both core and enabled revenues slowly mature

Cumulative core revenue 2013-2023

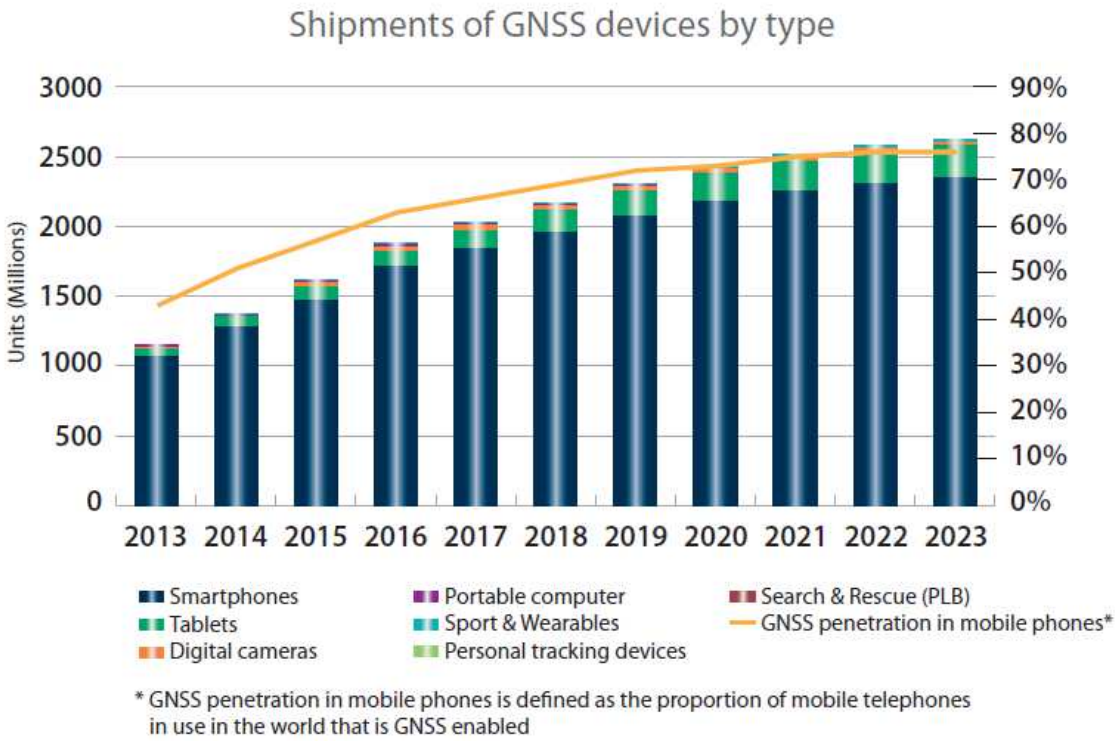


Cumulated revenues dominated by LBS

Positioning and timing information enable innovative mass market solutions



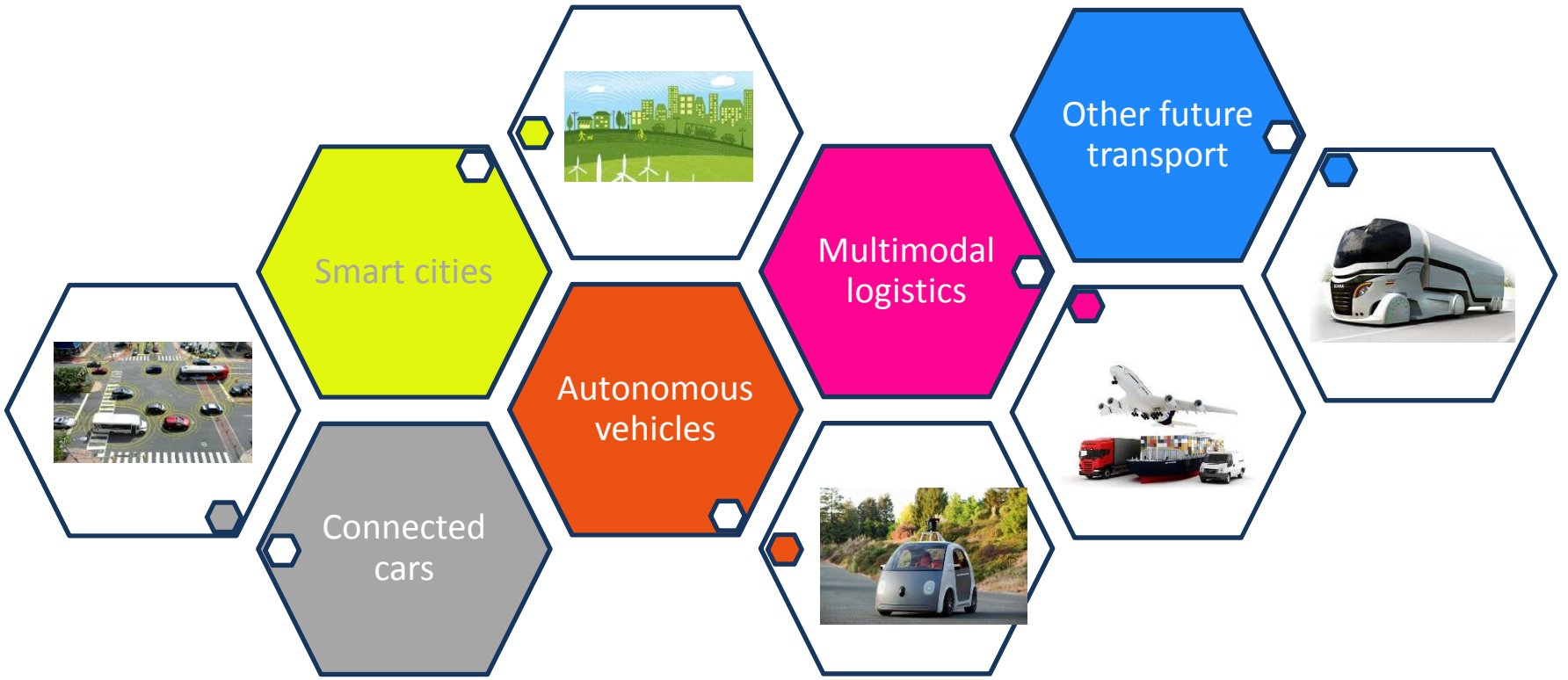
Extraordinary GNSS growth in LBS will continue over the next years



The market for smartphones will grow in size by 6.2% per year through 2023

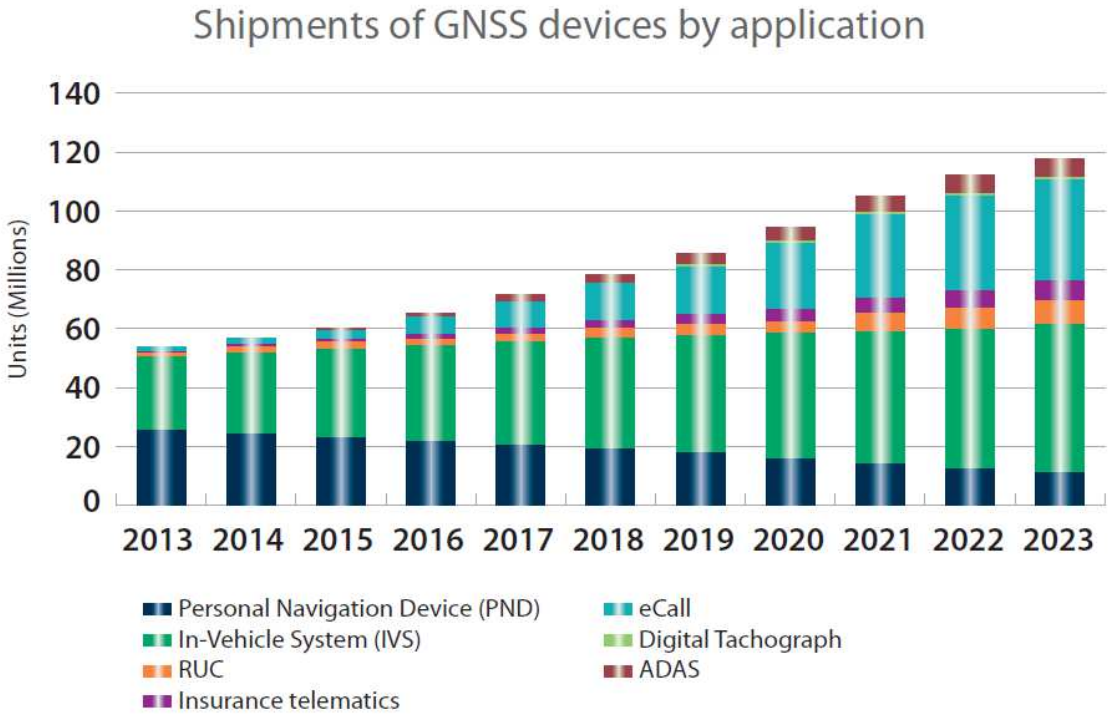
- **Personal tracking devices** represent a high value market niche and will gain prominence in the years to come
- Shipments of **wearables**, including GNSS fitness devices, smart watches and glasses, will further increase to 14 mln units by 2023

Emerging applications will support the efficient mobility and smart cities



New solutions and safety related applications will further drive GNSS growth in smart mobility

The emergence of new applications will double the size of the market in the next ten years



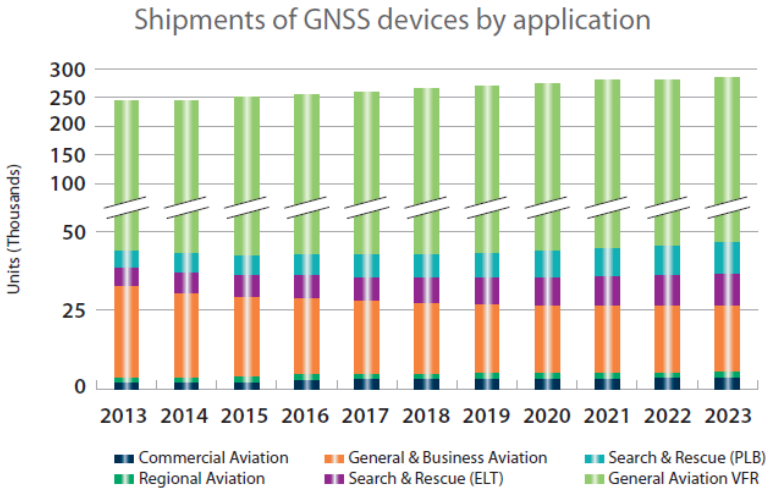
The decrease in **PND** sales will be compensated by the growth of **In-Vehicle Systems (IVS)** shipments enabling new possibilities**, such as autonomous driving and real-time traffic management**

Regulated applications will drive further growth in the road market for GNSS thanks to **eCall** like systems, digital tachographs and speed control on-board units

The move to Performance-Based Navigation drives GNSS uptake in Aviation

The use of GNSS within all aviation segments is expected to increase over the next ten years reaching penetration of over 90% in 2022.

This increase will be dominated by the VFR sub-segment with leisure flyers, realising the benefits of using GNSS enabled devices as supplementary information.



The trend in requirements centres on extending the utilisation of GNSS for an increasing number of **more demanding applications**:

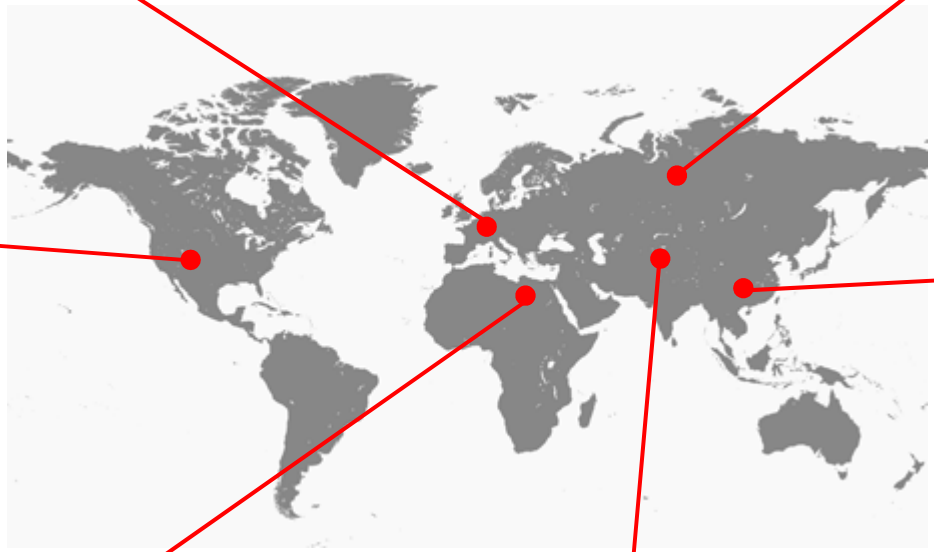
- **Transition from traditional routing to GNSS navigation solutions** for all phases of flight
- **Advanced PBN applications** benefitting from multi-frequency and multi-constellation navigation capabilities and also from the GNSS timing source to enable 4D applications
- **The availability of additional constellations is expected to be a key enabler for Ground Based Augmentation Systems** (GBAS), resulting in lower minima to CAT II or CAT III standards, demanded by some commercial operators
- Development of **ARAIM** gives an alternative to integrity coming from SBAS

Different levels of maturity for GNSS consideration in future Rail applications

In Europe, investigations are on-going to include GNSS as a complementing system for safety-relevant operations in the frame of the European Rail Traffic Management System (ERTMS). **GNSS**, being an innovative solution capable of decreasing costs, has been included in the ERTMS roadmap

Russia developed an Integrated Train Protection System (called KLUB-U) using both GPS and GLONASS technologies for train positioning

In the US, Positive Train Control implementation is planned soon. PTC combines control, communications, and information systems for safety, security, precision and efficiency of trains movements. **It includes GNSS** as a positioning technology for the train



China is investing heavily in infrastructure modernisation with the construction of new railways. **GPS localisation systems** are already used on some rail lines.
The entry into operation of BeiDou, planned in 2020, will contribute to the wider-scale deployment of such solutions
– and not only in China.

After many years of neglect, rail infrastructure in the **Middle East and North Africa** has experienced a huge growth

In the **Asian region**, India benefits from one of the largest railway networks requiring emphasis on the safety of applications. Huge investments are planned by the Indian government

Different fields of application in Rail transport will rely on GNSS

GNSS opportunities for the users
GNSS can bring many benefits depending on types of applications and specific user needs:

- For passengers, there is a strong need of **getting precise travel information**, which is aleady being widely implemented.
- For **asset management**, GNSS is becoming a necessity.
- GNSS enabled signalling applications **provide increased safety and reduce costs** of infrastructure management and operations compared to legacy signalling solutions.

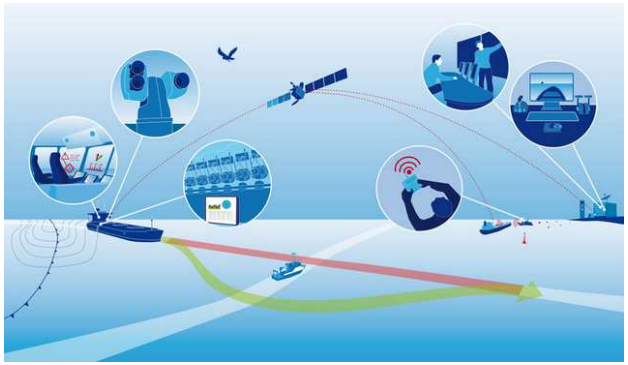
Example: GPS-based train-tracking platform launched

RailRadar GPS platform sources its data from the GPS on travellers' phones, presenting users with a more accurate depiction of where the train is, if it's late or not, nearest stations and other details

Users can search for trains by number, name or just click on the relevant train on the map. The platform then reveals information like the partial e-mail ID of the user providing the GPS info, the exact location of the train along with the latitude and longitude, and an on time or late status

Unmanned ships and port applications in Maritime will rely more and more on GNSS

EXAMPLE: Unmanned merchant ships will be a reality in the short term the concept of an autonomous ship provides an important pathway for a sustainable development of maritime transport.
The main objective of the **MUNIN project** will be to show the feasibility of an autonomous and unmanned vessel. Besides this, the project also aims to develop the individual components of the autonomous ship in a way that they can be retrofitted to existing ships thus improving their technical or navigational performance in short term



The use of GNSS in ports is forecasted to grow rapidly due to the increasing congestion of the waters in and around ports, combined with the ever increasing size of vessels.

Two significant applications are:

- Portable Pilot Units (PPUs), GNSS-enabled specialist navigation aids used to enter ports, and
- Port Automation, such as the tracking of shipping containers and other goods

Urban population growth drives the need for Smart Cities

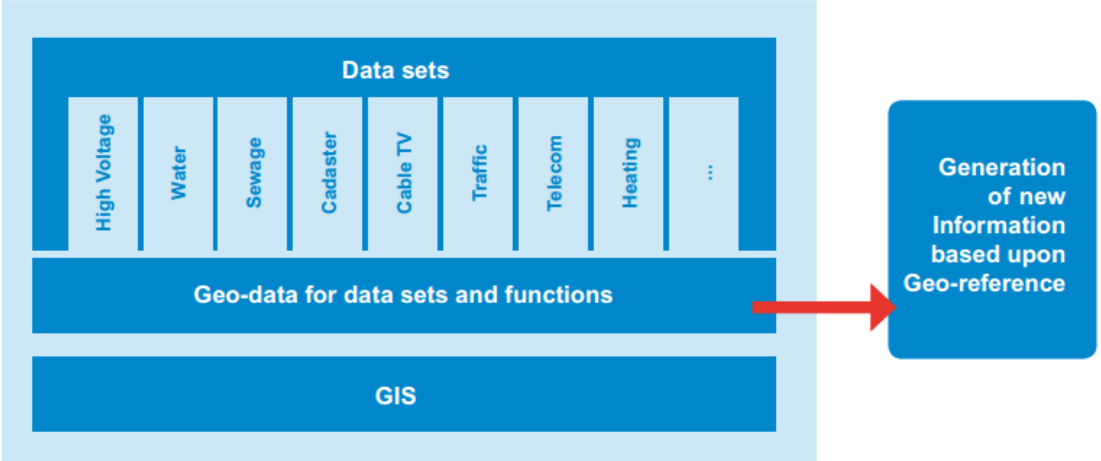
A **smart city** uses digital technologies to enhance quality and performance of urban services, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens

The market is driven by factors such as non-regulated expansion of cities and urbanization, growth in the construction sector, the widespread adoption of Green Technology and the stress on cost efficiency in electricity production and distribution

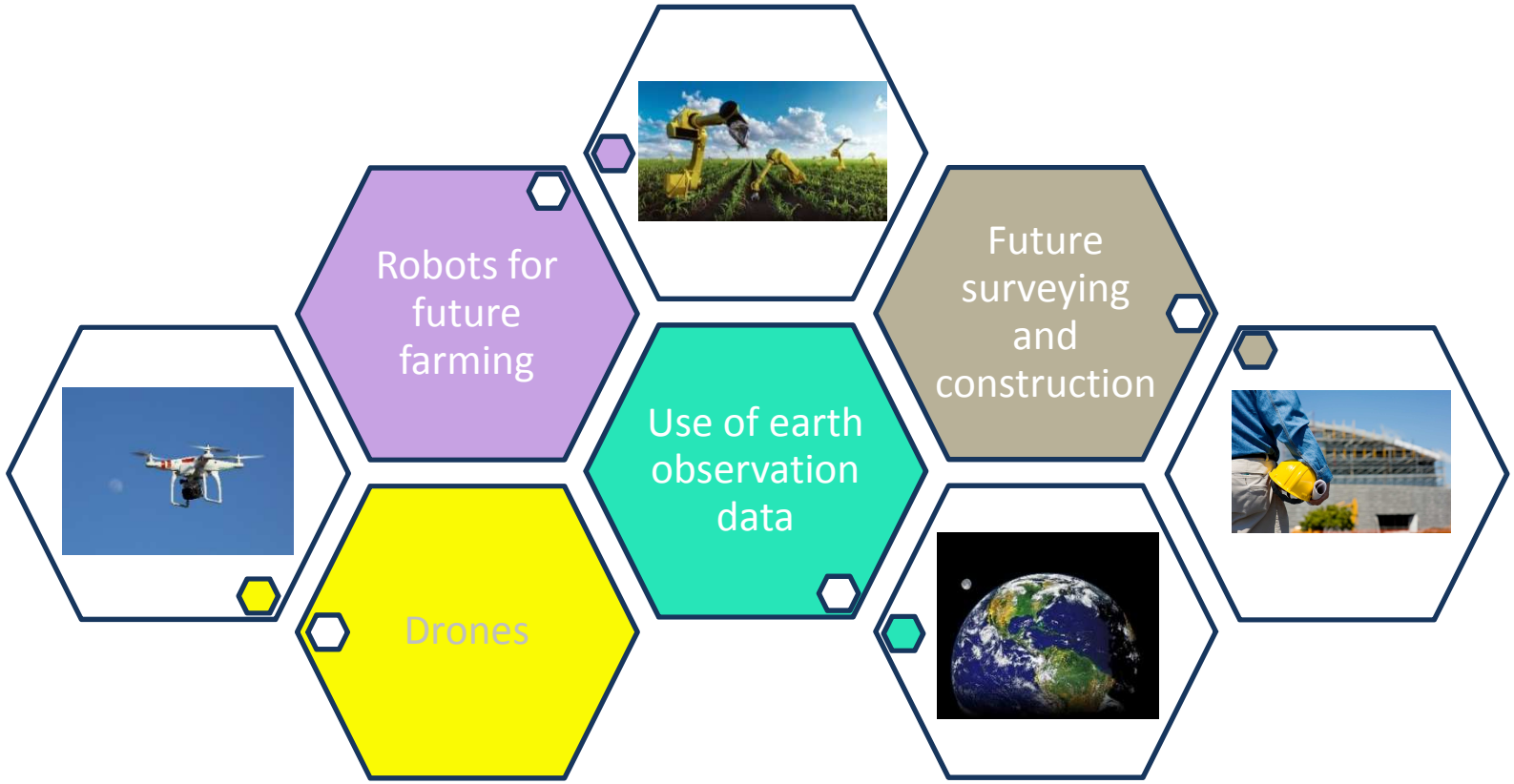
Sectors that have been developing smart city technology include:

- ✓ Government services
- ✓ Transport and traffic management
- ✓ Energy management
- ✓ Health care
- ✓ Water and waste management

Geospatial data and geographic information systems (GISs) are essential components for building smart cities in a basic way that maps the physical world into virtual environment as a referencing framework



High precision user segments will benefit from new tools to improve efficiency



Agricultural robots support the automation of processes on farms

- Machinery manufacturers and downstream processing industries look for system solutions and robots to achieve automation of processes.
- Robots meet stringent hygiene and safety regulations, work tirelessly 24 hours a day, and relieve human workers of physically arduous tasks.

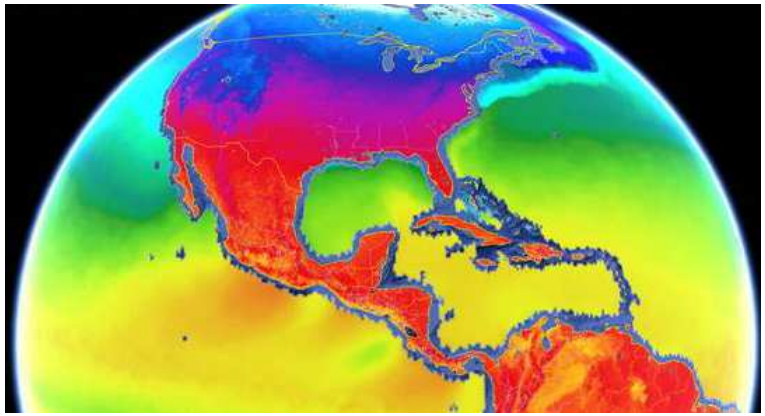
Applications of agricultural robots include:

- driverless tractors
- aerial surveying of farmlands
- data collection
- field management
- cow milking systems
- harvesting
- pruning
- weeding
- pick-and-place
- sorting
- seeding
- spraying

Source: Agricultural Robots: Market Shares, Strategies, and Forecasts, Worldwide, 2014 to 2020

New sources of data will arrive as more countries invest in Earth Observation

Over 50 countries are now investing in EO programs, with total global investment close to $9 billion in 2014, a ninth year of continued investment growth. **Investment is expected to top $10 billion in 2015.**

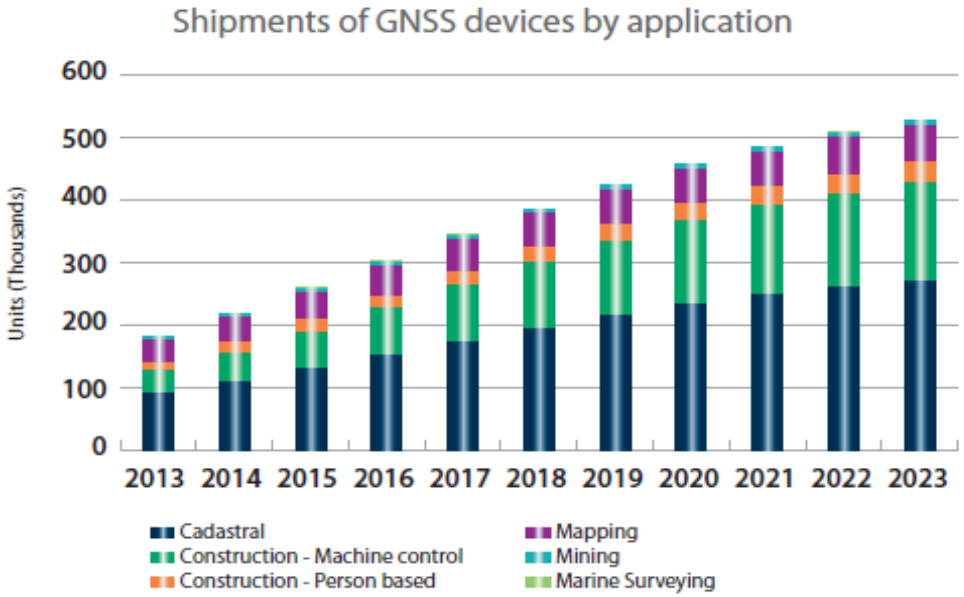


Applications integrating EO and GNSS:

- land monitoring (biomass, environmental management)
- marine monitoring (fishery protection, hydrographical surveys, sea pollution control)
- atmosphere monitoring (natural disaster management)
- emergency management (monitoring of critical infrastructures, crisis management)
- Security (border surveillance)
- climate change (coastal planning and restricted waters, volcanic ash monitoring)

Source: http://www.euroconsult-ec.com/shop/earth-observation/74-satellite-based-earth-observation-market-prospects-to-2024.html

Construction will drive GNSS growth and innovation in surveying



TRIMBLE AND MICROSOFT HOLOLENS: WEARABLE INNOVATION IN SURVEYING

Microsoft HoloLens is a head-mounted, holographic computer that provides a mixed-reality experience. When used by construction professionals, the HoloLens device extends interaction with 3D models, creating new ways for construction projects to visualize, share ideas and manage change.

The shipments of drones will reach 1.2M units in 2019, driven by consumer use

- **The drone market is forecast to grow from ~0.6M units today to ~1.2M units in 2019**
  - *Consumer/Hobbyist* expected to remain the largest segment (~1.1M units in 2019)
  - *Commercial* segment is most nascent, growth likely to come from Agriculture (~50-100K units in 2019)
  - *Government (Military & Civil)* segment is most mature but also smallest segment (~5K units in 2019)

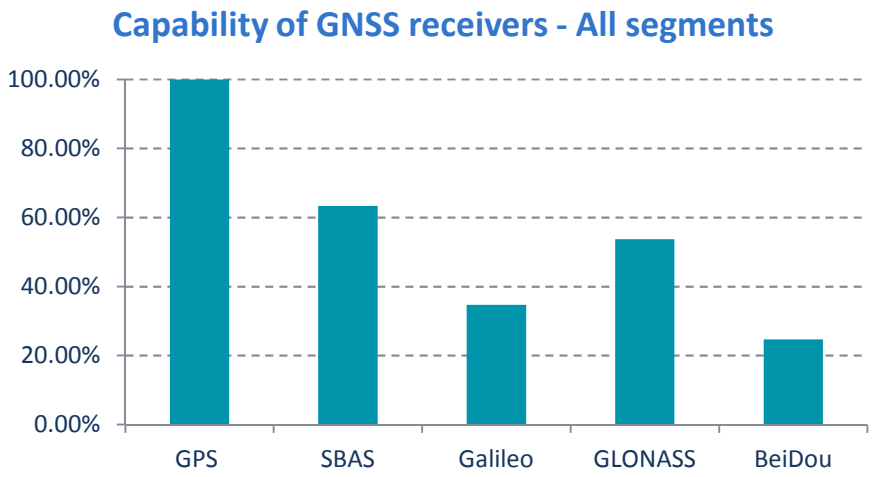
- **All three segments have distinct user needs:**
  - Most significant Consumer/Hobbyist unmet needs are drone cost and flight time
  - Commercial segment suffers from broadest set of perceived performance gaps, including regulatory uncertainty, generating insights from collected data, ease of use and unproven ROI
  - Government segment with fewest unaddressed pain points, biggest gaps seen in drone subsystem interoperability and operational performance

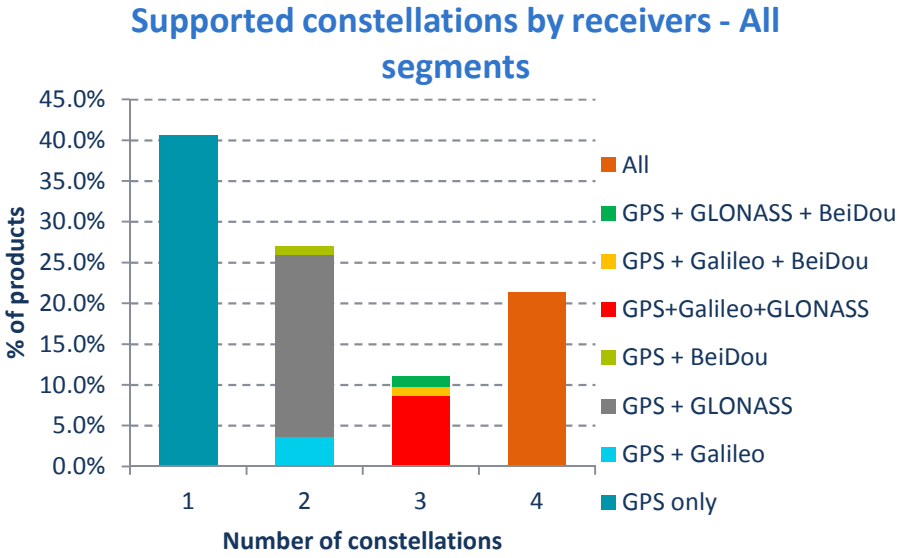
- **Regulatory environment is improving – FAA has released proposed rules that would permit use of small drones for commercial purposes**
  - Small drones would still be restricted to below 500ft, within line-of-sight and during daylight hours

User technology trends

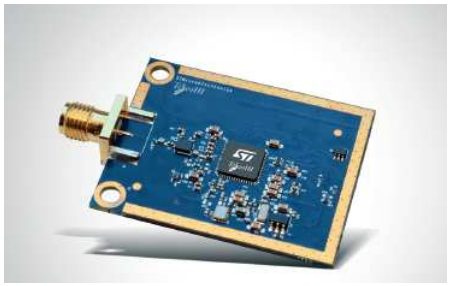
- By 2020 all new receivers will be **multi-constellation. I**t is expected that power consumption and processing capability may cause some limitations in the possibility to actively use all the available satellites, imposing a choice at receiver level. This choice will be also influenced by political pressure and regulations.
- **Multi-frequency** is already used for professional applications. For the mass market it is expected to follow, accelerated by the dedicated funding (FE).
- **Integration of GNSS with WiFi, MEMS, RFID and cellular positioning** will continue, led by the mass market. GNSS will remain main source of location information outdoors, especially outside cities.
- **Data Connections** via the mobile phone network will move towards “always-on” mode, also coming to all cars via the E-Call initiative.
- **Interference** concerns are growing and research intensified to cope with this vulnerability.

Analysis of the 2015 GNSS receivers' capabilities shows mature implementation of multi-constellation





Capability assessment of more than 300 receivers, chipsets and modules, currently available on the market



Analysed manufacturers: CSR, Furuno, Hemisphere GNSS, Japan Radio Co., Leica Geosystems AG, Mediatek, NavCom Technology, Nottingham Scientific Ltd, NovAtel, Orolia, Septentrio, STMicroelectronics, Topcon, Trimble, U-blox, Avidyne, Broadcom, Esterline, Garmin, Honeywell, Infineon, Intel, John Deere, Kongsberg, Omnicom, Qualcomm, Rockwell Collins, SkyTraq Technology, Texas Instruments, THALES Avionics, Universal Aviation.

Read more in GSA GNSS Market Report!

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The full 80-pages report can be downloaded at the GSA website, as well as by chapter of particular interest.

Download now free of charge at: http://www.gsa.europa.eu/2015-gnss-market-report


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