**OHB System AG**
Volker Schumacher
24.09.2014, Tartu/ Estonia

SPACE SYSTEMS

# Nanosatellite Applications and Link to Space Policy
# Tartu Conference, 24.09.2014

We. Create. Space.

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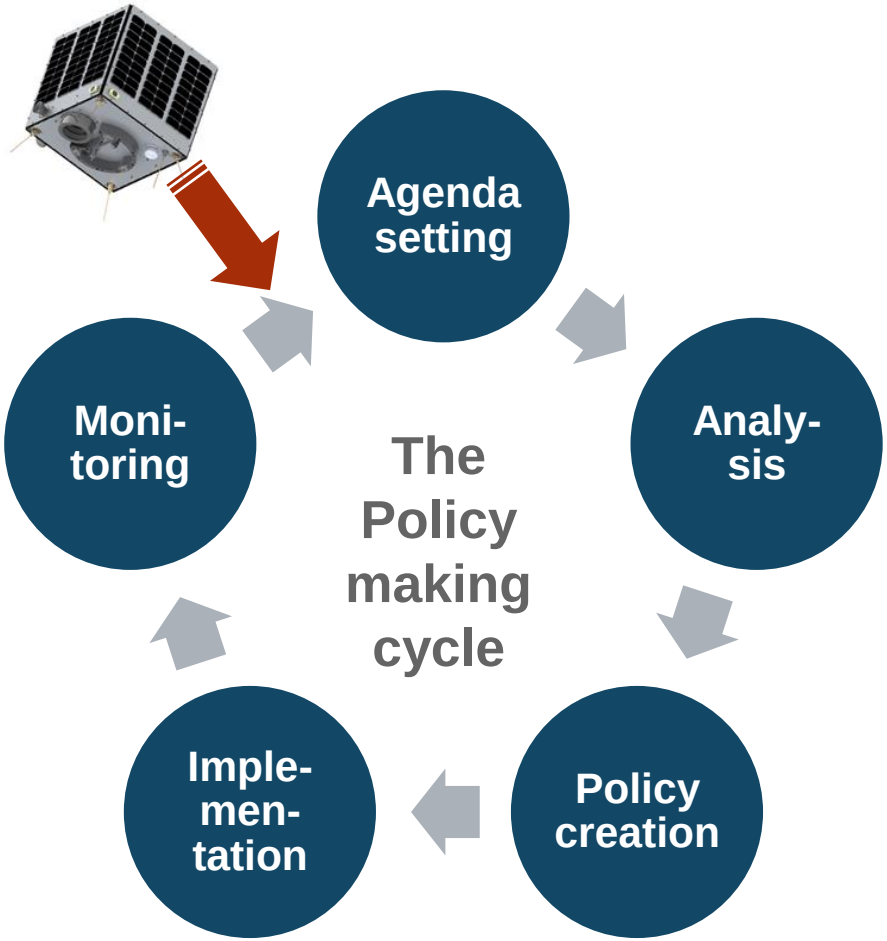
**The International Space Station (ISS) releases three nanosatellites on November 19th, 2013 (source: NASA)**

# Nanosatellite Applications and Link to Space Policy

- Which opportunities exist for nanosatellite missions to add value and create synergies by making a link between the dynamic development in the nanosatellite segment and the implementation of Space Policies (Regional, National, European level)?
- What is the added value nanosatellite derived information could bring to applications?
- **The European Space Policy is one of the EU's tools for achieving its ultimate goal: <u>the well-being of its citizens</u>**



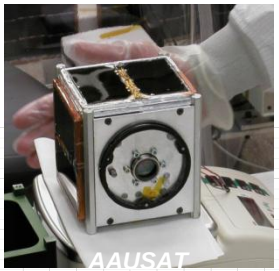
# Nanosatellite and the European Space Policy

## The European Space Policy

- “Space is a priority for the Union; Almost €12 billion will be invested in space technologies (Copernicus and Galileo) in the next 7 years” *(former European Commission Vice President A. Tajani)*
- Lisbon Treaty entering into force on 1 December 2009– the Treaty on the Functioning of the European Union (TFEU) – Art. 4(3) confers on the Union a shared space competence alongside that of the Member States


## The nanosatellite market

- **105 new nanosatellites** launched Nov 2013 –Feb 2014, at least **600** will be launched in next 10 years
- **Standardisation** and **mass production** are main drivers + offering on-demand data delivery, technology demonstrators



# A more dynamic market

How to benefit from these dynamic developments?

A. Technology transfer opportunity

- Cubesats/ microsats => larger satellites
- larger satellites => cubesats/ microsats
- Miniaturisation saving weight = saving costs
- Technology demonstration/ validation/ verification

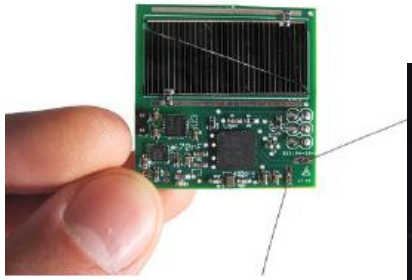
B. Business opportunity

- Manufacturing (low cost but high volume)
- Developing a product line
- Export markets
- Science driven opportunity (moon, mars, deep space)
- Mass markets

***"You can now, with a single chip, create most of the capabilities that you would have found in Sputnik, but, of course, orders of magnitude faster," (Mason Peck, former chief technologist at NASA now a professor at Cornell University)***

Vegetation instrument on SPOT (130kg), 1990 (left) and Proba V 2013, entire satellite (right)

In 2012, an NSR report found that "In the optical realm, small satellites weighing 300 kilograms today can offer **70 percent to 80 percent of the capabilities of a traditional commercial Earth observation satellite,**" NSR said in the report. "These can also offer download speeds and an onboard memory **of a 1-ton satellite launched for 10 years ….**" NSR Report "Global Satellite-Based Earth Observation, 3rd Edition"

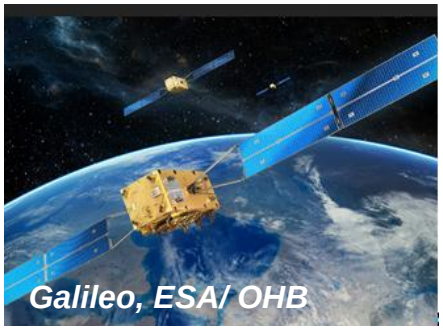


# EU Space Policy Areas

- Earth observation
- Navigation
- Communications
- Space exploration
- Space research and innovation
- Independent access to space
- Space situational awareness

*Copernicus, EC*

*Vega, ESA*



*Galileo, ESA/ OHB*

*Exomars, ESA*

**Market survey (marketandmarkets, 2014**):

- Among all applications of Nano and microsatellites, **earth observations and remote sensing is expected to account for highest market share by 2019**.
- Disaster monitoring application such as cyclones, storms, floods, fires, volcanic activities, earthquakes, landslides, oil slicks, environmental pollution, industrial and/or power plant disaster among various others

# Nanosatellite´s contribution to the European Space Policy


## Workshop and Policy Roundtable. Bremen, 19th March 2014

- Attended by 43 participants from 10 countries comprising representatives from agencies, universities and industry in Europe.

**Participants of the NANOSAT Workshop and Policy Roundtable event**, organised by and held at OHB System AG, Bremen

# Major Workshop and Roundtable Conclusions

Main Workshop conclusions:

- There is a need to work on **moving from educational missions to operational missions**
  - One successful example is **Space based AIS data** used for ship tracking and maritime navigation and safety and this could be a model for other key space policy application areas
- The importance of the **education factor**, leading to the **employment factor**
- The need to work on **overcoming bottlenecks** posing barriers to further development of nanosatellite opportunities (i.e. more frequent launch opportunities)

Main Policy roundtable conclusions:

- It was recognized that linking to the high level EU space policy objectives and its space programmes, there are **national level policy objectives** which address **specific opportunities** (e.g. those for small countries)
- The importance of the **outreach factor** and first time to space for smaller countries (Estonia, Latvia, Finland, Hungary etc)
- The **opportunities regarding new innovative services** as seen recently in the USA should be analysed in terms of what they could mean for Europe and how Europe could benefit from fostering such innovative services

# Nanosatellites contribution scenario

***Impacts***
- ***Growth and jobs***
- ***Safety and well being***


**+ national/ regional level policy**

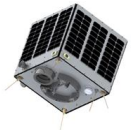
Space Programmes

R&D Programmes

Copernicus | SSA | Space exploration | Horizon2020 | [...]

**Products Services & Applications**

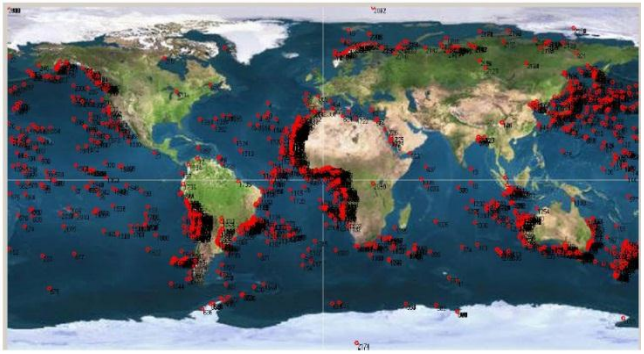
Climate change | Ocean Colour | Atmo-sphere | Deep space



**Nanosatellite contibutions**

# The satellite AIS success story

- The feasibility of receiving AIS (Automatic Identification System) messages from space was proven by nanosatellite missions, starting with R&D missions (AAUSAT, Rubin series, AISAT, etc.
- Following this success, operationalisation began
  - 2011: two 30kg ship-tracking SAT-AIS satellites Vesselsat were manufactured and launched by LuxSpace for Orbcomm Inc (USA)
  - 2011: as part of ESA's Advanced Research in Telecommunications Systems (ARTES) programme, SAT-AIS in ARTES 21 phase 2 – covers the detailed design and implementation of SAT-AIS microsatellites and payloads, and the development of innovative SAT-AIS applications and services



Example of AIS data from Rubin-7-AIS Mission (02.06.2008 – 19.11.2009)

**AIS signal reception from space**

**SAT-AIS (R&D , Universities)**

**SAT-AIS (operational missions)**

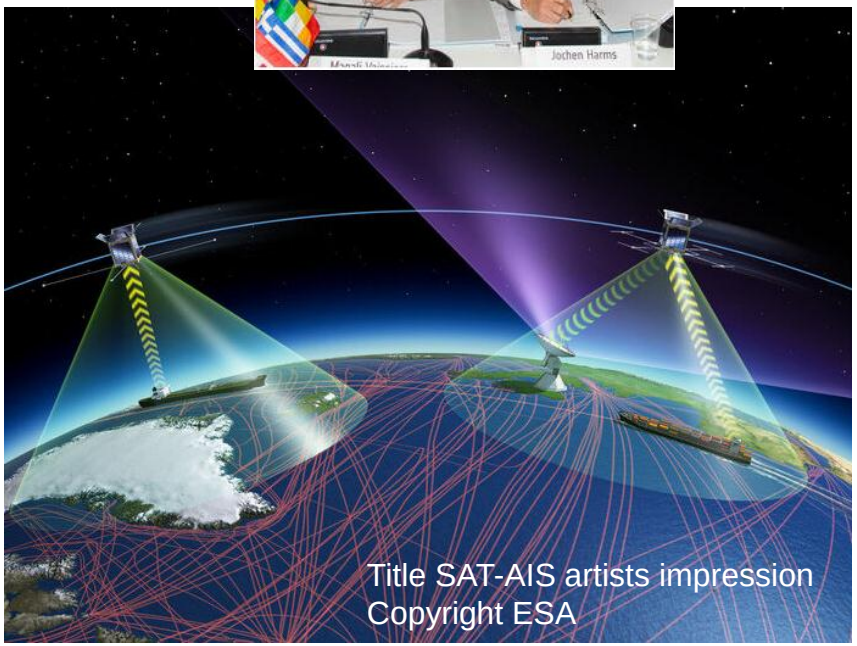
# Space Policy / Applications link- SAT AIS & Luxemburg

- In 2014, the **European Space Agency (ESA)** signed a €30 million development contract on a public–private partnership basis with **LuxSpace** for construction of two 100-kilogram microsatellites with SAT-AIS payloads
- **exactEarth Europe**, will own the satellites and distribute data publicly, including to the **European Maritime Safety Agency (EMSA)**, which is charged with implementing European Union maritime regulations
- “Because of its particular interest for the country, the ARTES 21 programme of ESA for SAT-AIS should receive a large participation of the Luxembourg Government.” (Source: Preparing Luxembourg’s Future in Space, Nov. 2012)

MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR ET DE LA RECHERCHE
Grand-Duché de Luxembourg

LUXSPACE
An OHB Company

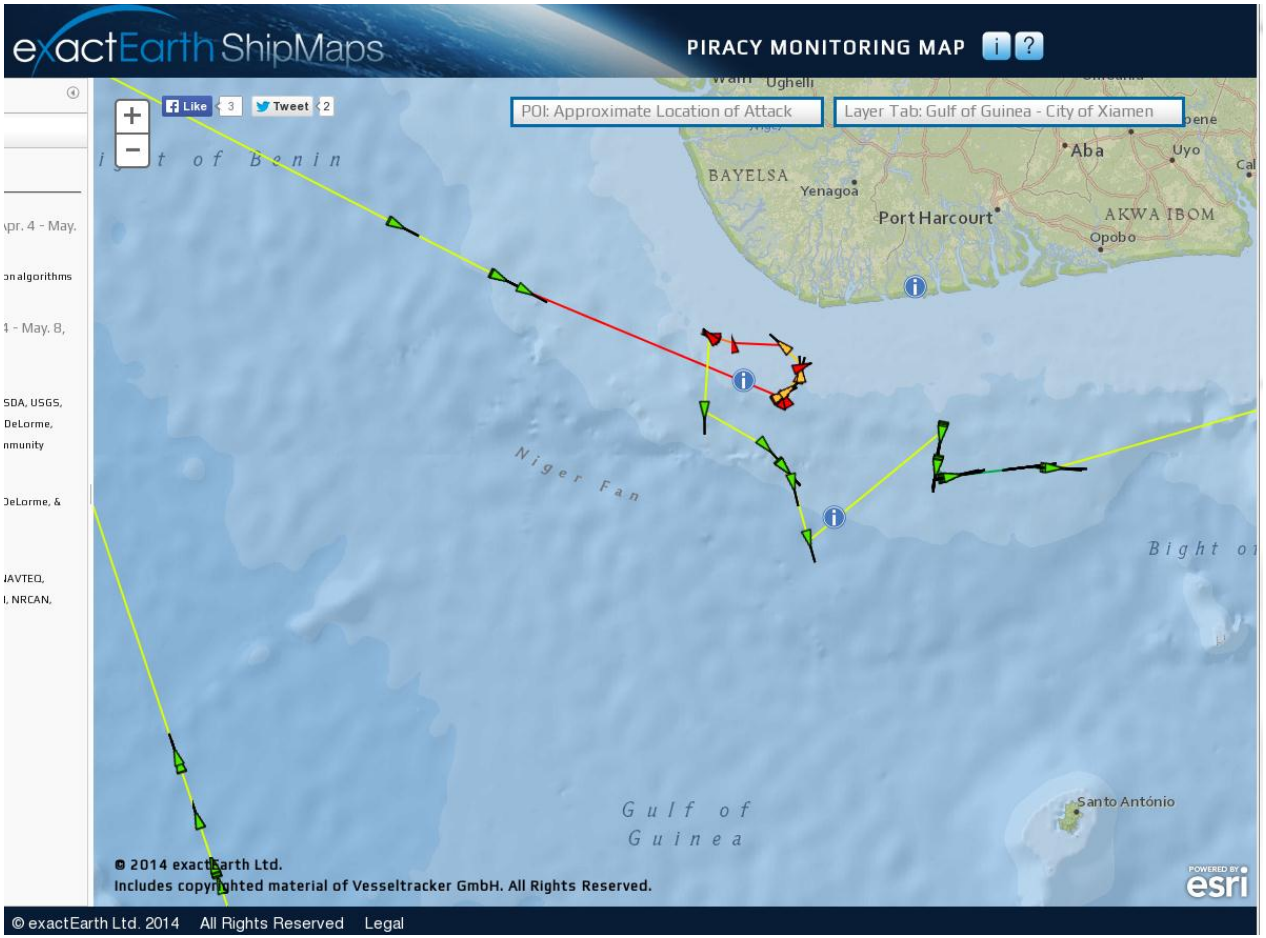

Source: ESA/ Luxspace



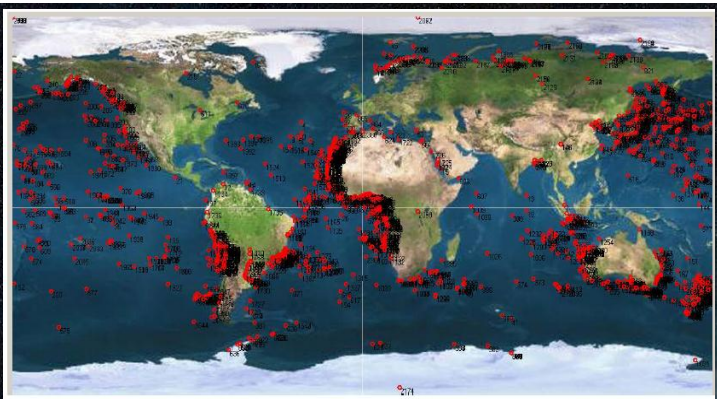
Title SAT-AIS artists impression
Copyright ESA

# Application example: Piracy monitoring via satellite AIS

- Demo case exactEarth showing ship track of „City of Xiamen“ having been captured by pirates in Gulf of Guinea
- To track the ship, SAT-AIS is the only option, since terrestrial stations do not exist in this area



# OHB Company Milestones (relevance small satellites)



Example of AIS data from Rubin-7-AIS Mission (02.06.2008 – 19.11.2009)

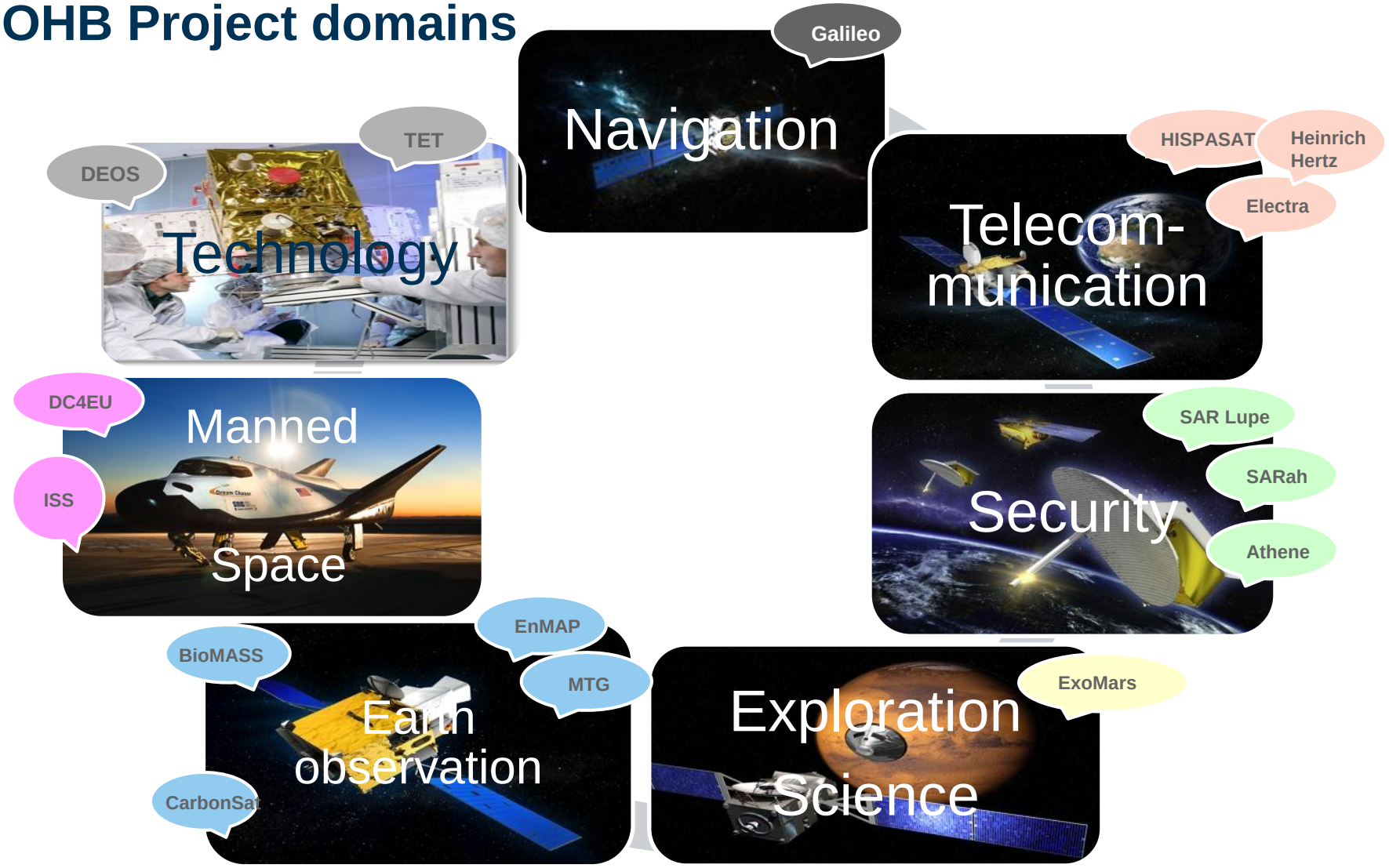
**Safir** (**Satellite for Information Relay**) is a global, satellite based, bi-directional communication System for digital data transfer. Mass: 60kg

SARah 2013-2019
EDRS-C 2011-2016
MTG 2010-2028
Galileo 2010-2016
EnMAP 2008-2017
Hispasat AG 1 2008-2015
TET 1 2008-2012
Columbus 2002-2008
SAR Lupe 2001-2008
ABRIXAS 2000-2009
SOFIA 1996-2014 ff
MITA 1995 -2000
RUBIN 1-9 1994-1999
D2-Mission 92
MIR-Mission 92
SAFIR I&II 1988 -1993
D1-Mission 1985

**RUBIN 7 Launched 2007:**
- **AIS receiver from OHB**
- **More than 850 000 AIVDM type AIS messages received in 10 days**
- **Two different AIS receivers successfully tested in orbit**

1985 1990 1995 2000 2005 2010 2015 2020

# OHB Project domains



# Company structure OHB AG

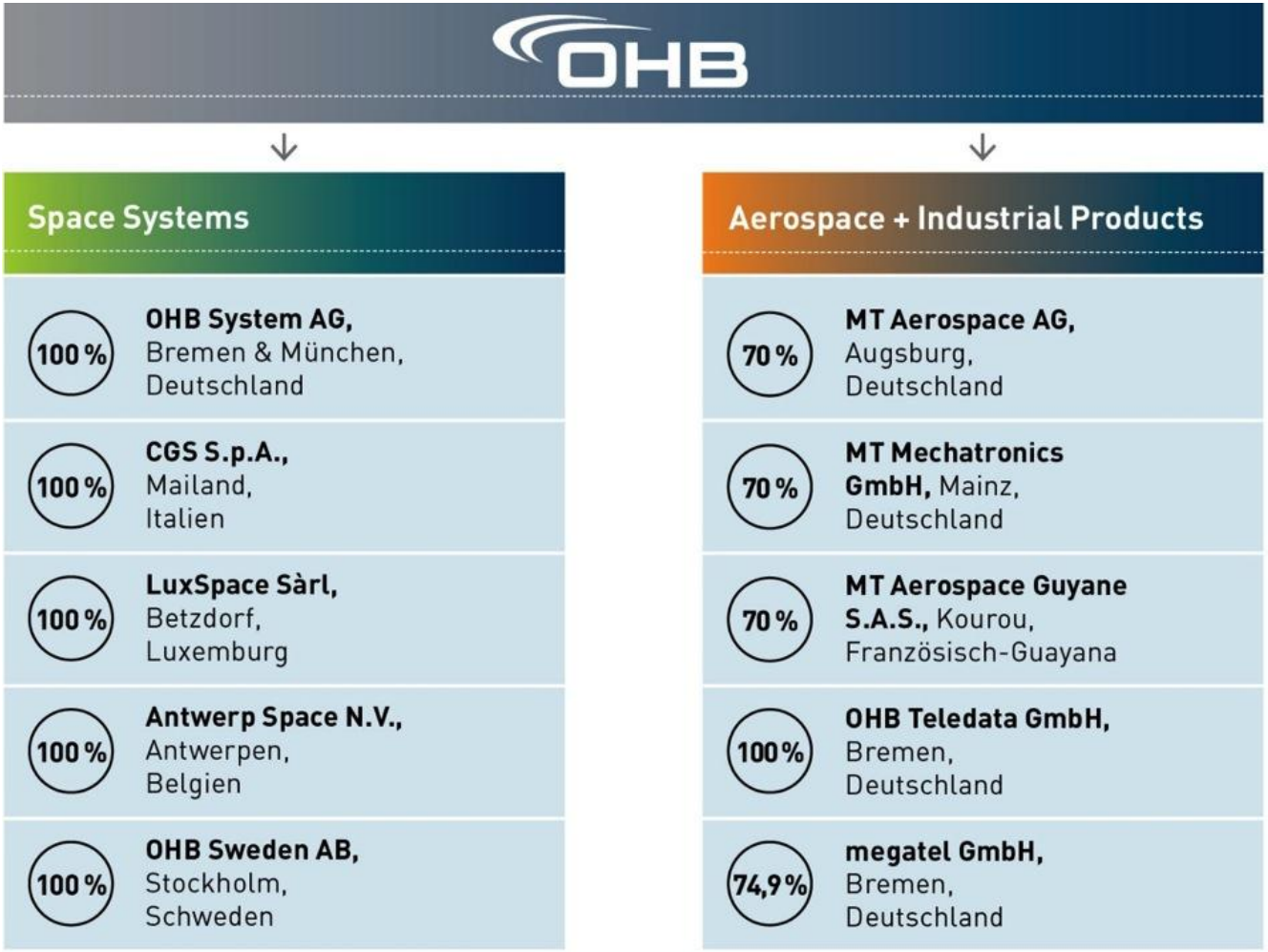
- 555 M€ turnover (2011), 220M€ OHB System
- Staff: 2352

Relevance small satellites

**=> On Orbit Verification**

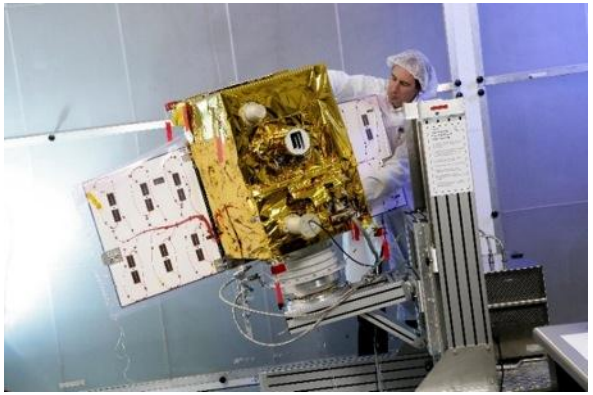
**=> SAT-AIS**

**=> Formation flying**



# OHB System- On-Orbit Verification: TET

- The German Technology Experiment Carrier TET-1 represents the core element of German Space Agency´s (DLR) On-Orbit Verification Program (OOV) and was successfully launched July 22, 2012
- A family of TET satellites is being designed to enable institutional and commercial customers to select a satellite best suited to their requirements. Because of its modular design, the TET satellite can be easily adapted to suit different mission needs.
- Such missions include ongoing OOV applications, classical Earth observation missions like early detection of forest fires, as well as dedicated missions
- OHB System Munich is TET-1 Prime contractor  including launch



**Technical Data TET-X**
Compact Satellite Design
**580 mm × 880 mm × 670 mm** (W × H × D)
**3-axes stabilized** (4 reaction wheels)
Service module **fully redundant**
3 solar panels (1 fixed plus 2 deployable)
Ample payload resources
Mass: 120 kg for total S/C, **50 kg for P/L**

# OHB Sweden- Prisma

- OHB Sweden AB, Solna, Sweden, specialised in developing micro- and mini-satellites
- In August 2011, the PRISMA mission was successfully completed with formation flying exercise
  - **Mango spacecraft,** 140 kg containing 3 propulsion systems; a standard hydrazine system and the 2 experiment systems (HPGP and micro propulsion).
  - **Tango spacecraft,** 40 kg, acting mainly as a target object for the Mango spacecraft

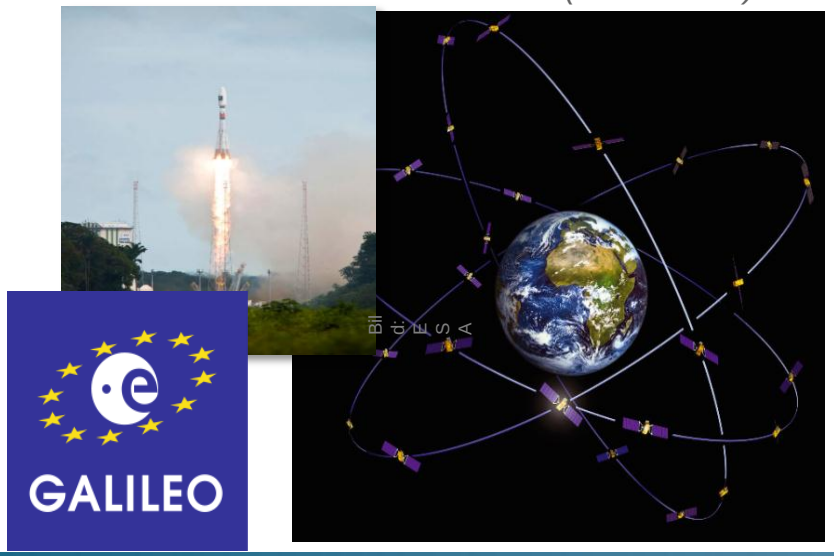
Target satellite of the Prisma formation and part of the earth, photographed from the second Prisma satellite; both satellites form part of the Prisma system at OHB in Sweden

# Reference projects OHB System

- **SAR Lupe/ Earth observation**
- First German satellite-based radar reconnaissance system
- Five radar satellites and a ground station
- Short system response time
- More than 22 cumulative error-free years of satellite operation, since 2007
- Contract signed 02.07.2013 for SAR-Lupe successor system SARah

- **Galileo/ Navigation**
- Prime contractor for the development and construction of a total of 22 satellites; customers: EU Commission and ESA
- Galileo FOC-Satelliten „Doresa“ and „Milena“ delivered on 07.05.2014 to Kourou and launched on board Soyuz 22.08.14

*SAR Lupe satellite in integration hall (source OHB)*

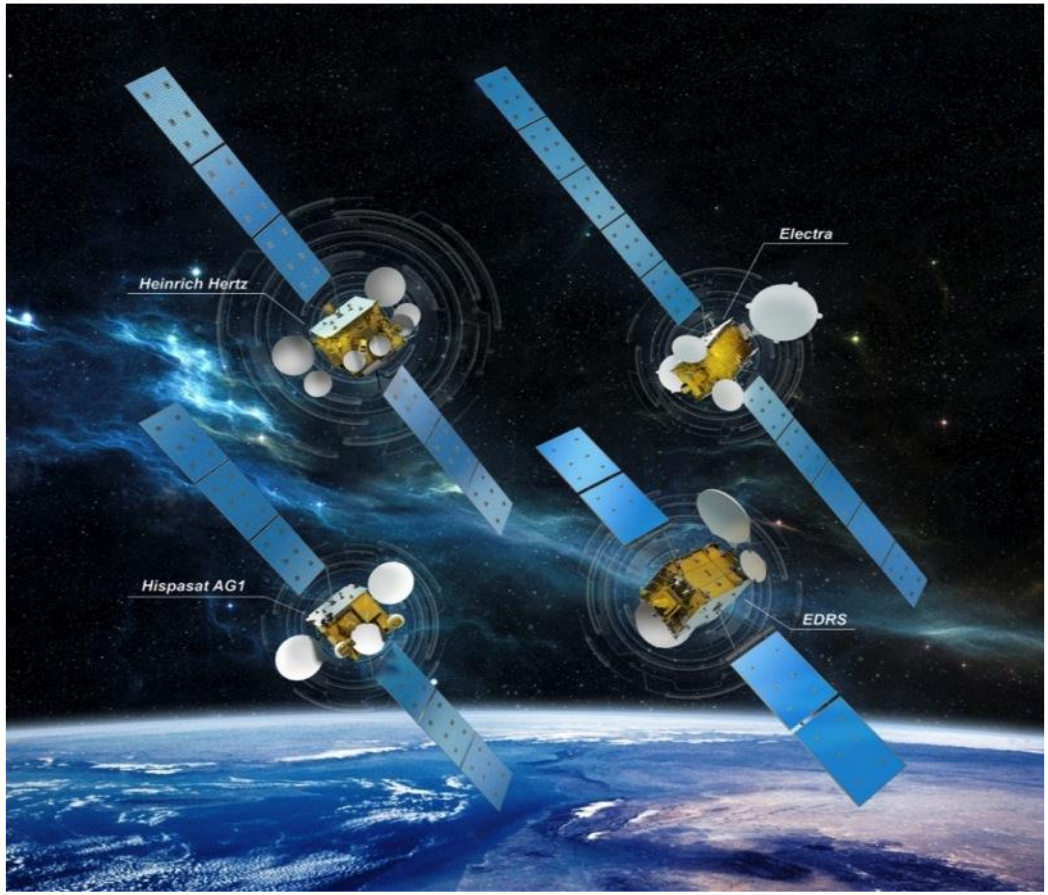



*Galileo constellation (source ESA)*

# SmallGEO-Product line

**FAST –
short delivery time**

- Conventional propulsion (chemical or hybrid)
- Payload capacity t of up to 450kg, 4.7kW and 30 active transponders
- L- to Ka-Band
- Mission duration more than 15 years




**FLEXI –
maximum payload**

- Fully electric propulsion
- Payload capacity over 600kg, 8kW equivalent 40 active transponders, up to 20 years life
- Dedicated ESA Programme ARTES 33 “Electra”

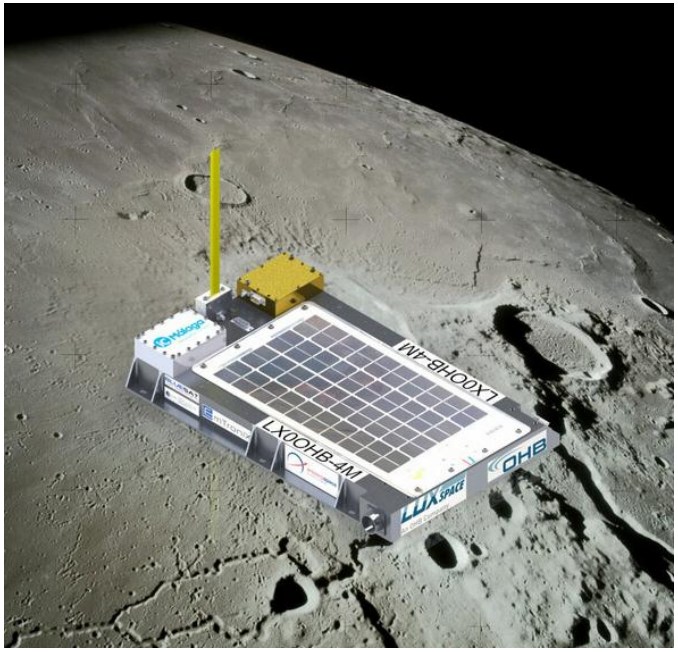
# Promoting the Educational Aspect

- Nanosatellites have proven to achieve educational impacts which translate later on into an important employment impact since space engineers are sought after in the space industry
  - Example **Max Valier** nanosatellite was built entirely by about 20 pupils over 6 years aged between 15-18 of the Max Valier School in Merano, in Italy, with engineering support by OHB.
  - But since not every student can look “into the satellite”, the **eSat** concept was devised to allow for such purposes.
  - As major educational impact, students see the full satellite, not just subsystems and the eSat enables actually “touching” the satellite which is not possible in commercial satellite business but not even common in educational satellite projects.


http://gobmeran-satellit.jimdo.com/projekt/satellit/


# 4M Mission: a Lunar FlyBy experiment

- The 4M mission is an opportunity mission and stands for: **Manfred Memorial Moon Mission** in memory of Professor Manfred Fuchs, founder and chairman of OHB group, who passed away in April 2014
- On October 23, 2014, a Chinese Lunar orbiter test model for its new lunar probe Chang'e-5 will be launched on a journey lasting 196 hours that should take it around the Moon before returning and re-entering the Earth's atmosphere
- It will carry a **14 kg payload known as 4M-LXS** which was developed at LuxSpace and includes a small number of small scientific instruments, i.e. a radio amateur beacon, an instrument providing radiation measures throughout its trajectory around the moon
- Radio amateurs around the world were encouraged to receive the transmissions and send in data/ messages
- First privately funded moon mission


**Model of the 4M spacecraft in front of the moon**

# Thank you for your attention!

**Company Contact**

OHB System AG
Universitätsallee 27-29
28359 Bremen, Germany

Tel: +49 421 2020 8
Fax: +49 421 2020 700

E-Mail: info@ohb.de

Internet: www.ohb.de

**NANOSAT Project Contact**

Volker Schumacher

OHB System AG
Universitätsallee 27-29
28359 Bremen, Germany

Tel: +49 421 2020 9473
Fax: +49 421 2020 700

volker.schumacher@ohb.de