

**GMV**

# Data Science in (Astro)Particle Physics

and

# the bridge to industry



# A GLOBAL HIGH TECH GROUP

Multinational  
technology  
group



SPACE NEWS  
**Top 50**

**1,600**  
employees



Roots tied to  
Space



CMMI level 5



Private  
capital

Subsidiaries in 11 countries

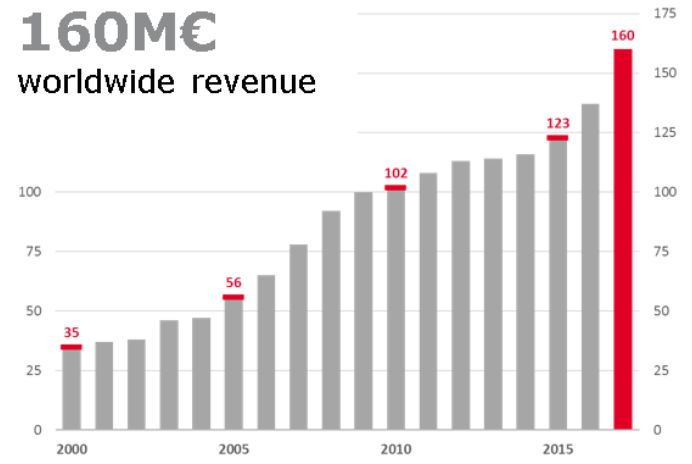


Founded in

**1984**

Aeronautics, Space, Defense, Security, Transportation,  
Healthcare, Banking & finances, and ICT industries

**160M€**  
worldwide revenue



WHO WE ARE

# INTERNATIONAL TECHNOLOGY LEADERSHIP



**#1 Worldwide**  
Satellite Control  
Center provider to  
commercial telecom  
operators (+400  
Satellite missions  
worldwide)



**First ever  
worldwide**  
intraoperative  
radiotherapy  
planning system



**Responsible** of  
safety critical  
systems of European  
GNSS systems  
(EGNOS and Galileo)

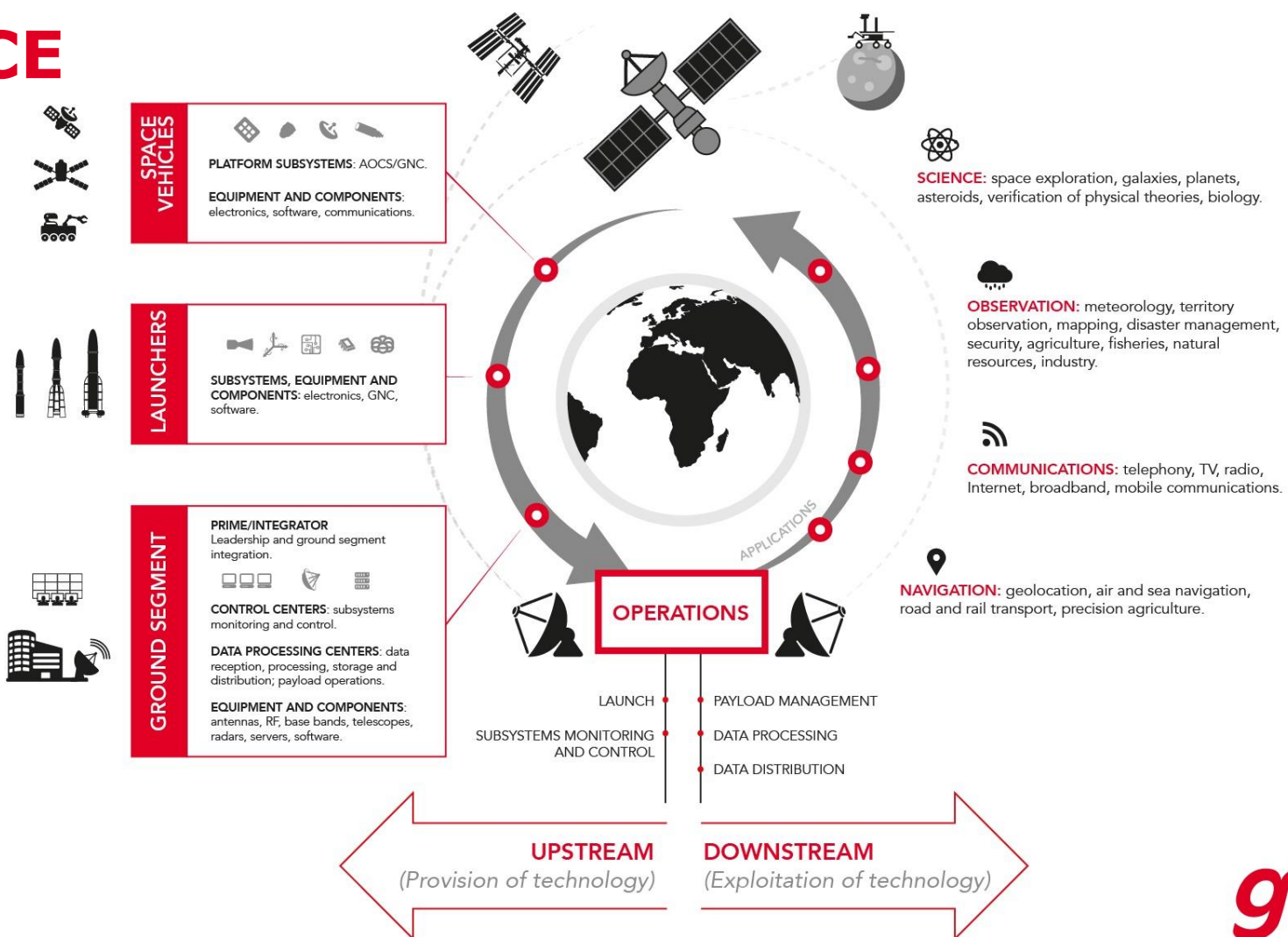


**Leader** of Intelligent  
Transportation  
Systems for the  
**public transport  
sector** (+400 cities  
in Europe, Asia and  
America)



GMV's **checker ATM  
security** is the  
**worldwide leader**  
as multivendor cyber  
security protection  
for **ATMs**

# OUR OFFER IN SPACE



GMV IN SPACE

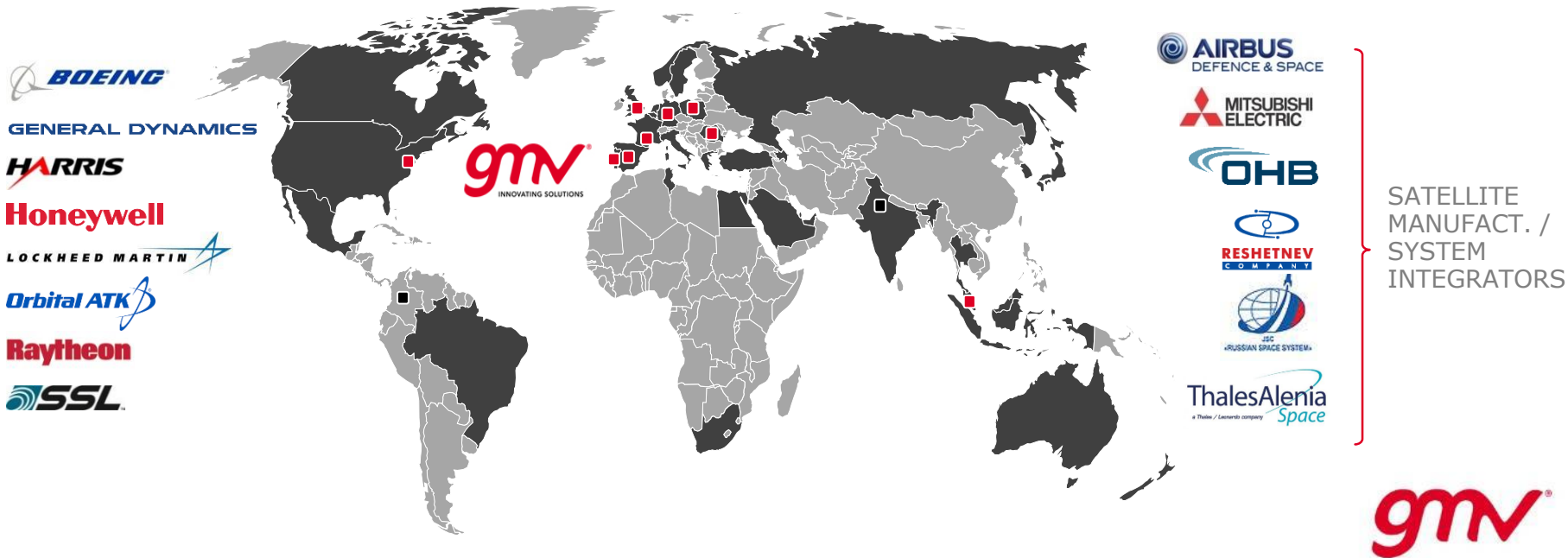
# MAIN SPACE CUSTOMERS



SPACE AGENCIES



TELECOM SATELLITE OPERATORS



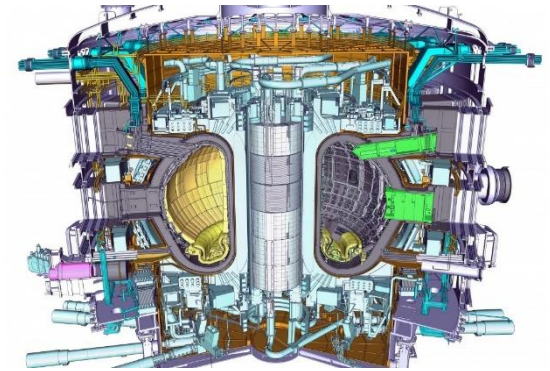
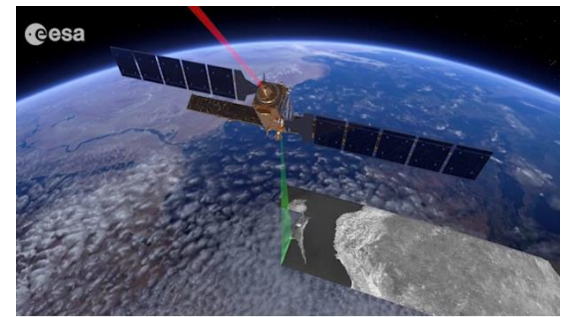
SATELLITE MANUFACT. / SYSTEM INTEGRATORS



# DATA SCIENCE

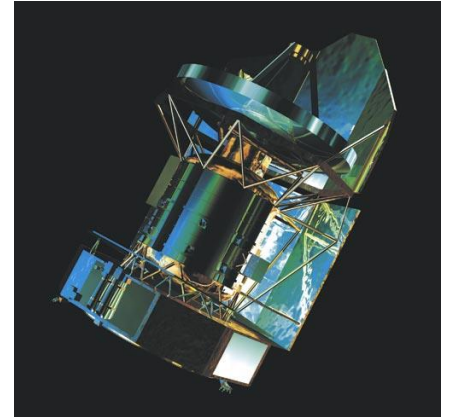
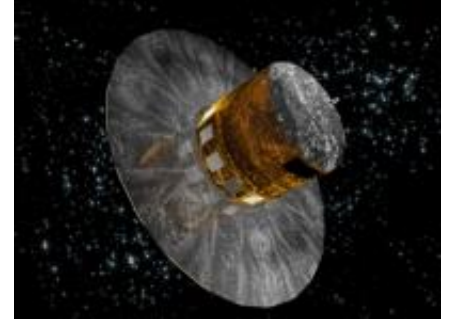
# DATA in SCIENCE

- GAIA generates a total volume of **1 Petabyte** for the whole data set
- All operational Sentinel satellites will deliver **~10 Petabytes of data** each year
- In operation, ITER will generate a total of a **few hundred Petabytes per year**
- Global business emails generate about **3,000 Petabytes** per year
- SKA (Mid) Phase 1 will generate **62,000 Petabytes** of raw data per year
- Total global yearly internet traffic in 2017 is one zettabyte (**1,000,000 Petabytes per year**)
- SKA will generate five zettabytes per year (**5,000,000 Petabytes per year**)



# GMV ACTIVITIES

- Data Acquisition Systems
- Real Time Processing
- Instrument Processing, Monitoring and Calibration
- Quality checks and validation
- Archive/ catalogue and dissemination
- Data fusion and data mining
- Visualization and analysis tools
- Monitoring and Control
- (cyber) security
- Simulation





# EARTH OBSERVATION (upstream)

**80**  
supported  
spacecraft



- **Mission Analysis** and Flight Dynamics for all Earth Explorers through ESOC
- End-to-end simulation for EarthCARE
- Mission Control System of Cryosat-2, GOCE and SMOS
- Mission Planning for Cryosat-2 and SMOS
- **Data Processors** for SMOS (L0), Swarm L1b, L1b NRT & L2, EarthCARE L0, BBR L1b, MSI L1b and Lidar L1b/L1c

- EPS-SG **Mission Control & Operations** prime contractor
- EPS-SG Scatterometer Ground Processor Simulator & Tools
- MTG Mission Operations Facility prime contractor
- MTG Instrument Data Processing Facilities
- MTG Instrument Quality Tool development
- Sentinel 3 Flight Operations Segment integration
- On-site consultants (10)

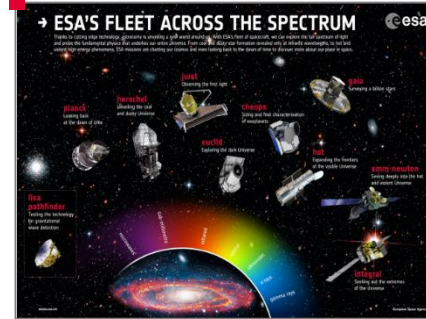
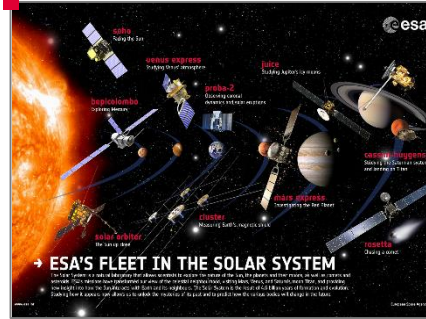
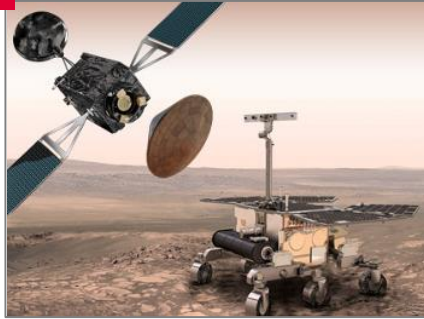
- Sentinel 1 and 5p Satellite Simulator
- Sentinel 3 Ocean and Land Color Instrument software
- Sentinel 2 Instrument Processing Facility
- Satellite Control Center and **Flight Dynamics System** for all Sentinels
- **Mission Planning** for Sentinels 1 and 3
- Operational POD service
- Next Generation Space Copernicus EC framework

- Ingenio:
- Mission Analysis
  - **Satellite Simulator**
  - Ground Prototype Processor
  - Flight Operations Segment: SCC and FDS
  - Mission Planning
  - User Services

- Paz:
- Ground Control Segment: SCC, FDS and MPS
  - User Services

# SCIENCE & ROBOTIC EXPLORATION

**48**  
supported spacecraft



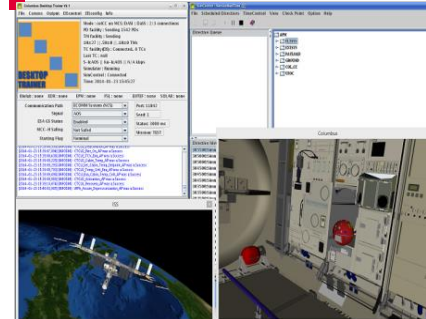
- ExoMars 2016 Entry Descent and Landing GNC OBSW
- Exomars 2020 on-board software
- Exomars Rover Operations Center
- Photoprint autonomous visual based GNC
- Lunar missions PILOT Absolute and Relative Navigation
- Leading Mars Sample Return ESA's GNC roadmap

- Bepi-Colombo Mission Control System
- ESOC Flight dynamics and operations team (inc. Rosetta mission)
- JUICE AOCS Support
- JUICE Navigation Camera Breadboarding
- ESAC operations staff

- CHEOPS Ground Control Segment and Satellite Simulator
- Gaia Data Processing
- Euclid SVF
- Lisa Pathfinder LTP ISV
- ESOC Flight dynamics and operations team
- ESAC operations staff

- Lunar Reconnaissance Orbiter (LRO) Mission Planning System
- World Space Observatory-Ultraviolet (WSO-UV) Ground Segment

# HUMAN SPACEFLIGHT



## Columbus Ground Control:

- 24/7 console operations and planning
- Ground subsystems configuration and management
- Upgrades definition and implementation
- New experiments and users support
- Customer PR activities

## Columbus Flight Control:

- 24/7 console operations
- Procedures development, verification and validation
- Telemetry and telecommand definition
- Display development
- Training and simulations

## ATV:

- Flight dynamics system
- Operations support

## Col-CC system engineering:

- Requirements specification
- Design and development
- Integration, verification and validation
- Sustaining engineering
- System level architecture
- Wide area network and LAN
- Monitoring & control system
- TM/TC collection and distribution system
- Video distribution system

## Operations Support Tools:

- R/T and off-line ops prep, execution and evaluation
- Issue Tracking, Flight Notes, Voice Loop, Reporting & more

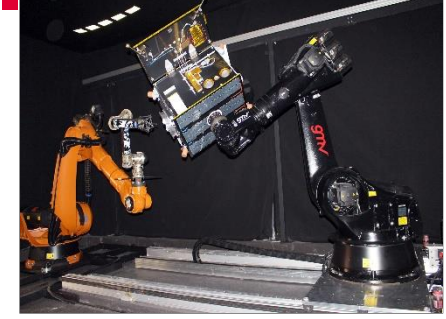
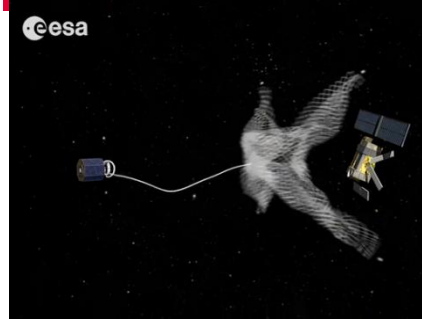
## Columbus Desktop Trainer:

- Training & E2E simulation including full ground segment

## 3D visualisation:

- R/T, simulated or playback data, 3D interaction

# SPACE SURVEILLANCE & DEBRIS REMOVAL



## Leading provider to ESA SST:

- Original SST activities at ESA: DISCOS, CRASS, ODIN
- Major involvement in ESA's SSA/SST (15+ projects) with leadership in SST Integration & Services; also Cataloguing, Sensors Tasking & Coordination

## Leading provider to CNES SST:

- Development of SST simulator and re-entry tools; also support to studies

- Definition of ESA's Space-Based Surveillance (SSBS) Demonstration Mission and SBSS Permanent System
- Leading ANDROID (Active Debris Removal Demonstration Mission) definition Study
- Contribution to e-Deorbit Mission Analysis and GNC design and development

## S3TOC: Spanish SST Operations Centre:

- Leadership of the development of S3TOC
- Leadership of S3TOC operations and maintenance
- Support to Spanish SST sensors qualification activities

## Test-bed & technology development:

- On ground validation of robotic arm based servicing
- Investigation of Active Detumbling Solutions for Debris Removal
- Net Parametric Characterization Parabolic Test experiment
- Control and Management of Robotics Active Debris removal

# LAUNCHERS



## IXV:

- Onboard Software
- Software Validation Facility
- Vehicle navigation as part of the GNC system
- Vehicle Model Identification or identification of reentry aerodynamic parameters

## TEC:

- Avionics test bench for next generation transportation systems

## Space Rider PRIDE:

- OBSW/SVF Definition and Design
- Contribution to GNC Sub-system Design and Develop.
- Use of PRIDE for Mars Sample Return GNC on-orbit experiment validation

## Dream Chaser:

- Collaboration with Sierra Nevada Corp. for the analysis of use for Active Debris Removal purposes

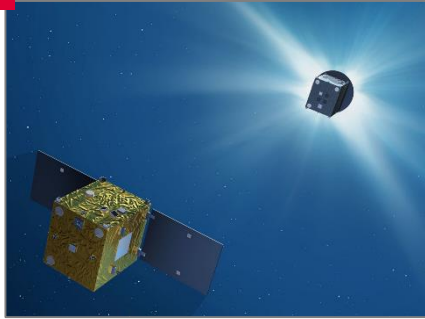
## VEGA:

- Contribution to Guidance, Navigation and Control design and validation, QA and RAMS
- Support to VEGA-C New Avionic Definition

## PLD SPACE:

- Complete avionics of ARION 1 and ARION 2, including guidance, navigation and control, telemetry and onboard software of both launchers
- Participation jointly with PLD Space in ARION 1 and ARION 2's integration, qualification and launching-support operations

# GENERIC TECHNOLOGY & TECHNO DEMO MISSIONS



## PROBA-3

- Full responsibility over the Formation Flying System, which is the major innovation in the mission.
- Responsible for the Formation Flying on-board guidance, navigation and control subsystem
- Developer of the on-ground flight dynamics system and formation flying monitoring system

## AIM

- Responsible of the guidance, navigation and control on-board system

## OPS-SAT:

- Key partner of OPS-SAT nanosat flying laboratory to test new techniques in mission control and on-board

## ASSIST:

- On-orbit servicing fuel transfer study on interfaces and standardisation


- Core partner and key developer of the European Ground Systems Common Core
- GOF9 Frame Contractor for Astrodynamics, Data Systems and Operations
- Developer of CNES SIRIUS Flight Dynamics System for new CNES missions
- CNES Frame Contractor for flight dynamics, operations and on-board software

Leading role in PERASPERA (Strategic Research Cluster on Space Robotics Technologies):

- ESROCOS: development of the operating system for control of space robots
- ERGO: Autonomy or artificial intelligence system
- FACILITATORS: Validation test phase in diverse European laboratories

# GEOSPATIAL SERVICES (downstream)

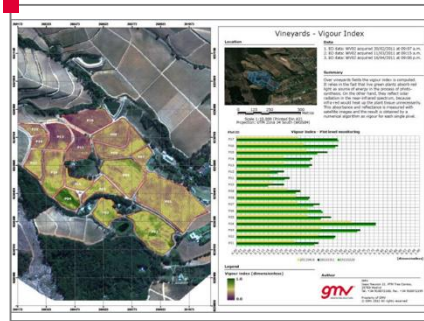
**WORLD CLASS**  
SUPPLIER OF  
**INTELLIGENT FLEET**  
MANAGEMENT SYSTEMS



SATNAV applications for integral solutions:

- Intelligent Transportation Management Systems
- Fare Collection Systems
- Scheduling and Rostering
- Passenger Information Systems
- Moviloc

World class supplier with more than **400 customers** in **35 countries** from **4 continents**

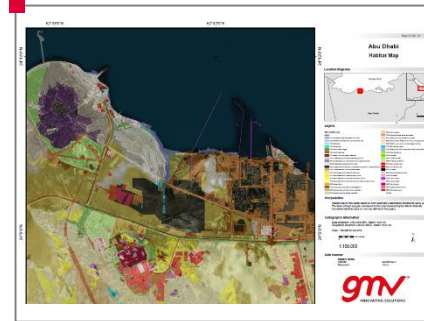


Agriculture:

- Crop growth models for Food security across Africa (AfriCultuReS)

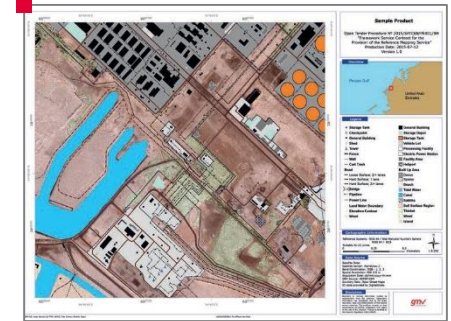
Forests:

- Mozambique mosaic generation to support REDD+
- Forest Biomass Estimations by means of multisource data in Spain
- Operational sustainable forestry (MySustainableForest)



Land characterization:

- Forest Geo-information for Monitoring Tree-dominated areas in Abu Dhabi Emirate
- Land use / Land Cover map for habitat conservation policies in Abu Dhabi Emirate
- Monitoring of Oil & gas pipelines fields in Iraq
- Urban green areas characterization (UrbanGreenUp)



Emergency and Security:

- Support to External Actions operational service provision FWC for the SATCEN
- Reference mapping FWC for the SATCEN
- Maritime surveillance for Guardia Civil
- Earthquake post-impact assessment for the International Red Cross

# OBRIGADA!

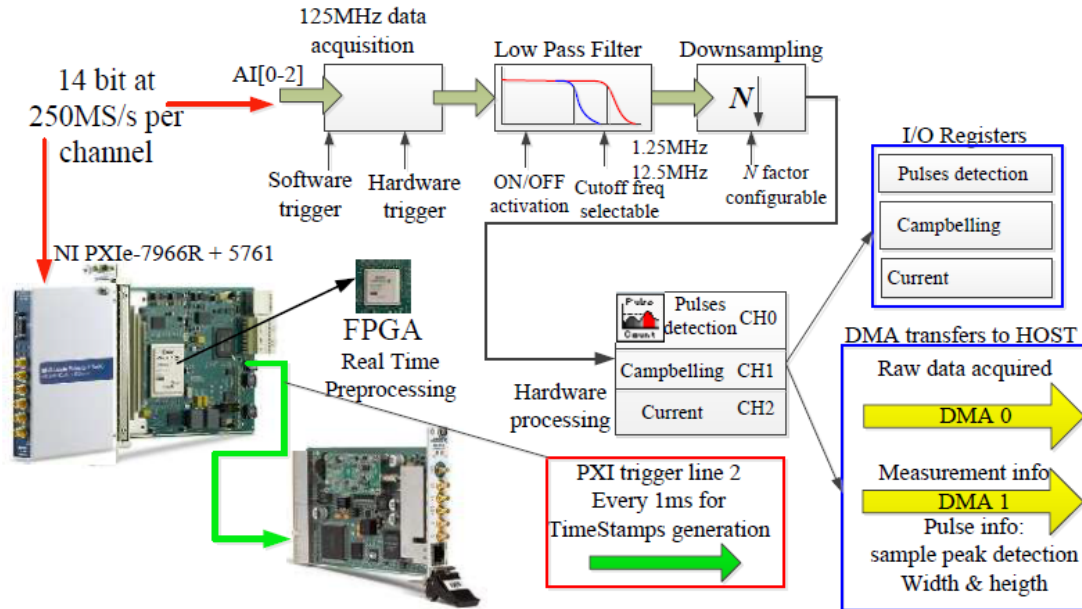
www.gmv.com



# ITER

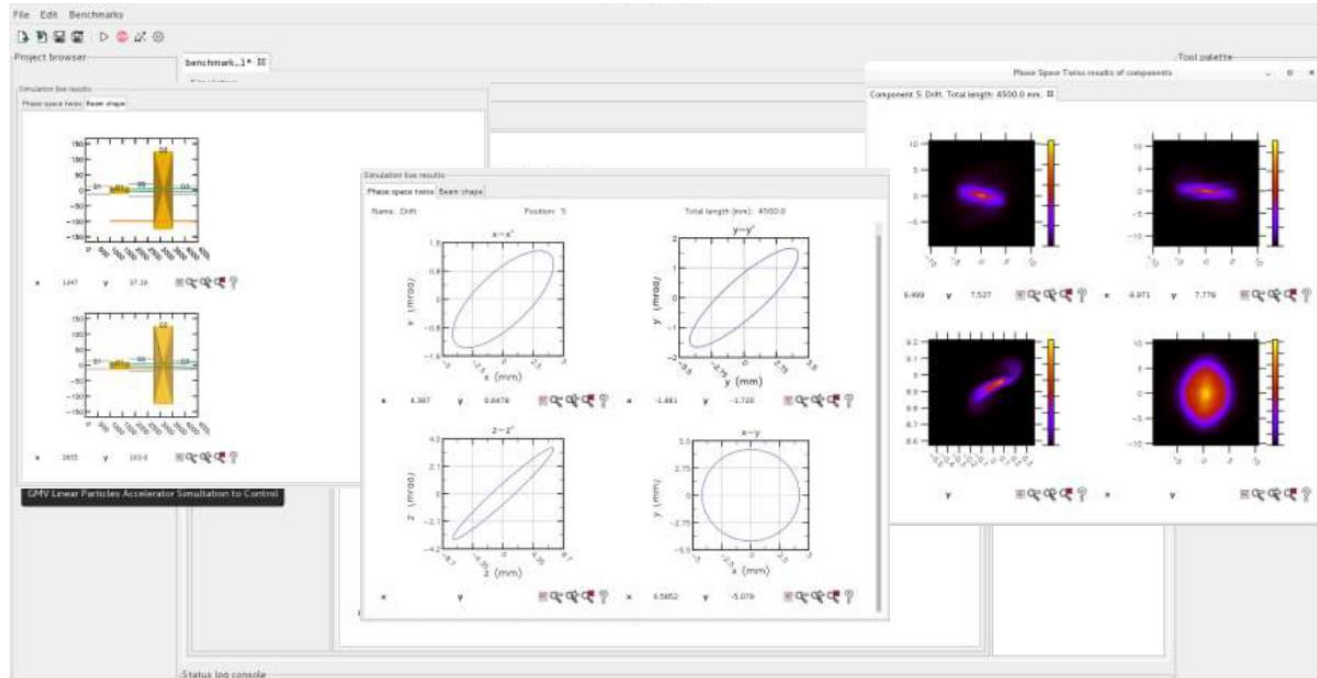
*ITER is a large-scale scientific experiment intended to prove the viability of fusion as an energy source*

- Development, maintenance and support for Nominal Device Support for timing and data acquisition devices
- Real time processing of chamber measurements
- Data Archiver network



# PARTICLE ACCELERATOR SIMULATOR

- Simulation of particle Accelerator, Irradiation, Plant Systems and Control Systems
- Acceleration line schematics, beam parameters visualisation and particles distribution



# radiance

- Dosimetry planning treatment tool for Intraoperative Radiation Therapy
  - Provides dose distribution (isodose curves)
  - Simulates the process of manipulating the position of the electron beam and its interaction with the subject's body.
- radiance offers different algorithms for a fast and accurate dose calculation (e.g. dose painting, Monte Carlo and pencil beam)

