

GALILEO In-Orbit Testing (IOT) Services



GALILEO IOV Phase

**Full Motion C-Band Antenna System
& Transmission Equipment for In Orbit
Testing (IOT) Mission**

May, 11th 2009

The GALILEO Program

▲ The GALILEO Program

- Europe's global navigation satellite system
- Interoperable with GPS and GLONASS

▲ The In-Orbit Validation Phase (IOV Phase C/D/E1) up to 2010

- Design and implement specific elements of the Program (space & ground)
- Manufacture, assemble & verify the performance of the space and ground elements

▲ The Full Deployment Phase (FD Phase) as of end 2009

- Finalise the design and implement the complete space and ground systems

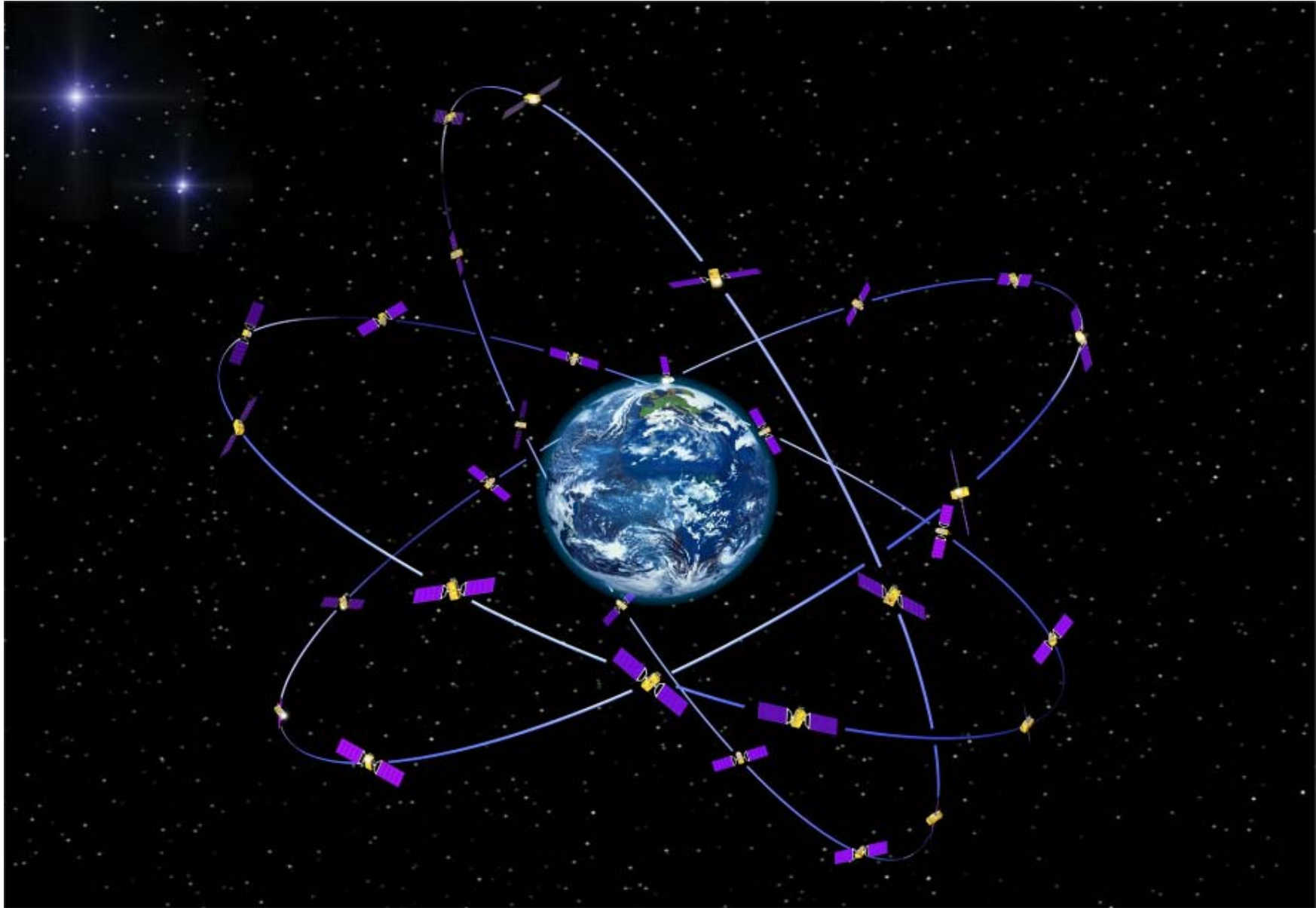
▲ The Full Operation Capability Phase (FOC Phase) as of 2012-2013

- Operations and commercialisation of the GALILEO constellation

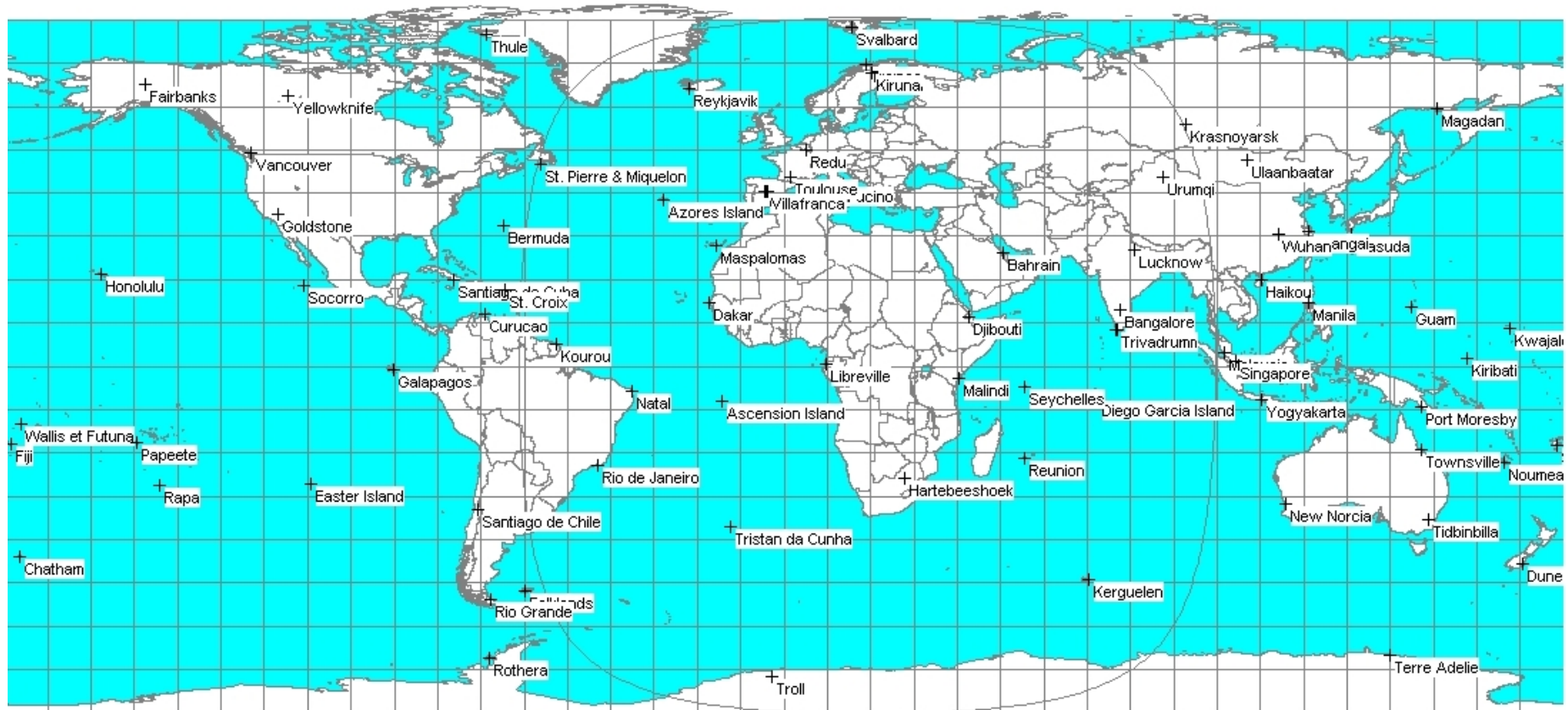
▲ In that frame – The Galileo Ground Control Segment (GCS)

- Infrastructure permitting the monitoring and control of the GALILEO satellite constellation

The GALILEO Satellite Fleet



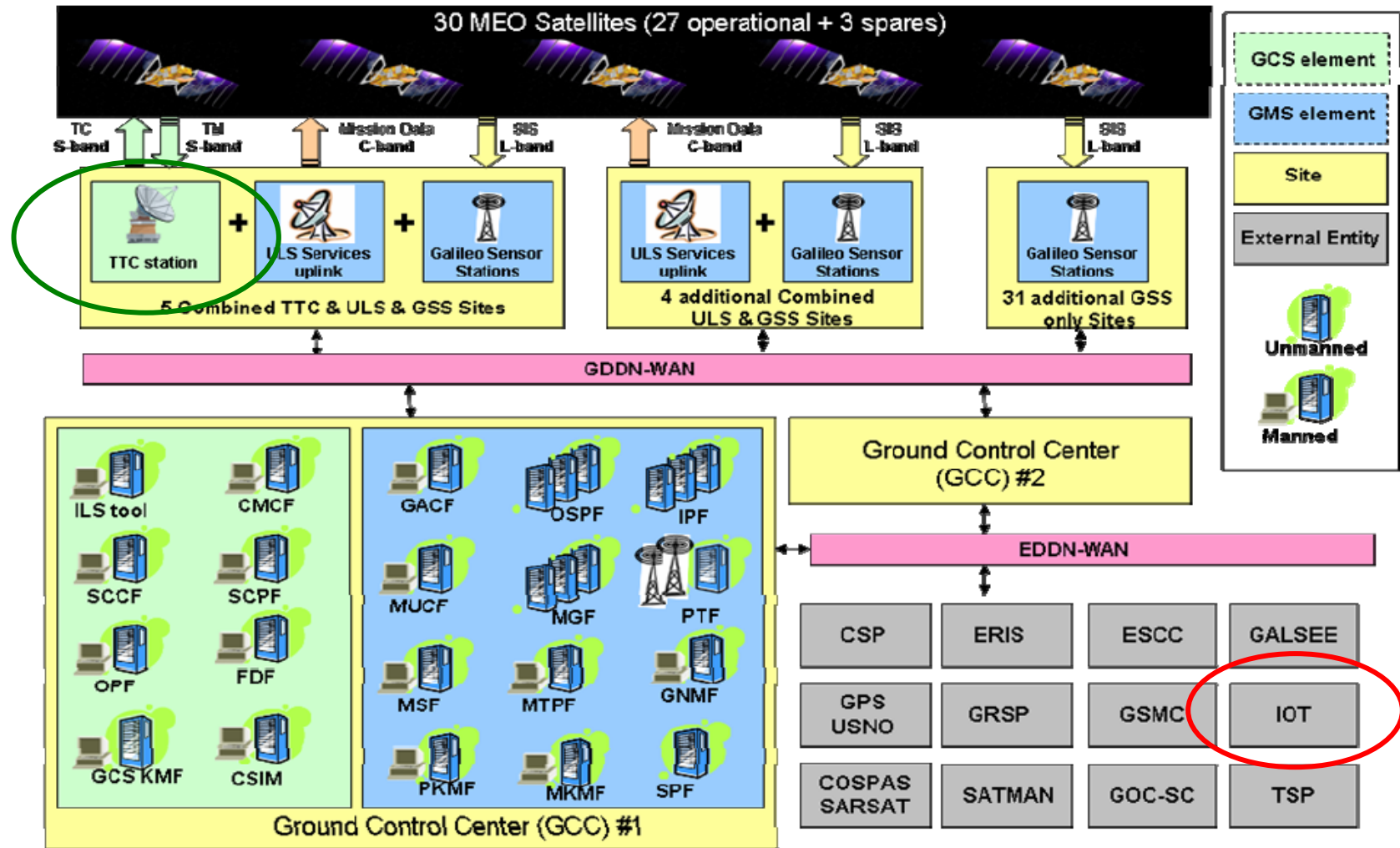
The GALILEO Ground Systems Hosting Sites



The Purpose of the System

- **Purpose of GALILEO**
 - Consumer applications (navigation, location-based-services,...)
 - Professional applications (maritime, aviation, aeronautical,...)
- **Requirements: High reliability & enhanced accuracy**
- **How: GALILEO satellites will receive data transmitted by the ground for re-distribution**
- **It contains**
 - Satellite service data (to be used by the satellite for its correct functioning & configuration)
 - GALILEO System validation data (Satellite Integrity, System Integrity, Service of Life authentication)
 - Alignment / correction information with GPS system
 -

The Deliverables by Luxembourg Industry



The Contribution of Luxembourg

- ▲ The Grand Duchy of Luxembourg subscribed to the GALILEO program during Q1, 2005 anticipating the adhesion of the Grand-Duchy to ESA
- ▲ Such subscription offered opportunities for Luxembourg based companies active in the space sector to participate in the build-up of the European GALILEO satellite system
- ▲ In 2005 SES ASTRA TechCom S.A. and HITEC Luxembourg S.A. decided to team up by pooling their skills and resources in the field of ground segment infrastructure, namely in the field of Telemetry, Tracking & Control (TT&C) antenna/systems
- ▲ Today Luxembourg can announce a second antenna procurement programme in the context of the Galileo IOV phase by the same team of Luxembourg companies

Purpose of IOT contract

▲ Purpose of our contract:

- Deliver Infrastructure to support the testing of the 30 GALILEO satellites
- Qualification of Satellites before Operations (immediately after launch)
- Verification of Satellites during Operations (during satellite lifetime)

▲ The system we are going to deliver will support the testing / verification / qualification of the GALILEO satellite reception capabilities

Project Award & Scope

SES ASTRA TechCom and HITEC Luxembourg have been selected for the provision of a Full Motion C-Band Antenna System in the frame of the In-Orbit Validation (IOV) Phase

- ▲ **Full motion antenna**
- ▲ **Diameter of 3,6 m**
- ▲ **Operating in C-Band**
- ▲ **IOT functionalities and specifications**
- ▲ **System for testing of GALILEO satellites after launch and during their lifetime**
- ▲ **Complementary to other GALILEO in orbit testing infrastructures**



Project Information

▲ Responsibilities

- System Engineering, Design & Manufacturing
- Project and Subcontractor Management
- On-site installation, testing and handover
- Training and Documentation

▲ Time Schedule

- Project Award & Kick-Off December 2008
- Contract Signature February 2009
- Factory Qualification Review in Luxembourg September 2009
- Installation on ESA site in Redu (Belgium) October 2009
- Site Acceptance Review November 2009

▲ Customer

- Inmarsat / DLR

▲ Project Consortium



▲ Key Suppliers



GALILEO In-Orbit Testing (IOT) Services



Project Objectives
Antenna Key Data
Project Deliverables

May, 11th 2009

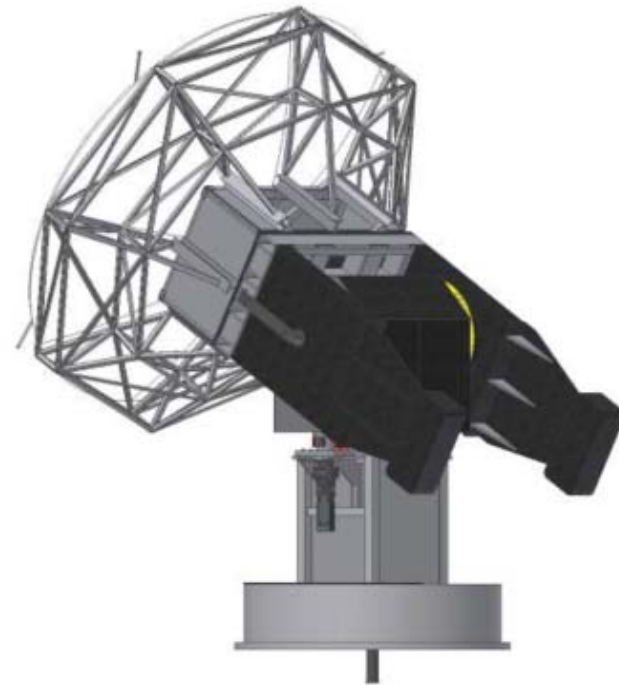
Antenna Key Data

- ▲ **Antenna diameter: 3.6 m**
- ▲ **Frequency Band: C-Band**
- ▲ **Polarization: Circular**
- ▲ **Operational wind loads**
 - Average wind speed: 60 km/h
 - Maximum wind speed (gust): 80 km/h
 - Survival wind speed: up to 200km/h
- ▲ **Drive limit: up to 110 km/h**
- ▲ **Temperature range**
 - Minimum: - 20 °C
 - Maximum: + 40 °C
- ▲ **Humidity: 0% to 100% (condensing)**
- ▲ **Travel range (mechanically)**
 - Azimuth: +- 300 deg
 - Elevation: -5 deg to 95 deg



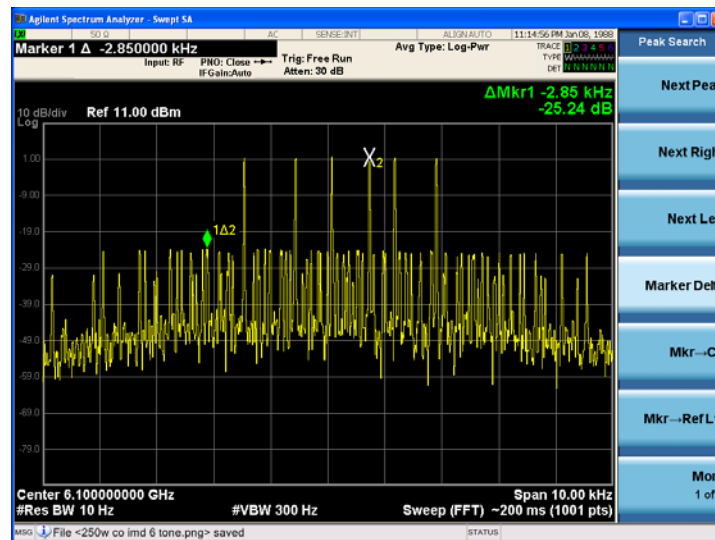
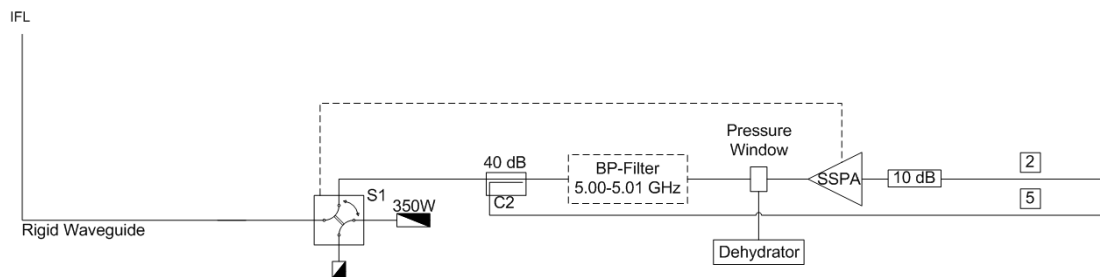
Antenna Key Data

- ▲ **Rate**
 - Azimuth: 0 – 3 deg/s (continuous)
 - Elevation: 0 – 3 deg/s (continuous)
- ▲ **Acceleration**
 - Azimuth: 0 – 3 deg/s² (continuous)
 - Elevation: 0 – 3 deg/s² (continuous)
- ▲ **Pointing accuracy:**
 - 0.09 deg rms (1 sigma)
 - HPBW of approximately 1.2 deg
 - 1 sigma rms pointing loss of approximately 0.07 dB and a maximum loss of 0.6 dB
- ▲ **Tracking speed: 0.2 deg/s**
- ▲ **Tracking mode: program track**
- ▲ **De-icing**
- ▲ **Availability: 98.9 %**



SES ASTRA TechCom Deliverables

- ▲ Engineering and integration of a satellite transmission system
- ▲ On Site installation of the baseband RF and testing of the infrastructure
- ▲ Radio Frequency testing of the overall Antenna Station



Galileo TT&C Antenna – Kiruna (Sw) Dec 2008

Installation and Operations Site

- ▲ System will be installed on the ESA site in Redu (B)
- ▲ Site is operated by the SES ASTRA TechCom subsidiary

Redu Space Services S.A

- ▲ Redu Space Services appointed by ESA and responsible for
 - Maintenance & Operations of the Station and the associated missions
 - Commercialisation of activities through a concession agreement with ESA



Questions and answers

GALILEO In-Orbit Testing (IOT) Services



GALILEO

Full Motion C-Band Antenna System
for IOT Services

The Luxembourg Partners
HITEC Luxembourg SA
SES ASTRA TechCom SA

May, 11th 2009

Discover HITEC Luxembourg

GENERAL

- high technology solutions
- covering 4 business areas
- a 100% owned Luxembourg company
- incepted in 1986
- business activities in the field of innovative and quality products and services

Studies, Project Management & Coordination
The Right Decision and Professional Support for Performance.

Pre-Engineering & Tender Preparation **Project Management & Coordination**

Industrial Solutions
Applying Experience & Scientific Know How to Industrial Solutions.

Rubber Testing Instruments
Customer Specific Developments
Monitoring & Control
High End Satellite Antenna Ground Segment and Components

Intelligent Infrastructure Solutions
Developing concepts for Infrastructures.

Public Safety Suite
Traffic Management Solutions
Software Development
ICT - Information and Communication Technology Services

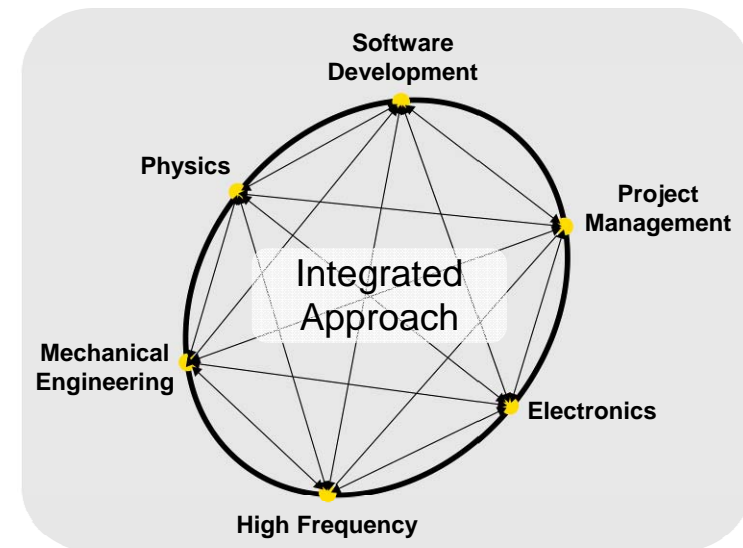
Manufacturing, Maintenance, Sustaining Engineering & Services
Preserve long-term sustainability and increase operational efficiency.

Manufacturing & Commissioning **Sustaining Engineering & Services** **Maintenance**



Outline of HITEC Luxembourg

- ▲ Dynamic Luxembourg business
- ▲ Serving multiple industrial areas and specialist engineering and technology markets
- ▲ Clients from private and public sector at an international and national level
- ▲ HITEC Luxembourg is in possession of specific national and international security clearances
- ▲ Offering value-added innovative solutions for
 - Pre-Engineering & Engineering
 - Project Management & Coordination
 - Consulting
 - Development
 - Manufacturing & Production
 - Maintenance & Sustaining Services
- ▲ Unique business philosophy based on an integrated approach of our various competencies



Project Objectives

▲ User Objectives

- Support efficient and effective mission planning and execution.
- Provide accurate and efficient training to Antenna control system and operations.
- Support an warranty extension period up to 3 years

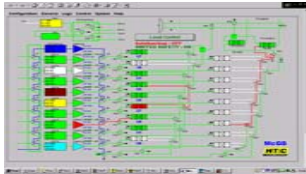
▲ System Objectives

- Provide a high-end C-band antenna system
- Provide interfaces with C-Band Box and the IOT measurement system
- Provide a smooth and homogenous integration and installation of the C-band Antenna in Redu
- Provide an accurate system to determine the power level transmitted by the C-Band Antenna
- Exhibit an outstanding reliability with respect to hardware and software components

HITEC Luxembourg – Product Lines & Customers

- ▲ Industrial Applications
- ▲ Consulting and Engineering
- ▲ Software Engineering & ICT Development
- ▲ Satellite Communications - Ground Segment

- » large “limited” and “full motion” antennas
- » fixed and mobile up-link stations
- » monitoring and control systems

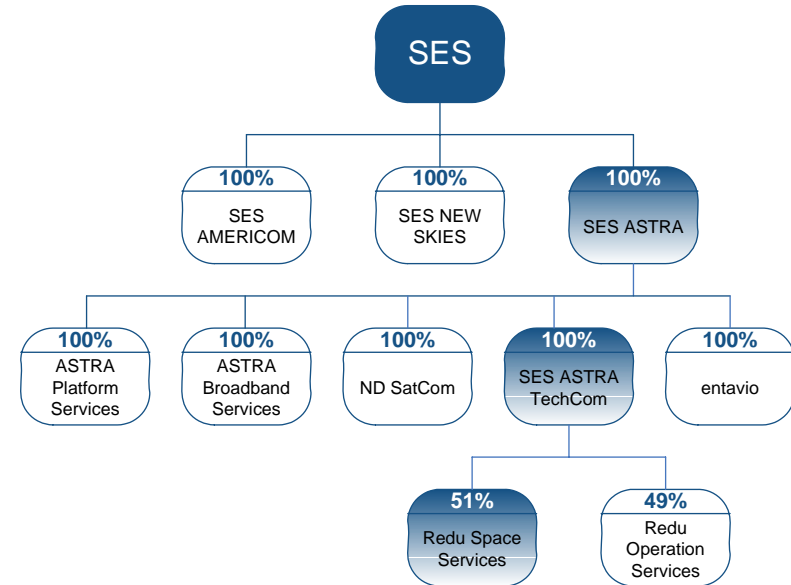


▲ Key Ground Segment Customers



Who are we?

- ▲ An entrepreneurial technology arm of SES
- ▲ Started in 2002
- ▲ Headquarter: Betzdorf – Luxembourg
- ▲ Operational sites:
 - Betzdorf – Luxembourg
 - Redu – Belgium (ESA Station)

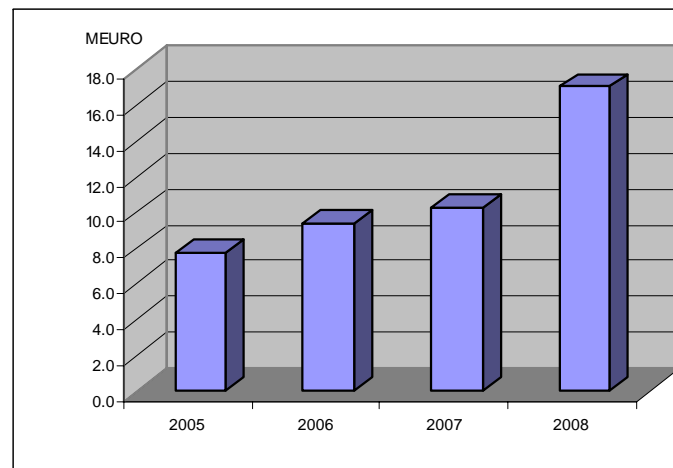


- ▲ Objective:
 - Leverage SES's 20+ years of successful satellite operations by providing superior technical services & products to the satellite industry at large

Evolution and Major Milestones

- ▲ **2003:** Operations of the Greek/Cypriot Satellite Hellas Sat 2 & provision of two Satellite Control Stations (Greece, Cyprus)
- ▲ **2005:** In Orbit Testing (IOT) of the Israeli satellite AMOS 2
- ▲ **2006:** Contract award for the delivery of two TT&C stations for the Vietnamese VINASAT satellite program (Vietnam)
Award of a contract for the delivery of two GALILEO TT&C antennas
- ▲ **2007:** REDU SPACE SERVICES S.A. is created. Award by ESA of a 10-year contract to operate and develop the ESA Station of Redu in Belgium
- ▲ **2008:** Award by the United Arabic Emirate satellite operator YAHSAT to build a satellite teleport in Abu Dhabi
IOT of the Israeli satellite AMOS 3

SES ASTRA TechCom Revenue Evolution



Our portfolio at a glance

Transforming commercial plans into technical success

