The Galileo Programme Status

IGS, Bern, 3 March 2004

Where is the programme now?

- Developing the Galileo System Test Bed V1 (GSTB V1)
- Developing the Galileo System Test Bed V2 (GSTB V2)
- Conducting the Phase C0
- Preparing procurement of the In Orbit Validation (IOV) Phase
- Development of simulators and initial ground and space segment components

Developing the Galileo System Test Bed V1

Chief objective of the GSTB V1 is to reduce risk on the development of the Galileo Ground Segment through early experimentation with Orbit Determination & Time Synchronisation and Integrity algorithms.

- **GSTB V1 is assembled, integrated and validated in the ESTEC Galileo System Test Bed (GSTB) and formally accepted January 2004.**
- **The GSTB V1 will become operational and commissioned during the 1st quarter of 2004.**
- **The GSTB V1 will support the GMS algorithm definition and experimentation in Phase C0.**

Developing the Galileo System Test Bed V2

Chief objectives of the GSTB V2 are to:

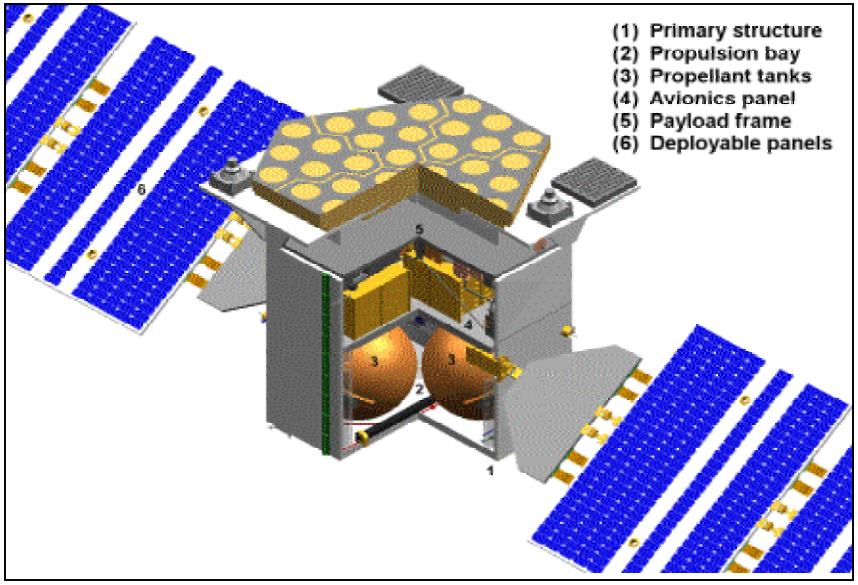
- **Secure Galileo Frequencies**
- **Test payload technology in space**
- **Provide experimental Signal in Space**

GSTB V2 includes 2 satellite development contracts:

- **GSTB V2A with Surrey Satellite Technology Ltd (UK)**
- **GSTB V2 B with Galileo Industries (B)**

Two satellite contracts mitigate risks by allowing for launch contingency in 2005.

GSTB V2A



Spacecraft

- Lift-off mass **450 kg**
- Power demand **660 W**
- Stowed Dimensions **1.3 m** x **1.74 m** x **1.4 m**
- Separation I/F **4 points**

Propulsion

- Propellant: **Butane**
- **2 Tanks**; Up to **25kg each**

Solar Array

- **2 Wings** with 2 Panels each (0.98 x 1.74 m) **Si** cells

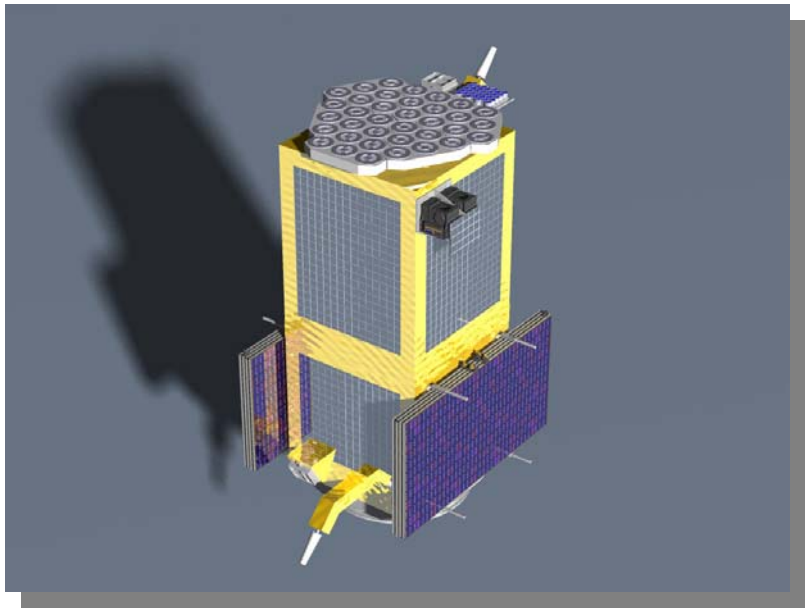
Electrical Power System

- **50 V** regulated Bus for payload
- **28 ± 6 V** unregulated Bus for platform

TT&C

- TT&C in **S-Band, SSTL standard**

GSTB V2B



Spacecraft

- Lift-off mass **523 kg**
- Power demand **943 W**
- Stowed Dimensions**: 0.955 m** x **0.955 m** x **2.4 m**
- Separation system**: Clamp-band 937mm**

Propulsion

- Mono-propellant **Hydrazine**
- 1 **Tank**; Up to **28kg**

Solar Array

- 2 **Wings** with 4 Panels each (1.49 x 0.8 m)
  Si cells

Electrical Power System

- **23 - 37V** unregulated Bus voltage

TT&C

- TT&C in **S-Band, ESA standard**

Conducting the Phase C0

The following contracts have been concluded:

- **Ground Control Segment with Logica CMG (UK)**
- **Ground Mission Segment with Logica CMG (UK)**
- **Test User Segment with Septentrio NV (B)**
- **Overall activities, including all modules with GaIn (B)**

Final Requirements Consolidation Milestone CCB was held in February with participation of all system and segment contractors.

Change requests to C0 contracts address:

- **The signal discussions between the US and the EU**
- **Security Threats and Vulnerability analyses**

Preparing procurement of the In Orbit Validation (IOV) Phase

Considerations…

- **Industrial constellations emerged through the competitive CO ITT**
- **Political constraints**
- **Clear customer – client relation**
- **Involvement of SMEs and a balanced qualitative and quantitative participation of industries of minor contributors to the programme.**

Requires…

- **High Level Commitment on schedule, industrial policy requirements and an efficient prime organisation.**

Leading to…

- **Direct negotiation with a Prime**
- **ESA controlled open competition for contracts at N-2 and below.**

Development of simulators and initial ground and space segment components (1)

Simulators:

- **Galileo Signal Validation Facility**
- **Galileo System Simulation Facility**
- **Ionospheric Model Development**
- **Linking Vehicle Positioning Systems to Virtual Toll Areas**

Ground Segment components:

- **Ground Segment Reference Receiver Antennas**
- **Communication Protocols and Network Security Management**
- **Ground Segment Reference Receivers Development**

Development of simulators and initial ground and space segment components (2)

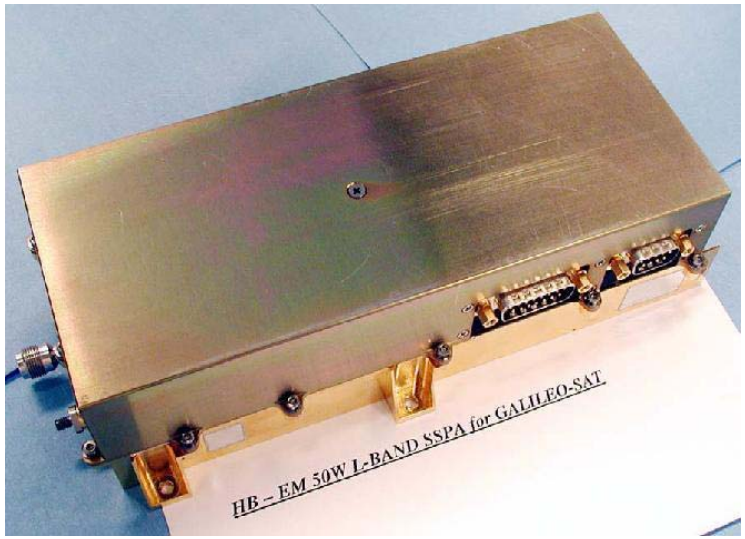
Space Segment components:

- **L-band High Power Amplifier**
- **L-band Output Multiplexer**
- **Navigation Signal Generator Unit**
- **TT&C Transponder**
- **GNSS-2 Wideband Radiator and Antenna Subsystem**
- **Lifetime qualification of Rubidium Clock and Atomic Frequency Standard**
- **Passive Hydrogen Maser Engineering Model**
- **Rubidium Maser Clock Evaluation**
- **Frequency Generator and Modulation Unit**
- **Clock Monitoring and Control Unit**
- **Search and Rescue Payload Antenna**
- **Preliminary Feasibility Study on a Caesium Clock**

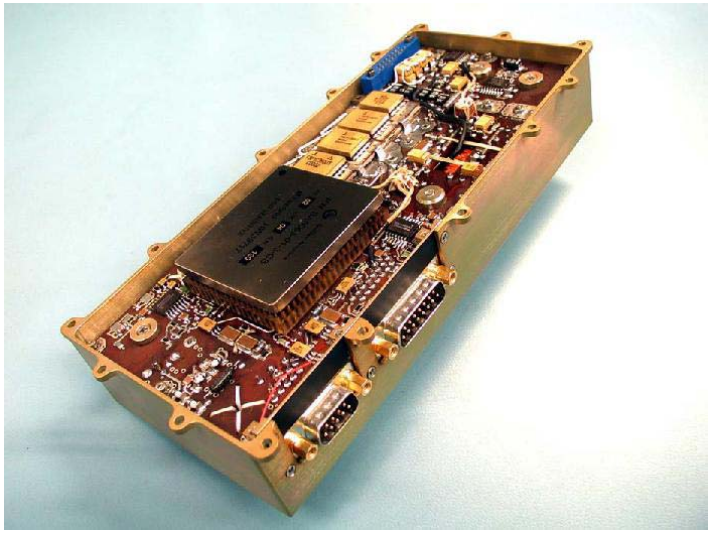
Space Segment Components – Example 1

SS Power Amplifier

Objective: Delivery of 2 EQM, 1 set PFM, FM and 1 spare FM



SSPA, complete



SSPA, open, EPC part

Key Figures:
Output Power: 50 Watt in L-band, PAE > 35%@ 2 dB Comp
Dimension: 239 x 109 x 62 mm
Mass: 1.3 kg

Space Segment Components – Example 2

Rubidium Atomic Frequency Standard

Engineering Model for GSTB V2

Space Segment Components – Example 3

Industrialisation of the Passive Hydrogen Maser

Contract Objectives:

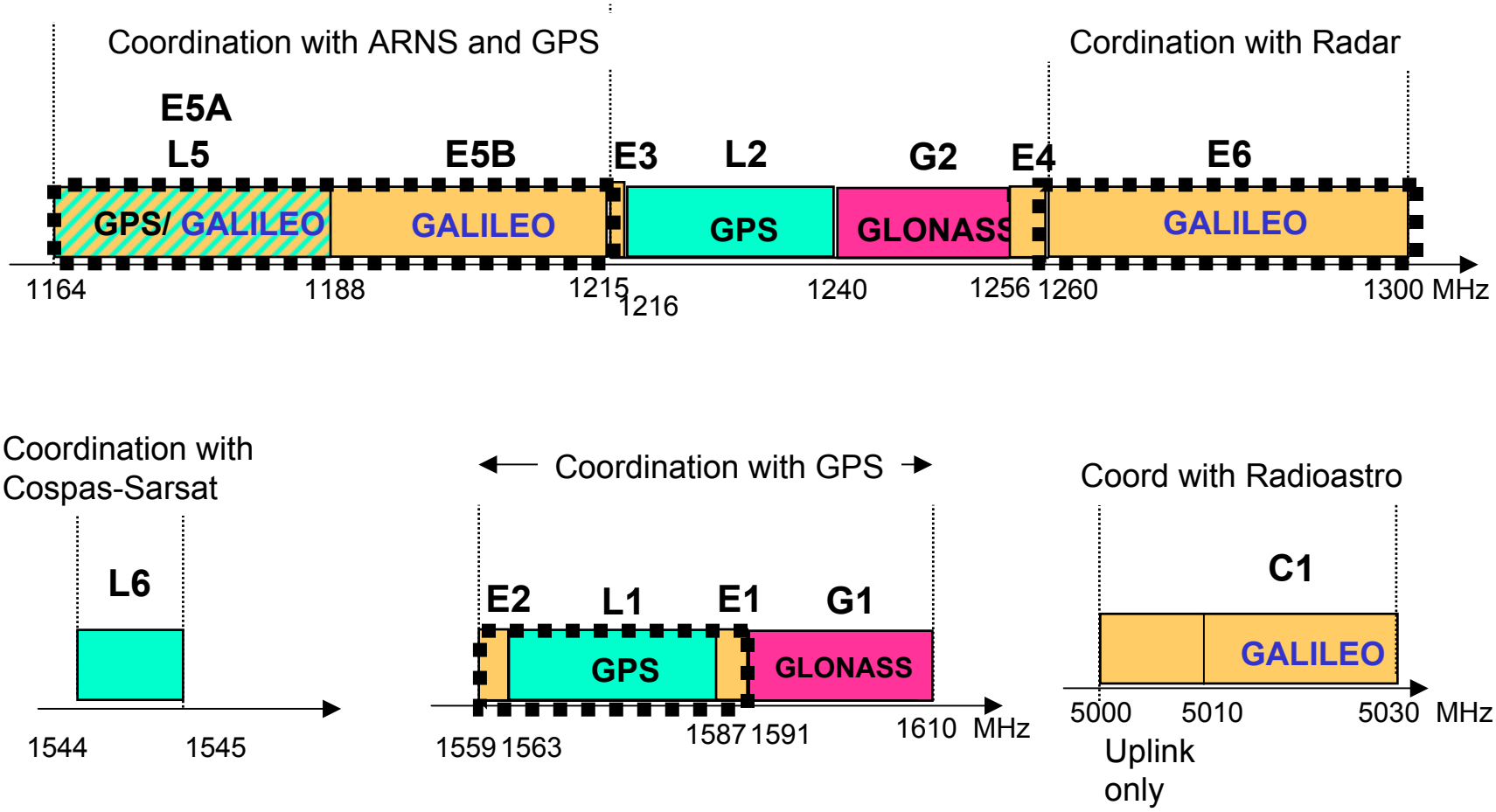
- Qualify the units for Galileo
- 5 Qualification Models to be manufactured and life tested
  - 1 EQM
  - 1 PFM
  - 2 FMs for GSTBV2

Frequency spectrum issues

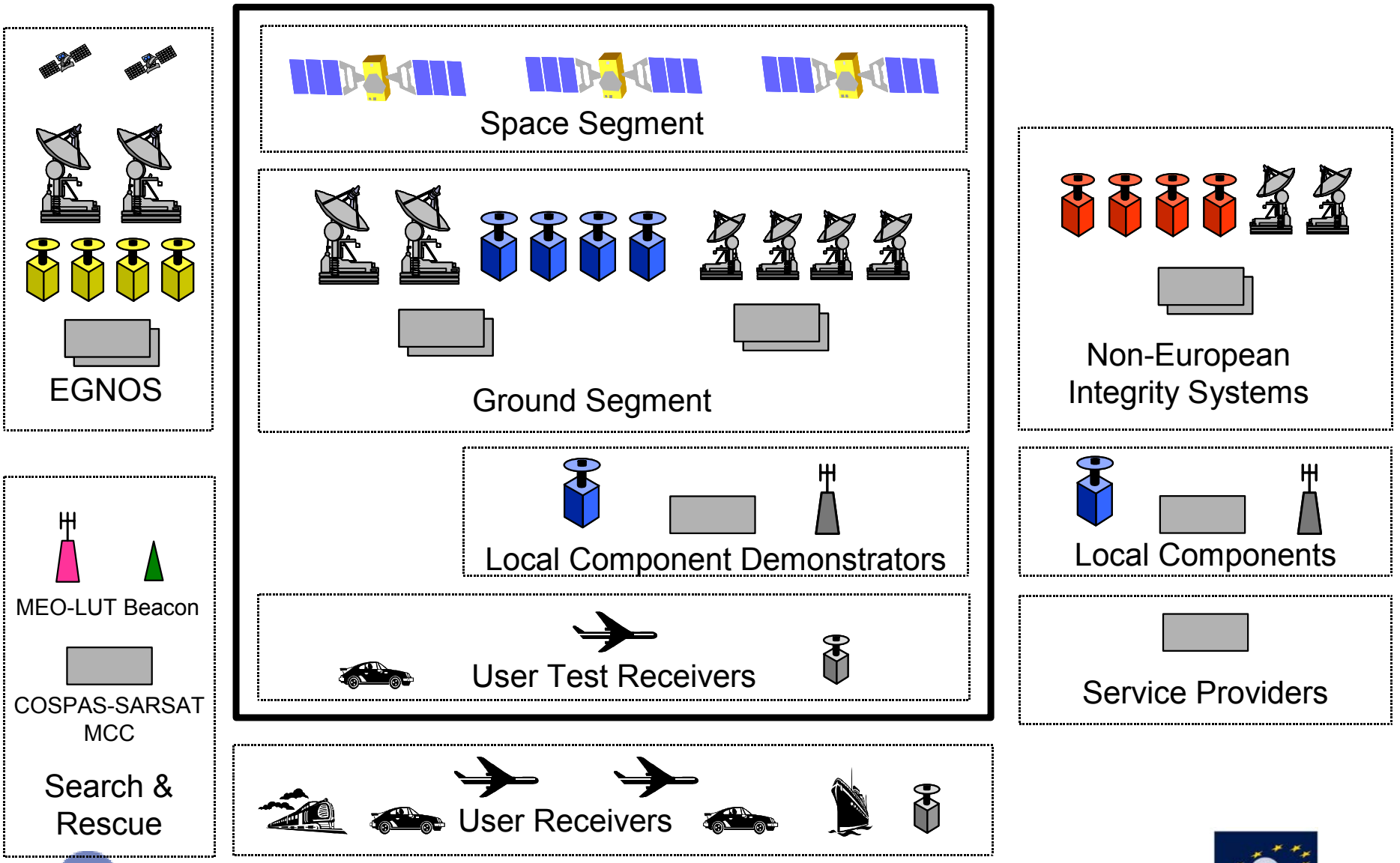
Successful negotiations between the US and the EU lead recently to agreements on most of the overall principles of the GPS/Galileo cooperation, including:

- Adoption of a common baseline signal structure for their respective open services – BOC (1.1) for the future GPS, optimised BOC (1.1) for Galileo
- Confirmation of a suitable baseline signal structure for the Galileo Public Regulated Service (PRS) – BOC (15, 2.5)
- A process allowing optimisation, either jointly or individually, of the baseline signal structures in order to further improve performances
- Confirmation of interoperable time and geodesy standards to facilitate the joint use of GPS and Galileo
- Non-discrimination in trade in satellite navigation goods and services
- Commitment to preserve national security capabilities
- Agreement not to restrict use of or access to respective open services by end-users
- Agreement to jointly finalize associated documents after which the agreement will be presented for signature

Frequency co-ordination



Overall Architecture - Schematic



Overall Architecture - Physical View