Galileo Control Center
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Galileo System Overview
Galileo System – Space and Ground Segment

- Global Network of GSS Stations; Reception of L-Band-Signal
- Global Network of ULS Stations; Transmission of Nav. Message in C-Band
- Global Network of TT&C Stations; Satellite Control via S-Band
- GCC’s for centralised processing, monitoring and control

30 satellites  
5 Telemetry, Tracking and Command Stations (TT&C)  
10 Uplink Stations (ULS)  
40 Galileo Sensor Stations (GSS)
Worldwide Site Options for Ground Stations

- GSS
- ULS
- TTC
- GCC
Role of Galileo Control Centre

- Monitoring and Control of the satellite constellation
- Monitoring and Control of the mission data processing (Orbit Determination, Time Synchronisation, Integrity, Search & Rescue)
- Monitoring and Control of ground assets world wide (Transmission and Reception Antennas, communications networks, control centre facilities)
- Special Operations for recovering from contingencies
- Operations of cryptographic devices
- Operations planning for satellite and mission control
- Support of ground-based pre-launch activities for individual satellites
- Conduction of simulations and trainings
Galileo Phases

2005
GIOVE B
Operations Preparation & Validation

2006
GIOVE B Operations

2007
System Design & Development
Operations Preparation & Validation

2008
IOV Operations

2009
FOC Operations Preparation and Validation
FOC Operations
Specification of the Galileo Control Centre
Composition of the Galileo Control Center

- The Galileo Control Centre consists of three components:
  - Building with at least 2800 m² and related infrastructure
  - Galileo Specific Facilities
    - GCS and GMS facilities (e.g. PTF)
  - Skilled Personnel Operating the Galileo Facilities and the Control Centre Infrastructure
    - Managers
    - Engineers
    - Controllers (on shift)
A Galileo Control Center consists of 2 Segments

- **Ground Control Segment (GCS)**
  - Satellite Platform, Payload and Constellation Control

- **Ground Mission Segment (GMS)**
  - Precise orbit determination and clock synchronization, integrity evaluation

- The number of facilities and their interactions contributes to the complex Galileo System structure

- The status of the various local and worldwide networks has to be available at any time

- For security reasons transferred data will be encrypted on various levels
Ground Control Segment

- Communications Facilities
  - 2 S-band TT&C Stations
  - Satellite Data Distribution Network (SDDN)

- On-Line Processing Facilities
  - S/C & Constellation Control Facility (SCCF)
  - GCS Key Management Facility (GCS KMF)
  - Central Monitoring & Control Facility (CMCF)

- Off-Line Processing Facilities
  - S/C Constellation Planning Facility (SCPF)
  - Operations Preparation Facility (OPF)
  - Constellation Sim. (CSIM) & rel. Training Tools
  - Flight Dynamics Facility (FDF)
  - ILS and AIV Tools
Ground Mission Segment

- Communications Facilities
  - C-band Uplink Stations (ULS)
  - L-band Galileo Sensor Stations (GSS)
  - Mission Data Dissemination Network (MDDN)

- Manned Facilities
  - Ground Assets Control Facility (GACF)
  - Mission Control Facility (MCF)
  - Mission Support Facility (MSF)
  - Service Products Facility (SPF)

- Unmanned Facilities
  - Orbit & Synchronisation Processing Facility (OSPF)
  - Integrity Processing Facility (IPF)
  - Message Generation Facility (MGF)
  - Uplink Scheduling Facility (USF)
  - Precise Timing Facility (PTF)
  - Mission Key Management Facility (M KMF)
  - Public Related Service Key Management Facility (P KMF)
Involved Personnel for Mission Operations

Unmanned Facilities
- MKMF
- PKMF
- MDDN
- ULS GSS
- USF
- GKMF
- SDDN
- TT&C
- CMCF

Manned Facilities
- IPF
- OSPF
- PTF
- MGF
- SPF
- SCPF
- FDF
- OPF CSIM ILS Tools

Controllers/Techn. (real-time)
- MKMF
- MDDN
- ULS GSS
- USF
- GKMF
- SDDN
- TT&C
- CMCF

Engineers/Analys. (off-line)
- MSF
- MCF
- SPF
- GACF
- SCCPF
- MDDN
- TT&C
- CMCF

Managers (off-line)
- USF
- GSS
- MDDN
- TT&C
- CMCF

Counts:
- Controllers/Techn. (real-time): 36
- Engineers/Analys. (off-line): 30
- Managers (off-line): 4
Our Solution for the Galileo Control Centre
New Control Centre Building for Galileo

- Located at DLR-Oberpfaffenhofen close to Munich
- Approx. 3000 m² floor space
- 3 floors plus one antenna room on top of the building
- Possibility for placing V-SAT antennas on top of the roof for communications purposes
- To be completed in 2007
Control Centre Layout

- 3 Control Rooms
- 4 Server Rooms
- 4 Shielded Rooms
- 6 Operations Rooms
- 6 Technical Rooms
- 4 Storage Rooms
- 43 Offices

The PTF clocks shall be maintained under the following environmental conditions:

- Temperature: $22°C \pm 2°C$
- Humidity: $50\% \pm 1\%$
- Temperature gradient: $< 0.1°C$ per hour
- Humidity gradient: $< 1\%$ per hour
- Air pressure variation: $< 1\text{ mbar}$
- Dust particle density
Control and Server Rooms

- 3 Control Rooms
  - Main Control Room
  - 2 Special Operations Control Room
  - Mission Planning Room
  - Flight Dynamics Room

- 4 Server Rooms
  - Final Number of Servers to be hosted unknown
  - Racks to be provided

- 4 Shielded Rooms for Security Equipment
  - Key Management Facilities
  - GKMF, MKMF, PKMF
Operations Preparation Tasks and Operations

1. Support in Design Process of Facilities (Requirements, Design Reviews, FAT)
2. Preparation of Mission, Satellite & Ground Operations Procedures
3. Support for Integration and Validation of Facilities; Operational Acceptance
4. Operations Validation: Databases, Procedures
5. Operations Execution: Training and Simulation
### 36 Years of Successful Space Mission Operations in German Space Operations Center (GSOC) Oberpfaffenhofen

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The German Space Operations Centre (GSOC) offers:

Experience from Multi-Mission Operations
- Scientific Satellites: complex payloads
- Commercial Satellites: cost efficiency, reliability
- Military Satellites: security
- Manned Missions: safety

Leading Technology Developments
- Autonomous Navigation: Precise Orbit Maintenance
- Mission Planning: Planning Automation
  - Operations of Satellite Constellations

In this combination unique in Europe!
Challenges for Galileo Operations

- Operations of complex payloads
- Cost Efficiency and Reliability
- Security against interference
- Safety of life operations
- Constellations operation of 30 satellites

The German Space Operations Center is able to fulfill these tasks!
Conclusion
Conclusion

- DLR GSOC is preparing for hosting the Galileo Control Centre
- DLR GSOC
  - with the experience from 36 years of operations in all field of space missions
  - and taking advantage of DLR research institutes (e.g. Institute for communications and Navigation)
  - and by entering partnerships with regional and European industries
is capable to operate the Galileo System.