



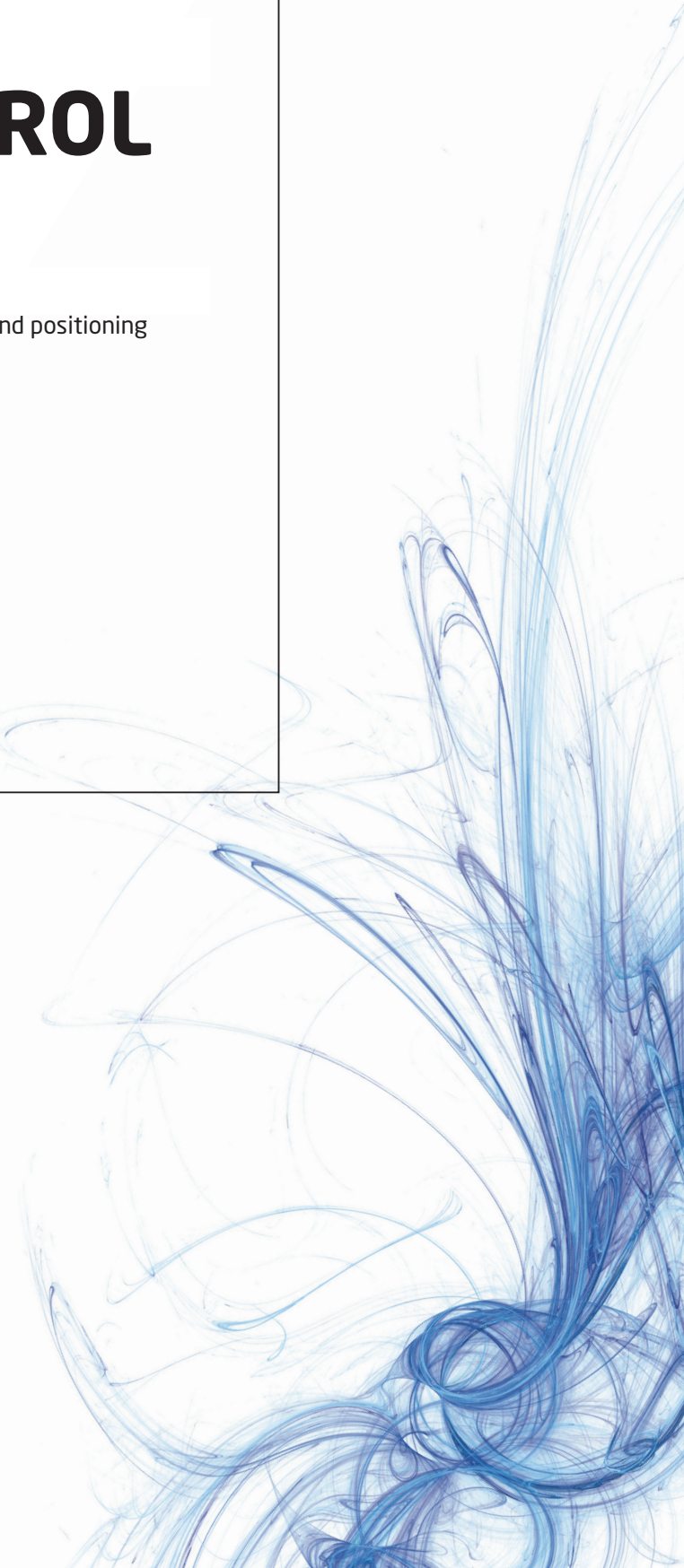
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SPACE

GROUND CONTROL SEGMENT

Satellite communications, earth observation, navigation and positioning
and control stations

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GROUND CONTROL SEGMENT



Developing ground control segment solution for more than 25 years

Upgrade of HISPASAT GCS

After delivery of HISPASAT 1 A/1 B GCS, Indra Espacio has been carried out the following GCS contracts for system upgrading in order to include operation of H1 C, H1 D and H1 E satellites. The number of GCS sites has been increased along the different contracts until reaching the current configuration:

- Arganda del Rey (Madrid, Spain). Control Center, TT&C, IOT and Carrier Monitoring Site
- Gobelás (Madrid, Spain). Control Centre and TT&C site
- Maspalomas (Canary Islands, Spain). TT&C Site.
- Balcarce (Buenos Aires Prov, Argentina). Carrier Monitoring Station
- Guaratiba (Rio de Janeiro, Brazil). IOT Site

Scope of Supply of the four HISPASAT GCS contracts:

- TTR Station Subsystem is the interface of the Ground Segment with the in-orbit satellites during nominal situations in Ku-Band. It consists of six TTR stations and one 9 meter AM station at Arganda, three TTR stations at Gobelás and three TTR stations at Maspalomas

- On Board Emergency TTR is the RF interface of the Ground Segment with the in-orbit satellites during On Board Emergency situations in S-Band (H1 A/H1 B/H1 C/H1 D) and Ku-Band (H1 E). It is composed of one 7.3 meter S-Band station and one 9.2 meter Ku-Band station at Arganda site
- IOT Stations are in charge of providing interfaces to GCS with the satellites and IOT Bench for IOT purposes. This function is performed by one 6.1 meter FSS station and one 8.1 meter DBS station at Arganda and one 8.1 meter Ku-Band Station at Guaratiba
- Carrier Measurement RF Front End is in charge to provide interfaces for measurement equipment devoted to this purpose. It includes several Ku-Band stations at Arganda and Balcarce sites
- Baseband Subsystem consists of Switching Matrices and BB units
- F&T subsystem is in charge of the frequency and time reference distribution signals to the equipment, as well as time distribution through GCS networks using Network Time Protocol

- Centralized Ground System Monitoring & Control for all GCS sites, allowing several operational modes (Master/Slave, Master/Master, Master/Down) and the sharing of resources between sites
- Localisation subsystem is in charge of localisation scenarios definition, scheduling and execution using RG/RG or RG/AM localisation strategies
- Communication subsystem provides the GS with the means to perform the internal and intersite communications based on TCP/IP
- Integration, validation and qualification of the overall GCS
- Training and Operational Support to HISPASAT



TTC facility element for GALILEO

The TTC facility element comprises a number of unique subsystems that perform the necessary uplink, downlink, ranging, calibration and control and monitor processing functions for the TTC management of the GALILEO constellation of satellites. During the IOV phase there will be 2 TTC stations, while in the FOC configuration the number of stations will be 5.

Each TTC station is composed of the following subsystems:

- Antenna and tracking
- RF transmission
- RF reception
- Timing and frequency references generation and distribution
- Baseband units (including TM, TC and ranging functions)
- Monitor and control subsystem
- Communications subsystem
- Calibration and testing
- Meteo
- Simulators



Development of SpainSat GCS architecture

The SpainSat Ground Control Segment (GCS) has been implemented in two sites: a primary site at Arganda (near Madrid) and a backup site at Maspalomas (Canary Islands). A number of subsystems in this GCS are also used for Xsat mission. The following subsystems are considered as part of SpainSat Ground Control Segment supply contract:

- RF subsystem composed of A1 and A2 stations at primary site and A6 station at backup site
- IF subsystem consisting of switching matrices and BB units
- F&T subsystem in charge of the frequency and time reference distribution signals to SpainSat and Xtar equipment
- M&C subsystem implemented is Indra Genius M&C tool
- Internal communication subsystem for the GCS. It was developed on TCP/IP
- Localisation subsystem in charge of localisation scenarios definition, scheduling and execution using RG/RG or RG/AM localisation strategies. Arganda and Maspalomas LOC's will conduct localisation scenarios in a coordinated manner

Spain Sat GCS includes interfaces with the following subsystems that are not part of the contract:

- SpainSat Flight Dynamic Subsystem (FDS)
- SpainSat SCC subsystem
- SpainSat Dynamic Software Satellite Simulator (DSSS)
- Payload Monitoring Subsystem (PMC)



Development of Amazonas GCS

The Amazonas GCS is the set of facilities in charge of controlling and monitoring Amazonas satellites (AMZ-1 and AMZ-2). GCS configuration copes with the reception of continuous satellite telemetry, spacecraft telecommand, ranging and tracking in order to provide information about health status and satellite positioning. The GCS allows to perform IOT campaign, VERA tests and carrier monitoring functions.

GCS sites are:

- RIO 1 (Rio de Janeiro, Brazil)
- RIO 2 (Rio de Janeiro, Brazil)
- ARGANDA (Arganda del Rey, Spain)
- MASPALOMAS (Canary Islands, Spain)
- New site (USA)
- Gobelás

The GCS of Amazonas includes:

- TTR Station Subsystem is the interface of the Ground Segment with the in-orbit satellites (AMZ-1 and AMZ-2) during Nominal situations and consists on R-TTR1 (8.1 meters), A-TTR5 (3.7 meters), and C-TTR2 (3.8 meters). All stations are designed to operate in Ku-band
- On Board Emergency TTR is the RF interface of the Ground Segment with in-orbit satellites (AMZ-1 and AMZ-2) during On Board Emergency situations and consists on a Station placed at ARGANDA (A-EMS-1)
- IOT Stations are in charge of providing interfaces to GCS with the satellite for IOT purposes. This function is performed by R-TTR1/IOT for Ku-band payload in America, RIOT/C for C-band payload in America and A-IOT/FSS for Ku-band payload in Europe
- Carrier access and payload monitoring in charge of providing interfaces for measurement equipment devoted to this purpose

- Baseband subsystem consists of switching matrices and BB units
- F&T subsystem in charge of the frequency and time reference distribution signals to the equipment, as well as time distribution through Amazonas networks using network time protocol
- GMC subsystem is in charge of the management of the different GCS equipment configuration, maintenance and event reporting
- Communication subsystem provides the GCS with the means to perform the internal and intersite communications based on TCP/IP
- Localisation subsystem in charge of localisation scenarios definition, scheduling and execution using RG/RG or RG/AM localisation strategies



Polar Station Facility (PSF)

The main role of the PSF is to acquire signals from polar orbiting satellites and to ensure the control of such satellites. Two kind of satellites are considered:

- European METOP 1, 2 and 3 of EUMETSAT
- US NOAA N and N' of NOAA

The PSF is composed of three earth stations:

Two Command and Data Acquisition (CDA) stations placed in Svalbard (Norway)

These stations are able to work in S, X, L and VHF bands providing the following functions:

- TT&C activities for METOP satellites in S-Band: These TT&C data sets will be archived locally and sent to/from EUMETSAT headquarters in Darmstadt via the intersite network
- TT&C activities for NOAA satellites in S-Band: These TT&C data sets will be archived locally and sent to/from EUMETSAT headquarters in Darmstadt
- GDS Data acquisition from METOP satellites in X-Band to be processed locally by the FEP before to be sending to EUMETSAT headquarters
- GAC Data acquisition from NOAA satellites in L-Band to be processed locally by the FEP before to be sending to EUMETSAT headquarters
- L-Band HRPT and VHF-band LRPT carriers monitoring from METOP satellites

One Reference User Station (RUS) located at EUMETSAT headquarters in Darmstadt (Germany)

This station will be used by operators as reference station and will provide L-band HRPT and VHF-band LRPT carriers acquisition and transmission to a dedicated FEP.



UPLINK FACILITY ELEMENT FOR GALILEO

The Uplink Station is responsible of uplinking the integrity and navigation messages to the GALILEO Fleet.

The ULS nominally comprises 9 ULS sites deployed all over the world, with capability to expand to regional ULS for additional services. Five ULS for the IOV phase with two Uplink Chains and the additional ones for the FOC.

Each ULS encompasses 4 independent uplink chains. Each one includes:

- 3.5 m full motion X/Y pedestal antenna transmitting antenna
- A outdoor 30 W solid state power amplifier
- A frequency converter set, with U/C and test D/C
- A spread spectrum baseband unit with doppler compensation capabilities

- A mission message processor in charge of message coding and assembly
- A monitoring and control system to manage the chain and the external interfaces
- A set of two shelters for field deployment
- A GALILEO system time receiver for frequency and time synchronization



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