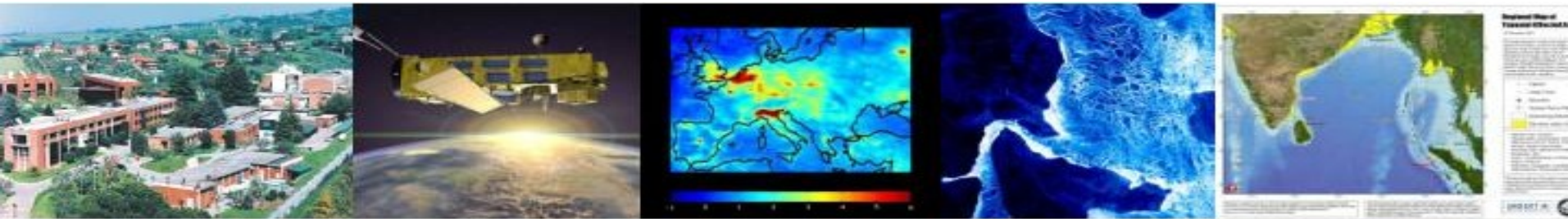


GSC Operations Concept & Sentinels Collaborative Ground Segment



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- Operations Phase Overview
- Operations Strategy
- GSC Core Ground Segment Architecture
- GSC Core Ground Segment Status
- Sentinels Collaborative Ground Segment Concept
- Preliminary review of Collaboration Proposals
- Collaborative Ground Segment Roadmap



- Some GMES Core and several Downstream services, and additional EU Agencies applications are today in 'Pre-Operations'
- GSC ground segment Coordinated Data System version 2 providing Data Access via ESA and GCMs is in 'Pre-Operations' since 2008
- Sentinel Space and Ground Segment development is on track for launch of A units in 2013 and 2014
- Operations concept drafted in 2008 and continuously refined since
- Several programmatic aspects still under consolidation:
 - Sentinel ownership, GSC operations funding, GMES Services long-term funding, Governance

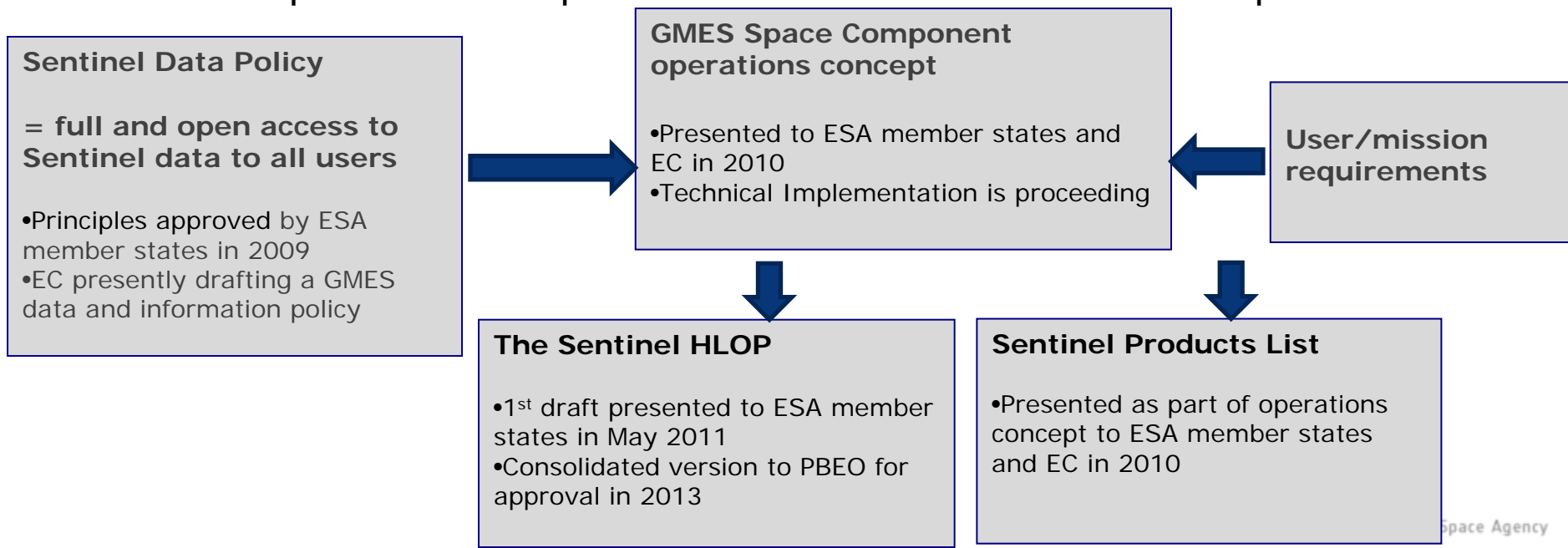
- The 'GSC Operations Concept' refers to the period from mid 2014 onwards by when 'operational budgets' from the EC are expected to be available

- An initial **ramp-up phase** is envisaged marking the transition towards the full operational capability:
 - progressive integration of each Sentinel spacecraft in the GSC overall system
 - a gradual evolution in the performance
 - ✓ in the data throughput and timeliness
 - ✓ in the services to users
 - ✓ in the availability of the overall system

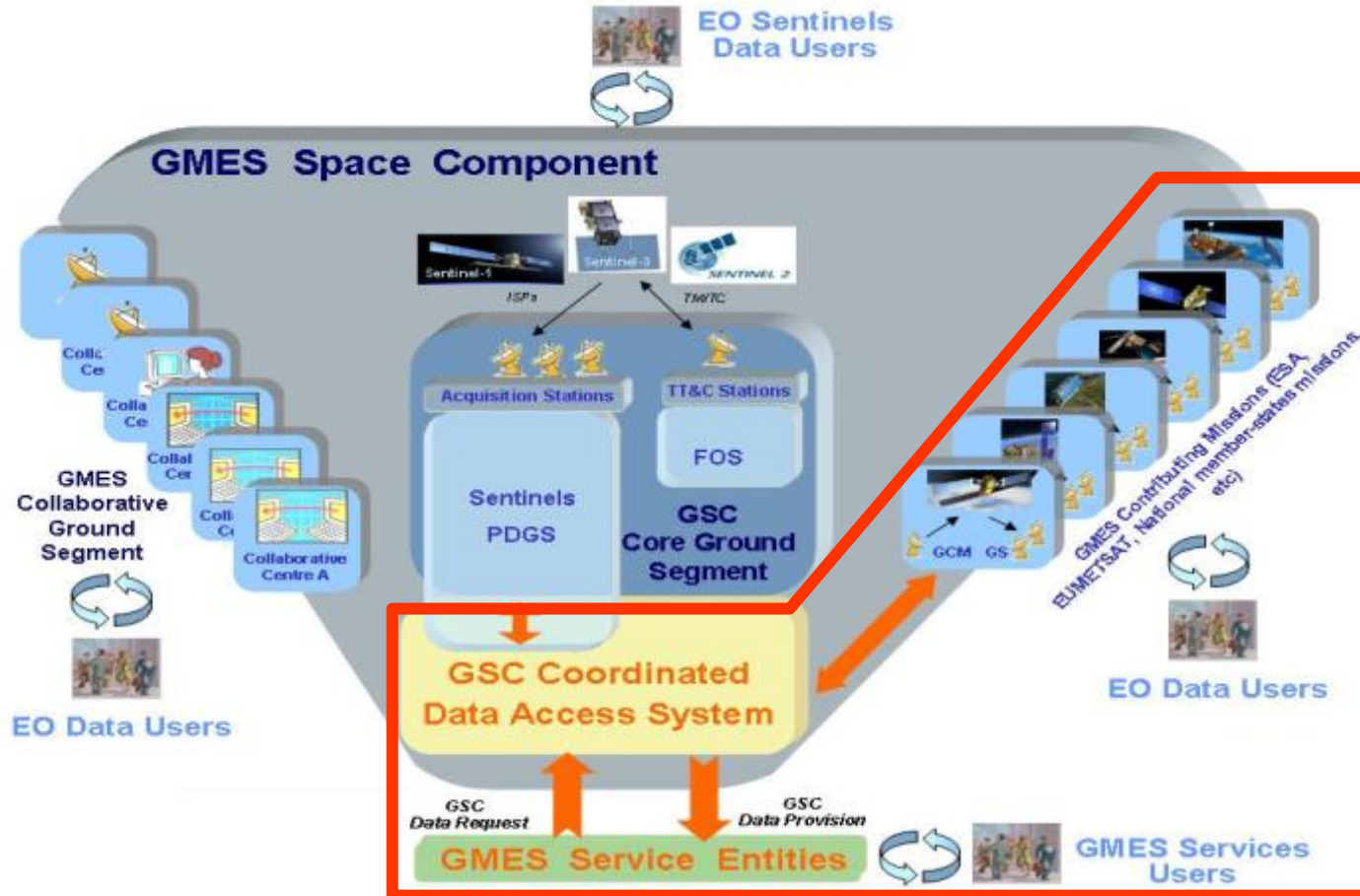
- The amount and type of funding available will determine the pace of the ramp-up from a 'Launch-Commissioning' configuration to the Full Operational configuration

Main objectives of the Sentinel operations strategy

- Provide data to GMES services and to Member States for national use
- Ensure systematic and routine operational activities:
 - with a high level of automation
 - with pre-defined operations to the maximum extent possible



Ground Segment Architecture



The GMES Space Component (GSC) Operations Concept relies on a GSC Ground Segment consisting of:

- a **GSC Core Ground Segment**, with **GSC-funded Functions and Elements**, providing :
 - the primary access to Sentinel Missions data as well as
 - the coordinating access functions to Contributing Missions data

- a **GSC (Sentinel) Collaborative Ground Segment**, with **non GSC-funded Functions and Elements**, providing:
 - a supplementary access to **Sentinel** Missions data, i.e. either through specific data acquisition services, or specific data products
 - the frame for international cooperation

- **The GSC Core Ground Segment** will ensure coherent EO data supply (end-to-end data access management, monitoring and control) for GMES use

- In particular the Core GS will:
 - Focus on systematic product generation
 - Provide online data distribution
 - Maintain a well-defined product list
 - Include a data access integration layer, comprising multi-mission planning, user registration, download & data delivery for Sentinels and GCMs
 - Apply the Sentinel Data Policy

- **Main Facilities** include:
 - Sentinel Flight Operations Segment (FOS)
 - Sentinel Data Acquisition and Near Real Time Product Generation
 - Sentinel Processing and Archiving Centres (PACs)
 - Sentinel Mission Performance Centres (MPCs)
 - Sentinel Precise Orbit Determination Service (POD)
 - Sentinel Payload Data Management Centre (PDMC)

- **Coordinated Data Access Systems** for Sentinel and GCMs include:
 - GSC Gap and EO data requirements analysis tools and systems
 - GSC Multi-Mission Mission Planning and scheduling
 - GSC User Services (e.g. Registration, Management)
 - GSC End to End Monitoring and Control (including Reporting)

Core Ground Stations Network



Core Ground Stations:

- Matera



- Maspalomas

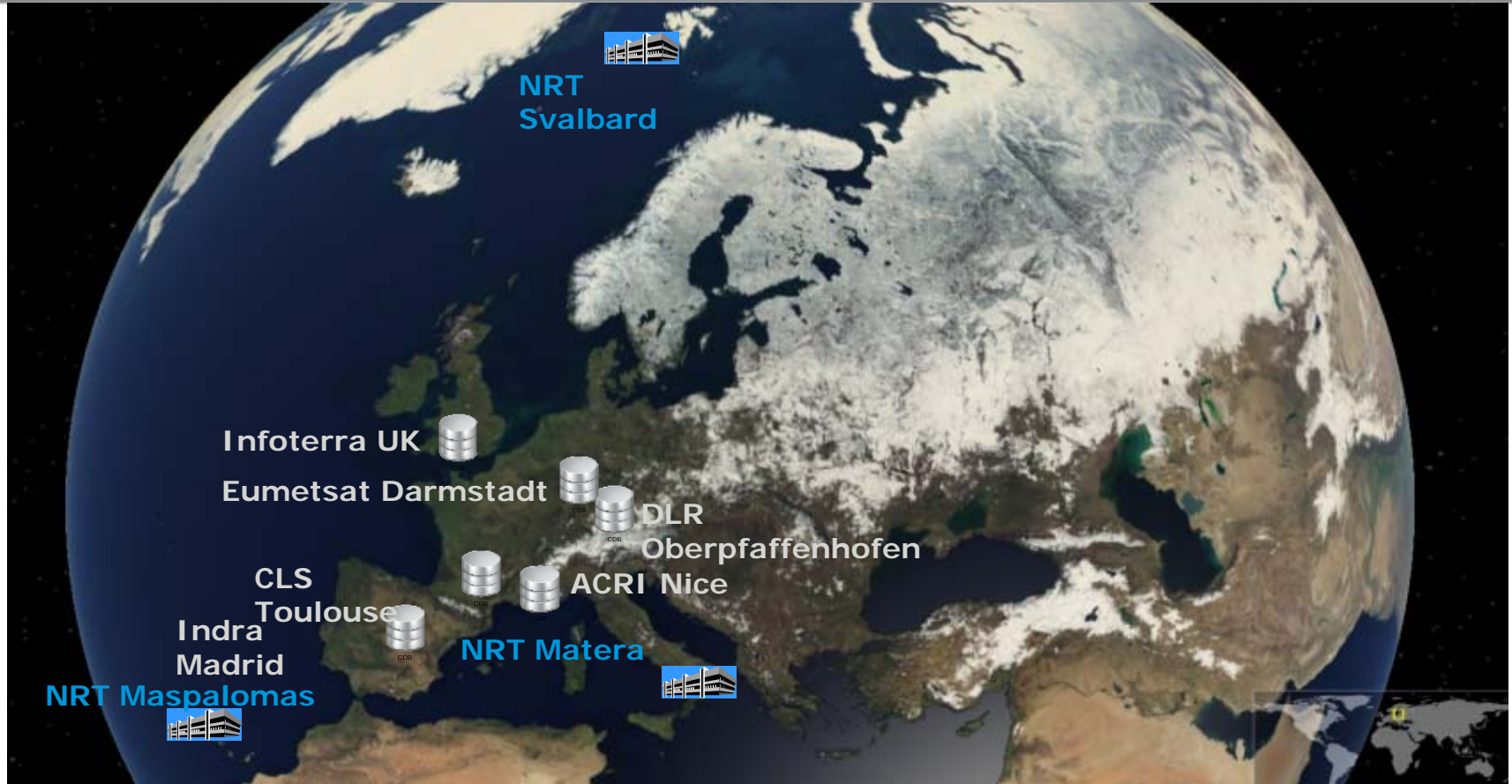


- Svalbard



- Alaska

Data Core NRT & Offline Processing Centers

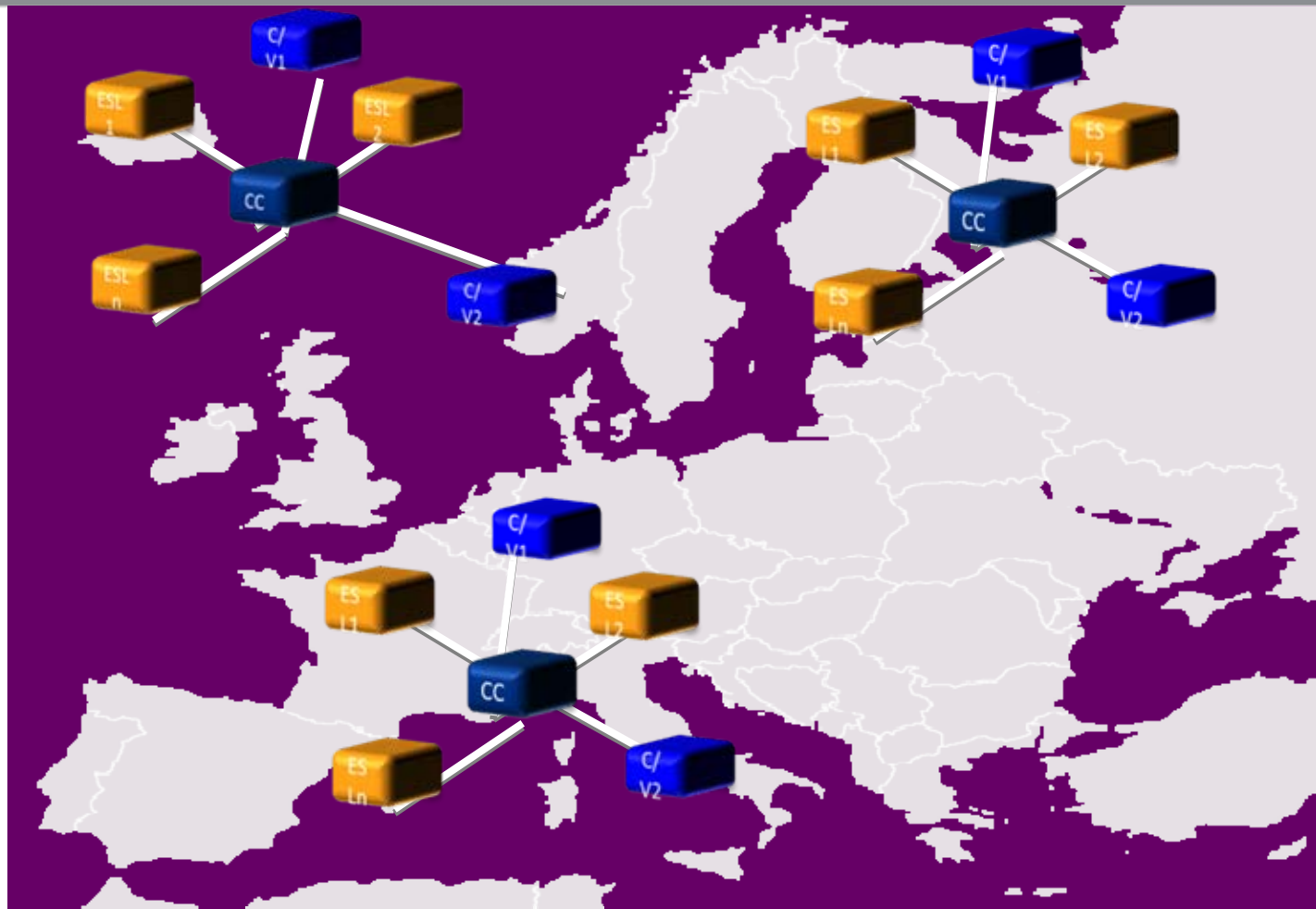
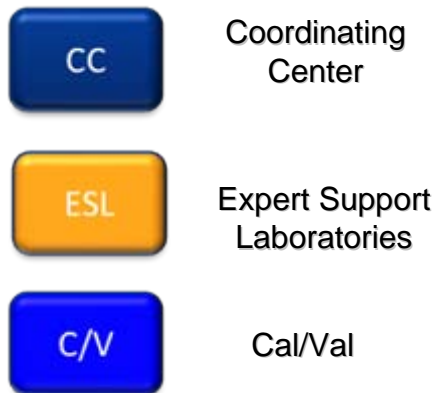


Near Real Time Processing Centre

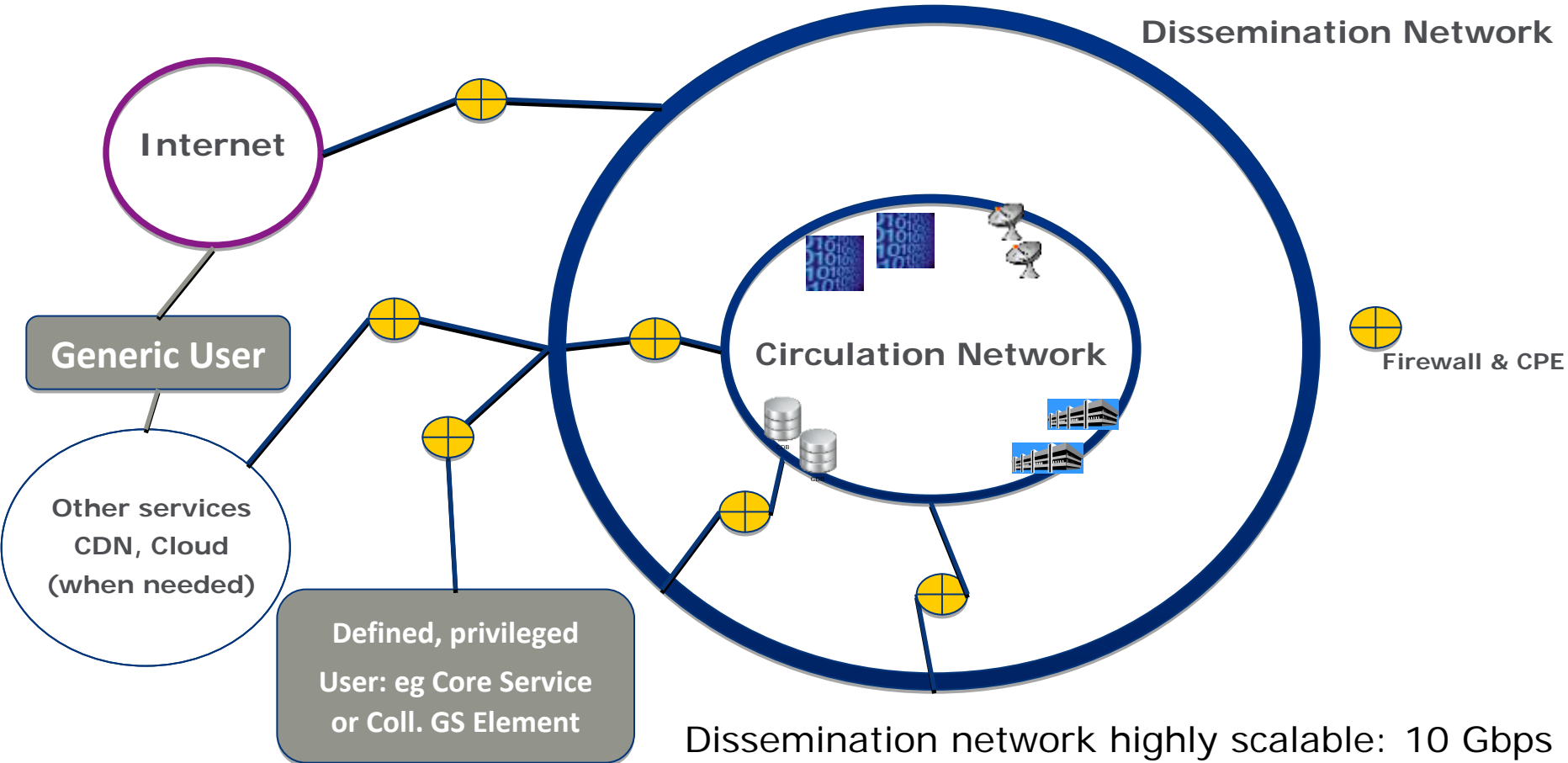


Archive and Offline Processing Centre

Mission Performance Centers



- 3 separated ITTs
- 3 MPC main contracts: MPC-S1, MPC-S2, MPC-S3
- Various sub-contracts are expected for ESL, Cal/Val, science expertise



Dissemination network highly scalable: 10 Gbps

- Specific GS development activities envisaged within the ESA **GSC Segment-3** programme proposal
 - Adaptation of Ground Segment, in particular for Sentinel-5 Precursor
 - Implementing the Sentinel data interfaces for national use
- Continuous Integration of new Contributing Missions
- Continuous Integration of new Collaborative Ground Segment Functions
- Accommodate GMES Core Services evolution
 - New core data products
 - Enhanced data dissemination functions

- Access to data through **collaborative agreements** allows further valorising the development of operational ground segment services complementing the GSC PDGS core services

- The collaboration provides a frame for **specialised solutions** to further enhance the Sentinels missions exploitation in the area of:
 1. Sentinels data acquisition and Quasi/Near Real Time production
 2. Complementary collaborative data products and algorithms definition
 3. GSC data product dissemination and access (e.g. mirror sites)
 4. Development of innovative tools and applications
 5. Complementary support to Calibration/Validation activities

- The collaboration will rely on the definition of formal agreements as well as the technical definition of dedicated operational interfaces

Implementation of the collaborative GS is based on 3 main steps:

1. Definition of process and collection of collaboration proposals

- Started in the framework of the GMES Operations Consultation Group (GOCG) – a Group with MS representatives (**ASI**) derived from the Ground Segment Coordination Body
- Requirements collection: questionnaire released in 2011
- Enable ESA to make a preliminary assessment of the planned initiatives
- Inputs from most MS received and under consolidation

2. Proposal feasibility analysis

- Execution of simulation scenarios. Identification of potential conflicts
- Proposal refinement with collaborative partner

3. Formalisation of collaboration

- Define and sign the formal agreement and document the operational interfaces
- Integrate, verify and validate the derived implementation

1 – Sentinel collaborative stations

→ Preliminary analysis of replies to questionnaire

a. Scope

- Collaborative stations complementing the Core X-band and Ka-band station network, aiming at (mainly) providing quasi real time services for Sentinel-1 and Sentinel-2

b. Received requests overview

- X-band stations, including related observation needs for S1:
Sodankylä (S1, S2, S5P), Azores (S1), Maspalomas (S1, S2), **Matera (S1)**, Neustrelitz (S1, S2, S3), Brest (S1), Kerguelen (S1), La Reunion (S1), French Guyana (S1), Kiruna (S1, S2), Tromsö (S1)

In addition: Canadian stations (not identified yet), EMSA CleanSeaNet stations (today Matera, Brest, Azores, Grimstadt, Tromsö, Svalbard)

- Ka-band stations, including related observation needs for S1:
Oberpfaffenhofen/Weilheim (S1, S2), Neustrelitz (S1, S2), Harwell (S1, S2)
- X-band stations outside MS's territories: **Malindi**, Inuvik / Chetumal / O'Higgins, station in South America Pacific coast, Cordoba, Gabon

c. Identified ESA support

- Implementation of observation needs (mainly for Sentinel-1), satellite acquisition/downlink planning
- Availability of Core GS developed elements for reuse, e.g. front end processor (to be procured by coll. partner), operational processor license and associated maintenance

d. Open issues

- The request for local stations in cooperating countries impacts the overall system resources: e.g. additional S1 observation needs, additional downlink requirements and constraints
- Some requests for downlink of S3 (and S5P) data: today not part of the foreseen scenario
- Some requests for receiving recorded data: accepted if in overlap to the Core Stations
- Some stations ask for involvement in the emergency / crisis planning, i.e. emergency data transmitted to collaborative stations: accepted if in overlap to the Core Stations

2 - Collaborative Data Products

→ Preliminary analysis of replies to questionnaire

a. Scope

- Definition, specification, generation of data products in complement to the set of products provided by the Core ground segment
- Generated either from collaborative station direct acquisition or from standard core products

b. Received requests overview

- Very wide range of products for Sentinel-1, -2 and -3 planned to be generated with all types of timeliness: quasi real-time, near real time, off-line few days, off-line with higher time delay (e.g. large scale products incl. mosaic, regional / global products, etc.)
- Different types of planned collaborative products in several thematic domains, e.g.:
 - Products in complement and of the same level of core products, e.g. Sentinel-3 level 2
 - Products beyond the standard core product level with specific attributes, e.g. Sentinel-1 orthorectified
 - Value-adding information products for end-users, e.g. maritime surveillance (e.g. ship detection), crisis mapping, subsidence maps/risks, land thematic information services
 - Large-scale national, continental, regional or global products, e.g. biophysical maps / crop field plots, forest monitoring, support to climate change monitoring, soil moisture, snow / glacier monitoring
 - Level 4 products, e.g. multi-mission (beyond the Sentinels)

c. Identified ESA support

- Dedicated access to core data products, in particular of large volumes of Sentinel-1/-2 data
- Verification of user documentation related to collaborative products: such support is foreseen to be limited to product level similar to core products

d. Open issues

- Volume of data to be routinely provided
- Network design, implementation
- Network operations costs

→ Preliminary analysis of replies to questionnaire

a. Scope

- Particular regional or thematic data access nodes and mechanisms, including redistribution services of Sentinels core products systematically received from the Core Ground Segment, deployment of additional pick-up points (e.g. mirror sites)

b. Received requests overview

- Set up of mirror sites for redistribution of Sentinel-1, -2 and -3 at National level: 3 requests received
- Set up of mirror sites for redistribution of Sentinel-1, -2 and -3 at regional level (e.g. Alps, Africa, part of South America): 3 requests received
- Dissemination of Sentinel-5P products: 2 requests received
- Few requests for data (re)distribution in NRT, with products generated from collaborative stations (X or Ka-band)
- 1 request for using cloud computing infrastructure

c. Identified ESA support

- Dedicated access to large volume of Sentinel core data products for national or regional coverage
- Set up of technical interface to mirror site
- Potential provision of tools to collaborative partners for user management / interface to GSC catalogues

d. Open points

- Volume of data to be routinely provided
- Technical interfaces with core PDGS (e.g. catalogues, security aspects)
- 1 request for redistribution of GCM (GMES Contributing Missions) data: not foreseen in the collaborative GS framework which concerns the Sentinels only

4 – Development of Innovative Tools and Applications



→ Preliminary analysis of replies to questionnaire

a. Scope

- Development of particular innovative tools or 'Apps' by and for the general public

b. Received requests overview

- Various types of proposals received, related to particular coverage (national, regional, etc.)
e.g.:
 - Geo data webserver
 - EO image library
 - Open Geospatial Consortium compliant services e.g. Web Mapping Service (WMS), Web Feature Service (WFS), Web Processing Service (WPS)
 - Web GIS
 - Mobile Apps
 - Information systems for National / Municipal services and for assistance and official use in EU directives (Water Framework, Maritime Strategy Framework, Habitats, etc.)

c. Identified ESA support

➤ Advertisement of collaborative tools / applications established in terms of WEB portal links, coupled interfaces for information of interest to GSC user community, during workshops, etc.

d. Open points

➤ None identified so far

5 – Complementary support to Cal/VAL activities

a. Scope

- Based on specific Cal-Val calls, engage world-class expertise and activities, through mutual benefit collaboration, that complements the implementation of the Sentinel calibration and validation activities
- Provide access to Cal-Val infrastructure and data
- Cooperation to be formalised through a collaborative ground segment agreement. No exchange of funds are foreseen.

b. Received requests

Note: This category was not part of the original ESA questionnaire, it has been identified after having issued it

- Some interest has however been expressed in a proposal for participating to Sentinel-3 SLSTR cal/val activities

c. Identified ESA support

- ESA has recently issued a Call for establishment of a complementary Sentinel-3 Validation, aiming at selecting cal-val support teams. Closure for proposals: end 2012
- Similar calls are being considered for Sentinel-1 and -2
- Dedicated access to core data products
- Coordinate activities

d. Open points

- None identified so far

Status of discussion with National collaborative ground segment partners



<i>Partner</i>	<i>Status of discussions / inputs</i>	<i>Summary of planned activities (based on presentations, reply to questionnaire, etc)</i>
<p>Italy ASI, (GOCC member)</p>	<p>→ On-going</p> <ul style="list-style-type: none"> - Participation to GOCC meetings - Bilateral meetings: <ul style="list-style-type: none"> - ESRIN, 11 May 2011 - Inputs via ASI presentation at GOCC-2 and GOCC-5 	<p>Preliminary inputs</p> <p>Acquisitions:</p> <ul style="list-style-type: none"> •Sentinel-1 observations, covering: Italy, Mediterranean sea, North Africa, Kenya, Somalia, Sudan, Eritrea, Ethiopia, West Indian Ocean, Indonesia and surrounding seas. •Sentinel-2: national interest for Italy and Mediterranean Sea <p>Data Acquisition</p> <ul style="list-style-type: none"> •Potential stations in addition to Matera: Malindi (“regional station for GMES Africa”), Cordoba (“regional station for South America”). <p>Planned activities: oil spill monitoring, terrain motion monitoring, ship detection, etc.</p> <p>Note: synergies with Cosmo-Skymed and SAOCOM identified</p>

Collaborative Ground Segment - Summary of ESA potential support



- Potential ESA support to Collaborative GS addresses several items e.g.:
 - Instruments and satellite tasking (to provide adequate observations and provide support to collaborative stations)
 - Availability of Core GS developed elements for reuse: front end processor, operational processors and associated maintenance
 - Development of specialised interfaces
 - Dedicated access links to core products
 - Access to cal/val infrastructure and data
 - Verification of user documentation related to collaborative products
 - ESA hosting of collaborative processors
 - Interface to mirror sites
 - Advertisement of collaborative activities (e.g. products) on the GSC Portals
 - Use of ESA developed toolbox to host collaborative product processing algorithm

- The extent of the support depends on the financial envelope allocated to ESA GSC Segment-3 by MSs at upcoming ESA Ministerial

Potential support from Collaborative Partners to ESA

- Potential CollGS support to Core GS addresses several items e.g.:
 - Mirror sites for re-distribution of core products
 - Provide access to ESA of cal/val infrastructure and data
 - Data repatriation from collaborative stations
 - For the redistribution of core products, provide ESA with user information including data access profile (e.g. user registration, traceability of data use)

- Collection of Requirements: in progress, close to completion
- Analysis and simulation of feasibility and cost to the Core GS: End 2012
 - ✓ Proposals iterative refinement started
- Draft formal agreements templates: 2nd half 2012
 - ✓ Confirmation of ownership approach and data policy: required ASAP
- Amendment of the Operations Concept: Q3/4 2012
- Update to the Sentinel High Level Operations Plan (HLOP): Q1 2013
- Confirmation of operational funding for GSC overall and collaborative interfaces in particular (GSC Segment-3): November 2012 (C-MIN)



Thank you for your attention