COSMO-SkyMed Interoperability, Expandability and Multi-Sensor Capabilities: The Keys for Full Multi-Mission Spectrum Operations

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ABSTRACT

Historically, Earth Observation (EO) missions have largely been technology-driven. A promising idea for an instrument design has often been the starting point for a satellite mission specifically conceived to satisfy certain scientific requirements.

This situation has led to a high number of scattered facilities each providing different specific, regional, thematic functions such as near real time data production and distribution, off-line archive and distribution, and added value services with complex data and information flows.

This has created a high level of complexity for the users to find and access the EO data, and an infrastructural overcapacity in the basic data services. This led, in turn, to usage, operational and cost inefficiencies over such different EO systems (operations of different systems, different cultures, procedures, formats, etc.)

Some initiatives, such as GMES (Global Monitoring for Environment and Security), GEOSS (Global Environment Outlook Support System), aim to find a viable way to provide cost-effective solutions, simple access to Multi-Mission/ Multi-Sensor (MM-MS) capabilities, and streamlined operations.

COSMO-SkyMed is an Earth Observation system born to cope with dual-use (i.e. military and civilian) and Multi-mission (SAR, Optical, ...) requirements to further expand to other sensors. Within this perspective, it is a highly innovative system, presenting cutting-edge MM-MS capabilities and, as such, capable to fully cope with the above needs. [1]

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This paper describes how COSMO-SkyMed is able to manage the whole MM-MS life cycle, from the deposit of a multi-sensor request to the delivery of the multi-sensor product.

A deep in-sight of such capabilities is provided explaining the related mechanisms:

- ***Interoperability** which allows to exchange Imagery Requests, catalogues and products through standard protocols and formats*
- ***Expandability** which allows to plug-in into COSMO SkyMed "partner elements" (called PFI-Partner Furnished Items) able to provide programming, acquisition and production functionality for different systems-sensors.*

The benefits of such capability is shown, in terms of both costs and user-friendliness, through actual cases, taken from current International cooperation's ASI is carrying on (ORFEO, SIASGE).

As such, we do believe that COSMO SkyMed is a valuable workbench to support current initiatives such as, but not limited to, the abovementioned GMES/GEOSS.

1. THE COSMO ARCHITECTURAL SCHEME FOR MULTI-MISSION AND MULTI-SENSORIALITY

The COSMO-SkyMed architecture has a much wider scope than a mission-dedicated system. Actually, from the elder design phases, COSMO-SkyMed has been envisaged as an outstanding versatile system such to cover a large variety of Defense and Civilian utilisation needs for SAR imagery. These highly versatile architectural elements are in turn: (1) the constellation of four satellites, (2) a multi-mode high resolution SAR instrument, and (3) the Dual Ground Segment.

The "native" high versatility characteristics of COSMO-SkyMed led the Italian Space Agency (ASI) and Ministry of Defense (MoD) to further promote these characteristics, looking forward an actual multi-mission architectural framework. This challenge envisages the COSMO-SkyMed system capable to be integrated and/or cooperating with heterogeneous Partner's EO systems, in order to plan multi-mission requests, and to exploit mission data from heterogeneous EO sensors, thous also saving not aonlu operational costs. But development/ integration as well.

This will constitute an EO system with first-class observation features capable to request, generate, process, and correlate imaging data products and information coming from combined observations of different sensors, e.g. multi-band SAR data, optical and SAR images, to provide Earth Observation integrated services to large User Communities and Partner Countries.

The multi-mission objective is pursued by ASI and MoD through a twofold strategy by: (1) establishing agreements with international Partners for sharing the EO assets, and (2) driving the COSMO-SkyMed system design and interfaces in order to achieve such an objective.

In order to fulfil these requirements, the COSMO-SkyMed architecture relies on the following key design features:

- *Interoperability* i.e. the capability of exchanging data and information with external heterogeneous systems according to pre-defined agreed modalities and standards, and irrespective of internal design of the cooperating parts. The COSMO-SkyMed architecture implements standard Catalogue Interoperability Protocol based on CEOS [1] guidelines, through which it provides access to a variety of EO systems worldwide, to cover the observation needs of the

[1] CEOS is the "Committee on Earth Observation Satellites".

largest number and typologies of Users, mainly for civilian institutional, commercial, and scientific purposes.

- *Multi-Sensoriality* i.e. the system ability to request, process, and manage data related to different observation sensors. At the time being, COSMO-SkyMed is envisaged to manage the following sensor data: X-band SAR data from its own spacecraft constellation, SAR Bistatic for interferometry, L-band SAR data from Argentinean SAOCOM satellites, and optical imaging data from the French 'Pleiades' constellation.

  Multi-sensoriality concerns a number of end-to-end functional chains, in turn: (1) *Mission Programming Chain*, including depositing, analysis, harmonisation of Programming Requests for acquisition from multiple sensors, up to the scheduling of the related image data takes, (2) *Image Chain*, to process data generated from different sensors, then to extract and to correlate the imaging features, and (3) *User Service Chain* providing End-Users with the capability of searching and ordering products from different sensors, as well as multi-sensor (e.g. co-registration) products.

  It should be pointed out that the Multi-Sensoriality feature does not necessarily imply the co-location of all architectural elements related to different sensor data in the same GS site. For example, a multi-sensor User Service Chain can be implemented through standard Catalogue Interoperability established among EO systems "federated" to provide integrated system services to the User community.

- *Expandability* i.e. the ability of an architecture to embody *mission-specific* components "imported" from Partner's EO System, thus designated as PFI (i.e. Partner's Furnished Items). The COSMO-SkyMed architecture is designed to manage several PFI's from different Partner's Systems, such as: (1) Acquisition Chain, (2) Processing Chain, and (3) Programming Chain, in order to *locally* achieve multi-mission and multi-sensor capabilities. Reciprocally, COSMO mission-specific components can be configured as PFI to be exported towards Partner's EO Systems. A clear specification of PFI's scope and interfaces constitute key issues for COSMO architecture expandability feature.

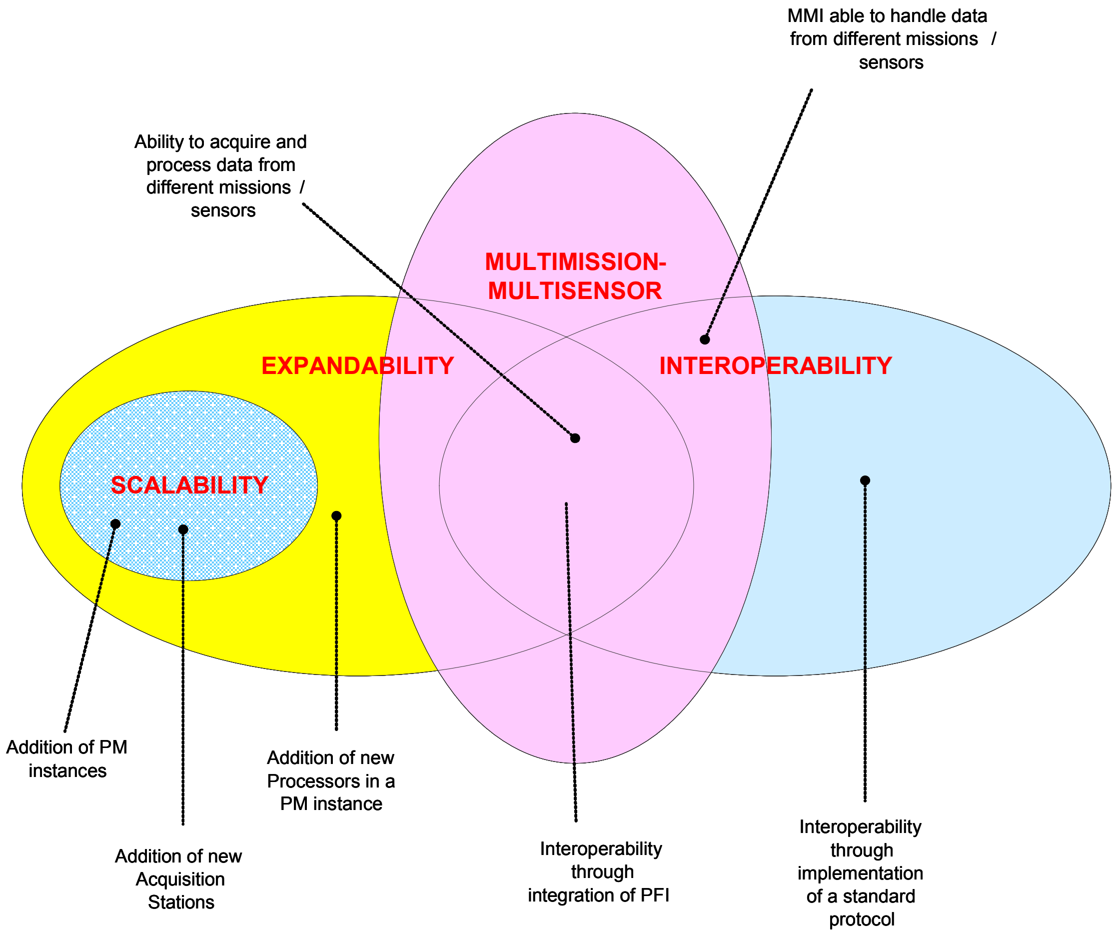
  A technically sound and cost effective expandability shall avoid unnecessary duplication of components for implementing functional chains related to different missions or sensors. This mainly depends on two aspects: (1) a scalable GS architecture, and (2) a clear identification of *mission-generic* elements, interacting with mission-specific elements through given interfaces.

  COSMO-SkyMed GS achieves both aspects. Scalability[2] is ensured through the GS modular design, which allows to increase capacities through plugging-in modules easily configurable and managed by the pre-existing architectural infrastructure.

  This modularity also helps in identifying and implementing mission-generic and mission-specific modules. The latter are conceived as plug-ins into the common infrastructure provided by the mission-generic components. For example, the Processor Encapsulator (PE) is an UGS mission-generic element that provides services to a variety of (mission-specific) Instrument Processors.

Next figure provides a pictorial view of the above concepts.

[2] Scalability is the capability to fulfil increasing performance needs (e.g. a higher number of products) by adding 'copies' of modules already part of the system architecture, and properly configuring them in order to make the whole system working at the requested performance levels.



Let us delineate in more detail how the aforementioned key elements of COSMO architecture achieve the multi-mission and multi-sensor features.

First, the spacecraft constellation. COSMO-SkyMed, in full orbit configuration, consists of a constellation of four satellites equi-phased in a sun-synchronous Low Earth Orbit (LEO) plane.

This design choice constitutes a strongly *scalable* EO System, which provides progressively increasing operational capabilities and performances, depending on number and orbital characteristics of the satellites deployed in orbit and put into operations.

Nowadays constellation represents an emerging concept for Earth Observation, in which sensing capabilities and orbital characteristics of a group of satellite are correlated such to provide *global operational performances*. Indeed a spacecraft constellation can significantly shorten revisit time of sites and imaging data latencies, providing performance levels not reachable by a single satellite even though large sized and hosting technologically advanced observation sensors, and specially allow a staggered deployment, scaling the reachable performance and a graceful degradation, along with the number of satellites deployed.

The COSMO-SkyMed system architecture, particularly its Ground Segment, is conceived to manage and exploit the whole spacecraft constellation. This multi-satellite framework leads us to conceive a system architecture capable to simultaneously face with several satellites in different phases (e.g. one in routine, the other in commissioning phase), operational mode, or instrument performances. Thus, the same system architecture can simultaneously manage satellites in different operational conditions and characteristics, in terms of activity planning and tasking, satellite characteristics parameters (Mission DB, planning DB), science data processing, instrument performances and calibration, operational profiles, and chronologies.

Now, these multi-satellite characteristics of COSMO-SkyMed architecture can be easily extended to become "multi-mission" features.

A significant example of this evolution is the COSMO-SkyMed integration with another Satellite System carrying a SAR instrument of different wavelength band. This objective has been pursued by ASI, in the framework of SIASGE Italian cooperation with Argentina, in which SAOCOM L-band SAR constellation is operationally integrated with COSMO-SkyMed system, with the aim of producing multi-spectral (X+L band) radar observation, and the enlargement of the system services offered to End-Users.

A SAOCOM satellite has similar orbital characteristics of COSMO-SkyMed, for example a repeat cycle of 16 days per satellite (same as for COSMO satellite).

This orbit repeat cycle (i.e. the time period in which a satellite starts to overlap its ground tracks) is a very important parameter for mission programming. Indeed it establishes the (mid-term) planning horizon for a satellite, which cover the complete cycle of satellite activities, thus an image taking which is not feasible within a repeat cycle, it is not feasible at all.

Therefore, the same repeat cycle of COSMO and SAOCOM satellite allows us to establish a common planning cycle and fixed operational chronologies for both constellations, to meaningfully define the Programming Requests, schedule image acquisitions, receive the download data from satellites, and then process and correlate the relevant SAR imaging data.

The above case does not represent the solely condition in which COSMO-SkyMed can cooperate with Partner's EO systems. Actually the cooperation can be implemented through a flexible architectural schema which takes advantages from the other two key elements characterising the COSMO-SkyMed system architecture: the multimode SAR, and a versatile dual Ground Segment.

Indeed, significant advantages derive from the large operative capacities of the multi-mode SAR instrument to take a high number of images at different acquisition modes, size, resolution, polarization and geolocation accuracy such to optimally provide the appropriate services that cover *different* utilization needs from Defense Users, and civilian Users as well. This versatility schema can be adopted also in the multi-mission cooperation scenario, differentiated between the international Defense cooperation, and the worldwide civilian use.

These differences concern both the provision of services /images with different characteristics, and the Ground Segment architecture that implements the cooperation in Defense and civilian scenario.

In concerning the architectural aspect, the versatility of COSMO-SkyMed Ground Segment allows us to identify the most appropriate mix of features (i.e. interoperability, multi-sensoriality, expandability) that optimally fulfil the specific cooperation needs respectively for Defense and civilian domains.

In general terms, the cooperation scenario for civilian domain privileges geographically distributed architectural solutions, in which the mission-specific capabilities reside on "proprietary" EO Systems, interoperable and federated such to provide integrated system services to the largest User community worldwide. Thus civilian multi-mission and multi-sensor scenario are implemented through more "service-bound" solutions obtained through interoperability and federation of Partner EO Systems.

On the other hand, multi-mission and multi-sensor cooperation scenario within the Defense domain shall also fulfil data confidentiality, integrity, and availability requirements, which are indispensable conditions for Defense use. Thus the cooperation scenario for Defense adopts a more "architecture-bound" solution, based on Ground Segment expandability.

This versatility can be better represented through the COSMO-SkyMed User Ground Segment (UGS) generic architecture.

This architecture, shown in the following figure, is "generic" since it represents the multi-mission and multi-sensor features of both UGS instances, i.e. civilian and Defense. Actually the generic architecture gives a complete picture of these features, which can be opportunely selected to compose either the Civilian UGS or the Defense UGS specific architecture.

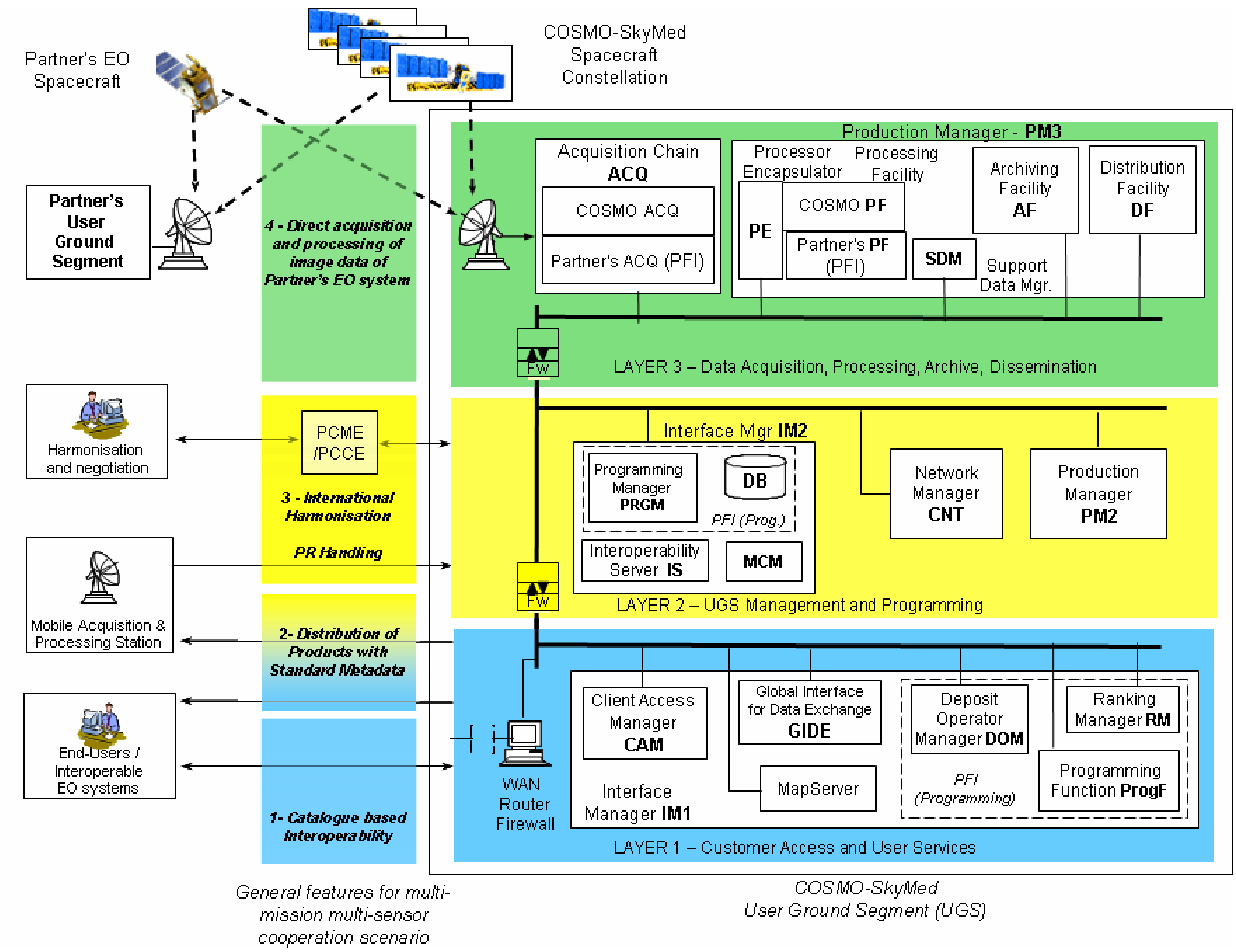


Figure 1 – COSMO-SkyMed UGS generic architecture implementing multi-mission and multi-sensor scenario.

The UGS generic architecture above shows the following multi-mission and multi-sensor features:

Catalogue-based Interoperability

This feature provides the possibility of accessing the catalogue of Partner's EO systems, searching for given products, ordering them, and receiving the queried products. Reciprocally, COSMO-SkyMed UGS allows the same type of access to Partner's EO systems. This interoperability is implemented through gateways which:

- import and maintain image data and descriptors from the Catalogues of the Partner's systems
- allow the access to Partner's data through a Catalogue Interoperability Protocol (CIP) developed according to CEOS guidelines
- manage the data importing and distribution to the Petitioners

This catalogue-based interoperability is a powerful feature, which allows the End-Users to access a worldwide network of EO cataloguing systems covering the largest and different business needs for imaging and information extraction. However, it is quite obvious that the feature is almost exclusively conceived for civilian use. For Defense, catalogue interoperability is restricted to few capabilities for administration and alignment of a Distributed Catalogue System among national Defense sites (e.g. D-UGS centre, distant cells, mobile station).

Distribution of Products with Standard Metadata

The image products are generated and managed in standard formats. In COSMO-SkyMed GS civilian context, data are handled in HDF5 format with metadata according to CEOS guidelines, whilst in Defense context, data are formatted according to standard STANAG 4545 NATO Secondary Imagery Format.

Programming Requests Handling, and International Harmonisation

This feature is implemented among strictly cooperating EO systems, either operatively integrated (e.g. the COSMO and SAOCOM case) or belonging to a services federation (e.g. COSMO-SkyMed (SAR) and Pleiades (optical) constellation). Its main purpose is the elaboration of Programming Requests related to different missions or sensor acquisitions, to include:

- ingestion of Imagery Requests from End-Users and compatibility checking wrt mission constraints
- PR (Programming Request) elaboration and depositing: definition of the scenes, decomposition in meshes, feasibility checking wrt resource constraints and sensor operational characteristics, identification of related Data Taking Opportunities (DTO), computation of quota utilisation associated to DTOs
- assignment of a priority value to the PR, generation of the priority PR's list in a given planning horizon, PR list conflict resolution, ranking, and generation of the (prioritised) PR Plan
- Harmonisation among PR Plans issued from international Partners in concerning the specific mission / sensor being addressed, taking into account the agreed resource sharing rules and the utilisation quota allocated to each Defense Partner.

The *entire* functional process delineated above applies to Defense domain, and it is carried out by specific components embedded into the Defense UGS (D-UGS) architecture "expanded" to the given Partner's mission programming function. Reciprocally, Partner's Defense GS facilities embed COSMO Mission Programming elements to perform analogous capabilities.

The Civilian domain can also implement part of the multi-mission programming process delineated above, though using design solution which may differ from pure expandability. For example, mission-specific programming capabilities may reside on their "native" system sites, being addressable through an advanced Product Ordering interoperability mechanisms. A similar approach is adopted by COSMO Civilian UGS for planning harmonisation among "privileged" civilian Partners, which can remotely access a PCCE server (i.e. "Program Coordinated Civilian Entity") to complete and mutually harmonise their PR Plans.

It should be pointed out that the "mission programming interoperability" among civilian Partners is also envisaged for the future GMES interoperability scenario, as an evolution of the existing ESA Multi-Mission User Services (MMUS). Therefore, also for this aspect, COSMO-SkyMed can be seen as a precursor that indicates key concepts and design approach for future Global Systems made by several interoperable missions.

Direct Acquisition and Processing of Image data of Partner's EO system

This feature can be implemented through design expandability, previously delineated. It mainly applies to Defense UGS, which is designed to host the whole end-to-end acquisition, processing, archiving, cataloguing, and distribution PFI chains related to Partner's mission data.

Civilian UGS (C-UGS) architecture, whose basic infrastructures and expandability features are similar to Defense UGS, can also be expanded to host specific PFI components. However, the Civilian UGS expandability schema can be more flexible than Defense UGS, based on geographical distribution of resources among Partners, thus achieving a better cost-effective solution. For example, we can assume that the C-UGS is capable to receive level 0 data from the Partner's site, and to locally process this data by its own PFI processors hosted at C-UGS.

The further PFI configuration at Civilian UGS to encompass future Partner's missions (e.g. GMES) is envisaged to be finalised during the system operative lifetime, depending on the actual applicative needs, and budget constraints. It should be pointed out that a future adding-on of PFI components into the C-UGS architecture will not imply substantial redesign, but only the installation and configuration of recurrent PFI components, as already operations-proven at D-UGS.

2. COSMO-SKYMED IMPLEMENTATION CASES OF MULTI-MISSION AND MULTI-SENSOR ARCHITECTURE

This paragraph delineates specific implementation cases of COSMO-SkyMed multi-mission and multi-sensor features felt particularly important for Civilian and/or Defense domain. These cases concern:

- Catalogue-based Interoperability
- Multi-Mission Programming Requests elaboration and harmonisation

As mentioned in the previous paragraph, the former is fundamental for the civilian worldwide business, whilst the latter, implemented through UGS architecture expandability, may be mandatory for the Defense domain.

As such, COSMO-SkyMed (civilian) architecture provides interoperability features based on CEOS guidelines on Catalogue Interoperable Schema. Services are offered through a Catalogue Interoperability Protocol (CIP) that is a Language enabling systems to exchange information by search & retrieval methods. Four level of interoperability are envisaged in CEOS guidelines:

- Level 1: An User accessing one service is routed directly to another related service offered by a CEOS partner; the context is not transferred, so the User has to issue a new connection to the Partner.
- Level 2: An User accessing one service is routed directly to another related service offered by a CEOS partner; the context is transferred, so the User is not required to issue a new connection to the Partner.
- Level 3: The user is hidden from the specific operations of each service. So a service request is routed automatically to one or more services, and the result from each Partner is transparently returned to the User (Petitioner).

- Level 4: A single data model applies to all services among the interoperable systems; thus an User's query is executed by using a single distributed Database.

COSMO-SkyMed implements the *level 3* of Interoperability, assuming that each Partner has a proper database, i.e. there is no a homogeneous architecture among Partners. Therefore, on receipt of an User's query implying access to more Partner's catalogues, COSMO-SkyMed automatically generates and forward queries to the relevant Partner's systems, in order to retrieve the searched data.

COSMO implements a multi-mission Catalogue Distributed System which can be shared among Partners. This catalogue is divided into collections, that are a set of homogeneous data identified by: couple of attributes (e.g. Satellite, Sensor) for raw data and products, attribute product type, for value-adding products and mixed products, and information concerning data location within the distributed data base.

The following table summarizes the services specified in the CEOS guidelines, and the specific implementation provided by COSMO-SkyMed Catalogue Distributed System architecture.

CEOS Guidelines on Catalogue Interoperable Schema		**COSMO-SkyMed Catalogue Distributed System implementation**	
Service	Description	Feature	Description
Directory Service	Provide high level information about metadata or data set catalogues available	**Catalogue Search**	Directory Search Service lists the collections available on Catalogue Distributed System
Guide Service	provide detailed background information about specific data sets such as satellite, sensor, resolution, format, processing algorithms etc.		Guide Search service provides data about collections characteristics including coverage area, resolution, temporal coverage, sensor and mission information, searchable attributes, resolution, key attribute, etc.
Inventory Service	provide information about individual data granules such as acquisition date, satellite, spatial or spectral resolution, geographic coverage; quality parameters (e.g. cloud cover, missing lines) and information about ordering (e.g. price).		Inventory Search service retrieves detailed information about collection items from the UGS catalogue
Browse Service	provide the possibility to view quick look (low-resolution image) of products and to determine whether they are satisfying for the user	**Service Request**	Manage ordering and delivering of services issued from an User to UGS, or towards a Partner's EO System, or vice-versa. A Service Request is submitted through the following steps: • List Request returns the list of available services • Parameter Request returns the list of parameters needed to be specified by the user • Service Request to specify the service parameters • Confirmation about the preceding service request • Service Request Status to monitor the status of issued orders.
Order Service	Manage ordering, formatting and delivering of data		
Security services	Provide authentication and authorization features	**Authentication Service**	Provide tools to check the user login and authorizations and to release the current session. A customer of Civilian UGS or a Partner's EO System requesting a service to the UGS has to follow the authentication procedure before, and make a disconnection from UGS after. If the User misses to issue the disconnection, connection to UGS is automatically closed on time out
		Notify Service	Notify about adding, deleting and updating of the structure of collections within the Catalogue Distributed System
		Update service	Provide methods to load, insert and delete information into the UGS Catalogue. This service is used internally to UGS and with fully integrated systems (e.g. MAPS) in order to store into the Catalogue metadata related to satellite acquired data

The Multi-Mission Programming Requests elaboration and harmonisation features are already delineated in the previous paragraph. Herein we intend to outline some key issues related to their implementation within the Defense UGS as a part of its expanded architecture. As anticipated in the previous paragraph, the key for a successful implementation is to clearly identify and specify mission-generic and mission-dependent components, and their interfaces.

Now, mission programming is highly mission dependent. However a common software platform is created to support the necessary interfaces with the D-UGS, as well as to provide the basic technologies, which implements generic functionality reusable for COSMO-SkyMed and Partner's satellites, where the specific mission-dependent features are plugged-in.

Function supported by this mission-generic environment are:

- the Human Computer Interface, which provide the Deposit Operator with homogeneous graphical screens for different mission planning, e.g. for depositing, syntax checking, and manipulation of Programming Requests for different missions
- Report Generation facilities
- Management of and access to Auxiliary Data Files (e.g. meteo data) in use for planning purpose
- PR list compilation and ranking functions
- Libraries for administration and accessing to mission-dependent planning data bases (e.g. SAR and optical missions)
- Protocols to perform international harmonisation and negotiation

On the other hand, the mission-dependent features mainly concern planning data bases for the specific mission / sensor to operate. Planning data bases contain reference data addressing the specific features of mission / sensor acquisition, such as:

- Setting parameters for controlling and configuring the observation instrument in a given imaging mode
- parameters related to the duration of the acquisition
- parameters related to the ancillary part (calibration and noise) of the acquisition
- parameters related to the image size
- parameters related to platform maneuver requested by instrument imaging (e.g. roll slew manoeuvre for SAR right/left viewing mode)

3. SUMMARY AND CONCLUSIONS

COSMO-SkyMed constitutes a primary example of EO system cooperating and interoperating with Partner's EO systems with the aim to provide multi-mission and multi-sensor integrated services to the largest number and variety of End-Users worldwide.

Specific cases of COSMO-SkyMed cooperation with Partner's EO systems are delineated, from the integration (i.e. with SAOCOM L-band SAR constellation) to a looser coupling, based on catalogue interoperability or on a federation of services (i.e. with French Pleiades optical satellites).

The multi-mission objectives are pursued by ASI and MoD through agreements with international Partners for sharing the EO assets, and by driving the COSMO-SkyMed system design and interfaces in order to achieve such objectives. These requirements led to define the COSMO-SkyMed system architecture with strong interoperability, multi-sensoriality, and expandability design features, whose meaning and impact are delineated.

These design characteristics are deeply rooted into the “native” versatility of the key elements composing the COSMO-SkyMed System Architecture, that is the SAR spacecraft constellation, the embarked multi-mode high resolution SAR instrument, and the Dual Ground Segment.

This versatility is also fundamental to optimally provide the appropriate services that cover *different* utilisation needs of Defense domain, and Civilian domain, e.g. for provision of images at different size, resolution, and geolocation accuracy. This versatility schema can be adopted also in the multi-mission cooperation scenario, differentiated between the international Defense cooperation, and the worldwide civilian use.

These differences mainly concern the Ground Segment configuration that differently implements the cooperation in the Defense and Civilian scenarios. The versatility of COSMO-SkyMed Ground Segment allows us to identify the most appropriate mix of features (i.e. interoperability, multi-sensoriality, multi-mission, expandability) that optimally fulfil the specific cooperation needs respectively for these two domains. Then, the cooperation scenario for civilian domain privileges geographically distributed architectural solutions, in which the mission-specific capabilities reside on “proprietary” EO Systems, interoperable and federated such to provide integrated system services to the largest User community worldwide. This designates a more “service-bound” solution for multi-mission and multi-sensor functionality provided to Civilian domain.

On the other hand, multi-mission and multi-sensor cooperation scenario within the Defense domain must fulfil data confidentiality, integrity, and availability requirements, deemed indispensable conditions for Defense use. Thus the cooperation scenario for Defense adopts a more “architecture-bound” solution, based on Ground Segment expandability to Partner Furnished Items (PFI) physical components.

Specific implementation cases are discussed for both Civilian and Defense domains, such as:

- Catalogue Interoperability Schema, implemented mainly for civilian use, and
- Multi-Mission Programming and International Harmonisation feature, implemented through UGS architecture expandability, in use for Defense domain and (with some differences) also for civilian domain.

Finally, in concerning the implementation aspects of a GS architecture scalable and expandable, it is underlined the importance of a correct identification and specification of both mission-generic and mission-dependent components, and of their interfaces. This avoid unnecessary duplication, and allows to achieve a cost effective architecture based on reusable (i.e. mission-generic) infrastructure and software “middleware”.

The approach followed in COSMO-SkyMed GS implementation is to identify, to the largest possible extent, Mission-generic facilities and components, limiting the mission-specific ones at the strictly necessary. This approach is targeted to fulfil requirements, as well as augmenting the possibility of reusing components, while reducing costs involved in Development, and Operations and Maintenance during the system operative lifetime.

All these features, though relevant to national EO Systems, share many aspects with global mission concept which International Agencies and organisations (e.g. ESA, European Community) are currently being defined, in terms of operational concepts, functions, key architectural definitions, and development approach.

This "common view" configures COSMO-SkyMed as a *precursor* indicating key concepts and approach for the future Global Systems made by several interoperable and cooperating Earth Observation missions, and heterogeneous (e.g. non-space) systems as well.

4. REFERENCES

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