Design and interface requirement for coverage management D10

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PU = Public,

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Abstract

This document describes the detailed design of the Coverage use case identified in the D2.2 Use Case Definition document.

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List of participants

Participant No	Participant organisation name	Country
1 (Coordinator)	Airbus Defence and Space SAS	FR
2	Capgemini Technology Services	FR
3	ITTI SP ZOO	PL
4	Oikoplus Gmbh	AT
5	Office National d'Etudes et de Recherches Aérospatiales	FR
6	Tilde SIA	LV
7	VVA Brussels	BE
8	Airbus Defence and Space GmbH	DE

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Applicable documents

Ref. / Document Title	Ref	Date
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Domino-E Grant Agreement 101082230	Ares(2022)7032529	11/10/2022
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Acronyms & Definitions	
AB	*Advisory Board*
EC	European Commission
EU	European Union
REA	Research Executive Agency
UAB	User Advisory Board
WP	Work Package
	To be completed

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1 INTRODUCTION

1.1 Scope

This document presents the design the of the use case Coverage (WP3000). It specifies the requirements that apply to the Federation Service in order to implement the use case defined in the Use Case Definition document.

1.2 Structure of the document

The document is organised as follows:
- this chapter gives an overview of the document and explains the requirement formalism;
- chapter 3 explains the vocabulary used;
- chapter 4 briefly introduces the component;
- chapter 5 describes its use cases;
- chapter 6 lists the functional requirements of the component;
- the following chapters give the non-functional requirements of the component:
  - deployment requirements in chapter 7;
  - operational requirements in chapter 8;
  - performance requirements in chapter 9;
  - security requirements in chapter 10;
  - external interfaces requirements in chapter 11;
  - design and development requirements in chapter 12;
  - testability requirements in chapter 13;
  - export control requirement in chapter 14.

1.3 Reading keys

Requirements within this document are described using the same format, consisting in several lines:
- a requirement identifier line, on the form [IDENTIFIER_CODE] Identifier Title;
- the requirement text;
- a set of attributes (one per line);
- an optional note;
- a tag [ReqEnd] to delimit the requirement.

The requirement text follows the requirement identifier line. If tables are considered as part of a requirement, they are referenced clearly in the text, inserted after and separated from the requirement and are managed as free text attached to the identifier requirement. All the attributes are prefixed by "DECOVER_".
Among the possible attributes, "DECOVER_Verification Method" is mandatory. The **Verification Method** codes are as follows (as per ECSS):
- R for Review of Design;

- **A** for Analysis;
- **I** for Inspection;
- **T** for Test;
- Any combination of the previous codes, comma separated, when a requirement needs to be verified using several methods (for example: T, I).

All document elements not presented in the format explained above are not requirements and will not be verified or tracked.
The following gives an example of the format of a requirement:

[DE-COVER-REQ-00100] Requirement Title

Requirement text.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

2. DEFINITION AND ACRONYMS

Definition and acronyms can be found in the Domino-X Glossary included in the [RD01].

2.1 Acronyms

The following table lists some additional acronyms used in this document:

Acronym	Meaning
REST	Representational State Transfer
ACS	Archive/Catalogue Service
ADGS	Auxiliary Data Gathering Service
APS	Advanced Processing Service
CS	TM/TC Ciphering Service
DDS	Data Distribution Service
DITS	Data Integrity and Traceability Service
EPS	Enhanced Processing Service
FDS	Flight Dynamic Service
FOS	Flight Operation Service
FS	Federation Service
INTS	Interoperability Service
IQS	Image Quality Service
KBDS	Knowledge Builder and Decision Service
MAPQS	Machine-learning Application Production & Quality Service
MPS	Mission Programming Service
OMS	Operational Monitoring Service
PPS	Primary Processing Service
SCMS	System Configuration Management Service

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SCRMS	**Satellite Communication and Resources Management Service**
SMS	**Security Monitoring Service**
SSS	**Satellite Simulator Service**
UAS	**User Access Service**

Table 1: Acronyms

2.2 Terms

The following table lists some additional terminology used in this document, and its context:

Term	Meaning	Context

Table 2: Terminology

Those terms are generally used throughout this document with the following convention: each compound word has the first letter capitalised (as in the first column of this table).

3. GROUND SEGMENT OVERALL DESCRIPTION

See Domino-X Architecture.

4. COMPONENT OVERVIEW

4.1 Component Main Role

The main component involved in the WP3000 is the Federation Service.
The Federation Service (FS) domino is in charge of offering unified services to the UAS while optimizing the use of federated systems and performing orchestration of dominoes activities. It gathers functions for User Requests management, and sequencing of related processing activities. [FS] Domino owns the User Requests, as so it is in charge of storing them and every updates related to them (updates, follow-up and cancellation).

The main functions of the [FS] Domino are:
- Distribution of federated systems capabilities
- User Requests management
- Programming requests feasibility analyses
- Multi-mission programming

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- Management of production "inter dominoes" workflows
- Management of event follow-up requests including automatic reprogramming
- Notifications to UAS

4.2 Stakeholders Identification

In this work package, the Federation Service is in interface with:
- User Access Service to receive the User Requests and analysis requests
- Mission Programming Service to push the programming requests and perform intrinsic analysis
- Interoperability Service to push the programming requests

4.3 System Data Model

The following diagram presents the Federation Service Domino and all its functional flows. A focus on the coverage use case is presented in the next sections.

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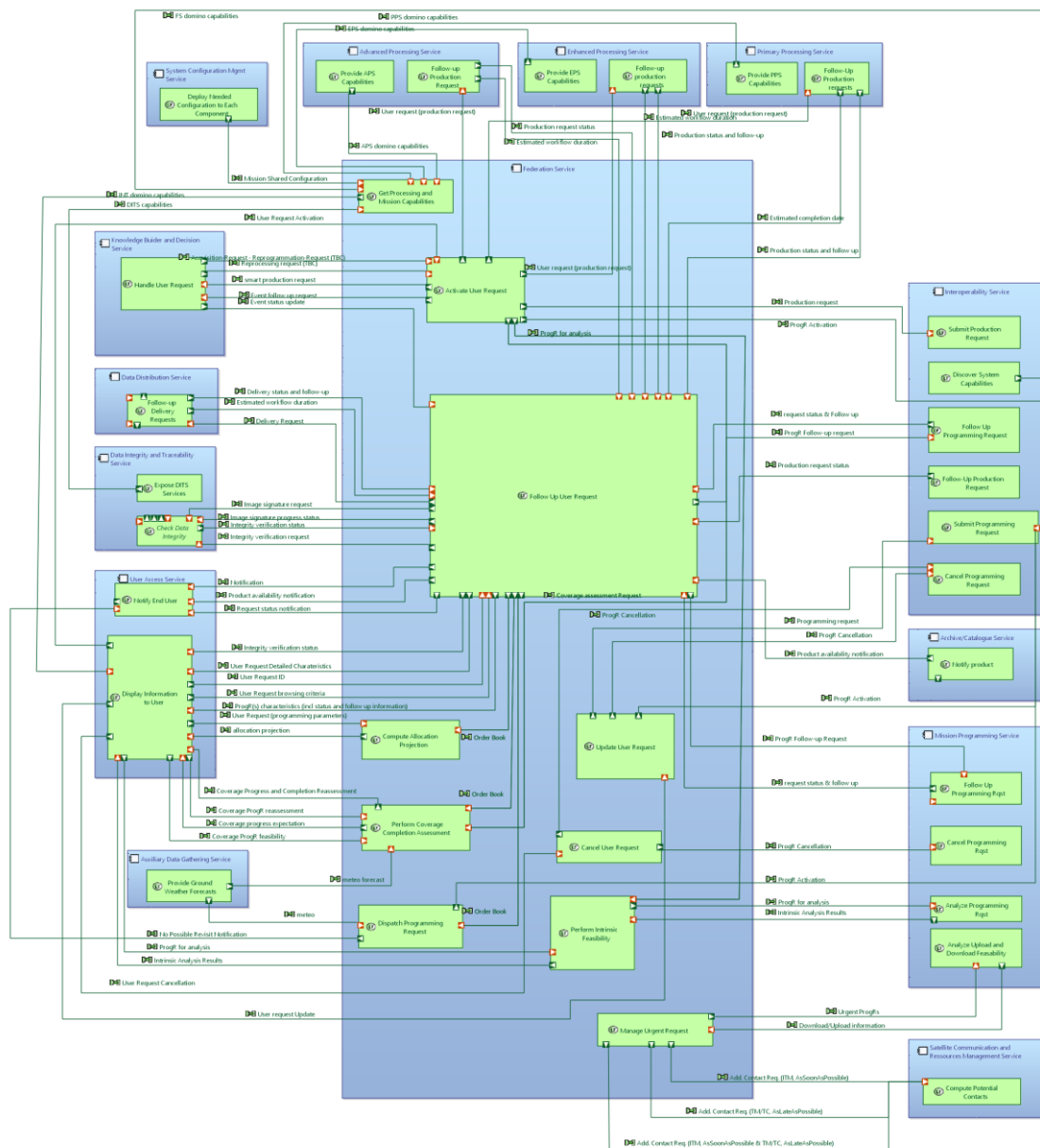
Figure 1: Context diagram of the Federation Service Domino.

4.4   Use Cases Identification

The use case considered in this document is described in the D2.2 Use Case Document. The main goal of this use case is to provide a coverage capability using several systems and evaluating the results depending on the followed strategy for acquisition subdivisions between systems for coverage requests.

4.4.1   Subdivision of the area of interest (case 1)

There are three strategies studied for the subdivision of the area of interest, each growing in complexity from the previous one.

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4.4.1.1 Subdivision chosen by the End User (Case 1.a)

In this case, the End User chooses the subdivisions of its area of interest and allocate each subdivision to only one constellation to be programmed on. A dispatch is not necessary in this case since the End User has already chosen the constellation, only the completion assessment and reassessment are used.

The following sequence diagram details the exchanges involved in this use case. In the green zone, the detailed functions of the Federation Service Domino involved can be found.
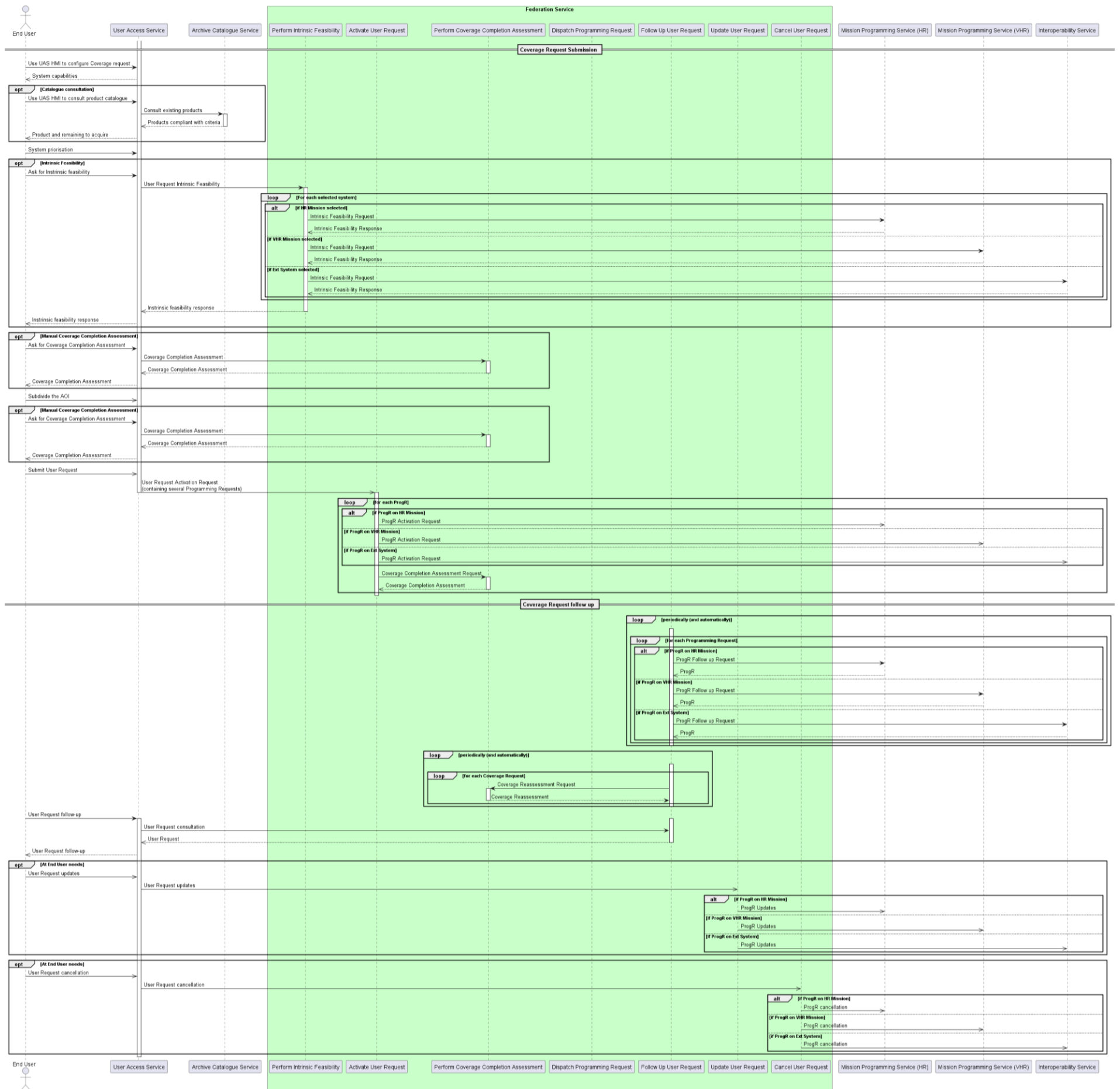
coverage_detailed_
1_a.png

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Figure 2: Case 1.a sequence diagram.

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In this use case, the following steps are involved:
- The End User connects to the UAS and can optionally browse existing products from the catalogue and build a User Request to program some image acquisitions;
- He can optionally request an Intrinsic Feasibility Analysis to know the possible accesses for its Programming Request and the associated meshing ;
- He can request for a Completion Assessment that will return for each constellation the estimation completion of the Programming Request over time;
- The End User chooses the subdivision of its area and for each sub area can request a Completion Assessment in order to choose the sub area–constellation allocation;
- At the User Request submission, one Programming Order by sub area is submitted on the allocated constellation ([MPS] or [INTS] corresponding dominoes) and an initial Completion Assessment is automatically performed and stored;
- Automatically and periodically [FS] performs a follow-up to the [MPS] or [INTS] where the Programming Requests have been submitted, a Completion Reassessment is also performed to know if the progress of the Programming Requests is according the expected;
- The End User can consult the progress of its User Requests, updates or cancels them.

4.4.1.2 Subdivision performed automatically at request submission (case 1.b)

In this case, the End User does not choose himself the subdivision and the constellation allocation but the Federation Service Domino is in charge of these actions. The End User submits its User Request after selecting the constellations that can be considered for the coverage of its request. The Federation Service Domino is in charge of choosing the adequate subdivisions of the request and their allocation to constellations in order to optimize the delay of completion of the full request. Once the subdivision is chosen and the associated Programming Requests have been submitted to the [MPS] or [INTS] dominoes, the subdivisions and allocations cannot be changed.

The following sequence diagram details the exchanges involved in this use case. In the green zone, the detailed functions of the Federation Service domino involved can be found.

coverage_detailed_
1_c.png

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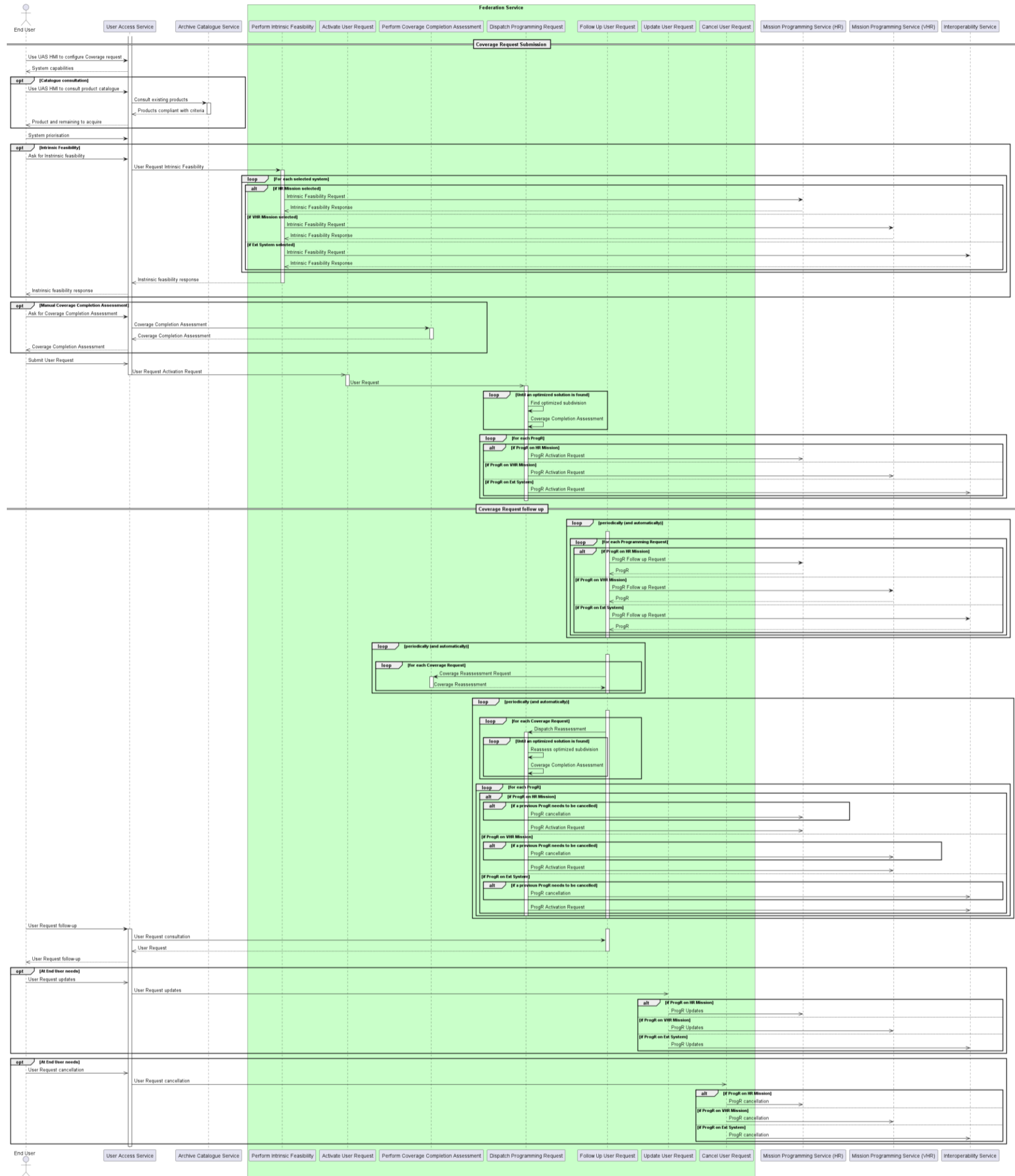
Figure 3: Case 1.b sequence diagram.

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4.4.1.3 Submission performed and reassessed automatically (case 1.c)

This case is an extension of the previous use case. The subdivision of the user request is performed at the User Request submission but during the automatic reassessment of the completion date, the Federation Service may attempt to find a new optimized subdivision for the remaining tasks to acquire for the User Request. This problem is more complex than the previous one since this reassessment needs to take into account all the requests that have to be reassessed at once, which importantly increases the combinatorial complexity of the problem compared to the initial assessment.

The following sequence diagram details the exchanges involved in this use case. In the green zone, the detailed functions of the Federation Service Domino involved can be found.

coverage_detailed_
1_c.png

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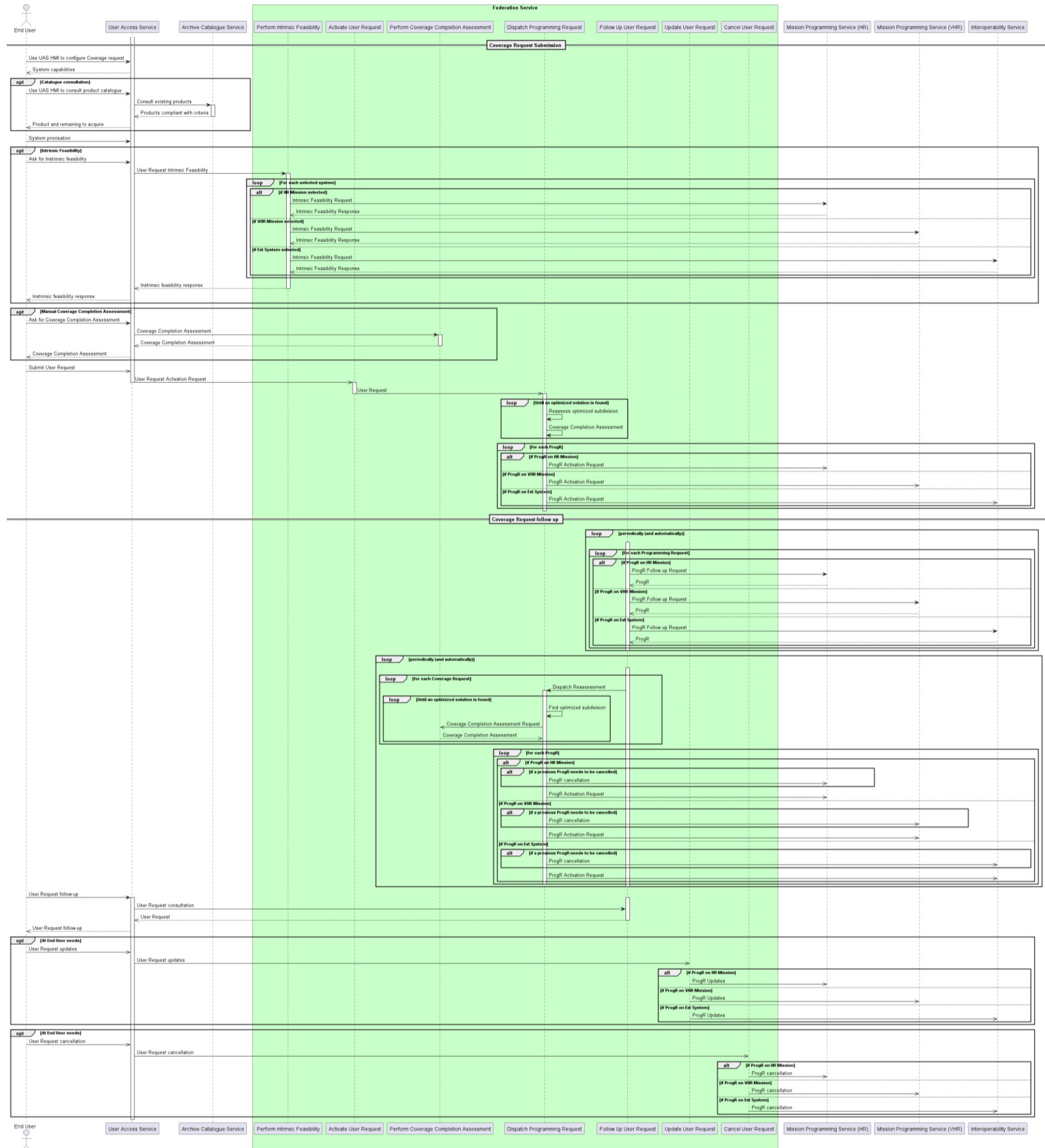
Figure 4: Case 1.c sequence diagram.

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4.4.2 No Subdivision of the area of interest (case 2)

The second case study does not subdivide the area of interest for a constellation allocation. It considers at each dispatch reassessment what are the meshes and associated constellations that could be relevant to create the Programming Request accordingly.
In this use case, the completion assessment is not performed due to the complexity to estimate all the possible combinations for programming requests allocations. Even if this brick would be necessary operationally, **it will not be prototyped in DOMINO-E** to focus on the planning part.

4.4.2.1 Use fixed meshing of the area of interest (Case 2.a)

In this case, the Federation Service periodically dispatches some Programming Requests on dedicated constellations using the meshing performed by the Mission Programming Service Domino. The meshing (one by constellation) is computed by the Mission Programming Service during the intrinsic analysis.
For each mission considered the meshing stays the same during the lifetime of the User Request.
The following sequence diagram details the exchanges involved in this use case. In the green zone, the detailed functions of the Federation Service domino involved can be found.

coverage_detailed_
2_a.png

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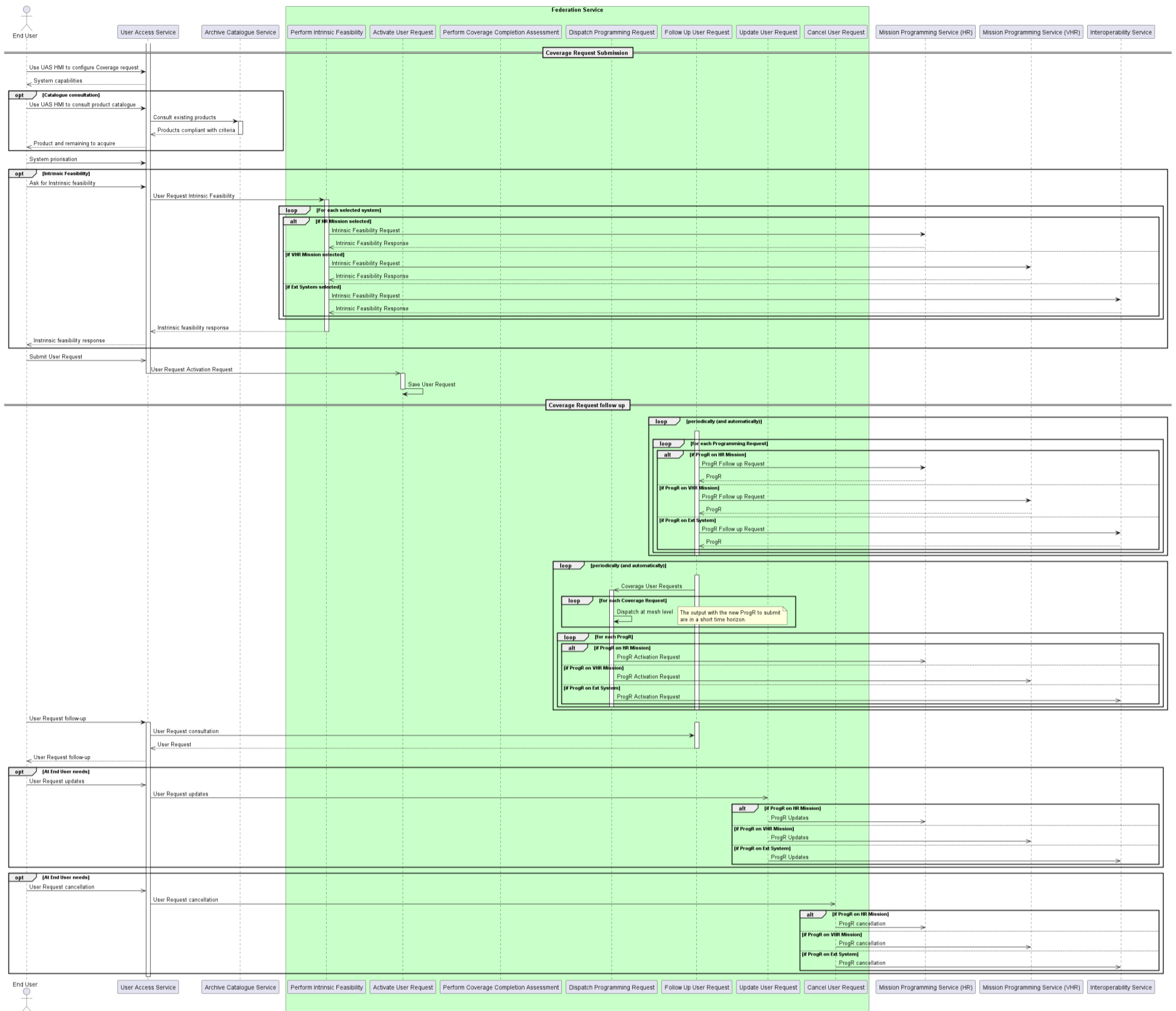
Figure 5: Case 2.a sequence diagram.

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4.4.2.2 Use evolving meshing during time (case 2.b)

In this case, the Federation Service can adapt the default meshing provided by the Mission Programming Service (through the intrinsic analysis) in bearing and position during time. The sequence is the same as in the previous use case, the difference is during the dispatch reassessment step, where the function can choose between different meshing strategies to optimize the completion time.

5. FUNCTIONAL REQUIREMENTS

The following diagram presents the functions of the Federation Service Domino with the identification of what will be prototyped and which algorithms needs to be developed to implement the Coverage and Dispatch Service of the Domino-E WP3000.
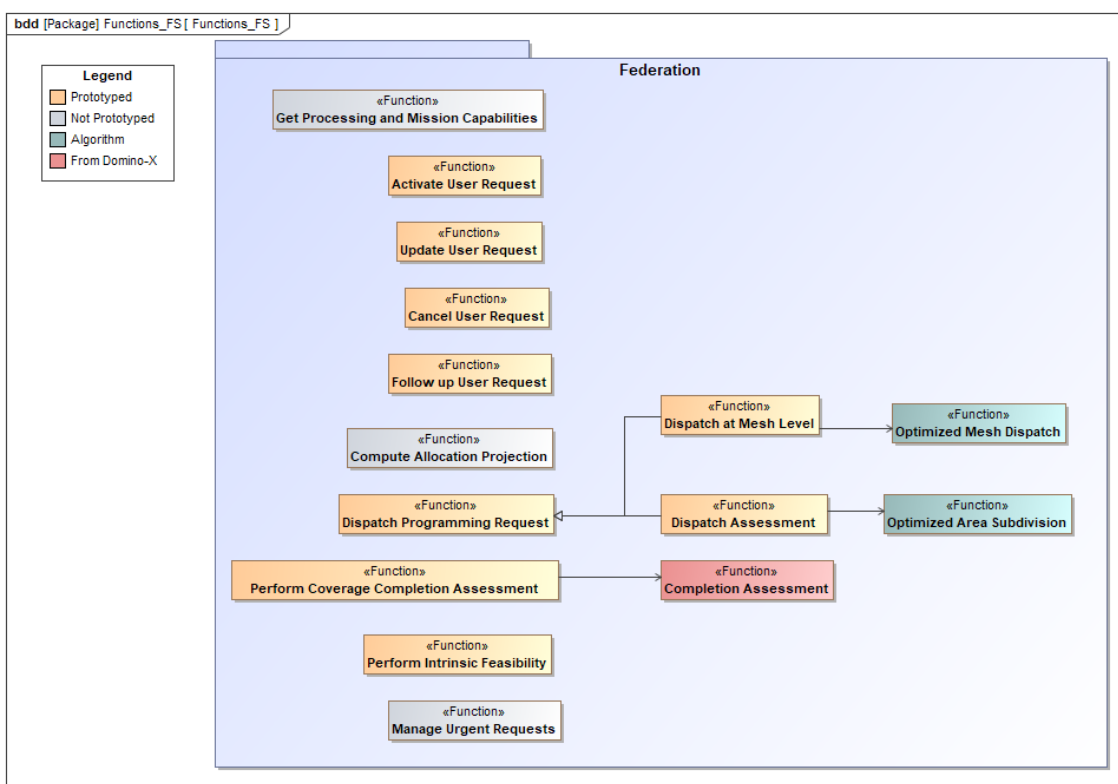
Figure 6: [FS] functions.

The algorithms are developed by the "WP3200 Coverage & Dispatch Service Algorithms". The prototyped functions calling the algorithms and implementing the use case are developed by the "W¨3300 Coverage & Dispatch Service Prototype".

5.1 Activate User Request

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[DE-COVER-REQ-00100] User Request from UAS

The [FS] shall receive User Request to activate from the [UAS].

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: This interface is described in the Domino-X ICD.

[ReqEnd]

The following figure presents the structure of a User Request:
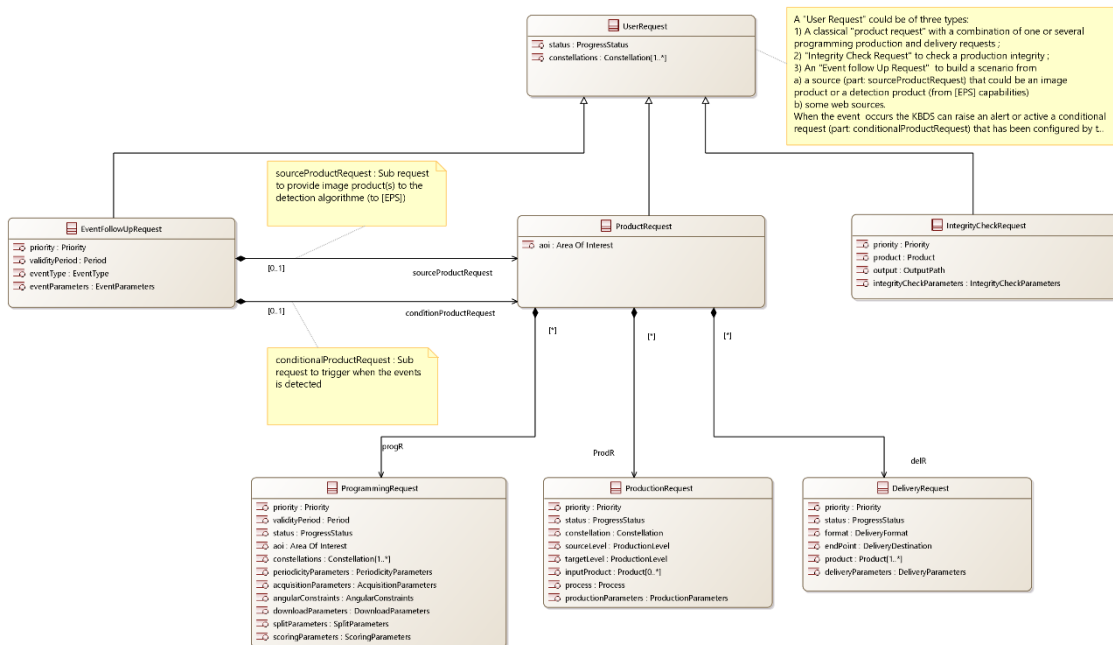
Figure 7: User Request.

A "User Request" could be of three types:
- A classical "product request" with a combination of one or several programming, production and delivery requests;
- "Integrity Check Request" to check a production integrity;
- An "Event follow Up Request" to build a scenario from:
  - a source (part: sourceProductRequest) that could be an image product or a detection product (from [EPS] capabilities);
  - some web sources.

When the event occurs the KBDS can raise an alert or activate a conditional request (part: conditionalProductRequest) that has been configured by the end user.

In Domino-E project, only the Product Requests are considered including:
- Programming Requests: to program new acquisition on a specific system (to MPS or INTS).

[DE-COVER-REQ-00200] Product Request with Programming Requests

For the Coverage and Dispatch Service, only the User Request of type "Product Request" shall be considered. The User Request shall contain only Programming Request(s), Production and Delivery Requests are not considered.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

 [DE-COVER-REQ-00300] Mono Constellation Programming Request

In the case the User Request contains only mono constellation Programming Request(s), the [FS] shall activate the different requests to the associated Domino:

- Associated [MPS] domino in case of sovereign constellation

- [INTS] Domino in case of external constellation

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: This kind of requests correspond to the case 1.a where the End User chooses the subdivisions and allocation by himself.

[ReqEnd]

[DE-COVER-REQ-00400] Multi Constellation Programming Request

In the case the User Request contains multi constellation Programming Request, the [FS] shall process the Programming Request through the "Dispatch Programming Request" function.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: This kind of requests correspond to the cases 1.b, 1.c, 2.a and 2.b where the subdivision or the allocation at mesh level is automatically performed.

[ReqEnd]

5.2 Update User Request

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[DE-COVER-REQ-00500] Update of User Request

In the case a User Request update is received from the [UAS], the [FS] shall update the associated Programming Requests that have already been activated on [MPS] and [INTS] Dominoes.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Only few parameters can be updated by the End User such as priority and internal acquisition parameters. In Domino-E project we consider the priority and the cloud coverage only

[ReqEnd]

5.3   Cancel User Request

[DE-COVER-REQ-00600] Cancel of User Request

In the case the User Request cancellation received from the [UAS], the [FS] shall cancel the associated Programming Requests that have already been activated on [MPS] and [INTS] Dominoes.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

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5.4 Follow-up User Request

[DE-COVER-REQ-00700] Follow-up of Programming Request

Periodically and automatically, the [FS] shall request the [MPS] and [INTS] Dominoes where Programming Requests have been submitted to know their progress. The progress shall include the status and the different acquisitions (with associated meshes) that have been programmed.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-00800] Follow-up of User Request from UAS

The [FS] shall provide a service to consult the follow-up of the User Request including the Programming Requests within.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: This service is called by the End User through the [UAS].

[ReqEnd]

5.5 Dispatch Programming Request

This function can include different functions depending on the complexity of the [FS] Domino implementation. In the context of Domino-E, there can be 3 different possibilities that should be considered:

- No Dispatch Programming Request : no need to dispatch the Programming Request, the constellation allocation is performed by the End User using the Coverage Completion Assessment function (case 1.a);
- Dispatch Assessment :
  o "Optimized Area Subdivision" called only at Programming Request submission : the subdivision and constellation allocation is automatic but performed only once (case 1.b);
  o automatically and periodically calls the "Optimized Area Subdivision" to readapt the subdivisions and allocation if needed (case 1.c);
- Dispatch at Mesh Level : dispatch the Programming Requests step by step at mesh level (case 2.a and 2.b).

To allow these functions to be tested simultaneously in the Domino-E Coverage and Dispatch Service of [FS], an option can be added (either at system configuration level or for each activated User Request) to specify which scenario will be used.

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5.5.1 Dispatch Assessment

[DE-COVER-REQ-00900] Automatic Dispatch Assessment

Automatically and periodically, the [FS] shall reassess the dispatch of the Coverage User Request by calling the "Optimized Area Subdivision" function.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Applicable if the scenario with automatic dispatch assessment is chosen (case 1c).

[ReqEnd]

[DE-COVER-REQ-01000] Activation after Dispatch Assessment

At the end of the Dispatch Assessment (i.e. after the call of "Optimized Area Subdivision"), if a new subdivision has been found and/or new constellation allocations have been chosen, the [FS] shall cancel the previous uncompleted Programming Request and activate the new ones.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Cancel and Activation of the Programming Requests are performed called the associated interface of the [MPS] or [INTS] Domino.

[ReqEnd]

[DE-COVER-REQ-01100] Optimized Area Subdivision library

The "Optimized Area Subdivision" algorithm library (see §10.2 Interface of the algorithm library for « Optimized Area Subdivision ») shall provide for each of the Coverage User Requests considered, the information needed to create the Programming Requests (mono constellation) to be activated.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

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[DE-COVER-REQ-01200] Optimized Area Subdivision function

The "Optimized Area Subdivision" algorithm library shall find the most adequate (according to the performance criteria listed in §6 Performance and sizing) subdivision of the area of interest of the User Request and for each subdivision which constellation is to be used.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-01300] Optimized Area Subdivision coverage assessment

The "Optimized Area Subdivision" shall use the "Coverage Completion Assessment" function to check and compare the envisaged solution for subdivision and constellation allocation.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

5.5.2   Dispatch at Mesh Level

[DE-COVER-REQ-01400] Automatic Dispatch at Mesh Level

5.5.2.1 Automatically and periodically, the [FS] shall dispatch the Coverage User Requests based on the "Optimized Mesh Dispatch" algorithm library (see §10.2.4.1 *Configuration General description*

The services will sometimes need to call the service "Completion Assessment" (for instance, Optimized Area Subdivision needs it to evaluate the performance of the subdivision). The configuration object shall then be adaptable to those of Completion Assessment. We defined the following model for the configuration object. (Contents of each class are described in tables below):

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With following contents for:
- OrbitParameter

Parameter name	Type	Unit	Description
SEMI_MAJOR_AXIS	Double	km	Semi-major axis length of the orbit
INCLINATION	Double	rad	Orbit inclination. Only necessary for non SSO orbits.
AN_LONGITUDE	Double	rad	Longitude at ascending node. Only necessary for non SSO orbits.

NB: Orbit is considered circular.
For sun-synchronous orbits (SSO), only the SEMI_MAJOR_AXIS is necessary.
For non SSO orbits, three parameters have to be defined: SEMI_MAJOR_AXIS, INCLINATION and AN_LONGITUDE.
In case of sun-synchronous orbit, only the semi-major axis is needed.
- SatelliteParameter

Parameter name	Type	Unit	Description
NAME	String	-	Satellite name
AN_REF_TIME	String	yyyy/MM/dd hh/mm/ss	Ascending node date used as reference, for each satellite of the system
AN_LOCAL_TIME	Double	Decimal hour	Local hour of the ascending node for this satellite

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- StationParameter

Parameter name	Type	Unit	Description
NAME	String	-	Station acronym (identical to the one used in the orderbooks).
LATITUDE	Double	deg	Station latitude
LONGITUDE	Double	deg	Station longitude
ELEV_MIN	Double	deg	Minimum elevation of the satellite relative to the download station
AVAILABLE_RATIO_DAY	Double	%	Available percentage of station visibility crenels in daylight orbit phases (range from 0.0 to 100.0)
AVAILABLE_RATIO_NIGHT	Double	%	Available percentage of station visibility crenels in eclipse orbit phases (range from 0.0 to 100.0)

- MeshingParameter

Parameter name	Type	Unit	Description
MESH_SIZE_EW	Double	km	East-West length of meshes
MESH_SIZE_NS	Double	km	North-South length of meshes
LATITUDE_MAX	Double	deg	Maximum latitude of accessible meshes
ASC_NODE_LONGITUDE	List<Double>	deg	**Array** of ascending node longitudes that will be considered for the limit. Each longitude is separated by a comma. The longitudes, whether they are defined for a cycle orbit or a range of values, are in the interval [-180° ; 180°].
MESH_LIMIT	List<Double>	Mesh number	Array of same length than ASC_NODE_LONGITUDE. Scene number limit between this longitude and the next one, separated by a comma.

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- SystemParameter

Parameter name	Type	Unit	Description
SYSTEM_NAME	String	-	System name
NB_CUSTOM_CLASS	Integer	-	Number of priority class
ELIGIBLE_CLASS	Integer	-	Classes eligible to weather bonus
UPGRADED_CLASS	Integer	-	Weather bonus value (PCC) – This field is required for each class eligible to weather bonus
DEPOINT_MAX	Double	deg	Maximum satellite depointing during an acquisition (in relation to nadir)
SUN_ZENITH_ANGLE_MAX	Double	deg	Maximum solar incidence angle for an acquisition
MEAN_DELAY_INTER_MESH	Double	s	Mean duration between two scene acquisitions, on a fully loaded orbit segment
VISI_SLOT_DURATION_MIN	Double	s	Minimum duration of a station visibility crenel
MEAN_DOWNLOAD_DURATION	Double	s	Mean duration of a scene download
MEMORY_SIZE	Double	-	Number of scenes that can be stored in onboard memory
MEMORY_RETENTION_MAX	Double	s	Maximum duration of image retention in memory
IMAGE_VALID_DELAY	Double	s	Mean delay between image reception and reprogramming if invalid

- WeatherParameter

Parameter name	Type	Unit	Description
WEATHER_BONUS_THRESHOLD	Double	%	Eligibility threshold for weather bonus (PCC) (range 0.0 to 100.0)

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Parameter name	Type	Unit	Description
WEATHER_BONUS_VALUE	Double	%	PCC value attributed when applying the weather bonus (range from 0.0 to 100)
REAL_WEATHER_OBSERVATIONS_DIRECTORY_PATHNAME	String	-	Relative/Absolute path to the folder containing the monthly ERA-interim files

- SimulationParameter

There would be also a configuration file for Simulation parameters (TBD).

Parameter name	Type	Unit	Description
HORIZON_DURATION	Integer	Number of Days	Simulation maximum duration for OptimizedAreaSubdivision service, Duration of computation's horizon for OptimizedMeshDispatch
MAX_ITERATION_NUMBER (TBC)	Integer	Number of Iteration	Number maximum of Subdivision to evaluate
TBD			

5.5.2.2 Specificity of "Optimized Area Subdivision"

Several parameters of the configuration might be used only by the service "Optimized Area Subdivision":

Parameter name	Type	Unit	Description
MAX_ITERATION_NUMBER (TBC)	Integer	Number of Iteration	Number maximum of Subdivision to evaluate
TBD			

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Interface of the algorithm library for « Optimized Mesh Dispatch »).

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Applicable if the scenario with dispatch at mesh level is chosen (case 2a and 2b).

[ReqEnd]

[DE-COVER-REQ-01500] Activation after Dispatch at Mesh Level

At the end of the Dispatch at Mesh Level (output of the library), if a new Programming Request has been created, the [FS] shall activate the Programming Requests whose validity period is in a given horizon.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: The objective is to activate only the Programming Request with validity end date before the next automatic dispatch in order to avoid activating Programming Requests that will be cancelled at the next dispatch.

[ReqEnd]

[DE-COVER-REQ-01600] Optimized Mesh Dispatch library

5.5.2.3 The "Optimized Mesh Dispatch" algorithm library (see §10.2.4.1 Configuration General description

The services will sometimes need to call the service "Completion Assessment" (for instance, Optimized Area Subdivision needs it to evaluate the performance of the subdivision). The configuration object shall then be adaptable to those of Completion Assessment. We defined the following model for the configuration object. (Contents of each class are described in tables below):

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With following contents for:
- OrbitParameter

Parameter name	Type	Unit	Description
SEMI_MAJOR_AXIS	Double	km	Semi-major axis length of the orbit
INCLINATION	Double	rad	Orbit inclination. Only necessary for non SSO orbits.
AN_LONGITUDE	Double	rad	Longitude at ascending node. Only necessary for non SSO orbits.

NB: Orbit is considered circular.
For sun-synchronous orbits (SSO), only the SEMI_MAJOR_AXIS is necessary.
For non SSO orbits, three parameters have to be defined: SEMI_MAJOR_AXIS, INCLINATION and AN_LONGITUDE.
In case of sun-synchronous orbit, only the semi-major axis is needed.

- SatelliteParameter

Parameter name	Type	Unit	Description
NAME	String	-	Satellite name
AN_REF_TIME	String	yyyy/MM/dd hh/mm/ss	Ascending node date used as reference, for each satellite of the system
AN_LOCAL_TIME	Double	Decimal hour	Local hour of the ascending node for this satellite

- StationParameter

Parameter name	Type	Unit	Description
NAME	String	-	Station acronym (identical to the one used in the orderbooks).
LATITUDE	Double	deg	Station latitude
LONGITUDE	Double	deg	Station longitude
ELEV_MIN	Double	deg	Minimum elevation of the satellite relative to the download station

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AVAILABLE_RATIO_DAY	Double	%	Available percentage of station visibility crenels in daylight orbit phases (range from 0.0 to 100.0)
AVAILABLE_RATIO_NIGHT	Double	%	Available percentage of station visibility crenels in eclipse orbit phases (range from 0.0 to 100.0)

- MeshingParameter

Parameter name	Type	Unit	Description
MESH_SIZE_EW	Double	km	East-West length of meshes
MESH_SIZE_NS	Double	km	North-South length of meshes
LATITUDE_MAX	Double	deg	Maximum latitude of accessible meshes
ASC_NODE_LONGITUDE	List<Double>	deg	**Array** of ascending node longitudes that will be considered for the limit. Each longitude is separated by a comma. The longitudes, whether they are defined for a cycle orbit or a range of values, are in the interval [-180° ; 180°].
MESH_LIMIT	List<Double>	Mesh number	Array of same length than ASC_NODE_LONGITUDE. Scene number limit between this longitude and the next one, separated by a comma.

- SystemParameter

Parameter name	Type	Unit	Description
SYSTEM_NAME	String	-	System name
NB_CUSTOM_CLASS	Integer	-	Number of priority class
ELIGIBLE_CLASS	Integer	-	Classes eligible to weather bonus

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UPGRADED_CLASS	Integer	-	Weather bonus value (PCC) – This field is required for each class eligible to weather bonus
DEPOINT_MAX	Double	deg	Maximum satellite depointing during an acquisition (in relation to nadir)
SUN_ZENITH_ANGLE_MAX	Double	deg	Maximum solar incidence angle for an acquisition
MEAN_DELAY_INTER_MESH	Double	s	Mean duration between two scene acquisitions, on a fully loaded orbit segment
VISI_SLOT_DURATION_MIN	Double	s	Minimum duration of a station visibility crenel
MEAN_DOWNLOAD_DURATION	Double	s	Mean duration of a scene download
MEMORY_SIZE	Double	-	Number of scenes that can be stored in onboard memory
MEMORY_RETENTION_MAX	Double	s	Maximum duration of image retention in memory
IMAGE_VALID_DELAY	Double	s	Mean delay between image reception and reprogramming if invalid

- WeatherParameter

Parameter name	Type	Unit	Description
WEATHER_BONUS_THRESHOLD	Double	%	Eligibility threshold for weather bonus (PCC) (range 0.0 to 100.0)
WEATHER_BONUS_VALUE	Double	%	PCC value attributed when applying the weather bonus (range from 0.0 to 100)
REAL_WEATHER_OBSERVATIONS_DIRECTORY_PATHNAME	String	-	Relative/Absolute path to the folder containing the monthly ERA-interim files

- SimulationParameter

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There would be also a configuration file for Simulation parameters (TBD).

Parameter name	Type	Unit	Description
HORIZON_DURATION	Integer	Number of Days	Simulation maximum duration for OptimizedAreaSubdivision service, Duration of computation's horizon for OptimizedMeshDispatch
MAX_ITERATION_NUMBER (TBC)	Integer	Number of Iteration	Number maximum of Subdivision to evaluate
TBD			

5.5.2.4 Specificity of "Optimized Area Subdivision"

Several parameters of the configuration might be used only by the service "Optimized Area Subdivision":

Parameter name	Type	Unit	Description
MAX_ITERATION_NUMBER (TBC)	Integer	Number of Iteration	Number maximum of Subdivision to evaluate
TBD			

Interface of the algorithm library for « Optimized Mesh Dispatch ») shall provide for each of the Coverage User Requests considered, the Programming Requests (mono constellation) to be activated.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

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[DE-COVER-REQ-01700] Optimized Mesh Dispatch using fixed meshing

The Optimized Mesh Dispatch shall be able to use the meshing provided by the intrinsic analysis of the Programming Requests for each possible constellation in order to choose the most adequate constellation.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: The usage of the fixed meshing provided by the first intrinsic analysis corresponds to the case 2.a.

[ReqEnd]

[DE-COVER-REQ-01800] Optimized Mesh Dispatch using adaptable meshing

The Optimized Mesh Dispatch shall be able to use an adapted meshing (in bearing and in position) from the one provided by the intrinsic analysis of the Programming Requests for each possible constellation in order to choose the most adequate constellation.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: The usage of an adaptable meshing corresponds to the case 2.b.

[ReqEnd]

5.6 Perform Coverage Completion Assessment

[DE-COVER-REQ-01900] Manual Coverage Completion Assessment

The [FS] shall provide a service to assess or reassess (taking into account the current realisation) the coverage completion of a Programming Request. The service shall be based on the "Coverage Assessment" algorithm library (see §10.1 Interfaces of the algorithm library for "Completion Assessment").

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: This interface is detailed in the Domino-X ICD Master. This service can be called by the End User through the [UAS].

[ReqEnd]

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[DE-COVER-REQ-02000] Coverage Completion Assessment at activation

The [FS] shall automatically assess the completion of a Programming Request based on the "Coverage Assessment" algorithm library (see §10.1 Interfaces of the algorithm library for "Completion Assessment") when it is activated. In this case, the current workload is taken into account.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-02100] Automatic Coverage Completion Assessment

In the case there is no automatic Dispatch Reassessment, the [FS] shall automatically reassess the completion date of its Programming Requests based on the "Coverage Assessment" algorithm library (see §10.1 Interfaces of the algorithm library for "Completion Assessment"). In this case, the current workload is taken into account.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-02200] Coverage Completion Assessment

The Coverage Completion Assessment of the [FS] Domino shall provide the completion estimation date and progress estimate during time of a set of Programming Requests taking into account weather information and optionally the current workload of the system.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

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5.7 Perform Intrinsic Analysis

[DE-COVER-REQ-02300] Intrinsic Analysis Service

The [FS] shall provide a service (used internally and by the [UAS]) to compute the intrinsic analysis of a Programming Request.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-02400] Intrinsic Analysis Delegation

The [FS] shall call the appropriate service to perform the Intrinsic Analysis depending on the selected constellations:

- The associated [MPS] Domino for sovereign constellation
- The [INTS] Domino for external constellation

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: This interface is detailed in the Domino-X ICD Master.

[ReqEnd]

[DE-COVER-REQ-02500] Intrinsic Analysis for Multi Constellation Programming Request

In the case of a multi constellation Programming Request, the [FS] shall perform an intrinsic analysis for each selected constellation and merge the results according to the expected output interface.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

6. PERFORMANCE AND SIZING

This section defines the key indicators that needs to be evaluated in the Coverage and Dispatch Service.

6.1 Performances

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[DE-COVER-REQ-02600] Comparison between solutions

All the performance criteria shall be evaluated and compared between the following solutions:
- Coverage using only one constellation
- Coverage with subdivision and allocation performed by End User
- Coverage with subdivision and allocation performed automatically once
- Coverage with subdivision and allocation performed automatically and reviewed over time
- Coverage with no subdivision and allocation performed at mesh level

    DECOVER_Product Version Applicability: V0

    DECOVER_Verification Method: R, T

    DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-02700] Completion delay

The completion (90% and 100% of completion) delay shall be evaluated and compared.

    DECOVER_Product Version Applicability: V0

    DECOVER_Verification Method: R, T

    DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-02800] Area Waste

The acquired area waste shall be evaluated from the following point of views:
- Percentage of area of interest acquired by several satellites
- Percentage of area acquired out of the area of interest

    DECOVER_Product Version Applicability: V0

    DECOVER_Verification Method: R, T

    DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

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[DE-COVER-REQ-02900] Impact of coverage request

The impact of the Coverage User Request on the order book in terms of completion delay shall be evaluated and compared.

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

6.2 Sizing

[DE-COVER-REQ-03000] Typical orderbook

The Coverage and Dispatch Service performances shall be evaluated considering a typical workload of the system:

- 500 acquisitions per day and satellite for high resolution satellites
- 200 acquisitions per day and satellite for very high resolution satellites

> DECOVER_Product Version Applicability: V0
>
> DECOVER_Verification Method: R, T
>
> DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

7. EXTERNAL INTERFACES

[DE-COVER-REQ-03100] FS Interfaces

The FS shall implement the interfaces as defined in the Domino-X Master ICD [AD01] relevant for the Coverage and Dispatch Service.

> DXSCRMS_Product Version Applicability: V0
>
> DXSCRMS_Verification Method: T
>
> DXSCRMS_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

The following table provides the interfaces of the [FS] Domino used and that need to be implemented for the Domino-E WP3000 Use Case about Coverage and Dispatch Service:

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Interface	Used in Domino-E WP3000	Type	Format	Description
[FS]_[INTS]_ProgR_Activation_Request	Yes	Domino-X	ProgR Activation Request	Submission of a programming request on an external system
[FS]_[INTS]_ProgR_Cancel_Request	Yes	Domino-X	ProgR Cancel Request	The "ProgR Cancel Request" Interface allows clients to cancel a Programming Request.
[FS]_[INTS]_ProgR_Consultation_Request	Yes	Domino-X	ProgR Consultation Request	Follow-up of a given programming request on an external system Consultation of programming requests submitted on an external system according to criteria
[FS]_[INTS]_ProgR_Update_Request	Yes	Domino-X	ProgR Update Request	The "ProgR Update Request" Interface allows clients to update a Programming Request.
[FS]_[MPS]_ProgR_Activation_Request	Yes	Domino-X	ProgR Activation Request	Submission of a programming request on a sovereign system
[FS]_[MPS]_ProgR_Analysis_Request	Yes	Domino-X	ProgR Analysis Request	On-line programming request analysis by a sovereign system (i.e. without submitting the request)
[FS]_[MPS]_ProgR_Cancel_Request	Yes	Domino-X	ProgR Cancel Request	The "ProgR Cancel Request" Interface allows clients to cancel a Programming Request.
[FS]_[MPS]_ProgR_Consultation_Request	Yes	Domino-X	ProgR Consultation Request	Follow-up of a given programming request on a sovereign system Consultation of programming requests submitted on a sovereign system according to criteria

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Interface	Used in Domino-E WP3000	Type	Format	Description
[FS]_[MPS]_ProgR_Update_Request	Yes	Domino-X	ProgR Update Request	Update of a programming request on a sovereign system: parameters and status. Include request cancellation.
[UAS]_[FS]_Coverage_ProgR_Feasibility_Request	Yes	Domino-X	Coverage ProgR Feasibility Request	Coverage request global analysis with or without order book consideration
[UAS]_[FS]_Coverage_ProgR_Manual_Reassessment	Yes	Domino-X	Coverage ProgR Manual Reassessment	On operator demand, the "Coverage ProgR Manual Reassessment" Interface allows a client to study the feasibility of a Coverage Programming Request (coverage ProgR Manual Reassessment). The client can ask to take the work load into account or not. This work load is a parameter of the request.
[UAS]_[FS]_ProgR_Analysis_Request	Yes	Domino-X	ProgR Analysis Request	On-line programming request analysis by addressed systems (ie without submitting the request)
[UAS]_[FS]_User_Request_Activation_Request	Yes	Domino-X	User Request Activation Request	The "**User Request Activation Request**" Interface allows clients to straightforwardly activate a "User Request".
[UAS]_[FS]_User_Request_Consultation_Request	Yes	Domino-X	User Request Consultation Request	The "User Request Consultation Request" Interface allows clients to consult a list of user requests according to search criteria. Requests presented to the client include the requested parameters and the "User Request GUID" is always sent.

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Interface	Used in Domino-E WP3000	Type	Format	Description
[UAS]_[FS]_User_Request_Detailed_Consultation_Request	Yes	Domino-X	User Request Detailed Consultation Request	The "User Request Detailed Consultation Request" Interface allows clients to ask for details of a "User Request". This "User Request" is identified by its GUID (User Request GUID is the parameter of the request).
[UAS]_[FS]_User_Request_Update_Request	Yes	Domino-X	User Request Update Request	The "User Request Update Request" Interface allows clients to update a User Request.
[ACS]_[FS]_Product_availability_notification	No	Domino-X	Product Availability Notification	FS subscribes to ACS to receive a notification when a new product is added to the catalogue for processing steps achievement.
[FS]_[ADGS]_Weather	No	Domino-X		Weather information used for internal algorithms of FS
[FS]_[APS]_Capabilities	No	Standard	OGC API Processes	Get FS capabilities (federated capabilities collected by the [FS] domino)
[FS]_[APS]_Production_Request_and_Follow_up	No	Standard	OGC API Processes	Get the production status and estimated date of completion, linked to the request
[FS]_[DDS]_Capabilities	No	Standard	OGC API Processes	Get FS capabilities (federated capabilities collected by the [FS] domino)
[FS]_[DDS]_Delivery_Request_and_Follow_up	No	Standard	OGC API Processes	Delivery request requested by FS and follow-up by of this request
[FS]_[DITS]_Capabilities	No	Standard	OGC API Processes	Get FS capabilities (federated capabilities collected by the [FS] domino)
[FS]_[DITS]_Image_integrity_check_request_and_follow_up	No	Standard	OGC API Processes	Integrity Check Request requested by FS and follow-up of this request

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Interface	Used in Domino-E WP3000	Type	Format	Description
[FS]_[DITS]_Image_signature_request_and_follow-up	No	Standard	OGC API Processes	
[FS]_[EPS]_Capabilities	No	Standard	OGC API Processes	Get FS capabilities (federated capabilities collected by the [FS] domino)
[FS]_[EPS]_Production_Request_and_follow-up	No	Standard	OGC API Processes	Follow-up of a given production request to know its status, estimated date of completion, product links
[FS]_[KBDS]_Capabilities	No	Standard	OGC API Processes	Get FS capabilities (federated capabilities collected by the [FS] domino)
[FS]_[KBDS]_Capabilities	No	Standard	OGC API Processes	Get KBDS capabilities
[FS]_[KBDS]_Event_Follow_up_Request	No	Standard	OGC API Processes	Request for event monitoring
[FS]_[KBDS]_Mission_Reprogramming_Request	No	Domino-X	Mission Reprogramming Request	The "Mission Reprogramming Request" Interface allows clients to retrieve a list of mission reprogramming requests since a date (till today) .
[FS]_[MPS]_Download/Upload_Feasibility	No	Domino-X	Download & Upload Feasibility	FS requests MPS to analyse urgents User Requests in term of download and upload
[FS]_[PPS]_Capabilities	No	Standard	OGC API Processes	Get FS capabilities (federated capabilities collected by the [FS] domino)
[FS]_[PPS]_Production_Request_and_Follow_up	No	Standard	OGC API Processes	Primary production is automatically performed. This interface will be used for reproduction needs.
[FS]_[SCRMS]_Contact_Request	No	Domino-X	Contact Request	Additional contact requested by FS for urgent request
[IQS]_[FS]_User_Request_Activation	No	Domino-X	User Request Activation Request	[IQS] Domino can submit User Requests for programming or production requests

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Interface	Used in Domino-E WP3000	Type	Format	Description
[IQS]_[FS]_User_Request_Consultation	No	Domino-X	User Request Detailed Consultation Request	The [IQS] Domino can follow its User Requests status and evolution through this interface
[UAS]_[FS]_Capabilities	No	Standard	OGC API Processes	Get FS capabilities (federated capabilities collected by the [FS] domino)
[UAS]_[FS]_Site_Monitoring_Allocation_Projection_Request	No	Domino-X	Site Monitoring Allocation Projection Request	The "Site Monitoring Allocation Projection Request" Interface allows a client to study the feasibility of site monotoring allocation projection request. This request returns an allocation projection results.

Table 3: Relevant FS Interfaces

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8. DESIGN AND DEVELOPMENT REQUIREMENTS

8.1 Portability

[DE-COVER-REQ-03200] Cloud deployment

The prototype developed for the Coverage and Dispatch Service shall be deployed into a public cloud.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

8.2 Technology

[DE-COVER-REQ-03300] Library Language

The algorithms developed for Coverage and Dispatch service use case shall be developed in Java 17 Language.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-03400] Library Packaging

The algorithms developed for Coverage and Dispatch service use case shall be delivered as java library (jar) potentially obfuscated.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

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[DE-COVER-REQ-03500] Embedding of algorithm libraries

The delivered algorithm libraries shall be embedded in order to provide callable services through web compatible API (REST web services or asynchronous messaging for instance).

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

[DE-COVER-REQ-03600] Target environment

The coverage service shall run under kubernetes.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: D, T

DECOVER_Rationale: Requirement rationale text.

Note: all production can be included in docker container.

[ReqEnd]

8.3   Reusability

[DE-COVER-REQ-03700] Coverage Completion Assessment

The function for Coverage Completion Assessment shall be based on the java library developed in Domino-X project.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: the interfaces of the library are defined in §10.1 Interfaces of the algorithm library for "Completion Assessment".

[ReqEnd]

9.   TESTABILITY REQUIREMENTS

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[DE-COVER-REQ-03800] Preparation for demonstration

The output of the Coverage and Dispatch prototype shall be usable for demonstration work package purpose.

DECOVER_Product Version Applicability: V0

DECOVER_Verification Method: R, T

DECOVER_Rationale: Requirement rationale text.

Note: Requirement complementary information.

[ReqEnd]

10. APPENDIX

10.1 Interfaces of the algorithm library for "Completion Assessment"

See Document « Domino-X ICD_MMFS_V1Released".

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ICD_MMFS_V1Relea

10.2 Interface of the algorithm library for « Optimized Area Subdivision »

10.2.1 Services

10.2.1.1 Find Optimized Subdivision

The following service is to be used to compute the optimized subdivision of a User Request at its activation.

Method	Inputs	Outputs
findOptimizedSubdivision	UserRequest AreaSubdivisionConfiguration OrderBookMultiSystem	RequestDistribution

10.2.1.2 Reassess Optimized Subdivision

The following service is to be used to reassess the subdivision of all the multi constellation User Requests. It provides the updated constellation allocation and areas to be covered as well as the estimated time of completion.

Method	Inputs	Outputs

reassessOptimizedSubdivision	List<UserRequest> AreaSubdivisionConfiguration OrderBookMultiSystem	Map<UserRequestId, RequestDistribution>

10.2.2 Input model

10.2.2.1 General description of input

The input model is shared with services of « Optimized Mesh Dispatch ». It shall just be used differently depending on which service uses it.

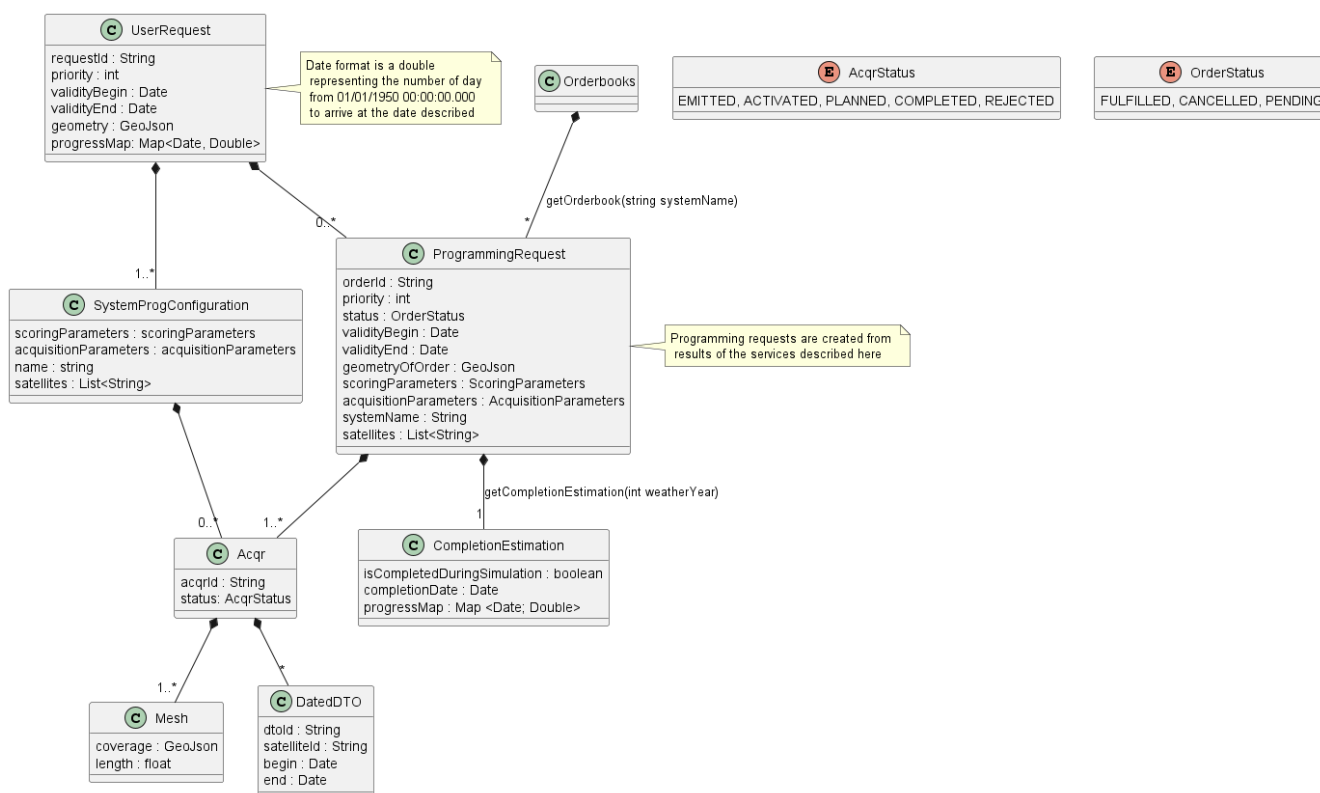The following diagram describes the datamodel of the UserRequest and of the OrderBook (TBC):

Figure 8.Class Diagram of UserRequest and OrderBooks

With,
- **OrderBook** class represents requests independent to the UserRequest studied that the system has to fulfil. It thus contains, for each system, a list of ProgrammingRequest.

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- **UserRequest** class represents the initial multi-mission request, with:
  - its initial area (field "geometry" described by a GeoJson TBC),
  - its main characteristics (dates of validity, id, priority),
  - a progressMap used to evaluate the efficiency of the service. The progressMap contains the progression of completion of the request at each day from start of validity of the Request. (Caution: it is the real progression of completion, not an evaluation of the future completion by the software)

- **SystemProgConfiguration** describes a System of satellite on which the UserRequest can be achieved, and characteristics of the request for that system.

- **ProgrammingRequest,** is a request previously submitted to one of the systems considered. It can then be a part of the workload, of the orderbook when it is not related to the UserRequest studied; or a part of one of the UserRequest previous subdivision assigned to one system when performing the "Reassess Optimized Subdivision". Thus, it contains:

  - The full description of a request (dates of validity, priority, acquisitionParameters)
  - Its geometry, which shall be a part of the UserRequest's initial geometry
  - A map containing, for each weather year taken in the simulation, evaluation of its completion given in the result of the call of "Optimized Area Subdivision" that led to its creation. So keys are Weather Year in integer and values are CompletionEstimationObject

NB: To evaluate future completion of the request, weather has to be taken into account. Several evaluations can be performed using several years as model for the weather of the year simulated. Those are the "weathers years".

  - A status, because, in case of reassessment, it can be cancelled.
  - AcqR, Mesh and DatedDTOs with their status to know what exactly has been acquired on the ProgrammingRequest, and at what date.

- **AcquisitionParameters** stores constraints asked specifically for this UserRequest. It is mainly about weather constraints, specifically CSPs (clear sky percentage) aimed and minimum asked.
- **CompletionEstimation:** contains some results of the evaluation of completion of an area by one system among which (TBC):
  - isCompletedDuringSimulation, Boolean saying whether the Area shall be fully completed by the system in the horizon of simulation
  - completionDate: only if isCompletedDuringSimulation is true, date when area is fully acquired by system
  - progressMap: completion percentage at each day simulated

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- **AcqR:** Represents a part of the request, on one system, that can be acquired in one pass of a system's satellite. Contains:
  - List of **Mesh**, (geographical unitary areas of the acquisition)
  - **Status**:
    - EMITTED when created but not yet taken into account by our services
    - ACTIVATED (TBC) when allocation has been chosen by our services but is still to submit,
    - REJECTED when refused by the system (TBC) or by the dispatcher,
    - PLANNED when programmed by system,
    - COMPLETED when fully realized.
  - List of **DatedDTO** of the AcqR. A DatedDTO represents a dated opportunity for a satellite of the system to acquire the AcqR. If the AcqR is PLANNED, it then contains only the planned datedDTO.

10.2.2.2   *Specificity of "Optimized area subdivision"*

There are three specificities for services of "Optimized area subdivision" that need to be pointed out:

- When using the service "Find optimized subdivision" the **UserRequest** will not contains any **ProgrammingRequest**.
- **ProgrammingRequest** will be presents in **UserRequest** when using the service "Reassess optimized subdivisions", as a subrequest, created from a subdivision selected by a previous call of "Find optimized subdivision"
- **SystemProgConfiguratio**n will not contain any AcqR, Meshes and DatedDTOs in both services of "Find optimized subdivision"

10.2.3 *Output model*

The following diagram describes the output "RequestDistribution" of services "find optimized subdivision" and "Reassess Optimized Division":

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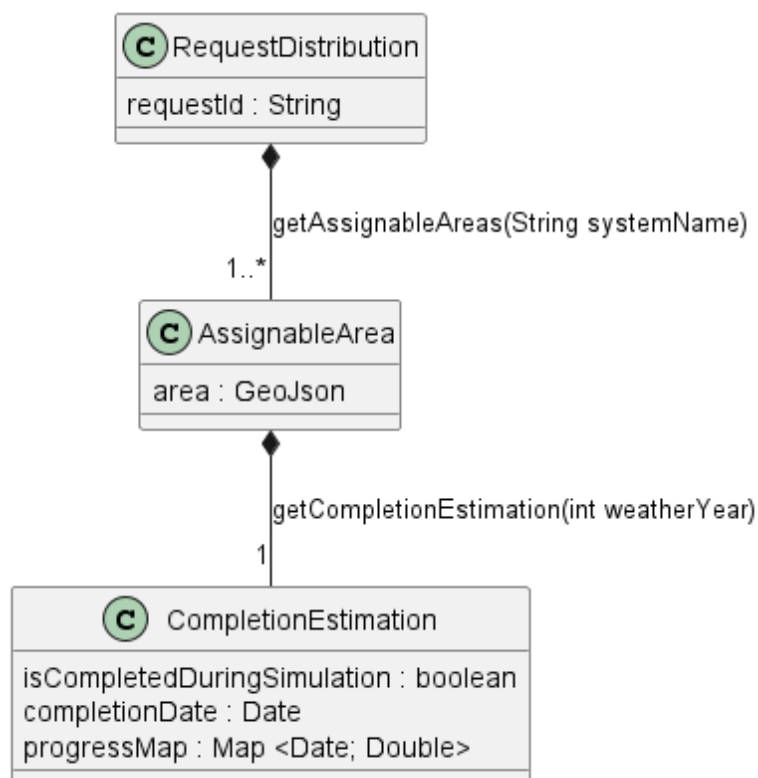
In **AssignableArea** objects:
- *area* describes the geometry of one part of the subdivision of the UserRequest, in format GeoJson (TBC).
- *completionEstimationPerWeatherYear* stores in a map the completionEstimation computed for each year used to simulate weather model in computation.

CompletionEstimation class was already described above.

In **RequestDistribution** object:
- *requestId* is the name of the UserRequest used as input.
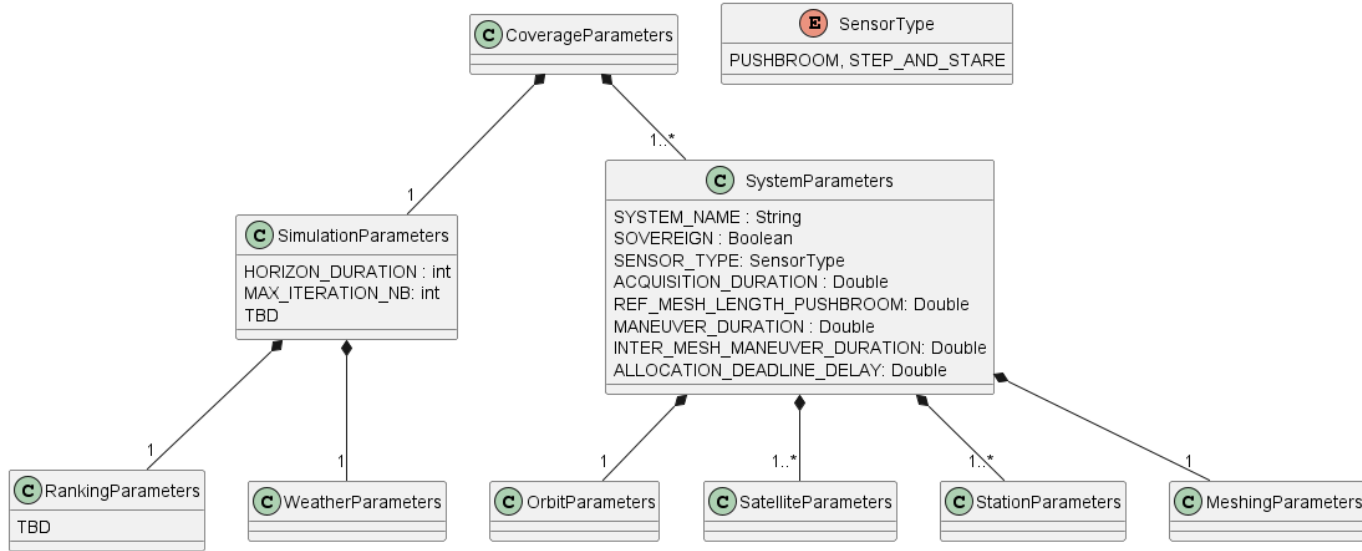- *assignableAreasPerSystem* stores as keys the names of the system, and as values the list of Area to assign to each system.

10.2.4 Configuration

The services "Optimized Area Subdivision" and "Optimized Mesh Dispatch" will use the same object as configuration, with some parameters specific for one or several of the services and useless in the others.

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10.2.4.1   Configuration General description

The services will sometimes need to call the service "Completion Assessment" (for instance, Optimized Area Subdivision needs it to evaluate the performance of the subdivision). The configuration object shall then be adaptable to those of Completion Assessment. We defined the following model for the configuration object. (Contents of each class are described in tables below):

With following contents for:
- OrbitParameter

Parameter name	Type	Unit	Description
SEMI_MAJOR_AXIS	Double	km	Semi-major axis length of the orbit
INCLINATION	Double	rad	Orbit inclination. Only necessary for non SSO orbits.
AN_LONGITUDE	Double	rad	Longitude at ascending node. Only necessary for non SSO orbits.

NB: Orbit is considered circular.
For sun-synchronous orbits (SSO), only the SEMI_MAJOR_AXIS is necessary.
For non SSO orbits, three parameters have to be defined: SEMI_MAJOR_AXIS, INCLINATION and AN_LONGITUDE.
In case of sun-synchronous orbit, only the semi-major axis is needed.
- SatelliteParameter

Parameter name	Type	Unit	Description
NAME	String	-	Satellite name

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| AN_REF_TIME | String | yyyy/MM/dd hh/mm/ss | Ascending node date used as reference, for each satellite of the system |
| AN_LOCAL_TIME | Double | Decimal hour | Local hour of the ascending node for this satellite |

- StationParameter

Parameter name	Type	Unit	Description
NAME	String	-	Station acronym (identical to the one used in the orderbooks).
LATITUDE	Double	deg	Station latitude
LONGITUDE	Double	deg	Station longitude
ELEV_MIN	Double	deg	Minimum elevation of the satellite relative to the download station
AVAILABLE_RATIO_DAY	Double	%	Available percentage of station visibility crenels in daylight orbit phases (range from 0.0 to 100.0)
AVAILABLE_RATIO_NIGHT	Double	%	Available percentage of station visibility crenels in eclipse orbit phases (range from 0.0 to 100.0)

- MeshingParameter

Parameter name	Type	Unit	Description
MESH_SIZE_EW	Double	km	East-West length of meshes
MESH_SIZE_NS	Double	km	North-South length of meshes
LATITUDE_MAX	Double	deg	Maximum latitude of accessible meshes

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| ASC_NODE_LONGITUDE | List<Double> | deg | **Array** of ascending node longitudes that will be considered for the limit. Each longitude is separated by a comma. The longitudes, whether they are defined for a cycle orbit or a range of values, are in the interval [-180° ; 180°]. |
| MESH_LIMIT | List<Double> | Mesh number | Array of same length than ASC_NODE_LONGITUDE. Scene number limit between this longitude and the next one, separated by a comma. |

- SystemParameter

Parameter name	Type	Unit	Description
SYSTEM_NAME	String	-	System name
NB_CUSTOM_CLASS	Integer	-	Number of priority class
ELIGIBLE_CLASS	Integer	-	Classes eligible to weather bonus
UPGRADED_CLASS	Integer	-	Weather bonus value (PCC) – This field is required for each class eligible to weather bonus
DEPOINT_MAX	Double	deg	Maximum satellite depointing during an acquisition (in relation to nadir)
SUN_ZENITH_ANGLE_MAX	Double	deg	Maximum solar incidence angle for an acquisition
MEAN_DELAY_INTER_MESH	Double	s	Mean duration between two scene acquisitions, on a fully loaded orbit segment [1]
VISI_SLOT_DURATION_MIN	Double	s	Minimum duration of a station visibility crenel

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MEAN_DOWNLOAD_DURATION	Double	s	Mean duration of a scene download
MEMORY_SIZE	Double	-	Number of scenes that can be stored in onboard memory
MEMORY_RETENTION_MAX	Double	s	Maximum duration of image retention in memory
IMAGE_VALID_DELAY	Double	s	Mean delay between image reception and reprogramming if invalid

- WeatherParameter

Parameter name	Type	Unit	Description
WEATHER_BONUS_THRESHOLD	Double	%	Eligibility threshold for weather bonus (PCC) (range 0.0 to 100.0)
WEATHER_BONUS_VALUE	Double	%	PCC value attributed when applying the weather bonus (range from 0.0 to 100)
REAL_WEATHER_OBSERVATIONS_DIRECTORY_PATHNAME	String	-	Relative/Absolute path to the folder containing the monthly ERA-interim files

- SimulationParameter

There would be also a configuration file for Simulation parameters (TBD).

Parameter name	Type	Unit	Description
HORIZON_DURATION	Integer	Number of Days	Simulation maximum duration for OptimizedAreaSubdivision service, Duration of computation's horizon for OptimizedMeshDispatch
MAX_ITERATION_NUMBER (TBC)	Integer	Number of Iteration	Number maximum of Subdivision to evaluate
TBD			

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10.2.4.2   Specificity of "Optimized Area Subdivision"

Several parameters of the configuration might be used only by the service "Optimized Area Subdivision":

Parameter name	Type	Unit	Description
MAX_ITERATION_NUMBER (TBC)	Integer	Number of Iteration	Number maximum of Subdivision to evaluate
TBD			

10.3   Interface of the algorithm library for « Optimized Mesh Dispatch »

10.3.1 Services

Method	Inputs	Outputs
dispatchAtMeshLevel	List<UserRequestMultiMission> DispatchConfiguration OrderBookMultiMission	Map<UserRequestId, RequestDispatched>

10.3.2 Input model

10.3.2.1   General description of input

The service of "Optimized mesh dispatch" will use, as inputs, the same objects, than those defined as inputs for "Optimized area subdivision".
See §10.2.2.1 *General description of input*., Figure 8.Class Diagram of UserRequest and OrderBooks, for precise description of this datamodel.

#### 10.3.2.2   Specificity of "Dispatch at mesh level"

There are still some specificities about how the input model is used for this service, here:
- **SystemProgConfiguration** objects shall have their list of AcqR with theirs meshes (using system's default meshing) and DatedDTOs.
- **In Case 2b),** if system's default meshing is not chosen, initials AcqR of objects SystemProgConfiguration shall be replaced with new ones, containing new Meshes and new DatedDTOs computed by the service.
- **ProgrammingRequests** objects are here to show what has already been submitted to a system, on the UserRequest, or to describe the Systems' OrderBooks.

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- **ProgrammingRequest'** *CompletionEstimationPerWeatherYear* attribute will here be empty as it has no use for this service. Thus, CompletionEstimation class will not be used on these services.
- **ScoringParameters** stores the parameters of one UserRequest that are needed to set the criteria used to choose between several system and accesses to perform the acquisition. (TBC)

10.3.3 Output model

Here is the datamodel used for the "Optimize Mesh Dispatch" 's output:
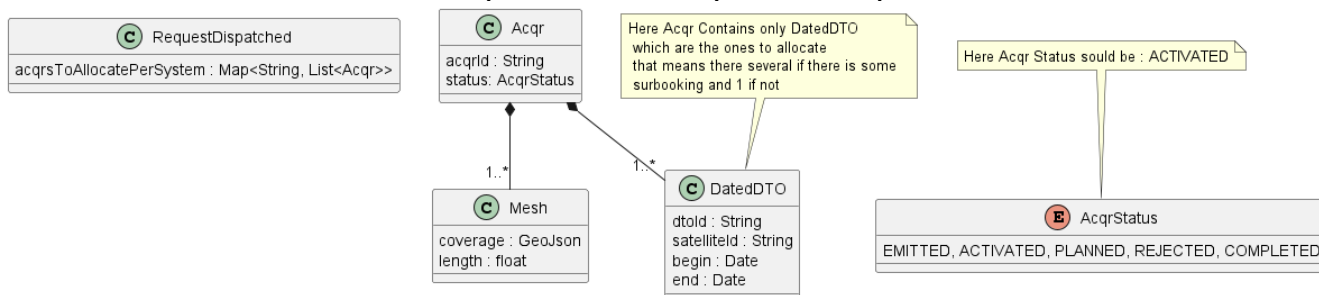
Acqr, Mesh DatedDTO and AcqrStatus were already described above.
RequestDispatched contains a map giving, for each System used, the list of Acqr assigned by the service to one system on one DatedDTO

10.3.4 Configuration

10.3.4.1 General description of configuration

The service of "Optimized mesh dispatch" will use, as configuration, the same object than the one defined as configuration for "Optimized area subdivision".
See § *10.2.4.1 Configuration general description*, for precise description of this datamodel.

10.3.4.2 Specificity of "Dispatch at mesh level"

The configuration of this service "Dispatch at mesh level" will use some parameters not used by other services:**Parameter name**	Type / (Unit)	Description
Simulation		
TBD		

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System The following parameters are defined for each system		
SOVEREIGN (TBC)	Boolean	True if the system is sovereign for dispatcher's user false if it is external to the user
SENSOR_TYPE (TBC)	Enum	Sensor type for the considered system. Can be PUSHBROOM or STEP_AND_STARE.
ACQUISITION_DURATION	Double (seconds)	Estimated acquisition duration. Depends on sensor type: ➤ PUSHBROOM : Unitary duration for a reference band length : REF_MESH_LENGTH_PUSH BROOM. It will be then adapted to the request's band length.STEP_AND_STARE : Unitary duration for a mesh (Will be multiplied by the number of meshes in a request)
REF_MESH_LENGTH_PUSHBROOM	Double(meters)	Length of mesh corresponding to the duration of acquisition defined in the configuration file.
MANEUVER_DURATION (TBC)	Double (values in seconds)	estimated maneuver duration
INTER_MESH_MANEUVER_DURATION (TBC)	Double (seconds)	Duration of maneuver between two mesh of same ProgR
ALLOCATION_DEADLINE_DELAY (TBC)	Double (seconds)	Delay needed between an allocation attempt and an access. Before it, no decisions are made because it is considered too late to task the system.
Ranking (TBD) parameters used to manage the ranking between systems, satellites and accesses for an area to acquire		

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