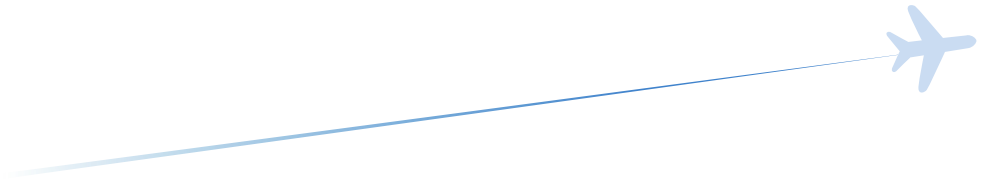

# GOF2.0 D2.4 – Appendix E Operational Message Exchange Service Specification

| | |
|---|---|
| **Deliverable ID:** | **D2.4-E** |
| **Dissemination Level:** | **PU** |
| **Project Acronym:** | **GOF2.0** |
| **Grant:** | **101017689** |
| **Call:** | **H2020-SESAR-2020-1 VLD Open 2** |
| **Topic:** | **U-space capabilities and services to enable Urban Air Mobility** |
| **Consortium Coordinator:** | **Lennuliiklusteeninduse Aktsiaselts (EANS)** |
| **Edition Date:** | **26 April 2021** |
| **Edition:** | **00.00.03** |
| **Template Edition:** | **03.00.00** |

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**Rejected By - Representatives of beneficiaries involved in the project**

| Name/Beneficiary | Position/Title | Date |
|---|---|---|
| | | |

## Document History

| Edition | Date | Status | Author | Justification |
|---|---|---|---|---|
| 00.00.01 | 2021-04-21 | Draft | Peter CORNELIUS | Document created. |
| 00.00.02 | 2021-04-26 | draft | WP2 Partners | Enhance and update |
| 00.00.03 | 2021-04-29 | released | WP2 Partners | Release |

# GOF2.0

## GOF2.0 INTEGRATED URBAN AIRSPACE VLD

This Updated Service Specification is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 101017689 under European Union's Horizon 2020 research and innovation programme.


## Abstract

This specification introduces an information exchange service which ensures interoperability and hence transparent and reliable information flow between the stakeholders in an operational U-space environment.

In accordance with ICAO SWIM, this document describes one of these Bridge Services, the Operational Message Exchange service in a logical, technology-independent manner.

# Table of Contents

# 1 Introduction

## 1.1 Purpose of the document

Based on the guidelines given in [GOF1-Arch-AppA], this document describes the OperationalMessage exchange service of a Common Information Service (CIS) in a logical technology-independent manner, that is:

- operational and business context of the service
  - requirements for the service, e.g. information exchange requirements
  - involved nodes: which operational components provide/consume the service
  - operational activities supported by the service
  - relation of the service to other services
- service description
  - service interface definitions
  - service interface operations
  - service payload definition
  - service dynamic behaviour description
- service provision and validation aspects

In addition, this document clearly defines the version of the service.

## 1.2 Scope

This document describes the OperationalMessage Exchange service for a CIS.

The OperationalMessage service provides a means for the operational nodes of the U-space to exchange operational messages, and a corresponding acknowlegement.

## 1.3 Target Group

This service specification is written for:

- service architects,
- system engineers and
- developers in charge of designing and developing an instance of the ConformanceMonitoring service.

In addition, this service specification is written for:

- enterprise architects,
- service architects,
- information architects,
- system engineers and developers in pursuing architecting, design and development activities of other related services.

## 1.4 Background

### 1.4.1 EU Regulation

The latest EU regulation draft contains requirements for conveying messages between operators, USSPs, and ATSUs involved in a given area whenever a non-conforming operation is detected. [EASA-Commission-Draft], Article 13, Conformance monitoring service refers:

> ***"1. A conformance monitoring service shall enable the UAS operators to verify whether they comply with the requirements set out in Article 6(1) and the terms of the UAS flight authorisation. To this end, this service shall alert the UAS operator when the flight authorisation deviation thresholds are violated and when the requirements in Article 6(1) are not complied with.***
>
> ***2. Where the conformance monitoring service detects a deviation from the flight authorisation, the U-space service provider shall alert the other UAS operators operating in the vicinity of the UAS concerned, other U-space service providers offering services in the same airspace and relevant air traffic services units, which shall acknowledge the alert."***

### 1.4.2 EUROCONTROL Specification for Monitoring Aids (MONA)

EUROCONTROL MONA [EC-MONA] defines conformance monitoring as follows.

> ***"2.2. Conformance Monitoring***
>
> ***The conformance monitoring function compares the system tracks with the corresponding flight clearances in order to warn the controller of any deviation of a flight from its clearance and, where possible, to establish the progress of the flight and to refine the prediction of the remaining trajectory to be flown.***
>
> ***Conformance is monitored in three dimensions, though the monitoring performed varies according to the type of clearance issued. In principle, warnings of deviation are generated in cases where the controller might be required to act to re-clear an aircraft that is assumed to be deviating from its clearance or to re-coordinate an aircraft whose boundary estimate changes significantly.***
>
> ***The [TP-SPEC] defines a planned trajectory and a tactical trajectory. Where possible, the system recalculates the trajectories that are active for a flight according to the actual behaviour of the aircraft, as described below.***
>
> ***..."***

### 1.4.3 EUROCONTROL Concept of Operations for U-space (CORUS)

EUROCONTROL CORUS [CORUS] Vol. 2 elaborates in 5.1.6.1 Monitoring service as follows.

> ***"5.1.6.1 Monitoring service***

***Subject to appropriate data-quality requirements, this service retrieves data from the tracking service and combines it with information related to non-cooperative obstacles and vehicles to provide an air situation status report for authorities, service providers, and operators, including pilots. This service may include operation plan conformance monitoring, geo-fence compliance monitoring and warnings (see 5.1.2.2), weather limit compliance monitoring, ground risk compliance monitoring, electromagnetic risk monitoring. The geo-fence compliance monitoring and warnings constitute U-space providing Geo-Awareness.***

***..."***

### 1.4.4 International Civil Aviation Organization (ICAO)

ICAO Doc 10039 [ICAO-SWIM] elaborates in section 3.4 INFORMATION EXCHANGE **SERVICES** on information exchange services as follow (para. 3.4.2).

***"Within the SWIM Global Interoperability Framework, the Information Exchange layer is instantiated by 'information services' as is further explained. Information services ensure interoperability between ATM applications which consume and provide interoperable information services. Consequently, the concept of information service is a fundamental building block of SWIM which enables interoperability through well-defined information exchanges."***

### 1.4.5 SESAR-JU

The European Commission identifies an increasing demand for a non-segregated use of airspace which is being driven by a rapidly growing market of EVery-Low-Level (VLL) airspace users, most of which are expected to be drones.

Via the Roadmap for the safe integration of drones into all classes of airspace [EATMP-Drone], within the European ATM Masterplan [EATMP], the European Commission seeks to ensure that this rapid growth of airspace use happens in a safe and controlled manner.

SESAR develops the required concepts and demonstrations for this process to happen. The roadmap [EATMP-Drone], in alignment with ICAO recommendations, identifies three phases for the integration, from which SESAR derives the four U-space service blocks presented in the U-space blueprint [UspaceBlueprint],

U1 U-space foundation services,

U2 U-space initial services,

U3 U-space advanced services, and

U4 U-space full services.

These stages reflect the anticipated quick growth of demand for U-space services. The state of the art has been, and is being, validated throughout Europe via several Very Large Demonstrator (VLD) projects such as the GOF USPACE project.

During the U1 phases, SESAR expects drones capable to supply their position via telemetry. The U1 and U2 blocks are anticipated to provide tracking capabilities and services.

### 1.4.6 Efficient, Safe and Sustainable Traffic at Sea (EfficienSea2)

The design method and terminology builds on experience from the EfficienSea2 project [EfficienSea2], [IALA-ENAV].

## 1.5 Glossary of Terms

| Term | Definition |
|---|---|
| External Data Model | Describes the semantics of the domain (or a significant part thereof) by defining data structures and their relations. This could be at logical level, e.g. in UML or at physical level, e.g. in XSD schema definitions, as for example standard data models. |
| Message Exchange Pattern | Describes the principles how two different parts of a message passing system (in our case: the service provider and the service consumer) interact and communicate with each other. Examples:<br>In the Request/Response MEP, the service consumer sends a request to the service provider in order to obtain certain information; the service provider provides the requested information in a dedicated response.<br>In the Publish/Subscribe MEP, the service consumer establishes a subscription with the service provider in order to obtain certain information; the service provider publishes information (either in regular intervals or upon change) to all subscribed service consumers. |
| Operational Activity | An activity performed by an operational node. Examples of operational activities are: Route Planning, Route Optimization, Logistics, Safety, Weather Forecast Provision, … |
| Operational Model | A structure of operational nodes and associated operational activities and their inter-relations in a process model. |
| Operational Node | A logical entity that performs activities. Note: nodes are specified independently of any physical realisation. Examples of operational nodes are: Control Center, Authority, Weather Information Provider, … |
| Service | The provision of something (a non-physical object), by one, for the use of one or more others, regulated by formal definitions and mutual agreements. Services involve interactions between providers and consumers, which can be performed in a digital form (data exchanges) or through voice communication or written processes and procedures. |
| Service Consumer | A service consumer uses service instances provided by service providers. |

| | |
|---|---|
| Service Data Model | Formal description of one dedicated service at logical level. The service data model is part of the service specification. Is typically defined in UML and/or XSD. If an external data model exists, e.g. a standard data model, then the service data model shall refer to it: each data item of the service data model shall be mapped to a data item defined in the external data model. |
| Service Design Description | Documents the details of a service technical design (most likely documented by the service implementer). The service design description includes (but is not limited to) a service physical data model and describes the used technology, transport mechanism, quality of service, etc. |
| Service Implementation | The provider side implementation of a dedicated service technical design, i.e. implementation of a dedicated service in a dedicated technology. |
| Service Implementer | Implementers of services from the service provider side and/or the service consumer side. |
| Service Instance | One service implementation may be deployed at several places by same or different service providers; each such deployment represents a different service instance, being accessible via different URLs. |
| Service Instance Description | Documents the details of a service implementation (most likely documented by the service implementer) and deployment (most likely documented by the service provider). The service instance description includes (but is not limited to) service technical design reference, service provider reference, service access information, service coverage information, etc. |
| Service Interface | Communication mechanism of the service, i.e., interaction mechanism between service provider and service consumer. A service interface is characterised by a message exchange pattern and consists of service operations that are either allocated to the provider or the consumer of the service. |
| Service Operation | Functions or procedure which enables programmatic communication with a service via a service interface. |
| Service Physical Data Model | Describes the realisation of a dedicated service data model in a dedicated technology. This includes a detailed description of the data payload to be exchanged using the chosen technology. The actual format of the service physical data model depends on the chosen technology. Examples may be WSDL and XSD files (e.g., for SOAP services) or swagger (Open API) specifications (e.g., for REST services). If an external data model exists (e.g., a standard data model), then the service physical data model shall refer to it: each data item of the service physical data model shall be mapped to a data item defined in the external data model.<br>In order to prove correct implementation of the service specification, there shall exist a mapping between the service physical data model and the service data model. This means, each data item used in the service physical data model shall be mapped to a corresponding data item of the service data model. (In |

| | |
|---|---|
| | case of existing mappings to a common external (standard) data model from both the service data model and the service physical data model, such a mapping is implicitly given.) |
| Service Provider | A service provider provides instances of services according to a service specification and service instance description. All users within the domain can be service providers, e.g., authorities, organizations (e.g., meteorological), commercial service providers, etc. |
| Service Specification | Describes one dedicated service at logical level. The Service Specification is technology-agnostic. The Service Specification includes (but is not limited to) a description of the Service Interfaces and Service Operations with their data payload. The data payload description may be formally defined by a Service Data Model. |
| Service Specification Producer | Producers of service specifications in accordance with the service documentation guidelines. |
| Service Technical Design | Technical design of a dedicated service in a dedicated technology. One service specification may result in several technical service designs, realising the service with different or same technologies. |
| Service Technology Catalogue | List and specifications of allowed technologies for service implementations. Currently, SOAP and REST are envisaged to be allowed service technologies. The service technology catalogue shall describe in detail the allowed service profiles, e.g., by listing communication standards, security standards, stacks, bindings, etc. |
| Spatial Exclusiveness | Service specification is characterised as "spatially exclusive", if in any geographical region only one service instance of that specification is allowed to be registered per technology. The decision, which service instance (out of a number of available spatially exclusive services) shall be registered for a certain geographical region, is a governance issue. |

**Tab. 1**: Glossary of Terms

## 1.6 List of Acronyms

| Acronym | Definition |
|---|---|
| API | Application Programming Interface |
| MEP | Message Exchange Pattern |
| NAF | NATO Architectural Framework |
| REST | Representational State Transfer |

| | |
|---|---|
| SOA | Service Oriented Architecture |
| SOAP | Simple Object Access Protocol |
| SSD | Service Specification Document |
| UML | Unified Modelling Language |
| URL | Uniform Resource Locator |
| WSDL | Web Service Definition Language |
| XML | Extendible Mark-up Language |
| XSD | XML Schema Definition |

**Tab. 2**: List of Acronyms

# 2 Service Identification

This chapter gives a unique identification of the service and describes where the service is in terms of the engineering lifecycle.

| Name | OperationalMessageExchange Service |
|---|---|
| ID | urn:frequentis:services:OperationalMessageExchangeService |
| Version | 1.0 |
| Description | A service which exchanges operational messages between UAS operators, USSPs, or ATSU including such to alert a party about a non-conforming operation, and require a corresponding acknowledgement. |
| Keywords | OperationalMessage Service, U-space, Warning, Alert |
| Architect(s) | 2021-today The Frequentis Group<br><br>2021-2022 The GOF2.0 U-Space Project Consortium |
| Status | Provisional |

**Tab. 3**: Service Identification

# 3 Operational Context

This section describes the context of the service from an operational perspective

## 3.1 Functional and Non-functional Requirements

The table below lists applicable existing requirements for the OperationalMessageExchange service:

| Requirement Id | Requirement Name | Requirement Text | References |
|---|---|---|---|
| [R-1] | Common Situational Awareness | At all times, all U-space participants shall operate on the same common set of data, during pre-flight planning stages as well as during all stages of flight operations. | CORUS [CORUS], 3.1.1.2 Z Volumes; B1-RPAS [ICAO-GANP];CEF-SESAR-2018-1 [GOF1-I-CFP], Objective O5 |
| [R-2] | Basis for Open Market | The U-space concept shall be designed such as to ensure a well-established line of authority while at the same time ensuring that an open market for VLL services may develop | SESAR Drone Roadmap [EATMP-Drone], Foreword, 4.1 and 4.2;U-space Blueprint [UspaceBlueprint], Benefits to European society and economy; CEF-SESAR-2018-1 [GOF1-I-CFP], Table 8 – Key Challenges |
| [R-3] | Interoperability | There shall be an implementation of a Flight Information Management System (FIMS) which ensures that, at all times, emerging unmanned traffic management systems and existing technologies from manned operations can exchange any data required to support such common situational awareness, be it for drone operations in areas where established ATC procedures apply, or in zones outside established ATC. | ICAO Doc 10039 [ICAO-SWIM];[R-2];CEF-SESAR-2018-1 [GOF1-I-CFP], Objective O6; CEF-SESAR-2018-1 [GOF1-I-CFP], Table 8 – Key Challenges<br><br>Note: The term 'Flight Information Management System (FIMS)' in some of these references has been since replaced by 'Common Information Services (CIS)'. This text hence elsewhere refers to CIS, rather than FIMS. |
| [R-4] | Standard Protocols | Standard communication protocols shall hence be used where available, and such | [R-2];SESAR Drone Roadmap [EATMP-Drone], 3.5, section 'Standards'; |

| | | | |
|---|---|---|---|
| | | standard protocols be developed otherwise, in order to ensure the lowest level of obstruction for an open VLL airspace use market to develop. | CEF-SESAR-2018-1 [GOF1-I-CFP], Table 8 – Key Challenges |
| [R-5] | Open Interfaces | Any interface and protocol hence must be openly defined and its definition be freely accessible in order to ensure the lowest level of obstruction for an open VLL airspace use market to develop. | [R-2];CEF-SESAR-2018-1 [GOF1-I-CFP], Table 8 – Key Challenges |
| [R-6] | SWIM | The implementation of a Flight Information Management System (FIMS) shall be based on an ICAO SWIM-compliant architecture. | [R-3];CEF-SESAR-2018-1 [GOF1-I-CFP], 5.3.4 Overall approach and methodology<br><br>Note: The term 'Flight Information Management System (FIMS)' used therein has been since replaced by 'Common Information Services (CIS)'. This text hence elsewhere refers to CIS, rather than FIMS. |
| [R-7] | Latency | Under no operational circumstance, the processing of position data may add significant latency to the overall detection-to-display latency of position data. In particular,<br><br>The processing latency added by the processing of positional data shall never exceed 10 per cent of the maximum value of the corresponding value permitted for the entire ATM automation system.<br><br>The processing latency and delay added by the processing of positional data should not exceed 1 per cent of the maximum value of the corresponding value permitted | [FAA-SUR-PERF], tables in the Executive Summary, [EC-ATM-PERF], 3N_C-R8 and 5N_C-R8 |

| | | | |
|---|---|---|---|
| | | for the entire ATM automation system.<br><br>The maximum value for latency and delay is the minimum of the values defined by the ATM system performance requirements by EUROCONTOL and the FAA; for a 3 NM minimal separation, this is 2.2 s, for a 5 NM separation, 2.5 s. | |
| [R-8] | UAS flight authorisation request | The UAS flight authorisation request shall comprise the following information:<br><br>1. the unique serial number of the unmanned aircraft or, if the unmanned aircraft is privately built, the unique serial number of the add-on;<br><br>2. mode of operation;<br><br>3. type of flight (special operations);<br><br>4. category of UAS operation (‘open’, ‘specific’, ‘certified’) and UAS aircraft class or UAS type certificate if applicable;<br><br>5. 4D trajectory;<br><br>6. identification technology;<br><br>7. expected connectivity methods ;<br><br>8. endurance;<br><br>9. applicable emergency procedure in case of a loss of command and control link;<br><br>10. registration number of the UAS operator and, when applicable, of the unmanned aircraft.1. | [EASA-Commission-Draft], Annex IV |

| | | | |
|---|---|---|---|
| [R-9] | Non-conformance alerting and acknowlegement | Subject to the airspace type requirements, there shall be continuous oversight about the compliance of U-space operations with the corresponding flight authorization.<br><br>There must be means to alert the UAS operator conducting an operation about any non-compliance with his flight authorization.<br><br>There must be means to alert other UAS operators operating in the vicinity of the non-compliant operation about this circumstance, other U-space service providers offering services in the same airspace and relevant air traffic services units, all which shall acknowledge the alert. | [EASA-Commission-Draft], Article 13 |

**Tab. 4**: Requirements for the OperationalMessageExchange Service

## 3.2 Other Constraints

### 3.2.1 Relevant Industrial Standards

#### 3.2.1.1 ICAO SWIM

The System Wide Information Management (SWIM, [ICAO-SWIM]) complements human-to-human with machine-to-machine communication, and improves data distribution and accessibility in terms of quality of the data exchanged. The SWIM Concept addresses the challenge of creating an "interoperability environment" which allows the SWIM IT systems to cope with the full complexity of operational information exchanges. The SWIM environment shifts the ATM information architecture paradigm from point-to-point data exchanges to system-wide interoperability.

### 3.2.2 Operational Nodes

The OperationalMessageExchange Service may consume and/or refer to information from a number of other services nodes including the following ones.

| Operational Service Node | Remarks |
|---|---|
| OperationPlan | Operation plans from the OperationPlan service, e. g. of a USSP, or an ATSU/ATSP |

| | |
|---|---|
| UasRegistration | Registry data from the UAS Registry service, e. g. of a USSP or an authority |
| TrafficTelemetry | PositionReports from the Traffic/Telemetry service, e. g. of a UAS operator, USSP, a CIS, a SDSP, an aircraft, or an ATSU/ATSP |
| GeoZone | GeoZone data from the GeoZone service, e. g. of a USSP, an ATSU/ATSP, or an authority |
| TrafficConformanceMonitoring | Traffic/Telemetry-based conformance monitoring service, e. g. of a USSP, an ATSU/ATSP, or an authority |

**Tab. 5**: Operational Services Nodes Providing Data for the OperationalMessageExchange Service

Operational nodes which may consume the service include the following ones:

| Operational Node | Remarks |
|---|---|
| GCS / UAS Operator | Operator ground control station of a UAS operator operating in the same area as this OperationalMessageExchange service |
| USSP | Other USSP(s) operating in the same area as this OperationalMessageExchange service |
| ATSU / ATSP | Air traffic service unit(s) or air traffic services provider operating in the same area as this OperationalMessageExchange service |
| SDSP | Supplementary data service provider(s) operating in the same area as this OperationalMessageExchange service |
| CIS | Common Information Servces operating in the same area as this OperationalMessageExchange service |

**Tab. 6**: Operational Nodes Consuming the OperationalMessageExchange Service

### 3.2.3 Operational Activities

Operational activities supported by the service include the following ones:

| Operational Activity | Remarks |
|---|---|
| Pre-Flight | Short-term communication with other stakeholders possible, e. g. to prevent a pending immediate take-off. |
| Normal flight operations | Communication of traffic advisories, or operational commands such as order to land immediately. |
| Abnormal flight operations | Communication of non-conforming or emergency operational state. |

| | |
|---|---|
| Post-flight activities | Evaluation of any message exchange for statistics or conformance evaluation purposes. |

**Tab. 7**: Operational Activities Supported by the OperationalMessageExchange Service

# 4 Service Interfaces

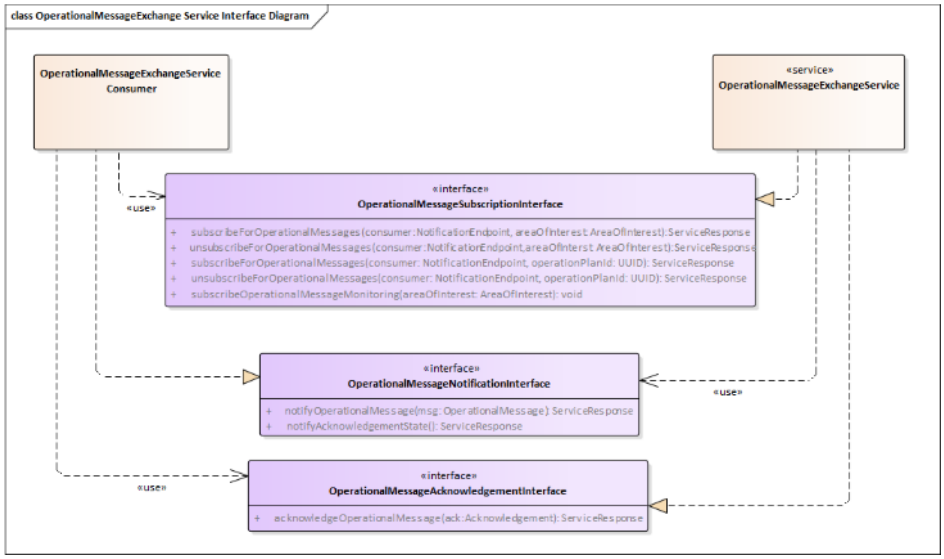


**Figure 1** OperationalMessageExchangeService Interface Definition diagram

An operator subscribes to the **OperationalMessageExchangeSunscriptionInterface** of her USSP for each one of her operationPlanId.

A USSP or ATSU subscribes to the **OperationalMessageExchangeSubscriptionInterface** for its **areaOfInterest** of the other USSPs or ATSUs operating that area, as does a monitoring consumer which **subscribeOperationalMessageMonitoring**.

| ServiceInterface | Role (from service provider point of view) | ServiceOperation |
|---|---|---|
| OperationalMessageSubscriptionInterface | Provided | subscribeForOperationalMessages<br>unsubscribeForOperationalMessages<br>subscribeOperationalMessageMonitoring |
| OperationalMessageAcknowledgementInterface | Provided | acknowlegeOperationalMessage |
| OperationalMessageNotificationInterface | Required | notifyOperationalMessage<br>notifyAcknowledgementState |

**Tab. 8**: Service Interfaces

# 5 Service Data Model

This section describes the information model, i.e., the logical data structures to be exchanged between providers and consumers of the service.

## 5.1 Overview

The OperationalMessageExchange service transfers operational messages, such as instructions by air traffic control or a UTM service provider (e. g. "Land now!"), and the corresponding acknowledgements via the **OperationalMessage** and **AckMessage** a data structures, respectively.

Such message exchange may take place between an operator and 'her' UTM service provider (USP), or between the involved USPs and/or air traffic services units (ATSU).

Each **OperationalMessage** shall be acknowledged by a corresponding **AckMessage**. Reference to the related **operationPlan**(s) should be provided. Likewise, the corresponding **droneRegistration**(s), positionInfo and reference to **airspace**(s) may be provided as required.

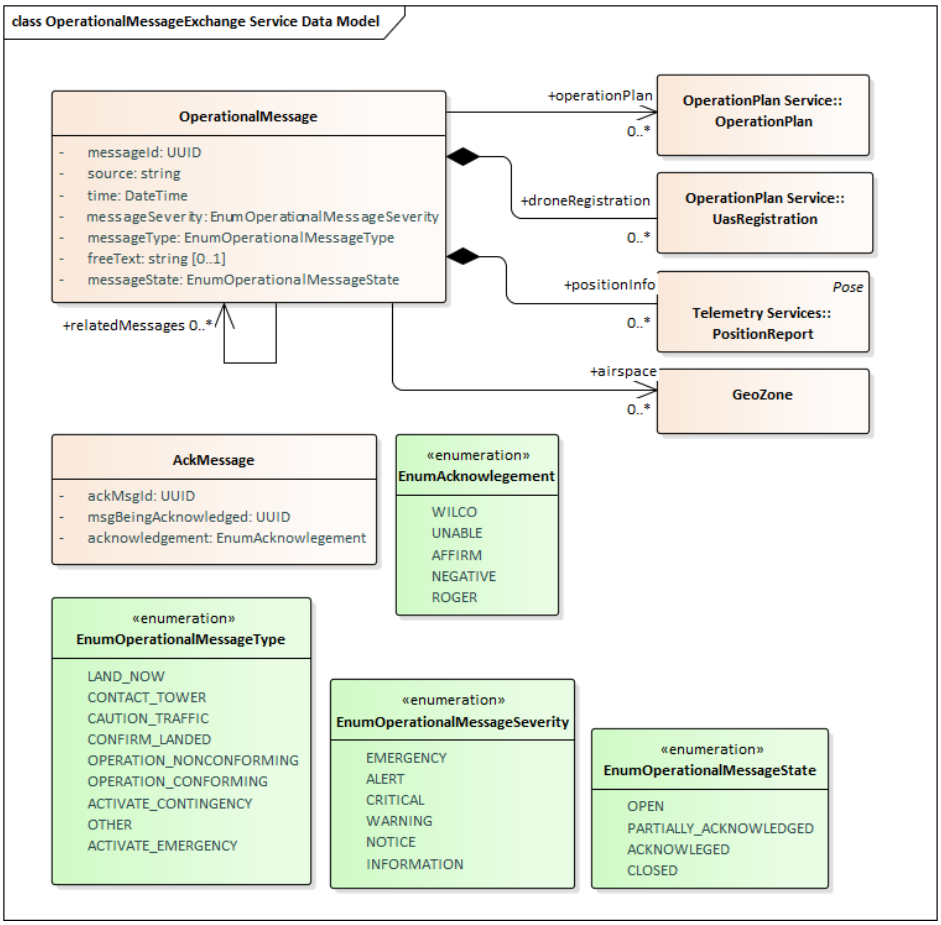


**Figure 2: Data Model diagram of the Identification Service**

## 5.2 OperationalMessage Data Structure

The **OperationalMessage** data structure carries the details of operational information being exchanged.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| messageId | UUID | 1 | Globally unique Operational Message identifier | |
| source | string | 1 | The name of the source of the OperationalMessage | Should be a recognized string by the CIS. |
| time | DateTime | 1 | The time stamp when the OperationalMessage was sent | |
| messageSeverity | EnumOperationalMessageSeverity | 1 | The severity of the OperationalMessage. | |
| messageType | EnumOperationalMessageType | 1 | The type of the OperationalMessage. | |
| freeText | string | 0..1 | Additional textual description of the **OperationalMessage**. | |
| messageState | EnumOperationalMessageState | 1 | The state the **OperationalMessage** is in when it was sent | |
| operationPlan | reference to OperationPlan | 0..* | List of references to OperationPlans the **OperationalMessage** is related to. | May consist of a list of UUIDs, referring to the OperationPlan identifiers. |
| droneRegistration | UasRegistration | 0..* | UAS Registration Information | May be omitted if information is present in the referred OperationPlan. |

| | | | | |
|---|---|---|---|---|
| positionInfo | PositionReport | 0..* | Positional indication of the **OperationalMessage** . | |
| airspace | GeoZone | 0..1 | Optional reference to an airspace. | |
| relatedMessages | reference to OperationalMessage | 0..* | List of references to other related **OperationalMessage** objects | may consist of a list of UUIDs, referring to the **OperationalMessage** identifiers. |

**Tab. 9**: **The** OperationalMessage **data structure**

## 5.3 AckMessage Data Structure

The **AckMessage** data structure carries the acknowledgements to an **OperationalMessage**.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| ackMsgId | UUID | 1 | Globally unique AckMessage identifier | |
| msgBeingAcknowledged | UUID | 1 | UUID of the OperationalMessage which this AckMessage acknowledges | |
| acknowlegement | EnumAcknowlegement | 1 | The kind of acknowlegement returned by this AckMessage | |

**Tab. 10**: The AckMessage data structure

## 5.4 EnumOperationalMessageSeverity Enumeration

The **EnumOperationalMessageSeveroty** enumeration type specifies the OperationalMessage severtities.

| Property | Description | Note |
|---|---|---|
| EMERGENCY | There is an *immediate* impact to the safety of other air operations, the safety of people, or the safety of structures on the ground. Actions to mitigate required by other operations. | |

| | | |
|---|---|---|
| ALERT | There may be an impact to the safety of other air operations, the safety of people, or the safety of structures on the ground. Actions to mitigate required by other operations. | |
| CRITICAL | Without mitigations by the affected operation, the situation may rise to an emergency in the near future. | |
| WARNING | There is a contained issue in this OperationalMessage that may result in the loss of aircraft. No immediate or likely effect to other operations, people on the ground, or structures. | |
| NOTICE | The information conveyed in this OperationalMessage is provided for situational awareness. Planning by operators and USSs may be affected. | |
| INFORMATION | The information conveyed in this OperationalMessage is provided for situational awareness. | |

**Tab. 11**: EnumOperationalMessageSeverity Enumeration

## 5.5 EnumOperationalMessageType Enumeration

The **EnumOperationalMessageType** enumeration type specifies the OperationalMessage types.

| Property | Description | Note |
|---|---|---|
| LAND_NOW | Instruct the receiver to land the drone immediately. | |
| CONTACT_TOWER | Instruct the receiver to contact the ATC tower. | |
| CAUTION_TRAFFIC | Informs the receiver about nearby traffic. | |
| CONFIRM_LANDED | Informs the receiver that the drone was landed. | |
| OPERATION_CONFORMING | Informs the receiver about a conforming operation. | |
| OPERATION_NONCONFORMING | Informs the receiver about a non-conforming operation. | |
| ACTIVATE_CONTINGENCY | Informs the receiver that the state of Contingency has been entered | |
| ACTIVATE_EMERGENCY | Informs the receiver that the state of Emergency has been entered | |

| | | |
|---|---|---|
| OTHER | Any other message as described in the freeText field. | This option should not be used, as it cannot be processed automatically. |

**Tab. 12**: EnumAertType Enumeration

## 5.6 EnumOperationalMessageSeverity Enumeration

The **EnumOperationalMessageSeverity** enumeration type specifies the OperationalMessage severtities.

| Property | Description | Note |
|---|---|---|
| EMERGENCY | There is an *immediate* impact to the safety of other air operations, the safety of people, or the safety of structures on the ground. Actions to mitigate required by other operations. | |
| ALERT | There may be an impact to the safety of other air operations, the safety of people, or the safety of structures on the ground. Actions to mitigate required by other operations. | |
| CRITICAL | Without mitigations by the affected operation, the situation may rise to an emergency in the near future. | |
| WARNING | There is a contained issue in this OperationalMessage that may result in the loss of aircraft. No immediate or likely effect to other operations, people on the ground, or structures. | |
| NOTICE | The information conveyed in this OperationalMessage is provided for situational awareness. Planning by operators and USSs may be affected. | |
| INFORMATION | The information conveyed in this OperationalMessage is provided for situational awareness. | |

**Tab. 13**: EnumOperationalMessageSeverity Enumeration

## 5.7 EnumOperationalMessageState Enumeration

The **EnumOperationalMessageState** enumeration type specifies the possible OperationalMessage states.

| Property | Description | Note |
|---|---|---|
| OPEN | At the time of the transmission of this OperationalMessage, it was in the OPEN state. | |
| PARTIALLY_ACKNOWLEDGED | At the time of the transmission of this **OperationalMessage**, it has been PARTIALLY_ACKNOWLEDGED, i. e., with some | |

| | | |
|---|---|---|
| | acknowlegements received, at least one expected acknowledgement was outstanding. | |
| ACKNOWLEDGED | At the time of the transmission of this **OperationalMessage**, it has been ACKNOWLEDGED from all recipients. | |
| CLOSED | At the time of the transmission of this **OperationalMessage**, it was in the CLOSED state. | |

**Tab. 14**: EnumOperationalMessageState Enumeration

## 5.8 EnumAcknowlegement Enumeration

The **EnumAcknowlegement** enumeration type specifies the available kinds of **OperationalMessage** acknowlegements available.

| Property | Description | Note |
|---|---|---|
| WILCO | Indicates that the acknowledging party will cooperate and comply with an instruction. | |
| UNABLE | Indicates that the acknowledging party CANNOT cooperate and will NOT comply with an instruction. | |
| AFFIRM | Indicates that the acknowledging party received the information conveyed via the corresponding **OperationalMessage** and confirms it. | |
| NEGATIVE | Indicates that the acknowledging party received the information conveyed via the corresponding **OperationalMessage** but does NOT confirm it. | |
| ROGER | Indicates that the acknowledging party received the information conveyed via the corresponding **OperationalMessage**. | |

**Tab. 15**: EnumAcknowlegement Enumeration

## 5.9 OperationPlan Data Structure

The OperationPlan data structure is defined in the OperationPlanExchange Service data model.

## 5.10 UasRegistration Data Structure

The **UasRegistration** data structure is defined in the OperationPlanExchange Service data model.

## 5.11 PositionReport Data Structure

The **PositionReport data structure is defined in the** TrafficTelemetry Service data model**.**

# 6 Service Interface Specifications

This chapter describes the details of each service interface. Each Service Interface has its own sub-chapter.

The Service Interface specification covers only the static design description while the dynamic design (behaviour) is described later.

## 6.1 Service Interface OperationalMessageSubscriptionInterface

### 6.1.1 Operation subscribeForOperationalMessages

#### 6.1.1.1 Operation Functionality

A consumer calls this operation to subscribe for receiving operational messages related to a certain geographical area of interest, or related to a certain operation plan.

The operation either expects an operationPlanId or an areaOfInterest input parameter.

#### 6.1.1.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| **consumer** | Input | NotificationEndpoint | Which endpoint shall be notified in case of new OperationalMessages |
| **operationPlanId** | Input | UUID | GUFI of the OperationPlan of interest to the consumer |
| **areaOfInterest** | Input | AreaOfInterest | Area of interest to the consumer |
| **response** | Return | ServiceResponse | Provide status information on subscription |

**Tab. 16**: Payload Description of subscribeForOperationalMessage Operation

### 6.1.2 Operation subscribeForOperationalMessageMonitoring

#### 6.1.2.1 Operation Functionality

A consumer calls this operation to subscribe to monitoring of operational messages related to a certain geographical area of interest.

#### 6.1.2.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| consumer | Input | NotificationEndpoint | Which endpoint shall be notified in case of new OperationalMessages |

| | | | |
|---|---|---|---|
| areaOfInterest | Input | AreaOfInterest | Area of interest to the consumer |
| response | Return | ServiceResponse | Provide status information on subscription |

**Tab. 17**: Payload Description of subscribeForOperationalMessageMonitoring Operation

An operator subscribes to the **OperationalMessageExchangeSunscriptionInterface** of her USSP for each one of her operationPlanId.

A USSP or ATSU subscribes to the **OperationalMessageExchangeSubscriptionInterface** for its **areaOfInterest** of the other USSPs or ATSUs operating that area, as does a monitoring consumer which **subscribeOperationalMessageMonitoring**.

### 6.1.3 Operation unSubscribeForOperationalMessages

#### 6.1.3.1 Operation Functionality

A consumer calls this operation at the provider to unsubscribe from operational messages related to a certain geographical area of interest or related to a certain operation plan.

The operation either expects an operationPlanId or an areaOfInterest input parameter.

#### 6.1.3.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| consumer | Input | NotificationEndpoint | Which endpoint shall be not be notified (anymore) in case of new OperationalMessages |
| operationPlanId | Input | UUID | GUFI of the OperationPlan of interest to the consumer, as given in the subscription |
| areaOfInterest | Input | AreaOfInterest | Area of interest to the consumer, as given in the subscription |
| response | Return | ServiceResponse | Provide status information on subscription |

**Tab. 18**: Payload Description of unSubscribeForOperationalMessages Operation

## 6.2 Service Interface OperationalMessageNotificationInterface

Consumer provides this interface, allowing the service provider to submit to the consumer operational messages.

### 6.2.1 Operation notifyOperationalMessage

#### 6.2.1.1 Operation Functionality

Once and while subscribed, consumer receives operational messages via this operation.

#### 6.2.1.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| operationalMessage | Input | OperationalMessage | An operational message that matches the OperationPlan UUID or area criterium provided with the subscription |
| Response | Return | ServiceResponse | Technical confirmation that the notification was delivered. |

**Tab. 19**: Payload Description of notifyOperationalMessage Operation

### 6.2.2 Operation notifyOperationalMessageState

#### 6.2.2.1 Operation Functionality

Once and while subscribed, consumer receives state changes of the operational message via this operation.

#### 6.2.2.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| messageId | Input | UUID | Unique identifier of the message for which a state change is notified. |
| operationalMessageState | Input | EnumOperationalMessageState | The state of the operational message that matches the OperationPlan UUID or area criterium provided with the subscription |
| Response | Return | ServiceResponse | Technical confirmation that the notification was delivered. |

**Tab. 20**: Payload Description of notifyOperationalMessageState Operation

## 6.3 Service Interface OperationalMessageAcknowledgementInterface

### 6.3.1 Operation acknowledgeOperationalMessage

#### 6.3.1.1 Operation Functionality

A consumer calls this operation to acknowledge an operational message.

#### 6.3.1.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| acknowledgeOperationalMessage | Input | AckMessage | Acknowledgment to operational message as requested by the OperationPlan UUID or area criterium provided with the subscription |
| Response | Return | ServiceResponse | Technical confirmation that the acknowledgement was delivered. |

**Tab. 21**: Payload Description of acknowledgeOperationalMessage Operation

# 7 Service Dynamic Behaviour

## 7.1 Sequence of events, cooperation with other services

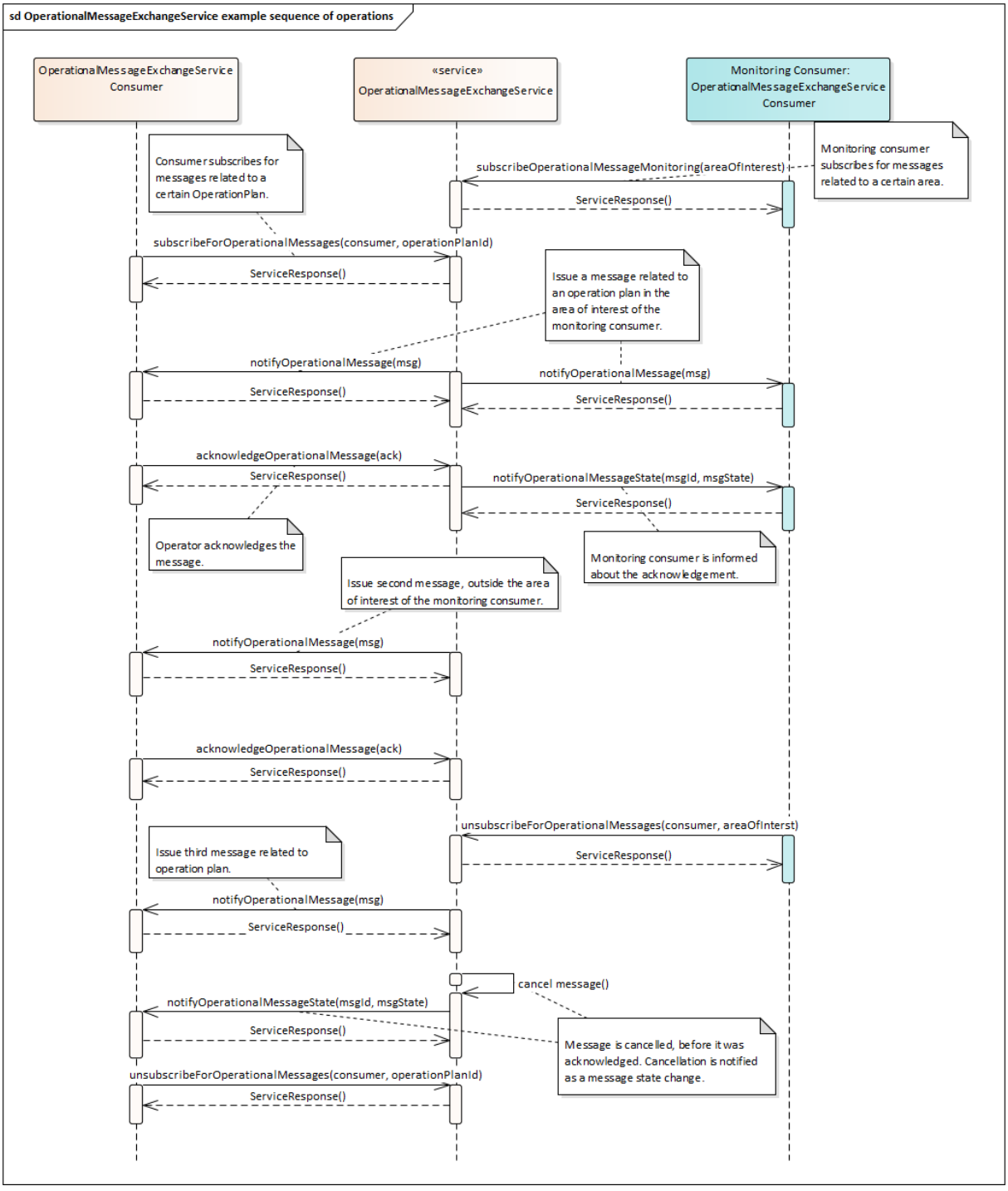


**Figure 3:** OperationalMessageExchange service operation sequence diagram

## 7.2 OperationalMessage State Machine

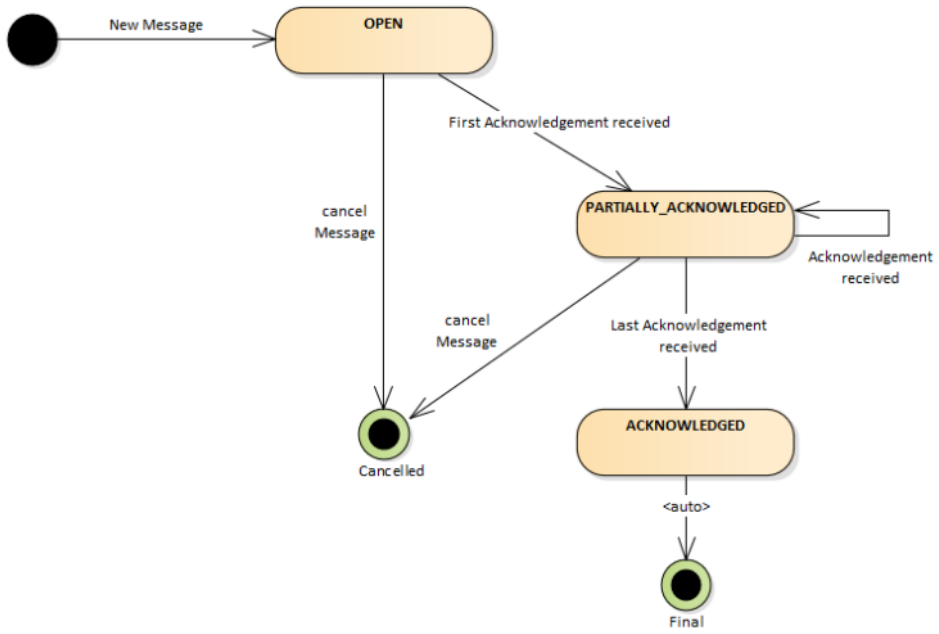


**Figure 4** OperationalMessage states - state transition diagram

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**Tab. 22**: List of References