# GOF 2.0 D2.4 – Appendix A Traffic/Telemetry Service Specification


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# GOF 2.0

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 a service of a Common Information Service (CIS) which ensures interoperability and hence transparent and reliable information flow between the stakeholders in an operational U-space environment. In accordance with ICAO SWIM, represents an Information Exchange Service.

Specifically, this document describes, in a logical, technology-independent manner, the Traffic/Telemetry service, a Position report Submission Sub-Service and Surveillance Data Service which accepts and carries surveillance data from a number of data sources to a Tracking Service which, in turn, provides a common situational picture to its consumers via this service.

Sources include, but are not limited to, primary and secondary radar and other drone detection services, on-board position telemetry services, and tracking service,

Consumers include, but are not limited to monitoring and traffic information services, tracking services, and display systems.

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# 1 Abstract

This specification introduces a service of a Common Information Service (CIS) which ensures interoperability and hence transparent and reliable information flow between the stakeholders in an operational U-space environment. In accordance with ICAO SWIM, represents an Information Exchange Service.

Specifically, this document describes, in a logical, technology-independent manner, the Traffic/Telemetry service, a **Position report Submission Sub-Service** and **Surveillance Data Service** which accepts and carries surveillance data from a number of data sources to a Tracking Service which, in turn, provides a common situational picture to its consumers via this service.

Sources include, but are not limited to, primary and secondary radar and other drone detection services, on-board position telemetry services, and tracking service,

Consumers include, but are not limited to monitoring and traffic information services, tracking services, and display systems.

# 2 Introduction

## 2.1 Purpose of the document

Based on the guidelines given in [3], this document describes the Traffic/Telemetry bridge service of a Common Information Service (CIS) in a logical technology-independent manner, that is:

- the 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
- the service description
    - service interface definitions
    - service interface operations
    - service payload definition
    - service dynamic behaviour description
- service provision and validation aspects

Furthermore, this document clearly defines the version of the service.

## 2.2 Scope

This document describes the Traffic/Telemetry service for a CIS.

The Traffic/Telemetry service provides a means for the operational nodes of the U-space to share their position reports and make them available for further processing.

The Traffic/Telemetry service furthermore provides a means for the operational nodes of the U-space to consume position reports from the U-space participants for further processing.

## 2.3 Intended readership

This service specification is intended to be read by service architects, system engineers and developers in charge of designing and developing an instance of the Traffic/Telemetry service.

Furthermore, this service specification is intended to be read by enterprise architects, service architects, information architects, system engineers and developers in pursuing architecting, design and development activities of other related services.

## 2.4 Background

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

EUROCONTROL CORUS [4] Vol. 2 elaborates in 5.1.1.4 Position reporting submission sub-Service as follows.

***"The Tracking service of U-space (section 5.1.1.5) cannot work unless U-space receives position reports concerning drones. The Position report submission sub-service has been added in this ConOps to allow that. It is not a service on its own but rather an important part of the Tracking service.***

***[…]***

***Position report submission will need to be secure, reliable and low latency. The information in Position Reports is safety critical. The Position report submission sub-service must be deployed in a robust and reliable manner because of its safety criticality.***

***[…]***

***Drone position report submission will be an automatic process (the pilot will not type lat-longs) hence the technical implementation will probably be fed by some software that is running at the drone or remote-piloting station. The feedback that is given is intended for the pilot and may be delivered the same way or through a web or similar interface that the pilot can conveniently consume.***

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***All drone position reports should be recorded to allow the provision of the Accident and Incident investigation (section 5.1.5.2). Hence the Position report submission service will feed the Legal Recording service (section 5.1.6.3).***

***The Position Reports sent to U-space should include***

***All drone position reports should be recorded to allow the provision of the Accident and Incident investigation (section 5.1.5.2). Hence the Position report submission service will feed the Legal Recording service (section 5.1.6.3).***

***The Position Reports sent to U-space should include***

- ***The current 3D position of the drone, expressed in the agreed measurement system and frame of reference, to the precision expected in the airspace concerned.***
- ***The uncertainty in the reported position (perhaps in the manner of ADS-B)***
- ***The precise time at which the position has been measured, if available***
- ***The means by which the position has been determined, and/or some identifier of the origin of the report – so as to help the tracking service combine multiple sources of reports for the same flight.***

- *If available the current speed vector of the vehicle, together with its uncertainty*
- *The identity of the vehicle, if available, preferably in the form used by Remote Identification see 3.1.4.1*
- *The identity of the operator of the vehicle, if available*
- *The identity of the mission plan being executed – if any and if available*
- *In the absence of the vehicle's identifier, if possible, a temporary identifier for the flight to ease the job of the tracker. "*

## 2.4.2 Global UTM Association (GUTMA) and GUTMA-related

### 2.4.2.1 Flight Logging Protocol

The Flight Logging Protocol [5], section **flight_logging** suggests some data items as follows.

*"For the moment, mandatory fields are timestamp, gps_lon, gps_lat, gps_altitude. speed and battery_voltage are also taken into account, but they are optional. Many types can be added, it will simply not be analysed, just stored.*

- *Timestamp : number of the seconds elapsed since logging_start_dtg. It is a float, with max 3 decimals (so precision is milliseconds). By extension, the last timestamp will be equal to the duration flight in seconds.*
- *gps_lon, gps_lat, gps_altitude: GPS coordinates*
- *speed: ground speed in m/s (float)*
- *battery_voltage: voltage in volt (float)*
- *logging_start_dtg: describes the beginning of the flight. It is mandatory.*
- *altitude_system: indicates the type of altitude reported: "AGL", "MSL" or "WGS84".*

*Event is used for notify events during the flight. It can be take off, gps lost, obstacle detection etc."*

### 2.4.2.2 Air Traffic Protocol

The Air Traffic Protocol has received several suggestions for extension [6]. From the **Objective** and **Data Sources** sections:

*"Therefore the core objective of this reporting standard is the following:*

- *Identify aircraft with high certainty*
- *Minimize Latency, reduce bandwidth*
- *Ensure quality and integrity of the data*
- *Ability to merge different data sources into a single feed.*

*(…)*

*The following data sources are considered in scope for the purposes of this data feed:*

- *Aircraft equipped with sensors that detect and produce data (e.g. ADS-B / Mode S / Primary Radar / Mode AC / FLARM / UAT)*

- *Sensors from private companies / 1st level sensors detecting emitted data (e.g. OEM / Radar manufacturers / Sensor manufacturers)*
- *UAS / Aircraft itself: In the future all drones will detect neighbouring aircraft and share it (Traffic information service - broadcast (TIS-B) collects information and broadcasts it to any aircraft in the region)"*

### 2.4.3 Federal Aviation Administration (FAA) Concepts of Operations

The FAA defines a messaging service in its **Concepts of Operations v1.0 - Appendix C - UTM Services - Messaging Service** [7] as follows.

***"A service which provides on demand, periodic, or event driven information on UAS operations (e.g. position reports, intent information, and status information) occurring within the subscribed airspace volume and time. Additional filtering may be performed as part of the service."***

### 2.4.4 Swiss Federal Office of Civil Aviation (FOCA)

From the FOCA **Concepts of Operations v1.0** [8], section 3.5.10 - Tracking Service:

***"A service, which tracks position reports of the UAVs in order for other services to operate (deconfliction,flight planning and so on). It fulfils following functions:***

- ***To track UA positions in real-time***
- ***To securely store tracked data***
- ***To provide different access levels to users with different credentials for the tracking data***

***The services will gather positions of the UAS and ensure privacy of its users and their activity. It will benefit the users by allowing the services and the competent authorities to access data while ensuring privacy and data protection of the participants."***

### 2.4.5 International Civil Aviation Organization (ICAO)

In the Global Air Navigation Plan [9], ICAO defines three Aviation System Block Upgrade (ASBU) blocks, B1-RPAS, B2-RPAS, and B3-RPAS, referring to scheduled implementation years of 2019, 2025, 2031, and beyond, and expects increased situational awareness from B1-RPAS onwards.

ICAO Doc 10039 [2] 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."***

### 2.4.6 Open Drone ID

Open Drone ID is a project to provide a low cost and reliable "beacon" capability for drones so that they can be identified when within range of a receiver. Open Drone ID receives support from large companies such as Intel.

The Open Drone ID Message Specification [10] proposes a Location Message in both, a byte and a JSON representation, which permits the transport of

- a position in three space dimensions,
- a velocity, and
- a data age.

The Open Drone ID Message Specification furthermore proposes messages to convey information about

- the type of drone,
- its in-flight status, and
- the location of the drone operator.

### 2.4.7 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 Very-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 [11], within the European ATM Masterplan [12], 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 [1], 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 [13],

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 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 is anticipated to provide tracking capabilities and services.

### 2.4.8 Efficient, safe and sustainable traffic at sea (EfficienSea2)

The design method and terminology builds on experience from the EfficienSea2 project [14], [15].

### 2.4.9 ASTM

F3411 - 22a, Standard Specification for Remote ID and Tracking provides a specification on performance requirements for remote identification for unmanned systems. It defines message formats, transmission methods and minimum performance standards for broadcast and network-based remote ID.

Especially, network-based remote ID, as described in F3411 - 22a can be considered a valid implementation of this service specification.

## 2.5 Glossary of terms

| Term | Definition |
|---|---|
| **AIR-REPORT** | A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting. |
| **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><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><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.<br><br>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 may be performed in a digital form (data exchanges) or through voice communication or written processes and procedures. |

| | |
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| **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** | The 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><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** | The 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** | A service specification is characterised as "spatially exclusive", if in any geographical region just one service instance of that specification is allowed to be registered per technology.<br><br>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. |

**Table 1: Glossary of terms**

## 2.6 List of Acronyms

| Acronym | Definition |
|---|---|
| **API** | Application Programming Interface |
| **CIS** | Common Information Services |
| **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 |

**Table 2: List of acronyms**

# 3 Service Identification

The purpose of this chapter is to provide a unique identification of the service and describe where the service is in terms of the engineering lifecycle.

| | |
|---|---|
| **Name** | **Traffic Telemetry Service** |
| **ID** | **urn:frequentis:services:TrafficTelemetryService** |
| **Version** | **2.0.2** |
| **Description** | **A service which provides position reports of objects such as aircraft (manned and unmanned),** |
| **Keywords** | **Position report Submission Sub-Service, Surveillance Data Service, U-space Tracking, UAV Orientation, Speed** |
| **Architect(s)** | **2020-today The Frequentis Group**<br><br>**2018-2020 The GOF U-Space Project Consortium** |
| **Status** | **Provisional** |

**Table 3: Service Identification**

# 4 Operational Context

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

## 4.1 Functional and Non-functional Requirements

The table below lists applicable existing requirements for the **Traffic/Telemetry** 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 [4], 3.1.1.2 Z Volumes; B1-RPAS [9];CEF-SESAR-2018-1 [1], 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 [11], Foreword, 4.1 and 4.2;U-space Blueprint [13], Benefits to European society and economy; CEF-SESAR-2018-1 [1], 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 [2];[R-2];CEF-SESAR-2018-1 [1], Objective O6; CEF-SESAR-2018-1 [1], Table 8 – Key Challenges<br><br>Note: The term 'Flight Information Management System (FIMS)' has been since replaced by 'Common Information Services (CIS)'. This text hence refers to CIS, rather than FIMS. |
| [R-4] | Standard Protocols | Standard communication protocols shall hence be used where available, and such standard protocols be developed otherwise, in order to ensure the lowest level of obstruction for an open VLL airspace use market to develop. | [R-2];SESAR Drone Roadmap [11], 3.5, section ‘Standards’;C EF-SESAR-2018-1 [1], 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 [1], 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 [1], 5.3.4 Overall approach and methodology<br><br>Note: The term 'Flight Information Management System (FIMS)' has been since replaced by 'Common Information Services (CIS)'. This text hence 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 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. | [17], tables in the Executive Summary, [16], 3N_C-R8 and 5N_C-R8 |

**Table 4: Requirements for the Traffic/Telemetry Service**

## 4.2 Other Constraints

### 4.2.1 Relevant Industrial Standards

#### 4.2.1.1 ICAO SWIM

The System Wide Information Management (SWIM, [2]) 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.

#### 4.2.1.2 EUROCONTROL ASTERIX

The All-purpose structured EUROCONTROL surveillance information exchange (ASTERIX) [18] is a set of documents defining the low level ("down to the bit") implementation of a data format used for exchanging surveillance-related information and other ATM applications.

EUROCONTROL-SPEC-0149-9 - EUROCONTROL Specification for Surveillance Data Exchange ASTERIX Part 9 Category 062 SDPS Track Messages

EUROCONTROL-SPEC-0149-12 - EUROCONTROL Specification for Surveillance Data Exchange ASTERIX Part 12 Category 21 ADS-B Target Reports

EUROCONTROL-SPEC-0149-14 - EUROCONTROL Specification for Surveillance Data Exchange ASTERIX Part 14 Category 20 Multilateration Target Reports

EUROCONTROL-SPEC-0149-17 - EUROCONTROL Specification for Surveillance Data Exchange ASTERIX Part 17 Category 004 Safety Net Messages

EUROCONTROL-SPEC-0149-28 - EUROCONTROLSpecification for Surveillance Data Exchange – ASTERIX Part 28 - Category 015: INCS System Target Reports

EUROCONTROL-SPEC-0149-29 - EUROCONTROL Specification for Surveillance Data Exchange – ASTERIX Part 29 - Category 129: UAS Identification Reports

EUROCONTROL-SPEC-0149-30 - EUROCONTROL Specification for Surveillance Data Exchange – ASTERIX Part 30 - Category 016: Independent Non-Cooperative Surveillance System Configuration Reports

EUROCONTROL-SPEC-0149-31 - EUROCONTROLSpecification for Surveillance Data Exchange – ASTERIX Part 31 - Category 205: Radio Direction Finder Reports

#### 4.2.1.3 EUROCONTROL ATM Automation System Environment Performance Requirements

Eurocontrol defines clear operational requirements and an elaborated assessment methodology for European surveillance in its Specification for ATM Surveillance System Performance [16]. For instance, for a separation of 3 nautical miles:

| Req. # | Quality of service | Mandatory performance |
|---|---|---|
| 3N_C-R8 | Forwarded pressure altitude average data age (see Note 7 in § 3.4.5) | Less than or equal to 2.5 seconds |

**Table 5: Excerpt from EUROCONTROL Specification for ATM Surveillance System Performance [16]**

Further requirements for update rates and error margins apply.

#### 4.2.1.4 FAA ATM Automation System Environment Performance Requirements

In a similar fashion, the Federal Aviation Administration concludes that the time from the determination of a position (measurement) to display (latency of the ATM system) shall not exceed similar values [17]:

| | |
|---|---|
| Latency | 2.2 seconds to display maximum |

The FAA also applies further requirements for update rates and error margins.

### 4.2.2 Operational Nodes

A typical U-space flight goes through several stages, starting strategic-tactically, pre-flight, from Strategic Planning, over to Pre-Tactical Planning, to Tactical Planning. Then, tactical-operationally it enters into the actual in-flight stages from Departure, over to In-Flight, and, finally Arrival. Further post-flight stages may evaluate the results from the data produced during the prior stages.

The Traffic/Telemetry service primarily is relevant during the actual operational in-flight stages of a U-space flight during which the flying device and/or the corresponding ground stations produce the position data which we convey via the Traffic/Telemetry service.

There are several nodes in U-space which could provide position information to the Traffic/Telemetry service.

- An actual aircraft (manned or unmanned), that provides position data to a ground station
- A ground station, relaying or providing position data to a Central Information Service (CIS)
- A CIS to consolidate for consuming applications and services

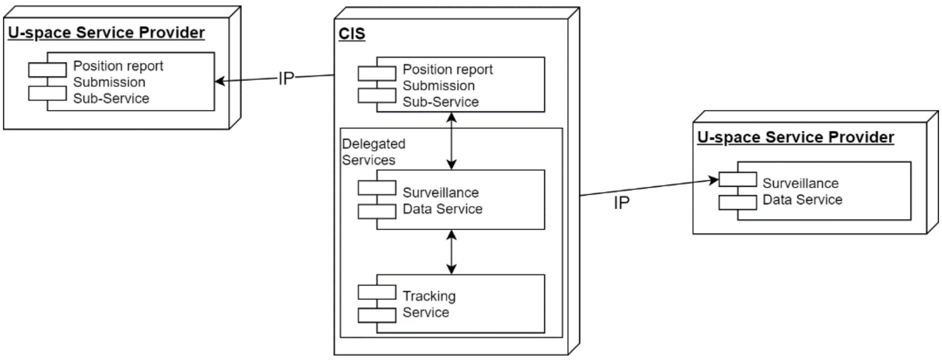

**Figure 1: U-space nodes related to the Traffic/Telemetry service**

Though a simple view on data provided by a Traffic/Telemetry service already could be used for some applications, typically consuming services and applications will utilize the service together with other services like

- Flight Planning Services - to retrieve more information about a flight associated with the position report
- Registration Services - for background on e.g. operator, pilot and flown device
- Geofencing Services – to draw a user's attention to a potential area conflict and to act accordingly, possibly even automatically

Consuming services and applications include the following services and applications.

- Tactical Deconfliction Service
- Tracking Service
- Traffic Alerting Service
- Displays for Situational Overview
- Accident and Incident Reporting Services
- Traffic Monitoring Services
- Traffic Information Services
- Legal Recording Service

Operational nodes which may provide data for the Traffic/Telemetry service include the following ones.

| Operational Node | Remarks |
|---|---|
| Aircraft | Manned, unmanned, and/or autonomous |
| Ground Station | Professional or recreational alike |
| UTM Service Provider | |
| Common Information Service | |

**Table 6: Operational Nodes providing the Traffic/Telemetry service**

Operational nodes which may consume the Traffic/Telemetry service include the following ones.

| Operational Node | Remarks |
|---|---|
| Common Information Service | |
| Information Display | |
| Telemetry Converter | |
| Legal Recorder | |

**Table 7: Operational Nodes consuming the Traffic/Telemetry service**

### 4.2.3 Operational Activities

Operational activities supported by the Traffic/Telemetry service include the following ones.

| Phase | Operational Activity | Remarks |
|---|---|---|
| Pre-flight | Set-up | *(Telemetry likely not operational yet at this stage)* |
| | Plan | *(Telemetry likely not operational yet at this stage)* |
| | Arm | *(Traffic/telemetry should start to run here)* |
| In-Flight | Depart | Traffic/Telemetry data operational for the flight |
| | Cruise | Traffic/Telemetry data operational for the flight |
| | Arrive | Traffic/Telemetry data operational for the flight |
| Post-Flight | Disarm | *(Traffic/telemetry likely stops here)* |
| | Report | *(Post/flight analysis only)* |

**Table 8: Operational Activities supported by the Traffic/Telemetry service**

# 5 Service Overview

## 5.1 Service Interfaces

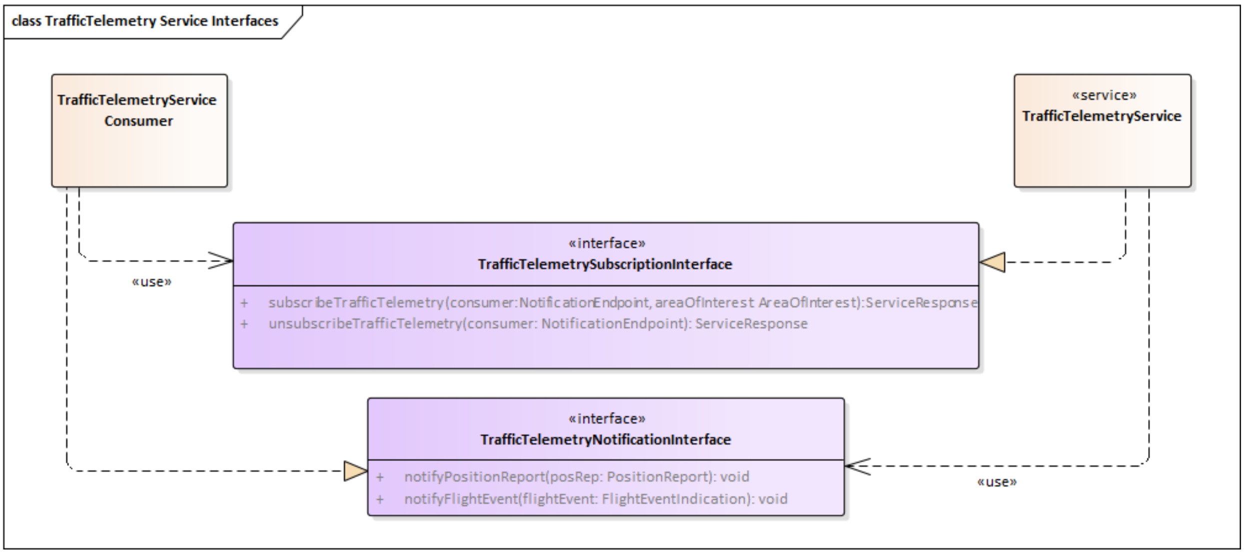


**Figure 2: Traffic/Telemetry Interface Definition diagram**

| ServiceInterface | Role (from service provider point of view) | ServiceOperation |
|---|---|---|
| TrafficTelemetrySubscriptionInterface | Provided | subscribeTrafficTelemetry<br>unsubscribeTrafficTelemetry |
| TrafficTelemetryNotificationInterface | Required | notifyPositionReport<br>notifyFlightEvent |

**Table 9: Service Interfaces**

# 6 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.

## 6.1 Overview

The Traffic/Telemetry service transfers positional data as **PositionReports**, aggregating **Position** and **Altitude** data, derived from the aggregated **Pose** structure which may carry **Velocity**, **Orientation**, **ObjectIdentification**, and an **ObjectPriority**. Optionally (if supported by the service provider), also **ObjectClassificationInfo** may be included.

The provision of the Position and at least one Altitude data item is mandatory.

There should be at least one **ObjectIdentifiation** data item in each Pose. Data sources should report as many **ObjectIdentification** and **ObjectClassificationInfo** data items as they have data available.

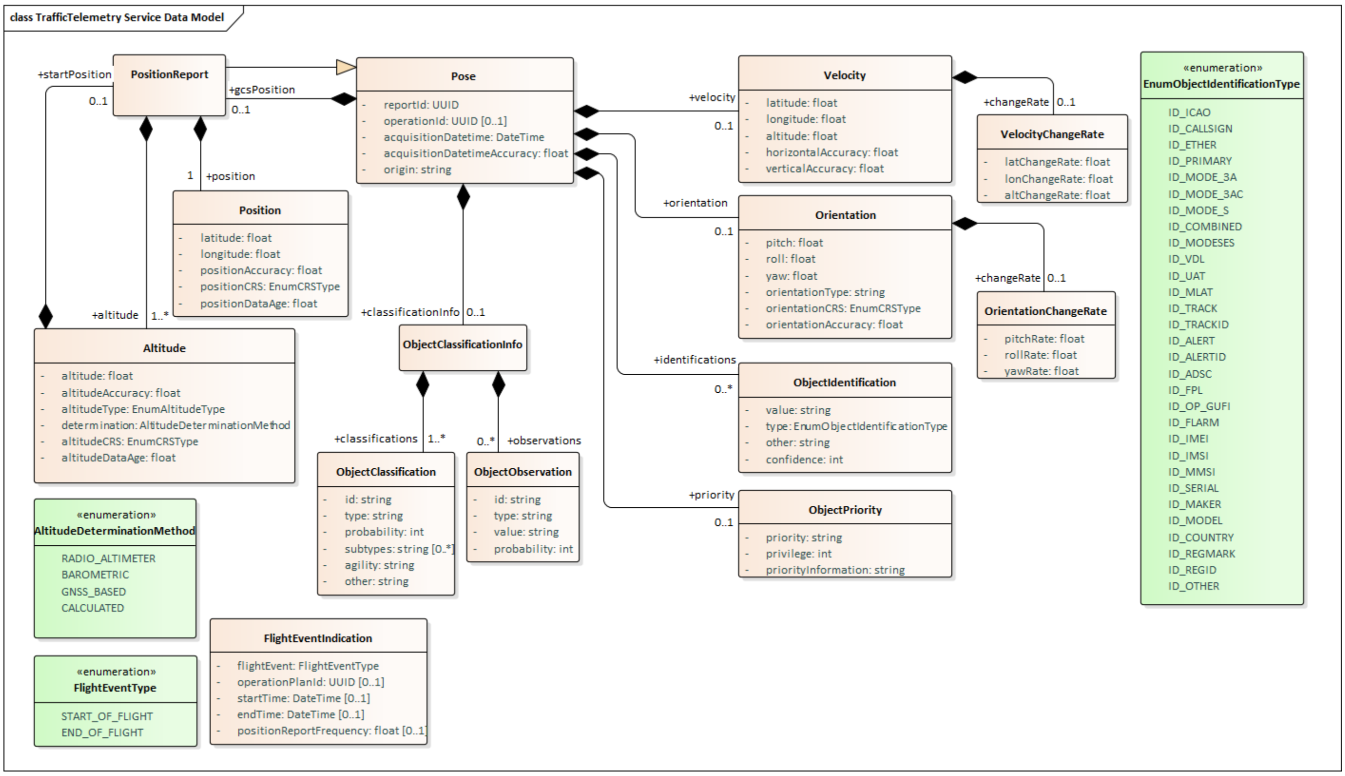


**Figure 3: Data Model diagram of the Traffic/Telemetry Service**

## 6.2 The Pose Data Structure

Pose is a composite of Velocity, Orientation, Object Identification, and Object Priority. This structure builds the base for dedicated Report structures (e.g., the PositionReport). Depending on a service provider's capabilities, only the core attributes of Pose and a (possibly empty) subset of its composing elements may be available on the service interface.

| **Property** | **Type** | **Multiplicity** | **Description** | **Note** |
|---|---|---|---|---|
| reportId | UUID | 1 | A uuid, globally unique to identify the position record | The UUI should be generated by as close as possible to the data originator (e.g. airborne, or by the operator). |
| operationId | UUID | 0..1 | The id of the operation, e. g. a flight_id i. e. a gufi, globally unique identifier referencing the flight producing this position report.<br><br>If no operation plan is known, this element is missing. | More information for an operation may be retrieved using a respective Common Information Service |
| acquisitionDatetime | DateTime | 1 | UTC point in time when the position was measured by the positioning unit of the device in operation | Expressed in UTC using the ISO 8601 date time format |
| acquisitionDatetimeAccuracy | Real | 1 | Accuracy of acquisition time measurement in ms | |
| origin | string | 1 | Indicates the origin of this position record. Can be, e.g., a sensor identification, or a tracker identification. | Two Pose records could be sent from the same aircraft – they would be identified by a different origin. Depending on bandwidth considerations all available sensors should be utiziled and transmit Pose records. |

| | | | | |
|---|---|---|---|---|
| gcsPosition | PositionReport | 0..1 | If provided, carries the Position and Altitude of the Ground Control Station being in control of the drone that is being reported about by this Pose data structure. | |
| velocity | Velocity | 0..1 | If provided, carries the velocity of the object being reported about in this **Pose**.<br><br>There may be none or one **Velocity** data structure provided for every **Pose**, providing all, or a subset, of the data it may carry. | There may be none or one **Velocity** data structure provided for every **Pose**, providing all, or a subset, of the data it may carry. |
| orientation | Orientation | 0..1 | If provided, carries the orientation data of the object being reported about in this **Pose**.<br><br>There may be none or one **Orientation** data structure provided for every **Pose**, providing all, or a subset, of the data it may carry. | There may be none or one **Orientation** data structure provided for every **Pose**, providing all, or a subset, of the data it may carry. |

| | | | | |
|---|---|---|---|---|
| identifications | ObjectIdentification | 0..* | If provided, carries data to assist in identifying the object we report about in this **Pose**. It can be a vehicle registration identifier or any other appropriate identifier.<br><br>There shall be none, one or more complete **ObjectIdentification** data structure(s) provided for every **Pose**, providing the means of identification of the target.<br><br>The first of the **ObjectIdentification** data structures provided shall contain the value which subsequent processing stages may rely on as accurate and binding.<br><br>Per default, this first **ObjectIdentification** data structure should contain the officially registered unique ID as assigned by the registering authority of the country of registration of the vehicle. | Data sources should report as many **ObjectIdentification** data items as they have data available.<br><br>There should be at least one **ObjectIdentifiation** data item in each **Pose**. |
| priority | ObjectPriority | 0..1 | If provided, carries data indicating the priority level of the object being reported about in this **Pose**.<br><br>There shall be none, or one, **ObjectPriority** data structure provided for every **Pose**. | |

| | | | | |
|---|---|---|---|---|
| classificationInfo | ObjectClassificationInfo | 0..1 | Optional information about the classification of the object being reported about. | |

**Table 10: The Pose data structure**

## 6.3 The Velocity Data Structure

The **Velocity** data structure may carry the velocity of the object being reported about. Velocity is represented as vector; it includes information on bearing and inclination.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| latitude | Real | 0..1 | Velocity in latitudinal direction in unit of measurement defined in unit of measurement as defined by Position.positionCrs. | |
| longitude | Real | 0..1 | Velocity in logitudinal direction in unit of measurement defined in unit of measurement as defined by Position.positionCrs. | |
| altitude | Real | 0..1 | Velocity in vertical direction in unit of measurement defined in unit of measurement as defined by Altitude.altitudeCrs. | |
| horizontalAccuracy | Real | 0..1 | Accuracy of horizontal velocity in unit of measurement defined by Position.positionCrs. | |
| verticalAccuracy | Real | 0..1 | Accuracy of vertical velocity in unit of measurement defined in Altitude.altitudeCrs. | |
| changeRate | VelocityChangeRate | 0..1 | Optional information about the change rate of the velocity (i.e., the acceleration). | |

**Table 11: The Velocity data structure**

## 6.4 The VelocityChangeRate Data Structure

The **VelocityChangeRate** data structure describes the speed change rate (acceleration) of the object being reported about.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| latChangeRate | Real | 0..1 | Change rate of the latitudinal velocity per time unit in unit of measurement as defined by Position.positionCrs. | |

| | | | | |
|---|---|---|---|---|
| lonChangeRate | Real | 0..1 | Change rate of the longitudinal velocity per time unit in unit of measurement as defined by Position.positionCrs. | |
| altChangeRate | Real | 0..1 | Change rate of the vertical velocity per time unit in unit of measurement as defined by Altitude.altitudeCrs. | |

**Table 12: The VelocityChangeRate data structure**

## 6.5 The Orientation Data Structure

The **Orientation** data structure may carry the orientation data of the object being reported about.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| pitch | Real | 0..1 | Transverse axis in unit of measurement as defined by orientationCrs | |
| roll | Real | 0..1 | Longitudinal axis in unit of measurement as defined by orientationCrs | |
| yaw | Real | 0..1 | Vertical axis in unit of measurement as defined by orientationCrs | |
| orientationType | OrientationType | 1 | Measured or calculcated | |
| orientationCrs | EnumCRSType | 1 | Coordinate reference system used (e. g., for WGS-84, EPSG:4979) | Enum values: S-UTM Services Common Data Model - Basic Geometry Data Types |
| orientationAccuracy | Real | 0..1 | Accuracy of orientation in unit of measurement defined in orientationCrs | |
| changeRate | OrientationChangeRate | 0..1 | Optional information about the change rate of the Orientation. | |

**Table 13: The Orientation data structure**

## 6.6 The OrientationChangeRate Data Structure

The **OrientationChangeRate** data structure describes the rate of change of the orientation of the object being reported about.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| pitchRate | Real | 0..1 | Change rate of the movement around the transversal axis per time unit in unit of measurement as defined by Orientation.orientationCrs. | |
| rollRate | Real | 0..1 | Change rate of the movement around the longitudinal axis per time unit in unit of measurement as defined by Orientation.orientationCrs. | |
| yawRate | Real | 0..1 | Change rate of the movement around the vertical axis per time unit in unit of measurement as defined by Orientation.orientationCrs. | |

**Table 14: The OrientationChangeRate data structure**

## 6.7 The ObjectIdentification Data Structure

The **ObjectIdentification** data structure may carry data to assist in identifying the object we report about in this report. It can be a vehicle registration identifier or any other identifier as listed in the IdentificationType property. Data sources should report all **ObjectIdentification** data items they have data about.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| value | String | 1 | The actual value of the identification of the object this report applies to, of type **type**. | |
| type | EnumObjectIdentificationType | 1 | Type of identification conveyed by this **ObjectIdentification** item, as defined by the **EnumObjectIdentificationType**. | |
| other | String | 0..1 | Optional empty item for temporary use until standardization is in place: Unless **type** is set to "ID_OTHER", do not set this field at all; however, if **type** is set to "ID_OTHER", set this field to a descriptive string for the type and set **value** to the corresponding value.<br><br>**NOTE:** Use of this field is **discouraged** at any time and permitted for local bilateral temporary deviation of standard only until updated standardization is in place. | |
| confidence | Integer | 0..1 | Optional item with a range from 0 to 100 representing the degree of confidence the emitter of this information has that the object we report about in this report actually can be identified by this particular **value**. | |

**Table 15: ObjectIdentification data structure**

## 6.8 The EnumObjectIdentificationType Enumeration

The **EnumObjectIdentificationType** enumeration type specifies possible ways to identify an object.

| Property | Description | Note |
|---|---|---|
| ID_ICAO | indicating an ICAO 24 bit address | |
| ID_CALLSIGN | indicating a call sign as per [ICAO-DOC-4444] | |
| ID_ETHER | indicating an Ethernet address | |
| ID_PRIMARY | primary surveillance | |
| ID_MODE_3A | secondary surveillance, 2D only, squawk | |
| ID_MODE_3AC | secondary surveillance, 3D, squawk | |
| ID_MODE_S | secondary surveillance, ICAO 24 bit address | |
| ID_COMBINED | ombined primary/secondary surveillance | |
| ID_MODE_SES | dependent surveillance, ICAO 24 bit address | |
| ID_VDL | dependent surveillance, ICAO 24 bit address | |
| ID_UAT | dependent surveillance, ICAO 24 bit address | |
| ID_MLAT | secondary surveillance, ICAO 24 bit address | |
| ID_TRACK | combined surveillance, numeric track id | |
| ID_TRACKID | combined surveillance, track uuid | |
| ID_ALERT | surveillance, numeric alert id | |
| ID_ALERTID | surveillance, alert uuid | |
| ID_ADSC | dependent surveillance, ICAO 24 bit address | |
| ID_FPL | dependent surveillance, squawk or no id, FPL number | |
| ID_GUFI | operation-id, i. e. the uuid of the operation | |
| ID_FLARM | dependent surveillance, FLARM-ID | |
| ID_IMEI | dependent surveillance, IMEI number | |
| ID_IMSI | dependent surveillance, IMSI number | |
| ID_MMSI | dependent surveillance, MMSI number | |
| ID_SERIAL | dependent surveillance, serial number of the vehicle as assigned by its manufacturer | |
| ID_MAKER | dependent surveillance, three letters identifying the manufacturer of the vehicle | |
| ID_MODEL | dependent surveillance, three letters identifying the model of the manufacturer of the vehicle | |

| Property | Description | Note |
|---|---|---|
| ID_COUNTRY | dependent surveillance, ISO 3166-1 Alpha 2 code of the country of registration of the vehicle | |
| ID_REGMARK | indicating a registration marking (e. g. [ICAO-ANN-10-IV], [ICAO-ANN-7]) | |
| ID_REGID | indicating a registration (e. g. uuid) from the national (aircraft or drone) registry | |
| ID_OTHER | **discouraged** | |

**Table 16: EnumObjectIdentificationType enumeration**

## 6.9 The ObjectPriority Data Structure

The **ObjectPriority** data structure may carry information about the status of the object and the priority it requires or requires/requests.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| priority | String | 1 | The status of the object this **ObjectPriority** item reports about, one of:<br><br>NORMAL Generic normal state of operations<br><br>FOLLOWME Normal state of operations, specifically operating as follow-me or marshal<br><br>RUNWAYCHECK Normal state of operations, specifically checking runway or taxiway<br><br>TOWING Normal state of operations, specifically towing vehicle, ship or aircraft<br><br>WIP Normal state of operations, work in progress such as maintenance or sweeping<br><br>TROUBLE Generic state of out-of-order operation such as technical failure<br><br>SAFETY Out-of-order state with safety impact to others (securité)<br><br>URGENCY Out-of-order state with immediate impact on the safety of the object or to human safety or health, or foreseeable distress<br><br>DISTRESS Out-of-order state with immediate danger to human life, on-board, or immediately related to the object | |

| | | | | |
|---|---|---|---|---|
| privilege | String | 1 | The privilege the object which this **ObjectPriority** item reports about requests or requires, one of:<br><br>NORMAL No privilege required nor requested<br><br>LAW Elevated privileges for law enforcement<br><br>EMERGENCY Elevated privileges to avoid danger of life<br><br>STATE Elevated privileges for matters of national security or other public safety, including military operations and diplomatic operations | |
| priorityInformation | String | 0..1 | Optional item which may hold additional information | |

**Table 17: The ObjectPriority data structure**

## 6.10The PositionReport Data Structure

The **PositionReport** data structure provides the actual position data, and one or more altitudes of the object being reported about. Furthermore, it inherits all properties of the **Pose** data structure.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| position | Position | 1 | Carries the position data of the object being reported about in this **PositionReport**. | There shall be one complete **Position** data structure provided for every **PositionReport**. |
| altitudes | Altitude | 1..* | Carries the altitude data of the object being reported about with this **PositionReport**.<br><br>There shall be one or more complete **Altitude** data structure provided for every **PositionReport**. The first of the **Altitude** data structures provided shall contain the value which subsequent processing stages may rely on as accurate and binding. | There shall be at least one complete **Altitude** data structure provided for every **PositionReport**. |
| all attributes inhertited from Pose | | | See Pose Data Structure | |

**Table 18: The PositionReport data structure**

## 6.11The Position Data Structure

The **Position** data structure carries the position data of the object being reported about.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| latitude | Real | 1 | Latitude of position record in unit of measurement as defined by positionCrs | Most commonly used CRSs use degrees as the UoM for the latitude; however, meters are used for Mercator projections. |
| longitude | Real | 1 | Longitude of position record in unit of measurement as defined by positionCrs | Most commonly used CRSs use degrees as the UoM for the longitude; however, meters are used for Mercator projections. |
| positionAccuracy | Real | 1 | Accuracy of **latitude** and **longitude** as the maximum deviation in the unit of measurement as defined by **positionCrs**. This means, for example, a value of **positionAccuracy**=x indicates that the real latitude reported in this position report is expected to be in the range of [**latitude**-x, **latitude**+x]. | The **positionAccuracy** value is mandatory and must be provided in any circumstance. It is the responsibility of the data provider to include an accuracy value into the position report.<br><br>In cases, where the accuracy value is not explicitly given by the data source, the accuracy has to be included according to the best knowledge, taking into account the documented sensor accuracy and the methodology of obtaining the value. |
| positionCrs | EnumCRSType | 1 | Coordinate reference system used (e. g., for WGS-84, EPSG:4979) | Enum values: S-UTM Services Common Data Model - Basic Geometry Data Types |
| positionDataAge | Real | 0..1 | Elapsed time in s since last position data received by the reporter of this **Position** | This attribute shall be provided, if the Position is used in a reporting service (e.g., in a PositionReport); in other cases this attribute may be omitted (e.g., in conversion operations). |

**Table 19: The Position data structure**

## 6.12The Altitude Data Structure

The **Altitude** data structure carries the altitude data of the object being reported about.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| altitude | Real | 1 | Altitude of position record in unit of measurement as defined by **altitudeCrs**. | All currently supported Coordinate Reference Systems use meters as unit of measurement for the altitude. |

| | | | | |
|---|---|---|---|---|
| altitudeAccuracy | Real | 1 | Spedifies the accuracy of **altitude** as the maximum deviation in the unit of measurement as defined by **altitudeCrs**. This means, for example, a value of **altitudeAccuracy**=x indicates that the real altitude reported in this position report is expected to be in the range of [**altitude**-x, **altitude**+x]. | The **altitudeAccuracy** value is mandatory and must be provided in any circumstance. It is the responsibility of the data provider to include an accuracy value into the position report.<br><br>In cases, where the accuracy value is not explicitly given by the data source, the accuracy has to be included according to the best knowledge, taking into account the documented sensor accuracy and the methodology of obtaining the value.<br><br>For example, in case of barometric altitude determination, the accuracy heavily depends on the current air pressure at the time of measurement. If the data provider is in the possession of up to date pressure data, the resulting |

| | | | | |
|---|---|---|---|---|
| | | | | accuracy will be higher; if no up to date pressure data is available, the data provider shall still add a worst case **altitudeAccuracy** value taking the worst case pressure deviations into account. |
| altitudeType | EnumAltitudeType | 1 | indicates the reference point for altitude measurement, e. g.:<br><br>altitude above mean-sea-level (MSL)<br><br>altitude above take-off location (ATO)<br><br>altitude above ground (AGL/SFC)<br><br>altitude above the WGS-84 ellipsoid; value delivered by GPS. | |
| determinationMethod | AltitudeDeterminationMethod | 1 | Method of determination of altitude, e. g.:<br><br>radio-altimeter<br><br>barometric<br><br>GNSS-based<br><br>calculated against reference point and mean-sea-level | |

| | | | | |
|---|---|---|---|---|
| altitudeCrs | EnumCRSType | 1 | Coordinate reference system used (e. g., for WGS-84, EPSG:4979) | Enum values: S-UTM Services Common Data Model - Basic Geometry Data Types |
| altitudeDataAge | Real | 0..1 | Elapsed time in s since last position data received by the reporter of this **Altitude** | This attribute shall be provided, if the Altitude is used in a reporting service (e.g., in a PositionReport); in other cases this attribute may be omitted (e.g., in conversion operations). |
| startPosition | PositionReport | 0..1 | If provided, contains Position and Altitude of the starting point, where this drone flight has departed. | This information shall be added to the Altitude structure in case that the altitudeType is set to ABOVE_TO. |

**Table 20: The Altitude data structure**

## 6.13The EnumAltitudeType **Enumeration**

The EnumAltitudeType enumeration type specifies the possible ways to express an altitude/height.

See Common Geometry Data types.

## 6.14The EnumCRSType **Enumeration**

The EnumCRSType enumeration type specifies the possible ways to express a coordinate reference system.

See Common Geometry Data types.

## 6.15The AltitudeDeterminationMethod **Enumeration**

The AltitudeDeterminationMethod enumeration type specifies the possible ways to determine an altitude.

| Property | Description | Note |
|---|---|---|
| RADIO_ALTIMETER | Altitude measured via radio altimeter. | |
| BAROMETRIC | Altitude measured via air pressure. | |
| GNSS_BASED | Altitude obtained by satellite navigation system. | |
| CALCULATED | Altitude calculated against reference point. | |

**Table 21: The AltitudeDeterminationMethod enumeration**

## 6.16The FlightEventIndication Data Structure

The **FlightEventIndication** data structure carries information about a flight event, such as a "start of flight" or "end of flight".

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| flightEvent | FlightEventType | 1 | Indicates the type of the flight event being reported about. | |
| operationPlanId | UUID | 0..1 | Reference to the related operation plan, if available. | |
| startTime | DateTime | 0..1 | Indicates the (expected) start time of the flight. To be provided with a START_OF_FLIGHT event indication. | |
| endTime | DateTime | 0..1 | Indicates the end time of the flight. To be provided with an END_OF_FLIGHT event indication. | |
| positionReportFrequency | Float | 0..1 | Expected number of position reports per second for this flight.<br><br>Optionally provided with a START_OF_FLIGHT event indication. | |

**Table 22: The FlightEventIndication data structure**

## 6.17The FlightEventType  Enumeration

The FlightEventType enumeration type specifies the types of flight events.

| Property | Description | Note |
|---|---|---|
| START_OF_FLIGHT | denotes a start-of-flight event. | |
| END_OF_FLIGHT | denotes an end-of-flight event. | |

**Table 23: The FlightEventType enumeration**

## 6.18Common Data Structures Used in UTM Service Specifications

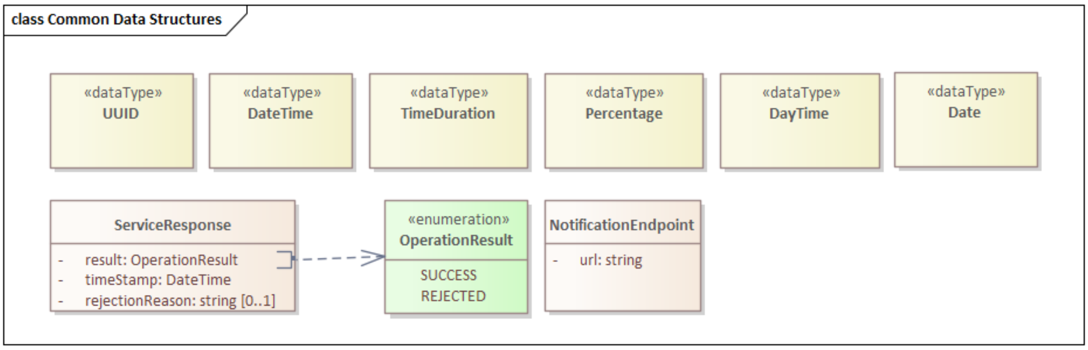


**Figure 4: Common Data Types Used in UTM Service Specifications**

## 6.18.1 NotificationEndpoint Data Structure

**NotificationEndpoint** is used in subscription and un-subscription operations to show the receiver of notifications as a result of the subscription.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| URL | String | 1 | Endpoint capable of receiving notifications | |

**Table 24: NotificationEndpoint Data Structure**

## 6.18.2 ServiceResponse Data Structure

ServiceResponse is the generic response provided by each service operation. In some cases, this basic data structure may be extended by inheritance.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| result | OperationResult | 1 | Indicates the result of the request to the service | |
| rejectReason | String | 0..1 | Optional additional information to be provided in case of negative result | |
| timeStamp | DateTime | 1 | | |

**Table 25: ServiceResponse Data Structure**

## 6.18.3 OperationResult Enumeration

The **OperationResult** enumeration type specifies the possible outcomes of calling an operation.

| Property | Description | Note |
|---|---|---|
| SUCCESS | Operation was successfully executed. | |
| REJECTED | Operation could not be executed. | |

**Table 26: OperationResult Enumeration**

## 6.19 Common Geometry Data Structures Used in UTM Service Specifications

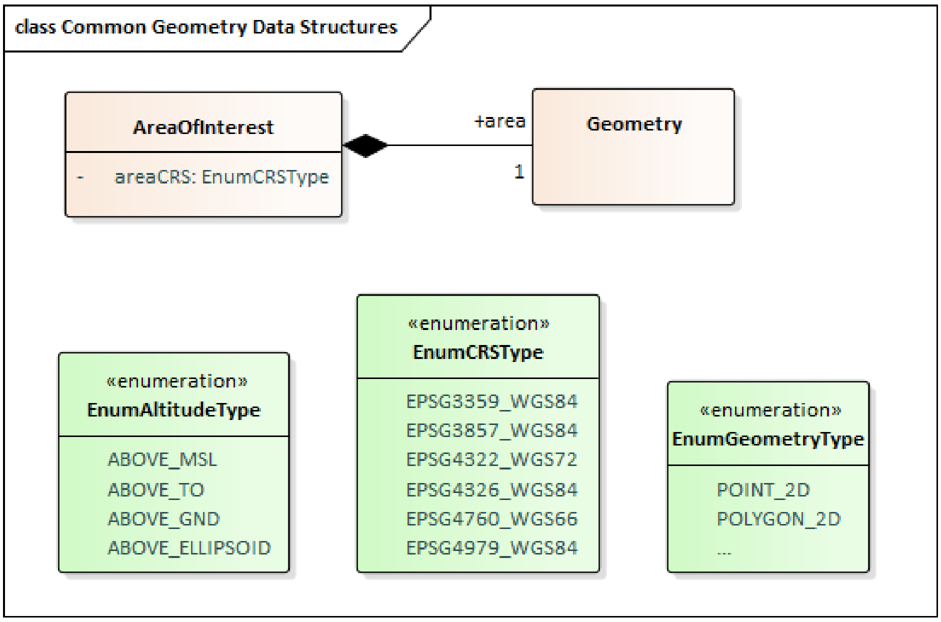


**Figure 5: Common Geometry Data Types Used in UTM Service Specifications**

### 6.19.1 AreaOfInterest **Data Structure**

**AreaOfInterest** is used in subscription operations to provide an indication of the geographic area for which the subscriber is interested to receive notifications.

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|
| **area** | **Geometry** | 1 | A geometric description of a geographic area. | Should be a 2-dimensional geometry in this case. |
| **areaCRS** | **EnumCRSType** | 1 | Coordinate reference system used (WGS-84, EPSG:4979) | |

**Table 27: AreaOfInterest Data Structure**

### 6.19.2 Geometry **Data Structure**

**Geometry** describes a geometrical shape of one, two or three dimensions.

The **Geometry** data structure is not further detailed in this service specification. One example of how a generic Geometry structure could be realized is sketched in the table below:

| Property | Type | Multiplicity | Description | Note |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **coordinates** | **Double** | 2..* | Collection of the coordinates, describing the geometry. | |
| **geometryType** | **GeometryType** | 1 | Type of geometry being described by the coordinates. | Examples: Point, Polygon, Polyhedron, etc. |

**Table 28: Geometry Data Structure**

### 6.19.3 EnumAltitudeType **Enumeration**

The **EnumAltitudeType** enumeration type specifies the possible ways to express an altitude/height.

| **Property** | **Description** | **Note** |
|---|---|---|
| **ABOVE_MSL** | Altitude above mean-sea-level.<br><br>Same as orthometric height; same as height above the earth geoid. | |
| ABOVE_TO | Altitude above take-off location. | |
| ABOVE_GND | Height above ground surface. | |
| **ABOVE_ELLIPSOID** | Altitude above the WGS-84 ellipsoid; value delivered by GPS. | |

**Table 29: EnumAltitudeType Enumeration**

### 6.19.4 EnumCRSType **Enumeration**

The **EnumCRSType** enumeration type specifies the possible ways to express a coordinate reference system. The most common values used are noted in bold letters.

| **Property** | **Description** | **Note** |
|---|---|---|
| EPSG3395_WGS84 | World Mercator<br><br>Geodetic CRS: WGS 84;<br><br>Coordinate System: Cartesian CS.<br><br>Axes: easting, northing (E, N). Orientations: east, north.<br><br>UoM: metre. | Euro-centric view of world excluding polar areas. |

| | | |
|---|---|---|
| EPSG3857_WGS84 | Pseudo-Mercator -- Spherical Mercator, Google Maps, OpenStreetMap, Bing, ArcGIS, ESRI<br><br>Geodetic CRS: WGS 84;<br><br>Coordinate System: Cartesian CS.<br><br>Axes: easting, northing (X, Y). Orientations: east, north.<br><br>UoM: metre. | Uses spherical development of ellipsoidal coordinates. Relative to WGS 84 / World Mercator (CRS code 3395) errors of 0.7 percent in scale and differences in northing of up to 43km in the map (equivalent to 21km on the ground) may arise. |
| **EPSG4322_WGS72** | Geodetic CRS: WGS 72;<br><br>Coordinate System: Ellipsoidal 2D CS.<br><br>Axes: latitude, longitude. Orientations: north, east.<br><br>UoM: degree. | Uses Historic World Geodetic System 1972.<br><br>Horizontal component of 3D system. |
| **EPSG4326_WGS84** | WGS84 - World Geodetic System 1984, used in GPS<br><br>Geodetic CRS: WGS 84;<br><br>Coordinate System: Ellipsoidal 2D CS.<br><br>Axes: latitude, longitude. Orientations: north, east.<br><br>UoM: degree. | Horizontal component of 3D system. Used by the GPS satellite navigation system and for NATO military geodetic surveying. |
| **EPSG4760_WGS66** | Geodetic CRS: WGS 66;<br><br>Coordinate System: Ellipsoidal 2D CS.<br><br>Axes: latitude, longitude. Orientations: north, east.<br><br>UoM: degree. | Uses Historic World Geodetic System 1966.<br><br>Horizontal component of 3D system. |

| | | |
|---|---|---|
| EPSG4979_WGS84 | Geodetic CRS: WGS 84;<br><br>Coordinate System: Ellipsoidal 3D CS.<br><br>Axes: latitude, longitude, ellipsoidal height. Orientations: north, east, up.<br><br>UoM: degree, degree, metre. | Used by the GPS satellite navigation system. |

**Table 30: EnumCRSType Enumeration**

## **6.19.5**EnumGeometryType **Enumeration**

The **EnumGeometryType** enumeration type specifies possible geometrical shapes.

| **Property** | **Description** | **Note** |
|---|---|---|
| POINT | Single point. | |
| POLYGON | Polygon. | |
| ... | | |

**Table 31: EnumGeometryType Enumeration**

# 7 Service Interface Specifications

This chapter describes the details of each service interface. One sub-chapter is provided for each Service Interface.

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

## 7.1 Service Interface TrafficTelemetrySubscriptionInterface

### 7.1.1 Operation subscribeForTrafficTelemetry

#### 7.1.1.1 Operation Functionality

A consumer calls this operation to subscribe to position report data.

#### 7.1.1.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| consumer | Input | NotificationEndpoint | Which endpoint shall be notified in case of new PositionReports (and FlightEvents, if supported). |
| areaOfInterest | Input | AreaOfInterest | Area of interest to the consumer |
| response | Return | ServiceResponse | Provide status information on subscription |

**Table 32: Payload description of subscribeForTrafficTelemetry operation**

### 7.1.2 Operation unSubscribeForTrafficTelemetry

#### 7.1.2.1 Operation Functionality

A consumer calls this operation at the provider to unsubscribe from position report data.

#### 7.1.2.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| consumer | Input | NotificationEndpoint | Which endpoint shall be not be notified (anymore) in case of new PositionReports. |
| response | Return | ServiceResponse | Provide status information on subscription |

**Table 33: Payload description of unSubscribeForTrafficTelemetry operation**

## 7.2 Service Interface TrafficTelemetryNotificationInterface

Consumer provides this interface, allowing the service provider to submit to the consumer position report data (and flight event notifications, if supported).

### 7.2.1 Operation notifyPositionReport

#### 7.2.1.1 Operation Functionality

Once and while subscribed, consumer receives position report data via this operation.

#### 7.2.1.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| positionReport | Input | PositionReport | A position report matching the area criterium provided with subscription. |

**Table 34: Payload description of notifyPositionReport operation**

### 7.2.2 Operation notifyFlightEvent

#### 7.2.2.1 Operation Functionality

Once and while subscribed, consumer receives flight event notifications via this operation.

#### 7.2.2.2 Operation Parameters

| Parameter Name | Direction | Data Type | Description |
|---|---|---|---|
| flightEvent | Input | FlightEventNotification | Indication of a flight event taking place in the area criterium provided with subscription. |

**Table 35: Payload description of notifyFlightEvent operation**

# 8 Service Dynamic Behaviour

## 8.1 Service Interfaces TrafficTelemetrySubscriptionInterface and TrafficTelemetryNotificationInterface

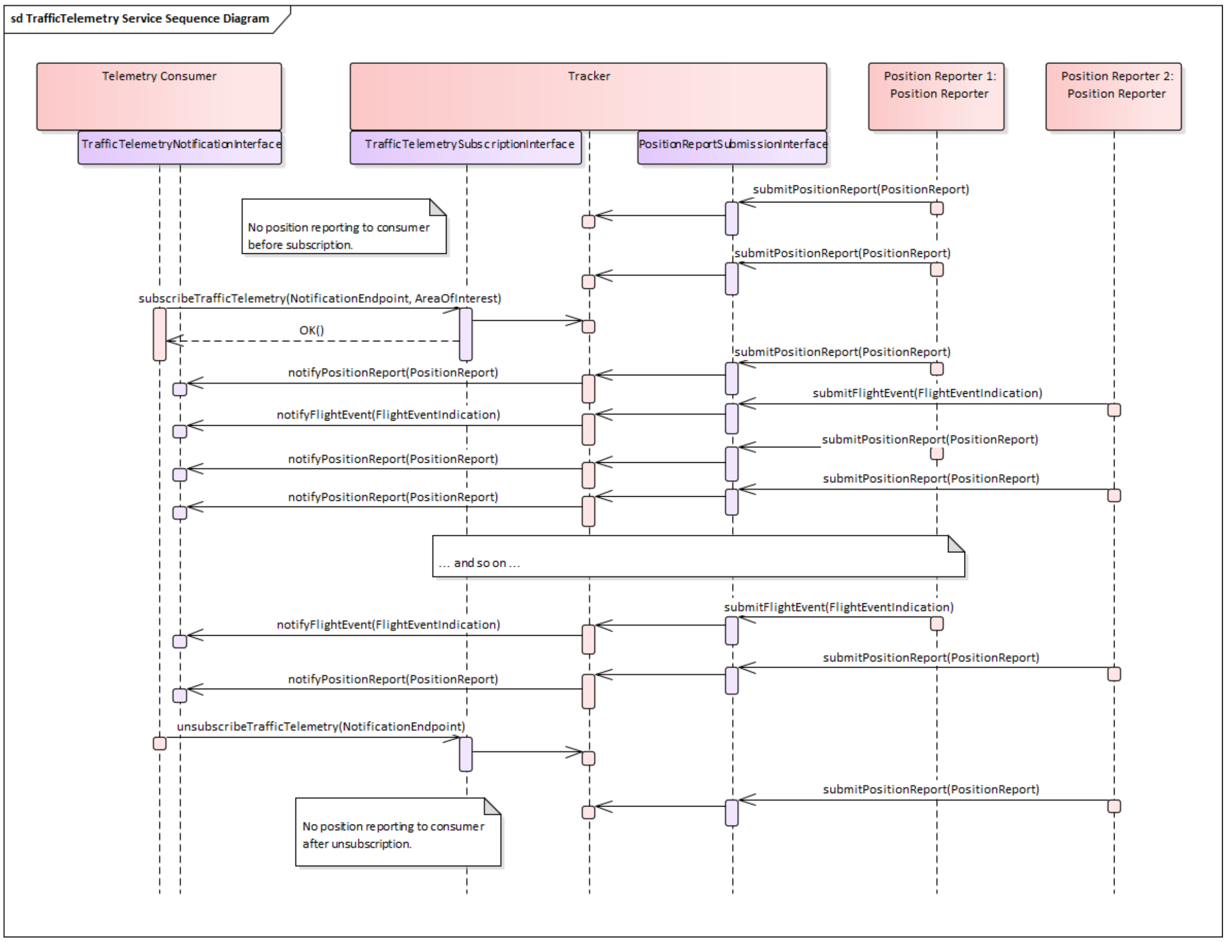


**Figure 6: Traffic/Telemetry Service interface operation sequence diagram**

The figure above provides an example scenario for the TrafficTelemetry service. The scenario assumes a Tracker system providing the TrafficTelemetry service as well as the PositionReportSubmission service. In this example, two different systems are assumed to submit position reports to the tracker. Furthermore, the scenario includes a consumer of the TrafficTelemetry service, subscribing to the Tracker at some point in time and unsubscribing some time later. The consumer, as long as it is subscribed to the Tracker, receives all position reports and flight event notifications matching the area of interest indicated in the subscription.

Note:
In order to illustrate the service operations in a realistic context, this Sequence Diagram contains

additional operations from the PositionReportSubmission service, not only TrafficTelemetry service operations.

# 9 References


| Nr. | Version | Reference |
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| | | |
|---|---|---|
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**Table 36: List of References**