The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

CROSS SUPPORT SERVICE MANAGEMENT— COMMUNICATIONS PLANNING INFORMATION FORMAT

RECOMMENDED STANDARD

CCSDS 902.2-B-1

BLUE BOOK

March 2022

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Email: secretariat@mailman.ccsds.org

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- Scientific and Technological Research Council of Turkey (TUBITAK)/Turkey.
- South African National Space Agency (SANSA)/Republic of South Africa.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

1.1.1 PURPOSE

This Recommended Standard for Communications Planning Information Formats specifies standard formats for use in transferring communications planning information related to ground stations and/or relay satellites between space agencies and commercial or governmental spacecraft operators. It can also be used in the case in which there is a landed asset (e.g., a rover) on a nonterrestrial celestial body. Such exchanges are used in

a) mission design, that is, in investigating the feasibility of a mission with respect to its uplink/downlink requirements and the availability of suitable ground station/relay satellite availability; and

b) operation planning, that is, checking that sufficient ground station/relay satellite resources are allocated to carry out the planned operations; this is typically an iterative process with the details becoming more refined as the execution time of the operations approach.

1.1.2 SCOPE

The scope of this Recommended Standard is limited to the exchange of communications planning information required in the context of CCSDS Service Management. In figure 1-1, the Communications Planning Information Formats specification is put into context with the various standards that together form the Space Communication Cross Support Service Management.

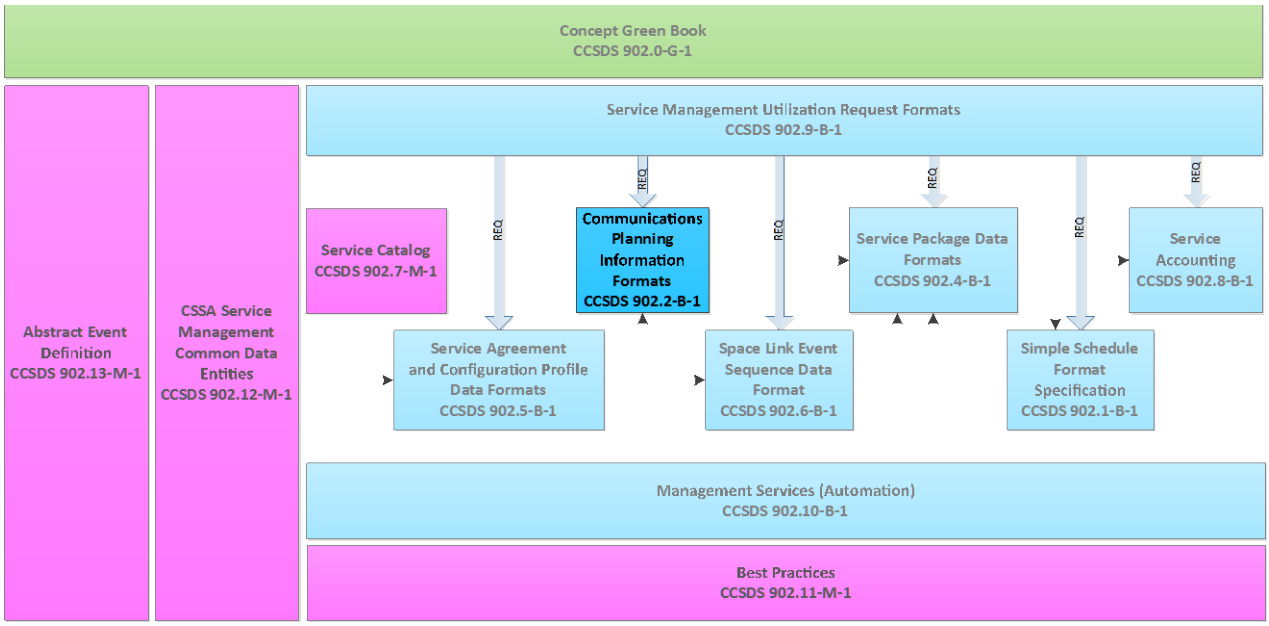

Figure 1-1: Communications Planning Information Formats in the Context of Space Communication Cross Support Service Management

1.1.2.1 Communications Planning Information

The purpose of the communications planning information is to supply information from the Provider Cross Support Service System (CSSS)[1] that is necessary to the planning of feasible service opportunities to the User CSSS. With this in mind, it is foreseen that the Communications Planning Information Formats Recommended Standard will convey the following types of communications planning information:

In the current issue:

a) predicted communications geometry events (see 3.3.1 below);

In a future revision of this Recommended Standard:

b) sustainable data rates and volume estimate events;

c) predicted radio frequency interference events;

d) predicted resource conflict events;

e) cost estimates.

The specific types of communications planning information contained in the communications planning information generated by a given Provider CSSS will depend on the kinds of communications planning information that it is capable of generating and that its client missions deem useful.

Communications planning information may be used as a basis for establishing a Service Agreement. The communications planning information is communicated from the Provider CSSS to the mission.

1.2 APPLICABILITY

This Recommended Standard is applicable only to the communications planning information formats and contents, not to its transmission.

1.3 RATIONALE

1.3.1 GENERAL

The primary goal of CCSDS is to increase the level of interoperability among Agencies. This Recommended Standard furthers that goal by establishing the means to exchange communications planning information between the tracking stations or ground data handling systems of various Agencies and the mission-specific components of a mission ground system.

The use cases described in the following sections were considered in deriving this Recommended Standard.

[1] A Provider Cross Support Service System is often colloquially referred to as a Network.

1.3.2 USE CASES

1.3.2.1 Mission Design

During the design phase of a mission, it is often desirable to be able to obtain some idea of the availability of ground station/relay satellite availability (or in the case of a landed asset the visibility periods) so that the feasibility of obtaining the required uplink and downlink services can be assessed. Typically, during the mission design phase, the information required relates to periods several years in the future. Currently there is no standardized way for specifying the mission requirements and constraints between different agencies.

Whilst this Recommended Standard does not address the mechanism by which the required communications planning information can be exchanged (this possibly being covered in the negotiations involved in establishing the service agreement), it provides a standard format in which the mission requirements and constraints can be specified.

1.3.2.2 Mission Planning

In the mission planning use case, the user agency provides the provider agency with a set of communications planning information that gives the provider agency the information it requires to allocate the appropriate resources to the user agency. It should be noted that this does not imply that the user agency will be allocated all the resources it requests. The allocation made by the provider agency will also take into account the needs of all users of its network and other constraints, such as any limits on usage that may have been specified in the service agreement between the agencies.

It should also be noted that the planning process will typically go through a number of cycles, starting months before the actual activities are expected to take place and being finalized a few days before execution. During these planning cycles, the operations will be refined as better orbit/trajectory/attitude predictions become available and/or science objectives are modified.

1.4 DOCUMENT STRUCTURE

This document is organized as follows:

a) Section 1 provides the purpose, scope, applicability, and rationale of this Recommended Standard and identifies the conventions and references used throughout the document. This section also describes how this document is organized. A brief description is provided for each section and annex so that the reader will have an idea of where information can be found in the document. It also identifies terminology that is used in this document but is defined elsewhere.

b) Section 2 provides a brief overview of the CCSDS-recommended communications planning information formats.

c) Section 3 provides details about the structure and content of the communications planning information formats.

d) Annex A contains the Implementation Conformance Statement (ICS) proforma.

e) Annex B discusses security, SANA, and patent considerations.

f) Annex C provides an informative description of the XML schema organization and packaging, as well as the location of examples of the communications planning information formats.

g) Annex D contains a list of abbreviations and acronyms applicable to the communications planning information formats.

h) Annex E is a list of informative references.

1.5 DEFINITIONS

For the purposes of this document, the following definition applies:

agency: A spacecraft operator or spacecraft service provider.

1.6 NOMENCLATURE

1.6.1 NORMATIVE TEXT

The following conventions apply for the normative specifications in this Recommended Standard:

a) the words ‘shall’ and ‘must’ imply a binding and verifiable specification;

b) the word ‘should’ implies an optional, but desirable, specification;

c) the word ‘may’ implies an optional specification;

d) the words ‘is’, ‘are’, and ‘will’ imply statements of fact.

NOTE – These conventions do not imply constraints on diction in text that is clearly informative in nature.

1.6.2 INFORMATIVE TEXT

In the normative sections of this document, informative text is set off from the normative specifications either in notes or under one of the following subsection headings:

– Overview;

– Background;

– Rationale;

– Discussion.

1.7 CONVENTIONS

1.7.1 THE UNIFIED MODELING LANGUAGE

The Unified Modelling Language (UML) diagrams used in the specification (including class diagrams, package diagrams, sequence diagrams, and activity diagrams) follow the notation, semantics, and conventions imposed by the Version 2.4.1 UML specification of the Object Management Group (OMG) (reference [1]).

Within the document, use is made only of class diagrams. A UML class diagram describes the structure of a message, its parts, and how those parts interrelate. A UML class, represented in the diagram as a box, represents a data set. Class diagram conventions include composition, generalization, multiplicity, and constraints. Enumeration notation is also used, but only when it is involved in a composition constraint.

1.8 REFERENCES

The following publications contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All publications are subject to revision, and users of this document are encouraged to investigate the possibility of applying the most recent editions of the publications indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS publications.

[1] *Unified Modeling Language (UML)*. Version 2.4.1. Needham, Massachusetts: Object Management Group, August 2011.

[2] "Planet and Satellite Names and Discoverers." Gazetteer of Planetary Nomenclature. https://planetarynames.wr.usgs.gov/Page/Planets.

[3] *Cross Support Service Management—Common Data Entities*. Issue 1. Recommendation for Space Data System Practices (Magenta Book), CCSDS 902.12-M-1. Washington, D.C.: CCSDS, February 2021.

[4] *Abstract Event Definition*. Issue 1. Recommendation for Space Data System Practices (Magenta Book), CCSDS 902.13-M-1. Washington, D.C.: CCSDS, February 2021.

[5] *CCSDS Space Assigned Numbers Authority (SANA)--Role, Responsibilities, Policies, and Procedures*. Issue 3. CCSDS Record (Yellow Book), CCSDS 313.0-Y-3. Washington, D.C.: CCSDS, October 2020.

2 OVERVIEW

2.1 GENERAL

This section provides a high-level overview of the CCSDS-recommended communications planning information formats, which is designed to facilitate standardized exchanges of communications planning information between space agencies.

2.2 COMMUNICATIONS PLANNING INFORMATION FORMATS

The communications planning information consists of files that are XML formatted. The formats of these files are suitable for automated interaction and/or (by means of a suitable XML viewer) human interaction.

Communications planning information is either mandatory, in which case, suitable values must be present, or optional, in which case, values may be present or not. Additionally, it is possible to extend the contents of the various communications planning information formats by defining additional parameters. The content of any parameters defined is outside the scope of this document and should be documented in an Interface Control Document (ICD) agreed upon by the involved parties.

2.3 MAPPING TO W3C XML SCHEMA

This Recommended Standard includes the specification of a mapping to World Wide Web Consortium (W3C) eXtensible Markup Language (XML) schema. The normative mapping of this Recommended Standard to XML W3C schemas is a virtual annex to this Recommended Standard and is contained in a stand-alone set of schema files.

NOTE – The XML schema has been elaborated on the basis of the mapping guidelines described in reference [E2].

3 COMMUNICATIONS PLANNING INFORMATION

3.1 GENERAL

The communications planning information shall consist of digital data exchanged in the form of a file.

3.2 COMMUNICATIONS PLANNING INFORMATION CONTENT AND STRUCTURE

3.2.1 OVERVIEW

Figure 3-1 shows the UML Class diagram for the communications planning information. It should be noted that, for clarity, *abstract* classes are highlighted in green.

The attributes of each class are described further in the following subsections and tables.

NOTES

1 In tables 3-1–3-3, xsd:*nnn* in the Data Type column indicates that the type is an XML Schema type. Thus, for example, xsd:string indicates that the type is an XML Schema string.

2 In general, the length of strings in this Recommended Standard is unbounded; that is, no length is specified (in practice, there is obviously the constraint of the maximum string length supported). However, in a number of cases in the various SANA registries, a length for string values is specified. For these cases, the effective restriction on string length shall be taken as the value specified in the SANA registry definition.

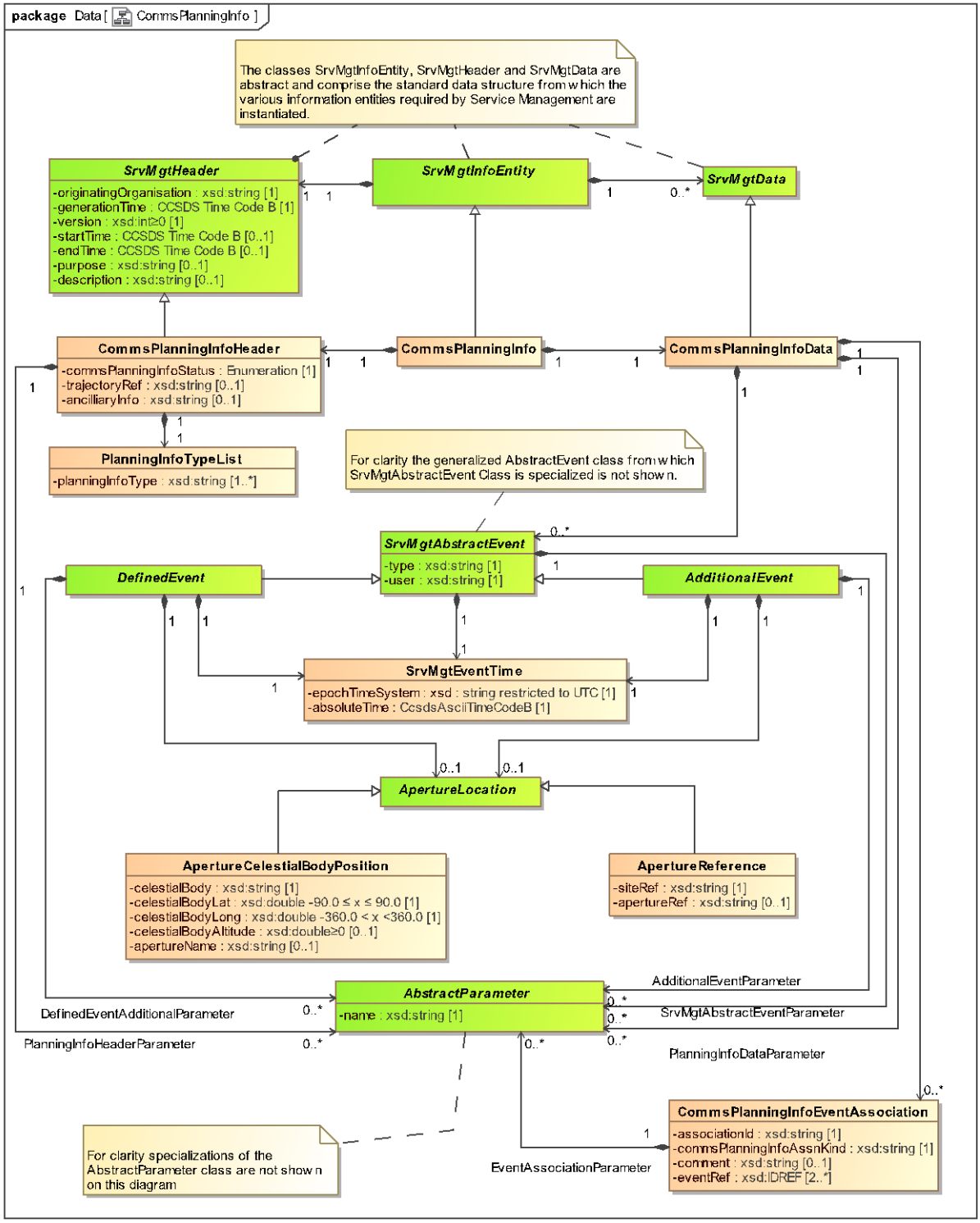

Figure 3-1: Communications Planning Information Class Diagram

3.2.2 CLASS CommsPlanningInfo

3.2.2.1 The CommsPlanningInfo class is mandatory and shall constitute the communications planning information entity.

NOTE – The CommsPlanningInfo class is a specialization of the SrvMgtInfoEntity class described in reference [3], and the generic description of the parameters is given there.

3.2.2.2 A CommsPlanningInfo class shall contain the following:

a) one and only one instance of the CommsPlaningInfoHeader class;

b) one and only one instance of the CommsPlanningInfoData class.

NOTE – The SrvMgtInfoEntity class contains no parameters (see reference [3], subsection 3.1.2).

3.2.3 CLASS CommsPlanningInfoHeader

3.2.3.1 The CommsPlanningInfoHeader class is mandatory and shall constitute the 'header' of the communications planning information.

NOTE – The CommsPlanningInfoHeader class is a specialization of the SrvMgtHeader class described in reference [3], and the generic description of the parameters is given there.

3.2.3.2 Each instance of the CommsPlanningInfoHeader class must contain one and only one instance of the PlanningInfoTypeList as described in reference [3].

3.2.3.3 Each instance of the CommsPlanningInfoHeader class may have zero or more instances of parameter classes derived from the AbstractParameter abstract class described in reference [4]. Usage of any additional parameters so specified is not within the scope of this document and should be specified in an ICD between the relevant parties.

3.2.3.4 Table 3-1 specifies the use of the parameters in the SrvMgtHeader in the scope of the CommsPlanningInfoHeader class.

3.2.3.5 The parameters for the CommsPlanningInfoHeader class shall be as described in reference [3], except as stated in table 3-1.

Table 3-1: Class CommsPlanningInfoHeader Parameters

Parameter	Description	Data Type	Data Units
`startTime`	The time at which the communications planning information starts. This corresponds to the time at which the earliest event contained in the communications planning information occurs.	(See reference [3].)	(See reference [3].)
`endTime`	The time at which the communications planning information ends. This corresponds to the time at which the latest event contained in the communications planning information occurs.	(See reference [3].)	(See reference [3].)

3.2.3.6 Additional parameters for the CommsPlanningInfoHeader class shall be those defined in table 3-2.

Table 3-2: Class CommsPlanningInfoHeader Additional Parameters

Parameter	Description	Data Type	Data Units
`commsPlanningInfoStatus`	The status of the communications planning information.	Enumeration The following values are permitted: – TEST indicates that the communications planning information has been generated for test purposes only. – OPERATIONAL indicates that this is operational communications planning information, but may still be subject to change.	n/a
`trajectoryXRef`	Optional Parameter. This is used to specify a reference to the trajectory that was used to generate the planning information file data. (See 3.2.3.7 and 3.2.3.8 for additional information.)	xsd:string	n/a
`ancilliaryInfo`	Optional parameter. This may be used to identify the modelling data used to calculate the communications geometry, or for specifying other ancillary information.	xsd:string	n/a

3.2.3.7 If possible, all data in any particular planning information file should be generated from one set of trajectory data.

3.2.3.8 In the event that more than one set of trajectory data is used in the generation of the communications planning information file data, a reference to only the **latest** trajectory data should be included.

3.2.4 CLASS CommsPlanningInfoData

3.2.4.1 The CommsPlanningInfoData class is mandatory and shall constitute the 'body' of the communications planning information.

NOTE – The CommsPlanningInfoData class is a specialization of the SrvMgtData class described in reference [3], and the generic description of the parameters is given there.

3.2.4.2 Each instance of the CommsPlanningInfoData class may have zero or more instances of parameter classes derived from the AbstractParameter abstract class described in reference [4]. Usage of any additional parameters so specified is not within the scope of this document and should be specified in an ICD between by the relevant parties.

3.2.4.3 Each instance of the CommsPlanningInfoData class may contain zero or more instances of a class derived from the SrvMgtAbstractEvent class, that is, either a class derived from DefinedEvent or AddtionalEvent classes.

3.2.4.4 If there are any classes derived from the SrvMgtAbstractEvent class, that is, either a class derived from DefinedEvent or AddtionalEvent classes, these shall appear in order of increasing time.

3.2.5 CLASS PlanningInfoTypeList

The PlanningInfoTypeList class is mandatory and shall allow the specification of a list of Planning Info Types.

NOTE – The PlanningInfoTypeList class is fully described in reference [3].

3.2.6 CLASS DefinedEvent (ABSTRACT)

3.2.6.1 The DefinedEvent class is optional and may be used to derive the classes for events that are contained in this Recommended Standard.

NOTE – The DefinedEvent class is a specialization of the SrvMgtAbstractEvent class described in reference [3], and the generic description of the parameters is given in that document.

3.2.6.2 In the context of service management, for each instance of a DefinedEvent, there must be one and only one instance of the SrvMgtEventTime class described in reference [3].

3.2.6.3 There shall be zero or more instances of the DefinedEvent class for each instance of the CommsPlanningInfoData class.

3.2.6.4 Each instance of the DefinedEvent class may have zero or more instances of parameter classes derived from the AbstractParameter abstract class described in reference [4]. Usage of these additional events is not within the scope of this Recommended Standard and should be specified in an ICD between the relevant parties.

NOTES

1 These parameter classes can be used to specify additional parameters, that is, parameters for events that are not defined in this Recommended Standard. The need for this may arise if it is found that, in certain cases (or missions), the parameters defined in this Recommended Standard are not sufficient, and additional information is required.

2 The various events defined in this Recommended Standard are specified in 3.3 below.

3.2.7 CLASS AdditionalEvent (ABSTRACT)

3.2.7.1 The AdditionalEvent abstract class is optional and may be used to instantiate events not defined in this Recommended Standard.

NOTES

1 The need for this may arise if it is found that, in certain cases (or missions), the events defined in this Recommended Standard are not sufficient, and additional events are required.

2 The AdditionalEvent class is a specialization of the SrvMgtAbstractEvent class described reference [3], and the description of the parameters is given in that document.

3.2.7.2 In the context of service management, for each instance of an AdditionalEvent, there must be one and only one instance of the SrvMgtEventTime class described in reference [3].

3.2.7.3 There shall be zero or more instances of the AdditionalEvent class for each instance of the CommsPlanningInfoData class.

3.2.7.4 Each instance of the AdditionalEvent class may have zero or more instances of parameter classes derived from the AbstractParameter abstract class described in reference [4]. The usage of these additional events is not within the scope of this document and should be specified in an ICD between the relevant parties.

3.2.8 CLASS AbstractParameter (ABSTRACT)

3.2.8.1 The AbstractParameter abstract class is optional and may be used to instantiate parameters for an event.

NOTE – The AbstractParameter abstract class is fully described in reference [4].

3.2.9 CLASS ApertureLocation (ABSTRACT)

3.2.9.1 The ApertureLocation abstract class is optional and may be used to instantiate the various classes of aperture location required by service management.

NOTE – The ApertureLocation abstract class is fully described in reference [3].

3.2.10 CLASS ApertureReference

3.2.10.1 The ApertureReference class is optional and may be used to specify of the location of an aperture by the site name where it is located and the name of the aperture.

NOTE – The ApertureReference class is a specialization of the ApertureLocation class mentioned in 3.2.9 and fully defined in reference [3].

3.2.11 CLASS ApertureCelestialBodyPosition

3.2.11.1 The ApertureCelesitalBodyPosition class is optional and may be used to specify an arbitrary location on a celestial body by means of latitude and longitude.

NOTES

1 The ApertureCelesitalBodyPosition class is a specialization of the ApertureLocation class mentioned in 3.2.9 and fully defined in reference [3].

2 The ApertureCelestialBodyPosition class can also be used to specify the position of an aperture as though it were located at the center of a celestial body. The reason and specification for doing this are defined in reference [3].

3.2.12 CLASS CommsPlanningInfoEventAssociation

3.2.12.1 The CommsPlanningInfoEventAssociation class is optional and may be used to specify associations between two or more events.

3.2.12.2 There shall be zero or more instances of the CommsPlanningInfoEventAssociation class in the CommsPlanningInfoData class.

3.2.12.3 Each instance of the CommsPlanningInfoEventAssociation class may have zero or more instances of parameter classes derived from the AbstractParameter abstract class described in reference [4]. Usage of any additional parameters so specified is not within the scope of this document and should be specified in an ICD between the relevant parties.

3.2.12.4 The parameters of the CommsPlanningInfoEventAssociation shall be as defined in table 3-3.

Table 3-3: Class CommsPlanningInfoEventAssociation Parameters

Parameter	Description	Data Type	Data Units
`associationId`	An identifier that uniquely identifies the association. This is assigned by the Provider CSSS. It should be noted that if the Communications Planning Information is regenerated, then the `associationId` for a particular event association may change.	xsd:string	n/a
`commsPlanningInfoAssnKind`	The type of the association.	xsd:string Permitted values are registered in SANA (see B2.5 for further information).	n/a
`comment`	Optional parameter: may be used for the provision of ad hoc information.	xsd:string Exact use of this may be specified in an ICD between relevant parties.	n/a
`eventIdRef`	A list of the identifiers (see the definition of the AbstractEvent class in reference [4]) of the events that are associated.	Array of xsd:IDREF	n/a

3.2.12.5 The xsd:IDREF type shall be used for an attribute that references an ID:

a) all attributes of type xsd:IDREF must reference an xsd:ID in the same XML document;

b) as with ID, an xsd:IDREF value must be an NCName.

3.2.12.6 For a CommsPlanningInfoEventAssociation to be valid, it must refer to a least two events that are in the same XML document (file).

3.3 DEFINED EVENT CLASSES

3.3.1 EVENT TYPE: COMMS

3.3.1.1 General

3.3.1.1.1 The predicted communications geometry events associated with the COMMS event type (see reference [E1], subsection 5.7) shall be as specified in table 3-4.

Table 3-4: Predicted Communications Geometry DefinedEvents

Event/Class Name	Description	Defined Parameter(s)
ElevationAscendingEvent	Ascending angle of elevation with respect to aperture, that is, when the aperture passes through a specified angle when ascending.	(See 3.3.1.3.)
ElevationDescendingEvent	Descending angle of elevation with respect to aperture, that is, when the aperture passes through a specified angle when descending.	(See 3.3.1.4.)
MaximumElevationEvent	Maximum elevation with respect to aperture.	(See 3.3.1.5.)
OccultationStartEvent	Start of occultation with respect to aperture.	(See 3.3.1.6.)
OccultationEndEvent	End of occultation with respect to aperture.	(See 3.3.1.7.)
SunAlignmentAngleEvent	Sun alignment angle (see 3.3.1.2 for definition).	(See 3.3.1.8.)
RangeEvent	Distance with respect to aperture.	(See 3.3.1.9.)
RangeRateEvent	Rate at which the range is changing with respect to aperture.	(See 3.3.1.10.)
RtltEvent	Round Trip Light Time with respect to aperture.	(See 3.3.1.11.)
RetCommsStartEvent	Start of possible Return communication window with respect to the Provider's constraints for tracking and receiving a return signal.	(See 3.3.1.12.)
RetCommsEndEvent	End of possible Return communication window with respect to the Provider's constraints for tracking and receiving a return signal.	(See 3.3.1.13.)
FwdCommsStartEvent	Start of possible Forward communication window with respect to the Provider's constraints for tracking and transmitting a forward signal.	(See 3.3.1.14.)
FwdCommsEndEvent	End of possible Forward communication window with respect to the Provider's constraints for tracking and transmitting a forward signal.	(See 3.3.1.15.)
ProviderLimitationStartEvent	Start of Provider limitation at aperture.	(See 3.3.1.16.)
ProviderLimitationEndEvent	End of Provider limitation at aperture.	(See 3.3.1.17.)

NOTES

1 The Forward and Return Communication Start and End events are used by the provider to specify the possible start and end of communication service windows to a user platform, relative to any and all limitations and constraints under which that provider can execute user services. The specific limitations and constraints are not implied and are left up to the provider to consider, so long as the user platform can

plan and request any service whose Start and End times are contained (inclusive) within the timeframe bounded by the FwdCommsStartEvent and FwdCommsEndEvent, and RetCommsStartEvent and RetCommsEndEvent events.

Typical limitations and constraints accounted for when defining the FwdCommsStartEvent and FwdCommsEndEvent, and RetCommsStartEvent and RetCommsEndEvent events are constraints associated with antenna elevation, cable wrap, visibility masks, slew rates, etc.

2 The provider limitation start and end events can be used to indicate periods within which, whilst the spacecraft may be in view and in principle trackable by the aperture, the spacecraft cannot be tracked due to limitations of the aperture. Such limitations include, but are not limited to, events (or combinations of events) such as cable wrap, keyhole, etc.

3 The RtltEvent and RangeEvent effectively are giving the same information, that is, the distance from the aperture to the spacecraft. Which of these is appropriate to use essentially depends on the mission type. For deep space missions, typically, the round trip light time (rtlt) value is specified, whilst for near Earth missions, range tends to be used.

3.3.1.1.2 All classes defining events of type COMMS are derived from the DefinedEvent abstract class defined in 3.2.5. The use of the parameters in the DefinedEvent class for derived classes of type COMMS shall be as specified in table 3-5.

Table 3-5: Class DefinedEvent Parameters in the Context of Derived Classes of Type COMMS

Parameter	Description	Data Type	Data Units
`type`	In the context of the DefinedEvent class, this parameter is mandatory and is used to specify the type of the event.	xsd:string—permitted values – COMMS Predicted communications geometry events (see reference [E1], subsection 5.7)	n/a
`user`	In the context of the DefinedEvent class, this parameter is mandatory.[2]	xsd:string—permitted values registered in SANA	n/a

[2] For Earth-based apertures, the user is typically a spacecraft that is either using a particular set of ground station apertures or will potentially use those apertures. This is in keeping with a traditional notion of service provider vs. service user. For off-Earth-based apertures, the user is typically a spacecraft providing relay services for the off-Earth-based aperture (which is likely to be a rover or other in situ asset). Broader terms that encompass both of these cases are ‘observer’ and ‘observed’. In all cases, the aperture is considered to be the ‘observer’, and the spacecraft for which communication geometry is stated is the ‘observed’. This recommendation retains the term ‘user’ to be consistent with a common data header for all of service management, but the term ‘user’ can and should be read as ‘observed’ for this recommendation.

3.3.1.2 Sun Alignment Angle Definition

The Sun Alignment Angle shall be the angle between the sun, the aperture (observer), and the spacecraft (observed) at a given time, with the aperture as the reference point (see figure 3-2).

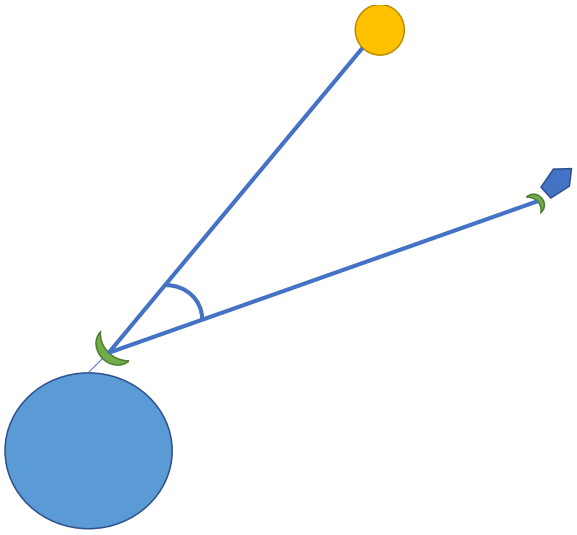

Figure 3-2: Sun Alignment Angle

3.3.1.3 Class ElevationAscendingEvent

3.3.1.3.1 The ElevationAscendingEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-6.

Table 3-6: Class ElevationAscendingEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	Y	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.3.2 The ElevationAscendingEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.4 Class ElevationDescendingEvent

3.3.1.4.1 The ElevationDescendingEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-7.

Table 3-7: Class ElevationDescendingEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	Y	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.4.2 The ElevationDescendingEvent class must contain one and only one of the following classes:

– ApertureReference class (see 3.2.10);

– ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.5 Class MaximumElevationEvent

3.3.1.5.1 The MaximumElevationEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-8.

Table 3-8: Class MaximumElevationEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	Y	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.5.2 The MaximumElevationEvent class must contain one and only one of the following classes:

– ApertureReference class (see 3.2.10);

– ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.6 Class OccultationStartEvent

3.3.1.6.1 The OccultationStartEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-9.

Table 3-9: Class OccultationStartEvent Parameters

Parameter	Mandatory	Parameter Definition
celestialBody	Y	(See table 3-24.)
occType	N	(See table 3-25.)
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.6.2 The OccultationStartEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.7 Class OccultationEndEvent

3.3.1.7.1 The OccultationEndEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-10.

Table 3-10: Class OccultationEndEvent Parameters

Parameter	Mandatory	Parameter Definition
celestialBody	Y	(See table 3-24.)
occType	N	(See table 3-25.)
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.7.2 The OccultationEndEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.8 Class SunAlignmentAngleEvent

3.3.1.8.1 The SunAlignmentAngleEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-11.

Table 3-11: Class SunAlignmentAngleEvent Parameters

Parameter	Mandatory	Parameter Definition
angle	Y	(See table 3-23.)
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.8.2 The SunAlignmentAngleEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.9 Class RangeEvent

3.3.1.9.1 The RangeEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-12.

Table 3-12: Class RangeEvent Parameters

Parameter	Mandatory	Parameter Definition
range	Y	(See table 3-26.)
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.9.2 The RangeEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.10 Class RangeRateEvent

3.3.1.10.1 The RangeRateEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-13.

Table 3-13: Class RangeRateEvent Parameters

Parameter	Mandatory	Parameter Definition
rangeRate	Y	(See table 3-27.)
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)

3.3.1.10.2 The RangeRateEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.11 Class RtltEvent

3.3.1.11.1 The RtltEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-14.

Table 3-14: Class RtltEvent Parameters

Parameter	Mandatory	Parameter Definition
rtlt	Y	(See table 3-28.)
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rangeRate	N	(See table 3-27.)

3.3.1.11.2 The RtltEvent class must contain one and only one of the following classes:

- ApperturelReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.12 Class RetCommsStartEvent

3.3.1.12.1 The RetCommsStartEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-15.

Table 3-15: Class RetCommsStartEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.12.2 The RetCommsStartEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.13 Class RetCommsEndEvent

3.3.1.13.1 The RetCommsEndEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-16.

Table 3-16: Class RetCommsEndEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.13.2 The RetCommsEndEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.14 Class FwdCommsStartEvent

3.3.1.14.1 The FwdCommsStartEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-17.

Table 3-17: Class FwdCommsStartEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.14.2 The FwdCommsStartEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.15 Class FwdCommsEndEvent

3.3.1.15.1 The FwdCommsEndEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-18.

Table 3-18: Class FwdCommsEndEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.15.2 The FwdCommsEndEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.16 Class ProviderLimitationStartEvent

3.3.1.16.1 The ProviderLimitationStartEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-19.

Table 3-19: Class KeyholeStartEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.16.2 The ProviderLimitationStartEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.1.17 Class ProviderLimitationEndEvent

3.3.1.17.1 The ProviderLimitationEndEvent class shall include the parameters of the DefinedEvent abstract class (3.2.6) and the parameters listed in table 3-20.

Table 3-20: Class KeyholeEndEvent Parameters

Parameter	Mandatory	Parameter Definition
elevation	N	(See table 3-21.)
azimuth	N	(See table 3-22.)
rtlt	N	(See table 3-28.)
rangeRate	N	(See table 3-27.)

3.3.1.17.2 The ProviderLimitationEndEvent class must contain one and only one of the following classes:

- ApertureReference class (see 3.2.10);
- ApertureCelesitalBodyPosition class (see 3.2.11).

3.3.2 DISCUSSION—EVENT TYPES NOT DEFINED IN THIS ISSUE OF THE RECOMMENDED STANDARD

3.3.2.1 Event Type: DATARATE

The DATARATE event type, dealing with sustainable data rates and volume estimate events (see reference [E1], subsection 5.8), is not defined in this issue of the Recommended Standard.

3.3.2.2 Event Type: RFI

The RFI event type, dealing with predicted radio frequency interference events (see reference [E1], subsection 5.9), is not defined in this issue of the Recommended Standard.

3.3.2.3 Event Type: CONFLICTS

The CONFLICTS event type, dealing with predicted resource conflict events (see reference [E1], subsection 5.10), is not defined in this issue of the Recommended Standard.

3.3.2.4 Event Type: COSTS

The COSTS event type, dealing with cost estimates (see reference [E1], subsection 5.11), is not defined in this issue of the Recommended Standard.

3.3.2.5 Event Type: OTHER

The OTHER event type consists of those events that are not covered by the above definitions. No such events are defined in this Recommended Standard; however, this category is defined as it can be useful in the definition of additional events.

3.4 PARAMETERS

The various parameters used by the events defined in this Recommended Standard shall be as defined in the following tables;

Table 3-21: Parameter elevation Definition

Description	Data Type	Data Units
Elevation	xsd:float -90.0 ≤ Elevation < 90	Degrees

Table 3-22: Parameter azimuth Definition

Description	Data Type	Data Units
Azimuth	xsd:float 0 ≤ Azimuth < 360	Degrees

Table 3-23: Parameter angle Definition

Description	Data Type	Data Units
Angle	xsd:float 0 ≤ Angle < 180	Degrees

Table 3-24: Parameter celestialBody Definition

Description	Data Type	Data Units
Celestial body	xsd:string—Permitted values are as follows: – Planet and Satellite Names—as per reference [2]; – Minor Planet Names—as per reference [2].	n/a

Table 3-25: Parameter occType Definition

Description	Data Type	Data Units
Occultation type	Enumeration The following values are permitted: – CELESTIALBODY; – ATMOSPHERE; – UMBRA; – PENUMBRA.	n/a

Table 3-26: Parameter range Definition

Description	Data Type	Data Units
Range	xsd:double ≥ 0	Km

Table 3-27: Parameter rangeRate Definition

Description	Data Type	Data Units
Rate of change of range	xsd:double	m/s

Table 3-28: Parameter rtlt Definition

Description	Data Type	Data Units
Round trip light time, that is, the time required for light to travel from the observer to the observed and back	xsd:double ≥ 0	Seconds

ANNEX A

IMPLEMENTATION CONFORMANCE STATEMENT PROFORMA

(NORMATIVE)

A1 INTRODUCTION

A1.1 OVERVIEW

This annex provides the ICS Requirements List (RL) for an implementation of the *Communications Planning Information Formats Specification* (CCSDS 902.2-B-1). The ICS for an implementation is generated by completing the RL in accordance with the instructions below. An implementation shall satisfy the mandatory conformance requirements referenced in the RL.

The RL in this annex is a blank form. An implementation's completed RL is called the ICS. The ICS states which capabilities and options have been implemented. The following can use the ICS:

- the implementer, as a checklist to reduce the risk of failure to conform to the standard through oversight;
- a supplier or potential acquirer of the implementation, as a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard ICS proforma;
- a user or potential user of the implementation, as a basis for initially checking the possibility of interworking with another implementation (it should be noted that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible ICSes);
- a tester, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

A1.2 ABBREVIATIONS AND CONVENTIONS

A1.2.1 General

The RL consists of information in tabular form. The status of features is indicated using the abbreviations and conventions described below.

A1.2.2 Item Column

The item column contains sequential numbers for items in the table.

A1.2.3 Description Column

The cdscription column contains a brief descriptive name for a feature. It implicitly means: 'Is this feature supported by the implementation?'

NOTE – The features itemized in the RL are elements of the communications planning information format. Therefore support for a mandatory feature indicates that a generated file will include that feature, and support for an optional feature indicates that generated files can include that feature.

A1.2.4 Class/Parameters Column

The Class/Parameters column contains, when applicable, the communications planning information format class associated with the feature.

A1.2.5 Reference Column

The reference column indicates the relevant subsection or table in the *Communications Planning Information Formats Specification* (CCSDS 902.2-B-1) (this document).

A1.2.6 Status Column

The status column uses the following notations:

M mandatory;

O optional.

It should be noted that a parameter may be marked as M while the class that contains it is marked O. This should be interpreted to mean that, while the class is optional, if it is present, then the parameter must be present.

A1.2.7 Support Column

The support column is to be used by the implementer to state whether a feature is supported by entering Y, N, or n/a, indicating:

Y Yes, supported by the implementation;

N No, not supported by the implementation;

n/a Not applicable.

A1.2.8 Item Support or Values Supported Column

The item support column is to be used by the implementer to state whether an item is supported by entering Y, N, or n/a, indicating:

Y Yes, supported by the implementation;

N No, not supported by the implementation;

n/a Not applicable.

In addition, where appropriate, it is to be used by the implementer to specify the permitted values or range(s) of values that are valid for the item.

A1.3 INSTRUCTIONS FOR COMPLETING THE RL

An implementer shows the extent of compliance to the Recommended Standard by completing the RL; that is, the state of compliance with all mandatory requirements and the options supported are shown. The resulting completed RL is called an ICS. The implementer shall complete the RL by entering appropriate responses in the support or values supported column, using the notation described in A1.2. If a conditional requirement is inapplicable, N/A should be used. If a mandatory requirement is not satisfied, exception information must be supplied by entering a reference *Xi*, where *i* is a unique identifier, to an accompanying rationale for the noncompliance.

A2 ICS PROFORMA FOR COMMUNICATIONS PLANNING INFORMATION FORMAT

A2.1 GENERAL INFORMATION

A2.1.1 Identification of ICS

Date of Statement (DD/MM/YYYY)	
ICS serial number	
System Conformance statement cross-reference	

A2.1.2 Identification of Implementation Under Test (IUT)

Implementation name	
Implementation version	
Special Configuration	
Other Information	

A2.1.3 Identification of Supplier

Supplier	
Contact Point for Queries	
Implementation Name(s) and Versions	
Other Information necessary for full identification, for example, names(s) and version(s) for machines and/or operating systems	

A2.1.4 Document Version

CCSDS 902.2-B-1	
Have any exceptions been required? Note: A YES answer means that the implementation does not conform to the Recommended Standard. Non-supported mandatory capabilities are to be identified in the ICS, with an explanation of why the implementation is non-conforming.	Yes _____ No _____

A2.1.5 Requirements List

A2.1.5.1 Class CommsPlanningInfo

A2.1.5.1.1 General

Item	Description	Ref.	Status	Support
1.	CommsPlanningInfo	3.2.2	M	

A2.1.5.1.2 Class CommsPlanningInfo Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
1.1.	Not applicable	Table 3-1	M	

A2.1.5.2 Class CommsPlanningInfoHeader

A2.1.5.2.1 General

Item	Description	Ref.	Status	Support
2.	CommsPlanningInfoHeader	3.2.3	M	

A2.1.5.2.2 Class CommsPlanningInfoHeader Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
2.1.	originatingOrganization	Reference [3], Table 3-1	M	
2.2.	generationTime	Reference [3], Table 3-1	M	
2.3.	version	Reference [3], Table 3-1	M	
2.4.	startTime	Table 3-1	M	
2.5.	endTime	Table 3-1	M	
2.6.	purpose	Reference [3], Table 3-1	O	
2.7.	description	Reference [3], Table 3-1	O	
2.8.	commsPlanningInfoStatus	Table 3-2	M	
2.9.	trajectoryXRef	Table 3-2	O	
2.10.	ancilliaryInfo	Table 3-2	O	

A2.1.5.3 Class CommsPlanningInfoData

A2.1.5.3.1 General

Item	Description	Ref.	Status	Support
3.	CommsPlanningInfoData	3.2.3	M	

A2.1.5.3.2 Class CommsPlanningInfoData Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
3.1.	There are no parameters	n/a	n/a	n/a

A2.1.5.4 Class PlanningInfoTypeList

A2.1.5.4.1 General

Item	Description	Ref.	Status	Support
4.	PlanningInfoTypeList	3.2.5	M	

A2.1.5.4.2 Class PlanningInfoTypeList Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
4.1.	planningInfoType	Reference [3], Table 3-7	M	

A2.1.5.5 Class DefinedEvent

A2.1.5.5.1 General

Item	Description	Reference	Status	Support
5.	`DefinedEvent`	3.2.6	O	

A2.1.5.5.2 Class DefinedEvent Parameters

Item	Parameter	Reference	Status	Item Support or Values Supported
5.1.	`type`	Reference [3], table 3-2	M	
5.2.	`user`	Reference [3], table 3-2	M	
5.3.	`description`	Reference [4], table 3-1	O	
5.4.	`latestOffset`	Reference [4], table 3-1	O	
5.5.	`earliestOffset`	Reference [4], table 3-1	O	
5.6.	`identifier`	Reference [4], table 3-1	O	

A2.1.5.6 Classes Derived from DefinedEvent of Type COMMS

A2.1.5.6.1 Class ElevationAscendingEvent

A2.1.5.6.1.1 General

Item	Description	Ref.	Status	Support
6.	ElevationAscendingEvent	3.2.6	O	

A2.1.5.6.1.2 Class ElevationAscendingEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
6.1.	type	Reference [3], table 3-2	M	
6.2.	user	Reference [3], table 3-2	M	
6.3.	description	Reference [4], table 3-1	O	
6.4.	latestOffset	Reference [4], table 3-1	O	
6.5.	earliestOffset	Reference [4], table 3-1	O	
6.6.	identifier	Reference [4], table 3-1	O	
6.7.	elevation	Table 3-21	M	
6.8.	azimuth	Table 3-22	O	
6.9.	rtlt	Table 3-28	O	
6.10.	rangeRate	Table 3-27	O	

A2.1.5.6.2 Class ElevationDescendingEvent

A2.1.5.6.2.1 General

Item	Description	Ref.	Status	Support
7.	ElevationDescendingEvent	3.2.6	O	

A2.1.5.6.2.2 Class ElevationDescendingEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
7.1.	type	Reference [3], table 3-2	M	
7.2.	user	Reference [3], table 3-2	M	
7.3.	description	Reference [4], table 3-1	O	
7.4.	latestOffset	Reference [4], table 3-1	O	
7.5.	earliestOffset	Reference [4], table 3-1	O	
7.6.	identifier	Reference [4], table 3-1	O	
7.7.	elevation	Table 3-21	M	
7.8.	azimuth	Table 3-22	O	
7.9.	rtlt	Table 3-28	O	
7.10.	rangeRate	Table 3-27	O	

A2.1.5.6.3 Class MaximumElevationEvent

A2.1.5.6.3.1 General

Item	Description	Ref.	Status	Support
8.	MaximumElevationEvent	3.2.6	O	

A2.1.5.6.3.2 Class MaximumElevationEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
8.1.	type	Reference [3], table 3-2	M	
8.2.	user	Reference [3], table 3-2	M	
8.3.	description	Reference [4], table 3-1	O	
8.4.	latestOffset	Reference [4], table 3-1	O	
8.5.	earliestOffset	Reference [4], table 3-1	O	
8.6.	identifier	Reference [4], table 3-1	O	
8.7.	elevation	Table 3-21	M	
8.8.	azimuth	Table 3-22	O	
8.9.	rtlt	Table 3-28	O	
8.10.	rangeRate	Table 3-27	O	

A2.1.5.6.4 Class OccultationStartEvent

A2.1.5.6.4.1 General

Item	Description	Ref.	Status	Support
9.	`OccultationStartEvent`	3.2.6	O	

A2.1.5.6.4.2 Class OccultationStartEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
9.1.	`type`	Reference [3], table 3-2	M	
9.2.	`user`	Reference [3], table 3-2	M	
9.3.	`description`	Reference [4], table 3-1	O	
9.4.	`latestOffset`	Reference [4], table 3-1	O	
9.5.	`earliestOffset`	Reference [4], table 3-1	O	
9.6.	`identifier`	Reference [4], table 3-1	O	
9.7.	`celestialBody`	Table 3-24	M	
9.8.	`occType`	Table 3-25	O	
9.9.	`elevation`	Table 3-21	O	
9.10.	`azimuth`	Table 3-22	O	
9.11.	`rtlt`	Table 3-28	O	
9.12.	`rangeRate`	Table 3-27	O	

A2.1.5.6.5 Class OccultationEndEvent

A2.1.5.6.5.1 General

Item	Description	Ref.	Status	Support
10.	`OccultationEndEvent`	3.2.6	O	

A2.1.5.6.5.2 Class OccultationEndEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
10.1.	`type`	Reference [3], table 3-2	M	
10.2.	`user`	Reference [3], table 3-2	M	
10.3.	`description`	Reference [4], table 3-1	O	
10.4.	`latestOffset`	Reference [4], table 3-1	O	
10.5.	`earliestOffset`	Reference [4], table 3-1	O	
10.6.	`identifier`	Reference [4], table 3-1	O	
10.7.	`celestialBody`	Table 3-24	M	
10.8.	`occType`	Table 3-25	O	
10.9.	`elevation`	Table 3-21	O	
10.10.	`azimuth`	Table 3-22	O	
10.11.	`rtlt`	Table 3-28	O	
10.12.	`rangeRate`	Table 3-27	O	

A2.1.5.6.6 Class SunAlignmentAngleEvent

A2.1.5.6.6.1 General

Item	Description	Ref.	Status	Support
11.	SunAlignmentAngleEvent	3.2.6	O	

A2.1.5.6.6.2 Class SunAlignmentAngleEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
11.1.	type	Reference [3], table 3-2	M	
11.2.	user	Reference [3], table 3-2	M	
11.3.	description	Reference [4], table 3-1	O	
11.4.	latestOffset	Reference [4], table 3-1	O	
11.5.	earliestOffset	Reference [4], table 3-1	O	
11.6.	identifier	Reference [4], table 3-1	O	
11.7.	angle	Table 3-23	M	
11.8.	elevation	Table 3-21	O	
11.9.	azimuth	Table 3-22	O	
11.10.	rtlt	Table 3-28	O	
11.11.	rangeRate	Table 3-27	O	

A2.1.5.6.7 Class RangeEvent

A2.1.5.6.7.1 General

Item	Description	Ref.	Status	Support
12.	RangeEvent	3.2.6	O	

A2.1.5.6.7.2 Class RangeEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
12.1.	type	Reference [3], table 3-2	M	
12.2.	user	Reference [3], table 3-2	M	
12.3.	description	Reference [4], table 3-1	O	
12.4.	latestOffset	Reference [4], table 3-1	O	
12.5.	earliestOffset	Reference [4], table 3-1	O	
12.6.	identifier	Reference [4], table 3-1	O	
12.7.	range	Table 3-26	M	
12.8.	elevation	Table 3-21	O	
12.9.	azimuth	Table 3-22	O	
12.10.	rtlt	Table 3-28	O	
12.11.	rangeRate	Table 3-27	O	

A2.1.5.6.8 Class RangeRateEvent

A2.1.5.6.8.1 General

Item	Description	Ref.	Status	Support
13.	RangeRateEvent	3.2.6	O	

A2.1.5.6.8.2 Class RangeRateEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
13.1.	type	Reference [3], table 3-2	M	
13.2.	user	Reference [3], table 3-2	M	
13.3.	description	Reference [4], table 3-1	O	
13.4.	latestOffset	Reference [4], table 3-1	O	
13.5.	earliestOffset	Reference [4], table 3-1	O	
13.6.	identifier	Reference [4], table 3-1	O	
13.7.	rangeRate	Table 3-27	M	
13.8.	elevation	Table 3-21	O	
13.9.	azimuth	Table 3-22	O	
13.10.	rtlt	Table 3-28	O	

A2.1.5.6.9 Class RtltEvent

A2.1.5.6.9.1 General

Item	Description	Ref.	Status	Support
14.	RtltEvent	3.2.6	O	

A2.1.5.6.9.2 Class RtltEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
14.1.	type	Reference [3], table 3-2	M	
14.2.	user	Reference [3], table 3-2	M	
14.3.	description	Reference [4], table 3-1	O	
14.4.	latestOffset	Reference [4], table 3-1	O	
14.5.	earliestOffset	Reference [4], table 3-1	O	
14.6.	identifier	Reference [4], table 3-1	O	
14.7.	rtlt	Table 3-28	M	
14.8.	elevation	Table 3-21	O	
14.9.	azimuth	Table 3-22	O	
14.10.	rangeRate	Table 3-27	O	

A2.1.5.6.10 Class RetCommsStartEvent

A2.1.5.6.10.1 General

Item	Description	Ref.	Status	Support
15.	RetCommsStartEvent	3.2.6	O	

A2.1.5.6.10.2 Class RetCommsStartEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
15.1.	type	Reference [3], table 3-2	M	
15.2.	user	Reference [3], table 3-2	M	
15.3.	description	Reference [4], table 3-1	O	
15.4.	latestOffset	Reference [4], table 3-1	O	
15.5.	earliestOffset	Reference [4], table 3-1	O	
15.6.	identifier	Reference [4], table 3-1	O	
15.7.	elevation	Table 3-21	O	
15.8.	azimuth	Table 3-22	O	
15.9.	rtlt	Table 3-28	O	
15.10.	rangeRate	Table 3-27	O	

A2.1.5.6.11 Class RetCommsEndEvent

A2.1.5.6.11.1 General

Item	Description	Ref.	Status	Support
16.	RetCommsEndEvent	3.2.6	O	

A2.1.5.6.11.2 Class RetCommsEndEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
16.1.	type	Reference [3], table 3-2	M	
16.2.	user	Reference [3], table 3-2	M	
16.3.	description	Reference [4], table 3-1	O	
16.4.	latestOffset	Reference [4], table 3-1	O	
16.5.	earliestOffset	Reference [4], table 3-1	O	
16.6.	identifier	Reference [4], table 3-1	O	
16.7.	elevation	Table 3-21	O	
16.8.	azimuth	Table 3-22	O	
16.9.	rtlt	Table 3-28	O	
16.10.	rangeRate	Table 3-27	O	

A2.1.5.6.12 Class FwdCommsStartEvent

A2.1.5.6.12.1 General

Item	Description	Ref.	Status	Support
17.	FwdCommsStartEvent	3.2.6	O	

A2.1.5.6.12.2 Class FwdCommsStartEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
17.1.	type	Reference [3], table 3-2	M	
17.2.	user	Reference [3], table 3-2	M	
17.3.	description	Reference [4], table 3-1	O	
17.4.	latestOffset	Reference [4], table 3-1	O	
17.5.	earliestOffset	Reference [4], table 3-1	O	
17.6.	identifier	Reference [4], table 3-1	O	
17.7.	elevation	Table 3-21	O	
17.8.	azimuth	Table 3-22	O	
17.9.	rtlt	Table 3-28	O	
17.10.	rangeRate	Table 3-27	O	

A2.1.5.6.13 Class FwdCommsEndEvent

A2.1.5.6.13.1 General

Item	Description	Ref.	Status	Support
18.	`Class FwdCommsEndEvent`	3.2.6	O	

A2.1.5.6.13.2 Class FwdCommsEndEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
18.1.	`type`	Reference [3], table 3-2	M	
18.2.	`user`	Reference [3], table 3-2	M	
18.3.	`description`	Reference [4], table 3-1	O	
18.4.	`latestOffset`	Reference [4], table 3-1	O	
18.5.	`earliestOffset`	Reference [4], table 3-1	O	
18.6.	`identifier`	Reference [4], table 3-1	O	
18.7.	`elevation`	Table 3-21	O	
18.8.	`azimuth`	Table 3-22	O	
18.9.	`rtlt`	Table 3-28	O	
18.10.	`rangeRate`	Table 3-27	O	

A2.1.5.6.14 Class ProviderLimitationStartEvent

A2.1.5.6.14.1 General

Item	Description	Ref.	Status	Support
19.	`ProviderLimitationStartEvent`	3.2.6	O	

A2.1.5.6.14.2 Class ProviderLimitationStartEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
19.1.	`type`	Reference [3], table 3-2	M	
19.2.	`user`	Reference [3], table 3-2	M	
19.3.	`description`	Reference [4], table 3-1	O	
19.4.	`latestOffset`	Reference [4], table 3-1	O	
19.5.	`earliestOffset`	Reference [4], table 3-1	O	
19.6.	`identifier`	Reference [4], table 3-1	O	
19.7.	`elevation`	Table 3-21	O	
19.8.	`azimuth`	Table 3-22	O	
19.9.	`rtlt`	Table 3-28	O	
19.10.	`rangeRate`	Table 3-27	O	

A2.1.5.6.15 Class ProviderLimitationEndEvent

A2.1.5.6.15.1 General

Item	Description	Ref.	Status	Support
20.	ProviderLimitationEndEvent	3.2.6	O	

A2.1.5.6.15.2 Class ProviderLimitationEndEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
20.1.	type	Reference [3], table 3-2	M	
20.2.	user	Reference [3], table 3-2	M	
20.3.	description	Reference [4], table 3-1	O	
20.4.	latestOffset	Reference [4], table 3-1	O	
20.5.	earliestOffset	Reference [4], table 3-1	O	
20.6.	identifier	Reference [4], table 3-1	O	
20.7.	elevation	Table 3-21	O	
20.8.	azimuth	Table 3-22	O	
20.9.	rtlt	Table 3-28	O	
20.10.	rangeRate	Table 3-27	O	

A2.1.5.7 Classes Derived from DefinedEvent of Type DATARATE

No classes derived from DefinedEvent of type DATARATE are defined in the issue of the Recommended Standard.

A2.1.5.8 Classes Derived from DefinedEvent of Type RFI

No classes derived from DefinedEvent of type RFI are defined in the issue of the Recommended Standard.

A2.1.5.9 Classes Derived from DefinedEvent of Type CONFLICTS

No classes derived from DefinedEvent of type CONFLICTS are defined in the issue of the Recommended Standard.

A2.1.5.10 Classes Derived from DefinedEvent of Type COSTS

No classes derived from DefinedEvent of type COSTS are defined in the issue of the Recommended Standard.

A2.1.5.11 Classes Derived from AdditionalEvent

The AdditionalEvents class may be used to permit the instantiation of additional events that are not defined in this Recommended Standard. For each class derived from the AdditionalEvent class, a section of the following format shall be specified:

A2.1.5.11.1 *Class NameOfAdditionalEvent*

A2.1.5.11.1.1 General

Item	Description	Ref.	Status	Support
21.	`NameOfAddtitionalEvent`	3.2.6	O	

A2.1.5.11.1.2 Class NameOfAddtitionalEvent Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
21.1.	`type`	Reference [3], table 3-2	M	
21.2.	`user`	Reference [3], table 3-2	M	
21.3.	`description`	Reference [4], table 3-1	O	
21.4.	`latestOffset`	Reference [4], table 3-1	O	
21.5.	`earliestOffset`	Reference [4], table 3-1	O	
21.6.	`identifier`	Reference [4], table 3-1	O	
21.7.	`newParameter1`	Table A-1		
21.8.	`newParameter2`	Table A-1		
21.9.	…	…	…	

NOTE – Parameters `type`, `user`, `latestOffset`, and `earliestOffset` are inherited from the AddtionalEvent abstract class.

Table A-1: Parameters Created for NameOfAdditionalEvent Class Definition

Parameter	*Description*	*Data Type*	*Data Units*
`newParameter1`	*Purpose of the parameter*		
`newParameter2`	*Purpose of the parameter*		
…	…	..	…

A2.1.5.12 Class SrvMgtEventTime

A2.1.5.12.1 General

Item	Description	Ref.	Status	Support
22.	`SrvMgtEventTime`	Ref. [3] 3.2.3	O	

A2.1.5.12.2 Class SrvMgtEventTime Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
22.1.	`epochTimeSystem`	Reference [3], table 3-4	M	
22.2.	`absoluteTime`	Reference [3], table 3-3	M	

A2.1.5.13 Additional Parameters Defined by Using Classes Instantiated from AbstractParameter Class

If additional parameters for classes CommsPlanningInfoHeader, CommsPlanningInfoData, or any of the classes derived from DefinedEvent or AdditionalEvent are specified by using one of the classes instantiated from class AbstractParameter (i.e., classes BooleanParameter, UnsignedInParameter, IntParameter, FloatParameter, DoubleParameter, StringParameter, ExtendedParameter, DurationParameter, TimeParameterA, or TimeParameterB), the additional parameters and permitted values for these should be specified as in tables A-2–A-5, below.

In the following tables, the columns have the following use:

– Name — This column is used to specify the names of the additional parameter(s).

– Description — This column is used to enter the description of what the additional parameter(s) is(are).

– Type — This column is used to specify what type the parameter is, for example, String, Integer, Unsigned Integer, Float, or CCSDS ASCII Time Code B.

– Permitted Values — This column is used to specify the values that are permitted for the additional parameter(s).

– Data units — This column is used to specify the Data Unit of the additional parameter(s), for example, Seconds, Hertz, Volts, or UTC.

Table A-2: AbstractParameter Class Instantiated for CommsPlanningInfoHeader Class

Name	Description	Type	Permitted Values	Data units

Table A-3: AbstractParameter Class Instantiated for CommsPlanningInfoData Class

Name	Description	Type	Permitted Values	Data units

Table A-4: AbstractParameter Class Instantiated for Classes Derived from DefinedEvent Class

Additional Parameters for Class …				
Name	**Description**	**Type**	**Permitted Values**	**Data units**

Table A-5: AbstractParameter Class Instantiated for Classes Derived from AdditionalEvent Class

Additional Parameters for Class …				
Name	**Description**	**Type**	**Permitted Values**	**Data units**

A2.1.5.14 Class ApertureLocation

A2.1.5.14.1 General

Item	Description	Ref.	Status	Support
23.	ApertureLocation	3.2.9	O	

A2.1.5.14.2 Class ApertureLocation Parameters

[n/a]

A2.1.5.15 Class ApertureReference

A2.1.5.15.1 General

Item	Description	Ref.	Status	Support
24.	ApertureReference	3.2.10	O	

A2.1.5.15.2 Class ApertureReference Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
24.1.	siteRef	Reference [3], table 3-5	M	
24.2.	apertureRef	Reference [3], table 3-5	M	

A2.1.5.16 Class ApertureCelestialBodyPosition

A2.1.5.16.1 General

Item	Description	Ref.	Status	Support
25.	ApertureCelestialBodyPosition	3.2.11	O	

A2.1.5.16.2 Class ApertureCelestialBodyPosition Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
25.1.	celestialBody	Reference [3], table 3-6	M	
25.2.	celestialBodyLat	Reference [3], table 3-6	M	
25.3.	celestialBodyLong	Reference [3], table 3-6	M	
25.4.	celestialBodyAltitude	Reference [3], table 3-6	O	
25.5.	apertureName	Reference [3], table 3-6	O	

A2.1.5.17 Class CommsPlanningInfoEventAssociation

A2.1.5.17.1 General

Item	Description	Ref.	Status	Support
26.	CommsPlanningInfoEventAssociation	3.2.12	M	

A2.1.5.17.2 Class CommsPlanningInfoEventAssociation Parameters

Item	Parameter	Ref.	Status	Item Support or Values Supported
26.1.	associationId	Table 3-3	M	
26.2.	commsPlanningInfoAssnKind	Table 3-3	M	
26.3.	comment	Table 3-3	O	
26.4.	eventIdRef	Table 3-3	M	

ANNEX B

SECURITY, SANA, AND PATENT CONSIDERATIONS

(INFORMATIVE)

B1 SECURITY CONSIDERATIONS

B1.1 OVERVIEW

This annex presents the results of an analysis of security considerations applied to the technologies specified in this Recommended Standard.

B1.2 CONSEQUENCES OF NOT APPLYING SECURITY TO THE TECHNOLOGY

The consequences of not applying security to the systems and networks on which this Recommended Standard is implemented could include potential loss, corruption, and theft of data. Since it is possible to utilize these messages in preparing and disseminating schedules relating to the availability of communications and tracking resources for spacecraft, the consequences of not applying security to the systems and networks on which this Recommended Standard is implemented could include compromise or loss of the mission if malicious tampering of a particularly severe nature occurs.

B1.3 POTENTIAL THREATS AND ATTACK SCENARIOS

Potential threats or attack scenarios include, but are not limited to, (a) unauthorized access to the programs/processes that generate and interpret the messages and (b) unauthorized access to the messages during transmission between exchange partners. Protection from unauthorized access during transmission is especially important if the mission utilizes open ground networks such as the Internet to provide ground station connectivity for the exchange of data formatted in compliance with this Recommended Standard. It is strongly recommended that potential threats or attack scenarios applicable to the systems and networks on which this Recommended Standard is implemented be addressed by the management of those systems and networks and by the utilization of adequate authentication, suitable protocols, and secured interfaces for the exchange of this information.

B1.4 SECURITY CONCERNS RELATED TO THIS RECOMMENDED STANDARD

B1.4.1 Data Privacy

Privacy of data formatted in compliance with the specifications of this Recommended Standard should be assured by the systems and networks on which this Recommended Standard is implemented.

B1.4.2 Data Integrity

Integrity of data formatted in compliance with the specifications of this Recommended Standard should be assured by the systems and networks on which this Recommended Standard is implemented.

B1.4.3 Authentication of Communicating Entities

Authentication of communicating entities involved in the transport of data that complies with the specifications of this Recommended Standard should be provided by the systems and networks on which this Recommended Standard is implemented.

B1.4.4 Data Transfer between Communicating Entities

The transfer of data formatted in compliance with this Recommended Standard between communicating entities should be accomplished via secure mechanisms approved by the Information Technology Security functionaries of exchange participants.

B1.4.5 Control of Access to Resources

Control of access to resources should be managed by the systems upon which provider formatting and recipient processing are performed.

B1.4.6 Auditing of Resource Usage

Auditing of resource usage should be handled by the management of systems and networks on which this Recommended Standard is implemented.

B1.5 UNAUTHORIZED ACCESS

Unauthorized access to the programs/processes that generate and interpret the messages should be prohibited in order to minimize potential threats and attack scenarios.

B1.6 DATA SECURITY IMPLEMENTATION SPECIFICS

Specific information-security interoperability provisions that apply between agencies and other independent users involved in an exchange of data formatted in compliance with this Recommended Standard should be specified in an ICD.

B2 SANA CONSIDERATIONS

B2.1 GENERAL

The recommendations of this document rely on the SANA registries described below. New assignments in these registries, in conformance with the policies identified, will be available at the SANA registry Web site: http://sanaregistry.org. Therefore the reader shall look at the SANA Web site for all assignments contained in these registries.

B2.2 REGISTRY FOR originatingOrganization

(See subsection A2.2 in reference [3].)

B2.3 REGISTRY FOR user

(See subsection A2.3 in reference [3].)

B2.4 REGISTRY FOR siteRef AND apertureRef

(See subsection A2.4 in reference [3].)

B2.5 REGISTRY FOR commsPlanningInfoAssnKind

The usage of Agency defined `commsPlanningInfoAssnKind` values (see table 3-3) is outside the scope of this Recommended Standard. However, to assist with inter-agency interoperations, the agency defined `commsPlanningInfoAssnKind` values are registered.

The information registered is:

a) Status – the status of the `commsPlanningInfoAssnKind`;

b) Organization – the agency that is registering the `commsPlanningInfoAssnKind`;

NOTE – This should be the same as the agency name in the SANA Organizations registry.

c) Point of Contact – the responsible party of the agency registering the particular agency `commsPlanningInfoAssnKind`;

NOTE – This should be one of the names found in the SANA Contacts registry.

d) Name – the name of the `commsPlanningInfoAssnKind`.

e) Description – a brief description of the nature of the `commsPlanningInfoAssnKind`.

f) Applicable Start Date – the date when an agency recognizes and processes this particular `commsPlanningInfoAssnKind`.

g) Applicable End Date – the date when an agency will no longer recognize and process this particular `commsPlanningInfoAssnKind`.

NOTE – This can have the value of 'indefinite' if the agency has no plans for ending implementation of the agency-specific `commsPlanningInfoAssnKind`

h) References – specifies any references that may be relevant to the `commsPlanningInfoAssnKind`. May be left empty.

In accordance with reference [5], section 3.12 (c), updates to this registry are at the discretion of CCSDS member agencies or registered organizations, via the registered agency or organization representative. The `commsPlanningInfoAssnKind` registry is located at:

https://sanaregistry.org/r/Comms_Planning_Info_Assn_Kinds

B2.6 USE OF UNREGISTERED VALUES

Values that have been registered should be used for the `originatingOrganization`, `user`, `siteRef`, and `apertureRef` parameters. However, if unregistered values are used for the `originatingOrganization`, `user`, `siteRef`, and `apertureRef` parameters, they should be prefixed with the string 'UNR::'.

NOTES

1 'UNR::' indicates an unregistered value;

2 this helps eliminate potential confusion in a multi-agency cross support context;

3 use of unregistered values is not recommended and should be avoided if possible.

B3 PATENT CONSIDERATIONS

No patent rights are known to adhere to any of the specifications of the Recommended Standard.

ANNEX C

XML SCHEMA ORGANIZATION, PACKAGING, AND EXAMPLES FOR THE COMMUNICATIONS PLANNING INFORMATION FORMATS

(INFORMATIVE)

C1 PURPOSE

This annex provides information regarding the XML Schema Organization and packaging. Examples of the communications planning information are also given.

C2 SCHEMA ORGANIZATION AND PACKAGING

The normative communications planning information schema types and global elements are contained in the file '902x02b1-CommsPlnInfo.xsd'.

The communications planning information types and global elements are registered in the 'urn:ccsds:schema:cssm:1.0.0' name space.

The planning information schema includes the following schemas:

a) 902x12m1-SchemaCssmSmAbstractEvent.xsd

   Types and global elements in this schema are registered in the 'urn:ccsds:schema:cssm:1.0.0' name space.

b) 902x12m1-SchemaCssmSmCommonClasses.xsd

   Types and global elements in this schema are registered in the 'urn:ccsds:schema:cssm:1.0.0' name space.

c) 902x12m1-SchemaCssmSmInfoEntityHeader.xsd

   Types and global elements in this schema are registered in the 'urn:ccsds:schema:cssm:1.0.0' name space.

The source of the following schema files,

- 902x02b1-CommsPlnInfo.xsd,
- 902x12m1-SchemaCssmSmAbstractEvent.xsd,
- 902x12m1-SchemaCssmSmCommonClasses.xsd, and
- 902x12m1-SchemaCssmSmInfoEntityHeader.xsd,

is the SANA SCCS-SM Information Entity XML Schemas registry:

http://sanaregistry.org/r/service_management_xml_schemas

C3 EXAMPLES

Various examples of the use of Communications Planning Information Formats are available. These are maintained in a git repository, https://github.com/cssAreaGH/CSSM-XML-InstanceExamples.

ANNEX D

ABBREVIATIONS AND ACRONYMS

(INFORMATIVE)

ASCII	American Standard Code for Information Interchange
CCSDS	Consultative Committee on Space Data Systems
CSSS	cross support service system
ICD	interface control document
ICS	implementation conformance statement
IUT	implementation under stress
n/a	not applicable
OMG	Object Management Group
RL	requirements list
rtlt	round trip light time
SANA	Space Assigned Numbers Authority
UML	Unified Modelling Language
UTC	Coordinated Universal Time
W3C	World Wide Web Consortium
XML	Extensible Markup Language

ANNEX E

INFORMATIVE REFERENCES

(INFORMATIVE)

[E1] *Extensible Space Communication Cross Support—Service Management—Concept*. Issue 1. Report Concerning Space Data System Standards (Green Book), CCSDS 902.0-G-1. Washington, D.C.: CCSDS, September 2014.

[E2] *Space Communication Cross Support—Service* Management—*Operations Concept*. Issue 1-S. Report Concerning Space Data System Standards (Historical), CCSDS 910.14-G-1-S. Washington, D.C.: CCSDS, (May 2011) June 2017.