

Recommendation for Space Data System Practices

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AUTHORITY

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FOREWORD

This document is a CCSDS Recommended Practice, which is intended to help a User Agency to access information from the Service Catalog of one or more Provider Agencies to enable an agreement to be made between a User Agency and a Provider Agency for space communications cross support.

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This **Recommended Practice** is therefore subject to CCSDS document management and change control procedures, which are defined in *Organization and Processes for the Consultative Committee for Space Data Systems* (CCSDS A02.1-Y-4). Current versions of CCSDS documents are maintained at the CCSDS Web site:

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* Swedish Space Corporation (SSC)/Sweden.
* United States Geological Survey (USGS)/USA.

DOCUMENT CONTROL

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| CCSDS 902.7-M-0.2 | Space Communications Cross Support - Service Catalog, Recommended Practice, Draft 0.2 | October 2016 | Second draft incorporating references to SANA registries. |
| CCSDS 902.7-M-0.3 | Space Communications Cross Support - Service Catalog, Recommended Practice, Draft 0.3 | May 2017 | Third draft listing parameters to be included in SANA registries and expanding content in response to comments on previous draft. |
| CCSDS 902.7-M-0.4 | Space Communications Cross Support - Service Catalog, Recommended Practice, Draft 0.4 | November 2017 | Fourth draft, re-orienting the document to describe how a service catalog should be compiled. |
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# Introduction

## Purpose

This Recommended Practice provides guidance for Service Providers, including member agencies, on how to express a service catalog in a standardized format using standard terms. This is intended to help a Service User to access information in a consistent way from the Service Catalogs of a number of Service Providers, as a first step in the development of a Service Agreement for CCSDS Space Communications Cross Support (SCCS).

## Scope

The Service Catalog recommendations in this document address the “core” and “extended” services of Service Catalog #1 (RD.1), produced by the Interagency Operations Advisory Group (IOAG). Core services are intended to be implemented by all IOAG agencies, while extended services are to be considered for bilateral cross support. The Service Catalog recommendations also accommodate historical agency standards that may still be in use.

The Service Catalog recommendation is related to the other SCCS Service Management recommendations as shown in . The Service Catalog provides information needed to develop the Service Agreement and Configuration Profiles.

Figure ‑ : Service Catalog in the Context of SCCS Service Management.

Currently, the Service Management Utilization Request Formats (SMURF) recommendation does not define an explicit format for a "Service Catalog Request". It is left to each Service Provider to create a mechanism for a Service User to access their Service Catalog.

## Applicability

The contents of this Recommended Practice are applicable to scenarios in which a Provider Agency wishes to provide SCCS services to a User Agency.

## Rationale

CCSDS is developing a set of Recommended Standards, as shown in Figure 1‑1, which define the parameters needed by SCCS Service Management (SCCS-SM) to support SCCS Transfer Services (SCCS-TS). In order to implement SCCS services, the SCCS-SM service parameters that are supported by a particular Service Provider need to be exposed to potential users in a Service Catalog. This Recommended Practice builds on the concepts and services defined by the IOAG in SC#1 and references the parameters defined by SCCS-SM.

NOTE: An Agency's Service Catalog may include additional information particular to the service provider that is over and above that needed to support SCCS services.

NOTE: The format of an Agency's Service Catalog is not addressed in this document.

## Document Structure

This document consists of several sections plus annexes.

* Section presents the purpose, scope, and rationale of this document and lists the definitions, conventions, and references used throughout the document.
* Section provides context and an overview of the SCCS services.
* Section provides a description of the SCCS services and references the associated SCCS-SM parameters.
* Section provides a top-level summary of SCCS-SM.
* Section 5 outlines an approach to obtaining SCCS services.
* Annexes provide a brief reference to security and Space Assigned Numbers Authority (SANA) information, a glossary, an acronym list and a list of informative references.

## Definitions

### Terms

A “Service” is a self-contained set of functions with standard, well-defined interfaces: a Service is specified by its functions and interfaces. Services are delivered via Service instances, which are a specific Service performed over a specified time period. A description of each of the Services is provided in Section 3.

“Service Management” provides the interface between the User mission and a SCCS Provider for managing the provision of services required by the User. It allows the user mission to schedule, control, and monitor the services and provides the user mission with service accountability information such as a comparison of committed and delivered services, descriptions of anomalies encountered during service provision and their resolution.

## Conventions

To be written.

## 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.

[] *IOAG Service Catalog #1.* Issue 2 Revision 1 Draft, IOAG, 26 January 2017.

[] *Space Communication Cross Support—Service Management—Service Specification*. Issue 1. Recommendation for Space Data System Standards (Blue Book), CCSDS 910.11-B-1. Washington, D.C.: CCSDS, August 2009.

[] *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

[] *Service Management Utilization Request Formats*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.9-W-003. Washington, D.C.: CCSDS, September 2016

[] *Planning Information Formats*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.2-W-0.1. Washington, D.C.: CCSDS, September 2016

[] *Service Package Data Formats*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.4-W-0.1. To be written

[] *Service Accounting*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.8-W-0.1. To be written

[] *Service Agreement and Service Configuration Profile*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.5-W-0.1. To be written

[] *Space Link Event Sequence Data Format*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.6-W-0.1. To be written

[] *Simple Schedule Format Specification*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.1-R-2. Washington, D.C.: CCSDS, May 2017

[] *TM Space Data Link Protocol*. Recommendation for Space Data System Standards, CCSDS 132.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[] *Space Packet Protocol*. Recommendation for Space Data System Standards, CCSDS 133.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[] *TM Synchronization and Channel Coding*. Recommendation for Space Data System Standards, CCSDS 131.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[] *AOS Space Data Link Protocol*. Recommendation for Space Data System Standards, CCSDS 732.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[] *TC Synchronization and Channel Coding*. Recommendation for Space Data System Standards, CCSDS 231.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[] *Communications Operation Procedure-1*. Recommendation for Space Data System Standards, CCSDS 232.1-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[17] *Space Link Extension—Return All Frames Service Specification*. Recommendation for Space Data System Standards, CCSDS 911.1-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, December 2004.

[18] *Space Link Extension—Return Channel Frames Service Specification*. Recommendation for Space Data System Standards, CCSDS 911.2-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, December 2004.

[] *Space Link Extension—Return Operational Control Fields Service Specification*. Recommendation for Space Data System Standards, CCSDS 911.5-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, December 2004.

[20] *Space Link Extension—Forward CLTU Service Specification*. Recommendation for Space Data System Standards, CCSDS 912.1-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, December 2004.

[] *Space Link Extension—Forward Space Packet Service Specification*. Recommendation for Space Data System Standards, CCSDS 912.3-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, December 2004.

[] *Orbit Data Messages*. Recommendation for Space Data System Standards, CCSDS 502.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2004.

[] *Radio Frequency and Modulation Systems—Part 1: Earth Stations and Spacecraft*. Recommendation for Space Data System Standards, CCSDS 401.0-B-20. Blue Book. Issue 27. Washington, D.C.: CCSDS, October 2017.

[] *XML Specification for Navigation Data Messages*. Draft Recommendation for Space Data System Standards, CCSDS 505.0-R-1. Red Book. Issue 1. Washington, D.C.: CCSDS, November 2005.

[] “CCSDS-910.11-B-1\_XML\_schemas.” http://public.ccsds.org/publications/archive/CCSDS-910.11-B-1\_XML\_schemas.zip.

[] SANA Website. <http://sanaregistry.org/>.

[] *TC Space Data Link Protocol*. Recommendation for Space Data System Standards, CCSDS 232.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003

[] *Encapsulation Service*. Recommendation for Space Data System Standards, CCSDS 133.1-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[] *CCSDS File Delivery Protocol*. Recommendation for Space Data System Standards, CCSDS 727.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2003.

[] *Forward CFDP-File Service*. Recommendation for Space Data System Standards, CCSDS xxx.0-B-1. Blue Book. To be written.

[] *Forward Packets-File Service*. Recommendation for Space Data System Standards, CCSDS xxx.0-B-1. Blue Book. To be written.

[] *Terrestrial Generic File Transfer Service*. Recommendation for Space Data System Standards, CCSDS 927.1-B-1. Blue Book. To be written.

[] *Optical Communications Physical Layer*. Recommendation for Space Data System Standards, CCSDS 141.0-B-1. Blue Book. To be written.

[] *Optical Communications Coding and Synchronization*. Recommendation for Space Data System Standards, CCSDS 142.0-B-1. Blue Book. To be written.

[] *Return CFDP-File Service*. Recommendation for Space Data System Standards, CCSDS xxx.0-B-1. Blue Book. To be written.

[] *Return Packets-File Service*. Recommendation for Space Data System Standards, CCSDS xxx.0-B-1. Blue Book. To be written.

[] *Tracking Data Cross Support Transfer Service*. Recommendation for Space Data System Standards, CCSDS 922.2-W-0.15. White Book. Draft 15. September 2016.

[] *Pseudo-Noise (PN) Ranging Systems*. Recommendation for Space Data System Standards, CCSDS 414.1-B-2. Blue Book. Issue 2. Washington, D.C.: CCSDS, February 2014.

[] *Management Services*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.10-W-1. To be written.

[] *Best Practices*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.11-W-1. To be written.

[] *Common Data Entities*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.12-W-1. To be written.

[] *Abstract Event Definition*. Draft Recommendation for Space Data System Standards (White Book), CCSDS 902.13-W-1. To be written.

[] *Monitored Data Cross Support Transfer Service*. Recommendation for Space Data System Standards, CCSDS 922.1-W-0.24. White Book. Draft 24. May 2016.

[] *Service Control Data Cross Support Transfer Service*. Recommendation for Space Data System Standards, CCSDS 922.X-W-0.23. White Book. Draft 23. March 2015.

# Overview

## Scope of Service Catalog

A Service Catalog should provide the information needed by a Service User to determine whether the Service Provider could provide the SCCS services required by the Service User. The information that the Service Catalog should provide includes:

1. An overview of the services offered and when they are available
2. A list of facilities and their major characteristics.
3. A description of engineering support available.
4. A summary of policies relating to the availability and pricing of services
5. Instructions on how to obtain services, including contact information.

It is intended that a common definition of the parameters within a Service Catalog is to be provided by various registries that will be defined in the Space Assigned Number Authority (SANA) Registry, RD.2.

The following sections address each of these points in turn, including pointers to the proposed SANA registries.

## Overview of services Offered

The Service Catalog should list the SCCS services provided by the Service Provider, including both data delivery services and radiometric data services in the following categories:

* Forward Data Delivery Services provide the capability for a User to transfer data from a control center to a spacecraft via a Provider network.
* Return Data Delivery Services provide the capability for a User at a control center or science center to receive data from a spacecraft via a Provider network.
* Radio Metric Services allow the results of radio metric measurements by one or more Provider networks to be delivered to a User at a control center or science center.
* Other services could include, for example, measurements of radio frequency (RF) signals for scientific purposes.

The context of the SCCS services is shown in .



Figure ‑ : Context of SCCS Services (reproduced from RD.1).

## Facilities and their Major characteristics

The Service Catalog should list and briefly describe the Service Provider assets that are offered for use by a Service User mission.

The Service Provider facilities include the “Functional Resources” that monitor and control all the parameters related to the RF communications assets and ground station equipment that are needed to support the mission spacecraft. The RF communication assets include the antennas and RF front-end equipment. The standard parameters of Functional Resources are to be defined in a TBD SANA registry.

The Service Provider facilities will need to be compatible with the mission spacecraft. The mission spacecraft details should be registered in the SANA registry “Spacecraft Identifiers” (<http://sanaregistry.org/r/spacecraftid/spacecraftid.html>).

## Service Provider ENGINEERING SUPPORT

The Service Provider may make its engineers available to assist user missions and increase the value of the SCCS services. The cost of engineering support may be negotiated on a case-by-case basis. Examples of possible support are described in the following subsections.

### System Engineering Support

The Service Provider may assist user missions in mapping their needs into SCCS services. Service Provider system engineers may also assist the user mission with developing mission system and flight system designs that can incorporate SCCS services in an effective manner. Where service customization is deemed most cost effective, Service Provider engineers may assist the user mission by developing design solutions as well as estimates of cost, schedule, and risk. Service Provider system engineers may also assist the user mission in contingency planning, including the design of contingency operations centers.

### Test Support

The Service Provider may require service compatibility testing prior to service scheduling for any new user mission. In addition to providing and staffing facilities for these tests, the Service Provider may make engineers available for other user mission tests such as mission end-to-end data systems tests. Service Provider engineers may work with the user mission to troubleshoot problems and resolve anomalies.

### Spectrum and Frequency Management Support

The Service Provider may assist user missions in selecting frequencies and signal formats that are compatible with SCCS services, ensure compliance with applicable regulations, and protect against adversely impacting others.

## Policies relating to Availability and Pricing of services

The Service Provider will need to provide a potential Service User with access to policy (including contractual) and pricing information pertaining to the provision of SCCS Services.

The format of this information and the way of accessing the information is not defined by CCSDS and is left to the discretion of the Service Provider. However, in the future, a standard way of defining the cost of a pass may be defined, to enable easier comparisons between providers to be made.

## HOW to obtain services and contact information

The Service Catalog needs to provide a potential Service User with information on how to obtain Service Provider services. The mechanism for doing this is left to the discretion of the Service Provider.

Contact information should be available in a new SANA registry “CSSC Provider Contacts”.

# Cross Support SERVICE descriptions

## Cross Support SERVICES

This section summarizes how the Service Provider should define the SCCS services it offers for cross support. At a high level, the requirements include:

the published Service Catalog shall state the forward, return and radiometric services offered according to the service definitions found in sections 3.2 to 3.4.

the supported frequency bands for services supported shall be stated (see section 3.5)

the classification for the service supported shall be stated (e.g. near earth, deep space)

and ...

Once a service has been chosen, there are parameter values to choose, such as polarization and modulation formats. The list of parameters and values that are relevant to each of the services are listed in Table 3-1, Table 3-3 and Table 3-5.

..

## FORWARD DATA DELIVERY SERVICES

The Forward Data Delivery Services transmit data to the user mission platform. The data are sent by the user mission ground system, e.g. Mission Operations Center (MOC) to the Service Provider network, which transmits them to the user mission platform. Data transmitted typically include commands, sequence loads, and flight software loads, but may also include any other type of data elements.

### FORWARD DATA Delivery Parameters

The forward data delivery parameters and allowed values that the Service Catalog should include are listed in Table 3-1.

---Command Service Table Example---- (provided by EB)

This is a placeholder for a more comprehensive table.

Table -: Forward Data Delivery Parameters and Values.

| **Parameter** | **Value** |
| --- | --- |
| Frequency Bands Supported | Near-Earth S, XDeep space S, X |
| EIRP and Transmitting Power |

|  |  |  |
| --- | --- | --- |
| S-Band: | 34m BWG | 99 dBW at 20 kW |
|  | 34m HEF | 79 dBW at 250 W |
|  | 70m | 106 dBW at 20 kW |
| X-band: | 34m BWG/HEF | 110 dBW at 20 kW |
|  | 70m | 116 dBW at 20 kW |

 |
| Polarizations Supported | RCPLCPNo RCP/LCP simultaneity |
| Modulation Types | BPSK on subcarrier for uplink rate ≤ 4 kbpsBPSK directly on carrier for uplink rate 4 kbps to 256 kbps |
| Modulation Formats | NRZ: L, M, SBi-phase L or Manchester, M, S |
| Modulation Index Range | Sine wave subcarrier: 0.1 – 1.52 radians Square wave subcarrier: 0.1 – 1.40 radians No subcarrier 0.1 – 1.57 radians |
| Carrier/Subcarrier Waveform | Residual carrier: sine waveSubcarrier: 8 or 16 kHz |
| Uplink Acquisition Types | CCSDS Physical Link Operations Procedure-2 (PLOP-2) |
| Uplink Data Rate | Maximum 256 kbpsMinimum 7.8 bps |
| Channel Coding | Provided by mission user |
| Data from MOC to DSN | Stream of CLTUs over a TCP/IP interface or File of CLTUs |
| Data from DSN To Spacecraft | CLTU per CCSDS TC Space Link Protocol (ref. CCSDS 232.0-B-1) |
| Data Unit Size | Maximum CLTU size: 32,752 bitsMinimum: 16 bitsA series of CLTUs can be contiguously radiated. |
| Data Retention Period | No data retention other than buffer staging for radiation |
| Data Delivery Methods from MOC to DSN | CCSDS Space Link Extension (SLE) Forward CLTU(ref. CCSDS 912.1-B-2), on-line delivery modeCCSDS SLE Enhanced Forward CLTU (ref. CCSDS 912.11-O-1), on-line delivery mode (being implemented, available in 2017) AMMOS Space Command Message File (SCMF) Interface, on-line or off-line delivery mode |
| Radiation Latency | ≤ 125 milliseconds per CLTU |
| Service Operating Mode | Automated |
| Service Availability | Nominal 95%Mission critical event 98% |
| Data Quality†  | Bit error rate: 10-7CLTU error rate: 10-4 |
| Accountability Reporting | SLE command radiation status report  |
| Ground Communication Interface Methods | Refer to Section 3.8 |
| DSN Interface Specifications  | DSN documents 810-005; 810-007; 820-013 0163-Telecomm, 0191-Telecomm, 0197-Telecomm, 0198-Telecomm |

### IOAG SC#1 FORWARD DATA DELIVERy Services

The list of forward data delivery services defined in IOAG SC#1 is reproduced in Table 3-2.

The forward data delivery services are elaborated in the following sections.

Table -: IOAG SC#1 Forward Data Delivery Services. Core services are in green.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **IOAG Service Types** | **Space Link Interface Standards** | **Ground Link Interface Standards** |
| **Forward Data Delivery Services** | Forward CLTU Service | * Radio Frequency and Modulation
* TC Synchronization and Channel Coding
 | * SLE Forward CLTU Service
 |
| Forward Space Packet Service | As for “Forward CLTU Service” plus:* TC Space Data Link Protocol
* Communications Operation Procedure 1
 | * SLE Forward Space Packet Service
 |
| Forward CFDP-File Service | As for “Forward CLTU Service” plus:* Space Packet Protocol
* Encapsulation Service
* CCSDS File Delivery Protocol
 | * Forward CFDP-File Service , over
* Cross Support - Terrestrial Generic File Transfer
 |
| Forward Packets-File Service | As for “Forward CLTU Service” plus:* Space Packet Protocol
* Encapsulation Service
 | * Forward Packets-File Service, over
* Cross Support - Terrestrial Generic File Transfer
 |

### Forward CLTU Service

#### Functional Description

The Forward CLTU service is specified in the following CCSDS documents;

* SLE Forward CLTU Service, RD.20
* Radio Frequency and Modulation, RD.23
* TC Synchronization and Channel Coding, RD.15

#### IOAG

This is an IOAG core service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from are required:

1. Parameter 1
2. Parameter 2
3. etc.

### Forward Space packet Service

#### Functional Description

The Forward Space Packet service is specified in the following CCSDS documents;

* SLE Forward Space Packet Service, RD.21
* Radio Frequency and Modulation, RD.23
* TC Synchronization and Channel Coding, RD.15
* TC Space Data Link Protocol, RD.27
* Communications Operation Procedure 1, RD.16

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from are required:

1. Parameter 1
2. Parameter 2
3. etc.

### Forward CFDP-FILE Service

#### Functional Description

The Forward CFDP-File service is specified in the following CCSDS documents;

* SLE Forward CFDP-File Service, RD.30
* Terrestrial Generic File Transfer Service, RD.32
* Radio Frequency and Modulation, RD.23
* TC Synchronization and Channel Coding, RD.15
* Space Packet Protocol, RD.12
* Encapsulation Service, RD.28
* CCSDS File Delivery Protocol, RD.29

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from are required:

1. Parameter 1
2. Parameter 2
3. etc.

### Forward Packets-FILE Service

#### Functional Description

The Forward Packets-File service is specified in the following CCSDS documents;

* SLE Forward Packets-File Service, RD.31
* Terrestrial Generic File Transfer Service, RD.32
* Radio Frequency and Modulation, RD.23
* TC Synchronization and Channel Coding, RD.15
* Space Packet Protocol, RD.12
* Encapsulation Service, RD.28

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from are required:

1. Parameter 1
2. Parameter 2
3. etc.

### Bilateral Forward data transfer Services

#### Functional Description

The Service Provider may include non-CCSDS forward data transfer services in their Service Catalog that are not in the portfolio of SCCS transfer services, e.g. forward IP datagram (over HDLC), forward bitstream etc.

#### IOAG

This is not IOAG SC #1 service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from are required:

1. Parameter 1
2. Parameter 2
3. etc.

## RETURN DATA DELIVERY SERVICES

Return Data Delivery Services retrieve data that a user mission platform has transmitted, and send them to the user mission ground system. This data can be platform health, engineering data, science data, or whatever else the user mission’s designers have chosen.

Return data are time-tagged when received by the SCCS Service Provider network so that user missions may correlate the user mission platform clock time with the standard terrestrial time reference.

### RETURN DATA Delivery Parameters

The return data delivery parameters and allowed values that the Service Catalog should include are listed in Table 3-3.

---Telemetry Service Table Example---- (provided by EB)

This is a placeholder for a more comprehensive table.

Table -: Return Data Delivery Parameters and Values.

| **Parameter** | **Value** |
| --- | --- |
| Frequency Bands Supported | Near-Earth S, X, KaDeep space S, X, Ka |
| G/T @ 45 Degree Elevation, diplexed (refer to Table 5.1) |

|  |  |
| --- | --- |
| S-Band | G/T (dB) |
| 34m BWG | 40.8 |
| 34m HEF | 39.4 |
| 70m | 49.8 |
|  |  |
| X-Band | G/T (dB) |
| 34m BWG | 54.2 |
| 34m HEF | 53.2 |
| 70m | 61.5 |
|  |  |
| Ka-Band | G/T (dB) |
| 34m BWG (deep space, 32 GHz) | 61.1 |
| 34m BWG (near Earth, 26 GHz) | 58.2 |

 |
| Polarizations Supported | RCPLCPRCP/LCP simultaneity at some stations for S-, X-and deep space Ka-band.  |
| Modulation Types | PSK on residual carrier (with or without subcarrier)BPSK on suppressed carrier (no ranging)QPSK, OQPSK\* (no ranging) |
| Modulation Formats | NRZ: L, M, S;Bi-phase L or Manchester, M, S |
| Carrier/Subcarrier Waveform | Residual carrier: sine or square wave |
| Downlink Data Rate(Information and redundancy) | Maximum: 150 Mbps for near Earth Ka-band 10 Mbps for other frequenciesMinimum: 10 bps (> 40 bps recommended for timely acquisition) |
| Downlink Symbol Rate | Maximum: 300 Msps for near Earth Ka-band (with ½ code) 20 Msps for other frequencies (with ½ code)Minimum: 20 sps (with ½ code) |
| Forward Error Correction | Convolutional codes: (k=7, r=1/2), without punctured code optionReed-Solomon (RS) interleave = 1 to 8Reed-Solomon (RS) without convolutional codeReed-Solomon (outer) concatenated with convolutional (inner) codeTurbo codes: 1/2, 1/3, and 1/4 (1.6 Mbps max); not available for near-Earth Ka-bandTurbo code: 1/6 (1 Mbps max); not available for near-Earth Ka-bandLow Density Parity Code (LDPC): ½, 2/3, 4/5, 7/8 (10 Msps, max); not available for near-Earth Ka-band |
| Data Format, from Spacecraft to the DSN | CCSDS TM Synchronization and Channel Coding (ref. CCSDS 131.0-B-1)Transfer frame format conforming to CCSDS TM Space Data Link Protocol (ref. CCSDS 132.0-B-1)VCDUs conforming to CCSDS AOS Space Data Link Protocol (ref. CCSDS 732.0-B-2) |
| Data Format, from DSN to MOC | Stream of frames or VCDUs |
| Data Unit Size (information bits only) | TM frame or VDCU: 8920 bits (nominal), 1760 bits (safing and critical events), 16 kbits (maximum) |
| Maximum Number Of Virtual Channels Supported | 64 (16 virtual channels can be processed at a given time) |
| Data Retention Period at the DSN | Nominal 14 days after acquisition. |
| Data Delivery Methods from the DSN to the MOC | CCSDS Space Link Extension (SLE) RAF/RCF (ref. CCSDS 911.1-B-2 and 911.2-B-2)On-line timelyOn-line completeOff-line |
| Data Delivery Latency (DSN to MOC) | Engineering telemetry: Typically on-line timely (seconds) and on-line complete (hours) Science telemetry: Typically off-line (hours to 24 hours).Note: Latency commitment limited by bandwidth from DSN to project MOS |
| Service Operating Mode | Automated |
| Service Availability | Nominal: 95%Mission critical event: 98% |
| Data Quality | Frame rejection rate: 10-4 to 10-5 typical |
| Time Tagging Accuracy | 10-50 microseconds in Earth Receive Time (ERT) relative to UTC, depending on downlink data rate |
| Accountability Reporting | SLE RAF/RCF status reportFrame accountability report0199-Telecomm, 0206-Telecomm-SLE |
| Ground Communication Interface Methods | Refer to Section 3.8 |

### IOAG SC#1 RETURN DATA DELIVERy Services

The list of return data delivery services defined in IOAG SC#1 is reproduced in Table 3-4.

Table -: IOAG SC#1 Return Data Delivery Services. Core services are in green.

|  | **IOAG Service Types** | **Space Link Interface Standards** | **Ground Link Interface Standards** |
| --- | --- | --- | --- |
| **Return Data Delivery Services** | Return All Frames Service | * Radio Frequency and Modulation
* TM Synchronization and Channel Coding
 | * SLE Return All Frames
 |
| Return All Frames Optical Service | * Optical Communications Coding and Modulation
 | * SLE Return All Frames
 |
| Return Channel Frames Service | As for “Return All Frames Service” plus:* TM Space Data Link Protocol
* AOS Space Data Link Protocol
 | * SLE Return Channel Frames
 |
| Return Channel Frames Optical Service | As for “Return All Frames Optical Service” plus:* TM Space Data Link Protocol
* AOS Space Data Link Protocol
 | * SLE Return Channel Frames
 |
| Return Operational Control Field Service | As for “Return Channel Frames Service” | * SLE Return Operational Control Field
 |
| Return CFDP-File Service | As for “Return Channel Frames Service” plus:* Space Packet Protocol
* Encapsulation Service
* CCSDS File Delivery Protocol
 | * Return CFDP-File Service over
* Cross Support - Terrestrial Generic File Transfer
 |
| Return Packets-File Service | As for “Return Channel Frames Service” plus:* Space Packet Protocol
* Encapsulation Service
 | * Return Packets-File Service over
* Cross Support - Terrestrial Generic File Transfer
 |

The return data delivery services are elaborated in the following sections.

### RETURN ALL FRAMES Service

#### Functional Description

The RAF service is specified in the following CCSDS documents;

* SLE Return All Frames service, RD.17
* Radio Frequency and Modulation, RD.23
* TM Synchronization and Channel Coding, RD.13

#### IOAG

This is an IOAG core service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### RETURN ALL FRAMES Optical Service

#### Functional Description

The RAF optical service is specified in the following CCSDS documents;

* SLE Return All Frames service, RD.17
* Optical Communications Coding and Modulation, RD.34

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### RETURN CHANNEL FRAMES Service

#### Functional Description

The Return Channel Frames service is specified in the following CCSDS documents;

* SLE Return Channel Frames service, RD.18
* Radio Frequency and Modulation, RD.23
* TM Synchronization and Channel Coding, RD.13
* TM Space Data Link Protocol, RD.11
* AOS Space Data Link Protocol, RD.14

#### IOAG

This is an IOAG core service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### RETURN Channel FRAMES Optical Service

#### Functional Description

The Return Channel Frames Optical service is specified in the following CCSDS documents;

* SLE Return Channel Frames service, RD.18
* Optical Communications Coding and Modulation, RD.34
* TM Space Data Link Protocol, RD.11
* AOS Space Data Link Protocol, RD.14

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### RETURN operational control field Service

#### Functional Description

The Return Operational Control Field service is specified in the following CCSDS documents;

* SLE Return Operational Control Field service, RD.19
* Radio Frequency and Modulation, RD.23
* TM Synchronization and Channel Coding, RD.13
* TM Space Data Link Protocol, RD.11
* AOS Space Data Link Protocol, RD.14

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### RETURN CFDP-FILE Service

#### Functional Description

The Return CFDP-File service is specified in the following CCSDS documents;

* Return CFDP-File Service, RD.35
* Cross Support Terrestrial Generic File Transfer Service, RD.31
* Radio Frequency and Modulation, RD.23
* TM Synchronization and Channel Coding, RD.13
* TM Space Data Link Protocol, RD.11
* AOS Space Data Link Protocol, RD.14
* Space Packet Protocol, RD.12
* Encapsulation Service, RD.28
* CCSDS File Delivery Protocol, RD.29

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### RETURN Packets-FILE Service

#### Functional Description

The Return Channel service is specified in the following CCSDS documents;

* Return Packets-File Service, RD.36
* Cross Support Terrestrial Generic File Transfer Service, RD.31
* Radio Frequency and Modulation, RD.23
* TM Synchronization and Channel Coding, RD.13
* TM Space Data Link Protocol, RD.11
* AOS Space Data Link Protocol, RD.14
* Space Packet Protocol, RD.12
* Encapsulation Service, RD.28

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### Bilateral return data transfer Services

#### Functional Description

The Service Provider may include non-CCSDS return data transfer services in their Service Catalog are not in the portfolio of SCCS transfer services, e.g. beacon tone, return IP datagram (over HDLC), return bitstream, etc.

#### IOAG

This is not IOAG SC #1 service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-3 are required:

1. Parameter 1
2. Parameter 2
3. etc.

## RADIOMETRIC ServiceS

Three types of radiometric service are proposed to be addressed in the Service Catalog:

* Validated Radio Metric Services make measurements that aid in the navigation of the user mission platform. All measurements from a tracking pass are delivered in a single file. If all equipment used to make the measurements have reported nominal status and performance, the file containing the measurements is marked “valid”.
* Raw Data Radio Metric Services make measurements that aid in the navigation of the user platform. The measurements are delivered in near-real time and are not validated, that is, they are “raw”.
* The Delta DOR (Differential One-way Ranging) Service measures the time delay between user mission platform signals arriving at two different tracking stations and, contemporaneously, measures the time delay of RF emissions from a quasar arriving at the same two tracking stations. From these measurements, the angular position of the user mission platform along the baseline between the two tracking stations, relative to the quasar can be inferred. The Service also provides an Extra-Galactic Radio Source (EGRS) Catalog listing the plane-of-sky position in inertial space of quasars used in the Delta DOR Service.

### RADIOMETRIC DATA Delivery Parameters

The radiometric data delivery parameters and allowed values that the Service Catalog should include are listed in Table 3-5.

---Radiometric Service Table Example----

This is a placeholder for a more comprehensive table.

Table -: Radiometric Data Delivery Parameters and Values.

| **Parameter** | **Value** |
| --- | --- |
| Frequency Bands Supported | Near-Earth S, X, KaDeep space S, X, Ka |
|  |  |

### IOAG SC#1 FORWARD DATA DELIVERy Services

The list of return data delivery services defined in IOAG SC#1 is reproduced in Table 3-6.

Table -: IOAG SC#1 Radiometric Services. Core services are in green.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **IOAG Service Types** | **Space Link Interface Standards** | **Ground Link Interface Standards** |
| **Radio Metric Services** | Validated Data Radio Metric Service | * Radio Frequency and Modulation
* Pseudo-Noise (PN) Ranging Systems
 | * Offline Radio Metric Cross Support Transfer Service, over
* Cross Support - Terrestrial Generic File Transfer
 |
| Raw Data Radio Metric Service | As for “Validated Data Radio Metric Service”  | * Tracking Data Cross Support Transfer Service
 |
| Delta DOR Service | * Radio Frequency and Modulation
 | * CSTS D-DOR Cross Support Transfer Service, over
* Cross Support - Terrestrial Generic File Transfer
 |

The radio metric services are elaborated in the following sections.

### VALIDATED Data RADIo Metric SERVICE

#### Functional Description

The Validated Data Radio Metric service is specified in the following CCSDS documents;

* Offline Radio Metric Cross Support Transfer Service (to be written)
* Cross Support Terrestrial Generic File Transfer Service, RD.31
* Radio Frequency and Modulation, RD.23
* Pseudo-Noise (PN) Ranging Systems, RD.38

#### IOAG

This is an IOAG core service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-5 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### RAW Data RADIo Metric SERVICE

#### Functional Description

The Raw Data Radio Metric service is specified in the following CCSDS documents;

* Tracking Data Cross Support Transfer Service, RD.37
* Radio Frequency and Modulation, RD.23
* Pseudo-Noise (PN) Ranging Systems, RD.38

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-5 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### DELTA DOR SERVICE

#### Functional Description

The Delta DOR service is specified in the following CCSDS documents;

* Delta-DOR Cross Support Transfer Service (to be written)
* Cross Support Terrestrial Generic File Transfer Service, RD.31
* Radio Frequency and Modulation, RD.23

#### IOAG

This is an IOAG extended service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-5 are required:

1. Parameter 1
2. Parameter 2
3. etc.

### Bilateral Radio metric Services

#### Functional Description

The Service Provider may include non-CCSDS radio metric services in their Service Catalog are not in the portfolio of SCCS transfer services, e.g. raw Doppler service, validated Doppler service, raw ranging service, raw tracking angle data service, etc.

In addition, the Service Provider may offer bilateral scientific services, including very long baseline interferometry (VLBI), radar science, radio science etc., and engineering services, including calibration services.

#### IOAG

This is not IOAG SC #1 service.

#### Service Catalog Parameters

To offer this service, the following Service Catalog parameters from Table 3-5 are required:

1. Parameter 1
2. Parameter 2
3. etc.

## RADIO Frequencies used by Space Missions

Include a table or refer to another document?

# Service MANAGEMENT

## SERVICE MANAGMENT Overview

The Service Provider network provides Service Management capabilities to allow the Service User to plan, schedule, monitor and control service execution by the Service Provider network.

The components of Service Management are shown in Figure 1‑1 and include:

* Concept Green Book, RD.3
* Simple Schedule Format Specification, RD.10
* Service Management Utilization Request Formats, RD.4
* Planning Information Formats, RD.5
* Service Package Data Formats, RD.6
* Service Agreement and Service Configuration Profile Data Formats, RD.8
* Space Link Event Sequence Data Format, RD.8
* Service Catalog (this document)
* Service Accounting, RD.7
* Management Services (Automation), RD.39
* Best Practices, RD.40
* Service Management Common Data Entities, RD.41
* Abstract Event Definition, RD.42
* Monitored Data Cross Support Transfer Service, RD.43
* Service Control Cross Support Transfer Service, RD.44

The mapping between the service management functions defined in IOAG SC#1 and those defined by CCSDS are shown in Table 4-1.

The service management functions and their relevance to the Service Catalog are described briefly in the following sections.

Table -: IOAG SC#1 Service Management Functions.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **IOAG Service Types** | **Space Link Interface Standards** | **Ground Link Interface Standards** |
| **Service Management Functions** | Assessment of service suitability | N/A | Service Catalog  |
| Service Agreement Development | N/A | Service Agreement and Configuration Profile Data Formats  |
| Request the information required to provide a cross support | N/A | Service Management Utilization Request Format  |
| Planning Information | N/A | Planning Information Formats |
| Event Sequences | N/A | Space Link Event Sequence Data Format |
| Service Package | N/A | Service Package Data Formats |
| Schedule and unallocated times | N/A | Simple Schedule Format |
| Service accounting | N/A | Service Accounting  |
| Management Service (Automation) | N/A | Management Services (Automation)  |
|  | Engineering Monitoring Data Delivery | N/A | Monitored Data - Cross Support Transfer Service |

The Service Management Concept Green Book provides an overview of the overall concept, including a service lifecycle that sets the Service Catalog in context. This document should be read first by someone wishing to understand the role of Service Management in delivering SCCS services.

## SERVICE MANAGEMENT pARAMETERS

### Overview of Service CATALOG PARAMETERS

This section lists the parameters that need to be included in a Service Agreement. The parameters are those defined in the *Space Communication Cross Support—Service Management—Service Specification* (reference [2]) as being necessary for CCSDS space communication cross support service management, as well as additional parameters, derived from existing Agency service agreements.

The Service Catalog parameters are grouped into the following logical blocks:

* Mission Registration
	+ User and provider agency contact details
	+ Service Agreement timescale
	+ Services to be provided
	+ Reference documents
	+ Testing required
	+ Pricing
* Service Options and Constraints
* Spacecraft Communication Interfaces
	+ Forward space link parameters (see Table 3-1)
	+ Return space link parameters (see Table 3-3)
	+ Radiometric parameters (see Table 3-5)
* Service Management Operational Constraints
	+ Configuration Profile parameters
	+ Trajectory Prediction parameters
	+ Service Package parameters
	+ Service Agreement parameters
* Service Monitoring and Reporting

## MISSION Registration

| **Parameter** | **Service Catalog ID** | **Definition** | **Service Management Name, Type and Value** |
| --- | --- | --- | --- |
| Supporting Agency | 01 | Name of the provider agency. | supportingAgency |
| Supporting Agency Contacts | 02 | List of human contacts and other entity names in the provider organization permitted to participate in the service | allowedCmSmEntityNames |
| Provider Complex  | 03 | Name of the Complex that will provide the service to the user | complexName |
| Services Provided | 04 | List of services that the provider will support. | supportedServices |
| RF compatibility test | N/A | Interface test between the mission spacecraft and the ground station | testSupport1not defined in SM |
| Ground communications test | N/A | Connectivity test between user and provider ground systems | testSupport2not defined in SM |
| Dataflow test | N/A | Functional test between user and provider ground systems | testSupport3not defined in SM |
| SLE test | N/A | Interface test between the service user and the service provider | testSupport4not defined in SM |
| End-to-end system test | N/A | End-to-end system test, using spacecraft simulator | testSupport5 not defined in SM |
| Operations readiness test | N/A | Operations readiness test, for operator training | testSupport6not defined in SM |
| Rehearsal | N/A | Full rehearsal of mission operations | testSupport7not defined in SM |
| Antenna price | N/A | Price charged by the Supporting Agency for use of a single antenna | pricePerHournot defined in SM |
| Labour price | N/A | Price charged by the Supporting Agency for any extra work that is negotiated | pricePerLabourHournot defined in SM |

## SERVICE OPTIONS and constraints

| **Parameter** | **Definition** | **Service Management Name, Type and Value** |
| --- | --- | --- |
| Share Antenna? | Indicates whether a user is willing and able to share an antenna with other missions, to assist provider ground station scheduling and/or reduce costs | shareAntennaBoolean (true, false) |
| Confirmation Timeout | Maximum time interval for a confirmation message to be received following transmission of a notification message by either the user or the provider | confirmationTimeout(part of the SM confirmed notification procedure pattern)Unsigned integer (seconds) |
| Enforce Ownership?  | Yes/No parameter which constrains the provider to allow only the ‘owner’ of a particular piece of SM information to modify it (‘Yes’) or to allow any one of the User Contacts to modify it (‘No’). | enforceOwnershipBoolean (true, false) |
| Support Space Link Event Profiles? | Yes/No parameter which indicates whether Space Link Event Profiles are supported by the Service Agreement. | spaceLinkEventsProfilesSupportedBoolean (true, false) |
| Time allowed between space link events | Minimum time allowed between space link events | minEventTemporalSpacingUnsigned integer (seconds) |
|  | Event Time Window | If Space Link Event Profiles are supported, these parameters define the maximum values that are allowed to be set in the associated Event dataset. | maxEventTimeWindowLeadmaxEventTimeWindowLagUnsigned integer (seconds) or NULL |
| Permit Handovers? | Yes/No parameter which indicates whether Service Requests may be supported by handovers between multiple ground stations or not. | handoverPermittedAgreementBoolean (true, false) |
|  | Handover Overlap | If handovers are supported, this parameter defines the minimum time for the overlap. | handoverOverlapUnsigned integer (seconds) or NULL |
|  | Handover Procedure | If handovers are supported, this parameter provides a reference to a document describing the handover procedure | handoverProcedureReferenceString256 |
| Maximum Number of Service Instances | Specifies the maximum number of service instances for any given type of Transfer Service that can be supported by all Service Packages at any single time. | maxInstanceOfTsTypePositive integer (seconds) |
| Maximum data rate on return service | Specifies the upper bound for any transfer service instance, where applicable. | maxDataRateLimitationPositive integer (bits/second) or NULL |
| Minimum value on Reporting Period | Specifies the minimum value on the reporting period for any transfer service instance. | minLowerBoundReportingLimitPositive integer (seconds) |
| Maximum value on Reporting Period | Specifies the maximum value on the reporting period for any transfer service instance. | maxUpperBoundReportingLimitPositive integer (seconds) |
| Size of return online buffer | Specifies the size of the return online buffer | rOnlineFrameBufferSizePositive integer (frames) |
| Number of return frames to discard? | Specifies the number of frames to be discarded if the return online buffer becomes full. | rOnlineFrameBufferOverflowDiscardNumberPositive integer (frames) |
| Allowed THROW EVENT Identifiers | Specifies the set of identifiers that are valid for THROW-EVENT operations. | allowedThrowEventIdentifiers Positive integers (list of) |
|  | THROW EVENT Procedures | If THROW-EVENTS are supported, this parameter provides a reference to a document describing the THROW-EVENT procedures | throwEventProcedureReferenceString256 |
| Service Management Operations | List of service management operations that the provider will support. | supportedSccsSmOperations |

## Spacecraft Communication Interfaces

### Forward Space link parameters

The forward space link parameters are listed in Table 3-1.

Compare with …..

| **Parameter** | **Service Catalog ID** | **Definition** | **Service Management Name, Type and Value** |
| --- | --- | --- | --- |
| Forward RF Carrier Identifiers | N/A | Specifies the forward carrier ID | f401SpaceLinkCarrierAgreementIDString256 |
| Forward RF Carrier Frequency Range | 10 | This defines the RF Band to be used, (This defines the minimum and maximum frequencies allowed for the forward carrier frequency, in Hz). | carrierFrequencyRange  |
|  |  |  |  |
| Forward RF Carrier Use | 12 | How the forward carrier is to be applied i.e. remnant or suppressed | carrierUse remnant suppressed |
|  | Forward RF Modulation Index Range | 13 | If Carrier Use is ‘remnant’, this parameter specifies the upper and lower bounds of the angle by which the RF carrier may be phase-shifted | modulationIndexRange lowerBound upperBoundmilliRadians or NULL |
| Subcarrier required? |  | Specifies whether subcarrier is required, for TC, ranging or both | subCarrierOption- not required- TC only- ranging only- TC and ranging (concurrent)- TC and ranging (not concurrent) |
| Forward Ranging |  | Specifies the type of ranging required | rangingOption- PNetc. |
| Forward RF Subcarrier Frequency Range | 14 | The minimum and maximum frequencies allowed for the forward subcarrier frequency, in Hz | subcarrierFrequencyRange minSubcarrierFrequency maxSubcarrierFrequencyHz |
| Forward RF Subcarrier Waveform Options | 15 | Whether the waveforms on the forward subcarrier are sine or square | subcarrierWaveformOptions sine square |
| Forward Symbol Rate Range | 16 | The minimum and maximum values for the symbol rates on the forward symbol stream | symbolRateRange minSymbolRate maxSymbolRatemilliSymbols/second |
| Forward Symbol Rate coherent with Subcarrier? |  | Specifies whether the forward symbol rate is coherent with the subcarrier | symbolRateCoherentBoolean (True, False) |
| Forward EIRP | 17 | The minimum and maximum required values for the forward EIRP | fMinEirpfMaxEirpInteger (dBm) |
| Forward RF Polarization Options | 18 | Specifies the polarization options available on the forward link | fPolarizationOptions linearHorizontal linearVertical rcp lcp  |
| Forward PCM Format Options | 19 | Specifies the set of PCM waveforms that may be modulated onto the forward RF carrier or subcarrier | pcmFormatOptions NRZ-L NRZ-M BiPhase-L BiPhase-M |
| Forward TC CMM-2 | 20 | Specifies the length of the acquisition sequence used in Telecommand Carrier Modulation Mode 2  | acquisitionSequenceLengthUnsigned integer (default = 16 octets) |
| PLOP in Effect | 21 | Specifies the Physical layer Operations Procedure to be used on the modulation channel. | plopInEffect plop-1 plop-2 |
|  | Minimum Idle Sequence Length | 22 | If PLOP in Effect is PLOP-1, this parameter specifies the length of the Idle Sequence to be used in CMM-4. | minimumIdleLength plopOneIdleSequenceLengthInteger (0 … 2040) or NULL |
| Forward Bit Lock Confirmation Required? | 23 | Specifies whether the CLCW will be used to confirm bit lock on the spacecraft. | bitLockConfirmationRequired clcwused clcwNotUsed |
| RF Availability Confirmation Required? | 24 | Specifies whether the CLCW will be used to determine the status of the receiver on the spacecraft. | rfAvailabilityConfirmationRequired clcwused clcwNotUsed |
| Reporting Channel Identifier(if CLCW is used) | 25 | Specifies the set of Master Channel IDs on the return signal that include the Virtual Channels that include the CLCWs that are needed by the provider to confirm bit lock. | reportingChannelIdIntegergVcId (0 … 1023) or mcId (0 … ?) |
| Maximum CLTU Length | 26 | Specifies the maximum length of the CLTU that will be sent from the user to the provider.  | maxLengthCltuUnsigned integer (octets) |
| CLTU Minimum Delay Time | 27 | Specifies the minimum delay allowed in the CLTU TRANSFER-DATA operation. This time determines the minimum idle sequence length. | minDelayTimeUnsigned integer (µs) |
| CLTU Protocol Abort Mode | 28 | Specifies how the CLTUs should be handled in the case of a protocol abort | protocolAbortMode flush continue |

### Return Space link parameters

The return space link parameters are listed in Table 3-3.

Compare with …..

| **Parameter** | **Service Catalog ID** | **Definition** | **Service Management Name, Type and Value** |
| --- | --- | --- | --- |
| Return RF Carrier Identifiers | N/A | Specifies the return carrier ID | r401SpaceLinkCarrierAgreementID |
| Return RF Carrier Frequency Range | 30 | This defines the RF Band to be used, (This defines the minimum and maximum frequencies allowed for the return carrier frequency, in Hz). | carrierFrequencyRange |
|  |  |  |  |
| Return RF Carrier Use | 32 | How the return carrier is to be applied i.e. remnant or suppressed | carrierUse remnant suppressed |
|  | Return RF Modulation Index Range | 33 | If Carrier Use is ‘remnant’, this parameter specifies the upper and lower bounds of the angle by which the RF carrier may be phase-shifted | modulationIndexRange lowerBound upperBound |
| Subcarrier required? |  | Specifies whether subcarrier is required, for TC, ranging or both | subCarrierOption- not required- TC only- ranging only- TC and ranging (concurrent)- TC and ranging (not concurrent) |
| Forward Ranging |  | Specifies the type of ranging required | rangingOption- PN- deltaDORetc. |
| Maximum DOR tone frequency |  | Specifies the maximum tone frequency when Delta DOR ranging is used | maximumDorTonePositive integer (Hz) |
| DeltaDOR Quasar List |  | References a document containing the list of quasars to be used for Delta DOR ranging | quasarListReferenceString256 |
| Return RF Carrier Modulation Options | 34 | Specifies the set of modulation types that may be applied to the return RF carrier | carrierModulationTypeOptions BPSK QPSK UQPSK OQPSK GMSK PCM/PM 8PSK unmodulated |
|  | Power Ratio Options | 35 | If Return RF Carrier Modulation is ‘UQPSK’, this parameter specifies the set of ratios between the power of the I-channel and the Q-channel. | powerRatioOptions (3, 4, 5, 6, 7, 8, 9, 10, 11, 12) |
| Phase Ambiguity Resolution (if OQPSK) |  | To be written | To be written |
| Return RF Subcarrier Frequency Range | 36 | The minimum and maximum frequencies allowed for the return subcarrier frequency, in Hz | subcarrierFrequencyRange minSubcarrierFrequency maxSubcarrierFrequency |
| Return RF Subcarrier Waveform Options | 37 | Whether the waveforms on the return subcarrier are sine or square | subcarrierWaveformOptions sine square |
| Return Symbol Rate Range | 38 | The minimum and maximum values for the symbol rates on the return symbol stream | symbolRateRange minSymbolRate maxSymbolRate |
| Return ‘EIRP’ | 39 | The minimum and maximum allowed values for the RF signal received by the ground station, calculated by the user from the spacecraft EIRP. | rMinEirprMaxEirp |
|  |  |  |  |
| Antenna Es/No |  | Specifies the range of antenna Es/No required for the mission. | rMinE/NrMaxE/N |
| Return RF Polarization Options | 40 | Specifies the polarization options available on the return link | rPolarizationOptions linearHorizontal linearVertical rcp lcp combined |
| Return PCM Format Options | 41 | Specifies the set of PCM waveforms that may be modulated onto the return RF carrier or subcarrier | pcmFormatOptions NRZ-L NRZ-M BiPhase-L BiPhase-M |
| Convolutional Coding Options | 42 | Specifies the types of convolutional coding options that may be used on the return link. | convolutionalCodingOptions notUsed rateOneHalf rateTwoThirds rateThreeQuarters rateFiveSixths rateSevenEighths |
| Channel Assignment Options | 43 | Specifies the combination of modulation type and channel used on the return link | channelAssignmentOptions bpskChannel qpskIChannelOnly qpskQChannelOnly qpskIChannelSeparate qpskQChannelSeparate qpskIInterleaved oqpskIChannelOnly oqpskQChannelOnly oqpskIChannelSeparate oqpskQChannelSeparate oqpskIInterleaved gmskChannel 8pskChannel pcmPmChannel pcmPskPmChannel |
| RAF Pseudo-randomization Used? | 44 | Specifies whether pseudo-randomization is used on a particular RAF channel | tlmRandomizationOptions tlmRandomizationUsed tlmRandomizationNotUsed |
| RAF and RCF range of transfer frame lengths | 45 | Specifies the maximum and minimum values for the length of the return transfer frames  | transferFrameLengthRange lowerBound upperBoundOctets (7 … 2048) |
| Non-standard Sync Word Length? |  | Specifies the length of the sync word if it is not CCSDS compliant (this can be accommodated by the CCSDS RAF and RCF services without any changes to the specifion) | Unsigned integer or NULL(NULL indicates that the sync word is CCSDS compliant)Octets (? to ?) |
| Reed-Solomon Error Correction Options | 46 | Specifies values for the error correction capability on the return link | eccOptionsInteger (8, 16) |
| Interleaving Options | 47 | Specifies the depths of interleave that may be used a particular RAF or RCF channel | interleaveOptionsInteger (1, 2, 3, 4, 5, 8) |
| Turbocode Options | 48 | Specifies the set of values for the turbocode rate on the return link | turboCodeRateOptions rateOneHalf rateOneThird rateOneFourth rateOneSixth |
|  | Information Block Length Options | 49 | Specifies the set of values for the Information Block on the return link (tied to turbocode option) | informationBlockLengthOptions (1784, 3568, 7136, 8920, 16384) |
| AOS or Packet TM? | N/A | This signifies whether the return link is AOS or packet TM.  | Enumerated- AOS- Packet TM |
|  | Packet TM Spacecraft ID | N/A | The Spacecraft Identifier (SCID) used in TM frames | ptScid |
|  | Packet TM Maximum Frame Rate | 50 | Specifies the maximum rate that MC Frames will be carried on a packet TM return link | maxMcFrameRate |
|  | Packet TM Virtual Channels  | N/A | Specifies the set of Virtual Channels on a packet TM return link (VCID and VC frame rate) | ptVirtualChannels maxVcFrameRate ptVcid |
|  | AOS Spacecraft ID | N/A | The Spacecraft Identifier (SCID) used in AOS frames | aosScid |
|  | AOS Maximum Frame Rate | 51 | Specifies the maximum rate that MC Frames will be carried on an AOS return link | maxAosFrameRate |
|  | AOS Virtual Channels  | N/A | Specifies the set of Virtual Channels on an AOS return link (VCID and VC frame rate) | aosVirtualChannels maxVcFrameRate aosVcid |

### Radiometric parameters

The radiometric parameters are listed in Table 3-5.

## SERVICE management OPeraTIONal constraintS

### Configuration Profile parameters

| **Parameter** | **Definition** | **Service Management Name, Type and Value** |
| --- | --- | --- |
| Allowed Bilateral Space link Carrier Profiles | Specifies values for bilateral space link carrier profiles, if applicable | allowedBilateralCarrierProfileFormatIdslist of String 256 or NULL |
| Allowed Bilateral Transfer Service Profiles | Specifies values for bilateral transfer service profiles, if applicable | allowedBilateralTransferServiceFormatIdslist of String 256 or NULL |
| Allowed Bilateral Space link Event Profiles | Specifies values for bilateral space link event profiles, if applicable | allowedBilateralSpaceLinkEventFormatIdslist of String 256 or NULL |
| Maximum number of Carrier Profile datasets  | Specifies the maximum allowed number of Carrier Profile datasets at any given time. | maxCarrierProfilesUnsigned integer |
| Maximum number of Transfer Service Profile datasets  | Specifies the maximum allowed number of Transfer Service datasets at any given time. | maxTransferServiceProfilesUnsigned integer |
| Maximum number of Space link Event Profile datasets | Specifies the maximum allowed number of Space link Event datasets at any given time. | maxSpaceLinkEventsProfilesUnsigned integer |
| Maximum lead time offset | Specifies the maximum allowed lead time offset that may be used in the Service Transfer Profile. | maxSiStartTimeOffsetLeadUnsigned integer (seconds) |
| Maximum lag time offset | Specifies the maximum allowed lag time offset that may be used in the Service Transfer Profile. | maxSiStopTimeOffsetLeadUnsigned integer (seconds) |

###

## SERVICE Monitoring and reporting Parameters

Service monitoring and reporting parameters will be defined in a future edition of this Recommended Standard, if and when the services are defined by CCSDS.

# OBTAINING sccS SERVICES

Figure 5‑1 provides an example of the interactions needed to obtain a SCCS service.

|  |  |
| --- | --- |
|  | 1. The mission queries the service catalogs of one or more service providers to determine which could support their mission in principle.
2. The mission draws up a shortlist of potential service providers with which to enter negotiations.
3. The user provides a mission scenario for the potential providers to see if they can support the user’s requirements.
4. On the basis of the information in “spacecraft contact plans” provided by each service provider, the user chooses the provider(s) with which to draw up one or more Service Agreements.
5. The service user and service provider create one or more Service Agreements.
6. Between the time the Service Agreement is created and the execution of Service Packages, the supported Agency or the supporting Agency may modify the agreement if necessary.
7. The Service Agreement ends once the mission no longer needs the service, or in exceptional cases, by other circumstances defined in the contract associated with the Service Agreement.
 |

Figure ‑ : Obtaining SCCS Services.

## Query SERVICE Catalog

A mission initially needs to discover the capabilities of the various Service Providers that might support the mission. This is achieved by reviewing the Service Catalogs maintained by the providers. Service Catalogs contain a list of the services supported and the technical characteristics of the facilities the Service Provider offers. Querying the Service Catalog would typically be performed by interacting with the latest version of the Service Catalog on the Service Provider’s website, followed up by e-mail or verbal clarifications, as required.

## NegOtIate SERVICE AVAILABILITY

Once the mission is satisfied that a Service Provider could, in principle, meet the mission requirements, they will need to establish whether the Service Provider’s complex will be available in the period that the Service User will need it, and to verify that the complex could meet the requirements of the mission scenario. This may be achieved by providing the preferred Service Provider with a mission scenario containing the provisional spacecraft communications and trajectory information, including link budgets for each phase of the mission. The Service Provider can then review the mission requirements and determine whether their complex can meet the spacecraft contact requirements. An output from this part of this process would be a “spacecraft contact plan” that summarizes contact opportunities, link budget considerations, physical limitations, and so on. Once it is established that the Service Provider could satisfy the mission requirements, the mission and Service Provider may proceed to the next stage, the creation of one or more Service Agreements for each phase of the mission. Negotiation of a Service Agreement occurs on the order of years in advance of the first support period provided to the mission.

## CREATE SERVICE AGREEMENT

Once the mission has determined that a Service Provider can support the mission, they will need to draw up a service agreement. The template for such an agreement is defined in this document. The process of creating the Service Agreement may be automated or manually intensive, but it is important that whatever method, or combination of methods is used, the information content is standardized.

The first step on the creation of a Service Agreement is the registration of the mission with the service provider. The information exchanged as part of registration process includes security and authentication credentials (including expiration dates and re-authentication criteria), points of contact, and general information about the mission. This will be followed by establishing the detailed characteristics of the spacecraft communications interface, and the bounds and constraints for SCCS-SM. This process may occur years before the intended mission support period, or within days of the require support in urgent cases.

In order to conduct the service agreement process efficiently, Agencies should follow the standard procedures described below:

1. Each service provider must specify
2. policies and conditions for providing cross support services
3. documents used for agreement and establishment of SCCS services, and
4. pricing information

The above information should be documented in the Service Catalog.

1. If the mission can meet the policies and conditions specified by the Service Provider, the mission submits necessary documents (for example, mission scenario, letter of intent, etc.) to request services to the Service Provider, based on which both Agencies conduct negotiations.
2. Both Agencies jointly generate documents specified by the ServiceProvider (for example, Memorandum of Agreement, etc.), which must be completed and signed off by the dates agreed upon by both Agencies.
3. The Agencies produce one or more Service Agreements.
4. Both Agencies must agree on the types of tests, if any, needed to verify the interfaces and conduct the tests according to the schedule agreed upon by both Agencies.

## MAINTAIN SERVICE AGREEMENT

Once the Service Agreement is created, it should be readily accessible to both the supported Agency and the supporting Agency. This provides a reference version of the Service Agreement against which future modifications may be made and against which the SCCS-SM parameters can be queried.

In any service relationship it is usually the Service Provider that maintains the master copy of a service agreement. Similarly, it is incumbent on the supporting Agency to maintain the reference copies of SCCS Service Agreements.

## MODIFY SERVICE AGREEMENT

The Service User and the Service Provider may need to renegotiate or refine the Service Agreement as the time for the execution of the service approaches. Changes may be made online or after negotiation between the Agencies, depending on the nature of the change.

## END SERVICE AGREEMENT

The Service Agreement will come to an end when all the services required by the mission have been supplied by the Service Provider. In addition, changes to the circumstances on either the mission or Service Provider side may require the Service Agreement to be ended early. For instance, the mission may fail prematurely or the Service Provider may no longer be able to provide the agreed services for some technical or financial reasons.

1. Security and SANA Considerations

(Informative)
	1. security Considerations with respect to the CCSDS document

Security concerns are handled within each of sections 4–7 as needed.

* 1. SANA Considerations with respect to the CCSDS document

No new SANA registries are created in this document. The use of existing SANA registries is referenced, as needed, in-line throughout the document.

1. Glossary

(Informative)

**To be edited**

**cross support**: An agreement between two or more organizations to exploit the technical capability of interoperability for mutual advantage, such as one organization offering support services to another in order to enhance or enable some aspect of a space mission.

**cross support service**: A function provided by one space agency to support operations of a space mission of another space agency.

**forward data**: Data sent from a ground element to a space element.

**interoperability**: A property of protocols or systems whereby elements adopt a commonly defined and implemented set of protocols, data, and behaviors.

**return data**: Data sent from a space element to a ground element.

**service management**: 1) The set of functions exposed by PM to utilization management for the purposes of acquiring and managing the services provided by the provider CSSS to the user CSSS. These functions include planning, scheduling, and managing the configuration of space communication service functions. 2) The specification for exchanging service management information.

**service provider**: The role played by a physical, functional, or organizational entity that provides a cross support service for a service user. (A single entity may simultaneously play the roles of service provider and service user.)

**service user**: The role played by a physical, functional, or organizational entity that uses a cross support service provided by a service provider. (A single entity may play the roles of service provider and service user at the same time.)

**space link**: A communications link between a spacecraft and its associated ground system or between two spacecraft. A space link consists of one or more physical channels in one or both directions.

**supported agency**: A space agency that uses cross support services.

**supporting agency**: A space agency that provides cross support services.

1. Acronyms

(Informative)

**To be edited**

AOS Advanced Orbiting Systems

CCSDS Consultative Committee for Space Data Systems

CFDP CCSDS File Delivery Protocol

CLCW Communications Link Control Wizard

CLTU Communication Link Transmission Unit

COP Communications Operations Procedure

CSRM Cross Support Reference Model

CSSE Cross Support Service Element

CSSS Cross Support Service System

CSTS Cross Support Transfer Services

CXFS Cross-Support File Service

DOR Differential One-way Range

EFCLTU Enhanced Forward Communication Link Transmission Unit

ENCAP Encapsulation (Packet Service)

EP Encapsulation Packet

ESLT Earth-Space Link Terminal

ESCCS-SM Extensible Space Communication Cross Support Service Management

F-CLTU Forward-Communication Link Transmission Unit

F-Frame Forward Frame

FOP Frame Operation Procedure

GSCID Global Spacecraft Identifier

I/F Interface

IOAG Interagency Operations Advisory Group

OCF Operational Control Field

PDU Protocol Data Unit

PLOP Physical Link Operations Procedure

PN pseudo-noise

RAF Return All Frames

RCF Return Channel Frames

RF Radio Frequency

S&F Store and Forward

SANA Space Assigned Numbers Authority

SAP Service Access Point

SCID Spacecraft Identifier

SCCS Space Communications Cross Support

SLE Space Link Extension

SM Service Management

SP Space Packet

SR Service Request

TBD to be determined

TC Telecommand (pertains to TC Space Data Link Protocol)

TM Telemetry (pertains to TM Space Data Link Protocol)

TT&C Telemetry, Tracking & Command

VC Virtual Channel

XML eXtensible Markup Language

1. Informative REferences

(Informative)

[D01] *Space Communications and Navigation (SCaN) Network Service Catalog Phase 2*. Revision 2, Washington, D.C., 17 June 2013.

NOTE – Normative references are found at section 0.