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The Consultative Committee for Space Data Systems

Recommendation for Space Data System Practices

SPACECRAFT ONBOARD INTERFACE SERVICES—DEVICE DATA POOLING SERVICE

RECOMMENDED PRACTICE

CCSDS 871.1-M-1

MAGENTA BOOK

November 2012

CCSDS HISTORICAL DOCUMENT

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FOREWORD

This document is a technical Recommended Practice for use in developing flight and ground systems for space missions and has been prepared by the Consultative Committee for Space Data Systems (CCSDS). The Device Data Pooling Service described herein is intended for missions that are cross-supported between Agencies of the CCSDS, in the framework of the Spacecraft Onboard Interface Services (SOIS) CCSDS area.

This Recommended Practice specifies a set of related services to be used by space missions to access pooled data acquired from devices over an onboard subnetwork. The SOIS Device Data Pooling Service provides a common service interface and quality of service regardless of the particular type of data link or protocol being used for communication.

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CCSDS 871.1-M-1	Spacecraft Onboard Interface Services—Device Data Pooling Service, Recommended Practice, Issue 1	November 2012	Original issue

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE OF THIS DOCUMENT

This document is one of a family of documents specifying Spacecraft Onboard Interface Services (SOIS)-compliant service to be provided to onboard applications.

The purpose of this document is to define the services and service interfaces provided by the SOIS Device Data Pooling Service (DDPS). Its scope is to specify the service only and not to specify methods of providing the service, although use of the SOIS subnetwork services is assumed.

This document conforms to the principles set out in the SOIS Green Book (reference [C2]) and is intended to be applied together with it.

1.2 APPLICABILITY

This document applies to any mission or equipment claiming to provide a SOIS-compatible Device Data Pooling Service.

1.3 RATIONALE

SOIS provides service interface specifications in order to promote interoperability and development reuse via peer-to-peer and vertical standardization.

1.4 DOCUMENT STRUCTURE

This document has four major sections and three annexes:

- this section, containing administrative information, definitions, and references;
- section 2, containing general concepts and assumptions;
- section 3, containing the Device Data Pooling Service specification;
- section 4, containing the Management Information Base (MIB) for this service;
- annex A, comprising the Service Conformance Statement Proforma;
- annex B, discussing security considerations;
- annex C, containing a list of informative references.

1.5 CONVENTIONS AND DEFINITIONS

1.5.1 DEFINITIONS

1.5.1.1 General

For the purpose of this document the following definitions apply.

1.5.1.2 Definitions from the Open Systems Interconnection Basic Reference Model

This document is defined using the style established by the Open Systems Interconnection (OSI) Basic Reference Model (reference [C1]). This model provides a common framework for the development of standards in the field of systems interconnection.

The following terms used in this Recommended Practice are adapted from definitions given in reference [C1]:

layer: Subdivision of the architecture, constituted by subsystems of the same rank.

service: Capability of a layer, and the layers beneath it (a service provider), provided to the service users at the boundary between the service providers and the service users.

1.6 TERMS DEFINED IN THIS RECOMMENDED PRACTICE

For the purposes of this Recommended Practice, the following definitions also apply.

acquisition: The act of acquiring a sample for an acquisition order.

acquisition order: Application-defined request to the service to acquire samples periodically and cache a history of them, so that the application can, on demand, acquire the samples from the service without having to access the devices directly.

application: Component of the onboard software that makes use of the Device Data Pooling service.

NOTE – Such components include flight software applications and higher-layer services.

data pool: Time-ordered cache of samples acquired for an acquisition order.

NOTE – A data pool is similar in concept to a database of the latest available data, or a bulletin board.

device: A real hardware component or a single register within such a component.

NOTE – Examples of such components are sensors and actuators.

device identifier: Abstract identification of a device.

NOTE – The format of a device identifier is implementation-specific.

sample: Set of data values acquired from different devices at the same time, in response to an acquisition order.

value: Formatted atomic unit of data that is acquired from a device.

timestamp: Time associated with a value.

NOTES

1 The format of a timestamp is implementation-specific.

2 The timestamp may indicate the time the value was generated by the device, emitted by the device, or acquired by the service. This is implementation-specific.

1.7 NOMENCLATURE

1.7.1 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.

1.7.2 INFORMATIVE TEXT

In the normative sections of this document (sections 3-4 and annex A), informative text is set off from the normative specifications either in notes or under one of the following subsection headings:

– Overview;

– Background;

– Rationale;

– Discussion.

1.8 REFERENCES

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

[1] *Spacecraft Onboard Interface Services—Device Access Service*. Draft Recommendation for Space Data System Practices, CCSDS 871.0-M-0. Draft Magenta Book. Issue 0. Washington, D.C.: CCSDS, November 2012.

[2] *Spacecraft Onboard Interface Services—Device Virtualization Service*. Draft Recommendation for Space Data System Practices, CCSDS 871.2-R-0. Red Book. Issue 0. Washington, D.C.: CCSDS, October 2012.

[3] *Spacecraft Onboard Interface Services—Subnetwork Synchronisation Service*. Recommendation for Space Data System Practices, CCSDS 853.0-M-1. Magenta Book. Issue 1. Washington, D.C.: CCSDS, December 2009.

NOTE – Informative references are contained in annex C.

2 OVERVIEW

2.1 FUNCTION

The Device Data Pooling Service (DDPS) provides a standard interface that enables onboard software (applications and high-level services) to access pooled data acquired from simple onboard hardware devices such as sensors and actuators, without explicitly requesting an acquisition from the real device.

2.2 CONTEXT

The Device Data Pooling Service is defined within the context of the overall SOIS architecture (reference [C2]) as one of the Command and Data Acquisition services of the Application Support Layer, as illustrated in figure 2-1.

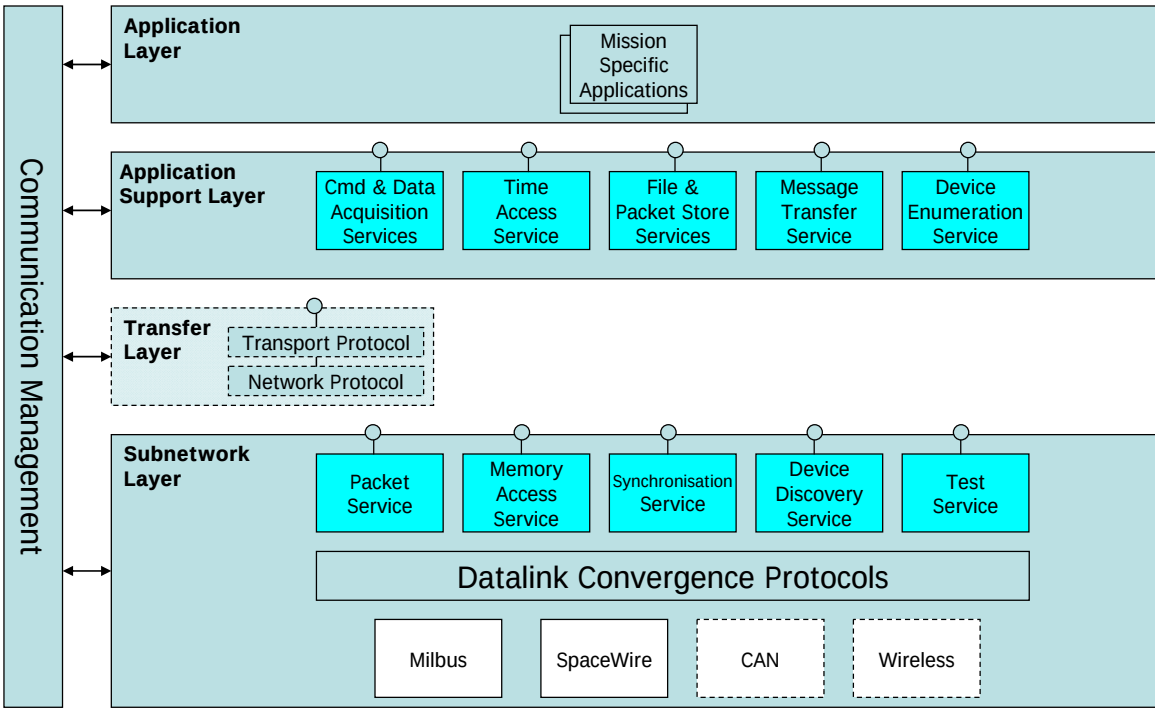

Figure 2-1: Device Data Pooling Service Context

The relationship of the DDPS to the other Command and Data Acquisition services is illustrated in figure 2-2.

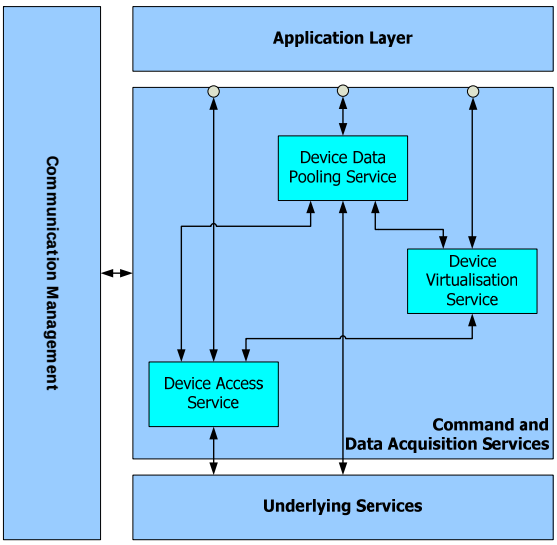

Figure 2-2: Relationship between SOIS Command and Data Acquisition Services

NOTE – The DDPS makes use of the Device Access Service (DAS) and/or the Device Virtualisation Service (DVS) to acquire data from Devices.

The DDPS provides a standard interface that enables onboard software (applications and high-level services) to access pooled data acquired from simple onboard hardware devices such as sensors and actuators, without explicitly requesting an acquisition from the real device.

The benefit of the service is that its use avoids multiple acquisitions from the same device when many applications require access to the same data, the result being reduced bandwidth from the device and probably reduced CPU load. In addition, the application is no longer concerned with the periodic acquisition process, the details of the location of the devices, their physical interfaces, or how they are accessed. As a result, configuration changes involving a change in the physical location of a device, or changes to its electrical interface; do not require changes to the application software using that device.

Although isolated from the details of device location and interface type, the application must still know the format of data read from the device, and the user remains responsible for correctly interpreting those formats.

2.2.1 DATA POOL AND SAMPLES

The basic concept underlying the service is that of a *data pool*. A data pool is a periodically acquired cache of samples of values acquired from a number of devices on the spacecraft. Applications are expected to be able to access samples from that pool, i.e., independently of the precise physical locations of the devices, without requiring detailed knowledge of the electrical interfaces to the devices, and without triggering immediate acquisitions from the devices. The data pool approach makes it easier to develop the onboard software, enables

configuration changes in the spacecraft design to be easily tolerated, and increases the re-use potential of the software.

The attributes of the pool are samples of values from real devices. Each *sample* is a set of values from a related set of devices, along with the acquisition time for that set of values. The acquisition interval for a *sample* is independent from all other samples in the pool. A short, application-defined ordered history of samples is held in the pool.

The relationship between the data pool, the samples, and the individual values read from devices is illustrated in figure 2-3.

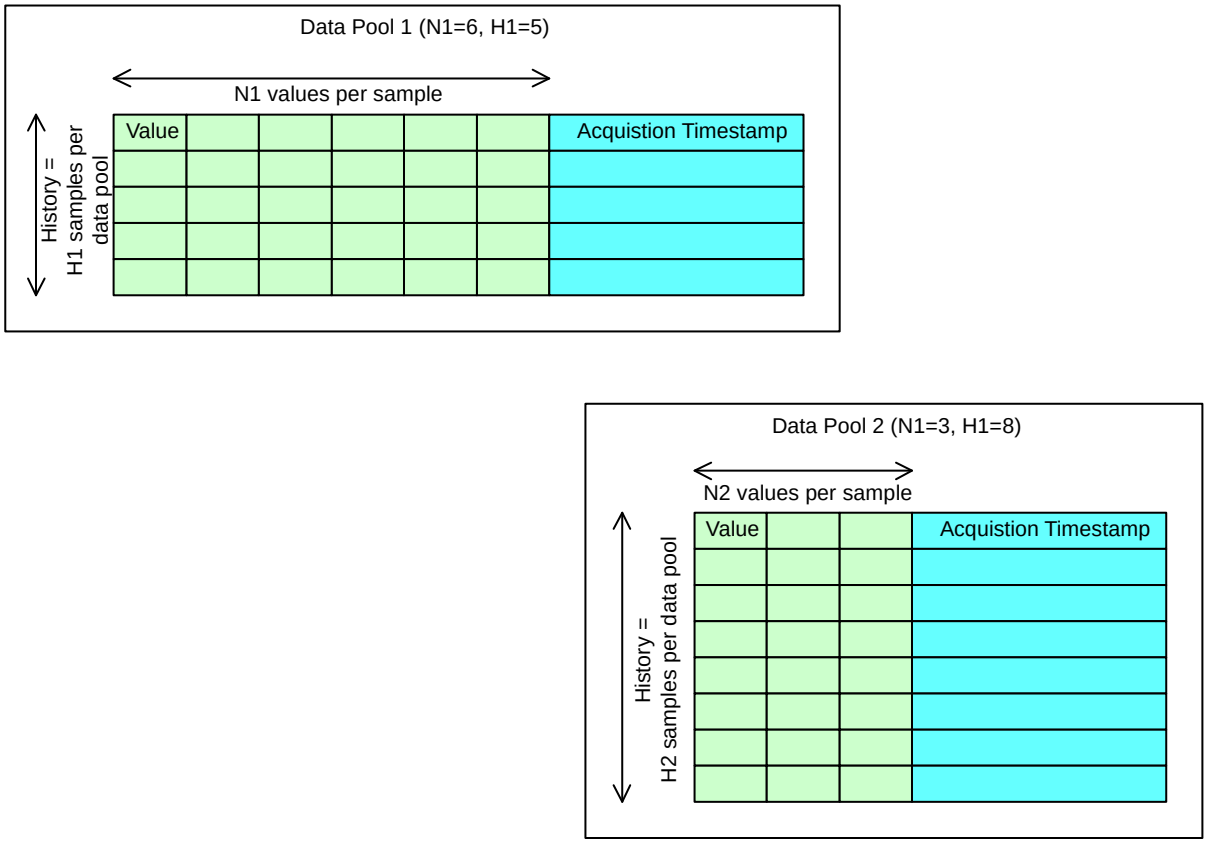

Figure 2-3: Data Pool Examples

NOTES

1 There are N values per sample and H samples in a data pool. These vary per data pool and are defined when the acquisition order is added by the user to the Device Data Pooling Service.

2 Validity metadata is also stored with each value acquired. This could be a simple flag indicating if the acquisition failed or the result metadata from the acquisition. When a sample of values is read by a user, the associated validity metadata for the values in the sample is also returned to the user.

To request the history of samples, an application provides to the service the logical identifier for the acquisition order and a history depth. The service then returns an indication to the application that contains a time-ordered list of samples, acquisition times, and results of the acquisitions.

2.2.2 SAMPLE ACQUISITION

Multiple acquisitions can be requested by different users on the same devices. The service implementation is responsible for optimizing the actual acquisitions performed to avoid over-sampling while still meeting all the users' requirements. The service uses either the Device Access Service (reference [1]) or the Device Virtualisation Service (reference [2]) to actually make the acquisition.

Upon making an acquisition and if requested by the user when the acquisition order was created, the service sends an indication to notify the application of the outcome of the acquisition; if the acquisition was successful, the notification indicates that a new sample is available for reading. The application can then immediately acquire the sample (thus being synchronized with the acquisition itself), defer the acquisition of the sample to a later time, or ignore the notification altogether. Therefore, there are three use cases for how the application obtains an acquired sample:

a) aperiodic acquisition of the history (or subset of the history) of the samples, i.e., immediate read of samples whenever the user wants;

b) periodic acquisition of the history (or subset of the history) of the samples synchronized with the acquisition period, i.e., read of the samples whenever an acquisition indication is received;

c) periodic acquisition of the history (or subset of the history) of the samples not synchronized with the acquisition period, i.e., read of the samples on a period not synchronized with the acquisitions.

NOTE – With the third case, there is no guarantee that the period of the acquisitions and the period of the user's reading of the samples will remain synchronized. It is an implementation issue if synchronization is maintained, e.g., by the use of a common clock source.

2.2.3 PRE-CONFIGURATION AND DYNAMIC CREATION OF ACQUISITION ORDERS

The service supports the offline pre-configuration of static acquisition orders, such that no dynamic adding, removing, starting, or stopping of acquisition orders is required. This is useful for simple, static systems. The logical identifiers for these acquisition orders may be well-known to both the service and the user entities or they may be obtained from the service's MIB.

Optionally, the acquisitions may be initiated on a demand-driven basis. Each user may make an *acquisition order*, which orders the sampling of values from a specified set of devices at a specified acquisition interval, with a specified history of samples maintained. To add an acquisition order for a set of devices, an application provides a set of logical identifiers for the devices and values, the service that should be used to acquire the values (Device Access Service or the Device Virtualisation Service), an acquisition interval, and a history size. The service assigns and returns to the application a logical identifier for that acquisition order so as to allow the application to manage the acquisition order and obtain the samples. For these dynamically created acquisition orders, the acquiring of samples can be started (at a defined first acquisition time), stopped, and removed by the application.

2.2.4 ACQUISITION SYNCHRONIZATION WITH UNDERLYING TRANSPORT SERVICES

Optionally, the service may wish to synchronize the acquisition of samples with the underlying transport services so as to avoid drift between the period of the service's acquisitions and any schedule maintained by the underlying transport services; e.g., it could be aligned with a MIL-STD-1553B bus schedule.

To achieve this, it is recommended that the acquisition be triggered using the underlying Subnetwork Synchronisation Service's TIME.indication (reference [3]).

Figure 2-4 illustrates the conceptual architecture of how the service interacts to achieve acquisitions synchronized to the underlying transport services. The procedure is as follows:

a) Based on the subnetwork schedule, the Subnetwork Synchronisation Service issues a TIME.indication, including the *time* parameter, to the service.

b) For each acquisition order, based on the order's next acquisition time relative to the received time parameter:

    1) the service issues an ACQUIRE_FROM_DEVICE.request to either the Device Access Service or the Device Virtualisation Service, which in turn uses the device-specific access protocol and associated underlying transport protocol to acquire the data from the device;

    2) upon receiving the acquired data from the device, the invoked acquisition service (the Device Access Service or the Device Virtualisation Service) issues an ACQUIRE_FROM_DEVICE.indication, including the *value, result metadata* and *timestamp* parameters, to the service;

    3) the service stores the value as a sample in the data pool and, if requested in the acquisition order, issues an ACQUISITION.indication to the user;

    4) the user may then read the sample from the data pool using the READ_SAMPLES.request.

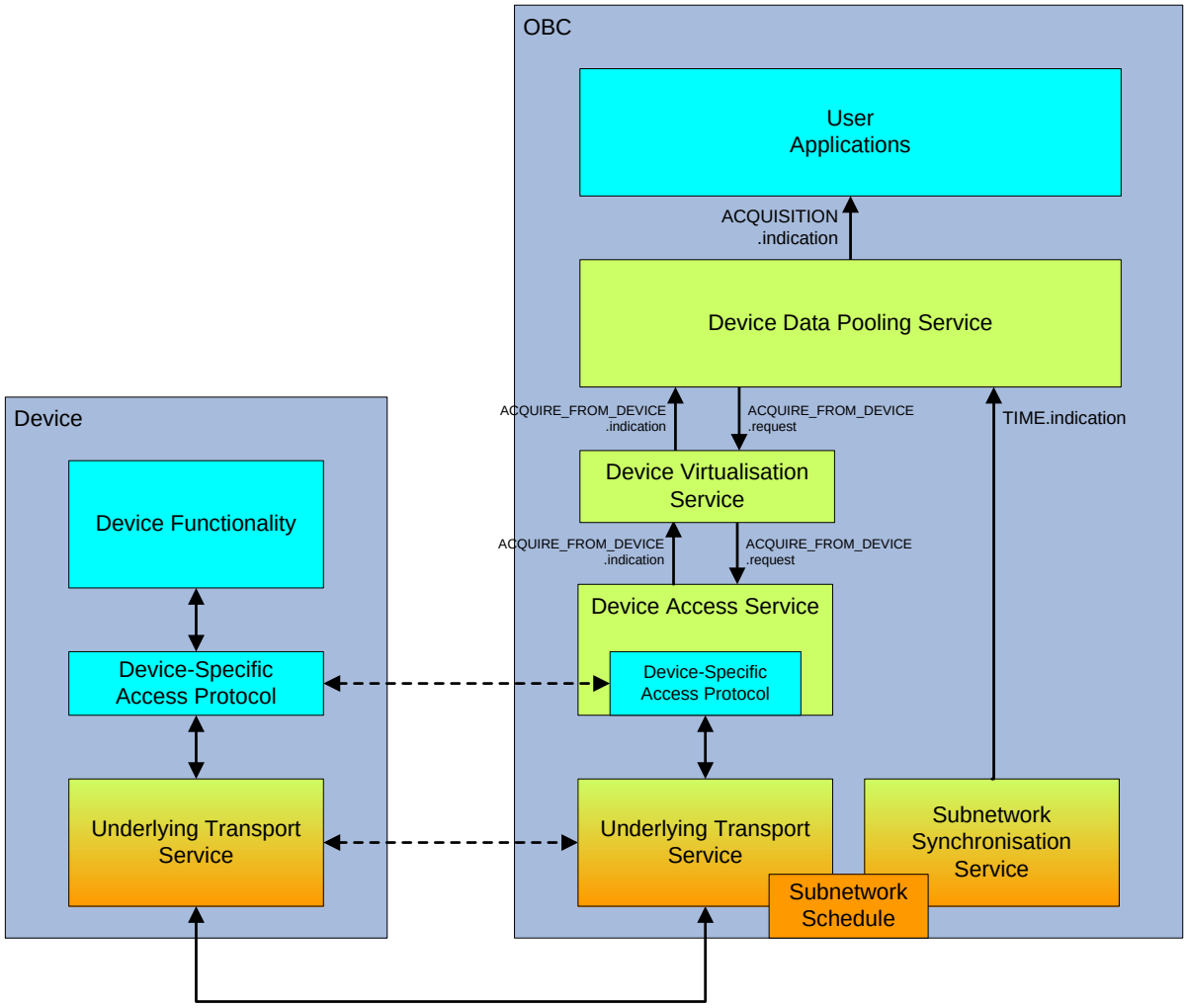

Figure 2-4: Conceptual Architecture for Synchronizing Acquisitions with Underlying Transport Services

2.3 PURPOSE AND OPERATION OF THE DEVICE DATA POOLING SERVICE

Applications invoke the DDPS to acquire periodically a sample of values from devices and then, as required, acquire the cached samples, rather than to acquire directly from the hardware itself.

From the application software perspective, use of the DDPS will result in applications that are more portable, that are easier to develop, and that can tolerate changes in the spacecraft hardware configuration. From the spacecraft platform implementers' perspective, use of the DDPS will make it easier to control the access to shared hardware resources.

The DDPS is operated using service requests and service indications passed between the service user and the service provider.

3 DEVICE DATA POOLING SERVICE

3.1 PROVIDED SERVICE

The Device Data Pooling Service shall provide the ability to maintain data pools, that is to say, a time-ordered cache of samples of values periodically acquired from devices, up to a user-defined maximum history size, as follows:

a) A user-specified history of samples can be read from the service, as specified in 3.4.11.

b) Optionally, new data pools can be added through the use of acquisition orders as specified in 3.4.2.

c) Optionally, old data pools can be removed through the use of acquisition orders removal as specified in 3.4.4.

d) Optionally, periodic acquisitions for the data pools can be started and stopped as specified in 3.4.6 and 3.4.8.

e) The period of the acquisition and the maximum history size are specified when the acquisition order is added, as specified in 3.4.2.

3.2 EXPECTED SERVICE FROM UNDERLYING LAYERS

3.2.1 The minimum expected service from the underlying layers shall be the ability to acquire a value from a device based on its device identifier and value identifier alone.

3.2.2 The mechanism by which the value is acquired should be transparent to the Device Data Pooling Service.

3.2.3 The service specified in 3.2.1 should be provided either by an implementation of the Device Access Service, as specified in reference [1], or an implementation of the Device Virtualisation Service, as specified in reference [2].

3.2.4 The set of valid device and value identifiers should be managed by the Device Access Service's Device and Value Identifier Resolution Table managed parameter (for the use of Device Access Service) and/or the Device Virtualisation Service's Device and Value Identifier Resolution Table managed parameter (for the use of Device Virtualisation Service).

3.2.5 Optionally, the underlying layers shall provide the ability to synchronize with the underlying layers.

3.2.6 The service specified in 3.2.5 should be provided by an implementation of the Subnetwork Synchronisation Service, as specified in reference [3].

3.3 SERVICE PARAMETERS

3.3.1 GENERAL

The Device Data Pooling Service shall use the parameters specified in 3.3.2 to 3.3.14.

3.3.2 TRANSACTION IDENTIFIER

3.3.2.1 The Transaction Identifier parameter shall be a value, assigned by the invoking user entity, which is subsequently used to associate indication primitives with the causal request primitives.

NOTE – The user entity is thus able to correlate all indications and confirmations with the originating service request.

3.3.2.2 The Transaction Identifier shall be unique within the user application entity.

3.3.3 RESULT METADATA

The Result Metadata parameter shall be used to provide information generated by the Device Data Pooling Service provider to the service invoking entity to provide information related to the successful or failed result of a device data pooling operation.

NOTE – The parameter can include information indicating failure conditions, e.g., the specified request could not be serviced within the managed timeout period or the Device Data Pooling Service is not functioning correctly.

3.3.4 DEVICE IDENTIFIER

The Device Identifier parameter shall be used to identify the device from which a value is to be acquired.

3.3.5 VALUE IDENTIFIER

The Value Identifier parameter shall be used to identify the data value to be acquired from the device.

3.3.6 SERVICE IDENTIFIER

The Service Identifier parameter shall be used to identify the source service for the acquisition. This shall either be the Device Access Service or the Device Virtualisation Service.

3.3.7 DEVICE VALUE LIST

3.3.7.1 The Device Value List parameter shall be used to identify the device values to be acquired. It shall consist of a list of Device Identifier (see 3.3.4), Value Identifier (see 3.3.5), and Service Identifier (see 3.3.6) tuples.

3.3.7.2 The Device Value List parameter shall contain no duplicate Device Identifier, Value Identifier, and Service Identifier tuples.

3.3.8 ACQUISITION INTERVAL

The Acquisition Interval parameter shall be used to request the time interval between successive acquisitions.

3.3.9 HISTORY SIZE

The History Size parameter shall be used to request the number of samples that are held in the data pool. The maximum the History Size parameter may be is defined by the Maximum History Size entry in the MIB (see 4.7).

3.3.10 ACQUISITION ORDER IDENTIFIER

The Acquisition Order Identifier parameter shall be used to identify an acquisition order.

3.3.11 FIRST ACQUISITION TIME

The First Acquisition Time parameter shall be used to request the absolute time at which the user wishes the first acquisition to take place.

3.3.12 READ HISTORY SIZE

The Read History Size shall be used to request the number of samples to be acquired from the data pool, starting with the most recently acquired sample and going back in time from that point.

3.3.13 SAMPLES

The Samples parameter shall provide a time-ordered set of samples, each with associated validity metadata and optionally an acquisition timestamp.

3.3.14 ASYNCHRONOUS ACQUISITION INDICATION FLAG

The Asynchronous Acquisition Indication Flag shall be used to request that an ACQUISITION.indication be issued each time an acquisition occurs, if the optional asynchronous acquisition indication function is implemented.

3.4 DEVICE DATA POOLING SERVICE PRIMITIVES

3.4.1 GENERAL

3.4.1.1 The Device Data Pooling Service interface shall provide the following primitives:

a) READ_SAMPLES.request, as specified in 3.4.11.

b) READ_SAMPLES.indication, as specified in 3.4.12.

3.4.1.2 The Device Data Pooling Service interface may provide the following primitives:

a) ADD_ACQUISITION_ORDER.request, as specified in 3.4.2.

b) ADD_ACQUISITION_ORDER.indication, as specified in 3.4.3.

c) REMOVE_ACQUISITION_ORDER.request, as specified in 3.4.4.

d) REMOVE_ACQUISITION_ORDER.indication, as specified in 3.4.5.

e) START_ACQUISITIONS.request, as specified in 3.4.6.

f) START_ACQUISITIONS.indication, as specified in 3.4.7.

g) STOP_ACQUISITIONS.request, as specified in 3.4.8.

h) STOP_ACQUISITIONS.indication, as specified in 3.4.9.

i) ACQUISITION.indication, as specified in 3.4.10.

3.4.2 ADD_ACQUISITION_ORDER.REQUEST

3.4.2.1 Function

The **ADD_ACQUISITION_ORDER.request** primitive shall be used to request that an order for the periodic acquisition of samples of values from a number of devices be added (but not enabled), resulting in the creation of a data pool.

3.4.2.2 Semantics

The **ADD_ACQUISITION_ORDER.request** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

ADD_ACQUISITION_ORDER.request (Transaction Identifier, Device Value List, Acquisition Interval, History Size, Asynchronous Acquisition Indication Flag (optional))

3.4.2.3 When generated

The **ADD_ACQUISITION_ORDER.request** primitive shall be passed to the SOIS Device Data Pooling Service provider to request the preparation of data pool for the periodic acquisition of samples.

3.4.2.4 Effect on Receipt

Receipt of the **ADD_ACQUISITION_ORDER.request** primitive shall cause the SOIS Device Data Pooling Service provider to establish a data pool with the required entries.

NOTE – Data acquisition will not be enabled until requested by the user entity through a START_ACQUISITIONS.request.

3.4.2.5 Additional comments

3.4.2.5.1 Multiple periodic acquisitions of the same value from a device may exist at the same time (in different acquisition orders). However, each acquisition order may only contain one instance of each value from a device. If over sampling is required, the period of the acquisition should be adjusted to achieve this.

NOTE – This primitive contains the set of device, value, and service identifiers; the acquisition interval; and the size of historical values to retain.

3.4.2.5.2 The device and value identifiers may consist of one or more pairs up to the maximum defined by the Maximum Device Values per Acquisition Order entry in the MIB (see 4.6).

3.4.3 ADD_ACQUISITION_ORDER.INDICATION

3.4.3.1 Function

The **ADD_ACQUISITION_ORDER.indication** primitive shall be used to pass the result of a ADD_ACQUISITION_ORDER.request to the user entity.

3.4.3.2 Semantics

The **ADD_ACQUISITION_ORDER.indication** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

ADD_ACQUISITION_ORDER.indication (Transaction Identifier, Result Metadata, Acquisition Order Identifier)

3.4.3.3 When generated

The **ADD_ACQUISITION_ORDER.indication** primitive shall be issued by the service provider to indicate the success or failure of a previous ADD_ACQUISITION_ORDER.request.

3.4.3.4 Effect on Receipt

The response of the user entity to an **ADD_ACQUISITION_ORDER.indication** primitive is unspecified.

3.4.3.5 Additional comments

None.

3.4.4 REMOVE_ACQUISITION_ORDER.REQUEST

3.4.4.1 Function

The **REMOVE_ACQUISITION_ORDER**.request primitive shall be used to request the removal of an existing acquisition order.

3.4.4.2 Semantics

The **REMOVE_ACQUISITION_ORDER.request** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

REMOVE_ACQUISITION_ORDER.request (Transaction Identifier, Acquisition Order Identifier)

3.4.4.3 When generated

The **REMOVE_ACQUISITION_ORDER.request** primitive shall be passed to the SOIS Device Data Pooling Service provider to request the removal of a previously established acquisition order.

3.4.4.4 Effect on receipt

Receipt of the **REMOVE_ACQUISITION_ORDER.request** primitive shall cause the SOIS Device Data Pooling Service provider to remove the previously established acquisition order.

3.4.4.5 Additional comments

An acquisition that has been started and not yet been stopped may not be removed.

3.4.5 REMOVE_ACQUISITION_ORDER.INDICATION

3.4.5.1 Function

The **REMOVE_ACQUISITION_ORDER.indication** primitive shall be used to pass the result of a previous request to remove and acquisition order.

3.4.5.2 Semantics

The **REMOVE_ACQUISITION_ORDER.indication** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

> **REMOVE_ACQUISITION_ORDER.indication** (Transaction Identifier, Result Metadata)

3.4.5.3 When Generated

The **REMOVE_ACQUISITION_ORDER.indication** primitive shall be issued by the service provider to indicate the success or failure of a previous REMOVE_ACQUISITION_ORDER.request.

3.4.5.4 Effect on Receipt

The response of the user entity to a **REMOVE_ACQUISITION_ORDER.indication** primitive is unspecified.

3.4.5.5 Additional comments

None.

3.4.6 START_ACQUISITIONS.REQUEST

3.4.6.1 Function

The **START_ACQUISITIONS.request** primitive shall be used to request that a periodic acquisition of samples for an acquisition order be started at a defined onboard time.

3.4.6.2 Semantics

The **START_ACQUISITIONS.request** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

> **START_ACQUISITIONS.request** (Transaction Identifier, Acquisition Order Identifier, First Acquisition Time)

3.4.6.3 When Generated

The **START_ACQUISITIONS.request** primitive shall be passed to the SOIS Device Data Pooling Service provider to request that the acquisition of samples for an acquisition order be started at a defined onboard time.

3.4.6.4 Effect on receipt

Receipt of the **START_ACQUISITIONS.request** primitive shall cause the SOIS Device Data Pooling Service provider to start the periodic acquisition of samples defined in a previous acquisition order at the defined onboard time.

3.4.6.5 Additional comments

None.

3.4.7 START_ACQUISITIONS.INDICATION

3.4.7.1 Function

The **START_ACQUISITIONS.indication** primitive shall be used to pass the result of a previous START_ACQUISITIONS.request to the user entity.

3.4.7.2 Semantics

The **START_ACQUISITIONS.indication** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

START_ACQUISITIONS.indication (Transaction Identifier, Result Metadata)

3.4.7.3 When Generated

The **START_ACQUISITIONS.indication** primitive shall be issued by the service provider to indicate the success or failure of a previous START_ACQUISITIONS.request.

3.4.7.4 Effect on receipt

The response of the user entity to a **START_ACQUISITIONS.indication** primitive is unspecified.

3.4.7.5 Additional comments

None.

3.4.8 STOP_ACQUISITIONS.REQUEST

3.4.8.1 Function

The **STOP_ACQUISITIONS.request** primitive shall be used to request that a periodic acquisition of samples be stopped.

3.4.8.2 Semantics

The **STOP_ACQUISITIONS.request** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

> **STOP_ACQUISITIONS.request** (Transaction Identifier, Acquisition Order Identifier)

3.4.8.3 When Generated

The **STOP_ACQUISITIONS.request** primitive shall be passed to the SOIS Device Data Pooling Service provider to request that a periodic acquisition of samples for an acquisition order be stopped immediately.

3.4.8.4 Effect on receipt

Receipt of the **STOP_ACQUISITIONS.request** primitive shall cause the SOIS Device Data Pooling Service provider to immediately stop the periodic acquisition of samples for the Acquisition order specified by the Acquisition Order Identifier parameter.

3.4.8.5 Additional comments

None.

3.4.9 STOP_ACQUISITIONS.INDICATION

3.4.9.1 Function

The **STOP_ACQUISITIONS.indication** primitive shall be used to pass the result of a STOP_ACQUISITIONS.request to the user entity.

3.4.9.2 Semantics

The **STOP_ACQUISITIONS.indication** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

STOP_ACQUISITIONS.indication (Transaction Identifier, Result Metadata)

3.4.9.3 When Generated

The **STOP_ACQUISITIONS.indication** primitive shall be issued by the service provider to indicate the success or failure of a previous STOP_ACQUISITIONS.request.

3.4.9.4 Effect on receipt

The response of the user entity to a **STOP_ACQUISITIONS.indication** primitive is unspecified.

3.4.9.5 Additional comments

None.

3.4.10 ACQUISITION.INDICATION

3.4.10.1 Function

The **ACQUISITION.indication** primitive shall be used to pass the result of an acquisition to the user.

3.4.10.2 Semantics

The **ACQUISITION.indication** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

> **ACQUISITION.indication** (Acquisition Order Identifier, Result Metadata)

3.4.10.3 When Generated

The **ACQUISITION.indication** primitive shall be issued by the service provider to indicate the results of an acquisition, the acquisition order for which requires that an asynchronous indication of an acquisition be issued.

3.4.10.4 Effect on receipt

The response of the user entity is unspecified.

3.4.10.5 Additional comments

None.

3.4.11 READ_SAMPLES.REQUEST

3.4.11.1 Function

The **READ_SAMPLES.request** primitive shall be used to request that a user-specified history of cached samples be returned.

3.4.11.2 Semantics

The **READ_SAMPLES.request** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

> **READ_SAMPLES.request** (Transaction Identifier, Acquisition Order Identifier, Read History Size)

3.4.11.3 When Generated

The **READ_SAMPLES.request** primitive shall be passed to the SOIS Device Data Pooling Service provider to request that a user-specified history of cached samples be acquired, starting with the most recently acquired sample.

3.4.11.4 Effect on receipt

Receipt of the **READ_SAMPLES.request** primitive shall cause the SOIS Device Data Pooling Service provider to return all cached samples for the specified Acquisition Order.

3.4.11.5 Additional comments

None.

3.4.12 READ_SAMPLES.INDICATION

3.4.12.1 Function

The **READ_SAMPLES.indication** primitive shall be used to pass the result of an acquisition to the user.

3.4.12.2 Semantics

The **READ_SAMPLES.indication** primitive shall use the following semantics, with the meaning of the parameters specified in 3.3.

READ_SAMPLES.**indication** (Transaction Identifier, Result Metadata, Samples)

3.4.12.3 When Generated

The **READ_SAMPLES**.**indication** primitive shall be issued by the service provider to indicate the results of previous READ_SAMPLES.request.

3.4.12.4 Effect on receipt

The response of the user entity to a **READ_SAMPLES.indication** primitive is unspecified.

3.4.12.5 Additional comments

None.

4 MANAGEMENT INFORMATION BASE

4.1 GENERAL

There is currently no Management Information Base associated with this service. All management items are associated with the implementation providing the service. However, guidance is provided as to MIB contents in 4.3.

4.2 SPECIFICATIONS

Any protocol claiming to provide this service in a SOIS-compliant manner shall publish its Management Information Base as part of the protocol specification.

4.3 MIB GUIDANCE

The MIB of the protocol providing the Device Data Pooling Service should consider the following aspects:

a) Acquisition Order Table, as specified in 4.4;

b) Acquisition Timing Accuracy, as specified in 4.5;

c) Maximum Device Values Per Acquisition Order; as specified in 4.6;

d) Maximum History Size, as specified in 4.7.

NOTE – These aspects are not in any way an indication of the complete contents of a MIB for a protocol providing the Device Data Pooling Service but are offered as guidance as to those aspects of the MIB which may relate to the Device Data Pooling Service interface.

4.4 ACQUISITION ORDER TABLE

4.4.1 The **Acquisition Order Table** shall contain a set of managed parameters that define the acquisition orders pre-configured for the service to perform.

4.4.2 Each entry shall contain the following elements:

a) Acquisition Order Identifier, as specified in 3.3.10;

b) Device Value List, as specified in 3.3.7;

c) History Size, as specified in 3.3.9;

d) Acquisition Interval, as specified in 3.3.8;

e) First Acquisition Time, as specified in 3.3.11;

4.4.3 Optionally, each entry may contain the following element:

Asynchronous Acquisition Indication Flag, as specified in 3.3.14.

4.4.4 Upon start-up, the service shall create and start acquisition orders for each entry in the Acquisition Order Table.

4.4.5 A service management entity should be able to access the Acquisition Order Table parameter.

4.5 ACQUISITION TIMING ACCURACY

4.5.1 The **Acquisition Timing Accuracy** parameter shall indicate how accurate after the requested time an acquisition request will take place.

NOTE – This parameter depends upon the stability of the local oscillator used in the local clock and efficiency of the implementation of the service and the alignment of the requested time with any schedule of the underlying transport service.

4.5.2 A service management entity should be able to access the Acquisition Timing Accuracy parameter.

4.6 MAXIMUM DEVICE VALUES PER ACQUISITION ORDER

4.6.1 The **Maximum Device Values per Acquisition Order** parameter shall indicate the maximum number of device identifier and value identifier pairs that make be in an acquisition order.

4.6.2 A service management entity should be able to access the Maximum Device Values per Acquisition Order parameter.

4.7 MAXIMUM HISTORY SIZE

4.7.1 The **Maximum History Size** parameter shall indicate the maximum sample history size that may be requested for an acquisition order.

4.7.2 A service management entity should be able to access the Maximum History Size parameter.

ANNEX A

DEVICE DATA POOLING SERVICE PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT PROFORMA

(NORMATIVE)

A1 INTRODUCTION

This section provides the Protocol Implementation Conformance Statement (PICS) Requirements List (PRL) for implementation of the Device Data Pooling Service, CCSDS 871.1-M-1, November 2012. The PICS for an implementation is generated by completing the PRL in accordance with the instructions below. An implementation shall satisfy the mandatory conformance requirements of the base standards referenced in the PRL.

The PRL in this section is blank. An implementation's complete PRL is called a PICS. The PICS states which capabilities and options of the services have been implemented. The following can use the PICS:

- The service implementer, as a checklist to reduce the risk of failure to conform to the standard through oversight;
- The supplier and acquirer 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 PICS proforma;
- The user or potential user of the implementation, as a basis for initially checking the possibility of interoperability with another implementation;
- A service tester, as a basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

A2 NOTATION

The following are used in the PRL to indicate the status of features:

Status Symbols

M	mandatory
O	optional

Support Column Symbols

The support of every item as claimed by the implementer is stated by entering the appropriate answer (Y, N or N/A) in the Support column:

Y	Yes, supported by the implementation
N	No, not supported by the implementation
N/A	Not applicable

A3 REFERENCED BASE STANDARDS

The base standards references in the PRL are:

– Device Data Pooling Service – this document.

A4 GENERATION INFORMATION

IDENTIFICATION OF PICS

Ref	Question	Response
1	Date of Statement (DD/MM/YYYY)	
2	PICS serial number	
3	System Conformance statement cross-reference	

A5 IDENTIFICATION OF IMPLEMENTATION UNDER TEST (IUT)

Ref	Question	Response
1	Implementation name	
2	Implementation version	
3	Special configuration	
4	Other information	

A6 IDENTIFICATION

Ref	Question	Response
1	Supplier	
2	Contact Point for Queries	
3	Implementation name(s) and Versions	
4	Other information necessary for full identification, e.g. name(s) and version(s) for machines and/or operating systems: System Name(s)	

A7 SERVICE SUMMARY

Ref	Question	Response
1	Service Version	
2	Addenda implemented	
3	Amendments implemented	
4	Have any exceptions been required? (Note: a YES answer means that the implementation does not conform to the service. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming.	Yes _____ No

A8 INSTRUCTIONS FOR COMPLETING THE PRL

An implementer shows the extent of compliance to the protocol by completing the PRL; that is, compliance to all mandatory requirements and the options that are not supported are shown. The resulting completed PRL is called a PICS. In the Support column, each response shall be selected either from the indicated set of responses or it shall comprise one or more parameter values as requested. If a conditional requirement is inappropriate, N/A shall be used. If a mandatory requirement is not satisfied, exception information must be supplied by

entering a reference X*i*, where *i* is a unique identifier, to an accompanying rationale for the non-compliance.

A9 GENERAL/MAJOR CAPABILITIES

Item	Service Feature	Reference (Magenta Book)	Status	Support
	READ_SAMPLES.request	3.4.11	M	
	READ_SAMPLES.indication	3.4.12	M	
	ADD_ACQUISITION_ORDER.request	3.4.2	O	
	ADD_ACQUISITION_ORDER.indication	3.4.3	O	
	REMOVE_ACQUISITION_ORDER.request	3.4.4	O	
	REMOVE_ACQUISITION_ORDER.indication	3.4.5	O	
	START_ACQUISITIONS.request	3.4.6	O	
	START_ACQUISITIONS.indication	3.4.7	O	
	STOP_ACQUISITIONS.request	3.4.8	O	
	STOP_ACQUISITIONS.indication	3.4.9	O	
	ACQUISITION.indication	3.4.10	O	
	Asynchronous Acquisition Indication Flag parameter	3.3.14	O	

A10 UNDERLYING LAYERS PROVIDING SERVICES TO IMPLEMENTATION

This section provides identification of the Underlying Layers providing Services to the implementation.

Service Feature	Reference	Status	Support
Device Access Service	3.2.a)	O	
Device Virtualisation Service	3.2.a)	O	

ANNEX B

SECURITY CONSIDERATIONS

(INFORMATIVE)

B1 SECURITY BACKGROUND

The SOIS services are intended for use with protocols that operate solely within the confines of an onboard subnet. It is therefore assumed that SOIS services operate in an isolated environment which is protected from external threats. Any external communication is assumed to be protected by services associated with the relevant space-link protocols. The specification of such security services is out of scope of this document.

B2 SECURITY CONCERNS

At the time of writing there are no identified security concerns. If confidentiality of data is required within a spacecraft it is assumed it is applied at the Application layer. For more information regarding the choice of service and where it can be implemented)see reference [C3]).

B3 POTENTIAL THREATS AND ATTACK SCENARIOS

Potential threats and attack scenarios typically derive from external communication and are therefore not the direct concern of the SOIS services, which make the assumption that the services operate within a safe and secure environment. It is assumed that all applications executing within the spacecraft have been thoroughly tested and cleared for use by the mission implementer. Confidentiality of applications can be provided by Application layer mechanisms or by specific implementation methods such as time and space partitioning. Such methods are outside the scope of SOIS.

B4 CONSEQUENCES OF NOT APPLYING SECURITY

The security services are out of scope of this document and are expected to be applied at layers above or below those specified in this document. If confidentiality is not implemented, science data or other parameters transmitted within the spacecraft might be visible to other applications resident within the spacecraft resulting in disclosure of sensitive or private information.

ANNEX C

INFORMATIVE REFERENCES

(INFORMATIVE)

[C1] *Information Technology—Open Systems Interconnection—Basic Reference Model: The Basic Model*. International Standard, ISO/IEC 7498-1:1994. 2nd ed. Geneva: ISO, 1994.

[C2] *Spacecraft Onboard Interface Services*. Report Concerning Space Data System Standards, CCSDS 850.0-G-1. Green Book. Issue 1. Washington, D.C.: CCSDS, June 2007.

[C3] *The Application of CCSDS Protocols to Secure Systems*. Report Concerning Space Data System Standards, CCSDS 350.0-G-2. Green Book. Issue 2. Washington, D.C.: CCSDS, January 2006.

NOTE – Normative references are listed in 1.8.

ANNEX D

ABBREVIATIONS AND ACRONYMS

(INFORMATIVE)

DAS	Device Access Service
DDPS	Device Data Pooling Service
DVS	Device Virtualisation Service
MIB	Management Information Base
MSB	Most Significant Bit
OSI	Open Systems Interconnection
SOIS	Spacecraft Onboard Interface Services