



The Consultative Committee for Space Data Systems

---

**Draft Recommendation for  
Space Data System Standards**

**SPACECRAFT ONBOARD  
INTERFACE SERVICES—  
SUBNETWORK TIME  
DISTRIBUTION SERVICE**

**PROPOSED DRAFT RECOMMENDED STANDARD**

**CCSDS 853.0-R-0**

**PROPOSED RED BOOK**

**March 2007**

## AUTHORITY

Issue:	Proposed Red Book, Issue 0
Date:	March 2007
Location:	Not Applicable

**(WHEN THIS RECOMMENDED STANDARD IS FINALIZED, IT WILL CONTAIN THE FOLLOWING STATEMENT OF AUTHORITY:)**

This document has been approved for publication by the Management Council of the Consultative Committee for Space Data Systems (CCSDS) and represents the consensus technical agreement of the participating CCSDS Member Agencies. The procedure for review and authorization of CCSDS documents is detailed in the *Procedures Manual for the Consultative Committee for Space Data Systems*, and the record of Agency participation in the authorization of this document can be obtained from the CCSDS Secretariat at the address below.

This document is published and maintained by:

CCSDS Secretariat  
Office of Space Communication (Code M-3)  
National Aeronautics and Space Administration  
Washington, DC 20546, USA

## STATEMENT OF INTENT

### (WHEN THIS RECOMMENDED STANDARD IS FINALIZED, IT WILL CONTAIN THE FOLLOWING STATEMENT OF INTENT:)

The Consultative Committee for Space Data Systems (CCSDS) is an organization officially established by the management of its members. The Committee meets periodically to address data systems problems that are common to all participants, and to formulate sound technical solutions to these problems. Inasmuch as participation in the CCSDS is completely voluntary, the results of Committee actions are termed **Recommended Standards** and are not considered binding on any Agency.

This **Recommended Standard** is issued by, and represents the consensus of, the CCSDS members. Endorsement of this **Recommendation** is entirely voluntary. Endorsement, however, indicates the following understandings:

- o Whenever a member establishes a CCSDS-related **standard**, this **standard** will be in accord with the relevant **Recommended Standard**. Establishing such a **standard** does not preclude other provisions which a member may develop.
- o Whenever a member establishes a CCSDS-related **standard**, that member will provide other CCSDS members with the following information:
  - The **standard** itself.
  - The anticipated date of initial operational capability.
  - The anticipated duration of operational service.
- o Specific service arrangements shall be made via memoranda of agreement. Neither this **Recommended Standard** nor any ensuing **standard** is a substitute for a memorandum of agreement.

No later than five years from its date of issuance, this **Recommended Standard** will be reviewed by the CCSDS to determine whether it should: (1) remain in effect without change; (2) be changed to reflect the impact of new technologies, new requirements, or new directions; or (3) be retired or cancelled.

In those instances when a new version of a **Recommended Standard** is issued, existing CCSDS-related member standards and implementations are not negated or deemed to be non-CCSDS compatible. It is the responsibility of each member to determine when such standards or implementations are to be modified. Each member is, however, strongly encouraged to direct planning for its new standards and implementations towards the later version of the Recommended Standard.

## FOREWORD

### (WHEN THIS RECOMMENDED STANDARD IS FINALIZED, IT WILL CONTAIN THE FOLLOWING FOREWORD:)

This document is a technical **Recommended Standard** 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 *Subnetwork Time Distribution 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 Standard** specifies a service to be used by space missions to maintain knowledge of time. The SOIS Subnetwork Time Distribution Service provides a common service interface regardless of the particular type of data link being used for communication.

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This Recommended Standard is therefore subject to CCSDS document management and change control procedures, which are defined in the *Procedures Manual for the Consultative Committee for Space Data Systems*. Current versions of CCSDS documents are maintained at the CCSDS Web site:

<http://www.ccsds.org/>

Questions relating to the contents or status of this document should be addressed to the CCSDS Secretariat at the address indicated on page i.

At time of publication, the active Member and Observer Agencies of the CCSDS were:

Member Agencies

- Agenzia Spaziale Italiana (ASI)/Italy.
- British National Space Centre (BNSC)/United Kingdom.
- Canadian Space Agency (CSA)/Canada.
- Centre National d'Etudes Spatiales (CNES)/France.
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/Germany.
- European Space Agency (ESA)/Europe.
- Federal Space Agency (Roskosmos)/Russian Federation.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- Japan Aerospace Exploration Agency (JAXA)/Japan.
- National Aeronautics and Space Administration (NASA)/USA.

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSPPO)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- Centro Tecnico Aeroespacial (CTA)/Brazil.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- Danish Space Research Institute (DSRI)/Denmark.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Hellenic National Space Committee (HNSC)/Greece.
- Indian Space Research Organization (ISRO)/India.
- Institute of Space Research (IKI)/Russian Federation.
- KFKI Research Institute for Particle & Nuclear Physics (KFKI)/Hungary.
- Korea Aerospace Research Institute (KARI)/Korea.
- MIKOMTEK: CSIR (CSIR)/Republic of South Africa.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- National Oceanic & Atmospheric Administration (NOAA)/USA.
- National Space Organization (NSPO)/Taipei.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

## PREFACE

This document is a draft CCSDS Recommended Standard. Its 'Red Book' status indicates that the CCSDS believes the document to be technically mature and has released it for formal review by appropriate technical organizations. As such, its technical contents are not stable, and several iterations of it may occur in response to comments received during the review process.

Implementers are cautioned **not** to fabricate any final equipment in accordance with this document's technical content.

## DOCUMENT CONTROL

Document	Title	Date	Status
CCSDS 853.0-R-0	Spacecraft Onboard Interface Services—Subnetwork Time Distribution Service, Proposed Draft Recommended Standard, Issue 0	March 2007	Current draft

## CONTENTS

<u>Section</u>	<u>Page</u>
<b>1 INTRODUCTION.....</b>	<b>1-1</b>
1.1 PURPOSE AND SCOPE OF THIS DOCUMENT .....	1-1
1.2 APPLICABILITY .....	1-1
1.3 RATIONALE.....	1-1
1.4 DOCUMENT STRUCTURE .....	1-1
1.5 CONVENTIONS AND DEFINITIONS.....	1-1
1.6 HOW THIS DOCUMENT FITS INTO THE SOIS DOCUMENTATION TREE	1-3
1.7 DOCUMENT NOMENCLATURE.....	1-3
1.8 REFERENCES .....	1-3
<b>2 OVERVIEW .....</b>	<b>2-1</b>
2.1 FUNCTION .....	2-1
2.2 CONTEXT.....	2-1
2.3 ASSUMPTIONS.....	2-2
2.4 QUALITY OF SERVICE.....	2-2
<b>3 SUBNETWORK TIME DISTRIBUTION SERVICE.....</b>	<b>3-1</b>
3.1 SERVICE PARAMETERS .....	3-1
3.2 TIME DISTRIBUTION SERVICE PRIMITIVES.....	3-1
<b>4 MANAGEMENT INFORMATION BASE .....</b>	<b>4-1</b>
<b>5 SERVICE CONFORMANCE STATEMENT PROFORMA.....</b>	<b>5-1</b>
<b>ANNEX A INFORMATIVE REFERENCES .....</b>	<b>A-1</b>

### Figure

2-1 Subnetwork Time Distribution Service Context.....	2-1
---	-----

# **1 INTRODUCTION**

## **1.1 PURPOSE AND SCOPE OF THIS DOCUMENT**

This document comprises an output of the Spacecraft Onboard Interface Services (SOIS) Area of the Consultative Committee for Space Data Systems. It is one of a family of documents specifying the SOIS-compliant services to be provided by onboard subnetworks.

The purpose of this document is to define services and service interfaces provided by the SOIS Subnetwork Time Distribution Service. Its scope is to specify the service only and not to specify methods of providing the service over a variety of onboard data links.

## **1.2 APPLICABILITY**

This document applies to any mission or equipment claiming to provide a CCSDS SOIS-compliant Subnetwork Time Distribution Service.

## **1.3 RATIONALE**

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

## **1.4 DOCUMENT STRUCTURE**

The document has five major sections:

- this section, containing administrative information, definitions and references;
- section 2, describing general concepts and assumptions;
- section 3, containing the Subnetwork Time Distribution Service specification;
- section 4, containing the Management Information Base (MIB) for the service;
- section 5, comprising a Service Conformance Statement Proforma.

In addition, annex A contains informative references.

## **1.5 CONVENTIONS AND DEFINITIONS**

### **1.5.1 BIT NUMBERING CONVENTION AND NOMENCLATURE**

In accordance with modern data communications practice, spacecraft data fields are often grouped into eight-bit ‘words’ widely known as bytes. Throughout this Recommended Standard, such an eight-bit word is called an ‘octet’. The numbering for octets within a data structure starts with zero.

By CCSDS convention, any ‘spare’ bits shall be permanently set to ‘0’.

## 1.5.2 DEFINITIONS

### 1.5.2.1 General

Within the context of this document the following definitions apply.

### 1.5.2.2 Definitions from the Open Systems Interconnection (OSI) Basic Reference Model

This document is defined using the style established by the Open Systems Interconnection (OSI) Basic Reference Model (reference [1]). This model provides a common framework for the development of standards in the field of systems interconnection.

The following terms, used in this Recommended Standard, are adapted from definitions given in reference [2]:

**Layer:** A subdivision of the architecture, constituted by subsystems of the same rank.

**Protocol Data Unit (PDU):** A unit of data specified in a protocol and consisting of protocol-control information and possibly user data.

**Service:** A capability of a layer (service provider) together with the layers beneath it, which is provided to the service users.

**Service Data Unit (SDU):** An amount of information whose identity is preserved when transferred between peer entities in a given layer and which is not interpreted by the supporting entities in that layer.

### 1.5.2.3 Terms Defined in this Recommended Standard

For the purposes of this Recommended Standard, the following definitions also apply. Many other terms that pertain to specific items are defined in the appropriate sections.

**Channel:** An identifier for network resources associated with a resource reservation. May be a list of time slots in a time division multiplexed system or a bandwidth limit in a bandwidth division multiplexed system. The subnetwork resources required for the communication may also be defined to allow simultaneous use of non-conflicting resources on subnetworks that support this feature.

**Octet:** An eight-bit word commonly referred to as a byte.

**Priority:** The transmit precedence of an SDU relative to other SDUs.

**QoS:** See Quality of Service.

**Quality of Service (QoS):** The level of service that is requested/provided. This is the concatenation of service class, priority and resource reserved channel.

**SOIS Subnetwork Layer Service Data Unit:** The user data provided to SOIS Subnetwork Layer for sending over the data link/subnetwork using the SOIS subnetwork layer service.

**SDU:** Service Data Unit.

**Service Access Point (SAP):** Within the subnetwork, a SOIS Subnetwork Service Access Point. As a minimum it locates a data system and a subnetwork user entity within that data system.

## 1.6 HOW THIS DOCUMENT FITS INTO THE SOIS DOCUMENTATION TREE

This document conforms to the principles set out in reference [A1] and should not be applied without first consulting reference [A1]. The protocols which provide this service are to be documented for individual links, and this may be in the purview of individual missions, agencies or of CCSDS depending on future circumstance.

## 1.7 DOCUMENT NOMENCLATURE

The following conventions apply throughout 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.

## 1.8 REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of this Recommended Standard. At the time of publication, the editions indicated were valid. All documents are subject to revision, and users of this Recommended Standard 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 Recommended Standards.

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

- [2] *Information Technology—Open Systems Interconnection—Basic Reference Model—Conventions for the Definition of OSI Services*. International Standard, ISO/IEC 10731:1994. Geneva: ISO, 1994.

NOTE — Informative references are contained in annex A.

## 2 OVERVIEW

### 2.1 FUNCTION

The SOIS Subnetwork Time Distribution Service provides a means for a user entity to maintain knowledge of time which is common to all data systems on the subnetwork.

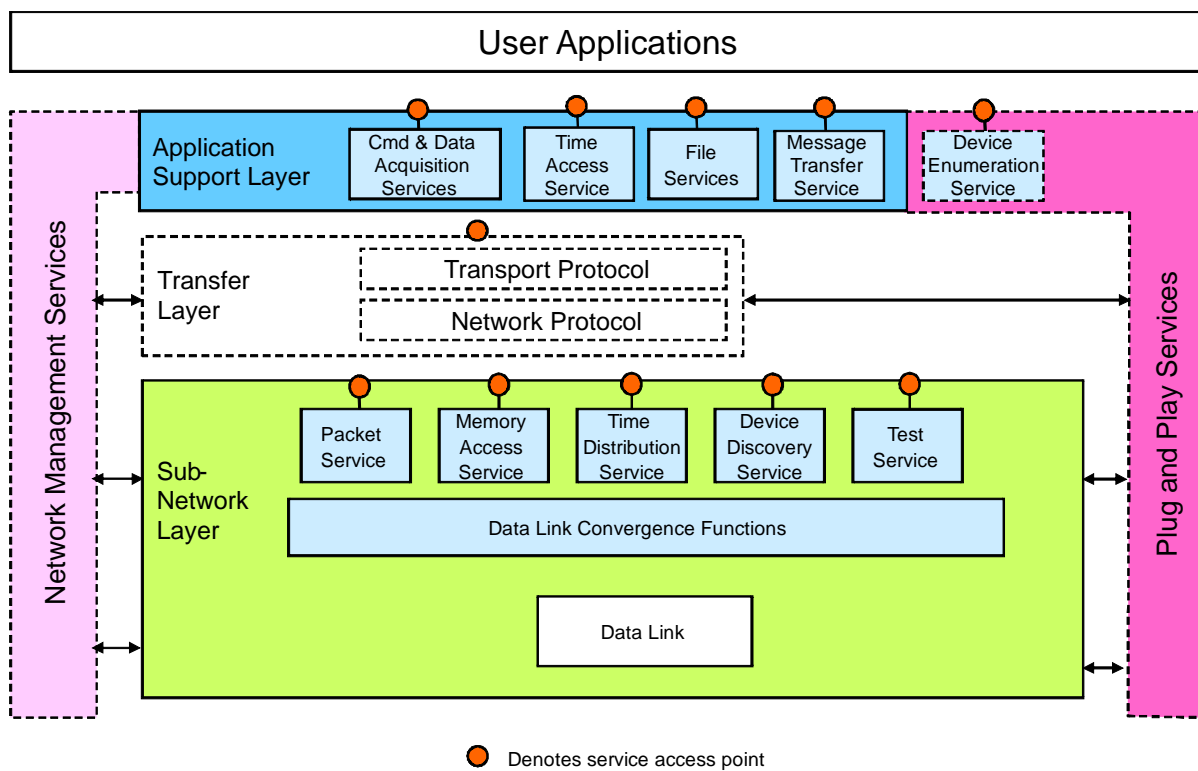
### 2.2 CONTEXT

The SOIS Subnetwork Layer provides the Time Distribution Service to user applications. The service may be provided over a variety of data links and the method of such provision is not in the scope of this document.

As shown in figure 2-1, the service is one of a number of services which may be provided by the SOIS Subnetwork.

The Subnetwork Time Distribution Service makes use of the data link to transfer data and control information. A variety of data links may be suited to provision of the service and the strategy for such service provision is outlined in reference [A1].

The Time Distribution Service is invoked by a consumer subnetwork user entity wishing to receive time data. The time data is provided by producer subnetwork user entity. Once the service is invoked it is expected that the producer entity will continuously supply time data to the consumer.



**Figure 2-1: Subnetwork Time Distribution Service Context**

## **2.3 ASSUMPTIONS**

The following assumptions have been made in designing the SOIS Subnetwork Time Distribution Service:

- The SOIS Subnetwork Time Distribution Service is provided across single subnetworks.
- The SOIS Subnetwork Time Distribution Service is made available to protocol entities in the application support layer.

## **2.4 QUALITY OF SERVICE**

Invocation of the Time Distribution Service operates with a best-effort Quality of Service. The service consumer should request the service until time data begins to be delivered. The time data should be delivered with best effort and with bounded latency. The bounded latency should be achieved via data link-specific mechanisms such as resource reservation, system analysis, or via the use of a dedicated timing bus. The quality of the bounded latency will depend on the mechanisms available.

### **3 SUBNETWORK TIME DISTRIBUTION SERVICE**

#### **3.1 SERVICE PARAMETERS**

The parameters of the Subnetwork Time Distribution Service are defined below:

##### **Source Subnetwork Service Access Point (SSNSAP)**

The SSNSAP identifies the SAP that identifies the consumer user entity that wishes to receive time data.

##### **Destination Subnetwork Service Access Point (DSNSAP)**

The SSNSAP identifies the SAP that locates the producer user entity that produces time data.

##### **Time**

The time parameter is an estimate of the time at the instance of the TIME.indication primitive.

#### **3.2 TIME DISTRIBUTION SERVICE PRIMITIVES**

##### **3.2.1 GENERAL**

In this subsection the service primitives for the SOIS Subnetwork Time Distribution Service are presented.

There are four primitives used by this service:

- TIME\_DISTRIBUTION.request, by which the time consumer requests time data;
- TIME\_DISTRIBUTION.indication which informs the time producer of the time distribution request;
- TIME.request by which the time producer requests time to be sent to the consumer;
- TIME.indication which delivers time data to the consumer.

## **3.2.2 TIME\_DISTRIBUTION.REQUEST**

### **3.2.2.1 Function**

The **TIME\_DISTRIBUTION.request** primitive requests the service to retrieve time from the SOIS Subnetwork Time Service provider.

### **3.2.2.2 Semantics**

**TIME\_DISTRIBUTION.request** (SSNSAP, DSNSAP)

### **3.2.2.3 When Generated**

The **TIME\_DISTRIBUTION.request** primitive shall be passed to the SOIS Subnetwork Time Distribution Service provider to request that time be retrieved.

### **3.2.2.4 Effect on Receipt**

Receipt of the **TIME\_DISTRIBUTION.request** primitive shall cause the SOIS Subnetwork service provider to retrieve the time.

### **3.2.2.5 Additional Comments**

SSNSAP identifies the invoking user entity. In order to maintain time coherence within a data system, there should be only one consuming user entity within that data system.

### **3.2.3 TIME\_DISTRIBUTION.INDICATION**

#### **3.2.3.1 Function**

The **TIME\_DISTRIBUTION.indication** is used to pass the request for time data to the time producer user entity.

#### **3.2.3.2 Semantics**

**TIME\_DISTRIBUTION.indication** (SSNSAP, DSNSAP)

#### **3.2.3.3 When Generated**

This primitive is issued by the service provider to the receiving user entity on receipt of a PDU originated by a TIME.request primitive.

#### **3.2.3.4 Effect on Receipt**

The response of the user entity to a **TIME\_DISTRIBUTION.indication** primitive should be to issue **TIME.indication** primitive(s).

#### **3.2.3.5 Additional Comments**

SSNSAP identifies the consumer user entity.

DSNSAP identifies the producer user entity.

### **3.2.4 TIME.REQUEST**

#### **3.2.4.1 Function**

The **TIME.request** primitive requests the service to send time to the SOIS Subnetwork Time Service consumer user entity.

#### **3.2.4.2 Semantics**

**TIME.request** (SSNSAP, DSNSAP, Time)

#### **3.2.4.3 When Generated**

The **TIME.request** primitive shall be passed to the SOIS Subnetwork Time Distribution Service provider to request that time be sent.

#### **3.2.4.4 Effect on Receipt**

Receipt of the **TIME.request** primitive shall cause the SOIS Subnetwork service provider to send time.

#### **3.2.4.5 Additional Comments**

SSNSAP identifies the provider user entity.

DSNSAP identifies the consumer user entity.

Time is the time data.

### **3.2.5 TIME.INDICATION**

#### **3.2.5.1 Function**

The **TIME.indication** is used to pass time data to the consumer user entity.

#### **3.2.5.2 Semantics**

**TIME.indication** (SSNSAP, DSNSAP, Time)

#### **3.2.5.3 When Generated**

This primitive is issued by the service provider to the consumer user entity on receipt of a time update in the subnetwork.

#### **3.2.5.4 Effect on Receipt**

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

#### **3.2.5.5 Additional Comments**

SSNSAP identifies the provider user entity.

DSNSAP identifies the consumer user entity.

Time is the time data.

## **4 MANAGEMENT INFORMATION BASE**

There is currently no Management Information Base associated with this service. All management items are associated with the protocol providing the service. Any protocol claiming to provide this service in a SOIS-compliant manner shall publish its Management Information Base as part of the protocol specification.

## 5 SERVICE CONFORMANCE STATEMENT PROFORMA

It is mandatory that, for any protocol implementation claiming to provide this service, this proforma be completed giving details of the capabilities of the implementation.

<b>Service Conformance Statement</b> <b>SOIS Subnetwork Time Distribution Service</b>
--

### Implementation Information

Implementer Identification	
Implementation Identification	
Version	
Underlying Data Link	
Protocol Identifier	

### Optional Features

Time consumer		Requires TIME_DISTRIBUTION.request, TIME.indication
Time provider		Requires TIME_DISTRIBUTION.indication, TIME.request

### Additional Information

Time format and accuracy	
--------------------------	--

## ANNEX A

### INFORMATIVE REFERENCES

- [A1] *Spacecraft Onboard Interface Services*. Draft Report Concerning Space Data System Standards, CCSDS 850.0-G-0.1. Draft Green Book. Issue 0.1. Washington, D.C.: CCSDS, March 2007.

NOTE – Normative references are listed in 1.8.