

---

---

**Space data and information transfer  
systems — TC synchronization and  
channel coding**

*Systèmes de transfert des données et informations spatiales —  
Synchronisation TC et codage de canal*

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 22642:2015](https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015)

[https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-  
c421b122a0c5/iso-22642-2015](https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015)



## iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 22642:2015

<https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015>



### **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

This International Standard cancels and replaces ISO 22642:2005 which has been technically revised. It also incorporates ISO 22642:2005/Cor.1:1997.

ISO 22642 was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 231.0-B-2, September 2010) and was adopted (without modifications except those stated in clause 2 of this International Standard) by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 13, *Space data and information transfer systems*.

<https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO 22642:2015

<https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015>

## Recommendation for Space Data System Standards

# TC SYNCHRONIZATION AND CHANNEL CODING

ITih STANDARD PREVIEW  
(standards.iteh.ai)

ISO 22642:2015

<https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015>

**RECOMMENDED STANDARD**

**CCSDS 231.0-B-2**

**BLUE BOOK**  
**September 2010**

## AUTHORITY

Issue:	Recommended Standard, Issue 2
Date:	September 2010
Location:	

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:

**iTeh STANDARD PREVIEW**  
CCSDS Secretariat (standards.iteh.ai)  
Space Communications and Navigation Office, 7L70  
Space Operations Mission Directorate  
NASA Headquarters  
Washington, DC 20546-0001, USA  
<https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-2015/iso-22642-2015>

## 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 canceled.

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

This document is a technical Recommended Standard for use in developing synchronization and channel coding systems and has been prepared by the Consultative Committee for Space Data Systems (CCSDS). The synchronization and channel coding concept described herein is intended for missions that are cross-supported between Agencies of the CCSDS.

This Recommended Standard establishes a common framework and provides a common basis for the synchronization and channel coding schemes to be used by space missions with the TC Space Data Link Protocol (reference [1]) over ground-to-space and space-to-space communications links. This Recommended Standard was developed from an older CCSDS Recommended Standard (reference [C2]), which defines essentially the same schemes but in a slightly different context.

This Recommended Standard does not change the major technical content defined in reference [C2], but the presentation of the specification has been changed so that:

- a) these schemes can be used to transfer any data over any space link in either direction;
- b) all CCSDS space link protocols are specified in a unified manner;
- c) the layered model matches the Open Systems Interconnection (OSI) Basic Reference Model (reference [2]).

Together with the change in presentation, a few technical specifications in reference [C2] have been changed in order to define all Space Data Link Protocols in a unified way. Also, some technical terms in reference [C2] have been changed in order to unify the terminology used in all the CCSDS Recommended Standards that define space link protocols and to define these schemes as general communications schemes. These changes are listed in annex D of this Recommended Standard.

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.
- Canadian Space Agency (CSA)/Canada.
- Centre National d'Etudes Spatiales (CNES)/France.
- China National Space Administration (CNSA)/People's Republic of China.
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/Germany.
- European Space Agency (ESA)/Europe.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- Japan Aerospace Exploration Agency (JAXA)/Japan.
- National Aeronautics and Space Administration (NASA)/USA.
- Russian Federal Space Agency (RFSA)/Russian Federation.
- UK Space Agency/United Kingdom.

#### Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSPPO)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- China Satellite Launch and Tracking Control General, Beijing Institute of Tracking and Telecommunications Technology (CLTC/BITTT)/China.
- Chinese Academy of Sciences (CAS)/China.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- CSIR Satellite Applications Centre (CSIR)/Republic of South Africa.
- Danish National Space Center (DNSC)/Denmark.
- Departamento de Ciência e Tecnologia Aeroespacial (DCTA)/Brazil.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Geo-Informatics and Space Technology Development Agency (GISTDA)/Thailand.
- 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.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- National Oceanic and Atmospheric Administration (NOAA)/USA.
- National Space Agency of the Republic of Kazakhstan (NSARK)/Kazakhstan.
- National Space Organization (NSPO)/Chinese Taipei.
- Naval Center for Space Technology (NCST)/USA.
- Scientific and Technological Research Council of Turkey (TUBITAK)/Turkey.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

**DOCUMENT CONTROL**

<b>Document</b>	<b>Title</b>	<b>Date</b>	<b>Status</b>
CCSDS 231.0-B-1	TC Synchronization and Channel Coding, Issue 1	September 2003	Original Issue
CCSDS 231.0-B-2	TC Synchronization and Channel Coding, Recommended Standard, Issue 2	September 2010	Current issue: – adds an option for repeated transmissions of Transfer Frames (note).

**iTeh STANDARD PREVIEW**

NOTE – Substantive changes from the previous issue are indicated by change bars in the inside margin. (standards.iteh.ai)

[ISO 22642:2015](https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015)

<https://standards.iteh.ai/catalog/standards/sist/a7b30fd0-94dd-4523-8496-c421b122a0c5/iso-22642-2015>

# CONTENTS

<u>Section</u>	<u>Page</u>
<b>1 INTRODUCTION</b> .....	<b>1-1</b>
1.1 PURPOSE.....	1-1
1.2 SCOPE.....	1-1
1.3 APPLICABILITY.....	1-1
1.4 RATIONALE.....	1-2
1.5 DOCUMENT STRUCTURE.....	1-2
1.6 CONVENTIONS AND DEFINITIONS.....	1-2
1.7 REFERENCES.....	1-5
<b>2 OVERVIEW</b> .....	<b>2-1</b>
2.1 ARCHITECTURE.....	2-1
2.2 SUMMARY OF FUNCTIONS.....	2-1
2.3 INTERNAL ORGANIZATION OF SUBLAYER.....	2-3
<b>3 BCH CODING</b> .....	<b>3-1</b>
<b>iTeh STANDARD PREVIEW</b> <b>(standards.iteh.ai)</b>	
3.1 INTRODUCTION.....	3-1
3.2 CODEBLOCK FORMAT.....	3-1
3.3 ENCODING PROCEDURE.....	3-1
3.4 FILL DATA.....	3-2
3.5 DECODING PROCEDURE.....	3-3
4.1 INTRODUCTION.....	4-1
4.2 CLTU UNIT FORMAT.....	4-1
4.3 CLTU RECEPTION LOGIC.....	4-2
<b>5 RANDOMIZER</b> .....	<b>5-1</b>
5.1 INTRODUCTION.....	5-1
5.2 RANDOMIZER DESCRIPTION.....	5-1
5.3 APPLICATION OF THE RANDOMIZER.....	5-2
<b>6 PHYSICAL LAYER OPERATIONS PROCEDURES</b> .....	<b>6-1</b>
6.1 INTRODUCTION.....	6-1
6.2 DATA FORMATS.....	6-1
6.3 CARRIER MODULATION MODES.....	6-2

**CONTENTS (continued)**

<u>Section</u>	<u>Page</u>
6.4 PLOP-1 .....	6-3
6.5 PLOP-2 .....	6-4
<b>7 MANAGED PARAMETERS .....</b>	<b>7-1</b>
7.1 OVERVIEW OF MANAGED PARAMETERS .....	7-1
7.2 MANAGED PARAMETERS FOR BCH CODING .....	7-1
7.3 MANAGED PARAMETERS FOR CLTU .....	7-1
7.4 MANAGED PARAMETERS FOR THE RANDOMIZER .....	7-2
7.5 MANAGED PARAMETERS FOR PLOPS .....	7-2
<b>ANNEX A SERVICE DEFINITION (NORMATIVE) .....</b>	<b>A-1</b>
<b>ANNEX B ACRONYMS AND TERMS (INFORMATIVE) .....</b>	<b>B-1</b>
<b>ANNEX C INFORMATIVE REFERENCES (INFORMATIVE) .....</b>	<b>C-1</b>
<b>ANNEX D CHANGES FROM REFERENCE [C2] (INFORMATIVE) .....</b>	<b>D-1</b>

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

Figure

2-1 Relationship with OSI Layers.....	2-1
2-2 Internal Organization of the Sublayer at the Sending End .....	2-3
2-3 Internal Organization of the Sublayer at the Receiving End .....	2-4
3-1 BCH Codeblock Format .....	3-1
3-2 (63,56) Modified BCH Code Generator .....	3-2
4-1 Components of the CLTU.....	4-1
4-2 CLTU Reception State Diagram (Receiving End) .....	4-2
5-1 Bit Transition Generator Logic Diagram.....	5-2
6-1 Sequence of CMMs Composing PLOP-1 .....	6-4
6-2 Sequence of CMMs Composing PLOP-2.....	6-5

Table

4-1 CLTU Reception States (Receiving End).....	4-3
4-2 CLTU Reception Events (Receiving End) .....	4-3
6-1 Carrier Modulation Modes .....	6-3
7-1 Managed Parameters for BCH Coding .....	7-1
7-2 Managed Parameters for CLTU.....	7-1
7-3 Managed Parameters for Randomizer.....	7-2
7-1 Managed Parameters for Repeated Transmissions .....	7-2
7-4 Managed Parameters for PLOPs.....	7-2
D-1 Terms That Have Been Changed from Reference [C2].....	D-2

# 1 INTRODUCTION

## 1.1 PURPOSE

The purpose of this Recommended Standard is to specify synchronization and channel coding schemes used with the Telecommand (TC) Space Data Link Protocol (reference [1]). These schemes are to be used over ground-to-space or space-to-space communications links by space missions.

## 1.2 SCOPE

This Recommended Standard defines synchronization and channel coding schemes in terms of:

- a) the services provided to the users of this specification;
- b) data formats; and
- c)

It does not specify:

- a) individual implementations or products;
- b) the methods or technologies required to perform the procedures; or
- c) the management activities required to configure and control the system.

## 1.3 APPLICABILITY

This Recommended Standard applies to the creation of Agency standards and to the future data communications over space links between CCSDS Agencies in cross-support situations. This Recommended Standard includes comprehensive specification of the data formats and procedures for inter-Agency cross support. It is neither a specification of, nor a design for, real systems that may be implemented for existing or future missions.

The Recommended Standard specified in this document is to be invoked through the normal standards programs of each CCSDS Agency, and is applicable to those missions for which cross support, based on capabilities described in this Recommended Standard, is anticipated. Where mandatory capabilities are clearly indicated in sections of this Recommended Standard, they must be implemented when this document is used as a basis for cross support. Where options are allowed or implied, implementation of these options is subject to specific bilateral cross support agreements between the Agencies involved.