



BSI Standards Publication

Space data and information transfer systems — Data transmission and pseudo-random noise (PN) ranging for 2 GHz code division multiple access (CDMA) link via data relay satellite

National foreword

This British Standard is the UK implementation of ISO 17810:2014.

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INTERNATIONAL STANDARD

**ISO
17810**

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Space data and information transfer systems — Data transmission and pseudo-random noise (PN) ranging for 2 GHz code division multiple access (CDMA) link via data relay satellite

*Systèmes de transfert des données et informations spatiales —
Transmission de données et mesure du pseudo bruit pour la liaison
AMRC à 2 GHz par satellite relais de données*



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Foreword

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ISO 17810 was prepared by the Consultative Committee for Space Data Systems (CCSDS) (as CCSDS 415.1-B-1, September 2011) 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*.

Space data and information transfer systems — Data transmission and pseudo-random noise (PN) ranging for 2 GHz code division multiple access (CDMA) link via data relay satellite

1 Scope

This International Standard defines CDMA spread spectrum modulation schemes in terms of:

- a) the services provided to the users of this specification;
- b) spreading code formats; and
- c) the procedures performed to generate and process the code formats.

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.

This International Standard provides only those parameter requirements relating to signal compatibility with the existing SNIP PN spread modulation systems (see C.1). There are many other types of requirements, not specifically related to PN spread modulation signal formats, which must be met to ensure system compatibility with existing SNIP hardware. Examples would include forward error correction coding format, data signal formats, etc.

This International 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 International 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.

This International Standard 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 International Standard is anticipated. Where mandatory capabilities are clearly indicated in sections of this International 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.

2 Requirements

Requirements are the technical recommendations made in the following publication (reproduced on the following pages), which is adopted as an International Standard:

CCSDS 415.1-B-1, September 2011, *Data transmission and PN ranging for 2 GHz CDMA link via data relay satellite*

For the purposes of international standardization, the modifications outlined below shall apply to the specific clauses and paragraphs of publication CCSDS 415.1-B-1.

Pages i to vi

This part is information which is relevant to the CCSDS publication only.

Page C-1

Add the following information to the reference indicated:

[C2] Document CCSDS 414.1-B-1, March 2009, is equivalent to ISO 18423:2013.

[C4] Document CCSDS 503-0-B-1, November 2007, is equivalent to ISO 13526:2010.

3 Revision of publication CCSDS 415.1-B-1

It has been agreed with the Consultative Committee for Space Data Systems that Subcommittee ISO/TC 20/SC 13 will be consulted in the event of any revision or amendment of publication CCSDS 415.1-B-1. To this end, NASA will act as a liaison body between CCSDS and ISO.

Recommendation for Space Data System Standards

DATA TRANSMISSION AND PN RANGING FOR 2 GHZ CDMA LINK VIA DATA RELAY SATELLITE

RECOMMENDED STANDARD

CCSDS 415.1-B-1

BLUE BOOK
September 2011

AUTHORITY

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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.

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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:

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 - 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 spread spectrum modulation systems and has been prepared by the Consultative Committee for Space Data Systems (CCSDS). The spread spectrum modulation concept described herein is intended for missions that are cross-supported between Agencies of the CCSDS.

The spread spectrum modulation systems currently used by the Space Network Interoperability Panel (SNIP) agencies involve Direct Sequence Spread Spectrum (DSSS) in the form of pseudo-random noise (PN) Gold codes and Maximal Length codes. The PN code libraries used by NASA Users are also shared by Users of the European Space Agency (ESA) and Japan Aerospace Exploration Agency (JAXA). Included in this Recommended Standard are proposed techniques for expanding the code libraries for additional CCSDS Users. The expanded code library fits into the existing SNIP architecture.

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

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:

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- 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.
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- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
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- 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.
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- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
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- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

DOCUMENT CONTROL

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this Recommended Standard is to specify a set of Code Division Multiple Access (CDMA) Direct Sequence (DS) spread spectrum modulation schemes for CCSDS Users. The schemes described in this Recommended Standard are currently used by NASA, ESA, and JAXA Users but are considered applicable to a wider CCSDS community. These schemes are to be used over space-to-space communications links by space missions.

Use of a common set (family) of spreading codes allows for minimum interference among Users and keeps signals from exceeding power spectral density limitations. The schemes described here are from the point of view of a LEO satellite or other satellite below GEO altitude transmitting to a relay satellite at GEO altitude in the 2 GHz frequency band.

The signals can also radiate upon the Earth and be received by an Earth station. Although it is not the intent of this document, an agency may choose to use the direct-to-Earth link. In order to avoid interference between such an operation and the Users of the relay link, the CCSDS recommends that, if any CCSDS member agency chooses such a link, it uses these codes so as to avoid mutual interference.

CDMA spread spectrum modulation has the inherent characteristic that the codes may be used for ranging.

The codes in this book are pseudo random and have been specifically chosen to limit the signal Power Spectral Density (PSD) at the Earth's surface and minimize Multiple Access Interference (MAI).

CCSDS recommends that member agencies that require PN ranging via Data Relay Satellite, use the codes described in this book.

1.2 SCOPE

This Recommended Standard defines CDMA spread spectrum modulation schemes in terms of:

- a) the services provided to the Users of this specification;
- b) spreading code formats; and
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1.3 APPLICABILITY

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1.4 RATIONALE

There is a Space Network Interoperability Panel (SNIP) agreement between three of the CCSDS agencies, NASA, ESA, and JAXA, that use a family of CDMA codes referred to as the SNIP code family. Recently, other CCSDS space agencies have shown interest in using similar CDMA techniques. If these agencies used PN spreading codes that were not compatible with the existing codes, interference and degraded service would be more likely to occur with both Users of the existing codes and Users of the new codes. The SNIP code family is limited in number and not sufficient for all of the CCSDS agencies that would like to participate. In order to promote interoperability and broaden the available set of codes agencies are permitted to use, CCSDS has developed a new family of codes presented here, referred to as the CCSDS PN code family, that have the same properties as the codes used by the SNIP agencies.

The CCSDS believes it is important to document the rationale underlying the recommendations chosen, so that future evaluations of proposed changes or improvements will not lose sight of previous decisions.