EUROPEAN COOPERATION

ECSS

FOR SPACE STANDARDIZATION

Space engineering

Adoption Notice of CCSDS 131.0-B-3, TM Synchronization and Channel Coding

Foreword

This Adoption Notice is one document of the series of ECSS Standards intended to be applied together for the management, engineering, product assurance and sustainability in space projects and applications. ECSS is a cooperative effort of the European Space Agency, national space agencies and European industry associations for the purpose of developing and maintaining common standards. Requirements in this Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

This Adoption Notice has been prepared by the ECSS Space Communications Working Group, reviewed by the ECSS Executive Secretariat and approved by the ECSS Technical Authority.

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Change log

ECSS-E-AS-50-21C	First issue
1 March 2021	NOTE: This document supersedes ECSS-E-ST-50-01 "Space data links – Telemetry synchronization and channel coding" (31 July 2008).

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Scope

This document identifies the clauses and requirements modified with respect to the standard CCSDS 131.0-B-3, *TM Synchronization and Channel Coding*, Issue 3, September 2017 for application in ECSS.

2
Context information

The standard CCSDS 131.0-B-3, *TM Synchronization and Channel Coding*, has been developed by CCSDS for use in developing synchronization and channel coding systems.

With this Adoption Notice ECSS is adopting and applying CCSDS 131.0-B-3 with a minimum set of modifications, identified in the present document, to allow for reference and for a consistent integration in the ECSS system of standards.

CCSDS 131.0-B-3 is similar to the ECSS standard ECSS-E-ST-50-01C *Space data links - Telemetry synchronization and channel coding* (31 July 2008), that is superseded by ECSS-E-AS-50-21C.

Differences between these standards that are not covered by the normative modifications in clause 4 are described in the informative Annex A.

Overview of superseded ECSS-E-50-xx Standards

Superseded ECSS	ECSS Adopted Notice	Based on CCSDS
ECSS-E-ST-50-01C 31 July 2008	ECSS-E-AS-50-21C	CCSDS 131.0-B-3 (Sept. 2017)
ECSS-E-ST-50-03C 31 July 2008	ECSS-E-AS-50-22C	CCSDS 132.0-B-2 (Sept. 2015)
	ECSS-E-AS-50-23C	CCSDS 732.0-B-3 (August 2016)
ECSS-E-ST-50-04C 31 July 2008	ECSS-E-AS-50-24C	CCSDS 231.0-B-3 (Sept. 2017)
	ECSS-E-AS-50-25C	CCSDS 232.0-B-3 (Sept. 2015)
	ECSS-E-AS-50-26C	CCSDS 232.1-B-2 (Sept. 2010)

3
Abbreviated terms

Abbreviation	Meaning
PSK	phase-shift keying
4D-8PSK-TCM	4-dimensional 8PSK trellis-coded modulation

4
Application requirements

a.   CCSDS 131.0-B-3, TM Synchronization and Channel Coding, Issue 3, September 2017 shall apply as written with the following modifications listed in Table 4-1.

Table 4-1: Applicability table for CCSDS 131.0-B-2

Clause or requirement number	Applicability	Applicable text (the new/added text is underlined)	Comments	Text as in the original document (deleted text with strikethrough)
3.2.4	Modified	Soft bit decisions with at least three-bit quantization shall be used for the decoder.	CCSDS requirement modified: for convolutional codes. Words "should be used whenever constraints (such as complexity of decoder) permit"deleted and replaced by words "shall be used for the decoder"	Soft bit decisions with at least three-bit quantization should be used whenever constraints (such as complexity of decoder) permit.
4.3.1c.	New requirement	E=8 shall not be used unless the modulation scheme is 4-dimensional 8PSK trellis-coded modulation (4D-8PSK-TCM).	New requirement added: restricted use of Reed-Solomon codes with E=8	

Clause or requirement number	Applicability	Applicable text (the new/added text is underlined)	Comments	Text as in the original document (deleted text with strikethrough)
4.3.5.1	Modified	The allowable values of interleaving depth <u>shall be:</u> <u>a) When E=16,</u> I=1, 2, 3, 4, 5, and 8. <u>b) When E=8, I=8</u>	CCSDS requirement modified for Reed-Solomon codes to explain better applicability of E=16 and E=8	The allowable values of interleaving depth ~~are~~ I=1, 2, 3, 4, 5, and 8.
4.3.5.2	Modified	The interleaving depth shall be fixed on a Physical Channel for a Mission Phase.	CCSDS requirement modified for Reed-Solomon codes: word "normally" deleted.	The interleaving depth shall ~~normally~~ be fixed on a Physical Channel for a Mission Phase.
5.1	Modified	Concatenated codes shall consist of a combination of a Reed-Solomon code <u>with E=16</u> defined in section 4 with one of the convolutional codes defined in section 3.	CCSDS requirement modified for restricted use of Reed-Solomon codes: the original requirement was applicable to both E=8 and E=16, the new requirement applies only to E=16	Concatenated codes shall consist of a combination of a Reed-Solomon code defined in section 4 with one of the convolutional codes defined in section 3.
5.1	New NOTE	NOTE - Reed-Solomon code with E=8 is not concatenated with one of the convolutional codes.	New NOTE added.	

Annex A (informative) Differences from ECSS-E-ST-50-01C

A.1 General

Clause 4 of this document contains normative additions and modifications concerning some of the differences between CCSDS 131.0-B-2 and the earlier ECSS standard ECSS-E-ST-50-01 (superseded by this Adoption Notice). This Annex describes some additional differences that are not covered by Clause 4.

This Annex lists the differences of technical content, but it is not the purpose of this Annex to provide complete details on each item in the list or to describe the consequences of each item in the list.

A.2 Differences

A.2.1 Addition of LDPC codes

CCSDS 131.0-B-3 specifies a number of low-density parity-check (LDPC) codes for the coding of either a Transfer Frame or a stream of Sync-Marked Transfer Frames (SMTFs). ECSS-E-ST-50-01 did not include any LDPC codes.

A.2.2 Transfer frame lengths

Section 11 of CCSDS 131.0-B-3 has a normative specification of the transfer frame lengths that can be used with each of the channel codes. Annex C of ECSS-E-ST-50-01 had an informative specification of the lengths.

A.2.3 Managed parameters

Section 12 of CCSDS 131.0-B-3 has a normative specification of the managed parameters used by synchronization and channel coding. Annex G of ECSS-E-ST-50-01 had an informative specification, and referred to the parameters as mission configuration parameters.

A.2.4 Specification of service interfaces

Annex A of CCSDS 131.0-B-3 provides a formal abstract specification of the service interfaces, including service primitives and parameters, provided by TM

Synchronization and Channel Coding. There was no equivalent in ECSS-E-ST-50-01.

A.2.5   Security considerations

Annex B of CCSDS 131.0-B-3 provides a discussion of security considerations related to TM Synchronization and Channel Coding. There was no equivalent in ECSS-E-ST-50-01.

A.2.6   Application profiles

Annex D of ECSS-E-ST-50-01 provided guidelines for choosing a coding scheme and included some information on coding scheme performance. There is no equivalent in CCSDS 131.0-B-3. The CCSDS Historical Document, CCSDS 131.4-M-1-S also provided guidance to users in the choice of coding scheme for a telemetry link. The CCSDS informational report, CCSDS 130.1-G-2, includes performance information related to TM synchronization and channel coding.

Bibliography

ECSS-E-AS-50-21C	Space engineering - Adoption Notice of CCSDS 131.0-B-3, TM Synchronization and Channel Coding
ECSS-E-AS-50-22C	Space engineering - Adoption Notice of CCSDS 132.0-B-2, TM Space Data Link Protocol
ECSS-E-AS-50-23C	Space engineering -Adoption Notice of CCSDS 732.0-B-3, AOS Space Data Link Protocol
ECSS-E-AS-50-24C	Space engineering - Adoption Notice of CCSDS 231.0-B-3, TC Synchronization and Channel Coding
ECSS-E-AS-50-25C	Space engineering - Adoption Notice of CCSDS 232.0-B-3, TC Space Data Link Protocol
ECSS-E-AS-50-26C	Space engineering - Adoption Notice of CCSDS 232.1-B-2, Communications Operation Procedure-1
ECSS-E-ST-50-01C 31 July 2008	Space engineering - Space data links - Telemetry synchronization and channel coding
ECSS-E-ST-50-03C 31 July 2008	Space engineering - Space data links - Telemetry transfer frame protocol
ECSS-E-ST-50-04C 31 July 2008	Space engineering - Space data links - Telecommand protocols synchronization and channel coding
CCSDS 130.1-G-2	TM Synchronization and Channel Coding, Summary of Concept and Rationale – Green Book, Issue 2, November 2012
CCSDS 131.4-M-1-S	TM Channel Coding Profiles – Silver Book, Issue 1, July 2011
CCSDS 230.1-G-2	TC Synchronization and Channel Coding, Summary of Concept and Rationale – Green Book, Issue 2, November 2012