INTERNATIONAL STANDARD

ISO 20207

First edition
2015-08-15

Space data and information transfer systems — CCSDS Space Link Protocols over ETSI DVB-S2 Standard

Systèmes de transfert des informations et données spatiales — Protocole pour liaisons spatiales CCSDS utilisant la Norme ETSI DVB-S2



Reference number
ISO 20207:2015(E)

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The Consultative Committee for Space Data Systems

Recommendation for Space Data System Standards

CCSDS SPACE LINK PROTOCOLS OVER ETSI DVB-S2 STANDARD

RECOMMENDED STANDARD

CCSDS 131.3-B-1

BLUE BOOK

March 2013

AUTHORITY

Issue:	Recommended Standard, Issue 1
Date:	March 2013
Location:	Washington, DC, USA

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This document is published and maintained by:

CCSDS Secretariat
Space Communications and Navigation Office, 7L70
Space Operations Mission Directorate
NASA Headquarters
Washington, DC 20546-0001, USA

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FOREWORD

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DOCUMENT CONTROL

Document	Title	Date	Status
CCSDS 131.3-B-1	CCSDS Space Link Protocols over ETSI DVB-S2 Standard, Recommended Standard, Issue 1	March 2013	Current issue

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1 INTRODUCTION

1.1 BACKGROUND

The high demand in TV broadcasting has pushed the European Telecommunications Standards Institute (ETSI) to define a new satellite communication standard called Digital Video Broadcasting—Satellite—Second Generation (DVB-S2) (reference [1]). This standard is suited to high data rate transmissions, and proposes variable or adaptive coding and modulation with high power and bandwidth efficiencies.

1.2 PURPOSE

The purpose of this document is to define a recommended interface between CCSDS Space Link Protocols (references [3] and [4]) and the DVB-S2 telecom standard (reference [1]), and to recommend options of the DVB-S2 standard suited to high data rate telemetry applications, such as Earth Exploration Satellite Services (EESS) payload telemetry.

1.3 SCOPE

The DVB-S2 standard (reference [1]) proposes advanced modulation techniques (QPSK, 8PSK, 16APSK, and 32APSK) and a wide range of coding rates (from 1/4 to 9/10) with near-Shannon coding schemes (LDPC codes). This high number of modulation and coding schemes allows a wide range of possibilities to satisfy specific mission constraints.

Moreover, to maximize the telemetry system throughput, it appears possible to adapt the transmitted waveform (and the useful data rate) to the variable conditions of the link. The DVB-S2 standard can actually implement Variable Coding and Modulation (VCM) mode, which adapts the transmission scheme to the channel conditions following a predetermined schedule (for example, following a dynamic link budget). When a channel is available to provide feedback (e.g., via a telecommand link), the transmission scheme can be dynamically adjusted using the Adaptive Coding and Modulation (ACM) mode.

The use of the DVB-S2 standard for telemetry makes possible the use of generic Very High Scale Integrated Circuits (VHSIC) Hardware Description Language (VHDL) Intellectual Property (IP) modules for developments. The use of a widely implemented standard simplifies finding transmitting or receiving equipment to check compatibility. Finally, for the ground part, some telecom DVB-S2 receivers or Application Specific Integrated Circuits (ASICs) developed for the telecom market could be reused.

This Recommended Standard is an adaptation profile describing how to use the DVB-S2 standard to transmit CCSDS Transfer Frames for telemetry purpose. The interface between CCSDS and DVB-S2 is based on the Attached Synchronization Marker (ASM) and Channel Access Data Unit (CADU) already introduced in reference [2].

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DVB-S2 is used in this adaptation profile as a complete and self-sufficient standard, and definitions and specifications taken from DVB-S2 are applicable only in the context of this Recommended Standard. However, individual DVB-S2 functions or components (e.g., VCM/ACM, 8-PSK, and higher-order modulations) might be reused, redefined, and/or respecified by CCSDS in future Recommended Standards.

1.4 APPLICABILITY

This Recommended Standard applies to the creation of Agency standards and to data communications over space links between CCSDS Agencies in cross-support situations for near Earth Exploration Satellite Services (EESS) payload telemetry. 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, it is mandatory to implement them 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.

1.5 DOCUMENT STRUCTURE

Section 1 presents the background, purpose, scope, applicability, and rationale of this Recommended Standard and lists the conventions, definitions, and references used throughout the document.

Section 2 provides an overview of the system architecture.

Section 3 specifies the CADU stream generation.

Section 4 specifies the DVB-S2 transmission of the CADU stream.

Section 5 specifies managed parameters.

Annex A provides the service definition.

Annex B discusses security, Space Assigned Numbers Authority (SANA), and patent considerations.

Annex C lists acronyms and terms used within this document.

Annex D lists MODCOD available in the DVB-S2 standard.

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1.6 NOMENCLATURE

1.6.1 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.

1.6.2 INFORMATIVE TEXT

In the normative sections of this document, informative text is set off from the normative specifications either in notes or under one of the following subsection headings:

– Overview;

– Background;

– Rationale;

– Discussion.

1.7 DEFINITIONS AND CONVENTIONS

1.7.1 DEFINITIONS

1.7.1.1 Definitions from the Open System Interconnection (OSI) Basic Reference Model

This Recommended Standard makes use of a number of terms defined in reference [5]. The use of those terms in this Recommended Standard shall be understood in a generic sense, i.e., in the sense that those terms are generally applicable to any of a variety of technologies that provide for the exchange of information between real systems. Those terms are:

a) Data Link Layer;

b) Physical Layer;

c) service;

d) service data unit.

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