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Space engineering - Telemetry and telecommand packet utilization

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Space engineering - Telemetry and telecommand packet utilization

Ingénierie spatiale - Utilisation de la télémétrie et de la télécommande par paquets

Raumfahrttechnik - Telemetrie und Telekommando

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European Foreword

This document (EN 16603-70-41:2017) has been prepared by Technical Committee CEN-CENELEC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16603-70-41:2017) originates from ECSS-E-ST-70-41C.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2018, and conflicting national standards shall be withdrawn at the latest by April 2018.

This document supersedes EN 14776:2004 Space engineering – Ground systems and operations - Telemetry and telecommand packet utilization.

The main purpose of the update of EN 14776:2004 was the need:

- to remove the deficiencies of the previous issue and to inject lessons learned,
- to improve the standard to meet the need for future missions,
- to acknowledge the existence of new ECSS and CCSDS standards and to ensure consistency,
- to implement the updated drafting rules that apply to any ECSS Standards (e.g. naming each requirement to facilitate tailoring, traceability),
- maintaining backward compatibility when possible.

The main changes are:

- the introduction of the PUS foundation model that:
  - has been used to produce the “standard service types”;
  - shall be used to produce the “mission-specific service types”, i.e.:
    - ◊ adding new service types, subservice types, message types, etc;
    - ◊ adding capabilities to the ”standard service types”;
  - shall be used to produce the “mission services”, i.e.:
    - ◊ creating the required services by:
      - ♦ “realising the service types”, and
      - ♦ inheriting all mandatory subservices and minimum capabilities;
    - ◊ selecting, for each service, the additional capabilities, the optional subservices, etc;
    - ◊ creating the service specific definitions.

- a proper separation of system versus interface requirements.
- material common to the three ECSS branches (Space engineering, Space project management and Space product assurance moved to EN 16601-00 (EN version of ECSS-S-ST-00), material specific to product assurance to this standard,
- reorganization of the content of the document to separate descriptive text and requirements, including clarification, modification of requirements and implementation of change requests,
- pre-tailoring matrix (Clause 6) added,
- addition of new DRDs.

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

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g. : aerospace).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The CCSDS Space Packet Protocol (CCSDS 133.0-B-1) and the ECSS-E-ST-50 series of standards address the end-to-end transport of telemetry and telecommand data between user applications on the ground and application processes on-board the spacecraft, and the intermediate transfer of these data through the different elements of the ground and space segments.

This packet utilization standard (PUS) complements those standards by defining the application-level interface between ground and space, in order to satisfy the requirements of electrical integration and testing and flight operations.

1 Scope

This Standard addresses the utilization of telecommand packets and telemetry packets for the purposes of remote monitoring and control of spacecraft subsystems and payloads.

This Standard does not address mission-specific payload data packets, but the rules contained herein can be extended to suit the requirements of any mission.

This Standard does not address audio and video data as they are not contained within either telecommand or telemetry packets.

This Standard defines a set of services that satisfy all the fundamental operational requirements for spacecraft monitoring and control during spacecraft integration, testing and flight operations, refer to ECSS-E-ST-70-11. It also specifies the structure and contents of the telecommand packets used to transport the requests and the telemetry packets used to transport the reports.

This Standard can be used by any mission, no matter what its domain of application, orbit or ground station coverage characteristics. However, it is not the intention that the PUS should be applied in its entirety to a given mission. The services defined in this Standard cover a wide spectrum of operational scenarios and, for a given mission, only a subset of these services is likely to be appropriate.

Choices are made early in the design phase of a new mission resulting in the need to tailor the PUS to suit the requirements of that mission. These choices include:

- the on-board system design and architecture, in terms of the number of on-board application processes, their on-board implementation (e.g. the allocation to on-board processors) and their roles (i.e. which functions or subsystems or payloads they support);
- which PUS services are supported by each application process.

Each mission usually documents the results of this design and selection process in a "**Space-to-Ground Interface Control Document**".

Some missions implement a centralized architecture with a small number of application processes, whilst others have a highly-distributed architecture within which a correspondingly larger number of application processes are distributed across several on-board processors.

The specification of services in this Standard is adapted to the expectation that different missions require different levels of complexity and capability from a given service. To this end, all services are optional and a given service can be implemented at one of several distinct levels, corresponding to the inclusion of

one or more capability sets. The minimum capability set corresponds to the simplest possible level that also remains sensible and coherent. At least this set is included in every implementation of a given service.

The standardized PUS services fulfil the following criteria:

- Commonality: each standard service corresponds to a group of capabilities applicable to many missions.
- Coherence: the capabilities provided by each standard service are closely related and their scope is unambiguously specified. Each standard service covers all the activities for managing inter-related state information and all activities that use that state information.
- Self-containment: each standard service has minimum and well-defined interactions with other services or on-board functions.
- Implementation independence: the standard services neither assume nor exclude a particular spacecraft architecture (hardware or software).

This Standard mainly addresses the requirements that apply to the spacecraft and its components. The ground segment counterpart requirements related to the testing or the operations of the spacecraft and its components can be derived from these requirements and are not specified in this Standard. Tailoring the PUS for a mission is mainly a task for the operations team and the spacecraft manufacturer. This Standard assumes that the mission ground segment used to test or operate the spacecraft implements all standardized capabilities and as such, does not further constrain the mission tailoring process of these capabilities.

The PUS should be viewed as a "Menu" from which the applicable services and service-levels are selected for a given mission. This selection process is repeated for each on-board application process, since each application process is designed to provide a specific set of tailored services.

This standard may be tailored for the specific characteristics and constraints of a space project in conformance with ECSS-S-ST-00.

This Standard does not include any protection against inadequate operations. This is considered mission specific.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system – Glossary of terms
EN 16603-70	ECSS-E-ST-70	Space engineering – Ground systems and operations
EN 16603-70-01	ECSS-E-ST-70-01	Space engineering – Spacecraft on-board control procedures
EN 16603-70-11	ECSS-E-ST-70-11	Space engineering – Space segment operability
EN 16603-70-31	ECSS-E-ST-70-31	Space engineering – Ground systems and operations – Monitoring and control data definition
	CCSDS 133.0-B-1, September 2003	Space Packet Protocol, Blue Book
	CCSDS 301.0-B-4, November 2010	Time Code Formats, Blue Book

koniec náhľadu – text ďalej pokračuje v platenej verzii STN