DEUTSCHE NORM Dezember 2014

# DIN EN 16603-50-03

DIN

ICS 49.140

## Raumfahrtproduktsicherung – Telemetrieübertragungs-Rahmen-Protokoll; Englische Fassung EN 16603-50-03:2014

Space engineering –
Space data links –
Telemetry transfer frame protocol;
English version EN 16603-50-03:2014

Ingénierie spatiale –
Liaisons des données spatiales –
Protocole trame de transfert de télémesure;
Version anglaise EN 16603-50-03:2014

Gesamtumfang 46 Seiten

DIN-Normenausschuss Luft- und Raumfahrt (NL)

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Full document details: DIN EN 16603-50-03:2014-12

## Nationales Vorwort

Dieses Dokument (EN 16603-50-03:2014) wurde vom Technischen Komitee CEN/CLC/TC 5 „Raumfahrt“ erarbeitet, dessen Sekretariat vom DIN (Deutschland) gehalten wird.

Das zuständige deutsche Normungsgremium ist der Arbeitsausschuss NA 131-10-01 AA „Interoperabilität von Informations-, Kommunikations- und Navigationssystemen“ im DIN-Normenausschuss Luft- und Raumfahrt (NL).

Dieses Dokument (EN 16603-50-03:2014) basiert auf ECSS-E-ST-50-03C.

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung von EN 16603-50-03:2014.

Dieses Dokument wurde speziell zur Behandlung von Raumfahrtsystemen erarbeitet und hat daher Vorrang vor jeglicher Europäischer Norm, da es denselben Anwendungsbereich hat, jedoch über einen größeren Geltungsbereich (z. B. Luft- und Raumfahrt) verfügt.



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# Nationaler Anhang NA
(informativ)

# Begriffe und Abkürzungen

## 3 Begriffe und Abkürzungen

### 3.1 Begriffe aus anderen Normen

Für die Anwendung dieses Dokuments gelten die Begriffe nach ECSS-S-ST-00-01.

### 3.2 Für diese Norm spezifische Begriffe

**3.2.1**
**nicht belegte Daten**
Daten, die keine Informationen tragen, jedoch übermittelt werden, um die zeit- oder synchronisationsbezogenen Anforderungen zu erfüllen

ANMERKUNG 1 zum Begriff: Das Bitmuster der nicht belegten Daten ist nicht festgelegt.

**3.2.2**
**Missionsphase**
Zeitspanne einer Mission, über die die festgelegten Telemetrie-Merkmale bestimmt werden

Anmerkung 1 zum Begriff: Der Übergang zwischen zwei aufeinanderfolgenden Missionsphasen kann eine Unterbrechung der Telemetriedienste verursachen.

**3.2.3**
**Oktett**
Satz von acht Binärziffern (Bits)

Anmerkung 1 zum Begriff: Die Benummerung von Oktetten innerhalb einer Datenstruktur beginnt mit 0.

Anmerkung 2 zum Begriff: Siehe 3.4 für die Konvention zur Benummerung von Bits.

**3.2.4**
**Paket**
Datenstruktur mit variabler Länge, bestehend aus Anwenderdaten einer höheren Schicht, die in die genormten Vorlaufinformationen eingebettet sind

**3.2.5**
**statisch**
ohne Änderungen innerhalb eines bestimmten virtuellen Kanals oder Masterkanals

Anmerkung 1 zum Begriff: Diese Norm enthält Anforderungen an die Unveränderlichkeit bestimmter Merkmale der darin festgelegten Datenstrukturen über eine oder alle Missionsphase(n).

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## 3.3 Abkürzungen

Für die Anwendung dieses Dokuments gelten die Abkürzungen in ECSS-S-ST-00-01 und die folgenden Abkürzungen:

| Abkürzung | Bedeutung |
|---|---|
| **ASM** | zugeordneter Synchronisationsmarker (en: attached sync marker) |
| **CCSDS** | Beratender Ausschuss für Weltraumdatensysteme (en: Consultative Committee for Space Data Systems) |
| **FECF** | Rahmenfehler-Kontrollfeld (en: Frame Error Control Field) |
| **MSB** | höchstwertiges Bit (en: most significant bit) |
| **TM** | Telemetrie (en: Telemetry) |

## 3.4 Konventionen

### 3.4.1 Bit 0, Bit 1, Bit $N$–1

Um jedes Bit in einem $N$-Bit-Feld zu identifizieren, ist das erste zu übertragende Bit im Feld (d. h. das in einer graphischen Darstellung am weitesten links gelegene) als Bit 0 definiert; das folgende Bit ist als Bit 1 definiert usw. bis zum Bit $N$-1.

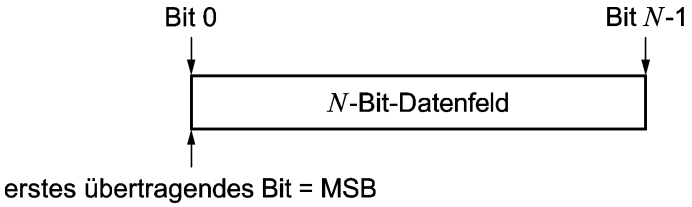


**Bild 3-1 — Benummerungskonvention für Bits**

### 3.4.2 Höchstwertiges Bit

Wird ein $N$-Bit-Feld zur Angabe eines Binärwerts genutzt (z. B. bei einer Zählvorrichtung), handelt es sich beim höchstwertigen Bit um das erste Bit im Feld, d. h. Bit 0 (siehe Bild 3-1).

### 3.4.3 Verwendung von Großbuchstaben bei den Bezeichnungen der Datenstrukturen und -felder

In dieser Norm werden für die Bezeichnungen der Datenstrukturen und -felder Großbuchstaben als erste Buchstaben verwendet.

Auf diese Weise können die Feldbezeichnungen innerhalb des Gesamttextes leicht identifiziert werden. So ist beispielsweise das Feld „Transfer Frame Data Field“ („Übertragungsrahmen-Datenfeld“) in einem Text, der Wörter wie „frame“ („Rahmen“), „data“ („Daten“) und „field“ („Feld“) enthält, leichter zu erkennen als das Feld „transfer frame data field“.

Außerdem wird die Zweideutigkeit dahingehend vermeiden, wo die Bezeichnung beginnt und endet. Beispielsweise bestehen die Felder „Transfer Frame Secondary Header“ („Sekundär-Header des Übertragungsrahmens“) und „Transfer Frame Secondary Header Length“ („Länge des Sekundär-Headers des Übertragungsrahmens“). Die Großbuchstaben helfen dem Leser bei der Unterscheidung zwischen „Transfer Frame Secondary Header length“ (d. h. der Länge des „Sekundär-Headers des Übertragungsrahmens“) und dem Feld mit der Bezeichnung „Transfer Frame Secondary Header Length“ (Feld „Länge des Sekundär-Headers des Übertragungsrahmens“).



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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 16603-50-03

September 2014

ICS 49.140

English version

# Space engineering - Space data links - Telemetry transfer frame protocol

Ingénierie spatiale - Liaisons des données spatiales - Protocole trame de transfert de télémesure

Raumfahrtproduktsicherung - Telemetrieübertragungs-Rahmen-Protokoll

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# Foreword

This document (EN 16603-50-03:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN.

This standard (EN 16603-50-03:2014) originates from ECSS-E-ST-50-03C.

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 March 2015, and conflicting national standards shall be withdrawn at the latest by March 2015.

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 mandate 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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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# 1 Scope

This Standard contains the definition for Telemetry Transfer Frames which are fixed-length data structures, suitable for transmission at a constant frame rate on a space data channel.

The Telemetry Transfer Frame provides a standardized data structure for the transmission of space-acquired data over a telemetry space data link.

Usually, the source of the data is located in space and the receiver is located on the ground. However, this Standard may also be applied to space-to-space telemetry data links.

Further provisions and guidance on the application of this standard can be found, respectively, in the following publications:

- The higher level standard ECSS-E-ST-50, Communications, which defines the principle characteristics of communication protocols and related services for all communication layers relevant for space communication (physical- to application-layer), and their basic relationship to each other.
- The handbook ECSS-E-HB-50, Communications guidelines, which provides information about specific implementation characteristics of these protocols in order to support the choice of a certain communications profile for the specific requirements of a space mission..

Users of this present standard are invited to consult these documents before taking decisions on the implementation of the present one.

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



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# 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 revisions 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 most 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 16603-50-01 | ECSS-E-ST-50-01 | Space engineering – Space data links – Telemetry synchronization and channel coding |
| EN 16603-50-04 | ECSS-E-ST-50-04 | Space engineering – Space data links – Telecommand protocols, synchronization and channel coding |
| | CCSDS 133.0-B-1 | Space Packet Protocol – Blue Book, Issue 1, September 2003 |
| | CCSDS 135.0-B-3 | Space Link Identifiers – Blue Book, Issue 3, October 2006 |



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# 3 Terms, definitions and abbreviated terms

## 3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-ST-00-01 apply.

## 3.2 Terms specific to the present standard

### 3.2.1 idle data

data which carries no information, but is sent to conform to timing or synchronization requirements

NOTE The bit pattern of idle data is not specified.

### 3.2.2 mission phase

period of a mission during which specified telemetry characteristics are fixed

NOTE The transition between two consecutive mission phases can cause an interruption of the telemetry services.

### 3.2.3 octet

group of eight bits

NOTE 1 The numbering for octets within a data structure starts with 0.

NOTE 2 Refer to clause 3.4 for the convention for the numbering of bits.

### 3.2.4 packet

variable-length data structure consisting of higher layer user data encapsulated within standard header information

### 3.2.5 static

unchanged within a specific virtual channel or within a specific master channel

NOTE This Standard contains requirements on the invariability, throughout one or all mission phases, of certain characteristics of the data structures specified in it.



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## 3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms from ECSS-ST-00-01 and the following apply:

| Abbreviation | Meaning |
|---|---|
| **ASM** | attached sync marker |
| **CCSDS** | Consultative Committee for Space Data Systems |
| **FECF** | Frame Error Control Field |
| **MSB** | most significant bit |
| **TM** | Telemetry |

## 3.4 Conventions

### 3.4.1 bit 0, bit 1, bit N−1

To identify each bit in an N-bit field, the first bit in the field to be transferred (i.e. the most left justified in a graphical representation) is defined as bit 0; the following bit is defined as bit 1 and so on up to bit N-1.

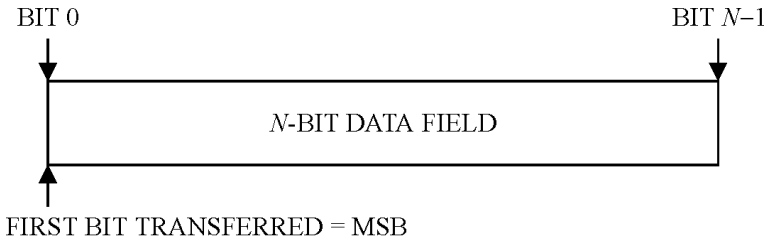


**Figure 3-1: Bit numbering convention**

### 3.4.2 most significant bit

When an N-bit field is used to express a binary value (such as a counter), the most significant bit is the first bit of the field, i.e. bit 0 (see Figure 3-1).

### 3.4.3 use of capitals for the names of data structures and fields

In this Standard initial capitals are used for the names of data structures and fields.

This enables field names to be easily identified in the surrounding text. For example, the field Transfer Frame Data Field is easier to see than transfer frame data field in text containing words such as frame and data and field.

It also prevents ambiguity over where the name begins and ends. For example, there are fields Transfer Frame Secondary Header and Transfer Frame Secondary Header Length. The capitals help the reader to distinguish between the Transfer Frame Secondary Header length (meaning 'the length of the Transfer Frame Secondary Header') and the Transfer Frame Secondary Header Length (meaning the field of that name).



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# 4 Overview

## 4.1 General

The Telemetry Transfer Frame is a fixed-length data structure that provides an envelope for transmitting data units of several types over a telemetry space link. The frame is compatible with the ECSS standard for telemetry synchronization and channel coding defined in ECSS-E-ST-50-01.

The telemetry transfer frame protocol can operate in various configurations of the telemetry space link, depending on the telemetry channel coding scheme and security options selected. The correct operation of the protocol can only occur if a high-quality data channel is provided between the peer entities of the protocol.

NOTE 1 The Standard for telemetry channel coding, ECSS-E-ST-50-01, defines the coding mechanisms for a high-quality data channel, including frame synchronization and randomization. CCSDS 350.0-G-2 describes the security options.

NOTE 2 In this Standard the terms TM Transfer Frame and Telemetry Transfer Frame are used interchangeably, i.e. they are synonyms and have the same meaning as.

NOTE 3 Annex D describes the mission configuration parameters within the scope of this Standard.

## 4.2 Physical channel

A data channel carrying a stream of bits in a single direction is referred to as a physical channel.

For the TM Transfer Frame specified in this Standard, the value of the Transfer Frame Version Number is constant for all frames of a physical channel.

The length of the frames for a given physical channel is fixed for a mission phase.



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## 4.3 Master channels and virtual channels

The TM Transfer Frame supports the division of the physical channel into master channels and virtual channels by means of identifier fields in the frame header.

A master channel is identified by the values of the Transfer Frame Version Number and the Spacecraft Identifier. Within a given physical channel, a master channel consists of all the frames that have the same Transfer Frame Version Number and the same Spacecraft Identifier.

For a typical space mission, all the frames on a physical channel have the same value for the Spacecraft Identifier, so in this case there is one master channel on the physical channel. However, multiple master channels can share a physical channel, which, for example, can be the case when one spacecraft is transporting another spacecraft such as a probe.

A master channel is divided into virtual channels using the Virtual Channel Identifier field. This is a 3-bit field and therefore supports up to eight virtual channels on a master channel.

## 4.4 Sharing transmission resources

Virtual channels enable one physical channel to be shared among multiple higher-layer data streams, each of which can have different characteristics.

The mechanisms and parameters for sharing access by the virtual channels to the physical channel are implementation dependent and not within the scope of this Standard.

## 4.5 Data fields in the frame

Every TM Transfer Frame contains the Transfer Frame Data Field, which is the main data-carrying field in the frame. Within a virtual channel, the length of the Transfer Frame Data Field is static during a mission phase.

There are status fields in the frame header that are related to the use of the Transfer Frame Data Field. The Transfer Frame Data Field carries packets or other data units.

Additionally to the Transfer Frame Data Field, the TM Transfer Frame has two optional fields for carrying data:

- The Transfer Frame Secondary Header, used to carry fixed-length mission-specific data.
- The Operational Control Field, used to carry status information to control the operation of the telecommand space link or other spacecraft activities.



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