SLOVENSKI STANDARD
oSIST prEN 16603-50-16:2021

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Vesoljska tehnika - Časovno proženi ethernet

Space engineering - Time triggered Ethernet

Raumfahrttechnik - Zeitgesteuertes Ethernet (TTE)

Ingénierie spatiale - Ethernet à déclenchement temporel (TTE)

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ICS:

49.140	Vesoljski sistemi in operacije	Space systems and operations

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English version

Space engineering - Time triggered Ethernet

Ingénierie spatiale - Ethernet à déclenchement temporel (TTE)

Raumfahrttechnik - Zeitgesteuertes Ethernet (TTE)

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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European Foreword

This document (prEN 16603-50-16:2021) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN (Germany).

This document (prEN 16603-50-16:2021) originates from ECSS-E-ST-50-16C DIR1.

This document is currently submitted to the Enquiry.

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

1 Scope

Using standard communication protocols for spacecraft communication links can provide interface compatibility between communication devices and components. Thus, it can improve the design and development process as well as integration and test activities at all levels and provide the potential of reusability across projects.

The aim of this space engineering standard is to define the interface services and to specify their corresponding network protocol elements for spacecraft using the Time-Triggered Ethernet data network. It also aims at defining requirements for the harmonisation of the physical interfaces and usage of the [IEEE 802.3] and [SAE AS6802] layer features.

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

Approach

The approach of the ECSS working group for defining this standard aims at identification of layers, services and functions of the typical Time-Triggered Ethernet communication network to ensure the use of the technology for various space projects. The standard aims at:

- Identifying Reference Architectures (Layers, Services, Functions and Elements of protocol) of typical Time-Triggered Ethernet communication network;
- Characterizing Services, Functions and Elements of Protocol of each Layer within identified Reference Architectures, using concrete project specifications;
- Define normative requirements rather than recommendations.

As far as possible, the defined communication requirements are extracted from the experience on existing spacecraft specifications.

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
	ARINC 664 part 2, 24 October 2018	Aircraft Data Network Part 2: Ethernet Physical and Data Link Layer Specification
	ARINC 664 part 7, 23 September 2009	Aircraft Data Network Part 2: Avionic Full-Duplex Switched Ethernet Network
	IEEE 802.3, 28 December 2012	Ethernet Standard
	SAE AS6802, November 2011	Time-triggered Ethernet
	RFC 768, 28 August 1980	User Datagram Protocol (UDP)
	RFC 791, September 1981	Internet Protocol (IP)
	RFC 792, September 1981	Internet Control Message Protocol (ICMP)
	RFC 1157, May 1990	A simple network management protocol (for SNMPv1)
	RFC 1350, July 1992	The TFTP Protocol (Revision 2)
	RFC 2349, May 1998	TFTP Timeout Interval and Transfer Size Options
	RFC 3697, March 2004	IPv6 Flow Label Specification

3
Terms, definitions and abbreviated terms

3.1 Terms from other standards

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

3.2 Terms specific to the present standard

3.2.1 acceptance window

timing interval in which the reception of the frame associated with a VL ID is expected

3.2.2 bandwidth allocation gap (BAG)

minimum delay between two consecutive Rate-Constrained frames belonging to the same sending interval

[ARINC 664 part 7]

3.2.3 best-effort traffic

standard Ethernet frame which is neither **critical traffic** nor flow controlled traffic

NOTE A Best-Effort frame or traffic as specified by the standard [IEEE 802.3].

3.2.4 broadcast

transmission of an Ethernet frame from one sender to all receivers

3.2.5 cluster

Ethernet network composed of nodes synchronized to each other by the time-triggered Ethernet protocol

3.2.6 compression master

role of an element of the cluster that collects protocol control frames (PCFs) from the synchronization masters and compresses uses them in a timing algorithm, compression, before sending them back to the configured synchronization masters and synchronization clients, to be used for synchronization purpose

3.2.7 critical traffic (CT)

flow of critical traffic frames, where each frame has the most significant 32 bits set to the critical traffic marker

NOTE Critical Traffic Marker is the value of the most significant 32 bits of the MAC Destination

Address that identifies a frame as Critical Traffic.

3.2.8 device

element of an Ethernet network or an element connected to an Ethernet node

NOTE A device can be either a switch or an **end system** or a host computer. A device does not necessarily support RC or TT or BE traffic.

3.2.9 end system

network component which provides the host device an interface to the network

NOTE Each host device uses an End System interface to guarantee a secure and reliable data interchange with other host device.

3.2.10 flow controlled traffic

sequence of Ethernet packets from one sender to one or multiple receivers

NOTE A Flow controlled traffic as specified by [RFC 3697].

3.2.11 frame

part of a packet

NOTE 1 The following frame types are used throughout this document:

- Best-Effort frame: Basic Frame
- Critical Traffic frame: Rate-Constrained (RC) frame; Protocol Control Frame (is a RC frame); Time-Triggered (TT) frame

NOTE 2 Example of a packet is shown in Figure 3-1.

3.2.12 globally administered

unique MAC address assigned to the network interface card by the manufacturer

3.2.13 link

physical connections between nodes in a network providing the means for transferring frames between them

3.2.14 locally administered

unique MAC address assigned to the network interface card locally

3.2.15 multicast

transmission of an Ethernet frame from one sender to multiple receivers

3.2.16 node

element of an Ethernet network

NOTE A node can be either a Switch or an End System. A node does not necessarily support RC and TT traffic but at least BE.

3.2.17 packet

complete Ethernet message including the header information consisting of the preamble and the start of frame delimiter

NOTE The Ethernet packet is specified in, 1000Base-X PCS, [IEEE 802.3] Clause 36 [2], section 1/section 3 ”Media Access Control (MAC) frame and packet specifications”. The structure is shown in Figure 3-1.

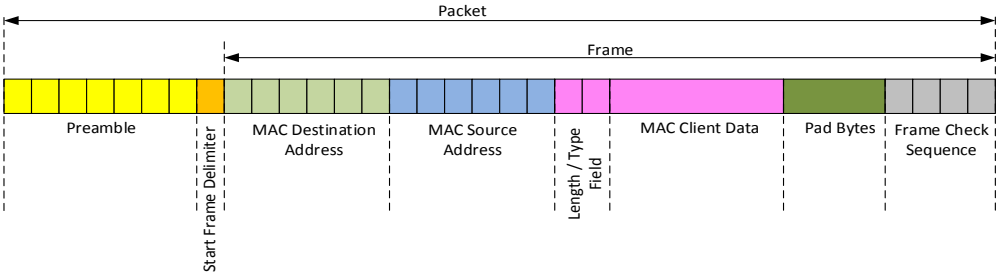

Figure 3-1: Structure of a Packet

3.2.18 protocol control frame

standard Ethernet frame whose Ethernet type field is set to 0x891D, which is used by the synchronization protocol

[SAE AS6802]

3.2.19 raster granularity

timeline on which scheduling events are placed

3.2.20 rate-constrained

guaranteed bandwidth traffic as specified by the standard

[ARINC 664 part 7]

3.2.21 schedule table

time schedule of transmission and reception events for critical traffic.

3.2.22 switch

hardware device that connects multiple End Systems or Switches to one network

NOTE A Switch works on Layer 2 of the Ethernet specification and has two different ways of packet switching between the different devices connected to its Ethernet ports which are static and dynamic switching. The static packet switching works according to a defined static switching table. Dynamic switching describes an