SLOVENSKI STANDARD
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Vesoljska tehnika - SpaceWire - Protokol za daljinski dostop do pomnilnika

Space engineering - SpaceWire - Remote memory access protocol

Raumfahrttechnik - SpaceWire - Protokoll zum ferngesteuerten Speicherzugriff

Ingénierie spatiale - SpaceWire - protocole d'accès à distance à la mémoire

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English version

Space engineering - SpaceWire - Remote memory access protocol

Ingénierie spatiale - SpaceWire - protocole d'accès à distance à la mémoire

Raumfahrttechnik - SpaceWire - Protokoll zum ferngesteuerten Speicherzugriff

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Foreword

This document (EN 16603-50-52:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN.

This standard (EN 16603-50-52:2014) originates from ECSS-E-ST-50-52C.

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of an identical text or by endorsement, at the latest by March 2015, and conflicting national standards shall be withdrawn at the latest by March 2015.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).

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1 Scope

There is a number of communication protocols that can be used in conjunction with the SpaceWire Standard (ECSS-E-ST-50-12), to provide a comprehensive set of services for onboard user applications. To distinguish between the various protocols a protocol identifier is used, as specified in ECSS-E-ST-50-51.

This Standard specifies the Remote Memory Access protocol (RMAP), which is one of these protocols that works over SpaceWire.

The aim of RMAP is to support reading from and writing to memory in a remote SpaceWire node. RMAP can be used to configure a SpaceWire network, control SpaceWire nodes, and to transfer data to and from SpaceWire nodes. RMAP is specified in this Standard.

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

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 16603-50-12	ECSS-E-ST-50-12	Space engineering - SpaceWire - Links, nodes, routers and networks
EN 16603-50-51	ECSS-E-ST-50-51	Space engineering - SpaceWire protocol identification

3
Terms, definitions and abbreviated terms

3.1 Terms defined in other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 and ECSS-E-ST-50-51 apply.

3.2 Terms specific to the present standard

None.

3.3 Abbreviated terms

The following abbreviations are defined and used within this standard:

Abbreviation	**Meaning**
CRC	cyclic redundancy code
EEP	error end of packet
EOP	end of packet
FCT	flow control token
FIFO	first in first out
ID	identifier
inc	increment
Len	length
LS	least-significant
LSB	least-significant bit
MS	most-significant
MSB	most-significant bit
RMAP	remote memory access protocol
RMW	read-modify-write
SOIS	spacecraft onboard interface services
SpW	SpaceWire
SSNSAP	source subnetwork service access point

VHDL	vhsic hardware description language
VHSIC	very high speed integrated circuit

3.4 Conventions

In this document hexadecimal numbers are written with the prefix 0x, for example 0x34 and 0xDF15.

Binary numbers are written with the prefix 0b, for example 0b01001100 and 0b01.

Decimal numbers have no prefix.

4 Principles

4.1 Remote Memory Access Protocol (RMAP) purpose

The aim of RMAP is to support reading from and writing to memory in a remote SpaceWire node. RMAP can be used to configure a SpaceWire network, control SpaceWire nodes, and to transfer data to and from SpaceWire nodes. RMAP is specified in this Standard.

The remote memory access protocol (RMAP) has been designed to support a wide range of SpaceWire applications. Its primary purposes however are to configure a SpaceWire network, to control SpaceWire nodes and to gather data and status information from those nodes. RMAP can operate alongside other communication protocols running over SpaceWire.

RMAP can be used to configure SpaceWire routing switches, setting their operating parameters and routing table information. It can also be used to monitor the status of those routing switches. RMAP can be used to configure and read the status of nodes on the SpaceWire network. For example, the operating data rate of a node can be set to 100 Mbits/s and the interface can be set to auto-start mode. RMAP can also be used to download and debug software on a remote processor.

For simple SpaceWire units without an embedded processor, RMAP can be used to set application configuration registers, to read status information and to read from or write data to memory in the unit.

For intelligent SpaceWire units RMAP can provide the basis for a wide range of communication services. Configuration, status gathering and data transfer to and from memory or mailboxes can be supported.

4.2 Guide to clause 5

Specification of the fields used in RMAP commands and replies is given in clause 5. The CRC used by RMAP is specified in clause 5.2. The write command is defined in clause 5.3, the read command in clause 5.4 and the read-modify-write command in clause 5.5. The error codes that are used in RMAP replies are listed in clause 5.6. The way in which partial implementations of RMAP can be implemented is described in clause 5.7. Clause 5.8 specifies the conformance statements i.e. clauses that are implemented and the ancillary information that is provided, in order for a supplier to claim conformance to the SpaceWire RMAP standard. Example VHDL and C-code for the 8-bit CRC used by RMAP is given in Annex A.

4.3 RMAP operations

4.3.1 Introduction

RMAP is used to write to and read from memory, registers, FIFO memory, mailboxes, etc, in a target on a SpaceWire network. Input/output registers, control/status registers and FIFOs are memory-mapped and therefore are accessed as memory. Mailboxes are indirect memory areas that are referenced using a memory address.

All read and write operations defined in the RMAP protocol are posted operations i.e. the initiator does not wait for a reply to be received. This means that many read and write commands can be outstanding at any time. There is no timeout mechanism implemented in RMAP for missing replies. If a reply timeout mechanism is used, it is implemented in the initiator user application.

4.3.2 Write commands

The write command provides a means for one node, the initiator, to write zero or more bytes of data into a specified area of memory in another node, the target on a SpaceWire network.

Write commands can be acknowledged or not acknowledged by the target when they have been received correctly. If the write command is acknowledged and there is an error with the write command, the target replies with an error/status code to the initiator (or other node) that sent the command. The error/status code can only be sent to the initiator if the write command header was received intact, so that a target that detected an error knows where to send the reply. If no reply is requested then the fact that an error occurred can be stored in a status register in the target.

Write commands can perform the write operation after verifying that the data has been transferred to the target without error, or it can write the data without verification. Verification on the data can be performed only by buffering in the target to store the data while it is being verified, before it is written. The amount of buffering is likely to be limited so verified writes can only be performed for a relatively small amount of data that fits into the available buffer at the target. Verified writes are normally used when writing to configuration or control registers. Larger amounts of data can be written but without verification prior to writing. Verification in this case is done after the data has been written.

The acknowledged/non-acknowledged and verified/non-verified options to the write command result in four different write operations:

- **Write non-acknowledged, non-verified** - writes zero or more bytes to memory in a target. The command header is checked using a CRC before the data is written, but the data itself is not checked before it is written. No reply is sent to the initiator of the write command. This command is typically used for writing large amounts of data to a target where it can be safely assumed that the write operation completed successfully. For example the writing of camera data to a temporary working buffer.