Association for Standardisation of
Automation and Measuring Systems

ASAM MCD-1 (XCP on SxI)

Universal Measurement and Calibration Protocol

SxI Transport Layer

Version 1.5.0

Date: 2017-11-30

Associated Standard

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1 FOREWORD

XCP is short for Universal Measurement and Calibration Protocol. The main purpose is the data acquisition and calibration access from electronic control units. Therefore a generic protocol layer is defined. As transport medium different physical busses and networks can be used. For each authorized transport medium a separated transport layer is defined. This separation is reflected in standard document structure, which looks like follows:

- One Base Standard
- Associated Standards for each physical bus or network type

The Base Standard describes the following content:

- Protocol Layer
- Interface to ASAM MCD-2 MC
- Interface to an external SEED&KEY function
- Interface to an external Checksum function
- Interface to an external A2L Decompression / Decrypting function
- Example Communication sequences

This associated standard describes the XCP on SxI (SPI, SCI) transport layer.

The **"X"** inside the term XCP generalizes the "various" transportation layers that are used by the members of the protocol family. Because XCP is based on CCP the "X" shall also show that the XCP protocol functionality is extended compared to CCP.

2 INTRODUCTION

This standard describes how XCP is transported on SxI as transport layer. It is shown how addressing shall be realized and the usage of the different communication models (see Chapter 4.2). Also the content of the control field of the XCP message frame format is described. For details about the frame format structure please refer the base standard [1]. The interface to the ASAM MCD-2 MC description file is described in chapter 7.

3 RELATIONS TO OTHER STANDARDS

3.1 BACKWARD COMPATIBILITY TO EARLIER RELEASES

3.1.1 SxI TRANSPORT LAYER

This Transport layer uses the version number 1.5. This version number is represented as 16 bit value, where the high byte contains the major version (U) and low byte contains the minor version (V) number.

If this associated standard is modified in such a way that a functional modification in the slave's driver software is needed, the higher byte of its XCP Transport Layer Version Number will be incremented. This could be the case e.g. when modifying the parameters of an existing command or adding a new command to the specification.

If this associated standard is modified in such a way that it has no direct influence on the slave's driver software, the lower byte of its XCP Transport Layer Version Number will be incremented. This could be the case e.g. when rephrasing the explaining text or modifying the AML description.

The slave only returns the most significant byte of the XCP Transport Layer Version Number for the current Transport Layer in the response upon CONNECT.

3.1.2 THE COMPATIBILITY MATRIX

The Compatibility Matrix gives an overview of the allowed combinations of Protocol Layer and Transport Layer parts. For details about the Compatibility Matrix please refer the base standard [1].

3.2 REFERENCES TO OTHER STANDARDS

For details about the References to other standards please refer the base standard [1].

4 THE XCP TRANSPORT LAYER FOR SXI (SPI AND SCI)

4.1 ADDRESSING

In general SPI and SCI (SxI) are no bus interfaces, they are used as a point to point connection. Therefore an addressing feature is not part of the transport layer.

4.2 COMMUNICATION MODEL

XCP on SxI makes use of the standard communication model.
The block transfer communication is optional.
The interleaved communication model is optional.

4.3 HEADER AND TAIL

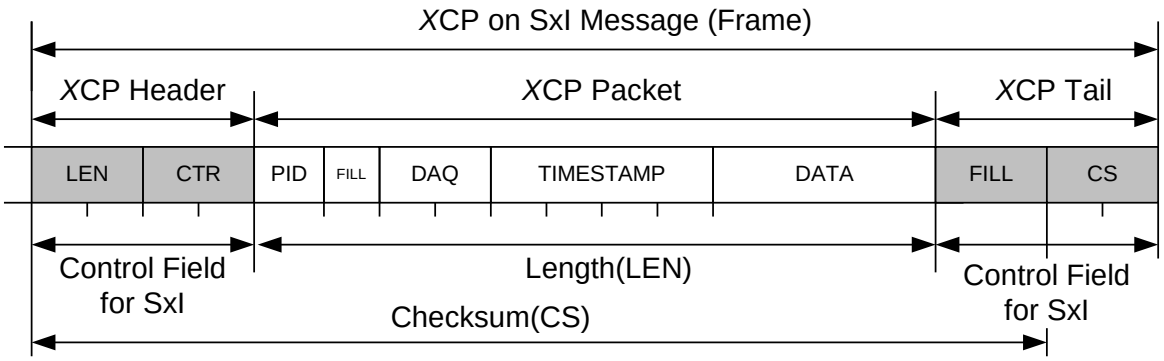

Figure 1 Header and tail for XCP on SxI

4.3.1 HEADER

The XCP packet header for SxI consists of a Control Field containing a **LEN**gth (LEN) and an optional **C**oun**T**e**R** (CTR).

4.3.1.1 LENGTH

LEN is the number of bytes in the original XCP Packet. LEN can be BYTE or WORD (Intel format).

4.3.1.2 COUNTER

The CTR value in the XCP Header allows detecting missing Packets.
The master has to generate a CTR value when sending a CMD or STIM message. The CTR value must be incremented for each new packet sent from master to the slave.
The slave has to generate a (second, independent) CTR value when sending RES, ERR, EV, SERV or DAQ messages. The CTR value must be incremented for each new packet sent from slave to the master.
If available, CTR always has the same size as LEN.

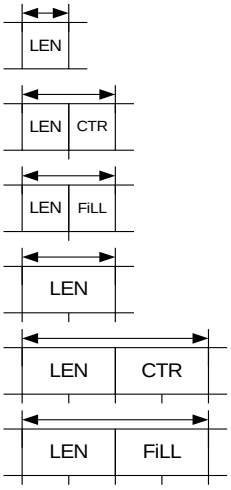

Figure 2 Header types for XCP on SxI

4.3.2 TAIL

4.3.2.1 FILL BYTES

Depending on the alignment (when using the SPI in WORD or DWORD mode) and the minimum packet size (when Master/Slave SPI mode is used), `LEN_FILL (= MAX_CTO(DTO)-LEN)` optional fill bytes can be added at the end of the XCP Message.

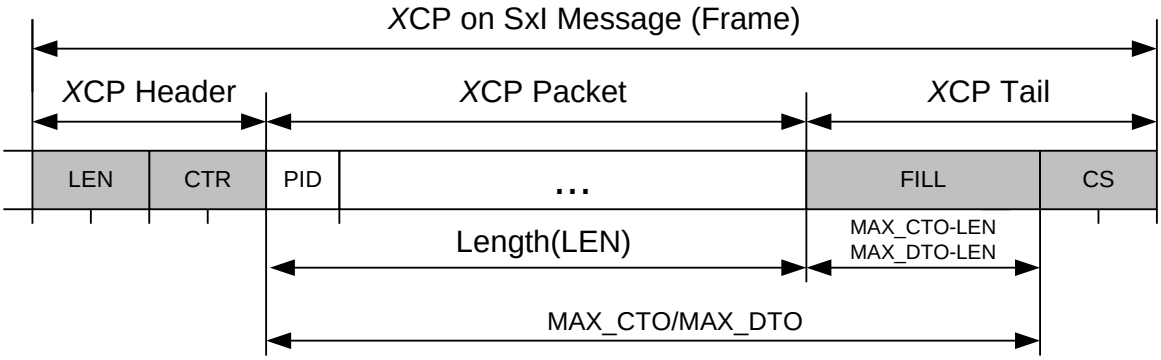

Figure 3 Fill bytes in tail for XCP on SxI

4.3.2.2 CHECKSUM

The XCP Tail may contain an optional BYTE or WORD size checksum.
For a BYTE checksum the calculation must be done byte-wise, for a WORD checksum the calculation must be done word-wise. The checksum is calculated by adding the bytes of the XCP Header, the bytes of the XCP Packet and the Fill bytes of the XCP Tail into a BYTE or WORD checksum, ignoring overflows.

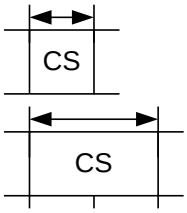

Figure 4 Checksum in tail for XCP on SxI

4.4 THE LIMITS OF PERFORMANCE

There are no additional restrictions of MAX_CTO and MAX_DTO for XCP on SxI.

Table 1 CTO and DTO range

Name	Type	Representation	Range of value
MAX_CTO	Parameter	BYTE	0x08 – 0xFF
MAX_DTO	Parameter	WORD	0x0008 – 0xFFFF

4.5 COMMUNICATION MODES

4.5.1 ASYNCHRONOUS COMMUNICATION MODE (SCI)

In asynchronous (SCI) full duplex mode each direction is fully independent of the other and there are no restrictions regarding the protocol.

4.5.1.1 ASYNCHRONOUS COMMUNICATION MODE WITH FRAMING

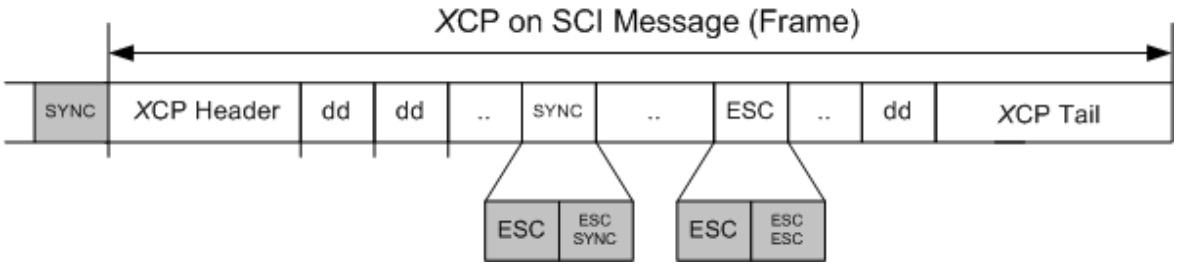

Figure 5 Framing for XCP on SCI

For improving frame detection capabilities, a framing mechanism can be used.
The framing protocol defines two special characters: SYNC and ESC. If framing is used, every XCP on SCI Message is preceded by a SYNC character. If Inside the XCP on SCI Message a data byte occurs that is the same as SYNC, it is replaced by the two-byte sequence ESC+ESC_SYNC. If inside the XCP on SCI Message a data byte occurs that is the same as ESC, it is replaced by the two-byte sequence ESC+ESC_ESC.
With the FRAMING block in the ASAM MCD-2 MC description file the slave can inform the master that it has to use the framing mechanism.
SYNC and ESC are configurable, ESC_SYNC = 0x01, ESC_ESC = 0x00

4.5.2 SYNCHRONOUS COMMUNICATION MODE (SPI)

4.5.2.1 FULL DUPLEX MODE

In synchronous (SPI) full duplex mode each direction has its own clock line.
Both directions are fully independent of each other and there are no restrictions regarding the protocol.
This mode is available for BYTE, WORD and DWORD SPI interfaces.
When using a WORD or DWORD SPI interface, alignment requirements must be met.
In this case the Identification_Field_Type for DAQ packets must be 0x01 or 0x03. Also the timestamp size must be 2 or 4 byte.
For XCP messages with odd length, a fill byte must be added in the XCP Tail.

Example:

LEN	CTR			ODT	DAQ	Timestamp		Data					
9	0	X	X	3	1	T_l	T_h	D[0]	D[1]	D[2]	D[3]	D[4]	0

DAQ message: WORD LEN, WORD CTR, WORD SPI, no CS, 1 fill byte

4.5.2.2 MASTER/SLAVE MODE

In synchronous (SPI) master/slave mode, one clock line is used for both directions.
The device which supplies the clock is called the SPI master.
In this case the SPI slave can only send a message, if the SPI master sends a message in parallel, because the clock is required from SPI master. The SPI slave must ensure that the message to be transmitted starts synchronously to the message to be received.
For DAQ purposes the XCP slave should be the SPI master to ensure that it is able to transmit a DAQ packet with low latency.
During configuration time, when no DAQ is running, the XCP slave must transmit dummy packets in order to enable the XCP master to send command packets for configuration. This needs to be done frequently.
The dummy packet is defined as an event packet with the event code `EV_TRANSPORT`. All other bytes of this event packet must be zero to be compatible with future extensions.

Example:

LEN		CTR		PID	EV	Fill bytes					
2	0	X	X	0xFD	0xFF	0	0	0	0	0	0

Dummy message with WORD LEN and CTR:

The minimum length for all packets sent by the XCP slave must be at least `MAX_CTO`.
This is to ensure that all kind of command packets could be sent by the XCP master.

This mode is available for BYTE, WORD and DWORD SPI interfaces.
When using a WORD or DWORD SPI interface, the same alignment requirements as for Full Duplex Mode must be met

5 SPECIFIC COMMANDS FOR XCP ON SXI

There are no specific commands for XCP on SxI at the moment.

6 SPECIFIC EVENTS FOR XCP ON SXI

Table 2 Event codes overview

Event	Code	Remark
EV_DUMMY	0xFF	Optional

6.1 DUMMY PACKET

Category SPI Master/Slave mode only, optional
Mnemonic `EV_DUMMY`

Table 3 EV_DUMMY event package

Position	Type	Description
0	BYTE	Event Packet = 0xFD
1	BYTE	EV_TRANSPORT = 0xFF

The DUMMY packet is used for SPI applications when the SPI is used in Master/Slave mode.
In this case an event packet must be sent by the XCP slave (which is the SPI master) frequently to keep the communication alive.
If DAQ is running, no DUMMY packets are required.

Note: The minimum message size must be at least `MAX_CTO` bytes, plus the size of the XCP Header, plus the size of the Checksum in the XCP Tail. Therefore additional fill bytes must be added in the Tail of the event message.

7 INTERFACE TO ASAM MCD-2 MC DESCRIPTION FILE

The following chapter describes the parameters that are specific for XCP on FlexRay.

7.1 ASAM MCD-2 MC AML FOR XCP ON SXI

The AML for the XCP on SxI transport layer specific properties is defined in the file named XCP_vX_Y_on_SxI.aml where vX_Y is the current protocol layer version.

7.2 IF_DATA EXAMPLE FOR XCP ON SXI

The file XCP_vX_Y_IF_DATA_example.a2l where vX_Y is the current protocol layer version gives an IF_DATA example for a XCP on SxI transport layer (see section beginning with “/begin XCP_ON_SxI”).

8 SYMBOL AND ABBREVIATED TERMS

A2L	ASAM MCD-2 MC Language File
CAN	Controller Area Network
CCP	CAN Calibration Protocol
CMD	Command
CTO	Command Transfer Object
CTR	Counter
DAQ	Data Acquisition
DTO	Data Transfer Objects
ECU	Electronic Control Unit
ERR	Error
EV	Event
IP	Internet Protocol
LEN	Length
PID	Packet Identifier
RES	Responses
SCI	Serial Communication Interface
SPI	Serial Peripheral Interface
STIM	Synchronous Data Stimulation
SxI	Serial X Interface
TCP	Transfer Control Protocol
UDP	User Datagram Protocol
USB	Universal Serial Bus
XCP	Universal Measurement and Calibration Protocol

9 BIBLIOGRAPHY

[1] ASAM AE MCD-1 XCP BS Protocol-Layer BS Version V1.3.0

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