Document Title	Requirements on Serial Peripheral Interface (SPI) Handler/Driver
Document Owner	AUTOSAR GbR
Document Responsibility	AUTOSAR GbR
Document Identification No	077
Document Classification	Auxiliary

Document Version	2.0.4
Document Status	Final
Part of Release	3.1
Revision	0001

Document Change History

Date	Version	Changed by	Change Description
23.06.2008	2.0.4	AUTOSAR Administration	Legal disclaimer revised
31.10.2007	2.0.3	AUTOSAR Administration	• Document meta information extended • Small layout adaptations made
24.01.2007	2.0.2	AUTOSAR Administration	• “Advice for users” revised • “Revision Information” added
28.11.2006	2.0.1	AUTOSAR Administration	Legal disclaimer revised
30.03.2006	2.0.0	AUTOSAR Administration	Release as a separate document. The SRS SPAL V1.0.0 has been split into 12 independent documents for Release 2.0. • Change of the document scope (§1), the functional overview (§5.1.1 / §5.2.1 / §5.3.1) • Add of [BSW13400] Scalable functional perimeter, [BSW13401] Functional perimeter statically configurable • Change of following requirements BSW12151, BSW12152, BSW12153, BSW12154 and BSW12197], [BSW13400], [BSW13401] • Approvement of [BSW12151], [BSW13400], [BSW13401], BSW12152, BSW12153 and BSW12154
11.07.2005	1.0.0	AUTOSAR Administration	Initial release as a part of the SRS SPAL V1.0.0

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Table of Content

1 Scope of this document

This document specifies requirements on the monolithic SPI Handler/Driver module including:

- Multiple SPI busses handling
- Synchronous SPI transmission
- Asynchronous SPI transmission

Constraints

First scope for specification of requirements on basic software module is systems which are not safety relevant. For this reason safety requirements are assigned to medium priority.

2 How to read this document

Each requirement has its unique identifier starting with the prefix “BSW” (for “Basic Software”). For any review annotations, remarks or questions, please refer to this unique ID rather than chapter or page numbers!

2.1 Conventions used

In requirements, the following specific semantics are used (taken from Request for Comment RFC 2119 from the Internet Engineering Task Force IETF)

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119. Note that the requirement level of the document in which they are used modifies the force of these words.

- MUST: This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.
- MUST NOT: This phrase, or the phrase „SHALL NOT“, means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
- MAY: This word, or the adjective „OPTIONAL“, means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation, which does not include a particular option, MUST be prepared to interoperate with another implementation, which does include the option, though perhaps with reduced functionality. In the same vein an implementation, which does include a particular option, MUST be prepared to interoperate with another implementation, which does not include the option (except, of course, for the feature the option provides.)

2.2 Requirements structure

Each module specific chapter contains a short functional description of the Basic Software Module. Requirements of the same kind within each chapter are grouped under the following headlines (where applicable):

Functional Requirements:
- Configuration (which elements of the module need to be configurable)
- Initialisation
- Normal Operation
- Shutdown Operation
- Fault Operation
- ...

Non-Functional Requirements:
- Timing Requirements
- Resource Usage
- Usability
- Output for other WPs (e.g. Description Templates, Tooling,...)
- ...

3 Acronyms, abbreviations and expressions

Acronyms and abbreviations that have a local scope are not contained in the AUTOSAR glossary. These must appear in a local glossary.

Acronym:	***Description:***
CS	Chip Select
DIO	Digital Input Output
ECU	Electric Control Unit
DMA	Direct Memory Access
HIS	Herstellerinitiative Software
ICU	Input Capture Unit
MAL	Old name of Microcontroller Abstraction Layer (replaced by MCAL because 'MAL' is a french term meaning 'bad')
MCAL	MicroController Abstraction Layer
MCU	MicroController Unit
MISO	Master Input Slave Output
MMU	Memory Management Unit
MOSI	Master Output Slave Input
Master	A device controlling other devices (slaves, see below)
Slave	A device being completely controlled by a master device
NMI	Non Maskable Interrupt
OS	Operating System
PLL	Phase Locked Loop
PWM	Pulse Width Modulation
RX	Reception (in the context of bus communication)
SPAL	The name of this working group
SFR	Special Function Register
RTE	RunTime Environment

Abbreviation:	***Description:***
STD	Standard
REQ	Requirement
UNINIT	Uninitialized (= not initialized)

As this is a document from professionals for professionals, all other terms/expressions are expected to be known.

Term / Expression:	***Description:***
Channel	A Channel is a software exchange medium for data that are defined with the same criteria: Config. Parameters, Number of Data elements with same size and data pointers (Source & Destination) or location.
Job	A Job is composed of one or several Channels with the same Chip Select (is not released during the processing of Job). A Job is considered atomic and therefore cannot be interrupted by another Job. A Job has an assigned priority.
Sequence	A Sequence is a number of consecutive Jobs to transmit but it can be rescheduled between Jobs using a priority mechanism. A Sequence transmission is interruptible (by another Sequence transmission) or not depending on a static configuration.

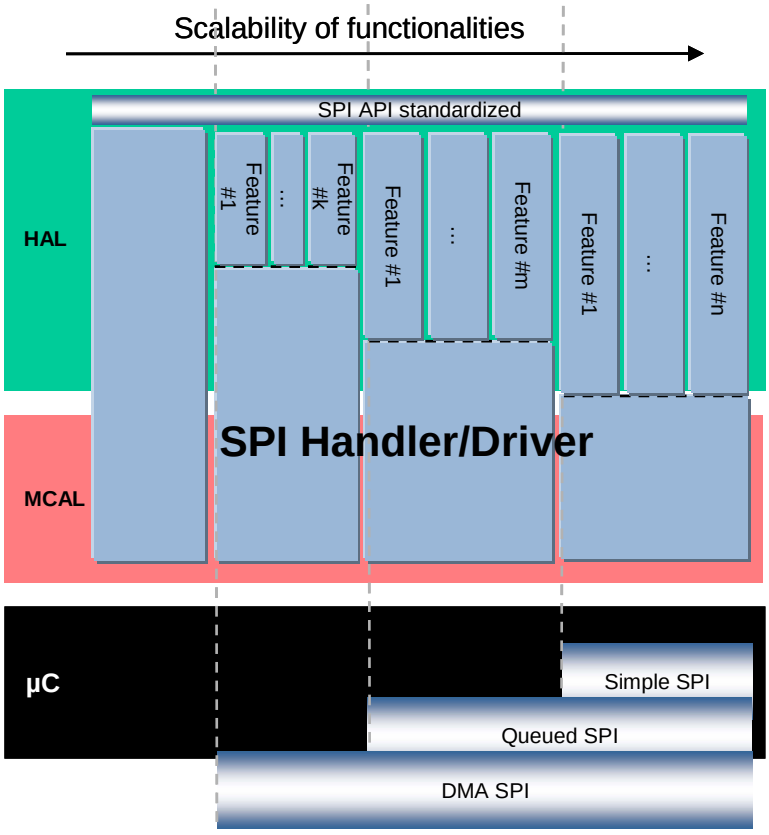
4 Requirement Specification

4.1 SPI Handler/Driver, common requirements

4.1.1 Functional Overview

A SPI bus is a master slave multi node bus system, the master sets a Chip Select (CS) to select a slave for data communication. The SPI (Serial Peripheral Interface) has a 4-wire synchronous serial interface. Data communication is enabled with a Chip Select wire (CS). Data is transmitted with a 3-wire interface consisting of wires for serial data input (MOSI), serial data output (MISO) and Serial ClocK (SCK).

The following SPI module provides channel based read, write and transfer access to different devices on SPI busses. A SPI channel represents data elements (8 to 16 data bits). These channels could be combined in sequence which shall not be interrupted (e.g. Daisy-Chain, EEPROM). Channels have a static configuration defining baud rate, chip select,… A SPI device is generally identified by the used SPI hardware unit and the associated chip select line. The module can operate only as SPI master.



The functional perimeter of this software module will be statically configurable to fit as far as possible to the real needs of each ECU. That means for instance synchronous, asynchronous or both SPI access could be present in the ECU. Consequently, two SPI drivers could exist but just one handler interface. This chapter contains common requirements that are valid both for synchronous and asynchronous SPI drivers.

4.1.2 Functional Requirements

4.1.2.1 General

4.1.2.1.1 [BSW12093] SPI Channel support

Initiator:	LEAR & WP4.2.2.1.12
Date:	08.11.2005
Short Description:	SPI Channel support
Type:	Changed (improve the usage of channel term) Changed (restriction is removed and no restriction to define channels)
Importance:	High
Description:	The SPI Handler/Driver shall be able to handle multiple busses of communication. Every device connected to SPI busses will be handled by channels..
Rationale:	This will abstract the upper layers from the hardware, making reference to the information and not to the hardware.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.1.2 [BSW12094] Chip select

Initiator:	LEAR
Date:	03.06.2004
Short Description:	Chip select
Type:	Changed (notification and chip select functionality split up into 2 requirements)
Importance:	High
Description:	The SPI Handler/Driver shall handle the chip select.
Rationale:	Basic functionality
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.1.3 [BSW12256] Support of all controller peripherals

Initiator:	SiemensVDO
Date:	23.07.04
Short Description:	Support of all controller peripherals
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall support all controller peripherals, which are capable of performing the SPI functionality (data in/ data out/ clock+ optional chip select signal).
Rationale:	HW encapsulation
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.1.4 [BSW12257] Support of chained HW devices

Initiator:	SiemensVDO
Date:	23.07.04
Short Description:	Support of chained HW devices
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall support the communication to daisy chained HW devices. During the transfer to/from the HW devices, the CS signal shall remain asserted.
Rationale:	Due to limited controller resources (CS signals) some external HW devices can be daisy chained, using the same CS signal.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.1.5 [BSW13400] Scalable functionality

Initiator:	VALEO
Date:	13.07.05
Short Description:	Scalable functionality
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall have a scalable functionality to fit the needs of the ECU. For example: Asynchronous, synchronous, interruptible sequences…
Rationale:	To optimize the memory and CPU resource usage.
Use Case:	If only non interruptible sequences are used do not implement any scheduling strategies based on priorities.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.2 Configuration

4.1.2.2.1 [BSW12025] Configuration of SPI general SW and HW properties

Initiator:	BMW & WP4.2.2.1.12
Date:	08.11.2005
Short Description:	Configuration of SPI general SW and HW properties
Type:	Changed (make the requirement more abstract) Changed (default chip select mode and slave mode removed, chip select functionality & mode, priority and notification function added) Changed (the data width, " Wrap around mode on/off " rejected because unclear).
Importance:	High
Description:	The SPI Handler/Driver shall allow the static configuration of all software and hardware properties related to SPI. The following list is a list of proposed properties: 1. assigned SPI HW Unit 2. assigned chip select pin (it is possible to assign no pin) 3. Chip select functionality on/off

	4. Chip select pin polarity high or low 5. Chip select mode (normal mode or hold mode) 6. Baud rate 7. Timing between clock and chip select 8. data width (1 up to 32 bits) 9. transfer start LSB or MSB 10. shift clock idle low or idle high 11. data shift with leading or trailing edge 12. MCU dependent properties for the channels
Rationale:	Flexibility and Scalability
Use Case:	--
Dependencies:	[BSW12259] Support of different timing and HW parameters [BSW12032] Chip select mode – normal mode [BSW12033] Chip select mode – hold mode
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.1.1

4.1.2.2.2 [BSW12179] SPI Channel linkage

Initiator:	LEAR
Date:	15.07.2004
Short Description:	SPI Channel linkage
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall allow linking consecutive SPI channels by static configuration.
Rationale:	Allow to form streams of SPI communication.
Use Case:	As a clarifying example: To communicate with an external SPI EEPROM someone uses channels 30 to 35 in such a way that: • Channel 30 is the action command • Channel 31 is the high address • Channel 32 is the low address • Channel 34 is the first byte of the data • Channel 35 is the second byte of the data
Dependencies:	[BSW12181] Handling of linked SPI channels
Conflicts:	--
Supporting Material:	[BSW12093] SPI Channel support

4.1.2.2.3 [BSW12026] Assignment of SPI Channel to SPI HW Unit

Initiator:	BMW
Date:	22.06.2004
Short Description:	Assignment of SPI Channel to SPI HW Unit
Type:	Changed (Slave mode removed)
Importance:	High
Description:	The SPI Handler/Driver shall allow the static configuration of the desired number of SPI channels (max. 255)..
Rationale:	The SPI-Master normally controls more than one device.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.1.2

4.1.2.2.4 [BSW12197] Definition of data width

Initiator:	CAS
Date:	14.12.2005
Short Description:	Definition of data width
Type:	Changed (new range from 1 up to 32 bits)
Importance:	High
Description:	The SPI Handler/Driver shall offer the possibility of configuring the transmission data width for each SPI channel in the range of 1 to 32 bits (not only 8, 16 or 32 bits).
Rationale:	The size of the registers in the SPI devices varies depending on application needs.
Use Case:	ADC result register is 10 bit, port extension is 8 bit. Whole transfer to one device done without releasing the CS.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.2.5 [BSW13401] Statically configurable functionalities

Initiator:	VALEO
Date:	13.07.05
Short Description:	Statically configurable functionalities
Type:	New
Importance:	High
Description:	The SPI Handler/Driver functionalities shall be statically configurable to include only those needed by the ECU.
Rationale:	To optimize the memory and CPU resource usage.
Use Case:	If only synchronous SPI access is required, do not include asynchronous SPI access.
Dependencies:	[BSW13400] Scalable functionality
Conflicts:	--
Supporting Material:	--

4.1.2.3 Normal Operation

4.1.2.3.1 [BSW12258] Data shall be accessible from each device individually

Initiator:	SiemensVDO & WP4.2.2.1.12
Date:	09.11.05
Short Description:	Data shall be accessible from each device individually
Type:	Change (name and short description)
Importance:	High
Description:	The SPI Handler/Driver shall support access to transferred data (read /write) related to a certain HW device independent of the HW configuration
Rationale:	To ensure HW device abstraction, the transferred data shall be individually accessible by the corresponding HW device driver, independent of the HW configuration.
Use Case:	In case of daisy chained HW devices (different HW devices using same CS signal), the data related to each of the HW devices must be accessible individually.
Dependencies:	--
Conflicts:	--

Supporting Material:	--

4.1.2.3.2 [BSW12259] Support of different timing and HW parameters

Initiator:	SiemensVDO
Date:	23.07.04
Short Description:	Support of different timing and HW parameters
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall support the configuration of the following parameters for each HW device: • Baud rate • Chip select pin polarity high or low • Timing between clock and chip select • shift clock idle low or idle high • data shift with leading or trailing edge
Rationale:	Each connected HW device has different timing requirements
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.3 [BSW12260] Support of different priorities of sequences

Initiator:	SiemensVDO
Date:	03.08.04
Short Description:	Support of different priorities of sequences
Type:	New
Importance:	medium
Description:	The SPI Handler/Driver shall support static assignment of a priority to each sequence
Rationale:	Allow prioritization of asynchronous communication requests.
Use Case:	Saving of crash data to external EEPROM should not be delayed due to other SPI communication. Already requested other SPI communication shall be delayed until crash data is saved.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.4 [BSW12180] Handling of single SPI channels

Initiator:	BMW
Date:	15.07.2004
Short Description:	Handling of single SPI channels
Type:	New
Importance:	High
Description:	If an SPI access request for a single (not linked) SPI channel is performed, the SPI Handler/Driver shall access the SPI bus only for this channel.
Rationale:	This is nearly trivial, but helps understanding the following requirement [BSW12181].
Use Case:	Simple transmission of one SPI channel.

Dependencies:	--
Conflicts:	--
Supporting Material:	[BSW12093] SPI Channel support

4.1.2.3.5 [BSW12181] Handling of linked SPI channels

Initiator:	LEAR
Date:	15.07.2004
Short Description:	Handling of linked SPI channels
Type:	New
Importance:	High
Description:	If an SPI access request for a linked channel is performed, the SPI Handler/Driver shall use this SPI channel and all consecutive channels of the same link for SPI bus access.
Rationale:	Support different communication stream lengths. In an SPI communication using linked channels, the starting channel of an action could be any of the channels that form the stream.
Use Case:	Channels 30 to 38 are linked. If an SPI access request selects channel 35 as starting channel for the access, only channels 35, 36, 37 and 38 will be used for that SPI access.
Dependencies:	[BSW12179] SPI Channel linkage
Conflicts:	--
Supporting Material:	[BSW12093] SPI Channel support

4.1.2.3.6 [BSW12032] Chip select mode – normal mode

Initiator:	BMW
Date:	22.06.2004
Short Description:	Chip select mode – normal mode
Type:	Changed (reformulated during review)
Importance:	High
Description:	For an SPI channel assigned to an SPI HW Unit the chip select mode “normal” shall be available: Selection of the assigned chip select pin before the transfer starts and deselection after the transfer has been finished. The SPI HW unit is released.
Rationale:	Normal SPI transfer.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.6.0

4.1.2.3.7 [BSW12033] Chip select mode – hold mode

Initiator:	BMW
Date:	22.06.2004
Short Description:	Chip select mode – hold mode
Type:	Changed (reformulated during review)
Importance:	High
Description:	For an SPI channel assigned to an SPI HW Unit the chip select mode “hold” shall be available:

	Selection of the assigned chip select pin before the transfer starts. If the transfer has been finished, the chip select is kept active. The SPI HW is kept allocated.
Rationale:	Some SPI slave devices require to be kept selected during data processing or between some coherent data transmissions.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.6.0

4.1.2.3.8 [BSW12198] Transfer one short data sequence with variable data

Initiator:	CAS
Date:	26.08.2004
Short Description:	Transfer one short data sequence with variable data
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall provide the functionality of transferring one short data sequence with **variable** data content. “Variable” means data contents change between two transmissions not during a transmit. “Short data sequence” means e.g. 10 words.
Rationale:	Base requirement for data transfer
Use Case:	Transfer data to a simple SPI slave device
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.9 [BSW12253] Transfer one short data sequence with constant data

Initiator:	CAS
Date:	26.08.2004
Short Description:	Transfer one short data sequence with constant data
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall provide the functionality of transferring one short data sequence with **constant** data content. “Short data sequence” means about 10 words.
Rationale:	--
Use Case:	Send commands and addresses, receive results
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.10 [BSW12199] Transfer data to multiple devices in one Sequence

Initiator:	CAS
Date:	14.09.2004
Short Description:	Transfer data to multiple devices in one Sequence

Type:	Change (Title of requirement & description to clarify more)
Importance:	High
Description:	The SPI Handler/Driver shall provide the functionality of transferring any data to any devices like [BSW12198] and [BSW12253] in one transfer sequence.
Rationale:	The amount of data sent shall not be limited by HW implementation. Static definition of communication sequences.
Use Case:	Transfer data to multiple devices connected to the same SPI bus. One single trigger (e.g. periodic 10 ms) can start the communication to multiple HW devices.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.11 [BSW12200] Read large data sequences from one slave device using dummy send data

Initiator:	CAS
Date:	14.09.2004
Short Description:	Read large data sequences from one slave device using dummy send data
Type:	Change (scope of requirement)
Importance:	High
Description:	The SPI Handler/Driver shall provide the functionality of transferring large (up to the magnitude of 100 words) data sequences with only one constant data to send.
Rationale:	--
Use Case:	Read multiple result registers from a complex SPI device sending only a dummy data
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.12 [BSW12261] Read large data sequences from one slave device using variable send data

Initiator:	WP4.2.2.1.12
Date:	31.08.2004
Short Description:	Read large data sequences from one slave device using variable send data
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall provide the functionality of transferring large (up to the magnitude of 100 words) data sequences with variable data to send to one device.
Rationale:	--
Use Case:	Read multiple result registers from a complex SPI device transferring addresses of the registers
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.13 [BSW12201] Read large data sequences from multiple slave devices using dummy send data

Initiator:	CAS
Date:	14.09.2004
Short Description:	Read large data sequences from multiple slave devices using dummy send data
Type:	Change (clarification of description)
Importance:	High
Description:	The SPI Handler/Driver shall provide the functionality of transferring large (up to the magnitude of 100 words) data sequences with constant data to send to multiple SPI slave devices.
Rationale:	--
Use Case:	Read multiple result registers from multiple complex SPI devices
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.14 [BSW12262] Read large data sequences from multiple slave devices using variable send data

Initiator:	WP4.2.2.1.12
Date:	14.09.2004
Short Description:	Read large data sequences from multiple slave devices using variable send data
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall provide the functionality of transferring large (up to the magnitude of 100 words) data sequences with variable data to send to multiple slave devices.
Rationale:	--
Use Case:	Read multiple result registers from multiple complex SPI devices
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3.15 [BSW12202] Support of variable data length

Initiator:	SiemensVDO
Date:	23.07.04
Short Description:	Support of variable data length
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall support data streams to a HW device (CS signal) with variable number of data.
Rationale:	--
Use Case:	Some external EEPROM devices support Burst modes and are capable of transfering data streams from 1 to 32 data bytes.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.4 Fault Operation

As the behavior of the SPI bus is synchronous, no timeout detection is supported by the SPI Handler/Driver itself.

4.2 Asynchronous SPI functionality

4.2.1 Functional Overview

This part of the monolithic SPI Handler/Driver could be so-called driver and provides asynchronous read, write and transfer access to different devices on SPI busses and callback notifications. The access to the different SPI channels is priority controlled.

4.2.2 Functional Requirements

For the asynchronous SPI Driver also the general SPI Handler/Driver requirements apply.

4.2.2.1 Configuration

4.2.2.1.1 [BSW12024] Configuration of SPI HW Unit

Initiator:	BMW
Date:	22.06.2004
Short Description:	Configuration of SPI HW Unit
Type:	Changed (half duplex mode and job management strategy removed)
Importance:	High
Description:	The SPI Handler/Driver shall allow the static configuration of the following options: • Buffer / FIFO usage • MCU dependent properties for SPI HW unit
Rationale:	Flexibility and Scalability
Use Case:	Configuration of DMA buffering for SPI
Dependencies:	--
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.1.0

4.2.2.1.2 [BSW12150] Configuration of SPI asynchronous SW and HW properties

Initiator:	BMW & WP4.2.2.1.12
Date:	08.11.2005
Short Description:	Configuration of SPI asynchronous SW and HW properties
Type:	Changed (make the requirement more abstract) Changed (Priority levels limited to 4)
Importance:	High
Description:	The SPI Handler/Driver shall allow the static configuration of all software and hardware properties related to asynchronous SPI aspects. The following list is a list of proposed properties:

	• Priority: 4 levels • Transmission end notification function
Rationale:	Flexibility and Scalability
Use Case:	→ 1: If a window watchdog and an EEPROM are connected to the SPI interface, the triggering of the watchdog shall have a higher priority than reading/writing streams from the external EEPROM. Other HW configurations may require different behavior and priorities.
Dependencies:	[BSW12025] Configuration of SPI general SW and HW properties
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.1.1

4.2.2.2 Normal Operation

4.2.2.2.1 [BSW12108] Callback notification

Initiator:	LEAR & WP4.2.2.1.12
Date:	08.11.2005
Short Description:	Callback notification.
Type:	Changed (make the requirement more abstract) Changed (derived from [BSW12094])
Importance:	High
Description:	The SPI Handler/Driver shall call the statically configured notification function associated to : • A single SPI channel when its transmission has been performed, • Linked SPI channels when their transmissions have been performed.
Rationale:	Real time behavior, flexibility.
Use Case:	--
Dependencies:	[BSW12180] Handling of single SPI channels [BSW12181] Handling of linked SPI channels
Conflicts:	--
Supporting Material:	--

4.2.2.2.2 [BSW12099] Asynchronous Read Functionality

Initiator:	LEAR & BMW
Date:	08.11.2005
Short Description:	Asynchronous Read Functionality
Type:	Changed (functionality instead of function abstracts more) Changed (LEAR and BMW merged)
Importance:	High
Description:	The SPI Handler/Driver shall provide an asynchronous read functionality. This functionality shall read a data block with the passed length from the selected SPI device giving the following parameters to the driver: • Channel • Address of data buffer where received data is written to • Length of the data This action shall be buffered and done when the driver is ready again. The caller shall be informed about the end of the transaction with a notification as configured..
Rationale:	To allow reading buffered data without blocking SPI transmissions.
Use Case:	--
Dependencies:	--

Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.2.0

4.2.2.2.3 [BSW12101] Asynchronous Write Functionality

Initiator:	LEAR & BMW
Date:	08.11.2005
Short Description:	Asynchronous Write Functionality
Type:	Changed (functionality instead of function abstracts more) Changed (LEAR and BMW merged)
Importance:	High
Description:	The SPI Handler/Driver shall provide an asynchronous write functionality. This functionality shall write a data block with the passed length to the selected SPI device giving the following parameters to the driver: • Channel • Source address • Length of the data The caller shall be informed about the end of the transaction with a notification as configured. The application should be able to read asynchronously the requested information..
Rationale:	This action will be buffered and done when the driver is ready again.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.4.0

4.2.2.2.4 [BSW12103] Asynchronous Read-Write Functionality

Initiator:	LEAR & BMW
Date:	08.11.2005
Short Description:	Asynchronous Read-Write Functionality
Type:	Changed (functionality instead of function abstracts more)
Importance:	High
Description:	The SPI Handler/Driver shall provide an asynchronous read-write functionality. This functionality shall write a data block with the passed length to the selected SPI device and simultaneously read a data block of the same length from the selected SPI device, giving the following parameters to the driver: • Channel • Source address • Write address • Length of the data The application should be able to read asynchronously the requested information.
Rationale:	This action will be buffered and done when the driver is ready again.
Use Case:	Write-read functionality for SPI devices with simultaneous feedback, e.g. control outputs using a SPI ASIC. These devices use to give you a feedback of the status of the outputs.
Dependencies:	--
Conflicts:	--

Supporting Material:	BMW Specification MCAL V1.0a

4.2.2.2.5 [BSW12037] Job Management Strategy – Priority controlled

Initiator:	BMW
Date:	03.05.2004
Short Description:	Job Management Strategy – Priority controlled
Type:	New
Importance:	High
Description:	The SPI Handler/Driver shall allow a priority controlled allocation of the HW SPI unit: The SPI channels can have different priorities. After release of the SPI HW unit, the requesting SPI channel with the highest priority gets the transfer right.
Rationale:	Efficient allocation algorithm with deterministic job execution.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BMW Specification MCAL V1.0a, MAL40.7.0

4.2.2.2.6 [BSW12104] SPI status functionality

Initiator:	WP4.2.2.1.12
Date:	08.11.2005
Short Description:	SPI status functionality
Type:	Changed (functionality instead of function abstracts more)
Importance:	High
Description:	The SPI Handler/Driver shall provide a synchronous functionality which returns any transfer status..
Rationale:	Check whether the SPI transmission is done.
Use Case:	To know if data transfer is done but also to know if ECU could go to sleep.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.2.2.2.7 [BSW12170] Concurrent Channel access

Initiator:	WP4.2.2.1.12
Date:	07.07.2004
Short Description:	Concurrent Channel access
Type:	Changed (totally clarified)
Importance:	High
Description:	The SPI Handler/Driver does not provide the ability to prevent a channel data overwrite. Because of this, it is the user's responsibility to take care of data consistency by waiting for the completion of a SPI channel's transmission before writing new data to the same SPI channel. This has to be described as a constraint in the software specification of the SPI Handler/Driver..
Rationale:	--

Use Case:	The user shall follow the following sequence: 1. Call 'write SPI channel' 2. Call 'start SPI channel transfer' 3. Wait for end of transmission 4. Call 'write SPI channel' The following sequence may cause overwriting of data: 1. Call 'write SPI channel' 2. Call 'start SPI channel transfer' 3. Call 'write SPI channel' (may overwrite the data if the SPI is not fast enough)
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.3 Synchronous SPI functionality

4.3.1 Functional Overview

This part of the monolithic SPI Handler/Driver could be so-called driver and provides synchronous read and write access to different devices on SPI busses.

4.3.2 Functional Requirements

For the synchronous SPI Driver also the general SPI Handler/Driver requirements apply.

4.3.2.1 Normal Operation

4.3.2.1.1 [BSW12152] Synchronous Read Function

Initiator:	VALEO
Date:	13.07.2005
Short Description:	Synchronous Read Function
Type:	Changed
Importance:	High
Description:	The SPI Handler/Driver shall provide a synchronous read functionality. This functionality shall allow the reading of a data block with the passed length from the selected SPI device giving the following parameters to the driver: • Channel • Address of data buffer where received data is written to • Length of the data This action shall be done synchronously with the call of function.
Rationale:	--
Use Case:	Read data from an I/O Shift register on board device.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.3.2.1.2 [BSW12153] Synchronous Write Function

Initiator:	VALEO
Date:	13.07.2005
Short Description:	Synchronous Write Function
Type:	Changed
Importance:	High
Description:	The SPI Handler/Driver shall provide a synchronous write functionality. This functionality shall allow the writing of a data block with the passed length to the selected SPI device giving the following parameters to the driver: • Channel • Source address • Length of the data This action shall be done synchronously with the call of function.
Rationale:	--
Use Case:	Write data to an external EEPROM device.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.3.2.1.3 [BSW12154] Synchronous Write-Read Function

Initiator:	VALEO
Date:	13.07.2005
Short Description:	Synchronous Write-Read Function
Type:	Changed
Importance:	High
Description:	The SPI Handler/Driver shall provide a synchronous write-read functionality. This functionality shall allow the writing of a data block with the passed length to the selected SPI device, and simultaneously the reading of a data block with the same length from the selected SPI device, giving the following parameters to the driver: • Channel. • Source address. • Destination address • Length of the data. This action shall be done synchronously.
Rationale:	--
Use Case:	Write-read functionality for SPI devices with simultaneous feedback (SMART devices for power stages).
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.3.2.1.4 [BSW12151] Job Management Strategy – Order of requests

Initiator:	VALEO
Date:	13.07.2005
Short Description:	Job Management Strategy – Order of requests
Type:	Changed
Importance:	High
Description:	The SPI Handler/Driver shall perform jobs in the order requested by the caller. During the processing of an SPI bus transmission all other requests to

	the same SPI bus shall be discarded.
Rationale:	To support a pre-emptive multi tasking system.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	--

5 Related Documentation

5.1 Deliverables of AUTOSAR

[1] List of Basic Software Modules
https:/svn2.autosar.org/repos2/22_Releases
AUTOSAR_BasicSoftwareModules.pdf

[2] Layered Software Architecture
https:/svn2.autosar.org/repos2/22_Releases
AUTOSAR_LayeredSoftwareArchitecture.pdf

[3] General Requirements on Basic Software Modules
https:/svn2.autosar.org/repos2/22_Releases
AUTOSAR_SRS_General.pdf

[4] General Requirements on SPAL
https:/svn2.autosar.org/repos2/22_Releases
AUTOSAR_SRS_SPAL_General.pdf