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1 Scope of Document

This document collects the requirements on the ECU Resource Template (EcuR). The main goal of the EcuR is to provide the scheme for the ECU Resource Description. The ECU Resource Description holds information about the hardware components used to build an AUTOSAR system.

The context of EcuR does enclose

- Processing units
- Memory segments
- IO and communication peripherals
- Micro-controllers
- Ecu electronics
- Sensor and actuators (internal in the Ecu housing but also externally connected to the Ecu)

One usage of the EcuR is to support the system design by providing information about the available hardware resources and their connections.

- Available micro-controller / processor cores on each ECU
- Available memory on each ECU
- Available bus communication interfaces on each ECU

Another usage is the support of the ECU Configuration [6] by providing detailed information about the hardware and their connections.

- How the Ecu electronics is connected to the micro-controller peripherals
- Which micro-controller core has access to which memory and peripherals

2 Conventions to be used

- In requirements, the following specific semantics shall be used (based on 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:

- **SHALL:** This word means that the definition is an absolute requirement of the specification.
- **SHALL NOT:** This phrase means that the definition is an absolute prohibition of the specification.
- **MUST:** This word means that the definition is an absolute requirement of the specification due to legal issues.
- **MUST NOT:** This phrase means that the definition is an absolute prohibition of the specification due to legal constraints.
- **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.)

3 Related Documentation

3.1 Input Documents

The following input documents have been used in the development of these requirements:

- AUTOSAR Methodology [4]
- AUTOSAR Glossary [1]
- Technical Overview [5]
- AUTOSAR Generic Structure Template [2]
- AUTOSAR Model Persistence Rules for XML [3]

3.2 Specification Documents

The requirements collected in this document will be satisfied by the Specification of the ECU Resource Template [7] document.

4 Requirements on ECU Resource Template

4.1 Functional Requirements

4.1.1 General Requirements

4.1.1.1 [ECUR0005] Support configuration of Basic Software

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Support configuration of Basic Software
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide means to describe hardware properties which are supporting the configuration of the AUTOSAR Basic Software.
Rationale:	Some ECU Configuration Parameter values can be derived from the ECU Resource description of the configured hardware.
Use Case:	The maximum number of ADC channels is determined by the available hardware and can therefore be derived from the ECU Resource description.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.1.2 [ECUR0003] Describe characteristic properties of specific hardware elements

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Describe characteristic properties of specific hardware elements
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide means to describe the common and characteristic properties of hardware elements based on their kind.
Rationale:	Due to the diversity in hardware kinds a dedicated description of the properties per hardware kind is needed.
Use Case:	Description of the guaranteed number of erase cycles for EEPROM.
Dependencies:	ECUR0004
Conflicts:	--
Supporting Material:	--

4.1.1.3 [ECUR0004] Describe generic hardware

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Describe generic hardware
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide means to describe hardware elements of any kind.
Rationale:	Some hardware elements can already be described using dedicated means of the ECU Resource template (ECUR0003) – however there are hardware elements which have not been considered in the development of the ECU Resource template. For such hardware generic description mechanisms

	shall be available.
Use Case:	Special ASIC hardware can not be described with dedicated description means but only with generic attributes.
Dependencies:	ECUR0003
Conflicts:	--
Supporting Material:	--

4.1.1.4 [ECUR0006] Describe connections between hardware elements

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Describe connections between hardware elements
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide means to describe in an abstracted way how the individual hardware elements - in an ECU and on the outside of the ECU - are connected.
Rationale:	The way how the individual hardware elements are connected to each other is essential for the configuration of the ECU.
Use Case:	<ul style="list-style-type: none"> In a dual-core micro-controller some memory segments can only be accessed by one core. With the dedicated description of the individual cores and their connections to the memory segments the accessibility can be described. A Can-Transceiver needs several DIO ports for the control. With a description of the connection between the DIO ports and the transceiver the association is formally defined.
Dependencies:	--
Conflicts:	--
Supporting Material:	[Main20] AUTOSAR shall provide mechanisms to support redundancy paths [9]

4.1.1.5 [ECUR0014] Timing properties of hardware

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Timing properties of hardware
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide means to describe the timing properties for hardware I/O, e.g. the latency introduced by a digital I/O hardware port.
Rationale:	Hardware I/O can introduce an additional significant latency, which must be taken into account for the analysis and validation of a system's timing behavior.
Use Case:	Analysis and validation of timing behavior.
Dependencies:	--
Conflicts:	--
Supporting Material:	[RSTM001] Timing properties [8]

4.1.1.6 [ECUR0015] Describe variability of the hardware

Initiator:	WP Methodology&Templates
Date:	24.07.2008

Short Description:	Describe variability of the hardware
Type:	New
Importance:	High
Description:	It shall be possible to describe the variability the actual hardware provides.
Rationale:	Most hardware is highly configurable, however there are restrictions and constraints on how the configuration can happen.
Use Case:	A pin of a controller can be either configured to be ADC or DIO. When the choice is done the other pins of that group are implicitly connected to the same peripheral.
Dependencies:	--
Conflicts:	Question: can this variability be described with ECU Configuration Definition means?
Supporting Material:	[Main360] Management of vehicle diversity is supported by AUTOSAR [9]

4.1.1.7 [ECUR0017] Documentation Support

Initiator:	WP Methodology&Templates
Date:	24.04.2009
Short Description:	Documentation Support
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide means to add documentation to the hardware elements.
Rationale:	To provide additional documentation about ECUs and peripherals, including elaborate text, figures and tables.
Use Case:	<ul style="list-style-type: none"> Provide schematic figures on the ECU Electronics.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.1.8 [ECUR0018] Support hardware descriptions from several sources

Initiator:	WP Methodology&Templates
Date:	12.05.2009
Short Description:	Support hardware descriptions from several sources
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide means to combine the hardware descriptions from several sources.
Rationale:	The different partners in AUTOSAR supplying hardware can contribute their hardware descriptions. The hardware integrator can utilize the individual hardware descriptions to deliver the complete hardware description.
Use Case:	The microcontroller vendor provides an ECU Resource Description for the microcontroller. The ECU vendor creates an ECU Resource Description for the ECU and uses the ECU Resource Description for the microcontroller from the microcontroller vendor.
Dependencies:	--
Conflicts:	--
Supporting Material:	[Main250] AUTOSAR shall provide means to achieve compositionality [9] [Main310] AUTOSAR shall support hierarchical design methods [9]

4.1.2 Requirements to describe dedicated hardware

4.1.2.1 [ECUR0007] Processing Unit specification

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Processing Unit specification
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide dedicated means to describe a processing unit. A processing unit shall be defined as the core of the micro controller / processor.
Rationale:	The number of processing units is essential for the design of a System and ECU.
Use Case:	<ul style="list-style-type: none"> In order to map the context of software execution to cores the individual cores need to be known. In a dual-core micro-controller some memory segments can only be accessed by one core. With the dedicated description of the individual cores the access to these memory segments can be described.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.2 [ECUR0008] Available memory

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Available memory
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide dedicated means to describe memory segments. This includes all possible memory kinds like RAM, ROM, EEPROM, Flash, etc.
Rationale:	The amount of memory segments and their attributes is essential for the design of a System and ECU.
Use Case:	<ul style="list-style-type: none"> The available memory amount is require to be able to allocate software to the different ECUs in the system and check whether the software will fit from a memory point of view. During the linker run the software's memory needs are mapped onto the physical available hardware memory. In order to support this activity the memory segments shall be described for each ECU. In a multi-core micro-controller some memory segments can only be accessed by one core. With the dedicated description of the individual cores the access to these memory segments can be described.
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.3 [ECUR0009] Available communication means

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Available communication means
Type:	New
Importance:	High

Description:	The ECU Resource template shall provide dedicated means to describe communication hardware.
Rationale:	The communication of the ECU is essential and shall be described in a coordinated way together with the System Description and the ECU Configuration.
Use Case:	<ul style="list-style-type: none"> Describe the network ports used for the System Description and the communication design between ECUs. Describe network ports which are not part of the System Description (local network ports to access intelligent sensors/actuators).
Dependencies:	--
Conflicts:	--
Supporting Material:	--

4.1.2.4 [ECUR0010] Available IO HW-Peripherals

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Available IO HW-Peripherals
Type:	New
Importance:	Medium
Description:	The ECU Resource template shall provide dedicated means to describe IO-HW-Peripherals.
Rationale:	The different IO-HW-Peripherals require dedicated means to describe their attributes from a hardware point of view. The different IO-HW-Peripherals require dedicated means to describe their connectivity in the micro controller and to the outside.
Use Case:	<ul style="list-style-type: none"> ADC channel 5 is available on pin 87 of the micro controller. Variant Handling: If the micro controller is configured to have ADC channel 7 on pin 53, DIO can not use the pins 50-57 for its purposes.
Dependencies:	[ECUR0015]
Conflicts:	--
Supporting Material:	--

4.1.2.5 [ECUR0016] IO-HW-Abstraction specification

Initiator:	WP Methodology&Templates
Date:	23.04.2009
Short Description:	IO-HW-Abstraction specification
Type:	New
Importance:	Medium
Description:	The ECU Resource template shall provide the abstract connection information between the hardware sensor / actuator and the IO-HW peripheral using the IO-HW-Abstraction layer.
Rationale:	For the configuration of the IO-HW-Peripherals it is essential to know which sensors / actuators are connected and how the IO-HW-Abstraction will access the corresponding IO-HW-Peripherals.
Use Case:	<ul style="list-style-type: none"> Speed sensor is connected via complex electronics to the IO-Port of the ADC channel 7, micro-controller pin 53. The behavior of the complex electronics will not be described; however the connection itself shall be specified. Thus allowing the implementer of the IO-HW-Abstraction software to get the proper connection information. Transceiver electronics is connected to the Can-Bus, has a connection to the Can Communication Controller, connection to the DIO channel 8 (pin 47) in order to enable the communication and a

	connection to the DIO channel 5 (pin 87) in order to initiate wake-up.
Dependencies:	--
Conflicts:	--
Supporting Material:	[Main130] AUTOSAR shall provide an abstraction of the application software from hardware [9] [Main160] AUTOSAR shall provide a functional interface view of the entire system [9]

4.1.2.6 [ECUR0011] Available sensors and actuators

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Available sensors and actuators
Type:	New
Importance:	High
Description:	The ECU Resource template shall provide dedicated means to describe sensors and actuators.
Rationale:	Allow to establish the relationship between Sensor/Actuator Software Components and the actual hardware elements.
Use Case:	<ul style="list-style-type: none"> Describe the wheel speed sensor hardware and the corresponding Sensor Software Component. Describe the window lifter motor and the corresponding Actuator Software Component.
Dependencies:	--
Conflicts:	--
Supporting Material:	[Main160] AUTOSAR shall provide a functional interface view of the entire system [9]

4.1.3 Requirements on the ECU Resource template development

4.1.3.1 [ECUR0012] Development according to the AUTOSAR Generic Structure Template document

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Development according to the AUTOSAR Generic Structure Template document
Type:	New
Importance:	High
Description:	The UML representation of the ECU Resource template SHALL be developed according to the AUTOSAR Generic Structure Template.
Rationale:	The experience and tools already available for the AUTOSAR Metamodeling shall be reused.
Use Case:	The ECU Resource template is similar to other templates already done with the AUTOSAR Metamodeling Guide.
Dependencies:	--
Conflicts:	--
Supporting Material:	AUTOSAR Generic Structure Template [2]

4.1.3.2 [ECUR0013] Transformation of ECU Resource template modeling according to the AUTOSAR Model Persistence Rules for XML

Initiator:	WP Methodology&Templates
Date:	01.07.2008
Short Description:	Transformation of ECU Resource template modeling according to the

	AUTOSAR Model Persistence Rules for XML
Type:	New
Importance:	High
Description:	The XML representation for the ECU Resource template shall be derived from its UML representation according to the AUTOSAR Model Persistence Rules for XML.
Rationale:	The experience and tools already available for the AUTOSAR Modeling shall be reused.
Use Case:	The ECU Resource template is similar to other templates already done with the AUTOSAR Metamodeling Guide.
Dependencies:	--
Conflicts:	--
Supporting Material:	Model Persistence Rules for XML [3]

5 References

- [1] Glossary
AUTOSAR_TR_Glossary.pdf
- [2] Generic Structure Template
AUTOSAR_TPS_GenericStructureTemplate.pdf
- [3] Model Persistence Rules for XML,
AUTOSAR_TR_XMLPersistenceRules.pdf
- [4] Methodology,
AUTOSAR_MOD_Methodology.pdf
- [5] Technical Overview,
AUTOSAR_TechnicalOverview.pdf
- [6] Specification of ECU Configuration,
AUTOSAR_TPS_ECUConfiguration.pdf
- [7] Specification of the ECU Resource Template
AUTOSAR_TPS_ECUResourceTemplate.pdf
- [8] AUTOSAR RS Timing Extensions
AUTOSAR_TPS_TimingExtensions.pdf
- [9] AUTOSAR Main Requirements
AUTOSAR_RS_inRequirements.pdf