

Overview of Acceptance Tests

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Introduction to AUTOSAR Acceptance Tests: Scope

- AUTOSAR Acceptance Tests are system tests (ICC1) provided at specification level.
- Based on the SW specifications, the scope of acceptance testing has been refined to match the AUTOSAR functionalities visible at the application and bus level

- **Application level**
 - RTE requirements with impact on applications (e.g. generation from artifacts, existence of APIs, behavior, ...)
 - BSW services (e.g. existence/compatibility of services, behavior, ...)
 - Libraries

- **Bus level**
 - Bus behavior (e.g. transmission behavior, bus off handling, network management)
 - Bus protocols (e.g. transport protocol, network management, diagnostic communication)

- AUTOSAR Acceptance Tests are optional. The release of standard acceptance tests does not mandate a specific business model.

Objective

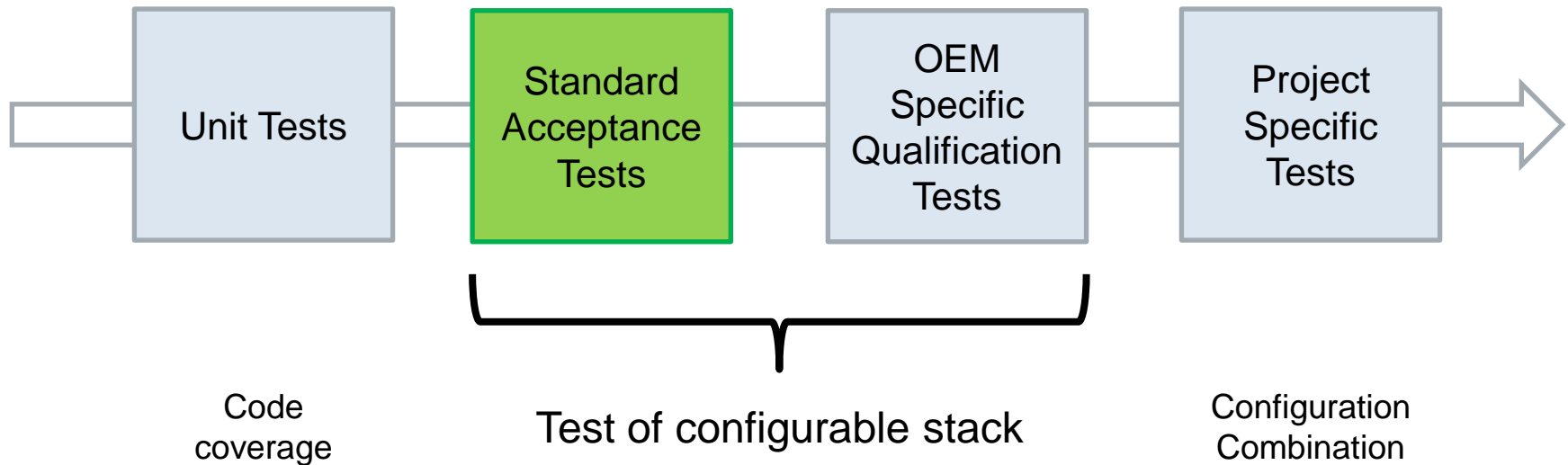
- AUTOSAR Acceptance Tests main objective is to minimize the test effort and test costs
- The specification of standard acceptance tests for an ICC1 stacks can contribute to this objective in the following ways
 - Common test development and maintenance
 - Users do not have to specify and maintain test cases specification
 - Methodology and extensibility
 - A methodology is provided which can be used by users to extend further the standard test suite (e.g. for standard feature not covered in the standard set, or for user specific features)
 - Exchange of trustable test execution results
 - Test cases do not need to be executed by both supplier and customer
 - Test cases can be executed once for multiple customers
 - A test suite implementation can be used for multiple stack implementations
- Limitation
 - Coverage: test cases are only specified for commonly agreed features
 - Tests are not intended to be executed on project specific configurations

Contents and limitations of the standard

- Standardization of test specification
 - AUTOSAR standardizes textual test specification
 - Limitations
 - Format: Test specifications are semi-formal
 - Implementation: The standard does not ensure a single implementation. Implementation designs are needed from implementers
 - Execution: Tests are not intended to be executed on series project specific configurations

- Test of tools
 - Test of tools is out of scope. But tools which participate in ECU code generation (e.g. RTE Generator) are implicitly tested

Acceptance Testing in the overall test activities

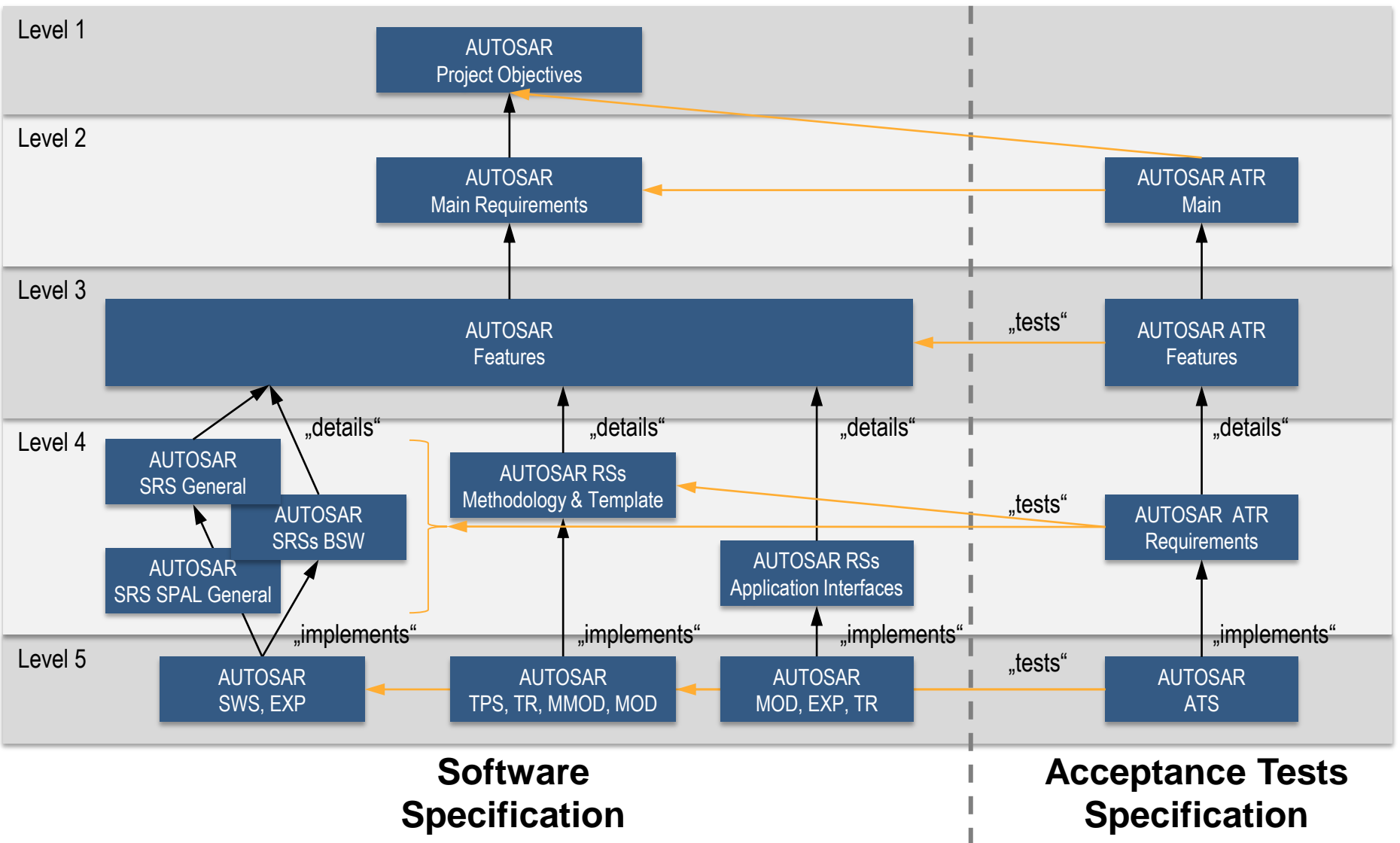


- Standard acceptance tests will not replace other testing activities
- Standard acceptance tests will not replace completely test suites for stack qualification

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Acceptance Tests is a separate work-product traceable to AUTOSAR SW specifications



Support for versions of the AUTOSAR SW specifications

- Test cases are developed for released versions of the software specifications
- At specification level, a test case can be valid for multiple versions (release or revision) of the AUTOSAR software specifications
 - The applicability to versions is documented in each test case (*AUTOSAR Releases* field)
- In order to support users of other releases, test cases can provide hints how the test cases could be adapted, in their configuration requirements or test sequences, to support those release (*Needed Adaptation to other Releases* field)
- The tests specification in the first release of Acceptance Tests are applicable to the software specification of the AUTOSAR Release 4.1, Revision 1.
- Earlier releases are supported
 - When test cases are known to be applicable to R4.0.3 or R3.2.2 (*AUTOSAR Releases* field)
 - When test cases are known to require adaptations in R4.0.3 or R3.2.2

List of AUTOSAR Acceptance Tests deliverables

- Acceptance Test Specifications
 - AUTOSAR_ATS_CommunicationCan, AUTOSAR_ATS_CommunicationFlexRay, AUTOSAR_ATS_CommunicationLin, AUTOSAR_ATS_CommunicationManagement, AUTOSAR_ATS_CommunicationViaBus, AUTOSAR_ATS_DiagnosticServices, AUTOSAR_ATS_EcuModeManagement, AUTOSAR_ATS_MemoryStack, AUTOSAR_ATS_RTE
- AUTOSAR_ATR_Main
 - Refines the objective defined by AUTOSAR to specify AT
 - Defines high level requirements: “AT shall use only ICC1 interfaces”, ...
- AUTOSAR_ATR_Features
 - Defines what is to be tested by AT
 - “AT shall test RTE features”, “TC dedicated to bus compatibility shall be developed”, “AT shall reuse real production examples”, ...
- AUTOSAR_ATR_Requirements
 - Lists SRS (exceptionally SWS) that should be tested by AT
 - Chosen as most relevant through a selection process (OEMs’, Tier 1s’, ... needs)
 - Regrouped by compatibility levels : application, bus, configuration
 - Used as traceability elements by AT specifications (test cases)
 - “AT shall support 1:n Sender-Receiver”, “AT shall support bus-off”, ...
- AUTOSAR_EXP_AcceptanceTestsOverview
 - The current document
- AUTOSAR_TR_ATSReleaseApplicability
 - Document the applicability of each test case on AUTOSAR software releases

Standard

Auxiliary

Content of Acceptance Tests Release R1.0.0

Document	# TC	Features	Short Description
AUTOSAR_ATS_CommunicationCan	6	RS_BRF_01592	Data Transfer
	2	RS_BRF_01648	Large Data Type
	6	RS_BRF_01707	Can Bus Off handling
AUTOSAR_ATS_CommunicationFlexRay	6	RS_BRF_01592	Data Transfer
	2	RS_BRF_01648	Large Data Type
AUTOSAR_ATS_CommunicationLin	6	RS_BRF_01592	Data Transfer
	2	RS_BRF_01648	Large Data Type
AUTOSAR_ATS_CommunicationManagement	5	RS_BRF_01448	ComM Current Mode
	10	RS_BRF_01680	Network management (Fr)
	4	RS_BRF_01680	Network management (Lin)
	10	RS_BRF_01688	ComM User Request
	4	RS_BRF_01696	Partial Networking
	14	RS_BRF_01680	Network management (Can)
AUTOSAR_ATS_CommunicationViaBus	6	RS_BRF_01600	Timeout Handling
	22	RS_BRF_01616	Initial Values
	4	RS_BRF_01632	Data Consistency
	13	RS_BRF_01592	Data Transfer (Bus independent)
	6	RS_BRF_01648	Large Data Type
AUTOSAR_ATS_DiagnosticServices	11	RS_BRF_02184	DiagnosticMonitor (DEM)
	8	RS_BRF_02144	DataServices (DCM)
	2	RS_BRF_02144	RoutineServices (DCM)
AUTOSAR_ATS_EcuModeManagement	2	RS_BRF_01488	EcuM Current Mode
	3	RS_BRF_01488	EcuM State Request
	2	RS_BRF_02152	EcuM Boot Target
	3	RS_BRF_02152	EcuM Shutdown Target
AUTOSAR_ATS_MemoryStack	15	RS_BRF_01416	NvM services
	19	RS_BRF_01312	Rte Client Server Feature
AUTOSAR_ATS_RTE		RS_BRF_01320	
	6	RS_BRF_01328	Rte SWC scheduling and activation from events
	20	RS_BRF_01376	Rte Data Conversion Feature
		RS_BRF_01304	
	13	RS_BRF_01352	Rte Sender Receiver Communication

AUTOSAR_ATR_Main – Example

[ATR_Main_00001] Acceptance tests shall minimize test effort and test costs

Type:	Valid
Description:	In order to avoid redundant test cycles and ease the reuse of test results for users of AUTOSAR standard, acceptance tests shall focus on reduction of test effort and test costs. Test concept shall address explicitly efficiency.
Rationale:	Users of acceptance tests will typically use these tests for checking that a BSW implementation is mature enough to enter the user's ECU software development process. Within this development process, there are usually more in-depth release tests in place. The acceptance tests are thus not required to test the BSW in full depth and with full coverage and can therefore not replace release tests at OEMs or Tier1s. Standard test ease the reuse of test results because they are commonly understood by different market partners (who use the test results / who implement the tests and who execute the tests).
Use Case:	BSW handover into Development process Selection of the standard tests needed for an application (where test results are required) / do implementation (v
Dependencies:	--
Supporting Material:	--
Tested Items:	--

|(RS_PO_00007, RS_PO_00002)

- Acceptance tests shall minimize test effort and test costs
- Acceptance tests shall test interoperability of BSW implementations of one AUTOSAR release in one vehicle network
- Acceptance tests shall test interoperability of BSW implementations in vehicle networks
- Acceptance tests shall test interoperability of BSW implementations to applications
- Acceptance tests shall provide means to measure quality of BSW implementation
- Acceptance tests shall exist for mainstream releases
- Execution of acceptance tests shall be feasible by any market partner
- Acceptance tests shall cover a commonly agreed subset of AUTOSAR requirements
- Acceptance test shall provide a commonly agreed test methodology
- Acceptance tests shall use only ICC1 interfaces

AUTOSAR_ATR_Features – Examples

[ATR_ATF_00004] Application and bus compatibility test cases shall specify the required configurations

Type:	valid
Description:	Application and bus compatibility test cases shall specify requirements on the configuration files needed when test suites are implemented or executed.
Rationale:	<ul style="list-style-type: none"> The AUTOSAR basic software and RTE is heavily dependent on the configuration for its interface to applications and behavior toward applications or buses. The usage of acceptance tests in different contexts (e.g. implementation and execution by a stack vendor, implementation dedicated to one OEM, or implementation required to support multiple basic software implementation) needs flexibility in the actual configuration files used to generate the ECU where tests are executed.

[ATR_ATF_00008] Acceptance Tests shall test BSW services

endency of test results
t for different business models and usage in different
iments

Type:	valid
Description:	AUTOSAR Acceptance Tests shall test all BSW services.
Rationale:	Software reuse is one of the major aims of AUTOSAR. The reuse of Software Components requires that the services of the BSW implementation are compatible
Use Case:	Reuse of a Software Component on different platforms
Dependencies:	
Supporting Material:	
Tested Items:	<ul style="list-style-type: none"> RS_BRF_01408 AUTOSAR shall provide a service layer that is accessible from each basic software layer RS_BRF_01424 AUTOSAR services shall support communication services RS_BRF_01440AUTOSAR services shall support system diagnostic functionality RS_BRF_01448 AUTOSAR services shall support mode and state management

](ATR_Main_00004, ATR_Main_00010)

AUTOSAR_ATR_Requirements - Example

[ATR_ATR_00001] AUTOSAR Acceptance Tests shall support Client Server Asynchronous communication

Type:	Valid
Description:	AUTOSAR shall provide acceptance tests for checking that Client Server Asynchronous communication (client not blocked after the service request is initiated until the response of the server is received) is supported according to the RTE specification.
Rationale:	Software Components with AUTOSAR interfaces shall have the possibility to use different communication schemes. Client Server Asynchronous communication is needed whenever the client needs to continue its operations after requesting a service from a server and collect a response later on.
Use Case:	--
Dependencies:	ATR_ATR_00022, ATR_ATR_00023
Supporting Material:	AUTOSAR_SWS_RTE.pdf, AUTOSAR_SRS_RTE.pdf, AUTOSAR_SoftwareComponentTemplate.pdf
Tested Items:	SRS_Rte_00029, SRS_Rte_00072, SRS_Rte_00079, SRS_Rte_00110, SRS_Rte_00111

|(ATR_ATF_00004, ATR_ATF_00027, ATR_ATF_00007, ATR_ATF_00011)

ATS documents

- ATS documents are organized as a set of test suites.
- Each test suite is documented by
 - General Test Objective and Approach
 - Test System
 - Overview on Architecture
 - Specific Requirements
 - Test Coordination Requirements
 - Test Configuration
 - Required ECU Extract of System Description Files
 - Required ECU Configuration Description Files
 - Required Software Component Description Files
 - Mandatory vs. Customizable Parts
 - Test Case Design
 - Explanations on the design of test cases
 - Re-usable Test Steps
 - Complex set of test steps that can be later reused in test cases
 - Test Cases
 - Set of test cases, each described using the same template. See next slides.



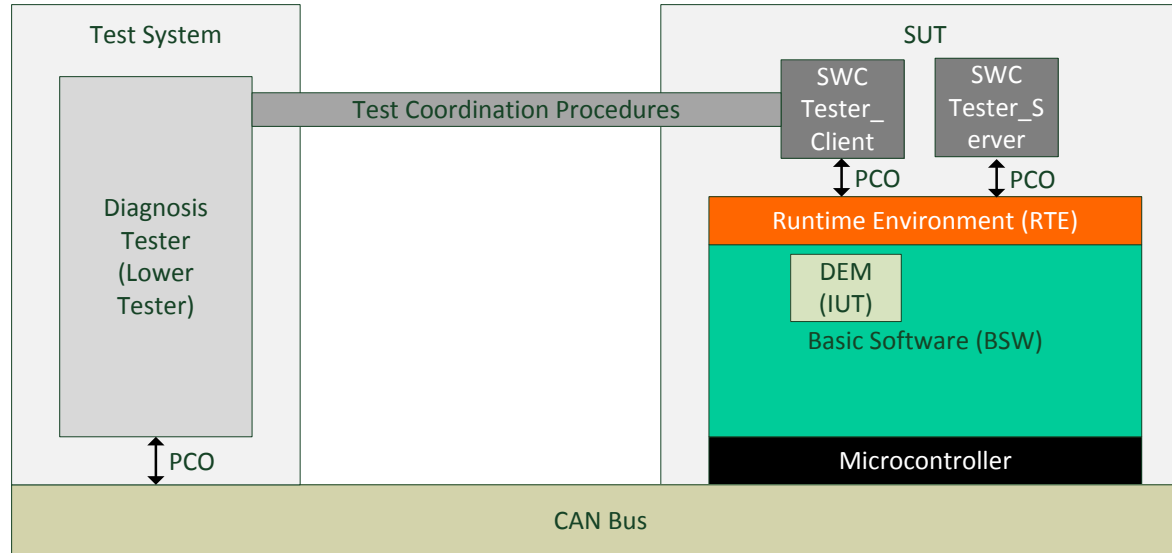
Description or requirements on the test system architecture used to test the feature.



Requirements on how to configure the BSW stack in order to test the feature. They can be completed or superseded by test case specific requirements.

ATS – Example of architecture

- In order to test the System Under Test (the basic software and RTE, seen as a black box ICC1 implementation), the test architecture is usually described using the ISO 9646 notation of a test harness
- The Test system is connected to a lower and upper tester which can both interact with the SUT
 - For example:
 - Messages are sent or observer on the bus
 - Applications on top of the RTE access services, RTE APIs, or receive notifications



ATS – Example - Specification of test cases (1/4)

Test case identifier.
It is unique over all test suites

Short description of the test objective.
This short description is also used as title of test case

Indication where the tested functionality is implemented (in case of ICC3 implementation)

Test Objective	Test Intra-ECU C/S argument rescaling - ClientServerInterfaceMapping Linear Scaling		
ID	ATS_RTE_00145	AUTOSAR Releases	4.0.3 4.1.1
Affected Modules	RTE	State	reviewed
Trace to Requirement on Acceptance Test Document	ATR: ATR_ATR_00028		
Trace to R4.1.1 Item	RTE: SWS_Rte_03818 RTE: SWS_Rte_03819 RTE: SWS_Rte_03829		

List of SW releases for which this test case specification is applicable

Test case state:
proposed,
accepted,
reviewed

Traceability to SWS items relevant for the tested functionality

Traceability to acceptance tests requirement
AUTOSAR_ATR_Requirements

ATS – Example – Specification of test cases (2/4)

Reference to a test environment, described in earlier section of the test suite, or specific requirements for this test case

Requirements / Reference to Test Environment	Use Case 03.01 : Intra-ECU C/S Communication
Configuration Parameters	<p>1 SWC Client The Operation uses parameter with ClientType LowerLimit = 0, UpperLimit = 100 ComputationMethod : PhyToInt : identical</p> <p>1 SWC Server The Operation uses parameter with ServerType LowerLimit = 200, UpperLimit = 1200 Computation Method: PhyToInt : Linear (10*x+200) Both are using uint32 types</p> <p>1 ClientServerInterfaceMapping maps the client to the server</p>

Requirement on the configuration.
 Those requirements have to be taken into account when the BSW stack is configured.
 When possible, they are expressed using upstream template parameters.

ATS – Example – Specification of test cases (3/4)

Detailed objective if needed and short description how the test works

Summary	<p>The Test Manager starts the Client, which calls the server The Test Manager checks that server was invoked with the converted values.</p>				
Needed Adaptation to other Releases	<p>Needed Adaptation for Release [3.2.2]</p> <table border="1"> <tr> <td data-bbox="562 746 857 839"> Configuration: [low] </td> <td data-bbox="857 746 1547 839"> Clinet-server argument rescaling does not exist in R3.2.2. </td> </tr> <tr> <td data-bbox="562 839 857 906"> Test Steps: [n/a] </td> <td data-bbox="857 839 1547 906"> The test case shall be removed </td> </tr> </table>	Configuration: [low]	Clinet-server argument rescaling does not exist in R3.2.2.	Test Steps: [n/a]	The test case shall be removed
Configuration: [low]	Clinet-server argument rescaling does not exist in R3.2.2.				
Test Steps: [n/a]	The test case shall be removed				

Hints on the adaptations needed to apply the test case to other releases (for releases which are not listed in the field "AUTOSAR Releases")

ATS – Example – Specification of test cases (4/4)

Pre-conditions mandatory to execute the test case

Sequence of test steps that shall be executed.

Steps are organized as an action and a pass criteria.

When one of the pass criteria fails, the test case fails.

The actions and pass criteria can be preceded by an indication on where the action has to be performed (resp. where the pass criteria has to be observed).

Pre-conditions	None	
Main Test Execution		
Test Steps		Pass Criteria
Step 1	TCP: starts Tester_Client_1, Tester_Server	
Step 2	Tester_Client_1: invokes the operation (Rte_call) with argument value 0	Tester_Server: is invoked with converted argument value 200
Step 3	Tester_Client_1: invokes the operation (Rte_call) with argument value 100	Tester_Server: is invoked with converted argument value 1200
Step 5	TCP: terminates Tester_Client_1	
Post-conditions	None	

Post-conditions mandatory to restore a working environment

Configuration

- AUTOSAR is highly configurable
 - Interfaces and behavior depends on configuration

- It is assumed that users of AUTOSAR Acceptance Tests use the AUTOSAR Methodology for configuring the System under Test (SUT) and integrating the SUT and test cases in the test environment

- BSW stacks introduce vendor specific parameters, or have specific structure expectation
 - As a result, ECU configuration description cannot easily be exchanged from one stack vendor to another.

- For acceptance tests, at ICC1 level, the idea is to focus on upstream template which can be exchanged:
 - SWC description
 - System description

- Test specification include requirements on configuration for these upstream templates. Requirements on configuration are specified per test case.

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- AUTOSAR Acceptance Tests Specification
 - Black Box tests for an ICC1 configurable stack
 - Well-structured specifications
 - Test cases available for topics identified with high market needs
 - Communication (CAN, LIN, Flexray)
 - Diagnostics
 - NVRAM
 - Mode Management
 - RTE

