Document Title	System Tests of Adaptive Platform
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	890

Document Status	published
Part of AUTOSAR Standard	Adaptive Platform
Part of Standard Release	R19-11

Document Change History

Date	Release	Changed by	Description
2019-11-28	R19-11	AUTOSAR Release Management	• Changed format for Actors (App, Events, Services etc.) • Added new sections and test cases for Security Management, Network Management and Cryptography • Added more test cases for CM, EMO, TS, and E2E • Changed Document Status from Final to published
2019-03-29	19-03	AUTOSAR Release Management	• Changed format for RS traceability items • Added new section and test cases for Time Synchronization • Added more test cases for CM, EMO, and DIAG
2018-10-31	18-10	AUTOSAR Release Management	• Added RS traceability for test cases • Added ISO 9646 framework and mapping on system test architecture • Added more test cases for CM, REST, EMO, and UCM
2018-03-31	18-03	AUTOSAR Release Management	• Test case for RESTful communication is added • Test case for Security is added • Test case for Update and Configuration Management is added • Test case for E2E is added

2010-10-27	17-10	AUTOSAR Release Management	• Initial release

Disclaimer

Table of Contents

1 Acronyms and abbreviations

The glossary below includes terms, acronyms and abbreviations relevant to System Test Specification that are not included in the AUTOSAR Glossary [1].

Abbreviation / Acronym:	Description:
Rx	Reception
RS	Requirement Specification
NRC	Negative Response Code
Tx	Transmission
ST	System Test
SM	State Manager
TCP	Test Coordination Procedures
PCO	Point of Control and Observation
SUT	System Under Test
UT	Upper Tester
IUT	Implementation Under Test
LT	Lower Tester
UTA	UCM Test Application

2 Scope of Document

The system test cases are used to validate RS items in order to confirm whether requirements of functional cluster are satisfied by the AUTOSAR Adaptive Platform Demonstrator. Each test case is applicable with the coupled specification release.

In this R19-11 release, Requirement Specifications of CM (someip, REST), EMO, DIA, LT, PER, IAM, UCM, E2E, TS, SEC, NM and CRYPTO are in the scope of this document.

2.1 Overview on test architecture

In this section, System Test architecture is described according to ISO 9646 test architecture manner. In System Test, FC tester is called as LT (Lower Tester) which stimulate and observe IUT (Implementation Under Test) behavior. AP instances is called as IUT (Implementation Under Test) which is the test target. Applications is called as UT (Upper Tester) which is stimulated by LT and take an action to request test step (e.g. sending message) to IUT.

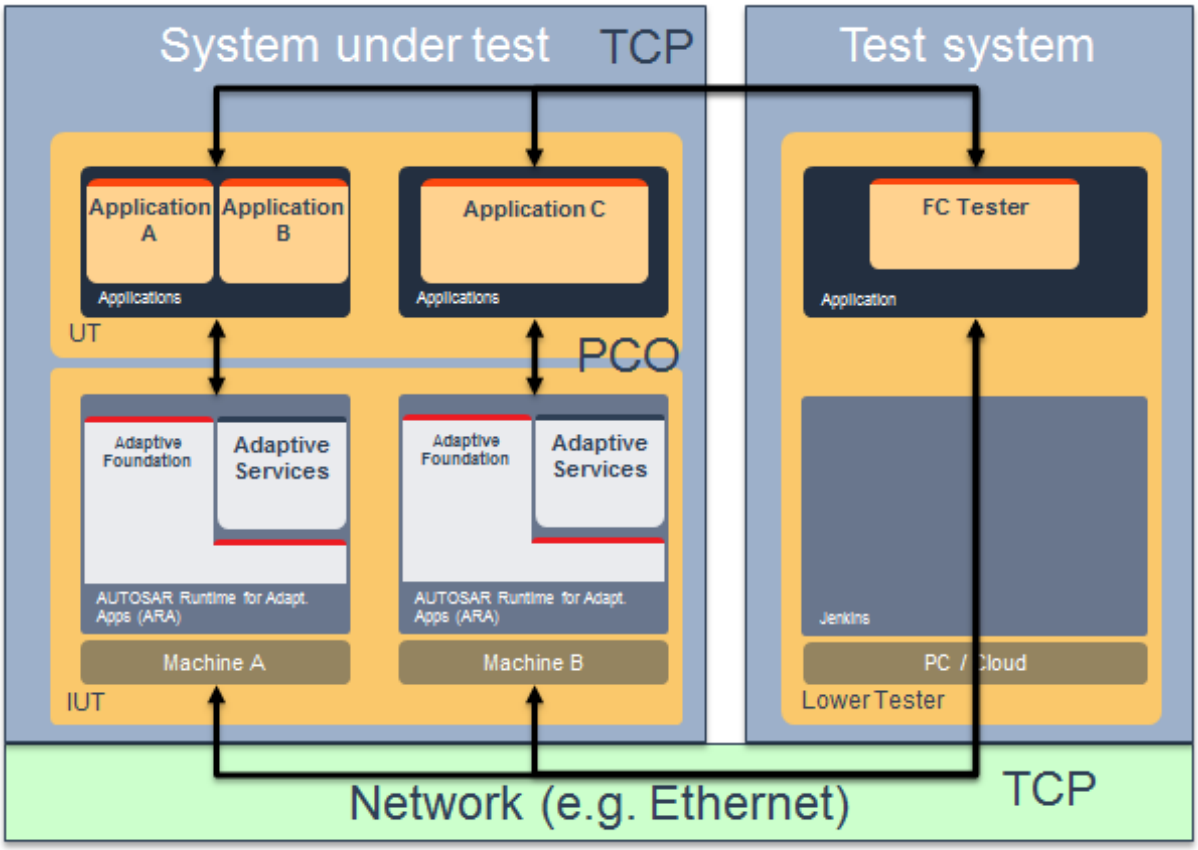

Figure 2.1: System Test architecture

The following picture describing that mapping to System Test implementation. In ST demonstrator, TCP is realized by stimulating application via Diagnostics routine service. PCO is realized by requesting action via ARA::API, and receive/ transmit Ethernet message so that IUT could react. Application send message after certain step is passed so that test system could observe what happens on System under test.

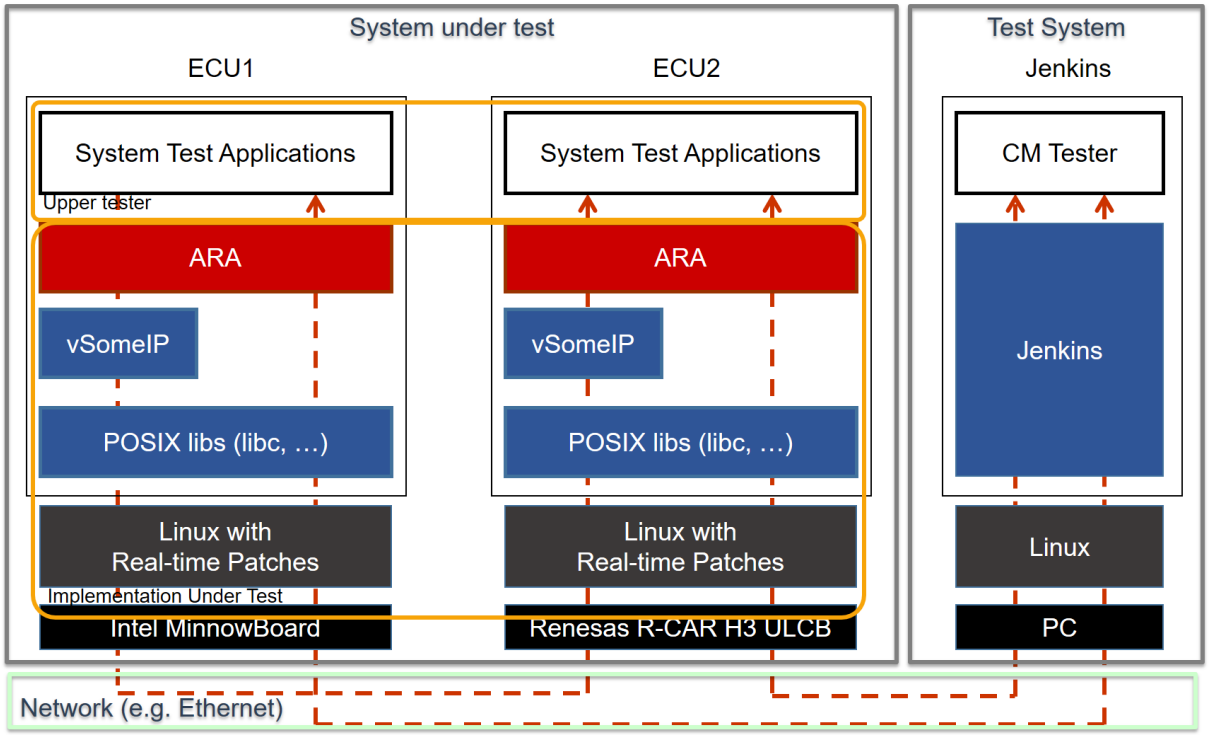

Figure 2.2: Map to System Test implementation

3 Limitations

There are several limitations in this document.

- Test cases may not cover whole RS as specified against test cases
- Test Setup and configurations are for reference purpose only and may cover broader scope than represented by test cases in corresponding sections
- Test cases may not be fully covered by corresponding system test implementations
- System test cases are just examples, since there could be many ways to define and implement use case scenarios
- DIAG traceability is obsolete as SRS is changed to RS
- LT does not have any RS traceability. Traceability will be added in next release
- In the E2E test case, the common parts of the E2E profiles are checked
- Time Base (TB) of Time Synchronization has five TB types. (Synchronized Master TB, Offset Master TB, Synchronized Slave TB, Offset Slave TB, Pure Local TB.) RS_TimeSynchronization describes multiple TB types as scope, but system test cases may not cover whole TB types.
- In Cryptography test cases STS_CRYPTO_00002 and STS_CRYPTO_00004, public and private keys are used only by the test application to simplify the test case (i.e. not corresponding to practical use of asymmetric keys)
- Even if the behaviour is different, same application and/or service numbers are used across different test cases

4 Test configuration and test steps for Communication Management

4.1 Test System

4.1.1 Test configurations Communication Management

Configuration ID	STC_CM_00001
Description	Standard Jenkins server for Communication Management test
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

Configuration ID	STC_CM_00002
Description	Scenario 2 Variant 2 - Reference Deployment
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the Communication Management test ([CM Tester]) is connected via Ethernet to [ECU1] hosting the System Test Application [CMApp01] (as well as [CMApp04] on the alternative configuration) and [ECU2] hosting the System Test Applications [CMApp02], [CMApp03], [CMApp04] and [CMApp05].

The [CM Tester] is supposed to collect the results.

The communication between [CM Tester] and the applications on the ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

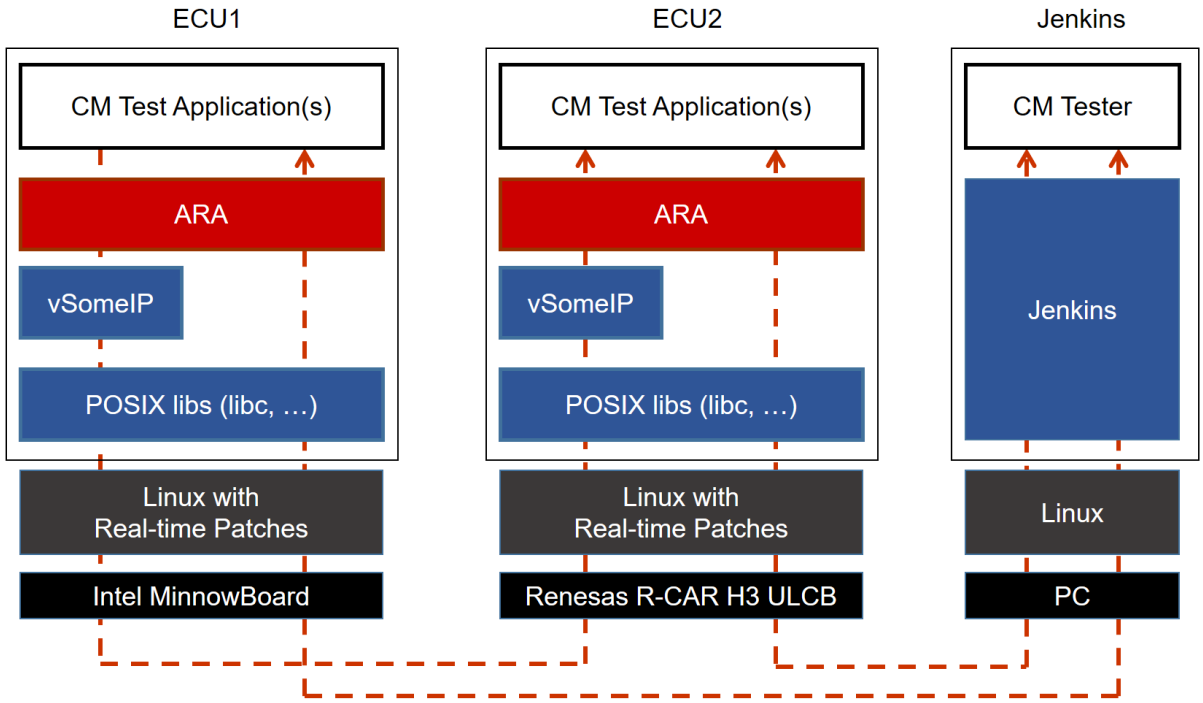

Figure 4.1: Illustration of test setup for Communication Management

4.1.2 Test configurations REST

Configuration ID	STC_REST_00001
Description	Client in backend/ cloud and server in vehicle communicates as per REST
ECU	Intel MinnowBoard Turbot, 192.168.100.5
Backend/ cloud	Server, 192.168.100.10

Configuration ID	STC_REST_00002
Description	Client in vehicle and server in backend/ cloud communicates as per REST
ECU	Intel MinnowBoard Turbot, 192.168.100.5
Backend/ cloud	Client, 192.168.100.10

The Jenkins Server, running the job with the RESTful Communication test [REST Tester] is connected via Ethernet to ECU and backend/ cloud hosting the System Test Applications.

The [REST Tester] is supposed to collect the results.

The communication between [REST Tester] and the applications on the ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

[RESTApp01] behaves as Client and [RESTApp02] behaves as Server.

4.2 Test cases

4.2.1 [STS_CM_00001] Local and remote service discovery.

Test Objective	To verify that the applications are able to offer, request and stop services and that service discovery works, establishing the correct communication paths.		
ID	STS_CM_00001	**State**	Draft
Affected Functional Cluster	Communication Management		
Trace to RS Criteria	[RS_CM_00101], [RS_CM_00102], [RS_CM_00105], [RS_CM_00107], [RS_CM_00211]		
Reference to Test Environment	STC_CM_00001		
Configuration Parameters	- The existing communication services comprise the following (service names are arbitrary): - [CMService01]: Offered by [CMApp02], requested by [CMApp01]. - [CMService02]: Offered by [CMApp02], requested by [CMApp03]. - [CMService03]: Offered by [CMApp01], requested by [CMApp02]. - [CMService04]: Not available, requested by [CMApp03]. - [CMService01], [CMService02], [CMService03] and [CMService04] are attributes of Methods, Events and Fields.		
Summary	First, the [CMApp02] and [CMApp03] applications on [ECU2] are started when Machine State for [ECU2] is changed to Driving. The [CMApp02] offers the services [CMService01] and [CMService02] and requests the service [CMService03]. [CMApp03] requests the service [CMService02]. The [CM Tester] trigger application [CMApp02] to Stop Offering service [CMService02]. Then [CMApp02] again offer service [CMService02] and initial reconnection is established between [CMApp02] and [CMApp03]. Then the [CMApp01] application on [ECU1] is started when Machine State for [ECU1] is changed to Driving. The [CMApp01] offers the service [CMService03] and requests the service [CMService01]. [CMApp03] requests the service [CMService04]. The [CMApp01] stops offering service [CMService03]. All services are supposed to be found once available. If a service is not available, the requesting application is expected to have the possibility to assess the availability. Note: As for order of offering, no particular order of offering and requesting is necessary.		
Pre-conditions	- [CM Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [CMApp01] on [ECU1] and [CMApp02], [CMApp03] on [ECU2] are shut down according to Machine State.		
Post-conditions	CM Tester is disconnected to both ECUs.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[CM Tester] Request change of Machine State to Driving for [ECU2].		Machine State for [ECU2] is changed to Driving.
Step 2	[CMApp02] Offer service [CMService01].		
Step 3	[CMApp02] Offer service [CMService02].		

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Step 4	[CMApp03] Request service [CMService02].	Service discovery callback with a handle for service [CMService02] is received by [CMApp03].
Step 5	[CM Tester] Trigger Application [CMApp02] to Stop Offering service [CMService02].	
Step 6	[CMApp02] Offer service [CMService02].	Service discovery callback with a handle for service [CMService02] is received by [CMApp03].
Step 7	[CMApp02] Request service [CMService03].	Service is not available.
Step 8	[CM Tester] Request change of Machine State to Driving for [ECU1].	Machine State for [ECU1] is changed to Driving.
Step 9	[CMApp01] Offer service [CMService03].	
Step 10	[CMApp02] Request service [CMService03].	Service discovery callback with a handle for service [CMService03] received by [CMApp02].
Step 11	[CMApp01] Request service [CMService01].	Service discovery callback with a handle for service [CMService01] is received by [CMApp01].
Step 12	[CMApp03] Request service [CMService04].	Service is not available.
Step 13	[CMApp01] Stop offering service [CMService03].	
Step 14	[CMApp02] Request service [CMService03]	Service is not available.

4.2.2 [STS_CM_00002] Communication for Methods.

Test Objective	To verify that the applications are able to offer, request and receive services and that communication work in a one-to-n communication topology for Methods.		
ID	STS_CM_00002	**State**	Draft
Affected Functional Cluster	Communication Management		
Trace to RS Criteria	[RS_CM_00101], [RS_CM_00102], [RS_CM_00211], [RS_CM_00212], [RS_CM_00213], [RS_CM_00214], [RS_CM_00215], [RS_CM_00225]		
Reference to Test Environment	STC_CM_00002		
Configuration Parameters	- The existing communication services comprise the following (service names are arbitrary): - [CMService05]: Offered by [CMApp04], requested by [CMApp05]. - [CMService06]: Offered by [CMApp02], requested by [CMApp04]. - [CMService07]: Offered by [CMApp03], requested by [CMApp04]. ▽		

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	△ - [CMService05] service receives requested services synchronously. - [CMService06] service receives requested services asynchronously. One by querying applications and another by triggering applications. - [CMService07] service is an attribute for fire & forget methods.
Summary	Firstly the [CMApp04] application on [ECU1] offers the service [CMService05]. This service is requested by one [CMApp05] instance on [ECU2] and another [CMApp05] instance on [ECU1]. The [CMApp02] application on [ECU2] offers the service [CMService06]. This service is requested by one [CMApp04] instance on [ECU1]. The [CMApp05] on [ECU2] receives data over service [CMService05] from [CMApp04] as synchronous service call. The [CMApp05] on [ECU1] receives data over service [CMService05] from [CMApp04] as synchronous service call. The [CMApp04] receives data as asynchronous service call by querying application [CMApp02] over service [CMService06]. Then [CMApp04] again request service [CMService06]. The [CMApp03] application on [ECU2] offers service [CMService07]. This service is requested by one [CMApp04] instance on [ECU1] as fire & forget service call. Then [CMApp04] receives data over service [CMService06] from [CMApp02] as asynchronous service call by notification. Through successful service discovery, a one-to-n communication topology is established. Note: As for order of offering, no particular order of offering and requesting is necessary.
Pre-conditions	- [CM Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [CMApp04], [CMApp05] on [ECU1] and [CMApp02], [CMApp03], [CMApp05] on [ECU2] are shut down according to Machine State.
Post-conditions	CM Tester is disconnected to both ECUs.

Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[CMApp04] Offer service [CMService05].	
Step 2	[CMApp05] [ECU2] Request service [CMService05].	Service discovery callback with a handle for service [CMService05] is received by [CMApp05] [ECU2].
Step 3	[CMApp05] [ECU1] Request service [CMService05].	Service discovery callback with a handle for service [CMService05] is received by [CMApp05] [ECU1].
Step 4	[CMApp02] Offer service [CMService06].	
Step 5	[CMApp04] Request service [CMService06].	Service discovery callback with a handle for service [CMService06] is received by [CMApp04] [ECU1].
Step 6	[CMApp05] [ECU2] Receive vehicle data over service [CMService05] from [CMApp04].	[CMApp05] [ECU2] Data is received from [CMApp04] over service [CMService05].
Step 7	[CMApp05] [ECU1] Receive vehicle data over service [CMService05] from [CMApp04].	[CMApp05] [ECU1] Data is received from [CMApp04] over service [CMService05].

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Step 8	[CMApp04] Receive vehicle data over service [CMService06].	[CMApp04] Data is received over service [CMService06] by querying application [CMApp02]
Step 9	[CMApp04] Request service [CMService06].	Service discovery callback with a handle for service [CMService06] is received by [CMApp04] [ECU1].
Step 10	[CMApp03] Offer service [CMService07].	
Step 11	[CMApp04] Request service [CMService07] by fire & forget methods.	Service discovery callback with a handle for service [CMService07] may or may not be received by [CMApp04] [ECU1].
Step 12	[CMApp04] Receive vehicle data over service [CMService06].	[CMApp04] is notified that the result is available and can be received from application [CMApp04] over service [CMService06].

4.2.3 [STS_CM_00003] Communication for Events based on polling-based style.

Test Objective	To verify that the applications are able to offer, subscribe, receive and stop subscribing services and that communication work in a one-to-n communication topology for Events. The applications are able to receive events and access them in polling-based style.		
ID	STS_CM_00003	**State**	Draft
Affected Functional Cluster	Communication Management		
Trace to RS Criteria	[RS_CM_00101], [RS_CM_00102], [RS_CM_00104], [RS_CM_00105], [RS_CM_00106], [RS_CM_00201], [RS_CM_00202], [RS_CM_00206]		
Reference to Test Environment	STC_CM_00002		
Configuration Parameters	- The existing communication services comprise the following (service names are arbitrary): - [CMService08]: Offered by [CMApp04], requested by [CMApp05]. - Service [CMService08] is an attribute of Events. - Reception of services from Server to Proxy is possible using pooling-based style.		
Summary	First [CM Tester] request applications on [ECU1] and [ECU2] to change Machine State to Driving. [CM Tester] Request extended diagnostic session on [ECU1] and [ECU2] [CM Tester] trigger application [CMApp04] [ECU2] to start offering service [CMService08] and then application [CMApp04][ECU2]or[ECU1] start offering service [CMService08]. Service [CMService08] is subscribed by application [CMApp05] instance on [ECU1]. The application [CMApp05] [ECU1] Queue received events, <n> being the queue length. Service [CMService08] is subscribed by application [CMApp05] instance on [ECU2]. The application [CMApp05] [ECU2] Queue received events, <n> being the queue length.		

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	△ The application [CMApp05] [ECU1] monitors state of subscription, which is offered by [CMApp04] of service [CMService08]. The application [CMApp05] [ECU2] monitors state of subscription, which is offered by [CMApp04] of service [CMService08]. [CM Tester] will trigger application [CMApp04] [ECU1] to start sending service [CMService08]. The application [CMApp04] [ECU2] will send service event over service [CMService08]. The application [CMApp05] [ECU2] poll for receiving events from application [CMApp04] over service [CMService08]. The application [CMApp05] [ECU1] poll for receiving events from application [CMApp04] over service [CMService08]. [CM Tester] trigger application [CMApp05] [ECU2] and application [CMApp05] [ECU1] to stop subscribing service [CMService08]. The application [CMApp05] [ECU2] Monitor state of subscription from service [CMService08] of application [CMApp04]. The application [CMApp05] [ECU1] Monitor state of subscription from service [CMService08] of application [CMApp04]. Through successful service discovery, a one-to-n communication topology is established. Note: As for order of offering, no particular order of offering and requesting is necessary.
Pre-conditions	- [CM Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [CMApp04], [CMApp05] on [ECU2] and [CMApp05] on [ECU1] are shut down according to Machine State.
Post-conditions	CM Tester is disconnected to both ECUs.

Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[CM Tester] Request change of Machine State to Driving for [ECU1] and [ECU2].	
Step 2	[CM Tester] Trigger Application [CMApp04][ECU2] to Start Offering service [CMService08].	
Step 3	[CMApp05][ECU1] Subscribe to service [CMService08].	
Step 4	[CMApp05] [ECU1] Queue received events, <n> being the queue length	
Step 5	[CMApp05][ECU2] Subscribe to service [CMService08].	
Step 6	[CMApp05] [ECU2] Queue received events, <n> being the queue length	
Step 7	[CMApp05][ECU1] Monitor state of subscription over service [CMService08].	[CMApp05] [ECU1] gets the current status of subscription and notification if it changes from service [CMService08] of application [CMApp04].
Step 8	[CMApp05][ECU2] Monitor state of subscription over service [CMService08].	[CMApp05] [ECU2] gets the current status of subscription and notification if it changes from service [CMService08] of application [CMApp04].

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Step 9	[CM Tester] Trigger Application [CMApp04][ECU2] to Start sending service [CMService08].	
Step 10	[CMApp04] [ECU2] send only 10 service event [CMService08]	
Step 11	[CMApp05] [ECU2] Poll for receiving events from application [CMApp04] over service [CMService08].	[CMApp05] [ECU2] Event is not received over service [CMService05] of application [CMApp04].
Step 12	[CMApp05] [ECU1] Poll for receiving events from application [CMApp04] over service [CMService08].	[CMApp05] [ECU1] Event is not received over service [CMService05] of application [CMApp04].
Step 13	[CM Tester] Trigger Application [CMApp05][ECU2] to Stop subscription of service [CMService08]	
Step 14	[CM Tester] Trigger Application [CMApp05][ECU1] to Stop subscription of service [CMService08]	
Step 15	[CMApp05] [ECU2] Monitor state of subscription from service [CMService08] of application [CMApp04].	[CMApp05] [ECU2] gets the current status of subscription, i.e. [CMApp05] [ECU2] has stopped subscription from service [CMService05].
Step 16	[CMApp05] [ECU1] Monitor state of subscription from service [CMService08] of application [CMApp04].	[CMApp05] [ECU1] gets the current status of subscription, i.e. [CMApp05] [ECU2] has stopped subscription from service [CMService05].

4.2.4 [STS_CM_00004] Communication for Events based on event-based style.

Test Objective	To verify that the applications are able to offer, subscribe, monitor, receive and stop subscribing services and that communication work in a one-to-n communication topology for Events. The applications are able to receive events and access them in event-based style.		
ID	STS_CM_00004	**State**	Draft
Affected Functional Cluster	Communication Management		
Trace to RS Criteria	[RS_CM_00101], [RS_CM_00102], [RS_CM_00104], [RS_CM_00105], [RS_CM_00106], [RS_CM_00201], [RS_CM_00203], [RS_CM_00206]		
Reference to Test Environment	STC_CM_00002		

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Configuration Parameters	- The existing communication services comprise the following (service names are arbitrary): - [CMService05]: Offered by [CMApp04], requested by [CMApp05]. - Service [CMService05] is an attribute of Events. - Reception of services from Server to Client is possible using event-based style.	
Summary	First [CM Tester] request applications on [ECU1] and [ECU2] to change Machine State to Driving. [CM Tester] Request extended diagnostic session [ECU1] and [ECU2]. [CM Tester] trigger application [CMApp04] [ECU1] to start offering service [CMService05] and then application [CMApp04][ECU1] start offering service [CMService05]. Service [CMService05] is subscribed by an application [CMApp05] instance on [ECU1]. The application [CMApp05] [ECU1] Queue received events, <n> being the queue length. Service [CMService05] is subscribed by another application [CMApp05] instance on [ECU2]. The application [CMApp05] [ECU2] Queue received events, <n> being the queue length. The application [CMApp05] [ECU2] monitors state of subscription, which is offered by [CMApp04] of service [CMService05]. The application [CMApp05] [ECU1] monitors state of subscription, which is offered by [CMApp04] of service [CMService05]. [CM Tester] will trigger application [CMApp04] [ECU1] to start sending service [CMService05]. The application [CMApp04] [ECU1] will send service event over service [CMService05]. [CMApp05] [ECU2] Get triggered when receiving event over service [CMService05] of application [CMApp04] [CMApp05] [ECU1] Get triggered when receiving event over service [CMService05] of application [CMApp04] [CM Tester] trigger application [CMApp05] [ECU2] and application [CMApp05] [ECU1] to stop subscribing service [CMService05]. [CMApp05] [ECU1] Monitor state of subscription from service [CMService05] of application [CMApp04]. [CMApp05] [ECU2] Monitor state of subscription from service [CMService05] of application [CMApp04]. Through successful service discovery, a one-to-n communication topology is established. Note: As for order of offering, no particular order of offering and requesting is necessary.	
Pre-conditions	- [CM Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [CMApp04], [CMApp05] on [ECU1] and [CMApp05] on [ECU2] are shut down according to Machine State.	
Post-conditions	CM Tester is disconnected to both ECUs.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[CM Tester] Request change of Machine State to Driving for [ECU1] and [ECU2].	
Step 2	[CM Tester] Trigger Application [CMApp04][ECU1] to Start Offering service [CMService05].	
Step 3	[CMApp05] [ECU1] Subscribe to service [CMService05].	

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Step 4	[CMApp05] [ECU1] Queue received events, <n> being the queue length.	
Step 5	[CMApp05] [ECU2] Subscribe to service [CMService05].	
Step 6	[CMApp05] [ECU2] Queue received events, <n> being the queue length.	
Step 7	[CMApp05][ECU1] Monitor state of subscription over service [CMService05].	[CMApp05] [ECU1] gets the current status of subscription and notification if it changes from service [CMService05] of application [CMApp04].
Step 8	[CMApp05][ECU2] Monitor state of subscription over service [CMService05].	[CMApp05] [ECU2] gets the current status of subscription and notification if it changes from service [CMService05] of application [CMApp04].
Step 9	[CM Tester] Trigger Application [CMApp04][ECU2] to Start sending service [CMService05].	
Step 10	[CMApp04] [ECU1] send service event [CMService05].	
Step 11	[CMApp05] [ECU2] Get triggered when receiving event over service [CMService05] of application [CMApp04].	[CMApp05] [ECU2] Events received and read them at the same time from service [CMService05].
Step 12	[CMApp05] [ECU1] Get triggered when receiving event over service [CMService05].	[CMApp05] [ECU1] Events received and read them at the same time from service [CMService05] of application [CMApp04].
Step 13	[CM Tester] Trigger Application [CMApp05][ECU2] to Stop subscription of service [CMService05]	
Step 14	[CM Tester] Trigger Application [CMApp05][ECU1] to Stop subscription of service [CMService05]	
Step 15	[CMApp05] [ECU1] Monitor state of subscription from service [CMService05] of application [CMApp04].	[CMApp05] [ECU1] gets the current status of subscription, i.e.[CMApp05] [ECU1] has stopped the subscription from service [CMService05].
Step 16	[CMApp05] [ECU2] Monitor state of subscription from service [CMService05] of application [CMApp04].	[CMApp05] [ECU2] gets the current status of subscription, i.e.[CMApp05] [ECU2] has stopped the subscription from service [CMService05].

4.2.5 [STS_CM_00005] Communication for Fields.

Test Objective	To verify that the applications are able to query (get) and modify (set) field value and that communication work for Fields.		
ID	STS_CM_00005	**State**	Draft
Affected Functional Cluster	Communication Management		
Trace to RS Criteria	[RS_CM_00216], [RS_CM_00217], [RS_CM_00218], [RS_CM_00219], [RS_CM_00220], [RS_CM_00221]		
Reference to Test Environment	STC_CM_00001		
Configuration Parameters	- The existing communication services comprise the following (service names are arbitrary): - [CMService05]: Offered by [CMApp04], requested by [CMApp05].		
Summary	Initially [CM Tester] requests applications to change Machine State to Driving. [CM Tester] requests [CMApp05] to get the current field value of service [CMService05] [CMApp04]. In turn [CMApp05] requests [CMApp04] to get the current field value of service [CMService05] [CMApp04]. The [CMApp04] provides a method to get the current field value of service [CMService05] [CMApp04]. [CM Tester] requests [CMApp05] to set the current field value of service [CMService05] [CMApp04]. In turn [CMApp05] requests [CMApp04] to set the current field value of service [CMService05] [CMApp04]. The [CMApp04] provides a method to set the current field value of service [CMService05] [CMApp04]. [CMApp04] sends normal return code notification to [CMApp05]. [CMApp05] returns a normal return code to [CM Tester]. Note: As for order of offering, no particular order of offering and requesting is necessary.		
Pre-conditions	- [CM Tester] is connected to [CMApp05]. - Both ECUs are in Machine State Parking. - Through successful service discovery, a communication is established. - A field without a setter and without a getter shall not exist. - The field shall contain at least a getter or a setter.		
Post-conditions	CM Tester is disconnected from CMApp05. - [CMApp04] on [ECU1] and [CMApp05] on [ECU1] are shut down according to Machine State.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[CM Tester] Request change of Machine State to Driving.		
Step 2	[CM Tester] Request [CMApp05] to get the current field value of service [CMService05] [CMApp04].		
Step 3	[CMApp05] Request [CMApp04] to get the current field value of service [CMService05] [CMApp04].		[CMApp04] Receives the request from application [CMApp05].
Step 4	[CMApp04] Provides a method to get the current field value of service [CMService05] [CMApp04].		[CMApp05] Receives response message from [CMApp04].
Step 5	[CMApp05] Returns the current field value of service [CMService05][CMApp04] to [CM Tester].		[CM Tester] Receives the default field value (e.g. zero) of [CMService05][CMApp04].

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Step 6	[CM Tester] Request [CMApp05] to set the current field value of service [CMService05][CMApp04].	
Step 7	[CMApp05] Request [CMApp04] to set the field value of service [CMService05][CMApp04].	[CMApp04] Receives the request from application [CMApp05].
Step 8	[CMApp04] Provides a method to set the current field value of service [CMService05][CMApp04].	[CMApp05] Receives response message from [CMApp04].
Step 9	[CMApp04] sends normal response to [CMApp05].	[CMApp05] Receives response from[CMApp04].
Step 10	[CMApp05] returns a normal return code to CM tester	[CM Tester] Receives termination notification from[CMApp04].
Step 11	[CM Tester] Request [CMApp05] to get the set field value of service [CMService05][CMApp04].	
Step 12	[CMApp05] Request [CMApp04] to get the current field value of service [CMService05] [CMApp04].	[CMApp04] Receives the request from application [CMApp05].
Step 13	[CMApp04] Provides a method to get the current field value of service [CMService05] [CMApp04].	[CMApp05] Receives response message from [CMApp04].
Step 14	[CMApp05] Returns the set field value of service [CMService05][CMApp04] to [CM Tester].	[CM Tester] Receives the set field value (set in the previous steps) of [CMService05][CMApp04].

4.2.6 [STS_CM_00006] Communication for Field Notification.

Test Objective	To verify that the applications are able to receive notifications and that communication work for Fields.		
ID	STS_CM_00006	**State**	Draft
Affected Functional Cluster	Communication Management		
Trace to RS Criteria	[RS_CM_00216], [RS_CM_00217], [RS_CM_00218], [RS_CM_00219], [RS_CM_00220], [RS_CM_00221], [RS_CM_00226], [RS_CM_00227]		
Reference to Test Environment	STC_CM_00001		
Configuration Parameters	- The existing communication services comprise the following (service names are arbitrary): - [CMService05]: Offered by [CMApp04], requested by [CMApp05].		

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Summary	Initially [CM Tester] requests applications to change Machine State to Driving. [CM Tester] requests [CMApp05] to subscribe [FIELD1] event notification of service [CMService05][CMApp04]. In turn [CMApp05] requests [CMApp04] to subscribe [FIELD1] event notification of service [CMService05][CMApp04]. [CMApp04] sends normal return code of [FIELD1] event subscription to [CMApp05]. [CMApp05] returns a normal return code to [CM Tester]. [CM Tester] requests [CMApp05] to set value <x> (not default value) to [FIELD1] of service [CMService05][CMApp04]. In turn [CMApp05] requests [CMApp04] to set value <x> to [FIELD1] of service [CMService05][CMApp04]. [CMApp04] sends normal return code of setting [FIELD1] to [CMApp05]. [CMApp05] sends a normal return code to [CM Tester]. [CM Tester] receives normal return code. [CMApp04] sends event notification of changing [FIELD1] value. [CMApp05] receives event notification of changing [FIELD1] value. After a time <tx>, [CM Tester] requests [CMApp05] to confirm receiving event notification. [CMApp05] sends received event notifications to [CM Tester]. [CM Tester] receives event notification. Note: As for order of offering, no particular order of offering and requesting is necessary.	
Pre-conditions	- [CM Tester] is connected to [CMApp05]. - Both ECUs are in Machine State Parking. - Through successful service discovery, a communication is established. - A field without a notifier shall not exist. - The field shall contain at least one notifier.	
Post-conditions	CM Tester is disconnected from CMApp05. [CMApp04] and [CMApp05] are shut down according to Machine State.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[CM Tester] Request change of Machine State to Driving.	
Step 2	[CM Tester] Requests [CMApp05] to subscribe [FIELD1] event notification of service [CMService05][CMApp04].	
Step 3	[CMApp05] Requests [CMApp04] to subscribe [FIELD1] event notification of service [CMService05][CMApp04].	[CMApp04] Receives the request from application [CMApp05].
Step 4	[CMApp04] Sends normal return code of [FIELD1] event subscription to [CMApp05].	[CMApp05] Receives response message from [CMApp04].
Step 5	[CMApp05] Returns a normal return code to [CM Tester].	[CM Tester] Receives the return code.
Step 6	[CM Tester] Requests [CMApp05] to set value <x> (not default value) to [FIELD1] of service [CMService05][CMApp04].	

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Step 7	[CMApp05] Requests [CMApp04] to set value <x> to [FIELD1] of service [CMService05][CMApp04].	[CMApp04] Receives the request from application [CMApp05].
Step 8	[CMApp04] Sends normal return code of setting [FIELD1] to [CMApp05].	[CMApp05] Receives response message from [CMApp04].
Step 9	[CMApp05] Sends a normal return code to [CM Tester].	[CM Tester] Receives the normal return code.
Step 10	[CMApp04] Sends event notification of changing [FIELD1] value.	[CMApp05] Receives event notification of changing [FIELD1] value.
Step 11	[CM Tester] After time <tx>, requests [CMApp05] to confirm receiving event notification.	
Step 12	[CMApp05] Sends received event notification to [CM Tester].	[CM Tester] Receives event notification.

4.3 Test cases REST

4.3.1 [STS_REST_00001] Client in backend/ cloud and server in vehicle communicates according to REST

Test Objective	To verify that server in vehicle responds client-defined request according to REST.		
ID	STS_REST_00001	**State**	Draft
Affected Functional Cluster	REST		
Trace to RS Criteria	[RS_CM_00300], [RS_CM_00304], [RS_CM_00309], [RS_CM_00312]		
Reference to Test Environment	STC_REST_00001		
Configuration Parameters	RESTful API is configured		
Summary	• Client is in backend/ cloud and server is in vehicle. • First client is set up and request is created with URI and Methods (GET/PUT/ POST/DELETE/OPTIONS). • Request is sent and response is received from server. • Server provide a RESTful service [RESTService01] which has resources [Resource1] and [Resource2]. Each resource has elements like - [Resource1/Element1], [Resource2/Element2]. Element1 have possible states <State1> and <State2> while Element2 have <State3> and <State4>. A new element [Element3] is created in resource [Resource2] using POST and later [Element3] is deleted using DELETE. • Response from server is processed and then client unsubscribe from the event. • Client is stopped.		

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Pre-conditions	- [REST Tester] is connected to ECU (vehicle). - ECU is in Machine State Parking.	
Post-conditions	TCP connections between [REST Tester] and both ECUs are closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength : <length> Accept: <application/json> Version: HTTP/1.1	
Step 2	[RESTApp02] Server Response: HTTP/1.1 200 OK Content-Type: <application/json> Status: <Status1> URI : http://<host-name>:<port>/RESTService01/Resource1/Element1/<Status>	Positive response is received from Server.
Step 3	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength : <length> Accept: <application/xml> Version: HTTP/1.1	
Step 4	[RESTApp02] Server Response: HTTP/1.1 200 OK Content-Type: <application/xml> Status: <Status1> URI : http://<host-name>:<port>/RESTService01/Resource1/Element1/<Status>	Positive response is received from Server.
Step 5	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	

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Step 6	[RESTApp02] Server Response: HTTP/1.1 200 OK Status: <Status1> URI : http://<host-name>:<port>/RESTService01/Resource1/Element1/<Status>	Positive response is received from Server.
Step 7	[RESTApp01] Send Request to update Resource1/Element1 (change status 1 to status 2) Method: PUT URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/Status2 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 8	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService01/Resource1/Element1/<Status>	Positive response is received from Server.
Step 9	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 10	[RESTApp02] Server Response: HTTP/1.1 200 OK Status: <Status2> URI : http://<host-name>:<port>/RESTService01/Resource1/Element1/<Status>	Positive response is received from Server.
Step 11	[RESTApp01] Send Request to get details of Resource2 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource2 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 12	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService01/Resource2/Element2/<Status>	Positive response is received from Server.

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Step 13	[RESTApp01] Send Request to create Resorce2/Element3 Method: POST URI: http://<host-name>:<port>/RESTService01/Resource2/Element3 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 14	[RESTApp02] Server Response: HTTP/1.1 201 Created URI : http://<host-name>:<port>/RESTService01/Resource2/Element3	Positive response is received from Server.
Step 15	[RESTApp01] Send Request to get details of Resource2 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource2 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 16	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService01/Resource2/Element2/<Status> URI : http://<host-name>:<port>/RESTService01/Resource2/Element3/<Status>	Positive response is received from Server.
Step 17	[RESTApp01] Send Request to delete [Element3] Method: DELETE URI: http://<host-name>:<port>/RESTService01/Resource2/Element3 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 18	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService01/Resource2/Element3	Positive response is received from Server.
Step 19	[RESTApp01] Send Request to get details of Resource2 (Element 3 should be deleted) Method: GET	

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	△ URI: http://<host-name>:<port>/RESTService01/Resource2 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 20	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService01/Resource2/Element2/<Status>	Positive response is received from Server.
Step 21	[RESTApp01] Send an invalid URI Request Method = GET, URI: http://<host-name>:<port>/RESTService05	
Step 22	[RESTApp02] Server replies with Status: 404 URI: http://<host-name>:<port>/RESTService05	Negative response is received from Server.
Step 23	[RESTApp01] Send multiple requests from client. Method = GET, URI: http://<host-name>:<port>/RESTService01/Resource1 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1 Method = GET URI: http://<host-name>:<port>/RESTService01/Resource2 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 24	[RESTApp02] Server replies with Status: 200 OK URI: http://<hostname>:<port>/RESTService01/Resource1/<status> Server replies with Status: 200 OK URI: http://<hostname>:<port>/RESTService01/Resource2/<status>	Positive response is received from Server.

4.3.2 [STS_REST_00002] Client in vehicle and server in backend/ cloud communicates according to REST

Test Objective	To verify that server in backend responds client-defined request according to REST.		
ID	STS_REST_00002	**State**	Draft
Affected Functional Cluster	REST		
Trace to RS Criteria	[RS_CM_00300], [RS_CM_00304], [RS_CM_00309], [RS_CM_00312]		
Reference to Test Environment	STC_REST_00002		
Configuration Parameters	RESTful API is configured		
Summary	- Client is in vehicle and server is in backend/ cloud. - First client is set up and request is created with URI and Methods (GET/PUT/ POST/DELETE/OPTIONS). - Request is sent and response is received from server. - Server provide a RESTful service [RESTService02] which has resources [Resource5] and [Resource6]. Each resource has elements like - [Resource5/Element5], [Resource6/Element6]. Element5 have possible states <State5> and <State6> while Element6 have <State7> and <State8>. A new element [Element7] is created in resource [Resource6] using POST and later [Element7] is deleted using DELETE. - Response from server is processed and then client unsubscribe from the event. Client is stopped.		
Pre-conditions	- [REST Tester] is connected to ECU. - ECU is in Machine State Parking.		
Post-conditions	TCP connections between [REST Tester] and both ECUs are closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[RESTApp01] Send Request to get status of Resource5/Element5 Method: GET URI: http://<host-name>:<port>/RESTService02/Resource5/Element5/?Status Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1		
Step 2	[RESTApp02] Server Response: HTTP/1.1 200 OK Status: <Status5> URI : http://<host-name>:<port>/RESTService02/Resource5/Element5/<Status>		Positive response is received from Server.

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Step 3	[RESTApp01] Send Request to update Resource5/Element5 (change status 5 to status 6) Method: PUT URI: http://<host-name>:<port>/RESTService02/Resource5/Element5/Status6 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 4	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService02/Resource5/Element5/<Status>	Positive response is received from Server.
Step 5	[RESTApp01] Send Request to get status of Resource5/Element5 Method: GET URI: http://<host-name>:<port>/RESTService02/Resource5/Element5/?Status Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 6	[RESTApp02] Server Response: HTTP/1.1 200 OK Status: <Status6> URI : http://<host-name>:<port>/RESTService02/Resource5/Element5/<Status>	Positive response is received from Server.
Step 7	[RESTApp01] Send Request to get details of Resourc6 Method: GET URI: http://<host-name>:<port>/RESTService02/Resource6 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 8	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService02/Resource6/Element6/<Status>	Positive response is received from Server.

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Step 9	[RESTApp01] Send Request to create Resorce6/Element7 Method: POST URI: http://<host-name>:<port>/RESTService02/Resource6/Element7 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 10	[RESTApp02] Server Response: HTTP/1.1 201 Created URI : http://<host-name>:<port>/RESTService02/Resource6/Element7	Positive response is received from Server.
Step 11	[RESTApp01] Send Request to get details of Resource6 Method: GET URI: http://<host-name>:<port>/RESTService02/Resource6 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 12	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService02/Resource6/Element6/<Status> URI : http://<host-name>:<port>/RESTService02/Resource6/Element7/<Status>	Positive response is received from Server.
Step 13	[RESTApp01] Send Request to delete [Element7] Method: DELETE URI: http://<host-name>:<port>/RESTService02/Resource6/Element7 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 14	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService02/Resource6/Element7	Positive response is received from Server.
Step 15	[RESTApp01] Send Request to get details of Resource6 Method: GET URI: http://<host-name>:<port>/RESTService02/Resource6	

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	△ Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 16	[RESTApp02] Server Response: HTTP/1.1 200 OK URI : http://<host-name>:<port>/RESTService02/Resource6/Element6/<Status>	Positive response is received from Server.
Step 17	[RESTApp01] Send an invalid URI Request Method = GET, URI: http://<host-name>:<port>/RESTService05	
Step 18	[RESTApp02] Server replies with Status: 404 URI: http://<host-name>:<port>/RESTService05	Negative response is received from Server.
Step 19	[RESTApp01] Send multiple requests from client. Method = GET, URI: http://<host-name>:<port>/RESTService01/Resource1 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1 Method = GET, URI: http://<host-name>:<port>/RESTService01/Resource2 Host: <host-name> ContentLength : <length> ContentType: <application/json> Version: HTTP/1.1	
Step 20	[RESTApp02] Server replies with Status: 200 OK URI: http://<hostname>:<port>/RESTService01/Resource1/<status> Server replies with Status: 200 OK URI: http://<hostname>:<port>/RESTService01/Resource2/<status>	Positive response is received from Server.

4.3.3 [STS_REST_00003] Portability of RESTful adaptive applications

Test Objective	To verify that the same RESTful adaptive application can be used with HTTP/1.1 or a IPC binding without changing any application code.		
ID	STS_REST_00003	**State**	Draft
Affected Functional Cluster	REST		
Trace to RS Criteria	[RS_CM_00301]		
Reference to Test Environment	STC_REST_00002		
Configuration Parameters	RESTful API is configured		
Summary	- Client Application [RESTApp03] has two instances one is in vehicle ECU [ECU1] and another is in backend [ECU2]. While Server Application [RESTApp04] is in vehicle ECU [ECU1] only. - Request is sent and response is received from server. - Server application [RESTApp04] provides a service [RESTService02] with resource [Resource1] service [RESTService02] is requested by [RESTApp03] by HTTP and inter Process Communication (IPC). - Response from server is processed and then client unsubscribe from the event. - Client is stopped. Note: In-vehicle ECU instance of [RESTApp03] uses IPC to request the service while instance of [RESTApp03] in backend request [RESTService02] using HTTP.		
Pre-conditions	- [REST Tester] is connected to ECU. - ECU is in Machine State Parking.		
Post-conditions	TCP connections between [REST Tester] and both ECUs are closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[RESTApp01] [RESTApp03] [ECU1] Send Request (using IPC) to get status of Resource1		
Step 2	[RESTApp02] [RESTApp04] [ECU1]		Positive response is received from Server.
Step 3	[RESTApp01] [RESTApp03] [ECU2] Send Request (using HTTP) to get status of Resource1		
Step 4	[RESTApp02] [RESTApp04] [ECU1]		Positive response is received from Server

4.3.4 [STS_REST_00004] Data Representation

Test Objective	To verify the Abstraction of the used payload format (e.g. JSON or XML).		
ID	STS_REST_00004	**State**	Draft
Affected Functional Cluster	REST		
Trace to RS Criteria	[RS_CM_00301], [RS_CM_00305], [RS_CM_00306], [RS_CM_00308], [RS_CM_00307], [RS_CM_00313]		
Reference to Test Environment	STC_REST_00002		

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Configuration Parameters	RESTful API is configured	
Summary	- Client and Server Applications communicates as per RESTful communication. - First client is set up and request is created with URI and Methods (GET/PUT/ POST/DELETE/OPTIONS). - Request is sent and response is received from server as Object Graph having payload format JSON or XML. - Response from server is processed and then client unsubscribe from the event. - Client is stopped.	
Pre-conditions	- [REST Tester] is connected to ECU. - ECU is in Machine State Parking.	
Post-conditions	TCP connections between [REST Tester] and both ECUs are closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength: <length> Accept: <application/json> Version: HTTP/1.1	
Step 2	[RESTApp02] Server Response: HTTP/1.1 200 OK Content-Type: <application/json> Status: <Status1> URI : http://<host-name>:<port>/RESTService01//Resource1/Element1/<Status>	Positive response is received from Server.
Step 3	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength: <length> Accept: <application/xml> Version: HTTP/1.1	
Step 4	[RESTApp02] Server Response: HTTP/1.1 200 OK Content-Type: <application/xml> Status: <Status1> URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/<Status>	Positive response is received from Server.

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	△ <resources> <resource>Resource1</resource> <elements> <status>Status1</status> </elements> <elements> <status>Status2</status> </elements> </resources>	
Step 5	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength: <length> Accept: <application/json> Version: HTTP/1.1	
Step 6	[RESTApp02] Server Response: HTTP/1.1 Content-Type: <application/xml> Status: <Status1> URI : http://<host-name>:<port>/RESTService01//Resource1/Element1/<Status>	Response is rejected due to mismatch in Content type.
Step 7	[RESTApp01] Send Request to get status of Resource1/Element1 Method: GET URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/?Status Host: <host-name> ContentLength: <length> Accept: <application/xml> Version: HTTP/1.1	
Step 8	[RESTApp02] Server Response: HTTP/1.1 Content-Type: <application/json> Status: <Status1> URI: http://<host-name>:<port>/RESTService01/Resource1/Element1/<Status>	Response is rejected due to mismatch in Content type.

4.3.5 [STS_REST_00005] Event communication with Web-sockets

Test Objective	To verify the event-based communication with the Websocket protocol.		
ID	STS_REST_00005	**State**	Draft
Affected Functional Cluster	REST		
Trace to RS Criteria	[RS_CM_00314]		
Reference to Test Environment	STC_REST_00001		
Configuration Parameters	RESTful API is configured		
Summary	- Client sends a handshake request to server to establish Websocket connection. - Server returns a Websocket handshake response. - Once the connection is established both client and server can listen for events. - Event subscription message is sent as JSON over Websocket channel. - Then Event cancellation message is sent as JSON over Websocket channel - Response from server is processed and then client unsubscribe from the event. - Client is stopped.		
Pre-conditions	- [REST Tester] is connected to ECU. - ECU is in Machine State Parking.		
Post-conditions	TCP connections between [REST Tester] and both ECUs are closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[RESTApp01] Send handshake request to server to establish Websocket connection. GET /<protocol> HTTP/1.1 Host: server.<URL> Upgrade: websocket Connection: Upgrade Sec-WebSocket-Key: <key>== Origin: http://<URL> Sec-WebSocket-Protocol: <protocol> Sec-WebSocket-Version: <version>		
Step 2	[RESTApp02] Handshake from the server: HTTP/1.1 101 Switching Protocols Upgrade: websocket Connection: Upgrade Sec-WebSocket-Accept: <key>o= Sec-WebSocket-Protocol: <protocol>		Positive Handshake Response is received from Server.
Step 3	Websocket channel is opened during the first Event subscription and subscription message is sent as JSON over Websocket channel. "type": "subscribe"		

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Step 4	[RESTApp02] Server Responses to subscription message	Positive Subscription Response is received from Server.
Step 5	[RESTApp01] Event cancellation message is sent as JSON over Websocket channel "type": "unsubscribe"	
Step 6	[RESTApp02] Server Responses to cancellation message	Positive cancellation Response is received from Server.
Step 7	[RESTApp01] Request Error message from server.	
Step 8	[RESTApp02] Server sends the Event error messages as JSON over the Websocket channel. "type": "error"	Error message is received from Server.

5 Test configuration and test steps for Execution Management

5.1 Test System

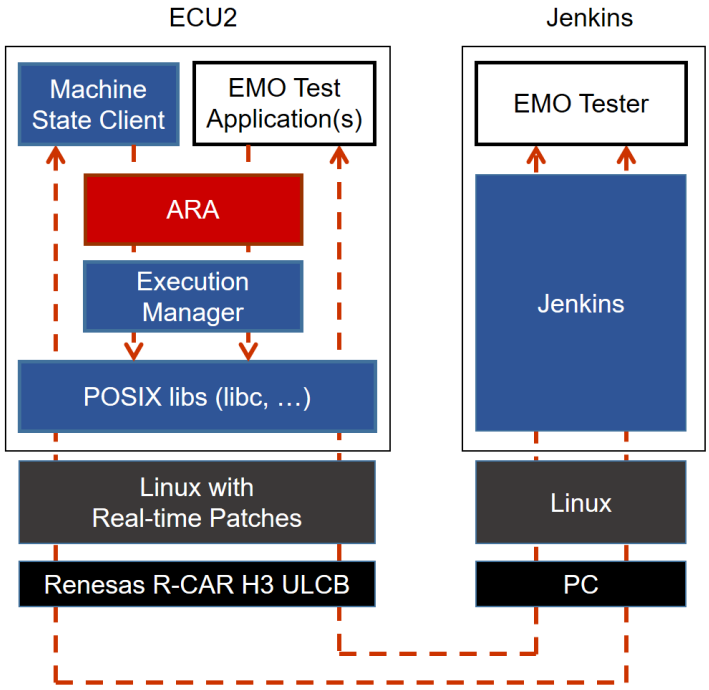

Figure 5.1: Illustration of test setup for Execution Management.

5.1.1 Test configurations

5.1.1.1 STC_EMO_00001

Configuration ID	STC_EMO_00001
Description	Standard Jenkins server for Execution Management test
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the Execution Management test (Exec Tester) is connected via Ethernet to ECU2 hosting the System Test Applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05].

The Exec Tester is supposed to check the pass criteria.

The communication between Exec Tester and the applications on the ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

5.1.1.1.1 Machine Manifest

Machine States	*Startup (Initial Mode)*
	Shutdown
	Restart
	Driving
	Parking

5.1.1.1.2 Application Manifest

Application Name	**EMOApp02**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
Application Name	**EMOApp03**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
Application Name	**EMOApp04**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
Application Name	**EMOApp05**		
Process	ModeDependentStartupConfig	machineMode	*Driving*

5.1.1.2 STC_EMO_00002

Configuration ID	STC_EMO_00002
Description	Standard Jenkins server for Execution Management test
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the Execution Management test (Exec Tester) is connected via Ethernet to ECU2 hosting the System Test Applications [EMOApp02], [EMOApp03], [EMOApp04], [EMOApp05] and [EMOApp06].

The Exec Tester is supposed to check the pass criteria.

The communication between Exec Tester and the applications on the ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

5.1.1.2.1 Machine Manifest

Machine States	*Startup (Initial Mode)*
	Shutdown
	Restart
	Driving
	Parking
Function Groups	
FG1	*Off*
	Running
	Fallback
	Diag
FG2	*Off*
	On
	Activate

5.1.1.2.2 Application Manifest

Application Name	**EMOApp02**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
Application Name	**EMOApp03**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
		executionDependency	[EMOApp02].*Running*
Application Name	**EMOApp04**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
		executionDependency	[EMOApp03].*Running*
Application Name	**EMOApp05**		
Process	ModeDependentStartupConfig	functionGroup	[FG2].*On* and [FG2].*Activate*
Application Name	**EMOApp06**		
Process	ModeDependentStartupConfig	functionGroup	[FG2].*Activate*

5.1.1.3 STC_EMO_00003

Configuration ID	STC_EMO_00003
Description	Standard Jenkins server for Execution Management test
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the Execution Management test (Exec Tester) is connected via Ethernet to ECU2 hosting the System Test Applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05].

The Exec Tester is supposed to check the pass criteria.

The communication between Exec Tester and the applications on the ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

5.1.1.3.1 Machine Manifest

Machine States	*Startup (Initial Mode)*			
	Shutdown			
	Restart			
	Driving			
	Parking			
PerStateTimeout				
PerStateTimeout1	state	MachineState	*Driving*	
	timeout	EnterExit Timeout	enterTimeoutValue	*EnterTimeValue1*
			exitTimeoutValue	*ExitTimeValue1*
PerStateTimeout2	state	MachineState	*Parking*	
	timeout	EnterExit Timeout	enterTimeoutValue	*EnterTimeValue2*
			exitTimeoutValue	*ExitTimeValue2*

5.1.1.3.2 Application Manifest

Application Name	**EMOApp02**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
Application Name	**EMOApp03**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
Application Name	**EMOApp04**		
Process	ModeDependentStartupConfig	machineMode	*Parking*
Application Name	**EMOApp05**		
Process	ModeDependentStartupConfig	machineMode	*Parking*

5.1.1.3.3 ProcessToMachineMapping

Application Name	**EMOApp02**			
Process	shallRunOn	ProcessorCore	CoreId	1 and 2
Application Name	**EMOApp03**			
Process	shallRunOn	ProcessorCore	CoreId	1 and 2
Application Name	**EMOApp04**			
Process	shallRunOn	ProcessorCore	CoreId	3 and 4
Application Name	**EMOApp05**			
Process	shallRunOn	ProcessorCore	CoreId	3 and 4

5.1.1.4 STC_EMO_00004

Configuration ID	STC_EMO_00004
Description	Standard Jenkins server for Execution Management test
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the Execution Management test (Exec Tester) is connected via Ethernet to ECU2 hosting the System Test Applications [EMOApp02], [EMOApp03] and [EMOApp04].

The Exec Tester is supposed to check the pass criteria.

The communication between Exec Tester and the applications on the ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

5.1.1.4.1 Machine Manifest

Machine States	*Startup (Initial Mode)*
	Shutdown
	Restart
	Driving
	Parking
Function Groups	
FG1	*Off*
	On
	Activate
OsModuleInstantiation	
ResourceGroups	
ResourceGroup1	cpuUsage *CPULIM1*
	memUsage *MEMLIM1*
ResourceGroup2	cpuUsage *CPULIM2*
	memUsage *MEMLIM2*

5.1.1.4.2 Application Manifest

Application Name	**EMOApp02**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
		schedulingPolicy	*schedulingPolicyRoundRobin*

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		schedulingPriority	3
Application Name	**EMOApp03**		
Process	ModeDependentStartupConfig	machineMode	*Driving*
		executionDependency	[EMOApp02].*Running*
		schedulingPolicy	*schedulingPolicyOther*
		schedulingPriority	0
Application Name	**EMOApp04**		
Process	ModeDependentStartupConfig	functionGroup	[FG1].*On*
		schedulingPolicy	*schedulingPolicyFifo*
		schedulingPriority	4
Application Name	**EMOApp05**		
Process1	ModeDependentStartupConfig	functionGroup	[FG1].*On*
		schedulingPolicy	*schedulingPolicyRoundRobin*
		schedulingPriority	1
		startupConfig	environmentVariable Key : APP_PATH Value : /home/user1
			startupOption optionArgument : inputfile_1 CommandLineOptionKindEnum : commandLineLongForm optionName : filename
Process2	ModeDependentStartupConfig	functionGroup	[FG2].*On*
		schedulingPolicy	*schedulingPolicyFifo*
		schedulingPriority	2
		startupConfig	environmentVariable Key : APP_PATH Value : /home/user2
			startupOption optionArgument : inputfile_2 CommandLineOptionKindEnum : commandLineLongForm optionName : filename

5.1.1.4.3 Process Configuration

Process Name	Executable Reference
EMOApp02Process	*EMOApp02Exec*
EMOApp03Process	*EMOApp03Exec*
EMOApp04Process	*EMOApp04Exec*

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EMOApp05Process1	*EMOApp05Exec*
EMOApp05Process2	*EMOApp05Exec*

5.2 Test cases

5.2.1 [STS_EMO_00001] Startup of applications with change of machine state.

Test Objective	Verification, that the execution management functional cluster can perform a change of Machine State and that applications associated with the new Machine State are started.		
ID	STS_EMO_00001	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00100], [RS_EM_00101]		
Reference to Test Environment	STC_EMO_00001		
Configuration Parameters	• Machine State Driving, in which all System Test Applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] shall start is defined.		
Summary	When initialized the system state is *Startup*. A change of Machine State from *Startup* to *Parking* is requested and it is verified that [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] are not started. A change of Machine State from *Parking* to *Driving* is requested and the startup of the applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] associated with this Machine State is verified.		
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - Operating system on ECU2 has booted.		
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to *Parking* for ECU2.		
Step 2	[SM] Request for change of Machine State to *Parking* from Execution Manager.		Machine State for ECU2 is changed to *Parking*.
Step 3	[Exec Tester] Query execution status of [EMOApp02].		[EMOApp02] is not executed.
Step 4	[Exec Tester] Query execution status of [EMOApp03].		[EMOApp03] is not executed.
Step 5	[Exec Tester] Query execution status of [EMOApp04].		[EMOApp04] is not executed.
Step 6	[Exec Tester] Query execution status of [EMOApp05].		[EMOApp05] is not executed.

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Step 7	[Exec Tester] Request change of Machine State to *Driving* for ECU2.	
Step 8	[SM] Request for change of Machine State to *Driving* from Execution Manager.	Machine State for ECU2 is changed to *Driving*.
Step 9	[Exec Tester] Query execution status of [EMOApp02].	[EMOApp02] is executed.
Step 10	[Exec Tester] Query execution status of [EMOApp03].	[EMOApp03] is executed.
Step 11	[Exec Tester] Query execution status of [EMOApp04].	[EMOApp04] is executed.
Step 12	[Exec Tester] Query execution status of [EMOApp05].	[EMOApp05] is executed.

5.2.2 [STS_EMO_00002] Shutdown of applications with change of machine state to Shutdown

Test Objective	Verification, that the execution management functional cluster executes a well-defined shutdown sequence for all configured and running applications, When shut-down is initiated		
ID	STS_EMO_00002	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00100], [RS_EM_00101]		
Reference to Test Environment	STC_EMO_00001		
Configuration Parameters	- Machine State Driving, in which all System Test Applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] shall start is defined. - ECU ID for ECU2 is set to ECU2 - [EMOApp02] has LT Application ID APPID2. - Context ID for [EMOApp02] is set to CTX2 - [EMOApp03] has LT Application ID APPID3. - Context ID for [EMOApp03] is set to CTX3 - [EMOApp04] has LT Application ID APPID4. - Context ID for [EMOApp04] is set to CTX4 - [EMOApp05] has LT Application ID APPID5. - Context ID for [EMOApp05] is set to CTX5		
Summary	A change of Machine State from *Driving* to *Shutdown* is requested and the Shutdown of the applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] is verified by logging the messages at the termination of application.		

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Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State Driving. - Operating system on ECU2 has booted. - Applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] are registered for logging and default log level is set to Verbose.	
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to *Shutdown* for ECU2.	
Step 2	[SM] Request for change of Machine State to *Shutdown* from Execution Manager.	Machine State for ECU2 is changed to *Shutdown*.
Step 3	[Exec Tester] Observe the log for applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05]	Message with context ID CTX2 and application ID APPID2 is received which is logged at [EMOApp02] application termination Message with context ID CTX3 and application ID APPID3 is received which is logged at [EMOApp03] application termination Message with context ID CTX4 and application ID APPID4 is received which is logged at [EMOApp04] application termination Message with context ID CTX5 and application ID APPID5 is received which is logged at [EMOApp05] application termination

5.2.3 [STS_EMO_00003] Ordered Startup and Shutdown of Executables based on the dependency with other processes

Test Objective	Verification, that the execution management functional cluster can perform a change of Machine State and that applications associated with the new Machine State are started considering the dependency with other processes. Also to verify the ordered shutdown of the processes.		
ID	STS_EMO_00003	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00100], [RS_EM_00101], [RS_EM_00103]		

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Reference to Test Environment	STC_EMO_00002
Configuration Parameters	- Machine State *Driving*, in which System Test Applications [EMOApp02], [EMOApp03] and [EMOApp04] shall start is defined. Dependency with other process is configured as mentioned in section 5.2.1.2.2 Application Manifest. - ECU ID for ECU2 is set to *ECU2* - [EMOApp02] has LT Application ID *APPID2* - Context ID for [EMOApp02] is set to *CTX2* - [EMOApp03] has LT Application ID *APPID3* - Context ID for [EMOApp03] is set to *CTX3* - [EMOApp04] has LT Application ID *APPID4* - Context ID for [EMOApp04] is set to *CTX4* - [EMOApp05] has LT Application ID *APPID5* - Context ID for [EMOApp05] is set to *CTX5* - [EMOApp06] has LT Application ID *APPID6* - Context ID for [EMOApp06] is set to *CTX6*
Summary	When initialized the system state is *Startup*. A change of Machine State from *Startup* to *Driving* is requested and the startup of the applications [EMOApp02], [EMOApp03] and [EMOApp04] associated with this Machine State are verified in the order of [EMOApp02], [EMOApp03] and [EMOApp04] by logging the messages at the Start of application processes. A change of Machine State from *Driving* to *Parking* is requested and the termination of the applications [EMOApp02], [EMOApp03] and [EMOApp04] is verified in the order of [EMOApp04], [EMOApp03] and [EMOApp02] by logging the messages at the termination of application processes.
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - Function Group State for [FG2] is *Off*. - Operating system on ECU2 has booted.
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.
Main Test Execution	
Test Steps	**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to *Driving* for ECU2.
Step 2	[SM] Request for change of Machine State to *Driving* from Execution Manager.	Machine State for ECU2 is changed to *Driving*.
Step 3	[Exec Tester] Observe the log for applications [EMOApp02]	Message with context ID *CTX2* and application ID *APPID2* is received which is logged at [EMOApp02] application startup
Step 4	[Exec Tester] Observe the log for applications [EMOApp03]	Message with context ID *CTX3* and application ID *APPID3* is received which is logged at [EMOApp03] application startup

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Step 5	[Exec Tester] Observe the log for applications [EMOApp04]	Message with context ID *CTX4* and application ID *APPID4* is received which is logged at [EMOApp04] application startup
Step 6	[Exec Tester] Request change of Machine State to *Shutdown* for ECU2.	
Step 7	[SM] Request for change of Machine State to *Parking* from Execution Manager.	Machine State for ECU2 is changed to *Parking*.
Step 8	[Exec Tester] Observe the log for applications [EMOApp04]	Message with context ID *CTX4* and application ID *APPID4* is received which is logged at [EMOApp04] application termination
Step 9	[Exec Tester] Observe the log for applications [EMOApp03]	Message with context ID *CTX3* and application ID *APPID3* is received which is logged at [EMOApp03] application termination
Step 10	[Exec Tester] Observe the log for applications [EMOApp02]	Message with context ID *CTX2* and application ID *APPID2* is received which is logged at [EMOApp02] application termination

5.2.4 [STS_EMO_00004] Startup of applications with change of Function Group state

Test Objective	Verification, that the execution management functional cluster can perform a change of Function Group State and that Applications associated with the new Function Group State are started.		
ID	STS_EMO_00004	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00100], [RS_EM_00101]		
Reference to Test Environment	STC_EMO_00002		
Configuration Parameters	- Function Group State *Activate* and Function Group State *On* of [FG2] in which System Test Application [EMOApp05] shall start is defined. - Function Group State *Activate* of [FG2] in which System Test Application [EMOApp06] shall start is defined		
Summary	When initialized the Function Group State of [FG2] is *Off*. A change of Function Group State of [FG2] to *On* is requested and the startup of the application [EMOApp05] associated with this Function Group State is verified. A change of Function Group State of [FG2] to *Activate* is requested and the startup of [EMOApp06] associated with this Function Group State is verified.		

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Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - Function Group State [FG2] is *Off*. - Operating system on ECU2 has booted.	
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Exec Tester] Request change of Function Group State [FG2] to *On*.	
Step 2	[SM] Request for change of Function Group State [FG2] to *On* from Execution Manager.	Function Group State [FG2] for ECU2 is changed to *On*.
Step 3	[Exec Tester] Query execution status of [EMOApp05].	[EMOApp05] is executed.
Step 4	[Exec Tester] Request change of Function Group State [FG2] to *Activate*.	
Step 5	[SM] Request for change of Function Group State [FG2] to *Activate* from Execution Manager.	Function Group State [FG2] for ECU2 is changed to *Activate*.
Step 6	[Exec Tester] Query execution status of [EMOApp06].	[EMOApp06] is executed.

5.2.5 [STS_EMO_00005] Execution Management shall prevent Processes from directly starting other Processes

Test Objective	Verification that the execution management shall prevent Processes from directly starting other Processes		
ID	STS_EMO_00005	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00009]		
Reference to Test Environment	STC_EMO_00003		
Configuration Parameters	- Machine State Driving, in which all System Test Applications [EMOApp02] and [EMOApp03] shall start is defined and Machine State Parking in which Applications [EMOApp04] and [EMOApp05] shall start is defined. - Each of the Applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] have one Executable invoked by a Process		

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Summary	A change of Machine State from *Startup* to *Driving* is requested. Start of [EMOApp02] and [EMOApp03] Processes from Execution Manager is checked. Create or fork a Process from [EMOApp02] Process and verify that no child Processes are created from [EMOApp02] Process. Execute [EMOApp05] Process from [EMOApp03] Process and verify that the [EMOApp05] Process is not invoked from [EMOApp03] Process.	
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - Operating system on ECU2 has booted.	
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to Driving for ECU2.	
Step 2	[SM] Request for change of Machine State to *Driving* from Execution Manager.	Machine State for ECU2 is changed to *Driving*.
Step 3	Query execution status of [EMOApp02]	[EMOApp02] Process is executed
Step 4	[EMOApp02] Fork or create a Process from [EMOApp02]	
Step 5	[Exec Tester] Get the Process ID of the Execution Manager	Received the Process ID of Execution Manager. *EXMPID*(1)
Step 6	[Exec Tester] Get the Process ID of [EMOApp02] Process	Received the Process ID of [EMOApp02] Process *APPID2*
Step 7	[Exec Tester] Get the Parent Process ID of [EMOApp02] Process	The Parent Process ID of [EMOApp02] Process is received as *EXMPID*(1)
Step 8	[Exec Tester] Get the Child Processes of Process ID *APPID2*	No child Processes of [EMOApp02] Process shall be received.
Step 9	Query execution status of [EMOApp03]	[EMOApp03] Process is executed
Step 10	[EMOApp03] Execute or Invoke [EMOApp05] Process from [EMOApp03] Process	[EMOApp05] Process is not executed

5.2.6 [STS_EMO_00006] Execution Management shall create one POSIX process for each Executable instance and shall launch the process with the scheduling policy and priority configured in the Execution Manifest

Test Objective	Verification that the one POSIX process is created for each Executable instance configured and the scheduling policy and priority for the process is assigned as specified in the Execution Manifest.		
ID	STS_EMO_00006	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00002]		
Reference to Test Environment	STC_EMO_00004		
Configuration Parameters	- Machine State Driving, in which Processes [EMOApp02].Process and [EMOApp03].Process shall start is defined with [EMOApp03].Process having dependency on [EMOApp02].Process The scheduling policy and scheduling priority are configured as schedulingPolicyRoundRobin and 3 respectively for [EMOApp02].Process and schedulingPolicyOther and 0 respectively for [EMOApp03].Process - Function Group State On of [FG2] in which Process [EMOApp04].Process shall start is defined with scheduling policy as schedulingPolicyFifo and scheduling priority 4.		
Summary	A change of Machine State from Startup to Driving is requested. Start of [EMOApp02].Process from the Execution Manager with the configured scheduling policy (schedulingPolicyRoundRobin) and priority (3) is checked. Start of [EMOApp03].Process from the Execution Manager with the configured scheduling policy (schedulingPolicyOther) and priority (0) is checked after the start of [EMOApp02].Process, since [EMOApp03].Process has dependency on [EMOApp02].Process A change of Function Group State of [FG1] to On is requested and the startup of the Process [EMOApp04].Process is verified with the configured scheduling policy (schedulingPolicyFifo) and scheduling priority (4).		
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - ECU2 Function Group State [FG2] is *Off*. - Operating system on ECU2 has booted.		
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to Driving for ECU2.		
Step 2	[SM] Request for change of Machine State to *Driving* from Execution Manager.		Machine State for ECU2 is changed to *Driving*.
Step 3	[Exec Tester] Query execution status of [EMOApp02] Process		[EMOApp02] Process is executed
Step 4	[Exec Tester] Get the Process ID of the Execution Manager		Received the Process ID of Execution Manager. *EXMPID*(1)

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Step 5	[Exec Tester] Get the Process ID of the [EMOApp02] Process	Received the Process ID of [EMOApp02] Process. *APPID2*
Step 6	[Exec Tester] Get the Parent Process ID of [EMOApp02]	The Parent Process ID of [EMOApp02] is received as *EXMPID*
Step 7	[Exec Tester] Get the scheduling policy of [EMOApp02] Process	Scheduling policy is received as SCHED_RR
Step 8	[Exec Tester] Get the scheduling priority of [EMOApp02] Process	Scheduling priority is received as 3
Step 9	[Exec Tester] Get the Process ID of the [EMOApp03] Process	Received the Process ID of [EMOApp03] Process. *APPID3*
Step 10	[Exec Tester] Get the Parent Process ID of [EMOApp03]	The Parent Process ID of [EMOApp03] is received as *EXMPID*
Step 11	[Exec Tester] Get the scheduling policy of [EMOApp03] Process	Scheduling policy is received as SCHED_OTHER
Step 12	[Exec Tester] Get the scheduling priority of [EMOApp02] Process	Scheduling priority is received as 0
Step 13	[SM] Request change of Function Group State [FG2] to *On*.	
Step 14	[Exec Tester] Request for change of Function Group State [FG2] to *On* from Execution Manager.	Function Group State [FG2] for ECU2 is changed to *On*.
Step 15	[Exec Tester] Get the Process ID of the [EMOApp04] Process	Received the Process ID of [EMOApp04] Process. *APPID4*
Step 16	[Exec Tester] Get the Parent Process ID of [EMOApp04]	The Parent Process ID of [EMOApp04] is received as *EXMPID*
Step 17	[Exec Tester] Get the scheduling policy of [EMOApp04] Process	Scheduling policy is received as SCHED_FIFO
Step 18	[Exec Tester] Get the scheduling priority of [EMOApp04] Process	Scheduling priority is received as 4

5.2.7 [STS_EMO_00007] Execution Management shall support multiple instantiation of Executable with different startup parameters from different Processes

Test Objective	Verification that Execution Management shall support multiple instantiation of Executable from different POSIX processes with different startup parameters.		
ID	STS_EMO_00007	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00010]		
Reference to Test Environment	STC_EMO_00004		
Configuration Parameters	Function Group State *On* of [FG1] in which Process [EMOApp05].Process1 shall start is defined with following StartupConfig schedulingPolicy : schedulingPolicyRoundRobin schedulingPriority : 1 StartupOption : filename = inputfile_1 Environment Variable : APP_PATH = /home/user1 Function Group State *On* of [FG1] in which Process [EMOApp05].Process2 shall start is defined with following StartupConfig schedulingPolicy : schedulingPolicyFifo schedulingPriority : 2 StartupOption : filename = inputfile_2 Environment Variable : APP_PATH = /home/user2		
Summary	A change of Function Group State of [FG1] to *On* is requested. startup of the Process [EMOApp05].Process1 is verified A change of Function Group State of [FG2] to *On* is requested. startup of the Process [EMOApp05].Process2 is verified It is verified that the same Executable *EMOApp05Exec* is invoked from both the Processes [EMOApp05].Process1 and [EMOApp05].Process2 with different startup parameters as specified below: [EMOApp05].Process1 scheduling policy : schedulingPolicyRoundRobin scheduling priority : 1 argument : filename = inputfile_1 environment variable : APP_PATH = /home/user1 [EMOApp05].Process2 scheduling policy : schedulingPolicyFifo scheduling priority : 2 argument : filename = inputfile_2 environment variable : APP_PATH = /home/user2 Note: *EMOApp05Exec* shall invoke a main program with 3 arguments which specifies argument count, argument list and environment list.		

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Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - ECU2 Function Group State [FG2] is *Off*. - Operating system on ECU2 has booted.	
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Exec Tester] Request change of Function Group State [FG1] to *On*.	
Step 2	[SM] Request for change of Function Group State [FG1] to *On* from Execution Manager	Function Group State [FG1] for ECU2 is changed to *On*.
Step 3	[Exec Tester] Query execution status of [EMOApp05].Process1	[EMOApp05].Process1 is executed
Step 4	[Exec Tester] Get the Process ID of the [EMOApp05].Process1	Received the Process ID of [EMOApp05].Process1 *APPID5*
Step 5	[Exec Tester] Get the scheduling policy of [EMOApp05].Process1	Scheduling policy is received as SCHED_RR
Step 6	[Exec Tester] Get the scheduling priority of [EMOApp05].Process1	Scheduling priority is received as 1
Step 7	[EMOApp05].Process1 Read the arguments	
Step 8	[Exec Tester] Get the arguments of [EMOApp05].Process1	Check if only one argument is received and the argument received is filename = inputfile_1
Step 9	[EMOApp05].Process1 Read the environment variables	
Step 10	[Exec Tester] Get the environment variables of [EMOApp05].Process1	Check if the environment variable APP_PATH has /home/user1
Step 11	[Exec Tester] Request change of Function Group State [FG2] to *On*.	
Step 12	[SM] Request for change of Function Group State [FG2] to *On* from Execution Manager	Function Group State [FG2] for ECU2 is changed to *On*.
Step 13	[Exec Tester] Query execution status of [EMOApp05].Process2	[EMOApp05].Process2 is executed
Step 14	[Exec Tester] Get the Process ID of the [EMOApp05].Process2	Received the Process ID of [EMOApp05].Process2 *APPID5*
Step 15	[Exec Tester] Get the scheduling policy of [EMOApp05].Process2	Scheduling policy is received as SCHED_FIFO

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Step 16	[Exec Tester] Get the scheduling priority of [EMOApp05].Process2	Scheduling priority is received as 2
Step 17	[EMOApp05].Process2 Read the arguments	
Step 18	[Exec Tester] Get the arguments of [EMOApp05].Process2	Check if only one argument is received and the argument received is filename = inputfile_2
Step 19	[EMOApp05].Process1 Read the environment variables	
Step 20	[Exec Tester] Get the environment variables of [EMOApp05].Process2	Check if the environment variable APP_PATH has /home/user2

5.2.8 [STS_EMO_00008] Execution Management shall support self initiated graceful shutdown of Processes

Test Objective	Verification that Execution Management shall support self initiated graceful shutdown of processes.		
ID	STS_EMO_00008	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00011]		
Reference to Test Environment	STC_EMO_00003		
Configuration Parameters	Machine State Driving, in which all System Test Applications [EMOApp02] shall start is defined		
Summary	A change of Machine State from Startup to Driving is requested. Start of [EMOApp02] Process is checked. Initiate self termination from [EMOApp02] Process and check that Execution Manager supports the self initiated shutdown of Process		
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - Operating system on ECU2 has booted.		
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to *Driving* for ECU2.		

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Step 2	[SM] Request for change of Machine State to *Driving* from Execution Manager.	Machine State for ECU2 is changed to *Driving*.
Step 3	[Exec Tester] Query execution status of [EMOApp02] Process	[EMOApp02] Process is executed
Step 4	[Exec Tester] Get the Process ID of the [EMOApp02] Process1	Received the Process ID of [EMOApp02] Process *APPID2*
Step 5	[EMOApp02] Process Report kTerminating state using API ExecutionClient::ReportExecutionState to Execution Manager	
Step 6	[EMOApp02] Process Exit from [EMOApp02] Process	
Step 7	[Exec Tester] Get the list of currently running process	Check if *APPID2* does not exist in the list of currently running process

5.2.9 [STS_EMO_00009] Execution Management shall support binding of processes and its associated threads to specified set of cores

Test Objective	Verification that the Execution Management shall support the binding of processes and its associated threads to specific set of cores as specified in the Execution Manifest.		
ID	STS_EMO_00009	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00008]		
Reference to Test Environment	STC_EMO_00003		
Configuration Parameters	- Machine State Driving, in which all System Test Applications [EMOApp02], [EMOApp03], [EMOApp04] and [EMOApp05] shall start is defined - [EMOApp02].Process and [EMOApp03].Process are mapped to cores 1 and 2 - [EMOApp04].Process and [EMOApp05].Process are mapped to cores 3 and 4		
Summary	A change of Machine State from Startup to Driving is requested. Start of [EMOApp02] Process is checked. Also it is checked that [EMOApp02] Process runs on core 1 and 2 as configured in the Execution Manifest. Threads are created inside the [EMOApp02] Process and it is checked that threads are running on core 1 or 2. Assign core 1 to thread created inside [EMOApp02] Process and it is checked that the thread runs in core 1. Assign core 3 to thread created inside [EMOApp02] Process and it is checked that the thread does not run in core 3, since core 3 is not set for [EMOApp02] Process		

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Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - Operating system on ECU2 has booted.	
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to *Driving* for ECU2.	
Step 2	[SM] Request for change of Machine State to *Driving* from Execution Manager.	Machine State for ECU2 is changed to *Driving*.
Step 3	[Exec Tester] Query execution status of [EMOApp02] Process	[EMOApp02] Process is executed
Step 4	[Exec Tester] Get the Process ID of the [EMOApp02] Process1	Received the Process ID of [EMOApp02] Process *APPID2*
Step 5	[Exec Tester] Get the core in which [EMOApp02] Process is running	Check if the [EMOApp02] Process is running in core 1 or 2
Step 6	[EMOApp02] Process Create a thread *APP2ProcThread1* inside the [EMOApp02] Process	
Step 7	[Exec Tester] Get the core in which the thread *APP2ProcThread1* is running	Check if the thread *APP2ProcThread1* is running in core 1 or 2
Step 8	[EMOApp02] Process Assign core 1 to the thread *APP2ProcThread1*	
Step 9	[Exec Tester] Get the core in which the thread *APP2ProcThread1* is running	Check if the thread *APP2ProcThread1* is running in core 1
Step 10	[EMOApp02] Process Create a thread *APP2ProcThread2* inside the [EMOApp02] Process	
Step 11	[Exec Tester] Get the core in which the thread *APP2ProcThread2* is running	Check if the thread *APP2ProcThread2* is running in core 1 or 2
Step 12	[EMOApp02] Process Assign core 3 to the thread *APP2ProcThread2*	
Step 13	[Exec Tester] Get the core in which the thread *APP2ProcThread2* is running	Check if the thread *APP2ProcThread2* is running in core 1 or 2

5.2.10 [STS_EMO_00010] Execution Management shall support the configuration of OS resource budgets for Process and group of Processes

Test Objective	Verification that the execution management shall assign the ResourceGroup to process or group of processes based on the configuration in the Execution Manifest and also to verify that the CPU limit and memory limit assigned to ResourceGroup is based on the configuration in the Execution Manifest.		
ID	STS_EMO_00010	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00005]		
Reference to Test Environment	STC_EMO_00004		
Configuration Parameters	- Machine State Driving, in which System Test Applications [EMOApp02] and [EMOApp03] shall start is defined - Function Group State On of [FG1] in which [EMOApp04] Process1 shall start is defined - Two ResourceGroups *ResourceGroup1* and *ResourceGroup2* are configured - *ResourceGroup1* is configured with CPU limit and Memory limit as *CPULIM1* and *MEMLIM1* respectively. *ResourceGroup2* is configured with CPU limit and Memory limit as *CPULIM2* and *MEMLIM2* respectively - [EMOApp02] and [EMOApp03] Process are mapped to *ResourceGroup1* and [EMOApp04] Process is mapped to *ResourceGroup2* Hint: CPU limit is specified as percentage of the total CPU capacity on the machine and Memory limit is specified in bytes		
Summary	A change of Machine State from *Startup* to *Driving* is requested. Start of [EMOApp02] Process is checked. Then start of [EMOApp03] Process is checked Get the Resource Group of [EMOApp02] and [EMOApp03] Process and check if the Resource Group assigned is *ResourceGroup1* Get the CPU and Memory limit of Resource Group *ResourceGroup1* and check if the CPU limit and Memory limit are *CPULIM1* and *MEMLIM1* respectively. A change of Function Group State of [FG1] to On is requested and startup of the [EMOApp04] Process is verified Get the Resource Group of [EMOApp04] Process and check if the Resource Group assigned is *ResourceGroup2*. Get the CPU and Memory limit of Resource Group *ResourceGroup2* and check if the CPU limit and Memory limit are *CPULIM2* and *MEMLIM2* respectively.		
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - ECU2 Function Group State [FG1] is *Off* - Operating system on ECU2 has booted.		
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to *Driving* for ECU2.		
Step 2	[SM] Request for change of Machine State to *Driving* from Execution Manager.		Machine State for ECU2 is changed to *Driving*.
Step 3	[Exec Tester] Query execution status of [EMOApp02] Process		[EMOApp02] Process is executed

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Step 4	[Exec Tester] Get the ResourceGroup of [EMOApp02] Process	ResourceGroup is received as *ResourceGroup1*
Step 5	[Exec Tester] Get the CPU limit of *ResourceGroup1*	CPU limit is received as *CPULIM1*
Step 6	[Exec Tester] Get the Memory limit of *ResourceGroup1*	Memory limit is received as *MEMLIM1*
Step 7	[Exec Tester] Query execution status of [EMOApp03]	[EMOApp03] Process is executed
Step 8	[Exec Tester] Get the ResourceGroup of [EMOApp03] Process	ResourceGroup is received as *ResourceGroup1*
Step 9	[Exec Tester] Request change of Function Group State [FG1] to *On*	
Step 10	[SM] Request for change of Function Group State [FG1] to On from Execution Manager.	Function Group State [FG1] for ECU2 is changed to *On*.
Step 11	[Exec Tester] Query execution status of [EMOApp04] Process	[EMOApp04] Process is executed
Step 12	[Exec Tester] Get the ResourceGroup of [EMOApp04] Process	ResourceGroup is received as *ResourceGroup2*
Step 13	[Exec Tester] Get the CPU limit of *ResourceGroup2*	CPU limit is received as *CPULIM2*
Step 14	[Exec Tester] Get the Memory limit of *ResourceGroup2*	Memory limit is received as *MEMLIM2*

5.2.11 [STS_EMO_00011] Execution Management shall support recovery actions in case an Process deviates from normal behavior

Test Objective	Verification that the Execution Manager shall support recovery actions when the Process is not terminated within the configured exit timeout value.		
ID	STS_EMO_00011	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00013]		
Reference to Test Environment	STC_EMO_00003		
Configuration Parameters	- Machine States *Driving* and *Parking* are configured - Machine State *Driving*, in which System Test Applications [EMOApp02] and [EMOApp03] shall start is defined - exitTimeoutValue is configured as *ExitTimeVal1* for Machine State Driving		

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Summary	A change of Machine State from *Startup* to *Driving* is requested. Start of [EMOApp02] and [EMOApp03] Process is checked A change of Machine State from *Driving* to *Parking* is requested. [EMOApp02] Process is not terminated within the configured exitTimeoutValue *ExitTimeVal1* Execution Manager notifies Platform Health Management that timeout is detected for [EMOApp02] Process. Platform Health Management shall trigger Recovery action to restart the Process.	
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - Operating system on ECU2 has booted.	
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Exec Tester] Query execution status of [PHM].	[PHM] is started
Step 2	[Exec Tester] Request change of Machine State to *Driving* for ECU2.	
Step 3	[SM] Request for change of Machine State to *Driving* from Execution Manager.	Machine State for ECU2 is changed to *Driving*.
Step 4	[Exec Tester] Query execution status of [EMOApp02] Process	[EMOApp02] Process is executed
Step 5	[Exec Tester] Query execution status of [EMOApp03] Process	[EMOApp03] Process is executed
Step 6	[Exec Tester] Request change of Machine State to *Parking* for ECU2.	
Step 7	[SM] Request for change of Machine State to *Parking* from Execution Manager.	Machine State for ECU2 is changed to *Parking*.
Step 8	[Exec Tester] Start *ExitTimeVal1* timer	
Step 9	[Exec Tester] After the *ExitTimeVal1* timer expires. Query execution status of [EMOApp02] Process	[EMOApp02] Process is not terminated.
Step 10	[EXM] Execution Manager shall notify Platform Health Management about timeout	
Step 11	[PHM] Request to Execution Manager to Restart the [EMOApp02] Process	Operation succeeded
Step 12	[EXM] Report error to State Manager that the state transition request is not fulfilled	State change request could not be finished in time

5.2.12 [STS_EMO_00012] Only Execution Management shall start Processes

Test Objective	Verification that all the processes are started by Execution Manager other than system specific processes directly started by the OS outside of AP.		
ID	STS_EMO_00012	**State**	Draft
Affected Functional Cluster	Execution Management		
Trace to RS Criteria	[RS_EM_00009]		
Reference to Test Environment	STC_EMO_00003		
Configuration Parameters	- Machine State Driving, in which System Test Applications [EMOApp02] and [EMOApp03] shall start is defined - Machine State Parking, in which System Test Applications [EMOApp04] and [EMOApp05] shall start is defined		
Summary	A change of Machine State from *Startup* to *Driving* is requested. Start of [EMOApp02] and [EMOApp03] Process is checked Get the parent Process ID of [EMOApp02] and [EMOApp03] Process and check if it is equal to the Process Id of Execution Manager A change of Machine State from Driving to Parking is requested. Start of [EMOApp04] and [EMOApp05] Process is checked Get the parent Process ID of [EMOApp04] and [EMOApp05] Process and check if it is equal to the Process Id of Execution Manager Get the parent Process Id of all the running Process other than the system specific processes directly started by the OS outside of AP and check if it is equal to the Process Id of Execution Manager		
Pre-conditions	- Exec Tester is connected to ECU2 via TCP. - Software components on ECU2 are initialized. - ECU2 is in Machine State *Startup*. - Operating system on ECU2 has booted.		
Post-conditions	TCP connection between Exec Tester and ECU2 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Exec Tester] Request change of Machine State to *Driving* for ECU2.		
Step 2	[SM] Request for change of Machine State to *Driving* from Execution Manager.		Machine State for ECU2 is changed to *Driving*.
Step 3	[Exec Tester] Get the Process ID of the Execution Manager		Received the Process ID of Execution Manager. *EXMPID*(1)
Step 4	[Exec Tester] Query execution status of [EMOApp02] Process		[EMOApp02] Process is executed
Step 5	[Exec Tester] Query execution status of [EMOApp03] Process		[EMOApp03] Process is executed
Step 6	[Exec Tester] Get the Process ID of [EMOApp02] Process		Received the Process ID of [EMOApp02] Process *APPID2*

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Step 7	[Exec Tester] Get the Parent Process ID of [EMOApp02] Process	The Parent Process ID of [EMOApp02] Process is received as *EXMPID*(1)
Step 8	[Exec Tester] Get the Process ID of [EMOApp03] Process	Received the Process ID of [EMOApp03] Process *APPID3*
Step 9	[Exec Tester] Get the Parent Process ID of [EMOApp03] Process	The Parent Process ID of [EMOApp03] Process is received as *EXMPID*(1)
Step 10	[Exec Tester] Request change of Machine State to *Parking* for ECU2.	
Step 11	[SM] Request for change of Machine State to *Parking* from Execution Manager.	Machine State for ECU2 is changed to *Parking*.
Step 12	[Exec Tester] Query execution status of [EMOApp04] Process	[EMOApp04] Process is executed
Step 13	[Exec Tester] Query execution status of [EMOApp05] Process	[EMOApp05] Process is executed
Step 14	[Exec Tester] Get the Process ID of [EMOApp04] Process	Received the Process ID of [EMOApp04] Process *APPID4*
Step 15	[Exec Tester] Get the Parent Process ID of [EMOApp04] Process	The Parent Process ID of [EMOApp04] Process is received as *EXMPID*(1)
Step 16	[Exec Tester] Get the Process ID of [EMOApp05] Process	Received the Process ID of [EMOApp05] Process *APPID5*
Step 17	[Exec Tester] Get the Parent Process ID of [EMOApp05] Process	The Parent Process ID of [EMOApp05] Process is received as *EXMPID*(1)
Step 18	[Exec Tester] Get all the running process other than the system specific process which are directly started by the OS outside of AP	The Parent Process ID for all the processes other than system specific processes is received as *EXMPID*(1)

6 Test configuration and test steps for Diagnostics

6.1 Test System

6.1.1 Test configurations

Configuration ID	STC_DIAG_00001
Description	Standard Jenkins server for diagnostic test
ECU 1	Intel Minnowboard Turbot, 192.168.100.5
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server running the job with the [Diagnostic Tester] is connected via Ethernet to [ECU1] hosting the System Test Application [DIAGApp01] respectively. The [Diagnostic Tester] will open TCP connections on port 13400 and send diagnostic data as UDS requests in DoIP packets.

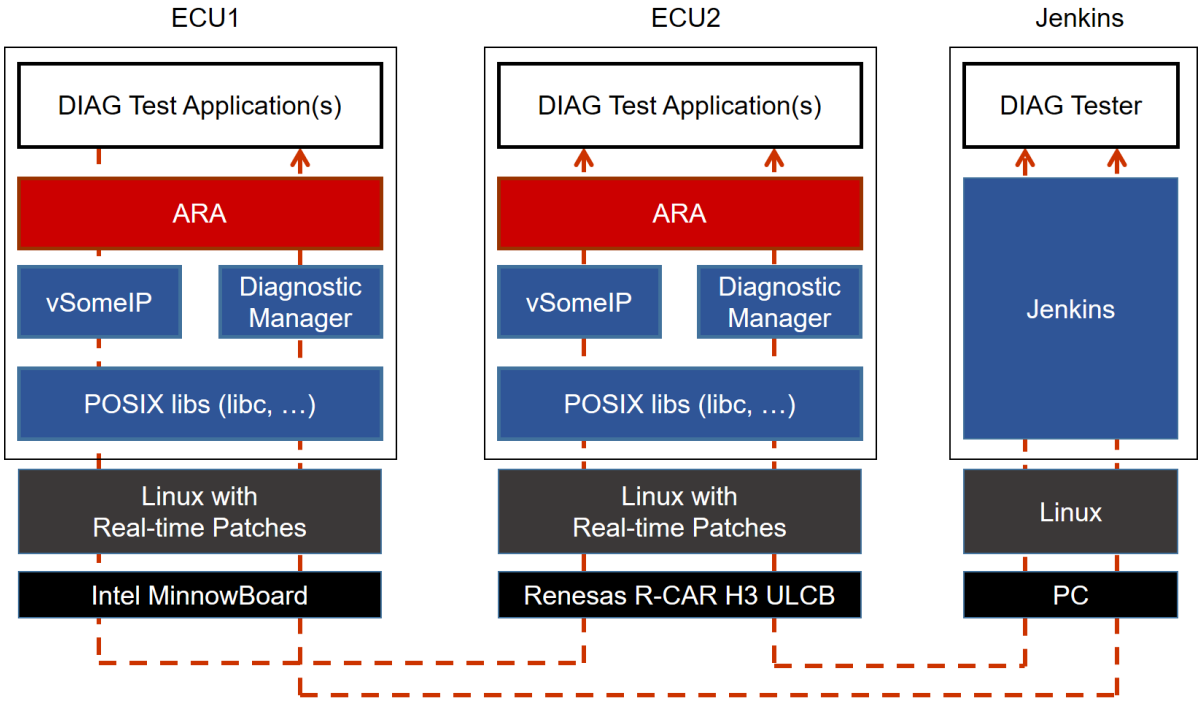

Figure 6.1: Illustration of test setup for Diagnostics.

6.2 Test cases

6.2.1 [STS_DIAG_00001] Utilization of Diagnostic service ReadDataByIdentifier (0x22) by external Tester via UDS messages over DoIP.

Test Objective	Verification of correct behavior of Diagnostic service ReadDataByIdentifier (0x22) by external Tester via UDS messages over DoIP.		
ID	STS_DIAG_00001	**State**	Draft
Affected Functional Cluster	Diagnostic		
Trace to RS Criteria	RS traceability will be added in next release		
Reference to Test Environment	STC_DIAG_00001		
Configuration Parameters	- Diagnostics module: • Service instance for service ReadDataByIdentifier with DID <0x0001> is configured. • Service instance with DID <0x0099> is NOT configured.		
Summary	This basic test tries to query the value of a variable contained by [DIAGApp01] on [ECU1] over the AP Diagnostics Module. The UDS service ReadDataByIdentifier (0x22) is used. The AP Diagnostics Module has to call a service in the Application Layer to retrieve the requested information and send it back as UDS response. If an unknown identifier is queried, a negative response must be sent.		
Pre-conditions	- [Diagnostic Tester] is connected to [ECU1] via TCP socket on DoIP-Port. - Software components on [ECU1] are initialized.		
Post-conditions	TCP connection between [Diagnostic Tester] and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Diagnostic Tester] Send Routing Activation Request (0x00005) with Activation type : Default(0x00)		
Step 2	[DIAGApp01] Send Routing Activation Response		
Step 3	[Diagnostic Tester] Send UDS Request to query value of <int1>: UDS-Service: ReadDataByIdentifier UDS-Payload: 0x22 ...		
Step 4	[DIAGApp01] Start mechanism to read the value of <int1>.		
Step 5	[Diagnostic Tester] Receive UDS response and save value of <int1> in <var1>.		Positive response received (0x62 ...). Payload of UDS response contains DID data with value of <int1>.
Step 6	[DIAGApp01] Start mechanism to change the value of <int1> by <delta>.		
Step 7	[Diagnostic Tester] Send UDS Request to query value of <int1>: UDS-Service: ReadDataByIdentifier UDS-Payload: 0x22 ...		

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Step 8	[DIAGApp01] Start mechanism to read value of <int1> and return it as DID data.	
Step 9	[Diagnostic Tester] Receive UDS response and save value of <int1> in <var2>.	Positive response received (0x62 ...). Payload of UDS response contains DID data. Compare values of <var1> and <var2>. <var2> should be greater than <var1> by <delta> i.e. <var2>=<var1> + <delta>.
Step 10	[Diagnostic Tester] Send UDS Request to query data with a non-implemented DID: UDS-Service: ReadDataByIdentifier UDS-Payload: 0x22 ...	Tester receives negative response: 0x7F 0x22 0x31.

6.2.2 [STS_DIAG_00002] Utilization of Diagnostic service RoutineControl (0x31) by external Tester via UDS messages over DoIP.

Test Objective	Verification of correct behavior of Diagnostic service RoutineControl (0x31) by external Tester via UDS messages over DoIP.		
ID	STS_DIAG_00002	**State**	Draft
Affected Functional Cluster	Diagnostic		
Trace to RS Criteria	SRS_Diag_04224		
Reference to Test Environment	STC_DIAG_00001		
Configuration Parameters	- The following service is configured [DIAGService01] in [DIAGApp01] - In this [DIAGService01], two different contents are available • <Content1> • <Content2> - Diagnostics module: • Service instance for service RoutineControl with RID <0x0001> is configured and only available in Extended Diagnostic Session. • Service Diagnostic Session Control is configured.		
Summary	This test tries to start a routine in [DIAGApp01] over the AP Diagnostics Module and the UDS service RoutineControl (0x31). In DefaultSession, execution is not allowed and a negative response is sent. After switching to ExtendedDiagnosticSession, the routine is started and a positive response is sent.		
Pre-conditions	- [Diagnostic Tester] is connected to [ECU1] via TCP socket on DoIP-Port. - Software components on [ECU1] are initialized. - [DIAGApp01] sends <Content1> via [DIAGService01].		
Post-conditions	TCP connection between Jenkins server and [ECU1] is closed.		
Main Test Execution			

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Test Steps		Pass Criteria
Step 1	[Diagnostic Tester] Send Routing Activation Request (0x00005) with Activation type : Default(0x00)	
Step 2	[DIAGApp01] Send Routing Activation Response	
Step 3	[Diagnostic Tester] Send UDS request to change content of [DIAGService01]: UDS-Service: RoutineControl UDS-Payload: 0x31 0x01 ...	Negative response received: Service Not Supported in Active Session (0x7F 0x31 0x7F).
Step 4	[Diagnostic Tester] Send UDS request to start an Extended Diagnostic Session: UDS-Service: DiagnosticSessionControl UDS-Payload: 0x10 0x03	Positive response received (0x50 0x03).
Step 5	[Diagnostic Tester] Send UDS request to change content of [DIAGService01] from <Content1> to <Content2>: UDS-Service: RoutineControl UDS-Payload: 0x31 0x01 ...	
Step 6	[DIAGApp01] Start mechanism to change content of [DIAGService01] from <Content1> to <Content2>	Content of Service is changed to <Content2>
Step 7	[DIAGApp01] Return from Subfunction Start of Routine with RID <0x0001>.	
Step 8	[Diagnostic Tester] Receive UDS response.	Positive response received (0x71 ...).

6.2.3 [STS_DIAG_00003] Utilization of Diagnostic service TesterPresent (0x3E) by External Tester via UDS messages over DoIP.

Test Objective	Verification of correct behavior of Diagnostic service TesterPresent (0x3E) by External Tester via UDS messages over DoIP.		
ID	STS_DIAG_00003	**State**	Draft
Affected Functional Cluster	Diagnostic		
Trace to RS Criteria	RS traceability will be added in next release		
Reference to Test Environment	STC_DIAG_00001		

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Configuration Parameters	Diagnostics module: • Service instance for service RoutineControl with RID <0x0001> is configured and only available in Extended Diagnostic Session. • Service Diagnostic Session Control and Extended Diagnostic Session time out is configured. • TesterPresent is configured.	
Summary	TesterPresent request is sent to indicate that previously activated non-default (e.g. extended) session will still be active. The UDS service RoutineControl (0x31) is executed to check if Extended session is active (Any other service which is supported in extended session may be used). Positive response is received for the TesterPresent request if suppressPosRspMsgIndicationBit is set to FALSE. No response is expected (by Client) from Server if, suppressPosRspMsgIndicationBit is set to TRUE	
Pre-conditions	- [Diagnostic Tester] is connected to [ECU1] via TCP socket on DoIP-Port. - Software components on [ECU1] are initialized.	
Post-conditions	TCP connection between Jenkins server and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Diagnostic Tester] Send Routing Activation Request (0x00005) with Activation type : Default(0x00)	
Step 2	[DIAGApp01] Send Routing Activation Response	
Step 3	[Diagnostic Tester] Send UDS request to start an Extended Diagnostic Session: UDS-Service: DiagnosticSessionControl(SID 0x10) UDS-Payload: 0x10 0x03	Positive response received (0x50 0x03).
Step 4	[Diagnostic Tester] Wait for time <t1> such that <t1> is less than Diagnostic session timer timeout.	
Step 5	[Diagnostic Tester] Send UDS request Tester Present with suppressPosRspMsg IndicationBit is set to FALSE. UDS-Service: TesterPresent (SID 0x3E) UDS-Payload: 0x3E 0x00	Positive response received (0x7E 0x00).
Step 6	[Diagnostic Tester] Wait for time <t2> such that - 1) <t2> is greater than Diagnostic session timer timeout. 2) <t2> is less than sum of Extended session timer and Diagnostic session timer timeout.	
Step 7	[Diagnostic Tester] Send UDS request RoutineControl to confirm if Extended Session is active. UDS-Service: RoutineControl (SID 0x31) UDS-Payload: 0x31 0x01 ...	Positive response received (0x71 ...).
Step 8	[Diagnostic Tester] Stop sending TesterPresent and wait for Extended Diagnostic Session to time out	

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Step 9	[Diagnostic Tester] Send UDS request RoutineControl to confirm if Extended Session is active. UDS-Service: RoutineControl UDS-Payload: 0x31 0x01 ...	Negative response received: Service Not Supported in Active Session (0x7F 0x31 0x7F (NRC)).
Step 10	[Diagnostic Tester] Send UDS request to start an Extended Diagnostic Session: UDS-Service: DiagnosticSessionControl UDS-Payload: 0x10 0x03	Positive response received (0x50 0x03).
Step 11	[Diagnostic Tester] Wait for time <t1> such that <t1> is less than Diagnostic session timer timeout.	
Step 12	[Diagnostic Tester] Send UDS request TesterPresent with suppressPosRspMsg IndicationBit is set to TRUE. UDS-Service: TesterPresent UDS-Payload: 0x3E 0x80	No response received for UDS request TesterPresent.
Step 13	[Diagnostic Tester] Wait for time <t2> such that - 1) <t2> is greater than Diagnostic session timer timeout. 2) <t2> is less than sum of Extended session timer and Diagnostic session timer timeout.	
Step 14	[Diagnostic Tester] Send UDS request RoutineControl to confirm if Extended Session is active. UDS-Service: RoutineControl UDS-Payload: 0x31 ...	Positive response received (0x71 ...).

6.2.4 [STS_DIAG_00004] Utilization of Diagnostic service WriteDataByIdentifier (0x2E) by External Tester via UDS messages over DoIP.

Test Objective	Verification of correct behavior of Diagnostic service WriteDataByIdentifier (0x2E) by External Tester via UDS messages over DoIP.		
ID	STS_DIAG_00004	**State**	Draft
Affected Functional Cluster	Diagnostic		
Trace to RS Criteria	RS traceability will be added in next release		
Reference to Test Environment	STC_DIAG_00001		
Configuration Parameters	Diagnostics module: - Service instances for service ReadDataByIdentifier and WriteDataByIdentifier with DID <0x0001> are configured.		

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Summary	This basic test tries to query the value of <int1> contained by [DIAGApp01] on [ECU1] over the AP Diagnostics Module. The UDS service ReadDataByIdentifier (0x22) is used and then the value of <int1> is overwritten by UDS service WriteDataByIdentifier (0x2E). Overwritten value of the variable <int1> is read back using UDS service ReadDataByIdentifier (0x22).	
Pre-conditions	- [Diagnostic Tester] is connected to [ECU1] via TCP socket on DoIP-Port - Software components on [ECU1] are initialized.	
Post-conditions	TCP connection between [Diagnostic Tester] and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[Diagnostic Tester] Send Routing Activation Request (0x00005) with Activation type : Default(0x00)	
Step 2	[DIAGApp01] Send Routing Activation Response	
Step 3	[Diagnostic Tester] Send UDS Request to query value of <int1>: UDS-Service: ReadDataByIdentifier UDS-Payload: 0x22 ...	
Step 4	[DIAGApp01] Wait for invocation.	Implementation of method Read for DID <0x0001> is invoked.
Step 5	[Diagnostic Tester] Receive UDS response with value of <int1>.	Positive response received (0x62 ...). Payload of UDS response contains DID data with value of <int1>.
Step 6	[Diagnostic Tester] Send UDS Request to overwrite value of <int1> with <int2> UDS-Service: WriteDataByIdentifier UDS-Payload: 0x2E ...	
Step 7	[Diagnostic Tester] Receive UDS response.	Positive response received (0x6E ...) after successful write.
Step 8	[Diagnostic Tester] Send UDS request to query value of <int1> UDS-Service: ReadDataByIdentifier UDS-Payload: 0x22 ...	
Step 9	[DIAGApp01] Wait for invocation.	Implementation of method Read for DID <0x0001> is invoked.
Step 10	[Diagnostic Tester] Receive UDS response with value of <int1> and store it in <var>.	Positive response received (0x62 ...). Payload of UDS response contains DID data with value of <int1>.
Step 11	[Diagnostic Tester] Compare <var> and <int2> values.	Both values should be equal.

6.2.5 [STS_DIAG_00005] Utilization of Diagnostic service InputOutputControl ByIdentifier (0x2F) by External Tester via UDS messages over DoIP.

Test Objective	Verification of correct behavior of Diagnostic service InputOutputControlByIdentifier (0x2F) by External Tester via UDS messages over DoIP.		
ID	STS_DIAG_00004	**State**	Draft
Affected Functional Cluster	Diagnostic		
Trace to RS Criteria	SRS_Diag_04218		
Reference to Test Environment	STC_DIAG_00001		
Configuration Parameters	Diagnostics module: - Service instances for service InputOutputControlByIdentifier with DID <0x0001> are configured. - Methods ShortTermAdjustment , FreezeCurrentState ,ReturnControlToECU ,ResettoDefault for InputOutputControlByIdentifier for DID <0x001>are available		
Summary	This basic test tries to send request for ShortTermAdjustment/FreezeCurrentState/ResettoDefault/FreezeCurrentState for DID <0x001> contained by [DIAGApp01]on [ECU1] over the AP Diagnostics Module. This test tries to substitute values of the input for DID <0x0001> and verify the output as desired		
Pre-conditions	- [Diagnostic Tester] is connected to [ECU1] via TCP socket on DoIP-Port - Software components on [ECU1] are initialized.		
Post-conditions	TCP connection between [Diagnostic Tester] and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Diagnostic Tester] Send Routing Activation Request (0x00005) with Activation type : Default(0x00)		
Step 2	[DIAGApp01] Send Routing Activation Response		
Step 3	[Diagnostic Tester] Send UDS Request for ShortTermAdjustment to value <x> for DID <0x0001> SID :0x2F ,InputOutputcontrolParameter = 0x03(ShortTermAdjustment) Payload : 0x2F 0x00 0x01 03 ...		
Step 4	[DIAGApp01] Wait for invocation.		Implementation of method ShortTermAdjustment for DID <0x0001> is invoked.
Step 5	[Diagnostic Tester] Receive UDS response with desired ShortTermAdjustment		Positive response received (0x6F ...). Payload of UDS response contains DID data with desired shorttermadjustment.
Step 6	[Diagnostic Tester] Send UDS Request to Freeze State of DID<0x001> SID :0x2F ,InputOutputcontrolParameter = 0x02(FreezeCurrentState) UDS-Payload: 0x2F ...		
Step 7	[DIAGApp01] Wait for invocation.		Implementation of method FreezeCurrentState for DID <0x0001> is invoked.
Step 8	[Diagnostic Tester] Receive UDS response with Current State Freezed.		Positive response received (0x6F ...). Payload of UDS response contains DID data .

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Step 9	[Diagnostic Tester] Send UDS request to ResetToDefault SID :0x2F ,InputOutputcontrolParameter = 0x01(ResetToDefault) UDS-Payload: 0x2F ...	
Step 10	[DIAGApp01] Wait for invocation.	Implementation of method ResetToDefault for DID <0x0001> is invoked.
Step 11	[Diagnostic Tester] Receive UDS response	Positive response received (0x6F ...). Payload of UDS response contains DID data reset to default .

6.2.6 [STS_DIAG_00006] Utilization of Diagnostic service ClearDTC (0x14) by External Tester via UDS messages over DoIP.

Test Objective	Verification of correct behavior of Diagnostic service ClearDTC (0x14) by External Tester via UDS messages over DoIP.		
ID	STS_DIAG_00006	**State**	Draft
Affected Functional Cluster	Diagnostic		
Trace to RS Criteria	RS traceability will be added in next release		
Reference to Test Environment	STC_DIAG_00001		
Configuration Parameters	Diagnostics module: - Service instances for service Clear DTC(0x14) are configured. - GroupofDTC <gtc1> is configured.		
Summary			
Pre-conditions	- [Diagnostic Tester] is connected to [ECU1] via TCP socket on DoIP-Port - Software components on [ECU1] are initialized.		
Post-conditions	TCP connection between [Diagnostic Tester] and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Diagnostic Tester] Send Routing Activation Request (0x00005) with Activation type : Default(0x00)		
Step 2	[DIAGApp01] Send Routing Activation Response		
Step 3	[Diagnostic Tester] Send UDS request to clear GroupofDTC<gtc1> related to event <e1> SID :0x14 Payload : 0x14 0xFF 0xFF 0x33		

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Step 4	[DIAGApp01] Implementation of Service Clear DTC is invoked.	Check if requested GroupofDTC<gtc1> is present in the configured group of DTC. If yes, Send response.
Step 5	[Diagnostic Tester] Receive UDS response	Positive response received (0x54 ...). Payload of UDS response contains status of cleared DTC.
Step 6	[Diagnostic Tester] Send UDS request to read cleared GroupofDTC<gtc1> related to event <e1> SID :0x19 Payload : 0x19 ..	
Step 7	[DIAGApp01] Invoke implementation of Diagnostic Service Read DTC	Check if DTC is available.
Step 8	[Diagnostic Tester] Receive UDS response	Positive response (0x59)with no available DTC is received
Step 9	[Diagnostic Tester] Send UDS request to clear GroupofDTC<gtc1> related to event <e1> SID :0x14 Payload: 0x14 0xFF FF .	
Step 10	[DIAGApp01] Implementation of service Clear DTC is invoked.Check Length of requested request	If length of requested UDS request is incorrect send NRC-13.
Step 11	[Diagnostic Tester] Receive UDS response for Clear DTC.	Negative response received (0x7F 0x14 0x13...).
Step 12	[Diagnostic Tester] Send UDS request for session change SID : 0x10 Payload: 0x10 0x03	
Step 13	[DIAGApp01] Prepare to start session change to extended session	
Step 14	[DiagnosticTester] Receive positive response for session change SID :0x10 Payload : 0x50 0x03	
Step 15	[Diagnostic Tester] Send UDS request to clear GroupofDTC<gtc1> related to event <e1> SID : 0x14 Payload: 0x14 0xFF 0xFF 0x35	
Step 16	[DIAGApp01] Implementation of service Clear DTC is invoked.Check if requested DTC group is available.	Group of DTC is not available,Send NRC-31 .
Step 17	[Diagnostic Tester] Receive UDS response	Negative response received (0x7F 0x14 0x31...)

6.2.7 [STS_DIAG_00007] Utilization of Diagnostic service SecurityAccess (0x27) by External Tester via UDS messages over DoIP.

Test Objective	Verification of correct behavior of Diagnostic service SecurityAccess (0x27) by External Tester via UDS messages over DoIP.		
ID	STS_DIAG_00007	**State**	Draft
Affected Functional Cluster	Diagnostic		
Trace to RS Criteria	SRS_Diag_04005		
Reference to Test Environment	STC_DIAG_00001		
Configuration Parameters	Diagnostics module: - Service instances for service Security access are configured - Service instances for Service ReadDataByIdentifier with DID <0x0001> are configured. - Sub functions (SecurityAccessType) are configured.		
Summary	This basic test tries to get an access of an ECU using Diagnostic service Security Access and try to access some secured parameters (DID <0x0001>)of an ECU. Tester first request for SEED, ECU responds with the SEED Value(random 2 byte number). Tester then generates the Key using the received SEED(Lower nibble of each byte masked with 0 ,Note that this could be OEM specific we are considering this as an example for demonstration) and send it to an ECU.ECU then verifies the key and grants access (Positive Response) .If Length of the request /sub function is not supported, then ECU shall send NRC		
Pre-conditions	- [Diagnostic Tester] is connected to [ECU1] via TCP socket on DoIP-Port - Software components on [ECU1] are initialized.		
Post-conditions	TCP connection between [Diagnostic Tester] and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[Diagnostic Tester] Send Routing Activation Request (0x00005) with Activation type : Default(0x00)		
Step 2	[DIAGApp01] Send Routing Activation Response		
Step 3	[Diagnostic Tester] Send UDS request to gain SecurityAccessType - 1 SID : 0x27 Payload - 0x27 01 ..		
Step 4	[DIAGApp01] Implementation of method RequestSeed is invoked		Seed (2 bytes of random number)is generated successfully and response is sent
Step 5	[Diagnostic Tester] Send Request to SendKey SID: 0x27 Payload : 0x27 0x02 ...		
Step 6	[DIAGApp01] Invoke method to verify received key		Check if the received Key is equal to internally generated key ,if yes send positive response
Step 7	[Diagnostic Tester] Receive positive response.		Positive response (0x67 ..) is received

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Step 8	[Diagnostic Tester] Send Request to read a secured paramter <var1> using ReadDID Service SID : 0x22 Payload : 0x22 0x00 0x01	
Step 9	[DIAGApp01] Invoke Service ReadDataByIdentifier	Provide value of <var1> as a response
Step 10	[DiagnosticTester] Receive UDS Service response	Positive response (0x62 0x00 0x01 var1)
Step 11	[Diagnostic Tester] Send UDS request to gain SecurityAccessType -1 SID : 0x27 Payload - 0x27 01 ..	
Step 12	[DIAGApp01] Implementation of Method - RequestSeed is invoked.	Check the length of the UDS security request, if the length is not correct send NRC-13
Step 13	[Diagnostic Tester] Receive UDS response	Negative response received (0x7F 0x27 0x13 ...)
Step 14	[Diagnostic Tester] Send UDS request to gain SecurityAccessType - 2 SID : 0x27 Payload - 0x27 02 ..	
Step 15	[DIAGApp01] Implementation of Method - RequestSeed is invoked.	Check if the sub function (SecurityAccessType -2) is supported or not. If not send NRC-12
Step 16	[Diagnostic Tester] Receive UDS response	Negative response (0x7F 0x27 0x12)

7 Test configuration and test steps for Logging and Tracing

7.1 Test System

7.1.1 Test configurations

Configuration ID	STC_LT_00001
Description	Standard Jenkins server for LT test
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the LT Tester, is connected via Ethernet to [ECU1] hosting the System Test Application [LTApp01] and [ECU2] hosting the System Test Application [LTApp02]. The LT Tester opens TCP connections on port 3490 and receives log messages from the LT module.

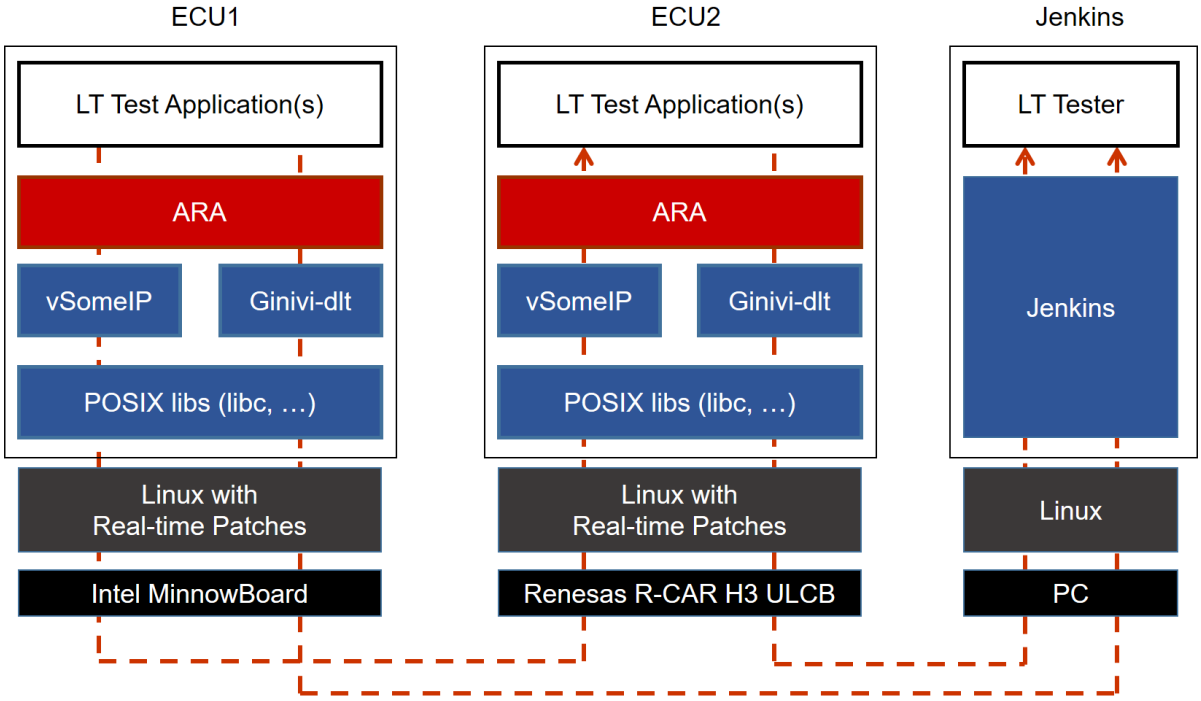

Figure 7.1: Illustration of test setup for Logging and Tracing.

7.2 Test cases

7.2.1 [STS_LT_00001] Receiving of log messages from LT module by external Tester and remote control of application's default log level.

Test Objective	Verification that all sent log messages from LT module are received by external Tester, that they carry the correct attributes like Application ID and ECU ID, and that the remote control of the application's default log level works.		
ID	STS_LT_00001	**State**	Draft
Affected Functional Cluster	Logging and Tracing		
Trace to RS Criteria	RS traceability will be added in next release		
Reference to Test Environment	STC_LT_00001		
Configuration Parameters	- LT module in ECU1 is configured properly: - ECU ID for ECU1 is set to ECU1 - [LTApp01] has LT Application ID APPID1. - Context ID for [LTApp01] is set to CTX1		
Summary	The LT Tester has to connect to the LT module, which has to receive and forward the log messages from the Application Layer. First, log messages on all log levels with correct attributes are expected. Then the applications default log level is consecutively lowered to more restrictive values and it is checked, whether the respective log messages disappear.		
Pre-conditions	[LT Tester] is connected to [ECU1] via TCP socket on Port 3490. • Software components on [ECU1] are initialized. • Video Provider's default log level is set to Verbose.		
Post-conditions	TCP connection between [LT Tester] and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[LT Tester] Receive log messages.		Tester receives log messages every 0.5 seconds. The messages are received for all log levels in context with ID CTX1 and contain ECU ID ECU1, and Application ID APPID1.
Step 2	[LT Tester] Send request to query change of [LTApp01] default log level to Debug.		Messages with log level Verbose are no longer received. Messages with lower log level are still coming in.
Step 3	[LT Tester] Send request to query change of [LTApp01] default log level to Info.		Messages with log level Debug are no longer received. Messages with lower log level are still coming in.
Step 4	[LT Tester] Send request to query change of [LTApp01] default log level to Warn.		Messages with log level Info are no longer received. Messages with lower log level are still coming in.
Step 5	[LT Tester] Send request to query change of [LTApp01] default log level to Error.		Messages with log level Warn are no longer received. Messages with lower log level are still coming in.
Step 6	[LT Tester] Send request to query change of [LTApp01] default log level to Fatal.		Messages with log level Error are no longer received. Messages with lower log level are still coming in.

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Step 7	[LT Tester] Send request to query change of [LTApp01] default log level to Off.	No log messages are received.

7.2.2 [STS_LT_00002] Receiving of log messages from LT modules of several ECUs.

Test Objective	Verification that all log messages from multiple ECUs are received and that they carry the correct attributes like Application ID and ECU ID.		
ID	STS_LT_00002	**State**	Draft
Affected Functional Cluster	Logging and Tracing		
Trace to RS Criteria	RS traceability will be added in next release		
Reference to Test Environment	STC_LT_00001		
Configuration Parameters	- LT modules in both ECUs are configured properly. - ECU ID for [ECU1] is set to ECU1 - [LTApp01] has LT Application ID APPID1. - Context ID for [LTApp01] is set to CTX1 - ECU ID for [ECU2] is set to ECU2 - [LTApp02] has LT Application ID APPID2. - Context ID for [LTApp02] is set to CTX2		
Summary	The LT Tester has to connect to the LT modules on the different ECUs. These have to receive and forward the log messages from the different applications in the Application Layers. First, log messages from [ECU1] on all log levels with correct attributes are expected. Then a connection to [ECU2] is established and additional messages with correct attributes are expected.		
Pre-conditions	- LT Tester is connected to [ECU1] via TCP socket on Port 3490. - [LTApp01] default log level is set to Verbose. - [LTApp02] default log level is set to Verbose.		
Post-conditions	TCP connections between Jenkins server and both ECUs are closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[LT Tester] Receive log messages.		Tester receives log messages every 0.5 seconds. The messages are received for all log levels in context with ID CTX1 and contain ECU ID ECU1, and Application ID APPID1.
Step 2	[LT Tester] Second LT Client connects to [ECU2] on Port 3490 using TCP.		Client connected.
Step 3	[LT Tester] Receive log messages		Messages from [ECU1] are still received every 0.5 seconds. Tester additionally receives log messages from ECU2 every 0.5 seconds.

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		△ The additional messages are received for log level Verbose in context with ID CTX2 and contain ECU ID ECU2, and Application ID APPID2.

8 Test configuration and test steps for Persistency

8.1 Test System

8.1.1 Test configurations

Configuration ID	STC_PER_00001
Description	Standard Jenkins server for Persistency test
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the Persistency Tester is connected via Ethernet to ECU1 hosting the Persistency Test Application. The Persistency Tester is supposed to check the pass criteria.

The communication with the Persistency Test Application may take place over the Diagnostics functional cluster in form of diagnostic messages. The functionality of the Persistency Test Application described in the test steps may for example entirely be contained in routines that are implementation of subroutines of instances of the Diagnostic service RoutineControl. This service also provides a means to transport data from the Persistency Tester to the Persistency Test Application and vice versa.

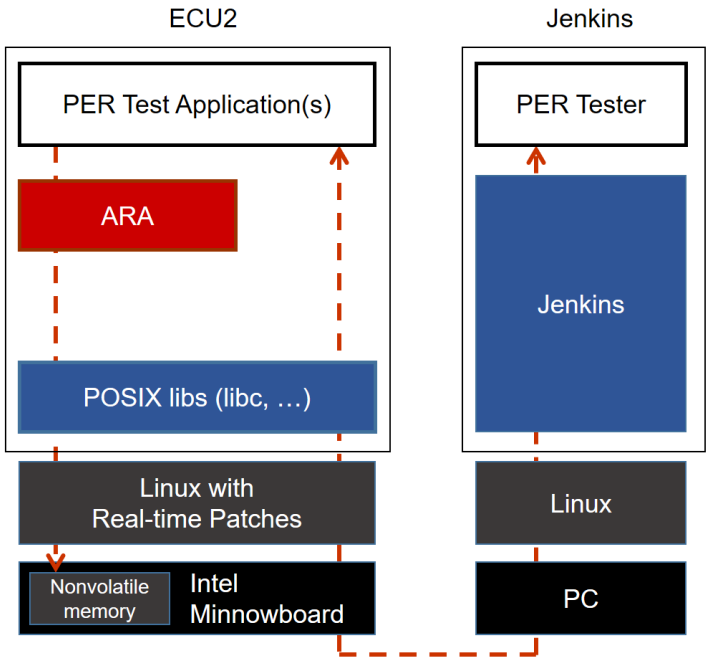

Figure 8.1: Illustration of test setup for Persistency.

8.2 Test cases

8.2.1 [STS_PER_00001] Storing an integer in a key-value database.

Test Objective	Verification, that integer data can be stored in a key-value database and that it can be retrieved again, using the associated key.		
ID	STS_PER_00001	**State**	Draft
Affected Functional Cluster	Persistency		
Trace to RS Criteria	[RS_PER_00003], [RS_PER_00010]		
Reference to Test Environment	STC_PER_00001		
Configuration Parameters	- File system contains an empty file for the key-value database.		
Summary	Integer data is stored in a key-value database. It is then retrieved again from the database using the associated key and the retrieved value is compared to the original one.		
Pre-conditions	- Persistency tester is connected to ECU1. - Software components on ECU1 are initialized. - File for key-value database opened successfully and the file should be empty		
Post-conditions	TCP connection between Persistency Tester and ECU1 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[PERApp01] Store integer <intData> with associated key <intKey> in key-value database.		
Step 2	[PERApp01] Retrieve integer from key-value database using the associated key and store it in variable <retIntData>.		Originally written integer value is returned. And values of <intData> and <retInt Data> are equal.

8.2.2 [STS_PER_00002] Storing a float in a key-value database.

Test Objective	Verification that float data can be stored in a key-value database and that it can be retrieved again, using the associated key.		
ID	STS_PER_00002	**State**	Draft
Affected Functional Cluster	Persistency		
Trace to RS Criteria	[RS_PER_00003], [RS_PER_00010]		
Reference to Test Environment	STC_PER_00001		
Configuration Parameters	- File system contains an empty file for the key-value database.		
Summary	Float data is stored in a key-value database. It is then retrieved again from the database using the associated key and the retrieved value is compared to the original one.		

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Pre-conditions	- Persistency tester is connected to ECU1. - Software components on ECU1 are initialized. - File for key-value database opened successfully and the file should be empty	
Post-conditions	TCP connection between Jenkins server and ECU1 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[PERApp01] Store float <floatData> with associated key <floatKey> in key-value database.	
Step 2	[PERApp01] Retrieve float from key-value database using the associated key and store it in variable <retFloatData>.	Originally written float value is returned. And Values of <floatData> and <ret FloatData> are equal

8.2.3 [STS_PER_00003] Storing a string in a key-value database.

Test Objective	Verification that string data can be stored in a key-value database and that it can be retrieved again, using the associated key.		
ID	STS_PER_00003	**State**	Draft
Affected Functional Cluster	Persistency		
Trace to RS Criteria	[RS_PER_00003], [RS_PER_00010]		
Reference to Test Environment	STC_PER_00001		
Configuration Parameters	- File system contains an empty file for the key-value database.		
Summary	A string is stored in a key-value database. It is then retrieved again from the database using the associated key and the retrieved value is compared to the original one.		
Pre-conditions	- Persistency tester is connected to ECU1. - Software components on ECU1 are initialized. - File for key-value database opened successfully and the file should be empty		
Post-conditions	TCP connection between Jenkins server and ECU1 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[PERApp01] Store string <stringData> with associated key <stringKey> in key-value database.		
Step 2	[PERApp01] Retrieve string from key-value database using the associated key and store it in variable <retStringData>.		Originally written string value is returned. And Values of <stringData> and <ret StringData> are equal.

8.2.4 [STS_PER_00004] Storing a string in a file.

Test Objective	Verification that a string can be stored in a file and retrieved again, using a file stream.		
ID	STS_PER_00004	**State**	Draft
Affected Functional Cluster	Persistency		
Trace to RS Criteria	[RS_PER_00004], [RS_PER_00010]		
Reference to Test Environment	STC_PER_00001		
Configuration Parameters	File system contains an empty file for the file stream.		
Summary	A string is stored in a file, using a file stream. It is then retrieved again from the file and the retrieved value is compared to the original one.		
Pre-conditions	- Persistency tester is connected to ECU1. - Software components on ECU1 are initialized. - File stream successfully opened file and the file should be empty		
Post-conditions	TCP connection between Jenkins server and ECU1 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[PERApp01] Write string <stringData> to file via file stream.		
Step 2	[PERApp01] Close file.		
Step 3	[PERApp01] Open file.		File opened successfully.
Step 4	[PERApp01] Retrieve string from file via file stream and store it in variable <retStringData>.		Originally written string value is retrieved. And Values of <stringData> and <ret StringData> are equal.

8.2.5 [STS_PER_00005] Storing an integer in a key-value database and retrieving it after reboot.

Test Objective	Verification, that integer data can be stored in a key-value database and, after a reboot, retrieved again using the associated key.		
ID	STS_PER_00005	**State**	Draft
Affected Functional Cluster	Persistency		
Trace to RS Criteria	[RS_PER_00001], [RS_PER_00002]		
Reference to Test Environment	STC_PER_00001		
Configuration Parameters	File system contains an empty file for the key-value database.		

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Summary	Integer data is stored in a key-value database. A reboot is performed and the integer data is retrieved again from the database. The retrieved value is then compared to the original one.	
Pre-conditions	- Persistency tester is connected to ECU1. - Software components on ECU1 are initialized. - File for key-value database opened successfully and the file should be empty	
Post-conditions	TCP connection between Jenkins server and ECU1 is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[PERApp01] Store integer <intData> with associated key <intKey> in key-value database.	
Step 2	[Persistency Tester] Request reboot.	
Step 3	[Persistency Tester] Wait until ECU1 has rebooted and PERApp01 is initialized.	
Step 4	[PERApp01] Open database.	Database file is opened.
Step 5	[PERApp01] Retrieve integer from key-value database using the associated key and store it in variable <retIntData>.	Originally written integer value is returned. And Values of <intData> and <retInt Data> are equal.

8.2.6 [STS_PER_00006] Storing a string in a file and retrieving it after reboot.

Test Objective	Verification, that string data can be stored in a file and, after a reboot, retrieved again using a file stream.		
ID	STS_PER_00006	**State**	Draft
Affected Functional Cluster	Persistency		
Trace to RS Criteria	[RS_PER_00001], [RS_PER_00002], [RS_PER_00004]		
Reference to Test Environment	STC_PER_00001		
Configuration Parameters	File system contains an empty file for the file stream.		
Summary	String data is stored in a file using a file stream provided by the Persistency Functional Cluster. A reboot is performed and the string data is retrieved again from the file. The retrieved value is then compared to the original one.		
Pre-conditions	- Persistency tester is connected to ECU1. - Software components on ECU1 are initialized. - File stream successfully opened file and the file should be empty		
Post-conditions	TCP connection between Jenkins server and ECU1 is closed.		
Main Test Execution			

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Test Steps		Pass Criteria
Step 1	[PERApp01] Write string <stringData> to file via file stream.	
Step 2	[PERApp01] Close file.	
Step 3	[Persistency Tester] Request reboot.	
Step 4	[Persistency Tester] Wait until ECU1 has rebooted and PERApp01 is initialized.	
Step 5	[PERApp01] Open file.	File opened successfully.
Step 6	[PERApp01] Retrieve string from file via file stream and store it in variable <retStringData>.	Originally written string value is retrieved. And Values of <stringData> and <ret StringData> are equal.

8.2.7 [STS_PER_00007] Exceeding the maximum allowed limit for storage

Test Objective	Verification that application can't exceed the maximum limit assigned to it in persistent storage.		
ID	STS_PER_00007	**State**	Draft
Affected Functional Cluster	Persistency		
Trace to RS Criteria	[RS_PER_00011]		
Reference to Test Environment	STC_PER_00001		
Configuration Parameters	- File system contains an empty file for the key-value database. - A configured max storage limit (Persistency-Deployment.maximumAllowedSize) for the application of size <intMaxLimit>		
Summary	Integer data is stored as multiple copies in a key-value database using a loop. At one step, the stored copies shall exceed the maximum allowed limit of storage for the application. This last storage request shall be denied by Persistency cluster.		
Pre-conditions	- Persistency tester is connected to ECU1. - Software components on ECU1 are initialized. - File for key-value database opened successfully and the file should be empty		
Post-conditions	TCP connection between Persistency Tester and ECU1 is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[PERApp01] Using a loop, store multiple copes of integer <intData> with associated key <intKey> in key-value database, till reaching the maximum allowed limit <int MaxLimit>		All storage requests are accepted with no errors.
Step 2	[PERApp01] Try to store another integer in the same database.		Storage request is denied.

9 Test configuration and test steps for Identity and Access Management

9.1 Test System

Identity and Access Management (IAM) requires each component to implement Policy Enforcement Point (PEP), which shall contact IAM to check access authorization of the requesting application.

System Test specification targets to check the PEP for Communication Management (FT-CM).

9.1.1 Test configurations

Configuration ID	STC_IAM_00001
Description	Standard Jenkins server for Identity and Access Management test
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the IAM Tester is connected via Ethernet to [ECU1] hosting the IAM Test Application (ITA).

The IAM Tester is supposed to check the pass criteria.

The communication with the ITA may take place over the Diagnostics functional cluster in form of diagnostic messages.

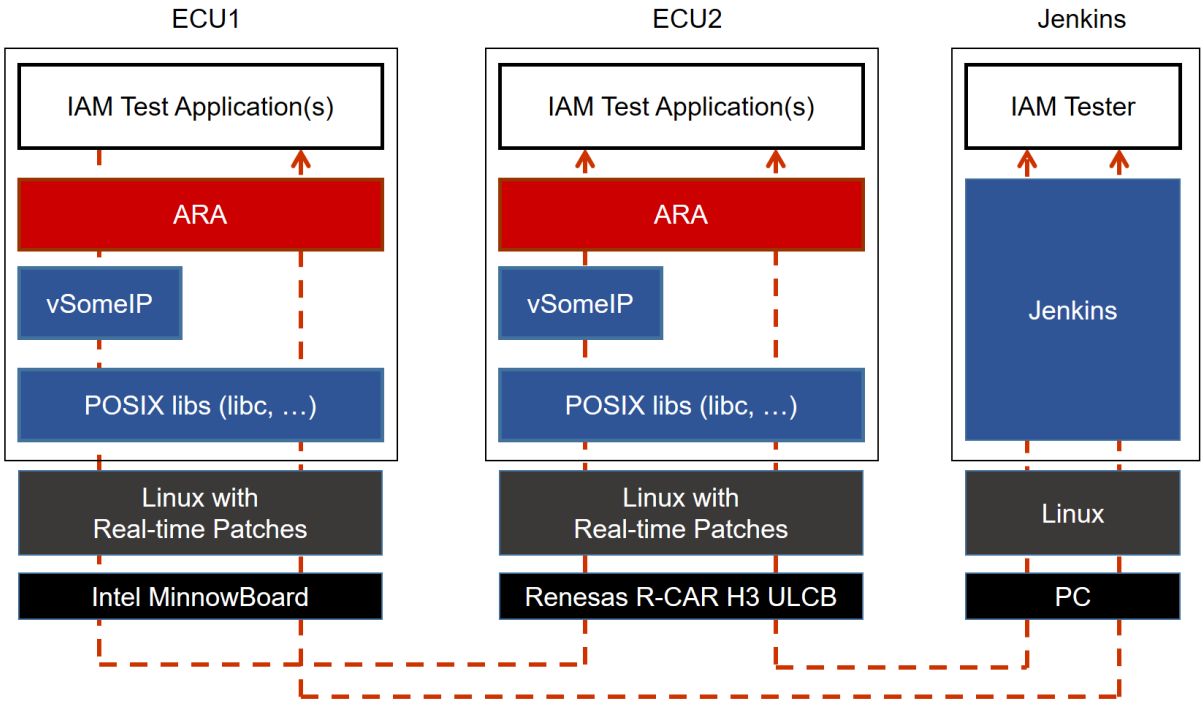

Figure 9.1: Illustration of test setup for Identity and Access Management.

9.2 Test cases

9.2.1 [STS_IAM_00001] Rejecting local service usage by an unauthorized application

Test Objective	Verification that unauthorized applications are not allowed to use services offered by another application.		
ID	STS_IAM_00001	**State**	Draft
Affected Functional Cluster	Identity and Access Management		
Trace to RS Criteria	[RS_IAM_00001], [RS_IAM_00002], [RS_IAM_00007], [RS_IAM_00010], [RS_IAM_00012]		
Reference to Test Environment	STC_IAM_00001		
Configuration Parameters	- [IAMApp01] offers and registers [IAMService01], [IAMService02], and [IAMService03] - [IAMApp02] is authorized to use [IAMService02] but not [IAMService01] and [IAMService03] - [IAMApp03] is authorized to use [IAMService03] but not [IAMService01] and [IAMService02]		
Summary	- [IAMApp02] can successfully use [IAMService02] but fails to use [IAMService01] and [IAMService03] - [IAMApp03] can successfully use [IAMService03] but fails to use [IAMService01] and [IAMService02]		

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Pre-conditions	- IAM Tester is connected to [ECU1] - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.	
Post-conditions	TCP connections between IAM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[IAMApp01] Offers service [IAMService01]	
Step 2	[IAMApp01] Offers service [IAMService02]	
Step 3	[IAMApp01] Offers service [IAMService03]	
Step 4	[IAMApp02] Requests service [IAMService02]	Service discovery callback with a handle for [IAMService02] is received by [IAMApp02].
Step 5	[IAMApp03] Requests service [IAMService03]	Service discovery callback with a handle for [IAMService03] is received by [IAMApp03].
Step 6	[IAMApp02] Requests service [IAMService01]	Service is not available.
Step 7	[IAMApp02] Requests service [IAMService03]	Service is not available.
Step 8	[IAMApp03] Requests service [IAMService01]	Service is not available.
Step 9	[IAMApp03] Requests service [IAMService02]	Service is not available.

9.2.2 [STS_IAM_00002] Rejecting events sent by an unauthorized application

Test Objective	Verification that unauthorized applications are not allowed to send events.		
ID	STS_IAM_00002	**State**	Draft
Affected Functional Cluster	Identity and Access Management		
Trace to RS Criteria	[RS_IAM_00002], [RS_IAM_00007], [RS_IAM_00012]		
Reference to Test Environment	STC_IAM_00001		
Configuration Parameters	- [IAMApp01] offers and registers [IAMService01] and is authorized to send [Event11] and [Event12] - [IAMApp02] offers and registers [IAMService02] and is authorized to send [Event21] but not [Event22] - [IAMApp03] is authorized to subscribe for [Event11] and [Event21]		

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Summary	- [IAMApp01] can successfully send [Event11] and [Event12] - [IAMApp02] can successfully send [Event21] but fails to send [Event22] - [IAMApp03] can successfully receive [Event11] from [IAMApp01] and [Event21] from [IAMApp02] - [IAMApp03] fails to receive [Event12] from [IAMApp01] and [Event22] from [IAMApp02]	
Pre-conditions	- IAM Tester is connected to [ECU1] - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking or Driving.	
Post-conditions	TCP connections between IAM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[IAMApp01] Offers service [IAMService01] with [Event11] and [Event12]	
Step 2	[IAMApp02] Offers service [IAMService02] with [Event21]	
Step 3	[IAMApp03] Subscribes for [Event11]	Subscription is successful.
Step 4	[IAMApp03] Subscribes for [Event21]	Subscription is successful.
Step 5	[IAMApp01] Sends [Event11]	[IAMApp03] receives notification for [Event11]
Step 6	[IAMApp02] Sends [Event22]	Event is dropped silently. [IAMApp02] is not notified.
Step 7	[IAMApp02] Sends [Event21]	[IAMApp03] receives notification for [Event21]
Step 8	[IAMApp01] Sends [Event12]	[IAMApp03] does not receive notification for [Event12]

9.2.3 [STS_IAM_00003] Rejecting events if no application is authorized to receive them

Test Objective	Verification that unauthorized applications are not allowed to receive events.		
ID	STS_IAM_00003	**State**	Draft
Affected Functional Cluster	Identity and Access Management		
Trace to RS Criteria	[RS_IAM_00002], [RS_IAM_00007], [RS_IAM_00012]		
Reference to Test Environment	STC_IAM_00001		
Configuration Parameters	- [IAMApp01] offers and registers [IAMService01] and is authorized to send [Event11] and [Event12] - [IAMApp02] offers and registers [IAMService02] and is authorized to send [Event21] but not [Event22] - [IAMApp03] is authorized to receive [Event11]		

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Summary	- [IAMApp01] can successfully send [Event11] and [Event12] - [IAMApp02] can successfully send [Event21] but fails to send [Event22] - [IAMApp03] can successfully receive [Event11] from [IAMApp01] - [IAMApp03] fails to subscribe for [Event12], [Event21] and [Event22]	
Pre-conditions	- IAM Tester is connected to [ECU1] - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking or Driving.	
Post-conditions	TCP connections between IAM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[IAMApp01] Offers service [IAMService01] with [Event11] and [Event12]	
Step 2	[IAMApp02] Offers service [IAMService02] with [Event21]	
Step 3	[IAMApp03] Subscribes for [Event11]	Subscription is successful.
Step 4	[IAMApp01] Sends [Event11]	[IAMApp03] receives notification for [Event11]
Step 5	[IAMApp01] Sends [Event12]	[Event12] is dropped and [IAMApp03] does not receive notification for [Event12]
Step 6	[IAMApp02] Sends [Event21]	[Event21] is dropped and [IAMApp03] does not receive notification for [Event21]
Step 7	[IAMApp02] Sends [Event22]	Event is dropped silently. [IAMApp02] is not notified.

10 Test configuration and test steps for Update and Configuration Management

10.1 Test System

The Update and Configuration Management (UCM) is responsible for update / installation / uninstallation of an Adaptive Application, an Adaptive platform itself and its underlying Operating System.There could be two use cases, Diagnostic use case and Over The Air (OTA)use case. The System Test Specification checks the functionalities provided by UCM irrespective of the use cases mentioned earlier.

10.1.1 Test configurations

Configuration ID	STC_UCM_00001
Description	Standard Jenkins server for Update and Configuration Management test
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server is running the job with the UCM Tester which is connected via Ethernet to the [ECU1] which is hosting the UCM Test Application.

The UCM Tester is supposed to check the pass criteria.

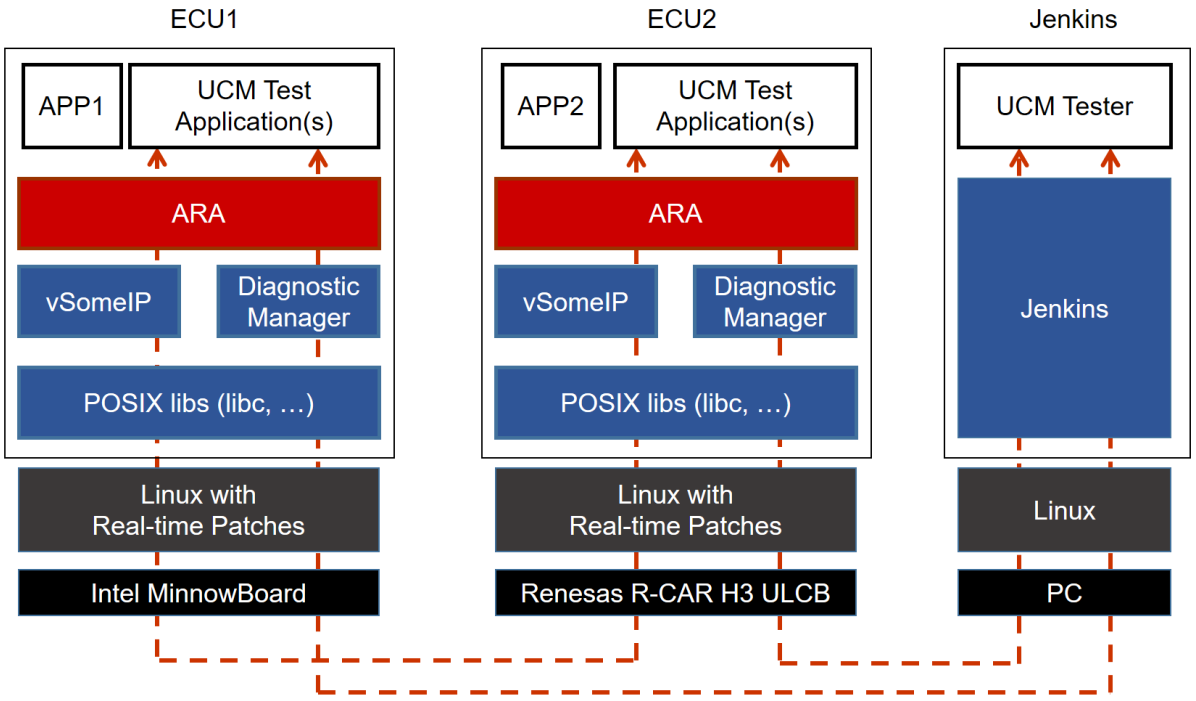

Figure 10.1: Illustration of test setup for Update and Configuration Management.

10.2 Test cases

10.2.1 [STS_UCM_00001] Check, if an update of a SW package is available.

Test Objective	Verification to check that, an Update of a SW Package is available on backend system and download the SW package, if an update is available.		
ID	STS_UCM_00001	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00010], [RS_UCM_00002], [RS_UCM_00013], [RS_UCM_00014]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		
Summary	- UCMApp01 queries UCM to check Current SW version/name, UCMApp01 then queries to the backend system to check if any updated are available. If any updates are available, present the list of available SW packages to user. User then selects the required package and request UCMApp01 to download the requested package.		
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.		
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[UCMTester]: Send a request to [UCMApp01] to read current SW version and name from UCM		
Step 2	[UCMApp01]: Start the mechanism to query read current SW version / name from UCM		
Step 3	[UCMTester]: Receive response from [UCMApp01] and store it in <UCM_SWVersion>		Payload of response contains SW version and name from UCM.
Step 4	[UCMTester]: Send a request to [UCMApp01] to read available SW version and name from Backend system		
Step 5	[UCMApp01]: Start mechanism to read all available SW Version/Name list		
Step 6	[UCMTester]: Receive response from [UCMApp01] and store it in <backend_SWVersion_List>		
Step 7	[UCMTester]: Send a request to download package <xyz> from available SW version/name list received from backend system.		
Step 8	[UCMApp01]: Start mechanism to download SW package as per specified in the request.		Requested package is downloaded successfully.

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Step 9	[UCMTester]: Send a request to read list of downloaded SW Packages	
Step 10	[UCMApp01]: Start mechanism to provide list of downloaded SW packages	Downloaded SW package list is populated successfully

10.2.2 [STS_UCM_00002] Update a SW package, on user request.

Test Objective	Verification that, a SW package is updated successfully on user request		
ID	STS_UCM_00002	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00011], [RS_UCM_00003], [RS_UCM_00023], [RS_UCM_00017], [RS_UCM_00030], [RS_UCM_00021]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		
Summary	- UCMApp01 has an Update available for a SW package. User selects to update the available SW package. After successful update, UCMApp01 reads SW version/name to verify that SW package is updated succesfully.If update was not successful then present Failure to user.		
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking. - SW Package is downloaded and available locally to be updated.		
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[UCMTester]: Send request to check availability of resources for data transfer.		
Step 2	[UCMApp01]: Start mechanism to check availability of resources.		If result == success
Step 3	[UCMTester]: Send request(Trigger from user) to update a SW package		
Step 4	[UCMApp01]: Starts mechanism to initialize it for approval.		Send an ACK message after successful initialization for performing an update.
Step 5	[UCMTester]: Send request (user approval) to update a SW package as per Package manifest (SW Version and name)		
Step 6	[UCMApp01]: Start mechanism to update a SW package.		
Step 7	[UCMTester]: Send a request to read progress status of an update.		ACK from UCM after successful update of SW package

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Step 8	[UCMApp01]: Start mechanism to provide progress status of an update of SW package.	Current SW version/name should be equal to the SW version/name requested to be Updated
Step 9	[UCMTester]: Receive response of successful update of the package.	
Step 10	Repeat Steps 1 to 9, to update another SW package.	
Step 11	[UCMTester]: Send request to Activate updated packages.	
Step 12	[UCMApp01]: Start mechanism to check SW Package dependencies.	
Step 13	[UCMTester]: Receive response of successful Activation	
Step 14	[UCMApp01]: Read value of Persistent data associated with the SW package.	Persistent data is updated in kvs database by UCM as expected.
Step 15	[UCMTester]: Send request (user approval)to update a SW package as per Package manifest (SW version and name)	
Step 16	[UCMApp01]: Start mechanism to update a SW package	
Step 17	[UCMTester]: Send request to read progress status of an Update.	
Step 18	[UCMTester]: Start mechanism to provide progress status of an update of the SW package	
Step 19	[UCMTester]: Receive response of unsuccessful update of the SW package.	
Step 20	[UCMTester]: Read value of Persistent data associated with the SW package.	Persistent data is not updated in KVS database by UCM

10.2.3 [STS_UCM_00003] Installing a SW package on user approval.

Test Objective	Verification that, a SW package is installed successfully on user request.		
ID	STS_UCM_00003	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00011], [RS_UCM_00001], [RS_UCM_00013], [RS_UCM_00017]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		

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Summary	UCMApp01 has the SW package available which is to be installed. UCMTester sends user approval for installation of a SW package to UCMApp01. UCMApp01 then queries UCM to perform SW package installation.	
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.	
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCMTester]: Send request to check availability of resources for data transfer	
Step 2	[UCMApp01]: Start mechanism to check availability of resources and return Result based on availability of resource.	Result == success
Step 3	[UCMTester]: Send request (user approval) to install a SW package as per Package manifest (SW Version/name).	
Step 4	[UCMApp01]: Start mechanism to install a SW package and write/Store Persistent data associated with the SW package.	
Step 5	[UCMTester]: Response of successful installation of package	ACK from UCM after successful installation of SW package
Step 6	[UCMTester]: Send request to read current SW version/name	SW version/name received as response should be equal to the requested SW version to be installed.
Step 7	[UCMApp01]: Read Persistent data associated with the installed SW package from KVS database	Persistent data read is as expected .

10.2.4 [STS_UCM_00004] Uninstalling a SW package, on user request.

Test Objective	Verification that, a SW package is uninstalled successfully on user request.		
ID	STS_UCM_00004	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00004], [RS_UCM_00005], [RS_UCM_00018]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		
Summary	UCMApp01 has the information about the SW package to be uninstalled. UCMTester sends user approval for uninstallation of a SW package to UCMApp01. UCMApp01 then queries UCM to perform SW package uninstallation.		

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Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.	
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCMTester]: Send request (Trigger from user) to uninstall a SW package and Persistent data associated with the SW package as per Package manifest.	
Step 2	[UCMApp01]: Start mechanism to uninstall a SW package.	
Step 3	[UCMTester]: Response of successful uninstallation of package	ACK from UCM after successful uninstallation of SW package
Step 4	[UCMTester]: Send request (Trigger from user) to uninstall a SW package as per package manifest	
Step 5	[UCMApp01]: Start mechanism to uninstall a SW package	
Step 6	[UCMTester]: Response of unsuccessful installation of package	NACK from UCM after unsuccessful installation of SW package
Step 7	[UCMApp01]: Read Persistent data associated with the uninstalled SW package	Persistent data should be deleted / not available

10.2.5 [STS_UCM_00005] Rollback to previous version, after corrupted SW package installation.

Test Objective	Verification that, a SW package is rolled back to its previous version after corrupted SW package installation on an adaptive Platform		
ID	STS_UCM_00005	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00008], [RS_UCM_00001], [RS_UCM_00023]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		
Summary	- UCMTester queries UCMApp01 to update a SW package .Update of SW package fails.UCM informs UCMApp01 about the corruption. UCMApp01 then queries UCM to roll back to the previous working SW version.		

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Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.	
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCMTester]: Send request to install a SW package as per Package manifest.	
Step 2	[UCMApp01]: Start mechanism to install a SW package.	
Step 3	[UCMTester]: Send request to get SW package installation status.	
Step 4	[UCMApp01]: Start mechanism to get Installation status of a requested SW package.	
Step 5	[UCMTester]: Receive response of installation status.	Installation status is received as Failed
Step 6	[UCMTester]: Send request to perform rollback to Previous SW version.	
Step 7	[UCMApp01]: Start mechanism to rollback to Previous SW version	
Step 8	[UCMTester]: Receive response of unsuccessful Rollback	NACK for unsuccessful Rollback
Step 9	[UCMTester]: Send Request to rollback to previous SW package version.	
Step 10	[UCMApp01]: Start mechanism to rollback to previous SW package	
Step 11	[UCMTester]: Receive response of successful Rollback	ACK from UCM after successful rollback.

10.2.6 [STS_UCM_00006] Read update history on an adaptive platform, on demand.

Test Objective	Verification that, an update history of an adaptive platform is available and can be read, on demand.		
ID	STS_UCM_00006	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Reference to Test Environment	STC_UCM_00001		
Trace to RS Criteria	[RS_UCM_00032]		

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Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.	
Summary	- UCMApp01 queries UCM to read Update history, UCM checks if update history is available or not. If available, it returns update information like last update time stamp, update on user approval/auto approved.	
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.	
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCMTester]: Send request to read update history of an adaptive platform.	
Step 2	[UCMApp01]: Start mechanism to read Update history of the platform.	ACK from UCM
Step 3	[UCMTester]: Receive response from UCMApp01 with update history data.	Response from [UCMApp01] regarding update history is received. Update history may contain information like-Update version ,Time stamp, Previous version ,AUTO updated ,User updated etc.
Step 4	[UCMTester]: Send request to read update history of an adaptive platform.	
Step 5	[UCMApp01]: Start mechanism to read Update history of the platform.	NACK from UCM
Step 6	[UCMTester]: Receive response from UCMApp01 with no history data.	Response from [UCMApp01] regarding update history is not available.

10.2.7 [STS_UCM_00007]Data Transfer from Multiple clients,Simultaneously.

Test Objective	Verification to check that mutiple clients can perform data transfer of SW Packages ,simultaneously.		
ID	STS_UCM_00007	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Reference to Test Environment	STC_UCM_00001		
Trace to RS Criteria	[RS_UCM_00019]		
Configuration Parameters	- [UCMApp01] is configured. - [UCMApp02] is configured. - [Diagnostic module] is configured.		
Summary	- UCMApp01 starts data transfer of SW package 1. - UCMApp02 also starts data trasfer of SW Package 2, simultaneously. - UCM allows UCMApp01 /UCMApp02 to perform data Trasnfer, simultaneously.		

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Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.	
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCMTester]: Send request to UCMApp01 to transfer SW Package 1	
Step 2	[UCMApp01]: Start mechanism to prepare for accepting SW Package 1	
Step 3	[UCMTester]: Send request to UCMApp02 for data transfer of SW Package 2	
Step 4	[UCMApp02]: Start mechanism to prepare for accepting SW Package 2	
Step 5	[UCMTester]: Send a request to get information about transferred SW Package list	
Step 6	[UCMApp01/UCMApp02]: Receive response of list of SW Packages transferred to UCM	SWPackageList = SW Package 1 ,SW Package 2

10.2.8 [STS_UCM_00008]Install/Update/Removal of SW Package from multiple clients,sequentially.

Test Objective	Verification to check that mutiple clients can perform Install/Update/Removal of SW packages, sequentially.		
ID	STS_UCM_00008	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Reference to Test Environment	STC_UCM_00001		
Trace to RS Criteria	[RS_UCM_00024], [RS_UCM_00026], [RS_UCM_00002]		
Configuration Parameters	- [UCMApp01] is configured. - [UCMApp02] is configured. - [Diagnostic module] is configured.		
Summary	- UCMApp01 queries UCM to Install/Update/Remove SW Package 1, UCMApp02 also queries UCM to Install/Update/Remove SW Package 2 ,simultaneously. - UCM rejects Install/Update/Removal request from UCMApp02. UCMApp02 has to wait untill UCMApp01 finishes Install/Update/Removal of SW package 1.		
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.		

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Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCMTester]: Send request to read current SW version.	
Step 2	[UCMApp01]: Start mechanism to provide current SW version.	
Step 3	[UCMTester]: Receive response of current SW version and store it in <var1>.	
Step 4	[UCMTester]: Send a request to Install/Update/Remove SW Package 1 to UCMApp01.	
Step 5	[UCMApp01]: Start mechanism to Install/Update/Remove SW Package 1.	
Step 6	[UCMTester]: Send a request to read current SW version to UCMApp02	
Step 7	[UCMApp02]: Start mechanism to provide current SW version	
Step 8	[UCMTester]: Receive response as a SW version and store it in <var2>	
Step 9	[UCMTester]: Send a request to Install/Update/Remove SW Package 2 to UCMApp02	
Step 10	[UCMApp02]: Start mechanism to Install/Update/Remove SW package	
Step 11	[UCMTester]: Receive response as status of Install/Update/Removal	Status = Reject
Step 12	[UCMTester]: Send a request to UCMApp02 to get current status of UCM	
Step 13	[UCMApp02]: Start mechanism to provide UCM state	
Step 14	[UCMTester]: Receive response as UCM state .If State = Busy ,wait untill state changes to READY	UCMState = Busy/READY
Step 15	[UCMTester]: Send request to UCMApp02 to Install/Update/Removal SW Package 2	
Step 16	[UCMApp02]: Start mechanism to prepare for Install/Update/Removal of SW Package 2	
Step 17	[UCMTester]: Receive response as successful Install/Update/Removal of SW Package 2	

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Step 18	[UCMTester]: Send a request to read SW version	
Step 19	[UCMApp02]: Start mechanism to send SW version of newly installed SW Package	
Step 20	[UCMTester]: Receive response as SW version of newly installed SW Package	

10.2.9 [STS_UCM_00009]Cancel Install/Update operation of SW Package .

Test Objective	Verification to check that Install/Update operation from the client can be Cancelled.		
ID	STS_UCM_00009	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Reference to Test Environment	STC_UCM_00001		
Trace to RS Criteria	[RS_UCM_00020], [RS_UCM_00002], [RS_UCM_00003]		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		
Summary	- UCMApp01 queries UCM to install/Update a SW Package 2. - UCMApp01 later realises that there are some discrepancies, it issues Cancel request to cancel ongoing Install/Update of SW Package.		
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking.		
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[UCMTester]: Send request to read current version of the installed SW Package.		
Step 2	[UCMApp01]: Start mechanism to provide current version of SW Package.		
Step 3	[UCMTester]: Receive response of current SW version and store it in <var1>.		
Step 4	[UCMTester]: Send a request to Install/Update SW Package 2		
Step 5	[UCMApp01]: Start mechanism to Install/Update SW Package 2		
Step 6	[UCMTester]: Send a request to cancel ongoing Install/Update of SW Package 2		

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Step 7	[UCMApp01]: Prepare to cancel ongoing operation and send an ACK for successful cancellation.	
Step 8	[UCMTester]: Send a request to read SW version.	
Step 9	[UCMApp01]: Start mechanism to provide SW version.	
Step 10	[UCMTester]: Receive response of current SW version.	<var1> and <var2> are equal (New SW Package 2 Install/update is cancelled succesfully)

10.2.10 [STS_UCM_00010] Update underlying Operating System, on user request.

Test Objective	Verification that, underlying Operating System is updated successfully on user request		
ID	STS_UCM_00010	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00011], [RS_UCM_00023], [RS_UCM_00030], [RS_UCM_00029]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		
Summary	- UCMApp01 has an Update available for underlying Operating System. User selects to update the available OS package. After successful update, UCMApp01 reads SW version/name to verify that OS package is updated successfully. If update was not successful then present Failure to user.		
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking. - OS Package is downloaded and available locally to be updated.		
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[UCMTester]: Send request to check availability of resources for data transfer.		
Step 2	[UCMApp01]: Start mechanism to check availability of resources.		If result == success
Step 3	[UCMTester]: Send request(Trigger from user) to update the OS package.		
Step 4	[UCMApp01]: Start mechanism to initialize it for approval.		Send an ACK message after successful initialization for performing an update.

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Step 5	[UCMTester]: Send request (user approval) to update the OS package as per Package manifest (SW Version and name)	
Step 6	[UCMApp01]: Start mechanism to update the OS package.	
Step 7	[UCMTester]: Send a request to read progress status of an update.	
Step 8	[UCMApp01]: Start mechanism to provide progress status of an update of OS package.	Current SW version/name should be equal to the SW version/name requested to be Updated
Step 9	[UCMTester]: Receive response of successful update of the OS package.	ACK from UCM after successful update of OS package
Step 10	[UCMTester]: Send request to Activate updated OS package.	
Step 11	[UCMApp01]: Start mechanism to check OS Package dependencies.	
Step 12	[UCMTester]: Receive response of successful Activation	
Step 13	[UCMTester]: Send request (user approval) to update OS package as per Package manifest (SW version and name)	
Step 14	[UCMApp01]: Start mechanism to update the OS package	
Step 15	[UCMTester]: Send request to read progress status of an Update.	
Step 16	[UCMTester]: Start mechanism to provide progress status of an update of the OS package	
Step 17	[UCMTester]: Receive response of unsuccessful update of the OS package.	

10.2.11 [STS_UCM_00011] Update Adaptive Platform's Functional Clusters, on user request.

Test Objective	Verification that, Functional Cluster is updated successfully on user request		
ID	STS_UCM_00011	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00011], [RS_UCM_00023], [RS_UCM_00030], [RS_UCM_00028]		
Reference to Test Environment	STC_UCM_00001		

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Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.	
Summary	- UCMApp01 has an Update available for Functional Cluster. User selects to update the available package with Functional Cluster component. After successful update, UCMApp01 reads SW version/name to verify that SW package is updated successfully. If update was not successful then present Failure to user.	
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking. - SW Package is downloaded and available locally to be updated.	
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCMTester]: Send request to check availability of resources for data transfer.	
Step 2	[UCMApp01]: Start mechanism to check availability of resources.	If result == success
Step 3	[UCMTester]: Send request(Trigger from user) to update the SW package with Functional Cluster component.	
Step 4	[UCMApp01]: Start mechanism to initialize it for approval.	Send an ACK message after successful initialization for performing an update.
Step 5	[UCMTester]: Send request (user approval) to update the SW package as per Package manifest (SW Version and name)	
Step 6	[UCMApp01]: Start mechanism to update the SW package.	
Step 7	[UCMTester]: Send a request to read progress status of an update.	
Step 8	[UCMApp01]: Start mechanism to provide progress status of an update of SW package.	Current SW version/name should be equal to the SW version/name requested to be Updated
Step 9	[UCMTester]: Receive response of successful update of the SW package.	ACK from UCM after successful update of SW package
Step 10	[UCMTester]: Send request to Activate updated SW package.	
Step 11	[UCMApp01]: Start mechanism to check SW Package dependencies.	
Step 12	[UCMTester]: Receive response of successful Activation	
Step 13	[UCMTester]: Send request (user approval) to update SW package as per Package manifest (SW version and name)	

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Step 14	[UCMApp01]: Start mechanism to update the SW package	
Step 15	[UCMTester]: Send request to read progress status of an Update.	
Step 16	[UCMTester]: Start mechanism to provide progress status of an update of the SW package	
Step 17	[UCMTester]: Receive response of unsuccessful update of the SW package.	

10.2.12 [STS_UCM_00012] Validate SW manifest and report invalid SW manifest if found inconsistent.

Test Objective	Verification that, SW manifest received during a SW update is consistent. If it is found to be inconsitent then it should report manifest error.		
ID	STS_UCM_00012	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00012]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		
Summary	- Downloaded SW packages are available locally (with some discrepencies in the SW manifest). When UCM receives a command to install the SW package, UCM first checks consistency of the SW manifest. If there are discrepencies then it should report invalid manifest.		
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking. - SW Packages SW1 and SW2 is downloaded and available locally to be updated. - SW1 is a SW package with consistent manifest, SW2 is a SW package with an inconsistent manifest.		
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[UCM Tester]: Send request to check availability of the resources for data transfer.		
Step 2	[UCMApp01]: Start mechanism to check availability of resources.		If result == success
Step 3	[UCMTester]: Send request(trigger from user) to update the SW package.		

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Step 4	[UCMApp01]: Start mechanism to initialize it for approval.	Send an ACK message after successful initialization for performing an update.
Step 5	[UCMTester]: Send request (user approval) to update the SW package SW1.	
Step 6	[UCMApp01]: Start mechanism to submit the SW package SW1 to be updated to UCM.	
Step 7	[UCMTester]: Send request to get the status of the SW package update.	
Step 8	[UCMApp01]: Start mechanism to provide progress status of an update of the SW package SW1.	Current SW version/name should be equal to the SW version/name requested to be updated.
Step 9	[UCMTester]: Receive response of successful update of the SW package.	
Step 10	[UCMTester]: Send request to activate updated SW package.	
Step 11	[UCMApp01]: Start mechanism to check SW Package dependencies.	
Step 12	[UCMTester]: Receive response of successful Activation.	
Step 13	[UCMTester]: Send request (user approval) to update the SW package SW2.	
Step 14	[UCMApp01]: Start mechanism to submit the SW package SW2 to be updated to UCM.	Inconsistent manifest error is reported by UCM.
Step 15	[UCMTester]: Receive response invalid manifest and update request will be discarded.	

10.2.13 [STS_UCM_00013] Install/Update authenticated SW package.

Test Objective	Verification that, the SW package being installed/updated is from an authenticated source.		
ID	STS_UCM_00013	**State**	Draft
Affected Functional Cluster	Update and Configuration Management		
Trace to RS Criteria	[RS_UCM_00006]		
Reference to Test Environment	STC_UCM_00001		
Configuration Parameters	- [UCMApp01] is configured. - [Diagnostic module] is configured.		

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Summary	- SW package to be updated/installed is available locally. If the signature of the SW package does not match then discard the operation.	
Pre-conditions	- UCM Tester is connected to [ECU1]. - Software components on [ECU1] are initialized. - [ECU1] is in Machine State Parking. - SW Package SW1 with valid signature, SW package SW2 with invalid signature are downloaded and available locally to be updated/installed.	
Post-conditions	- TCP connection between UCM Tester and [ECU1] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[UCM Tester]: Send request to check availability of the resources for the data transfer.	
Step 2	[UCMApp01]: Start mechanism to check availability of the resources.	If result = = success.
Step 3	[UCMTester]: Send request to update/install the SW package SW1.	
Step 4	[UCMApp01]: Start mechanism to submit SW package SW1 to be installed/updated to UCM.	ACK from UCM of successful authentication of the SW package.
Step 5	[UCMTester]: Send a request to read progress status of an update.	
Step 6	[UCMApp01]: Start mechanism to provide status of the update/install.	ACK of successful update/install of the SW package.
Step 7	[UCMTester]: Send a request to update/install SW package SW2.	
Step 8	[UCMApp01]: Start mechanism to submit SW package SW2 to be installed/updated to UCM.	NACK for signature authentication failure.

11 Test configuration and test steps for E2E Protection

11.1 Test System

11.1.1 Test configurations E2E Protection

Configuration ID	STC_E2E_00001
Description	Nominal AP Apps for E2E Protection
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

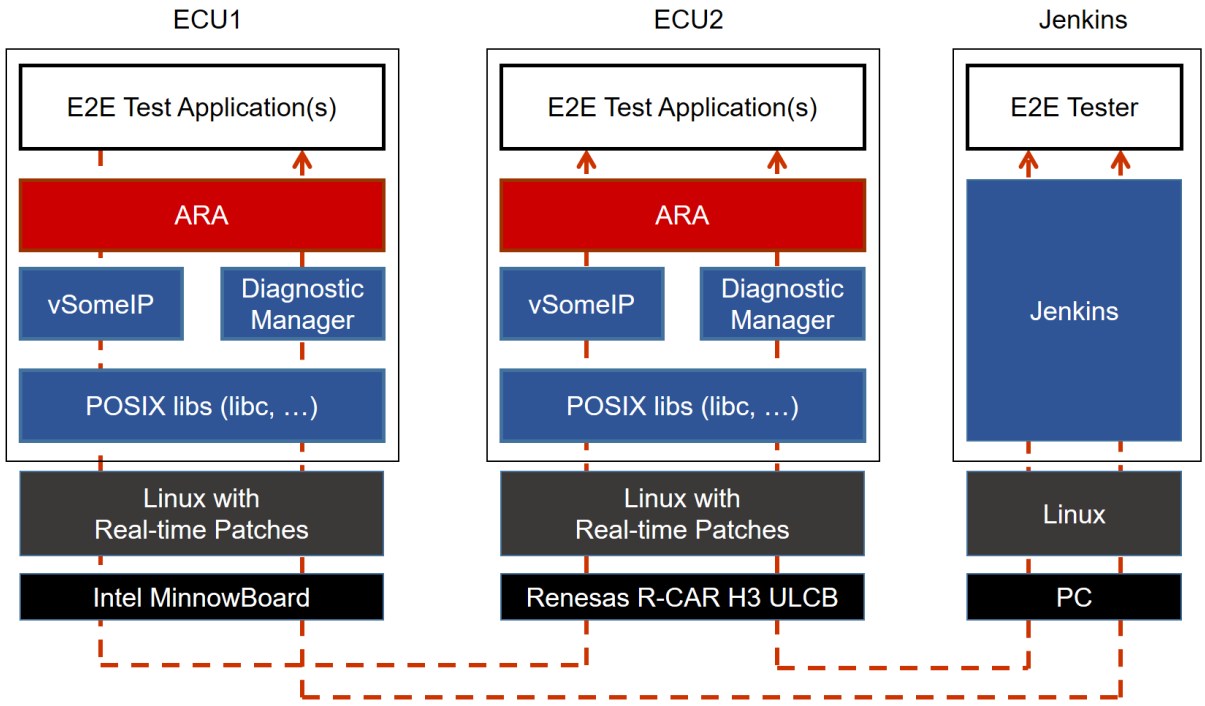

Figure 11.1: Illustration of test setup for STC-E2E-00001.

Configuration ID	STC_E2E_00002
Description	Nominal AP Apps for E2E Protection + Corrupting App Intervention
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

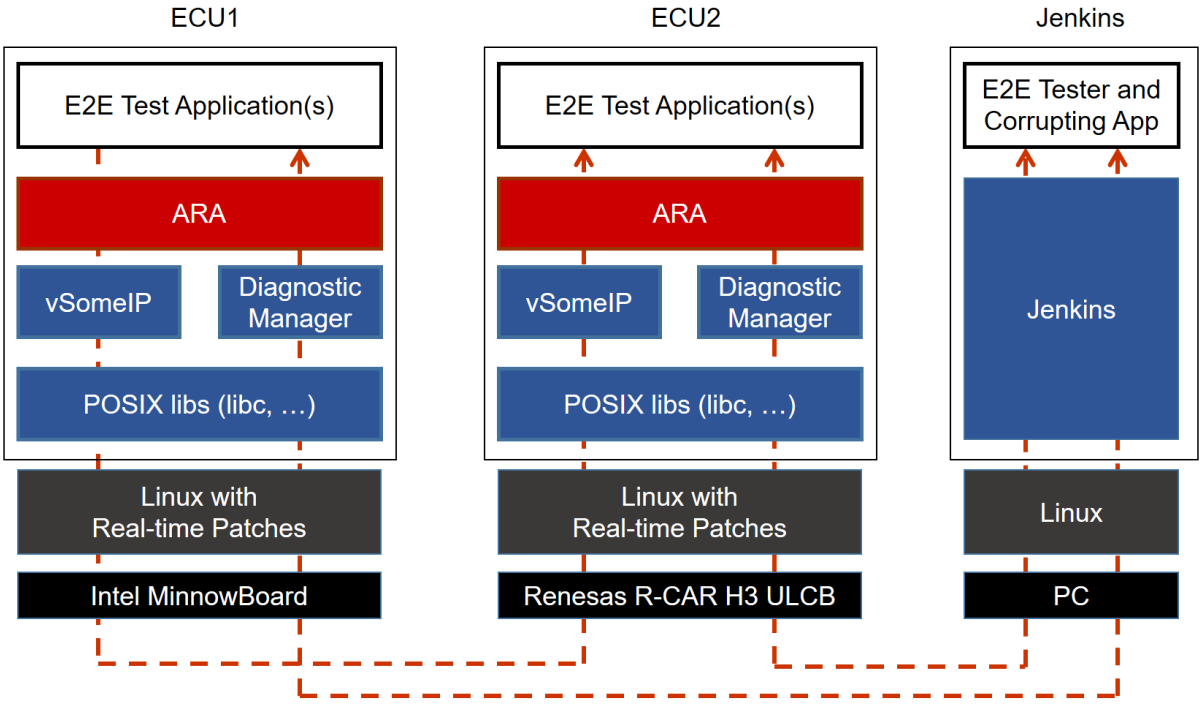

Figure 11.2: Illustration of test setup for STC-E2E-00002.

The Jenkins Server, running the job with the E2E protection test ([E2E Tester]) is connected via Ethernet to [ECU1] and [ECU2].

The [E2E Tester] is supposed to collect the results.

The communication between [E2E Tester] and the applications on ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

11.2 Test cases

11.2.1 [STS_E2E_00001] E2E Protection from AP to AP

Test Objective	To verify that the E2E protection is done properly between applications in adaptive platforms		
ID	STS_E2E_00001	**State**	Draft
Affected Functional Cluster	Safety		
Trace to RS Criteria	[RS_E2E_08539], [RS_E2E_08541], [RS_E2E_08543]		
Reference to Test Environment	STC_E2E_00001		
Configuration Parameters	- Event based communication. - The existing communication services comprise the following (service & data names are arbitrary): - [E2EService01]: Offered by [E2EApp01], requested by [E2EApp02]. - <Data1> is protected by E2E, sent by [E2EApp01] and received by [E2EApp02].		

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Summary	[E2EService01] is offered by [E2EApp01] on ECU1 and is requested by [E2EApp02] on ECU2. [E2EApp01] sends <Data1> to [E2EApp02] and the communication has no E2E errors.	
Pre-conditions	- [E2E Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [E2EApp01] and [E2EApp02] are shut down according to Machine State.	
Post-conditions	E2E Tester is disconnected to both ECUs.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[E2E Tester] Request for change of Machine State to Driving from Execution Manager. Machine State for ECU1 and ECU2 are changed to Driving, and [E2EApp01] and [E2EApp02] are started up.	
Step 2	[E2EApp01] Offer service [E2EService01].	
Step 3	[E2EApp02] Request service [E2EService01].	
Step 4	[E2EApp01] Send E2E protected <Data1> with arbitrary values.	
Step 5	[E2EApp02] Call GetProfileCheckStatus() for <Data1>.	[E2EApp02] reads ProfileCheckStatus = Ok
Step 6	[E2EApp02] Execute Update for <Data1>.	[E2EApp02] receives correct value of <Data1>
Step 7	Repeat setp4 to step6 for 10 times. Every time length of <Data1> is changed. One of 10 times has 4 kbyte length of <Data1>.	ProfileCheckStatus is always = Ok <Data1> is always received with correct values

The following sequence diagram shows the schematic operation of STS_E2E_00001. (Note that not all test steps are represented exactly.)

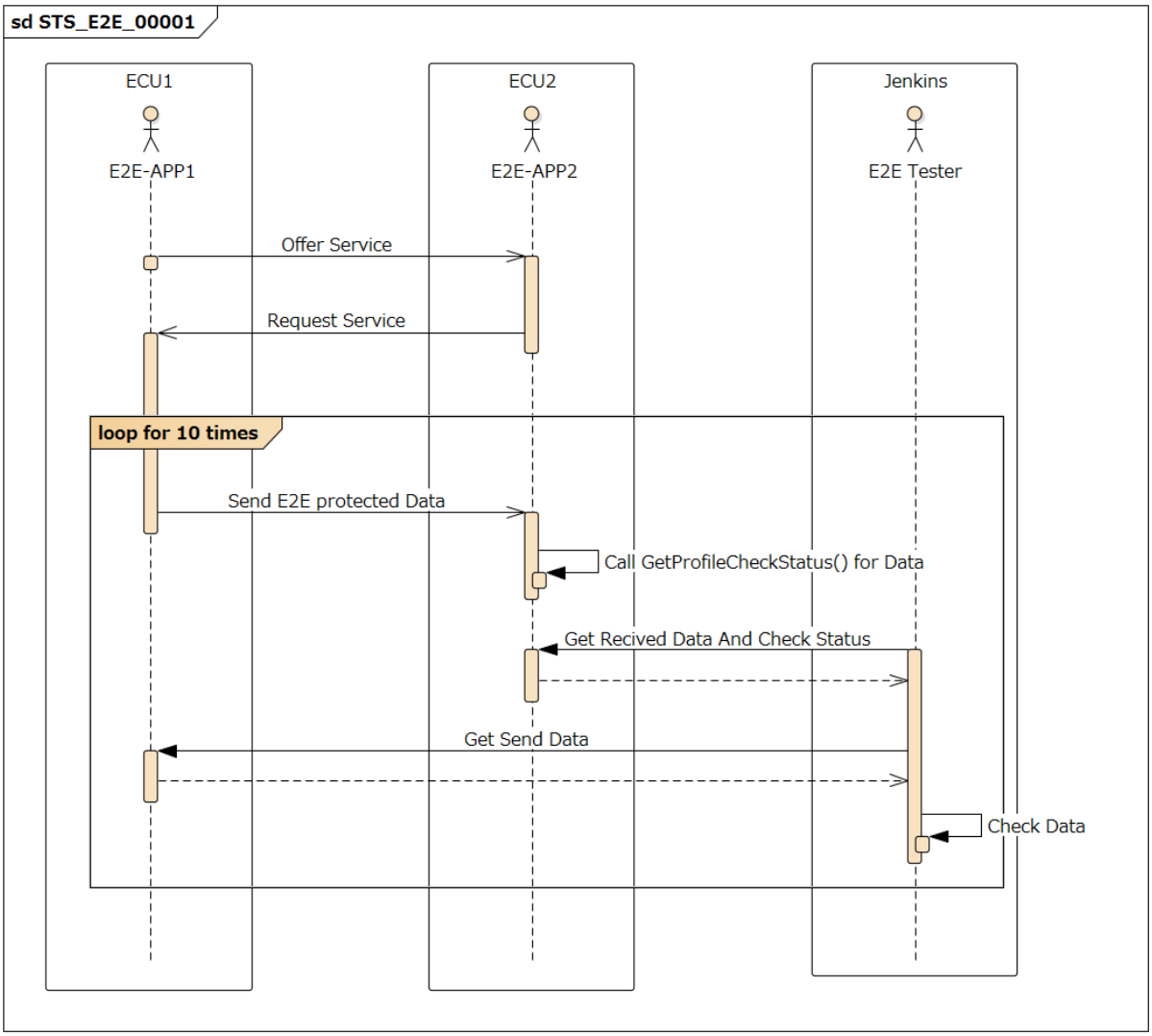

Figure 11.3: Sequence diagram of STS_E2E_00001.

11.2.2 [STS_E2E_00002] Corrupting App Affecting Communication

Test Objective	To verify that the Corrupting App to simulate a corrupted communication is detected by E2E		
ID	STS_E2E_00002	**State**	Draft
Affected Functional Cluster	Safety		
Trace to RS Criteria	[RS_E2E_08529], [RS_E2E_08534], [RS_E2E_08545], [RS_E2E_08548]		
Reference to Test Environment	STC_E2E_00002		

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Configuration Parameters	- maxDeltaCounter is set to 5. - windowSize is set to 2. - minOkStateInit is set to 1. - maxErrorStateInit is set to 1. - minOkStateValid is set to 1. - maxErrorStateValid is set to 1. - minOkStateInvalid is set to 1. - maxErrorStateInvalid is set to 1. - Event based communication. - The existing communication services comprise the following (service & data names are arbitrary): - [E2EService01]: Offered by [E2EApp01], requested by [E2EApp02]. - <Data1> is protected by E2E, sent by [E2EApp01] and received by [E2EApp02]. - [E2EDataCorrupter01] to send <Data1>, with similar message format as sent by [E2EApp01]	
Summary	[E2EService01] is offered by [E2EApp01] on ECU1 and is requested by [E2EApp02] on ECU2. [E2EApp01] sends <Data1> to [E2EApp02]. [E2EDataCorrupter01] sends the same communication data sent by [E2EApp01], but it has corrupted data. [E2EApp02] detects the corrupted data thanks to the E2E protection.	
Pre-conditions	- [E2E Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [E2EApp01] and [E2EApp02] are shut down according to Machine State.	
Post-conditions	E2E Tester is disconnected to both ECUs.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[E2E Tester] Request for change of Machine State to Driving from Execution Manager. Machine State for ECU1 and ECU2 are changed to Driving, and [E2EApp01] and [E2EApp02] are started up.	
Step 2	[E2EApp01] Offer service [E2EService01].	
Step 3	[E2EApp02] Request service [E2EService01].	
Step 4	[E2EApp01] Send E2E protected <Data1> twice with arbitrary values.	
Step 5	[E2EApp02] • Call GetProfileCheckStatus() for <Data1> • Call GetSMState()	[E2EApp02] • reads ProfileCheckStatus = Ok • reads SMState = Valid
Step 6	[E2EDataCorrupter01] Send the same communication data as <Data1> sent by [E2EApp01], but it has corrupted data.	[E2EApp02] • reads ProfileCheckStatus = Error (CRC error) • reads SMState = Valid

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Step 7	[E2EDataCorrupter01] Send the same communication data as <Data1> sent by [E2EApp01], but it has corrupted data again.	[E2EApp02] • reads ProfileCheckStatus = Error (CRC error) • reads SMState = Invalid
Step 8	[E2EApp01] Send E2E protected <Data1> with arbitrary values.	[E2EApp02] • reads ProfileCheckStatus = Ok • reads SMState = Valid
Step 9	[E2EDataCorrupter01] Send the same communication data as <Data1> sent by [E2EApp01], but it has the corrupted Counter field and the recalculated CRC field for <Data1>. (The Counter value which added maxDeltaCounter or more should be set.)	[E2EApp02] • reads ProfileCheckStatus = WrongSequence • reads SMState = Valid

The following sequence diagram shows the schematic operation of STS_E2E_00002. (Note that not all test steps are represented exactly.)

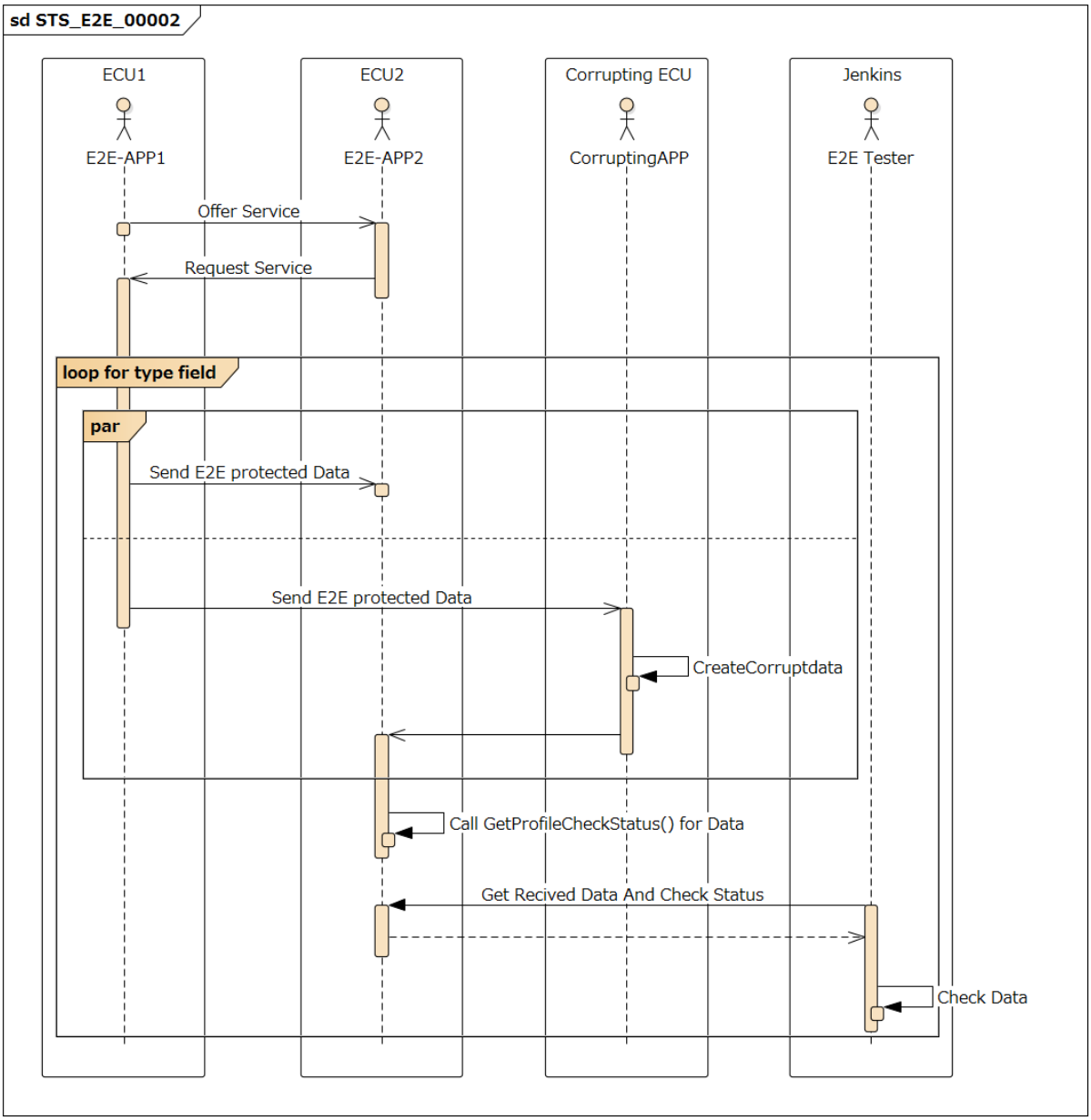

Figure 11.4: Sequence diagram of STS_E2E_00002.

12 Test configuration and test steps for Time Synchronization

12.1 Test System

12.1.1 Test configurations

Configuration ID	STC_TS_00001
Description	Standard Jenkins server for Time Synchronization test
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

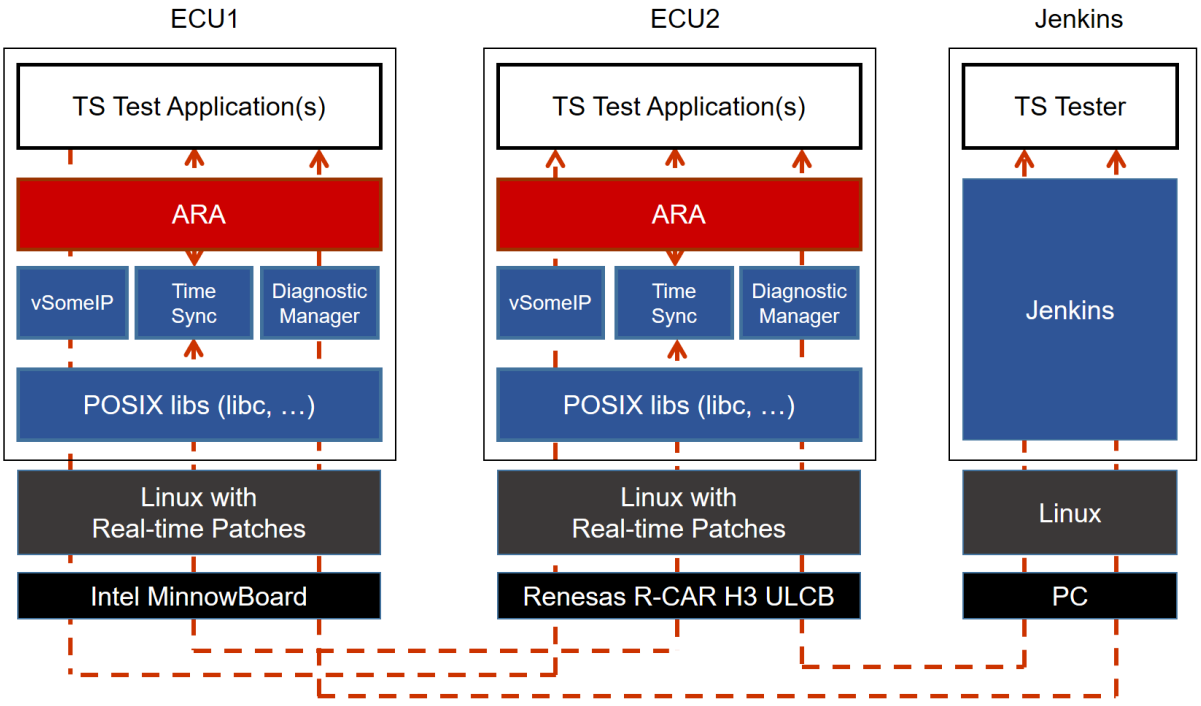

Figure 12.1: Illustration of test setup for Time Synchronization.

The Jenkins Server, running the job with the Time Synchronization test ([TS Tester]) is connected via Ethernet to [ECU1] hosting the System Test Application [TSApp01] and [ECU2] hosting the System Test Application [TSApp02].

The [TS Tester] is supposed to collect the results.

The communication between [TS Tester] and the applications on ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

12.2 Test cases

12.2.1 [STS_TS_00001] Check APIs of Offset Slave TimeBase (TB)

Test Objective	Verification that whether APIs of a Offset Slave TB can be used correctly.		
ID	STS_TS_00001	**State**	Draft
Affected Functional Cluster	Time Synchronization		
Trace to RS Criteria	[RS_TS_00001], [RS_TS_00005], [RS_TS_00012], [RS_TS_00013], [RS_TS_00017], [RS_TS_00021], [RS_TS_00026]		
Reference to Test Environment	STC_TS_00001		
Configuration Parameters	- [ECU1] is synced by [ECU2]. - [ECU2] is Global Time Master. - [ECU1] has a Offset Slave TB and a Synchronized Slave TB. - [ECU2] has a Offset Master TB and a Synchronized Master TB. - The Synchronized Slave TB on [ECU1] is synced by the Synchronized Master TB on [ECU2]. - The Offset Slave TB on [ECU1] depend on the Synchronized Slave TB on [ECU1], - The Offset Master TB on [ECU2] depend on the Synchronized Mater TB on [ECU2].		
Summary	Verification that [TSApp01] can use APIs of Offset Slave TB.		
Pre-conditions	- [TS Tester] is connected to [ECU1]. - [ECU1] is in Machine State Parking. - [TSApp01] is shut down according to Machine State.		
Post-conditions	[TS Tester] is disconnected to [ECU1].		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[TS Tester] Request for change of Machine State to Driving from Execution Manager. Machine State for [ECU1] is changed to Driving, and [TSApp01] is started up.		
Step 2	[TSApp01] Find the Offset Slave TB on [ECU1].		The Offset Slave TB on [ECU1] is found successfully.
Step 3	[TSApp01] Configure the Offset Slave TB on [ECU1].		
Step 4	[TSApp01] Get rate deviation of the Offset Slave TB on [ECU1].		Rate deviation is got successfully.
Step 5	[TSApp01] Get Time Base Status of the Offset Slave TB on [ECU1].		Time Base Status is got successfully.
Step 6	[TSApp01] Get a getType of the Offset Slave TB on [ECU1].		The getType is Offset Slave TB.
Step 7	[TSApp01] Set Offset value of the Offset Slave TB on [ECU1].		

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Step 8	[TSApp01] Get Offset value of the Offset Slave TB on [ECU1].	Offset value is the value set in Step 7.
Step 9	[TSApp01] Get current time of the Offset Slave TB on [ECU1].	Current time is got successfully.
Step 10	[TSApp01] Start the timer of the Offset Slave TB on [ECU1] so that the timer will expire at the specified time.	
Step 11	[TSApp01] When time-up is notified. Get current time of the Offset Slave TB on [ECU1].	Current time is the specified time.

12.2.2 [STS_TS_00002] TimeSynchronization of applications between ECUs.

Test Objective	Verification that synchronization between the application on [ECU1] and [ECU2] can correctly be done.		
ID	STS_TS_00002	**State**	Draft
Affected Functional Cluster	Time Synchronization		
Trace to RS Criteria	[RS_TS_00005], [RS_TS_00020], [RS_TS_00026]		
Reference to Test Environment	STC_TS_00001		
Configuration Parameters	- [ECU1] is synced by [ECU2]. - [ECU2] is Global Time Master. - [ECU1] has a Offset Slave TimeBase(TB) and a Synchronized Slave TB. - [ECU2] has a Offset Master TB and a Synchronized Master TB. - The Synchronized Slave TB on [ECU1] is synced by the Synchronized Master TB on [ECU2]. - The Offset Slave TB on [ECU1] depend on the Synchronized Slave TB on [ECU1], - The Offset Master TB on [ECU2] depend on the Synchronized Mater TB on [ECU2]. - Event based communication. - The existing communication services comprise the following (service & data names are arbitrary): • [TSService01]: Offered by [TSApp01], requested by [TSApp02]. • [TSService01]: [TSApp01] send a synchronization time to [TSApp02].		
Summary	Verification that [TSApp01] and [TSApp02] can be synchronized.		
Pre-conditions	- [TS Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [TSApp01] and [TSApp02] are shut down according to Machine State.		
Post-conditions	[TS Tester] is disconnected to both ECUs.		
Main Test Execution			
Test Steps			**Pass Criteria**

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Step 1	[TS Tester] Request for change of Machine State to Driving from Execution Manager. Machine State for [ECU1] and [ECU2] are changed to Driving, and [TSApp01] and [TSApp02] are started up.	
Step 2	[TSApp01] Offer service [TSService01].	
Step 3	[TSApp02] Request service [TSService01].	
Step 4	[TSApp01] Find the Offset Slave TB on [ECU1].	The Offset Slave TB on [ECU1] is found successfully.
Step 5	[TSApp01] Configure the Offset Slave TB on [ECU1].	
Step 6	[TSApp02] Find the Offset Master TB on [ECU2].	The Offset Master TB on [ECU2] is found successfully.
Step 7	[TSApp02] Configure the Offset Master TB on [ECU2].	
Step 8	[TSApp01] Get current time of the Offset Slave TB on [ECU1].	
Step 9	[TSApp01] Decide a future synchronization time based on the current time so that [TSApp01] and [TSApp02] will be notified simultaneously and sync then.	
Step 10	[TSApp01] Start the timer of the Offset Slave TB on [ECU1] so that the timer will expire at the synchronization time.	
Step 11	[TSApp01] Send the synchronization time to [TSApp02].	
Step 12	[TSApp02] Receive the synchronization time from [TSApp01].	
Step 13	[TSApp02] Get current time of the Offset Master TB on [ECU2].	
Step 14	[TSApp02] Start the timer of the Offset Master TB on [ECU2] so that the timer will expire at the synchronization time.	
Step 15	[TSApp01][TSApp02] Receive notify from the timer at the synchronization time.	
Step 16	[TSApp01][TSApp02] Get the current time and store the current time.	Both current times are almost same.

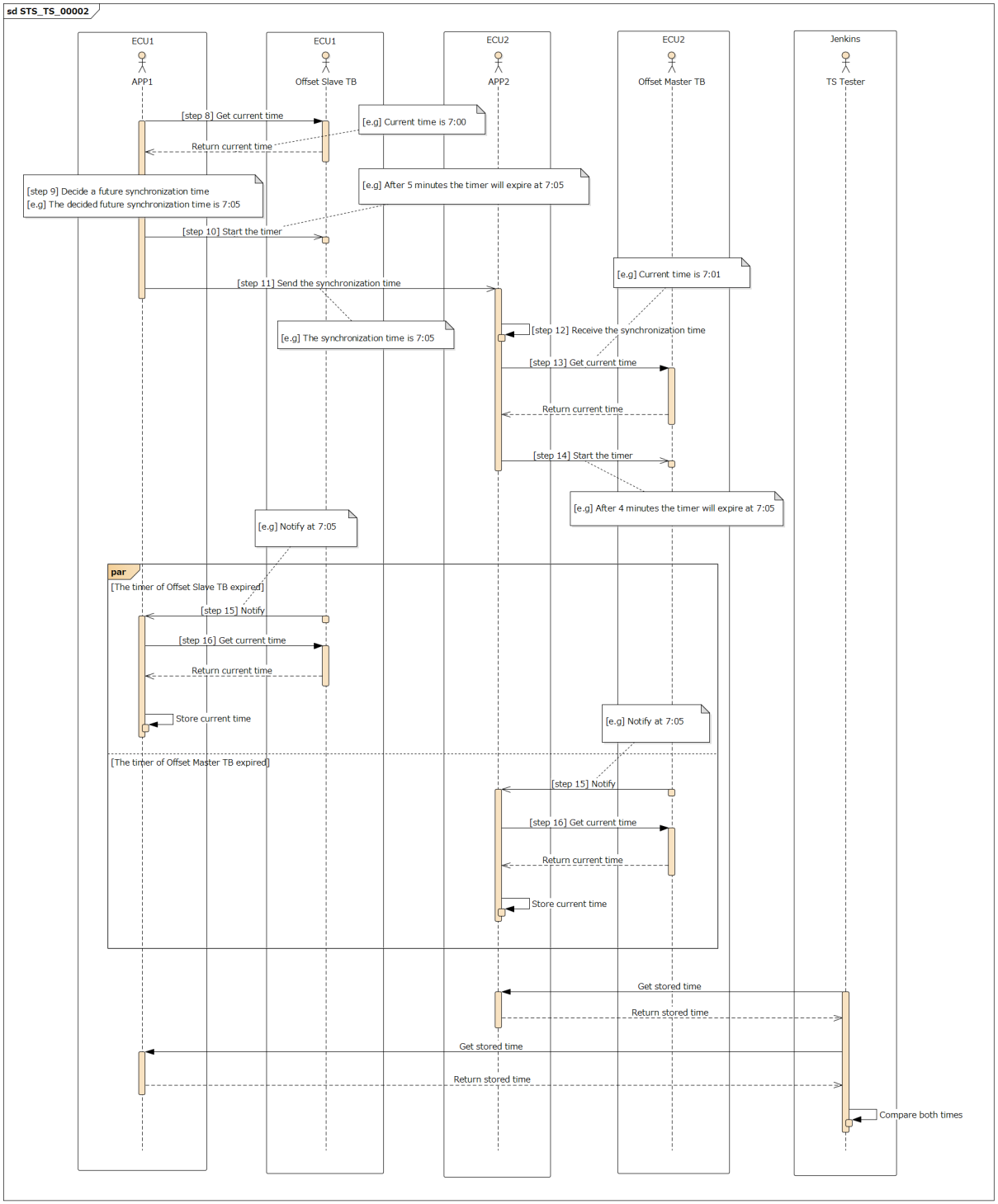

Figure 12.2: Sequence diagram of STS_TS_00002. [e.g] TSApp01 and TSApp02 sync at 7:05.

12.2.3 [STS_TS_00003] Check APIs of Offset Master TimeBase (TB) which do not impact other TB.

Test Objective	Verification that whether APIs of Offset Master TB can be used correctly.		
ID	STS_TS_00003	**State**	Draft
Affected Functional Cluster	Time Synchronization		
Trace to RS Criteria	[RS_TS_00001], [RS_TS_00005], [RS_TS_00012], [RS_TS_00013], [RS_TS_00017], [RS_TS_00026]		
Reference to Test Environment	STC_TS_00001		
Configuration Parameters	- [ECU2] is Global Time Master. - [ECU2] has a Offset Master TB and a Synchronized Master TB. - The Offset Master TB on [ECU2] depend on the Synchronized Master TB on [ECU2].		
Summary	Test case 3 calls APIs of Offset Master TB on [ECU2] and confirms whether it works properly. The test scope is APIs which impact only Offset Master TB on [ECU2], do not impact Sync Master TB on [ECU2].		
Pre-conditions	- [TS Tester] is connected to [ECU2]. - [ECU2] is in Machine State Parking. - [TSApp02] is shut down according to Machine State.		
Post-conditions	[TS Tester] is disconnected to [ECU2].		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[TS Tester] Request for change of Machine State to Driving from Execution Manager. Machine State for [ECU2] is changed to Driving, and [TSApp02] is started up.		
Step 2	[TSApp02] Find the Offset Master TB on [ECU2].		The Offset Master TB on [ECU2] is found successfully.
Step 3	[TSApp02] Find the Synch Master TB on [ECU2].		The Synch Master TB on [ECU2] is found successfully.
Step 4	[TSApp02] Get a getType of the Offset Master TB on [ECU2].		The getType is Offset Master TB.
Step 5	[TSApp02] Set Offset value of the Offset Master TB on [ECU2].		
Step 6	[TSApp02] Get Offset value of the Offset Master TB on [ECU2].		Offset value is the value set in Step 5.
Step 7	[TSApp02] Get current time of the Synch Master TB on [ECU2].		Current time is got successfully.
Step 8	[TSApp02] Get current time of the Offset Master TB on [ECU2].		Current time is approximately that Offset value got in Step 6 added time value got in Step 7.

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Step 9	[TSApp02] Start the timer of the Offset Master TB on [ECU2], so that the timer will expire at the specified time.	
Step 10	[TSApp02] When time-up is notified. Get current time of the Offset Master TB on [ECU2].	Current time is the specified time.

12.2.4 [STS_TS_00004] Check APIs of Offset Master TB which impact Sync Master TB.

Test Objective	Verification that APIs of Offset Master TB which impact Sync Master TB work properly and APIs of Time Base Status of Offset Master TB work properly.		
ID	STS_TS_00004	**State**	Draft
Affected Functional Cluster	Time Synchronization		
Trace to RS Criteria	[RS_TS_00010], [RS_TS_00014], [RS_TS_00015], [RS_TS_00018], [RS_TS_00021], [RS_TS_00026]		
Reference to Test Environment	STC_TS_00001		
Configuration Parameters	- [ECU2] is Global Time Master. - [ECU2] has a Offset Master TB and a Synchronized Master TB. - The Offset Master TB on [ECU2] depend on the Synchronized Master TB on [ECU2].		
Summary	Set rate correction of Offset Master TB and confirm it is reflected by the value of rate deviation of Offset Master TB and Sync Master TB . Set Global time of Offset Master TB and confirm it is reflected by Offset Master TB and Sync Master TB. Set User data of Offset Master TB and confirm it is reflected by Offset Master TB and Sync Master TB. Get Time Base Status by calling API and confirm that It is got successfully.		
Pre-conditions	- [TS Tester] is connected to [ECU2]. - [ECU2] is in Machine State Parking. - [TSApp02] is shut down according to Machine State.		
Post-conditions	[TS Tester] is disconnected to [ECU2].		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[TS Tester] Request for change of Machine State to Driving from Execution Manager. Machine State for [ECU2] is changed to Driving, and [TSApp02] is started up.		
Step 2	[TSApp02] Find the Offset Master TB on [ECU2].		The Offset Master TB on [ECU2] is found successfully.
Step 3	[TSApp02] Find the Synch Master TB on [ECU2].		The Synch Master TB on [ECU2] is found successfully.

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Step 4	[TSApp02] Set rate correction of the Offset Master TB on [ECU2].	
Step 5	[TSApp02] Get rate deviation of the Offset Master TB on [ECU2].	The value of rate deviation is the value set in Step 4 minus one.
Step 6	[TSApp02] Get rate deviation of the Synch Master TB on [ECU2].	The value of rate deviation is the value set in Step 4 minus one.
Step 7	[TSApp02] Set Global time of the Offset Master TB on [ECU2] by API of <SetTime>.	
Step 8	[TSApp02] Get current time of the Offset Master TB on [ECU2].	The time is approximately the value set in step 7.
Step 9	[TSApp02] Get current time of the Synch Master TB on [ECU2].	The time is approximately the value set in step 7.
Step 10	[TSApp02] Set Global time of the Offset Master TB on [ECU2] by API of <UpdateTime>.	
Step 11	[TSApp02] Get current time of the Offset Master TB on [ECU2].	The time is approximately the value set in step 10.
Step 12	[TSApp02] Get current time of the Synch Master TB on [ECU2].	The time is approximately the value set in step 10.
Step 13	[TSApp02] Set User Data of the Offset Master TB on [ECU2].	
Step 14	[TSApp02] Get Time Base Status of the Offset Master on [ECU2].	Time Base Status is got successfully.
Step 15	[TSApp02] Get User Data of the Time Base Status of the Offset Master on [ECU2].	The value of User Data is the value set in Step 13.
Step 16	[TSApp02] Get Update Counter of the Time Base Status of the Offset Master on [ECU2].	Update Counter is got successfully.
Step 17	[TSApp02] Get Synch Status of the Time Base Status of the Offset Master on [ECU2].	Synch Status is got successfully.
Step 18	[TSApp02] Get Status Flag of the Time Base Status of the Offset Master on [ECU2].	Status Flag is got successfully.
Step 19	[TSApp02] Get Creation Time of the Time Base Status of the Offset Master on [ECU2].	Creation Time is got successfully.

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Step 20	[TSApp02] Get Time Leap of the Time Base Status of the Offset Master on [ECU2].	Time Leap is got successfully.
Step 21	[TSApp02] Get Time Base Status of the Sync Master on [ECU2].	Time Base Status is got successfully.
Step 22	[TSApp02] Get User Data of the Time Base Status of the Sync Master on [ECU2].	The value of User Data is the value set in Step 13. User data is common value between Offset Master TB and Sync Master TB.

12.2.5 [STS_TS_00005] Check APIs of Offset Master TB which impact Offset Slave TB on the other ECU.

Test Objective	Verification that APIs of setting Global Time and User data work properly.		
ID	STS_TS_00005	**State**	Draft
Affected Functional Cluster	Time Synchronization		
Trace to RS Criteria	[RS_TS_00007], [RS_TS_00010], [RS_TS_00011], [RS_TS_00015], [RS_TS_00021], [RS_TS_00026]		
Reference to Test Environment	STC_TS_00001		
Configuration Parameters	- [ECU1] is synced by [ECU2]. - [ECU2] is Global Time Master. - [ECU1] has a Offset Slave TimeBase(TB) and a Synchronized Slave TB. - [ECU2] has a Offset Master TB and a Synchronized Master TB. - The Synchronized Slave TB on [ECU1] is synced by the Synchronized Master TB on [ECU2]. - The Offset Slave TB on [ECU1] depend on the Synchronized Slave TB on [ECU1], - The Offset Master TB on [ECU2] depend on the Synchronized Master TB on [ECU2]. - Event based communication. - The existing communication services comprise the following (service & data names are arbitrary): • [TSService01]: Offered by [TSApp02], requested by [TSApp01]. • [TSService01]: [TSApp02] send a global time and user data to [TSApp01].		
Summary	Set User data of Offset Master TB and confirm it is reflected by Offset Master TB on [ECU2] and Offset Slave TB on [ECU1]. User data is sent from Master TB to Slave TB. Set Global time of Offset Master TB and confirm it is reflected by Offset Master TB on [ECU2] and Offset Slave TB on [ECU1].		
Pre-conditions	- [TS Tester] is connected to both ECUs. - Both ECUs are in Machine State Parking. - [TSApp01] and [TSApp02] are shut down according to Machine State.		
Post-conditions	[TS Tester] is disconnected to both ECUs.		
Main Test Execution			
Test Steps			**Pass Criteria**

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Step 1	[TS Tester] Request for change of Machine State to Driving from Execution Manager. Machine State for [ECU1] and [ECU2] are changed to Driving, and [TSApp01] and [TSApp02] are started up.	
Step 2	[TSApp02] Offer service [TSService01].	
Step 3	[TSApp01] Request service [TSService01].	
Step 4	[TSApp02] Find the Offset Master TB on [ECU2].	The Offset Master TB on [ECU2] is found successfully.
Step 5	[TSApp01] Find the Offset Slave TB on [ECU1].	The Offset Slave TB on [ECU1] is found successfully.
Step 6	[TSApp02] Set User Data of the Offset Master TB on [ECU2].	
Step 7	[TSApp02] Get Time Base Status of the Offset Master TB on [ECU2].	Time Base Status is got successfully.
Step 8	[TSApp02] Get User Data of Time Base Status of the Offset Master TB on [ECU2].	The value of User Data is the value set in Step 6.
Step 9	[TSApp02] Set a Global time of the Offset Master TB by API of <SetTime>.	
Step 10	[TSApp02] Get current time of the Offset Master TB on [ECU2].	Current time is approximately the value set in step 9.
Step 11	[TSApp02] The Global time set in step 9 and User data set in step 6 is sent to [TSApp01] and wait until [TSApp01] has confirmed Global time and User Data.	
Step 12	[TSApp01] Receive a set Global time and User Data from [TSApp02].	
Step 13	[TSApp01] Get Time Base Status of the Offset Slave TB on [ECU1].	Time Base Status is got successfully.
Step 14	[TSApp01] Get User Data of Time Base Status of the Offset Slave TB on [ECU1].	The value of User Data is the value set in Step 6. User data is common value between Master TB on [ECU2] and Slave TB on [ECU1].
Step 15	[TSApp01] Get current time of the Offset Slave TB on [ECU1].	Current time is approximately the value set in step 9.

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Step 16	[TSApp02] Set a Global time of the Offset Master TB by API of <UpdateTime>.	
Step 17	[TSApp02] Get current time of the Offset Master TB on [ECU2].	Current time is approximately the value set in step 16.
Step 18	[TSApp02] The set Global time is sent to [TSApp01].	Both current times are almost same.
Step 19	[TSApp01] Receive a set global time from [TSApp02] and wait until Global Time on [ECU1] has been updated.	
Step 20	[TSApp01] Get current time of the Offset Slave TB on [ECU1].	Current time is approximately the value set in step 16.

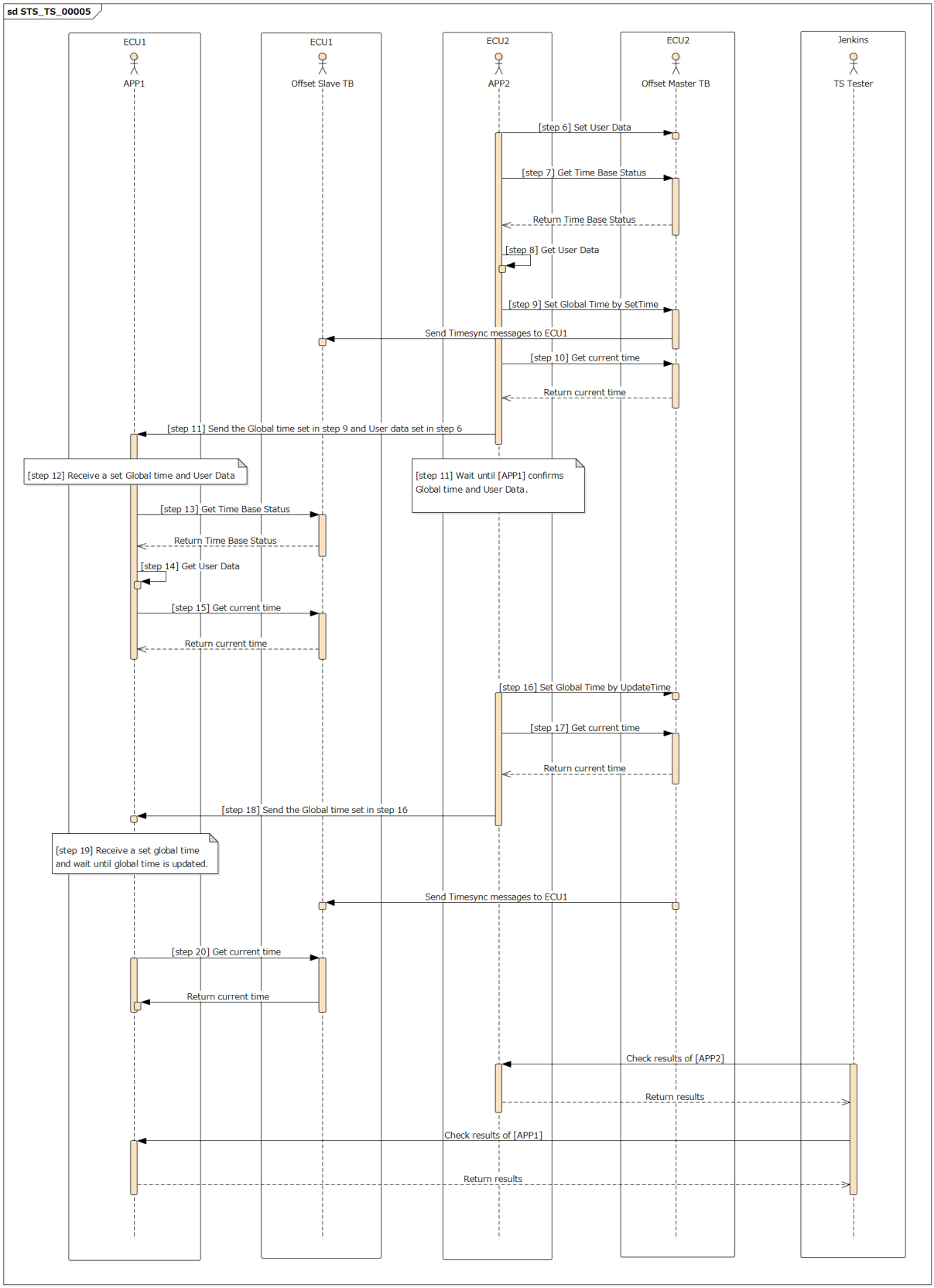

Figure 12.3: Sequence diagram of STS_TS_00005.

13 Test configuration and test steps for Security Management

13.1 Test System

Security Management is responsible for aspects related to Secure Communication and Protected Runtime Environment.

The purpose of Secure Communication is to ensure message confidentiality, integrity and authentication. These capabilities are offered as a library to facilitate reusability.

Protected Runtime Environment ensures inter-process separation (spatial, time and resource) and protection against memory corruption attacks.

System Tests target to check successful communication of messages using secure channels, irrespective of underlying libraries and cypher suites.

13.1.1 Test configurations

Configuration ID	STC_SEC_00001
Description	Standard Jenkins server for Security test
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

Jenkins Server, running the job with Security Tester is connected via Ethernet to [ECU1] hosting the Security Test Application (STA) and [ECU2].

[ECU1] sends the data to [ECU2]. Man-in-middle attack is performed through Jenkins Server.

The Security Tester is supposed to check pass criteria.

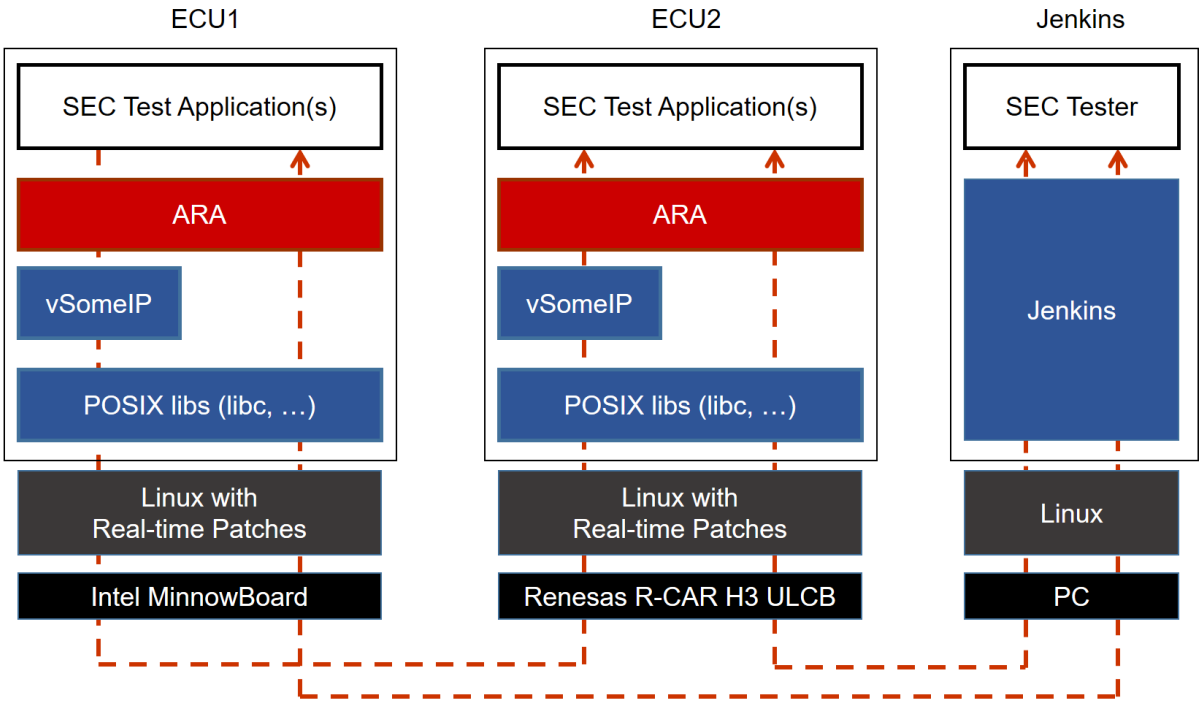

Figure 13.1: Illustration of test setup for Security Management.

13.2 Test cases for Secure Communication

13.2.1 [STS_SEC_00001] Message authentication

Test Objective	Verification that the messages from only authentic source are considered and replay attacks are prevented.		
ID	STS_SEC_00001	**State**	Draft
Affected Functional Cluster	Security		
Trace to RS Criteria	[RS_SEC_04001], [RS_SEC_04002], [RS_SEC_04003], [RS_SEC_04004]		
Reference to Test Environment	STC_SEC_00001		
Configuration Parameters	- Secure channels and cypher suites are peoperly configured in the manifest. - Secure channel configurations for the applications are provided by manifests.		
Summary	This test case aims to verify that - Messages are securely transferred from sender [ECU1] to the receiver [ECU2] - Messages are successfully authenticated and verified - Any replay attacks are unsuccessful		

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Pre-conditions	- Security Tester is connected to [ECU1] and [ECU2] - Software components on [ECU1] and [ECU2] are initialized - Secure channel between [SECApp01] on [ECU1] and [SECApp02] on [ECU2] exists - [ATTACKER] is configured on Jenkins to listen to the same port as [SECApp02]	
Post-conditions	TCP connections between Security Tester and [ECU1] and [ECU2] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[SECApp01] Create a payload "Hello World" and send using secure channel to [SECApp02]	
Step 2	[SECApp02] Receive message and try to authenticate	Message authentication successful, which means message received from [SECApp01]
Step 3	[ATTACKER] Perform replay attack by sending message "Hello World" to [SECApp02]	
Step 4	[SECApp02] Receive message and try to authenticate	Message authentication fails which means message was not sent by [SECApp01]. Message is discarded and replay attack is unsuccessful.

13.2.2 [STS_SEC_00002] Message confidentiality and integrity

Test Objective	Verification that only authorized source can decrypt a message and the message integrity is maintained.		
ID	STS_SEC_00002	**State**	Draft
Affected Functional Cluster	Security		
Trace to RS Criteria	[RS_SEC_04001], [RS_SEC_04002], [RS_SEC_04003], [RS_SEC_04004]		
Reference to Test Environment	STC_SEC_00001		
Configuration Parameters	- Secure channels and cypher suites are peoperly configured in the manifest. - Secure channel configurations for the applications are provided by manifests.		
Summary	This test case aims to verify that - Messages are securely transferred from sender [ECU1] to the receiver [ECU2] - Messages are successfully authenticated and verified - Decryption and tempering of message is unsuccessful		
Pre-conditions	- Security Tester is connected to [ECU1] and [ECU2] - Software components on [ECU1] and [ECU2] are initialized - Secure channel between [SECApp01] on [ECU1] and [SECApp02] on [ECU2] exists - [ATTACKER] is configured on Jenkins to listen to the same port as [SECApp02]		
Post-conditions	TCP connections between Security Tester and [ECU1] and [ECU2] is closed.		
Main Test Execution			

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Test Steps		Pass Criteria
Step 1	[SECApp01] Create a payload "Hello World" and send plain text to [TESTER]	Message "Hello World" received by [TESTER]
Step 2	[SECApp01] Send the same payload using secure channel to [SECApp02]	Encrypted messaged received by [SECApp02]
Step 3	[SECApp02] Authenticate the messaged received from [SECApp01]	Message authentication successful, which means message received from [SECApp01]
Step 4	[SECApp02] Decrypt message from [SECApp01]	Message decrypted as "Hello World". Message integrity is proved.
Step 5	[SECApp02] Send decrypted message to [TESTER]	"Hello World" received by [TESTER] and is stored for further comparison
Step 6	[ATTACKER] Sniff the message sent over secure channel from [SECApp01] to [SECApp02]	Encrypted message received by [ATTACKER]
Step 7	[ATTACKER] Try to decrypt message sniffed earlier	Decryption attempt unsuccessful. Message confidentiality is proven.
Step 8	[ATTACKER] If the decryption was successful (by guessing the key or if encryption was weak), then send decrypted message to [TESTER], else send sniffed (encrypted) message to [TESTER]	Message received by [TESTER] and is stored for further comparison
Step 9	[TESTER] Compare plain text from [SECApp01] and decrypted message from [SECApp02]	Both messages are exactly same. Message integrity is proved.
Step 10	[TESTER] Compare plain text from [SECApp01] and encrypted/ decrypted message from [ATTACKER]	Both messages are different. Message confidentiality is proved.

14 Test configuration and test steps for Network Management

14.1 Test System

14.1.1 Test configurations NM

Configuration ID	STC_NM_00001
Description	Scenario 1 - All ECUs are in the same NM Cluster
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
ECU 3	Raspberry Pi, 192.168.100.3
Jenkins	Jenkins Server, 192.168.100.10

Configuration ID	STC_NM_00002
Description	Scenario 2 - only ECU2 is in the NM cluster
ECU 1	Intel MinnowBoard Turbot, 192.168.100.5
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
ECU 3	Raspberry Pi, 192.168.100.3
Jenkins	Jenkins Server, 192.168.100.10

The Jenkins Server, running the job with the Network Management test [NM TESTER] is connected via Ethernet to [ECU1] hosting the NM Test Application [NMApp01], [ECU2] hosting the NM Test Application [NMApp02] and [ECU3] hosting the NM Test Application [NMApp03].

The [NM Tester] is supposed to collect the results by checking multicast messages.

The communication between [NM Tester] and the applications on the ECU may take place over the Diagnostics functional cluster in form of diagnostic messages.

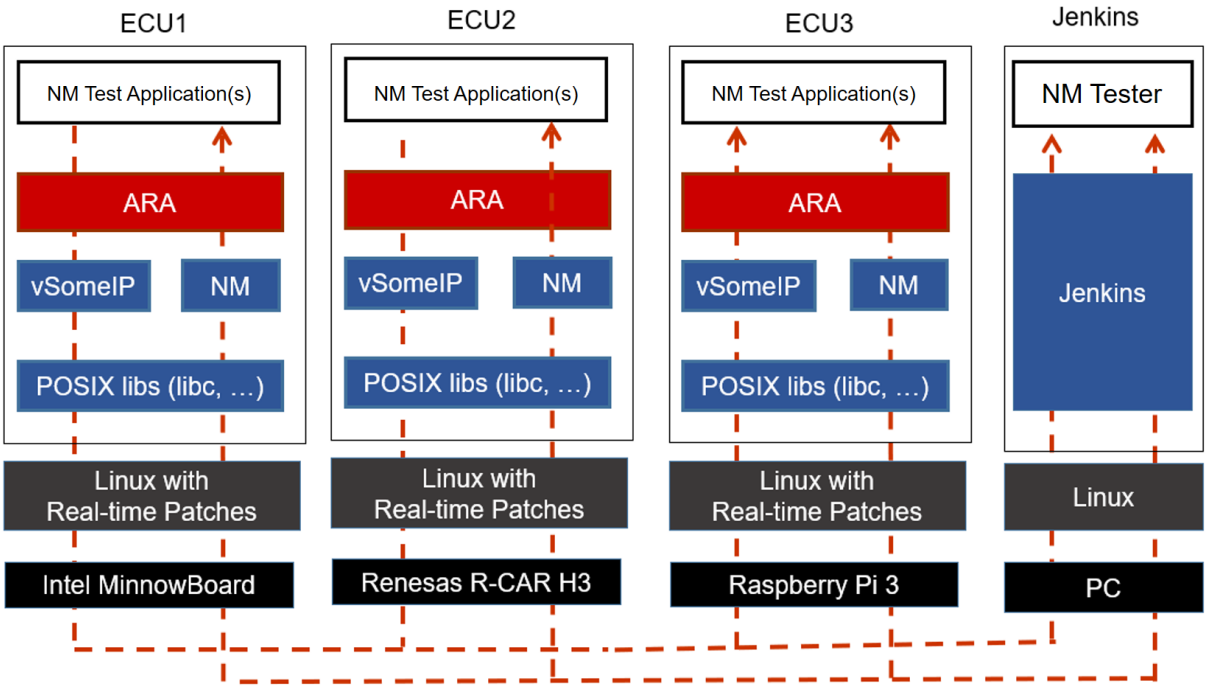

Figure 14.1: Illustration of test setup for Network Management

14.2 Test cases Network Management

14.2.1 [STS_NM_00001] Basic Network Management functionality of ECUs in same NM Cluster.

Test Objective	To verify that the Basic Network Management functionality of ECUs in same NM Cluster works.		
ID	STS_NM_00001	**State**	Draft
Affected Functional Cluster	NM		
Trace to RS Criteria	[RS_Nm_00047], [RS_Nm_00048]		
Reference to Test Environment	STC_NM_00001		
Configuration Parameters	NM configuration parameters are configured		
Summary	Initially all three ECUs are in inactive state. Machine state of [ECU2] is changed to Driving. [ECU2] sends multicast NM messages periodically which is received by [ECU1] and [ECU3] and due to this [ECU1] and [ECU3] become active. Network change its mode from Bus sleep mode to Network Mode. [ECU2] stops sending NM messages and becomes inactive. [ECU1] and [ECU3] does not receive NM messages for a time <t> and [ECU1] becomes inactive. Network transitions its modes as per configured timeouts.		

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Pre-conditions	- [NM Tester] is connected to all ECUs. - All ECUs are in Machine State Parking. - Applications are shut down according to Machine State.	
Post-conditions	TCP connections between [NM Tester] and all ECUs are closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[NM TESTER] Request the change of Machine State to Driving for ECU2.	Machine State for ECU2 is changed to Driving.
Step 2	[NMApp02] Request NM to send multicast messages.	
Step 3	[NM TESTER] Check NM multicast messages	Multicast messages are received with source node ID of [ECU2] with logical network information bit set to 1. [ECU1] and [ECU3] become awake. Network enters into Network Mode (Repeat Message State).
Step 4	[NM TESTER] Check NM multicast messages after <Repeat Message timer> expired	Network enters into Network Mode (Normal Operation State).
Step 5	[NM TESTER] Check NM multicast messages after <NM-timeout timer> if all ECUs are still awake	Multicast messages are received with source node ID of [ECU2] [ECU1] and [ECU3] are awake.
Step 5	[NMApp02] Indicate NM to release the network to stop sending multicast message.	
Step 6	[NM TESTER] Check NM multicast messages.	Multicast messages are not received with source node ID of [ECU2] and Network goes to Ready Sleep state
Step 7	[NM TESTER] Check NM multicast messages after NM Timout timer <t>	Network goes to Prepare Bus sleep Mode.
Step 8	[NM TESTER] Check NM multicast messages after wait bus sleep timer <t>	Network goes to Bus sleep Mode.

14.2.2 [STS_NM_00002] Basic Network Management functionality of ECUs not in same partial network Cluster.

Test Objective	To verify that the Basic Network Management functionality of ECUs not in same partial network Cluster works.		
ID	STS_NM_00002	**State**	Draft
Affected Functional Cluster	NM		

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Trace to RS Criteria	[RS_Nm_00047], [RS_Nm_00048]	
Reference to Test Environment	STC_NM_00002	
Configuration Parameters	NM configuration parameters are configured	
Summary	Initially all three ECUs are in inactive state. [ECU1] and [ECU2] forms a partial network. Machine state of [ECU2] is changed to Driving. [ECU2] sends multicast NM messages periodically which is received by [ECU1] but [ECU3] ignores it and due to this [ECU1] becomes active while [ECU3] remains inactive. Network change its mode from Bus sleep mode to Network Mode. [ECU2] stops sending NM messages and becomes inactive. [ECU1] and [ECU3] does not receive NM messages for a time <t1> and [ECU1] becomes inactive. Network transitions its modes as per configured timeouts.	
Pre-conditions	- [NM Tester] is connected to all the ECUs. - All ECUs are in Machine State Living. - Applications are shut down according to Machine State.	
Post-conditions	TCP connections between [NM Tester] and both ECUs are closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[NM TESTER] Request the change of Machine State to Driving for ECU2.	Machine State for ECU2 is changed to Driving.
Step 2	[NMApp02] Request NM to send multicast messages.	
Step 3	[NM TESTER] Check NM multicast messages	Multicast messages are received with source node ID of [ECU2] with logical network information bit set to 1. [ECU1] becomes awake and [ECU3] ignores it and remains inactive. Network enters into Network Mode (Repeat Message State).
Step 4	[NM TESTER] Check NM multicast messages after <Repeat Message timer> expired	Network enters into Network Mode (Normal Operation State).
Step 5	[NM TESTER] Check NM multicast messages after <NM-timeout timer> if [ECU2] is awake and [ECU3] is in sleep.	Multicast messages are received with source node ID of [ECU2] [ECU1] is awake while [ECU3] remains inactive. NM message is received from [ECU1]
Step 6	[NMApp02] Indicate NM to release the network to stop sending multicast message.	

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Step 7	[NM TESTER] Check NM multicast messages.	Multicast messages are not received with source node ID of [ECU2] and Network goes to Ready Sleep state
Step 8	[NM TESTER] Check NM multicast messages after NM Timout timer <t1>	Network goes to Prepare Bus sleep Mode.
Step 9	[NM TESTER] Check NM multicast messages after wait bus sleep timer <t2>	Network goes to Bus sleep Mode.

15 Test configuration and test steps for Cryptography

15.1 Test System

15.1.1 Test configurations

Configuration ID	STC_CRYPTO_00001
Description	Standard Jenkins server for Cryptography test
ECU 2	Renesas R-Car H3 ULCB, 192.168.100.2
Jenkins	Jenkins Server, 192.168.100.10

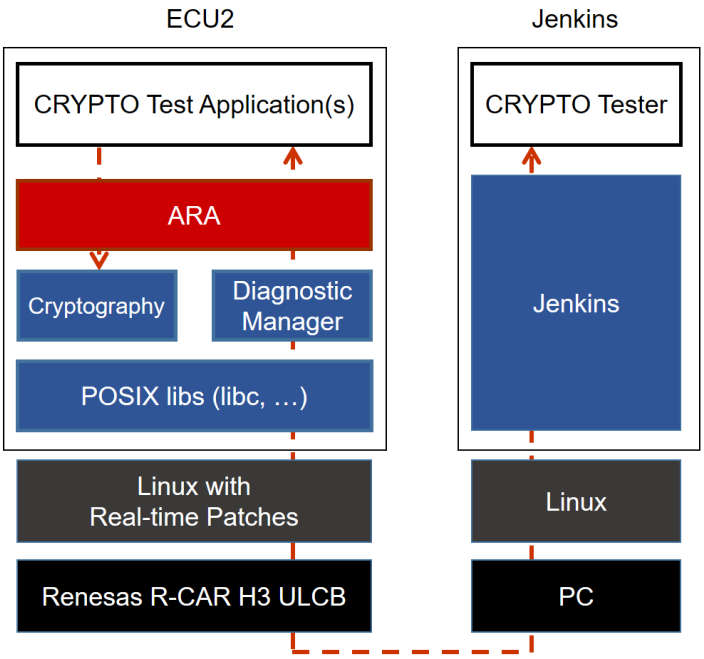

Figure 15.1: Illustration of test setup for Cryptography.

The Jenkins Server, running the job with the Cryptography test ([CRYPTO Tester]) is connected via Ethernet to [ECU2] hosting the CRYPTO Test Applications [CRYPTOApp01].

The [CRYPTO Tester] is supposed to check the pass criteria.

The communication between [CRYPTO Tester] and the [CRYPTOApp01] may take place over the Diagnostics functional cluster in form of diagnostic messages.

15.2 Test cases

15.2.1 [STS_CRYPTO_00001] Encrypting and decrypting data using an algorithm for symmetric encryption/decryption primitives

Test Objective	Verify that Crypto Stack correctly encrypts and decrypts data using symmetric key.		
ID	STS_CRYPTO_00001	**State**	Draft
Affected Functional Cluster	Cryptography		
Trace to RS Criteria	[RS_CRYPTO_02001], [RS_CRYPTO_02005], [RS_CRYPTO_02008], [RS_CRYPTO_02108], [RS_CRYPTO_02201], [RS_CRYPTO_02302]		
Reference to Test Environment	STC_CRYPTO_00001		
Configuration Parameters	- Provide key for symmetric encryption/decryption. - Allow use of symmetric key for encryption and decryption by [CRYPTOApp01].		
Summary	<Plaintext1> with arbitrary value and size is sent from [CRYPTO Tester] to [CRYPTOApp01] and <Plaintext1> is encrypted on the [CRYPTOApp01] side using a symmetric key to obtain <Ciphertext1>. <Ciphertext1> is sent back from [CRYPTOApp01] to [CRYPTO Tester] and checked by [CRYPTO Tester]. Conversely, <Ciphertext1> is sent from [CRYPTO Tester] to [CRYPTOApp01] and <Ciphertext1> is decrypted on the [CRYPTOApp01] side. The decrypted data is sent back from [CRYPTOApp01] to [CRYPTO Tester] and checked by [CRYPTO Tester].		
Pre-conditions	- Crypto stack and [CRYPTOApp01] are initialized with used key, algorithm, and domain parameter as applicable. - Communication between [CRYPTO Tester] and [CRYPTOApp01] has been set up. - A symmetric key can be accessed by [CRYPTOApp01].		
Post-conditions	Communication between [CRYPTO Tester] and [CRYPTOApp01] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[CRYPTO Tester] Send arbitrary <Plaintext1> to [CRYPTOApp01].		
Step 2	[CRYPTOApp01] Receive <Plaintext1>.		
Step 3	[CRYPTOApp01] Encrypt <Plaintext1> using symmetric key to obtain <Ciphertext1>.		[CRYPTOApp01] Encryption is finished without an error.
Step 4	[CRYPTOApp01] Send <Ciphertext1> to [CRYPTO Tester].		
Step 5	[CRYPTO Tester] Receive <Ciphertext1>.		
Step 6	[CRYPTO Tester] Compare <Ciphertext1> with one in [CRYPTO Tester].		[CRYPTO Tester] <Ciphertext1> matches with one in [CRYPTO Tester].
Step 7	[CRYPTO Tester] Send <Ciphertext1> to [CRYPTOApp01].		
Step 8	[CRYPTOApp01] Receive <Ciphertext1>.		

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Step 9	[CRYPTOApp01] Decrypt <Ciphertext1> using symmetric key to obtain <Plaintext1>.	[CRYPTOApp01] Decryption is finished without an error.
Step 10	[CRYPTOApp01] Send <Plaintext1> to [CRYPTO Tester].	
Step 11	[CRYPTO Tester] Receive <Plaintext1>.	
Step 12	[CRYPTO Tester] Compare <Plaintext1> with one in [CRYPTO Tester].	[CRYPTO Tester] <Plaintext1> matches with one in [CRYPTO Tester].

15.2.2 [STS_CRYPTO_00002] Encrypting and decrypting data using an algorithm for asymmetric encryption/decryption primitives.

Test Objective	Verify that Crypto Stack correctly encrypts and decrypts data using public and private keys.		
ID	STS_CRYPTO_00002	**State**	Draft
Affected Functional Cluster	Cryptography		
Trace to RS Criteria	[RS_CRYPTO_02002], [RS_CRYPTO_02005], [RS_CRYPTO_02008], [RS_CRYPTO_02108], [RS_CRYPTO_02202], [RS_CRYPTO_02302]		
Reference to Test Environment	STC_CRYPTO_00001		
Configuration Parameters	- Provide public and private key pair for tested asymmetric encryption/decryption algorithm. - Allow use of public and private key pair for encryption and decryption by [CRYPTOApp01].		
Summary	<Plaintext1> with arbitrary value and size (up to maximum possible bit length for used algorithm) is sent from [CRYPTO Tester] to [CRYPTOApp01] and <Plaintext1> is encrypted on the [CRYPTOApp01] side using [CRYPTOApp01]'s public key to obtain <Ciphertext1>. <Ciphertext1> is sent back from [CRYPTOApp01] to [CRYPTO Tester] and checked by [CRYPTO Tester]. Conversely, <Ciphertext1> is sent from [CRYPTO Tester] to [CRYPTOApp01] and <Ciphertext1> is decrypted on the [CRYPTOApp01] side using [CRYPTOApp01]'s private key. The decrypted data is sent back from [CRYPTOApp01] to [CRYPTO Tester] and checked by [CRYPTO Tester].		
Pre-conditions	- Crypto stack and [CRYPTOApp01] are initialized with used key, algorithm, and domain parameter as applicable. - Communication between [CRYPTO Tester] and [CRYPTOApp01] has been set up. - Public and private key pair can be accessed by [CRYPTOApp01].		
Post-conditions	Communication between [CRYPTO Tester] and [CRYPTOApp01] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[CRYPTO Tester] Send arbitrary <Plaintext1> to [CRYPTOApp01].		
Step 2	[CRYPTOApp01] Receive <Plaintext1>.		
Step 3	[CRYPTOApp01] Encrypt <Plaintext1> using [CRYPTOApp01]'s public key to obtain <Ciphertext1>.		[CRYPTOApp01] Encryption is finished without an error.

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Step 4	[CRYPTOApp01] Send <Ciphertext1> to [CRYPTO Tester].	
Step 5	[CRYPTO Tester] Receive <Ciphertext1>.	
Step 6	[CRYPTO Tester] Compare <Ciphertext1> with one in [CRYPTO Tester].	[CRYPTO Tester] <Ciphertext1> matches with one in [CRYPTO Tester].
Step 7	[CRYPTO Tester] Send <Ciphertext1> to [CRYPTOApp01].	
Step 8	[CRYPTOApp01] Receive <Ciphertext1>.	
Step 9	[CRYPTOApp01] Decrypt <Ciphertext1> using [CRYPTOApp01]'s private key to obtain <Plaintext1>.	[CRYPTOApp01] Decryption is finished without an error.
Step 10	[CRYPTO Tester] Send <Plaintext1> to [CRYPTO Tester].	
Step 11	[CRYPTO Tester] Receive <Plaintext1>.	
Step 12	[CRYPTO Tester] Compare <Plaintext1> with one in [CRYPTO Tester].	[CRYPTO Tester] <Plaintext1> matches with one in [CRYPTO Tester].

15.2.3 [STS_CRYPTO_00003] Generation and verification of message authentication code.

Test Objective	Verify that Crypto Stack correctly generates and verifies message authentication code.		
ID	STS_CRYPTO_00003	**State**	Draft
Affected Functional Cluster	Cryptograpny		
Trace to RS Criteria	[RS_CRYPTO_02001], [RS_CRYPTO_02005], [RS_CRYPTO_02008], [RS_CRYPTO_02108], [RS_CRYPTO_02203], [RS_CRYPTO_02302]		
Reference to Test Environment	STC_CRYPTO_00001		
Configuration Parameters	- Provide symmetric key for used block cipher algorithm. - Allow use of symmetric key for generation of message authentication code by [CRYPTOApp01].		
Summary	<Data1> with arbitrary value and size is sent from [CRYPTO Tester] to [CRYPTOApp01] and message authentication code is generated by [CRYPTOApp01] from <Data1> to obtain <MAC1>. <MAC1> is sent back from [CRYPTOApp01] to [CRYPTO Tester] and checked by [CRYPTO Tester]. <Data1> and <MAC1> are sent from [CRYPTO Tester] to [CRYPTOApp01] and verified by [CRYPTOApp01].		

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Pre-conditions	- Crypto stack and [CRYPTOApp01] are initialized with used key, algorithm, and domain parameter as applicable. - Communication between [CRYPTO Tester] and [CRYPTOApp01] has been set up. - Symmetric key can be accessed by [CRYPTOApp01], if symmetric cipher algorithm is used.	
Post-conditions	Communication between [CRYPTO Tester] and [CRYPTOApp01] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[CRYPTO Tester] Send arbitrary <Data1> to [CRYPTOApp01].	
Step 2	[CRYPTOApp01] Receive <Data1>.	
Step 3	[CRYPTOApp01] Generate message authentication code from <Data1> to obtain <MAC1>.	[CRYPTOApp01] Generation of <MAC1> is finished without an error.
Step 4	[CRYPTOApp01] Send <MAC1> to [CRYPTO Tester].	
Step 5	[CRYPTO Tester] Receive <MAC1>.	
Step 6	[CRYPTO Tester] Compare <MAC1> with one in [CRYPTO Tester].	[CRYPTO Tester] <MAC1> matches with one in [CRYPTO Tester].
Step 7	[CRYPTO Tester] Send <Data1> and <MAC1> to [CRYPTOApp01].	
Step 8	[CRYPTOApp01] Receive <Data1> and <MAC1>.	
Step 9	[CRYPTOApp01] Verify <MAC1>.	[CRYPTOApp01] Verification of <MAC1> is successful.
Step 10	[CRYPTOApp01] Send verification result to [CRYPTO Tester].	
Step 11	[CRYPTO Tester] Receive verification result.	
Step 12	[CRYPTO Tester] Check verification result.	[CRYPTO Tester] Verification result is successful.

15.2.4 [STS_CRYPTO_00004] Generation and verification of digital signature.

Test Objective	Verify that Crypto Stack correctly generates and verifies digital signature.		
ID	STS_CRYPTO_00004	**State**	Draft
Affected Functional Cluster	Cryptography		
Trace to RS Criteria	[RS_CRYPTO_02002], [RS_CRYPTO_02005], [RS_CRYPTO_02008], [RS_CRYPTO_02108], [RS_CRYPTO_02202], [RS_CRYPTO_02204], [RS_CRYPTO_02302]		

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Reference to Test Environment	STC_CRYPTO_00001	
Configuration Parameters	- Provide asymmetric key for used algorithm. - Allow use of asymmetric key pair for generation of digital signature by [CRYPTOApp01].	
Summary	<Data1> with arbitrary value and size is sent from [CRYPTO Tester] to [CRYPTOApp01] and digital signature is generated by [CRYPTOApp01] from <Data1> using [CRYPTOApp01]'s private key to obtain <DS1>. <DS1> is sent back from [CRYPTOApp01] to [CRYPTO Tester] and checked by [CRYPTO Tester]. <Data1> and <DS1> are sent from [CRYPTO Tester] to [CRYPTOApp01] and <Data1> is verified by [CRYPTOApp01] using <DS1> and [CRYPTOApp01]'s public key.	
Pre-conditions	- Crypto stack and [CRYPTOApp01] are initialized with used key, algorithm, and domain parameter as applicable. - Communication between [CRYPTO Tester] and [CRYPTOApp01] has been set up. - Asymmetric key pair can be accessed by [CRYPTOApp01].	
Post-conditions	Communication between [CRYPTO Tester] and [CRYPTOApp01] is closed.	
Main Test Execution		
Test Steps		**Pass Criteria**
Step 1	[CRYPTO Tester] Send arbitrary <Data1> to [CRYPTOApp01].	
Step 2	[CRYPTOApp01] Receive <Data1>.	
Step 3	[CRYPTOApp01] Generate digital signature using <Data1> and [CRYPTOApp01]'s private key to obtain <DS1>.	[CRYPTOApp01] Generation of <DS1> is finished without an error.
Step 4	[CRYPTOApp01] Send <DS1> to [CRYPTO Tester].	
Step 5	[CRYPTO Tester] Receive <DS1>.	
Step 6	[CRYPTO Tester] Compare <DS1> with one in [CRYPTO Tester].	[CRYPTO Tester] <DS1> matches with one in [CRYPTO Tester].
Step 7	[CRYPTO Tester] Send <Data1> and <DS1> to [CRYPTOApp01].	
Step 8	[CRYPTOApp01] Receive <Data1> and <DS1>.	
Step 9	[CRYPTOApp01] Verify <Data1> using <DS1> and [CRYPTOApp01]'s public key.	[CRYPTOApp01] Verification of <Data1> is successful.
Step 10	[CRYPTOApp01] Send verification result to [CRYPTO Tester].	
Step 11	[CRYPTO Tester] Receive verification result.	
Step 12	[CRYPTO Tester] Check verification result.	[CRYPTO Tester] Verification result is successful.

15.2.5 [STS_CRYPTO_00005] Generation of hash value.

Test Objective	Verify that Crypto Stack correctly generates hash value.		
ID	STS_CRYPTO_00005	**State**	Draft
Affected Functional Cluster	Cryptography		
Trace to RS Criteria	[RS_CRYPTO_02005], [RS_CRYPTO_02108], [RS_CRYPTO_02205], [RS_CRYPTO_02302]		
Reference to Test Environment	STC_CRYPTO_00001		
Configuration Parameters	-		
Summary	<Data1> with arbitrary value and size is sent from [CRYPTO Tester] to [CRYPTOApp01] and hash value is generated by [CRYPTOApp01] from <Data1> to obtain <Hash1>. <Hash1> is sent back from [CRYPTOApp01] to [CRYPTO Tester] and checked by [CRYPTO Tester].		
Pre-conditions	- Crypto stack and [CRYPTOApp01] are initialized with used algorithm and domain parameter as applicable. - Communication between [CRYPTO Tester] and [CRYPTOApp01] has been set up.		
Post-conditions	Communication between [CRYPTO Tester] and [CRYPTOApp01] is closed.		
Main Test Execution			
Test Steps			**Pass Criteria**
Step 1	[CRYPTO Tester] Send arbitrary <Data1> to [CRYPTOApp01].		
Step 2	[CRYPTOApp01] Receive <Data1>.		
Step 3	[CRYPTOApp01] Generate hash from <Data1> to obtain <Hash1>.		[CRYPTOApp01] Generation of <Hash1> is finished without an error.
Step 4	[CRYPTOApp01] Send <Hash1> to [CRYPTO Tester].		
Step 5	[CRYPTO Tester] Receive <Hash1>.		
Step 6	[CRYPTO Tester] Compare <Hash1> with one in [CRYPTO Tester].		[CRYPTO Tester] <Hash1> matches with one in [CRYPTO Tester].

16 References

[1] Glossary AUTOSAR_TR_Glossary