BS ISO 21111-10:2021

BSI Standards Publication

Road vehicles — In-vehicle Ethernet

Part 10: Transport layer and network layer conformance test plans

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National foreword

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Part 10: Transport layer and network layer conformance test plans

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

A list of all parts in the ISO 21111 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The ISO 21111 series includes in-vehicle Ethernet requirements and test plans that are disseminated in other International Standards and complements them with additional test methods and requirements. The resulting requirement and test plans are structured in different documents following the Open Systems Interconnection (OSI) reference model and grouping the documents that depend on the physical media and bit rate used.

In general, the Ethernet requirements are specified in ISO/IEC/IEEE 8802-3. The ISO 21111 series provides supplemental specifications (e.g. wake-up, I/O functionality), which are required for in-vehicle Ethernet applications. In road vehicles, Ethernet networks are used for different purposes requiring different bit-rates. Currently, the ISO 21111 series specifies the 1-Gbit/s optical and 100-Mbit/s electrical physical layer.

The ISO 21111 series contains requirement specifications and test methods related to the in-vehicle Ethernet. This includes requirement specifications for physical layer entity (e.g. connectors, physical layer implementations) providers, device (e.g. electronic control units, gateway units) suppliers, and system (e.g. network systems) designers. Additionally, there are test methods specified for conformance testing and for interoperability testing.

Safety (electrical safety, protection, fire, etc.) and electromagnetic compatibility (EMC) requirements are out of the scope of the ISO 21111 series.

The structure of the specifications given in the ISO 21111 series complies with the Open Systems Interconnection (OSI) reference model specified in ISO/IEC 7498-1 [1] and ISO/IEC 10731 [2].

ISO 21111-1 defines the terms which are used in this series of standards and provides an overview of the standards for in-vehicle Ethernet including the complementary relations to ISO/IEC/IEEE 8802-3, the document structure, type of physical entities, in-vehicle Ethernet specific functionalities and so on.

ISO 21111-2 specifies the interface between reconciliation sublayer and physical entity including reduced gigabit media independent interface (RGMII), and the common physical entity wake-up and synchronized link sleep functionalities, independent from physical media and bit rate.

ISO 21111-2 specifies supplemental requirements to a physical layer capable of transmitting 1-Gbit/s over plastic optical fibre compliant with ISO/IEC/IEEE 8802-3, with specific application to communications inside road vehicles, and a test plan for physical entity conformance testing.

ISO 21111-4 specifies the optical components requirements and test methods for 1-Gbit/s optical invehicle Ethernet.

ISO 21111-5 specifies, for 1-Gbit/s optical in-vehicle Ethernet, requirements on the physical layer at system level, requirements on the interoperability test set-ups, the interoperability test plan that checks the requirements for the physical layer at system level, requirements on the device-level physical layer conformance test set-ups, and device-level physical layer conformance test plan that checks a set of requirements for the OSI physical layer that are relevant for device vendors.

ISO 21111-6 specifies advanced features of an ISO/IEC/IEEE 8802-3 in-vehicle Ethernet physical layer (often also called transceiver), e.g. for diagnostic purposes for in-vehicle Ethernet physical layers. It specifies advanced physical layer features, wake-up and sleep features, physical layer test suite,

physical layer control requirements and conformance test plan, physical sublayers test suite and physical sublayers requirements and conformance test plan.

ISO 21111-7 specifies the implementation for ISO/IEC/IEEE 8802-3:2021, which defines the interface implementation for automotive applications together with requirements on components used to realize this Bus Interface Network (BIN). ISO 21111-7 also defines further testing and system requirements for systems implemented according to the system specification. In addition, ISO 21111-7 defines the channels for tests of transceivers with a test wiring harness that simulates various electrical communication channels.

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ISO 21111-8 specifies the transmission media, the channel performance and the tests for ISO/IEC/IEEE 8802-3 in-vehicle Ethernet.

ISO 21111-9 specifies the data link layer requirements. It specifies the requirements for devices and systems with bridge functionality.

This document specifies the transport layer and network layer requirements and conformance test plans. It specifies the conformance test plans for devices and systems that include functionality related with OSI layers from 4 and 3.

ISO 21111-11 specifies the application layer to session layer requirements and conformance test plans. It specifies the conformance test plans for devices and systems that include functionality related with OSI layers from 7 to 5.

Figure 1 shows the parts of the ISO 21111 series and the document structure.

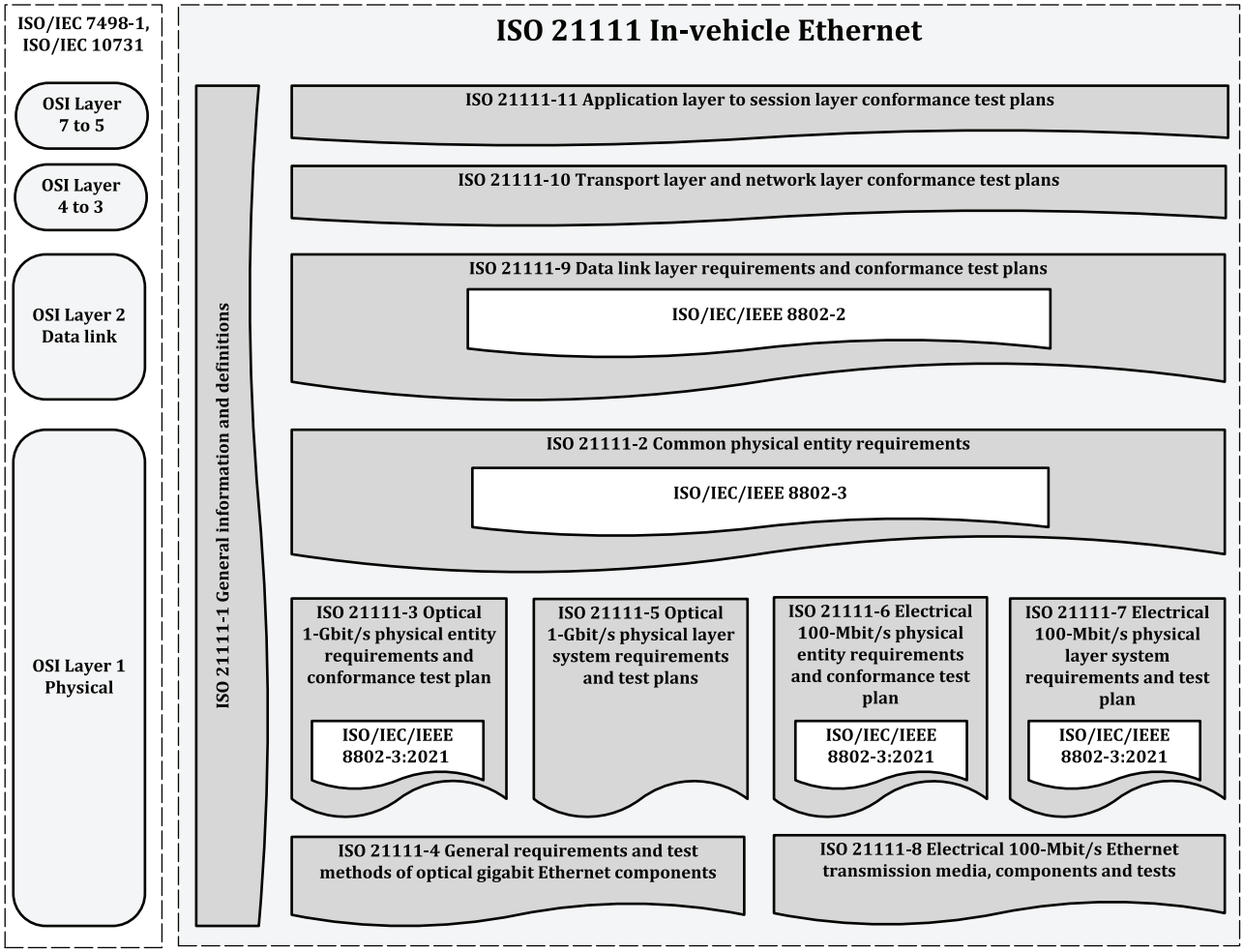

Figure 1 — In-vehicle Ethernet documents reference according to OSI model

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Road vehicles — In-vehicle Ethernet —

Part 10: Transport layer and network layer conformance test plans

1 Scope

This document specifies in-vehicle Ethernet transport layer and network layer conformance test plans (CTP) for electronic control units (ECUs). This document is a collection of all conformance test cases which are recommended to be considered for automotive use and should be referred by car manufacturers within their quality control processes.

The document includes conformance test plans for the address resolution protocol, Internet control message protocol version 4, Internet protocol version 4, Internet protocol version 4 auto configuration, user datagram protocol, transport control protocol, and dynamic host configuration protocol version 4.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 9646-1, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 1: General concepts*

ISO 21111-1, *Road vehicles — In-vehicle Ethernet — Part 1: General information and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21111-1, ISO/IEC 9646-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
REPEAT
pseudo code command for an iteration

3.2
full-sized segment
segment with size equal to the effective send MSS

3.3
result code
value attributed to a result

3.4
generic result code
specific and universal value attributed to a result

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3.5
full-window operation
IUT's TCP has reached a state where it is allowed to send data segments of size of test system Host-1's entire receive without getting any acknowledgement from the test system Host-1

4 Symbols and abbreviated terms

4.1 Symbols

—	empty table cell or feature undefined
V_{BAT}	voltage of the battery
$t_{\texttt{ARP-Dynamic-Cache-Timeout}}$	time for which a dynamic entry is present in the ARP cache
$t_{\texttt{ARP-Dynamic-Cache-Tolerance}}$	tolerance time for the ARP dynamic cache of the IUT to get refreshed
$t_{\texttt{ARP-Tolerance}}$	IUT: tolerance time for the ARP cache of the IUT to get refreshed LT: time variance associated to any wait-event
$t_{\texttt{Valid-Time-To-Live}}$	time interval of IP datagram send
$t_{\texttt{Listen-Time}}$	maximum time interval for which the LT waits for an ICMP reply segment
$t_{\texttt{Fragment-Reassemly-Timeout}}$	fragment reassembly timeout
$t_{\texttt{Valid-Time-To-Live}}$	value used in IP datagram send
$t_{\texttt{Probe_Min}}$	value of PROBE_MIN constant
$t_{\texttt{Probe_Max}}$	value of PROBE_MAX constant
$t_{\texttt{Announce_Wait}}$	value of ANNOUNCE_WAIT constant
$t_{\texttt{Announce_Interval}}$	value of ANNOUNCE_INTERVAL constant
$t_{\texttt{Rate_Limit_Interval}}$	value of RATE_LIMIT_INTERVAL constant
$t_{\texttt{Defend_Interval}}$	value of DEFEND_INTERVAL constant

4.2 Abbreviated terms

ACK	acknowlege
Addr	address
AL	application layer
ANVL	automated network validation library
ARL	address resolution lookup
ARP	address resolution protocol
ASP	abstract service primitive

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CTC	conformance test case
CTP	conformance test plan
EMC	electromagnetic compatibility
EOP	end of option
ETS	enhanced testability service
FIF	filtering of incoming frames
FIN	finish control flag
FINWAIT	finish wait
GEN	general requirements
GND	ground
ICMP	internet control message protocol
IHL	Internet header length
IUT	implementation under test
IUT-Iface	IUT physical layer interface
ISN	initial sequence number
LT	lower tester
LT-Iface	LT physical layer interface
MSL	maximum segment lifetime
MSS	maximum segment size
MTU	maximum transmission unit
Mv	manipulated value
NL	network layer
NOP	no operation
PCO	points of control and observation
PHY	physical layer
PSH	push
QOS	qualitiy of service and audio/video bridging
RCVD	received
RCV.NXT	receive next
RPC	remote procedure call
RST	reset

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RTO	retransmission timeout
SEQ	sequence
SL	session layer
SUT	system under test
SYN	synchronize control flag
SYN-RCVD	SYN received
SYN-SENT	SYN sent
TCP	transmission control protocol
TIME	time synchronisation
TL	transport layer
UDP	user datagram protocol
UT	upper tester

5 Conventions

This document is based on OSI service conventions as specified in ISO/IEC 10731 [2].

6 CTP test system set-up and CTC structure

6.1 General

This document specifies a CTP according to the requirements as specified in the ISO/IEC 9646 series. A CTP does not provide qualification of test results but expected responses of the IUT. A CTP is used by a test house to develop a conformance test specification specific for the test system used in their lab environment.

The CTCs specified in this document are organized in such a manner as to simplify the identification of information related to a test and to facilitate in the actual testing process. CTCs are organized into groups, primarily in order to reduce set-up time in the lab environment. The different groups typically also tend to focus on specific aspects of device functionality.

A CTC reference name, e.g. "ARP_03 – ARP entry learned on ARP request (no ARP request)" is used to organize the CTC name, where:

— CTC indicates that this is a conformance test case;

— name/subject of CTC;

— supplemental name, e.g. ARP, which is address resolution protocol;

— CTC number;

— after the hyphen a descriptive name of the CTC follows.

The CTC definitions themselves are intended to provide a high-level description of the purpose, references, prerequisite, steps/procedures, expected responses, remarks, and methodologies pertinent to each test (see 6.3).

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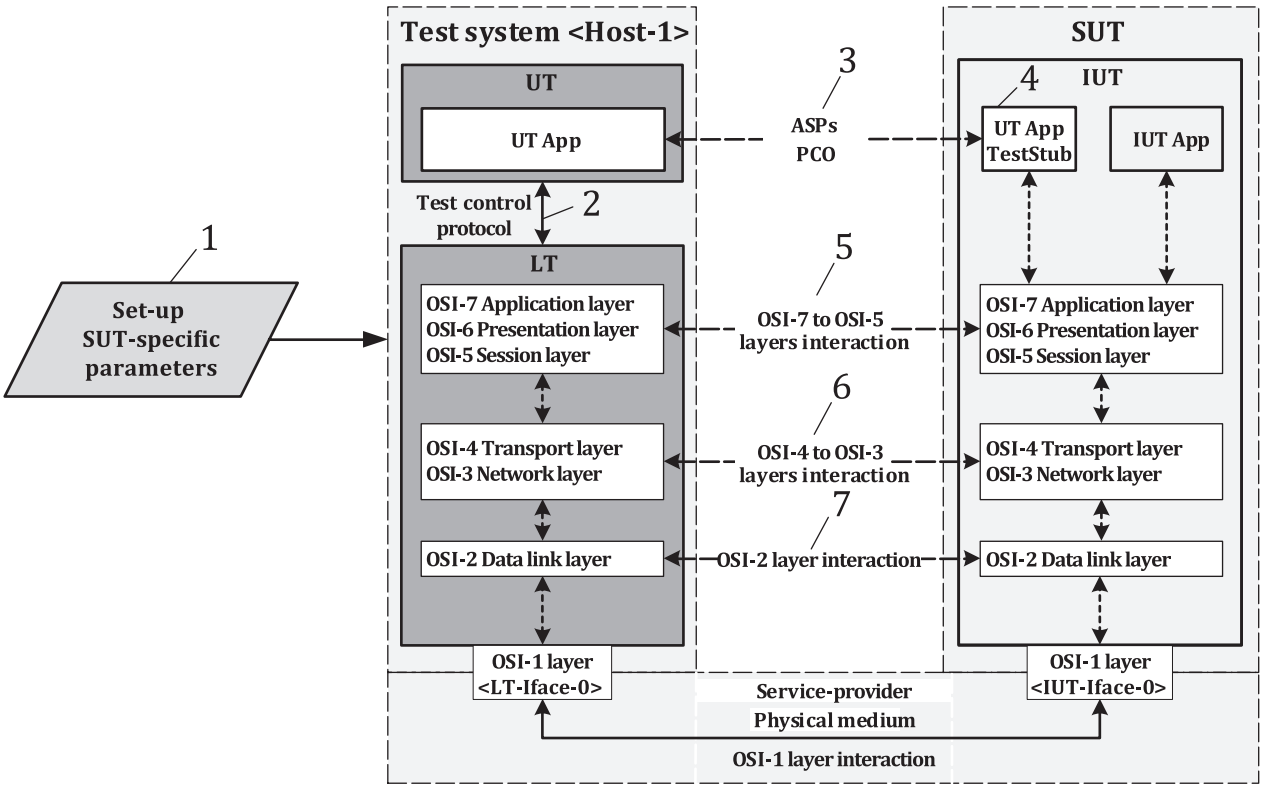
6.2 Test system set-up

The test system topology follows ISO/IEC 9646-1 and consists of a test set-up which consists of a test system and a system under test (SUT) connected via the physical medium. The test system implements a UT and an LT. The UT uses the test control protocol (Figure 2, key 2) to control the LT. The LT supports the functionality required to test the OSI layer (Figure 2, key 5, key 6, and key 7) of the IUT. The test system uses IUT-specific set-up parameters (Figure 2, key 1) for testing the communication with the IUT.

The control and measurement functionality is provided by direct logical access to the service interface (dashed line) (Figure 2, key 3) and the associated parameters of the OSI layer. The UT in the IUT (Figure 2, key 4) supports an equivalent part of the abstract service interface (ASPs, PCO) (dashed line) (Figure 2, key 3) and the associated parameters to control and measure the state(s) of the IUT.

The UT conformance test controller in the test system manipulates the service primitive interface parameters in the IUT via the ASPs (ETSs) and PCO of the OSI layers to fulfil the purpose of each CTC.



Key

1 set-up parameters (node's electronic data sheet)

2 test control protocol

3 points of control and observation (PCO) and abstract service primitives (ASPs) based on enhanced testability services (ETS)

4 UT application with ETS interface

5 OSI layer 7 to 5 protocol

6 OSI layer 4 to 3 protocol

7 OSI layer 2 protocol

Figure 2 — Test system set-up

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6.3 CTC definition

CTCs are independent of one another. Each CTC checks the behaviour of the IUT for a particular purpose of this document. CTCs, which require variations of individual parameters, shall be repeated for each value of the parameter. Each CTC is specified according to a common CTC structure as shown in Table 1.

Table 1 — CTC structure

Item	Content
CTC # – Title	CTC_x.y.z-a – CTC structure
Purpose	The purpose is a brief statement outlining what the test attempts are to achieve. The test is written at the functional level. It is recommended to begin the description of purpose with "This CTC verifies ...".
Reference	The purpose of reference is to specify source material external to the test suite, including any other references that might be helpful in understanding the test methodology and/or test results. External sources are always referenced by number when mentioned in the test description. Any other references not specified by number are stated with respect to the test suite document itself. EXAMPLE AUTOSAR SOME/IP Protocol Specification, R20-11,[13] PRS_SOMEIP_00042; PRS_SOMEIP_00099; ...
Prerequisite	The purpose of prerequisites is to specify the test hardware and/or software needed to perform the CTC. This is generally expressed in terms of minimum requirements. In some cases, specific equipment manufacturer/model information may be provided. EXAMPLE The IUT is running and offering the enhanced testability service.
Set-up	The purpose of set-up is to describe the initial configuration of the test environment. Small changes in the configuration should not be included here and are generally covered in the test procedure below. EXAMPLE The test system set-up shall be in accordance with Figure 3.
Step	The test procedure includes the test description, which contains the systematic instructions for carrying out the test. It provides a cookbook approach to testing and may be interspersed with observable results. Each test step shall have a numeric number in ascending order. 1. Configure the IUT as master or as slave. 2. Establish a valid link with the IUT. 3. Monitor the transmissions from the IUT and cause the management to request a PMA reset while simultaneously ceasing transmissions from the test system.
Iteration	The purpose of test iterations is to include test procedure definitions, which are repeated more than once. a) REPEAT step 2 to step 3 with the IUT configured as master, 1 time. b) REPEAT step 2 to step 3 with the IUT configured as slave, 1 time.
Expected response	The purpose of expected response is to describe the expected results to be examined by the test system Host-1 in order to verify that the IUT is operating. When multiple values for an observable are possible, this description provides a short discussion on how to interpret them. The determination of a pass or fail outcome for a particular test is generally based on the successful (or unsuccessful) detection of a specific observable. After iteration a): The IUT stops transmitting with tx_mode = SEND_N and starts transmitting with tx_mode = SEND_I for 1 iteration a). The IUT sets link_status = FAIL. After iteration b): The IUT stops transmitting for 1 iteration b). The IUT sets link_status = FAIL.
Remark	The purpose of remarks is to describe known issues with the test procedure, which can affect test results in certain situations. It can also refer the reader to test suite annexes and/or white papers that can provide more detail regarding these issues.

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6.4 Terminology used in CTCs

Table 2 specifies the terminology used in CTCs.

Table 2 — Terminology used in CTCs

Name	Content
Upper tester (UT)	Entity which is responsible for controlling the LT via the test control protocol and the IUT UT ETS via the abstract service primitives (ASPs).
Lower tester (LT)	Entity which is responsible for validating the implementation under test (IUT).
IUT_CONFIGURE	This entry causes the IUT to configure/execute various commands for clearing cache, adding static address, send echo request, etc.
IUT	Implementation under test in the SUT.
CLEANUP	This is a command, which causes the IUT to remove the static entry from its ARP cache.

6.5 IUT prerequisites – TCP/IP TestStub

6.5.1 General

The TCP/IP TestStub defines interfaces required to test the TCP/IP communication stack functionality.

The protocol parts covered by the TCP/IP TestStub include:

— UDP and TCP – socket connection establishment and termination;

— UDP and TCP – message transmission and reception.

The TCP/IP TestStub is specified in Reference [14] (AUTOSAR). This document references a subset of the AUTOSAR specification.

6.5.2 TCP/IP TestStub service primitives

Table 3 references *AUTOSAR Testability Protocol and Service Primitives, TC Release 1.1.0*, '6.10 Service Primitives'[14]. A subset of service primitives are supported by the UT to observe and control the TCP/IP UT TestStub in the IUT.

Table 3 provides an overview of the service primitives, the identifier, applicability and applicability of UDP and TCP.

Table 3 — TCP/IP TestStub methods (service primitives)

Method name (service primitive)	Identifier	Applicability	UDP	TCP
GET_VERSION	1_{16}	optional	—	—
START_TEST	2_{16}	mandatory	—	—
END_TEST	3_{16}	mandatory	—	—
CLOSE_SOCKET	0_{16}	—	mandatory	mandatory
CREATE_AND_BIND	1_{16}	—	mandatory	mandatory
SEND_DATA	2_{16}	—	mandatory	mandatory
RECEIVE_AND_FORWARD	3_{16}	—	mandatory	mandatory
LISTEN_AND_ACCEPT	4_{16}	—	—	mandatory
CONNECT	5_{16}	—	—	mandatory
SHUTDOWN	7_{16}	—	—	optional

Key

— empty cell/undefined

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6.5.3 Result codes

Due to different stack implementations there is no generic way to retrieve specific result codes. Only generic result codes are supported. The generic result codes of the TCP/IP TestStub methods (see Table 3) are E_OK and E_NOK.

7 Network and transport layers CTCs

7.1 NL – Address resolution protocol (ARP)

7.1.1 General

The objective of this subclause is to specify CTCs for the ARP from RFC 826:1982 [8].

7.1.2 Referenced specification

RFC 826:1982 [8] specifies an Ethernet address resolution protocol. All CTCs in 7.1 are in accordance with this RFC.

7.1.3 Test system topology – NL – ARP

Figure 3 shows the test system topology – NL – ARP.

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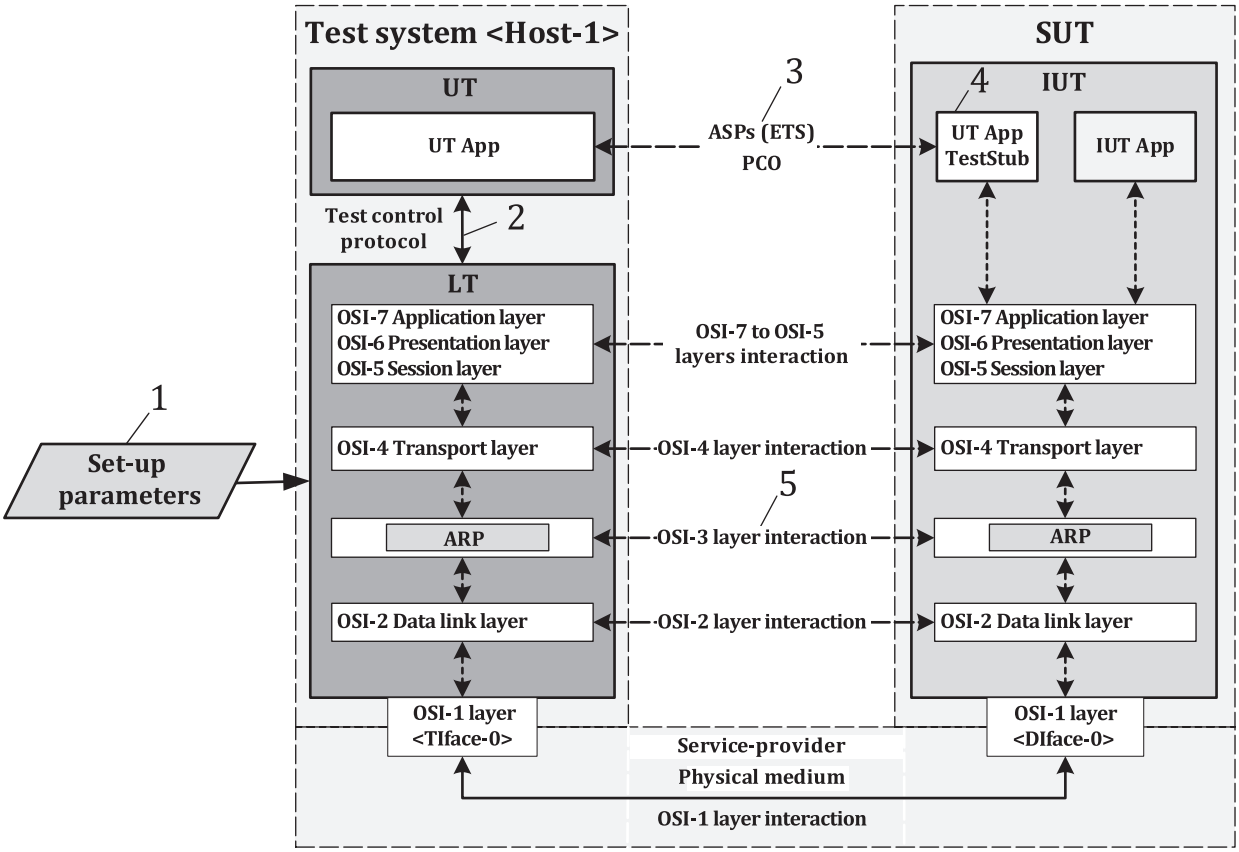

Key

1 IUT-specific set-up parameters (electronic data sheet)

2 test control protocol

3 PCO and ASPs based on ETS

4 UT TestStub application

5 OSI layer 3 ARP interaction

Figure 3 — Test system topology – NL – ARP

7.1.4 Test system topology and related CTC configuration

Test system Host-1 configuration required for the tests in the following sections pertaining to ARP tests.

— Correct IUT MAC address for the IUT interface (IUT-Iface-0) connected to LT interface (LT-Iface-0).

— All CTCs that use an IP interface need to perform ARP packet exchange. This ARP fragment exchange is performed after the IUT interface is configured with an IP address. Using this fragment exchange the LT automatically learns the MAC address of IUT. The learned MAC address is then used in the CTCs to send segments to the IUT.

— All CTCs in this conformance test plan require the IUT to be configured with only one IP interface (IUT-Iface-0).

7.1.5 CTC ARP overview

Table 4 shows the CTC ARP overview.

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Table 4 — CTC ARP overview

Specification document	Subclause number	Test category	Test number (s)
RFC 826: an Ethernet address resolution protocol, Packet generation	7.1.7.1	Packet generation	CTC_ARP_01 to CTC_ARP_15
RFC 826: an Ethernet address resolution protocol, Packet reception	7.1.7.2	Packet reception	CTC_ARP_16 to CTC_ARP_49

7.1.6 ARP parameters used in CTCs

7.1.6.1 User defined configuration parameters for IUT

The configuration parameter values are user defined. Table 5 defines the user defined configuration parameters for IUT.

Table 5 — User defined configuration parameters for IUT

Parameter used in CTCs	Content
$t_{\text{ARP-Dynamic-Cache-Timeout}}$	This is the time for which a dynamic entry is present in the ARP cache. This timeout is only effective if it has been configured using the script named ARP IUT configure ARP dynamic cache entry timeout command.
$t_{\text{ARP-Tolerance}}$	This is the tolerance time for the ARP cache of the IUT to get refreshed.
$t_{\text{ARP-Dynamic-Cache-Tolerance}}$	This is the tolerance time for the ARP dynamic cache of the IUT to get refreshed.

$t_{\text{ARP-Dynamic-Cache-Tolerance}}$ is specified in Formula (1).

$$t_{\text{ARP-Dynamic-Cache-Tolerance}} = t_{\text{ARP-Tolerance}} + t_{\text{ARP-Dynamic-Cache-Timeout}} \quad (1)$$

7.1.6.2 User defined configuration parameters for LT

The configuration set-up parameter values are user defined. Table 6 specifies the user defined configuration parameters for the LT.

Table 6 — User defined configuration parameters for LT

Parameter used in CTCs	Content
Host-1	This denotes ARP Host-1 simulated in the LT.
Host-1-IP	This denotes IP address of Host-1.
IUT-Iface-0	This denotes the IUT interface to which the LT Host-1 is connected.
IUT-Iface-0-IP	This denotes IP address of IUT-Iface-0.

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Parameter used in CTCs	Content
Param-Listen-Time	This is the maximum time interval for which the LT waits for a fragment for cases when a certain event has been triggered on the IUT either by some protocol timer or using some external mechanism.
MAC-Addr-1	The first unused MAC address that the LT can use for emulating specific topologies needed in the CTC.
MAC-Addr-2	The second unused MAC address that the LT can use for emulating specific topologies needed in test. This is auto generated as consecutive to MAC-Addr-1.
MAC-Addr-3	The third unused MAC address that the LT can use for emulating specific topologies needed in the CTC. This is auto generated as consecutive to MAC-Addr-2.
IUT-Iface-0-MAC-Addr	This is the MAC address of IUT-Iface-0 of the IUT.
Arbitrary-MAC-Addr	This indicates an arbitrary MAC address. This value is equal to 12:34:56:78:90:00.
Unknown-ARP-Hardware-Type	This indicates an unknown/wrong value of a hardware type resolution segment.
Unknown-Hardware-Addr-Len	This indicates an unknown/wrong length of a hardware address.
Unknown-ARP-Prot-Type	This indicates an unknown/wrong value of a protocol type.
Unknown-Prot-Addr-Len	This indicates an unknown/wrong length of a protocol address.
$t_{\text{ARP-Tolerance}}$	This value depicts the time variance associated to any wait-event.
Eth-Addr-Len	The length in bytes of the Ethernet MAC address that has the value 6.
Arbit-MAC-Addr	This indicates an arbitrary MAC address.
ARP-Hardware-Eth	This indicates the ARP hardware type “Ethernet” (0001_{16}).
MAC-Addr-1	MAC address 1
ARP-Hardware-Type-Unknown	This indicates an unknown ARP hardware type.
ARP-Protocol-IP	This indicates the ARP protocol type “IP” (0800_{16}).
ARP-Protocol-Unknown	This indicates an unknown ARP protocol type.
IP-First-Unused_Addr-Iface-1	This indicates an IP address that is currently not assigned to the IUT interface IUT-Iface-0.
Operation-Request	This indicates the ARP operation code “Request” (0001_{16}).
Operation-Response	This indicates the ARP operation code “Response” (0002_{16}).

7.1.7 ARP CTCs

7.1.7.1 CTC_ARP – Packet generation

Table 7 specifies the ARP_03 – ARP entry learned on ARP request (no ARP request) test case.

Table 7 — ARP_03 – ARP entry learned on ARP request (no ARP request)

Item	Content
CTC # – Title	CTC_ARP_03 – ARP entry learned on ARP request (no ARP request)
Purpose	This CTC verifies that when the LT sends an ARP request to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the UT causes the IUT to send a UDP datagram using the new ARP cache entry, the IUT does not send any ARP request.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send the ARP request to the IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — Ethernet source address set to MAC-Addr-1. 3. The LT shall wait $t_{\texttt{ARP-Tolerance}}$ second(s) for the ARP cache of the IUT to get refreshed. 4. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — ARP sender IP address set to IUT-Iface-0-IP; — ARP target IP address set to Host-1-IP. 5. The LT shall listen Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 5: The IUT shall not send an ARP request.
Remark	—

Table 8 specifies the ARP_04 – ARP entry learned on ARP request (ARP entry used).

Table 8 — ARP_04 – ARP entry learned on ARP request (ARP entry used)

Item	Content
CTC # – Title	CTC_ARP_04 – ARP entry learned on ARP request (ARP entry used)
Purpose	This CTC verifies that when the LT sends an ARP request to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the UT causes the IUT to send a UDP datagram using the new ARP cache entry, the IUT sends the expected UDP datagram.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — Ethernet source address set to MAC-Addr-1. 3. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 4. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 5. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 5: The IUT sends the UDP datagram.
Remark	—

Table 9 specifies the ARP_05 – ARP entry learned on gratuitous ARP response (no ARP request).

Table 9 — ARP_05 – ARP entry learned on gratuitous ARP response (no ARP request)

Item	Content
CTC # – Title	CTC_ARP_05 – ARP entry learned on gratuitous ARP response (no ARP request)
Purpose	This CTC verifies that when the LT sends a gratuitous ARP response to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the UT causes the IUT to send a UDP datagram using the new ARP cache entry, the IUT does not send any ARP request.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send gratuitous ARP response to IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — Ethernet source address set to MAC-Addr-1; — Ethernet destination address set to Eth-Broadcast-Addr. 3. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 4. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 5. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 5: The IUT shall not send an ARP request.
Remark	—

Table 10 specifies the ARP_06 – ARP entry learned on gratuitous ARP response (ARP entry used).

Table 10 — ARP_06 – ARP entry learned on gratuitous ARP response (ARP entry used)

Item	Content
CTC # – Title	CTC_ARP_06 – ARP entry learned on gratuitous ARP response (ARP entry used)
Purpose	This CTC verifies that when the LT sends a gratuitous ARP response to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the UT causes the IUT to send a UDP datagram using the new ARP cache entry, the IUT sends the expected UDP datagram.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send gratuitous ARP response to IUT through DIFACE-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — Ethernet source address set to MAC-Addr-1. 3. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 4. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 5. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 5: The IUT sends the UDP datagram.
Remark	—

Table 11 specifies the ARP_07 – ARP request sending (ARP request send on missing entry).

Table 11 — ARP_07 – ARP request sending (ARP request send on missing entry)

Item	Content
CTC # – Title	CTC_ARP_07 – ARP request sending (ARP request send on missing entry)
Purpose	This CTC verifies that when the UT causes the IUT to send a UDP datagram to destination IP address Host-1-IP and there is no entry related to Host-1-IP in the IUT's ARP cache, then the IUT sends as ARP request.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request.
Remark	—

Table 12 specifies the ARP_08 – ARP request sending (hardware type check).

Table 12 — ARP_08 – ARP request sending (hardware type check)

Item	Content
CTC # – Title	CTC_ARP_08 – ARP request sending (hardware type check)
Purpose	This CTC verifies that the hardware type of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation;
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT shall verify that the received ARP request contains the hardware type set to ARP-Hardware-Eth.
Remark	—

Table 13 specifies the ARP_09 – ARP request sending (protocol type check).

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Table 13 — ARP_09 – ARP request sending (protocol type check)

Item	Content
CTC # – Title	CTC_ARP_09 – ARP request sending (protocol type check)
Purpose	This CTC verifies that the protocol type of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT shall verify that the received ARP request contains the protocol type set to ARP-Protocol-IP.
Remark	—

Table 14 specifies the ARP_10 – ARP request sending (hardware address length check).

Table 14 — ARP_10 – ARP request sending (hardware address length check)

Item	Content
CTC # – Title	CTC_ARP_10 – ARP request sending (hardware address length check)
Purpose	This CTC verifies that the hardware address length of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT shall verify that the received ARP request contains the hardware address length set to Eth-Addr-Len.
Remark	—

Table 15 specifies the ARP_11 – ARP request sending (protocol address length check).

Table 15 — ARP_11 – ARP request sending (protocol address length check)

Item	Content
CTC # – Title	CTC_ARP_11 – ARP request sending (protocol address length check)
Purpose	This CTC verifies that the protocol address length of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT shall verify that the received ARP request contains the protocol address length set to IP_ADDR_LEN.
Remark	—

Table 16 specifies the ARP_12 – ARP request sending (operation code check).

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Table 16 — ARP_12 – ARP request sending (operation code check)

Item	Content
CTC # – Title	CTC_ARP_12 – ARP request sending (operation code check)
Purpose	This CTC verifies that the operation code of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation;
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT verifies that the received ARP request contains the operation code set to Operation-Request.
Remark	—

Table 17 specifies the ARP_13 – ARP request sending (ARP sender hardware address check).

Table 17 — ARP_13 – ARP request sending (ARP sender hardware address check)

Item	Content
CTC # – Title	CTC_ARP_13 – ARP request sending (ARP sender hardware address check)
Purpose	This CTC verifies that the sender hardware address of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation;
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT verifies that the received ARP request contains the ARP sender hardware address set to IUT-Iface-0-MAC-Addr.
Remark	—

Table 18 specifies the ARP_14 – ARP request sending (sender IP address check).

Table 18 — ARP_14 – ARP request sending (sender IP address check)

Item	Content
CTC # – Title	CTC_ARP_14 – ARP request sending (sender IP address check)
Purpose	This CTC verifies that the sender IP address of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT verifies that the received ARP request contains the sender IP address set to IUT-Iface-0-IP.
Remark	—

Table 19 specifies the ARP_15 – ARP request sending (target IP address correct).

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Table 19 — ARP_15 – ARP request sending (target IP address correct)

Item	Content
CTC # – Title	CTC_ARP_15 – ARP request sending (target IP address correct)
Purpose	This CTC verifies that the target IP address of ARP request packets sent by the IUT is set correctly.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 3: The LT verifies that the received ARP request contains the target IP address set to Host-1-IP.
Remark	—

7.1.7.2 CTC_ARP – Packet reception

Table 20 specifies the ARP_16 – ARP request reception (ARP target hardware address = 00:00:00:00:00:00) test case.

Table 20 — ARP_16 – ARP request reception (ARP target hardware address = 00:00:00:00:00:00)

Item	Content
CTC # – Title	CTC_ARP_16 – ARP request reception (ARP target hardware address = 00:00:00:00:00:00)
Purpose	This CTC verifies that when the LT sends an ARP request with ARP target hardware address set to all zeroes to the IUT, then the IUT sends an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP target hardware address set to all-zeroes. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 2: The IUT sends an ARP response.
Remark	—

Table 21 specifies the ARP_17 – ARP request reception (ARP target hardware address = FF:FF:FF:FF:FF:FF:FF in hexadecimal format).

Table 21 — ARP_17 – ARP request reception (ARP target hardware address = ff:ff:ff:ff:ff:ff:ff)

Item	Content
CTC # – Title	CTC_ARP_17 – ARP request reception (ARP target hardware address = ff:ff:ff:ff:ff:ff:ff)
Purpose	This CTC verifies that when the LT sends an ARP request with ARP target hardware address set to Ethernet Broadcast address, then the IUT sends an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP target hardware address set to Eth-Broadcast-Addr. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 2: The IUT sends an ARP response.
Remark	—

Table 22 specifies the ARP_18 – ARP request reception (ARP target hardware address = random).

Table 22 — ARP_18 – ARP request reception (ARP target hardware address = random)

Item	Content
CTC # – Title	CTC_ARP_18 – ARP request reception (ARP target hardware address = random)
Purpose	This CTC verifies that when the LT sends an ARP request with the ARP target hardware address set to an arbitrary value, then the IUT sends an ARP response.

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Item	Content
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP target hardware address set to Arbit-MAC-Addr. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 2: The IUT sends an ARP response.
Remark	—

Table 23 specifies the ARP_19 – ARP request reception (ARP target hardware address = address of IUT).

Table 23 — ARP_19 – ARP request reception (ARP target hardware address = address of IUT)

Item	Content
CTC # – Title	CTC_ARP_19 – ARP request reception (ARP target hardware address = address of IUT)
Purpose	This CTC verifies that when the LT sends an ARP request with the ARP target hardware address set to the IUT MAC address and Ethernet destination address set to the Ethernet broadcast address, then the IUT sends an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP target hardware address set to IUT-Iface-0-MAC-Addr; — Ethernet destination address set to Eth-Broadcast-Addr. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 2: The IUT sends an ARP response.
Remark	—

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Table 24 specifies the ARP_20 – ARP request reception (hardware type correct).

Table 24 — ARP_20 – ARP request reception (hardware type correct)

Item	Content
CTC # – Title	CTC_ARP_20 – ARP request reception (hardware type correct)
Purpose	This CTC verifies that when the LT sends an ARP request with the hardware type set to Ethernet, then the IUT sends an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP hardware type set to ARP-Hardware-Eth; — Ethernet source address set to MAC-Addr-1. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP response.
Remark	—

Table 25 specifies the ARP_21 – ARP request reception (hardware type wrong).

Table 25 — ARP_21 – ARP request reception (hardware type wrong)

Item	Content
CTC # – Title	CTC_ARP_21 – ARP request reception (hardware type wrong)
Purpose	This CTC verifies that when the LT sends an ARP request with the hardware type set to ARP-Hardware-Type-Unknown, then the IUT does not send an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP hardware type set to ARP-Hardware-Type-Unknown. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT does not send an ARP response.
Remark	—

Table 26 specifies the ARP_22 – ARP response reception (hardware type wrong).

Table 26 — ARP_22 – ARP response reception (hardware type wrong)

Item	Content
CTC # – Title	CTC_ARP_22 – ARP response reception (hardware type wrong)
Purpose	This CTC verifies that when the LT sends a gratuitous ARP response to the IUT with the hardware type field set ARP-Hardware-Type-Unknown, an entry of Host-1-IP, MAC-Addr-1 does not get added to the IUT's ARP cache. When the UT causes the IUT to send a UDP datagram with destination IP address set to Host-1-IP, the IUT sends an ARP request.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP response to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP hardware type set to ARP-Hardware-Type-Unknown; — ARP sender hardware address set to MAC-Addr-1; — ARP target hardware address set to Eth-Broadcast-Addr. 3. The test system Host-1 shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 4. The UT shall configure the IUT to send a UDP datagram from of IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 5. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 5: The IUT sends an ARP request.
Remark	—

Table 27 specifies the ARP_26 – ARP request reception (protocol type correct).

Table 27 — ARP_26 – ARP request reception (protocol type correct)

Item	Content
CTC # – Title	CTC_ARP_26 – ARP request reception (protocol type correct)
Purpose	This CTC verifies that when the LT sends an ARP request with the protocol type field set to type IP, then the IUT sends an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP protocol type set to ARP-Protocol-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP response.
Remark	—

Table 28 specifies the ARP_27 – ARP request reception (protocol type wrong).

Table 28 — ARP_27 – ARP request reception (protocol type wrong)

Item	Content
CTC # – Title	CTC_ARP_27 – ARP request reception (protocol type wrong)
Purpose	This CTC verifies that when the LT sends an ARP request with the protocol type field set to an unknown protocol type value, then the IUT does not send an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP protocol type set to ARP-Protocol-Unknown. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT does not send an ARP response.
Remark	—

Table 29 specifies the ARP_28 – ARP response reception (protocol type wrong).

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Table 29 — ARP_28 – ARP response reception (protocol type wrong)

Item	Content
CTC # – Title	CTC_ARP_28 – ARP response reception (protocol type wrong)
Purpose	This CTC verifies that the UT configures the IUT to clear its ARP cache entries. The LT then sends an ARP response with the protocol type field set to an unknown protocol value. All the other fields in the ARP response fragment are set to their correct values. The UT then causes the IUT to send an ICMP echo request and the LT expects that the IUT sends an ARP request. This CTC verifies that when the LT sends a gratuitous ARP response to the IUT with the protocol type field set to an unknown protocol value, an entry of Host-1-IP, MAC-Addr-1 does not get added to the IUT's ARP cache. When the UT causes the IUT to send a UDP datagram with destination IP address set to Host-1-IP, the IUT sends an ARP request.
Reference	RFC 826:1982, [8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP response to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP protocol type set to ARP-Protocol-Unknown; — ARP sender hardware address set to MAC-Addr-1; — ARP target hardware address set to Eth-Broadcast-Addr. 3. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 4. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 5. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 5: The IUT sends an ARP request.
Remark	—

Table 30 specifies the ARP_32 – ARP entry update (request/request).

Table 30 — ARP_32 – ARP entry update (request/request)

Item	Content
CTC # – Title	CTC_ARP_32 – ARP entry update (request/request)

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Item	Content
Purpose	This CTC verifies that when the LT sends an ARP request to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the LT then sends another ARP request to the IUT with ARP sender hardware address set to MAC-Addr-2, the ARP cache gets updated.
Reference	RFC 826:1982, [8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-1. 3. The LT shall send ARP request to IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-2; — Ethernet source address set to MAC-Addr-2. 4. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 5. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 6. The LT shall listen up to Param-Listen-Time on LT-Iface-0 with: — destination IP address set to Host-1-IP; — Ethernet destination address set to MAC-Addr-2.
Iteration	Not applicable
Expected response	After step 6: The sends the UDP datagram.
Remark	—

Table 31 specifies the ARP_33 – ARP entry update (response/response).

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Table 31 — ARP_33 – ARP entry update (response/response)

Item	Content
CTC # – Title	CTC_ARP_33 – ARP entry update (response/response)
Purpose	This CTC verifies that when the LT sends an ARP response to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the LT then sends another ARP response to the IUT with ARP sender hardware address set to MAC-Addr-2, the ARP cache gets updated.
Reference	RFC 826:1982, [8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP response to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-1; — ARP target hardware address set to Eth-Broadcast-Addr. 3. The LT shall send ARP response to IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-2; — ARP target hardware address set to Eth-Broadcast-Addr. 4. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 5. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 6. The LT shall listen up to Param-Listen-Time on LT-Iface-0 with: — destination IP address set to Host-1-IP; — Ethernet destination address set to MAC-Addr-2.
Iteration	Not applicable
Expected response	After step 6: The IUT sends the UDP datagram.
Remark	—

Table 32 specifies the ARP_34 – ARP entry update (request/response).

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Table 32 — ARP_34 – ARP entry update (request/response)

Item	Content
CTC # – Title	CTC_ARP_34 – ARP entry update (request/response)
Purpose	This CTC verifies that when the LT sends an ARP request to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the LT then sends an ARP response to the IUT with ARP sender hardware address set to MAC-Addr-2, the ARP cache gets updated.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-1. 3. The LT shall send ARP response to IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-2; — ARP target hardware address set to Eth-Broadcast-Addr. 4. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 5. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 6. The LT shall listen up to Param-Listen-Time on LT-Iface-0 with: — destination IP address set to Host-1-IP; — Ethernet destination address set to MAC-Addr-2.
Iteration	Not applicable
Expected response	After step 6: The IUT sends the UDP datagram.
Remark	—

Table 33 specifies the ARP_35 – ARP entry update (response/request).

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Table 33 — ARP_35 – ARP entry update (response/request)

Item	Content
CTC # – Title	CTC_ARP_35 – ARP entry update (response/request)
Purpose	This CTC verifies that when the LT sends an ARP response to the IUT, an entry of Host-1-IP, MAC-Addr-1 gets added to the IUT's ARP cache. When the LT then sends an ARP request to the IUT with ARP sender hardware address set to MAC-Addr-2, the ARP cache gets updated.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP response to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-1; — ARP target hardware address set to Eth-Broadcast-Addr. 3. The LT shall send ARP request to IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-2. 4. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 5. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 6. The LT shall listen up to Param-Listen-Time on LT-Iface-0 with; — destination IP address set to Host-1-IP; — Ethernet destination address set to MAC-Addr-2.
Iteration	Not applicable
Expected response	After step 6: The IUT sends the UDP datagram.
Remark	—

Table 34 specifies the ARP_36 – ARP request reception (target protocol address correct).

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Table 34 — ARP_36 – ARP request reception (target protocol address correct)

Item	Content
CTC # – Title	CTC_ARP_36 – ARP request reception (target protocol address correct)
Purpose	This CTC verifies that when the LT sends an ARP request with target protocol address field set to IUT-Iface-0-IP, then the IUT sends an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The sends an ARP response.
Remark	—

Table 35 specifies the ARP_37 – ARP request reception (target protocol address wrong).

Table 35 — ARP_37 – ARP request reception (target protocol address wrong)

Item	Content
CTC # – Title	CTC_ARP_37 – ARP request reception (target protocol address wrong)
Purpose	This CTC verifies that when the LT sends an ARP request with the the target protocol address field set IP-First-Unused_Addr-Iface-1, then the IUT does not send an ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IP-First-Unused_Addr-Iface-1. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT does not send an ARP response.
Remark	—

Table 36 specifies the ARP_38 – ARP response reception (target protocol address wrong).

Table 36 — ARP_38 – ARP response reception (target protocol address wrong)

Item	Content
CTC # – Title	CTC_ARP_38 – ARP response reception (target protocol address wrong)
Purpose	This CTC verifies that when the LT sends an ARP response to the IUT with the target IP address set to IP-First-Unused_Addr-Iface-1, an entry of Host-1-IP, MAC-Addr-1 does not get added to the IUT's ARP cache. When the UT causes the IUT to send a UDP datagram with destination IP address set to Host-1-IP, the IUT sends an ARP request.
Reference	RFC 826:1982, [8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP response to IUT though IUT-Iface-0 containing: — ARP source IP address set to Host-1-IP; — ARP target IP address set to IP-First-Unused_Addr-Iface-1; — Ethernet source address set to MAC-Addr-1; — Ethernet destination address set to Eth-Broadcast-Addr. 3. The LT shall wait up to (1) second(s) for the ARP cache of IUT to get refreshed. 4. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 5. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 5: The IUT sends an ARP request.
Remark	—

Table 37 specifies the ARP_39 – ARP learning (request answers request).

Table 37 — ARP_39 – ARP learning (request answers request)

Item	Content
CTC # – Title	CTC_ARP_39 – ARP learning (request answers request)
Purpose	This CTC verifies that when the IUT sends an ARP request and the LT also sends an ARP request in return, then the IUT creates an ARP cache entry for the sender IP address and sender hardware address of the LT's ARP request.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP.1. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0. 4. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-2. 5. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 6. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 7. The LT shall listen up to Param-Listen-Time on LT-Iface-0 with: — destination IP address set to Host-1-IP; — Ethernet destination address set to MAC-Addr-2.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 7: The IUT sends the UDP datagram.
Remark	—

Table 38 specifies the ARP_40 – ARP learning (response answers request).

Table 38 — ARP_40 – ARP learning (response answers request)

Item	Content
CTC # – Title	CTC_ARP_40 – ARP learning (response answers request)
Purpose	This CTC verifies that when the IUT sends an ARP request and the LT sends an ARP response in return, then the IUT creates an ARP cache entry for the sender IP address and sender hardware address of the LT's ARP response.
Reference	RFC 826:1982, [8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. IUT CONFIGURE: Configure IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address which shall be set to IUT-Iface-0-IP; — destination IP address which shall be set to Host-1-IP. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0. 4. The LT shall send ARP response to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-3; — ARP target hardware address set to Eth-Broadcast-Addr. 5. The LT shall wait up to $t_{\text{ARP-Tolerance}}$ second(s) for the ARP cache of IUT to get refreshed. 6. The UT shall configure the IUT to send a UDP datagram from IUT-Iface-0 with: — source IP address set to IUT-Iface-0-IP; — destination IP address set to Host-1-IP. 7. The LT shall listen up to Param-Listen-Time on LT-Iface-0 with: — destination IP address set to Host-1-IP; — Ethernet destination address set to MAC-Addr-3.
Iteration	Not applicable
Expected response	After step 3: The IUT sends an ARP request. After step 7: The IUT sends the UDP datagram.
Remark	—

Table 39 specifies the ARP_41 – ARP responding (response answers request).

Table 39 — ARP_41 – ARP responding (response answers request)

Item	Content
CTC # – Title	CTC_ARP_41 – ARP responding (response answers request)
Purpose	This CTC verifies that when the LT sends an ARP request, then the IUT sends an ARP response with the operation code field set to response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.

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Item	Content
Step	1. The LT shall send an ARP request to the IUT through the IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-1. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0 with: — for ARP packet with operation code set to response.
Iteration	Not applicable
Expected response	After step 2: The IUT sends the ARP response.
Remark	—

Table 40 specifies the ARP_42 – ARP responding (no response to response).

Table 40 — ARP_42 – ARP responding (no response to response)

Item	Content
CTC # – Title	CTC_ARP_42 – ARP responding (no response to response)
Purpose	This CTC verifies that when the LT sends an ARP packet with the opcode field set to Operation-Response, then the IUT does not send any ARP response.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The LT shall send ARP response to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — operation code set to Operation-Response. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 2: The IUT does not send an ARP response.
Remark	—

Table 41 specifies the ARP_43 – ARP response (Ethernet source hardware address check).

Table 41 — ARP_43 – ARP response (Ethernet source hardware address check)

Item	Content
CTC # – Title	CTC_ARP_43 – ARP response (Ethernet source hardware address check)
Purpose	This CTC verifies that when the LT sends an ARP request, the IUT sends an ARP response with Ethernet source hardware address set to IUT-Iface-0-MAC-Addr.

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Item	Content
Reference	RFC 826:1982, [8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — source IP address set to Host-1-IP; — destination IP address set to IUT-Iface-0-IP. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 2: The IUT sends the ARP response. After step 2: The LT verifies that the received ARP response contains the Ethernet source hardware address set to IUT-Iface-0-MAC-Addr.
Remark	—

Table 42 specifies the ARP_44 – ARP response (sender IP address check).

Table 42 — ARP_44 – ARP response (sender IP address check)

Item	Content
CTC # – Title	CTC_ARP_44 – ARP response (sender IP address check)
Purpose	This CTC verifies that when the LT sends an ARP request, the IUT sends an ARP response with sender IP address set to IUT-Iface-0-IP.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-1. 2. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 2: The IUT sends the ARP response. After step 2: The LT verifies that the received ARP response contains the sender IP address set to IUT-Iface-0-IP.
Remark	—

Table 43 specifies the ARP_45 – ARP response (ARP target hardware address check).

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Table 43 — ARP_45 – ARP response (ARP target hardware address check)

Item	Content
CTC # – Title	CTC_ARP_45 – ARP response (ARP target hardware address check)
Purpose	This CTC verifies that when the LT sends an ARP request, the IUT sends an ARP response with ARP target hardware address set to ARP sender hardware address of the LT's ARP request.
Reference	RFC 826:1982,[8] Packet generation
Prerequisite	The IUT shall be powered on and shall be linked-up with the test system. The IUT shall implement the TCP/IP TestStub in accordance with 6.5. The IUT shall be running and the TCP/IP TestStub shall be active.
Set-up	The test system set-up shall be in accordance with Figure 3. The test system shall be parameterized in accordance with the configuration set-up parameters as specified in 7.1.6.1 and 7.1.6.2.
Step	1. The UT shall configure the IUT to clear the dynamic entries in the ARP cache of IUT-Iface-0 containing: — IP address Host-1-IP. 2. The LT shall send ARP request to IUT though IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-1. 3. The LT shall listen up to Param-Listen-Time on LT-Iface-0. 4. The LT shall send ARP request to IUT through IUT-Iface-0 containing: — ARP sender IP address set to Host-1-IP; — ARP target IP address set to IUT-Iface-0-IP; — ARP sender hardware address set to MAC-Addr-2. 5. The LT shall listen up to Param-Listen-Time on LT-Iface-0.
Iteration	Not applicable
Expected response	After step 3: The IUT sends the ARP response. After step 3: The LT verifies that the received ARP response contains the ARP target hardware address set to MAC-Addr-1. After step 5: The IUT sends the ARP response. After step 5: The LT verifies that the received ARP response contains the ARP target hardware address set to MAC-Addr-2.
Remark	—

Table 44 specifies the ARP_46 – ARP response (hardware type check).

Table 44 — ARP_46 – ARP response (hardware type check)

Item	Content
CTC # – Title	CTC_ARP_46 – ARP response (hardware type check)
Purpose	This CTC verifies that when the LT sends an ARP request, the IUT sends an ARP response with hardware type set to ARP-Hardware-Eth.
Reference	RFC 826:1982,[8] Packet generation

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