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Technical Specification

Methods for Testing and Specification (MTS);
Internet Protocol Testing (IPT): IPv6 Core Protocol;
Interoperability Test Suite (ITS)

Reference

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Methods for Testing and Specification (MTS).

1 Scope

The present document specifies the interoperability Test Descriptions (TDs) with integrated Test Purposes (TPs) for the IPv6 Core standards. The TDs are presented in the tabular form specified in TS 102 424 [1] and the TPs are defined using the TPLan notation also described in TS 102 424 [1]. The Test Suite Structure is based on the IETF RFCs which, together, form the IPv6 Core specification and is reflected in the use of "Group/End Group" statements in the TPLan code presented in annex A.

2 References

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ETSI TS 102 424 (2005): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Requirements of the NGN network to support Emergency Communication from Citizen to Authority".

[2] IETF RFC 1981: "Path MTU Discovery for IP version 6".

[3] IETF RFC 2460: "Internet Protocol, Version 6 (IPv6) Specification".

[4] IETF RFC 2461: "Neighbor Discovery for IP Version 6 (IPv6)".

[5] IETF RFC 2462: "IPv6 Stateless Address Autoconfiguration".

[6] IETF RFC 2463: "Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification".

[7] IETF RFC 2675: "IPv6 Jumbograms".

[8] IETF RFC 3513: "Internet Protocol Version 6 (IPv6) Addressing Architecture".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

EUT	Equipment Under Test
HS	Host
i/f	interface
LL	Link Local
M/cast	Multicast
MTU	Maximum Transmission Unit
PMTU	Path MTU
QE	Qualified Equipment
RT	RouTer
SL	Site Local
TP	Test Purpose
TD	Test Description
TPLan	Test Purpose Language
TSS	Test Suite Structure

4 IPv6 Core Interoperability Test Specification

4.1 Introduction

The IPv6 Core Interoperability Test Descriptions (TDs) defined in the following clauses are derived from the Test Purposes (TPs) specified in annex A.

4.2 Test Descriptions

4.2.1 Group 1 RFC 2460

4.2.1.1 Group 1.2 Process IPv6 Packet

4.2.1.1.1 Group 1.2.4 Process IPv6 Header

4.2.1.1.1.1 Group 1.2.4.4 Process Hop Limit

Test Description			
Identifier:	TD_COR_1002_01	**Test Purpose:**	TP_COR_1002_01
Summary:	EUT decreases the Hop Limit field of a traversed IPv6 packet and forwards it		
Roles:	Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1002		

```
with { QE1 'configured with a unique global unicast address '
   and QE2 'configured with a unique global unicast address'
   and EUT 'configured with two unique global unicast addresses on the link
            connecting QE1 and EUT, and the link connecting QE2 and EUT, respectively' }

ensure that {
   when { EUT receives 'a packet'
            containing 'QE1 as source address and QE2 as destination address'
        and containing  'Hop Limit > 1' }
   then { EUT sends 'the packet with the Hop Limit decremented' to QE2 }
        }
```

Pre-test conditions:	EUT established as the default router for QE1		
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
1	Cause QE1 to send an Echo Request with QE2 identified as the destination and hop limit larger than 1		
2	Check: Does protocol monitor on link2 show that the Echo Request was sent from QE1 to QE2, with a decremented hop limit?	Yes	No
3	Check: Does QE1 receive an Echo Reply from QE2?	Yes	No
Observations:			

Test Description			
Identifier:	TD_COR_1002_02	**Test Purpose:**	TP_COR_1002_02
Summary:	EUT drops a traversed IPv6 packets with a zero Hop Limit and returns an ICMP error message to the source		
Roles:	Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1002		

```
with { QE1 'configured with a unique global unicast address '
   and QE2 'configured with a unique global unicast address'
   and EUT 'configured with two unique global unicast addresses on the link
            connecting QE1 and EUT, and on the link connecting QE2 and EUT, respectively' }

ensure that {
   when { EUT receives 'a packet'
            containing 'QE1 as source address and QE2 as destination address'
        and containing 'Hop Limit = 0' }
   then { EUT discards 'the packet'
   and EUT sends 'an ICMP error message' to QE1 }
        }
```

Pre-test conditions:	EUT established as the default router for QE1		
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
1	Cause QE1 to send an Echo Request with QE2 identified as the destination and hop limit of 1		
2	Check: Does the protocol monitor on link2 show that the Echo Request was sent from QE1 to QE2?	No	Yes
3	Check: Does the protocol monitor on link1 show that an ICMP error message was sent from EUT to QE1?	Yes	No
Observations:			

Test Description			
Identifier:	TD_COR_1058_01	**Test Purpose:**	TP_COR_1058_01
Summary:	Discard packets if Hop Limit ≤ 1		
Roles:	Host, Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1058		

```
ensure that {
   when { QE1 is requested to 'send a packet to QE2'
                   containing 'Routing header Type = 0'
              and containing 'Segments Left value other than zero'
              and containing 'Segments Left value not greater than the number of addresses
                              in the Routing header'
              and containing 'an even "Hdr Ext Len" value'
          and not containing 'multicast address as next address to be visited or IPv6 Destination'
              and containing 'IPv6 hop limit ≤ 1'
              and containing 'EUT as next routing hop' }
   then { EUT sends 'ICMP "Time Exceeded" error message' to QE1
      and EUT discards 'the packet' }
            }
```

Pre-test conditions:	EUT established as the default router for QE1		
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
1	Cause QE1 to send an Echo Request with the following properties: - hop limit =1 - type 0 routing header - EUT as next routing hop - QE2 as final destination		
2	Check: Does the protocol monitor on link2 show that the Echo Request was sent from QE1 to QE2?	No	Yes
3	Check: Does the protocol monitor on link1 show that an ICMP 'Time Exceeded' error message was sent from EUT to QE1?	Yes	No
Observations:	A QE cannot send out any message with hop limit = 0, thus hop limit = 1 is chosen for this test.		

Test Description			
Identifier:	TD_COR_1059_01	**Test Purpose:**	TP_COR_1059_01
Summary:	Process packets if Hop Limit > 1		
Roles:	Host, Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1059		

```
ensure that {
   when { QE1 is requested to 'send a packet to QE2'
                   containing 'Routing header Type = 0'
               and containing 'Segments Left value other than zero'
               and containing 'Segments Left value not greater than the number of addresses in
                               the Routing header'
               and containing 'an even "Hdr Ext Len" value'
           and not containing 'multicast address as next address to be visited or IPv6 Destination'
               and containing 'IPv6 hop limit > 1'
               and containing 'EUT as next routing hop' }
   then { EUT sends 'the packet to QE2' }
            }
```

Pre-test conditions:	EUT established as the default router for QE1		
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
1	Cause QE1 to send an Echo Request with the following properties: - hop limit >1 - type 0 routing header - EUT as next routing hop - QE2 as final destination		
2	Check: Does the protocol monitor on link2 show that the Echo Request was sent from QE1 to QE2?	Yes	No
Observations:			

4.2.1.1.2 Group 1.2.6 Process Flow Label

Test Description			
Identifier:	TD_COR_1130_01	**Test Purpose:**	TP_COR_1130_01
Summary:	EUT detects two packets with different hop-by-hop option contents but the same source and destination addresses and the same flow label		
Roles:	Host, Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1130		

```
with { QE1 'configured with a unique global unicast address '
   and QE2 'configured with a unique global unicast address'
   and EUT 'configured with two unique global unicast addresses on the link connecting QE1 and
            EUT and, the link connecting QE2 and EUT, respectively' }

ensure that {
   when { EUT receives 'two packets'
            containing 'QE1 as source address and QE2 as destination address'
        and containing 'a same flow label'
        and containing 'different hop-by-hop options' }
   then { EUT sends 'an ICMP parameter problem message' to QE1
   and EUT discards 'the packets' }
            }
```

Pre-test conditions:			
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
Observations:	This IOP test is practically impossible. One router cannot guarantee the arrival and processing of two different packets at same time.		

Test Description			
Identifier:	TD_COR_1130_02	**Test Purpose:**	TP_COR_1130_02
Summary:	EUT detects two packets with different routing header contents but the same source and destination addresses and the same flow label		
Roles:	Host, Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1130		

```
with { QE1 'configured with a unique global unicast address '
   and QE2 'configured with a unique global unicast address'
   and EUT 'configured with two unique global unicast addresses on the link connecting QE1 and
            EUT and, the link connecting QE2 and EUT, respectively' }

ensure that {
   when { EUT receives 'two packets'
            containing 'QE1 as source address and QE2 as destination address'
        and containing 'a same flow label'
        and containing 'different hop-by-hop options' }
   then { EUT sends 'an ICMP parameter problem message' to QE1
   and EUT discards 'the packets'}
            }
```

Pre-test conditions:			
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
Observations:	This IOP test is practically impossible. One router cannot guarantee the arrival and processing of two different packets at same time.		

4.2.1.2 Group 1.4 Extension Headers

4.2.1.2.1 Group 1.4.2 Process Extension Headers

Test Description			
Identifier:	TD_COR_1004_01	**Test Purpose:**	TP_COR_1004_01
Summary:	EUT does NOT process (modify) a Routing Header contained in a packet NOT destined for the EUT		
Roles:	Host, Router	**Configuration:**	CF_CORE_31
References:	RQ_000_1004		

```
with { QE1 'configured with a unique non link-local unicast address'
   and QE2 'configured as a router with a unique non link-local unicast address'
   and QE3 'configured with a unique non link-local unicast address'
   and EUT 'configured with one unique non link-local unicast address on each link'
   and EUT 'established as the default Router for QE1' }

ensure that {
   when { EUT receives 'a packet' from QE1
            containing 'an indication that QE2 is the destination'
        and containing 'a Routing Header'
            indicating 'QE2 as the first node to process the Routing Header
                        and QE3 as the final destination of the packet' }
   then { EUT 'forwards the packet, with the Routing Header UNMODIFIED' to QE2}
            }
```

Pre-test conditions:	QE2 is configured as a Router EUT established as the default router for QE1		
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
1	Cause QE1 to send an Echo Request with QE3 identified as the final destination, QE2 as an intermediate hop and normal routing tables bypassed (ping6 -r QE2 QE3)		
2	Check: Does protocol monitor show that the Echo Request was sent from QE1 to QE3?	Yes	No
3	Check: Does QE1 receive an Echo Reply fromQE3?	Yes	No
Observations:			

Test Description			
Identifier:	TD_COR_1004_02	**Test Purpose:**	TP_COR_1004_02
Summary:	EUT does NOT process(remove) a Fragmentation Header contained in a packet NOT destined for the EUT		
Roles:	Host, Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1004		

```
with { QE1 'configured with a non link-local unicast address'
   and EUT 'configured with a unique non link-local unicast address on each link' }

ensure that {
   when { EUT receives 'a packet' from QE1
            containing 'an indication that QE2 is the destination'
        and containing 'a Fragmentation Header' }
   then { EUT 'forwards the packet with its Fragmentation Header' to QE2 }
            }
```

Pre-test conditions:			
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
Observations:			

Test Description			
Identifier:	TD_COR_1004_03	**Test Purpose:**	TP_COR_1004_03
Summary:	EUT does NOT process(modify or remove) a Destination Options Header in a packet NOT destined for the EUT		
Roles:	Host, Router	**Configuration:**	CF_CORE_31
References:	RQ_000_1004		

```
with { QE1 'configured with a unique non link-local unicast address'
   and QE2 'configured as a router with a unique non link-local unicast address'
   and QE3 'configured with a unique global unicast address'
   and EUT 'configured with a unique non link-local unicast address on each link' }

ensure that {
   when { EUT receives 'a packet' from QE1
            containing 'an indication that QE2 is the destination'
        and containing 'a Destination Options Header' }
   then { EUT 'forwards the packet, with the Destination Options Header UNMODIFIED'
             to QE2 }
            }
```

Pre-test conditions:			
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
Observations:	In an interoperability testing environment it is almost (if not totally) impossible to reproduce the conditions that would reliably cause the Destination Options Header to be used.		

Test Description			
Identifier:	TD_COR_1005_01	**Test Purpose:**	TP_COR_1005_01
Summary:	EUT processes a Destination Options Header contained in a packet destined for the EUT		
Roles:	Host, Router	**Configuration:**	CF_CORE_11
References:	RQ_000_1005		

```
with { QE  'configured with a unique link-local address'
   and EUT 'configured with a unique link-local address' }

ensure that {
   when { EUT receives 'fragment packets of a Request that requires a Reply' from QE
            containing 'a Fragmentaion Option in the Destination Options Header' }
      -- A Destination Options Header can carry a Fragmentation option that
      -- achieves the same results as a Fragmentation Header.--
      -- The usage choice depends on the processing resources consumed--
   then { EUT sends 'the expected Reply' to QE }
            }
```

Pre-test conditions:			
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
Observations:	In an interoperability testing environment it is almost (if not totally) impossible to reproduce the conditions that would reliably cause the Destination Options Header to be used.		

4.2.1.2.2 Group 1.4.4 Routing Header

4.2.1.2.2.1 Group 1.4.4.2 Process Routing Header

Test Description			
Identifier:	TD_COR_1042_01	**Test Purpose:**	TP_COR_1042_01
Summary:	Discard packet and generate ICMP error message if packet size larger than MTU		
Roles:	Router	**Configuration:**	CF_CORE_22
References:	RQ_000_1042		

```
with { 'Link2 configured with a smaller MTU than Link1' }

ensure that {
   when { QE1 is requested to 'send a packet larger than Link2 MTU to QE2'
                  containing 'EUT as next routing hop' }
   then { EUT discards 'the packet'
      and EUT sends 'ICMP "Packet too big" error message 'to QE1 }
          }
```

Pre-test conditions:	PMTU of link1 is set to a value greater than PMTU of link2.		
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
1	Cause QE1 to send an Echo Request with the following properties: - (PMTU of link2) < Echo Request packet size < (PMTU of link1) - EUT is the next routing hop. - QE2 is the final destination.		
2	Check: Does the protocol monitor on Link2 show that the Echo Request has NOT been forwarded to QE2? (EUT has discarded the Echo Request)	Yes	No
3	Check: Does the protocol monitor on Link1 show that EUT has sent an ICMP 'Packet too big' error message to QE1?	Yes	No
Observations:			

Test Description			
Identifier:	TD_COR_1049_01	**Test Purpose:**	TP_COR_1049_01
Summary:	Routing Header NOT processed until IPv6 header Dest. Addr. reached		
Roles:	Host, Router	**Configuration:**	CF_CORE_31
References:	RQ_000_1004		

```
with { EUT 'not included in the Routing Header vector (hop) list' }

ensure that {
   when { QE1 is requested to 'send a packet to QE3'
                  containing 'QE2 as next routing hop'
      and EUT 'is on the path to QE2' }
   then { EUT ignores 'the routing header'
      and EUT 'routes the packet to QE2' }
          }
```

Pre-test conditions:	EUT is established as default router for all nodes QE2 is a router		
Step	**Test Sequence**	**Verdict**	
		Pass	**Fail**
1	Cause QE1 to send an Echo Request with the following properties: - QE2 is the next routing hop - QE3 is the final destination		
2	Check: Does the protocol monitor on Link2 show that EUT forwarded the Echo Request message to QE2 without changing the routing header?	Yes	No
Observations:			