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Path MTU Discovery for IP version 6
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Abstract

This document describes Path MTU Discovery for IP version 6. It is largely derived from RFC 1191, which describes Path MTU Discovery for IP version 4. It obsoletes RFC1981.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

When one IPv6 node has a large amount of data to send to another

node, the data is transmitted in a series of IPv6 packets. These packets can have a size less than or equal to the Path MTU (PMTU). Alternatively, they can be larger packets that are fragmented into a series of fragments each with a size less than or equal to the PMTU.

It is usually preferable that these packets be of the largest size that can successfully traverse the path from the source node to the destination node without the need for IPv6 fragmentation. This packet size is referred to as the Path MTU, and it is equal to the minimum link MTU of all the links in a path. This document defines a standard mechanism for a node to discover the PMTU of an arbitrary path.

IPv6 nodes SHOULD implement Path MTU Discovery in order to discover and take advantage of paths with PMTU greater than the IPv6 minimum link MTU [I-D.ietf-6man-rfc2460bis]. A minimal IPv6 implementation (e.g., in a boot ROM) may choose to omit implementation of Path MTU Discovery.

Nodes not implementing Path MTU Discovery MUST use the IPv6 minimum link MTU defined in [I-D.ietf-6man-rfc2460bis] as the maximum packet size. In most cases, this will result in the use of smaller packets than necessary, because most paths have a PMTU greater than the IPv6 minimum link MTU. A node sending packets much smaller than the Path MTU allows is wasting network resources and probably getting suboptimal throughput.

Nodes implementing Path MTU Discovery and sending packets larger than the IPv6 minimum link MTU are susceptible to problematic connectivity if ICMPv6 [ICMPv6] messages are blocked or not transmitted. For example, this will result in connections that complete the TCP three-way handshake correctly but then hang when data is transferred. This state is referred to as a black hole connection. Path MTU Discovery relies on such messages to determine the MTU of the path.

An extension to Path MTU Discovery defined in this document can be found in [RFC4821]. RFC4821 defines a method for Packetization Layer Path MTU Discovery (PLPMTUD) designed for use over paths where delivery of ICMPv6 messages to a host is not assured.

2. Terminology

node	a device that implements IPv6.
router	a node that forwards IPv6 packets not explicitly addressed to itself.
host	any node that is not a router.
upper layer	a protocol layer immediately above IPv6. Examples are transport protocols such as TCP and UDP, control protocols such as ICMPv6, routing protocols such as OSPF, and internet or lower-

	layer protocols being "tunneled" over (i.e., encapsulated in) IPv6 such as IPX, AppleTalk, or IPv6 itself.
link	a communication facility or medium over which nodes can communicate at the link layer, i.e., the layer immediately below IPv6. Examples are Ethernets (simple or bridged); PPP links; X.25, Frame Relay, or ATM networks; and internet (or higher) layer "tunnels", such as tunnels over IPv4 or IPv6 itself.
interface	a node's attachment to a link.
address	an IPv6-layer identifier for an interface or a set of interfaces.
packet	an IPv6 header plus payload. The packet can have a size less than or equal to the PMTU. Alternatively, this can be a larger packet that is fragmented into a series of fragments each with a size less than or equal to the PMTU.
link MTU	the maximum transmission unit, i.e., maximum packet size in octets, that can be conveyed in one piece over a link.
path	the set of links traversed by a packet between a source node and a destination node.

path MTU	the minimum link MTU of all the links in a path between a source node and a destination node.
PMTU	path MTU
Path MTU Discovery	process by which a node learns the PMTU of a path
EMTU_S	Effective MTU for sending, used by upper layer protocols to limit the size of IP packets they queue for sending [RFC6691].
EMTU_R	Effective MTU for receiving, the largest packet that can be reassembled at the receiver.
flow	a sequence of packets sent from a particular source to a particular (unicast or multicast) destination for which the source desires special handling by the intervening routers.

flow id	a combination of a source address and a non-zero flow label.

3. Protocol Overview

This memo describes a technique to dynamically discover the PMTU of a path. The basic idea is that a source node initially assumes that the PMTU of a path is the (known) MTU of the first hop in the path. If any of the packets sent on that path are too large to be forwarded by some node along the path, that node will discard them and return ICMPv6 Packet Too Big messages. Upon receipt of such a message, the source node reduces its assumed PMTU for the path based on the MTU of the constricting hop as reported in the Packet Too Big message. The decreased PMTU causes the source to send smaller fragments or change EMTU_S to cause upper layer to reduce the size of IP packets it sends.

The Path MTU Discovery process ends when the node's estimate of the PMTU is less than or equal to the actual PMTU. Note that several iterations of the packet-sent/Packet-Too-Big-message-received cycle may occur before the Path MTU Discovery process ends, as there may be links with smaller MTUs further along the path.

Alternatively, the node may elect to end the discovery process by ceasing to send packets larger than the IPv6 minimum link MTU.

The PMTU of a path may change over time, due to changes in the routing topology. Reductions of the PMTU are detected by Packet Too Big messages. To detect increases in a path's PMTU, a node periodically increases its assumed PMTU. This will almost always result in packets being discarded and Packet Too Big messages being generated, because in most cases the PMTU of the path will not have changed. Therefore, attempts to detect increases in a path's PMTU should be done infrequently.

Path MTU Discovery supports multicast as well as unicast destinations. In the case of a multicast destination, copies of a packet may traverse many different paths to many different nodes. Each path may have a different PMTU, and a single multicast packet may result in multiple Packet Too Big messages, each reporting a different next-hop MTU. The minimum PMTU value across the set of paths in use determines the size of subsequent packets sent to the multicast destination.

Note that Path MTU Discovery must be performed even in cases where a node "thinks" a destination is attached to the same link as itself. In a situation such as when a neighboring router acts as proxy [ND]

for some destination, the destination can to appear to be directly connected but is in fact more than one hop away.

4. Protocol Requirements

As discussed in Section 1, IPv6 nodes are not required to implement Path MTU Discovery. The requirements in this section apply only to those implementations that include Path MTU Discovery.

Nodes SHOULD appropriately validate the payload of ICMPv6 PTB messages to ensure these are received in response to transmitted traffic (i.e., a reported error condition that corresponds to an IPv6 packet actually sent by the application) per [ICMPv6].

If a node receives a Packet Too Big message reporting a next-hop MTU

that is less than the IPv6 minimum link MTU, it MUST discard it. A node MUST NOT reduce its estimate of the Path MTU below the IPv6 minimum link MTU.

When a node receives a Packet Too Big message, it MUST reduce its estimate of the PMTU for the relevant path, based on the value of the MTU field in the message. The precise behavior of a node in this circumstance is not specified, since different applications may have different requirements, and since different implementation architectures may favor different strategies.

After receiving a Packet Too Big message, a node MUST attempt to avoid eliciting more such messages in the near future. The node MUST reduce the size of the packets it is sending along the path. Using a PMTU estimate larger than the IPv6 minimum link MTU may continue to elicit Packet Too Big messages. Since each of these messages (and the dropped packets they respond to) consume network resources, the node MUST force the Path MTU Discovery process to end.

Nodes using Path MTU Discovery MUST detect decreases in PMTU as fast as possible. Nodes MAY detect increases in PMTU, but because doing so requires sending packets larger than the current estimated PMTU, and because the likelihood is that the PMTU will not have increased, this MUST be done at infrequent intervals. An attempt to detect an increase (by sending a packet larger than the current estimate) MUST NOT be done less than 5 minutes after a Packet Too Big message has been received for the given path. The recommended setting for this timer is twice its minimum value (10 minutes).

A node MUST NOT increase its estimate of the Path MTU in response to the contents of a Packet Too Big message. A message purporting to announce an increase in the Path MTU might be a stale packet that has been floating around in the network, a false packet injected as part

of a denial-of-service attack, or the result of having multiple paths to the destination, each with a different PMTU.

5. Implementation Issues

This section discusses a number of issues related to the implementation of Path MTU Discovery. This is not a specification, but rather a set of notes provided as an aid for implementers.

The issues include:

- What layer or layers implement Path MTU Discovery?

- How is the PMTU information cached?

- How is stale PMTU information removed?

- What must transport and higher layers do?

5.1. Layering

In the IP architecture, the choice of what size packet to send is made by a protocol at a layer above IP. This memo refers to such a protocol as a "packetization protocol". Packetization protocols are usually transport protocols (for example, TCP) but can also be higher-layer protocols (for example, protocols built on top of UDP).

Implementing Path MTU Discovery in the packetization layers simplifies some of the inter-layer issues, but has several drawbacks: the implementation may have to be redone for each packetization protocol, it becomes hard to share PMTU information between different packetization layers, and the connection-oriented state maintained by some packetization layers may not easily extend to save PMTU information for long periods.

It is therefore suggested that the IP layer store PMTU information and that the ICMPv6 layer process received Packet Too Big messages. The packetization layers may respond to changes in the PMTU by changing the size of the messages they send. To support this layering, packetization layers require a way to learn of changes in the value of MMS_S, the "maximum send transport-message size".

MMS_S is a transport message size calculated by subtracting the size of the IPv6 header (including IPv6 extension headers) from the largest IP packet that can be sent, EMTU_S. MMS_S is limited by a combination of factors, including the PMTU, support for packet fragmentation and reassembly, and the packet reassembly limit (see [I-D.ietf-6man-rfc2460bis] section "Fragment Header"). When source

fragmentation is available, EMTU_S is set to EMTU_R, as indicated by

the receiver using an upper layer protocol or based on protocol requirements (1500 octets for IPv6). When a message larger than PMTU is to be transmitted, the source creates fragments, each limited by PMTU. When source fragmentation is not desired, EMTU_S is set to PMTU, and the upper layer protocol is expected to either perform its own fragmentation and reassembly or otherwise limit the size of its messages accordingly.

However, packetization layers are encouraged to avoid sending messages that will require source fragmentation (for the case against fragmentation, see [FRAG]).

5.2. Storing PMTU information

Ideally, a PMTU value should be associated with a specific path traversed by packets exchanged between the source and destination nodes. However, in most cases a node will not have enough information to completely and accurately identify such a path. Rather, a node must associate a PMTU value with some local representation of a path. It is left to the implementation to select the local representation of a path.

In the case of a multicast destination address, copies of a packet may traverse many different paths to reach many different nodes. The local representation of the "path" to a multicast destination must represent a potentially large set of paths.

Minimally, an implementation could maintain a single PMTU value to be used for all packets originated from the node. This PMTU value would be the minimum PMTU learned across the set of all paths in use by the node. This approach is likely to result in the use of smaller packets than is necessary for many paths. In the case of multipath routing (e.g., Equal Cost Multipath Routing, ECMP), a set of paths can exist even for a single source and destination pair.

An implementation could use the destination address as the local representation of a path. The PMTU value associated with a destination would be the minimum PMTU learned across the set of all paths in use to that destination. This approach will result in the use of optimally sized packets on a per-destination basis. This approach integrates nicely with the conceptual model of a host as described in [ND]: a PMTU value could be stored with the corresponding entry in the destination cache.

If flows [I-D.ietf-6man-rfc2460bis] are in use, an implementation could use the flow id as the local representation of a path. Packets sent to a particular destination but belonging to different flows may

use different paths, as with ECMP, in which the choice of path might depending on the flow id. This approach might result in the use of optimally sized packets on a per-flow basis, providing finer granularity than PMTU values maintained on a per-destination basis.

For source routed packets (i.e. packets containing an IPv6 Routing header [I-D.ietf-6man-rfc2460bis]), the source route may further qualify the local representation of a path.

Initially, the PMTU value for a path is assumed to be the (known) MTU of the first-hop link.

When a Packet Too Big message is received, the node determines which path the message applies to based on the contents of the Packet Too Big message. For example, if the destination address is used as the local representation of a path, the destination address from the original packet would be used to determine which path the message applies to.

> Note: if the original packet contained a Routing header, the Routing header should be used to determine the location of the destination address within the original packet. If Segments Left is equal to zero, the destination address is in the Destination Address field in the IPv6 header. If Segments Left is greater than zero, the destination address is the last address (Address[n]) in the Routing header.

The node then uses the value in the MTU field in the Packet Too Big message as a tentative PMTU value or the IPv6 minimum link MTU if that is larger, and compares the tentative PMTU to the existing PMTU. If the tentative PMTU is less than the existing PMTU estimate, the tentative PMTU replaces the existing PMTU as the PMTU value for the path.

The packetization layers must be notified about decreases in the PMTU. Any packetization layer instance (for example, a TCP connection) that is actively using the path must be notified if the PMTU estimate is decreased.

> Note: even if the Packet Too Big message contains an Original Packet Header that refers to a UDP packet, the TCP layer must be notified if any of its connections use the given path.

Also, the instance that sent the packet that elicited the Packet Too Big message should be notified that its packet has been dropped, even if the PMTU estimate has not changed, so that it may retransmit the

dropped data.

Note: An implementation can avoid the use of an asynchronous notification mechanism for PMTU decreases by postponing notification until the next attempt to send a packet larger than the PMTU estimate. In this approach, when an attempt is made to SEND a packet that is larger than the PMTU estimate, the SEND function should fail and return a suitable error indication. This approach may be more suitable to a connectionless packetization layer (such as one using UDP), which (in some implementations) may be hard to "notify" from the ICMPv6 layer. In this case, the normal timeout-based retransmission mechanisms would be used to recover from the dropped packets.

It is important to understand that the notification of the packetization layer instances using the path about the change in the PMTU is distinct from the notification of a specific instance that a packet has been dropped. The latter should be done as soon as practical (i.e., asynchronously from the point of view of the packetization layer instance), while the former may be delayed until a packetization layer instance wants to create a packet. Retransmission should be done for only for those packets that are known to be dropped, as indicated by a Packet Too Big message.

5.3. Purging stale PMTU information

Internetwork topology is dynamic; routes change over time. While the local representation of a path may remain constant, the actual path(s) in use may change. Thus, PMTU information cached by a node can become stale.

If the stale PMTU value is too large, this will be discovered almost immediately once a large enough packet is sent on the path. No such mechanism exists for realizing that a stale PMTU value is too small, so an implementation SHOULD "age" cached values. When a PMTU value has not been decreased for a while (on the order of 10 minutes), the PMTU estimate should be set to the MTU of the first-hop link, and the packetization layers should be notified of the change. This will cause the complete Path MTU Discovery process to take place again.

Note: an implementation should provide a means for changing the

timeout duration, including setting it to "infinity". For example, nodes attached to an FDDI link which is then attached to the rest of the Internet via a small MTU serial line are never going to discover a new non-local PMTU, so they should not have to put up with dropped packets every 10 minutes.

An upper layer must not retransmit data in response to an increase in the PMTU estimate, since this increase never comes in response to an indication of a dropped packet.

One approach to implementing PMTU aging is to associate a timestamp field with a PMTU value. This field is initialized to a "reserved" value, indicating that the PMTU is equal to the MTU of the first hop link. Whenever the PMTU is decreased in response to a Packet Too Big message, the timestamp is set to the current time.

Once a minute, a timer-driven procedure runs through all cached PMTU values, and for each PMTU whose timestamp is not "reserved" and is older than the timeout interval:

- The PMTU estimate is set to the MTU of the first hop link.

- The timestamp is set to the "reserved" value.

- Packetization layers using this path are notified of the increase.

5.4. Packetization layer actions

A packetization layer (e.g., TCP) must track the PMTU for the path(s) in use by a connection; it should not send segments that would result in packets larger than the PMTU, except to probe during PMTU discovery (this probe packet must not be fragmented to the PMTU). A simple implementation could ask the IP layer for this value each time it created a new segment, but this could be inefficient. An implementation typically caches other values derived from the PMTU. It may be simpler to receive asynchronous notification when the PMTU changes, so that these variables may be also updated.

A TCP implementation must also store the Maximum Segment Size (MSS) value received from its peer, which represents the EMTU_R, the largest packet that can be reassembled by the receiver, and must not send any segment larger than this MSS, regardless of the PMTU.

The value sent in the TCP MSS option is independent of the PMTU; it is determined by the receiver reassembly limit EMTU_R. This MSS option value is used by the other end of the connection, which may be using an unrelated PMTU value. See [I-D.ietf-6man-rfc2460bis] sections "Packet Size Issues" and "Maximum Upper-Layer Payload Size" for information on selecting a value for the TCP MSS option.

When a Packet Too Big message is received, it implies that a packet was dropped by the node that sent the ICMPv6 message. It is sufficient to treat this in the same way as any other dropped segment, and will be recovered by normal retransmission methods. If the Path MTU Discovery process requires several steps to find the PMTU of the full path, this could delay the connection by many round-trip times.

Alternatively, the retransmission could be done in immediate response to a notification that the Path MTU has changed, but only for the specific connection specified by the Packet Too Big message. The packet size used in the retransmission should be no larger than the new PMTU.

> Note: A packetization layer must not retransmit in response to every Packet Too Big message, since a burst of several oversized segments will give rise to several such messages and hence several retransmissions of the same data. If the new estimated PMTU is still wrong, the process repeats, and there is an exponential growth in the number of superfluous segments sent. Retransmissions can increase network load in response to congestion, worsening that congestion. Any packetization layer that uses retransmission is responsible for congestion control of its retransmissions. See [RFC8085] for more information.
>
> This means that the TCP layer must be able to recognize when a Packet Too Big notification actually decreases the PMTU that it has already used to send a packet on the given connection, and should ignore any other notifications.

Many TCP implementations incorporate "congestion avoidance" and "slow-start" algorithms to improve performance [CONG]. Unlike a retransmission caused by a TCP retransmission timeout, a

retransmission caused by a Packet Too Big message should not change the congestion window. It should, however, trigger the slow-start mechanism (i.e., only one segment should be retransmitted until acknowledgements begin to arrive again).

TCP performance can be reduced if the sender's maximum window size is not an exact multiple of the segment size in use (this is not the congestion window size).

5.5. Issues for other transport protocols

Some transport protocols are not allowed to repacketize when doing a retransmission. That is, once an attempt is made to transmit a segment of a certain size, the transport cannot split the contents of the segment into smaller segments for retransmission. In such a case, the original segment can be fragmented by the IP layer during retransmission. Subsequent segments, when transmitted for the first time, should be no larger than allowed by the Path MTU.

Path MTU Discovery for IPv4 [RFC1191] used NFS as an example of a UDP-based application that benefits from PMTU discovery. Since then [RFC7530], states the supported transport layer between NFS and IP must be an IETF standardized transport protocol that is specified to

avoid network congestion; such transports include TCP and the Stream Control Transmission Protocol (SCTP). In this case, the transport is itself responsible for determining and using an effective Path MTU, including implementing PMTU discovery when this is needed.

5.6. Management interface

It is suggested that an implementation provide a way for a system utility program to:

- Specify that Path MTU Discovery not be done on a given path.

- Change the PMTU value associated with a given path.

The former can be accomplished by associating a flag with the path; when a packet is sent on a path with this flag set, the IP layer does not send packets larger than the IPv6 minimum link MTU.

These features might be used to work around an anomalous situation, or by a routing protocol implementation that is able to obtain Path MTU values.

The implementation should also provide a way to change the timeout period for aging stale PMTU information.

6. Security Considerations

This Path MTU Discovery mechanism makes possible two denial-of-service attacks, both based on a malicious party sending false Packet Too Big messages to a node.

In the first attack, the false message indicates a PMTU much smaller than reality. In response, the victim node should never set its PMTU estimate below the IPv6 minimum link MTU. A sender that falsely reduces to this MTU would observe suboptimal performance.

In the second attack, the false message indicates a PMTU larger than reality. If believed, this could cause temporary blockage as the victim sends packets that will be dropped by some router. Within one round-trip time, the node would discover its mistake (receiving Packet Too Big messages from that router), but frequent repetition of this attack could cause lots of packets to be dropped. A node, however, should never raise its estimate of the PMTU based on a Packet Too Big message, so should not be vulnerable to this attack.

A malicious party could also cause problems if it could stop a victim from receiving legitimate Packet Too Big messages, but in this case there are simpler denial-of-service attacks available.

If ICMPv6 filtering prevents reception of ICMPv6 Packet Too Big messages, the source will not learn the actual path MTU. Packetization Layer Path MTU Discovery [RFC4821] does not rely upon network support for ICMPv6 messages and is therefore considered more robust than standard PMTUD. It is not susceptible to "black holing" of ICMPv6 message. See [RFC4890] for recommendations regarding filtering ICMPv6 messages.

7. Acknowledgements

We would like to acknowledge the authors of and contributors to [RFC1191], from which the majority of this document was derived. We would also like to acknowledge the members of the IPng working group for their careful review and constructive criticisms.

8. IANA Considerations

This document does not have any IANA actions

9. References

9.1. Normative References

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9.2. Informative References

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Appendix A. Comparison to RFC 1191

This document is based in large part on RFC 1191, which describes Path MTU Discovery for IPv4. Certain portions of RFC 1191 were not needed in this document:

router specification	Packet Too Big messages and corresponding router behavior are defined in [ICMPv6]
Don't Fragment bit	there is no DF bit in IPv6 packets
TCP MSS discussion	selecting a value to send in the TCP MSS option is discussed in [I-D.ietf-6man-rfc2460bis]
old-style messages	all Packet Too Big messages report the MTU of the constricting link

MTU plateau tables	not needed because there are no old-style messages

Appendix B. Changes Since RFC 1981

This document is based on RFC1981 has the following changes from RFC1981:

- Clarified Section 1 "Introduction" that the purpose of PMTUD is to reduce the need for IPv6 fragmentation.
- Added text to Section 1 "Introduction" and Section 6 "Security Considerations" about the effects on PMTUD when ICMPv6 messages are blocked.
- Added a short summary to the Section 1 "Introduction" of Packetization Layer Path MTU Discovery ((PLPMTUD) and a reference to RFC4821 that defines it.
- Aligned text in Section 2 "Terminology" to match current packetization layer terminology.
- Added clarification in Section 4 "Protocol Requirements" that nodes should validate the payload of ICMP PTB message per RFC4443.
- Remove Note from Section 4 "Protocol Requirements" about a Packet Too Big message reporting a next-hop MTU that is less than the IPv6 minimum link MTU because this was removed from [I-D.ietf-6man-rfc2460bis].
- Added clarification in Section 5.2 "Storing PMTU information" to discard an ICMPv6 Packet Too Big message if it contains a MTU less than the IPv6 minimum link MTU.
- Removed text in Section 5.2 "Storing PMTU information" about the RH0 routing header because it was deprecated by RFC5095.
- Removed text about obsolete security classification from Section 5.2 "Storing PMTU information".
- Changed title of Section 5.4 to "Packetization Layer actions" and changed to text in the first paragraph to to generalize this section to cover all packetization layers, not just TCP.
- Clarified text in Section 5.4 "Packetization Layer actions" to use normal packetization layer retransmission methods.

- Removed text in Section 5.4 "Packetization Layer actions" that described 4.2 BSD because it is obsolete, and removed reference to TP4.

- Updated text in Section 5.5 "Issues for other transport protocols" about NFS including adding a current reference to NFS and removing obsolete text.

- Editorial Changes.

B.1. Change History Since RFC1981

NOTE TO RFC EDITOR: Please remove this subsection prior to RFC Publication

This section describes change history made in each Internet Draft that went into producing this version. The numbers identify the Internet-Draft version in which the change was made.

Working Group Internet Drafts

06) Revised Appendix B "Changes since RFC1981" to have a summary of changes since RFC1981 and a separate subsection with a change history of each Internet Draft. This subsection will be removed when the RFC is published.

06) Editorial changes based on comments received after publishing the -05 draft.

05) Changes based on IETF last call reviews by Gorry Fairhurst, Joe Touch, Susan Hares, Stewart Bryant, Rifaat Shekh-Yusef, and Donald Eastlake. This includes includes:

- Clarify that the purpose of PMTUD is to reduce the need for IPv6 Fragmentation.

- Added text to Introduction about effects on PMTUD when ICMPv6 messages are blocked.

- Clarified in Section 4. that nodes should validate the payload of ICMPv6 PTB messages per RFC4443.

- Removed text in Section 5.2 about the number of paths to a destination.

- Changed title of Section 5.4 to "Packetization layer actions".

- Clarified first paragraph in Section 5.4 to to cover all packetization layers, not just TCP.

- Clarified text in Section 5.4 to use normal retransmission methods.

- Add clarification to Note in Section 5.4 about retransmissions.

- Removed text in Section 5.4 that described 4.2BSD as it is now obsolete.

- Removed reference to TP4 in Section 5.5.

- Updated text in Section 5.5 about NFS including adding a current reference to NFS and removing obsolete text.

- Revised text in Section 6 to clarify first attack response.

- Added new text in Section 6 to clarify the effect of ICMPv6 filtering on PMTUD.

- Aligned terminology for the packetization layer terminology.

- Editorial changes.

04) Changes based on AD Evaluation including removing details about RFC4821 algorithm in Section 1, remove text about

decrementing hop limit from Section 3, and removed text about obsolete security classifications from Section 5.2.

04) Editorial changes and clarification in Section 5.2 based on IP Directorate review by Donald Eastlake

03) Remove text in Section 5.3 regarding RH0 since it was deprecated by RFC5095

02) Clarified in Section 3 that ICMPv6 Packet Too Big should be sent even if the node doesn't decrement the hop limit

01) Revised the text about PLPMTUD to use the word "path".

01) Editorial changes.

00) Added text to discard an ICMPv6 Packet Too Big message containing an MTU less than the IPv6 minimum link MTU.

00) Revision of text regarding RFC4821.

00) Added R. Hinden as Editor to facilitate ID submission.

00) Editorial changes.

Individual Internet Drafts

01) Remove Note about a Packet Too Big message reporting a next-hop MTU that is less than the IPv6 minimum link MTU. This was removed from [I-D.ietf-6man-rfc2460bis].

01) Include a link to RFC4821 along with a short summary of what it does.

01) Assigned references to informative and normative.

01) Editorial changes.

00) Establish a baseline from RFC1981. The only intended changes are formatting (XML is slightly different from .nroff),

differences between an RFC and Internet Draft, fixing a few ID Nits, updating references, and updates to the authors information. There should not be any content changes to the specification.

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