Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: September 7, 2009

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March 6, 2009

TWAMP Reflect Octets Feature
draft-ietf-ippm-twamp-reflect-octets-01

Status of this Memo

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Abstract

The IETF has completed its work on the core specification of TWAMP - the Two-Way Active Measurement Protocol. This memo describes a new feature for TWAMP: an optional capability where the responder host returns some of the command octets or padding octets to the controller, and/or ensures that the same test packet sizes are used in both directions.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

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1. Introduction

The IETF has completed its work on the core specification of TWAMP - the Two-Way Active Measurement Protocol [RFC5357]. TWAMP is an extension of the One-way Active Measurement Protocol, OWAMP [RFC4656]. The TWAMP specification gathered wide review as it approached completion, and the by-products were several recommendations for new features in TWAMP. There are a growing number TWAMP implementations at present, and wide-spread usage is expected. There are even devices that are designed to test implementations for protocol compliance.

This memo describes a new feature for TWAMP. This feature adds the OPTIONAL capability for the responder host to return a limited number of unassigned (padding) octets to the Control-Client or Session-Sender entities. With this capability, the Control-Client or Session-Sender can embed octets of information it deems useful and have the assurance that the corresponding reply/test packet will contain that information when it is reflected and returned (by the Server or Session-Reflector. The feature also adds the Session-Reflector capability to assure that reflected test packets SHALL have their padding octets truncated, so that TWAMP-Test protocol uses the same packet size in both directions of transmission.

The relationship between this memo and TWAMP is intended to be an update to [RFC5357] when published.

2. Purpose and Scope

The purpose of this memo is to describe a new feature for TWAMP [RFC5357]. The feature enhances the TWAMP responder's capabilities to perform simple operations on control and test packets: the reflection of octets or padding and the guaranteed truncation of padding to compensate for the different sizes of TWAMP fields in the test packets. Motivations include permitting the controller host to tag packets with an index for simplified identification, and/or assert that the same size test packets MUST be used in each direction.

The scope of the memo is currently limited to specifications of the following feature:

- Extension of the modes of operation through assignment of new values in the Mode Field (see section 3.1 [RFC4656] for the format of the Server Greeting message), while retaining backward compatibility with the core TWAMP [RFC5357] implementations. These two values identify the ability of the Server/

Session-Reflector to reflect specific octets back to the Client/ Session-Sender, and/or to truncate padding octets and ensure that TWAMP-Test protocol uses the same packet size in both directions.

3. TWAMP Control Extensions

TWAMP-Control protocol [RFC5357] uses the Modes Field to identify and select specific communication capabilities, and this field is a recognized extension mechanism. The following sections describe one such extension.

3.1. Connection Setup with Reflect Padding Feature

TWAMP connection establishment follows the procedure defined in section 3.1 of [RFC4656] and section 3.1 of [RFC5357]. The new feature requires two new bit positions (and values) to identify the ability of the Server/Session-Reflector to reflect specific octets back to the Control-Client/Session-Sender, and to truncate padding octets when required. With this added feature, the complete set of TWAMP Modes Field bit positions and values would be as follows:

Value	Description	Reference/Explanation
0	Reserved	
1	Unauthenticated	RFC4656, Section 3.1
2	Authenticated	RFC4656, Section 3.1
4	Encrypted	RFC4656, Section 3.1
8	Unauth. TEST protocol, Encrypted CONTROL	draft-ietf-more-twamp (3)
xxx	Reflect Octets Capability	new bit position (X)
yyy	Truncate Padding Capability	new bit position (Y)

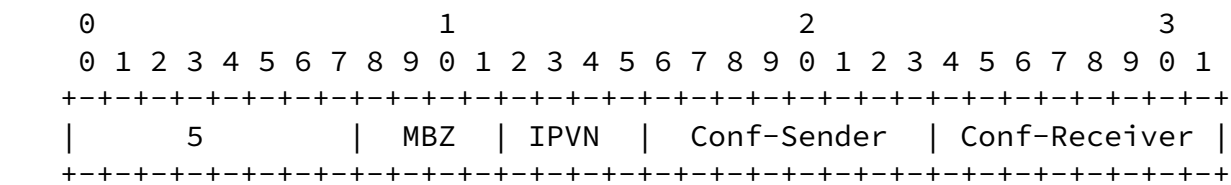
In the original OWAMP Modes Field, setting bit positions 0, 1 or 2 indicated the security mode of the Control protocol, and the Test protocol inherited the same mode (see section 4 of [RFC4656]). In the memo [I-D.ietf-ippm-more-twamp], bit position 3 allows unauthenticated TWAMP Test protocol to be used with encryption on the TWAMP-Control protocol.

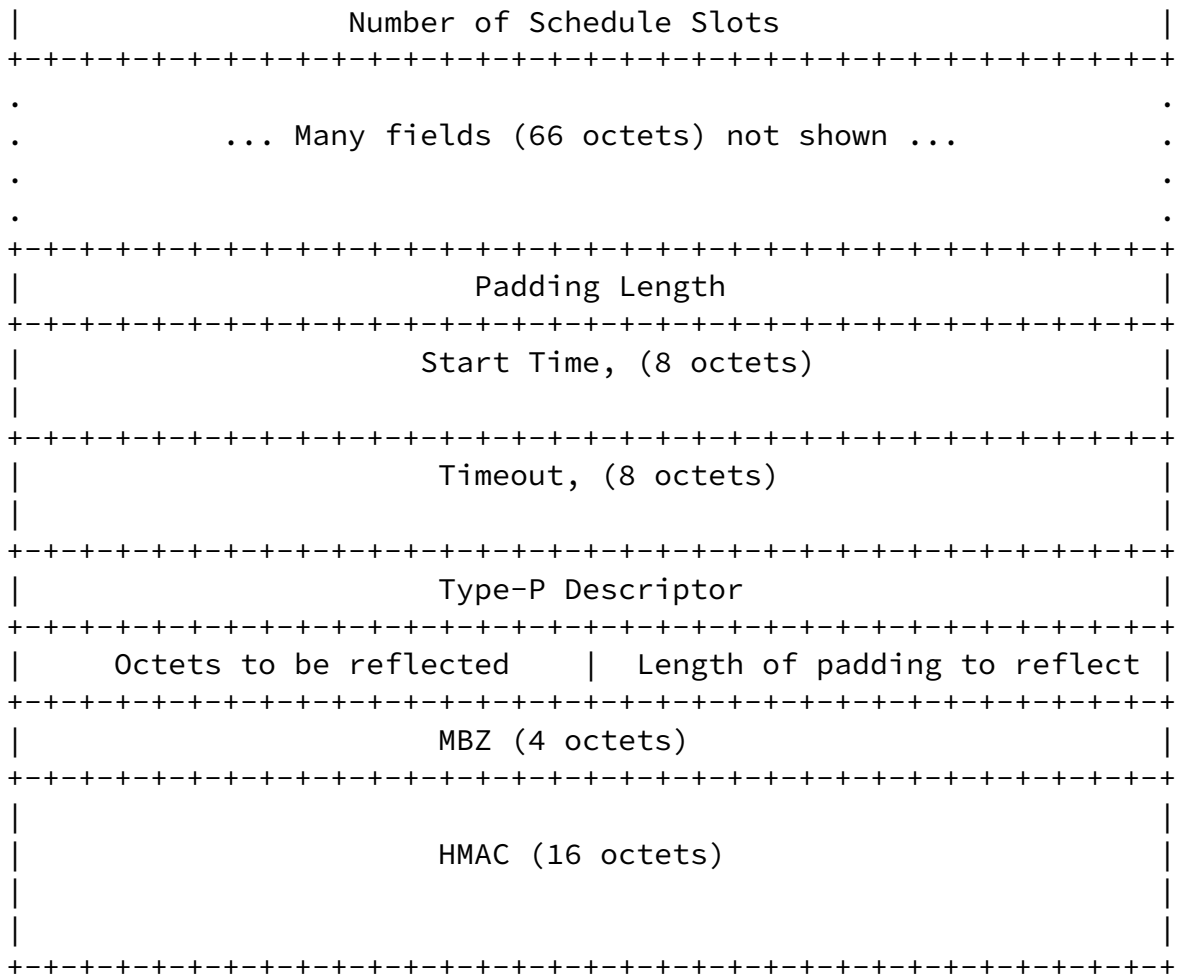
The Server sets one or both of the new bit positions (X and Y) in the Modes Field of the Server Greeting message to indicate its capabilities and willingness to operate in these modes if desired. >>>IANA: change X and Y to the assigned values <<<

If the Control-Client intends to operate all test sessions invoked with this control connection using one or both of the new modes, it MUST set the Modes Field bit corresponding to that function in the Setup Response message.

3.2. Request-TW-Session Packet Format

The bits designated for the Reflect Octets feature in the Request-TW-Session command are as shown in the packet format below.





The "Padding Length" Field *continues* to specify the number of padding octets that the Session-Sender will append to ALL TWAMP-Test packets associated with this test session. See below for considerations on the minimum length of the padding octets, especially when complying with the options described in this memo, following the definitions of the two new fields that follow the

Type-P Descriptor.

Note that the number of padding octets appended to the Session-Reflector's test packet depends on support for the OPTIONAL Truncate Padding mode, or the RECOMMENDED truncation process in TWAMP section 4.2.1 [RFC5357].

The "Octets to be reflected" Field SHALL be 2 octets long, as shown

and contains the octets that the Server MUST reflect in the Accept Session message as specified below.

The "Length of padding to reflect" Field SHALL be 2 octets long, and contain an unsigned binary value in units of octets. This field communicates the length of the padding in the TWAMP-Test Packet that the Session-Sender expects to be reflected, and the length of octets that the Session-Reflector SHALL return in include in its TWAMP-Test packet format (see section 4.2). By including this length field in the Request-TW-Session message, a Server is able to determine if it can comply with a specific request to reflect padding in the TWAMP-Test packets, and to arrange for the Session-Reflector processing in advance.

The "Padding Length" SHOULD be >= 27 octets when specifying a test session using the Unauthenticated TWAMP-Test mode, to allow for the RECOMMENDED truncation process in TWAMP section 4.2.1 [RFC5357].

The "Padding Length" SHOULD be >= 56 octets when specifying a test session using the Authenticated or Encrypted TWAMP-Test modes, to allow for the RECOMMENDED truncation process in TWAMP section 4.2.1 [RFC5357].

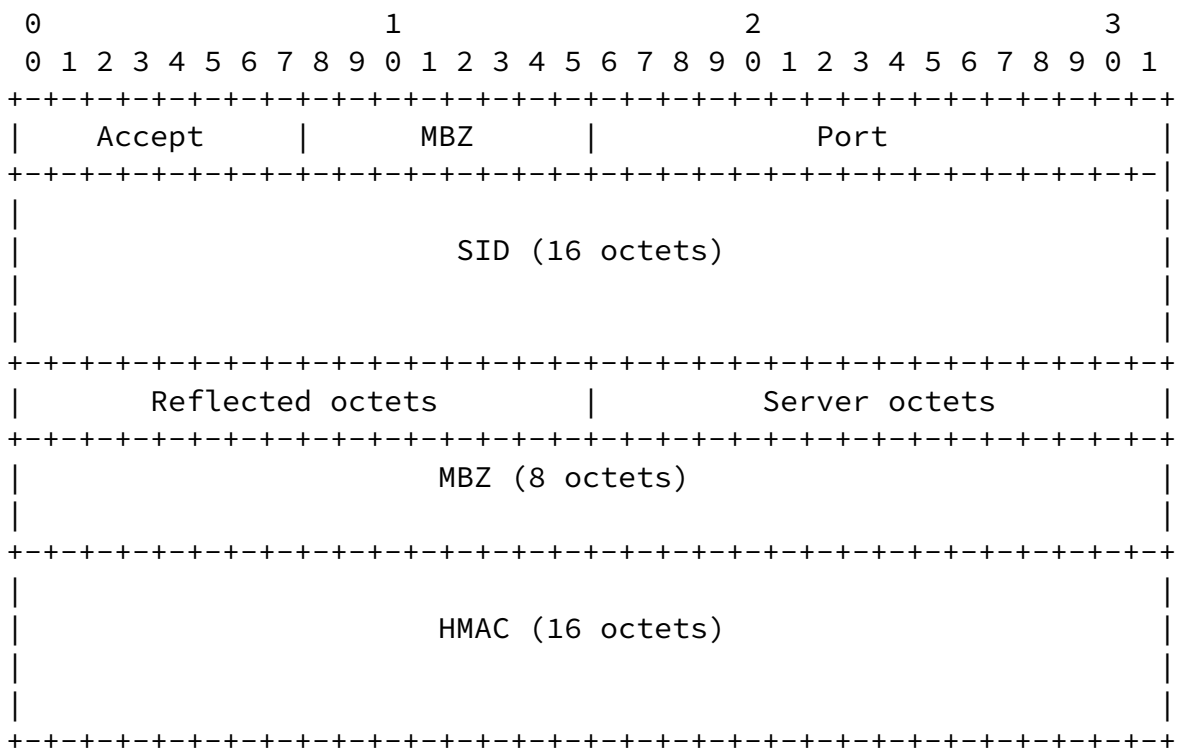
The "Padding Length" SHALL be > the "Length of padding to reflect" when specifying a test session using the OPTIONAL Reflect Octets mode.

The "Padding Length" SHALL be >= 27 + "Length of padding to reflect" octets when specifying a test session using BOTH the OPTIONAL Reflect Octets mode and OPTIONAL Truncate Padding mode with the Unauthenticated TWAMP-Test mode.

The "Padding Length" SHALL be >= 56 + "Length of padding to reflect" octets when specifying a test session using BOTH the OPTIONAL Reflect Octets mode and OPTIONAL Truncate Padding mode with the Authenticated or Encrypted TWAMP-Test modes.

3.3. Accept Session Packet Format

The bits designated for the Reflect Padding feature in the Accept Session command are as shown in the packet format below.



The "Reflected octets" field SHALL contain the octets from the Request-TW-Session "Octets to be reflected" Field, and be 2 octets long, as shown.

The "Server octets" field SHALL contain information that the Server intends to be returned in the TWAMP-Test packet padding to-be-reflected Field, OR SHALL be zero, and be 2 octets long, as shown. Although the Server determines the SID, this field is very long (16 octets) and does not normally appear in TWAMP-Test packets.

In Truncate Padding mode, IF calculations on the Padding lengths reveal that there are insufficient octets supplied to produce equal-length Session-Sender and Session-Reflector test packets, then the Accept Field MUST be set to 3 = some aspect of the request is not supported.

3.4. Additional considerations

The value of the Modes Field sent by the Server in the Server Greeting message is the bit-wise OR of the mode values that it is willing to support during this session.

Thus, the last six bits of the Modes 32-bit Field are used. A client conforming to this extension of [RFC5357] MAY ignore the values in the first 24 bits of the Modes Field, or it MAY support other features that are communicated in these bit positions. (The first 24 bits are available for future protocol extensions.)

Other ways in which TWAMP extends OWAMP are described in [RFC5357].

4. Extended TWAMP Test

The TWAMP test protocol is similar to the OWAMP [RFC4656] test protocol with the exception that the Session-Reflector transmits test packets to the Session-Sender in response to each test packet it receives. TWAMP section 4[RFC5357] defines two additional test packet formats for packets transmitted by the Session-Reflector. The appropriate format depends on the security mode chosen. The new modes specified here utilize some of the padding octets within each test packet format, or require truncation of those octets depending on the security mode in use.

4.1. Sender Behavior

This section describes extensions to the behavior of the TWAMP Session-Sender.

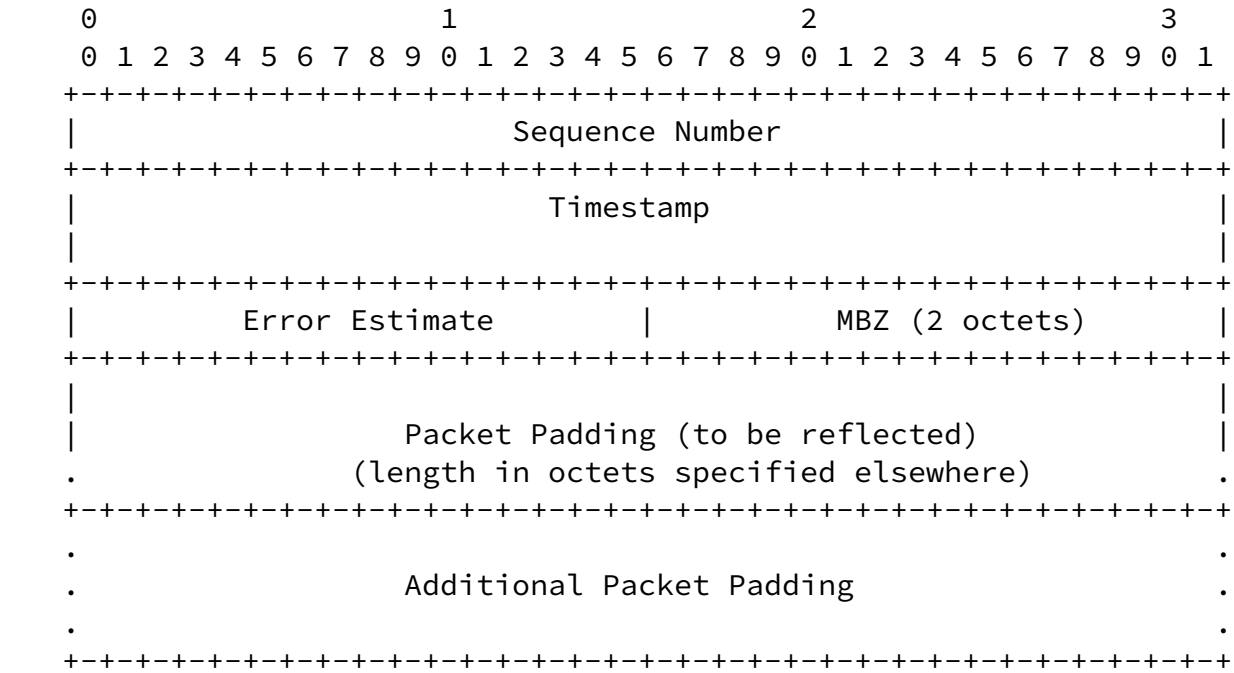
4.1.1. Packet Timings

The Send Schedule is not utilized in TWAMP, and this is unchanged in this memo.

4.1.2. Packet Formats and Contents

The Session-Sender packet format and content follow the same procedure and guidelines as defined in section 4.1.2 of [RFC4656] (as indicated in section 4.1.2 of TWAMP [RFC5357]).

The Reflect octets mode re-designates the original TWAMP-Test (and OWAMP-Test) Packet Padding Field (see section 4.1.2 of [RFC4656]), as shown below for unauthenticated mode:



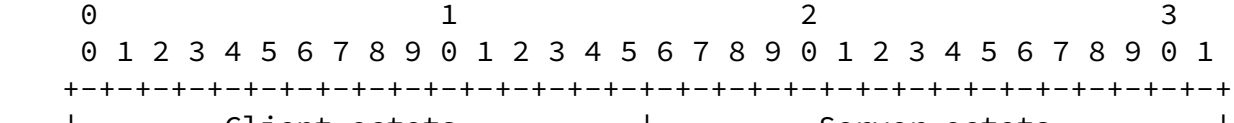
The "Packet Padding (to be reflected)" Field SHALL correspond to the length of octets specified in the Request-TW-Session "Length of padding to reflect" Field to this test session. These are the octets that the Session-Sender expects will be returned by the Session-Reflector.

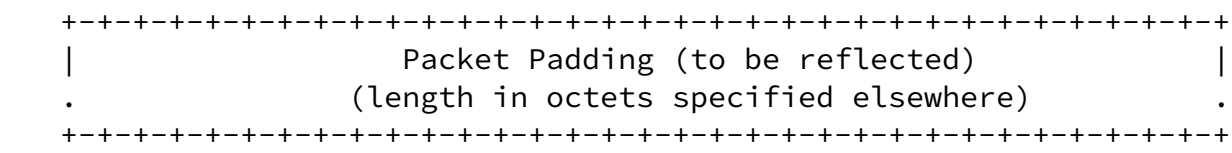
The length of the "Additional Packet Padding" Field is the difference between two fields in the Request-TW-Session command, as follows:

"Additional Packet Padding", in octets =

"Padding Length" - "Length of padding to reflect"

One possible use of the first 4 octets of the "Packet Padding (to be reflected)" Field is shown below:





In this example, the "Client octets" and the "Server octets" fields contain the same information that the Client and Server exchanged in the Request-TW-Session and Accept-Session messages corresponding to this specific test session. These octets would be reflected the same as the rest of the "Packet Padding (to be reflected)" Field.

4.1.3. Padding Truncation

When the Truncate Padding mode is selected and communicated in the Setup Response message, the Session-Sender MUST anticipate a minimum padding required to achieve equal size test packets in both directions. The amount of padding needed depends on BOTH the security mode (Unauthenticated/Authenticated/Encrypted) and whether the Reflect Octets mode is selected simultaneously.

When using the Truncate Padding mode, the Session-Sender MUST append sufficient Packet Padding octets to allow the same IP packet payload lengths to be used in each direction of transmission (this is usually desirable). To compensate for the Session-Reflector's larger test packet format, the Session-Sender MUST append at least 27 octets of padding in Unauthenticated mode, and at least 56 octets in Authenticated and Encrypted modes.

When using the Reflect Octets mode simultaneously with the Truncate Padding mode, the Session-Sender MUST append at least 27 octets of padding plus the "Length of the padding to reflect" octets when operating in Unauthenticated mode. The Session-Sender MUST append at least 56 octets of padding plus the "Length of the padding to reflect" octets when operating in Authenticated and Encrypted modes.

4.2. Reflector Behavior

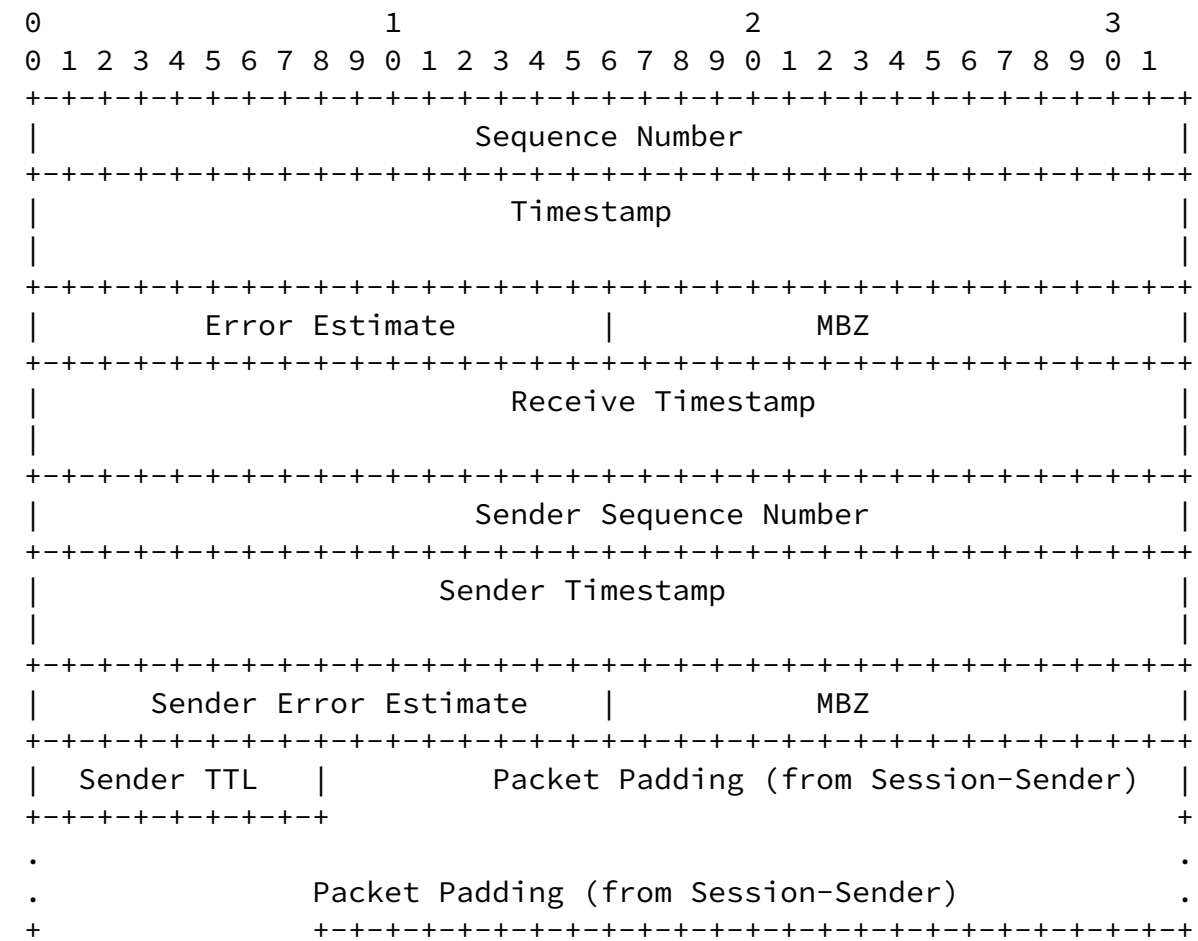
The TWAMP Reflector follows the procedures and guidelines in section 4.2 of [RFC5357], with the following additional functions:

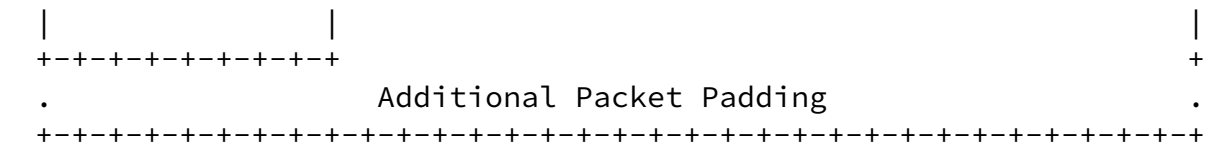
- Reflect Octets mode: Designated octets in the "Packet Padding (to be reflected)" field of the Session-Sender's test packet MUST be included in the Session-Reflector's test packet.

- Truncate Padding mode: Octets in the packet padding field of the Session-Sender's test packet MUST be truncated so that the length of the Session-Reflector's test packet equals the length of the Session-Sender's test packet.

4.2.1. Packet Format and Contents

The Reflect Padding feature re-designates the packet padding field, as shown below for unauthenticated mode:





The "Packet Padding (from Session-Sender)" field MUST be the same octets as the "Packet Padding (to be reflected)" field in the Session-Sender's test packet, and therefore MUST conform to the length specified in the Request-TW-Session message.

IF the test packet length is truncated within the padding fields in conformance with the RECOMMENDED truncation process in TWAMP section 4.2.1 [RFC5357], THEN ALL padding designated to be reflected MUST be reflected by Session-Reflectors using this feature.

4.2.2. Padding Truncation

Note that the Session-Reflector Test Packet Formats are larger than the Sender's formats. When the Truncate Padding mode is selected and communicated in the Setup Response message, the Session-Reflector must truncate a specific number of padding octets to achieve equal size test packets in both directions. The number of octets truncated depends on BOTH the security mode (Unauthenticated/Authenticated/ Encrypted) and whether the Reflect octets mode is selected

simultaneously.

When using the Truncate Padding mode, the Session-Reflector MUST truncate exactly 27 octets of padding in Unauthenticated mode, and exactly 56 octets in Authenticated and Encrypted modes. The Session-Reflector MAY re-use the Sender's Packet Padding (since the requirements for padding generation are the same for each), and in this case the Session-Reflector MUST truncate the padding such that the highest number octets are discarded.

When simultaneously using the Truncate Padding mode AND Reflect octets mode, the Session-Reflector MUST reflect the designated octets from the Session-Sender's test packet in the "Packet Padding (from Session-Sender)" Field, and MAY re-use additional Packet Padding from the Session-Sender. The Session-Reflector MUST truncate the padding such that the highest number octets are discarded, and the test packet length equals the Session-Sender's packet length.

5. Possible Alternative

If new TWAMP-Test packet formats are defined, the Reflect Octets and Truncate Padding modes could be folded into one new mode.

It would be possible to obtain even 4 octet boundaries in the revised format.

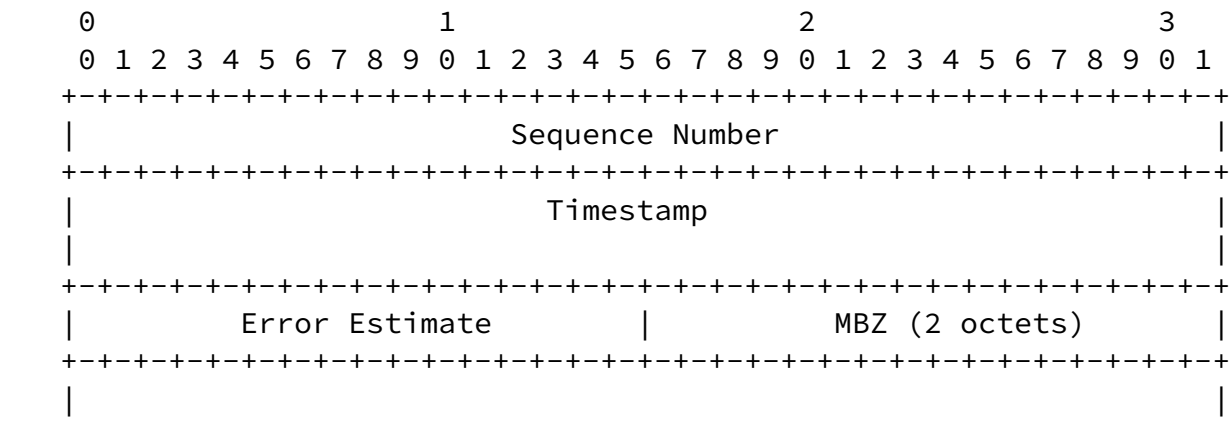
It is also possible to simplfy test packet reflection by leaving the Session-Sender's fields exactly as received, and replacing the Discard Fill Field with the new time stamps and sequence number determined by the Session-Reflector.

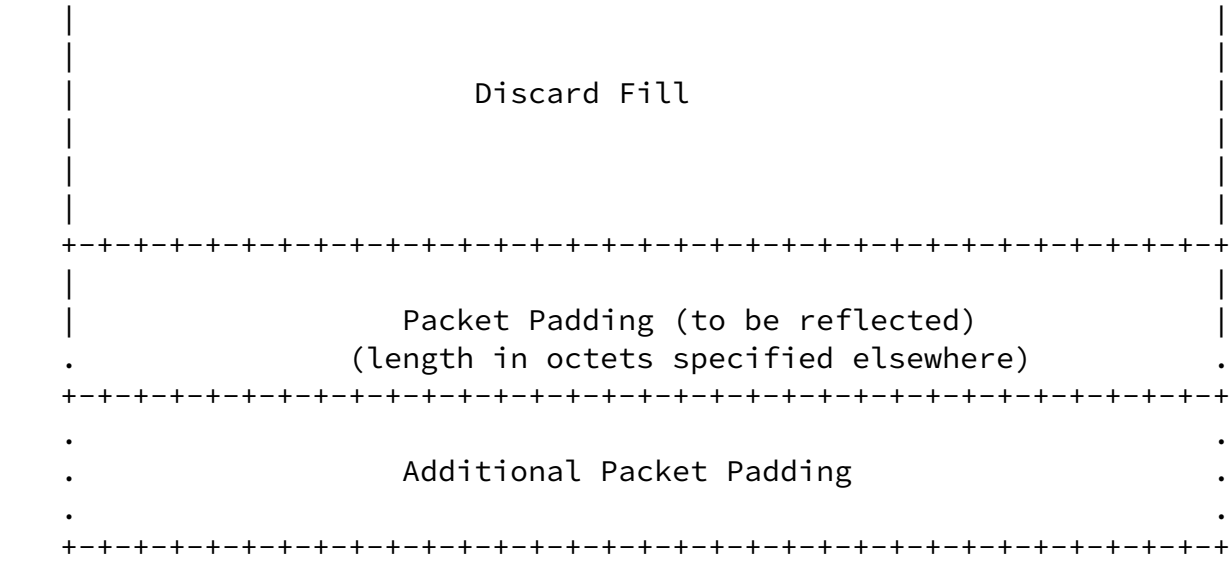
No calculations on padding are needed, and symmetrical packet size is ensured for both directions of transmssion.

The "Packet Padding (to be reflected)" Field could contain information that is TLV encoded, but in general the padding is opaque to the Session-Reflector.

This Alternative is illustrated for discussion purposes.

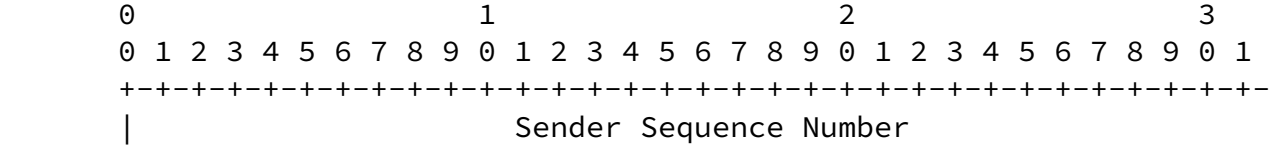
New Session-Sender Test Packet Format:

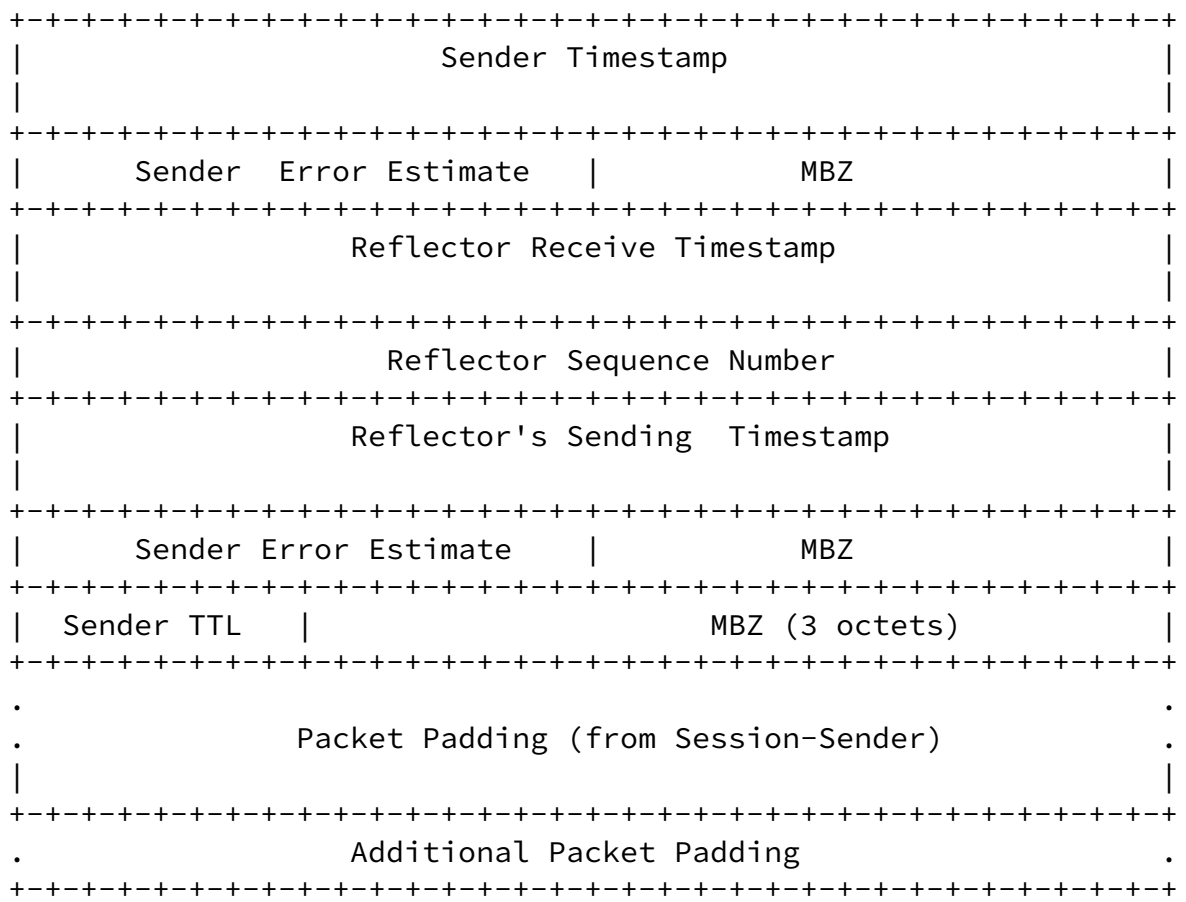




The "Discard Fill" octets are discarded at the Session-Reflector.

New Session-Reflector Test Packet format:





6. Security Considerations

These extended modes of operation do not appear to permit any new attacks on hosts communicating with core TWAMP [RFC5357] ???

The security considerations that apply to any active measurement of live networks are relevant here as well. See [RFC4656] and [RFC5357].

7. IANA Considerations

This memo adds two mode combinations to the IANA registry for the TWAMP Modes Field, and describes behavior when the new modes are used. This field is a recognized extension mechanism for TWAMP.

7.1. Registry Specification

IANA has created a TWAMP-Modes registry (as requested in [I-D.ietf-ippm-more-twamp]). TWAMP-Modes are specified in TWAMP Server Greeting messages and Set-up Response messages, as described in section 3.1 of [RFC5357], consistent with section 3.1 of [RFC4656], and extended by this memo. Modes are indicated by setting bits in the 32-bit Modes field. Thus, this registry can contain a total of 32 possible values.

7.2. Registry Management

Because the Modes registry can contain only thirty-two values, and because TWAMP is an IETF protocol, this registry must be updated only by "IETF Consensus" as specified in [RFC2434](an RFC documenting registry use that is approved by the IESG). For the Modes registry, we expect that new features will be assigned using monotonically increasing bit positions and in the range [0-31] and the corresponding values, unless there is a good reason to do otherwise.

7.3. Experimental Numbers

No experimental values are currently assigned for the Modes Registry.

7.4. Registry Contents

TWAMP Modes Registry is recommended to be augmented as follows:

Value	Description	Semantics Definition
0	Reserved	
1	Unauthenticated	RFC4656, Section 3.1
2	Authenticated	RFC4656, Section 3.1
4	Encrypted	RFC4656, Section 3.1
8	Unauth. TEST protocol, Auth. CONTROL	draft-ietf-more-twamp (3)
xxx	Reflect Octets Capability	this memo, section 3.1 new bit position (X)
yyy	Truncate Padding Capability	this memo, section 3.1 new bit position (Y)

The suggested values are

X=4, xxx=16

Y=5, yyy=32

8. Acknowledgements

The authors would like to thank Walt Steverson for helpful review and comments.

9. References

9.1. Normative References

[I-D.ietf-ippm-more-twamp]
Morton, A. and K. Hedayat, "More Features for TWAMP", draft-ietf-ippm-more-twamp-00 (work in progress), October 2008.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2434] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 2434, October 1998.

[RFC4656] Shalunov, S., Teitelbaum, B., Karp, A., Boote, J., and M. Zekauskas, "A One-way Active Measurement Protocol (OWAMP)", RFC 4656, September 2006.

[RFC5357] Hedayat, K., Krzanowski, R., Morton, A., Yum, K., and J. Babiarz, "A Two-Way Active Measurement Protocol (TWAMP)", RFC 5357, October 2008.

9.2. Informative References

[x] "".

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