Simple Two-Way Active Measurement Protocol (STAMP) Extensions for Residual Bit Error Rate Measurement

draft-gandhi-ippm-stamp-ber-03

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Objective

- Measure residual bit error rate (BER)
  - Single bit error or burst of bit errors
  - Bit errors that escape CRC detection and FEC correction
  - Result in L3/L4 bit errors (e.g., UDP checksum errors)
- Note: CRC errors on the link resulting in packet drops reflected in packet loss metric

Agenda

1. Requirements
2. Procedure and Extensions
3. Data Model
4. Next Steps

Requirements, Goals and Scope

Requirements

- Residual Bit Error Rate Measurement
  - Forward and Reverse directions

Goals

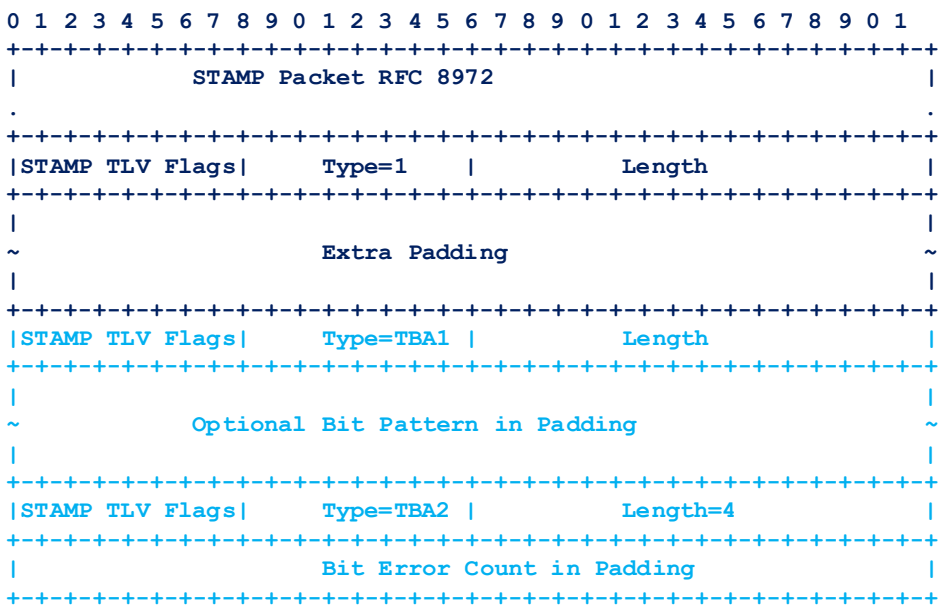
- Reasonable approximation of the Residual Bit Error Rate

Scope

- STAMP [RFC 8762]
- STAMP Optional Extensions [RFC 8972]

Residual BER Measurement Procedure

1. STAMP is used for Residual BER measurement, in addition to latency and loss measurement
2. Residual BER measured in STAMP “Extra Padding” TLV (Type=1) defined in [RFC8972]
3. Sender fills data in extra padding TLV with repeated bit pattern of configured length
4. Reflector checks the extra padding for bit errors by pattern matching with the expected bit pattern that can be signaled or locally configured
   a. Returns the bit error count back to the sender in a new STAMP TLV
   b. Clears the bit errors in the extra padding using pattern matching and reflects the TLV to measure Residual BER in the reverse direction



STAMP Extensions: Define two new STAMP TLVs.

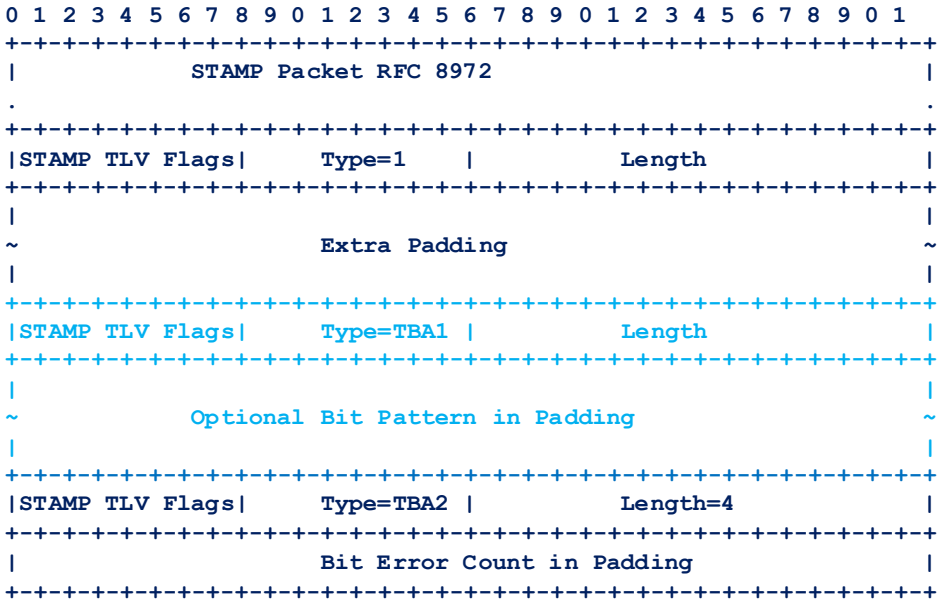
1. TBA1: Bit Pattern in Padding TLV
2. TBA2: Bit Error Count in Padding TLV

STAMP Extension 1 - Bit Pattern in Padding TLV

1. New STAMP “Bit Pattern in Padding” TLV (Type: TBA1) defined to carry a variable length padding pattern
2. Reflector to match the received padding pattern with the “Extra Padding” TLV to detect bit errors
3. This TLV is optional

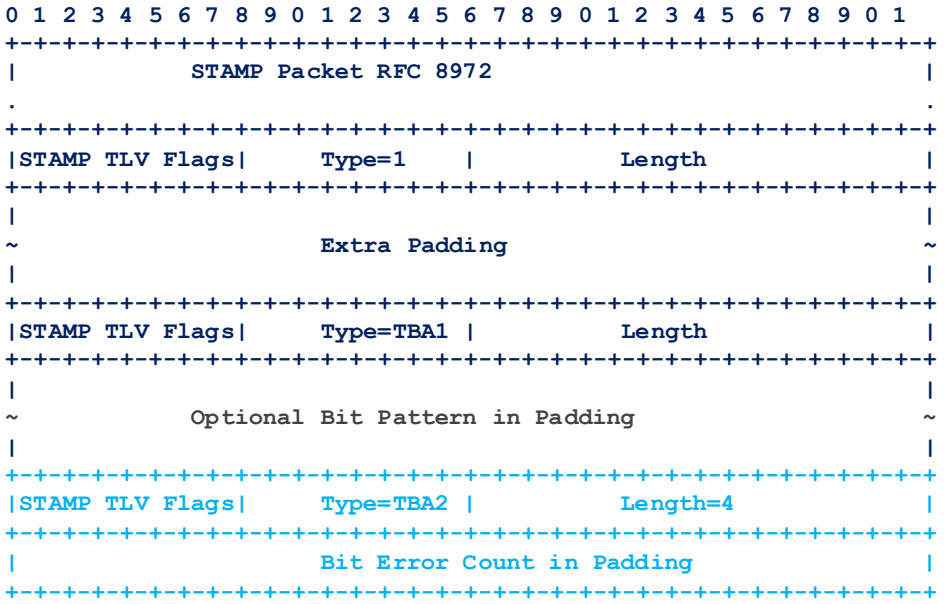
Note: It is possible that the bit pattern in the "Bit Pattern in Padding" TLV itself is corrupted.

a. Use local configuration on Sender and Reflector
b. Use default value of 0xFF00 as a bit pattern
c. Discard the measurement for that test packet



STAMP Extension 2 - Bit Error Count in Padding TLV

1. New STAMP “Bit Error Count in Padding” TLV (Type: TBA2) defined to carry bit error count
2. The reflected “Bit Error Count in Padding” TLV returns the (forward direction) error count to the Sender



STAMP Extension 3 - Conformant (C Flag) Checking

- C flag in STAMP TLV flag [draft-ietf-ippm-asymmetrical-pkts] to indicate inconsistency of TLVs in the test packet.
- Packet must conform to:
  - ✓ One Extra Padding TLV
  - ✓ One Bit Error Count in Padding TLV
  - ✓ None or one Bit Pattern in Padding TLV

Considerations for Link Aggregation Group

- Measure Residual BER for each member link of a LAG
  - Separate micro-session for each member link using RFC 9534
  - Same member link in both directions using micro-session ID
- Larger padding size and faster packet transmission rate
  - Better approximation of the residual bit error rate
  - Length of the padding as the link MTU size

Configuration Data Model Parameters

1. Padding size
2. Padding bit pattern
3. Transmit interval
4. Computation interval (as a multiple of transmit interval)
   - For computing and reporting metrics

OPER Data Model Parameters

Near-end Residual PER:

a. Number of total packets received in the computation interval
b. Number of total packets received with non-zero Bit Error Count in TLV in the computation interval

Near-end Residual BER:

a. Number of total bits in the padding TLV of all received packets in the computation interval
b. Number of total Bit Error Count in TLV of all received packets in the computation interval

Far-end Residual PER:

a. Number of total packets received in the computation interval
b. Number of total packets received with bit errors in the computation interval

Far-end Residual BER:

a. Number of total bits in the padding TLV of all received packets in the computation interval
b. Number of total bit errors in all received packets in the computation interval

Threshold Check for Telemetry and Alarms

- Threshold check every computation interval for forward and reverse directions
  - Residual Bit Errors per Million Bits
  - Residual Packet Errors per Million Packets

Implementation

An open-source implementation of the STAMP [RFC 8762] available in Teaparty.

- https://github.com/cerfcast/teaparty

Implementation of Residual BER:

- https://github.com/cerfcast/teaparty/commit/592558a38dbcf9b273acb2a2fe8ab0d8f16d0709

And (bonus!) there is support for Residual BER in the Wireshark dissector:

- https://github.com/cerfcast/teaparty/commit/608b9e89fce2f25ed88eaa367d0bacc693845da2

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Next Steps

- Thanks to William Hawkins, Ruediger Geib, Greg Mirsky, Zhenqiang Li, Xiao Min for review comments
- Welcome further review comments and suggestions
- Requesting WG adoption

Thank you!