Explicit Flow Measurements

draft-ietf-ippm-explicit-flow-measurements-01

https://datatracker.ietf.org/doc/draft-ietf-ippm-explicit-flow-measurements/

WG Last Call

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Explicit Flow Measurements: Recap

The Problem

- Network Operators must be able to detect and troubleshoot packet loss and latency problems
- To do that, they must observe the problem as it is happening, both within one's network and on the borders of one's network
- But encrypted transports hide any usable header information!
  - Concern with disclosing too much information, compromising user privacy
  - Concern with on-path devices enforcing header format, ossifying the protocol

❖ Other applications (draft-fz-core-coap-pm)

The Solution

- Develop explicit measurement techniques that use just a few bits
  - Fewer bits => the easier privacy and security analysis, and less information is inadvertently disclosed
  - Explicit signal => not integral to the protocol and can be greased or enabled by clients on demand only

Explicit Flow Measurements (EFM): Bits

Prior

- S: Latency spin bit implemented in QUIC v1 (RFC 9000) and further described in draft-ietf-quic-manageability

This draft adds new EFM bits to the menu

- D: Delay bit (with the “hidden RTT” option: D^-bit)
- T: Round trip loss bit
- Q: Square bit
- L: Loss event bit
- R: Reflection square bit
- E: ECN echo event bit

EFM: Latency Metrics Summary

Bits Used	Bits	Unidirectional Observer	Bidirectional Observer	# of Measurements	Impairment Resiliency
S Spin Bit	1	RTT	x2 Half-RTT	Very High	Low
D Delay bit	1	RTT	x2 Half-RTT	Medium º	High
D^ Hidden Delay bit	1	RTT^	x2 Left Half-RTT^ Right Half-RTT	High ~	High
SD Spin + Delay bit *	2	RTT	x2 Half-RTT	Very High	High

º It depends on the "application delay" threshold (e.g. E=1 ms.), causing DbS discarded, and on DbS losses. But many of these missing measurements are "error" measurements.

~ The "application delay" threshold (e.g. E=1 ms.) is only on the Server (see previous note).

* Both algorithms work independently; an observer could use approximate spin bit measures when delay bit ones are unavailable.

X2 Same metric for both directions.

^ Masked metric (real value can be calculated only by those who know the Additional Delay).

EFM: Loss Metrics Summary

Bits Used	Bits	Unidirectional Observer	Bidirectional Observer	Proto	Measurement Fidelity	Measurement Delay
T round Trip loss bit	1+spin	Round Trip	Round Trip Half-RT x2	*	Rate by sampling $\frac{1}{3}$ to $\frac{1}{3*ppa}$ pkts over 2 RTT	~6 RTT
Q sQuare bit	1	Upstream	Upstream x2	*	Rate over N packets (e.g. N=64)	N packets (e.g. B-64)
L Loss event	1	End-to-End	End-to-End x2	#	Loss shape and rate	Min: RTT Max: RTO
QL sQuare + Loss event	2	Upstream Downstream End-to-End	Upstream x2 Downstream x2 End-to-End x2	# 	→ see Q → see Q|L → see L	→ see Q → see L → see L
QR sQuare + Reflection square bit	2	Upstream "3/4 RT" Opp. Dir. E2E	Upstream x2 "3/4 RT" x2 End-to-End x2 Downstream x2 Half-RT x2	*	Rate over $N * ppa$ packets (e.g. N=64)	Upstream: see Q Others: $N * ppa$ pkts (e.g. N=64)

*	All protocols	x2	Metric in both directions	ppa	Packets-per-Ack
#	Protocols with loss detection	Q|L	See Q if Upstream loss is significant; L otherwise		

Real World Implementations

Production implementations reported by the contributors:

- ✓ **Akamai - Orange** implementation => Akamai production CDNs and Orange core network probes in multiple countries on multiple continents
- ✓ **Telecom Italia - TIM** implementation => Android mobile phone probe
- ✓ **Ericsson** implementation => core network probes
- ✓ **Huawei** implementation => work in progress

University implementations:

- ✓ **Aachen University** implementation: ANRW paper (*Packet Loss measurements: L, Q, R, T bits*) and Intel Tofino Implementation (paper)
- ✓ **Politecnico di Torino** is developing explicit performance probes.
- ✓ **Technion** (Israel Institute of Technology) is developing explicit performance probes.

IETF Hackathons

- ✓ **"QUIC Measurements"** project

Draft History

- **IPPM WG adoption on October 22, 2021**
- **WG Last Call started on July 6, 2022**
- **Substative feedback received from Marcus on July 26**
  - **Is there value in the "Hidden" part of the Delay bit technique, or is this of limited practical value since the "hidden" offset is easy to uncover?**
  - **WG discussion on this topic (and other topics) is welcome**
- **Extending WG Last Call?**

Please, read the draft and provide WG Last Call feedback!