TCP and SCTP RTO Restart

draft-hurtig-tcpm-rtorestart-03

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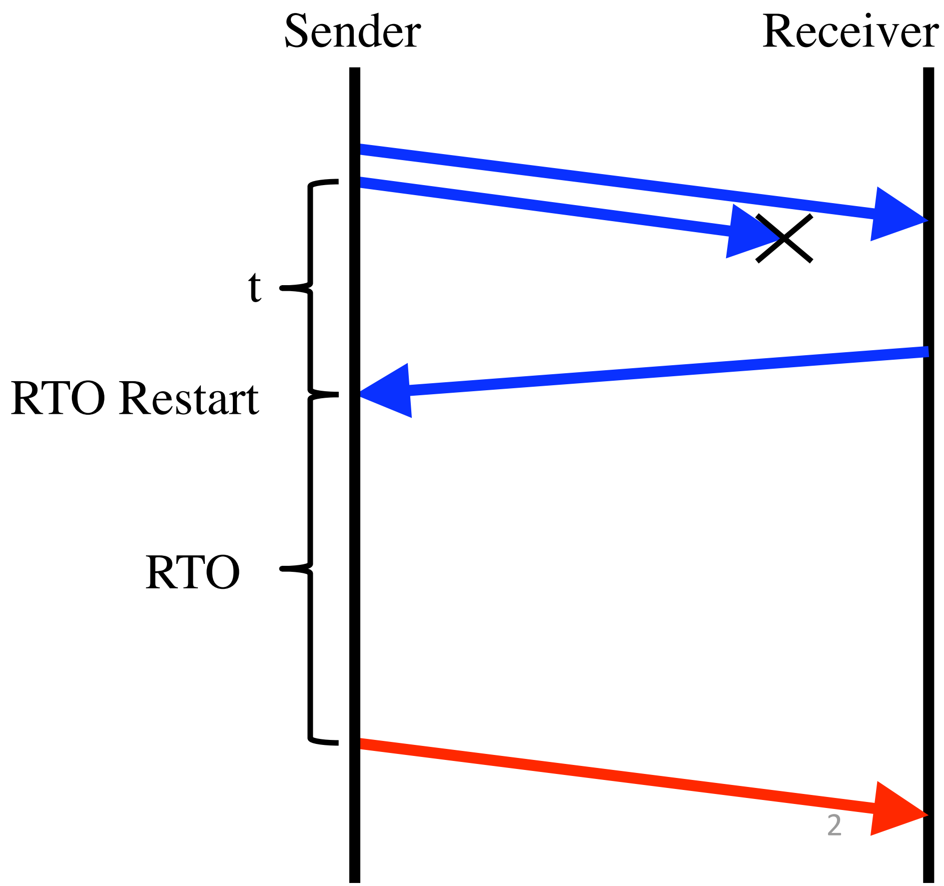
TCPM, 85th IETF Meeting
6. 11. 2012

The problem

- Sometimes, RTO must be used for loss recovery
  - e.g., if a connection has 2 outstanding packets and 1 is lost
- However, the effective RTO often becomes RTO = RTO + t
  - Where t ≈ RTT [+delACK]
- Because the timer is restarted on each incoming ACK (RFC 6298, RFC 4960)



TCP and SCTP RTO Restart

- To allow retransmissions after exactly RTO seconds, the timer is restarted as RTO = RTO – t
  - Requires storing the 4 most recent timestamps
- The modified restart is only used when
  - the number of outstanding segments < 4;
  - and there is no unsent data ready for transmission.
  - Thus, only flows incapable of FR can use modified RTO restart
- Risk of spurious timeout seemed low in initial experiments
- Note: this algorithm is still the same
  - Variations were proposed and discussed, but dismissed

RTO restart vs. TLP

- RTO restart
  - focus on thin streams, limited to max. 4 outstanding segments
  - makes the RTO timer expire after exactly RTO seconds more often
- TLP
  - send up to two "probe segments" when a different (Probe Timeout, PTO) timer fires
  - PTO timer is set to 2 RTTs, which is sometimes smaller than the RTO
    - Spurious PTO is not a big deal compared to spurious RTO

Example: thin stream

- App-limited case
  - TLP: a "probe segment" is a new segment if new data is available, *else a retransmission*
  - PTO applies to max. 2 packets, RTO restart applies to max. 3 packets
  - PTO fires after 2 RTTs, RTO restart fires after (“correct”) RTO

Example: repeated web downloads

- End of a larger window
  - TLP: PTO timer fires after 2 RTTs
  - Spurious PTO: send up to 2 unnecessary packets
  - Spurious RTO from RTO restart: impact worse, but:
    - Unlikely because of RTO variation "safety net"
    - Spurious RTO's effect limited if application's sending pause > RTO (cwnd should become RW anyway)

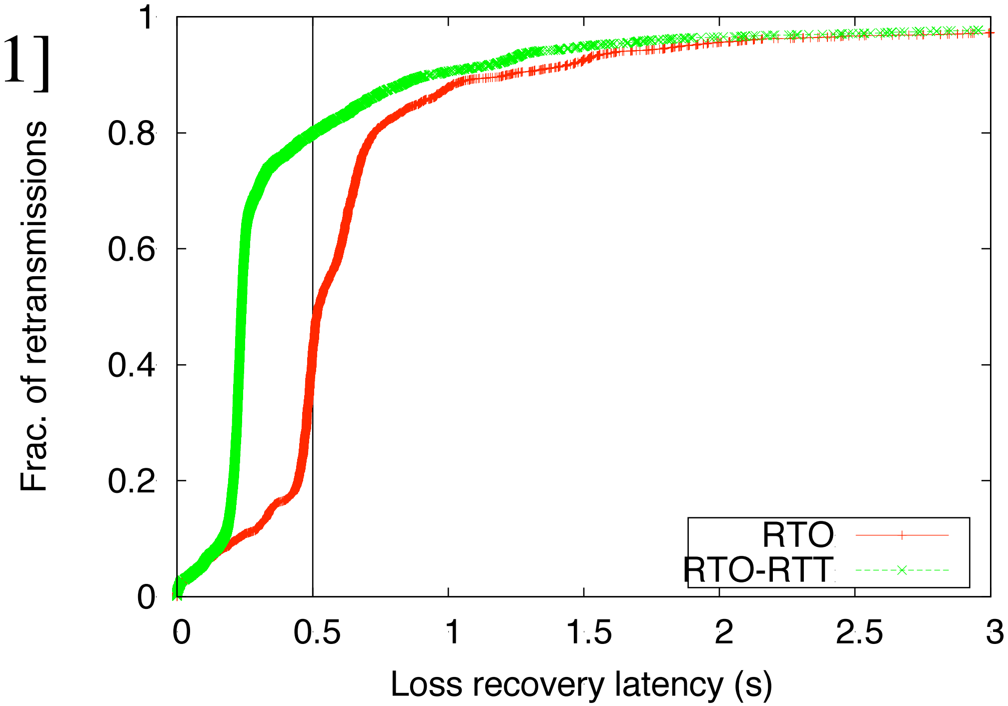
Backup slides

What if we use both?

- TLP could kick in in situations where RTO restart does not
- TLP could overrule (= retransmit packets earlier) RTO restart in cases where (# outstanding segments < 4) and no new segments are available for transmission.
- RTO restart reduces the probability that TLP is activated because PTO might be farther than RTO

Faster Recovery Needed?

- One extra RTT could lead to performance problems for short-lived (e.g. web) and thin streams
  - Thin streams are flows that only use a fraction of the available bandwidth (e.g. signaling, online games, chat, VoIP, …)
  - IETF 78: http://www.ietf.org/proceedings/78/slides/iccrg-4.pdf
- Example: Anarchy Online [1]
  - Approx. 1% packet loss
  - Most loss recovered using RTOs
  - Maximum tolerable latency about 500 msec [2]

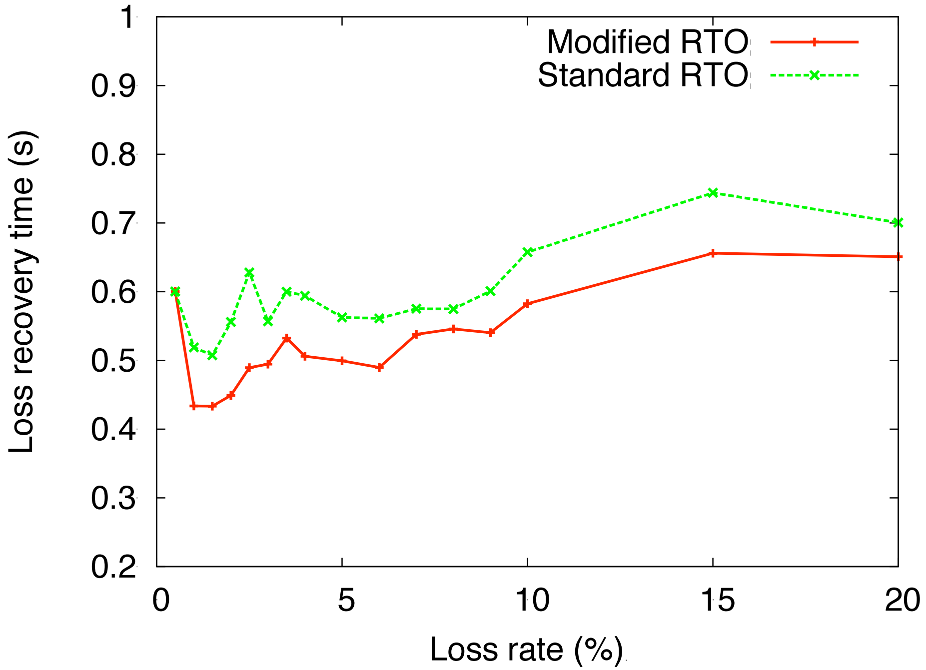


[1] A. Petlund, P. Halvorsen, P. F. Hansen, T. Lindgren, R. Casais, C. Griwodz "Network Traffic from Anarchy Online: Analysis, Statistics and Applications", In Proc of ACM MMSys, February 2012.

[2] M. Claypool and K. Claypool, "Latency and Player Actions in Online Games", In Communications of the ACM, November 2006.

Performance

- Initial simulations
  - Ns-3 (with real Linux TCP)
  - Short-lived flows
  - Multiple clients served by one host
  - Large set of bw's and delays
- Results show that
  - Loss recovery times are reduced with approximately 1 RTT on average
  - The amount of spurious RTOs is slightly higher than for regular TCP (<1% more)
- New experiments underway
  - Congestion losses
  - New RTO management alg.
  - To investigate burst situations more thoroughly



Results from 200 concurrent flows with 100 ms RTT