Computing TCP's Retransmission Timer

`draft-paxson-tcp-rto-00.txt`

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Goals

- Document RTO timers principles and have traditionally been implemented.
- Leave changes to the traditional behavior for later discussion, research, haggling, documents.
- Non-goal: The congestion control implications of the RTO timer expiring are covered in RFC 2581.

Basic Algorithm

- The basic RTO computation algorithm is from Jacobson [JK88].
- Until an RTT measurement is taken a TCP SHOULD set RTO=3 seconds, per RFC 1122 [Bra89].
- After taking the first RTT sample (R) a TCP MUST set:

  $SRTT \leftarrow R$
  $RTTVAR \leftarrow R/2$
  $RTO \leftarrow SRTT + K \cdot RTTVAR$

  (where $K = 4$)

Basic Algorithm (cont.)

- For each subsequent RTT sample (R') a TCP MUST set:

  $$RTTVAR \leftarrow (1 - \beta) \cdot RTTVAR + \beta \cdot \mid SRTT - R' \mid$$
  $$SRTT \leftarrow (1 - \alpha) \cdot SRTT + \alpha \cdot R'$$

  (where $\alpha = 1/8$ and $\beta = 1/4$)

- Also, update RTO, per:

  $$RTO \leftarrow SRTT + K \cdot RTTVAR$$

Basic Algorithm (cont.)

- Bounds on RTO:
  - If the computed RTO is less than 1 second, the RTO SHOULD be rounded up to 1 second.
    - Allman/Paxson [AP99] suggests this is important in making the timers conservative.
  - A maximum value MAY be placed on RTO provided it is at least 60 seconds.

Taking RTT Samples

- Per Karn's algorithm [KP87], a TCP MUST NOT take RTT samples from segments that have been retransmitted.
  - The exception is when the timestamp option (RFC 1323 [JBB92]) is used.
- At least one RTT sample MUST be taken every round-trip time (unless prevented by Karn's algorithm)

Clock Granularity

- No requirement on clock granularity (G).
- However, if $RTTVAR$ is calculated as zero, $RTTVAR$ MUST be set to G seconds.

Managing the RTO Timer

- The following algorithm MUST be used to start/stop the RTO timer:
  - When data is sent, set timer to expire after RTO seconds if the timer is not already running.
  - When all outstanding data has been ACKed, turn off timer.
  - When an ACK covering new data is received, restart the RTO timer.

Managing the RTO Timer (cont.)

- When the retransmission timer expires:
  - Retransmit the earliest segment that has not yet been acknowledged.
  - A TCP MUST set $RTO \leftarrow RTO \cdot 2$ ("backing off the timer")
  - Restart the timer such that it expires after RTO seconds (for the value of RTO after the above doubling).
  - Perform congestion control per RFC 2581.