TCP for Large Congestion Windows

High Speed TCP(HSTCP)

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Problem Statement

- TCP's average congestion window is roughly $1.2/\sqrt{p}$.
  where

$$p = \frac{\text{number of packets marked or number of packets dropped}}{\text{total number of packets sent}}$$

  p is known as packet drop rate
- Maintaining an average cwnd of at least1.2×10^k packets requires a packet loss/corruption rate of at most 10^{2k}
- A Standard TCP connection with:
  - 1500-byte packets
  - a 100 ms round-trip time
  - a steady-state throughput of 10 Gbps

  would require:
  - an average congestion window of 83,333 segments
  - and at most one drop (or mark) every 5,000,000,000 packets (or equivalently, at most one drop every 1 2/3 hours).
- this is not possible!!

What is High Speed TCP

- Just like Standard TCP when cwnd is low
- More aggressive than Standard TCP when cwnd is high.
- important question is when is cwnd is low and at what point it is going to differ with standard TCP.
- if the size of cwnd is 38 segments then it is considered as low cwnd and standard TCP is followed.
- but if size of cwnd is more than 38 segments then HSTCP is followed.

How is TCP is different from HSTCP

- A standard TCP flow in congestion avoidance increases its window by at most one packet per round-trip time and
- a multiplicative decrease of halving the current congestion window
  but in case of HSTCP :
- the congestion window increase by a(cwnd) segments per round-trip time in the absence of congestion.

$$cwnd = cwnd + a(cwnd)$$

  where a(w) is 1 for standard TCP
- In case of congestion the congestion window is reduced by b(cwnd) as

$$cwnd = (1 - b(cwnd)) * cwnd$$

  where b(w) is 0.5 for standard TCP

How is a(cwnd) and b(cwnd) is calculated: Algorithm

- important variables used in the algorithm are:
  - cwnd = current congestion window size.
  - Low_Window = 38 segments, used to differ from standard TCP.
  - High_Window = 83000 segments.
  - High_P=10^{-7}
  - High_Decrease =0.1 (ie decrease by 10%)

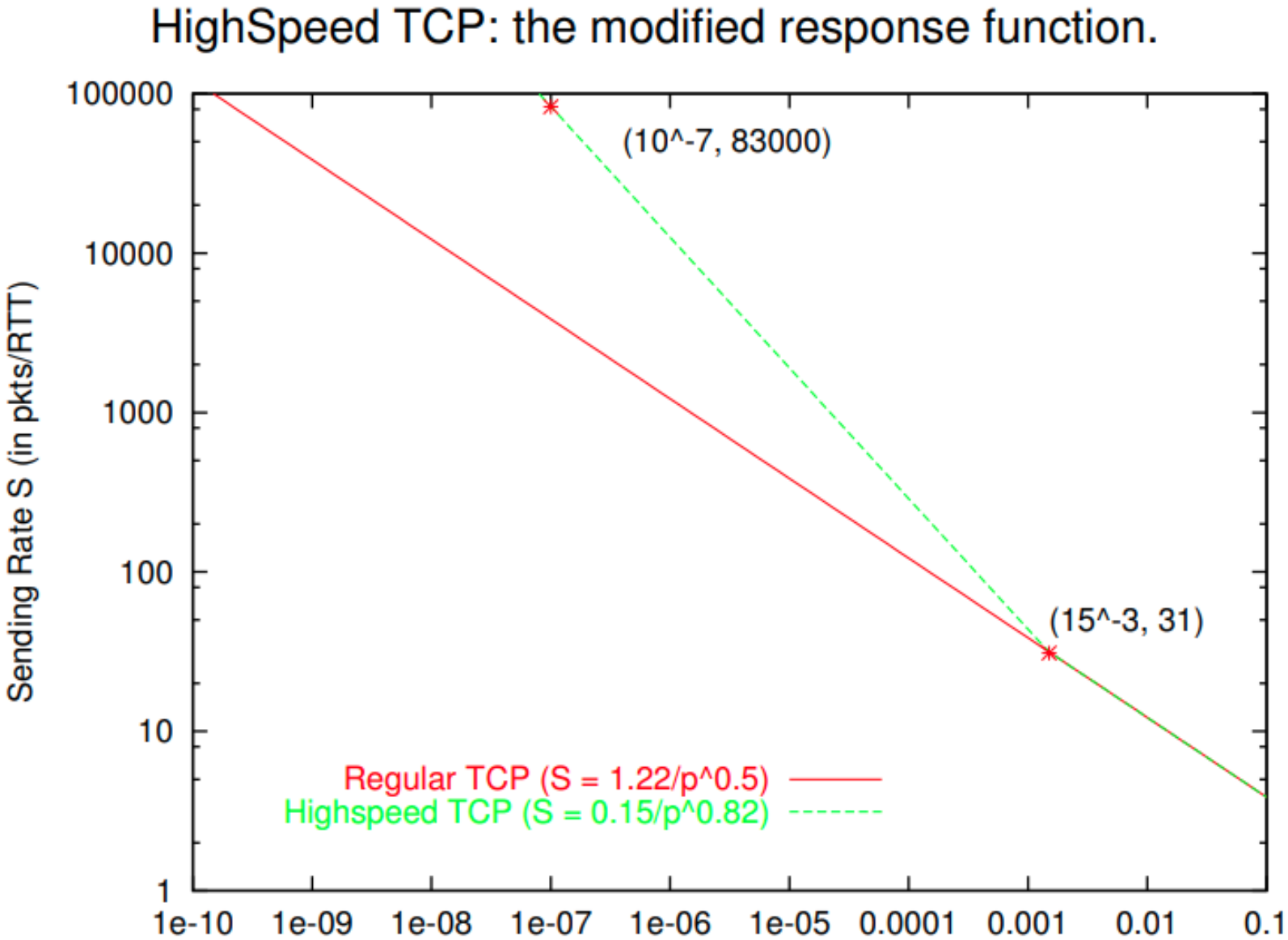
Algorithm: Sudo Code

- Remember 2 imp formula :
  - for increasing cwnd, $cwnd = cwnd + a(cwnd)$
  - during congestion, $cwnd = (1 - b(cwnd)) \times cwnd$
- if $cwnd \leq Low\_Window$
  use standard TCP , a(cwnd)=1 and b(cwnd)=0.5
- if $(cwnd > Low\_Window) \wedge (cwnd \leq High\_Window)$
  $b(cwnd) =$
  $(High\_Decrease - 0.5) \frac{(log(cwnd) - log(Low\_Window))}{(log(High\_Window) - log(Low\_Window))} + 0.5$
  $a(cwnd) = w^2 \times p(cwnd) \times 2 \times b(cwnd)/(2 - b(cwnd))$
  $p(cwnd) = \frac{0.078}{w^{1.2}}$

Algorithm: Contd..

- if$cwnd > High_Window$
  $b(cwnd) = High\_Decrease$
  $a(cwnd) = High\_Window^2 \times High\_P \times 2 \times b(w)/(2 - b(w))$

Comparison between standard TCP and HSTCP



Problems with HSTCP

- Unfair
  - it is unfair to the devices which will be using standard TCP as in HSTCP the rate at which we are increasing the window size is more and
  - also during the congestion standard TCP reduce congestion window by half while in HSTCP we reduce by small amount as comparison to standard TCP.
  - it is also unfair to new HSTCP connection if already a older HSTCP data packets are present on the same bandwidth.

References

- RFC 3649 : https://www.ietf.org/rfc/rfc3649.txt
- Home page HSTCP :http://www.icir.org/floyd/hstcp.html
- Wiki page:https://en.wikipedia.org/wiki/HSTCP