H-TCP: TCP Congestion Control for High Bandwidth-Delay Product Paths

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The pipe size of a link is roughly $BT + q_{\text{max}}$

where $B$ is the link rate (packets/s), $T$ is the propagation delay and $q_{\text{max}}$ is the queue size.

On a long distance gigabit link, $B=100,000$ packets/s, $T=200\text{ms}$, $q_{\text{max}}=1000$ and

$$BT + q_{\text{max}} = 21,000$$

Note that the pipe size determines the peak window size of a TCP source.

High Bandwidth-Delay Product Paths

- TCP becomes sluggish, and requires v.low drop rate to achieve reasonable throughput.
Background

• Scalable TCP
• High-Speed TCP
• FAST TCP

etc

Moving forward
Seek to re-open discussion on congestion control algorithms for high BDP paths

Guiding principle - seek smallest changes to TCP that yield scalability with respect to BDP.
H-TCP - Adjust increase rate as function of time since last backoff

$cwnd \leftarrow cwnd + \frac{f(T)}{cwnd}$

$T$ elapsed time since last backoff
$f(.)$ determines response function.

Preserves symmetry in network (newly started flows with small $cwnd$ compete on level playing field).

- Responsiveness (measured in congestion epochs) similar to standard TCP
- Fairness properties (including RTT unfairness) similar.
- Backward compatibility guaranteed on low BDP paths.
- Aggressiveness/response function is a design parameter.
Current Status

Extensive experimental testing over last two years or so
- SLAC 2004
- Hamilton Institute 2005
plus misc smaller tests by various groups.

Stable algorithm/Linux implementation

Ongoing testing in more diverse environments

Initial I-D to solicit comments.
Example  Scalable TCP

Scaleable TCP  has convergence issues …