HighSpeed TCP for Large Congestion Windows

- Designed as minimal change to TCP to allow use of high-bandwidth paths.
- Response function: $S=0.15/p^{0.82}$, for S the sending rate in pkts/RTT.
- Limited Slow-Start.
- Approved by IETF as Experimental.

- Joint work with Sylvia Ratnasamy and Scott Shenker, additional contributions from Evandro de Souza, Deb Agarwal,Tom Dunigan.
- www.icir.org/floyd/papers/

Performance of a HighSpeed TCP connection

Bandwidth	Avg Cwnd w (pkts)	Increase a(w)	Decrease b(w)
1.5 Mbps	12.5	1	0.50
10 Mbps	83	1	0.50
100 Mbps	833	6	0.35
1 Gbps	8333	26	0.22
10 Gbps	83333	70	0.10

Is HighSpeed TCP addressing a pressing problem in practice?

- Nope.   Users can do one of the following:
    - Open up N parallel TCP connections; or
    - Use MulTCP (roughly like an aggregate of N virtual TCP connections).

- However, we can do better:
    - Better flexibility (no N to configure);
    - Better scaling (bandwidths, numbers of flows);
    - Better slow-start behavior;
    - Competing more fairly with current TCP (where TCP is able to use the available bandwidth).

QuickStart: How to start up quickly?

- An expired internet-draft.
- In an IP option in the SYN packet, the sender's desired sending rate:
  - Routers on the path decrement a TTL counter,
  - and decrease the allowed initial sending rate, if necessary.

QuickStart, cont.

- The receiver sends feedback to the sender in the SYN/ACK packet:
  - The sender knows if all routers on the path participated.
  - The sender has an RTT measurement.
  - The sender can set the initial congestion window.
  - The sender continues with AIMD as usual.
- From an initial proposal by Amit Jain.

How do we evaluate proposals in this space?

- **Many metrics:** utilization; delay; drop rates; fairness; convergence times; transfer times; oscillations.

- **Models:** competing traffic: range of connection sizes and of RTTs?; reverse-path traffic?; flows limited by slower links?; packet sizes?

- **Balancing the present and the future:** AQM or Drop-Tail? ECN? Many highspeed flows, or just one?

- E.g., "Internet Research Needs Better Models", with Eddie Kohler, Hotnets I.

Architectural sub-themes favoring incremental deployment:

- A goal of incremental deployment in the current Internet.

- Steps must go in the fundamentally correct, long-term direction, not be short-term hacks.

- Robustness in heterogeneous environments valued over efficiency of performance in well-defined environments.

- A preference for simple mechanisms, but a skepticism towards simple traffic and topology models.

- Learning from actual deployment is an invaluable step.

- The Internet will continue to be decentralized and fast-changing.