Simulation Based Study of TCP Fairness in Multi-Hop Wireless Networks

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Why study TCP fairness in wireless networks?

- Current TCP versions are optimized for wired networks
- high bit error rate
- mobility
- continuously changing topology
- few formal studies of the subject

Background

- congestion control
- TCP Tahoe
- TCP Reno
- TCP New Reno
- TCP SACK

Background (2)

- Flows with different round-trip times can cause unfairness
- Flows that got head-start can starve new flows
- Different solutions for increasing TCP performance have been suggested (ECN, Split TCP, Snoop TCP, etc.)

Fairness criteria

- Closeness of achieved throughput to its fair share
- Properties of good fairness measuremens

Fairness criteria (2)

- Max-Min Fairness

$$U = \max_i \left| \frac{A_i - F_i}{F_i} \right|$$

$$F_i = MMF_i\,(C, d_1, d_2, \ldots, d_n)$$

Simulation model

- OPNET modeller was used
- Five stationary sender and receiver nodes
- Each FTP flow starts at the same time
- Simulation parameters follow IEEE 802.11b standard
- Packet size, receive buffer size and traffic loads are varied (with and without RTS/CTS)

Results

- Only tentative conclusions
- TCP is more fair at higher loads without RTS/CTS and vice versa with RTS/CTS
- Large TCP receive buffer improves fairness
- Packet size is dependent on receive buffer size for yielding a higher TCP fairness
- TCP Tahoe is least unfair but its throughput is poor

Critique

- A lot of good background information…
- …but in some parts unnecessary details are covered
- It's difficult to say if TCP fairness is a minor or major problem in wireless networks based on this study
- Effect of error rates in network is not covered
- No mobility
- Only one network topology