The problem of explict-control-based transport protocols in wireless networks

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Abstract-- **Recently, control theory has been applied to the study of network protocols. One such example is XCP, a new Internet transport protocol that uses explicit router feedback to control congestion. Analytical and simulation studies have shown that XCP's control feedback loop is stable.**

We have conducted an experimental study of XCP in a wireless network and discovered that it may not converge. Through an analysis of XCP's control law we found that stability of XCP's control feedback loop relies on an accurate estimation of the link capacity. Unfortunately, it is well understood in wireless communications that an accurate prediction of a wireless channel is very difficult to achieve. This means that, in wireless networks, any feedback control based protocol must deal with the mismatch of estimated capacity and actual capacity.

To further study this problem, we have conducted a control theoretic analysis of XCP protocol and studied its properties in the presence of capacity estimation errors. With a revised fluid model, we discovered that XCP will not settle at zero steady-state error. However, we also found that the steady-state error is bounded by the estimation error, and this bound can be exploited in router queue size planning.