5.2 LE with Various Congestion Control Algorithms

We evaluated the performances of the new loss recovery algorithm with two different congestion control algorithms: TCP-Westwood and TCP-RR. The results are shown in Figure 9, and our main observations are as follows.

- Though the new loss recovery algorithm achieved better performance with TCP-Westwood, the performance improvement was not as significant as that in the simulation of Figure 6(c).
- With TCP-RR congestion control, a performance improvement of 50% was observed when the loss rate is high.

5.2.1 TCP-Westwood

First, the performance of LE was better than that of FACK. At the loss rate of 10%, LE achieved more than 4Mbps while SACK and FACK achieves approximately 3.5Mbps. The line with triangle tick shows the throughput with a fixed congestion window of 10, which can be considered as an upper bound. Observe that the throughput slowly decreased with increasing loss rate. Even though LE did not approach the ideal line, it achieved almost 80% of the ideal value.

Second, though LE achieved a relatively higher throughput, the testbed results were very different from the simulation results of Figure 6(c). We expected a much better performance of LE with Westwood congestion control. We investigated the issue to determine the possible causes of the large discrepancies between the simulation and emulation. It turned out that the Westwood available bandwidth algorithm did not function as well in the testbed experiment as in the simulation. When packet loss rate was less than 0.1%, the measured bandwidth approached the correct one. However, when the loss rate was greater than 1%, the measured bandwidth is smaller by 1Mbps, which is why the testbed results are poorer. Because the estimated bandwidth was so low in the testbed, a worse performance was concluded for Westwood. For this reason, the throughputs of all loss recovery algorithms exponentially decreased at packet loss rates greater than