SCTP vs TCP : Performance Comparison in MANETs

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Abstract

We provide a simulation-based performance comparison of SCTP vs TCP in MANET environments. We conclude that behavior of SCTP and TCP in MANETs is similar, but TCP outperforms SCTP in most cases because of extra overheads present in SCTP.

1. Introduction

Transmission Control Protocol (TCP) [4] has been shown to perform poorly in MANETs. *Stream Control Transmission Protocol* (SCTP) [5] is a new transport layer protocol developed with the goal of overcoming limitations of TCP. It has support for both multistreaming and multihoming, apart from other new features. However, additional overheads associated with extra supports may hinder the expected performance improvement. Here, we present a performance comparison of both the protocols through simulations.

2. Performance Evaluation

Network Simulator (NS-2) [1], together with SCTP patch [2], was used for simulations. The scenario consisted of 46 mobile nodes placed in a 1000m by 300m rectangle, using *Random Way Point* mobility model. First set of simulations (for varying mobility) contained background traffic consisting of 10 CBR connections each with data rate of 16 Kbps. The raw link bandwidth was 2 Mbps. One TCP connection (or one SCTP association) was started after all the CBR connections were running. Total transport protocol run time was 900 seconds. SACK (Selective ACK) enabled version of TCP was used for the simulations. The MTU for each link was kept at 1500 bytes. The TCP segment size was kept at 1400 bytes while each SCTP data chunk was of size 700 bytes. Chunk bundling was enabled for SCTP, allowing 1400 bytes in 1 data packet. The initial congestion and flow control parameters for both TCP and SCTP were kept same. AODV [3] routing protocol was used. Second set of simulations involved varying network load by varying the CBR traffic rate. For each case in both simulation sets, performance metrics were averaged over simulation run on 12 scenarios. The multihomed endpoints had two interfaces. **Goodput**, **Connect time**, **No. of retransmissions** and **SACK bandwidth**, were the metrics on which we evaluated the performance.

3. Results and Discussion

3.1. Results

The simulations were performed for three combination of *multihoming/mobility* cases – **No Multihoming, Mobile**; **Multihoming, Mobile**; and **Multihoming, Stationary** nodes. The results for each of these were similar, each showing decreasing goodput and increasing retransmissions with increased mobility, as expected. Goodput of SCTP remains slightly lower than that of TCP, while SACK bandwidth showed opposite trend. Most importantly, it was noticed that SACK takes up an order of magnitude more bandwith in case of SCTP than TCP. *Connect time* graph showed no particular trend in all cases. The graphs for *Multihoming, Mobile Nodes* are shown in Figures 1, 2, and 3.

Simulations involving varying network load gave expected results, with goodput and SACK bandwidth decreasing sharply with increasing background traffic, while connect time increases correspondingly.

Proceedings of the 29th Annual IEEE International Conference on Local Computer Networks (LCN'04)
0742-1303/04 $ 20.00 IEEE

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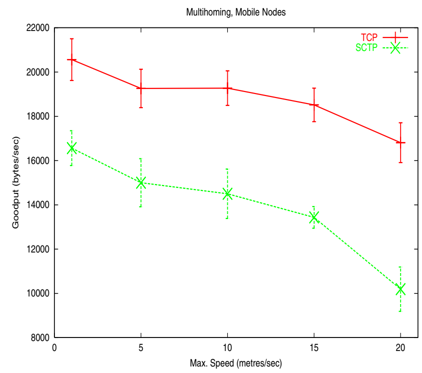

Figure 1. Goodput comparison, with 95% confidence interval.

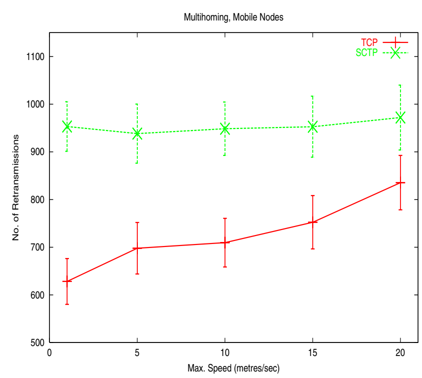

Figure 2. Retransmissions comparison, with 95% confidence interval.

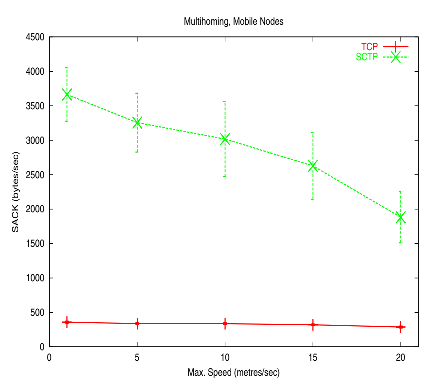

Figure 3. SACK bandwidth comparison, with 95% confidence interval.

3.2. Discussion

It can be seen that both TCP and SCTP behave identically, but TCP outperforms SCTP by a narrow margin. In a highly bandwidth-limited, high-loss network like MANET, the congestion control mechanism for both TCP and SCTP plays a major role in overall performance. However, both the protocols follow almost the same algorithm [5], leading to similarity in behavior. A major reason for poorer performance of SCTP compared to TCP could be the bandwidth taken up by SACK in case of SCTP (Fig. 3). The difference between SCTP and TCP goodput is about the same as the difference between SACK bandwidth of SCTP and that of TCP. SCTP defines a special chunk – *SACK Chunk*, as the way of acknowledgment [5], and it has several additional fields leading to larger as well as variable size of SCTP SACK. Large and variable size of SACK (and SACK retransmission), eats up the shared bandwidth, leading to performance degradation. Moreover, additional overheads on the bandwith constrained MANET by SCTP, like heartbeats and chunk bundling, hamper performance. Also, multihoming does not improve performance, if the the routing protocol produces same intermediate path leading to every interface of a node. Thus, in real scenarios, multihoming might only help if each of the interfaces of a multihomed node is on a different network.

4. Conclusions

We demonstrated that SCTP behaves quite similar to TCP in MANETs, primarily because of similar congestion and flow control mechanisms. However the complexity and additional features of SCTP lead to its slightly poorer performance in this environment. Comparison of performance when *multistreaming* is also present in the SCTP association, may give further useful insights. Improved performance may require support from other layers like the routing layer. These issues will be investigated in further studies.

References

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