Performance Analysis of SCTP Non-Renegable Selective Acknowledgments (NR-SACKs)

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Acknowledgment Types

- Cumulative Acknowledgment (ACK) – cum-ack *n :*

(TCP) acks all data up to but not including byte *n,* (SCTP) acks all TSNs up to and including TSN *n*

- Selective Acknowledgment (SACK) – gap-ack : acks data received out-of-order
- Duplicate SACK (D-SACK) : acks data received multiple times

Reneging

- occurs when receiver gap-acks data and later discards the data without having delivered it to the receiving application
- is discouraged but permitted (Receiver's OS might need to reclaim buffer space)
- by definition, does NOT occur on data that has been delivered to the receiving application

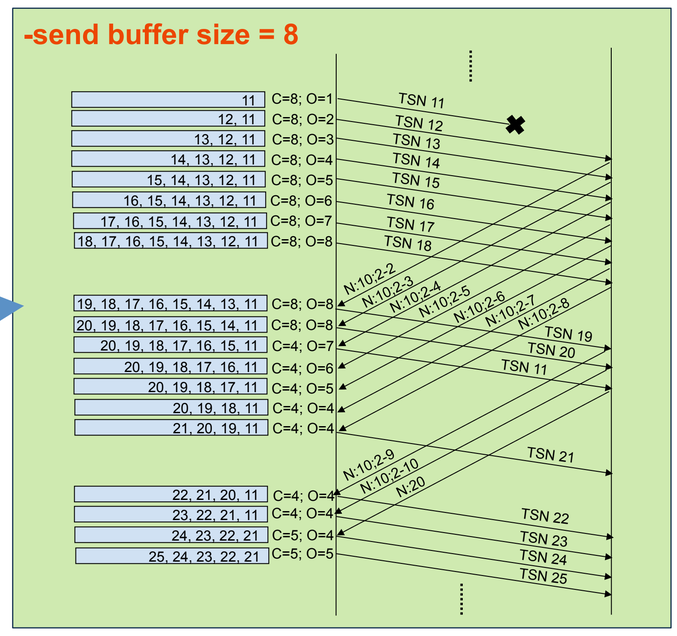
SACK Limitations

- SCTP's data receiver has no mechanism to inform a data sender about out-of-order data that has been delivered (and therefore cannot be reneged)
- SCTP's data receiver has no mechanism to inform a data sender about out-of-order data that has not been delivered *and* will never be reneged

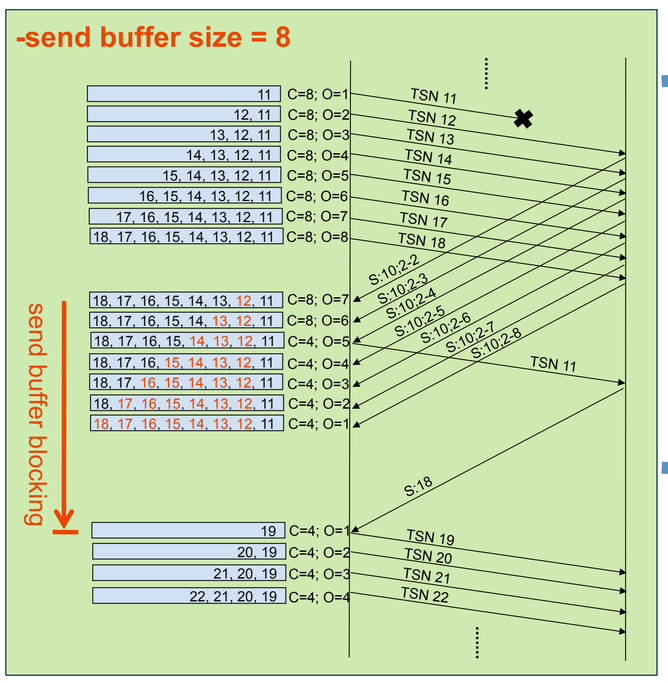
NR-SACKs

- out-of-order data is non-renegable either when the data has been delivered to the application, or when the receiver takes responsibility for delivery of the data
- NR-SACKs enable data receiver to convey the renegable vs. non-renegable nature of out-of-order data. When out-of-order data is non-renegable, the data sender is no longer responsible for the data and can remove the data from its retransmission queue

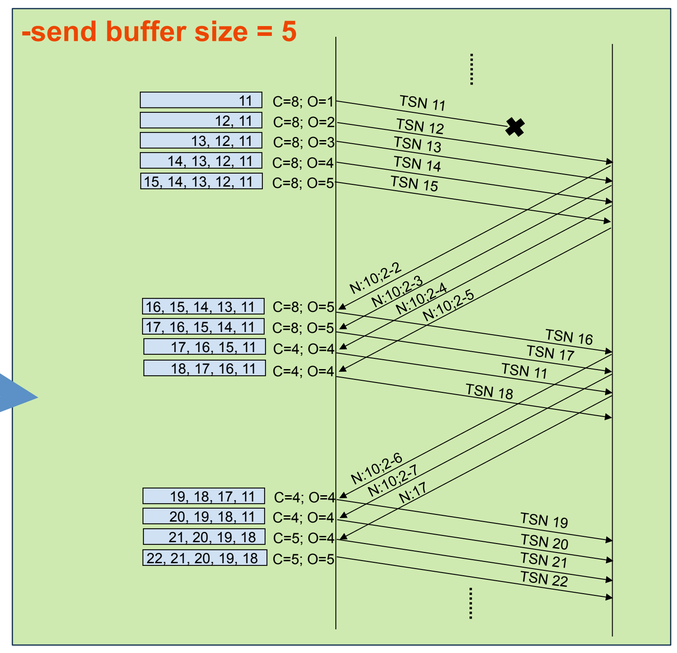
SCTP with NR-SACKs



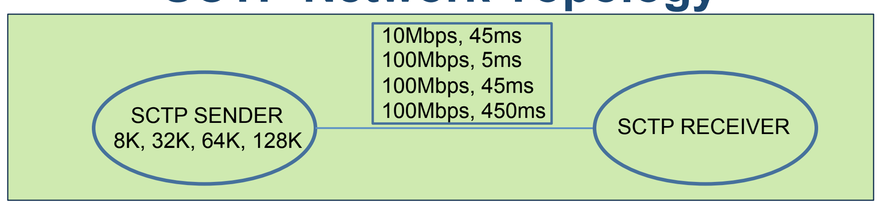
SCTP with SACKs



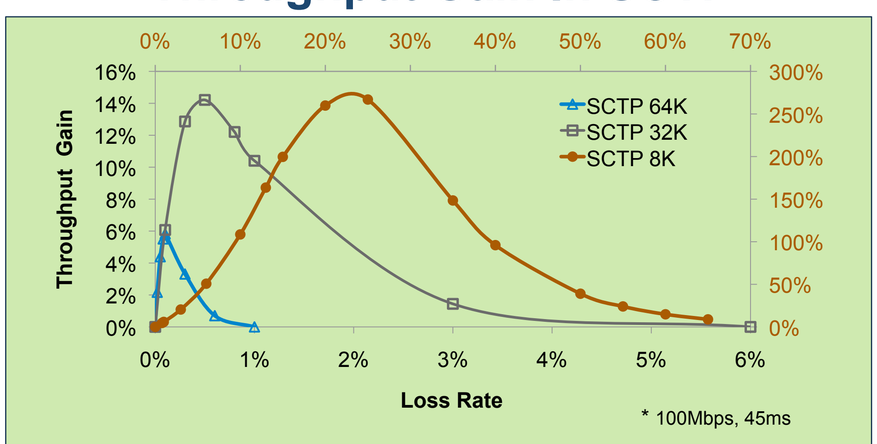
SCTP with NR-SACKs



SCTP Network Topology

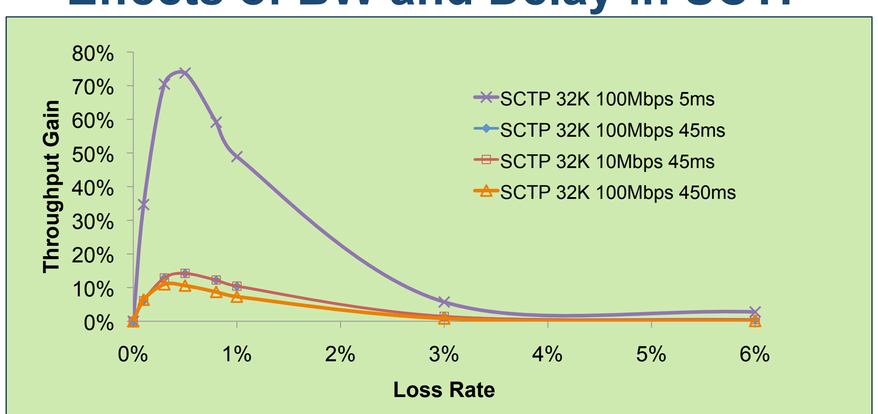


Throughput Gain In SCTP



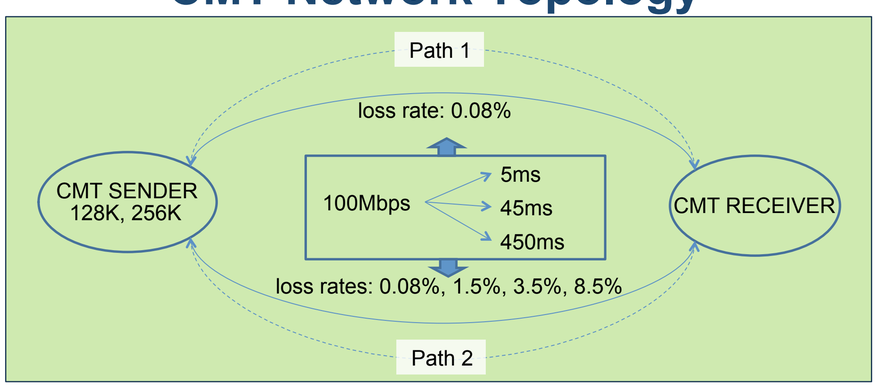
- Narrower "*region of gain"* for larger send buffers.
- Higher peak throughput gain for smaller send buffers.

Effects of BW and Delay in SCTP

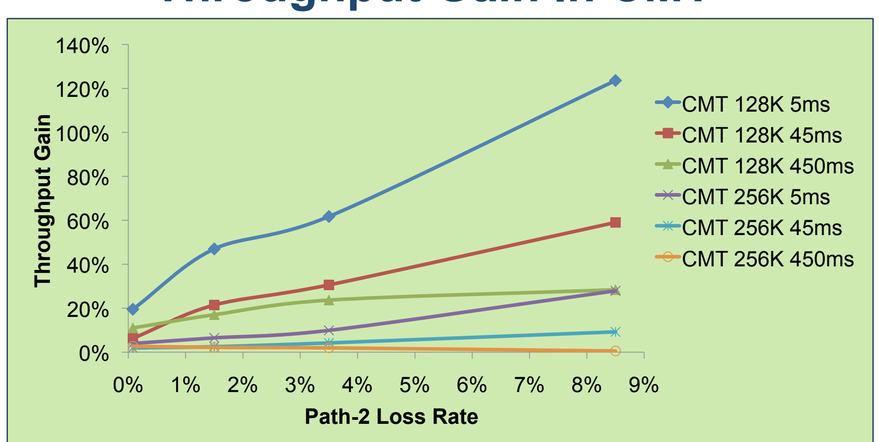


- BW has no effect on throughput gain (given BDP>SB).
- Shorter delay allows better throughput gain in SCTP.

CMT Network Topology



Throughput Gain In CMT



- Higher throughput gain as paths get more asymmetric.
- Smaller send buffer results in higher throughput gain.
- Shorter delay allows better throughput gain in CMT.

References

- P. Natarajan, P. Amer, E. Yilmaz, R. Stewart, J. Iyengar. *Non-Renegable Selective Acknowledgments for SCTP*, IETF Internet Draft: draft-natarajan-tsvwg-sctp-nrsack (in-progress)
- E.Yilmaz, N. Ekiz, P. Natarajan, P. Amer, F.Baker. *Performance analysis of SCTP Non-Renegable Selective Acknowledgements(NR-SACKs)* (in-progress)
- P. Natarajan. *Leveraging Innovative Transport Layer Services for Improved Application Performance*, PhD Dissertation, CIS Department, University of Delaware
- Preethi Natarajan, Nasif Ekiz, Ertugrul Yilmaz, Paul D. Amer, Janardhan Iyengar and Randall Stewart, *Non-Renegable Selective Acknowledgments (NR-SACKs) for SCTP*, International Conference on Network Protocols (ICNP) 2008, Orlando, October 2008.

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