SCTP Sendbuffer Advertising

CS4099 Project

Midterm Report

Arpan Kapoor (B120555CS)
Deepak Sirone J (B120097CS)
K Prasad Krishnan (B120128CS)

Guided By:
Dr. Vinod Pathari
Mr. V Anil Kumar, Principal Scientist, CSIR, Bengaluru

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1 Introduction

Stream Control Transport Protocol (SCTP) is a reliable transport protocol designed to transport Public Switched Telephone Network (PSTN) signaling messages over IP networks, but is capable of broader applications. Unlike TCP, SCTP offers sequenced delivery of user messages within multiple unidirectional logical channels called streams. Each SCTP endpoint is represented as a set of destination transport addresses, one of which is the primary address. If the primary address becomes unreachable SCTP chooses another destination transport address to route the messages thereafter. This provides network-level fault tolerance and is called multi-homing. It also employs a security cookie mechanism during association initialization to provide resistance to flooding and masquerade attacks.

Advertising the amount of backlogged data present in the sender's buffer can help network operators evaluate the end-to-end performance of a connection in a better way than that with the existing passive measurements. This information can also be used to infer whether a connection is limited by the network or the application.

2 Problem Statement

To propose a scheme to advertise sendbuffer occupancy information in SCTP, implement it in the Linux kernel and study the performance and security implications of the same.

3 Literature Survey

RFC 3286 [3] provides a high level introduction to the capabilities supported by SCTP, while RFC 4960 [4] describes the complete protocol. Agache and Raiciu [1] propose a scheme to advertise sendbuffer occupancy in TCP. [2] was used to study the state machine employed in the Linux SCTP implementation. It was also used to understand the SCTP packet flow within the kernel.

4 Work Done in the previous semester

Initially, we wrote a file transfer utility that uses SCTP as the transport protocol. We modified a kernel module called `sctp_probe` to measure and plot the sendbuffer size at regular intervals during a file transfer performed using our userspace program.

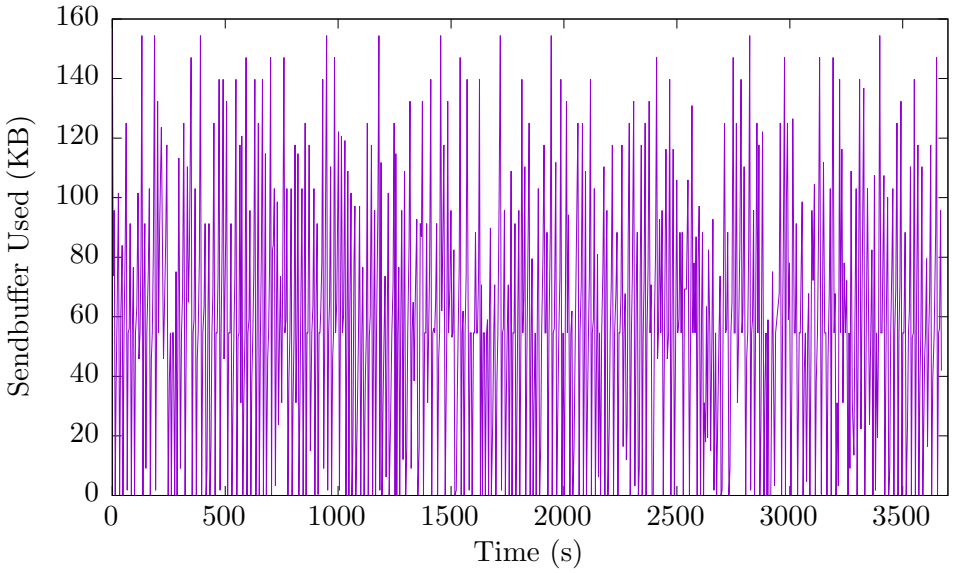

Figure 1: Sendbuffer variation during a 1 GB file transfer.

We explored the Linux kernel SCTP implementation to understand how the data from userspace is transformed into a SCTP packet and sent to the network layer. The data structures related to the state information, specifically the out queue were studied in detail. The parameter corresponding to the sendbuffer information, which is to be advertised was identified.

4.1 Design

Each chunk is formatted with a Chunk Type field, a chunk-specific Flag field, a Chunk Length field, and a Value field. Chunk Type, which takes a value from 0 to 254, identifies the type of information contained in the Chunk Value field. The Chunk Type values from 15 to 62, 64 to 126, 128 to 190 and 192 to 254 are not used presently in the SCTP implementation. For advertising the sendbuffer occupancy,a new Chunk Type value is selected from 128 to 190. RFC 4960 [4] lays out the actions when the processing endpoint does not recognize the Chunk Type (as is the case here) depending on the highest order 2 bits. RFC 4960 [4] specifies that if the chunk is not recognised by the endpoint and the highest order bits are 10, the chunk will be skipped without sending an Unrecognized Chunk Type error chunk. This ensures that proposed addition of a new Chunk Type would not affect hosts running the unmodified SCTP linux implementation.

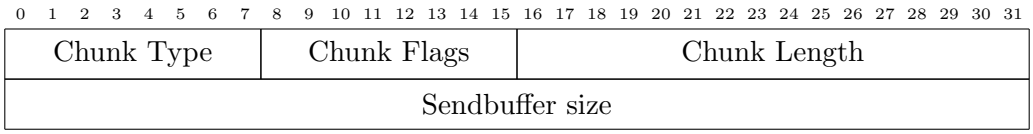

Figure 2: Proposed Chunk for sendbuffer advertisement

The overhead of 8 bytes which can come up in the proposed solution is considerable as it is just 0.53% of a 1500 byte packet.

5 Work Done in the current semester

A working prototype of sendbuffer advertisement was implemented in the Linux kernel. The interval for sending the sendbuffer advertisement chunk can be modified at runtime.

6 Future Work and Conclusions

To test the prototype of sendbuffer advertising for SCTP in the Linux kernel in a network. Security implications of the prototype will also be studied.

There are several scheduling algorithms which prioritizes packets based on some criteria. One of these priority based scheduling algorithms can be modified to consider the sendbuffer information and to improve QoS for high volume flows.

References

[1] A. Agache and C. Raiciu. *TCP Sendbuffer Advertising*. Internet-Draft draft-agache-tcpm-sndbufadv-00.txt. IETF Secretariat, July 2015.

[2] Karthik Budigere. "Linux Implementation Study of Stream Control Transmission Protocol". In: *Proceedings of Seminar on Network Protocols in Operating Systems*, p. 22.

[3] L. Ong and J. Yoakum. *An Introduction to the Stream Control Transmission Protocol (SCTP)*. RFC 3286. RFC Editor, May 2002, pp. 1–10. URL: `http://www.rfc-editor.org/rfc/rfc3286.txt`.

[4] R. Stewart. *Stream Control Transmission Protocol*. RFC 4960. RFC Editor, Sept. 2007, pp. 1–152. URL: `http://www.rfc-editor.org/rfc/rfc4960.txt`.