Implementing a Simple SRM Framework with Adaptive Loss Recovery

COMP90020 Project Proposal

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April, 2022

Background of Topic

Multicasting is a method of disseminating single copy of information from one host to a set of interested recipients, where such set is called a multicast group for Layer-3 IP multicast. According to RFC-3376, a host submits an IGMP request before it joins and leaves any multicast group, also hosts (and routers) report group memberships to any neighbouring multicast router. This one-to-many communication helps save network bandwidth by sending only one stream of data instead of multiple unicast streams.

Because most IP multicast applications must be UDP-based, datagrams aren't guaranteed to arrive in an ordered, intact, loseless manner. Lecture covered 3 possible ordering styles, which that FIFO/causal are orthogonal to total and they can hybridize. UDP checksum almost overcomes the integrity problem since it has only a very low chance to fail false positive. Thus the real issue is reliability. Our background survey finds that researchers have provided at least 2 schemes assuring receiver-based reliability in an asynchronous system - ACK or Negative ACK (NACK).

Reliable Multicast Transport Protocol[1] (RMTP) is a well-known ACK-based protocol that dynamically assigns a number of designated routers (DRs) in each region to prevent message implosion. DRs collect local acknowledgements then notify the sender periodically. Lost packets are recovered via local selective repeat retransmission, leading to a considerable decrease in end-to-end latency. However, RMTP has limited efficiency for small group size. We choose for the alternative NACK-oriented **Scalable Reliable Multicast[2] (SRM)** framework for our application development.

Algorithms

Each member multicasts session messages that involves sequence number states from active sources on a regular basis, allowing receivers to identify last packet loss. Furthermore, receivers leverage the session messages to estimate the one-way "distance" $d_{X,Y}$ between nodes in seconds.

SRM exchanges repair requests and retransmission for its global loss recovery. A request can be answered by any server that possesses a copy of the requested data. Repair requests differ slightly from traditional NACKs by sharing the same idea of the XTP[3] design. Before sending any repair request, first delay a uniformly-distributed random function time of $d_{S,A}$, where this function adapts dynamically to request delay and count of duplicate messages. If A receives a request from another receiver before the request timer expires, then it refrains from sending also adjust the timer, known to be suppressed on redundant feedback. The concept of retransmission and repair timer are similar.

Application Design

Draw & Guess is a multiplayer cooperative game on Steam. A player draws a word, the next player guesses the word that the drawing wants to represent, then another person draws the guess again. Continue the loop, let's see if the last player guessed the first word correctly.

Our team plan to develop a similar version, but instead clients will communicate via (reliable) multicast on the implemented SRM framework. Game mechanism and a state machine model will be discussed in our 5-minute video presentation: https://www.youtube.com/watch?v=Gv-Uqe6_V4E.

[1] Paul, S., Sabnani, K. K., Lin, J. C.-H., & Bhattacharyya, S. (1997). Reliable multicast transport protocol (RMTP). IEEE Journal on Selected Areas in Communications, 15(3), 407–421.

[2] Floyd, S., Jacobson, V., Liu, C.-G., McCanne, S., & Zhang, L. (1997). A reliable multicast framework for light-weight sessions and application level framing. IEEE/ACM Transactions on Networking, 5(6), 784–803.

[3] Strayer, W. T., Dempsey, B. J., & Weaver, A. C. (1992). XTP: The Xpress transfer protocol. Addison-Wesley.