Duplicating RTP Streams

draft-begen-avtcore-rtp-duplication-00

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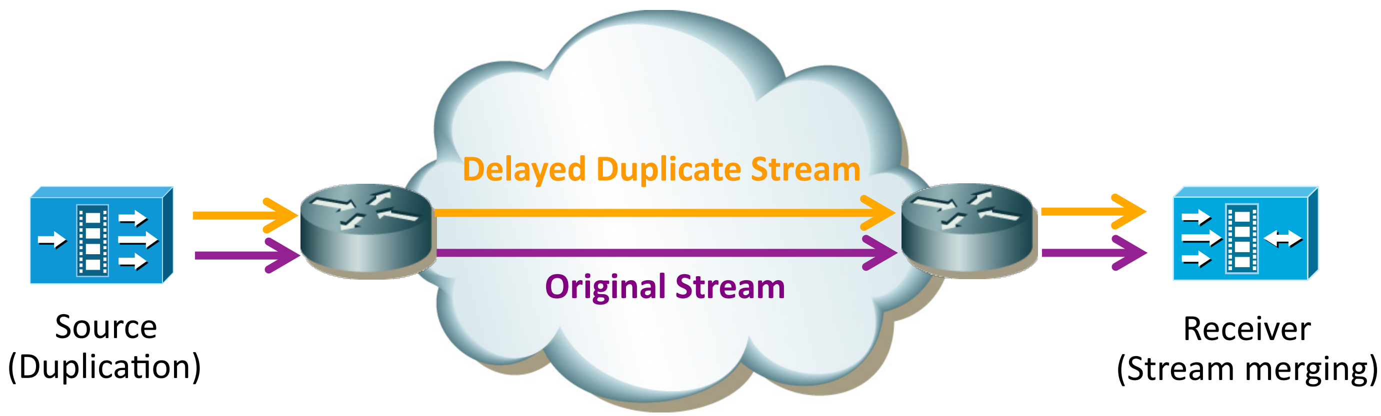
Motivation

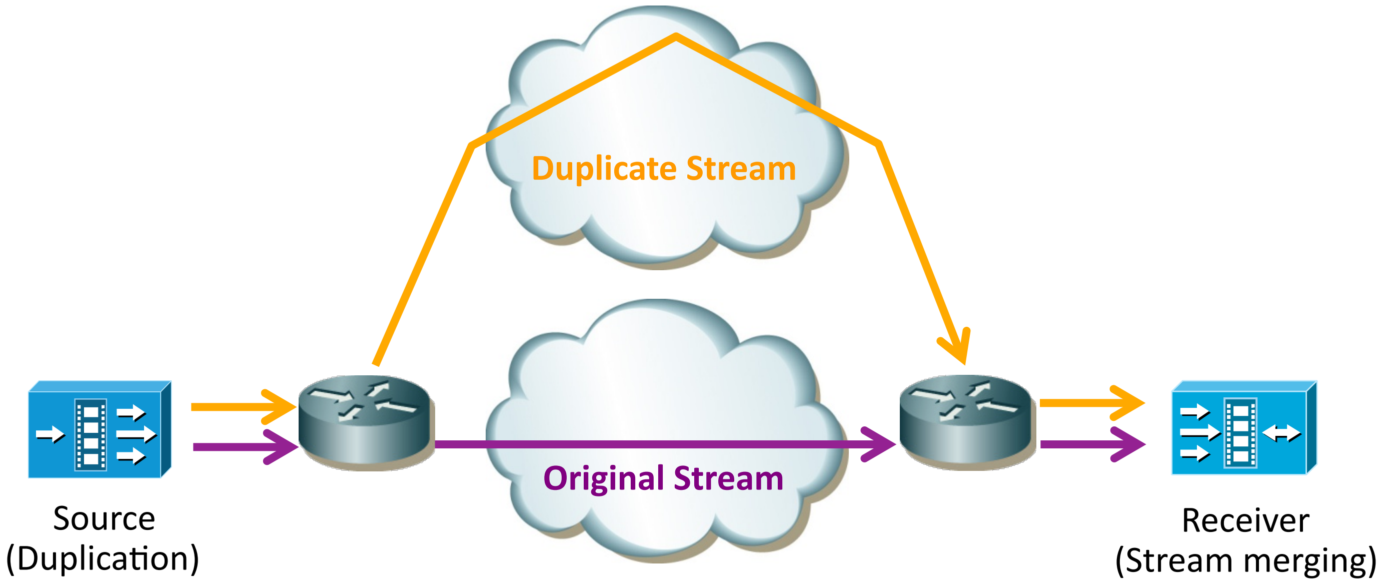
- Packet loss is unavoidable due to congestion or network outages
  - It is especially more problematic in multicasting due to large fanout
  - One basic recovery (within a bounded delay and bandwidth) method is to send redundant stream(s)
- A redundant stream can carry FEC-like data or the duplicates of the original source packets
  - Here we are interested in methods where duplicates are used
  - We focus on dual streaming, but triple, quadruple, etc., streaming is also possible (although not generally desirable due to very high overhead…)
  - It is not clear how RTP duplication should be done, and how RTCP should be handled
- This document explains how RTP streams are to be duplicated without breaking RTP and RTCP rules

Temporal (Time-Shifted) Redundancy Use Case



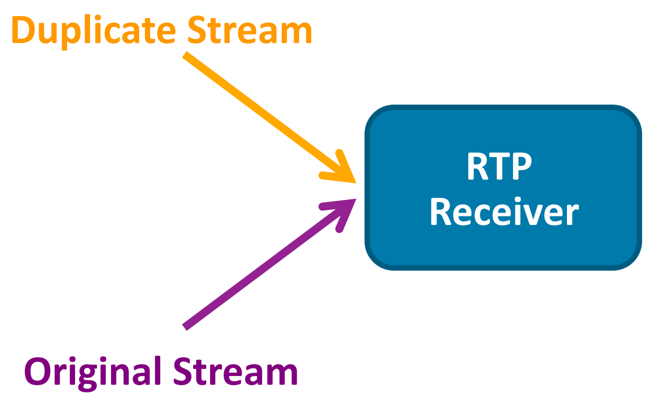
- Packets are transmitted twice, each separated by Q time units where Q is the max outage duration that is intended to be repaired
- 5-tuple is the same for both main and redundant streams (If NAPT devices exist, using anything other than an identical 5-tuple can cause spatial redundancy)
- Thus, the streams are in the same RTP session and must use different SSRCs, chosen according to the usual SSRC selection rules
- The RTCP for the redundant stream is generated exactly as-if the redundant stream were a regular media stream
- Open issue: How should we correlate the duplicate streams?

Spatial Redundancy Use Case



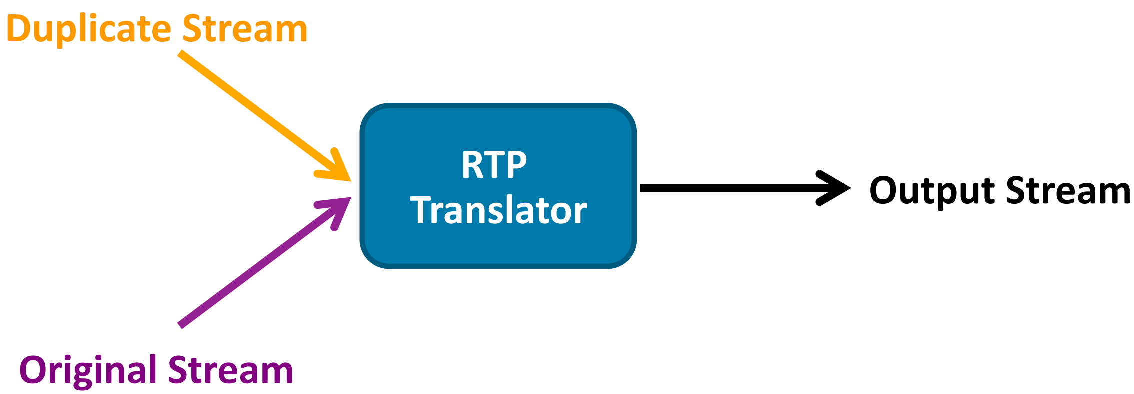
- Two streams are sent over diverse paths using
  - Separate source interfaces and/or
  - Separate destination addresses and/or ports
- Thus, the streams are in separate RTP sessions, and choose SSRCs randomly
- The RTCP for the redundant stream is generated exactly as-if the redundant stream were a regular media stream

Stream Merging at Receiver



- Media play out delay sized to be longer than the temporal offset of the duplicate stream
- Original and duplicate streams are time synchronised using the usual RTP mechanisms (RTP timestamp, mapped to NTP-format timestamp using RTCP SR/RFC 6051 header extension)
- Packets from the duplicate stream are decoded where lost packets exist in the original stream, and the media is inserted into the original stream; otherwise they're discarded
- RTP RR (and RTCP XR, if desired) is sent for *both* original and duplicate stream, treating them entirely separately. Any post-repair loss reports are sent for the original stream after repair.

Stream Merging in Network



- Translator buffering delay sized to be longer than the temporal offset of the duplicate stream
- Original and duplicate streams are time synchronised using the usual RTP mechanisms (RTP timestamp, mapped to NTP-format timestamp using RTCP SR/RFC 6051 header extension)
- Translator suppresses duplicates; it repairs loss by generating missing packets based on the surrounding packet headers in the original stream, and media data from the duplicate stream
- The SSRC of the output stream is the same as the main stream, and will almost certainly be different to the SSRC of the redundant stream
- In case of SRTP, will need to re-authenticate the packets repair by the duplicate stream, and avoid re-encryption, with appropriate signaling of who authenticates the packets
- Also may need to translate RTCP packets flowing upstream

Open Issues

- How to correlate the streams?
  - RTCP SDES SRCNAME? SDP SSRC and/or session grouping?
- Can we use standard RTP synchronization tools to align the streams, or should we mandate RTP timestamp alignment?
  - The former is more complex, but a cleaner fit with the architecture
- If stream merging happens in network element, how do RTCP reports work?
  - If the merging is done by an RTP translator, the merged stream has the same SSRC as the original, and so cannot be reported upon directly
  - Should an in-network stream merging device be treated as an RTP mixer to ease RTCP reporting?

Next Steps

- Is there interest in pursuing this work in AVTCORE?