ECN for RTP over UDP/IP

draft-westerlund-avt-ecn-for-rtp-00.txt

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TAKING YOU FORWARD
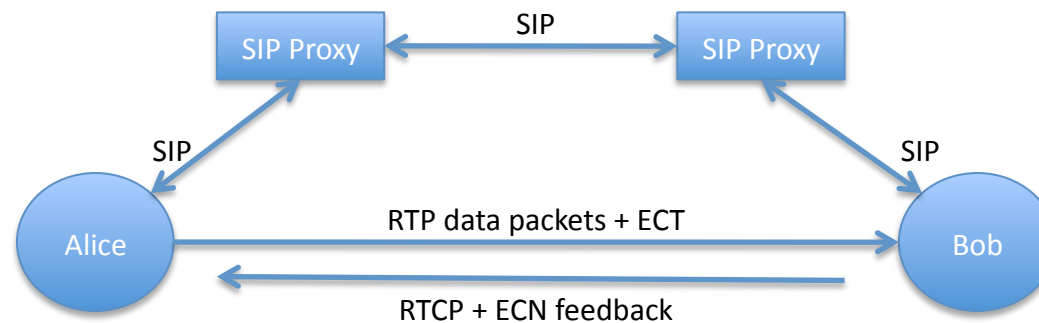
Aims & Rationale

- Much real-time multimedia traffic uses RTP running over UDP/IP
  - Modern codecs are highly adaptive; good implementations of RTP react to packet loss as a congestion signal
  - But, impact of packet loss on real-time audio-visual flows is highly visible and disrupts user experience
  - ECN support would allow codec to adapt before loss occurs
    - The application controls how it reduces its sending rate, and hence how media quality is impacted
    - Better user experience than responding to packet loss, and more network friendly

ECN for RTP over UDP/IP

- Initially seems straight-forward:
  - Signal ECN support in SIP using SDP offer/answer
  - Set ECT on RTP data packets sent in UDP/IP
  - Send feedback piggybacked on RTCP reception reports
    - (No portable way to monitor received ECN marks on UDP)
  - Respond to ECN-CE by varying media encoding rate

- Yes, but…

Why is ECN for RTP Difficult? (1/5)

- Signalling
  - RTP relies on out-of-band signalling to initiate sessions; no in-band handshake or negotiation
    - i.e. no equivalent of TCP three-way handshake to negotiate ECN support

  - SIP can negotiate the end-point *capability* to support ECN, but says nothing about the media path
  - ICE can be extended to test the media path in *some* cases

Why is ECN for RTP Difficult? (2/5)
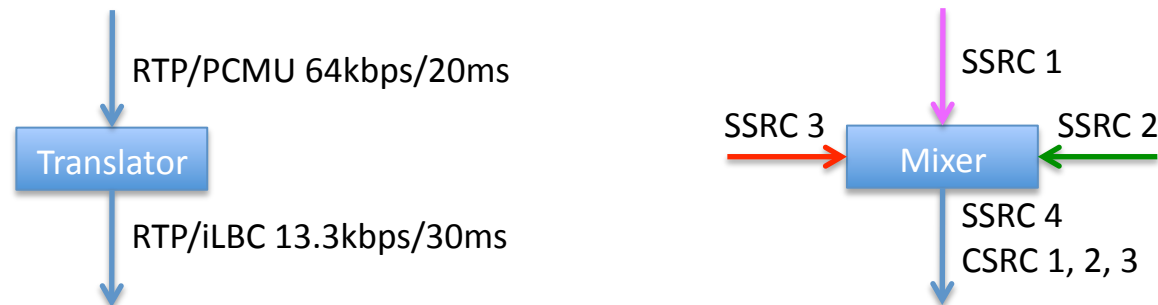
- Feedback
  - RTP does not explicitly acknowledge receipt of datagrams
  - RTCP provides reception quality feedback
    - Usual feedback interval O($seconds$); but configurable
    - RTP/AVPF allows rapid feedback, provided feedback event rate within configured bandwidth constraint

  - Implies slower adaptation than TCP if congestion events are frequent

Why is ECN for RTP Difficult? (3/5)

- Congestion Response
  - Modern codecs can adapt over a wide rate, but often have constraints on what transmission rates are possible, and how quickly they can adapt

  - Frequent variation destroys user experience

  - Can respond to congestion, but unlikely to be TCP friendly (no worse than RTP over UDP/IP without ECN)

Why is ECN for RTP Difficult? (4/5)

- Middle-boxes
  - RTP explicitly supports application level *translators* and *mixers* within the network
    - Translator is a middle-box; must interpose itself in the ECN negotiation, split the connection, respond to congestion
    - Mixer acts as end-point; terminates transport connections

RTP/PCMU 64kbps/20ms

Translator

RTP/iLBC 13.3kbps/30ms

SSRC 1

SSRC 3   SSRC 2

Mixer

SSRC 4
CSRC 1, 2, 3

  - Only *part* of an RTP session may support ECN

Why is ECN for RTP Difficult? (5/5)

- Multicast
  - RTP is inherently a *group* communication protocol
    - ASM with many-to-many groups and multicast feedback
    - SSM with unicast feedback, potentially very large groups
      - IPTV channels, potentially millions of receivers

  - ECN per sender tree? For the entire group? All receivers? Again, only *parts* of the session may support ECN
  - May require receiver driven congestion response (layered coding?)

ECN for RTP over UDP/IP: Proposal

- Four pieces to the proposed solution:
  - Negotiation of ECN capability
    - SIP with SDP offer/answer; ICE option
  - Initiation and verification of ECT
    - Using RTP and RTCP
    - Using STUN and ICE
  - Ongoing use of ECN with RTP session
  - Failure detection, verification, and fallback

Initiation and Verification of ECT

- If end-points are capable, how to negotiate ECT?
  - Using RTP and RTCP
    - Mark a small fraction of RTP/UDP/IP packets as ECT during probing phase; don't ECN mark any RTCP packets
    - New RTCP feedback packet reports receipt of ECT marked packets
    - Sender switches to using ECN for all RTP packets once the receiver population is stable, and all receivers report receipt of ECT marked packets
      - Choice to use ECN made on per-sender basis
      - Implications for multicast groups
  - Using STUN/ICE – see draft for details

Ongoing use of ECN with RTP

- RTCP reporting and feedback
  - Regular RTCP reports; use RTP/AVPF for CE events
  - ECN nonce + RLE or bit vector of lost/marked packets

- Congestion response
  - Sender driven, e.g. TFRC
  - Receiver driven, e.g. layered coding

- Detecting failure
  - Misbehaving receivers or middle-boxes
  - Path changes and/or mobility
  - Group membership changes

Continually monitor ECN operation and fallback to non-ECN mode if necessary

Input and Future Directions

- Technical details of RTP/RTCP extensions to be discussed in AVT on Friday
  - draft-westerlund-avt-ecn-for-rtp-00.txt

- From this group:
  - ECN for RTP over UDP/IP is a significant change compared to ECN for TCP/IP
  - Is this conceptually a good idea?
  - What transport issues have we missed?

  - Please read the draft!