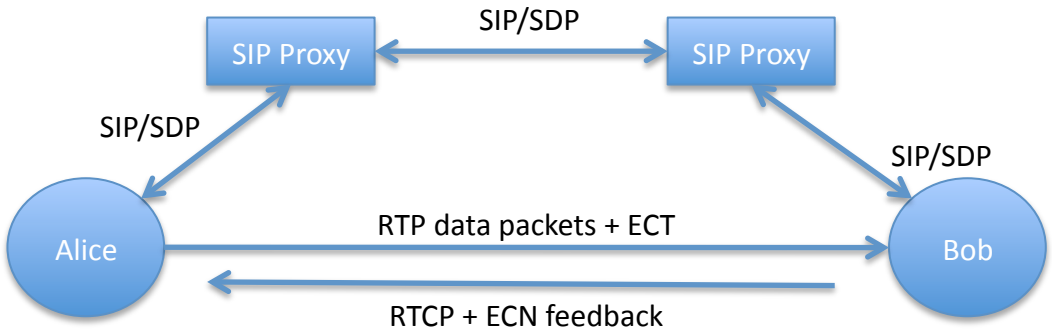
ECN for RTP over UDP/IP

draft-westerlund-avt-ecn-for-rtp-02.txt

Magnus Westerlund
Ingemar Johansson
Colin Perkins
Piers O'Hanlon
Ken Carlberg

Overview of Proposal

- Discusses how ECN can be used with RTP sessions running over UDP/IP
  - Negotiation of ECN capability
  - Initiation of ECN use within an RTP session
  - Ongoing use of ECN
  - Detecting failures and receiver misbehaviour



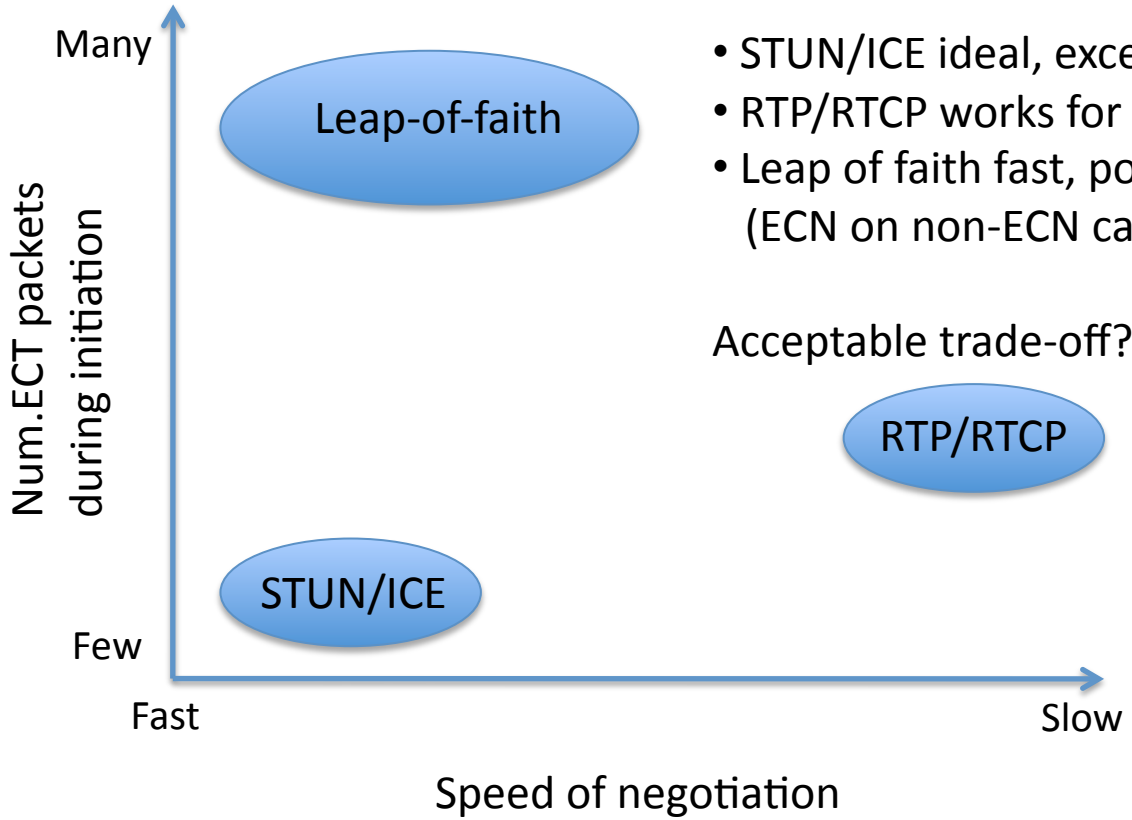
Changes since last meeting

- Merged with draft-carlberg-avt-rtp-ecn-02.txt and draft-carlberg-avt-rtcp-xr-ecn-01.txt
- Added leap-of-faith initiation
- Made use of ECN nonce optional
- Updated signalling, RTCP packet formats
  - Receiver preference for sender ECT: 0, 1, or random
    - Recommend random, but allow non-random to avoid disrupting header compression, especially in controlled environments
    - Sender can still ignore preference to use random
  - Negotiate capability to read or set ECN bits independently for each session participant
- Editorial cleanup

Initiation of ECN Usage

- Three options
  - Probe using RTP data, use RTCP for feedback
    - Requires 3 RTCP reporting intervals with ECT marks received and stable receiver population before transition to full ECT
  - Probe using STUN request, feedback on STUN response
    - One additional RTT to verify ECN-support once candidate chosen
    - Only suitable for sessions using ICE for NAT traversal
  - Leap-of-faith: send RTP with ECT, report failure via RTCP
    - Assumes ECN-capable path; suitable for controlled network only

Initiation of ECN Usage



- STUN/ICE ideal, except not all sessions use ICE
- RTP/RTCP works for all sessions, but slow
- Leap of faith fast, potentially serious failure modes (ECN on non-ECN capable path -> total media loss)

Acceptable trade-off?

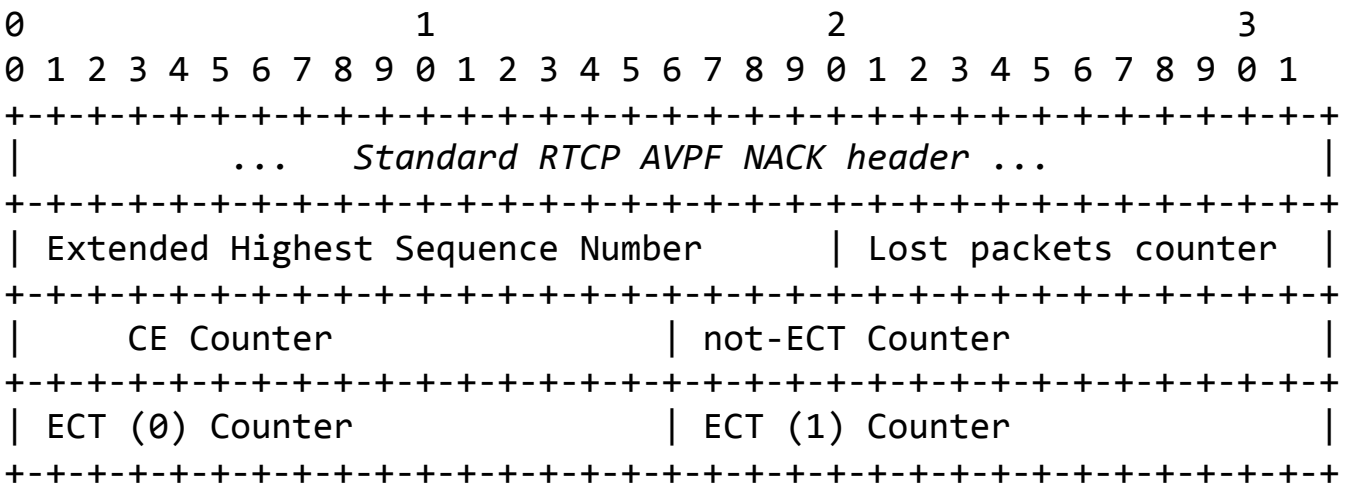
RTP/RTCP

Ongoing use of ECN with RTP

- RTCP reporting and feedback
  - Regular RTCP reports to monitor continuous operation
  - Use RTP/AVPF with minimal reports for CE events
  - Optional ECN nonce + RLE of lost/marked packets in regular reports
- 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

Rapid RTCP ECN-CE feedback

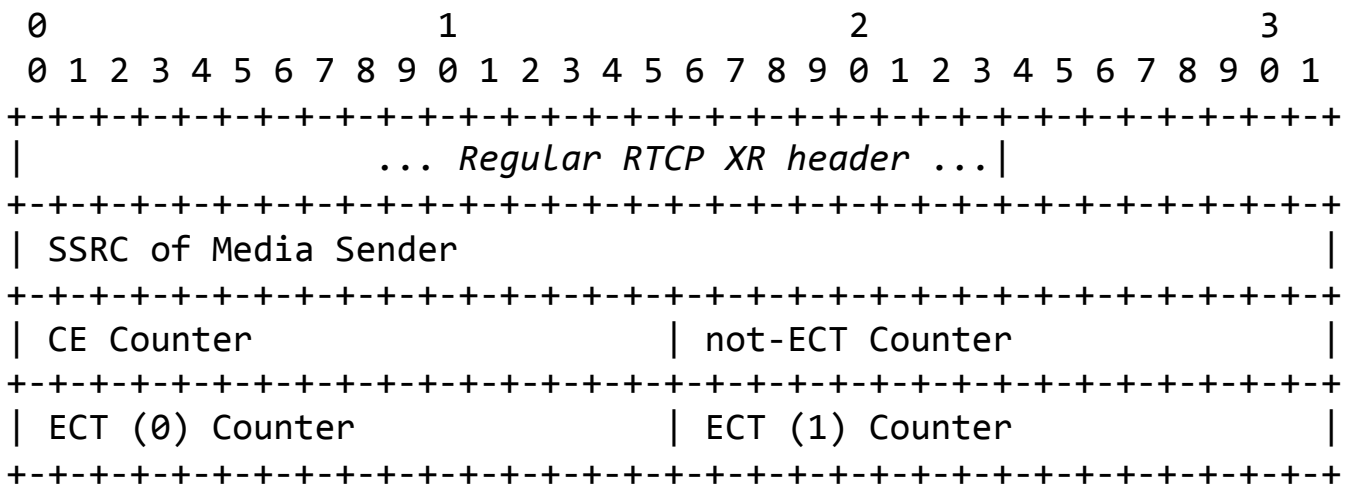


Sent in RTCP AVPF NACK to indicate CE-mark received; generally rapid feedback

Extended highest sequence number start value unpredictable

Counters are cumulative and start at zero
-> provides some robustness to loss of feedback
-> duplicates included in the count

Regular RTCP-based Feedback



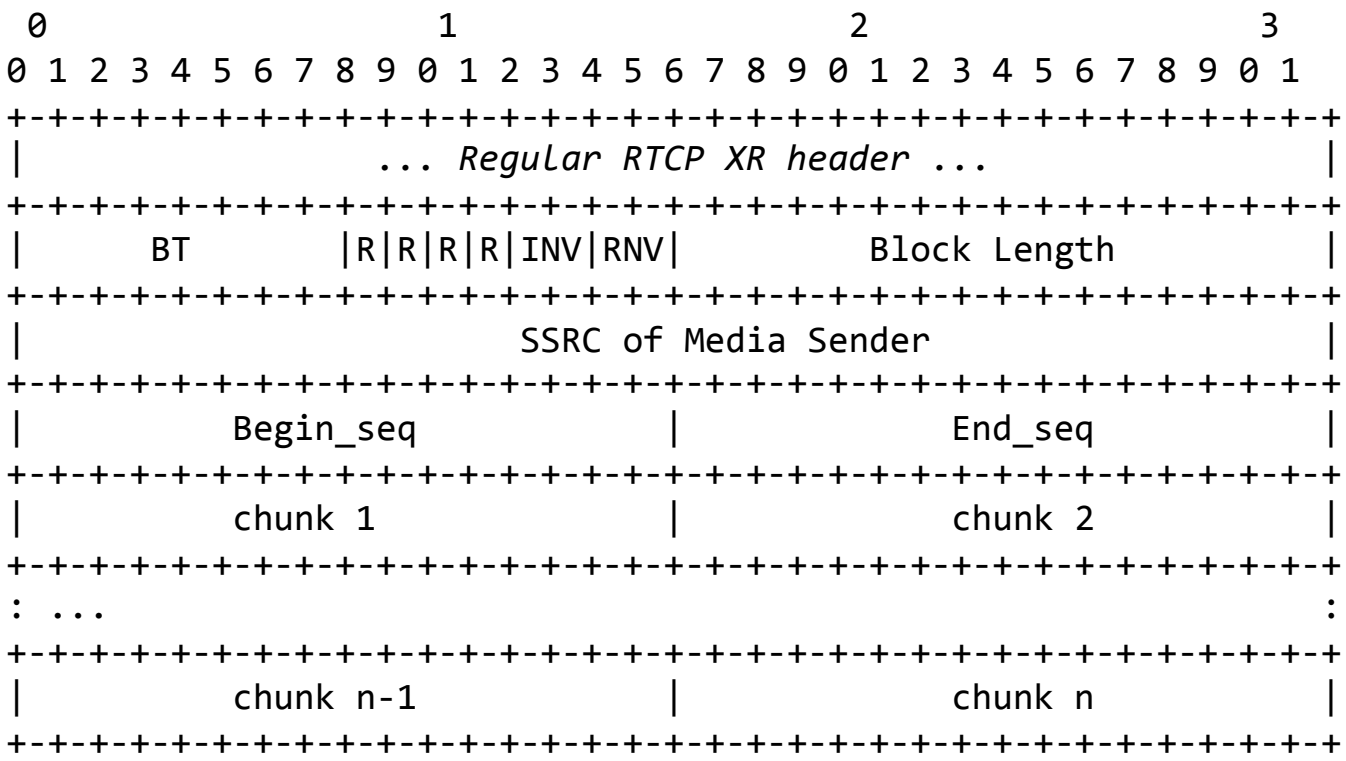
Sent in regularly scheduled compound RTCP packet, with RTCP SR/RR
->O(seconds) reporting interval

Same statistics as rapid feedback report, when combined with SR/RR
Provides robustness against lost reports

Handling duplication of RTP packets

- The counters have an issue with packet duplication
  - Each received packet will be counted by receiver => receiver will have counters where sum over them is larger than number sent
  - Duplicate packets may arrive with different markings, for example as ECN-CE and as ECT
  - This creates uncertainty in verification process
    - If number of duplicates are larger than re-marked packets it may not be detected.
    - Sender needs more advanced logic to determine issues
  - Tracking duplication requires substantial receiver state
    - Not done in regular RTCP Receiver reports

Transport of ECN nonce in RTCP



2-bit Nonce XOR sum; chunks run-length encoded list of lost/CE-marked packets

Use of ECN nonce is OPTIONAL, to detect cheating receivers – regular reports allow detection of non-ECN-capable middle-boxes

Other Issues

- Consider initiation optimizations to allow for multi-SSRC sender nodes to have rapid usage of ECN
- Feedback suppression for ECN-CE reports, both for groups, and in case an additional CE mark arrives within an RTT at the receiver

Actions and Future Directions

- Hope to charter as an AVT work item, with parallel review and last call in TSVWG
  - This draft will continue to focus on how to signal and convey ECN for use with RTP sessions over UDP/IP
  - Detailed congestion response for real-time traffic will not be specified in this draft
    - System must respond to ECN-CE marks in the same way it responds to packet loss (there are a range of solutions)