ECN for RTP over UDP/IP
draft-westerlund-avt-ecn-for-rtp-02.txt

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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 capability negotiation signalling
- Updated RTCP packet formats
- Editorial cleanup
Parameters specify:
• Initiation method (RTP/RTCP, STUN/ICE, leap-of-faith)
• ECN mode (set ECT, read ECN bits, both)
• Nonce enabled or not
• Receiver preference for sender ECT marking (0, 1, random)
SDP Capability Negotiation

• Negotiate capability to read or set ECT bits
  – Some systems only allow read or set ECT, not both
• Nonce can be enabled to detect cheating receivers
  – Increases required RTCP bandwidth
• 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
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
    • Some failure modes are highly disruptive to the media
Initiation of ECN Usage

- **Leap-of-faith**: Fast, potentially serious failure modes (ECN on non-ECN capable path => total media loss)
- **STUN/ICE**: Ideal, except not all sessions use ICE
- **RTP/RTCP**: Works for all sessions, but slow

The diagram shows a relationship between the number of ECT packets during initiation and the speed of negotiation.
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
Rapid RTCP ECN-CE feedback

```
<table>
<thead>
<tr>
<th>EXTENDED HIGHEST SEQUENCE NUMBER</th>
<th>LOST PACKETS COUNTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE COUNTER</td>
<td>not-ECT COUNTER</td>
</tr>
<tr>
<td>ECT (0) COUNTER</td>
<td>ECT (1) COUNTER</td>
</tr>
</tbody>
</table>
```

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

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

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

```plaintext
+---------------------------------------------------------------------+
| |  ... Regular RTCP XR header  ... | +---------------------------------------------------------------------+
| BT | R | R | R | INV | RNV | Block Length |
+---------------------------------------------------------------------+
| +---------------------------------------------------------------------+
| SSRC of Media Sender |
+---------------------------------------------------------------------+
| +---------------------------------------------------------------------+
| Begin_seq | End_seq |
+---------------------------------------------------------------------+
| +---------------------------------------------------------------------+
| chunk 1 | chunk 2 |
+---------------------------------------------------------------------+
| : ... |
+---------------------------------------------------------------------+
| : ... |
| : ... |
| +---------------------------------------------------------------------+
| chunk n-1 | chunk n |
+---------------------------------------------------------------------+

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
Actions and Future Directions

• Adopt as 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)