Adding Explicit Congestion Notification (ECN) Capability to TCP's SYN/ACK Packets

A. Kuzmanovic, A. Mondal, S. Floyd, and K.K. Ramakrishnan

draft-ietf-tcpm-ecn-syn-02.txt

TCPM

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Purpose:

- Specifies a modification to RFC 3168 to allow TCP SYN/ACK packets to be ECN-Capable.
- Based on the SIGCOMM 2005 paper by A. Kuzmanovic.
- Avoids the retransmit timeout when a SYN/ACK packet would have been dropped.
- If the SYN/ACK packet is ECN-marked, the sender of that packet responds by reducing the initial window to one segment, instead of two to four segments.
More:

- The SYN/ACK packet can be sent as ECN-Capable only in response to an ECN-setup SYN packet.
- The SYN packet still MUST NOT be sent as ECN-Capable.
- The benefit of adding ECN-capability to SYN/ACK packets can be high, particularly for small web transfers.
The TODO List from March 2006:

• Converge on the response to a marked SYN/ACK packet.

• Look at the costs of adding ECN-Capability in a worst-case scenario. (From feedback from Mark Allman and Janardhan Iyengar.)

• Find out how current TCP implementations respond when receiving a SYN/ACK packet that has been ECN-marked?
Response to an ECN-Marked SYN/ACK Packet?

• Set initial cwnd to one packet:
  – Instead of setting cwnd to 2-4 packets.
  – Continue in congestion avoidance instead of slow-start.

OR

• Wait an RTT before sending a data packet:
  – Proposed by Mark Allman.

• Simulations reported in Appendix A.
Results from Simulations:

Simulations with RED in Packet Mode, 3 KB Average Flow Size

![Graph showing the relationship between Loss Rate and Dropped or Marked Packets for different methods such as ECN, ECN+, and ECN/Wait. The graph illustrates how the number of dropped or marked packets increases with rising loss rate.]
Results from Simulations:

Simulations with RED in Packet Mode, 3 KB Average Flow Size, #2
Results from Simulations:

Simulations with RED in Packet Mode, 3 KB Average Flow Size, #3

- ECN, drops
- ECN+, drops
- ECN/Wait, drops
- ECN, marks
- ECN+, marks
- ECN/Wait, marks

Dropped or Marked Packets

Loss Rate
Simulation Overview:

• Heavy-tailed distribution of file sizes
  – With a range of average file sizes.

• Topology:
  – Target delay 1 ms, 5 ms, 10 ms.
  – 100 Mbps congested link.
  – Minimum RTT of 12 ms.
  – RED in gentle mode.

• Simulations with RED in packet and byte mode.
  – For the simulations with RED in byte mode, SYN packets aren’t dropped or marked very often. So it doesn’t make much difference if SYN/ACK packets are ECN-Capable.
Lessons from Simulations:

• Dangers with high congestion?
  – When congestion is high, packets are dropped rather than ECN-marked, with or without ECN+.

• Comparing ECN+ with ECN/Wait:
  – The overall congestion level with ECN+ (without waiting) is similar to that with ECN/Wait (waiting after an ECN/SYN packet is marked).
Current TCP Implementations:

- Fedora Linux TCP:
  - Shouldn’t crash after an ECN-marked SYN/ACK packet.
  - Shouldn’t respond to the CE codepoint in a SYN/ACK packet either.
- FreeBSD?
- Microsoft Vista?
Next steps?
Extra Viewgraphs:
Security Concerns:

- “Bad” middleboxes that drop ECN-Capable SYN/ACK packets?
  - We don’t know of any.
  - If the first SYN/ACK packet is dropped, the retransmitted SYN/ACK should not be ECN-Capable.

- There is no danger on congestion collapse:
  - Routers are free to drop rather than mark ECN-Capable packets.
  - If the SYN/ACK packet is marked, the sender sends at most one data packet; if that packet is dropped or marked, the sender waits for a retransmit timeout.
Changes in January (2006) revision:

- Added a discussion to the Conclusions about adding ECN-capability to relevant set-up packets in other protocols. From a suggestion from Wesley Eddy.

- Added a discussion of one-way data transfers, where the host sending the SYN/ACK packet sends no data packets.

- Added a description of SYN exchanges with SYN cookies. From a suggestion from Wesley Eddy.
  - This needs further clarifications.
The guidelines:

• **RFC 3168:**
  “Upon the receipt by an ECN-Capable transport of a single CE packet, the congestion control algorithms followed at the end-systems MUST be essentially the same as the congestion control response to a *single* dropped packet. For example, for ECN-Capable TCP the source TCP is required to halve its congestion window for any window of data containing either a packet drop or an ECN indication.”

• **Question:**
  If TCP’s response to a dropped SYN/ACK packet a congestion control response? Or is this a special case, allowing a new response?