ECN+, ECN+/Wait, ECN+/TryOnce and Alternative Backoff with ECN (ABE)

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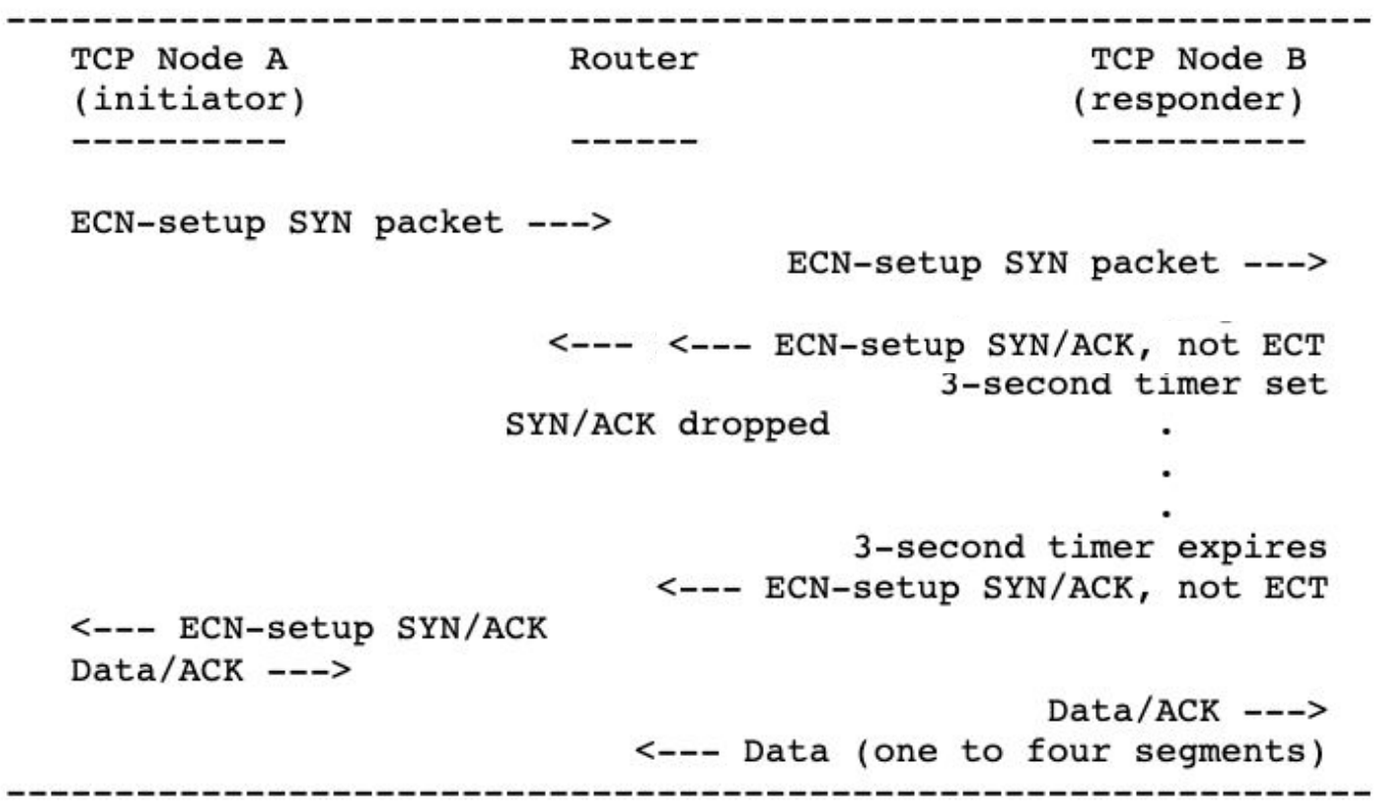
Overview

- ECN+
  - Extends ECN marking to SYN/ACK packet (i.e., second packet in TCP handshake)
  - Reason: SYN/ACK packet drop leads to wastage of resources. How?
- ECN+/Wait [RFC 5562]
  - Extends ECN+ mechanism
  - Suitable for mild to moderate level congestion
- ECN+/TryOnce [RFC 5562]
  - Extends ECN+ mechanism
  - Suitable for high level of congestion
- Alternative Backoff with ECN (ABE) [RFC 8511]
  - Differentiates the congestion response for a marked packet and dropped packet

ECN+

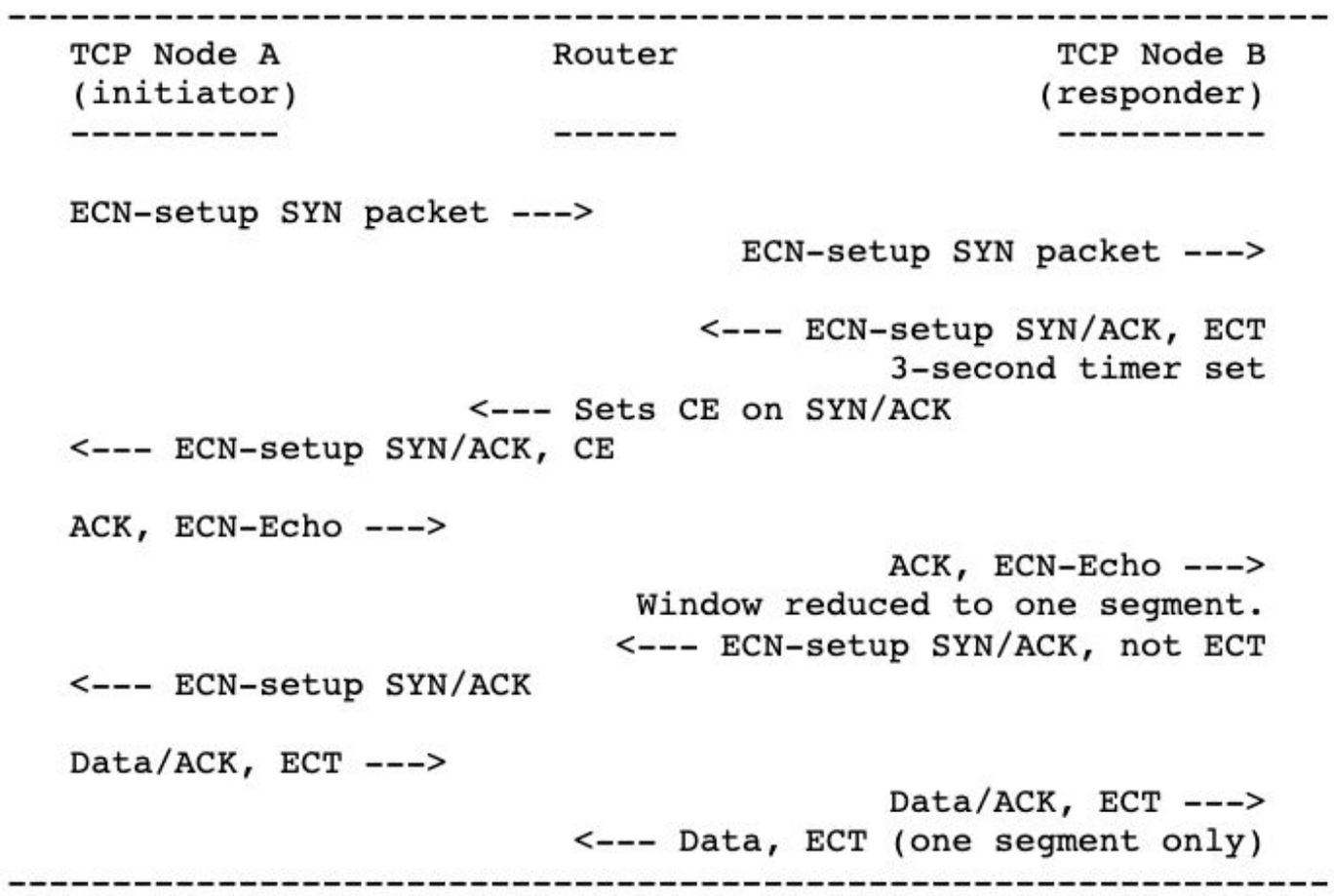
- SYN/ACK packet is permitted to carry ECT(0) or ECT(1) in IP header
  - It means SYN/ACK packet can get marked by the router if there is congestion
  - ECN+ is a server-side mechanism



Original ECN

Image Credits: https://datatracker.ietf.org/doc/html/rfc5562

ECN+ (contd ...)

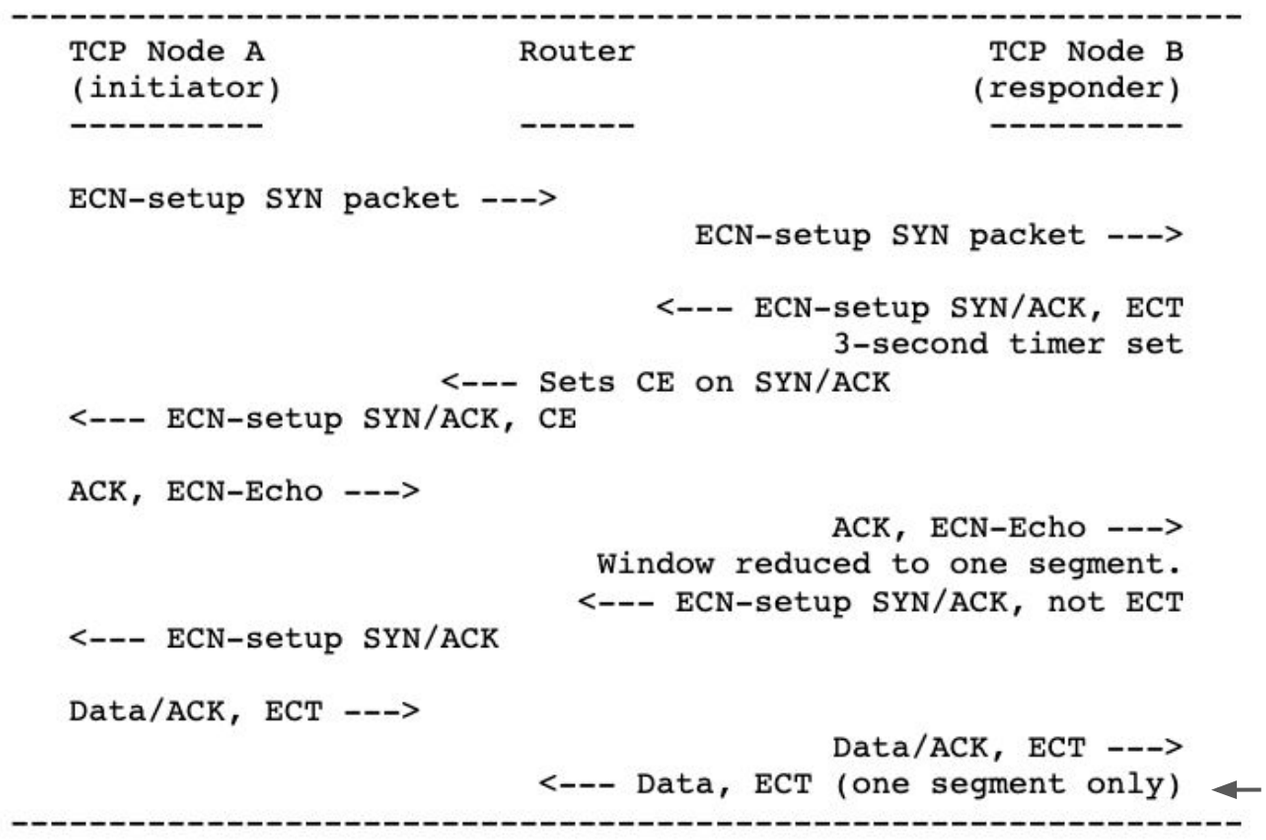


This is ECN+

Image Credits: https://datatracker.ietf.org/doc/html/rfc5562

ECN+/Wait

- If an ACK arrives with a ECN-Echo, the server reduces the congestion window to 1 segment and waits for one RTT before sending the data packet.



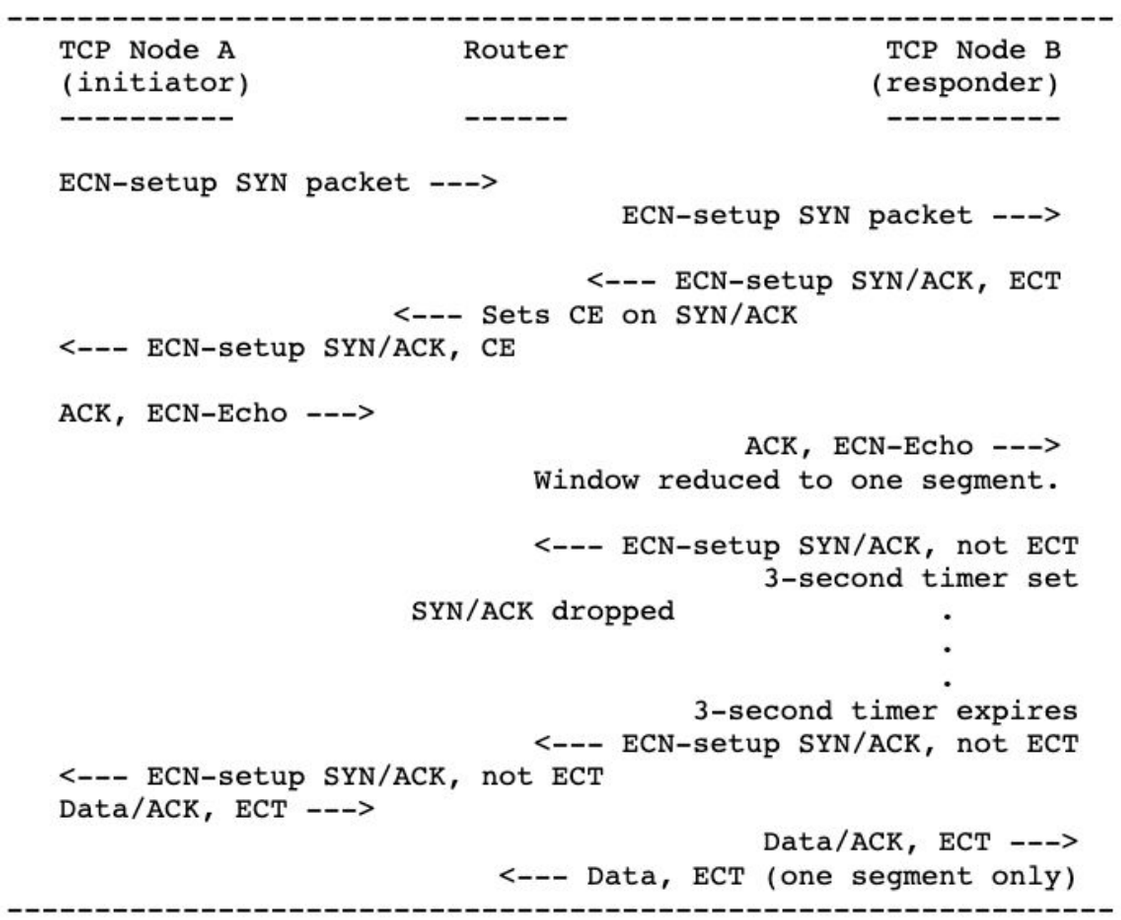
ECN+/Wait

Wait for 1 RTT before sending this data packet

Image Credits: https://datatracker.ietf.org/doc/html/rfc5562

ECN+/TryOnce

- If an ACK arrives with a ECN-Echo, the server reduces the congestion window to 1. Besides, it first retransmits the SYN/ACK without ECT and confirms that the network is not heavily congested



ECN+/TryOnce

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ECN+/TryOnce

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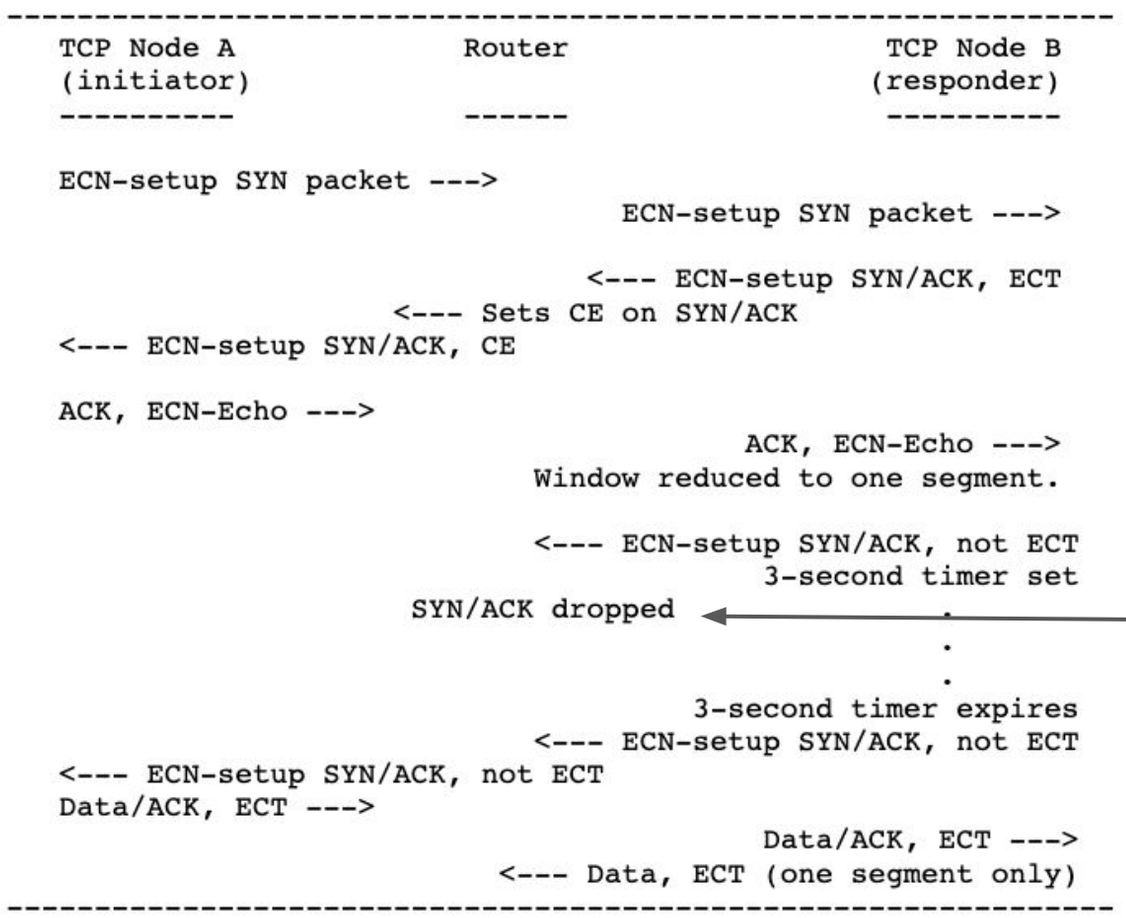

ECN+/TryOnce

If it does not get dropped, ECN+/TryOnce becomes the same as ECN+/Wait

Image Credits: https://datatracker.ietf.org/doc/html/rfc5562

Alternative Backoff with ECN (RFC 8511)

- ECN signals are treated same as ‘packet drop’ signals by the TCP senders
  - This behavior was recommended in RFC 3168 (the original ECN mechanism)
- ABE defines an alternative behavior for ECN marked packets
  - Because ‘ECN marked’ packets are not ‘actually’ dropped.
  - So the congestion window reduction can be less aggressive
  - Note: a concept similar to ABE was proposed in DECBit paper (by the author of ECN)
- Recommendations by RFC 8511 for congestion response by a TCP Sender using ABE:
  - For CUBIC: multiply cwnd by 0.85 if packet is ECN marked, 0.7 if it is dropped
  - For Reno: multiply cwnd by [0.7, 0.85] if packet is ECN marked, 0.5 if it is dropped

Recommended Reading

RFC 5562: Adding Explicit Congestion Notification (ECN) Capability to TCP's SYN/ACK Packets

Link: https://datatracker.ietf.org/doc/html/rfc5562

RFC 8511: TCP Alternative Backoff with ECN (ABE)

Link: https://datatracker.ietf.org/doc/html/rfc8511