More Accurate ECN Feedback in TCP

draft-ietf-tcpm-accurate-ecn-21

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Recent draft history
draft-ietf-tcpm-accurate-ecn

- 20→21: 7 Nov '22 [summary of changes on list]:
  - if multiple SYNs, server MUST feed back latest IP-ECN
    - discovered missing from spec during Hackathon testing
  - recorded early IANA registrations of TCP Option Kinds

AccECN Roadmap

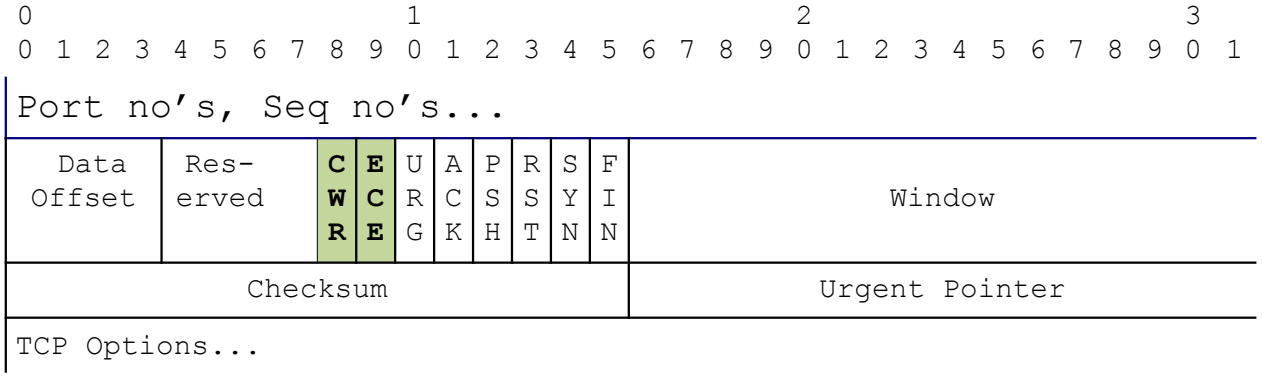
- Recap of AccECN landscape prior to WGLC (next 8 slides):
  - goal & approach
  - relation to other activities
  - placement in the stack
  - aspects to be reviewed
  - implementation status

Goal

- Feed back extent of congestion
  not just existence
- To enable congestion control for very low queuing delay
  - 0.5 ms (vs. 5-15 ms) over public Internet

Problem (Recap)
Congestion Existence, not Extent

- Problem with RFC3168 ECN feedback:
  - only one TCP feedback per RTT
  - rcvr repeats ECE flag for reliability, until sender's CWR flag acks it
  - suited TCP at the time – one congestion response per RTT

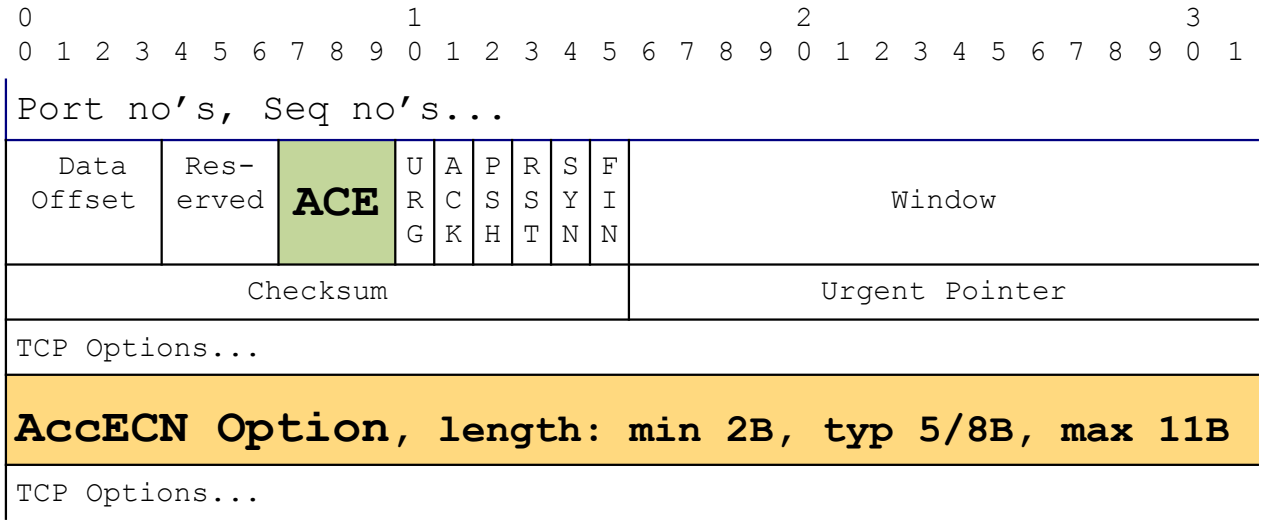


- Explicit Congestion Notification (ECN) recap
  - routers/switches mark more packets as load grows
  - RFC3168 added ECN to IP and TCP

IP-ECN	Codepoint	Meaning
00	not-ECT	No ECN
10	ECT(0)	ECN-Capable Transport
01	ECT(1)	
11	CE	Congestion Experienced

Solution (recap)
Congestion extent, not just existence

- AccECN: Change to TCP wire protocol
  - Repeated count of CE packets (ACE) - essential
  - and CE bytes (AccECN Option) – supplementary

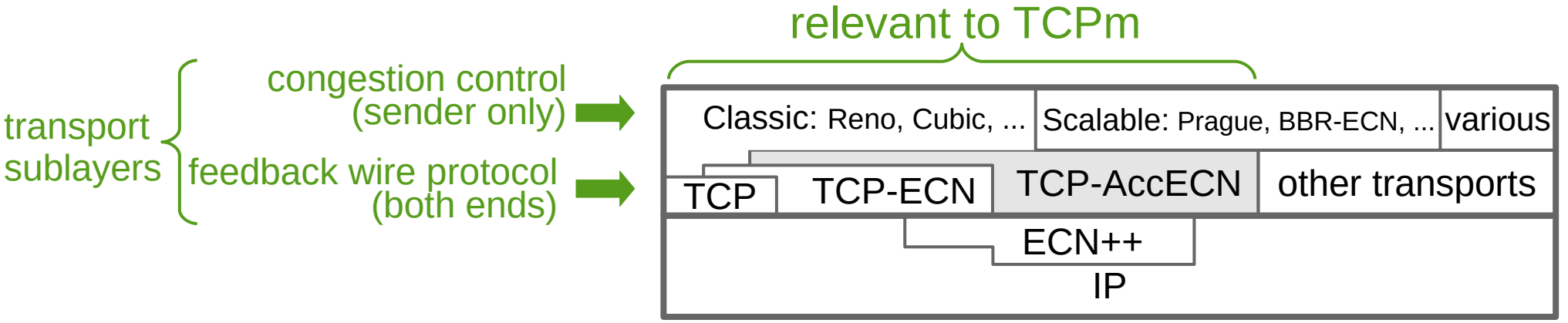


Relation to other activities

- DCTCP [RFC8257]
  - DCTCP's ECN feedback differs from RFC3168 and AccECN
  - but without negotiation (assumes DC-wide sys-admin)
  - Can use AccECN negotiation, and either AccECN or DCTCP-style ECN feedback
    - depending on initial value of the 3 TCP-ECN flags after 3WHS
    - already in Linux implementation of AccECN
- New Congestion Control Algorithms (CCAs)
  - AccECN steers clear of saying anything about congestion response
  - ECN feedback is wire protocol – architecturally 'below' a CCA
  - Can use AccECN ECN feedback for any CCA incl. Classic (Reno, CUBIC, BBR, …)
- L4S experiment [draft-ietf-tsvwg-l4s-arch, ecn-l4s-id, etc.]
  - Low Latency, Low Loss and Scalable throughput
  - L4S CCAs can be used with TCP or other transport protocols (QUIC, etc)
  - L4S CCA with TCP requires AccECN to be negotiated
- ECN++ experiment [draft-ietf-tcpm-generalized-ecn]
  - Removes the rule against using ECN capability in IP-ECN of TCP control pkts & re-xmts
  - AccECN spec RECOMENDS ECN++
  - Full capabilities of ECN++ only available with AccECN

Where AccECN Fits

- Can only enable AccECN if both TCP endpoints support it
  - falls back to RFC3168 TCP-ECN otherwise
  - no dependency on network changes
- Replaces & extends feedback part of TCP-ECN [RFC3168]
- Out of scope for AccECN:
  - Not what sender puts in the IP-ECN field
  - Not sender's congestion response to the feedback



Note: diagram shows what works over what;
not how an implementation would be structured

Aspects of AccECN to review

- Negotiation phase
  - Backward & forward compatibility
  - Mangling detection
  - Fall-back contingencies
- Resilience against ACK loss / coalescing
- Implications of TCP wire protocol changes
  - Implications of middleboxes / offload
  - Implications for middleboxes / offload
- Interaction with TCP variants
  - time-stamp, window scaling, SACK, TCP-AO, TFO, MPTCP, ...
- Security
  - flooding attacks, feedback integrity, downgrade attacks? ...

AccECN implementation status 1/2

- Linux (thx to Neal Cardwell)
  - Intended as reference implementation of the whole spec
  - Based off v5.15 kernel: https://github.com/google/bbr/commits/l4s-testing-2022-10-14-v1 (merge into L4S repo imminent)
  - Also latest packetdrill tests: https://github.com/google/bbr/commits/l4s-packetdrill-2022-08-21-v1
- Free BSD (thx to Richard Scheffenegger)
  - will be in FBSD 14 (without optional TCP option)
  - remaining parts in progress:
    - heuristic for long runs of missing ACKs
    - some details of the TCP option
    - passes all packet drill tests, except consistency betw. ACE & TCP Option

AccECN implementation status 2/2

- Apple platforms (MacOS, iOS, etc, thx to Vidhi Goel)
  - reflector side implemented – off by default
  - enable with net.inet.tcp.accurate_ecn sysctl

- Testing of all the above (Linux, FBSD, MacOS) in 2nd IETF L4S interop (co-located with this IETF)

- tcpdump patches for AccECN submitted (thx Richard Scheffenegger)
- Wireshark 4.0 decodes AccECN, incl. TCP option (thx Michael Tuexen)

Status & Next Steps

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- WGLC

- draft-ietf-tcpm-generalized-ecn (EXP)
  - also ready for WGLC but dependent on AccECN

AccECN

Q&A