More Accurate ECN Feedback in TCP

draft-ietf-tcpm-accurate-ecn-14

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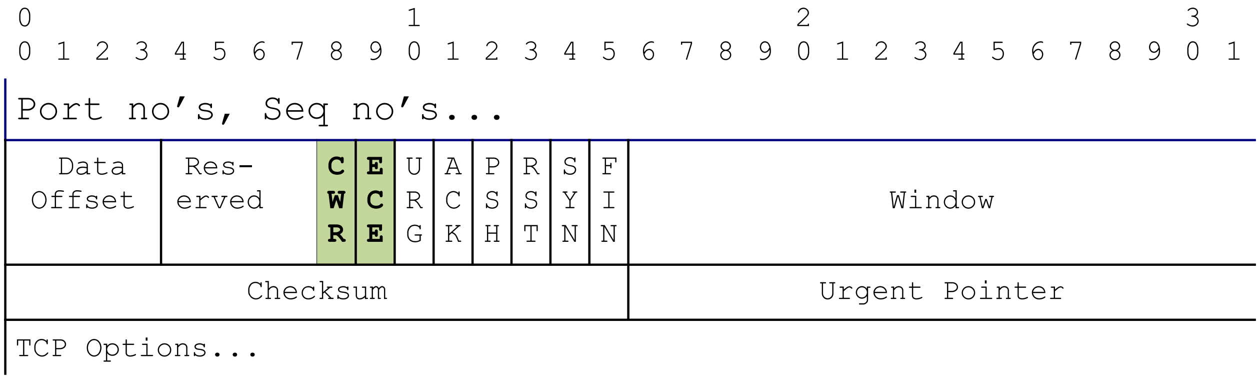
Problem (Recap)
Congestion Existence, not Extent

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

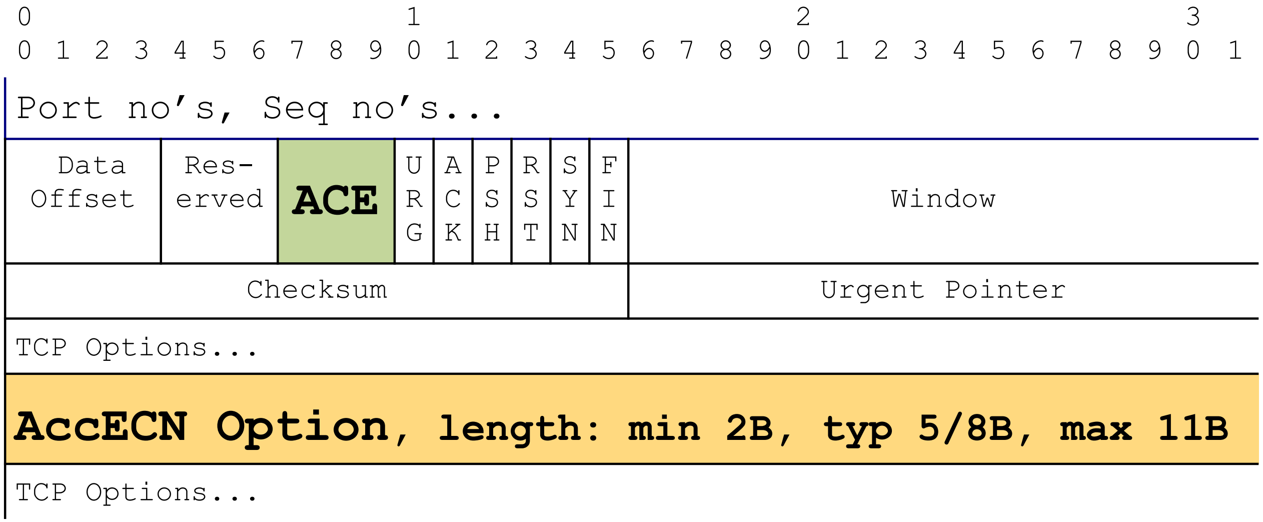
IP-ECN	Codepoint	Meaning
00	not-ECT	No ECN
10	ECT(0)	ECN-Capable Transport
01	ECT(1)	
11	CE	Congestion Experienced



- 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

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



0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

Port no's, Seq no's...

Data Offset | Res-erved | **ACE** | URG | ACK | PSH | RST | SYN | FIN | Window

Checksum | Urgent Pointer

TCP Options...

AccECN Option, length: min 2B, typ 5/8B, max 11B

TCP Options...

- Key to congestion control for low queuing delay
  - 0.5 ms (vs. 5-15 ms) over public Internet
- Applicability: (see spare slide)

Field Order of AccECN TCP Option

- How to distinguish 2 different field orders in the AccECN Option
  - ExxB = Echo Byte counter xx, where xx = E0, E1, CE (each 3 B)

kind0	length	EE0B	[ECEB	[EE1B]]
kind1	length	EE1B	[ECEB	[EE0B]]

- After IETF-109, a third alternative:
  1) Two Option Kinds [MScharf]
  2) Add flags byte to option [Ilpo]
  3) Use most significant bit of first 24-bit field to signal field order [Joe]
- Conclusion
  - Kept two Option Kinds after a little push-back against #3

Forward Compatibility vs. Covert Channel

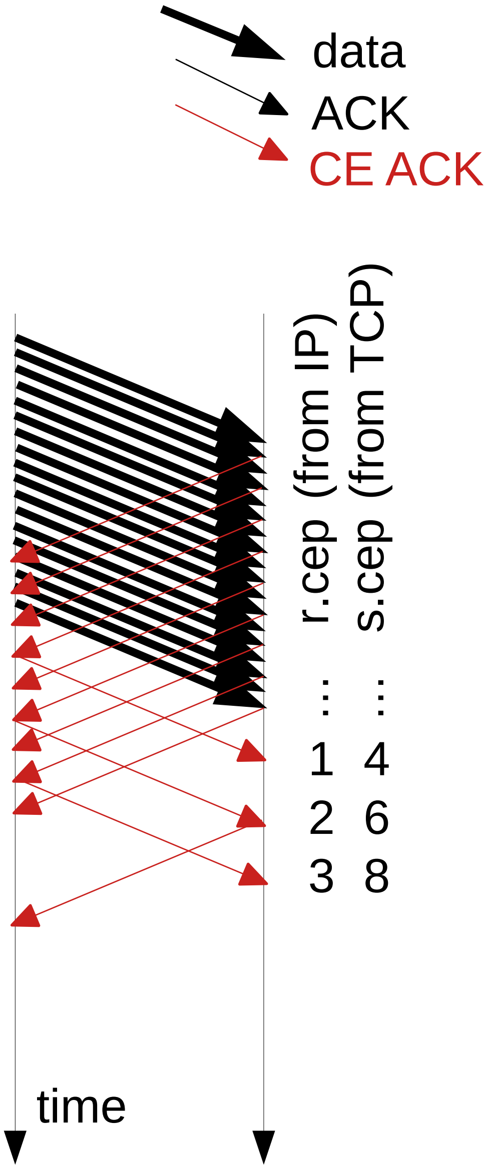
kind	length	[3 octets	[3 octets	[3 octets]]]

- <u>Background</u>: Valid AccECN Option lengths: 2 + (0, 3, 6, or 9) octets
  - For forward compatibility, if the AccECN Option is of any other length, implementations MUST use those whole 3-octet fields that fit within the length and ignore the remainder of the option, treating it as padding.
  - A middlebox **claiming to be transparent** at the transport layer MUST forward the AccECN TCP Option unaltered, whether or not the length value matches one of those specified
- Creates a covert channel of up to 29B [MScharf]
  - Now identified in Security Considerations
  - Prompted chairs to ask for early SECDIR review
- We could sacrifice forward compatibility; but no real need here
- Not a new covert channel
  - A TCP MUST ignore without error any TCP option it does not implement [RFC1122]
- Where nec., current IDSs already close off these channels
  - block unknown options or known options with unknown lengths

To ACK ACKs or not to ACK?
That is the question

An AccECN Data Receiver:

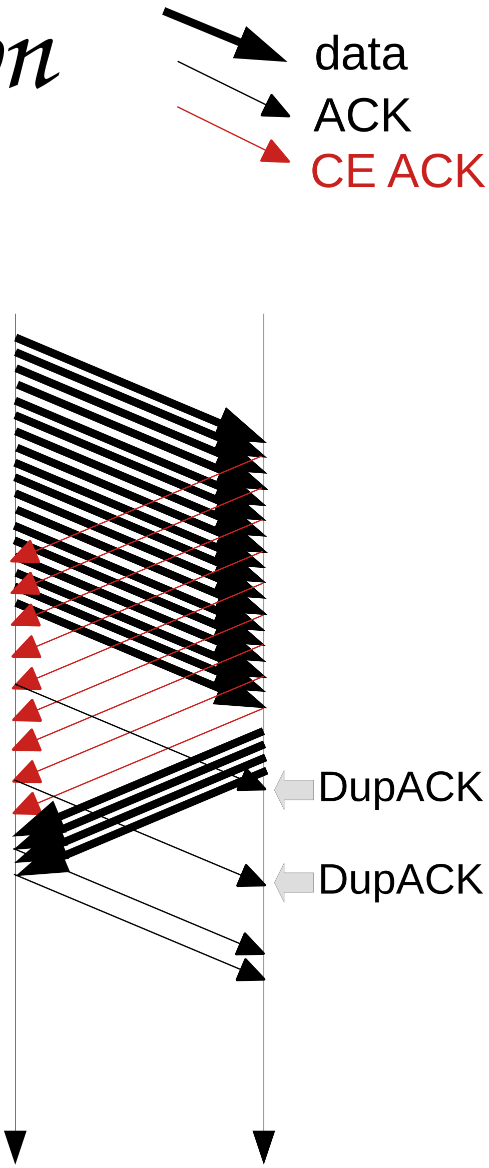
- SHOULD immediately send an ACK whenever a **data packet** marked CE arrives after the previous **packet** was not CE.
- MUST immediately send an ACK once 'n' CE marks have arrived since the previous ACK, where 'n' SHOULD be 2 and MUST be in the range 2 to 6 inclusive.



- Intentions:
  - rapid feedback at congestion onset
  - reduce risk of double wrap of 3-bit ACE counter
- Realized 2nd bullet could lead to ACKs of ACKs (first bullet deliberately doesn't)
  - **'OK in principle': ACKing new information (new CE marks)**
  - to maintain cwnd during idles, or ready for adding ACK CC
  - but potential ACK ping-pong must be strongly damped

To ACK ACKs or not to ACK?
DupACKs is another question

- ACKs of ACKs could look like DupACKs [Yoshi]
  - If ACK stream CE marked
  - and data volleys take turns
- Low risk
  - Already a corner case
  - and only if SACK not negotiated*
  - harm would be spurious re-xmt(s)



* AccECN recommends SACK. If SACK-negotiated, and if no SACK on ACK, not a DupACK

To ACK ACKs or not to ACK?
What is the answer?

Two positions:

A) Prevent ACKs of ACKS completely

`MUST immediately send an ACK once 'n' CE marks have arrived since the previous ACK` **`and there is outstanding data to acknowledge`**`, where 'n' SHOULD be 2 and MUST be in the range 2 to 6 inclusive.`

B) Take opportunity to still feed back CE on ACKs, but damp any potential ACK ping-pong

- `MUST immediately send an ACK once 'n' CE marks have arrived since the previous ACK {1}, where 'n' SHOULD be` ~~2~~ **3** `and MUST be in the range` ~~2~~ **3** `to 6 inclusive.`

- There are simplicity arguments on both sides

Other changes

- Editorial fixes throughout
    - Esp. ACK Filtering
    - thx to Gorry's latest review

Status & Next Steps

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- Once ACKs of ACKs resolved
  ready for WGLC
- draft-ietf-tcpm-generalized-ecn (EXP)
  dependent on this
- April’20 tcpm interim:
  - WG resolved to wait a while for L4S,
    but go ahead soon if still waiting

AccECN

Q&A

spare slides