ECN++: Adding ECN to TCP Control Packets

draft-ietf-tcpm-generalized-ecn-03

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ECN++ Recap

TCP packet type	RFC3168	ECN++ [draft-ietf-tcpm-generalized-ecn-03]		
		AccECN f/b negotiated	RFC3168 f/b negotiated	congestion response
SYN[1]	not-ECT	ECT	not-ECT	[2]Reduce IW
SYN-ACK	not-ECT	ECT	ECT	Reduce IW
Pure ACK	not-ECT	ECT	not-ECT	[2]Usual (?) cwnd response & MAY AckCC [RFC5690]
Window probe	not-ECT	ECT	ECT	Usual cwnd response
FIN	not-ECT	ECT	ECT	None or MAY AckCC [RFC5690]
RST	not-ECT	ECT	ECT	N/A
Re-XMT	not-ECT	ECT	ECT	Usual cwnd response
Data	ECT	ECT	ECT	Usual cwnd response

[1] For SYN, 'negotiated' means requested

[2] Obviously only in AccECN case

We thought we'd finished...

- Editorial issues:
  1) Separate: AccECN vs. RFC3168 f/b negotiated

- Technical issues:
  2) Response to CE on Pure ACK
  3) New ECN++ measurement study: dire
  4) Widened scope: *receiver* packet validation / acceptance

CE = Congestion Experienced

Dependence of ECN++ on AccECN experiment

- Problem: unclear which parts of ECN++ draft to follow
  - if you choose not to implement AccECN
  - if AccECN expriment evolved to something different

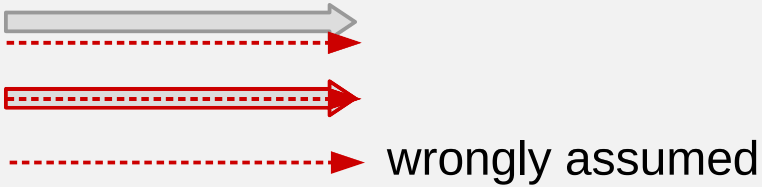
- Proposed solutions ranged across:
    - Split into 2 near-identical drafts
    - Appendix explaining what depends on AccECN
- Solution
    - Divided the SYN & Pure ACK sections for each case
    - Flagged which case at start of each sub-sub-section

Pure ACK Congestion Response (1/2)

- Problem:
  - Now the sender knows about congestion on ACKs, how does it respond?
- Congestion response specifics out of scope
  - Where draft can say 'usual cwnd/IW response' it does (see table)
  - If it can't (Pure ACK), specifics ought to be defined for each congestion control [Reno, Cubic, BBR, DCTCP]
  - But we ought to give some (informational) guidance in this draft

Pure ACK Congestion Response (2/2)

- A CE-marked Pure ACK is part of an aggregate causing congestion; e.g.
    1) other data flow(s) in parallel to the ACKs
    2) data and ACKs interspersed in one flow
    3) or purely Pure ACK congestion



- Suggest two potential responses (informative only):
    - Optionally AckCC [RFC5690]
    - Reduce cwnd proportional to: $\frac{\text{(CE-marked header bytes + CE-marked data bytes)}}{\text{(all header bytes + all data bytes)}}$

- Deals reasonably with all three scenarios:
    - 1) & 2) cwnd reduction scaled down by 40/1500 (say)
    - 1) & 3) cwnd reduction has no effect on the pure ACKs

- Addresses “it's wrong to do nothing” concern
    - even tho current TCP does nothing if a Pure ACK is lost

Using a nominal header size
(not so important to be correct)

Recall: only applicable with AccECN f/b
which can count CE packets and bytes

Network mangling nil; Server mangling 84

- Tracing Internet Path Transparency, Kuehlewind, M., Walter, M., Learmonth, I., and B. Trammell, TMA, June 2018.
- Of the 82% of servers that now support ECN,
  - 84% disable ECN for the connection if they receive an ECT SYN
- Traced to May 2012 Linux patch (and other OSs?):

```
%  RFC3168 : 6.1.1: SYN packets must not have ECT/ECN bits set.
%   If we receive a SYN packet with these bits set,
%   it means a network is playing bad games with TOS bits.
%   In order to avoid possible false congestion notifications,
%   we disable TCP ECN negociation.
```

- The draft calls this the 'Contra-Postel' ECN test...

The Contra-Postel ECN Test – getting code fixed

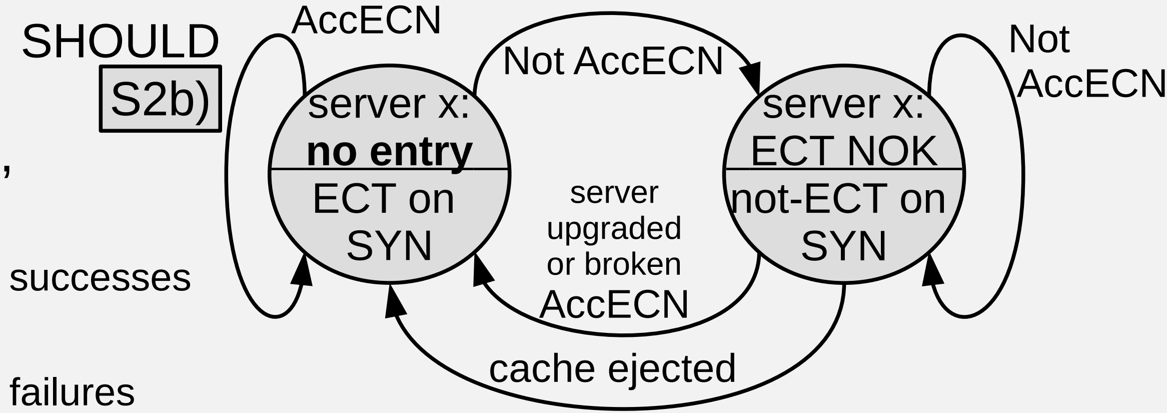
- Ironic: this form of network mangling of ECN is non-existent, but servers disable ECN in their attempt to detect it
  - drastic action based on 1-ended inference of a codepoint transition
  - and silent – no logging of the 'problem' to get it fixed
- Recommendations

1) Remove the Contra-Postel ECN test:
   - while deploying AccECN on servers
     - replaces 1-ended with 2-ended test for mangling
   - while deploying ECN++ on servers
   - just remove it from Linux ECN code

   Removes zero-ECN mangling detection (incidence is currently extremely low or zero). Best to discuss with the Linux community.
2) Add client cache work-round (next slide)
3) Fix the specs (subsequent slide)

Workround: client cache of server support for ECT on SYN (size-capped)

- If client implements AccECN, three caching strategies:
  - S1: Pessimistic ECT and cache successes
  - S2a): Optimistic ECT, no cache
  - S2b) Optimistic ECT and cache failures


SHOULD

S2b)

server x: **no entry**

ECT on SYN

server x: ECT NOK

not-ECT on SYN

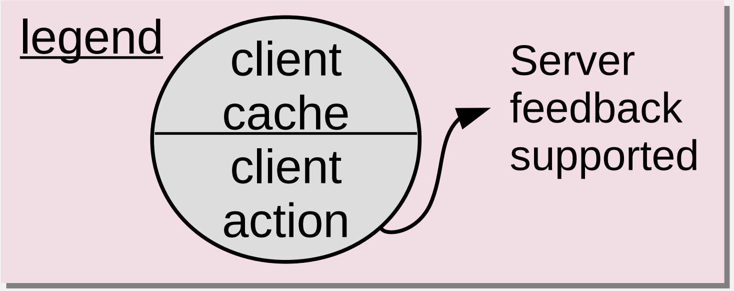
AccECN

Not AccECN

Not AccECN

server upgraded or broken AccECN

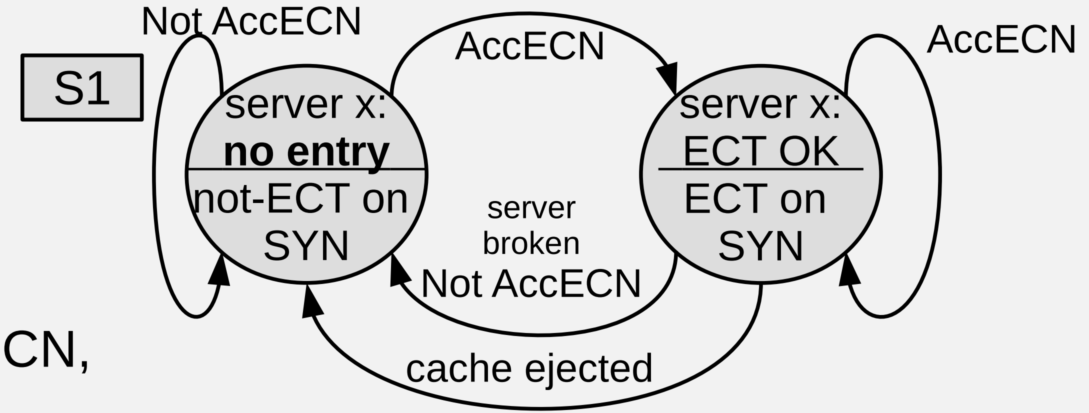
cache ejected


legend

client cache

client action

Server feedback supported


S1

server x: **no entry**

not-ECT on SYN

server x: ECT OK

ECT on SYN

Not AccECN

AccECN

AccECN

server broken Not AccECN

cache ejected

- If client doesn't implement AccECN, no ECT on SYN anyway

The Contra-Postel ECN Test – fixing the specs

- RFC3168: "`A host MUST NOT set ECT on SYN or SYN-ACK packets.`"
- RFC8311 adds: "`...unless otherwise specified by an Experimental RFC...`"
- What does a server do if it receives non-zero ECN on SYN?
  - RFC 3168: Silence
  - RFC 8311: Silence
  - Silence → Postel's Robustness Principle: "...be liberal in what you accept"?
- ECN++ draft adds: "`In order for this experiment to be useful, the following requirements follow from RFC8311:`
  - `Any TCP implementation SHOULD accept receipt of any valid TCP control packet or retransmission irrespective of its IP/ECN field. If any existing implementation does not, it SHOULD be updated to do so.`
  - `A TCP implementation taking part in the experiments proposed here MUST accept receipt of any valid TCP control packet or retransmission irrespective of its IP/ECN field.`"

Receiver packet validation / acceptance

- Original scope of ECN++ draft:
  - Solely behaviour of sender of a control pkt
  - Some recommended Receiver-side packet validation checks had been muddled in with Sender-side requirements
- Widened scope:
  - Added specific receiver acceptance guidance for ECN on each type of control packet (previous slide)
  - Warranted separating out a Receiver-side section
- ECN++ is still a sender-only *deployment*

Next Steps

- Really have finished now
- Closed off all open issues
    1) Separate: AccECN vs. RFC3168 f/b negotiated
    2) Response to CE on Pure ACK
    3) Contra-Postel ECN test
    4) Widened scope: *receiver* packet validation / acceptance
- WGLC