Lessons learned: TCP Fast Open and ECN in the Wild Internet

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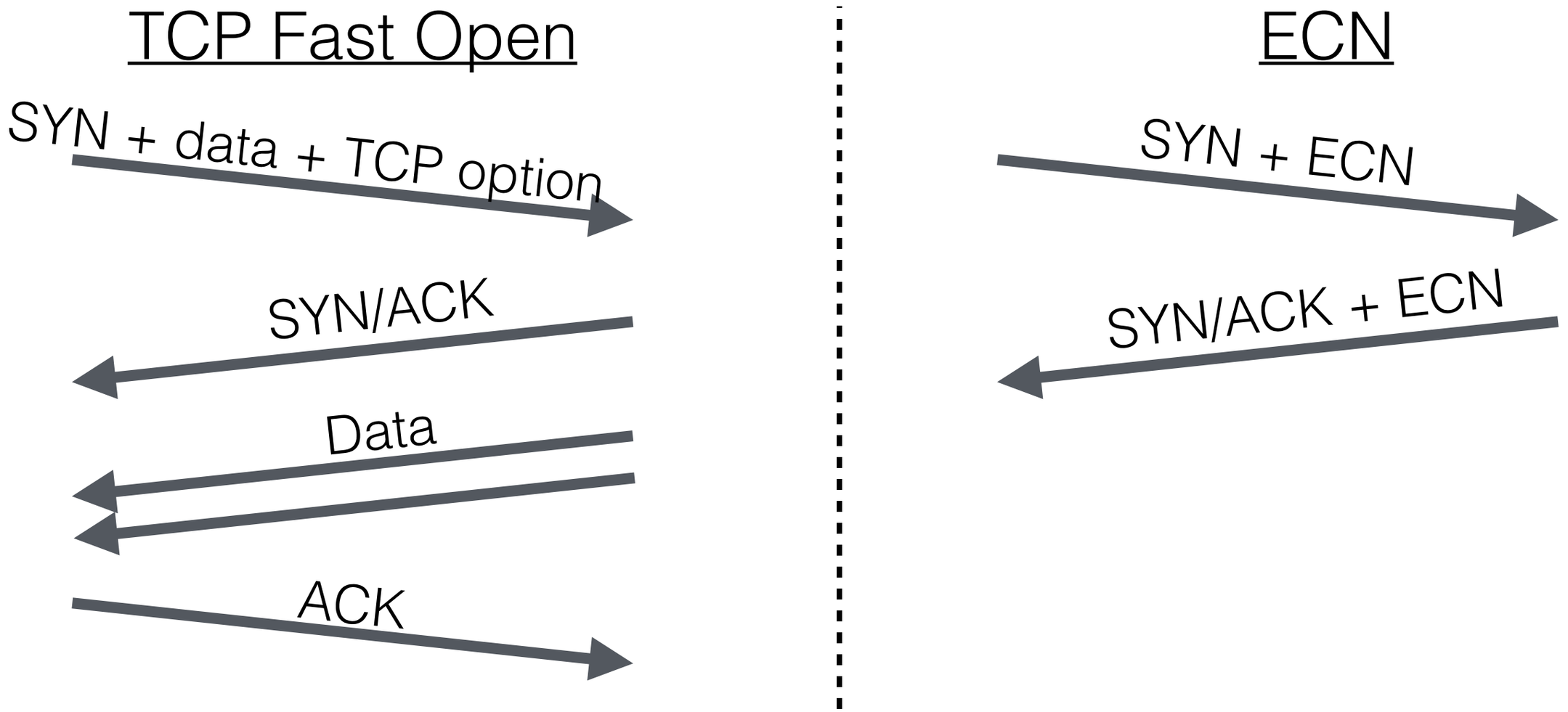
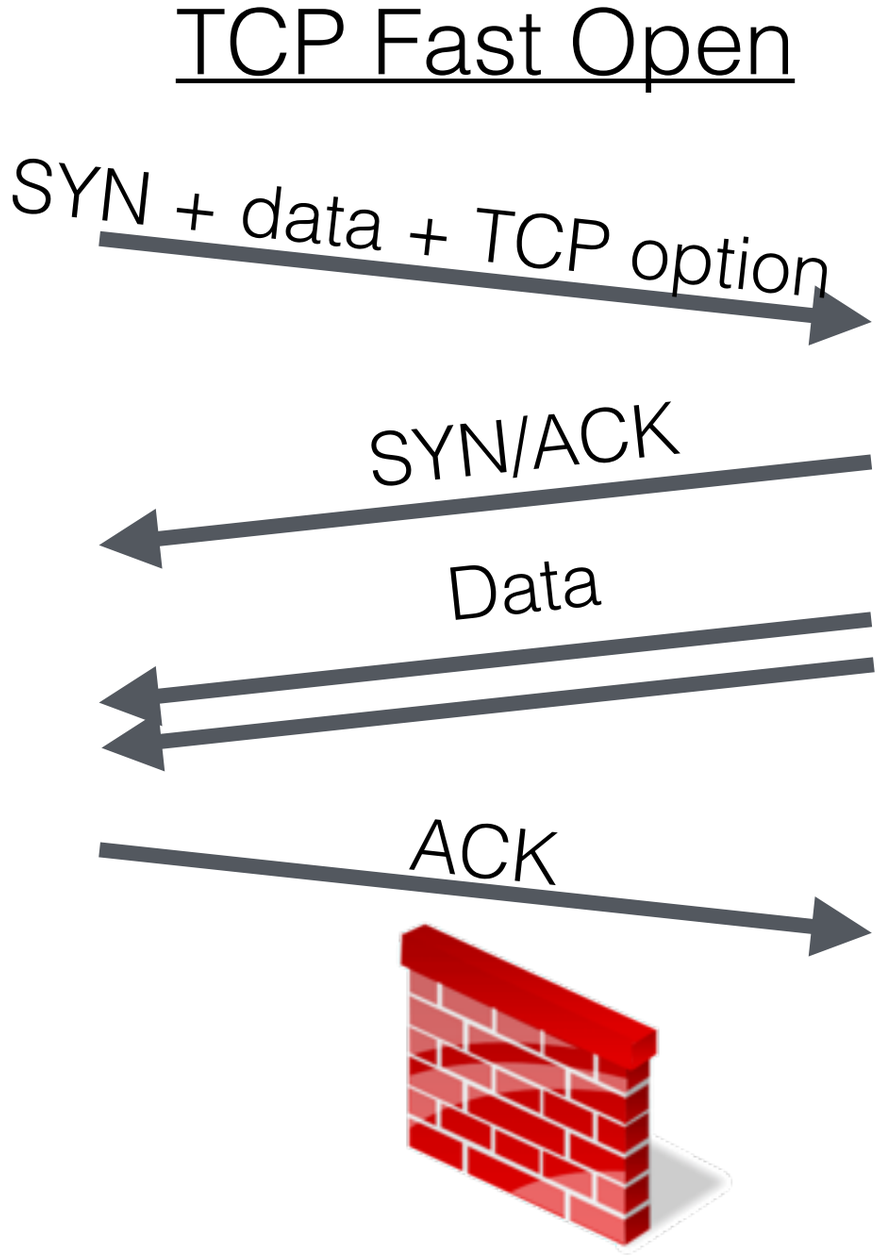
Middleboxes interfere with TCP extensions

Typical measurement campaigns inspect the handshake-part of TCP extensions (e.g., removing TCP options, dropping SYN+ECN)



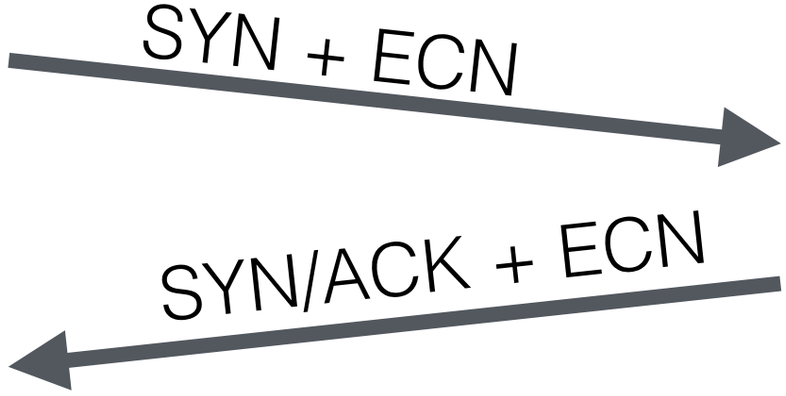
Middleboxes “break” the flow after the handshake

<u>TCP Fast Open</u>



Flow gets blackhole’d

<u>ECN</u>



- Mark all packets with CE
- Randomly reorder ECT-marked packets
- …

Lessons learned

- New TCP extensions might *confuse* middlebox's internal state
- This *confusion* might show its effects only later on, long after the handshake

Measurement campaigns of middlebox interference should consider the *whole flow*