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

**TCP Fast Open**
- SYN + data + TCP option
- SYN/ACK
- Data
- ACK

**Flow gets blackhole’d**

**ECN**
- SYN + ECN
- SYN/ACK + ECN

- 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*