Service Awareness rather than Path Awareness

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The problem

- Performance Enhancing Proxies (PEPs) sometimes let TCP work better than QUIC, e.g. over satellites
  - Has anyone tried QUIC over mmWave?
  - Encrypting transport headers solves ossification, but at a cost
- PEPs are not strictly evil
  - They try to be useful, and sometimes succeed
  - Claim: ossification is at least partially due to transparent proxy design (they must cheat, so they must make assumptions about header fields)
- MASQUE is not transparent. Add PEP functions there?
  - Maybe? But this might cause ossification problems again...
  - Perhaps depending on the PEP function

What we suggest

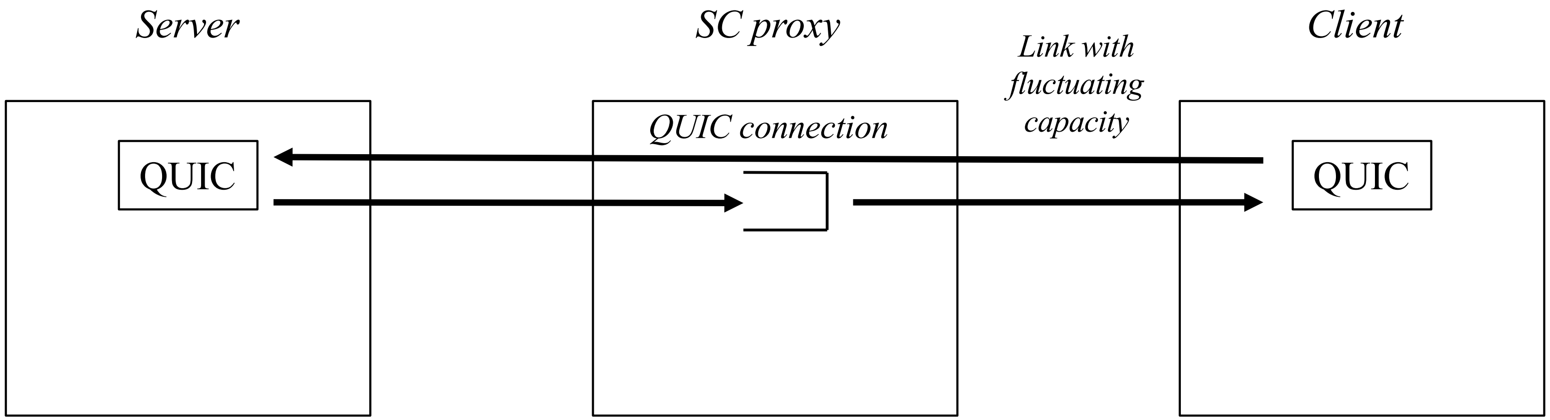
- **Separation of concerns**
  - A separate "**sidecar (SC)**" protocol for non-critical PEP functions, independent of main protocol
  - Non-criticality ensured by letting main protocol choose services over a local sidecar interface (*on the same host!*)
- Minimize changes to "main" protocol
  - Sidecar ossification means: the PEP function does not improve further (bad but harmless)
- PEP functions are use cases of the sidecar protocol

Sidecar functionality

- **Data plane:** directly affect main protocol
  - Without parsing header: queue management, re-transmission, ..
- **Control plane**
  - Local (on host) information exchange with main protocol
- SC ACKs between sidecar entities
  - Hash over main protocol's transport header
  - SC ACKs are either separate or piggybacked (e.g., QUIC: UDP options)
- Next: two example use cases
  - Written "QUIC", but should work the same way for, e.g., TCP or SCTP

Example use case 1:
link-specific congestion control

- Adjacent to fluctuating-capacity link
  - SC proxy’s congestion control should track available capacity better, and needs data packets for when capacity becomes available



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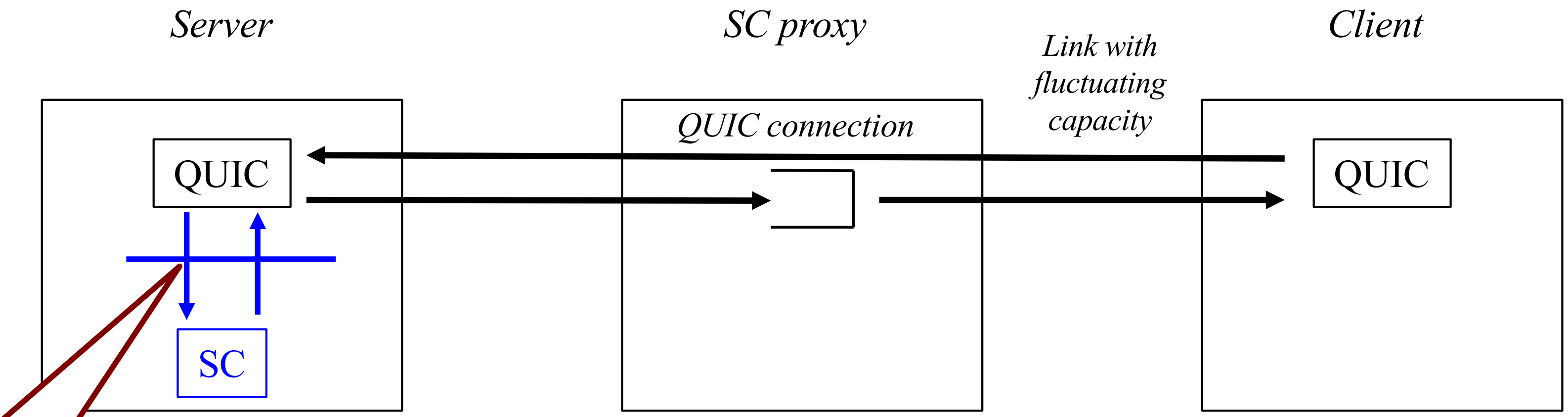

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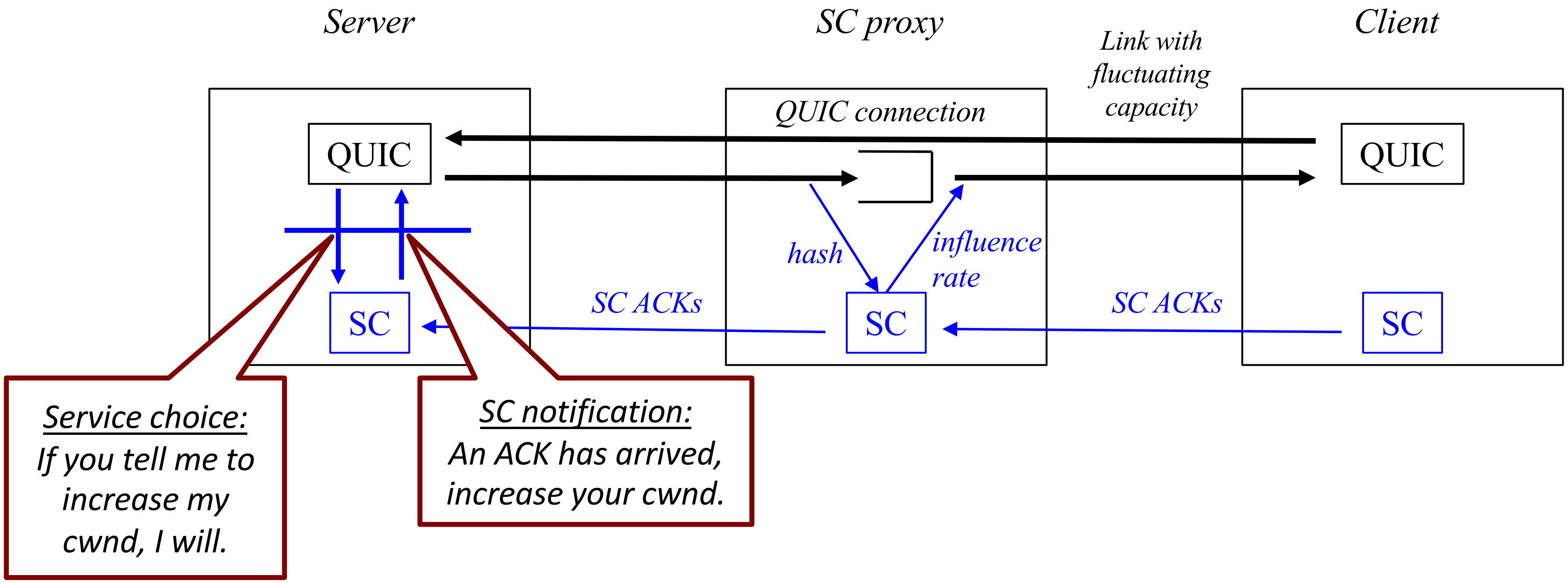

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<u>SC notification:</u> *An ACK has arrived, increase your cwnd.*

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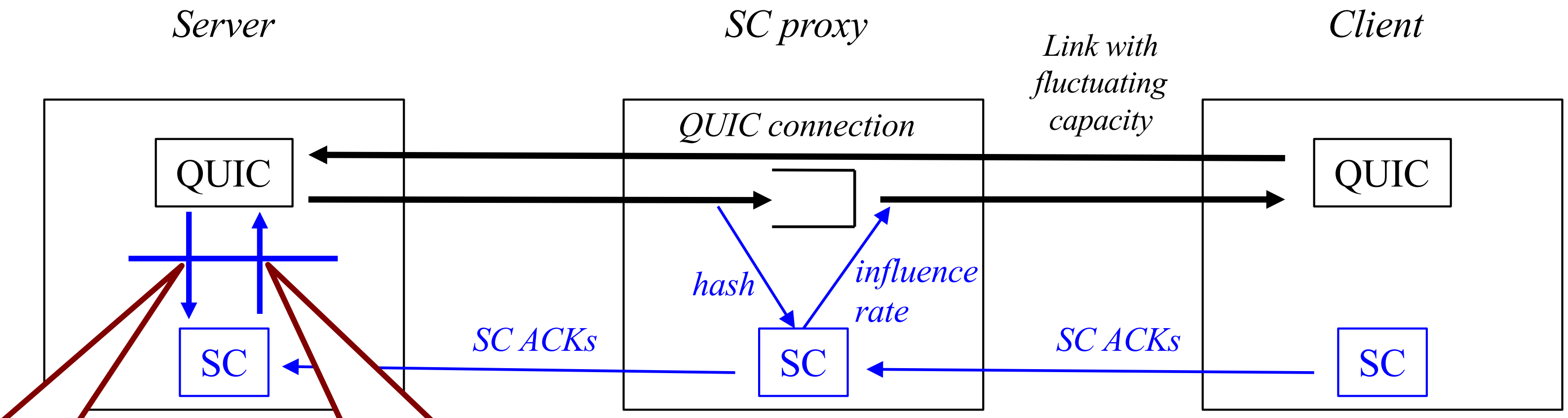

Service choice:
If you tell me to increase my cwnd, I will.

SC notification:
An ACK has arrived, increase your cwnd.

Minimal changes to QUIC: only server side

- *Local interface communication*
- *If the service is chosen: increase cwnd when SC tells us to*

Example use case 2:
WiFi AP ACKs on behalf of host

- AP keeps track of transport packet – ACK mapping
- Creates a transport ACK to the server when LL ACK from client arrives
  - Client can send fewer transport ACKs. Reduces overhead: fewer collisions, less power wasted

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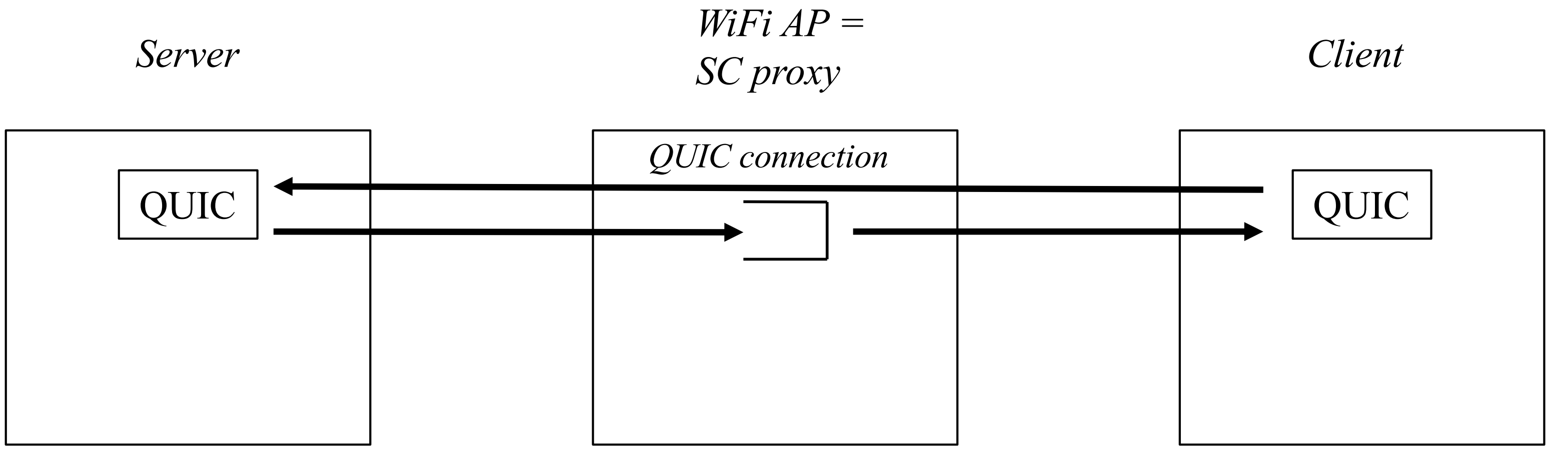

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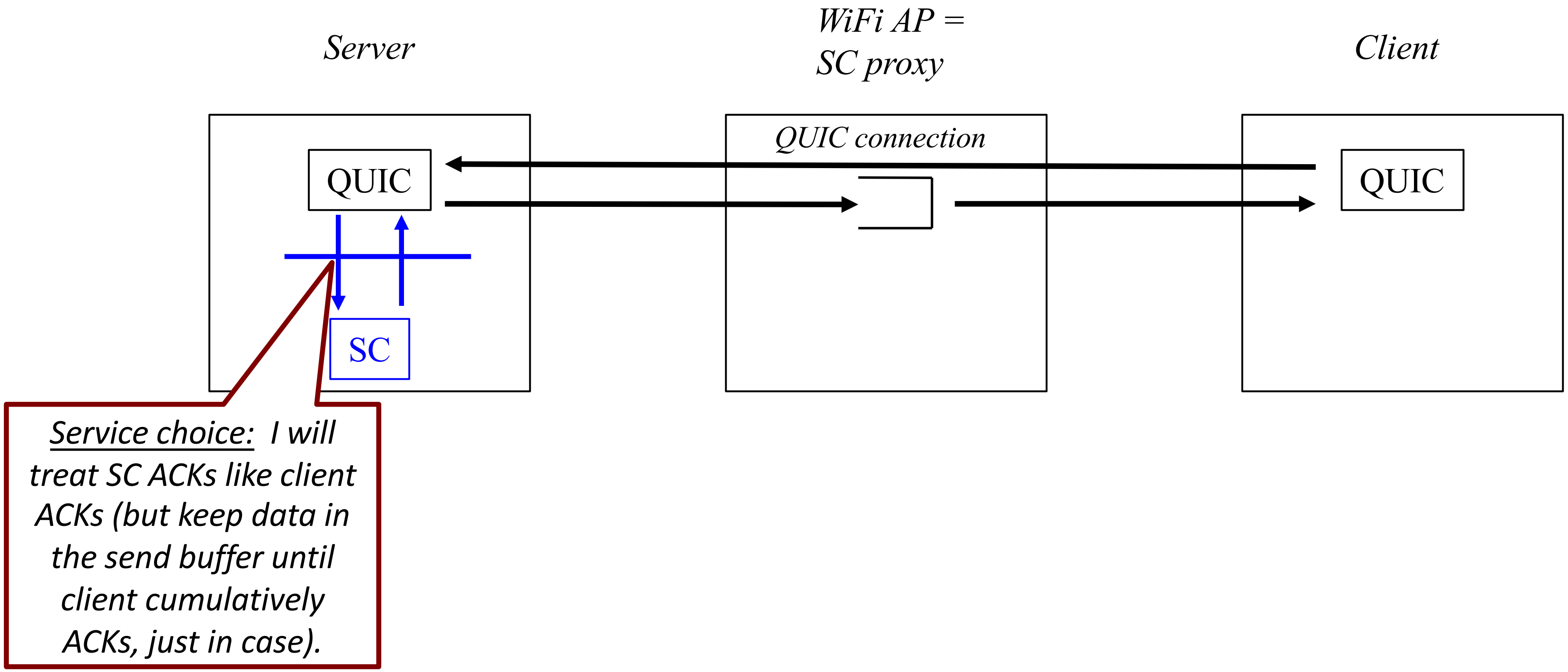

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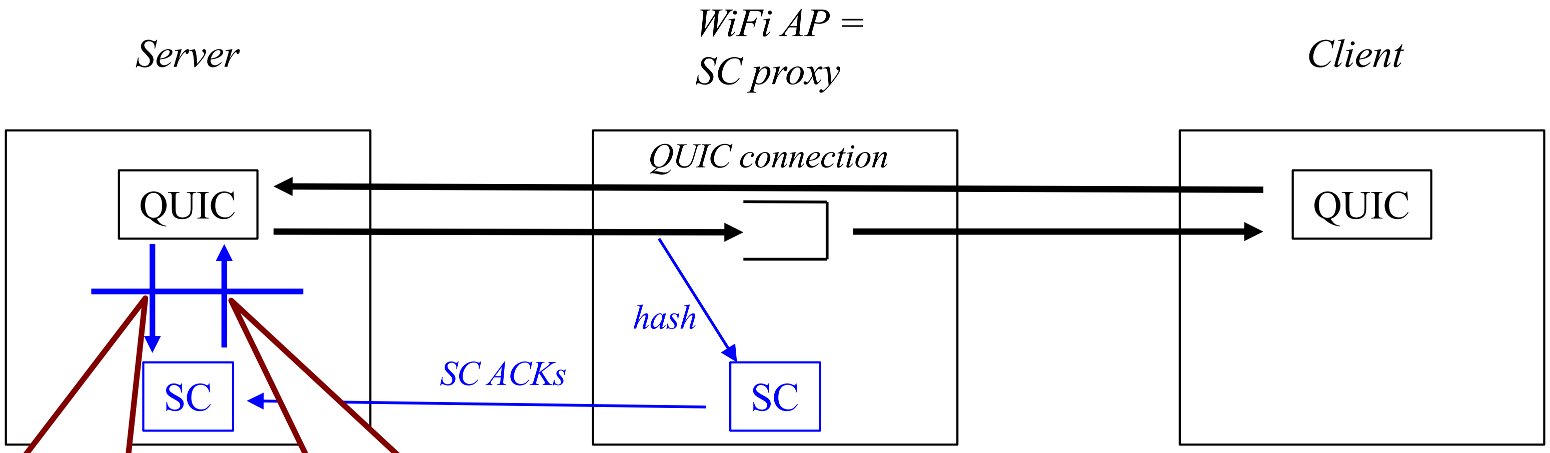

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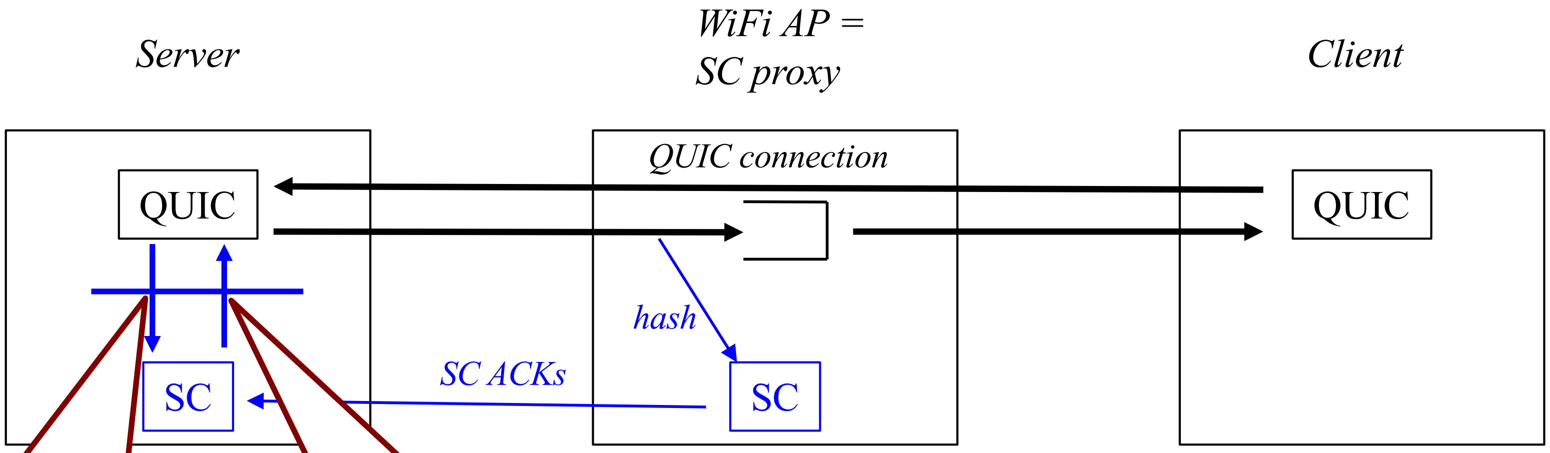

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SC notification: An ACK has arrived.

Minimal changes to QUIC: server + client side

- *Server: local interface communication*
- *If the service is chosen:*
  - *Via QUIC, tell client to send fewer ACKs*
  - *Accept ACKs from SC, but keep data in send buffer*

Conclusion

- We believe this is a way forward to solve the e2e encryption / ossification / PEP dilemma

- Research needed
  - How to limit hashing / SC ACK overhead?
  - The devil is in the details: what are viable use cases?
    - E.g., link-specific congestion control use case: different from TCP connection splitter, SC entities must find and trust each other
      - SC proxy can just send SC ACKs back towards the sender; doesn't need to trust anyone
      - Sender-side SC entity needs to trust the SC proxy... but the SC proxy can't easily guess hashes
      - Path changes: if there's a different SC proxy on the new path, it just begins to send SC ACKs
      - ... but there needs to be a setup phase, or else we could get N SC proxies on a path, all ACKing ☺
  - Can this really be done independent of the main protocol?

Thanks!

Questions?