TCPLS: Closely Integrating TCP and TLS

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Avec le soutien de la Wallonie

Motivations

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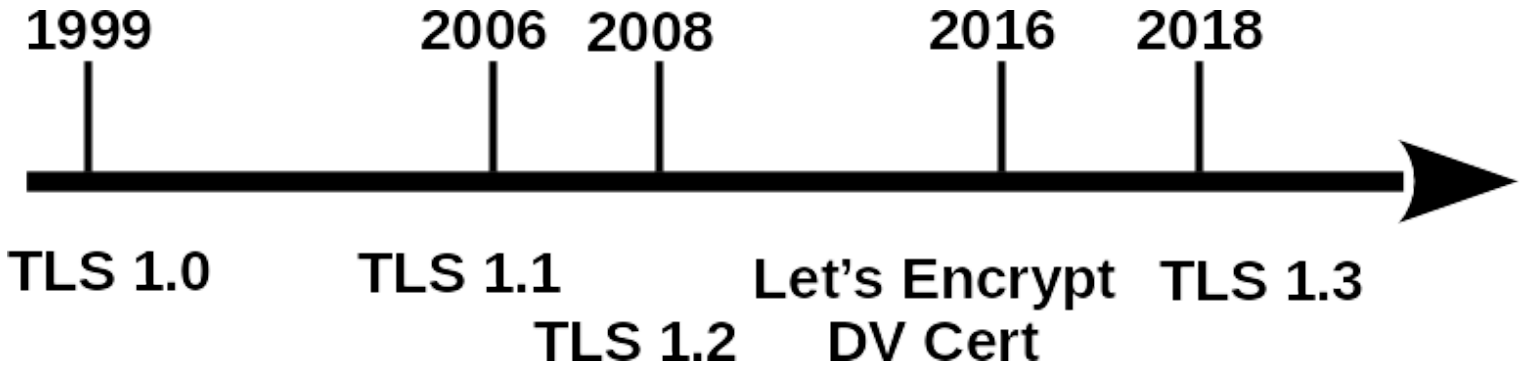
  - The world changes! TCP without TLS over untrusted networks becomes unrealistic



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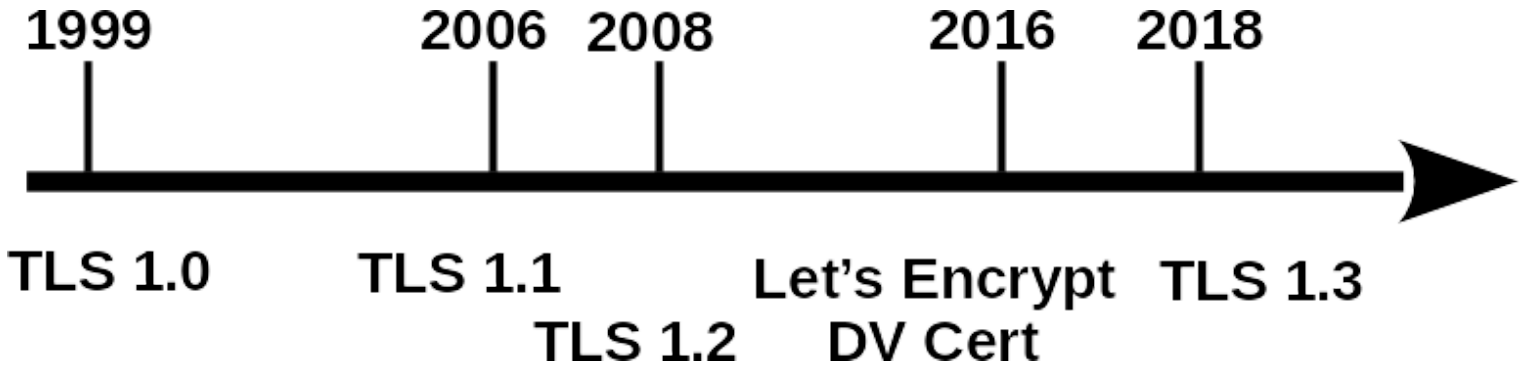

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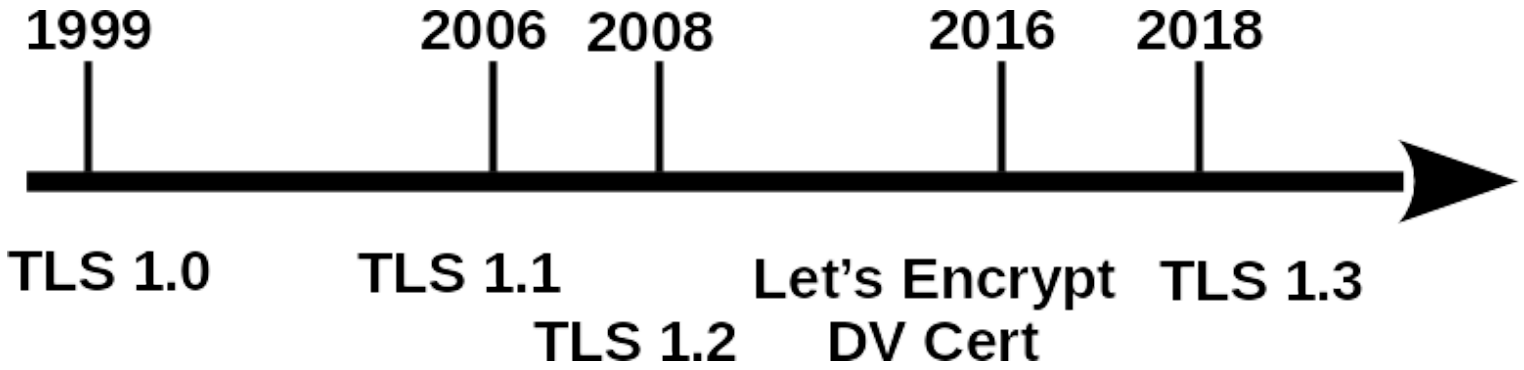

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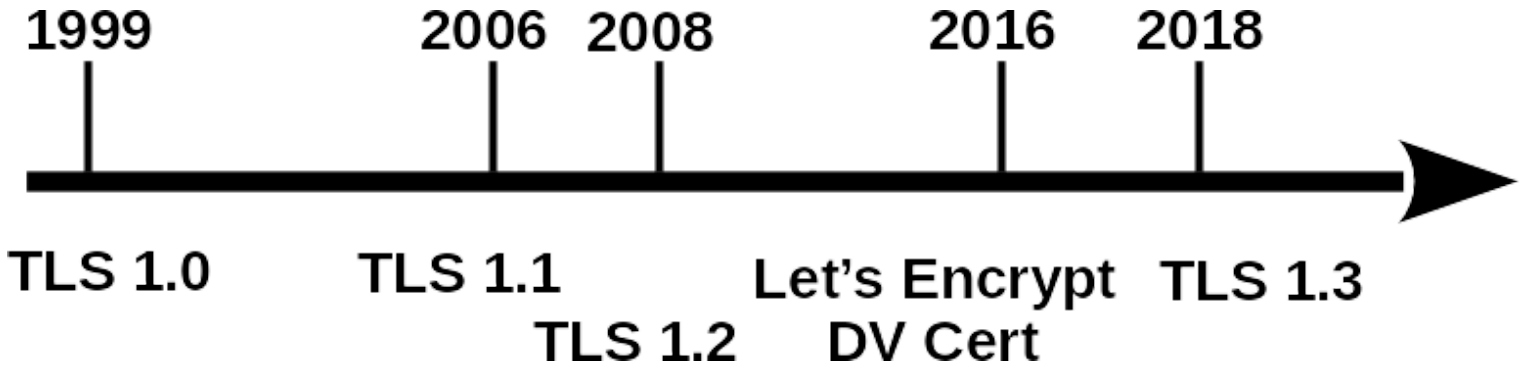

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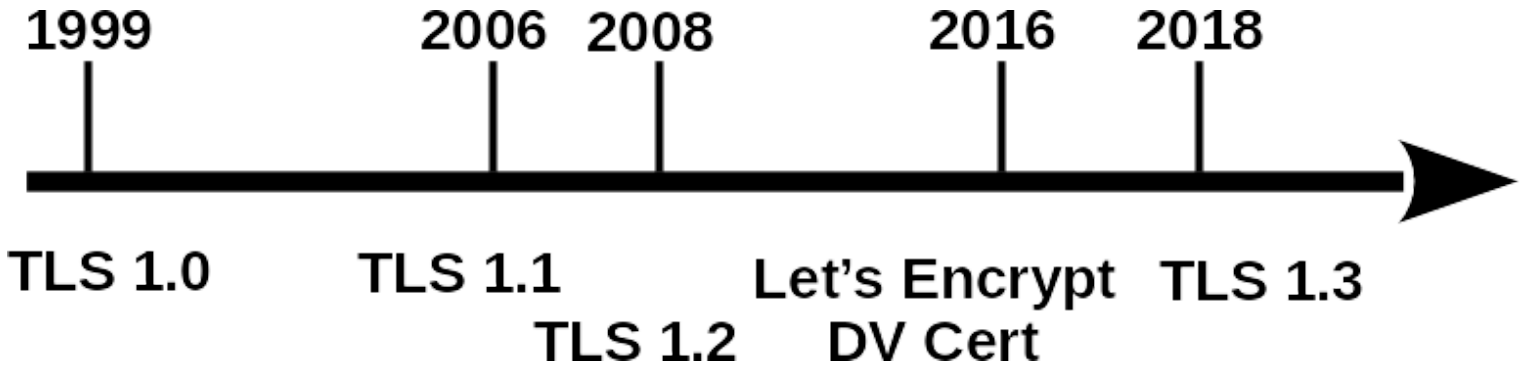
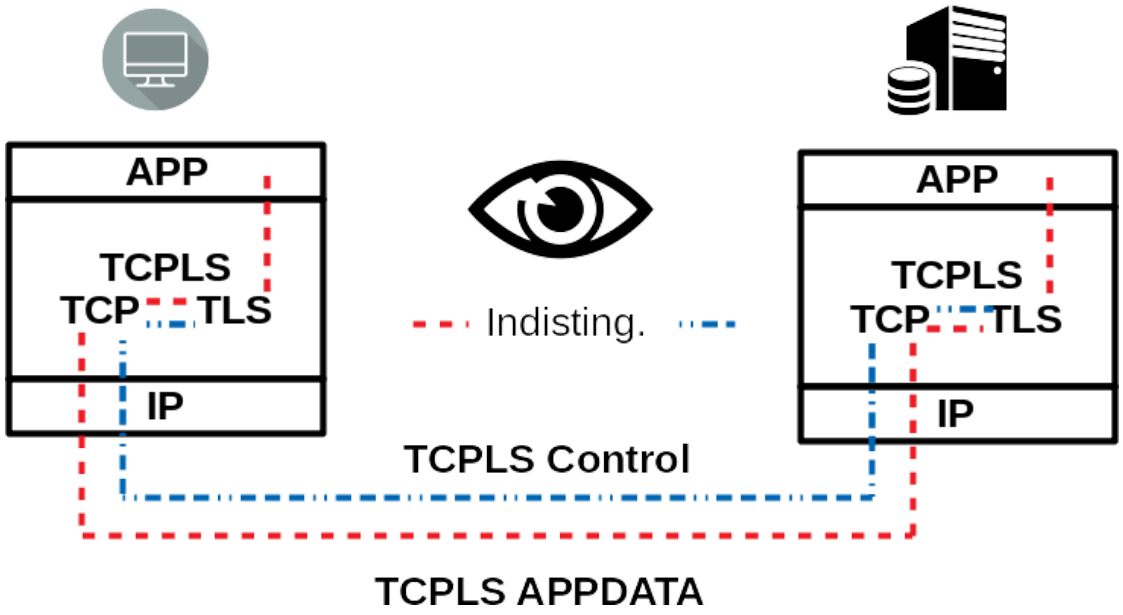


  - Maybe we can benefit from merging the stack?
  - TCP needs a boost to compete with QUIC in the future
    - Improving on Header space issue; middlebox interferences
  - Towards more application tuning
    - Lack of complex transport features exposed to the application

How?

- TCPLS's Secure Control Channel
  - We aim at a synergy with recent efforts in the linux kernel for more eBPF in TCP
  - TCPLS messages are indistinguishable from TLS 1.3 APPDATA messages



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- Major improvement of TCP's extensibility and deployability
  - TCPLS's Secure Control Channel
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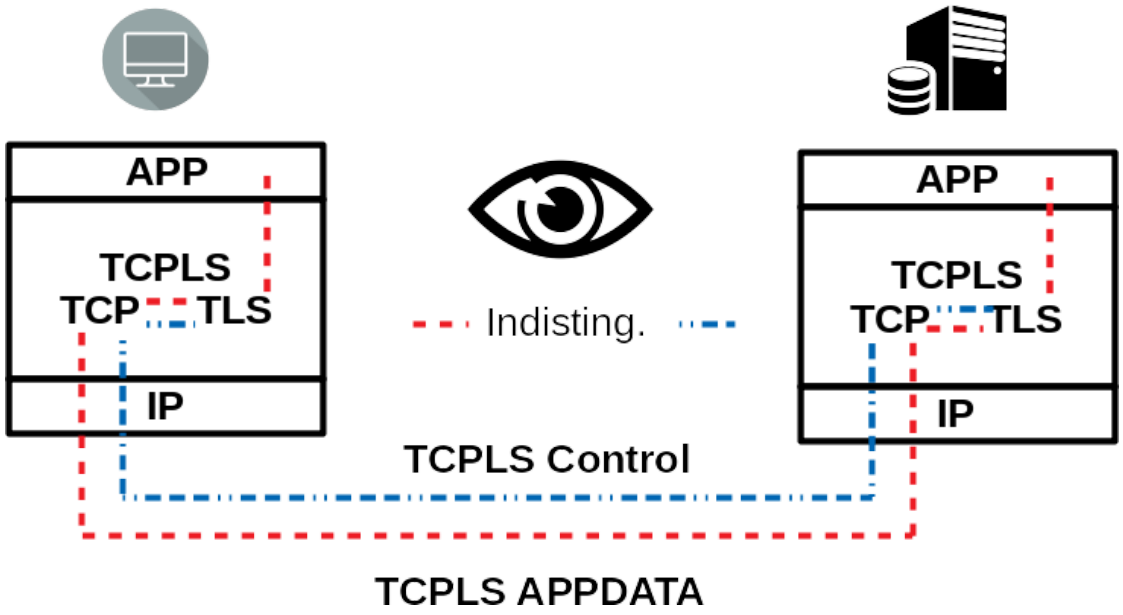
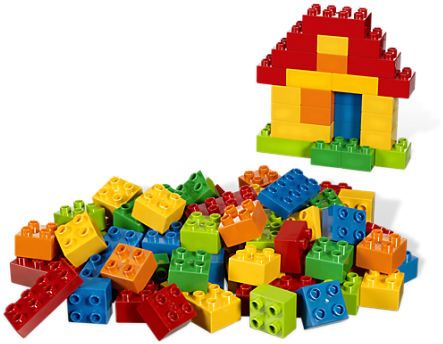


How?

- API to export complex transport features: composable basic blocks
  - Multihoming, multipathing, QUIC-like streams, 0-RTT, Happy Eyeball, TCP options, eBPF injection, ...
  - E.g., notion of path, notion of streams: implication of composing streams with paths



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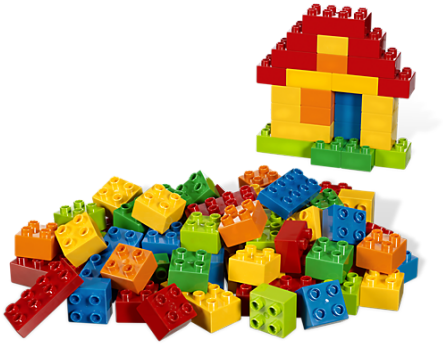
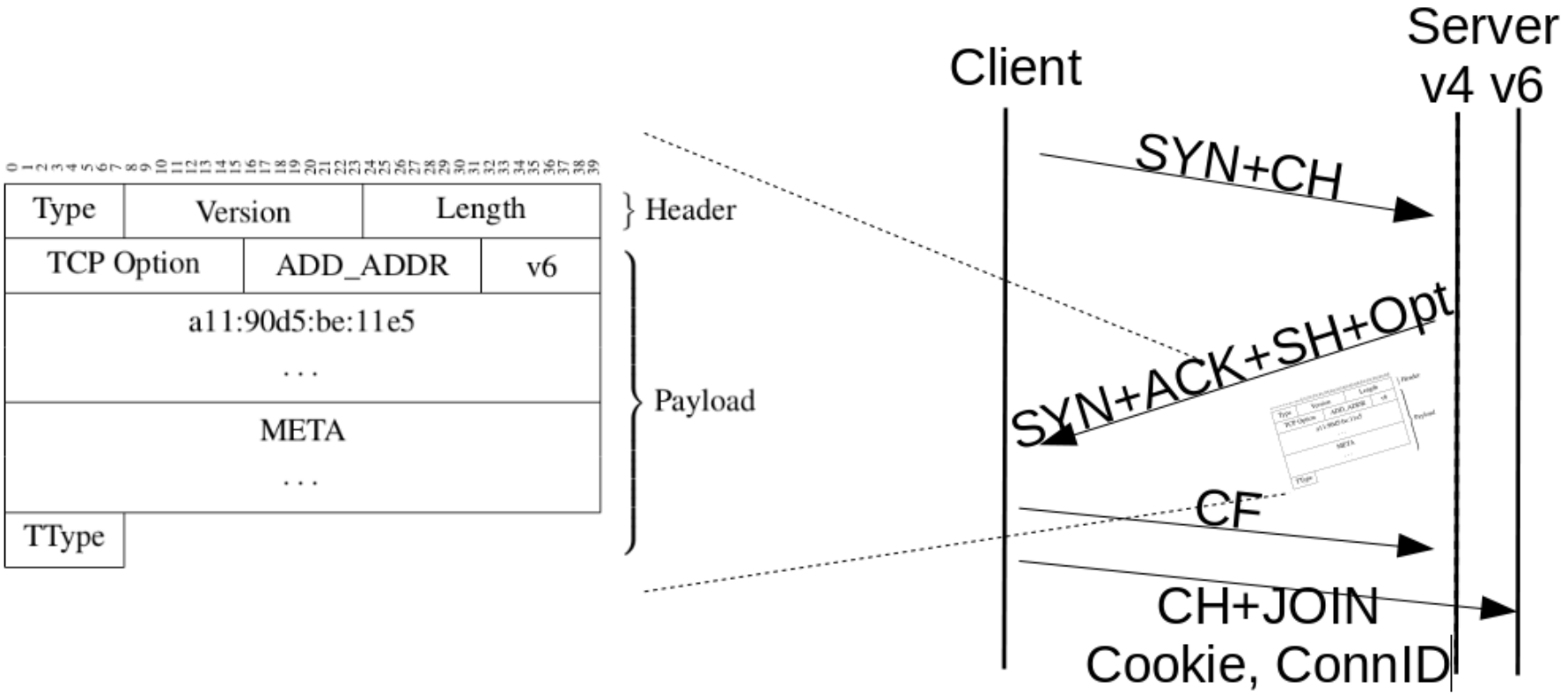


- Showing the similarities and the nuanced differences between QUIC and TCPLS

TCPLS Secure Channel

- Goal: Provides an encrypted and authenticated channel to negotiate TCP/IP extensions



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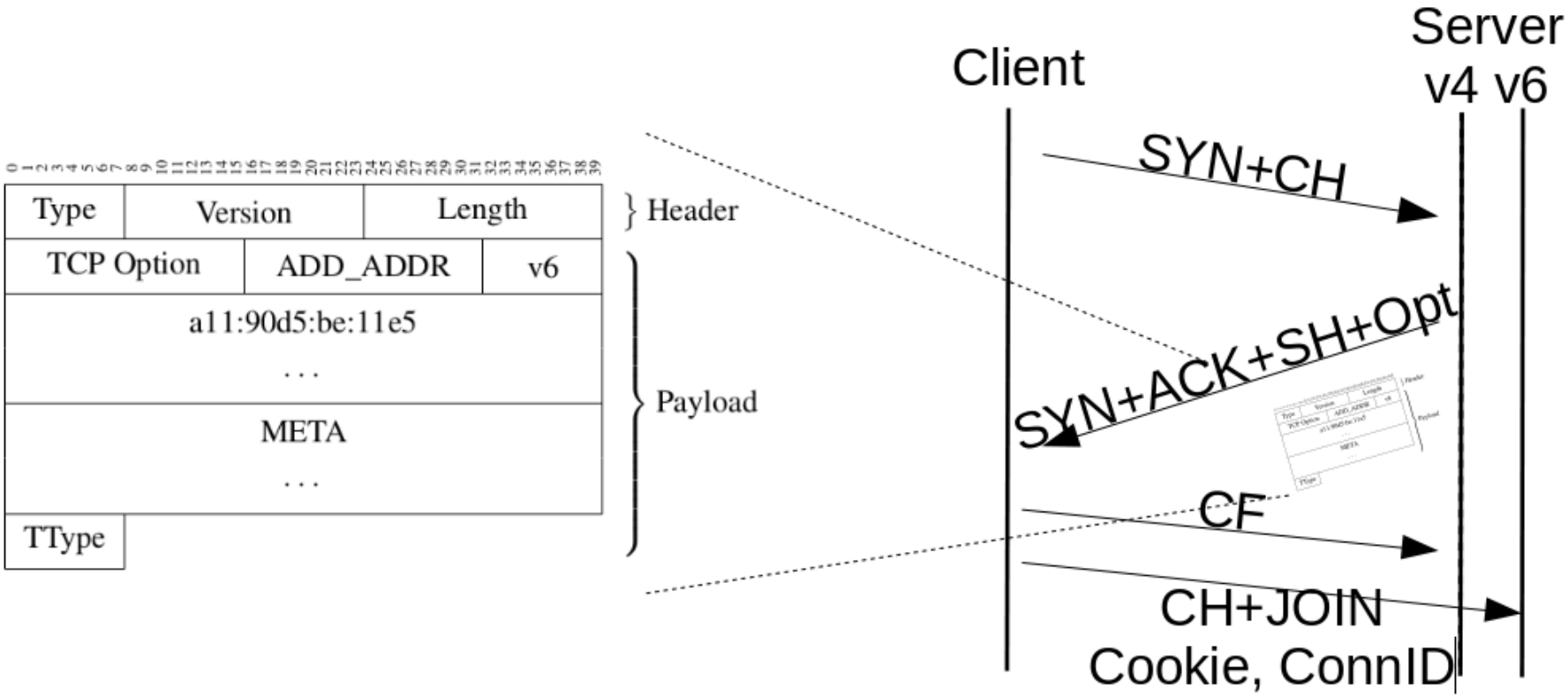

- Use TLS 1.3's protocol extensibility design
  - The "visible" type (Type) is APPDATA
  - The true type (TType) is located at the end of the payload

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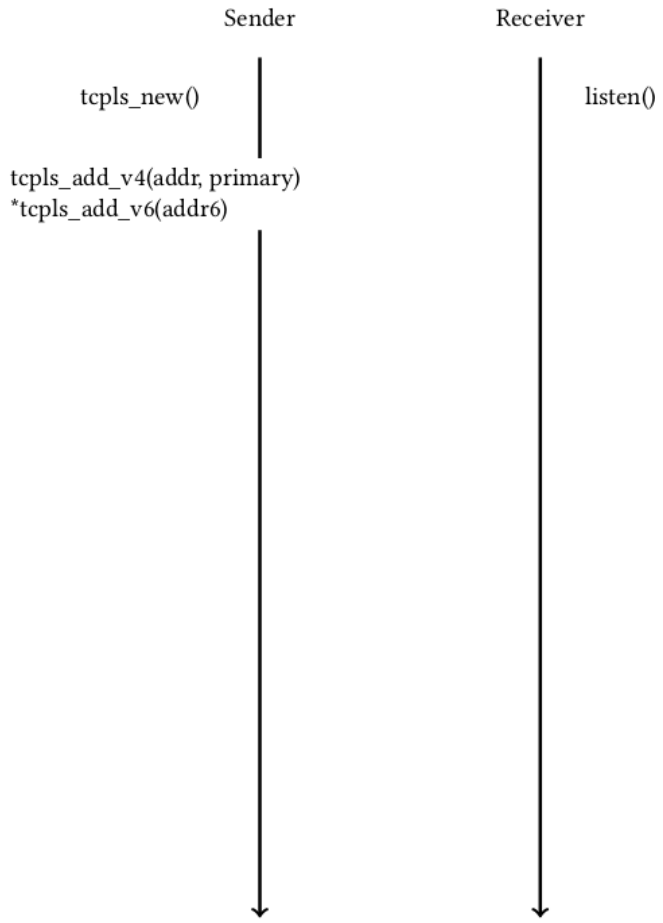

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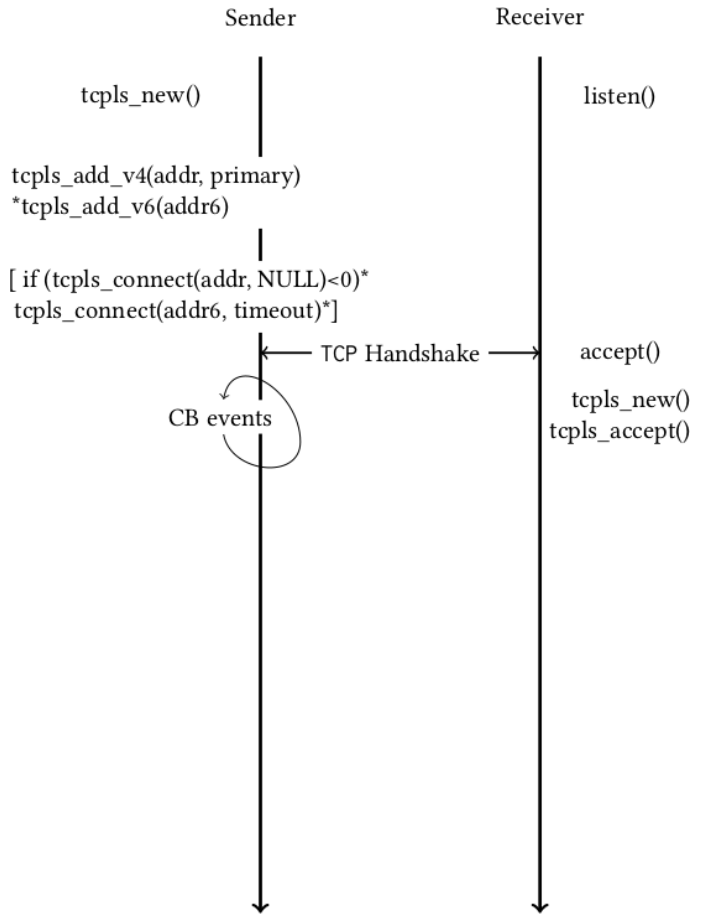

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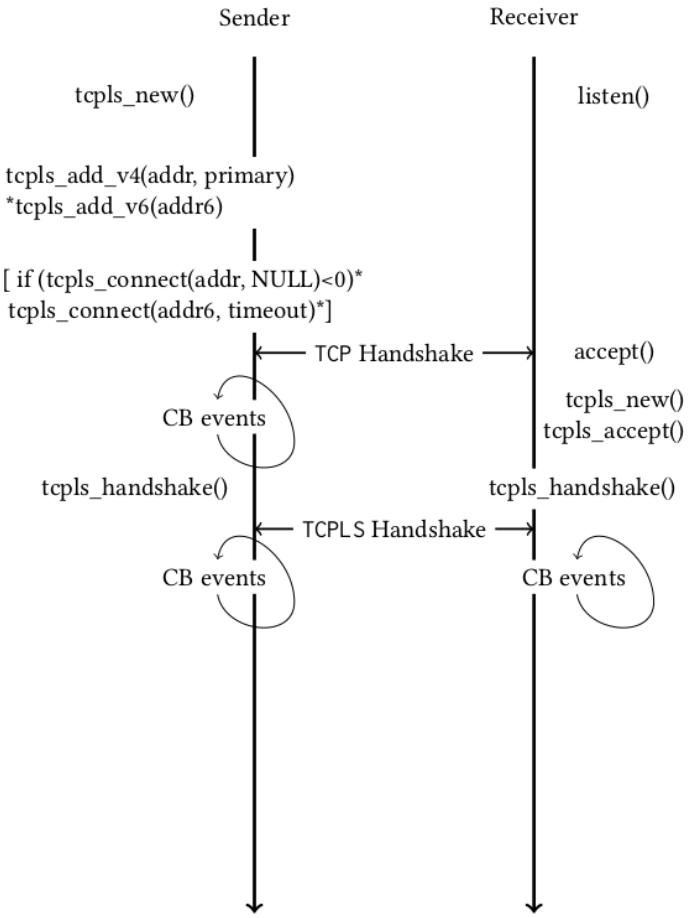

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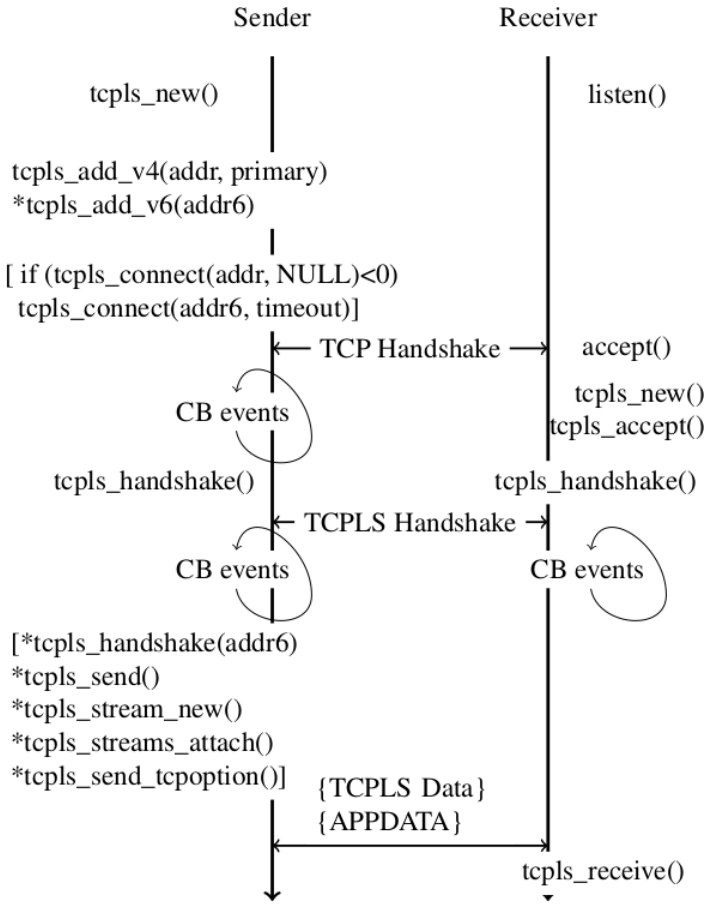

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Example: App-level Con Migration

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 2 prop.client.mpjoin = 1;
 3 prop.client.zero_rtt = 1;
 4 prop.client.dest = dest_addr;
 5 /** Make a tcpls mpjoin handshake */
 6 ret = tcpls_handshake(tcpls, &prop);
 7 if (!ret) {
 8   /** Create a stream on the new connection and attach it now*
 9   tcpls_stream_new(tcpls, NULL, dest_addr);
10   tcpls_streams_attach(tcpls, 0, 1);
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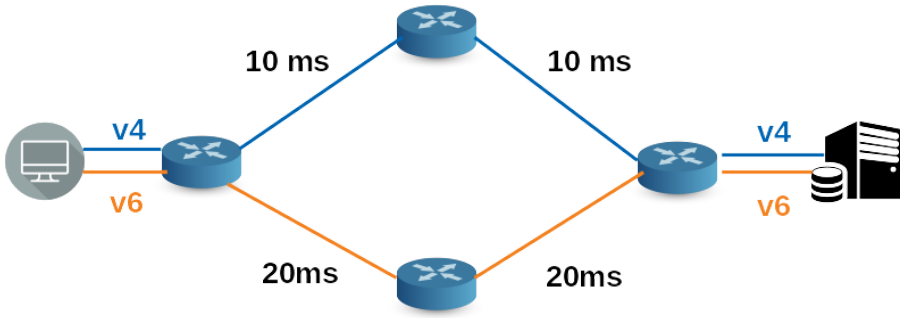
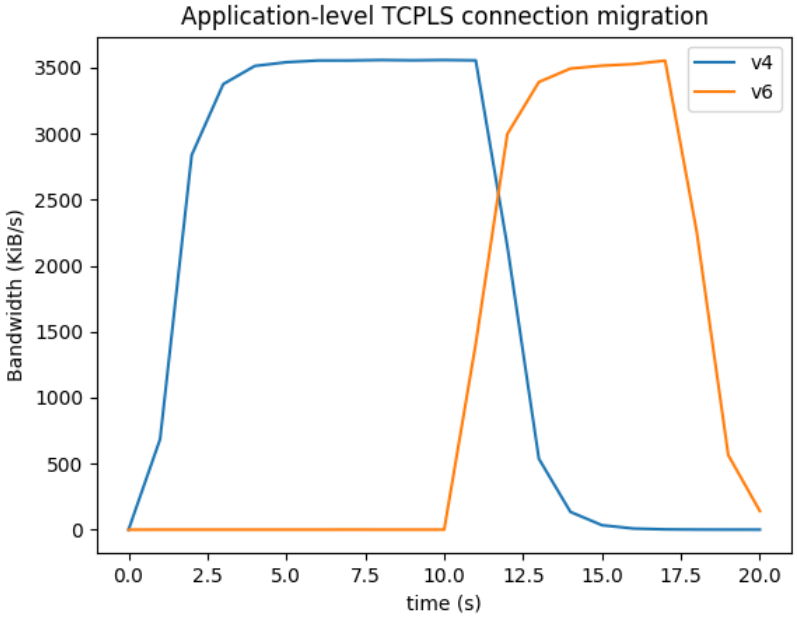
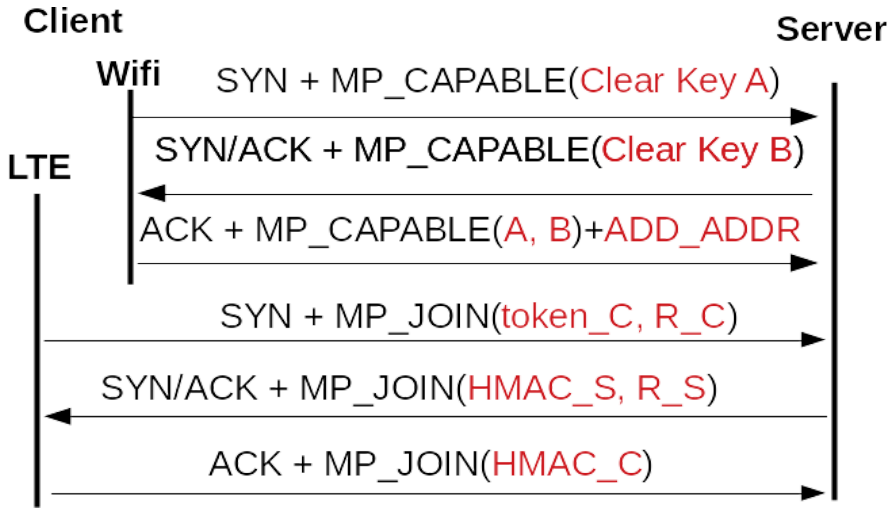
- Download of a 60MB file over a virtual network with two 30mbps links
- Multipath mode activated during the migration





Research Agenda

- Applicability of TCPLS's ideas
  - A more secure MPTCP?
    - MPTCP ADD_ADDR and RM_ADDR inside the TCPLS secure channel + new setsockopt
    - We can drop the in clear symmetric key exchange and the truncated HMAC
    - Significant but highly benefical redesign of MPTCP



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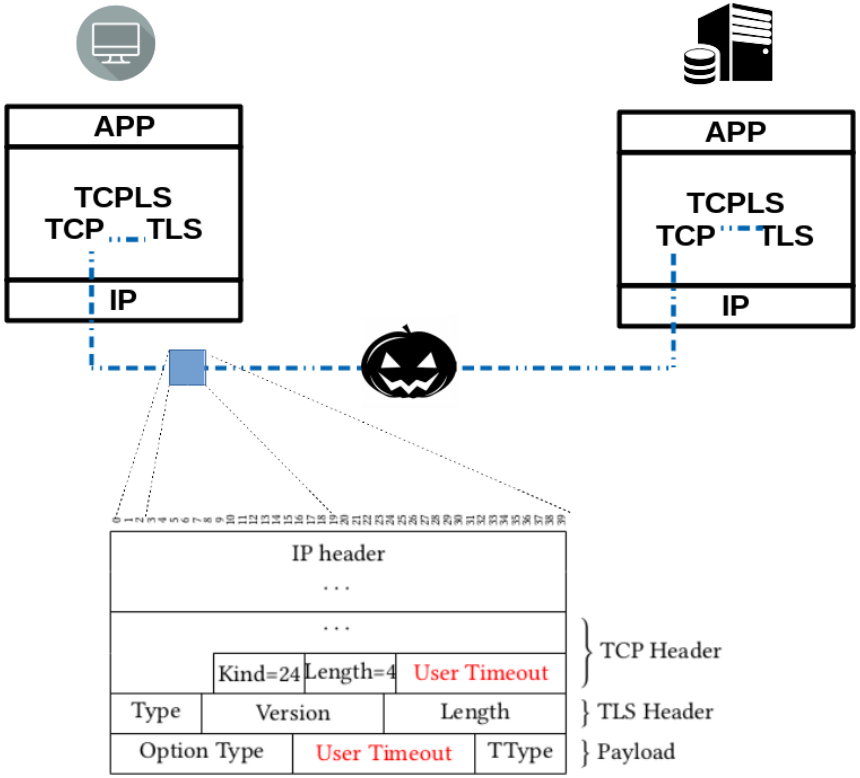
- Applicability of TCPLS's ideas
  - Helpful for detecting Middleboxes messing with TCP?
    - Send options in TCP, send them also in TCPLS's control channel, and compare



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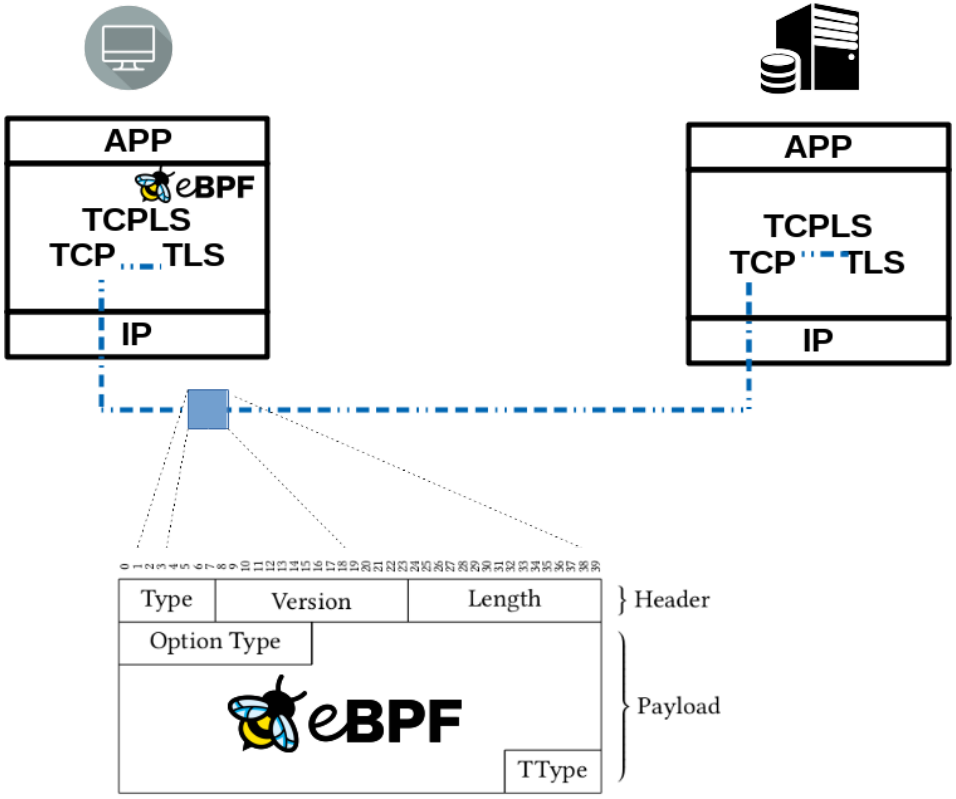
- Applicability of TCPLS's ideas
  - Pluginizing TCPLS?
    - Similarly to PQUIC and xBGP; advancing towards pluginized protocols -- e.g.:
      - Deploying cutting-edge research in AEAD ciphers through plugins!
      - Letting the sender send and set the multipath scheduler to the receiver
      - Configuring the peer's TCP stack -- in line with current efforts in the kernel



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https://github.com/pluginized-protocols/picotcpls/

https://pluginized-protocols.org/

@frochet