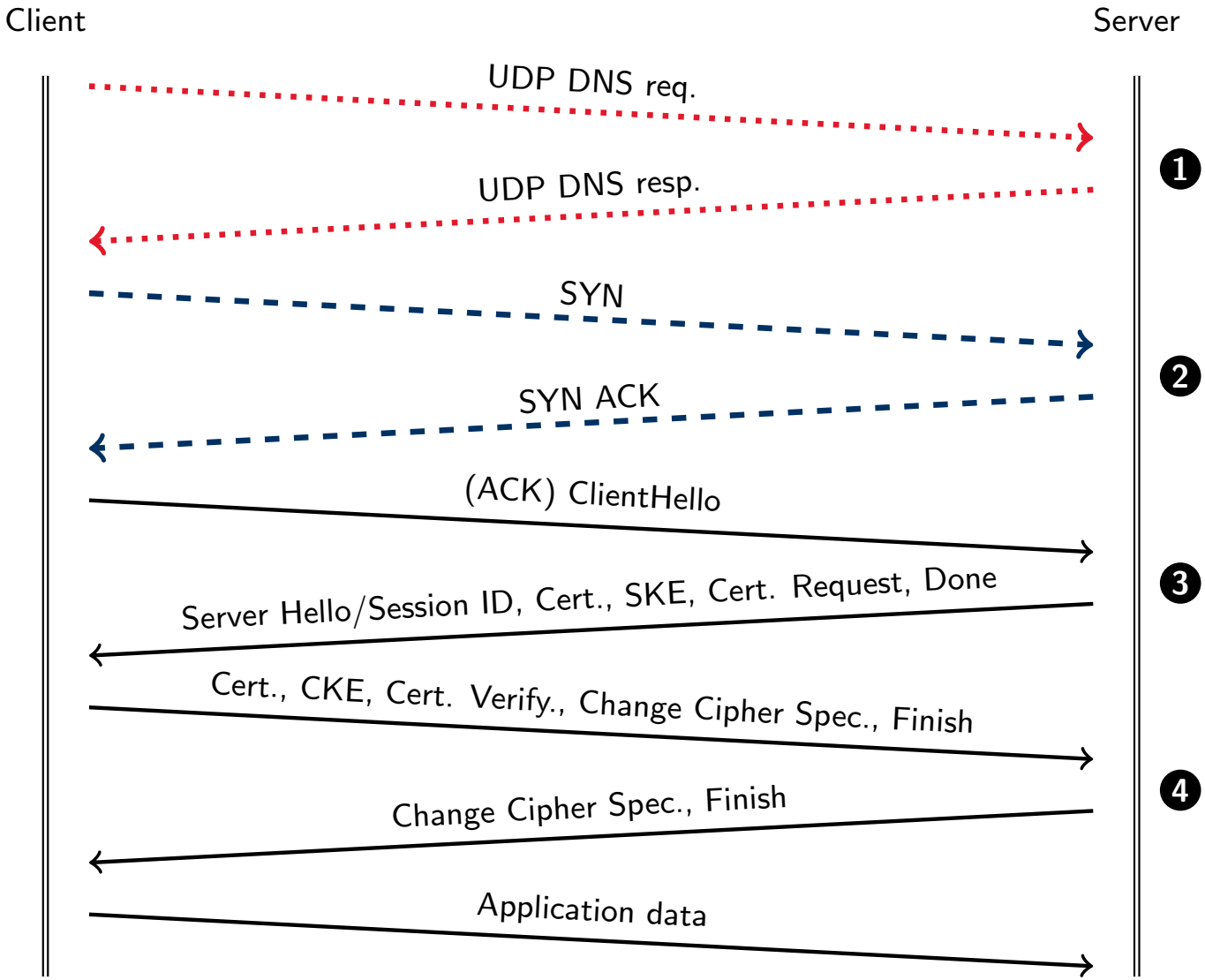
TLS alternatives – faster and more secure

Tanja Lange
Technische Universiteit Eindhoven

26 April 2015

TLS: 4 roundtrips



Slide credit: Mike Petullo.

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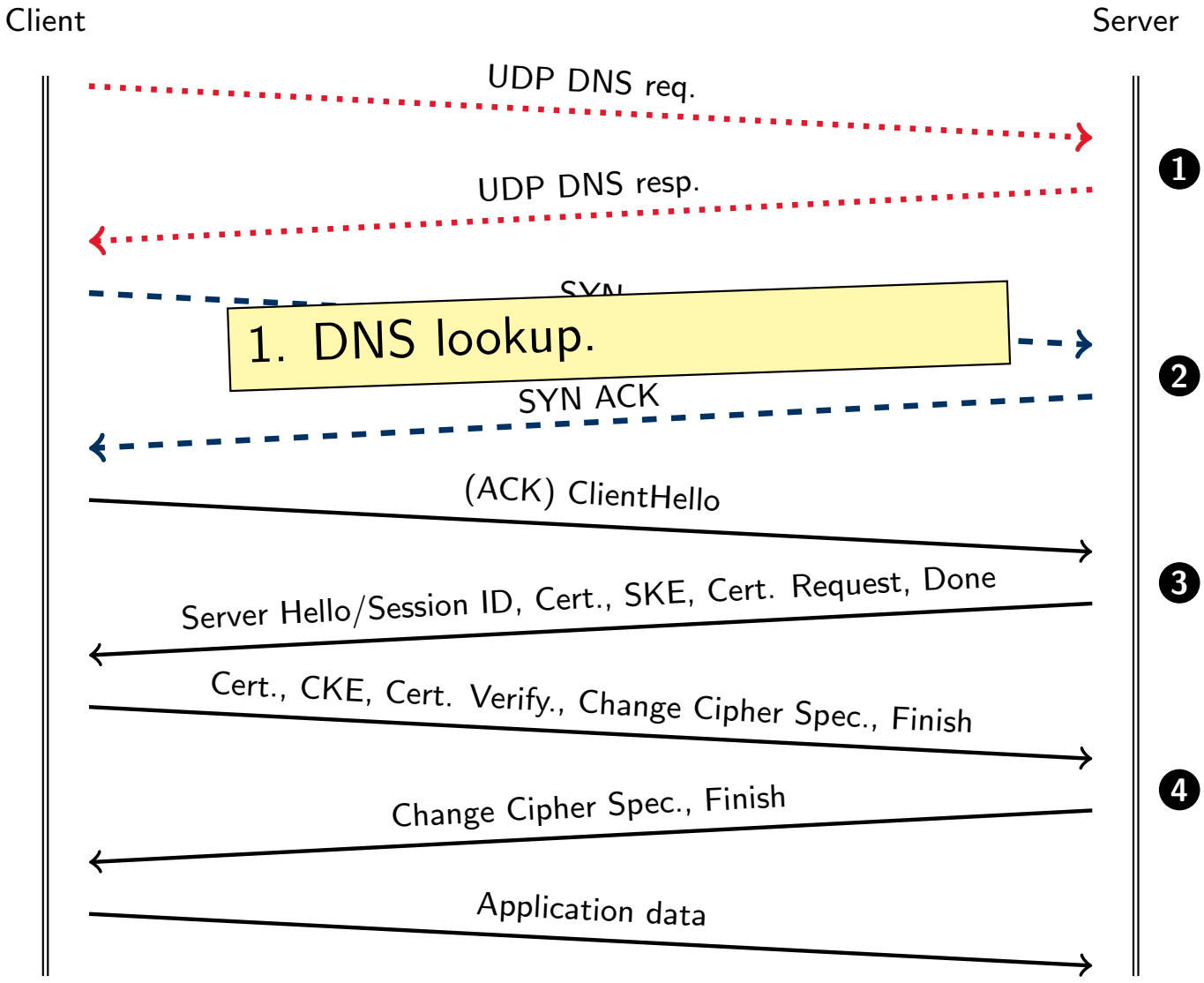
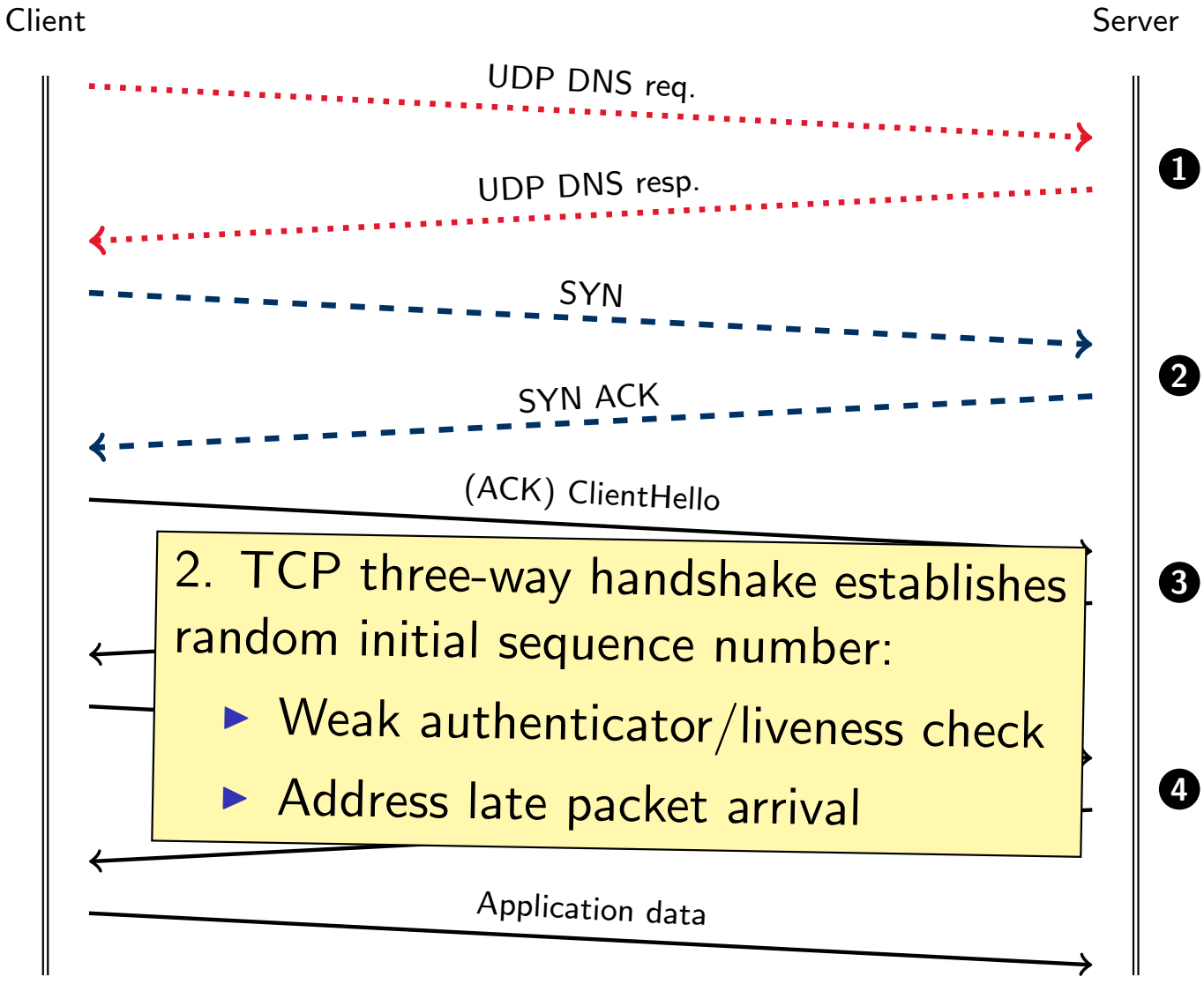


Slide credit: Mike Petullo.

TLS: 4 roundtrips



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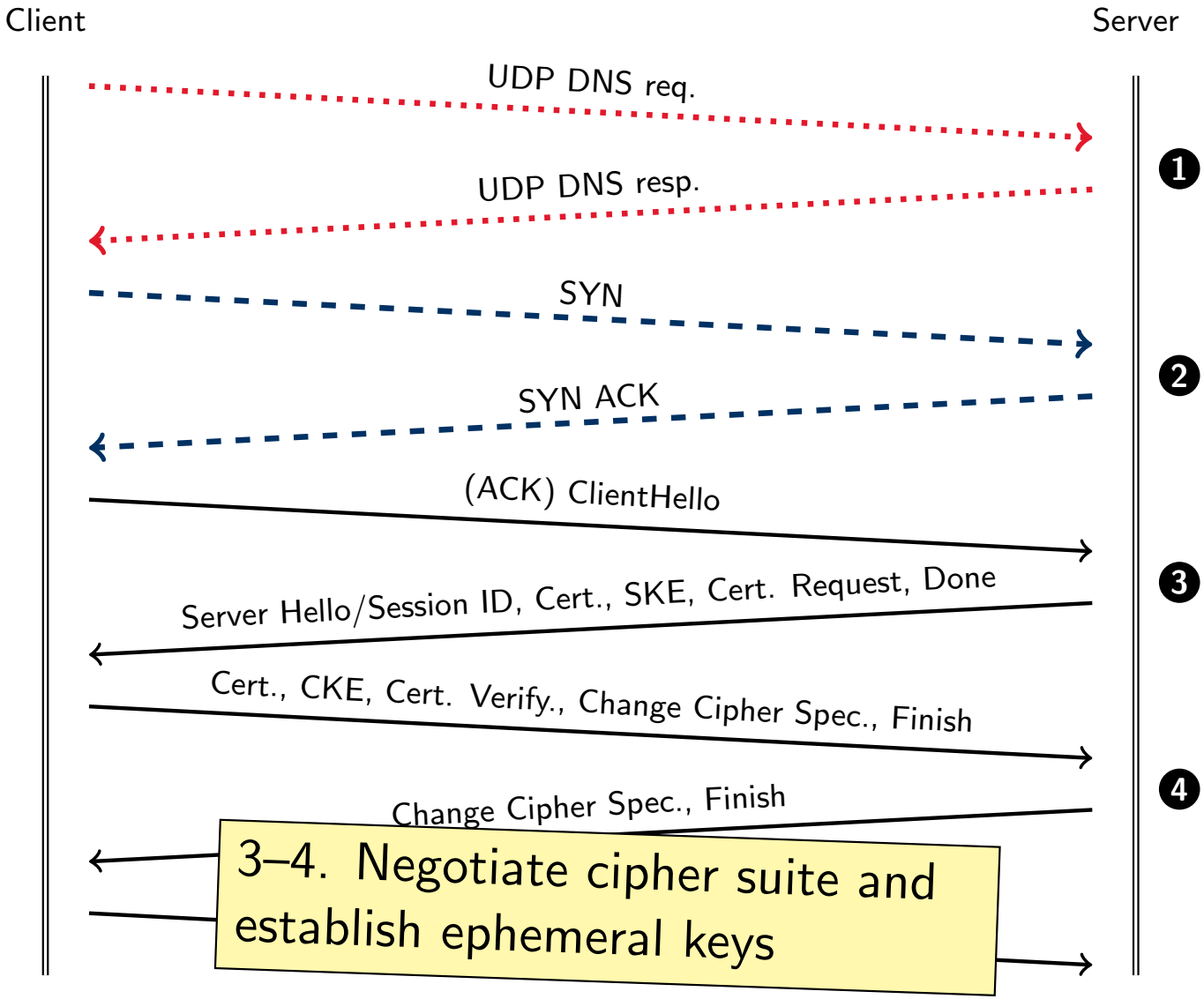
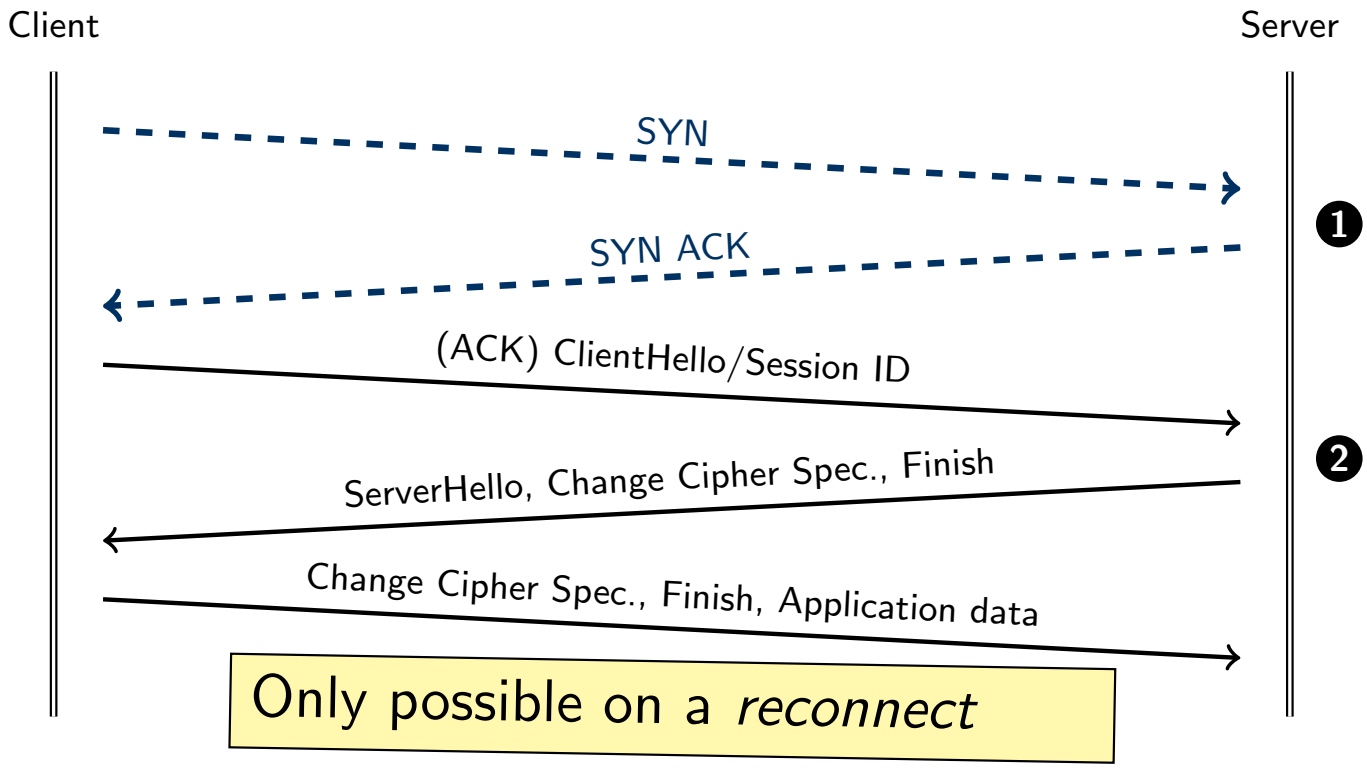


Slide credit: Mike Petullo.

TLS (abbreviated): 2 roundtrips



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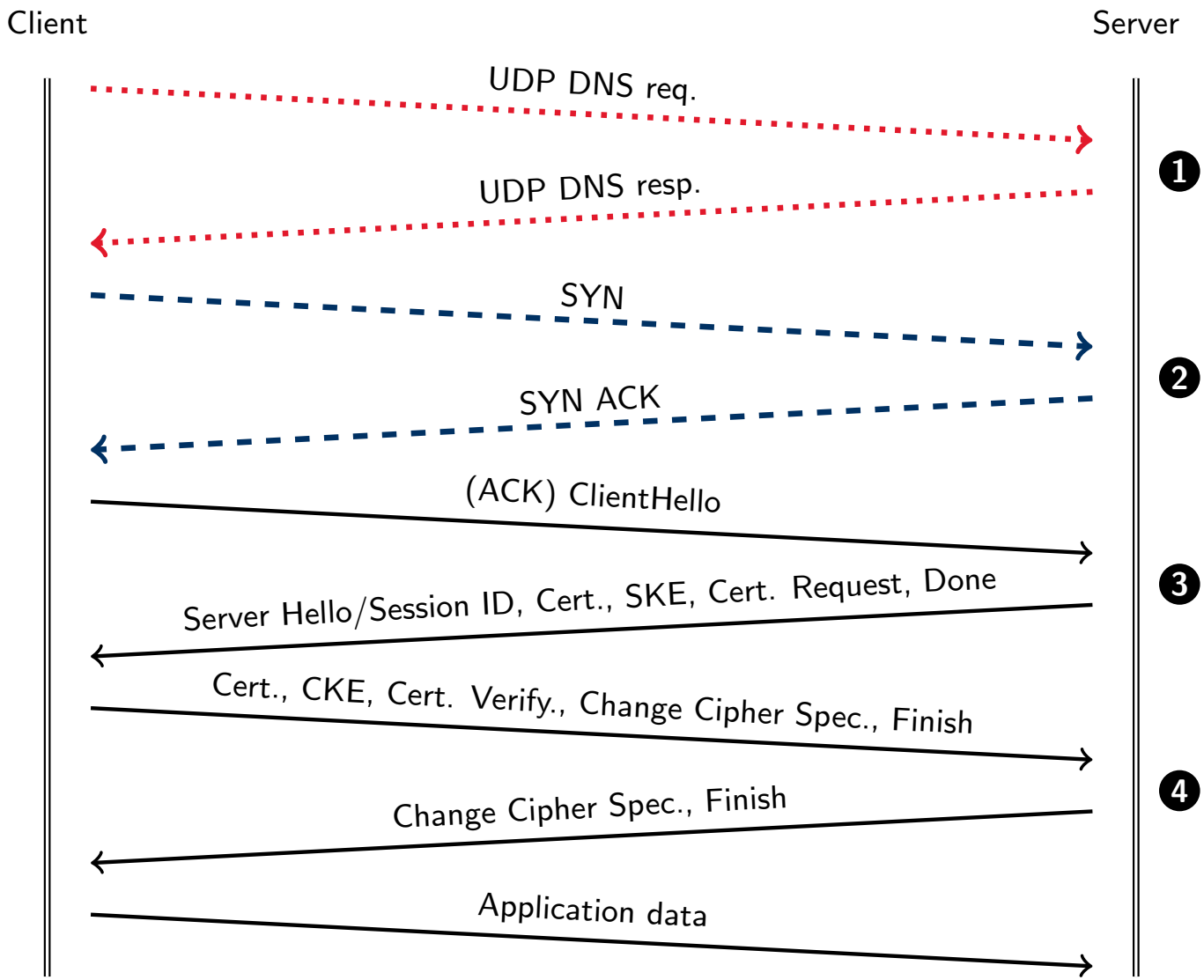
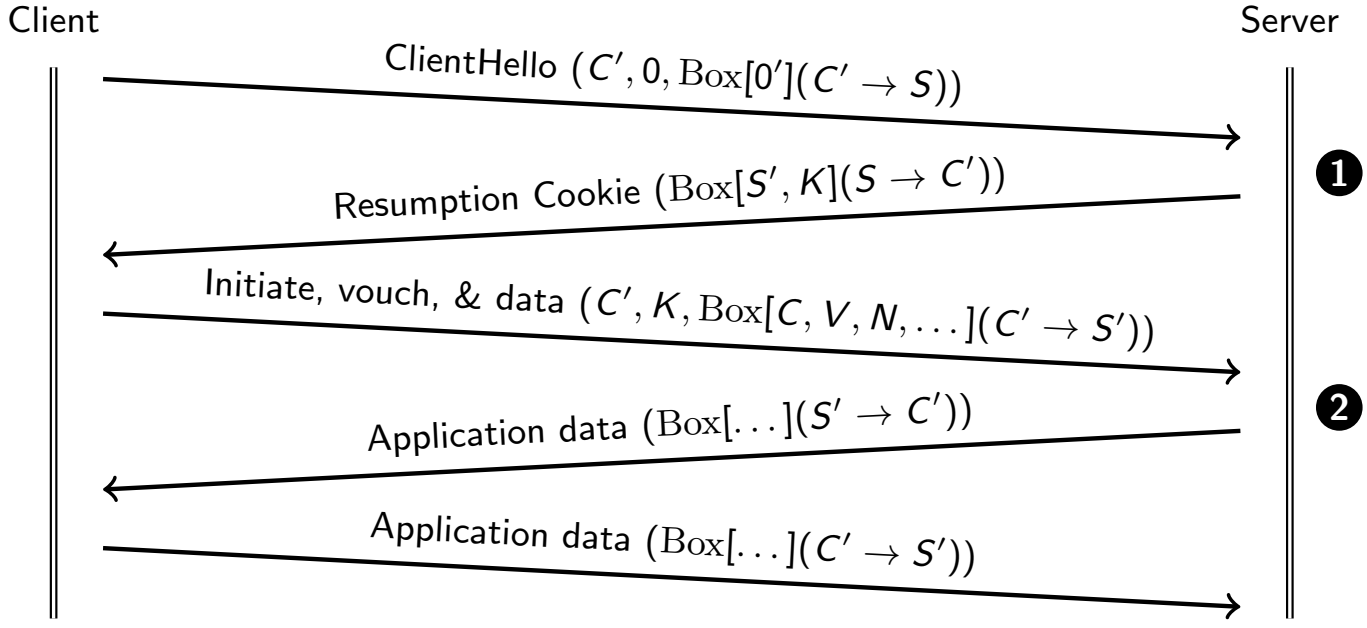
TLS: 4 roundtrips



Slide credit: Mike Petullo.

CurveCP: Usable security for the Internet, DJB, 2010



c', C': client's short-term private & public key
s, S: server's long-term private & public key
s', S': server's short-term private & public key
$\mathrm{Box}[m](C' \to S)$: encrypt m using DH key obtained from c' and S
$K = \mathrm{Box}[C', s'](t)$: encrypt m under minute key t.
If no long-term C: skip V, else $V = \mathrm{Box}[C'](C \to S)$.

MinimaLT: Minimal Latency Tunneling, CCS'13

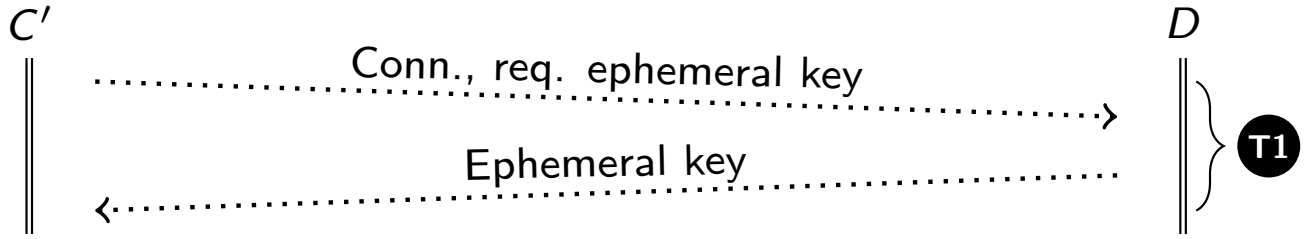
(Petullo, Zhang, Solworth, Bernstein, Lange
implementation for linux and ethos involves more UIC students.)

MinimaLT objects

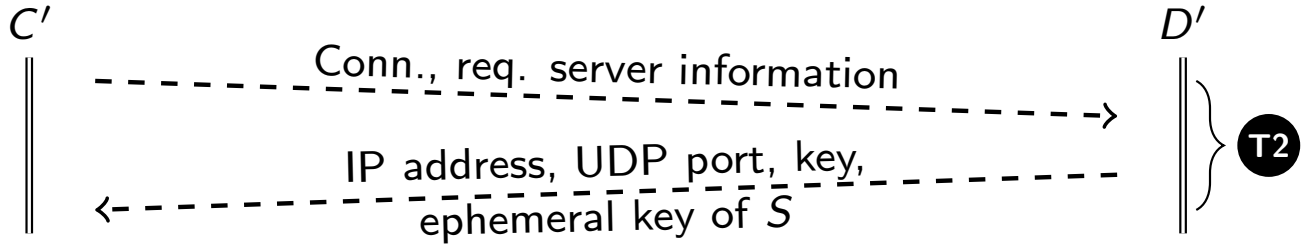
- **Public keys**: identify client users and servers
- **Ephemeral keys**: time-based and cryptographically protect identifying traffic
- **Tunnels**: an encrypted channel between two hosts which multiplexes connections
- **Connections**: user-authenticated two-way communication within a tunnel
- **Directory and name service**: resolve hostnames to IP addresses and keys

MinimaLT roundtrips

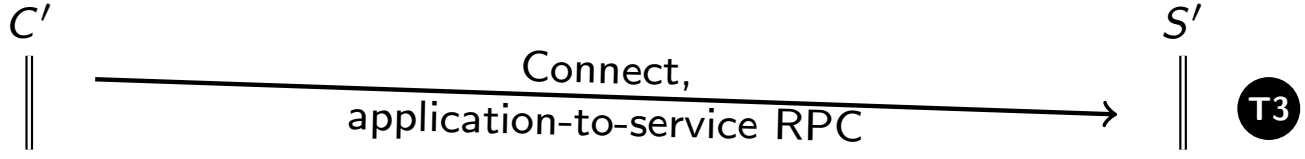
Obtaining D's ephemeral key (only at boot time):



DNS-like lookup (only if tunnel does not yet exist):



Connection establishment:



Plus: Lots of cool crypto in rekeying, proof-of-work puzzles, resumption at different IP address.

QUIC: Quick UDP Internet Connections

Design Document and Specification Rationale, Roskind
QUIC Crypto, Langley, Chang

- 0 RTT achieved similar to current 0 RTT proposals:
  - Client tries previous (stored) server key.
  - If key still active, get 0 RTT. Else data in first packet (or prior to ACK) is lost.
  - Server can reply with fresh key (1 RTT, 2 RTT worst case).
- Con: Less radical change than MinimaLT.
- Con: Favors long key validity, so bad for forward secrecy.
- Pro: Actually in use for Chrome – Google connections.
  Chromium Blog: Results so far are positive, with the data showing that QUIC provides a real performance improvement over TCP
- Less cool stuff on rekeying.