TLS: Transport Layer Security

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TLS

- One of the most widely deployed cryptographic protocol : HTTPS, 802.1x, VPNs, mail, VoIP, ...
- Many implementations : SChannel, OpenSSL, NSS, GnuTLS, JSSE, PolarSSL
- many patches every year
- many attacks : Heartbleed, POODLE, RC4, FREAK, Logjam...

$\rightarrow$ 20 years of attacks, fixes, new versions, and extensions

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3. The client and the server establish a master session key used to derive session keys.
   - The server may be authenticated (or not)
   - The client may be authenticated (or not)

In general, the server is authenticated, not the client.

Agility

An extremely agile protocol

- a wide choice of algorithms (key-exchange protocols, encryption mode) ;
- very flexible in terms of who is authenticated ;
- possibility to authenticate afterwards.
  Example : a client browses anonymously some web pages and then authenticates to access some service.

Record Layer

Handshake

establishes a key k

Record Layer

uses the key k

The encryption key is passed to the Record Layer even if the authentication is not completed yet.

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In both cases, these exchanges under the Security Layer, with the current session key.

How it works in more details

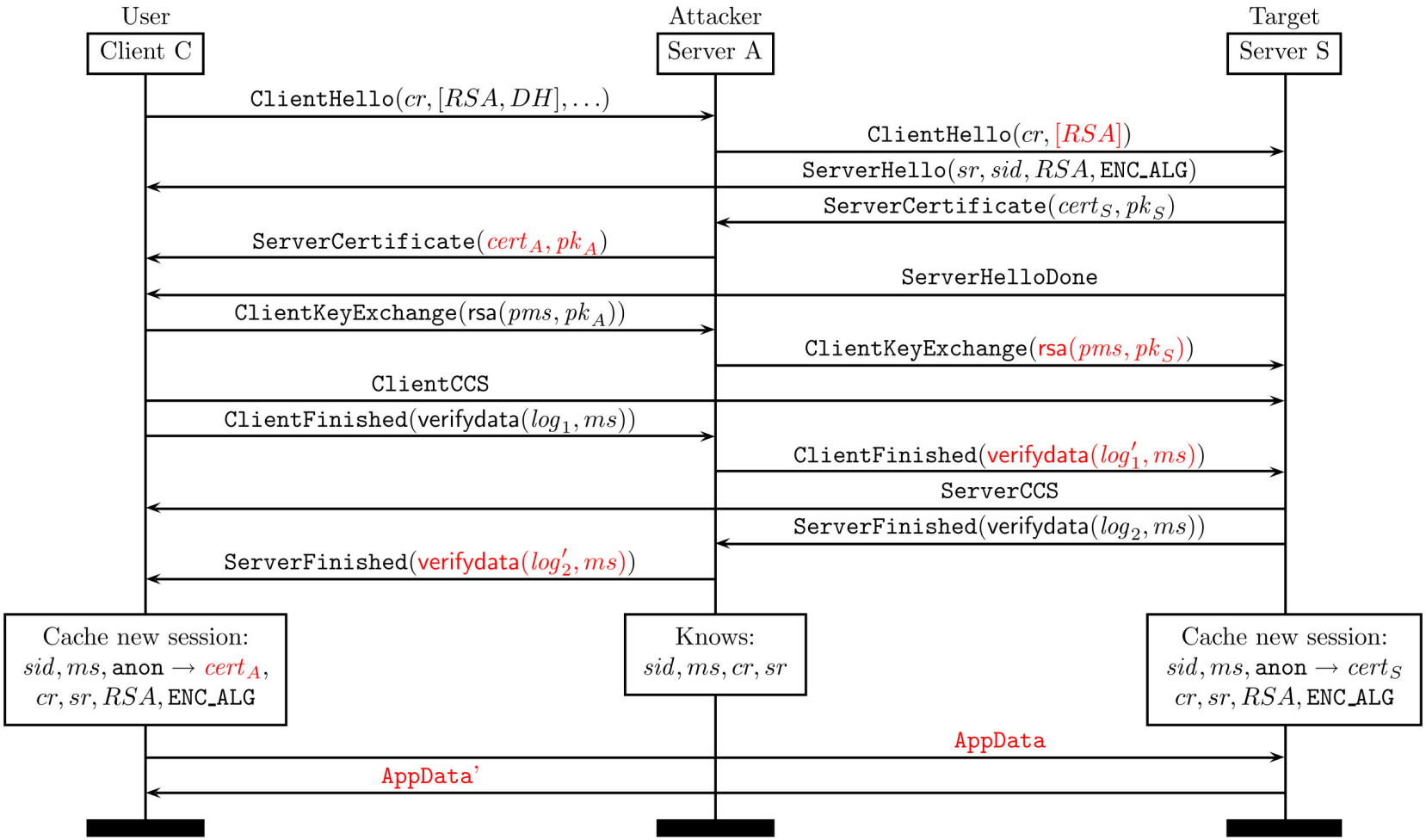
cf course.

Triple Handshake attacks

`https://mitls.org/pages/attacks/3SHAKE`

- attack found using formal tools
- authors : Antoine Delignat-Lavaud, Karthikeyan Bhargavan and Alfredo Pironti
  from the Prosecco research team at INRIA Paris-Rocquencourt.
- miTLS research project, aimed at building and verifying a reference TLS implementation.

Phase 1 : Man in the middle



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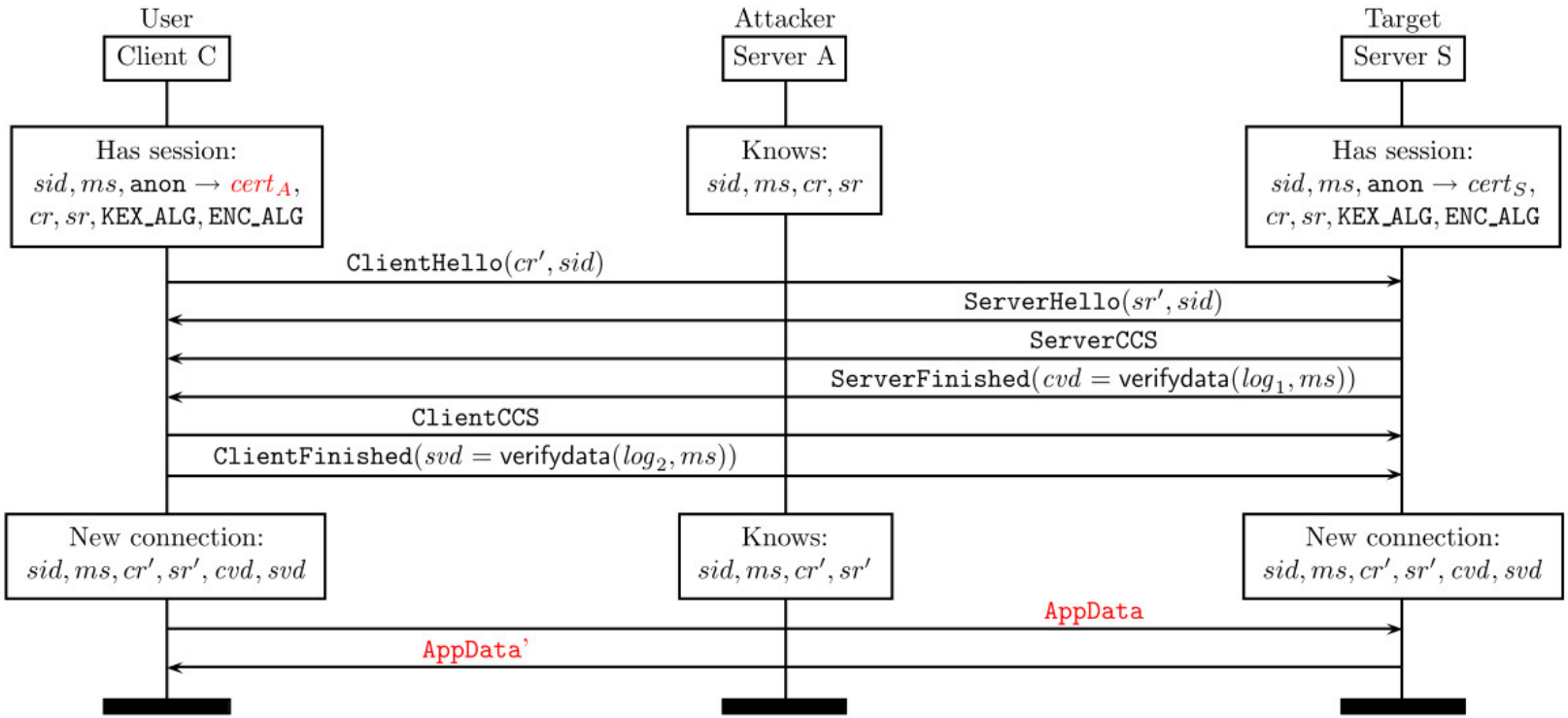
Phase 2 : Resumption



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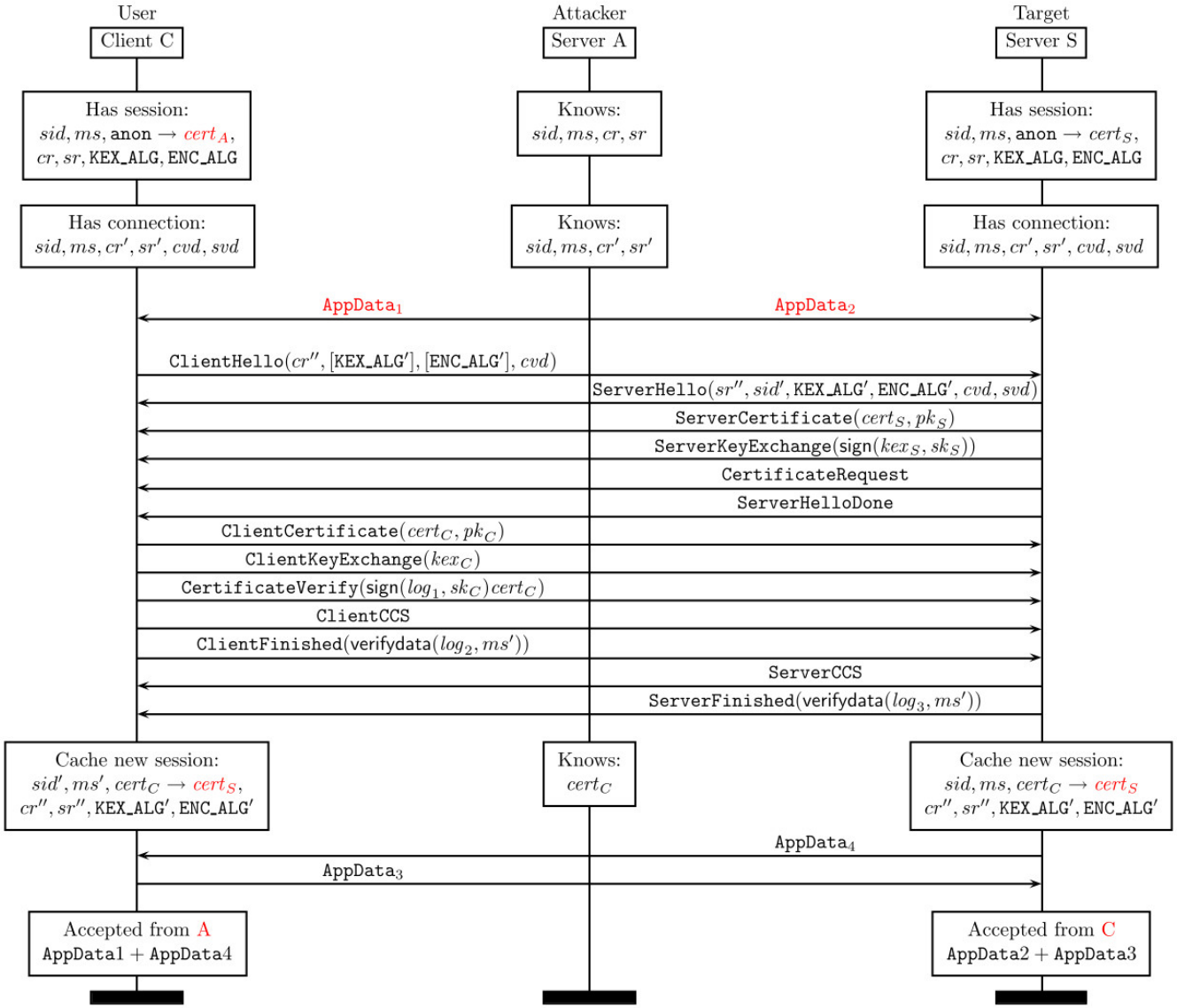
Phase 3 : Renegotiation



FREAK attack - February 2015

Bhargavan et al.

LOGJAM attack - February 2015

Adrian et al.