STORMSHIELD

Network Endpoint Data

TLS 1.3 : Solving new challenges for next-generation firewalls (NGFW)

Pass The Salt 2019

Who are we ?

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Does stuff,
Did not have a choice to talk
In front of you

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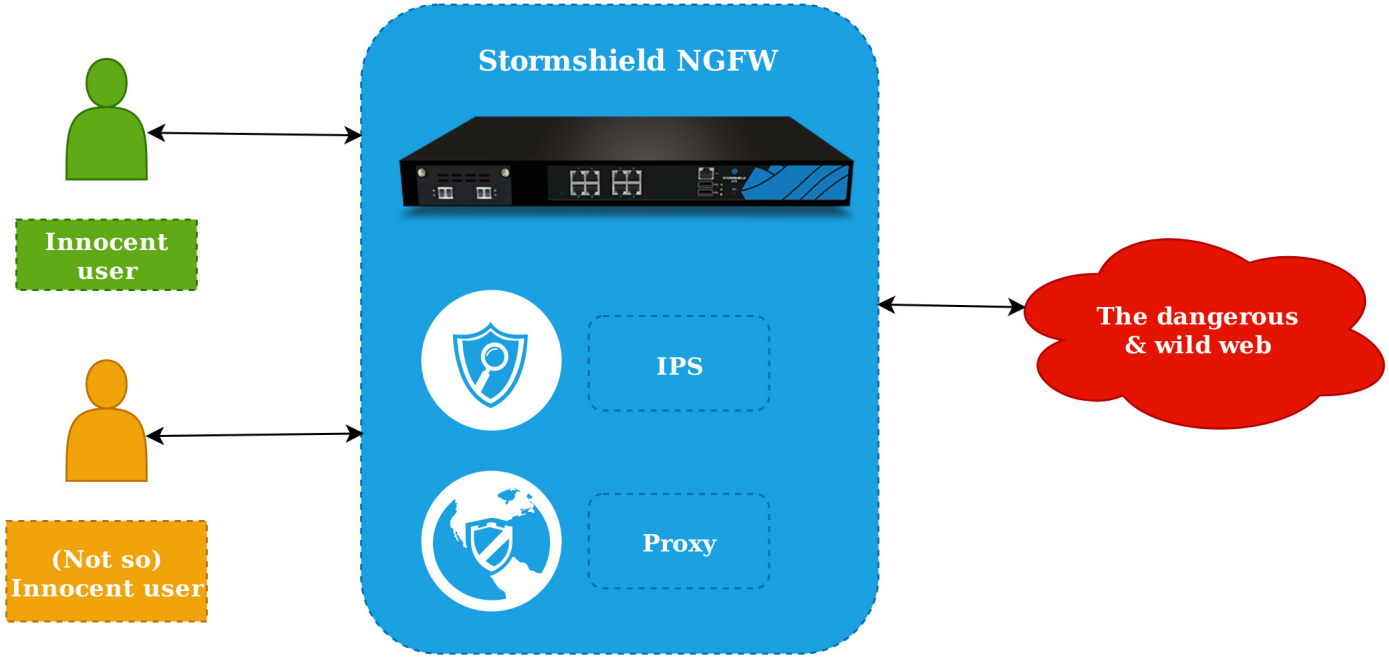
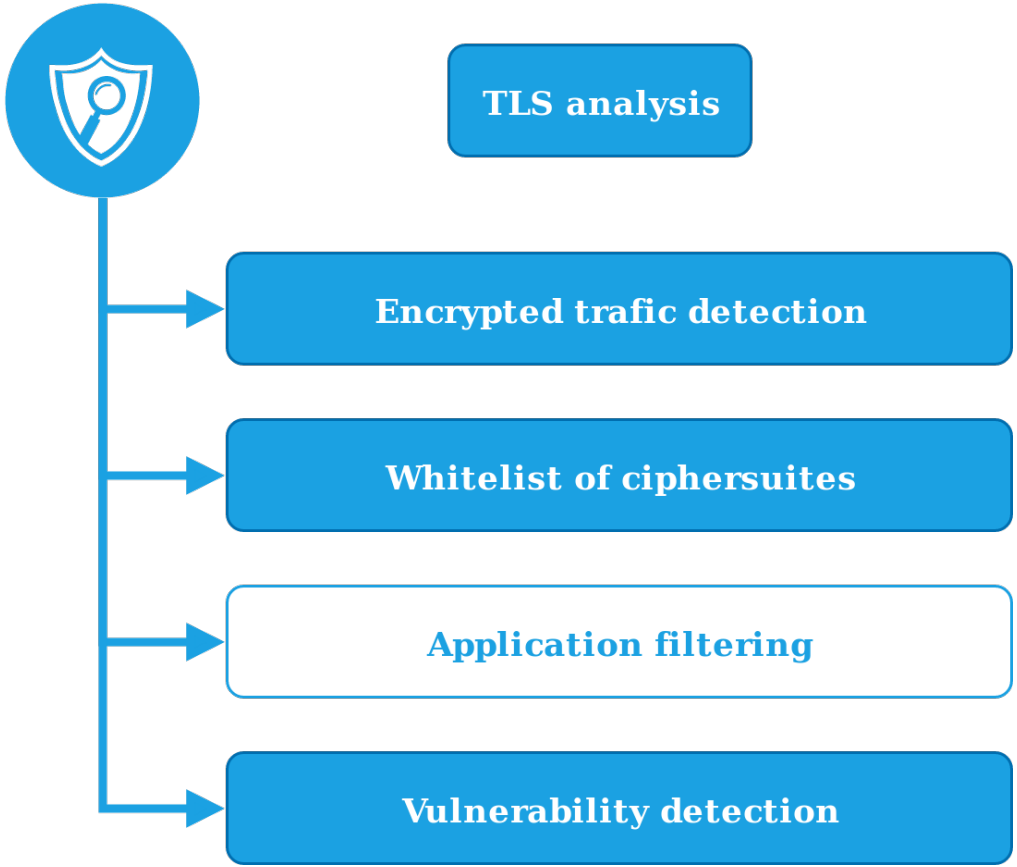
We’re on the network …

We protect users & enforce company policy

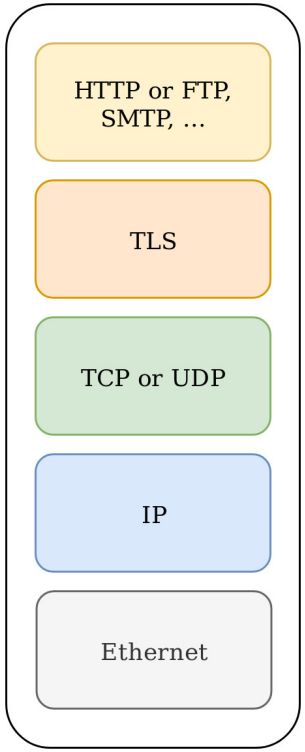


With our state of the art IPS

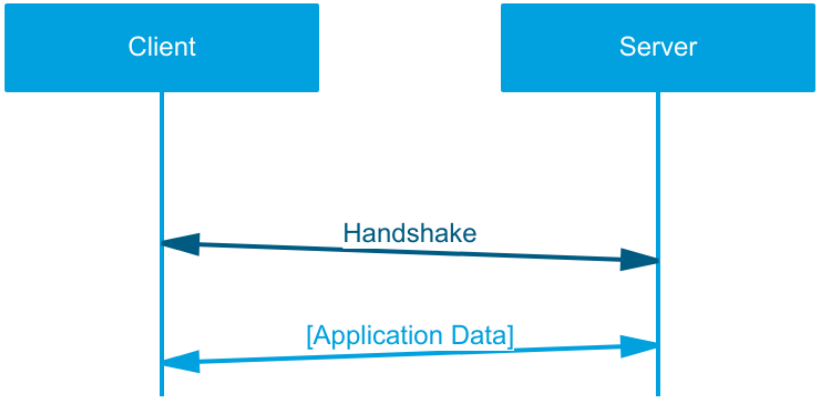


Focus on TLS application filtering

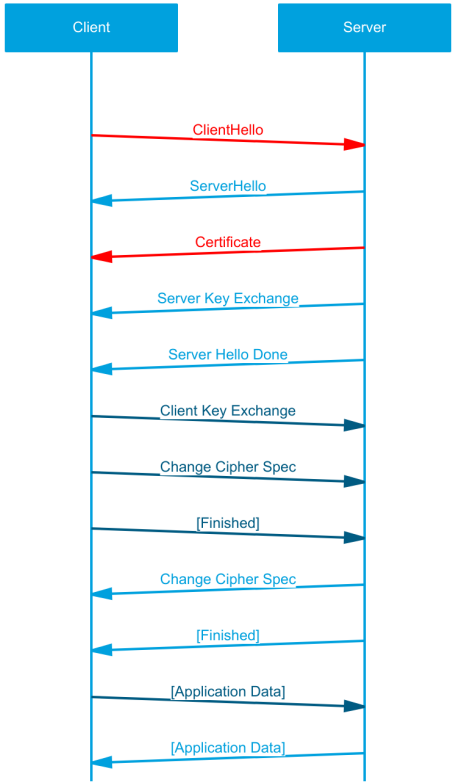
TLS : Transport layer security



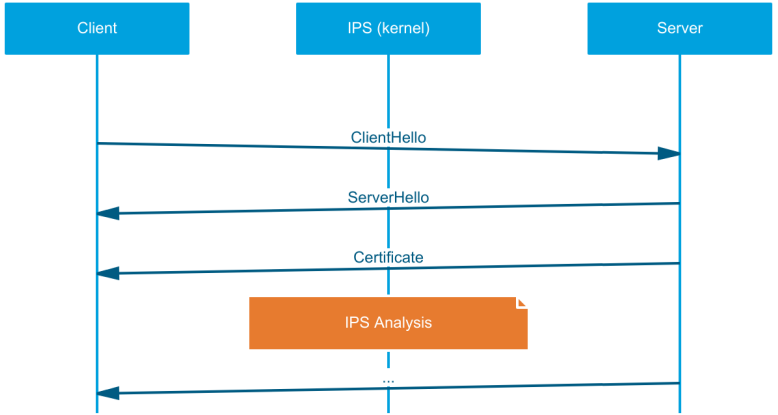
TLS in the network stack



A TLS connection



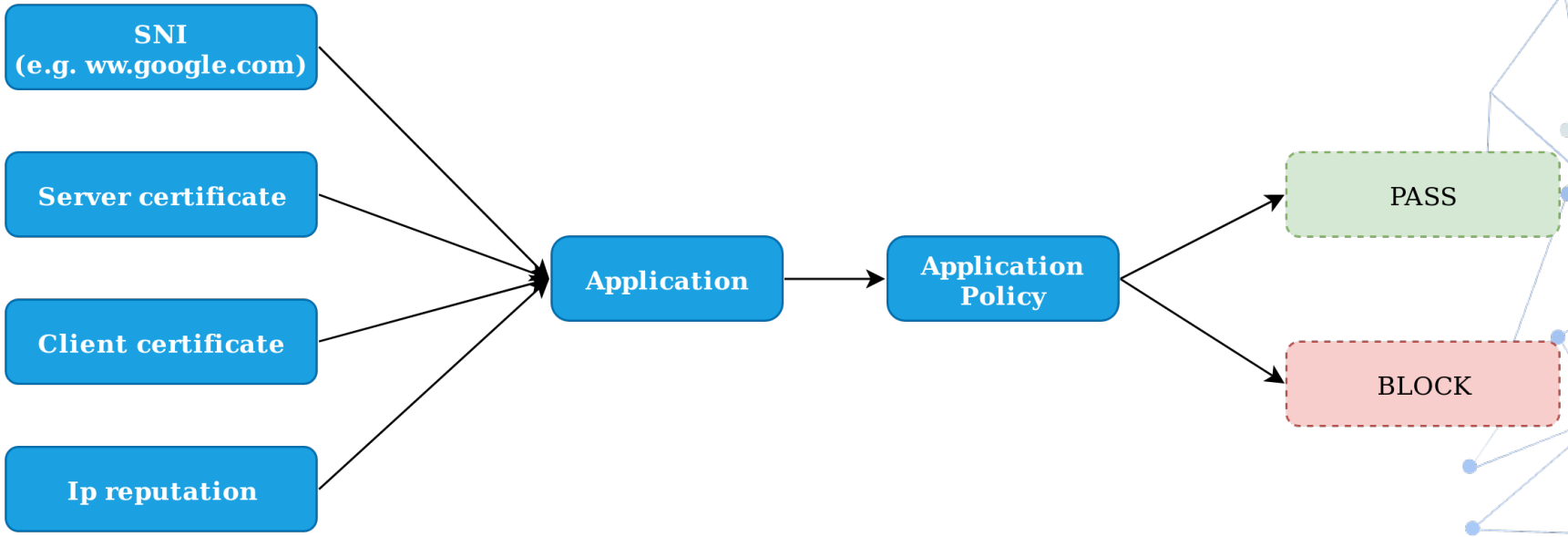
TLS 1.2 - Handshake



TLS 1.2 – Analysed Handshake

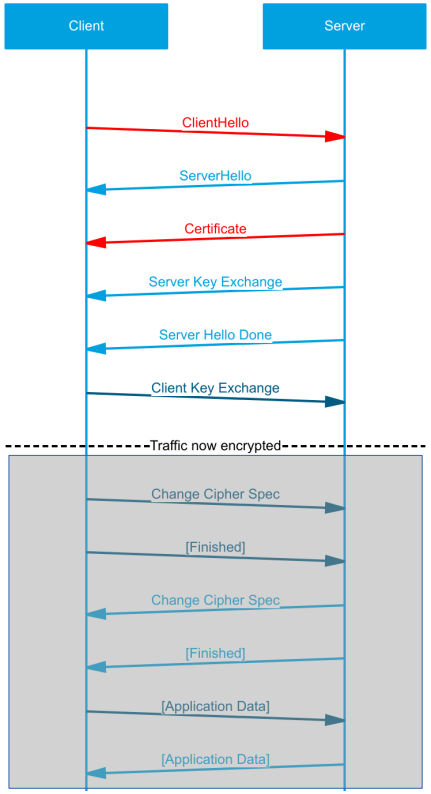
[ ] = Encrypted

With these data

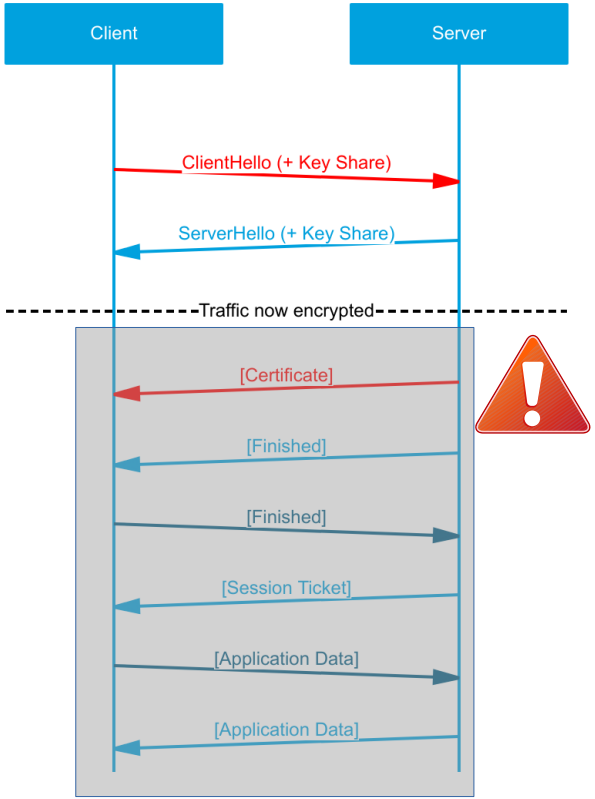


But now … TLS 1.3 encrypts server certificate

Brand new TLS 1.3 handshake



TLS 1.2



TLS 1.3*

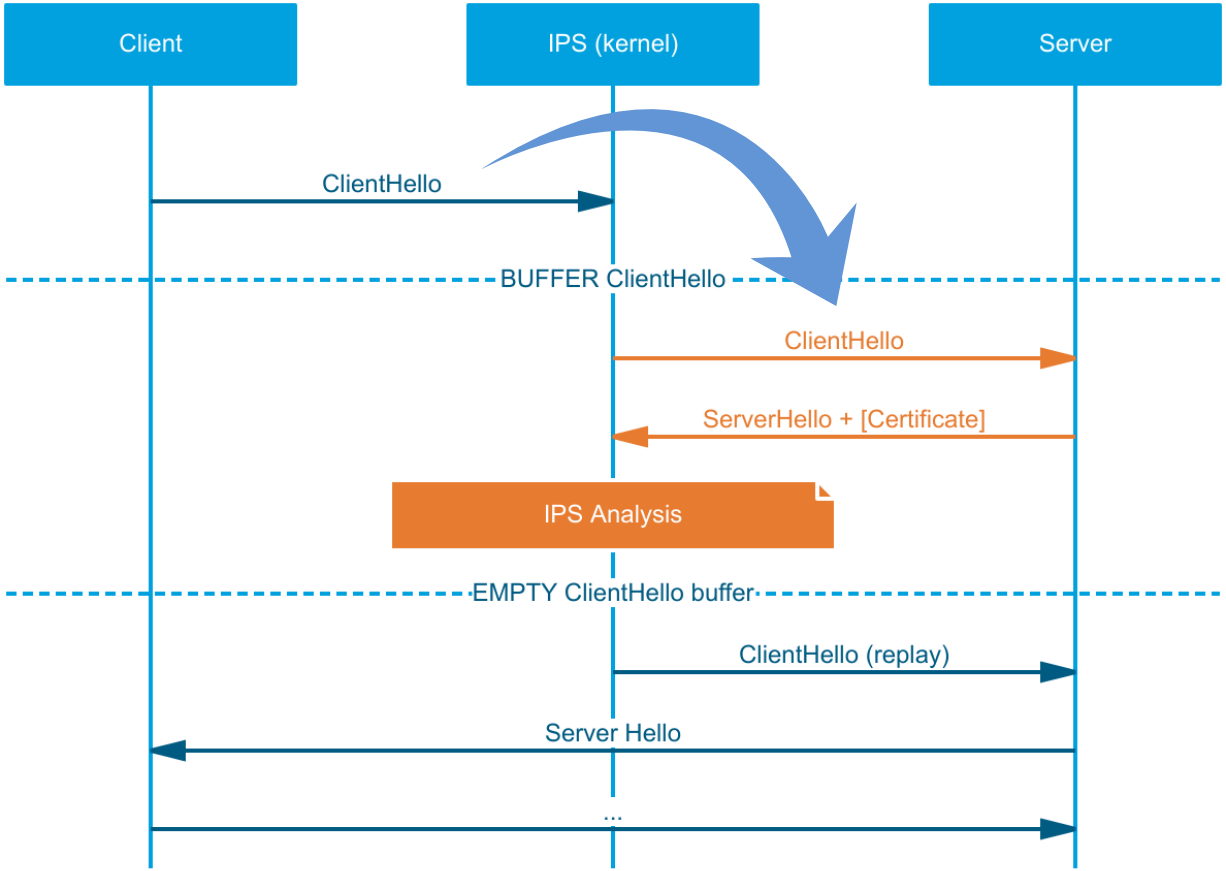
[ ] = Encrypted

*RFC8446

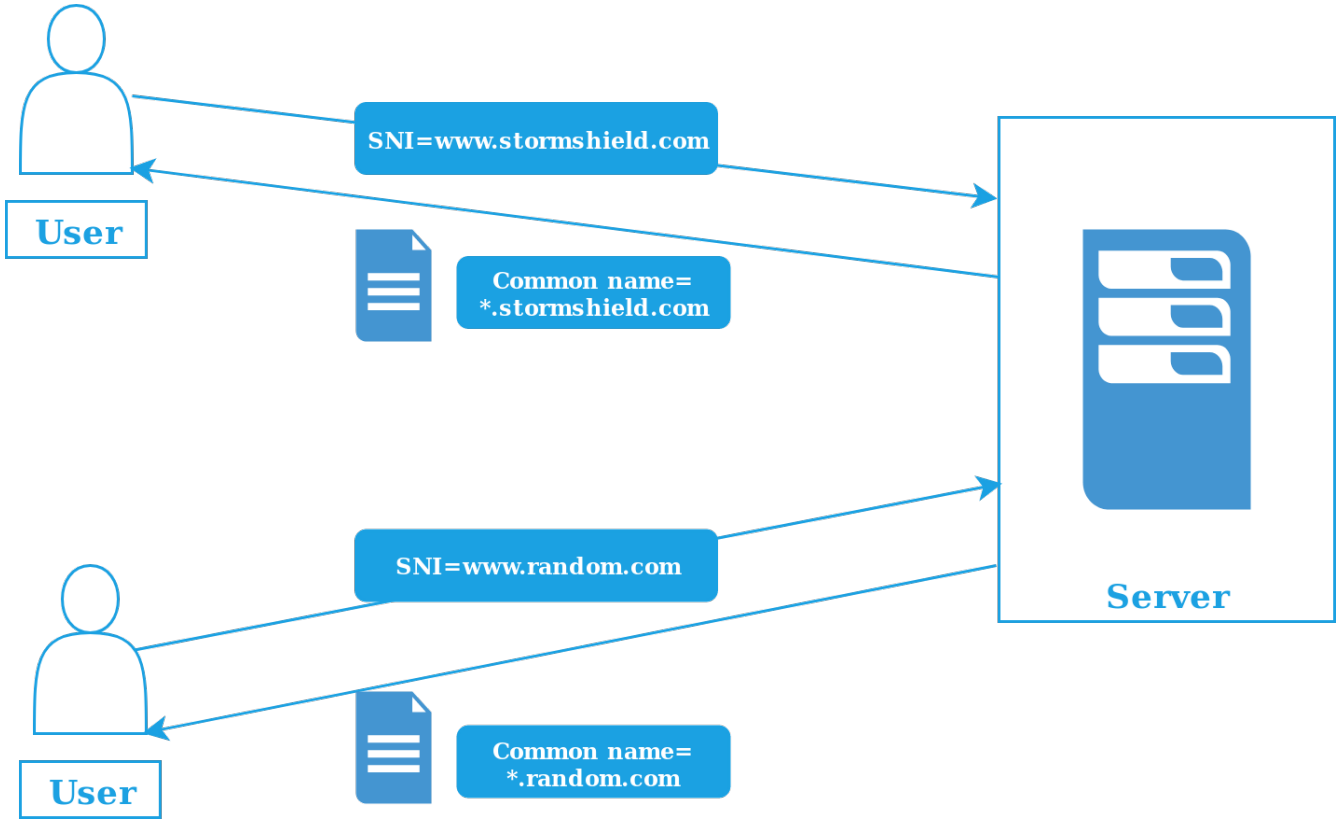
We are passive*, we do not decrypt

*On the TLS layer

Server certificate is a public information

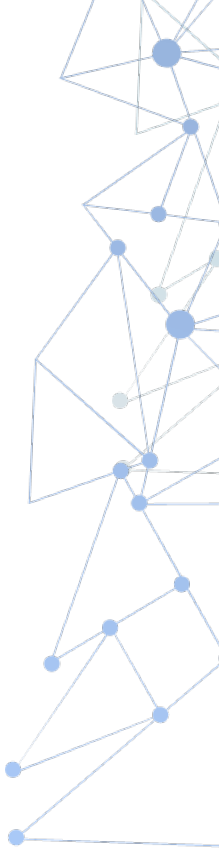


About certificates



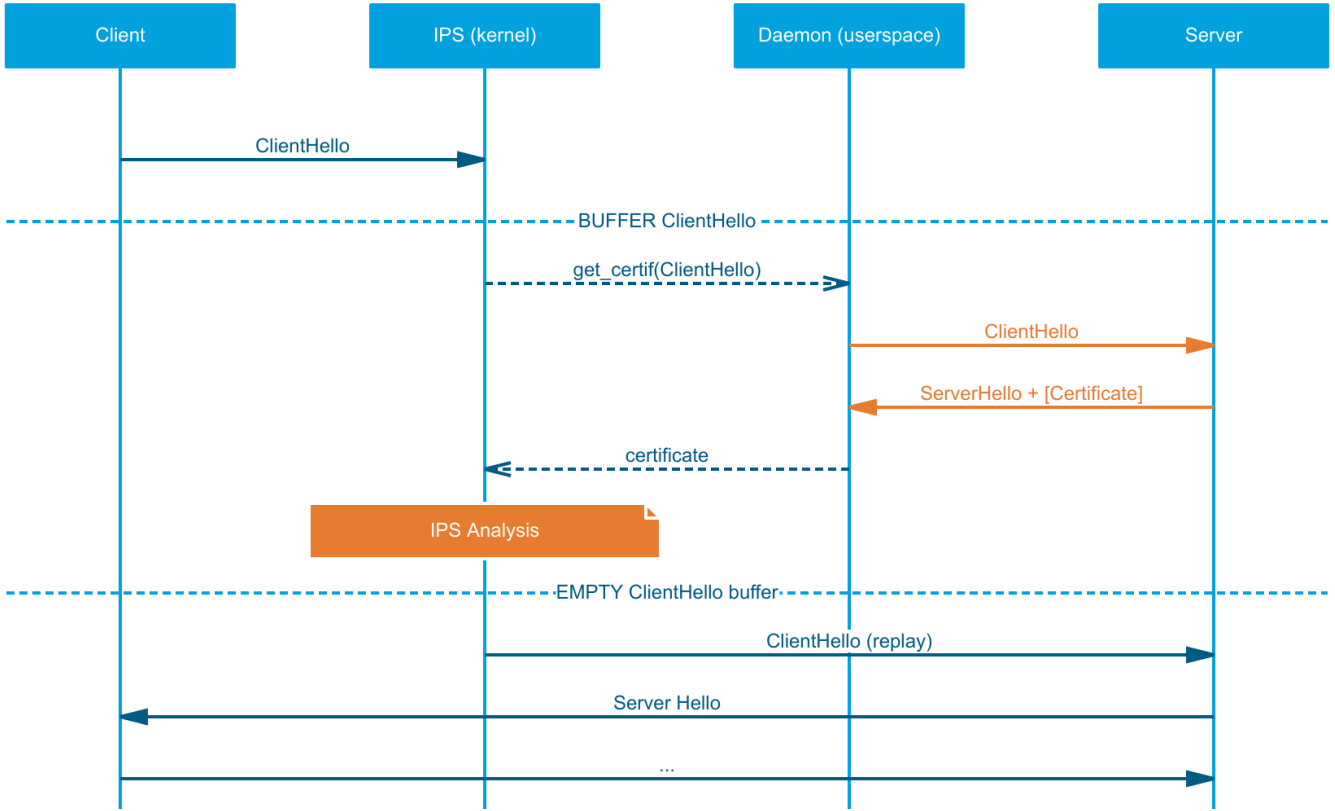
How-to: Get the same certificate

- Send the **same** server name indication (SNI)
- Propose the **same** cipherlist
- Send **our own** KeyShare extension



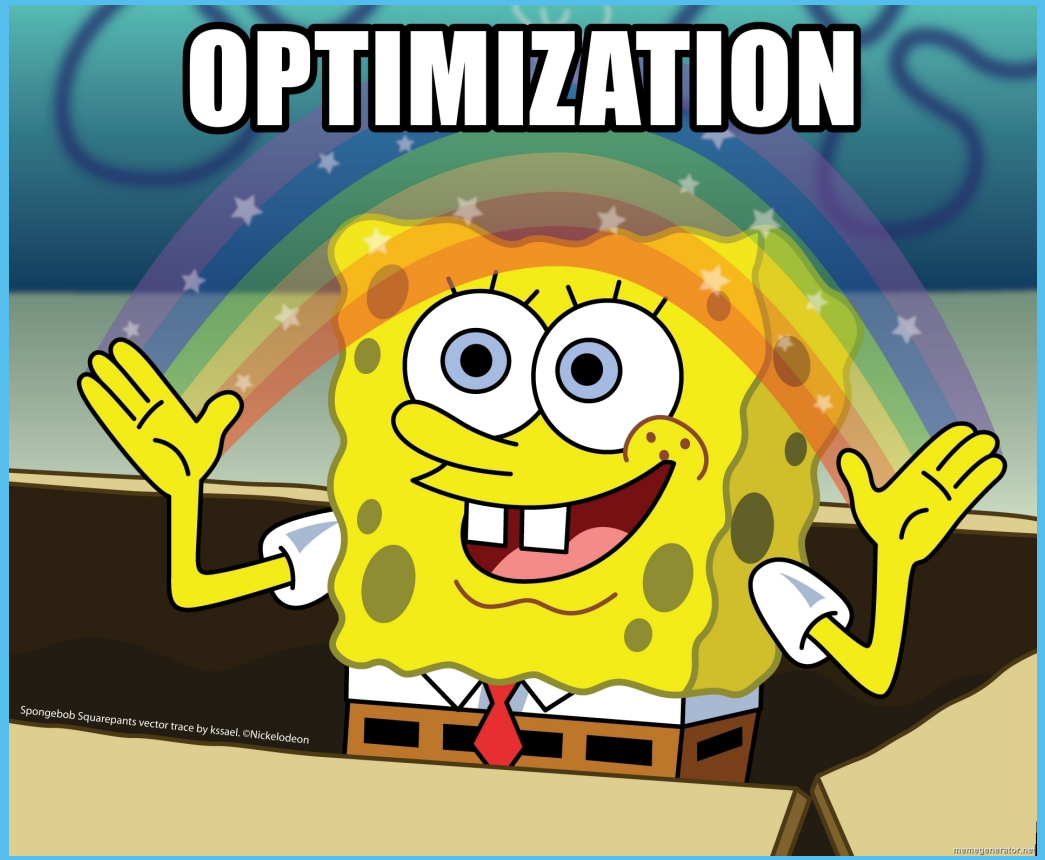
Wait, usually kernels don’t speak TLS !

Dear userspace daemon, talk for me



Yay ! We saved our feature

But for each connection ?!


OPTIMIZATION
Spongebob Squarepants vector trace by kssael. ©Nickelodeon

Let’s cache certificate !

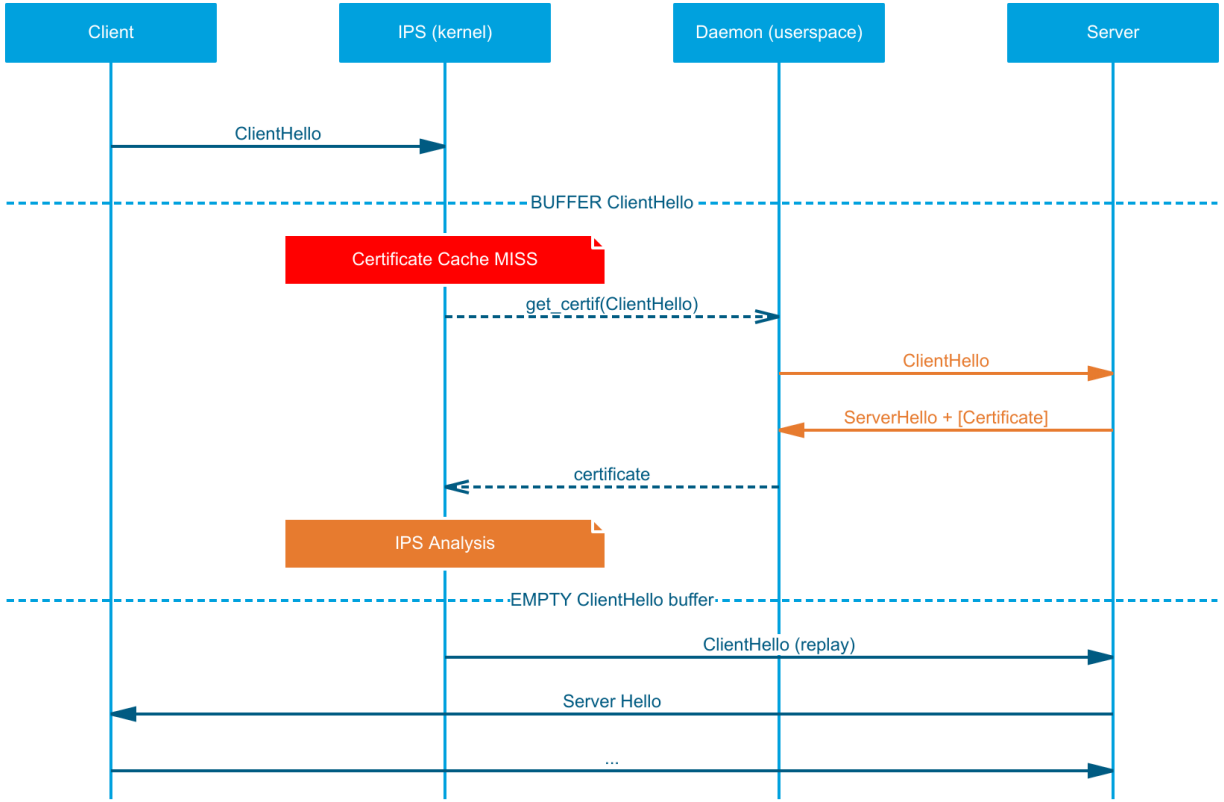
Pros 

- 0 delay certificate retrieval
- Less load on server
- Less load on NGFW

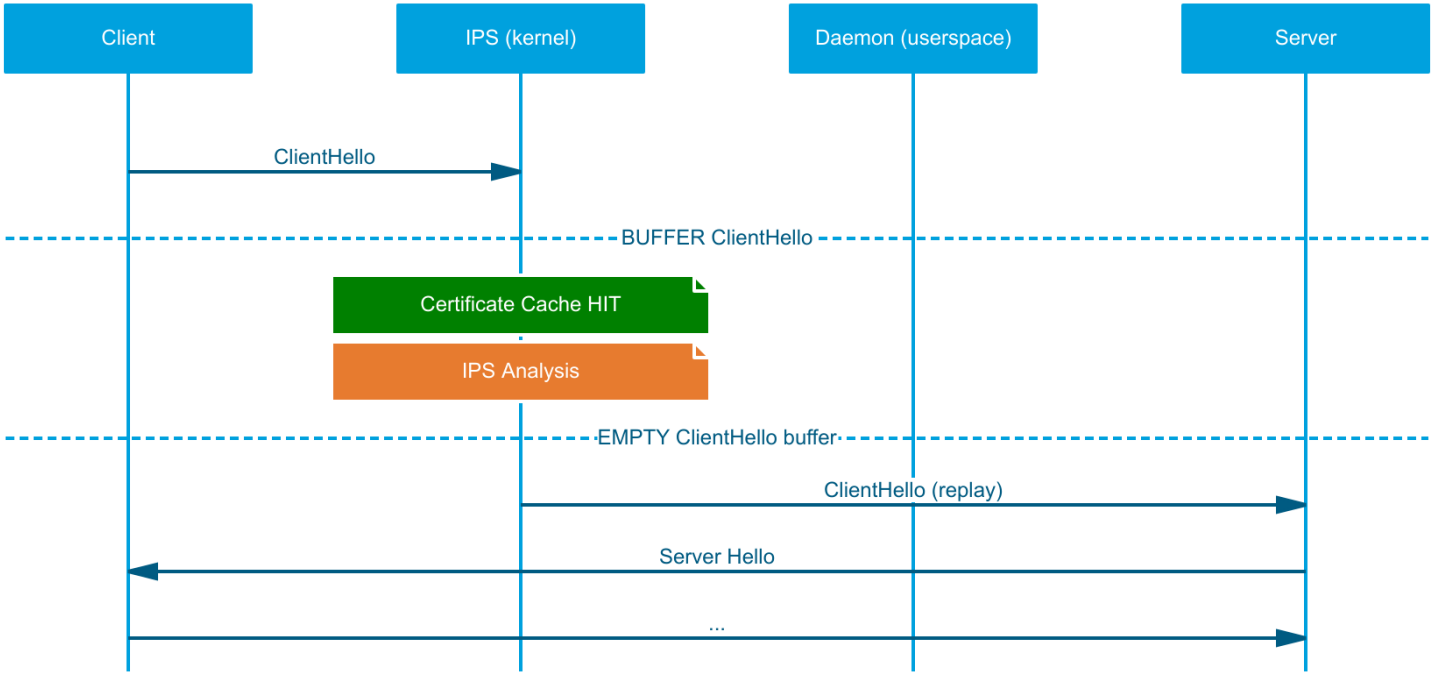
Cons 

- Design the cache : tune entry expiration date & cache size
- Design the cache #2 : do something that works

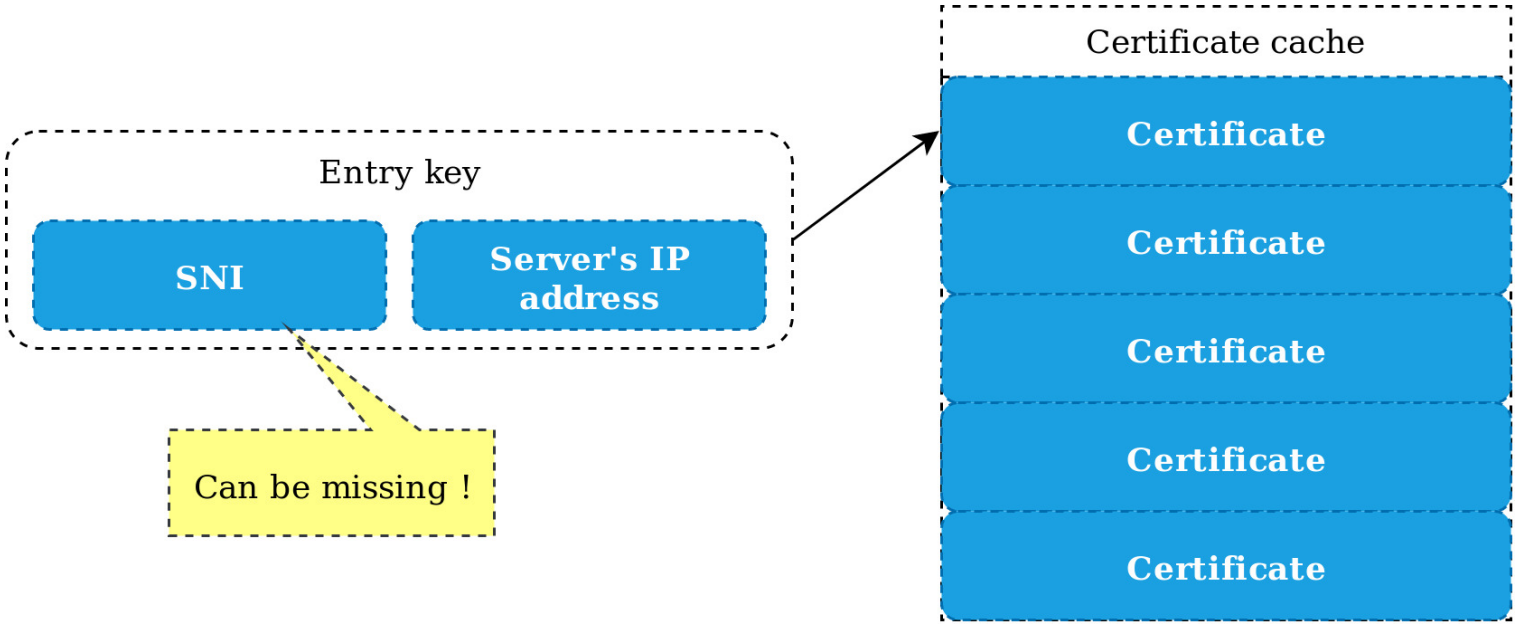
Let’s cache it !



Let’s cache it !

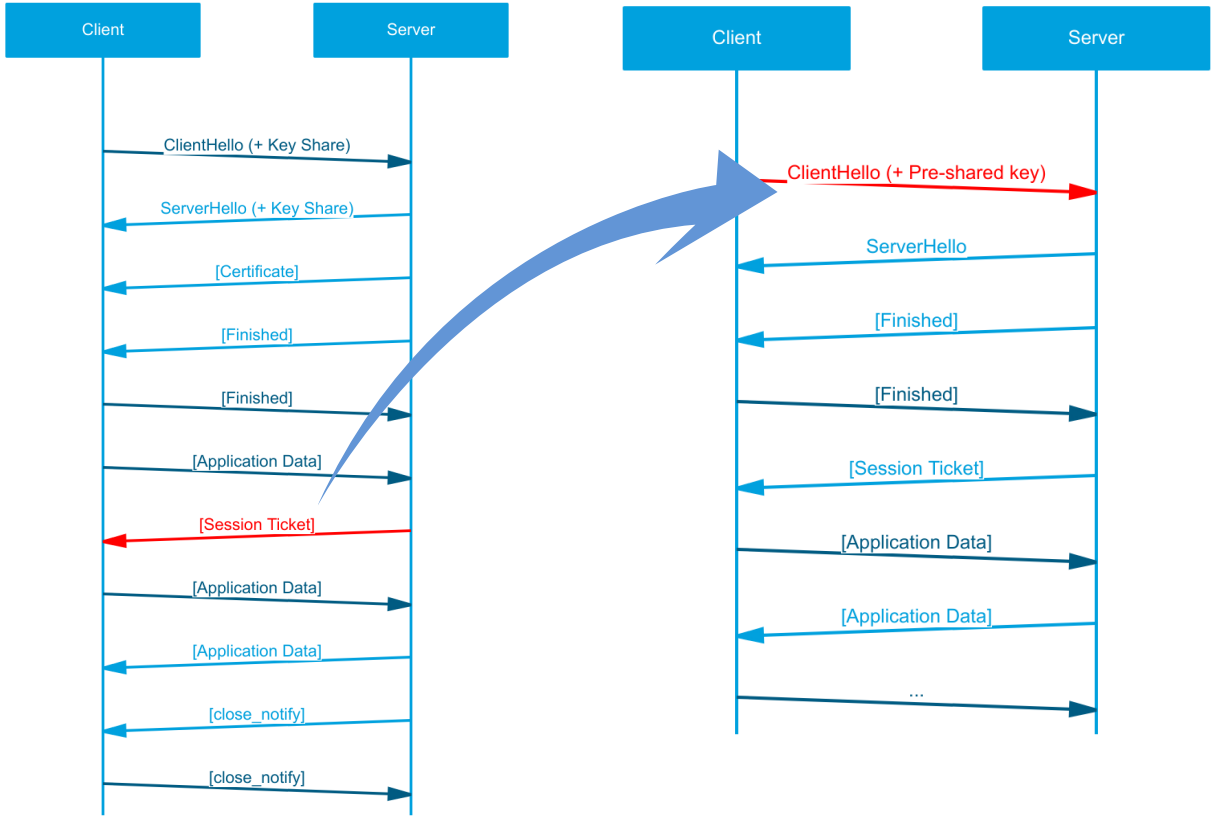


How do we identify cache entries ?



Handling session resumption

TLS 1.3 session resumption



TLS 1.3 session resumption : limitations

- Not really impacting our solution

  We base ourselves on **ClientHello information**

  => SNI is « theorically* » provided in resumption ClientHello

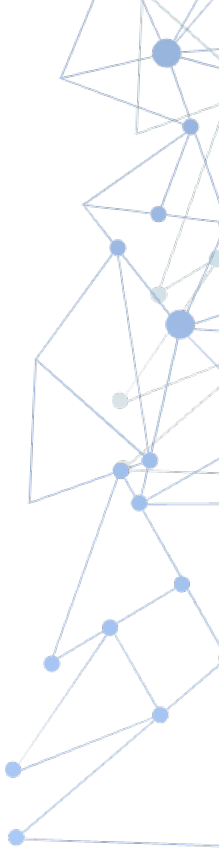
- Some malicious peers could **not provide SNI** during resumption, thus breaking our filtering

*RFC 8446 section 4.2.11 : Pre-Shared Key Extension

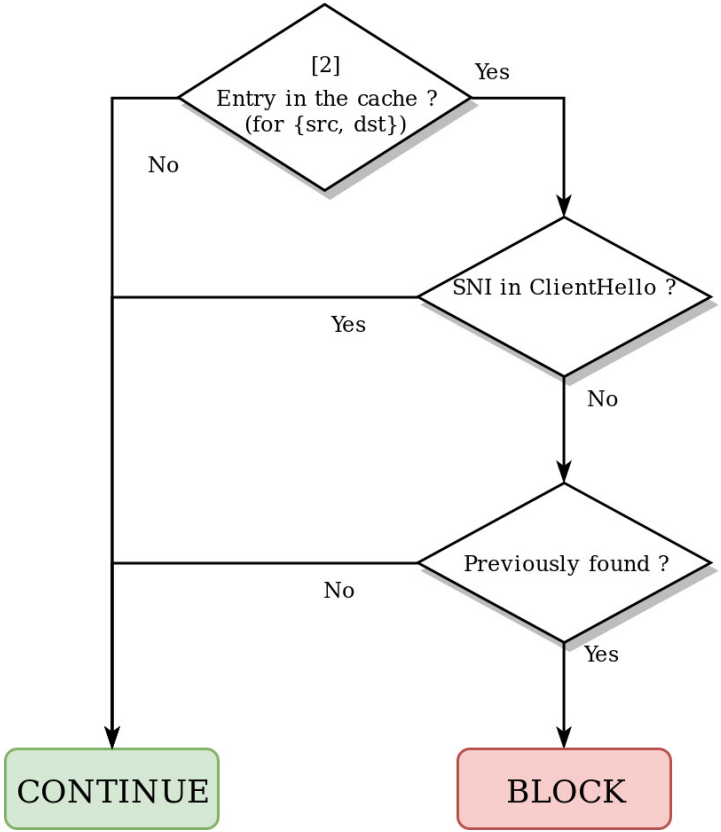
Simple, just check the presence of SNI no ?

The problem with SNI

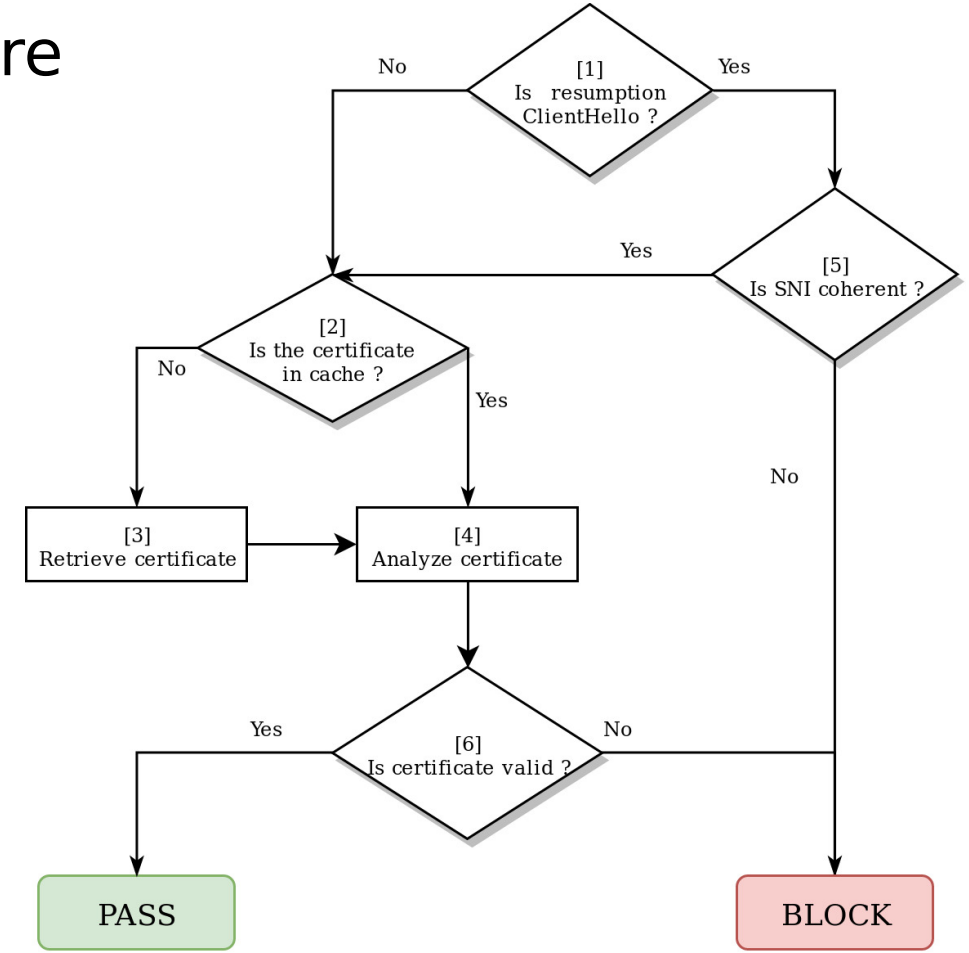
- SNI is not mandatory ...
- Need to check if original session was initiated with SNI
- How to do that ?



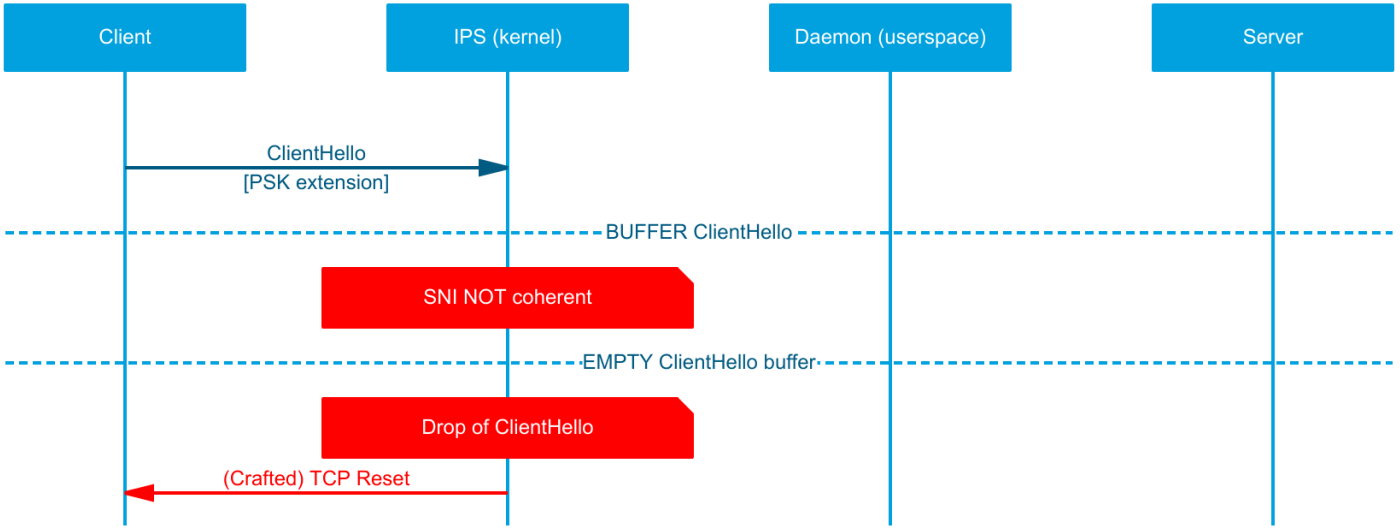
Another cache ... for the SNI !



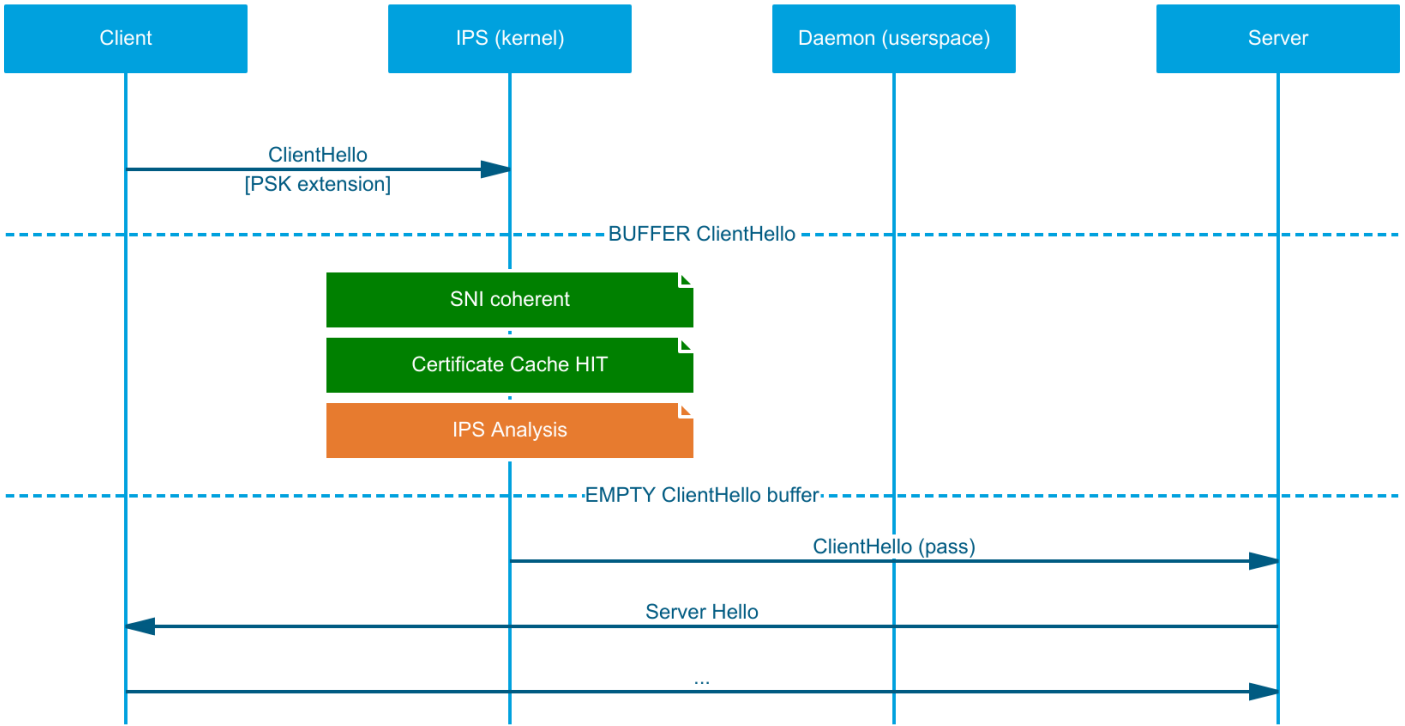
The big picture



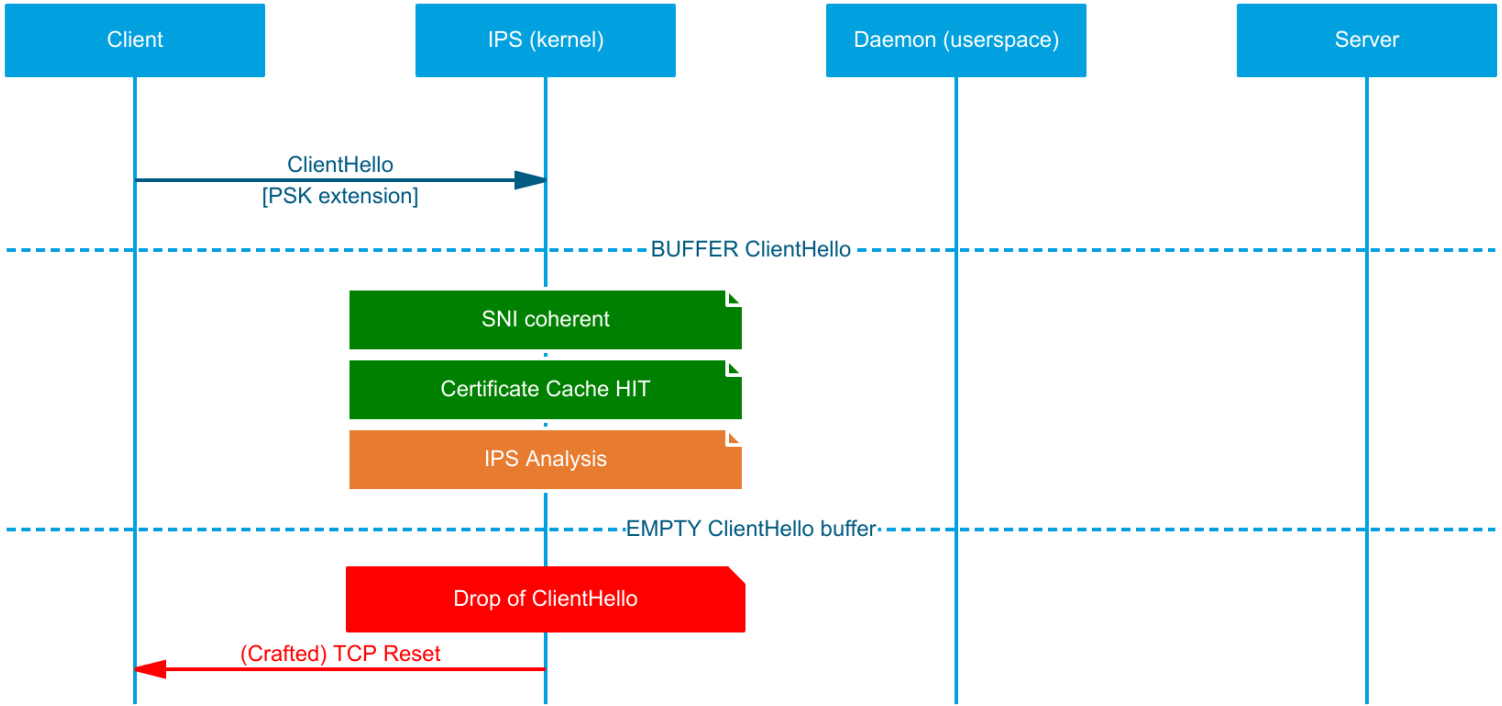
SNI not coherent



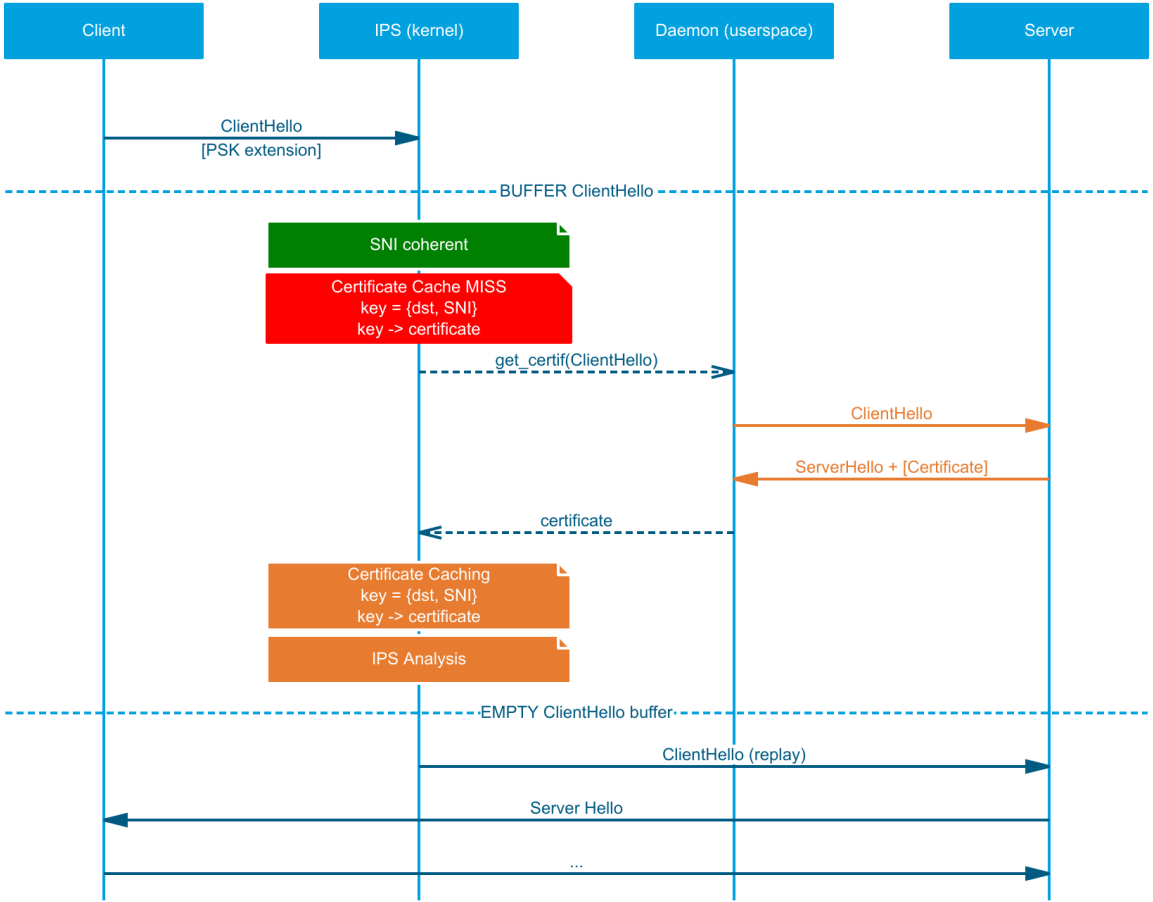
SNI coherent & Cache HIT - PASS



SNI coherent & Cache HIT - BLOCK

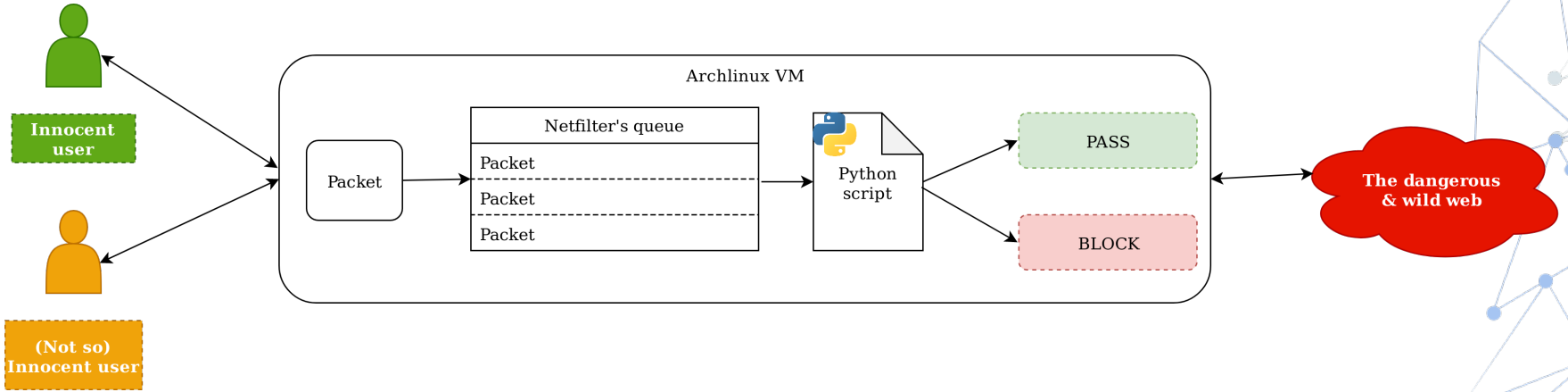


SNI coherent & Cache MISS - PASS



Proof of concept

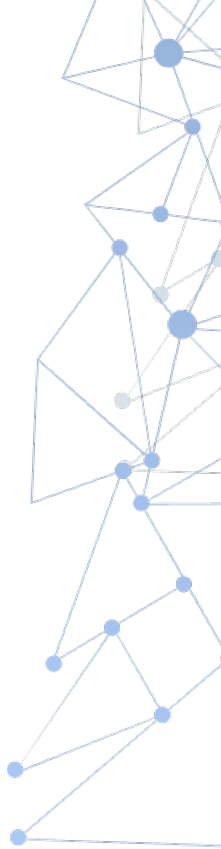
PoC : design


Innocent user
(Not so) Innocent user
Archlinux VM
Packet
Netfilter's queue
Packet
Packet
Packet
Python script
PASS
BLOCK
The dangerous & wild web

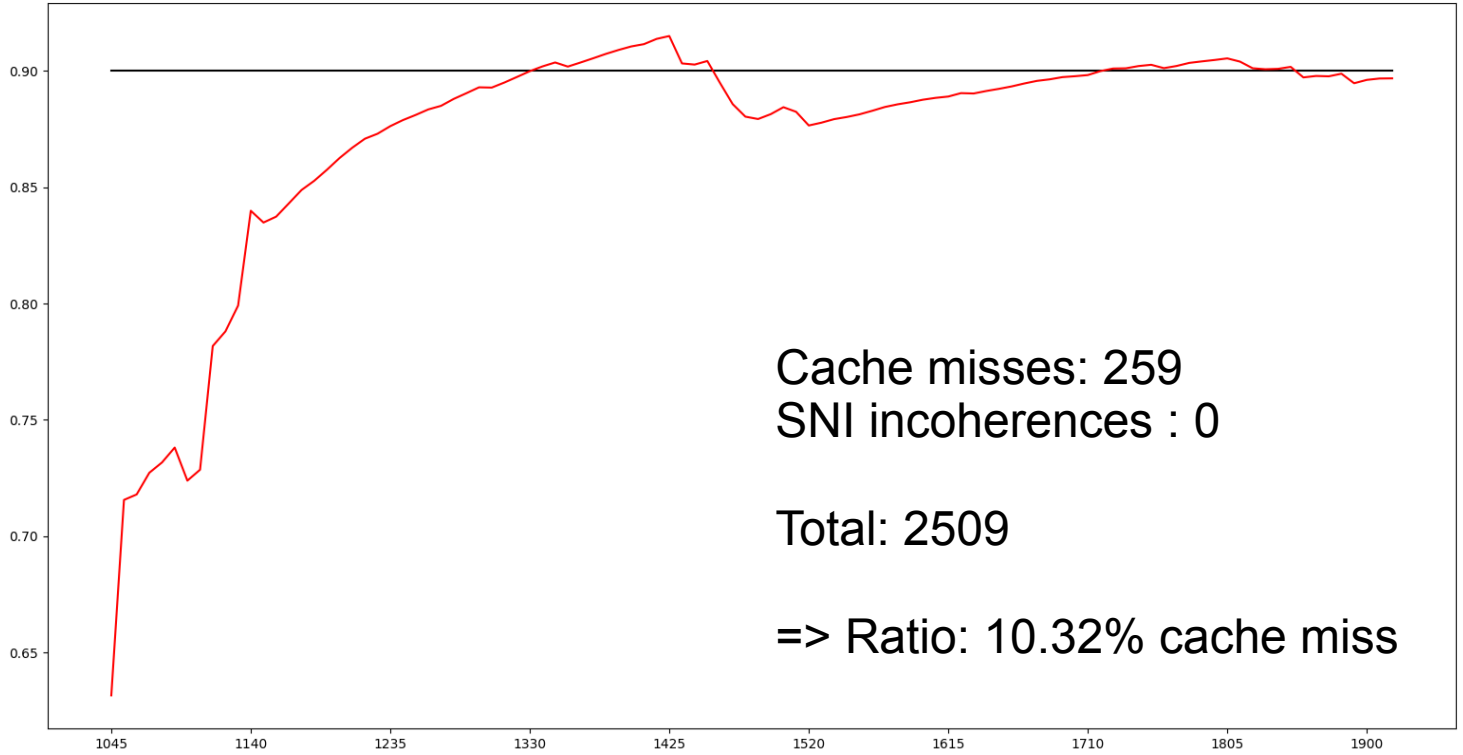
PoC : supported features

- SNI coherence cache
- Certificate Caching
- Application blacklisting

  => Statistics gathering



PoC : results for 1 day / 1 user



Final note

World is safer now

- Facebook is blocked again
- That’s how we saved the world

20+ Open jobs!

STORMSHIELD

Villeneuve d’Ascq – Paris (ILM) - Lyon

www.stormshield.com/join-us/

Thank you

Looking forward to hearing from you

Get in Touch

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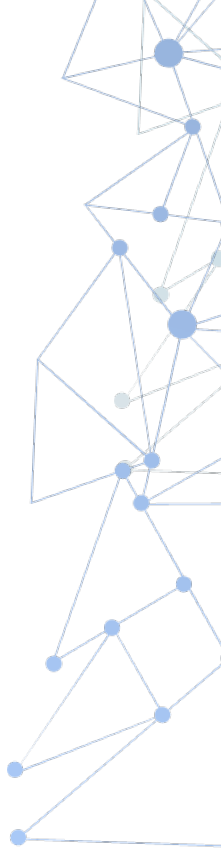
About encrypted SNI (eSNI)

- Currently as a draft
- Can break our solution as we are not able do obtain the SNI
- Encrypted via key given in DNS

  => Solution: We also analyze DNS trafic

  (If you use DNSsec on top of that you may beat us)

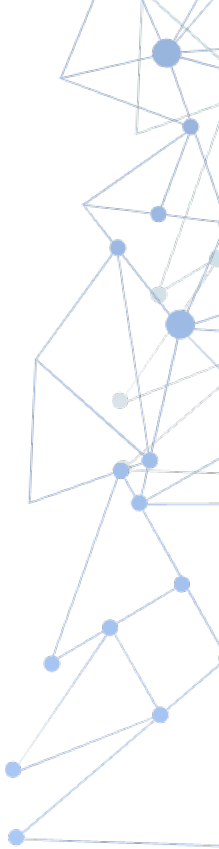


TLS in kernel

- Requires to have the whole chain of cert in kernel

  => Not enough memory to do that, too costly

- It is technically possible to do TLS in kernel



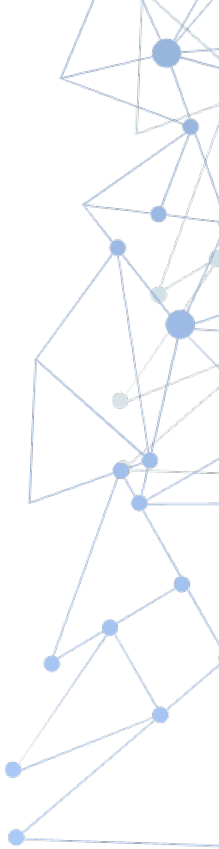
About PSK-only servers (if it exists)

- PSK can be used to authenticate server

  => Thus no need for server certificate

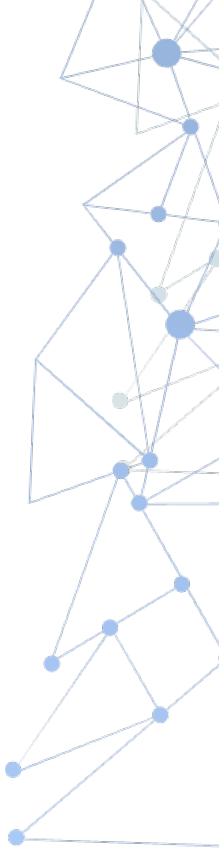
  => Our solution don’t work (or don’t apply)

- **Solution**: Whitelist PSK-only servers

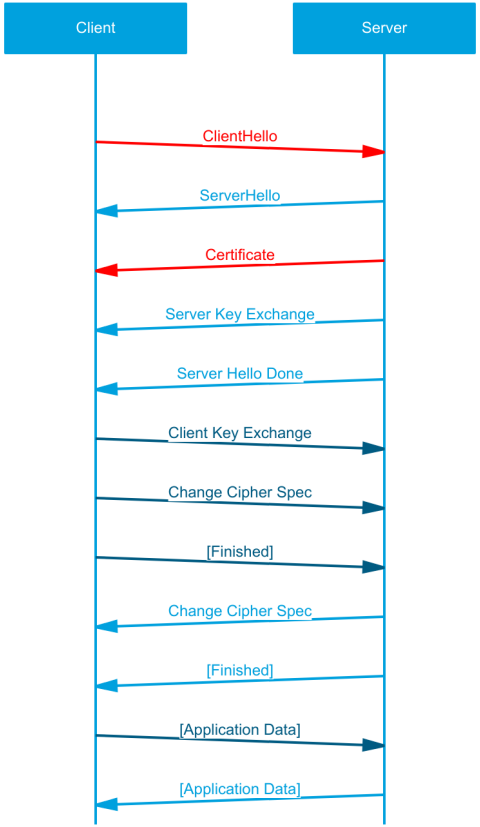


TLS 1.3 early-data

- Stripped when mimicking ClientHello
- Concerns about anti-replay
- We can’t provide sufficient security for anti-replay

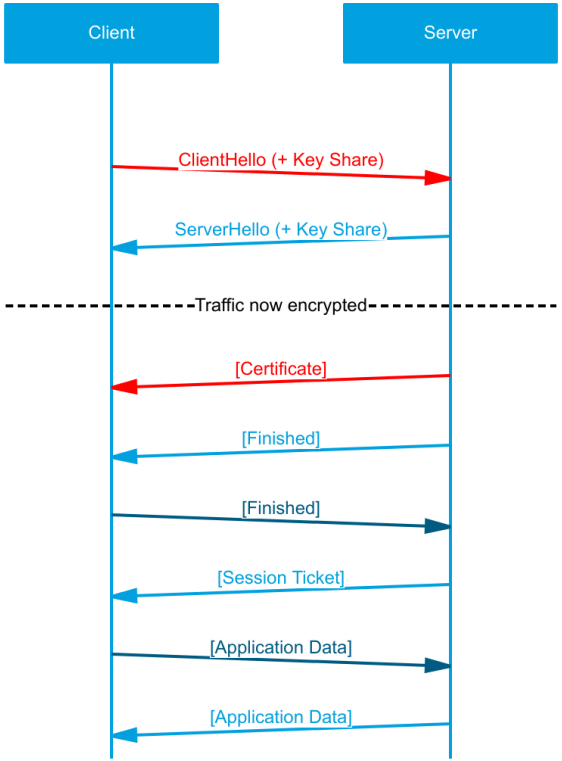


TLS 1.2 handshake



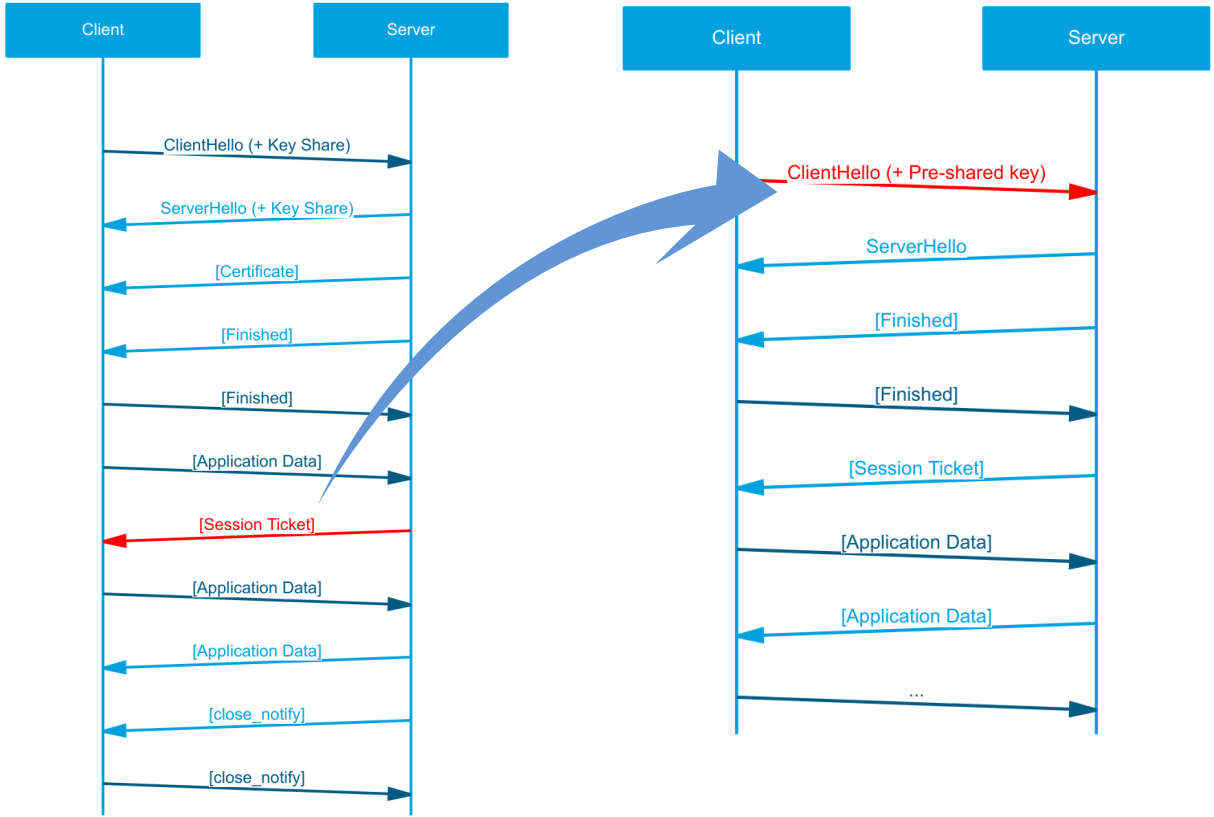
[ ] = Encrypted

TLS 1.3 handshake



[ ] = Encrypted

TLS 1.3 session resumption



TLS 1.3 0-RT == Resumption + Early data