PLAYBACK: A TLS 1.3 STORY



WHO ARE WE?



Alfonso García Alguacil



Alejo Murillo Moya

INTRODUCING TLS 1.3

The **Good**

- KISS – Only 5 ciphers supported
- No vulnerable to the attacks impacting previous versions
- Welcome Forward Secrecy
- Formal security analysis performed to the protocol

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The **Bad**

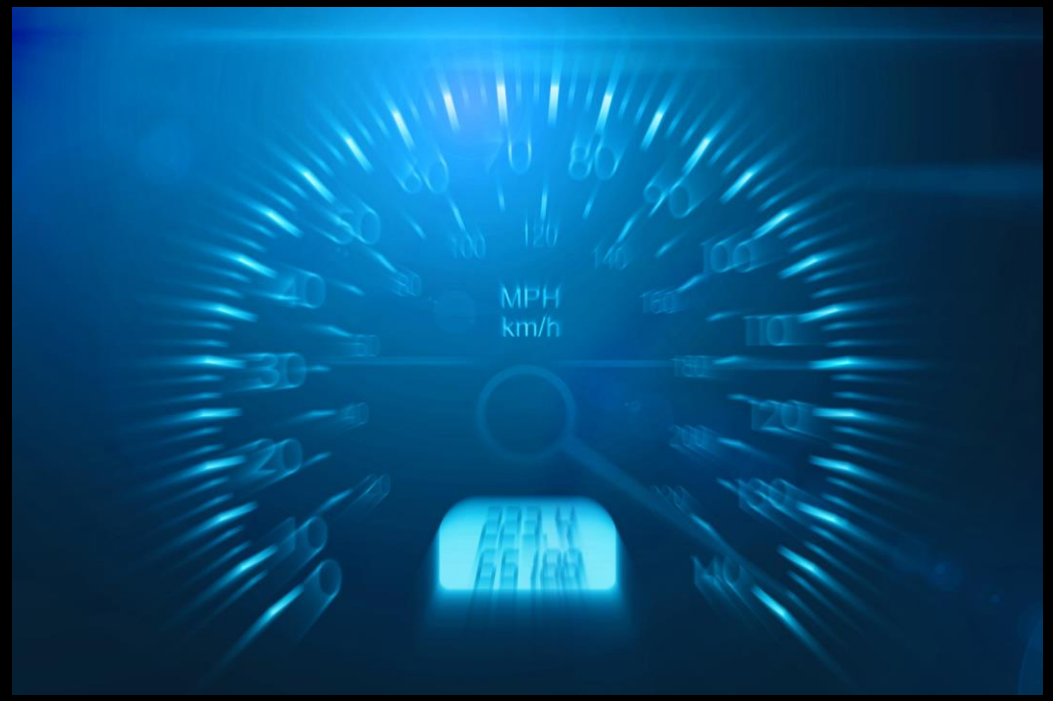
- Protocol tainted due to “compatibility issues” ☹

INTRODUCING TLS 1.3

The **Ugly**

- 0-RTT (this talk ☺)

0-RTT: SPEED AT A COST

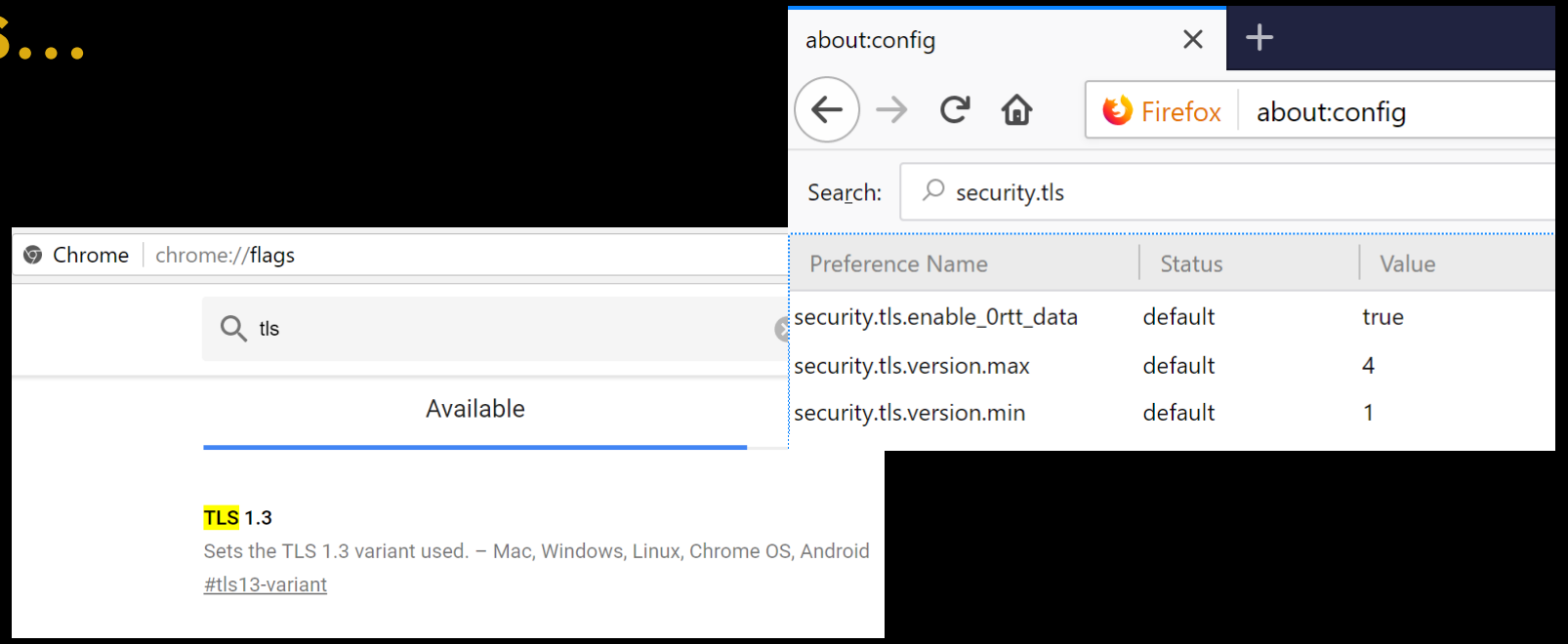


vs




TELL ME AGAIN...
WHY SHOULD I CARE?
memes.com

Your browsers…



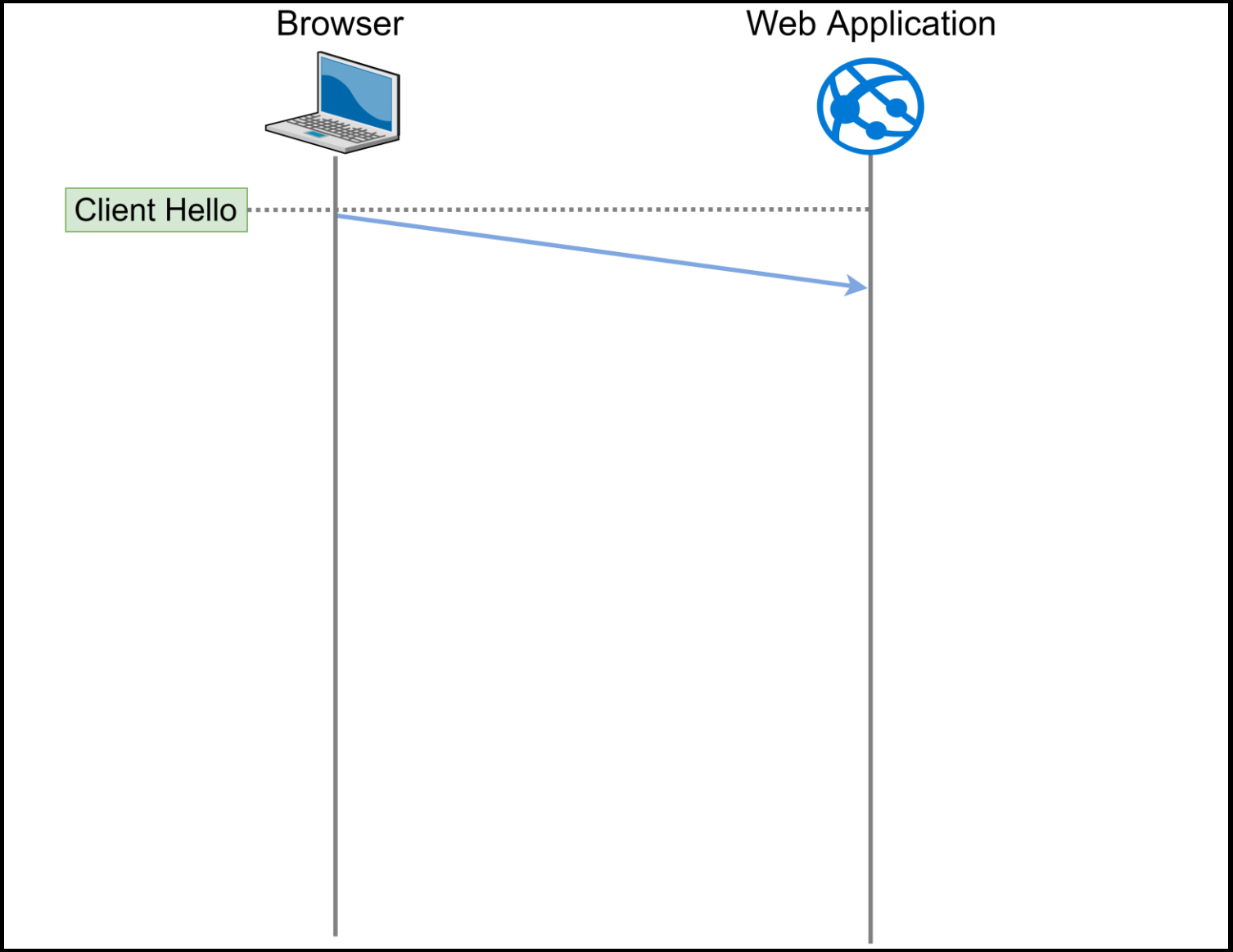
… implementations …

OpenSSL
Cryptography and SSL/TLS Toolkit

BoringSSL

… and CDNs may already be supporting TLS 1.3 0-RTT!

TLS 1.3 HANDSHAKE



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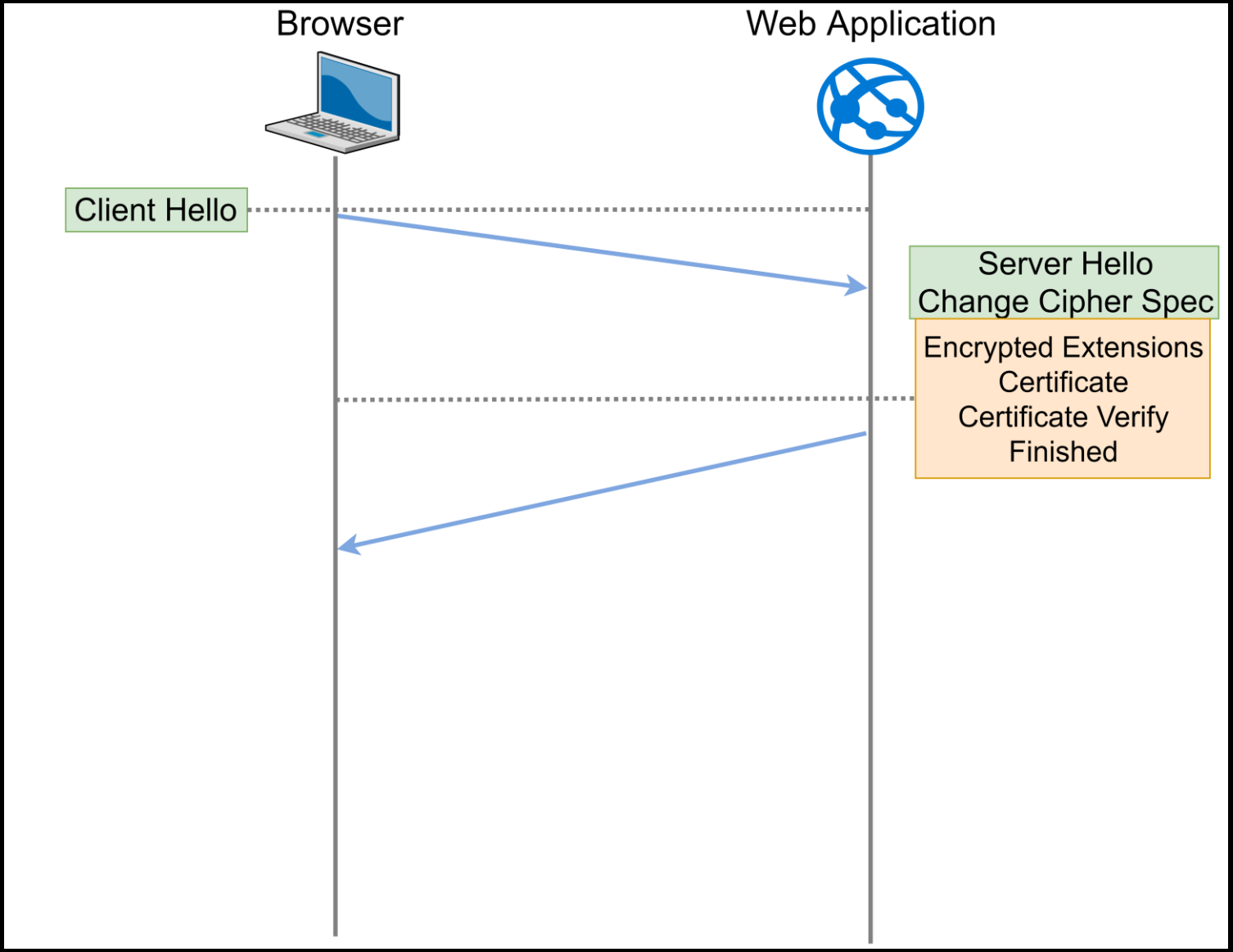

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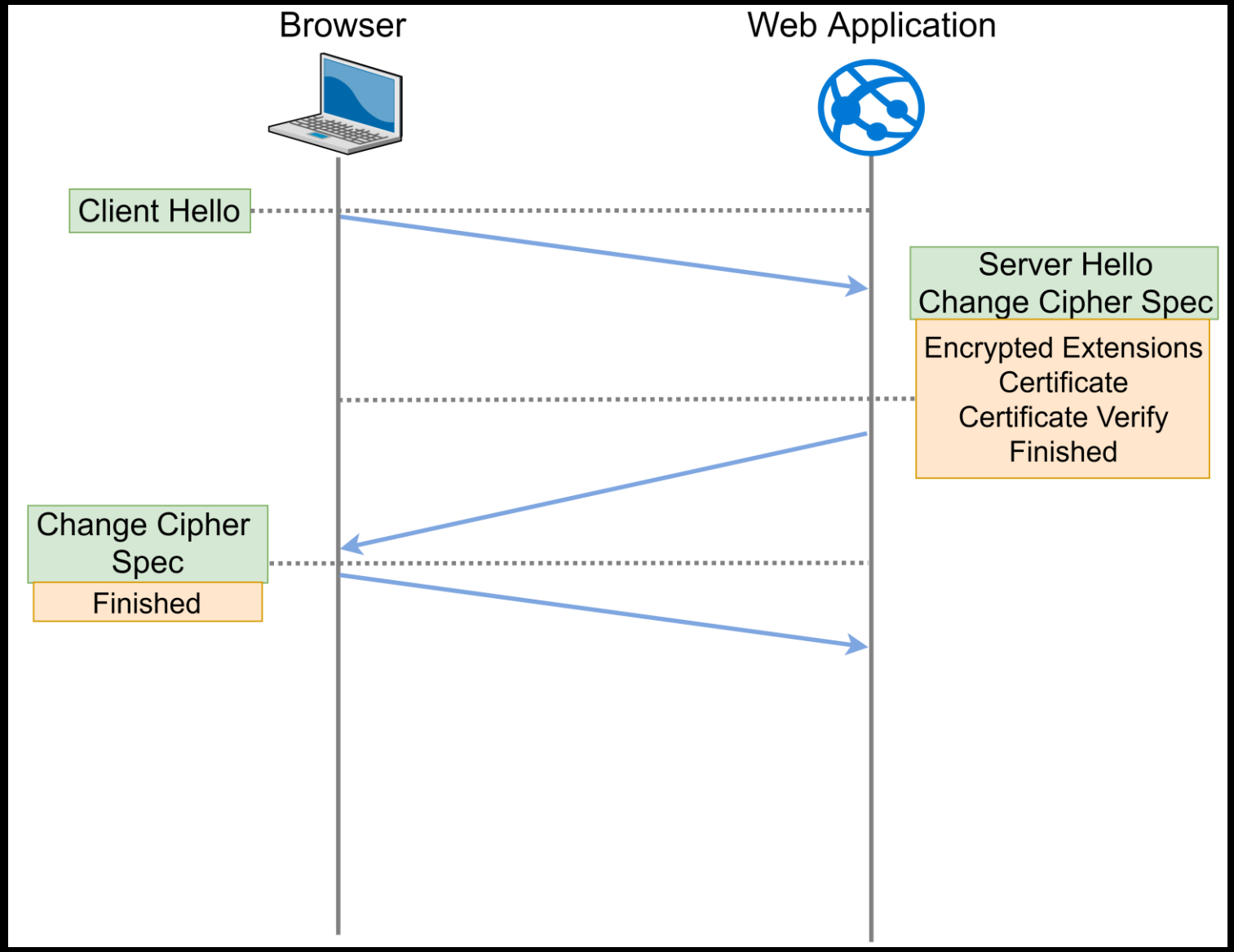

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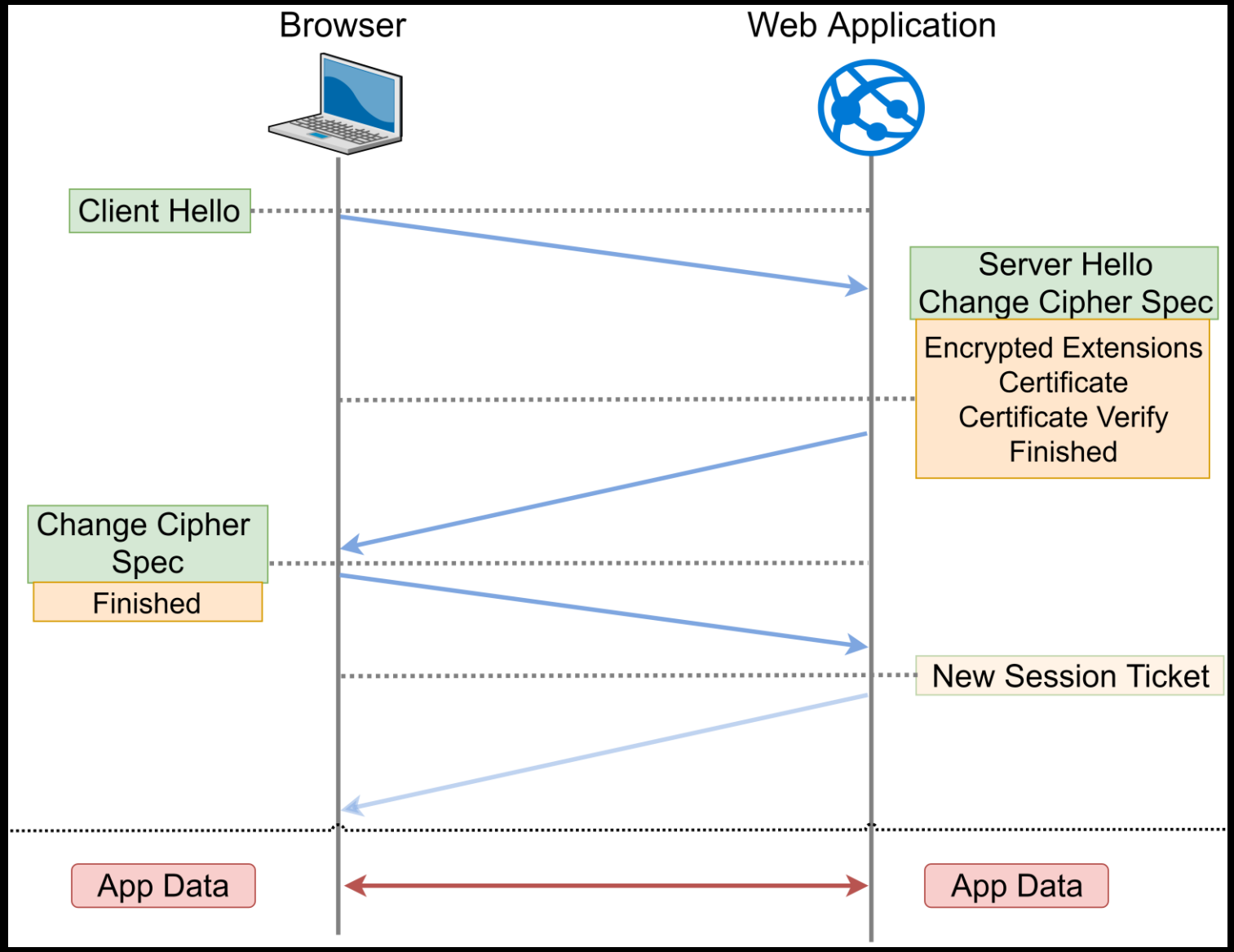
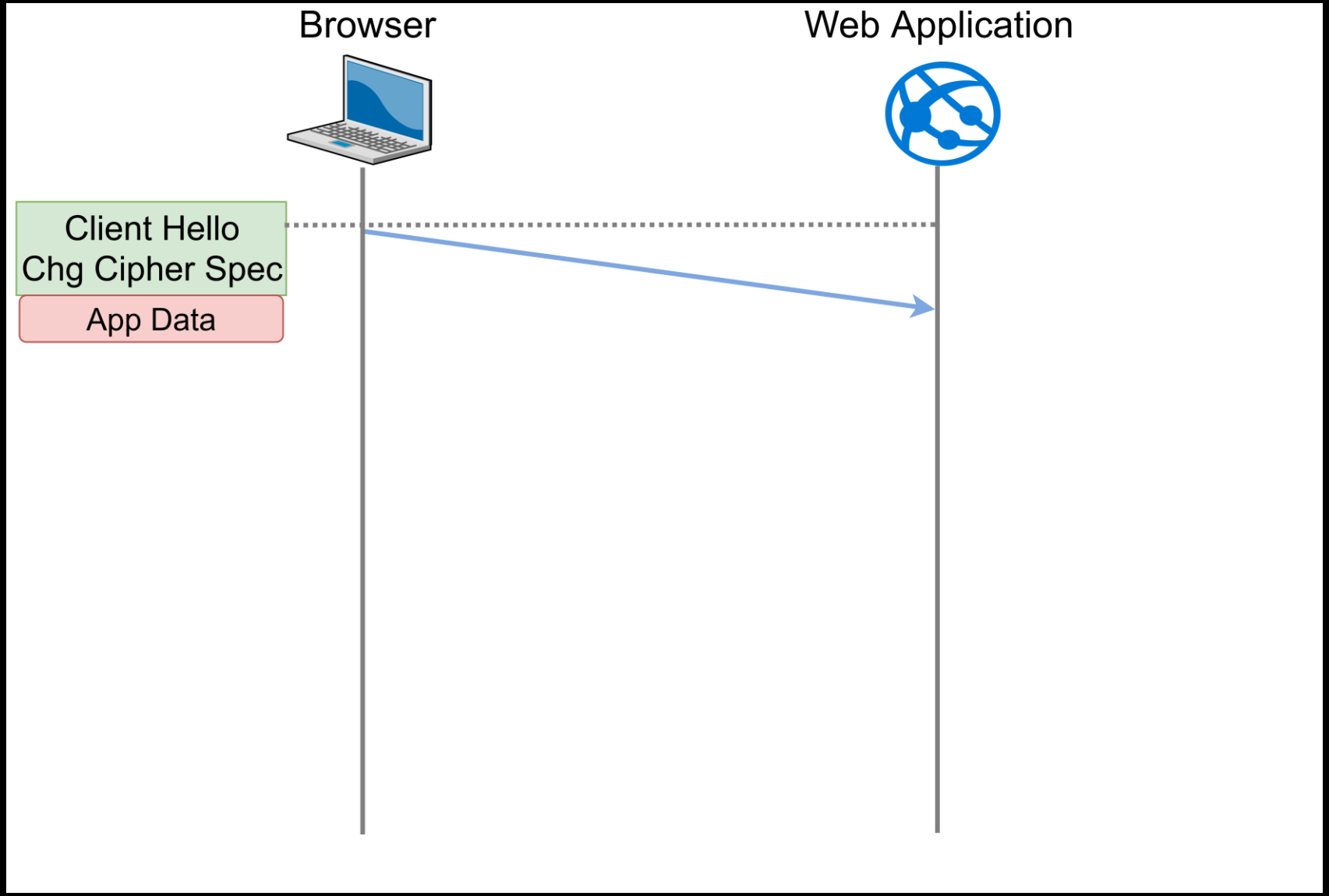
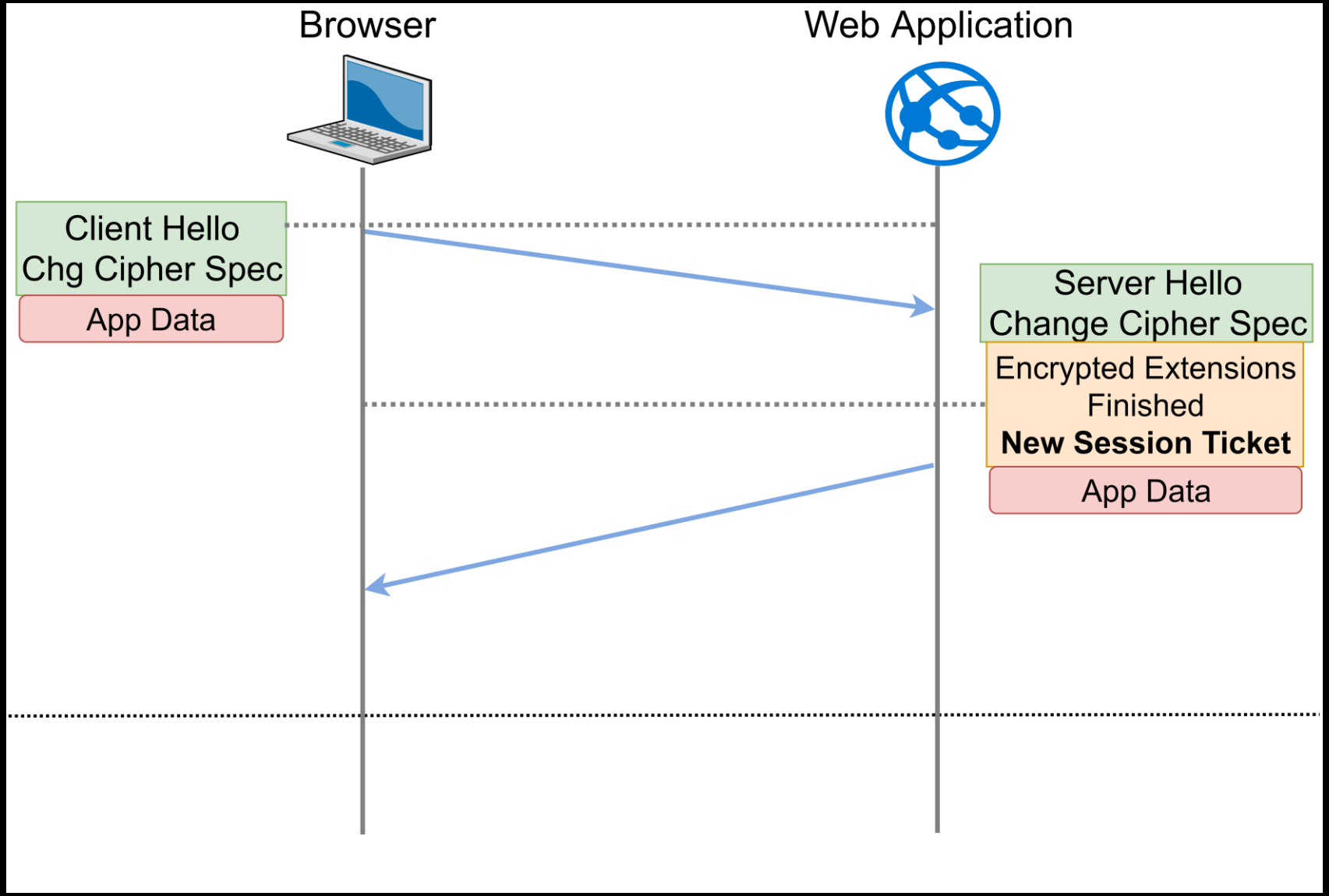


TLS 1.3 0-RTT


Browser
Web Application
Client Hello
Chg Cipher Spec
App Data

TLS 1.3 0-RTT


Browser
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Client Hello
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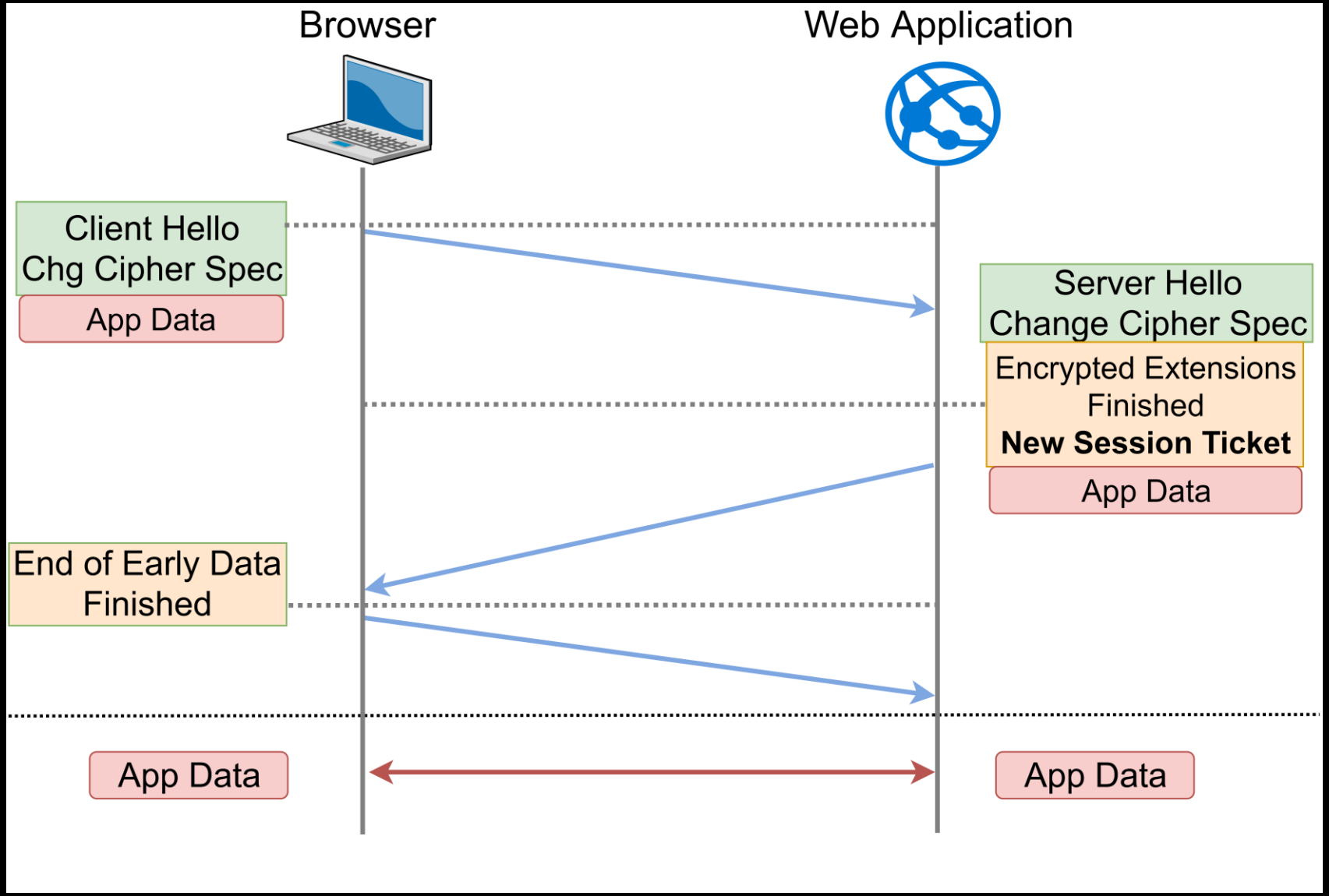
Server Hello
Change Cipher Spec
Encrypted Extensions
Finished
New Session Ticket
App Data

TLS 1.3 0-RTT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Chg Cipher Spec
App Data
Server Hello
Change Cipher Spec
Encrypted Extensions
Finished
New Session Ticket
App Data
End of Early Data
Finished
App Data
App Data

As you can see…

it may be possible to do **REPLAY**

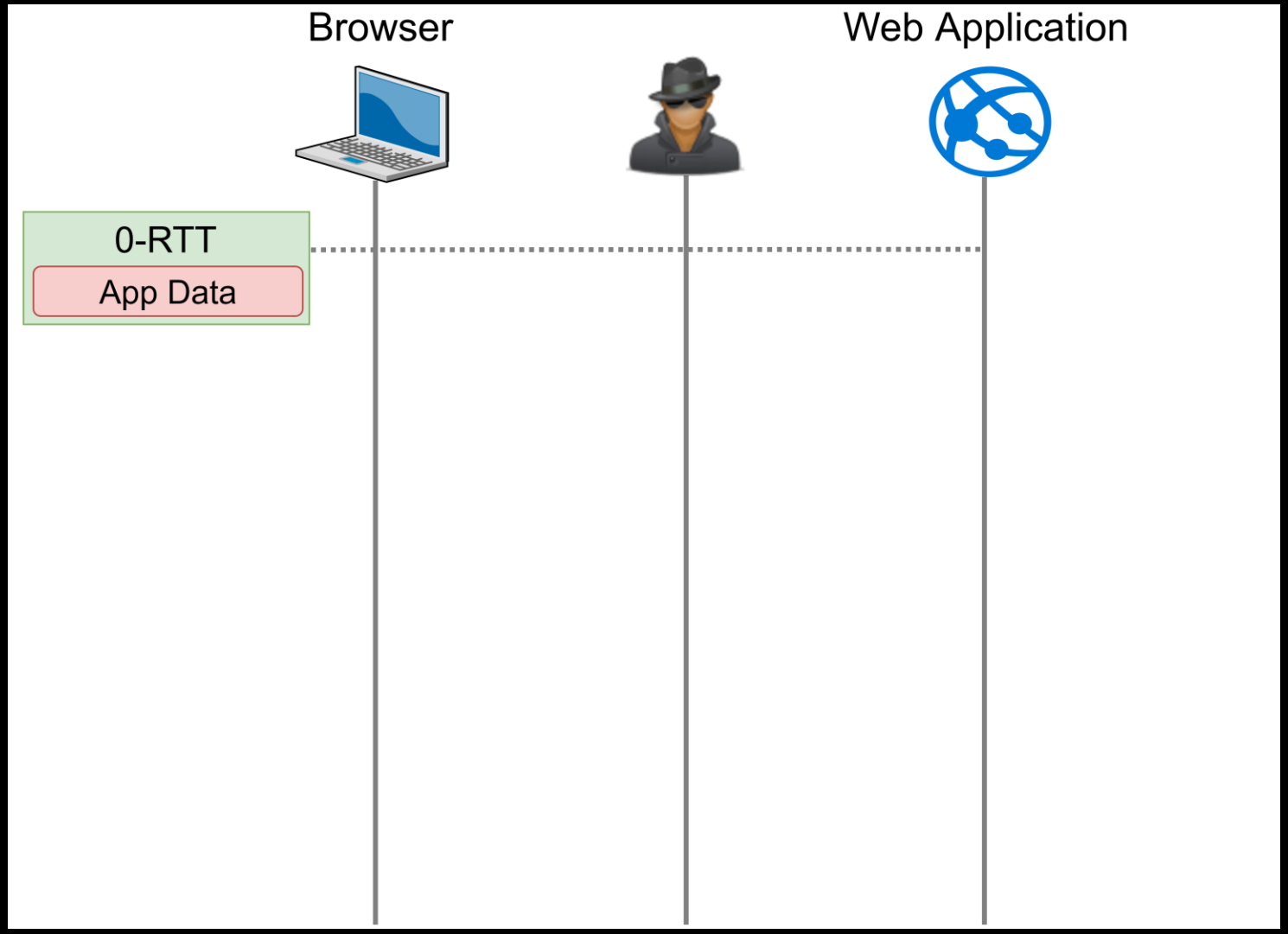
REPLAY

REPLAY

REPLAY

REPLAY attacks!

TLS 1.3 0-RTT REPLAY



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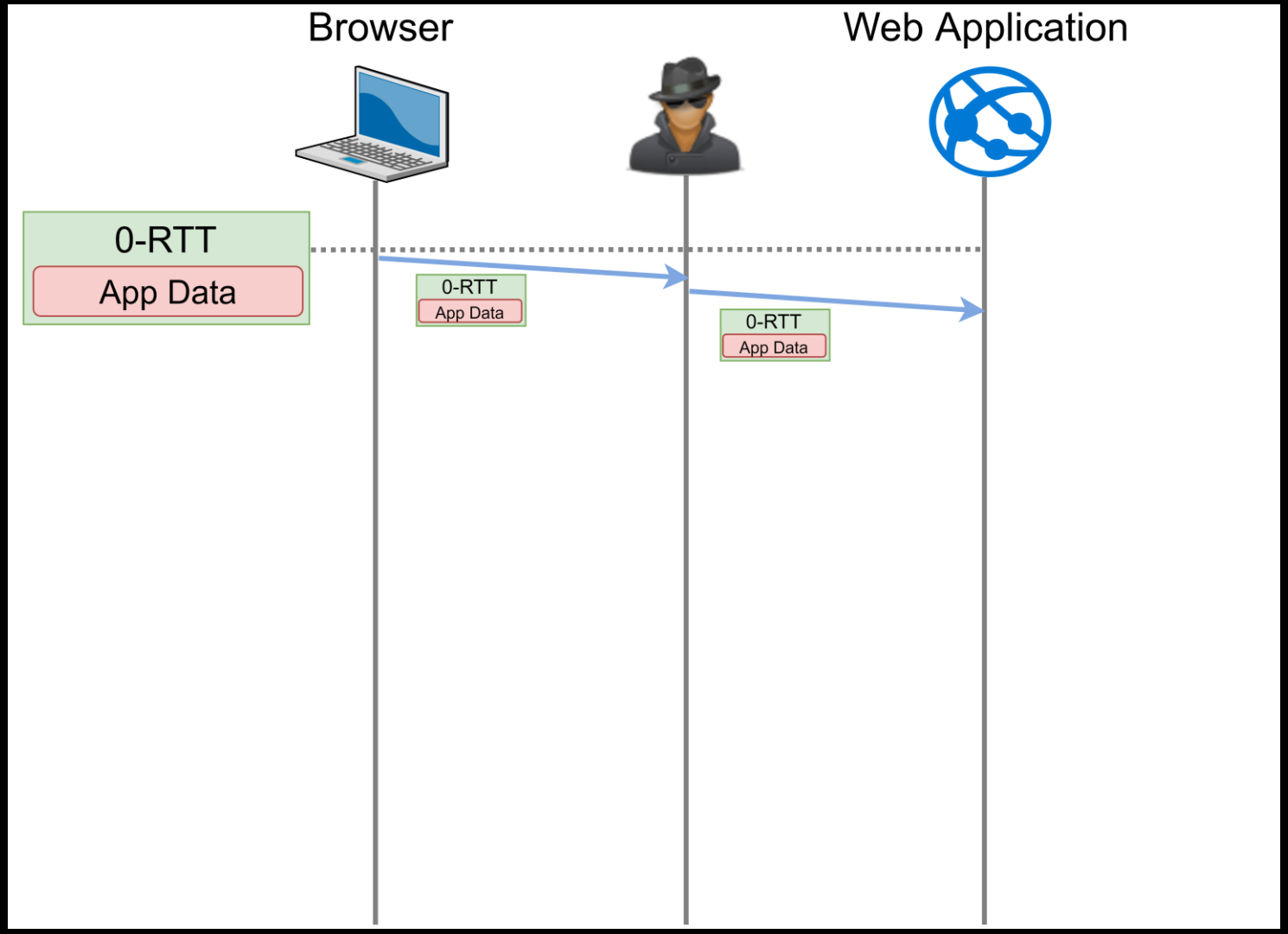

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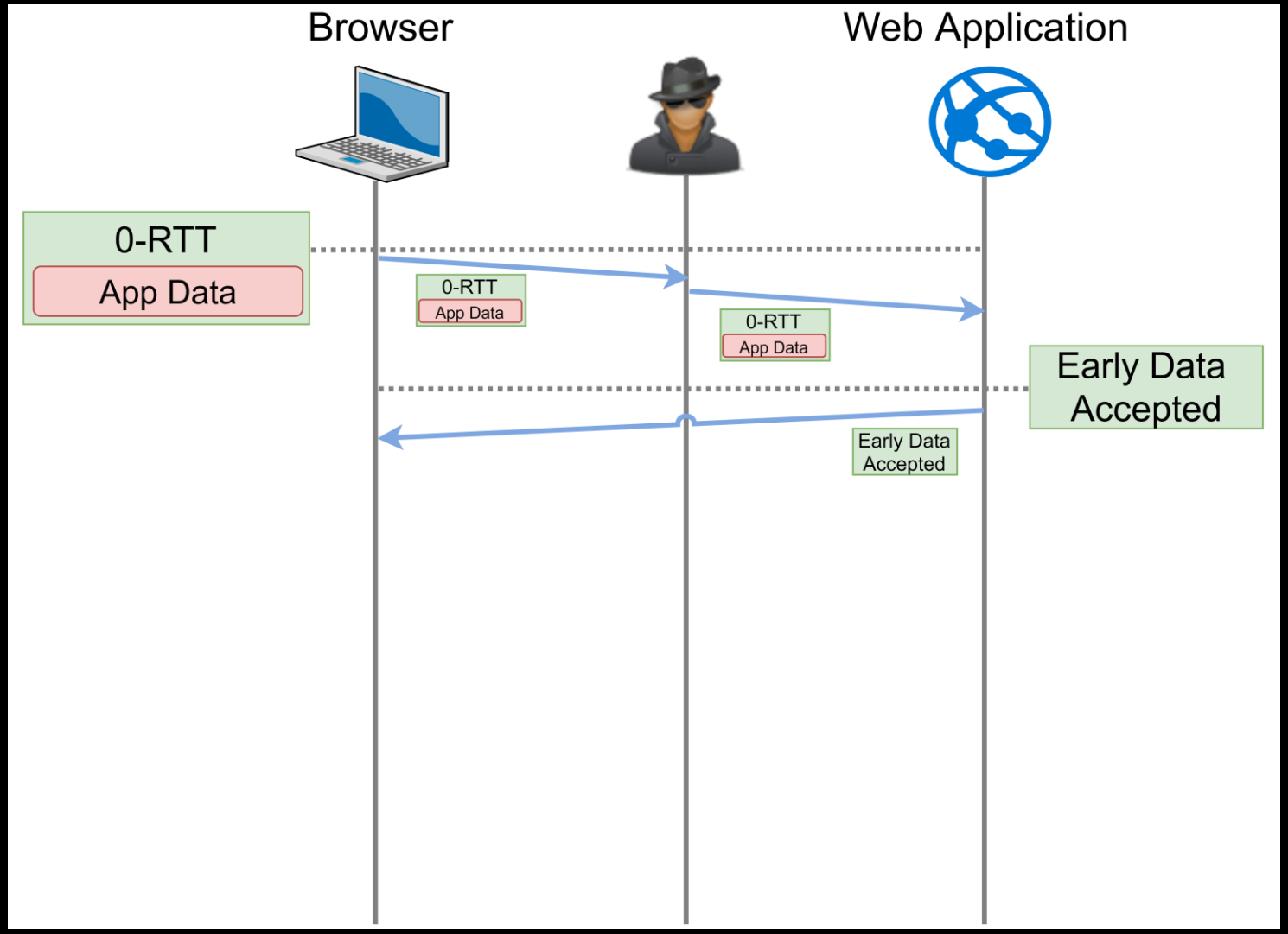

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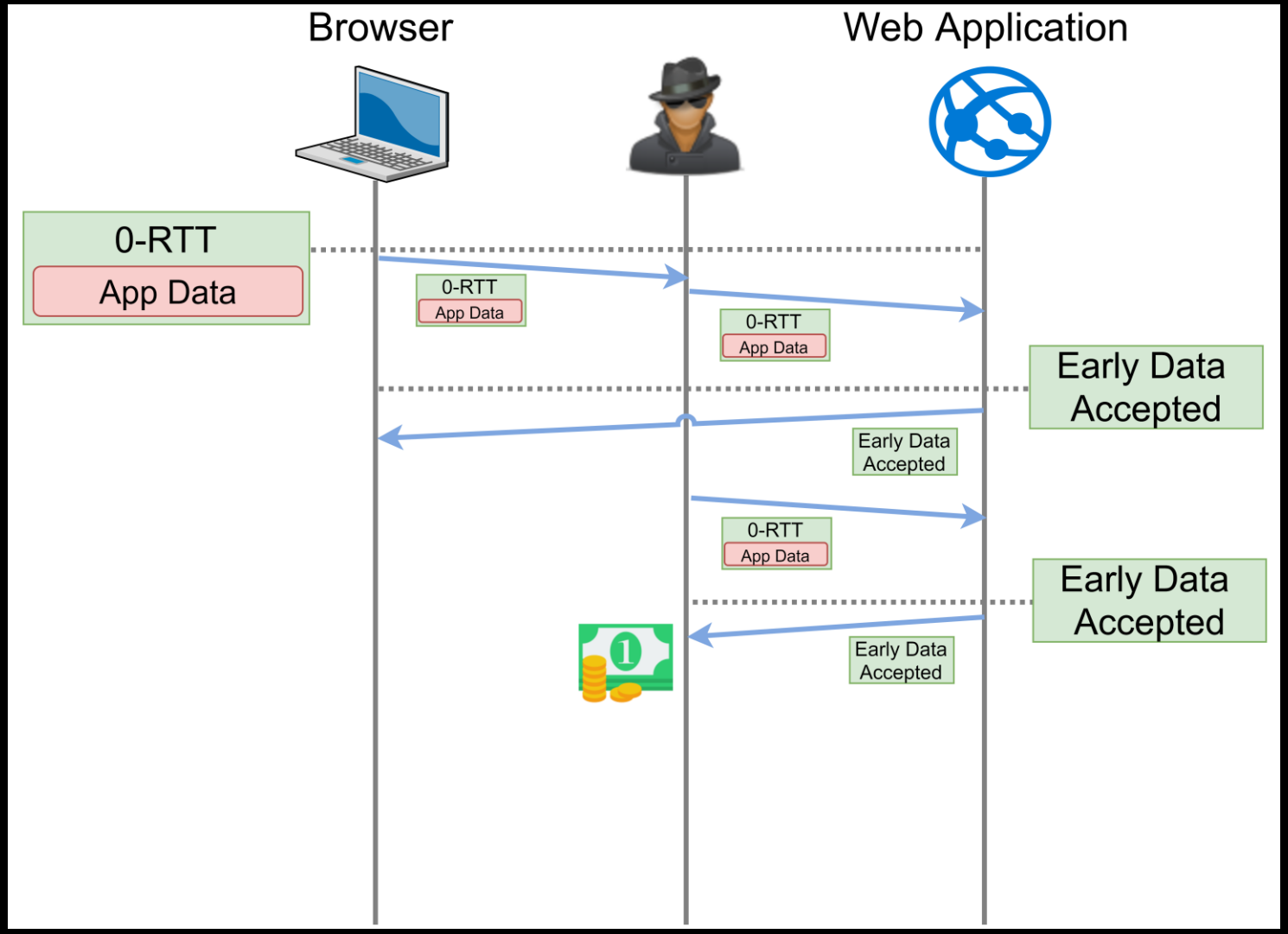

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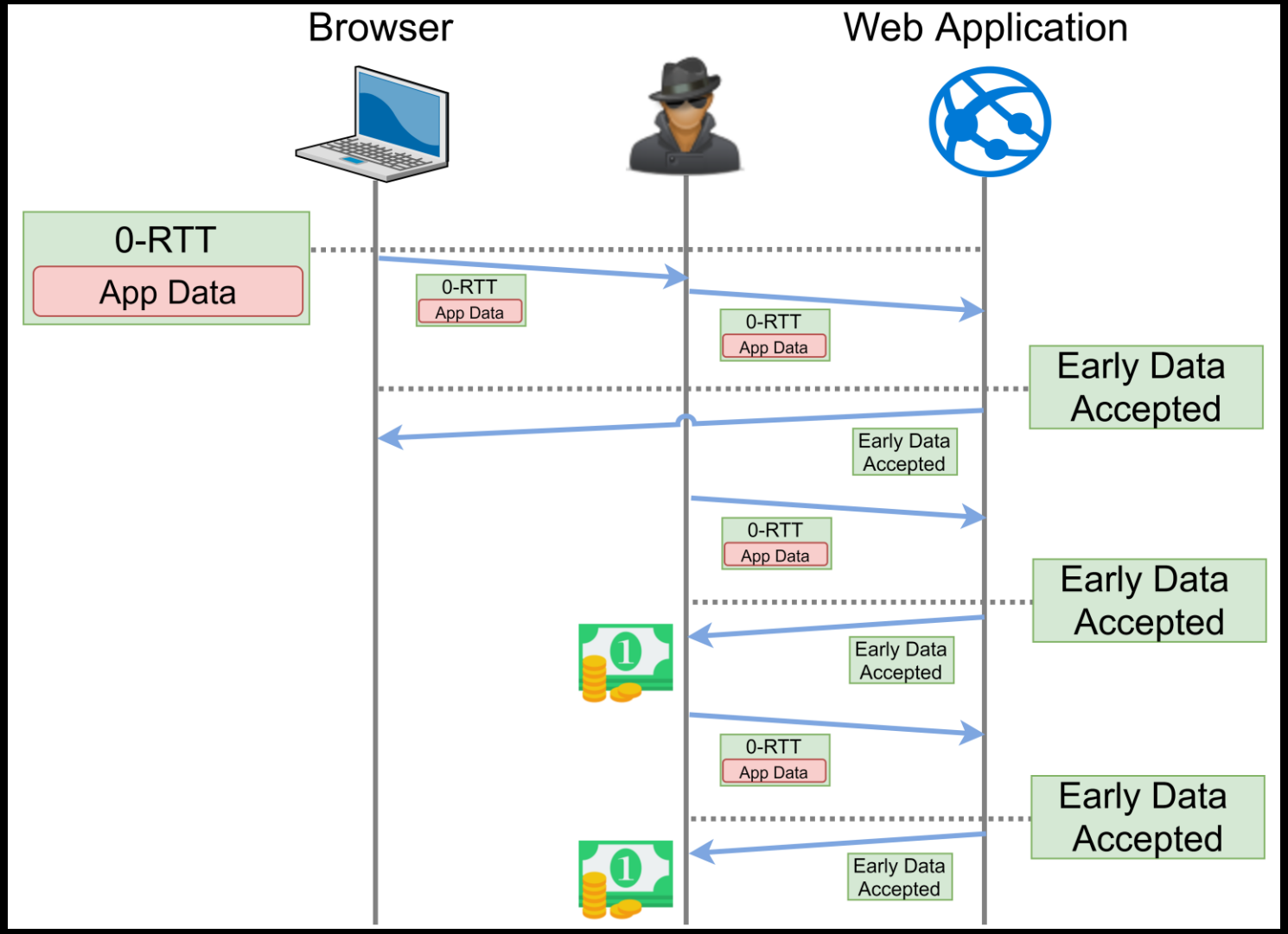

ANTI-REPLAY PROTECTIONS

Single-Use Tickets

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Client-Hello Recording

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Application profiles

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Separate API

ANTI-REPLAY PROTECTIONS (JUL-2018)

	Single-Use Tickets	Client-Hello Recording	Application Profile	Other protections
OpenSSL Cryptography and SSL/TLS Toolkit	✓		n/a	Different API for handling 0-RTT
BoringSSL			n/a	0-RTT disabled by default
CLOUDFLARE	✓		Partial (HTTP Header)	0-RTT only on "safe" methods, no params
	n/a		n/a	0-RTT not available
	n/a		n/a	0-RTT only on "safe" methods

ANATOMY OF AN ATTACK

- **Vantage point** in the network
- Browser and server with TLS 1.3 and **0-RTT enabled**
- GET not being a "**safe method**" (a.k.a. RFC meets reality)

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THE BROWSER BEHAVIOUR

- **The browser decides** when to send 0-RTT data, which reduces the window for attacks

DEMO

IMPROVING OUR ATTACK

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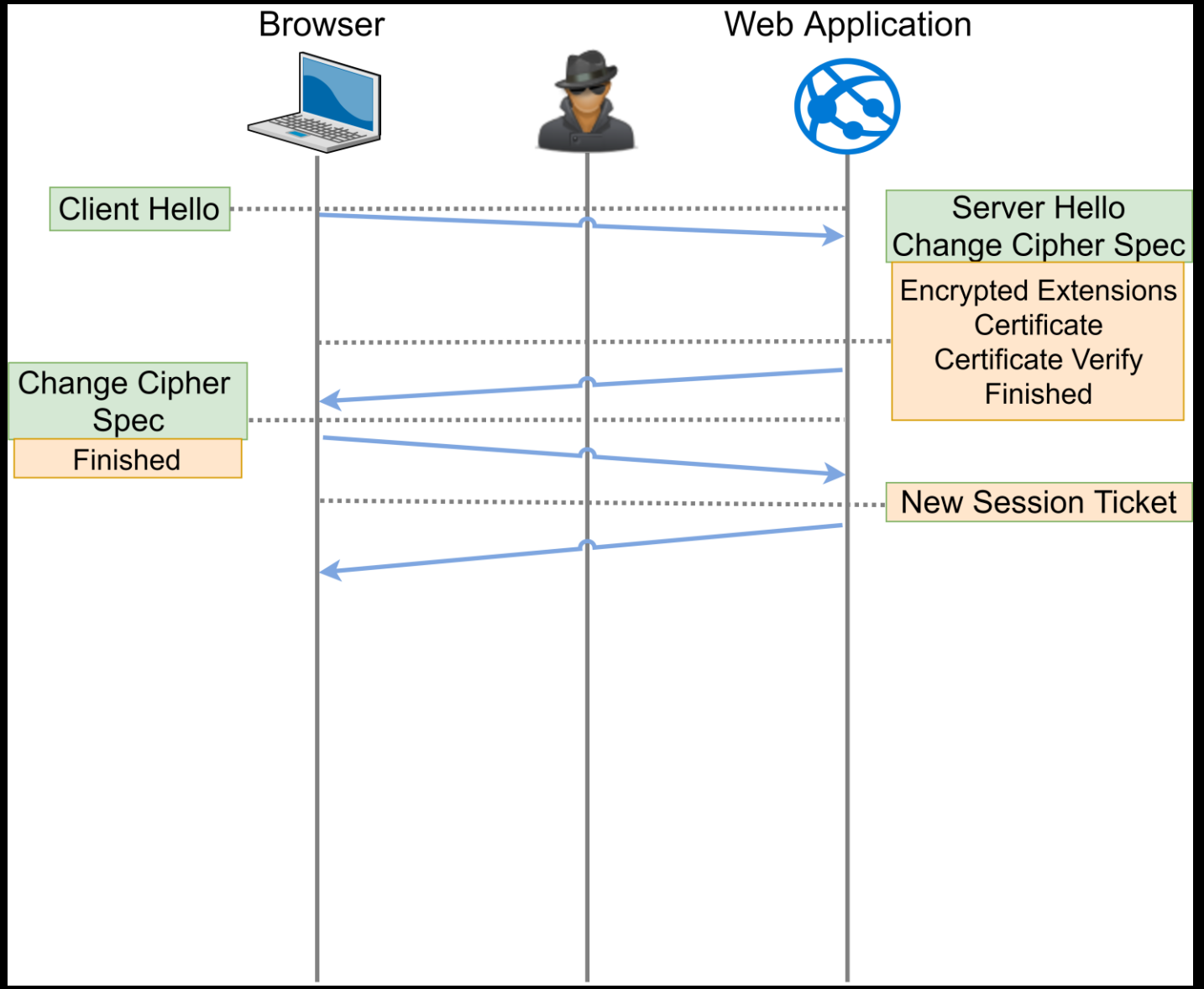
YES!!!

CONTROLLING THE BROWSER



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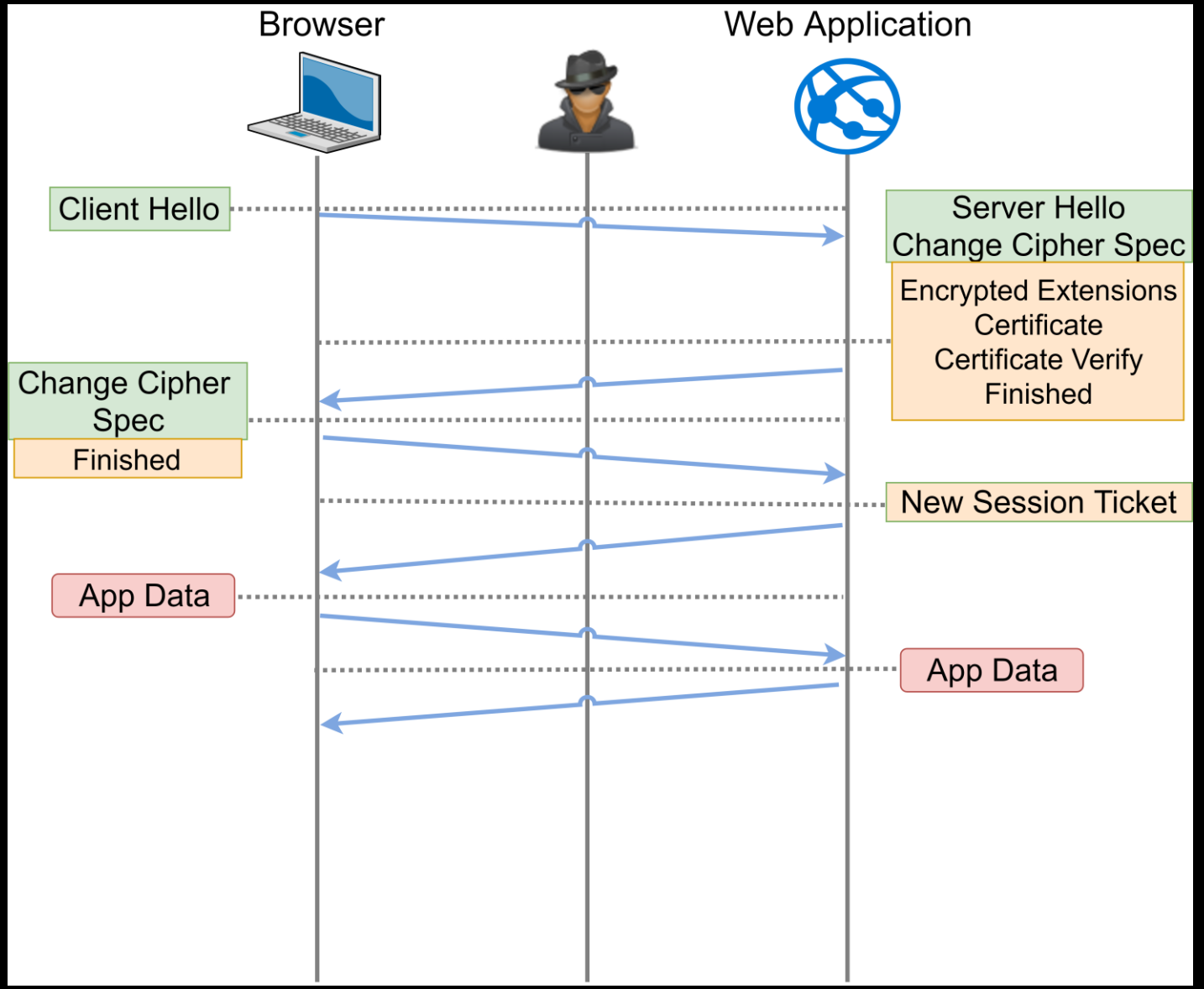

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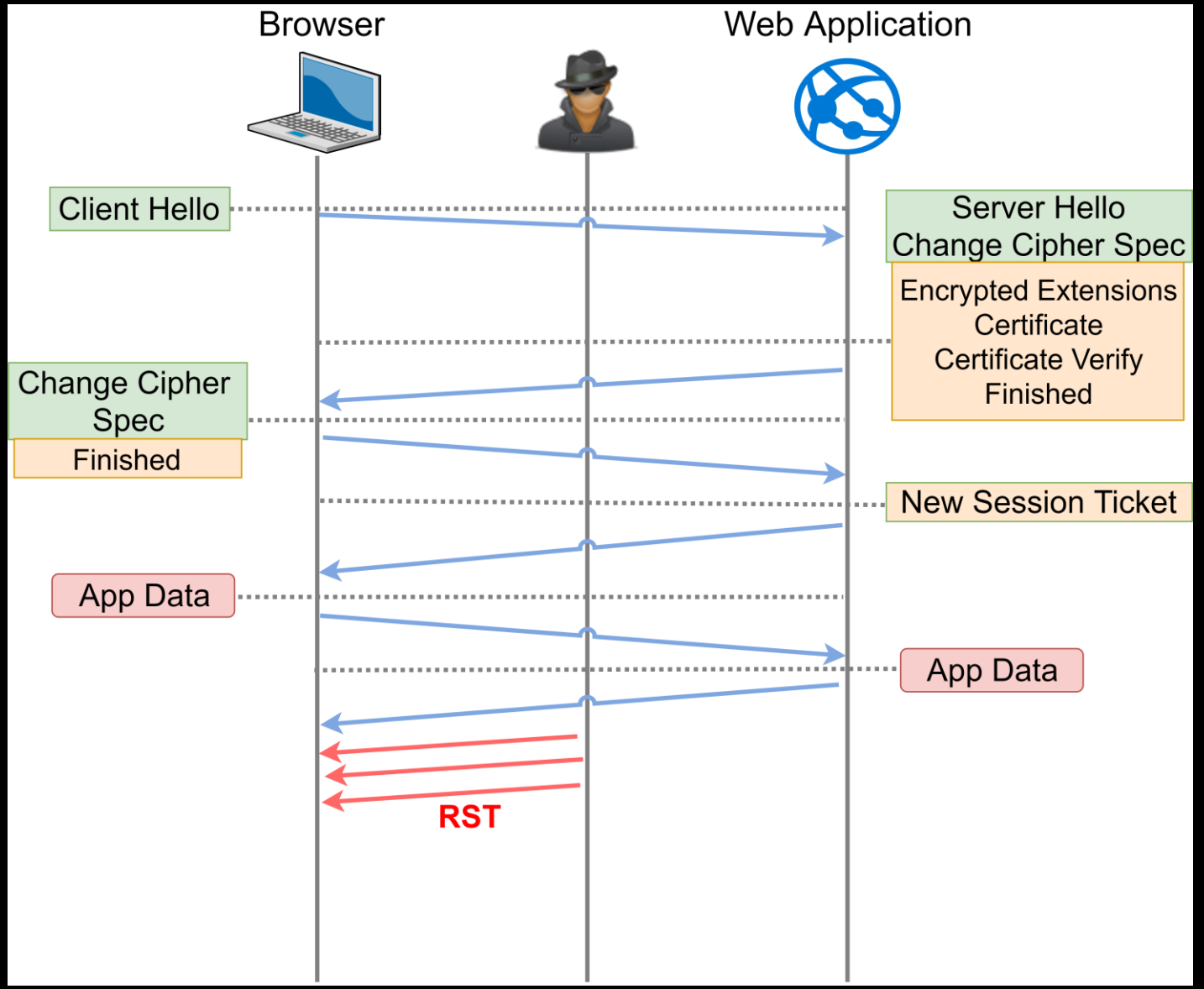

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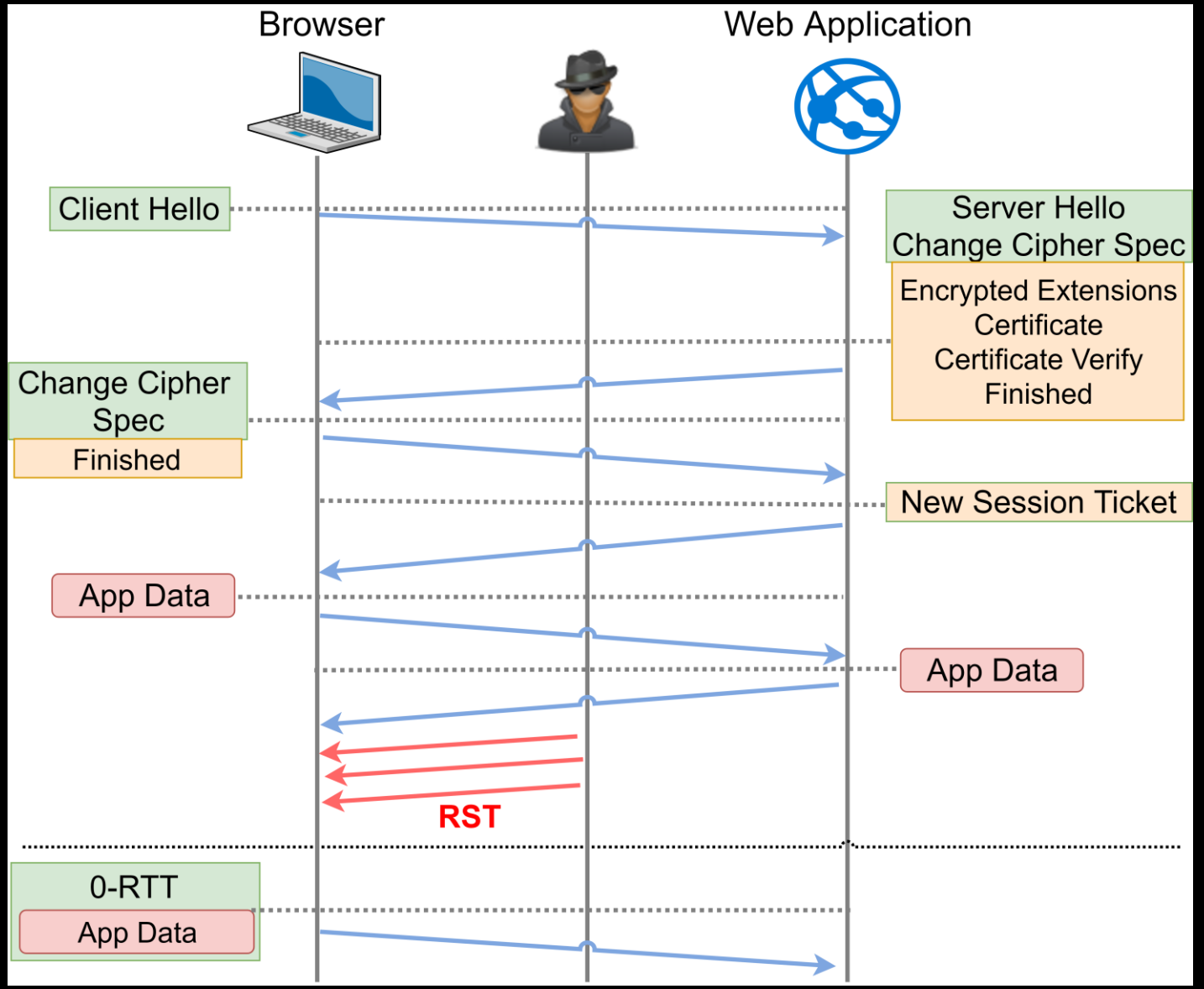

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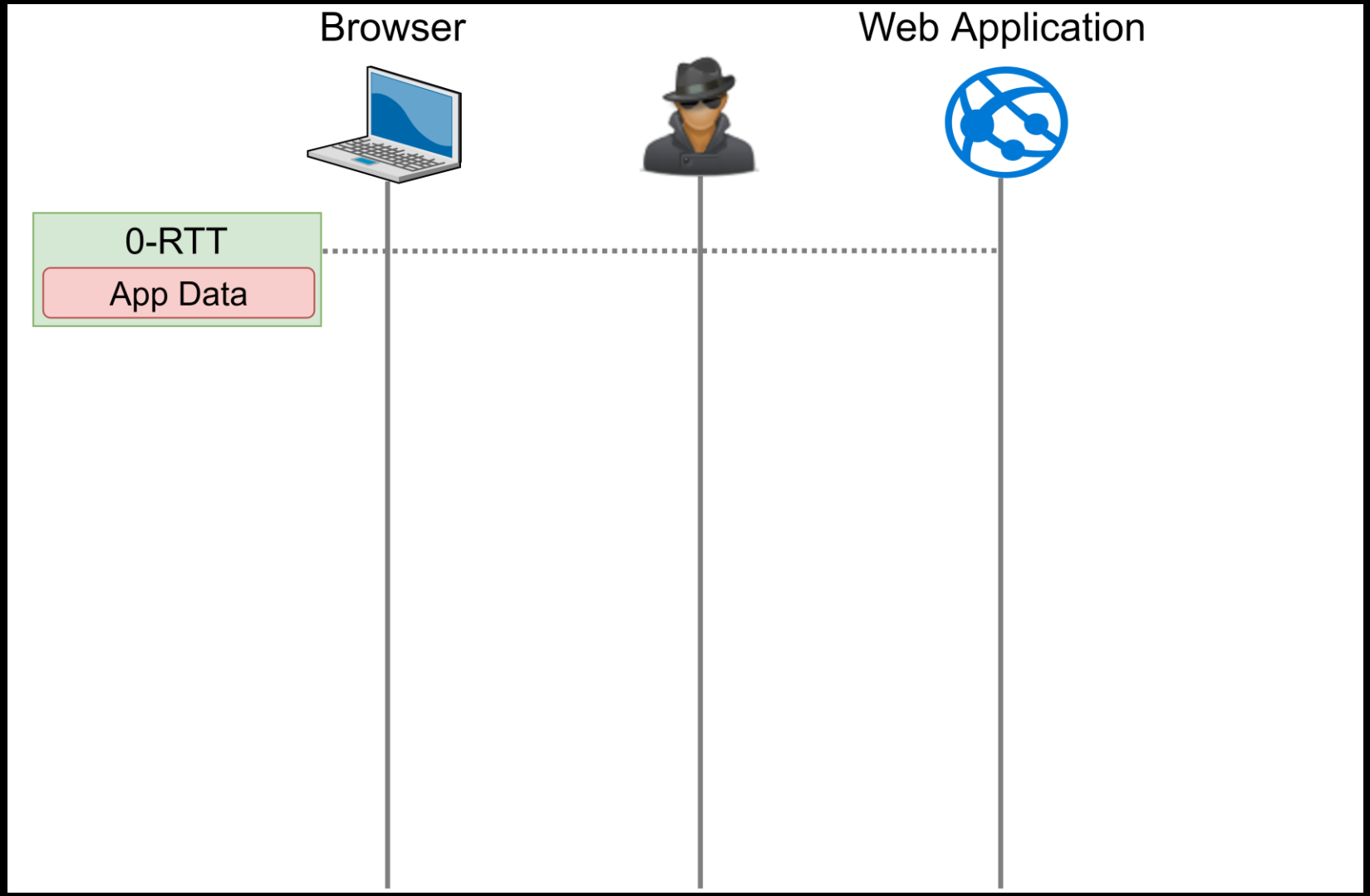

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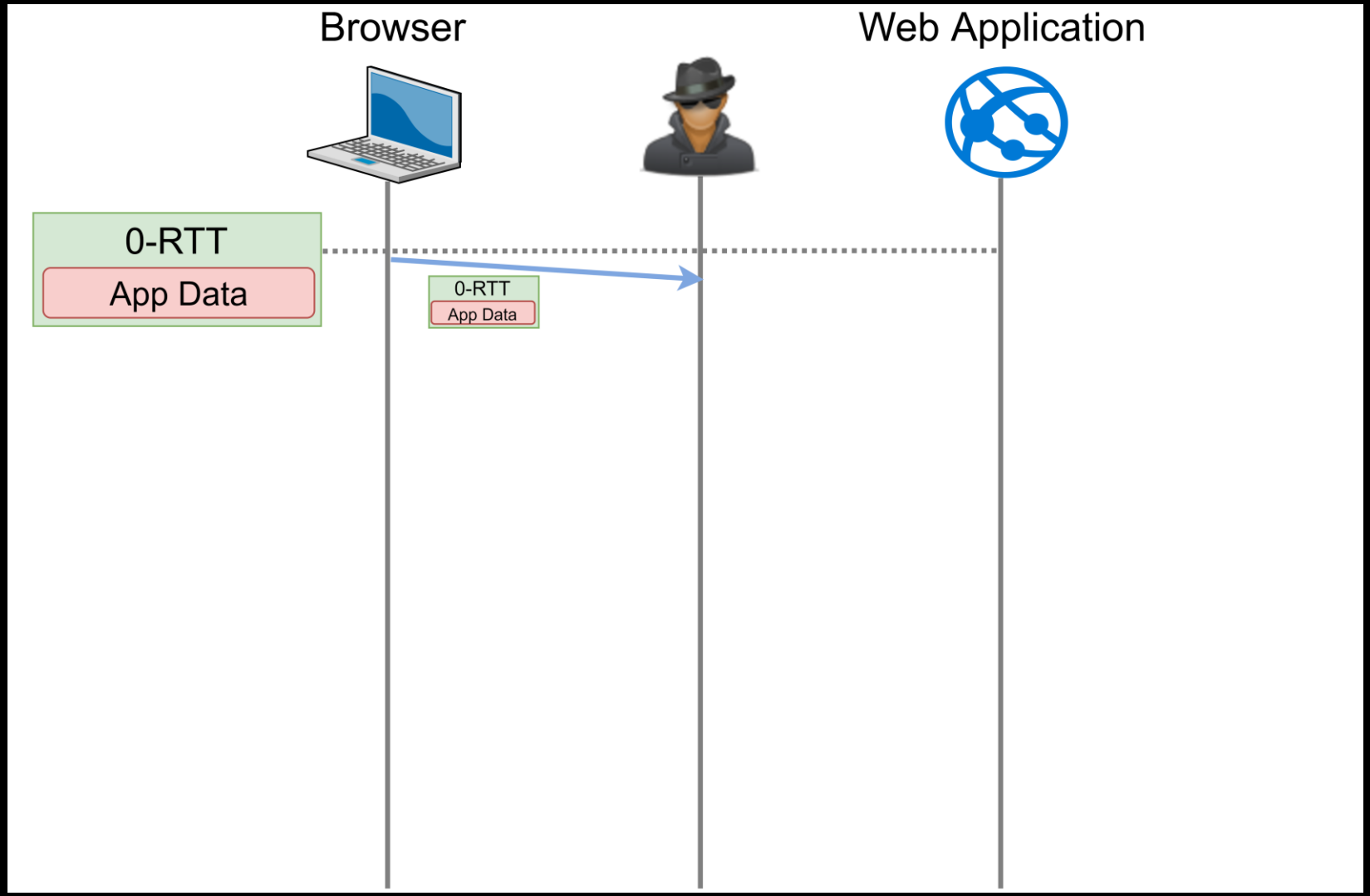

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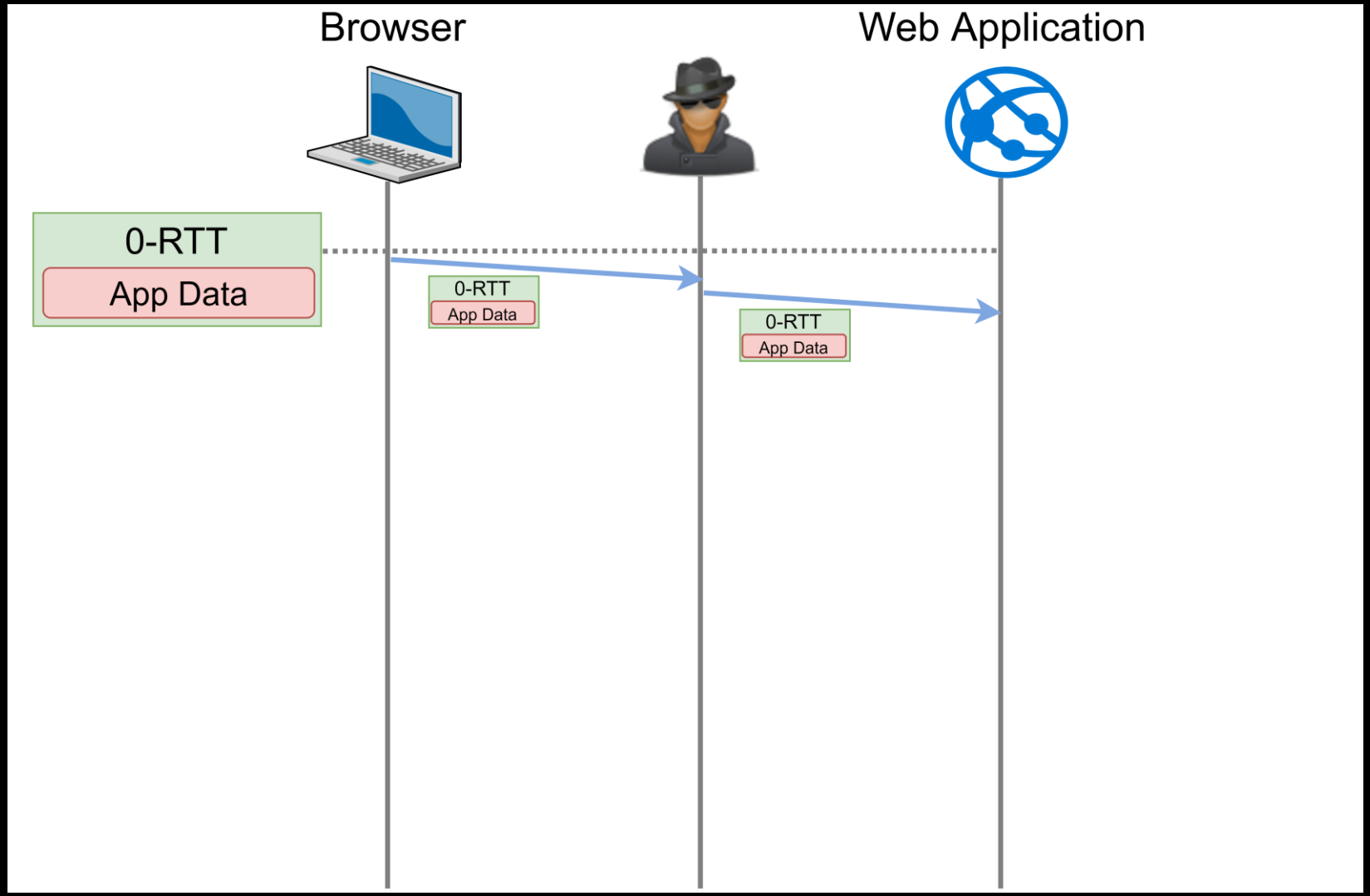

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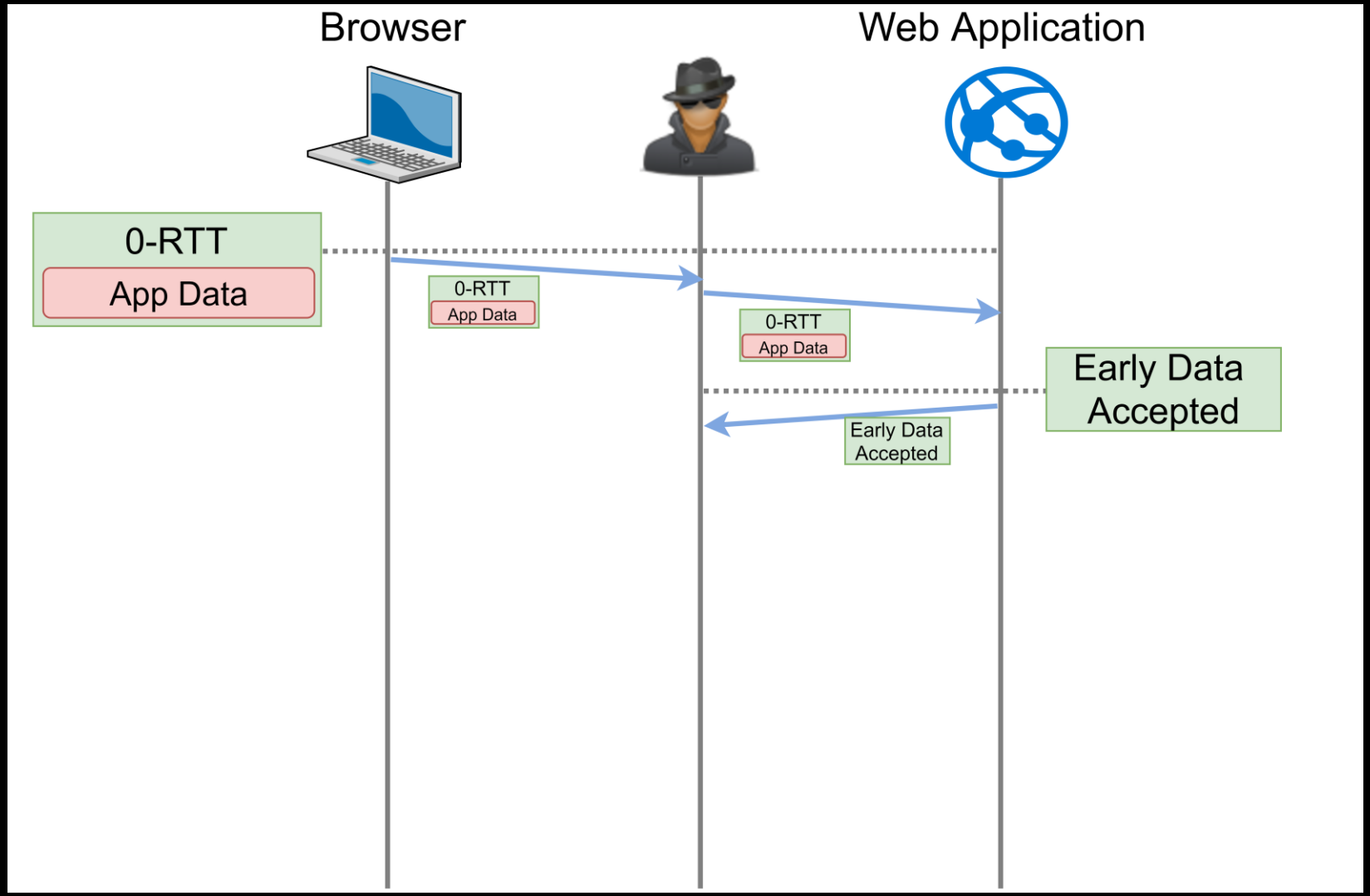

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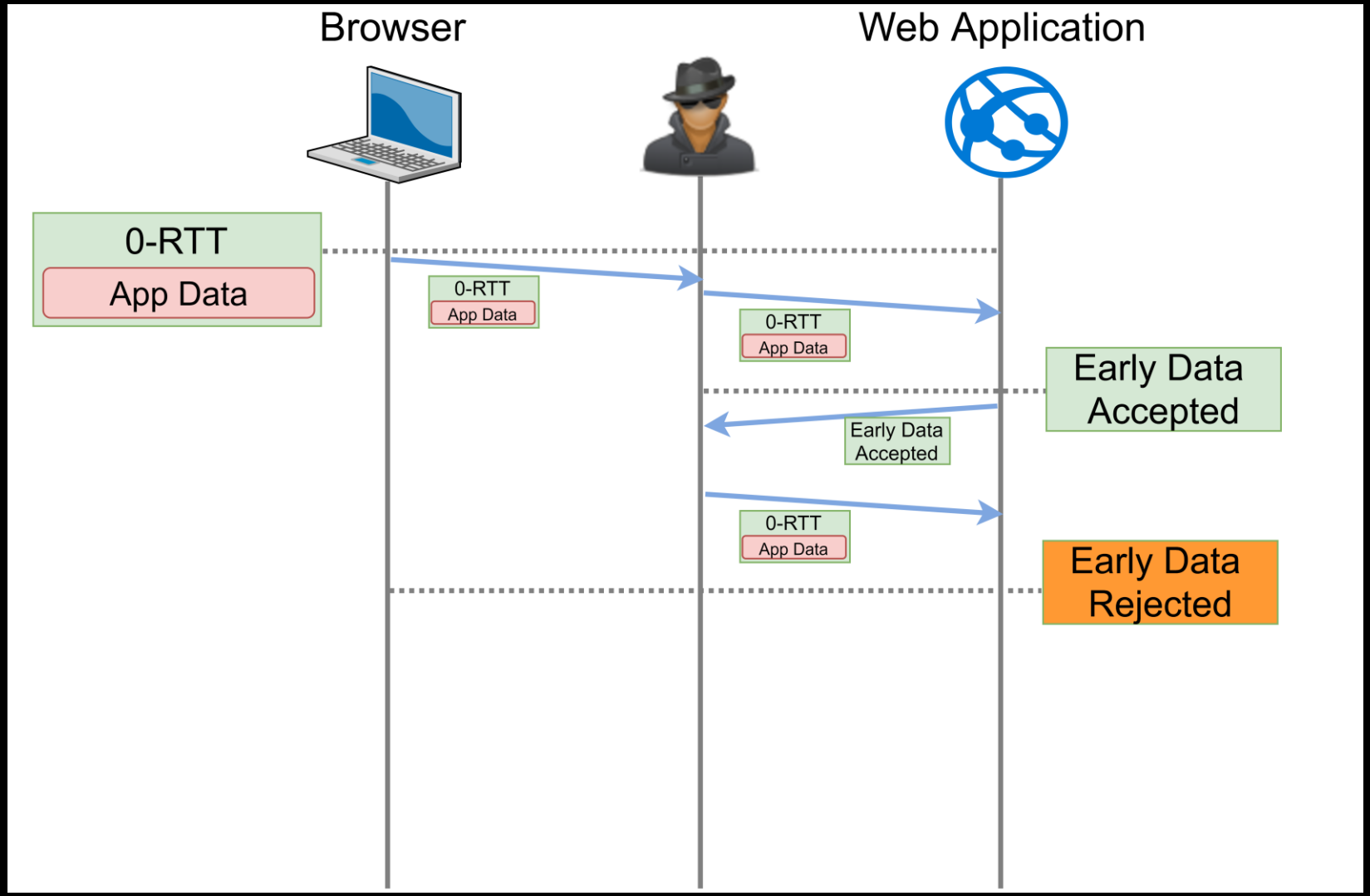

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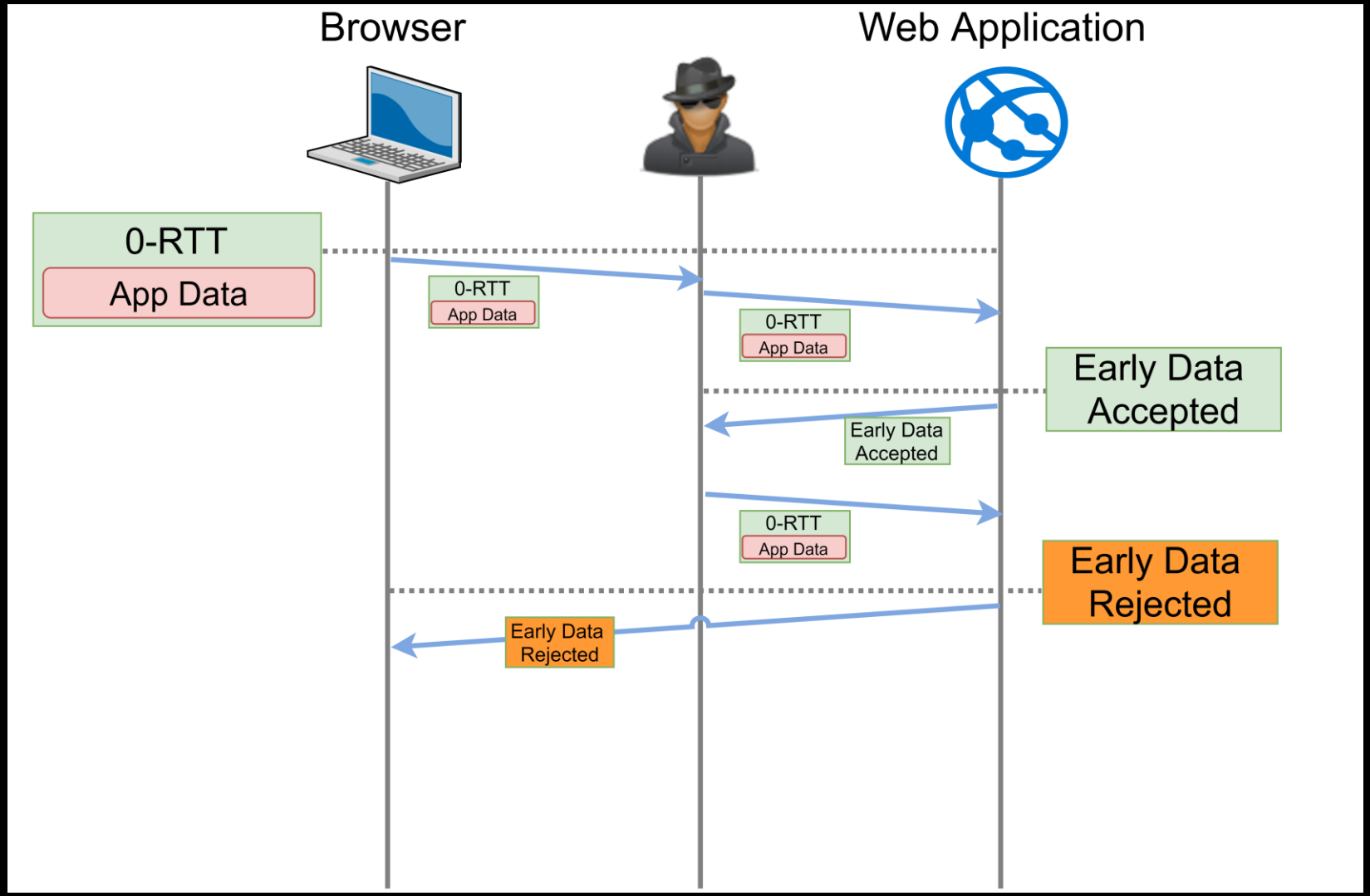

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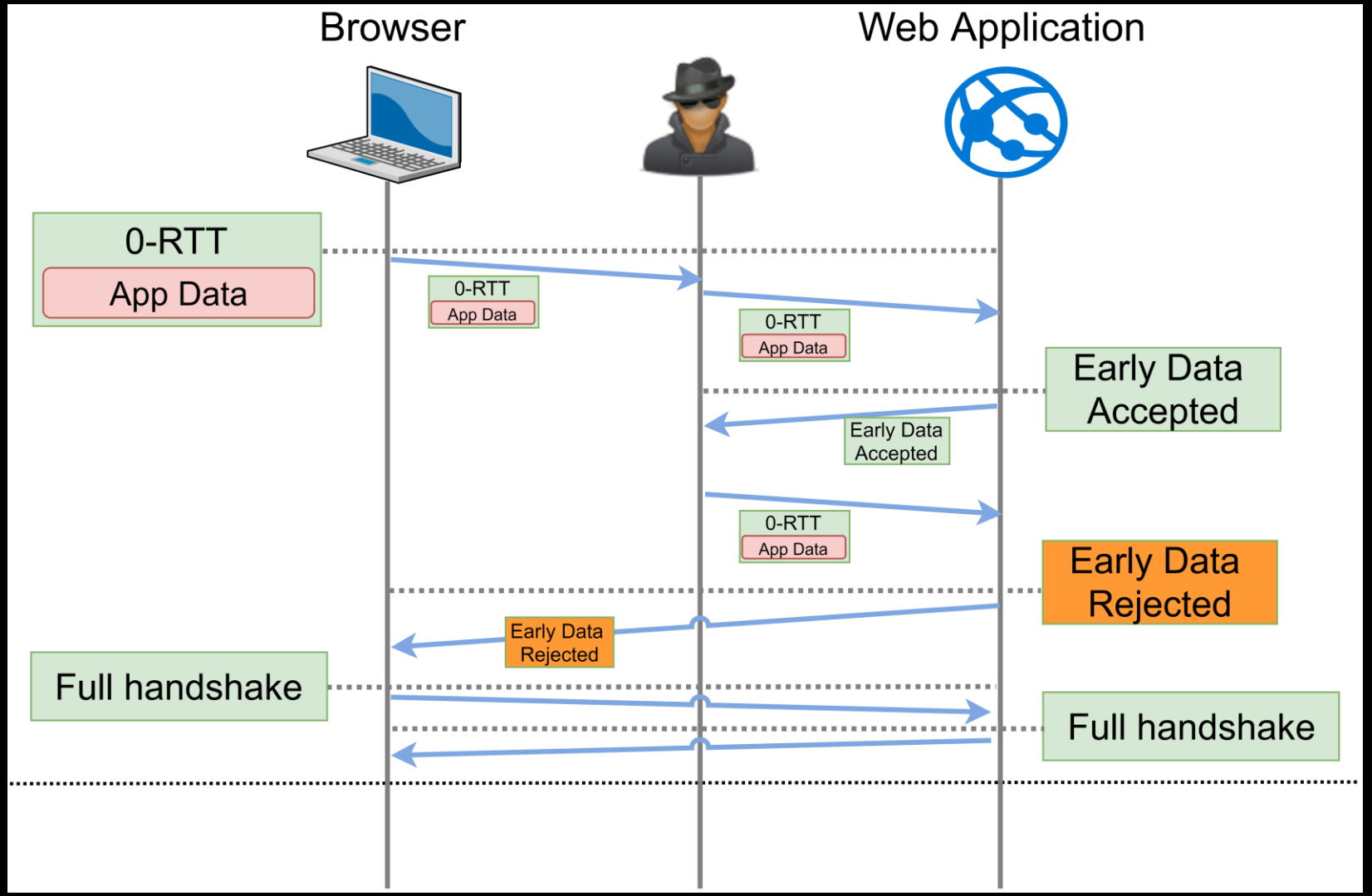

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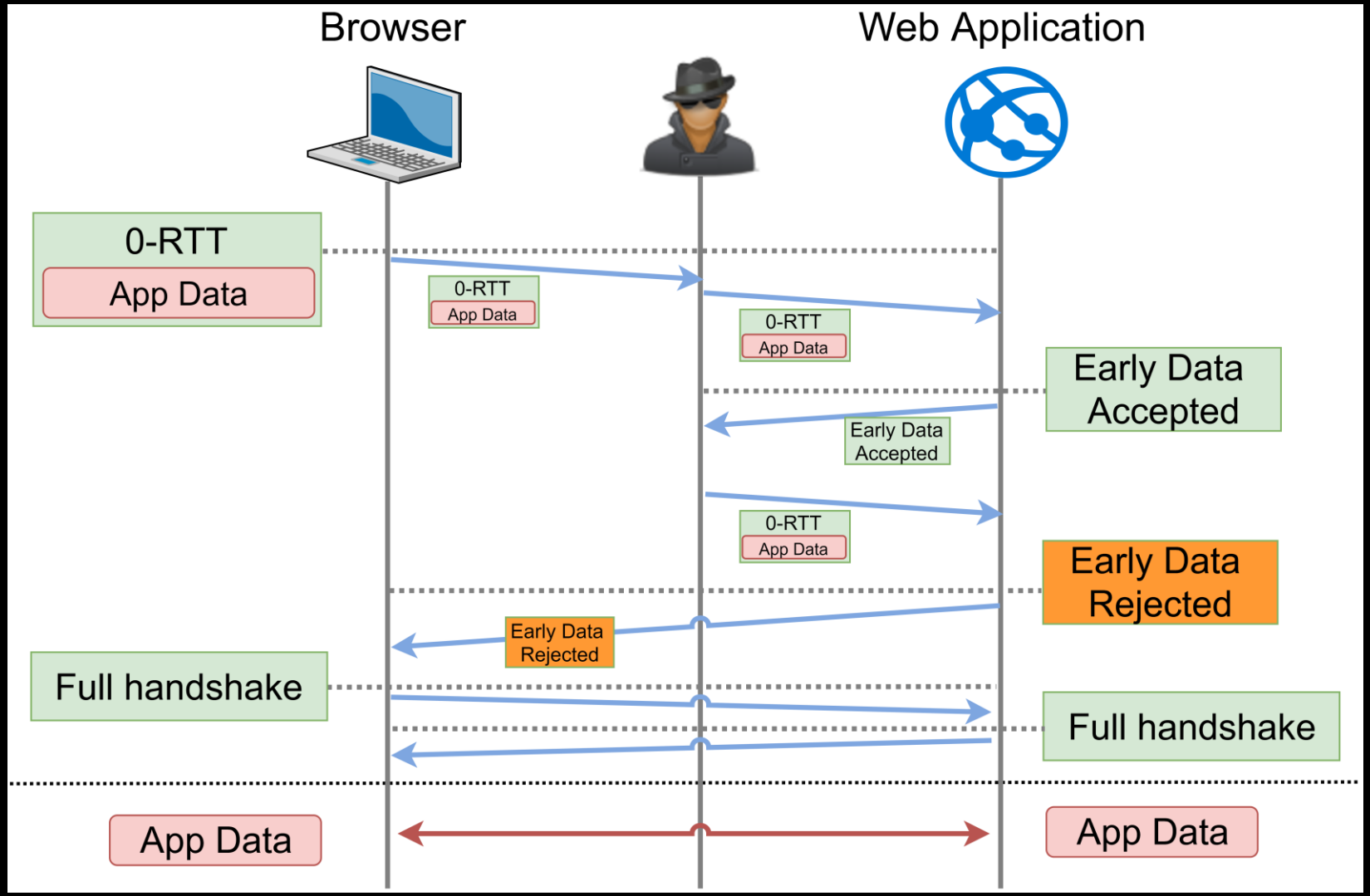

DEMO

TOOL: HIGH-LEVEL DESCRIPTION

- Assumes a vantage point in the network
- Provides creation of templates for encrypted traffic.
- Supports the two attacks described on this presentation.
- Available at https://github.com/portcullislabs/tlsplayback

SIDE EFFECTS OF 0-RTT

- It is important to understand that 0-RTT creates a **dependency between the application and** the underlying TLS 1.3 **protocol**
- The application will need to be **0-RTT aware**.
- Enabling 0-RTT could leave you application vulnerable to **replay attacks**
- Ultimately, the **last line of defence** would be the application itself.

MITIGATIONS

- **Disable 0-RTT**
- Ensure that your application does not allow replays (e.g. strict **CSRF**). Ensure that REST services are developed properly
- Create an strict **application profile** after careful analysis

KEY TAKEAWAYS

- **TLS 1.3 is awesome**, but could lead to a vulnerable application if 0-RTT is being used.
- Your application (not just webapps) needs to be **0-RTT-aware** to prevent side effects
- You may need to change your application or server/CDN configuration to **protect against replay attacks**

Thanks!