TLS 1.3 Adoption in the Wild

Sajjad Arshad

Some slides are borrowed from the paper published in NDSS 2017
"**The Security Impact of HTTPS Interception**"

About me

- Fourth year PhD student at Northeastern University in **Boston**
  - Winter is Coming!
- Studying Web security/privacy problems by large-scale measurements
- Working with Eric "Ekr" Rescorla as part of Advanced Technology Lab

HTTPS

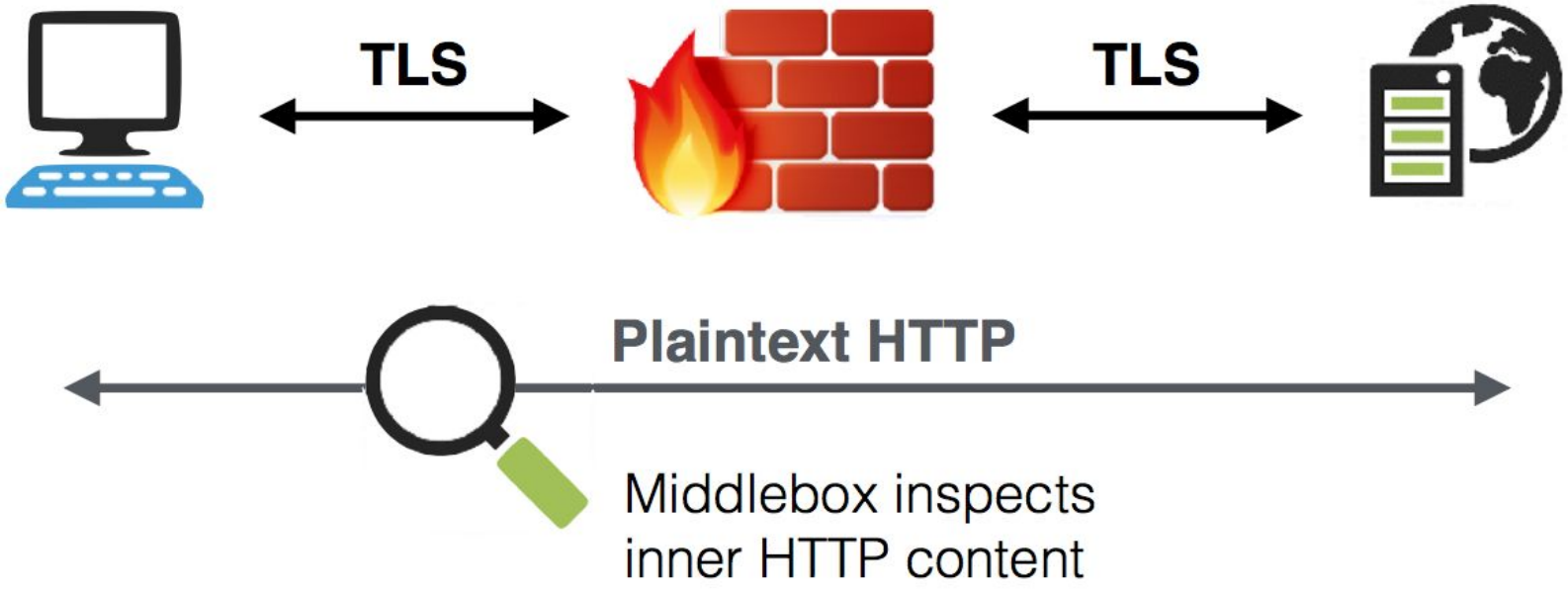
- Secure Socket Layer (SSL)
  - Developed by Netscape
  - 1.0 (1993) , 2.0 (1995), 3.0 (1996)
  - Deprecated!
- Transport Layer Security (TLS)
  - TLS 1.0 (1999) was an upgrade of SSL 3.0
  - TLS 1.1 (2006)
  - TLS 1.2 (2008) is now supported by more than 86% of HTTPS-enabled websites
  - **TLS 1.3 (2017)** is faster and more secure than its predecessor
    - Firefox and Chrome enabled it by default
    - But it was disabled due to incompatible middleboxes

Middleboxes

- Some middleboxes (e.g., Firewalls, IDS/IPS, Antiviruses, Proxies) intercept HTTPS connections
  - Passively (e.g., Network-level Firewalls and IDS/IPS)
  - Actively (e.g., Proxies, WAF)

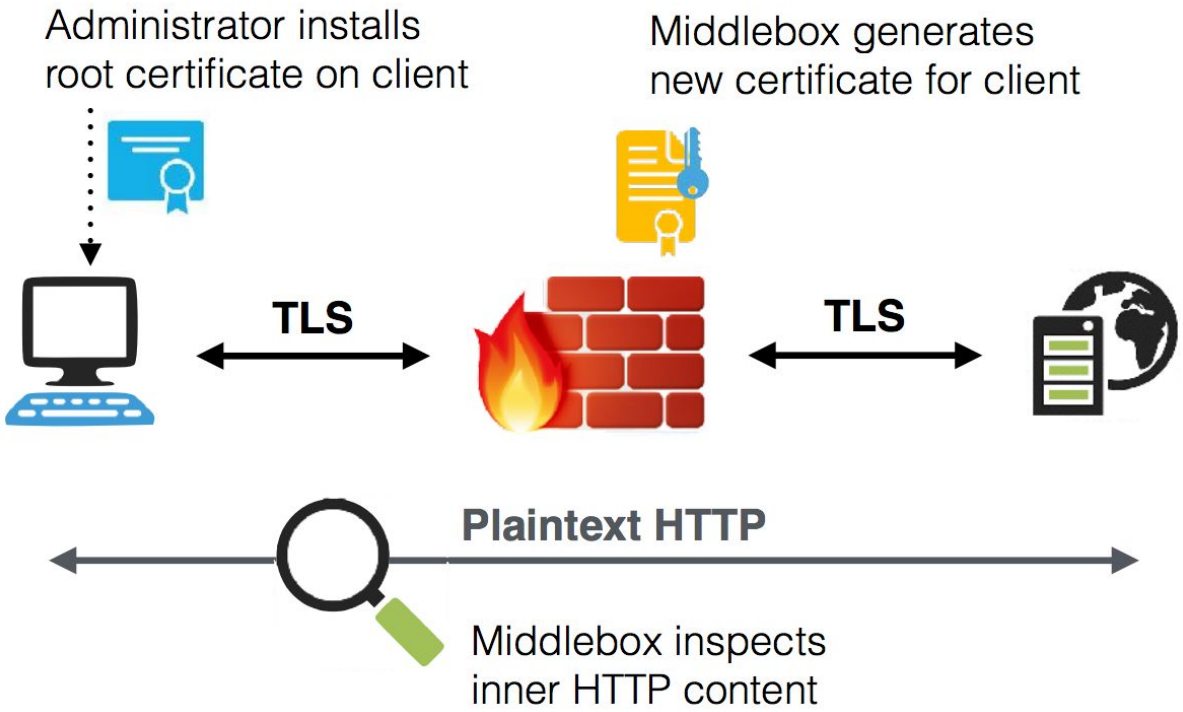
Borrowed from “The Security Impact of HTTPS Interception (NDSS 2017)”

HTTPS Interception (Active)



Borrowed from “The Security Impact of HTTPS Interception (NDSS 2017)”

HTTPS Interception (Active)



Borrowed from "The Security Impact of HTTPS Interception (NDSS 2017)"

Experiment

- Developed a Firefox add-on that makes XHR requests to some known websites
  - Modify preferences to enable TLS 1.3 in Firefox
  - Connect to a server NOT supporting TLS 1.3
  - Connect to a server supporting TLS 1.3
  - If the first connection succeeded and the second connection failed, we have a problem!
- Shipped the add-on to 20% of Firefox Beta users
- Collected the results using Telemetry platform

Preliminary Results

- 991,740 clients participated in the experiment
  - The experiment failed for 3,933 clients
- 297,541 (~30%) of the clients had a third-party root certificate installed
- 24,431 (~2.5%) of the clients faced errors initiating a TLS 1.3 connection
  - They succeeded initiating TLS 1.2 connections though
  - We also observed clients that successfully initiated TLS 1.3 connection but not TLS 1.2
    - Solution: running the experiment multiple times to gather more reliable data
- We observed 31 different error types:
  - NS_ERROR_NET_INTERRUPT (The connection was established, but the data transfer was interrupted)
  - SSL_ERROR_ACCESS_DENIED_ALERT (Peer received a valid certificate, but access was denied.)
  - SSL_ERROR_RX_UNEXPECTED_APPLICATION_DATA (SSL received an unexpected Application Data record.)
  - SEC_ERROR_UNKNOWN_ISSUER (Peer's Certificate issuer is not recognized.)
  - SSL_ERROR_RX_RECORD_TOO_LONG (SSL received a record that exceeded the maximum permissible length.)

Ongoing Work

- Constantly improving the add-on
  - Gathering more reliable data by running experiment multiple times
  - Minimizing the experiment’s side-effects on the users
    - In case of crash, it leaves the browser with the modified preferences that could affect future user’s browsing experience
- Providing more fine-grained access on the TLS configurations to developers
  - Modifying Firefox code base
  - Running the experiments without changing the preferences (no side-effects)

Thank You

Questions?