TLS 1.3 for Penetration Testers

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Who am I?

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Principal Security Consultant

- Security
- Software Engineering
- Lots of SSL/TLS

Agenda

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- Why TLS 1.3
- Changes in TLS 1.3 Basics
- Testing the Basics
- Changes in TLS 1.3
- Deployment
- Bleeding edge features


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Do we need TLS 1.3?

Security Whack-a-mole

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- Heartbleed
- BEAST
- Padding oracle attacks
- CRIME, BREACH (compression)
- PKI compromises (Comodohacker, Lavabit)
- Protocol flaws (renegotiation)
- Poor use of Diffie-Hellman (lack of support, configuration)

Many issues were identified years ago

- Issues with TLS CBC cipher suites identified in 2004
  - Of course they weren't thought to be practical…
- Weak ciphers
  - But no one would leave these enabled in production…
- RSA key exchange
  - Allows passive eavesdropping if you know the server key

And so TLS 1.3 was born

- Encrypt as much as possible
- Address known weaknesses
- Make privacy an aim

- Removing features, not just adding
- Input from cryptographers

Changes in TLS 1.3 Basics

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Removal of legacy (ciphers)

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- Bad or outdated ciphers
  - NULL
  - RC4, 3DES
  - Export ciphers
  - All mention of legacy RC2, single-DES etc.
- Unusual ciphers
  - ARIA, Camellia, Seed,…

what does this mean for me?

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- No more “Weak ciphers” vulnerabilities ☺
  - We can finally concentrate on more interesting issues
  - And no more padding pentest reports with noise…
  - Sadly we’ll still have this for things supporting older versions too

Ciphers Suites in TLS 1.3

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- Cipher suites have been redefined
  - No longer include certificate type (e.g. RSA)
  - No longer include key exchange
- Only 5 options
- More on this later

Removal of legacy (cipher modes)

- All CBC mode ciphersuites
- Always uses Authenticated Encryption with Additional Data (AEAD)

What does this mean for me?

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- No more padding oracle flaws
  - POODLE
  - TLS POODLE
  - BEAST
  - Zombie POODLE
  - GOLDENDOODLE

Encrypted Handshake

- Handshake now encrypts as much as possible
- Even ‘public’ information like the server certificate
- TLS Extensions

what does this mean for me?

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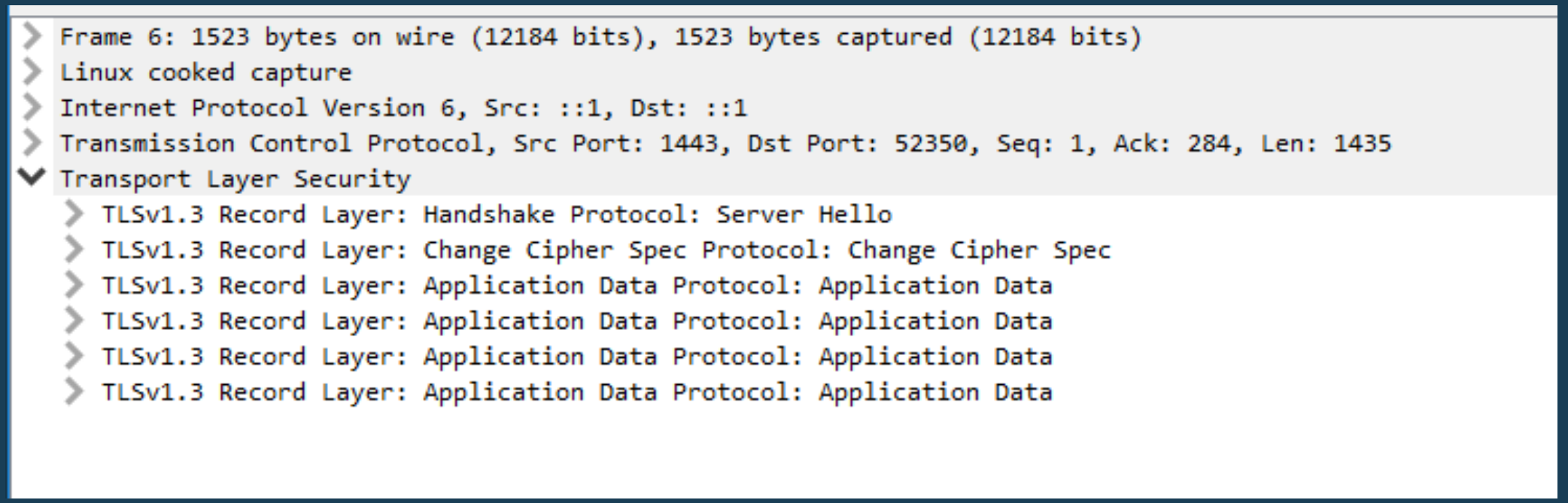
- Most of the handshake is no longer visible in wireshark – “Application Data”



Testing TLS 1.3 Basics

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Demo

Tooling Support

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Tool	TLS 1.3 Support
Openssl (1.1.1or newer)	Yes
sslscan	No
testssl (latest kali)	No
testssl (latest github)	Yes (buggy)
sslyze	Yes
BurpSuite Pro	Yes (2.1 only)

Openssl Examples

- TLS 1.3 only server
- TLS 1.2/1.3 server
- List supported versions of a server
- List supported ciphers TLS 1.3 of a server

Changes in TLS 1.3

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Removal of legacy (key exchange)

- Removal of RSA key exchange
  - Currently widely used
  - Lacks forward secrecy
- Removal of DSA certificates and key exchange
  - Meh (no one used these anyway)
- Now always uses Diffie Hellman
  - Client key is sent in ClientHello as an extension

what does this mean for me?

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- Forward secrecy is always enforced
- You can't just give tools the private key and decrypt traffic
  - Wireshark can't decrypt
  - WAFs and inspecting proxies must terminate and re-encrypt
  - No longer possible to log traffic and decrypt it later

How can I decrypt traffic?

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- But I need to…
  - Thick client tests
  - Useful for protocol analysis, debugging etc.
- Log the key by setting the SSLKEYLOGFILE environment variable
  - Firefox (and anything else that uses NSS)
  - Chrome
  - GnuTLS
  - Does not work for OpenSSL

How can I decrypt traffic?

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- OpenSSL
  - Provides a callback that can be used to get the keys
  - Need to either use a debugger or LD_PRELOAD hooking
  - Peter Wu from Wireshark has already written a tool for this
    - https://git.lekensteyn.nl/peter/wireshark-notes/tree/src/sslkeylog.c
  - Will not work for applications that statically link ☹

Demo

Other Changes

Version Negotiation

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- TLS always had a version negotiation
  - Record layer version number
  - Client hello version number
  - Server picks the result (usually the highest)
- Or that was the theory…
- Too many broken implementations
- TLS 1.3 introduces a new version negotiation extension

Early Data – 0 RTT

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- TLS has allowed sessions to be stored and resumed for years
- Makes for fast connections to servers
- TLS 1.3 extends to let clients send data in the hello message
- Allows server to start sending responses quickly
- Risky
  - Early data can be replayed
  - Applications allowing early data must protect against this

Demo

Deployment

Current Support

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- OpenSSL 1.1.1
- GnuTLS 3.6.4
- Chrome
- Firefox
- Java 11
- Cloudflare
- F5 BigIP 14.1.0.1
- Android Q

Deployment Scenarios

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- Websites
  - Likely to support both TLS 1.2 and 1.3 for the foreseeable future
- Internal services
  - If you control both endpoints then why not?
  - TLS 1.3 is faster, so deployment is likely
  - No need for TLS 1.2 in this situation
- Mozilla TLS config generator agrees
  - Intermediate is 1.2 + 1.3
  - Modern is 1.3 only

Summary

- TLS 1.3 is coming
- You should be aware of it as a Pentester
  - It will impact your testing
  - Tooling support is uneven
  - Cross-checking the results is easy

Questions?

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