

# The OpenSSL Guide

The OpenSSL Project

January 28, 2018

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**Part I**

**Foundations**

# Chapter 1

## Outline - to be deleted

### I. Part: Foundations

#### A. Chapter: Introduction

1. Purpose of this book
2. Layout and how to navigate this book
3. This is an open source book
4. About the authors

#### B. Chapter: About OpenSSL

1. What is OpenSSL
  - a. Describe OpenSSL as a command line tool
  - b. Describe OpenSSL as a SSL/TLS/DTLS library
  - c. Describe OpenSSL as a crypto library
2. OpenSSL History
  - a. SSLeay
  - b. OpenSSL formation
  - c. The lean years and FIPS
  - d. Changes in the team membership and processes
  - e. OpenSSL today

#### C. Chapter: Getting OpenSSL

1. OpenSSL Version Numbering
2. Using pre-built binaries
3. Pre-requisites for building OpenSSL from source
4. Compiling and installing from source
5. Troubleshooting some common build issues

#### D. Chapter: Programming Fundamentals

1. Memory management
  - a. new and free functions

- b. OPENSSL\_malloc, OPENSSL\_zalloc and OPENSSL\_free
      - c. get0, get1, set0, set1 etc
      - d. Debugging memory issues
    - 2. BIOs
    - 3. Serialisation and De-serialisation
      - a. i2d and d2i functions
    - 4. Stacks
    - 5. LHashes
    - 6. NIDs
    - 7. Identifying the OpenSSL version
    - 8. Automatic Library Initialisation and De-initialisation
    - 9. Threads
  - E. Chapter: Certificates and Certificate Authorities
  - F. Chapter: Working with Certificate and Key files
    - 1. PEM files
    - 2. PKCS8 files
    - 3. PCKS12 files
  - G. Chapter: Certificate Revocation
    - 1. CRLs
    - 2. OCSP
  - H. Chapter: Configuration via CONF
  - I. Chapter: Engines (Advanced Topic)
  - J. Chapter: Stores (Advanced Topic)
  - K. Chapter: Advanced Certificates (Advanced Topic)
  - L. Chapter: Certificate Transparency (Advanced Topic)
  - M. Chapter: Asynchronous operation (Advanced Topic)
  - N. Chapter: ASN.1 (Advanced Topic)
  - O. Chapter: UIs (Advanced Topic)
- II. Part: SSL/TLS/DTLS
- A. Chapter: Understanding SSL/TLS
    - 1. Security properties of an SSL/TLS connection
    - 2. Overview of SSL/TLS versions
    - 3. Overview of establishing identity
    - 4. Overview of ciphersuites
    - 5. Records
    - 6. Overview of the Handshake
    - 7. Sessions and resumption

## B. Chapter: Getting Started

1. Creating an SSL\_CTX
2. Creating a self-signed certificate
3. Starting the test server
4. A simple client
  - a. Connecting
  - b. Exchanging data
  - c. Shutting down
5. Compilation
6. Running the client
7. Adding the trusted CAs
8. A simple server
  - a. Setting up the SSL\_CTX
  - b. Accepting incoming connections

## C. Chapter: Ciphersuites

1. Parts of the Ciphersuite
2. Ciphersuite Naming
3. TLSv1.3 Ciphersuites
4. Configuring the available Ciphersuites
5. Ciphersuite selection (client vs server preference)
6. Key Exchange Mechanisms
  - a. RSA
  - b. DHE
  - c. ECDHE (covering some basics of curve types: P-256, X25519 etc)
  - d. SRP
  - e. PSK
7. Authentication
  - a. RSA
  - b. ECDSA
  - c. EdDSA? (future)
8. Encryption
  - a. AES
  - b. Camellia
  - c. ChaCha
  - d. etc
9. MAC/AEAD

## D. Chapter: Basic Operation

1. The read and write BIOs

- 2. Alerts
- 3. Version Negotiation
- 4. SSL\_read, SSL\_write and SSL\_get\_error
  - a. Non-blocking IO
  - b. Pending data
- 5. Shutting down
- 6. Client Authentication
- 7. Renegotiation
- 8. Compression
- 9. SSL BIO
- 10. Exporting secrets
- E. Chapter: Sessions
  - 1. Resumption handshakes
  - 2. Simple sessions and session files
  - 3. Session tickets
  - 4. Session caches
- F. Chapter: Configuration
  - 1. Setting options and modes
    - a. Some common options/modes
      - (1) SSL\_MODE\_AUTO\_RETRY
      - (2) SSL\_MODE\_RELEASE\_BUFFERS
  - 2. Signature Algorithms
  - 3. Supported Groups
  - 4. Configuration using SSL\_CONF
  - 5. Security levels and the security callbacks
- G. Chapter: DTLS
  - 1. Key differences with TLS
  - 2. Transports
    - a. UDP
    - b. SCTP
    - c. MTU issues
  - 3. Retransmissions and the DTLS timer
  - 4. Listening for connections and cookies
- H. Chapter: TLSv1.3
- I. Chapter: Debugging Connection Failures
- J. Chapter: Advanced Extensions (Advanced Topic)
  - 1. SNI
  - 2. ALPN and NPN

- 3. SRTP
- 4. EC point formats
- 5. Extended Master Secret
- 6. Encrypt-Then-MAC
- 7. OCSP in SSL/TLS
- 8. Certificate Transparency in SSL/TLS
- 9. Custom extensions
- K. Chapter: DANE (Advanced Topic)
- L. Chapter: Optimisation (Advanced Topic)
  - 1. Multiblock
  - 2. Async
  - 3. Pipelining
  - 4. Fragment sizes
  - 5. Read ahead
- III. Part: Cryptography
  - A. Chapter: Working with BIGNUMs
  - B. Chapter: Random Numbers
  - C. Chapter: Encryption and Decryption (Symmetric)
    - 1. What is symmetric encryption
    - 2. Block and stream ciphers
    - 3. Modes
    - 4. IVs and Nonces
    - 5. A simple encryption/decryption example
    - 6. AEAD
      - a. Tags
      - b. GCM
      - c. OCB
      - d. CCM
      - e. ChaCha20-Poly1305
    - 7. XTS
  - D. Chapter: Asymmetric encryption and decryption
  - E. Chapter: Digital signatures
  - F. Chapter: Hashes
  - G. Chapter: Message Authentication Codes
  - H. Chapter: Key Generation and Derivation
  - I. Chapter: CMS (PKCS.7) and S/MIME (Advanced Topic)
  - J. Chapter: Elliptic Curves (Advanced Topic)



## Chapter 2

# About OpenSSL

[TODO:Add some text here.]

# **Part II**

## **SSL/TLS/DTLS**

**Part III**

**Cryptography**