CS 6393 and CS 4483
Cyber Security Foundations and Practice

Module 2.3
SSL Architecture

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SSL

- layered on top of TCP
- SSL versions 1.0, 2.0, 3.0, 3.1
- Netscape protocol
- later refitted as IETF standard TLS (Transport Layer Security)
- TLS 1.0 very close to SSL 3.1
- Currently at TLS 1.3

SSL

- application protocol independent
- does not specify how application protocols add security with SSL
    - how to initiate SSL handshaking
    - how to interpret certificates
- left to designers of upper layer protocols to figure out

SSL vs TCP Ports

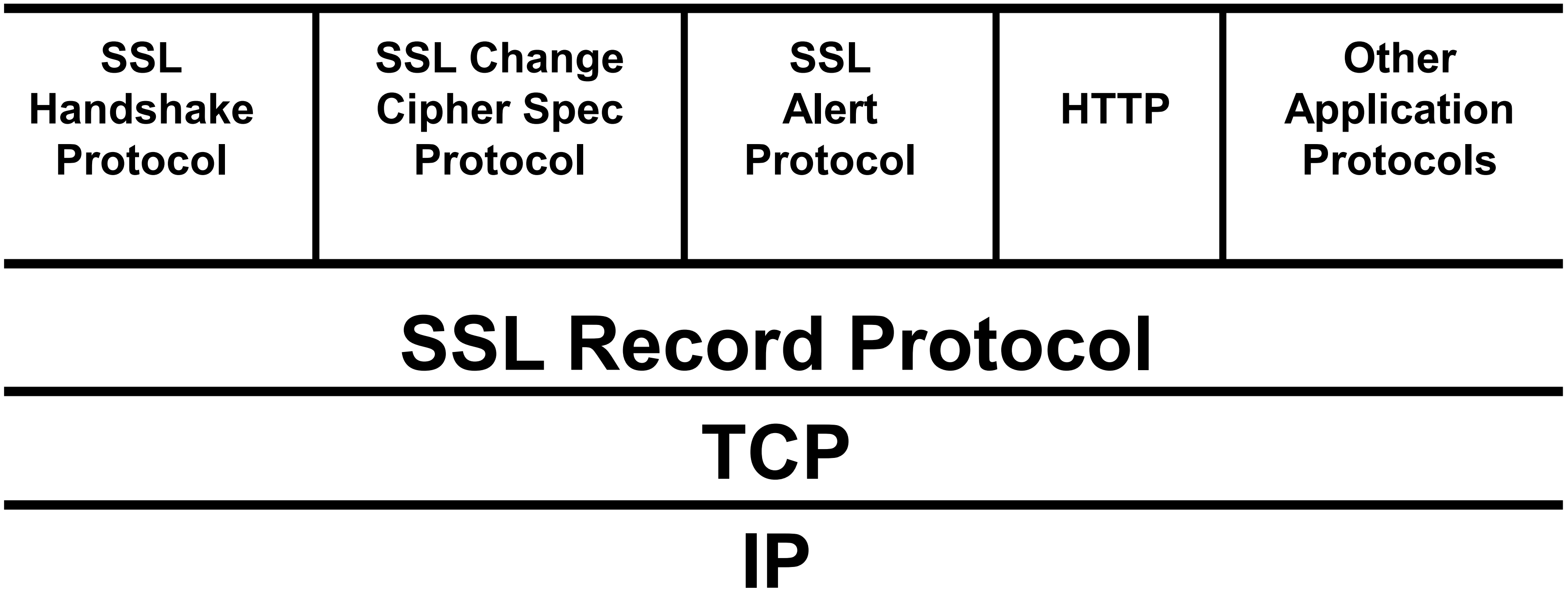
https	443
ssmtp	465
snntp	563
sldap	636
spop3	995

ftp-data	889
ftps	990
imaps	991
telnets	992
ircs	993

SSL Services

- peer entity authentication
- data confidentiality
- data authentication and integrity
- compression/decompression
- generation/distribution of session keys
  - integrated into protocol
- security parameter negotiation

SSL Architecture



SSL Handshake Protocol

SSL Change Cipher Spec Protocol

SSL Alert Protocol

HTTP

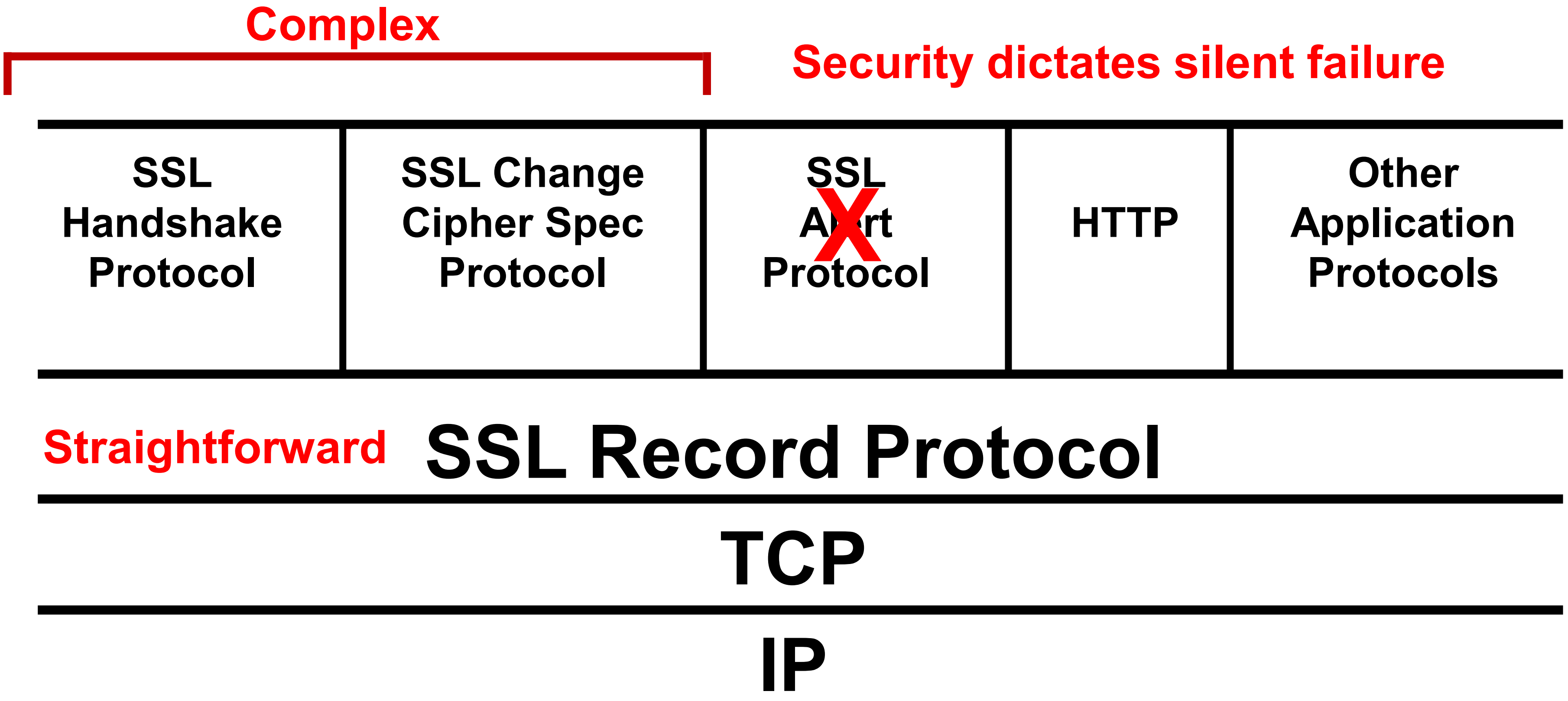
Other Application Protocols

SSL Record Protocol

TCP

IP

SSL Architecture



Complex

Security dictates silent failure

SSL Handshake Protocol	SSL Change Cipher Spec Protocol	SSL Alert Protocol	HTTP	Other Application Protocols

Straightforward

SSL Record Protocol

TCP

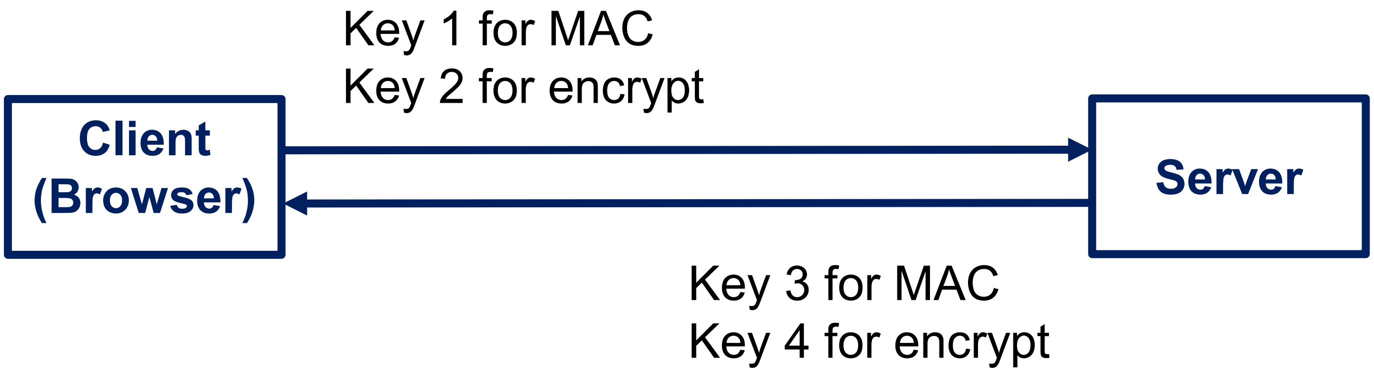
IP

SSL Architecture

- Handshake protocol: complicated
  - embodies key exchange & authentication
  - runs in plaintext
  - 10 message types
- Change Cipher Spec protocol: straightforward
  - single 1 byte message with value 1
  - could be considered part of handshake protocol
  - transitions from plaintext to encrypted and mac’ed
- Record protocol: straightforward
  - fragment, compress, MAC, encrypt
  - uses 4 symmetric keys
- Alert protocol: straightforward
  - 2 byte messages
  - 1 byte alert level- fatal or warning; 1 byte alert code

SSL Record Protocol

- 4 symmetric keys



SSL Record Protocol

- 4 steps by sender (reversed by receiver)
  - Fragmentation
  - Compression
  - MAC
  - Encryption

SSL Record Protocol

- each SSL record contains
  - content type: 8 bits, only 4 defined
    - change_cipher_spec
    - alert
    - handshake
    - application_data
  - protocol version number: 8 bits major, 8 bits minor
  - length: max 16K bytes (actually 2^{14}+2048)
  - data payload: optionally compressed and encrypted
  - message authentication code (MAC)