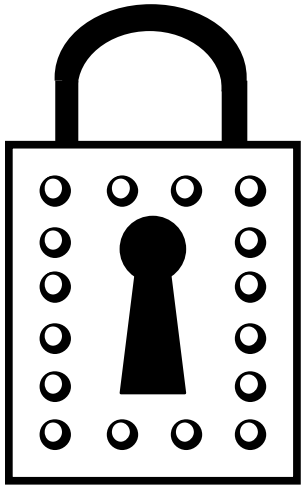
SSL and TLS



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What are SSL and TLS?

- In 1994, the world wide web was new and immature:
  - Web browsers and web servers sent only plaintext messages
  - Unsafe to use your credit-card to buy something from a website
- Netscape designed SSL to provide encrypted communication for the web
  - SSL stands for *secure sockets layer*
  - Netscape had a patent for SSL, but made SSL open
- SSL matured quickly with the help of the web community:
  - In 1995, SSL 3.0 was released
  - In 1996, Netscape handed over responsibility for SSL to the IETF
    - IETF = *Internet Engineering Task Force*
    - IEFT is an international standards organization
    - IETF renamed the next version of SSL to TLS 1.0
  - You can think of TLS 1.0 as being SSL 3.1

An extra layer in the protocol stack

- An application-level protocol normally talks directly to TCP/IP
- SSL was designed so:
  - It could be used with HTTP (an application-level protocol)
  - It could be used with other application-level protocols too
- For example:
  - CORBA is a remote procedure call (RPC) mechanism
  - The insecure CORBA protocol is called IIOP
  - The secure CORBA protocol is called IIOP/TLS

Simplified overview of SSL/TLS

- Recall:
  - Symmetric ciphers:
    - Are fast
    - But how do the two parties *securely* agree on a secret key?
  - Asymmetric ciphers have the opposite properties:
    - Are 100–1000 times slower than symmetric ciphers
    - Can safely exchange public keys, even if other people overhear
- Slightly simplified explanation of how SSL works:
  - SSL uses both symmetric and asymmetric ciphers
  - Uses an asymmetric cipher to securely communicate a private key for use with a symmetric cipher
  - Then switches over to using the symmetric cipher with the agreed-upon private key

Simplified overview of SSL/TLS (cont')

- Actually, SSL uses six secret keys rather than just one:
  - Three are for client-generated messages
  - And three are for server-generated messages
  - The use of multiple keys makes life even harder for hackers
- Each group of three secret keys consists of:
  - A key used by the encryption cipher
  - A key used by the MAC cipher
  - A key used to initialize the encryption cipher

SSL/TLS supports many ciphers

- SSL/TLS uses one of each of the following:
  - A symmetric cipher
  - An asymmetric cipher
  - A MAC cipher
- But there are many competing ciphers in each category
  - Which one should be used?
- During the initial SSL/TLS handshaking:
  - Client sends a list of ciphers it understands to the server
  - The server picks one from each category and notifies client of its choice
- Benefits:
  - SSL/TLS can adapt whenever better ciphers are developed in the future
  - SSL/TLS can adapt to legal restrictions on ciphers in some countries

Summary

- TLS is the new name for SSL
  - TLS 1.0 = SSL 3.1
- SSL was first used to secure communication via HTTP
  - But can be used to secure other protocols
- SSL uses both symmetric and asymmetric ciphers:
  - Uses an asymmetric cipher to securely communicate a private key for use with a symmetric cipher
  - Then switches over to using the symmetric cipher with agreed-upon private keys
- SSL is *not* hardcoded to use a particular set of
  - Client and server negotiate on which set of ciphers to use
  - SSL can evolve to support newer, better ciphers when they are developed