Cryptography and Network Security

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Chapter 17 – Web Security

Use your mentality
Wake up to reality

—From the song, "I've Got You under My Skin" by Cole Porter

Web Security

- Web now widely used by business, government, individuals
- but Internet & Web are vulnerable
- have a variety of threats
 - integrity
 - confidentiality
 - denial of service
 - authentication
- need added security mechanisms

SSL (Secure Socket Layer)

- transport layer security service
- originally developed by Netscape
- version 3 designed with public input
- subsequently became Internet standard known as TLS (Transport Layer Security)
- uses TCP to provide a reliable end-to-end service
- SSL has two layers of protocols

SSL Architecture

SSL Handshake Protocol	SSL Change Cipher Spec Protocol	SSL Alert Protocol	нттр
SSL Record Protocol			
TCP			
IP			

SSL Architecture

SSL session

- an association between client & server
- created by the Handshake Protocol
- define a set of cryptographic parameters
- may be shared by multiple SSL connections

SSL connection

- a transient, peer-to-peer, communications link
- associated with 1 SSL session

SSL Record Protocol

confidentiality

- using symmetric encryption with a shared secret key defined by Handshake Protocol
- IDEA, RC2-40, DES-40, DES, 3DES, Fortezza, RC4-40, RC4-128
- message is compressed before encryption

message integrity

- using a MAC with shared secret key
- similar to HMAC but with different padding

SSL Change Cipher Spec Protocol

- one of 3 SSL specific protocols which use the SSL Record protocol
- a single message
- causes pending state to become current
- hence updating the cipher suite in use

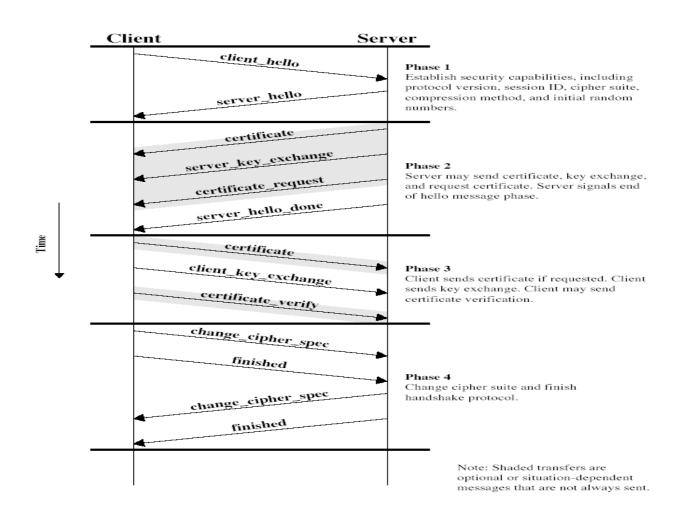
SSL Alert Protocol

- conveys SSL-related alerts to peer entity
- severity
 - warning or fatal
- specific alert
 - unexpected message, bad record mac, decompression failure, handshake failure, illegal parameter
 - close notify, no certificate, bad certificate, unsupported certificate, certificate revoked, certificate expired, certificate unknown
- compressed & encrypted like all SSL data

SSL Handshake Protocol

- allows server & client to:
 - authenticate each other
 - to negotiate encryption & MAC algorithms
 - to negotiate cryptographic keys to be used
- comprises a series of messages in phases
 - Establish Security Capabilities
 - Server Authentication and Key Exchange
 - Client Authentication and Key Exchange
 - Finish

SSL Handshake Protocol



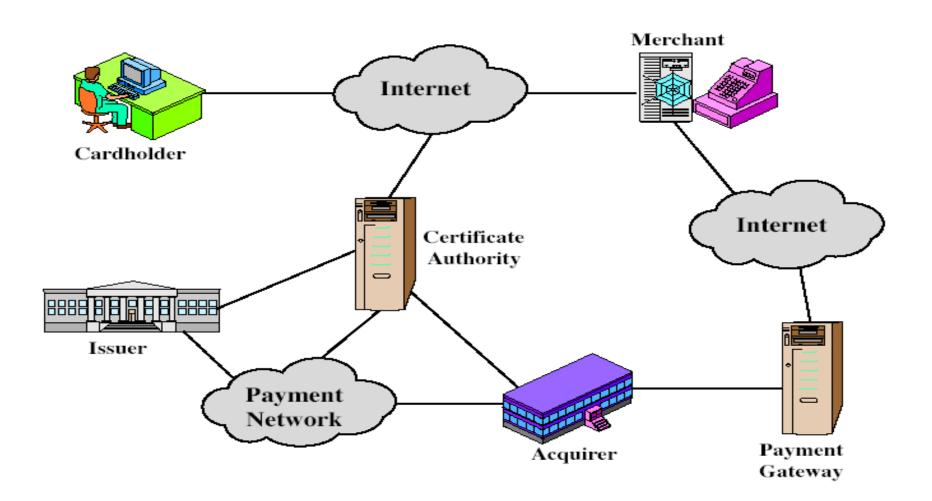
TLS (Transport Layer Security)

- IETF standard RFC 2246 similar to SSLv3
- with minor differences
 - in record format version number
 - uses HMAC for MAC
 - a pseudo-random function expands secrets
 - has additional alert codes
 - some changes in supported ciphers
 - changes in certificate negotiations
 - changes in use of padding

Secure Electronic Transactions (SET)

- open encryption & security specification
- to protect Internet credit card transactions
- developed in 1996 by Mastercard, Visa etc
- not a payment system
- rather a set of security protocols & formats
 - secure communications amongst parties
 - trust from use of X.509v3 certificates
 - privacy by restricted info to those who need it

SET Components



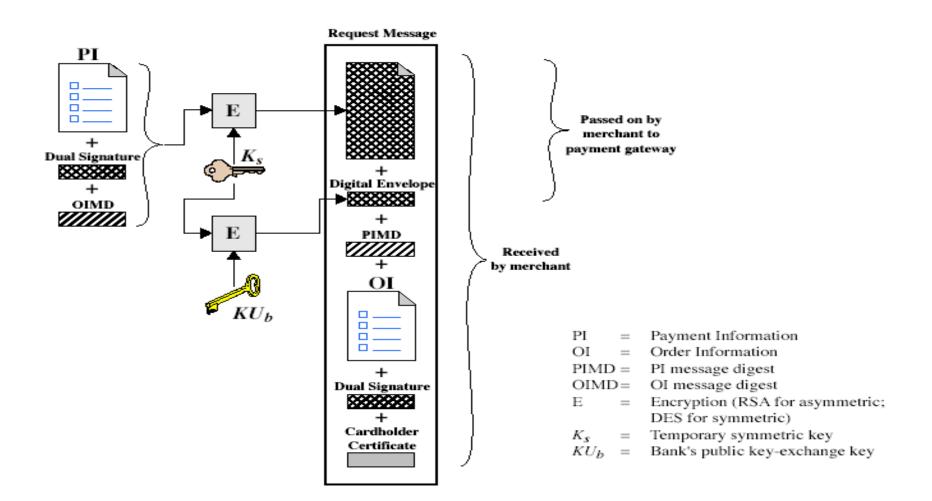
SET Transaction

- 1. customer opens account
- 2. customer receives a certificate
- merchants have their own certificates
- 4. customer places an order
- 5. merchant is verified
- 6. order and payment are sent
- merchant requests payment authorization
- 8. merchant confirms order
- 9. merchant provides goods or service
- 10. merchant requests payment

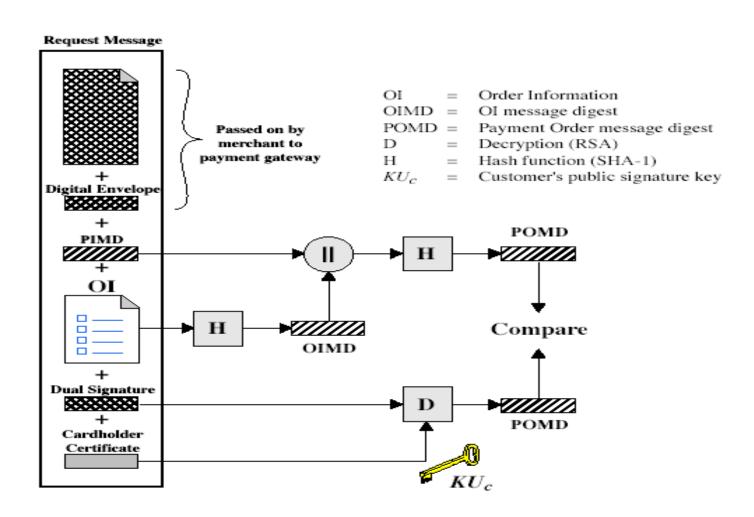
Dual Signature

- customer creates dual messages
 - order information (OI) for merchant
 - payment information (PI) for bank
- neither party needs details of other
- but must know they are linked
- use a dual signature for this
 - signed concatenated hashes of OI & PI

Purchase Request – Customer



Purchase Request – Merchant



Purchase Request – Merchant

- 1. verifies cardholder certificates using CA sigs
- 2. verifies dual signature using customer's public signature key to ensure order has not been tampered with in transit & that it was signed using cardholder's private signature key
- 3. processes order and forwards the payment information to the payment gateway for authorization (described later)
- 4. sends a purchase response to cardholder

Payment Gateway Authorization

- 1. verifies all certificates
- 2. decrypts digital envelope of authorization block to obtain symmetric key & then decrypts authorization block
- 3. verifies merchant's signature on authorization block
- 4. decrypts digital envelope of payment block to obtain symmetric key & then decrypts payment block
- 5. verifies dual signature on payment block
- verifies that transaction ID received from merchant matches that in PI received (indirectly) from customer
- 7. requests & receives an authorization from issuer
- 8. sends authorization response back to merchant

Payment Capture

- merchant sends payment gateway a payment capture request
- gateway checks request
- then causes funds to be transferred to merchants account
- notifies merchant using capture response

Summary

- have considered:
 - need for web security
 - SSL/TLS transport layer security protocols
 - SET secure credit card payment protocols