# X.509

CPSC 457/557

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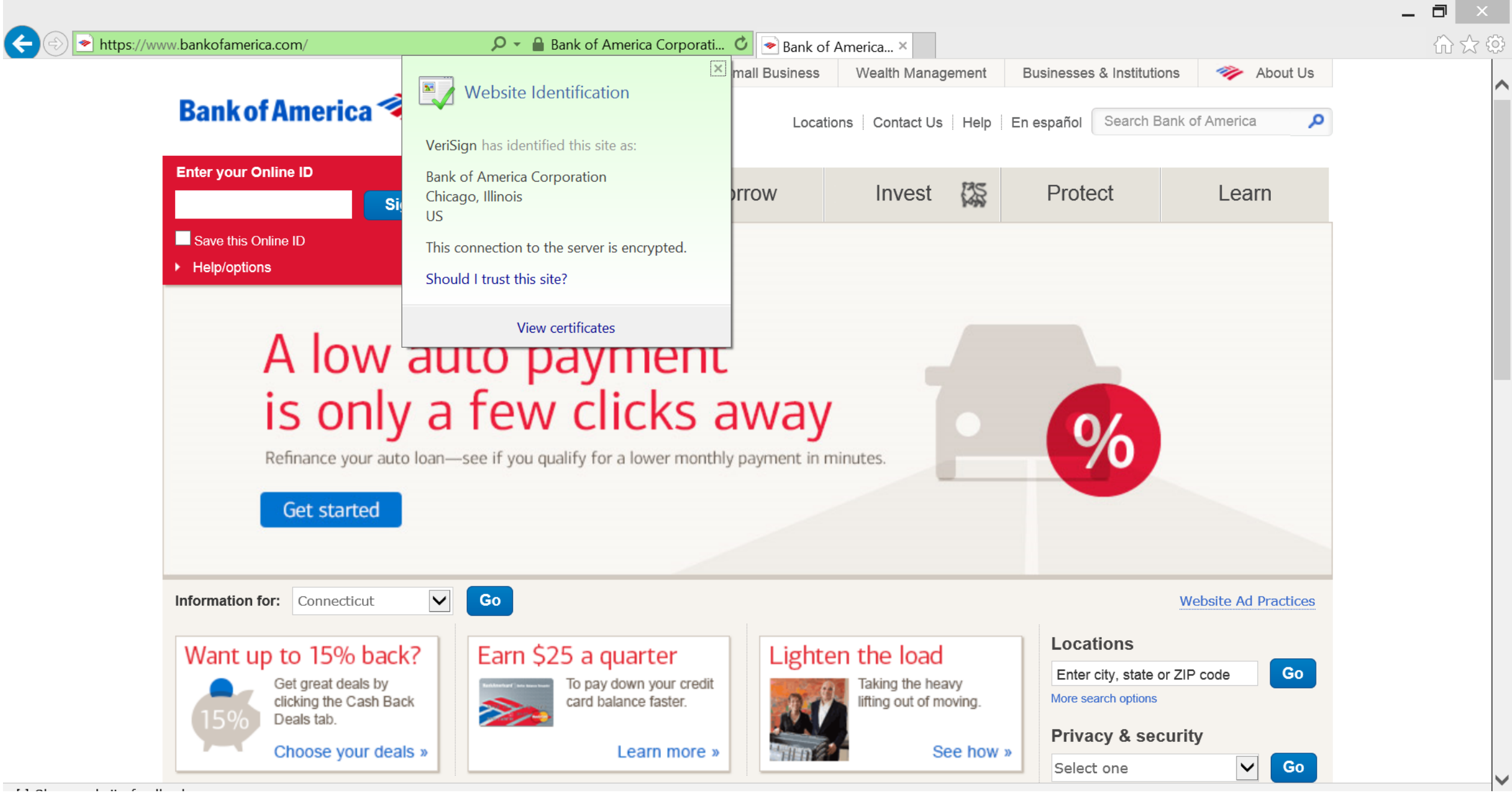
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# X.509 Outline

- X.509 Overview
- Certificate Lifecycle
- Alternative Certification Models

# What is X.509?

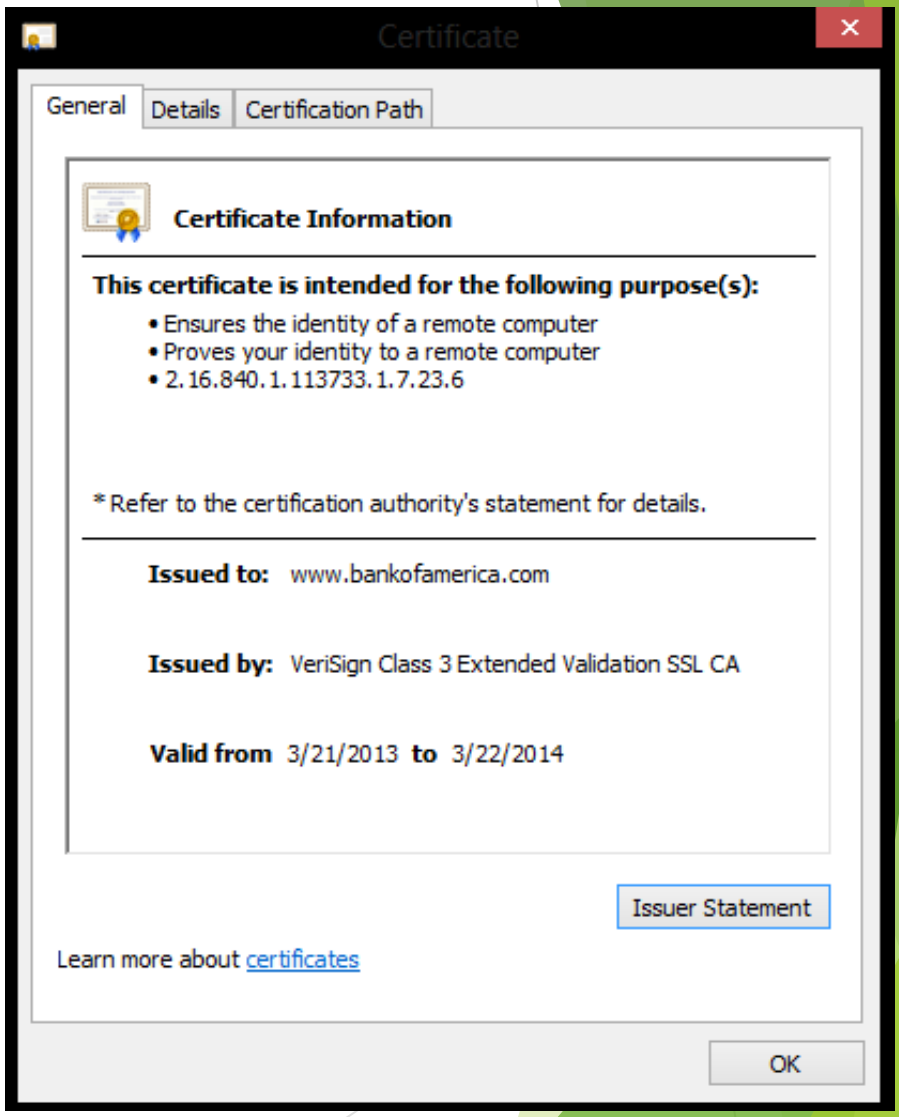
- The most commonly used Public Key Infrastructure (PKI) on the web
- Public Key Infrastructure
  - Create, manage, distribute, and store certificates
- Certification Validation Path Algorithms
- Certificate Lifecycle Management
  - Certificate Revocation Lists

# Assumptions and Goals

- Users of certificates will utilize them in a variety of environments
  - Certificates should be nonspecific in regards to environment
- Users of PKI will not necessarily be technologically sophisticated
  - Need for automated and deterministic forms of authentication and identification
- Large number of security dimensions/attributes
  - Minimize chances that CA administration mistake will result in broad compromise
  - Decrease the number of configuration choices necessary

# X.509 Architecture

- End entity
  - Subjects or users of PKI certificates
- Certification Authority (CA)
  - Issues and signs certificates
  - Certification Practice Statement determined by each CA
- CRL issuer
  - May be the same entity as CA
- Repository
  - System that stores certificates and CRLs
  - Distributes them as necessary to end entities



# Commercial Certification

- On the local level:
  - Extremely fragmented
- For websites:
  - Most use SSL certificates
  - Significant barriers to entry
    - Symantec – 42.9%
    - Comodo Group – 26%
    - Go Daddy – 14%
    - Global Sign – 7.7%

# Certificate Structure

- Certificate
  - Version
  - Subject
  - Issuer
  - Public key for Subject
  - Validity period
    - Not Before
    - Not After
- Signature Algorithm
- Signature Field

Must be Distinguished Names:

- Unique identifier in CA's domain
- Can contain
  - Country
  - Organization
  - State or Province
  - Common name
  - Serial Number

# Extensions

- Allow for flexibility of certificates to contain additional fields
  - Critical vs. Non-critical extensions
- Common Extensions:
  - Authority Key Identifier – means of identifying public key corresponding to private key used to sign
  - Subject Key Identifier – identify certificates that contain particular public key
  - Key Usage – defines purpose of key
  - Certificate Policy information

# Certificate Lifecycle

- Once a CA verifies the credentials of a user, it can create and issue a certificate for that user
  - Policy matter – context dependent
- After certificates are issued, they are either renewed or allowed to expire
- Can be revoked if:
  - CA has been compromised
  - User's secret key was leaked
  - Name was changed

# Certificate Revocation List (CRL)

- Two major types of CRLs
  - Complete CRL – signed and time-stamped list identifying revoked certificates
  - Delta CRL – used for updates to the complete CRL
- Published periodically at defined interval

- Issues
  - Mistakes in revocation list
  - Access to most current CRLs
  - No guarantee that all certificate copies will be revoked

# Comparisons to X.509

- PGP (Web of Trust model)
  - Introducer Model - users are referred from one user to another (creating a “web”)
  - Updates to the web are found by users themselves
    - No guarantee if or when the web will be up-to-date
  - No centralized entity
  - Not scalable, but potentially preferable in a small group
- X.509
  - Users trust CAs, rather than each other (transitive trust)
  - Hierarchical certification validation from centralized entities
  - Updates managed by CAs
  - Scalable

# Practical Implications of X.509

- Each browser has a built in set of predetermined “trusted root CAs” to facilitate SSL transactions
  - The browser developers determine the primary CA’s that are trusted third parties to the users
- The Internet is all about decentralization, but X.509 relies on a few number of centralized authorities.
  - Usage of duplicate RSA-moduli keys, man-in-the-middle attacks, etc. have all occurred in the last few years
  - Can we trust them?  If not, what alternatives do we have?
  - Is this an issue?  Do we need a large number of providers?