Public-Key Certificates

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Lecture 4

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Public-Key Certificates

- authenticated distribution of public-keys
- public-key encryption
  - sender needs public key of receiver
- public-key digital signatures
  - receiver needs public key of sender
- public-key key agreement
  - both need each other’s public keys
<table>
<thead>
<tr>
<th>Version</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Serial Number</td>
<td></td>
</tr>
<tr>
<td>Signature Algorithm</td>
<td></td>
</tr>
<tr>
<td>Issuer (Certificate Authority)</td>
<td></td>
</tr>
<tr>
<td>Validity</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td></td>
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<tr>
<td>Subject Public Key Info</td>
<td></td>
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<tr>
<td>Signature</td>
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X.509v1 Certificate

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1234567891011121314</td>
</tr>
<tr>
<td>RSA+SHA-3, 2048</td>
</tr>
<tr>
<td>C=US, S=TX, O=UTSA, OU=CS</td>
</tr>
<tr>
<td>1/1/17-12/31/18</td>
</tr>
<tr>
<td>C=US, S=TX, O=UTSA, OU=CS, CN=Ravi Sandhu</td>
</tr>
<tr>
<td>RSA, 2048, xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx</td>
</tr>
<tr>
<td>SIGNATURE</td>
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Certificate Trust

- How to acquire public key of the issuer to verify signature
- Whether or not to trust certificates signed by the issuer for this subject
  - Prefix rule is not universally applicable
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SET CA Hierarchy

- Root
  - Brand
  - Brand
  - Brand
  - Geo-Political
    - Bank
    - Acquirer
      - Customer
      - Merchant
Certificate Revocation Lists (CRLs)

- Signature Algorithm
- Issuer
- Last Update
- Next Update
- Revoked Certificates
  - Signature
  - Serial Number
  - Revocation Date
X.509 Certificates

- X.509v1
  - very basic

- X.509v2
  - adds unique identifiers to prevent against reuse of X.500 names

- X.509v3
  - adds many extensions
  - can be further extended
X.509v3 Innovations

- distinguish various certificates
  - signature, encryption, key-agreement
- identification info in addition to X.500 name
  - internet names: email addresses, host names, URLs
- issuer can state policy and usage
  - ok for casual email but not for signing checks
- extensible
  - proprietary extensions can be defined and registered
- attribute certificates
  - to enable attribute-based authorization
X.509v2 CRL Innovations

- CRL distribution points
- indirect CRLs
- delta CRLs
- revocation reason
- push CRLs
General Hierarchical Structure
General Hierarchical Structure with Added Links
Top-Down Hierarchical Structure
Multiple Root CA's Plus Intermediate CA's

Model on the web today
Certificate Triangle

User (Identity)

Attributes

Public-keys + Secured secrets