X.509 Authentication services

X.509 defines a framework for the provision of authentication services by the X.500 directory to its users. The directory may serve as a repository of public-key certificates. Each certificate contains the public key of a user and is signed with the private key of a trusted certification authority. In addition, X.509 defines alternative authentication protocols based on the use of public-key certificates.

X.509 is based on the use of public-key cryptography and digital signatures

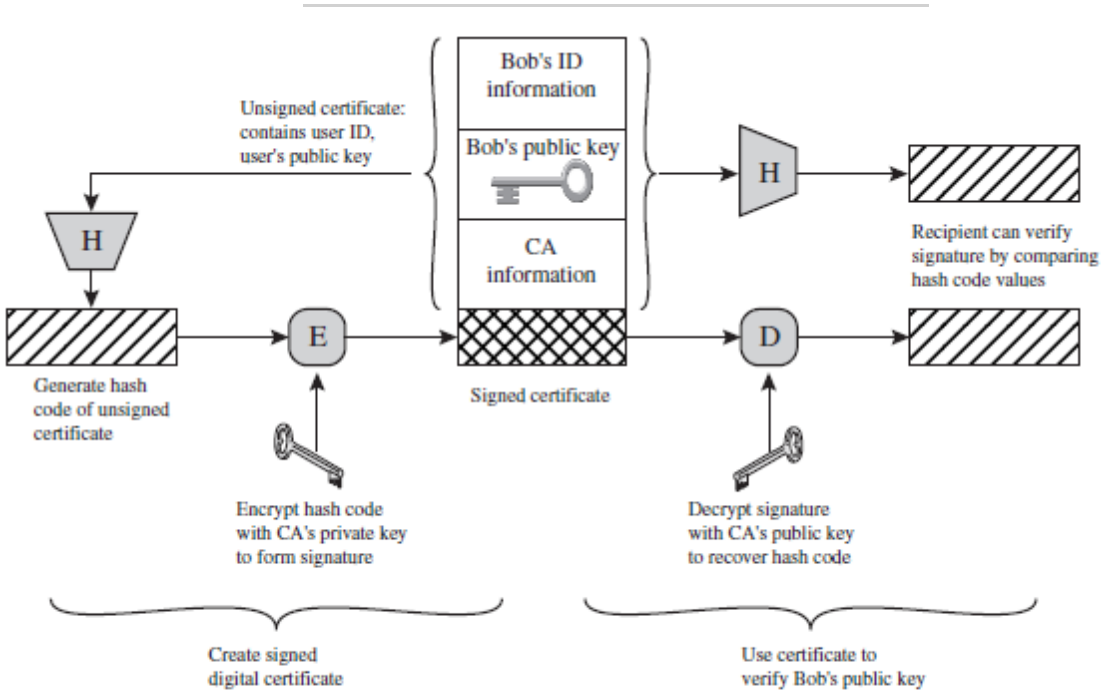


Figure 14.14 Public-Key Certificate Use

Certificates

The heart of the X.509 scheme is the public-key certificate associated with each user. These user certificates are assumed to be created by some trusted certification authority (CA) and placed in the directory by the CA or by the user.

Version: Differentiates among successive versions of the certificate format; the default is version 1. If the Issuer Unique Identifier or Subject Unique Identifier are present, the value must be version 2. If one or more extensions are present, the version must be version 3.

Serial number: An integer value, unique within the issuing CA, that is unambiguously associated with this certificate.

Signature algorithm identifier: The algorithm used to sign the certificate, together with any associated parameters. Because this information is repeated in the Signature field at the end of the certificate, this field has little, if any, utility.

Issuer name: X.500 name of the CA that created and signed this certificate.
Period of validity: Consists of two dates: the first and last on which the certificate is valid.

Subject name: The name of the user to whom this certificate refers. That is, this certificate certifies the public key of the subject who holds the corresponding private key.

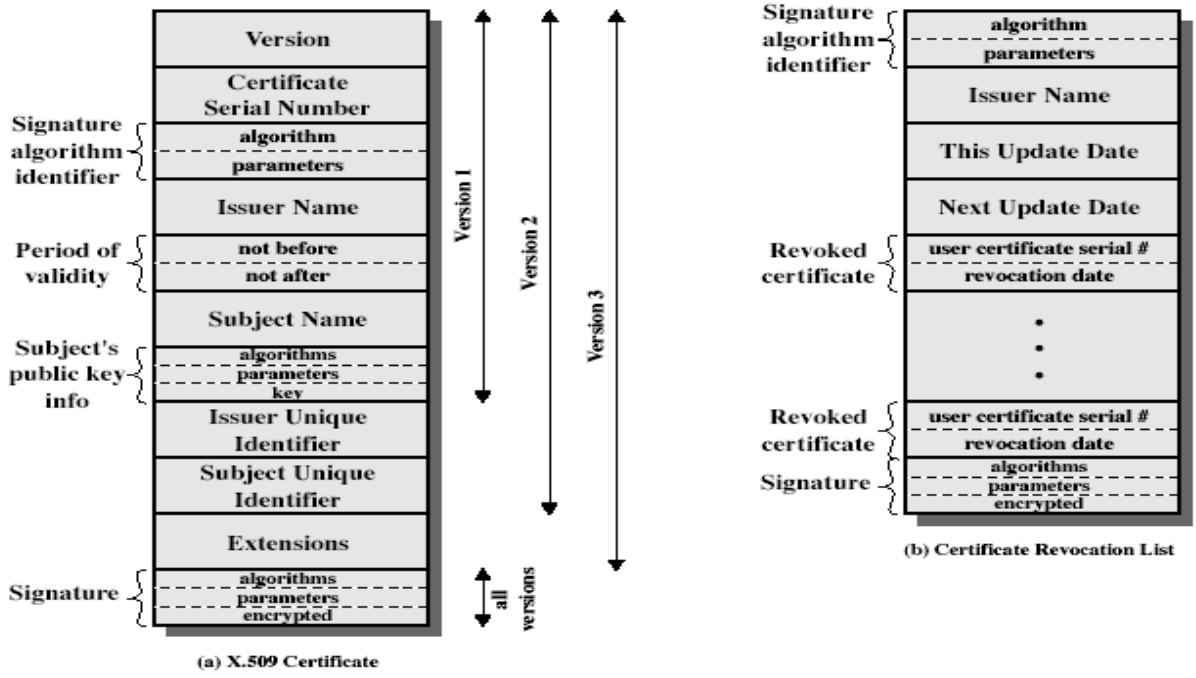
Subject's public-key information: The public key of the subject, plus an identifier of the algorithm for which this key is to be used, together with any associated parameters.

Issuer unique identifier: An optional bit string field used to identify uniquely the issuing CA in the event the X.500 name has been reused for different entities.

Subject unique identifier: An optional bit string field used to identify uniquely the subject in the event the X.500 name has been reused for different entities.

Extensions: A set of one or more extension fields. Extensions were added in version 3 and are discussed later in this section.

Signature: Covers all of the other fields of the certificate; it contains the hash code of the other fields, encrypted with the CA's private key. This field includes the signature algorithm identifier.



- notation CA<<A>> denotes certificate for A signed by CA

Obtaining a Certificate

- Any user with access to CA can get any certificate from it
- Only the CA can modify a certificate
- Because cannot be forged, certificates can be placed in a public directory

CA Hierarchy

- If both users share a common CA then they are assumed to know its public key
- Otherwise CA's must form a hierarchy
- Use certificates linking members of hierarchy to validate other CA's
  - each CA has certificates for clients (forward) and parent (backward)
- Each client trusts parents certificates
- Enable verification of any certificate from one CA by users of all other CAs in hierarchy

- Forward certificates: Certificates of X generated by other CAs
- Reverse certificates: Certificates generated by X that are the certificates of other CAs

CA Hierarchy Use

In the example given below , user A can acquire the following certificates from the directory to establish a certification path to B:

X<<W>> W <<V>> V <<Y>> <<Z>> Z <<B>>

When A has obtained these certificates, it can unwrap the certification path in sequence to recover a trusted copy of B's public key.

Using this public key, A can send encrypted Messages to B. If A wishes to receive encrypted messages back from B, or to sign messages sent to B, then B will require A's public key, which can be obtained from the following certification path:

Z<<Y>> Y <<V>> V <<W>> W <<X>>X <<A>>

B can obtain this set of certificates from the directory, or A can provide them as part of its initial message to B.

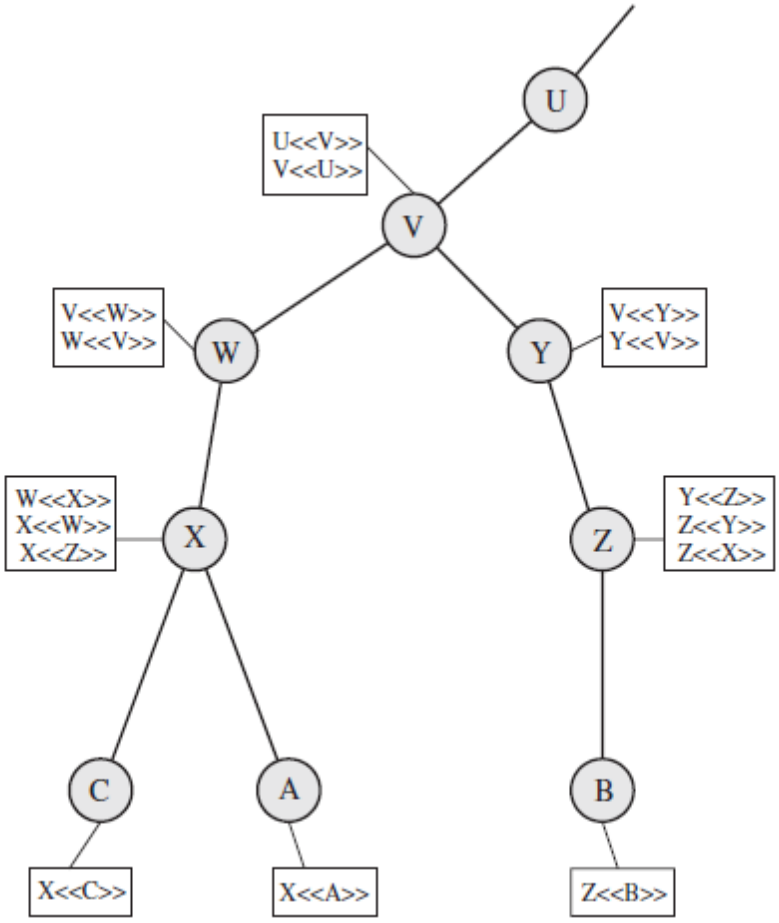


Figure 14.16 X.509 Hierarchy: A Hypothetical Example

Certificate Revocation

• Certificates have a period of validity

• may need to revoke before expiry, for the following reasons eg:

1. User's private key is compromised
2. User is no longer certified by this CA
3. CA's certificate is compromised

CA's maintain list of revoked certificates, the Certificate Revocation List (CRL).Users should - check certificates with CA's CRL.