Web Services Security
X.509 Certificate Token Profile

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Abstract:

This document describes how to use X.509 Certificates with the **WS-Security** specification.

Status:

This is an interim draft.

Committee members should send comments on this specification to the wss@lists.oasis-open.org list. Others should subscribe to and send comments to the wss-

comment@lists.oasis-open.org list. To subscribe, visit http://lists.oasis-open.org/ob/adm.pl.

For information on whether any patents have been disclosed that may be essential to implementing this specification, and any offers of patent licensing terms, please refer to the Intellectual Property Rights section of the WS-Security TC web page (http://www.oasis-open.org/committees/wss/ipr.php).

Table of Contents

1 Introduction (Non-Normative)

This specification describes the use of the X.509 authentication framework with the Web Services Security: SOAP Message Security specification [WS-Security].

An X.509 certificate specifies a binding between a public key and a set of attributes that includes (at least) a subject name, issuer name, serial number and validity interval. This binding may be subject to subsequent revocation advertised by mechanisms that include issuance of CRLs, OCSP tokens or mechanisms that are outside the X.509 framework, such as XKMS.

An X.509 certificate may be used to validate a public key that may be used to authenticate a WS-Security-enhanced message or to identify the public key with which a WS-Security-enhanced message has been encrypted.

2 Notations and Terminology

This section specifies the notations, namespaces and terminology used in this specification.

2.1 Notational Conventions

This document uses the notational conventions defined in SOAP Message Security [WS-Security].

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC2119 [KEYWORDS].

2.2 Namespaces

The XML namespace URIs that MUST be used by implementations of this specification are as follows (note that elements used in this specification are defined in one or other of these namespaces):

```
        http://schemas.xmlsoap.org/ws/2003/06/secext
        http://schemas.xmlsoap.org/ws/2003/06/utility
```

The following namespace prefixes are used in this document:

Prefix	Namespace
S	http://www.w3.org/2001/12/soap-envelope
ds	http://www.w3.org/2000/09/xmldsig#
xenc	http://www.w3.org/2001/04/xmlenc#
wsse	http://schemas.xmlsoap.org/ws/2003/06/secext
wsu	http://schemas.xmlsoap.org/ws/2003/06/utility

Table 1- Namespace prefixes

2.3 Terminology

This specification adopts the terminology defined in SOAP Message Security [WS-Security].

Readers are presumed to be familiar with the definitions of terms in the Internet Security Glossary [Glossary].

3 Usage

This specification describes the syntax and processing rules for the use of the X.509 authentication framework with the Web Services Security: SOAP Message Security specification [WS-Security].

3.1 Token types

This profile defines the syntax of, and processing rules for, three types of binary security token using the QName values specified in Table 2.

Token	ValueType QName	Description
Single certificate	wsse:X509v3	An X.509 v3 signature-verification certificate
Certificate Path	wsse:X509PKIPathv1	An ordered list of X.509 certificates packaged in a PKIPath
Set of certificates and CRLs	wsse:PKCS7	A list of X.509 certificates and (optionally) CRLs packaged in a PKCS#7 wrapper

Table 2 – Token types

3.1.1 wsse:X509v3 Token Type

The type of the end-entity that is authenticated by a certificate used in this manner is a matter of policy that is outside the scope of this specification.

3.1.2 wsse:X509PKIPathv1 Token Type

The wsse:X509PKIPathv1 token type MAY be used to represent a certificate path.

3.1.3 wsse:PKCS7 Token Type

The wsse:PKCS7 token type MAY be used to represent a certificate path. It is RECOMMENDED that applications use the PKIPath object for this purpose instead.

The order of the certificates in a PKCS#7 data structure is not significant. If an ordered certificate path is converted to PKCS#7 encoded bytes and then converted back, the order of the certificates may not be preserved. Processors SHALL NOT assume any significance to the order of the certificates in the data structure. See [PKCS7] for more information.

3.2 Token References

In order to ensure a consistent processing model across all the token types supported by WS-Security, the wsse:SecurityTokenReference element SHALL be used to specify all references to X.509 token types in signature or encryption elements that comply with this profile.

A wsse:SecurityTokenReference MAY reference an X.509 token type by one of the following means:

Reference to a Subject Key Identifier

The wsse:SecurityTokenReference element contains a wsse:KeyIdentifier element that specifies the token data by means of a X.509 SubjectKeyIdentifier reference.

Reference to a Binary Security Token

The wsse:SecurityTokenReference element contains a wsse:Reference element that references a local wsse:BinarySecurityToken element or a remote data source that contains the token data itself.

Reference to an Issuer and Serial Number

The wsse:SecurityTokenReference element contains a ds:X509IssuerSerial element that uniquely identifies an end entity certificate by its X.509 Issuer and Serial Number.

3.2.1 Reference to a Subject Key Identifier

The wsse:KeyIdentifier element is used to specify a reference to an X.509 certificate by means of a reference to its X.509 SubjectKeyIdentifier attribute.

The wsse:SecurityTokenReference from which the reference is made contains the wsse:KeyIdentifier element. The wsse:KeyIdentifier element MUST have a ValueType attribute with the value wsse:X509SubjectKeyIdentifier and its contents MUST be the value of the certificate's X.509 SubjectKeyIdentifier extension, encoded as per the wsse:KeyIdentifier element's EncodingType attribute. For the purposes of this specification, the value of the SubjectKeyIdentifier extension is the contents of the KeyIdentifier octet string, excluding the encoding of the octet string prefix.

3.2.2 Reference to a Security Token

The wsse:Reference element is used to reference an X.509 security token value by means of a URI reference.

The URI reference MAY be internal in which case the URI reference SHOULD be a bare name XPointer reference to a wsse:BinarySecurityToken element contained in a preceding message header that contains the binary X.509 security token data.

3.2.3 Reference to an Issuer and Serial Number

The ds:IssuerSerial element is used to specify a reference to an X.509 security token by means of the certificate issuer name and serial number.

The ds:IssuerSerial element is a direct child of the wsse:SecurityTokenReference element in which the reference is made.

3.3 Signature

Signed data MAY specify the certificate associated with the signature using any of the X.509 security token types and references defined in this specification.

An X.509 certificate specifies a binding between a public key and a set of attributes that includes (at least) a subject name, issuer name, serial number and validity interval. Other attributes MAY specify constraints on the use of the certificate or affect the recourse that may be open to a relying party that depends on the certificate. A given public key may be specified in more than one X.509 certificate; consequently a given public key MAY be bound to two or more distinct sets of attributes.

It is therefore necessary to ensure that a signature created under an X.509 certificate token uniquely and irrefutably specifies the certificate under which the signature was created.

Implementations SHOULD protect against a certificate substitution attack by including either the certificate itself or an immutable and unambiguous reference to the certificate within the scope of the signature according to the method used to reference the certificate as follows:

3.3.1 Key Identifier

The wsse:KeyIdentifier element does not guarantee an immutable and unambiguous reference to the certificate referenced. Consequently implementations that use this form of reference within a signature SHOULD employ the wsse:SecurityTokenReference deferencing transform within a core barename XPointer reference to the signature key information in order to ensure that the referenced certificate is signed, and not just the ambiguous reference.

The following example shows a certificate referenced by means of a Key Identifier

```
<S:Envelope xmlns:S="http://www.w3.org/2001/12/soap-envelope">
   <S:Header>
      <wsse:Security
           xmlns:wsse="http://schemas.xmlsoap.org/ws/2003/06/secext"
           xmlns:wsu="http://schemas.xmlsoap.org/ws/2003/06/utility">
         <wsse:BinarySecurityToken
              wsu:Id="A1UdAQQ8MDqAEEVs"
              ValueType="wsse:X509v3"
              EncodingType="wsse:Base64Binary">
            MIIEZzCCA9CgAwIBAgIQEmtJZc0…
         </wsse:BinarySecurityToken>
         <ds:Signature
              xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
            <ds:SignedInfo>…
               <ds:Reference URI="#body">…</ds:Reference>
               <ds:Reference URI="#keyinfo">
                  <ds:Transforms>
                     <ds:Transform
             Algorithm="http://schemas.xmlsoap.org/2003/06/STR-Transform">
                        <ds:CanonicalizationMethod Algorithm="…"/>
                     </ds:Transform>
                  </ds:Transforms>…
               </ds:Reference>
            </ds:SignedInfo>
            <ds:SignatureValue>HFLP…</ds:SignatureValue>
            <ds:KeyInfo Id="keyinfo">
               <wsse:SecurityTokenReference>
                  <wsse:KeyIdentifier EncodingType="wsse:Base64Binary"
                       ValueType="wsse:X509SubjectKeyIdentifier">
                     MIGfMa0GCSq…
                  </wsse:KeyIdentifier>
               </wsse:SecurityTokenReference>
            </ds:KeyInfo>
         </ds:Signature>
      </wsse:Security>
   </S:Header>
   <S:Body wsu:Id="body"
        xmlns:wsu="http://schemas.xmlsoap.org/ws/2003/06/utility">
      …
   </S:Body>
</S:Envelope>
```

3.3.2 Reference to a Binary Security Token

The signed data SHOULD contain a core bare name XPointer reference to the wsse:BinarySecurityToken element that contains the security token referenced, or a core reference to the external data source containing the security token.

The following example shows a certificate embedded in a wsse:BinarySecurityToken element and referenced by URI within a signature.

```
<S:Envelope xmlns:S="http://www.w3.org/2001/12/soap-envelope">
```

```
   <S:Header>
      <wsse:Security
           xmlns:wsse="http://schemas.xmlsoap.org/ws/2003/06/secext"
           xmlns:wsu="http://schemas.xmlsoap.org/ws/2003/06/utility">
         <wsse:BinarySecurityToken
              wsu:Id="binarytoken"
              ValueType="wsse:X509v3"
              EncodingType="wsse:Base64Binary">
            MIIEZzCCA9CgAwIBAgIQEmtJZc0…
         </wsse:BinarySecurityToken>
         <ds:Signature
              xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
            <ds:SignedInfo>…
               <ds:Reference URI="#body">…</ds:Reference>
               <ds:Reference URI="#binarytoken">…</ds:Reference>
            </ds:SignedInfo>
            <ds:SignatureValue>HFLP…</ds:SignatureValue>
            <ds:KeyInfo>
               <wsse:SecurityTokenReference>
                  <wsse:Reference URI="#binarytoken" />
               </wsse:SecurityTokenReference>
            </ds:KeyInfo>
         </ds:Signature>
      </wsse:Security>
   </S:Header>
   <S:Body wsu:Id="body"
        xmlns:wsu="http://schemas.xmlsoap.org/ws/2003/06/utility">
      …
   </S:Body>
</S:Envelope>
```

3.3.3 Reference to an Issuer and Serial Number

The signed data SHOULD contain a core bare name XPointer reference to the ds:KeyInfo element that contains the security token reference.

The following example shows a certificate referenced by means of its issuer name and serial number.

```
<S:Envelope xmlns:S="http://www.w3.org/2001/12/soap-envelope">
   <S:Header>
      <wsse:Security
           xmlns:wsse="http://schemas.xmlsoap.org/ws/2003/06/secext"
           xmlns:wsu="http://schemas.xmlsoap.org/ws/2003/06/utility">
         <ds:Signature
               xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
            <ds:SignedInfo>…
               <ds:Reference URI="#body"></ds:Reference>
               <ds:Reference URI="#keyinfo"></ds:Reference>
            </ds:SignedInfo>
            <ds:SignatureValue>HFLP…</ds:SignatureValue>
            <ds:KeyInfo Id="keyinfo">
               <wsse:SecurityTokenReference>
                  <ds:X509IssuerSerial>
                     <ds:X509IssuerName>
                        DC=ACMECorp, DC=com
                     </ds:X509IssuerName>
                     <ds:X509SerialNumber>12345678</X509SerialNumber>
                  </ds:X509IssuerSerial>
               </wsse:SecurityTokenReference>
            </ds:KeyInfo>
         </ds:Signature>
```

```
      </wsse:Security>
   </S:Header>
   <S:Body wsu:Id="body"
        xmlns:wsu="http://schemas.xmlsoap.org/ws/2003/06/utility">
      …
   </S:Body>
</S:Envelope>
```

3.4 Encryption

Encrypted keys or data MAY identify a key required for decryption by identifying the corresponding key used for encryption by means of any of the X.509 security token types or references specified herein.

Since the sole purpose is to identify the decryption key it is not necessary to specify either a trust path or the specific contents of the certificate itself.

It is RECOMMENDED that implementations specify an encryption key by reference to the Issuer and Serial Number of an X509v3 certificate security token.

The following example shows a decryption key referenced by means of the issuer name and serial number of an associated certificate.

```
<S:Envelope
     xmlns:S="http://www.w3.org/2001/12/soap-envelope"
     xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
     xmlns:wsse="http://schemas.xmlsoap.org/ws/2003/06/secext"
     xmlns:xenc="http://www.w3.org/2001/04/xmlenc#">
   <S:Header>
      <wsse:Security>
         <xenc:EncryptedKey>
            <xenc:EncryptionMethod Algorithm="…"/>
            <ds:KeyInfo>
               <wsse:SecurityTokenReference>
                  <ds:X509IssuerSerial>
                     <ds:X509IssuerName>
                        DC=ACMECorp, DC=com
                     </ds:X509IssuerName>
                     <ds:X509SerialNumber>12345678</X509SerialNumber>
                  </ds:X509IssuerSerial>
               </wsse:SecurityTokenReference>
            </ds:KeyInfo>
            <xenc:CipherData>
               <xenc:CipherValue>…</xenc:CipherValue>
            </xenc:CipherData>
            <xenc:ReferenceList>
               <xenc:DataReference URI="#encrypted"/>
            </xenc:ReferenceList>
         </xenc:EncryptedKey>
      </wsse:Security>
   </S:Header>
   <S:Body>
      <xenc:EncryptedData Id="encrypted" Type="…">
         <xenc:CipherData>
            <xenc:CipherValue>…</xenc:CipherValue>
         </xenc:CipherData>
      </xenc:EncryptedData>
   </S:Body>
</S:Envelope>
```

3.5 Error Codes

When using X.509 certificates, the error codes defined in the SOAP Message Security [WS-Security] specification MUST be used.

If an implementation requires the use of a custom error it is recommended that a sub-code be defined as an extension of one of the codes defined in the SOAP Message Security specification.

3.6 Threat Model and Countermeasures

The use of X509 certificates with WS-Security introduces no new threats beyond those identified in SOAP Message Security.

Message alteration and eavesdropping can be addressed by using the integrity and confidentiality mechanisms described in SOAP Message Security. Replay attacks can be addressed by using message timestamps and caching, as well as other application-specific tracking mechanisms. For X.509 certificates, identity is authenticated by use of keys, man-in-the-middle attacks are generally mitigated.

It is strongly RECOMMENDED that all relevant and immutable message data be signed.

It should be noted that transport-level security MAY be used to protect the message and the security token as an alternative.

4 References

[Glossary] Informational RFC 2828, "Internet Security Glossary," May 2000.

[KEYWORDS] S. Bradner, "Key words for use in RFCs to Indicate Requirement Levels," RFC 2119, Harvard University, March 1997

[SOAP] W3C Note, "SOAP: Simple Object Access Protocol 1.1," 08 May 2000.

[URI] T. Berners-Lee, R. Fielding, L. Masinter, "Uniform Resource Identifiers (URI): Generic Syntax," RFC 2396, MIT/LCS, U.C. Irvine, Xerox Corporation, August 1998.

[WS-Security] http://www.oasis-open.org/committees/download.php/1686/WSS-SOAPMessageSecurity-12-04021.pdf

[XML-ns] W3C Recommendation, "Namespaces in XML," 14 January 1999.

[XML Signature] W3C Recommendation, "XML Signature Syntax and Processing," 12 February 2002.

[PKCS7] **TBS** http://www.rsasecurity.com/rsalabs/pkcs/pkcs-7/index.html

[X509] **TBS**

Appendix A: Revision History

Rev	Date	What
01	18-Sep-02	Initial draft based on input documents and editorial review
03	30-Jan-03	Changes in title
04	19-May-03	Added by reference and pkipath modes of cert identification. Added section 1 introduction, changes to formatting etc.
05	6 June 2003	
06	20 June 2003	Included examples showing how tokens must be referenced from signatures and cipher values. Defined how key-agreement keys are to be conveyed in a Security header.
07	4 August 2003	Modifications to KeyIdentifier handling and use of SecurityTokenReference. Changes to the acknowledgements section.
08	6 August 2003	Reorganization of major sections to simplify flow
09	14 August 2003	Editorial corrections raised in off list emails.
10	19 August 2003	Editorial corrections raised in profile teleconference.

Appendix B: Notices

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