



Web Services Security Username Token Profile Version 1.1.1

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Related work:

This specification is one part of a multi-part Work Product. The other parts include:

[Web Services Security: SOAP Message Security Version 1.1.1](#)
[Web Services Security SAML Token Profile Version 1.1.1](#)
[Web Services Security Kerberos Token Profile Version 1.1.1](#)
[Web Services Security Rights Expression Language \(REL\) Token Profile Version 1.1.1](#)
[Web Services Security SOAP Messages with Attachments \(SwA\) Profile Version 1.1.1](#)
[Web Services Security X.509 Certificate Token Profile Version 1.1.1](#)
Schemas: <http://docs.oasis-open.org/wss-m/wss/v1.1.1/csd01/xsd/>

This specification replaces or supersedes:

- [Web Services Security Username Token Profile 1.1 OASIS Standard](#)

Abstract:

This document describes how to use the Username Token with the Web Services Security (WSS) specification.

Status:

This document was last revised or approved by the [OASIS Web Services Security Maintenance \(WSS-M\) TC](#) on the above date. The level of approval is also listed above. Check the “Latest Version” location noted above for possible later revisions of this document.

Technical Committee members should send comments on this specification to the Technical Committee’s email list. Others should send comments to the Technical Committee by using the “[Send A Comment](#)” button on the Technical Committee’s web page at <http://www.oasis-open.org/committees/wss-m/>.

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This document integrates specific error corrections or editorial changes to the preceding specification, within the scope of the Web Services Security and this TC.

This document introduces a third digit in the numbering convention where the third digit represents a consolidation of error corrections, bug fixes or editorial formatting changes (e.g., 1.1.1); it does not add any new features beyond those of the base specifications (e.g., 1.1).

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1 Introduction

2 This document describes how to use the UsernameToken with the WSS: SOAP Message Security
3 specification [[WSS](#)]. More specifically, it describes how a web service consumer can supply a
4 UsernameToken as a means of identifying the requestor by “username”, and optionally using a password
5 (or shared secret, or password equivalent) to authenticate that identity to the web service producer.

6

7 This section is non-normative. Note that Sections 2.1, 2.2, all of 3, 4 and indicated parts of 6 are
8 normative. All other sections are non-normative.

2 Notations and Terminology

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

2.1 Notational Conventions

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 [RFC 2119](#).

When describing abstract data models, this specification uses the notational convention used by the XML Infoset. Specifically, abstract property names always appear in square brackets (e.g., [some property]).

When describing concrete XML schemas [\[XML-Schema\]](#), this specification uses the notational convention of WSS: SOAP Message Security. Specifically, each member of an element's [children] or [attributes] property is described using an XPath-like [\[XPath\]](#) notation (e.g., /x:MyHeader/x:SomeProperty/@value1). The use of {any} indicates the presence of an element wildcard (<xs:any/>). The use of @{any} indicates the presence of an attribute wildcard (<xs:anyAttribute/>).

Commonly used security terms are defined in the Internet Security Glossary [\[SECGLO\]](#). Readers are presumed to be familiar with the terms in this glossary as well as the definition in the Web Services Security specification.

2.2 Namespaces

Namespace URIs (of the general form "some-URI") represents some application-dependent or context-dependent URI as defined in RFC 3986 [\[URI\]](#). This specification is designed to work with the general SOAP [\[SOAP11, SOAP12\]](#) message structure and message processing model, and should be applicable to any version of SOAP. The current SOAP 1.1 namespace URI is used herein to provide detailed examples, but there is no intention to limit the applicability of this specification to a single version of SOAP.

The namespaces used in this document are shown in the following table (note that for brevity, the examples use the prefixes listed below but do not include the URIs – those listed below are assumed).

Prefix	Namespace
S11	http://schemas.xmlsoap.org/soap/envelope/
S12	http://www.w3.org/2003/05/soap-envelope
wsse	http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd
wsse11	http://docs.oasis-open.org/wss/oasis-wss-wssecurity-secext-1.1.xsd
wsu	http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-1.0.xsd

39

40 The URLs provided for the *wsse* and *wsu* namespaces can be used to obtain the schema files. URI
41 fragments defined in this specification are relative to a base URI of the following unless otherwise stated:

42 `http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-`
43 `profile-1.0`

44

45 The following table lists the full URI for each URI fragment referred to in this specification.

46

URI Fragment	Full URI
#PasswordDigest	<code>http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0#PasswordDigest</code>
#PasswordText	<code>http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0#PasswordText</code>
#UsernameToken	<code>http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0#UsernameToken</code>

47 2.3 Acronyms and Abbreviations

48 The following (non-normative) table defines acronyms and abbreviations for this document.

49

Term	Definition
SHA	Secure Hash Algorithm
SOAP	Simple Object Access Protocol
URI	Uniform Resource Identifier
XML	Extensible Markup Language

3 UsernameToken Extensions

3.1 Usernames and Passwords

The `<wsse:UsernameToken>` element is introduced in the WSS: SOAP Message Security documents as a way of providing a username.

Within `<wsse:UsernameToken>` element, a `<wsse:Password>` element may be specified. Passwords of type `PasswordText` and `PasswordDigest` are not limited to actual passwords, although this is a common case. Any password equivalent such as a derived password or S/KEY (one time password) can be used. Having a type of `PasswordText` merely implies that the information held in the password is “in the clear”, as opposed to holding a “digest” of the information. For example, if a server does not have access to the clear text of a password but does have the hash, then the hash is considered a *password equivalent* and can be used anywhere where a “password” is indicated in this specification. It is not the intention of this specification to require that all implementations have access to clear text passwords.

Passwords of type `PasswordDigest` are defined as being the Base64 [\[XML-Schema\]](#) encoded, SHA-1 hash value, of the UTF8 encoded password (or equivalent). However, unless this digested password is sent on a secured channel or the token is encrypted, the digest offers no real additional security over use of `wsse:PasswordText`.

Two optional elements are introduced in the `<wsse:UsernameToken>` element to provide a countermeasure for replay attacks: `<wsse:Nonce>` and `<wsu:Created>`. A nonce is a random value that the sender creates to include in each `UsernameToken` that it sends. Although using a nonce is an effective countermeasure against replay attacks, it requires a server to maintain a cache of used nonces, consuming server resources. Combining a nonce with a creation timestamp has the advantage of allowing a server to limit the cache of nonces to a “freshness” time period, establishing an upper bound on resource requirements. If either or both of `<wsse:Nonce>` and `<wsu:Created>` are present they MUST be included in the digest value as follows:

$$\text{Password_Digest} = \text{Base64} (\text{SHA-1} (\text{nonce} + \text{created} + \text{password}))$$

That is, concatenate the nonce, creation timestamp, and the password (or shared secret or password equivalent), digest the combination using the SHA-1 hash algorithm, then include the Base64 encoding of that result as the password (digest). This helps obscure the password and offers a basis for preventing replay attacks. For web service producers to effectively thwart replay attacks, three counter measures are RECOMMENDED:

1. It is RECOMMENDED that web service producers reject any `UsernameToken` *not* using *both* nonce *and* creation timestamps.
2. It is RECOMMENDED that web service producers provide a timestamp “freshness” limitation, and that any `UsernameToken` with “stale” timestamps be rejected. As a guideline, a value of five minutes can be used as a minimum to detect, and thus reject, replays.
3. It is RECOMMENDED that used nonces be cached for a period at least as long as the timestamp freshness limitation period, above, and that `UsernameToken` with nonces that have already been used (and are thus in the cache) be rejected.

94

95 Note that the nonce is hashed using the octet sequence of its decoded value while the timestamp is
96 hashed using the octet sequence of its UTF8 encoding as specified in the contents of the element.

97

98 Note that `PasswordDigest` can only be used if the plain text password (or password equivalent) is
99 available to both the requestor and the recipient.

100

101 Note that the secret is put at the end of the input and not the front. This is because the output of SHA-1 is
102 the function's complete state at the end of processing an input stream. If the input stream happened to fit
103 neatly into the block size of the hash function, an attacker could extend the input with additional blocks
104 and generate new/unique hash values knowing only the hash output for the original stream. If the secret
105 is at the end of the stream, then attackers are prevented from arbitrarily extending it -- since they have to
106 end the input stream with the password which they don't know. Similarly, if the nonce/created was put at
107 the end, then an attacker could update the nonce to be nonce+created, and add a new created time on
108 the end to generate a new hash.

109

110 The countermeasures above do not cover the case where the token is replayed to a different receiver.
111 There are several (non-normative) possible approaches to counter this threat, which may be used
112 separately or in combination. Their use requires pre-arrangement (possibly in the form of a separately
113 published profile which introduces new password type) among the communicating parties to provide
114 interoperability:

115

- 116 • including the username in the hash, to thwart cases where multiple user accounts have
117 matching passwords (e.g. passwords based on company name)
- 118 • including the domain name in the hash, to thwart cases where the same username/password
119 is used in multiple systems
- 120 • including some indication of the intended receiver in the hash, to thwart cases where
121 receiving systems don't share nonce caches (e.g., two separate application clusters in the
122 same security domain).

123

124 The following illustrates the XML syntax of this element:

125

```
126 <wsse:UsernameToken wsu:Id="Example-1">  
127   <wsse:Username> ... </wsse:Username>  
128   <wsse:Password Type="..."> ... </wsse:Password>  
129   <wsse:Nonce EncodingType="..."> ... </wsse:Nonce>  
130   <wsu:Created> ... </wsu:Created>  
131 </wsse:UsernameToken>
```

132

133 The following describes the attributes and elements listed in the example above:

134

135 `/wsse:UsernameToken/wsse:Password`

136 This optional element provides password information (or equivalent such as a hash). It is
137 RECOMMENDED that this element only be passed when a secure transport (e.g. HTTP/S) is
138 being used or if the token itself is being encrypted.

139

140 `/wsse:UsernameToken/wsse:Password/@Type`

141 This optional URI attribute specifies the type of password being provided. The table below
 142 identifies the pre-defined types (note that the URI fragments are relative to the URI for this
 143 specification).
 144

URI	Description
#PasswordText (default)	The actual password for the username, the password hash, or derived password or S/KEY. This type should be used when hashed password equivalents that do not rely on a nonce or creation time are used, or when a digest algorithm other than SHA1 is used.
#PasswordDigest	The digest of the password (and optionally nonce and/or creation timestamp) for the username using the algorithm described above.

145
 146 /wsse:UsernameToken/wsse:Password/{any}
 147 This is an extensibility mechanism to allow additional attributes, based on schemas, to be added
 148 to the element.
 149

150 /wsse:UsernameToken/wsse:Nonce
 151 This optional element specifies a cryptographically random nonce. Each message including a
 152 <wsse:Nonce> element MUST use a new nonce value in order for web service producers to
 153 detect replay attacks.
 154

155 /wsse:UsernameToken/wsse:Nonce/{EncodingType}
 156 This optional attribute URI specifies the encoding type of the nonce (see the definition of
 157 <wsse:BinarySecurityToken> for valid values). If this attribute isn't specified then the default
 158 of Base64 encoding is used.
 159

160 /wsse:UsernameToken/wsu:Created
 161 The optional <wsu:Created> element specifies a timestamp used to indicate the creation time.
 162 It is defined as part of the <wsu:Timestamp> definition.
 163

164 All compliant implementations MUST be able to process the <wsse:UsernameToken> element. Where
 165 the specification requires that an element be "processed" it means that the element type MUST be
 166 recognized to the extent that an appropriate error is returned if the element is not supported.
 167

168 Note that <wsse:KeyIdentifier> and <ds:KeyName> elements as described in the WSS: SOAP
 169 Message Security specification are not supported in this profile.
 170

171 The following example illustrates the use of this element. In this example the password is sent as clear
 172 text and therefore this message should be sent over a confidential channel:
 173

```

174 <S11:Envelope xmlns:S11="..." xmlns:wsse="...">
175   <S11:Header>

```

```

176     ...
177     <wsse:Security>
178         <wsse:UsernameToken>
179             <wsse:Username>Zoe</wsse:Username>
180             <wsse:Password>IloveDogs</wsse:Password>
181         </wsse:UsernameToken>
182     </wsse:Security>
183     ...
184 </S11:Header>
185     ...
186 </S11:Envelope>

```

187
188 The following example illustrates using a digest of the password along with a nonce and a creation
189 timestamp:

```

190  

191 <S11:Envelope xmlns:S11="..." xmlns:wsse="..." xmlns:wsu="...">
192   <S11:Header>
193     ...
194     <wsse:Security>
195       <wsse:UsernameToken>
196         <wsse:Username>NNK</wsse:Username>
197         <wsse:Password Type="...#PasswordDigest">
198           weYI3nXd8LjMNVksCKFV8t3rgHh3Rw==
199         </wsse:Password>
200         <wsse:Nonce>WScqanjCEAC4mQoBE07sAQ==</wsse:Nonce>
201         <wsu:Created>2003-07-16T01:24:32Z</wsu:Created>
202       </wsse:UsernameToken>
203     </wsse:Security>
204     ...
205   </S11:Header>
206   ...
207 </S11:Envelope>

```

208
209 **3.2 Token Reference**

210 When a UsernameToken is referenced using <wsse:SecurityTokenReference> the ValueType
211 attribute is not required. If specified, the value of #UsernameToken MUST be specified.

212
213 The following encoding formats are pre-defined (note that the URI fragments are relative to
214 [http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-](http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0)
215 [profile-1.0](http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0)):

216

URI	Description
#UsernameToken	UsernameToken

217
218 When a UsernameToken is referenced from a <ds:KeyInfo> element, it can be used to derive a key for
219 a message authentication algorithm as described in Section 4 Key Derivation

221 There is no definition of a `KeyIdentifier` for a `UsernameToken`. Consequently, `KeyIdentifier`
222 references MUST NOT be used when referring to a `UsernameToken`.

223

224 Similarly, there is no definition of a `KeyName` for a `UsernameToken`. Consequently, `KeyName` references
225 MUST NOT be used when referring to a `UsernameToken`.

226

227 All references refer to the `wsu:Id` for the token.

228 **3.3 Error Codes**

229 Implementations may use custom error codes defined in private namespaces if needed. But it is
230 RECOMMENDED that they use the error handling codes defined in the WSS: SOAP Message Security
231 specification for signature, decryption, and encoding and token header errors to improve interoperability.

232

233 When using custom error codes, implementations should be careful not to introduce security
234 vulnerabilities that may assist an attacker in the error codes returned.

235 4 Key Derivation

236 The password associated with a username may be used to derive a shared secret key for the purposes of
237 integrity or confidentiality protecting message contents. This section defines schema extensions and a
238 procedure for deriving such keys. This procedure **MUST** be employed when keys are to be derived from
239 passwords in order to ensure interoperability.

240
241 It must be noted that passwords are subject to several kinds of attack, which in turn will lead to the
242 exposure of any derived keys. This key derivation procedure is intended to minimize the risk of attacks on
243 the keys, to the extent possible, but it is ultimately limited by the insecurity of a password that it is
244 possible for a human being to remember and type on a standard keyboard. This is discussed in more
245 detail in the security considerations section of this document.

246
247 Two additional elements are required to enable the derivation of a key from a password. They are
248 `<wsse11:Salt>` and `<wsse11:Iteration>`. These values are not secret and **MUST** be conveyed in
249 the UsernameToken when key derivation is used. When key derivation is used the password **MUST NOT**
250 be included in the UsernameToken. The receiver will use its knowledge of the password to derive the
251 same key as the sender.

252
253 The following illustrates the syntax of the `<wsse11:Salt>` and `<wsse11:Iteration>` elements.

```
254 <wsse:UsernameToken wsse:Id="...">  
255   <wsse:Username>...</wsse:Username>  
256   <wsse11:Salt>...</wsse11:Salt>  
257   <wsse11:Iteration>...</wsse11:Iteration>  
258 </wsse:UsernameToken>
```

259 The following describes these elements.

260
261 `/wsse11:UsernameToken/wsse:Salt`

262 This element is combined with the password as described below. Its value is a 128 bit number
263 serialized as `xs:base64Binary`. It **MUST** be present when key derivation is used.

264
265 `/wsse11:UsernameToken/wsse11:Iteration`

266 This element indicates the number of times the hashing operation is repeated when deriving the
267 key. It is expressed as a `xs:unsignedInteger` value. If it is not present, a value of 1000 is
268 used for the iteration count.

269
270 A key derived from a password may be used either in the calculation of a Message Authentication Code
271 (MAC) or as a symmetric key for encryption. When used in a MAC, the key length will always be 160 bits.
272 When used for encryption, an encryption algorithm **MUST NOT** be used which requires a key of length
273 greater than 160 bits. A sufficient number of the high order bits of the key will be used for encryption.
274 Unneeded low order bits will be discarded. For example, if the AES-128 algorithm is used, the high order
275 128 bits will be used and the low order 32 bits will be discarded from the derived 160 bit value.

276
277 The `<wsse11:Salt>` element is constructed as follows. The high order 8 bits of the Salt will have the
278 value of 01 if the key is to be used in a MAC and 02 if the key is to be used for encryption. The remaining
279 120 low order bits of the Salt should be a random value.

280
281 The key is derived as follows. The password (which is UTF-8 encoded) and Salt are concatenated in that
282 order. Only the actual octets of the password are used, it is not padded or zero terminated. This value is
283 hashed using the SHA1 algorithm. The result of this operation is also hashed using SHA1. This process is
284 repeated until the total number of hash operations equals the Iteration count.
285
286 In other words: $K1 = \text{SHA1}(\text{password} + \text{Salt})$
287 $K2 = \text{SHA1}(K1)$
288 ...
289 $Kn = \text{SHA1}(Kn-1)$
290 Where + means concatenation and n is the iteration count.
291
292 The resulting 160 bit value is used in a MAC function or truncated to the appropriate length for encryption

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5 Security Considerations

The use of the UsernameToken introduces no additional threats beyond those already identified for other types of SecurityTokens. Replay attacks can be addressed by using message timestamps, nonces, and caching, as well as other application-specific tracking mechanisms. Token ownership is verified by use of keys and man-in-the-middle attacks are generally mitigated. Transport-level security may be used to provide confidentiality and integrity of both the UsernameToken and the entire message body.

When a password (or password equivalent) in a <UsernameToken> is used for authentication, the password needs to be properly protected. If the underlying transport does not provide enough protection against eavesdropping, the password SHOULD be digested as described in this document. Even so, the password must be strong enough so that simple password guessing attacks will not reveal the secret from a captured message.

When a password is encrypted, in addition to the normal threats against any encryption, two password-specific threats must be considered: replay and guessing. If an attacker can impersonate a user by replaying an encrypted or hashed password, then learning the actual password is not necessary. One method of preventing replay is to use a nonce as mentioned previously. Generally it is also necessary to use a timestamp to put a ceiling on the number of previous nonces that must be stored. However, in order to be effective the nonce and timestamp must be signed. If the signature is also over the password itself, prior to encryption, then it would be a simple matter to use the signature to perform an offline guessing attack against the password. This threat can be countered in any of several ways including: don't include the password under the signature (the password will be verified later) or sign the encrypted password.

The reader should also review Section 13 of WSS: SOAP Message Security document for additional discussion on threats and possible counter-measures.

The security of keys derived from passwords is limited by the attacks available against passwords themselves, such as guessing and brute force. Because of the limited size of password that human beings can remember and limited number of octet values represented by keys that can easily be typed, a typical password represents the equivalent of an entropy source of a maximum of only about 50 bits. For this reason a maximum key size of only 160 bits is supported. Longer keys would simply increase processing without adding to security.

The key derivation algorithm specified here is based on one described in RFC 2898. It is referred to in that document as PBKDF1. It is used instead of PBKDF2, because it is simpler and keys longer than 160 bits are not required as discussed previously.

The purpose of the salt is to prevent the bulk pre-computation of key values to be tested against distinct passwords. The Salt value is defined so that MAC and encryption keys are guaranteed to have distinct values even when derived from the same password. This prevents certain cryptanalytic attacks.

The iteration count is intended to increase the work factor of a guessing or brute force attack, at a minor cost to normal key derivation. An iteration count of at least 1000 (the default) SHOULD always be used.

This section is non-normative.

338 6 References

339 The following are normative references:

- 340 **[SECGLO]** Informational RFC 2828, "Internet Security Glossary," May 2000.
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347 **[URI]** T. Berners-Lee, R. Fielding, L. Masinter, "Uniform Resource Identifiers (URI):
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353 **[WS-Security]** A. Nadalin et al., Web Services Security: SOAP Message Security 1.1.1
354 [http://docs.oasis-open.org/wss-m/wss/v1.1.1/csd01/wss-SOAPMessageSecurity-](http://docs.oasis-open.org/wss-m/wss/v1.1.1/csd01/wss-SOAPMessageSecurity-v1.1.1-csd01.pdf)
355 [v1.1.1-csd01.pdf](http://docs.oasis-open.org/wss-m/wss/v1.1.1/csd01/wss-SOAPMessageSecurity-v1.1.1-csd01.pdf)
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357 The following are non-normative references included for background and related material:

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364 December 2002.
365 **[XML-ns]** W3C Recommendation, "[Namespaces in XML](#)," 14 January 1999.
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367 *Signature Syntax and Processing*, W3C Recommendation, 12 February 2002.

368 **# Conformance**

369 The last numbered section in the specification must be the Conformance section. Conformance
370 Statements/Clauses go here.

371 **A. Acknowledgements**

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B. Revision History

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Revision	Date	Editor	Changes Made
WD01	17-January-2011	Carlo Milono	Corrected/added hyperlinks where missing; added Status section
WD02	8-February-2011	Carlo Milono	Added Related Work to reflect v1.1.1 of the specs; changed References for SOAP Message Security to reflect v1.1.1; Changed WD# to 2; Added Date; Moved Current Members to Previous and added new Current Members; saved document under wd02; entered the Revision History Merged Old Current Contributors with Old Previous, created a New Current Contributors.
WD03	16-March-2011	David Turner	Corrected and updated links

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