SAML V2.0 Holder-of-Key Subject Confirmation Profile

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Abstract:
This profile describes the issuing and processing of a holder-of-key `<saml:SubjectConfirmation>` element. Specifically, we show how an identity provider binds X.509 data to a `<ds:KeyInfo>` element and how a service provider confirms that a `<ds:KeyInfo>` element matches given X.509 data. The binding material used by the identity provider and the matching data used by the service provider is obtained from a standard X.509 certificate.

Status

This document was last revised or approved by the SSTC on the above date. The level of approval is also listed above. Check the current location noted above for possible later revisions of this document. This document is updated periodically on no particular schedule.

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1 Introduction

This *SAML V2.0 Holder-of-Key Subject Confirmation Profile* describes the issuing and processing of a holder-of-key `<saml:SubjectConfirmation>` element. Specifically, we show how an identity provider binds X.509 data to a `<ds:KeyInfo>` element and how an service provider confirms that a `<ds:KeyInfo>` element matches given X.509 data. The binding material used by the identity provider and the matching data used by the service provider is obtained from a standard X.509 certificate.

1.1 Notation

This specification uses normative text.

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

> …they MUST only be used where it is actually required for interoperation or to limit behavior which has potential for causing harm (e.g., limiting retransmissions)…

These keywords are thus capitalized when used to unambiguously specify requirements over protocol and application features and behavior that affect the interoperability and security of implementations. When these words are not capitalized, they are meant in their natural-language sense.

```
Listings of XML schemas appear like this.
```

```
Example code listings appear like this.
```

Conventional XML namespace prefixes are used throughout the listings in this specification to stand for their respective namespaces as follows, whether or not a namespace declaration is present in the example:

Prefix	XML Namespace	Comments
`saml:`	urn:oasis:names:tc:SAML:2.0:assertion	This is the SAML V2.0 assertion namespace defined in the SAML V2.0 core specification [SAML2Core].
`samlp:`	urn:oasis:names:tc:SAML:2.0:protocol	This is the SAML V2.0 protocol namespace defined in the SAML V2.0 core specification [SAML2Core].
`ds:`	http://www.w3.org/2000/09/xmldsig#	This is the XML Signature namespace [XMLSig].

This specification uses the following typographical conventions in text: `<SAMLElement>`, `<ns:ForeignElement>`, `Attribute`, **Datatype**, `OtherCode`.

1.2 Normative References

[RFC2119] S. Bradner. *Key words for use in RFCs to Indicate Requirement Levels*. IETF RFC 2119, March 1997. http://www.ietf.org/rfc/rfc2119.txt

[RFC2253] M. Wahl, S. Kille, T. Howes. *Lightweight Directory Access Protocol (v3): UTF-8 String Representation of Distinguished Names.* IETF RFC 2253, December 1997. http://www.ietf.org/rfc/rfc2253.txt

[RFC5280] D. Cooper, S. Santesson, S. Farrell, S. Boeyen, R. Housley, W. Polk. *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile.* IETF RFC 5280, May 2008. http://www.ietf.org/rfc/rfc5280.txt

[SAML2Core] S. Cantor, J. Kemp, R. Philpott, E. Maler. *Assertions and Protocols for the OASIS Security Assertion Markup Language (SAML) V2.0.* OASIS Standard, March 2005. http://docs.oasis-open.org/security/saml/v2.0/saml-core-2.0-os.pdf

[SAML2Prof] J. Hughes, S. Cantor, J. Hodges, F. Hirsch, P. Mishra, R. Philpott, E. Maler. *Profiles for the OASIS Security Assertion Markup Language (SAML) V2.0.* OASIS Standard, March 2005. http://docs.oasis-open.org/security/saml/v2.0/saml-profiles-2.0-os.pdf

[XMLSig] D. Eastlake, J. Reagle, D. Solo. *XML-Signature Syntax and Processing.* World Wide Web Consortium Recommendation, 12 February 2002. http://www.w3.org/TR/xmldsig-core/

1.3 Non-normative References

[CONNOTECH] T. Moreau. *Explicit Meaningless X.509 Security Certificates as a Specifications-Based Interoperability Mechanism.* CONNOTECH Document Number C004635 (2008/07/23). http://www.connotech.com/pkc-only-meaningless-certs.pdf

[RFC3820] S. Tuecke, V. Welch, D. Engert, L. Pearlman, M. Thompson. *Internet X.509 Public Key Infrastructure (PKI) Proxy Certificate Profile.* IETF RFC 3820, June 2004. http://www.ietf.org/rfc/rfc3820.txt

[RFC4346] T. Dierks, E. Rescorla. *The Transport Layer Security (TLS) Protocol.* IETF RFC 4346, April 2006. http://www.ietf.org/rfc/rfc4346.txt

1.4 Conformance

1.4.1 SAML V2.0 Holder-of-Key Subject Confirmation Profile

All parties involved MUST conform to section 2.3. This includes the identity provider, the service provider, and the presenter.

An identity provider MUST follow the issuing rules in section 2.4. In particular, an identity provider MUST produce `<ds:KeyInfo>` elements that conform to section 2.4.1. Likewise, a service provider MUST follow the processing rules in section 2.5.

To claim conformance to this specification, an identity provider implementation MUST support both the `<ds:X509Certificate>` element and the `<ds:X509SKI>` element specified in section 2.4.1. Support for the `<ds:X509SubjectName>` element and the `<ds:X509SerialIssuer>` element by identity providers is OPTIONAL.

Likewise a conforming service provider implementation MUST support both the `<ds:X509Certificate>` element and the `<ds:X509SKI>` element specified in section 2.5. Support for the `<ds:X509SubjectName>` element and the `<ds:X509SerialIssuer>` element by service providers is OPTIONAL.

2 SAML V2.0 Holder-of-Key Subject Confirmation Profile

2.1 Required Information

Contact information: security-services-comment@lists.oasis-open.org

SAML Confirmation Method Identifiers: The SAML V2.0 holder-of-key confirmation method identifier (`urn:oasis:names:tc:SAML:2.0:cm:holder-of-key`) is associated with every `<saml:SubjectConfirmation>` element issued under this profile.

Description: Given below.

Updates: Refines the holder-of-key confirmation method described in section 3.1 of [SAML2Prof].

2.2 Background

A distinguishing characteristic of this profile is that *the presenter is the subject*. The case where the presenter is acting on behalf of the subject does not apply since the latter does not result in holder-of-key SAML assertions.

Suppose a presenter presents a SAML request and an X.509 certificate to a SAML identity provider. The presenter proves possession of the private key corresponding to the public key of the presented certificate and authenticates to the identity provider by unspecified means. The identity provider consumes the SAML request and returns a SAML response to the presenter.

Assume the SAML response issued by the identity provider contains one or more holder-of-key assertions (otherwise this specification is not applicable). By definition, a *holder-of-key SAML assertion* contains a `<saml:SubjectConfirmation>` element whose `Method` attribute is set to `urn:oasis:names:tc:SAML:2.0:cm:holder-of-key`. This specification describes how the identity provider binds selected X.509 data to the `<saml:SubjectConfirmation>` element of a holder-of-key assertion.

The complementary exchange involves a presenter who presents a signed holder-of-key SAML assertion and an X.509 certificate to a SAML service provider. Again the presenter proves possession of the private key corresponding to the public key of the presented certificate, after which the service provider consumes the assertion and creates a security context for the subject. This specification describes how the service provider confirms that the X.509 data bound to the assertion matches the data in the X.509 certificate.

For the purposes of this profile, the particular binding used at the protocol layer is unspecified. The holder-of-key assertion may be bound to the original SAML response in a complete end-to-end flow, or the response may be consumed at some intermediate step, leaving the assertion to be bound to something else such as a SOAP header or perhaps even the X.509 certificate itself. In any event, it's the assertion that's of interest in the subsequent exchange, not the binding substrate.

We assume that the service provider trusts the identity provider to issue assertions regarding the subject. On the other hand, the identity provider may not even know the intended service provider (if the presenter is the SAML requester, e.g.), so there is no underlying assumption that the identity provider trusts the service provider.

The identity provider and the service provider may or may not trust the issuer of the X.509 certificate. For our purposes here, this is mostly out of scope. In some situations, however, it is assumed that the service provider trusts the X.509 issuer to safely confirm the subject. These cases are included for completeness but a conforming SAML entity (identity provider or service provider) is not mandated to implement these special cases.

2.3 X.509 Certificate Usage

There are no explicit requirements with respect to the X.509 certificate presented to the identity provider, and later to the service provider. All that matters is that the presenter MUST prove possession of the private key corresponding to the presented public key. The fact that the latter is typically bound to an X.509 public key certificate is mostly irrelevant.

That said, this specification mandates that the presenter MUST present an X.509 public key certificate [RFC5280] to the identity provider or the service provider. However, the specific characteristics of this certificate are wholly out of scope with respect to this specification. In particular, there is no expectation that either the identity provider or the service provider trusts the issuer of the certificate, and therefore all portions of the certificate, apart from the public key, are out of scope.

The only exception is the case where the `<ds:X509Data>` element specified in section 2.4.1 contains a `<ds:X509SubjectName>` element or a `<ds:X509SerialIssuer>` element. In these two cases, the service provider MUST trust the X.509 issuer in order to confirm the subject. This is discussed more fully in section 2.5 below.

2.4 Holder-of-Key Subject Confirmation Issuing Rules

Every assertion containing a holder-of-key `<saml:SubjectConfirmation>` element MUST conform to [SAML2Core] (see section 2.4.1, and especially section 2.4.1.3) and section 3.1 of [SAML2Prof]. Where this specification conflicts with the SAML V2.0 specification, the former takes precedence.

The presenter presents a SAML request and an X.509 certificate to the identity provider. The presenter MUST prove possession of the private key corresponding to the public key of the presented certificate. The presenter authenticates to the identity provider by unspecified means.

If the presenter can prove possession of the private key, the identity provider issues a `<samlp:Response>` element containing one or more holder-of-key assertions. If the presenter is unable to prove possession of the private key, or the identity provider wishes to return an error for any other reason, the identity provider MUST NOT include any assertions in the `<samlp:Response>` message. Otherwise the `<samlp:Response>` element MUST contain at least one holder-of-key assertion. Each holder-of-key assertion MUST be signed. The `<samlp:Response>` element MAY itself be signed.

The expected content of a holder-of-key `<saml:SubjectConfirmation>` element is specified in the next section.

2.4.1 KeyInfo Usage

According to the SAML V2.0 specification, a holder-of-key `<saml:SubjectConfirmation>` element MUST contain at least one `<ds:KeyInfo>` element, and that `<ds:KeyInfo>` element MUST conform to the XML Signature specification [XMLSig]. The current specification further constrains the content of each `<ds:KeyInfo>` element to contain exactly one `<ds:X509Data>` element. The `<ds:X509Data>` element MUST NOT contain a `<ds:X509CRL>` element. Instead, the following content options are specified, at least one of which MUST be satisfied:

- The `<ds:X509Data>` element MAY contain a `<ds:X509Certificate>` element. If it does, the `<ds:X509Certificate>` element MUST contain a base64 encoding of the DER-encoded X.509 certificate presented to the identity provider.
- The `<ds:X509Data>` element MAY contain a `<ds:X509SKI>` element. If it does, the `<ds:X509SKI>` element MUST contain a base64 encoding of the SHA-1 hash of the public key bound to the X.509 certificate presented to the identity provider.

- The <ds:X509Data> element MAY contain a <ds:X509SubjectName> element. If it does, the <ds:X509SubjectName> element MUST contain the subject distinguished name (DN) bound to the X.509 certificate presented to the identity provider.

- The <ds:X509Data> element MAY contain a <ds:X509IssuerSerial> element. If it does, the <ds:X509IssuerSerial> element MUST contain the issuer DN and the issuer serial number (as specified in [XMLSig]) bound to the X.509 certificate presented to the identity provider.

Use of the <ds:X509Certificate> element or the <ds:X509IssuerSerial> element is most restrictive since the exact same certificate must be presented to both the identity provider and the service provider. Use of the <ds:X509SKI> element or the <ds:X509SubjectName> element is less restrictive since a different certificate may be presented to the service provider provided the certificate contains the same key or DN (resp.) presented to the identity provider.

Use of the <ds:X509SubjectName> element or the <ds:X509IssuerSerial> element is warranted in those situations where the service provider trusts the issuer of the X.509 certificate. The identity provider SHOULD NOT bind either of these elements to the <ds:X509Data> element unless it knows such a trust relationship exists.

Note that the format of the DN contained in the <ds:X509SubjectName> element or the <ds:X509IssuerSerial> element is specified in [XMLSig]. It is RECOMMENDED that the DN conform to [RFC2253] in all cases.

2.5 Holder-of-Key Subject Confirmation Processing Rules

The presenter presents one or more holder-of-key SAML assertions and an X.509 certificate to the service provider. The presenter MUST prove possession of the private key corresponding to the public key of the presented certificate.

Regardless of the protocol used, any assertions relied upon MUST be valid according to the processing rules specified in [SAML2Core]. In particular, the service provider MUST verify the signature on each assertion containing a holder-of-key <saml:SubjectConfirmation> element. Any assertion that is not valid, or whose subject confirmation requirements cannot be met, SHOULD be discarded and SHOULD NOT be used to establish a security context for the subject.

The service provider MUST confirm that the presented certificate matches the content of the <ds:X509Data> element as follows:

- If the <ds:X509Data> element contains a <ds:X509Certificate> element, the service provider MUST confirm that the DER-encoded certificate bound to the assertion matches (byte for byte) the presented X.509 certificate.

- If the <ds:X509Data> element contains a <ds:X509SKI> element, the service provider MUST confirm that the hash value bound to the assertion matches the SHA-1 hash of the public key bound to the presented X.509 certificate .

- If the <ds:X509Data> element contains a <ds:X509SubjectName> element, the service provider MUST confirm that the DN bound to the assertion matches the subject distinguished name (DN) bound to the presented X.509 certificate. If, however, the service provider does not trust the certificate issuer to issue such a DN, the subject is not confirmed and the service provider SHOULD disregard the enclosing assertion.

- If the <ds:X509Data> element contains a <ds:X509IssuerSerial> element, the service provider MUST confirm that the issuer DN and issuer serial number bound to the assertion match the issuer DN and the issuer serial number (resp.) bound to the presented X.509 certificate. If the service provider does not trust the issuer to issue X.509 certificates, the subject is not confirmed and the service provider SHOULD disregard the enclosing assertion.

In the case of a <ds:X509Certificate> element or a <ds:X509SKI> element, the matching is a relatively straightforward process. If the <ds:X509Data> element contains a <ds:X509SubjectName> element or a <ds:X509IssuerSerial> element, however, the service provider MUST trust the issuer of the certificate before the subject can be considered confirmed. If such a trust relationship between the service provider and certificate issuer does not exist, the service provider SHOULD disregard the enclosing assertion.

2.6 Security and Privacy Considerations

This profile assumes the presenter possesses an X.509 public key certificate and corresponding private key. For those deployments that wish to avoid or do not require a public key infrastructure (PKI), this may seem unnecessarily restrictive. However, the use of X.509 certificates provides a number of advantages. First, if the presenter is the SAML requester, the subject DN of the certificate can be used in lieu of an entityID. Second, observe that the SSL/TLS protocol [RFC4346] requires the use of X.509 certificates. Finally, and most importantly, since there is no presumption of an underlying trust model for X.509 certificates, the full range of possible content for the <ds:KeyInfo> element is avoided. Those deployments that are in fact based on such a trust model, or wish to avoid X.509 certificates altogether, may choose to profile additional child elements such as <ds:KeyName> or <ds:KeyValue>.

Deployments that rely on holder-of-key SAML assertions will no doubt impose their own requirements on the X.509 certificates used to obtain those assertions. For example, some applications will require the certificate to be an X.509 end-entity certificate [RFC5280] issued by a trusted X.509 certification authority (CA) or a certificate based on a trusted X.509 end-entity certificate (such as an X.509 proxy certificate [RFC3820]). This specification imposes no such restrictions, however.

In particular, note that self-signed certificates are permitted with this specification. However, self-signed certificates should be used with care since it is well known that the use of such certificates may break certain implementations or protocols. For maximum interoperability, implementers are encouraged to use X.509 end-entity certificates [RFC5280] exclusively. For those deployments that wish to avoid or do not require a PKI, yet want to maintain interoperability, observe that so-called "meaningless X.509 certificates" [CONNOTECH] satisfy the requirements of X.509 end-entity certificates without belaboring the assumption of an underlying trust model.

Appendix A. Acknowledgments

The editors would like to acknowledge the contributions of the OASIS Security Services Technical Committee, whose voting members at the time of publication were:

- TBD

The editor would also like to acknowledge the following contributors:

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Appendix B. Revision History

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sstc-saml2-holder-of-key-draft-01	7 Aug 2008	T. Scavo	Initial draft.