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OIO SAML Profile for Identity Tokens

Version 1.2

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Document History

Date	Version	Initials	Changes
09-06-2009	0.9	SPN	Specified only supported SAML confirmation method to be Holder-of-Key. Document ready for OIO public hearing
21-09-2009	1.0	TG	Document updated after public hearing. Assertions are now allowed to be encrypted entirely using the `<EncryptedAssertion>` element in order to better support scenarios with strong privacy requirements.
22-01-2017	1.1	TG	References to deprecated Liberty Profiles have been removed and references have been updated. Requirements for cryptographic algorithms and key lengths have been strengthened. Requirements for holder-of-key element is relaxed from a 'MUST' to a 'SHOULD'. The Issuer ID is no longer required to be bound to the Issuer's domain. AssuranceLevel requirements now refers to NSIS. Requirements to follow attribute naming and encoding rules from OIOSAML have been changed from a 'MUST' to a 'SHOULD'. Improved clarity of requirements by usage of RFC 2119.
05-02-2021	1.2	TG	Updated references to latest versions of documents (e.g. OIOSAML 3.0). Added description of how the STS can use metadata from the WSP in order to taylor the AttributeStatement to the WSP's needs – including parallel support of both OIOSAML 2.0 and 3.0 attributes.

Introduction

This document specifies a SAML 2.0 profile for identity tokens to be used in context of identity-based web services. The profile re-uses a number of elements from the OIO SAML profile for Web SSO described in [OIO-SAML-SSO].

A number of scenarios containing extensions to the web SSO scenarios can be found in [Scenarios]. In all these scenarios, a Service Provider needs to invoke a remote identity-based web service in order to service the end-user. For this purpose the user identity is passed in the web service call in a SAML assertion called an identity token (specified in this profile). Thus, the *invocation entity* (the user) is different from the *sender* (the Web Service Consumer).

The identity token is different from the authentication assertion established during web SSO in a number of ways:

- The goal is not to establish a browser session but instead to hand the Web Service Provider a user context for the web service invocation.
- The subject confirmation element may bind the assertion to the web service consumer's signature key (i.e. holder-of-key assertions).
- The identity token is not intended for the Service Provider who has an active session with the user – but for the provider of the identity-based web service (Web Service Provider). This has implications for audience, encryption and name identifiers. For example, the user may potentially have different identifiers (e.g. pseudonyms) at different Service Providers.
- The token will normally be requested using a profile of the WS-Trust standard (see [OIO-WST]) and issued by a Security Token Service.

The primary goal of an identity token is thus to convey a set of identity attributes about a user.

Notational Conventions

The key words "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.

The following abbreviations are used:

- Identity Provider (IdP) - a federated authentication service (typically based on SAML 2.0).
- Service Provider (SP) - a web application or portal allowing federated log-in using an Identity Provider.
- Security Token Service (STS) - a service issuing security tokens for web service invocations (typically based on WS-Trust).
- Web Service Consumer (WSC) - an application or client that needs to invoke a foreign identity-based web service in context of a particular user.
- Web Service Provider (WSP) - a provider of an identity-based web service that allows access based on a security token issued by a trusted STS.

Related profiles

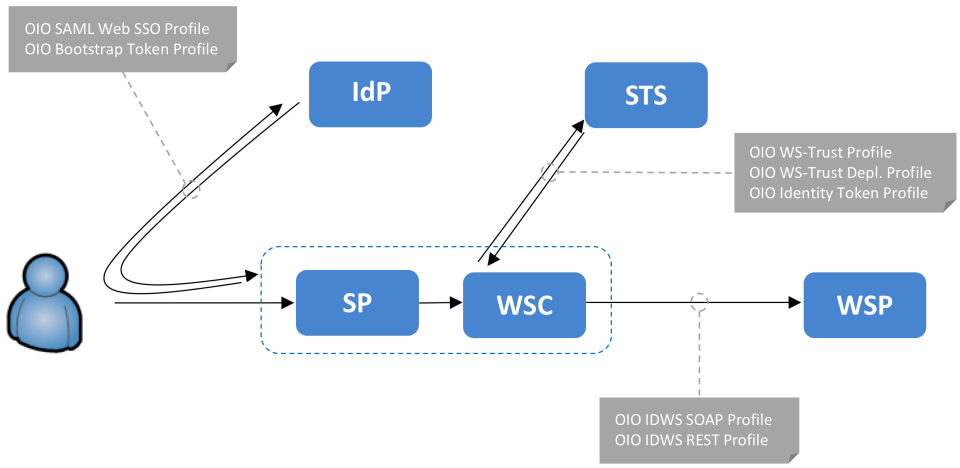
This profile is designed to be "compatible" with the following profiles:

- The OASIS Web Services Security SAML Token Profile 1.1 [WSS-SAML].

A number of other documents and profiles are closely related:

- The [Scenarios] document describes the overall business goals and requirements and shows how the different OIO profiles are combined to achieve these.
- Tokens conforming to this profile can be used in web service invocations according to the OIO IDWS SOAP Profile or OIO IDWS REST Profile.
- The OIO WS-Trust Profile shows how to request and retrieve identity tokens from a secure token service (STS) [OIO-WST].
- The OIO Web SSO SAML profile [OIO-SAML-SSO] specifies a SAML 2.0 profile for web SSO which is used to “bootstrap” identity-based web services. The SAML authentication assertions described in there may contain Identity Provider endpoint references and bootstrap tokens which can be used to retrieve identity tokens described in this profile from an STS.

The figure below illustrates the "big picture" of OIO IDWS profiles in a typical scenario:



The reader is assumed to be familiar with the existing web SSO profile [OIO-SAML-SSO].

Profile Requirements

This profile specifies a number of requirements for SAML Assertions issued by Security Token Services for subsequent use as identity tokens. Notice that neither SAML protocols nor bindings are relevant for the profile since identity tokens will be used as message elements in other protocols having their own bindings.

<Assertion> Requirements

- The `<Issuer>` element MUST contain the unique identifier of the issuing entity (i.e. Security Token Service). The Format attribute MUST be omitted or have a value of `urn:oasis:names:tc:SAML:2.0:nameid-format:entity`.
- The assertion MUST contain exactly one `<AttributeStatement>` element and one `<AuthnStatement>`.
- The assertion MUST NOT contain an `<AuthzDecisionStatement>`.
- The assertion MUST be signed by the STS by including a `<ds:Signature>` element. The private key used for signing MUST be bound to the STS's X.509 certificate.
- An assertion MUST contain exactly one `<Subject>` representing the identity associated with the assertion.
- When the identity token is to be used in a later web service call, the `<Subject>` element MUST represent the invocation entity (i.e. the entity on whose behalf the web service call is made).
- The assertion MAY be encrypted using the `<saml2:EncryptedAssertion>` element. This can e.g. be used when the requester (WSC) should not learn the user's identity at the destination service (WSP) – for example when pseudonyms are used.
- The Name identifier element MAY be of type `<saml2:EncryptedID>` when the subject identity is only to be disclosed to the relying party.
- Encryption of the entire assertion or NameID element SHOULD always be applied if pseudonyms are used.
- The subject element SHOULD[1] contain at least one `<SubjectConfirmation>` sub-element with a confirmation method of
    - `urn:oasis:names:tc:SAML:2.0:cm:holder-of-key`
- When holder-of-key subject confirmation is used:
    - The element MUST be qualified with an `xsi:type` of `saml2:KeyInfoConfirmationDataType`
    - Exactly one `<ds:KeyInfo>` element MUST be included containing a `<ds:X509Data>` and a `<ds:X509Certificate>` with the X.509 certificate of the sender as a base64 encoded value.
    - If sender / attesting entity (e.g. a Web Service Consumer) is different from the Subject of the assertion, this MUST be identified in the `<saml2:SubjectConfirmation>` element using

[1] Using 'bearer' tokens instead of holder-of-key tokens is not recommended in scenarios where sensitive data are accessed unless other mitigating controls have been deployed.

a separate <saml2:NameID> element with a Format attribute value of urn:oasis:tc:SAML2:2.0:nameid-format:entity. The value SHOULD identify the attesting entity to the recipient and MAY contain a SAML entity ID, a service address (e.g. the content of the <wsa:Address> in the <wsa:ReplyTo> header) or identity from the sender's certificate (e.g. Distinguished Name).

- The <SubjectConfirmation> element SHOULD include a NotOnOrAfter attribute. After this instant, the assertion MUST be considered invalid. Relying parties MAY reject identity tokens based on stricter local policies regarding life time of assertions (time since the assertion's IssueInstant).
- The assertion MUST contain an <AudienceRestriction> including the intended recipient's unique identifier as an <Audience>.
- Advice elements MAY safely be ignored by implementations.

<AttributeStatement> Requirements

- The <AttributeStatement> element SHOULD follow the naming and encoding rules for attributes defined in [OIO-SAML-SSO].
    - The STS SHOULD use metadata from the WSP in order to taylor the AttributeStatement to the WSP's needs. One WSP may e.g. require a set of OIOSAML 2.0.9/2.1.0 attributes and another may require a set of OIOSAML 3.0 attributes.
- The assurance level attribute dk:gov:saml:attribute:AssuranceLevel (in case of OIOSAML 2.0.9/2.1.0) or the NSIS LoA https://data.gov.dk/concept/core/nsis/loa (in case of OIOSAML 3.0) MUST be included and its value MUST reflect the assurance level of the user identity. This is the only required attribute specified in this profile[2].
- If an attribute values require confidentiality and the entire assertion is not encrypted at the outer level through a <saml2:EncryptedAssertion> element, the attribute element SHOULD be of type <saml2:EncryptedAttribute>[3].
- The assertion Issuer MAY limit the resource which the invoker may access at the relying party by describing relevant resources in the <saml2:AttributeStatement>, or by including attributes describing the subject's roles etc. Such attributes will not be part of this profile and SHOULD be agreed bilaterally between issuer and relying party. The attribute encoding rules defined in [OIO-SAML-SSO] MUST be followed.

SAML 2 Token Processing

When an assertion conforming to this profile is used within a web service request, the following steps should be taken during validation by the recipient (WSP):

- The recipient MUST verify that the message was not issued after the time indicated in the NotOnOrAfter conditions (subject to allowed clock skew).
- The recipient MUST verify that it is listed as an intended audience in the <saml2:AudienceRestriction> element.

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[2] OIOSAML attributes are not required in identity tokens either.

[3] Note that this overrides [OIO-SAML-SSO] which requires encryption of the entire assertion.

- The signature on the assertion MUST be validated as described in the SAML 2 specification. Requirements for checking the revocation status of certificates including the allowed methods (CRL, OCSP etc.) is left as a policy decision.
- If the assertion employs a holder-of-key confirmation method, the WSP MUST verify that the requester is in possession of the corresponding private key.

Security Requirements

Note that requirements for signing and encrypting SAML messages or elements have already been listed in previous sections.

Certificates

- For signing and encryption of messages, X.509 certificates MUST be used. It is left to federations using the profile to determine the allowed types of certificates (and hence trust mechanisms).

Cryptographic Algorithms

- Symmetric encryption MUST be performed using the AES algorithm with at least 128 bit keys.
- Digital signatures SHOULD be performed with SHA256withRSA using a 2048 bit modulus or stronger.

Security Considerations

This profile is not known to introduce any new security issues not described in the underlying profiles. We refer to [WSS-SAML] and [SAML-CORE] for details.

Profile and Architectural Decisions

This chapter presents the rationale behind important profile decisions. The descriptions are not normative but attempts to provide the reader with some insights to why the profile is designed the way it is.

Encryption of Assertions

Problem	Should identity assertions be encrypted entirely as in the web SSO profile or should attribute-level encryption be used?!
Assumptions	The assertion may contain sensitive data. For example, the user might have different identifiers (pseudonyms) with different service providers and may not want the service provider requesting the identity token to learn the identifier used at the other service provider for which the token is destined.
Alternatives	• Encrypt entire assertion. • Encrypt only parts such as NameID and attributes. • No encryption – assertion is secured using transport security mechanisms (e.g. SSL/TLS or WS-Security message encryption).
Analysis	Transport level encryption will not keep the assertion contents confidential from the requester for the token so this option is not viable. Encrypting the entire assertion under the recipient's public key makes the assertion unreadable by the service provider who requests it. This solves privacy problems but may however introduce new problems. For example, the requesting service provider may not know if there are subject confirmation obligations he should honor in the web service call e.g. proving possession of a key. Attribute-level encryption solves privacy problems but puts more processing overhead on the recipient (e.g. several decryption operations may be needed).
Decision	Allow entire assertion as well as individual name IDs and attributes to be encrypted.

Subject Confirmation

Problem	Which subject confirmation method should be allowed?!
Assumptions	
Alternatives	• Bearer • Holder of key • Sender vouches
Analysis	Bearer assertions have the advantage of being simple to implement (e.g. few processing rules) and may be well-suited for basic scenarios. However, there is a potential that the assertion can be misused by a third party as it is not bound to the sender or message.

	Sender-vouches assertions do not seem to offer any advantages over bearer assertions in our scenarios since signing is always used. Holder-of-key assertions allow the assertion to be bound to a particular Web Service Consumer which reduces the risk of misuse. Furthermore, they can be used to establish message authentication and trust since a third party asserts the relation between a key and an identity. This is useful in when trust domains are crossed and the recipient e.g. does not trust the sender's certificate.
Decision	Prefer holder-of-key subject confirmations but allow bearer tokens.

Assertion usage semantics

Problem	Should identity tokens have a one-time usage semantics defined (as Web SSO tokens have)?!
Assumptions	Identity tokens are expensive to retrieve since they require a protocol exchange with a third party.
Alternatives	• Require one-time usage in the profile (via recipient processing rules). • Allow identity tokens to be used several times subject to life-time restrictions (`NotOnOrAfter` attribute).
Analysis	Ideally, a web service consumer should retrieve an identity token for each web service invocation. This would allow fine-grained authorization decisions to take place at the token issuer. Further it will reduce the risk that a token is used after the user has logged out of his browser session with the Identity Provider[4]. On the other hand, retrieving identity tokens for every web service invocation can severely impact performance of the applications.
Decision	Allow the token to be used several times subject to life-time restrictions. The token life time is left as a policy decision such that sensible trade-offs between security/control and performance can be made. Further, the relying party receiving the token is allowed to enforce a stricter time-out policy based on the `IssueInstant` attribute in the assertion. Thus, he may reject tokens that are not yet expired.

Include Authentication Statements

Problem	Should identity tokens be allowed to include `<AuthnStatement>` elements?!
Assumptions	The relying party may need to know details of the user authentication at the Identity Provider in order to enforce local authorization policy.

[4] We assume here that the Identity Provider and token issuer communicate such that identity tokens can only be issued when the user has an active browser session with the Identity Provider.

Alternatives	• Allow them. • Do not allow them.
Analysis	The benefit of allowing an `<AuthnStatement>` in identity tokens is that the relying party can see details of the authentication event including the time of authentication and possibly specifics of the authentication mechanism. For example, Liberty [LIB-SAML] allows such statements in identity tokens. On the other hand, such statements introduce additional complexity. In the Danish scenarios, the identity token will always include the `AssuranceLevel` attribute in the `<AttributeStatement>` which is probably what a relying party would want to inspect. In effect, the assurance level is carried over from the authentication token to the identity token.
Decision	Allow `<AuthnStatement>` elements.

Allow authorization information

Problem	Should the token issuer be allowed to include authorization information in the identity token?!
Assumptions	The assertion issuing authority may want to limit the resources which the invoker may access at the relying party by describing relevant resources as part of the token. Alternatively, an assertion issuing authority may want to include attributes describing the subject's roles which can then be used in authorization decisions by the relying party.
Alternatives	• Allow such information to be included as attributes. • Allow such information to be included in an `<AuthzDecisionStatement>` element. • Disallow authorization information.
Analysis	Authorizations or roles may in some scenarios be managed centrally by the component issuing tokens. Including such information in identity tokens may therefore be a handy way to distribute such information. `<AuthzDecisionStatement>` elements are deprecated in SAML 2.0 and it is therefore unwise to use them. Including authorization information in attributes is better and will probably not break any implementations that do not understand the attributes. Since authorizations and roles may vary with context the format of such attributes will have to be agreed outside this profile.
Decision	Allow authorization information to be included only as attributes.

References

[SAML-CORE]	"Assertions and Protocols for the OASIS Security Assertion Markup Language (SAML) V2.0", OASIS Standard, 15 March 2005.
[OIO-SAML-SSO]	"OIO Web SSO Profile V2.1.0" and "OIO Web SSO Profile V3.0.2". Danish Agency for Digitisation.
[OIO-WST]	"OIO WS-Trust Profile V1.2", Danish Agency for Digitisation.
[OIO-WSP-DEP]	"OIO WS-Trust Deployment Profile V1.2", Danish Agency for Digitisation.
[WSS-SAML]	"Web Services Security: SAML Token Profile 1.1", OASIS Standard, 1 February 2006.
[Scenarios]	"Identity-Based Web Services – Scenarios", Danish Agency for Digitisation.
[NSIS]	"National Standard for Identiteters Sikringsniveauer (NSIS) 2.0.1", Danish Agency for Digitisation.