Assertions and Protocol for the OASIS Security Assertion Markup Language (SAML) V1.1

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Abstract:
This specification defines the syntax and semantics for XML-encoded assertions about authentication, attributes and authorization, and for the protocol that conveys this information.

Status:

This is an OASIS Standard document produced by the Security Services Technical Committee. It was approved by the OASIS membership on 2 September 2003.

Committee members should submit comments and potential errata to the security-services@lists.oasis-open.org list. Others should submit them to the security-services-comment@lists.oasis-open.org list (to post, you must subscribe; to subscribe, send a message to security-services-comment-request@lists.oasis-open.org with "subscribe" in the body) or use other OASIS-supported means of submitting comments. The committee will publish vetted errata on the Security Services TC web page (http://www.oasis-open.org/committees/security/).

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 web page for the Security Services TC (http://www.oasis-open.org/committees/security/ipr.php).

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1 Introduction

This specification defines the syntax and semantics for XML-encoded Security Assertion Markup Language (SAML) assertions, protocol requests, and protocol responses. These constructs are typically embedded in other structures for transport, such as HTTP form POSTs and XML-encoded SOAP messages. The SAML specification for bindings and profiles **[SAMLBind]** provides frameworks for this embedding and transport. Files containing just the SAML assertion schema **[SAML-XSD]** and protocol schema **[SAMLP-XSD]** are available.

The following sections describe how to understand the rest of this specification.

1.1 Notation

This specification uses schema documents conforming to W3C XML Schema **[Schema1]** and normative text to describe the syntax and semantics of XML-encoded SAML assertions and protocol messages.

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 IETF RFC 2119 **[RFC 2119]**:

> …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 SAML schemas appear like this.
```

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

In cases of disagreement between the SAML schema files **[SAML-XSD] [SAMLP-XSD]** and this specification, the schema files take precedence.

Conventional XML namespace prefixes are used throughout the listings in this specification to stand for their respective namespaces (see Section 1.2) as follows, whether or not a namespace declaration is present in the example:

- The prefix `saml:` stands for the SAML assertion namespace.
- The prefix `samlp:` stands for the SAML request-response protocol namespace.
- The prefix `ds:` stands for the W3C XML Signature namespace **[XMLSig-XSD]**.
- The prefix `xsd:` stands for the W3C XML Schema namespace **[Schema1]** in example listings. In schema listings, this is the default namespace and no prefix is shown.

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

1.2 Schema Organization and Namespaces

The SAML assertion structures are defined in a schema **[SAML-XSD]** associated with the following XML namespace:

```
urn:oasis:names:tc:SAML:1.0:assertion
```

The SAML request-response protocol structures are defined in a schema **[SAMLP-XSD]** associated with the following XML namespace:

```
urn:oasis:names:tc:SAML:1.0:protocol
```

The assertion schema is imported into the protocol schema. Also imported into both schemas is the schema for XML Signature **[XMLSig-XSD]**, which is associated with the following XML namespace:

```
http://www.w3.org/2000/09/xmldsig#
```

See Section 4.2 for information on SAML namespace versioning.

1.2.1 String and URI Values

All SAML string and URI reference values have the types **xsd:string** and **xsd:anyURI** respectively, which are built in to the W3C XML Schema Datatypes specification **[Schema2]**. All strings in SAML messages MUST consist of at least one non-whitespace character (whitespace is defined in the XML Recommendation **[XML]** §2.3). Empty and whitespace-only values are disallowed. Also, unless otherwise indicated in this specification, all URI reference values MUST consist of at least one non-whitespace character, and are strongly RECOMMENDED to be absolute **[RFC 2396]**.

1.2.2 Time Values

All SAML time values have the type **xsd:dateTime**, which is built in to the W3C XML Schema Datatypes specification **[Schema2]**, and MUST be expressed in UTC form.

SAML system entities SHOULD NOT rely on other applications supporting time resolution finer than milliseconds. Implementations MUST NOT generate time instants that specify leap seconds.

1.2.3 ID and ID Reference Values

The **xsd:ID** simple type is used to declare SAML identifiers for assertions, requests, and responses. Values declared to be of type **xsd:ID** in this specification MUST satisfy the following properties:

- Any party that assigns an identifier MUST ensure that there is negligible probability that that party or any other party will accidentally assign the same identifier to a different data object.
- Where a data object declares that it has a particular identifier, there MUST be exactly one such declaration.

The mechanism by which a SAML system entity ensures that the identifier is unique is left to the implementation. In the case that a pseudorandom technique is employed, the probability of two randomly chosen identifiers being identical MUST be less than or equal to 2^{-128} and SHOULD be less than or equal to 2^{-160}. This requirement MAY be met by encoding a randomly chosen value between 128 and 160 bits in length. The encoding must conform to the rules defining the **xsd:ID** datatype.

The **xsd:NCName** simple type is used in SAML to reference identifiers of type **xsd:ID**. Note that **xsd:IDREF** cannot be used for this purpose since, in SAML, the element referred to by a SAML reference identifier might actually be defined in a document separate from that in which the identifier reference is used. XML **[XML]** requires that names of type **xsd:IDREF** must match the value of an ID attribute on some element in the same XML document.

1.2.4 Comparing SAML Values

Unless otherwise noted, all elements in SAML documents that have the XML Schema **xsd:string** type, or a type derived from that, MUST be compared using an exact binary comparison. In particular, SAML implementations and deployments MUST NOT depend on case-insensitive string comparisons, normalization or trimming of white space, or conversion of locale-specific formats such as numbers or currency. This requirement is intended to conform to the W3C Requirements for String Identity, Matching, and String Indexing **[W3C-CHAR]**.

If an implementation is comparing values that are represented using different character encodings, the implementation MUST use a comparison method that returns the same result as converting both values to the Unicode character encoding, Normalization Form C **[UNICODE-C]**, and then performing an exact binary comparison. This requirement is intended to conform to the W3C Character Model for the World Wide Web **[W3C-CharMod]**, and in particular the rules for Unicode-normalized Text.

Applications that compare data received in SAML documents to data from external sources MUST take into account the normalization rules specified for XML. Text contained within elements is normalized so that line endings are represented using linefeed characters (ASCII code $10_{Decimal}$), as described in the XML Recommendation **[XML]** §2.11. Attribute values defined as strings (or types derived from strings) are normalized as described in **[XML]** §3.3.3. All white space characters are replaced with blanks (ASCII code $32_{Decimal}$).

The SAML specification does not define collation or sorting order for attribute or element values. SAML implementations MUST NOT depend on specific sorting orders for values, because these may differ depending on the locale settings of the hosts involved.

1.3 SAML Concepts (Non-Normative)

This section is informative only and is superseded by any contradicting information in the normative text in Section 2 and following. A glossary of SAML terms and concepts **[SAMLGloss]** is available.

1.3.1 Overview

The Security Assertion Markup Language (SAML) is an XML-based framework for exchanging security information. This security information is expressed in the form of assertions about subjects, where a subject is an entity (either human or computer) that has an identity in some security domain. A typical example of a subject is a person, identified by his or her email address in a particular Internet DNS domain.

Assertions can convey information about authentication acts that were previously performed by subjects, attributes of subjects, and authorization decisions about whether subjects are allowed to access certain resources. A single assertion might contain several different internal statements about authentication, authorization, and attributes.

Assertions are issued by SAML authorities, namely, authentication authorities, attribute authorities, and policy decision points. SAML defines a protocol by which clients can request assertions from SAML authorities and get a response from them. This protocol, consisting of XML-based request and response message formats, can be bound to many different underlying communications and transport protocols; SAML currently defines one binding, to SOAP over HTTP.

SAML authorities can use various sources of information, such as external policy stores and assertions that were received as input in requests, in creating their responses. Thus, while clients always consume assertions, SAML authorities can be both producers and consumers of assertions.

The following model is conceptual only; for example, it does not account for real-world information flow or the possibility of combining of authorities into a single system.

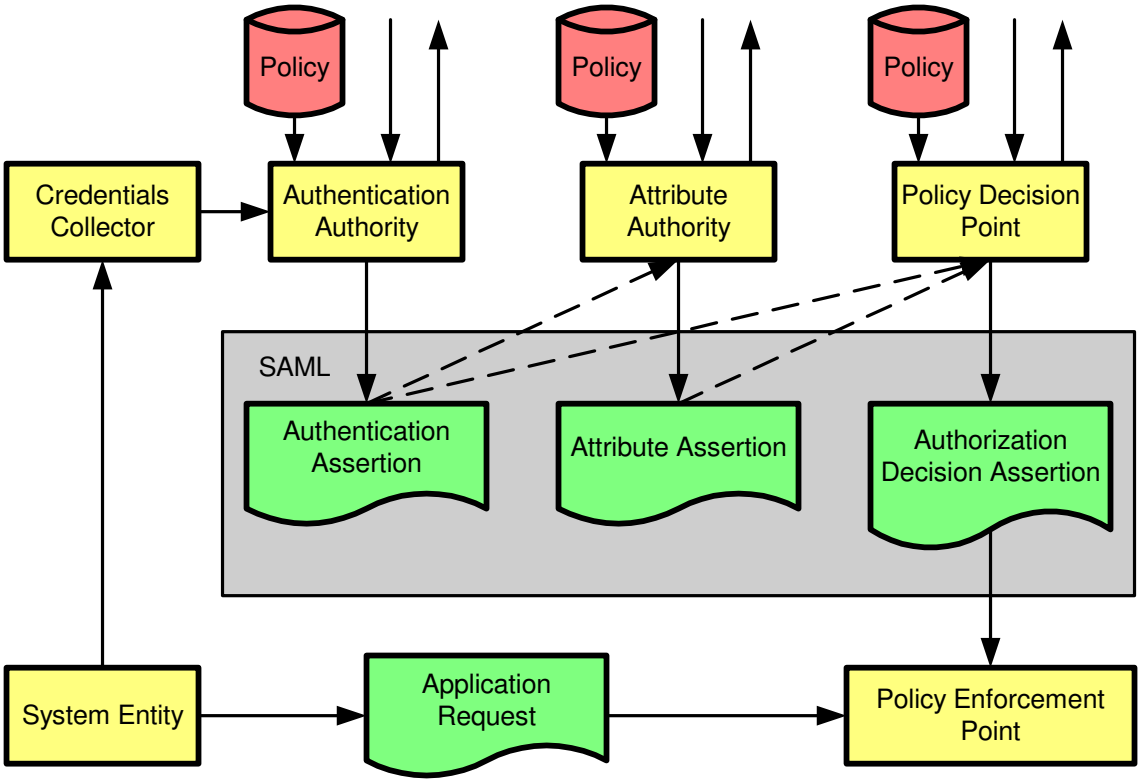

Figure 1 The SAML Domain Model

One major design goal for SAML is Single Sign-On (SSO), the ability of a user to authenticate in one domain and use resources in other domains without re-authenticating. However, SAML can be used in various configurations to support additional scenarios as well. Several profiles of SAML have been defined that support different styles of SSO, as well as the securing of SOAP payloads.

The assertion and protocol data formats are defined in this specification. The bindings and profiles are defined in a separate specification **[SAMLBind]**. A conformance program for SAML is defined in the conformance specification **[SAMLConform]**. Security issues are discussed in a separate security and privacy considerations specification **[SAMLSecure]**.

1.3.2 SAML and URI-Based Identifiers

SAML defines some identifiers to manage references to well-known concepts and sets of values. For example, the SAML-defined identifier for the password authentication method is as follows:

```
urn:oasis:names:tc:SAML:1.0:am:password
```

For another example, the SAML-defined identifier for the set of possible actions on a resource consisting of Read/Write/Execute/Delete/Control is as follows:

```
urn:oasis:names:tc:SAML:1.0:action:rwedc
```

These identifiers are defined as Uniform Resource Identifier (URI) references, but they are not necessarily able to be resolved to some Web resource. At times, SAML authorities need to use identifier strings of their own design, for example to define additional kinds of authentication methods not covered by SAML-defined identifiers. In the case where a form is used that is compatible with interpretation as a URI reference, it is not required to be resolvable to some Web resource. However, using URI references – particularly URLs based on the `http:` scheme or URNs based on the `urn:` scheme – is likely to mitigate problems with clashing identifiers to some extent.

The Read/Write/Execute/Delete/Control identifier above is an example of a namespace (not in the sense of an XML namespace). SAML uses this namespace mechanism to manage the universe of possible types of actions and possible names of attributes.

See Section 7 for a list of SAML-defined identifiers.

1.3.3 SAML and Extensibility

The XML formats for SAML assertions and protocol messages have been designed to be extensible. Section 6 describes SAML's design for extensibility in more detail.

However, it is possible that the use of extensions will harm interoperability and therefore the use of extensions should be carefully considered.

2 SAML Assertions

An assertion is a package of information that supplies one or more statements made by a SAML authority. This SAML specification defines three different kinds of assertion statement that can be created by a SAML authority. As mentioned above and described in Section 6, extensions are permitted by the SAML assertion schema, allowing user-defined extensions to assertions and SAML statements, as well as allowing the definition of new kinds of assertion statement. The three kinds of statement defined in this specification are:

- **Authentication:** The specified subject was authenticated by a particular means at a particular time.
- **Attribute:** The specified subject is associated with the supplied attributes.
- **Authorization Decision:** A request to allow the specified subject to access the specified resource has been granted or denied.

The outer structure of an assertion is generic, providing information that is common to all of the statements within it. Within an assertion, a series of inner elements describe the authentication, authorization decision, attribute, or user-defined statements containing the specifics.

2.1 Schema Header and Namespace Declarations

The following schema fragment defines the XML namespaces and other header information for the assertion schema:

```
<schema
   targetNamespace="urn:oasis:names:tc:SAML:1.0:assertion"
   xmlns="http://www.w3.org/2001/XMLSchema"
   xmlns:saml="urn:oasis:names:tc:SAML:1.0:assertion"
   xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
   elementFormDefault="unqualified"
   attributeFormDefault="unqualified"
   version="1.1">
   <import namespace="http://www.w3.org/2000/09/xmldsig#"
   schemaLocation="http://www.w3.org/TR/xmldsig-core/xmldsig-core-
schema.xsd"/>
   <annotation>
          <documentation>
                Document identifier: oasis-sstc-saml-schema-assertion-1.1
                Location: http://www.oasis-
open.org/committees/documents.php?wg_abbrev=security
                Revision history:
                V1.0 (November, 2002):
                  Initial standard schema.
                V1.1 (September, 2003):
                  * Note that V1.1 of this schema has the same XML
                    namespace as V1.0.
                  Rebased ID content directly on XML Schema types
                  Added DoNotCacheCondition element and
                    DoNotCacheConditionType
          </documentation>
   </annotation>
…
</schema>
```

2.2 Simple Types

The following section(s) define the SAML assertion-related simple types.

2.2.1 Simple Type DecisionType

The **DecisionType** simple type defines the possible values to be reported as the status of an authorization decision statement.

`Permit`

The specified action is permitted.

`Deny`

The specified action is denied.

`Indeterminate`

The SAML authority cannot determine whether the specified action is permitted or denied.

The `Indeterminate` decision value is used in situations where the SAML authority requires the ability to provide an affirmative statement that it is not able to issue a decision. Additional information as to the reason for the refusal or inability to provide a decision MAY be returned as `<StatusDetail>` elements.

The following schema fragment defines the **DecisionType** simple type:

```
<simpleType name="DecisionType">
   <restriction base="string">
          <enumeration value="Permit"/>
          <enumeration value="Deny"/>
          <enumeration value="Indeterminate"/>
   </restriction>
</simpleType>
```

2.3 Assertions

The following sections define the SAML constructs that contain assertion information.

2.3.1 Element <AssertionIDReference>

The `<AssertionIDReference>` element makes a reference to a SAML assertion.

The following schema fragment defines the `<AssertionIDReference>` element:

```
<element name="AssertionIDReference" type="NCName"/>
```

2.3.2 Element <Assertion>

The `<Assertion>` element is of **AssertionType** complex type. This type specifies the basic information that is common to all assertions, including the following elements and attributes:

`MajorVersion` [Required]

The major version of this assertion. The identifier for the version of SAML defined in this specification is `1`. SAML versioning is discussed in Section 4.

`MinorVersion` [Required]

The minor version of this assertion. The identifier for the version of SAML defined in this specification is `1`. SAML versioning is discussed in Section 4.

`AssertionID` [Required]

The identifier for this assertion. It is of type **xsd:ID**, and MUST follow the requirements specified in Section 1.2.3 for identifier uniqueness.

`Issuer` [Required]

The SAML authority that created the assertion. The name of the issuer is provided as a string. The issuer name SHOULD be unambiguous to the intended relying parties. SAML authorities may use an identifier such as a URI reference that is designed to be unambiguous regardless of context.

`IssueInstant` [Required]

The time instant of issue in UTC, as described in Section 1.2.2.

`<Conditions>` [Optional]

Conditions that MUST be taken into account in assessing the validity of the assertion.

`<Advice>` [Optional]

Additional information related to the assertion that assists processing in certain situations but which MAY be ignored by applications that do not support its use.

`<ds:Signature>` [Optional]

An XML Signature that authenticates the assertion, as described in Section 5.

One or more of the following statement elements:

`<Statement>`

A statement defined in an extension schema.

`<SubjectStatement>`

A subject statement defined in an extension schema.

`<AuthenticationStatement>`

An authentication statement.

`<AuthorizationDecisionStatement>`

An authorization decision statement.

`<AttributeStatement>`

An attribute statement.

The following schema fragment defines the `<Assertion>` element and its **AssertionType** complex type:

```
<element name="Assertion" type="saml:AssertionType"/>
<complexType name="AssertionType">
   <sequence>
          <element ref="saml:Conditions" minOccurs="0"/>
          <element ref="saml:Advice" minOccurs="0"/>
          <choice maxOccurs="unbounded">
                <element ref="saml:Statement"/>
                <element ref="saml:SubjectStatement"/>
                <element ref="saml:AuthenticationStatement"/>
                <element ref="saml:AuthorizationDecisionStatement"/>
                <element ref="saml:AttributeStatement"/>
          </choice>
          <element ref="ds:Signature" minOccurs="0"/>
```

```
   </sequence>
   <attribute name="MajorVersion" type="integer" use="required"/>
   <attribute name="MinorVersion" type="integer" use="required"/>
   <attribute name="AssertionID" type="ID" use="required"/>
   <attribute name="Issuer" type="string" use="required"/>
   <attribute name="IssueInstant" type="dateTime" use="required"/>
</complexType>
```

2.3.2.1 Element <Conditions>

The <Conditions> element MAY contain the following elements and attributes:

NotBefore [Optional]

Specifies the earliest time instant at which the assertion is valid. The time value is encoded in UTC as described in Section 1.2.2.

NotOnOrAfter [Optional]

Specifies the time instant at which the assertion has expired. The time value is encoded in UTC as described in Section 1.2.2.

<Condition> [Any Number]

Provides an extension point allowing extension schemas to define new conditions.

<AudienceRestrictionCondition> [Any Number]

Specifies that the assertion is addressed to a particular audience.

<DoNotCacheCondition> [Any Number]

Specifies that the assertion SHOULD be used immediately and MUST NOT be retained for future use.

The following schema fragment defines the <Conditions> element and its **ConditionsType** complex type:

```
<element name="Conditions" type="saml:ConditionsType"/>
<complexType name="ConditionsType">
   <choice minOccurs="0" maxOccurs="unbounded">
          <element ref="saml:AudienceRestrictionCondition"/>
          <element ref=”saml:DoNotCacheCondition”>
          <element ref="saml:Condition"/>
   </choice>
   <attribute name="NotBefore" type="dateTime" use="optional"/>
   <attribute name="NotOnOrAfter" type="dateTime" use="optional"/>
</complexType>
```

If an assertion contains a <Conditions> element, the validity of the assertion is dependent on the sub-elements and attributes provided. When processing the sub-elements and attributes of a <Conditions> element, the following rules MUST be used in the order shown to determine the overall validity of the assertion:

1. If no sub-elements or attributes are supplied in the <Conditions> element, then the assertion is considered to be ***Valid***.
2. If any sub-element or attribute of the <Conditions> element is determined to be invalid, then the assertion is ***Invalid***.
3. If any sub-element or attribute of the <Conditions> element cannot be evaluated, then the validity of the assertion cannot be determined and is deemed to be ***Indeterminate***.
4. If all sub-elements and attributes of the <Conditions> element are determined to be ***Valid***, then the assertion is considered to be ***Valid***.

The <Conditions> element MAY be extended to contain additional conditions. If an element contained within a <Conditions> element is encountered that is not understood, the status of the condition cannot

be evaluated and the validity status of the assertion MUST be deemed to be ***Indeterminate*** in accordance with rule 3 above.

Note that an assertion that has validity status ***Valid*** may not be trustworthy for reasons such as not being issued by a trustworthy SAML authority or not being authenticated by a trustworthy means.

2.3.2.1.1 Attributes NotBefore and NotOnOrAfter

The `NotBefore` and `NotOnOrAfter` attributes specify time limits on the validity of the assertion.

The `NotBefore` attribute specifies the time instant at which the validity interval begins. The `NotOnOrAfter` attribute specifies the time instant at which the validity interval has ended.

If the value for either `NotBefore` or `NotOnOrAfter` is omitted it is considered unspecified. If the `NotBefore` attribute is unspecified (and if any other conditions that are supplied evaluate to ***Valid***), the assertion is valid at any time before the time instant specified by the `NotOnOrAfter` attribute. If the `NotOnOrAfter` attribute is unspecified (and if any other conditions that are supplied evaluate to ***Valid***), the assertion is valid from the time instant specified by the `NotBefore` attribute with no expiry. If neither attribute is specified (and if any other conditions that are supplied evaluate to ***Valid***), the assertion is valid at any time.

The `NotBefore` and `NotOnOrAfter` attributes are defined to have the **dateTime** simple type that is built in to the W3C XML Schema Datatypes specification **[Schema2]**. All time instants are specified in Universal Coordinated Time (UTC) as described in Section 1.2.2. Implementations MUST NOT generate time instants that specify leap seconds.

2.3.2.1.2 Element <Condition>

The `<Condition>` element serves as an extension point for new conditions. Its **ConditionAbstractType** complex type is abstract and is thus usable only as the base of a derived type.

The following schema fragment defines the `<Condition>` element and its **ConditionAbstractType** complex type:

```
<element name="Condition" type="saml:ConditionAbstractType"/>
<complexType name="ConditionAbstractType" abstract="true"/>
```

2.3.2.1.3 Elements <AudienceRestrictionCondition> and <Audience>

The `<AudienceRestrictionCondition>` element specifies that the assertion is addressed to one or more specific audiences identified by `<Audience>` elements. Although a SAML relying party that is outside the audiences specified is capable of drawing conclusions from an assertion, the SAML authority explicitly makes no representation as to accuracy or trustworthiness to such a party. It contains the following elements:

`<Audience>`

A URI reference that identifies an intended audience. The URI reference MAY identify a document that describes the terms and conditions of audience membership.

The audience restriction condition evaluates to ***Valid*** if and only if the SAML relying party is a member of one or more of the audiences specified.

The SAML authority cannot prevent a party to whom the assertion is disclosed from taking action on the basis of the information provided. However, the `<AudienceRestrictionCondition>` element allows the SAML authority to state explicitly that no warranty is provided to such a party in a machine- and human-readable form. While there can be no guarantee that a court would uphold such a warranty exclusion in every circumstance, the probability of upholding the warranty exclusion is considerably improved.

The following schema fragment defines the `<AudienceRestrictionCondition>` element and its **AudienceRestrictionConditionType** complex type:

```
<element name="AudienceRestrictionCondition"
   type="saml:AudienceRestrictionConditionType"/>
<complexType name="AudienceRestrictionConditionType">
   <complexContent>
         <extension base="saml:ConditionAbstractType">
               <sequence>
                     <element ref="saml:Audience" maxOccurs="unbounded"/>
               </sequence>
         </extension>
   </complexContent>
</complexType>
<element name="Audience" type="anyURI"/>
```

2.3.2.1.4 Element <DoNotCacheCondition>

Indicates that the assertion SHOULD be used immediately by the relying party and MUST NOT be retained for future use. A SAML authority SHOULD NOT include more than one `<DoNotCacheCondition>` element within a `<Conditions>` element of an assertion. Note that no Relying Party implementation is required to perform caching. However, any that do so MUST observe this condition. If multiple `<DoNotCacheCondition>` elements appear within a `<Conditions>` element, a Relying Party MUST treat the multiple elements as though a single `<DoNotCacheCondition>` element was specified. For the purposes of determining the validity of the `<Conditions>` element, the `<DoNotCacheCondition>` (see Section 2.3.2.1) is considered to always be valid.

```
<element name="DoNotCacheCondition" type="saml:DoNotCacheConditionType" />
<complexType name="DoNotCacheConditionType">
   <complexContent>
     <extension base="saml:ConditionAbstractType"/>
   </complexContent>
</complexType>
```

2.3.2.2 Element <Advice>

The `<Advice>` element contains any additional information that the SAML authority wishes to provide. This information MAY be ignored by applications without affecting either the semantics or the validity of the assertion.

The `<Advice>` element contains a mixture of zero or more `<Assertion>` elements, `<AssertionIDReference>` elements, and elements in other namespaces, with lax schema validation in effect for these other elements.

Following are some potential uses of the `<Advice>` element:

- Include evidence supporting the assertion claims to be cited, either directly (through incorporating the claims) or indirectly (by reference to the supporting assertions).
- State a proof of the assertion claims.
- Specify the timing and distribution points for updates to the assertion.

The following schema fragment defines the `<Advice>` element and its **AdviceType** complex type:

```
<element name="Advice" type="saml:AdviceType"/>
<complexType name="AdviceType">
   <choice minOccurs="0" maxOccurs="unbounded">
         <element ref="saml:AssertionIDReference"/>
         <element ref="saml:Assertion"/>
         <any namespace="##other" processContents="lax"/>
   </choice>
</complexType>
```

2.4 Statements

The following sections define the SAML constructs that contain statement information.

2.4.1 Element <Statement>

The <Statement> element is an extension point that allows other assertion-based applications to reuse the SAML assertion framework. Its **StatementAbstractType** complex type is abstract and is thus usable only as the base of a derived type.

The following schema fragment defines the <Statement> element and its **StatementAbstractType** complex type:

```
<element name="Statement" type="saml:StatementAbstractType"/>
<complexType name="StatementAbstractType" abstract="true"/>
```

2.4.2 Element <SubjectStatement>

The <SubjectStatement> element is an extension point that allows other assertion-based applications to reuse the SAML assertion framework. It contains a <Subject> element that allows a SAML authority to describe a subject. Its **SubjectStatementAbstractType** complex type, which extends **StatementAbstractType**, is abstract and is thus usable only as the base of a derived type.

The following schema fragment defines the <SubjectStatement> element and its **SubjectStatementAbstractType** abstract type:

```
<element name="SubjectStatement" type="saml:SubjectStatementAbstractType"/>
<complexType name="SubjectStatementAbstractType" abstract="true">
   <complexContent>
          <extension base="saml:StatementAbstractType">
                <sequence>
                      <element ref="saml:Subject"/>
                </sequence>
          </extension>
   </complexContent>
</complexType>
```

2.4.2.1 Element <Subject>

The <Subject> element specifies the principal that is the subject of the statement. It contains either or both of the following elements:

<NameIdentifier>

An identification of a subject by its name and security domain.

<SubjectConfirmation>

Information that allows the subject to be authenticated.

If the <Subject> element contains both a <NameIdentifier> and a <SubjectConfirmation>, the SAML authority is asserting that if the SAML relying party performs the specified <SubjectConfirmation>, it can be confident that the entity presenting the assertion to the relying party is the entity that the SAML authority associates with the <NameIdentifier>. A <Subject> element SHOULD NOT identify more than one principal.

The following schema fragment defines the <Subject> element and its **SubjectType** complex type:

```
<element name="Subject" type="saml:SubjectType"/>
<complexType name="SubjectType">
   <choice>
          <sequence>
                <element ref="saml:NameIdentifier"/>
```

```
                <element ref="saml:SubjectConfirmation" minOccurs="0"/>
            </sequence>
            <element ref="saml:SubjectConfirmation"/>
      </choice>
</complexType>
```

2.4.2.2 Element <NameIdentifier>

The <NameIdentifier> element specifies a subject by a combination of a name qualifier, a name, and a format. The name is provided as element content. The <NameIdentifier> element has the following attributes:

NameQualifier [Optional]

The security or administrative domain that qualifies the name of the subject. This attribute provides a means to federate names from disparate user stores without collision.

Format [Optional]

A URI reference representing the format in which the <NameIdentifier> information is provided. See Section 7.3 for some URI references that MAY be used as the value of the Format attribute. If the Format attribute is not included, the identifier urn:oasis:names:tc:SAML:1.0:nameid-format:unspecified (see Section 7.3.1) is in effect. Regardless of format, issues of anonymity, pseudonymity, and the persistence of the identifier with respect to the asserting and relying parties are implementation-specific.

The following schema fragment defines the <NameIdentifier> element and its **NameIdentifierType** complex type:

```
<element name="NameIdentifier" type="saml:NameIdentifierType"/>
<complexType name="NameIdentifierType">
   <simpleContent>
         <extension base="string">
               <attribute name="NameQualifier" type="string" use="optional"/>
               <attribute name="Format" type="anyURI" use="optional"/>
         </extension>
   </simpleContent>
</complexType>
```

When a Format other than those specified in Section 7.3 is used, the NameQualifier attribute and the <NameIdentifier> element's content are to be interpreted according to the specification of that format as defined outside of this specification.

2.4.2.3 Elements <SubjectConfirmation>, <ConfirmationMethod>, and <SubjectConfirmationData>

The <SubjectConfirmation> element specifies a subject by supplying data that allows the subject to be authenticated. It contains the following elements in order:

<ConfirmationMethod> [One or more]

A URI reference that identifies a protocol to be used to authenticate the subject. URI references identifying SAML-defined confirmation methods are currently defined with the SAML profiles in the SAML bindings and profiles specification **[SAMLBind]**. Additional methods may be added by defining new profiles or by private agreement.

<SubjectConfirmationData> [Optional]

Additional authentication information to be used by a specific authentication protocol.

<ds:KeyInfo> [Optional]

An XML Signature **[XMLSig]** element that provides access to a cryptographic key held by the subject.

The following schema fragment defines the <SubjectConfirmation> element and its **SubjectConfirmationType** complex type, along with the <SubjectConfirmationData> element and the <ConfirmationMethod> element:

```
<element name="SubjectConfirmation" type="saml:SubjectConfirmationType"/>
<complexType name="SubjectConfirmationType">
   <sequence>
          <element ref="saml:ConfirmationMethod" maxOccurs="unbounded"/>
          <element ref="saml:SubjectConfirmationData" minOccurs="0"/>
          <element ref="ds:KeyInfo" minOccurs="0"/>
   </sequence>
</complexType>
<element name="SubjectConfirmationData" type="anyType"/>
<element name="ConfirmationMethod" type="anyURI"/>
```

2.4.3 Element <AuthenticationStatement>

The <AuthenticationStatement> element describes a statement by the SAML authority asserting that the statement's subject was authenticated by a particular means at a particular time. It is of type **AuthenticationStatementType**, which extends **SubjectStatementAbstractType** with the addition of the following elements and attributes:

AuthenticationMethod [Required]

A URI reference that specifies the type of authentication that took place. URI references identifying common authentication protocols are listed in Section 7.1.

AuthenticationInstant [Required]

Specifies the time at which the authentication took place. The time value is encoded in UTC as described in Section 1.2.2.

<SubjectLocality> [Optional]

Specifies the DNS domain name and IP address for the system entity from which the subject was apparently authenticated.

<AuthorityBinding> [Any Number]

Indicates that additional information about the subject of the statement may be available.

The following schema fragment defines the <AuthenticationStatement> element and its **AuthenticationStatementType** complex type:

```
<element name="AuthenticationStatement"
                type="saml:AuthenticationStatementType"/>
<complexType name="AuthenticationStatementType">
   <complexContent>
          <extension base="saml:SubjectStatementAbstractType">
                <sequence>
                      <element ref="saml:SubjectLocality" minOccurs="0"/>
```

```
                        <element ref="saml:AuthorityBinding"
                                 minOccurs="0" maxOccurs="unbounded"/>
                </sequence>
                <attribute name="AuthenticationMethod" type="anyURI"
use=”required”/>
                <attribute name="AuthenticationInstant" type="dateTime"
use=”required”/>
          </extension>
   </complexContent>
</complexType>
```

2.4.3.1 Element <SubjectLocality>

The `<SubjectLocality>` element specifies the DNS domain name and IP address for the system entity that was authenticated. It has the following attributes:

`IPAddress` [Optional]

The IP address of the system entity that was authenticated.

`DNSAddress` [Optional]

The DNS address of the system entity that was authenticated.

This element is entirely advisory, since both these fields are quite easily “spoofed,” but current practice appears to require its inclusion.

The following schema fragment defines the `<SubjectLocality>` element and its **SubjectLocalityType** complex type:

```
<element name="SubjectLocality"
                type="saml: SubjectLocalityType"/>
<complexType name="SubjectLocalityType">
   <attribute name="IPAddress" type="string" use="optional"/>
   <attribute name="DNSAddress" type="string" use="optional"/>
</complexType>
```

2.4.3.2 Element <AuthorityBinding>

The `<AuthorityBinding>` element MAY be used to indicate to a SAML relying party processing an AuthenticationStatement that a SAML authority may be available to provide additional information about the subject of the statement. A single SAML authority may advertise its presence over multiple protocol bindings, at multiple locations, and as more than one kind of authority by sending multiple elements as needed.

NOTE: This element is deprecated; use of this element SHOULD be avoided because it is planned to be removed in the next major version of SAML.

The `<AuthorityBinding>` element has the following attributes:

`AuthorityKind` [Required]

The type of SAML protocol queries to which the authority described by this element will respond. The value is specified as an XML Schema QName. The AuthorityKind value is either the QName of the desired SAML protocol query element or, in the case of an extension schema, the QName of the SAML **QueryAbstractType** complex type or some extension type that was derived from it. In the case of an extension schema, the authority will respond to all query elements of the specified type.

For example, an attribute authority would be identified by `AuthorityKind="samlp:AttributeQuery"`, where there is a namespace declaration in the scope of this attribute that binds the `samlp:` prefix to the SAML protocol namespace.

`Location` [Required]

A URI reference describing how to locate and communicate with the authority, the exact syntax of

760 which depends on the protocol binding in use. For example, a binding based on HTTP will be a web
761 URL, while a binding based on SMTP might use the `mailto:` scheme.

762 `Binding` [Required]

763 A URI reference identifying the SAML protocol binding to use in communicating with the authority. All
764 SAML protocol bindings will have an assigned URI reference.

765 The following schema fragment defines the `<AuthorityBinding>` element and its
766 **AuthorityBindingType** complex type:

```
767 <element name="AuthorityBinding" type="saml:AuthorityBindingType"/>
768 <complexType name="AuthorityBindingType">
769    <attribute name="AuthorityKind" type="QName" use="required"/>
770    <attribute name="Location" type="anyURI" use="required"/>
771    <attribute name="Binding" type="anyURI" use="required"/>
772 </complexType>
```

773 2.4.4 Element <AttributeStatement>

774 The `<AttributeStatement>` element describes a statement by the SAML authority asserting that the
775 statement's subject is associated with the specified attributes. It is of type **AttributeStatementType**,
776 which extends **SubjectStatementAbstractType** with the addition of the following element:

777 `<Attribute>` [One or More]

778 The `<Attribute>` element specifies an attribute of the subject.

779 The following schema fragment defines the `<AttributeStatement>` element and its
780 **AttributeStatementType** complex type:

```
781 <element name="AttributeStatement" type="saml:AttributeStatementType"/>
782 <complexType name="AttributeStatementType">
783    <complexContent>
784           <extension base="saml:SubjectStatementAbstractType">
785                  <sequence>
786                         <element ref="saml:Attribute" maxOccurs="unbounded"/>
787                  </sequence>
788           </extension>
789    </complexContent>
790 </complexType>
```

791 2.4.4.1 Elements <AttributeDesignator> and <Attribute>

792 The `<AttributeDesignator>` element identifies an attribute name within an attribute namespace. It
793 has the **AttributeDesignatorType** complex type. It is used in an attribute query to request that attribute
794 values within a specific namespace be returned (see Section 3.3.4 for more information). The
795 `<AttributeDesignator>` element contains the following XML attributes:

796 `AttributeNamespace` [Required]

797 The namespace in which the `AttributeName` elements are interpreted.

798 `AttributeName` [Required]

799 The name of the attribute.

800 The following schema fragment defines the `<AttributeDesignator>` element and its
801 **AttributeDesignatorType** complex type:

```
802 <element name="AttributeDesignator" type="saml:AttributeDesignatorType"/>
803 <complexType name="AttributeDesignatorType">
804    <attribute name="AttributeName" type="string" use="required"/>
805    <attribute name="AttributeNamespace" type="anyURI" use="required"/>
806 </complexType>
```

The <Attribute> element supplies the value for an attribute of an assertion subject. It has the **AttributeType** complex type, which extends **AttributeDesignatorType** with the addition of the following element:

<AttributeValue> [Any Number]

The value of the attribute.

The following schema fragment defines the <Attribute> element and its **AttributeType** complex type:

```
<element name="Attribute" type="saml:AttributeType"/>
<complexType name="AttributeType">
   <complexContent>
          <extension base="saml:AttributeDesignatorType">
                <sequence>
                      <element ref="saml:AttributeValue”
maxOccurs="unbounded"/>
                </sequence>
          </extension>
   </complexContent>
</complexType>
```

2.4.4.1.1 Element <AttributeValue>

The <AttributeValue> element supplies the value of a specified attribute. It is of the **anyType** simple type, which allows any well-formed XML to appear as the content of the element.

If the data content of an AttributeValue element is of an XML Schema simple type (such as **xsd:integer** or **xsd:string**), the data type MAY be declared explicitly by means of an xsi:type declaration in the <AttributeValue> element. If the attribute value contains structured data, the necessary data elements MAY be defined in an extension schema.

The following schema fragment defines the <AttributeValue> element:

```
<element name="AttributeValue" type="anyType"/>
```

2.4.5 Element <AuthorizationDecisionStatement>

The <AuthorizationDecisionStatement> element describes a statement by the SAML authority asserting that a request for access by the statement's subject to the specified resource has resulted in the specified authorization decision on the basis of some optionally specified evidence.

The resource is identified by means of a URI reference. In order for the assertion to be interpreted correctly and securely, the SAML authority and SAML relying party MUST interpret each URI reference in a consistent manner. Failure to achieve a consistent URI reference interpretation can result in different authorization decisions depending on the encoding of the resource URI reference. Rules for normalizing URI references are to be found in IETF RFC 2396 **[RFC 2396]** §6:

> In general, the rules for equivalence and definition of a normal form, if any, are scheme dependent. When a scheme uses elements of the common syntax, it will also use the common syntax equivalence rules, namely that the scheme and hostname are case insensitive and a URL with an explicit ":port", where the port is the default for the scheme, is equivalent to one where the port is elided.

To avoid ambiguity resulting from variations in URI encoding SAML system entities SHOULD employ the URI normalized form wherever possible as follows:

- SAML authorities SHOULD encode all resource URI references in normalized form.
- Relying parties SHOULD convert resource URI references to normalized form prior to processing.

Inconsistent URI reference interpretation can also result from differences between the URI reference syntax and the semantics of an underlying file system. Particular care is required if URI references are

employed to specify an access control policy language. The following security conditions should be satisfied by the system which employs SAML assertions:

- Parts of the URI reference syntax are case sensitive. If the underlying file system is case insensitive, a requester SHOULD NOT be able to gain access to a denied resource by changing the case of a part of the resource URI reference.
- Many file systems support mechanisms such as logical paths and symbolic links, which allow users to establish logical equivalences between file system entries. A requester SHOULD NOT be able to gain access to a denied resource by creating such an equivalence.

The `<AuthorizationDecisionStatement>` element is of type **AuthorizationDecisionStatementType**, which extends **SubjectStatementAbstractType** with the addition of the following elements (in order) and attributes:

`Resource` [Required]

A URI reference identifying the resource to which access authorization is sought. It is permitted for this attribute to have the value of the empty URI reference (""), and the meaning is defined to be "the start of the current document", as specified by IETF RFC 2396 **[RFC 2396]** §4.2.

`Decision` [Required]

The decision rendered by the SAML authority with respect to the specified resource. The value is of the **DecisionType** simple type.

`<Action>` [One or more]

The set of actions authorized to be performed on the specified resource.

`<Evidence>` [Optional]

A set of assertions that the SAML authority relied on in making the decision.

The following schema fragment defines the `<AuthorizationDecisionStatement>` element and its **AuthorizationDecisionStatementType** complex type:

```
<element name="AuthorizationDecisionStatement"
type="saml:AuthorizationDecisionStatementType"/>
<complexType name="AuthorizationDecisionStatementType">
   <complexContent>
          <extension base="saml:SubjectStatementAbstractType">
                <sequence>
                      <element ref="saml:Action" maxOccurs="unbounded"/>
                      <element ref="saml:Evidence" minOccurs="0"/>
                </sequence>
                <attribute name="Resource" type="anyURI" use="required"/>
                <attribute name="Decision" type="saml:DecisionType"
use="required"/>
          </extension>
   </complexContent>
</complexType>
```

2.4.5.1 Element <Action>

The `<Action>` element specifies an action on the specified resource for which permission is sought. It has the following attribute and string-data content:

895 `Namespace` [Optional]

896 A URI reference representing the namespace in which the name of the specified action is to be
897 interpreted. If this element is absent, the namespace urn:oasis:names:tc:SAML:1.0:action:rwedc-
898 negation specified in Section 7.2.2 is in effect.

899 *`string data`* [Required]

900 An action sought to be performed on the specified resource.

901 The following schema fragment defines the `<Action>` element and its **ActionType** complex type:

```
902 <element name="Action" type="saml:ActionType"/>
903 <complexType name="ActionType">
904    <simpleContent>
905           <extension base="string">
906                  <attribute name="Namespace" type="anyURI"/>
907           </extension>
908    </simpleContent>
909 </complexType>
```

910 2.4.5.2 Element <Evidence>

911 The `<Evidence>` element contains an assertion or assertion reference that the SAML authority relied on
912 in issuing the authorization decision. It has the **EvidenceType** complex type. It contains one of the
913 following elements:

914 `<AssertionIDReference>`

915 Specifies an assertion by reference to the value of the assertion's `AssertionID` attribute.

916 `<Assertion>`

917 Specifies an assertion by value.

918 Providing an assertion as evidence MAY affect the reliance agreement between the SAML relying party
919 and the SAML authority making the authorization decision. For example, in the case that the SAML
920 relying party presented an assertion to the SAML authority in a request, the SAML authority MAY use that
921 assertion as evidence in making its authorization decision without endorsing the `<Evidence>` element's
922 assertion as valid either to the relying party or any other third party.

923 The following schema fragment defines the `<Evidence>` element and its **EvidenceType** complex type:

```
924 <element name="Evidence" type="saml:EvidenceType"/>
925 <complexType name="EvidenceType">
926    <choice maxOccurs="unbounded">
927           <element ref="saml:AssertionIDReference"/>
928           <element ref="saml:Assertion"/>
929    </choice>
930 </complexType>
```

3 SAML Protocol

SAML assertions MAY be generated and exchanged using a variety of protocols. The bindings and profiles specification for SAML **[SAMLBind]** describes specific means of transporting assertions using existing widely deployed protocols.

SAML-aware requesters MAY in addition use the SAML request-response protocol defined by the `<Request>` and `<Response>` elements. The requester sends a `<Request>` element to a SAML responder, and the responder generates a `<Response>` element, as shown in Figure 2.

Figure 2: SAML Request-Response Protocol

3.1 Schema Header and Namespace Declarations

The following schema fragment defines the XML namespaces and other header information for the protocol schema:

```
<schema
   targetNamespace="urn:oasis:names:tc:SAML:1.0:protocol"
   xmlns="http://www.w3.org/2001/XMLSchema"
   xmlns:samlp="urn:oasis:names:tc:SAML:1.0:protocol"
   xmlns:saml="urn:oasis:names:tc:SAML:1.0:assertion"
   xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
   elementFormDefault="unqualified"
   attributeFormDefault="unqualified"
   version="1.1">
   <import namespace="urn:oasis:names:tc:SAML:1.0:assertion"
          schemaLocation="oasis-sstc-saml-schema-assertion-1.1.xsd"/>
   <import namespace="http://www.w3.org/2000/09/xmldsig#"
          schemaLocation=" http://www.w3.org/TR/xmldsig-core/xmldsig-core-
schema.xsd "/>
   <annotation>
          <documentation>
                Document identifier: oasis-sstc-saml-schema-protocol-1.1
                Location: http://www.oasis-
open.org/committees/documents.php?wg_abbrev=security
                Revision history:
                V1.0 (November, 2002):
                  Initial standard schema.
                V1.1 (September, 2003):
                  * Note that V1.1 of this schema has the same XML
                    namespace as V1.0.
                  Rebased ID content directly on XML Schema types
          </documentation>
   </annotation>
…
</schema>
```

3.2 Requests

The following sections define the SAML constructs that contain request information.

3.2.1 Complex Type RequestAbstractType

All SAML requests are of types that are derived from the abstract **RequestAbstractType** complex type. This type defines common attributes and elements that are associated with all SAML requests:

`RequestID` [Required]

An identifier for the request. It is of type **xsd:ID** and MUST follow the requirements specified in Section 1.2.3 for identifier uniqueness. The values of the `RequestID` attribute in a request and the `InResponseTo` attribute in the corresponding response MUST match.

`MajorVersion` [Required]

The major version of this request. The identifier for the version of SAML defined in this specification is `1`. SAML versioning is discussed in Section 4.

`MinorVersion` [Required]

The minor version of this request. The identifier for the version of SAML defined in this specification is `1`. SAML versioning is discussed in Section 4.

`IssueInstant` [Required]

The time instant of issue of the request. The time value is encoded in UTC as described in Section 1.2.2.

`<RespondWith>` [Any Number]

Each `<RespondWith>` element specifies a type of response that is acceptable to the requester.

`<ds:Signature>` [Optional]

An XML Signature that authenticates the request, as described in Section 5.

The following schema fragment defines the **RequestAbstractType** complex type:

```
<complexType name="RequestAbstractType" abstract="true">
  <sequence>
        <element ref="samlp:RespondWith"
                 minOccurs="0" maxOccurs="unbounded"/>
        <element ref = "ds:Signature" minOccurs="0"/>
  </sequence>
  <attribute name="RequestID" type="ID" use="required"/>
  <attribute name="MajorVersion" type="integer" use="required"/>
  <attribute name="MinorVersion" type="integer" use="required"/>
  <attribute name="IssueInstant" type="dateTime" use="required"/>
</complexType>
```

3.2.1.1 Element <RespondWith>

The `<RespondWith>` element specifies the type of statement the SAML relying party wants from the SAML authority. Multiple `<RespondWith>` elements MAY be included to indicate that the relying party will accept assertions containing any of the specified types. If no `<RespondWith>` element is given, the SAML authority MAY return assertions containing statements of any type.

NOTE: This element is deprecated; use of this element SHOULD be avoided because it is planned to be removed in the next major version of SAML.

If the `<Request>` element contains one or more `<RespondWith>` elements, the SAML authority MUST NOT respond with assertions containing statements of any type not specified in one of the `<RespondWith>` elements.

Inability to find assertions that meet `<RespondWith>` criteria should be treated as identical to any other query for which no assertions are available. In both cases a status of success MUST be returned in the Response message, but no assertions will be included.

The content of each <RespondWith> element is an XML QName. The <RespondWith> content is either the QName of the desired SAML statement element name or, in the case of an extension schema, it is the QName of the SAML **StatementAbstractType** complex type or some type that was derived from it. In the case of an extension schema, all statements of the specified type are requested.

For example, a relying party that wishes to receive assertions containing only attribute statements would specify <RespondWith>saml:AttributeStatement</RespondWith>, where the prefix is bound to the SAML assertion namespace in a namespace declaration that is in the scope of this element.

The following schema fragment defines the <RespondWith> element:

```
<element name="RespondWith" type="QName"/>
```

3.2.2 Element <Request>

The <Request> element specifies a SAML request. It provides either a query or a request for a specific assertion identified by <AssertionIDReference> or <AssertionArtifact>. It has the complex type **RequestType**, which extends **RequestAbstractType** by adding a choice of one of the following elements:

<Query>

An extension point that allows extension schemas to define new types of query.

<SubjectQuery>

An extension point that allows extension schemas to define new types of query that specify a single SAML subject.

<AuthenticationQuery>

Makes a query for authentication information.

<AttributeQuery>

Makes a query for attribute information.

<AuthorizationDecisionQuery>

Makes a query for an authorization decision.

<AssertionIDReference> [One or more]

Requests an assertion by reference to the value of its AssertionID attribute.

<AssertionArtifact> [One or more]

Requests assertions by supplying an assertion artifact that represents it.

The following schema fragment defines the <Request> element and its **RequestType** complex type:

```
<element name="Request" type="samlp:RequestType"/>
<complexType name="RequestType">
   <complexContent>
         <extension base="samlp:RequestAbstractType">
               <choice>
                     <element ref="samlp:Query"/>
                     <element ref="samlp:SubjectQuery"/>
                     <element ref="samlp:AuthenticationQuery"/>
                     <element ref="samlp:AttributeQuery"/>
                     <element ref="samlp:AuthorizationDecisionQuery"/>
                     <element ref="saml:AssertionIDReference"
maxOccurs="unbounded"/>
                     <element ref="samlp:AssertionArtifact"
maxOccurs="unbounded"/>
               </choice>
         </extension>
   </complexContent>
</complexType>
```

3.2.2.1 Requests for Assertions by Reference

In the context of a <Request> element, the <saml:AssertionIDReference> element is used to request an assertion by means of its ID. See Section 2.3.1 for more information on this element.

3.2.2.2 Element <AssertionArtifact>

The <AssertionArtifact> element is used to specify the assertion artifact that represents an assertion being requested. Its use is governed by the specific profile of SAML that is being used; see the SAML specification for bindings and profiles **[SAMLBind]** for more information on the use of assertion artifacts in profiles.

The following schema fragment defines the <AssertionArtifact> element:

```
<element name="AssertionArtifact" type="string"/>
```

3.3 Queries

The following sections define the SAML constructs that contain query information.

3.3.1 Element <Query>

The <Query> element is an extension point that allows new SAML queries to be defined. Its **QueryAbstractType** is abstract and is thus usable only as the base of a derived type. **QueryAbstractType** is the base type from which all SAML query elements are derived.

The following schema fragment defines the <Query> element and its **QueryAbstractType** complex type:

```
<element name="Query" type="samlp:QueryAbstractType"/>
<complexType name="QueryAbstractType" abstract="true"/>
```

3.3.2 Element <SubjectQuery>

The <SubjectQuery> element is an extension point that allows new SAML queries that specify a single SAML subject. Its **SubjectQueryAbstractType** complex type is abstract and is thus usable only as the base of a derived type. **SubjectQueryAbstractType** adds the <Subject> element.

The following schema fragment defines the <SubjectQuery> element and its **SubjectQueryAbstractType** complex type:

```
<element name="SubjectQuery" type="samlp:SubjectQueryAbstractType"/>
<complexType name="SubjectQueryAbstractType" abstract="true">
  <complexContent>
        <extension base="samlp:QueryAbstractType">
              <sequence>
                    <element ref="saml:Subject"/>
              </sequence>
        </extension>
  </complexContent>
</complexType>
```

3.3.3 Element <AuthenticationQuery>

The <AuthenticationQuery> element is used to make the query “What assertions containing authentication statements are available for this subject?” A successful response will be in the form of assertions containing authentication statements.

The <AuthenticationQuery> element MUST NOT be used as a request for a new authentication using credentials provided in the request. <AuthenticationQuery> is a request for statements about

authentication acts that have occurred in a previous interaction between the indicated subject and the Authentication Authority.

This element is of type **AuthenticationQueryType**, which extends **SubjectQueryAbstractType** with the addition of the following attribute:

`AuthenticationMethod` [Optional]

If present, specifies a filter for possible responses. Such a query asks the question "What assertions containing authentication statements do you have for this subject with the supplied authentication method?"

In response to an authentication query, a SAML authority returns assertions with authentication statements as follows:

- Rules given in Section 3.4.4 for matching against the `<Subject>` element of the query identify the assertions that may be returned.
- If the `AuthenticationMethod` attribute is present in the query, at least one `<AuthenticationStatement>` element in the set of returned assertions MUST contain an `AuthenticationMethod` attribute that matches the `AuthenticationMethod attribute in the query`. It is OPTIONAL for the complete set of all such matching assertions to be returned in the response.
- If any `<RespondWith>` elements are present and none of them contain "`saml:AuthenticationStatement`", then the SAML authority returns no assertions with authentication statements. (See Section 3.2.1.1 for more information.)

The following schema fragment defines the `<AuthenticationQuery>` element and its **AuthenticationQueryType** complex type:

```
<element name="AuthenticationQuery" type="samlp:AuthenticationQueryType"/>
<complexType name="AuthenticationQueryType">
  <complexContent>
        <extension base="samlp:SubjectQueryAbstractType">
              <attribute name="AuthenticationMethod" type="anyURI"/>
        </extension>
  </complexContent>
</complexType>
```

3.3.4 Element <AttributeQuery>

The `<AttributeQuery>` element is used to make the query "Return the requested attributes for this subject." A successful response will be in the form of assertions containing attribute statements. This element is of type **AttributeQueryType**, which extends **SubjectQueryAbstractType** with the addition of the following element and attribute:

`Resource` [Optional]

If present, specifies that the attribute query is being made in order to evaluate a specific access request relating to the resource. The SAML authority MAY use the resource attribute to establish the scope of the request. It is permitted for this attribute to have the value of the empty URI reference (""), and the meaning is defined to be "the start of the current document", as specified by **[RFC 2396]** §4.2.

If the resource attribute is specified and the SAML authority does not wish to support resource-specific attribute queries, or if the resource value provided is invalid or unrecognized, then the Attribute Authority SHOULD respond with a top-level `<StatusCode>` value of `Responder` and a second-level `<StatusCode>` value of `ResourceNotRecognized`.

`<AttributeDesignator>` [Any Number] (see Section 2.4.4.1)

Each `<AttributeDesignator>` element specifies an attribute whose value is to be returned. If no attributes are specified, it indicates that all attributes allowed by policy are requested.

In response to an attribute query, a SAML authority returns assertions with attribute statements as follows:

- Rules given in Section 3.4.4 for matching against the `<Subject>` element of the query identify the assertions that may be returned.
- If any `<AttributeDesignator>` elements are present in the query, they constrain the attribute values returned, as noted above.
- The SAML authority MAY take the `Resource` attribute into account in further constraining the values returned, as noted above.
- The attribute values returned MAY be constrained by application-specific policy considerations.
- If any `<RespondWith>` elements are present and none of them contain "`saml:AttributeStatement`", then the SAML authority returns no assertions with attribute statements. (See Section 3.2.1.1 for more information.)

The following schema fragment defines the `<AttributeQuery>` element and its **AttributeQueryType** complex type:

```
<element name="AttributeQuery" type="samlp:AttributeQueryType"/>
<complexType name="AttributeQueryType">
   <complexContent>
          <extension base="samlp:SubjectQueryAbstractType">
                <sequence>
                      <element ref="saml:AttributeDesignator"
                            minOccurs="0" maxOccurs="unbounded"/>
                </sequence>
                <attribute name="Resource" type="anyURI" use="optional"/>
          </extension>
   </complexContent>
</complexType>
```

3.3.5 Element <AuthorizationDecisionQuery>

The `<AuthorizationDecisionQuery>` element is used to make the query "Should these actions on this resource be allowed for this subject, given this evidence?" A successful response will be in the form of assertions containing authorization decision statements. This element is of type **AuthorizationDecisionQueryType**, which extends **SubjectQueryAbstractType** with the addition of the following elements and attribute:

`Resource` [Required]

A URI reference indicating the resource for which authorization is requested.

`<Action>` [One or More]

The actions for which authorization is requested.

`<Evidence>` [Optional]

A set of assertions that the SAML authority MAY rely on in making its authorization decision.

In response to an authorization decision query, a SAML authority returns assertions with authorization decision statements as follows:

- Rules given in Section 3.4.4 for matching against the `<Subject>` element of the query identify the assertions that may be returned.
- If any `<RespondWith>` elements are present and none of them contain "`saml:AuthorizationDecisionStatement`", then the SAML authority returns no assertions with authorization decision statements. (See Section 3.2.1.1 for more information.)

The following schema fragment defines the `<AuthorizationDecisionQuery>` element and its **AuthorizationDecisionQueryType** complex type:

```
<element name="AuthorizationDecisionQuery"
type="samlp:AuthorizationDecisionQueryType"/>
<complexType name="AuthorizationDecisionQueryType">
   <complexContent>
         <extension base="samlp:SubjectQueryAbstractType">
               <sequence>
                     <element ref="saml:Action" maxOccurs="unbounded"/>
                     <element ref="saml:Evidence" minOccurs="0"/>
               </sequence>
               <attribute name="Resource" type="anyURI" use="required"/>
         </extension>
   </complexContent>
</complexType>
```

3.4 Responses

The following sections define the SAML constructs that contain response information.

3.4.1 Complex Type ResponseAbstractType

All SAML responses are of types that are derived from the abstract **ResponseAbstractType** complex type. This type defines common attributes and elements that are associated with all SAML responses:

`ResponseID` [Required]

An identifier for the response. It is of type **xsd:ID**, and MUST follow the requirements specified in Section 1.2.3 for identifier uniqueness.

`InResponseTo` [Optional]

A reference to the identifier of the request to which the response corresponds, if any. If the response is not generated in response to a request, or if the `RequestID` attribute value of a request cannot be determined (because the request is malformed), then this attribute MUST NOT be present. Otherwise, it MUST be present and its value MUST match the value of the corresponding `RequestID` attribute value.

`MajorVersion` [Required]

The major version of this response. The identifier for the version of SAML defined in this specification is `1`. SAML versioning is discussed in Section 4.

`MinorVersion` [Required]

The minor version of this response. The identifier for the version of SAML defined in this specification is `1`. SAML versioning is discussed in Section 4.

`IssueInstant` [Required]

The time instant of issue of the response. The time value is encoded in UTC as described in Section 1.2.2.

`Recipient` [Optional]

The intended recipient of this response. This is useful to prevent malicious forwarding of responses to unintended recipients, a protection that is required by some use profiles. It is set by the generator of the response to a URI reference that identifies the intended recipient. If present, the actual recipient MUST check that the URI reference identifies the recipient or a resource managed by the recipient. If it does not, the response MUST be discarded.

`<ds:Signature>` [Optional]

An XML Signature that authenticates the response, as described in Section 5.

The following schema fragment defines the **ResponseAbstractType** complex type:

```
<complexType name="ResponseAbstractType" abstract="true">
   <sequence>
         <element ref = "ds:Signature" minOccurs="0"/>
   </sequence>
   <attribute name="ResponseID" type="ID" use="required"/>
   <attribute name="InResponseTo" type="NCName" use="optional"/>
   <attribute name="MajorVersion" type="integer" use="required"/>
   <attribute name="MinorVersion" type="integer" use="required"/>
   <attribute name="IssueInstant" type="dateTime" use="required"/>
   <attribute name="Recipient" type="anyURI" use="optional"/>
</complexType>
```

3.4.2 Element <Response>

The `<Response>` element specifies the status of the corresponding SAML request and a list of zero or more assertions that answer the request. It has the complex type **ResponseType**, which extends **ResponseAbstractType** by adding the following elements in order:

`<Status>` [Required]

A code representing the status of the corresponding request.

`<Assertion>` [Any Number]

Specifies an assertion by value. (See Section 2.3.2 for more information.)

The following schema fragment defines the `<Response>` element and its **ResponseType** complex type:

```
<element name="Response" type="samlp:ResponseType"/>
<complexType name="ResponseType">
   <complexContent>
          <extension base="samlp:ResponseAbstractType">
                <sequence>
                      <element ref="samlp:Status"/>
                      <element ref="saml:Assertion" minOccurs="0"
maxOccurs="unbounded"/>
                </sequence>
          </extension>
   </complexContent>
</complexType>
```

3.4.3 Element <Status>

The <Status> element contains the following elements:

<StatusCode> [Required]

A code representing the status of the corresponding request.

<StatusMessage> [Optional]

A message which MAY be returned to an operator.

<StatusDetail> [Optional]

Additional information concerning an error condition.

The following schema fragment defines the <Status> element and its **StatusType** complex type:

```
<element name="Status" type="samlp:StatusType"/>
<complexType name="StatusType">
   <sequence>
          <element ref="samlp:StatusCode"/>
          <element ref="samlp:StatusMessage" minOccurs="0"/>
          <element ref="samlp:StatusDetail" minOccurs="0"/>
   </sequence>
</complexType>
```

3.4.3.1 Element <StatusCode>

The <StatusCode> element specifies one or more possibly nested, codes representing the status of the corresponding request. The <StatusCode> element has the following element and attribute:

Value [Required]

The status code value. This attribute contains an XML Schema QName; a namespace prefix MUST be provided. The value of the topmost <StatusCode> element MUST be from the top-level list provided in this section.

<StatusCode> [Optional]

A subordinate status code that provides more specific information on an error condition.

The top-level <StatusCode> values are QNames associated with the SAML protocol namespace. The local parts of these QNames are as follows:

1310 `Success`

1311 The request succeeded.

1312 `VersionMismatch`

1313 The SAML responder could not process the request because the version of the request message was
1314 incorrect.

1315 `Requester`

1316 The request could not be performed due to an error on the part of the requester.

1317 `Responder`

1318 The request could not be performed due to an error on the part of the SAML responder or SAML
1319 authority.

1320 The following second-level status codes are referenced at various places in the specification. Additional
1321 second-level status codes MAY be defined in future versions of the SAML specification.

1322 `RequestVersionTooHigh`

1323 The SAML responder cannot process the request because the protocol version specified in the
1324 request message is a major upgrade from the highest protocol version supported by the responder.

1325 `RequestVersionTooLow`

1326 The SAML responder cannot process the request because the protocol version specified in the
1327 request message is too low.

1328 `RequestVersionDeprecated`

1329 The SAML responder can not process any requests with the protocol version specified in the request.

1330 `TooManyResponses`

1331 The response message would contain more elements than the SAML responder will return.

1332 `RequestDenied`

1333 The SAML responder or SAML authority is able to process the request but has chosen not to
1334 respond. This status code MAY be used when there is concern about the security context of the
1335 request message or the sequence of request messages received from a particular requester.

1336 `ResourceNotRecognized`

1337 The SAML authority does not wish to support resource-specific attribute queries, or the resource
1338 value provided in the request message is invalid or unrecognized.

1339 SAML system entities are free to define more specific status codes in other namespaces, but MUST NOT
1340 define additional codes in the SAML assertion or protocol namespace.

1341 The QNames defined as status codes SHOULD be used only in the `<StatusCode>` element's `Value`
1342 attribute and have the above semantics only in that context.

1343 The following schema fragment defines the `<StatusCode>` element and its **StatusCodeType** complex
1344 type:

```
1345 <element name="StatusCode" type="samlp:StatusCodeType"/>
1346 <complexType name="StatusCodeType">
1347   <sequence>
1348         <element ref="samlp:StatusCode" minOccurs="0"/>
1349   </sequence>
1350   <attribute name="Value" type="QName" use="required"/>
1351 </complexType>
```

1352 3.4.3.2 Element <StatusMessage>

1353 The `<StatusMessage>` element specifies a message that MAY be returned to an operator:

The following schema fragment defines the <StatusMessage> element and its **StatusMessageType** complex type:

```
<element name="StatusMessage" type="string"/>
```

3.4.3.3 Element <StatusDetail>

The <StatusDetail> element MAY be used to specify additional information concerning an error condition.

The following schema fragment defines the <StatusDetail> element and its **StatusDetailType** complex type:

```
<element name="StatusDetail" type="samlp:StatusDetailType"/>
<complexType name="StatusDetailType">
   <sequence>
          <any namespace="##any" processContents="lax" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
</complexType>
```

3.4.4 Responses to Queries

In response to a query, every assertion returned by a SAML authority MUST contain at least one statement whose <saml:Subject> element **strongly matches** the <saml:Subject> element found in the query.

A <saml:Subject> element S1 strongly matches S2 if and only if the following two conditions both apply:

- If S2 includes a <saml:NameIdentifier> element, then S1 must include an identical <saml:NameIdentifier> element.
- If S2 includes a <saml:SubjectConfirmation> element, then S1 must include an identical <saml:SubjectConfirmation> element.

If the SAML authority cannot provide an assertion with any statements satisfying the constraints expressed by a query, the <Response> element MUST NOT contain an <Assertion> element and MUST include a <StatusCode> element with value Success. It MAY return a <StatusMessage> element with additional information.

4 SAML Versioning

The SAML specification set is versioned in two independent ways. Each is discussed in the following sections, along with processing rules for detecting and handling version differences, when applicable. Also included are guidelines on when and why specific version information is expected to change in future revisions of the specification.

When version information is expressed as both a Major and Minor version, it may be expressed discretely, or in the form *Major.Minor*. The version number $Major_B.Minor_B$ is higher than the version number $Major_A.Minor_A$ if and only if:

$$Major_B > Major_A \vee ((Major_B = Major_A) \wedge Minor_B > Minor_A)$$

4.1 SAML Specification Set Version

Each release of the SAML specification set will contain a major and minor version designation describing its relationship to earlier and later versions of the specification set. The version will be expressed in the content and filenames of published materials, including the specification set document(s), and XML schema instance(s). There are no normative processing rules surrounding specification set versioning, since it merely encompasses the collective release of normative specification documents which themselves contain processing rules.

The overall size and scope of changes to the specification set document(s) will informally dictate whether a set of changes constitutes a major or minor revision. In general, if the specification set is backwards compatible with an earlier specification set (that is, valid older messages, protocols, and semantics remain valid), then the new version will be a minor revision. Otherwise, the changes will constitute a major revision. Note that SAML V1.1 has made one backwards-incompatible change to SAML V1.0, described in Section 5.4.7.

4.1.1 Schema Version

As a non-normative documentation mechanism, any XML schema instances published as part of the specification set will contain a schema "version" attribute in the form *Major.Minor*, reflecting the specification set version in which it has been published. Validating implementations MAY use the attribute as a means of distinguishing which version of a schema is being used to validate messages, or to support a multiplicity of versions of the same logical schema.

4.1.2 SAML Assertion Version

The SAML `<Assertion>` element contains attributes for expressing the major and minor version of the assertion using a pair of integers. Each version of the SAML specification set will be construed so as to document the syntax, semantics, and processing rules of the assertions of the same version. That is, specification set version 1.0 describes assertion version 1.0, and so on.

There is explicitly NO relationship between the assertion version and the SAML assertion XML namespace that contains the schema definitions for that assertion version.

The following processing rules apply:

- A SAML authority MUST NOT issue any assertion with an assertion version number not supported by the authority.
- A SAML relying party MUST NOT process any assertion with a major assertion version number not supported by the relying party.
- A SAML relying party MAY process or MAY reject an assertion whose minor assertion version number is higher than the minor assertion version number supported by the relying party. However, all assertions that share a major assertion version number MUST share the same general processing

rules and semantics, and MAY be treated in a uniform way by an implementation. That is, if a V1.1 assertion shares the syntax of a V1.0 assertion, an implementation MAY treat the assertion as a V1.0 assertion without ill effect.

4.1.3 SAML Protocol Version

The SAML protocol `<Request>` and `<Response>` elements contain attributes for expressing the major and minor version of the request or response message using a pair of integers. Each version of the SAML specification set will be construed so as to document the syntax, semantics, and processing rules of the protocol messages of the same version. That is, specification set version 1.0 describes request and response version V1.0, and so on.

There is explicitly NO relationship between the protocol version and the SAML protocol XML namespace that contains the schema definitions for protocol messages for that protocol version.

The version numbers used in SAML protocol `<Request>` and `<Response>` elements will be the same for any particular revision of the SAML specification set.

4.1.3.1 Request Version

The following processing rules apply to requests:

- A SAML requester SHOULD issue requests with the highest request version supported by both the SAML requester and the SAML responder.
- If the SAML requester does not know the capabilities of the SAML responder, then it should assume that it supports requests with the highest request version supported by the requester.
- A SAML requester MUST NOT issue a request message with a request version number matching a response version number that the requester does not support.
- A SAML responder MUST reject any request with a major request version number not supported by the responder.
- A SAML responder MAY process or MAY reject any request whose minor request version number is higher than the highest supported request version that it supports. However, all requests that share a major request version number MUST share the same general processing rules and semantics, and MAY be treated in a uniform way by an implementation. That is, if a V1.1 request shares the syntax of a V1.0 request, a responder MAY treat the request message as a V1.0 request without ill effect.

4.1.4 Response Version

The following processing rules apply to responses:

- A SAML responder MUST NOT issue a response message with a response version number higher than the request version number of the corresponding request message.
- A SAML responder MUST NOT issue a response message with a major response version number lower than the major request version number of the corresponding request message except to report the error `RequestVersionTooHigh`.

An error response resulting from incompatible SAML protocol versions MUST result in reporting a top-level `<StatusCode>` value of `VersionMismatch`, and MAY result in reporting one of the following second-level values: `RequestVersionTooHigh`, `RequestVersionTooLow`, or `RequestVersionDeprecated`.

4.1.5 Permissible Version Combinations

In general, assertions of a particular major version may appear in response messages of the same major version, as permitted by the importation of the SAML assertion namespace into the SAML protocol schema. Future versions of this specification are expected to explicitly describe the permitted combinations across major versions.

Specifically, this permits a V1.1 assertion to appear in a V1.0 response message and a V1.0 assertion to appear in a V1.1 response message.

4.2 SAML Namespace Version

XML schema instances and "qualified names" (QNames) published as part of the specification set contain one or more target namespaces into which the type, element, and attribute definitions are placed. Each namespace is distinct from the others, and represents, in shorthand, the structural and syntactical definitions that make up that part of the specification.

The namespace URIs defined by the specification set will generally contain version information of the form *Major.Minor* somewhere in the URI. The major and minor version in the URI MUST correspond to the major and minor version of the specification set in which the namespace is first introduced and defined. This information is not typically consumed by an XML processor, which treats the namespace opaquely, but is intended to communicate the relationship between the specification set and the namespaces it defines.

As a general rule, implementers can expect the namespaces (and the associated schema definitions) defined by a major revision of the specification set to remain valid and stable across minor revisions of the specification. New namespaces may be introduced, and when necessary, old namespaces replaced, but this is expected to be rare. In such cases, the older namespaces and their associated definitions should be expected to remain valid until a major specification set revision.

4.2.1 Schema Evolution

In general, maintaining namespace stability while adding or changing the content of a schema are competing goals. While certain design strategies can facilitate such changes, it is complex to predict how older implementations will react to any given change, making forward compatibility difficult to achieve. Nevertheless, the right to make such changes in minor revisions is reserved, in the interest of namespace stability. Except in special circumstances (for example to correct major deficiencies or fix errors), implementations should expect forward compatible schema changes in minor revisions, allowing new messages to validate against older schemas.

Implementations SHOULD expect and be prepared to deal with new extensions and message types in accordance with the processing rules laid out for those types. Minor revisions MAY introduce new types that leverage the extension facilities described in Section 6. Older implementations SHOULD reject such extensions gracefully when they are encountered in contexts that dictate mandatory semantics. Examples include new query, statement, or condition types.

5 SAML and XML Signature Syntax and Processing

SAML assertions and SAML protocol request and response messages may be signed, with the following benefits:

- An assertion signed by the SAML authority supports:
  - Assertion integrity.
  - Authentication of the SAML authority to a SAML relying party.
  - If the signature is based on the SAML authority's public-private key pair, then it also provides for non-repudiation of origin.
- A SAML protocol request or response message signed by the message originator supports:
  - Message integrity.
  - Authentication of message origin to a destination.
  - If the signature is based on the originator's public-private key pair, then it also provides for non-repudiation of origin.

A digital signature is not always required in SAML. For example, it may not be required in the following situations:

- In some circumstances signatures may be "inherited," such as when an unsigned assertion gains protection from a signature on the containing protocol response message. "Inherited" signatures should be used with care when the contained object (such as the assertion) is intended to have a non-transitory lifetime. The reason is that the entire context must be retained to allow validation, exposing the XML content and adding potentially unnecessary overhead.
- The SAML relying party or SAML requester may have obtained an assertion or protocol message from the SAML authority or SAML responder directly (with no intermediaries) through a secure channel, with the SAML authority or SAML responder having authenticated to the relying party or SAML responder by some means other than a digital signature.

Many different techniques are available for "direct" authentication and secure channel establishment between two parties. The list includes TLS/SSL, HMAC, password-based mechanisms, etc. In addition, the applicable security requirements depend on the communicating applications and the nature of the assertion or message transported.

It is recommended that, in all other contexts, digital signatures be used for assertions and request and response messages. Specifically:

- A SAML assertion obtained by a SAML relying party from an entity other than the SAML authority SHOULD be signed by the SAML authority.
- A SAML protocol message arriving at a destination from an entity other than the originating site SHOULD be signed by the origin site.

Profiles may specify alternative signature mechanisms such as S/MIME or signed Java objects that contain SAML documents. Caveats about retaining context and interoperability apply. XML Signatures are intended to be the primary SAML signature mechanism, but the specification attempts to ensure compatibility with profiles that may require other mechanisms.

Unless a profile specifies an alternative signature mechanism, enveloped XML Digital Signatures MUST be used if signing.

5.1 Signing Assertions

All SAML assertions MAY be signed using the XML Signature. This is reflected in the assertion schema as described in Section 2.3.

5.2 Request/Response Signing

All SAML protocol request and response messages MAY be signed using the XML Signature. This is reflected in the schema as described in Sections 3.2 and 3.4.

5.3 Signature Inheritance

A SAML assertion may be embedded within another SAML element, such as an enclosing `<Assertion>` or a `<Request>` or `<Response>`, which may be signed. When a SAML assertion does not contain a `<ds:Signature>` element, but is contained in an enclosing SAML element that contains a `<ds:Signature>` element, and the signature applies to the `<Assertion>` element and all its children, then the assertion can be considered to inherit the signature from the enclosing element. The resulting interpretation should be equivalent to the case where the assertion itself was signed with the same key and signature options.

Many SAML use cases involve SAML XML data enclosed within other protected data structures such as signed SOAP messages, S/MIME packages, and authenticated SSL connections. SAML profiles may define additional rules for interpreting SAML elements as inheriting signatures or other authentication information from the surrounding context, but no such inheritance should be inferred unless specifically identified by the profile.

5.4 XML Signature Profile

The XML Signature specification **[XMLSig]** calls out a general XML syntax for signing data with flexibility and many choices. This section details the constraints on these facilities so that SAML processors do not have to deal with the full generality of XML Signature processing. This usage makes specific use of the **xsd:ID**-typed attributes optionally present on the root elements to which signatures can apply: the `AssertionID` attribute on `<Assertion>`, the `RequestID` attribute on `<Request>`, and the `ResponseID` attribute on `<Response>`. These three attributes are collectively referred to in this section as the identifier attributes.

5.4.1 Signing Formats and Algorithms

XML Signature has three ways of relating a signature to a document: enveloping, enveloped, and detached.

SAML assertions and protocols MUST use enveloped signatures when signing assertions and protocol messages. SAML processors SHOULD support the use of RSA signing and verification for public key operations in accordance with the algorithm identified by http://www.w3.org/2000/09/xmldsig#rsa-sha1.

5.4.2 References

Signed SAML assertions and protocol messages MUST supply a value for the identifier attribute on the root element (`<Assertion>`, `<Request>`, or `<Response>`). The assertion's or message's root element may or may not be the root element of the actual XML document containing the signed assertion or message.

Signatures MUST contain a single `<ds:Reference>` containing a URI reference to the identifier attribute value of the root element of the message being signed. For example, if the attribute value is "foo", then the `URI` attribute in the `<ds:Reference>` element MUST be "#foo".

5.4.3 Canonicalization Method

SAML implementations SHOULD use Exclusive Canonicalization **[Excl-C14N]**, with or without comments, both in the `<ds:CanonicalizationMethod>` element of `<ds:SignedInfo>`, and as a `<ds:Transform>` algorithm. Use of Exclusive Canonicalization ensures that signatures created over SAML messages embedded in an XML context can be verified independent of that context.

5.4.4 Transforms

Signatures in SAML messages SHOULD NOT contain transforms other than the enveloped signature transform (with the identifier http://www.w3.org/2000/09/xmldsig#enveloped-signature) or the exclusive canonicalization transforms (with the identifier http://www.w3.org/2001/10/xml-exc-c14n# or http://www.w3.org/2001/10/xml-exc-c14n#WithComments).

Verifiers of signatures MAY reject signatures that contain other transform algorithms as invalid. If they do not, verifiers MUST ensure that no content of the SAML message is excluded from the signature. This can be accomplished by establishing out-of-band agreement as to what transforms are acceptable, or by applying the transforms manually to the content and reverifying the result as consisting of the same SAML message.

5.4.5 KeyInfo

XML Signature **[XMLSig]** defines usage of the `<ds:KeyInfo> element`. SAML does not require the use of `<ds:KeyInfo>` nor does it impose any restrictions on its use. Therefore, `<ds:KeyInfo>` MAY be absent.

5.4.6 Binding Between Statements in a Multi-Statement Assertion

Use of signing does not affect semantics of statements within assertions in any way, as stated in Section 2.

5.4.7 Interoperability with SAML V1.0

The use of XML Signature **[XMLSig]** described above is incompatible with the usage described in the SAML V1.0 specification **[SAMLCore1.0]**. The original profile was underspecified and was insufficient to ensure interoperability. It was constrained by the inability to use URI references to identify the SAML content to be signed. With this limitation removed by the addition of SAML identifier attributes, a decision has been made to forgo backwards compatibility with the older specification in this respect.

5.4.8 Example

Following is an example of a signed response containing a signed assertion. Line breaks have been added for readability; the signatures are not valid and cannot be successfully verified.

```
<Response
  IssueInstant="2003-04-17T00:46:02Z"
  MajorVersion="1"
  MinorVersion="1"
  Recipient="www.opensaml.org"
  ResponseID="_c7055387-af61-4fce-8b98-e2927324b306"
  xmlns="urn:oasis:names:tc:SAML:1.0:protocol"
  xmlns:samlp="urn:oasis:names:tc:SAML:1.0:protocol"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<ds:Signature
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
<ds:SignedInfo>
<ds:CanonicalizationMethod
  Algorithm="http://www.w3.org/2001/10/xml-exc-c14n#"/>
<ds:SignatureMethod
  Algorithm="http://www.w3.org/2000/09/xmldsig#rsa-sha1"/>
<ds:Reference
  URI="#_c7055387-af61-4fce-8b98-e2927324b306">
<ds:Transforms>
<ds:Transform
  Algorithm="http://www.w3.org/2000/09/xmldsig#enveloped-signature"/>
<ds:Transform
```

```
  Algorithm="http://www.w3.org/2001/10/xml-exc-c14n#">
<InclusiveNamespaces
  PrefixList="#default saml samlp ds xsd xsi"
  xmlns="http://www.w3.org/2001/10/xml-exc-c14n#"/>
</ds:Transform>
</ds:Transforms>
<ds:DigestMethod
  Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
<ds:DigestValue>TCDVSuG6grhyHbzhQFWFzGrxIPE=</ds:DigestValue>
</ds:Reference>
</ds:SignedInfo>
<ds:SignatureValue>
x/GyPbzmFEe85pGD3c1aXG4Vspb9V9jGCjwcRCKrtwPS6vdVNCcY5rHaFPYWkf+5
EIYcPzx+pX1h43SmwviCqXRjRtMANWbHLhWAptaK1ywS7gFgsD01qjyen3CP+m3D
w6vKhaqledl0BYyrIzb4KkHO4ahNyBVXbJwqv5pUaE4=</ds:SignatureValue>
<ds:KeyInfo>
<ds:X509Data>
<ds:X509Certificate>
MIICyjCCAjOgAwIBAgICAnUwDQYJKoZIhvcNAQEEBQAwgakxCzAJBgNVBAYTAlVT
MRIwEAYDVQQIEwlXaXNjb25zaW4xEDAOBgNVBAcTB01hZGlzb24xIDAeBgNVBAoT
F1VuaXZlcnNpdHkgb2YgV2lzY29uc2luMSswKQYDVQQLEyJEaXZpc2lvbiBvZiBJ
bmZvcm1hdGlvbiBUZWNobm9sb2d5MSUwIwYDVQQDExxIRVBLSSBTZXJ2ZXIgQ0Eg
LS0gMjAwMjA3MDFBMB4XDTAyMDcyNjA3Mjc1MVoXDTA2MDkwNDA3Mjc1MVowgYsx
CzAJBgNVBAYTAlVTMREwDwYDVQQIEwhNaWNoaWdhbjESMBAGA1UEBxMJQW5uIEFy
Ym9yMQ4wDAYDVQQKEwVVQ0FJRDEcMBoGA1UEAxMTc2hpYjEuaW50ZXJuZXQyLmVk
dTEnMCUGCSqGSIb3DQEJARYYcm9vdEBzaGliMS5pbnRlcm5ldDIuZWR1MIGfMA0G
CSqGSIb3DQEBAQUAA4GNADCBiQKBgQDZSAb2sxvhAXnXVIVTx8vuRay+x50z7GJj
IHRYQgIv6IqaGG04eTcyVMhoekE0b45QgvBIaOAPSZBl13R6+KYiE7x4XAWIrCP+
c2MZVeXeTgV3Yz+USLg2Y1on+Jh4HxwkPFmZBctyXiUr6DxF8rvoP9W7O27rhRjE
pmqOIfGTWQIDAQABox0wGzAMBgNVHRMBAf8EAjAAMAsGA1UdDwQEAwIFoDANBgkq
hkiG9w0BAQQFAAOBgQBfDqEW+OI3jqBQHIBzhujN/PizdN7s/z4D5d3pptWDJf2n
qgi7lFV6MDkhmTvTqBtjmNk3No7v/dnP6Hr7wHxvCCRwubnmIfZ6QZAv2FU78pLX
8I3bsbmRAUg4UP9hH6ABVq4KQKMknxu1xQxLhpR1ylGPdiowMNTrEG8cCx3w/w==
</ds:X509Certificate>
</ds:X509Data>
</ds:KeyInfo>
</ds:Signature>
<Status><StatusCode Value="samlp:Success"/></Status>
<Assertion
  AssertionID="_a75adf55-01d7-40cc-929f-dbd8372ebdfc"
  IssueInstant="2003-04-17T00:46:02Z"
  Issuer="www.opensaml.org"
  MajorVersion="1"
  MinorVersion="1"
  xmlns="urn:oasis:names:tc:SAML:1.0:assertion"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<Conditions
  NotBefore="2003-04-17T00:46:02Z"
  NotOnOrAfter="2003-04-17T00:51:02Z">
<AudienceRestrictionCondition><Audience>http://www.opensaml.org</Audience>
</AudienceRestrictionCondition></Conditions>
<AuthenticationStatement
  AuthenticationInstant="2003-04-17T00:46:00Z"
  AuthenticationMethod="urn:oasis:names:tc:SAML:1.0:am:password">
<Subject>
<NameIdentifier
  Format="urn:oasis:names:tc:SAML:1.1:nameid-format:emailAddress">
scott@example.org</NameIdentifier>
<SubjectConfirmation>
<ConfirmationMethod>urn:oasis:names:tc:SAML:1.0:cm:bearer</ConfirmationMethod>
</SubjectConfirmation></Subject>
<SubjectLocality
```

```
  IPAddress="127.0.0.1"/>
</AuthenticationStatement>
<ds:Signature
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
<ds:SignedInfo>
<ds:CanonicalizationMethod
  Algorithm="http://www.w3.org/2001/10/xml-exc-c14n#"/>
<ds:SignatureMethod
  Algorithm="http://www.w3.org/2000/09/xmldsig#rsa-sha1"/>
<ds:Reference
  URI="#_a75adf55-01d7-40cc-929f-dbd8372ebdfc">
<ds:Transforms>
<ds:Transform
  Algorithm="http://www.w3.org/2000/09/xmldsig#enveloped-signature"/>
<ds:Transform
  Algorithm="http://www.w3.org/2001/10/xml-exc-c14n#">
<InclusiveNamespaces
  PrefixList="#default saml samlp ds xsd xsi"
  xmlns="http://www.w3.org/2001/10/xml-exc-c14n#"/>
</ds:Transform>
</ds:Transforms>
<ds:DigestMethod
  Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
<ds:DigestValue>Kclet6XcaOgOWXM4gty6/UNdviI=</ds:DigestValue>
</ds:Reference>
</ds:SignedInfo>
<ds:SignatureValue>
hq4zk+ZknjggCQgZm7ea8fI79gJEsRy3E8LHDpYXWQIgZpkJN9CMLG8ENR4Nrw+n
7iyzixBvKXX8P53BTCT4VghPBWhFYSt9tHWu/AtJfOTh6qaAsNdeCyG86jmtp3TD
MWuL/cBUj2OtBZOQMFn7jQ9YB7klIz3RqVL+wNmeWI4=</ds:SignatureValue>
<ds:KeyInfo>
<ds:X509Data>
<ds:X509Certificate>
MIICyjCCAjOgAwIBAgICAnUwDQYJKoZIhvcNAQEEBQAwgakxCzAJBgNVBAYTAlVT
MRIwEAYDVQQIEwlXaXNjb25zaW4xEDAOBgNVBAcTB01hZGlzb24xIDAeBgNVBAoT
F1VuaXZlcnNpdHkgb2YgV2lzY29uc2luMSswKQYDVQQLEyJEaXZpc2lvbiBvZiBJ
bmZvcm1hdGlvbiBUZWNobm9sb2d5MSUwIwYDVQQDExxIRVBLSSBTZXJ2ZXIgQ0Eg
LS0gMjAwMjA3MDFBMB4XDTAyMDcyNjA3Mjc1MVoXDTA2MDkwNDA3Mjc1MVowgYsx
CzAJBgNVBAYTAlVTMREwDwYDVQQIEwhNaWNoaWdhbjESMBAGA1UEBxMJQW5uIEFy
Ym9yMQ4wDAYDVQQKEwVVQ0FJRDEcMBoGA1UEAxMTc2hpYjEuaW50ZXJuZXQyLmVk
dTEnMCUGCSqGSIb3DQEJARYYcm9vdEBzaGliMS5pbnRlcm5ldDIuZWR1MIGfMA0G
CSqGSIb3DQEBAQUAA4GNADCBiQKBgQDZSAb2sxvhAXnXVIVTx8vuRay+x50z7GJj
IHRYQgIv6IqaGG04eTcyVMhoekE0b45QgvBIaOAPSZBl13R6+KYiE7x4XAWIrCP+
c2MZVeXeTgV3Yz+USLg2Y1on+Jh4HxwkPFmZBctyXiUr6DxF8rvoP9W7O27rhRjE
pmqOIfGTWQIDAQABox0wGzAMBgNVHRMBAf8EAjAAMAsGA1UdDwQEAwIFoDANBgkq
hkiG9w0BAQQFAAOBgQBfDqEW+OI3jqBQHIBzhujN/PizdN7s/z4D5d3pptWDJf2n
qgi7lFV6MDkhmTvTqBtjmNk3No7v/dnP6Hr7wHxvCCRwubnmIfZ6QZAv2FU78pLX
8I3bsbmRAUg4UP9hH6ABVq4KQKMknxu1xQxLhpR1ylGPdiowMNTrEG8cCx3w/w==
</ds:X509Certificate>
</ds:X509Data>
</ds:KeyInfo>
</ds:Signature></Assertion></Response>
```

6 SAML Extensions

The SAML schemas support extensibility. An example of an application that extends SAML assertions is the Liberty Protocols and Schema Specification **[LibertyProt]**. The following sections explain how to use the extensibility features in SAML to create extension schemas.

Note that elements in the SAML schemas are not blocked from substitution, so that all SAML elements MAY serve as the head element of a substitution group. Also, types are not defined as `final`, so that all SAML types MAY be extended and restricted. The following sections discuss only elements that have been specifically designed to support extensibility.

6.1 Assertion Schema Extension

The SAML assertion schema is designed to permit separate processing of the assertion package and the statements it contains, if the extension mechanism is used for either part.

The following elements are intended specifically for use as extension points in an extension schema; their types are set to `abstract`, and are thus usable only as the base of a derived type:

- `<Condition>`
- `<Statement>`
- `<SubjectStatement>`

The following elements that are directly usable as part of SAML MAY be extended:

- `<AuthenticationStatement>`
- `<AuthorizationDecisionStatement>`
- `<AttributeStatement>`
- `<AudienceRestrictionCondition>`

The following elements are defined to allow elements from arbitrary namespaces within them, which serves as a built-in extension point without requiring an extension schema:

- `<AttributeValue>`
- `<Advice>`

6.2 Protocol Schema Extension

The following SAML protocol elements are intended specifically for use as extension points in an extension schema; their types are set to `abstract`, and are thus usable only as the base of a derived type:

- `<Query>`
- `<SubjectQuery>`

The following elements that are directly usable as part of SAML MAY be extended:

- `<Request>`
- `<AuthenticationQuery>`
- `<AuthorizationDecisionQuery>`
- `<AttributeQuery>`
- `<Response>`

6.3 Use of Type Derivation and Substitution Groups

W3C XML Schema **[Schema1]** provides two principal mechanisms for specifying an element of an extended type: type derivation and substitution groups.

For example, a <Statement> element can be assigned the type **NewStatementType** by means of the xsi:type attribute. For such an element to be schema-valid, **NewStatementType** needs to be derived from **StatementType**. The following example of a SAML assertion assumes that the extension schema (represented by the new: prefix) has defined this new type:

```
<saml:Assertion …>
  <saml:Statement xsi:type="new:NewStatementType">
  …
  </saml:Statement>
</saml:Assertion>
```

Alternatively, the extension schema can define a <NewStatement> element that is a member of a substitution group that has <Statement> as a head element. For the substituted element to be schema-valid, it needs to have a type that matches or is derived from the head element's type. The following is an example of an extension schema fragment that defines this new element:

```
<xsd:element "NewStatement" type="new:NewStatementType"
      substitutionGroup="saml:Statement"/>
```

The substitution group declaration allows the <NewStatement> element to be used anywhere the SAML <Statement> element can be used. The following is an example of a SAML assertion that uses the extension element:

```
<saml:Assertion …>
   <new:NewStatement>
      …
   </new:NewStatement>
</saml:Assertion>
```

The choice of extension method has no effect on the semantics of the XML document but does have implications for interoperability.

The advantages of type derivation are as follows:

- A document can be more fully interpreted by a parser that does not have access to the extension schema because a "native" SAML element is available.
- At the time of this writing, some W3C XML Schema validators do not support substitution groups, whereas the xsi:type attribute is widely supported.

The advantage of substitution groups is that a document can be explained without the need to explain the functioning of the xsi:type attribute.

7 SAML-Defined Identifiers

The following sections define URI-based identifiers for common authentication methods, resource access actions, and subject name identifier formats.

Where possible an existing URN is used to specify a protocol. In the case of IETF protocols the URN of the most current RFC that specifies the protocol is used. URI references created specifically for SAML have one of the following stems:

```
urn:oasis:names:tc:SAML:1.0:
urn:oasis:names:tc:SAML:1.1:
```

7.1 Authentication Method Identifiers

The `AuthenticationMethod` attribute of an `<AuthenticationStatement>` and the `<SubjectConfirmationMethod>` element of a SAML subject perform different functions, although both can refer to the same underlying mechanisms. An authentication statement with an `AuthenticationMethod` attribute describes an authentication act that occurred in the past. The `AuthenticationMethod` attribute indicates how that authentication was done. Note that the authentication statement does not provide the means to perform that authentication, such as a password, key, or certificate.

In contrast, `<SubjectConfirmationMethod>` is a part of the `<SubjectConfirmation>` element, which is an optional part of a SAML subject. `<SubjectConfirmation>` is used to allow the SAML relying party to confirm that the request or message came from a system entity that corresponds to the subject in the statement or query. The `<SubjectConfirmationMethod>` element indicates the method that the relying party can use to do this in the future. This may or may not have any relationship to an authentication that was performed previously. Unlike the authentication method, the subject confirmation method may be accompanied by some piece of information, such as a certificate or key, that will allow the relying party to perform the necessary check.

Subject confirmation methods are defined in the SAML profiles in which they are used; see the SAML bindings and profiles specification **[SAMLBind]** for more information. Additional methods may be added by defining new profiles or by private agreement.

The following identifiers refer to SAML-specified authentication methods.

7.1.1 Password

URI: urn:oasis:names:tc:SAML:1.0:am:password

The authentication was performed by means of a password.

7.1.2 Kerberos

URI: urn:ietf:rfc:1510

The authentication was performed by means of the Kerberos protocol **[RFC 1510]**, an instantiation of the Needham-Schroeder symmetric key authentication mechanism **[Needham78]**.

7.1.3 Secure Remote Password (SRP)

URI: urn:ietf:rfc:2945

The authentication was performed by means of Secure Remote Password protocol as specified in **[RFC 2945]**.

7.1.4 Hardware Token

URI: urn:oasis:names:tc:SAML:1.0:am:HardwareToken

The authentication was performed using some (unspecified) hardware token.

7.1.5 SSL/TLS Certificate Based Client Authentication:

URI: urn:ietf:rfc:2246

The authentication was performed using either the SSL or TLS protocol with certificate-based client authentication. TLS is described in **[RFC 2246]**.

7.1.6 X.509 Public Key

URI: urn:oasis:names:tc:SAML:1.0:am:X509-PKI

The authentication was performed by some (unspecified) mechanism on a key authenticated by means of an X.509 PKI **[X.500][PKIX]**. It may have been one of the mechanisms for which a more specific identifier has been defined below.

7.1.7 PGP Public Key

URI: urn:oasis:names:tc:SAML:1.0:am:PGP

The authentication was performed by some (unspecified) mechanism on a key authenticated by means of a PGP web of trust **[PGP]**. It may have been one of the mechanisms for which a more specific identifier has been defined below.

7.1.8 SPKI Public Key

URI: urn:oasis:names:tc:SAML:1.0:am:SPKI

The authentication was performed by some (unspecified) mechanism on a key authenticated by means of a SPKI PKI **[SPKI]**. It may have been one of the mechanisms for which a more specific identifier has been defined below.

7.1.9 XKMS Public Key

URI: urn:oasis:names:tc:SAML:1.0:am:XKMS

The authentication was performed by some (unspecified) mechanism on a key authenticated by means of a XKMS trust service **[XKMS]**. It may have been one of the mechanisms for which a more specific identifier has been defined below.

7.1.10 XML Digital Signature

URI: urn:ietf:rfc:3075

The authentication was performed by means of an XML digital signature **[RFC 3075]**.

7.1.11 Unspecified

URI: urn:oasis:names:tc:SAML:1.0:am:unspecified

The authentication was performed by an unspecified means.

7.2 Action Namespace Identifiers

The following identifiers MAY be used in the `Namespace` attribute of the `<Action>` element (see Section 2.4.5.1) to refer to common sets of actions to perform on resources.

7.2.1 Read/Write/Execute/Delete/Control

URI: urn:oasis:names:tc:SAML:1.0:action:rwedc

Defined actions:

```
Read Write Execute Delete Control
```

These actions are interpreted as follows:

`Read`

The subject may read the resource.

`Write`

The subject may modify the resource.

`Execute`

The subject may execute the resource.

`Delete`

The subject may delete the resource.

`Control`

The subject may specify the access control policy for the resource.

7.2.2 Read/Write/Execute/Delete/Control with Negation

URI: urn:oasis:names:tc:SAML:1.0:action:rwedc-negation

Defined actions:

```
Read Write Execute Delete Control ~Read ~Write ~Execute ~Delete ~Control
```

The actions specified in Section 7.2.1 are interpreted in the same manner described there. Actions prefixed with a tilde (~) are negated permissions and are used to affirmatively specify that the stated permission is denied. Thus a subject described as being authorized to perform the action `~Read` is affirmatively denied read permission.

A SAML authority MUST NOT authorize both an action and its negated form.

7.2.3 Get/Head/Put/Post

URI: urn:oasis:names:tc:SAML:1.0:action:ghpp

Defined actions:

```
GET HEAD PUT POST
```

These actions bind to the corresponding HTTP operations. For example a subject authorized to perform the `GET` action on a resource is authorized to retrieve it.

The `GET` and `HEAD` actions loosely correspond to the conventional read permission and the `PUT` and `POST` actions to the write permission. The correspondence is not exact however since an HTTP GET operation may cause data to be modified and a POST operation may cause modification to a resource other than the one specified in the request. For this reason a separate Action URI reference specifier is provided.

7.2.4 UNIX File Permissions

URI: urn:oasis:names:tc:SAML:1.0:action:unix

The defined actions are the set of UNIX file access permissions expressed in the numeric (octal) notation.

The action string is a four-digit numeric code:

extended user group world

Where the *extended* access permission has the value

+2 if sgid is set

+4 if suid is set

The *user group* and *world* access permissions have the value

+1 if execute permission is granted

+2 if write permission is granted

+4 if read permission is granted

For example, `0754` denotes the UNIX file access permission: user read, write and execute; group read and execute; and world read.

7.3 NameIdentifier Format Identifiers

The following identifiers MAY be used in the Format attribute of the `<NameIdentifier>` element (see Section 2.4.2.2) to refer to common formats for the content of the `<NameIdentifier>` element. The recommended identifiers shown below SHOULD be used in preference to the deprecated identifiers, which are planned to be removed in the next major version of the SAML assertion specification.

7.3.1 Unspecified

URI: urn:oasis:names:tc:SAML:1.1:nameid-format:unspecified

The interpretation of the content of the `<NameQualifier>` element is left to individual implementations.

7.3.2 Email Address

Recommended URI: urn:oasis:names:tc:SAML:1.1:nameid-format:emailAddress

Deprecated URI: urn:oasis:names:tc:SAML:1.0:assertion#emailAddress

Indicates that the content of the `<NameIdentifier>` element is in the form of an email address, specifically "addr-spec" as defined in IETF RFC 2822 **[RFC 2822]** §3.4.1. An addr-spec has the form local-part@domain. Note that an addr-spec has no phrase (such as a common name) before it, has no comment (text surrounded in parentheses) after it, and is not surrounded by "<" and ">".

7.3.3 X.509 Subject Name

Recommended URI: urn:oasis:names:tc:SAML:1.1:nameid-format:X509SubjectName

Deprecated URI: urn:oasis:names:tc:SAML:1.0:assertion#X509SubjectName

Indicates that the content of the `<NameIdentifier>` element is in the form specified for the contents of the `<ds:X509SubjectName>` element in the XML Signature Recommendation **[XMLSig]**. Implementors should note that the XML Signature specification specifies encoding rules for X.509 subject names that differ from the rules given in IETF RFC 2253 **[RFC 2253]**.

7.3.4 Windows Domain Qualified Name

Recommended URI: urn:oasis:names:tc:SAML:1.1:nameid-format:WindowsDomainQualifiedName

Deprecated URI: urn:oasis:names:tc:SAML:1.0:assertion#WindowsDomainQualifiedName

Indicates that the content of the `<NameIdentifier>` element is a Windows domain qualified name. A Windows domain qualified user name is a string of the form "DomainName\UserName". The domain name and "\" separator MAY be omitted.

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