SAML V2.0 Attribute Predicate Profile Version 1.0

Working Draft 01

17 May 2011

Abstract:
This profile provides a mechanism to allow a SAML authority to certify that a given Boolean predicate holds over one or more of a subject’s attribute values, without revealing the exact values of these attributes. The profile further defines a query format for attribute predicates.

Status:
This Working Draft (WD) has been produced by one or more TC Members; it has not yet been voted on by the TC or approved as a Committee Draft (Committee Specification Draft or a Committee Note Draft). The OASIS document Approval Process begins officially with a TC vote to approve a WD as a Committee Draft. A TC may approve a Working Draft, revise it, and reapprove it any number of times as a Committee Draft.

Copyright © OASIS Open 2011. All Rights Reserved.
All capitalized terms in the following text have the meanings assigned to them in the OASIS Intellectual Property Rights Policy (the “OASIS IPR Policy”). The full Policy may be found at the OASIS website.
This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published, and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this section are included on all such copies and derivative works. However, this document itself may not be modified in any way, including by removing the copyright notice or references to OASIS, except as needed for the purpose of developing any document or deliverable produced by an OASIS Technical Committee (in which case the rules applicable to copyrights, as set forth in the OASIS IPR Policy, must be followed) or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by OASIS or its successors or assigns.
Table of Contents

1 Introduction ................................................................................................................................. 3
  1.1 Terminology ......................................................................................................................... 3
  1.2 Normative References ............................................................................................................ 3
  1.3 Non-Normative References ................................................................................................. 4
2 Profile Overview .......................................................................................................................... 5
3 Profile Description ......................................................................................................................... 6
  3.1 Element <AttributePredicate> ............................................................................................. 6
  3.2 Element <AttributePredicateQuery> ..................................................................................... 6
  3.3 Type <AttributePredicateStatementType> .......................................................................... 7
4 Predicate Evaluation .................................................................................................................... 8
5 Examples (non-normative) ........................................................................................................... 10
6 Conformance ............................................................................................................................... 12
A. Acknowledgements .................................................................................................................... 13
B. Revision History ......................................................................................................................... 14
# 1 Introduction

SAML attribute assertions enable a SAML authority, sometimes also referred to as an issuer, to certify to a relying party that a subject is associated with a specified set of attribute values. There are many circumstances, however, where the relying party is not interested in the exact attribute values, but merely needs to be assured that a certain condition is satisfied. For example, a SAML authority may keep its subjects’ dates of birth on record, but to control access to a teenage chat room, the relying party merely needs to ensure that the requesting subject belongs to the correct age group. Not only may users be reluctant to disclose such identifying information to the chat room host, but also the host itself may prefer not to know the exact date to avoid liability claims in case a data breach occurs.

For small numbers of predicates this problem can obviously be overcome by defining a dedicated Boolean attribute for each possible predicate, which the issuer authenticates by means of a SAML attribute statement. While this may work for common age restrictions such as being younger or older than eighteen, it is impractical when the space of relevant predicates is large. For example, it is rather unlikely that a dedicated attribute will be globally agreed upon if the minimum age to sign up for a theoretical driving test is seventeen years and nine months.

As another example where attribute predicates can be useful, consider an online opinion poll hosted on a city’s website and a SAML authority that certifies subjects’ ZIP codes. The city may want to ensure that only legal residents of the metropolitan area can participate in the poll, but for privacy reasons may not want to keep track of the voting statistics of separate neighborhoods. Other websites may want to ensure that the subject has an email address within a particular domain (e.g., youremployer.com), but to guarantee the users’ privacy, they have no interest in the exact address.

Predicates may also involve relation among multiple attributes known to the SAML authority. For example, the signup form for an obesity summer camp may restrict access to participants whose body-mass index, computed as the weight divided by the square of the height, is above a certain threshold, but does not want to force participants to disclose their exact weight, height, or body-mass index.

[All text is normative unless otherwise labeled]

## 1.1 Terminology

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

## 1.2 Normative References

1.3 Non-Normative References

[Reference] [Full reference citation]
2 Profile Overview

This profile defines how to use SAML 2.0 to query a SAML authority for the truth value of a Boolean predicate over one or more of a subject’s attribute values. In particular, this profile defines the following types and elements:

- `<AttributePredicate>`: An element describing a Boolean predicate over one or more of a subject’s attribute values.
- `<AttributePredicateQuery>`: An element used to query a SAML authority for the truth value of a particular subject’s attribute predicate.
- `<AttributePredicateStatementType>`: A SAML statement type describing a statement asserting that a subject’s attribute predicate has a particular truth value.
3 Profile Description

The following sections provide detailed definitions of the defined types and elements.

3.1 Element <AttributePredicate>

The <AttributePredicate> element describes a Boolean predicate over one or more of a subject’s attribute values. The predicate is expressed by means of an <xacml:Apply> element that denotes application of a specified function (identified by a URI in its FunctionId attribute) to one or more arguments of the <xacml:Expression> element substitution group. The return data-type of the <xacml:Apply> element MUST be “http://www.w3.org/2001/XMLSchema#boolean”. Arbitrarily complex predicates can be formulated by nesting multiple <xacml:Apply> elements.

```xml
<xs:element name="AttributePredicate" type="AttributePredicateType"/>
<xs:complexType name="AttributePredicateType">
  <xs:sequence>
    <xs:element ref="xacml:Apply"/>
  </xs:sequence>
  <xs:attribute name="FriendlyDescription" type="xs:string" use="optional"/>
</xs:complexType>
```

The following four members of the <xacml:Expression> element substitution group may occur in the attribute predicate:

- <xacml:AttributeValue>
- <xacml:AttributeDesignator>
- <xacml:Apply>
- <xacml:Function>

Any <xacml:AttributeDesignator> element used MUST be of category urn:oasis:names:tc:xacml:1.0:subject-category:access-subject. The Issuer attribute in the <xacml:AttributeDesignator> element, if present, MUST have the same value as specified in the <saml:Issuer> element of the enclosing query or assertion.

The attribute predicate expressed as an XACML expression. All function URIs marked as mandatory in XACML version 3.0 [XACML] MUST be supported as value for the FunctionId XML attribute by any implementation of this profile. Functions marked as optional MAY be supported, as well as any additional self-defined functions, as long as the semantics are understood by all of the involved parties. The return data type of the outermost <xacml:Apply> element MUST be http://www.w3.org/2001/XMLSchema#boolean.

3.2 Element <AttributePredicateQuery>

The <AttributePredicateQuery> element is used to make the query “Does the specified Boolean predicate hold over this subject’s attribute value(s)?”. The query additionally specifies whether the response should contain an assertion that explicitly repeats the queried predicate in an attribute predicate statement. A successful response states that the queried predicate is true. This element is of type AttributePredicateQueryType, which extends SubjectQueryAbstractType with the addition of the following element and attribute:

- IncludePredicateInResponse [Optional]
A Boolean value. If “true”, the queried attribute predicate MUST be included in an attribute predicate statement in the response.

`<AttributePredicate> [Required]`

The queried Boolean predicate over one or more of the subject’s attribute values.

A SAML authority responds to an attribute predicate query according to the conventions specified in Section 4.

The following schema fragment defines the `AttributePredicateQuery` element and its `AttributePredicateQueryType` complex type:

```xml
<xs:element name="AttributePredicateQuery" type="AttributePredicateQueryType"/>
<xs:complexType name="AttributePredicateQueryType">
  <xs:complexContent>
    <xs:extension base="samlp:SubjectQueryAbstractType">
      <xs:sequence>
        <xs:element ref="AttributePredicate"/>
      </xs:sequence>
      <xs:attribute name="IncludePredicateInResponse" type="xs:boolean" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

### 3.3 Type `<AttributePredicateStatementType>`

A `<saml:Statement>` element of type `AttributePredicateStatementType` describes a statement by the SAML authority asserting that a Boolean predicate over one or more of the assertion subject’s attribute values is true. In this profile, statements of this type are referred to as attribute predicate statements. Attribute predicate statements MUST contain a `<Subject>` element.

The type `AttributePredicateStatementType` extends `StatementAbstractType` with the addition of the following element:

`<AttributePredicate> [Required]`

The `<AttributePredicate>` element specifies a Boolean predicate over one or more of the assertion subject’s attribute values.

The following schema fragment defines the `AttributePredicateStatementType` complex type:

```xml
<xs:complexType name="AttributePredicateStatementType">
  <xs:complexContent>
    <xs:extension base="saml:StatementAbstractType">
      <xs:sequence>
        <xs:element ref="AttributePredicate"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```
4 Predicate Evaluation

A SAML authority that receives an incoming `<AttributePredicateQuery>` evaluates the truth of the queried `<AttributePredicate>` in a way that is semantically equivalent to evaluating an XACML request [XACML] containing all known attributes of the concerned subject against an XACML policy – with rule-combining algorithm “Permit-overrides” – that contains a single applicable rule – with effect “Permit” – whose condition solely contains the queried predicate expressed as `<xacml:Apply>` element. An XACML Policy Decision Point (PDP) evaluating such request will return one of the following three evaluation decisions:

“Permit”

In case the XACML PDP returns decision “Permit”, the SAML authority MAY return a SAML response with status code `urn:oasis:names:tc:SAML:2.0:status:Success`. If the IncludePredicateInResponse XML attribute of the corresponding query is present and “true”, an assertion with an attribute predicate statement containing an attribute predicate that is equal to the queried attribute predicate MUST be included in the response. Here, equality is defined either as string equality (i.e., including whitespaces), or, in case the assertion is signed, as equality under the XML canonicalization method used to compute the XML Signature (see [XMLSig] for more information on canonicalization methods). Note that there may be situations where the SAML authority MAY not return an assertion containing an attribute predicate statement, even though the XACML PDP returns decision “Permit”. For example, when additional policies apply or when the subject does not give permission to return the queried assertion.

“NotApplicable”

In case the XACML PDP returns decision “NotApplicable”, which arises when the SAML authority knows all required attributes but they do not satisfy the predicate, the SAML authority MAY return a response with top-level status code `urn:oasis:names:tc:SAML:2.0:status:Responder` and second-level status code `urn:oasis:names:tc:SAML:2.0:status:PredicateFalse`.

“Indeterminate”

In case the XACML PDP returns decision “Indeterminate”, the SAML authority MUST return a response with top-level status code `urn:oasis:names:tc:SAML:2.0:status:Responder` and second-level status code `urn:oasis:names:tc:SAML:2.0:status:UnknownAttrProfile`. In particular, this situation arises when an `<xacml:AttributeDesignator>` element that must be present is not known by the SAML authority with respect to the concerned subject.

If the XACML PDP returns any decision other than “Permit”, then the SAML authority MUST NOT return a response with status code `urn:oasis:names:tc:SAML:2.0:status:Success`. In the following situations a SAML authority MUST return a response with top-level status code `urn:oasis:names:tc:SAML:2.0:status:Requester` and second-level status code `urn:oasis:names:tc:SAML:2.0:status:InvalidPredicate`:

- an attribute predicate contains an `<xacml:AttributeDesignator>` element with a category different from `urn:oasis:names:tc:xacml:1.0:subject-category:access-subject`,
- an attribute predicate contains an `<xacml:AttributeDesignator>` element with the Issuer value different from the one specified in the `<saml:Issuer>` element of the enclosing query, or
- an attribute predicate contains an `<xacml:AttributeSelector>` or `<xacml:VariableReference>` element.

Table 1 summarizes the prescribed status codes and their interpretations.
<table>
<thead>
<tr>
<th>Evaluation Decision</th>
<th>Top-level &lt;StatusCode&gt;</th>
<th>Second-level &lt;StatusCode&gt;</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Permit&quot;</td>
<td>&quot;Success&quot;</td>
<td>Don't care</td>
<td>Attribute predicate is true</td>
</tr>
<tr>
<td>&quot;Permit&quot;</td>
<td>&quot;Requester&quot;</td>
<td>Appropriate status code</td>
<td>Interpretation according to second-level status code For example, additional policies apply, subject does not give permission, etc.)</td>
</tr>
<tr>
<td>Different from &quot;Permit&quot;</td>
<td>MUST NOT be &quot;Success&quot;</td>
<td>Appropriate status code</td>
<td>Interpretation according to top-level and second-level status code</td>
</tr>
<tr>
<td>&quot;NotApplicable&quot;</td>
<td>&quot;Responder&quot;</td>
<td>&quot;PredicateFalse&quot;</td>
<td>Attribute predicate is false</td>
</tr>
<tr>
<td>&quot;Indeterminate&quot;</td>
<td>&quot;Requester&quot;</td>
<td>&quot;UnknownAttrProfile&quot;</td>
<td>Attribute contained in predicate not known by SAML authority</td>
</tr>
<tr>
<td>Don't care</td>
<td>&quot;Requester&quot;</td>
<td>&quot;InvalidPredicate&quot;</td>
<td>Malformed attribute predicate</td>
</tr>
</tbody>
</table>
5 Examples (non-normative)

The following example query requests from SAML authority idp.example.com an assertion that the subject’s date of birth is before 1 January 1993.

```
<AttributePredicateQuery
  Version="2.0"
  ID="query23a0821cf186ea0a22e3818750a809b6cb3b4cda"
  IssueInstant="2011-02-28T23:59:58"
  IncludePredicateInResponse="true">
  <samla:Issuer>idp.example.com</samla:Issuer>
  <samla:Subject>
    <samla:NameID Format="urn:oasis:names:tc:SAML:2.0:nameid-format:transient">
      pseudonym123456
    </samla:NameID>
  </samla:Subject>
  <AttributePredicate FriendlyDescription="The requestor is over 18 years of age.">
    <xacml:Apply FunctionId="urn:oasis:names:tc:xacml:1.0:func: date-less-than-or-equal">
      <xacml:Apply FunctionId="urn:oasis:names:tc:xacml:1.0:func: date-one-and-only">
        <xacml:AttributeDesignator DataType="http://www.w3.org/2001/XMLSchema#date"
          MustBePresent="true"
          Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
          AttributeId="urn:example:identity:birthdate"/>
        <xacml:AttributeValue DataType="http://www.w3.org/2001/XMLSchema#date">
          1993-01-01
        </xacml:AttributeValue>
      </xacml:Apply>
    </xacml:Apply>
  </AttributePredicate>
</AttributePredicateQuery>
```

If the subject’s birth date is indeed before 1 January 1993, the response of the SAML authority could be the following. (Note that the signature is not valid and cannot be successfully verified.)

```
<samlp:Response
  Version="2.0"
  ID="responsebd6996d271d23129dc2068c497ea3415f007b73"
  InResponseTo="query23a0821cf186ea0a22e3818750a809b6cb3b4cda"
  IssueInstant="2011-02-28T23:59:59">
  <samla:Issuer>idp.example.com</samla:Issuer>
  <samlp:Status>
  </samlp:Status>
  <saml:Assertion
    IssueInstant="2011-02-28T23:59:59"
    ID="assertion116fccc686a3feb788e5c89520b5f4eadf5ebbcf"
    Version="2.0">
    <samla:Issuer>idp.example.com</samla:Issuer>
    <ds:Signature>
      <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="#assertion116fccc686a3feb788e5c89520b5f4eadf5ebbcf"/>
      </ds:SignedInfo>
      <ds:Transforms>
        <ds:Transform Algorithm="http://www.w3.org/2000/09/xmldsig#envelopedsignature"/>
        <ds:Transform Algorithm="http://www.w3.org/2001/10/xml-exc-c14n#"/>
      </ds:Transforms>
    </ds:Signature>
  </saml:Assertion>
</samlp:Response>
```
<ds:DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
<ds:DigestValue>192d3b53f6c4fda041ff36899a91422e9e9a8a2b</ds:DigestValue>
</ds:Reference>
<ds:SignatureValue>
hq4zk+2knjgCQgZm7ea8f179gJEzRy3S8LHdpYXWQ1g2pkJN9CMLG8ENR4Nrw+n7lyzixvKV8X5P3BTCT4VghF8WhFYST9tHwU/AtJfOf6q5aAzNdeCyG86jtmp3TDMwUL/cRUj20tB0QMFn7jQ9YBTkl1z3RqlV+wmneWI4=
</ds:SignatureValue>
<ds:KeyInfo>
<ds:X509Data>
<ds:X509Certificate>
MIICyjCCAjOgAwIBAgICAnUwDQYJKoZIhvcNAQEEBQAwggYx
</ds:X509Certificate>
</ds:X509Data>
</ds:KeyInfo>
</ds:Signature>
<samla:Subject>
<samla:NameID Format="urn:oasis:names:tc:SAML:2.0:nameid-format:transient">
pseudonym123456
</samla:NameID>
</samla:Subject>
<samla:Statement xsi:type="ap:AttributePredicateStatementType">
<AttributePredicate FriendlyDescription="The requestor is over 18 years of age.">
<xacml:Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:date-less-than-or-equal">
<xacml:Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:date-one-and-only" MustBePresent="true"
Category="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject"
AttributeId="urn:example:identity:birthdate"/>
</xacml:Apply>
<xacml:AttributeValue DataType="http://www.w3.org/2001/XMLSchema#date">
1993-01-01
</xacml:AttributeValue>
</xacml:Apply>
</xacml:AttributeValue>
</samla:Statement>
</samlp:Response>
6 Conformance

A conforming application implements all of the mandatory features of the normative sections.
A. Acknowledgements

The following individuals have participated in the creation of this specification and are gratefully acknowledged:

Participants:

[Participant Name, Affiliation | Individual Member]

[Participant Name, Affiliation | Individual Member]
B. Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Editor</th>
<th>Changes Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Rev number]</td>
<td>[Rev Date]</td>
<td>[Modified By]</td>
<td>[Summary of Changes]</td>
</tr>
</tbody>
</table>