



# SAML V2.0 Subject Identifier Attributes Profile Version 1.0

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### Related work:

This specification is related to:

- eduPerson Object Class Specification (201602)  
<http://software.internet2.edu/eduperson/internet2-mace-dir-eduperson-201602.html>.

### Abstract:

This specification standardizes two new SAML Attributes to identify security subjects, as a replacement for long-standing inconsistent practice with the `<saml:NameID>` and `<saml:Attribute>` constructs, and to address recognized deficiencies with the SAML persistent NameID format.

### Status:

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# 1 Introduction

## 1.1 IPR Policy

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## 1.2 Terminology and Notation

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 [\[RFC2119\]](#).

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

Prefix	XML Namespace	Comments
saml:	urn:oasis:names:tc:SAML:2.0:assertion	This is the SAML V2.0 assertion namespace <a href="#">[SAML2Core]</a> .
samlp:	urn:oasis:names:tc:SAML:2.0:protocol	This is the SAML V2.0 protocol namespace <a href="#">[SAML2Core]</a> .
md:	urn:oasis:names:tc:SAML:2.0:metadata	This is the SAML V2.0 metadata namespace <a href="#">[SAML2Meta]</a> .
mdattr:	urn:oasis:names:tc:SAML:metadata:attributes	This is the SAML V2.0 metadata extension for entity attributes namespace <a href="#">[MetaAttr]</a> .
xsd:	<a href="http://www.w3.org/2001/XMLSchema">http://www.w3.org/2001/XMLSchema</a>	This namespace is defined in the W3C XML Schema specification <a href="#">[XMLSCHEMA-2]</a> .

## 1.3 Normative References

- [RFC2119]** Bradner, S., “Key words for use in RFCs to Indicate Requirement Levels”, BCP 14, RFC 2119, March 1997. <http://www.ietf.org/rfc/rfc2119.txt>.
- [SAML2Core]** *Assertions and Protocols for the OASIS Security Assertion Markup Language (SAML) V2.0*. Edited by Scott Cantor, John Kemp, Rob Philpott, Eve Maler. 15 March 2005. OASIS Standard. <http://docs.oasis-open.org/security/saml/v2.0/saml-core-2.0-os.pdf>
- [MetaAttr]** *SAML V2.0 Metadata Extension for Entity Attributes Version 1.0*. Edited by Scott Cantor. 4 August 2009. OASIS Committee Specification. <http://docs.oasis-open.org/security/saml/Post2.0/sstc-metadata-attr-cs-01.pdf>. Latest version: <http://docs.oasis-open.org/security/saml/Post2.0/sstc-metadata-attr.pdf>.
- [SAML2Errata]** *SAML V2.0 Errata*. Edited by Scott Cantor. 1 May 2012. OASIS Approved Errata. <http://docs.oasis-open.org/security/saml/v2.0/errata05/os/saml-v2.0-errata05-os.pdf>. Latest version: <http://docs.oasis-open.org/security/saml/v2.0/sstc-saml-approved-errata-2.0.pdf>
- [SAML2Meta]** *Metadata for the OASIS Security Assertion Markup Language (SAML) V2.0*. Edited by Scott Cantor, Jahan Moreh, Rob Philpot, Eve Maler. 15 March 2005.

OASIS Standard. <http://docs.oasis-open.org/security/saml/v2.0/saml-metadata-2.0-os.pdf>

**[XMLSCHEMA-2]** *XML Schema Part 2: Datatypes Second Edition*. Paul V. Biron, A. Malhotra, Editors. W3C Recommendation. October 28, 2004. <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028/>. Latest version: <http://www.w3.org/TR/xmlschema-2/>.

## 17 1.4 Non-Normative References

**[eduPerson]** Internet2, “eduPerson Object Class Specification (201602)”, February 2016. <http://software.internet2.edu/eduperson/internet2-mace-dir-eduperson-201602.html>.

**[RFC4648]** Josefson, S., “The Base16, Base32, and Base64 Data Encodings”, RFC 4648, October 2006. <http://www.ietf.org/rfc/rfc4648.txt>.

**[SAML2Prof]** *Profiles for the OASIS Security Assertion Markup Language (SAML) V2.0*. Edited by John Hughes, Scott Cantor, Jeff Hodges, Frederick Hirsch, Prateek Mishra, Rob Philpot, Eve Maler. 15 March 2005. OASIS Standard. <http://docs.oasis-open.org/security/saml/v2.0/saml-profiles-2.0-os.pdf>

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## 18 2 Motivation

### 19 2.1 Problem Statement

20 Identification of subjects in security protocols and applications has a fraught history of inconsistent syntax,  
21 bugs, terrible but deeply cemented practices such as misuse of email addresses, vertical market-specific  
22 approaches, and failure to precisely communicate intended semantics and constraints. These problems  
23 lead to overly complex burdens on both asserting and relying parties to supply and consume a variety of  
24 different identifiers in different formats, many of which work poorly with off the shelf applications. Much of  
25 this is self-inflicted fragmentation due to the constant tension between fixing problems with new solutions  
26 and avoiding them to gain scale.

27 SAML itself has its origins in a design philosophy that tried to avoid breaking new ground in this area, and  
28 instead attempted to design for generality, which is valuable, but did not ease adoption due to a lack of  
29 guidance. SAML also complicates itself by providing an optional, singly-appearing construct for  
30 identification (the `<saml:NameID>` element) *and* a more general multiply-appearing  
31 `<saml:Attribute>` construct that inherently overlap.

32 This, together with inconsistent technical precision by implementers and deployers, creates complexity.  
33 Deployment experience has shown that use of the NameID feature is confusing in many implementations.  
34 It also, through its presence in the SAML Single Logout protocol, potentially appears in web access logs,  
35 leading to the added complexity of encryption when privacy is a consideration.

36 There is a general consensus by most federated identity practitioners around a few common  
37 requirements:

- 38 • Identifiers should be as stable as possible and should never have a risk of reassignment to  
39 different subjects due to the lack of tight synchronization<sup>1</sup> inherent between loosely-coupled  
40 systems.
- 41 • Opaque (i.e., superficially random) identifiers are inherently more stable than name-based  
42 identifiers or email addresses in many organizations.
- 43 • Identifiers should be compact and simple to handle and manipulate.
- 44 • The ability to clearly express the scope of an identifier's uniqueness and enforce policy around the  
45 issuers permitted to supply an identifier is crucial to federated systems and the lack of such policy  
46 has led to widely-publicized breaches.

47 Another requirement perhaps more common to education and research is the ability for different asserting  
48 parties to issue the same identifier. This is facilitated by ensuring the scope of an identifier is part of its  
49 value and not implicit in a protocol-specific value specific to an asserting party.

50 SAML does not define an identifier that meets all of these requirements well. It does standardize a kind of  
51 NameID termed “persistent” that meets some of them in the particular case of so-called “pairwise”  
52 identification, where an identifier varies by relying party. It has seen minimal adoption outside of a few  
53 contexts, and fails at the “compact” and “simple to handle” criteria above, on top of the disadvantages  
54 inherent with all NameID usage.

55 Pairwise identification helps meet certain privacy and regulatory requirements, but does not address many  
56 common use cases that demand cross-system correlation without the friction of complex linking protocols  
57 and the involvement of the data subject.

58 In addition, it has come to light that many, if not most, applications have a predisposition to handle  
59 identifiers case-insensitively, partly due to a long-standing, though factually untrue, assumption that e-mail

---

1 It's worth noting that SAML actually defines a protocol for managing changes to NameID values, but it has seen very little adoption, further demonstrating the lack of value of NameID usage.

60 address mailbox names are case-insensitive data. SAML's "persistent" NameID definition explicitly  
61 requires case-sensitive handling, making them impossible to use safely with such applications without  
62 resorting to additional layers of profiling. Note that any other specification promulgating such identifiers is  
63 potentially unsafe in combination with such applications and should be used with caution.

64 For all these reasons, this profile attacks these problems using a clean-slate approach that abandons  
65 existing practice instead of attempting to layer more profiling and out of band agreements on top of  
66 existing solutions, an approach that has seemingly reached its breaking point.

## 67 **2.2 Relationship to Existing Work**

68 Clean slate notwithstanding, this profile is based on a thorough review of practice within the higher  
69 education sector, which has seen extensive adoption of SAML and partially-successful efforts to  
70 standardize subject identification and avoid the "email address" trap that most of the technical world fell  
71 into many years ago.

72 Among the significant work in this space, the [[eduPerson](#)] schema includes a number of identifier  
73 attributes, some widely adopted and some less so. This profile is particularly influenced by:

- 74 • Experience with the SAML "persistent" NameID construct and the eduPersonTargetedID attribute.
- 75 • The eduPersonPrincipalName and eduPersonUniqueid attributes, the former successful but  
76 deeply flawed, the latter less successful but more consciously defined.
- 77 • Success with DNS domain-based scoping of values and managing policy around their use in  
78 SAML.
- 79 • Challenges in the adoption of profiles required to accommodate the limitations of widely deployed  
80 identifiers.

81 Portions of this specification are borrowed liberally from the [[eduPerson](#)] specification in a deliberate  
82 desire to remain consistent with the formulation of the eduPersonUniqueid attribute.

---

## 83 3 SAML V2.0 Subject Identifier Attributes Profile 84 Version 1.0

### 85 3.1 Required Information

86 **Identification:** urn:oasis:names:tc:SAML:profile:subject-id

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

88 **Description:** Given below.

89 **Updates:** None.

### 90 3.2 Overview

91 This profile defines a pair of SAML Attributes providing for unique identification of security subjects  
92 (generally but not exclusively people). One is designed for general use as a correlatable identifier, and the  
93 other is a pairwise identifier suitable for more specialized use.

94 Both Attributes are limited to a single value when expressed in SAML assertions and other constructs.  
95 They may be mapped to and form other technical forms (e.g., LDAP) but this profile does not include such  
96 mappings.

97 In the terminology used in this profile:

- 98 • "asserting party" refers to a SAML entity, uniquely identified by an entityID, that issues assertions  
99 containing one or both of these Attributes
- 100 • "relying party" refers to one or more SAML entities, each uniquely identified by an entityID, that  
101 receive assertions containing one or both of these Attributes

102 In addition, this profile defines a signaling mechanism for a Service Provider to express its subject  
103 identification requirements via SAML metadata [[SAML2Meta](#)], by means of the  
104 <mdattr:EntityAttributes> extension [[MetaAttr](#)]. This allows Identity Providers to unambiguously  
105 understand the requirements of the service and facilitates deployment profiles that wish to mandate  
106 support for one or both of these Attributes, while maintaining appropriate privacy expectations.

### 107 3.3 Standard Subject Identifier

108 For standard identification of subjects, the following SAML Attribute is defined:

109 **Name:** urn:oasis:names:tc:SAML:attribute:subject-id

110 **NameFormat:** urn:oasis:names:tc:SAML:2.0:attrname-format:uri

111 This is a long-lived, non-re-assignable, omni-directional identifier suitable as a globally-unique external key  
112 by applications.

#### 113 3.3.1 Syntax and Handling

114 This Attribute, when appearing as a SAML <saml:Attribute> element, MUST contain exactly one  
115 <saml:AttributeValue> element, whose xsi:type SHOULD be absent or if present MUST BE  
116 bound to the XML Schema xsd:string data type [[XMLSCHEMA-2](#)].

117 Any leading or trailing whitespace present in the <saml:AttributeValue> element's content is not  
118 significant and MUST be stripped by the relying party prior to evaluation or comparison.

119 The value consists of two substrings (termed a “unique ID” and a “scope” in the remainder of this  
120 definition) separated by an @ symbol (ASCII 64) as an inline delimiter.

121 The unique ID consists of from 1 to 127 characters, all either alphanumeric or the equals sign (ASCII 61)  
122 or hyphen (ASCII 45). The first character MUST be alphanumeric.

123 The scope consists of 1 to 127 alphanumeric, hyphen (ASCII 45), or period (ASCII 46) characters. The  
124 first character MUST be alphanumeric. The scope deliberately resembles, and typically may be, a DNS  
125 domain name, but is drawn from a more limited character set due to case folding considerations, and no  
126 attempt is made to limit the allowable grammar to legal domain names (e.g., it allows consecutive  
127 periods).

128 The ABNF grammar is therefore:

129       <value> = <uniqueID> "@" <scope>  
130       <uniqueID> = (ALPHA / DIGIT) 0\*126(ALPHA / DIGIT / "=" / "-")  
131       <scope> = (ALPHA / DIGIT) 0\*126(ALPHA / DIGIT / "-" / ".")

132 Value comparison MUST be performed case-insensitively (that is, values that differ only by case are the  
133 same, and refer to the same subject). It is RECOMMENDED that alphabetic characters be in lower-case  
134 when expressing and storing values.

### 135 3.3.2 Semantics and Practices

136 A value (the unique ID and scope together) MUST be bound to only one subject, but the same unique ID  
137 given a different scope may refer to the same or (far more likely) a different subject.

138 The relationship between an asserting party and a scope is an arbitrary one and does not reflect any  
139 assumed relationship between a scope in the form of a domain name and a domain found in a given  
140 SAML entityID.

141 A value MUST NOT be assigned to more than a single subject over its lifetime of use under any  
142 circumstances. The unique ID should therefore be constructed in a fashion that reduces the probability of  
143 non-technical or political considerations leading to a violation of this requirement, and any such violation  
144 should be treated as a potential security risk to the relying parties to which the value may have been given.

145 Relying parties should not treat this identifier as an email address for the subject as it is unlikely (though  
146 not precluded) for it to be valid for that purpose. Most organizations will find that existing email address  
147 values will not serve well as values for this Attribute.

148 The unique ID should not change as a result of a change to any other data associated with the subject  
149 (e.g., name, email address, age, organizational role).

150 A given value MUST identify the same subject regardless of the context of use and for which relying  
151 parties to which the Attribute is given. It is therefore to be assumed by relying parties that receive a given  
152 value that the same subject has been identified.

153 Note that, policy permitting, a given value could be provided by any asserting party, and the requirement  
154 still holds: identical values correspond to the same subject. While it will be common in many deployments  
155 to limit values with a given scope to a single asserting party, this is ultimately left to the discretion of the  
156 relying party and the use case.

157 Inevitably, a single subject may be identified simultaneously by multiple values, but this should be  
158 minimized to the extent possible.

## 159 3.4 Pairwise Subject Identifier

160 For pairwise identification of subjects, the following SAML Attribute is defined:

161       **Name:** urn:oasis:names:tc:SAML:attribute:pairwise-id

162           **NameFormat:** urn:oasis:names:tc:SAML:2.0:attrname-format:uri

163 This is a long-lived, non-re-assignable, uni-directional identifier suitable as a unique external key specific  
164 to particular applications. Its value for a given subject depends on the relying party to whom it is given,  
165 preventing unrelated systems from using it as a basis for correlation.

### 166 **3.4.1 Syntax and Handling**

167 The requirements for this Attribute are identical to those described in Section 3.3.1. That is, values of this  
168 Attribute are indistinguishable, lacking context, from the other.

### 169 **3.4.2 Semantics and Practices**

170 Given a particular relying party, a value (the unique ID and scope together) **MUST** be bound to only one  
171 subject, but the same unique ID given a different scope may refer to the same or (far more likely) a  
172 different subject. The same value provided to different relying parties **MAY** refer to different subjects, and  
173 indeed that is the primary distinguishing characteristic of this identifier Attribute.

174 The relationship between an asserting party and a scope is an arbitrary one and does not reflect any  
175 assumed relationship between a scope in the form of a domain name and a domain found in a given  
176 SAML entityID.

177 A value **MUST NOT** be assigned to more than a single subject over its lifetime of use under any  
178 circumstances. The unique ID should therefore be constructed in a fashion that reduces the probability of  
179 non-technical or political considerations leading to a violation of this requirement, and any such violation  
180 should be treated as a potential security risk to the relying parties to which the value may have been given.

181 The value **MUST NOT** be reversible by a relying party into a non-pairwise identifier for the subject through  
182 ordinary effort.

183 Relying parties should not treat this identifier as an email address for the subject as it is unlikely (though  
184 not precluded) for it to be valid for that purpose. Most organizations will find that existing email address  
185 values will not serve well as values for this Attribute.

186 The unique ID should not change as a result of a change to any other data associated with the subject  
187 (e.g., name, email address, age, organizational role).

188 Assuming a particular scope, a given subject **MUST** be identified with a different, though consistent,  
189 unique ID for each relying party to which a value is provided; however, the relationship between relying  
190 parties and SAML entities is not defined by this profile and is interpreted from the perspective of the  
191 asserting party. While it would be typical for an Identity Provider to base its notion of a relying party  
192 boundary on a single Service Provider's entityID, that is not specifically required by this profile. The  
193 boundary **MAY** be larger or even smaller, at the Identity Provider's discretion or as addressed by additional  
194 profiles.

195 While it will be common in many deployments to limit values with a given scope to a single asserting party,  
196 this is ultimately left to the discretion of the relying party and the use case. It is unspecified by this profile  
197 whether a given value provided by two or more asserting parties correspond to the same subject. This  
198 would depend on out of band arrangements made between the parties. But, in such cases, the "standard"  
199 subject identifier defined in Section 3.3 is likely to be a much better choice.

### 200 **3.4.3 Strategies**

201 Supporting pairwise identifiers typically involves either the generation and storage of random values, or the  
202 computation of reproducible values that can be produced on demand but need not be stored. This profile  
203 does not require any specific approach, but implementers should be aware that some techniques for  
204 computing values may result in an unacceptable risk of case conflicts. For example, a salted hash over a  
205 seed identifier together with a relying party identifier produces a "safe" generated value, but becomes  
206 unsafe when encoded in Base64 [[RFC4648](#)] (and the allowable character set is defined in part to preclude

207 this choice). However, encoding hashes in Base32 [RFC4648] is a safe choice, and the equals sign is  
208 included in the allowable character set to accommodate this.

### 209 3.4.4 Differences from "persistent" NameIDs

210 This Attribute is a direct replacement for the `urn:oasis:names:tc:SAML:2.0:nameid-`  
211 `format:persistent` NameID Format defined in SAML [SAML2Core]. There are obvious syntactic  
212 differences, in a deliberate attempt at simplification. The XML syntax and data "triple" are replaced with a  
213 simpler id/scope pair encoded into a string, and the awkward use of a URI to qualify the value is replaced  
214 with a simpler, shorter, and more flexible approach that more easily emulates the email address syntax  
215 required by many applications, and decouples identifier scoping from SAML entity naming.

216 One functional gap is the interoperable mechanism of SAML "affiliations" to group entities for the purpose  
217 of targeting pairwise identifiers to multiple Service Providers, which was baked into the SAML protocol. It  
218 has been left out of this profile due to the general lack of adoption by implementers or deployers in the  
219 intervening years since the publication of the standard. Were there demand, it could be incorporated into a  
220 future revision of this work.

## 221 3.5 Considerations for SAML Profiles

222 The Attributes defined in this profile are designed to be used in conjunction with any SAML profiles that  
223 support the use of SAML Attributes, though its predominant expected use is with the various SAML  
224 authentication profiles [SAML2Prof] such as the Browser SSO and Enhanced Client and Proxy profiles.

### 225 3.5.1 Requirements Signaling

226 In the event that SAML metadata [SAML2Meta] is used, a relying party MUST express its identifier  
227 requirements by including an `<mdattr:EntityAttribute>` extension [MetaAttr] in its metadata  
228 containing the following Attribute:

229       **Name:** `urn:oasis:names:tc:SAML:profile:subject-id`

230       **NameFormat:** `urn:oasis:names:tc:SAML:2.0:attrname-format:uri`

231 This Attribute, MUST contain exactly one `<saml:AttributeValue>` element, whose `xsi:type`  
232 SHOULD be absent or if present MUST BE bound to the XML Schema `xsd:string` data type  
233 [XMLSCHEMA-2].

234 The value MUST be one of the following, signaling the corresponding requirement:

- 235     • `subject-id`
  - 236       ◦ The relying party requires the standard identifier Attribute defined in Section 3.3.
- 237     • `pairwise-id`
  - 238       ◦ The relying party requires the pair-wise identifier Attribute defined in Section 3.4.
- 239     • `none`
  - 240       ◦ The relying party does not require any subject identifier and is designed to operate without a
  - 241       specific user identity (e.g., with authorization based on non-identifying data).
- 242     • `any`
  - 243       ◦ The relying party will accept any of the identifier Attributes defined in this profile but requires at
  - 244       least one.

245 This profile does not define specific normative behavior on the part of asserting parties in response to this  
246 metadata, but it is expected that other profiles will do so in the future.

### 247 **3.5.2 NameID Considerations**

248 While the Attributes defined in this profile have as a goal the explicit replacement of the `<saml:NameID>`  
249 element as a means of subject identification, it is certainly possible to compose them with existing  
250 NameID usage provided the same subject is being identified. This can also serve as a migration strategy  
251 for existing applications.

252 In addition, some profiles such as the Single Logout Profile [[SAML2Prof](#)] require the use of a  
253 `<saml:NameID>` element, which implies the earlier use of a NameID. In such cases, it is  
254 **RECOMMENDED** that the `urn:oasis:names:tc:SAML:2.0:nameid-format:transient` NameID  
255 Format be used.

---

## 256 4 Conformance

### 257 4.1 Conformance Clause 1: Asserting Party Implementations

258 An asserting party implementation conforms to this specification if it can be configured to produce the two  
259 identifier Attributes conforming to the normative requirements in Sections 3.3 and 3.4.

### 260 4.2 Conformance Clause 2: Relying Party Implementations

261 A relying party implementation conforms to this specification if it can be configured to consume neither,  
262 either, and both of the two identifier Attributes conforming to the normative requirements in Sections 3.3  
263 and 3.4.

264 If the relying party implementation provides a mechanism for generation and/or publication of SAML  
265 metadata [[SAML2Meta](#)], then it MUST support the inclusion of the extension defined in Section 3.5.1.

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## 266 **Appendix A Acknowledgments**

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269 **Appendix B Revision History**

<b>Revision</b>	<b>Date</b>	<b>Editor</b>	<b>Changes Made</b>
WD 01	30 Aug 2017	Scott Cantor	Initial draft
WD 02	13 Sep 2017	Scott Cantor	Added considerations for other profiles
WD 03	15 Sep 2017	Scott Cantor	Added hyphen as legal character in unique ID

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