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# Namespace Considerations and Registries for GSS-API Extensions
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## Abstract

This document describes the ways in which the GSS-API may be extended and directs the creation of an IANA registry for various GSS-API namespaces.

## Status of This Memo

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## 1. Conventions used in this document

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## 2. Introduction

There is a need for private-use and mechanism-specific extensions to the Generic Security Services Application Programming Interface (GSS-API). As such extensions are designed and standardized (or not), both at the IETF and elsewhere, there is a non-trivial risk of namespace pollution and conflicts. To avoid this we set out guidelines for extending the GSS-API and direct the creation of an IANA registry for GSS-API namespaces.

Registrations of individual items and sub-namespaces are allowed. Each sub-namespace may provide different rules for registration, e.g., for mechanism-specific and private-use extensions.

## 3. Extensions to the GSS-API

Extensions to the GSS-API can be categorized as follows:

- Abstract API extensions

- Implementation-specific
- Mechanism-specific
- Language binding-specific

Extensions to the GSS-API may be purely semantic, without effect on the GSS-API's namespaces. Or they may introduce new functions, constants, types, etc...; these clearly affect the GSS-API namespaces.

Extensions that affect the GSS-API namespaces should be registered with the IANA as described herein.

## 4. Generic GSS-API Namespaces

The abstract API namespaces for the GSS-API are:

- Type names
- Function names
- Constant names for various types
- Constant values for various types
- Name types (OID, type name and syntaxes)

Additionally we have namespaces associates with the OBJECT IDENTIFIER (OID) type. The IANA already maintains a registry of such OIDs:

- Mechanism OIDs
- Name Type OIDs

## 5. Language Binding-Specific GSS-API Namespaces

Language binding specific namespaces include, among others:

- Header/interface module names
- Object classes and/or types
- Methods and/or functions
- Constant names
- Constant values

## 6. Extension-Specific GSS-API Namespaces

Extensions to the GSS-API may create additional namespaces. See Section 8.2.

## 7. Registration Form

Registrations for GSS-API namespaces SHALL take the following form:

| Registration Field | Possible Values | Description |
|---|---|---|
| Bindings | 'Generic', 'C-bindings', 'Java', 'C#', <programming language name> | Indicates the name of the programming language that this registration involves, or, if 'Generic', that this is an entry for the generic abstract GSS-API (i.e., not specific to any programming language). |
| Registration type | 'Instance', 'Sub-Namespace' | Indicates whether this entry reserves a given symbol name (and possibly, constant value), or whether it reserves an entire sub-namespace (the name is a pattern) or constant value range. |
| Object Type | <Symbol> defined by the binding language (for example 'Data-Type', 'Function', 'Method', 'Integer', 'String', 'OID', 'Context-Flag', 'Name-Type', 'Macro', 'Header-File-Name', 'Module-Name', 'Class') | Indicates the type of the object whose symbolic name or constant value this entry registers. The possible values of this field depend on the programming language in question, therefore they are not all specified here. |
| Symbol Name/Prefix | <Symbol name or name pattern> | The name of a symbol or symbol sub-namespace being |

| | | |
|---|---|---|
| | | registered. See Section 8.2.1 |
| Binding of | <Name of abstract API element of which this object is a binding> | If the registration is for a specific language binding of the GSS-API, then this names the abstract API element of which it is a binding (OPTIONAL). |
| Constant Value/Range | <Constant value> or <constant value range> | The value of the constant named by the <Symbol Name/Prefix>. This field is present only for Instance and Sub-namespace registrations of Constant object types. |
| Description | <Text> | Description of the registration. Multiple instances of this field may result (see Section 8.2.3). |
| Registration Rules | <Reference> to an IANA registration Policy defined in [RFC5226] (or an RFC that updates it), for instance 'IESG Approval', 'Expert Review', 'First Come First Served', 'Private Use'. | Describes the rules for allocation of items that fall in this sub-namespace, for entries with Registration Type of Sub-namespace (OPTIONAL). For private use sub-namespaces the submitter MUST provide the e-mail address of a responsible contact. If this field is not specified for a sub-namespace, the default registration rules specified in Section 8.2 apply. |
| Reference | <Reference> | Reference to a document that describes the registration, if any (OPTIONAL). Multiple instances of this field are allowed, with one reference each. |
| Expert Reviewer | <Name of expert reviewers, possibly | OPTIONAL, see Section 8.2.2. Multiple instances of this |

| | | |
|---|---|---|
| | WG names> | field are allowed, with one expert reviewer per-instance. Leave this field blank when requesting a registration. It will be filled in by the Expert who reviews the registration. |
| Expert Review Notes | <Notes from the expert review> | Expert reviewers may request that some comments be included with the registration, e.g., regarding security considerations of the registered extension. |
| Status | 'Registered' or 'Obsoleted' | Status of the registration. |
| Obsoleting Reference | <Reference> | Reference to a document, if any, that obsoletes this registration. Multiple instances of this field are allowed, with one reference each. (OPTIONAL) |

The IANA should create a single GSS-API namespace registry, or multiple registries, one for symbolic names and one for constant values, and/or it may create a registry per-programming language, at its convenience.

Entries in these registries should consist of all the fields from their corresponding registration entries.

Entries should be sorted by: programming language, registration type, object type, and symbol name/pattern.

## 8. IANA Considerations

This document deals with IANA considerations throughout. Specifically it creates a single registry of various kinds of things, though the IANA may instead create multiple registries, each for one of those kinds of things. Of particular interest may be that IANA will now be the registration authority for the GSS-API name type OID space.

### 8.1. Initial Namespace Registrations

Initial registry content corresponding to the items defined in [RFC2743], [RFC2744], [RFC2853], [RFC1964] and [RFC4121] and others will be supplied during the IANA review portion of the RFC publishing process. [[Note to RFC Editor: Delete the following sentence before publication:]] The KITTEN WG chairs MUST indicate that such content has been reviewed by the WG and that there is WG consensus that the entries are in agreement with those RFCs.

#### 8.1.1. Example registrations

In order to sanity check recommended IANA registration templates, this section registers several entries.

| Registration Field | Possible Values |
|---|---|
| Bindings | C-bindings |
| Registration type | Instance |
| Object Type | Function |
| Symbol Name | gss_init_sec_context |
| Binding of | GSS_Init_sec_context |
| Constant Value/Range | N/A |
| Description | Create a security context by initiator |
| Registration Rules | N/A |
| Reference | RFC 2744 |
| Expert Reviewer | Kitten WG |
| Expert Review Notes | |
| Status | Registered |
| Obsoleting Reference | N/A |

| Registration Field | Possible Values |
|---|---|
| Bindings | C-bindings |
| Registration type | Instance |
| Object Type | Function |
| Symbol Name | gss_accept_sec_context |
| Binding of | GSS_Accept_sec_context |
| Constant Value/Range | N/A |
| Description | Accept a security context from initiator |
| Registration Rules | N/A |
| Reference | RFC 2744 |
| Expert Reviewer | Kitten WG |
| Expert Review Notes | |
| Status | Registered |
| Obsoleting Reference | N/A |

| Registration Field | Possible Values |
|---|---|
| Bindings | C-bindings |
| Registration type | Instance |
| Object Type | Context-Flag |
| Symbol Name | GSS_C_DELEG_FLAG |
| Binding of | deleg_state or deleg_req_flag |
| Constant Value/Range | 1 |
| Description | On output (if set): Delegated credentials are available via the delegated_cred_handle parameter of GSS_Accept_sec_context. On input (if set): With the call to GSS_Init_sec_context, delegate credentials to the acceptor. |
| Registration Rules | N/A |
| Reference | RFC 2744 |
| Expert Reviewer | Kitten WG |
| Expert Review Notes | |
| Status | Registered |
| Obsoleting Reference | N/A |

## 8.2. Registration Maintenance Guidelines

Standards-Track RFCs can create new items with any non-conflicting Symbol Name/Prefix value for this registry by virtue of IESG approval to publish as a Standards-Track RFC -- that is, without additional expert review.

Standards-Track RFCs can mark existing entries as obsolete, and can even create conflicting entries if explicitly stated (the IESG, of course, should review conflicts carefully, and may reject them).

IANA shall also consider submissions from individuals, and via Informational and Experimental RFCs, subject to Expert Review. IANA SHALL allow such registrations if a) they are not conflicting, b) provided that the registration is for object types other than Context-Flags, and c) subject to expert review. Guidelines for expert reviews are given below.

#### 8.2.1. Sub-Namespace Symbol Pattern Matching

Sub-namespace registrations must provide a pattern for matching symbols for which the sub-namespace's registration rules apply. The pattern consists of a string with the following special tokens:

- '*', meaning "match any string."
- "%m", meaning "match any mechanism family short-hand name."
- "%i", meaning "match any implementor vanity short-hand name."

For example, "GSS_%m_*" matches "GSS_krb5_foo" since "krb5" is a common short-hand for the Kerberos V GSS-API mechanism [RFC1964]. But "GSS_%m_*" does not match "GSS_foo_bar" unless "foo" is asserted to be a short-hand for some mechanism.

#### 8.2.2. Expert Reviews of Individual Submissions

[[The following paragraph should be deleted from the document before publication, as it will not age well. It should be moved to the shepherding write-up.]]

Expert review selection SHALL be done as follows. If, at the time that the IANA receives an individual submission for registration in this registry, there are any IETF Working Groups chartered to produce GSS-API-related documents, then the IANA SHALL ask the chairs of such WGs to be expert reviewers or to name one. If there are no such WGs at that time, then the IANA SHALL ask past chairs of the KITTEN WG and the author/editor of this RFC to act as expert reviewers or name an alternate.

Expert reviewers of individual registration submissions with Registration Type == Sub-namespace should check that the registration request has a suitable description (which doesn't need to be sufficiently detailed for others to implement) and that the Symbol Name/Prefix is sufficiently descriptive of the purpose of the sub-namespace or reflective of the name of the submitter or associated company.

Expert reviewers of individual registration submissions with

Registration Type == Instance should check that the Symbol Name falls under a sub-namespace controlled by the submitter. Registration of such entries which do not fall under such a sub-namespace may be allowed provided that they correspond to long existing non-standard extensions to the GSS-API and this can be easily checked or demonstrated, otherwise IESG Protocol Action is REQUIRED (see previous section). Also, reviewers should check that any registration of constant values have a detailed description that is suitable for other implementors to reproduce, and that they don't conflict with other usages or are otherwise dangerous in the reviewers estimation.

Expert reviewers should review impact on mechanisms, security and interoperability, and may reject or annotate registrations which can have mechanism impact that requires IESG protocol action. Consider, for example, new versions of GSS_Init_sec_context() and/or GSS_Accept_sec_context which have new input and/or output parameters which imply changes on the wire or in behaviour that may result in interoperability issues. A reviewer could choose to add notes to the registration describing such issues, or the reviewer might conclude that the danger to Internet interoperability is sufficient to warrant rejecting the registration.

### 8.2.3. Change Control

Registered entries may be marked obsoleted using the same expert review process as for registering new entries. Obsoleted entries are not, however, to be deleted, but merely marked having Obsoleted Status. Note that entries may be created as obsoleted to record the fact that the given symbol(s) have been used before, even though continued use of them is discouraged.

Registered entries may also be updated in two other ways: additional references, obsoleting references, and descriptions may be added.

All changes are subject to expert review, except for changes to registrations in a sub-namespace which are subject to the rules of the relevant sub-namespace. The submitter of a change request need not be the same as the original submitter.

Registrations may be modified by addition, but under no circumstance may any fields be modified except for the Status field or Contact Address, or to correct for transcription errors in filing or processing registration requests.

The IANA SHALL add a field describing the date that a an addition or modification was made, and a description of the change.

## 9. Security Considerations

General security considerations relating to IANA registration services apply; see [RFC5226].

Also, expert reviewers should look for and may document security related issues with submitters' GSS-API extensions, to the best of the reviewers' ability given the information furnished by the submitter. Reviewers may add comments regarding their limited ability to review a submission for security problems if the submitter is unwilling to provide sufficient documentation.

## 10. References

### 10.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC2743] Linn, J., "Generic Security Service Application Program Interface Version 2, Update 1", RFC 2743, DOI 10.17487/RFC2743, January 2000, <http://www.rfc-editor.org/info/rfc2743>.

[RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, DOI 10.17487/RFC5226, May 2008, <http://www.rfc-editor.org/info/rfc5226>.

### 10.2. Informative References

[RFC1964] Linn, J., "The Kerberos Version 5 GSS-API Mechanism", RFC 1964, DOI 10.17487/RFC1964, June 1996, <http://www.rfc-editor.org/info/rfc1964>.

[RFC2744] Wray, J., "Generic Security Service API Version 2 : C-bindings", RFC 2744, DOI 10.17487/RFC2744, January 2000, <http://www.rfc-editor.org/info/rfc2744>.

[RFC2853] Kabat, J. and M. Upadhyay, "Generic Security Service API Version 2 : Java Bindings", RFC 2853, DOI 10.17487/RFC2853, June 2000, <http://www.rfc-editor.org/info/rfc2853>.

[RFC4121] Zhu, L., Jaganathan, K., and S. Hartman, "The Kerberos Version 5 Generic Security Service Application Program Interface (GSS-API) Mechanism: Version 2", RFC 4121, DOI 10.17487/RFC4121, July 2005, <http://www.rfc-editor.org/info/rfc4121>.

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# GSS-API Naming Extensions
# draft-ietf-kitten-gssapi-naming-exts-15

## Abstract

The Generic Security Services API (GSS-API) provides a simple naming architecture that supports name-based authorization. This document introduces new APIs that extend the GSS-API naming model to support name attribute transfer between GSS-API peers.

## Status of this Memo

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## 2. Introduction

As described in [RFC4768] the GSS-API's naming architecture suffers from certain limitations. This document defines concrete GSS-API extensions.

A number of extensions to the GSS-API [RFC2743] and its C Bindings [RFC2744] are described herein. The goal is to make information modeled as "name attributes" available to applications. Such information MAY for instance be used by applications to make authorization-decisions. For example, Kerberos V authorization data elements, both in their raw forms, as well as mapped to more useful value types, can be made available to GSS-API applications through these interfaces.

The model is that GSS names have attributes. The attributes of a name may be authenticated (e.g., an X509 attribute certificate or signed SAML attribute assertion), or may have been set on a GSS name for the purpose of locally "asserting" the attribute during credential acquisition or security context exchange. Name attributes' values are network representations thereof (e.g., the actual value octets of the contents of an X.509 certificate extension, for example) and are intended to be useful for constructing portable access control facilities. Applications may often require language- or platform-specific data types, rather than network representations of name attributes, so a function is provided to obtain objects of such types associated with names and name attributes.

Future updates of this specification may involve adding an attribute namespace for attributes that only have application-specific semantics. Note that mechanisms will still need to know how to transport such attributes. The IETF may also wish to add functions by which to inquire whether a mechanism(s) understands a given attribute name or namespace, and to list which attributes or attribute namespaces a mechanism understands. Finally, the IETF may want to consider adding a function by which to determine the name of the issuer of a name attribute.

## 3. Name Attribute Authenticity

An attribute is 'authenticated' if and only if there is a secure association between the attribute (and its values) and the trusted source of the peer credential. Examples of authenticated attributes are (any part of) the signed portion of an X.509 certificate or AD-KDCIssued authorization-data elements in Kerberos V Tickets provided of course that the authenticity of the respective security associations (e.g., signatures) have been verified.

Note that the fact that an attribute is authenticated does not imply anything about the semantics of the attribute nor that the trusted credential source was authorized to assert the attribute. Such interpretations SHOULD be the result of applying local policy to the attribute.

An un-authenticated attribute is called _asserted_ in what follows. This is not to be confused with other uses of the word asserted or assertion such as "SAML attribute assertion", the attributes of which may be authenticated in the sense of this document for instance if the SAML attribute assertion was signed by a key trusted by the peer.

## 4. Name Attributes/Values as ACL Subjects

To facilitate the development of portable applications that make use of name attributes to construct and evaluate portable ACLs the GSS-API makes name attribute values available in canonical network encodings thereof.

## 5. Naming Contexts

Several factors influence the context in which a name attribute is interpreted. One is the trust context.

As discussed previously, applications apply local policy to determine whether a particular peer credential issuer is trusted to make a given statement. Different GSS-API mechanisms and deployments have different trust models surrounding attributes they provide about a name.

For example, Kerberos deployments in the enterprise typically trust a KDC to make any statement about principals in a realm. This includes attributes such as group membership.

In contrast, in a federated SAML environment, the identity provider typically exists in a different organization than the acceptor. In this case, the set of group memberships or entitlements that the IDP is permitted to make needs to be filtered by the policy of the

acceptor and federation.

So even an attribute containing the same information such as e-mail address would need to be treated differently by the application in the context of an enterprise deployment from the context of a federation.

Another aspect related to trust is the role of the credential issuer in providing the attribute. Consider Kerberos PKINIT [RFC4556]. In this protocol, a public key and associated certificate are used to authenticate to a Kerberos KDC. Consider how attributes related to a pkinit certificate should be made available in GSS-API authentications based on the Kerberos ticket. In some deployments the certificate may be fully trusted; in including the certificate information in the ticket, the KDC permits the acceptor to trust the information in the certificate just as if the KDC itself had made these statements. In other deployments, the KDC may have authorized a hash of the certificate without evaluating the content of the certificate or generally trusting the issuing certification authority. In this case, if the certificate were included in the issued ticket, the KDC would only be making the statement that the certificate was used in the authentication. This statement would be authenticated, but would not imply that the KDC stated particular attributes of the certificate described the initiator.

Another aspect of context is encoding of the attribute information. An attribute containing an ASCII [ANSI.X3-4.1986] or UTF-8 [RFC3629] version of an e-mail address could not be interpreted the same as a ASN.1 Distinguished Encoding Rules e-mail address in a certificate.

All of these contextual aspects of a name attribute affect whether two attributes can be treated the same by an application and thus whether they should be considered the same name attribute. In the GSS-API naming extensions, attributes that have different contexts MUST have different names so they can be distinguished by applications. As an unfortunate consequence of this requirement, multiple attribute names will exist for the same basic information. That is, there is no single attribute name for the e-mail address of an initiator. Other aspects of how mechanisms describe information about subjects would already make this true. For example, some mechanisms use OIDs to name attributes; others use URIs.

Local implementations or platforms are likely to have sufficient policy and information to know when contexts can be treated as the same. For example the GSS-API implementation may know that a particular certification authority can be trusted in the context of a pkinit authentication. The local implementation may have sufficient policy to know that a particular credential issuer is trusted to make

a given statement. In order to take advantage of this local knowledge within the GSS-API implementation, naming extensions support the concept of local attributes in addition to standard attributes. For example, an implementation might provide a local attribute for e-mail address. The implementation would specify the encoding and representation of this attribute; mechanism-specific standards attributes would be re-encoded if necessary to meet this representation. Only e-mail addresses in contexts that meet the requirements of local policy would be mapped into this local attribute.

Such local attributes inherently expose a tradeoff between interoperability and usability. Using a local attribute in an application requires knowledge of the local implementation. However using a standardized attribute in an application requires more knowledge of policy and more validation logic in the application. Sharing this logic in the local platform provides more consistency across applications as well as reducing implementation costs. Both options are needed.

## 6. Representation of Attribute Names

Different underlying mechanisms (e.g., SAML or X.509 certificates) provide different representations for the names of their attribute. In X.509 certificates, most objects are named by object identifiers (OIDs). The type of object (certificate extension, name constraint, keyPurposeID, etc) along with the OID is sufficient to identify the attribute. By contrast, according to Section 8.2 and 2.7.3.1 of [OASIS.saml-core-2.0-os], the name of an attribute has two parts. The first is a URI describing the format of the name. The second part, whose form depends on the format URI, is the actual name. In other cases an attribute might represent a certificate that plays some particular role in a GSS-API mechanism; such attributes might have a simple mechanism-defined name.

Attribute names MUST support multiple components. If there are more than one component in an attribute name, the more significant components define the semantics of the less significant components.

Attribute names are represented as OCTET STRING elements in the API described below. These attribute names have syntax and semantics that are understood by the application and by the lower-layer implementations (some of which are described below).

If an attribute name contains a space (ASCII 0x20), the first space separates the most significant or primary component of the name from the remainder. We may refer to the primary component of the

attribute name as the attribute name's "prefix". If there is no space, the primary component is the entire name, otherwise it defines the interpretation of the remainder of the name.s

If the primary component contains an ASCII : (0x3a), then the primary component is a URI. Otherwise, the attribute is a local attribute and the primary component has meaning to the implementation of GSS-API or to the specific configuration of the application. Local attribute names with an at-sign ('@') in them are reserved for future allocation by the IETF.

Since attribute names are split at the first space into prefix and suffix, there is a potential for ambiguity if a mechanism blindly passes through a name attribute whose name it does not understand. In order to prevent such ambiguities the mechanism MUST always prefix raw name attributes with a prefix that reflects the context of the attribute.

Local attribute names under the control of an administrator or a sufficiently trusted part of the platform need not have a prefix to describe context.

## 7. API

### 7.1. SET OF OCTET STRING

The construct SET OF OCTET STRING occurs once in RFC 2743 [RFC2743] where it is used to represent a set of status strings in the GSS_Display_status call. The Global Grid Forum has defined SET OF OCTET STRING as a buffer-set type in GFD.024 [GFD.024] which also provides one API for memory management of these structures. The normative reference to GFD.024 [GFD.024] is for the buffer set functions defined in section 2.5 and the associated buffer set C types defined in section 6 (namely gss_buffer_set_desc, gss_buffer_set_t, gss_create_empty_buffer_set, gss_add_buffer_set_member, gss_release_buffer_set). Nothing else from GFD.024 is required to implement this document. In particular, that document specify changes in behaviour existing GSS-API functions in section 3: implementing those changes are not required to implement this document. Any implementation of SET OF OCTET STRING for use by this specification MUST preserve order.

### 7.2. Const types

The C bindings for the new APIs uses some types from [RFC5587] to avoid issues with the use of "const". The normative reference to [RFC5587] is for the C types specified in Figure 1 of 3.4.6, nothing

else from that document is required to implement this document.

### 7.3. GSS_Display_name_ext()

Inputs:

- name INTERNAL NAME,
- display_as_name_type OBJECT IDENTIFIER

Outputs:

- major_status INTEGER,
- minor_status INTEGER,
- display_name OCTET STRING -- caller must release with GSS_Release_buffer()

Return major_status codes:

- GSS_S_COMPLETE indicates no error.
- GSS_S_UNAVAILABLE indicates that the given name could not be displayed using the syntax of the given name type.
- GSS_S_FAILURE indicates a general error.

This function displays a given name using the given name syntax, if possible. This operation may require mapping Mechanism Names (MNs) to generic name syntaxes or generic name syntaxes to mechanism-specific name syntaxes; such mappings may not always be feasible and MAY be inexact or lossy, therefore this function may fail.

#### 7.3.1. C-Bindings

The display_name buffer is de-allocated by the caller with gss_release_buffer.

```
OM_uint32 gss_display_name_ext(
  OM_uint32                    *minor_status,
  gss_const_name_t             name,
  gss_const_OID                display_as_name_type,
  gss_buffer_t                 display_name
);
```

### 7.4. GSS_Inquire_name()

Inputs:

- name INTERNAL NAME

Outputs:

- major_status INTEGER,
- minor_status INTEGER,
- name_is_MN BOOLEAN,
- mn_mech OBJECT IDENTIFIER,
- attrs SET OF OCTET STRING -- the caller is responsible for de-allocating memory using GSS_Release_buffer_set

Return major_status codes:

- GSS_S_COMPLETE indicates no error.
- GSS_S_FAILURE indicates a general error.

This function outputs the set of attributes of a name. It also indicates if a given name is an Mechanism Name (MN) or not and, if it is, what mechanism it's an MN of.

#### 7.4.1. C-Bindings

```
OM_uint32 gss_inquire_name(
  OM_uint32                    *minor_status,
  gss_const_name_t             name,
  int                          *name_is_MN,
  gss_OID                      *MN_mech,
  gss_buffer_set_t             *attrs
);
```

The gss_buffer_set_t is used here as the C representation of SET OF OCTET STRING. This type is used to represent a set of attributes and is a NULL-terminated array of gss_buffer_t. The gss_buffer_set_t type and associated API is defined in GFD.024 [GFD.024]. The "attrs" buffer set is de-allocated by the caller using gss_release_buffer_set().

### 7.5. GSS_Get_name_attribute()

Inputs:

- name INTERNAL NAME,
- attr OCTET STRING

Outputs:

- major_status INTEGER,
- minor_status INTEGER,
- authenticated BOOLEAN, -- TRUE if and only if authenticated by the trusted peer credential source.
- complete BOOLEAN -- TRUE if and only if this represents a complete set of values for the name.
- values SET OF OCTET STRING -- the caller is responsible for de-allocating memory using GSS_Release_buffer_set.
- display_values SET OF OCTET STRING -- the caller is responsible for de-allocating memory using GSS_Release_buffer_set

Return major_status codes:

- GSS_S_COMPLETE indicates no error.
- GSS_S_UNAVAILABLE indicates that the given attribute OID is not known or set.
- GSS_S_FAILURE indicates a general error.

This function outputs the value(s) associated with a given GSS name object for a given name attribute.

The complete flag denotes that (if TRUE) the set of values represents a complete set of values for this name. The peer being an authoritative source of information for this attribute is a sufficient condition for the complete flag to be set by the peer.

In the federated case when several peers may hold some of the attributes about a name this flag may be highly dangerous and SHOULD NOT be used.

NOTE: This function relies on the GSS-API notion of "SET OF" allowing for order preservation; this has been discussed on the KITTEN WG mailing list and the consensus seems to be that, indeed, that was always the intention. It should be noted however that the order presented does not always reflect an underlying order of the mechanism specific source of the attribute values.

### 7.5.1. C-Bindings

The C-bindings of GSS_Get_name_attribute() requires one function call per-attribute value, for multi-valued name attributes. This is done by using a single gss_buffer_t for each value and an input/output integer parameter to distinguish initial and subsequent calls and to indicate when all values have been obtained.

The 'more' input/output parameter should point to an integer variable whose value, on first call to gss_get_name_attribute() MUST be -1, and whose value upon function call return will be non-zero to indicate that additional values remain, or zero to indicate that no values remain. The caller should not modify this parameter after the initial call. The status of the complete and authenticated flags MUST NOT change between multiple calls to iterate over values for an attribute.

The output buffers "value" and "display_value" are de-allocated by the caller using gss_release_buffer().

```
OM_uint32 gss_get_name_attribute(
  OM_uint32                    *minor_status,
  gss_const_name_t             name,
  gss_const_buffer_t           attr,
  int                          *authenticated,
  int                          *complete,
  gss_buffer_t                 value,
  gss_buffer_t                 display_value,
  int                          *more
);
```

## 7.6. GSS_Set_name_attribute()

Inputs:

- name INTERNAL NAME,
- complete BOOLEAN, -- TRUE if and only if this represents a complete set of values for the name.

- attr OCTET STRING,
- values SET OF OCTET STRING

Outputs:

- major_status INTEGER,
- minor_status INTEGER

Return major_status codes:

- GSS_S_COMPLETE indicates no error.
- GSS_S_UNAVAILABLE indicates that the given attribute NAME is not known or could not be set.
- GSS_S_FAILURE indicates a general error.

When the given NAME object is an MN this function MUST fail (with GSS_S_FAILURE) if the mechanism for which the name is an MN does not recognize the attribute name or the namespace it belongs to. This is because name attributes generally have some semantics that mechanisms must understand.

On the other hand, when the given name is not an MN this function MAY succeed even if none of the available mechanisms understand the given attribute, in which subsequent credential acquisition attempts (via GSS_Acquire_cred() or GSS_Add_cred()) with the resulting name MUST fail for mechanisms that do not understand any one or more name attributes set with this function. Applications may wish to use a non-MN, then acquire a credential with that name as the desired name. The acquired credentials will have elements only for the mechanisms that can carry the name attributes set on the name.

Note that this means that all name attributes are locally critical: the mechanism(s) must understand them. The reason for this is that name attributes must necessarily have some meaning that the mechanism must understand, even in the case of application-specific attributes (in which case the mechanism must know to transport the attribute to any peer). However, there is no provision to ensure that peers understand any given name attribute. Individual name attributes may be critical with respect to peers, and the specification of the attribute will have to indicate which of the mechanism’s protocol or the application is expected to enforce criticality.

The complete flag denotes that (if TRUE) the set of values represents

a complete set of values for this name. The peer being an authoritative source of information for this attribute is a sufficient condition for the complete flag to be set by the peer.

In the federated case when several peers may hold some of the attributes about a name this flag may be highly dangerous and SHOULD NOT be used.

NOTE: This function relies on the GSS-API notion of "SET OF" allowing for order preservation; this has been discussed on the KITTEN WG mailing list and the consensus seems to be that, indeed, that was always the intention. It should be noted that underlying mechanisms may not respect the given order.

#### 7.6.1. C-Bindings

The C-bindings of GSS_Set_name_attribute() requires one function call per-attribute value, for multi-valued name attributes -- each call adds one value. To replace an attribute's every value delete the attribute's values first with GSS_Delete_name_attribute().

```
OM_uint32 gss_set_name_attribute(
  OM_uint32                    *minor_status,
  gss_const_name_t             name,
  int                          complete,
  gss_const_buffer_t           attr,
  gss_const_buffer_t           value
);
```

### 7.7. GSS_Delete_name_attribute()

Inputs:

- name INTERNAL NAME,
- attr OCTET STRING,

Outputs:

- major_status INTEGER,
- minor_status INTEGER

Return major_status codes:

- GSS_S_COMPLETE indicates no error.

- GSS_S_UNAVAILABLE indicates that the given attribute NAME is not known.
- GSS_S_UNAUTHORIZED indicates that a forbidden delete operation was attempted, such as deleting a negative attribute.
- GSS_S_FAILURE indicates a general error.

Deletion of negative authenticated attributes from NAME objects MUST NOT be allowed and must result in a GSS_S_UNAUTHORIZED.

#### 7.7.1. C-Bindings

```
OM_uint32 gss_delete_name_attribute(
  OM_uint32                    *minor_status,
  gss_const_name_t             name,
  gss_const_buffer_t           attr
);
```

### 7.8. GSS_Export_name_composite()

Inputs:

- name INTERNAL NAME

Outputs:

- major_status INTEGER,
- minor_status INTEGER,
- exp_composite_name OCTET STRING -- the caller is responsible for de-allocating memory using GSS_Release_buffer

Return major_status codes:

- GSS_S_COMPLETE indicates no error.
- GSS_S_FAILURE indicates a general error.

This function outputs a token which can be imported with GSS_Import_name(), using GSS_C_NT_COMPOSITE_EXPORT as the name type and which preserves any name attribute information (including the authenticated/complete flags) associated with the input name (which GSS_Export_name() may well not). The token format is not specified here as this facility is intended for inter-process communication

only; however, all such tokens MUST start with a two-octet token ID, hex 04 02, in network byte order.

The OID for GSS_C_NT_COMPOSITE_EXPORT is <TBD>.

#### 7.8.1. C-Bindings

The "exp_composite_name" buffer is de-allocated by the caller with gss_release_buffer.

```
OM_uint32 gss_export_name_composite(
  OM_uint32                    *minor_status,
  gss_const_name_t             name,
  gss_buffer_t                 exp_composite_name
);
```

## 8. IANA Considerations

This specification has no actions for IANA.

This document creates a namespace of GSS-API name attributes. Attributes are named by URIs, so no single authority is technically needed for allocation. However future deployment experience may indicate the need for an IANA registry for URIs used to reference names specified by IETF standards. It is expected that this will be a registry of URNs but this document provides no further guidance on this registry.

## 9. Security Considerations

This document extends the GSS-API naming model to include support for name attributes. The intention is that name attributes are to be used as a basis for (among other things) authorization decisions or personalization for applications relying on GSS-API security contexts.

The security of the application may be critically dependent on the security of the attributes. This document classifies attributes as asserted or authenticated. Asserted (non-authenticated) attributes MUST NOT be used if the attribute has security implications for the application (e.g., authorization decisions) since asserted attributes may easily be controlled by the peer directly.

It is important to understand the meaning of ’authenticated’ in this setting. Authenticated does not imply that any semantic of the attribute is claimed to be true. The only implication is that a

trusted third party has asserted the attribute as opposed to the attribute being asserted by the peer itself. Any additional semantics are always the result of applying policy. For instance in a given deployment the mail attribute of the subject may be authenticated and sourced from an email system where 'authoritive' values are kept. In another situation users may be allowed to modify their mail addresses freely. In both cases the 'mail' attribute may be authenticated by virtue of being included in signed SAML attribute assertions or by other means authenticated by the underlying mechanism.

When the underlying security mechanism does not provide a permanent unique identity (e.g., anonymous kerberos), GSS-API naming extensions may be used to provide a permanent unique identity attribute. This may be a globally unique identifier, a value unique within the namespace of the attribute issuer, or a "directed" identifier that is unique per peer acceptor identity. SAML, to use one example technology, offers a number of built-in constructs for this purpose, such as a <NameID> with a Format of "urn:oasis:names:tc:SAML:2.0:nameid-format:persistent". SAML deployments also typically make use of domain-specific attribute types that can serve as identifiers.

# 10. References

## 10.1. Normative References

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## 10.2. Informative References

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# A set of SASL Mechanisms for OAuth
# draft-ietf-kitten-sasl-oauth-23.txt

## Abstract

OAuth enables a third-party application to obtain limited access to a protected resource, either on behalf of a resource owner by orchestrating an approval interaction, or by allowing the third-party application to obtain access on its own behalf.

This document defines how an application client uses credentials obtained via OAuth over the Simple Authentication and Security Layer (SASL) to access a protected resource at a resource serve. Thereby, it enables schemes defined within the OAuth framework for non-HTTP-based application protocols.

Clients typically store the user's long-term credential. This does, however, lead to significant security vulnerabilities, for example, when such a credential leaks. A significant benefit of OAuth for usage in those clients is that the password is replaced by a shared secret with higher entropy, i.e., the token. Tokens typically provide limited access rights and can be managed and revoked separately from the user's long-term password.

## Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on November 30, 2015.



Table of Contents

## 1. Introduction

OAuth 1.0a [RFC5849] and OAuth 2.0 [RFC6749] are protocol frameworks that enable a third-party application to obtain limited access to a protected resource, either on behalf of a resource owner by orchestrating an approval interaction, or by allowing the third-party application to obtain access on its own behalf.

The core OAuth 2.0 specification [RFC6749] specifies the interaction between the OAuth client and the authorization server; it does not define the interaction between the OAuth client and the resource server for the access to a protected resource using an Access Token. Instead, the OAuth client to resource server interaction is described in separate specifications, such as the bearer token specification [RFC6750]. OAuth 1.0a included the protocol specification for the communication between the OAuth client and the resource server in [RFC5849].

The main use cases for OAuth 2.0 and OAuth 1.0a have so far focused on an HTTP-based [RFC7230] environment only. This document integrates OAuth 1.0a and OAuth 2.0 into non-HTTP-based applications using the integration into SASL. Hence, this document takes advantage of the OAuth protocol and its deployment base to provide a way to use the Simple Authentication and Security Layer (SASL) [RFC4422] to gain access to resources when using non-HTTP-based protocols, such as the Internet Message Access Protocol (IMAP) [RFC3501] and the Simple Mail Transfer Protocol (SMTP) [RFC5321]. This document gives examples of use in IMAP and SMTP.

To illustrate the impact of integrating this specification into an OAuth-enabled application environment, Figure 1 shows the abstract message flow of OAuth 2.0 [RFC6749]. As indicated in the figure, this document impacts the exchange of messages (E) and (F) since SASL is used for interaction between the client and the resource server instead of HTTP.

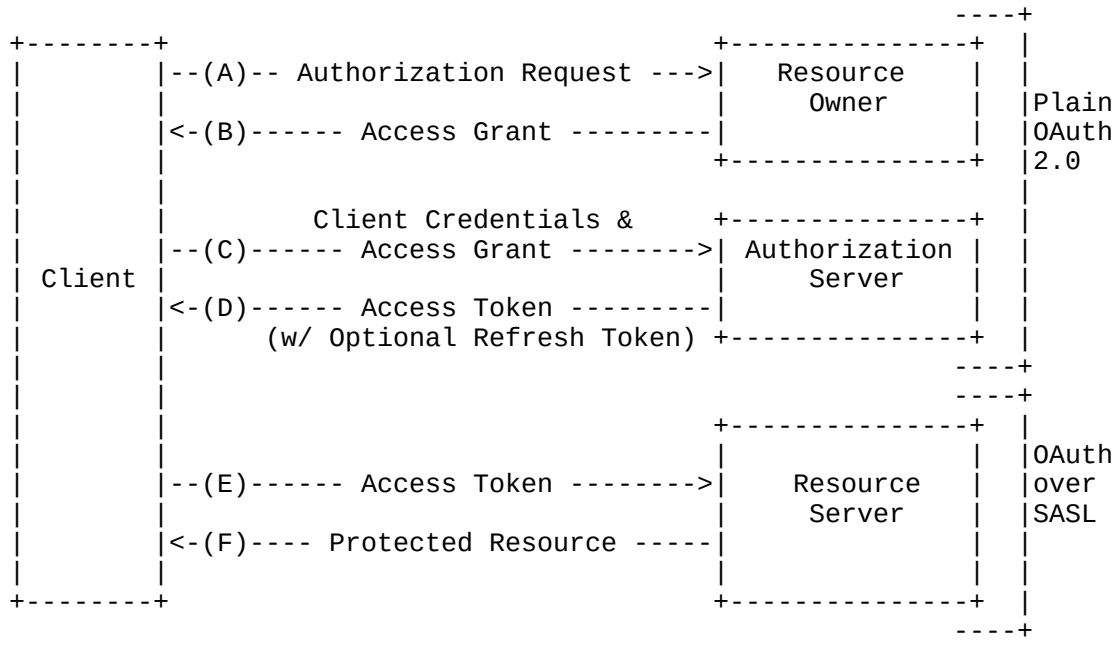


Figure 1: OAuth 2.0 Protocol Flow

The Simple Authentication and Security Layer (SASL) is a framework for providing authentication and data security services in connection-oriented protocols via replaceable authentication mechanisms. It provides a structured interface between protocols and mechanisms. The resulting framework allows new protocols to reuse existing authentication mechanisms and allows old protocols to make use of new authentication mechanisms. The framework also provides a protocol for securing subsequent exchanges within a data security layer.

When OAuth is integrated into SASL the high-level steps are as follows:

(A) The client requests authorization from the resource owner. The authorization request can be made directly to the resource owner (as shown), or indirectly via the authorization server as an intermediary.

(B) The client receives an authorization grant which is a credential representing the resource owner’s authorization, expressed using one of the grant types defined in [RFC6749] or [RFC5849] or using an extension grant type. The authorization

grant type depends on the method used by the client to request authorization and the types supported by the authorization server.

(C) The client requests an access token by authenticating with the authorization server and presenting the authorization grant.

(D) The authorization server authenticates the client and validates the authorization grant, and if valid issues an access token.

(E) The client requests the protected resource from the resource server and authenticates by presenting the access token.

(F) The resource server validates the access token, and if valid, indicates a successful authentication.

Again, steps (E) and (F) are not defined in [RFC6749] (but are described in, for example, [RFC6750] for the OAuth Bearer Token instead) and are the main functionality specified within this document. Consequently, the message exchange shown in Figure 1 is the result of this specification. The client will generally need to determine the authentication endpoints (and perhaps the service endpoints) before the OAuth 2.0 protocol exchange messages in steps (A)-(D) are executed. The discovery of the resource owner, authorization server endpoints, and client registration are outside the scope of this specification. The client must discover the authorization endpoints using a discovery mechanism such as OpenID Connect Discovery [OpenID.Discovery] or Webfinger using host-meta [RFC7033]. Once credentials are obtained the client proceeds to steps (E) and (F) defined in this specification. Authorization endpoints MAY require client registration and generic clients SHOULD support the Dynamic Client Registration protocol [I-D.ietf-oauth-dyn-reg].

OAuth 1.0 follows a similar model but uses a different terminology and does not separate the resource server from the authorization server.

## 2. Terminology

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

The reader is assumed to be familiar with the terms used in the OAuth 2.0 specification [RFC6749] and SASL [RFC4422].

In examples, "C:" and "S:" indicate lines sent by the client and server respectively. Line breaks have been inserted for readability.

Note that the IMAP SASL specification requires base64 encoding, as specified in Section 4 of [RFC4648].

## 3. OAuth SASL Mechanism Specifications

SASL is used as an authentication framework in a variety of application layer protocols. This document defines the following SASL mechanisms for usage with OAuth:

OAUTHBEARER: OAuth 2.0 bearer tokens, as described in [RFC6750]. RFC 6750 uses Transport Layer Security (TLS) [RFC5246] to secure the protocol interaction between the client and the resource server.

OAUTH10A: OAuth 1.0a MAC tokens (using the HMAC-SHA1 keyed message digest), as described in Section 3.4.2 of [RFC5849].

New extensions may be defined to add additional OAuth Access Token Types. Such a new SASL OAuth mechanism can be added by registering the new name(s) with IANA in the SASL Mechanisms registry and citing this specification for the further definition.

SASL mechanisms using this document as their definition do not provide a data security layer; that is, they cannot provide integrity or confidentiality protection for application messages after the initial authentication. If such protection is needed, TLS or some similar solution should be used. Additionally, for the two mechanisms specified in this document, TLS MUST be used for OAUTHBEARER to protect the bearer token; for OAUTH10A the use of TLS is RECOMMENDED.

These mechanisms are client initiated and lock-step, the server always replying to a client message. In the case where the client has and correctly uses a valid token the flow is:

1. Client sends a valid and correct initial client response.

2. Server responds with a successful authentication.

In the case where authentication fails the server sends an error result, then client MUST then send an additional message to the server in order to allow the server to finish the exchange. Some protocols and common SASL implementations do not support both sending

a SASL message and finalizing a SASL negotiation. The additional client message in the error case deals with this problem. This exchange is:

1. Client sends an invalid initial client response.

2. Server responds with an error message.

3. Client sends a dummy client response.

4. Server fails the authentication.

### 3.1. Initial Client Response

Client responses are a GS2 [RFC5801] header followed by zero or more key/value pairs, or may be empty. The gs2-header is defined here for compatibility with GS2 if a GS2 mechanism is formally defined, but this document does not define one. The key/value pairs take the place of the corresponding HTTP headers and values to convey the information necessary to complete an OAuth style HTTP authorization. Unknown key/value pairs MUST be ignored by the server. The ABNF [RFC5234] syntax is:

```
  kvsep          = %x01
  key            = 1*(ALPHA)
  value          = *(VCHAR / SP / HTAB / CR / LF )
  kvpair         = key "=" value kvsep
;;gs2-header     = See RFC 5801
  client_resp    = (gs2-header kvsep *kvpair kvsep) / kvsep
```

The GS2 header MAY include the user name associated with the resource being accessed, the "authzid". It is worth noting that application protocols are allowed to require an authzid, as are specific server implementations.

The client response consisting of only a single kvsep is used only when authentication fails, and is only valid in that context. If sent as the first message from the client the server MAY simply fail the authentication without returning discovery information since there is no user or server name indication.

The following keys and corresponding values are defined in the client response:

auth (REQUIRED): The payload that would be in the HTTP Authorization header if this OAuth exchange was being carried out over HTTP.

host: Contains the host name to which the client connected. In an HTTP context this is the value of the HTTP Host header.

port: Contains the destination port that the client connected to, represented as a decimal positive integer string without leading zeros.

For OAuth token types such as OAuth 1.0a that use keyed message digests the client MUST send host and port number key/values, and the server MUST fail an authorization request requiring keyed message digests that are not accompanied by host and port values. In OAuth 1.0a for example, the so-called "signature base string calculation" includes the reconstructed HTTP URL.

### 3.1.1. Reserved Key/Values

In these mechanisms values for path, query string and post body are assigned default values. OAuth authorization schemes MAY define usage of these in the SASL context and extend this specification. For OAuth Access Token Types that include a keyed message digest of the request the default values MUST be used unless explicit values are provided in the client response. The following key values are reserved for future use:

mthd (RESERVED): HTTP method, the default value is "POST".

path (RESERVED): HTTP path data, the default value is "/".

post (RESERVED): HTTP post data, the default value is the empty string ("").

qs (RESERVED): The HTTP query string, the default value is the empty string ("").

## 3.2. Server’s Response

The server validates the response according to the specification for the OAuth Access Token Types used. If the OAuth Access Token Type utilizes a keyed message digest of the request parameters then the client must provide a client response that satisfies the data requirements for the scheme in use.

The server fully validates the client response before generating a server response; this will necessarily include the validation steps listed in the specification for the OAuth Access Token Type used. However, additional validation steps may be needed, depending on the particular application protocol making use of SASL. In particular, values included as kvpairs in the client response (such as host and port) which correspond to values known to the application server by some other mechanism (such as an application protocol data unit or pre-configured values) MUST be validated to match between the initial client response and the the other source(s) of such information. As a concrete example, when SASL is used over IMAP to an IMAP server for a single domain the hostname can be available via configuration; this hostname must be validated to match the value sent in the 'host' kvpair.

The server responds to a successfully verified client message by completing the SASL negotiation. The authenticated identity reported by the SASL mechanism is the identity securely established for the client with the OAuth credential. The application, not the SASL mechanism, based on local access policy determines whether the identity reported by the mechanism is allowed access to the requested resource. Note that the semantics of the authzid is specified by the SASL framework [RFC4422].

### 3.2.1. OAuth Identifiers in the SASL Context

In the OAuth framework the client may be authenticated by the authorization server and the resource owner is authenticated to the authorization server. OAuth access tokens may contain information about the authentication of the resource owner and about the client and may therefore make this information accessible to the resource server.

If both identifiers are needed by an application the developer will need to provide a way to communicate that from the SASL mechanism back to the application.

### 3.2.2. Server Response to Failed Authentication

For a failed authentication the server returns a JSON [RFC7159] formatted error result, and fails the authentication. The error result consists of the following values:

status (REQUIRED): The authorization error code. Valid error codes are defined in the IANA "OAuth Extensions Error Registry" specified in the OAuth 2 core specification.

scope (OPTIONAL): An OAuth scope which is valid to access the service. This may be omitted which implies that unscoped tokens are required. If a scope is specified then a single scope is preferred. At the time this document was written there are several implementations that do not properly support space separated lists of scopes, so the use of a space separated list of scopes is NOT RECOMMENDED.

openid-configuration (OPTIONAL): The URL for a document following the OpenID Provider Configuration Information schema as described in OpenID Connect Discovery (OIDCD) [OpenID.Discovery] section 3 that is appropriate for the user. As specified in OIDCD this will have the "https" URL scheme. This document MUST have all OAuth related data elements populated. The server MAY return different URLs for users in different domains and the client SHOULD NOT cache a single returned value and assume it applies for all users/domains that the server suports. The returned discovery document SHOULD have all data elements required by the OpenID Connect Discovery specification populated. In addition, the discovery document SHOULD contain the 'registration_endpoint' element to identify the endpoint to be used with the Dynamic Client Registration protocol [I-D.ietf-oauth-dyn-reg] to obtain the minimum number of parameters necessary for the OAuth protocol exchange to function. Another comparable discovery or client registration mechanism MAY be used if available.

The use of the 'offline_access' scope, as defined in [OpenID.Core] is RECOMMENDED to give clients the capability to explicitly request a refresh token.

If the resource server provides a scope then the client MUST always request scoped tokens from the token endpoint. If the resource server does not return a scope the client SHOULD presume an unscoped token is required to access the resource.

Since clients may interact with a number of application servers, such as email servers and XMPP [RFC6120] servers, they need to have a way to determine whether dynamic client registration has been performed already and whether an already available refresh token can be re-used to obtain an access token for the desired resource server. This specification RECOMMENDs that a client uses the information in the 'iss' element defined in OpenID Connect Core [OpenID.Core] to make this determination.

### 3.2.3. Completing an Error Message Sequence

Section 3.6 of SASL [RFC4422] explicitly prohibits additional information in an unsuccessful authentication outcome. Therefore, the error message is sent in a normal message. The client MUST then send either an additional client response consisting of a single %x01 (control A) character to the server in order to allow the server to finish the exchange or send a SASL cancellation token as generally defined in section 3.5 of SASL [RFC4422]. A specific example of a cancellation token can be found in IMAP [RFC3501] section 6.2.2.

## 3.3. OAuth Access Token Types using Keyed Message Digests

OAuth Access Token Types may use keyed message digests and the client and the resource server may need to perform a cryptographic computation for integrity protection and data origin authentication.

OAuth is designed for access to resources identified by URIs. SASL is designed for user authentication, and has no facility for more fine-grained access control. In this specification we require or define default values for the data elements from an HTTP request which allow the signature base string to be constructed properly. The default HTTP path is "/" and the default post body is empty. These atoms are defined as extension points so that no changes are needed if there is a revision of SASL which supports more specific resource authorization, e.g., IMAP access to a specific folder or FTP access limited to a specific directory.

Using the example in the OAuth 1.0a specification as a starting point, on an IMAP server running on port 143 and given the OAuth 1.0a style authorization request (with %x01 shown as ^A and line breaks added for readability) below:

```
n,a=user@example.com,^A
host=example.com^A
port=143^A
auth=OAuth realm="Example",
           oauth_consumer_key="9djdj82h48djs9d2",
           oauth_token="kkk9d7dh3k39sjv7",
           oauth_signature_method="HMAC-SHA1",
           oauth_timestamp="137131201",
           oauth_nonce="7d8f3e4a",
           oauth_signature="Tm90IGEgcmVhbCBzaWduYXR1cmU"^A^A
```

The signature base string would be constructed per the OAuth 1.0 specification [RFC5849] with the following things noted:

- The method value is defaulted to POST.

- The scheme defaults to be "http", and any port number other than 80 is included.
- The path defaults to "/".
- The query string defaults to "".

In this example the signature base string with line breaks added for readability would be:

```
POST&http%3A%2F%2Fexample.com:143%2F&oauth_consumer_key%3D9djdj82h4
8djs9d2%26oauth_nonce%3D7d8f3e4a%26oauth_signature_method%3DHMAC-SH
A1%26oauth_timestamp%3D137131201%26oauth_token%3Dkkk9d7dh3k39sjv7
```

## 4. Examples

These examples illustrate exchanges between IMAP and SMTP clients and servers. All IMAP examples use SASL-IR [RFC4959] and send payload in the initial client response. The Bearer Token examples assume encrypted transport; if the underlying connection is not already TLS then STARTTLS MUST be used as TLS is required in the Bearer Token specification.

Note to implementers: The SASL OAuth method names are case insensitive. One example uses "Bearer" but that could as easily be "bearer", "BEARER", or "BeArEr".

### 4.1. Successful Bearer Token Exchange

This example shows a successful OAuth 2.0 bearer token exchange in IMAP. Note that line breaks are inserted for readability.

```
[Initial connection and TLS establishment...]
S: * OK IMAP4rev1 Server Ready
C: t0 CAPABILITY
S: * CAPABILITY IMAP4rev1 AUTH=OAUTHBEARER SASL-IR
S: t0 OK Completed
C: t1 AUTH OAUTHBEARER bixhPXVzZXJAZXhhbXBsZS5jb20sAWhvc3Q9c2Vy
      dmVyLmV4YW1wbGUuY29tAXBvcnQ9MTQzAWF1dGg9QmVhcmVyIHZGOWRmd
      DRxbVRjMk52YjNSbGNrQmhiSFJoZG1semRHRXVZMjl0Q2c9PQEB
S: t1 OK SASL authentication succeeded
```

As required by IMAP [RFC3501], the payloads are base64-encoded. The decoded initial client response (with %x01 represented as ^A and long lines wrapped for readability) is:

```
n,a=user@example.com,^Ahost=server.example.com^Aport=143^A
auth=Bearer vF9dft4qmTc2Nvb3RlckBhbHRhdmlzdGEuY29tCg==^A^A
```

The same credential used in an SMTP exchange is shown below. Again this example assumes that TLS is already established per the Bearer Token specification requirements.

```
[connection begins]
S: 220 mx.example.com ESMTP 12sm2095603fks.9
C: EHLO sender.example.com
S: 250-mx.example.com at your service,[172.31.135.47]
S: 250-SIZE 35651584
S: 250-8BITMIME
S: 250-AUTH LOGIN PLAIN OAUTHBEARER
S: 250-ENHANCEDSTATUSCODES
S: 250-STARTTLS
S: 250 PIPELINING
[Negotiate TLS...]
C: t1 AUTH OAUTHBEARER bixhPXVzZXJAZXhhbXBsZS5jb20sAWhvc3Q9c2Vy
      dmVyLmV4YW1wbGUuY29tAXBvcnQ9NTg3AWF1dGg9QmVhcmVyIHZGOWRmd
      DRxbVRjMk52YjNSbGNrQmhiSFJoZG1semRHRXVZMjl0Q2c9PQEB
S: 235 Authentication successful.
[connection continues...]
```

The decoded initial client response is:

```
n,a=user@example.com,^Ahost=server.example.com^Aport=587^A
auth=Bearer vF9dft4qmTc2Nvb3RlckBhbHRhdmlzdGEuY29tCg==^A^A
```

## 4.2. Successful OAuth 1.0a Token Exchange

This IMAP example shows a successful OAuth 1.0a token exchange. Note that line breaks are inserted for readability. This example assumes that TLS is already established. Signature computation is discussed in Section 3.3.

```
S: * OK IMAP4rev1 Server Ready
C: t0 CAPABILITY
S: * CAPABILITY IMAP4rev1 AUTH=OAUTHBEARER OAUTH10A SASL-IR
S: t0 OK Completed
C: t1 AUTH OAUTH10A bixhPXVzZXJAZXhhbXBsZS5jb20sAWhvc3Q9ZXhhb
      XBsZS5jb20BcG9ydD0xNDMBYXV0aD1PQXV0aCByZWFsbT0iRXhhbXBsZSIsb2F1
      dGhfY29uc3VtZXJfa2V5PSI5ZGpkajgyaDQ4ZGpzOWQyIixvYXV0aF90b2tlbj0
      ia2trOWQ3ZGgzazM5c2p2NyIsb2F1dGhfc2lnbmF0dXJlX21ldGhvZD0iSE1BQy
      1TSEExIixvYXV0aF90aW1lc3RhbXA9IjEzNzEzMTIwMSIsb2F1dGhfbm9uY2U9I
      jdkOGYzZTRhIixvYXV0aF9zaWduYXR1cmU9IlRtOTBJR0VnY21WaGJDQnphV2R1
      WVhSMWNtVSUzRCIBAQ==
S: t1 OK SASL authentication succeeded
```

As required by IMAP [RFC3501], the payloads are base64-encoded. The decoded initial client response (with %x01 represented as ^A and lines wrapped for readability) is:

```
n,a=user@example.com,^A
host=example.com^A
port=143^A
auth=OAuth realm="Example",
           oauth_consumer_key="9djdj82h48djs9d2",
           oauth_token="kkk9d7dh3k39sjv7",
           oauth_signature_method="HMAC-SHA1",
           oauth_timestamp="137131201",
           oauth_nonce="7d8f3e4a",
           oauth_signature="SSdtIGEgbGl0dGxlIHRlYSBwb3Qu"^A^A
```

### 4.3. Failed Exchange

This IMAP example shows a failed exchange because of the empty Authorization header, which is how a client can query for the needed scope. Note that line breaks are inserted for readability.

```
S: * OK IMAP4rev1 Server Ready
C: t0 CAPABILITY
S: * CAPABILITY IMAP4rev1 AUTH=OAUTHBEARER SASL-IR
S: t0 OK Completed
C: t1 AUTH OAUTHBEARER bixhPXVzZXJAZXhhbXBsZS5jb20sAW
      hvc3Q9c2VydmVyLmV4YW1wbGUuY29tAXBvcnQ9MTQzAWF1dGg9AQE=
S: + eyJzdGF0dXMiOiJpbnZhbGlkX3Rva2VuIiwic2NvcGUiOiJleGFtcGxl
     X3Njb3BlIiwib3BlbmlkLWNvbmZpZ3VyYXRpb24iOiJodHRwczovL2V4
     YW1wbGUuY29tLy53ZWxsLWtub3duL29wZW5pZC1jb25maWcifQ==
C: AQ==
S: t1 NO SASL authentication failed
```

The decoded initial client response is:

```
n,a=user@example.com,^Ahost=server.example.com^A
port=143^Aauth=^A^A
```

The decoded server error response is:

```
{
"status":"invalid_token",
"scope":"example_scope",
"openid-configuration":"https://example.com/.well-known/openid-config"
}
```

The client responds with the required dummy response, "AQ==" is the base64 encoding of the ASCII value 0x01. The same exchange using the

IMAP specific method of cancelling an AUTHENTICATE command sends "*" and is shown below.

```
S: * OK IMAP4rev1 Server Ready
C: t0 CAPABILITY
S: * CAPABILITY IMAP4rev1 AUTH=OAUTHBEARER SASL-IR IMAP4rev1
S: t0 OK Completed
C: t1 AUTH OAUTHBEARER bixhPXVzZXJAZXhhbXBsZS5jb20sAW
      hvc3Q9c2VydmVyLmV4YW1wbGUuY29tAXBvcnQ9MTQzAWF1dGg9AQE=
S: + eyJzdGF0dXMiOiJpbnZhbGlkX3Rva2VuIiwic2NvcGUiOiJleGFtcGxl
     X3Njb3BlIiwib3BlbmlkLWNvbmZpZ3VyYXRpb24iOiJodHRwczovL2V4
     YW1wbGUuY29tLy53ZWxsLWtub3duL29wZW5pZC1jb25maWd1cmF0aW9u
     In0=
C: *
S: t1 NO SASL authentication failed
```

### 4.4. SMTP Example of a Failed Negotiation

This example shows an authorization failure in an SMTP exchange. TLS negotiation is not shown but as noted above it is required for the use of Bearer Tokens.

```
[connection begins]
S: 220 mx.example.com ESMTP 12sm2095603fks.9
C: EHLO sender.example.com
S: 250-mx.example.com at your service,[172.31.135.47]
S: 250-SIZE 35651584
S: 250-8BITMIME
S: 250-AUTH LOGIN PLAIN OAUTHBEARER
S: 250-ENHANCEDSTATUSCODES
S: 250 PIPELINING
[Negotiate TLS...]
C: AUTH OAUTHBEARER bix1c2VyPXNvbWV1c2VyQGV4YW1wbGUuY29tLAFhdXRoPUJlYXJl
       ciB2RjlkZnQ0cW1UYzJOdmIzUmxja0JoZEhSaGRtbHpkR0V1WTI5dENnPT0BAQ==
S: 334 eyJzdGF0dXMiOiJpbnZhbGlkX3Rva2VuIiwic2NoZW1lcyI6ImJlYXJlciBtYWMiL
       CJzY29wZSI6Imh0dHBzOi8vbWFpbC5leGFtcGxlLmNvbS8ifQ==
C: AQ==
S: 535-5.7.1 Username and Password not accepted. Learn more at
S: 535 5.7.1 http://support.example.com/mail/oauth
[connection continues...]
```

The initial client response is:

```
n,user=someuser@example.com,^A
auth=Bearer vF9dft4qmTc2Nvb3RlckBhdHRhdmlzdGEuY29tCg==^A^A
```

The server returned an error message in the 334 SASL message, the client responds with the required dummy response, and the server finalizes the negotiation.

```
{
    "status":"invalid_token",
    "schemes":"bearer mac",
    "scope":"https://mail.example.com/"
}
```

## 5. Security Considerations

OAuth 1.0a and OAuth 2 allow for a variety of deployment scenarios, and the security properties of these profiles vary. As shown in Figure 1 this specification is aimed to be integrated into a larger OAuth deployment. Application developers therefore need to understand their security requirements based on a threat assessment before selecting a specific SASL OAuth mechanism. For OAuth 2.0 a detailed security document [RFC6819] provides guidance to select those OAuth 2.0 components that help to mitigate threats for a given deployment. For OAuth 1.0a Section 4 of RFC 5849 [RFC5849] provides guidance specific to OAuth 1.0.

This document specifies two SASL Mechanisms for OAuth and each comes with different security properties.

OAUTHBEARER: This mechanism borrows from OAuth 2.0 bearer tokens [RFC6750]. It relies on the application using TLS to protect the OAuth 2.0 Bearer Token exchange; without TLS usage at the application layer this method is completely insecure. Consequently, TLS MUST be provided by the application when choosing this authentication mechanism.

OAUTH10A: This mechanism re-uses OAuth 1.0a MAC tokens (using the HMAC-SHA1 keyed message digest), as described in Section 3.4.2 of [RFC5849]. To compute the keyed message digest in the same way as in RFC 5839 this specification conveys additional parameters between the client and the server. This SASL mechanism only supports client authentication. If server-side authentication is desireable then it must be provided by the application underneath the SASL layer. The use of TLS is strongly RECOMMENDED.

Additionally, the following aspects are worth pointing out:

An access token is not equivalent to the user’s long term password.

Care has to be taken when these OAuth credentials are used for actions like changing passwords (as it is possible with some

protocols, e.g., XMPP [RFC6120]). The resource server should ensure that actions taken in the authenticated channel are appropriate to the strength of the presented credential.

Lifetime of the application sessions.

It is possible that SASL will be used to authenticate a connection and the life of that connection may outlast the life of the access token used to establish it. This is a common problem in application protocols where connections are long-lived, and not a problem with this mechanism per se. Resource servers may unilaterally disconnect clients in accordance with the application protocol.

Access tokens have a lifetime.

Reducing the lifetime of an access token provides security benefits and OAuth 2.0 introduces refresh tokens to obtain new access token on the fly without any need for a human interaction. Additionally, a previously obtained access token might be revoked or rendered invalid at any time. The client MAY request a new access token for each connection to a resource server, but it SHOULD cache and re-use valid credentials.

## 6. Internationalization Considerations

The identifer asserted by the OAuth authorization server about the resource owner inside the access token may be displayed to a human. For example, when SASL is used in the context of IMAP the client may assert the resource owner’s email address to the IMAP server for usage in an email-based application. The identifier may therefore contain internationalized characters and an application needs to ensure that the mapping between the identifier provided by OAuth is suitable for use with the application layer protocol SASL is incorporated into.

At the time of writing the standardization of the various claims in the access token (in JSON format) is still ongoing, see [I-D.ietf-oauth-json-web-token]. Once completed it will provide a standardized format for exchanging identity information between the authorization server and the resource server.

## 7. IANA Considerations

### 7.1. SASL Registration

The IANA is requested to register the following entry in the SASL Mechanisms registry:

SASL mechanism name: OAUTHBEARER

Security Considerations: See this document

Published Specification: See this document

For further information: Contact the authors of this document.

Intended usage: common

Owner/Change controller: the IESG

Note: None

The IANA is requested to register the following entry in the SASL Mechanisms registry:

SASL mechanism name: OAUTH10A

Security Considerations: See this document

Published Specification: See this document

For further information: Contact the authors of this document.

Intended usage: common

Owner/Change controller: the IESG

Note: None

## 8. References

### 8.1. Normative References

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## 8.2. Informative References

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[RFC6819] Lodderstedt, T., McGloin, M., and P. Hunt, "OAuth 2.0 Threat Model and Security Considerations", RFC 6819, January 2013.

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[RFC7230] Fielding, R. and J. Reschke, "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing", RFC 7230, June 2014.

## Appendix A. Acknowlegements

The authors would like to thank the members of the Kitten working group, and in addition and specifically: Simon Josefson, Torsten Lodderstadt, Ryan Troll, Alexey Melnikov, Jeffrey Hutzelman, Nico Williams, Matt Miller, and Benjamin Kaduk.

This document was produced under the chairmanship of Alexey Melnikov, Tom Yu, Shawn Emery, Josh Howlett, Sam Hartman. The supervising area director was Stephen Farrell.

## Appendix B. Document History

[[ to be removed by RFC editor before publication as an RFC ]]

-23

- AD feedback from IESG review and comments.
- Fixed port number in SMTP examples.
- Minor editorial changes.
- Dyn-Reg draft becomes normative.

- Added explicit TLS start indicator in all examples, removed text that said we assume that.

-19

- Last call feedback agaiun.

- Clarified usage of TLS in examples and fixed them some more. Adding reference to RFC4422 and cancellation token and an example for that.

-18

- Last call feedback round #5. Fixed -17 change log.

- Corrected "issue" to "iss", other minor changes.

-17

- Last call feedback again (WGLC #4). eradicated comma splicing. Removed extra server message in example 4.3.

- Added recommendations for discovery and dynamic client registration support.

-16

- Last call feedback again. Primarily editorial changes. Corrected examples.

-15

- Last call feedack on the GS2 stuff being ripped out completely.

- Removed the "user" parameter and put stuff back into the gs2-header. Call out that the authzid goes in the gs2-header with some prose about when it might be required. Very comparable to -10.

- Added an OAuth 1.0A example explicitly.

-14

- Last call feedack on RFC citations needed, small editorial.

- Added the "user" parameter back, which was pulled when we started down the GS2 path. Same language as -03.

- Defined a stub GS2 header to make sure that when the GS2 bride is defined for this that nothing will break when it actually starts to get populated.

-13

- Changed affiliation.

-12

- Removed -PLUS components from the specification.

-11

- Removed GSS-API components from the specification.
- Updated security consideration section.

-10

- Clarifications throughout the document in response to the feedback from Jeffrey Hutzelman.

-09

- Incorporated review by Alexey and Hannes.
- Clarified the three OAuth SASL mechanisms.
- Updated references
- Extended acknowledgements

-08

- Fixed the channel binding examples for p=$cbtype
- More tuning of the authcid language and edited and renamed 3.2.1.

-07

- Struck the MUST langiage from authzid.
- 

-06

- Removed the user field. Fixed the examples again.

- Added canonicalization language.

- 

-05

- Fixed the GS2 header language again.

- Separated out different OAuth schemes into different SASL mechanisms. Took out the scheme in the error return. Tuned up the IANA registrations.

- Added the user field back into the SASL message.

- Fixed the examples (again).

- 

-04

- Changed user field to be carried in the gs2-header, and made gs2 header explicit in all cases.

- Converted MAC examples to OAuth 1.0a. Moved MAC to an informative reference.

- Changed to sending an empty client response (single control-A) as the second message of a failed sequence.

- Fixed channel binding prose to refer to the normative specs and removed the hashing of large channel binding data, which brought mroe problems than it solved.

- Added a SMTP examples for Bearer use case.

-03

- Added user field into examples and fixed egregious errors there as well.

- Added text reminding developers that Authorization scheme names are case insensitive.

-02

- Added the user data element back in.

- Minor editorial changes.

-01

- Ripping out discovery. Changed to refer to I-D.jones-appsawg-webfinger instead of WF and SWD older drafts.
- Replacing HTTP as the message format and adjusted all examples.

-00

- Renamed draft into proper IETF naming format now that it's adopted.
- Minor fixes.

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February 24, 2012

# A SASL & GSS-API Mechanism for OpenID
# draft-ietf-kitten-sasl-openid-08

## Abstract

OpenID has found its usage on the Internet for Web Single Sign-On. Simple Authentication and Security Layer (SASL) and the Generic Security Service Application Program Interface (GSS-API) are application frameworks to generalize authentication. This memo specifies a SASL and GSS-API mechanism for OpenID that allows the integration of existing OpenID Identity Providers with applications using SASL and GSS-API.

## Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on August 25, 2012.

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Table of Contents



## 1. Introduction

OpenID [OpenID] is a web-based three-party protocol that provides a means for a user to offer identity assertions and other attributes to a web server (Relying Party) via the help of an identity provider. The purpose of this system is to provide a way to verify that an end user controls an identifier.

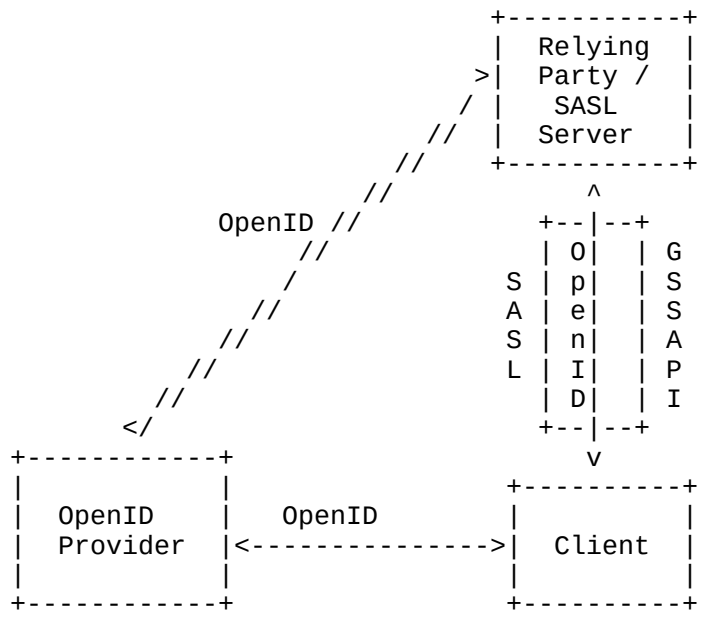
Simple Authentication and Security Layer (SASL) [RFC4422] (SASL) is used by application protocols such IMAP [RFC3501], POP [RFC1939] and XMPP [RFC6120], with the goal of modularizing authentication and security layers, so that newer mechanisms can be added as needed. This memo specifies just such a mechanism.

The Generic Security Service Application Program Interface (GSS-API) [RFC2743] provides a framework for applications to support multiple authentication mechanisms through a unified interface. This document defines a pure SASL mechanism for OpenID, but it conforms to the new bridge between SASL and the GSS-API called GS2 [RFC5801]. This means that this document defines both a SASL mechanism and a GSS-API mechanism. Implementors of the SASL component MAY implement the GSS-API interface as well.

This mechanism specifies interworking between SASL and OpenID in order to assert identity and other attributes to relying parties. As such, while SASL servers (as relying parties) will advertise SASL mechanisms, clients will select the OpenID mechanism.

The OpenID mechanism described in this memo aims to re-use the OpenID mechanism to the maximum extent and therefore does not establish a separate authentication, integrity and confidentiality mechanism. It is anticipated that existing security layers, such as Transport Layer Security (TLS) [RFC5246], continue to be used. Minimal changes are required to non-web applications, as most of the transaction occurs through a normal web browser. Hence, this specification is only appropriate for use when such a browser is available.

Figure 1 describes the interworking between OpenID and SASL. This document requires enhancements to the Relying Party and to the Client (as the two SASL communication end points) but no changes to the OpenID Provider (OP) are necessary. To accomplish this goal indirect messaging required by the OpenID specification is tunneled through the SASL/GSS-API mechanism.




## 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 RFC 2119 [RFC2119].

The reader is assumed to be familiar with the terms used in the OpenID 2.0 specification.

## 1.2. Applicability

Because this mechanism transports information that should not be controlled by an attacker, the OpenID mechanism MUST only be used over channels protected by TLS, and the client MUST successfully validate the server certificate. [RFC5280][RFC6125]

# 2. Applicability for application protocols other than HTTP

OpenID was originally envisioned for HTTP [RFC2616] and HTML [W3C .REC-html401-19991224] based communications, and with the associated semantic, the idea being that the user would be redirected by the Relying Party to an identity provider who authenticates the user, and then sends identity information and other attributes (either directly or indirectly) to the Relying Party. The identity provider in the OpenID specifications is referred to as an OpenID Provider (OP). The actual protocol flow can be found in Section 3 of the OpenID 2.0

specification [OpenID]. The reader is strongly encouraged to be familiar with the specification before continuing.

When considering that flow in the context of SASL, we note that while the RP and the client both need to change their code to implement this SASL mechanism, it is a design constraint that the OP behavior remain untouched, in order for implementations to interoperate with existing IdPs. Hence, an analog flow that interfaces the three parties needs to be created. In the analog, we note that unlike a web server, the SASL server already has some sort of session (probably a TCP connection) established with the client. However, it may be necessary for a SASL client to invoke to another application. This will be discussed below. By doing so, we externalize much of the authentiction from SASL.

The steps are listed below:

1. The SASL server advertises support for the SASL OpenID mechanism to the client.

2. The client initiates a SASL authentication and transmits the User-Supplied Identifier as its first response. The SASL mechanism is client-first, and as explained in [RFC4422] the server will send an empty challenge if needed.

3. After normalizing the User-Supplied Identifier as discussed in [OpenID], the Relying Party performs discovery on it and establishes the OP Endpoint URL that the end user uses for authentication.

4. The Relying Party and the OP optionally establish an association -- a shared secret established using Diffie-Hellman Key Exchange. The OP uses an association to validate those messages through the use of an HMAC; this removes the need for subsequent direct requests to verify the signature after each authentication request/response.

5. The Relying Party transmits an authentication request to the OP to obtain an assertion in the form of an indirect request. These messages are passed through the client rather than directly between the RP and the OP. OpenID defines two methods for indirect communication, namely HTTP redirects and HTML form submission. Both mechanisms are not directly applicable for usage with SASL. To ensure that a standard OpenID 2.0 capable OP can be used a new method is defined in this document that requires the OpenID message content to be encoded using a Universal Resource Idenitifier (URI). [RFC3986] Note that any Internationalized Resource Identifiers (IRIs) must be normalized to URIs by the SASL client, as specified in [RFC3987], prior to transmitting them to the SASL server.

6. The SASL client now sends an response consisting of "=", to indicate that authentication continues via the normal OpenID flow.

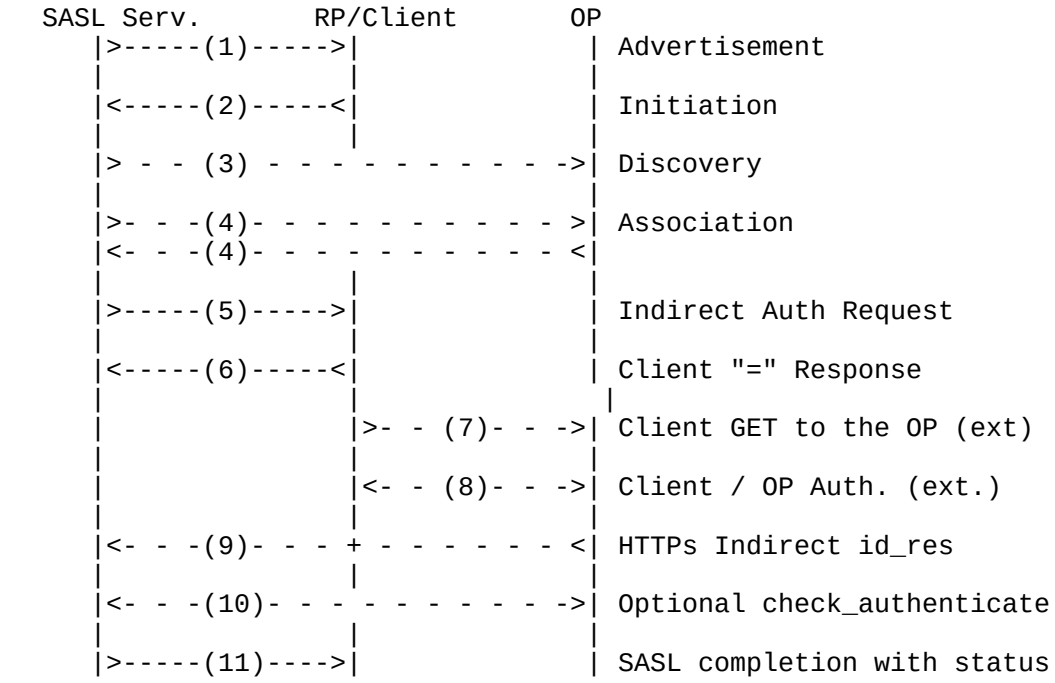
7. At this point the client application MUST construct a URL containing the content received in the previous message from the RP. This URL is transmitted to the OP either by the SASL client application or an appropriate handler, such as a browser.

8. Next the client optionally authenticates to the OP and then approves or disapproves authentication to the Relying Party. For reasons of its own the OP has the option of not authenticating a request. The manner in which the end user is authenticated to their respective OP and any policies surrounding such authentication is out of scope of OpenID and and hence also out of scope for this specification. This step happens out of band from SASL.

9. The OP will convey information about the success or failure of the authentication phase back to the RP, again using an indirect response via the client browser or handler. The client transmits over HTTP/TLS the redirect of the OP result to the RP. This step happens out of band from SASL.

10. The RP MAY send an OpenID check_authentication request directly to the OP, if no association has been established, and the OP should respond. Again this step happens out of band from SASL.

11. The SASL server sends an appropriate SASL response to the client, with optional Open Simple Registry (SREG) attributes.




Note the directionality in SASL is such that the client MUST send the "=" response. Specifically, the SASL client processes the redirect and then awaits a final SASL decision, while the rest of the OpenID authentication process continues.

## 2.1. Binding SASL to OpenID in the Relying Party

OpenID is meant to be used in serial within the web, where browser cookies are easily accessible. As such, there are no transaction-ids within the protocol. To ensure that a specific request is bound, and in particular to ease interprocess communication, the relying party MUST encode a nonce or transaction-id in the URIs it transmits through the client for success or failure, either as a base URI or fragment component to the "return_to" URI. This value is to be used to uniquely identify each authentication transaction. The nonce value MUST be at least 2^32 large and large enough to handle well in excess of the number of concurrent transactions a SASL server shall see.

## 2.2. Discussion

As mentioned above OpenID is primarily designed to interact with web-based applications. Portions of the authentication stream are only defined in the crudest sense. That is, when one is prompted to approve or disapprove an authentication, anything that one might find on a browser is allowed, including JavaScript, fancy style-sheets, etc. Because of this lack of structure, implementations will need to invoke a fairly rich browser in order to ensure that the authentication can be completed.

Once there is an outcome, the SASL server needs to know about it. The astute will hopefully by now have noticed an "=" client SASL response. This is not to say that nothing is happening, but rather that authentication flow has shifted from SASL and the client application to OpenID within the browser, and will return to the client application when the server has an outcome to hand to the client. The alternative to this flow would be some sort of signal from the HTML browser to the SASL client of the results that would in turn be passed to the SASL server. The inter-process communication issue this raises is substantial. Better, we conclude, to externalize the authentication to the browser, and have an "=" client response.

## 3. OpenID SASL Mechanism Specification

This section specifies the details of the OpenID SASL mechanism. Recall section 5 of [RFC4422] for what needs to be described here.

The name of this mechanism "OPENID20". The mechanism is capable of transferring an authorization identity (via "gs2-header"). The mechanism does not offer a security layer.

The mechanism is client-first. The first mechanism message from the client to the server is the "initial-response" described below. As described in [RFC4422], if the application protocol does not support sending a client-response together with the authentication request, the server will send an empty server-challenge to let the client begin.

The second mechanism message is from the server to the client, the "authentication_request" described below.

The third mechanism message is from client to the server, and is the fixed message consisting of "=".

The fourth mechanism message is from the server to the client, described below as "outcome_data" (with SREG attributes), sent as additional data when indicating a successful outcome.

## 3.1. Initiation

A client initiates an OpenID authentication with SASL by sending the GS2 header followed by the URI, as specified in the OpenID specification.

```
initial-response = gs2-header Auth-Identifier
Auth-Identifier = Identifier ; authentication identifier
Identifier = URI       ;  Identifier is specified in
                       ;  Sec. 7.2 of the OpenID 2.0 spec.
```

The syntax and semantics of the "gs2-header" are specified in [RFC5801], and we use it here with the following limitations: The "gs2-nonstd-flag" MUST NOT be present. The "gs2-cb-flag" MUST be "n" because channel binding is not supported by this mechanism.

URI is specified in [RFC3986]. XRIs MUST NOT be used. [XRI2.0]

## 3.2. Authentication Request

The SASL Server sends the URL resulting from the OpenID authentication request, containing an "openid.mode" of either "checkid_immediate" or "checkid_setup", as specified in Section 9.1 of the OpenID 2.0 specification.

```
authentication-request = URI
```

As part of this request, the SASL server MUST append a unique transaction id to the "return_to" portion of the request. The form of this transaction is left to the RP to decide, but SHOULD be large enough to be resistant to being guessed or attacked.

The client now sends that request via an HTTP GET to the OP, as if redirected to do so from an HTTP server.

The client MUST handle both user authentication to the OP and confirmation or rejection of the authentiation by the RP via this SASL mechanism.

After all authentication has been completed by the OP, and after the response has been sent to the client, the client will relay the response to the Relying Party via HTTP/TLS, as specified previously in the transaction ("return_to").

### 3.3. Server Response

The Relying Party now validates the response it received from the client via HTTP/TLS, as specified in the OpenID specification, using the "return_to" URI given previsiously in the transaction.

The response by the Relying Party constitutes a SASL mechanism outcome, and SHALL be used to set state in the server accordingly, and it SHALL be used by the server to report that state to the SASL client as described in [RFC4422] Section 3.6. In the additional data, the server MAY include OpenID Simple Registry (SREG) attributes that are listed in Section 4 of [SREG1.0].SREG attributes are encoded as follows:

1. Strip "openid.sreg." from each attribute name.

2. Treat the concatentation of results as URI parameters that are separated by an ampersand (&) and encode as one would a URI, absent the scheme, authority, and the question mark.

For example: email=lear@example.com&fullname=Eliot%20Lear

More formally:

```
outcome-data = [ sreg-avp *( "," sreg-avp ) ]
sreg-avp     = sreg-attr "=" sreg-val
sreg-attr    = sreg-word
sreg-val     = sreg-word
sreg-word    = 1*( unreserved / pct-encoded )
               ; pct-encoded from Section 2.1 of RFC 3986
               ; unreserved from Section 2.3 of RFC 3986
```

A client who does not support SREG MUST ignore SREG attributes sent by the server. Similarly, a client MUST ignore unknown attributes.

In the case of failures, the response MUST follow this syntax:

```
outcome_data = "openid.error" "=" sreg_val *( "," sregp_avp )
```

### 3.4. Error Handling

[RFC4422] Section 3.6 explicitly prohibits additional information in an unsuccessful authentication outcome. Therefore, the openid.error and openid.error_code are to be sent as an additional challenge in the event of an unsuccessful outcome. In this case, as the protocol is lock step, the client will follow with an additional exchange containing "=", after which the server will respond with an application-level outcome.

## 4. OpenID GSS-API Mechanism Specification

This section and its sub-sections and appropriate references of it not referenced elsewhere in this document are not required for SASL implementors, but this section MUST be observed to implement the GSS-API mechanism discussed below.

The OpenID SASL mechanism is actually also a GSS-API mechanism. The OpenID user takes the role of the GSS-API Initiator and the OpenID Relying Party takes the role of the GSS-API Acceptor. The OpenId Provider does not have a role in GSS-API, and is considered an internal matter for the OpenID mechanism. The messages are the same, but a) the GS2 header on the client's first message and channel binding data is excluded when OpenID is used as a GSS-API mechanism, and b) the RFC2743 section 3.1 initial context token header is prefixed to the client's first authentication message (context token).

The GSS-API mechanism OID for OpenID is OID-TBD (IANA to assign: see IANA considerations).

OpenID security contexts MUST have the mutual_state flag (GSS_C_MUTUAL_FLAG) set to TRUE. OpenID does not support credential delegation, therefore OpenID security contexts MUST have the deleg_state flag (GSS_C_DELEG_FLAG) set to FALSE.

The mutual authentication property of this mechanism relies on successfully comparing the TLS server identity with the negotiated target name. Since the TLS channel is managed by the application outside of the GSS-API mechanism, the mechanism itself is unable to confirm the name while the application is able to perform this comparison for the mechanism. For this reason, applications MUST match the TLS server identity with the target name, as discussed in [RFC6125].

The OpenID mechanism does not support per-message tokens or GSS_Pseudo_random.

The [RFC5587] mechanism attributes for this mechanism are GSS_C_MA_MECH_CONCRETE, GSS_C_MA_ITOK_FRAMED, and GSS_C_MA_AUTH_INIT.

## 4.1. GSS-API Principal Name Types for OpenID

OpenID supports standard generic name syntaxes for acceptors such as GSS_C_NT_HOSTBASED_SERVICE (see [RFC2743], Section 4.1).

OpenID supports only a single name type for initiators: GSS_C_NT_USER_NAME. GSS_C_NT_USER_NAME is the default name type for OpenID.

OpenID name normalization is covered by the OpenID specification, see [OpenID] section 7.2.

The query, display, and exported name syntaxes for OpenID principal names are all the same. There are no OpenID-specific name syntaxes -- applications should use generic GSS-API name types such as GSS_C_NT_USER_NAME and GSS_C_NT_HOSTBASED_SERVICE (see [RFC2743], Section 4). The exported name token does, of course, conform to [RFC2743], Section 3.2, but the "NAME" part of the token should be treated as a potential input string to the OpenID name normalization rules. For example, the OpenID identifier "https://openid.example/" will have a GSS_C_NT_USER_NAME value of "https://openid.example/".

GSS-API name attributes may be defined in the future to hold the normalized OpenID Identifier.

## 5. Example

Suppose one has an OpenID of https://openid.example, and wishes to authenticate his IMAP connection to mail.example (where .example is the top level domain specified in [RFC2606]). The user would input his Openid into his mail user agent, when he configures the account. In this case, no association is attempted between the OpenID RP and the OP. The client will make use of the return_to attribute to capture results of the authentication to be redirected to the server. Note the use of [RFC4959] for initial response. The authentication on the wire would then look something like the following:

```
      (S = IMAP server; C = IMAP client)

      C: < connects to IMAP port>
      S: * OK
      C: C1 CAPABILITY
      S: * CAPABILITY IMAP4rev1 SASL-IR SORT [...] AUTH=OPENID20
      S: C1 OK Capability Completed
      C: C2 AUTHENTICATE OPENID biwsaHR0cHM6Ly9vcGVuaWQuZXhhbXBsZS8=
      [  This is the base64 encoding of "n,,https://openid.example/".
         Server performs discovery on http://openid.example/ ]
      S: + aHR0cHM6Ly9vcGVuaWQuZXhhbXBsZS9vcGVuaWQvP29wZW5pZC5ucz1
           odHRwOi8vc3BlY3Mub3BlbmlkLm5ldC9hdXRoLzIuMCZvcGVuaWQucm
           V0dXJuX3RvPWh0dHBzOi8vbWFpbC5leGFtcGxlL2NvbnN1bWVyLzFlZ
           jg4OGMmb3BlbmlkLmNsYWltZWRfaWQ9aHR0cHM6Ly9vcGVuaWQuZXhh
           bXBsZS8mb3BlbmlkLmlkZW50aXR5PWh0dHBzOi8vb3BlbmlkLmV4YW1
           wbGUvJm9wZW5pZC5yZWFsbT1pbWFwOi8vbWFpbC5leGFtcGxlJm9wZW
           5pZC5tb2RlPWNoZWNraWRfc2V0dXA=

      [ This is the base64 encoding of "https://openid.example/openid/
            ?openid.ns=http://specs.openid.net/auth/2.0
            &openid.return_to=https://mail.example/consumer/1ef888c
            &openid.claimed_id=https://openid.example/
            &openid.identity=https://openid.example/
            &openid.realm=imap://mail.example
            &openid.mode=checkid_setup"
         with line breaks and spaces added here for readibility.
      ]
      C: PQ==
      [ The client now sends the URL it received to a browser for
        processing. The user logs into https://openid.example, and
        agrees to authenticate imap://mail.example.  A redirect is
        passed back to the client browser who then connects to
        https://imap.example/consumer via SSL with the results.
        From an IMAP perspective, however, the client sends the "="
        response, and awaits mail.example.
        Server mail.example would now contact openid.example with an
        openid.check_authenticate message.  After that...
      ]
      S: + ZW1haWw9bGVhckBtYWlsLmV4YW1wbGUsZnVsbG5hbWU9RWxp
           b3QlMjBMZWFy
        [ Here the IMAP server has returned an SREG attribute of
          email=lear@mail.example,fullname=Eliot%20Lear.
          Line break in response added in this example for clarity. ]
      C:
        [ In IMAP client must send a blank response after receiving the
          SREG data. ]
      S: C2 OK
```

In this example, the SASL server / RP has made use of a transaction id 1ef888c.

## 6. Security Considerations

This section will address only security considerations associated with the use of OpenID with SASL and GSS-API. For considerations relating to OpenID in general, the reader is referred to the OpenID specification and to other literature [1]. Similarly, for general SASL [RFC4422] and GSS-API [RFC5801] Security Considerations, the reader is referred to those specifications.

### 6.1. Binding OpenIDs to Authorization Identities

As specified in [RFC4422], the server is responsible for binding credentials to a specific authorization identity. It is therefore necessary that a registration process takes place in advance that binds specific OpenIDs to specific authorization identities, or that only specific trusted OpenID Providers be allowed, where a mapping is predefined. For example, it could be pre-arranged between an IdP and RP that "https://example.com/user" maps to "user" for purposes of authorization.

### 6.2. RP redirected by malicious URL to take an improper action

In the initial SASL client response a user or host can transmit a malicious response to the RP for purposes of taking advantage of weaknesses in the RP's OpenID implementation. It is possible to add port numbers to the URL so that the outcome is the RP does a port scan of the site. The URL could contain an unauthorized host or even the local host. The URL could contain a protocol other than http or https, such as file or ftp.

One mitigation would be for RPs to have a list of authorized URI bases. OPs SHOULD only redirect to RPs with the same domain component of the base URI. RPs MUST NOT automatically retry on failed attempts. A log of those sites that fail SHOULD be kept, and limitations on queries from clients SHOULD be imposed, just as with any other authentication attempt. Applications SHOULD NOT invoke browsers to communicate with OPs that they are not themselves configured with.

### 6.3. User Privacy

The OP is aware of each RP that a user logs into. There is nothing in the protocol to hide this information from the OP. It is not a requirement to track the visits, but there is nothing that prohibits the collection of information. SASL servers should be aware that OpenID Providers will be able to track - to some extent - user access to their services and any additional information that OP provides.

## 7. IANA Considerations

The IANA is requested to update the SASL Mechanism Registry using the following template, as described in [RFC4422].

SASL mechanism name: OPENID20

Security Considerations: See this document

Published specification: See this document

Person & email address to contact for further information: Authors of this document

Intended usage: COMMON

Owner/Change controller: IETF

Note: None

The IANA is further requested to assign an OID for this GSS mechanism in the SMI numbers registry, with the prefix of iso.org.dod.internet.security.mechanisms (1.3.6.1.5.5) and to reference this specification in the registry.

## 8. Acknowledgments

The authors would like to thank Alexey Melnikov, Joe Hildebrand, Mark Crispin, Chris Newman, Leif Johansson, Sam Hartman, Nico Williams, Klaas Wierenga, Stephen Farrell, and Stephen Kent for their review and contributions.

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## Appendix A. Changes

This section to be removed prior to publication.

- 04 - 07 04 - 07 address LC and review comments, including those of Stephen Farrell, Steve Kent, and Brian Carpenter.
- 03 Clarifies messages and ordering, and replace the empty message with a "=" message.
- 02 Address all WGLC comments.
- 01 Specific text around possible improvements for OOB browser control in security considerations. Also talk about transaction id.
- 00 WG -00 draft. Slight wording modifications abou design constraints per Alexey.
- 02 Correct single (significant) error on mechanism name.
- 01 Add nonce discussion, add authorized identity, explain a definition. Add gs2 support.
- 00 Initial Revision.

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February 20, 2012

# A SASL and GSS-API Mechanism for SAML
# draft-ietf-kitten-sasl-saml-09.txt

## Abstract

Security Assertion Markup Language (SAML) has found its usage on the Internet for Web Single Sign-On. Simple Authentication and Security Layer (SASL) and the Generic Security Service Application Program Interface (GSS-API) are application frameworks to generalize authentication. This memo specifies a SASL mechanism and a GSS-API mechanism for SAML 2.0 that allows the integration of existing SAML Identity Providers with applications using SASL and GSS-API.

## Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on August 23, 2012.

## Copyright Notice

Table of Contents

## 1. Introduction

Security Assertion Markup Language (SAML) 2.0 [OASIS.saml-core-2.0-os] is a set of specifications that provide various means for a user to be identified to a relying party (RP) through the exchange of (typically signed) assertions issued by an identity provider (IdP). It includes a number of protocols, protocol bindings [OASIS.saml-bindings-2.0-os], and interoperability profiles [OASIS.saml-profiles-2.0-os] designed for different use cases.

Simple Authentication and Security Layer (SASL) [RFC4422] is a generalized mechanism for identifying and authenticating a user and for optionally negotiating a security layer for subsequent protocol interactions. SASL is used by application protocols like IMAP [RFC3501], POP [RFC1939] and XMPP [RFC6120]. The effect is to make modular authentication, so that newer authentication mechanisms can be added as needed. This memo specifies just such a mechanism.

The Generic Security Service Application Program Interface (GSS-API) [RFC2743] provides a framework for applications to support multiple authentication mechanisms through a unified programming interface. This document defines a pure SASL mechanism for SAML, but it conforms to the new bridge between SASL and the GSS-API called GS2 [RFC5801]. This means that this document defines both a SASL mechanism and a GSS-API mechanism. The GSS-API interface is OPTIONAL for SASL implementers, and the GSS-API considerations can be avoided in environments that use SASL directly without GSS-API.

As currently envisioned, this mechanism enables interworking between SASL and SAML in order to assert the identity of the user and other attributes to relying parties. As such, while servers (as relying parties) will advertise SASL mechanisms (including SAML), clients will select the SAML SASL mechanism as their SASL mechanism of choice.

The SAML mechanism described in this memo aims to re-use the Web Browser SSO profile defined in section 4.1 of the SAML profiles 2.0 specification [OASIS.saml-profiles-2.0-os] to the maximum extent and therefore does not establish a separate authentication, integrity and confidentiality mechanism. The mechanism assumes a security layer, such as Transport Layer Security (TLS [RFC5246]), will continue to be used. This specification is appropriate for use when a browser instance is available. In the absence of a browser instance, SAML profiles that don’t require a browser such as the Enhanced Client or Proxy profile (as defined in section 4.2 of the SAML profiles 2.0 specification [OASIS.saml-profiles-2.0-os] may be used, but that is outside the scope of this specification.

Figure 1 describes the interworking between SAML and SASL: this document requires enhancements to the Relying Party (the SASL server) and to the Client, as the two SASL communication end points, but no changes to the SAML Identity Provider are necessary. To accomplish this goal some indirect messaging is tunneled within SASL, and some use of external methods is made.

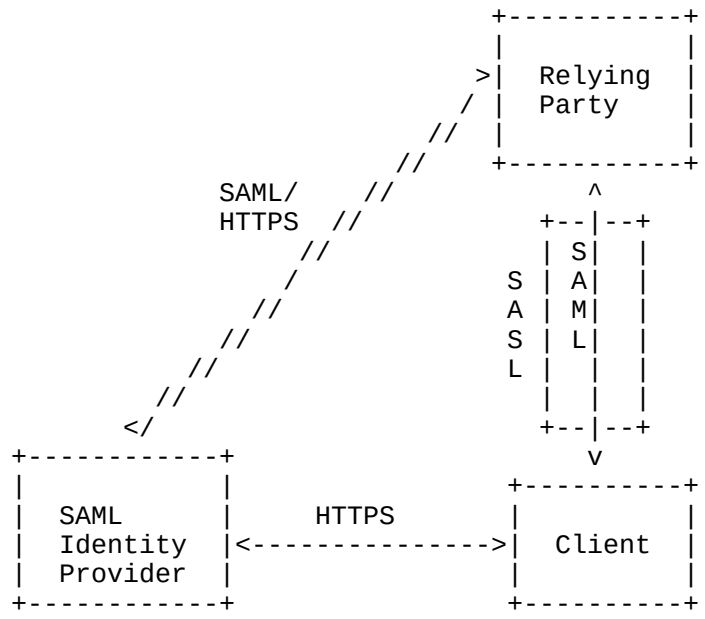


Figure 1: Interworking Architecture

## 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 RFC 2119 [RFC2119].

The reader is assumed to be familiar with the terms used in the SAML 2.0 specification [OASIS.saml-core-2.0-os].

## 1.2. Applicability

Because this mechanism transports information that should not be controlled by an attacker, the SAML mechanism MUST only be used over

channels protected by TLS, or over similar integrity protected and authenticated channels. In addition, when TLS is used the client MUST successfully validate the server certificate ([RFC5280], [RFC6125])

Note: An Intranet does not constitute such an integrity protected and authenticated channel!

## 2. Authentication flow

While SAML itself is merely a markup language, its common use case these days is with HTTP [RFC2616] or HTTPS [RFC2818] and HTML [W3C.REC-html401-19991224]. What follows is a typical flow:

1. The browser requests a resource of a Relying Party (RP) (via an HTTP request).

2. The Relying Party redirects the browser via an HTTP redirect (as described in Section 10.3 of [RFC2616]) to the Identity Provider (IdP) or an IdP discovery service. When it does so, it includes the following parameters: (1) an authentication request that contains the name of resource being requested, (2) a browser cookie, and (3) a return URL as specified in Section 3.1 of the SAML profiles 2.0 specification [OASIS.saml-profiles-2.0-os].

3. The user authenticates to the IdP and perhaps authorizes the release of user attributes to the Relying Party.

4. In its authentication response, the IdP redirects (via an HTTP redirect) the browser back to the RP with an authentication assertion (stating that the IdP vouches that the subject has successfully authenticated), optionally along with some additional attributes.

5. The Relying Party now has sufficient identity information to approve access to the resource or not, and acts accordingly. The authentication is concluded.

When considering this flow in the context of SASL, we note that while the Relying Party and the client both must change their code to implement this SASL mechanism, the IdP can remain untouched. The Relying Party already has some sort of session (probably a TCP connection) established with the client. However, it may be necessary to redirect a SASL client to another application or handler. The steps are as follows:

1. The SASL server (Relying Party) advertises support for the SASL SAML20 mechanism to the client

2. The client initiates a SASL authentication with SAML20 and sends a domain name that allows the SASL server to determine the appropriate IdP

3. The SASL server transmits an authentication request encoded using a Uniform Resource Identifier (URI) as described in RFC 3986 [RFC3986] and an HTTP redirect to the IdP corresponding to the

domain

4. The SASL client now sends an empty response, as authentication continues via the normal SAML flow and the SASL server will receive the answer to the challenge out-of-band from the SASL conversation.

5. At this point the SASL client MUST construct a URL containing the content received in the previous message from the SASL server. This URL is transmitted to the IdP either by the SASL client application or an appropriate handler, such as a browser.

6. Next the user authenticates to the IdP. The manner in which the end user is authenticated to the IdP and any policies surrounding such authentication is out of scope for SAML and hence for this draft. This step happens out of band from SASL.

7. The IdP will convey information about the success or failure of the authentication back to the the SASL server (Relying Party) in the form of an Authentication Statement or failure, using a indirect response via the client browser or the handler (and with an external browser client control should be passed back to the SASL client). This step happens out of band from SASL.

8. The SASL Server sends an appropriate SASL response to the client, along with an optional list of attributes

Please note: What is described here is the case in which the client has not previously authenticated. It is possible that the client already holds a valid SAML authentication token so that the user does not need to be involved in the process anymore, but that would still be external to SASL. This is classic Web Single Sign-On, in which the Web Browser client presents the authentication token (cookie) to the RP without renewed user authentication at the IdP.

With all of this in mind, the flow appears as follows in Figure 2:

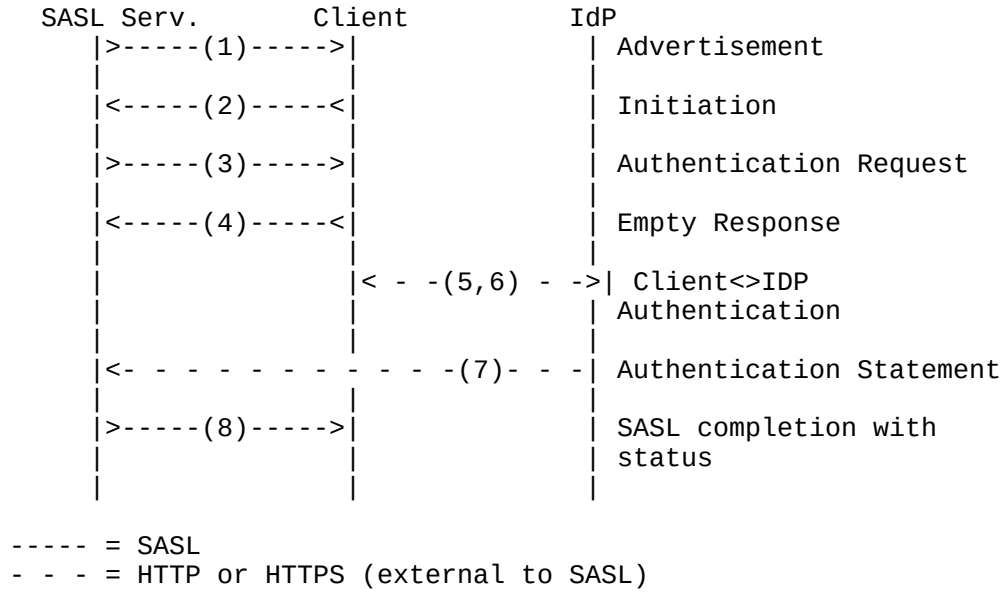


Figure 2: Authentication flow

## 3. SAML SASL Mechanism Specification

This section specifies the details of the SAML SASL mechanism. See section 5 of [RFC4422] for what is described here.

The name of this mechanism is "SAML20". The mechanism is capable of transferring an authorization identity (via the "gs2-header"). The mechanism does not offer a security layer.

The mechanism is client-first. The first mechanism message from the client to the server is the "initial-response". As described in [RFC4422], if the application protocol does not support sending a client-response together with the authentication request, the server will send an empty server-challenge to let the client begin. The second mechanism message is from the server to the client, containing the SAML "authentication-request". The third mechanism message is from client to the server, and is the fixed message consisting of "=" (i.e., an empty response). The fourth mechanism message is from the server to the client, indicating the SASL mechanism outcome.

### 3.1. Initial Response

A client initiates a "SAML20" authentication with SASL by sending the GS2 header followed by the authentication identifier (message 2 in Figure 2) and is defined as follows:

```
initial-response = gs2-header Idp-Identifier
IdP-Identifier = domain ; domain name with corresponding IdP
```

The "gs2-header" is used as follows:

- The "gs2-nonstd-flag" MUST NOT be present.

- The "gs2-cb-flag" MUST be set to "n" because channel binding [RFC5056] data cannot be integrity protected by the SAML negotiation. (Note: In theory channel binding data could be inserted in the SAML flow by the client and verified by the server, but that is currently not supported in SAML.)

- The "gs2-authzid" carries the optional authorization identity as specified in [RFC5801] (not to be confused with the IdP-Identifier).

Domain name is specified in [RFC1035]. A domain name is either a "traditional domain name" as described in [RFC1035] or an "internationalized domain name" as described in [RFC5890]. Clients

and servers MUST treat the IdP-Identifier as a domain name slot [RFC5890]. They also SHOULD support internationalized domain names (IDNs) in the Idp-Identifier field; if they do so, all of the domain name's labels MUST be A-labels or NR-LDH labels [RFC5890], if necessary internationalized labels MUST be converted from U-labels to A-labels by using the Punycode encoding [RFC3492] for A-labels prior to sending them to the SASL-server as described in the protocol specification for Internationalized Domain Names in Applications [RFC5891].

### 3.2. Authentication Request

The SASL Server transmits to the SASL client a URI that redirects the SAML client to the IdP (corresponding to the domain that the user provided), with a SAML authentication request as one of the parameters (message 3 in Figure 2) in the following way:

```
authentication-request = URI
```

URI is specified in [RFC3986] and is encoded according to Section 3.4 (HTTP Redirect) of the SAML bindings 2.0 specification [OASIS.saml-bindings-2.0-os]. The SAML authentication request is encoded according to Section 3.4 (Authentication Request) of the SAML core 2.0 specification [OASIS.saml-core-2.0-os]. Should the client support Internationalized Resource Identifiers (IRIs) [RFC3987] it MUST first convert the IRI to a URI before transmitting it to the server [RFC5890].

Note: The SASL server may have a static mapping of domain to corresponding IdP or alternatively a DNS-lookup mechanism could be envisioned, but that is out-of-scope for this document.

Note: While the SASL client MAY sanity check the URI it received, ultimately it is the SAML IdP that will be validated by the SAML client which is out-of-scope for this document.

The client then sends the authentication request via an HTTP GET (sent over a server-authenticated TLS channel) to the IdP, as if redirected to do so from an HTTP server and in accordance with the Web Browser SSO profile, as described in section 3.1 of SAML profiles 2.0 specification [OASIS.saml-profiles-2.0-os] (message 5 and 6 in Figure 2).

The client handles both user authentication to the IdP and confirmation or rejection of the authentiation of the RP (out-of-scope for this document).

After all authentication has been completed by the IdP, the IdP will send a redirect message to the client in the form of a URI corresponding to the Relying Party as specified in the authentication request ("AssertionConsumerServiceURL") and with the SAML response as one of the parameters (message 7 in Figure 2).

Please note: this means that the SASL server needs to implement a SAML Relying Party. Also, the SASL server needs to correlate the session it has with the SASL client with the appropriate SAML authentication result. It can do so by comparing the ID of the SAML authentication request it has issued with the one it receives in the SAML authentication statement.

### 3.3. Outcome and parameters

The SASL server (in its capacity as a SAML Relying Party) now validates the SAML authentication response it received from the SAML client via HTTP or HTTPS.

The outcome of that validation by the SASL server constitutes a SASL mechanism outcome, and therefore (as stated in [RFC4422]) SHALL be used to set state in the server accordingly, and it SHALL be used by the server to report that state to the SASL client as described in [RFC4422] Section 3.6 (message 8 in Figure 2).

## 4. SAML GSS-API Mechanism Specification

This section and its sub-sections are not required for SASL implementors, but this section MUST be observed to implement the GSS-API mechanism discussed below.

This section specify a GSS-API mechanism that when used via the GS2 bridge to SASL behaves like the SASL mechanism defined in this document. Thus, it can loosely be said that the SAML SASL mechanism is also a GSS-API mechanism. The SAML user takes the role of the GSS-API Initiator and the SAML Relying Party takes the role of the GSS-API Acceptor. The SAML Identity Provider does not have a role in GSS-API, and is considered an internal matter for the SAML mechanism. The messages are the same, but

a) the GS2 header on the client's first message and channel binding data is excluded when SAML is used as a GSS-API mechanism, and

b) the RFC2743 section 3.1 initial context token header is prefixed to the client's first authentication message (context token).

The GSS-API mechanism OID for SAML is OID-TBD (IANA to assign: see IANA considerations).

SAML20 security contexts MUST have the mutual_state flag (GSS_C_MUTUAL_FLAG) set to TRUE. SAML does not support credential delegation, therefore SAML security contexts MUST have the deleg_state flag (GSS_C_DELEG_FLAG) set to FALSE.

The mutual authentication property of this mechanism relies on successfully comparing the TLS server identity with the negotiated target name. Since the TLS channel is managed by the application outside of the GSS-API mechanism, the mechanism itself is unable to confirm the name while the application is able to perform this comparison for the mechanism. For this reason, applications MUST match the TLS server identity with the target name, as discussed in [RFC6125]. More precisely, to pass identity validation the client uses the securely negotiated targ_name as the reference identifier and match it to the DNS-ID of the server certificate, and MUST reject the connection if there is a mismatch. For compatibility with deployed certificate hierarchies, the client MAY also perform a comparison with the CN-ID when there is no DNS-ID present. Wildcard matching is permitted. The targ_name reference identifier is a "traditional domain names" thus the comparison is made using case-insensitive ASCII comparison.

The SAML mechanism does not support per-message tokens or GSS_Pseudo_random.

### 4.1. GSS-API Principal Name Types for SAML

SAML supports standard generic name syntaxes for acceptors such as GSS_C_NT_HOSTBASED_SERVICE (see [RFC2743], Section 4.1). SAML supports only a single name type for initiators: GSS_C_NT_USER_NAME. GSS_C_NT_USER_NAME is the default name type for SAML. The query, display, and exported name syntaxes for SAML principal names are all the same. There are no SAML-specific name syntaxes -- applications should use generic GSS-API name types such as GSS_C_NT_USER_NAME and GSS_C_NT_HOSTBASED_SERVICE (see [RFC2743], Section 4). The exported name token does, of course, conforms to [RFC2743], Section 3.2.

# 5. Examples

## 5.1. XMPP

Suppose the user has an identity at the SAML IdP saml.example.org and a Jabber Identifier (JID) "somenode@example.com", and wishes to authenticate his XMPP connection to xmpp.example.com. The authentication on the wire would then look something like the following:

Step 1: Client initiates stream to server:

```
<stream:stream xmlns='jabber:client'
xmlns:stream='http://etherx.jabber.org/streams'
to='example.com' version='1.0'>
```

Step 2: Server responds with a stream tag sent to client:

```
<stream:stream
xmlns='jabber:client' xmlns:stream='http://etherx.jabber.org/streams'
id='some_id' from='example.com' version='1.0'>
```

Step 3: Server informs client of available authentication mechanisms:

```
<stream:features>
 <mechanisms xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
  <mechanism>DIGEST-MD5</mechanism>
  <mechanism>PLAIN</mechanism>
  <mechanism>SAML20</mechanism>
 </mechanisms>
</stream:features>
```

Step 4: Client selects an authentication mechanism and provides the initial client response containing the according to the definition in Section 4 ofBASE64 [RFC4648] encoded gs2-header and domain:

```
<auth xmlns='urn:ietf:params:xml:ns:xmpp-sasl' mechanism='SAML20'>
biwsZXhhbXBsZS5vcmc</auth>
```

The decoded string is: n,,example.org

Step 5: Server sends a BASE64 encoded challenge to client in the form of an HTTP Redirect to the SAML IdP corresponding to example.org (https://saml.example.org) with the SAML Authentication Request as specified in the redirection url:

aHR0cHM6Ly9zYW1sLmV4YW1wbGUub3JnL1NBTUwvQnJvd3Nlcj9TQU1MUmVx
dWVzdD1QSE5oYld4d09rRjFkR2h1VW1WeGRXVnpkQ0I0Yld4dWN6cHpZVzFz
Y0QwaWRYSnVPbTloYzJsek9tNWhiV1Z6T25Sak9sTkJUVXc2TWk0d09uQnli
M1J2WTI5c0lnMEtJQ0FnSUVsRVBTSmZZbVZqTkRJMFptRTFNVEF6TkRJNE9U
QTVZVE13Wm1ZeFpUTXhNVFk0TXpJM1pqYzVORGMwT1RnMElpQldaWEp6YVc5
dVBTSXlMakFpRFFvZ0lDQWdTWE56ZFdWSmJuTjBZVzUwUFNJeU1EQTNMVEV5
TFRFd1ZERXhPak01T2pNMFdpSWdSbTl5WTJWQmRYUm9iajBpWm1Gc2MyVWlE
UW9nSUNBZ1NYTlFZWE56YVhabFBTSm1ZV3h6WlNJTkNpQWdJQ0JRY205MGIy
TnZiRUpwYm1ScGJtYzlJblZ5YmpwdllYTnBjenB1WVcxbGN6cDBZenBUUVUx
TU9qSXVNRHBpYVc1a2FXNW5jenBJVkZSUUxWQlBVMVFpRFFvZ0lDQWdRWE56
WlhKMGFXOXVRMjl1YzNWdFpYSlRaWEoyYVdObFZWSk1QUTBLSUNBZ0lDQWdJ
Q0FpYUhSMGNITTZMeTk0YlhCd0xtVjRZVzF3YkdVdVkyOXRMMU5CVFV3dlFY
TnpaWEowYVc5dVEyOXVjM1Z0WlhKVFpYSjJhV05sSWo0TkNpQThjMkZ0YkRw
SmMzTjFaWElnZUcxc2JuTTZjMkZ0YkQwaWRYSnVPbTloYzJsek9tNWhiV1Z6
T25Sak9sTkJUVXc2TWk0d09tRnpjMlZ5ZEdsdmJpSStEUW9nSUNBZ0lHaDBk
SEJ6T2k4dmVHMXdjQzVsZUdGdGNHeGxMbU52YlEwS0lEd3ZjMkZ0YkRwSmMz
TjFaWEkrRFFvZ1BITmhiV3h3T2s1aGJXVkpSRkJ2YkdsamVTQjRiV3h1Y3pw
ellXMXNjRDBpZFhKdU9tOWhjMmx6T201aGJXVnpPblJqT2xOQlRVdzZNaTR3
T25CeWIzUnZZMjlzSWcwS0lDQWdJQ0JHYjNKdFlYUTlJblZ5YmpwdllYTnBj
enB1WVcxbGN6cDBZenBUUVUxTU9qSXVNRHB1WVcxbGFXUXRabTl5YldGME9u
Qmxjbk5wYzNSbGJuUWlEUW9nSUNBZ0lGTlFUbUZ0WlZGMVlXeHBabWxsY2ow
aWVHMXdjQzVsZUdGdGNHeGxMbU52YlNJZ1FXeHNiM2REY21WaGRHVTlJblJ5
ZFdVaUlDOCtEUW9nUEhOaGJXeHdPbEpsY1hWbGMzUmxaRUYxZEdodVEyOXVk
R1Y0ZEEwS0lDQWdJQ0I0Yld4dWN6cHpZVzFzY0QwaWRYSnVPbTloYzJsek9t
NWhiV1Z6T25Sak9sTkJUVXc2TWk0d09uQnliM1J2WTI5c0lpQU5DaUFnSUNB
Z0lDQWdRMjl0Y0dGeWFYTnZiajBpWlhoaFkzUWlQZzBLSUNBOGMyRnRiRHBC
ZFhSb2JrTnZiblJsZUhSRGJHRnpjMUpsWmcwS0lDQWdJQ0FnZUcxc2JuTTZj
MkZ0YkQwaWRYSnVPbTloYzJsek9tNWhiV1Z6T25Sak9sTkJUVXc2TWk0d09t
RnpjMlZ5ZEdsdmJpSStEUW9nb0NBZ0lDQjFjbTQ2YjJGemFYTTZibUZ0WlhN
NmRHTTZVMEZOVERveUxqQTZZV002WTJ4aGMzTmxjenBRWVhOemQyOXlaRkJ5
YjNSbFkzUmxaRlJ5WVc1emNHOXlkQTBLSUNBOEwzTmhiV3c2UVhWMGFHNURi
MjUwWlhoMFEyeGhjM05TWldZK0RRb2dQQzl6WVcxc2NEcFNaWEYxWlhOMFpX
UkJkWFJvYmtOdmJuUmxlSFErSUEwS1BDOXpZVzFzY0RwQmRYUm9ibEpsY1hW
bGMzUSs=

The decoded challenge is:

```
https://saml.example.org/SAML/Browser?SAMLRequest=PHNhbWxwOk
F1dGhuUmVxdWVzdCB4bWxuczpzYW1scD0idXJuOm9hc2lzOm5hbWVzOnRjOl
NBTUw6Mi4wOnByb3RvY29sIg0KICAgIElEPSJfYmVjNDI0ZmE1MTAzNDI4OT
A5YTMwZmYxZTMxMTY4MzI3Zjc5NDc0OTg0IiBWZXJzaW9uPSIyLjAiDQogIC
AgSXNzdWVJbnN0YW50PSIyMDA3LTEyLTEwVDExOjM5OjM0WiIgRm9yY2VBdX
Robj0iZmFsc2UiDQogICAgSXNQYXNzaXZlPSJmYWxzZSINCiAgICBQcm90b2
NvbEJpbmRpbmc9InVybjpvYXNpczpuYW1lczp0YzpTQU1MOjIuMDpiaW5kaW
5nczpIVFRQLVBPU1QiDQogICAgQXNzZXJ0aW9uQ29uc3VtZXJTZXJ2aWNlVV
JMPQ0KICAgICAgICAiaHR0cHM6Ly94bXBwLmV4YW1wbGUuY29tL1NBTUwvQX
NzZXJ0aW9uQ29uc3VtZXJTZXJ2aWNlIj4NCiA8c2FtbDpJc3N1ZXIgeG1sbn
M6c2FtbD0idXJuOm9hc2lzOm5hbWVzOnRjOlNBTUw6Mi4wOmFzc2VydGlvbi
I+DQogICAgIGh0dHBzOi8veG1wcC5leGFtcGxlLmNvbQ0KIDwvc2FtbDpJc3
N1ZXI+DQogPHNhbWxwOk5hbWVJRFBvbGljeSB4bWxuczpzYW1scD0idXJuOm
9hc2lzOm5hbWVzOnRjOlNBTUw6Mi4wOnByb3RvY29sIg0KICAgICBGb3JtYX
Q9InVybjpvYXNpczpuYW1lczp0YzpTQU1MOjIuMDpuYW1laWQtZm9ybWF0On
BlcnNpc3RlbnQiDQogICAgIFNQTmFtZVF1YWxpZmllcj0ieG1wcC5leGFtcG
xlLmNvbSIgQWxsb3dDcmVhdGU9InRydWUiIC8+DQogPHNhbWxwOlJlcXVlc3
RlZEF1dGhuQ29udGV4dA0KICAgICB4bWxuczpzYW1scD0idXJuOm9hc2lzOm
5hbWVzOnRjOlNBTUw6Mi4wOnByb3RvY29sIiANCiAgICAgQ29tcGFyaX
Nvbj0iZXhhY3QiPg0KICA8c2FtbDpBdXRobkNvbnRleHRDbGFzc1JlZg0KIC
AgICAgeG1sbnM6c2FtbD0idXJuOm9hc2lzOm5hbWVzOnRjOlNBTUw6Mi4wOm
Fzc2VydGlvbiI+DQogICAgICAgICAgIHVybjpvYXNpczpuYW1lczp0YzpTQU
1MOjIuMDphYzpjbGFzc2VzOlBhc3N3b3JkUHJvdGVjdGVkVHJhbnNwb3J0DQ
ogIDwvc2FtbDpBdXRobkNvbnRleHRDbGFzc1JlZj4NCiA8L3NhbWxwOlJlcX
Vlc3RlZEF1dGhuQ29udGV4dD4gDQo8L3NhbWxwOkF1dGhuUmVxdWVzdD4=
```

Where the decoded SAMLRequest looks like:

```
 <samlp:AuthnRequest xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
     ID="_bec424fa5103428909a30ff1e31168327f79474984" Version="2.0"
     IssueInstant="2007-12-10T11:39:34Z" ForceAuthn="false"
     IsPassive="false"
     ProtocolBinding="urn:oasis:names:tc:SAML:2.0:bindings:HTTP-POST"
     AssertionConsumerServiceURL=
         "https://xmpp.example.com/SAML/AssertionConsumerService">
  <saml:Issuer xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion">
      https://xmpp.example.com
  </saml:Issuer>
  <samlp:NameIDPolicy xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
      Format="urn:oasis:names:tc:SAML:2.0:nameid-format:persistent"
      SPNameQualifier="xmpp.example.com" AllowCreate="true" />
  <samlp:RequestedAuthnContext
      xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
         Comparison="exact">
   <saml:AuthnContextClassRef
       xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion">
       urn:oasis:names:tc:SAML:2.0:ac:classes:PasswordProtectedTransport
   </saml:AuthnContextClassRef>
  </samlp:RequestedAuthnContext>
 </samlp:AuthnRequest>
```

Note: the server can use the request ID (_bec424fa5103428909a30ff1e31168327f79474984) to correlate the SASL session with the SAML authentication.

Step 5 (alternative): Server returns error to client if no SAML Authentication Request can be constructed:

```
<failure xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
 <temporary-auth-failure/>
</failure>
</stream:stream>
```

Step 6: Client sends the empty response to the challenge encoded as a single =:

```
<response xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
 =
</response>
```

The following steps between brackets are out of scope for this

document but included to better illustrate the entire flow.

[The client now sends the URL to a browser instance for processing. The browser engages in a normal SAML authentication flow (external to SASL), like redirection to the Identity Provider (https://saml.example.org), the user logs into https://saml.example.org, and agrees to authenticate to xmpp.example.com. A redirect is passed back to the client browser who sends the AuthN response to the server, containing the subject-identifier as an attribute. If the AuthN response doesn't contain the JID, the server maps the subject-identifier received from the IdP to a JID]

Step 7: Server informs client of successful authentication:

```
<success xmlns='urn:ietf:params:xml:ns:xmpp-sasl'/>
```

Step 7 (alt): Server informs client of failed authentication:

```
<failure xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
 <not-authorized/>
</failure>
</stream:stream>
```

Please note: line breaks were added to the base64 for clarity.

## 5.2. IMAP

The following describes an IMAP exchange. Lines beginning with 'S:' indicate data sent by the server, and lines starting with 'C:' indicate data sent by the client. Long lines are wrapped for readability.

```
S: * OK IMAP4rev1
C: . CAPABILITY
S: * CAPABILITY IMAP4rev1 STARTTLS
S: . OK CAPABILITY Completed
C: . STARTTLS
S: . OK Begin TLS negotiation now
C: . CAPABILITY
S: * CAPABILITY IMAP4rev1 AUTH=SAML20
S: . OK CAPABILITY Completed
C: . AUTHENTICATE SAML20
S: +
C: biwsZXhhbXBsZS5vcmc
S: + aHR0cHM6Ly9zYW1sLmV4YW1wbGUub3JnL1NBTUwvQnJvd3Nlcj9TQU1M
UmVxdWVzdD1QSE5oYld4d09rRg0KMWRHaHVVbVZ4ZFdWemRDQjRiV3h1Y3pwe
llXMXNjRDBpZFhKdU9tOWhjMmx6T201aGJXVnpPblJqT2xOQg0KVFV3Nk1pNH
dPbkJ5YjNSdlkyOXNJZzBLSUNBZ0lFbEVQU0pmWW1Wak5ESTBabUUxTVRBek5
ESTRPVEE1WQ0KVE13Wm1ZeFpUTXhNVFk0TXpJM1pqYzVORGMwT1RnMElpQlda
WEp6YVc5dVBTSXlMakFpRFFvZ0lDQWdTWA0KTnpkV1ZKYm5OMFlXNTBQU0l5T
URBM0xURXlMVEV3VkRFeE9qTTVPak0wV2lJZ1JtOXlZMlZCZFhSb2JqMA0KaV
ptRnNjMlVpRFFvZ0lDQWdTWE5RWVhOemFYWmxQU0ptWVd4elpTSU5DaUFnSUN
CUWNtOTBiMk52YkVKcA0KYm1ScGJtYzlJblZ5YmpwdllYTnBjenB1WVcxbGN6
cDBZenBUUVUxTU9qSXVNRHBpYVc1a2FXNW5jenBJVg0KRlJRTFZCUFUxUWlEU
W9nSUNBZ1FYTnpaWEowYVc5dVEyOXVjM1Z0WlhKVFpYSjJhV05sVlZKTVBRME
tJQw0KQWdJQ0FnSUNBaWFIUjBjSE02THk5dFlXbHNMbVY0WVcxd2JHVXVZMjl
0TDFOQlRVd3ZRWE56WlhKMGFXOQ0KdVEyOXVjM1Z0WlhKVFpYSjJhV05sSWo0
TkNpQThjMkZ0YkRwSmMzTjFaWElnZUcxc2JuTTZjMkZ0YkQwaQ0KZFhKdU9tO
WhjMmx6T201aGJXVnpPblJqT2xOQlRVdzZNaTR3T21GemMyVnlkR2x2YmlJK0
RRb2dJQ0FnSQ0KR2gwZEhCek9pOHZlRzF3Y0M1bGVHRnRjR3hsTG1OdmJRMEt
JRHd2YzJGdGJEcEpjM04xWlhJK0RRb2dQSA0KTmhiV3h3T2s1aGJXVkpSRkJ2
YkdsamVTQjRiV3h1Y3pwellXMXNjRDBpZFhKdU9tOWhjMmx6T201aGJXVg0Ke
k9uUmpPbE5CVFV3Nk1pNHdPbkJ5YjNSdlkyOXNJZzBLSUNBZ0lDQkdiM0p0WV
hROUluVnlianB2WVhOcA0KY3pwdVlXMWxjenAwWXpwVFFVMU1Pakl1TURwdVl
XMWxhV1F0Wm05eWJXRjBPbkJsY25OcGMzUmxiblFpRA0KUW9nSUNBZ0lGTlFU
bUZ0WlZGMVlXeHBabWxsY2owaWVHMXdjQzVsZUdGdGNHeGxMbU52YlNJZ1FXe
HNiMw0KZERjbVZoZEdVOUluUnlkV1VpSUM4K0RRb2dQSE5oYld4d09sSmxjWF
ZsYzNSbFpFRjFkR2h1UTI5dWRHVg0KNGRBMEtJQ0FnSUNCNGJXeHVjenB6WVc
xc2NEMGlkWEp1T205aGMybHpPbTVoYldek9uUmpPbE5CVFV3Ng0KTWk0d09u
QnliM1J2WTI5c0lpQU5DaUFnSUNBZ0lDQWdRMjl0Y0dGeWFYTnZiajBpWlhoa
FkzUWlQZzBLSQ0KQ0E4YzJGdGJEcEJkWFJvYmtOdmJuUmxlSFJEYkdGemMxSm
xaZzBLSUNBZ0lDQWdlRzFzYm5NNmMyRnRiRA0KMGlkWEp1T205aGMybHpPbTV
oYldWek9uUmpPbE5CVFV3Nk1pNHdPbUZ6YzJWeWRHbHZiaUkrRFFvZ0lDQQ0K
Z0lDQjFjbTQ2YjJGemFYTTZibUZ0WlhNNmRHTTZVMEZOVERveUxqQTZZV002W
TJ4aGMzTmxjenBRWVhOeg0KZDI5eVpGQnliM1JsWTNSbFpGUnlZVzV6Y0c5eW
RBMEtJQ0E4TDNOaGJXdzZRWFYwYUc1RGIyNTBaWGgwUQ0KMnhoYzNOU1pXWSt
EUW9nUEM5ellXMXNjRHBTWlhGMVpYTjBaV1JCZFhSb2JrTnZiblJsZUhRK0lB
MEtQQw0KOXpZVzFzY0RwQmRYUm9ibEpsY1hWbGMzUSs=
C:
S: . OK Success (tls protection)
```

The decoded challenge is:

https://saml.example.org/SAML/Browser?SAMLRequest=PHNhbWxwOkF
1dGhuUmVxdWVzdCB4bWxuczpzYW1scD0idXJuOm9hc2lzOm5hbWVzOnRjOlNB
TUw6Mi4wOnByb3RvY29sIg0KICAgIElEPSJfYmVjNDI0ZmE1MTAzNDI4OTA5Y
TMwZmYxZTMxMTY4MzI3Zjc5NDc0OTg0IiBWZXJzaW9uPSIyLjAiDQogICAgSX
NzdWVJbnN0YW50PSIyMDA3LTEyLTEwVDExOjM5OjM0WiIgRm9yY2VBdXRobj0
iZmFsc2UiDQogICAgSXNQYXNzaXZlPSJmYWxzZSINCiAgICBQcm90b2NvbEJp
bmRpbmc9InVybjpvYXNpczpuYW1lczp0YzpTQU1MOjIuMDpiaW5kaW5nczpIV
FRQLVBPU1QiDQogICAgQXNzZXJ0aW9uQ29uc3VtZXJTZXJ2aWNlVVJMPQ0KIC
AgICAgICAiaHR0cHM6Ly9tYWlsLmV4YW1wbGUuY29tL1NBTUwvQXNzZXJ0aW9
uQ29uc3VtZXJTZXJ2aWNlIj4NCiA8c2FtbDpJc3N1ZXIgeG1sbnM6c2FtbD0i
dXJuOm9hc2lzOm5hbWVzOnRjOlNBTUw6Mi4wOmFzc2VydGlvbiI+DQogICAgI
Gh0dHBzOi8veG1wcC5leGFtcGxlLmNvbQ0KIDwvc2FtbDpJc3N1ZXI+DQogPH
NhbWxwOk5hbWVJRFBvbGljeSB4bWxuczpzYW1scD0idXJuOm9hc2lzOm5hbWV
zOnRjOlNBTUw6Mi4wOnByb3RvY29sIg0KICAgICBGb3JtYXQ9InVybjpvYXNp
czpuYW1lczp0YzpTQU1MOjIuMDpuYW1laWQtZm9ybWF0OnBlcnNpc3RlbnQiD
QogICAgIFNQTmFtZVF1YWxpZmllcj0ieG1wcC5leGFtcGxlLmNvbSIgQWxsb3
dDcmVhdGU9InRydWUiIC8+DQogPHNhbWxwOlJlcXVlc3RlZEF1dGhuQ29udGV
4dA0KICAgICB4bWxuczpzYW1scD0idXJuOm9hc2lzOm5hbWVzOnRjOlNBTUw6
Mi4wOnByb3RvY29sIiANCiAgICAgQ29tcGFyaXNvbj0iZXhhY3QiPg0KI
CA8c2FtbDpBdXRobkNvbnRleHRDbGFzc1JlZg0KICAgICAgeG1sbnM6c2FtbD
0idXJuOm9hc2lzOm5hbWVzOnRjOlNBTUw6Mi4wOmFzc2VydGlvbiI+DQogICA
gICB1cm46b2FzaXM6bmFtZXM6dGM6U0FNTDoyLjA6YWM6Y2xhc3NlczpQYXNz
d29yZFByb3RlY3RlZFRyYW5zcG9ydA0KICA8L3NhbWw6QXV0aG5Db250ZXh0Q
2xhc3NSZWY+DQogPC9zYW1scDpSZXF1ZXN0ZWRBdXRobkNvbnRleHQ+IA0KPC
9zYW1scDpBdXRoblJlcXVlc3Q+

Where the decoded SAMLRequest looks like:

```
 <samlp:AuthnRequest xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
     ID="_bec424fa5103428909a30ff1e31168327f79474984" Version="2.0"
     IssueInstant="2007-12-10T11:39:34Z" ForceAuthn="false"
     IsPassive="false"
     ProtocolBinding="urn:oasis:names:tc:SAML:2.0:bindings:HTTP-POST"
     AssertionConsumerServiceURL=
         "https://mail.example.com/SAML/AssertionConsumerService">
  <saml:Issuer xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion">
      https://xmpp.example.com
  </saml:Issuer>
  <samlp:NameIDPolicy xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
      Format="urn:oasis:names:tc:SAML:2.0:nameid-format:persistent"
      SPNameQualifier="xmpp.example.com" AllowCreate="true" />
  <samlp:RequestedAuthnContext
      xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
         Comparison="exact">
   <saml:AuthnContextClassRef
       xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion">
       urn:oasis:names:tc:SAML:2.0:ac:classes:PasswordProtectedTransport
   </saml:AuthnContextClassRef>
  </samlp:RequestedAuthnContext>
 </samlp:AuthnRequest>
```

## 6. Security Considerations

This section addresses only security considerations associated with the use of SAML with SASL applications. For considerations relating to SAML in general, the reader is referred to the SAML specification and to other literature. Similarly, for general SASL Security Considerations, the reader is referred to that specification.

### 6.1. Man in the middle and Tunneling Attacks

This mechanism is vulnerable to man-in-the-middle and tunneling attacks unless a client always verifies the server identity before proceeding with authentication (see [RFC6125]). Typically TLS is used to provide a secure channel with server authentication.

### 6.2. Binding SAML subject identifiers to Authorization Identities

As specified in [RFC4422], the server is responsible for binding credentials to a specific authorization identity. It is therefore necessary that only specific trusted IdPs be allowed. This is typical part of SAML trust establishment between Relying Parties and IdP.

### 6.3. User Privacy

The IdP is aware of each Relying Party that a user logs into. There is nothing in the protocol to hide this information from the IdP. It is not a requirement to track the visits, but there is nothing that prohibits the collection of information. SASL server implementers should be aware that SAML IdPs will be able to track - to some extent - user access to their services.

### 6.4. Collusion between RPs

It is possible for Relying Parties to link data that they have collected on the users. By using the same identifier to log into every Relying Party, collusion between Relying Parties is possible. In SAML, targeted identity was introduced. Targeted identity allows the IdP to transform the identifier the user typed in to a Relying Party specific opaque identifier. This way the Relying Party would never see the actual user identifier, but a randomly generated identifier.

### 6.5. GSS-API specific security considerations

Security issues inherent in GSS-API (RFC 2743) and GS2 (RFC 5801) apply to the SAML GSS-API mechanism defined in this document. Further, and as discussed in section 4, proper TLS server identity

verification is critical to the security of the mechanism.

# 7. IANA Considerations

## 7.1. IANA mech-profile

The IANA is requested to register the following SASL profile:

SASL mechanism profile: SAML20

Security Considerations: See this document

Published Specification: See this document

For further information: Contact the authors of this document.

Owner/Change controller: the IETF

Intended usage: COMMON

Note: None

## 7.2. IANA OID

The IANA is further requested to assign a new entry for this GSS mechanism in the sub-registry for SMI Security for Mechanism Codes, whose prefix is iso.org.dod.internet.security.mechanisms (1.3.6.1.5.5) and to reference this specification in the registry.

# 8. References

## 8.1. Normative References

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## 8.2. Informative References

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## Appendix A. Acknowledgments

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## Appendix B. Changes

This section to be removed prior to publication.

- 09 Fixed text per IESG review
- 08 Fixed text per Gen-Art review
- 07 Fixed text per comments Alexey Melnikov
- 06 Fixed text per AD comments
- 05 Fixed references per ID-nits
- 04 Added request for IANA assignment, few text clarifications
- 03 Number of cosmetic changes, fixes per comments Alexey Melnikov
- 02 Changed IdP URI to domain per Joe Hildebrand, fixed some typos
- 00 WG -00 draft. Updates GSS-API section, some fixes per Scott Cantor
- 01 Added authorization identity, added GSS-API specifics, added client supplied IdP
- 00 Initial Revision.

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August 28, 2019

# SAML Enhanced Client SASL and GSS-API Mechanisms
# draft-ietf-kitten-sasl-saml-ec-19

## Abstract

Security Assertion Markup Language (SAML) 2.0 is a generalized framework for the exchange of security-related information between asserting and relying parties. Simple Authentication and Security Layer (SASL) and the Generic Security Service Application Program Interface (GSS-API) are application frameworks to facilitate an extensible authentication model. This document specifies a SASL and GSS-API mechanism for SAML 2.0 that leverages the capabilities of a SAML-aware "enhanced client" to address significant barriers to federated authentication in a manner that encourages reuse of existing SAML bindings and profiles designed for non-browser scenarios.

## Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at https://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on February 29, 2020.

Table of Contents

## 1. Introduction

Security Assertion Markup Language (SAML) 2.0 [OASIS.saml-core-2.0-os] is a modular specification that provides various means for a user to be identified to a relying party (RP) through the exchange of (typically signed) assertions issued by an identity provider (IdP). It includes a number of protocols, protocol bindings [OASIS.saml-bindings-2.0-os], and interoperability profiles [OASIS.saml-profiles-2.0-os] designed for different use cases. Additional profiles and extensions are also routinely developed and published.

Simple Authentication and Security Layer (SASL) [RFC4422] is a generalized mechanism for identifying and authenticating a user and for optionally negotiating a security layer for subsequent protocol interactions. SASL is used by application protocols like IMAP, POP and XMPP [RFC6120]. The effect is to make authentication modular, so that newer authentication mechanisms can be added as needed.

The Generic Security Service Application Program Interface (GSS-API) [RFC2743] provides a framework for applications to support multiple authentication mechanisms through a unified programming interface. This document defines a pure SASL mechanism for SAML, but it conforms to the bridge between SASL and the GSS-API called GS2 [RFC5801]. This means that this document defines both a SASL mechanism and a GSS-API mechanism. The GSS-API interface is optional for SASL implementers, and the GSS-API considerations can be avoided in environments that use SASL directly without GSS-API.

The mechanisms specified in this document allow a SASL- or GSS-API-enabled server to act as a SAML relying party, or service provider (SP), by advertising this mechanism as an option for SASL or GSS-API clients that support the use of SAML to communicate identity and attribute information. Clients supporting this mechanism are termed "enhanced clients" in SAML terminology because they understand the federated authentication model and have specific knowledge of the IdP(s) associated with the user. This knowledge, and the ability to act on it, addresses a significant problem with browser-based SAML profiles known as the "discovery", or "where are you from?" (WAYF) problem. In a "dumb" client such as a web browser, various intrusive user interface techniques are used to determine the appropriate IdP to use because the request to the IdP is generated as an HTTP redirect by the RP, which does not generally have prior knowledge of the IdP to use. Obviating the need for the RP to interact with the client to determine the right IdP (and its network location) is both a user interface and security improvement.

The SAML mechanism described in this document is an adaptation of an existing SAML profile, the Enhanced Client or Proxy (ECP) Profile (V2.0) [SAMLECP20].

Figure 1 describes the interworking between SAML and SASL: this document requires enhancements to the RP and to the client (as the two SASL communication endpoints) but no changes to the SAML IdP are assumed apart from its support for the applicable SAML profile. To accomplish this, a SAML protocol exchange between the RP and the IdP, brokered by the client, is tunneled within SASL. There is no assumed communication between the RP and the IdP, but such communication may occur in conjunction with additional SAML-related profiles not in scope for this document.

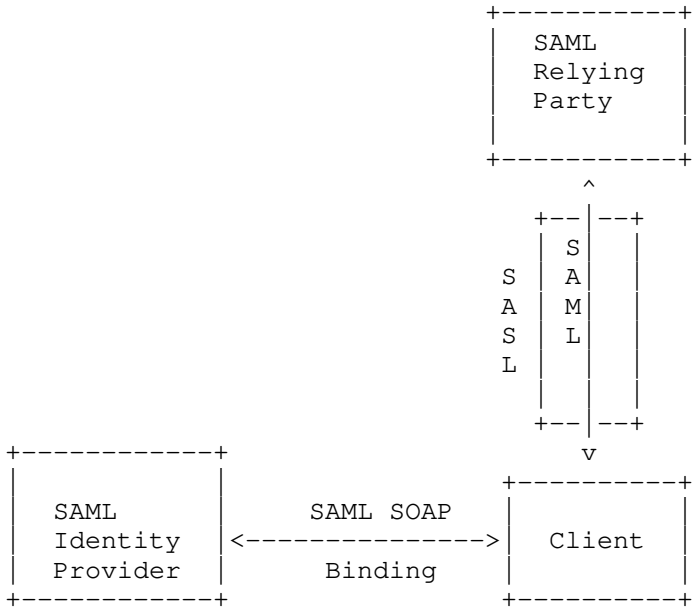


Figure 1: Interworking Architecture

## 2. 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 RFC 2119 [RFC2119].

The reader is also assumed to be familiar with the terms used in the SAML 2.0 specification, and an understanding of the Enhanced Client or Proxy (ECP) Profile (V2.0) [SAMLECP20] is necessary, as part of this mechanism explicitly reuses and references it.

This document can be implemented without knowledge of GSS-API since the normative aspects of the GS2 protocol syntax have been duplicated in this document. The document may also be implemented to provide a GSS-API mechanism, and then knowledge of GSS-API is essential. To faciliate these two variants, the references has been split into two parts, one part that provides normative references for all readers, and one part that adds additional normative references required for implementers that wish to implement the GSS-API portion.

## 3. Applicability for Non-HTTP Use Cases

While SAML is designed to support a variety of application scenarios, the profiles for authentication defined in the original standard are designed around HTTP [RFC7230] applications. They are not, however, limited to browsers, because it was recognized that browsers suffer from a variety of functional and security deficiencies that would be useful to avoid where possible. Specifically, the notion of an "Enhanced Client" (or a proxy acting as one on behalf of a browser, thus the term "ECP") was specified for a software component that acts somewhat like a browser from an application perspective, but includes limited, but sufficient, awareness of SAML to play a more conscious role in the authentication exchange between the RP and the IdP. What follows is an outline of the Enhanced Client or Proxy (ECP) Profile (V2.0) [SAMLECP20], as applied to the web/HTTP service use case:

1. The Enhanced Client requests a resource of a Relying Party (RP) (via an HTTP request). In doing so, it advertises its "enhanced" capability using HTTP headers.

2. The RP, desiring SAML authentication and noting the client's capabilities, responds not with an HTTP redirect or form, but with a SOAP [W3C.soap11] envelope containing a SAML <AuthnRequest> along with some supporting headers. This request identifies the RP (and may be signed), and may provide hints to the client as to what IdPs the RP finds acceptable, but the choice of IdP is generally left to the client.

3. The client is then responsible for delivering the body of the SOAP message to the IdP it is instructed to use (often via configuration ahead of time). The user authenticates to the IdP ahead of, during, or after the delivery of this message, and perhaps explicitly authorizes the response to the RP.

4. Whether authentication succeeds or fails, the IdP responds with its own SOAP envelope, generally containing a SAML <Response> message for delivery to the RP. In a successful case, the message will include one or more SAML <Assertion> elements containing authentication, and possibly attribute, statements about the subject. Either the response or each assertion is signed, and the assertion(s) may be encrypted to a key negotiated with or known to belong to the RP.

5. The client then delivers the SOAP envelope containing the <Response> to the RP at a location the IdP directs (which acts as an additional, though limited, defense against MITM attacks). This completes the SAML exchange.

6. The RP now has sufficient identity information to approve the original HTTP request or not, and acts accordingly. Everything between the original request and this response can be thought of as an "interruption" of the original HTTP exchange.

When considering this flow in the context of an arbitrary application protocol and SASL, the RP and the client both must change their code to implement this SASL mechanism, but the IdP can remain unmodified. The existing RP/client exchange that is tunneled through HTTP maps well to the tunneling of that same exchange in SASL. In the parlance of SASL [RFC4422], this mechanism is "client-first" for consistency with GS2. The steps are shown below:

1. The server MAY advertise the SAML20EC and/or SAML20EC-PLUS mechanisms.

2. The client initiates a SASL authentication with SAML20EC or SAML20EC-PLUS.

3. The server sends the client a challenge consisting of a SOAP envelope containing its SAML <AuthnRequest>.

4. The SASL client unpacks the SOAP message and communicates with its chosen IdP to relay the SAML <AuthnRequest> to it. This communication, and the authentication with the IdP, proceeds separately from the SASL process.

5. Upon completion of the exchange with the IdP, the client responds to the SASL server with a SOAP envelope containing the SAML <Response> it obtained, or a SOAP fault, as warranted.

6. The SASL Server indicates success or failure.

Note: The details of the SAML processing, which are consistent with the Enhanced Client or Proxy (ECP) Profile (V2.0) [SAMLECP20], are such that the client MUST interact with the IdP in order to complete any SASL exchange with the RP. The assertions issued by the IdP for the purposes of the profile, and by extension this SASL mechanism, are short lived, and therefore cannot be cached by the client for later use.

Encompassed in step four is the client-driven selection of the IdP, authentication to it, and the acquisition of a response to provide to the SASL server. These processes are all external to SASL.

Note also that unlike an HTTP-based profile, the IdP cannot participate in the selection of, or evaluation of, the location to which the SASL Client Response will be delivered by the client. The use of GSS-API Channel Binding is an important mitigation of the risk of a "Man in the Middle" attack between the client and RP, as is the use of a negotiated or derived session key in whatever protocol is secured by this mechanism.

With all of this in mind, the typical flow appears as follows:

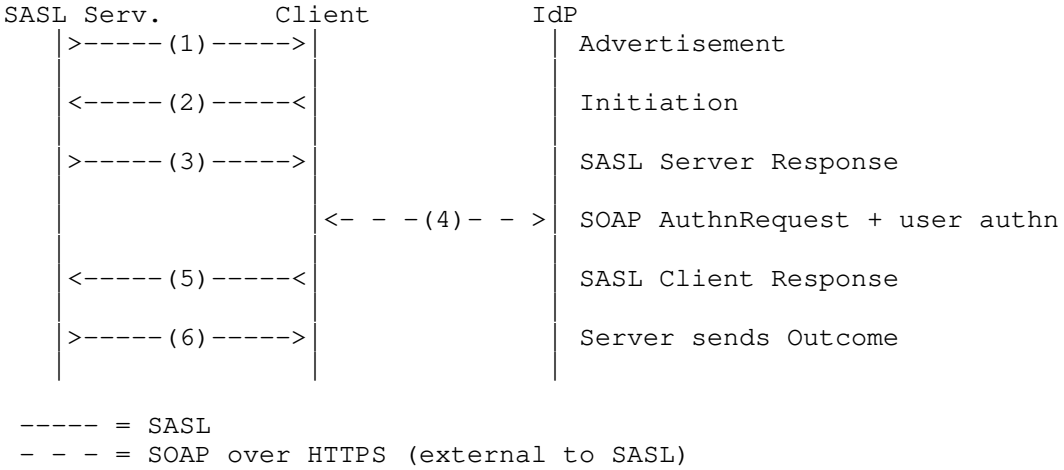


Figure 2: Authentication flow

## 4. SAML Enhanced Client SASL Mechanism Specification

Based on the previous figures, the following operations are defined by the SAML SASL mechanism:

### 4.1. Advertisement

To advertise that a server supports this mechanism, during application session initiation, it displays the name "SAML20EC" and/or "SAML20EC-PLUS" in the list of supported SASL mechanisms.

In accordance with [RFC5801] the "-PLUS" variant indicates that the server supports channel binding and would be selected by a client with that capability.

### 4.2. Initiation

A client initiates "SAML20EC" or "SAML20EC-PLUS" authentication. If supported by the application protocol, the client MAY include an initial response, otherwise it waits until the server has issued an empty challenge (because the mechanism is client-first).

The format of the initial client response ("initresp") is as follows:

```
hok = "urn:oasis:names:tc:SAML:2.0:cm:holder-of-key"

mut = "urn:oasis:names:tc:SAML:2.0:profiles:SSO:ecp:2.0:" \
  "WantAuthnRequestsSigned"

del = "urn:oasis:names:tc:SAML:2.0:conditions:delegation"

initresp = gs2-cb-flag "," [gs2-authzid] "," [hok] "," [mut] "," [del]
```

The gs2-cb-flag flag MUST be set as defined in [RFC5801] to indicate whether the client supports channel binding. This takes the place of the PAOS HTTP header extension used in [SAMLECP20] to indicate channel binding support.

The optional "gs2-authzid" field holds the authorization identity, as requested by the client.

The optional "hok" field is a constant that signals the client's support for stronger security by means of a locally held key. This takes the place of the PAOS HTTP header extension used in [SAMLECP20] to indicate "holder of key" support.

The optional "mut" field is a constant that signals the client's desire for mutual authentication. If set, the SASL server MUST

digitally sign its SAML <AuthnRequest> message. The URN constant above is a single string; the linefeed is shown for RFC formatting reasons.

The optional "del" field is a constant that signals the client's desire for the acceptor to request an assertion usable for delegation of the client's identity to the acceptor.

### 4.3. Server Response

The SASL server responds with a SOAP envelope constructed in accordance with section 2.3.2 of [SAMLECP20]. This includes adhering to the SOAP header requirements of the SAML PAOS Binding [OASIS.saml-bindings-2.0-os], for compatibility with the existing profile. Various SOAP headers are also consumed by the client in exactly the same manner prescribed by that section.

### 4.4. User Authentication with Identity Provider

Upon receipt of the Server Response (Section 4.3), the steps described in sections 2.3.3 through 2.3.6 of [SAMLECP20] are performed between the client and the chosen IdP. The means by which the client determines the IdP to use, and where it is located, are out of scope of this mechanism.

The exact means of authentication to the IdP are also out of scope, but clients supporting this mechanism MUST support HTTP Basic Authentication as defined in [RFC7617] and TLS 1.3 client authentication as defined in [RFC8446].

### 4.5. Client Response

Assuming a response is obtained from the IdP, the client responds to the SASL server with a SOAP envelope constructed in accordance with section 2.3.7 of [SAMLECP20]. This includes adhering to the SOAP header requirements of the SAML PAOS Binding [OASIS.saml-bindings-2.0-os], for compatibility with the existing profile. If the client is unable to obtain a response from the IdP, or must otherwise signal failure, it responds to the SASL server with a SOAP envelope containing a SOAP fault.

### 4.6. Outcome

The SAML protocol exchange having completed, the SASL server will transmit the outcome to the client depending on local validation of the client responses. This outcome is transmitted in accordance with the application protocol in use.

### 4.7. Additional Notes

Because this mechanism is an adaptation of an HTTP-based profile, there are a few requirements outlined in [SAMLECP20] that make reference to a response URL that is normally used to regulate where the client returns information to the RP. There are also security-related checks built into the profile that involve this location.

For compatibility with existing IdP and profile behavior, and to provide for mutual authentication, the SASL server MUST populate the responseConsumerURL and AssertionConsumerServiceURL attributes with its service name. As discussed in Section 5.6.2, most SASL profiles rely on a service name format of "service@host", but regardless of the form, the service name is used directly rather than transformed into an absolute URI if it is not already one, and MUST be percent-encoded per [RFC3986].

The IdP MUST securely associate the service name with the SAML entityID claimed by the SASL server, such as through the use of SAML metadata [OASIS.saml-metadata-2.0-os]. If metadata is used, a SASL service's <SPSSODescriptor> role MUST contain a corresponding <AssertionConsumerService> whose Location attribute contains the appropriate service name, as described above. The Binding attribute MUST be one of "urn:ietf:params:xml:ns:samlec" (RECOMMENDED) or "urn:oasis:names:tc:SAML:2.0:bindings:PAOS" (for compatibility with older implementations of the ECP profile in existing identity provider software).

Finally, note that the use of HTTP status signaling between the RP and client mandated by [SAMLECP20] may not be applicable.

## 5. SAML EC GSS-API Mechanism Specification

This section and its sub-sections and all normative references of it not referenced elsewhere in this document are INFORMATIONAL for SASL implementors, but they are NORMATIVE for GSS-API implementors.

The SAML Enhanced Client SASL mechanism is also a GSS-API mechanism. The messages are the same, but a) the GS2 [RFC5801] header on the client's first message is excluded when SAML EC is used as a GSS-API mechanism, and b) the [RFC2743] section 3.1 initial context token header is prefixed to the client's first authentication message (context token).

The GSS-API mechanism OID for SAML EC is OID-TBD (IANA to assign: see IANA considerations). The DER encoding of the OID is TBD.

The mutual_state request flag (GSS_C_MUTUAL_FLAG) MAY be set to TRUE, resulting in the "mut" option set in the initial client response. The security context mutual_state flag is set to TRUE only if the server digitally signs its SAML <AuthnRequest> message and the signature and signing credential are appropriately verified by the identity provider. The identity provider signals this to the client in an <ecp:RequestAuthenticated> SOAP header block.

The lifetime of a security context established with this mechanism SHOULD be limited by the value of a SessionNotOnOrAfter attribute, if any, in the <AuthnStatement> element(s) of the SAML assertion(s) received by the RP. By convention, in the rare case that multiple valid/confirmed assertions containing <AuthnStatement> elements are received, the most restrictive SessionNotOnOrAfter is generally applied.

### 5.1. GSS-API Credential Delegation

This mechanism can support credential delegation through the issuance of SAML assertions that an identity provider will accept as proof of authentication by a service on behalf of a subject. An initiator may request delegation of its credentials by setting the "del" option field in the initial client response to "urn:oasis:names:tc:SAML:2.0:conditions:delegation".

An acceptor, upon receipt of this constant, requests a delegated assertion by including in its <AuthnRequest> message a <Conditions> element containing an <AudienceRestriction> identifying the IdP as a desired audience for the assertion(s) to be issued. In the event that the specific identity provider to be used is unknown, the constant "urn:oasis:names:tc:SAML:2.0:conditions:delegation" may be used as a stand-in, per Section 2.3.2 of [SAMLECP20].

Upon receipt of an assertion satisfying this property, and containing a <SubjectConfirmation> element that the acceptor can satisfy, the security context may have its deleg_state flag (GSS_C_DELEG_FLAG) set to TRUE.

The identity provider, if it issues a delegated assertion to the acceptor, MUST include in the SOAP response to the initiator a <samlec:Delegated> SOAP header block, indicating that delegation was enabled. It has no content, other than mandatory SOAP attributes (an example follows):

```
<samlec:Delegated xmlns:samlec="urn:ietf:params:xml:ns:samlec"
    xmlns:S="http://schemas.xmlsoap.org/soap/envelope/"
    S:mustUnderstand="1"
    S:actor="http://schemas.xmlsoap.org/soap/actor/next" />
```

Upon receipt of such a header block, the initiator MUST fail the establishment of the security context if it did not request delegation in its initial client response to the acceptor. It SHOULD signal this failure to the acceptor with a SOAP fault message in its final client response.

As noted previously, the exact means of client authentication to the IdP is formally out of scope of this mechanism. This extends to the use of a delegation assertion as a means of authentication by an acceptor acting as an initiator. In practice, some profile of [WSS-SAML] is used to attach the assertion and a confirmation proof to the SOAP message from the client to the IdP.

### 5.2. GSS-API Channel Binding

GSS-API channel binding [RFC5554] is a protected facility for exchanging a cryptographic name for an enclosing channel between the initiator and acceptor. The initiator sends channel binding data and the acceptor confirms that channel binding data has been checked.

The acceptor SHOULD accept any channel binding provided by the initiator if null channel bindings are passed into gss_accept_sec_context. Protocols such as HTTP Negotiate [RFC4559] depend on this behavior of some Kerberos implementations.

The exchange and verification of channel binding information is described by [SAMLECP20].

### 5.3. Session Key Derivation

Some GSS-API features (discussed in the following sections) require a session key be established as a result of security context establishment. In the common case of a "bearer" assertion in SAML, a mechanism is defined to communicate a key to both parties via the identity provider. In other cases such as assertions based on "holder of key" confirmation bound to a client-controlled key, there may be additional methods defined in the future, and extension points are provided for this purpose.

Information defining or describing the session key, or a process for deriving one, is communicated between the initiator and acceptor using a <samlec:SessionKey> element, defined by the XML schema in

Appendix A. This element is a SOAP header block. The content of the element further depends on the specific use in the mechanism. The Algorithm XML attribute identifies a mechanism for key derivation. It is omitted to identify the use of an Identity Provider-generated key (see following section) or will contain a URI value identifying a derivation mechanism defined outside this specification. Each header block's mustUnderstand and actor attributes MUST be set to "1" and "http://schemas.xmlsoap.org/soap/actor/next" respectively.

In the acceptor's first response message containing its SAML request, one or more <samlec:SessionKey> SOAP header blocks MUST be included. The element MUST contain one or more <EncType> elements containing the number of a supported encryption type defined in accordance with [RFC3961]. Encryption types should be provided in order of preference by the acceptor.

In the final client response message, a single <samlec:SessionKey> SOAP header block MUST be included. A single <EncType> element MUST be included to identify the chosen encryption type used by the initiator.

All parties MUST support the "aes128-cts-hmac-sha1-96" encryption type, number 17, defined by [RFC3962].

Further details depend on the mechanism used, one of which is described in the following section.

#### 5.3.1. Generated by Identity Provider

The identity provider, if issuing a bearer assertion for use with this mechanism, SHOULD provide a generated key for use by the initiator and acceptor. This key is used as pseudorandom input to the "random-to-key" function for a specific encryption type defined in accordance with [RFC3961]. The key is base64-encoded and placed inside a <samlec:GeneratedKey> element. The identity provider does not participate in the selection of the encryption type and simply generates enough pseudorandom bits to supply key material to the other parties.

The resulting <samlec:GeneratedKey> element is placed within the <saml:Advice> element of the assertion issued. The identity provider MUST encrypt the assertion (implying that it MUST have the means to do so, typically knowledge of a key associated with the RP). If multiple assertions are issued (allowed, but not typical), the element need only be included in one of the assertions issued for use by the relying party.

A copy of the element is also added as a SOAP header block in the response from the identity provider to the client (and then removed when constructing the response to the acceptor).

If this mechanism is used by the initiator, then the <samlec:SessionKey> SOAP header block attached to the final client response message will identify this via the omission of the Algorithm attribute and will identify the chosen encryption type using the <samlec:EncType> element:

```
<samlec:SessionKey xmlns:samlec="urn:ietf:params:xml:ns:samlec"
    xmlns:S="http://schemas.xmlsoap.org/soap/envelope/"
    S:mustUnderstand="1"
    S:actor="http://schemas.xmlsoap.org/soap/actor/next">
  <samlec:EncType>17</samlec:EncType>
<samlec:SessionKey>
```

Both the initiator and acceptor MUST execute the chosen encryption type's random-to-key function over the pseudorandom value provided by the <samlec:GeneratedKey> element. The result of that function is used as the protocol and session key. Support for subkeys from the initiator or acceptor is not specified.

### 5.3.2. Alternate Key Derivation Mechanisms

In the event that a client is proving possession of a secret or private key, a formal key agreement algorithm might be supported. This specification does not define such a mechanism, but the <samlec:SessionKey> element is extensible to allow for future work in this space by means of the Algorithm attribute and an optional <ds:KeyInfo> child element to carry extensible content related to key establishment.

However a key is derived, the <samlec:EncType> element will identify the chosen encrytion type, and both the initiator and acceptor MUST execute the encryption type's random-to-key function over the result of the key agreement or derivation process. The result of that function is used as the protocol key.

## 5.4. Per-Message Tokens

The per-message tokens SHALL be the same as those for the Kerberos V5 GSS-API mechanism [RFC4121] (see Section 4.2 and sub-sections).

The replay_det_state (GSS_C_REPLAY_FLAG), sequence_state (GSS_C_SEQUENCE_FLAG), conf_avail (GSS_C_CONF_FLAG) and integ_avail (GSS_C_INTEG_FLAG) security context flags are always set to TRUE.

The "protocol key" SHALL be a key established in a manner described in the previous section. "Specific keys" are then derived as usual as described in Section 2 of [RFC4121], [RFC3961], and [RFC3962].

The terms "protocol key" and "specific key" are Kerberos V5 terms [RFC3961].

SAML20EC is PROT_READY as soon as the SAML response message has been seen.

### 5.5. Pseudo-Random Function (PRF)

The GSS-API has been extended with a Pseudo-Random Function (PRF) interface in [RFC4401]. The purpose is to enable applications to derive a cryptographic key from an established GSS-API security context. This section defines a GSS_Pseudo_random that is applicable for the SAML20EC GSS-API mechanism.

The GSS_Pseudo_random() [RFC4401] SHALL be the same as for the Kerberos V5 GSS-API mechanism [RFC7802]. There is no acceptor-asserted sub-session key, thus GSS_C_PRF_KEY_FULL and GSS_C_PRF_KEY_PARTIAL are equivalent. The protocol key to be used for the GSS_Pseudo_random() SHALL be the same as the key defined in the previous section.

### 5.6. GSS-API Principal Name Types for SAML EC

Services that act as SAML relying parties are typically identified by means of a URI called an "entityID". Clients that are named in the <Subject> element of a SAML assertion are typically identified by means of a <NameID> element, which is an extensible XML structure containing, at minimum, an element value that names the subject and a Format attribute.

In practice, a GSS-API client and server are unlikely to know in advance the name of the initiator as it will be expressed by the SAML identity provider upon completion of authentication. It is also generally incorrect to assume that a particular acceptor name will directly map into a particular RP entityID, because there is often a layer of naming indirection between particular services on hosts and the identity of a relying party in SAML terms.

To avoid complexity, and avoid unnecessary use of XML within the naming layer, the SAML EC mechanism relies on the common/expected

name types used for acceptors and initiators, GSS_C_NT_HOSTBASED_SERVICE and GSS_C_NT_USER_NAME. The mechanism provides for validation of the host-based service name in conjunction with the SAML exchange. It does not attempt to solve the problem of mapping between an initiator "username", the user's identity while authenticating to the identity provider, and the information supplied by the identity provider to the acceptor. These relationships must be managed through local policy at the initiator and acceptor.

SAML-based information associated with the initiator SHOULD be expressed to the acceptor using GSS-API naming extensions [RFC6680], in accordance with [RFC7056].

#### 5.6.1. User Naming Considerations

The GSS_C_NT_USER_NAME form represents the name of an individual user. Clients often rely on this value to determine the appropriate credentials to use in authenticating to the identity provider, and supply it to the server for use by the acceptor.

Upon successful completion of this mechanism, the server MUST construct the authenticated initiator name based on the <saml:NameID> element in the assertion it successfully validated. The name is constructed as a UTF-8 string in the following form:

```
name = element-value "!" Format  "!" NameQualifier
    "!" SPNameQualifier "!" SPProvidedID
```

The "element-value" token refers to the content of the <saml:NameID> element. The other tokens refer to the identically named XML attributes defined for use with the element. If an attribute is not present, which is common, it is omitted (i.e., replaced with the empty string). The Format value is never omitted; if not present, the SAML-equivalent value of "urn:oasis:names:tc:SAML:1.1:nameid-format:unspecified" is used.

Not all SAML assertions contain a <saml:NameID> element. In the event that no such element is present, including the exceptional cases of a <saml:BaseID> element or a <saml:EncryptedID> element that cannot be decrypted, the GSS_C_NT_ANONYMOUS name type MUST be used for the initiator name.

As noted in the previous section, it is expected that most applications able to rely on SAML authentication would make use of naming extensions to obtain additional information about the user based on the assertion. This is particularly true in the anonymous case, or in cases in which the SAML name is pseudonymous or transient in nature. The ability to express the SAML name in

GSS_C_NT_USER_NAME form is intended for compatibility with applications that cannot make use of additional information.

#### 5.6.2. Service Naming Considerations

The GSS_C_NT_HOSTBASED_SERVICE name form represents a service running on a host; it is textually represented as "service@host". This name form is required by most SASL profiles and is used by many existing applications that use the Kerberos GSS-API mechanism. As described in in the SASL mechanism's Section 4.7, such a name is used directly by this mechanism as the effective AssertionConsumerService "location" associated with the service and applied in IdP verification of the request against the claimed SAML entityID.

## 6. Example

Suppose the user has an identity at the SAML IdP saml.example.org and a Jabber Identifier (jid) "somenode@example.com", and wishes to authenticate his XMPP connection to xmpp.example.com (and example.com and example.org have established a SAML-capable trust relationship). The authentication on the wire would then look something like the following:

Step 1: Client initiates stream to server:

```
<stream:stream xmlns='jabber:client'
xmlns:stream='http://etherx.jabber.org/streams'
to='example.com' version='1.0'>
```

Step 2: Server responds with a stream tag sent to client:

```
<stream:stream
xmlns='jabber:client' xmlns:stream='http://etherx.jabber.org/streams'
id='some_id' from='example.com' version='1.0'>
```

Step 3: Server informs client of available authentication mechanisms:

```
<stream:features>
 <mechanisms xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
  <mechanism>DIGEST-MD5</mechanism>
  <mechanism>PLAIN</mechanism>
  <mechanism>SAML20EC</mechanism>
 </mechanisms>
</stream:features>
```

Step 4: Client selects an authentication mechanism and sends the initial client response (it is base64 encoded as specified by the XMPP SASL protocol profile):

```
<auth xmlns='urn:ietf:params:xml:ns:xmpp-sasl' mechanism='SAML20EC'>
biwsLCw=
</auth>
```

The initial response is "n,,,," which signals that channel binding is not used, there is no authorization identity, and the client does not support key-based confirmation, or want mutual authentication or delegation.

Step 5: Server sends a challenge to client in the form of a SOAP envelope containing its SAML <AuthnRequest>:

```
<challenge xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
PFM6RW52ZWxvcGUKICAgIHhtbG5zOnNhbWw9InVybjpvYXNpczpuYW1lczp0YzpT
QU1MOjIuMDphc3NlcnRpb24iCiAgICB4bWxuczpzYW1scD0idXJuOm9hc2lzOm5h
bWVzOnRjOlNBTUw6Mi4wOnByb3RvY29sIgogICAgeG1sbnM6Uz0iaHR0cDovL3Nj
aGVtYXMueG1sc29hcC5vcmcvc29hcC9lbnZlbG9wZS8iPgogIDxTOkhlYWRlcj4K
ICAgIDxwYW9zOlJlcXVlc3QgeG1sbnM6cGFvcz0idXJuOmxpYmVydHk6cGFvczoy
MDAzLTA4IgogICAgICBtZXNzYWdlSUQ9ImMzYTRmOGI5YzJkIiBTOm11c3RVbmRl
cnN0YW5kPSIxIgogICAgICBTOmFjdG9yPSJodHRwOi8vc2NoZW1hcy54bWxzb2Fw
Lm9yZy9zb2FwL2FjdG9yL25leHQiCiAgICAgIHJlc3BvbnNlQ29uc3VtZXJVUkw9
InhtcHBAeG1wcC5leGFtcGxlLmNvbSIKICAgICAgc2VydmljZT0idXJuOm9hc2lz
Om5hbWVzOnRjOlNBTUw6Mi4wOnByb2ZpbGVzOlNTTzplY3AiLz4KICAgIDxlY3A6
UmVxdWVzdAogICAgICB4bWxuczplY3A9InVybjpvYXNpczpuYW1lczp0YzpTQU1M
OjIuMDpwcm9maWxlczpTU086ZWNwIgogICAgICBTOmFjdG9yPSJodHRwOi8vc2No
ZW1hcy54bWxzb2FwLm9yZy9zb2FwL2FjdG9yL25leHQiCiAgICAgIFM6bXVzdFVu
ZGVyc3RhbmQ9IjEiIFByb3ZpZGVyTmFtZT0iSmFiYmVyIGF0IGV4YW1wbGUuY29t
Ij4KICAgICAgPHNhbWw6SXNzdWVyPmh0dHBzOi8veG1wcC5leGFtcGxlLmNvbTwv
c2FtbDpJc3N1ZXI+CiAgICA8L2VjcDpSZXF1ZXN0PgogICAgPHNhbWxwOlJlcXVl
c3QgeG1sbnM6c2FtbD0idXJuOmxldGY6cGFyYW1zOnhtbDpuczpzYW1s
ZWMiCiAgICAgIHhtbG5zOlM9Imh0dHA6Ly9zY2hlbWFzLnhtbHNvYXAub3JnL3Nv
YXAvZW52ZWxvcGUvIgogICAgICBTOm11c3RVbmRlcnN0YW5kPSIxIgogICAgICBT
OmFjdG9yPSJodHRwOi8vc2NoZW1hcy54bWxzb2FwLm9yZy9zb2FwL2FjdG9yL25l
eHQiPgogICAgICA8c2FtbGVjOkVuY1R5cGU+MTc8L3NhbWxlYzpFbmNUeXBlPgog
ICAgICA8c2FtbGVjOkVuY1R5cGU+MTg8L3NhbWxlYzpFbmNUeXBlPgogICAgPHNh
bWxlYzpTZXNzaW9uS2V5PgogIDwvUzpIZWFkZXI+CiAgPFM6Qm9keUT4KICAgIDxz
YW1scDpBdXRoblJlcXVlc3QKICAgICAgSUQ9ImMzYTRmOGI5YzJkIiBWZXJzaW9u
PSIyLjAiIElzc3VlSW5zdGFudD0iMjAwNy0xMi0xMFQxMTozOTozNFoiCiAgICAg
IEFzc2VydGlvbkNvbnN1bWVyU2VydmljZVVSTD0ieG1wcEB4bXBwLmV4YW1wbGUu
Y29tIj4KICAgICAgPHNhbWw6SXNzdWVyIHhtbG5zOnNhbWw9InVybjpvYXNpczpu
YW1lczp0YzpTQU1MOjIuMDphc3NlcnRpb24iPgogICAgICAgaHR0cHM6Ly94bXBw
LmV4YW1wbGUuY29tCiAgICAgIDwvc2FtbDpJc3N1ZXI+CiAgICAgIDxzYW1scDO
YW1lSURQb2xpY3kgQWxsb3dDcmVhdGU9InRydWUiCiAgICAgICAgRm9ybWF0PSJ1
cm46b2FzaXM6bmFtZXM6dGM6U0FNTDoyLjA6bmFtZWlkLWZvcm1hdDpwZXJzaXN0
ZW50Ii8+CiAgICAgIDxzYW1scDpSZXF1ZXN0ZWRBdXRobkNvbnRleHQgQ29tcGFy
aXNvbj0iZXhhY3QiPgogICAgICAgPHNhbWw6QXV0aG5Db250ZXh0Q2xhc3NSZWY+
CiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAg
YXNzd29yZFByb3RlY3RlZFRyYW5zcG9ydAogICAgICAgPC9zYW1sOkF1dGhuQ29u
dGV4dENsYXNzUmVmPgogICAgICA8L3NhbWxwOlJlcXVlc3RlZEF1dGhuQ29udGV4
dD4gCiAgICA8L3NhbWxwOkF1dGhuUmVxdWVzdD4KPC9TOkVudmVsb3BlPgo=
</challenge>
```

The Base64 [RFC4648] decoded envelope:

```
<S:Envelope
    xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion"
    xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
    xmlns:S="http://schemas.xmlsoap.org/soap/envelope/">
  <S:Header>
    <paos:Request xmlns:paos="urn:liberty:paos:2003-08"
      messageID="c3a4f8b9c2d" S:mustUnderstand="1"
      S:actor="http://schemas.xmlsoap.org/soap/actor/next"
      responseConsumerURL="xmpp@xmpp.example.com"
      service="urn:oasis:names:tc:SAML:2.0:profiles:SSO:ecp"/>
    <ecp:Request
      xmlns:ecp="urn:oasis:names:tc:SAML:2.0:profiles:SSO:ecp"
      S:actor="http://schemas.xmlsoap.org/soap/actor/next"
      S:mustUnderstand="1" ProviderName="Jabber at example.com">
      <saml:Issuer>https://xmpp.example.com</saml:Issuer>
    </ecp:Request>
    <samlec:SessionKey xmlns:samlec="urn:ietf:params:xml:ns:samlec"
      xmlns:S="http://schemas.xmlsoap.org/soap/envelope/"
      S:mustUnderstand="1"
      S:actor="http://schemas.xmlsoap.org/soap/actor/next">
      <samlec:EncType>17</samlec:EncType>
      <samlec:EncType>18</samlec:EncType>
    <samlec:SessionKey>
  </S:Header>
  <S:Body>
    <samlp:AuthnRequest
      ID="c3a4f8b9c2d" Version="2.0" IssueInstant="2007-12-10T11:39:34Z"
      AssertionConsumerServiceURL="xmpp@xmpp.example.com">
      <saml:Issuer xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion">
       https://xmpp.example.com
      </saml:Issuer>
      <samlp:NameIDPolicy AllowCreate="true"
        Format="urn:oasis:names:tc:SAML:2.0:nameid-format:persistent"/>
      <samlp:RequestedAuthnContext Comparison="exact">
       <saml:AuthnContextClassRef>
       urn:oasis:names:tc:SAML:2.0:ac:classes:PasswordProtectedTransport
       </saml:AuthnContextClassRef>
      </samlp:RequestedAuthnContext>
    </samlp:AuthnRequest>
  </S:Body>
</S:Envelope>
```

Step 5 (alt): Server returns error to client:

```
<failure xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
 <incorrect-encoding/>
</failure>
</stream:stream>
```

Step 6: Client relays the request to IdP in a SOAP message transmitted over HTTP (over TLS). HTTP portion not shown, use of Basic Authentication is assumed. The body of the SOAP envelope is exactly the same as received in the previous step.

```
<S:Envelope
    xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion"
    xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
    xmlns:S="http://schemas.xmlsoap.org/soap/envelope/">
    <S:Body>
        <samlp:AuthnRequest>
        <!-- same as above -->
        </samlp:AuthnRequest>
    </S:Body>
</S:Envelope>
```

Step 7: IdP responds to client with a SOAP response containing a SAML <Response> containing a short-lived SSO assertion (shown as an encrypted variant in the example). A generated key is included in the assertion and in a header for the client.

```
<S:Envelope
    xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion"
    xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
    xmlns:S="http://schemas.xmlsoap.org/soap/envelope/">
  <S:Header>
    <ecp:Response S:mustUnderstand="1"
      S:actor="http://schemas.xmlsoap.org/soap/actor/next"
      AssertionConsumerServiceURL="xmpp@xmpp.example.com"/>
    <samlec:GeneratedKey xmlns:samlec="urn:ietf:params:xml:ns:samlec">
      3w1wSBKUosRLsU69xGK7dg==
    </samlec:GeneratedKey>
  </S:Header>
  <S:Body>
    <samlp:Response ID="d43h94r389309r" Version="2.0"
        IssueInstant="2007-12-10T11:42:34Z" InResponseTo="c3a4f8b9c2d"
        Destination="xmpp@xmpp.example.com">
      <saml:Issuer>https://saml.example.org</saml:Issuer>
      <samlp:Status>
        <samlp:StatusCode
            Value="urn:oasis:names:tc:SAML:2.0:status:Success"/>
      </samlp:Status>
      <saml:EncryptedAssertion>
        <!-- contents elided, copy of samlec:GeneratedKey in Advice -->
      </saml:EncryptedAssertion>
    </samlp:Response>
  </S:Body>
</S:Envelope>
```

Step 8: Client sends SOAP envelope containing the SAML <Response> as a response to the SASL server’s challenge:

```
<response xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
PFM6RW52ZWxvcGUKICAgIHhtbG5zOnNhbWw9InVybjpvYXNpczpuYW1lczp0YzpT
QU1MOjIuMDphc3NlcnRpb24iCiAgICB4bWxuczpzYW1scD0idXJuOm9hc2lzOm5h
bWVzOnRjOlNBTUw6Mi4wOnByb3RvY29sIgogICAgeG1sbnM6Uz0iaHR0cDovL3Nj
aGVtYXMueG1sc29hcC5vcmcvc29hcC9lbnZlbG9wZS8iPgogIDxTOkhlYWRlcj4K
ICAgIDxwYW9zOlJlc3BvbnNlIHhtbG5zOnBhb3M9InVybjpsaWJlcnR5OnBhb3M6
MjAwMy0wOCIKICAgICAgUzphY3Rvcj0iaHR0cDovL3NjaGVtYXMueG1sc29hcC5v
cmcvc29hcC9hY3Rvci9uZXh0IgogICAgICBTOm11c3RVbmRlcnN0YW5kPSIxIiBy
ZWZUb01lc3NhZ2VJRD0iNmMzYTRmOGI5YzJkIi8+CiAgICA8c2FtbGVjOlNlc3Np
b25LZXkgeG1sbnM6c2FtbGVjPSJ1cm46aWV0ZjpwYXJhbXM6eG1sOm5zOnNhbWxl
YyIKICAgICAgeG1sbnM6Uz0iaHR0cDovL3NjaGVtYXMueG1sc29hcC5vcmcvc29h
cC9lbnZlbG9wZS8iCiAgICAgIFM6bXVzdFVuZGVyc3RhbmQ9IjEiCiAgICAgIFM6
YWN0b3I9Imh0dHA6Ly9zY2hlbWFzLnhtbHNvYXAub3JnL3NvYXAvYWN0b3IvbmV4
dCI+CiAgICAgIDxzYW1sZWM6RW5jVHlwZT5hZXMxMjgtY3RzLWhtYWMtc2hhMS05
Njwvc2FtbGVjOkVuY1R5cGU+CiAgICA8c2FtbGVjOlNlc3Npb25LZXk+CiAgPC9T
OkhlYWRlcj4KICA8UzpCb2R5PgogICAgPHNhbWxwOlJlIEElEPSJkNDNo
OTRyMzg5MzA5ciIgVmVyc2lvbj0iMi4wIgogICAgICAgIElzc3VlSW5zdGFudD0i
MjAwNy0xMi0xMTo0MjozNFoiIEluUmVzcG9uc2VUbz0iYzNhNGY4YjljMmQi
CiAgICAgICAgRGVzdGluYXRpb249InhtcHBAeG1wcC5leGFtcGxlLmNvbSI+CiAg
ICAgIDxzYW1sOklzc3Vlcj5odHRwczovL3NhbWwuZXhhbXBsZS5vcmc8L3NhbWw6
SXNzdWVyPgogICAgICA8c2FtbHA6U3RhdHVzPgogICAgICAgIDxzYW1scDpTdGF0
dXNDb2RlCiAgICAgICAgICAgIFZhbHVlPSJ1cm46b2FzaXM6bmFtZXM6dGM6U0FN
TDoyLjA6c3RhdHVzOlN1Y2Nlc3MiLz4KICAgICAgPC9zYW1scDpTdGF0dXM+CiAg
ICAgIDxzYW1sOkVuY3J5cHRlZEFzc2VydGlvbj4KICAgICAgICA8IS0tIGNvbnRl
bnRzIGVsaWRlZCwgY29weSBvZiBzYW1sZWM6R2VuZXJhdGVkS2V5IGluIEFkdmlj
ZSAtLT4KICAgICAgPC9zYW1sOkVuY3J5cHRlZEFzc2VydGlvbj4KICAgIDwvc2Ft
bHA6UmVzcG9uc2U+CiAgPC9TOkJvZHk+CjwvUzpFbnZlbG9wZT4K
</response>
```

The Base64 [RFC4648] decoded envelope:

```
 <S:Envelope
     xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion"
     xmlns:samlp="urn:oasis:names:tc:SAML:2.0:protocol"
     xmlns:S="http://schemas.xmlsoap.org/soap/envelope/">
   <S:Header>
     <paos:Response xmlns:paos="urn:liberty:paos:2003-08"
       S:actor="http://schemas.xmlsoap.org/soap/actor/next"
       S:mustUnderstand="1" refToMessageID="6c3a4f8b9c2d"/>
     <samlec:SessionKey xmlns:samlec="urn:ietf:params:xml:ns:samlec"
       xmlns:S="http://schemas.xmlsoap.org/soap/envelope/"
       S:mustUnderstand="1"
       S:actor="http://schemas.xmlsoap.org/soap/actor/next">
       <samlec:EncType>17</samlec:EncType>
     <samlec:SessionKey>
   </S:Header>
   <S:Body>
     <samlp:Response ID="d43h94r389309r" Version="2.0"
         IssueInstant="2007-12-10T11:42:34Z" InResponseTo="c3a4f8b9c2d"
         Destination="xmpp@xmpp.example.com">
       <saml:Issuer>https://saml.example.org</saml:Issuer>
       <samlp:Status>
         <samlp:StatusCode
             Value="urn:oasis:names:tc:SAML:2.0:status:Success"/>
       </samlp:Status>
       <saml:EncryptedAssertion>
         <!-- contents elided, copy of samlec:GeneratedKey in Advice -->
       </saml:EncryptedAssertion>
     </samlp:Response>
   </S:Body>
 </S:Envelope>
```

Step 9: Server informs client of successful authentication:

```
<success xmlns='urn:ietf:params:xml:ns:xmpp-sasl'/>
```

Step 9 (alt): Server informs client of failed authentication:

```
<failure xmlns='urn:ietf:params:xml:ns:xmpp-sasl'>
 <temporary-auth-failure/>
</failure>
</stream:stream>
```

Step 10: Client initiates a new stream to server:

```
<stream:stream xmlns='jabber:client'
xmlns:stream='http://etherx.jabber.org/streams'
to='example.com' version='1.0'>
```

Step 11: Server responds by sending a stream header to client along with any additional features (or an empty features element):

```
<stream:stream xmlns='jabber:client'
xmlns:stream='http://etherx.jabber.org/streams'
id='c2s_345' from='example.com' version='1.0'>
<stream:features>
 <bind xmlns='urn:ietf:params:xml:ns:xmpp-bind'/>
 <session xmlns='urn:ietf:params:xml:ns:xmpp-session'/>
</stream:features>
```

Step 12: Client binds a resource:

```
   <iq type='set' id='bind_1'>
     <bind xmlns='urn:ietf:params:xml:ns:xmpp-bind'>
       <resource>someresource</resource>
     </bind>
   </iq>
```

Step 13: Server informs client of successful resource binding:

```
   <iq type='result' id='bind_1'>
     <bind xmlns='urn:ietf:params:xml:ns:xmpp-bind'>
       <jid>somenode@example.com/someresource</jid>
     </bind>
   </iq>
```

Please note: line breaks were added to the base64 for clarity.

## 7. Security Considerations

This section will address only security considerations associated with the use of SAML with SASL applications. For considerations relating to SAML in general, the reader is referred to the SAML specification and to other literature. Similarly, for general SASL Security Considerations, the reader is referred to that specification.

Version 2.0 of the Enhanced Client or Proxy Profile [SAMLECP20] adds optional support for channel binding and use of "Holder of Key" subject confirmation. The former is strongly recommended for use with this mechanism to detect "Man in the Middle" attacks between the client and the RP without relying on flawed commercial TLS infrastructure. The latter may be impractical in many cases, but is a valuable way of strengthening client authentication, protecting against phishing, and improving the overall mechanism.

### 7.1. Risks Left Unaddressed

The adaptation of a web-based profile that is largely designed around security-oblivious clients and a bearer model for security token validation results in a number of basic security exposures that should be weighed against the compatibility and client simplification benefits of this mechanism.

When channel binding is not used, protection against "Man in the Middle" attacks is left to lower layer protocols such as TLS, and the development of user interfaces able to implement that has not been effectively demonstrated. Failure to detect a MITM can result in phishing of the user's credentials if the attacker is between the client and IdP, or the theft and misuse of a short-lived credential (the SAML assertion) if the attacker is able to impersonate a RP. SAML allows for source address checking as a minor mitigation to the latter threat, but this is often impractical. IdPs can mitigate to some extent the exposure of personal information to RP attackers by encrypting assertions with authenticated keys.

### 7.2. User Privacy

The IdP is aware of each RP that a user logs into. There is nothing in the protocol to hide this information from the IdP. It is not a requirement to track the activity, but there is nothing technically that prohibits the collection of this information. Servers should be aware that SAML IdPs will track - to some extent - user access to their services. This exposure extends to the use of session keys generated by the IdP to secure messages between the parties, but note that when bearer assertions are involved, the IdP can freely impersonate the user to any relying party in any case.

It is also out of scope of the mechanism to determine under what conditions an IdP will release particular information to a relying party, and it is generally unclear in what fashion user consent could be established in real time for the release of particular information. The SOAP exchange with the IdP does not preclude such interaction, but neither does it define that interoperably.

### 7.3. Collusion between RPs

Depending on the information supplied by the IdP, it may be possible for RPs to correlate data that they have collected. By using the same identifier to log into every RP, collusion between RPs is possible. SAML supports the notion of pairwise, or targeted/directed, identity. This allows the IdP to manage opaque, pairwise identifiers for each user that are specific to each RP. However, correlation is often possible based on other attributes supplied, and is generally a topic that is beyond the scope of this mechanism. It is sufficient to say that this mechanism does not introduce new correlation opportunities over and above the use of SAML in web-based use cases.

## 8. IANA Considerations

### 8.1. GSS-API and SASL Mechanism Registration

The IANA is requested to assign a new entry for this GSS mechanism in the sub-registry for SMI Security for Mechanism Codes, whose prefix is iso.org.dod.internet.security.mechanisms (1.3.6.1.5.5) and to reference this specification in the registry.

The IANA is requested to register the following SASL profile:

SASL mechanism profiles: SAML20EC and SAML20EC-PLUS

Security Considerations: See this document

Published Specification: See this document

For further information: Contact the authors of this document.

Owner/Change controller: the IETF

Note: None

### 8.2. XML Namespace Name for SAML-EC

A URN sub-namespace for XML constructs introduced by this mechanism is defined as follows:

URI: urn:ietf:params:xml:ns:samlec

Specification: See Appendix A of this document.

Description: This is the XML namespace name for XML constructs introduced by the SAML Enhanced Client SASL and GSS-API Mechanisms.

Registrant Contact: the IESG

# 9. References

## 9.1. Normative References

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## 9.2. Informative References

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## Appendix A. XML Schema

The following schema formally defines the "urn:ietf:params:xml:ns:samlec" namespace used in this document, in conformance with [W3C.REC-xmlschema-1] While XML validation is optional, the schema that follows is the normative definition of the constructs it defines. Where the schema differs from any prose in this specification, the schema takes precedence.

```
<schema
  targetNamespace="urn:ietf:params:xml:ns:samlec"
  xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
  xmlns:S="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:samlec="urn:ietf:params:xml:ns:samlec"
  elementFormDefault="unqualified"
  attributeFormDefault="unqualified"
  blockDefault="substitution"
  version="1.0">

  <import namespace="http://www.w3.org/2000/09/xmldsig#"/>
  <import namespace="http://schemas.xmlsoap.org/soap/envelope/"/>

  <element name="SessionKey" type="samlec:SessionKeyType"/>
  <complexType name="SessionKeyType">
    <sequence>
      <element ref="samlec:EncType" maxOccurs="unbounded"/>
      <element ref="ds:KeyInfo" minOccurs="0"/>
    </sequence>
    <attribute ref="S:mustUnderstand" use="required"/>
    <attribute ref="S:actor" use="required"/>
    <attribute name="Algorithm"/>
  </complexType>

  <element name="EncType" type="integer"/>

  <element name="GeneratedKey" type="samlec:GeneratedKeyType"/>
  <complexType name="GeneratedKeyType">
    <simpleContent>
      <extension base="base64Binary">
        <attribute ref="S:mustUnderstand"/>
        <attribute ref="S:actor"/>
      </extension>
    </simpleContent>
  </complexType>

  <element name="Delegated" type="samlec:DelegatedType"/>
  <complexType name="DelegatedType">
    <sequence/>
    <attribute ref="S:mustUnderstand" use="required"/>
    <attribute ref="S:actor" use="required"/>
  </complexType>

</schema>
```

## Appendix B. Acknowledgments

The authors would like to thank Klaas Wierenga, Sam Hartman, Nico Williams, Jim Basney, and Venkat Yekkirala for their contributions.

## Appendix C. Changes

This section to be removed prior to publication.

- 19, update obsoleted references
- 15,16,17,18 avoid expiration
- 14, address some minor comments
- 13, clarify SAML metadata usage, adding a recommended Binding value alongside the backward-compatibility usage of PAOS
- 12, clarifying comments based on WG feedback, with a normative change to use enctype numbers instead of names
- 11, update EAP Naming reference to RFC
- 10, update SAML ECP reference to final CS
- 09, align delegation signaling to updated ECP draft
- 08, more corrections, added a delegation signaling header
- 07, corrections, revised section on delegation
- 06, simplified session key schema, moved responsibility for random-to-key to the endpoints, and defined advertisement of session key algorithm and enctypes by acceptor
- 05, revised session key material, added requirement for random-to-key, revised XML schema to capture enctype name, updated GSS naming reference
- 04, stripped down the session key material to simplify it, and define an IdP-brokered keying approach, moved session key XML constructs from OASIS draft into this one
- 03, added TLS key export as a session key option, revised GSS naming material based on list discussion
- 02, major revision of GSS-API material and updated references

- 01, SSH language added, noted non-assumption of HTTP error handling, added guidance on life of security context.

- 00, Initial Revision, first WG-adopted draft. Removed support for unsolicited SAML responses.

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