RFC 8693
OAuth 2.0 Token Exchange

Abstract

This specification defines a protocol for an HTTP- and JSON-based Security Token Service (STS) by defining how to request and obtain security tokens from OAuth 2.0 authorization servers, including security tokens employing impersonation and delegation.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

A security token is a set of information that facilitates the sharing of identity and security information in heterogeneous environments or across security domains. Examples of security tokens include JSON Web Tokens (JWTs) [JWT] and Security Assertion Markup Language (SAML) 2.0 assertions [OASIS.saml-core-2.0-os]. Security tokens are typically signed to achieve integrity and sometimes also encrypted to achieve confidentiality. Security tokens are also sometimes described as assertions, such as in [RFC7521].

A Security Token Service (STS) is a service capable of validating security tokens provided to it and issuing new security tokens in response, which enables clients to obtain appropriate access credentials for resources in heterogeneous environments or across security domains. Web Service clients have used WS-Trust [WS-Trust] as the protocol to interact with an STS for token exchange. While WS-Trust uses XML and SOAP, the trend in modern Web development has been
towards RESTful (Representational State Transfer) patterns and JSON. The OAuth 2.0 Authorization Framework [RFC6749] and OAuth 2.0 Bearer Tokens [RFC6750] have emerged as popular standards for authorizing third-party applications’ access to HTTP and RESTful resources. The conventional OAuth 2.0 interaction involves the exchange of some representation of resource owner authorization for an access token, which has proven to be an extremely useful pattern in practice. However, its input and output are somewhat too constrained as is to fully accommodate a security token exchange framework.

This specification defines a protocol extending OAuth 2.0 that enables clients to request and obtain security tokens from authorization servers acting in the role of an STS. Similar to OAuth 2.0, this specification focuses on client developer simplicity and requires only an HTTP client and JSON parser, which are nearly universally available in modern development environments. The STS protocol defined in this specification is not itself RESTful (an STS doesn't lend itself particularly well to a REST approach) but does utilize communication patterns and data formats that should be familiar to developers accustomed to working with RESTful systems.

A new grant type for a token exchange request and the associated specific parameters for such a request to the token endpoint are defined by this specification. A token exchange response is a normal OAuth 2.0 response from the token endpoint with a few additional parameters defined herein to provide information to the client.

The entity that makes the request to exchange tokens is considered the client in the context of the token exchange interaction. However, that does not restrict usage of this profile to traditional OAuth clients. An OAuth resource server, for example, might assume the role of the client during token exchange in order to trade an access token that it received in a protected resource request for a new token that is appropriate to include in a call to a backend service. The new token might be an access token that is more narrowly scoped for the downstream service or it could be an entirely different kind of token.

The scope of this specification is limited to the definition of a basic request-and-response protocol for an STS-style token exchange utilizing OAuth 2.0. Although a few new JWT claims are defined that enable delegation semantics to be expressed, the specific syntax, semantics, and security characteristics of the tokens themselves (both those presented to the authorization server and those obtained by the client) are explicitly out of scope, and no requirements are placed on the trust model in which an implementation might be deployed. Additional profiles may provide more detailed requirements around the specific nature of the parties and trust involved, such as whether signing and/or encryption of tokens is needed or if proof-of-possession-style tokens will be required or issued. However, such details will often be policy decisions made with respect to the specific needs of individual deployments and will be configured or implemented accordingly.

The security tokens obtained may be used in a number of contexts, the specifics of which are also beyond the scope of this specification.
1.1. Delegation vs. Impersonation Semantics

One common use case for an STS (as alluded to in the previous section) is to allow a resource server A to make calls to a backend service C on behalf of the requesting user B. Depending on the local site policy and authorization infrastructure, it may be desirable for A to use its own credentials to access C along with an annotation of some form that A is acting on behalf of B ("delegation") or for A to be granted a limited access credential to C but that continues to identify B as the authorized entity ("impersonation"). Delegation and impersonation can be useful concepts in other scenarios involving multiple participants as well.

When principal A impersonates principal B, A is given all the rights that B has within some defined rights context and is indistinguishable from B in that context. Thus, when principal A impersonates principal B, then insofar as any entity receiving such a token is concerned, they are actually dealing with B. It is true that some members of the identity system might have awareness that impersonation is going on, but it is not a requirement. For all intents and purposes, when A is impersonating B, A is B within the context of the rights authorized by the token. A’s ability to impersonate B could be limited in scope or time, or even with a one-time-use restriction, whether via the contents of the token or an out-of-band mechanism.

Delegation semantics are different than impersonation semantics, though the two are closely related. With delegation semantics, principal A still has its own identity separate from B, and it is explicitly understood that while B may have delegated some of its rights to A, any actions taken are being taken by A representing B. In a sense, A is an agent for B.

Delegation and impersonation are not inclusive of all situations. When a principal is acting directly on its own behalf, for example, neither delegation nor impersonation are in play. They are, however, the more common semantics operating for token exchange and, as such, are given more direct treatment in this specification.

Delegation semantics are typically expressed in a token by including information about both the primary subject of the token as well as the actor to whom that subject has delegated some of its rights. Such a token is sometimes referred to as a composite token because it is composed of information about multiple subjects. Typically, in the request, the subject_token represents the identity of the party on behalf of whom the token is being requested while the actor_token represents the identity of the party to whom the access rights of the issued token are being delegated. A composite token issued by the authorization server will contain information about both parties. When and if a composite token is issued is at the discretion of the authorization server and applicable policy and configuration.

The specifics of representing a composite token and even whether or not such a token will be issued depend on the details of the implementation and the kind of token. The representations of composite tokens that are not JWTs are beyond the scope of this specification. The actor_token request parameter, however, does provide a means for providing information about the desired actor, and the JWT act claim can provide a representation of a chain of delegation.
1.2. Requirements Notation and Conventions

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 BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

1.3. Terminology

This specification uses the terms "access token type", "authorization server", "client", "client identifier", "resource server", "token endpoint", "token request", and "token response" defined by OAuth 2.0 [RFC6749], and the terms "Base64url Encoding", "Claim", and "JWT Claims Set" defined by JSON Web Token (JWT) [JWT].

2. Token Exchange Request and Response

2.1. Request

A client requests a security token by making a token request to the authorization server's token endpoint using the extension grant type mechanism defined in Section 4.5 of [RFC6749].

Client authentication to the authorization server is done using the normal mechanisms provided by OAuth 2.0. Section 2.3.1 of [RFC6749] defines password-based authentication of the client, however, client authentication is extensible and other mechanisms are possible. For example, [RFC7523] defines client authentication using bearer JSON Web Tokens (JWTs) [JWT]. The supported methods of client authentication and whether or not to allow unauthenticated or unidentified clients are deployment decisions that are at the discretion of the authorization server. Note that omitting client authentication allows for a compromised token to be leveraged via an STS into other tokens by anyone possessing the compromised token. Thus, client authentication allows for additional authorization checks by the STS as to which entities are permitted to impersonate or receive delegations from other entities.

The client makes a token exchange request to the token endpoint with an extension grant type using the HTTP POST method. The following parameters are included in the HTTP request entity-body using the application/x-www-form-urlencoded format with a character encoding of UTF-8 as described in Appendix B of [RFC6749].

grant_type

REQUIRED. The value urn:ietf:params:oauth:grant-type:token-exchange indicates that a token exchange is being performed.

resource

OPTIONAL. A URI that indicates the target service or resource where the client intends to use the requested security token. This enables the authorization server to apply policy as appropriate for the target, such as determining the type and content of the token to be issued or if and how the token is to be encrypted. In many cases, a client will not have knowledge of the logical organization of the systems with which it interacts and will only
know a URI of the service where it intends to use the token. The resource parameter allows the client to indicate to the authorization server where it intends to use the issued token by providing the location, typically as an https URL, in the token exchange request in the same form that will be used to access that resource. The authorization server will typically have the capability to map from a resource URI value to an appropriate policy. The value of the resource parameter MUST be an absolute URI, as specified by Section 4.3 of [RFC3986], that MAY include a query component and MUST NOT include a fragment component. Multiple resource parameters may be used to indicate that the issued token is intended to be used at the multiple resources listed. See [OAUTH-RESOURCE] for additional background and uses of the resource parameter.

audience

OPTIONAL. The logical name of the target service where the client intends to use the requested security token. This serves a purpose similar to the resource parameter but with the client providing a logical name for the target service. Interpretation of the name requires that the value be something that both the client and the authorization server understand. An OAuth client identifier, a SAML entity identifier [OASIS.saml-core-2.0-os], and an OpenID Connect Issuer Identifier [OpenID.Core] are examples of things that might be used as audience parameter values. However, audience values used with a given authorization server must be unique within that server to ensure that they are properly interpreted as the intended type of value. Multiple audience parameters may be used to indicate that the issued token is intended to be used at the multiple audiences listed. The audience and resource parameters may be used together to indicate multiple target services with a mix of logical names and resource URIs.

scope

OPTIONAL. A list of space-delimited, case-sensitive strings, as defined in Section 3.3 of [RFC6749], that allow the client to specify the desired scope of the requested security token in the context of the service or resource where the token will be used. The values and associated semantics of scope are service specific and expected to be described in the relevant service documentation.

requested_token_type

OPTIONAL. An identifier, as described in Section 3, for the type of the requested security token. If the requested type is unspecified, the issued token type is at the discretion of the authorization server and may be dictated by knowledge of the requirements of the service or resource indicated by the resource or audience parameter.

subject_token

REQUIRED. A security token that represents the identity of the party on behalf of whom the request is being made. Typically, the subject of this token will be the subject of the security token issued in response to the request.

subject_token_type

REQUIRED. An identifier, as described in Section 3, that indicates the type of the security token in the subject_token parameter.

actor_token
A security token that represents the identity of the acting party. Typically, this will be the party that is authorized to use the requested security token and act on behalf of the subject.

**actor_token_type**

An identifier, as described in Section 3, that indicates the type of the security token in the actor_token parameter. This is **REQUIRED** when the actor_token parameter is present in the request but **MUST NOT** be included otherwise.

In processing the request, the authorization server **MUST** perform the appropriate validation procedures for the indicated token type and, if the actor token is present, also perform the appropriate validation procedures for its indicated token type. The validity criteria and details of any particular token are beyond the scope of this document and are specific to the respective type of token and its content.

In the absence of one-time-use or other semantics specific to the token type, the act of performing a token exchange has no impact on the validity of the subject token or actor token. Furthermore, the exchange is a one-time event and does not create a tight linkage between the input and output tokens, so that (for example) while the expiration time of the output token may be influenced by that of the input token, renewal or extension of the input token is not expected to be reflected in the output token's properties. It may still be appropriate or desirable to propagate token-revocation events. However, doing so is not a general property of the STS protocol and would be specific to a particular implementation, token type, or deployment.

### 2.1.1. Relationship between Resource, Audience, and Scope

When requesting a token, the client can indicate the desired target service(s) where it intends to use that token by way of the **audience** and **resource** parameters as well as indicate the desired scope of the requested token using the **scope** parameter. The semantics of such a request are that the client is asking for a token with the requested scope that is usable at all the requested target services. Effectively, the requested access rights of the token are the Cartesian product of all the scopes at all the target services.

An authorization server may be unwilling or unable to fulfill any token request, but the likelihood of an unfulfillable request is significantly higher when very broad access rights are being solicited. As such, in the absence of specific knowledge about the relationship of systems in a deployment, clients should exercise discretion in the breadth of the access requested, particularly the number of target services. An authorization server can use the **invalid_target** error code, defined in Section 2.2.2, to inform a client that it requested access to too many target services simultaneously.

### 2.2. Response

The authorization server responds to a token exchange request with a normal OAuth 2.0 response from the token endpoint, as specified in Section 5 of [RFC6749]. Additional details and explanation are provided in the following subsections.
2.2.1. Successful Response

If the request is valid and meets all policy and other criteria of the authorization server, a successful token response is constructed by adding the following parameters to the entity-body of the HTTP response using the “application/json” media type, as specified by [RFC8259], and an HTTP 200 status code. The parameters are serialized into a JavaScript Object Notation (JSON) structure by adding each parameter at the top level. Parameter names and string values are included as JSON strings. Numerical values are included as JSON numbers. The order of parameters does not matter and can vary.

access_token

**REQUIRED.** The security token issued by the authorization server in response to the token exchange request. The access_token parameter from Section 5.1 of [RFC6749] is used here to carry the requested token, which allows this token exchange protocol to use the existing OAuth 2.0 request and response constructs defined for the token endpoint. The identifier access_token is used for historical reasons and the issued token need not be an OAuth access token.

issued_token_type

**REQUIRED.** An identifier, as described in Section 3, for the representation of the issued security token.

token_type

**REQUIRED.** A case-insensitive value specifying the method of using the access token issued, as specified in Section 7.1 of [RFC6749]. It provides the client with information about how to utilize the access token to access protected resources. For example, a value of Bearer, as specified in [RFC6750], indicates that the issued security token is a bearer token and the client can simply present it as is without any additional proof of eligibility beyond the contents of the token itself. Note that the meaning of this parameter is different from the meaning of the issued_token_type parameter, which declares the representation of the issued security token; the term "token type" is more typically used to mean the structural or syntactical representation of the security token, as it is in all _token_type parameters in this specification. If the issued token is not an access token or usable as an access token, then the token_type value N_A is used to indicate that an OAuth 2.0 token_type identifier is not applicable in that context.

expires_in

**RECOMMENDED.** The validity lifetime, in seconds, of the token issued by the authorization server. Oftentimes, the client will not have the inclination or capability to inspect the content of the token, and this parameter provides a consistent and token-type-agnostic indication of how long the token can be expected to be valid. For example, the value 1800 denotes that the token will expire in thirty minutes from the time the response was generated.

scope

**OPTIONAL.** If the scope of the issued security token is identical to the scope requested by the client; otherwise, it is **REQUIRED.**
refresh_token

**OPTIONAL.** A refresh token will typically not be issued when the exchange is of one temporary credential (the subject_token) for a different temporary credential (the issued token) for use in some other context. A refresh token can be issued in cases where the client of the token exchange needs the ability to access a resource even when the original credential is no longer valid (e.g., user-not-present or offline scenarios where there is no longer any user entertaining an active session with the client). Profiles or deployments of this specification should clearly document the conditions under which a client should expect a refresh token in response to `urn:ietf:params:oauth:grant-type:token-exchange` grant type requests.

### 2.2.2. Error Response

If the request itself is not valid or if either the subject_token or actor_token are invalid for any reason, or are unacceptable based on policy, the authorization server **MUST** construct an error response, as specified in Section 5.2 of [RFC6749]. The value of the error parameter **MUST** be the invalid_request error code.

If the authorization server is unwilling or unable to issue a token for any target service indicated by the resource or audience parameters, the invalid_target error code **SHOULD** be used in the error response.

The authorization server **MAY** include additional information regarding the reasons for the error using the error_description as discussed in Section 5.2 of [RFC6749].

Other error codes may also be used, as appropriate.

### 2.3. Example Token Exchange

The following example demonstrates a hypothetical token exchange in which an OAuth resource server assumes the role of the client during the exchange. It trades an access token, which it received in a protected resource request, for a new token that it will use to call to a backend service (extra line breaks and indentation in the examples are for display purposes only).

**Figure 1** shows the resource server receiving a protected resource request containing an OAuth access token in the Authorization header, as specified in Section 2.1 of [RFC6750].

```
GET /resource HTTP/1.1
Host: frontend.example.com
Authorization: Bearer accVkjcJyb4BWCxGsndESCJQbdFMogUC5PbRDqceLTC
```

**Figure 1: Protected Resource Request**

In **Figure 2**, the resource server assumes the role of client for the token exchange, and the access token from the request in **Figure 1** is sent to the authorization server using a request as specified in Section 2.1. The value of the subject_token parameter carries the access token, and the value of the subject_token_type parameter indicates that it is an OAuth 2.0 access token. The resource server, acting in the role of the client, uses its identifier and secret to authenticate to the
authorization server using the HTTP Basic authentication scheme. The resource parameter indicates the location of the backend service, <https://backend.example.com/api>, where the issued token will be used.

```
POST /as/token.oauth2 HTTP/1.1
Host: as.example.com
Authorization: Basic cnMwODpsb25nLXNlY3VyZSlyYW5kb20tc2VjcmV0
Content-Type: application/x-www-form-urlencoded

grant_type=urn%3Aietf%3Aparams%3Aoauth%3Agrant-type%3Atoken-exchange
&resource=https%3A%2F%2Fbackend.example.com%2Fapi
&subject_token=accVkjcJyb4WxCxGsndESCJqbdFMogUC5PbRDqceLTC
&subject_token_type=urn%3Aietf%3Aparams%3Aoauth%3Atoken-type%3Aaccess_token
```

**Figure 2: Token Exchange Request**

The authorization server validates the client credentials and the subject_token presented in the token exchange request. From the resource parameter, the authorization server is able to determine the appropriate policy to apply to the request and issues a token suitable for use at <https://backend.example.com>. The access_token parameter of the response shown in Figure 3 contains the new token, which is itself a bearer OAuth access token that is valid for one minute. The token happens to be a JWT; however, its structure and format are opaque to the client, so the issued_token_type indicates only that it is an access token.

```
HTTP/1.1 200 OK
Content-Type: application/json
Cache-Control: no-cache, no-store

{
  "access_token": "eyJhbGciOiJFUzI1NiIsImtpZCI6IjllciJ9.eyJhdWQiOiJodHRwczovL2JhY2tlbmQuc2VjcmV0LmNvbSIsImlhdCI6MTczNzAyMjE3MCwiZXhwIjoxOTMyMTgyMzQsInN1YiI6IiJuLi0xMDAwMDAyMDMyIiwic2NvcHV0aWQiOjEsInJlc3VsaW5lIjoiY29tcGxleSIsImNhdHVyZSI6IiJ9.40y3ZgQedw6rx5-kdXjwhw",
  "issued_token_type": "urn:ietf:params:oauth:token-type:access_token",
  "token_type": "Bearer",
  "expires_in": 60
}
```

**Figure 3: Token Exchange Response**

The resource server can then use the newly acquired access token in making a request to the backend server as illustrated in Figure 4.
GET /api HTTP/1.1
Host: backend.example.com
Authorization: Bearer eyJhbGciOiJFUzI1NiIsImtpZCI6IjllciJ9.eyJhbGciOiJFUzI1NiIsImtpZCI6IjllciJ9.eyJhdWQiOiJodHRwczovL2JhY2tldmVsdWFuLmNvbS5jb20iLCJpc3MiOiJodHRwczovL2FzLmV4YW1wbGUvY29tIiwiZXhwIjoxNDQxOTE3NTkzLCJpYXQiOjE0NDE5MTc1MzMsInN1YiI6ImJkY0BleGFtcGxlLmNvbSIsInNjb3BlIjoiYXBpIn0.40y3ZgQe dw6xf59WlwHDD9jryFor0_wh3CGozQBihNBhnXEQgU85AI9x3KmsPottVMLPIW vmDCMy5_kdXjwhw

Figure 4: Backend Protected Resource Request

Additional examples can be found in Appendix A.

3. Token Type Identifiers

Several parameters in this specification utilize an identifier as the value to describe the token in question. Specifically, they are the requested_token_type, subject_token_type, and actor_token_type parameters of the request and the issued_token_type member of the response. Token type identifiers are URIs. Token exchange can work with both tokens issued by other parties and tokens from the given authorization server. For the former, the token type identifier indicates the syntax (e.g., JWT or SAML 2.0) so the authorization server can parse it; for the latter, it indicates what the given authorization server issued it for (e.g., access_token or refresh_token).

The following token type identifiers are defined by this specification. Other URIs MAY be used to indicate other token types.

- urn:ietf:params:oauth:token-type:access_token
  Indicates that the token is an OAuth 2.0 access token issued by the given authorization server.

- urn:ietf:params:oauth:token-type:refresh_token
  Indicates that the token is an OAuth 2.0 refresh token issued by the given authorization server.

- urn:ietf:params:oauth:token-type:id_token
  Indicates that the token is an ID Token as defined in Section 2 of [OpenID.Core].

- urn:ietf:params:oauth:token-type:saml1
  Indicates that the token is a base64url-encoded SAML 1.1 [OASIS.saml-core-1.1] assertion.

- urn:ietf:params:oauth:token-type:saml2
  Indicates that the token is a base64url-encoded SAML 2.0 [OASIS.saml-core-2.0-os] assertion.

The value urn:ietf:params:oauth:token-type:jwt, which is defined in Section 9 of [JWT], indicates that the token is a JWT.
The distinction between an access token and a JWT is subtle. An access token represents a delegated authorization decision, whereas JWT is a token format. An access token can be formatted as a JWT but doesn't necessarily have to be. And a JWT might well be an access token, but not all JWTs are access tokens. The intent of this specification is that urn:ietf:params:oauth:token-type:access_token be an indicator that the token is a typical OAuth access token issued by the authorization server in question, opaque to the client, and usable the same manner as any other access token obtained from that authorization server. (It could well be a JWT, but the client isn't and needn't be aware of that fact.) Whereas, urn:ietf:params:oauth:token-type:jwt is to indicate specifically that a JWT is being requested or sent (perhaps in a cross-domain use case where the JWT is used as an authorization grant to obtain an access token from a different authorization server as is facilitated by [RFC7523]).

Note that for tokens that are binary in nature, the URI used for conveying them needs to be associated with the semantics of a base64 or other encoding suitable for usage with HTTP and OAuth.

4. JSON Web Token Claims and Introspection Response Parameters

It is useful to have defined mechanisms to express delegation within a token as well as to express authorization to delegate or impersonate. Although the token exchange protocol described herein can be used with any type of token, this section defines claims to express such semantics specifically for JWTs and in an OAuth 2.0 Token Introspection [RFC7662] response. Similar definitions for other types of tokens are possible but beyond the scope of this specification.

Note that the claims not established herein but used in examples and descriptions, such as iss, sub, exp, etc., are defined by [JWT].

4.1. "act" (Actor) Claim

The act (actor) claim provides a means within a JWT to express that delegation has occurred and identify the acting party to whom authority has been delegated. The act claim value is a JSON object, and members in the JSON object are claims that identify the actor. The claims that make up the act claim identify and possibly provide additional information about the actor. For example, the combination of the two claims iss and sub might be necessary to uniquely identify an actor.

However, claims within the act claim pertain only to the identity of the actor and are not relevant to the validity of the containing JWT in the same manner as the top-level claims. Consequently, non-identity claims (e.g., exp, nbf, and aud) are not meaningful when used within an act claim and are therefore not used.

Figure 5 illustrates the act (actor) claim within a JWT Claims Set. The claims of the token itself are about user@example.com while the act claim indicates that admin@example.com is the current actor.
A chain of delegation can be expressed by nesting one act claim within another. The outermost act claim represents the current actor while nested act claims represent prior actors. The least recent actor is the most deeply nested. The nested act claims serve as a history trail that connects the initial request and subject through the various delegation steps undertaken before reaching the current actor. In this sense, the current actor is considered to include the entire authorization/delegation history, leading naturally to the nested structure described here.

For the purpose of applying access control policy, the consumer of a token must only consider the token's top-level claims and the party identified as the current actor by the act claim. Prior actors identified by any nested act claims are informational only and are not to be considered in access control decisions.

The following example in Figure 6 illustrates nested act (actor) claims within a JWT Claims Set. The claims of the token itself are about user@example.com while the act claim indicates that the system <https://service16.example.com> is the current actor and <https://service77.example.com> was a prior actor. Such a token might come about as the result of service16 receiving a token in a call from service77 and exchanging it for a token suitable to call service26 while the authorization server notes the situation in the newly issued token.

Figure 5: Actor Claim

```json
{
  "aud":"https://consumer.example.com",
  "iss":"https://issuer.example.com",
  "exp":1443904177,
  "nbf":1443904077,
  "sub":"user@example.com",
  "act":
  {
    "sub":"admin@example.com"
  }
}
```

Figure 6: Nested Actor Claim

```json
{
  "aud":"https://service26.example.com",
  "iss":"https://issuer.example.com",
  "exp":1443904100,
  "nbf":1443904000,
  "sub":"user@example.com",
  "act":
  {
    "sub":"https://service16.example.com",
    "act":
    {
      "sub":"https://service77.example.com"
    }
  }
}
```
When included as a top-level member of an OAuth token introspection response, `act` has the same semantics and format as the claim of the same name.

### 4.2. "scope" (Scopes) Claim

The value of the `scope` claim is a JSON string containing a space-separated list of scopes associated with the token, in the format described in Section 3.3 of [RFC6749].

Figure 7 illustrates the `scope` claim within a JWT Claims Set.

```json
{
    "aud":"https://consumer.example.com",
    "iss":"https://issuer.example.com",
    "exp":1443904177,
    "nbf":1443904077,
    "sub":"dgaf4mvfs75Fci_FL3heQA",
    "scope":"email profile phone address"
}
```

**Figure 7: Scopes Claim**

OAuth 2.0 Token Introspection [RFC7662] already defines the `scope` parameter to convey the scopes associated with the token.

### 4.3. "client_id" (Client Identifier) Claim

The `client_id` claim carries the client identifier of the OAuth 2.0 [RFC6749] client that requested the token.

The following example in Figure 8 illustrates the `client_id` claim within a JWT Claims Set indicating an OAuth 2.0 client with "s6BhdRkqt3" as its identifier.

```json
{
    "aud":"https://consumer.example.com",
    "iss":"https://issuer.example.com",
    "exp":1443904177,
    "sub":"user@example.com",
    "client_id":"s6BhdRkqt3"
}
```

**Figure 8: Client Identifier Claim**

OAuth 2.0 Token Introspection [RFC7662] already defines the `client_id` parameter as the client identifier for the OAuth 2.0 client that requested the token.
4.4. "may_act" (Authorized Actor) Claim

The may_act claim makes a statement that one party is authorized to become the actor and act on behalf of another party. The claim might be used, for example, when a subject_token is presented to the token endpoint in a token exchange request and may_act claim in the subject token can be used by the authorization server to determine whether the client (or party identified in the actor_token) is authorized to engage in the requested delegation or impersonation. The claim value is a JSON object, and members in the JSON object are claims that identify the party that is asserted as being eligible to act for the party identified by the JWT containing the claim. The claims that make up the may_act claim identify and possibly provide additional information about the authorized actor. For example, the combination of the two claims iss and sub are sometimes necessary to uniquely identify an authorized actor, while the email claim might be used to provide additional useful information about that party.

However, claims within the may_act claim pertain only to the identity of that party and are not relevant to the validity of the containing JWT in the same manner as top-level claims. Consequently, claims such as exp, nbf, and aud are not meaningful when used within a may_act claim and are therefore not used.

*Figure 9* illustrates the may_act claim within a JWT Claims Set. The claims of the token itself are about user@example.com while the may_act claim indicates that admin@example.com is authorized to act on behalf of user@example.com.

```
{
    "aud":"https://consumer.example.com",
    "iss":"https://issuer.example.com",
    "exp":1443904177,
    "nbf":1443904077,
    "sub":"user@example.com",
    "may_act":{
        "sub":"admin@example.com"
    }
}
```

*Figure 9: Authorized Actor Claim*

When included as a top-level member of an OAuth token introspection response, may_act has the same semantics and format as the claim of the same name.

5. Security Considerations

Much of the guidance from Section 10 of [RFC6749], the Security Considerations in The OAuth 2.0 Authorization Framework, is also applicable here. Furthermore, [RFC6819] provides additional security considerations for OAuth, and [OAUTH-SECURITY] has updated security guidance based on deployment experience and new threats that have emerged since OAuth 2.0 was originally published.
All of the normal security issues that are discussed in [JWT], especially in relationship to comparing URIs and dealing with unrecognized values, also apply here.

In addition, both delegation and impersonation introduce unique security issues. Any time one principal is delegated the rights of another principal, the potential for abuse is a concern. The use of the `scope` claim (in addition to other typical constraints such as a limited token lifetime) is suggested to mitigate potential for such abuse, as it restricts the contexts in which the delegated rights can be exercised.

6. Privacy Considerations

Tokens employed in the context of the functionality described herein may contain privacy-sensitive information and, to prevent disclosure of such information to unintended parties, MUST only be transmitted over encrypted channels, such as Transport Layer Security (TLS). In cases where it is desirable to prevent disclosure of certain information to the client, the token MUST be encrypted to its intended recipient. Deployments SHOULD determine the minimally necessary amount of data and only include such information in issued tokens. In some cases, data minimization may include representing only an anonymous or pseudonymous user.

7. IANA Considerations

7.1. OAuth URI Registration

IANA has registered the following values in the "OAuth URI" subregistry of the "OAuth Parameters" registry [IANA.OAuth.Parameters]. The "OAuth URI" subregistry was established by [RFC6755].

- URN: urn:ietf:params:oauth:grant-type:token-exchange
  - Common Name: Token exchange grant type for OAuth 2.0
  - Change Controller: IESG
  - Specification Document: Section 2.1 of RFC 8693

- URN: urn:ietf:params:oauth:token-type:access_token
  - Common Name: Token type URI for an OAuth 2.0 access token
  - Change Controller: IESG
  - Specification Document: Section 3 of RFC 8693

  - Common Name: Token type URI for an OAuth 2.0 refresh token
  - Change Controller: IESG
  - Specification Document: Section 3 of RFC 8693

- URN: urn:ietf:params:oauth:token-type:id_token
  - Common Name: Token type URI for an ID Token
7.2. OAuth Parameters Registration

IANA has registered the following values in the "OAuth Parameters" subregistry of the "OAuth Parameters" registry [IANA.OAuth.Parameters]. The "OAuth Parameters" subregistry was established by [RFC6749].

- Parameter name: audience
  - Parameter usage location: token request
  - Change controller: IESG
  - Specification document(s): Section 2.1 of RFC 8693
- Parameter name: requested_token_type
  - Parameter usage location: token request
  - Change controller: IESG
  - Specification document(s): Section 2.1 of RFC 8693
- Parameter name: subject_token
  - Parameter usage location: token request
  - Change controller: IESG
  - Specification document(s): Section 2.1 of RFC 8693
- Parameter name: subject_token_type
  - Parameter usage location: token request
  - Change controller: IESG
  - Specification document(s): Section 2.1 of RFC 8693
- Parameter name: actor_token
  - Parameter usage location: token request
  - Change controller: IESG
7.3. OAuth Access Token Type Registration

IANA has registered the following access token type in the "OAuth Access Token Types" subregistry of the "OAuth Parameters" registry [IANA.OAuth.Parameters]. The "OAuth Access Token Types" subregistry was established by [RFC6749].

- Type name: N_A
- Additional Token Endpoint Response Parameters: none
- HTTP Authentication Scheme(s): none
- Change controller: IESG
- Specification document(s): Section 2.2.1 of RFC 8693

7.4. JSON Web Token Claims Registration

IANA has registered the following Claims in the "JSON Web Token Claims" subregistry of the "JSON Web Token (JWT)" registry [IANA.JWT]. The "JSON Web Token Claims" subregistry was established by [JWT].

- Claim Name: act
- Claim Description: Actor
- Change Controller: IESG
- Specification Document(s): Section 4.1 of RFC 8693

- Claim Name: scope
- Claim Description: Scope Values
- Change Controller: IESG
- Specification Document(s): Section 4.2 of RFC 8693

- Claim Name: client_id
- Claim Description: Client Identifier
- Change Controller: IESG
7.5. OAuth Token Introspection Response Registration

IANA has registered the following values in the "OAuth Token Introspection Response" registry of the "OAuth Parameters" registry [IANA.OAuth.Parameters]. The "OAuth Token Introspection Response" registry was established by [RFC7662].

- Name: act
  - Description: Actor
  - Change Controller: IESG
  - Specification Document(s): Section 4.1 of RFC 8693

- Name: may_act
  - Description: Authorized Actor - the party that is authorized to become the actor
  - Change Controller: IESG
  - Specification Document(s): Section 4.4 of RFC 8693

8. References

8.1. Normative References


[RFC7662]
8.2. Informative References


[RFC7521]
Appendix A. Additional Token Exchange Examples

Two example token exchanges are provided in the following sections illustrating impersonation and delegation, respectively (with extra line breaks and indentation for display purposes only).

A.1. Impersonation Token Exchange Example

A.1.1. Token Exchange Request

In the following token exchange request, a client is requesting a token with impersonation semantics (delegation is impossible with only a subject_token and no actor_token). The client tells the authorization server that it needs a token for use at the target service with the logical name urn:example:cooperation-context.

![Figure 10: Token Exchange Request](https://www.example.com/image.png)

A.1.2. Subject Token Claims

The subject_token in the prior request is a JWT, and the decoded JWT Claims Set is shown here. The JWT is intended for consumption by the authorization server within a specific time window. The subject of the JWT (bdc@example.net) is the party on behalf of whom the new token is being requested.
A.1.3. Token Exchange Response

The access_token parameter of the token exchange response shown below contains the new token that the client requested. The other parameters of the response indicate that the token is a bearer access token that expires in an hour.

HTTP/1.1 200 OK
Content-Type: application/json
Cache-Control: no-cache, no-store

{  "access_token":"eyJhbGciOiJFUzI1NiIsImtpZCI6IjcyIn0.eyJhdWQiOiJ1cm46ZXhhbXBsZTpjbj29wZXPxhGlvbi1jb256ZXhhbXBsZTpjbj29wZXPxhG1wiwiaXNzIjoiaHR0cHM6Ly9hcy5l
   eGftcGxllmV0Iiwic2NvcGUiOiJvcmRlcnMgcHJvZmlsZSBoaXN0b3J5In0.rMdWpSGNACTvnF
   nVKh85A",  "issued_token_type":  "urn:ietf:params:oauth:token-type:access_token",  "token_type":  "Bearer",  "expires_in":3600
}

A.1.4. Issued Token Claims

The decoded JWT Claims Set of the issued token is shown below. The new JWT is issued by the authorization server and intended for consumption by a system entity known by the logical name urn:example:cooperation-context any time before its expiration. The subject (sub) of the JWT is the same as the subject the token used to make the request, which effectively enables the client to impersonate that subject at the system entity known by the logical name of urn:example:cooperation-context by using the token.
A.2. Delegation Token Exchange Example

A.2.1. Token Exchange Request

In the following token exchange request, a client is requesting a token and providing both a 
subject_token and an actor_token. The client tells the authorization server that it needs a 
token for use at the target service with the logical name urn:example:cooperation-context. 
Policy at the authorization server dictates that the issued token be a composite.

![Figure 14: Token Exchange Request](image)

A.2.2. Subject Token Claims

The subject_token in the prior request is a JWT, and the decoded JWT Claims Set is shown here. 
The JWT is intended for consumption by the authorization server before a specific expiration 
time. The subject of the JWT (user@example.net) is the party on behalf of whom the new token 
is being requested.

![Figure 13: Issued Token Claims](image)
A.2.3. Actor Token Claims

The actor_token in the prior request is a JWT, and the decoded JWT Claims Set is shown here. This JWT is also intended for consumption by the authorization server before a specific expiration time. The subject of the JWT (admin@example.net) is the actor that will wield the security token being requested.

```
{
    "aud":"https://as.example.com",
    "iss":"https://original-issuer.example.net",
    "exp":1441910060,
    "scope":"status feed",
    "sub":"admin@example.net"
}
```

Figure 16: Actor Token Claims

A.2.4. Token Exchange Response

The access_token parameter of the token exchange response shown below contains the new token that the client requested. The other parameters of the response indicate that the token is a JWT that expires in an hour and that the access token type is not applicable since the issued token is not an access token.
HTTP/1.1 200 OK
Content-Type: application/json
Cache-Control: no-cache, no-store

{
  "access_token": "eyJhbGciOiJFUzI1NiIsImtpZCI6IjcyIn0.eyJhbXbXSZTpjb29wZXJhdGlvbvi1jb250ZXh0IiwiaXNzIjoiHR0cHM6Ly9hcy5l
  eGftcGxllmNvbSIsImV4cCI6MTQ0MTkxMzYxMCwiX19uZiI6IzQ5MSIsImNvbGUiOiJwcmV0dXJlc3QiLCJpYXQiOjE2NT
  4yNzYzNDcyMDc3MX0.3paKl9UySKYB5ng6_cUtQ2qlO8Rc_y7Mea7IweEXTcYbNdwG
  9-G1EKCFe5fw3H0hwX-MSZ49Wpcb1SiAZaOQBtw",
  "issued_token_type": "urn:ietf:params:oauth:token-type:jwt",
  "token_type": "N_A",
  "expires_in": 3600
}

Figure 17: Token Exchange Response

A.2.5. Issued Token Claims

The decoded JWT Claims Set of the issued token is shown below. The new JWT is issued by the
authorization server and intended for consumption by a system entity known by the logical
name urn:example:cooperation-context any time before its expiration. The subject (sub) of
the JWT is the same as the subject of the subject_token used to make the request. The actor
(act) of the JWT is the same as the subject of the actor_token used to make the request. This
indicates delegation and identifies admin@example.net as the current actor to whom authority
has been delegated to act on behalf of user@example.net.

{
  "aud": "urn:example:cooperation-context",
  "iss": "https://as.example.com",
  "exp": 1441913610,
  "scope": "status feed",
  "sub": "user@example.net",
  "act":
    {
      "sub": "admin@example.net"
    }
}

Figure 18: Issued Token Claims

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