User-Managed Access (UMA)

Protocol Implementation Details
Vo.8

Contributed by

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This document describes UMA protocol implementation with OpenID-Connect integration in detail, so one can experience how UMA works.
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1 What is UMA?

Managing of sharing information in social networks is a difficult task for users and can violate the user's privacy. With respect to privacy, the User-Managed Access — a novel access management solution (consist of an architecture and access control delegation protocol based on OAuth 2.0. It is being developed at the kantara Initiative for ultimate contribution to the IETF) that enables the "Authorizing User" to control access to his/her own resources — identities, preferences, data, through an "Authorization Manager" (AM). Based on user's policies the AM may grant access to third parties that request for that information.

When a "Requester" attempts access to a protected resource owned and protected by the authorizing user stored at some "Host", he is told where to go — the location of the AM, in order to request an access token. When he gets to the AM, he might be asked to convey claims about the requesting party, e.g. a web user or corporation, which satisfy the user's policy. After obtaining the right access token the requester is then able to receive the information he originally asked for.

Figure 1.1
2 Terminologies used

Authorizing user: An UMA-defined variant of an OAuth resource owner; a web user who configures an authorization manager with policies that control how it makes access decisions when a requester attempts to access a protected resource at a host. [1]

Authorization manager: An UMA-defined variant of an OAuth authorization server that carries out an authorizing user’s policies governing access to a protected resource. [1]

Host: An UMA-defined variant of an OAuth resource server that enforces access to the protected resources it hosts, as decided by an authorization manager. [1]

Requester: An UMA-defined variant of an OAuth client that seeks access to a protected resource. [1]

Protected resource: An access-restricted resource at a host. [1]

Host access token: An access token representing the authorizing user's consent for a host to trust a particular authorization manager for access decisions about resources hosted there. [1]

Requester access token: An access token representing the authorizing user's consent for a requester’s access to particular resources at a host. [1]

Requesting party: A web user, or a corporation (or other legal person), that uses a requester to seek access to a protected resource. [1]

Claim: A statement of the value or values of one or more identity attributes of a requesting party. Claims are conveyed by a requester on behalf of a requesting party to an authorization manager in an attempt to satisfy an authorizing user's policy. [1]

JSON: JavaScript Object Notation is a lightweight data-interchange format.

XRD: XRD document is a well-formed XML document as defined by [XML 1.0] with a root element of <XRD>.
3 What we have done so far?

Three servers are developed namely Authorization manager, Host and Client. Client provides an interface which initiates the process of introducing Host at Authorization manager by Authorizing user.

3.1 Three main steps of UMA

3.1.1 Step 1:

Authorizing user introduces host to AM

3.1.1.1 Host looks up AM metadata

Authorizing user initiates the process on Client interface and provides initialization endpoint and metadata endpoint. On the basis of initialization endpoint, authorizing user is redirected to Host. The metadata endpoint provided by authorizing user is used by Host to get metadata from Authorization manager. When user clicks on Introduce Host, control is passed to Host and Host gets metadata from AM. The retrieval of metadata is done at backend and is not visible to authorizing user. This metadata is retrieved in xml form and is saved as an xml file on Host server for future use.

3.1.1.2 Host dynamically registers with AM

When the control is passed to Host, it redirects to AM where AM will confirm that you really want to introduce this Host on AM. In case of YES, the host will be registered with AM if it is not already. In case of NO, the process is cancelled and control is given back to Client. In case of Registration, record is saved in both AM and Host’s database. In Host’s database we save that this host is registered with the named AM. In AM’s database we save that with this AM, the named Host is registered.

3.1.1.3 Host obtains host access token

After confirmation of authorizing user that he/she wants to introduce the Host on the given AM, if the Host is not registered then it is registered first otherwise the OAuth 2.0 steps are followed for getting host access token. In this process, firstly host is authenticated and then token is issued to it. Host gets access token from AM and saves it in a database against the AM which issued this token. This token is also saved in AM’s database.
3.1.2 Step2:

**Requester gets access token from AM**

Resources page is available to requester. When requester clicks on a certain resource, an interface is provided to requester by Host in order to communicate with AM and access token from AM. Requester provides its credentials/details to AM. Based on the policy defined by Authorizing user, an access token is issued to the requester. Currently we are using very simple policy which just checks the existence of the requester in AM’s database and offering access token for one time access.

3.1.3 Step3:

**Requester wields access token at host to gain access**

3.1.3.1 Requester attempts access

When requester gets access token from AM, it then presents it to Host to get access to the desired resource.

3.1.3.2 Host asks AM to validate requester access token

When the Host gets access token from requester, it will validate it from AM. For validation, Host needs to send this requester access token along with its own access token to AM.

3.1.3.3 Valid response

AM validates both access tokens if they are existing in database of AM against the given Host and Requester. Currently we are just checking the existence of both tokens in the AM’s database against the given requester and Host. We will improve it later to check also the scope and policy of the tokens. If both the tokens are validated and they are OK, then a response is sent to Host by AM that requester can be given access otherwise an erroneous response is sent to Host and the requester will not be allowed to access the desired resource. In case of valid response from AM to Host, the requester is given access to the desired resource as defined by the scope of the token.

3.1.3.4 Error responses

Different errors can take place at different times so there are different responses which are sent to Host based on error nature. For example, the requester token is not valid, AM sends the error message to Host that this requester is not allowed to access the resource and the Host displays it the requester.
3.2 Scope & Resource Registration

3.2.1 Scope Registration

Scopes are basically simple strings which only have meaning to the Host and are completely transparent to the Authorization Manager. For instance a scope can be all photos of a Host being marked as "for family only" or all photos of a certain resolution.

Scopes are registered with an AM by the Host and can be revoked again at any time.

Resources are bundled to scopes only on the Host side. The Authorization Manager never knows in advance which resource (and thus URI pointing to one) falls under which scope unless a request is made to a resource in which case the Host informs the Authorization Manager about the scopes it falls under. The Authorization Manager can then make a decision based on the scope information if access is granted or not.

In order to do so, resource owners attach policies to scopes. This can be as simple as being asked on every request or as complex as fulfilling a chain of claims.

3.2.2 Resource Registration

To provide a method for a host to register, update, check, and delete resource-related information at an authorization manager (AM) so that the user's resources can be put under scoped protection.

Resource registration will provide the following functionality.

The host will be able to register information about resources to be protected so that the AM can apply authorization constraints to them according to the user's wishes.

The host will be able to determine (unilaterally or as instructed by the user) the universe of resources belonging to this user that are to be protected by the AM, and will assign a resource identifier to sets of these resources. Such a set might include a status update API endpoint (applying to the user's entire update stream), or an individual status update, or a photo album, or all photos with a particular user-assigned tag, or even the set of "all resources managed by this user at this host".
The host will also be able to determine the universe of actions that is possible for requesting parties to perform on each resource set. Such actions might involve "viewing", "adding", "printing", or whatever other actions the application supports for that resource set. Typically each action covers a broad list of methods in the host’s published API.

Once the host has registered resource sets and their descriptive information with the AM, the AM (under the authorizing user’s instructions) is able to map particular authorization constraints to a particular set of resources and a particular set of actions and to take part in the process of limiting (scoping) access to resource sets.

Host will be free to offer the option to protect any subset of the user’s resources using different AMs or other means entirely, or to protect some resources and not others.

### 3.3 Policy Administration

On AM side we have a section for policy administration. We have a page on Host side which contains all protected resources. When resource is uploaded and protected with AM, it is not displayed on protected resources page until policies are assigned to this resource. When policy is assigned to the resource on AM side, a message is sent to Host regarding this and then the resource can be displayed on protected resources page. In policy administration, policies are assigned to resource. Policies can be assigned to requesters, groups of requesters, facebook friends etc. If user assigns policy to a facebook friend, his/her friends are fetched from facebook and policy is assigned to them.

### 3.4 Login via third party

At both AM and Host, login process can be performed through third party like facebook, google, yahoo etc. Currently we are only handling facebook but it will also cover other IDP in future. User can also login to the system using his/her credential of this system.
3.5 OpenID-Connect Support

At both AM and Host we implemented third party login support via Facebook as well as via OpenID-Connect. With OpenID it is easy to sign up and access web accounts because it is decentralized protocol for authentication. We used OpenID-Connect (dyuproject [13] library) listed on OpenID-Connect website [14] and integrated it with both AM and Host. By clicking on “Identity Provider” button, the user is redirected to the following page where user can select a certain identity provider (myOpenID, Google, Yahoo etc) and click “Send”. User will be redirected to home page of selected identity and will be prompted for authentication. After successful authentication, user will be redirected home page of UMA system.
3.6 Secure end to end Communication

3.6.1 Use of HTTPS

HTTPS (HTTP over SSL or HTTP Secure) is the use of Secure Socket Layer (SSL) or Transport Layer Security (TLS) as a sub layer under regular HTTP application layering. HTTPS encrypts and decrypts user page requests as well as the pages that are returned by the Web server. The use of HTTPS protects against eavesdropping and man-in-the-middle attacks. HTTPS was developed by Netscape.

HTTPS and SSL support the use of X.509 digital certificates from the server so that, if necessary, a user can authenticate the sender. Unless a different port is specified, HTTPS uses port 443 instead of HTTP port 80 in its interactions with the lower layer, TCP/IP. In our System we changed the ports according to our requirements. As for communication with https server (in code), the digital certificate of the server must be obtained from any well know certificate Issuer Company otherwise it will not work. In our system, we developed two programs, one for certificates generation and the other is used for adding these certificates to trusted zone for the
local computer. For the real deployment of our system we should get these digital certificates from the Issuer Company so that it can be accepted by every system and browser. All our three servers are upgraded and they are now running on Https server.

3.7 Web Interface

3.7.1 Web Interface for Authorization Manager

In UMA protocol Authorization manager is a separate application server. A lot of operations are performed on this server indirectly by Host server but some of the functionalities must be handled directly by Authorization manager for which we designed web interface for this server. With the use of this direct interface to AM, the authorizing user will be able to define policies, operate as admin for his/her account (accept/reject requests), see list of all registered host with the AM, see list of all requesters registered with AM and much more. This server is currently running on Https.

Figure 1.4
3.7.2 Web Interface for Host

In UMA protocol Host is a separate web application server. On Host we provided different interfaces to requester e.g. protected resources page, upload resource page, protect resource with AM page etc.

![Web Interface for Host](image)

Figure 1.5

3.7.3 Web Interface for Client

Client is also a separate web application. As before any communication between Host and AM, they should know each other or we can say that Host must be introduced at AM. This application provides the starting point of Host introduction at AM and then the whole process is continued step by step through graphical interface between Host and AM.
3.7.4 **Web Interface for all steps Involved**

During the process of introducing Host at AM by Authorizing user and getting access to resource by requester requires certain steps. In some steps the user must respond (for these steps interface is mandatory) but in some steps user response is not important and doesn’t matter so there is no need for showing that to Authorizing user. For making the system understandable and for those who are not familiar with UMA, we provided interface for each major step, so that viewers can understand what’s going on in the system. Later on during real deployment, we will remove the interface of unimportant steps and will only leave those, in which user response is necessary. For example when the user confirms that he/she wants to introduce this Host at AM, then directly the last step in which access token is issued to the host will be shown to the authorizing user. All the intermediate steps of registration, authorization etc will take place at backend. Currently we are showing all these steps to user through an interface.
3.8 Error Responses

3.8.1 Null or Empty Code
In case of Null or Empty code the following response is sent.
“HTTP/1.1 400 Bad - Request No Token”

3.8.2 Ambiguous Policy
In case of ambiguous action on resource, the following response is sent.
“HTTP/1.1 403 Forbidden - ambiguous-policy”

3.8.3 Ambiguous Resource
In case of accessing an undefined resource, the following response is sent.
“HTTP/1.1 403 Forbidden - ambiguous-resource”

3.8.4 Wrong Token
In case of presenting wrong token to AM, the following response is sent.
“HTTP/1.1 401 Unauthorized - No such token exists”

3.8.5 Insufficient Access Rights
In case of accessing a resource for which user doesn’t have enough privileges, the following response is sent.
"HTTP/1.1 403 Forbidden - Insufficient access rights"

4 Technologies we are using

We are using the following technologies in the implementation of UMA.
Due to many distinct qualities of Java we are using Java as our development language.

For frontend interfaces, .jsp pages are used.

In our application we are following MVC architecture, for which we selected Spring 3.0

Because of the ease of use and user friendliness we are using Tomcat 7.0.8 as our deployment server

We are using this plug-in for automatic generation of queries. We don’t need to write queries manually as it generates all the commonly used queries for us.
4.6 **PostgreSQL**
For data storage we are using PostgreSQL database.

4.7 **Dreamweaver**
For design of interfaces we are using Dreamweaver.

4.8 **Navicat**
For interface to database we are using Navicat.

5 **How our System work?**

5.1 **Deployment Details**
As we have three applications namely Client, Host and Authorization Manager. All these three applications are deployed on different servers and are using Https. Client is deployed on Tomcat 7.0.8 at port 8080, Host at port 8090 and Authorization Manager at 8070.

5.2 **Flow of the System**
We have three major steps which are explained by the following figures.
Figure 1.8

UMA - Step 1: User registers Host at AM

HOST
(as Client for 1st OAuth)

AUTHORIZING USER
(End-user at browser)

AUTHORIZATION MANAGER
(as Authorization Server)

Provision of AM location

Retrieve host-meta metadata

Metadata document

Learn about User Authorization URL (OAuth end-user authz. endpoint)

1st OAuth - Step 1. Obtaining end-user authorization

[Redirection of end-user user’s agent to end-user authz. endpoint] Client Identifier & Redirect URI

User authenticates & decides on access request


1st OAuth - Step 2. Obtaining an Access Token (HOST ACCESS TOKEN)

Client Credentials & Authorization Code & Redirect URI

Validate Authorization Code

Access Token (w/ optional Refresh Token)

Optional registration of scopes
UMA - Step 2: Requester gets access token from AM

HOST (as Resource Server for 2nd OAuth)

AUTHORIZATION MANAGER (as Authorization Server for 2nd OAuth)

REQUESTER (as Client for 2nd OAuth)

2nd OAuth: Autonomous client profile (there is no Step 1)

2nd OAuth – Step 2. Obtaining an Access Token (REQUESTER ACCESS TOKEN)
Request for Access Token (Client credentials, optional scope)

Loop Evaluate against applicable policy

Alt

Access Token (wi optional Refresh Token)

Unsuccessful access token response

Claims-required document

Submit claims

Figure 1.9
5.3 Scenarios

5.3.1 UMA – Step 1

In this step authorizing user Introduces Host at Authorization manager.

5.3.1.1 Scenario #1

When Host is not registered at Authorization manager and Authorizing user wants to Introduce Host at Authorization Manager.
Figure 2.1

UMA Client Application

Introduce Host at Authorization Managed
Database with empty tables

Figure 2.2
No Host registered with Authorization Manager

*Figure 2.3*
Introduce Host at given URL

UMA Client Application

Required UMA parameters:

Host Initialization URL: http://localhost:8090/UMA_Host/uma/initialize

Host Meta data URL: http://localhost:8070/UMA_AM/uma/retrieve_metadata

Figure 2.4
Figure 2.5

UMA Authorization Manager

Confirmation

Do you want to introduce Host to this Authorization Manager

[ ] YES  [ ] NO
We need endpoint for certain functionality in order to access it. An xml file is transferred to Host by AM containing all the endpoints of AM which is saved to database for future use. The endpoint for this file is provided by the Authorizing user in the start of the process as metadata URI.

Figure 2.6
Host Registration at AM

**Figure 2.7**

### UMA Host

**Host Registration**

Required UMA Registration parameters:

<table>
<thead>
<tr>
<th>Application Name</th>
<th>HOST INTRODUCTION AT AUTHORIZATION MANAGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application URL</td>
<td><a href="http://localhost:8070/UMA_Host/">http://localhost:8070/UMA_Host/</a></td>
</tr>
<tr>
<td>OAuth Registration Endpoint</td>
<td><a href="http://localhost:8070/UMA_AM/urna/register">http://localhost:8070/UMA_AM/urna/register</a></td>
</tr>
</tbody>
</table>

[Register Host]
Database with new entry

Figure 2.8
Figure 2.9
Getting Authorization Code from AM

![UMA Host Authentication](image)

**Host Authorization**

- Required UMA parameters:
  - Requested Access Scope
  - End-User Authorization URL: http://localhost:8070/uka AM/uma/authorize
  - Token Endpoint: http://localhost:8070/uka AM/uma/token
  - Client ID: host_id
  - Client Secret: host_secret
  - Redirect URI: http://localhost:8090/uka Host/uma/redirect

**Figure 3.0**
Getting Access token from AM

**Figure 3.1**
Host Access token

**Figure 3.2**
Host access token saved at Authorization Manager

Figure 3.3
Access token saved at Host

Figure 3.4
5.3.1.2 Scenario # 2

In this Scenario authorization code will be issued to Host without asking for registration, because Host is already registered at Authorization server.

Getting Authorization Code from AM

![Diagram of UMA Host with details for acquiring authorization code](image)

**Figure 3.5**
Getting Access token from AM

<table>
<thead>
<tr>
<th>UMA Host</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Getting Access Token</strong></td>
</tr>
<tr>
<td>Required OAuth parameters:</td>
</tr>
<tr>
<td>Authorization Code:</td>
</tr>
<tr>
<td>Token Endpoint:</td>
</tr>
<tr>
<td>Client ID:</td>
</tr>
<tr>
<td>Client Secret:</td>
</tr>
<tr>
<td>Redirect URI:</td>
</tr>
</tbody>
</table>

**Figure 3.6**
Host Access token

Figure 3.7
5.3.2 UMA – Step 2 & Step 3
In these steps Requester (i.e. web browser) wants to access resource located on Host, Requester is asked to get permission (i.e. access token) from Authorization Manager.

5.3.2.1 Accessing resource if user is registered with AM and policy is assigned to it.
In this case access token is provided on the right user code.

Host Protected Resources Page

![Host Protected Resources Page](image)

*Figure 3.8*
Getting Requester access token

**Figure 3.9**
Validating access token

**Figure 4.0**
Requested Resource

**UMA Host**

**Your Resource:**

![Figure 4.1](image-url)

*Figure 4.1*
In case of wrong credentials

**Figure 4.2**
Result of wrong credentials (Unauthorized User)

Figure 4.3
In case of wrong requester access token

Figure 4.4
Result of wrong requester access token

Figure 4.5
5.3.2.2 Accessing resource via “Facebook” if this requester is in “Facebook Friends list” of resource owner and policy is assigned to it

In this case the requester provides his/her code just like the previous case. System checks this code and if the user is facebook user, then he/she is redirected to facebook login page. When the user is verified by both facebook and system, an authorization code is then given to the requester.

Getting Requester access token
Facebook Login page

Figure 4.7
Requester Access token issued after verification

**Figure 4.8**
5.3.3 Resource Upload Scenario

This scenario will explain how a resource is uploaded on Host.

Login page

Figure 4.9
Welcome page is displayed after logging in to application

*Figure 5.0*
After clicking on “Upload Resource” on welcome page, upload resource page is displayed

Figure 5.1
After selecting resource and filling in the fields

*Figure 5.2*
After uploading resource

Resource successfully uploaded

*Figure 5.3*
5.3.4 Protecting Resource with AM

Protecting resource after uploading it

*Figure 5.4*
Here we select the resource we want to protect and give location of AM

Figure 5.5
After specifying AM location and clicking on Protect Resource button, we are redirected to login page of AM where we can login with both “Account on AM” and “Facebook”.

*Figure 5.6*
After logging in, this page is displayed and the resource is protected with AM but policies are not yet assigned. Using the below page, requester can go back to “Upload Resource page” and “Assign Policy page”.

![Figure 5.7](image-url)
5.3.5 Assigning Policies to Resources which are protected with AM

Index page of AM

User-centric Web-Resource Management System

Managing sharing information in social networks is a difficult task for users and can violate the user's privacy. The UMA protocol enables the "Authorizing User" to control access to his/her own resources, i.e. identities, preferences, data, through an "Authorization Manager" (AM). Based on user's policies the AM may grant access to third parties that request for these information. When a "Requester" attempts access to a protected resource owned and protected by the authorizing user stored at some "Host", he is told where to go (the location of the AM) in order to request an access token. When he gets to the AM, he might be asked to convey claims about the requesting party, e.g. a web user or corporation, that satisfy the user's policy. After obtaining the right access token the requester is then able to receive the information he originally asked for.

Figure 5.8
Login page of AM where user can login using both “Account on AM” and Facebook.

Figure 5.9
After logging in to AM, user is redirected to home page of AM.
After clicking on “Policy Administration” on home page, user will be redirected to this page. On this page user can assign policies to different users, groups. User can also assign policies to Facebook Friends by using the checkbox present at the end. If user checks this checkbox, friends of user will be fetched from facebook and the specified policy will be assigned to them.

Figure 6.1
After assigning policies to users and groups for a specific resource.

Figure 6.2
6 What’s next?

6.1 Trusted Claim

A statement of the value or values of one or more identity attributes of a requesting party. Claims are conveyed by a requester on behalf of a requesting party to an authorization manager in an attempt to satisfy an authorizing user's policy.

6.2 JWT

JSON Web Token (JWT) is a compact token format intended for space constrained environments such as HTTP Authorization headers and URI query parameters. JWTs encode claims to be transmitted as a JSON object that is base64url encoded and digitally signed. The JWT signature mechanisms are independent of the type of content being signed, allowing arbitrary content to be signed. Encryption for JWTs is described in a separate companion specification.

6.3 Digital Signature

A digital signature or digital signature scheme is a mathematical scheme for demonstrating the authenticity of a digital message or document. A valid digital signature gives a recipient reason to believe that the message was created by a known sender, and that it was not altered in transit. Digital signatures are commonly used for software distribution, financial transactions, and in other cases where it is important to detect forgery or tampering.

7 Help for Developers

This application is for Demo purpose which demonstrates how UMA protocol works. It consists of three servers named UMA_Client, UMA_AM and UMA_Host.

For successful use of this application, one have to install PostgreSQL 9.0 database server and create databases of the names “uma_authz_manager” and “uma_host”.

After creating databases, one should use respective sql files to generate the database tables. Navicat can be used as database client application for doing all this database creation and running sql queries. Data related to database configuration is in database.properties file which is located in src folder of UMA_AM and UMA_Host.
After database setup, war files of the above three servers should be deployed on application server (e.g. tomcat 6.0). As these servers communicate with each other so IP addresses and ports of other servers must be known to every server. File named “uma_url_links.txt” is placed in every project which shows the places where changes should be made in case of port or IP change.

We are using spring (3.0) framework. The controllers (also called Endpoints) which are accessed from outside application are located in de.fraunhofer.aisec.uma.endpoints package. All Controllers which are for internal access are located in de.fraunhofer.aisec.uma.controllers package. For communication between database and application we are using ibatus plugin. Configuration file of Ibatus named as sqlMap-config.xml is located in src folder.

8 References

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