Samples Guide

/ ForgeRock Identity Management 6.0

Latest update: 6.0.0.7

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Abstract

Guide providing a number of "sample deployments" that walk you through the essential features of ForgeRock® Identity Management software, as they would be implemented.

Table of Contents

Preface

ForgeRock Identity Platform™ serves as the basis for our simple and comprehensive Identity and Access Management solution. We help our customers deepen their relationships with their customers, and improve the productivity and connectivity of their employees and partners. For more information about ForgeRock and about the platform, see https://www.forgerock.com.

The ForgeRock Common REST API works across the platform to provide common ways to access web resources and collections of resources.

1. Using This Guide

This guide describes a number of sample deployments that demonstrate the core functionality of ForgeRock Identity Management (IDM) software. The samples correspond to the configurations provided in the `openidm/samples` directory.

This guide is written for anyone testing IDM to manage identities, and to ensure compliance with identity management regulations.

The guide covers a number of IDM features, often including multiple features in a single sample.

You do not need a complete understanding of IDM software to learn something from this guide, although a background in identity management and maintaining web application software can help. You do need some background in managing services on your operating systems and in your application servers. You can nevertheless get started with this guide, and then learn more as you go along.

2. Accessing Documentation Online

ForgeRock publishes comprehensive documentation online:

- The ForgeRock Knowledge Base offers a large and increasing number of up-to-date, practical articles that help you deploy and manage ForgeRock software.

  While many articles are visible to community members, ForgeRock customers have access to much more, including advanced information for customers using ForgeRock software in a mission-critical capacity.

- ForgeRock product documentation, such as this document, aims to be technically accurate and complete with respect to the software documented. It is visible to everyone and covers all product features and examples of how to use them.

3. Using the ForgeRock.org Site

The ForgeRock.org site has links to source code for ForgeRock open source software, as well as links to the ForgeRock forums and technical blogs.

If you are a *ForgeRock customer*, raise a support ticket instead of using the forums. ForgeRock support professionals will get in touch to help you.

Chapter 1

Overview of the Samples

This chapter lists all the samples provided with IDM and gives a high-level overview of the purpose of each sample. This chapter also provides information that is required for all of the samples. Read this chapter, specifically "Running the Samples" and "Preparing IDM" before you try any of the samples.

1.1. Samples Provided With IDM

A number of samples are provided in the `openidm/samples` directory. This section describes the purpose of each sample:

Getting Started

The Getting Started sample describes how to install and evaluate IDM.

`(samples/getting-started)`

"Synchronizing Data From a CSV File to IDM"

This sample demonstrates one-way synchronization from an external resource to an IDM repository. The external resource in this case is a simple CSV file. User objects in that file are synchronized with the managed users in the IDM repository.

`(samples/sync-with-csv)`

"One Way Synchronization From LDAP to IDM"

This sample uses the generic LDAP connector to connect to an LDAP directory. The sample includes one mapping from the LDAP directory to the managed user repository, and demonstrates reconciliation from the external resource to the repository.

`(samples/sync-with-ldap)`

"Two Way Synchronization Between LDAP and IDM"

This sample uses the generic LDAP connector to connect to an LDAP directory. The sample includes two mappings - one from the LDAP directory to the managed user repository, and one in the opposite direction. The sample demonstrates reconciliation from the LDAP directory to the repository and implicit synchronization from the managed user repository to the LDAP directory.

`(samples/sync-with-ldap-bidirectional)`

"***Synchronizing LDAP Groups***"

This sample uses the generic LDAP connector to connect to an LDAP directory. The sample builds on the previous sample by providing an additional mapping, from the LDAP groups object, to the managed groups object. The sample illustrates a new managed object type (groups) and shows how this object type is synchronized with group containers in LDAP.

`(samples/sync-with-ldap-groups)`

"***Synchronizing LDAP Group Membership***"

This sample uses the generic LDAP connector to connect to an LDAP directory. The sample includes two mappings, one from the LDAP directory to the managed user repository, and one from the repository to the LDAP directory. The sample demonstrates synchronization of group membership, that is, how the value of the `ldapGroups` property in a managed user object is mapped to the corresponding user object in LDAP.

`(samples/sync-with-ldap-group-membership)`

"***Synchronizing Data Between Two External Resources***"

This sample demonstrates synchronization between two external resources, routed through the IDM repository. The resources are named `LDAP` and `AD` and represent two separate LDAP directories. In the sample both resources are simulated with simple CSV files.

`(samples/sync-two-external-resources)`

"***Asynchronous Reconciliation Using a Workflow***"

This sample shows how you can use workflows to launch an asynchronous reconciliation operation.

`(samples/sync-asynchronous)`

"***LiveSync With an LDAP Server***"

This sample illustrates the liveSync mechanism that pushes changes from an external resource to the IDM repository. The sample uses an LDAP connector to connect to an LDAP directory, either ForgeRock Directory Services (DS) or Active Directory.

`(samples/livesync-with-ad)`

"***Synchronizing Accounts With the Google Apps Connector***"

This sample uses the Google Apps Connector to create users and groups on an external Google system and to reconcile those accounts with the IDM managed user repository.

`(samples/sync-with-google)`

"***Synchronizing Users Between Salesforce and IDM***"

This sample demonstrates how to create and update users in Salesforce, using the Salesforce Connector. The sample also shows synchronization of users between Salesforce and the IDM managed user repository.

`(samples/sync-with-salesforce)`

"***Synchronizing Kerberos User Principals***"

This sample demonstrates how to use the scripted Kerberos connector to manage Kerberos user principals and to reconcile user principals with IDM managed user objects.

`(samples/sync-with-kerberos)`

"***Storing Multiple Passwords For Managed Users***"

This sample demonstrates how to set up multiple passwords for managed users and how to synchronize separate passwords to different external resources. The sample includes two target LDAP servers, each with different password policy and encryption requirements. The sample also shows how to extend the password history policy to apply to multiple password fields.

`(samples/multiple-passwords)`

"***Linking Multiple Accounts to a Single Identity***"

This sample illustrates how IDM addresses links from multiple accounts to one identity. The sample shows how you can create links between a single source account and multiple target accounts, using *link qualifiers* that enable one-to-many relationships in mappings and policies.

`(samples/multi-account-linking)`

"***Linking Historical Accounts***"

This sample demonstrates the retention of inactive (historical) LDAP accounts that have been linked to a corresponding managed user account.

`(samples/historical-account-linking)`

"***Provisioning With Roles***"

This sample builds on the sample described in "*One Way Synchronization From LDAP to IDM*", and demonstrates how attributes are provisioned to an external system (an LDAP directory), based on role membership.

`(samples/provisioning-with-roles)`

"***Using a Workflow to Provision User Accounts***"

The provisioning workflow sample demonstrates a typical use case of a workflow — provisioning new users. The sample demonstrates the use of the Self-Service UI that lets end users complete a registration process.

`(samples/provisioning-with-workflow)`

"*Connecting to DS With ScriptedREST*"

This sample uses the Groovy Connector Toolkit to implement a ScriptedREST connector that interacts with the DS REST API.

`(samples/scripted-rest-with-dj)`

"*Connecting to a MySQL Database With ScriptedSQL*"

This sample uses the Groovy Connector Toolkit to implement a ScriptedSQL connector that interacts with an external MySQL database.

`(samples/scripted-sql-with-mysql)`

"*Connecting to Active Directory With the PowerShell Connector*"

This sample uses the MS Active Directory PowerShell module to demonstrate how you can synchronize managed objects with a Microsoft Active Directory deployment. The sample provides a number of PowerShell scripts that enable you to perform basic CRUD (create, read, update, delete) operations on an Active Directory server.

`(samples/scripted-powershell-with-ad)`

"*Connecting to Azure AD With the PowerShell Connector*"

This sample uses the Microsoft Azure Active Directory (Azure AD) PowerShell module to demonstrate how you can synchronize managed object data such as users and groups with a Microsoft AzureAD deployment.

`(samples/scripted-powershell-with-azure-ad)`

"*Directing Audit Information To a MySQL Database*"

This sample uses a ScriptedSQL implementation of the Groovy Connector Toolkit to direct audit information to a MySQL database.

`(samples/audit-jdbc)`

"*Directing Audit Information To a JMS Broker*"

This sample demonstrates how the JMS audit event handler can publish messages that comply with the *Java(TM) Message Service Specification Final Release 1.1*

`(samples/audit-jms)`

"*Subscribing to JMS Messages*"

This sample demonstrates the scripted JMS message handler, and how it performs ForgeRock REST operations.

`(samples/scripted-jms-subscriber)`

"*Authenticating Using a Trusted Servlet Filter*"

This sample demonstrates how to use a custom servlet filter and the "Trusted Request Attribute Authentication Module" to allow IDM to authenticate through another service.

`(samples/trusted-servlet-filter)`

"*Integrating IDM With the ForgeRock Identity Platform*"

This sample demonstrates the integration of three products within the ForgeRock Identity Platform. The sample shows ForgeRock Access Management, (AM), ForgeRock Directory Services (DS), and ForgeRock Identity Management (IDM) working together working together to manage identities and authentication.

`(samples/full-stack)`

"*Creating a Custom Endpoint*"

IDM supports scriptable custom endpoints that enable you to launch arbitrary scripts through an IDM REST URI. This example shows how custom endpoints are configured and returns a list of variables available to each method used in a custom endpoint script.

`(samples/example-configurations/custom-endpoint)`

1.2. Example Configuration Files

In addition to these complete, runnable samples, the `samples/` directory includes a number of example configuration and data files that you can use when setting up your own project. These examples files are under the `example-configurations` subdirectory. Details on each of these files is provided in the documentation that corresponds to the purpose of the file. For example, the `conf/external.email.json` file is described in "*Configuring Outbound Email*" in the *Integrator's Guide*.

1.3. Running the Samples

Each sample directory in `openidm/samples/` contains a number of subdirectories, such as `conf/` and `script/`. To start IDM with a sample configuration, navigate to the `/path/to/openidm` directory and use the `-p` option of the **startup** command to point to the sample whose configuration you want to use. Some, but not all samples require additional software, such as an external LDAP server or database.

Many of the procedures in this guide refer to paths such as `samples/sample-name`. In each of these cases, the complete path is assumed to be `/path/to/openidm/samples/sample-name`.

When you move from one sample to the next, bear in mind that you are changing the IDM configuration. For information on how configuration changes work, see "Making Configuration Changes" in the *Integrator's Guide*.

The command-line examples in this chapter (and throughout the IDM documentation) assume a UNIX shell. If you are running these samples on Windows, adjust the command-line examples accordingly.

1.4. Preparing IDM

Install an instance of IDM specifically to try the samples. That way you can experiment as much as you like, and discard the result if you are not satisfied.

If you are using the same IDM instance for multiple samples, it is helpful to clear out the repository created for an earlier sample. To do so, shut down IDM and delete the `openidm/db/openidm` directory.

```
$ rm -rf /path/to/openidm/db/openidm
```

IDM should then be ready to start with a new sample. For a number of the samples in this guide, users are created either with the UI or directly with a commons REST call. Users that have been created in the repository (managed users) should be able to log into the Self-Service UI.

Chapter 2

Synchronizing Data From a CSV File to IDM

This sample demonstrates one-way synchronization from an external resource to an IDM repository.

The external resource in this case is a simple CSV file. User objects in that file are synchronized with the managed users in the IDM repository.

This chapter walks you through the sample and demonstrates the configuration files that correspond to each part of the synchronization process. For a complete list of the samples provided with IDM, and an overview of each sample, see "*Overview of the Samples*".

2.1. About This Sample

IDM connects data objects held in separate resources by mapping one object to another. To connect to external resources, IDM uses *connectors*, that are configured for each external resource.

When objects in one external resource change, IDM determines how the changes affect the objects in the connected resource, and can make the changes in that resource as necessary. This sample demonstrates how IDM does this by using *reconciliation*. Reconciliation compares the objects in one resource to the mapped objects in another resource. For a complete explanation of reconciliation and synchronization, see "Types of Synchronization" in the *Integrator's Guide*.

In this sample, IDM connects to a CSV file that holds sample user data. The CSV file is configured as the authoritative source. A *mapping* is configured between objects in the CSV file and managed user objects in the IDM repository.

Note that you can use IDM to synchronized objects between two external resources without going through the IDM repository. In such a case, objects are synchronized directly through connectors to the external resources.

This sample involves only one external resource. In practice, you can connect as many resources as needed for your deployment.

About the Configuration Files

The configuration files for this sample are located in the `/path/to/openidm/samples/sync-with-csv/conf` directory. When you start IDM with the `-p` project variable (**./startup.sh -p samples/sync-with-csv**), the *project location* (`&{idm.instance.dir}`) is set to a value of `samples/sync-with-csv`. All subsequent paths use this project location as a base. Throughout this documentation, you will see things like "...in your project's `conf/` directory...". The project here refers to the the value of the `&{idm.instance.dir}` variable.

The following configuration files play important roles in this sample:

`samples/sync-with-csv/conf/provisioner.openicf-csvfile.json`

This file provides the configuration for this instance of the CSV connector. It describes, among other things, the connector version, the location of the CSV file resource, and the object types that are supported for this connection. For a complete understanding of connector configuration files, see "Configuring Connectors" in the *Integrator's Guide*.

`samples/sync-with-csv/conf/sync.json`

This file, also called a *mapping file*, defines the configuration for reconciliation and synchronization. This sample file includes only one mapping - `systemCsvfileAccounts_managedUser`. The mapping specifies the synchronization configuration between the CSV file (source) and the IDM repository (target). Examine the file to see how objects are mapped between the two resources, and the actions that IDM should take when it finds objects in specific situations:

```
{
    "mappings": [
        {
            "name" : "systemCsvfileAccounts_managedUser",
            "source" : "system/csvfile/account",
            "target": "managed/user",
            "correlationQuery": {
                "type": "text/javascript",
                "source": "var query = {'_queryId' : 'for-userName',
                    'uid' :  source.name};query;"
            },
            "properties": [
                {
                    "source": "email",
                    "target": "mail"
                },
                {
                    "source": "firstname",
                    "target": "givenName"
                },
                {
                    "source": "lastname",
                    "target": "sn"
                },
                {
                    "source": "description",
                    "target": "description"
                },
                {
                    "source": "_id",
                    "target": "_id"
                },
                {
                    "source": "name",
                    "target": "userName"
                },
                {
                    "source": "password",
                    "target": "password"
```

```
                },
                {
                    "source" : "mobileTelephoneNumber",
                    "target" : "telephoneNumber"
                },
                {
                    "source" : "roles",
                    "transform" : {
                        "type" : "text/javascript",
                        "source" : "var _ = require('lib/lodash'); _.map(source.split(','),
                         function(role) { return {'_ref': 'repo/internal/role/' + role} });"
                    },
                    "target" : "authzRoles"
                }
            ],
            "policies": [
                {
                    "situation": "CONFIRMED",
                    "action": "UPDATE"
                },
                {
                    "situation": "FOUND",
                    "action": "IGNORE"
                },
                {
                    "situation": "ABSENT",
                    "action": "CREATE"
                },
                {
                    "situation": "AMBIGUOUS",
                    "action": "IGNORE"
                },
                {
                    "situation": "MISSING",
                    "action": "IGNORE"
                },
                {
                    "situation": "SOURCE_MISSING",
                    "action": "IGNORE"
                },
                {
                    "situation": "UNQUALIFIED",
                    "action": "IGNORE"
                },
                {
                    "situation": "UNASSIGNED",
                    "action": "IGNORE"
                }
            ]
        }
    ]
}
```

Source and target paths that start with `managed`, such as `managed/user`, always refer to objects in the IDM repository. Paths that start with `system`, such as `system/csvfile/account`, refer to external objects, in this case, objects in the CSV file.

When you start a reconciliation, IDM queries all users in the source, and then creates, deletes, or modifies users in the IDM repository, as mapped in `conf/sync.json`.

For more information about synchronization, reconciliation, and the `sync.json` file, see "*Synchronizing Data Between Resources*" in the *Integrator's Guide*.

`samples/sync-with-csv/conf/schedule-reconcile_systemCsvAccounts_managedUser.json`

The sample schedule configuration file defines a task that launches a reconciliation every minute for the mapping named `systemCsvfileAccounts_managedUser`. The schedule is disabled by default:

```
{
    "enabled" : false,
    "type": "simple",
    "repeatInterval": 3600000,
    "persisted" : true,
    "concurrentExecution" : false,
    "misfirePolicy" : "fireAndProceed",
    "invokeService" : "sync",
    "invokeContext" : {
        "action" : "reconcile",
        "mapping" : "systemCsvfileAccounts_managedUser"
    }
}
```

IDM regularly scans the `conf/` directory for any schedule configuration files. For information about the schedule configuration, see "*Scheduling Tasks and Events*" in the *Integrator's Guide*.

Apart from the scheduled reconciliation run, you can also start reconciliation run through the REST interface. The call to the REST interface is an HTTP POST such as the following:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemCsvfileAccounts_managedUser&waitForCompletion=true"
```

The `waitForCompletion=true` parameter specifies that the operation should return only when it has completed.

`samples/sync-with-csv/data/csvConnectorData.csv`

This CSV file is the external resource or data store in this sample. The file contains two users, bjensen and scarter. During the sample, you will reconcile those users *from* the CSV file *to* the managed user repository.

2.2. Running the Sample

To run this sample, start IDM with the configuration for the sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-csv
```

You can work through the sample using the command line, or using the Admin UI. This section provides instructions for both methods.

2.2.1. Running the Sample by Using the Command Line

1. When you have started IDM, reconcile the objects in both resources.

   You can trigger the reconciliation either by setting `"enabled" : true` in the schedule configuration file (`conf/schedule-reconcile_systemCsvAccounts_managedUser.json`) and then waiting until the scheduled reconciliation happens, or by running the following **curl** command:

   ```
   $ curl \
    --header "X-OpenIDM-Username: openidm-admin" \
    --header "X-OpenIDM-Password: openidm-admin" \
    --request POST \
    "http://localhost:8080/openidm/recon?
   _action=recon&mapping=systemCsvfileAccounts_managedUser&waitForCompletion=true"
   ```

   Successful reconciliation returns a reconciliation run ID, and the status of the reconciliation operation, as follows:

   ```
   {
     "_id":"2d87c817-3d00-4776-a705-7de2c65937d8",
     "state":"SUCCESS"
   }
   ```

2. Display the managed user records that were created by the reconciliation operation.

   You can use any REST client to query the repository. Perform an HTTP GET on the URL `http://localhost:8080/openidm/managed/user?_queryId=query-all-ids` with the headers `"X-OpenIDM-Username: openidm-admin"` and `"X-OpenIDM-Password: openidm-admin"`. The following example uses the **curl** command to obtain the managed user records, in JSON format:

   ```
   $ curl \
    --header "X-OpenIDM-Username: openidm-admin" \
    --header "X-OpenIDM-Password: openidm-admin" \
    --request GET \
    "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"

      {
     "result": [
       {
         "_id": "bjensen",
         "_rev": "00000000a059dc9f"
       },
       {
         "_id": "scarter",
         "_rev": "00000000d84ade1c"
       }
     ]
   ,
   ...
   }
   ```

In addition to querying the users by their ID, you can user any arbitrary query filter to return the information you need. For more information, see "Defining and Calling Queries" in the *Integrator's Guide*.

3. Now display user bjensen's record by appending her user ID to the URL:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/bjensen"
  {
  "_id": "bjensen",
  "_rev": "00000000a059dc9f"
  "mail": "bjensen@example.com",
  "givenName": "Barbara",
  "sn": "Jensen",
  "description": "Created By CSV",
  "userName": "bjensen",
  "telephoneNumber": "1234567",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

This command returns bjensen's complete user record. If you need this level of information for all users, you can use the predefined query `query-all` instead of `query-all-ids`.

4. You restrict the query output with the `fields` parameter, as follows:

```
$ curl \
   --header "X-OpenIDM-Username: openidm-admin" \
   --header "X-OpenIDM-Password: openidm-admin" \
   --request GET \
   "http://localhost:8080/openidm/managed/user?_queryFilter=true&_fields=userName,mail"

   {
  "result": [
    {
      "_id": "scarter",
      "_rev": "00000000d84ade1c"
      "userName": "scarter",
      "mail": "scarter@example.com"
    },
    {
      "_id": "bjensen",
      "_rev": "00000000a059dc9f"
      "userName": "bjensen",
      "mail": "bjensen@example.com"
    }
  ],
  ...
}
```

5. To test the scheduled reconciliation, add a user to the CSV data file, `samples/sync-with-csv/data/csvConnectorData.csv`. For example, add user jberg as follows:

```
"description", "uid",     "username",            "firstname", "lastname", "email",
 "mobile...
"Created ...", "bjensen", "bjensen@example.com", "Barbara",   "Jensen",   "bjensen@example.com",
 "123456...
"Created ...", "scarter", "scarter@example.com", "Steven",    "Carter",   "scarter@example.com",
 "123456...
"Created ...", "jberg",   "jberg@example.com",   "James",     "Berg",     "jberg@example.com",
 "123456...
```

6. If you enabled the scheduled reconciliation in Step 1, you can simply wait for the reconciliation operation to run. Otherwise, run the reconciliation manually with the same command you used in that step.

7. After the reconciliation has run, query the local repository to see the new user in the list of managed users:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "bjensen",
      "_rev": "00000000792afa08"
    },
    {
      "_id": "scarter",
      "_rev": "000000004121fb7e"
    },
    {
      "_id": "jberg",
      "_rev": "000000001298f6a6"
    }
  ],
  ...
}
```

8. You can see what happened in this sample by looking at the JSON format audit logs in the `openidm/audit` directory:

```
$ ls /path/to/openidm/audit/
access.audit.json  authentication.audit.json recon.audit.json
activity.audit.json  config.audit.json  sync.audit.json
```

For more information about the contents of each of these files, see "Logging Audit Events" in the *Integrator's Guide*.

To see what happened during the reconciliation operation, look at the reconciliation audit log, `openidm/audit/recon.audit.json`. The following sample excerpt shows what happened during the second reconciliation run:

```
{
    "transactionId":"846b36f7-f4ce-4e50-a3dc-464f6c5340d4-273",
    "timestamp":"2017-02-06T13:20:03.983Z",
    "eventName":"recon",
    "userId":"openidm-admin",
    "action":"CREATE",
    "exception":null,
    "linkQualifier":"default",
    "mapping":"systemCsvfileAccounts_managedUser",
    "message":null,
    "situation":"ABSENT",
    "sourceObjectId":"system/csvfile/account/jberg",
    "status":"SUCCESS",
    "targetObjectId":"managed/user/jberg",
    "reconciling":"source",
    "ambiguousTargetObjectIds":"",
    "entryType":"entry",
    "reconId":"846b36f7-f4ce-4e50-a3dc-464f6c5340d4-273",
    "_id":"846b36f7-f4ce-4e50-a3dc-464f6c5340d4-284"
}
```


The relevant properties in this audit log are: `action`, `situation`, `sourceObjectId`, and `targetObjectId`. For each object in the source resource, reconciliation leads to an action on the target resource.

You configure the action that IDM takes for each situation in the mapping file, `conf/sync.json`. For the list of all possible situations and actions, see "Synchronization Situations and Actions" in the *Integrator's Guide*.

2.2.2. Running the Sample in the Administrative User Interface

IDM includes a web-based Administrative User Interface, known as the Admin UI. For details, see "Configuring the Server from the Admin UI" in the *Integrator's Guide*.

After starting IDM, access the Admin UI by navigating to `https://localhost:8443/admin`. The first time you log in, use the default administrative credentials, (Login: openidm-admin, Password: openidm-admin).

Warning

To protect your deployment in production, change the default administrative password. To do so, navigate to the Self-Service UI at `https://localhost:8443/` and click Change Password.

You should now see the Dashboard screen, with quick start cards for common administrative tasks. with the connectors and managed objects associated with that configuration.

1. Reconcile the two resources as follows:

   Click Configure > Mappings, select the `systemCsvfileAccounts_managedUser` mapping, and click Reconcile.

2. After reconciliation, display the user records in both the source and target resources.

Select the Association tab and scroll down to the bottom of the page to see the resulting source and target users.

Chapter 3

One Way Synchronization From LDAP to IDM

This sample demonstrates one-way synchronization from an LDAP directory to an IDM repository. The sample shows how IDM can pick up new or changed objects from an external resource.

The sample has been tested with ForgeRock Directory Services (DS) but should work with any LDAPv3-compliant server. The configuration includes one mapping, from the LDAP resource to the IDM repository. The sample does not push any changes made to IDM managed user objects out to the LDAP server.

3.1. LDAP Server Configuration

This sample expects the following configuration for the LDAP server:

- The LDAP server runs on the local host.
- The LDAP server listens on port 1389.
- A user with DN `cn=Directory Manager` and password `password` has read access to the LDAP server.
- Directory data for that server is stored under base DN `dc=example,dc=com`.
- User objects for that server are stored under base DN `ou=People,dc=example,dc=com`.
- User objects have the object class `inetOrgPerson`.
- User objects have the following attributes:
  - `cn`
  - `description`
  - `givenName`
  - `mail`
  - `sn`
  - `telephoneNumber`
  - `uid`

- `userPassword`

An example user object follows.

```
dn: uid=bjensen,ou=People,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
objectClass: top
givenName: Barbara
uid: bjensen
cn: Barbara Jensen
telephoneNumber: 1-360-229-7105
sn: Jensen
mail: bjensen@example.com
description: Created for OpenIDM
userPassword: password
```

- The LDIF data for this sample is provided in the file `openidm/samples/sync-with-ldap/data/Example.ldif`. You can import this data during your DS setup.

The following steps provide setup instructions for DS 6.0. Adjust these instructions if you are using an older version of DS, or an alternative LDAP server.

1. Download DS from ForgeRock's BackStage site and extract the zip archive.

2. Set up DS and import the `Example.ldif` file for this sample:

```
$ cd /path/to/opendj
$ ./setup \
 directory-server \
 --rootUserDN "cn=Directory Manager" \
 --rootUserPassword password \
 --hostname localhost \
 --ldapPort 1389 \
 --adminConnectorPort 4444 \
 --baseDN dc=com \
 --ldifFile /path/to/openidm/samples/sync-with-ldap/data/Example.ldif \
 --acceptLicense
Validating parameters .....Done.
Configuring Certificates .....Done.
Configuring server .....Done.
Importing data from /path/to/openidm/samples/sync-with-ldap/data/Example.ldif ........Done.
Starting Directory Server ............Done.

To see basic server status and configuration, you can launch /path/to/opendj/bin/status
```

3.2. Running the Sample

In this section, you will start IDM and reconcile the repository. The mapping configuration file (`sync.json`) for this sample includes one mapping, `systemLdapAccounts_managedUser`, which synchronize users from the source LDAP server with the target IDM repository.

Before you start, prepare IDM as described in "Preparing IDM", then start the server with the configuration for the sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-ldap
```

You can work through the sample using the command line, or using the Admin UI. This section provides instructions for both methods.

3.2.1. Running the Sample by Using the Command Line

1. Reconcile the repository by running the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemLdapAccounts_managedUser&waitForCompletion=true"
{
  "_id": "b1394d10-29b0-4ccf-81d8-c88948ea121c-4",
  "state": "SUCCESS"
}
```

   The reconciliation operation creates the two users from the LDAP server in the IDM repository, assigning the new objects random unique IDs.

2. Retrieve the users from the repository by querying their IDs as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "53b0bca5-ada4-4b4b-a224-f389b15cfee0",
      "_rev": "00000000792afa08"
    },
    {
      "_id": "a09139f1-fb51-4c32-83c5-d74b57644cce",
      "_rev": "000000004121fb7e"
    }
  ]
,
...
}
```

3. Retrieve the individual user objects by including their ID in the URL, for example:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/53b0bca5-ada4-4b4b-a224-f389b15cfee0"
{
  "_id": "53b0bca5-ada4-4b4b-a224-f389b15cfee0",
  "_rev": "00000000c7554e13",
  "displayName": "Barbara Jensen",
  "description": "Created for OpenIDM",
  "givenName": "Barbara",
  "mail": "bjensen@example.com",
  "sn": "Jensen",
  "telephoneNumber": "1-360-229-7105",
  "userName": "bjensen",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

3.2.2. Running the Sample by Using the Admin UI

1. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

   Warning

   To protect your deployment in production, change the default administrative password. To do so, navigate to the Self-Service UI at `https://localhost:8443/` and click Change Password.

2. Click Configure > Mappings.

   This page shows one mapping, from the `ldap` server to the IDM repository (`managed/user`).

3. Select the mapping, then select Reconcile.

   The reconciliation operation creates the two users from the LDAP server in the IDM repository.

4. Retrieve the users in the repository. Click Manage > User.

   You should now see two users from the LDAP server, reconciled to the IDM repository.

5. When you click a username, you can view the details of that user account.

Chapter 4

Two Way Synchronization Between LDAP and IDM

This sample demonstrates bidirectional synchronization between an LDAP directory and an IDM repository.

The sample has been tested with ForgeRock Directory Services, but should work with any LDAPv3-compliant server. The configuration includes two mappings, one from the LDAP resource to the IDM repository, and one from IDM to LDAP.

The LDIF data for this sample is provided in the file `openidm/samples/sync-with-ldap-bidirectional/data/Example.ldif`. Before you start, configure the LDAP server as shown in "LDAP Server Configuration", but import the LDIF file that is specific to this sample during the setup. The LDAP user must have write access to create users from IDM on the LDAP server.

4.1. Running the Sample

In this section, you will start IDM and reconcile the two data sources. The mapping configuration file (`sync.json`) for this sample includes two mappings, `systemLdapAccounts_managedUser`, which synchronizes users from the source LDAP server with the target repository, and `managedUser_systemLdapAccounts`, which synchronizes changes from the repository to the LDAP server.

Before you start, prepare IDM as described in "Preparing IDM", then start the server with the configuration for the sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-ldap-bidirectional
```

You can work through the sample using the command line, or using the Admin UI. This section provides instructions for both methods.

4.1.1. Running the Sample by Using the Command Line

1. Reconcile the repository over the REST interface by running the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemLdapAccounts_managedUser&waitForCompletion=true"
{
  "state": "SUCCESS",
  "_id": "027e25e3-7a33-4858-9080-161c2b40a6bf-2"
}
```

The reconciliation operation returns a reconciliation run ID and the status of the operation. Reconciliation creates user objects from LDAP in the IDM repository, assigning the new objects random unique IDs.

2. To retrieve the users from the repository, query their IDs as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "d460ed00-74f9-48fb-8cc1-7829be60ddac",
      "_rev": "00000000792afa08"
    },
    {
      "_id": "74fe2d25-4eb1-4148-a3ae-ff80f194b3a6",
      "_rev": "00000000a92657c7"
    }
  ]
,
...
}
```

3. To retrieve individual user objects, include the ID in the URL, for example:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/d460ed00-74f9-48fb-8cc1-7829be60ddac"
{
  "_id": "d460ed00-74f9-48fb-8cc1-7829be60ddac",
  "_rev": "00000000792afa08",
  "displayName": "Barbara Jensen",
  "description": "Created for OpenIDM",
  "givenName": "Barbara",
  "mail": "bjensen@example.com",
  "telephoneNumber": "1-360-229-7105",
  "sn": "Jensen",
  "userName": "bjensen",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

4. Test the second mapping by creating a user in the IDM repository:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
    "mail":"fdoe@example.com",
    "sn":"Doe",
    "telephoneNumber":"555-1234",
    "userName":"fdoe",
    "givenName":"Felicitas",
    "description":"Felicitas Doe",
    "displayName":"fdoe"}' \
 "http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id": "90d1f388-d8c3-4438-893c-be4e498e7a1c",
  "_rev": "00000000792afa08",
  "mail": "fdoe@example.com",
  "sn": "Doe",
  "telephoneNumber": "555-1234",
  "userName": "fdoe",
  "givenName": "Felicitas",
  "description": "Felicitas Doe",
  "displayName": "fdoe",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

5. By default, *implicit synchronization* is enabled for mappings *from* the `managed/user` repository *to* any external resource. This means that when you update a managed object, any mappings defined in the `sync.json` file that have the managed object as the source are automatically executed to update the target system. For more information, see "Mapping Source Objects to Target Objects" in the *Integrator's Guide*.

Test that the implicit synchronization has been successful by querying the users in the LDAP directory over REST, as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "0da50512-79bb-3461-bd04-241ee4c785bf",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com"
    },
    {
      "_id": "887732e8-3db2-31bb-b329-20cd6fcecc05",
      "dn": "uid=bjensen,ou=People,dc=example,dc=com"
    },
    {
      "_id": "2f03e095-ec81-4eb5-9201-a4df2f1f9add",
      "dn": "uid=fdoe,ou=People,dc=example,dc=com"
    }
  ]
,
...
}
```

Note the new entry for user `fdoe`.

6. Query the complete entry by including `fdoe`'s LDAP ID in the URL.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account/2f03e095-ec81-4eb5-9201-a4df2f1f9add"
{
  "_id": "2f03e095-ec81-4eb5-9201-a4df2f1f9add",
  "telephoneNumber": "555-1234",
  "aliasList": [],
  "description": "Felicitas Doe",
  "uid": "fdoe",
  "dn": "uid=fdoe,ou=People,dc=example,dc=com",
  "cn": "fdoe",
  "givenName": "Felicitas",
  "employeeType": [],
  "mail": "fdoe@example.com",
  "objectClass": [
    "top",
    "inetOrgPerson",
    "organizationalPerson",
    "person"
  ],
  "sn": "Doe",
  "kbaInfo": [],
  "ldapGroups": []
}
```

4.1.2. Running the Sample by Using the Admin UI

1. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

   Warning

   To protect your deployment in production, change the default administrative password. To do so, navigate to the Self-Service UI at `https://localhost:8443/` and click Change Password.

2. Click Configure > Mappings.

   This tab shows two configured mappings, one from the `ldap` server to the IDM repository (`managed/user`) and one from the repository to the `ldap` server.

3. On the first mapping (LDAP to managed user), click Reconcile.

   The reconciliation operation creates the two users from the LDAP server in the IDM repository.

4. Retrieve the users in the repository. Click Manage > User.

5. You should see two users from the LDAP server, reconciled to the repository.

6. To retrieve the details of a specific user, click that username in the User List page.

7. Add a new user in the repository by clicking New User in the User List page.

   Complete the user details and click Save.

8. By default, *implicit synchronization* is enabled for mappings *from* the `managed/user` repository *to* any external resource. This means that when you update a managed object, any mappings defined in the `sync.json` file that have the managed object as the source are automatically executed to update the target system. For more information, see "Mapping Source Objects to Target Objects" in the *Integrator's Guide*.

   To test that the implicit synchronization has been successful, select Manage > User and select the record of the new user you created in the previous step.

   Select the Linked Systems tab. The information under this tab includes the external resource to which this user entry is mapped.

Chapter 5
Synchronizing LDAP Groups

This sample demonstrates synchronization between an LDAP directory and an IDM repository, with a focus on synchronizing LDAP group objects (rather than LDAP group membership, demonstrated in "*Synchronizing LDAP Group Membership*").

The sample has been tested with ForgeRock Directory Services (DS) but should work with any LDAPv3-compliant server. The sample includes mappings from the LDAP server to the IDM repository, and from the IDM repository to the LDAP server. During the reconciliation, user entries and group entries are synchronized.

The LDIF data for this sample is provided in the file `openidm/samples/sync-with-ldap-groups/data/Example.ldif`.

Before you start, configure the LDAP server as shown in "LDAP Server Configuration", but import the LDIF file that is specific to this sample during the setup. This file includes a number of LDAP groups, including the following:

```
dn: ou=Groups,dc=example,dc=com
ou: Groups
objectClass: organizationalUnit
objectClass: top

dn: cn=openidm,ou=Groups,dc=example,dc=com
uniqueMember: uid=jdoe,ou=People,dc=example,dc=com
cn: openidm
objectClass: groupOfUniqueNames
objectClass: top

dn: cn=openidm2,ou=Groups,dc=example,dc=com
uniqueMember: uid=bjensen,ou=People,dc=example,dc=com
cn: openidm2
objectClass: groupOfUniqueNames
objectClass: top
```

The user with dn `uid=jdoe,ou=People,dc=example,dc=com` is also imported with the `Example.ldif` file.

There is an additional user, `bjensen` in the sample LDIF file. This user is essentially a "dummy" user, provided for compliance with RFC 4519, which stipulates that every `groupOfUniqueNames` object must contain at least one `uniqueMember`. `bjensen` is not actually used in this sample.

5.1. Running the Sample

In this section, you will start IDM and reconcile the repository. The mapping configuration file (`sync.json`) for this sample includes three mappings:

`systemLdapAccounts_managedUser`

Synchronizes users from the source LDAP server with the target IDM repository.

`managedUser_systemLdapAccounts`

Synchronizes users from the IDM repository to the LDAP server.

`systemLdapGroups_managedGroup`

Synchronizes groups from the source LDAP server with the target IDM repository.

Due to the similarity with the previous two samples described in this guide, this sample focuses only on the groups mapping, `systemLdapGroups_managedGroup`.

Before you start, prepare IDM as described in "Preparing IDM", then start the server with the configuration for the sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-ldap-groups
```

You can work through the sample using the command line, or using the Admin UI. This section provides instructions for both methods.

5.1.1. Running the Sample by Using the Command Line

1. Reconcile the group objects over the REST by running the following command:

```
$  curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemLdapGroups_managedGroup&waitForCompletion=true"
```

   The reconciliation operation returns a reconciliation run ID, and the status of the operation.

2. The reconciliation creates managed group objects for each group that exists in DS. To list the managed groups, run the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/group?_queryFilter=true"
```

   The resulting JSON object should include content similar to the following.

```
{
  "result": [
    {
      "_id": "b6c4d7ce-2103-42c2-b5f2-74ca9309ad37",
      "_rev": "0000000001298f6a6",
      "dn": "cn=Contractors,ou=Groups,dc=example,dc=com",
      "description": null,
      "uniqueMember": [],
      "name": "Contractors"
    },
    {
      "_id": "2326b9ee-6975-4c19-aa3c-d228afc4ff71",
      "_rev": "00000000dc6160c8",
      "dn": "cn=openidm2,ou=Groups,dc=example,dc=com",
      "description": null,
      "uniqueMember": [
        "uid=bjensen,ou=People,dc=example,dc=com"
      ],
      "name": "openidm2"
    },
    {
      "_id": "035f6444-bce3-4931-96b7-e10b2301fe74",
      "_rev": "000000004cab60c8",
      "dn": "cn=Employees,ou=Groups,dc=example,dc=com",
      "description": null,
      "uniqueMember": [],
      "name": "Employees"
    },
    {
      "_id": "65c8fb86-01e6-4fca-9237-e50c251f4575",
      "_rev": "0000000050c62938",
      "dn": "cn=Chat Users,ou=Groups,dc=example,dc=com",
      "description": null,
      "uniqueMember": [],
      "name": "Chat Users"
    },
    {
      "_id": "5c3e4965-16d7-4a8f-af73-3ab165b66cf9",
      "_rev": "000000004121fb7e",
      "dn": "cn=openidm,ou=Groups,dc=example,dc=com",
      "description": null,
      "uniqueMember": [
        "uid=jdoe,ou=People,dc=example,dc=com"
      ],
      "name": "openidm"
    }
  ],
  ...
}
```


5.1.2. Running the Sample by Using the Admin UI

1. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

Warning

To protect your deployment in production, change the default administrative password. To do so, navigate to the Self-Service UI at `https://localhost:8443/` and click Change Password.

2. Click Configure > Mappings.

   This page shows three configured mappings, from the `ldap` server user accounts to the IDM repository (`managed/user`), from the IDM repository back to the `ldap` server, and from the `ldap` server group entries to the IDM `managed/group` repository.

3. On the third mapping (LDAP groups to managed groups), click Reconcile.

   The reconciliation operation creates the two groups from the LDAP server in the IDM repository.

4. Select Manage > Group to see the five groups from the LDAP server (source) that have been reconciled to the IDM repository (target).

Chapter 6

Synchronizing LDAP Group Membership

This sample demonstrates synchronization between an LDAP directory and an IDM repository, with a focus on synchronizing LDAP group membership, that is, how the value of the `ldapGroups` property in a managed user object is mapped to the corresponding user object in LDAP.

The sample has been tested with ForgeRock Directory Services (DS) but should work with any LDAPv3-compliant server. The sample includes mappings from the LDAP server to the IDM repository, and from the IDM repository to the LDAP server. During the reconciliation, memberships are synchronized, in addition to user entries.

The LDIF data for this sample is provided in the file `openidm/samples/sync-with-ldap-group-membership/data/Example.ldif`.

Before you start, configure the LDAP server as shown in "LDAP Server Configuration", but import the LDIF file that is specific to this sample during the setup. This file includes a number of LDAP groups, including the following:

```
dn: ou=Groups,dc=example,dc=com
ou: Groups
objectClass: organizationalUnit
objectClass: top

dn: cn=openidm,ou=Groups,dc=example,dc=com
uniqueMember: uid=jdoe,ou=People,dc=example,dc=com
cn: openidm
objectClass: groupOfUniqueNames
objectClass: top

dn: cn=openidm2,ou=Groups,dc=example,dc=com
uniqueMember: uid=bjensen,ou=People,dc=example,dc=com
cn: openidm2
objectClass: groupOfUniqueNames
objectClass: top
```

The users with DNs `uid=jdoe,ou=People,dc=example,dc=com` and `uid=bjensen,ou=People,dc=example,dc=com` are also imported with the `Example.ldif` file.

6.1. Running the Sample

In this section, you will start IDM and reconcile the repository. Before you start, prepare IDM as described in "Preparing IDM", then start the server with the configuration for the sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-ldap-group-membership
```

You can work through the sample using the command line, or using the Admin UI. This section provides instructions for both methods.

6.1.1. Running the Sample by Using the Command Line

1. Reconcile the repository over the REST interface by running the following command:

```
$ curl \
  --header "X-OpenIDM-Username: openidm-admin" \
  --header "X-OpenIDM-Password: openidm-admin" \
  --request POST \
  "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemLdapAccounts_managedUser&waitForCompletion=true"
 {
   "_id": "6652c292-5309-40e5-b272-b74d67dd95c9-4",
   "state": "SUCCESS"
 }
```

   The reconciliation operation returns a reconciliation run ID and the status of the operation. Reconciliation creates user objects from LDAP in the IDM repository, assigning the new objects random unique IDs.

2. To retrieve the users from the repository, query their IDs as follows:

```
$ curl \
  --header "X-OpenIDM-Username: openidm-admin" \
  --header "X-OpenIDM-Password: openidm-admin" \
  --request GET \
  "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
 {
   "result": [
     {
       "_id": "b63fb9a7-99bc-4eb4-8bfd-15f14a756e5b",
       "_rev": "00000000792afa08"
     },
     {
       "_id": "8462fe0c-2ab2-459a-a25e-474474889c9e",
       "_rev": "000000004121fb7e"
     }
   ],
 ...
 }
```

3. To retrieve individual user objects, include the ID in the URL. The following request retrieves the user object for John Doe:

```
$ curl \
  --header "X-OpenIDM-Username: openidm-admin" \
  --header "X-OpenIDM-Password: openidm-admin" \
  --request GET \
  "http://localhost:8080/openidm/managed/user/8462fe0c-2ab2-459a-a25e-474474889c9e"
 {
   "_id": "8462fe0c-2ab2-459a-a25e-474474889c9e",
   "_rev": "000000004121fb7e",
   "displayName": "John Doe",
   "description": "Created for OpenIDM",
   "givenName": "John",
   "mail": "jdoe@example.com",
   "telephoneNumber": "1-415-599-1100",
   "sn": "Doe",
   "userName": "jdoe",
   "ldapGroups": [
     "cn=openidm,ou=Groups,dc=example,dc=com"
   ],
   "accountStatus": "active",
   "effectiveRoles": [],
   "effectiveAssignments": []
 }
```

Note that John Doe's user object contains an `ldapGroups` property, the value of which indicates his groups on the LDAP server:

```
"ldapGroups":["cn=openidm,ou=Groups,dc=example,dc=com"]
```

4. Update John Doe's `ldapGroups` property, to change his membership from the `openidm` group to the `openidm2` group.

```
$ curl \
  --header "X-OpenIDM-Username: openidm-admin" \
  --header "X-OpenIDM-Password: openidm-admin" \
  --header "Content-Type: application/json" \
  --request POST \
  --data '[
     {
       "operation":"replace",
       "field":"/ldapGroups",
       "value": ["cn=openidm2,ou=Groups,dc=example,dc=com"]
     }
  ]' \
  "http://localhost:8080/openidm/managed/user?_action=patch&_queryId=for-userName&uid=jdoe"
 {
   "displayName": "John Doe",
   "description": "Created for OpenIDM",
   "givenName": "John",
   "mail": "jdoe@example.com",
   "telephoneNumber": "1-415-599-1100",
   "sn": "Doe",
   "userName": "jdoe",
   "accountStatus": "active",
   "effectiveRoles": [],
   "effectiveAssignments": [],
   "_id": "8462fe0c-2ab2-459a-a25e-474474889c9e",
   "_rev": "0000000050c62938",
   "ldapGroups": [
     "cn=openidm2,ou=Groups,dc=example,dc=com"
   ]
 }
```

This command changes John Doe's `ldapGroups` property in the IDM repository, from `"cn=openidm ,ou=Groups,dc=example,dc=com"` to `"cn=openidm2,ou=Groups,dc=example,dc=com"`. As a result of implicit synchronization, the change is propagated to the LDAP server. John Doe is removed from the first LDAP group and added to the second LDAP group in DS.

5. You can verify this change by querying John Doe's record on the LDAP server, as follows:

```
$ curl \
  --header "X-OpenIDM-Username: openidm-admin" \
  --header "X-OpenIDM-Password: openidm-admin" \
  --request GET \
  "http://localhost:8080/openidm/system/ldap/account/?_queryFilter=uid+eq+'jdoe'"
 {
  "result": [
    {
      "_id": "0da50512-79bb-3461-bd04-241ee4c785bf",
      "sn": "Doe",
      "description": "Created for OpenIDM",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com",
      "ldapGroups": [
        "cn=openidm2,ou=Groups,dc=example,dc=com"
      ],
      "cn": "John Doe",
      "aliasList": [],
      "givenName": "John",
      "kbaInfo": [],
```

```
      "objectClass": [
        "top",
        "inetOrgPerson",
        "organizationalPerson",
        "person"
      ],
      "mail": "jdoe@example.com",
      "uid": "jdoe",
      "employeeType": [],
      "telephoneNumber": "1-415-599-1100"
    }
  ],
  ...
}
```

6.1.2. Running the Sample by Using the Admin UI

1. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

   Warning

   To protect your deployment in production, change the default administrative password. To do so, navigate to the Self-Service UI at `https://localhost:8443/` and click Change Password.

2. Click Configure > Mappings.

   This window shows two configured mappings, one from the LDAP server to the IDM repository (`managed/user`) and one from the IDM repository to the LDAP server.

3. On the first mapping (LDAP to managed user), click Reconcile.

   The reconciliation operation creates the two users from the LDAP server in the IDM repository.

4. Select Manage > User. Examine the users reconciled from the LDAP server to the internal repository.

5. To retrieve the details of a specific user, click that username. In this case, click on user `jdoe` and examine the information stored for this user.

6. Select the Linked Systems tab.

   The Linked Resource item indicates the external resource to which John Doe's managed object is mapped, in this case, `ldap/account`.

   In this linked resource, John Doe's `ldapGroups` are displayed. Currently, John Doe is a member of `cn=openidm,ou=Groups,dc=example,dc=com`.

7. Update John Doe's `ldapGroups` property to change his membership from the `openidm` group to the `openidm2` group. Currently, you can only do this over the REST interface, as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '[
    {
      "operation":"replace",
      "field":"/ldapGroups",
      "value": ["cn=openidm2,ou=Groups,dc=example,dc=com"]
    }
 ]' \
 "http://localhost:8080/openidm/managed/user?_action=patch&_queryId=for-userName&uid=jdoe"
{
  "displayName": "John Doe",
  "description": "Created for OpenIDM",
  "givenName": "John",
  "mail": "jdoe@example.com",
  "telephoneNumber": "1-415-599-1100",
  "sn": "Doe",
  "userName": "jdoe",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": [],
  "_id": "8462fe0c-2ab2-459a-a25e-474474889c9e",
  "_rev": "0000000050c62938",
  "ldapGroups": [
    "cn=openidm2,ou=Groups,dc=example,dc=com"
  ]
}
```

This command changes John Doe's `ldapGroups` property in the IDM repository, from `"cn=openidm,ou=Groups,dc=example,dc=com"` to `"cn=openidm2,ou=Groups,dc=example,dc=com"`. As a result of implicit synchronization, the change is propagated to the LDAP server. John Doe is removed from the first LDAP group and added to the second LDAP group in DS.

8. You can verify this change by reloading John Doe's user information, selecting Linked Systems, and examining the value of his `ldapGroups` property.

Chapter 7

Synchronizing Data Between Two External Resources

This sample demonstrates synchronization between two external resources, routed through the IDM repository.

The resources are named `LDAP` and `AD` and represent two separate LDAP directories. In the sample both resources are simulated with simple CSV files.

The sample also demonstrates the (optional) configuration of an outbound email service. You can set up outbound email if you want to receive emailed reconciliation summaries.

7.1. Configuring Email for the Sample

If you do not configure the email service, the functionality of the sample does not change. However, you might see the following message in the OSGi console when you run a reconciliation operation:

```
Email service not configured; report not generated.
```

To configure IDM to send a reconciliation summary by email, follow these steps:

1. Copy the `external.email.json` file from the `samples/example-configurations/conf/` directory to the `conf/` directory of this sample:

   ```
   $ cd /path/to/openidm
   $ cp samples/example-configurations/conf/external.email.json samples/sync-two-external-resources/conf
   ```

2. Edit the `external.email.json` file for outbound email, as described in "To Set Up Outbound Email" in the *Integrator's Guide*.

3. In the `samples/sync-two-external-resources/script` directory, edit the `reconStats.js` script to reflect the correct email details.

   Near the start of the file, locate the `var email` variable and update the values as required:

```
var email = {
      //UPDATE THESE VALUES
      from : "openidm@example.com",
      to : "youremail@example.com",
      cc : "idmadmin2@example.com,idmadmin3@example.com",
      subject : "Recon stats for " + global.mappingName,
      type : "text/html"
},
template,
...
```

7.2. Running the Sample

No external configuration is required for this sample. Before you start, prepare IDM as described in "Preparing IDM".

1. Start the server with the configuration of this sample:

   ```
   $ cd /path/to/openidm
        $ ./startup.sh -p samples/sync-two-external-resources
   ```

2. Examine the data files.

   The CSV files that simulate the two LDAP resources are located in the `openidm/samples/sync-two-external-resources/data/` directory. Look at the contents of these files. Initially, the `csvConnectorLDAPData.csv` file contains one user and the `csvConnectorADData.csv` file contains no users.

3. Run a reconciliation operation to synchronize the contents of the simulated LDAP resource with the IDM repository.

   You can run the reconciliation in the Admin UI (Configure > Mappings, click `systemLdapAccounts_managedUser`, then click Reconcile) or over the command-line as follows:

   ```
   $ curl \
    --header "X-OpenIDM-Username: openidm-admin" \
    --header "X-OpenIDM-Password: openidm-admin" \
    --request POST \
    "http://localhost:8080/openidm/recon?
   _action=recon&mapping=systemLdapAccounts_managedUser&waitForCompletion=true"
   ```

   The reconciliation creates a managed user in the IDM repository. You do not need to run a second reconciliation to synchronize the AD resource. Implicit synchronization propagates any change made to managed users in the repository to the simulated AD resource.

   For more information about implicit synchronization, see "Types of Synchronization" in the *Integrator's Guide*.

4. Review the contents of the simulated AD resource (`csvConnectorADData.csv`):

```
$ more openidm/samples/sync-two-external-resources/data/csvConnectorADData.csv
"uid", "username", "password",        "firstname", "description", "email",              "lastname"
"1",             , "initial_Passw0rd","Barbara",                , "bjensen@example.com","Jensen"
```

This file should now contain the same user that was present in the `csvConnectorLDAPData.csv` file.

Alternatively, you can list users in the AD resource with the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ad/account?_queryId=query-all-ids"
   {
  "result": [
    {
      "_id": "1",
      "name": "1"
    }
  ],
  ...
}
```

5. Use the `_id` of the user to read the complete user record from the AD resource:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ad/account/1"
{
  "_id": "1",
  "firstname": "Barbara",
  "lastname": "Jensen",
  "email": [
    "bjensen@example.com"
  ],
  "name": "1"
}
```

6. To verify that the sample is working, repeat the process.

   Set up a second user in the `csvConnectorLDAPData.csv` file. The following example shows how that file might appear with a second user (`scarter`):

```
"uid","username","password",     "firstname","description",   "email",              "lastname"
"1",  "bjensen", "TestPassw0rd2","Barbara",  "Created By CSV","bjensen@example.com","Jensen"
"2",  "scarter", "Passw0rd",     "Steve",    "Created By CSV","scarter@example.com","Carter"
```

7. Rerun the reconciliation and query REST commands shown previously.

   The reconciliation operation creates the new user from the simulated LDAP resource in the IDM repository. An implicit synchronization operation then creates that user in the AD resource.

8. If you configured the reconciliation email summary at the beginning of this sample, you should have received an email that lists the details of the reconciliation operations.

Chapter 8

Asynchronous Reconciliation Using a Workflow

This sample demonstrates asynchronous reconciliation using workflows.

The data for this sample is in the file `samples/sync-asynchronous/data/csvConnectorData.csv`. That file contains two users, as follows:

```
"description", "uid",     "username",            "firstname", "lastname", "email",
 "mobile..."
"Created ...", "bjensen", "bjensen@example.com", "Barbara",   "Jensen",   "bjensen@example.com", 1234..."
"Created ...", "scarter", "scarter@example.com", "Steven",    "Carter",   "scarter@example.com", 1234..."
```

During the sample, you will reconcile the users in the CSV file with the managed user repository. Instead of creating each user immediately, the reconciliation operation generates an approval request for each ABSENT user (users who are not found in the repository). The configuration for this action is defined in the `conf/sync.json` file, which specifies that an `ABSENT` condition should launch the `managedUserApproval` workflow:

```
...
    {
        "situation" : "ABSENT",
        "action" : {
            "workflowName" : "managedUserApproval",
            "type" : "text/javascript",
            "file" : "workflow/triggerWorkflowFromSync.js"
        }
    },
 ...
```

When each request is approved by an administrator, an asynchronous reconciliation operation is launched, that ultimately creates the users in the repository.

8.1. Running the Sample

Before you start, prepare IDM as described in "Preparing IDM".

1. Start IDM with the configuration for this sample:

   ```
   $ cd /path/to/openidm
   $ ./startup.sh -p samples/sync-asynchronous
   ```

2. The sample is configured to assign new workflow tasks to an admin account named `async.admin`. You will need to create this account:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
 "userName": "async.admin",
 "givenName": "async",
 "sn" : "admin",
 "password" : "Passw0rd",
 "displayName" : "async admin",
 "mail" : "async.admin@example.com",
 "authzRoles": [
    {"_ref": "repo/internal/role/openidm-admin"},
    {"_ref": "repo/internal/role/openidm-authorized"}
 ],
 "_id" : "asyncadmin"
 }' \
 "http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id":"asyncadmin",
  "_rev":"00000000e8f502db",
  "userName":"async.admin",
  "givenName":"async",
  "sn":"admin",
  "displayName":"async admin",
  "mail":"async.admin@example.com",
  "accountStatus":"active",
  "effectiveRoles":[],
  "effectiveAssignments":[]
}
```

3. Run reconciliation over the REST interface:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?_action=recon&mapping=systemCsvfileAccounts_managedUser"
{
  "_id": "98d7f3c5-684e-4ef0-b4f9-f2e816a339cf-32",
  "state": "ACTIVE"
}
```

The reconciliation operation returns a reconciliation run ID, and the status of the operation.

This reconciliation launches a workflow that generates an approval process for each ABSENT user. The approval processes must be approved by an administrator before the workflow can continue.

4. Review the approval tasks launched by the reconciliation.

   - To review the tasks in the Admin UI, log into the Admin UI at `https://localhost:8443/admin/` using an administrator account (either `openidm-admin` or `async.admin` will work) and select Manage > Tasks.

You should see two task instances launched by the Managed User Approval Workflow.

- To view the approval tasks over REST run the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/workflow/taskinstance?_queryId=query-all-ids"
```

The request returns two task instances, each with a process ID (`_id`) and a process definition ID.


```
{
   "result": [
      {
         "_id": "33",
         "_rev": "1",
         "activityInstanceVariables": {},
         "cachedElContext": null,
         "category": null,
         "createTime": "2018-01-22T13:10:15.538Z",
         "delegationState": null,
         "delegationStateString": null,
         "deleted": false,
         "description": null,
         "dueDate": null,
         "eventName": null,
         "executionId": "5",
         "name": "Evaluate request",
         "owner": null,
         "parentTaskId": null,
         "priority": 50,
         "processDefinitionId": "managedUserApproval:1:4",
         "processInstanceId": "5",
         "processVariables": {},
         "queryVariables": null,
         "revisionNext": 2,
         "suspended": false,
         "suspensionState": 1,
         "taskDefinitionKey": "evaluateRequest",
         "taskLocalVariables": {},
         "tenantId": "",
         "assignee": "async.admin"
      }, {
         "_id": "34",
         "_rev": "1",
         "activityInstanceVariables": {},
         "cachedElContext": null,
         "category": null,
         "createTime": "2018-01-22T13:10:15.538Z",
         "delegationState": null,
         "delegationStateString": null,
         "deleted": false,
         "description": null,
         "dueDate": null,
         "eventName": null,
```

```
        "executionId": "6",
        "name": "Evaluate request",
        "owner": null,
        "parentTaskId": null,
        "priority": 50,
        "processDefinitionId": "managedUserApproval:1:4",
        "processInstanceId": "6",
        "processVariables": {},
        "queryVariables": null,
        "revisionNext": 2,
        "suspended": false,
        "suspensionState": 1,
        "taskDefinitionKey": "evaluateRequest",
        "taskLocalVariables": {},
        "tenantId": "",
        "assignee": "async.admin"
      }
   ],
  ...
}
```

5. Complete each approval task.

   - To complete the approval tasks using the UI, log into the Self-Service UI at `https://localhost:8443/#login/` as user `async.admin` with password `Passw0rd`.

     You should see two Evaluate request tasks under My Tasks on the Dashboard.

     For each task, click Details, select Yes, and click Complete.

   - Alternatively, approve the requests over REST, by setting `requestApproved` to `true` for each task instance, and using the `complete` action. Specify the `_id` of each task in the URL.

     For example, to approve the first request:

     ```
     $ curl \
      --header "X-OpenIDM-Username: async.admin" \
      --header "X-OpenIDM-Password: Passw0rd" \
      --header "Content-Type: application/json" \
      --request POST \
      --data '{"requestApproved": "true"}' \
      "http://localhost:8080/openidm/workflow/taskinstance/33?_action=complete"
     {
       "Task action performed": "complete"
     }
     ```

     Repeat this command for each task ID.

6. When the requests have been approved, select Manage > User in the Admin UI to see the new users in the repository, or query the managed users over REST as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
{
  "result": [
    {
        "_id": "asyncadmin",
        "_rev": "00000000e8f502db"
    }, {
        "_id": "scarter",
        "_rev": "000000007e120780"
    }, {
        "_id": "bjensen",
        "_rev": "00000000d9390751"
    }
  ],
 ...
}
```

Chapter 9

LiveSync With an LDAP Server

This sample resembles the sample described in "*Synchronizing Data Between Two External Resources*". However, this sample demonstrates *liveSync* from one external LDAP resource to another. LiveSync is the mechanism by which changes are pushed from an external resource to IDM and then, optionally, to another external resource. For more information see "Types of Synchronization" in the *Integrator's Guide*.

The sample assumes a scenario where changes in an Active Directory server are synchronized, using LiveSync, with a ForgeRock Directory Services (DS) server.

The sample provides a configuration for two scenarios, depending on whether you are using a live Active Directory (AD) service, or whether you are simulating the AD service with a DS server. Each scenario is associated with a file in the `livesync-with-ad/alternatives` directory. Depending on your scenario, copy the corresponding file to the `livesync-with-ad/conf` directory:

Live AD Instance

If you have an AD instance to test with, use that AD instance as the first LDAP resource. For the second LDAP resource, configure DS as described in "Setting Up the LDAP Resources". The data for the DS instance is contained in the file `samples/livesync-with-ad/data/Example.ldif`.

For the connection to Active Directory, copy the `provisioner.openicf-realad.json` file to the `conf/` subdirectory and rename it `provisioner.openicf-ad.json`.

Because this sample demonstrates synchronization *from* the AD server *to* DS, data on the AD server is not changed.

Simulated AD Instance

If you are simulating the AD instance with a DS server, copy the `provisioner.openicf-fakead.json` file to the `conf/` subdirectory and rename it `provisioner.openicf-ad.json`.

This sample simulates an AD server on the same instance of DS, using a different base DN (`dc=fakead,dc=com`). You can also simulate the AD server with a separate DS instance, running on the same host, as long as the two instances communicate on different ports. The data for the simulated AD instance is contained in the file `samples/livesync-with-ad/data/AD.ldif`. The data for the DS instance is contained in the file `samples/livesync-with-ad/data/Example.ldif`.

9.1. Setting Up the LDAP Resources

Whether you use a simulated Active Directory server, or a live Active Directory server, you must still set up a DS instance as the second LDAP resource. The following section describes that setup.

9.1.1. Preparing DS

To use DS as the LDAP resource that simulates AD, you must set up DS for liveSync. The easiest way to do this is to configure the DS server for replication. A replicated DS instance includes an External Change Log (ECL) that publishes the changes for liveSync.

Follow these steps to install and configure a DS instance for liveSync:

1. Download DS from ForgeRock's BackStage site and extract the zip archive.
2. Set up DS and import the data file for this sample, as follows:

```
$ cd /path/to/opendj
$ ./setup \
 directory-server
 \
--hostname localhost
 \
--ldapPort 1389
 \
--rootUserDN "cn=Directory Manager"
 \
--rootUserPassword password
 \
--adminConnectorPort 4444
 \
--baseDN dc=com
 \
--ldifFile /path/to/openidm/samples/livesync-with-ad/data/Example.ldif
 \
--acceptLicense
Validating parameters .....Done.
Configuring Certificates .....Done.
Configuring server .....Done.
Importing data from /path/to/openidm/samples/livesync-with-ad/data/Example.ldif ........Done.
Starting Directory Server ............Done.

To see basic server status and configuration, you can launch /path/to/opendj/bin/status
```

The sample assumes the following configuration:

- The DS server is installed on the localhost.
- The server listens for LDAP connections on port 1389.
- The administration connector port is 4444.
- The root user DN is `cn=Directory Manager`.

- The root user password is `password`.

3. Configure the DS directory server as a replication server.

   To enable liveSync, this server must be configured for replication, even if it does not actually participate in a replication topology. The following commands configure the server for replication.

```
$ cd /path/to/opendj/bin
$ ./dsconfig create-replication-server \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --provider-name "Multimaster Synchronization" \
 --set replication-port:8989 \
 --set replication-server-id:2 \
 --trustAll \
 --no-prompt

$ ./dsconfig create-replication-domain \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --provider-name "Multimaster Synchronization" \
 --domain-name "fakead.com" \
 --set base-dn:dc=fakead,dc=com \
 --set replication-server:localhost:8989 \
 --set server-id:3 \
 --trustAll \
 --no-prompt
```

When DS is configured, you can proceed with either a live or simulated AD instance.

9.1.2. Configuring the Connection to a Live AD Instance

To configure the connection to a live AD instance, open the connector configuration file (`provisioner.openicf-ad.json`) in a text editor. Update the file as required to reflect your AD instance. At a minimum, check and update the following parameters:

`host`

The hostname or IP address of the AD server

`port`

The LDAP port; 389 by default.

`ssl`

Whether the connection to the AD instance is secured over SSL; false by default.

`principal`

The full DN of the account that is used to bind to the server, for example, "CN=Administrator,CN=Users,DC=example,DC=com"

`credentials`

If a password is used, replace null with that password. When IDM starts, it encrypts that password in the `provisioner.openicf-ad.conf` file.

`baseContexts`

A list of DNs for account containers, for example, "CN=Users,DC=Example,DC=com"

`baseContextsToSynchronize`

Set to the same value as `baseContexts`

`accountSearchFilter`

The LDAP search filter to locate accounts; only user accounts by default

`accountSynchronizationFilter`

The LDAP search filter to synchronize user accounts; only user accounts by default

If you do not want to filter out computer and disabled user accounts, set the `accountSearchFilter` and `accountSynchronizationFilter` to `null`.

9.1.3. Configuring the Connection to a Simulated AD Instance

If you do not have a testable instance of AD available, you can use the `AD.ldif` file from the `data/` subdirectory to simulate an AD instance in a separate suffix on the existing DS instance.

If you have not already done so, copy the `provisioner.openicf-fakead.json` file to the `conf` subdirectory and rename it `provisioner.openicf-ad.json`.

As previously mentioned, you can use a separate DS instance to simulate the AD server. However, the following instructions assume that the simulated AD server runs on the same DS instance.

Open the `provisioner.openicf-ad.json` file and note the following:

- DS directory server uses port 1389 by default for users who cannot use privileged ports, so this is the port that is specified in the provisioner file. Adjust the port if your DS server is listening on a different port.
- The simulated AD server uses the base DN `dc=fakead,dc=com`.

To load the data for the simulated AD instance, run the following command:

```
$  cd /path/to/opendj/bin
$ ./ldapmodify
 \
--bindDN "cn=Directory Manager"
 \
--bindPassword password
 \
--hostname localhost
 \
--port 1389
 \
--filename /path/to/openidm/samples/livesync-with-ad/data/AD.ldif
# Processing ADD request for dc=fakead,dc=com
# ADD operation successful for DN dc=fakead,dc=com
# Processing ADD request for ou=People,dc=fakead,dc=com
# ADD operation successful for DN ou=People,dc=fakead,dc=com
# Processing ADD request for uid=bobf,ou=People,dc=fakead,dc=com
# ADD operation successful for DN uid=bobf,ou=People,dc=fakead,dc=com
# Processing ADD request for uid=stony,ou=People,dc=fakead,dc=com
# ADD operation successful for DN uid=stony,ou=People,dc=fakead,dc=com
```

9.2. Running the Sample

Now that DS and a real or simulated AD server is configured, prepare IDM as described in "Preparing IDM". Then start IDM with the configuration for this sample.

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/livesync-with-ad
```

The following sections show how to synchronize the two external LDAP data stores by running a reconciliation operation, how to configure scheduled liveSync.

9.2.1. Reconciling the Two LDAP Data Stores

Review the entries in the DS server (imported from the `Example.ldif` file). When you run reconciliation, any entries that share the same `uid` with the AD data store will be updated with the contents from AD.

If you have set up the simulated AD data store as described in "Configuring the Connection to a Simulated AD Instance", compare the entries in the `AD.ldif` and `Example.ldif` files. Note that each file has two different users (implying that the AD instance has users bobf and stony, and the DS instance has users jdoe and bjensen.

Run reconciliation over the REST interface:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemAdAccounts_managedUser&waitForCompletion=true"
```

The reconciliation operation returns a reconciliation run ID, and the status of the operation.

```
{
  "state": "SUCCESS",
  "_id": "985ee939-fbe1-4607-a757-00b404b4ef77"
}
```

The reconciliation operation synchronizes the data in the AD server with the IDM repository (managed/user). That information is then automatically synchronized to the DS server, as described in "Synchronization Situations and Actions" in the *Integrator's Guide*.

After reconciliation, list all users in the DS server:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryId=query-all-ids"
```

The result should resemble the following JSON object.

```
{
  "result": [
    {
      "_id": "0da50512-79bb-3461-bd04-241ee4c785bf",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com"
    },
    {
      "_id": "887732e8-3db2-31bb-b329-20cd6fcecc05",
      "dn": "uid=bjensen,ou=People,dc=example,dc=com"
    },
    {
      "_id": "9fba6f59-98c7-4791-a0c7-11e9401c983e",
      "dn": "uid=bobf,ou=People,dc=example,dc=com"
    },
    {
      "_id": "cefc89a4-c979-4769-8957-5d912a6447ad",
      "dn": "uid=stony,ou=People,dc=example,dc=com"
    }
  ],
  "resultCount": 4,
  "pagedResultsCookie": null,
  "totalPagedResultsPolicy": "NONE",
  "totalPagedResults": -1,
  "remainingPagedResults": -1
}
```

Note that the two users from the AD server have been added to the DS server.

9.2.2. Configuring LiveSync

You can launch a liveSync operation over REST, but liveSync requires a configured schedule to poll for changes. When this sample's default liveSync schedule (`schedule-activeSynchroniser_systemAdAccount.json`) is enabled, a liveSync operation is launched every 15 seconds.

LiveSync pushes changes made in the AD data store to the IDM repository automatically.

The liveSync schedule is disabled by default. To activate liveSync, change the value of the `enabled` property from `false` to `true`:

```
{
    "enabled" : true,
    "type" : "simple",
    "repeatInterval" : 15000,
    "persisted" : true,
    "concurrentExecution" : false,
    "invokeService" : "provisioner",
    "invokeContext" : {
        "action" : "liveSync",
        "source" : "system/ad/account"
    },
    "invokeLogLevel" : "debug"
}
```

Testing LiveSync

1. To test liveSync, create an LDIF file with a new user entry (`uid=bsmith`) that will be added to the simulated AD data store.

2. The following is the contents of a sample LDIF file (`bsmith.ldif`) for demonstration purposes:

```
dn: uid=bsmith,ou=People,dc=fakead,dc=com
objectClass: person
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: top
givenName: Barry
description: Created to see liveSync work
uid: bsmith
cn: Barry
sn: Smith
mail: bsmith@example.com
telephoneNumber: 1-415-523-0772
userPassword: passw0rd
```

3. Use the **ldapmodify** command to add the new user to the AD data store:

```
$ cd /path/to/opendj/bin
$ ./ldapmodify \
 --port 1389 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --filename /path/to/bsmith.ldif
```

4. Within 15 seconds, liveSync should create the user in the IDM repository.

   Test that the liveSync has worked by viewing the new user in IDM.

   The easiest way to do this, is through the Self-Service UI. You should be able to log in to the Self-Service UI (at `https://localhost:8443/`) as any of the user accounts in the AD data store.

For this example, log in to the UI as user `bsmith`, with password `passw0rd`. The fact that you can log into the UI as this new user indicates that liveSync has synchronized the user from the AD data store to the managed/user repository.

5. Implicit synchronization pushes this change out to the DS server. To test this synchronization operation, search the DS baseDN for the new user entry.

```
$ ./ldapsearch \
 --port 1389 \
 --baseDN ou=people,dc=example,dc=com \
 "(uid=bsmith)"
```

Chapter 10

Synchronizing Accounts With the Google Apps Connector

OpenICF provides a Google Apps Connector that enables you to interact with Google's web applications.

This sample shows how to create users and groups on an external Google system how to synchronize those accounts with the IDM managed user repository. The sample requires that you have a Google Apps account. Obtaining a Google Apps account is described in the Google documentation.

10.1. Before You Start

To set up IDM to connect to your Google Apps account, you must have a Google Apps project (or create a new project) that authorizes consent for IDM.

1. Log in to the Google Apps Developers Console (at https://console.developers.google.com/start) and update your project or create a new project for IDM.
2. Enable the following APIs for your IDM project:
   - Admin SDK API
   - Enterprise License Manager API
3. Set up an OAuth2 Client ID.

   The Google Apps connector uses OAuth2 to authorize the connection to the Google service. Set up an OAuth2 Client ID as follows:

   a. In the Google Apps Developers Console, select Credentials > New Credentials > OAuth Client ID.

   b. Click Configure Consent Screen and enter a Product Name.

      This is the name that will be shown for all applications registered in this project.

      For the purposes of this example, we use the Product Name `OpenIDM`.

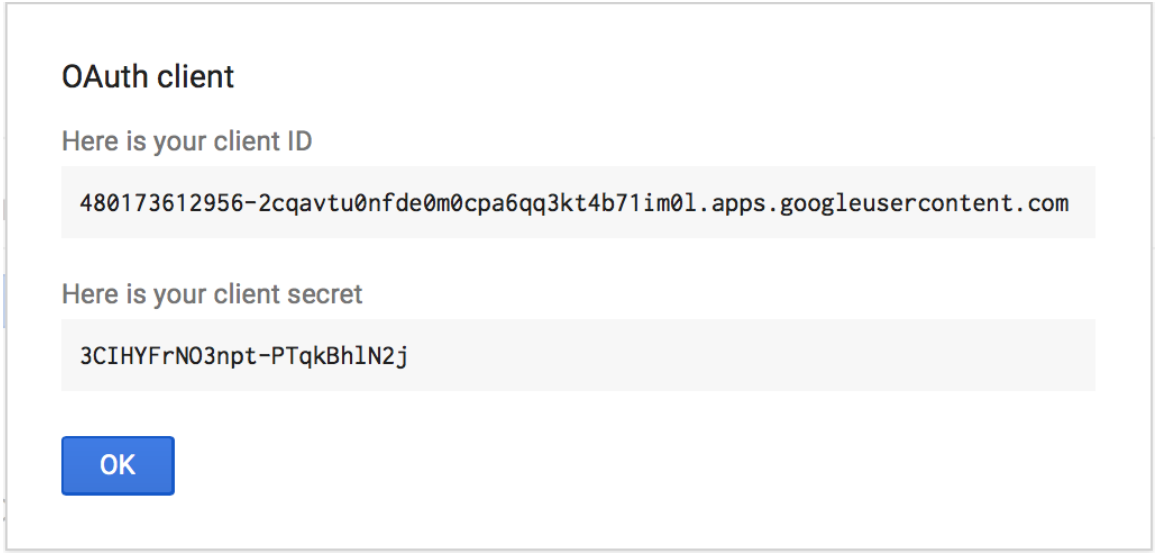
      Click Save.

c. Select Credentials > OAuth Client ID > Web application.

Under Authorized redirect URIs, enter the callback URL (the URL at which your clients will access your application). The default IDM callback URL is `https://localhost:8443/admin/oauth.html`. Click Create to set up the callback URL.

Click Create again to set up the client ID.

This step generates an OAuth Client ID and Client, similar to the following:



Copy and paste these values into a text file as you will need them when you configure the Google Apps connector.

10.2. Configuring the Google Apps Connector

This procedure uses the Admin UI to set up the Google Apps connector.

1. To configure the connector, start IDM with the Google Apps sample configuration:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-google
Executing ./startup.sh...
Using OPENIDM_HOME:   /path/to/openidm
Using PROJECT_HOME:   /path/to/openidm/samples/sync-with-google/
Using OPENIDM_OPTS:   -Xmx1024m -Xms1024m
Using LOGGING_CONFIG: -Djava.util.logging.config.file=/path/to/openidm/conf/logging.properties
Using boot properties at /path/to/openidm/resolver/boot
.properties
-> OpenIDM ready
```

2. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

   This URL reflects the host on which IDM is installed and corresponds to the callback URL that you specified in the previous section. The URL must be included in the list of Authorized redirect URIs for your project.

3. Select Configure > Connectors and click on the Google Apps connector.

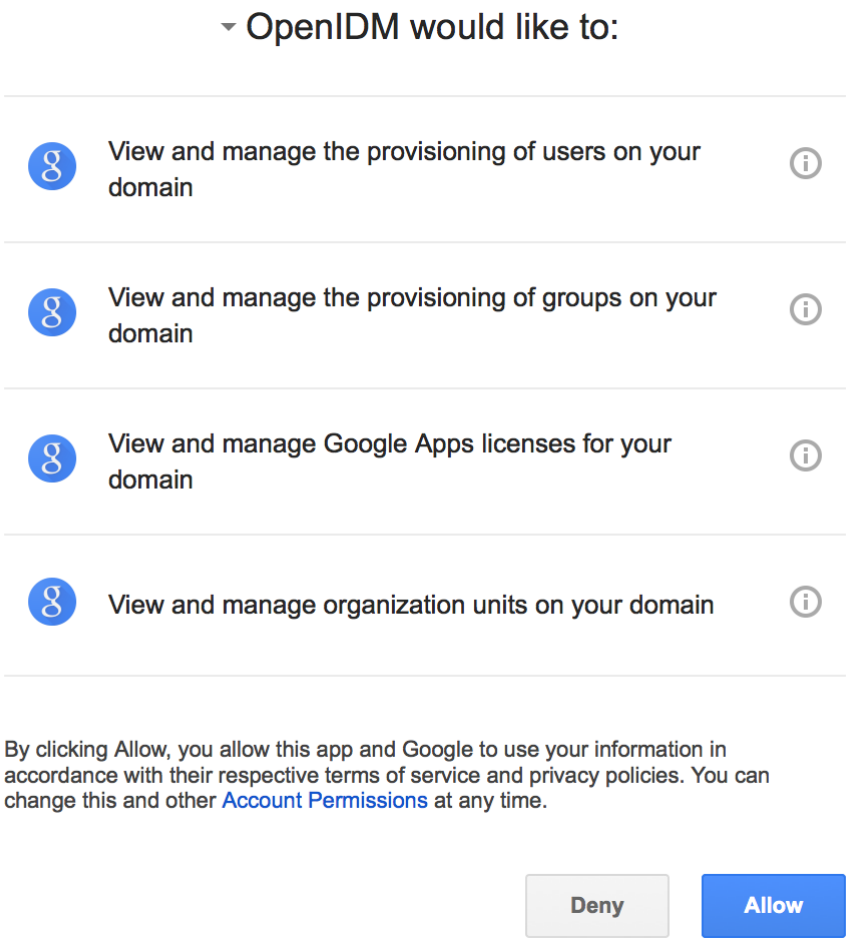
4. On the Details tab, set the Enabled field to True.

5. Enter the Oauth2 Client ID and Client Secret that you obtained in the previous section.

6. Click Save Connector Changes.

7. You are redirected to Google's Login page.

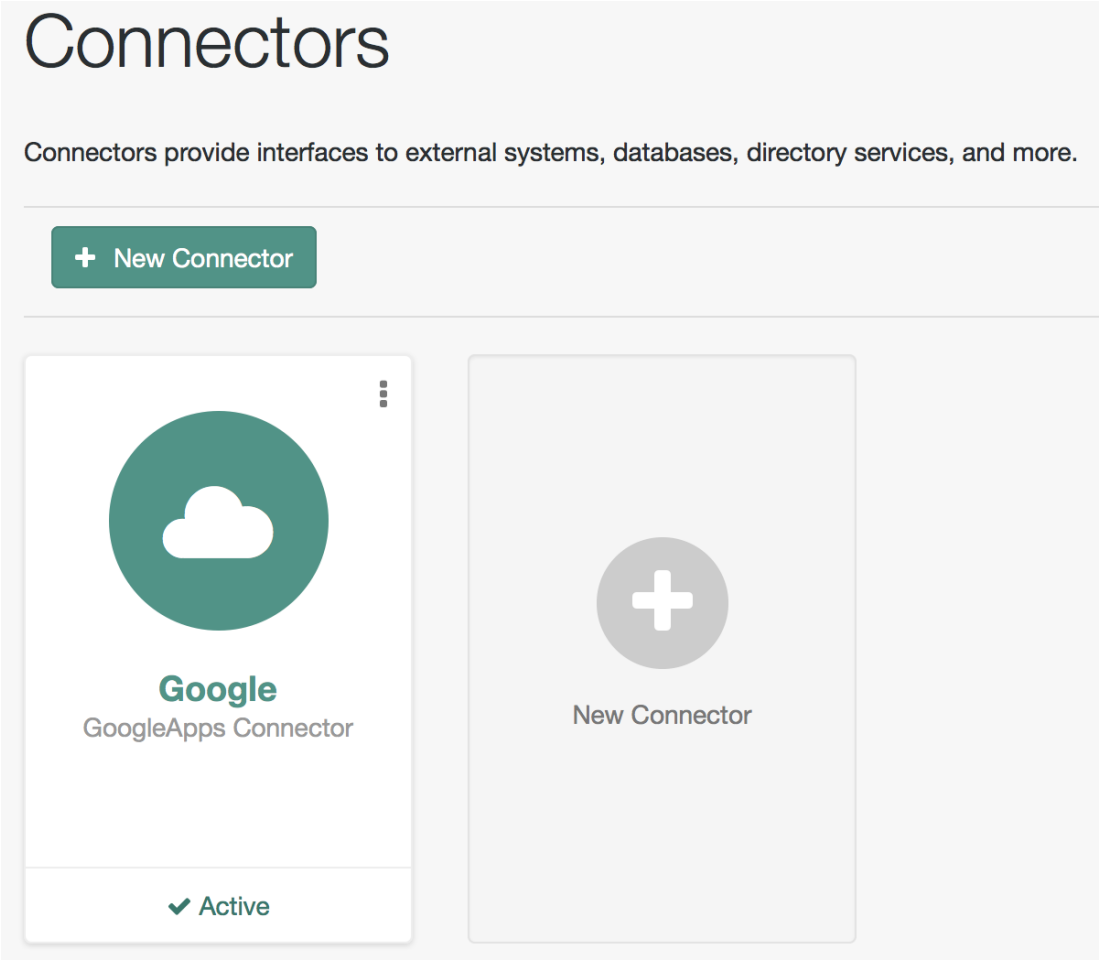
   When you have logged in, Google requests that you allow access from your project, in this case, IDM.



Click Allow.

If you click Deny here, you will need to return to the Connector Configuration > Details tab in the Admin UI and save your changes again.

When you allow access, you are redirected to the Connectors page in the Admin UI, where the Google Apps Connector should now be Active.



10.3. Running the Synchronization With Google Sample

This procedure uses create, read, update, and delete (CRUD) operations on the Google resource, to verify that the connector is working as expected. The procedure uses a combination of REST commands, to manage objects on the Google system, and the Admin UI, to reconcile users from the Google system to the manage user repository.

The sample configuration has one mapping *from* the Google system *to* the managed user repository.

All of the commands shown here assume that your domain is `example.com`. Adjust the examples to manage your domain.

1. Create a user entry on your Google resource, over REST.

   When you create resources for Google, note that the equals (=) character cannot be used in any attribute value.

   The following command creates an entry for user `Sam Carter`:

```
$  curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
  "__NAME__": "samcarter@example.com",
  "__PASSWORD__"  : "password",
  "givenName" : "Sam",
  "familyName": "Carter",
  "agreedToTerms": true,
  "changePasswordAtNextLogin" : false
 }' \
 "http://localhost:8080/openidm/system/google/__ACCOUNT__?_action=create"
{
  "_id": "103567435255251233551",
  "_rev": "\"iwpzoDgSq9BJw-XzORg0bILYPVc/LWHPMXXG8M0cjQAPITM95Y636cM\"",
  "orgUnitPath": "/",
  "isAdmin": false,
  "fullName": "Sam Carter",
  "customerId": "C02rsqddz",
  "relations": null,
  "nonEditableAliases": null,
  "suspensionReason": null,
  "includeInGlobalAddressList": true,
  "givenName": "Sam",
  "addresses": null,
  "isDelegatedAdmin": false,
  "changePasswordAtNextLogin": false,
  "isMailboxSetup": true,
  "__NAME__": "samcarter@example.com",
  "agreedToTerms": true,
  "externalIds": null,
  "ipWhitelisted": false,
  "aliases": null,
  "lastLoginTime": [
    "1970-01-01T00:00:00.000Z"
  ],
  "organizations": null,
  "suspended": false,
  "deletionTime": null,
  "familyName": "Carter",
  "ims": null,
  "creationTime": [
    "2016-02-02T12:52:30.000Z"
  ],
  "thumbnailPhotoUrl": null,
  "emails": [
    {
      "address": "samcarter@example.com",
      "primary": true
```

```
    }
  ],
  "phones": null
}
```

Note the ID of the new user (`10356743525525123355 1` in this example). You will need this ID for the update commands in this section.

2. Reconcile the Google resource with the managed user repository.

   This step should create the new user, Sam Carter (and any other users in your Google resource) in the managed user repository.

   To run reconciliation follow these steps:

   a. In the Admin UI, select Configure > Mappings.

   b. Click on the sourceGoogle__ACCOUNT___managedUser mapping, and click Reconcile.

   c. Select Manage > User and verify that the user Sam Carter has been created in the repository.

3. Update Sam Carter's phone number in your Google resource by sending a PUT request with the updated data, and specifying the user `_id` in the request:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PUT \
 --header "If-Match : *" \
 --data '{
  "__NAME__": "samcarter@example.com",
  "__PASSWORD__"  : "password",
  "givenName" : "Sam",
  "familyName": "Carter",
  "agreedToTerms": true,
  "changePasswordAtNextLogin" : false,
  "phones" :
   [
    {
     "value": "1234567890",
     "type": "home"
    },
    {
     "value": "0987654321",
     "type":"work"
    }
   ]
  }' \
 "http://localhost:8080/openidm/system/google/__ACCOUNT__/103567435255251233551"
{
  "_id": "103567435255251233551",
  "_rev": "\"iwpzoDgSq9BJw-XzORg0bILYPVc/vfSJgHt-STUUto4lM_4ESO9izR4\""
,
...
 "emails": [
```

```
    {
      "address": "samcarter@example.com",
      "primary": true
    }
  ],
  "phones": [
    {
      "value": "1234567890",
      "type": "home"
    },
    {
      "value": "0987654321",
      "type": "work"
    }
  ]
}
```

4. Read Sam Carter's entry from your Google resource by including his `_id` in the URL:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/google/__ACCOUNT__/103567435255251233551"
{
  "_id": "103567435255251233551",
  "__NAME__": "samcarter@example.com"
,
...
 "phones": [
    {
      "value": "1234567890",
      "type": "home"
    },
    {
      "value": "0987654321",
      "type": "work"
    }
  ]
}
```

5. Create a group entry on your Google resource:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
  "__NAME__": "testGroup@example.com",
  "__DESCRIPTION__": "Group used for google-connector sample.",
  "name": "TestGroup"
 }' \
 "http://localhost:8080/openidm/system/google/__GROUP__?_action=create"

{
  "_id": "00meukdy40gpg98",
  "_rev": "\"iwpzoDgSq9BJw-XzORg0bILYPVc/LLhHx2plMJPKeY1-h6eX_OVDi4c\"",
  "adminCreated": true,
  "__NAME__": "testgroup@example.com",
  "aliases": null,
  "nonEditableAliases": null,
  "__DESCRIPTION__": "Group used for google-connector sample.",
  "name": "TestGroup",
  "directMembersCount": 0
}
```

6. Add Sam Carter to the test group you have just created. Include the `Member` endpoint, and Sam Carter's `_id` in the URL. Specify the `_id` of the group you created as the value of the `groupKey` in the JSON payload:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PUT \
 --data '{
  "groupKey" : "00meukdy40gpg98",
  "role": "MEMBER",
  "__NAME__": "samcarter@example.com",
  "email": "samcarter@example.com",
  "type": "MEMBER"
 }' \
 "http://localhost:8080/openidm/system/google/Member/103567435255251233551"
{
  "_id": "00meukdy40gpg98/samcarter@example.com",
  "_rev": "\"iwpzoDgSq9BJw-XzORg0bILYPVc/CPNpkRnowkGWRvNQvUK9ev6gQ90\"",
  "__NAME__": "00meukdy40gpg98/samcarter@example.com",
  "role": "MEMBER",
  "email": "samcarter@example.com",
  "type": "USER",
  "groupKey": "103567435255251233551"
}
```

7. Read the group entry by specifying the group `_id` in the request URL. Notice that the group has one member (`"directMembersCount": 1`).

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/google/__GROUP__/00meukdy40gpg98"

{
  "_id": "00meukdy40gpg98",
  "_rev": "\"iwpzoDgSq9BJw-XzORg0bILYPVc/chUdq5m5_cycV2G4sdl7ZKAF75A\"",
  "adminCreated": true,
  "__NAME__": "testgroup@example.com",
  "aliases": null,
  "nonEditableAliases": [
    "testGroup@example.test-google-a.com"
  ],
  "__DESCRIPTION__": "Group used for google-connector sample.",
  "name": "TestGroup",
  "directMembersCount": 1
}
```

8. Delete the group entry.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request DELETE \
 "http://localhost:8080/openidm/system/google/__GROUP__/00meukdy40gpg98"
{
  "_id": "00meukdy40gpg98",
  "_rev": "\"iwpzoDgSq9BJw-XzORg0bILYPVc/chUdq5m5_cycV2G4sdl7ZKAF75A\"",
  "adminCreated": true,
  "__NAME__": "testgroup@example.com",
  "aliases": null,
  "nonEditableAliases": [
    "testGroup@example.com.test-google-a.com"
  ],
  "__DESCRIPTION__": "Group used for google-connector sample.",
  "name": "TestGroup",
  "directMembersCount": 1
}
```

The delete request returns the complete group object.

9. Delete Sam Carter, to return your Google resource to its original state.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request DELETE \
 "http://localhost:8080/openidm/system/google/__ACCOUNT__/103567435255251233551"
{
  "_id": "103567435255251233551",
  "_rev": "\"iwpzoDgSq9BJw-XzORg0bILYPVc/ah6xBLujMAHieSWSisPa1CV6T3Q\"",
  "orgUnitPath": "/",
  "isAdmin": false,
  "fullName": "Sam Carter",
  "customerId": "C02rsqddz",
  "relations": null,
```

```
  "nonEditableAliases": [
    "samcarter@example.com.test-google-a.com"
  ],
  "suspensionReason": null,
  "includeInGlobalAddressList": true,
  "givenName": "Sam",
  "addresses": null,
  "isDelegatedAdmin": false,
  "changePasswordAtNextLogin": false,
  "isMailboxSetup": true,
  "__NAME__": "samcarter@example.com",
  "agreedToTerms": true,
  "externalIds": null,
  "ipWhitelisted": false,
  "aliases": null,
  "lastLoginTime": [
    "1970-01-01T00:00:00.000Z"
  ],
  "organizations": null,
  "suspended": false,
  "deletionTime": null,
  "familyName": "Carter",
  "ims": null,
  "creationTime": [
    "2016-02-02T12:52:30.000Z"
  ],
  "thumbnailPhotoUrl": null,
  "emails": [
    {
      "address": "samcarter@example.com",
      "primary": true
    }
  ],
  "phones": [
    {
      "value": "1234567890",
      "type": "home"
    },
    {
      "value": "0987654321",
      "type": "work"
    }
  ]
}
```


In this sample, you used the Google Apps connector to add and delete user and group objects in your Google application, and to reconcile users from your Google application to the managed user repository. You can expand on this sample by customizing the connector configuration to provide additional synchronization functionality between IDM and your Google applications. For more information on configuring connectors, see "*Connecting to External Resources*" in the *Integrator's Guide*.

Chapter 11

Synchronizing Users Between Salesforce and IDM

The Salesforce connector enables provisioning, reconciliation, and synchronization between Salesforce and IDM.

This sample shows how to synchronize Salesforce user accounts and managed users in the IDM repository. You can use either the Admin UI, or the command line to run this sample. Both methods are outlined in the sections that follow.

11.1. Before you Start

To test this sample you must have an existing Salesforce organization, a Salesforce developer account, and a Connected App with OAuth enabled. For instructions on setting up a Connected App, see "Setting Up Salesforce" in the *Integrator's Guide*.

When you have set up the Connected App, locate the *Consumer Key* and *Consumer Secret* as you will need them in the following section.

11.2. Install the Sample

Prepare IDM as described in "Preparing IDM", then start the server with the configuration for the Salesforce sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-salesforce
```

11.3. Running the Sample by Using the Admin UI

The Admin UI is the recommended way to test this sample.

1. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

Warning

To protect your deployment in production, change the default administrative password. To do so, navigate to the Self-Service UI at `https://localhost:8443/` and click Change Password.

The Resources tab shows the Salesforce connector, which is currently disabled.

2. Enable the Salesforce connector by completing the authentication details as follows. You will need the Consumer Key and Consumer Secret that you obtained in the previous section.

   - Select the Salesforce connector and select Enable to enable the connector.
   - Under Base Connector Details select Sandbox (for the purposes of testing the sample) and enter the Connector Key and Secret that you obtained in the previous section.
   - You can leave the remaining default configuration. Click Save to update the connector configuration.
   - The connector now attempts to access your Salesforce organization.

     Enter your Salesforce login credentials.

     On the permission request screen click Allow, to enable IDM to access your Salesforce Connected App.

     Note

     In the current IDM release, an issue is occasionally seen where the system appears to time out while retrieving the refresh token from Salesforce, at this stage. If this happens, refresh your browser and attempt the connector setup again.

     On the Resources tab, your Salesforce Connector should now be Active.

3. To test reconciliation, select Configure > Mappings.

   There are two configured mappings, one from Salesforce to the IDM repository (`managed/user`) and one from the repository to Salesforce.

4. Select Reconcile on the first mapping.

   The reconciliation operation creates the users that were present in your Salesforce organization in the IDM repository.

5. Retrieve the users in the repository by selecting Manage > User.

   The repository should now contain all the users from your Salesforce organization.

6. To test the second mapping (from IDM to Salesforce), update any user in the repository.

By default, *implicit synchronization* is enabled for mappings *from* the `managed/user` repository *to* any external resource. This means that when you update a managed object, any mappings defined in the `sync.json` file that have the managed object as the source are automatically executed to update the target system. For more information, see "Mapping Source Objects to Target Objects" in the *Integrator's Guide*.

To test that the implicit synchronization has been successful, check the updated user record in Salesforce.

11.4. Running the Sample by Using the Command Line

Running the sample by using the command line is a little more complex. This section breaks the sample into two tasks - configuring the connector, and then testing the configuration by running reconciliation operations between the two systems.

To Set Up the Salesforce Connector

Before you start, you will need the Consumer Key and Consumer Secret that you obtained in the previous section.

1. Obtain the refresh token from salesforce.com by pointing your browser to the following URL:

   ```
   SALESFORCE_URL/services/oauth2/authorize?
   response_type=code&client_id=CONSUMER_KEY&redirect_uri=REDIRECT_URI&scope=id+api+refresh_token
   ```

   Where:

   - *SALESFORCE_URL* is one of the following:
     - `https://login.salesforce.com`
     - `https://test.salesforce.com`
     - A custom Salesforce MyDomain URL, such as:

       `https://ic-example-com--SUP1.cs21.my.salesforce.com`
   - *CONSUMER_KEY* is the Consumer Key associated with the Connected App that you created within your Salesforce organization.
   - *REDIRECT_URI* corresponds to the IDM `/admin/oauth.html` page. This URI must match the Redirect URI specified within your Salesforce Connect App configuration, for example:

     `https://localhost:8443/admin/oauth.html`

or

```
http://localhost:8080/admin/oauth.html
```

2. You are redirected to Salesforce, and prompted to give this application access to your Salesforce account. When you have given consent, you should receive a response URL that looks similar to the following:

```
https://localhost:8443/admin/index.html#connectors/edit//&code=aPrxJZTK7Rs03PU634VK8Jn9o_U3ZY1ERxM7IiklF.
..
```

The `&code` part of this URL is an authorization code, that you need for the following step.

Caution

Note that this authorization code expires after 10 minutes. If you do not complete the OAuth flow within that time, you will need to start this process again.

3. Copy the authorization code from the response URL and use it as the value of the `code` parameter in the following REST call. The *consumer-key*, *redirect-uri*, and *SALESFORCE_URL* must match what you used in the first step of this procedure:

```
$  curl \
 --verbose \
 --data "grant_type=authorization_code" \
 --data "client_id=consumer-key" \
 --data "client_secret=consumer-secret" \
 --data "redirect_uri=https://localhost:8443/admin/oauth.html" \
 --data "code=access-token-code" \
 "SALESFORCE_URL/services/oauth2/token"
{
  "access_token": "00DS0000003K4fU!AQMAQOzEU
.8tCjg8Wk79yKPKCtrtaszX5jrHtoT4NBpJ8x2NFZGjg3PNuc0TWq0EgiGS_mVkfg5f4pVN5...",
  "signature": "2uREX1lseXdg3Vng/2+Hrlo/KHOWYoim+poj74wKFtw=",
  "refresh_token": "5Aep861KIwKdekr90I4iHdtDgWwRoG7O_6uHrgJ
.yVtMS0UaGxRqE6WFM77W7wCV4muVMgdqKjuWI2i5S6sjN2X",
  "token_type": "Bearer",
  "instance_url": "https://example-com.cs1.my.salesforce.com",
  "scope": "id api refresh_token",
  "issued_at": "1417182949781",
  "id": "https://login.salesforce.com/id/00DS0000003K4fUMAS/00530000009hWLcAAM"
}
```

The output includes an `access_token` and a `refresh_token`. You will need the `refresh_token` in the following step.

4. Edit the `configurationProperties` in your Salesforce connector configuration file (`openidm/samples/sync-with-salesforce/conf/provisioner.salesforce-salesforce.json`) to include your Consumer Key (`clientID`), Consumer Secret (`clientSecret`), refresh token, and your Salesforce login URL.

In addition, set the `instanceUrl` to the value returned in the previous step, and set the `enabled` property to `true`.

The relevant excerpts of the `provisioner.salesforce-salesforce.json` file are as follows:

```
{
    "name" : "salesforce",
    "enabled" : true,
...
    "configurationProperties" : {
        "connectTimeout" : 120000,
        "loginUrl" : https://login.salesforce.com/services/oauth2/token,
        "idleCheckInterval" : 10000,
        "refreshToken" : "5Aep861KIwKdekr90I4iHdtDgWwRoG7O_6uHrgJ.yVtMS0UaGxRqE6WFM...",
        "clientSecret" : "4850xxxxxxxxxxxx425",
        "clientId" : "3MVG98dostKihXN7Is8Q0g5q1xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxP...",
        "instanceUrl" : "https://example-com.cs1.my.salesforce.com",
        "version" : 29
    }
...
```

5. Check that your connector configuration is correct by testing the status of the connector, over REST.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/system?_action=test"
[
  {
    "ok": true,
    "connectorRef": {
      "bundleVersion": "6.0.0",
      "systemType": "provisioner.salesforce",
      "displayName": "Salesforce Connector",
      "bundleName": "org.forgerock.openidm.salesforce",
      "connectorName": "org.forgerock.openidm.salesforce.Salesforce"
    },
    "objectTypes": [
      "User",
      "PermissionSet",
      "PermissionSetAssignment",
      "Profile",
      "PermissionSetLicenseAssign",
      "Organization",
      "PermissionSetLicense",
      "Group",
      "GroupMember"
    ],
    "config": "config/provisioner.salesforce/salesforce",
    "enabled": true,
    "name": "salesforce"
  }
]
```

Run Reconciliation by Using the Command Line

The mapping configuration file (`sync.json`) for this sample includes two mappings, `sourceSalesforceUser_managedUser`, which synchronizes users from the Salesforce with the IDM repository, and `managedUser_sourceSalesforceUser`, which synchronizes changes from the repository to Salesforce.

1. Reconcile the repository over the REST interface by running the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=sourceSalesforceUser_managedUser&waitForCompletion=true"
{
  "state": "SUCCESS",
  "_id": "8a6281ef-6faf-43dd-af5c-3a842b38c468"
}
```

   The reconciliation operation returns a reconciliation run ID and the status of the operation. Reconciliation creates user objects from Salesforce in the IDM repository, assigning the new objects random unique IDs.

2. Retrieve the managed users in the repository:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "180c6686-b098-460a-a246-4e03fa0b8eb2",
      "_rev": "00000000cfe1fccf"
    },
    {
      "_id": "d0c25a0c-f7e6-4249-9c81-e546728f5bdd",
      "_rev": "000000000828e760"
    },
    {
      "_id": "25181ab3-0d40-4f80-96d6-d620eef7b6da",
      "_rev": "0000000038b6e342"
    }
  ],
  "resultCount": 3,
  "pagedResultsCookie": null,
  "totalPagedResultsPolicy": "NONE",
  "totalPagedResults": -1,
  "remainingPagedResults": -1
}
```

   The output shows that the users in the Salesforce data store have been created in the repository.

Chapter 12

Synchronizing Kerberos User Principals

This sample demonstrates how to manage Kerberos user principals and how to reconcile user principals with IDM managed user objects.

The connector configuration (`/path/to/openidm/samples/sync-with-kerberos/conf/provisioner.openicf-kerberos.json`) assumes that IDM is running on a host that is separate from the Kerberos host.

This sample assumes that the default realm is `EXAMPLE.COM` and that there is an existing user principal `openidm/admin`. Adjust the sample to match your Kerberos realm and principals.

12.1. Editing the Kerberos Connector Configuration

Before you run this sample, edit the connector configuration file to match your Kerberos environment. Specifically, set the correct values for the following properties:

`host`

The host name or IP address of the machine on which Kerberos is running.

`port`

The SSH port on that machine.

Default: `22` (the default SSH port)

`user`

The username of the account that is used to connect to the SSH server.

`password`

The password of the account that is used to connect to the SSH server.

`prompt`

A string that represents the remote SSH session prompt. This must be the exact prompt string, in the format `username@target:`, for example `root@localhost:~$` . The easiest way to obtain this string is to `ssh` into the machine and copy paste the prompt.

`customConfiguration`

The details of the admin user principal and the default realm.

This example assumes an admin user principal of `openidm/admin`.

For more information on setting this property, see `customConfiguration` in the *Connector Reference*.

`customSensitiveConfiguration`

The password for the user principal.

For more information on setting this property, see `customSensitiveConfiguration` in the *Connector Reference*.

Your connector configuration should look something like the following:

```
...
  "configurationProperties" : {
    "host" : "192.0.2.0",
    "port" : 22,
    "user" : "admin",
    "password" : "Passw0rd",
    "prompt" : "admin@myhost:~$",
    "sudoCommand" : "/usr/bin/sudo",
    "echoOff" : true,
    "terminalType" : "vt102",
    "setLocale" : false,
    "locale" : "en_US.utf8",
    "connectionTimeout" : 5000,
    "expectTimeout" : 5000,
    "authenticationType" : "PASSWORD",
    "throwOperationTimeoutException" : true,
    "customConfiguration" : "kadmin { cmd = '/usr/sbin/kadmin.local'; user='openidm/admin';
 default_realm='EXAMPLE.COM' }",
    "customSensitiveConfiguration" : "kadmin { password = 'Passw0rd'}",
   ...
```

IDM encrypts passwords in the configuration when it starts up, or whenever it reloads the configuration file.

For information about the complete Kerberos connector configuration, see "Configuring the Kerberos Connector" in the *Connector Reference*.

Caution

Do not modify the value of the `scriptRoots` or `classpath` properties unless you have extracted the scripts from the connector bundle and placed them on the filesystem.

12.2. Running the Kerberos Sample

The commands in this section achieve the following:

1. Start IDM and check that the connector can reach the Kerberos server.
2. Create two users in the managed repository.

3. Reconcile the managed repository with the Kerberos server so that the new users are created in Kerberos.
4. Retrieve the details of one of the new Kerberos principals from the server.
5. Delete one of the managed users.
6. Reconcile the managed repository again and note that the corresponding Kerberos principal has been deleted.

1. Start IDM with the configuration for the Kerberos sample:

```
$ cd /path/to/openidm
```

```
$ startup.sh -p samples/sync-with-kerberos
```

2. Test that your connector configuration is correct and that IDM can reach your Kerberos server, with the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/system?_action=test"
[
  {
    "name": "kerberos",
    "enabled": true,
    "config": "config/provisioner.openicf/kerberos",
    "objectTypes": [
      "__ALL__",
      "account"
    ],
    "connectorRef": {
      "bundleName": "org.forgerock.openicf.connectors.kerberos-connector",
      "connectorName": "org.forgerock.openicf.connectors.kerberos.KerberosConnector",
      "bundleVersion": "[1.4.0.0,1.6.0.0)"
    },
    "displayName": "Kerberos Connector",
    "ok": true
  }
]
```

If the command returns `"ok": true`, as in the preceding output, your configuration is correct and you can continue with the sample.

3. Retrieve a list of the existing user principals in the Kerberos database:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/kerberos/account?_queryId=query-all-ids"
{
  "result": [
    {
```

```
      "_id": "K/M@EXAMPLE.COM",
      "principal": "K/M@EXAMPLE.COM"
    },
    {
      "_id": "kadmin/admin@EXAMPLE.COM",
      "principal": "kadmin/admin@EXAMPLE.COM"
    },
    {
      "_id": "kadmin/changepw@EXAMPLE.COM",
      "principal": "kadmin/changepw@EXAMPLE.COM"
    },
    {
      "_id": "kadmin/krb1.example.com@EXAMPLE.COM",
      "principal": "kadmin/krb1.example.com@EXAMPLE.COM"
    },
    {
      "_id": "kiprop/krb1.example.com@EXAMPLE.COM",
      "principal": "kiprop/krb1.example.com@EXAMPLE.COM"
    },
    {
      "_id": "krbtgt/EXAMPLE.COM@EXAMPLE.COM",
      "principal": "krbtgt/EXAMPLE.COM@EXAMPLE.COM"
    },
    {
      "_id": "openidm/admin@EXAMPLE.COM",
      "principal": "openidm/admin@EXAMPLE.COM"
    }
  ],
  ...
}
```

4. Create two new managed users, either over REST or by using the Admin UI.

   The following command creates users bjensen and scarter over REST. To create similar users by using the Admin UI, select Managed > User and click New User:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-type: application/json" \
 --request POST \
 --data '{
  "userName": "bjensen",
  "givenName": "Barbara",
  "sn" : "Jensen",
  "password" : "Passw0rd",
  "displayName" : "Barbara Jensen",
  "mail" : "bjensen@example.com"
 }' \
 "http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id": "ce3d9b8f-1d15-4950-82c1-f87596aadcb6",
  "_rev": "00000000792afa08",
  "userName": "bjensen",
  "givenName": "Barbara",
  "sn": "Jensen",
  "displayName": "Barbara Jensen",
  "mail": "bjensen@example.com",
```

```
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-type: application/json" \
 --request POST \
 --data '{
  "userName": "scarter",
  "givenName": "Steven",
  "sn" : "Carter",
  "password" : "Passw0rd",
  "displayName" : "Steven Carter",
  "mail" : "scarter@example.com"
 }' \
 "http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id": "a204ca60-b0fc-42f8-bf93-65bb30131361",
  "_rev": "000000004121fb7e",
  "userName": "scarter",
  "givenName": "Steven",
  "sn": "Carter",
  "displayName": "Steven Carter",
  "mail": "scarter@example.com",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

5. Run a reconciliation operation between the managed user repository and the Kerberos database to create the new users bjensen and scarter in Kerberos. You can run the reconciliation over REST, or using the Admin UI.

   The following command creates runs the reconciliation over REST:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?_action=recon&mapping=managedUser_systemKerberos"
{
  "_id": "862ab9ba-d1d9-4058-b6bc-a23a94b68776-234",
  "state": "ACTIVE"
}
```

   To run the reconciliation by using the Admin UI, select Configure > Mappings, click on the `managedUser_systemKerberos` mapping, and click Reconcile.

6. Retrieve the list of Kerberos user principals again. You should now see bjensen and scarter in this list:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/kerberos/account?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "bjensen@EXAMPLE.COM",
      "principal": "bjensen@EXAMPLE.COM"
    },
    {
      "_id": "scarter@EXAMPLE.COM",
      "principal": "scarter@EXAMPLE.COM"
    },
    ...
    {
      "_id": "openidm/admin@EXAMPLE.COM",
      "principal": "openidm/admin@EXAMPLE.COM"
    }
  ],
  ...
}
```

7. Retrieve bjensen's complete user principal from the Kerberos server:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/kerberos/account/bjensen@EXAMPLE.COM"
{
  "_id": "bjensen@EXAMPLE.COM",
  "lastFailedAuthentication": "[never]",
  "passwordExpiration": "[none]",
  "lastSuccessfulAuthentication": "[never]",
  "maximumTicketLife": "0 days 10:00:00",
  "lastModified": "Tue May 24 04:05:45 EDT 2016 (openidm/admin@EXAMPLE.COM)",
  "policy": "user [does not exist]",
  "expirationDate": "[never]",
  "failedPasswordAttempts": "0",
  "maximumRenewableLife": "7 days 00:00:00",
  "principal": "bjensen@EXAMPLE.COM",
  "lastPasswordChange": "Tue May 24 04:05:45 EDT 2016"
}
```

   Note the default values for properties such as `maximumRenewableLife`. These values are set in your connector configuration. For more information, see "Configuring the Kerberos Connector" in the *Connector Reference*.

   To perform this step in the Admin UI, select Manage > User, click bjensen's entry, and click the Linked Systems tab to display her corresponding entry on the Kerberos server.

8. Delete the managed user bjensen by specifying her managed object ID in the DELETE request.

   First, obtain her ID by querying for her userName:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryFilter=userName+eq+'bjensen'"
{
  "result": [
    {
      "_id": "ce3d9b8f-1d15-4950-82c1-f87596aadcb6",
      "_rev": "00000000a92657c7",
      "userName": "bjensen",
      "givenName": "Barbara",
      "sn": "Jensen",
      "displayName": "Barbara Jensen",
      "mail": "bjensen@example.com",
      "accountStatus": "active",
      "effectiveRoles": [],
      "effectiveAssignments": []
    }
  ],
  ...
}
```

Now delete the user with ID `ce3d9b8f-1d15-4950-82c1-f87596aadcb6`. This ID will obviously be different in your example.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request DELETE \
 "http://localhost:8080/openidm/managed/user/ce3d9b8f-1d15-4950-82c1-f87596aadcb6"
{
  "_id": "ce3d9b8f-1d15-4950-82c1-f87596aadcb6",
  "_rev": "00000000a92657c7",
  "userName": "bjensen",
  "givenName": "Barbara",
  "sn": "Jensen",
  "displayName": "Barbara Jensen",
  "mail": "bjensen@example.com",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

To delete bjensen's managed user entry by using the Admin UI, select Manage > User, click on bjensen's entry, select the checkbox next to her entry, and click Delete Selected.

9. Reconcile the managed user repository and the Kerberos database again:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?_action=recon&mapping=managedUser_systemKerberos"
{
  "_id": "862ab9ba-d1d9-4058-b6bc-a23a94b68776-584",
  "state": "ACTIVE"
}
```

10. Retrieve the list of Kerberos user principals again. The Kerberos principal for bjensen should have been been removed from the list:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/kerberos/account?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "K/M@EXAMPLE.COM",
      "principal": "K/M@EXAMPLE.COM"
    },
    {
      "_id": "kadmin/admin@EXAMPLE.COM",
      "principal": "kadmin/admin@EXAMPLE.COM"
    },
    {
      "_id": "kadmin/changepw@EXAMPLE.COM",
      "principal": "kadmin/changepw@EXAMPLE.COM"
    },
    {
      "_id": "kadmin/krb1.example.com@EXAMPLE.COM",
      "principal": "kadmin/krb1.example.com@EXAMPLE.COM"
    },
    {
      "_id": "kiprop/krb1.example.com@EXAMPLE.COM",
      "principal": "kiprop/krb1.example.com@EXAMPLE.COM"
    },
    {
      "_id": "krbtgt/EXAMPLE.COM@EXAMPLE.COM",
      "principal": "krbtgt/EXAMPLE.COM@EXAMPLE.COM"
    },
    {
      "_id": "scarter@EXAMPLE.COM",
      "principal": "scarter@EXAMPLE.COM"
    },
    {
      "_id": "openidm/admin@EXAMPLE.COM",
      "principal": "openidm/admin@EXAMPLE.COM"
    }
  ],
  ...
}
```

Note

Some user IDs in Kerberos include characters such as a forward slash (`/`) and an "at sign" (`@`) that prevent them from being used directly in a REST URL. For example, `openidm/system/kerberos/account/kadmin/admin@EXAMPLE.COM`, where the ID is `kadmin/admin@EXAMPLE.COM`. To retrieve such entries directly over REST, you must URL-encode the Kerberos ID as follows:

```
"http://localhost:8080/openidm/system/kerberos/account/kadmin%2Fadmin%40EXAMPLE.COM"
```

Chapter 13

Storing Multiple Passwords For Managed Users

This sample demonstrates how to set up multiple passwords for managed users and how to synchronize separate passwords to different external resources.

Note that you cannot run this sample through the Admin UI. To make the sample work with the Admin UI, set the `viewable` and `required` fields of the `password` property in the `conf/managed.json` file as follows:

```
"password" : {
    "title" : "Password",
    "type" : "string",
    "viewable" : true,
    "required" : true,
...
```

13.1. Configuration of the Multiple Passwords Sample

This sample assumes the following scenario:

- The managed/user repository is the source system.
- There are two target LDAP servers — `ldap` and `ldap2`.

  For the purposes of this sample, the two servers are represented by two separate organizational units on a single ForgeRock Directory Services (DS) instance.
- Managed user objects have two additional password fields, each mapped to one of the two LDAP servers.
- The two LDAP servers have different requirements for password policy and encryption.
- Both LDAP servers have a requirement for a password history policy, but the history size differs for the two policies.

  The sample shows how to extend the password history policy, described in "Creating a Password History Policy" in the *Integrator's Guide*, to apply to multiple password fields.
- The value of a managed user's `password` field is used by default for the additional passwords *unless* the CREATE, UPDATE, or PATCH requests on the managed user explicitly contain a value for these additional passwords.

The sample includes several customized configuration files in the `samples/multiple-passwords/conf/` directory. These customizations are crucial to the sample functionality, and are described in detail in the following list:

`provisioner.openicf-ldap.json`

Configures the connection to the first LDAP directory.

`provisioner.openicf-ldap2.json`

Configures the connection to the second LDAP directory.

`sync.json`

Provides the mappings from the IDM managed user repository to the respective LDAP servers. The file includes two mappings:

- A mapping from IDM managed users to the LDAP user objects at the `system/ldap/account` endpoint. This endpoint represents the `ou=People` subtree.

  This mapping specifies an `onCreate` and an `onUpdate` script that pull the pre-hashed value (if it is present) out of the context chain and use it to set the `userPassword` on the target object. Note that this mapping does not include an explicit mapping from `ldapPassword` to `userPassword`, as this is handled in the `onCreate` and `onUpdate` scripts.

- A mapping from IDM managed users to the LDAP user objects at the `system/ldap2/account` endpoint. This endpoint represents the `ou=Customers` subtree.

  This mapping includes an explicit mapping from `ldap2Password` to `userPassword` in the standard property mappings. Because this password is encrypted (as opposed to hashed) a transform script is defined which uses `openidm.decrypt()` to set the value on the target object.

`managed.json`

Contains a customized schema for managed users that includes the additional password fields.

This file has been customized as follows:

- An `onValidate` script stores the pre-hashed value of the `ldapPassword` field. This value is stored in the `ManagedObjectContext` in the Context chain of the request. During the sync event, the value can be pulled out of the context chain and used to map the target object. This is necessary because the hashed fields of a managed object are already hashed in the object itself by the time it reaches the sync process.
- The schema includes an `ldapPassword` field that is mapped to the accounts in the `system/ldap/accounts` target. This field is subject to the standard policies associated with the `password` field of a managed user. In addition, the `ldapPassword` must contain two capital letters instead of the usual one capital letter requirement. This field also uses hashing instead of encryption.
- The schema includes an `ldap2Password` field that is mapped to the accounts in the `system/ldap2/accounts` target. This field is subject to the standard policies associated with the `password` field of

a managed user. In addition, the `ldap2Password` must contain two numbers instead of the usual one number requirement.

- A custom password history policy (`"policyId" : "is-new"`) applies to each of the two mapped password fields `ldapPassword`, and `ldap2Password`.

`router.json`

A scripted filter on `managed/user` and `policy/managed/user` that populates the values of the additional password fields with the value of the main `password` field if the additional fields are not included in the request content.

The sample includes the following customized scripts in the `script` directory:

- `onCreate-onUpdate-sync.js` performs custom mapping logic. Specifically, this script maps the pre-hashed password value and sets the target object DN on create events.
- `storeFields.groovy` stores the pre-hashed values of fields in the context chain, on validate events.
- `onCreate-user-custom.js` and `onUpdate-user-custom.js` are used for validation of the password history policy when a user is created or updated.
- `pwpolicy.js` is an additional policy script for the password history policy.
- `set-additional-passwords.js` populates the values of the additional password fields with the value of the main `password` field if the additional fields are not included in the request content.

13.2. Understanding the Password History Policy

The sample includes a custom password history policy. Although the sample demonstrates the history of password attributes only, you can use this policy to enforce history validation on any managed object property.

The following configuration changes set up the password history policy:

- A `fieldHistory` property is added to managed users. The value of this field is a map of field names to a list of historical values for that field. These lists of values are used by the policy to determine if a new value has previously been used.

  The `fieldHistory` property is not accessible over REST by default, and cannot be modified.

- The `onCreate-user-custom.js` script performs the standard `onCreate` tasks for a managed user object but also stores the initial value of each of the fields for which IDM should keep a history. The script is passed the following configurable properties:

  - `historyFields` — a list of the fields to store history on.
  - `historySize` — the number of historical fields to store.

- The `onUpdate-user-custom.js` script compares the old and new values of the historical fields on update events to determine if the values have changed. When a new value is detected, it is stored in the list of historical values for that field.

  This script also contains logic to deal with the comparison of encrypted or hashed field values. The script is passed the following configurable properties:

  - `historyFields` — a list of the fields to store history on.
  - `historySize` — the number of historical fields to store.

- The `pwpolicy.js` script contains the additional policy definition for the password history policy. This script compares the new field value with the list of historical values for each field.

  The policy configuration (`policy.json`) references this script in its `additionalFiles` list, so that the policy service loads the policy definition. The new policy takes a `historyLength` parameter, which indicates the number of historical values to enforce the policy on. This number must not exceed the `historySize` specified in the `onCreate` and `onUpdate` scripts.

- The `ldapPassword` and `ldap2Password` fields in the managed user schema have been updated with the policy. For the purposes of this sample the `historySize` has been set to 2 for `ldapPassword` and to 4 for `ldap2Password`.

13.3. Configuring the LDAP Server

This sample expects the configuration for the external LDAP server to be the same as described in "LDAP Server Configuration".

The following steps provide setup instructions for DS version 6.0. Adjust these instructions if you are using an older version of DS, or an alternative LDAP server.

The LDIF data for this sample is provided in the file `openidm/samples/multiple-passwords/data/Example.ldif`. Import this data during your DS setup.

1. Download DS from ForgeRock's BackStage site and extract the zip archive.

2. Set up DS and import the `Example.ldif` file for this sample:

```
$ cd /path/to/opendj
$ ./setup \
 directory-server \
 --hostname localhost \
 --ldapPort 1389 \
 --rootUserDN "cn=Directory Manager" \
 --rootUserPassword password \
 --adminConnectorPort 4444 \
 --baseDN dc=com \
 --ldifFile /path/to/openidm/samples/multiple-passwords/data/Example.ldif \
 --acceptLicense
Validating parameters .....Done.
Configuring Certificates .....Done.
Configuring server .....Done.
Importing data from /path/to/openidm/samples/multiple-passwords/data/Example.ldif ........Done.
Starting Directory Server ............Done.

To see basic server status and configuration, you can launch /path/to/opendj/bin/status
```

3. Run an `ldapsearch` on the LDAP directory and look at the organizational units:

```
$ cd /path/to/opendj
$ bin/ldapsearch
 \
--hostname localhost
 \
--port 1389
 \
--bindDN "cn=directory manager"
 \
--bindPassword password
 \
--baseDN "dc=example,dc=com" \
"ou=*" \
ou
dn: ou=People,dc=example,dc=com
ou: people

dn: ou=Customers,dc=example,dc=com
ou: people
ou: Customers
```

The organizational units, `ou=People` and `ou=Customers`, represent the two different target LDAP systems that our mappings point to.

13.4. Demonstrating the Use of Multiple Accounts

This section starts IDM with the sample configuration, then creates a user with multiple passwords, adhering to the different policies in the configured password policy. The section tests that the user was synchronized to two separate LDAP directories, with the different required passwords, and that the user can bind to each of these LDAP directories.

1. Prepare IDM as described in "Preparing IDM", then start the server with the configuration for the multiple passwords sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/multiple-passwords
```

2. Create a user in IDM. Include a main `password` field but no additional password fields. The additional password fields (`ldapPassword` and `ldap2Password`) will be populated with the value of the main `password` field as a result of the script described previously.

   For the purposes of this example, we will not use the Admin UI, so that the result of each command can be clearly seen. Create the user over REST, by running the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PUT \
 --data '{
   "userName": "jdoe",
   "givenName": "John",
   "sn" : "Doe",
   "displayName" : "John Doe",
   "mail" : "john.doe@example.com",
   "password" : "Passw0rd"
 }' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "code": 403,
  "reason": "Forbidden",
  "message": "Policy validation failed",
  "detail": {
    "result": false,
    "failedPolicyRequirements": [
      {
        "policyRequirements": [
          {
            "policyRequirement": "AT_LEAST_X_CAPITAL_LETTERS",
            "params": {
              "numCaps": 2
            }
          }
        ],
        "property": "ldapPassword"
      },
      {
        "policyRequirements": [
          {
            "policyRequirement": "AT_LEAST_X_NUMBERS",
            "params": {
              "numNums": 2
            }
          }
        ],
        "property": "ldap2Password"
      }
    ]
```

```
  }
}
```

Notice that the create request failed with a policy validation failure on the two new password fields. Although the password met the requirement for the main `password` field, the user could not be created because the password did not meet the requirements of the `ldapPassword` and `ldap2Password` fields.

You can fix this problem either by updating the `password` field to one that passes both of the new requirements, or by updating the individual password fields to specifically pass their individual validation requirements.

3. Now, try to create user jdoe again, this time providing individual values for each of the different password fields, that comply with the three different password policies:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PUT \
 --data '{
   "userName": "jdoe",
   "givenName": "John",
   "sn" : "Doe",
   "displayName" : "John Doe",
   "mail" : "john.doe@example.com",
   "password" : "Passw0rd",
   "ldapPassword" : "PPassw0rd",
   "ldap2Password" : "Passw00rd"
 }' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "_id": "jdoe",
  "_rev": "000000001298f6a6",
  "userName": "jdoe",
  "givenName": "John",
  "sn": "Doe",
  "displayName": "John Doe",
  "mail": "john.doe@example.com",
  "ldapPassword": {
    "$crypto": {
      "value": {
        "algorithm": "SHA-256",
        "data": "CpbVZlXAEFL/LUqWyq9Bcks/tLVwJ0pHrc/smLWf8UmC/0BDtEKRo1o2IjB6mNFz"
      },
      "type": "salted-hash"
    }
  },
  "ldap2Password": {
    "$crypto": {
      "value": {
        "cipher": "AES/CBC/PKCS5Padding",
        "salt": "FQXojsuDX3JYeQguIykRDQ==",
        "data": "2oHsVDZmNfrIUtVN7LKB/A==",
        "iv": "hUK2gOWIhv6g+5Ykms46xg==",
        "key": "openidm-sym-default",
        "mac": "hAMNkwcxb7Ka/hrWRmogyw=="
```

```
      },
      "type": "x-simple-encryption"
    }
  }
,
...
}
```

The user has been created with three different passwords that comply with three distinct password policies. The passwords have been hashed or encrypted, as defined in the `managed.json` file.

4. As a result of implicit synchronization, two separate LDAP accounts should have been created for user jdoe on our two simulated LDAP servers. For more information about implicit synchronization, see "Types of Synchronization" in the *Integrator's Guide*.

5. Query the IDs in the LDAP directory as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryId=query-all-ids"
{
  "result" : [ {
    "_id": "3bbf1f43-e120-4d34-a4c9-05bd02be23bd",
    "dn" : "uid=jdoe,ou=People,dc=example,dc=com"
  }, {
    "_id": "d6c73ea1-fd05-4b80-8625-c50303755c91",
    "dn" : "uid=jdoe,ou=Customers,dc=example,dc=com"
  } ]
,
...
}
```

Note that jdoe has two entries - one in `ou=People` and one in `ou=Customers`.

6. Now, see if you can search each LDAP server, as user jdoe, with the separate passwords that you created for each directory.

This step will indicate that the passwords were propagated correctly to the separate LDAP servers.

```
$ cd /path/to/opendj
$ bin/ldapsearch
 \
--hostname localhost
 \
--port 1389
 \
--bindDN uid=jdoe,ou=People,dc=example,dc=com
 \
--bindPassword PPassw0rd
 \
--baseDN dc=example,dc=com \
uid=jdoe
```

```
dn: uid=jdoe,ou=People,dc=example,dc=com
objectClass: top
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
mail: john.doe@example.com
sn: Doe
cn: John Doe
givenName: John
userPassword: {SSHA512}qr8cljBrAHF/rEOGQe71EvCJzuUbLmWnA7tOfN0t3FaQjJVK2Ys5M...
uid: jdoe

dn: uid=jdoe,ou=Customers,dc=example,dc=com
objectClass: top
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
mail: john.doe@example.com
sn: Doe
cn: John Doe
givenName: John
uid: jdoe
$ bin/ldapsearch
 \
--hostname localhost
 \
--port 1389
 \
--bindDN uid=jdoe,ou=Customers,dc=example,dc=com
 \
--bindPassword Passw00rd
 \
--baseDN dc=example,dc=com \
uid=jdoe
dn: uid=jdoe,ou=People,dc=example,dc=com
objectClass: top
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
mail: john.doe@example.com
sn: Doe
cn: John Doe
givenName: John
uid: jdoe

dn: uid=jdoe,ou=Customers,dc=example,dc=com
objectClass: top
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
mail: john.doe@example.com
sn: Doe
cn: John Doe
givenName: John
userPassword: {SSHA512}PVtdOxRfBL8mG5duCE7RopCW5eA4NWJudZsW9WhNFpqC58M9koA9...
uid: jdoe
```

7. Patch jdoe's managed user entry to change his `ldapPassword`.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[ {
   "operation" : "replace",
   "field" : "ldapPassword",
   "value" : "TTestw0rd"
 } ]' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "_id": "jdoe",
  "_rev": "000000001298f6a6",
  "userName": "jdoe",
  "givenName": "John",
  "sn": "Doe",
  "displayName": "John Doe",
   ...
  "ldapPassword": {
    "$crypto": {
      "value": {
        "algorithm": "SHA-256",
        "data": "Vc6hvmzXaSSdG9WroqOTg3PQVdixhpg9tD/uKT610Z/H5iC6vsoOpE0/R5FaiDUg"
      },
      "type": "salted-hash"
    }
  },
 ...
}
```

8. Search the "first" LDAP server again, as user jdoe, with this new password to verify that the password change was propagated correctly to the LDAP server.

```
$ cd /path/to/opendj
$ bin/ldapsearch
 \
--hostname localhost
 \
--port 1389
 \
--bindDN uid=jdoe,ou=People,dc=example,dc=com
 \
--bindPassword TTestw0rd
 \
--baseDN dc=example,dc=com \
uid=jdoe
dn: uid=jdoe,ou=People,dc=example,dc=com
objectClass: top
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
mail: john.doe@example.com
sn: Doe
cn: John Doe
userPassword: {SSHA512}Fc1DATM62kIz5DZNJOUStBfvAlHl2QJtMwd8+bhCupUUoLhtIXr4D...
givenName: John
uid: jdoe

dn: uid=jdoe,ou=Customers,dc=example,dc=com
objectClass: top
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
mail: john.doe@example.com
sn: Doe
cn: John Doe
givenName: John
uid: jdoe
```

This concludes the demonstration of how multiple password policies can be managed across resources.

13.5. Demonstrating the Use of the Password History Policy

This section demonstrates the password history policy by patching jdoe's managed user entry, changing his `ldapPassword` a number of times.

1. Send the following patch requests, changing the value of jdoe's `ldapPassword` each time:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[ {
   "operation" : "replace",
   "field" : "ldapPassword",
   "value" : "TTestw0rd1"
```

```
 } ]' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "_id": "jdoe",
  "_rev": "00000000a92657c7",
  "userName": "jdoe",
  "givenName": "John",
  "sn": "Doe",
  "displayName": "John Doe",
  "mail": "john.doe@example.com"
,
...
  "ldapPassword": {
    "$crypto": {
      "value": {
        "algorithm": "SHA-256",
        "data": "N7WR9d+JsJDe2Atr5dc1bIVlhT+SaA+vKV1v2tUR2A13mpu/cTIQWiIBMpE/JilO"
      },
      "type": "salted-hash"
    }
  },
}
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[ {
   "operation" : "replace",
   "field" : "ldapPassword",
   "value" : "TTestw0rd2"
 } ]' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "_id": "jdoe",
  "_rev": "00000000dc6160c8",
  "userName": "jdoe",
  "givenName": "John",
  "sn": "Doe",
  "displayName": "John Doe",
  ...
  "ldapPassword": {
    "$crypto": {
      "value": {
        "algorithm": "SHA-256",
        "data": "6ukaCgcNzGjG9++SoHnIPYlSV4JZ2MBtHt5YepONl/oSNGQ3SQh7YozSO1PA+HAC"
      },
      "type": "salted-hash"
    }
  }
}
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[ {
   "operation" : "replace",
   "field" : "ldapPassword",
```

```
   "value" : "TTestw0rd3"
 } ]' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "_id": "jdoe",
  "_rev": "00000000a92657c7",
  "userName": "jdoe",
  "givenName": "John",
  "sn": "Doe",
  "displayName": "John Doe",
 ...
  "ldapPassword": {
    "$crypto": {
      "value": {
        "algorithm": "SHA-256",
        "data": "zJUQB7xMoLWwJPZZli99iktMIL+L2rh2wo0ueODekQ/bKobk8JCAOvudFinSmX1T"
      },
      "type": "salted-hash"
    }
  }
}
```

User jdoe now has a *history* of `ldapPassword` values, that contains `TTestw0rd3`, `TTestw0rd2`, `TTestw0rd1`, and `TTestw0rd`, in that order.

2. The history size for the `ldapPassword` policy is set to 2. To demonstrate the history policy, attempt to patch jdoe's entry with a password value that was used in his previous 2 password resets: `TTestw0rd2`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[ {
   "operation" : "replace",
   "field" : "ldapPassword",
   "value" : "TTestw0rd2"
 } ]' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "code": 403,
  "reason": "Forbidden",
  "message": "Failed policy validation",
  "detail": {
    "result": false,
    "failedPolicyRequirements": [
      {
        "policyRequirements": [
          {
            "policyRequirement": "IS_NEW"
          }
        ],
        "property": "ldapPassword"
      }
    ]
  }
}
```

The password reset fails the `IS_NEW` policy requirement.

3. Now, reset jdoe's `ldapPassword` to a value that was not used in the previous two updates:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[ {
   "operation" : "replace",
   "field" : "ldapPassword",
   "value" : "TTestw0rd"
 } ]' \
 "http://localhost:8080/openidm/managed/user/jdoe"
{
  "_id": "jdoe",
  "_rev": "00000000792afa08",
  "userName": "jdoe",
  "givenName": "John",
  "sn": "Doe",
  "displayName": "John Doe",
 ...
  "ldapPassword": {
    "$crypto": {
      "value": {
        "algorithm": "SHA-256",
        "data": "qAeh50kePULpYVkaUM8hgdDV/SeVDJorehoXQgmyK5jKEClB02PWZm0ny6eC/eLp"
      },
      "type": "salted-hash"
    }
  }
}
```

This time, the password reset succeeds.

Chapter 14

Linking Multiple Accounts to a Single Identity

This sample illustrates how IDM handles links from multiple accounts to a single identity.

The sample is based on a common use case in the insurance industry, where a company (Example.com) employs agents to sell policies to their insured customers. Most of their agents are also insured, which means that they have two distinct *roles* within the company - customers, and agents. With minor changes, this sample works for other use cases. For example, you might have a hospital that employs doctors who treat patients. Some of the doctors are also patients of that hospital.

14.1. Before You Start: Link Qualifiers, Agents, and Insured Customers

You define mappings between source and target accounts in the your project's `sync.json` file. As part of a mapping, you can create a link between a single source account and multiple target accounts using a *link qualifier*, that enables one-to-many relationships in mappings and policies. For more information about mappings and link qualifiers, see "Mapping Source Objects to Target Objects" in the *Integrator's Guide* and "Mapping a Single Source Object to Multiple Target Objects" in the *Integrator's Guide*.

This sample uses two link qualifiers:

- `Insured` represents the accounts associated with Example.com's Insured customers, created under the LDAP container `ou=Customers,dc=example,dc=com`.
- `Agent` represents agent accounts, considered independent contractors, and created under the LDAP container `ou=Contractors,dc=example,dc=com`.

Assume that agents and insured customers connect via two different portals, and that each group has access to different features, depending on the portal.

Agents might have two separate accounts; one each for professional and personal use. Although the accounts are different, the identity information for each agent should be the same for both accounts.

This sample therefore uses link qualifiers to distinguish the two *categories* of users. The link qualifiers are named `insured` and `agent`, and are defined as part of the `managedUser_systemLdapAccounts` mapping in the `sync.json` file:

```
{
  "name" : "managedUser_systemLdapAccounts",
  "source" : "managed/user",
  "target" : "system/ldap/account",
  "linkQualifiers" : [
    "insured",
    "agent"
  ],
  .....
}
```

You can check this configuration in the Admin UI. Click Configure > Mappings > `managedUser_systemLdapAccounts` > Properties > Link Qualifiers. You should see `insured` and `agent` in the list of configured link qualifiers.

In addition, the sample uses a transformation script that determines the LDAP Distinguished Name (`dn`) from the user category. The following excerpt of the `sync.json` file shows that script:

```
{
   "target" : "dn",
   "transform" : {
      "type" : "text/javascript",
      "globals" : { },
      "source" :
         "if (linkQualifier === 'agent') {
            'uid=' + source.userName + ',ou=Contractors,dc=example,dc=com';
         } else if (linkQualifier === 'insured') {
            'uid=' + source.userName + ',ou=Customers,dc=example,dc=com';
         }"
},
```

Finally, the following `validSource` script assesses the effective roles of a managed user to determine if that user has an `Agent` or `Insured` role. The script then assigns a link qualifier based on the assessed role.

```
"validSource" : {
  "type" : "text/javascript",
  "globals" : { },
  "source" : "var res = false;
    var i=0;

    while (!res && i < source.effectiveRoles.length) {
      var roleId = source.effectiveRoles[i];
      if (roleId != null && roleId.indexOf("/") != -1) {
        var roleInfo = openidm.read(roleId);
        logger.warn("Role Info : {}",roleInfo);
        res = (((roleInfo.properties.name === 'Agent')
          &&(linkQualifier ==='agent'))
        || ((roleInfo.properties.name === 'Insured')
          &&(linkQualifier ==='insured')));
        }
        i++;
      }
      res"
}
```

14.2. External LDAP Configuration

Configure the LDAP server as shown in "LDAP Server Configuration".

The LDAP user must have write access to create users from IDM on the LDAP server. When you configure the LDAP server, import the LDIF data file for this sample, *openidm/samples/multi-account-linking/data/Example.ldif*.

14.3. Running the Multi-Account Linking Sample

This section assumes that you have installed and configured ForgeRock Directory Services (DS), as described in the previous section.

1. Prepare IDM as described in "Preparing IDM", then start the server with the configuration for the Multi-Account Linking sample:

   ```
   $ cd /path/to/openidm
   ```

   ```
   $ ./startup.sh -p samples/multi-account-linking
   ```

2. Create the managed users.

   For the purpose of this sample, create managed user entries for John Doe and Barbara Jensen. To create these users from the Admin UI, navigate to `https://localhost:8443/admin` and click Manage > User > New User.

   Alternatively, use the following REST calls to create these managed user entries:

```
$ curl \
--header "Content-Type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST
 \
--data '{
  "displayName" : "Barbara Jensen",
  "description" : "Created for OpenIDM",
  "givenName" : "Barbara",
  "mail" : "bjensen@example.com",
  "telephoneNumber" : "1-360-229-7105",
  "sn" : "Jensen",
  "userName" : "bjensen",
  "accountStatus" : "active"
}' \
"http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id": "580f1441-ff8e-434b-9605-90e10a6fbdf6",
  "_rev": "00000000792afa08",
  "displayName": "Barbara Jensen",
  "description": "Created for OpenIDM",
  "givenName": "Barbara",
  "mail": "bjensen@example.com",
  "telephoneNumber": "1-360-229-7105",
  "sn": "Jensen",
  "userName": "bjensen",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

```
$ curl \
--header "Content-Type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST
 \
--data '{
  "displayName" : "John Doe",
  "description" : "Created for OpenIDM",
  "givenName" : "John",
  "mail" : "jdoe@example.com",
  "telephoneNumber" : "1-415-599-1100",
  "sn" : "Doe",
  "userName" : "jdoe",
  "accountStatus" : "active"
}' \
"http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id": "02632173-e413-4af1-8495-f749d5880226",
  "_rev": "000000001298f6a6",
  "displayName": "John Doe",
  "description": "Created for OpenIDM",
  "givenName": "John",
  "mail": "jdoe@example.com",
  "telephoneNumber": "1-415-599-1100",
  "sn": "Doe",
  "userName": "jdoe",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

In the output, you will see an `_id` associated with each user, for example, `580f1441-ff8e-434b-9605-90e10a6fbdf6`. Make a note of these `_id`s because you will need them when you assign roles to the managed users.

3. Set up the managed roles.

   This sample uses two managed roles, Agent, and Insured, to distinguish between the two user types described previously. To set up these roles in the Admin UI, navigate to `https://localhost:8443/admin` and click Manage > Role > New Role.

   Alternatively, use the following REST calls to set up the two managed roles:

```
$ curl \
--header "Content-Type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST
 \
--data '{
  "name" : "Agent",
  "description" : "Role assigned to insurance agents."
}' \
"http://localhost:8080/openidm/managed/role?_action=create"
{
  "_id": "1b58ec8d-fae2-4b28-a5cf-b63567e4cf3f",
  "_rev": "000000005b3d5ebd",
  "name": "Agent",
  "description": "Role assigned to insurance agents."
}
```

```
$ curl \
--header "Content-Type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST
 \
--data '{
  "name" : "Insured",
  "description" : "Role assigned to insured customers."
}' \
"http://localhost:8080/openidm/managed/role?_action=create"
{
  "_id": "617368f2-fa4e-44a2-a25a-f0a86e16ef00",
  "_rev": "000000002b845f24",
  "name": "Insured",
  "description": "Role assigned to insured customers."
}
```

Take note of the `_id` of each managed role. You will need these IDs to assign the roles to your managed users.

4. Grant the managed roles to the users.

   This step assumes that user jdoe is both an Agent and an Insured customer and that user bjensen is just an Insured customer of Example.com.

   To grant the roles, you need the `_id` for each user and the `_id` of each role, that you obtained when you created the users and roles.

   The following command grants the Agent role to jdoe:

```
$ curl \
```

```
--header "Content-type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request PATCH
 \
--data '[
    {
      "operation" : "add",
      "field" : "/roles/-",
      "value" : {
        "_ref" : "managed/role/1b58ec8d-fae2-4b28-a5cf-b63567e4cf3f"
      }
    }
  ]' \
"http://localhost:8080/openidm/managed/user/02632173-e413-4af1-8495-f749d5880226"
{
  "_id": "02632173-e413-4af1-8495-f749d5880226",
  "_rev": "00000000dc6160c8",
  "displayName": "John Doe",
  "description": "Created for OpenIDM",
  "givenName": "John",
  "mail": "jdoe@example.com",
  "telephoneNumber": "1-415-599-1100",
  "sn": "Doe",
  "userName": "jdoe",
  "accountStatus": "active",
  "effectiveRoles": [
    {
      "_ref": "managed/role/1b58ec8d-fae2-4b28-a5cf-b63567e4cf3f"
    }
  ],
  "effectiveAssignments": []
}
```

The following command grants the Insured role to user bjensen:

```
$ curl \
--header "Content-type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request PATCH
 \
--data '[
    {
      "operation" : "add",
      "field" : "/roles/-",
      "value" : {
        "_ref" : "managed/role/617368f2-fa4e-44a2-a25a-f0a86e16ef00"
      }
    }
  ]' \
"http://localhost:8080/openidm/managed/user/580f1441-ff8e-434b-9605-90e10a6fbdf6"
```

```
{
  "_id": "580f1441-ff8e-434b-9605-90e10a6fbdf6",
  "_rev": "000000004cab60c8",
  "displayName": "Barbara Jensen",
  "description": "Created for OpenIDM",
  "givenName": "Barbara",
  "mail": "bjensen@example.com",
  "telephoneNumber": "1-360-229-7105",
  "sn": "Jensen",
  "userName": "bjensen",
  "accountStatus": "active",
  "effectiveRoles": [
    {
      "_ref": "managed/role/617368f2-fa4e-44a2-a25a-f0a86e16ef00"
    }
  ],
  "effectiveAssignments": []
}
```

The following command grants the Insured role to jdoe, because he is both an insured customer and an agent:

```
$ curl \
--header "Content-type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request PATCH
 \
--data '[
    {
      "operation" : "add",
      "field" : "/roles/-",
      "value" : {
        "_ref" : "managed/role/617368f2-fa4e-44a2-a25a-f0a86e16ef00"
      }
    }
  ]' \
"http://localhost:8080/openidm/managed/user/02632173-e413-4af1-8495-f749d5880226"
{
  "_id": "02632173-e413-4af1-8495-f749d5880226",
  "_rev": "00000000a92657c7",
  "displayName": "John Doe",
  "description": "Created for OpenIDM",
  "givenName": "John",
  "mail": "jdoe@example.com",
  "telephoneNumber": "1-415-599-1100",
  "sn": "Doe",
  "userName": "jdoe",
  "accountStatus": "active",
  "effectiveRoles": [
    {
      "_ref": "managed/role/1b58ec8d-fae2-4b28-a5cf-b63567e4cf3f"
    },
    {
      "_ref": "managed/role/617368f2-fa4e-44a2-a25a-f0a86e16ef00"
```

```
    }
  ],
  "effectiveAssignments": []
}
```

Note from the output that jdoe now has two managed roles (and thus, two values for his `effectiveRoles` property.

5. Create the managed assignments.

   Assignments specify what a role actually does on a target system. A single account frequently has different functions on a system. For example, while agents might be members of the Contractor group, insured customers might be part of a Chat Users group (possibly for access to customer service). The following commands create two managed assignments that will be attached to the agent and insured roles. Note the `_id` of each assignment because you will need these when you attach the assignment to its corresponding role.

   The following command creates an `ldapAgent` assignment. Users who have this assignment will have their `ldapGroups` property in DS set to `cn=Contractors,ou=Groups,dc=example,dc=com`. The assignment is associated with the `agent` link qualifier:

```
$ curl \
 --header "Content-Type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 --data '{
   "name" : "ldapAgent",
   "description" : "LDAP Agent Assignment",
   "mapping" : "managedUser_systemLdapAccounts",
   "attributes": [
     {
       "name": "ldapGroups",
       "value": [
         "cn=Contractors,ou=Groups,dc=example,dc=com"
       ],
       "assignmentOperation" : "mergeWithTarget",
       "unassignmentOperation" : "removeFromTarget"
     }
   ],
   "linkQualifiers": ["agent"]
 }' \
 "http://localhost:8080/openidm/managed/assignment?_action=create"
{
  "_id": "cc0dbcdc-64a4-4f5b-aade-648fc012e2b5",
  "_rev": "00000000c7554e13",
  "name": "ldapAgent",
  "description": "LDAP Agent Assignment",
  "mapping": "managedUser_systemLdapAccounts",
  "attributes": [
    {
      "name": "ldapGroups",
      "value": [
        "cn=Contractors,ou=Groups,dc=example,dc=com"
      ],
      "assignmentOperation": "mergeWithTarget",
```

```
      "unassignmentOperation": "removeFromTarget"
    }
  ],
  "linkQualifiers": [
    "agent"
  ]
}
```

The following command creates an `ldapCustomer` assignment. Users who have this assignment will have their `ldapGroups` property in DS set to `cn=Chat Users,ou=Groups,dc=example,dc=com`. The assignment is associated with the `insured` link qualifier:

```
$ curl \
  --header "Content-Type: application/json" \
  --header "X-OpenIDM-Username: openidm-admin" \
  --header "X-OpenIDM-Password: openidm-admin" \
  --request POST \
  --data '{
    "name" : "ldapCustomer",
    "description" : "LDAP Customer Assignment",
    "mapping" : "managedUser_systemLdapAccounts",
    "attributes": [
      {
        "name": "ldapGroups",
        "value": [
          "cn=Chat Users,ou=Groups,dc=example,dc=com"
        ],
        "assignmentOperation" : "mergeWithTarget",
        "unassignmentOperation" : "removeFromTarget"
      }
    ],
    "linkQualifiers": ["insured"]
  }' \
"http://localhost:8080/openidm/managed/assignment?_action=create"
{
  "_id": "56b1f300-7156-4110-9b23-2052c16dd2aa",
  "_rev": "000000000cde398e",
  "name": "ldapCustomer",
  "description": "LDAP Customer Assignment",
  "mapping": "managedUser_systemLdapAccounts",
  "attributes": [
    {
      "name": "ldapGroups",
      "value": [
        "cn=Chat Users,ou=Groups,dc=example,dc=com"
      ],
      "assignmentOperation": "mergeWithTarget",
      "unassignmentOperation": "removeFromTarget"
    }
  ],
  "linkQualifiers": [
    "insured"
  ]
}
```

6. Add the assignments to their respective roles.

Add the `ldapCustomer` assignment to the Insured customer role:

```
$ curl \
--header "Content-type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request PATCH
 \
--data '[
    {
      "operation" : "add",
      "field" : "/assignments/-",
      "value" : {
        "_ref" : "managed/assignment/56b1f300-7156-4110-9b23-2052c16dd2aa"
      }
    }
  ]' \
"http://localhost:8080/openidm/managed/role/617368f2-fa4e-44a2-a25a-f0a86e16ef00"
{
  "_id": "617368f2-fa4e-44a2-a25a-f0a86e16ef00",
  "_rev": "0000000050c62938",
  "name": "Insured",
  "description": "Role assigned to insured customers."
}
```

7. Add the `ldapAgent` assignment to the Agent role:

```
$ curl \
--header "Content-type: application/json"
 \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request PATCH
 \
--data '[
    {
      "operation" : "add",
      "field" : "/assignments/-",
      "value" : {
        "_ref" : "managed/assignment/cc0dbcdc-64a4-4f5b-aade-648fc012e2b5"
      }
    }
  ]' \
"http://localhost:8080/openidm/managed/role/1b58ec8d-fae2-4b28-a5cf-b63567e4cf3f"
```

14.4. Reconciling Managed Users to the External LDAP Server

With the managed roles and assignments set up, you reconcile the managed user repository with the DS data store:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?_action=recon&mapping=managedUser_systemLdapAccounts"
```

With the roles, assignments and link qualifiers that you set up in the previous step, this reconciliation creates three new accounts in DS:

- Two accounts under `ou=Customers,dc=example,dc=com` (one for each user who has the insured customers role), `bjensen` and `jdoe`.
- One account under `ou=Contractors,dc=example,dc=com` (for the use who has the agents role), `jdoe`.

Note that both of these users already existed in DS (from the `Example.ldif` file that you imported during the setup). If you query the list of users in DS now, you will see the multiple accounts created for jdoe and bjensen as a result of the reconciliation:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "3bbf1f43-e120-4d34-a4c9-05bd02be23bd",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com"
    },
    {
      "_id": "d6c73ea1-fd05-4b80-8625-c50303755c91",
      "dn": "uid=bjensen,ou=People,dc=example,dc=com"
    },
    {
      "_id" : "0acc77a5-0f38-473b-b533-e37ca1d4fd4c",
      "dn": "uid=jdoe,ou=Contractors,dc=example,dc=com"
    },
    {
      "_id" : "3310b29a-0d7f-4ed5-aa0d-795d2780e002",
      "dn": "uid=bjensen,ou=Customers,dc=example,dc=com"
    },
    {
      "_id" : "3c8e3c3d-f748-44c1-8cfc-172f5b0a9b5e",
      "dn": "uid=jdoe,ou=Customers,dc=example,dc=com"
    }
  ]
,
...
}
```

Chapter 15

Linking Historical Accounts

This sample demonstrates the retention of inactive (historical) LDAP accounts that have been linked to a corresponding managed user account. The sample builds on "*Two Way Synchronization Between LDAP and IDM*" and uses the LDAP connector to connect to a ForgeRock Directory Services (DS) instance. You can use any LDAP-v3 compliant directory server.

In this sample, IDM is the source resource. Managed users in the IDM repository maintain a list of the accounts to which they have been linked on the local LDAP server. This list is stored in the `historicalAccounts` field of the managed user entry. The list contains a reference to all past and current LDAP accounts. Each LDAP account in the list is represented as a *relationship* and includes information about the date the accounts were linked or unlinked, and whether the account is currently active. For more information about relationship objects, see "*Managing Relationships Between Objects*" in the *Integrator's Guide*.

This sample includes the following custom scripts, in its `script` directory:

- `onLink-managedUser_systemLdapAccounts.js`

  When a managed user object is linked to a target LDAP object, this script creates the relationship entry in the managed user's `historicalAccounts` property. The script adds two relationship properties:

  - `linkDate` — specifies the date that the link was created.
  - `active` — boolean true/false. When set to true, this property indicates that the target object is *currently* linked to the managed user account.

- `onUnlink-managedUser_systemLdapAccounts.js`

  When a managed user object is unlinked from a target LDAP object, this script updates that relationship entry's properties with an `unlinkDate` that specifies when the target was unlinked, and sets the `active` property to false, indicating that the target object is no longer linked.

- `check_account_state_change.js`

  During liveSync or reconciliation, this script checks if the LDAP account state has changed. If the state has changed, the script updates the historical account properties to indicate the new state (enabled or disabled), and the date that the state was changed. This date can only be approximated and is set to the time that the change was detected by the script.

- `ldapBackCorrelationQuery.js`

  This script correlates entries in the LDAP directory with managed user identities in IDM.

15.1. Configuring the LDAP Server

This sample expects the configuration for the external LDAP server to be the same as described in "LDAP Server Configuration".

The following steps provide setup instructions for DS version 6.0. Adjust these instructions if you are using an older version of DS, or an alternative LDAP server.

The LDIF data for this sample is provided in the file `openidm/samples/historical-account-linking/data/Example.ldif`. Import this data during your DS setup.

Although there is only one LDAP server in this example, you must enable *replication* on that server, so that the server has an external change log. The change log is required for liveSync between DS and IDM.

1. Download DS from ForgeRock's BackStage site and extract the zip archive.

2. Set up DS and import the `Example.ldif` file for this sample:

```
$ cd /path/to/opendj
$ ./setup \
 directory-server \
 --hostname localhost \
 --ldapPort 1389 \
 --rootUserDN "cn=Directory Manager" \
 --rootUserPassword password \
 --adminConnectorPort 4444 \
 --baseDN dc=com \
 --ldifFile /path/to/openidm/samples/historical-account-linking/data/Example.ldif \
 --acceptLicense
.Validating parameters .....Done.
Configuring Certificates .....Done.
Configuring server .....Done.
Importing data from /path/to/openidm/samples/historical-account-linking/data/Example.ldif ........Done
.
Starting Directory Server ............Done.

To see basic server status and configuration, you can launch /path/to/opendj/bin/status
```

3. Enable replication:

```
$ cd /path/to/opendj/bin
$ ./dsconfig create-replication-server \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --provider-name "Multimaster Synchronization" \
 --set replication-port:8989 \
 --set replication-server-id:2 \
 --trustAll \
 --no-prompt
The Replication Server was created successfully
```

```
$ ./dsconfig create-replication-domain \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --provider-name "Multimaster Synchronization" \
 --set base-dn:dc=example,dc=com \
 --set replication-server:localhost:8989 \
 --set server-id:3 \
 --domain-name example.com\
 --trustAll \
 --no-prompt
The Replication Domain was created successfully
```

15.2. Running the Historical Accounts Sample

This section walks you through each step of the sample to demonstrate how historical accounts are stored.

1. Prepare IDM as described in "Preparing IDM", then start the server with the configuration for the historical accounts sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/historical-account-linking/
Executing ./startup.sh...
Using OPENIDM_HOME:   /path/to/openidm
Using PROJECT_HOME:   /path/to/openidm/samples/historical-account-linking
Using OPENIDM_OPTS:   -Xmx1024m -Xms1024m
Using LOGGING_CONFIG: -Djava.util.logging.config.file=
      /path/to/openidm/samples/historical-account-linking/conf/logging.properties
Using boot properties at
      /path/to/openidm/resolver/boot
.properties
-> OpenIDM version "6.0.0.7"
OpenIDM ready
```

2. Create a user, Joe Smith, in IDM.

   The following command creates the user over REST, and assigns the user the ID `joesmith`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
     "userName": "joe.smith",
     "givenName": "Joe",
     "sn" : "Smith",
     "password" : "Passw0rd",
     "displayName" : "Joe Smith",
     "mail" : "joe.smith@example.com",
     "_id" : "joesmith"
 }' \
 "http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id": "joesmith",
  "_rev": "00000000b8ea3183",
  "userName": "joe.smith",
  "givenName": "Joe",
  "sn": "Smith",
  "displayName": "Joe Smith",
  "mail": "joe.smith@example.com",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

3. Verify that the user Joe Smith was created in DS.

   Because implicit synchronization is enabled by default, any change to the managed/user repository should be propagated to DS. For more information about implicit synchronization, see "Types of Synchronization" in the *Integrator's Guide*.

   The following command returns all IDs in DS and shows that user joesmith was created successfully:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "0da50512-79bb-3461-bd04-241ee4c785bf",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com"
    },
    {
      "_id": "887732e8-3db2-31bb-b329-20cd6fcecc05",
      "dn": "uid=bjensen,ou=People,dc=example,dc=com"
    },
    {
      "_id": "0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "dn": "uid=joe.smith0,ou=People,dc=example,dc=com"
    }
  ],
  ...
}
```

Note that Joe Smith's `uid` in DS is appended with a `0`. The `onCreate` script, defined in the mapping (`sync.json`), increments the `uid` each time a new DS entry is linked to the same managed user object.

4. Verify that the historical account *relationship object* that corresponds to this linked LDAP account was created in the IDM repository.

   The following command returns all of the `historicalAccounts` for user joesmith:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/joesmith/historicalAccounts?_queryId=query-all"
{
  "result": [
    {
      "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
      "_rev": "000000002ec6cd4f",
      "_ref": "system/ldap/account/0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refResourceCollection": "system/ldap/account",
      "_refResourceId": "0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refProperties": {
        "active": true,
        "stateLastChanged": "Mon Feb 26 2018 12:09:46 GMT+0200 (SAST)",
        "state": "enabled",
        "linkDate": "Mon Feb 26 2018 12:09:46 GMT+0200 (SAST)",
        "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
        "_rev": "000000002ec6cd4f"
      }
    }
  ]
,
...
}
```

At this stage, Joe Smith has only one historical account link — the link to `system/ldap/account/0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3`, which corresponds to the DN `"dn": "uid=joe.smith0,ou=People,dc=example,dc=com"`. Note that the relationship properties (`_refProperties`) show the following information about the linked accounts:

- The date on which the accounts were linked
- The fact that this link is currently active
- The state of the account in DS (`enabled`)

5. Enable the liveSync schedule to propagate changes made in DS to the managed user repository.

   To start liveSync, set `enabled` to `true` in the `conf/schedule-liveSync.json` file:

```
$ cd /path/to/openidm
$ more samples/historical-account-linking/conf/schedule-liveSync.json
{
    "enabled" : true,
    "type" : "simple",
    "repeatInterval" : 15000
,
...
```

6. Use the `manage-account` command in the `opendj/bin` directory to disable Joe Smith's account in DS:

```
$ cd /path/to/opendj
$ bin/manage-account set-account-is-disabled
 \
--port 4444
 \
--bindDN "cn=Directory Manager"
 \
--bindPassword password
 \
--operationValue true
 \
--targetDN uid=joe.smith0,ou=people,dc=example,dc=com
 \
--trustAll
Account Is Disabled:  true
```

Within 15 seconds, according to the configured schedule, liveSync should pick up the change. IDM should then adjust the `state` property in Joe Smith's managed user account.

7. Check Joe Smith's historical accounts again, to make sure that the state of this linked account has changed:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/joesmith/historicalAccounts?_queryId=query-all"
{
  "result": [
    {
      "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
      "_rev": "00000000b535e3e6",
      "_ref": "system/ldap/account/0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refResourceCollection": "system/ldap/account",
      "_refResourceId": "0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refProperties": {
        "active": true,
        "stateLastChanged": "Mon Feb 26 2018 12:22:22 GMT+0200 (SAST)",
        "state": "disabled",
        "linkDate": "Mon Feb 26 2018 12:09:46 GMT+0200 (SAST)",
        "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
        "_rev": "00000000b535e3e6"
      }
    }
  ]
,
...
}
```

8. Now, deactivate Joe Smith's managed user account by setting his `accountStatus` property to `inactive`.

   You can deactivate the account over the REST interface, or by using the Admin UI.

   To use the Admin UI, simply select Manage > User, select Joe Smith's account and change his Status to inactive, on his Details tab.

The following command deactivates Joe Smith's account over REST:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[
      { "operation" : "replace",
        "field" : "accountStatus",
        "value" : "inactive" }
 ]' \
 "http://localhost:8080/openidm/managed/user/joesmith"
{
  "_id": "joesmith",
  "_rev": "00000000579f3324",
  "userName": "joe.smith",
  "givenName": "Joe",
  "sn": "Smith",
  "displayName": "Joe Smith",
  "mail": "joe.smith@example.com",
  "accountStatus": "inactive",
  ...
}
```

9. Request Joe Smith's historical accounts again:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/joesmith/historicalAccounts?_queryId=query-all"
{
  "result": [
    {
      "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
      "_rev": "00000000f00cf26e",
      "_ref": "system/ldap/account/0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refResourceCollection": "system/ldap/account",
      "_refResourceId": "0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refProperties": {
        "active": false,
        "stateLastChanged": "Mon Feb 26 2018 12:22:22 GMT+0200 (SAST)",
        "state": "disabled",
        "linkDate": "Mon Feb 26 2018 12:09:46 GMT+0200 (SAST)",
        "unlinkDate": "Mon Feb 26 2018 12:29:35 GMT+0200 (SAST)",
        "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
        "_rev": "00000000f00cf26e"
      }
    }
  ]
,
...
}
```

10. Activate Joe Smith's managed user account by setting his `accountStatus` property to active. This action should create a new entry in DS (with `uid=joe.smith1`), and a new link from Joe Smith's managed user object to that DS entry.

    You can activate the account over the REST interface, or by using the Admin UI, as described previously.

    The following command activates Joe Smith's account over REST:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[
      { "operation" : "replace",
        "field" : "accountStatus",
        "value" : "active" }
 ]' \
 "http://localhost:8080/openidm/managed/user/joesmith"
{
  "_id": "joesmith",
  "_rev": "00000000c2cb3095",
  "userName": "joe.smith",
  "givenName": "Joe",
  "sn": "Smith",
  "displayName": "Joe Smith",
  "mail": "joe.smith@example.com",
  "accountStatus": "active",
 ...
}
```

11. Verify that a new LDAP entry for user Joe Smith was created in DS.

    The following command returns all IDs in DS and shows that two entries now exist for Joe Smith - `uid=joe.smith0` and `uid=joe.smith1`.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "0da50512-79bb-3461-bd04-241ee4c785bf",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com"
    },
    {
      "_id": "887732e8-3db2-31bb-b329-20cd6fcecc05",
      "dn": "uid=bjensen,ou=People,dc=example,dc=com"
    },
    {
      "_id": "0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "dn": "uid=joe.smith0,ou=People,dc=example,dc=com"
    },
    {
      "_id": "30ca4ec1-9561-49d8-8199-ed52e66a66f2",
      "dn": "uid=joe.smith1,ou=People,dc=example,dc=com"
    }
  ]
,
...
}
```

12. Request Joe Smith's historical accounts again:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/joesmith/historicalAccounts?_queryId=query-all"
{
  "result": [
    {
      "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
      "_rev": "00000000f00cf26e",
      "_ref": "system/ldap/account/0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refResourceCollection": "system/ldap/account",
      "_refResourceId": "0fa26f3f-55c1-4e0f-993b-dec7b9bc26d3",
      "_refProperties": {
        "active": false,
        "stateLastChanged": "Mon Feb 26 2018 12:22:22 GMT+0200 (SAST)",
        "state": "disabled",
        "linkDate": "Mon Feb 26 2018 12:09:46 GMT+0200 (SAST)",
        "unlinkDate": "Mon Feb 26 2018 12:29:35 GMT+0200 (SAST)",
        "_id": "2fe2f801-fbde-4c61-9b30-485e67ad08cc",
        "_rev": "00000000f00cf26e"
      }
    },
    {
      "_id": "dd8f895d-4b6e-4425-b92a-1963e1720987",
      "_rev": "000000008770cc38",
      "_ref": "system/ldap/account/30ca4ec1-9561-49d8-8199-ed52e66a66f2",
      "_refResourceCollection": "system/ldap/account",
```

```
      "_refResourceId": "30ca4ec1-9561-49d8-8199-ed52e66a66f2",
      "_refProperties": {
        "active": true,
        "stateLastChanged": "Mon Feb 26 2018 12:30:40 GMT+0200 (SAST)",
        "state": "enabled",
        "linkDate": "Mon Feb 26 2018 12:30:40 GMT+0200 (SAST)",
        "_id": "dd8f895d-4b6e-4425-b92a-1963e1720987",
        "_rev": "000000008770cc38"
      }
    }
  ],
  ...
}
```

Note that Joe Smith's entry now shows two DS accounts, but that only the link to `uid=joe.smith1` (`"_ref": "system/ldap/account/30ca4ec1-9561-49d8-8199-ed52e66a66f2",`) is `enabled` and `active`.

Chapter 16

Provisioning With Roles

This sample demonstrates how attributes are provisioned to an external system (an LDAP directory), based on role membership. This sample uses ForgeRock Directory Services (DS) as the LDAP directory, but you can use any LDAP v3-compliant server.

IDM supports two types of roles:

- *Provisioning roles* specify how objects are provisioned to an external system.
- *Authorization roles* specify the authorization rights of a managed object internally, within IDM.

Both provisioning roles and authorization roles use the relationships mechanism to link the role object, and the managed object to which the role applies. For more information about relationships between objects, see "*Managing Relationships Between Objects*" in the *Integrator's Guide*. For information about managing roles, see "*Working With Managed Roles*" in the *Integrator's Guide*.

Important

Most of the commands in this sample can be run by using the command-line but it is generally much easier to use the Admin UI. In some cases, the command-line version makes it easier to explain what is happening in IDM. Therefore, in all steps, the sample first shows the command-line version, and then provides the equivalent method of running the command in the Admin UI.

16.1. Provisioning to an LDAP Server

The main purpose of IDM roles is to provision a set of attributes, based on a managed user's role membership.

The sample assumes a company, example.com. As an *Employee* of example.com, a user should be added to two groups in DS - the Employees group and the Chat Users group (presumably to access certain internal applications). As a *Contractor*, a user should be added only to the Contractors group in DS. A user's employee type must also be set correctly in DS, based on the role that is granted to the user.

16.1.1. External LDAP Configuration

Configure the LDAP server as shown in "LDAP Server Configuration". The LDAP user must have write access to create users from IDM on the LDAP server. When you set up the LDAP server, import the LDIF file for this sample (`openidm/samples/provisioning-with-roles/data/Example.ldif`).

16.1.2. Before You Start

This section sets up the scenario by performing the following tasks:

1. Start IDM with the configuration for this sample.
2. Create two managed roles, Employee and Contractor.
3. Reconcile the managed user repository with the user entries in the LDAP server.

1. Prepare IDM as described in "Preparing IDM", then start the server with the configuration for this sample:

```
$ cd /path/to/openidm
```

```
$ ./startup.sh -p samples/provisioning-with-roles
```

2. Create two managed roles, Employee and Contractor, either by using the Admin UI, or by running the following commands:

```
$ curl \
 --header "Content-type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 --data '{
   "name" : "Employee",
   "description": "Role granted to workers on the payroll."
 }' \
 "http://localhost:8080/openidm/managed/role?_action=create"
{
  "_id": "19991736-eb6a-4d62-bc73-f149524e21f8",
  "_rev": "00000000292c6022",
  "name": "Employee",
  "description": "Role granted to workers on the payroll."
}
```

```
$ curl \
 --header "Content-type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 --data '{
   "name" : "Contractor",
   "description": "Role granted to contract workers."
 }' \
 "http://localhost:8080/openidm/managed/role?_action=create"
{
  "_id": "f7da3805-50dd-4585-9bf6-e01658dece01",
  "_rev": "00000000f5ac5f89",
  "name": "Contractor",
  "description": "Role granted to contract workers."
}
```

Note the IDs of these two roles because you will use them in the commands that follow.

3. Reconcile the repository.

   The `sync.json` configuration file for this sample includes two mappings: `systemLdapAccounts_managedUser`, which synchronizes users from the source LDAP server with the target IDM repository; and `managedUser_systemLdapAccounts`, which synchronizes changes from the repository with the LDAP server.

   Run a reconciliation operation for the first mapping, either by using the Admin UI, or over the REST interface:

   - To use the Admin UI, select Configure > Mapping, click on the first mapping (System/Ldap/Account --> Managed User) and click Reconcile.
   - To use the REST interface, run the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemLdapAccounts_managedUser&waitForCompletion=true"
{
  "_id": "b5c535f8-5c1f-44dc-afa3-40d4f9984925-24",
  "state": "SUCCESS"
}
```

The sample is now ready to demonstrate provisioning roles.

16.1.3. Run the Sample

This section assumes that you have reconciled the managed user repository to populate it with the users from the LDAP server, and that you have created the Employee and Contractor roles.

This part of the sample demonstrates the following features of the roles implementation:

- "Adding Assignments to a Role Definition"
- "Granting a Role to a User and Observing that User's Role Assignments"
- "Propagating Assignments to an External System"
- "Removing a Role Grant From a User and Observing That User's Role Assignments"

16.1.3.1. Adding Assignments to a Role Definition

A role *assignment* is the logic that provisions a managed user to an external system, based on some criteria. The most common use case of a role assignment is the provisioning of specific attributes to an external system, based on the role or roles that the managed user has been granted. Assignments

are sometimes called *entitlements*. For more information about assignments, see "Working With Role Assignments" in the *Integrator's Guide*.

In this section, you will create an assignment and add it to the Employee role that you created previously. This section assumes the following scenario:

example.com's policy requires that every employee has the correct value for their `employeeType` in their corporate directory (DS).

1. Display the roles that you created in the previous section:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/role?_queryFilter=true"
{
  "result": [
    {
      "_id": "19991736-eb6a-4d62-bc73-f149524e21f8",
      "_rev": "00000000292c6022",
      "name": "Employee",
      "description": "Role granted to workers on the payroll."
    },
    {
      "_id": "f7da3805-50dd-4585-9bf6-e01658dece01",
      "_rev": "00000000f5ac5f89",
      "name": "Contractor",
      "description": "Role granted to contract workers."
    }
  ]
,
...
}
```

Tip

Display the roles in the Admin UI by selecting Manage > Role.

2. Create a new managed assignment named Employee.

   The assignment is specifically for the mapping from the managed user repository to the LDAP server. The assignment sets the value of the `employeeType` attribute on the LDAP server to `Employee`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-type: application/json" \
 --request POST \
 --data '{
   "name" : "Employee",
   "description": "Assignment for employees.",
   "mapping" : "managedUser_systemLdapAccounts",
   "attributes": [
```

```
    {
      "name": "employeeType",
      "value": [
        "Employee"
      ],
      "assignmentOperation" : "mergeWithTarget",
      "unassignmentOperation" : "removeFromTarget"
    }
  ]
 }' \
 "http://localhost:8080/openidm/managed/assignment?_action=create"
{
  "_id": "8f2c3111-5d5a-4bed-abc8-810ec8b9278d",
  "_rev": "00000000b2369bf7",
  "name": "Employee",
  "description": "Assignment for employees.",
  "mapping": "managedUser_systemLdapAccounts",
  "attributes": [
    {
      "name": "employeeType",
      "value": [
        "Employee"
      ],
      "assignmentOperation": "mergeWithTarget",
      "unassignmentOperation": "removeFromTarget"
    }
  ]
}
```

Tip

Create the assignment in the Admin UI:

1. Select Manage > Assignment, and click New Assignment.
2. Enter a name and description for the assignment, and select the mapping for which the assignment is applied (managedUser_systemLdapAccounts).
3. Click Add Assignment.
4. Select the Attributes tab, and click Add an Attribute.
5. Select employeeType, click item, select string, and enter the value Employee.
6. Click Save.

3. Add the assignment to the Employee role that you created previously.

   Assignments are implemented as *relationship objects*. This means that you add an assignment to a role by *referencing* the assignment in the role's `assignments` field:

   This command patches the Employee role to update its `assignments` field.

```
$ curl \
 --header "Content-type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request PATCH \
 --data '[
   {
     "operation" : "add",
     "field" : "/assignments/-",
     "value" : { "_ref": "managed/assignment/8f2c3111-5d5a-4bed-abc8-810ec8b9278d"}
   }
 ]' \
 "http://localhost:8080/openidm/managed/role/19991736-eb6a-4d62-bc73-f149524e21f8"
{
  "_id": "19991736-eb6a-4d62-bc73-f149524e21f8",
  "_rev": "00000000292c6022",
  "name": "Employee",
  "description": "Role granted to workers on the payroll."
}
```

Tip

Add the assignment to the role in the Admin UI:

1. Select Manage > Role, and select the Employee role.
2. On the Managed Assignments tab, click Add Managed Assignments.
3. Select the Employee assignment and click Add.

16.1.3.2. Granting a Role to a User and Observing that User's Role Assignments

When a role is granted to a user (by updating the users `roles` property), any assignments that are referenced by the role are automatically referenced in the user's `assignments` property.

In this section, we will grant the Employee role we created previously to the user Barbara Jensen, who was created in the managed/user repository during the reconciliation from DS.

1. Before you can update Barbara Jensen's entry, determine the identifier of her entry by querying her username, `bjensen`, and requesting only her `_id` field:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryFilter=/userName+eq+'bjensen'&_fields=_id"
{
  "result": [
    {
      "_id": "0728d860-1ac5-402d-8d6a-2bef98a15ebc",
      "_rev": "000000008a64fd25"
    }
  ],
  ...
}
```

From the output, you can see that bjensen's `_id` is `0728d860-1ac5-402d-8d6a-2bef98a15ebc`. (This unique ID will obviously be different in your command output.)

2. Update bjensen's entry by adding a reference to the ID of the Employee role as a value of her `roles` attribute:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-type: application/json" \
 --request PATCH \
 --data '[
     {
         "operation" : "add",
         "field" : "/roles/-",
         "value" : { "_ref": "managed/role/19991736-eb6a-4d62-bc73-f149524e21f8" }
     }
 ]' \
 "http://localhost:8080/openidm/managed/user/0728d860-1ac5-402d-8d6a-2bef98a15ebc"
{
  "_id": "0728d860-1ac5-402d-8d6a-2bef98a15ebc",
  "_rev": "00000000e89de6f9",
  "displayName": "Barbara Jensen",
  "description": "Created for OpenIDM",
  "givenName": "Barbara",
  "mail": "bjensen@example.com",
  "telephoneNumber": "1-360-229-7105",
  "sn": "Jensen",
  "userName": "bjensen",
  "accountStatus": "active",
  "effectiveRoles": [
    {
      "_ref": "managed/role/19991736-eb6a-4d62-bc73-f149524e21f8"
    }
  ],
  "effectiveAssignments": [
    {
      "name": "Employee",
      "description": "Assignment for employees.",
      "mapping": "managedUser_systemLdapAccounts",
      "attributes": [
        {
```

```
          "name": "employeeType",
          "value": [
            "Employee"
          ],
          "assignmentOperation": "mergeWithTarget",
          "unassignmentOperation": "removeFromTarget"
        }
      ],
      "_rev": "00000000b2369bf7",
      "_id": "8f2c3111-5d5a-4bed-abc8-810ec8b9278d"
    }
  ]
}
```

Tip

Assign the role to bjensen by using the Admin UI:

1. Select Manage > User, and click on bjensen's entry.
2. On the Provisioning Roles tab, click Add Provisioning Roles.
3. Select the Employee role and click Add.

3. Take a closer look at bjensen's entry, specifically at her roles, effective roles and effective assignments:

```
$ curl \
   --header "X-OpenIDM-Username: openidm-admin" \
   --header "X-OpenIDM-Password: openidm-admin" \
   --request GET \
   "http://localhost:8080/openidm/managed/user?_queryFilter=/userName+eq+'bjensen'&_fields=_id
,userName,roles,effectiveRoles,effectiveAssignments"
{
  "_id": "0728d860-1ac5-402d-8d6a-2bef98a15ebc",
  "_rev": "00000000e89de6f9",
  "displayName": "Barbara Jensen",
  "description": "Created for OpenIDM",
  "givenName": "Barbara",
  "mail": "bjensen@example.com",
  "telephoneNumber": "1-360-229-7105",
  "sn": "Jensen",
  "userName": "bjensen",
  "accountStatus": "active",
  "effectiveRoles": [
    {
      "_ref": "managed/role/19991736-eb6a-4d62-bc73-f149524e21f8"
    }
  ],
  "effectiveAssignments": [
    {
      "name": "Employee",
      "description": "Assignment for employees.",
      "mapping": "managedUser_systemLdapAccounts",
      "attributes": [
```

```
        {
          "name": "employeeType",
          "value": [
            "Employee"
          ],
          "assignmentOperation": "mergeWithTarget",
          "unassignmentOperation": "removeFromTarget"
        }
      ],
      "_rev": "00000000b2369bf7",
      "_id": "8f2c3111-5d5a-4bed-abc8-810ec8b9278d"
    }
  ]
}
```


Note that bjensen now has the calculated property `effectiveAssignments`, which includes the set of assignments that pertains to any user with the Employee role. Currently the assignment lists the `employeeType` attribute.

In the next section, you will see how the assignment is used to set the value of the `employeeType` attribute in the LDAP server.

16.1.3.3. Propagating Assignments to an External System

This section provides a number of steps that show how effective assignments are propagated out to the external systems associated with their mappings.

1. Verify that bjensen's `employeeType` has been set correctly in DS.

   Because implicit synchronization is enabled by default, any changes made to a managed user object are pushed out to all the external systems for which mappings are configured.

   So, because bjensen has an effective assignment that sets an attribute in her LDAP entry, you should immediately see the resulting change in her LDAP entry.

   To verify that her entry has changed, run an `ldapsearch` on her entry and check the value of her `employeeType` attribute.

Note

This command assumes that you are using the **ldapsearch** command that is provided with DS (`opendj/bin/ldapsearch`).

```
$ ldapsearch \
 --port 1389 \
 --hostname localhost \
 --baseDN "dc=example,dc=com" \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --searchScope sub \
 "(uid=bjensen)" dn uid employeeType
dn: uid=bjensen,ou=People,dc=example,dc=com
uid: bjensen
employeeType: Employee
```

Note that bjensen's `employeeType` attribute is correctly set to `Employee`.

2. To observe how a managed user's roles can be used to provision group membership in an external directory, we add the groups that an Employee and a Contractor should have in the corporate directory (DS) as assignment attributes of the respective roles.

   First, look at the current `assignments` of the Employee role again:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/role/19991736-eb6a-4d62-bc73-f149524e21f8?_fields=assignments
,name"
{
  "_id": "19991736-eb6a-4d62-bc73-f149524e21f8",
  "_rev": "00000000292c6022",
  "name": "Employee",
  "assignments": [
    {
      "_ref": "managed/assignment/8f2c3111-5d5a-4bed-abc8-810ec8b9278d",
      "_refResourceCollection": "managed/assignment",
      "_refResourceId": "8f2c3111-5d5a-4bed-abc8-810ec8b9278d",
      "_refProperties": {
        "_id": "62318c1c-4386-44dd-b9e8-f971cce9a4fa",
        "_rev": "00000000cd61a7bf"
      }
    }
  ]
}
```

   To update the `groups` attribute in bjensen's LDAP entry, you do not need to create a *new* assignment. You simply need to add the attribute for LDAP groups to the Employee assignment (with ID `8f2c3111-5d5a-4bed-abc8-810ec8b9278d`):

```
$ curl \
 --header "Content-type: application/json" \
```

```
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request PATCH \
 --data '[
     {
         "operation" : "add",
         "field" : "/attributes/-",
         "value" : {
             "name": "ldapGroups",
             "value": [
                 "cn=Employees,ou=Groups,dc=example,dc=com",
                 "cn=Chat Users,ou=Groups,dc=example,dc=com"
             ],
             "assignmentOperation" : "mergeWithTarget",
             "unassignmentOperation" : "removeFromTarget"
         }
     }
 ]' \
 "http://localhost:8080/openidm/managed/assignment/8f2c3111-5d5a-4bed-abc8-810ec8b9278d"
{
  "_id": "8f2c3111-5d5a-4bed-abc8-810ec8b9278d",
  "_rev": "000000003b22fb6d",
  "name": "Employee",
  "description": "Assignment for employees.",
  "mapping": "managedUser_systemLdapAccounts",
  "attributes": [
    {
      "name": "employeeType",
      "value": [
        "Employee"
      ],
      "assignmentOperation": "mergeWithTarget",
      "unassignmentOperation": "removeFromTarget"
    },
    {
      "name": "ldapGroups",
      "value": [
        "cn=Employees,ou=Groups,dc=example,dc=com",
        "cn=Chat Users,ou=Groups,dc=example,dc=com"
      ],
      "assignmentOperation": "mergeWithTarget",
      "unassignmentOperation": "removeFromTarget"
    }
  ]
}
```

So, the Employee assignment now sets two attributes on the LDAP system - the `employeeType` attribute, and the `ldapGroups` attribute.

Tip

To add more attributes to the Employee assignment in the Admin UI:

1. Select Manage > Assignment, and click on the Employee assignment.
2. On the Attributes tab, select Add an attribute and select the ldapGroups attribute.

3. Enter the values

   ```
   cn=Employees,ou=Groups,dc=example,dc=com
   ```

   and

   ```
   cn=Chat Users,ou=Groups,dc=example,dc=com
   ```

   and click Save.

3. With the implicit synchronization between the managed user repository and DS, bjensen should now be a member of the `cn=Employees` and `cn=Chat Users` groups in LDAP.

   You can verify this with the following `ldapsearch` command. This command returns bjensen's group membership, in her `isMemberOf` attribute.

   ```
   $ ldapsearch \
    --port 1389 \
    --hostname localhost \
    --baseDN "dc=example,dc=com" \
    --bindDN "cn=Directory Manager" \
    --bindPassword password \
    --searchScope sub \
    "(uid=bjensen)" dn uid employeeType isMemberOf
   dn: uid=bjensen,ou=People,dc=example,dc=com
   uid: bjensen
   employeeType: Employee
   isMemberOf: cn=openidm2,ou=Groups,dc=example,dc=com
   isMemberOf: cn=Chat Users,ou=Groups,dc=example,dc=com
   isMemberOf: cn=Employees,ou=Groups,dc=example,dc=com
   ```

   You can also check bjensen's group membership by querying her object in the LDAP system, over the REST interface:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryFilter=/uid+sw+'bjensen'&_fields=dn,uid
,employeeType,ldapGroups"
{
  "result": [
    {
      "_id": "887732e8-3db2-31bb-b329-20cd6fcecc05",
      "dn": "uid=bjensen,ou=People,dc=example,dc=com",
      "uid": "bjensen",
      "employeeType": [
        "Employee"
      ],
      "ldapGroups": [
        "cn=openidm2,ou=Groups,dc=example,dc=com",
        "cn=Employees,ou=Groups,dc=example,dc=com",
        "cn=Chat Users,ou=Groups,dc=example,dc=com"
      ]
    }
  ],
  ...
}
```

In the original LDIF file, bjensen was already a member of the openidm2 group. You can ignore this group for the purposes of this sample.

Tip

Use the Admin UI to see bjensen's LDAP groups as follows:

1. Select Manage > User, and select bjensen's entry.
2. On the Linked Systems tab, scroll down to the ldapGroups item.

4. Now, create a new assignment that will apply to Contract employees, and add that assignment to the Contractor role.

   Create the Contractor assignment with the following command. This assignment sets the value of the `employeeType` attribute to `Contractor`, and updates the user's `ldapGroups` attribute to include the `cn=Contractors` group:

```
$ curl \
 --header "Content-type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 --data '{
     "name" : "Contractor",
     "description": "Contractor assignment for contract workers.",
     "mapping": "managedUser_systemLdapAccounts",
     "attributes": [
```

```
        {
            "name": "ldapGroups",
            "value": [
                "cn=Contractors,ou=Groups,dc=example,dc=com"
            ],
            "assignmentOperation" : "mergeWithTarget",
            "unassignmentOperation" : "removeFromTarget"
        },
        {
            "name": "employeeType",
            "value": [
              "Contractor"
            ],
            "assignmentOperation" : "mergeWithTarget",
            "unassignmentOperation" : "removeFromTarget"
        }
    ]
 }' \
 "http://localhost:8080/openidm/managed/assignment?_action=create"
{
  "_id": "10505bda-4415-4f85-a088-bbef47009210",
  "_rev": "0000000080badf28",
  "name": "Contractor",
  "description": "Contractor assignment for contract workers.",
  "mapping": "managedUser_systemLdapAccounts",
  "attributes": [
    {
      "name": "ldapGroups",
      "value": [
        "cn=Contractors,ou=Groups,dc=example,dc=com"
      ],
      "assignmentOperation": "mergeWithTarget",
      "unassignmentOperation": "removeFromTarget"
    },
    {
      "name": "employeeType",
      "value": [
        "Contractor"
      ],
      "assignmentOperation": "mergeWithTarget",
      "unassignmentOperation": "removeFromTarget"
    }
  ]
}
```

Note the ID of the Contractor assignment (10505bda-4415-4f85-a088-bbef47009210 in this example).

Tip

Create the assignment by using the Admin UI, as described in "Adding Assignments to a Role Definition").

5. Now, add the Contractor assignment to the Contractor role (ID f7da3805-50dd-4585-9bf6-e01658dece01 in this example):

```
$ curl \
 --header "Content-type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request PATCH \
 --data '[
     {
         "operation" : "add",
         "field" : "/assignments/-",
         "value" : {
             "_ref" : "managed/assignment/10505bda-4415-4f85-a088-bbef47009210"
         }
     }
 ]' \
 "http://localhost:8080/openidm/managed/role/f7da3805-50dd-4585-9bf6-e01658dece01"
{
  "_id": "f7da3805-50dd-4585-9bf6-e01658dece01",
  "_rev": "00000000f5ac5f89",
  "name": "Contractor",
  "description": "Role granted to contract workers."
}
```

Tip

Add the Contractor assignment to the Contractor role in the Admin UI, as follows:

1. Select Manage > Role, and select the Contractor role.
2. On the Managed Assignments tab, click Add Managed Assignment.
3. Select the Contractor assignment from the dropdown list, and click Add.

6. Next, we need to grant the Contractor role to user jdoe. Before we can patch jdoe's entry, we need to know their system-generated ID. To obtain the ID, query jdoe's entry as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryFilter=/userName+eq+'jdoe'&_fields=_id"
{
  "result": [
    {
      "_id": "d1397900-4b10-410b-a82f-4243b7d218c8",
      "_rev": "00000000a2f1f449"
    }
  ],
  ...
}
```

From the output, you can see that jdoe's `_id` is `d1397900-4b10-410b-a82f-4243b7d218c8`. (This unique ID will obviously be different in your command output.)

7. Update jdoe's entry by adding a reference to the ID of the Contractor role (f7da3805-50dd-4585-9bf6-e01658dece01) as a value of their `roles` attribute:

```
$ curl \
 --header "Content-type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request PATCH \
 --data '[
     {
         "operation" : "add",
         "field" : "/roles/-",
         "value" : {
             "_ref": "managed/role/f7da3805-50dd-4585-9bf6-e01658dece01"
         }
     }
 ]' \
 "http://localhost:8080/openidm/managed/user/d1397900-4b10-410b-a82f-4243b7d218c8"
{
  "_id": "d1397900-4b10-410b-a82f-4243b7d218c8",
  "_rev": "00000000dc1163b4",
  "displayName": "John Doe",
  "description": "Created for OpenIDM",
  "givenName": "John",
  "mail": "jdoe@example.com",
  "telephoneNumber": "1-415-599-1100",
  "sn": "Doe",
  "userName": "jdoe",
  "accountStatus": "active",
  "effectiveRoles": [
    {
      "_ref": "managed/role/f7da3805-50dd-4585-9bf6-e01658dece01"
    }
  ],
  "effectiveAssignments": [
    {
      "name": "Contractor",
      "description": "Contractor assignment for contract workers.",
      "mapping": "managedUser_systemLdapAccounts",
      "attributes": [
        {
          "name": "ldapGroups",
          "value": [
            "cn=Contractors,ou=Groups,dc=example,dc=com"
          ],
          "assignmentOperation": "mergeWithTarget",
          "unassignmentOperation": "removeFromTarget"
        },
        {
          "name": "employeeType",
          "value": [
            "Contractor"
          ],
          "assignmentOperation": "mergeWithTarget",
          "unassignmentOperation": "removeFromTarget"
        }
      ],
      "_rev": "0000000080badf28",
      "_id": "10505bda-4415-4f85-a088-bbef47009210"
```

```
    }
  ]
}
```

Tip

Grant the Contractor role to jdoe by using the Admin UI, as follows:

1. Select Manage > User, and click on jdoe's entry.
2. On the Provisioning Roles tab, click Add Provisioning Roles.
3. Select the Contractor role and click Add.

8. Check jdoe's entry on the LDAP system.

   With the implicit synchronization between the managed user repository and DS, jdoe should now be a member of the `cn=Contractors` group in LDAP. In addition, his `employeeType` should have been set to `Contractor`.

   You can verify this with the following REST query. This command returns jdoes's group membership, in his `isMemberOf` attribute, and his `employeeType`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryFilter=/uid+sw+'jdoe'&_fields=dn,uid
,employeeType,ldapGroups"
{
  "result": [
    {
      "_id": "0da50512-79bb-3461-bd04-241ee4c785bf",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com",
      "uid": "jdoe",
      "employeeType": [
        "Contractor"
      ],
      "ldapGroups": [
        "cn=openidm,ou=Groups,dc=example,dc=com",
        "cn=Contractors,ou=Groups,dc=example,dc=com"
      ]
    }
  ],
  ...
}
```

Tip

Use the Admin UI to see jdoe's LDAP groups as follows:

1. Select Manage > User, and select jdoe's entry.

2. On the Linked Systems tab, scroll down to the ldapGroups item.

Note

When working with large groups in LDAP services such as DS, you should use dynamic groups instead of static groups. The steps laid out above for setting assignments and roles work with the exception of how you add a user to a group: in dynamic groups, membership is determined by whether a user has an attribute the group is configured to search for.

For example, if the Employees group was a dynamic group, membership might be set based on the `employeeType` attribute directly, by setting the `memberURL` in the group to `ldap:///ou=People,dc=example,dc=com??sub?(employeeType=Employee)`. You would then remove the `ldapGroups` attribute from the Employee assignment, since group membership is handled by `employeeType`.

This membership won't be listed in the `ldapGroups` attribute in IDM (since it is no longer set there), but can be verified by querying DS directly:

```
$ ldapsearch \
 --port 1389 \
 --hostname localhost \
 --baseDN "dc=example,dc=com" \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --searchScope sub \
 "(uid=bjensen)" dn uid employeeType isMemberOf
dn: uid=bjensen,ou=People,dc=example,dc=com
uid: bjensen
employeeType: Employee
isMemberOf: cn=openidm2,ou=Groups,dc=example,dc=com
isMemberOf: cn=Chat Users,ou=Groups,dc=example,dc=com
isMemberOf: cn=Employees,ou=Groups,dc=example,dc=com
```

For more information about dynamic groups in DS, see *Creating Dynamic Groups* in the *Developer's Guide* for ForgeRock Directory Services.

16.1.3.4. Removing a Role Grant From a User and Observing That User's Role Assignments

In this section, you will remove the Contractor role from jdoe's managed user entry and observe the subsequent change to jdoe's managed assignments, and to the corresponding attributes in DS.

1. Before you change jdoe's roles, view his entry again to examine his current roles.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryFilter=/userName+eq+'jdoe'&_fields=_id,roles"
{
  "result": [
    {
      "_id": "d1397900-4b10-410b-a82f-4243b7d218c8",
      "_rev": "00000000dc1163b4",
      "roles": [
        {
          "_ref": "managed/role/f7da3805-50dd-4585-9bf6-e01658dece01",
          "_refResourceCollection": "managed/role",
          "_refResourceId": "f7da3805-50dd-4585-9bf6-e01658dece01",
          "_refProperties": {
            "_id": "ccc12e8f-c42b-4398-983a-db675ec5a472",
            "_rev": "000000009ebba40f"
          }
        }
      ]
    }
  ],
  ...
}
```

Note the following IDs in this output:

1. The ID of jdoe's user object is `d1397900-4b10-410b-a82f-4243b7d218c8`
2. The ID of the contractor role (`_refResourceId`) is `f7da3805-50dd-4585-9bf6-e01658dece01`
3. The ID of the *relationship* that expresses the role grant is `ccc12e8f-c42b-4398-983a-db675ec5a472`.

You will need these IDs in the next step.

Tip

View jdoe's current roles in the Admin UI:

1. Select Manage > User, and select jdoe's entry.
2. The Provisioning Roles tab lists the current roles.

2. Remove the Contractor role from jdoe's entry by sending a DELETE request to his user entry, specifying the *relationship ID*:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request DELETE \
 "http://localhost:8080/openidm/managed/user/d1397900-4b10-410b-a82f-4243b7d218c8/roles/ccc12e8f-c42b
-4398-983a-db675ec5a472"
{
  "_id": "ccc12e8f-c42b-4398-983a-db675ec5a472",
  "_rev": "000000009ebba40f",
  "_ref": "managed/role/f7da3805-50dd-4585-9bf6-e01658dece01",
  "_refResourceCollection": "managed/role",
  "_refResourceId": "f7da3805-50dd-4585-9bf6-e01658dece01",
  "_refProperties": {
    "_id": "ccc12e8f-c42b-4398-983a-db675ec5a472",
    "_rev": "000000009ebba40f"
  }
}
```

The output shows that the *relationship* between the user and the role was deleted.

Tip

Use the Admin UI to remove the Contractor role from jdoe's entry as follows:

1. Select Manage > User, and select jdoe's entry.
2. On the Provisioning Roles tab, check the box next to the Contractor role and click Remove Selected Provisioning Roles.

3. Verify jdoe's `employeeType` and `ldapGroups`.

   The removal of the Contractor role causes a synchronization operation to be run on jdoe's entry. His `employeeType` and `ldapGroups` attributes in DS should be reset to what they were before he was granted the Contractor role.

   You can check jdoe's attributes by querying his object in the LDAP directory, over the REST interface:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/ldap/account?_queryFilter=/uid+sw+'jdoe'&_fields=dn,uid
,employeeType,ldapGroups"
{
  "result": [
    {
      "_id": "0da50512-79bb-3461-bd04-241ee4c785bf",
      "dn": "uid=jdoe,ou=People,dc=example,dc=com",
      "uid": "jdoe",
      "employeeType": [],
      "ldapGroups": [
        "cn=openidm,ou=Groups,dc=example,dc=com"
      ]
    }
  ],
  ...
}
```

Tip

Use the Admin UI to see jdoe's LDAP groups as follows:

1. Select Manage > User, and select jdoe's entry.
2. On the Linked Systems tab, scroll down to the ldapGroups item.

This concludes the provisioning with roles sample. For more information about roles, assignments, and how to manipulate them, see "*Working With Managed Roles*" in the *Integrator's Guide*.

Chapter 17

Using a Workflow to Provision User Accounts

This sample demonstrates a typical workflow use case — provisioning new users.

The sample shows how to use the Admin UI to set up the initial users and roles, then shows how end users can use the Self-Service UI to complete their registration process.

The sample simulates the following scenario:

- An existing employee requests that an outside contractor be granted access to an organization's system.
- The *system* in this case, is the IDM managed user repository and a remote HR data source, represented by a CSV file (`hr.csv`).
- User roles are stored separately, in a second CSV file (`roles.csv`).

The sample has three mappings — two for the bidirectional synchronization of the managed user repository and the HR data store, and one for the synchronization of the roles data to the managed repository.

17.1. Preparing IDM For the Provisioning Sample

In this section, you start IDM, configure the outbound email service, and reconcile user and role data. The reconciliation operations create two managed users, `user1` and `manager1`, and two managed roles, `employee` (assigned to `user1`) and `manager` (assigned to `manager1`).

1. Start IDM with the configuration for the provisioning sample:

   ```
   $ cd /path/to/openidm
   $ ./startup.sh -p samples/provisioning-with-workflow
   ```

2. Log in to the Admin UI (`https://localhost:8443/admin`) with the default username (`openidm-admin` and password (`openidm-admin`).

3. Configure the outbound email service.

   An email configuration is required to send a password reset email to the user, at the end of the sample.

   Select Configure > Email Settings and provide the connection information for your email host.

   Gmail is configured by default but you must still supply credentials to use Gmail.

4. Reconcile the role data, and the user data.

    a. Select Configure > Mappings.

    b. Choose the first mapping (`systemRolesFileRole_managedRole`) and select Reconcile.

    This reconciliation operation creates two roles in the managed repository (`employee` and `manager`). You can verify the result of the reconciliation by selecting Manage > Role.

    c. Go back to the Mappings page (Configure > Mappings), choose the second mapping (`systemCsvfileAccounts_managedUser`) and select Reconcile.

    This reconciliation operation creates the top-level managers (users who do not have their own `manager` property) in the managed user repository. In this sample, there is only one top-level manager (`manager1`).

    d. Select Reconcile a second time.

    This reconciliation operation creates the employees of the managers that were created by the previous reconciliation. In this sample, there is only one employee (`employee1`).

    Verify that the manager and employee entries were created correctly by selecting Manage > User. You should have two users — `manager1` and `user1`.

5. Verify the relationships between your new user and role objects:

    a. Select `user1`. Note that the `Manager` field shows `manager1` for this user.

    b. On the Authorization Roles tab, note that user1 has two roles—a `Basic minimum user` role and an `employee` role.

    c. Navigate back to the User List and select `manager1`. Note that the `Manager` field is empty for this user.

    d. On the Authorization Roles tab, note that manager1 has two roles—a `Basic minimum user` role and a `manager` role.

6. Verify the available workflows:

    a. Select Manage > Processes > Definitions.

    b. Select the Contractor onboarding process and look at the sequence diagram for this workflow.

7. Log out of the Admin UI by selecting Log Out from the top right drop-down menu.

IDM is now prepared and contains the users and roles required for the Provisioning sample. In the next section you will walk through the workflow whose sequence diagram you saw in the previous step.

17.2. Running the Provisioning Sample

During this part of the sample, an existing employee initiates a *Contractor Onboarding* process. This process is a request to add a contractor to the managed user repository, with an option to include the contractor in the original HR data source (the `hr.csv` file).

When the employee has completed the required form, the request is sent to the manager for approval. Any user with the role `manager` can claim the approval task. If the request is approved, an email is sent to the address provided in the initial form, with a request for the contractor to reset their password. When the password reset has been completed, the contractor is created in the managed user repository. If a request was made to add the contractor to the original HR data source, this is done when the manager approves the request.

1. Log in to the Self-Service UI (`https://localhost:8443/`) as the user you created in the previous section (`user1`), with password `Welcome1`.

   The user Dashboard is displayed.

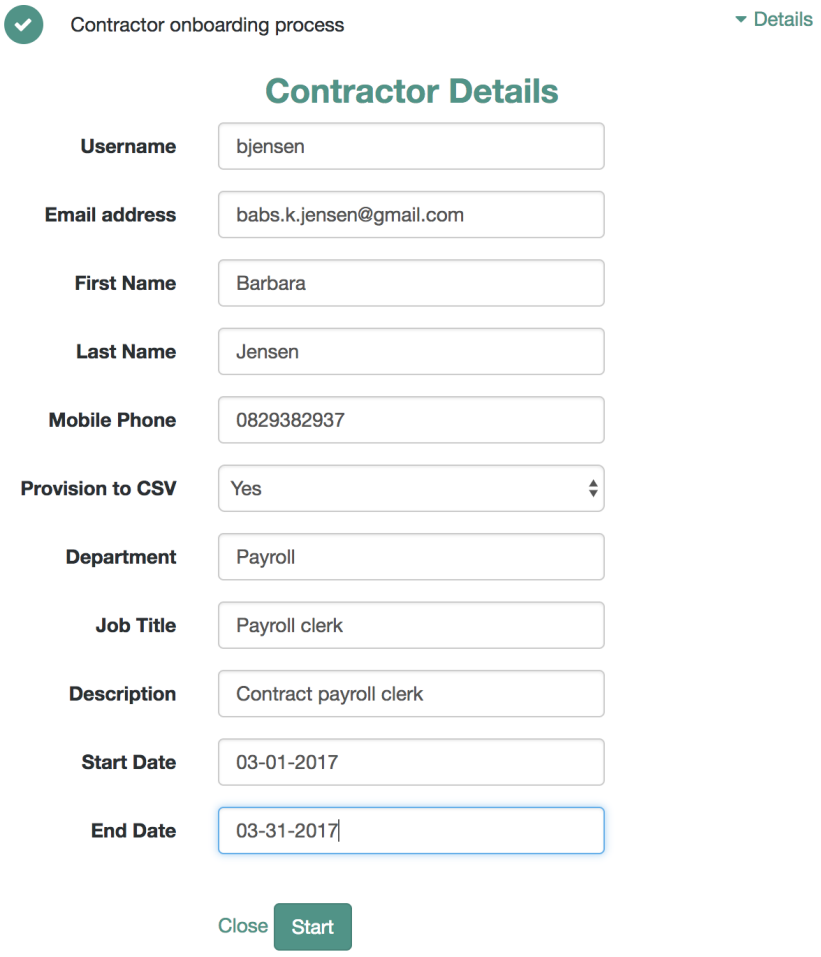
2. Initiate the provisioning workflow as user1:

   a. Scroll down to Processes and select Details next to the Contractor onboarding process.

      Complete the form for the sample user you will be creating. You can use any sample data here but use an email address to which you have access because you will need the email that is sent to this address to complete the workflow.

      In the Provision to CSV field, select Yes.

      This selection enables implicit synchronization from the managed user repository to the `hr.csv` file.



Note that user1 does not provide a password for this user. A password reset request is sent to the email address provided on this form to ensure that only the actual contractor can log in with this account.

b. Select Start to initiate the process.

c. Log out of the Self-Service UI.

3. Approve the workflow task as manager1:

a. Log in to the Self-Service UI as `manager1`, with password `Welcome1`.

b. Under My Group's Tasks, locate the Approve Contractor task and select Assign to Me.

c. Approve Contractor is now listed under My Tasks.

   Select Details next to the task name.

d. Review the form content. (It is the same content that you provided as `user1`, along with a Decision field.)

   Select Accept, then Complete to finish the task.

e. Log out of the Self-Service UI.

4. Verify that the contractor has been created in the HR data source (`hr.csv`):

```
$ more /path/to/openidm/samples/provisioning-with-workflow/data/hr.csv

"username","firstname","lastname","manager", "department","jobTitle",     ...,"password",...
"user1",   "Ordinary", "Employee","manager1","dep1",      "job1",         ...,"Welcome1",...
"manager1","Big",      "Manager", "",        "dep1",      "Manager",      ...,"Welcome1",...
"bjensen", "Barbara",  "Jensen",  "user1",   "Payroll",   "Payroll clerk",...,,,...
```

   Note the addition of the new contractor entry, in this case, bjensen. Note also that there is no value for the `password` field, and that `user1` is the manager of the new contractor.

5. Complete the password reset process:

   a. Verify the inbox of the email account that you provided when you completed the initial form.

      You should have received two emails — one with the subject "Your account has been created" and one with the subject "Reset your password".

   b. Open the password reset email and click `Password reset link`.

      The link takes you to the Self-Service UI, with the option to Reset Your Password.

   c. Enter a new password and confirmation password, submit the form.

      The password that you enter here must comply with the default password policy for managed users, described in "Enforcing Password Policy" in the *Integrator's Guide*.

   d. Select Return to Login Page and log in with the username that you provided when you completed the initial form, and the new password you have just set.

      Notice the Welcome message under Notifications.

6. Verify that the password reset has been propagated to the HR data source:

   Open `/path/to/openidm/samples/provisioning-with-workflow/data/hr.csv` and note that the password for the contractor has been added to their entry.

If you declined the approval request, the user is not created in the managed user repository, or in the HR CSV file.

Chapter 18

Connecting to DS With ScriptedREST

This sample uses the scripted REST connector to interact with the ForgeRock Directory Services (DS) REST API, using Groovy scripts. The sample demonstrates reconciliation, implicit sync, and liveSync between the IDM repository and a DS instance.

The scripted REST connector is bundled with IDM in the JAR `openidm/connectors/scriptedrest-connector-1.5.20.0.jar`.

The Groovy scripts required for the sample are located in the `samples/scripted-rest-with-dj/tools` directory. You must customize these scripts to address the requirements of your specific deployment, however, the sample scripts are a good starting point on which to base your customization.

Important

The Rest2ldap HTTP endpoint provided with DS is an evolving interface. As such, compatibility between versions is not guaranteed. This sample was tested with DS 6.0.

18.1. Setting Up DS

This sample assumes a DS server, running on the localhost. Follow these steps to install and configure the DS instance.

1. Download and extract the DS zip archive from ForgeRock's BackStage site.

2. Set up DS as follows. Include the `--httpPort` option to enable HTTP access during the setup. This example uses port `8090` so that it does not conflict with the default IDM port:

```
$ cd /path/to/opendj
$ ./setup \
 directory-server \
 --rootUserDN "cn=Directory Manager" \
 --rootUserPassword password \
 --hostname localhost \
 --ldapPort 1389 \
 --adminConnectorPort 4444 \
 --httpPort 8090 \
 --addBaseEntry \
 --baseDN dc=com \
 --acceptLicense
Validating parameters .....Done.
Configuring Certificates .....Done.
Configuring server .....Done.
Creating Base Entry dc=com .....Done.
Starting Directory Server ............Done.

To see basic server status and configuration, you can launch /path/to/opendj/bin/status
```

The sample assumes the following DS configuration:

- The server is installed on the localhost.
- The server listens for LDAP connections on port 1389.
- The administration connector port is 4444.
- The root user DN is `cn=Directory Manager`.
- The root user password is `password`.

3. Configure the DS server for replication.

   To enable liveSync, this server must be configured for replication, even if it does not actually participate in a replication topology. The following commands configure the server for replication.

```
$ cd /path/to/opendj/bin
$ ./dsconfig create-replication-server \
  --hostname localhost \
  --port 4444 \
  --bindDN "cn=Directory Manager" \
  --bindPassword password \
  --provider-name "Multimaster Synchronization" \
  --set replication-port:8989 \
  --set replication-server-id:2 \
  --trustAll \
  --no-prompt

$ ./dsconfig create-replication-domain \
  --hostname localhost \
  --port 4444 \
  --bindDN "cn=Directory Manager" \
  --bindPassword password \
  --provider-name "Multimaster Synchronization" \
  --domain-name "example.com" \
  --set base-dn:dc=example,dc=com \
  --set replication-server:localhost:8989 \
  --set server-id:3 \
  --trustAll \
  --no-prompt
```

4. Enable the DS HTTP access log.

```
$ ./dsconfig \
 set-log-publisher-prop \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --publisher-name "File-Based HTTP Access Logger" \
 --set enabled:true \
 --no-prompt \
 --trustAll
```

5. Import the LDIF data required for the sample.

```
$ ./ldapmodify \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --hostname localhost \
 --port 1389 \
 --filename /path/to/openidm/samples/scripted-rest-with-dj/data/ldap.ldif
Processing ADD request for dc=example,dc=com
ADD operation successful for DN dc=example,dc=com
Processing ADD request for ou=Administrators,dc=example,dc=com
ADD operation successful for DN ou=Administrators,dc=example,dc=com
Processing ADD request for uid=idm,ou=Administrators,dc=example,dc=com
ADD operation successful for DN uid=idm,ou=Administrators,dc=example,dc=com
Processing ADD request for ou=People,dc=example,dc=com
ADD operation successful for DN ou=People,dc=example,dc=com
Processing ADD request for ou=Groups,dc=example,dc=com
ADD operation successful for DN ou=Groups,dc=example,dc=com
```

6. Set up the access control that enables the IDM administrator user to read the DS changelog:

```
$ ./dsconfig \
 set-access-control-handler-prop \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --add global-aci:"(target=\"ldap:///cn=changelog\")(targetattr=\"*||+\") \
 (version 3.0; acl \"IDM can access cn=changelog\"; \
 allow (read,search,compare) \
 userdn=\"ldap:///uid=idm,ou=Administrators,dc=example,dc=com\";)" \
 --trustAll \
 --no-prompt

$ ./dsconfig \
 set-access-control-handler-prop \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --add global-aci:"(targetcontrol=\"1.3.6.1.4.1.26027.1.5.4\") \
 (version 3.0; acl \"IDM changelog control access\"; \
 allow (read) \
 userdn=\"ldap:///uid=idm,ou=Administrators,dc=example,dc=com\";)" \
 --trustAll \
 --no-prompt
```

7. Enable the default Rest2ldap HTTP endpoint:

```
$ ./dsconfig \
 set-http-endpoint-prop \
 --hostname localhost \
 --port 4444 \
 --bindDN "cn=Directory Manager" \
 --bindPassword password \
 --endpoint-name /api \
 --set authorization-mechanism:"HTTP Basic" \
 --set config-directory:config/rest2ldap/endpoints/api \
 --set enabled:true \
 --no-prompt \
 --trustAll
```

   For more information, see *To Set Up REST Access to User Data* in the *DS Administration Guide*.

8. Replace the default DS REST to LDAP configuration with the configuration for this sample:

```
$ cd /path/to/opendj
$ cp /path/to/openidm/samples/scripted-rest-with-dj/data/example-v1.json config/rest2ldap/endpoints/
api/
```

9. Restart DS for the configuration change to take effect.

```
$ cd /path/to/opendj/bin
$ ./stop-ds --restart
Stopping Server..
.
...
The Directory Server has started successfully
[07/Feb/2018:12:12:23 +0200] category=PROTOCOL severity=NOTICE msgID=276 msg=Started
 listening for new connections on HTTP Connection Handler 0.0.0.0 port 8090
```

DS is now configured for this sample.

18.2. Running the Sample

This section illustrates the basic CRUD operations on users and groups using the ScriptedREST connector and the DS REST API. Note that the power of the Groovy connector is in the associated Groovy scripts, and their application in your particular deployment. The scripts provided with this sample are specific to the sample and customization of the scripts is required.

1. Start IDM with the configuration for the ScriptedREST sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/scripted-rest-with-dj/
```

2. Check that the scripted REST connector can reach the DS instance by obtaining the connector status over REST:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/system/scriptedrest?_action=test"
{
  "name": "scriptedrest",
  "enabled": true,
  "config": "config/provisioner.openicf/scriptedrest",
  "connectorRef": {
    "bundleVersion": "[1.5.0.0,1.6.0.0)",
    "bundleName": "org.forgerock.openicf.connectors.scriptedrest-connector",
    "connectorName": "org.forgerock.openicf.connectors.scriptedrest.ScriptedRESTConnector"
  },
  "displayName": "Scripted REST Connector",
  "objectTypes": [
    "__ALL__",
    "account",
    "group"
  ],
  "ok": true
}
```

3. Create a group entry on the DS server.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
   "cn" : "group1"
 }' \
 "http://localhost:8080/openidm/system/scriptedrest/group?_action=create"
{
  "_id": "group1",
  "displayName": "group1",
  "created": "2018-02-07T10:14:12Z",
  "members": null,
  "cn": "group1"
}
```

4. Create a user entry on the DS server. This command creates a user with `uid` scarter:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
   "givenName" : "Steven",
   "familyName" : "Carter",
   "emailAddress" : "scarter@example.com",
   "telephoneNumber" : "444-444-4444",
   "password" : "Passw0rd",
   "displayName" : "Steven.Carter",
   "uid" : "scarter"
 }' \
 "http://localhost:8080/openidm/system/scriptedrest/account?_action=create"
{
  "_id": "scarter",
  "familyName": "Carter",
  "givenName": "Steven",
  "created": "2018-02-07T10:14:31Z",
  "uid": "scarter",
  "groups": null,
  "emailAddress": "scarter@example.com",
  "displayName": "Steven.Carter",
  "telephoneNumber": "444-444-4444"
}
```

   Notice that at this stage, the user is not a member of any group.

5. Reconcile the DS server with the managed user repository:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemRestLdapUser_managedUser&waitForCompletion=true"
{
  "_id": "ee7534bd-ccfd-4f6a-bdc3-49caa6d2043c-547",
  "state": "SUCCESS"
}
```

6. The reconciliation creates a managed user with a server-assigned ID. To retrieve the ID, run the following query:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "4657a420-6608-410e-baa7-f64668cc500c",
      "_rev": "000000007995f006"
    }
  ],
  ...
}
```

7. To initialize liveSync set the sync token by running one liveSync operation over REST:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/system/scriptedrest/account?_action=liveSync"
{
  "connectorData": {
    "nativeType": "string",
    "syncToken": "9"
  },
  "_rev": "00000000109353c9",
  "_id": "SYSTEMSCRIPTEDRESTACCOUNT"
}
```

8. Update Steven Carter's managed user entry, by modifying his telephone number. Specify the user ID that you retrieved previously:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--header "Content-Type: application/json"
 \
--request PATCH
 \
--data '[
    {
        "operation" : "replace",
        "field" : "telephoneNumber",
        "value" : "555-555-5555"
    }
]' \
"http://localhost:8080/openidm/managed/user/4657a420-6608-410e-baa7-f64668cc500c"
{
  "_id": "4657a420-6608-410e-baa7-f64668cc500c",
  "_rev": "0000000096edf021",
  "userName": "scarter",
  "mail": "scarter@example.com",
  "displayName": "Steven.Carter",
  "telephoneNumber": "555-555-5555",
  "givenName": "Steven",
  "sn": "Carter",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

9. The implicit synchronization mechanism between the managed user repository and DS propagates the change to DS. You can check this change by reading scarter's user entry in DS and noting the changed `telephoneNumber`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/scriptedrest/account/scarter"
{
  "_id": "scarter",
  "familyName": "Carter",
  "givenName": "Steven",
  "created": "2018-02-07T10:14:31Z",
  "uid": "scarter",
  "groups": null,
  "emailAddress": "scarter@example.com",
  "displayName": "Steven.Carter",
  "telephoneNumber": "555-555-5555"
}
```

10. Now, update Steven Carter's entry on the DS server, by modifying his `givenName`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PATCH \
 --data '[
    {
        "operation" : "replace",
        "field" : "givenName",
        "value" : "Steve"
    }
 ]' \
 "http://localhost:8080/openidm/system/scriptedrest/account/scarter"
    {
  "_id": "scarter",
  "familyName": "Carter",
  "givenName": "Steve",
  "created": "2018-02-07T10:14:31Z",
  "uid": "scarter",
  "groups": null,
  "emailAddress": "scarter@example.com",
  "displayName": "Steven.Carter",
  "telephoneNumber": "555-555-5555"
}
```

11. To propagate the change made on DS back to the managed user entry, launch a liveSync operation, either by defining a schedule, or directly over REST. The following command launches liveSync over REST:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/system/scriptedrest/account?_action=liveSync"
    {
  "connectorData": {
    "nativeType": "string",
    "syncToken": "9"
  },
  "_rev": "000000000a585336",
  "_id": "SYSTEMSCRIPTEDRESTACCOUNT"
}
```

12. Verify that the changes were propagated by reading scarter's managed user entry and noting the changed `givenName`:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request GET \
"http://localhost:8080/openidm/managed/user/4657a420-6608-410e-baa7-f64668cc500c"
{
  "_id": "4657a420-6608-410e-baa7-f64668cc500c",
  "_rev": "000000007937efb7",
  "userName": "scarter",
  "mail": "scarter@example.com",
  "displayName": "Steven.Carter",
  "telephoneNumber": "555-555-5555",
  "givenName": "Steve",
  "sn": "Carter",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

13. Add user scarter to the group you created previously, by updating the group entry:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --header "If-Match: *" \
 --request PUT \
 --data '{
 "_id" : "group1",
 "members" : [{"_id" : "scarter"}]
 }' \
 "http://localhost:8080/openidm/system/scriptedrest/group/group1"
{
  "_id": "group1",
  "displayName": "group1",
  "created": "2018-02-07T10:14:12Z",
  "members": [
    {
      "_id": "scarter",
      "displayName": "Steven.Carter"
    }
  ],
  "cn": "group1",
  "lastModified": "2018-02-07T10:20:22Z"
}
```

14. Read Steven Carter's user entry in DS, to verify that he is now a member of group1:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/scriptedrest/account/scarter"
{
  "_id": "scarter",
  "familyName": "Carter",
  "givenName": "Steve",
  "created": "2018-02-07T10:14:31Z",
  "uid": "scarter",
  "groups": [
    {
      "_id": "group1"
    }
  ],
  "emailAddress": "scarter@example.com",
  "displayName": "Steven.Carter",
  "telephoneNumber": "555-555-5555"
}
```

15. Read the group entry to verify its members:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/scriptedrest/group/group1"
{
  "_id": "group1",
  "displayName": "group1",
  "created": "2018-02-07T10:14:12Z",
  "members": [
    {
      "_id": "scarter",
      "displayName": "Steven.Carter"
    }
  ],
  "cn": "group1",
  "lastModified": "2018-02-07T10:20:22Z"
}
```

16. Reconcile the DS groups with the managed group repository:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemRestLdapGroup_managedGroup&waitForCompletion=true"
{
  "_id": "ee7534bd-ccfd-4f6a-bdc3-49caa6d2043c-1477",
  "state": "SUCCESS"
}
```

17. The reconciliation creates a managed group with a server-assigned ID. To retrieve the group ID, run the following query:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request GET \
 "http://localhost:8080/openidm/managed/group?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "67b5ec50-d5a6-4bfa-bb19-17965447ad00",
      "_rev": "00000000b0e95e9b"
    }
  ],
  ...
}
```

18. Read the managed group to verify that the DS group has been added, and that its members have been reconciled to the managed group repository. Specify the ID that you retrieved in the previous step:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/group/67b5ec50-d5a6-4bfa-bb19-17965447ad00"
{
  "_id": "67b5ec50-d5a6-4bfa-bb19-17965447ad00",
  "_rev": "00000000b0e95e9b",
  "members": [
    {
      "_id": "scarter",
      "displayName": "Steven.Carter"
    }
  ],
  "displayName": "group1"
}
```

19. Delete the DS user and group entries, returning the DS server to its initial state.

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request DELETE \
 "http://localhost:8080/openidm/system/scriptedrest/account/scarter"
{
  "_id": "scarter",
  "familyName": "Carter",
  "givenName": "Steve",
  "created": "2018-02-07T10:14:31Z",
  "uid": "scarter",
  "groups": [
    {
      "_id": "group1"
    }
  ],
  "emailAddress": "scarter@example.com",
  "displayName": "Steven.Carter",
```

```
  "telephoneNumber": "555-555-5555"
}
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request DELETE \
 "http://localhost:8080/openidm/system/scriptedrest/group/group1"
{
  "_id": "group1",
  "displayName": "group1",
  "created": "2018-02-07T10:14:12Z",
  "members": null,
  "cn": "group1",
  "lastModified": "2018-02-07T10:20:22Z"
}
```

Chapter 19

Connecting to Active Directory With the PowerShell Connector

This chapter describes an implementation of the PowerShell Connector toolkit and provides a number of PowerShell scripts that enable you to perform basic CRUD (create, read, update, delete) operations on an Active Directory server.

The sample uses the MS Active Directory PowerShell module. For more information on this module, see the corresponding Microsoft documentation.

The generic *PowerShell Connector Toolkit* enables you to run PowerShell scripts on any external resource. The PowerShell Connector Toolkit is not a complete connector, in the traditional sense. Rather, it is a framework within which you must write your own PowerShell scripts to address the requirements of your Microsoft Windows ecosystem. You can use the PowerShell Connector Toolkit to create connectors that can provision any Microsoft system.

The PowerShell Connector Toolkit is available from ForgeRock's BackStage site.

This sample assumes that IDM is running on a Windows system on the localhost. It also assumes that Active Directory and the OpenICF .NET connector server run on a remote Windows server. The PowerShell connector runs on the .NET connector server.

To use this sample for IDM instances installed on UNIX systems, adjust the relevant commands shown with PowerShell prompts.

Note

By default, the `Get-ADUser` and `Get-ADGroup` cmdlets are not thread safe. To avoid thread issues when you use this connector with Active Directory, you must set the pooling configuration properties as follows:

```
"UseInterpretersPool" : true,
"MinInterpretersPoolSize" : 1,
"MaxInterpretersPoolSize" : 10
```

For more information about these properties see "Configuring the PowerShell Connector" in the *Connector Reference*.

19.1. Setting Up the PowerShell Active Directory Sample

Run the commands in this procedure from the PowerShell command line. The continuation character used in the command is the back-tick (`).

1. Install, configure, and start the .NET connector server on the machine that is running an Active Directory Domain Controller or on a workstation on which the Microsoft Active Directory PowerShell module is installed.

   For instructions on installing the .NET connector server, see "Installing the .NET Connector Server" in the *Integrator's Guide*.

2. Configure IDM to connect to the .NET connector server.

   To do so, copy the remote connector server configuration file from the `openidm\samples\provisioners` directory to your project's `conf\` directory, and edit the file according to your configuration:

   ```
   PS C:\ cd \path\to\openidm
   PS C:\path\to\openidm cp samples\provisioners\provisioner.openicf.connectorinfoprovider.json conf
   ```

   For instructions on editing this file, see "Configuring IDM to Connect to the .NET Connector Server" in the *Integrator's Guide*.

3. Download the PowerShell Connector Toolkit archive (`mspowershell-connector-1.4.5.0.zip`) from ForgeRock's BackStage site.

   Extract the archive and move the `MsPowerShell.Connector.dll` to the folder in which the connector server application (`connectorserver.exe`) is located.

4. Copy the PowerShell scripts and the ADSISearch module from the `samples\scripted-powershell-with-ad\tools` directory, to the machine on which the connector server is installed.

   ```
   PS C:\path\to\openidm>dir samples\scripted-powershell-with-ad\tools
   Directory: C:\path\to\openidm\samples\scripted-powershell-with-ad\tools

   Mode                 LastWriteTime         Length Name
   ----                 -------------         ------ ---
   -
   -a----         4/3/2018   3:26 AM           4279 ADAuthenticate
   .ps1
   -a----         4/3/2018   3:26 AM           9055 ADCreate
   .ps1
   -a----         4/3/2018   3:26 AM           3717 ADDelete
   .ps1
   -a----         4/3/2018   3:26 AM          10756 ADSchema
   .ps1
   -a----         4/3/2018   3:26 AM           4625 ADSearch
   .ps1
   -a----         4/3/2018   3:26 AM           8064 ADSISearch
   .psm1
   -a----         4/3/2018   3:26 AM           5918 ADSync
   .ps1
   -a----         4/3/2018   3:26 AM           2408 ADTest
   .ps1
   -a----         4/3/2018   3:26 AM          18406 ADUpdate.ps1
   PS C:\path\to\openidm>
   ```

5. Copy the sample connector configuration for the PowerShell connector from the `samples\provisioners` directory to your project's `conf` directory.

```
PS C:\ cd \path\to\openidm
PS C:\ cp samples\provisioners\provisioner.openicf-adpowershell.json conf
```

The following excerpt of the sample connector configuration shows the configuration properties:

```
"configurationProperties" : {
    "AuthenticateScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/
ADAuthenticate.ps1",
    "CreateScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/ADCreate.ps1",
    "DeleteScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/ADDelete.ps1",
    "SchemaScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/ADSchema.ps1",
    "SearchScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/ADSearch.ps1",
    "SyncScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/ADSync.ps1",
    "TestScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/ADTest.ps1",
    "UpdateScriptFileName" : "C:/openidm/samples/scripted-powershell-with-ad/tools/ADUpdate.ps1",
    "VariablesPrefix" : "Connector",
    "QueryFilterType" : "Ldap",
    "ReloadScriptOnExecution" : true,
    "UseInterpretersPool" : true,
    "SubstituteUidAndNameInQueryFilter" : true,
    "UidAttributeName" : "ObjectGUID",
    "NameAttributeName" : "DistinguishedName",
    "PsModulesToImport" : [
        "ActiveDirectory",
        "C:/openidm/samples/scripted-powershell-with-ad/tools/ADSISearch.psm1"
    ],
    "Host" : "",
    "Port" : null,
    "Login" : "",
    "Password" : null,
    "CustomProperties" : ["baseContext = CN=Users,DC=example,DC=com" ],
    "MinInterpretersPoolSize" : 1,
    "MaxInterpretersPoolSize" : 10
},
```

The sample connector configuration assumes that the scripts are located in `C:/openidm/samples/scripted-powershell-with-ad/tools/`. If you copied your scripts to a different location, or are using a different base context for search and synchronization operations such as `DC=example,DC=org`, adjust your connector configuration file accordingly.

Note that the OpenICF framework requires the path to use forward slash characters and not the backslash characters that you would expect in a Windows path.

The host, port, login and password of the machine on which Active Directory runs do not need to be specified here. By default the Active Directory cmdlets pick up the first available Domain Controller. In addition, the scripts are executed using the credentials of the .Net connector server.

Note

The `ReloadScriptOnExecution` property is set to `true` in this sample configuration. This setting causes script files to be reloaded each time the script is invoked. Having script files reloaded each time is suitable for

debugging purposes. However, this property should be set to `false` in production environments, as the script reloading can have a negative performance impact.

In addition, make sure that the value of the `connectorHostRef` property in the connector configuration file matches the value that you specified in the remote connector configuration file, in step 2 of this procedure. For example:

```
"connectorHostRef" : "dotnet",
```

19.2. Testing the PowerShell Active Directory Sample

Because you have copied all of the required configuration files into the default IDM project, you can start IDM with the default configuration (that is, without the `-p` option):

```
PS C:\ cd \path\to\openidm
PS C:\ .\startup.bat
```

When IDM has started, test the sample by using the `curl` command-line utility. The following examples test the scripts that were provided in the `tools` directory.

1. Test the connector configuration, and whether IDM is able to connect to the .NET connector server with the following request:

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --request POST `
 "http://localhost:8080/openidm/system?_action=test"
[
  {
    "ok": true,
    "connectorRef": {
      "bundleVersion": "[1.4.2.0,1.5.0.0)",
      "bundleName": "MsPowerShell.Connector",
      "connectorName": "Org.ForgeRock.OpenICF.Connectors.MsPowerShell.MsPowerShellConnector"
    },
    "objectTypes": [
      "__ALL__",
      "group",
      "account"
    ],
    "config": "config/provisioner.openicf/adpowershell",
    "enabled": true,
    "name": "adpowershell"
  }
]
```

2. Query the users in your Active Directory with the following request:

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --request GET `
```

```
 "http://localhost:8080/openidm/system/adpowershell/account?_queryId=query-all-ids"
{
  "remainingPagedResults": -1,
  "pagedResultsCookie": null,
  "resultCount": 1257,
  "result": [
    {
      "_id": "7c41496a-9898-4074-a537-bed696b6be92",
      "distinguishedName": "CN=Administrator,CN=Users,DC=example,DC=com"
    },
    {
      "_id": "f2e08a5c-473f-4798-a2d5-d5cc27c862a9",
      "distinguishedName": "CN=Guest,CN=Users,DC=example,DC=com"
    },
    {
      "_id": "99de98a3-c125-48dd-a7c2-e21f1488ab06",
      "distinguishedName": "CN=Ben Travis,CN=Users,DC=example,DC=com"
    },
    {
      "_id": "0f7394cc-c66a-404f-ad6d-38dbb4b6526d",
      "distinguishedName": "CN=Barbara Jensen,CN=Users,DC=example,DC=com"
    },
    {
      "_id": "3e6fa858-ed3a-4b58-9325-1fca144eb7c7",
      "distinguishedName": "CN=John Doe,CN=Users,DC=example,DC=com"
    },
    {
      "_id": "6feef4a0-b121-43dc-be68-a96703a49aba",
      "distinguishedName": "CN=Steven Carter,CN=Users,DC=example,DC=com"
    }
,
...
```

3. To return the complete record of a specific user, include the ID of the user in the URL. The following request returns the record for Steven Carter.

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --request GET `
 "http://localhost:8080/openidm/system/adpowershell/account/6feef4a0-b121-43dc-be68-a96703a49aba"
{
  "_id": "6feef4a0-b121-43dc-be68-a96703a49aba",
  "postalCode": null,
  "passwordNotRequired": false,
  "cn": "Steven Carter",
  "name": "Steven Carter",
  "trustedForDelegation": false,
  "uSNChanged": "47219",
  "manager": null,
  "objectGUID": "6feef4a0-b121-43dc-be68-a96703a49aba",
  "modifyTimeStamp": "11/27/2014 3:37:16 PM",
  "employeeNumber": null,
  "sn": "Carter",
  "userAccountControl": 512,
  "passwordNeverExpires": false,
  "displayName": "Steven Carter",
  "initials": null,
```

```
  "pwdLastSet": "130615726366949784",
  "scriptPath": null,
  "badPasswordTime": "0",
  "employeeID": null,
  "badPwdCount": "0",
  "accountExpirationDate": null,
  "userPrincipalName": "steve.carter@ad0.example.com",
  "sAMAccountName": "steve.carter",
  "mail": "steven.carter@example.com",
  "logonCount": "0",
  "cannotChangePassword": false,
  "division": null,
  "streetAddress": null,
  "allowReversiblePasswordEncryption": false,
  "description": null,
  "whenChanged": "11/27/2014 3:37:16 PM",
  "title": null,
  "lastLogon": "0",
  "company": null,
  "homeDirectory": null,
  "whenCreated": "6/23/2014 2:50:48 PM",
  "givenName": "Steven",
  "telephoneNumber": "555-2518",
  "homeDrive": null,
  "uSNCreated": "20912",
  "smartcardLogonRequired": false,
  "distinguishedName": "CN=Steven Carter,CN=Users,DC=example,DC=com",
  "createTimeStamp": "6/23/2014 2:50:48 PM",
  "department": null,
  "memberOf": [
    "CN=employees,DC=example,DC=com"
  ],
  "homePhone": null
}
```

4. Test that you can authenticate as one of the users in your Active Directory. The username that you specify here can be either an ObjectGUID, UPN, sAMAccountname or CN.

```
$ PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --header "Content-Type: application/json" `
 --request POST `
 --data '{
     \"username\" : \"Steven Carter\",
     \"password\" : \"Passw0rd\"
     } `
 "http://localhost:8080/openidm/system/adpowershell/account?_action=authenticate"
{
  "_id": "6feef4a0-b121-43dc-be68-a96703a49aba"
}
```

   The request returns the ObjectGUID if the authentication is successful.

5. You can return the complete record for a specific user, using the query filter syntax described in "Constructing Queries" in the *Integrator's Guide*.

The following query returns the record for the guest user.

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --request GET `
 'http://localhost:8080/openidm/system/adpowershell/account?_queryFilter=cn+eq+"guest"'
{
  "remainingPagedResults": -1,
  "pagedResultsCookie": null,
  "resultCount": 1,
  "result": [
    {
      "_id": "f2e08a5c-473f-4798-a2d5-d5cc27c862a9",
      "postalCode": null,
      "passwordNotRequired": true,
      "cn": "Guest",
      "name": "Guest",
      "trustedForDelegation": false,
      "uSNChanged": "8197",
      "manager": null,
      "objectGUID": "f2e08a5c-473f-4798-a2d5-d5cc27c862a9",
      "modifyTimeStamp": "6/9/2014 12:35:16 PM",
      "employeeNumber": null,
      "userAccountControl": 66082,
      "whenChanged": "6/9/2014 12:35:16 PM",
      "initials": null,
      "pwdLastSet": "0",
      "scriptPath": null,
      "badPasswordTime": "0",
      "employeeID": null,
      "badPwdCount": "0",
      "accountExpirationDate": null,
      "sAMAccountName": "Guest",
      "logonCount": "0",
      "cannotChangePassword": true,
      "division": null,
      "streetAddress": null,
      "allowReversiblePasswordEncryption": false,
      "description": "Built-in account for guest access to the computer/domain",
      "userPrincipalName": null,
      "title": null,
      "lastLogon": "0",
      "company": null,
      "homeDirectory": null,
      "whenCreated": "6/9/2014 12:35:16 PM",
      "givenName": null,
      "homeDrive": null,
      "uSNCreated": "8197",
      "smartcardLogonRequired": false,
      "distinguishedName": "CN=Guest,CN=Users,DC=example,DC=com",
      "createTimeStamp": "6/9/2014 12:35:16 PM",
      "department": null,
      "memberOf": [
        "CN=Guests,CN=Builtin,DC=example,DC=com"
      ],
      "homePhone": null,
      "displayName": null,
```

```
      "passwordNeverExpires": true
    }
  ]
}
```

6. Test that you can create a user on the Active Directory server by sending a POST request with the `create` action.

   The following request creates the user `Jane Doe` on the Active Directory server.

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --header "Content-Type: application/json" `
 --request POST `
 --data "{
  \"distinguishedName\" : \"CN=Jane Doe,CN=Users,DC=example,DC=com\",
  \"sn\" : \"Doe\",
  \"cn\" : \"Jane Doe\",
  \"sAMAccountName\" : \"sample\",
  \"userPrincipalName\" : \"janedoe@example.com\",
  \"__ENABLE__\" : true,
  \"password\" : \"Passw0rd\",
  \"telephoneNumber\" : \"0052-611-091\"
 }" `
 "http://localhost:8080/openidm/system/adpowershell/account?_action=create"
{
  "_id": "42725210-8dce-4fdf-b0e0-393cf0377fdf",
  "title": null,
  "uSNCreated": "47244",
  "pwdLastSet": "130615892934093041",
  "cannotChangePassword": false,
  "telephoneNumber": "0052-611-091",
  "smartcardLogonRequired": false,
  "badPwdCount": "0",
  "department": null,
  "distinguishedName": "CN=Jane Doe,CN=Users,DC=example,DC=com",
  "badPasswordTime": "0",
  "employeeID": null,
  "cn": "Jane Doe",
  "division": null,
  "description": null,
  "userPrincipalName": "janedoe@example.com",
  "passwordNeverExpires": false,
  "company": null,
  "memberOf": [],
  "givenName": null,
  "streetAddress": null,
  "sn": "Doe",
  "initials": null,
  "logonCount": "0",
  "homeDirectory": null,
  "employeeNumber": null,
  "objectGUID": "42725210-8dce-4fdf-b0e0-393cf0377fdf",
  "manager": null,
  "lastLogon": "0",
  "trustedForDelegation": false,
  "scriptPath": null,
```

```
  "allowReversiblePasswordEncryption": false,
  "modifyTimeStamp": "11/27/2014 8:14:53 PM",
  "whenCreated": "11/27/2014 8:14:52 PM",
  "whenChanged": "11/27/2014 8:14:53 PM",
  "accountExpirationDate": null,
  "name": "Jane Doe",
  "displayName": null,
  "homeDrive": null,
  "passwordNotRequired": false,
  "createTimeStamp": "11/27/2014 8:14:52 PM",
  "uSNChanged": "47248",
  "sAMAccountName": "sample",
  "userAccountControl": 512,
  "homePhone": null,
  "postalCode": null
}
```

7. Test that you can update a user object on the Active Directory server by sending a PUT request with the complete object, and including the user ID in the URL.

   The following request updates user `Jane Doe`'s entry, including her ID in the request. The update sends the same information that was sent in the `create` request, but adds an `employeeNumber`.

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --header "Content-Type: application/json" `
 --header "If-Match: *" `
 --request PUT `
 --data "{
  \"distinguishedName\" : \"CN=Jane Doe,CN=Users,DC=example,DC=com\",
  \"sn\" : \"Doe\",
  \"cn\" : \"Jane Doe\",
  \"userPrincipalName\" : \"janedoe@example.com\",
  \"__ENABLE__\" : true,
  \"password\" : \"Passw0rd\",
  \"telephoneNumber\" : \"0052-611-091\",
  \"employeeNumber\": \"567893\"
 }" `
 "http://localhost:8080/openidm/system/adpowershell/account/42725210-8dce-4fdf-b0e0-393cf0377fdf"
{
  "_id": "42725210-8dce-4fdf-b0e0-393cf0377fdf",
  "title": null,
  "uSNCreated": "47244",
  "pwdLastSet": "130615906375709689",
  "cannotChangePassword": false,
  "telephoneNumber": "0052-611-091",
  "smartcardLogonRequired": false,
  "badPwdCount": "0",
  "department": null,
  "distinguishedName": "CN=Jane Doe,CN=Users,DC=example,DC=com",
  "badPasswordTime": "0",
  "employeeID": null,
  "cn": "Jane Doe",
  "division": null,
  "description": null,
  "userPrincipalName": "janedoe@example.com",
```

```
  "passwordNeverExpires": false,
  "company": null,
  "memberOf": [],
  "givenName": null,
  "streetAddress": null,
  "sn": "Doe",
  "initials": null,
  "logonCount": "0",
  "homeDirectory": null,
  "employeeNumber": "567893",
  "objectGUID": "42725210-8dce-4fdf-b0e0-393cf0377fdf",
  "manager": null,
  "lastLogon": "0",
  "trustedForDelegation": false,
  "scriptPath": null,
  "allowReversiblePasswordEncryption": false,
  "modifyTimeStamp": "11/27/2014 8:37:17 PM",
  "whenCreated": "11/27/2014 8:14:52 PM",
  "whenChanged": "11/27/2014 8:37:17 PM",
  "accountExpirationDate": null,
  "name": "Jane Doe",
  "displayName": null,
  "homeDrive": null,
  "passwordNotRequired": false,
  "createTimeStamp": "11/27/2014 8:14:52 PM",
  "uSNChanged": "47253",
  "sAMAccountName": "sample",
  "userAccountControl": 512,
  "homePhone": null,
  "postalCode": null
}
```


8. Test whether you are able to delete a user object on the Active Directory server by sending a DELETE request with the user ID in the URL.

   The following request deletes user `Jane Doe`'s entry.

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --request DELETE `
 "http://localhost:8080/openidm/system/adpowershell/account/42725210-8dce-4fdf-b0e0-393cf0377fdf"
```

   The response includes the complete user object that was deleted.

   You can you attempt to query the user object to confirm that it has been deleted.

```
PS C:\ curl `
 --header "X-OpenIDM-Username: openidm-admin" `
 --header "X-OpenIDM-Password: openidm-admin" `
 --request GET `
 "http://localhost:8080/openidm/system/adpowershell/account/42725210-8dce-4fdf-b0e0-393cf0377fdf"
{
  "message": "",
  "reason": "Not Found",
  "code": 404
}
```

Chapter 20

Connecting to Azure AD With the PowerShell Connector

This sample uses the Microsoft Azure Active Directory (Azure AD) PowerShell module. For more information about this module, see https://docs.microsoft.com/en-us/powershell/module/Azuread/?view=azureadps-2.0.

The sample assumes that IDM runs on a local UNIX/Linux machine and that the PowerShell Connector Toolkit (and the OpenICF .NET connector server) run on a remote Windows host with access to an instance of AzureAD. Adjust the command-line examples if your IDM instance runs on Windows.

This sample demonstrates how you can synchronize managed object data such as users and groups with a Microsoft AzureAD deployment.

Note

This sample sets up a connection between three systems: IDM on UNIX/Linux, an OpenICF .NET connector server on Windows, and Azure AD "in the cloud". Internet connection times vary widely and performance is based on responses to external calls, including potential timeouts, if a command doesn't perform the first time, try again. IDM's synchronization and reconciliation performance will be fully dependent on the performance of the system resource.

20.1. Before You Start

Before you can run this sample, your system must meet several prerequisites. This section describes each of the prerequisites, and how to install or test them.

- You must have a Microsoft account, which gives you access to Microsoft Azure.

  You can set up a Microsoft account at https://signup.live.com/.

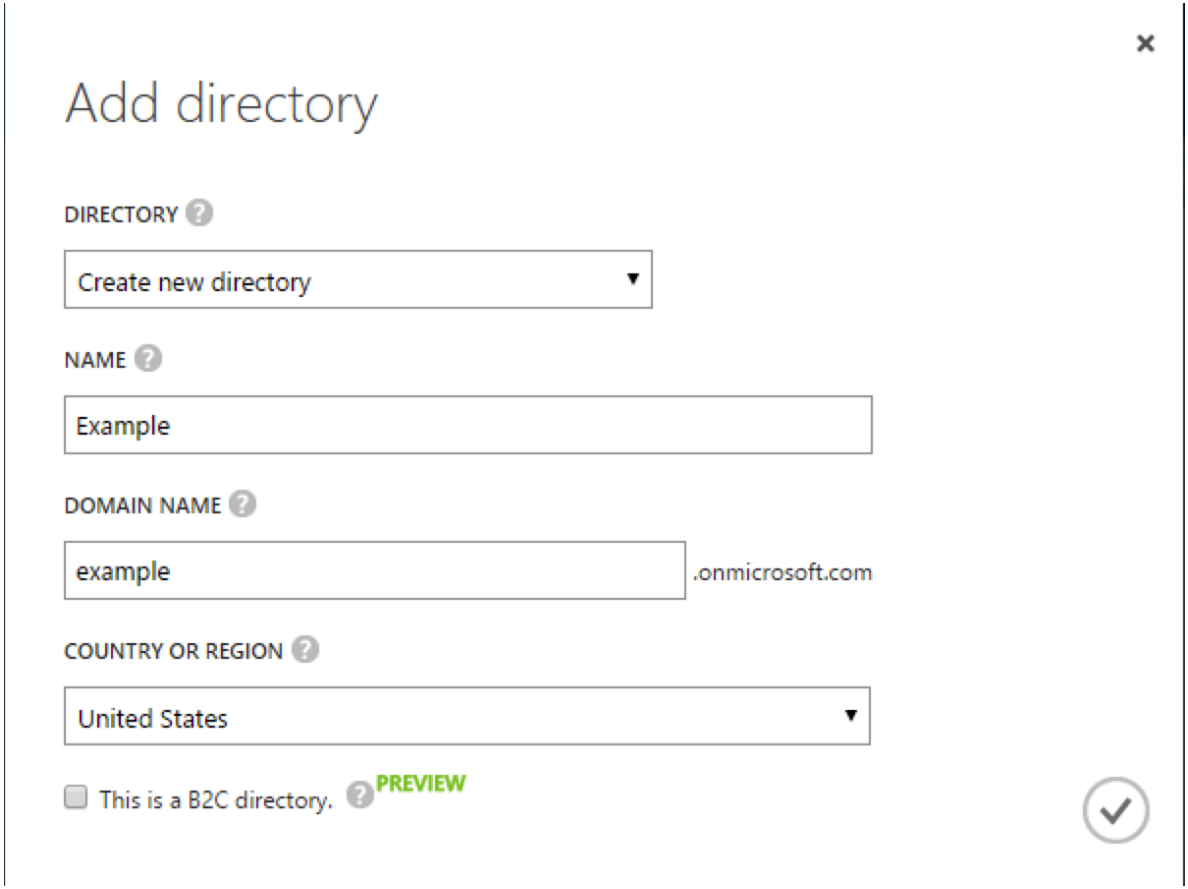
  With a Microsoft account, you can access the Azure portal at http://azure.microsoft.com.

- You must have an Azure AD cloud directory.

  If you do not have an existing Azure AD cloud, set one up as follows:

  1. Navigate to https://account.windowsazure.com/signup. When you have logged in in with your Microsoft credentials, fill in the prompts and Microsoft will create an Azure subscription.

2. Navigate to http://portal.azure.com, log in with your Microsoft account.
3. In the Microsoft Azure screen, select New on the left hand menu.
4. From the New list, select Security + Identity > Active Directory.
5. Complete the Add Directory form with the details of your directory, and select the check mark at the bottom of the form to submit.



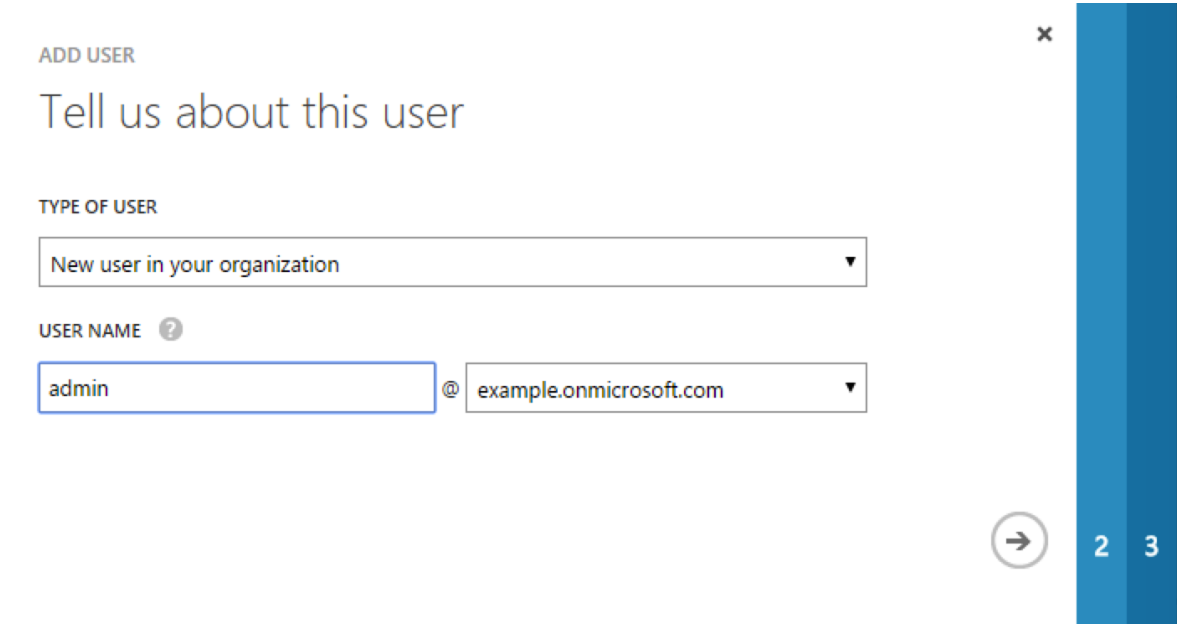
Your directory should now be created and listed.

- Apart from your default Microsoft Azure account, you must have an *administrative user account* for your Azure AD.

  By default your directory will have a single identity, your Microsoft Azure account. You cannot use this account to run the PowerShell Connector scripts that administer the Azure AD.

If your Azure AD does not already include other administrative accounts, create a local administrative identity that is native to your directory as follows:

1. Log in to https://portal.azure.com/ with your Microsoft Azure credentials.
2. From the left-hand menu, select Browse > Active Directory.
3. Select your cloud directory from the left-hand menu and select USERS in the top navigation bar.
4. At the bottom of the page select Add User and enter the details of the new administrative user.

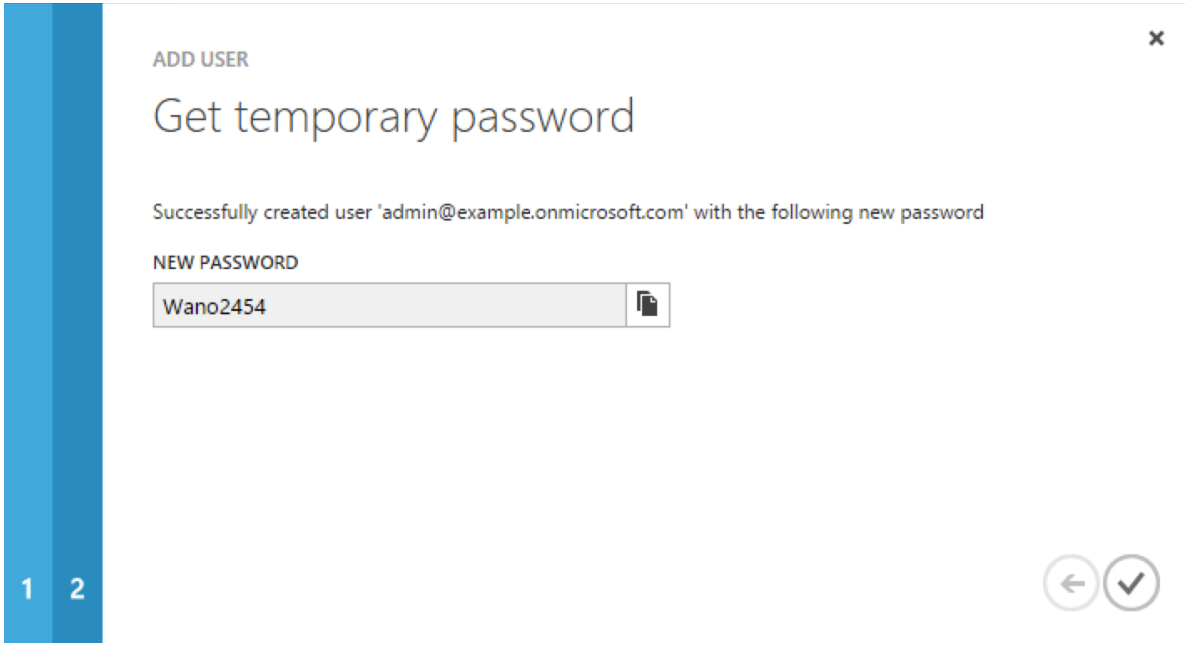


   Select the arrow to continue.

5. On the User Profile screen, enter the details of this administrative user. Make sure that the user's Role is at least User Admin.

   Select the arrow to continue.

6. On the final screen, select Create and note the temporary password that is assigned to the user.



Because new administrative users are forced to change their password on first login, you should log in as this user to change the password.

Select the check mark to complete the new user creation process.

7. Select the username at the top right of the screen and select Sign-out to sign out of your Microsoft Azure account, then select SIGN IN > Use Another Account to sign in as your new administrative user.
8. Enter the email address of the new administrative user and select Continue.
9. Enter the temporary password that you received and select Sign In.
10. On the Update Your Password screen, enter a new password, then select Update password and sign in.

    You now have a new administrative user account that the PowerShell scripts will use to access your Azure AD.

- The Windows Azure AD Module for Windows PowerShell must be installed on the Windows host that connects to Azure.

  If needed, install the Azure AD Module as described in the following Microsoft article.

- Your Windows host must be able to contact your Azure AD deployment.

Verify the connection as follows:

1. Open a PowerShell window and type `Connect-Msolservice` at the command prompt.

2. On the Enter Credentials screen, enter the credentials of the administrative account that you created for the Azure directory.

   If the PowerShell command returns with no error, you have successfully connected to your remote Azure AD deployment.

- The OpenICF .NET connector server must be installed on your Windows host.

  If you have not yet installed the .NET connector server, follow the instructions in "Installing and Configuring a .NET Connector Server" in the *Integrator's Guide*.

- The PowerShell Connector Toolkit must be installed on your Windows host.

  If you have not yet installed the PowerShell Connector Toolkit, follow the instructions in "*PowerShell Connector Toolkit*" in the *Connector Reference*. In these instructions, you will use a command with a **/setkey** option to create a password key for your .NET connector server. You will use that key in "Setting Up the PowerShell Azure AD Sample".

Important

Before you continue, check that the OpenICF .NET connector server is still running. If it is not running, restart the connector server and check the logs. In some cases, Windows blocks the PowerShell connector dll. If the connector server fails to start, right-click on `MsPowerShell.Connector.dll` and select Properties > Security. If you see the following text on that tab:

```
    This file came from another computer and might be blocked to help protect
    this computer.
```

Select the Unblock button to unblock the connector dll. Then restart the connector server.

When all of the above elements are in place, you can proceed with running the sample, as described in "Setting Up the PowerShell Azure AD Sample".

20.2. Setting Up the PowerShell Azure AD Sample

This section assumes that IDM is installed on the local UNIX/Linux machine.

1. On the Windows host, create a directory for the PowerShell scripts.

   The sample connector configuration expects the scripts in the directory `C:/openidm/samples/scripted-powershell-with-azure-ad/tools/`. If you put them in a different location, adjust your connector configuration accordingly.

   ```
   PS C:\> mkdir -Path openidm\samples\scripted-powershell-with-azure-ad\azureADScripts

       Directory: C:\openidm\samples\scripted-powershell-with-azure-ad

   Mode                 LastWriteTime     Length Name
   ----                 -------------     ------ ----
   d----          5/4/2016   11:26 AM           azureADScripts

   PS C:\>
   ```

2. Copy the PowerShell sample scripts from the IDM instance on your UNIX/Linux host to the new directory on the remote Windows server.

   One way to do this is to run an `scp` client, such as `pscp` in your Windows terminal. The following command copies the PowerShell scripts from the IDM installation to the Windows machine:

   ```
   PS C:\> cd openidm\samples\scripted-powershell-with-azure-ad\tools
   PS C:\> pscp -r username@openidm-host:path/to/openidm/samples/scripted-powershell-with-azure-ad/
   azureADScripts/*.ps .
   ```

   The following scripts should now be in the `azureADScripts` directory on your Windows system:

```
PS C:\openidm\samples\scripted-powershell-with-azure-ad\azureADScripts> ls

    Directory: C:\openidm\samples\scripted-powershell-with-azure-ad\azureADScripts

Mode                 LastWriteTime     Length Name
----                 -------------     ------ ---
-
-a---         5/4/2016  11:26 AM       7258 AzureADCreate
.ps1
-a---         5/4/2016  11:26 AM       3208 AzureADDelete
.ps1
-a---         5/4/2016  11:26 AM       6952 AzureADSchema
.ps1
-a---         5/4/2016  11:26 AM       8149 AzureADSearch
.ps1
-a---         5/4/2016  11:26 AM       2465 AzureADTest
.ps1
-a---         5/4/2016  11:26 AM      10840 AzureADUpdate.ps1
```

Note

You need to set the execution policy, as Windows by default does not trust downloaded scripts. For more information, see the following article: Using the Set-ExecutionPolicy Cmdlet

You can then run the `Unblock-File` cmdlet to allow IDM to run the scripts on your Windows system. For more information, see the following article: Unblock-File.

3. On the Linux/UNIX machine on which IDM is installed, navigate to the `path/to/openidm/samples/scripted-powershell-with-azure-ad` directory, and open the `provisioner.openicf.connectorinfoprovider.json conf` file.

4. Edit the remote connector server configuration file to match the settings of the remote .NET connector server.

   Change the port to `8760`, and the password (`key`) that you configured for the .NET connector server.

   The following example assumes that the .NET connector server is running on the host `198.51.100.1`, listening on the default port, and configured with a secret key of `Passw0rd`:

```
{
   "remoteConnectorServers" :
      [
         {
            "name" : "dotnet",
            "host" : "198.51.100.1",
            "port" : 8760,
            "useSSL" : false,
            "timeout" : 0,
            "key" : "Passw0rd"
         }
      ]
}
```

5. Open the sample Azure AD PowerShell connector configuration file, `provisioner.openicf-azureadpowershell.json`, and edit it to match your deployment. In particular, set the following properties in that file:

```
"Host" : "198.51.100.1",
"Port" : 8760,
"Login" : "admin@example.onmicrosoft.com",
"Password" : "Passw0rd",
```

`Host`

The hostname or IP address on which the .NET connector server is running.

`Port`

The port on which the .NET connector server is listening.

`Login`

The username of the administrative account you created for the Azure directory in the previous section.

`Password`

The password of the administrative account you created for the Azure directory in the previous section.

If you have placed the PowerShell scripts in a directory other than the default (`C:\openidm\samples\scripted-powershell-with-azure-ad\azureADScripts`) you must also update those paths in the PowerShell connector configuration file.

6. Start IDM with the PowerShell AzureAD sample configuration:

```
$ cd path/to/openidm
$ ./startup.sh -p samples/scripted-powershell-with-azure-ad
```

20.3. Managing Users and Groups with the PowerShell Azure AD Sample

This section walks you through several REST commands that enable you to test the connector configuration, and perform basic CRUD operations in your Azure AD, through the PowerShell connector.

1. Test that the connector has been configured correctly and that the Azure AD resource can be reached:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/system/azureadpowershell?_action=test"
{
  "name": "azureadpowershell",
  "enabled": true,
  "config": "config/provisioner.openicf/azureadpowershell",
  "objectTypes": [
    "__ALL__",
    "account",
    "group"
  ],
  "connectorRef": {
    "bundleName": "MsPowerShell.Connector",
    "connectorName": "Org.ForgeRock.OpenICF.Connectors.MsPowerShell.MsPowerShellConnector",
    "bundleVersion": "[1.4.2.0,1.5.0.0)"
  },
  "displayName": "PowerShell Connector ",
  "ok": true
}
```

If you see no response from this connector test, review any changes that you made to the `provisioner-openicf*` files in your project's `conf/` subdirectory. If you've made changes appropriate for your deployment, wait a couple of minutes and try again.

2. Query the IDs of the existing users in your Azure AD deployment:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/azureadpowershell/account?_queryId=query-all-ids"
{
  "result": [ {
      "_id": "51560d42-e60e-49a8-855b-42b6eca35ca6",
      "UserPrincipalName": "admin@example.onmicrosoft.com"
    },
    {
      "_id": "5e63b42f-c93a-466f-af86-f0a8d00f2491",
      "UserPrincipalName": "scarter@example.onmicrosoft.com"
    } ]
,
...
}
```

3. Use a query filter to return all details of all existing users in your Azure AD:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/azureadpowershell/account?_queryFilter=true"
{
  "result": [
    {
```

```
      "_id": "51560d42-e60e-49a8-855b-42b6eca35ca6",
      "LiveId": "10033FFF96C5186D",
      "FirstName": "Barbara",
      "LastName": "Jensen",
      "UserPrincipalName": "admin@example.onmicrosoft.com",
      "AlternateEmailAddress" : [ "bjensen@example.com" ],
      "LastPasswordChangeTimestamp": "3/15/2016 11:02:19 AM",
      "DisplayName": "Barbara Jensen",
      "PasswordNeverExpires": false,
      "MobilePhone" : "+1 3602297105"
    },
    {
      "_id": "5e63b42f-c93a-466f-af86-f0a8d00f2491",
      "LiveId": "1003BFFD96A4CFBA",
      "FirstName": "Sam",
      "LastName": "Carter",
      "UserPrincipalName": "scarter@example.onmicrosoft.com"
      "AlternateEmailAddresses": [ "scarter@example.com" ],
      "LastPasswordChangeTimestamp": "3/7/2016 1:09:31 PM",
      "DisplayName": "Sam Carter",
      "PasswordNeverExpires": false,
      "MobilePhone" : "+1 3602297105"
    }
  ]
,
...}
```


4. Return details for a specific user account, by its `_id`

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/azureadpowershell/account/51560d42-e60e-49a8-855b-42b6eca35ca6"
```

5. Create a new user in Azure AD. Substitute the domain for your Azure AD deployment for `example.onmicrosoft.com`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 --header "content-type: application/json" \
 --data '{
   "PasswordNeverExpires": false,
   "AlternateEmailAddresses": ["John.Bull@example.com"],
   "LastName": "Bull",
   "PreferredLanguage": "en-GB",
   "FirstName": "John",
   "UserPrincipalName": "Dev_John.Bull@example.onmicrosoft.com",
   "DisplayName": "John Bull"
 }' \
 "http://localhost:8080/openidm/system/azureadpowershell/account?_action=create"
{
  "_id" : "d4aac947-2037-4f29-b0f5-d404fd99938c",
  "LiveId" : "10037FFE979FB2C1",
  "FirstName" : "John",
  "LastName" : "Bull",
  "UserPrincipalName" : "Dev_John.Bull@example.onmicrosoft.com",
  "AlternateEmailAddresses" : [ "John.Bull@example.com" ],
  "LastPasswordChangeTimestamp" : "5/5/2016 3:52:43 PM",
  "DisplayName" : "John Bull",
  "PasswordNeverExpires" : false,
  "PreferredLanguage" : "en-GB"
}
```

Rerun the same command. You should see the following error:

```
{
  "code" : 500,
  "reason" : "Internal Server Error",
  "message" : "Operation CREATE failed with ConnectorException on system object:
      Dev_John.Bull@example.onmicrosoft.com"
}
```

6. Update the user entry that you have just created with a patch request. Include the `_id` of the new user in the URL. Save that `_id` value for a later step.

   The following example updates the user's display name:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "if-match: *" \
 --header "content-type: application/json" \
 --request PATCH \
 --data '[
    {
       "operation": "replace",
       "field": "DisplayName",
       "value": "John P. Bull"
    }
 ]' \
 "http://localhost:8080/openidm/system/azureadpowershell/account/d4aac947-2037-4f29-b0f5-d404fd99938c"
{
  "_id" : "d4aac947-2037-4f29-b0f5-d404fd99938c",
  "LiveId" : "10037FFE979FB2C1",
  "FirstName" : "John",
  "LastName" : "Bull",
  "UserPrincipalName" : "Dev_John.Bull@mikejangfr.onmicrosoft.com",
  "AlternateEmailAddresses" : [ "John.Bull@example.com" ],
  "LastPasswordChangeTimestamp" : "5/5/2016 3:52:43 PM",
  "DisplayName" : "John P. Bull",
  "PasswordNeverExpires" : false,
  "PreferredLanguage" : "en-GB"
}
```

7. Now create a group:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--header 'content-type: application/json'
 \
--request POST
 \
--data '{
      "DisplayName" : "Dev Testers group",
      "Description" : "Description of a Dev Group"
}' \
'http://localhost:8080/openidm/system/azureadpowershell/group?_action=create'
     {
  "_id" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd",
  "Members" : [ ],
  "DisplayName" : "Dev Testers Group",
  "GroupType" : "Security",
  "Description" : "Description of a Dev Group",
  "objectId" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd"
}
```

8. Add your recently created user to this new group. Use the `_id` of that user, as the `ObjectId`. Use the `_id` of the newly created group in the endpoint:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--header "Content-Type: application/json"
 \
--header "If-Match: *"
 \
--request PUT
 \
--data '{
   "Members" : [
      {
         "ObjectId" : "d4aac947-2037-4f29-b0f5-d404fd99938c"
      }
   ]
}' \
"http://localhost:8080/openidm/system/azureadpowershell/group/9091be74-f37e-408d-9198-2d2b5f4b4cdd"
     {
   "_id" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd",
   "Members" : [ {
      "ObjectId" : "d4aac947-2037-4f29-b0f5-d404fd99938c",
      "DisplayName" : "John P. Bull",
      "GroupMemberType" : "User",
      "EmailAddress" : "Dev_John.Bull@example.onmicrosoft.com"
   } ],
   "DisplayName" : "Testing Devs Group",
   "GroupType" : "Security",
   "Description" : "Description of a Dev Group",
   "objectId" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd"
}
```

9. Confirm the result, by the `_id` of the group:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request GET \
"http://localhost:8080/openidm/system/azureadpowershell/group/9091be74-f37e-408d-9198-2d2b5f4b4cdd"
```

10. Update a label for the group. Use the same group `_id`:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--header "Content-Type: application/json"
 \
--header "If-Match: *"
 \
--request PUT
 \
--data '{
   "_id" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd",
   "Description" : "Dev Masters Group",
   "Members" : [
      {
         "ObjectId" : "d4aac947-2037-4f29-b0f5-d404fd99938c",
         "DisplayName" : "John P. Bull",
         "GroupMemberType" : "User",
         "EmailAddress" : "Dev_John.Bull@example.onmicrosoft.com"
      }
   ],
   "DisplayName" : "Testing Devs Group",
   "GroupType" : "Security",
   "objectId" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd"
}' \
"http://localhost:8080/openidm/system/azureadpowershell/group/9091be74-f37e-408d-9198-2d2b5f4b4cdd"
```

You should see the new `Description` in the output.

11. Remove the user from the new group. Use the same group `_id` Note how the `Members` in the `--data` block, and the output, are blank:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--header "Content-Type: application/json"
 \
--header "If-Match: *"
 \
--request PUT
 \
--data '{
   "_id" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd",
   "Description" : "Dev Masters Group",
   "Members" : [ ],
   "DisplayName" : "Testing Devs Group",
   "GroupType" : "Security",
   "objectId" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd"
}' \
"http://localhost:8080/openidm/system/azureadpowershell/group/9091be74-f37e-408d-9198-2d2b5f4b4cdd"
     {
  "_id" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd",
  "Members" : [ ],
  "DisplayName" : "Testing Devs Group",
  "GroupType" : "Security",
  "Description" : "Dev Masters Group",
  "objectId" : "9091be74-f37e-408d-9198-2d2b5f4b4cdd"
}
```

12. Delete the user that you created earlier:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request DELETE \
"http://localhost:8080/openidm/system/azureadpowershell/account/d4aac947-2037-4f29-b0f5-d404fd99938c"
```

To verify that the user was deleted, run the REST call to `query-all-ids` shown earlier in this section. The ID associated with that user should have been removed.

20.4. Reconciling Users Between IDM and Azure AD

In this section, you'll run commands that demonstrate reconciliation mappings between IDM managed users and your remote instance of Azure AD.

In preparation, create a new user on the Azure AD system:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST
 \
--header "content-type: application/json"
 \
--data '{
    "UserPrincipalName": "CEO@example.onmicrosoft.com",
    "LastName": "Officer",
    "FirstName": "Chief",
    "DisplayName": "Chief Executive Officer",
    "PasswordNeverExpires": false
}' \
"http://localhost:8080/openidm/system/azureadpowershell/account?_action=create"
```

In the steps that follow, you'll run reconciliations to see what happens to that user in the IDM respository.

1. Review the list of current managed users in the repository, filtered for the `userName` that starts with (`sw`) CEO:

   ```
   $ curl \
   --header "X-OpenIDM-Username: openidm-admin"
    \
   --header "X-OpenIDM-Password: openidm-admin"
    \
   --request GET \
   "http://localhost:8080/openidm/managed/user?_queryFilter=userName+sw+'CEO'"
   ```

   Until you reconcile Azure AD to IDM, the outputshould be empty:

   ```
   {
      "result" : [ ],
      "resultCount" : 0,
      "pagedResultsCookie" : null,
      "totalPagedResultsPolicy" : "NONE",
      "totalPagedResults" : -1,
      "remainingPagedResults" : -1
   }
   ```

2. Run a reconciliation from Azure AD to IDM:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST \
"http://localhost:8080/openidm/recon?
_action=recon&mapping=systemAzureadpowershellAccount_managedUser&waitForCompletion=true"

     {
   "_id" : "71811f1c-2ec0-47ae-ba47-d62c7094201b-1105",
   "state" : "SUCCESS"
}
```

3. Now rerun the command to list of current managed users in the IDM repository, filtered for the `userName` that starts with (`sw`) CEO:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request GET \
"http://localhost:8080/openidm/managed/user?_queryFilter=userName+sw+'CEO'"
      {
   "result" : [ {
   "_id" : "3a012a60-19c2-4fb4-99cc-0bb82dc4588c",
   "_rev" : "1",
   "userName" : "CEO@example.onmicrosoft.com",
   "mail" : "CEO@example.onmicrosoft.com",
   "sn" : "Officer",
   "givenName" : "Chief",
   "accountStatus" : "active",
   "effectiveRoles" : [ ],
   "effectiveAssignments" : [ ]
   } ],
   "resultCount" : 1,
   "pagedResultsCookie" : null,
   "totalPagedResultsPolicy" : "NONE",
   "totalPagedResults" : -1,
   "remainingPagedResults" : -1
}
```

4. Delete that CEO user from the Azure AD system, by the `_id` shown earlier when you searched that system:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request DELETE \
"http://localhost:8080/openidm/system/azureadpowershell/account/3a012a60-19c2-4fb4-99cc-0bb82dc4588c"
```

   If successful, you'll see the data for the CEO user one last time.

5. Run a second reconciliation from Azure AD to IDM

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST \
"http://localhost:8080/openidm/recon?
_action=recon&mapping=systemAzureadpowershellAccount_managedUser&waitForCompletion=true"
```

6. Rerun the command to search the IDM repository for a `userName` that starts with 'CEO' one more time, to confirm that user has been reconciled out of the IDM repository:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request GET \
"http://localhost:8080/openidm/managed/user?_queryFilter=userName+sw+'CEO'"
```

Chapter 21

Connecting to a MySQL Database With ScriptedSQL

This sample uses the Groovy Connector Toolkit to implement a ScriptedSQL connector that interacts with an external MySQL database (HRDB).

The Groovy Connector Toolkit is bundled with IDM in the JAR `openidm/connectors/groovy-connector-1.5.20.0.jar`.

In addition, this sample demonstrates the following IDM functionality:

- Complex data types

  Complex data types can be stored, retrieved and synchronized like any other object property. They are stored in the managed data as JSON objects, represented as a string, but can be mapped to external resources in any format required. You can customize the mapping to do additional work with or transformations on the complex data types.

  This sample defines one complex data type, `cars`, discussed in more detail later in this section.

- Event hooks to perform actions

  The mapping from the internal repository to the external `hrdb` database includes two script hooks. The first hook is for an `onCreate` event and the second is for an `onUpdate` event.

  For more information, see "Testing the Event Hooks".

- Custom scripted endpoints

  Custom scripted endpoints are configured in the provisioner configuration file and allow you to execute custom scripts over REST. This sample uses a custom scripted endpoint to reset the database and populate it with data. For more information about custom scripted endpoints, see "Creating Custom Endpoints to Launch Scripts" in the *Integrator's Guide*.

Caution

Because MySQL cannot "un-hash" user passwords there is no way for a reconciliation operation to retrieve the password from MySQL and store it in the managed user object. This issue might impact configurations that support multiple external resources in that passwords might not be synchronized immediately after reconciliation from MySQL to the managed user repository. Users who are missing in the repository will be created by reconciliation but their passwords will be empty. When those users are synchronized to other

external resources, they will have empty passwords in those resources. Additional scripting might be required to handle this situation, depending on the requirements of your deployment.

The Groovy scripts required for the sample are located in the `samples/scripted-sql-with-mysql/tools` directory. Note that the power of the Groovy connector is in the associated Groovy scripts, and their application in your particular deployment. The scripts provided with this sample are specific to the sample. You must customize these scripts to address the requirements of your specific deployment. The sample scripts are a good starting point on which to base your customization.

21.1. Configuring the External MySQL Database

This sample assumes a MySQL database, running on the localhost. Follow these steps to install and configure the MySQL database:

1. Download MySQL Connector/J, version 5.1 or later from the MySQL website.

   Extract the contents of the zip file, and copy the .jar into the `openidm/bundle` directory:

   ```
   $ cp mysql-connector-java-version-bin.jar /path/to/openidm/bundle/
   ```

2. Set up MySQL to listen on localhost, port 3306. IDM will connect to the `hrdb` database as user `root` with password `password`.

   If want to use an existing MySQL instance that runs on a different host or port, or you want to change the database credentials, adjust the `configurationProperties` in the connector configuration file (`samples/scripted-sql-with-mysql/conf/provisioner.openicf-hrdb.json`) before you start the sample. The default configuration is as follows:

   ```
   "configurationProperties" : {
       "username" : "root",
       "password" : "password",
       "driverClassName" : "com.mysql.jdbc.Driver",
       "url" : "jdbc:mysql://localhost:3306/hrdb",
   ```

3. Set up the `hrdb` database, with which IDM will synchronize its managed user repository:

```
mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 3
Server version: 5.7.13 MySQL Community Server (GPL)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql> CREATE DATABASE hrdb CHARACTER SET utf8 COLLATE utf8_bin;
Query OK, 1 row affected (0.00 sec)
mysql> quit
Bye
```

21.2. Running the Sample

In this section, you will start IDM with the sample configuration, test the connection to the MySQL database, and populate the database with sample data.

The mapping configuration file (`sync.json`) for this sample includes the mapping `systemHrdb_managedUser`. You will use this mapping to synchronize users from the source `hrdb` database with the target IDM repository.

1. Start IDM with the configuration for the ScriptedSQL sample:

   ```
   $ cd /path/to/openidm
   $ ./startup.sh -p samples/scripted-sql-with-mysql
   ```

2. Run the custom script described in the previous section to reset the database and populate it with sample data.

   You can run the script again, at any point, to reset the database.

   ```
   $ curl \
    --header "X-OpenIDM-Username: openidm-admin" \
    --header "X-OpenIDM-Password: openidm-admin" \
    --request POST \
    "http://localhost:8080/openidm/system/hrdb?_action=script&scriptId=ResetDatabase"
   {
     "actions": [
       {
         "result": "Database reset successful."
       }
     ]
   }
   ```

   The `hrdb` database should now be populated with sample data.

3. Review the contents of the database as follows:

```
$ mysql -u root -p
Enter password:
...
mysql > use hrdb;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql > select * from users;

+----+--------+--------------+-----------+----------+---------------+--------...
| id | uid    | password     | firstname | lastname | fullname      | email  ...
+----+--------+--------------------------------------+-----------+-------...
|  1 | bob    | e38ad2149... | Bob       | Fleming  | Bob Fleming   | Bob.Fle...
|  2 | rowley | 2aa60a8ff... | Rowley    | Birkin   | Rowley Birkin | Rowley....
|  3 | louis  | 1119cfd37... | Louis     | Balfour  | Louis Balfour | Louis.B...
|  4 | john   | a1d7584da... | John      | Smith    | John Smith    | John.Sm...
|  5 | jdoe   | edba955d0... | John      | Doe      | John Doe      | John.Do...
+----+--------+--------------------------------------+-----------+-------...
5 rows in set (0.00 sec)
```

Note

The passwords in the output shown above are hashed to the SHA-1 standard because as they cannot be read into IDM as clear text. The SHA-1 Hash function is used for compatibility reasons. Use a more secure algorithm in a production database.

4. Reconcile the hrdb database with the managed user repository.

   - To reconcile the repository by using the Administration UI:

     1. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

     2. Select Configure > Mappings.

        The Mappings page shows two mappings, one from the `hrdb` database to the IDM managed user repository (`managed/user`), and one in the opposite direction.

     3. Click Reconcile on the first mapping (systemHrdb_managedUser).

   - To reconcile the repository by using the command-line, launch the reconciliation operation with the following command:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST \
"http://localhost:8080/openidm/recon?
_action=recon&mapping=systemHrdb_managedUser&waitForCompletion=true"
{
  "state": "SUCCESS",
  "_id": "f3c618aa-cc3b-49ed-9a3a-00b012db2513"
}
```

The reconciliation operation creates the five users from the MySQL database in the IDM repository.

5. Retrieve the list of users from the repository.

   - To retrieve the users in the repository from the Admin UI:

     1. Select Manage > User to display the User List.

        The five users from the `hrdb` database have been reconciled to the OpenIDM repository.

     2. To retrieve the details of a specific user, click that user entry.

   - To retrieve the users from the repository by using the command-line, query the IDs in the repository as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user?_queryId=query-all-ids"
{
  "result": [
    {
      "_id": "1b379e4d-3b8d-47e7-93d5-a72c4b483e39",
      "_rev": "000000002d93e471"
    },
    {
      "_id": "a658f751-d6e9-4b5d-af56-071a9b05c3af",
      "_rev": "000000003c83d48a"
    },
    {
      "_id": "5b31027b-09f8-4c7f-abfa-c6bc86ae3943",
      "_rev": "00000000b042e559"
    },
    {
      "_id": "1b3f6b06-1752-4c40-ba34-51d30b184b9d",
      "_rev": "0000000092bdda6d"
    },
    {
      "_id": "9c62f0d2-47e2-4fc5-89d1-b50b782b1022",
      "_rev": "0000000025cdd3c6"
    }
```

```
  ],
  "resultCount": 5,
  "pagedResultsCookie": null,
  "totalPagedResultsPolicy": "NONE",
  "totalPagedResults": -1,
  "remainingPagedResults": -1
}
```

To retrieve a complete user record, query the userName of the individual user entry. The following query returns the record for the user `Rowley Birkin`:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/managed/user/?_queryId=for-userName&uid=rowley"

  "result": [
    {
      "_id": "1b379e4d-3b8d-47e7-93d5-a72c4b483e39",
      "_rev": "000000002d93e471",
      "mail": "Rowley.Birkin@example.com",
      "userName": "rowley",
      "sn": "Birkin",
      "organization": "SALES",
      "givenName": "Rowley",
      "cars": [
        {
          "year": "2013",
          "make": "BMW",
          "model": "328ci"
        },
        {
          "year": "2010",
          "make": "Lexus",
          "model": "ES300"
        }
      ],
      "accountStatus": "active",
      "effectiveRoles": [],
      "effectiveAssignments": []
    }
  ],
  ...
}
```

Regardless of how you have retrieved Rowley Birkin's entry, note the `cars` property in this user's entry. This property demonstrates a complex object, stored in JSON format in the user entry, as a list that contains multiple objects. In the MySQL database, the `car` table joins to the `users` table through a `cars.users_id` column. The Groovy scripts read this data from MySQL and repackage it in a way that IDM can understand. With support for complex objects, the data is passed through to IDM as a list of `car` objects. Data is synchronized from IDM to MySQL in the same way. Complex objects can also be nested to any depth.

Group membership (not demonstrated here) is maintained with a traditional "join table" in MySQL (`groups_users`). IDM does not maintain group membership in this way, so the Groovy scripts do the work to translate membership between the two resources.

21.3. Testing the Event Hooks

This sample uses the `onCreate` and `onUpdate` hooks to log messages when a user is created or updated in the external database.

The sample's `conf/sync.json` file defines these event hooks as follows:

```
...
    {
        "name" : "managedUser_systemHrdb",
        "source" : "managed/user",
        "target" : "system/hrdb/account",
        "links" : "systemHrdb_managedUser",
        "correlationQuery" : {
            "type" : "text/javascript",
            "source" : "({'_queryFilter': 'uid eq \"' + source.userName + '\"'});"
        },
        "onCreate" : {
            "type" : "text/javascript",
            "source" : "logger.info(\"Creating new user in external repo\")"
        },
        "onUpdate" : {
            "type" : "text/javascript",
            "source" : "logger.info(\"Updating existing user in external repo\")"
        },
...
```

Using these event hooks, IDM logs a message when a user is created or updated in the external database. In this sample, the script source is included in the mapping. However, a script can also be called from an external file. For more information about event hooks, see "Places to Trigger Scripts" in the *Integrator's Guide*.

To test the event hooks, create a new managed user as follows:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-Type: application/json" \
 --request POST \
 --data '{
    "mail":"fdoe@example.com",
    "sn":"Doe",
    "telephoneNumber":"555-1234",
    "userName":"fdoe",
    "givenName":"Felicitas",
    "description":"Felicitas Doe",
    "displayName":"fdoe"}' \
 "http://localhost:8080/openidm/managed/user?_action=create"
{
  "_id": "2e5e9748-77e6-4019-90e1-abe9ab897343",
  "_rev": "0000000015b2d4ba",
  "mail": "fdoe@example.com",
  "sn": "Doe",
  "telephoneNumber": "555-1234",
  "userName": "fdoe",
  "givenName": "Felicitas",
  "description": "Felicitas Doe",
  "displayName": "fdoe",
  "accountStatus": "active",
  "effectiveRoles": [],
  "effectiveAssignments": []
}
```

The implicit synchronization between the managed user repository and the HRDB database creates that user in the database automatically.

Check the latest log file at `path/to/openidm/logs/openidm0.log.0`. You should see the following message at the end of the log:

```
INFO: Creating new user in external repo
```

Query the new user entry in the HRDB database:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/hrdb/account?_queryFilter=uid+eq+'fdoe'"
{
  "result": [
    {
      "_id": "6",
      "cars": [],
      "firstName": "Felicitas",
      "uid": "fdoe",
      "lastName": "Doe",
      "organization": "IDM",
      "fullName": "Felicitas Doe",
      "email": "fdoe@example.com"
    }
  ],
  ...
}
```

Update fdoe's entry in the HRDB database with a patch request. The following request updates the user's `organization` field:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--header "Content-Type: application/json"
 \
--request PATCH
 \
--data '[ {
   "operation" : "replace",
   "field" : "organization",
   "value" : "example.com"
} ]' \
"http://localhost:8080/openidm/system/hrdb/account/6"
{
  "_id": "6",
  "cars": [],
  "firstName": "Felicitas",
  "uid": "fdoe",
  "lastName": "Doe",
  "organization": "example.com",
  "fullName": "Felicitas Doe",
  "email": "fdoe@example.com"
}
```

Note that this update does not reference the `onUpdate` script hook so this change is not logged in `openidm0.log.0`.

21.4. Using Paging With the ScriptedSQL Sample

All OpenICF connectors from version 1.4 onwards support the use of paging parameters to restrict query results. The following command indicates that only two records should be returned (`_pageSize=2`) and that the records should be sorted according to their `timestamp` and `_id` (`_sortKeys=timestamp,id`). Including the `timestamp` in the sort ensures that, as you page through the set, changes to records that have already been visited are not lost. Instead, those records are pushed onto the last page:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/hrdb/account?_queryFilter=true&_pageSize=2&_sortKeys=timestamp,id"
{
  "result": [
    {
      "_id": "1",
      "firstName": "Bob",
      "cars": [
        {
          "year": "1979",
          "make": "Ford",
          "model": "Pinto"
        }
      ],
      "fullName": "Bob Fleming",
      "email": "Bob.Fleming@example.com",
      "uid": "bob",
      "lastName": "Fleming",
      "organization": "HR"
    },
    {
      "_id": "2",
      "firstName": "Rowley",
      "cars": [
        {
          "year": "2013",
          "make": "BMW",
          "model": "328ci"
        }
      ],
      "fullName": "Rowley Birkin",
      "email": "Rowley.Birkin@example.com",
      "uid": "rowley",
      "lastName": "Birkin",
      "organization": "SALES"
    }
  ],
  "resultCount": 2,
  "pagedResultsCookie": "2018-04-05+16%3A30%3A22.0%2C2",
  "totalPagedResultsPolicy": "NONE",
  "totalPagedResults": -1,
  "remainingPagedResults": -1
}
```

The `pagedResultsCookie` is used by the server to keep track of the position in the search results. You can ignore the `"remainingPagedResults": -1` in the output. The real value of this property is not returned because the scripts that the connector uses do not do any counting of the records in the resource.

Using the `pagedResultsCookie` from the previous step, run a similar query, to retrieve the following set of records in the database:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/system/hrdb/account?_queryId=query-all-ids&_pageSize=2&_sortKeys=timestamp
,id&_pagedResultsCookie=2018-04-05+16%3A30%3A22.0%2C2"
{
  "result": [
    {
      "_id": "3",
      "uid": "louis"
    },
    {
      "_id": "4",
      "uid": "john"
    }
  ],
  "resultCount": 2,
  "pagedResultsCookie": "2018-04-05+16%3A30%3A22.0%2C4",
  "totalPagedResultsPolicy": "NONE",
  "totalPagedResults": -1,
  "remainingPagedResults": -1
}
```

For more information about paging support, see "Paging Query Results" in the *Integrator's Guide*.

Chapter 22

Directing Audit Information To a MySQL Database

This sample shows how to direct audit information to a MySQL database.

The sample includes an external CSV file and a mapping between objects in that file and the managed user repository. The reconciliations across this mapping generate the audit records that will be directed to the MySQL database. The connection to the MySQL database is through a ScriptedSQL implementation of the Groovy Connector Toolkit.

22.1. About the Configuration Files

The files that demonstrate the functionality of this sample are located under `/path/to/openidm/samples/audit-jdbc/`, in the `conf/` and `data/` directories.

The following files play important roles in this sample:

`conf/provisioner.openicf-auditdb.json`

This file provides the configuration for the Scripted SQL implementation of the Groovy Connector. The file specifies, among other things, the connection details to the MySQL database, the connector version information, and the object types that are supported for this connection. For more information, see "*Groovy Connector Toolkit*" in the *Connector Reference*.

`conf/provisioner.openicf-csvfile.json`

This file provides the configuration for this instance of the CSV connector. It includes, among other things, the location of the CSV file resource.

`conf/sync.json`

Provides the mapping between managed users and the data set in the CSV file.

`conf/audit.json`

This file configures the router as the audit event handler, and routes logs to a remote system, identified as `auditdb`. For information about configuring how audit logs are handled, see "Configuring the Audit Service" in the *Integrator's Guide*.

`data/csvConnectorData.csv`

This file contains the sample data set that will be reconciled to the managed user repository.

`data/sample_audit_db.mysql`

This file sets up the schema for the MySQL database that will contain the audit logs.

`tools/*.groovy`

The Groovy scripts in this directory allow the connector to perform operations on the MySQL database.

22.2. Configuring the MySQL Database

Before you start this sample, MySQL must be installed and running, and must include the database required for the sample. In addition, IDM must include the connector .jar required to connect to the MySQL database.

The sample assumes the following MySQL configuration:

- You can connect to the MySQL database over the network, as user `root` with password `password`.

1. Install and configure MySQL.
2. When MySQL is up and running, import the database schema to set up the database required for the sample:

```
$ mysql -u root -p < /path/to/openidm/samples/audit-jdbc/data/sample_audit_db.mysql
Enter password: password
$
```

This step sets up an `audit` database with six tables that correspond to the various audit events. You can view the tables in the audit database as follows:

```
$ mysql -u root -p
Enter password: password
mysql> use audit
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> show tables;
+---------------------+
| Tables_in_audit     |
+---------------------+
| auditaccess         |
| auditactivity       |
| auditauthentication |
| auditconfig         |
| auditrecon          |
| auditsync           |
+---------------------+
6 rows in set (0.00 sec)
```

3. Download MySQL Connector/J, version 5.1 or later from the MySQL website. Unpack the delivery, and copy the .jar into the `openidm/bundle` directory:

```
$ cp mysql-connector-java-version-bin.jar /path/to/openidm/bundle/
```

4. Edit the `url` property in the SQL connector configuration file (`conf/provisioner.openicf-auditdb.json`) to match the host and port of your MySQL instance. For example:

```
"url" : "jdbc:mysql://localhost:3306/audit",
```

22.3. Running the Sample

In this section, you will start IDM, then run a reconciliation between the CSV file and the managed user repository. After the reconciliation, you should be able to read the audit logs in the `audit` database on your MySQL instance.

1. Prepare IDM as described in "Preparing IDM", then start the server with the configuration for this sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/audit-jdbc
```

2. Reconcile the two data sources, either over the command-line or by using the Admin UI.

   To run the reconciliation over REST, use the following command:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 "http://localhost:8080/openidm/recon?
_action=recon&mapping=systemCsvfileAccounts_managedUser&waitForCompletion=true"
{
  "_id": "a3664c26-bf82-4100-b411-19edc248c306-7",
  "state": "SUCCESS"
}
```

   To run the reconciliation from the Admin UI, select Configure > Mappings, select the `systemCsvfileAccounts_managedUser` mapping, then select Reconcile.

3. Inspect the tables in the `audit` database to see how the logs have been routed to that location.

   The following example displays the reconciliation audit logs:

```
$ $ mysql -u root -p
Enter password: password
...
mysql> use audit;
...
mysql> show tables;
+--------------------+
| Tables_in_audit    |
+--------------------+
| auditaccess        |
| auditactivity      |
| auditauthentication |
| auditconfig        |
| auditrecon         |
| auditsync          |
+--------------------+
 6 rows in set (0.01 sec)
mysql> select * from auditrecon;

| id | objectid | transactionid | activitydate | eventname | userid        | ... | mapping...
|  1 | a3664... | a3664c26-b... | 2017-02-1... | recon     | openidm-admin | ... | systemCsvfile...
```

You can inspect the other audit logs in the same way.

4. By default, the audit configuration in this sample uses the router audit handler for queries, as indicated in the following line from the `conf/audit.json` file:

```
"handlerForQueries" : "router",
```

With this configuration, when you query the audit logs over REST, the audit data is returned from the router handler (in this case the MySQL database). The following example shows how to query the reconciliation audit log:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/audit/recon?_queryFilter=true"
{
  "result": [
    {
      "_id": "a3664c26-bf82-4100-b411-19edc248c306-16",
      "action": null,
      "trackingIds": null,
      "sourceObjectId": null,
      "timestamp": "2017-02-14T10:19:30.688Z",
      "ambiguousTargetObjectIds": null,
      "reconId": "a3664c26-bf82-4100-b411-19edc248c306-7",
      "status": null,
      "eventName": "recon",
      "mapping": "systemCsvfileAccounts_managedUser",
      "targetObjectId": null,
      "situation": null,
      "userId": "openidm-admin",
      "transactionId": "a3664c26-bf82-4100-b411-19edc248c306-7",
      "message": "Reconciliation initiated by openidm-admin",
      "reconAction": "recon",
```

```
      "messageDetail": null,
      "entryType": "start",
      "linkQualifier": null,
      "reconciling": null,
      "exception": null
    },
    ...
}
```

You can query the other audit logs in the same way.

For more information about querying the audit logs, see "Querying Audit Logs Over REST" in the *Integrator's Guide*.

Chapter 23

Directing Audit Information To a JMS Broker

This sample shows how to configure a Java Message Service (JMS) audit event handler to direct audit information to a JMS broker.

23.1. About This Sample

JMS is an API that supports Java-based peer-to-peer messages between clients. The JMS API can create, send, receive, and read messages, reliably and asynchronously. You can set up a JMS audit event handler to publish messages that comply with the *Java Message Service Specification Final Release 1.1*.

This sample demonstrates the use of the JMS audit event handler. In the sample you will set up communication between IDM and an external JMS Message Broker, as well as *Apache Active MQ* as the JMS provider and message broker.

Note

JMS topics are not related to ForgeRock audit event topics. The ForgeRock implementation of JMS topics uses the publish/subscribe messaging domain to direct messages to the JMS audit event handler. In contrast, ForgeRock audit event topics specify categories of events.

23.2. Adding the Dependencies for JMS Messaging

The JMS audit event handler requires ActiveMQ, and a number of dependencies. This section lists the dependencies, where they can be downloaded, and where they must be installed in the OpenIDM instance.

This sample was tested with the versions of the files mentioned in this list. If you use a different ActiveMQ version, the dependency versions might differ.

- Download the ActiveMQ binary from http://activemq.apache.org/download.html. This sample was tested with ActiveMQ 5.14.3.
- Download the *ActiveMQ Client* that corresponds to your ActiveMQ version from https://repository.apache.org/content/repositories/releases/org/apache/activemq/activemq-client/.
- Download the JmDNS JAR, version 3.4.1.

- Download the *bnd* tool that allows you to create a JAR with OSGi meta data. This sample was tested with **bnd** version 2.4.0, downloaded from https://repo1.maven.org/maven2/biz/aQute/bnd/bnd/.
- Download the Apache Geronimo J2EE management bundle (`geronimo-j2ee-management_1.1_spec-1.0.1.jar`) from https://repo1.maven.org/maven2/org/apache/geronimo/specs/geronimo-j2ee-management_1.1_spec/1.0.1/.
- Download the *hawtbuf* Maven-based protocol buffer compiler (hawtbuf-1.11.jar).

1. Unpack the ActiveMQ binary. For example:

```
$ tar -zxvf ~/Downloads/apache-activemq-5.14.3-bin.tar.gz
```

2. Create a temporary directory, copy the Active MQ Client and `bnd` JAR files to that directory, then change to that directory:

```
$ mkdir ~/Downloads/tmp
$ mv activemq-client-5.14.3.jar ~/Downloads/tmp/
$ mv bnd-2.4.0.jar ~/Downloads/tmp/
$ cd ~/Downloads/tmp/
```

3. Create an OSGi bundle as follows:

   a. In a text editor, create a BND file named `activemq.bnd` with the following contents:

```
version=5.14.3
Export-Package: *;version=${version}
Bundle-Name: ActiveMQ :: Client
Bundle-SymbolicName: org.apache.activemq
Bundle-Version: ${version}
```

   Your `tmp/` directory should now contain the following files:

```
$ ls
activemq-client-5.14.3.jar activemq.bnd   bnd-2.4.0.jar
```

   b. In that same directory, create the OSGi bundle archive file as follows:

```
$ java -jar bnd-2.4.0.jar \
 wrap --properties activemq.bnd \
 --output activemq-client-5.14.3-osgi.jar \
 activemq-client-5.14.3.jar
```

4. Copy the resulting `activemq-client-5.14.3-osgi.jar` file to the `openidm/bundle` directory:

```
$ cp activemq-client-5.14.3-osgi.jar /path/to/openidm/bundle/
```

5. Copy the *Apache Geronimo*, *hawtbuf*, and *JmDNS* JAR files to the `openidm/bundle` directory:

```
$ cp ~/Downloads/geronimo-j2ee-management_1.1_spec-1.0.1.jar /path/to/openidm/bundle/
$ cp ~/Downloads/hawtbuf-1.11.jar /path/to/openidm/bundle/
$ cp ~/Downloads/jmdns-3.4.1.jar /path/to/openidm/bundle
```

Your OpenIDM instance is now ready for you to configure the JMS audit event handler.

23.3. Starting the ActiveMQ Broker and Running the Sample

With the appropriate bundles in the `/path/to/openidm/bundle/` directory, you can start the ActiveMQ message broker, then start IDM with the configuration for this sample.

1. Navigate to the directory where you unpacked the ActiveMQ binary, for example:

```
$  cd ~/Downloads/apache-activemq-5.14.3
```

2. If you need SSL protection for your audit data, edit the ActiveMQ configuration file, `activemq.xml`, in the `conf/` subdirectory.

   Find the code block associated with `<transportConnectors>`, and add the following (all on one line) within that block:

```
<transportConnector name="ssl"
uri="ssl://0.0.0.0:61617?transport.enabledCipherSuites=
    SSL_RSA_WITH_RC4_128_SHA,SSL_DH_anon_WITH_3DES_EDE_CBC_SHA
&amp;maximumConnections=1000&amp;wireFormat.maxFrameSize=104857600&amp;transport.daemon=true"/>
```

3. Navigate to the directory where you unpacked the ActiveMQ binary and run the following command to start the ActiveMQ broker:

```
$ bin/activemq start
INFO: Loading '/path/to/Downloads/apache-activemq-5.14.3//bin/env'
INFO: Using java '/usr/bin/java'
INFO: Starting - inspect logfiles specified in logging.properties and log4j.properties to get details
INFO: pidfile created : '/path/to/Downloads/apache-activemq-5.14.3//data/activemq.pid' (pid '69627')
```

4. Start IDM with the configuration for this sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/audit-jms
```

Note

If you see the following error in the OSGi console, make sure that you have installed all the dependencies described in "Adding the Dependencies for JMS Messaging" and that you have started the ActiveMQ broker.

```
SEVERE: Unable to create JmsAuditEventHandler 'jms': null
```

23.4. Configuring and Using a JMS Consumer Application

To take advantage of the Apache ActiveMQ event broker, the JMS audit sample includes a Java consumer in the following directory: `/path/to/openidm/samples/audit-jms/consumer/`

Assuming you have Apache Maven installed on the local system, you can compile that sample consumer with the following commands:

```
$ cd /path/to/openidm/samples/audit-jms/consumer/
$ mvn clean install
```

When the build process is complete, you'll see a `BUILD SUCCESS` message:

```
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time: 22.852 s
[INFO] Finished at: 2017-02-17T17:21:35+02:00
[INFO] Final Memory: 18M/148M
[INFO] ------------------------------------------------------------------------
```

Note

You might see `[WARNING]` messages during the build. As long as the messages end with `BUILD SUCCESS`, you can proceed with the JMS consumer application.

When the consumer is compiled, run the following command in the same directory to output audit messages related to IDM actions:

```
$ mvn \
exec:java \
-Dexec.mainClass="consumer.src.main.java.SimpleConsumer"
 \
-Dexec.args="tcp://localhost:61616"
   [INFO]
[INFO] ------------------------------------------------------------------------
[INFO] Building SimpleConsumer 1.0-SNAPSHOT
[INFO] ------------------------------------------------------------------------
[INFO]
[INFO] --- exec-maven-plugin:1.5.0:java (default-cli) @ SimpleConsumer ---
Downloading: https://repo.maven.apache.org/maven2/org/apache/commons/commons-exec/...
Downloaded: https://repo.maven.apache.org/maven2/org/apache/commons/commons-exec/...
Downloading: https://repo.maven.apache.org/maven2/org/apache/commons/commons-exec/...
Downloaded: https://repo.maven.apache.org/maven2/org/apache/commons/commons-exec/...
Connection factory=org.apache.activemq.ActiveMQConnectionFactory
READY, listening for messages. (Press 'Enter' to exit)
```

Look for the message `READY, listening for messages`.

If you've configured ActiveMQ on a secure port, as described in "Starting the ActiveMQ Broker and Running the Sample", you can run this alternative command:

```
$ mvn \
exec:java \
-Dexec.mainClass="consumer.src.main.java.SimpleConsumer"
 \
-Dexec.args="ssl://localhost:61617?daemon=true&socket.enabledCipherSuites=
    SSL_RSA_WITH_RC4_128_SHA,SSL_DH_anon_WITH_3DES_EDE_CBC_SHA"
```

Try some actions on IDM, either in a different console or in the Admin UI. Watch the output in the `SimpleConsumer` console. For example, you might see output similar to the following when you run a reconciliation on the data in this sample:

```
{
  "auditTopic": "recon",
  "event": {
   "transactionId": "f3e108a9-eb75-4ec8-96c5-9dc2f5137d51-176",
   "timestamp": "2017-02-17T15:25:34.899Z",
   "eventName": "recon",
   "userId": "openidm-admin",
   "exception": null,
   "linkQualifier": null,
   "mapping": "systemCsvfileAccounts_managedUser",
   "message": "SOURCE_IGNORED: 0 UNASSIGNED: 0 AMBIGUOUS: 0 CONFIRMED: ...",
   "messageDetail": {
    "_id": "f3e108a9-eb75-4ec8-96c5-9dc2f5137d51-176",
    "mapping": "systemCsvfileAccounts_managedUser",
    "state": "SUCCESS",
    "stage": "COMPLETED_SUCCESS",
    "stageDescription": "reconciliation completed.",
    "progress": {
     "source": {
      "existing": {
       "processed": 2,
       "total": "2"
      }
     },
   ...
  }
 }
```

Chapter 24

Synchronizing Data Between MongoDB and IDM

This sample uses the Groovy Connector Toolkit to implement a scripted connector that interacts with a MongoDB database. The connector can be used for provisioning MongoDB database users and roles from an IDM managed repository.

The Groovy Connector Toolkit is bundled with IDM in the JAR `openidm/connectors/groovy-connector-1.5.20.0.jar`.

The Groovy scripts required for the sample are bundled within the MongoDB connector. If you wish to customize these scripts, you can specify different scripts by adjusting the `scriptRoot` property and script names in `provisioner.openicf-mongodb.json`.

This sample allows you to synchronize from IDM Managed User to an external MongoDB database.

Note

There is currently no way to synchronize passwords from an external MongoDB database to IDM. Because of this, it is recommended that IDM be used for user creation and password management.

While not demonstrated in this sample, the MongoDB connector can also:

- Synchronize from a dedicated store of IDM Managed MongoDB Roles to an external MongoDB database.
- Synchronize from an external MongoDB database to a dedicated IDM store of Managed MongoDB Roles.

24.1. Configuring the MongoDB Database

This sample assumes a MongoDB database, running on the localhost system. Follow these steps to install and configure the MongoDB database:

1. Use the instructions for downloading and installing MongoDB in the MongoDB Manual. For the supported version of MongoDB, see "*MongoDB Connector*" in the *Connector Reference*.
2. Set up MongoDB, based on the `configurationProperties` discussed in "*MongoDB Connector*" in the *Connector Reference*. By default, it listens on localhost, port 27017. For the purpose of this

sample, we'll set up an administrative user of `myUserAdmin` with a password of `Passw0rd` in the `admin` database. We will then create a database in MongoDB named `hrdb`.

> **Note**
>
> The MongoDB administrative user must have the `userAdminAnyDatabase` role, or attempts to update users will fail.

If want to use an existing MongoDB instance that runs on a different host or port, or you want to change the database credentials, adjust the `configurationProperties` in the connector configuration file (`samples/sync-with-mongodb/conf/provisioner.openicf-mongodb.json`) before you start the sample, as described in "Configuring the MongoDB Connector" in the *Connector Reference*.

3. Set up the MongoDB database, with which IDM will synchronize its managed user repository, by:
   - Enabling authentication, as described in the following MongoDB document: *Enable Auth* .
   - Setting up users and roles, as described in this MongoDB document: *Manage Users and Roles* .

24.2. Running the Sample

In this section, you will start IDM with the sample configuration, test the connection to the MongoDB database, and populate the database with sample data.

The mapping configuration file (`sync.json`) for this sample includes one mapping: `managedUser_systemMongodbAccount`. You will use this mapping to synchronize users between the IDM repository and the MongoDB database:

1. Update `samples/sync-with-mongodb/conf/provisioner.openicf-mongodb.json` with the credentials and database information you created when configuring MongoDB. In our example, `database` would be set to `hrdb`, while `user` would be `myUserAdmin` with `userDatabase` set to `admin`.
2. Start IDM with the configuration for the MongoDB sample:
```
$ cd /path/to/openidm
$ ./startup.sh -p samples/sync-with-mongodb
```
3. Create at least one assignment and role to assign roles to users. In this example, we are creating a role to assign read privileges to users. The role created is conditional, and only assigned to active users:
```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "Content-type: application/json" \
 --request POST \
 --data '{
   "name" : "MongoDB Read Access",
   "description": "Basic Read Access to HRDB",
   "mapping" : "managedUser_systemMongodbAccount",
   "attributes": [
```

```
    {
      "name": "roles",
      "value": [
        {
          "role": "read",
          "db": "hrdb"
        }
      ],
      "assignmentOperation" : "mergeWithTarget",
      "unassignmentOperation" : "removeFromTarget"
    }
  ]
 }' \
"http://localhost:8080/openidm/managed/assignment?_action=create"
{
  "_id": "fb98f4a5-0f4d-4e22-9e17-79c45c11fe20",
  "_rev": "000000005c2da0eb",
  "name": "MongoDB Read Access",
  "description": "Basic Read Access to HRDB",
  "mapping": "managedUser_systemMongodbAccount",
  "attributes": [
    {
      "name": "roles",
      "value": [
        {
          "role": "read",
          "db": "hrdb"
        }
      ],
      "assignmentOperation": "mergeWithTarget",
      "unassignmentOperation": "removeFromTarget"
    }
  ]
}
```

```
$ curl \
 --header "Content-type: application/json" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request POST \
 --data '{
   "name" : "MongoDB Read Access",
   "description": "Role for accounts with read access in MongoDB.",
   "condition": "/accountStatus eq \"active\"",
   "assignments": [
     {
       "_ref": "managed/assignment/fb98f4a5-0f4d-4e22-9e17-79c45c11fe20",
       "_refResourceCollection": "managed/assignment",
       "_refResourceId": "fb98f4a5-0f4d-4e22-9e17-79c45c11fe20"
     }
   ]
 }' \
 "http://localhost:8080/openidm/managed/role?_action=create"
{
  "_id": "5f16238e-39e1-4f8c-8b16-27d39dc64dc3",
  "_rev": "0000000011e566a2",
  "name": "MongoDB Read Access",
  "description": "Role for accounts with read access in MongoDB.",
  "condition": "/accountStatus eq \"active\""
}
```

4. Create new users in IDM. Note that MongoDB requires user name, password, and roles properties to successfully create a user. In this example, the `read` role is assigned to new users automatically.

5. Reconcile the managed user repository with the external MongoDB database:

   - To reconcile the repository through the UI:

     1. Log in to the Admin UI at the URL `https://localhost:8443/admin` as the default administrative user (`openidm-admin`) with password `openidm-admin`.

     2. Select Configure > Mappings.

        The Mappings page shows one mapping: From the IDM Managed User repository to the MongoDB database (`managedUser_systemMongodbAccount`).

     3. Select the `managedUser_systemMongodbAccount` mapping, and choose the Reconcile option.

   - To reconcile the repository by using the command-line, launch the reconciliation operation with the following command:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request POST \
"http://localhost:8080/openidm/recon?
_action=recon&mapping=managedUser_systemMongodbAccount&waitForCompletion=true"
{
  "_id": "e5bf074e-4da6-4ea7-8203-d4ec6f5a814a-24344",
  "state": "SUCCESS"
}
```

The reconciliation operation creates MongoDB users from the users found in `managed/user`.

Chapter 25

Subscribing to JMS Messages

IDM can subscribe to Java Messaging Service (JMS) messages using the Messaging Service's JMS Subscriber. In an event-driven architecture, also known as a message-driven architecture, there are publishers and subscribers. When a publisher sends a message over JMS, that message is broadcast. All active and subscribed clients receive that message. This sample shows how IDM can act as a JMS message subscriber, using the ActiveMQ JMS message broker.

For more information on how IDM can publish JMS messages, using the JMS Audit Event Handler, see "*Directing Audit Information To a JMS Broker*"

With the scripted message handler shown in this sample, you can configure scripts to parse the contents of JMS messages, and act on that content.

The script in this sample, `crudpaqTextMessageHandler.js`, demonstrates how JMS can handle ForgeRock REST operations. If you customize a script to manage JMS messages, you must also modify the `messaging.json` file in the `conf/` subdirectory.

This sample uses ActiveMQ, a JMS message broker. With the ActiveMQ UI, you can act as the JMS message provider. This sample demonstrates how you can input REST payloads through the ActiveMQ UI.

To set up ActiveMQ, you must download and process several files. For more information, see "Adding the Dependencies for JMS Messaging".

25.1. Starting the ActiveMQ Broker and IDM

With the appropriate bundles in the `/path/to/openidm/bundles` directory, you're ready to start the ActiveMQ message broker, as well as IDM with the JMS Audit Sample.

To start the ActiveMQ broker, navigate to the directory where you unpacked the ActiveMQ binary, and run the following command:

```
$ bin/activemq start
INFO: Loading '/path/to/apache-activemq-5.13.0/bin/env'
INFO: Using java '/usr/bin/java'
INFO: Starting - inspect logfiles specified in logging.properties and log4j.properties to get details
INFO: pidfile created : '/path/to/apache-activemq-5.13.0/data/activemq.pid' (pid '22671')
```

Now start IDM, with the configuration for this sample:

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/scripted-jms-subscriber
```

25.1.1. Configuring a Secure Port for JMS Messages

To set up SSL protection for your JMS messages, stop ActiveMQ and edit the following files:

- `activemq.xml` in the `/path/to/apache-activemq-5.13.0/` directory, typically where you unpacked the downloaded ActiveMQ binary.

  Find the code block associated with `<transportConnectors>`, and add the following line within that block:

  ```
  <transportConnector name="ssl"
        uri="ssl://0.0.0.0:61617?transport.enabledCipherSuites=
        SSL_RSA_WITH_RC4_128_SHA,SSL_DH_anon_WITH_3DES_EDE_CBC_SHA
        &amp;maximumConnections=1000&amp;wireFormat.maxFrameSize=104857600&amp;transport.daemon=true"/>
  ```

- `messaging.json` in the `conf/` subdirectory of the sample.

  Change the value of the `java.naming.provider.url` to:

  ```
  ssl://127.0.0.1:61617?daemon=true&socket.enabledCipherSuites=
  SSL_RSA_WITH_RC4_128_SHA,SSL_DH_anon_WITH_3DES_EDE_CBC_SHA
  ```

After making these changes, start ActiveMQ as described in "Starting the ActiveMQ Broker and IDM".

25.2. Access the REST Interface via the ActiveMQ UI

In this section, you will run REST calls through the ActiveMQ UI. This assumes you started ActiveMQ and IDM in "Starting the ActiveMQ Broker and IDM".

1. Access the ActiveMQ web console, at `http://localhost:8161/admin`. Log in as an administrator; the default administrative user and password are `admin` and `admin`.
2. In the ActiveMQ web console, in the Queue Name text box, enter the value of `idmQ` from the `messaging.json` file in the `conf/` subdirectory. The default value for `queue.idmQ` and `destinationName` is `idmQ`. Enter that value and select Create.
3. In the Queues window for the `idmQ` queue, select the `Send To` link under Operations.
4. You should see a `Send a JMS Message` window, with a `Message body` text box towards the bottom.
5. Copy the following text, a payload to create a new user with a user ID of `mgr1`, to the `Message body` text box:

```
{
   "operation" : "CREATE",
   "resourceName" : "/managed/user",
   "newResourceId" : "mgr1",
   "content" : {
      "mail" : "mgr1@example.com",
      "sn" : "Sanchez",
      "givenName" : "Jane",
      "password" : "Password1",
      "employeenumber" : 100,
      "accountStatus" : "active",
      "telephoneNumber" : "",
      "roles" : [ ],
      "postalAddress" : "",
      "userName" : "mgr1",
      "stateProvince" : ""
   },
   "params" : {},
   "fields" : [ "*", "*_ref" ]
}
```

For comparison, note the following equivalent REST call to create the same user:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--header "Content-Type: application/json"
 \
--request POST
 \
--data '{
     "mail" : "mgr1@example.com",
     "sn" : "Sanchez",
     "givenName" : "Jane",
     "password" : "Password1",
     "employeenumber" : 100,
     "accountStatus" : "active",
     "telephoneNumber" : "",
     "roles" : [ ],
     "postalAddress" : "",
     "userName" : "mgr1",
     "stateProvince" : "",
     "params" : {},
     "fields" : [ "*", "*_ref" ]
}' \
"http://localhost:8080/openidm/managed/user?_action=create"
```

6. Observe the OSGi console. You should see output in two parts. The first part starts with:

```
*****request received******
Parsed JMS JSON =
...
```

The first part should include a JSON-formatted replay of the request that you entered in the `Message body` text box.

The second part of the output includes information for that same user, as written to the managed user repository.

7. Confirm that user either in the Admin UI, or via the following REST call:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request GET \
"http://localhost:8080/openidm/managed/user/mgr1"
```

8. Repeat the process to create additional users. Try a different REST function. For example, you can enter the following payload in the ActiveMQ UI `Message body` text box, to change the first name (`givenName`) of the `mgr1` user to Donna:

```
{
   "operation" : "PATCH",
   "resourceName" : "/managed/user/mgr1",
   "rev" : "",
   "value" : [
      {
         "operation":"replace",
         "field":"/givenName",
         "value": "Donna"
      }
   ]
}
```

25.3. Customizing the Scripted JMS Sample

If you set up a custom script to parse and process JMS messages, store that script in the `script/` subdirectory. Assume that script is named `myCustomScript.js`.

Edit the `messaging.json` file in the `conf/` subdirectory, and point it to that file:

```
{
  "subscribers" : [
    {
      "name" : "IDM CREST Queue Subscriber",
      "instanceCount": 3,
      "enabled" : true,
      "type" : "JMS",
      "handler" : {
        "type" : "SCRIPTED",
        "properties" : {
          "script" : {
            "type" : "text/javascript",
            "file" : "myCustomScript.js"
          }
        }
      },
      "properties" : {
        "sessionMode" : "CLIENT",
        "jndi" : {
          "contextProperties" : {
            "java.naming.factory.initial" : "org.apache.activemq.jndi.ActiveMQInitialContextFactory",
            "java.naming.provider.url" : "tcp://127.0.0.1:61616?daemon=true",
            "queue.idmQ" : "idmQ"
          },
          "destinationName" : "idmQ",
          "connectionFactoryName" : "ConnectionFactory"
        }
      }
    }
  ]
}
```

You'll find some of these properties in "JMS Audit Event Handler Unique `config` Properties" in the *Integrator's Guide*. Despite the name of the table and the different configuration file, the properties are the same.

Other properties of interest in the `messaging.json` file are shown in the following table:

JMS `messaging.json` Configuration Properties

`messaging.json` File Label	Description
`subscribers`	Needed to subscribe to incoming JMS message requests
`name`	Arbitrary name for the subscriber
`instanceCount`	Each `instanceCount` manages a single connection between IDM and the messaging channel. Supports multithreading throughput. If subscribing to a queue, such as `queue.idmQ`, the message is handled by a single instance. If subscribing to a topic, all instances receive and handle the same message.
`handler`	Parses the JMS message, then processes it, possibly through a script

`messaging.json` File Label	Description
`queue.idmQ`	One of the JNDI context properties. Name of the JMS queue in the ActiveMQ UI.
`destinationName`	JNDI lookup name for message delivery

Chapter 26

Authenticating Using a Trusted Servlet Filter

This sample demonstrates how to use a custom servlet filter and the "Trusted Request Attribute Authentication Module" to allow IDM to authenticate through another service.

To configure authentication using ForgeRock Access Management, see "*Integrating IDM With the ForgeRock Identity Platform*".

26.1. Before You Start

Before you start this sample, complete the following steps:

- Prepare a fresh IDM installation. (See "Preparing IDM").
- Download and install the Apache Maven build tool.
- Build the custom servlet filter bundle file:

```
$ cd /path/to/openidm/samples/trusted-servlet-filter/filter
$ mvn clean install
```

- Copy the newly built servlet bundle file to the `openidm/bundle` directory:

```
$ cp target/sample-trusted-servletfilter-1.0.jar /path/to/openidm/bundle
```

26.2. The Sample Servlet Filter

In the previous step, you built a bundle file from a Java file in the following `trustedservletfilter/filter` subdirectory: `src/main/java/org/forgerock/openidm/sample/trustedservletfilter`. The file is named `SampleTrustedServletFilter.java`.

The following line looks for the `X-Special-Trusted-User` header, to identify a specific User ID as a "trusted" user.

```
final String specialHeader = ((HttpServletRequest) servletRequest).getHeader("X-Special-Trusted-User");
```

The next line sets the special Servlet attribute `X-ForgeRock-AuthenticationId` to this trusted User ID.

```
servletRequest.setAttribute("X-ForgeRock-AuthenticationId", specialHeader);
```

The rest of the servlet filter chain continues request processing:

```
filterChain.doFilter(servletRequest, servletResponse);
```

This sample includes a `servletfilter-trust.json` file that calls the compiled IDM trusted servlet `filterClass`:

```
{
   "classPathURLs" : [ ],
   "systemProperties" : { },
   "requestAttributes" : { },
   "scriptExtensions" : { },
   "initParams" : { },
   "urlPatterns" : [
      "/*"
   ],
   "filterClass" : "org.forgerock.openidm.sample.trustedservletfilter.SampleTrustedServletFilter"
}
```

26.3. Run the Sample

Start IDM with the configuration for the trusted filter sample.

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/trusted-servlet-filter
Executing ./startup.sh...
Using OPENIDM_HOME:   /path/to/openidm
Using PROJECT_HOME:   /path/to/openidm
Using OPENIDM_OPTS:   -Xmx1024m -Xms1024m
Using LOGGING_CONFIG: -Djava.util.logging.config.file=/path/to/openidm/samples/trusted-servlet-filter/conf
/logging.properties
Using boot properties at /path/to/openidm/resolver/boot
.properties
-> OpenIDM ready
```

26.4. Create a Trusted User

In this section, you will create a user, and then apply the special request header `X-Special-Trusted-User` to authenticate that user.

Create user Barbara Jensen in IDM, with `userName bjensen`:

```
$ curl \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "Content-Type: application/json" \
 --request PUT \
 --data '
   {
      "userName": "bjensen",
      "telephoneNumber": "6669876987",
      "givenName": "Barbara",
      "sn": "Jensen",
      "description": "Example User",
      "mail": "bjensen@example.com",
      "authzRoles" : [
         {
            "_ref" : "repo/internal/role/openidm-authorized"
         }
      ]
   }' \
 "http://localhost:8080/openidm/managed/user/bjensen"
```

Now you can demonstrate the servlet filter by configuring it with the noted special header. Normally, a servlet filter used for authentication does not allow a client to masquerade as any user. This sample demonstrates a basic use of a servlet filter by establishing the authentication ID.

```
$ curl \
 --header "X-Special-Trusted-User: bjensen" \
 --request GET \
 "http://localhost:8080/openidm/info/login?_fields=authenticationId,authorization"
```

The output should include a JSON structure with the user's authentication and authorization details. In this case, user `bjensen` is authenticated with the "openidm-authorized" role.

```
{
  "_id": "login",
  "authenticationId": "bjensen",
  "authorization": {
    "component": "managed/user",
    "roles": [
      "openidm-authorized"
    ],
    "id": "bjensen",
    "moduleId": "TRUSTED_ATTRIBUTE"
  }
}
```

26.5. Customizing the Sample for an External System

To customize this sample for an external authentication/authorization system, you need a servlet filter which authenticates against that external system. You may use a third-party supplied filter, or develop your own filter, using the one in this sample as a model.

The filter you use should have at least the following capabilities:

- Perform REST calls to another system.
- Search through databases.
- Inspect headers related to authentication and authorization requests.

This servlet filter must set the username of the authenticated user in a special request attribute. You need to configure that same attribute name in the `TRUSTED_ATTRIBUTE` authentication module, specifically the value of `authenticationIdAttribute`.

It is helpful if you have a filter that returns an object with the `userRoles` property. If your filter does not support queries using the following parameter:

```
queryOnResource + "/" + authenticationId
```

You will need to provide a security context augmentation script that populates the following authorization properties in the "security" object:

- `security.authorization.component`
- `security.authorization.roles`

The value for the `security.authorization.component` is automatically set to the value specified in any exisitng `queryOnResource` property.

Chapter 27

Integrating IDM With the ForgeRock Identity Platform

This sample demonstrates the integration of three products within the ForgeRock Identity Platform. The sample shows ForgeRock Access Management, (AM), ForgeRock Directory Services (DS), and IDM (IDM) working together to manage identities and authentication.

In this sample, you'll set up an *OpenID Connect Authorization Code Flow*, where IDM acts as the Relying Party, and AM takes the role of the OpenID Provider.

After you've demonstrated integration between the noted three ForgeRock products, you'll see how you can integrate customer identity and access management, in "Integrating Social Identity Providers".

Note

The authentication process used in this sample is fully compliant with the OpenID Connect Discovery specification. For more information, see "Standards-Based Integration" in the *Integrator's Guide*.

This sample provides the foundation for features such as User-Managed Access (UMA), Trusted Devices, and Privacy & Consent. For more information, see "Setting Up User-Managed Access (UMA), Trusted Devices, and Privacy" in the *Integrator's Guide*.

27.1. Preparing Your Systems

In this section, you'll prepare dedicated systems for the installation of IDM, AM, and DS.

Note

This sample assumes that you will install the latest version of each platform component (IDM, AM and DS).

AM requires the use of a Fully-Qualified Domain Name (FQDN). For consistency, this sample includes FQDNs for IDM, AM and, DS on either an appropriate DNS server or the `hosts` file for each system.

This sample assumes that you have assigned the following FQDNs to the AM, DS, and IDM systems, respectively:

- `openam.example.com`

- `opendj.example.com`
- `openidm.example.com`

Note

The `example.com` domain is used in this sample, for consistency with the `Example.ldif` file that you'll find in the `openidm/samples/full-stack/data` directory. If you want to use a different domain with this sample, change the data in the `Example.ldif` file accordingly.

Refer to the following sections of each product document to prepare your systems.

- For IDM, see "Before You Install" in the *Installation Guide*.
- For AM, see Preparing for Installation in the *Access Management Installation Guide*. Pay particular attention to the following section on *Enabling CORS Support*. To support communication between IDM and AM, you must enable cross-origin resource sharing (CORS). To support this sample, you must edit the `web.xml` file before deploying AM, as described in the following section of the AM *Release Notes*: *Limitations*.

  Note

  For the full stack sample, the noted `web.xml` file requires installation of AM in the Apache Tomcat web container.

- For DS, see Before You Install in the *Directory Services Installation Guide*.

27.2. Preparing an Instance of DS

In the full stack sample, there are two instances of DS:

- An external user data store shared by IDM and AM, configured with an administrative port of 4444.
- A configuration data store solely for AM, configured with an administrative port of 5444.

This section helps you set up the DS user data store.

To do so, configure the DS server as described in "LDAP Server Configuration", with one exception. When you import an `Example.ldif` file to DS, import the following file: `openidm/samples/full-stack/data/Example.ldif`.

After unpacking the DS binary, import the `Example.ldif` file for this sample:

```
$ cd /path/to/opendj
$ ./setup \
 directory-server \
 --rootUserDN "cn=Directory Manager" \
 --rootUserPassword password \
 --hostname localhost \
 --ldapPort 1389 \
 --adminConnectorPort 4444 \
 --baseDN dc=com \
 --ldifFile /path/to/openidm/samples/full-stack/data/Example.ldif \
 --acceptLicense
```

Based on this DS configuration, you'd use the following information when installing AM to configure DS as an external user data store:

- Access URL and port for the LDAP server; for this sample, we use opendj.example.com:1389.
- LDAP Bind DN, in this case: `cn=Directory Manager`.
- LDAP Bind Password, which should match the `rootUserPassword` configured this LDAP server.

You'll use this information when installing AM in the following section: "Installing AM for Integration".

27.3. Starting IDM

Prepare IDM, as described in "Preparing IDM", then start the server with the configuration for the full stack sample.

```
$ cd /path/to/openidm
$ ./startup.sh -p samples/full-stack
```

Note

If you add features to the sample, it may increase the size of associated headers beyond the default limit of 8192 bytes. To prevent errors such as the following:

```
WARNING: Header is too large >8192
```

Edit the `jetty.xml` file in your project's `conf/` directory. Increase the `requestHeaderSize` as shown:

```
<Set name="requestHeaderSize">16384</Set>
```

The `jetty.xml` file has been updated with this change in IDM 6.5 and above.

27.4. Installing AM for Integration

This section is based on the following chapter in the AM Installation Guide, To Custom Configure an Instance.

In that chapter, you'll deploy the AM `.war` file to the appropriate web application container directory. AM supports multiple web application containers. For one example, see Deploying in the *AM Installation Guide*.

Note

This sample uses the default unencrypted web container port (8080) for convenience. In production, you should set up AM over a secure port, as described Securing Installations in the *Access Management Installation Guide*.

In production, AM also supports the use of regular accounts as administrators. For more information, see the discussion in the following section of the *AM Maintenance Guide*: *Web-Based AM Console*. For the corresponding IDM feature, see "Granting Internal Authorization Roles" in the *Integrator's Guide*.

If you followed the procedure associated with the AM `.war` file, and configured the FQDNs described in "Preparing Your Systems", point your browser to `http://openam.example.com:8080/openam`. You should see a startup screen with two options. Select the following option:

Custom Configuration

Then take the following steps to install AM:

Installing AM for This Sample

To install AM, read through the following procedure: To Custom Configure an Instance in the *Access Management Installation Guide*.

1. Enter a password. The password that you set during the AM installation process becomes the password for the AM administrative user, `amadmin`. Once the full stack setup is complete, you'll use `amadmin` and that password to log into IDM.

2. When you see the `Server Settings` step, verify that the server settings are valid for your configuration. Make sure these settings correspond to the FQDN for your instance of AM. For this sample, you'd specify:

   - `Server URL`: `http://openam.example.com:8080`

   - `Cookie Domain`: `openam.example.com`

3. Now you should see the Configuration Data Store Settings screen. The defaults allow AM to store configuration data in an embedded directory.

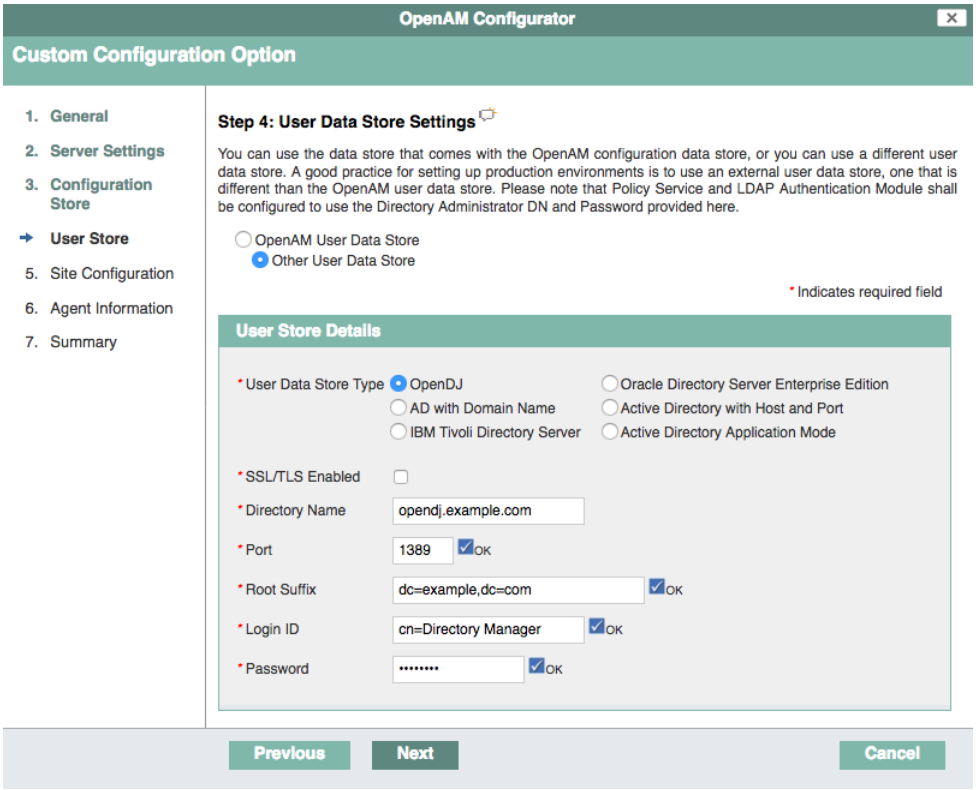
   If you set up the external instance of DS as described in "Preparing an Instance of DS", the *Admin Port* should be `5444`. You'll also need to change the *Root Suffix* to match the root domain for your instance of AM, in this case, `dc=example,dc=com`.

Note

If your configuration of DS includes a different Root Suffix, modify your AM installation settings accordingly.

4. In the User Data Store Settings screen, configure where AM looks for user identities. In this case, select `Other User Data Store` and choose `DS` as the User Data Store type. You can then point this installation to the DS server configured at `opendj.example.com`, on port 1389, with a root suffix of `dc=example,dc=com`. Enter the password that you used in this section: "Preparing an Instance of DS".

   AM verifies what you enter in the User Data Store Settings screen with the instance of DS that you created. Once verified, AM then allows you to select Next:



5. For this sample, you're installing one instance of AM. So when you reach the Site Configuration screen, accept the default `No`, and select Next to continue.

6. Complete the AM installation process as directed, until you're logged into AM. For details, see To Custom Configure an Instance in the *Access Management Installation Guide*.

7. You'll be taken to an AM installation screen. The AM administrative user is `amadmin` and the password is what you set during the AM installation process.

Now proceed with the configuration of AM as an OpenID Connect provider for IDM, as described in the following section:

27.5. Configuring AM for Integration with IDM

To integrate AM and IDM, you need to configure AM as an OpenID Connect provider. OpenID Connect 1.0 is an authentication service built on OAuth 2.0. In the following sections, you'll configure OpenID Connect 1.0 and OAuth 2.0 settings, using information from IDM.

27.5.1. Configuring AM as an OAuth 2.0 Provider for IDM

In this section, you'll set up AM as an OAuth 2.0 provider. To do so, take the following steps:

1. Navigate to `http://openam.example.com:8080/openam`. Log into AM as an administrator, with username `amadmin`, with the password you created during "Installing AM for This Sample".
2. For the purpose of this sample, choose the default Top Level Realm.
3. Select Configure OAuth Provider.
4. Select Configure OpenID Connect. You should see a screen with the following title:

   ```
   Configure OpenID Connect
   ```

   Accept the default OpenID Connect options, which enable AM as an OpenID Connect authorization server.
5. Choose the Create button in the Configure OpenID Connect window.
6. You'll see the following message:

   ```
   OAuth2 Configured for the given realm

   Successfully configured OAuth2 for realm /.
   ```

   Select OK.

For detailed information on AM's OAuth 2.0 Provider configuration, see the *Access Management OAuth 2.0 Guide*.

27.5.2. Getting Information From IDM

IDM includes helpful information for the next step in the AM configuration process, "Configuring AM's OpenID Connect Agent". To see this information from the Admin UI, navigate to Configure > Authentication, and select ForgeRock Identity Provider.

The window that appears includes information that you'll need when configuring AM. Do *not* press Submit until you've worked through the following section: "Plugging IDM Into AM".

- Redirection URIs
- Scope
- Post Logout Redirect URIs
- Implied Consent
- Allow Clients to Skip Consent
- Authorized OIDC SSO Clients

For an explanation of the values you see in the window, refer to OAuth 2.0 and OpenID Connect 1.0 Client Settings in the *Access Management OpenID Connect 1.0 Guide*.

27.5.3. Configuring AM's OpenID Connect Agent

In this section, you'll configure an AM Client Agent that allows you to register your instance of IDM as an OpenID Connect 1.0 Client.

To proceed, navigate to the AM UI at `http://openam.example.com:8080/openam`. Log into the UI as the AM administrative user, `amadmin`, and the password you created for that user earlier in this chapter.

Follow the guidance described in the following section of the *Access Management OpenID Connect 1.0 Guide*: Registering OAuth 2.0 Clients With the Authorization Service.

When you enter the `Client ID` and `Client Secret`, save this information for the IDM Admin UI, when you navigate to Configure > Authentication > ForgeRock Identity Provider.

For this sample, set a name (`clientId`) of `openidm` and a password (`clientSecret`) of `openidm`.

Use the other information from the IDM window that appears, as described in "Getting Information From IDM".

Limits on the Post Logout Redirect URI

The Post Logout Redirect URIs for this sample must match the URIs expected for IDM. In this case, for the Admin and Self-Service UIs, you'd include the following values:

```
http://openidm.example.com:8080/admin/
http://openidm.example.com:8080/
```

If you've configured connections over a secure port, modify the Post Logout Redirect URIs accordingly.

Save your changes. Scroll to the top of the screen, and select Save.

27.5.4. Integrating AM's OAuth2 Provider Service

Now that you've configured AM's OpenID Connect Agent, you can configure AM's OAuth2 Provider Service. To do so in AM, take the following steps:

1. Navigate to `http://openam.example.com:8080/openam/`. Log into AM as an administrator, with username `amadmin`, and the password you created during "Installing AM for This Sample".

2. Choose the default Top Level Realm.

3. Choose Services > OAuth2 Provider.

4. In the Authorized OIDC SSO Clients text box, enter `openidm`; for more information, see the following section of the AM OAuth 2.0 Guide: *Advanced OpenID Connect*.

5. Enable the *Allow Clients to Skip Consent* option; for more information, see the following section of the AM OAuth 2.0 Guide: *Allowing Clients to Skip Consent*

   Select *Save Changes*.

27.6. Plugging IDM Into AM

Now that you've configured an OpenID Connect Client on AM, you can configure IDM as an OpenID Connect *Relying Party* to authenticate through AM. Return to the IDM Admin UI. Navigate to Configure > Authentication. In the window that appears, select ForgeRock Identity Provider.

The ForgeRock Identity Provider is also known as AM.

You'll need to modify three things before the UI allows you to tap Submit to implement your settings:

- `Well-Known Endpoint`

  An AM endpoint with related configuration information.

  For more information on the AM Well-Known Endpoint, see the Access Management OpenID Connect 1.0 Guide on *Configuring for OpenID Connect Discovery*.

- `Client ID`

  Use the name for the OAuth 2.0/OpenID Connect Client agent that you configured in "Configuring AM's OpenID Connect Agent".

- `Client Secret`

  Use the password for the OAuth 2.0/OpenID Connect Client agent that you configured in "Configuring AM's OpenID Connect Agent".

Note

You'll see one additional option: *Route to AM User Datastore*. For this sample, the default should match the repository for the external data store, in this case, `system/ldap/account`.

Choose Submit to save your changes. If successful, you'll see the following message:

```
Your current session may be invalid. Click here to logout and re-authenticate.
```

When you select the link IDM takes you to the AM Login Screen. You should now be able to connect as the AM Administrative user, `amadmin`, with the password you set when installing AM.

In this configuration, when you log into AM, you're taken to the Admin UI.

27.6.1. Changes to Session and Authentication Modules

When you activate the ForgeRock Identity Provider, IDM implements the following changes to the session module, as shown in the `authentication.json` file:

- The maximum token lifetime of the `JWT_SESSION` is shortened from the IDM default of 120 minutes to 5 seconds.
- The token idle lifetime is reduced from the default of 30 minutes to 5 seconds.

Reducing the IDM-specific session token times in this way supports a rapid reaction when the AM session expires. In essence, this change means that sessions are governed by AM. For more information, see the *About Sessions* section of the *Access Management Authentication and Single Sign-On Guide*.

Authentication Modules Associated With the ForgeRock Identity Provider

Authentication Module	Status
STATIC_USER	No Change
MANAGED_USER	Disabled
INTERNAL_USER	No Change
CLIENT_CERT	Disabled
PASSTHROUGH	Disabled
SOCIAL_PROVIDERS	No change
OAUTH_CLIENT	Enabled

For more information on each module, see "Supported Authentication and Session Modules" in the *Integrator's Guide*.

27.7. Demonstrating Integration

Once this process is complete, navigate to the Admin UI. For this sample, navigate to `http://openidm.example.com:8080/admin`. The settings you changed in "Plugging IDM Into AM", along with what you did to configure AM in this sample, will redirect you to `http://openam.example.com:8080/openam`*`longRedirectURI`*.

To see how this process works, see "Authorization Flow in the Full Stack Sample".

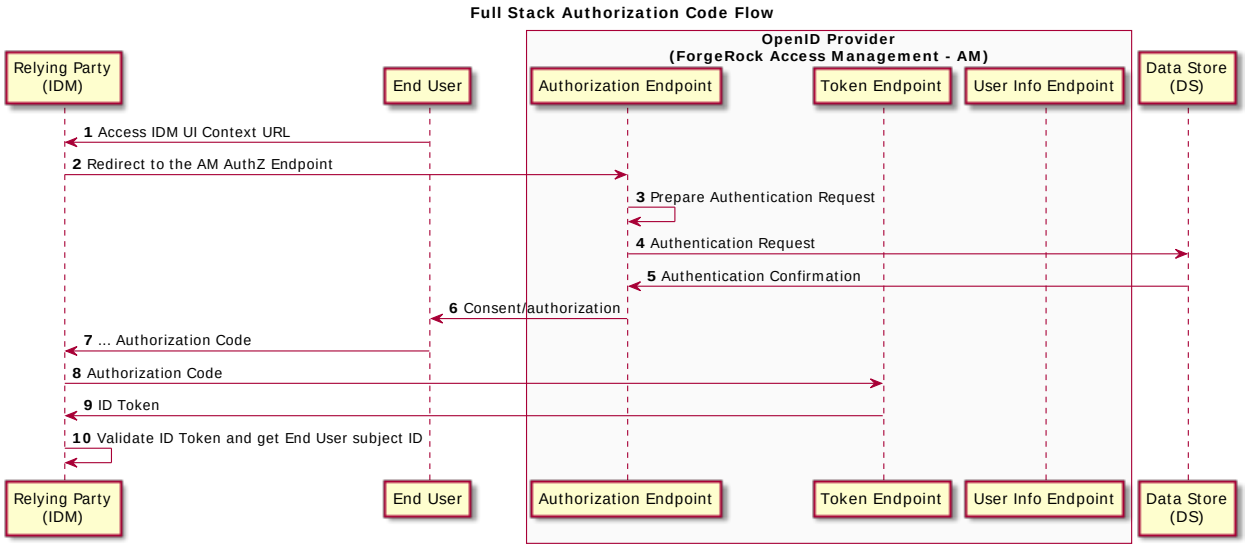
When you log into AM, with this *longRedirectURI*, as the AM administrative user (`amadmin`), it connects you to the Admin UI, as the IDM administrative user. To understand why, read:

- "Analyzing the AM Redirect URI"
- "Understanding the Integrated AM Administrative User"

27.7.1. Authorization Flow in the Full Stack Sample

The full stack Authorization Code Flow specifies how IDM as a (Relying Party) interacts with AM, based on the OAuth 2.0 authorization grant. The following sequence diagram illustrates successful processing from the authorization request, through grant of the authorization code, and ID token from the authorization provider, AM.

Full Stack Authorization Code Flow



The figure assumes that end users and administrators use different UI context URLs:

- End users log into the IDM Self-Service UI at `http://openidm.example.com:8080`

- Administrators log into the Admin UI at `http://openidm.example.com:8080/admin`

As long as end users and administrators stay with their designated UI contexts, the authorization flow is the same.

The following list describes details of each item in the authorization flow:

1. A user navigates to the appropriate IDM browser UI context URL.
2. That user is redirected to the AM login screen, on the authorization endpoint, with a *longRedirectURI*, as described in "Analyzing the AM Redirect URI".
3. AM prepares an authentication request.
4. AM uses the ForgeRock Directory Services (DS) data store to review the authentication request.
5. DS confirms authentication to AM
6. AM sends a redirect message, with an authorization code, to the end user's browser. The redirect message goes to an `oauthReturn` endpoint, configured in `ui.context-oauth.json` in your project's `conf/` directory.

   You'll find the endpoint in your project's `authentication.json` file with the following property: `redirectUri`.
7. The browser transmits the redirect message, with the authorization code, to IDM.
8. IDM records the authorization code, and sends it to the AM Token Endpoint.
9. The AM token endpoint returns an ID token.
10. IDM validates the token, and proceeds with the login process.
    - If you're an administrator who started by accessing the Admin UI at `http://openidm.example.com:8080/admin`, you'll be taken to the IDM Admin UI.
    - If you're an end user who started by accessing the Self-Service UI at `http://openidm.example.com:8080/`, you'll be taken to the IDM Self-Service UI.

For the URI and properties associated with each endpoint shown in the associated diagram, find the Well-Known Endpoint URL shown in your project's `authentication.json` file, and substitute it for the URL shown in the following REST call:

```
$ curl \
--header "X-OpenIDM-Username: openidm-admin"
 \
--header "X-OpenIDM-Password: openidm-admin"
 \
--request GET \
"http://openam.example.com:8080/openam/oauth2/.well-known/openid-configuration"
```

The final browser context URL depends on AM, specifically what might be configured in the following section of the AM *Authentication and Single Sign-On Guide* section on *Redirection URL Precedence* and "Changing the UI Path" in the *Integrator's Guide*.

27.7.2. Analyzing the AM Redirect URI

To understand what happened when you configured AM and IDM, it may help to analyze the Redirect URI. When you do, you'll also discover other OpenID Connect-compliant information.

To find the Redirect URI for this sample, navigate to `http://openidm.example.com:8080/admin/`. You'll be taken to the AM login screen, with a Redirect URI that brings you back to the IDM Admin UI after a successful login.

Based on the configuration described in this sample, you should see something similar to the following Redirect URI in the address text box for your browser:

```
http://openam.example.com:8080/openam/XUI/?realm=%2F&goto=
http%3A%2F%2Fopenam.example.com%3A8080%2Fopenam%2Foauth2%2Fauthorize
%3Fnonce%3Dhm60yqa565mq715yky8eci4gete08gk
%26response_type%3Dcode%26client_id%3Dopenidm
%26redirect_uri%3Dhttp%253A%252F%252Fopenidm.example.com%253A8080%252FoauthReturn
%252F%26scope%3Dopenid%26state%3Dqncvemm9nvas5hrxhl00clkeqk2cxp0#login/
```

If you analyze the full redirect URI, you should see several settings that you configured in AM in this sample:

- `oauth2`: See "Configuring AM as an OAuth 2.0 Provider for IDM"
- `scope`: See *OAuth 2.0 and OpenID Connect 1.0 Client Settings,* from the *Access Management OpenID Connect 1.0 Guide*
- `redirect_uri`: See *OAuth 2.0 and OpenID Connect 1.0 Client Settings,* from the *Access Management OpenID Connect 1.0 Guide*
- `nonce`: See *OpenID Connect Core 1.0 Specification, Nonce Implementation Notes*
- `clientId`: See "Configuring AM's OpenID Connect Agent"

27.7.3. Understanding the Integrated AM Administrative User

If you've tried the integrated AM/IDM system, as described in "Demonstrating Integration", you'll realize that you used the AM Administrative account `amadmin` to log into IDM. After logging in, you can confirm that the account in use to administer IDM is the default, `openidm-admin`.

To understand how that works, examine the `amSessionCheck.js` file in the following directory: `/path/to/openidm/bin/defaults/script/auth`. See the following code block, and how it gives user `amadmin` the IDM administrative user `id`, along with the IDM user and administrative roles: `openidm-authorized` and `openidm-admin`.

```
if (security.authenticationId === "amadmin") {
    security.authorization = {
        "id" : "openidm-admin",
        "component" : "repo/internal/user",
        "roles" : ["openidm-admin", "openidm-authorized"],
        "moduleId" : security.authorization.moduleId
    };
}
```

You can modify this script as desired. For example, you could limit the IDM roles given to the AM administrative account. Alternatively, if you set up a different AM administrative account (other than `amadmin`), modify the value of `security.authenticationId` accordingly.

27.8. The Integrated `authentication.json` File

When you configure this sample as described in this chapter, IDM adds the following lines to the `authentication.json` file in your project's `conf/` subdirectory.

The following excerpt includes information that appears to go beyond what you configured. IDM reads the wellKnownEndpoint that you included in "Plugging IDM Into AM", and includes the following information in the `authentication.json` file:

- `authorizationEndpoint` as described in the *OpenID Connect Discovery 1.0* specification.
- `tokenEndpoint` as described in the *OpenID Connect Discovery 1.0* specification.
- `endSessionEndpoint` as described in the *OpenID Connect Session Management 1.0* specification.

```
{
    "name" : "OAUTH_CLIENT",
    "properties" : {
        "augmentSecurityContext" : {
            "type" : "text/javascript",
            "globals" : {
                "sessionValidationBaseEndpoint" : "http://openam.example.com:8080/openam/json/sessions/"
            },
            "file" : "auth/amSessionCheck.js"
        },
        "propertyMapping" : {
            "authenticationId" : "uid",
            "userRoles" : "authzRoles"
        },
        "defaultUserRoles" : [
            "openidm-authorized"
        ],
        "idpConfig" : {
            "provider" : "OPENAM",
            "icon" : "<button class=\"btn btn-lg btn-default btn-block btn-social-provider\"><img src=\"images/
forgerock_logo.png\">Sign In</button>",
            "scope" : [
                "openid"
            ],
```

```
            "authenticationIdKey" : "sub",
            "clientId" : "openidm",
            "clientSecret" : {
                "$crypto" : {
                    "type" : "x-simple-encryption",
                    "value" : {
                        "cipher" : "AES/CBC/PKCS5Padding",
                        "salt" : "qLh7QjuBd8oNXhnriEDQPg==",
                        "data" : "Kj/j/gMFEqqOz22cTWkXQw==",
                        "iv" : "aposp8u/gputkf13KsIDVQ==",
                        "key" : "openidm-sym-default",
                        "mac" : "02D1KtxADUt9oVzcTcOfRg=="
                    }
                }
            },
            "authorizationEndpoint" : "http://openam.example.com:8080/openam/oauth2/authorize",
            "tokenEndpoint" : "http://openam.example.com:8080/openam/oauth2/access_token",
            "endSessionEndpoint" : "http://openam.example.com:8080/openam/oauth2/connect/endSession",
            "wellKnownEndpoint" : "http://openam.example.com:8080/openam/oauth2/.well-known/openid-configuration",
            "redirectUri" : "http://openidm.example.com:8080/oauthReturn/",
            "configClass" : "org.forgerock.oauth.clients.oidc.OpenIDConnectClientConfiguration",
            "displayIcon" : "forgerock",
            "enabled" : true
        },
        "queryOnResource" : "system/ldap/account"
    },
    "enabled" : true
}
```

27.9. Reconciliation and AM

In this section, you'll see how reconciliation in IDM affects users seen in AM.

When you first integrated the three products (IDM, AM, and DS), you included information from an `Example.ldif` file from the `openidm/samples/full-stack/data/` subdirectory.

When you set up DS, you populated the directory with user data from from the `Example.ldif` file in the `openidm/samples/fullStack/data/` directory. To get that user data from DS into the IDM managed user repository, run reconciliation. To do so, select Configure > Mappings. You'll see two mappings:

- `systemLdapAccounts_managedUser`, which maps information from the LDAP datastore (DS - `systemLdapAccounts`) to the managed user repository.
- `managedUser_systemLdapAccounts`, which maps information in the reverse direction.

Before running reconciliation, open the AM administrative interface. Navigate to `http://openam.example.com:8080/openam`. Log in as the AM administrative user, `amadmin`, with the password you used when installing AM earlier in this sample, in "Installing AM for Integration".

Select Top Level Realm > Identities. You should see four accounts:

- Two default AM accounts: `amadmin` and `anonymous`.

- Two accounts from the aforementioned `Example.ldif` file, which have been loaded into the common user datastore, DS.

Now return to the Admin UI. Select Configure > Mappings. In the `systemLdapAccounts_managedUser` mapping, choose Reconcile.

Once reconciliation is complete, you'll see users from `Example.ldif` when you select Manage > User.

Create a new IDM user as described in "To Add a User Account" in the *Integrator's Guide*. Add a password to that account.

Return to the AM administrative interface at `http://openam.example.com:8080/openam`. Select Top-Level Realm > Identities. The next time IDM synchronizes the managed user to DS, you should see a list of users that include the user that you created in IDM.

27.10. Integrating Social Identity Providers

This section assumes that you've configured the full stack sample, as described so far in this chapter.

To take advantage of the authorization features provided by AM, you can extend the features shown in this sample. This section demonstrates how you can integrate social identities, specifically Google and Facebook. It also assumes that you've configured the full stack sample, as described so far in this chapter.

Before you start this process, you may want to go through the social authentication process for both IDM and AM, as described in the following chapters:

- For IDM, "*Configuring Social Identity Providers*" in the *Integrator's Guide* provides guidance for all IDM-supported social identity providers. For a list, see the subsections of that chapter.
- For AM, refer to:
  - The following chapter of the AM *Authentication and Single Sign-On Guide*: *Implementing Social Authentication*.
  - The following procedure of the AM *User Self Service Guide*: *To Delegate User Self Registration to IDM*.

As this setup uses AM to manage authentication for social identities, you can ignore the associated IDM authentication module, described in "Configuring the Social Providers Authentication Module" in the *Integrator's Guide*. However, you still have to:

- Set up desired social identity providers on both IDM and AM.
- Change the following defaults when configuring social identity providers on AM, based on the following chapter of the AM *Authentication and Single Sign-On Guide*: *Implementing Social Authentication*. :
  - Disable the following option: `Use Basic Auth`, to match the following setting in `identityProviders.json`

```
"basicAuth" : false
```

- Enable the following account provisioning options:
  - `Use IDM as Registration Service`
  - `Create account if it does not exist`

- In the AM administrative console, select Services > Add a Service, and add the `IDM Provisioning` service.
- The window that appears will include text boxes described in the following section of the AM *Authentication and Single Sign-On Guide*: *IDM Provisioning*
  - Enable the service.
  - Set an appropriate `Deployment URL`. If you've configured an IDM Self-Service UI on `http://openidm.example.com:8080/`, enter it in the `Deployment URL` text box.
  - When IDM starts, it generates key aliases as described in "Displaying the Contents of the Keystore" in the *Integrator's Guide*. You'll need to incorporate the following IDM aliases into the AM keystore:
    - `openidm-selfservice-key`
    - `selfservice`

    To incorporate these aliases in AM, see the following section of the AM *Setup and Maintenance Guide*: *Copying Key Aliases*

    Note

    AM includes default IDM key aliases, which you'll have to replace with the actual key aliases generated when IDM starts.

27.11. Registering Users Through IDM

You can now register users by their social identities through IDM. To do so, take the following steps:

1. Navigate to `http://openidm.example.com:8080/#register/`. Be sure to enter the full URL, including the final forward slash `/`.
2. In the *Register Your Account* screen that appears, you should see the following options:
   - *Register with Google*
   - *Register with Facebook*

3. Select one of these options, and proceed as prompted with either a Google or Facebook account.

Review the list of users in both IDM and AM. You should see the same social identity accounts in both systems. Since AM and IDM both use the same instance of DS, the lists of users (beyond the defaults for each system) should be identical.

- In the Admin UI, select Manage > User.
- In the AM Administrative Interface, select Realm > Identities.

Note

If you see the following error:

```
User requires profile to login
```

Follow the procedure at the beginning of this section. You need to register that user first.

Once you've registered users, you can navigate to `http://openidm.example.com:8080/`. The configuration of this sample means that your browser gets redirected to `http://openam.example.com:8080/openam/XUI/?realm<longURI>`.

You'll see icons for the social identity providers that you configured, such as Google and Facebook. When you select one of these icons, what happens next depends:

- If you have cleared the cache on the browser, you'll be prompted to log into your selected social identity provider.
- If you have not cleared the cache, the full stack sample assumes that you want to log in with the social identity provider account that you just configured.

The result is the same; you're taken to the IDM end user dashboard.

Chapter 28
Creating a Custom Endpoint

Scriptable custom endpoints enable you to launch arbitrary scripts using the IDM REST URI. For information about how custom endpoints are configured, see "Creating Custom Endpoints to Launch Scripts" in the *Integrator's Guide*.

The example endpoint provided in `/path/to/openidm/samples/example-configurations/custom-endpoint` illustrates the configuration of a custom endpoint, and the structure of custom endpoint scripts.

The purpose of this custom endpoint is to return a list of variables available to each method used in a script. The scripts show the complete set of methods that can be used. These methods map to the standard HTTP verbs - create, read, update, delete, patch, query, and action. A sample JavaScript and Groovy script is provided.

To run the sample:

1. Copy the endpoint configuration file (`samples/example-configurations/custom-endpoint/conf/endpoint-echo.json`) to your project's `conf` directory.

2. Copy either the JavaScript file (`samples/example-configurations/custom-endpoint/script/echo.js`) or Groovy script file (`samples/example-configurations/custom-endpoint/script/echo.groovy`) to your project's `script` directory.

3. Open the endpoint configuration file in a text editor:

```
{
    "file" : "echo.groovy",
    "type" : "groovy",
    "_file" : "echo.js",
    "_type" : "text/javascript"
}
```

   The configuration file contains nothing more than a reference to the endpoint scripts. In this case, the JavaScript script is commented out (with an underscore before the `file` and `type` properties). If you want to use the JavaScript endpoint script, uncomment these lines and comment out the lines that correspond to the Groovy script in the same way.

   Endpoint configuration files can include a `context` property that specifies the route to the endpoint, for example:

```
"context" : "endpoint/linkedView/*"
```

   If no `context` is specified, the route to the endpoint is taken from the file name, in this case `endpoint/echo`.

4. Test each method in succession to return the expected request structure of that method. The following examples show the request structure of the read, create and patch methods. The configuration file has been edited to use the JavaScript file, rather than the Groovy file. The output shown in these examples has been cropped for legibility. For a description of each parameter, see "Writing Custom Endpoint Scripts" in the *Integrator's Guide*.

   The following command performs a read on the echo endpoint and returns the request structure of a read request:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/endpoint/echo
{
  "_id": "",
  "method": "read",
  "resourceName": "",
  "parameters": {},
  "context": {
  ...
  }
}
```

   The following command performs a query on the echo endpoint and returns the request structure of a query request:

```
$ curl \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "X-OpenIDM-Password: openidm-admin" \
 --request GET \
 "http://localhost:8080/openidm/endpoint/echo?_queryId=query-all-ids"
{
  "result": [
    {
      "method": "query",
      "resourceName": "",
      "pagedResultsCookie": null,
      "pagedResultsOffset": 0,
      "pageSize": 0,
      "queryExpression": null,
      "queryId": "query-all-ids",
      "queryFilter": "null",
      "parameters": {},
      "content": null,
      "context": {
      ...
      }
    }
  ],
  ...
}
```

   The following command sends a create request to the echo endpoint. No user is actually created. The endpoint script merely returns the request structure of a create request. The `content` parameter in this case provides the JSON object that was sent with the request:

```
$ curl \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "Content-Type: application/json" \
 --data '{
       "userName":"steve",
       "givenName":"Steve",
       "sn":"Carter",
       "telephoneNumber":"0828290289",
       "mail":"scarter@example.com",
       "password":"Passw0rd"
       }' \
 --request POST \
 "http://localhost:8080/openidm/endpoint/echo?_action=create"
{
  "_id": "",
  "method": "create",
  "resourceName": "",
  "newResourceId": null,
  "parameters": {},
  "content": {
    "userName": "steve",
    "givenName": "Steve",
    "sn": "Carter",
    "telephoneNumber": "0828290289",
    "mail": "scarter@example.com",
    "password": "Passw0rd"
  },
  "context": {
  ...
  }
}
```

The following command sends a patch request to the echo endpoint.

```
$ curl \
 --header "X-OpenIDM-Password: openidm-admin" \
 --header "X-OpenIDM-Username: openidm-admin" \
 --header "Content-Type: application/json" \
 --data '[
    {
      "operation":"replace",
      "field":"/givenName",
      "value":"Steven"
    }
 ]' \
 --request PATCH \
 "http://localhost:8080/openidm/endpoint/echo"
{
  "_id": "",
  "method": "patch",
  "resourceName": "",
  "revision": null,
  "patch": [
    {
      "operation": "replace",
      "field": "/givenName",
      "value": "Steven"
    }
  ],
  "parameters": {},
  "context": {
  ...
  }
}
```

IDM Glossary

correlation query	A correlation query specifies an expression that matches existing entries in a source repository to one or more entries on a target repository. While a correlation query may be built with a script, it is *not* a correlation script. As noted in "Correlating Source Objects With Existing Target Objects" in the *Integrator's Guide*, you can set up a query definition, such as `_queryId`, `_queryFilter`, or `_queryExpression`, possibly with the help of a `linkQualifier`.
correlation script	A correlation script matches existing entries in a source repository, and returns the IDs of one or more matching entries on a target repository. While it skips the intermediate step associated with a `correlation query`, a correlation script can be relatively complex, based on the operations of the script.
entitlement	An entitlement is a collection of attributes that can be added to a user entry via roles. As such, it is a specialized type of `assignment`. A user or device with an entitlement gets access rights to specified resources. An entitlement is a property of a managed object.
JSON	JavaScript Object Notation, a lightweight data interchange format based on a subset of JavaScript syntax. For more information, see the JSON site.
JSON Pointer	A JSON Pointer defines a string syntax for identifying a specific value within a JSON document. For information about JSON Pointer syntax, see the JSON Pointer RFC.

JWT	JSON Web Token. As noted in the *JSON Web Token draft IETF Memo*, "JSON Web Token (JWT) is a compact URL-safe means of representing claims to be transferred between two parties." For IDM, the JWT is associated with the `JWT_SESSION` authentication module.
managed object	An object that represents the identity-related data managed by IDM. Managed objects are configurable, JSON-based data structures that IDM stores in its pluggable repository. The default configuration of a managed object is that of a user, but you can define any kind of managed object, for example, groups or roles.
mapping	A policy that is defined between a source object and a target object during reconciliation or synchronization. A mapping can also define a trigger for validation, customization, filtering, and transformation of source and target objects.
OSGi	A module system and service platform for the Java programming language that implements a complete and dynamic component model. For more information, see What is OSGi? Currently, only the Apache Felix container is supported.
reconciliation	During reconciliation, comparisons are made between managed objects and objects on source or target systems. Reconciliation can result in one or more specified actions, including, but not limited to, synchronization.
resource	An external system, database, directory server, or other source of identity data to be managed and audited by the identity management system.
REST	Representational State Transfer. A software architecture style for exposing resources, using the technologies and protocols of the World Wide Web. REST describes how distributed data objects, or resources, can be defined and addressed.
role	IDM distinguishes between two distinct role types - provisioning roles and authorization roles. For more information, see "*Working With Managed Roles*" in the *Integrator's Guide*.
source object	In the context of reconciliation, a source object is a data object on the source system, that IDM scans before attempting to find a corresponding object on the target system. Depending on the defined mapping, IDM then adjusts the object on the target system (target object).
synchronization	The synchronization process creates, updates, or deletes objects on a target system, based on the defined mappings from the source system. Synchronization can be scheduled or on demand.

system object	A pluggable representation of an object on an external system. For example, a user entry that is stored in an external LDAP directory is represented as a system object in IDM for the period during which IDM requires access to that entry. System objects follow the same RESTful resource-based design principles as managed objects.
target object	In the context of reconciliation, a target object is a data object on the target system, that IDM scans after locating its corresponding object on the source system. Depending on the defined mapping, IDM then adjusts the target object to match the corresponding source object.

Index

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