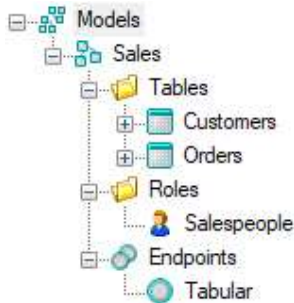# BUILDING SEMANTIC MODELS

Data is not very much use if it is not put to use. In Discovery Hub, semantic models, along with OLAP Cubes, serve as the last stop before analysis and visualization tools. As the name suggest, semantic models are part of the semantic layer that "translates" data into forms usable by business users.

Each semantic model can be deployed to one or more endpoints. Endpoints are application specific adapters that connect to a client application such as PowerBI or Qlik Sense. How data is deployed to the endpoint depends on the application. Currently, the following endpoints are supported:

- Analysis Services Tabular ("SSAS Tabular" for short)
- QlikView
- Qlik Sense
- Tableau

ADDING A SEMANTIC MODEL

To add a semantic model, follow the steps below.

1. On the **Semantic** tab, right click **Models** and click **Add Semantic Model**. The **Add Semantic Model** window appears.
2. Enter a name for the model in the **Name** box
3. Under **Show settings for these endpoint**, clear the checkbox next to endpoint types that you will not be using. Settings unique to these endpoints will then be hidden in the user interface.

   Note: Settings that only applies to some endpoint types are marked with an info icon with a tooltip that lists the endpoint types.

4. (Optional) Click **Guard on deployment** or **Guard on execution** to prevent the model from being deployed or executed.

   Note: If you use multiple environments, a related setting is available for each end-point in **Environment Properties**. If you set the **Active** setting to **False**, the end-point will not be deployed or executed in that specific environment. You can use this

setting to have different active endpoints for e.g. your production, test and development environments.
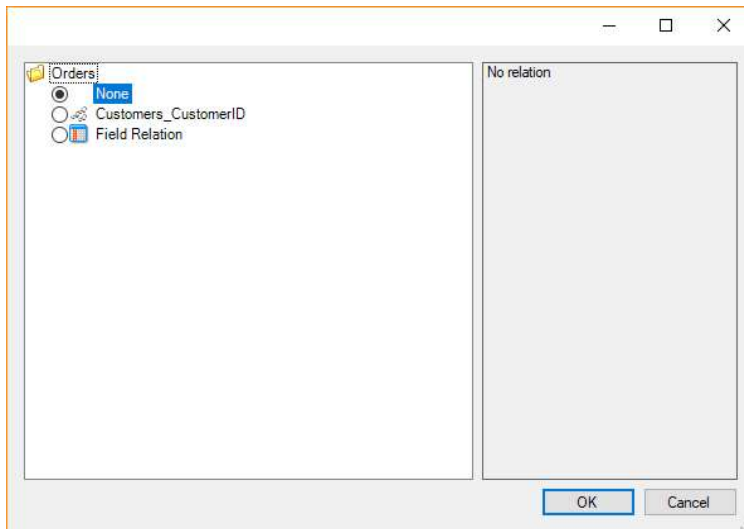
TABLES

ADDING A TABLE TO A MODEL

To add a table to a semantic model, follow the steps below.

1. On the Semantic tab, right click **Models**, click **Open Data in New Window** and click the data warehouse or staging database that contains the data.
2. Expand the model you want to add the table to.
3. Drag the table from the window you opened to **Tables** under the relevant model. The **Add Semantic Table** window appears.
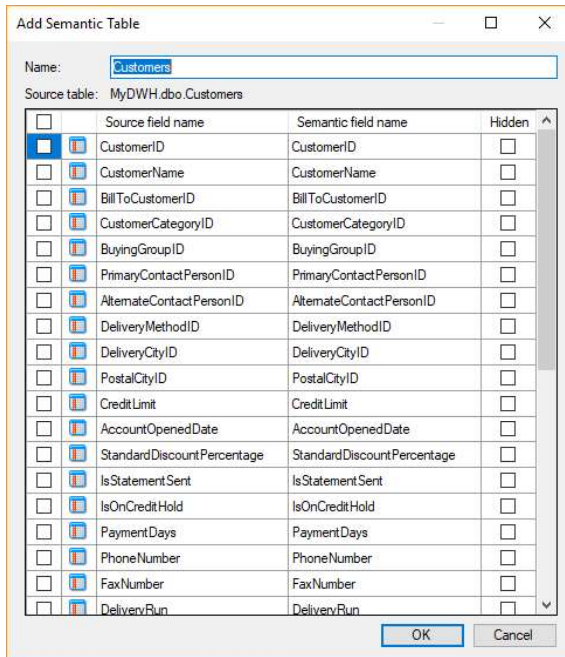
4. Select the fields you want in the semantic table.
5. (Optional) In the **Hidden** column, select the fields you want to add to the semantic table, but not show in the endpoint.
6. Click **OK** to add the table.
7. If there are other tables on the model that have an existing relation to the new table or a field with the same name as a field on the new table, the **Set Up Relations** window appears.

Here, you can set how the table you are adding is related to existing tables in the semantic model. For each existing table, you have the following options:

- **None:** No relations to that table model.
- An existing relation defined in the data warehouse (recommended).
- **Field relation:** Relate using identical field names on both tables.

8. Click **OK** to add the relations (if any).

ADDING A DATA SELECTION RULE TO A TABLE

Data selection rules are used to specify a set of conditions that data extracted from a source table must satisfy. By applying selection rules, only the subset of data that you actually need is loaded into the semantic table.
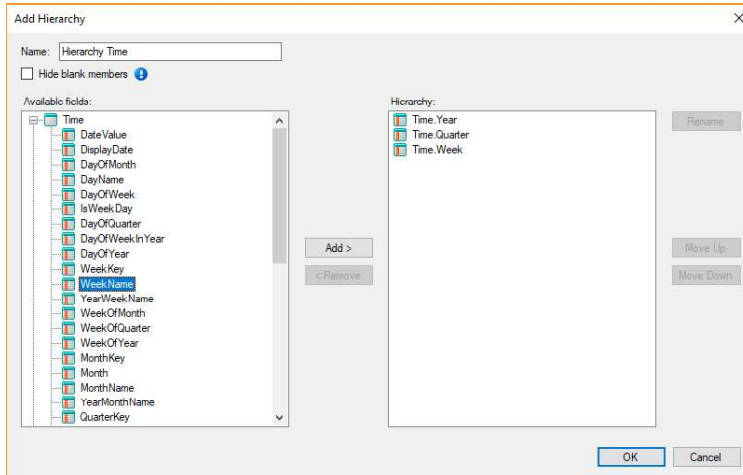
See Data Selection Rules for more information about adding data selection rules.

ADDING A HIERARCHY TO A TABLE

Adding hierarchies makes it easier to browse data in frontend applications.

To add a hierarchy to a table, follow the steps below.

1. Right click the table and click **Add Hierarchy**. The **Add Hierarchy** window appears.

2. Type a name for the hierarchy in the **Name** box.
3. Select **Hide blank members** to hide blank members in the hierarchy caused by ragged hierachies. For example, in a country-state-city hierarchy, some cities, e.g. Washington DC, doesn't actually belong to a state. These cities will then have a blank member above them in the hierachy.

   Note: This setting applies to SSAS Tabular endpoints only.

4. Click a field in the **Available fields** list and click **Add >** or double-click a field in the **Available fields** list to add it to the hierarchy.
5. Click a field in the **Hierarchy** list and click **Move Up** or **Move Down** to reorder the field.
6. (Optional) Click a field in the **Hierarchy** list and click **Rename** or press **F2** to rename the field.
7. Click **OK** to add the hierachy. In the tree, you can find it in a Hierarchies folder under the table.

SETTING A DEFAULT DATE TABLE

Note: This setting applies to SSAS Tabular endpoints only.

Knowing what table is the default, or primary, date table enables additional features in Analysis Services Tabular client applications such as PowerBI.

Any table can be set as the default date table, including date tables added in the data warehouse and tables from a data source. To work, the table needs a field of the data type 'datetime' to be used as key. On date tables created by Discovery Hub, this would be the 'datevalue' field.

To set a table as the default date table

- Right click the table and click **Set as Default Date Table**.
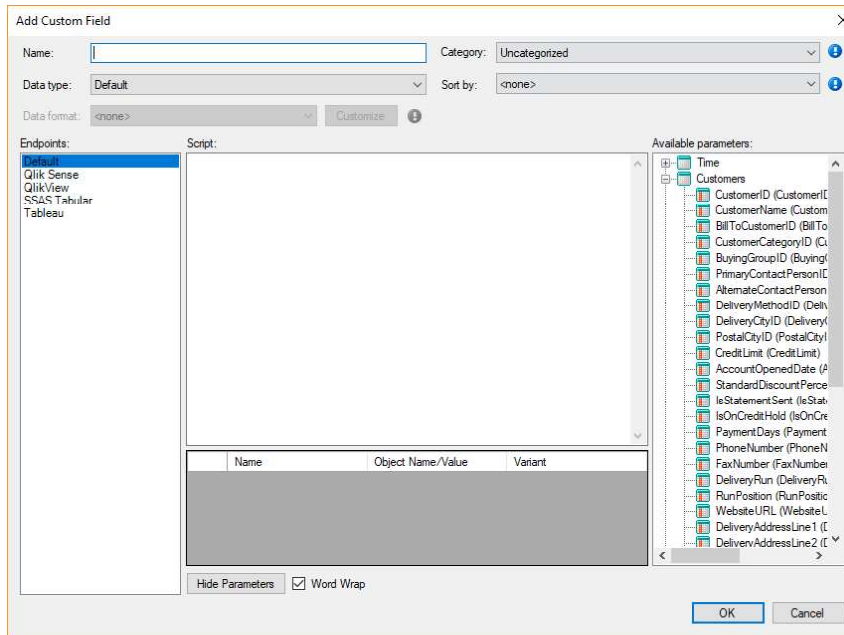
To remove a table as the default date table

- Right click the table and click **Remove as Default Date Table**.

FIELDS

ADDING A CUSTOM FIELD

To add a custom field to a table, follow the steps below.

1. Right click a table and click **Add Custom Field**. The **Add Custom Field** window appears.

2. In the **Name** box, type a name for the field.
3. In the **Data type** list, click on the data type you want to use for the custom field.

   Note: This setting applies to SSAS Tabular and Tableau endpoints only.

4. In the **Data format** list, click on the data format you want the field to have. For some data types, just one data format is available which is set and cannot be changed. Click **Customize** to customize the data format, e.g. number of decimal places for decimal numbers.

   Note: This setting applies to SSAS Tabular endpoints only.

5. In the **Category** list, click on the category you want the field to have.

   Note: This setting applies to SSAS Tabular endpoints only.

6. In the **Sort by** list, click on the field that contains the values you want to sort by.

   Note: This setting applies to SSAS Tabular endpoints only.

7. In the **Script** box, enter the script that generates the value of the custom field. Since syntax differs between endpoint types, you can add a script for each endpoint type. Click on an endpoint type in the **Endpoints** list to switch between endpoint types. Any

endpoint type that does not have a specific script will use the Default script. You can drag in fields from the **Available parameters** list to use them as parameters in the script.
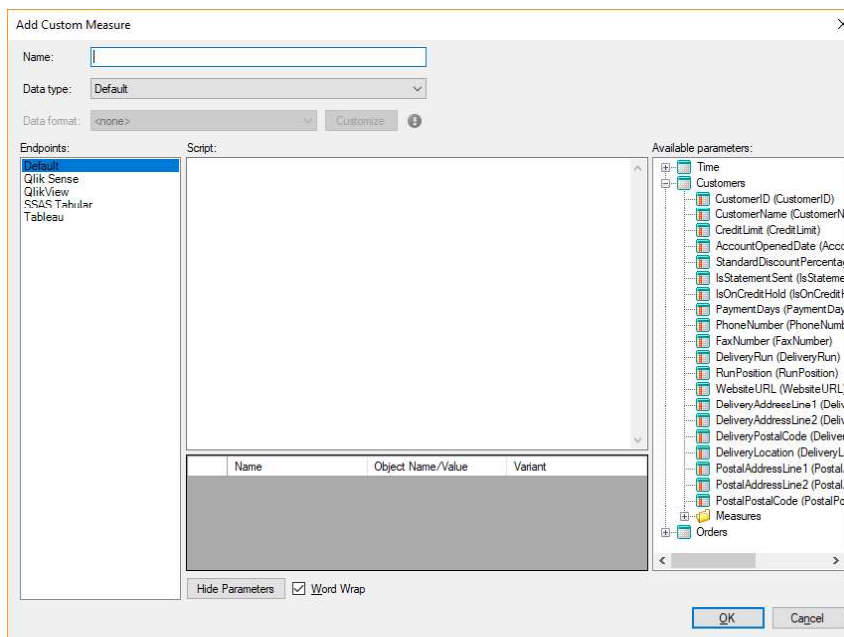
ADDING A CUSTOM MEASURE

Note: This setting applies to SSAS Tabular and Tableau endpoints only.

Custom measures use a script to calculate the value of the measure.

To add a custom measure, follow the steps below.

1. Right click a table and click **Add Custom Measure**. The **Add Custom Measure** window appears.

2. In the **Name** box, type a name for the field.
3. In the **Data type** list, click on the data type you want to use for the custom field.
4. In the **Data format** list, click on the data format you want the field to have. For some data types, just one data format is available which is set and cannot be changed. Click **Customize** to customize the data format, e.g. number of decimal places for decimal numbers.

Note: This setting applies to SSAS Tabular endpoints only.

5. In the **Script** box, enter the script that generates the value of the custom measure. Since syntax differs between endpoint types, you can add a script for each endpoint type. Click on an endpoint type in the **Endpoints** list to switch between endpoint types. Any endpoint type that does not have a specific script will use the Default script.
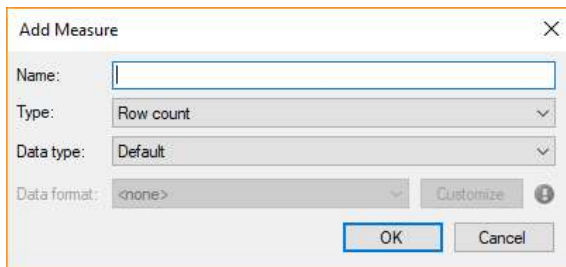
You can drag in fields from the **Available parameters** list to use them as parameters in the script.

ADDING A MEASURE BASED ON A TABLE

You can add measures to a table based on both the table itself and fields on the table.

To add a measure based on a table, follow the steps below.

1. Right click a table and click **Add Measure** The **Add Measure** window appears.

2. In the **Name** box, type a name for the measure.
3. In the **Type** list, click on the type of measure you want to create. You have the following options:

    - **Row Count**: The value will be the number of rows in the table.

4. In the **Data type** list, click on the data type you want to use for the custom field.

    Note: This setting applies to SSAS Tabular and Tableau endpoints only.
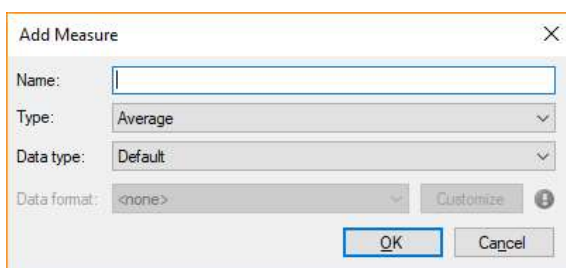
5. In the **Data format** list, click on the data format you want the field to have. For some data types, just one data format is available which is set and cannot be changed. Click **Customize** to customize the data format, e.g. number of decimal places for decimal numbers.

    Note: This setting applies to SSAS Tabular endpoints only.

ADDING A MEASURE BASED ON A FIELD

To add a measure based on a field, follow the steps below.

1. Right click a field and click **Add Measure**. The **Add Measure** window appears.

2. In the **Name** box, type a name for the measure.

3. In the **Type** list, click on the type of measure you want to create. You have the following options:
    - **Average**: An average on the field values.
    - **Count**: The number of field values.
    - **Distinct count**: The number of unique field values.
    - **Maximum**: The highest field value.
    - **Minimum**: The lowest field value.
    - **Sum**: The sum of the field values.
4. In the **Data type** list, click on the data type you want to use for the custom field.

    Note: This setting applies to SSAS Tabular and Tableau endpoints only.

5. In the **Data format** list, click on the data format you want the field to have. For some data types, just one data format is available which is set and cannot be changed. Click **Customize** to customize the data format, e.g. number of decimal places for decimal numbers.

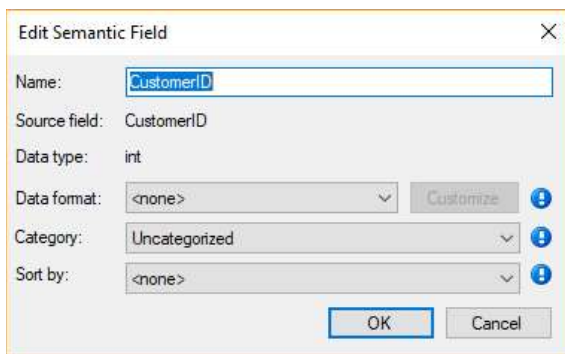   **Note:** This setting applies to SSAS Tabular endpoints only.

SETTING DATA FORMAT AND CATEGORY

Note: This setting applies to SSAS Tabular endpoints only.

By setting data format and category, you can control how a fields data will be displayed in client applications. For instance, text fields categorized as "Web URL" will be displayed as links in PowerBI.

To set data format and category for a field, follow the steps below.

1. Right click the field you want to sort and click **Edit Field**. The Edit Field window appears.

2. In the **Data format** list, click on the data format you want the field to have. The options depend on the data type which can be changed on the source field in the data warehouse or staging database. For some data types, just one data format is available which is set and cannot be changed.

3. Click **Customize** to customize the data format, e.g. number of decimal places for decimal numbers.
4. In the **Category** list, click on the category you want the field to have.

SORTING A FIELD BY ANOTHER FIELD

Note: This setting applies to SSAS Tabular endpoints only.

Some fields have a certain conventional sort order. For instance, month names are usually ordered January - December, not alphabetically April - September. In this case, it would make sense to order the months according to a month number instead of the month name.

In Discovery Hub you can set a field to be sorted by another field.

To sort one field by another field, follow the steps below.

1. Right click the field you want to sort and click **Edit Field**.
2. In the **Sort by** list, click on the field that contains the values you want to sort by.

ORGANIZING FIELDS AND MEASURES IN DISPLAY FOLDERS

Note: This setting applies to SSAS Tabular endpoints only.

With display folders, you can organize fields and measures in folders in client applications such as PowerBI.

To add a display folder and add fields to it, follow the steps below.

1. Right click the table that contains the fields and click **Display Folders**. The **Display Folders** window appears.
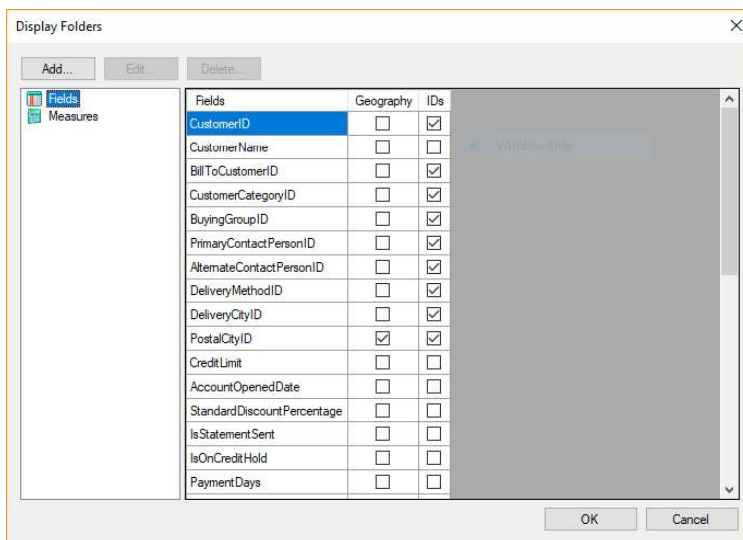
2. Click **Add** and type a name for the folder in the **Name** box in the window that appears. The syntax for display folders has two special characters:

- **Forward slash:** Use forward slash to create a hierarchy of display folders. For example, "A/B" will create a display folder "A" that contains a display folder "B".
- **Semicolon:** Behind the scenes, Discovery Hub creates one display folder string for each field where each folder is seperated by a semicolon. It is possible, but not recommended, to create display folders with semicolon in the name.
  For example, mapping a display folder called "A;B" to a field is the same as mapping the field to a display folder "A" and a display folder "B".

Display folders are shared across the model.

3. Map the fields to display folders by clicking the check box where a field and a display folder intersect in the grid.

RELATIONS

All relations for each table are listed under Relations under the table. This means that the same relation is listed under both the tables involved.

Each relation has a default name that consist of the two table names with a "-" between, but it can be renamed. A relation contains one or more relation items, i.e. relations between two fields.
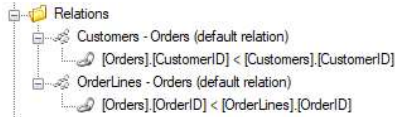
ADDING RELATIONS

When adding relations, the available settings depend on the endpoint types you have selected for the model - see Adding a Semantic Model.

To add a new relation on a model where Qlik is the only endpoint type enabled

- Drag a field from one table on the model to field on another table and the click **Yes** when asked if you want to add a relation.

To add a new relation on a model where the endpoint type Analysis Services Tabular or Tableau is enabled, follow the steps below.

1. Drag a field from one table on the model to field on another table. If the cardinality of the tables involved is not one-to-one, drag from the "one" table to the "many". A window appears with settings.
2. In the **Cardinality** list, click on the option the represents the cardinality of the table relationship.
3. In the **Filter direction** list, click on option you prefer:
   - **To [table]:** [Table] is filtered by the other table in the relationship.
   - **To both tables:** The tables filter each other.

   Note: This setting applies to SSAS Tabular endpoints only.

To add a new relation item to an existing relation

- Drag a field from one table on the model to field on another table and click on the existing relation in the menu that appears.

CHANGING THE DEFAULT RELATION

You can have multiple relations between two tables. The first one will be designated as the default relation, which are necessary in some endpoints.

To set a relation as the default relation

- Right click the relation and click **Set as default relation**.

CHANGING A RELATION'S CARDINALITY

Note: This setting applies to SSAS Tabular and Tableau endpoints only.

Each relation has cardinality. In the tree, the cardinality can be identified on the relation items as follows:

- **=** : One to one
- **<** : One to Many
- **>** : Many to one

To change the cardinality for a relation

- Right click the relation, click **Cardinality** and click on the cardinality you want for the relation.

CHANGING A RELATION'S FILTER DIRECTION

Note: This setting applies to SSAS Tabular endpoints only.

Each relation also has a filter direction. To change the filter direction

- Right click on the relation, click on **Filter Direction** and click on the filter direction you want to set for the table.

SECURITY

In the semantic layer, you can setup access to data on the row and model level. In other words, you can decide who has access to a model and what data in the model they have access to. For instance, a sales team could have access to a model while the individual sales people has access to data on the specific customers they work with.

To setup access on the model level, you add a role and map it to an endpoint. To refine the access to the row level, you add a row-level security setup and map this to one or more roles.

ADDING A ROLE

To add a role, follow the steps below.

1. Navigate to the relevant model, right click Roles and click **Add Role**. The **Add Role** window appears.
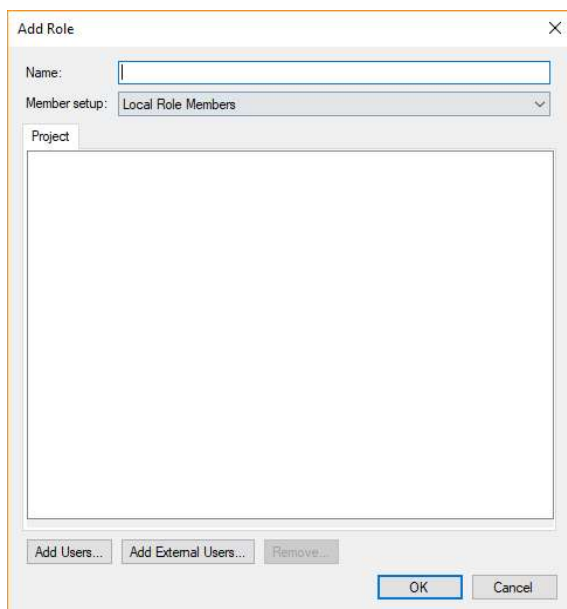
2. Type a name for the role in the **Name** box.
3. Click **Add AD Users...** to add users from a local AD. The standard **Select Users and Groups** window appears.
4. Click **Add External Users...** to add an external user, e.g. an Azure AD user. The Add External Users window appears. Type the users e-mail address and click **Add** to add him to the role.
5. Click **OK** to add the role.

MAPPING A ROLE TO AN ENDPOINT

Mapping a role to an endpoint restricts access to data on that endpoint to members of the role.

To map a role to an endpoint

- Right-click the role, click **Endpoints** and click the endpoint you want to map the role to
  - OR -
  Drag the role to the endpoint

ADDING A ROW-LEVEL SECURITY SETUP

> **Note:** This setting applies to SSAS Tabular and Qlik endpoints only.

There are different ways of setting up row-level security depending on the endpoint(s) you are targeting and how security is handled in your organization. See How to Setup Up Row-level Security below for more information.

To add a row -level security setup, follow the steps below.

1. Right click a field and click **Add Row-level Security Setup**.

2. Type a name for the setup in the **Name** box.
3. Selecting one or more row values in the **Values** list and one or more members in the **Members** list and click **Add >** to map values and members. The "(Role members)" member maps the values to the members of the roles that are mapped to the setup.
4. Enter a username in the text box and click **Add Member** to add that user or group to the list of members. Usernames added this way will be deployed with the roles that are mapped to the setup.

MAPPING A ROW-LEVEL SECURITY SETUP TO A ROLE

Mapping a row-level security setup to a role restricts access to data on that endpoint according to the mapping of row values and members in the setup.

To map a row-level setup to a role

- Right-click the row-level security setup, click **Roles** and click the role you want to map the setup to
  - OR -
  Drag the row-level security setup to the role

SETTING UP ROW-LEVEL SECURITY

You can add as many or as few roles and row-level security setups as you like and each role can be mapped to any number of row-level security setups and vice-versa. This gives you a lot of flexibility to set up row-level security in a way that makes sense in your particular situation.

There are two basic approaches you can use:

- **One role and one setup:**
  - Add one role. If you target SSAS Tabular, all users and groups that you later add to the security setup must be members to have access. If you only target Qlik, the role can be empty since it only serves as a link between the security setup and the endpoint.
  - Add one setup. Add the users and groups as members in the setup and map the relevant values to the members you have added.
  - Map the setup to the role and the role to the endpoint(s).
  - This works well if you have the relevant groups in Active Directory and can manage membership from there.
- **Many roles and setups:**
  - Add a role for each user or group that should have access to a specific subset of data.
  - Add a setup for each of the roles. Map the relevant values to the "(Role Member)".
  - Map the setups to the roles and the roles to the endpoint(s).
  - This works well if you want to use roles as groups in the semantic layer.

As hinted above, Analysis Services and Qlik handles security differently:

- On Analysis Services, access is granted to a role and Discovery Hub uses DAX scripting to give users and groups access on the row level.
- Qlik does not have roles, so all access is granted on the users/groups-level. For Qlik, roles in the semantic layer is simply an ad hoc collection of users and groups that have access to the same data.
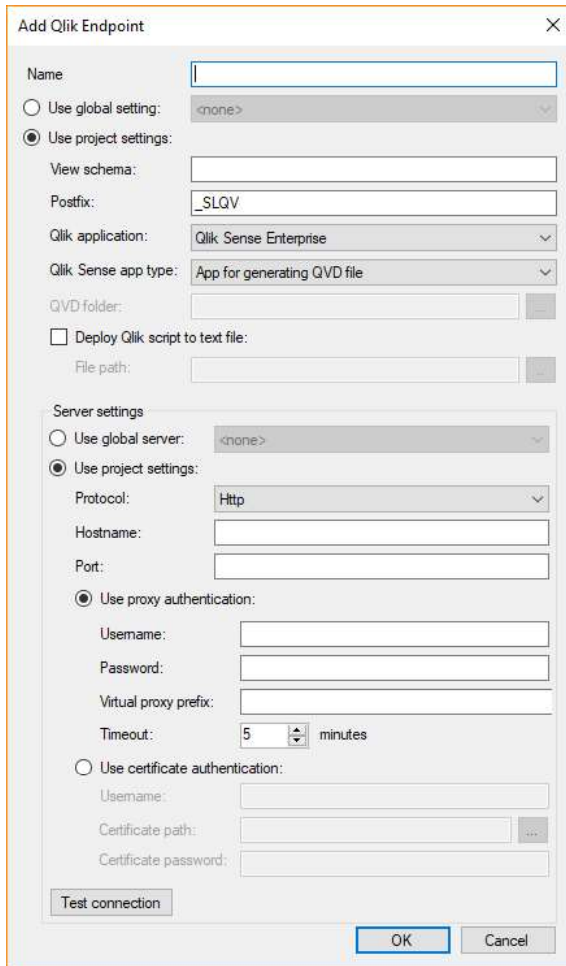
ENDPOINTS

Your semantic models can have a number of endpoints. At the time of writing, Discovery Hub supports three different endpoints: Qlik, Tableau and Analysis Services Tabular.

ADDING A QLIK ENDPOINT

To add a Qlik endpoint, follow the steps below.

1. Expand the model you want to add an endpoint to, right click Endpoints and click **Add Qlik Endpoint**. The **Add Qlik Endpoint** window appears.

2. In the **Name** box, enter a name for the endpoint.
3. (Optional) In the **View schema** box, type the schema name you want to use for the views generated by Discovery Hub.
4. (Optional) In **Postfix** box, type the postfix Discovery Hub uses for views, folder names etc.
5. (Optional) In the **App prefix** box, type a string to be prefixed to the endpoint name to create the app name used in Qlik Sense.

6. In the **Qlik application** list, click on the Qlik application to target. You have the following options:
   - **Qlik Sense Enterprise**: Use a Qlik Sense Enterprise server. When you chose this application type, you need to enter server connection information under server settings. For more information on the settings, see [Deploying to Qlik Enterprise](#).
   - **Qlik Sense Desktop**
   - **QlikView**

   Note: For more information on deploying to the different applications, see [Qlik Endpoint Deployment](#) below.

7. If you are deploying to Qlik Sense Enterprise or Qlik Sense Desktop, click on the app type you want to create in the **Qlik Sense app type** list. You have the following options:
   - **App for generating QVD file:** Creates an app that generates a QVD file with data from the model in the **QVD folder** you specify. The **QVD folder** should accessible for both Discovery Hub and Qlik Enterprise.
   - **App for displaying data:** Creates an app and loads data from the model into it.
8. Select **Deploy Qlik script to text file** and enter a path in **File path** to have Discovery Hub output the script it generates to a text file.
9. Click **OK** to add the endpoint.

ADDING A TABLEAU ENDPOINT

To add a Tableau endpoint, follow the steps below.

1. Expand the model you want to add an endpoint to, right click Endpoints and click **Add Tableau Endpoint**. The **Add Tableau Endpoint** window appears.
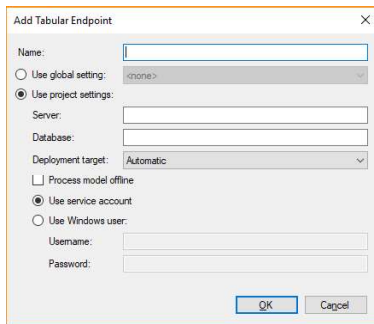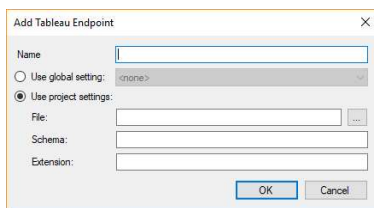

2. In the **Name** box, enter a name for the endpoint.
3. In the **File** box, enter the path and file name for the Tableau data source file generated by Discovery Hub.
4. (Optional) In the **Schema** box, type the schema name you want to use for the views generated by Discovery Hub.
5. (Optional) In the **Extension** box, type the postfix Discovery Hub uses for views etc.
6. Click **OK** to add the endpoint.

ADDING A TABULAR ENDPOINT

To add a Tabular Endpoint, follow the steps below.

1. Expand the model you want to add an endpoint to, right click Endpoints and click **Add Tabular Endpoint**. The **Add Tabular Endpoint** window appears.

2. In the **Name** box, enter a name for the endpoint.
3. In the **Server** box, type the name of the Tabular server. The server can be on-premise or in Azure.
4. In the **Database** box, type the name of the database.
5. Select **Process model offline** to process the model "behind the scenes" and make the deployment seamless for the users.
6. For authentication, the default is to use the SQL Server Analysis Services service account. Click **Use Windows authentication** to use another user and then enter the user name for the user in the **Username** box and the corresponding password in the **Password** box.
7. Click **OK** to add the endpoint.

DEPLOYMENT AND EXECUTION

Deploying and executing a semantic model means deploying and executing the the end-points on the model. All endpoints can be deployed, but not all endpoints need to be executed. Your options will vary accordingly.

To deploy a model or endpoint

- Right click the model or endpoint, click **Deploy**, **Execute** or **Deploy and Execute** and click **Start** in the **Deploy and/or Execute** window that appears.

What happens during deployment and execution depends on the endpoint.

QLIK ENDPOINT DEPLOYMENT

For Qlik endpoints, the end product is a QVD file for each table in the model. QVD is a proprietary data format that stores data in the way that gives the best performance in Qlik apps. Since only Qlik applications can create QVD files, deployment and execution of Qlik endpoints create apps or scripts that a Qlik application can use to create QVD files.

Data for the QVD files is extracted from views. On deployment, a view for each table in the model is created in the data warehouse or staging database that house the table. The view name depends on the settings on the endpoint and has the format [view schema].[table name]_[postfix], e.g. "QView.Customers_QV".

Apart from creating the views, deployment is different depending on your choice of Qlik application:

- **Qlik Sense Enterprise**: An app called "[Endpoint name]_QVDApp" is created on the server. Unlike the other Qlik applications, Qlik Sense Enterprise has an execution step. On execution, the app on the server is executed and creates QVD files on the file path specified.
- **Qlik Sense Desktop**: You can right click the endpoint and click **Create Qlik Sense App** to create an app in the application. When you execute this app in Qlik Sense Desktop, it creates QVD files based on the tables in the semantic model on the file path specified.
- **QlikView**: You can right-click the endpoint and click **QlikView Scripts** to show and copy the script you need to use in QlikView to generate QVD files based on the tables in the semantic model.

TABLEAU ENDPOINT DEPLOYMENT

On deployment, a view for each table in the model is created in the data warehouse or staging database that house the table. The view name depends on the settings on the endpoint and has the format [view schema].[model name]_[endpoint name]_[table name]_[postfix], e.g. "Tableau.MyModel_MyTableau_Customers_tab".

In addition to that, a TDS file is created on the file path specified in the endpoint. Use this file in Tableau to connect to the views.

ANALYSIS SERVICES TABULAR ENDPOINT DEPLOYMENT

On deployment, the model is created on the SSAS Tabular server. To get data in the model, you need to execute the model as well.

VALIDATING A SEMANTIC MODEL OR ENDPOINT

You can run a validation on a semantic model or endpoint to catch issues that would case problems in the frontend after deployment and execution.

To validate a semantic model or endpoint, follow the steps below

1. Right click a model and click **Validate Model**
    - OR -
    Right click an endpoint and click **Validate Endpoint**.

    If the validation results in warnings, the **Validate Semantic Model** or **Validate Semantic Endpoint** window appears.
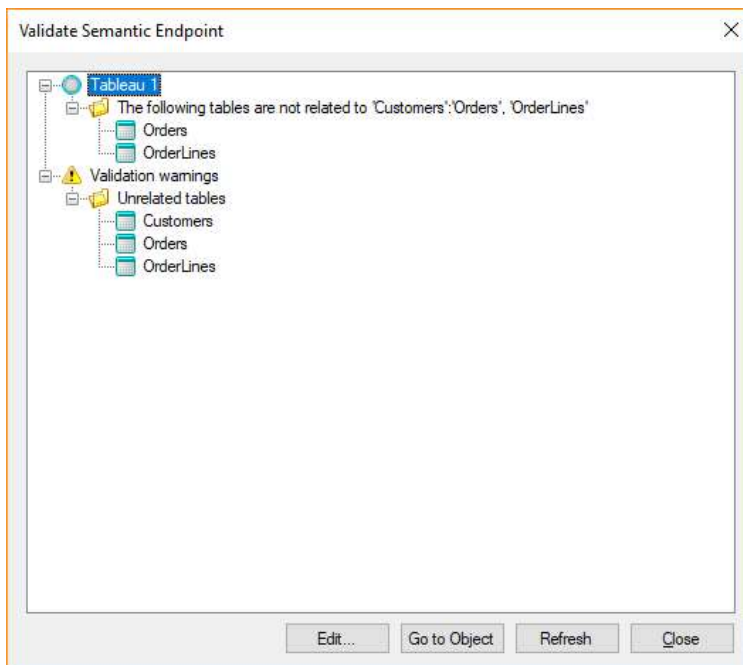
2. To help you fix the warnings, the window contains some shortcuts for each item in the list:
    1. Click **Edit...** to edit the selected object
    2. Click **Go to Object** to reveal the selected object in the tree.
    3. Right click an object and click **Delete** if you want to delete the object.