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SAS® 9.1.3 Open Metadata Interface

User's Guide

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Contents

PART 1 Using the Interface to Create, Update, and Delete Metadata 1

Chapter 1 △ Introduction 3
About This Guide 3
Introduction to the SAS Open Metadata Interface 3
Prerequisite Information 4

Chapter 2 △ Adding Metadata Objects 5
Overview of Adding Metadata 5
Introduction to the AddMetadata Method 5
Example of Creating a Repository Object 9
Example of Creating an Application Metadata Object 10
Example of Creating an Object and an Association to an Existing Object 11
Example of Creating Multiple, Related Metadata Objects 12
Example of Creating Multiple, Unrelated Metadata Objects 14
Creating a Metadata Object and an Association to an Object in Another Repository 17
Additional Information 18

Chapter 3 △ Updating Metadata Objects 19
Overview of Updating Metadata 19
Using the UpdateMetadata Method 20
Example of Modifying a Metadata Object's Attributes 24
Example of Modifying an Association 25
Example of Merging Associations 26
Example of Deleting an Association 28
Example of Appending Associations 29
Additional Information 30

Chapter 4 △ Deleting Metadata Objects 31
Overview of Deleting Metadata 31
Example of Deleting a Metadata Object 32
Additional Information 33

PART 2 Using the Interface to Query Metadata 35

Chapter 5 △ Overview 37
Overview of Querying Metadata Objects 37
Example of Listing the Metadata Types in a Namespace 38
Listing the Available Repositories 39
Listing the Metadata Types in a Repository 40

Chapter 6 △ Querying All Metadata of a Specified Type 43

Introduction to the GetMetadataObjects Method **43**
Expanding a GetMetadataObjects Request to Include Subtypes **45**
Expanding a GetMetadataObjects Request to Retrieve Additional Properties **46**
Filtering a GetMetadataObjects Request **52**
Expanding a GetMetadataObjects Request to Search Additional Repositories **59**

Chapter 7 △ Querying Specific Metadata Objects 61
Introduction to the GetMetadata Method **61**
Retrieving All Properties of a Specified Object **62**
Retrieving the Attributes of a Specified Object **64**
Retrieving Properties of Associated Objects **65**
Retrieving Subtypes **66**
Combining GetMetadata Flags **66**
Filtering the Associated Objects that are Returned by a GetMetadata Request **67**
Using Templates **68**

PART 3 Using the Interface to Perform Repository Management Tasks 73

Chapter 8 △ Creating Relationships Between Repositories 75
Overview **75**
Creating Dependency Associations **76**
Creating Cross-Repository References **79**
Querying Dependency Associations **81**
Querying Cross-Repository References **82**
Querying Objects Across Multiple Repositories (Federated Query) **83**
Deleting a Dependency Association **84**
Deleting a Cross-Repository Reference **85**

Chapter 9 △ Creating a Repository on an External DBMS 87
Overview of Creating a Repository on an External DBMS **87**
Software Requirements **87**
Host Requirements **88**
DBMS Requirements **88**
Repository Registration Requirements **88**
Oracle Connection Options **88**
DB2 Connection Options **90**
Using a Repository on an External DBMS **91**
Example of Registering a Repository on an External DBMS **91**

Chapter 10 △ Invoking a Repository Audit Trail 93
Overview **93**
Starting the Audit Trail **94**
Physical versus Logical Deletion of Metadata Records **97**
Usage Considerations **97**
Restoring a Metadata Record on Windows Hosts **98**
Deleting an Audit Trail **102**

Changing the Audit Trail Location 103
Turning Off Auditing 103

Chapter 11 △ Metadata Locking Options 105
Overview of Metadata Locking Options 105
Using SAS Open Metadata Interface Flags to Lock Objects 105
Promoting Repositories Between Servers 106

Chapter 12 △ Using the Change Management Facility 107
Introduction to the Change Management Facility 107
Summary of Change Management Methods 108
Setting Up Primary and Project Repositories 109
How Access Controls are Handled by the Change Management Facility 110
Checking Out Metadata Objects 110
Fetching Metadata 113
Updating Metadata Objects in a Project Repository 114
Adding and Copying Metadata Objects in a Project Repository 114
Deleting a Metadata Object 116
Checking In Metadata Objects 117
Querying the Primary Repository 118
Querying the Project Repository 120
Emptying the Project Repository 121
Default Lock Templates 121

Chapter 13 △ Repository Maintenance Tasks 129
Clearing or Deleting a Repository 129
Unregistering and Re-registering a Repository 129

PART 4 Model Usage 131

Chapter 14 △ Model Usage Scenarios 133
Overview of Model Usage Scenarios 134
Usage Scenario: Creating Metadata Objects that Represent a DBMS 135
Usage Scenario: Creating Metadata for a Cube 137
Usage Scenario: Creating a Prototype 144
Usage Scenario: Creating Metadata for a SAS Library 158
Usage Scenario: Creating Metadata for Tables, Columns, and Keys 163
Usage Scenario: Creating Metadata for a SAS/SHARE Server 171
Usage Scenario: Creating Metadata for a Stored Process 175
Usage Scenario: Creating Tree and Group Objects 183
Usage Scenario: Creating Metadata for a Workspace Server 187

PART 5 Appendix 229

Appendix 1 △ Recommended Reading 231
Recommended Reading 231

PART 1

Using the Interface to Create, Update, and Delete Metadata

Chapter **1**. . . . . **Introduction** *3*

Chapter **2**. . . . . **Adding Metadata Objects** *5*

Chapter **3**. . . . . **Updating Metadata Objects** *19*

Chapter **4**. . . . . **Deleting Metadata Objects** *31*

CHAPTER 1 Introduction

About This Guide **3**
Introduction to the SAS Open Metadata Interface **3**
Prerequisite Information **4**

About This Guide

This guide describes how to perform basic and advanced metadata management tasks using the SAS Open Metadata Interface. It also provides sample usage scenarios that describe how to use the metadata types in the SAS Metadata Model to store metadata.

The SAS Open Metadata Interface uses XML as its transport language. If you are unfamiliar with XML, see the W3C XML Specifications at **`www.w3.org/TR/1998/REC-xml-19980210`** before reading this guide.

The examples in this guide show how to issue calls without regard to the programming environment. For details about writing SAS Open Metadata Interface clients in specific environments, see the *SAS Open Metadata Interface: Reference*.

Introduction to the SAS Open Metadata Interface

The SAS Open Metadata Interface is an application programming interface that provides a set of methods and metadata types for reading and writing metadata about application elements. The SAS Open Metadata Interface can also be used to do such things as register repositories, define dependencies between them, define access controls for repositories and metadata objects, and to perform version control on repositories, but these are secondary tasks. The primary purpose of the SAS Open Metadata Interface is to enable you to read and write metadata.

To read or write a metadata object, you must pass a string of properties that describe that object to the appropriate SAS Open Metadata Interface method. This string identifies the appropriate metadata type to use to represent the application element and supplies or queries specific values for the object's attributes and associations.

This guide is divided into four parts:

- *Using the Interface to Create, Update, and Delete Metadata* describes how to use the application programming interface to create and modify metadata. It identifies the correct method to use to add, update, and delete metadata objects and their associations.
- *Using the Interface to Query Metadata* describes how to query metadata. The interface provides the GetMetadataObjects method to query all objects of a specific metadata type, and the GetMetadata method to query specific metadata objects.

This section describes how to use method flags and templates to control the metadata properties that you want to return.

- *Using the Interface to Perform Repository Management Tasks* describes how to perform more advanced metadata management tasks, such as defining relationships between repositories, implementing an object locking scheme, and using change management methods, among other things.
- *Model Usage* contains usage scenarios to help you identify the correct metadata type to use to create metadata representing the most common application elements.

Prerequisite Information

In order to successfully use SAS Open Metadata Interface methods, you must understand how to use the metadata types documentation in the *SAS Open Metadata Interface: Reference*. Review "Overview of the Metadata Model and Model Documentation" in the reference carefully before attempting to follow the examples in this guide. Metadata types for application elements are described in "Alphabetical Listing of SAS Namespace Metadata Types." This listing is available only in the online version of the *SAS Open Metadata Interface: Reference*.

The SAS Open Metadata Interface enables you to instantiate objects for method parameters and issue method calls directly from the client, or to define all of a method's parameters in an XML string and submit it to the server via a generic DoRequest method. The first approach is referred to as the "standard interface". The second is referred to as the "DoRequest method." The examples in this guide use the DoRequest method. For detailed information about the interfaces, see "Call Interfaces" in the reference. Method calls formatted for the DoRequest method can be passed in Java, Visual Basic, and C++ clients, and in PROC METADATA.

For reference information about the methods used in this book, see "Methods for Reading and Writing Metadata (IOMI Class)" in the reference.

CHAPTER 2

Adding Metadata Objects

Overview of Adding Metadata **5**
Introduction to the AddMetadata Method **5**
  Creating Associations to New and Existing Objects **6**
  Creating Associations to Objects in Other Repositories **7**
  Examples **7**
  Creating Multiple Objects in an AddMetadata Request **8**
  Symbolic Names **8**
Example of Creating a Repository Object **9**
Example of Creating an Application Metadata Object **10**
Example of Creating an Object and an Association to an Existing Object **11**
Example of Creating Multiple, Related Metadata Objects **12**
Example of Creating Multiple, Unrelated Metadata Objects **14**
Creating a Metadata Object and an Association to an Object in Another Repository **17**
Additional Information **18**

Overview of Adding Metadata

The SAS Open Metadata Interface allows you to create metadata objects and their associations directly or to create the metadata objects first and add associations to them later.

You create metadata objects with the AddMetadata method. With AddMetadata, you can

- create an object
- create an object and an association to an existing object
- create an object, an association, and the associated object.

You add associations to existing objects by using the UpdateMetadata method. For information about using the UpdateMetadata method, see Chapter 3, "Updating Metadata Objects," on page 19.

Introduction to the AddMetadata Method

The AddMetadata method enables you to create metadata objects that describe both metadata repositories and application elements. Adding a metadata object that describes a metadata repository registers the repository in the metadata server's repository manager. A metadata repository must be registered before you can define application metadata objects in it. Application metadata objects describe application elements, such as tables, columns, and servers.

To create any metadata object with the AddMetadata method, you must supply the following:

- □ a metadata property string that defines the object to be created
- □ an identifier that indicates where the object is to be stored
- □ the namespace (set of metadata types) in which to process the request.

You must also specify the OMI_TRUSTED_CLIENT (268435456) flag. The OMI_TRUSTED_CLIENT flag is required to write a metadata object in a SAS metadata repository.

This information is passed as AddMetadata parameters. The parameters are illustrated here as XML elements that can be submitted to the SAS Metadata Server using the DoRequest method.

```
<AddMetadata>
   <Metadata>metadata_property_string</Metadata>
   <Reposid>repository_identifier</Reposid>
   <NS>namespace</NS>
   <Flags>268435456</Flags>
   <Options/>
</AddMetadata>
```

To create a metadata object describing a repository, you specify:

- □ a metadata property string defining the repository's properties
- □ the repository manager identifier A0000001.A0000001
- □ the REPOS namespace.

To create a metadata object describing an application element, you specify:

- □ a metadata property string defining the element's properties
- □ a repository identifier
- □ the SAS namespace.

The metadata property string must be formatted in XML as described in "Constructing a Metadata Property String" in the *SAS Open Metadata Interface: Reference*. At a minimum, the metadata property string must specify the metadata type and any required properties of the object to be created. Most metadata types have required attributes. Some also have required associations. Refer to "REPOS Namespace Metadata Types" in the reference for information about the required and optional properties of the repository metadata types. See "Alphabetical Listing of SAS Namespace Metadata Types" in the reference for information about required and optional properties of application metadata types.

Note: The alphabetical listing is available only in online versions of the reference. △

Although it is not required, it is recommended that you supply values for all of an object's attributes and as many associations as possible in order to make your metadata more meaningful.

Creating Associations to New and Existing Objects

The AddMetadata method creates a new object for every object described in the <Metadata> element unless the ObjRef attribute is used to specify the object's instance identifier. That is, the metadata server will assign a new identifier in all of the following cases:

- □ when you omit the Id attribute from the metadata property string

- when you specify the Id attribute with a null value (Id=“ ”)
- when you specify a symbolic name in the Id attribute (Id=“$Table”)
- when you specify a real value in the Id attribute (Id=“A53TPPVI”), in either the main element or in an association subelement.

Supported only in associated object definitions, the ObjRef attribute signifies to the server that the reference is to an existing object and instructs the metadata server to create an object reference to the specified object without modifying the specified object in any other way.

Creating Associations to Objects in Other Repositories

By default, any new metadata objects are created in the repository specified in the <Reposid> element. If relationships have been defined between repositories (see Chapter 8, “Creating Relationships Between Repositories,” on page 75), you can also create associations and new associated objects in other repositories. This is done by including the desired repository identifier in the associated object definition. An association that is defined to an object that exists or is created in another repository is referred to as a *cross-repository reference*.

Examples

The following is an example of a metadata property string that creates an object, an association, and the associated object in the same repository. Note that neither the main element nor the associated object definition specifies an Id attribute.

```
<MetadataType Name="String" Desc="String">
   <AssociationName>
     <AssociatedMetadataType Name="String" Desc="String"/>
   </AssociationName>
</MetadataType>
```

The following is an example of a metadata property string that creates an object and an association to an existing object in the same repository. Note that the main element omits the Id attribute and that the associated object definition specifies the Objref attribute.

```
<MetadataType Name="String" Desc="String">
   <AssociationName>
     <AssociatedMetadataType Objref="Objectid" Name="String"/>
   </AssociationName>
</MetadataType>
```

To create a metadata object and an association to an existing object in another repository, use the Objref attribute in the associated object definition and include the repository identifier along with the object identifier in the form *Reposid.Objectid*. (You can determine the available repositories and their unique identifiers by using the GetRepositories method. For more information, see “Listing the Available Repositories” on page 39.)

```
<MetadataType Name="String" Desc="String">
   <AssociationName>
     <AssociatedMetadataType Objref="Reposid.Objectid" Name="String"/>
   </AssociationName>
</MetadataType>
```

To create an object and an association to a new associated object in another repository, specify the Id attribute, the repository identifier, and a symbolic name in the associated object definition. For example:

```
<MetadataType Name="String" Desc="String">
   <AssociationName>
     <AssociatedMetadataType Id="Reposid.SymbolicName" Name="String"/>
   </AssociationName>
</MetadataType>
```

Creating Multiple Objects in an AddMetadata Request

The AddMetadata method supports two ways of creating multiple objects in a single request.

To create multiple, related associated objects in an AddMetadata request, nest their object definitions under the association name. For example:

```
<MetadataType Name="String" Desc="String">
   <AssociationName>
     <AssociatedMetadataType Name="String" Desc="String"/>
     <AssociatedMetadataType Name="String" Desc="String"/>
     <AssociatedMetadataType Name="String" Desc="String"/>
   </AssociationName>
</MetadataType>
```

To create multiple, unrelated objects, stack the metadata property strings that define the metadata objects in the <Metadata> element as follows:

```
<Metadata>
  <MetadataType1 Name="String" Desc="String">
   <AssociationName>
     <AssociatedMetadataType Name="String" Desc="String"/>
   </AssociationName>
 </MetadataType1>
 <MetadataType2 Name="String" Desc="String">
   <AssociationName>
     <AssociatedMetadataType Name="String" Desc="String"/>
   </AssociationName>
 </MetadataType2>
</Metadata>
```

Symbolic Names

A symbolic name is an alias which is preceded by a dollar sign ($) that you assign to a metadata object in order to reference a metadata object before it is created. Symbolic names are used to create associations and new associated objects in other repositories. They also enable you to create references between multiple, unrelated metadata objects in a single XML request. See "Example of Creating Multiple, Unrelated Metadata Objects" on page 14 for more information about this usage.

When used to create an association and a new object in another repository, the symbolic name has the form *Reposid.$Alias* and the symbolic name is specified in the Id= attribute of the association subelement.

When used to create multiple, unrelated objects in the same repository, the form *$Alias* is used.

The alias can be any name as long as it is preceded by a dollar sign ($). At the successful completion of AddMetadata or UpdateMetadata processing, the alias and any references to it are automatically replaced with a real object identifier.

Example of Creating a Repository Object

Creating a repository object registers a repository in a metadata server's repository manager. You must register at least one repository in the repository manager before you can create metadata objects representing application elements. The repository object provides the metadata server with information necessary to access the metadata.

The following is an example of an AddMetadata request that creates a repository:

```
<AddMetadata>
  <Metadata>
    <RepositoryBase
      Name="Test repository 1"
      Desc="Repository created to illustrate registering
            a repository using AddMetadata."
      Path="C:\testdat\repository1"/>
   </Metadata>
   <Reposid>A0000001.A0000001</Reposid>
   <NS>REPOS</NS>
   <!-- OMI_TRUSTED_CLIENT flag -->
   <Flags>268435456</Flags>
   <Options/>
 </AddMetadata>
```

In the method call:

- The <AddMetadata> element identifies the method.
- The <Metadata> element contains the metadata property string. In this string,

RepositoryBase	is the metadata type used to define a repository object.
Name	is a unique name for the repository.
Desc	is an optional description of the repository.
Path	is the path to an existing directory. The pathname must be unique and it must point to an empty directory.

- The <Reposid> element specifies the storage location. When defining creating a repository, you must specify the repository manager identifier *A0000001.A0000001*.
- The <NS> element identifies the namespace in which to process the request. The REPOS namespace contains repository metadata types.
- The <Flags> element supplies special processing instructions. The OMI_TRUSTED_CLIENT flag (268435456) is required to write a metadata object.
- The <Options> element is blank. *Options* is a required parameter in all SAS Open Metadata Interface methods; however, AddMetadata currently does not support any options.

The output from the request is returned in the DoRequest method's *outMetadata* parameter. Here is an example of the output returned by the metadata server:

```
<!-- Using the ADDMETADATA method. -->
```

```
<RepositoryBase Name="Test repository 1" Desc="Repository created to illustrate
  registering a repository using AddMetadata." Path="C:\testdat\repository1"
  Id="A0000001.A53TPPVI" Access="0"/>
```

The output string mirrors the input string; however, the metadata server assigns a two-part object identifier in the form:

```
Reposmgrid.Reposid
```

to the object in its Id attribute. *Reposmgrid* is the repository manager's unique object identifier.*Reposid* is the repository's unique object identifier. You will use the unique repository identifier in the <Reposid> element of AddMetadata calls when you create metadata objects representing application elements. You can also use the repository identifier to create relationships between repositories. For more information, see Chapter 8, "Creating Relationships Between Repositories," on page 75.

Note: Beginning in SAS 9.0, it is recommended that you register repositories in SAS Management Console instead of following the steps presented here. When you register a repository in SAS Management Console, default authorization metadata and templates to assist you in creating global metadata are also created in the repository. These items are required to secure a repository and are not available when you register a repository using the SAS Open Metadata Interface. △

Example of Creating an Application Metadata Object

The following example creates a metadata object describing a SAS library. A SAS library is represented in the SAS Metadata Model by the SASLibrary metadata type.

```
<AddMetadata>
 <Metadata>
   <SASLibrary
      Name="NW Sales"
      Desc="NW region sales data"
      Engine="base"
      IsDBMSLibname="0"
      Libref="nwsales"/>
 </Metadata>
 <Reposid>A0000001.A53TPPVI</Reposid>
 <NS>SAS</NS>
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

In this method call, note:

- The <Metadata> element specifies the metadata property string. In this string, SASLibrary is the metadata type and Name, Desc, Engine, IsDBMSLibname, and Libref are attributes of the SASLibrary metadata type.
- The <Reposid> element specifies the unique identifier of the repository in which to create the metadata object.
- The <NS> element identifies the namespace to process the request. The SAS namespace contains metadata types that define application elements.
- The <Flags> element specifies the OMI_TRUSTED_CLIENT (268435456) flag.

Here is an example of the output returned by the metadata server:

```
<!-- Using the ADDMETADATA method. -->

<SASLibrary Name="NW Sales" Desc="NW region sales data" Engine="base"
  IsDBMSLibname="0" Libref="nwsales" Id="A53TPPVI.A1000001"/>
```

The output string mirrors the input string except that a two-part object instance identifier is assigned to the new object in the form:

```
Reposid.Objectid
```

Reposid is the repository identifier.*Objectid* is the metadata object's unique object identifier. You will use this unique object identifier any time that you need to reference the metadata object. In "Example of Creating an Object and an Association to an Existing Object" on page 11, this identifier is used to create an association to the object.

Example of Creating an Object and an Association to an Existing Object

The following XML string creates a ResponsibleParty object and associates it with the SASLibrary object created in "Example of Creating an Application Metadata Object" on page 10. The ResponsibleParty metadata type is used to associate a set of Person objects with a particular role or responsibility. This ResponsibleParty object is created with the role of "Owner".

```
<AddMetadata>
 <Metadata>
   <ResponsibleParty Name="LibraryAdministrator"
      Desc="NW Region Sales Data"
      Role="Owner">
     <Objects>
       <SASLibrary ObjRef="A53TPPVI.A1000001" Name="NW Sales"/>
     </Objects>
   </ResponsibleParty>
 </Metadata>
 <Reposid>A0000001.A53TPPVI</Reposid>
 <NS>SAS</NS>
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

The <Reposid>, <NS>, and <Flags> elements contain the same values as in "Example of Creating an Application Metadata Object" on page 10. In the metadata property string, note:

- ResponsibleParty is the metadata type.
- Name, Desc, and Role are XML attributes of the ResponsibleParty metadata type.
- Objects is the association name and is specified as a nested element.
- SASLibrary is the metadata type of the associated metadata object.
- The ObjRef attribute in the association subelement instructs the metadata server to create an association to the specified object instance and also not to modify any of the object's other properties.

Here is an example of the output returned by the metadata server:

```
<!-- Using the ADDMETADATA method. -->

<ResponsibleParty Name="LibraryAdministrator" Desc="NW Region Sales Data"
  Role="Owner" Id="A53TPPVI.A2000001">
  <Objects>
    <SASLibrary ObjRef="A53TPPVI.A1000001" Name="NW Sales"/>
  </Objects>
</ResponsibleParty>
```

The output string mirrors the input string except that a two-part object instance identifier is assigned to the ResponsibleParty object.

Example of Creating Multiple, Related Metadata Objects

The following XML string creates a table object, its related column objects, and an association to a SASLibrary object in a single method call. The SAS Metadata Model supports several metadata types for describing tables. Here the PhysicalTable metadata type is used to represent a table that is materialized in a file system. A PhysicalTable object is associated to a Column object via a Columns association. The request creates four column objects that describe the contents of the table as nested subelements. A PhysicalTable object is associated to a SASLibrary object via a TablePackages association.

```
<AddMetadata>
 <Metadata>
   <PhysicalTable Name="Sales Offices" Desc="Sales offices in NW region">
     <TablePackages>
       <SASLibrary ObjRef="A53TPPVI.A1000001" Name="NW Sales"/>
     </TablePackages>
     <Columns>

      <Column
         Name="City"
         Desc="City of Sales Office"
         ColumnName="City"
         SASColumnName="City"
         ColumnType="12"
         SASColumnType="C"
         ColumnLength="32"
         SASColumnLength="32"
         SASFormat="$Char32."
         SASInformat="$32."/>

      <Column
         Name="Address"
         Desc="Street Address of Sales Office"
         ColumnName="Address"
         SASColumnName="Street_Address"
         ColumnType="12"
         SASColumnType="C"
         ColumnLength="32"
         SASColumnLength="32"
```

```
            SASFormat="$Char32."
            SASInformat="$32."/>

         <Column
            Name="Manager"
            Desc="Name of Operations Manager"
            ColumnName="Manager"
            SASColumnName="Manager"
            ColumnType="12"
            SASColumnType="C"
            ColumnLength="32"
            SASColumnLength="32"
            SASFormat="$Char32."
            SASInformat="$32."/>

         <Column
           Name="Employees"
           Desc="Number of employees"
           ColumnName="Employees"
           SASColumnName="Employees"
           ColumnType="6"
           SASColumnType="N"
           ColumnLength="3"
           SASColumnLength="3"
           SASFormat="3.2"
           SASInformat="3.2"/>
         </Columns>
       </PhysicalTable>
    </Metadata>
    <Reposid>A0000001.A53TPPVI</Reposid>
    <NS>SAS</NS>
    <Flags>268435456</Flags>
    <Options/>
   </AddMetadata>
```

The <Reposid>, <NS>, and <Flags> elements contain the same values as in "Example of Creating an Application Metadata Object" on page 10. In the metadata property string, note:

- □ The PhysicalTable metadata type is specified in the main XML element.
- □ The second element defines the TablePackages association to the SAS library. Use of the Objref attribute instructs the metadata server to create the association to the specified existing object.
- □ The column definitions are nested under the Columns association name.
- □ For each column:
  - □ the ColumnName=, ColumnType=, and ColumnLength= attributes describe the names and values of the items in a DBMS
  - □ the SASColumnName=, SASColumnType=, and SASColumnLength= attributes indicate their corresponding values in a SAS table
  - □ A ColumnType value of 12 indicates VARCHAR; a ColumnType value of 6 indicates FLOAT.

  For more information about the properties defined for the PhysicalTable and Column metadata types, see their descriptions in the "Alphabetical Listing of SAS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. This listing is available only in online versions of the reference. See *SAS Help and Documentation* or *SAS OnlineDoc*.

Here is an example of the output returned by the metadata server:

```
<!-- Using the ADDMETADATA method. -->

<PhysicalTable Name="Sales Offices" Desc="Sales offices in NW region"
 Id="A53TPPVI.A4000001">
 <TablePackages>
  <SASLibrary ObjRef="A53TPPVI.A1000001" Name="NW Sales"/>
 </TablePackages>
 <Columns>
  <Column Name="City" Desc="City of Sales Office" ColumnName="City"
    SASColumnName="City"  ColumnType="12" SASColumnType="C" ColumnLength="32"
    SASColumnLength="32" SASFormat="$Char32." SASInformat="$32."
    Id="A53TPPVI.A5000001">
    <Table>
     <PhysicalTable ObjRef="A53TPPVI.A4000001"/>
    </Table>
  </Column>
  <Column Name="Address" Desc="Street Address of Sales Office"
    ColumnName="Address" SASColumnName="Street_Address" ColumnType="12"
    SASColumnType="C" ColumnLength="32" SASColumnLength="32" SASFormat="$Char32."
    SASInformat="$32." Id="A53TPPVI.A5000002">
    <Table>
     <PhysicalTable ObjRef="A53TPPVI.A4000001"/>
    </Table>
  </Column>
  <Column Name="Manager" Desc="Name of Operations Manager" ColumnName="Manager"
    SASColumnName="Manager" ColumnType="12" SASColumnType="C" ColumnLength="32"
    SASColumnLength="32" SASFormat="$Char32." SASInformat="$32."
    Id="A53TPPVI.A5000003">
    <Table>
     <PhysicalTable ObjRef="A53TPPVI.A4000001"/>
    </Table>
  </Column>
  <Column Name="Employees" Desc="Number of employees" ColumnName="Employees"
    SASColumnName="Employees" ColumnType="6" SASColumnType="N" ColumnLength="3"
    SASColumnLength="3" SASFormat="3.2" SASInformat="3.2" Id="A53TPPVI.A5000004">
    <Table>
     <PhysicalTable ObjRef="A53TPPVI.A4000001"/>
    </Table>
  </Column>
</Columns>
</PhysicalTable>
```

The output string mirrors the input string except that a two-part object instance identifier is assigned to each new metadata object.

Example of Creating Multiple, Unrelated Metadata Objects

The following method calls shows another way to format an AddMetadata request that creates multiple objects. The request creates a second table object, named “Sales

Associates", and creates objects representing the table's columns by stacking their metadata property strings. A Column object cannot be created without an association to a table object. Therefore, a symbolic name is assigned to the PhysicalTable object to enable the column objects to reference the PhysicalTable object before it is created.

```
<AddMetadata>
 <Metadata>
 <PhysicalTable Id="$Employees" Name="Sales Associates"
     Desc="Sales associates in NW region">
     <TablePackages>
       <SASLibrary ObjRef="A53TPPVI.A1000001" Name="NW Sales"/>
     </TablePackages>
   </PhysicalTable>

   <Column
      Name="Name"
      Desc="Name of employee"
      ColumnName="Employee_Name"
      SASColumnName="Employee"
      ColumnType="12"
      SASColumnType="C"
      ColumnLength="32"
      SASColumnLength="32"
      SASFormat="$Char32."
      SASInformat="$32.">
      <Table>
         <PhysicalTable ObjRef="$Employees"/>
      </Table>
    </Column>

    <Column
      Name="Address"
      Desc="Home Address"
      ColumnName="Employee_Address"
      SASColumnName="Home_Address"
      ColumnType="12"
      SASColumnType="C"
      ColumnLength="32"
      SASColumnLength="32"
      SASFormat="$Char32."
      SASInformat="$32.">
      <Table>
         <PhysicalTable ObjRef="$Employees"/>
      </Table>
    </Column>

    <Column
      Name="Title"
      Desc="Job grade"
      ColumnName="Title"
      SASColumnName="Title"
      ColumnType="12"
      SASColumnType="C"
      ColumnLength="32"
      SASColumnLength="32"
```

```
          SASFormat="$Char32."
          SASInformat="$32.">
          <Table>
             <PhysicalTable ObjRef="$Employees"/>
          </Table>
        </Column>

     </Metadata>
     <Reposid>A0000001.A53TPPVI</Reposid>
     <NS>SAS</NS>
     <Flags>268435456</Flags>
     <Options/>
    </AddMetadata>
```

The <Reposid>, <NS>, and <Flags> elements contain the same values as in "Example of Creating an Application Metadata Object" on page 10. In the <Metadata> element, note:

- □ There are multiple metadata property strings, stacked one after the other.
- □ The metadata property string defining the PhysicalTable metadata type is the top-most string. This property string includes an Id attribute that assigns the symbolic name $Employees.
- □ A separate metadata property string is used to define each Column object.
- □ The Column definitions each define a Table association to the PhysicalTable by specifying the Objref attribute and referencing the symbolic name $Employees.

Here is an example of the output returned by the metadata server:

```
<!-- Using the ADDMETADATA method. -->

<PhysicalTable Id="A53TPPVI.A4000002" Name="Sales Associates"
  Desc="Sales associates in NW region">
 <TablePackages>
  <SASLibrary ObjRef="A53TPPVI.A1000001" Name="NW Sales"/>
 </TablePackages>
</PhysicalTable>
<Column Name="Name" Desc="Name of employee" ColumnName="Employee_Name"
  SASColumnName="Employee" ColumnType="12" SASColumnType="C" ColumnLength="32"
  SASColumnLength="32" SASFormat="$Char32." SASInformat="$32." Id="A53TPPVI.A5000005">
  <Table>
   <PhysicalTable ObjRef="A53TPPVI.A4000002"/>
  </Table>
</Column>
<Column Name="Address" Desc="Home Address" ColumnName="Employee_Address"
  SASColumnName="Home_Address" ColumnType="12" SASColumnType="C" ColumnLength="32"
  SASColumnLength="32" SASFormat="$Char32." SASInformat="$32." Id="A53TPPVI.A5000006">
  <Table>
   <PhysicalTable ObjRef="A53TPPVI.A4000002"/>
  </Table>
</Column>
<Column Name="Title" Desc="Job grade" ColumnName="Title" SASColumnName="Title"
  ColumnType="12" SASColumnType="C" ColumnLength="32" SASColumnLength="32"
  SASFormat="$Char32." SASInformat="$32." Id="A53TPPVI.A5000007">
  <Table>
   <PhysicalTable ObjRef="A53TPPVI.A4000002"/>
  </Table>
</Column>
```

Note that the symbolic name is replaced by with the PhysicalTable object's unique object identifier in the output.

Creating a Metadata Object and an Association to an Object in Another Repository

Before a reference can be created between two repositories, a relationship must have been defined between the repositories. This topic contains two AddMetadata requests:

- □ The first request creates a second repository and defines a dependency association to the repository created in "Example of Creating a Repository Object" on page 9.
- □ The second request creates a Person object in the new repository, and associates the Person object with the ResponsibleParty object created in "Example of Creating an Object and an Association to an Existing Object" on page 11. A Person object has a Responsibilities association to a ResponsibleParty object.

For more information about defining relationships between repositories, see Chapter 8, "Creating Relationships Between Repositories," on page 75.
This requests creates the second repository:

```
<AddMetadata>
  <Metadata>
    <RepositoryBase
      Name="Test repository 2"
      Desc="Second test repository."
      Path="C:\testdat\repository2">
      <DependencyUses>
       <RepositoryBase ObjRef="A0000001.A53TPPVI" Name="Test repository 1"/>
      </DependencyUses>
    </RepositoryBase>
   </Metadata>
   <Reposid>A0000001.A0000001</Reposid>
   <NS>REPOS</NS>
   <!-- OMI_TRUSTED_CLIENT flag -->
   <Flags>268435456</Flags>
   <Options/>
</AddMetadata>
```

In the request, note:

- □ The <Metadata> element specifies the RepositoryBase metadata type and defines a DependencyUses association to another RepositoryBase object.
- □ The subelement defining the second RepositoryBase object specifies the unique repository identifier of Test repository 1 in the Objref attribute.
- □ The <Reposid> element specifies the repository manager identifier.
- □ The <NS> element specifies the REPOS namespace.
- □ The <Flags> parameter specifies the OMI_TRUSTED_CLIENT flag (268435456).

Here is an example of the output returned by the metadata server:

```
<!-- Using the ADDMETADATA method. -->

<RepositoryBase Name="Test repository 2" Desc="Second test repository."
  Path="C:\testdat\repository2" Id="A0000001.A5KD78HW" Access="0">
  <DependencyUses>
    <RepositoryBase ObjRef="A0000001.A53TPPVI" Name="Test repository 1"/>
  </DependencyUses>
</RepositoryBase>
```

Note that the Test repository 2 has the unique repository identifier A0000001.A5KD78HW.

The following AddMetadata request creates the Person object in Test repository 2.

```
<AddMetadata>
 <Metadata>
    <Person Name="John Doe" Desc="NW Region DB Administrator">
       <Responsibilities>
        <ResponsibleParty ObjRef="A53TPPVI.A2000001" Name="LibraryAdministrator"/>
       </Responsibilities>
    </Person>
 </Metadata>
 <Reposid>A0000001.A5KD78HW</Reposid>
 <NS>SAS</NS>
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

In this request, note the following:

- □ The <Metadata> subelement that defines the Responsibilities association to the ResponsibleParty object specifies the Objref attribute.
- □ The Objref attribute specifies the unique repository identifier assigned to Test repository 1 in the target object's identifier.
- □ The <Reposid> element specifies the unique repository identifier assigned to Test repository 2.

Here is an example of the output returned by the metadata server:

```
<!-- Using the ADDMETADATA method. -->

<Person Name="John Doe" Desc="NW Region DB Administrator" Id="A5KD78HW.A1000001">
 <Responsibilities>
   <ResponsibleParty ObjRef="A53TPPVI.A2000001" Name="LibraryAdministrator"/>
 </Responsibilities>
</Person>
```

Person object A5KD78HW.A1000001 was successfully created in repository A0000001.A5KD78HW.

Additional Information

For more information about the metadata types used in these examples, see the "Alphabetical Listing of SAS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. This listing is available only in online versions of the reference. For reference information about the AddMetadata method, see "AddMetadata" in "Methods for Reading and Writing Metadata (IOMI Class)" in the reference.

CHAPTER

3

Updating Metadata Objects

Overview of Updating Metadata **19**
Using the UpdateMetadata Method **20**
Function= Attribute **21**
Associated Object Identifier and Value **22**
Examples **23**
Summary of Function Directives **23**
Associated Object Identifier Summary **24**
Deleting Associations **24**
Example of Modifying a Metadata Object's Attributes **24**
Example of Modifying an Association **25**
Example of Merging Associations **26**
Example of Deleting an Association **28**
Example of Appending Associations **29**
Additional Information **30**

Overview of Updating Metadata

The SAS Open Metadata Interface provides the UpdateMetadata method for updating the properties of an existing metadata object. Using the UpdateMetadata method, you can

- modify an existing metadata object's attributes
- add an association between two existing metadata objects
- add an association between the existing metadata object and a new metadata object
- modify an associated object's properties.
- delete an association.

The UpdateMetadata method does not allow you to directly create new objects. For information about directly creating a metadata object, see Chapter 2, "Adding Metadata Objects," on page 5. UpdateMetadata can only add associated objects indirectly as a result of defining an association.

The UpdateMetadata method also cannot be used to directly delete a metadata object. The UpdateMetadata method might indirectly delete dependent objects in order to enforce cardinality rules when an association is deleted. For example, if a table is updated to remove an association to a given column, then the column object, which is dependent on the table, will be deleted as well. However, a column cannot be updated to remove its association to a table and be deleted. For information to directly delete a metadata object, see Chapter 4, "Deleting Metadata Objects," on page 31.

Using the UpdateMetadata Method

The UpdateMetadata method enables you to add or modify any attribute or association in the metadata type documentation that is not marked as “required for add.” An association that is marked as “required for add” typically indicates the object is a dependent object. A dependent object cannot be modified. To modify the properties of a dependent metadata object, you must delete the object and create a new one with the desired properties.

To modify an object’s attributes, specify the metadata object, the attributes that you want to modify, and their new values in a metadata property string and submit it to the UpdateMetadata method in the <Metadata> parameter. The following is an example of an UpdateMetadata method call that is formatted for the DoRequest method.

```
<UpdateMetadata>
  <Metadata>
    <Metadata_Type Id="reposid.objectid" Attribute1="new_value"
                   Attribute2="new_value" Attribute3="new_value"/>
  </Metadata>
  <NS>SAS</NS>
  <--- OMI_TRUSTED_CLIENT Flag --->
  <Flags>268435456</Flags>
  <Options/>
</UpdateMetadata>
```

In the request, note the following:

- The <Metadata> parameter identifies the metadata type, the object instance, and the attributes that you want to modify. A two-part object instance identifier is used in the object definition to identify the repository in which to execute the request. Attribute1, Attribute2, and Attribute3 are metadata type attributes. The new values specified for these attributes will replace any existing values in the repository and any unmodified attributes will remain unchanged.
- The <NS> parameter specifies the namespace in which to process the request.
- The OMI_TRUSTED_CLIENT (268435456) flag is required to update the metadata object.

To add, modify, or delete an association, or to modify an associated object’s attributes, specify an association name element and associated object definition in the metadata property string. Include in the association name element the appropriate Function directive and in the associated object definition the appropriate identifier and value as follows:

```
<UpdateMetadata>
  <Metadata>
    <MetadataType Id="reposid.objectid">
       <AssociationName Function="directive">
         <AssociatedMetadataType Id |Objref="value"/>
       </AssociationName>
    </MetadataType>
  </Metadata>
  <NS>SAS</NS>
  <--- OMI_TRUSTED_CLIENT Flag --->
  <Flags>268435456</Flags>
  <Options/>
</UpdateMetadata>
```

In this request, note the following:

- □ The <Metadata> parameter identifies the metadata type, the object instance, and the association name and associated object definition that you want to modify.
- □ The association name element specifies a Function= attribute which specifies a directive that tells the metadata server how to process the associated object definition, depending on whether the association name supports a single or a multiple association.
- □ The associated object definition supports a choice of object identifiers and values. The type of object identifier that you specify in the associated object definition determines whether to create the associated object, to modify its properties, or to simply add an association.
- □ The <NS> parameter specifies the namespace in which to process the request.
- □ The OMI_TRUSTED_CLIENT (268435456) flag is required to update the metadata object.

Function= Attribute

Supported only in the association name element of a metadata property string that is passed to the UpdateMetadata method, the Function= attribute instructs the metadata server how to process the associated object definitions submitted for the association name, depending on whether the association is a single or a multiple association.

A *single association* refers to an association name that has a 0 to 1 or 1 to 1 cardinality defined for it in the metadata type documentation. This means that only one association of that name is supported between the specified metadata types.

A *multiple association* refers to an association name that has a 0 to many or 1 to many cardinality (denoted as 0 to * and 1 to * in the metadata types documentation) and supports many associations between the specified metadata types.

The Function= attribute supports the directives shown in Function Directives Supported by the UpdateMetadata Method. If the Function= attribute is omitted from an UpdateMetadata request, Modify is the default directive for a single association and Merge is the default directive for a multiple association.

Table 3.1 Function Directives Supported by the UpdateMetadata Method

Directive	Supported for Single Associations?	Supported for Multiple Associations?	Description
Append	No	Yes	Appends the specified associations to the specified object's association element list without modifying any of the other associations on the list.
Merge	Yes	Yes	Adds or modifies associations in the specified object's association list as necessary.

Directive	Supported for Single Associations?	Supported for Multiple Associations?	Description
Modify	Yes	No	Modifies an existing association or adds an association if an association does not already exist.
Replace	Yes	Yes	*Single:* Overwrites an existing association with the specified association. *Multiple:* Replaces the existing association list with the specified association list. Any existing associations that are not represented in the new association list are deleted.
Remove	Yes	Yes	Deletes the specified associations from the specified object's association list without modifying any of the other associations in the list.

Associated Object Identifier and Value

The following table describes the identifiers and values that are supported in an associated object definition and their behavior when used in the UpdateMetadata method.

Table 3.2 Identifiers and Values Supported in an Associated Object Definition

Identifier and Value	Result
Id="", Id="*SymbolicName*", or no identifier	Creates an association and the associated object. For more information about symbolic names, see "Symbolic Names" on page 8.
Id="*real_value*"	Modifies the specified object with the specified properties, if the object is found. If the object is not found, the requested update fails.
ObjRef="*real_value*"	Creates an association to, but does not modify the properties of the specified object, if the object is found. If the object is not found, the requested update fails.

Examples

The following is an example of an association name element and an associated object definition that adds an association to an existing object in the same repository:

```
<AssociationName Function="Directive">
  <AssociatedMetadataType Objref="Objectid" Name="Name"/>
</AssociationName>
```

Note the use of the Objref attribute and an object identifier in the associated object definition.

The following is an example of an association name element and an associated object definition that adds an association and a new object in the same repository:

```
<AssociationName Function="Directive">
  <AssociatedMetadataType Id="" Name="Name"/>
</AssociationName>
```

Note the use of the Id attribute with a null value in the associated object definition. Another way to create the associated object is to omit an object identifier from the associated object definition.

The following is an example of an association name element and an associated object definition that modifies an existing associated object in the same repository:

```
<AssociationName Function="Directive">
  <AssociatedMetadataType Id="Objectid" Name="Name"
    Desc="This is a new description for this associated object."/>
</AssociationName>
```

Note the use of the Id attribute with a real object identifier in the associated object definition.

To create an association to an existing object in another repository using the UpdateMetadata method, specify the ObjRef attribute and include the object's repository identifier in the object instance identifier of the associated object definition. For example:

```
<AssociationName Function="Directive">
  <AssociatedMetadataType Objref="Reposid.Objectid" Name="Name"/>
</AssociationName>
```

To create an association and a new object in another repository, specify the Id attribute, a repository identifier and a symbolic name in the object instance identifier of the associated object definition. For example:

```
<AssociationName Function="Directive">
  <AssociatedMetadataType Id="Reposid.SymbolicName" Name="Name"/>
</AssociationName>
```

Summary of Function Directives

- To add associations to an existing association element list without modifying the properties of the existing associated objects, specify Function="Append".
- To add new associations and modify the properties of the existing associated objects as necessary, specify Function="Merge".
- To overwrite an existing association or association list with a new association or association list, specify Function="Replace".

- To remove an association without modifying any other associations in an existing association list, specify Function="Remove".
- To modify the properties of the associated object in a single association, specify Function="Modify".

Associated Object Identifier Summary

- To add an association and create the associated object, either omit the Id attribute or specify a null or symbolic identifier (Id="" or Id="*SymbolicName*") in the associated object definition and define properties for the associated object.
- To add an association to an existing object, specify the associated object's unique instance identifier in the ObjRef attribute. The ObjRef attribute will prevent you from updating any of the object's other properties.
- To add an association to an existing object and modify the associated object's properties, specify the associated object's unique instance identifier in the Id attribute and specify the attributes to be modified.

Deleting Associations

To delete an association, specify the Replace or Remove directives in the Function= attribute of the association name element.

- The Replace directive replaces any existing associations with the specified association object definition or list of association object definitions. Use this directive with care to prevent accidentally overwriting associations that you want to keep.
- The Remove directive removes the association to the specified associated object definition from the list of associations maintained for that association name without affecting other associations.

Deleting an association does not delete the associated object, unless the associated object is a dependent object. A dependent object is one that requires an association to another metadata object in order to exist. Metadata types that have required associations are noted in the metadata type documentation as having a 1 to 1 cardinality in their Associations table.

If you wish to delete an object's associated objects in addition to its associations, you must delete each object individually using the DeleteMetadata method. For more information, see Chapter 4, "Deleting Metadata Objects," on page 31.

The UpdateMetadata method does not include dependent objects that it might have deleted in its output as a matter of course. To print the dependent objects deleted by an update operation, set the OMI_RETURN_LIST (1024) flag in the UpdateMetadata request.

For an example of deleting an association, see "Example of Deleting an Association" on page 28.

Example of Modifying a Metadata Object's Attributes

The following is an example of an UpdateMetadata request that modifies an object's attributes. The specified attributes and values will replace those stored for the object of the specified metadata type and object instance identifier.

Note: The SAS Open Metadata Interface supports two call interfaces. This and other examples in this section are formatted for the DoRequest method. For more information, see "Call Interfaces" in the *SAS Open Metadata Interface: Reference*. △

```
<UpdateMetadata>
   <Metadata>
      <SASLibrary
        Id="A53TPPVI.A1000001"
        Engine="oracle"
        IsDBMSLibname="1"/>
   </Metadata>
   <NS>SAS</NS>
   <!-- OMI_TRUSTED_CLIENT flag -->
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

In the request, note the following:

□ The Id attribute is used in the main element and it specifies a real value. If the object is not found, the request will fail.

□ The request submits new values for SASLibrary object A53TPPVI.A1000001's Engine and IsDBMSLibname attributes. Unmodified attributes will remain unchanged.

Example of Modifying an Association

The following is an example of an UpdateMetadata request that adds a single association (one that has a 0 to 1 or 1 to 1 cardinality in the metadata type documentation). PhysicalTable object A53TPPVI.A4000001 is updated to add a PrimaryPropertyGroup association to a PropertyGroup object. A PhysicalTable object has a 0 to 1 cardinality to a PropertyGroup object in a PrimaryPropertyGroup association.

```
<UpdateMetadata>
   <Metadata>
      <PhysicalTable Id="A53TPPVI.A4000001">
         <PrimaryPropertyGroup Function="Modify">
            <PropertyGroup Id="" Name="Read Options"/>
         </PrimaryPropertyGroup>
      </PhysicalTable>
   </Metadata>
   <NS>SAS</NS>
   <!-- OMI_TRUSTED_CLIENT Flag -->
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

In the request, note the following:

□ The main element specifies the Id attribute with a real value.

□ The association name element (PrimaryPropertyGroup) specifies the Function attribute with the Modify directive, which is required to modify single associations.

□ Use of the Id attribute in the associated object definition with a null value instructs the metadata server to create the PrimaryPropertyGroup association and the required PropertyGroup object if they do not already exist, and to modify the properties of the PropertyGroup object if it does exist.

To replace an existing PrimaryPropertyGroup association with a new one, you would need to specify Function="Replace".

Example of Merging Associations

The following Update examples illustrate the use of the Merge directive. Merge is the default directive for multiple associations when the Function attribute is omitted from an UpdateMetadata request. It is useful for adding and modifying associations without fear of overwriting any existing associations.

The first example adds UniqueKey and ForeignKey associations to the table objects created in Chapter 2, "Adding Metadata Objects," on page 5. The update request consists of two main parts:

- It adds a UniqueKeys association to PhysicalTable A53TPPVI.A4000002 and identifies the table's Name column (A53TPPVI.A5000005) as the keyed column.
- It associates the UniqueKey with PhysicalTable A53TPPVI.A4000001 by creating a ForeignKeys association. The ForeignKey object identifies the table's Employees column (A53TPPVI.A5000004) as its keyed column.

```
<UpdateMetadata>
   <Metadata>
      <PhysicalTable Id="A53TPPVI.A4000002">
         <UniqueKeys Function="Merge">
            <UniqueKey Id="" Name="Sales Associates in NW Region">
              <KeyedColumns Function="Merge">
                <Column Objref="A53TPPVI.A5000005" Name="Name"/>
              </KeyedColumns>
              <ForeignKeys Function="Merge">
                <ForeignKey Id="" Name="Link to Sales Associates table">
                  <Table>
                    <PhysicalTable Objref="A53TPPVI.A4000001"
                                   Name="Sales offices in NW Region"/>
                  </Table>
                  <KeyedColumns Function="Merge">
                    <Column Objref="A53TPPVI.A5000004" Name="Employees"/>
                  </KeyedColumns>
                </ForeignKey>
             </ForeignKeys>
           </UniqueKey>
        </UniqueKeys>
      </PhysicalTable>
   </Metadata>
   <NS>SAS</NS>
   <!-- OMI_TRUSTED_CLIENT Flag -->
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

In the request, note the following:

- The Id attribute in the main element specifies a real value.
- The null Id values in the <UniqueKey> and <ForeignKey> subelements instruct the to create new, associated objects.

- The ObjRef attribute in the <Column> element specifies to create an association to an existing object.
- The Function directive in the <UniqueKeys>, <KeyedColumns>, and <ForeignKeys> association elements specifies to merge the new associations with any existing associations defined in the association lists of the specified tables and columns. Merge is the default directive for multiple associations, so the directives could have been omitted from the request.
- The Table association is a single association. The default directive for single associations is Modify, which will modify an existing association or add it if the association does not exist. Use of the Objref attribute prevents the table's other attributes from being modified.

Here is an example of the output returned by the metadata server:

```
<!-- Using the UPDATEMETADATA method. -->

<PhysicalTable Id="A53TPPVI.A4000002">
<UniqueKeys>
<UniqueKey Id="A53TPPVI.A8000001" Name="Sales Associates in NW Region">
<KeyedColumns>
<Column Objref="A53TPPVI.A5000005" Name="Name"/>
</KeyedColumns>
<ForeignKeys>
<ForeignKey Id="A53TPPVI.A9000001" Name="Link to Sales Associates table">
<Table>
<PhysicalTable Objref="A53TPPVI.A4000001" Name="Sales offices in NW Region"/>
</Table>
<KeyedColumns>
<Column Objref="A53TPPVI.A5000004" Name="Employees"/>
</KeyedColumns>
<PartnerUniqueKey>
<UniqueKey ObjRef="A53TPPVI.A8000001"/>
</PartnerUniqueKey>
</ForeignKey>
</ForeignKeys>
<Table>
<PhysicalTable ObjRef="A53TPPVI.A4000002"/>
</Table>
</UniqueKey>
</UniqueKeys>
</PhysicalTable>
```

The request created seven associations and two new objects (UniqueKey and ForeignKey).

The following example updates the UniqueKey object created in the previous request to modify the Name attribute of the keyed column and to add an association to a second keyed column.

```
<UpdateMetadata>
   <Metadata>
      <UniqueKey Id="A53TPPVI.A8000001">
         <KeyedColumns>
             <Column Id="A53TPPVI.A5000005" Name="EmployeeName"/>
             <Column Objref="A53TPPVI.A5000006" Name="Address"/>
          </KeyedColumns>
      </UniqueKey>
   </Metadata>
   <NS>SAS</NS>
   <!-- OMI_TRUSTED_CLIENT Flag -->
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

In the request, note the use of the Id and Objref attributes.

- □ Use of the Id attribute to identify the original keyed column allows the column's properties to be updated.
- □ Use of the Objref attribute to identify the newly associated column creates the association and does not modify any of the column object's other attributes.
- □ A function directive is omitted from the request because KeyedColumns is a multiple association and the default value of Merge is appropriate for the operation.

Here are the results of a GetMetadata request that lists the UniqueKey object's KeyedColumns associations:

```
<!-- Using the GETMETADATA method. -->

<UniqueKey Id="A53TPPVI.A8000001" Name="Sales Associates in NW Region">
<KeyedColumns>
<Column Id="A53TPPVI.A5000005" Name="EmployeeName" Desc="Name of employee"/>
<Column Id="A53TPPVI.A5000006" Name="Address" Desc="Home Address"/>
</KeyedColumns>
</UniqueKey>
```

Column A53TPPVI.A5000005's Name attribute was changed from "Name" to "EmployeeName."

Example of Deleting an Association

The following example deletes the keyed column association added in the second example of "Example of Merging Associations" on page 26.

```
<UpdateMetadata>
  <Metadata>
     <UniqueKey Id="A53TPPVI.A8000001">
       <KeyedColumns Function="Remove">
           <Column Id="A53TPPVI.A5000006" Name="Address"/>
       </KeyedColumns>
     </UniqueKey>
  </Metadata>
  <NS>SAS</NS>
  <!-- OMI_TRUSTED_CLIENT Flag -->
  <Flags>268435456</Flags>
  <Options/>
</UpdateMetadata>
```

The Function="Remove" directive instructs the server to remove the specified association from the UniqueKey object's KeyedColumns association list. If Function="Replace" had been specified, the existing KeyedColumns association list would have been replaced with the specified association.

Here are the results of a GetMetadata call that requests a revised list of the UniqueKey object's KeyedColumns associations:

```
<!-- Using the GETMETADATA method. -->

<UniqueKey Id="A53TPPVI.A8000001" Name="Sales Associates in NW Region">
<KeyedColumns>
<Column Id="A53TPPVI.A5000005" Name="EmployeeName" Desc="Name of employee"/>
</KeyedColumns>
</UniqueKey>
```

Example of Appending Associations

The following example adds an association and a new Column object to PhysicalTable A53TPPVI.A4000002 using the Append directive.

```
<UpdateMetadata>
   <Metadata>
      <PhysicalTable Id="A53TPPVI.A4000002">
         <Columns Function="Append">
             <Column Id="" Name="Salary"/>
         </Columns>
      </PhysicalTable>
   </Metadata>
   <NS>SAS</NS>
   <!-- OMI_TRUSTED_CLIENT Flag -->
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

In the example, the null Id value in the associated object definition indicates the associated object is to be created. Here is an example of the output returned by the metadata server:

```
<!-- Using the UPDATEMETADATA method. -->

<PhysicalTable Id="A53TPPVI.A4000002">
<Columns Function="Append">
<Column Id="A53TPPVI.A500002U" Name="Salary">
<Table>
<PhysicalTable ObjRef="A53TPPVI.A4000002"/>
</Table>
</Column>
</Columns>
</PhysicalTable>
```

The association to the new object is added to the existing association list without affecting other associated objects. Here is the output of a GetMetadata request that lists the Column objects associated with PhysicalTable A53TPPVI.A4000002.

```
<!-- Using the GETMETADATA method. -->

<PhysicalTable Id="A53TPPVI.A4000002" Name="Sales Associates">
<Columns>
```

```
<Column Id="A53TPPVI.A5000005" Name="EmployeeName" Desc="Name of employee"/>
<Column Id="A53TPPVI.A5000006" Name="Address" Desc="Home Address"/>
<Column Id="A53TPPVI.A5000007" Name="Title" Desc="Job grade"/>
<Column Id="A53TPPVI.A500002U" Name="Salary" Desc=""/>
</Columns>
</PhysicalTable>
```

Additional Information

For reference information about the UpdateMetadata method, see “UpdateMetadata” in “Methods for Reading and Writing Metadata (IOMI Class)” in the *SAS Open Metadata Interface: Reference*.

CHAPTER

4

Deleting Metadata Objects

Overview of Deleting Metadata **31**
Deleting a Repository **32**
Example of Deleting a Metadata Object **32**
Additional Information **33**

Overview of Deleting Metadata

A metadata object is deleted by using the DeleteMetadata method. The DeleteMetadata method does not allow for deletion of specific properties. To delete a metadata object's properties, you must use the UpdateMetadata method. For more information, see Chapter 3, "Updating Metadata Objects," on page 19.

To delete a metadata object, you must submit a metadata property string that identifies the metadata object to the DeleteMetadata method. The property string must specify the object's two-part object instance identifier (*Reposid.Objectid*), so that the metadata server knows in which repository to process the request. You must also specify the OMI_TRUSTED_CLIENT (268436480) flag in the request. This flag is required to write to a SAS metadata repository.

When a metadata object is deleted, all of its associations and dependent objects are automatically deleted as well. A dependent object is one that requires an association to another metadata object in order to exist. Metadata types that have required associations are noted in the metadata type documentation as having a 1 to 1 cardinality in their Associations table. An example of a dependent object is a Column object. A Column object cannot exist without an association to a table object. When a table object is deleted, all of its associated Column objects are deleted as well. This is referred to as a "cascading delete".

Cardinality rules are enforced on the current repository and on any repositories on which the current repository depends. That is, when a delete request is received, the metadata server will delete both dependent objects found in the current repository and in any repositories to which the repository has a DependencyUses association. If any dependent objects exist in repositories to which the target repository has a DependencyUsedBy association, you will need to delete these objects directly. For more information about repository dependencies, see Chapter 8, "Creating Relationships Between Repositories," on page 75.

You can identify associated objects that exist in repositories that have a DependencyUsedBy association by issuing a GetMetadata request that sets the OMI_ALL (1) and the OMI_DEPENDENCY_USED_BY (16384) flags before deleting a metadata object. These flags will list the Id and Name attributes of all objects associated with the specified metadata object in all repositories to which the host repository has a relationship. Then use the metadata type documentation to determine which associations are to dependent objects.

In addition, you might want to identify metadata objects that have a 0 to 1 cardinality. Objects that have this cardinality are associated only with the metadata object to be deleted, but can exist on their own. An example of such an object is a Note defined for a PhysicalTable. Any associated Note objects will remain in a repository after a PhysicalTable object is deleted, even though they might have been created solely to describe the PhysicalTable object.

The DeleteMetadata method does not include dependent objects that it might have deleted in its output as a matter of course. To print the dependent objects deleted by a delete operation, set the OMI_RETURN_LIST (1024) flag in the DeleteMetadata request. OMI_RETURN_LIST returns a complete list of deleted object Ids.

Multiple metadata objects can be deleted in a DeleteMetadata request by stacking the metadata property strings that identify them in the <Metadata> element. The following is an example of a DeleteMetadata request that stacks metadata property strings:

```
<DeleteMetadata>
  <Metadata>
    <MetadataType1 Id="Reposid.Objectid" Name="Name"/>
    <MetadataType2 Id="Reposid.Objectid" Name="Name"/>
    <MetadataType3 Id="Reposid.Objectid" Name="Name"/>
  </Metadata>
  <!--- OMI_TRUSTED_CLIENT Flag --->
<NS>SAS</NS>
<Flags>268436480</Flags>
 <Options/>
</DeleteMetadata>
```

Nested deletions are not supported. That is, the DeleteMetadata method does not allow you to specify associated objects to be deleted, unless you identify them in the method call as shown above.

CAUTION:

The DeleteMetadata method is destructive. Its changes cannot be reversed. When using this method, verify the delete request before issuing the method call. △

Deleting a Repository

The method call for deleting a repository is formatted similarly to a method call deleting an application metadata object with two exceptions. To delete a repository, you specify:

- □ the REPOS namespace
- □ one of several flags that indicate whether you want to delete the whole repository, simply clear the repository's contents, or whether you only want to unregister the repository.

For more information, see "Clearing or Deleting a Repository" on page 129.

Example of Deleting a Metadata Object

The following is an example of DeleteMetadata request that deletes a SASLibrary object and a PhysicalTable object.

```
<DeleteMetadata>
 <Metadata>
    <SASLibrary Id="A7654321.A2000001"/>
    <PhysicalTable Id="A7654321.A400000C"/>
 </Metadata>
<NS>SAS</NS>
<!--OMI_TRUSTED_CLIENT flag-->
<Flags>268436480</Flags>
<Options/>
</DeleteMetadata>
```

The request deletes the specified objects and any Column objects associated with the PhysicalTable that exist in both the current repository and any repositories on which the current repository depends.

Additional Information

For reference information about the DeleteMetadata method, see "DeleteMetadata" in "Methods for Reading and Writing Metadata (IOMI Class)" in the *SAS Open Metadata Interface: Reference*.

PART 2

Using the Interface to Query Metadata

Chapter **5**. . . . . **Overview** *37*

Chapter **6**. . . . . **Querying All Metadata of a Specified Type** *43*

Chapter **7**. . . . . **Querying Specific Metadata Objects** *61*

CHAPTER 5

Overview

Overview of Querying Metadata Objects **37**
Namespaces **37**
Repositories **37**
Metadata Objects **38**
Example of Listing the Metadata Types in a Namespace **38**
Listing a Metadata Type's Subtypes **39**
Listing the Available Repositories **39**
Listing the Metadata Types in a Repository **40**

Overview of Querying Metadata Objects

The SAS Open Metadata Interface provides methods to get information about namespaces, repositories, and metadata objects.

Namespaces

A *namespace* refers to the metadata model that can be accessed by the SAS Metadata Server. The SAS Open Metadata Interface defines two namespaces:

- The REPOS namespace contains repository metadata types.
- The SAS namespace contains all other metadata types.

Other applications might define additional metadata types in special-purpose namespaces.

The GetNamespaces method enables you to identify the namespaces defined in a particular repository manager. If a special-purpose namespace has been defined, you can use the SAS Open Metadata Interface GetTypes and GetTypeProperties methods to list the types in the namespace and their properties. Then you can use the GetSubtypes and IsSubtypeOf methods to determine the type hierarchy, if one exists. Together, these methods are referred to as *management methods* because they enable you to get information about the metadata environment. This information provides useful background information when preparing to create metadata objects.

For usage information, see "Example of Listing the Metadata Types in a Namespace" on page 38.

Repositories

A *repository* is a collection of metadata that is stored and can be accessed from a central location. However, before you can store metadata in a repository, you must store metadata about the repository itself, including information about its physical location, the engine used to access the data, and other pertinent details. Creation of a repository metadata object *registers* the repository in the repository manager and enables the repository to be accessed by the SAS Open Metadata Interface.

You can determine the repositories that have been registered in a repository manager by using the GetRepositories method. The GetRepositories method lists the repository identifier and name of the repositories registered in a particular repository manager. A repository identifier is required to add metadata to a repository. For usage information, see “Listing the Available Repositories” on page 39.

You might also want to query a repository for the following reasons:

- □ to identify the repository’s relationships with other repositories
- □ to determine the repository’s current state and default access mode.

See “Querying Dependency Associations” on page 81 for instructions to query a repository’s relationships with other repositories. A repository’s current state and access mode is obtained by using the GetRepositories method and setting the OMI_ALL flag (1). For instructions, see “Listing the Available Repositories” on page 39.

Metadata Objects

A *metadata object* consists of a group of attributes and associations that uniquely describe a particular entity. The entity can be an application element or a repository. The SAS Open Metadata Interface provides two methods for reading metadata objects:

- □ the GetMetadata method is provided to query the properties of a specific metadata object instance
- □ the GetMetadataObjects method is provided to query all metadata of a specified metadata type.

The methods support flags and options that enable you to expand or to filter your query requests. For usage information, see Chapter 6, “Querying All Metadata of a Specified Type,” on page 43 and Chapter 7, “Querying Specific Metadata Objects,” on page 61.

For reference information about the SAS Open Metadata Interface query methods, see “Methods for Reading and Writing Metadata (IOMI Class)” in the *SAS Open Metadata Interface: Reference*.

Example of Listing the Metadata Types in a Namespace

The SAS Open Metadata Interface provides the GetTypes method for listing the metadata types in a namespace. The following is an example of a GetTypes request that is formatted for the DoRequest method:

```
<GetTypes>
   <Types/>
   <NS>SAS</NS>
   <Flags/>
   <Options/>
</GetTypes>
```

The <NS>, <Flags>, and <Options> XML elements are input parameters. This example does not specify any flags or options. The <Types> element is an output parameter.

The <Types> element will return information similar to the following for each metadata type in the specified namespace (“SAS” in this example). For brevity, only the first line of the output is shown.

```
<Type Id="AbstractExtension" Desc="Abstract Extension" HasSubtypes="1"/>
```

In the output:

- Id= is a metadata type name
- Desc= is a system-supplied description of the metadata type
- HasSubtypes is a boolean indicator that identifies whether a metadata type has subtypes. A value of 1 indicates that the type has subtypes. A value of 0 indicates that it does not.

Listing a Metadata Type’s Subtypes

To list a metadata type’s subtypes, you use the GetSubtypes method. Here is an example of a GetSubtypes request to list the subtypes of the AbstractExtension metadata type:

```
<GetSubtypes>
  <Supertype>AbstractExtension</Supertype>
   <Subtypes/>
   <NS>SAS</NS>
   <Flags>0</Flags>
   <Options/>
</GetSubtypes>
```

The <SuperType>, <NS>, <Flags>, and <Options> XML elements are input parameters. In the request, the <Supertype> XML element specifies the AbstractExtension metadata type. The <NS> element specifies the SAS namespace. The request does not specify any flags or options.

The <Subtypes> element is an output parameter. Here is an example of the output received from the metadata server:

```
<!-- Using the GETSUBTYPES method. -->

<SubTypes>
 <Type Id="Extension" Desc="Object Extensions" HasSubtypes="0"/>
 <Type Id="NumericExtension" Desc="Numeric Extension" HasSubtypes="0"/>
</SubTypes>
```

The AbstractExtension metadata type has two subtypes: Extension and NumericExtension.

Listing the Available Repositories

You can list the repositories registered on a metadata server by using the GetRepositories method. The following is an example of a GetRepositories request that is formatted for the DoRequest method.

```
<GetRepositories>
   <Repositories/>
   <Flags>0</Flags>
   <Options/>
 </GetRepositories>
```

The request retrieves the Id and Name attributes of all repositories registered on the current metadata server. Here is an example of the output returned by the metadata server:

```
<!-- Using the GETREPOSITORIES method. -->

<Repositories>
 <Repository Id="A0000001.A53TPPVI" Name="Test repository 1"
   Desc="Repository created to illustrate registering a repository
    using AddMetadata." DefaultNS="SAS"/>
 <Repository Id="A0000001.A5KD78HW" Name="Test repository 2"
   Desc="Second test repository." DefaultNS="SAS"/>
</Repositories>
```

The current repository manager has two repositories registered in it: Test repository 1 and Test repository 2.

To list the repositories' Access and PauseState attributes, set the OMI_ALL flag (1) in the GetRepositories request.

- □ The Access attribute stores a repository's default access mode. A value of 0 indicates that a repository is available for read, write, and update access. A value of 1 indicates that it is read-only.
- □ The PauseState attribute indicates whether a repository has been temporarily paused to another state. A repository that has a state value in the PauseState attribute will remain in that state until it is resumed. A repository is generally paused in order to perform a backup.

To request attributes for a specific repository, use the GetMetadata method.

Listing the Metadata Types in a Repository

After adding metadata objects, you can identity which metadata types are represented in a repository by using the GetTypes method with the OMI_SUCCINCT (2048) flag. When used with OMI_SUCCINCT and its corresponding <Reposid> element, the GetTypes method returns the metadata types for which metadata has been defined in a specific repository.

This is an example of a GetTypes request that specifies the OMI_SUCCINCT flag:

```
<GetTypes>
   <Types/>
   <NS>SAS</NS>
   <!-- specify the OMI_SUCCINCT flag -->
   <Flags>2048</Flags>
   <Options>
     <!-- include <Reposid> XML element and a repository identifier -->
     <Reposid>A0000001.A53TPPVI</Reposid>
   </Options>
</GetTypes>
```

The <NS>, <Flags>, <Options>, and <Reposid> XML elements are input parameters.

- □ The <NS> element specifies the namespace to examine.
- □ The <Flags> element specifies the OMI_SUCCINCT flag (2048).
- □ The <Options> element passes the <Reposid> element to the server.
- □ The <Reposid> element specifies the target repository identifier.

The <Types> element is an output parameter. The following is example of the output returned by the metadata server:

```
<!-- Using the GETTYPES method. -->

<Types>
<Type Id="Column" Desc="Columns" HasSubtypes="0"/>
<Type Id="PhysicalTable" Desc="Physical Table" HasSubtypes="1"/>
<Type Id="ResponsibleParty" Desc="Responsible Party" HasSubtypes="0"/>
<Type Id="SASLibrary" Desc="SAS Library" HasSubtypes="0"/>
</Types>
```

The repository contains metadata objects of four metadata types: Column, PhysicalTable, ResponsibleParty, and SASLibrary.

- □ Id= specifies the metadata type.
- □ Desc= returns a system-supplied description of the metadata type.
- □ When OMI_SUCCINCT is set, HasSubtypes has no meaning.

To list actual objects of each type, you must use the GetMetadataObjects method. See Chapter 6, “Querying All Metadata of a Specified Type,” on page 43.

CHAPTER

6

Querying All Metadata of a Specified Type

Introduction to the GetMetadataObjects Method 43
Review of Terms 44
Expanding a GetMetadataObjects Request to Include Subtypes 45
Expanding a GetMetadataObjects Request to Retrieve Additional Properties 46
Specifying GetMetadata Flags in a GetMetadataObjects Request 46
Combining GetMetadata and GetMetadataObjects Flags 46
Retrieving All Properties for All Objects 47
Limiting OMI_ALL Output 49
Retrieving All Attributes of All Objects 50
Retrieving Specific Properties of All Objects 51
Filtering a GetMetadataObjects Request 52
<XMLSelect> Element Form and Search Criteria Syntax 52
Object Component 53
Attribute Criteria Component 54
Association Path Component 55
Understanding Association Paths 55
Searching by Date, Time, and Datetime Values 56
Examples 57
Single Attribute Search on the Metadata Type in the <Type> Element 57
Single Attribute Search on a Subtype of the <Type> Element 57
Selecting Objects Whose Attributes "Begin With" a Value 58
Selecting Objects Whose Attributes Have a Missing Value or Blank String 58
Specifying Concatenated Attributes 58
Searching By Association Name 58
Searching by Association Name and Attribute Criteria 58
Specifying Concatenated Association Paths 58
Specifying the <XMLSelect> Element in a GetMetadataObjects Call 59
Using OMI_XMLSELECT with Other Flags 59
Expanding a GetMetadataObjects Request to Search Additional Repositories 59

Introduction to the GetMetadataObjects Method

The SAS Open Metadata Interface provides the GetMetadataObjects method for retrieving metadata objects of a specified metadata type. The default behavior of the GetMetadataObjects method is to retrieve general, identifying information for each object of the specified type in the specified repository. The method also provides flags and options that enable you to expand or to filter the object request.

The following is an example of a GetMetadataObjects request that does not contain flags or options. The request returns a list of all objects of type PhysicalTable in Test repository 1 and their Id and Name attributes. The call is formatted for the DoRequest method.

```
<GetMetadataObjects>
<!--Reposid specifies Test repository 1 -->
 <Reposid>A0000001.A53TPPVI</Reposid>
 <Type>PhysicalTable</Type>
 <Objects/>
 <NS>SAS</NS>
 <Flags>0</Flags>
 <Options/>
</GetMetadataObjects>
```

In the request, note the following:

- The <Reposid> element specifies a repository identifier.
- The <Type> element specifies the name of the metadata type whose objects you want to list.
- The <NS> element specifies the namespace in which to process the request.
- The <Flags> and <Options> elements, though empty here, support flags and additional XML elements that you can use to expand or filter the GetMetadataObjects request.

  You can expand a GetMetadataObjects request to include subtypes, to retrieve specific properties, and to include additional repositories in the query. For more information, see “Expanding a GetMetadataObjects Request to Include Subtypes” on page 45, “Expanding a GetMetadataObjects Request to Retrieve Additional Properties” on page 46, and “Expanding a GetMetadataObjects Request to Search Additional Repositories” on page 59.

  You filter a GetMetadataObjects request by specifying an XMLSELECT flag (128) and by specifying search criteria in an <XMLSelect> element. For more information, see “Filtering a GetMetadataObjects Request” on page 52.

The <Objects> element is an output parameter. Here is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATAOBJECTS method. -->

<Objects>
<PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices"/>
<PhysicalTable Id="A53TPPVI.A4000002" Name="Sales Associates"/>
</Objects>
```

Test repository 1 has two objects of metadata type PhysicalTable defined.

Review of Terms

An *attribute* is a characteristic of a metadata type that defines the metadata type. For example, in addition to its Id and Name attributes, a PhysicalTable has Desc, MetadataCreated, MetadataUpdated, ChangeState, DBMSType, IsCompressed, IsDBMSView, IsEncrypted, MemberType, NumRows, SASTableName, and TableName attributes.

An *association* is a relationship between a metadata type and another metadata type. For example, the PhysicalTable metadata type has a Columns association to metadata objects describing its columns. In addition, it supports associations to metadata types defining keys, indexes, transformations, etc.

A *metadata object* is an instance of a metadata type that is uniquely defined by its attribute values and associations.

General, identifying information refers to the Id and Name attributes of a metadata object. For more information, see “Identifying Metadata” in “Methods for Reading and Writing Metadata (IOMI Class)” in the *SAS Open Metadata Interface: Reference*.

In this documentation, the term “properties” is used to collectively refer to an object’s attributes and associations.

Expanding a GetMetadataObjects Request to Include Subtypes

The GetMetadataObjects method supports the OMI_INCLUDE_SUBTYPES (16) flag to enable you to list all subtypes of the metadata type specified in the <Type> element. A subtype is a metadata type that inherits properties from a supertype. A supertype can have many subtypes. You can view the supertype/subtype relationships defined in the SAS Metadata Model in the “Hierarchical Listing of SAS Namespace Metadata Types” in the “SAS Namespace Metadata Types” section of the *SAS Open Metadata Interface: Reference*.

When OMI_INCLUDE_SUBTYPES is set, the GetMetadataObjects method retrieves all objects of all possible subtypes of the specified metadata type in addition to all objects of the specified metadata type. This prevents you from having to query each subtype for information individually. If you want to retrieve information about some subtypes but not others, use the hierarchical listing to assess the hierarchical level at which to target your request.

The following is an example of a GetMetadataObjects request that sets OMI_INCLUDE_SUBTYPES and specifies to retrieve all subtypes of supertype DataTable.

```
<GetMetadataObjects>
<! -- Reposid parameter specifies Test repository 1 -->
   <Reposid>A0000001.A53TPPVI</Reposid>
   <Type>DataTable</Type>
   <Objects/>
   <NS>SAS</NS>
   <! -- Specify OMI_INCLUDE_SUBTYPES (16) flag -->
   <Flags>16</Flags>
   <Options/>
</GetMetadataObjects>
```

The DataTable supertype has the following subtypes defined for it in the SAS Metadata Model: ExternalTable, JoinTable, PhysicalTable, QueryTable, RelationalTable, and WorkTable. OMI_INCLUDE_SUBTYPES will return all metadata objects of these subtypes that have been defined in Test repository 1.

Here is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATAOBJECTS method. -->

<Objects>
<PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices"/>
<PhysicalTable Id="A53TPPVI.A4000002" Name="Sales Associates"/>
</Objects>
```

Thus far, Test repository 1 contains two objects of subtype PhysicalTable and no objects of the other subtypes.

The default behavior of the GetMetadataObjects method is to return the Id and Name properties for all objects that are found. When OMI_INCLUDE_SUBTYPES is set with

OMI_GET_METADATA (256) and GetMetadata flags, the GetMetadataObjects method will retrieve the requested properties for all subtype objects. For more information, see .

Expanding a GetMetadataObjects Request to Retrieve Additional Properties

You expand a GetMetadataObjects method call to retrieve additional properties by setting the OMI_GET_METADATA (256) flag and specifying flags defined for the GetMetadata method in the GetMetadataObjects request.

The OMI_GET_METADATA flag executes a GetMetadata request for each metadata object that is returned by the GetMetadataObjects method. When OMI_GET_METADATA is set without specifying any other GetMetadata flags, the GetMetadata method returns the Id and Name attributes for each object returned by GetMetadataObjects. Specifying one or more other GetMetadata flags with OMI_GET_METADATA enables you to retrieve specific properties or categories of properties for each metadata object. For an overview of the flags supported for the GetMetadataObjects and GetMetadata methods, see "Summary Table of IOMI Flags" in "Methods for Reading and Writing Metadata (IOMI Class" in the *SAS Open Metadata Interface: Reference*.

This document describes how the following GetMetadata flags are used in a GetMetadataObjects request:

- OMI_ALL (1) — Gets all of the properties of the requested object and general, identifying information about any objects that are associated with the requested objects.
- OMI_ALL_SIMPLE (8) — Gets all of the attributes of the requested objects.
- OMI_SUCCINCT (2048) — Suppresses retrieval of properties that do not contain values or that contain a null value.
- OMI_TEMPLATES (4) — Instructs the metadata server to look in the <Options> element for one or more user-defined templates that specify which metadata properties to return. The templates are specified in a <Templates> element.

Specifying GetMetadata Flags in a GetMetadataObjects Request

To specify a GetMetadata flag in a GetMetadataObjects request, simply add the flag's value to that of the OMI_GET_METADATA flag and any other GetMetadataObjects flags that you have already set. For example, if OMI_XMLSELECT (128) is already set and you want to specify OMI_GET_METADATA (256) and OMI_ALL_SIMPLE (8) to retrieve all of the attributes of each object, add their values together (128+256+8=392) and specify the sum in the <Flags> element.

Combining GetMetadata and GetMetadataObjects Flags

The flags described in this section can be combined with other GetMetadataObjects flags.

- When GetMetadata flags are used with OMI_INCLUDE_SUBTYPES (16), the GetMetadataObjects method will return the specified properties for all subtypes of the specified metadata type in addition to all objects of the specified type.
- When GetMetadata flags are used with OMI_XMLSELECT (128), the GetMetadataObjects method will retrieve the specified properties only for metadata objects that meet <XMLSelect> search criteria.

- When GetMetadata flags are used with OMI_DEPENDENCY_USES (8192) or OMI_DEPENDENCY_USED_BY (16384), the GetMetadataObjects method will return the specified properties for objects of the specified type in the repository in which the request was executed and all repositories that either use or are used by the target repository.

Retrieving All Properties for All Objects

The following is an example of a GetMetadataObjects request that sets the OMI_GET_METADATA (256) and OMI_ALL (1) flags. The OMI_ALL flag will list all attributes and associations for all PhysicalTable objects returned by the GetMetadataObjects request.

```
 <GetMetadataObjects>
<!-- Reposid parameter specifies Test repository 1 -->
   <Reposid>A0000001.A53TPPVI</Reposid>
   <Type>PhysicalTable</Type>
   <Objects/>
   <NS>SAS</NS>
   <!-- Specify OMI_GET_METADATA(256) + OMI_ALL (1) flags -->
   <Flags>257</Flags>
   <Options/>
</GetMetadataObjects>
```

In the request, note the following:

- The <Reposid> element specifies to execute the request in Test repository 1.
- The <Type> element specifies to retrieve all objects of the PhysicalTable metadata type.
- The <Flags> element specifies a number representing the sum of the OMI_GET_METADATA and OMI_ALL flags.

The following is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATAOBJECTS method. -->

<Objects>
<PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices" DBMSType=""
  Desc="Sales offices in NW region" IsCompressed="0" IsEncrypted="0"
  LockedBy="" MemberType="" MetadataCreated="05Feb2002:09:37:00"
  MetadataUpdated="05Feb2002:09:37:00" NumRows="-1" SASTableName="" TableName="">
<AccessControls/>
<Aggregations/>
<AnalyticTables/>
<Changes/>
<Columns>
<Column Id="A53TPPVI.A5000001" Name="City" Desc="City of Sales Office"/>
<Column Id="A53TPPVI.A5000002" Name="Address" Desc="Street Address of Sales Office"/>
<Column Id="A53TPPVI.A5000003" Name="Manager" Desc="Name of Operations Manager"/>
<Column Id="A53TPPVI.A5000004" Name="Employees" Desc="Number of employees"/>
</Columns>
<Documents/>
<Extensions/>
<ExternalIdentities/>
<ForeignKeys/>
<Groups/>
<Implementors/>
```

```
<Indexes/>
<Keywords/>
<ModelResults/>
<Notes/>
<PrimaryPropertyGroup/>
<Properties/>
<PropertySets/>
<ReachThruCubes/>
<ResponsibleParties/>
<Roles/>
<SASPasswords/>
<SourceClassifierMaps/>
<SourceTransformations/>
<SpecSourceTransformations/>
<SpecTargetTransformations/>
<TablePackage/>
<TargetClassifierMaps/>
<TargetTransformations/>
<Timestamps/>
<TrainedModelResults/>
<Trees/>
<UniqueKeys/>
<UsedByPrototypes/>
<UsingPrototype/>
</PhysicalTable>
<PhysicalTable Id="A53TPPVI.A4000002" Name="Sales Associates" DBMSType=""
  Desc="Sales associates in NW region" IsCompressed="0" IsEncrypted="0"
  LockedBy="" MemberType="" MetadataCreated="05Feb2002:09:50:56"
  MetadataUpdated="05Feb2002:09:50:56" NumRows="-1" SASTableName="" TableName="">
<AccessControls/>
<Aggregations/>
<AnalyticTables/>
<Changes/>
<Columns>
<Column Id="A53TPPVI.A5000005" Name="Name" Desc="Name of employee"/>
<Column Id="A53TPPVI.A5000006" Name="Address" Desc="Home Address"/>
<Column Id="A53TPPVI.A5000007" Name="Title" Desc="Job grade"/>
</Columns>
<Documents/>
<Extensions/>
<ExternalIdentities/>
<ForeignKeys/>
<Groups/>
<Implementors/>
<Indexes/>
<Keywords/>
<ModelResults/>
<Notes/>
<PrimaryPropertyGroup/>
<Properties/>
<PropertySets/>
<ReachThruCubes/>
<ResponsibleParties/>
<Roles/>
```

```
<SASPasswords/>
<SourceClassifierMaps/>
<SourceTransformations/>
<SpecSourceTransformations/>
<SpecTargetTransformations/>
<TablePackage/>
<TargetClassifierMaps/>
<TargetTransformations/>
<Timestamps/>
<TrainedModelResults/>
<Trees/>
<UniqueKeys/>
<UsedByPrototypes/>
<UsingPrototype/>
</PhysicalTable>
</Objects>
```

The OMI_ALL flag retrieves all of the attributes and associations for each object, including those for which no value has been defined. This is useful when you want to view both actual and potential properties of all of the objects.

Limiting OMI_ALL Output

To limit a GetMetadataObjects request to return only properties that have values defined for them, you can additionally set the OMI_SUCCINCT (2048) flag. Here is an example of the output of the previous GetMetadataObjects request when OMI_SUCCINCT is added to the other flags.

```
<!-- Using the GETMETADATAOBJECTS method. -->

<Objects>
<PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices"
  Desc="Sales offices in NW region" IsCompressed="0" IsEncrypted="0"
  MetadataCreated="05Feb2002:09:37:00"
  MetadataUpdated="05Feb2002:09:37:00" NumRows="-1">
<Columns>
<Column Id="A53TPPVI.A5000001" Name="City" Desc="City of Sales Office"/>
<Column Id="A53TPPVI.A5000002" Name="Address" Desc="Street Address of Sales Office"/>
<Column Id="A53TPPVI.A5000003" Name="Manager" Desc="Name of Operations Manager"/>
<Column Id="A53TPPVI.A5000004" Name="Employees" Desc="Number of employees"/>
</Columns>
</PhysicalTable>
<PhysicalTable Id="A53TPPVI.A4000002" Name="Sales Associates"
  Desc="Sales associates in NW region" IsCompressed="0" IsEncrypted="0"
  MetadataCreated="05Feb2002:09:50:56" MetadataUpdated="05Feb2002:09:50:56"
  NumRows="-1">
<Columns>
<Column Id="A53TPPVI.A5000005" Name="Name" Desc="Name of employee"/>
<Column Id="A53TPPVI.A5000006" Name="Address" Desc="Home Address"/>
<Column Id="A53TPPVI.A5000007" Name="Title" Desc="Job grade"/>
</Columns>
</PhysicalTable>
</Objects>
```

Retrieving All Attributes of All Objects

The following is an example of a GetMetadataObjects request that sets the OMI_GET_METADATA (256), OMI_ALL_SIMPLE (8), and OMI_SUCCINCT (2048) flags. OMI_SIMPLE is a GetMetadata flag that returns all of the attributes defined for a metadata object (OMI_ALL returns all attributes and associations). When OMI_ALL_SIMPLE is set in a GetMetadataObjects request, the flag returns all of the attributes of all of the objects returned by the GetMetadataObjects request.

The request specifies to retrieve all of the attributes of all Column objects in Test repository 1.

```
<GetMetadataObjects>
<!-- Reposid parameter specifies Test repository 1 -->
   <Reposid>A0000001.A53TPPVI</Reposid>
   <Type>Column</Type>
   <Objects/>
   <NS>SAS</NS>
   <!-- Specify OMI_GET_METADATA (256) + OMI_ALL_SIMPLE (8)
         + OMI_SUCCINCT (2048) flags -->
   <Flags>2312</Flags>
   <Options/>
</GetMetadataObjects>
```

Here is the output returned by the metadata server:

```
<!-- Using the GETMETADATAOBJECTS method. -->

<Objects>
<Column Id="A53TPPVI.A5000001" Name="City" BeginPosition="0" ColumnLength="32"
  ColumnName="City" ColumnType="12" Desc="City of Sales Office" EndPosition="0"
  IsDiscrete="0" IsNullable="0" MetadataCreated="05Feb2002:09:37:00"
  MetadataUpdated="05Feb2002:09:37:00" SASColumnLength="32" SASColumnName="City"
  SASColumnType="C" SASExtendedLength="0" SASFormat="$Char32." SASInformat="$32."
  SASPrecision="0" SASScale="0"/>
<Column Id="A53TPPVI.A5000002" Name="Address" BeginPosition="0" ColumnLength="32"
  ColumnName="Address" ColumnType="12" Desc="Street Address of Sales Office"
  EndPosition="0" IsDiscrete="0" IsNullable="0" MetadataCreated="05Feb2002:09:37:00"
  MetadataUpdated="05Feb2002:09:37:00" SASColumnLength="32"
  SASColumnName="Street_Address" SASColumnType="C" SASExtendedLength="0"
  SASFormat="$Char32." SASInformat="$32." SASPrecision="0" SASScale="0"/>
<Column Id="A53TPPVI.A5000003" Name="Manager" BeginPosition="0" ColumnLength="32"
  ColumnName="Manager" ColumnType="12" Desc="Name of Operations Manager"
  EndPosition="0" IsDiscrete="0" IsNullable="0" MetadataCreated="05Feb2002:09:37:00"
  MetadataUpdated="05Feb2002:09:37:00" SASColumnLength="32" SASColumnName="Manager"
  SASColumnType="C" SASExtendedLength="0" SASFormat="$Char32." SASInformat="$32."
  SASPrecision="0" SASScale="0"/>
<Column Id="A53TPPVI.A5000004" Name="Employees" BeginPosition="0" ColumnLength="3"
  ColumnName="Employees" ColumnType="6" Desc="Number of employees" EndPosition="0"
  IsDiscrete="0" IsNullable="0" MetadataCreated="05Feb2002:09:37:00"
  MetadataUpdated="05Feb2002:09:37:00" SASColumnLength="3" SASColumnName="Employees"
  SASColumnType="N" SASExtendedLength="0" SASFormat="3.2" SASInformat="3.2"
  SASPrecision="0" SASScale="0"/>
<Column Id="A53TPPVI.A5000005" Name="Name" BeginPosition="0" ColumnLength="32"
  ColumnName="Employee_Name" ColumnType="12" Desc="Name of employee" EndPosition="0"
  IsDiscrete="0" IsNullable="0" MetadataCreated="05Feb2002:09:50:56"
```

```
    MetadataUpdated="05Feb2002:09:50:56" SASColumnLength="32"
    SASColumnName="Employee" SASColumnType="C" SASExtendedLength="0"
    SASFormat="$Char32." SASInformat="$32." SASPrecision="0" SASScale="0"/>
  <Column Id="A53TPPVI.A5000006" Name="Address" BeginPosition="0" ColumnLength="32"
    ColumnName="Employee_Address" ColumnType="12" Desc="Home Address"
    EndPosition="0" IsDiscrete="0" IsNullable="0" MetadataCreated="05Feb2002:09:50:56"
    MetadataUpdated="05Feb2002:09:50:56" SASColumnLength="32"
    SASColumnName="Home_Address" SASColumnType="C" SASExtendedLength="0"
    SASFormat="$Char32." SASInformat="$32." SASPrecision="0" SASScale="0"/>
  <Column Id="A53TPPVI.A5000007" Name="Title" BeginPosition="0" ColumnLength="32"
    ColumnName="Title" ColumnType="12" Desc="Job grade" EndPosition="0"
    IsDiscrete="0" IsNullable="0" MetadataCreated="05Feb2002:09:50:56"
    MetadataUpdated="05Feb2002:09:50:56" SASColumnLength="32" SASColumnName="Title"
    SASColumnType="C" SASExtendedLength="0" SASFormat="$Char32." SASInformat="$32."
    SASPrecision="0" SASScale="0"/>
  </Objects>
```

The OMI_SUCCINCT flag has no effect on OMI_ALL_SIMPLE. OMI_ALL_SIMPLE returns all attributes of all objects of the requested type, including those that do not have values or have null values.

Retrieving Specific Properties of All Objects

The following is an example of a GetMetadataObjects request that retrieves specific properties of all objects of the specified metadata type. The example sets the OMI_GET_METADATA (256) and OMI_TEMPLATES (4) flags and supplies a template that defines the properties to retrieve in a <Templates> XML element.

```
<GetMetadataObjects>
<!-- Reposid parameter specifies Test repository 1 -->
   <Reposid>A0000001.A53TPPVI</Reposid>
   <Type>PhysicalTable</Type>
   <Objects/>
   <NS>SAS</NS>
   <!-- Specify OMI_GET_METADATA(256) + OMI_TEMPLATE (4) flags -->
   <Flags>260</Flags>
   <Options>
    <Templates>
      <PhysicalTable DBMSType="" IsCompressed="" IsEncrypted=""
        MemberType="">
        <Extensions/>
      </PhysicalTable>
    </Templates>
   </Options>
</GetMetadataObjects>
```

In the request, the template specifies to retrieve the DBMSType=, IsCompressed=, IsEncrypted=, and MemberType= attributes for each of the PhysicalTable objects in repository A53TPPVI. In addition, the template specifies to retrieve any associated Extension objects that might have been defined for each PhysicalTable object. Here is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATAOBJECTS method. -->

<Objects>
<PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices" DBMSType=""
```

```
  IsCompressed="0" IsEncrypted="0" MemberType="">
<Extensions/>
</PhysicalTable>
<PhysicalTable Id="A53TPPVI.A4000002" Name="Sales Associates" DBMSType=""
  IsCompressed="0" IsEncrypted="0" MemberType="">
<Extensions/>
</PhysicalTable>
</Objects>
```

The metadata server returns the requested properties in addition to the Id and Name attributes that are returned by default.

For information about how to create a template, see "Using Templates" on page 68.

Filtering a GetMetadataObjects Request

The GetMetadataObjects method supports an OMI_XMLSELECT (128) flag to enable you to filter the objects that are retrieved by the SAS Metadata Server. The OMI_XMLSELECT flag instructs the metadata server to look in the <Options> element for search criteria specified in an <XMLSelect> element. The <XMLSelect> search syntax enables you to filter the objects that are selected by

- attributes
- association name
- associated metadata type
- a combination of the above.

In addition, the syntax supports concatenated attribute and path criteria through the use of logical operators. Concatenation of attribute criteria enables inclusive and exclusive filtering in an object request. For example, you could specify to select objects that have a Name= attribute value of 'John Doe' or 'Jane Doe'. Or you could specify to select objects that have the attribute/value pairs Name='John Doe' and Title='Manager'.

Concatenation of association paths permits filtering of object requests at multiple association levels. For example, you could specify to select Document objects that have a ResponsibleParties association to any ResponsibleParty objects that have a Persons association to any Person objects that have a Locations association to a Location object that has an Area= attribute value of 'New York'.

For more information, see:

- "<XMLSelect> Element Form and Search Criteria Syntax" on page 52
- "Understanding Association Paths" on page 55
- "Searching by Date, Time, and Datetime Values" on page 56
- "Examples" on page 57
- "Using OMI_XMLSELECT with Other Flags" on page 59

<XMLSelect> Element Form and Search Criteria Syntax

The <XMLSelect> element is specified in the <Options> element in the form:

```
<XMLSelect search="criteria"/>
```

The syntax of *criteria* is:

```
Object[AttributeCriteria][AssociationPath]
```

The brackets denote optional criteria and are also part of the search string specification. For example, a statement that specifies attribute criteria and association path criteria is specified as:

```
Object[AttributeCriteria][AssociationPath]
```

A statement that specifies only attribute criteria is specified as:

```
Object[AttributeCriteria]
```

A statement that specifies only association path criteria is specified as:

```
Object[AssociationPath]
```

A statement that specifies a subelement as the criteria is specified as:

```
Object
```

Attribute criteria are concatenated by specifying logical operators within the brackets. For example:

```
Object[AttributeCriteria and|or AttributeCriteria]
```

If only attribute criteria are specified, the server will accept search strings that omit the *Object* component, as follows:

```
AttributeCriteria and|or AttributeCriteria

(AttributeCriteria and|or AttributeCriteria)
```

Path criteria are concatenated by placing a forward-slash character (/) between the path specifications inside the brackets. For example:

```
Object[AssociationPath1/AssociationPath2]
```

A detailed description of each syntax component is provided in the sections that follow.

Object Component

The *Object* component is required for all but simple attribute criteria searches and specifies the object class type. Valid values are a metadata type name or an asterisk (*).

- The metadata type name can be the same metadata type name that is specified in the GetMetadataObjects <Type> element or a subtype of the metadata type. Refer to the metadata type descriptions in the *SAS Open Metadata Interface: Reference* to determine the subtypes of a metadata type.
- An * is a short-hand method of referring to the metadata type named in the <Type> element.

The *Object* component is specified once outside of the brackets of the other search components. For example:

```
MetadataType[AttributeCriteria][AssociationPath]
```

or

```
MetadataType[AttributeCriteria]
```

or

```
*[AssociationPath]
```

Attribute Criteria Component

The *AttributeCriteria* component is optional and enables you to filter the objects that are retrieved to those matching a specified attribute/value pair. The syntax of *AttributeCriteria* is:

```
[@attrname cop 'value' lop AttributeCriterian]
```

where:

□ *@attrname* specifies an attribute name; for example, “@Name” or “@Desc”

□ *cop* is a comparison operator. The supported comparison operators are described in the following table:

Table 6.1 Comparison Operators Supported in Attribute Criteria

Symbol or Mnemonic	Description
=, eq, or EQ	equal to
?, contains, or CONTAINS	contains the specified character string
=:	begins with the specified character string

□ ’*value*’ is a character or numeric string, a blank, or a . (period – to denote a missing numeric value), enclosed within single quotation marks.

Note: Searches of date, time, and datetime values are handled differently than searches of other values. For more information, see “Searching by Date, Time, and Datetime Values” on page 56. △

□ *lop AttributeCriteria* is an optional, concatenated *AttributeCriteria* string that is appended to the first by the logical operator “and” or “or”. An example of concatenated attribute criteria is:

```
[@Name = 'John Doe' or @Name = 'Jane Doe']
```

The string is an example of an inclusive search: it instructs the metadata server to select for retrieval all metadata objects that have the Name attribute value of ’John Doe’ or ’Jane Doe’.

Compound attribute criteria are also supported. Use parentheses to control evaluation order. For example:

```
search="*[@ProductName='SAS/CONNECT' and
(@Name contains 'test - SAS/CONNECT Server' or @Name='test')]"
```

In this example, the expression contained within the parenthesis is evaluated first.

Note: When single or concatenated attribute criteria is used, the attribute test is applied only if all of the specified attribute names are valid for the object. That is, if one of the attribute names in the attribute string is misspelled, then no objects are selected.

If the OMI_INCLUDE_SUBTYPES flag is set with OMI_XMLSELECT, the type and subtype objects to be tested may support a different set of attribute names. Only objects that contain all of the specified attribute names will be tested for a match. △

Association Path Component

The *AssociationPath* component is optional and specifies an association name, an associated object, and optional attribute criteria. The syntax of *AssociationPath* is:

```
[AssociationName/AssociatedObject [AttributeCriteria]/AssociationPathn]
```

where:

- *AssociationName* specifies an association name that has been and is a required component.
- *AssociatedObject* is a metadata type or an asterisk, as described in "Object Component" on page 53, and is a required component.
- *AttributeCriteria* is an optional *AttributeCriteria* string, as described in "Attribute Criteria Component" on page 54.
- /*AssociationPathn* is an optional association path that is concatenated to the first by using a slash (/). The / functions like an "and" operator.

An example of concatenated association paths is:

```
[ResponsibleParties/ResponsibleParty/Persons/Person/Locations/
Location[Area='New York']]
```

The concatenation operators are bolded. This example concatenates three *attribute-criteria* strings:

- ResponsibleParties/ResponsibleParty
- Persons/Person
- Locations/Location[Area='New York']

The previous example did not specify an *Object* component. The *AssociationPath* criteria will not be applied unless it is preceded by an *Object* component. For more information, see "Understanding Association Paths" on page 55.

Understanding Association Paths

The term "association path" refers to a set of objects that are identified in the form:

```
[AssociationName/AssociatedObject[AttributeCriteria]]
```

However, to better understand how the metadata server processes this component, it is important to consider the association path within the context of the complete search criteria syntax, which prepends an *Object* component to the path:

```
Object[AssociationName/AssociatedObject[AttributeCriteria]]
```

The *Object* component sets the scope of the retrieval request:

- If *Object* is an asterisk (*), then *AssociationName* can refer to any association name defined for the metadata type specified in the GetMetadataObjects <Type> element.
- If *Object* is a metadata type, then *AssociationName* refers to a specific association name that is defined for the specified metadata type.

The value specified for the Object component can have profound effect on the request when the OMI_INCLUDE_SUBTYPES (16) flag is specified with OMI_XMLSELECT. When OMI_INCLUDE_SUBTYPES is set, the metadata server retrieves subtypes for the metadata type identified in the *Object* component of the search criteria. If an asterisk is specified, this selects for retrieval all subtypes of the metadata type indicated in the <Type> element.

The *AssociatedObject* component also supports a metadata type name or an asterisk:

- □ If *AssociatedObject* is an asterisk, the metadata server selects for retrieval objects of all subelement types supported by the specified association name.
- □ If *AssociatedObject* is a metadata type, the metadata server selects for retrieval only objects of the specified metadata type.

As an example, consider the following search path specifications:

```
*[ReportLocation/*]

Report[ReportLocation/Email]
```

The first request specifies to select all objects of the metadata type specified in the <Type> element that have a ReportLocation association to any objects that qualify as subelement objects. The second request restricts the retrieval request to Report objects that have a ReportLocation association to an Email object.

Report is a subtype of Classifier. If Classifier is the metadata type specified in the <Type> element and the OMI_INCLUDE_SUBTYPES flag is set, specifying an * in the first object position potentially selects objects of up to 12 subtypes. Classifier is a supertype of the Cube, DataTable, Dimension, ExternalTable, Index, JoinTable, PhysicalTable, QueryTable, RelationalTable, Report, TableCollection, and WorkTable metadata types. Of these metadata types, only Report supports the ReportLocation association. In addition, the ReportLocation association supports 18 potential subelement types. Specifying an asterisk in the second position selects objects of all 18 types. Specifying Email selects for retrieval only Email objects. When choosing whether to specify a metadata type or an asterisk, consult the SAS Namespace Metadata Types documentation. For some metadata types and associations, specifying an asterisk or a metadata type can make a big difference in the number of objects that are selected for retrieval (and the number of objects that need to be searched before a selection is made, thereby affecting performance).

The *AttributeCriteria* component enables you to qualify the subelement objects that are retrieved to those containing specified attributes. For example, the following request retrieves Report objects that have a ReportLocation association to objects of type Document that also have the attribute TextType="XML".

```
Report[ReportLocation/Document[@TextType='XML']]
```

When attribute criteria are specified in a query that has an * in the *AssociatedObject* component, the attribute criteria is applied to all subelements.

Concatenating pathnames further filters a retrieval request. For example, the following request selects for retrieval Report objects that have a ReportLocation association to Document objects that have the attribute TextType="XML" and a ResponsibleParties association to a ResponsibleParty object that has the Name= attribute value "Jane Doe."

```
Report[ReportLocation/Document[@TextType='XML']/ResponsibleParties/ResponsibleParty
  [@Name='Jane Doe']]
```

Searching by Date, Time, and Datetime Values

In the current release, searches by date or by time are not supported. However, the metadata server supports limited datetime queries on the MetadataCreated and MetadataUpdated attributes using two operators:

- □ LT (or lt)
- □ GT (or gt)

The supported DATETIME formats are:

- □ *ddmmmyyyy:hh:mm:ss.s*
- □ *ddmmmyyyy:hh:mm:ss*
- □ a SAS date value that represents a *ddmmmyyyy:hh:mm:ss* value.

Note: The "<" and ">" operators are *not* supported; nor is the DATE format *ddmmmyyyy*.

Datetime queries are supported only in the standard call interface. For more information about SAS Open Metadata Interface call interfaces, see "Call Interfaces" in "Open Client Requirements" in the *SAS Open Metadata Interface: Reference*.

Objects are persisted to disk with a GMT datetime value; therefore, an object created in local time might have a different datetime value on disk. For example, an object created at '30May2003:*16*:20:01' CST could have a persisted datetime value of '30May2003:*21*:20:01'. To accommodate the storage conversion, the server converts values that you specify in an <XMLSelect> search string to GMT for you. However, the datetime values returned by the server will look different than the values that you submitted in the search string. △

The following are examples of queries in the supported formats:

```
<XMLSELECT search="*[@MetadataCreated GT '27May2003:09:20:17.2']"/>
<XMLSELECT search="*[@MetadataCreated LT '27May2010:09:20:17']"/>
<XMLSELECT search="*[@MetadataCreated GT '1309907400']"/>
```

In the third example, '1309907400' is the SAS date value for '30May2003:19:03:11' GMT.

To retrieve objects created on a specific date, submit a concatenated datetime query as follows:

```
<XMLSELECT search="*[@MetadataCreated GT '28May2003:00:00:00'
  and @MetadataCreated LT '28May2003:23:59:59.9']"/>
```

This request will retrieve all objects created between 00:00:00 and 23:59:59.9 on May 28, 2003.

Examples

Single Attribute Search on the Metadata Type in the <Type> Element

The following <XMLSelect> element selects all objects that have a Name= attribute value of 'John Doe':

```
<Type>Person</Type>
...
<XMLSelect search="*[@Name='John Doe']"/>
or
<XMLSelect search="Person[@Name='John Doe']"/>
```

Single Attribute Search on a Subtype of the <Type> Element

The following <XMLSelect> element selects PhysicalTable objects that have a DBMSType= attribute value of 'Oracle':

```
<Type>RelationalTable</Type>
...
```

```
<XMLSelect search="PhysicalTable[@DBMSType='Oracle']"/>
```

Selecting Objects Whose Attributes “Begin With” a Value

The following <XMLSelect> element selects Person objects that have a Name= attribute value that begins with 'John':

```
<XMLSelect search="Person[@Name =:'John']">
```

Selecting Objects Whose Attributes Have a Missing Value or Blank String

The following <XMLSelect> element selects WorkTable objects that have a missing numeric value in the NumRows attribute:

```
<XMLSelect search="WorkTable[@NumRows='.']"/>
```

The following <XMLSelect> element selects WorkTable objects that have a blank string in the MemberType attribute:

```
<XMLSelect search="WorkTable[@MemberType='']"/>
```

Specifying Concatenated Attributes

The following <XMLSelect> element selects objects that have either the Name= attribute value of 'John Doe' or 'Jane Doe':

```
<XMLSelect search="*[@Name='John Doe' OR @Name='Jane Doe']"/>
```

It is an example of an exclusive search. It will return objects that have either of these two names in the Name attribute. The logical operators AND and OR can be specified in uppercase or lowercase letters.

Searching By Association Name

The following <XMLSelect> element selects objects that have any objects associated with them through the ResponsibleParties association:

```
<XMLSelect search="*[ResponsibleParties/*]"/>
```

It is an example of a simple Path specification (Object*AssociationName/AssociatedObject*).

Searching by Association Name and Attribute Criteria

The following <XMLSelect> element selects any objects that have a Role= attribute value of OWNER associated with them through the ResponsibleParties association:

```
<XMLSelect search="*[ResponsibleParties/*[@Role='OWNER']]"/>
```

It is an example of a Path specification with embedded attribute criteria (*AssociationName/AssociatedObject*[*AttributeCriteria*]).

Specifying Concatenated Association Paths

The following <XMLSelect> element specifies concatenated association paths.

```
<XMLSelect search="*[ResponsibleParties/*[@Role='OWNER']/
Persons/Person[@Name='John Doe']]"/>
```

The first path selects objects that have a Role= attribute value of OWNER associated with them through the ResponsibleParties association. The second path selects Person objects that have a Name= attribute value of 'John Doe' associated with them through the Persons association name (*AssociationName/AssociatedObject*[*AttributeCriteria*]/ *AssociationName/AssociatedObject*[*AttributeCriteria*]).

The following <XMLSelect> element selects objects owned by any type of object with a Name= attribute value of 'John Doe':

```
<XMLSelect search="*[ResponsibleParties/*[@Role='OWNER']/
Persons/*[@Name='John Doe']]"/>
```

This request is identical to the preceding example, except that an asterisk is substituted for the Person object to signify any object in the second path.

Specifying the <XMLSelect> Element in a GetMetadataObjects Call

The following example illustrates how the <XMLSelect> element is specified in a GetMetadataObjects request:

```
<GetMetadataObjects>
  <Reposid>A0000001.A50TC1Z2</Reposid>
  <!-- specify the initial object set -->
  <Type>Document</Type>
  <NS>SAS</NS>
  <!-- set the OMI_XMLSELECT flag -->
  <Flags>128</Flags>
  <Options>
  <!-- specify a search string in the <XMLSelect> element -->
   <XMLSelect search="*[ResponsibleParties/*[@Role='OWNER']/
    Persons/*[@Name='Joe E. Accountant']]"/>
   </Options>
</GetMetadataObjects>
```

The <XMLSelect> element is specified as a nested element of the <Options> element.

Using OMI_XMLSELECT with Other Flags

By default, XML searches are not case-sensitive. A case-sensitive search can be performed by specifying the OMI_MATCH_CASE (512) flag in addition to the OMI_XMLSELECT flag.

If the OMI_INCLUDE_SUBTYPES (16) flag is specified with OMI_XMLSELECT, the server will retrieve subtypes for the metadata type identified in the first object component of the search criteria. If an asterisk is specified, this selects for retrieval all subtypes of the metadata type indicated in the *Type* parameter. If a metadata type is specified, the server will retrieve subtypes only for that metadata type.

Expanding a GetMetadataObjects Request to Search Additional Repositories

A GetMetadataObjects request that searches multiple repositories is called a *federated query*. A federated query is a GetMetadataObjects request that sets either or both of the OMI_DEPENDENCY_USES (8192) and OMI_DEPENDENCY_USED_BY (16384) flags to search for objects of a specified type in other repositories.

- □ OMI_DEPENDENCY_USES specifies to retrieve objects of the specified type from all repositories that have a DependencyUses association to the specified repository in the repository chain. That is, it returns objects from repositories that the specified repository depends on or uses.
- □ OMI_DEPENDENCY_USED_BY specifies to retrieve objects of the specified type from all repositories that have a DependencyUsedBy association to the specified repository in the repository chain. It returns objects from repositories that depend upon or are used by the specified repository.

Before a federated query can be performed, the specified dependency must have been established between the repositories being queried. In “Creating a Metadata Object and an Association to an Object in Another Repository” on page 17, we created a DependencyUses association between Test repository 2 and Test repository 1. This means that Test repository 2 uses Test repository 1. We also created a Person object in Test Repository 2.

The following is an example of a federated query that searches repositories that either use or are used by Test repository 1 for objects of metadata type Person.

```
<GetMetadataObjects>
<!-- Reposid parameter specifies Test repository 1 -->
   <Reposid>A0000001.A53TPPVI</Reposid>
   <Type>Person</Type>
   <Objects/>
   <NS>SAS</NS>
 <!-- Specify OMI_DEPENDENCY_USES (8192) and OMI_DEPENDENCY_USED_BY (16384) flags -->
   <Flags>24576</Flags>
   <Options/>
</GetMetadataObjects>
```

Here is example output received from the server:

```
<!-- Using the GETMETADATAOBJECTS method. -->

<Objects>
<Person Id="A5KD78HW.A1000001" Name="John Doe"/>
</Objects>
```

The query found one Person object, whose object instance identifier indicates that it came from Test Repository 2. Test Repository 1 is used by Test repository 2. For more information about dependency relationships, see Chapter 8, “Creating Relationships Between Repositories,” on page 75.

CHAPTER 7 Querying Specific Metadata Objects

Introduction to the GetMetadata Method **61**
Retrieving All Properties of a Specified Object **62**
Retrieving the Attributes of a Specified Object **64**
Retrieving Properties of Associated Objects **65**
Retrieving Subtypes **66**
Combining GetMetadata Flags **66**
Filtering the Associated Objects that are Returned by a GetMetadata Request **67**
Using Templates **68**
  Creating a Template **68**
  Using a Template to Specify Search Criteria **69**
  Additional GetMetadata Examples **69**
  Additional GetMetadataObjects Examples **70**

Introduction to the GetMetadata Method

To retrieve properties for a specific metadata object, the SAS Open Metadata Interface provides the GetMetadata method. The default behavior of the GetMetadata method is to return the metadata object and properties specified in the <Metadata> element. The properties can include the XML attributes of the specified metadata object and association names. As an example, consider the following GetMetadata request:

```
<GetMetadata>
 <Metadata>
   <Column Id="A53TPPVI.A5000001" Name="" Desc="" ColumnType="" SASFormat="">
    <Table/>
   </Column>
 </Metadata>
 <NS>SAS</NS>
 <Flags>0</Flags>
 <Options/>
</GetMetadata>
```

In the <Metadata> element, the property string specifies to retrieve the following:

- the Column object that has the object instance identifier A53TPPVI.A5000001. The A53TPPVI portion of the identifier specifies the repository to look in; A5000001 is the unique object identifier.
- the Name, Desc, ColumnType, and SASFormat attributes of the Column object.
- any objects that are associated to the Column object via the Table association name. A Column can have one table object associated with it. See the “Alphabetical Listing of SAS Namespace Metadata Types” in the *SAS Open*

Metadata Interface: Reference for a list of the association names defined for a given metadata type and their cardinalities. This listing is available only in online versions of the reference.

Here is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATA method. -->

<Column Id="A53TPPVI.A5000001" Name="City" Desc="City of Sales Office"
  ColumnType="12" SASFormat="$Char32.">
  <Table>
    <PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices"/>
   </Table>
</Column>
```

The metadata server returns values for the requested attributes of the specified Column object and general, identifying information (Id and Name) about the associated PhysicalTable object.

To retrieve additional properties for the specified object and attributes for associated objects, the GetMetadata method supports the following flags:

- OMI_ALL (1) — Gets all of the attributes and associations of the requested object and general, identifying information about any associated objects.
- OMI_ALL_SIMPLE (8) — Gets simply the attributes of the requested object.
- OMI_INCLUDE_SUBTYPES (16) — Gets metadata objects that are subtypes of the requested object in addition to the request metadata object.
- OMI_SUCCINCT (2048) — Suppresses retrieval of properties that do not contain values or that contain a null value.
- OMI_TEMPLATE (4) — Instructs the metadata server to look in the <Options> element for one or more user-defined templates that define additional metadata properties to return. The templates can request additional properties for the specified metadata object and the attributes of associated metadata objects. The templates are specified in a <Templates> element.

The use of the flags is described in:

- “Retrieving All Properties of a Specified Object” on page 62
- “Retrieving the Attributes of a Specified Object” on page 64
- “Retrieving Subtypes” on page 66
- “Combining GetMetadata Flags” on page 66

The GetMetadata method also supports search strings to filter the associated objects that are retrieved. For more information, see “Filtering the Associated Objects that are Returned by a GetMetadata Request” on page 67.

Retrieving All Properties of a Specified Object

To retrieve all of a metadata object’s properties, the GetMetadata method provides the OMI_ALL (1) flag. Here is an example of a GetMetadata request that sets the OMI_ALL flag.

```
<GetMetadata>
 <Metadata>
   <Column Id="A53TPPVI.A5000001"/>
 </Metadata>
 <NS>SAS</NS>
 <!--OMI_ALL flag -->
 <Flags>1</Flags>
 <Options/>
</GetMetadata>
```

In the request, note the following:

□ The <Metadata> element specifies simply a metadata type and an object instance identifier. Here that is Column A53TPPVI.A5000001.

□ The <NS> parameter specifies the namespace in which to process the request.

□ The <Flags> element specifies the number representing the OMI_ALL flag.

Here is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATA method. -->

<Column Id="A53TPPVI.A5000001" BeginPosition="0" ColumnLength="32"
  ColumnName="City" ColumnType="12" Desc="City of Sales Office" EndPosition="0"
  IsDiscrete="0" IsNullable="0" LockedBy="" MetadataCreated="05Feb2002:09:37:00"
  MetadataUpdated="05Feb2002:09:37:00" Name="City" SASAttribute=""
  SASColumnLength="32" SASColumnName="City" SASColumnType="C" SASExtendedColumnType=""
  SASExtendedLength="0" SASFormat="$Char32." SASInformat="$32." SASPrecision="0"
  SASScale="0" SortOrder="" SummaryRole="">
<AccessControls/>
<AnalyticColumns/>
<Changes/>
<DisplayForKey/>
<Documents/>
<Extensions/>
<ExternalIdentities/>
<ForeignKeyAssociations/>
<Groups/>
<Implementors/>
<Indexes/>
<Keys/>
<Keywords/>
<MLAggregations/>
<Notes/>
<PrimaryPropertyGroup/>
<Properties/>
<PropertySets/>
<QueryClauses/>
<ResponsibleParties/>
<SourceFeatureMaps/>
<SourceTransformations/>
<SpecSourceTransformations/>
<SpecTargetTransformations/>
<Table>
<PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices"
  Desc="Sales offices in NW region"/>
</Table>
<TargetFeatureMaps/>
<TargetTransformations/>
<Timestamps/>
  <Trees/>
<UniqueKeyAssociations/>
<UsedByPrototypes/>
```

```
<UsingAggregations/>
<UsingPrototype/>
</Column>
```

The OMI_ALL flag retrieves all possible attributes and associations for the specified Column object, including those for which values have not been defined. To limit the output to properties that have values, you can additionally set the OMI_SUCCINCT (2048) flag. Simply add the value of OMI_SUCCINCT to OMI_ALL (2048 + 1= 2049) and specify the sum in the <Flags> element. The OMI_SUCCINCT flag instructs the metadata server to omit any properties that are empty or have a null value from the output.

Retrieving the Attributes of a Specified Object

To retrieve only a metadata object's attributes, set the OMI_ALL_SIMPLE (8) flag in the GetMetadata request. The following is an example of a GetMetadata request that sets the OMI_ALL_SIMPLE flag:

```
<GetMetadata>
 <Metadata>
   <Column Id="A53TPPVI.A5000001"/>
 </Metadata>
 <NS>SAS</NS>
 <!--OMI_ALL_SIMPLE flag -->
 <Flags>8</Flags>
 <Options/>
</GetMetadata>
```

In the request:

- □ The <Metadata> element specifies simply a metadata type and an object instance identifier.
- □ The <NS> parameter specifies the namespace in which to process the request.
- □ The <Flags> element specifies the number representing the OMI_ALL_SIMPLE flag.

Here is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATA method. -->

<Column Id="A53TPPVI.A5000001" BeginPosition="0" ColumnLength="32"
  ColumnName="City" ColumnType="12" Desc="City of Sales Office"
  EndPosition="0" IsDiscrete="0" IsNullable="0" LockedBy=""
  MetadataCreated="05Feb2002:09:37:00" MetadataUpdated="05Feb2002:09:37:00"
  Name="City" SASAttribute="" SASColumnLength="32" SASColumnName="City"
  SASColumnType="C" SASExtendedColumnType="" SASExtendedLength="0"
  SASFormat="$Char32." SASInformat="$32." SASPrecision="0" SASScale="0"
  SortOrder="" SummaryRole=""/>
```

The GetMetadata method retrieves all possible attributes for the specified Column object, including those for which values have not been defined. To limit the output to attributes that have values, additionally set the OMI_SUCCINCT (2048) flag. Any attributes that are null or empty will be omitted from the returned metadata.

Retrieving Properties of Associated Objects

To retrieve properties for associated objects, the GetMetadata method supports the OMI_TEMPLATES (4) flag and templates. A template is an additional property string that is specified in the <Options> element in a <Templates> element. The default behavior of the GetMetadata method is to return specified properties for the metadata object identified in the <Metadata> element and the Id= and Name= attributes for any associated objects. That is, any attributes specified for associated (nested) objects in the main property string are ignored.

A template enables you to request additional attributes for the main object in the GetMetadata request as well as specific attributes for associated objects and additional associated objects. Any properties identified in the template are retrieved in addition to the properties requested in the <Metadata> element or requested by other GetMetadata flags.

The following is an example of a GetMetadata request that specifies a template.

```
<GetMetadata>
 <Metadata>
   <Column Id="A53TPPVI.A5000001" Name="" Desc="" ColumnType=""
     SASFormat="">
    <Table/>
   </Column>
 </Metadata>
 <NS>SAS</NS>
 <!-- OMI_TEMPLATE -->
 <Flags>4</Flags>
 <Options>
  <Templates>
    <Column Id="" ColumnLength="" BeginPosition="" EndPosition=""/>
    <PhysicalTable Id="" Name="" Desc="" DBMSType="" MemberType=""/>
  </Templates>
 </Options>
</GetMetadata>
```

In the request, note the following:

- The <Metadata> element specifies a metadata type, an object instance identifier, four of the metadata type's attributes, and an association name.
- The <NS> element specifies the namespace in which to process the request.
- The <Flags> element specifies the number representing the OMI_TEMPLATE flag.
- The <Options> element contains a <Template> element and two templates. The first template specifies additional attributes to retrieve for the Column object identified in the <Metadata> element. The second template specifies attributes to retrieve for the PhysicalTable object that is associated with the Column.

Here is an example of the output returned by the metadata server:

```
<!-- Using the GETMETADATA method. -->

<Column Id="A53TPPVI.A5000001" Name="City" Desc="City of Sales Office"
  ColumnType="12" SASFormat="$Char32." ColumnLength="32" BeginPosition="0"
  EndPosition="0">
<Table>
<PhysicalTable Id="A53TPPVI.A4000001" Name="Sales Offices"
  Desc="Sales offices in NW region" DBMSType="" MemberType=""/>
</Table>
</Column>
```

The request retrieved the values of the Name, Desc, ColumnType, SASFormat, ColumnLength, BeginPosition, and EndPosition attributes of the specified Column object. In addition, it retrieved the Id, Name, Desc, DBMSType, and MemberType attributes of the Column object's associated PhysicalTable object.

For information about how to create a template, see Using Templates.

Retrieving Subtypes

The GetMetadata method provides the OMI_INCLUDE_SUBTYPES (16) flag for retrieving the subtypes of a metadata object. A subtype is a metadata type that inherits properties from another metadata type and stores additional properties. The flag can be useful for retrieving common metadata for related metadata types.

OMI_INCLUDE_SUBTYPES cannot be set in a GetMetadata call unless OMI_TEMPLATES (4) is also set. When OMI_INCLUDE_SUBTYPES is set, the GetMetadata method returns the metadata requested in the <Templates> element for the metadata object identified in the <Metadata> parameter and any subtypes.

Combining GetMetadata Flags

When OMI_SUCCINCT (2048) is added to any flag combination, only attributes that are non-null and association containers that hold associated objects are returned.

When OMI_ALL (1) and OMI_ALL_SIMPLE (8) are set together, the behavior is the same as if OMI_ALL was set alone. The server returns all possible attributes for the requested object and the Id and Name attributes of all possible associated objects.

When OMI_ALL_SIMPLE (8) is set with OMI_TEMPLATE (4), the server returns all possible attributes for the specified object and attributes for associated objects that are specified in the template.

When OMI_ALL (1) is set with OMI_TEMPLATE (4), the server returns all possible attributes for the specified object, the Id and Name attributes of all possible associated objects, and any additional attributes for associated objects specified in the template.

When OMI_INCLUDE_SUBTYPES (16) is set with OMI_TEMPLATE (4), the server returns the properties requested in the template for the specified object and any subtypes of the specified object. When OMI_INCLUDE_SUBTYPES is set without OMI_TEMPLATE, it is ignored.

Filtering the Associated Objects that are Returned by a GetMetadata Request

The GetMetadata method supports search criteria in the property strings specified in both the <Metadata> element and in the <Templates> element to filter the associated objects that are retrieved by a given request. The search criteria enables you to select to retrieve only associated objects that match a specified attribute=value pair. The search strings are specified on the association name element of the XML property string in the form:

```
<AssociationName search="AttributeCriteria"/>
```

In the <Metadata> element, the search string would look like this:

```
<Metadata>
  <MetadataType>
    <AssociationName search="AttributeCriteria"/>
  </MetadataType>
</Metadata>
```

In the <Templates> element, the search string would look like this:

```
<Templates>
  <MetadataType>
    <AssociationName search="AttributeCriteria"/>
  </MetadataType>
</Templates>
```

AttributeCriteria supports the same syntax as the <XMLSelect> AttributeCriteria component. The criteria is described in “Attribute Criteria Component” on page 54.

An example of a GetMetadata request that specifies a search string is shown below:

```
<GetMetadata>
 <Metadata>
   <Column Id="A53TPPVI.A5000001" Name="" Desc="">
    <Indexes search="@IsUnique='Yes'"/>
   </Column>
 </Metadata>
 <NS>SAS</NS>
 <Flags>0</Flags>
 <Options/>
</GetMetadata>
```

The request retrieves Index objects associated with the specified Column object that have the value “Yes” in the IsUnique attribute.

When a search string is specified in both the <Metadata> element and in a template, the following rules apply:

- If the search criteria is specified for different association names in the <Metadata> and <Templates> elements, both will be applied.
- If the search criteria is specified for the same association name in both the <Metadata> and <Templates> elements, the template definition is ignored.

For an example of a GetMetadata request that specifies a search string in the <Template> element, see “Additional GetMetadata Examples” on page 69.

Using Templates

A template is a property string that you specify in a <Templates> element. In a GetMetadata or GetMetadataObjects method call, the <Templates> element is passed in the <Options> element to request additional properties for the metadata type specified in the main element of the method call, its subtypes, or its associated objects. The purpose of the template is to expand or to filter the properties requested by other GetMetadata and GetMetadataObjects parameters.

This section describes how to create a template and contains additional examples of GetMetadata and GetMetadataObject requests that specify templates.

Creating a Template

A template is an XML property string that describes the information that will be returned for a particular metadata type. The string includes the attributes and associations that should be returned for that type. The string should not request properties for nested subelements. Instead, additional templates should be created to request properties for associated objects.

As an example, the following is a template for a PhysicalTable object that returns its object Id, the date when the table was created, and the columns associated with the table:

```
<PhysicalTable Id="" CreatedDT="">
   <Columns/>
</PhysicalTable>
```

To retrieve properties for the requested Column objects, you would submit an additional template that looks like this:

```
<Column Name="" SASFormat=""/>
```

The metadata server will retrieve the Name and SASFormat attributes for the column objects requested by the first template.

Templates are passed to the metadata server in a <Templates> element in the <Options> element of a method call. When the <Templates> element is used, the OMI_TEMPLATE (4) flag (or other appropriate template flag) must also be set to instruct the metadata server to look for the element. The following is an example of a <Templates> element that passes the two templates previously described:

```
<Templates>
   <PhysicalTable Id="" CreatedDT="">
     <Columns/>
   </PhysicalTable>
   <Column Name="" SASFormat=""/>
</Templates>
```

The metadata type specified in a template can be the same one specified in the <Metadata> element of the GetMetadata request (or the <Type> element in a GetMetadataObjects method call), a subtype, or the metadata type of an associated object. In the preceding examples, the object requested in the main element is assumed to be the PhysicalTable metadata type.

The order of the templates in the <Templates> element is not important unless the OMI_INCLUDE_SUBTYPES (16) flag is also set. The default behavior of the metadata server is to search for objects of every type listed in the <Templates> element, and to retrieve the specified properties if found. When OMI_INCLUDE_SUBTYPES is set, the metadata server cycles through the templates iteratively, beginning with the first template and proceeding in order to the last, and retrieves the specified properties of the specified type and its subtypes. If a template for a subtype is found before one for its supertype, then the subtype's template is applied, and no more searching is done for that particular type.

Using a Template to Specify Search Criteria

The GetMetadata method supports search criteria on association names both in the metadata property strings specified in the <Metadata> element and in a template to filter the associated objects that are retrieved by a given request. The search criteria enable you to select to retrieve only associated objects matching a specified attribute/ value pair.

An example of a template that specifies search criteria is:

```
<PhysicalTable Id="">
   <Columns search="@SASAttribute='XV_A_UNICODE'"/>
</PhysicalTable>
```

This example specifies to retrieve only Column objects that have a value of "XV_A_UNICODE" in the SASAttribute attribute, meaning that the columns they describe support unicode data. For a detailed description of search criteria syntax, and for information about the behavior when a search string is specified in both the <Metadata> element and a template, see "Filtering the Associated Objects that are Returned by a GetMetadata Request" on page 67.

Additional GetMetadata Examples

The following is an example of a GetMetadata request that specifies search criteria in both the <Metadata> element and in a template. Even though the search criteria are specified on the same association name, both requests are honored because they specify different attribute criteria.

```
<GetMetadata>
 <Metadata>
  <Document Id="A5000002.A7000001">
   <ResponsibleParties search="@Name='Jim'"/>
  </Document>
 </Metadata>
 <NS>SAS</NS>
 <Flags>4</Flags>
 <Options>
  <Templates>
   <Document Id="" Name="" TextType="">
    <ResponsibleParties search="@Role='owner'"/>
   </Document>
  </Templates>
 </Options>
 </GetMetadata>
```

The following is an example of a GetMetadata request that filters associated objects at several levels:

```
<GetMetadata>
 <Metadata>
  <Document Id="A5000002.A7000001"/>
 </Metadata>
 <NS>SAS</NS>
 <Flags>4</Flags>
 <Options>
   <Templates>
      <Document Id="" Name="" TextType="">
        <ResponsibleParties search="@Role='OWNER'"/>
      </Document>
      <ResponsibleParty Id="" Name="">
        <Persons search="@Name?'Joe'"/>
      </ResponsibleParty>
      <Person Id="" Name="" Title=""/>
   </Templates>
```

The first template requests attributes for a Document object and filters objects that have a ResponsibleParties association using the Role attribute. The second template requests attributes for the returned ResponsibleParty objects and specifies a second filter to retrieve only Person objects that have a Name attribute value of 'Joe'. The third template requests the Id, Name, and Title attributes of the returned Person objects.

Additional GetMetadataObjects Examples

In order to retrieve properties for the objects returned by the GetMetadataObjects method, you must set the OMI_GET_METADATA (256) flag and one or more other GetMetadata flags. When OMI_TEMPLATE (4) is set and a template is specified in a GetMetadataObjects request, the properties specified in the template are returned in addition to any properties requested by other flags and options. By including search criteria, a template can also be used to filter the associated objects that are retrieved.

The following is an example of a GetMetadataObjects request that uses templates to retrieve attributes for objects of the requested metadata type and their associated objects. The request retrieves the Id, Name, and TextType attributes of all Document objects in the named repository. In addition, the request retrieves the Id, Name, and Role attributes of all ResponsibleParty objects that are associated with the Document objects.

```
<GetMetadataObjects>
   <Reposid>A00000001.A50TC12Z</Reposid>
   <Type>Document</Type>
   <Objects/>
   <NS>SAS</NS>
   <!-- OMI_GET_METADATA(256) + OMI_TEMPLATE(4) -->
   <Flags>260</Flags>
   <Options>
      <Templates>
         <Document Id="" Name="" TextType="">
           <ResponsibleParties/>
         </Document>
         <ResponsibleParty Id="" Name="" Role=""/>
      </Templates>
   </Options>
</GetMetadataObjects>
```

The following is an example of a GetMetadataObjects request that uses an <XMLSelect> element to filter the initial set of objects that are retrieved and a template to filter the associated objects. The <XMLSelect> element specifies to retrieve only Document objects that contain the word 'Customer' in the Name attribute. The template specifies to retrieve only associated ResponsibleParty objects that have the Role attribute value of OWNER.

```
<GetMetadataObjects>
   <Reposid>A00000001.A50TC12Z</Reposid>
   <Type>Document</Type>
   <Objects/>
   <NS>SAS</NS>
<!-- OMI_XMLSELECT(128) + OMI_GET_METADATA(256) + OMI_TEMPLATE(4) -->
   <Flags>388</Flags>
   <Options>
      <XMLSelect search="@Name contains 'Customer'"/>
      <Templates>
         <Document Id="" Name="" TextType="">
           <ResponsibleParties search="@Role='OWNER'"/>
         </Document>
      </Templates>
   </Options>
</GetMetadataObjects>
```

P A R T 3

Using the Interface to Perform Repository Management Tasks

Chapter ***8*** . . . . **Creating Relationships Between Repositories** *75*

Chapter ***9*** . . . . **Creating a Repository on an External DBMS** *87*

Chapter ***10*** . . . . **Invoking a Repository Audit Trail** *93*

Chapter ***11*** . . . . **Metadata Locking Options** *105*

Chapter ***12*** . . . . **Using the Change Management Facility** *107*

Chapter ***13*** . . . . **Repository Maintenance Tasks** *129*

CHAPTER 8 Creating Relationships Between Repositories

Overview **75**
Creating Dependency Associations **76**
    Example of Adding a Dependency to a Repository **77**
Creating Cross-Repository References **79**
    Example **79**
Querying Dependency Associations **81**
    Example of Querying Dependency Associations for a Single Repository **81**
    Example of Querying Dependency Associations for All Repositories **81**
Querying Cross-Repository References **82**
    Example of Querying Cross-Repository References **83**
Querying Objects Across Multiple Repositories (Federated Query) **83**
    Example of a Federated Query **84**
Deleting a Dependency Association **84**
    Example **85**
Deleting a Cross-Repository Reference **85**
    Example **85**

Overview

The SAS Open Metadata Architecture permits relationships to be defined between repositories.

□ A relationship links two repositories so that you can create cross-repository references between the repositories. A *cross-repository reference* is an association that exists between metadata objects in different repositories. An example of a cross-repository reference is a UsingPackages association that is created between a SASLibrary object that exists in a Corporate repository and a SASLibrary object that exists in a Department repository. A cross-repository reference cannot be created unless a relationship exists between the repositories.

□ When linking multiple repositories, relationships can be used to create a repository chain. The existence of a chain enables you to query metadata objects across the repositories. For example, if a repository chain were defined that included a Corporate repository, a Department repository, and a Group repository, you could request to list all metadata objects of type SASLibrary that exist in these repositories from the perspective of any repository in the chain. A query that includes multiple repositories is known as a “federated query”.

A relationship is created by defining a *dependency association* between two repositories. A dependency association is an association that marks a repository as “using” or “being used by” another repository.

Note: A user must have Administrative User status on the SAS Metadata Server in order to add a dependency association to a repository. For more information about this privilege, see the *SAS Intelligence Platform: Security Administration Guide*. △

Creating Dependency Associations

A dependency association is created by defining a DependencyUses or a DependencyUsedBy association between two repository objects. A repository object is an object that is created using a metadata type from the REPOS namespace of the SAS Open Metadata Interface. The only repository metadata type supported at this time is RepositoryBase.

- □ A repository that is defined as having a *DependencyUses* association to another repository is said to *use* the other repository.
- □ A repository that is defined as having a *DependencyUsedBy* association to another repository is said to be *used by* the other repository.

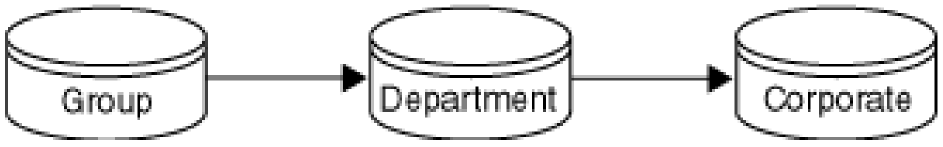
The “direction” of the association is significant in two ways:

- □ Cross-repository references are stored in the repository that has the DependencyUses association. Therefore, queries of cross-repository references in the repository that has a DependencyUses association are much faster than queries of the repository that has the DependencyUsedBy association. When defining a dependency association between two repositories, define the DependencyUses association for the repository that is expected to be queried the most frequently.
- □ In a federated query, the “uses” and “used by” relationships determine what repositories are included in the object search. For example, if a repository chain were defined such that a Group repository had a DependencyUses association to a Department repository, and the Department repository had a DependencyUses association to a Corporate repository, a query of each repository would have the results summarized in Table 1. A graphic representation of the repository chain is provided in Figure 1.

Table 8.1 Repositories Searched in a Federated Query

Repository Queried	**Flag**	**Repositories Searched**
Group	OMI_DEPENDENCY_USES	All
Group	OMI_DEPENDENCY_USED_BY	Group
Department	OMI_DEPENDENCY_USES	Department, Corporate
Department	OMI_DEPENDENCY_USED_BY	Department, Group
Corporate	OMI_DEPENDENCY_USES	Corporate
Corporate	OMI_DEPENDENCY_USED_BY	All

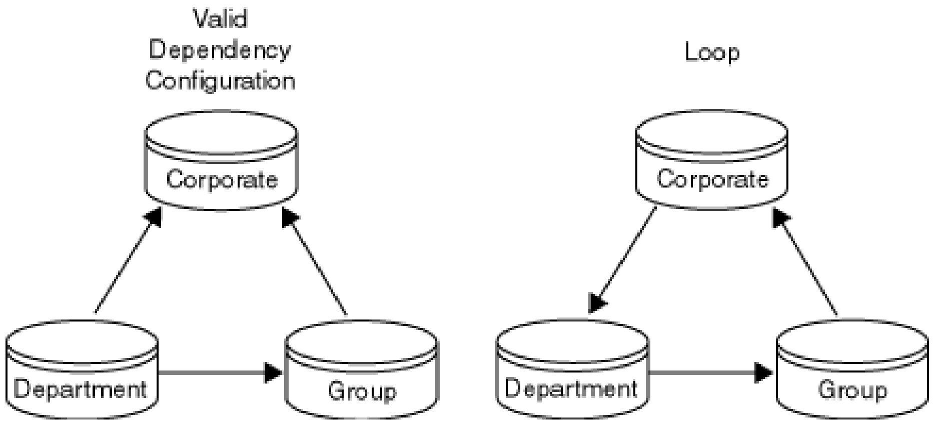
Display 8.1 Representation of a Repository Chain



Rules for creating dependency associations are as follows:

- □ The repositories in a relationship must use the same metadata server.
- □ A repository chain cannot contain loops or cycles. Example of a Valid Configuration and a Loop illustrates what is considered a valid configuration and what is considered a loop.

Display 8.2 Example of a Valid Configuration and a Loop



- □ When a repository chain is defined, cross-repository references can be created only between repositories that have a direct dependency. For example, if a dependency association is defined between a Corporate repository and a Department repository, and another is defined between the Department repository and a Group repository, then you cannot create cross-repository references between the Corporate repository and the Group repository. In order to create references between them, you must also define a dependency association between the Corporate and the Group repositories.

A dependency association can be created when a repository is created (using the AddMetadata method) or it can be added to an existing repository (using the UpdateMetadata method). For an example of how a dependency association is created, see "Example of Adding a Dependency to a Repository" on page 77. To learn more about cross-repository references, see "Creating Cross-Repository References" on page 79. To learn more about federated queries, see "Querying Objects Across Multiple Repositories (Federated Query)" on page 83.

Example of Adding a Dependency to a Repository

The following example creates three repositories – Corporate, Department, and Group1 – then after the repositories are created, uses the UpdateMetadata method to add relationships between them.

This method call creates the repositories:

```
<AddMetadata>
  <Metadata>
   <!-- Create Corporate repository -->
   <RepositoryBase Name="corporate" Desc="Corporate repository"
              Path="c:\testdat\xrpos\corporate"/>
   <!-- Create Department repository -->
   <RepositoryBase Name="dept" Desc="Department repository"
              Path="c:\testdat\xrpos\dept"/>
   <!-- Create Group 1 repository -->
   <RepositoryBase Name="group1" Desc="Group1 repository"
              Path="c:\testdat\xrpos\group1"/>
   </Metadata>
   <Reposid>A0000001.A0000001</Reposid>
   <NS>REPOS</NS>
   <!-- OMI_TRUSTED_CLIENT flag -->
   <Flags>268435456</Flags>
   <Options/>
</AddMetadata>
```

This is the output returned by the metadata server:

```
<RepositoryBase Name="corporate" Desc="Corporate repository"
Path="c:\testdat\xrpos\corporate" Id="A0000001.A3WB4KWB" Access="0" RepositoryType=""/>
<RepositoryBase Name="dept" Desc="Department repository"
Path="c:\testdat\xrpos\dept" Id="A0000001.A3POH2A5" Access="0" RepositoryType=""/>
<RepositoryBase Name="group1" Desc="Group1 repository"
Path="c:\testdat\xrpos\group1" Id="A0000001.A39V7REZ" Access="0" RepositoryType=""/>
```

The following method call creates dependency associations between the repositories.

```
<UpdateMetadata>
  <Metadata>
   <!-- Update Corporate repository -->
   <RepositoryBase Id="A0000001.A3WB4KWB">
      <DependencyUsedBy>
      <!-- Specify Department repository -->
         <RepositoryBase Objref="A0000001.A3POH2A5"/>
      </DependencyUsedBy>
   </RepositoryBase>
   <!-- Update Department repository -->
   <RepositoryBase Id="A0000001.A3POH2A5"/>
      <DependencyUsedBy>
        <!-- Specify Group 1 repository -->
        <RepositoryBase Objref="A0000001.A39V7REZ"/>
      </DependencyUsedBy>
   </RepositoryBase>
   </Metadata>
   <NS>REPOS</NS>
   <!-- OMI_TRUSTED_CLIENT flag -->
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

Here is the output returned by the metadata server:

```
<RepositoryBase Id="A0000001.A3WB4KWB">
 <DependencyUsedBy>
     <RepositoryBase Objref="A0000001.A3POH2A5"/>
 </DependencyUsedBy>
</RepositoryBase>
<RepositoryBase Id="A0000001.A3POH2A5">
  <DependencyUsedBy>
    <RepositoryBase Objref="A0000001.A39V7REZ"/>
  </DependencyUsedBy>
</RepositoryBase>
```

A DependencyUsedBy association is created between the Corporate repository and the Department repository and between the Department repository and the Group1 repository. This means the Group1 repository uses the Department repository and the Department repository uses the Corporate repository. In the method calls, note:

- □ the AddMetadata request specifies the repository manager identifier (A0000001.A0000001) in the <Reposid> element
- □ both calls specify the REPOS namespace
- □ both calls specify the OMI_TRUSTED_CLIENT flag (268435456), which is required for write operations.

Creating Cross-Repository References

As previously stated, a cross-repository reference is an association that is created between objects in different repositories. A dependency association must have been established between the repositories in question before a cross-repository reference can be created.

Like other associations, cross-repository references can be added both to objects that already exist, or can be defined when the objects are created.

- □ To create a cross-repository reference to an existing object, simply specify its repository identifier along with its object instance identifier in the form *reposid.instanceid* in the ObjRef attribute of the XML subelement defining the association.
- □ To create a cross-repository reference and a new object in a foreign repository, specify the repository identifier and a symbolic name for the object using the Id attribute. Use of the Id attribute with a symbolic name is equivalent to passing a null value in the Id attribute; it indicates to the server that a new object is to be created. A symbolic name is an alias that is preceded by $ (dollar sign). The alias enables you to refer back to the object that is being created before the server assigns it an identifier, and is automatically replaced by the real identifier when the object is created in the specified repository.

Example

The following XML method calls create a SASLibrary object in each of the three repositories and creates cross-references between the objects.

This method call creates a SASLibrary object in the Group 1 repository named Group1Lib:

```
<AddMetadata>
 <Metadata>
 <!-- Metadata specifies library object named Group1Lib -->
    <SASLibrary Name="Group1Lib" Desc="Group 1 Library"/>
 </Metadata>
 <!-- Reposid specifies Group 1 repository -->
 <Reposid>A0000001.A39V7REZ</Reposid>
 <NS>SAS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -->
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

This is the information returned by the metadata server:

```
<SASLibrary Name="Group1Lib" Desc="Group 1 Library" Id="A39V7REZ.A1000001"/>
```

This method call creates a SASLibrary object in the Corporate repository named CorpLib:

```
<AddMetadata>
 <Metadata>
 <!-- Metadata specifies library object named CorpLib -->
   <SASLibrary Name="CorpLib" Desc="Corporate Library"/>
 </Metadata>
 <!-- Reposid specifies the Corporate repository -->
 <Reposid>A0000001.A3WB4KWB</Reposid>
 <NS>SAS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -->
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

This is the output returned by the metadata server:

```
<SASLibrary Name="CorpLib" Desc="Corporate Library" Id="A3WB4KWB.A1000001"/>
```

This method call creates a SASLibrary object in the Department repository named DeptLib and creates cross-repository references between DeptLib, CorpLib, and Group1Lib. The cross-repository references are created at the same time as DeptLib because library will have an association to the other two libraries and the Department repository has a dependency association with both of the other repositories.

```
<AddMetadata>
 <Metadata>
  <!-- Metadata specifies library object named DeptLib -->
  <SASLibrary Name="DeptLib" Desc="Department library">
    <!-- The next two statements create an association to DeptLib -->
    <UsingPackages>
       <!-- ObjRef= specifies the Corporate library -->
       <SASLibrary ObjRef="A3WB4KWB.A1000001" Name="CorpLib"/>
    </UsingPackages>
    <UsedByPackages>
      <!-- ObjRef= specifies the Group1Lib -->
      <SASLibrary ObjRef="A39V7REZ.A1000001" Name="Group1Lib"/>
    </UsedByPackages>
  </SASLibrary>
 </Metadata>
 <!-- Reposid specifies the Department repository -->
 <Reposid>A0000001.A3POH2A5</Reposid>
 <NS>SAS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -->
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

Here is the output returned by the metadata server:

```
<SASLibrary Name="DeptLib" Desc="Department library" Id="A3POH2A5.A1000001">
  <UsingPackages>
    <SASLibrary ObjRef="A3WB4KWB.A1000001" Name="CorpLib"/>
  </UsingPackages>
  <UsedByPackages>
    <SASLibrary ObjRef="A39V7REZ.A1000001" Name="Group1Lib"/>
  </UsedByPackages>
```

```
</SASLibrary>
```

A UsingPackages association is created between DeptLib and CorpLib. A UsedByPackages association is created between DeptLib and Group1Lib.

Querying Dependency Associations

Information about dependency associations is stored in the repository manager and can be retrieved by using the GetMetadata method or the GetMetadataObjects method.

- Use the GetMetadata method to retrieve dependency information for a specific repository.
- Use the GetMetadataObjects method to retrieve dependency information for all repository objects in the repository manager.

When GetMetadataObjects is used, the OMI_GET_METADATA (256) flag and a GetMetadata flag that enables you to retrieve associations, such as OMI_ALL (1) or OMI_TEMPLATE (4), must also be set.

Example of Querying Dependency Associations for a Single Repository

The following is an example of a GetMetadata request that queries the dependency associations defined for the Corporate repository.

```
<GetMetadata>
 <Metadata>
 <!-- Corporate repository -->
 <RepositoryBase Id="A0000001.A3WB4KWB" Name="corporate">
   <DependencyUses/>
   <DependencyUsedBy/>
 </RepositoryBase>
 </Metadata>
 <NS>REPOS</NS>
 <Flags>0</Flags>
 <Options/>
</GetMetadata>
```

Here is the output received from the metadata server:

```
<RepositoryBase Id="A0000001.A3WB4KWB" Name="corporate">
  <DependencyUses/>
  <DependencyUsedBy>
     <RepositoryBase Id="A0000001.A3POH2A5" Name="dept" Desc="Department repository"/>
  </DependencyUsedBy>
</RepositoryBase>
```

The Corporate repository does not have any DependencyUses associations defined for it. It has one DependencyUsedBy association to the Department repository.

Example of Querying Dependency Associations for All Repositories

The following is an example of a method call that retrieves the dependency associations defined for all repositories registered in a repository manager:

```
<GetMetadataObjects>
 <!--Specify repository manager identifier -->
 <Reposid>A0000001.A0000001</Reposid>
 <Type>RepositoryBase</Type>
 <Objects/>
 <NS>REPOS</NS>
 <!-- Specify OMI_GET_METADATA (256) + OMI_TEMPLATE (4) flags -->
 <Flags>260</Flags>
 <Options>
  <Templates>
    <RepositoryBase Id="" Name="" Desc="">
     <DependencyUses/>
    </RepositoryBase>
  </Templates>
</Options>
</GetMetadataObjects>
```

In the call, note:

- the <Reposid> element specifies the repository manager identifier
- the <Type> element specifies the RepositoryBase metadata type
- the <Flags> element specifies OMI_GET_METADATA (256) and OMI_TEMPLATE (4)
- the <Options> element includes a <Templates> element that requests the Id=, Name=, and Desc= attributes and all DependencyUses associations found for each object.

The output returned by the metadata server is as follows:

```
<RepositoryBase Id="A0000001.A3WB4KWB" Name="corporate" Desc="Corporate repository">
 <DependencyUses/>
</RepositoryBase>
<RepositoryBase Id="A0000001.A3POH2A5" Name="dept" Desc="Department repository">
 <DependencyUses>
  <RepositoryBase Id="A0000001.A3WB4KWB" Name="corporate" Desc="Corporate repository">
 <DependencyUses/>
</RepositoryBase>
</DependencyUses>
</RepositoryBase>
<RepositoryBase Id="A0000001.A39V7REZ" Name="group1" Desc="Group1 repository">
<DependencyUses>
<RepositoryBase Id="A0000001.A3POH2A5" Name="dept" Desc="Department repository">
<DependencyUses>
<RepositoryBase Id="A0000001.A3WB4KWB" Name="corporate" Desc="Corporate repository">
<DependencyUses/>
</RepositoryBase>
</DependencyUses>
</RepositoryBase>
</DependencyUses>
</RepositoryBase>
```

Querying Cross-Repository References

Information about cross-repository references is obtained by using the GetMetadata method. The GetMetadata method retrieves specified attributes and associations for a specific metadata object. Because cross-repository references are stored in the repository that has a DependencyUses association, no additional flags are required to retrieve cross-repository references when a repository that has a DependencyUses association is queried. However, when querying a repository that has a DependencyUsedBy association, the OMI_DEPENDENCY_USED_BY (16384) flag must be set to retrieve the cross-repository references. The OMI_DEPENDENCY_USED_BY flag instructs the metadata server to search the partner repository's association list.

Example of Querying Cross-Repository References

The following example queries the Department repository for objects that have UsingPackages and UsedByPackages associations defined.

```
<GetMetadata>
 <Metadata>
  <!-- Specify DeptLib and request information about the associations -->
  <SASLibrary Id="A3POH2A5.A1000001">
   <UsingPackages/>
   <UsedByPackages/>
  </SASLibrary>
 </Metadata>
 <NS>SAS</NS>
 <!-- No flags are included-->
 <Flags>0</Flags>
 <Options/>
</GetMetadata>
```

Here is the output returned by the metadata server:

```
<SASLibrary Id="A36LIBAV.A1000001">
  <UsingPackages>
    <SASLibrary Id="A3ZX5267.A1000001" Name="CorpLib"
     Desc="Corporate Library"/>
  </UsingPackages>
  <UsedByPackages/>
</SASLibrary>
```

Note that the server returns information about the cross-reference between CorpLib and DeptLib but not about DeptLib and Group1Lib. This is because information about cross-repository references is stored in the repository that has a DependencyUses association, and the Department repository has a DependencyUsedBy association to the Group1 repository.

Querying Objects Across Multiple Repositories (Federated Query)

When a repository chain has been defined, you can retrieve all objects of a specified type from all or some of the repositories in the chain by using the GetMetadataObjects method. This is referred to as a federated query. To perform a federated query, simply specify the metadata type of the objects that you want to retrieve in the <Type> element, then set one or both of the OMI_DEPENDENCY_USES (8192) or OMI_DEPENDENCY_USED_BY (16384) flags.

- OMI_DEPENDENCY_USED_BY instructs the metadata server to search for objects in repositories that have a DependencyUsedBy association in relation to the repository in which the request was issued.

- □ OMI_DEPENDENCY_USES instructs the metadata server to search repositories that have a DependencyUses association in relation to the repository in which the request was issued.
- □ When set together, the flags instruct the server to search repositories on both sides of the repository chain.

Note that queries that cross three or more repositories have more overhead associated with them than a query between two repositories. In addition, a query that sets the OMI_DEPENDENCY_USES flag is considerably faster than one that sets the OMI_DEPENDENCY_USED_BY flag.

The default behavior of the GetMetadataObjects method is to return general, identifying information for each object of the specified type. To retrieve additional properties for each type, you can set the OMI_GET_METADATA (256) flag and one or more other GetMetadata flags. However, exercise caution when using these flags. When a GetMetadata request is issued from within a federated query, the server retrieves the specified properties *for each object* returned by GetMetadataObjects in each repository, *including any cross-repository references* defined for each object, under the constraints described in "Querying Cross-Repository References" on page 82. When repositories that have a DependencyUsedBy association are queried, this can result in significant processing overhead.

Example of a Federated Query

The following is an example of a federated query. Issued from the Corporate repository, it retrieves all SASLibrary objects in repositories that have a DependencyUsedBy association in the repository chain.

```
<GetMetadataObjects>
<!-- Corporate repository -->
<Reposid>A0000001.A3WB4KWB</Reposid>
<Type>SASLibrary</Type>
<Objects/>
<NS>SAS</NS>
<!-- OMI_DEPENDENCY_USED_BY flag  -->
<Flags>16384</Flags>
<Options/>
</GetMetadataObjects>
```

Here is the output returned by the metadata server:

```
<Objects>
  <SASLibrary Id="A3WB4KWB.A1000001" Name="CorpLib"/>
  <SASLibrary Id="A3POH2A5.A1000001" Name="DeptLib"/>
  <SASLibrary Id="A39V7REZ.A1000001" Name="Group1Lib"/>
</Objects>
```

No GetMetadata flags are set; therefore, the server retrieves only the Id and Name attributes of each object.

Deleting a Dependency Association

A dependency association is deleted by using the UpdateMetadata method.

Example

The following method call removes the dependency association between the Department repository and the Group 1 repository. Specifying the Function="Replace" directive on the DependencyUsedBy association name without specifying any association subelements deletes any associations of that name defined for the specified RepositoryBase object.

```
<UpdateMetadata>
   <Metadata>
    <!--Metadata specifies Department repository -->
    <RepositoryBase Id="A0000001.A3POH2A5">
      <DependencyUsedBy Function="Replace"/>
   </RepositoryBase>
   </Metadata>
   <Reposid>A0000001.A0000001</Reposid>
   <NS>REPOS</NS>
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

Here is the output returned by the metadata server:

```
<RepositoryBase Id="A0000001.A3POH2A5">
  <DependencyUsedBy Function="Replace"/>
</RepositoryBase>
```

The request deletes all DependencyUsedBy associations that might have been defined for the Department repository.

Deleting a Cross-Repository Reference

Cross-repository references are also removed by using the UpdateMetadata method, from the repository that has a DependencyUses association.

Example

The following UpdateMetadata request removes the UsingPackages and UsedByPackages associations defined for DeptLib in the Department repository. Specifying the Function="Replace" directive on each association name without specifying any association subelements deletes any associations of those names defined for the specified SASLibrary object.

```
<UpdateMetadata>
   <Metadata>
    <!-- Metadata specifies DeptLib and associations to be deleted -->
    <SASLibrary Id="A3POH2A5.A1000001" Name="DeptLib">
      <UsingPackages Function="Replace"/>
      <UsedByPackages Function="Replace"/>
   </SASLibrary>
   </Metadata>
   <NS>SAS</NS>
   <!-- OMI_TRUSTED_CLIENT flag -->
   <Flags>268435456</Flags>
   <Options/>
</UpdateMetadata>
```

Here is the output returned by the metadata server:

```
<SASLibrary Id="A3POH2A5.A1000001" Name="DeptLib">
  <UsingPackages Function="Replace"/>
  <UsedByPackages Function="Replace"/>
</SASLibrary>
```

The cross-reference between CorpLib and DeptLib is removed, but the cross-reference between DeptLib and Group1Lib remains. This is because the Replace directive is executed on the current repository and the cross-reference between DeptLib and Group1Lib is stored in the Group 1 repository (the repository that has the DependencyUses association in that particular association). To remove the cross-reference between DeptLib and Group1Lib, you must update the Group1 repository.

CHAPTER 9 Creating a Repository on an External DBMS

Overview of Creating a Repository on an External DBMS **87**
Software Requirements **87**
Host Requirements **88**
DBMS Requirements **88**
Repository Registration Requirements **88**
Oracle Connection Options **88**
DB2 Connection Options **90**
Using a Repository on an External DBMS **91**
Example of Registering a Repository on an External DBMS **91**
    Register an Oracle Repository **91**
    Register a DB2 Repository **91**

Overview of Creating a Repository on an External DBMS

The SAS Metadata Server enables you to create and use SAS metadata repositories on the Oracle and IBM DB2 external database management systems.

SAS metadata repositories are SAS libraries. Like base engine libraries, DBMS libraries and tables are accessed by passing engine-connection and LIBNAME options to the appropriate LIBNAME engine.

You create SAS metadata repositories on an external DBMS by specifying an alternate engine and passing SAS/ACCESS LIBNAME options at repository registration. The SAS Metadata Server repository manager is also a SAS metadata repository. You can define the server's repository manager in an external DBMS by specifying an alternate engine and passing SAS/ACCESS LIBNAME options in the omaconfig.xml server configuration file. For information about modifying the omaconfig.xml file, see the *SAS Intelligence Platform: System Administration Guide*.

Software Requirements

A host that will create or access a repository that exists on an external DBMS must have SAS software, the appropriate DBMS client software, and the appropriate SAS/ACCESS interface software. For example, in addition to SAS 9.1,

- an Oracle client needs the latest version of Oracle Client software and SAS/ACCESS Interface to Oracle software
- a DB2 client needs the latest version of DB2 Client software and SAS/ACCESS Interface to DB2 under UNIX and PC hosts software.

The SAS/ACCESS software and DBMS software must be installed on the same machine as SAS software.

Host Requirements

Both SAS/ACCESS to DB2 software and SAS/ACCESS to Oracle software use shared libraries. When a metadata server is running in a UNIX host environment, you must specify the location of the shared libraries in a system environment variable, and sometimes indicate the software version of the DBMS that you have installed at your site. For DB2, you must also set the INSTHOME environment variable to your DB2 home directory. For Oracle, you must set the ORACLE_HOME environment variable to your Oracle home directory.

The environment variables are platform-specific. See the *Configuration Guide for SAS Foundation for UNIX Environments* for information about the environment variables that are appropriate for your environment. This document is included in your SAS Installation Kit.

DBMS Requirements

The libraries in which repositories will be created and their subordinate tables can be created by the metadata server, via SAS/ACCESS software, or you can create the tables in the database before registering a repository.

Repository Registration Requirements

The metadata server uses the following parameters to register (create) a repository or repository manager on an external DBMS:

ENGINE=	specifies the engine to use to access the repository. This can be the default base engine or a SAS/ACCESS engine, such as Oracle or DB2.
NAME=	is a name for the repository. The repository name is required.
DESC=	is an optional description of the repository.
PATH=	is the location of the repository directory. When creating a repository on an external DBMS, this parameter is left blank. The location of the DBMS table is identified using database-specific engine-connection and SAS/ACCESS LIBNAME options in the *Options* parameter.
OPTIONS=	specifies options for accessing the external DBMS. For more information, see “Oracle Connection Options” on page 88 and “DB2 Connection Options” on page 90.

Oracle Connection Options

SAS/ACCESS Interface to Oracle requires the following engine-connection and LIBNAME options to connect to and register a repository on Oracle.

PATH=
: specifies an alias representing the Oracle driver, node, and database. If you do not know how to create an alias representing the necessary Oracle driver, node, and database for your repository, ask your database administrator to provide you with one.

USER=
: specifies an Oracle user name. If the user name contains blanks or national characters, enclose the name in quotation marks. If you omit an Oracle user name and password, the default Oracle user ID OPS$sysid is used, if it is enabled. USER= must be used with PASSWORD=.

PASSWORD=
: specifies an Oracle password that is associated with the Oracle user name. If you omit PASSWORD=, the password for the default Oracle user ID OPS$sysid is used, if it is enabled.

CONNECTION=shared
: specifies that all tables that are opened for reading by this LIBNAME or libref share this connection.

DBCHAR_CONSTANT_IS_SPOOFED=YES
: this option is required and is only valid when used for access to SAS Metadata Repositories by the Oracle engine.

INSERTBUFF=1
: specifies the number of rows in a single Oracle insert operation. A value of 1 of is required.

PRESERVE_NAMES=YES
: preserves spaces, special characters, and mixed case in DBMS column and table names.

READBUFF=1
: specifies the number of rows in a single Oracle fetch. A value of 1 of is required.

REREAD_EXPOSURE=YES
: specifies that the SAS/ACCESS engine will behave like a random access engine for the scope of the connection.

SCHEMA=*schema_name*
: enables you to register multiple repositories using the same Oracle user account. When SCHEMA= is omitted, the software uses the default schema, which is the requesting user ID, to create the repository. A *schema_name* such as “SASrmgr” is recommended when creating the repository manager. The *schema_name* must be a valid SAS name that is unique for the USER=, PASSWORD=, and PATH.

SPOOL=NO
: prevents spooling in the Oracle engine. Spooling data by the Oracle engine is unnecessary because the SAS Metadata Server uses the SAS In Memory Database for the repository tables. Although the SAS Metadata Server should not cause spooling to occur in the Oracle engine, explicitly setting the option to NO should guarantee that no spooling is done.

UTILCONN_TRANSIENT=NO
: specifies that a utility connection is maintained for the lifetime of the libref.

For a more detailed description of Oracle engine-connection and LIBNAME options, see “SAS/ACCESS LIBNAME Statement: Oracle Specifics” in the *SAS Language Reference: Dictionary*.

DB2 Connection Options

The metadata server requires that you specify the following engine-connection and LIBNAME options to connect to and create a repository on DB2.

DATABASE= (DB=)*database_name*
: specifies the DB2 data source or database to which you want to connect.

USER=*userid*
: enables you to connect to a DB2 database with a user ID that is different from the user ID requesting the connection. The USER= and PASSWORD= connections are optional in DB2. If you specify USER=, you must also specify PASSWORD=. If USER= is omitted, your default user ID for your operating environment is used.

PASSWORD=*passwd*
: specifies the DB2 password that is associated with your DBMS user ID, if the USER= option is specified.

CONNECTION=SHARED
: specifies that all tables that are opened for reading by this LIBNAME or libref share this connection.

DBCHAR_CONSTANT_IS_SPOOFED=YES
: this option is required and is only valid when used for access to SAS Metadata Repositories by the DB2 engine.

PRESERVE_NAMES=YES
: preserves spaces, special characters, and mixed case in DBMS column and table names.

REREAD_EXPOSURE=YES
: specifies that the SAS/ACCESS engine will behave like a random access engine for the scope of the connection.

SCHEMA=*schema_name*
: enables you to register multiple repositories using the same DB2 user account. When SCHEMA= is omitted, the software uses the default schema, which is the requesting user ID, to create the repository. A *schema_name* such as "SASrmgr" is recommended when creating the repository manager. The *schema_name* must be a valid SAS name that is unique for the USER=, PASSWORD=, and DB=.

SPOOL=NO
: prevents spooling in the DB2 engine. Spooling data by the DB2 engine is unnecessary because the SAS Metadata Server uses the SAS In Memory Database for the repository tables. Although the SAS Metadata Server should not cause spooling to occur in the DB2 engine, explicitly setting the option to NO should guarantee that no spooling is done.

INSERTBUFF=1
: specifies the number of rows in a single DB2 insert operation. A value of 1 of is required.

READBUFF=0
: specifies the number of rows in each DB2 fetch. A value of 0 is required.

UTILCONN_TRANSIENT=NO
: specifies that a utility connection is maintained for the lifetime of the libref.

For a detailed description of these options, see “SAS/ACCESS LIBNAME Statement: DB2 Specifics” in the *SAS Language Reference: Dictionary*.

Using a Repository on an External DBMS

Client requests to a repository on an external DBMS are processed the same way as they are when the repository is a SAS library.

Example of Registering a Repository on an External DBMS

You can register a repository on an external DBMS by using the SAS Open Metadata Interface or by using SAS Management Console. The following are examples of registering a repository using the SAS Open Metadata Interface. In the requests, note that a repository is created by instantiating an object of metadata type RepositoryBase. For information about the metadata types used to represent repositories, see "REPOS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. For more information about the AddMetadata method, see "Methods for Reading and Writing Metadata (IOMI Class)" in the reference.

Register an Oracle Repository

The following method call creates a repository named Scratch1 in an Oracle database identified by the alias "alien". The request is formatted for the DoRequest method.

```
<AddMetadata>
 <Metadata>
 <RepositoryBase
   Engine="oracle"
   Name="scratch1"
   Desc="test repository"
   PATH=""
   Options="path=alien user=ot1 password=ot11
   reread_exposure=yes preserve_names=yes dbchar_constant_is_spoofed=yes
   connection=shared readbuff=1 insertbuff=1 spool=no utilconn_transient=no">
 </RepositoryBase>
 </Metadata>
 <Reposid>A0000001.A0000001</Reposid>
 <NS>REPOS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -- >
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

Register a DB2 Repository

The following method call creates a repository named Scratch1 in a DB2 database named "sample". The request is formatted for the DoRequest method.

```
<AddMetadata>
 <Metadata>
  <RepositoryBase
    Engine="db2"
    Name="scratch1"
    Desc="test repository"
    Path=""
    Options="db=sample user=ot1 password=Lupin1 reread_exposure=yes
    preserve_names=yes dbchar_constant_is_spoofed=yes
    connection=shared spool=no readbuff=0 insertbuff=1
    utilconn_transient=no">
  </RepositoryBase>
 </Metadata>
 <Reposid>A0000001.A0000001</Reposid>
 <NS>REPOS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -- >
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

The following example creates two repositories named Scratch2 and Scratch3 in a DB2 database called “sample”. Note the use of the SCHEMA= SAS/ACCESS LIBNAME option. When SCHEMA= is not used, the software uses the default schema, which is the user ID, to create the repository. The request is formatted for the DoRequest method.

```
<AddMetadata>
 <Metadata>
  <RepositoryBase
    Engine="db2"
    Name="scratch2"
    Desc="test repository 2"
    Path=""
    Options="db=sample schema=ot18 user=ot1 password=Lupin1
    reread_exposure=yes preserve_names=yes dbchar_constant_is_spoofed=yes
    connection=shared spool=no readbuff=0 insertbuff=1 utilconn_transient=no">
  </RepositoryBase>
  <RepositoryBase
    Engine="db2"
    Name="scratch3"
    Desc="test repository 3"
    Path=""
    Options="db=sample schema=ot19 user=ot1 password=Lupin1
    reread_exposure=yes preserve_names=yes dbchar_constant_is_spoofed=yes
    connection=shared spool=no readbuff=0 insertbuff=1 utilconn_transient=no">
  </RepositoryBase>
 </Metadata>
 <Reposid>A0000001.A0000001</Reposid>
 <NS>REPOS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -- >
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

CHAPTER 10 Invoking a Repository Audit Trail

Overview **93**
Starting the Audit Trail **94**
  AuditType Attribute **94**
  AuditPath Attribute **94**
  Audit File Format **95**
  Example of Using AddMetadata to Enable Auditing **96**
  Example of Using UpdateMetadata to Enable Auditing **96**
Physical versus Logical Deletion of Metadata Records **97**
  Example of Migrating Deleted Records **97**
Usage Considerations **97**
  Recovering Audit Records **98**
Restoring a Metadata Record on Windows Hosts **98**
  Example: Listing Audit Files **98**
  Example: Listing Audit File Variable Names **99**
  Example: Viewing Audit File Records **100**
  Example: Restoring Audit Records **101**
Deleting an Audit Trail **102**
Changing the Audit Trail Location **103**
Turning Off Auditing **103**

Overview

The SAS Metadata Server supports saving information about changes to metadata in a set of audit files. The information in the audit files can be used to restore the metadata to a previous state. The information in the audit files is referred to as an “audit trail.”

Auditing is performed on individual repositories and is enabled by specifying values for four new attributes for RepositoryBase metadata objects:

AuditType	turns auditing on and off and specifies the type of records that will be logged.
AuditPath	specifies an existing directory where the audit trail is to be created.
AuditEngine	specifies the engine with which to create the audit files.
AuditOptions	specifies engine connection options.

The audit trail stores information about added, deleted, and updated records and supports audit files created with the base engine. A subsequent release will support additional engines.

Starting the Audit Trail

Auditing is enabled by specifying values for a repository's AuditType and AuditPath attributes. Values for the AuditType and AuditPath attributes can be assigned in the AddMetadata method that creates a repository. Values can be added to existing repositories by using the UpdateMetadata method. The UpdateMetadata method is also used to change the audit trail location and to turn off auditing. For examples of how to issue the method calls, see "Example of Using AddMetadata to Enable Auditing" on page 96, "Example of Using UpdateMetadata to Enable Auditing" on page 96, "Changing the Audit Trail Location" on page 103, and "Turning Off Auditing" on page 103.

AuditType Attribute

The AuditType attribute is required in any method call related to auditing. In calls that turn auditing on and off, it specifies the action to perform and the type of records to audit. When a call is made to update an audit attribute, such as the AuditPath, the AuditType attribute enables auditing at the new location. Only one audit trail location is supported for a repository. Changing the AuditPath turns off auditing in the previous location and turns auditing on in the new location.

The AuditType attribute supports six values:

1	turns on auditing and writes an audit record for all added metadata records.
2	turns on auditing and writes an audit record for all deleted metadata records.
4	turns on auditing and writes an audit record for all updated metadata records.
7	turns on auditing and writes an audit record for all record types (Add, Delete, and Update).
0	(zero) turns off auditing and indicates that auditing has been disabled.
-1	a system-supplied value (representing a missing value) that indicates auditing has not been initiated for the repository.

When AuditType="2" is set, the audit trail writes an audit record for each metadata object that is directly or indirectly deleted from a repository. A metadata object is directly deleted when it is specified in a DeleteMetadata method call and can be indirectly deleted by the DeleteMetadata or UpdateMetadata method, if it is dependent on another object that is deleted. The DeleteMetadata method also supports flags that enable you to delete all objects in a repository, to unregister a repository, and to destroy a repository. Audit records are not written for DeleteMetadata calls that set these flags.

When AuditType="4" is set, the audit trail writes two audit records for each update transactions: a before-update image and an after-update image. For more information, see "Audit File Format" on page 95.

AuditPath Attribute

The AuditPath attribute is required to turn on auditing; omit it from method calls that disable auditing. AuditPath identifies the location to write the audit trail. The specified directory must exist, it must be empty, and it must be a different location than the repository directory. It is recommended that you use the same name for the AuditPath directory as the repository directory and create it in an Audit subdirectory of the server directory. For example:

```
repository path: omasvr/repository1

audit path: omasvr/audit/repository1
```

Storing the audit trail in a subdirectory of the server directory enables audit files to inherit the file and directory access permissions set for the server directory.

Audit File Format

The audit trail consists of a copy of the repository's metadata for the type of records being audited. For example, the audit trail stores a copy of all added, deleted, and updated metadata records.

In addition, each record has the following variables assigned to it:

ATID	contains a 36-character Global Unique Identifier (GUID). An example of a GUID is 46629670-59C4-4AE8-B089-2E861ED884C5.
ATIME	contains a datetime value indicating when the audit record was created.
ATYPE	contains a letter indicating the audit record type: □ "N" identifies an added (new) metadata record □ "D" identifies a deleted metadata record □ "B" identifies an before-update metadata record □ "A" identifies an after-update metadata record.
DELETED	contains a datetime value indicating when the record was deleted. Records that were logically deleted in a repository by previous releases of SAS software and migrated to the audit file will have the DELETED variable set to the datetime when the record was logically deleted. Otherwise, the DELETED value will be missing. For more information about migrating records from previous releases, see "Example of Migrating Deleted Records" on page 97.

The _ATID_ and _ATIME_ values in the audit file records are the same for all records created by a single method call. For example, all before- and after-record images for all metadata records updated by a single UpdateMetadata method call will have the same _ATID_ and _ATIME_ values. Also, the audit records for all metadata records created by a single AddMetadata call will have the same _ATID_ and _ATIME_ values, and the audit records for all metadata records deleted by a single DeleteMetadata method call will have the same _ATID_ and _ATIME_ values.

Audit records are stored according to metadata type in separate files in the audit directory. For example, all deleted PhysicalTable records are stored in a PhysicalTable container, deleted Column records are stored in a Column container, and so on. You can list the audit files created for a repository by using PROC DATASETS. PROC DATASETS can also be used to list the variables in an audit file. To read the records in an audit file, you use PROC PRINT. For more information, see "Example: Listing Audit Files" on page 98, "Example: Listing Audit File Variable Names" on page 99, and "Example: Viewing Audit File Records" on page 100.

Example of Using AddMetadata to Enable Auditing

The following is an example of an AddMetadata method call that creates a repository and turns on auditing. The call is formatted for the *inMetadata* parameter of the DoRequest method.

```
<AddMetadata>
  <Metadata>
    <RepositoryBase
      Name="repository1"
      Desc="my repository"
      Path="omasvr/repository1"
      AuditPath="omasvr/audit/repository1"
      AuditType="2"/>
  </Metadata>
  <Reposid>A0000001.A0000001</Reposid>
  <NS>REPOS</NS>
  <!--OMI_TRUSTED_CLIENT flag -->
  <Flags>268435456</Flags>
  <Options/>
</AddMetadata>
```

In the metadata property string, note:

- □ the Path and AuditPath attributes specify directories of the same name, but different locations.
- □ the AuditType attribute specifies "2", which turns on auditing of deleted records. AuditType is an optional attribute. Omitting AuditType causes the repository to be created without an audit trail.

In the remainder of the call, note:

- □ the <NS> element specifies the REPOS namespace, which is required to write to a repository.
- □ the <Reposid> element specifies the repository manager identifier. The repository manager manages repositories.
- □ the <Flags> element specifies the OMI_TRUSTED_CLIENT flag (268435456), which is required to write a metadata object.

Example of Using UpdateMetadata to Enable Auditing

The following is an example of an UpdateMetadata method call that turns on auditing. The call is formatted for the *inMetadata* parameter of the DoRequest method.

```
<UpdateMetadata>
  <Metadata>
    <RepositoryBase
      Id="A0000001.A1234566"
      Name="Repository2"
      AuditPath="audit/repository2"
      AuditType="7"/>
  </Metadata>
  <NS>REPOS</NS>
  <!--OMI_TRUSTED_CLIENT flag -->
  <Flags>268435456</Flags>
  <Options/>
```

```
</UpdateMetadata>
```

In the metadata property string, note:

- □ the Id and Name attributes identify an existing repository for which to enable auditing.
- □ there is no need to specify a Path attribute for the repository.
- □ the AuditType attribute specifies the value "7", which creates audit records for added and updated metadata records in addition to deleted metadata records.
- □ the AuditPath attribute specifies the location to write the audit trail.

The other elements are the same as in the AddMetadata request.

Physical versus Logical Deletion of Metadata Records

The default behavior of the SAS 9.0 Metadata Server was to logically, rather than physically, delete metadata records from a repository. This allowed a record of deleted metadata objects to be kept until an auditing capability was added to the server. In the current release of the SAS Metadata Server, the default was changed to physically delete any new metadata records that are deleted; however, any logical records created by the previous server remain in a repository.

You can migrate logical records that exist in a repository to the audit trail by issuing a DeleteMetadata method on the desired repository(ies) that sets the OMI_PURGE (1048576) flag. The OMI_PURGE flag removes previously deleted metadata records from a repository without disturbing the current metadata objects. For the migration to be successful, repository auditing must have been enabled with AuditType="2". For an example of the method call, see "Example of Migrating Deleted Records" on page 97.

Example of Migrating Deleted Records

The following is an example of a DeleteMetadata method call that migrates logically deleted records from the specified repository to the audit trail. For the migration to be successful, repository auditing must have been enabled with AuditType="2" (delete). The migration will not work if auditing was enabled with AuditType="7" (all).

```
<DeleteMetadata>
  <Metadata>
    <RepositoryBase Id="A0000001.A1234566"/>
  </Metadata>
  <NS>REPOS</NS>
  <!--OMI_TRUSTED_CLIENT (268435456) and OMI_PURGE (1048576) flags -->
  <Flags>269484032</Flags>
  <Options/>
</DeleteMetadata>
```

The OMI_PURGE flag removes previously deleted metadata records from the repository without disturbing the current metadata objects. Meanwhile, an audit record is created for every metadata object deleted by the DeleteMetadata method.

Usage Considerations

The auditing functionality is not intended to provide system backups. A system backup is a copy of a repository usually made using operating system tools on a daily basis. The system backup provides a complete repository image for protection from a catastrophic disk failure. The audit restore provides recovery for a logically damaged repository. This could happen if an update destroyed or corrupted the metadata.

For information about backing up a repository, see “Backing Up the Metadata Server” in the *SAS Intelligence Platform: System Administration Guide*.

Recovering Audit Records

Metadata that has gaps in data may corrupt a repository if restored. Incomplete data can result from:

- turning repository auditing on and off
- not auditing all the metadata record types in a repository
- not auditing all of the repositories on a server, particularly if cross-references are supported between the repositories.

As this release does not support a rollback mechanism, it cannot be used to restore a damaged repository to its original state. However, you can use information in the audit trail to restore specific records. When restoring a deleted record, note that a metadata record can have multiple dependent records that might have been indirectly deleted as well. When deleting records, you can set the OMI_RETURN_LIST flag to keep track of the dependent records. The OMI_RETURN_LIST flag returns a list of deleted object IDs, as well as any cascading object IDs that were deleted.

The general steps for restoring a metadata record from the audit trail are described in “Restoring a Metadata Record on Windows Hosts” on page 98.

Restoring a Metadata Record on Windows Hosts

The SAS metadata audit trail can be used to restore specific metadata records to a repository. The process for restoring metadata in this release is accomplished through the use of SAS programs and not the metadata server.

Caution: The repository must be paused to an offline state before data is restored. A repository can be paused by issuing a PAUSE action in PROC METAOPERATE. A repository that is paused must eventually be resumed. This is done by issuing a RESUME action in PROC METAOPERATE. See “METAOPERATE Procedure” in “SAS Language Metadata Interfaces” section of the *SAS Open Metadata Interface: Reference* for details.

Example: Listing Audit Files

The audit trail stores records according to metadata type. A separate audit file is maintained for each metadata type that an audit record has been written. You can list the audit file names comprising an audit trail using PROC DATASETS. First, assign an AUDIT libref to the location specified in the AuditPath attribute; then, specify the libref in the Library= statement, as follows:

```
libname audit 'repos\audit\repos1';
proc datasets library=audit;
run;
quit;
```

Here is an example of the information that is written to the SAS Log:

```
                Directory

   Libref         AUDIT
   Engine         V9
   Physical Name  U:\tkmeta\repos\audit\repos1
   File Name      U:\tkmeta\repos\audit\repos1

             Member    File
#  Name      Type      Size  Last Modified
1  CNTAINER  DATA      5120   28OCT2002:12:06:22
2  EMAIL     DATA     17408   28OCT2002:12:09:21
3  MRRGSTRY  DATA      9216   28OCT2002:12:06:22
4  PERSON    DATA     17408   28OCT2002:12:09:21
5  PHONE     DATA     17408   28OCT2002:12:09:21
```

The CNTAINER and MRRGSTRY files are audit control files. They do not contain audit records. In this example, there are three audit files: EMAIL, PERSON, and PHONE.

Example: Listing Audit File Variable Names

The variable names in an audit file can also be listed using PROC DATASETS. To list the variable names, specify an audit file name in the CONTENTS statement. In this example, the CONTENTS statement specifies the audit file PERSON.

```
libname audit 'repos\audit\repos1';
proc datasets library=audit;
   contents data=audit.person;
run;
quit;
```

Here is the information written to the SAS Log:

```
DATASETS Procedure   Monday, October 28, 2002

 Data Set Name       AUDIT.PERSON              Observations         2
 Member Type         DATA                      Variables            17
 Engine              V9                        Indexes              0
 Created             Monday, October 28, 2002  Observation Length   1504
 Last Modified       Monday, October 28, 2002  Deleted Observations 0
 Protection                                    Compressed           NO
 Data Set Type                                 Sorted               NO
 Label
 Data Representation WINDOWS
 Encoding            any  Any encoding

Engine/Host Dependent Information

 Data Set Page Size          16384
 Number of Data Set Pages    1
 First Data Page             1
 Max Obs per Page            10
 Obs in First Data Page      2
 Number of Data Set Repairs  0
 File Name                    U:\tkmeta\repos\audit\repos1\person.sas7bdat
 Release Created              9.0100A0
 Host Created                 XP_PRO

Alphabetic List of Variables and Attributes

  #    Variable    Type    Len
 13    CHNGSTT     Char    128
  1    CLASNAME    Char     70
  3    DEFCREDT    Num       8
  4    DEFMODDT    Num       8
  5    DELETED     Num       8
  6    EXPLABEL    Char     80
 11    ICON        Char     80
  7    ID          Char     34
  8    LDESC       Char    400
 12    LOCKEDBY    Char     64
  9    MRACCESS    Num       8
  2    OBJNAME     Char    120
 14    TITLE       Char    400
 10    VERSION     Num       8
 17    _ATID_      Char     72
 16    _ATIME_     Num       8
 15    _ATYPE_     Char      2
```

In this example there are 14 repository variables and three audit variables: _ATYPE_, _ATIME_ and _ATID_.

Example: Viewing Audit File Records

To view audit file records, use PROC PRINT. The following example prints the contents of the PERSON audit file:

```
libname audit 'repos\audit\repos1';
proc print data=audit.person;
   var clasname id objname ldesc deleted;
run;
```

The VAR statement specifies the variables to print. Here is the information written to the SAS Log:

```
12:12 Monday, October 28, 2002
Obs CLASNAME
 1  O M S p e r s o n
 2  O M S p e r s o n

Obs ID
 1  A 5 J Z B Y C 7 . A 1 0 0 0 0 0 1
 2  A 5 J Z B Y C 7 . A 1 0 0 0 0 0 2

Obs OBJNAME
 1  W i l l
 2  C a r l a

Obs LDESC
 1  S t u d e n t
 2  S t u d e n t

Obs    DELETED
 1  1351447597.5
 2  1351447598.2
```

There are two deleted metadata records stored in the PERSON audit file.

CLASNAME	displays the records' SAS Metadata Server object class name.
ID	displays the records' unique object instance identifier.
OBJNAME	displays the value in the records' Name attribute.
LDESC	displays the value in the records' Desc attribute.
DELETED	displays a SAS datetime value indicating when each record was deleted.

Example: Restoring Audit Records

The following is an example of a DATA step that restores the metadata record describing "Carla" to a repository.

```
/* Set the repository and audit librefs */
libname repos 'repos\repos1';
libname audit 'repos\audit\repos1';

/* Select audit records to be restored */
/* the DELETED field is set to missing which activates the record. */
data work.select (drop=find);
  set audit.person( drop= _ATYPE_ _ATIME_ _ATID_ );
  /* find 'A5JZBYC7.A1000002' */
     find='A' || '00'x ||
          '5' || '00'x ||
          'J' || '00'x ||
          'Z' || '00'x ||
          'B' || '00'x ||
          'Y' || '00'x ||
          'C' || '00'x ||
          '7' || '00'x ||
          '.' || '00'x ||
          'A' || '00'x ||
          '1' || '00'x ||
          '0' || '00'x ||
          '0' || '00'x ||
          '0' || '00'x ||
          '0' || '00'x ||
          '0' || '00'x ||
          '2' || '00'x ;
  DELETED = . ;
  if ID = find then OUTPUT;
run;

/* Print the selected audit records. */
proc print data=work.select;
   var clasname id objname ldesc deleted;
run;
```

```
/* Append selected audit records to the repository file. */
data repos.person;
   set repos.person work.select;
run;
```

Here is the output written to the SAS Output window:

```
12:12 Monday, October 28, 2002

Obs CLASNAME
 1  O M S p e r s o n

Obs ID
 1  A 5 J Z B Y C 7 . A 1 0 0 0 0 0 2

Obs OBJNAME
 1  C a r l a

Obs LDESC
 1  S t u d e n t

Obs DELETED
 1  .
```

Here is the information written to the SAS Log:

```
NOTE: Libref REPOS was successfully assigned as follows:
      Engine:        V9
      Physical Name: U:\tkmeta\repos\repos1
NOTE: Libref AUDIT was successfully assigned as follows:
      Engine:        V9
      Physical Name: U:\tkmeta\repos\audit\repos1
NOTE: There were 2 observations read from the data set AUDIT.PERSON.
NOTE: The data set WORK.SELECT has 1 observations and 14 variables.
NOTE: DATA statement used (Total process time):
      real time           0.73 seconds
      cpu time            0.04 seconds
NOTE: There were 1 observations read from the data set WORK.SELECT.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds
NOTE: There were 4 observations read from the data set REPOS.PERSON.
NOTE: There were 1 observations read from the data set WORK.SELECT.
NOTE: The data set REPOS.PERSON has 5 observations and 14 variables.
NOTE: DATA statement used (Total process time):
      real time           0.14 seconds
      cpu time            0.01 seconds
```

Deleting an Audit Trail

The audit trail is deleted by deleting the audit files in the audit directory. The audit files can be deleted using PROC DATASETS. The audit trail should be deleted when its companion repository has been deleted.

Here is a sample program that deletes an audit trail:

```
/* delete all audit files */

libname audit 'repos\audit\repos1';

proc datasets library=audit KILL;

run;

quit;
```

Changing the Audit Trail Location

The following is an example of an UpdateMetadata request that changes the audit trail location. The audit trail location is specified in the AuditPath attribute of a RepositoryBase object.

```
<UpdateMetadata>
  <Metadata>
    <RepositoryBase
      Id="A0000001.A1234566"
      Name="Repository2"
      AuditType="2"
      AuditPath="omasvr/audit/repository2"/>
  </Metadata>
  <NS>REPOS</NS>
  <!--OMI_TRUSTED_CLIENT flag -->
  <Flags>268435456</Flags>
  <Options/>
</UpdateMetadata>
```

Any location specified in the AuditPath attribute that does not exactly match the current registration is considered a new location. For example, a relative pathname and an absolute pathname are considered different locations. As a result of the method call, audit records for Repository2 are written to the omasvr/audit/repository2 directory instead of the audit/repository2 directory.

Turning Off Auditing

The following is an example of an UpdateMetadata method call that turns off auditing. The call is formatted for the *inMetadata* parameter of the DoRequest method.

```
<UpdateMetadata>
  <Metadata>
    <RepositoryBase
      Id="A0000001.A1234566"
      AuditType="0"/>
  </Metadata>
  <NS>REPOS</NS>
  <!--OMI_TRUSTED_CLIENT flag -->
  <Flags>268435456</Flags>
  <Options/>
```

```
</UpdateMetadata>
```

The AuditType value of “0” turns off auditing and signifies that auditing was disabled for Repository2. Here is sample output from a GetMetadata method call on a repository that had auditing disabled:

```
Information received from server :
<GetMetadata>
  <Metadata>
    <RepositoryBase Id="A0000001.A1234566" Access="0" AuditEngine=""
    AuditOptions="" AuditPath="omasvr/audit/repository2" AuditType="0"
    Desc="" Engine="" MetadataCreated="24Oct2002:12:55:15"
    MetadataUpdated="24Oct2002:12:55:15" Name="Repository2" Options=""
    Path="omasvr/repository2" RepositoryType=""/>
  </Metadata>
 <NS>REPOS</NS>
 <Flags>
 </Flags>
 <Options/>
</GetMetadata>
```

The AuditType attribute is “0” but the AuditPath attribute continues to show the location of the audit trail.

CHAPTER

11

Metadata Locking Options

Overview of Metadata Locking Options **105**
Using SAS Open Metadata Interface Flags to Lock Objects **105**
Promoting Repositories Between Servers **106**

Overview of Metadata Locking Options

The SAS Open Metadata Interface enables you to control concurrent access to metadata by multiple users in a number of ways:

- You can perform object-level locking within a given repository by setting the SAS Open Metadata Interface OMI_LOCK and OMI_UNLOCK flags.
- You can impose a change management process in which metadata objects are locked and checked from a primary repository to a project repository by using the SAS Open Metadata Interface change management facility.
- You can set up dedicated metadata servers representing the phases of the metadata development life cycle and promote repositories between the servers.
- You can use a combination of these mechanisms.

In order to use any of these mechanisms, a user must have a registered identity on the SAS Metadata Server. For information about creating a metadata identity for a user or a group, see the *SAS Intelligence Platform: Security Administration Guide*.

For more information about the change management facility, see Chapter 12, "Using the Change Management Facility," on page 107.

Using SAS Open Metadata Interface Flags to Lock Objects

The SAS Open Metadata Interface provides the OMI_LOCK, OMI_UNLOCK, and OMI_UNLOCK_FORCE flags to lock metadata objects. The flags represent the simplest of the concurrency controls provided by the SAS Open Metadata Architecture. Before making an update, you simply issue a GetMetadata method call on the objects that you wish to modify that sets the OMI_LOCK flag. The software locks the specified object and any associated objects specified by GetMetadata flags and options, and updates the objects' LockedBy attribute with the metadata identifier representing the calling user. The objects remain locked from update by users other than the calling identity until an UpdateMetadata method is issued that sets the OMI_UNLOCK or OMI_UNLOCK_FORCE flags.

OMI_UNLOCK releases a lock held by the calling user and is the recommended method of releasing a lock. OMI_UNLOCK_FORCE unlocks a lock held by another user and is intended to be used as an emergency override mechanism. While locked, objects can be read by other users; they simply cannot be updated by other users until the user holding the lock completes his update.

The LockedBy attribute is set and cleared automatically by the lock flags and can be queried to determine whether an object is locked and who holds the lock. The LockedBy attribute cannot be changed or cleared with the UpdateMetadata method.

In SAS 9.1, object-level locking is supported only in the SAS Open Metadata Interface. That is, you must write a SAS Open Metadata Interface client to lock objects, update them, then unlock them. For information about writing a SAS Open Metadata Interface client, see “Open Client Requirements” in the *SAS Open Metadata Interface: Reference*. For more information about the GetMetadata and UpdateMetadata methods, see “GetMetadata” and “UpdateMetadata” in “Methods for Reading and Writing Metadata (IOMI Class)” in the reference.

Promoting Repositories Between Servers

Repository promotion is the most restrictive of the concurrency controls. It involves maintaining multiple metadata servers and versions of repositories.

The promotion process is implemented by using the Metadata Manager plug-in to SAS Management Console. The Metadata Manager contains Replication and Promotion wizards that enables you to create a job definition for copying a repository and its contents from one metadata server to another. The replication process copies a repository on the source metadata server and recreates it on the target metadata server using the same repository and object identifiers. The promotion process copies a repository on the source metadata server and recreates it on the target metadata server while modifying certain repository attributes.

Before using SAS Management Console, you must set up and start a SAS Metadata Server for each life cycle phase that you wish to represent. For example, if you plan to support development, test, and production environments, set up a SAS Metadata Server for each of these environments. For more information about setting up and managing a replication or promotion, see the *SAS Intelligence Platform: System Administration Guide*.

CHAPTER 12
Using the Change Management Facility

Introduction to the Change Management Facility **107**
Summary of Change Management Methods **108**
Setting Up Primary and Project Repositories **109**
- *Registering Users* **109**
- *Assigning Users Permissions to the Primary and Project Repositories* **110**

How Access Controls are Handled by the Change Management Facility **110**
Checking Out Metadata Objects **110**
- *Lock Templates* **111**
- *Issuing a CheckoutMetadata Call* **112**
- *LockedBy Attribute* **112**
- *ChangeState Attribute* **112**

Fetching Metadata **113**
Updating Metadata Objects in a Project Repository **114**
Adding and Copying Metadata Objects in a Project Repository **114**
Deleting a Metadata Object **116**
Checking In Metadata Objects **117**
- *Association Handling* **117**
- *Change Objects* **118**

Querying the Primary Repository **118**
Querying the Project Repository **120**
Emptying the Project Repository **121**
Default Lock Templates **121**
- *Document Lock Template* **121**
- *ExternalTable Lock Template* **121**
- *Job Lock Template* **122**
- *PhysicalTable Lock Template* **125**
- *Report Lock Template* **126**
- *SASLibrary Lock Template* **126**
- *ServerComponent Lock Template* **126**
- *ServerContext Lock Template* **127**
- *TextStore Lock Template* **127**
- *Tree Lock Template* **127**

Introduction to the Change Management Facility

The SAS Open Metadata Interface provides an optional change management facility for controlling concurrent access to metadata. Concurrent access is the ability for multiple users to safely update metadata at any given time. For example, an enterprise may have an environment set up that allows developers to make changes to metadata in an area that is independent of the existing “primary” metadata. The change management facility will allow changes to occur to existing metadata without interfering with existing usage. In addition, as changes are made, information relative to the change is maintained. This information can be used to track change history in determining who made the change to the object, when the change was made, and how it related to other objects in the metadata.

The facility consists of a set of methods that enable users to “check out” metadata that they wish to update from a primary repository to a project repository, then check it back in again when the update is complete. During checkout, metadata in the primary repository is locked to other users. The primary repository represents your stable environment of non-changing metadata and the project repository represents a development area where changes are made and tested. When metadata in a primary repository is locked by a user, other users may see the metadata in order to continue their work, but they will not be allowed to update it. When the modified metadata has been fully tested and is “checked in” to the primary repository, any subsequent reads by another user will reflect the changes just created. The change history is created as the objects are checked in to the primary repository from the project repository.

The facility also provides FetchMetadata and CopyMetadata methods. A “fetch” operation copies metadata objects from a primary repository to a project repository without locking them. Fetched metadata objects can be modified without fear of updating the corresponding primary repository object. Fetching metadata objects is useful when a developer needs to complete the most robust testing while only locking objects from other users that require changes. CopyMetadata is provided as a way to create new metadata objects in the project repository that can be added to a primary repository. For example, an enterprise may need to create a new primary repository that is a hybrid of other repositories. In this case, the developer could copy metadata from the two sources into a new project, modify it as needed, and incorporate the entire project into a new primary repository. The CopyMetadata method allows a metadata object to be copied from a project repository or a primary repository source.

In order to use the change management facility, you must set up a primary and a project repository, register users who will update the primary repository, and use change management methods to move metadata between the primary and project repositories.

Summary of Change Management Methods

The change management methods exist in the IOMI class and include:

Table 12.1 Change Management Methods

Method	Description
CheckoutMetadata	Locks and copies metadata objects from a primary repository to a project repository.
CheckinMetadata	Copies metadata objects from a project repository to a primary repository and unlocks them.
CopyMetadata	Copies metadata objects within a repository or between repositories.

Method	Description
FetchMetadata	Copies metadata objects from a primary repository to a project repository without locking them.
UndoCheckoutMetadata	Deletes and unlocks metadata objects that were checked out to a project repository by mistake. Also deletes fetched objects from the project repository.

See “Methods for Reading and Writing Metadata (IOMI Class)” in the *SAS Open Metadata Interface: Reference* for reference information about the methods.

Setting Up Primary and Project Repositories

A *primary repository* is a base-level or “production” repository. Objects in a primary repository are not updated directly when using the change management facility. There can be more than one primary repository for any given project repository.

The *project repository* is a playpen repository where metadata objects are modified. This repository is empty except for metadata objects copied from a primary repository to the project repository by using the CheckoutMetadata or FetchMetadata methods and new objects created for the purpose of updating the primary repository. New objects are created by using AddMetadata or CopyMetadata. There can be more than one project repository for any given primary repository.

In order for change management to be implemented between two repositories, you must establish a relationship between the repositories. A relationship is established by creating a DependencyUses or a DependencyUsedBy association between the repositories. For the purpose of change management, it is recommended that the project repository have a DependencyUses association to any primary repositories. This causes any cross-repository references created by change management methods to be stored in the project repository, which makes the references easier to query, particularly if multiple primary repositories are defined for a given project repository.

You are led through the steps for creating the necessary dependencies when you select to create a Project repository using the Add Repository wizard of the Metadata Manager plug-in of SAS Management Console. You can also create dependencies when you create a repository using the SAS Open Metadata Interface. The SAS Open Metadata Interface also allows you to add dependencies to existing repositories. For more information about creating repositories using SAS Management Console, see the Help for the Add Repository wizard. For information about creating repository dependencies using the SAS Open Metadata Interface, see Chapter 8, “Creating Relationships Between Repositories,” on page 75.

Registering Users

In order to use change management methods, a user must have an identity (Person or IdentityGroup metadata object) and associated Login object(s) defined for him or her on the metadata server. These identities are created in the SAS Management Console User Manager plug-in. You create Person metadata objects when you add a New User in the SAS Management Console User Manager. You create IdentityGroup metadata objects when you add a New Group in the User Manager. (An IdentityGroup represents a group of users that log into the server using a shared login.)

Identities are protected resources on a metadata server. A user requires Administrative User status on the server in order to create a metadata identity for an individual user. Only Administrative Users and users that have been granted specific permissions to an existing user or group identity can update the identity. For more information about user and group management, see the *SAS Intelligence Platform: Security Administration Guide*.

Assigning Users Permissions to the Primary and Project Repositories

An identity must have CheckinMetadata permission to a primary repository in order to update it with changes from a project repository. An Administrative User can assign the CheckinMetadata permission in the primary repository's Default ACT or on individual objects within a primary repository. An identity that has CheckinMetadata permission in a primary repository also needs ReadMetadata and WriteMetadata permission in the corresponding project repository, so that the objects can be written to the project repository when they are checked-out. ReadMetadata and WriteMetadata permission must be assigned in the project repository's Default ACT. The Default ACT is the only access control evaluated when making an authorization decision for an object in a project repository.

The Default ACT created for a project repository has different default settings than a Default ACT created for a custom or foundation repository. The Default ACT for a project repository denies the PUBLIC group ReadMetadata and WriteMetadata permission to the repository and to all objects in the repository, and grants ReadMetadata and WriteMetadata permission to the repository owner. The repository owner is the user ID that created the repository. The repository owner must modify a project repository's Default ACT to grant ReadMetadata and WriteMetadata permission to other users. For information about how to assign permissions, see the *SAS Intelligence Platform: Security Administration Guide*.

How Access Controls are Handled by the Change Management Facility

In order to maintain the integrity of authorizations that might have been defined to protect the metadata in a primary repository, authorization metadata (AccessControl, AccessControlEntry, AccessControlTemplate, SecurityRule, SecurityRuleSchema, SecurityContainmentRule, Permission, and PermissionCondition metadata objects) cannot be checked out from a primary repository to a project repository. Also, SAS Management Console prevents objects of these types from being created in a project repository. The Default ACT is the only access control evaluated when making an authorization decision for an object in a project repository.

Checking Out Metadata Objects

The CheckoutMetadata method is the primary form of object movement from a primary repository to a project repository. Conceptually, the method

- locks the requested object in the primary repository
- copies it to the specified project repository
- stores the metadata identifier of the person who locked the object in the LockedBy attribute of the primary repository object
- stores information about the object's modified status in the ChangeState attribute of both the original and copied metadata objects.

When an object is checked out, associated objects specified in a are checked out as well. If a default template does not exist for a type, or you wish to override the default lock template, you can specify your own lock template by setting the OMI_LOCK_TEMPLATE (65536) flag and supplying a list of associated objects that you wish to include, in template form, in a <LockTemplates> element in the <Options> element.

Lock Templates

A *lock template* is an XML property string that specifies a set of associated objects that are processed in addition to the metadata object specified in a CheckoutMetadata, FetchMetadata, or CopyMetadata request. Because metadata objects are so interconnected, checkout of a single object is not very useful and could be dangerous to metadata integrity. To maintain metadata integrity, the change management facility uses lock templates to enable associated objects to be checked out, fetched, and copied as a group.

The change management facility provides a default lock template for the metadata types described in . You can specify your own lock template in any of these methods by setting the OMI_LOCK_TEMPLATE (65536) flag and supplying a template identifying the associated objects that you wish to include in a <LockTemplates> element in the <Options> element.

A lock template specifies a metadata type and the association names identifying the associated objects that you wish to retrieve. For example, if you are checking out a SASLibrary object and want to additionally check out all Property metadata objects associated with it, you would specify the following template in the <LockTemplates> element:

```
<SASLibrary>
 <Properties/>
</SASLibrary>
```

'SASLibrary' is the metadata type whose associated objects you are interested in. 'Properties' is the association name that represents the relationship between SASLibrary and Property metadata objects.

To additionally check out PropertyType objects defined for each Property object that is retrieved, additionally specify the following template:

```
<Property>
 <OwningType/>
</Property>
```

In this template, 'Property' is the metadata type whose associated objects you are interested in and 'OwningType' is the association name that represents the relationship between Property and PropertyType metadata objects.

The templates are submitted together in the <Options> element as follows:

```
<Options>
 <LockTemplates>
  <SASLibrary>
    <Properties/>
  </SASLibrary>
  <Property>
    <OwningType/>
  </Property>
 </LockTemplates>
</Options>
```

Note: The lock template used to check out or fetch a metadata object must be used to undo its checkout. Consult the “Alphabetical Listing of SAS Namespace Types” in the *SAS Open Metadata Interface: Reference* to determine the association names required to retrieve associated objects. This listing is available only in online versions of the reference. △

Issuing a CheckoutMetadata Call

The following is an example of a CheckoutMetadata call. The CheckoutMetadata method locks and copies specified metadata objects to a specified project repository. You identify the metadata object to be checked out by passing a metadata property string consisting of the object’s metadata type and a unique two-part primary repository object identifier in the method’s inMetadata parameter (<Metadata> element). You can specify multiple metadata objects in a CheckoutMetadata request by stacking their property strings in the inMetadata parameter. You identify the target project repository in the ProjReposid parameter (<ProjReposid> element). The following is an example of a stacked CheckoutMetadata request:

```
<CheckoutMetadata>
   <Metadata>
      <PhysicalTable ID="PrimaryReposid.Objectid"/>
      <PhysicalTable ID="PrimaryReposid.Objectid"/>
   </Metadata>
   <ProjReposid>Reposmgrid.ProjectReposid</ProjReposid>
   <NS>SAS</NS>
   <Flags>0</Flags>
   <Options/>
</CheckoutMetadata>
```

The request locks and copies two PhysicalTable objects from a primary repository to a project repository. A default lock template is associated with the PhysicalTable metadata type, therefore, any Column, Key, Property, Index, Document, TextStore, Extension, and Role objects associated with the PhysicalTable objects will be checked out as well.

LockedBy Attribute

When a metadata object is checked out from a primary repository to a project repository, the metadata identifier of the person who initiated the action is stored in the primary metadata object’s LockedBy attribute. An unlocked object has an empty string in the LockedBy attribute. You can determine which objects in a primary repository are locked by querying which objects have a value in the LockedBy attribute. For more information, see “Querying the Primary Repository” on page 118.

ChangeState Attribute

When a metadata object is copied from a primary repository to a project repository by using the CheckoutMetadata or FetchMetadata methods, information describing the action is recorded in a ChangeState attribute in one or both of the objects. Every metadata type in the SAS Metadata Model has a ChangeState attribute, which is used exclusively by the change management facility.

In a primary repository object, the ChangeState attribute stores an empty string or the value:

```
Checked-out to: <ProjIdentifier>
```

An empty string indicates the object is available for reading and writing in the primary repository. The value indicates the object is currently locked and checked-out to a project repository and stores the unique 17-character identifier of the object's project repository counterpart. The ChangeState attribute of a fetched object contains an empty string because a fetched object is not locked, and could be fetched to more than one project repository. In a primary repository, the ChangeState attribute can be queried to determine which objects are checked out and to what project repository. For more information, see "Querying the Primary Repository" on page 118.

In a project repository object, the value of the ChangeState attribute has the form:

```
CMState:SrcIdentifier
```

where

- □ *CMState* identifies the process that copied the object into the project repository: one of Checkout, Fetch, New, or an empty string. Objects created in a project repository by using the AddMetadata or CopyMetadata method either have an empty string or the word "New" in this position.
- □ *SrcIdentifier* is either the 17-character identifier of the object's primary repository counterpart or an empty string. For new objects, it is recommended that you update this attribute to supply the unique eight-character identifier of a destination primary repository.

The change management facility uses the ChangeState attribute to determine a project repository object's disposition at checkin as follows:

- □ an object whose *CMState* is Checkout will be used to update the primary repository object identified in *SrcIdentifier*.
- □ an object whose *CMState* is Fetch will be ignored.
- □ an object whose *CMState* is New or an empty string will be created in the primary repository identified in *SrcIdentifier*.
- □ an object whose *SrcIdentifier* is an empty string will be created in the first repository found that has a DependencyUsedBy association to the project repository during checkin.

In a project repository, you can query the ChangeState attribute to determine how a given object came to be in the project repository, to which primary repository a project repository object belongs, and to identify new objects. For more information, see "Querying the Project Repository" on page 120.

Fetching Metadata

The FetchMetadata method creates object instances in the project repository that cannot be copied back to the corresponding primary repository. This enables you to modify the fetched object without fear of affecting the corresponding primary object.

Like CheckoutMetadata, the FetchMetadata method copies the specified metadata object and any objects identified in the object's from a primary repository to the specified project repository. Unlike CheckoutMetadata, the objects are not locked in the primary repository.

You identify the metadata object to fetch using its metadata type and unique object instance identifier in the method's <Metadata> element. You can fetch multiple metadata objects by stacking their property strings in the <Metadata> element. You can specify an alternate, user-defined lock template by setting the OMI_LOCK_TEMPLATE flag and submitting a lock template in a <LockTemplates> element in the <Options> element. For information about how to create a lock template, see . The following is an example of a FetchMetadata request that specifies an alternate lock template:

```
<FetchMetadata>
   <Metadata>
      <PhysicalTable ID="PrimaryReposid.Objectid"/>
   </Metadata>
   <ProjectReposid>Reposmgrid.ProjectReposid</ProjectReposid>
   <NS>SAS</NS>
   <!-- OMI_LOCK_TEMPLATE flag -->
   <Flags>65536</Flags>
   <Options>
    <LockTemplates>
       <PhysicalTable/>
         <UniqueKeys/>
       </PhysicalTable/>
    </LockTemplates>
</FetchMetadata>
```

The specified lock template overrides the default lock template for a PhysicalTable object and retrieves only objects that have a UniqueKeys association to the specified PhysicalTable object. For more information, see “FetchMetadata” in “Methods for Reading and Writing Metadata (IOMI Class)” in the *SAS Open Metadata Interface: Reference*.

Updating Metadata Objects in a Project Repository

All metadata objects in a project repository are referenced using a project repository identifier. For example, an UpdateMetadata call modifying an object to create an association to another existing object identifies the objects as shown below:

```
<UpdateMetadata>
  <Metadata>
    <PhysicalTable Id="projectReposid.Objectid">
      <TablePackage>
        <SASLibrary ObjRef="projectReposid.Objectid"/>
      </TablePackage>
    </PhysicalTable>
  </Metadata>
  <NS>SAS</NS>
  <!-- OMI_TRUSTED_CLIENT flag -->
  <Flags>268435456</Flags>
  <Options/>
</UpdateMetadata>
```

Adding and Copying Metadata Objects in a Project Repository

New metadata objects created in a project repository by using the AddMetadata, CopyMetadata, or UpdateMetadata methods are created with the repository identifier of the project repository. In environments where a single project repository serves multiple primary repositories, it is recommended that you specify the target primary repository by defining a value for the ChangeState attribute along with the object's other properties.

The following is an example of an AddMetadata method call that creates a metadata object and an associated metadata object in a project repository and defines values for their ChangeState attributes.

```
<AddMetadata>
  <Metadata>
    <!--Specify the target repository IDs in the ChangeState attribute-->
    <SASLibrary
      Name="Test library 1"
      Desc="Library object created in project repository"
      ChangeState="New:AFXFGX9C"/>
        <Tables>
          <PhysicalTable
             Name="Test table 1"
             Desc="Table object created in project repository"
             ChangeState="New:AFXFGX9C"/>
        </Tables>
    </SASLibrary>
 </Metadata>
 <!--Specify the project repository ID in the <Reposid> element-->
 <Reposid>A0000001.A5NZA58I</Reposid>
 <NS>SAS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -->
 <Flags>268435456</Flags>
 <Options/>
</AddMetadata>
```

The form of a ChangeState attribute value is described in . In this example, "New" indicates the objects' state; "AFXFGX9C" is the eight-character identifier of the target primary repository. When specifying a SrcIdentifier for a new metadata object, there is no need to specify a full 17-character repository identifier.

The following is an example of an UpdateMetadata method call that creates an association and a new associated object that will ultimately reside in a different primary repository than the main object.

```
<UpdateMetadata>
  <Metadata>
    <!-- Main element references project repository in object ID -->
    <SASLibrary Id="A5NZA58I.A0000033" Name="Test library 1"/>
        <Tables>
          <!-- Subelement omits Id= attribute to indicate a new object is to be
created and identifies target repository in ChangeState attribute -->
          <PhysicalTable
             Name="Test table 3"
             Desc="Table object destined for different primary repository"
             ChangeState="New:ALCLMNOC"/>
        </Tables>
    </SASLibrary>
 </Metadata>
 <NS>SAS</NS>
 <!-- OMI_TRUSTED_CLIENT flag -->
 <Flags>268435456</Flags>
 <Options/>
</UpdateMetadata>
```

The ChangeState attribute of the associated object specifies a different primary repository identifier than the one defined for Text Library 1 in the preceding AddMetadata example.

You can use UpdateMetadata to specify a ChangeState value for an object created by CopyMetadata.

A project repository object whose ChangeState attribute is an empty string will be copied to the first repository found that has a DependencyUsedBy association to the project repository during checkin.

For more information about adding metadata objects with AddMetadata, see Chapter 2, “Adding Metadata Objects,” on page 5. For information about adding and updating metadata objects with UpdateMetadata, see Chapter 3, “Updating Metadata Objects,” on page 19. For reference information about AddMetadata and UpdateMetadata, and more information about CopyMetadata, see “Methods for Reading and Writing Metadata (IOMI Class” in the *SAS Open Metadata Interface: Reference*.

Deleting a Metadata Object

The method used to delete a metadata object from a project repository depends on whether the object will also be deleted from the primary repository:

- A metadata object that will be deleted from the primary repository is deleted using DeleteMetadata.
- A metadata object that will remain in the primary repository (it was checked out by mistake or was copied into the project repository using the FetchMetadata method) is removed using UndoCheckoutMetadata.

The following is an example of a DeleteMetadata request that is executed on a project repository:

```
<DeleteMetadata>
   <Metadata>
   <!-- Identify the object by its project repository identifier  -->
      <PhysicalTable Id="A5NZA58I.AA000002"/>
   </Metadata>
   <NS>SAS</NS>
   <!-- OMI_TRUSTED_CLIENT flag -->
   <Flags>268436480</Flags>
   <Options/>
</DeleteMetadata>
```

The following is an example of an UndoCheckoutMetadata request:

```
<UndoCheckoutMetadata>
   <Metadata>
   <!--Identify the object by its project repository identifier -->
      <PhysicalTable Id="A5NZA58I.AB000004"/>
   </Metadata>
   <NS>SAS</NS>
   <Flags>0</Flags>
   <Options/>
</UndoCheckoutMetadata>
```

Note: The same lock template used to check out or fetch a metadata object should be used to undo the checkout.

The DeleteMetadata method does not support lock templates. The DeleteMetadata method will delete any associated objects that are dependent on the deleted objects. However, if you wish to delete other associated objects, you will need to issue additional DeleteMetadata requests. For more information about deleting metadata objects with DeleteMetadata, see Chapter 4, “Deleting Metadata Objects,” on page 31. For reference information about DeleteMetadata and UndoCheckoutMetadata, see “Methods for Reading and Writing Metadata (IOMI Class)” in the *SAS Open Metadata Interface: Reference*. △

Checking In Metadata Objects

Checkin is the process of integrating the changes from a project repository into the corresponding primary repository. Checkin of individual metadata objects is not supported; the CheckinMetadata method copies all eligible objects in a project repository to their corresponding primary repositories at once. An “eligible” metadata object is one that was copied to the project repository using CheckoutMetadata or created in the project repository using AddMetadata, CopyMetadata, or UpdateMetadata. Objects copied into the project repository using FetchMetadata are ineligible. Conceptually, the CheckinMetadata method

- □ updates and unlocks checked metadata objects in their corresponding primary repository
- □ copies and creates new metadata objects in the primary repository identified in their ChangeState attribute
- □ deletes metadata objects deleted by DeleteMetadata from their corresponding primary repository
- □ updates the primary repository’s association list, as described in “Association Handling” on page 117.
- □ creates a Change object in each primary repository that stores information about the changes.
- □ removes checked and new metadata objects from the project repository. Fetched objects remain in the project repository, unless the OMI_CI_DELETE_ALL (33) flag is set to delete them. You can keep copies of checked and new metadata objects in the project repository by setting the OMI_CI_NODELETE (524288) flag in the CheckinMetadata request. For more information about these flags, see “CheckinMetadata” in “Methods for Reading and Writing Metadata (IOMI Class)” in the *SAS Open Metadata Interface: Reference*.

Association Handling

Information about a metadata object’s associations is maintained separately from its attributes in an association list. When an object is checked out to a project repository, both its attributes and association list are copied; however, only the attributes are locked. The association list in the primary repository can still be updated if the partner object in the association is updated. For example, if you check out a PhysicalTable object that has a Groups association to a Group object, but do not also check out the Group object, then the association list can still be modified by updating the Group object’s Members association. (Group has a Members association to PhysicalTable.) To protect the integrity of an object’s associations, it is recommended that you check out all important associated objects when checking out an object. You can check these objects out individually, or create a user-defined lock template to check them out.

At checkin, the change management facility compares the contents of the association list in the project repository to the association list in the primary repository and applies updates as follows:

1. Associations marked as deleted in the project repository association list are deleted from the primary repository association list.
2. New associations in the project repository association list are written to the primary repository association list.
3. Associations that exist in both the project and primary repository association lists are overwritten by those in the project association list.
4. Associations that exist only in the primary association list are left alone.

The association order is modified as little as possible.

Change Objects

The CheckinMetadata method creates a Change object in each primary repository in which it copies or deletes metadata objects. This Change object stores information about the checkin, including the date and time the Change object was created (and thus, the time its corresponding changes were integrated into the primary repository), a name and a description for the change as supplied in the CheckinMetadata ChangeName and ChangeDesc parameters (<ChangeName> and <ChangeDesc> elements), and two associations:

ChangeIdentity	links the Change object to the identity object (Person or Group) representing the user who made the change.
Objects	links the Change object to the metadata objects in the primary repository that were part of the change.

The purpose of the Change object is to enable you to query the primary repository for information about an update. For more information, see “Querying the Primary Repository” on page 118.

Querying the Primary Repository

You might want to query the objects in a primary repository to determine which objects are available for update, which objects are locked, who locked them, and what changes were made.

You can determine which objects are available for update in a primary repository by querying which objects have an empty string in the LockedBy attribute. The LockedBy attribute stores a value for objects locked by using either the OMI_LOCK flag or the CheckoutMetadata method. An empty string indicates an object is not locked. Use the GetMetadataObjects method to query the objects as follows:

```
<GetMetadataObjects>
  <!--Specify primary repository ID -->
  <Reposid>A0000001.A3N4OMZV</Reposid>
  <Type>Root</Type>
  <Objects/>
  <NS>SAS</NS>
  <!-- OMI_INCLUDE_SUBTYPES, OMI_XMLSELECT, OMI_GET_METADATA, OMI_TEMPLATES flags -->
  <Flags>404</Flags>
  <Options>
  <!-- Specify XMLSelect search of LockedBy attribute -->
   <XMLSelect search="*[@LockedBy = ' ']"/>
   <Templates>
  <!-- Specify to retrieve Id= and LockedBy= attribute values -->
     <Root Id="" LockedBy=""/>
   </Templates>
  </Options>
</GetMetadataObjects>
```

In the request, note:

- □ The <Type> element specifies the Root metadata type.
- □ The OMI_INCLUDE_SUBTYPES flag is set to return all metadata types that are subtypes of Root.
- □ The OMI_GET_METADATA and OMI_TEMPLATES flags are set to submit a template that retrieves the Id and LockedBy attributes for all objects.
- □ The OMI_XMLSELECT flag is set and <XMLSelect> search string is specified to filter the request to select objects that have an empty string in the LockedBy attribute.

To identify the objects locked by a given identity (user or group), specify the metadata identifier of the identity in the search string.

To determine which objects are checked-out by the CheckoutMetadata method, issue the same method call as above but specify the ChangeState attribute and a value in the <XMLSelect> search string instead of the LockedBy attribute. For example:

```
<GetMetadataObjects>
  <!--Specify primary repository ID -->
  <Reposid>A0000001.A3N4OMZV</Reposid>
  <Type>Root</Type>
  <Objects/>
  <NS>SAS</NS>
  <!-- OMI_INCLUDE_SUBTYPES, OMI_XMLSELECT, OMI_GET_METADATA, OMI_TEMPLATES flags -->
  <Flags>404</Flags>
  <Options>
  <!--Specify XMLSelect search of ChangeState attribute -->
   <XMLSelect search="*[@ChangeState CONTAINS 'Checked-out to']"/>
   <Templates>
  <!-- Specify to retrieve Id=, ChangeState=, and LockedBy= attribute values -->
     <Root Id="" ChangeState="" LockedBy=""/>
   </Templates>
  </Options>
</GetMetadataObjects>
```

The search string will return all objects that have the words 'Checked-out to:' in the ChangeState attribute. To determine which objects are checked out to a specific project repository, include the project repository's 17-character identifier in the search string.

To obtain information about changes to a primary repository, issue a GetMetadataObjects call that specifies the Change metadata type in the <Type> element and sets the OMI_GET_METADATA (256), OMI_ALL (1), and OMI_SUCCINCT (2048) flags as follows:

```
 <GetMetadataObjects>
  <!--Repository of primary repository -->
  <Reposid>A0000001.A5WW3LXC</Reposid>
  <Type>Change</Type>
  <Objects/>
  <NS>SAS</NS>
  <!-- OMI_GET_METADATA, OMI_ALL, and OMI_SUCCINCT flags -->
  <Flags>2305</Flags>
  <Options/>
</GetMetadataObjects>
```

In the call:

- The OMI_GET_METADATA and OMI_ALL flags specify to retrieve all properties for all Change objects that are found.
- The OMI_SUCCINCT flag limits the request to properties that have values defined for them. The output will be the Id, Name, and Desc attributes of all Change objects as well as any objects that have a ChangeIdentity and Objects association to each Change object. The ChangeIdentity association will list the identity object representing the user who made the change. The Objects association will list all metadata objects affected by a change.

Querying the Project Repository

You might want to query the objects in a project repository to determine which came from a given repository and to identify how they came to be in the project repository (checkout, fetch, or new). All of this information can be obtained by querying the project repository objects' ChangeState attribute.

The following GetMetadataObjects example queries a project repository to determine which objects originated in primary repository AFXFGX9C.

```
<GetMetadataObjects>
  <!--Repository of project repository -->
  <Reposid>A0000001.A5NZA58I</Reposid>
  <Type>Root</Type>
  <Objects/>
  <NS>SAS</NS>
  <!-- OMI_INCLUDE_SUBTYPES, OMI_XMLSELECT, OMI_GET_METADATA, and OMI_TEMPLATES flags -->
  <Flags>404</Flags>
  <Options>
   <XMLSelect search="*[@ChangeState CONTAINS 'AFXFGX9C']"/>
   <Templates>
     <Root Id="" Name="" LockedBy=""/>
   </Templates>
  </Options>
</GetMetadataObjects>
```

In the call:

- The <Type> element specifies the Root metadata type.
- The OMI_INCLUDE_SUBTYPES flag is set to return all metadata types that are subtypes of Root.
- The OMI_XMLSELECT flag is set and an <XMLSelect> search string specifies to filter the request to select objects that have the value 'AFXFGX9C' in the ChangeState attribute.
- The OMI_GET_METADATA and OMI_TEMPLATES flags are set to pass a template to retrieve the Id, Name, and LockedBy attributes for the selected objects.

To identify fetched objects, issue the same method call modifying the search string as follows:

```
search="*[@ChangeState CONTAINS 'Fetch']"
```

To identify new objects, issue the method call with the search string:

```
search="*[@ChangeState CONTAINS 'New' or @ChangeState = ' ']"
```

For more information about the GetMetadataObjects method, see Chapter 6, “Querying All Metadata of a Specified Type,” on page 43.

Emptying the Project Repository

To clear a repository whose objects have already been checked in, issue a DeleteMetadata request on the repository, setting the OMI_REINIT (2097152) flag. The OMI_REINIT flag deletes all metadata objects from a repository without deleting the repository itself and reinitializes the repository.

Note: A user must have Administrative User status on the SAS Metadata Server in order to delete or clear a repository. △

Default Lock Templates

To protect metadata integrity, the change management facility supports a set of default lock templates for certain metadata types. Default lock templates are defined for the Document, ExternalTable, Job, PhysicalTable, Report, SASLibrary, ServerComponent, ServerContext, TextStore, and Tree metadata types. If a default template does not exist for a type, then only the indicated object is processed (no associated objects), unless you specify a user-defined lock template.

The associated objects defined in each default lock templates are shown in the sections that follow.

Document Lock Template

```
<Document>
  <Documents/>
  <Notes/>
  <Extensions/>
</Document>
```

ExternalTable Lock Template

```
<ExternalTable>
  <Columns/>
  <OwningFile/>
  <Extensions/>
  <Notes/>
  <Documents/>
  <Properties/>
</ExternalTable>
```

```
<Document>
 <Documents/>
 <Notes/>
 <Extensions/>
</Document>
```

Job Lock Template

```
<Job>
  <JobActivities/>
  <SourceCode/>
  <Extensions/>
  <Notes/>
  <Documents/>
  <Properties/>
  <TransformationSources/>
  <TransformationTargets/>
</Job>
<TransformationActivity>
  <Steps/>
  <TransformationTargets/>
  <SourceCode/>
  <Extensions/>
  <Notes/>
  <Documents/>
  <Properties/>
</TransformationActivity>
<TransformationStep>
  <SuccessorDependencies/>
  <PredecessorDependencies/>
  <Transformations/>
  <SourceCode/>
  <Extensions/>
  <Notes/>
  <Documents/>
  <Properties/>
  <UsingPrototype/>
  <PropertySets/>
</TransformationStep>
<Select>
  <ClassifierTargets/>
  <ClassifierSources/>
  <FeatureMaps/>
  <AssociatedRowSelector/>
  <HavingForSelect/>
  <GroupByForSelect/>
  <WhereForSelect/>
  <OrderByForSelect/>
  <SourceCode/>
  <Extensions/>
  <Notes/>
  <Documents/>
  <Properties/>
  <PropertySets/>
  <SubstitutionVariables/>
</Select>
<ClassifierMap>
  <FeatureMaps/>
  <ClassifierTargets/>
  <ClassifierSources/>
  <AssociatedRowSelector/>
  <SourceCode/>
  <Extensions/>
  <Notes/>
  <Documents/>
  <Properties/>
  <PropertySets/>
  <SubstitutionVariables/>
</ClassifierMap>
<RowSelector>
  <SourceCode/>
</RowSelector>
<OrderByClause>
 <Columns/>
</OrderByClause>
<FeatureMap>
  <FeatureSources/>
  <FeatureTargets/>
  <SourceCode/>
  <Extensions/>
  <Notes/>
  <Documents/>
  <Properties/>
  <SubstitutionVariables/>
</FeatureMap>
<WorkTable>
 <Columns/>
</WorkTable>
<PhysicalTable>
  <Columns/>
  <UniqueKeys/>
  <Properties/>
  <Indexes/>
  <Documents/>
  <Notes/>
  <Extensions/>
  <Roles/>
  <PropertySets/>
  <ForeignKeys/>
</PhysicalTable>
<Column>
  <Documents/>
  <Notes/>
  <Extensions/>
  <UniqueKeyAssociations/>
  <Keys/>
</Column>
<Index>
```

```
  <Documents/>
  <Notes/>
  <Extensions/>
</Index>
<Property>
  <SpecTargetTransformations/>
  <StoredConfiguration/>
</Property>
<Prototype>
  <PrototypeProperties/>
  <Properties/>
</Prototype>
<Transformation>
  <SourceCode/>
  <SourceSpecifications/>
</Transformation>
<PropertySet>
  <Properties/>
</PropertySet>
<Variable>
  <AssociatedObject/>
</Variable>
<UniqueKey>
  <ForeignKeys/>
</UniqueKey>
<ForeignKey>
  <KeyAssociations/>
</ForeignKey>
<Cube>
  <TargetTransformations/>
  <Aggregations/>
  <AssociatedFile/>
  <Dimensions/>
  <Hierarchies/>
  <Measures/>
  <Properties/>
  <PropertySets/>
  <Documents/>
  <Notes/>
  <Extensions/>
</Cube>
<Aggregation>
  <AggregateAssociations/>
  <Levels/>
  <AggregationTables/>
  <Properties/>
</Aggregation>
<AggregateAssociation>
  <AggregatedColumns/>
  <MeasureOrLevel/>
  </AggregateAssociation>
<Dimension>
  <TargetTransformations/>
  <Hierarchies/>
```

```
    <Levels/>
    <Measures/>
    <DefaultMeasure/>
    <Properties/>
    <Notes/>
  </Dimension>
  <Hierarchy>
    <Levels/>
    <OLAPProperties/>
    <Notes/>
    <Properties/>
  </Hierarchy>
  <Measure>
    <TargetTransformations/>
    <DefaultForDimension/>
    <MLAggregations/>
    <Notes/>
  </Measure>
  <Level>
    <MLAggregations/>
    <Notes/>
    <Properties/>
  </Level>
  <Document>
    <Documents/>
    <Notes/>
    <Extensions/>
  </Document>
```

PhysicalTable Lock Template

```
  <PhysicalTable>
    <Columns/>
    <UniqueKeys/>
    <Properties/>
    <Indexes/>
    <Documents/>
    <Notes/>
    <Extensions/>
    <Roles/>
  </PhysicalTable>
  <Column>
    <Documents/>
    <Notes/>
    <Extensions/>
    <UniqueKeyAssociations/>
    <Keys/>
  </Column>
  <Index>
    <Documents/>
    <Notes/>
    <Extensions/>
  </Index>
  <PropertySet>
    <Properties/>
  </PropertySet>
  <UniqueKey>
    <ForeignKeys/>
  </UniqueKey>
  <ForeignKey>
    <KeyAssociations/>
  </ForeignKey>
  <Document>
    <Documents/>
    <Notes/>
    <Extensions/>
  </Document>
```

Report Lock Template

```
<Report>
  <ReportLocation/>
  <FileRefs/>
  <Documents/>
  <Notes/>
  <Extensions/>
  <Properties/>
  <PropertySets/>
</Report>
```

SASLibrary Lock Template

```
<SASLibrary>
  <UsingPackages/>
  <Properties/>
  <Documents/>
  <Notes/>
  <Extensions/>
</SASLibrary>
<DatabaseSchema>
  <Documents/>
  <Notes/>
  <Extensions/>
</DatabaseSchema>
<Document>
  <Documents/>
  <Notes/>
  <Extensions/>
</Document>
```

ServerComponent Lock Template

```
<ServerComponent>
   <Properties/>
   <ServiceTypes/>
   <SourceConnections/>
   <InitProcesses/>
   <DescriptiveComponent/>
</ServerComponent>
<Connection>
   <Properties/>
</Connection>
```

ServerContext Lock Template

```
<ServerContext>
   <UsingComponents/>
</ServerContext>
<LogicalServer>
   <UsingComponents/>
   <InitProcesses/>
</LogicalServer>
<ServerComponent>
   <Properties/>
   <ServiceTypes/>
   <SourceConnections/>
   <InitProcesses/>
   <DescriptiveComponent/>
</ServerComponent>
<Connection>
   <Properties/>
</Connection>
```

TextStore Lock Template

```
<TextStore>
  <Documents/>
  <Notes/>
  <Extensions/>
</TextStore>
<PropertySet>
  <Properties/>
</PropertySet>
<Document>
  <Documents/>
  <Notes/>
  <Extensions/>
</Document>
```

Tree Lock Template

```
<Tree>
  <Documents/>
  <Notes/>
  <Extensions/>
</Tree>
<Document>
  <Documents/>
  <Notes/>
  <Extensions/>
</Document>
```

CHAPTER 13

Repository Maintenance Tasks

Clearing or Deleting a Repository **129**
Unregistering and Re-registering a Repository **129**

Clearing or Deleting a Repository

There may be times when you want to clear the contents of a repository, for example, to repopulate it with metadata. If many individual metadata objects have been deleted from a repository, you might also want to remove any structures that might have been left by the deleted objects in order to maintain performance efficiency. You might also have a need to destroy the repository itself.

You can do all of these things by using the DeleteMetadata method, specifying a RepositoryBase object instance, and setting one of the OMI_DELETE, OMI_PURGE, OMI_REINIT, or OMI_TRUNCATE flags.

- Set OMI_REINIT (2097152) to clear a repository if your wish is to repopulate it completely with different metadata.
- Set OMI_TRUNCATE (4194304) if you want to repopulate a repository using metadata object containers created for the previous repository.
- Set OMI_PURGE (1048576) to remove the remnants of any individually deleted metadata objects.
- Set OMI_DELETE (32) to destroy a repository. OMI_DELETE destroys the contents of a repository and also removes its registration from the repository manager.

Be sure to specify the REPOS namespace in the method call.

Note: You must have Administrative User status on the SAS Metadata Server in order to clear or delete a repository. For more information about this privilege, see the *SAS Intelligence Platform: Security Administration Guide*. △

CAUTION:
You should not combine the REPOS namespace flags. Each one should be run independently of the others. Combining them will potentially yield undesirable results. △

Unregistering and Re-registering a Repository

A repository is unregistered by issuing a DeleteMetadata method on its RepositoryBase object instance in the REPOS namespace and setting only the OMI_TRUSTED_CLIENT flag.

A repository is re-registered by issuing the AddMetadata method (omitting the repository's identifier from the Id= attribute) and specifying the repository directory in the Path attribute. The metadata server reads the CNTAINER and MRRGSTRY files found at the path location and uses the repository identifier from them to create a new registration.

Note: A user must have Administrative User status on the SAS Metadata Server in order to unregister and re-register a repository. For more information about this privilege, see the *SAS Intelligence Platform: Security Administration Guide*. △

PART 4

Model Usage

Chapter 14 . . . . **Model Usage Scenarios** *133*

CHAPTER
14 Model Usage Scenarios

Overview of Model Usage Scenarios **134**
Usage Scenario: Creating Metadata Objects that Represent a DBMS **135**
  Purpose **135**
  Requirements **135**
  Creating Objects that Represent a DBMS **135**
Usage Scenario: Creating Metadata for a Cube **137**
  Purpose **137**
  Requirements **137**
  Creating Metadata Objects **137**
  Sample PROC OLAP Code **143**
Usage Scenario: Creating a Prototype **144**
  Purpose **144**
  Requirements **144**
  Description of a Prototype **144**
  Prototype Objects **144**
    Prototype and Properties **144**
  Prototype and Property **145**
  PropertyGroups and Properties **146**
  XML Example **147**
  Example of Creating a Prototype **147**
Usage Scenario: Creating Metadata for a SAS Library **158**
  Purpose **158**
  Requirements **158**
  Defining a Library **158**
  Examples of SAS Library Objects **159**
    Library with Tables in a Directory **159**
  Library with Tables in a Foreign Database **160**
  XML Representation of Metadata Objects that Define a SAS Library, Directory, and Data Sets **161**
  XML Representation of Metadata Objects Used to Define a SAS Library with Tables in a Foreign Database **162**
Usage Scenario: Creating Metadata for Tables, Columns, and Keys **163**
  Purpose **163**
  Requirements **164**
  Creating a SASLibrary and PhysicalTable Objects **164**
  Creating a Column Objects and Keys **165**
  XML Representation of SASLibrary and Physical Table Objects **168**
  XML Representation of Column Objects for Period Table **169**
  XML Representation of Column Objects for Sales Table **170**
  XML Representation of Keys **171**
Usage Scenario: Creating Metadata for a SAS/SHARE Server **171**
  Purpose **171**

Requirements **171**
Software Deployment Metadata Types **172**
Example **173**
XML Representation of Metadata Objects Representing a SAS/SHARE Server, Libraries, and Connections **174**
Usage Scenario: Creating Metadata for a Stored Process **175**
Purpose **175**
Requirements **175**
Description of a Stored Process **175**
How to Define A Stored Process **176**
XML Representation of Metadata Objects for a Stored Process **179**
Usage Scenario: Creating Tree and Group Objects **183**
Purpose **183**
Requirements **183**
Trees and Groups **183**
Tree, Group, and Members **183**
Tree Hierarchy, Groups, Members, SoftwareComponent **184**
XML Representation of a Single Tree and Two Group Objects **185**
XML Representation of a Tree Hierarchy **186**
Usage Scenario: Creating Metadata for a Workspace Server **187**
Purpose **187**
Requirements **187**
Description of a Server **187**
Workspace Server Metadata Objects **187**
DeployedComponent Types and Properties **188**
ServerComponent and Initialization **190**
TCPIPConnection and Property Objects **191**
Putting All of the Pieces Together **193**
Prototype Objects **195**
Prototype and Properties **195**
Prototype and Property **195**
PropertyGroups and Properties **196**
XML Example **197**
XML Representation of Metadata Objects for a Workspace Server **198**

Overview of Model Usage Scenarios

This section describes how to the use the SAS namespace metadata types to create metadata objects for the most commonly used application elements. It describes which metadata types to use to represent actual objects and the relationships between these objects. It also provides sample XML requests that show how to create the actual metadata objects.

The information is presented in a series of scenarios that describe how to use the metadata types in different situations. Note that the XML requests included represent only *one* way of creating the metadata, in order to demonstrate how to use the metadata types.

These usage scenarios assume the reader has general understanding of the submodels of the SAS Metadata Model. For more information about these submodels, see “SAS Namespace Metadata Types” in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of the SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

- describes the metadata types that represent DBMSs, database schemas, and the metadata types used to represent SAS software’s access to DBMS information.

- □ "Usage Scenario: Creating Metadata for a Cube" on page 137 describes the metadata types used to represent a cube.
- □ describes how to create a prototype.
- □ describes the metadata types used to define a SAS library.
- □ describes how to create metadata for tables, columns, and relational keys.
- □ describes how to use the metadata types that represent software deployment information, that is, information about how to run and access installed software and the resources (files and data) that the software can access.
- □ describes how to define a stored process and how to define parameters for the stored process using PropertyGroups.
- □ describes how to use the metadata types that represent an application hierarchy.
- □ describes how to define a SAS Integration Technologies workspace server using metadata types from the Software Deployment submodel. This scenario also includes information on creating a prototype for the server using the Property submodel.

Usage Scenario: Creating Metadata Objects that Represent a DBMS

Purpose

This usage scenario describes how to define a DBMS server. You must use metadata types from several SAS Metadata Model submodels to define a DBMS server, including the Software Deployment Submodel, Resource Submodel, and Relational Submodel. For more information about these submodels, see "SAS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. This example focuses on how to create the DBMS and define the server context of the SAS System that will be used to access the DBMS data.

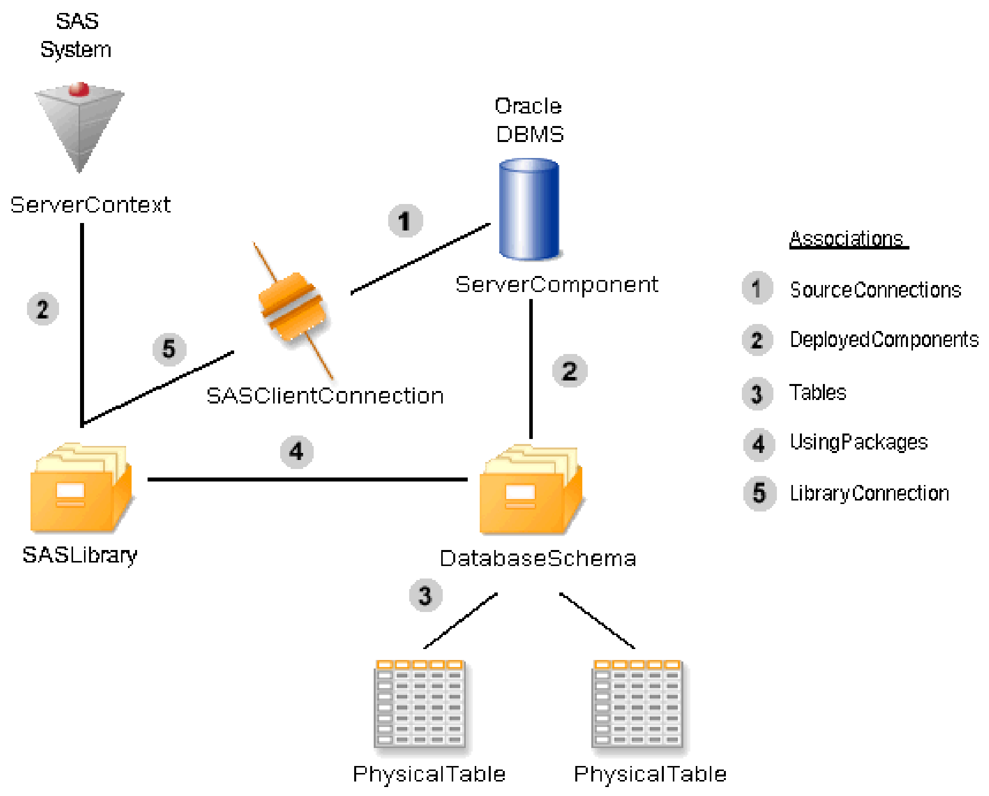
Requirements

This usage scenario assumes the reader has general understanding of the Software Deployment Submodel, Resource Submodel, and Relational Submodel of the SAS Metadata Model. For more information about these submodels, see "SAS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of the SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Creating Objects that Represent a DBMS

Figure 14.1 on page 136 depicts the metadata objects that represent the information necessary to access tables in a DBMS from SAS software.

Figure 14.1 Metadata Objects that Represent the Information Necessary to Access DBMS Tables from SAS Software



The metadata type ServerComponent is used to represent installed, runnable software such as the Oracle DBMS represented in this scenario. A ServerContext is used to define an application context by grouping non-homogeneous servers together which each can access the same resources. Resources include file system directories, database schemas, and SAS libraries which are represented by metadata types subtyped from DeployedDataPackage. There is an association between a ServerComponent and/or ServerContext and the DeployedDataPackage objects that it can access. If the software is configured as a server, in this example the Oracle DBMS, the information used to access the server is contained in one of the Connection metadata types.

In the previous diagram, the Oracle DBMS is a type of ServerComponent. The association labeled “1” in the figure is called SourceConnections from the ServerComponent’s perspective and Source from the Connection’s perspective. The SourceConnections is the list of Connection objects that can be used by other software to access the server. There may be many Connection objects, for example, one that contains OLEDB connection information, JDBC connection information, or SAS software connection information. There are several attributes which describe the protocols supported by the Connection object. The CommunicationProtocol attribute contains a value such as APPC or TCPIP that describes the communication protocol used to access the component. The ApplicationProtocol contains a value such as HTTP, RMI, Bridge, or SHARE. Each Connection object has a Source association with one and only one ServerComponent object.

Each ServerContext and ServerComponent may also have a list of data packages it can access. This association is labeled “2” in the figure. The Oracle DBMS has an association to its DatabaseSchema object. The SAS software has an association to its SASLibrary object. The list of packages available to a ServerComponent is the association named DataPackages. From the package’s perspective, the list of ServerComponent objects that can access it are in its ServerComponents association.

A SASLibrary may be associated with a single DatabaseSchema. This association is labeled “4” in the figure. If a SASLibrary is associated with a DatabaseSchema, it also needs the connection information for the server, and that association is labeled “5” in the figure. From the SASLibrary object’s perspective, this association is called LibraryConnection. From the Connection object’s perspective, the association is called Libraries.

There is a subtype of DeployedDataPackage called RelationalSchema that has an association to DataTable objects. SASLibrary and DatabaseSchema are subtypes of RelationalSchema. The association labeled "3" in the figure is inherited from RelationalSchema and is called Tables from the RelationalSchema perspective and TablePackage from the DataTable perspective. PhysicalTable inherits this association from DataTable. This example uses PhysicalTable objects because the objects represent actual tables residing in a DBMS or file system. PhysicalTable objects should be associated with a DatabaseSchema, if they reside in a DBMS, or a SASLibrary, if they are SAS data sets.

Usage Scenario: Creating Metadata for a Cube

Purpose

This usage scenario describes how to create metadata representing a cube. A cube is represented using metadata types from several submodels, including the Analysis Submodel, the Relational Submodel, and the Transform Submodel. This scenario depicts only one usage pattern.

Developers are discouraged from creating or consuming cube metadata using the SAS Open Metadata Interface. Instead, cubes should be defined by using either SAS OLAP Cube Studio or PROC OLAP. Sample PROC OLAP code that shows how to create the cube metadata object and the related cube metadata is provided.

Requirements

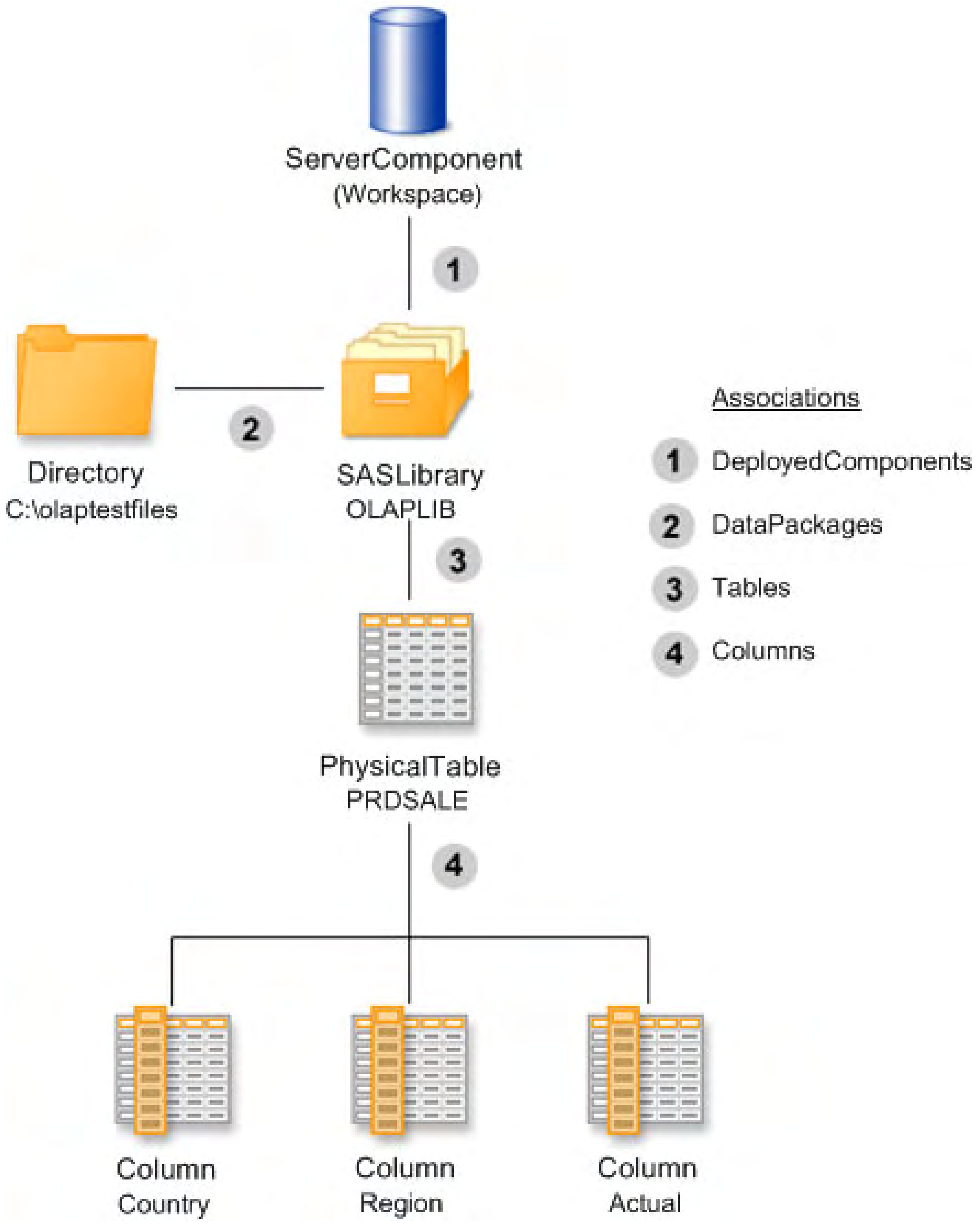
This usage scenario assumes that the reader has a general understanding of the Analysis Submodel, the Relational Submodel, and the Transform Submodel of the SAS Metadata Model. For more information about these submodels, see “SAS Namespace Metadata Types” in the *SAS Open Metadata Interface: Reference*. It also assumes that the reader has at least introductory knowledge of OLAP concepts. If you are not familiar with OLAP concepts, see the SAS OLAP Cube Studio or PROC OLAP documentation.

Creating Metadata Objects

A cube is a set of data that is organized and structured in a hierarchical, multidimensional arrangement. The cube is usually derived from a subset of a data warehouse. Unlike relational databases, which use two-dimensional data structures (often in the form of columns and rows in a spreadsheet), OLAP cubes are logical, multidimensional models that can have numerous dimensions and levels of data. Metadata about a cube consists of information about the dimensions, levels, and measures; information about the relational tables that contain the data from which a cube is derived; and information about the transformation that creates the cube.

Figure 14.2 on page 138 shows the metadata that needs to be defined to represent a typical input table.

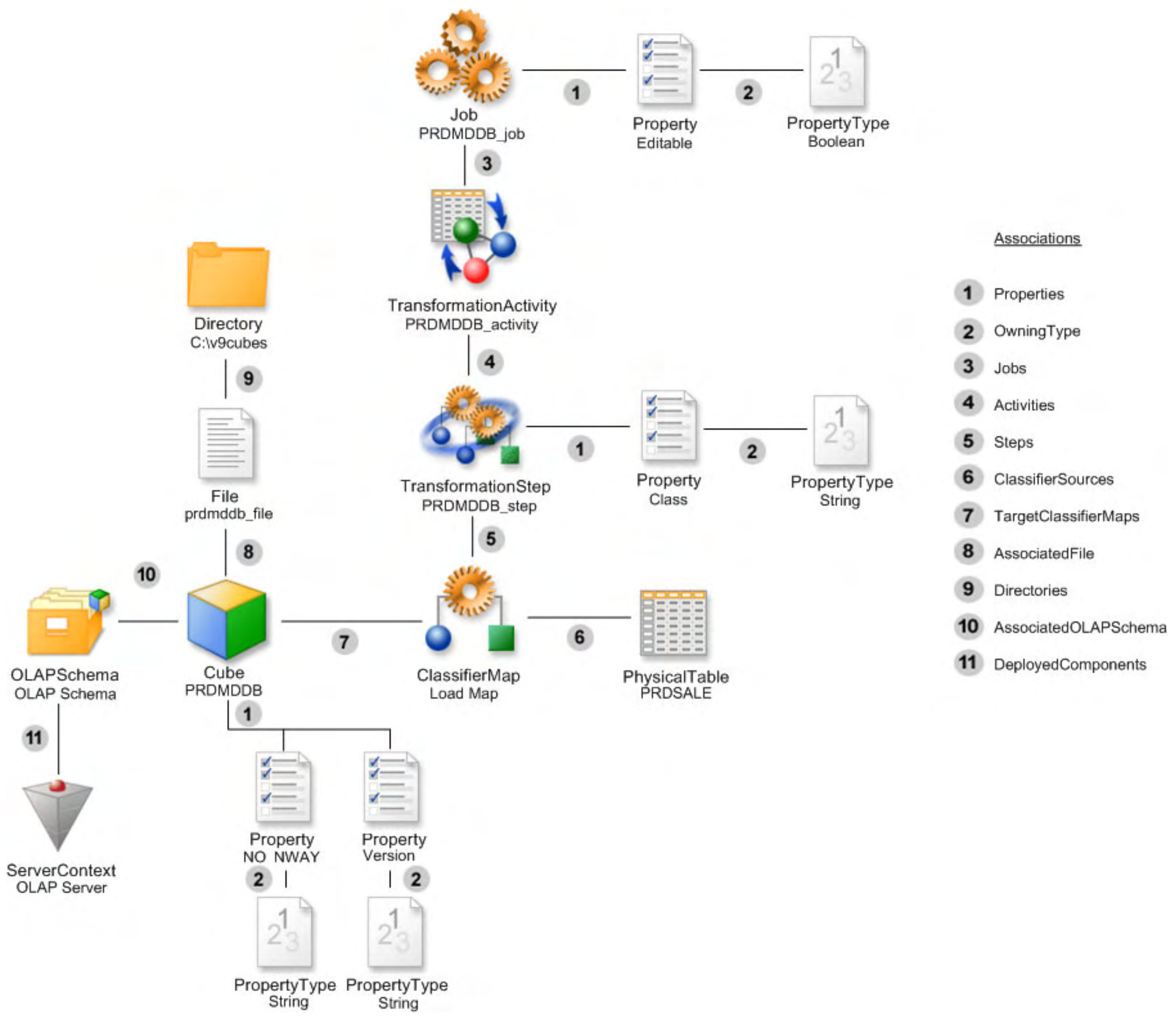
Figure 14.2 Metadata Objects Used to Define an Input Table



The SAS Metadata Model defines several metadata types that represent tables. Cubes are built from tables described by the PhysicalTable metadata type. The PhysicalTable metadata type is used to represent a relational table or data set that physically resides in a file system or DBMS. A PhysicalTable must have an associated SAS library, directory, and server. These are represented by the SASLibrary, Directory, and ServerComponent metadata types. A table's columns are represented by the Column metadata type. As shown in Figure 14.2 on page 138, the ServerComponent has a DeployedComponents association to the SASLibrary metadata type (numbered 1 in the figure), the SASLibrary metadata type has a DataPackages association to the Directory metadata type (numbered 2), the SASLibrary has a Tables associations to the PhysicalTable metadata type (numbered 3) and the PhysicalTable has a Columns association (numbered 4) to the Column metadata objects representing its columns.

Figure 14.3 on page 139 shows the process that creates the cube.

Figure 14.3 Metadata Objects Used to Create a Cube



The process of creating a cube is represented by the ClassifierMap metadata type and associated TransformationStep, TransformationActivity, and Job metadata types.

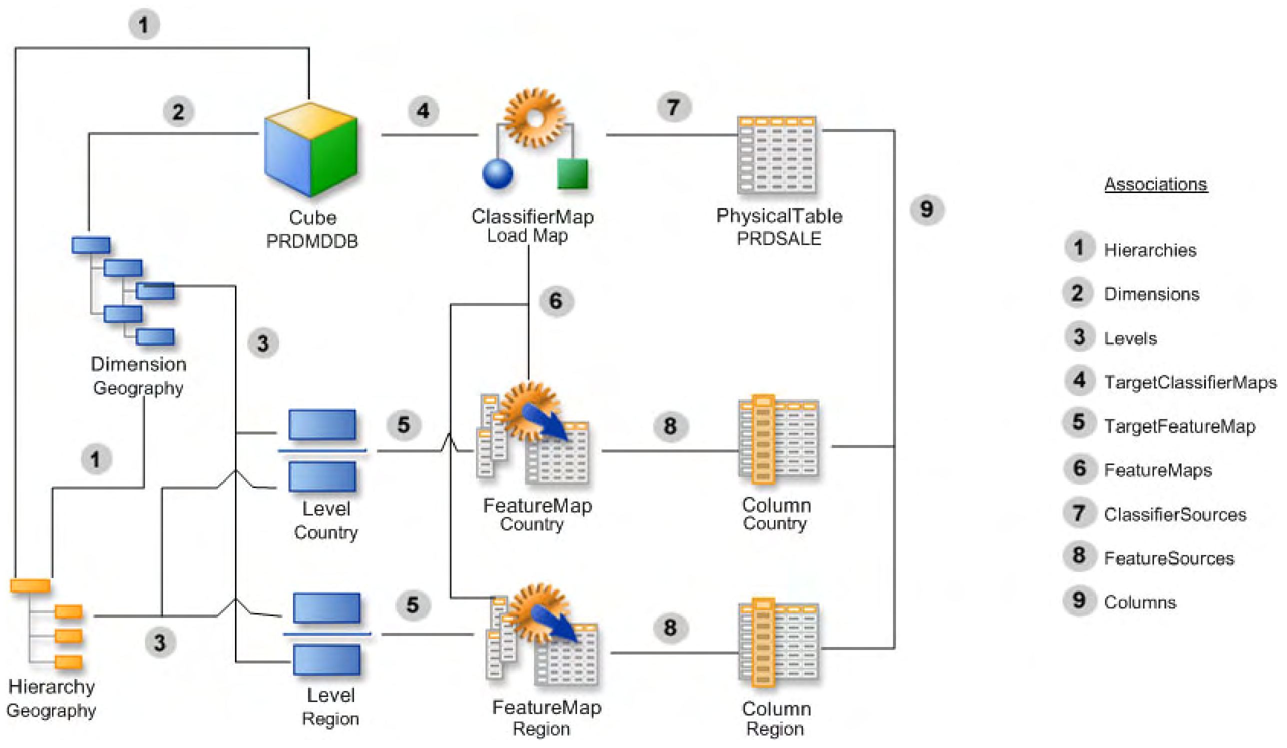
The cube has a TargetClassifierMaps association (numbered 7 in the figure) to the ClassifierMap metadata type, and the ClassifierMap has a ClassifierSources association (numbered 6) to the PhysicalTable metadata type. The CubeType attribute on the Cube is set to “MOLAP” to indicate that the cube is built from a detail table with no aggregate data in relational tables. The CubeName attribute for the Cube is left blank until PROC OLAP physically creates the cube. The Name attribute for the ClassifierMap metadata type should be set to “Load Map” and the TransformRole attribute should be set to “BASE.” The ClassifierMap also has a Steps association (numbered 5) to the TransformationStep metadata type, the TransformationStep has an Activities association (numbered 4) to the TransformationActivity metadata type, and the TransformationActivity has a Jobs association (numbered 3) to the Job metadata type. The Job metadata type has a Properties association (numbered 1) to a Property metadata type, and the Property metadata type has an OwningType association (numbered 2) to a PropertyType metadata type. The Name attribute and PropertyName attribute of the Property object associated with the Job are both set to “Editable”, and the DefaultValue attribute is set to “0.” The PropertyType has the Name attribute set to “Boolean”, and the SQLType attribute set to “-7.” The TransformationStep also has a Properties association (numbered 1) to a Property metadata type and the Property has an OwningType association (numbered 2) to a PropertyType metadata type. The Name attribute and the PropertyName attribute of the Property associated with the TransformationStep both are set to “CLASS.” The DefaultValue attribute for the Property is set to “com.sas.olapadmin.designer.model.CodeGeneration,” and the Role attribute is set to “TRANSFORMATIONSTEP.” The PropertyType has the Name attribute set to “String” and the SQLType set to “12.”

The Cube metadata type also has an AssociatedFile association (numbered 8) to a File metadata type, and the File has a Directories association (numbered 9) to a Directory metadata type. The File represents the storage location for the cube. The FileExtension attribute of the File is set to “CUBE,” and the TextRole attribute is set to ”METAUTILITY.” The Cube has an AssociatedOLAPSchema association (numbered 10) to an OLAPSchema metadata type, and the OLAPSchema has a DeployedComponents association (numbered 11) to a ServerContext metadata type. The OLAPSchema is used to group cubes together to be processed by an OLAP Server. The OLAP Server is represented by a ServerContext metadata type.

Finally, the Cube has a Properties association (numbered 1) to two Property metadata types, and each Property has an OwningType association (numbered 2) to a PropertyType metadata type. The first Property has the Name and PropertyName attributes set to “Version.” The DefaultValue is set to “2.” All cubes created with SAS 9.1 have the version number set to “2.” The PropertyType for the Version Property has the Name attribute set to “Integer” and the SQLType attribute set to “4.” The second Property has the Name and PropertyName attributes set to “NO_NWAY.” This attribute indicates if the cube will have an NWAY aggregation saved with the cube. If the DefaultValue attribute for the Property is set to “NO,” then an NWAY is saved. If it is set to “YES,” then the NWAY is not saved. The PropertyTyep for the NO_NWAY Property has the Name attribute set to “String” and the SQLType set to “12.”

Figure 14.4 on page 141 shows the dimensions, levels, and hierarchies for a cube. The cube in this example has a single dimension called Geography. The Geography dimension has a two levels, Country and Region, and one hierarchy called Geography. Each level is derived from a single column in the input table.

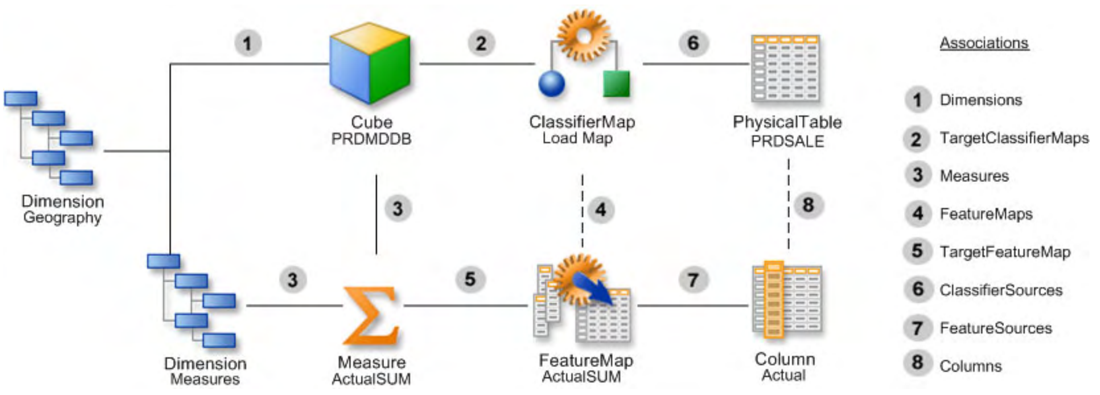
Figure 14.4 Metadata Objects Used to Define Dimensions, Levels, and Hierarchies of a Cube



The Cube has a Dimensions association to a Dimension metadata type (numbered 2 in the figure) and a Hierarchies association (numbered 1) to a Hierarchy metadata type. The Dimension and the Hierarchy metadata types both have a Levels association (numbered 3) to a Level metadata type. The Dimension has the DimensionType attribute set to “STANDARD.” The Levels association from the Hierarchy to the Level is an order list of Level metadata types, while the Levels association from the Dimension to the Level is not. Each Level has a TargetFeatureMap association (numbered 4) to a FeatureMap metadata type, and the FeatureMap has a FeatureSources association (numbered 8) to a Column metadata type. The TransformRole attribute of the FeatureMap is set to “ONETOONE.” The Cube has a TargetClassifierMaps association (numbered 4) to a ClassifierMap metadata type. The ClassifierMap has a ClassifierSources association (numbered 7) to a Physical Table metadata type and a FeatureMaps association (numbered 6) to each FeatureMap. The PhysicalTable has a Columns association (numbered 9) to the Column metadata types.

Figure 14.5 on page 142 shows the measures for a cube. The cube in this example has a single measure, ActualSUM, which is derived from a single column on the input table.

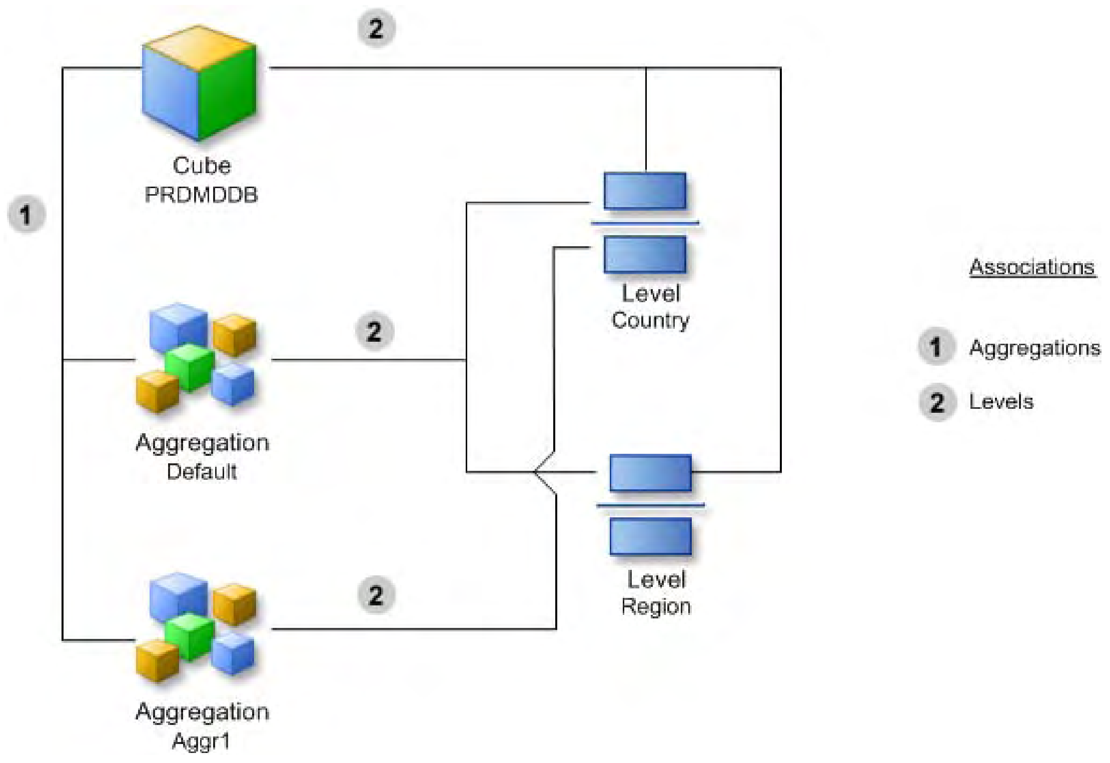
Figure 14.5 Metadata Objects Used to Define the Measures of a Cube



The Cube has a Dimensions association (numbered 1 in the figure) to two Dimension metadata objects. The first Dimension represents the dimension described in Figure 14.4 on page 141. The second Dimension represents the Measures dimension and must have the DimensionType set to "MEASURES." The Dimension and the Cube both have a Measures association (numbered 3) to a Measure metadata type, the Measure has a TargetFeatureMap association (numbered 5) to a FeatureMap metadata type, and the FeatureMap has a FeatureSources association (numbered 7) to a Column. The Statistic attribute is set to "SUM," and the IsStoredStatistic is set to "1" for the Measure. The TransformRole attribute for the FeatureMap is set to "TRNSFORM." The Cube metadata type has a TargetClassifierMaps association (numbered 2) to a ClassifierMap. The ClassifierMap has a FeatureMaps association (numbered 4) to the FeatureMap and a ClassifierSources association (numbered 7) to a PhysicalTable metadata type. The PhysicalTable has a Columns association (numbered 8) to a Column metadata type.

Figure 14.6 on page 143 shows the aggregations for the cube. The cube in this example has two aggregations. The first aggregation has the levels Country and Region. The second aggregation has only the Country level. The Cube has an Aggregations association (numbered 1 in the figure) to the Aggregation metadata types. Each Aggregation has a Levels association (numbered 2) to a Level metadata type. The first Aggregation has its Name attribute set to "Default" and the NWAY attribute set to "1." This aggregation represents the NWAY (sometimes called the default) aggregation. Its Levels association (numbered 2) must contain each Level. The second Aggregation has its Name attribute set to "Aggr1" and the NWAY attribute set to "0." Its Levels association only contains the Country Level.

Figure 14.6 Metadata Objects Used to Define the Aggregations of a Cube



Sample PROC OLAP Code

The following sample PROC OLAP code shows how to create the metadata objects shown in the figures for this usage scenario.

```
LIBNAME OLAPLIB BASE "c:\olaptestfiles" ;

PROC OLAP Data=OLAPLIB.PRDSALE cube=prdmddb Path="c:\v9cubes";
METASVR host="hostname" port=9999 protocol=bridge userid=""
pw="" repository="Foundation" olap_schema="Olap Schema";

DIMENSION Geography hierarchies=(Geography) CAPTION='Geography';
HIERARCHY Geography levels=( COUNTRY REGION ) CAPTION='Geography' DEFAULT ;
LEVEL REGION CAPTION='Region' ;
LEVEL COUNTRY CAPTION='Country' ;

MEASURE ACTUALSUM STAT=SUM COLUMN=ACTUAL CAPTION='Sum of ACTUAL' FORMAT=DOLLAR12.2 ;

AGGREGATION COUNTRY;

RUN;
```

Usage Scenario: Creating a Prototype

Purpose

This usage scenario describes how to create a prototype using the Property Submodel. The example focuses on creating a SAS/CONNECT connection prototype. An XML representation of the prototype is included to show how to construct prototype objects and their properties.

Requirements

This usage scenario assumes the reader has a general understanding of the Property Submodel and Software Deployment Submodel of the SAS Metadata Model. For more information about these submodels, see "SAS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Description of a Prototype

A prototype is a template used for creating other metadata objects or sets of metadata objects that represent a concept. The prototype includes all possible valid options or properties that may be used to describe the metadata object that is represented by the prototype. The prototype may then be used to drive a user interface that will aid a user in the creation of metadata.

Prototype Objects

A Prototype object is used to as a template for creating other metadata objects. This example describes a prototype for a SAS/CONNECT connection. A Prototype object contains an attribute that contains the metadata type described by the prototype, in this case a SASClientConnection, and has associations to other objects that define the attributes and associations for the object.

Prototype and Properties

In this example, the prototype describes the information needed for a SAS/CONNECT connection. Its attribute, MetadataType, identifies which type is being described. Prototype objects may have AttributeProperty objects that describe the settings of the attributes of the templated metadata type. In this example, the AttributeProperty for ClassIdentifier indicates the only valid setting for this attribute for a Workspace Server.

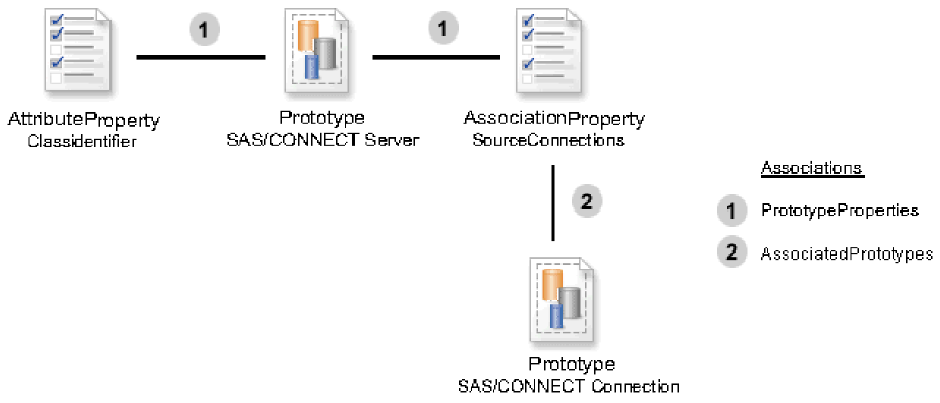
Prototype objects may also have AssociationProperty objects that describe the characteristics of associated objects. In this case, the AssociationProperty connects a prototype of a TCPIPConnection object to the prototype of a SASClientConnection.

Prototype objects locate AttributeProperty and AssociationProperty objects through the PrototypeProperties association or through PropertyGroup objects.

Objects created by using a prototype definition may maintain an association to the prototype that was used to create them through the UsingPrototype association.

Figure 14.7 on page 145 depicts a prototype for a SASClientConnection, an AttributeProperty, and an AssociationProperty. The associations indicated by the number “1” in the figure represent the association called PrototypeProperties. A Prototype object can have a PrototypeProperties association to AttributeProperty and AssociationProperty objects. That is, a SAS/CONNECT server can have both a class identifier and source connections defined as properties. The association from the AssociationProperty object to the SAS/CONNECT Connection Prototype (numbered “2” in the figure) is called AssociatedPrototypes and is used to link prototype definitions together.

Figure 14.7 Metadata Objects that Represent a Prototype for a SASClientConnection



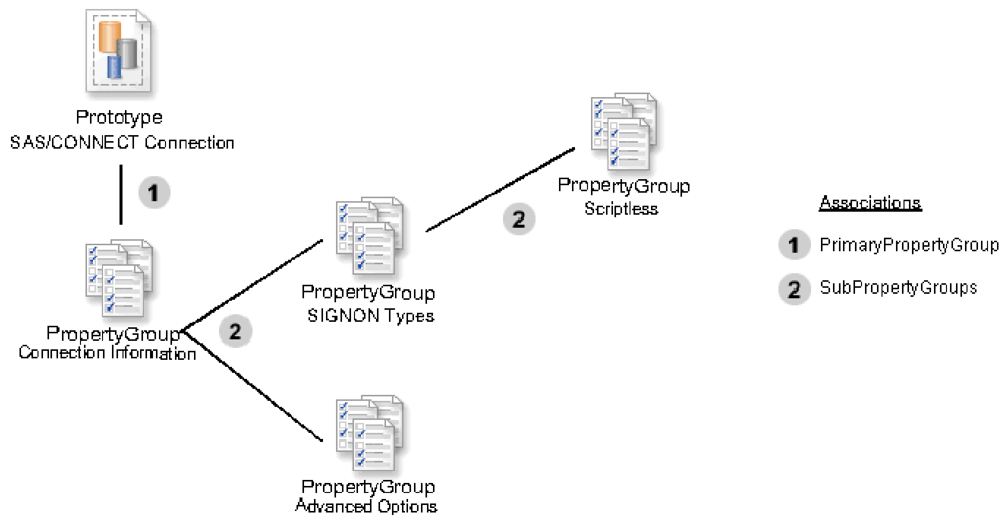
Prototype and Property

The TCPIPConnection that describes a Bridge connection has Property objects that describe the encryption level and algorithms. A prototype also uses Property objects to contain that information, but the Properties and PropertySet associations are not used. Unfortunately, due to our subtyping structure, these associations are available to a Prototype object. However, these associations should never be used.

If a prototype requires Property objects, then it should have a top-level PropertyGroup object associated to it through the PrimaryPropertyGroup association. PropertyGroup objects are used to logically group AttributeProperty, AssociationProperty, and Property objects. This grouping is primarily used to organize these objects for a user interface.

Figure 14.8 on page 146 depicts how to group properties. Each prototype has a single top-level PropertyGroup, in this case named Connection Information. Each PropertyGroup may have subgroups. The association between the Prototype and its top-level group is called a PrimaryPropertyGroup association (number “1” in Figure 14.8 on page 146). The association between the top-level PropertyGroup and its subgroups (numbered “2” in the figure) is called SubpropertyGroups.

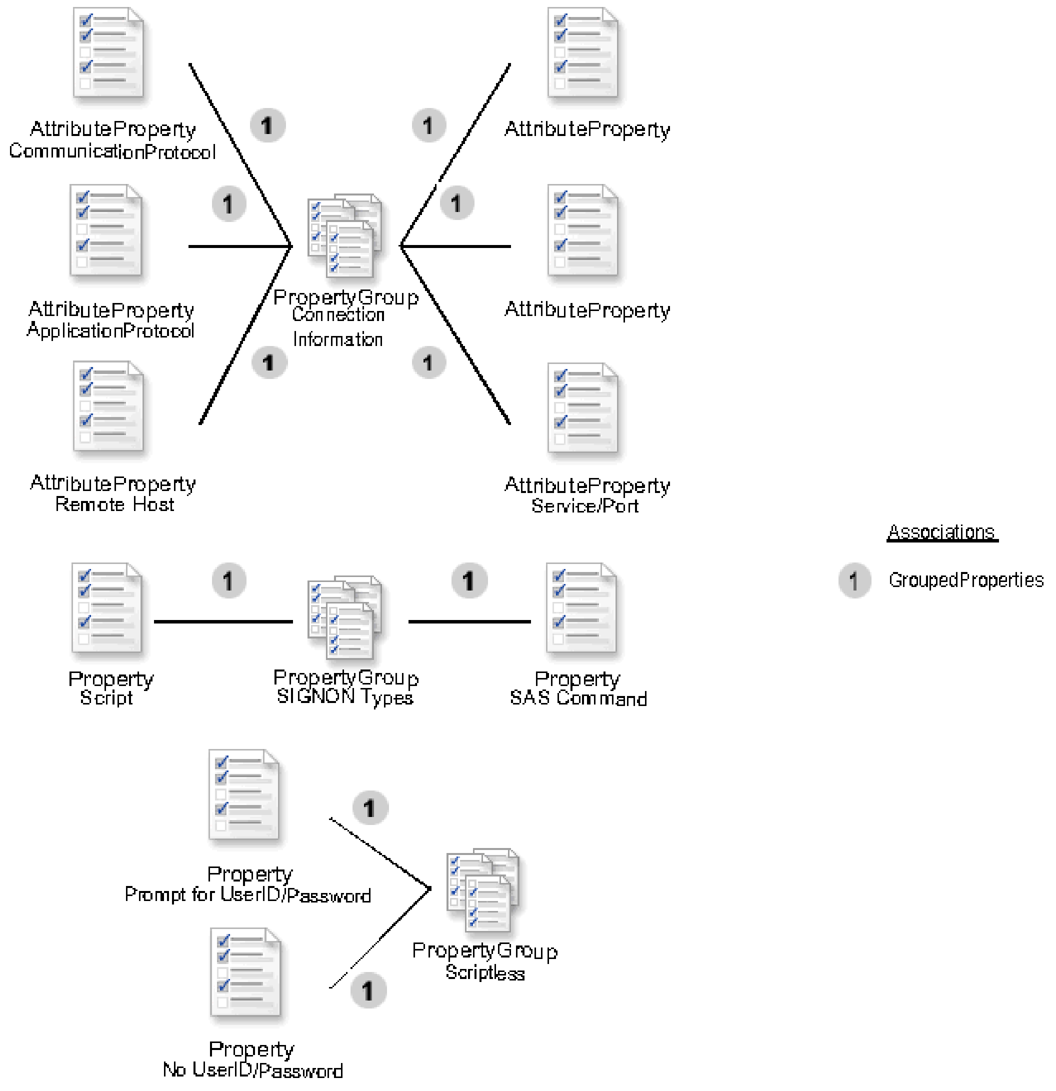
Figure 14.8 Metadata Objects for Grouping Properties



PropertyGroups and Properties

Figure 14.9 on page 147 depicts the relationship between the subtypes of AbstractProperty objects and PropertyGroups. When used as part of a prototype definition, a Property object must be associated to a only one PropertyGroup. AttributeProperty and AssociationProperty are associated using the GroupedProperties association (numbered “1” in Figure 14.9 on page 147).

Figure 14.9 Relationship between the Subtypes of AbstractProperty Objects and PropertyGroup Objects



XML Example

See Example of Creating a Prototype to view the XML representation of the prototype for a SAS/CONNECT server. This is the actual prototype which would be installed by SAS Management Console when initializing a new repository. This prototype is used by the server wizard to aid a user in creating a metadata definition for a SAS/CONNECT server.

Example of Creating a Prototype

```
<AddMetadata>
   <Metadata>
     <PropertyType Id="$String" Name="String" SQLType="12"/>
     <PropertyType Id="$Boolean" Name="Boolean" SQLType="-7"/>
```

```
<PropertyType Id="$Integer" Name="Integer" SqlType="4"/>
<PropertyType Id="$File" Name="File" SqlType="12"/>
<PropertyType Id="$StringArray" Name="String Array" SqlType="2003">
   <ElementType>
      <PropertyType ObjRef="$String"/>
   </ElementType>
</PropertyType>
<PropertyType Id="$AuthenticationTypes" Name="AuthenticationTypes" SqlType="12">
    <StoredConfiguration>
        <TextStore Name="Enumeration of Authentication Types"
                   TextRole="config"
                   TextType="xml"
                   StoredText="<Configuration>
                               <Enumeration>
                                 <Value name="user/password"/>
                                 <Value name="none"/>
                                 <Value name="password"/>
                                 <Value name="certificate"/>
                                </Enumeration>
                                </Configuration>"/>
    </StoredConfiguration>
</PropertyType>
<PropertyType Id="$EncryptionKeySizes" Name="EncryptionKeySizes" SqlType="12">
    <StoredConfiguration>
        <TextStore Name="Enumeration of Encryption Key Sizes"
                   TextRole="config"
                   TextType="xml"
                   StoredText="<Configuration>
                               <Enumeration>
                                <Value name="0"/>
                                <Value name="40"/>
                                <Value name="128"/>
                               </Enumeration>
                               </Configuration>"/>
    </StoredConfiguration>
</PropertyType>
<PropertyType Id="$CommunicationProtocols" Name="CommunicationProtocols"
    SqlType="12">
    <ElementType>
       <PropertyType ObjRef="$String"/>
    </ElementType>
    <StoredConfiguration>
        <TextStore Name="Communication Protocols Enumeration"
                   TextRole="config"
                   TextType="xml"
                   StoredText="<Configuration>
                               <Enumeration>
                                <Value name="TCP"/>
                                <Value name="APPC"/>
                                <Value name="XMS"/>
                               </Enumeration>
                              </Configuration>"/>
    </StoredConfiguration>
</PropertyType>
```

```
<Prototype Id="$CONNSASConn" Name="SAS/CONNECT Connection"
  MetadataType="SASClientConnection">
    <PrimaryPropertyGroup>
       <PropertyGroup Id="$ConnectionInformation" Name="Connection Information">
          <SubpropertyGroups>
               <PropertyGroup Id="$SignonInformation"
                              Name="SIGNON Types"
                              Desc="Select one of the following types of signon."
                              Minimum="1"
                              Maximum="1" >
                              <SubpropertyGroups>
                                  <PropertyGroup Id="$Scriptless"
                                                 Name="Scriptless"
                                                 Desc=""
                                                 Minimum="1"
                                                 Maximum="1"/>
                              </SubpropertyGroups>
               </PropertyGroup>
               <PropertyGroup Id="$AdvancedOptions"
                              Name="Advanced Options"
                              Desc="" />
           </SubpropertyGroups>
       </PropertyGroup>
   </PrimaryPropertyGroup>
   <PrototypeProperties>
       <AttributeProperty Name="Communication Protocol"
                          PropertyName="CommunicationProtocol"
                          IsExpert="0"
                          IsRequired="1"
                          IsUpdateable="1"
                          IsVisible="1"
                          DefaultValue="TCP">
                          <OwningType>
                            <PropertyType ObjRef="$CommunicationProtocols"/>
                          </OwningType>
                          <OwningPrototype>
                             <Prototype ObjRef="$CONNSASConn"/>
                          </OwningPrototype>
                          <AssociatedPropertyGroup>
                             <PropertyGroup ObjRef="$ConnectionInformation"/>
                          </AssociatedPropertyGroup>
       </AttributeProperty>
       <AttributeProperty Name="Application Protocol"
                          PropertyName="ApplicationProtocol"
                          IsExpert="0"
                          IsRequired="1"
                          IsUpdateable="0"
                          IsVisible="0"
                          DefaultValue="CONNECT">
                          <OwningType>
                              <PropertyType ObjRef="$String"/>
                          </OwningType>
                          <OwningPrototype>
                              <Prototype ObjRef="$CONNSASConn"/>
```

```
                    </OwningPrototype>
                    <AssociatedPropertyGroup>
                        <PropertyGroup ObjRef="$ConnectionInformation"/>
                    </AssociatedPropertyGroup>
        </AttributeProperty>
        <AssociationProperty
                 Name="Authentication Domain"
                 AssociationName="Domain"
                 PartnerName="Connections"
                 MetadataType="AuthenticationDomain"
                 IsExpert="0"
                 IsVisible="1"
                 IsUpdateable="1"
                 Minimum=""
                 Maximum="1">
                 <StoredConfiguration>
                 <TextStore Name="Authentication Domains"
                 TextRole="config"
                 TextType="xml"
                 StoredText="<Configuration>
                              <MetadataRequest>
                              <GetMetadataObjects>
                              <Reposid>_ReposID_</Reposid>
                              <Type>AuthenticationDomain</Type>
                              <NS>SAS</NS>
                              <Flags>264</Flags>
                              <Options></Options>
                              </GetMetadataObjects>
                              </MetadataRequest>
                              <ClassParameters>
                               <Parm Name="_ParentComponent_"/>
                               <Parm Name="_ObjectStore_Persist_"/>
                               <Parm Name="_ReposID_"/>
                               <Parm Name="_Prototype_"/>
                               <Parm Name="New Authentication Domain"/>
                              </ClassParameters>
                             </Configuration>"/>
                 </StoredConfiguration>
                 <Customizers>
                     <ConfiguredComponent
                        Name="PrototypePropertiesDialog Java Class"
                        ClassIdentifier="com.sas.workspace.visuals.
                        PrototypePropertiesDialog"/>
                 </Customizers>
                 <AssociatedPrototypes>
                     <Prototype ObjRef="$CONNSASConn"/>
                     <Prototype ObjRef="$AuthDomain"/>
                 </AssociatedPrototypes>
                 <OwningPrototype>
                     <Prototype ObjRef="$CONNSASConn"/>
                 </OwningPrototype>
                 <AssociatedPropertyGroup>
                     <PropertyGroup ObjRef="$ConnectionInformation"/>
                 </AssociatedPropertyGroup>
```

```
    </AssociationProperty>
    <AttributeProperty
             Name="Remote Host"
             PropertyName="RemoteAddress"
             IsExpert="0"
             IsRequired="1"
             IsUpdateable="1"
             IsVisible="1"
             DefaultValue="">
             <OwningType>
                 <PropertyType ObjRef="$String"/>
             </OwningType>
             <OwningPrototype>
                 <Prototype ObjRef="$CONNSASConn"/>
             </OwningPrototype>
             <AssociatedPropertyGroup>
                 <PropertyGroup ObjRef="$ConnectionInformation"/>
             </AssociatedPropertyGroup>
    </AttributeProperty>
    <AttributeProperty
             Name="Service/Port"
             PropertyName="Service"
             IsExpert="0"
             IsRequired="0"
             IsUpdateable="1"
             IsVisible="1"
             DefaultValue="">
             <OwningType>
                 <PropertyType ObjRef="$String"/>
             </OwningType>
             <OwningPrototype>
                 <Prototype ObjRef="$CONNSASConn" />
             </OwningPrototype>
             <AssociatedPropertyGroup>
                 <PropertyGroup ObjRef="$ConnectionInformation"/>
             </AssociatedPropertyGroup>
    </AttributeProperty>
</PrototypeProperties>
<Properties>
    <Property
             Name="Script"
             PropertyName="Script"
             IsExpert="0"
             IsRequired="1"
             IsUpdateable="1"
             IsVisible="1"
             DefaultValue="">
             <OwningType>
                <PropertyType ObjRef="$File"/>
             </OwningType>
             <AssociatedPropertyGroup>
                <PropertyGroup ObjRef="$SignonInformation"/>
             </AssociatedPropertyGroup>
    </Property>
```

```
<Property
         Name="Prompt for Userid/Password"
         PropertyName="Prompt"
         IsExpert="0"
         IsRequired="1"
         IsUpdateable="1"
         IsVisible="1"
         DefaultValue="0">
         <OwningType>
             <PropertyType ObjRef="$Boolean"/>
         </OwningType>
         <AssociatedPropertyGroup>
             <PropertyGroup ObjRef="$Scriptless"/>
         </AssociatedPropertyGroup>
</Property>
<Property
         Name="No Userid/Password"
         PropertyName="NoPrompt"
         IsExpert="0"
         IsRequired="1"
         IsUpdateable="1"
         IsVisible="1"
         DefaultValue="1">
         <OwningType>
             <PropertyType ObjRef="$Boolean"/>
         </OwningType>
        <AssociatedPropertyGroup>
            <PropertyGroup ObjRef="$Scriptless"/>
         </AssociatedPropertyGroup>
</Property>
<Property
         Name="SAS Command"
         PropertyName="SASCMD"
         IsExpert="0"
         IsRequired="1"
         IsUpdateable="1"
         IsVisible="1"
         DefaultValue="">
         <OwningType>
             <PropertyType ObjRef="$String"/>
         </OwningType>
         <AssociatedPropertyGroup>
             <PropertyGroup ObjRef="$SignonInformation"/>
         </AssociatedPropertyGroup>
</Property>
<Property
         Name="Remote Session Macvar"
         PropertyName="macvar"
         IsExpert="1"
         IsRequired="0"
         IsUpdateable="1"
         IsVisible="1"
         DefaultValue="">
         <OwningType>
```

```
            <PropertyType ObjRef="$String"/>
        </OwningType>
        <AssociatedPropertyGroup>
            <PropertyGroup ObjRef="$AdvancedOptions"/>
        </AssociatedPropertyGroup>
</Property>
<Property
        Name="Execute Remote Submits Synchronously"
        PropertyName="ConnectWait"
        IsExpert="1"
        IsRequired="0"
        IsUpdateable="1"
        IsVisible="1"
        DefaultValue="1">
        <OwningType>
            <PropertyType ObjRef="$Boolean"/>
        </OwningType>
        <AssociatedPropertyGroup>
            <PropertyGroup ObjRef="$AdvancedOptions"/>
        </AssociatedPropertyGroup>
</Property>
<Property
        Name="Display Status Window"
        PropertyName="ConnectStatus"
        IsExpert="1"
        IsRequired="0"
        IsUpdateable="1"
        IsVisible="1"
        DefaultValue="1">
        <OwningType>
            <PropertyType ObjRef="$Boolean"/>
        </OwningType>
        <AssociatedPropertyGroup>
            <PropertyGroup ObjRef="$AdvancedOptions"/>
        </AssociatedPropertyGroup>
</Property>
<Property
        Name="Transmission Buffer Size"
        PropertyName="Tbufsize"
        IsExpert="1"
        IsRequired="0"
        IsUpdateable="1"
        IsVisible="1"
        DefaultValue="">
        <OwningType>
            <PropertyType ObjRef="$String"/>
        </OwningType>
        <AssociatedPropertyGroup>
            <PropertyGroup ObjRef="$AdvancedOptions"/>
        </AssociatedPropertyGroup>
</Property>
<Property
        Name="Requires Encryption"
        PropertyName="Encryption"
```

```
                IsExpert="1"
                IsRequired="0"
                IsUpdateable="1"
                IsVisible="1"
                DefaultValue="0">
                <OwningType>
                    <PropertyType ObjRef="$Boolean"/>
                </OwningType>
                <AssociatedPropertyGroup>
                    <PropertyGroup ObjRef="$AdvancedOptions"/>
                </AssociatedPropertyGroup>
       </Property>
       <Property
                Name="Encryption Algorithm Names"
                PropertyName="EncryptionAlgorithms"
                IsExpert="1"
                IsRequired="0"
                IsUpdateable="1"
                IsVisible="1"
                DefaultValue="">
                <OwningType>
                    <PropertyType ObjRef="$String"/>
                </OwningType>
                <AssociatedPropertyGroup>
                    <PropertyGroup ObjRef="$AdvancedOptions"/>
                </AssociatedPropertyGroup>
       </Property>
       <Property
                Name="Encryption Algorithm Key Size"
                PropertyName="EncryptionKeySize"
                IsExpert="1"
                IsRequired="0"
                IsUpdateable="1"
                IsVisible="1"
                DefaultValue="">
                <OwningType>
                    <PropertyType ObjRef="$EncryptionKeySizes"/>
                </OwningType>
                <AssociatedPropertyGroup>
                    <PropertyGroup ObjRef="$AdvancedOptions"/>
                </AssociatedPropertyGroup>
       </Property>
   </Properties>
</Prototype>
<Prototype Id="$CONNDC" Name="SAS/CONNECT Server"
              Desc="This server defines a SAS/CONNECT Server for SAS 9."
              MetadataType="ServerComponent">
              <Extensions>
                  <Extension Name="UITreeCategory"
                             Value="SAS Servers.SAS Application Server Components"
                             ExtensionType="VARCHAR" />
              </Extensions>
              <Associations>
                  <AssociationProperty
                Name=""
                AssociationName="SourceConnections"
                PartnerName="Source"
                Minimum="1"
                Maximum="1"
                MetadataType="ServerComponent">
                  <AssociatedPrototypes>
                     <Prototype ObjRef="$CONNSASConn" />
                   </AssociatedPrototypes>
                   <OwningPrototype>
                     <Prototype ObjRef="$CONNDC" />
                   </OwningPrototype>
    </AssociationProperty>
</Associations>
<PrimaryPropertyGroup>
    <PropertyGroup Id="$CONNECTServer"
                   Name="CONNECT Server Properties"/>
</PrimaryPropertyGroup>
<PrototypeProperties>
    <AttributeProperty
              Name="ClassIdentifier"
              PropertyName="ClassIdentifier"
              IsExpert="0"
              IsRequired="1"
              IsUpdateable="0"
              IsVisible="0"
              DefaultValue="028e4060-d545-11d5-880d-aa0004006d06">
                 <OwningType>
                    <PropertyType ObjRef="$Integer"/>
                 </OwningType>
                 <OwningPrototype>
                     <Prototype ObjRef="$CONNDC"/>
                 </OwningPrototype>
                 <AssociatedPropertyGroup>
                     <PropertyGroup ObjRef="$CONNECTServer"/>
                 </AssociatedPropertyGroup>
    </AttributeProperty>
    <AttributeProperty
              Name="Major Version Number"
              PropertyName="Major"
              IsExpert="0"
              IsRequired="1"
              IsUpdateable="1"
              IsVisible="1"
              DefaultValue="9">
                 <OwningType>
                    <PropertyType ObjRef="$Integer"/>
                 </OwningType>
                 <OwningPrototype>
                    <Prototype ObjRef="$CONNDC"/>
                 </OwningPrototype>
                 <AssociatedPropertyGroup>
                    <PropertyGroup ObjRef="$CONNECTServer"/>
                 </AssociatedPropertyGroup>
```

```
</AttributeProperty>
<AttributeProperty
          Name="Minor Version Number"
          PropertyName="Minor"
          IsExpert="0"
          IsRequired="1"
          IsUpdateable="1"
          IsVisible="1"
          DefaultValue="0">
             <OwningType>
                <PropertyType ObjRef="$Integer"/>
             </OwningType>
             <OwningPrototype>
                 <Prototype ObjRef="$CONNDC"/>
             </OwningPrototype>
             <AssociatedPropertyGroup>
                 <PropertyGroup ObjRef="$CONNECTServer"/>
             </AssociatedPropertyGroup>
</AttributeProperty>
<AttributeProperty
          Name="Product Name"
          PropertyName="ProductName"
          IsExpert="0"
          IsRequired="1"
          IsUpdateable="0"
          IsVisible="0"
          DefaultValue="SAS/CONNECT">
             <OwningType>
                 <PropertyType ObjRef="$String"/>
             </OwningType>
             <OwningPrototype>
                 <Prototype ObjRef="$CONNDC"/>
             </OwningPrototype>
             <AssociatedPropertyGroup>
                 <PropertyGroup ObjRef="$CONNECTServer"/>
             </AssociatedPropertyGroup>
</AttributeProperty>
<AttributeProperty
          Name="Software Version"
          PropertyName="SoftwareVersion"
          IsExpert="0"
          IsRequired="1"
          IsUpdateable="1"
          IsVisible="1"
          DefaultValue="9.0">
             <OwningType>
                <PropertyType ObjRef="$String"/>
             </OwningType>
             <OwningPrototype>
                <Prototype ObjRef="$CONNDC"/>
             </OwningPrototype>
             <AssociatedPropertyGroup>
                <PropertyGroup ObjRef="$CONNECTServer"/>
             </AssociatedPropertyGroup>
```

```
                  </AttributeProperty>
                  <AttributeProperty
                            Name="Vendor"
                            PropertyName="Vendor"
                            IsExpert="0"
                            IsRequired="1"
                            IsUpdateable="1"
                            IsVisible="1"
                            DefaultValue="SAS Institute">
                               <OwningType>
                                  <PropertyType ObjRef="$String"/>
                               </OwningType>
                               <OwningPrototype>
                                  <Prototype ObjRef="$CONNDC"/>
                               </OwningPrototype>
                               <AssociatedPropertyGroup>
                                  <PropertyGroup ObjRef="$CONNECTServer"/>
                               </AssociatedPropertyGroup>
                  </AttributeProperty>
              </PrototypeProperties>
</Prototype>
<Prototype Id="$AuthDomain" Name="Authentication Domain"
     MetadataType="AuthenticationDomain">
     <PrimaryPropertyGroup>
        <PropertyGroup Name="Primary Group" >
           <GroupedProperties>
               <AttributeProperty
                         Name="Name"
                         PropertyName="Name"
                         IsExpert="0"
                         IsRequired="1"
                         IsUpdateable="1"
                         IsVisible="1"
                         DefaultValue="">
                           <OwningType>
                              <PropertyType ObjRef="$String"/>
                           </OwningType>
                           <OwningPrototype>
                              <Prototype ObjRef="$AuthDomain" />
                           </OwningPrototype>
               </AttributeProperty>
               <AttributeProperty
                         Name="Description"
                         PropertyName="Desc"
                         IsExpert="0"
                         IsRequired="0"
                         IsUpdateable="1"
                         IsVisible="1"
                         DefaultValue="">
                           <OwningType>
                              <PropertyType ObjRef="$String"/>
                           </OwningType>
                           <OwningPrototype>
                              <Prototype ObjRef="$AuthDomain" />
```

```
                                </OwningPrototype>
                        </AttributeProperty>
                    </GroupedProperties>
                </PropertyGroup>
            </PrimaryPropertyGroup>
        </Prototype>
    </Metadata>
    <Reposid>_ReposID_</Reposid>
    <Ns>SAS</Ns>
    <Flags>268435456</Flags>
    <Options/>
</AddMetadata>
```

Usage Scenario: Creating Metadata for a SAS Library

Purpose

This usage scenario describes the metadata objects used to define a SAS library. An XML representation of the metadata objects is provided.

Requirements

This usage scenario assumes the reader has a general understanding of the Resource Submodel, Software Deployment Submodel, and Relational Submodel of the SAS Metadata Model. For more information about these submodels, see "SAS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of the SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Defining a Library

The primary metadata type used to describe a SAS library is the SASLibrary type. It has attributes for the engine type, the libref name, and whether the library is already pre-assigned in the SAS session. A library has the IsPreassigned flag set to true if the library is assigned during initialization of the SAS session. SASLibrary is a subtype of RelationalSchema, because the SAS library concept acts much like a schema in that it is a grouping of tables (or data sets). RelationalSchema is a subtype of DeployedDataPackage because it contains data items.

In most situations, a SASLibrary will be associated with another DeployedDataPackage through the UsingPackages association to describe the physical location of the tables. This associated DeployedDataPackage could be a Directory, DatabaseSchema, or another SASLibrary object. The Directory object contains a DirectoryName attribute which is the name of the directory in the file system. If the IsRelative attribute is set to false (0), then it is assumed that the file system name is complete. If it is set to true (1), then there should be associated directory objects. The DirectoryName of these objects should be pre-pended to the DirectoryName of the base Directory object. When creating multiple levels of relative directory names, the relative names must be stored in such a way that simply pre-pending the relative name will create a valid directory name. This includes any required delimiters.

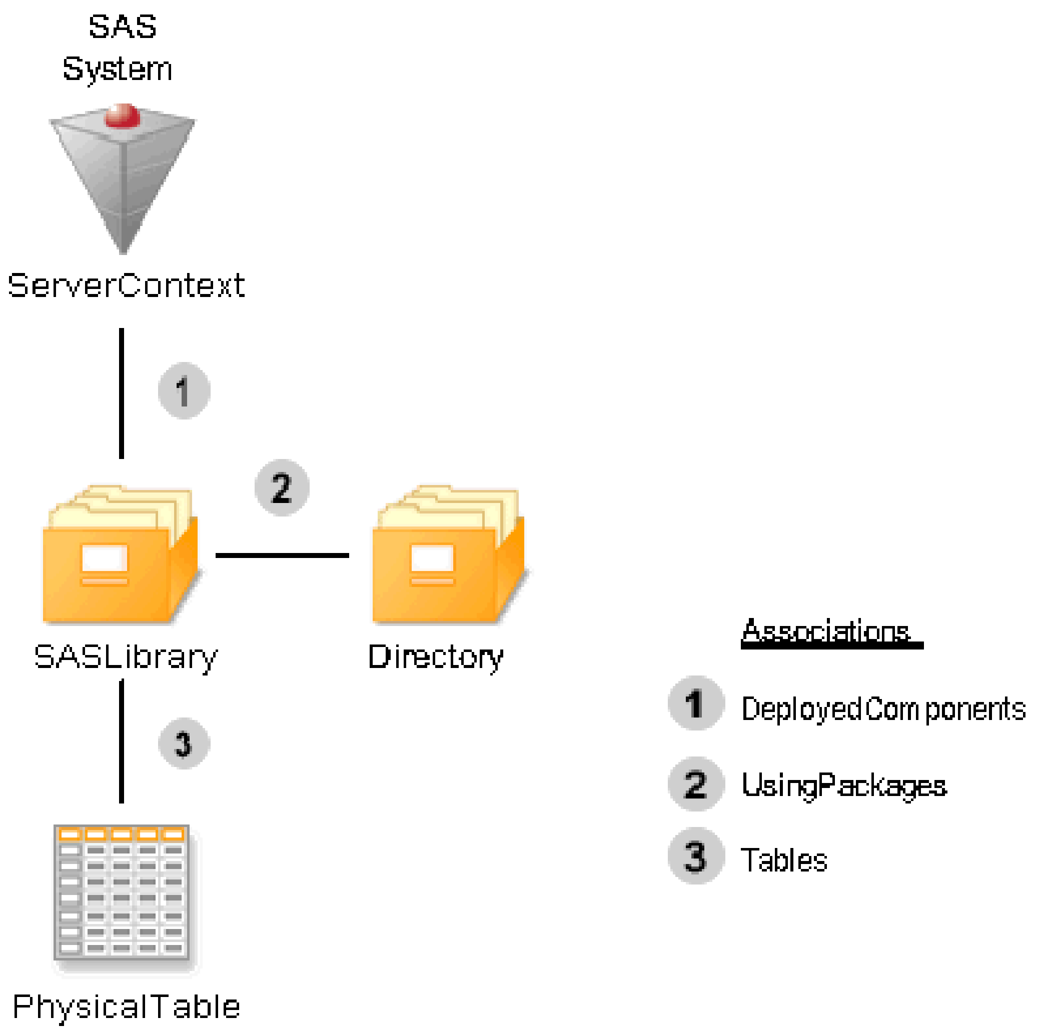
Tables may be associated to one and only one RelationalSchema. If the tables reside in a DMBS, they should be associated to a DBMS schema, which in turn is associated to a SASLibrary. If the tables reside in a directory, then they should be associated directly to a SASLibrary. If there are multiple ways of specifying the directory, such as c:\mystuff and \\mypc\mystuff, then the Alias association should be used. Each of these scenarios is described in the examples below.

Examples of SAS Library Objects

Library with Tables in a Directory

Figure 14.10 on page 159 shows the metadata objects used to describe a SAS library, directory, and data sets. The library is represented with the SASLibrary object, a Directory object describes the physical location of the data, and the data set is a PhysicalTable object. The ServerContext object describes which SAS software systems can use this library definition.

Figure 14.10 Metadata Objects that Define a SAS Library, Directory, and Data Sets



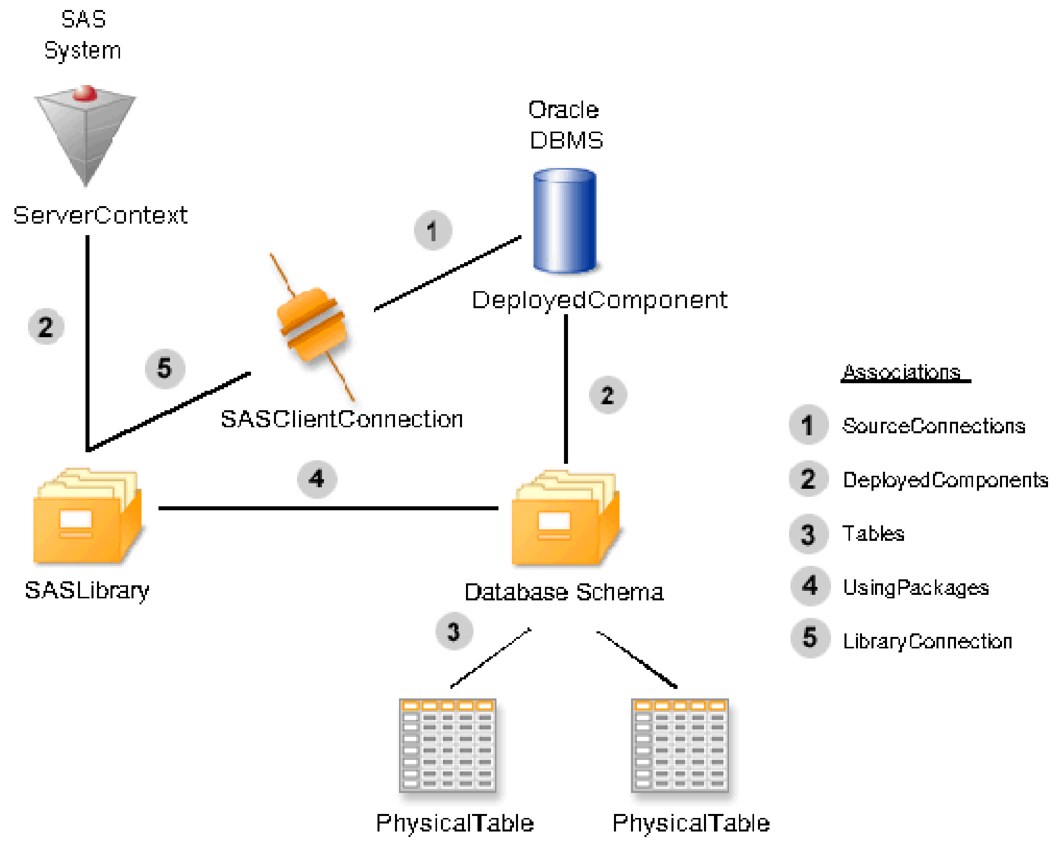
The SAS software that can use this library definition is associated to the SASLibrary through the DeployedComponents association (numbered “1” in the figure). The Directory is associated to the SASLibrary through the UsingPackages association (numbered “2” in the figure). This association is used to identify the “physical location” which can be represented by a Directory object, DatabaseSchema object, or in the case of concatenated libraries, a SASLibrary object. The DirectoryName attribute of Directory contains the pathname of the directory. This attribute should always end with the proper directory delimiter, in this case a “/”. The PhysicalTables are associated to the SASLibrary through the Tables association (numbered “3” in the figure). If a library has tables associated to it, then it is the primary or owning library.

See XML Representation of Metadata Objects that Define a SAS Library, Directory, and Data Sets to view the XML representation of the metadata objects shown in Figure 14.10 on page 159.

Library with Tables in a Foreign Database

Figure 14.11 on page 161 shows the metadata objects used to describe a SAS library, directory and data sets. The library is represented by a SASLibrary object, the schema is represented by a DatabaseSchema object, and the relational table is represented by a PhysicalTable object. The ServerContext object describes which SAS software systems can use this library definition. The DeployedComponent is used to represent the database server where the schema and tables reside. The SASClientConnection defines the connection used by the SAS application to access the data in the foreign database.

Figure 14.11 Metadata Objects Used to Define a SAS Library with Tables in a Foreign Database



The database is a ServerComponent which has connection information used by SAS software in the SASClientConnection object. From the ServerComponent for the DBMS, the connection information is found through the SourceConnections association (number “1“ in Figure 14.11 on page 161). The DatabaseSchema is an owning package (it has tables associated to it through the Tables association (numbered “3” in the figure) and is associated to the ServerComponent through the DeployedComponents association (numbered “2” in the figure). The SASLibrary is associated to the DatabaseSchema which it can access through the UsingPackages association (number “4”) and to the SAS Software which used this library using the DeployedComponents association (number “2”). SASLibrary uses the LibraryConnection to get the connection information for the library (number “5”).

See XML Representation of Metadata Objects Used to Define a SAS Library with Tables in a Foreign Database to view the XML representation of the metadata objects shown in Figure 14.11 on page 161.

XML Representation of Metadata Objects that Define a SAS Library, Directory, and Data Sets

```
<SASLibrary Id="A1234567.A1000001"
            Name="Sales Library"
            Desc="Sales Library"
            Engine="base"
            IsDBMSLibname="0"
            Libref="SALES"
            IsPreassigned="0">
            <DeployedComponents>
               <ServerContext Id="A1234567.A4000001"
                              Name="AppServer"
                              ProductName="SAS"
                              ClassIdentifier="SAS Application Server"
                              Vendor="SAS Institute" />
            </DeployedComponents>
            <UsingPackages>
               <Directory Name="Sales Data Directory"
                          Id="A1234567.A2000001"
                          Desc="Directory for Sales Data"
                          DirectoryName="/data/sales/"/>
            </UsingPackages>
            <Tables>
               <PhysicalTable Id="A1234567.A3000001"
                              Name="Invoice"
                              Desc="Invoice Demo Table"
                              SASTableName="Invoice"
                              TableName="INVOICE"
                              MemberType="DATA"/>
            </Tables>
</SASLibrary>
```

XML Representation of Metadata Objects Used to Define a SAS Library with Tables in a Foreign Database

```
<SASLibrary Id="A34OVRO3.AO00002T"
            Engine="DB2UNXPC"
            IsDBMSLibname="1"
            IsPreassigned="0"
            Libref="CWM"
            Name="CWM Library">
     <DeployedComponents>
        <ServerContext Id="A34OVRO3.AP000001"
                       ClassIdentifier="SAS Application Server"
                       IsLicensed="0"
                       Major="9"
                       Minor="0"
                       Name="AppServer"
                       ProductName="SAS"
                       SoftwareVersion="9.0"
                       Vendor="SAS Institute"/>
     </DeployedComponents>
     <LibraryConnection>
          <SASClientConnection Objref="A34OVRO3.AK00002T"/>
     </LibraryConnection>
     <UsingPackages>
        <DatabaseSchema Id="A34OVRO3.AN00002T" Name="DB2Schema">
          <Tables>
            <PhysicalTable Id="A34OVRO3.AS000001"
                           DBMSType="DB2UNXPC"
                           IsCompressed="0"
                           IsEncrypted="0"
                           MemberType="DATA"
                           Name="PERIOD"
                           NumRows="-1"
                           SASTableName="PERIOD"
                           TableName="PERIOD"/>
            <PhysicalTable Id="A34OVRO3.AS000002"
                           DBMSType="DB2UNXPC"
                           IsCompressed="0"
                           IsEncrypted="0"
                           MemberType="DATA"
                           MetadataCreated="14May2002:18:08:21"
                           MetadataUpdated="14May2002:18:08:21"
                           Name="PRODUCT"
                           NumRows="-1"
                           SASTableName="PRODUCT"
                           TableName="PRODUCT"/>
          </Tables>
          <DeployedComponents>
            <ServerComponent Id="A34OVRO3.AI00002U"
                              ClassIdentifier="DB2UNXPC"
                              IsLicensed="0"
                              Major="7"
                              Minor="2"
                              Name="My Server"
                              ProductName="DB2UNXPC"
                              SoftwareVersion="7.2"
                              Vendor="International Business Machines Corporation">
                <SourceConnections>
                     SASClientConnection Id="A34OVRO3.AK00002T"
                                         ApplicationProtocol="DB2UDBPROTOCOL"
                                         AuthenticationType="user/password"
                                         CommunicationProtocol="TCP"
                                         Name="Connection: My Server" Port="0"/>
                </SourceConnections>
            </ServerComponent>
          </DeployedComponents>
        </DatabaseSchema>
     </UsingPackages>
</SASLibrary>
```

Usage Scenario: Creating Metadata for Tables, Columns, and Keys

Purpose

This usage scenario describes how to create PhysicalTable, Column, and key objects.

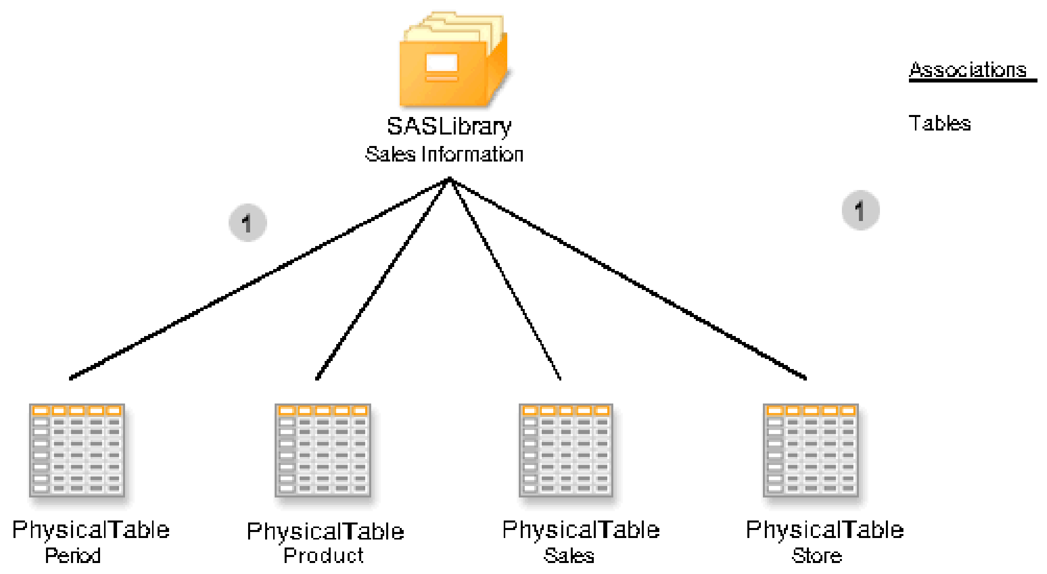
Requirements

This usage scenario assumes that the reader has general understanding of the Resource Submodel and Relational Submodel of the SAS Metadata Model. For more information about these submodels, see “SAS Namespace Metadata Types” in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of the SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Creating a SASLibrary and PhysicalTable Objects

Figure 14.12 on page 164 depicts the metadata objects that represent the SAS library Sales Information and its four tables: PERIOD, PRODUCT, SALES, and STORE.

Figure 14.12 Metadata Objects that Represent SAS Library “Sales Information” and its four tables: “Period”, “Product”, “Sales” and “Store”



The metadata type SASLibrary is used to represent SAS libraries. SASLibrary is a subtype of RelationalSchema, which is a subtype of DeployedDataPackage, and inherits all of the attributes and associations of its supertype.

There are several metadata types that represent tables. PhysicalTable is the metadata type used to represent a relational table or data set that physically resides in a file system or DBMS. RelationalTable is used to represent tables that do not have a physical mapping, for example, a table created using a data modeling tool. WorkTable is used to represent a transient table; that is, a table that resides in the SAS WORK library.

These objects can be created using the following XML request. See XML Representation of SASLibrary and PhysicalTable Objects to view the XML representation of the metadata objects shown in Figure 14.12 on page 164.

In the sample XML request, the first element is “AddMetadata”, which identifies the method that is invoked on the SAS Metadata server. The next element is “Metadata”, which indicates that the elements that follow are metadata objects.

The element SASLibrary defines the SAS library and has the attributes Name, Libref, and Engine. Also included is the IsPreassigned attribute, which should be set to "true" if the library will be pre-assigned during initialization of the associated DeployedComponent. A metadata object of type SASLibrary will be created with those attributes set to the values provided in the document.

All of the immediate subelements of a metadata type are names of associations. The subelements of SASLibrary define the associations between SASLibrary and other metadata objects. In this example, Tables is a subelement of SASLibrary and defines a relationship with a set of tables. This association is numbered "1" the figure. The association Tables is inherited from SASLibrary's supertype: RelationalSchema. The Tables association is defined between the metadata type RelationalSchema and the DataTable type.

Each end of the association is named. A RelationalSchema object refers to its associated objects by using the XML tag Tables. DataTable objects refer to their associated RelationalSchema objects by using the XML tag TablePackages.

Any subtype of RelationalSchema and DataTable can use the Tables/TablePackages association to create an association between the two objects. SASLibrary is a subtype of RelationalSchema, so it inherits this association. PhysicalTable is subtype of DataTable, so it also inherits this association.

If you refer back to the XML, there are four PhysicalTable objects defined inside the Tables element. All of the elements inside the Tables will be associated with the SASLibrary.

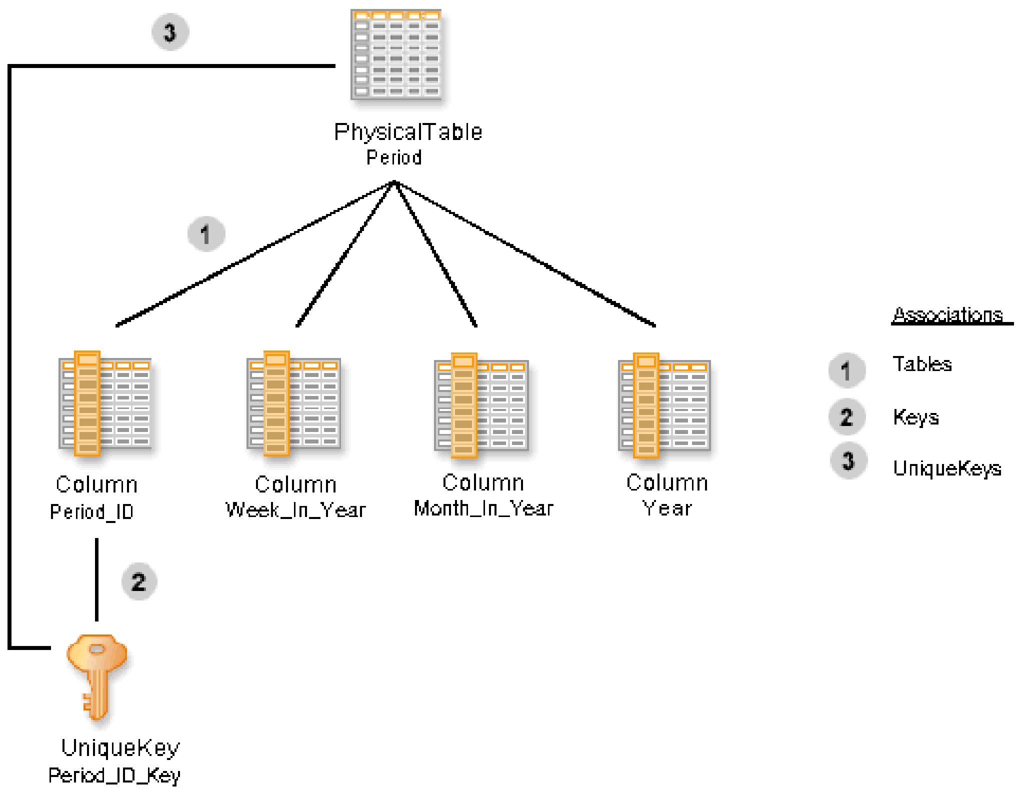
PhysicalTable has three name attributes: Name, SASTableName, and TableName. The Name attribute is a descriptive or display name. The SASTableName attribute is the name used by SAS software to refer to the table. The TableName attribute is only used if the table resides in a DBMS and the DBMS name is different than the name used by SAS. In this case, TableName is the DBMS name for the table.

When this XML document was sent to the server, it created five new metadata objects. The server allocated the following identifiers for the objects: for the SASLibrary, the ID is ABCDEFGH.A1000001; for the PERIOD table, the ID is ABCDEFGH.A2000001; for the SALES table, the ID is ABCDEFGH.A2000002; and so on.

Creating a Column Objects and Keys

Figure 14.13 on page 166 depicts the columns and keys associated with the PERIOD table. The column named PERIOD_ID has a primary key associated with it.

Figure 14.13 Metadata Objects that Represent the Columns and Keys Associated with PhysicalTable “Period”



Column is the metadata type used to represent columns in a table. A unique key or a primary key is represented by the metadata type UniqueKey. The attribute IsPrimary defaults to 0, which means the key is not a primary key. This attribute should be set to 1 if the key is a primary key.

These objects can be created using the following XML request. See XML Representation of Column Objects for Period Table to view the XML representation of the metadata objects shown in Figure 14.13 on page 166.

The Column object requires an association to a DataTable object or an object that is a subtype of DataTable. In this example, each Column element has a subelement Table, which is the name of the association to a DataTable. This association is identified with the number “1” in second figure. Because the metadata object for the table already exists, it is referred to by using the ObjRef attribute with the value of the identifier of the table. This syntax is explained fully in Chapter 2, “Adding Metadata Objects,” on page 5.

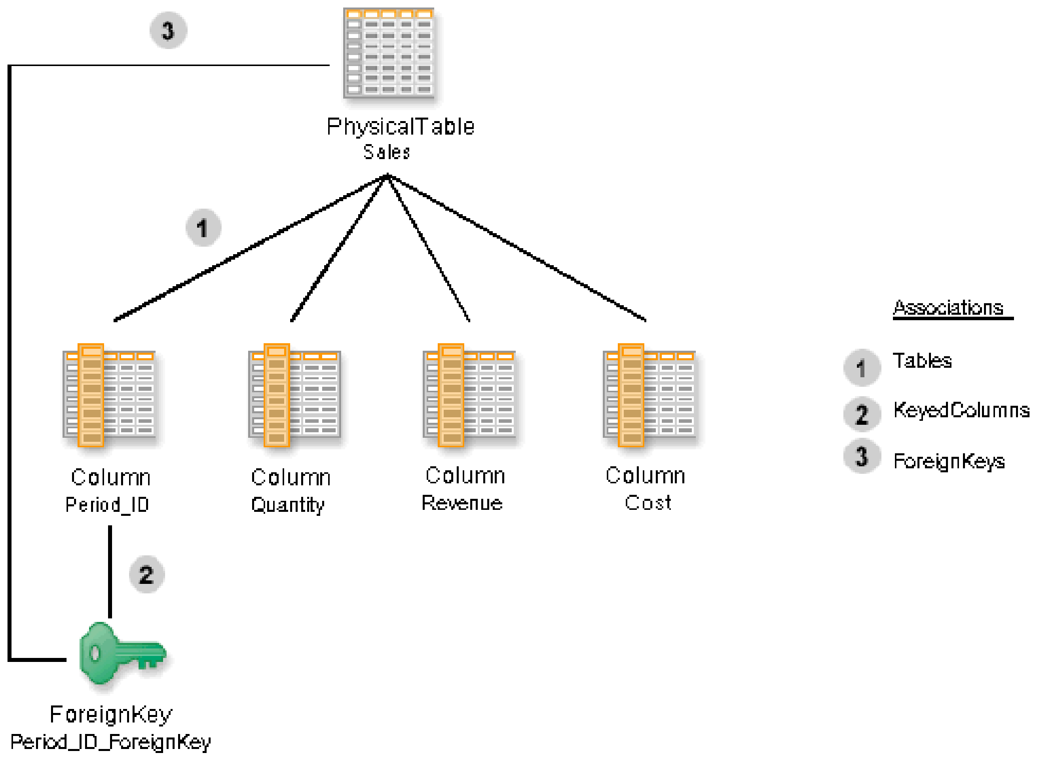
The first Column also has objects associated with it via the Keys association. Any type of key can be associated with a Column using the Keys association. In this example, the column named PERIOD_ID is associated with the unique key named PERIOD_ID_KEY. This association is identified with the number “2” in the figure.

A key has a required association to both a table and a set of columns. The association between a UniqueKey and a DataTable from the UniqueKey’s perspective is called Table. From the DataTable, it is called UniqueKeys. This association is identified by the number “3”. From the Column’s perspective, the association is named Keys; from the Key’s perspective, it is named KeyedColumns. In the XML request, the UniqueKey element has the subelement Table followed by a reference to the PhysicalTable's identifier.

When this request was executed on the server, it created five new objects: four Column objects and one UniqueKey object. The PERIOD_ID column was given the identifier ABCDEFGH.A3000001, and the primary key was given the identifier ABCDEFGH.A4000001.

Figure 14.14 on page 167 depicts the columns associated with the SALES table. The column named PERIOD_ID has a foreign key associated with it.

Figure 14.14 Metadata Objects that Represent the Columns and Keys Associated with PhysicalTable "Sales"



These Column objects can be created using the following XML request. See XML Representation of Column Objects for Sales Table to view the XML representation.

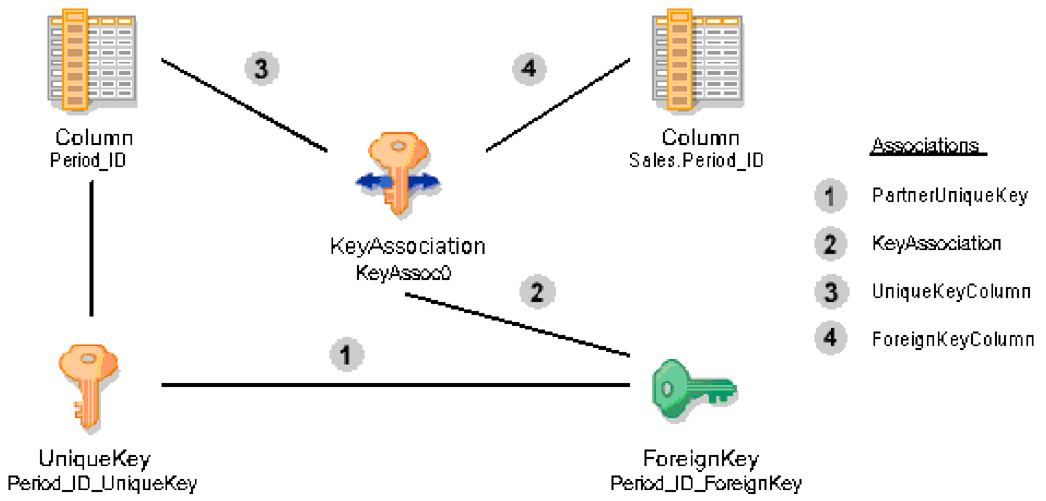
After this request is executed on the server, the Column objects are created, and the association numbered "1" in the figure is created between the PhysicalTable object and the Column objects. PERIOD_ID column in the SALES table is given the identifier ABCDEFGH.A3000007.

The foreign key, its required associations, and additional objects are created using the following XML request. See XML Representation of Keys to view the XML representation.

The foreign key named PERIOD_ID_FOREIGN_KEY is associated with the PERIOD_ID column in the SALES table through the KeyedColumns association, which is numbered "2" in the figure. It is also associated with the SALES table through the Table association, which is numbered "3".

ForeignKey objects have two additional required associations: they must have an association with a UniqueKey and a set of KeyAssociation objects. These associations are depicted in Figure 14.15 on page 168.

Figure 14.15 Metadata Objects that are Associated with ForeignKey Objects



The ForeignKey object's association with the primary key in the PERIOD table is created through the PartnerUniqueKey association in the XML. This association is numbered "1" in Figure 14.15 on page 168.

All ForeignKey objects have a set of KeyAssociation objects, one for each column associated with the foreign key. This association numbered "2" in the figure.

The KeyAssociation object associates one column of the unique key with the corresponding column in the foreign key. From the KeyAssociation object, these associations are called the UniqueKeyColumn and the ForeignKeyColumn. These associations are identified by the numbers "3" and "4" in the figure. In this example, there is only one column for each key, so there is only one KeyAssociation object created. The KeyAssociation object has an association to one column in the UniqueKey and one column in the ForeignKey. This association is used to easily identify which columns correspond in a unique key/foreign key relationship. If the characteristics of one of the columns changes, it is easy to identify the associated columns and change their characteristics as well.

XML Representation of SASLibrary and Physical Table Objects

```
<AddMetadata>
  <Metadata>
    <SASLibrary Name="Sales Information" Libref="SALEINFO" Engine="Base">
      <UsingPackages>
          <Directory DirectoryName="/data" Name="/data" IsRelative="0"/>
      </UsingPackages>
      <Tables>
        <PhysicalTable Name="PERIOD" SASTableName="PERIOD"/>
        <PhysicalTable Name="SALES" SASTableName="SALES"/>
        <PhysicalTable Name="PRODUCT" SASTableName="PRODUCT"/>
        <PhysicalTable Name="STORE" SASTableName="STORE"/>
      </Tables>
    </SASLibrary>
  </Metadata>
  <Reposid>A0000001.ABCDEFGH</Reposid>
  <NS>SAS</NS>
  <Flags>268435456</Flags>
  <Options/>
</AddMetadata>
```

XML Representation of Column Objects for Period Table

```
<AddMetadata>
  <Metadata>
    <Column SASColumnType="N"
            SASColumnName="PERIOD_ID"
            ColumnLength="10"
            Name="PERIOD_ID">
            <Table>
               <PhysicalTable ObjRef="ABCDFEGH.A2000001"/>
            </Table>
            <Keys>
               <UniqueKey IsPrimary="1" Name="PERIOD_ID_KEY">
                <Table>
                  <PhysicalTable Objref="ABCDFEGH.A2000001"/>
                </Table>
               </UniqueKey>
            </Keys>
    </Column>
    <Column SASColumnType="N"
            SASColumnName="WEEK_IN_YEAR"
            ColumnLength="10"
            Name="WEEK_IN_YEAR">
            <Table>
               <PhysicalTable ObjRef="ABCDFEGH.A2000001"/>
            </Table>
    </Column>
    <Column SASColumnType="N"
            SASColumnName="MONTH_IN_YEAR"
            ColumnLength="10"
            Name="MONTH_IN_YEAR">
            <Table>
               <PhysicalTable ObjRef="ABCDFEGH.A2000001"/>
            </Table>
    </Column>
    <Column SASColumnType="N"
            SASColumnName="YEAR"
            ColumnLength="10"
            Name="YEAR"
            ColumnName="YEAR">
            <Table>
               <PhysicalTable ObjRef="ABCDFEGH.A2000001"/>
            </Table>
    </Column>
  </Metadata>
```

```
    <Reposid>A0000001.ABCDEFGH</Reposid>
    <NS>SAS</NS>
    <Flags>268435456</Flags>
    <Options/>
  </AddMetadata>
```

XML Representation of Column Objects for Sales Table

```
<AddMetadata>
  <Metadata>
    <Column SASColumnType="N"
            SASColumnName="PERIOD_ID"
            ColumnLength="10"
            Name="PERIOD_ID">
            <Table>
               <PhysicalTable ObjRef="ABCDEFGH.A2000002"/>
            </Table>
    </Column>
    <Column SASColumnType="N"
            SASColumnName="QUANTITY"
            ColumnLength="10"
            Name="QUANTITY">
            <Table>
               <PhysicalTable ObjRef="ABCDEFGH.A2000002"/>
            </Table>
    </Column>
    <Column SASColumnType="N"
            SASColumnName="REVENUE"
            ColumnLength="10"
            Name="REVENUE">
            <Table>
               <PhysicalTable ObjRef="ABCDEFGH.A2000002"/>
            </Table>
    </Column>
    <Column SASColumnType="N"
            SASColumnName="COST"
            ColumnLength="10"
            Name="COST">
            <Table>
               <PhysicalTable ObjRef="ABCDEFGH.A2000002"/>
            </Table>
    </Column>
  </Metadata>
  <Reposid>A0000001.ABCDEFGH</Reposid>
  <NS>SAS</NS>
  <Flags>268435456</Flags>
  <Options/>
</AddMetadata>
```

XML Representation of Keys

```
<AddMetadata>
  <Metadata>
    <ForeignKey Name="PERIOD_ID_FOREIGN_KEY">
      <KeyedColumns>
        <Column ObjRef="ABCDEFGH.A3000007"/>
      </KeyedColumns>
      <Table>
        <PhysicalTable Objref="ABCDEFGH.A2000002"/>
      </Table>
      <PartnerUniqueKey>
        <UniqueKey Objref="ABCDEFGH.A4000001"/>
      </PartnerUniqueKey>
      <KeyAssociations>
        <KeyAssociation Name="KeyAssoc0">
          <ForeignKeyColumn>
            <Column Objref="ABCDEFGH.A3000007"/>
          </ForeignKeyColumn>
          <UniqueKeyColumn>
            <Column Objref="ABCDEFGH.A3000001"/>
          </UniqueKeyColumn>
        </KeyAssociation>
      </KeyAssociations>
    </ForeignKey>
  </Metadata>
  <Reposid>A0000001.ABCDEFGH</Reposid>
  <NS>SAS</NS>
  <Flags>268435456</Flags>
  <Options/>
</AddMetadata>
```

Usage Scenario: Creating Metadata for a SAS/SHARE Server

Purpose

This scenario describes how to use the metadata types that represent software deployment information; that is, information about how to run and access installed software and the resources (files and data) that the software can access. An XML representation is included to show how to create software deployment objects and their associations.

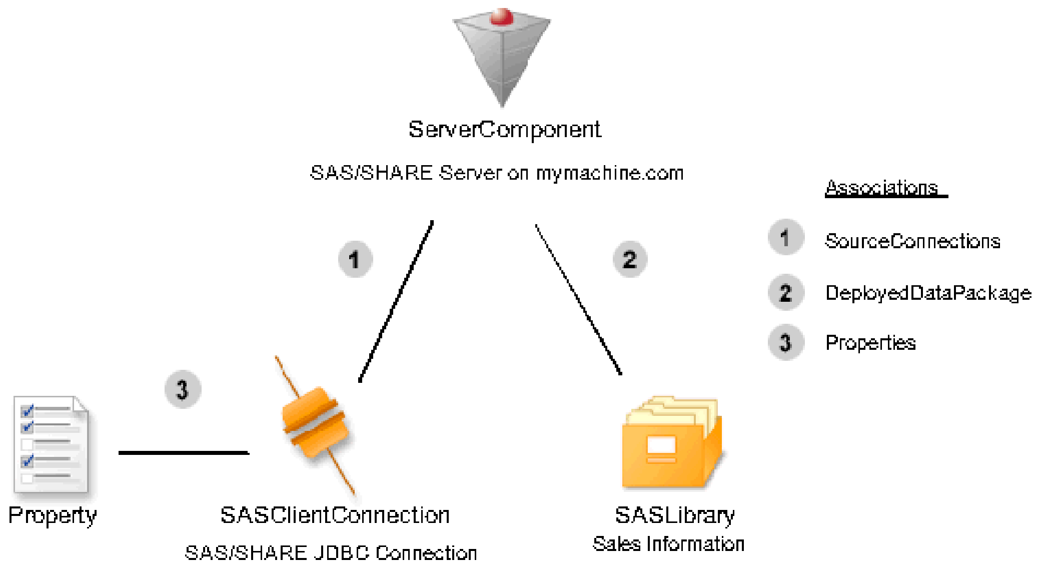
Requirements

This usage scenario assumes the reader has a general understanding of the Property Submodel and Software Deployment Submodel of the SAS Metadata Model. For more information about these submodels, see “SAS Namespace Metadata Types” in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of the SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Software Deployment Metadata Types

This scenario depicts metadata objects that represent a SAS/SHARE server, the information used by a JDBC driver to access the server, and the SAS library ("Sales Information"). Figure 14.16 on page 172 shows these metadata objects and their associations.

Figure 14.16 Metadata Objects Representing a SAS/SHARE Server, Libraries, and Connections



The metadata type ServerComponent represents a configured instance of an installed and runnable deployed component. This metadata type contains attributes that describe the software, such as name, vendor, version, and number. ServerComponent objects may be associated with a Transformation using the InitInfo association. The Transformation contains associations to other objects that provide startup information for the server. Startup information may include scripts, properties, login information for the startup process, log files, or any other information used at startup time. The DeployedDataPackage association identified by the number “2” in the figure represents the data packages, such as directories, schemas or libraries, that are available to the server. In this scenario, the DataPackages association refers to a SASLibrary.

ServerComponent objects may also be associated with Connection objects using the SourceConnections association (identified by the number "1" in the figure). The connections may describe how other software components communicate with this object or how this component should communicate with other software components. The model has very few types to represent different connections. These types include: COMConnection, TCPIPConnection, and SASClientConnection. Each of these types contain a subset of attributes that are common for each type of connection. Associated Properties (identified by the number “3” in the figure) are used to provide additional information for specific connection types. In this example, we use a SASClientConnection to represent the SAS/SHARE JDBC connection. Additional properties that would be stored with this connection object include the server name, physical name, libref, and encryption algorithm key size. The SAS Management

Console uses Prototypes (see also Usage Scenario: Creating a Prototype) to determine which properties are appropriate when creating connections.

Example

See XML Representation of Metadata Objects Representing a SAS/SHARE Server, Libraries, and Connections to view the XML representation of the metadata objects shown in Figure 14.16 on page 172.

The ServerComponent, which represents the server, is the first object that is created. The subelement *SourceConnections* is the name of one of the associations from a ServerComponent to Connection objects. The Connection objects in the *SourceConnections* describe how to access this server (the ServerComponent). This association is numbered "1" in the figure.

Connection objects have a set of protocol attributes. For example, the information required for a DCOM connection is different from the information required for a CORBA connection. The *CommunicationProtocol* attribute of the Connection object describes the network protocol used to access the server, such as TCP or APPC. The *ApplicationProtocol* describes the application level protocol used by the application to communicate with the server. For example, the application protocol could be DCOM, CORBA, HTTP, RMI, Telnet, or in this case, the proprietary protocol, "SHARE". For TCPIP communication, the RemoteAddress is required, in addition to the port or service used by the server. For this type of connection, there is more information than is needed. This information is stored in PropertyObjects and associated with the Properties association (numbered "3" in the figure). The Property objects each must have a PropertyType which is associated using the OwningType association. This association is not pictured, but is represented in the XML request. Note that three of the properties expect the value of the property to be set as a string. Each of these properties point to a Property object already defined in the metadata for a string. The encryption algorithm key size property has an enumerated list of possible values. This enumeration is a TextStore object that is associated using the StoredConfiguration association on the PropertyType.

The metadata type SASClientConnection is a subtype of the metadata type Connection and contains information about how to access a SAS/SHARE server from a Java or other open client. For example, the SAS/SHARE driver for JDBC could use the information in this object to create the URL used to connect to the server. In order to find available SAS/SHARE servers, the JDBC application could search the repository for SASClientConnection objects that have the attribute *ApplicationProtocol* value set to "Share". These would provide connection information for all of the SAS/SHARE servers registered in the repository.

A ServerComponent can also have a set of Connection objects that are available through the *ProviderConnections*. These are the Connection objects used by this component to access other components. If the JDBC application was registered in the repository as a ServerComponent, its *ProviderConnections* could contain the *TCPIPConnection* objects it uses to access servers.

A ServerComponent could have Connection objects in both lists. For example, server one may forward a request to server two. Server one would have a connection object in *SourceConnections* that describes how to connect to it (Server one). Server one's *ProviderConnections* would contain the Connection object that describes how to connect to Server Two.

The other association to ServerComponent in this example is DataPackages (numbered "2" in the figure). The DataPackages identify data packages, which are SAS libraries, file system directories, DBMS catalogs, or schemas, that can be accessed by this ServerComponent. For SAS software, the DataPackages is the list of SASLibrary objects that are accessible. In this XML example, the SASLibrary object has already been created, so the XML contains a reference to the existing object using the ObjRef attribute.

XML Representation of Metadata Objects Representing a SAS/SHARE Server, Libraries, and Connections

```
<AddMetadata>
    <Metadata>
      <ServerComponent Name="SAS/SHARE server on mymachine.com">
        <SourceConnections>
          <SASClientConnection Name="SAS/SHARE JDBC Connection"
            ApplicationProtocol="SHARE"
            CommunicationProtocol= "TCP"
            Port="5010"
            RemoteAddress="d1234.na.sas.com">
            <Properties>
               <Property Name="Encryption Algorithm Key Size"
                         PropertyName="EncryptionKeySize"
                         DefaultValue="0">
                         <OwningType>
                           <PropertyType Objref="$EncKey"/>
                         </OwningType>
               </Property>
               <Property Name="Server Name"
                         PropertyName="ServerName"
                         DefaultValue="sdfsd" >
                         <OwningType>
                            <PropertyType Objref="ABCDEFGH.A2000001"/>
                         </OwningType>
               </Property>
               <Property Name="PhysicalName"
                         PropertyName="LibraryPhysName"
                         DefaultValue="sdsf" >
                         <OwningType>
                            <PropertyType Objref="ABCDEFGH.A2000001"/>
                         </OwningType>
               </Property>
               <Property Name="Libref"
                         PropertyName="ClientLibref"
                         DefaultValue="myLib" >
                         <OwningType>
                            <PropertyType Objref="ABCDEFGH.A2000001"/>
                         </OwningType>
               </Property>
            </Properties>
        </SourceConnections>
        <DataPackages>
          <SASLibrary ObjRef="ABCDEFGH.A7000001"/>
        </DataPackages>
      </ServerComponent>
      <PropertyType Id="$EncKey" Name="EncryptionKeySizes"
                    SQLType="12"
                    <StoredConfiguration>
                       <TextStore Name="Enumeration of Encryption Key Sizes"
```

```
                                        TextRole="config"
                                        TextType="xml"
                                        StoredText="<Configuration>
                                                     <Enumeration>
                                                       <Value name="0"/>
                                                       <Value name="40"/>
                                                       <Value name="128"/>
                                                     </Enumeration>
                                                    </Configuration>" />

                          </StoredConfiguration>
              </PropertyType>
            </Metadata>
            <Reposid>A0000001.ABCDEFGH</Reposid>
            <NS>SAS</NS>
            <Flags>268435456</Flags>
            <Options />
        </AddMetadata>
```

Usage Scenario: Creating Metadata for a Stored Process

Purpose

This usage scenario describes how to define a stored process. It explains how to define parameters for the stored process using PropertyGroups. An example XML request is included that represents one way to create the metadata for this usage scenario.

The scenario depicts one usage pattern for the model, which integrates several submodels. It is not recommended that developers directly create or consume stored process metadata. Instead stored processes should be defined using the Stored Process Manager plug-in for SAS Management Console.

Requirements

This usage scenario assumes the reader has a general understanding of the Software Deployment Submodel, Transform Submodel, and Property Submodel of the SAS Metadata Model. For more information about these submodels, see “SAS Namespace Metadata Types” in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of the SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Description of a Stored Process

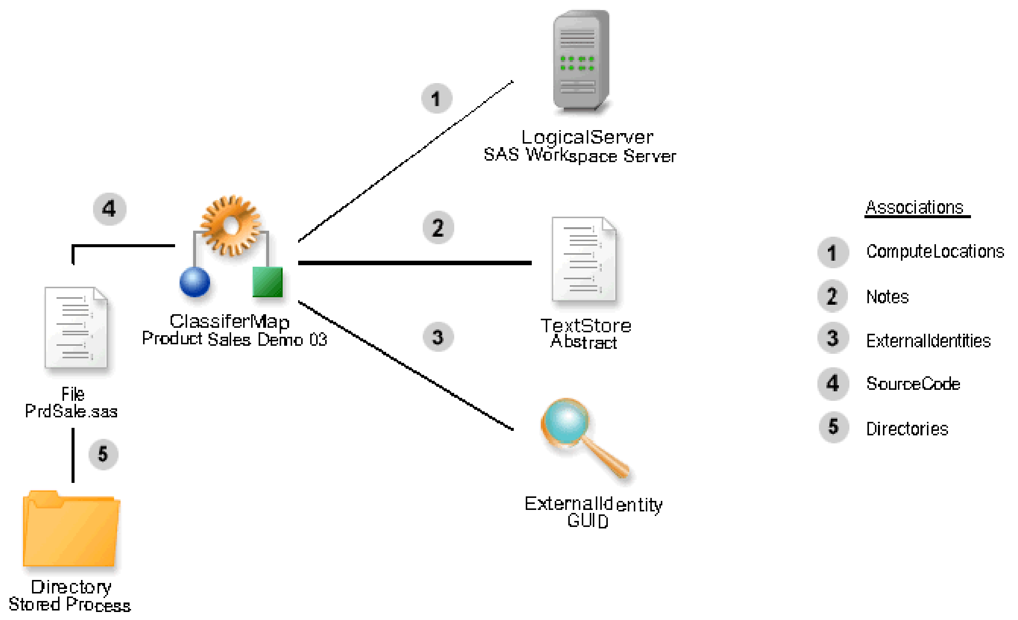
A stored process is a set of metadata objects that define the information necessary to run a process. This includes information about where the process can be run, the code that should be run, parameters that need to be supplied by a user or another process, the physical inputs to the process, and the outputs of the process.

How to Define A Stored Process

In this scenario, we define the Product Sales Demo. Central to defining a stored process is the ClassifierMap type. The ClassifierMap is a subtype of a transformation and is used to show the flow of data through a process. The ClassifierMap has properties that an application needs to determine what the process is and how to run it. The ClassifierMap is differentiated from other transformation types by the ClassifierSource and ClassifierTarget associations. A Classifier and its subtypes represent data in the model and may have features. For example, a PhysicalTable is a type of Classifier which has features called Columns. The process which represents the Product Sales demo consists of stored SAS code, which runs against a SAS data set to produce a sales report. The SAS code is associated to the ClassifierMap via the SourceCode association (numbered "4" in Figure 14.17 on page 176). Source code may be any type of text object, including a TextStore (used for code stored in the repository), Document (a URI to an external document), SASCatalogEntry, ArchiveFile (Zip file), ArchiveEntry (an entry in the Zip file), or a File. In this scenario, the source code is stored in a File named PrdSale.sas. The File has a Directories association (numbered "5" in the figure) to the directory where the file is located. In addition, an application may choose to store Notes about the process and an external identifier for the process. Note text is stored in a TextStore object and associated to the ClassifierMap via a Notes association (numbered "2" in the figure). The external identifier is stored in an ExternalIdentity object and associated with the ClassifierMap via an ExternalIdentities association (numbered "3" in the figure). An ExternalIdentity is an identifier that is assigned by an external source, a GUID in this scenario, but may be any string that uniquely identifies this process to the application.

The application also needs to know where the process can run, which LogicalServer to use, and how to access it. The ComputeLocations association (numbered "1" in the figure) has a list of the LogicalServer(s) that can run the process. In this scenario, the LogicalServer is a SAS Workspace Server, because SAS is necessary to run the SAS code.

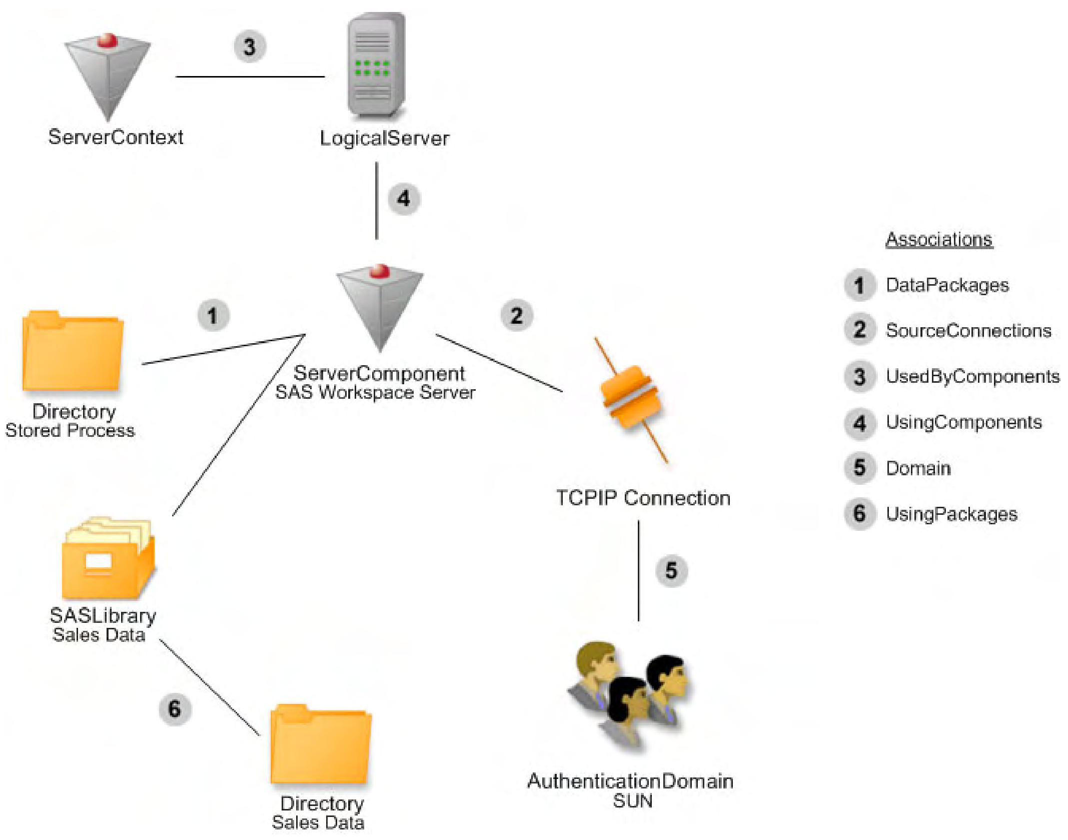
Figure 14.17 Metadata Objects Used to Define Stored Process for the Product Sales Demo



The SAS Workspace Server is defined, in part, using the LogicalServer type (Figure 14.18 on page 177). (Also see Usage Scenario: Creating Metadata for a Workspace Server.) Once we know which component to use, we may need additional information about how to access this component. The LogicalServer has a ServerComponent associated using the UsingComponents association (number “4” in the second figure). The ServerComponent has a SourceConnections association (numbered "2" in figure) to a TCPIPConnection. The TCPIPConnection gives the information necessary for the process to connect to the Workspace Server and has information about the AuthenticationDomain for this server. The TCPIPConnection object is associated to the AuthenticationDomain via a Domain association (number “5” in the second figure).

In addition, the Workspace Server LogicalServer object has a UsedByComponents association (number “3” in the second figure) to a ServerContext object, which has associations to the DataPackages that are known to this server. In this example, two objects have a DataPackages association to the Workspace Server: a Directory and a SASLibrary (numbered “1” in the second figure). When a SASLibrary is defined, often the directory information will also be stored. This occurs via the UsingComponents association between the ServerComponent and the LogicalServer (number 4 in the figure). The SAS Management Console supports the creation of library definitions. Refer to Usage Scenario: Creating Metadata for a SAS Library for more information.

Figure 14.18 Metadata Objects for Defining a SAS Workspace Server

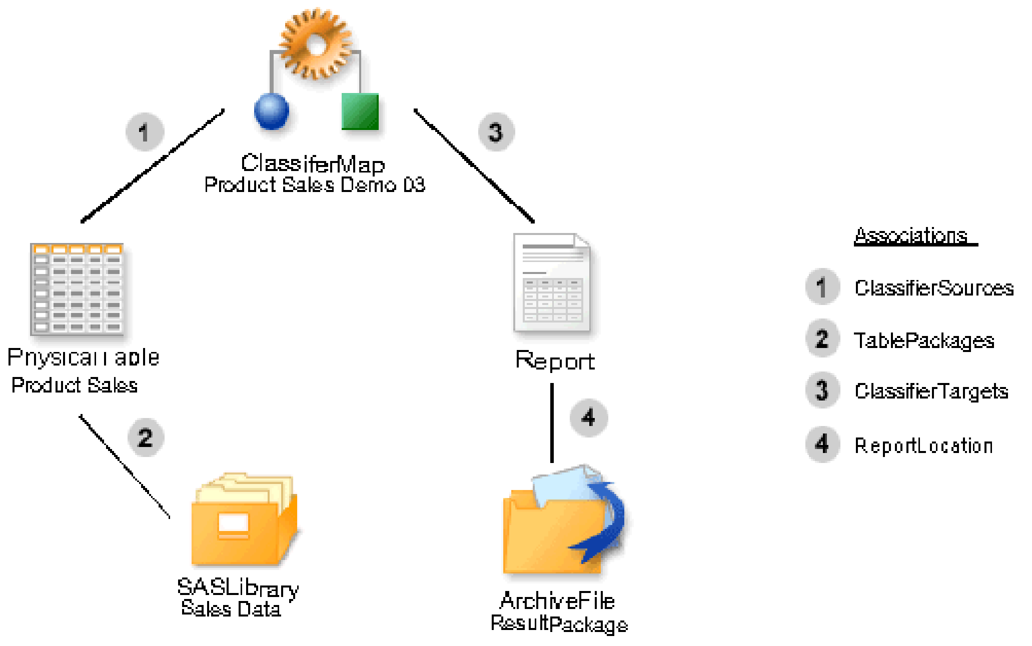


We now know where the code is for this process and where we can run this process. We now need to know something about the inputs (ClassifierSources) and outputs (ClassifierTargets). Note that only types which inherit from the Classifier type may be part of this association. Generally, types which are considered classifiers represent objects that have structure. Some examples of classifiers are data tables, reports, and cubes. The input and/or output information may or may not be embedded in the source code. However, even if it is part of the source code, this should be documented as part of this process to facilitate impact analysis. If a source is changed or moved, it is helpful to know all the processes that may be affected by the change.

In this scenario, a SAS data set is the only source and is associated to the ClassifierMap via the ClassifierSources association (number "1" in Figure 14.19 on page 178). A SAS data set is represented by the PhysicalTable type and has an TablePackages association that helps to locate the dataset. In this scenario, it is associated to a SASLibrary (number "2" in the third figure). Note that this library is a library that is known to the SAS Workspace Server where the process is run.

The output, or ClassifierTarget, for this scenario is a Report, illustrated by the association between the ClassifierMap and Report objects (number "3" in the third figure). The Report is stored as an Archive file in this example. An ArchiveFile contains all the elements that are used by the report that was created. The Report could be output to any ContentLocation, including a Stream (stream of data), Email, File, or TextStore (represents text stored in the metadata repository). For a complete list of ContentLocation types, refer to the documentation for the ContentLocation metadata type in SAS Namespace Metadata Types in the *SAS Open Metadata Interface: Reference*.

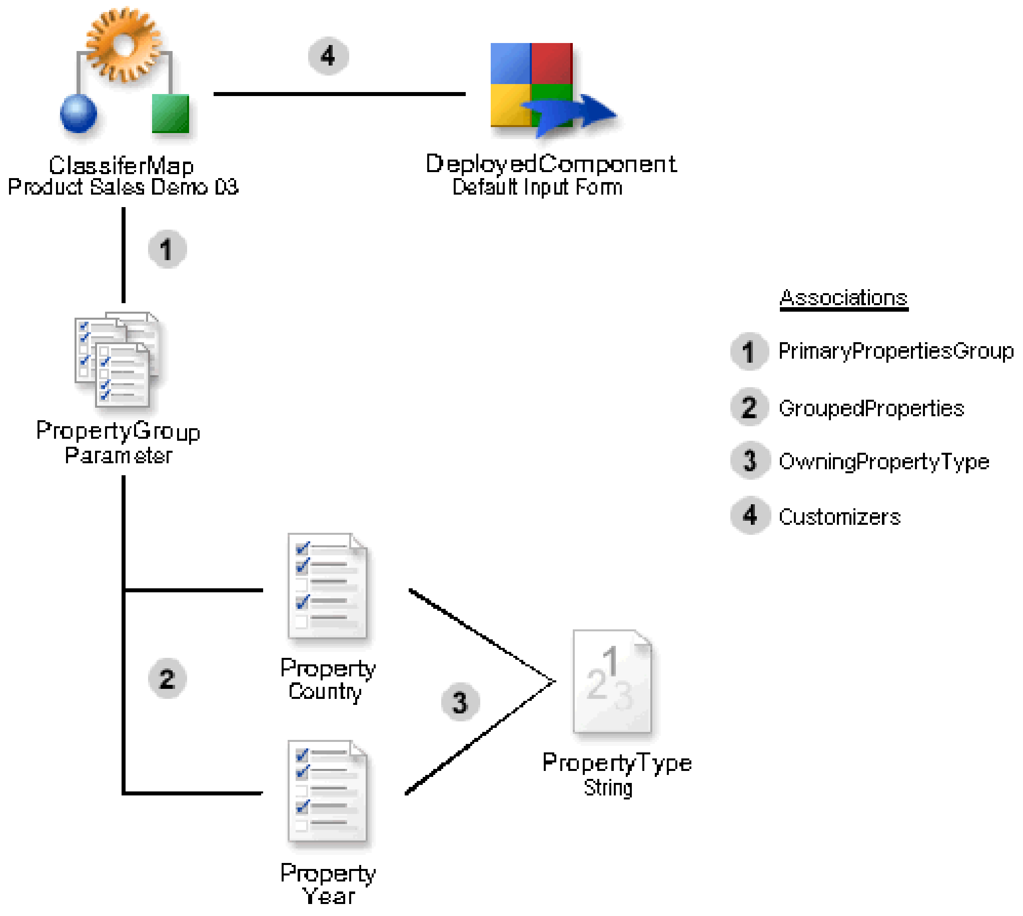
Figure 14.19 Metadata Objects for Creating a Report



This stored process requires a user to submit two parameters. These parameters are defined using Property objects in a PropertyGroup (Figure 14.20 on page 179). The PropertyGroup is associated to the ClassifierMap using the PrimaryPropertiesGroup association (number "1" in the fourth figure) and to Properties using the GroupedProperties association (number "2" in the fourth figure). Each Property object represents one of the parameters necessary for the stored process to run. The Property objects also require an OwningPropertyType association to a PropertyType object (number "3" in the fourth figure). The PropertyType gives information about the expected format of the property value. In this case, it is a simple string, but it could represent a more complex type like arrays or may have associated enumeration or local information. The associated configuration information would be stored in a Text object.

We now know what the parameters are but need to have a way for a user to enter values for the parameters. The ClassifierMap has a Customizers association (number "4" in the fourth figure) to a DeployedComponent. The DeployedComponent in this scenario is a .jsp that provides a user interface for input of the parameter values.

Figure 14.20 Metadata Objects that Store Properties for a Stored Process



See XML Representation of Metadata Objects for a Stored Process to view the XML representation.

XML Representation of Metadata Objects for a Stored Process

```
<AddMetadata>
  <Metadata>
    <PropertyType
        Id="$String"
        Name="String"
        SQLType="12" />
    <LogicalServer
        Id="$LogicalWorkspaceServer"
```

```
Name="My Test Server"
Desc="This is a test StoredProcessServer. Use at your own risk."
ClassIdentifier="15931E31-667F-11D5-8804-00C04F35AC8C"
ProductName="SAS Integration Technologies"
Vendor="SAS Institute">
  <ServiceTypes>
     <ServiceType Name="Logical IOM Server" />
  </ServiceTypes>
  <UsingComponents>
     <ServerComponent
         Id="$WorkspaceServer"
         Name="SAS"
         ProductName="SAS"
         ClassIdentifier="440196D4-90F0-11D0-9F41-00A024BB830C"
         Desc="SAS V9.0"
         Vendor="SAS"
         SoftwareVersion="9.0">
         <SourceConnections>
           <TCPIPConnection
                Id="$C1"
                Name="Workspace Server"
                ApplicationProtocol="bridge"
                Port="4059"
                HostName="sunidb2.unx.sas.com"
                AuthenticationType="User/Password"
                CommunicationProtocol="TCP">
                <Domain>
                   <AuthenticationDomain
                         Name="Sun"
                         Desc="Authentication Domain for Workspace Server">
                   </AuthenticationDomain>
                </Domain>
           </TCPIPConnection>
         </SourceConnections>
     </ServerComponent>
  </UsingComponents>
  <UsedbyComponents>
     <ServerContext>
         <DataPackages>
           <Directory
                Name="Stored Process Directory"
                Id="$SPDir"
                Desc="Directory for Stored Processes"
                DirectoryName="file:/pub/sas/sprocess"/>
                <SASLibrary
                   Name="Sales Data"
                   Id="$Lib"
                   Desc="Sales Library" Engine="base"
                   IsDBMSLibname="0"
                   Libref="Sales"
                   IsPreassigned="0">
                   <UsingPackages>
                       <Directory
                          Name="Sales Data Directory"
```

```
                              Desc="Directory for Sales Data"
                              DirectoryName="/dept/sales/data"/>
                       </UsingPackages>
                       <Tables>
                           <PhysicalTable
                              Name="Product Sales"
                              Id="$SalesTbl"
                              TableName="ProdSal"
                              MemberType="Data" />
                       </Tables>
                    </SASLibrary>
               </Directorty>
             </DataPackages>
         </ServerContext>
      </UsedbyComponents>
</LogicalServer>
<ClassifierMap
      TransformRole="StoredProcess"
      Name="Product Sales Demo"
      Desc="An example of a sales report that runs against the product
            sales data set">
       <Notes>
         <TextStore
              Name="Abstract"
              TextRole="Abstract"
              StoredText="This text is the Product Sales Demo abstract"/>
       </Notes>
       <Customizers>
         <DeployedComponent
              Platform="SERVLET"
              Name="DefaultInputForm"
              ClassIdentifier="/jsp/html/portal/DefaultInputForm.jsp"/>
       </Customizers>
       <ComputeLocations>
         <LogicalServer ObjRef="$LogicalWorkspaceServer"/>
       </ComputeLocations>
       <SourceCode>
         <File
              Name="Source Code"
              Desc="Source code for Product Sales Demo"
              FileName="prdsale1.sas"
              IsARelativeName="1">
              <Directories>
                <Directory ObjRef="$SPDir"/>
              </Directories>
         </File>
       </SourceCode>
       <PrimaryPropertyGroup>
         <PropertyGroup
              Id="$ParameterPropertyGroup"
              Name="ParameterPropertyGroup">
              <GroupedProperties>
                  <Property
                      Name="Country"
```

```
                          Desc="Country for which the report is run"
                          IsRequired="1"
                          PropertyName="pCountry"
                          PropertyRole="Parameter">
                          <OwningType>
                              <PropertyType ObjRef="$String"/>
                          </OwningType>
                      </Property>
                      <Property
                          Name="Year"
                          Desc="Year for which the report is run"
                          IsRequired="1"
                          PropertyName="pYear"
                          PropertyRole="Parameter">
                          <OwningType>
                              <PropertyType ObjRef="$String"/>
                          </OwningType>
                      </Property>
                  </GroupedProperties>
             </PropertyGroup>
           </PrimaryPropertyGroup>
           <ClassifierTargets>
              <Report>
                 <ReportLocation>
                    <ArchiveFile
                          Name="ResultPackage"
                          FileName="TEMPFILE"/>
                 </ReportLocation>
              </Report>
           </ClassifierTargets>
           <ClassifierSources>
              <PhysicalTable Objref="$SalesTbl" />
           </ClassifierSources>
           <ExternalIdentities>
              <ExternalIdentity
                    Name="GUID"
                    Context="GUID"
                    Identifier="4ed904:e6118d4944:-7ffe-10.26.1.47"/>
           </ExternalIdentities>
    </ClassifierMap>
  </Metadata>
<Reposid>A0000001.A529V630</Reposid>
<Ns>SAS</Ns>
<Flags>268435456</Flags>
<Options/>
</AddMetadata>
```

Usage Scenario: Creating Tree and Group Objects

Purpose

This usage scenario describes how to use the metadata types that represent an application hierarchy. The application hierarchy is used to group metadata in a meaningful way for an application.

Requirements

This usage scenario assumes the reader has a general understanding of the Grouping Submodel and Software Deployment Submodel of the SAS Metadata Model. For more information about these submodels, see “SAS Namespace Metadata Types” in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Trees and Groups

The SAS Metadata Model provides the following metadata types for grouping metadata objects together:

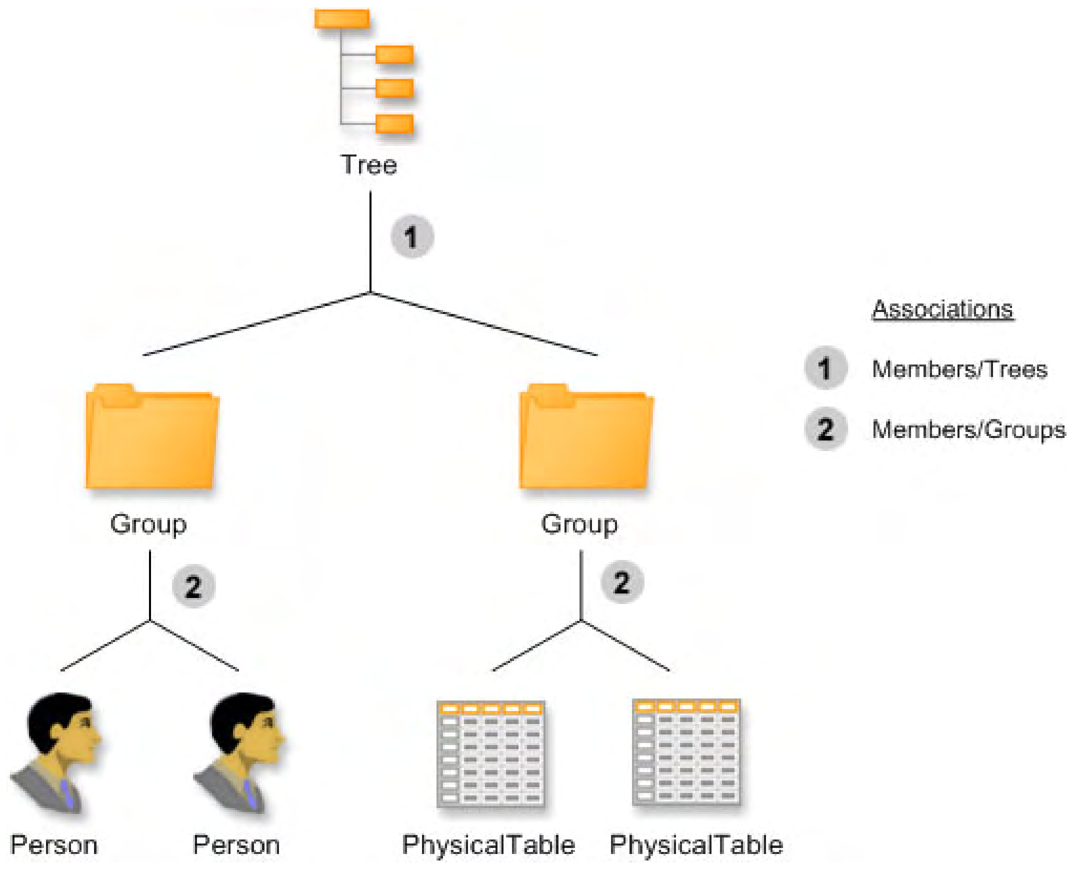
- Tree - used to create a tree hierarchy.
- Group - used to group objects together.

These metadata types have an association called Members, which can be associated with any other object. Usually, a Tree metadata object is created that contains references to other Tree objects as well as Groups. All of these objects are associated to the Tree through the Members association. To create the tree hierarchy, the trees are nested. A ParentTree has associations to its SubTrees. In addition, a tree object may be associated with a SoftwareComponent. This association gives the tree context via an application. The hierarchy of the tree is traversed through the ParentTree and SubTrees associations.

Tree, Group, and Members

The scenario depicted in Figure 14.21 on page 184 is a single Tree with two Groups, each of which contain two objects. There is a Group that contains Person objects and a Group that contains PhysicalTable objects.

Figure 14.21 Metadata Objects Used to Represent a Single Tree with Two Groups



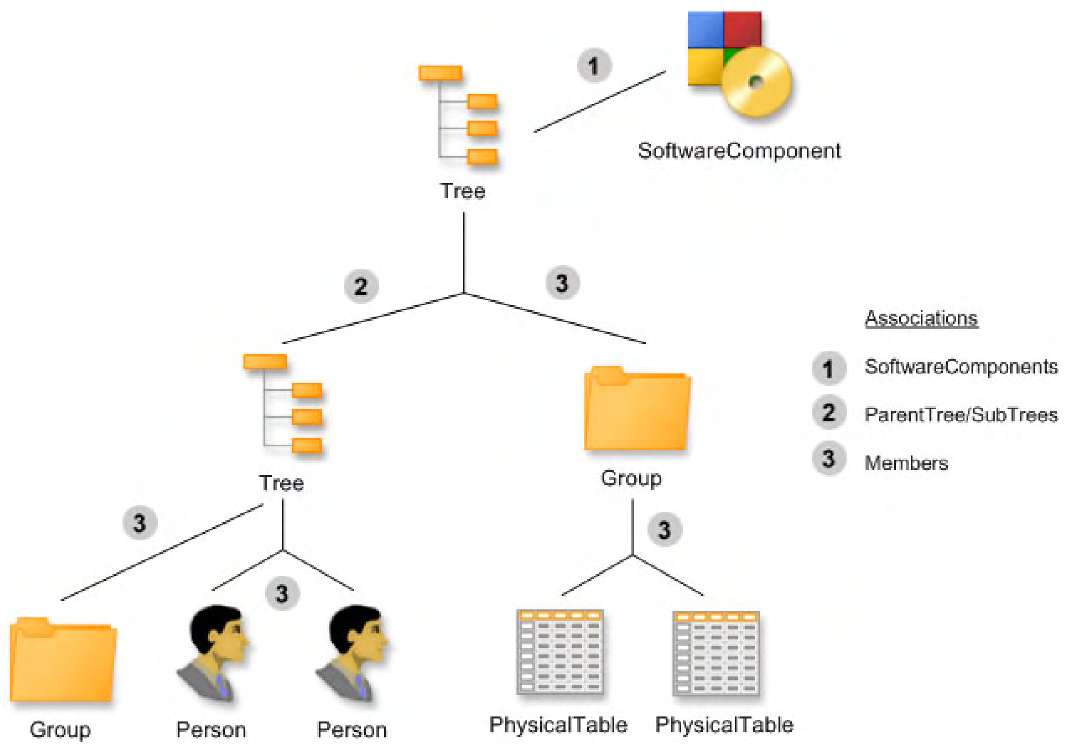
The following XML request shows how to create the Tree and Group objects. In this example, the Person and PhysicalTable objects are already created in the repository. See XML Representation of a Single Tree and Two Group Objects to view the XML representation.

The Tree object named “All my metadata" has two Group objects in its Members association. The Tree could have other objects in this list, but this simple example only has Group objects. Each Group has a reference to the tree it is a part of, the reference being a symbolic reference to the Tree. The association is represented by the number “1” in the figure. Each Group also has a Members association to two other objects. These associations are represented by the number “2” in the figure.

Tree Hierarchy, Groups, Members, SoftwareComponent

The scenario in Figure 14.22 on page 185 depicts a Tree hierarchy in which two trees are nested. Each Tree has a Group and/or other members. There is also an association from one Tree to a SoftwareComponent.

Figure 14.22 Metadata Objects that Represent a Tree Hierarchy



The following XML request creates the Tree and Group objects. In this example, the Person and PhysicalTable objects are already created in the repository. See XML Representation of a Tree Hierarchy to view the XML representation.

The Tree has several Members associations (numbered “3” in the second figure), a SubTrees association (numbered “2” in the second figure), and a SoftwareComponents association (numbered “1” in the second figure). The Group objects are associated to the Tree objects using the Members association. From the Group, the association is Trees. Trees are associated to other trees using the ParentTree/SubTrees association. Note that a Tree can have only one ParentTree association but can have multiple Subtrees. In our example, there is only one SubTree. The Tree also has an association to a SoftwareComponent. This association helps an application determine which trees contain information for this application.

XML Representation of a Single Tree and Two Group Objects

```
<AddMetadata>
  <Metadata>
    <Tree Id="$1" Name="All my metadata" >
      <Members>
        <Group Name="People">
          <Members>
            <Person ObjRef="ABCDEFGH.A8000001"/>
            <Person ObjRef="ABCDEFGH.A8000002"/>
          </Members>
        </Group>
        <Group Name="Data">
          <Members>
```

```
            <PhysicalTable ObjRef="ABCDEFGH.A2000001"/>
            <PhysicalTable ObjRef="ABCDEFGH.A2000002"/>
          </Members>
        </Group>
      </Members>
    </Tree>
  </Metadata>
  <Reposid>A0000001.ABCDEFGH</Reposid>
  <NS>SAS</NS>
  <Flags>268435456</Flags>
  <Options/>
</AddMetadata>
```

XML Representation of a Tree Hierarchy

```
<AddMetadata>
  <Metadata>
    <Tree Id="$1" Name="All my metadata" >
      <Members>
        <Group Name="Data">
          <Members>
            <Person ObjRef="ABCDEFGH.A8000001"/>
            <Person ObjRef="ABCDEFGH.A8000002"/>
          </Members>
        </Group>
       </Members>
       <SubTrees>
           <Tree Id="$2" Name="Child Tree">
               <Members>
                  <Group Name="AGroup"/>
                  <PhysicalTable ObjRef="ABCDEFGH.A2000001"/>
                 <PhysicalTable ObjRef="ABCDEFGH.A2000002"/>
               </Members>
           </Tree>
       </SubTrees>
       <SoftwareComponents >
           <SoftwareComponent Name="myComponent" />
        </SoftwareComponents>
     </Tree>
  </Metadata>
  <Reposid>A0000001.ABCDEFGH</Reposid>
  <NS>SAS</NS>
  <Flags>268435456</Flags>
  <Options/>
</AddMetadata>
```

Usage Scenario: Creating Metadata for a Workspace Server

Purpose

This usage scenario describes how to define a server. The example focuses on using the Property submodel to describe a SAS Integration Technologies Workspace server and explains how to create a template for this type of server. An XML representation is included to show how to construct Prototype objects and their properties.

Requirements

This usage scenario assumes the reader has a general understanding of the Property Submodel, Software Deployment Submodel, and Transform Submodel of the SAS Metadata Model. For more information about these submodels, see "SAS Namespace Metadata Types" in the *SAS Open Metadata Interface: Reference*. Readers who are not familiar with the general concepts of the SAS Open Metadata Architecture should also refer to *Getting Started with SAS Open Metadata Interface*.

Description of a Server

A server is described in metadata using a set of DeployedComponent types (used to describe installed software) that has associated Connection objects (used to describe how to communicate with the server). IOM servers, DBMSs, and other servers are all described using these metadata types. There are several subtypes of Connection that provide additional information based on the communication protocol. For example, TCPIPConnection contains additional attributes used by TCP/IP communication, such as the host name and the port number.

DeployedComponent and its subtypes, along with TCPIPConnection, are generic types. Specific information about the software or the connection is provided through associated Property objects.

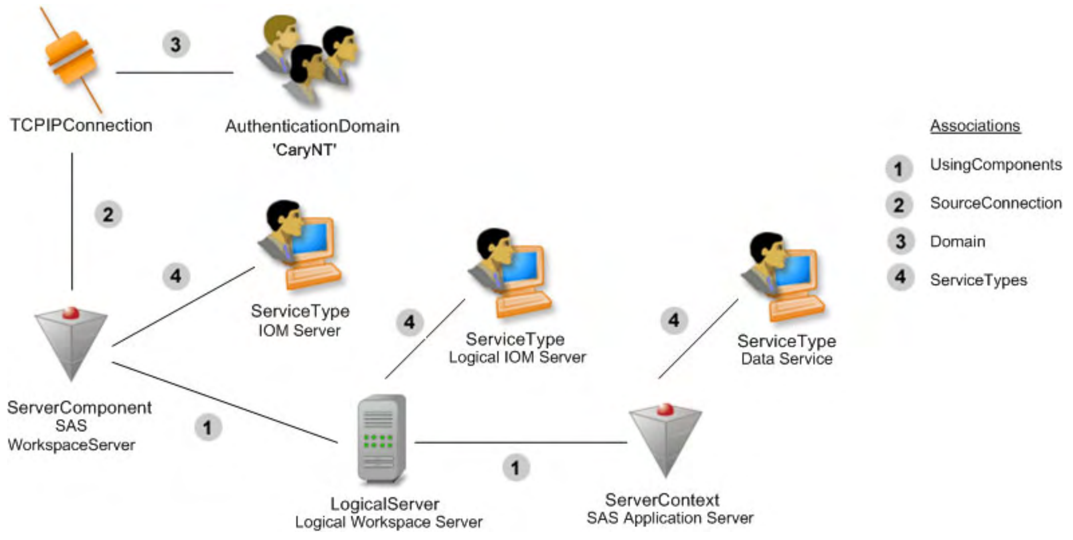
Workspace Server Metadata Objects

Figure 14.23 on page 188 depicts the main objects used to describe a Workspace server. A ServerContext allows an application to group non-homogeneous servers together that share resources. The resources that are shared include SAS Libraries and directories. The ServerContext has an associated LogicalServer (number "1" in the figure). The LogicalServer is used to group homogeneous servers together. The servers grouped by the LogicalServer would typically be used for pooling or load balancing. However, it is important to note that even a single workspace server would be represented using a set of ServerContext, LogicalServer, and ServerComponent types. The ServerComponent represents the actual Workspace server. A ServerComponent type represents a configured instance of installed software. One installation of SAS, for example, may have several configurations of a server, each with different resources or options defined. The installation of the software is represented by a DeployedComponent type. Each of these software deployment types inherit from the DeployedComponent type. Each DeployedComponent has a ClassIdentifier attribute that is used to identify the kind of component. The ClassIdentifier can be a unique identifier, such as the GUID generated through CDTool, or a Java class name (including the package), or some other unique string. In this example, the ServerContext has a class identifier of SAS Application Server. The LogicalServer and the ServerComponent both use 440196D4-90F0-11D0-9F41-00A024BB830C.

The ServiceType object describes the kinds of services available from the server and is associated to each of the DeployedComponent types (see "4" in the figure). In this case, the ServerComponent is tagged as an IOM server. The spawner uses this information to locate the servers it should start. The LogicalServer has a service type of Logical IOM Server and the ServerContext has a service type of Data Service.

The TCPIPConnection object describes how to access the server and is associated to the ServerComponent using the SourceConnections association (number “2” in the figure). The AuthenticationDomain object describes the authentication domain used by the server when accessed using this connection information (number “3” in the figure).

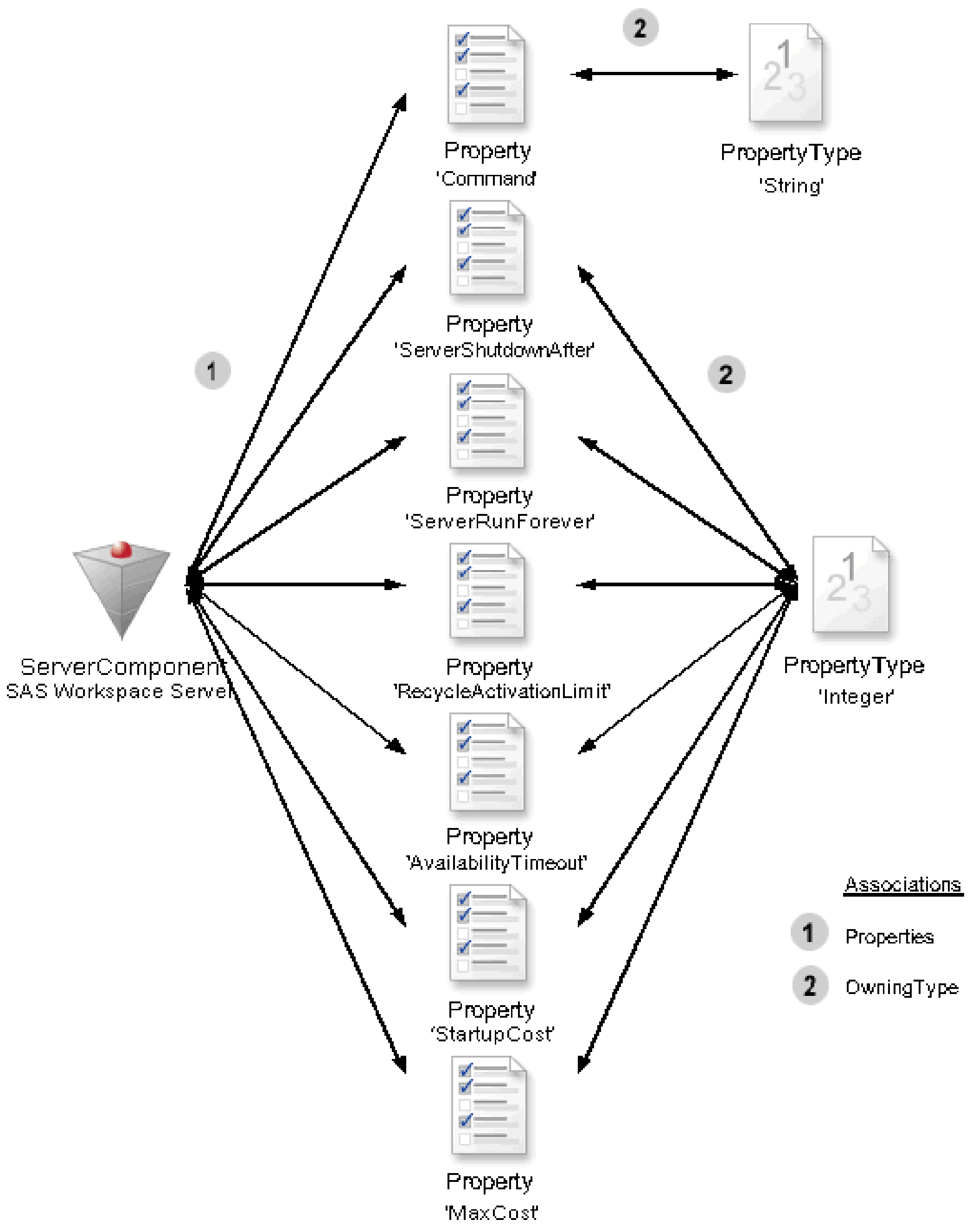
Figure 14.23 Metadata Objects Used to Describe a Workspace Server



DeployedComponent Types and Properties

Both the workspace server objects and the connection object require more information than is defined in the DeployedComponent types or a TCPIPConnection. The additional information is contained in Property objects. Figure 14.24 on page 189 depicts the ServerComponent and its associated Property and PropertyType objects.

Figure 14.24 Property Objects for a WorkSpace Server



The Workspace server must provide information about how to start and manage it. These are not specific attributes of ServerComponent, so the information is kept in Property objects. The Property objects shown in Figure 14.24 on page 189 are the default settings for the server. The associations numbered "1" depict the association of a Property object to its owning object, in this example, a ServerComponent. This association (from the owning object's perspective) is called Properties. All of the default Property objects should be available through this association.

If there are valid alternative values for Property objects, other than the default values, then PropertySet objects are used. If someone wants to find ALL of the default

Property objects, they will find them through the Properties association. If they are looking for a specific set of Property objects, then they should obtain a PropertySet object through the PropertySets association. The Property objects are available from the PropertySet object through the SetProperties association.

A PropertySet is also required to have a complete set of Property objects for a particular usage. There may be duplicate Property objects available through the Properties association, as well as through PropertySet objects, but that is because each of these are required to provide a complete set. An application should be able to obtain either the Property objects in the Properties association, or those in a PropertySet, and have all of the required information needed. There is no merging of Property objects through these associations, and there is no hierarchy of Property objects allowed through these associations.

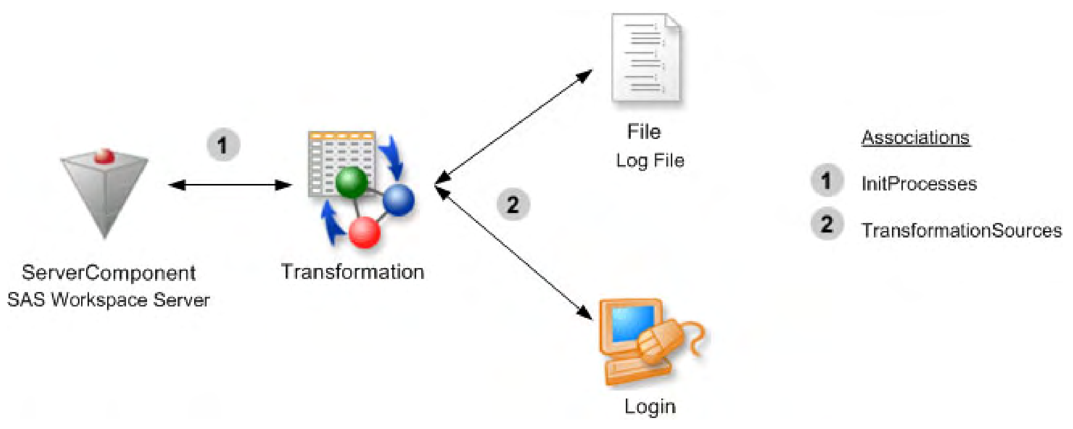
The Property object contains the name of the property used by a program (PropertyName). The value of the Property is saved in the DefaultValue attribute if it is a single value, or in an associated Text object if it refers to an array of values. This usage of the Text object is explained later in the TCPIPConnection and Property Objects“TCPIPConnection and Property Objects” on page 191 section. Each Property object has a set of attributes that describe whether the Property is required, can be updated, and should be visible in a user interface. If a Property indicates that it is required, it does NOT mean that the model requires the Property; it means that a value must be provided for proper usage of this object. If a Property indicates that it cannot be updated, then the DefaultValue contains the only valid setting for the Property.

Each Property object must be associated to a PropertyType object that describes the SQL type of information stored in the DefaultValue or associated Text object. The association between a Property and its PropertyType (numbered “2” in the second figure) is called OwningType. From the PropertyType, this association is called TypedProperties.

ServerComponent and Initialization

If the ServerComponent requires initialization information that should be stored in other metadata types, such as file names and locations, login information, or SAS library information, then a Transformation object that describes initialization process should be defined to associate that information to the ServerComponent. Figure 14.25 on page 190 depicts an example of an initialization process.

Figure 14.25 Metadata Objects Used to Define an Initialization Process that Uses a File and Login as Input



There are two metadata types that represent processes. Processes that do not represent data flow are represented as a Transformation object, in this case, the initialization process. Processes that represent data flow, for example a SAS procedure that accepts input data and creates output data, are represented as ClassifierMaps.

This example shows an initialization process that uses a file and login as input to the process. The ServerComponent locates its initialization processes through the InitProcesses association (number "1" in the third figure). The Transformation identifies the inputs to the initialization process through the TransformationSources association (number "2" in the third figure).

TCPIPConnection and Property Objects

The metadata type TCPIPConnection provides connection information for SAS/SHARE, SAS/CONNECT, and SAS Integration Technologies servers as well as DBMSs and other types of servers. The TCPIPConnection object has a set of attributes that contain generic information used to access a server accessible through TCP/IP, but it does not contain all of the specific information required for a particular server. For example, servers provided by SAS may require a set of encryption options as part of the connection information. Other options and their values may be needed to complete a connection to a server. Rather than create a large number of subtypes of TCPIPConnection, one can be tailored to include specific connection information for each type of server. Additional connection information is contained in the Property objects.

Figure 14.26 on page 192 depicts the metadata objects that contain the information needed to connect to a SAS Integration Technologies server using Bridge protocol.

Figure 14.26 Metadata Objects Representing a SAS Integration Technologies Server Connection

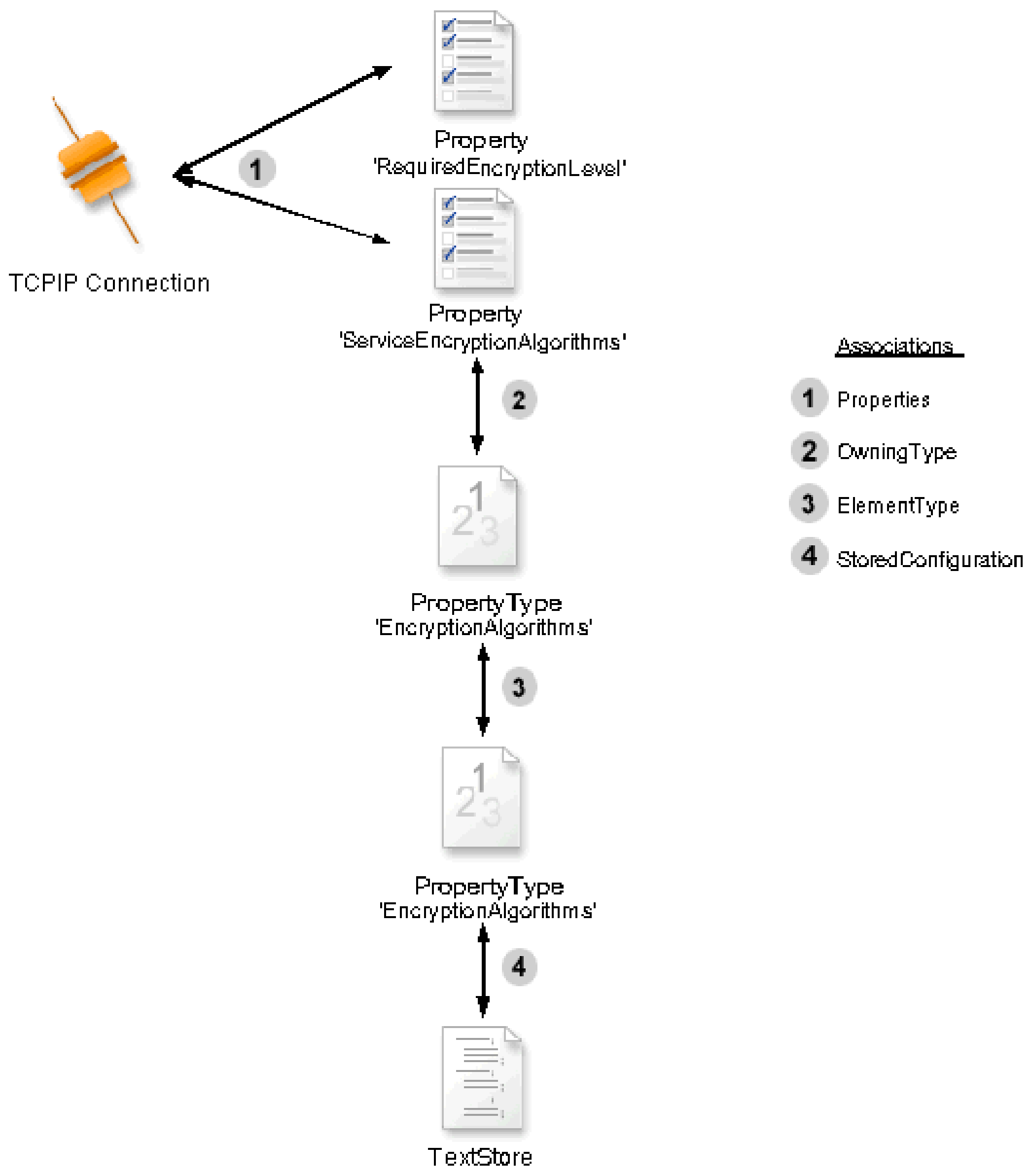


Figure 14.26 on page 192 is very similar to Figure 14.24 on page 189, but it includes additional information about the Property values and constraint information for the PropertyType.

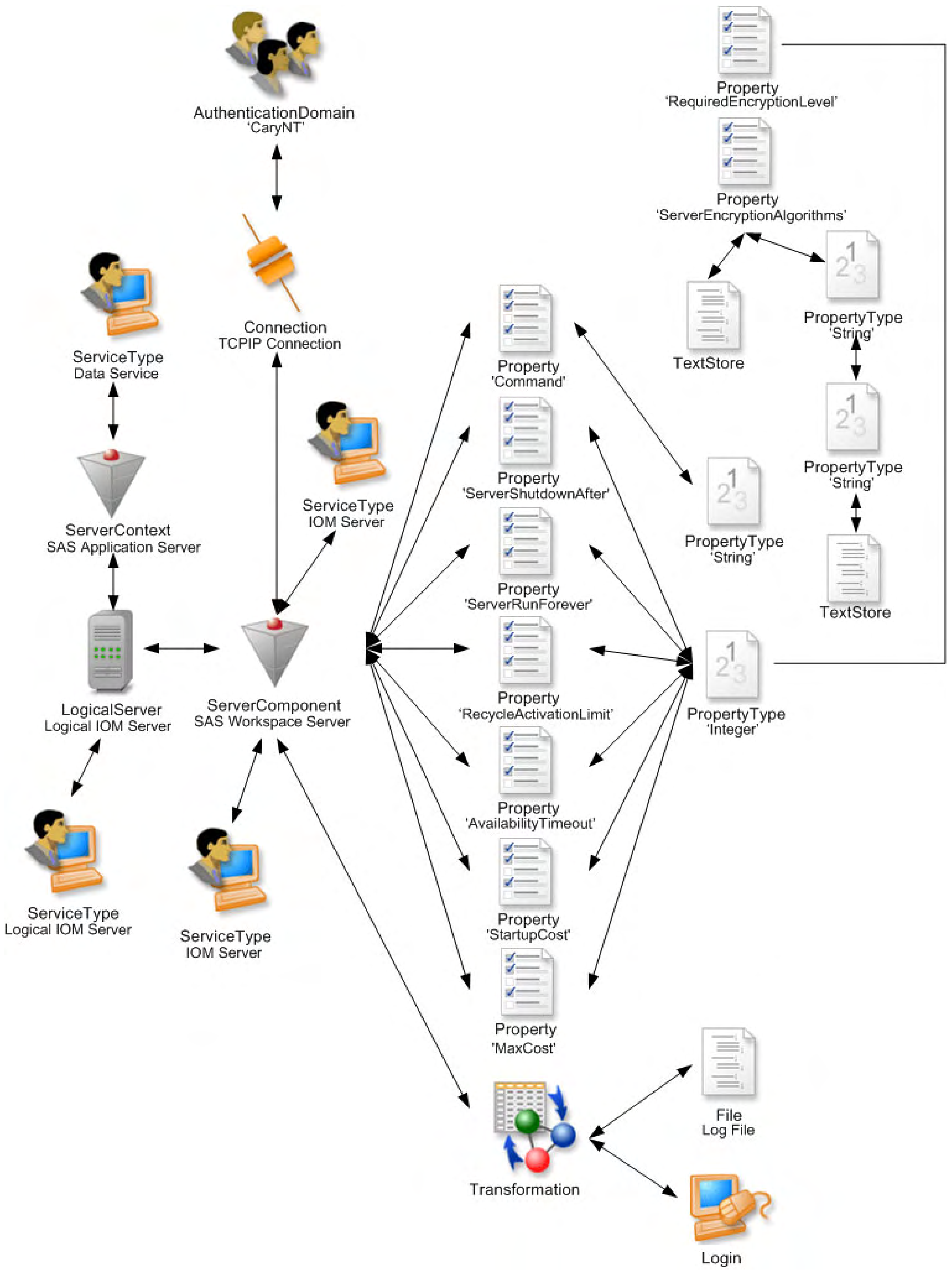
Just like DeployedComponent, TCPIPConnection contains generic connection information used to communicate with any server accessible through TCP/IP. In this example, there are two Property objects that contain additional information used to establish the connection: one for the RequiredEncryptionLevel and one for the ServerEncryptionAlgorithms. These Property objects represent the default values and are accessible from the TCPIPConnection object through the Properties association (number "1" in fourth figure).

The Property for EncryptionAlgorithms differs from the other Property objects because the type of the object is Array. A PropertyType that has an SQLType of Array should use the ElementType association (number "3" in fourth figure) to find the type of the elements of the array. The valid values of the EncryptionAlgorithm PropertyType are constrained to a list of four values: RC2, RC4, DES and Triple DES. This list is stored in a Text object, in this case, the subtype TextStore. The association between the Text object and PropertyType is called StoredConfiguration (number “4” in fourth figure).

Putting All of the Pieces Together

Figure 14.27 on page 194 depicts all of the objects used to describe this Workspace server.

Figure 14.27 Summary of Objects Used to Describe the WorkSpace Server



Prototype Objects

We just described how to use Property objects to store additional information for an object, but how do you describe a property sheet that describes all of the information required for a scenario? Which Property objects should be included?

A Prototype object is used as a template for creating other metadata objects. In this example, we describe a Prototype for a Workspace server. A Prototype object contains an attribute that contains the metadata type described by the Prototype, in this case, a DeployedComponent, and has associations to other objects that define the attributes and associations for the object.

Prototype and Properties

In this example, the Prototype describes the information needed for a Workspace server. Its attribute, MetadataType, identifies which type is being described. Prototype objects may have AttributeProperty objects that describe the settings of the attributes of the templated metadata type. In this example, the AttributeProperty for ClassIdentifier indicates the only valid setting for this attribute for a Workspace Server.

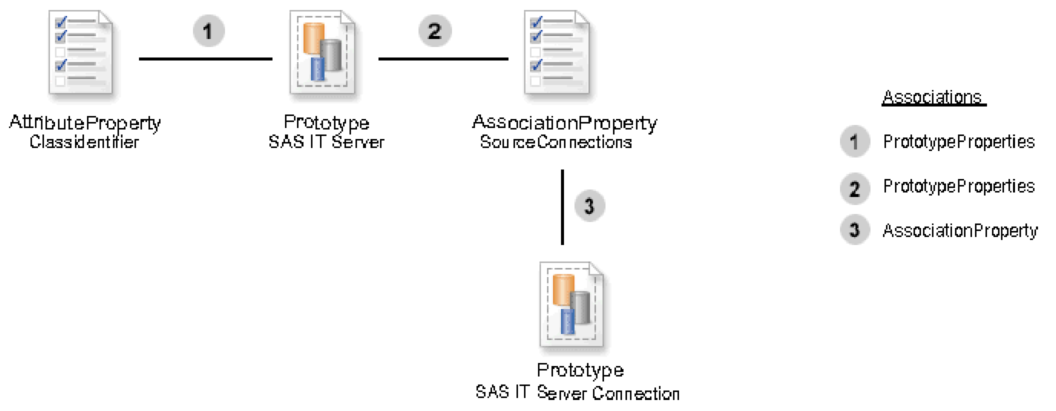
Prototype objects may also have AssociationProperty objects that describe the characteristics of associated objects. In this case, the AssociationProperty connects a Prototype of a TCPIPConnection object to the Prototype of a DeployedComponent.

Prototype objects locate AttributeProperty and AssociationProperty objects through the PrototypeProperties association or through PropertyGroup objects.

Objects created by using a Prototype definition may maintain an association to the Prototype that was used to create them through the UsingPrototype association.

Figure 14.28 on page 195 depicts a Prototype for a DeployedComponent and an AttributeProperty and an AssociationProperty. The numbers “1” and “2” in the sixth figure represent the association called PrototypeProperties from the Prototype. The association from the AssociationProperty is called AssociatedPrototypes (numbered “3” in sixth figure) and is used to link prototype definitions together.

Figure 14.28 WorkSpace Server Prototype



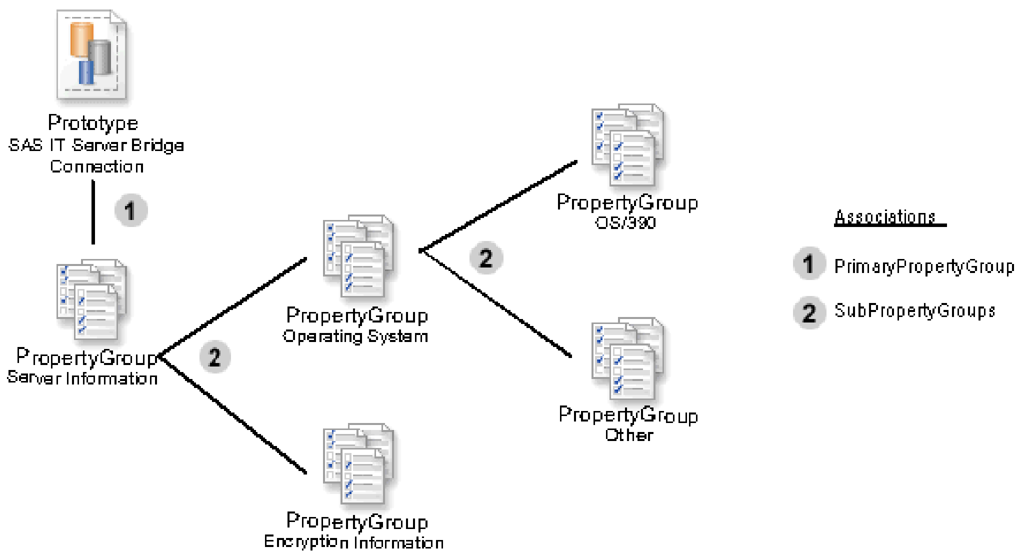
Prototype and Property

The TCPIPConnection that describes a Bridge connection has Property objects that describe the encryption level and algorithms. A Prototype also uses Property objects to contain that information, but the Properties and PropertySet associations are not used. Unfortunately, due to our subtyping structure, these associations are available to a Prototype object. However, these associations should never be used.

If a Prototype requires Property objects, then it should have a top-level PropertyGroup object associated to it through the PrimaryPropertyGroup association. PropertyGroup objects are used to logically group AttributeProperty, AssociationProperty, and Property objects. This grouping is primarily used to organize these objects for a user interface.

Each Prototype has a single top-level PropertyGroup, in this case named Server Information. Each PropertyGroup may have subgroups. The association between the Prototype and its top level group is identified as a PrimaryPropertyGroup (number "1" in Figure 14.29 on page 196). The association between the top level PropertyGroup and its subgroups is SubpropertyGroups (number "2" in the seventh figure). The subgroup Operating System has two subgroups labeled 'OS/390' and 'Other'. This association is numbered "3" in the seventh figure and is also known as SubpropertyGroups.

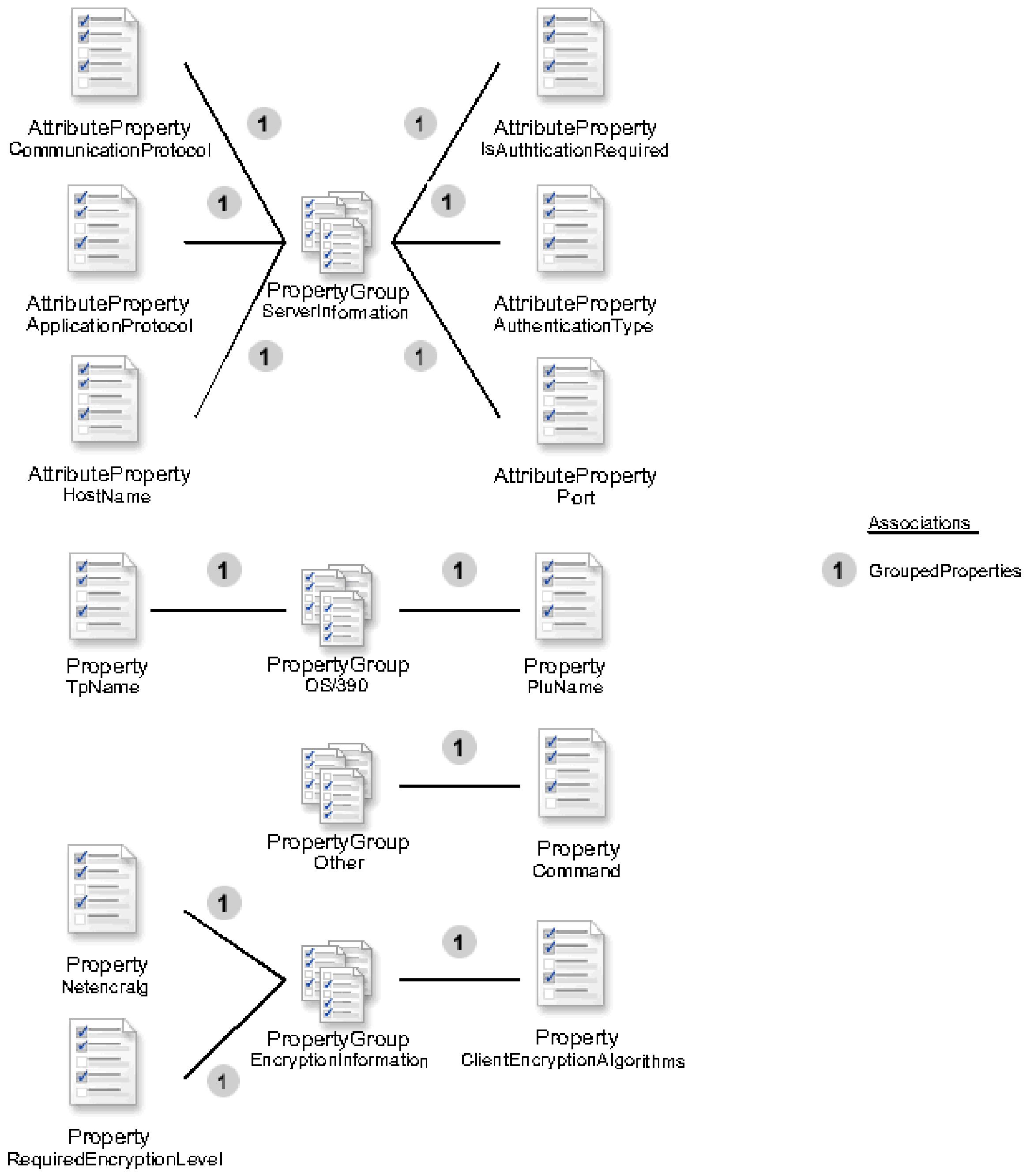
Figure 14.29 WorkSpace Server Bridge Connection Prototype



PropertyGroups and Properties

Figure 14.30 on page 197 depicts the relationship between the subtypes of AbstractProperty objects and PropertyGroups. When used as part of a Prototype definition, a Property object must be associated to a only one PropertyGroup. AttributeProperty and AssociationProperty are associated using the GroupedProperties association (number "1" in eighth figure).

Figure 14.30 Relationship between the Subtypes of AbstractProperty Objects and PropertyGroup Objects


AttributeProperty CommunicationProtocol
AttributeProperty IsAuthticationRequired
AttributeProperty ApplicationProtocol
PropertyGroup ServerInformation
AttributeProperty AuthenticationType
AttributeProperty HostName
AttributeProperty Port
Associations
1 GroupedProperties
Property TpName
PropertyGroup OS/390
Property PluName
PropertyGroup Other
Property Command
Property Netencralg
PropertyGroup EncryptionInformation
Property ClientEncryptionAlgorithms
Property RequiredEncryptionLevel
1

XML Example

See XML Representation of Metadata Objects for a Workspace Server to view the XML representation.

XML Representation of Metadata Objects for a Workspace Server

```
<AddMetadata>
  <Metadata>
    <PropertyType Id="$String" Name="String" SQLType="12"/>
    <PropertyType Id="$Boolean" Name="Boolean" SQLType="-7"/>
    <PropertyType Id="$Integer" Name="Integer" SqlType="4"/>
    <PropertyType Id="$StringArray" Name="String Array" SqlType="2003">
      <ElementType>
        <PropertyType ObjRef="$String"/>
      </ElementType>
    </PropertyType>
    <PropertyType Id="$IOMClassIds" Name="IOMClassIds" SqlType="12">
       <StoredConfiguration>
          <TextStore
             Name="Enumeration of IOM Class Ids"
             TextRole="config"
             TextType="xml"
             StoredText=
             "<Configuration>
              <Enumeration>
              <Value name="440196D4-90F0-11D0-9F41-00A024BB830C">Workspace</Value>
              <Value name="class id goes here">friendly name goes here</Value>
              </Enumeration>
              </Configuration>"/>
       </StoredConfiguration>
    </PropertyType>
    <PropertyType Id="$AuthenticationTypes"
              Name="AuthenticationTypes"
              SqlType="12">
       <StoredConfiguration>
         <TextStore
             Name="Enumeration of Authentication Types"
             TextRole="config"
             TextType="xml"
             StoredText="<Configuration>
                         <Enumeration>
                         <Value name="user/password"/>
                         <Value name="none"/>
                         <Value name="password"/>
                         <Value name="certificate"/>
                         </Enumeration>
                         </Configuration>"/>
       </StoredConfiguration>
    </PropertyType>
    <PropertyType Id="$SASEncryptionAlgorithms"
              Name="SASEncryptionAlgorithms"
              SqlType="2003">
       <ElementType>
          <PropertyType ObjRef="$String"/>
       </ElementType>
       <StoredConfiguration>
         <TextStore
              Name="SAS Encryption Algorithms Enumeration"
              TextRole="config"
              TextType="xml"
              StoredText="<Configuration>
                          <Enumeration>
                          <Value name="RC2"/>
                          <Value name="RC4"/>
                          <Value name="DES"/>
                          <Value name="Triple DES"/>
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              TextType="xml"
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       </StoredConfiguration>
    </PropertyType>
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               Name="Workspace Server"
               Desc="This server defines a SAS Workspace Server for
                    Version 9.0 of the SAS System."
               MetadataType="ServerComponent">
       <Extensions>
         <Extension Name="UITreeCategory"
                    Value="SAS Servers.SAS Application Server Components"
                    ExtensionType="VARCHAR" />
         </Extensions>
         <PrimaryPropertyGroup>
          <PropertyGroup Name="Primary Group">
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                 PropertyName="ClassIdentifier"
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                 <OwningType>
                    <PropertyType ObjRef="$IOMClassIds"/>
                 </OwningType>
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                   <Prototype ObjRef="$IOMServer"/>
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                 IsRequired="1"
                 IsUpdateable="1"
                 IsVisible="1"
                 DefaultValue="9">
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      AssociationName="ServiceTypes"
      PartnerName="DeployedComponents"
      MetadataType="ServiceType"
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      IsUpdateable="0"
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      Maximum="2">
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          </OwningPrototype>
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          PartnerName="Source"
          MetadataType="OpenClientConnection"
          IsExpert="0" Minimum="1">
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            <Prototype Objref="$BridgeConnection"/>
            <Prototype Objref="$MultiBridgeConnection"/>
            <Prototype Objref="$COMConnection"/>
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          <OwningPrototype>
            <Prototype ObjRef="$IOMServer"/>
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          AssociationName="UsedByComponents"
          PartnerName="UsingComponents"
          MetadataType="LogicalServer"
          IsExpert="0"
          Minimum="1">
          <AssociatedPrototypes>
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            <Prototype Objref="$LoadBalancing"/>
            <Prototype Objref="$Pooling"/>
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          <OwningPrototype>
            <Prototype ObjRef="$IOMServer"/>
          </OwningPrototype>
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     </GroupedProperties>
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         <GroupedProperties>
           <Property
              Name="Command"
              PropertyName="Command"
              Desc="Required for servers with Bridge connections"
              IsExpert="1"
              IsRequired="0"
              IsUpdateable="1"
              IsVisible="1"
              DefaultValue="">
              <OwningType>
                <PropertyType ObjRef="$String"/>
              </OwningType>
           </Property>
           <Property
              Name="Object Server Parameters"
              PropertyName="ObjectServerParms"
              Desc="Parameters to override what the spawner passes to
                   SAS on the -objectserverparms option"
              IsExpert="1"
              IsRequired="0"
              IsUpdateable="1"
              IsVisible="1"
              DefaultValue="">
              <OwningType>
                <PropertyType ObjRef="$String"/>
              </OwningType>
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         </GroupedProperties>
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              Name="Login Group"
              AssociationName="InitProcesses"
              PartnerName="DeployedComponents"
              MetadataType="Transformation"
              IsExpert="1"
              IsVisible="1"
              IsUpdateable="1"
              Minimum="0"
              Maximum="1">
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                     TextType="xml"
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                         <Flags>392</Flags>
                         <Options>
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                         </GetMetadataObjects>
                         </MetadataRequest>
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                         <Parm Name="_ObjectStore_"/>
                         <Parm Name="_ReposID_"/>
                         <Parm Name="_Prototype_"/>
                         <Parm Name="New Initialization Process"/>
                         </ClassParameters>
                         </Configuration>"/>
              </StoredConfiguration>
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                 ClassIdentifier=
                 "com.sas.workspace.visuals.PrototypePropertiesDialog"/>
              </Customizers>
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                <Prototype Objref="$IOMServer"/>
                <Prototype Objref="$ServerLoginProc"/>
              </AssociatedPrototypes>
              <OwningPrototype>
                <Prototype ObjRef="$IOMServer" />
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           </AssociationProperty>
         </GroupedProperties>
       </PropertyGroup>
       <PropertyGroup Name="Properties">
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                          Name="Common Properties"/>
           <PropertyGroup Id="$ServerProperties"
                          Name="Specific Properties"
                          Minimum="1"
                          Maximum="1">
             <SubPropertyGroups>
               <PropertyGroup Id="$LoadBalanceProperties"
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                              Minimum=""
                              Maximum=""/>
               <PropertyGroup Id="$PoolingProperties"
                              Name="Pooling"
                              Minimum=""
                              Maximum=""/>
             </SubPropertyGroups>
           </PropertyGroup>
         </SubPropertyGroups>
       </PropertyGroup>
       <PropertyGroup
           Name="File Navigation"
           Desc="Select the initial directory where file navigation
                begins on the server."
           Minimum="1"
           Maximum="1">
         <GroupedProperties>
           <Property Name="SAS User Root"
                     PropertyName="FileNavigation"
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                    IsRequired="0"
                    IsUpdateable="0"
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                    DefaultValue=".">
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              </OwningType>
          </Property>
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                    PropertyName="FileNavigation"
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                    IsRequired="0"
                    IsUpdateable="0"
                    IsVisible="1"
                    DefaultValue="$">
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          </Property>
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                    PropertyName="FileNavigation"
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                    IsRequired="0"
                    IsUpdateable="1"
                    IsVisible="1"
                    DefaultValue="">
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        </GroupedProperties>
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          <Property Name="Bound Library"
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                    IsExpert="1"
                    IsRequired="0"
                    IsUpdateable="1"
                    IsVisible="1"
                    DefaultValue="">
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        </GroupedProperties>
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    </SubpropertyGroups>
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</PrimaryPropertyGroup>
<Properties>
  <Property
      Name="Availability Timeout"
      PropertyName="AvailabilityTimeout"
      Desc="Number of milliseconds to wait for available server"
      IsExpert="1"
      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="0">
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       <PropertyGroup ObjRef="$LoadBalanceProperties"/>
     </AssociatedPropertyGroup>
  </Property>
  <Property
      Name="Run Server Forever"
      PropertyName="ServerRunForever"
      IsExpert="1"
      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="1">
     <OwningType>
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     </OwningType>
     <AssociatedPropertyGroup>
       <PropertyGroup ObjRef="$StandardProperties"/>
     </AssociatedPropertyGroup>
  </Property>
  <Property
      Name="Shut Server Down After (s)"
      Desc="Applicable only if the server is not set to run forever."
      PropertyName="ServerShutdownAfter"
      IsExpert="1"
      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="0">
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      <PropertyType ObjRef="$Integer"/>
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     <AssociatedPropertyGroup>
       <PropertyGroup ObjRef="$StandardProperties"/>
     </AssociatedPropertyGroup>
  </Property>
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            IsRequired="1"
            IsUpdateable="1"
            IsVisible="1"
            DefaultValue="0">
     <OwningType>
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     <AssociatedPropertyGroup>
       <PropertyGroup ObjRef="$LoadBalanceProperties"/>
     </AssociatedPropertyGroup>
  </Property>
  <Property Name="Recycle Activation Limit"
            PropertyName="RecycleActivationLimit"
            Desc="Number of times this server will be used
                  before it is restarted"
            IsExpert="1"
            IsRequired="1"
           IsUpdateable="1"
           IsVisible="1"
            DefaultValue="0">
      <OwningType>
        <PropertyType ObjRef="$Integer"/>
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      <AssociatedPropertyGroup>
        <PropertyGroup ObjRef="$StandardProperties"/>
      </AssociatedPropertyGroup>
  </Property>
  <Property
      Name="Maximum Cost"
      PropertyName="MaxCost"
      Desc="Maximum cost value this server can afford"
      IsExpert="1"
      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="0">
     <OwningType>
       <PropertyType ObjRef="$Integer"/>
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     <AssociatedPropertyGroup>
        <PropertyGroup ObjRef="$LoadBalanceProperties"/>
     </AssociatedPropertyGroup>
  </Property>
  <Property
      Name="Startup Cost"
      PropertyName="StartupCost"
      Desc="Cost associated with starting this server"
      IsExpert="1"
      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="0">
     <OwningType>
       <PropertyType ObjRef="$Integer"/>
     </OwningType>
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       <PropertyGroup ObjRef="$LoadBalanceProperties"/>
     </AssociatedPropertyGroup>
  </Property>
  <Property
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          Name="Maximum Clients"
          PropertyName="MaxClients"
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          IsUpdateable="1"
          IsVisible="1"
          DefaultValue="1">
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         </AssociatedPropertyGroup>
      </Property>
    </Properties>
</Prototype>
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    Id="$BridgeConnection" Name="Bridge Connection"
    Desc="Specifies a TCP/IP port to which the spawner listens
         for clients connecting to SAS."
    MetadataType="TCPIPConnection">
  <PrimaryPropertyGroup>
    <PropertyGroup Name="Primary Group" >
      <GroupedProperties>
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              PropertyName="CommunicationProtocol"
              IsExpert="0"
              IsRequired="1"
              IsUpdateable="0"
              IsVisible="0"
              DefaultValue="TCP">
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               <Prototype ObjRef="$BridgeConnection" />
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        </AttributeProperty>
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              PropertyName="ApplicationProtocol"
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              IsRequired="1"
              IsUpdateable="0"
              IsVisible="0"
              DefaultValue="Bridge">
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               <Prototype ObjRef="$BridgeConnection" />
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        </AttributeProperty>
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      PropertyName="AuthenticationType"
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      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="user/password">
     <OwningType>
       <PropertyType ObjRef="$AuthenticationTypes"/>
     </OwningType>
     <OwningPrototype>
       <Prototype ObjRef="$BridgeConnection"/>
     </OwningPrototype>
</AttributeProperty>
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      AssociationName="Domain"
      PartnerName="Connections"
      MetadataType="AuthenticationDomain"
      IsExpert="0"
      IsRequired="1"
      IsVisible="1"
      IsUpdateable="1"
      Minimum=""
      Maximum="1">
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                  TextType="xml"
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                   <NS>SAS</NS>
                   <Flags>264</Flags>
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                   </ClassParameters>
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     ClassIdentifier=
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     </Customizers>
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     </OwningPrototype>
  </AssociationProperty>
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      IsVisible="1"
      DefaultValue="">
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      PropertyName="Port"
      IsExpert="0"
      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="">
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       <Prototype ObjRef="$BridgeConnection" />
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            PropertyName="Service"
            IsExpert="1"
            IsRequired="0"
            IsUpdateable="1"
            IsVisible="1"
            DefaultValue="sasobjspawn">
           <OwningType>
             <PropertyType ObjRef="$String"/>
```

```
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                    <Prototype ObjRef="$BridgeConnection" />
                  </OwningPrototype>
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          </PropertyGroup>
          <PropertyGroup Name="Encryption" >
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                    IsExpert="1"
                    IsRequired="0"
                    IsUpdateable="1"
                    IsVisible="1"
                    DefaultValue="">
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                   </OwningType>
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                    IsExpert="1"
                    IsRequired="0"
                    IsUpdateable="1"
                    IsVisible="1"
                    DefaultValue="">
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  </PrimaryPropertyGroup>
</Prototype>
<Prototype Id="$MultiBridgeConnection"
           Name="MultiBridge Connection"
           Desc="Specifies a TCP/IP port that clients may get redirected
                 to when using Load Balancing."
           MetadataType="TCPIPConnection">
    <PrimaryPropertyGroup>
       <PropertyGroup Name="Primary Group" >
         <GroupedProperties>
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                 PropertyName="CommunicationProtocol"
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                 IsRequired="1"
                 IsUpdateable="0"
                 IsVisible="0"
                 DefaultValue="TCP">
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                <OwningPrototype>
                 <Prototype ObjRef="$MultiBridgeConnection" />
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            </AttributeProperty>
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                  PropertyName="ApplicationProtocol"
                  IsExpert="0"
                  IsRequired="1"
                  IsUpdateable="0"
                  IsVisible="0"
                  DefaultValue="MultiBridge">
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                </OwningType>
                <OwningPrototype>
                 <Prototype ObjRef="$MultiBridgeConnection" />
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            </AttributeProperty>
            <AttributeProperty
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                  PropertyName="AuthenticationType"
                  IsExpert="0"
                  IsRequired="1"
                  IsUpdateable="1"
                  IsVisible="1"
                  DefaultValue="user/password">
                <OwningType>
                  <PropertyType ObjRef="$AuthenticationTypes"/>
                </OwningType>
                <OwningPrototype>
                  <Prototype ObjRef="$MultiBridgeConnection" />
                </OwningPrototype>
            </AttributeProperty>
            <AssociationProperty
                 Name="Authentication Domain"
                 AssociationName="Domain"
                 PartnerName="Connections"
                 MetadataType="AuthenticationDomain"
                 IsExpert="0"
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                 Minimum=""
                 Maximum="1">
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                       TextType="xml"
```

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                        <Reposid>_ReposID_</Reposid>
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                        <NS>SAS</NS>
                        <Flags>264</Flags>
                        <Options></Options>
                        </GetMetadataObjects>
                        </MetadataRequest>
                        <ClassParameters>
                        <Parm Name="_ParentComponent_"/>
                        <Parm Name="_ObjectStore_Persist_"/>
                        <Parm Name="_ReposID_"/>
                        <Parm Name="_Prototype_"/>
                        <Parm Name="New Authentication Domain"/>
                        </ClassParameters>
                        </Configuration>"/>
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     ClassIdentifier=
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    </Customizers>
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      <Prototype ObjRef="$AuthDomain" />
    </AssociatedPrototypes>
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      <Prototype ObjRef="$MultiBridgeConnection" />
    </OwningPrototype>
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      PropertyName="HostName"
      IsExpert="0"
      IsRequired="1"
      IsUpdateable="1"
      IsVisible="1"
      DefaultValue="">
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    <OwningPrototype>
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    </OwningPrototype>
</AttributeProperty>
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      PropertyName="Port"
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      IsRequired="1"
      IsUpdateable="1"
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        IsVisible="1"
        DefaultValue="">
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      </OwningType>
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      </OwningPrototype>
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             PropertyName="Service"
             IsExpert="1"
             IsRequired="0"
             IsUpdateable="1"
             IsVisible="1"
             DefaultValue="sasobjspawn">
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             </OwningType>
             <OwningPrototype>
               <Prototype ObjRef="$MultiBridgeConnection" />
             </OwningPrototype>
        </AttributeProperty>
      </GroupedProperties>
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   <PropertyGroup Name="Encryption" >
      <GroupedProperties>
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                  PropertyName="ServerEncryptionAlgorithms"
                  IsExpert="1"
                  IsRequired="0"
                  IsUpdateable="1"
                  IsVisible="1"
                  DefaultValue="">
             <OwningType>
               <PropertyType ObjRef="$SASEncryptionAlgorithms"/>
             </OwningType>
        </Property>
        <Property Name="Required Encryption Level"
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                  IsExpert="1"
                  IsRequired="0"
                  IsUpdateable="1"
                  IsVisible="1"
                  DefaultValue="">
              <OwningType>
                <PropertyType ObjRef="$SASEncryptionLevel"/>
              </OwningType>
        </Property>
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               </GroupedProperties>
            </PropertyGroup>
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      </PropertyGroup>
   </PrimaryPropertyGroup>
</Prototype>
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           Desc="Specifies a hostname where clients can connect to SAS
                 using COM protocol." MetadataType="COMConnection">
   <PrimaryPropertyGroup>
      <PropertyGroup Name="Primary Group" >
         <GroupedProperties>
            <AttributeProperty
                  Name="Communication Protocol"
                  PropertyName="CommunicationProtocol"
                  IsExpert="0"
                  IsRequired="1"
                  IsUpdateable="0"
                  IsVisible="0"
                  DefaultValue="COM">
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                 <PropertyType ObjRef="$String"/>
                </OwningType>
                <OwningPrototype>
                  <Prototype ObjRef="$COMConnection" />
                </OwningPrototype>
            </AttributeProperty>
            <AttributeProperty
                  Name="Application Protocol"
                  PropertyName="ApplicationProtocol"
                  IsExpert="0"
                  IsRequired="1"
                  IsUpdateable="0"
                  IsVisible="0"
                  DefaultValue="COM">
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               </OwningType>
               <OwningPrototype>
                <Prototype ObjRef="$COMConnection" />
               </OwningPrototype>
            </AttributeProperty>
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  <Options/>
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PART 5

Appendix

Appendix ***1*** . . . . **Recommended Reading** *231*

APPENDIX 1 Recommended Reading

Recommended Reading **231**

Recommended Reading

Here is the recommended reading list for this title:

- *Getting Started with SAS Open Metadata Interface*
- *SAS Open Metadata Interface: Reference*
- *SAS Java Metadata Interface: User's Guide*

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