Matisse® ODL Programmer’s Guide

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Matisse ODL Programming Guide

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Contents

1 Introduction

1.1 Scope of This Document

This document is a guide to using Matisse's Object Definition Language (ODL) to create Matisse database schemas. It covers all aspects of ODL programming and use of the `mt_sdl` utility that are the same regardless of which language binding(s) you use.

General information about designing Matisse database schemas is covered in *Getting Started with MATISSE*. Binding-specific aspects of Matisse ODL are covered in the C++, Java, PHP, Python and Eiffel binding programmer's guides.

1.2 Before Reading This Document

Throughout this document, we presume that you have read *Getting Started with MATISSE*, which provides an overview of Matisse schema elements and a discussion on schema design.

1.3 SQL DDL and Matisse Modeler

You may use SQL DDL (Data Definition Language) or Matisse modeling tool to create or update Matisse database schema. For more information, refer to *Matisse SQL Programmer's Guide* or *Matisse Modeler User's Guide*.

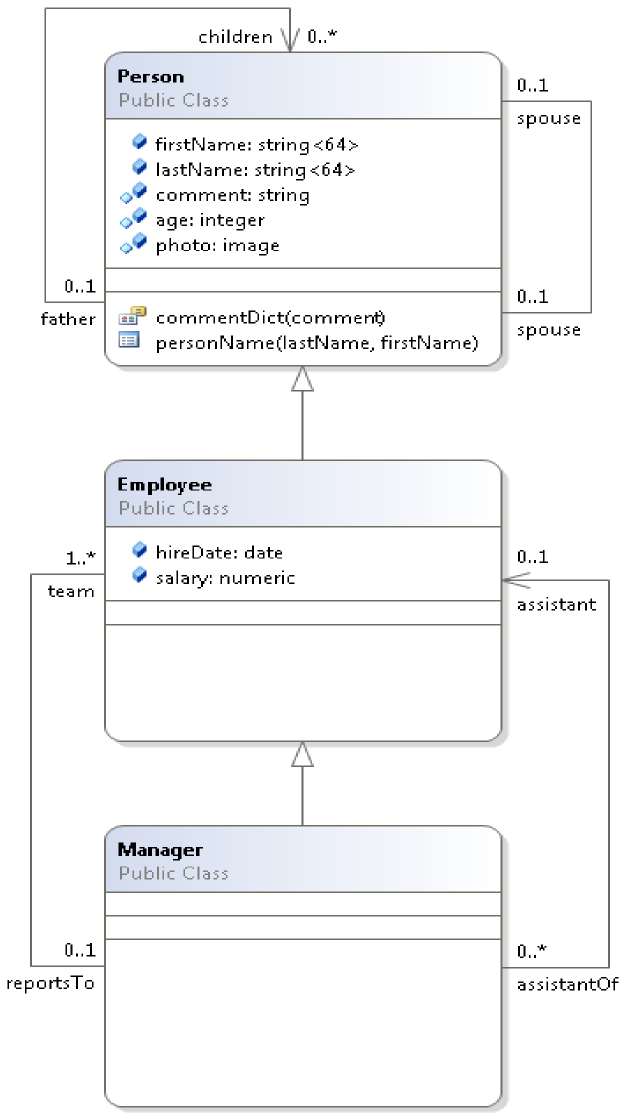
Note that you need to use an ODL file to generate persistent stub classes for the C++, Java, PHP, Python or Eiffel bindings. However, you can generate an ODL file from the Matisse database using the mt_sdl utility, or the Matisse Enterprise Manager, after you create the database schema using SQL DDL or the Matisse Modeler. For more information about mt_sdl, read 3 Using the mt_sdl utility

2 Creating a Schema with ODL

2.1 Overview of ODL Programming

To to create a schema in Matisse ODL, you create an `.odl` file, a text file containing a set of ODL declarations. You can then use the `mt_sdl` utility or the Matisse Enterprise Manager to load the schema in a newly initialized database and to generate source code for use with the C++, Java, PHP, Python or Eiffel binding.

The following is the ODL code for the schema diagrammed at right:



```
interface Person : persistent {
  attribute String firstName;
  attribute String lastName;
  attribute String<500> Nullable
comment;
  attribute Integer Nullable age =
NULL;
  attribute Image Nullable photo =
NULL;
  relationship Person spouse[0, 1]
      inverse Person::spouse;
  relationship List<Person>
children
      inverse Person::father;
  readonly relationship Person
father[0, 1]
      inverse Person::children;
};

interface Employee : Person :
persistent {
  attribute Date hireDate;
  attribute Numeric(10, 2) salary;
  relationship Manager reportsTo
    inverse Manager::team;
};

interface Manager : Employee : persistent {
  relationship List<Employee> team[1, -1]
    inverse Employee::reportsTo;
  relationship Employee assistant[0, 1];
};
```

Default cardinality for a relationship declared using `relationship List<`*Class_name*`>` is `0, -1`, while for a relationship declared using `relationship` *Class_name* default cardinality is `1, 1`. Thus the cardinality does not need to be declared for the `children` or `reportsTo` relationships. See *Specifying Relationships with ODL* on page 13 for more information.

2.2 Specifying Namespaces with ODL

Define a namespace

`module` *Namespace_name* `{...};`

Associated classes, indexes and entry-point dictionaries are declared within the brackets.

For example, defining `Person` and `Company` classes in `MyCompany.MyApp` namespace and `Employee` and `Manager` in sub-namespace `HR`:

```
module MyCompany
{
  module MyApp
  {
    interface Person : persistent
    {
       attribute String<16> name;
    };
    interface Company : persistent
    {
       attribute String<32> name;
    };
    module HR
    {
      interface Employee: MyCompany.MyApp.Person: persistent
      {
      };
      interface Manager: Employee: persistent
      {
      };
    };
  };
};
```

2.3 Specifying Classes with ODL

Define a class

`interface` *Class_name* `: persistent {...};`

Associated attributes, relationships, indexes and entry-point dictionaries are declared within the brackets, separated by semicolons.

Extend a class

`interface` *Class_name* `:` *Superclass_name* `: persistent {...};`

Extends an existing class (*Superclass_name*) to create a subclass. The subclass inherits all of the properties of the superclass.

For the multiple inheritance, enumerate the superclasses separated with a comma:

```
interface Class_name : Superclass1, Superclass2 : persistent
    {...};
```

2.4 Specifying Attributes with ODL

Basic declaration (name and type)

`attribute` *type Attibute_name*

Specifies an attribute of *type*, where *type* is the ODL name for one of Matisse's scalar (`Boolean`, `Byte`, `Char`, `Date`, `Double`, `Float`, `Integer`, `Interval`, `Long`, `Numeric`, `Short`, `String`, or `Timestamp`) or streamable (`Audio`, `Bytes`, `Image`, `Text`, `Video`) data types. For additional information, see the *Matisse Data Type Reference*.

Table 1 Scalar types and media types

Type	Description
Boolean	True or false
Byte	A single byte. Valid range is from 0 to 255.
Char	A single byte character.
Date	Year, month, and day values of date
Double	A double-precision floating-point number, 64-bit approximation of a real number.
Float	A single-precision floating-point number, 32-bit approximation of a real number.
Integer	4-byte signed integer.
Interval	A period of time in days, hours, minutes, seconds, and micro-seconds.
Long	8-byte signed integer.
Numeric Numeric(*p*, *s*)	A fixed-point decimal number having precision *p* and scale *s*. Default precision and scale is 19 and 2. Precision sets the total number of digits and scale sets the number of those digits to the right of the decimal point.
Short	2-byte signed integer.
String String<*n*>	A variable length character string, optionally having the maximum length *n*. The maximum length is 2147483648 (2Gbytes). If *n* is not specified, the maximum size is 2147483648.
String UTF16 String<*n*> UTF16	A variable length Unicode character string, optionally having the maximum number of characters *n*. The maximum number of characters is 1073741824 (1G). If *n* is not specified, the maximum is 1073741824.
Timestamp	Date and time consisting of year, month, day, hour, minute, second, and micro-second.

Type	Description
Audio Audio<*n*> Bytes Bytes<*n*> Image Image<*n*> Video Video<*n*>	Streamable binary large object, optionally having the maximum size *n* in bytes. The maximum size of these types is 2147483648. If *n* is not specified the maximum size is 2147483648.
Text Text<*n*>	Streamable character large object, optionally having the maximum length *n* in bytes. The maximum length of this type is 2147483648. If *n* is not specified the maximum length is 2147483648.
Text UTF16 Text<*n*> UTF16	Streamable Unicode character large object, optionally having the maximum number of characters *n*. The maximum number of characters of this type is 1073741824. If *n* is not specified the maximum length is 1073741824.

List types

`attribute List<`*type*`>` *Attibute_name*
`attribute List<`*type, max_elements*`>` *Attibute_name*

Defines the type as the `LIST` variation of the specified scalar type. It optionally specifies the maximum number of elements allowed in a list. For additional information, see the *Matisse Data Type Reference*.

The following is the list of available list types:

```
List<Boolean>
List<Date>
List<Double>
List<Float>
List<Integer>
List<Interval>
List<Long>
List<Numeric>
List<Short>
List<String>
List<String UTF16>
List<Timestamp>
```

Nullable flag

`attribute` *type* **`Nullable`** *Attibute_name*

Allows null values. If you specify `Nullable` and do not specify a default value, the attribute value will default to NULL. For example, in the case of a `DateOfDeath` attribute, a null would be appropriate for a living person.

Default value `attribute` *type* *Attibute_name* **=** ***default_value***

Explicitly defines a default value (which must be compatible with *type*). Syntax for *default_value* varies with the type:

Type	Default value syntax
Boolean	TRUE|FALSE
Byte	Byte(*value*)
Char	'a'
Date	Date("YYYY-MM-DD")
Double	Double(*value*)
Float	Float(*value*)
Integer	*value*
Interval	Interval("[-]*days* HH:MM:SS.MMMMMM") Note that there is a space after the *days* value.
Long	Long(*value*)
Numeric	Numeric(0.00) (The only default value allowed is 0.)
Short	Short(*value*)
String	"*string*"

String UTF16	UTF16("cycling")
	UTF16("v\u00E9lo")
	UTF16("\u81EA\u884C\u8F66")

Timestamp	Timestamp("YYYY-MM-DD HH:MM:SS.MMMMMM")
Audio	Audio()
Bytes	Bytes()
Image	Image()
Text	Text("*string*")
Text UTF16	Text UTF16("cycling") Text UTF16("v\u00E9lo") Text UTF16("\u81EA\u884C\u8F66")
Video	Video()

`attribute` *type* `nullable` *Attibute_name* `= NULL`

Sets the default value to `NULL`.

`attribute List<`*type*`>` *Attibute_name* `= List<`*type*`>{` *default_value_1*`,`
default_value_2`, ...}`

Sets a list of default values.

```
attribute List<type> Attibute_name = List<type>{}
```

Sets the default value as an empty list.

To change a default value, revise the ODL file and use `mt_sdl` to update the database (see *Loading a schema* on page 18).

Scalar default value examples

```
attribute Boolean Attibute_name = TRUE
attribute Byte Attibute_name = Byte(0)
attribute Char Attibute_name = 'A'
attribute Date Attibute_name = Date("1997-07-29")
attribute Double Attibute_name = Double(0.000000)
attribute Float Attibute_name = Float(0.000000)
attribute Integer Attibute_name = 0
attribute Interval Attibute_name = Interval("-29 12:00:00")
attribute Long Attibute_name = Long(0)
attribute Numeric Attibute_name = Numeric(0)
attribute Short Attibute_name = Short(0)
attribute String<32> Attibute_name = "ascii string"
attribute String<32> UTF16 Attibute_name = UTF16("v\u00E9lo")
attribute Text Attibute_name = Text("ascii string")
attribute Text UTF16 Attibute_name = Text
    UTF16("\u81EA\u884C\u8F66")
attribute Timestamp Attibute_name = Timestamp("2000-12-31
    12:00:00")
```

List default value examples

```
attribute List<Boolean> Attibute_name = List<Boolean>{ TRUE, FALSE
    }
attribute List<Byte> Attibute_name = List<Byte>{ 11, 21 }
attribute List<Double> Attibute_name = List<Double>{ 11.100000,
    21.100000 }
attribute List<Float> Attibute_name = List<Float>{ 11.100000,
    21.100000 }
attribute List<Integer> Attibute_name = List<Integer>{ 11, 21 }
attribute List<Interval> Attibute_name = List<Interval>{
    Interval("-19 12:00:00"), Interval("-29 12:00:00") }
attribute List<Long> Attibute_name = List<Long>{ 11, 21 }
attribute List<Numeric>{ Numeric(0.00, 0.00)}
attribute List<Short> Attibute_name = List<Short>{ 11, 21 }
attribute List<String> Attibute_name = List<String>{ "a","b","c" }
attribute List<String UTF16> Attibute_name = List<String>{
    UTF16("cycling"), UTF16("v\u00E9lo"),
    UTF16("\u81EA\u884C\u8F66") }
attribute List<Timestamp> Attibute_name = List<Timestamp>{
    Timestamp("2000-12-31 12:00:00"), Timestamp("2001-01-01
    12:00:00") }
```

2.5 Specifying Relationships with ODL

Basic declaration (name and default cardinality)

There are three ways to declare a relationship:

```
relationship Successor_class Direct_name
relationship List <Successor_class> Direct_name
relationship Set <Successor_class> Direct_name
```

You may also define an inverse relationship for all these declarations:

```
relationship Successor_class Direct_name
  inverse Successor_class::Inverse_name
relationship List <Successor_class> Direct_name
     inverse Successor_class::Inverse_name
relationship Set <Successor_class> Direct_name
     inverse Successor_class::Inverse_name
```

When you declare a relationship with `List or Set`, the default cardinality is `[0, -1]` (any number of successors); without `List or Set`, the default cardinality is `[1, 1]` (one successor).

If you define and inverse relationship, the relationships must be declared in each of the two classes involved. For example:

```
interface Employee: persistent {
  relationship Department MemberOf inverse
    Department::Members;
};

interface Department: persistent {
  relationship List <Person> Members inverse Person::MemberOf;
};
```

Cardinality

```
relationship ... Direct_name [min_#_succs, max_#_succs] ...
```

Cardinality is specified on the direct relationship part. To explicitly set cardinality for both ends of a relationship, specify it for each of the direct declarations.

When `List or Set` is used, cardinality if not set explicitly is `[0, -1]` (minimum zero, maximum unlimited): any number of successors, or none, may be specified. Thus the following two declarations are equivalent:

```
relationship List<Person> Members
relationship List<Person> Members [0, -1]
```

With `List or Set`, you may explicitly set any minimum and maximum, for example:

```
relationship List ... Direct_name [0, 2] ...
relationship List ... Direct_name [3, 10] ...
relationship List ... Direct_name [2, -1] ...
```

Without `List or Set`, cardinality if not set explicitly is `[1, 1]`: one and only one successor must be specified. Thus the following two declarations are equivalent:

```
relationship Department MemberOf inverse ...
relationship Department MemberOf [1, 1] inverse ...
```

The only other cardinality supported without `List or Set` is `[0, 1]`: a single successor, or none, may be specified.

Whenever the minimum cardinality is greater than 0, the relationship must always have a successor. In this case, any transaction that creates an object or clears all successors must set a successor before it can be committed.

Order

When you declare a relationship with `List`, the order of successors of the relationship is preserved. On the other hand, if you declare a relationship with `Set`, the order of successors need not be preserved.

"Read-only"

```
readonly relationship …
```

When `readonly` is specified, the direct relationship can be used to get or query successors, but cannot be used to update or delete.

Multiple successor classes

`relationship List <`*Successor_class_1, Successor_class_2*`>`
  Direct_name `inverse` *Inverse_name*

A relationship may have more than one successor class: for example, the class `Person` might have a relationship `Owner` / `OwnedBy` with the classes `Car` and `House`.

Usually a more straightforward and flexible way to represent such real-world correspondences is with inheritance. For example, `Person` would have a relationship `Owner` / `OwnedBy` with the class `Property`, which would have subclasses `Car` and `House`.

Note that this is not an "*n*-ary" relationship: that is, it cannot be used to create links between *Successor_class_1* objects and *Successor_class_2* objects.

2.6 Specifying Indexes with ODL

Index criteria

`mt_index` *Index_name* `criteria`
  `{`*Class_name*`::`*Attribute1_name sort_order*`},`
  `{`*Class_name*`::`*Attribute2_name sort_order*`},`
  `{`*Class_name*`::`*Attribute3_name sort_order*`},`
  `{`*Class_name*`::`*Attribute4_name sort_order*`};`

An index may include up to four of its class's attributes (which may be inherited from superclasses rather than declared in the class) that are referred as criteria for the index. For example:

```
interface Person : persistent
{
  attribute String<16> firstName;
  attribute String<16> lastName;
  mt_index personName
    criteria {person::lastName MT_ASCEND},
             {person::firstName MT_ASCEND};
};
```

sort_order must be either `MT_ASCEND` or `MT_DESCEND`.

The maximum size allowed for a key is 256 bytes. Thus the sum of the sizes for the attributes that are indexed cannot exceed 256 bytes.

Unique key

```
mt_index Index_name
  unique_key TRUE
  criteria
    {Class_name::Attribute1_name  sort_order}...
```

If set to `TRUE`, each entry in the index must be unique, allowing them to be used as primary keys. The default is `FALSE`, so if this option is not specified the index may contain duplicate entries. `unique_key` must be specified before `criteria`.

2.7 Specifying Entry-Point Dictionaries with ODL

NOTE: Use entry-point dictionaries with attributes of type `String` only. For other data types, use indexes.

Basic declaration

```
mt_entry_point_dictionary Dictionary_name
  entry_point_of Attribute_name
```

Creates an entry-point dictionary for the attribute. Options must be specified in the order shown in this example for an attribute `comment`):

```
interface Document : persistent
{
  attribute String comment;
  mt_entry_point_dictionary commentDict
    entry_point_of comment
    unique_key FALSE
    case_sensitive FALSE
    make_entry_function "make-full-text-entry";
};
```

Unique key

```
mt_entry_point_dictionary Dictionary_name
  entry_point_of Attribute_name unique_key TRUE
```

If set to `TRUE`, each entry in the dictionary must be unique, allowing them to be used as primary keys. The default is `FALSE`, so if this option is not specified the dictionary may contain duplicate entries.

Case sensitivity

```
mt_entry_point_dictionary Dictionary_name
```

`entry_point_of` *Attribute_name* `case_sensitive TRUE`

If set to `TRUE`, dictionary lookups are case-sensitive. Otherwise, they are case-insensitive. The default is `FALSE`, so if this option is not specified lookups are case-insensitive.

Function

`mt_entry_point_dictionary` *Dictionary_name*
`entry_point_of` *Attribute_name* `make_entry_function "`*function_name*`"`

function_name specifies the function to be used to generate the dictionary. Two such functions are included with Matisse:

- `"make-entry"` (default): generates one entry point per object based on the attribute value
- `"make-full-text-entry"`: generates a separate entry point for each word in the string

If no function is specified, Matisse will use the default method, `make-entry`.

2.8 Specifying SQL Methods with ODL

Basic declaration

`mt_method "`*`SQL_DDL_statement`*`"`

SQL_DDL_Statement is either a CREATE METHOD statement or a CREATE STATIC METHOD statement. This generates a SQL method in the database for a class. For more information about SQL methods, refer to *Matisse SQL Programmer's Guide*.

When you use a double quotation mark (") within mt_method, it needs to be preceded by a backslash (\).

Example

The following example defines a method which concatenates the first name and the last name of a person:

```
interface Person : persistent {
    attribute String firstName;
    attribute String lastName;
    mt_method "CREATE METHOD fullName()
        RETURNS STRING
        FOR \”Person\”
        BEGIN
            RETURN CONCAT(firstName, lastName);
        END;";
};
```

3 Using the mt_sdl utility

Once you have defined a schema in an ODL file, you may use either the Matisse Enterprise Manager or the `mt_sdl` utility to load it into a Matisse database and/or generate schema-class source code for your application.

3.1 Loading a schema

First, create and initialize a database as described in the *Matisse Server Administration Guide*. Then use the following command to load the schema defined in your ODL file into the new database:

```
mt_sdl -d db_name@host_name import --odl -f odl_filename
```

3.2 Exporting a schema

The `mt_sdl` utility with the export command allows you to export the database scheam in ODL. With the `-n <namespace>` option, you only export the database schema under the provided namespace.

```
$ mt_sdl export -h
MATISSE Schema Definition Language x64 Version 9.1.0.0 (64-bit Edition) - Apr
29 2013.
(c) Copyright 2013 Matisse Software Inc. All rights reserved.

Usage:
  mt_sdl [OPTIONS] export -f <schema file> {-o | -d} [-n <namespace>] [-h]
    -f, --file=...  Specify the schema definitions script file to be generated
                    from the database.
    -o, --odl       Generate the ODL class definitions from a database schema.
    -d, --ddl       Generate the SQL DDL script from a database schema.
    -n, --ns=...    Export only the schema objects under the provided namespace
    -h, --help      Display this help and exit.
```

3.3 Generating class files

The following command generates source code files for the classes defined in the schema:

```
$ mt_sdl stubgen -h
MATISSE Schema Definition Language x64 Version 9.1.0.0 (64-bit Edition) - Apr
29 2013.
(c) Copyright 2013 Matisse Software Inc. All rights reserved.

Usage:
  mt_sdl stubgen { -l cxx [-s <namespace>] [-n <namespace>]
                 | -l java [-s <namespace>] [-n <package>] [-m]
                 | -l php [-s <namespace>] [-n <namespace>]
                 | -l python [-s <namespace>]
                 | -l eiffel [-s <namespace>] } -f <ODL file> [-h]
    -f, --file=...    Specify the ODL class definitions file.
```

```
-l, --lang cxx    Create C++ files from the ODL class definitions.
-l, --lang java   Create Java files from the ODL class definitions.
-l, --lang php    Create PHP files from the ODL class definitions.
-l, --lang python Create Python files from the ODL class definitions.
-l, --lang eiffel Create Eiffel files from the ODL class definitions.
-s, --sn=...       Specify the schema class namespace that is mapped to a
                  language class namespace if any and if language supports
                  namespaces.
-n, --ln=...       Specify the language class namespace for the generated
                 proxi classes. when the --sn and --ln options are omitted,
                 each class is generated in a namespace matching the schema
                  class namespace.
-m, --psm         Generate methods mapping SQL method calls.
-h, --help        Display this help and exit.
```

Depending on whether you choose `cxx`, `eiffel`, `java`, `python`, or `php` a `.h`, `.e`, `.java`, `.py`, or `.php` file is created in the current directory for each class defined in the specified ODL file. For C++, a `.cpp` source file with the same name as the ODL file is also created; Specifying the `-sn` *ns_name* and `-ln` *ns_name* option associates the classes with the specified Java package or PHP or C++ namespace. With -psm option, the SQL method calls are generated.

The portion of the class files that you should not modify are bracketed by the following comments:

```
// BEGIN generated code
// END of generated code
```

Add any additional methods required by your application after the `END` comment or before `BEGIN`.

`mt_sdl` places some sample user methods after the generated code. You may modify or delete these methods as appropriate. If you delete these methods, they will not be replaced by `mt_sdl` if it is run again to update the class with schema modifications. If you modify them, be sure to modify the preceding comment accordingly.

See the programmer's guide for the C++, Java, Objective C, PHP, Python and Eiffel bindings for more information on `mt_sdl` output.

For the class file generation of other languages (C#, VisualBasic), please refer to the documentation of each language binding.

3.4 Updating an application

If you modify an ODL schema definition, you may run

`mt_sdl` again to update the database and/or source code with the changes, with the following limitations:

- You cannot rename attributes or relationships, indexes, or entry-point dictionaries. (You can rename them with SQL DDL.)

For classes that have instances (objects):

- You cannot change inheritance, for example, you cannot change `interface Employee : Person` to `interface Manager : Employee: Person`.
- You cannot change an attribute descriptor's type.
- You cannot remove the default value from a non-nullable attribute.
- You cannot make the cardinality of a relationship descriptor more restrictive. For example, you can change `[1, 1]` to `[0, 1]` or `[1, -1]`, but you cannot change `[0, -1]` to `[1, -1]` or `[0, 1]`.

If you need to make any of the above changes:

1. Use `mt_xml` to export all of the data.
2. Initialize the database.
3. Use `mt_sdl` to generate source code and load the updated schema.
4. Use `mt_xml` to load the previously exported data.
5. For any renamed classes, copy any user methods you added to the `mt_sdl`-generated source code from the old generated file to the new name, then delete the old file

See the *Matisse XML Programming Guide* for instructions on using `mt_xml`.

3.5 Preprocessing a schema file

The Matisse ODL files support pre-processing directives (for example - #include) that allow you to include other ODL files.

To use this capability, you must set the `MATISSE_CPP` environment variable to the location of a preprocessor.

UNIX

```
MATISSE_CPP=`which cpp`; export MATISSE_CPP
or with spaces in the path
export MATISSE_CPP='"/opt/tools/my compiler/cpp" -DMYVAR=1'
```

MS-Windows

```
set MATISSE_CPP=cl.exe -E
or
set MATISSE_CPP="C:\<install path>\cl.exe" -E
or
set MATISSE_CPP="C:\<install path>\cl.exe" /EP /C
or to use it from Matisse Enterprise Manager
SET MATISSE_CPP="C:\<install path>\vcvarsall.bat" x86 && "C:\<install
path>\Bin\cl.exe" -E
```

4 Extending the Meta-Schema with ODL

This section covers Matisse Meta-Schema extensions. While you are still able to generate persistent stub classes from the ODL file or from the database schema, no methods are generated to access or update your Meta-Schema extensions. These extensions can be accessed using the Matisse discovery (reflection) APIs.

This section is indented for advanced Matisse developers.

4.1 Matisse Meta-Schema

Matisse Meta-Schema relies on the three basic concepts of Class, Attribute and Relationship to be described. Matisse Meta-Schema is comprised of a set of classes which provides the necessary means to describe an application database schema with an Object-Oriented model.

4.2 Modifying the Meta-Schema

Matisse Meta-Schema can be extended to meet your schema description needs that go beyond Matisse Object-Oriented model. As in Matisse, Meta-Classes, Classes and Instances are objects, developers could modify the Meta-Schema with the same programming API used to create or modify classes and instances. However, to simplify Meta-Schema extensions, Matisse ODL includes specific features to describe the Meta-Schema extensions.

The Matisse Meta-Classes (i.e. `MtClass`, `MtAttribute`, `MtRelationship`, etc.) could be described in ODL like any of your application schema classes. However, it would be tedious to have to specify the full definition of the Meta-Schema classes to be extended. So only added properties need to be described when added to pre-defined Meta-Classes.

NOTE: Modifying the Meta-Schema is quite complex. So in order to limit invalid or inappropriate modifications, we recommend that you import the ODL file, export the schema in a new ODL file and then check that the exported ODL description matches to your original schema.

4.3 Extending Meta-Schema Classes

Matisse allows you to create your own Meta-Classes. To do this, you need to create a sub-class of a pre-defined Meta-Class. To specify that a class in your schema is an instance of your newly created Meta-Class, use the `mt_instance_of` ODL clause.

```
// Meta-Schema Extensions
interface KClass : MtClass : persistent
{
};
```

You are then able to refer to the new Meta-Class in your class definition as follows:

```
// Application Classes
interface Document : persistent
{
   mt_instance_of KClass;
};
```

4.4 Adding an Attribute to a Meta-Class

Matisse allows you also to add new attributes to a Meta-Class, whether it is your own or a Matisse one. Matisse ODL allows you to specify the newly created attribute by using the `mt_property` ODL clause. For example, suppose you want to associate a comment with each class definition. To do this, you add an attribute `Description` of type `String` to the `MtClass` definition as follows:

```
// Meta-Schema Extensions
interface MtClass : persistent
{
  attribute String Description = String(NULL);
};
```

You are then able to use the new attribute in your class definition as follows:

```
// Application Classes
interface Person : persistent
{
  mt_property Description = "My application comments for Person";

  attribute String FirstName = String(NULL);
  attribute String LastName = String(NULL);
};
```

4.5 Adding a Relationship to a Meta-Class

New relationships can also be added your own Meta-Class or a pre-defined one. The `mt_property` ODL clause also enables to specify these relationships in your application class. For example, let's suppose that you need to keep a list of public attributes in your application classes.

```
// Meta-Schema Extensions
interface MtClass : persistent
{
  relationship List<MtAttribute> PublicAttributes
     inverse MtAttribute::PublicAttributeOf;
};

interface MtAttribute : persistent
{
  relationship MtClass PublicAttributeOf [0, 1]
     inverse MtClass::PublicAttributes;
};
```

You are then able to use the new relationship in your class definition as follows:

```
// Application Classes
interface Person : persistent
{
  attribute String FirstName = String(NULL)
    mt_property PublicAttributeOf = {interface(Person)};
  attribute String LastName = String(NULL)
    mt_property PublicAttributeOf = {interface(Person)};

  mt_property PublicAttributes = {
    attribute(Person::FirstName),
    attribute(Person::LastName) };
};
```

CAUTION: Both the relationship (`PublicAttributes`) and its inverse (`PublicAttributeOf`) must be specified in the class definition.

The value of a relationship always refer to a list of Attribute, Relationship, Class or a combination of the three which can be expressed as follows:

- a list of attributes:
  ```
  attribute_list {"class1::att1", "class1::att2"}
  {attribute("class1::att1"), attribute("class1::att2")}
  ```
- a list of relationships:
  ```
  relationship_list {"class1::rel1", "class1::rel2"}
  {relationship("class1::rel1"), relationship("class1::rel2")}
  ```
- a list of classes:
  ```
  interface_list {"class1", "class2"}
  {interface("class1"), interface("class2")}
  ```
- a list of attributes and relationships:
  ```
  property_list {"class1::att1", "class1::rel1"}
  {attribute("class1::att1"), relationship("class1::rel1")}
  ```
- a list of attributes, relationships and classes:
  ```
  { attribute("class1::att1"),
    relationship("class1::rel1"),
    interface("class1") }
  ```

4.6 Extending Matisse MtAttribute

Matisse enables you to define your own attribute description class by creating a sub-class of Matisse MtAttribute. The `mt_instance_of` ODL clause allows you to specify that an attribute in your schema is an instance of your newly created Meta-Class. For example, suppose that you need to define an alias to each attribute in your application classes.

```
// Meta-Schema Extensions
interface KAttribute : MtAttribute : persistent
{
   attribute String Alias = String(NULL);
```

```
};
```

You are then able to use the new attribute Meta-Class in your class definition as follows:

```
// Application Classes
interface Person : persistent
{
  attribute String FirstName = String(NULL)
    mt_property Alias = "Person First Name"
    mt_instance_of KAttribute;
};
```

4.7 Extending Matisse MtRelationship

Matisse enables you to define your own relationship description class by creating a sub-class of Matisse MtRelationship. The `mt_instance_of` ODL clause allows you to specify that a relationship in your schema is an instance of your newly created Meta-Class. For example, suppose that you want to specify whether or not a relationship is indexed.

```
// Meta-Schema Extensions
interface KRelationship : MtRelationship : persistent
{
  attribute Boolean Indexed = FALSE;
  attribute String IndexKey = String(NULL);
};
```

You are then able to use the new relationship Meta-Class in your class definition as follows:

```
// Application Classes
interface Document : persistent
{
  relationship List<Topic> Topics
    inverse Topic::Documents
    mt_property Indexed = TRUE
    mt_property IndexKey = "Topic::Weight"
    mt_instance_of KRelationship;
};


interface Topic : persistent
{
  attribute String Name;
  attribute Integer Weight = 0;
  relationship List<Document> Documents
    inverse Document::Topics
    mt_instance_of KRelationship;
};
```

4.8 Extending Matisse MtClass

Matisse allows you to extend Matisse MtClass so you can enrich the description of your application classes. The `mt_instance_of` ODL clause allows you to specify that a class in your schema is an instance of your newly created Meta-Class. For example, suppose that you want to extend Matisse class description to support a description field and to list the properties that are public for the application.

```
// Meta-Schema Extensions
interface KClass : MtClass : persistent
{
   attribute String Description = String(NULL);

   relationship List<KAttribute> PublicAttributes
     inverse KAttribute::PublicAttributeOf;
   relationship List<KRelationship> PublicRelationships
     inverse KRelationship::PublicRelationshipOf;
};

interface KAttribute : MtAttribute : persistent
{
   attribute String Alias = String(NULL);

   relationship KClass PublicAttributeOf [0, 1]
     inverse KClass::PublicAttributes;
};

interface KRelationship : MtRelationship : persistent
{
   attribute Boolean Indexed = FALSE;
   attribute String IndexKey = String(NULL);

   relationship KClass PublicRelationshipOf [0, 1]
     inverse KClass::PublicRelationships;
};
```

You are then able to use the new class Meta-Class in your application class definition as follows:

```
// Application Classes
interface Document : persistent
{
   mt_instance_of KClass;

   attribute String Title
       mt_instance_of KAttribute
       mt_property PublicAttributeOf = {interface(Document)}
       mt_property Alias = "Document Title";

   attribute String CreationDate
       mt_instance_of KAttribute
       mt_property Alias = "Document Creation Date";

   relationship List<Topic> Topics
```

```
          inverse Topic::Documents
          mt_property Indexed = TRUE
          mt_property IndexKey = "Topic::Weight"
          mt_property PublicRelationshipOf = {interface(Document)}
          mt_instance_of KRelationship;

      mt_property Description = "My application comments about Document";
      mt_property PublicAttributes = { attribute(Document::Title) };
      mt_property PublicRelationships = { relationship(Document::Topics) };
   };

   interface Topic : persistent
   {
      mt_instance_of KClass;

      attribute String Name
          mt_instance_of KAttribute
          mt_property PublicAttributeOf = {interface(Topic)}
          mt_property Alias = "Topic Name";

      attribute Integer Weight = 0
          mt_instance_of KAttribute
          mt_property Alias = "Topic Weight";

      relationship List<Document> Documents
        inverse Document::Topics
        mt_instance_of KRelationship;

      mt_property Description = "My application comments about Topic";
      mt_property PublicAttributes = { attribute(Topic::Name) };
   };
```

5 Sharing Properties with ODL

This section covers Matisse ability to share property definitions amongst classes without relying on inheritance. The term property is used to designate an attribute or a relationship.

This section is indented for advanced Matisse developers.

5.1 Shared Properties

In Matisse, properties are objects like any other in the database. Therefore they can exist outside of a class definition and can then be shared by multiple classes. If you consider that an object is a set of properties and that any given property has a unique meaning (described by set of characteristics), then a property can be shared by objects of various types.

In most object-oriented languages, the scope of a property is the class and its subclasses, so there is no ODL syntax to describe properties outside of a class definition. The `mt_attribute` and `mt_relationship` ODL clauses allow you to define respectively a shared attribute and a shared relationship outside of a class definition.

NOTE: shared properties are global to the database, their name must be unique.

CAUTION: Shared properties are not supported by SQL DDL.

5.2 Defining a Shared Attribute

Matisse allows you to define attributes shared by multiples classes. The `mt_attribute` ODL clause allows you to specify that an attribute is shared. The attribute is only defined once. When you need to refer to the attribute in a class definition, declare it by specifying its name after the clause `mt_attribute`. The unique definition of the attribute can be made within the definition of a class, or outside of it. For example, suppose that you want the attribute Comment to be part of many of your application classes, but you don't want these classes to inherit from a common super-class containing the Comment attribute and/or that you don't want to use multiple inheritance.

```
// Application Classes

mt_attribute String Comment = String(NULL);

interface Document : persistent
{
  attribute String Title;
  mt_attribute Comment;
};

interface Topic : persistent
{
  attribute String Name;
  mt_attribute Comment;
};
```

5.3 Defining a Shared Relationship

Matisse allows you to define relationships shared by multiples classes. The `mt_relationship` ODL clause allows you to specify that an attribute is shared. The relationship is only defined once. When you need to refer to the relationship in a class definition, declare it by specifying its name after the clause `mt_relationship`. For example, suppose you want to link on your front page the most popular items which happens to be of different kinds.

```
// Application Classes
mt_relationship List<{News, Person, Location}> MostPopular
  inverse OnFrontPages;
mt_relationship Set<FrontPage> OnFrontPages inverse MostPopular;

interface FrontPage : persistent
{
  mt_relationship MostPopular;
};

interface News : persistent
{
  mt_relationship OnFrontPages;
};

interface Person : persistent
{
  mt_relationship OnFrontPages;
};

interface Location : persistent
{
  mt_relationship OnFrontPages;
};
```

5.4 Defining a Shared Index

Matisse allows you to define an index on shared attributes. This declaration must be made outside the scope of a class definition. The `mt_classes` clause is used to specify the indexed classes. The other characteristics of the definition are similar to the definition of an index inside a class definition. The definition of such an index is as follows:

```
// Application Classes

mt_attribute String<64> Name = String(NULL);

interface Nation : persistent
{
  mt_attribute Name;
};

interface Topic : persistent
{
  mt_attribute Name;
};

interface Ship : persistent
{
  mt_attribute Name;
};
  mt_index SharedNameIdx
    mt_classes { Nation, Topic, Ship }
    criteria { Name MT_ASCEND };
```

5.5 Defining a Shared Entry-Point Dictionary

Matisse allows you to define an Entry-Point Dictionary on a shared attribute of type `String`. This declaration must be made outside the scope of a class definition. The syntax for the description of an Entry-Point dictionary is identical to the one used to define a Entry-Point Dictionary inside a class description. The definition of an Entry-Point Dictionary on a shared attribute of type `String` is as follows:

```
// Application Classes

mt_attribute String Comment = String(NULL);
mt_entry_point_dictionary commentDict entry_point_of Comment
  unique_key FALSE
  case_sensitive FALSE
  make_entry_function "make-full-text-entry";

interface Document : persistent
{
  attribute String Title;
  mt_attribute Comment;
};

interface Topic : persistent
{
  attribute String Name;
  mt_attribute Comment;
};
```

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