RTI Connext DDS

Core Libraries and Utilities

XML-Based Application Creation

Getting Started Guide

Version 5.1.0

Your systems. Working as one.

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Chapter 1 Introduction

XML-Based Application Creation is a mechanism to simplify the development and programming of *RTI Connext*™ applications. *Connext* supports the use of XML for the complete system definition. This includes not only the definition of the data types and Quality of Service settings (as was possible in previous versions of the product), **but also the definition of the *Topics*, *DomainParticipants*, and all the Entities they contain** (*Publishers, Subscribers, DataWriters* and *DataReaders*).

With the traditional approach an application developer must program explicitly into the code the actions needed to join a domain, register the data types it will use, create the *Topics* and all the Entities (*Publishers*, *Subscribers*, *DataReaders* and *DataWriters*) that the application uses. Even for simple applications this "system creation" code can result in hundreds of lines of boiler-plate code. Beyond being error prone, the traditional approach results in larger code-bases that are harder to understand and maintain. Using XML-Based Application Creation can significantly simplify this process.

This document assumes you have a basic understanding of Connext application development and concepts such as Domains, DomainParticipants, Topics, DataWriters and DataReaders. For an overview of these concepts, please read Introduction to Connext, Section 3.2 in the RTI Core Libraries and Utilities Getting Started Guide, which is part of your distribution, or you can find it online at http://community.rti.com/content/page/documentation.

XML-Based Application Creation is a simple layer that builds on top of the standard APIs. Everything that you do with the XML configuration can also be done with the underlying APIs. In this manner, an application can be initially developed using XML-Based Application Creation and transitioned to the traditional API at a later time. This would be useful in case the application has to be deployed on a platform without a file system or needs to be ported to a DDS-compliant library that does not support XML-based configuration such as *RTI Connext Micro*.

Using XML-Based Application Creation is easy: simply edit **USER_QOS_PROFILE.xml** to define:

- The data types that will be used to communicate information in the system
- The *Topics* that will be used in the domain, associating each *Topic* with a data type
- The *DomainParticipants* that can potentially be used, giving each a **participant name**
- The *DataWriters* and *DataReaders* present within each *DomainParticipant*, each associated with its corresponding *Topic*.

The application code simply indicates the **participant configuration name** of the *DomainParticipant* that the application wants to create. The XML-Based Application Creation infrastructure takes care of the rest: creating the *DomainParticipant*, registering the types and *Topics*, and populating all the configured Entities.

When the application needs to read or write data, register listeners, or perform any other action, it simply looks up the appropriate Entity by name and uses it.

XML-Based Application Creation enables several powerful new work flows:

- Developers can describe all the Entities that a *Connext* application will need in an XML file and then create that application with a single function call, saving many hundreds of lines of setup code.
- Application descriptions written in XML are usable from all programming languages.
- The complete domain (including the data types and *Topics* that can be in the domain) may be defined in an XML file and shared amongst all the developers and applications.
- The Quality of Service (QoS) that should be used for each *DomainParticipant*, *Topic*, *DataReader*, and *DataWriter* can be fully specified in the XML and shared amongst a group of developers and applications.
- The XML description of the application can be used in combination with *RTI Prototyper* to design and prototype application deployment scenarios, allowing quick testing and validation without the need for programming.

To use the companion *RTI Connext Prototyper,* see Chapter 3.

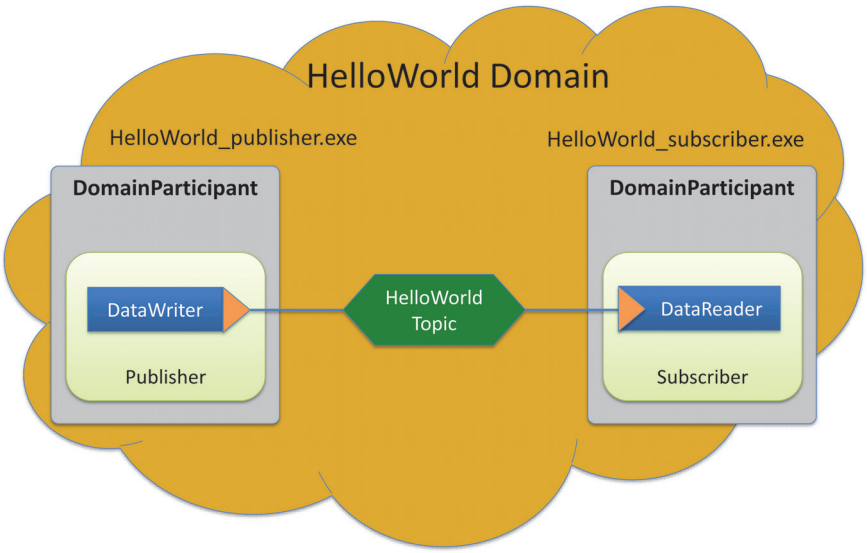
Chapter 2 A 'Hello, World' Example

This chapter assumes that you have installed the *RTI Connext Core Libraries and Utilities* and configured your environment correctly. If you have not done so, please follow the steps in the *RTI Core Libraries and Utilities Getting Started Guide*, specifically Chapter 2 "Installing RTI Connext" and Section 3.1 "Building and running Hello World" in Chapter 3. The guide is part of your distribution; you can also find it online at http://community.rti.com/content/page/documentation. The guide will assist you in the correct setting of both your environment variable NDDSHOME and, depending on your architecture, the environment variable PATH (on Windows Systems), LD_LIBRARY_PATH (on Linux systems), or DYLD_LIBRARY_PATH (on MacOS Systems).

2.1 Hello World using XML and Dynamic Data

The files for this example are located in the directory **<*installation directory*>/example/CPP/HelloWorld_xml_dynamic**. This simple scenario consists of two applications, illustrated in the figure below: **HelloWorld_publisher.exe** which writes the *Topic*, **HelloWorldTopic**, and **HelloWorld_subscriber.exe** which subscribes to that *Topic*.

Figure 2.1 **Hello World Domain**



First we will run the application, then we will examine the configuration file and source code.

2.1.1 Build the Application

The example code is provided in C++, C#, and Java. The following instructions describe how to build it on Windows and UNIX-based systems. If you will be using an embedded platform, see the *Core Libraries and Utilities Getting Started Guide Addendum for Embedded Systems* (**RTI_CoreLibrariesAndUtilities_GettingStarted_EmbeddedSystemsAddendum.pdf**) for instructions specific to these platforms.

To build the example C++ applications on a Windows System:

1. In Windows Explorer, go to **<*installation directory*>\example\CPP\HelloWorld_xml_dynamic\win** and open the Microsoft® Visual Studio® solution file for your architecture. For example, the file for Visual Studio 2008 32-bit platforms is **HelloWorld-vs2008.sln**.
2. The Solution Configuration combo box in the toolbar indicates whether you are building debug or release executables; select **Release**. Then select **Build Solution** from the Build menu.

To build the example C++ applications on a UNIX-based System:

1. From your command shell, change directory to **<*installation directory*>/example/CPP/HelloWorld_xml_dynamic**.
2. Type:

   ```
   > gmake -f make/Makefile.<architecture>
   ```

   where <*architecture*> is one of the supported architectures (e.g., **Makefile.i86Linux2.6gcc4.4.5**); see the contents of the **make** directory for a list of available architectures. This command will build a *release* executable. To build a *debug* version instead, type:

   ```
   > gmake -f make/Makefile.<architecture> DEBUG=1
   ```

2.1.2 Run the Application

The previous step should have built two executables: **HelloWorld_subscriber** and **HelloWorld_publisher**. These applications should be in proper architecture subdirectory under the **objs** directory. For example, **objs\i86Win32VS2008** in the Windows example cited below and **objs/i86Linux2.6gcc4.4.5** in the Linux example.

To start the subscribing application on a Windows system:

From your command shell, go to **<*installation directory*>\example\CPP\HelloWorld_xml_dynamic** and type:

```
> objs\<architecture>\HelloWorld_subscriber.exe
```

where <*architecture*> is the architecture you just built; look in the **objs** directory to see the name of the architecture you built. For example, the Windows architecture name corresponding to 32-bit Visual Studio 2008 is i86Win32VS2008.

To start the subscribing application on a UNIX-based systems:

From your command shell, change directory to **<*installation directory*>/example/CPP/HelloWorld_xml_dynamic** and type:

```
> objs/<architecture>/HelloWorld_subscriber
```

where <*architecture*> is the architecture you just built; look in the **objs** directory to see the name of the architecture you built. For example, **i86Linux2.6gcc4.4.5**.

You should immediately see some messages from the publishing application showing that it is writing data and messages from the subscribing application showing the data it receives. Do not

worry about the contents of the messages. They are generated automatically for this example. The important thing is to understand how the application is defined, which will be explained in the following sections.

2.1.3 Examine the XML Configuration Files Definition

A *Connext* application is defined in the file **USER_QOS_PROFILES.xml** found in the directory **<*installation directory*>/example/CPP/HelloWorld_xml_dynamic**. Let's review its content to see how this scenario was constructed. The main sections in the file are:

- ❏ QoS definition section
- ❏ Type definition section
- ❏ Domain definition section
- ❏ Participant definition section

The entire file is shown below. The we will examine the file section-by-section.

```
<dds xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:noNamespaceSchemaLocation="../../../resource/qos_profiles_5.1.0/schema/
    rti_dds_profiles.xsd"
    version="5.1.0">

    <!-- QoS Library -->
        <qos_library name="qosLibrary">
            <qos_profile name="DefaultProfile">
            </qos_profile>
        </qos_library>

    <!-- types -->
    <types>
        <const name="MAX_NAME_LEN" type="long" value="64"/>
        <const name="MAX_MSG_LEN"  type="long" value="128"/>

        <struct name="HelloWorld">
            <member name="sender" type="string" key="true"
                          stringMaxLength="MAX_NAME_LEN"/>
            <member name="message" type="string"
                          stringMaxLength="MAX_MSG_LEN"/>
            <member name="count" type="long"/>
        </struct>
    </types>

    <!-- Domain Library -->
    <domain_library name="MyDomainLibrary" >

        <domain name="HelloWorldDomain" domain_id="0">
            <register_type name="HelloWorldType"
                          kind="dynamicData"
                          type_ref="HelloWorld" />

            <topic name="HelloWorldTopic"
                register_type_ref="HelloWorldType">

            <topic_qos name="HelloWorld_qos"
                base_name="qosLibrary::DefaultProfile"/>
            </topic>
        </domain>

    </domain_library>
```

```
<!-- Participant library -->
<participant_library name="MyParticipantLibrary">

    <domain_participant name="PublicationParticipant"
        domain_ref="MyDomainLibrary::HelloWorldDomain">
        <publisher name="MyPublisher">
            <data_writer name="HelloWorldWriter"
                topic_ref="HelloWorldTopic"/>
        </publisher>
    </domain_participant>

    <domain_participant name="SubscriptionParticipant"
        domain_ref="MyDomainLibrary::HelloWorldDomain">
        <subscriber name="MySubscriber">
            <data_reader name="HelloWorldReader"
                topic_ref="HelloWorldTopic">
                <datareader_qos name="HelloWorld_reader_qos"
                    base_name="qosLibrary::DefaultProfile"/>
            </data_reader>
        </subscriber>
    </domain_participant>

</participant_library>
```

2.1.3.1 QoS Definition

The DDS Entities that are defined have an associated QoS. The QoS section of the XML file provides the means to define QoS libraries and profiles that can be used to configure the QoS of the defined Entities.

The syntax of the QoS libraries and profiles section is described in the *RTI Core Libraries and Utilities User's Manual*, Chapter 17 "Configuring QoS with XML."

In this example, the QoS library and profile are empty, just to provide a placeholder where the QoS can be specified. Using this empty profile results in the default DDS QoS being used:

```
<!-- QoS Library -->
    <qos_library name="qosLibrary">
        <qos_profile name="DefaultProfile">
        </qos_profile>
    </qos_library>
```

2.1.3.2 Type Definition

The data associated with the HelloWorld *Topic* consists of two strings and a numeric counter:

- The first string contains the name of the sender of the message. This field is marked as "key" as signals the identity of the data-object.
- The second string contains a message.
- The third field is a simple counter which the application increments with each message.

This example uses the dynamic data API, so the data type must be defined in the XML configuration. This is accomplished by adding the type definition within the <types> tag:

```
<types>
    <const name="MAX_NAME_LEN" type="long" value="64"/>
    <const name="MAX_MSG_LEN"  type="long" value="128"/>

    <struct name="HelloWorld">
        <member name="sender" type="string" key="true"
            stringMaxLength="MAX_NAME_LEN"/>
        <member name="message" type="string"
            stringMaxLength="MAX_MSG_LEN"/>
        <member name="count" type="long"/>
    </struct>
</types>
```

The <types> tag may be used to define a library containing the types that the different applications will need. However, for this simple example just one data-type, the HelloWord type seen above, is included.

2.1.3.3 Domain Definition

The domain section is used to define the system's *Topics* and the corresponding data types associated with each *Topic*. To define a *Topic*, the associated data type must be registered with the domain giving it a registered type name. The registered type name is used to refer to that data type within the domain at the time the *Topic* is defined.

In this example, the configuration file registers the previously defined HelloWorld type under the name HelloWorldType and then defines a topic with name HelloWorldTopic associated with the registered type, referring to it by its registered name HelloWorldType:

```
<!-- Domain Library -->
<domain_library name="MyDomainLibrary" domain_id="0" >
   <domain name="HelloWorldDomain">
       <register_type name="HelloWorldType"
           kind="dynamicData"
           type_ref="HelloWorld"/>

       <topic name="HelloWorldTopic"
           register_type_ref="HelloWorldType"/>
   </domain>
</domain_library>
```

Note that attribute **type_ref** in the <register_type> element refers to the same HelloWorld type defined in the <types> section.

A domain definition may register as many data types and define as many *Topics* as it needs. In this example a single data type and *Topic* suffices.

Note that **domain_library** can be used to define multiple domains. However in this example only one domain is used.

2.1.3.4 Participant Definition

The participant section is used to define the *DomainParticipants* in the system and the *DataWriters* and *DataReaders* that each participant has. *DomainParticipants* are defined within the <participant_library> tag.

Each *DomainParticipant*:

- ❏ Has a unique name (within the library) which will be used later by the application that creates it.
- ❏ Is associated with a domain, which defines the **domain_id**, *Topics* and data types the *DomainParticipant* will use.

- ❏ Defines the *Publishers* and *Subscribers* within the *DomainParticipant*. *Publishers* contain *DataWriters* and *Subscribers* contain *DataReaders*.
- ❏ Defines the set of *DataReaders* it will use to write data. Each *DataReader* has a QoS and a unique name which can be used from application code to retrieve it.
- ❏ Defines the set of *DataWriters* it will use to write data. Each *DataWriter* has a QoS and a unique name which can be used from application code to retrieve it.
- ❏ Optionally the *Participants*, *Publishers*, *Subscribers*, *DataWriters* and *DataReaders* can specify a QoS profile that will be used to configure them.

The example below defines two *DomainParticipant* entities called **PublicationParticipant** and **SubscriptionParticipant**:

```
<participant_library name="MyParticipantLibrary">

   <domain_participant name="PublicationParticipant"
       domain_ref="MyDomainLibrary::HelloWorldDomain">

       <publisher name="MyPublisher">
           <data_writer name="HelloWorldWriter"
               topic_ref="HelloWorldTopic"/>
       </publisher>
   </domain_participant>

   <domain_participant name="SubscriptionParticipant"
       domain_ref="MyDomainLibrary::HelloWorldDomain">

       <subscriber name="MySubscriber">

           <data_reader name="HelloWorldReader"
               topic_ref="HelloWorldTopic">

           <datareader_qos name="HelloWorld_reader_qos"
               base_name="qosLibrary::DefaultProfile"/>
           </data_reader>

       </subscriber>
   </domain_participant
</participant_library>
```

Examining the XML we see that:

- ❏ The **PublicationParticipant** bound to the domain **MyDomainLibrary::HelloWorldDomain**.
- ❏ The participant contains a single Publisher (with name **MyPublisher** which itself contains a single *DataWriter* named **HelloWorldWriter**.
- ❏ The *DataWriter* writes the *Topic* **HelloWorldTopic** which is defined in the domain **MyDomainLibrary::HelloWorldDomain**.

Similarly:

- ❏ The **SubscriptionParticipant** is also bound to the domain **MyDomainLibrary::HelloWorldDomain**.
- ❏ The participant contains a single *Subscriber* (with name **MySubscriber** which itself contains a single *DataReader* named **HelloWorldReader**.
- ❏ The *DataReader* reads the topic **HelloWorldTopic** which is defined in the domain **MyDomainLibrary::HelloWorldDomain**.

Since both participants are in the same domain and the HelloWorldWriter *DataWriter* writes the same *Topic* that the HelloWorldReader *DataReader* reads the two participants will communicate as was illustrated in Figure 2.1, "Hello World Domain," on page 2-1.

2.1.4 Publisher Application

Open the file **<*installation directory*>/examples/CPP/HelloWorld_publisher.cxx** and look at the source code.

The logic of this simple application is contained in the **publisher_main()** function. The logic can be seen as composed of two parts:

- ❏ Entity Creation
- ❏ Use of the Entities

Entity Creation: The application first creates a *DomainParticipant* using the function **create_participant_from_config()** this function takes the configuration name of the participant **MyParticipantLibrary::PublicationParticipant** which is the same name that was specified in the XML file. Note that the name in the XML file **PublicationParticipant** has been qualified with the name of the library it belongs to **MyParticipantLibrary**.

```
DDSDomainParticipant * participant =
   DDSTheParticipantFactory->create_participant_from_config(
           "MyParticipantLibrary::PublicationParticipant");
```

This single function call registers all the necessary data types and creates and the *Topics* and Entities that were specified in the XML file. In this simple case the participant only contains a *Publisher* **MyPublisher** with a single *DataWriter* **HelloDataWriter**. However, in more realistic scenarios this single call can create hundreds of entities (both readers and writers).

Use of the Entities: The remaining part of the function uses the created Entities to perform the logic of the program.

This example writes data using the single *DataWriter*. So the application looks up the **HelloWorldWriter** *DataWriter* using the fully qualified name **MyPublisher::HelloWorldWriter** and narrows it to be a **DynamicDataWriter**:

```
DDSDynamicDataWriter * dynamicWriter = DDSDynamicDataWriter::narrow(
   participant->lookup_datawriter_by_name(
       "MyPublisher::HelloWorldWriter"));
```

Once the *DataWriter* is available, some data objects need to be created and used to send the data. As this example uses dynamic data, and the type code is internally created, you can use the operations **create_data()** and **delete_data()** in a *DataWriter* to create and delete a data object. This is achieved with the calls seen below:

```
/* Create data */
DDS_DynamicData *dynamicData = dynamicWriter->create_data(
                                    DDS_DYNAMIC_DATA_PROPERTY_DEFAULT);

/* Main loop to repeatedly send data */
for (count=0; count < 100 ; ++count) {

   /* Set the data fields */
   retcode = dynamicData->set_string(
                                "sender",
                                DDS_DYNAMIC_DATA_MEMBER_ID_UNSPECIFIED,
                                "John Smith");
```

```
    retcode = dynamicData->set_string(
                                "message",
                                DDS_DYNAMIC_DATA_MEMBER_ID_UNSPECIFIED,
                                "Hello World!");
    retcode = dynamicData->set_long(
                                "count",
                                DDS_DYNAMIC_DATA_MEMBER_ID_UNSPECIFIED,
                                count);
    /* Write the data */
    retcode = dynamicWriter->write(*dynamicData, DDS_HANDLE_NIL);
    ...
}

/* Delete data sample */
dynamicWriter->delete_data(dynamicData
```

Note that the operations, such as **set_long()** are used to set the different attributes of the dynamicData object. These operations refer to the attribute names (e.g., "count") that were defined as part of the data type.

2.1.5 Subscriber Application

Open the file ***<installation directory>*/examples/CPP/HelloWorld_subscriber.cxx** and look at the source code.

The logic of this simple application is contained in the **subscriber_main()** function. Similar to the publisher application the logic can be seen as composed of two parts:

- ❏ Entity Creation
- ❏ Use of the Entities

Entity Creation: The application first creates a *DomainParticipant* using the function **create_participant_from_config()**. This function takes the configuration name of the participant **MyParticipantLibrary::SubscriptionParticipant** which is the same name that was specified in the XML file. Notice that the name in the XML file **SubscriptionParticipant** has been qualified with the name of the library it belongs to **MyParticipantLibrary**.

```
DDSDomainParticipant * participant =
    DDSTheParticipantFactory->create_participant_from_config(
                            "MyParticipantLibrary::SubscriptionParticipant");
```

This single function call registers all the necessary data types and creates and the *Topics* and Entities that were specified in the XML file. In this simple case the participant only contains a subscriber **MySubscriber** with a single *DataReader* **HelloDataReader**. However in more realistic scenarios this single call can create hundreds of Entities (both *DataReaders* and *DataWriters*).

Use of the Entities: The remaining part of the function uses the entities that were created to perform the logic of the program.

This example only needs to read data using the single *DataReader*. So the application looks up the **HelloWorldReader** *DataReader* using the fully qualified name **MySubscriber::HelloWorldReader** and narrows it to be a DynamicDataReader:

```
DDSDynamicDataReader * dynamicReader = DDSDynamicDataReader::narrow(
                            participant-> lookup_datareader_by_name(
                            "MySubscriber::HelloWorldReader"));
```

To process the data, the application installs a Listener on the *DataReader*. The **HelloWorldListener**, defined on the same file implements the DataReaderListener interface, which the *DataReader* uses to notify the application of relevant events, such as the reception of data.

```
/* Create a DataReaderListener */
HelloWorldListener * reader_listener = new HelloWorldListener();

/* set listener */
retcode = dynamicReader->set_listener(reader_listener,
                                      DDS_DATA_AVAILABLE_STATUS);
```

The last part is the implementation of the listener functions. In this case, we only implement the **on_data_available()** operation which is the one called when data is received.

The **on_data_available()** function receives all the data into a sequence and then uses the **DDS_DynamicData::print()** function to print each data item received.

```
void HelloWorldListener::on_data_available(DDSDataReader* reader)
{
    DDSDynamicDataReader * ddDataReader = NULL;
    DDS_DynamicDataSeq dataSeq;
    DDS_SampleInfoSeq infoSeq;
    DDS_ReturnCode_t retcode = DDS_RETCODE_ERROR;
    DDS_Long i = 0;

    ddDataReader = DDSDynamicDataReader::narrow(reader);

    retcode = ddDataReader->take(
        dataSeq, infoSeq, DDS_LENGTH_UNLIMITED,
        DDS_ANY_SAMPLE_STATE, DDS_ANY_VIEW_STATE, DDS_ANY_INSTANCE_STATE);

    printf("on_data_available:%s\n",
                      ddDataReader->get_topicdescription()->get_name());
    for (i = 0; i < dataSeq.length(); ++i) {
        if (infoSeq[i].valid_data) {
            retcode = dataSeq[i].print(stdout, 0);
        }
    }
    retcode = ddDataReader->return_loan(dataSeq, infoSeq);
}
```

2.1.6 Subscribing with a Content Filter

To use a content filter, modify the **SubscriptionParticipant** configuration to look like this:

```
<participant_library name="MyParticipantLibrary">
   ...
   <domain_participant name="SubscriptionParticipant"
           domain_ref="MyDomainLibrary::HelloWorldDomain">

       <subscriber name="MySubscriber">

           <data_reader name="HelloWorldReader" topic_ref="HelloWorldTopic">

           <datareader_qos name="HelloWorld_reader_qos"
               base_name="qosLibrary::DefaultProfile"/>

               <filter name="HelloWorldTopic" kind="builtin.sql">
                   <expression>  count > 2   </expression>
               </filter>
           </data_reader>
       </subscriber>
       </domain_participant>
</participant_library>
```

The extra XML within the <filter> tag adds a SQL content filter which only accepts samples with the field count greater than two.

Now run **HelloWorld_subscriber** without recompiling and check the expected that the behavior.

2.2 Hello World using XML and Compiled Types

The files for this example are located in the directory **<*installation directory*>/example/CPP/HelloWorld_xml_compiled**. This simple scenario consists of two applications identical in purpose to the one illustrated in Figure 2.1, "Hello World Domain," on page 2-1: **HelloWorld_publisher.exe**, which writes to the *Topic* "HelloWorldTopic," and **HelloWorld_subscriber.exe** which subscribes to that same *Topic*.

In contrast with previous example, which uses the DynamicData API, this example uses compiled types.

Compiled types are syntactically nicer to use from application code and provide better performance. The drawback is that there is an extra step of code-generation involved to create that supporting infrastructure to marshal and unmarshal the types into a format suitable for network communications.

2.2.1 Define the Data Types using IDL or XML

The first step is to describe the data-type in a programming-language neutral manner. Two languages are supported by the *Connext* tools: XML and IDL. These languages (XML and IDL) provide equivalent type-definition capabilities so you can choose either one depending on your personal preference. You can even transform between one and the other with the RTI tools. That said, as the rest of the configuration files use XML, it is often more convenient to also use XML to describe the data types so they can be shared or moved to other XML configuration files.

The directory **<*installation directory*>/example/CPP/HelloWorld_xml_compiled** contains the XML description of the data type in the file **HelloWorld.xml** and it also contains the equivalent IDL description in **HelloWorld.idl**.

Let's examine the contents of the XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<types xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="../../../resource/rtiddsgen/schema/
rti_dds_topic_types.xsd">

   <const name="MAX_NAME_LEN" type="long" value="64"/>
   <const name="MAX_MSG_LEN"  type="long" value="128"/>

   <struct name="HelloWorld">
    <member name="sender" type="string" key="true"
            stringMaxLength="MAX_NAME_LEN"/>
    <member name="message" type="string" stringMaxLength="MAX_MSG_LEN"/>
    <member name="count"   type="long"/>
   </struct>
</types>
```

The file defines a structure type called "HelloWorld" consisting of a string (the sender), a string (the message), and an integer count. Note that the type-declaration syntax is identical the one used within the **USER_QOS_PROFILES.xml** file that we used for the dynamic example (section Type Definition (Section 2.1.3.2)).

2.2.2 Generate Type-Support Code from the Type Definition

This step produces code to support the direct use of the structure 'HelloWorld' from application code. The code is generated using the provided tool named *rtiddsgen*.

The code-generation supports many programming languages. The XML-Based Application Creation currently supports C, C++, Java, and C#. We will use C++ in this example.

To generate code, follow these steps (replacing <*architecture*> as needed for your system; e.g., **i86Win32VS2008** or **i86Linux2.6gcc4.4.5**):

On a Windows system:

From your command shell, change directory to ***<installation directory>*\example\CPP\HelloWorld_xml_compiled** and type:

```
rtiddsgen -language C++ -example <architecture> HelloWorld.xml
```

On a UNIX-based system:

From your command shell, change directory to ***<installation directory>*/example/CPP/HelloWorld_xml_dynamic** and type:

```
rtiddsgen -language C++ -example <architecture> HelloWorld.xml
```

As a result of this step you will see the following files appear in the directory **HelloWorld_xml_dynamic**: **HelloWorld.h, HelloWorld.cxx**, **HelloWorldPlugin.h**, **HelloWorldPlugin.cxx**, **HelloWorldSupport.h**, and **HelloWorldSupport.cxx**

The most notable thing at this point is the fact that the **HelloWorld.h** file contains the declaration of the C++ structure, built according to the specification in the XML file:

```
static const DDS_Long MAX_NAME_LEN = 64;
static const DDS_Long MAX_MSG_LEN = 128;
typedef struct HelloWorld
{
    char*  sender; /* maximum length = ((MAX_NAME_LEN)) */
    char*  message; /* maximum length = ((MAX_MSG_LEN)) */
    DDS_Long  count;

} HelloWorld;
```

2.2.3 Build the Application

The example code is provided in C++, C#, and Java. The following instructions describe how to build it on Windows and UNIX-based systems. If you will be using an embedded platform, see the *RTI Core Libraries and Utilities Getting Started Guide Addendum for Embedded Systems* (**RTI_CoreLibrariesAndUtilities_GettingStarted_EmbeddedSystemsAddendum.pdf**) for instructions specific to these platforms.

C++ on Windows Systems:

1. In the Windows Explorer, go to ***<installation directory>*\example\CPP\HelloWorld_xml_compiled** and open the Microsoft Visual Studio solution file for your architecture. For example, the file for Visual Studio 2008 for 32-bit platforms is **HelloWorld-vs2008.sln**.
2. The Solution Configuration combo box in the toolbar indicates whether you are building debug or release executables; select **Release**. Select **Build Solution** from the Build menu.

C++ on UNIX-based Systems:

1. From your command shell, change directory to **<*installation directory*>/example/CPP/HelloWorld_xml_compiled**.
2. Type:

   ```
   gmake -f Makefile.<architecture>
   ```

   where <*architecture*> is one of the supported architectures (e.g., **Makefile.i86Linux2.6gcc4.4.5**). This command will build a release executable. To build a debug version instead, type:

   ```
   gmake -f Makefile.<architecture> DEBUG=1
   ```

2.2.4 Run the Application

The previous step built two executables: HelloWorld_subscriber and HelloWorld_publisher. These applications should be in proper architecture subdirectory under the **objs** directory. For example, **objs\i86Win32VS2008** in the Windows example cited below and **objs/i86Linux2.6gcc4.4.5** in the Linux example.

1. Start the subscribing application:

   #### On a Windows system:

   From your command shell, go to **<*installation directory*>\example\CPP\HelloWorld_xml_compiled** and type:

   ```
   objs\<architecture>\HelloWorld_subscriber.exe
   ```

   where <*architecture*> is the architecture you just built; see the contents of the **objs** directory to see the name of the architecture you built. For example, the Windows architecture name corresponding to 32-bit Visual Studio 2005 is i86Win32VS2005.

   #### On a UNIX-based system:

   From your command shell, change directory to **<*installation directory*>/example/CPP/HelloWorld_xml_ compiled** and type:

   ```
   objs/<architecture>/HelloWorld_subscriber
   ```

   where <*architecture*> is the architecture you just built of the supported architectures; examine the contents of the **objs** directory to see the name of the architecture you built.

2. Start the publishing application:

   #### On a Windows system:

   From your command shell, go to **<*installation directory*>\example\CPP\HelloWorld_xml_compiled** and type:

   ```
   objs\<architecture>\HelloWorld_publisher.exe
   ```

   where <*architecture*> is the architecture you just built; see the contents of the **objs** directory to see the name of the architecture you built.

   #### On a UNIX-based system:

   From your command shell, change directory to **<*installation directory*>/example/CPP/HelloWorld_xml_ compiled** and type:

   ```
   objs/<architecture>/HelloWorld_publisher
   ```

You should immediately see some messages on the publishing application showing that it is writing data and messages in the subscribing application indicating the data it receives. Do not worry about the contents of the messages. They are generated automatically for this example. The important thing is to understand how the application is defined which will be explained in the following subsections.

2.2.5 Examine the XML Configuration Files Definition

This system is defined in the file **USER_QOS_PROFILES.xml** found in the directory ***<installation directory>*/example/CPP/HelloWorld_xml_compiled**. Let's look at its content and what are the elements defined to construct this scenario.

```
<dds xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="../../../resource/qos_profiles_5.1.0/schema/
rti_dds_profiles.xsd"
version="5.1.0">

    <!-- Qos Library -->
    <qos_library name="qosLibrary">
        <qos_profile name="DefaultProfile">
        </qos_profile>
    </qos_library>

    <!-- Domain Library -->
    <domain_library name="MyDomainLibrary" >
        <domain name="HelloWorldDomain" domain_id="0">
            <register_type name="HelloWorldType" kind="userGenerated"/>
            <topic name="HelloWorldTopic"
                register_type_ref="HelloWorldType">
            <topic_qos name="HelloWorld_qos"
                base_name="qosLibrary::DefaultProfile"/>
            </topic>
        </domain>
    </domain_library>

    <!-- Participant library -->
    <participant_library name="MyParticipantLibrary">
        <domain_participant name="PublicationParticipant"
            domain_ref="MyDomainLibrary::HelloWorldDomain">
            <publisher name="MyPublisher">
                <data_writer name="HelloWorldWriter"
                    topic_ref="HelloWorldTopic"/>
            </publisher>
        </domain_participant>
        <domain_participant name="SubscriptionParticipant"
            domain_ref="MyDomainLibrary::HelloWorldDomain">
            <subscriber name="MySubscriber">
                <data_reader name="HelloWorldReader"
                    topic_ref="HelloWorldTopic">
                        <datareader_qos name="HelloWorld_reader_qos"
                        base_name="qosLibrary::DefaultProfile"/>
                </data_reader>
            </subscriber>
        </domain_participant>
    </participant_library>
</dds>
```

The examination of this file reveals virtually the same information as was found in the **HelloWorld_xml_dynamic** example. This is no surprise as we are essentially trying to define the same system. Please revisit Examine the XML Configuration Files Definition (Section 2.1.3) for a

description of what each section in the XML does.

Here we highlight the only two differences that can be seeing in the configuration file for the of the **HelloWorld_xml_compiled** example when compared with that of the **HelloWorld_xml_dynamic** example:

- ❏ The type definition "<types>" section does not appear in the configuration of the **HelloWorld_xml_compiled** example.
- ❏ The registration of the data types within the domain is slightly different

The type-definition section that appears between the tags "<types>" and "</types>" is not there because in this case the data types are compiled in. So the type-definition has been moved to an external file to facilitate the code generation described in Section Generate Type-Support Code from the Type Definition (Section 2.2.2).

The registration of the data-type inside the domain uses the syntax:

```
<register_type name="HelloWorldType" kind="userGenerated" />
```

This contrasts with what was used in the HelloWorld_xml_dynamic example:

```
<register_type name="HelloWorldType" kind="dynamicData" type_ref="HelloWorld" />
```

The modified syntax indicates a **kind="userGenerated"** which means that the type will be defined via code generation and not use the DynamicData API. Since the type is defined via code generation there is no need to provide a reference to the type-definition so the **type_ref** attribute is not present.

To sum it up, the XML configuration file is essentially the same except that the type definitions of the data types that will be compiled in are not present and that is indicated at the time the data type is registered in the domain by means of the attribute **kind="userGenerated"**.

2.2.6 Publisher Application

Open the file ***<installation directory>*/examples/CPP/HelloWorld_publisher.cxx** and look at the source code.

The logic of this simple application is contained in the **publisher_main()** function. The logic can be seen as composed of three parts:

- ❏ Type registration (this step is new compared to the **HelloWorld_xml_dynamic**)
- ❏ Entity creation
- ❏ Use of the Entities

Type Registration: The first thing the application does is register the data-types that were defined in the code-generation step. This is accomplished by calling the **register_type_support()** function on the DomainParticipantFactory.

```
/* type registration */
retcode = DDSTheParticipantFactory->register_type_support(
                        HelloWorldTypeSupport::register_type,
                        "HelloWorldType");
```

The function **register_type_support()** must be called for each code-generated data type that will be associated with the *Topics* published and subscribed by the application. In this example there is only one *Topic* and one data type, so only one call to this function is required.

The function **register_type_support()** takes as a parameter the TypeSupport function that defines the data type in compile code. In this case it is **HelloWorldTypeSupport::register_type** this function is declared in the **HelloWorldSupport.h**. However you cannot see it directly there because it is defined using macros. Instead you will find the line:

```
DDS_TYPESUPPORT_CPP(HelloWorldTypeSupport, HelloWorld);
```

This line defines the **HelloWorldTypeSupport::register_type()** function.

In general if you include multiple data-type definitions in a single XML (or IDL) file called **MyFile.xml** (or **MyFile.idl**) you will have multiple TypeSupport types defines within the generated file **MyFileTypeSupport.h**. You can identify them searching for the **DDS_TYPESUPPORT_CPP()** macro and you should register each of them (the ones the application uses) using the operation **register_type_support()** as was shown earlier.

Entity Creation: The steps needed to create the entities are the same as for the **HelloWorld_xml_dynamic** example. The application first creates a *DomainParticipant* using the function **create_participant_from_config()** this function takes the configuration name of the participant "**MyParticipantLibrary::PublicationParticipant**" which is the same name that was specified in the XML file. Note that the name in the XML file "**PublicationParticipant**" has been qualified with the name of the library it belongs to "**MyParticipantLibrary**".

```
DDSDomainParticipant * participant =
   DDSTheParticipantFactory->create_participant_from_config(
                       "MyParticipantLibrary::PublicationParticipant");
```

This single function call registers all the necessary data types and creates and the *Topics* and Entities that were specified in the XML file. In this simple case the participant only contains a publisher "**MyPublisher**" with a single *DataWriter* "**HelloDataWriter**". However in more realistic scenarios this single call can create hundreds of entities (both readers and writers).

Use of the Entities: The remaining part of the function uses the entities that were created to perform the logic of the program.

This example only needs to write data using the single data writer. So the application looks-up the "**HelloWorldWriter**" *DataWriter* using the fully qualified name "**MyPublisher::HelloWorldWriter**" and narrows it to be a HelloWorldDataWriter. Note the difference with the **HelloWorld_xml_dynamic** example. Rather than the generic "**DynamicDataWriter**" used in the example here we use a *DataWriter* specific to the HelloWorld data type.

```
HelloWorldDataWriter * helloWorldWriter = HelloWorldDataWriter::narrow(
                          participant->lookup_datawriter_by_name(
                         "MyPublisher::HelloWorldWriter"));
/* Create data */
HelloWorld * helloWorldData = HelloWorldTypeSupport::create_data();

/* Main loop */
   for (count=0; (sample_count == 0) || (count < sample_count); ++count)
   {
       printf("Writing HelloWorld, count: %d\n", count);

       /* Set the data fields */
       helloWorldData->sender  = "John Smith";
       helloWorldData->message = "Hello World!";
       helloWorldData->count   = count;

       retcode = helloWorldWriter->write(*helloWorldData, DDS_HANDLE_NIL);
       if (retcode != DDS_RETCODE_OK) {
           printf("write error %d\n", retcode);
           publisher_shutdown(participant);
           return -1;
       }
       NDDSUtility::sleep(send_period);
}
```

Note that the data object helloWorldData can be manipulated directly as a plain-language object. This means that in order to set a field in the object the application can refer to it directly as in:

```
helloWorldData->count   = count;
```

This "plain language object" API is both higher performance and friendlier to the programmer than the DynamicData API.

2.3 Subscriber Application

Open the file ***<installation directory>*/examples/CPP/HelloWorld_subscriber.cxx** and look at the source code.

The logic of this simple application is in the **subscriber_main()** function. Similar to the publisher application the logic can be seen as composed of three parts:

- ❏ Type registration (this step is new compared to the HelloWorld_xml_dynamic)
- ❏ Entity creation
- ❏ Use of the Entities

Type Registration: This step is identical to the one for the publisher application. The first thing the application does is register the data-types that were defined in the code-generation step. This is accomplished calling the **register_type_support()** function on the DomainParticipantFactory.

```
/* type registration */
retcode = DDSTheParticipantFactory->register_type_support(
            HelloWorldTypeSupport::register_type, "HelloWorldType");
```

Please refer to the explanation of the publishing application for more details as this step us regardless of whether the application uses a type to publish or subscribe.

Entity Creation: The steps needed to create the entities are the same as for the HelloWorld_xml_dynamic example. The application first creates a *DomainParticipant* using the function **create_participant_from_config()** this function takes the configuration name of the participant "MyParticipantLibrary::SubscriptionParticipant" which is the same name that was specified in the XML file. Note that the name in the XML file "SubscriptionParticipant" has been qualified with the name of the library it belongs to "MyParticipantLibrary".

```
DDSDomainParticipant * participant =
   DDSTheParticipantFactory->create_participant_from_config(
                      "MyParticipantLibrary::SubscriptionParticipant");
```

This single function call registers all the necessary data-types and creates and the *Topics* and Entities that were specified in the XML file. In this simple case the participant only contains a *Subscriber* "MySubscriber" with a single *DataReader* "HelloDataReader". However in more realistic scenarios this single call can create hundreds of entities (both *DataReaders* and *DataWriters*).

Use of the Entities: The remaining part of the function uses the entities that were created to perform the logic of the program.

This example only needs to read data using the single *DataReader* So the application looks-up the "HelloWorldReader" *DataReader* using the fully qualified name "MyPublisher::HelloWorldReader" and narrows it to be a HelloWorldDataReader:

```
HelloWorldDataReader * helloWorldReader =
   HelloWorldDataReader::narrow(
           participant->lookup_datareader_by_name(
           "MySubscriber::HelloWorldReader"));
```

To process the data, the application installs a Listener on the *DataReader*. The HelloWorldListener, defined on the same file implements the DataReaderListener interface, which the *DataReader* uses to notify the application of relevant events, such as the reception of data.

```
/* Create a data reader listener */
HelloWorldListener *reader_listener = new HelloWorldListener();

/* set listener */
retcode = helloWorldReader->set_listener(reader_listener,
                                         DDS_DATA_AVAILABLE_STATUS);
```

The last part is the implementation of the listener functions. In this case we only implement the **on_data_available()** operation, which is called when data is received.

The **on_data_available()** function receives all the data into a sequence and then uses the HelloWorldTypeSupport::print() function to print each data item received.

```
void HelloWorldListener::on_data_available(DDSDataReader* reader)
{
    HelloWorldDataReader *helloWorldReader = NULL;
    HelloWorldSeq dataSeq;
    DDS_SampleInfoSeq infoSeq;
    DDS_ReturnCode_t retcode = DDS_RETCODE_ERROR;
    DDS_Long i = 0;

    helloWorldReader = HelloWorldDataReader::narrow(reader);

    retcode = helloWorldReader->take(
        dataSeq, infoSeq, DDS_LENGTH_UNLIMITED,
        DDS_ANY_SAMPLE_STATE, DDS_ANY_VIEW_STATE, DDS_ANY_INSTANCE_STATE);

    for (i = 0; i < dataSeq.length(); ++i) {
        if (infoSeq[i].valid_data) {
            HelloWorldTypeSupport::print_data(&dataSeq[i]);
        }
    }

    retcode = helloWorldReader->return_loan(dataSeq, infoSeq);
}
```

Note that the sequence received is of type **HelloWorldSeq** which contains the native plain language objects of type **HelloWorld**. This can be manipulated directly by the application. For example the fields can be dereferenced as shown in the code snippet below:

```
   HelloWorld *helloWorldData = &dataSeq[i];
       printf("count= %s\n", helloWorldData->count);
```

Chapter 3 Using Connext Prototyper

RTI Connext Prototyper is a companion tool for use with the XML-Based Application Creation feature. This tool allows application developers to quickly try out scenarios directly from their XML descriptions, without writing any code. *Prototyper* is included with *Connext DDS* and *Connext Mesaging*.

On a Windows system:

From your command shell, go to ***<installation directory>*\example\CPP\HelloWorld_xml_dynamic**. Open two console windows.

In one window, type (all on one line):

```
$NDDSHOME\scripts\rtiddsprototyper
    -cfgName PublicationParticipant "MyParticipantLibrary::PublicationParticipant"
```

In the other window, type (all on one line):

```
$NDDSHOME\scripts\rtiddsprototyper
    -cfgName SubscriptionParticipant "MyParticipantLibrary::SubscriptionParticipant"
```

On a UNIX-based system:

From your command shell, go to ***<installation directory>*/example/CPP/HelloWorld_xml_dynamic**. Open two console windows.

In one window, type (all on one line):

```
${NDDSHOME}/scripts/rtiddsprototyper
    -cfgName PublicationParticipant "MyParticipantLibrary::PublicationParticipant"
```

In the other window, type (all on one line):

```
${NDDSHOME}/scripts/rtiddsprototyper
    -cfgName SubscriptionParticipant "MyParticipantLibrary::SubscriptionParticipant"
```

You can run both of these on the same computer or on separate computers within the same (multicast enabled) network. You should immediately see the subscribing application receive and print the information from the publishing side.

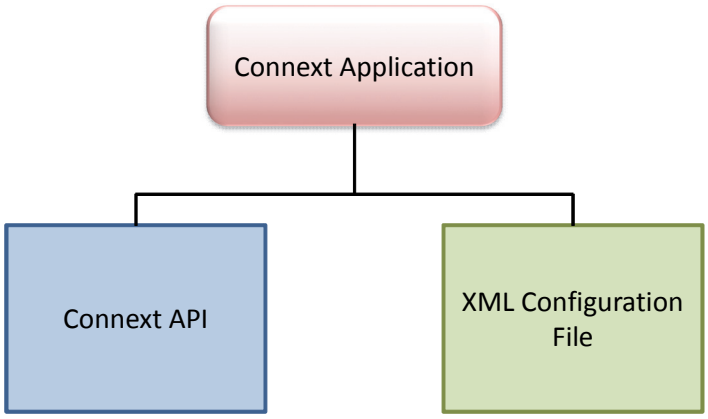
For more information, please read the *RTI Connext Prototyper Getting Started Guide* (in **<NDDSHOME>/doc/pdf**).

Chapter 4 Understanding XML-Based Application Creation

Figure 4.1 depicts a *Connext* application built with the aid of both the *Connext* API and an XML configuration file. Using the XML configuration file in combination with the XML-Based Application Creation feature simplifies and accelerates application development.

The Entities defined in the XML configuration file can be created by a single call to the API. Once created, all Entities can be retrieved from application code using standard "lookup" operations so they can be used to read and write data.

Figure 4.1 **Using both Connext API and XML Configuration File to Develop an Application**



4.1 Important Points

- Applications can instantiate a *DomainParticipant* from a participant configuration described in the XML Configuration file. All the *Entities* defined by such a participant configuration are created automatically as part of *DomainParticipant* creation. In addition, multiple participant configurations may be defined within a single XML configuration file.
- All the Entities created from a participant configuration are automatically assigned an entity name. Entities can be retrieved via "lookup" operations specifying their name. Each Entity stores its own name in the QoS policies of the Entity so that they can be retrieved locally (via a lookup) up and communicated via discovery. This is described in

Creating and Retrieving Entities Configured in an XML File (Section 4.7).

- An XML configuration file is not tied to the application that uses it. Different applications may run using the same configuration file. A single file may define multiple participant configurations. A single application can instantiate as many *DomainParticipants* as desired.
- Changes in the XML configuration file do not require recompilation, even if Entities are added or removed, unless the logic that uses the Entities also needs to change.

4.2 Loading XML Configuration Files

Connext loads its XML configuration from multiple locations. This section presents the various approaches, listed in load order.

The following locations contain QoS Profiles (see Chapter 15 in the *RTI Core Libraries and Utilities User's Manual*) and may also contain *Entity* configurations.

- **$NDDSHOME/resource/qos_profiles_5.x.y/xml/NDDS_QOS_PROFILES.xml**

  This file contains the *Connext* default QoS values; it is loaded automatically if it exists. When present this is the first file loaded. (Where *x.y* represent version numbers.)

- File specified in NDDS_QOS_PROFILES Environment Variable

  The files (or XML strings) separated by semicolons referenced in this environment variable, if any, are loaded automatically. These files are loaded after the **NDDS_QOS_PROFILES.xml** and they are loaded in the order they appear listed in the environment variable.

- **<working directory>/USER_QOS_PROFILES.xml**

  This file is loaded automatically if it exists in the 'working directory' of the application, that is, the directory from which the application is run. This file is loaded last.

4.3 XML Syntax and Validation

The configuration files uses XML format. Please see Examine the XML Configuration Files Definition (Section 2.1.3) for an example XML file and a description of its contents.

4.3.1 Validation at Run-Time

Connext validates the input XML files using a built-in Document Type Definition (DTD). You can find a copy of the builtin DTD in **$NDDSHOME/resource/qos_profiles_<*version*>/schema/rti_dds_profiles.dtd**.

This is only a copy of the DTD that *Connext* uses. Changing this file has no effect unless you specify its path with the DOCTYPE tag, described below.

You can overwrite the built-in DTD by using the XML tag, <!DOCTYPE>. For example, the following indicates that *Connext* must use a different DTD file to perform validation:

```
<!DOCTYPE dds SYSTEM
"/local/usr/rti/dds/modified_rti_dds_profiles.dtd">
```

If you do not specify the DOCTYPE tag in the XML file, the built-in DTD is used. The DTD path can be absolute or relative to the application's current working directory.

4.3.2 Validation during Editing

Connext provides DTD and XSD files that describe the format of the XML content. We highly recommend including a reference to the XSD in the XML file. This provides helpful features in code editors such as Visual Studio, Eclipse, or Netbeans, including validation and auto-completion while you are editing the XML file.

To include a reference to the XSD file, use the **noNamespaceSchemaLocation** attribute inside the opening <dds> tag, as illustrated below (replace '5.x.y' with the current version number):

```
<?xml version="1.0" encoding="UTF-8"?>
<dds xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:noNamespaceSchemaLocation="../../../resource/qos_profiles_5.x.y/schema/
      rti_dds_profiles.xsd"
      version="5.x.y">
```

You may use relative or absolute paths to the schema files. These files are provided as part of your distribution in the following location (replace 5.x.y with the current version number):

- **<*Connext installation directory*>/resource/qos_profiles_5.x.y/schema/rti_dds_profiles.xsd**
- **<*Connext installation directory*>/resource/qos_profiles_5.x.y/schema/rti_dds_profiles.dtd**

If you want to use the DTD for syntax validation instead of the XSD, use the <!DOCTYPE> tag. Note, however, that this validation is less strict and will offer far less help in terms of auto-completion. The use of <!DOCTYPE> is shown below. Simply replace $NDDSHOME with your *Connext* installation directory and replace '5.x.y' with the current version number:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE dds SYSTEM
    $NDDSHOME/resource/qos_profiles_5.x.y/schema/rti_dds_profiles.dtd">
<dds>
    ...
</dds>
```

4.4 Accessing Entities Defined in XML Configuration from an Application

You can use the operations listed in Table 4.1 to retrieve and then use the *Entities* defined in your XML configuration files.

Table 4.1 **Operations Intended for Use with XML-Based Configuration**

Working with…	Configuration-Related Operations	Reference
DomainParticipantFactory	create_participant_from_config create_participant_from_config_w_params lookup_participant_by_name	Section 4.7.1
	register_type_support	Section 4.7.5

Table 4.1 **Operations Intended for Use with XML-Based Configuration**

Working with…	Configuration-Related Operations	Reference
DomainParticipant	lookup_publisher_by_name lookup_subscriber_by_name lookup_datawriter_by_name lookup_datareader_by_name	Section 4.7.2
Publisher	lookup_datawriter_by_name	Section 4.7.3
Subscriber	lookup_datareader_by_name	

4.5 XML Tags for Configuring Entities

There are two top-level tags to configure Entities in the XML configuration files:

- **<domain_library>**: Defines a collection of domains. A domain defines a global dataspace where applications can publish and subscribe to data by referring to the same *Topic* name. Each domain within the domain library defines the *Topics* and associated datatypes that can be used within that domain. Note that this list is not necessarily exhaustive. The participants defined within the <participant_library> might add *Topics* beyond the ones listed in the domain library.
- **<participant_library>**: Defines a collection of *DomainParticipants*. A *DomainParticipant* provides the means for an application to join a domain. The *DomainParticipant* contains all the Entities needed to publish and subscribe data in the domain (*Publishers*, *Subscribers*, *DataWriters*, *DataReaders*, etc.).

Figure 4.2 and Table 4.2 describe the top-level tags that are allowed within the root <dds> tag.

Figure 4.2 **Top-Level Tags in Configuration File**

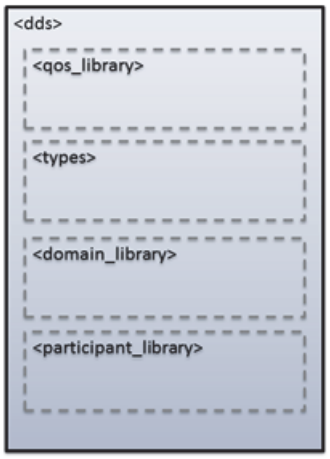


Table 4.2 **Top-Level Tags in Configuration File**

Tags within <dds>	Description		Number of Tags Allowed
<domain_library>	Specifies a domain library. Set of <domain> definitions. Attributes:		0 or more
	name	Domain library name	

Table 4.2 **Top-Level Tags in Configuration File**

Tags within <dds>	Description		Number of Tags Allowed
<participant_library>	Specifies a participant library. Set of <domain_participant> definitions.		0 or more
	name	Participant library name	
<qos_library>	Specifies a QoS library and profiles. The contents of this tag are specified in the same manner as for a *Connext* QoS profile file—see Chapter 15 in the *RTI Core Libraries and Utilities User's Manual*.		0 or more
<types>	Defines types that can be used for dynamic data registered types.		0 or 1

4.5.1 Domain Library

A domain library provides a way to organize a set of domains that belongs to the same system. A domain represents a data space where data can be shared by means of reading and writing the same *Topics*, each *Topic* having an associated data-type. Therefore, in a <domain> tag you can specify *Topics* and their data types.

Figure 4.3 **Domain Library Tag**

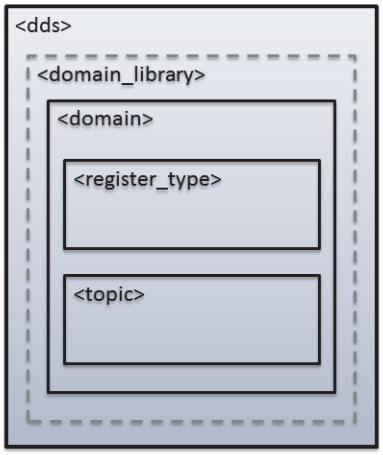


Figure 4.3, Table 4.3, and Table 4.4 describe what tags can be in a <domain_library>.

- The <register_type> tag specifies a type definition that will be registered in the *DomainParticipants* whenever they specify a *Topic* associated with that data type.
- The <topic> tag specifies a *Topic* by associating it with a <register_type> that contains the type information.

In a domain, you can also specify the domain ID to which the *DomainParticipant* associated with this domain will be bound.

Table 4.3 **Domain Library Tags**

Tags within <domain_library>	Description		Number of tags allowed
<domain>	Specifies a domain. Attributes:		1 or more
	name	Domain name	
	domain_id (*optional*)	Domain ID (default id=0)	
	base_name (*optional*)	Base domain name. Specifies another domain from which properties will be inherited.	

Note that a domain may inherit from another "base domain" definition by using the **base_name** attribute. A domain that declares a "base domain" might still override some of the properties in the base domain. Overriding is done simply by including elements in the derived domain with the same name as in the base domain.

Table 4.4 **Domain Tags**

Tags within <domain>	Description		Number of tags allowed
<register_type>	Specifies how a type is registered Attributes:		1 or more
	name	Name used to refer to this registered type within the XML file. This is also the name under which the type is registered with the *DomainParticipants* unless overridden by the <registered_name> tag.	
	kind	Specifies whether the type is built-in, dynamic data or generated by the user.	
	type_ref (*optional*)	Reference (fully qualified name) to a defined type within <types>. Required when **kind** is dynamic data.	
<topic>	Specifies a topic associating its data-type and optionally QoS. Attributes:		1 or more
	name	Name of the topic if no <registered_name> is specified.	
	register_type_ref	Reference (name) to a register_type within this domain with which this topic is associated.	

The <register_type> tag, described in Figure 4.4 and Table 4.5, determines how a type is registered by specifying the type definition and the name with which it is registered.

Figure 4.4 **Register Type Tag**

Table 4.5 **Register Type Tag**

Tags within <register_type>	Description	Number of tags allowed
<registered_name>	Name with which the type is registered.	0 or 1

The <topic> tag, described in Figure 4.5 and Table 4.6, describes a *Topic* by specifying the name and type of the *Topic*. It may also contain the QoS configuration for that *Topic*.

Figure 4.5 **Topic Tag**

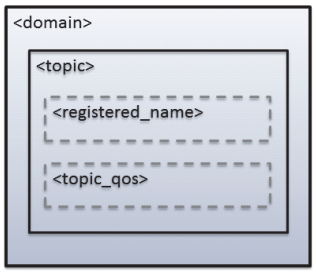


Table 4.6 **Topic Tag**

Tags within <topic >	Description	Number of tags allowed
<registered_name>	Name of the *Topic*.	0 or 1
<topic_qos>	*Topic* QoS configuration.	0 or 1

Some elements may refer to already specified types and QoS tags. The definitions of these referenced tags may appear either in the same configuration file or in a different one—as long as it is one of the ones loaded by *Connext* as described in Section 4.2.

If a QoS is not specified for an Entity, then the QoS will be set to a default value that is either the default configured in the XML files, or if such default does not exist, then the *Connext* QoS defaults. Please see Chapter 15 "Configuring QoS with XML" in the *RTI Core Libraries and Utilities User's Manual* for additional details in configuring QoS via XML.

For example:

```
<!-- types -->
<types>
    <struct name="MyType">
           <member name="message" type="string"/>
           <member name="count" type="long"/>
    </struct>
</types>

<!-- Domain Library -->
<domain_library name="MyDomainLibrary" >
    <domain name="MyDomain" domain_id="10">
           <register_type name="MyRegisteredType"
            kind="dynamicData" type_ref="MyType"/>
           <topic name="MyTopic" register_type_ref="MyType">
               <topic_qos base_name="qosLibrary::DefaultProfile"/>
           </topic>
    </domain>
</domain_library>
```

The above configuration defines a domain with name "MyDomain" and domain_id "10" containing a *Topic* called "MyTopic" with type "MyType" registered with the name "MyRegisteredType":

- <register_type>: It defines the registration of a dynamic data type with name "MyRegisteredType" and definition "MyType"–defined in the same file.
- <topic>: with name "MyTopic" and whose corresponding type is the one defined above with the name "MyRegisteredType" found within the same configuration. The *Topic* QoS configuration is the one defined by the profile "qosLibrary::DefaultProfile", which is defined in a different file.

Note that the *DomainParticipant* created from a configuration profile bound this domain will be crated with domain_id=10, unless the domain_id is overridden in the participant configuration.

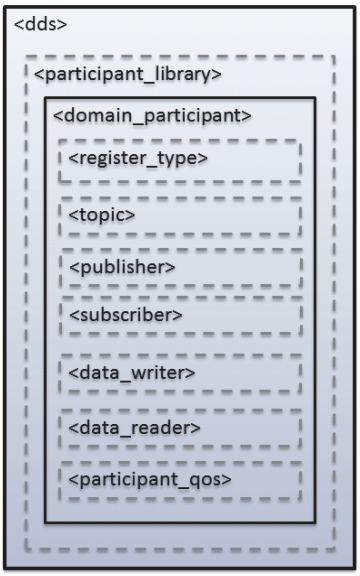
4.5.2 Participant Library

A participant library provides a way to organize a set of participants belonging to the same system. A participant configuration specifies all the entities that a *DomainParticipant* created from this configuration will contain.

Figure 4.6, Table 4.7, and Table 4.8 shows the description of a <participant_library> and the tags it contains.

A <domain_participant> can be associated with a domain where topics and their associated types are already defined. The elements <register_type> and <topic> may also be defined in a <domain_participant>—the same way it is done in a <domain>. This makes it possible to add Topics, data-types, etc. beyond the ones defined in the domain, or alternatively redefine the elements that are already in the <domain>.

Figure 4.6 **Participant Library Tag**



A <domain_participant> is defined by specifying the set of Entities it contains. This is done using tags such as <publisher>, <subscriber>, <data_writer> and <data_reader>, which specify a Entity of their corresponding type. These Entities are created within the *DomainParticipant* instantiated from the configuration profile that contains the definitions.

Table 4.7 **Participant Library Tag**

Tags within <participant_library>	Description		Number of Tags Allowed
<domain_participant>	Specifies a participant configuration. Attributes:		1 or more
	name	Participant configuration name.	
	base_name (*optional*)	Base participant name. It specifies another participant from which to inherit the configuration.	
	domain_ref (*optional*)	Reference (fully qualified name) to a defined <domain> in the domain library.	
	domain_id (*optional*)	Domain ID. If specified, overrides the id in the domain it refers to. If no domain_id is specified directly or in the referenced domain then the default domain_id is 0.	

A <domain_participant> may inherit its configuration from another "base participant" specified using the **base_name** attribute. In this case, overriding applies to the base <domain_participant> as well as to the referred <domain>.

Note that in *DataWriters* always belong to a *Publisher* and *DataReaders* to a *Subscriber*. For this reason the <data_writer> and <data_reader> typically appear nested inside the corresponding <publisher> and <subscriber> tags. However, for convenience, it is possible to define

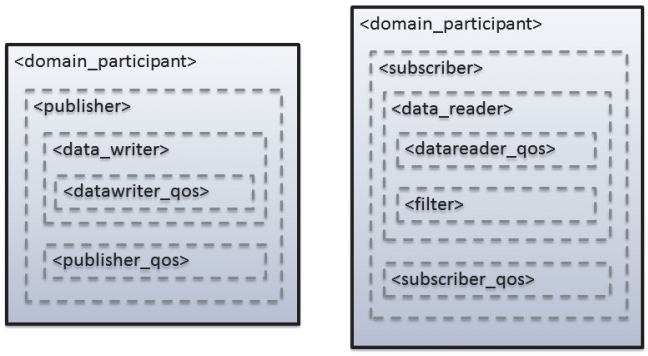
<data_writer> and <data_reader> tags directly under the <domain_participant> tag. In this case, the *DataWriters* and *DataReaders* are created inside the implicit *Publisher* and *Subscriber*, respectively.

Table 4.8 **Domain Participant Tag**

Tags within <domain_participant >	Description		Number of Tags Allowed
<register_type>	Specifies how a type is registered. Same as within the <domain> tag		0 or more
<topic>	Specifies a topic. Same as within the <domain> tag		0 or more
<publisher>	Specifies a *Publisher* configuration. Attributes:		0 or more
	name	*Publisher* configuration name.	
	multiplicity (*optional*)	Number of *Publishers* that are created with this configuration. Default is 1.	
<subscriber>	Specifies a *Subscriber* configuration. Attributes:		0 or more
	name	*Subscriber* configuration name.	
	multiplicity (*optional*)	Number of *Subscribers* that are created with this configuration. Default is 1.	
<data_writer>	Specifies a *DataWriter* configuration. The *DataWriter* will be created inside the implicit *Publisher*. Attributes:		0 or more
	name	*DataWriter* configuration name.	
	topic_ref	Reference (name) a <topic> within the <domain> referenced by its <participant> parent.	
	multiplicity (*optional*)	Number of *DataWriters* that are created with this configuration. Default is 1.	
<data_reader>	Specifies a data reader configuration. The *DataReader* will be created inside the implicit subscriber. Attributes:		0 or more
	name	Data reader configuration name.	
	topic_ref	Reference (name) a <topic> within the <domain> referenced by its <participant> parent.	
	multiplicity (*optional*)	Number of *DataReaders* that are created with this configuration. Default is 1.	
<participant_qos>	*DomainParticipant* QoS configuration.		0 or 1

The <publisher>, <subscriber>, <data_writer>, and <data_reader> tags are described in Figure 4.7, Table 4.9, Table 4.10, Table 4.11 and Table 4.12.

Figure 4.7 **Publisher and Subscriber Tags**



The <publisher> tag defines by default a *Publisher*. It may contain a QoS configuration and a several *DataWriters*. Likewise, the <subscriber> tag defines by default a *Subscriber*. It may contain a QoS configuration and a several *DataReaders*.

Table 4.9 **Publisher Tag**

Tags within <publisher >	Description	Number of Tags Allowed
<data_writer>	Specifies a *DataWriter* configuration. Same as within the <participant> tag.	0 or more
<publisher_qos>	*Publisher* QoS configuration.	0 or 1

Table 4.10 **Subscriber Tag**

Tags within <subscriber>	Description	Number of Tags Allowed
<data_reader>	Specifies a *DataReader* configuration. Same as within the <participant> tag.	0 or more
<subscriber_qos>	*Subscriber* QoS configuration.	0 or 1

Table 4.11 **DataWriter Tag**

Tags within <data_writer >	Description	Number of Tags Allowed
<datawriter_qos>	*DataWriter* QoS configuration	0 or 1

Table 4.12 **DataReader Tags**

Tags within <data_reader>	Description	Number of Tags Allowed
<datareader_qos>	*DataReader* QoS configuration.	0 or more

Table 4.12 **DataReader Tags**

Tags within <data_reader>	Description		Number of Tags Allowed
<filter>	Enables the creation of *DataReader* with this configuration from a ContentFilteredTopic. Attributes:		0 or 1
	name	Name of the ContentFilteredTopic. The ContentFilteredTopic will be associated with the same *Topic* referenced by the containing <data_reader>	
	filter_kind	Specifies which ContentFilter to use. It defaults to the builtin.sql filter.	

The <filter> tag within a <data_reader> enables content filtering. It causes the corresponding *DataReader* to be created from a ContentFilteredTopic with the specified filter characteristics.

Table 4.13 **Filter Tag**

Tags within <filter >	Description	Number of Tags Allowed
<expression>	Filter expression	0 or 1

<parameter_list>	List of parameters. Parameters are specified using <param> tags.
	The maximum number of parameters is 100.
	`<parameter_list>`
	`  <param>param_0</param>`
	`  <param>param_1</param>`
	`  ...`
	`</parameter_list>`
		0 or 1

For example:

```
<domain_participant name="MyParticipant"
    domain_ref="MyDomainLibrary::MyDomain">

    <publisher name="MyPublisher">
        <data_writer name="MyWriter" topic_ref="MyTopic"/>
    </publisher>

    <subscriber name="MySubscriber">
        <data_reader name="MyReader"   topic_ref="MyTopic">
            <filter name="MyFilter" kind="builtin.sql">
                <expression> count > %0 </expression>
                <parameter_list>
                    <param>10<param>
                </parameter_list>
            </filter>
        </data_reader>
    </subscriber>

</domain_participant>
```

The above configuration defines a <domain_participant> that is bound to the <domain> “MyDomain”.

A *DomainParticipant* created from this configuration will contain:

- A Publisher which has a *DataWriter* created from the *Topic* “MyTopic”.
- A Subscriber which has *DataReader* created from a ContentFilteredTopic whose related *Topic*, “MyTopic”, uses a SQL filter.

4.6 Names Assigned to Entities

Each Entity configured in a XML file is given a unique name. This name is used to refer to them from other parts of the XML configuration and also to retrieve them at run-time using the *Connext* API.

In the context of XML-based configuration we should distinguish between two kinds of names:

- **Configuration name**: The name of a specific Entity’s configuration. It is given by the name attribute of the corresponding XML element.
- **Entity name**: The actual name of the Entity within the run-time system. In most cases, the Entity name is the same as the configuration name. However there are two exceptions:
  - *DomainParticipants* may be given their Entity names explicitly when they are created using **create_participant_from_config_w_params()**. If no explicit name is given, as occurs with **create_participant_from_config()**, a name will be generated automatically (see Creating and Retrieving a DomainParticipant Configured in an XML File (Section 4.7.1)).
  - Whenever the attribute **multiplicity** is set to a value greater than one. This setting indicates that a set of Entities should be all from the same configuration. As each Entity must have a unique name the system will automatically append a number to the configuration name to obtain the Entity name. For example, if we specified a multiplicity of “N”, then for each index “i” between 0 and N-1 the system will assign entity names according to the table below:

Entity Name	Index: i
“configuration_name”	0
“configuration_name#i”	[1,N-1]

That is, the Entity name followed by the token “#” and an index.

For example:

```
<publisher name="MyPublisher">
    <data_writer name="MyWriter" multiplicity="3"
     topic_ref="MyTopic"/>
</publisher>
```

For the above XML configuration, the name assignment is:

Configuration	Entity	Multiplicity	Entity Names
"MyPublisher"	*Publisher*	1	"MyPublisher"
"MyWriter"	*DataWriter*	3	"MyWriter" "MyWriter#1" "MyWriter#2"

The entity name is stored by *Connext* using the EntityNameQosPolicy QoS policy for *DomainParticipants*, *Publishers*, *Subscribers*, *DataWriters* and *DataReaders*. The policy is represented by the following C structure:

```
Struct DDS_EntityNameQosPolicy {
    char * name;
    char * role_name
}
```

The mapping is:

Field	Value
name	Entity name
role_name	Configuration name

For example, for the following configuration:

```
<domain_participant name="MyParticipant"
 domain_ref="MyDomainLibrary::MyDomain">
    <publisher name="MyPublisher">
        <data_writer name="MyWriter" topic_ref="MyTopic"/>
    </publisher>
</domain_participant>
```

The corresponding QoS policies for each entity are:

Entity	QoS Policy	Field Values
DomainParticipant	EntityNameQosPolicy	name = [*participant_name*] role_name = "MyParticipant"
Publisher	EntityNameQosPolicy	name = "MyPublisher" role_name = "MyPublisher"
DataWriter	EntityNameQosPolicy	name = "MyWriter" role_name = "MyWriter"

Where [*participant_name*] represents the value of the participant entity name specified at creation time.

4.6.1 Referring to Entities and Other Elements within XML Files

Entities and other elements within the XML file are addressed using a hierarchical name that matches their declaration hierarchy. This is summarized in the table below.

Entity or Element	Hierarchical Name	Example Use
type	[type_name]	type_ref="MyType"
qos	[qos_library_name]::[qos_profile_name]	base_name="qosLibrary::DefaultProfile"

Entity or Element	Hierarchical Name	Example Use
domain	[domain_libary_name]::[domain_name]	domain_ref= "MyDomainLibrary::MyDomain"
participant	[participant_library_name]:: [participant_name]	base_name= ″MyParticipantLibrary::PublicationParticipant″
topic	[topic_name] Must be defined within the scope of the Domain or the Participant that refer to it	topic_ref="MyTopic"
publisher	[subscriber_name] Must be defined within the scope of the Participant that refers to it	base_name=″MyPublisher″
subscriber	[subscriber_name] Must be defined within the scope of the Participant that refers to it	base_name=″MySubscriber″
data_writer	[publisher_name]::[datawriter_name] If addressing from within the same Publisher the “publisher_name::” prefix may be omitted	base_name=″MyPublisher::MyWriter″ base_name=″MyWriter″
data_reader	[subscriber_name]::[datareader_name] If addressing from within the same Subscriber the “subscriber_name::” prefix may be omitted	base_name=″MySubscriber::MyReader″ base_name=″MyReader″

The example above corresponds to a configuration such as the one following:

```
<dds xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:noNamespaceSchemaLocation="../../../resource/qos_profiles_5.x.y/
 schema/rti_dds_profiles.xsd"
 version="5.x.y">

    <types>
        <struct name="MyType">
            <member name="mylong" type="long"/>
        </struct>
    </types>

    <domain_library name="MyDomainLibrary" >
        <domain name="MyDomain" domain_id="0">
            <register_type name="MyRegisteredType"
                kind="dynamicData" type_ref="MyType" />

            <topic name="MyTopic"
                register_type_ref="MyRegisteredType"/>
        </domain>
    </domain_library>

    <participant_library name="MyParticipantLibrary">

    <domain_participant name="MyParticipant"
        domain_ref="MyDomainLibrary::MyDomain">

            <publisher name="MyPublisher">
```

```
            <data_writer name="MyWriter" topic_ref="MyTopic"/>
        </publisher>

        <subscriber name="MySubscriber">
            <data_reader name="MyReader" topic_ref="MyTopic"/>
        </subscriber>

    </domain_participant>
</participant_library>
</dds>
```

4.7 Creating and Retrieving Entities Configured in an XML File

There are two kinds of operations that affect *Entities* configured in an XML file:

- Create the defined entities. Only the operation **create_participant_from_config()** in the DomainParticipantFactory triggers the creation of a *DomainParticipant* and all its contained Entities given a configuration name.
- Retrieve the defined entities: After creation, you can retrieve the defined Entities by using the **lookup_by_name()** operations available in the DomainParticipantFactory, *DomainParticipant*, *Publisher* and *Subscriber*.

4.7.1 Creating and Retrieving a DomainParticipant Configured in an XML File

To create a *DomainParticipant* from a configuration profile in XML, use the function **create_participant_from_config()**, which receives the configuration name and creates all the entities defined by that configuration.

For example :

```
<participant_library = "MyLibrary">
    <domain_participant name="MyParticipant"
           domain_ref="MyDomainLibrary::MyDomain"
           domain_id="1>
           ...
    </domain_participant>
</participant_library>
```

Given the above configuration, a DomainParticipant is created as follows:

```
DDSDomainParticipant * participant =
             DDSTheParticipantFactory->create_participant_from_config
                                        ("MyLibrary::MyParticipant");
if (participant == NULL) {
    //handle error
}
```

The *DomainParticipant* is bound to the domain_id specified in either the <domain_participant> tag—this has precedence—or the <domain> tag. In this example the domain_id is set to one.

When the *DomainParticipant* is created by means of **create_participant_from_config()**, a name will be generated automatically based on the configuration name and the number of existing participants created from the same configuration. The generation follows the same strategy explained in Names Assigned to Entities (Section 4.6) for the domain entities where the multi-

plicity is replaced by the number of existing participants. If this is number is identified by "N", the participant name for a new participant will be assigned as follows:

Participant Name	N
"configuration_name"	0
"configuration_name#N"	[1,N-1]

For example, if we create three participants from the configuration "lib::participant", the names assigned as the participants are created will be:

- -participant
- -participant#1
- -participant#2

Once a participant is created, it can be retrieved by its name at any other place in your program as follows, based on the previous example and assuming that only one participant was created:

```
participant =
    DDSTheParticipantFactory->lookup_participant_by_name("MyParticipant");
if (participant == NULL) {
     //handle error
}
```

To provide more flexibility, **create_participant_from_config_w_params()** allows you to specify the participant name. You can also override the specification in the configuration for the domain ID and QoS profile for the participant and entites in the domain.

4.7.2 Creating and Retrieving Publishers and Subscribers

Publishers and *Subscribers* configured in XML are created automatically when a *DomainParticipant* is created from the <domain_participant> that contains the <publisher> and <subscriber> configurations.

Given the following example:

```
<domain_participant name="MyParticipant"
                    domain_ref="MyDomainLibrary::MyDomain">
    <publisher name="MyPublisher" multiplicity="2">
        ...
    </publisher>

    <subscriber name="MySubscriber">
        ...
    </subscriber>
</domain_participant>
```

Once a *DomainParticipant* is created as explained in Creating and Retrieving a DomainParticipant Configured in an XML File (Section 4.7.1), *Publishers* and *Subscribers* can be retrieved from the created *DomainParticipant* using their name as follows:

```
DDSPublisher * publisher =
    participant->lookup_publisher_by_name("MyPublisher");
if (publisher == NULL) {
    //handle error
}
```

```
DDSPublisher * publisher_1 =
    participant->lookup_publisher_by_name("MyPublisher#1");
if (publisher == NULL) {
    //handle error
}

DDSSubscriber * subscriber =
    participant->lookup_subscriber_by_name("MySubscriber");
if (subscriber == NULL) {
    //handle error
}
```

4.7.3 Creating and Retrieving DataWriters and DataReaders

DataWriters and *DataReaders* configured in XML are created automatically when a *DomainParticipant* is created from the <domain_participant> that contains the <data_writer> and <data_reader> configurations.

Given the following example:

```
<domain_participant name="MyParticipant"
    domain_ref="MyDomainLibrary::MyDomain">

    <publisher name="MyPublisher">
        <data_writer name="MyWriter" topic_ref="MyTopic"/>
    </publisher>

    <subscriber name="MySubscriber">
        <data_reader name="MyReader" topic_ref="MyTopic"/>
    </subscriber>

</domain_participant>
```

Once a *DomainParticipant* is created as explained in Section 4.7.1, *DataWriters* and *DataReaders* can be retrieved from the created *DomainParticipant* using their fully-qualified name as shown below:

```
DDSDataWriter * dataWriter =
  participant->lookup_dataWriter_by_name("MyPublisher::MyWriter");

if (dataWriter == NULL) {
    //handle error
}

DDSDataReader * dataReader =
  participant->lookup_datareader_by_name("MySubscriber::MyReader");

if (dataReader == NULL) {
    //handle error
}
```

Or from the created Publisher and Subscriber using their 'unqualified' name as shown below:

```
DDSDataWriter * dataWriter =
    publisher->lookup_dataWriter_by_name("MyWriter");

if (dataWriter == NULL) {
    //handle error
}
```

```
DDSDataReader * dataReader =
    subscriber->lookup_datareader_by_name("MyReader");
```

4.7.4 Creating Content Filters

To use a content filter, modify the "SubscriptionParticipant" configuration to look like this:

```
<participant_library name="MyParticipantLibrary">
    ...
    <domain_participant name="SubscriptionParticipantWithFilter"
        domain_ref="MyDomainLibrary::HelloWorldDomain">

        <subscriber name="subscriber">

            <data_reader name="HelloWorldReader"
                topic_ref="HelloWorldTopic">

                <datareader_qos name="HelloWorld_reader_qos"
                    base_name="qosLibrary::DefaultProfile"/>

                <filter name="HelloWorldTopic" kind="builtin.sql">
                    <expression>count> count < 20 </expression>
                </filter>

            </data_reader>
        </subscriber>
    </domain_participant>
</participant_library>
```

It adds a SQL content filter, which only accepts samples with the field count greater than two.

Now run the HelloWorld_subscriber application without recompiling and check that it only receives data when counter less than 20 as expected.

4.7.5 Using User-Generated Types

If a user-generated type by means of *rtiddsgen* is desired rather than dynamic data, the corresponding type support must be registered with the DomainParticipantFactory before creating a *DomainParticipant*. To register the type support, use the function **register_type_support()** in the DomainParticipantFactory, which takes (a) a pointer to a function that registers a type and (b) the type name it is registered with. Then the specified function will be called automatically by the middleware whenever the type registration is needed.

The definition of this function is given by:

```
typdef DDS_ReturnCode_t (*DomainParticipantFactory_RegisterTypeFunction)
                                (DDSDomainParticipant * participant,
                                 const char * type_name);
```

This "register type function" should be generated using the *rtiddsgen* command-line tool from the IDL or XML definition of the data type. See Hello World using XML and Compiled Types (Section 2.2) for a simple example of how to follow this process.

For example, the following XML snippet defines a data type registered under the name **MyType** with a TypeSupport that is user-generated. To use this data type, the application must also generate the TypeSupport code for the appropriate language binding using *rtiddsgen* and associate the generated TypeSupport with the name **MyType**. This association is made by calling the operation **register_type_support()** on the DomainParticipantFactory:

```
<domain name="MyDomain" domain_id="13">
        <register_type name="MyType" kind="userGenerated"/>
        ...
</domain>
```

Continuing the example above, assume that the structure of "MyType" is described in the IDL file **MyType.idl**. Also assume that you are using the C++ language API and you have already run rtiddsgen and generated the type-support files: **MyTypeSupport.h** and **MyTypeSupport.cxx**. These files will contain the declaration and implementation of the function **MyTypeSupport::register_type().** In this situation, you must associate the **MyTypeSupport::register_type()** operation with the type name **MyType** by calling **DDSTheParticipantFactory->register_type_support()** from your application code prior to creating the *DomainParticipant* as shown in the C++ snippet below:

```
DDS_ReturnCode_t * retCode =
    DDSTheParticipantFactory->register_type_support(
                            FooTypeSupport::register_type, "MyType");
if (retCode != DDS_RETCODE_OK) {
    //handle error
}
```

You can find an example of using a user-generated type in **<*installation directory*>/examples/CPP/HelloWorld_xml_compiled**. Also refer to the description of this example in Hello World using XML and Compiled Types (Section 2.2).