

RTI[®] DDS Toolkit for LabVIEW[™]

Getting Started Guide

Version 1.3.0



Your systems. Working as one.



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Chapter 1 Installation

1.1 Introduction

Developing heterogeneous distributed systems is a complex challenge. Individual subsystems are often developed by independent teams, third parties, and legacy systems. These complexities can be substantially reduced by leveraging the combined power of *RTI® Connex™ DDS* and National Instruments® LabVIEW™.

By using LabVIEW and *Connex DDS* together, you can develop advanced and unique system architectures to simplify system integration, data communication, network bandwidth management, and redundancy.



This document will help you install and get started with *RTI DDS Toolkit for LabVIEW*. The instructions assume you are already familiar with the basics of using LabVIEW.

1.2 Installing

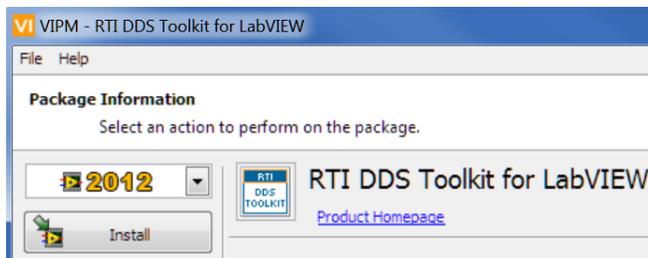
Note: If you are upgrading *RTI DDS Toolkit for LabVIEW*, skip to [Upgrading \(Section 1.5\)](#).

To Install RTI DDS Toolkit for LabVIEW:

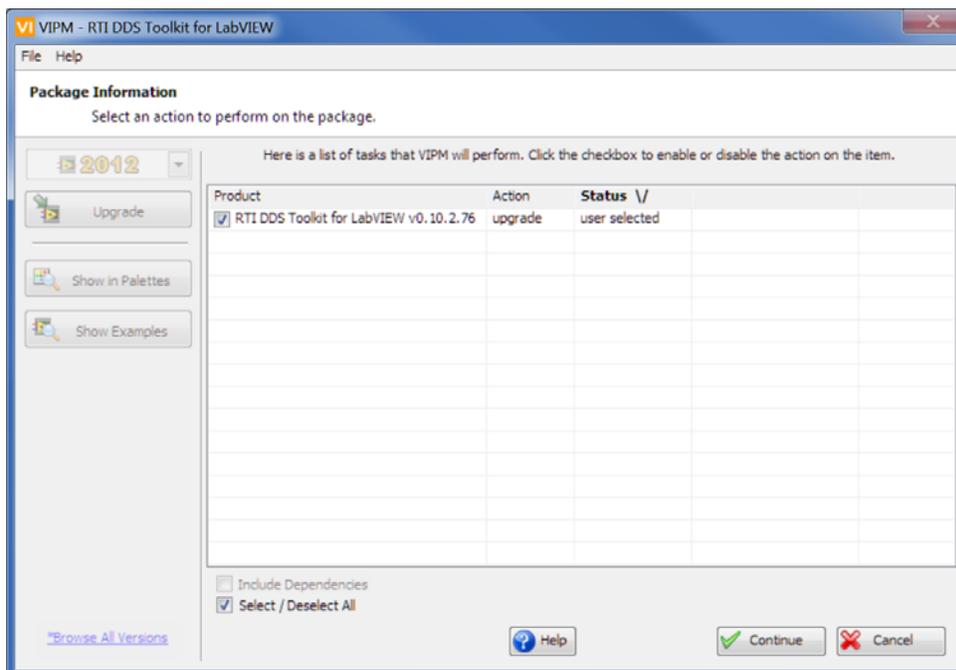
1. Verify you have a supported version of LabVIEW already installed (see the *Release Notes* for supported versions).
2. Login with administrator privileges.

3. Install the JKI LabVIEW VI Package Manager (VIPM) if you have not done so already (available here: <http://jki.net/vipm/download>). It is typically installed in **C:\Program Files (x86)\JKI\VI Package Manager**.
4. Ensure that LabVIEW is *not* running.
5. Launch the VIPM, then:
 - a. From the **File** menu, select **Open Package File(s)**.
 - b. Locate and open the **RTI DDS Toolkit for LabVIEW .vip** file provided by RTI, such as **real-time_innovations_lvdds-<version>.vip**.
6. Install *RTI DDS Toolkit for LabVIEW*:
 - a. Select the LabVIEW version for which you want to install *RTI DDS Toolkit for LabVIEW*.

If you have more than one version of LabVIEW installed, you will be able to select a version from a drop-down list.



- b. Select **Install**.
7. The VIPM will start the installation process and display a window similar to the one below. Select **Continue** to proceed.



Note: When running the VIPM for the first time, the VIPM will test the connection to LabVIEW and display the default port for LabVIEW. Select **Test** and allow the test to complete.

During this step, the VIPM launches the LabVIEW version selected for the *RTI DDS Toolkit for LabVIEW* installation. The LabVIEW application will appear in the Windows Task Bar at the bottom of your screen. You may need to open the LabVIEW application from the Task Bar and select **Launch LabVIEW** before the VIPM test times out.

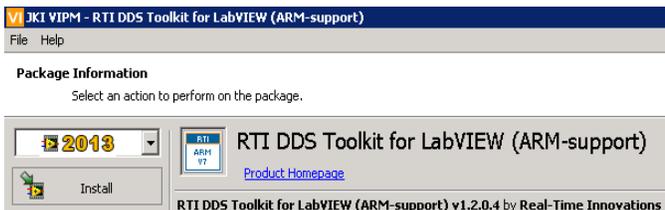
8. If offered, select **Finish** when the installation is complete.

1.2.1 Installing RTI DDS Toolkit for LabVIEW Support Files on a Target

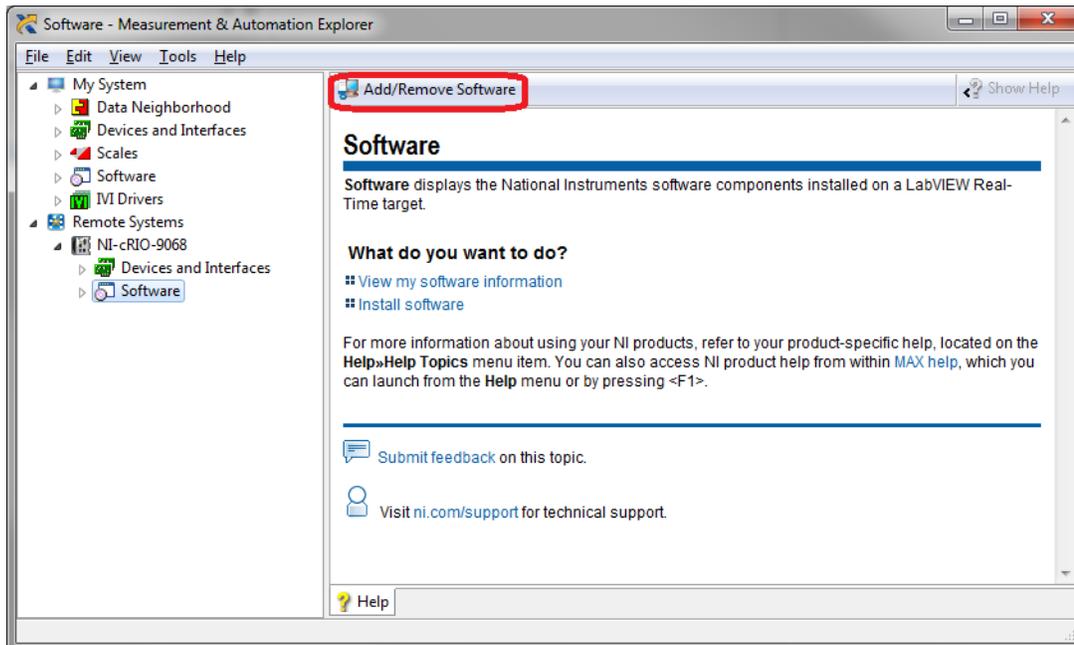
To install cRIO support for RTI DDS Toolkit for LabVIEW:

RTI DDS Toolkit for LabVIEW support files allow you to deploy VIs using the RTI DDS Toolkit for LabVIEW into your target. The following instructions assume you have JKI VIPM and LabVIEW installed.

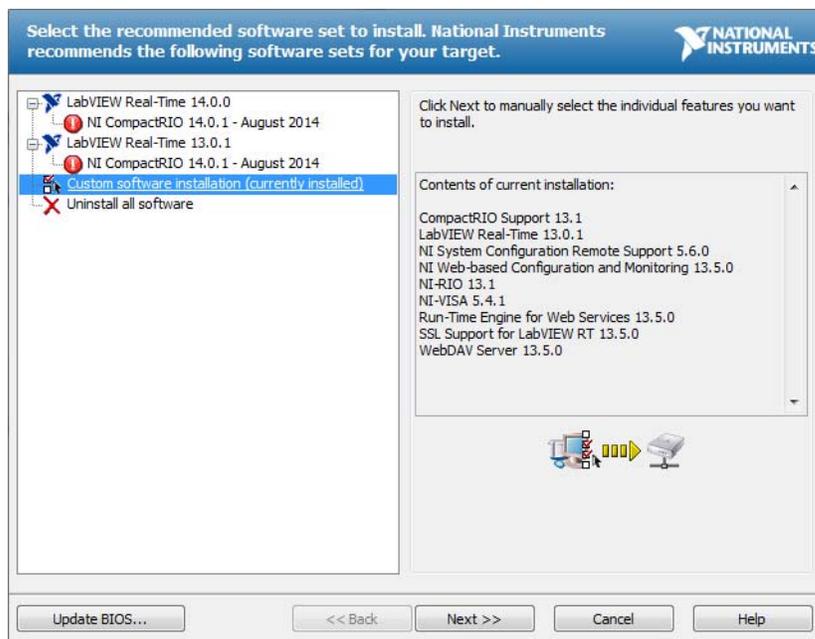
Note: Your target will be rebooted as part of the installation process.

1. Ensure that LabVIEW is *not* running.
2. Launch the VIPM as administrator, then:
 - a. From the **File** menu, select **Open Package File(s)**.
3. Locate and open the **RTI DDS Toolkit for LabVIEW Support Files .vip** file provided by RTI, such as **real-time_innovations_lvdds_arm_support_-<version>.vip**.
4. Install *RTI DDS Toolkit for LabVIEW*:
 - a. Select the LabVIEW version for which you want to install *RTI DDS Toolkit for LabVIEW Support Files*.
 If you have more than one version of LabVIEW installed, you will be able to select a version from a drop-down list.
 
 - b. Select **Install**.
 - c. The VIPM will start the installation process. Select **Continue** to proceed.
 - d. Once installed, you can close VIPM.
5. Launch NI MAX (Measurement & Automation Explorer).
6. Navigate to **Remote Systems** and select your cRIO-9068.

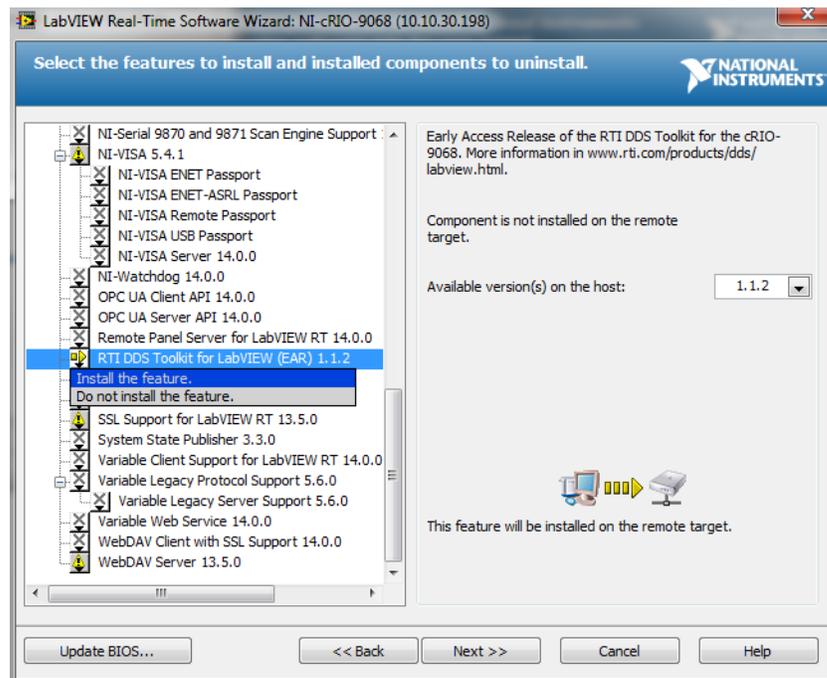
- Go to **Software** and click on **Add/Remove Software** to launch the LabVIEW Real-Time Software Wizard..



- Login with administration privileges in your cRIO-9068.
- In the LabVIEW Real-Time Software Wizard, select **Custom software installation**. A dialog will ask if you are sure you want to install customized software. Click **yes**.



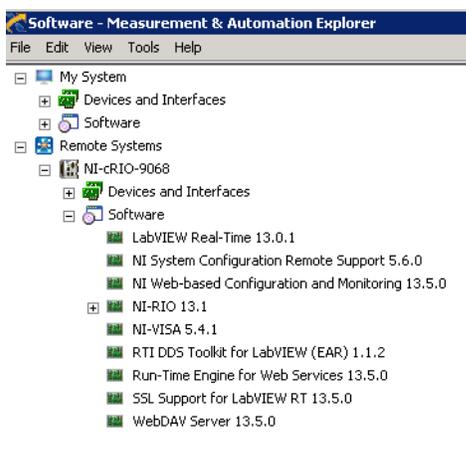
10. Navigate to the RTI DDS Toolkit for LabVIEW feature, click on the icon to the left of the name and select **Install the feature**.



Note: If you are upgrading to a newer release, make sure you select the newest version from the drop-down list on the right side (**Available version(s) on the host**).

11. Click **Next** and verify **RTI DDS Toolkit for LabVIEW** is selected to be installed.
 12. Click **Next**. The installation will start, then the cRIO-9068 will automatically reboot.

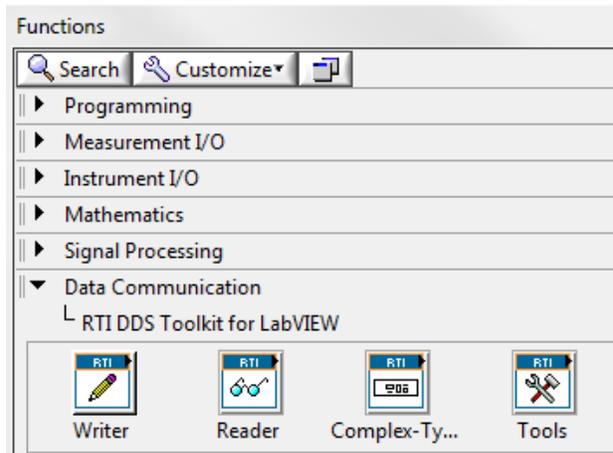
After installation, **RTI DDS Toolkit for LabVIEW** will appear in the installed Software list of your cRIO.



1.3 Verifying Installation

1. Launch LabVIEW.
2. Select **File, New VI**.
3. From the Block Diagram's **View** menu, open the **Functions Palette**. From this palette, select the down arrows at the bottom. Select **Data Communication** and verify that you see **RTI DDS Toolkit for LabVIEW**.

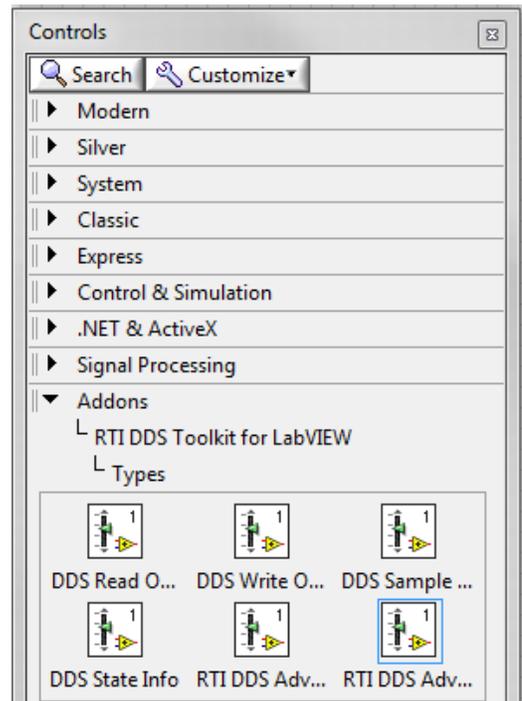
For details, see [LabVIEW Functions Palette \(Section 1.3.1\)](#).



4. From the Front Panel's **View** menu, open the **Controls Palette**. From this palette, select the down arrows at the bottom. Select **Addons** and verify that you see RTI DDS Toolkit for LabVIEW.

For details, see [LabVIEW Controls Palette \(Section 1.3.2\)](#).

See also: [Appendix D: File Folders Installed within LabVIEW](#).



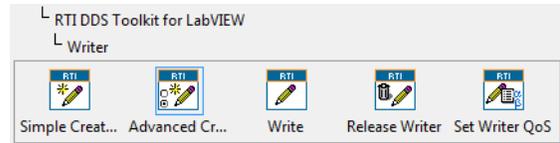
1.3.1 LabVIEW Functions Palette

RTI DDS Toolkit for LabVIEW adds the following to the Data Communication section of the Block Diagram's Functions Palette:

☐ *RTI DDS Toolkit for LabVIEW*

- **Writer**

- Simple Create Writer
- Advanced Create Writer
- Write
- Release Writer
- Set Writer QoS



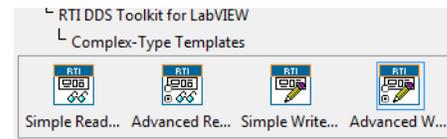
- **Reader**

- Simple Create Reader
- Advanced Create Reader
- Read
- Release Reader
- Set Reader QoS



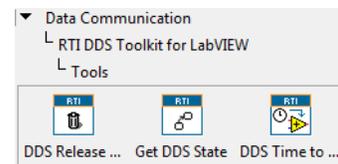
- **Complex-Type Templates**
(to publish or subscribe to complex data)

- Simple Reader Template
- Advanced Reader Template
- Simple Writer Template
- Advanced Writer Template



- **Tools**

- DDS Release Unused Entities
- Get DDS State
- DDS Time to LV Time



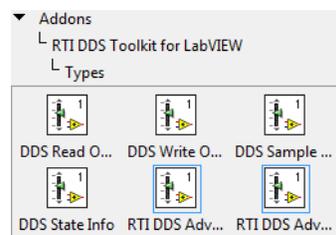
1.3.2 LabVIEW Controls Palette

RTI DDS Toolkit for LabVIEW adds the following to the Addons section of the Front Panel's Controls Palette:

☐ *RTI DDS Toolkit for LabVIEW*

- **Types**

- DDS Read Object Ref
- DDS Write Object Ref
- DDS Sample Info
- DDS State Info
- RTI DDS Advanced Reader Configuration
- RTI DDS Advanced Writer Configuration



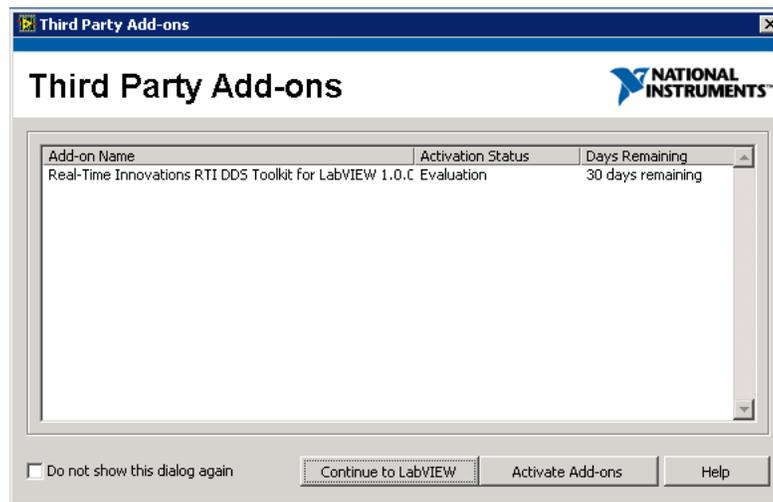
1.4 License Management

1.4.1 Activating the Add-on License on Windows Systems

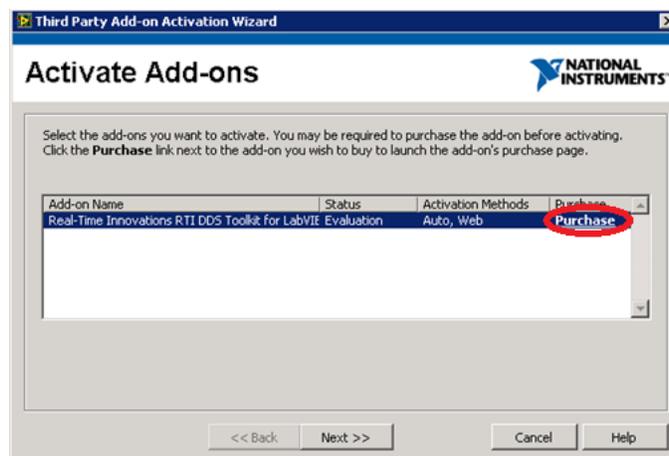
RTI DDS Toolkit for LabVIEW comes with a 30-day license. You can easily obtain a permanent license; which has a \$0 cost for 32-bit LabVIEW users.

To purchase and activate your permanent license follow these steps:

1. Open the Third Party Add-ons dialog. This dialog opens automatically when LabVIEW opens. You can also open it from LabVIEW by selecting **Help, Activate Add-ons....**
2. Select *RTI DDS Toolkit for LabVIEW*, then click on **Activate Add-ons**.



3. If you don't have a licenseID, click on **Purchase**. A web browser will open this URL:
<https://softwarekey.ni.com/solo/products/ProductOption.aspx?ProdOptionID=1443>.



- Click on **Order Now!** and follow the instructions on the website. You will need to register and provide some customer information. Then you will receive a License ID and Password, which you will need to activate your license:



Order Complete

Real-Time Innovations Date: 00/00/0000
Invoice #00000000000

Customer Information:

Billing Information:
Terms: Prepaid

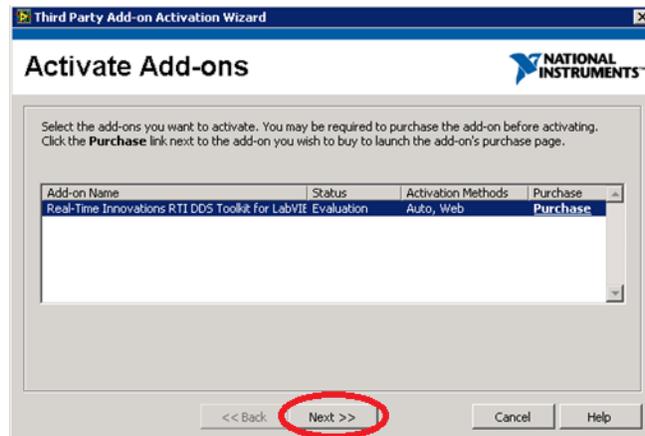
Order Information:

| Description | Quantity | Unit Price | Extended Price |
|--|----------|------------|----------------------|
| RTI DDS Toolkit for LabVIEW License | 1 | \$0.00 | \$0.00 |
| License ID:00000000 Password:***** | | | |
| The application will ask for a License ID and Password to enable it. Use the values above to activate your purchase. | | | |
| | | | Total: \$0.00 |

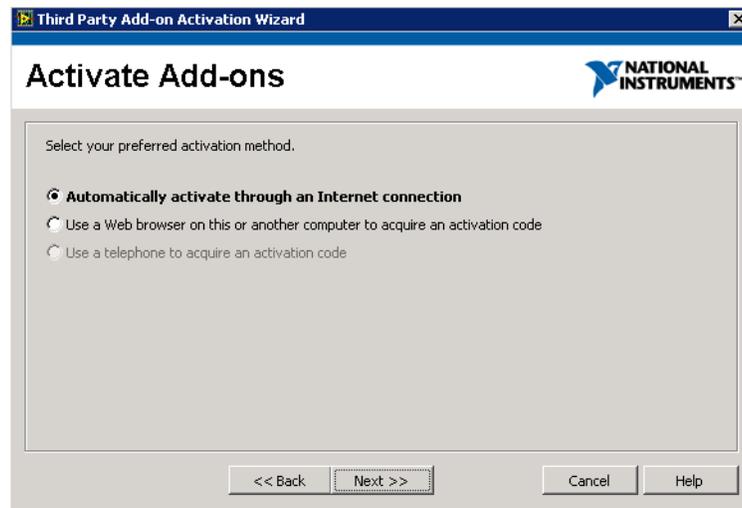
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Sales Email: labview@rti.com
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Print

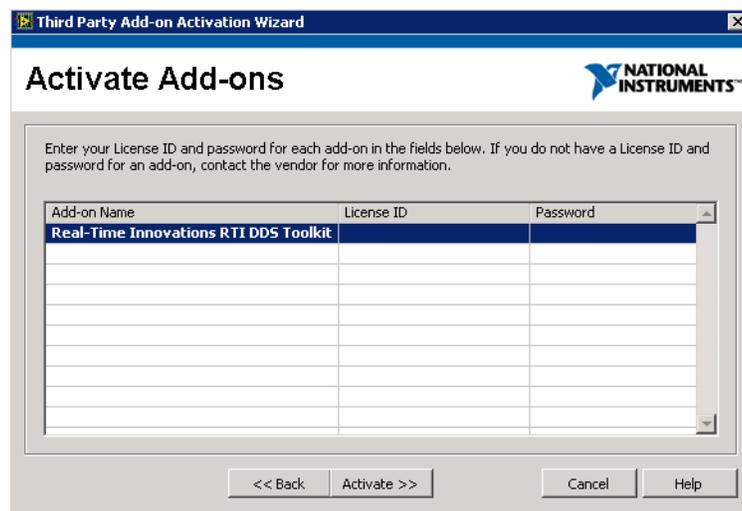
- Go back to the Activation Wizard and click on **Next>>**.



6. Select an activation method:



7. Use the LicenseID and Password from [Step 4](#) to complete the activation process. Follow the instructions in the wizard.



1.4.2 License Management on the cRIO

In general, *RTI DDS Toolkit for LabVIEW* requires a license file to run on a cRIO. Our cRIO licenses are associated to the target's MAC address, so each board requires its own license. This is why you will need to provide that MAC address as part of the license request process.

After purchasing your RTI DDS Toolkit support files for the cRIO, you will receive an email containing a Product Activation Code. Use this code and your target's MAC address to request a license file in this website: www.rti.com/go/labview-license-request.

1.4.2.1 Installing a New License File

After requesting your license as explained above, you will receive a new license file by email. Copy the license file to the following folder in your cRIO target:

```
/home/lvuser/rti/rti_license.dat
```

You can copy the file using Secured FTP directly to your target. Use any FTP Client that supports sftp protocol such as *Filezilla* and connect directly to your target's IP. You will be prompted to introduce your user name and password.

If an old license file is already installed in the above folder, please replace it with the new one.

1.5 Upgrading

If you have already installed *RTI DDS Toolkit for LabVIEW* and are upgrading to a newer release:

1. Login with administrator privileges.
2. Ensure that LabVIEW is not running.
3. Launch the VIPM, then:
 - a. Select **File, Open Package File(s)**
 - b. Find and open the latest *RTI DDS Toolkit for LabVIEW .vip* file
4. Upgrade *RTI DDS Toolkit for LabVIEW*
 - a. Select the LabVIEW version for which you want to upgrade *RTI DDS Toolkit for LabVIEW*.
 - If you have more than one version of LabVIEW installed, you will be able to select the LabVIEW version from the LabVIEW version drop down list.
 - The VIPM allows you to view all versions of *RTI DDS Toolkit for LabVIEW* available to your system by selecting ***Browse All Versions** in the lower-left corner.
 - b. Select **Upgrade**.
5. The VIPM will start the installation process. Select **Continue** to proceed.
6. If prompted, select **Finish** when the installation is complete.

1.5.1 Additional Steps when Upgrading to Version 1.2.0.90 or Later

If you have upgraded from a version previous to 1.2.0.90, you will need to follow these steps to upgrade your VIs to a newer version. Follow these instructions after upgrading the toolkit.

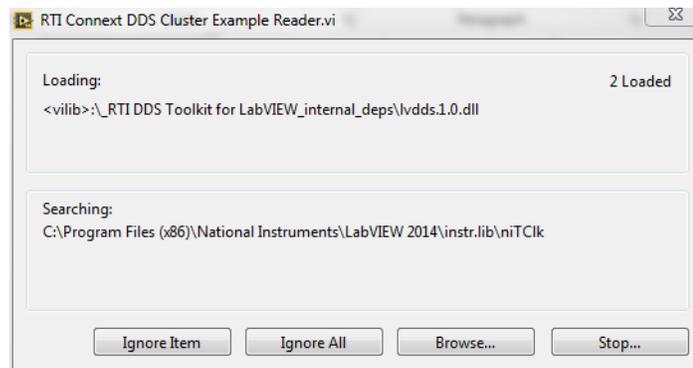
1. The VIs that use simple types (which currently call the *Create Reader/Writer* subVIs) need no additional changes to work. However, the *Create Reader/Writer* subVIs have been deprecated; their icons have changed to reflect this:



We strongly recommend that you upgrade the VIs to use the *Simple Create Reader/Writer* or *Advanced Create Reader/Writer*. The old *Create Reader/Writer* subVIs will be removed in future releases. See Chapter 6 for details.

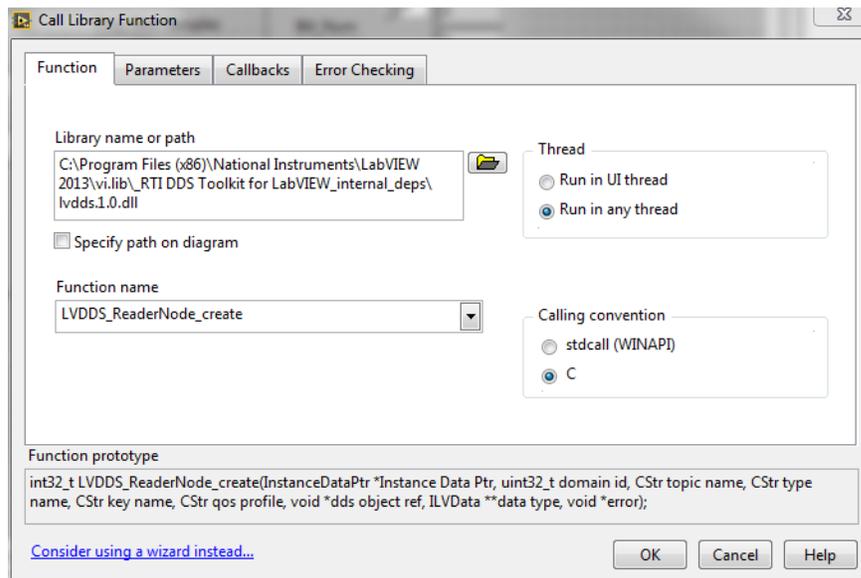
2. For each VI using complex types (clusters, enums or arrays)

- a. Open the VI. A window searching for a missing DLL will appear.

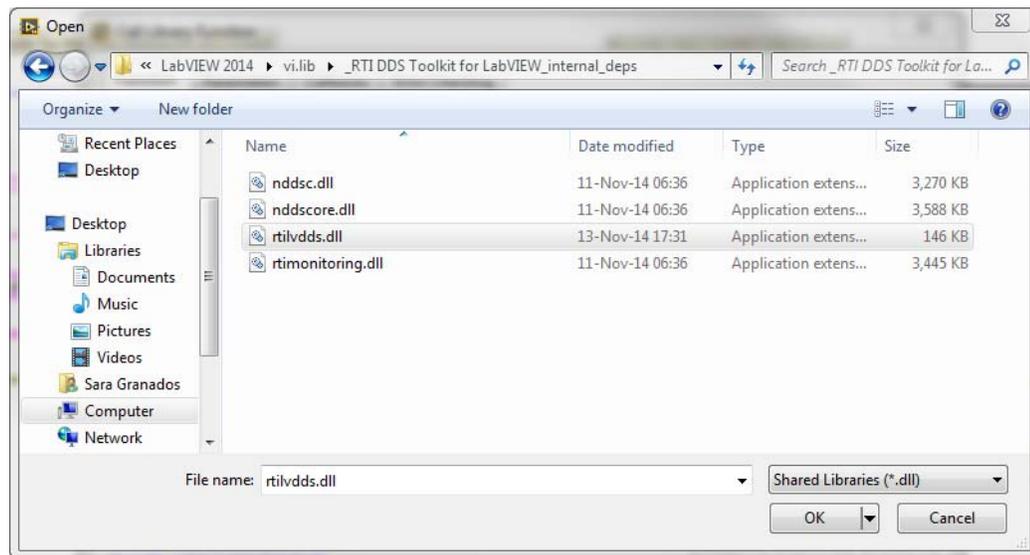


Starting in version 1.2.0.90, the *RTI DDS Toolkit for LabVIEW* library name has been changed from **lvdds.1.0.dll** to **rtilvdds.dll**. Thus, LabVIEW cannot find that library.

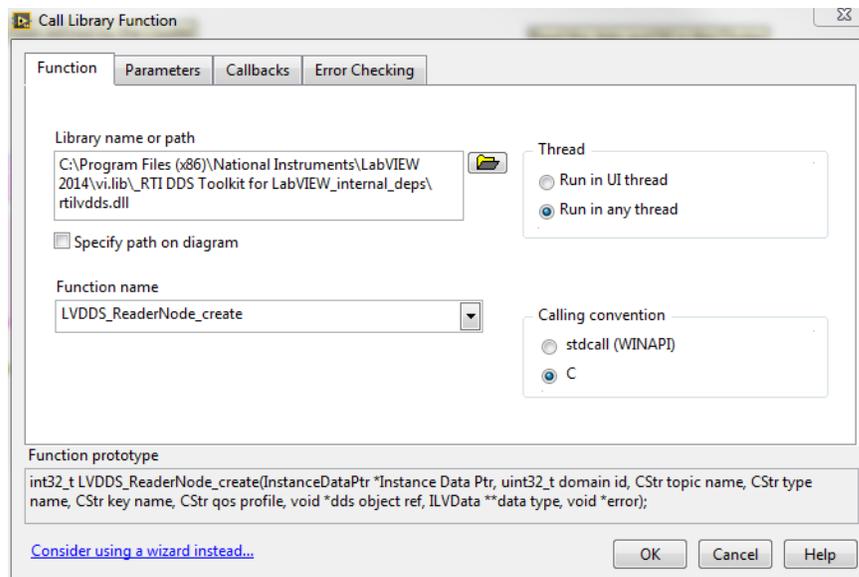
- b. A file browser will be shown. Click **Cancel** and **Ignore All**.
- c. Your VI will be loaded with a broken arrow.
- d. For each Call Library Function node (CLF) in the Block Diagram,
- Open the CLF by double-clicking on it.
 - Click on the folder icon to the left of the Library name or path box in the Function tab.



- Navigate to <LabVIEW folder>\vi.lib_RTI DDS Toolkit for LabVIEW_internal_deps. Select the library rtlvdds.dll.



- The resulting CLF should look like this:



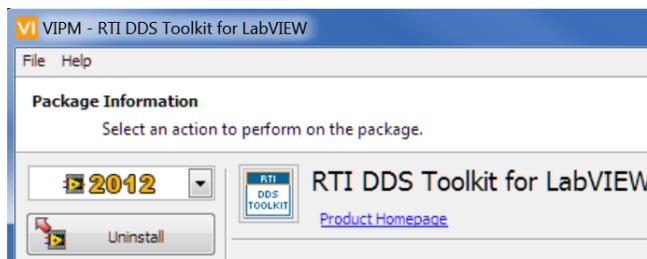
- Click OK.
- e. If you are updating a *Reader* subVI, the data output pin of the *Read* CLF may look broken. Wire a complex type of the same type as the data output as input of the *Read* CLF. After LabVIEW recognizes the type, the error will be correct. Then you should delete the type in the input and verify that the connected wire is still valid.

1.6 Uninstalling

To uninstall *RTI DDS Toolkit for LabVIEW*:

1. Login with administrator privileges.
2. Ensure that LabVIEW is *not* running.
3. Launch the VIPM, then:
 - a. Scroll down to locate **RTI DDS Toolkit for LabVIEW**.
 - b. Double-click on **RTI DDS Toolkit for LabVIEW** to open the Package Information screen.
4. Select the LabVIEW version you want to work with from the LabVIEW version drop-down list.

Note: The VIPM allows you to view all versions of *RTI DDS Toolkit for LabVIEW* available to your system by selecting ***Browse All Versions** in the bottom left-hand corner.



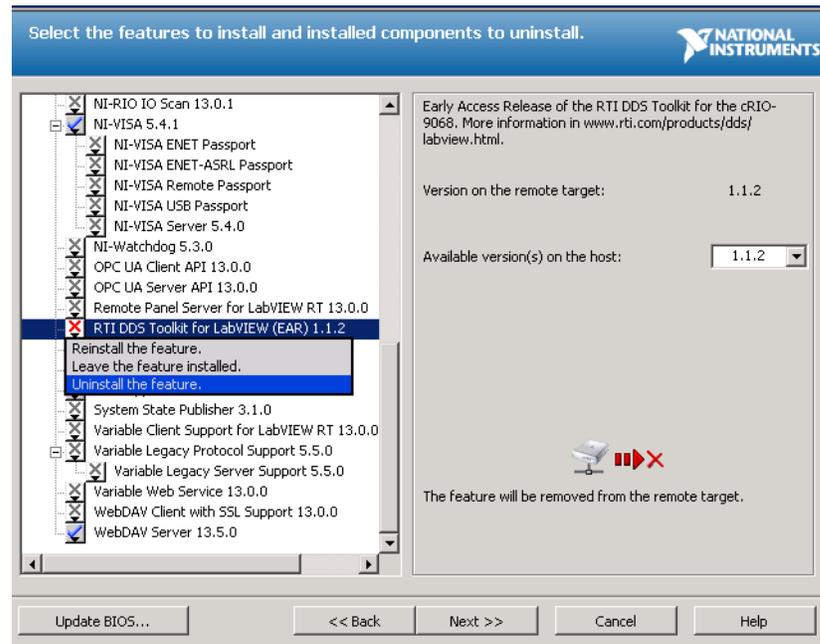
5. Select **Uninstall**.
6. Select **Continue**.
7. If offered, select **Finish** when the VIPM finishes uninstalling *RTI DDS Toolkit for LabVIEW*.

1.6.1 Uninstalling RTI DDS Toolkit for LabVIEW Support Files from cRIO-9068

To uninstall cRIO support for RTI DDS Toolkit for LabVIEW:

1. Make sure no LabVIEW application is using the libraries on the cRIO-9068.
2. Launch NI MAX.
3. Navigate to **Remote Systems** and select your cRIO-9068.
4. Go to **Software** and click on **Add/Remove Software** to launch the LabVIEW Real-Time Software Wizard.
5. Login with administration privileges to your cRIO-9068.

- In the LabVIEW Real-Time Software Wizard, select **Custom software installation**. A dialog will ask if you are sure you want to install customized software. Click **yes**.



- Navigate to the **RTI DDS Toolkit for LabVIEW** feature, click on the icon to the left of the name and select **Uninstall the feature**.
- Click **Next** and verify **RTI DDS Toolkit for LabVIEW** is selected to be uninstalled.
- Click **Next**. The uninstallation will start, then the cRIO will automatically reboot.

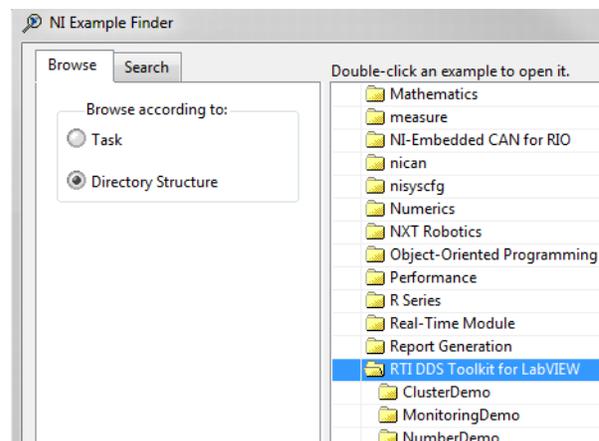
1.7 LabVIEW Examples

RTI DDS Toolkit for LabVIEW includes several examples which are used in later chapters. To access these examples:

- Select the LabVIEW **Help** menu.
- Select **Find Examples...**
- In the Browse tab, select the radio button to browse according to **Directory Structure**:
- Scroll down and open the **RTI DDS Toolkit for LabVIEW** folder
- Open the **Examples** folder.

You will find the following examples:

- ClusterDemo**: Shows how to handle complex types (such as clusters). It was created by following the lessons in [Chapter 4: Tutorial](#)



- (Lesson 2—Using Templates to Publish and Subscribe to Complex Data (Clusters) (Section 4.2))
 - Lesson 3—Filtering Data (Section 4.3)
 - Lesson 4—Reading Only New Samples (Section 4.4)).
- ❑ **cRIOProject**: Shows how to use *RTI DDS Toolkit for LabVIEW* on a cRIO 9068. It is explained in Lesson 9—Using the RTI DDS Toolkit on a cRIO-9068 Target (Section 4.9).
 - ❑ **MonitoringDemo**: Uses a QoS profile that enables *RTI Monitoring Library*. It was created by following Lesson 8—Debugging Your RTI Connex DDS Application Using a Monitoring Profile (Section 4.8).
 - ❑ **NumberDemo**: Shows how to read and write a simple type (such as a numeric one). It was created by following Lesson 1—Using DDS to Publish and Subscribe to Simple Data (Numeric) (Section 4.1).
 - ❑ **ReadAllDemo**: Shows how to read all available data by calling the Read function several times and storing the data in an array without adding already existing samples. It is explained in Lesson 7—Reading All Samples (Reliable Communication) (Section 4.7).
 - ❑ **ShapesDemo**: Shows how to publish and subscribe to an already existing DDS application: *RTI Shapes Demo*. It is explained in Lesson 5—Using Keyed Types (RTI Shapes Demo) (Section 4.5).
 - ❑ **StringsDemo**: Shows how to write a string. It is explained in Chapter 3: A Simple Read/Write Example.

Note: If you see an error after opening one of the examples (such as “*This application has failed to start because its side by side configuration is incorrect*”), see Section 3.4.3.

1.8 Product Support

For technical support or questions about *RTI DDS Toolkit for LabVIEW*, please visit the RTI Community portal (<http://community.rti.com>).

If you have an RTI support subscription, please contact support@rti.com. If you do not have an RTI support subscription, you can acquire one by contacting labview@rti.com.

Chapter 2 Communication Models

This section provides an overview of middleware communication paradigms, including publish-subscribe, along with details of the OMG Data Distribution Service (DDS) standard.

Software applications are becoming increasingly distributed. A node in a distributed system must access the right data, know where to send it, and deliver it to the right place at the right time. Simplifying the access to this data would enable a whole new class of distributed applications. The challenge, especially in mission-critical and time-critical networks, is to quickly access and disseminate information to many nodes.

Three major middleware communication paradigms have emerged to meet this need:

- ❑ Client/Server
- ❑ Message passing
- ❑ Publish/Subscribe

Client/Server is fundamentally a many-to-one design that works well for systems with centralized information, such as databases, transaction processing systems, and central file servers. However, if multiple nodes generate information, client/server architectures require all the information be sent to the server for later redistribution to the clients, resulting in inefficient client-to-client communication.

The central server is a potential bottleneck and single-point of failure. It also adds inefficiencies and unknown delay (and therefore indeterminism) to the system, because the receiving client does not know when it has a message waiting, so it has to keep polling periodically.

Message Passing architectures work by implementing queues of messages. Processes can create queues, send messages, and service messages that arrive. Message passing makes it easier to exchange information between many nodes in the system. However, applications remain coupled. Each message placed in a queue goes to a single consumer and the addition of new consumers impacts the network.

In practice, applications find data indirectly by targeting specific sources (e.g., by process ID, "channel", or queue name) on specific nodes. So this architecture does not address how applications know the location of a process/channel, what happens if that process/channel does not exist, etc. The application must determine where to get data, where to send it, and when to perform the transaction. A message-passing architecture provides a model for the transfer of data, but no model for the data itself.

Publish/Subscribe decouples the producers and consumers of the information. Producer publishes data they have and consumers subscribe to data based on their interests. The publish/subscribe middleware infrastructure is responsible for delivering each message published to all interested consumers. Applications remain decoupled because the presence of new consumers

does not perturb existing consumers. Existing consumer's requirements are met, regardless of how many other consumers subscribe to the same data.

The fundamental communications model implies both discovery (i.e., *what* data should be sent) and delivery (i.e., *when* and *where* to send the data). This design mirrors time-critical and mission-critical information delivery systems in everyday life (e.g., television, radio, magazines and newspapers). The publish/subscribe network architecture is excellent at distributing large quantities of time-critical information quickly, even in the presence of unreliable delivery mechanisms.

The publish/subscribe architecture maps well to high-performance and real-time communication challenges. Finding the right data becomes straightforward; nodes just declare their interest once and the middleware handles all the details of the network and delivery. Sending the data quickly is also inherent; publishers send data when the data is available. Publish/subscribe is highly efficient because the data flows directly from source (publisher) to destination (subscriber) without requiring intermediate servers, brokers, or daemons. Multiple sources and destinations are easily defined within the model, providing inherent redundancy and fault tolerance.

Data-Centric Publish/Subscribe (DCPS) middleware, such as the OMG Data Distribution Service (DDS), defines a data model on top of the publish/subscribe infrastructure, allowing the data to be structured. The schema of the data being published is declared by the application and known to the middleware. Similar to the relational model in databases, each data type (a DDS *Topic*) has an associated schema and a set of attributes that identify the 'key' for that *Topic*. Data published on that *Topic* is understood by the middleware, allowing advanced capabilities such as content-based filtering, last value (or history) caching, and applying fine-grained Quality of Service (QoS) separately for each data-object written to the *Topic*.

In summary,

- ❑ Client/server middleware is best for centralized data designs and for systems where the dominant communication pattern is request-reply, such as file servers and transaction systems.
- ❑ Message passing, with its "send that there" semantics, maps well to systems with clear and simple data-flow requirements, and requires the application to discover where data resides.
- ❑ Publish/subscribe, by providing both discovery and messaging, decouples the producers and consumers effectively. DCPS middleware provides publish/subscribe services to an application-defined data-model, allowing fine-grained control of QoS, enabling the infrastructure to do smart-caching of the information and provide content and time filtering at the source and destination. The data-centric architecture provides the best decoupling between application components and is best suited for time-critical and mission critical distributed applications.

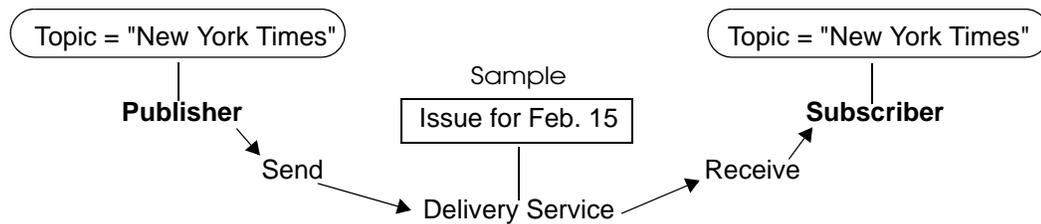
2.1 Publish/Subscribe – A Simple Analogy

The publish/subscribe communications model is analogous to that of a traditional magazine or newspaper business model. A *Topic* represents the kind of publication (data or information), for example "Newspaper" or "Magazine". If we use the Newspaper as the model, the Key is used to identify each different news corporation ("New York Times", "San Francisco Chronicle", "La Strada", "Le Monde", etc.). The type specifies the format of the information (how it is encoded). The user data is the contents (text and graphics) of each sample (weekly or daily issues). The middleware is the distribution service (US Postal Service or a paper delivery service) that deliv-

ers the publication from where it is created (a printing house) to the individual subscribers (people's homes). This analogy is illustrated in [Figure 2.1](#).

Note that by subscribing to a publication, subscribers are requesting current and future samples of that publication, so that as new samples are published, they are delivered without having to submit another request for data. By specifying a content-filter on the value of the Key (the periodical name in this case) a subscriber may indicate he only wants certain periodicals (e.g., yes to the "New York Times" and "La Strada", but no to others). Content filters could also select based on other attributes in the data (e.g., select the ones written in a specific language, or coming from a specific region). Time-based filters can be used to request only a subset of the samples (e.g., only the Sunday edition).

Figure 2.1 **An Example of Publish-Subscribe**



The publish/subscribe model is analogous to publishing magazines or newspapers. The Publisher sends samples of a particular Topic to all Subscribers of that Topic.

In this example, Quality of Service (QoS) parameters can be linked to delivery requirements; only deliver the Sunday edition, the paper must be delivered by 7:00am, the paper must be in the mailbox or on the porch, or delivered by certified mail with the subscriber signing receipt of delivery.

QoS parameters specify how, where, and when the data is to be delivered, controlling not only transport-level delivery properties, but also application-level concepts of fault tolerance, ordering, and reliability.

2.2 The DDS Paradigm

The Object Management Group (OMG) Data Distribution Service (DDS) standard the comprehensive specification available for publish/subscribe data-centric designs. The DDS publish/subscribe model connects anonymous information producers (publishers) with information consumers (subscribers). The overall distributed application is composed of processes called "Participants," each running in a separate address space, and often on different computer or system nodes. A Participant may simultaneously publish and subscribe to typed data-streams identified by a string name, these streams are called *Topics* in DDS. The model allows publishers and subscribers to present type-safe interfaces to the application.

DDS defines a communications relationship between publishers and subscribers. The communications are decoupled in space (nodes can be anywhere—same node, a local node, or a geographically remote node), time (delivery may be immediate or controlled), and flow (delivery may be reliable with a controlled bandwidth). To increase scalability, *Topics* may contain multiple independent data channels identified by "Keys." This allows system nodes to subscribe too many, possibly thousands, of similar data streams with a single subscription. When the data

arrives, the middleware can cache and sort data using the Key and deliver it for efficient processing.

Additionally, DDS is fundamentally designed to work over unreliable transports, such as UDP, wireless, or disadvantaged networks without the requirement for central servers or special nodes. Direct, peer-to-peer communications, and support for reliable multicasting, enable a highly efficient data distribution model.

2.3 Quality of Service (QoS)

Fine-grained control over QoS is a powerful feature of DDS. Each publisher/subscriber pair can establish independent QoS agreements. Thus, DDS designs can support extremely sophisticated and flexible data-flow requirements.

QoS parameters control most aspects of the DDS paradigm and the underlying communication mechanisms. Many QoS parameters are implemented as "contracts" between publishers and subscribers; publishers offer and subscribers request levels of service. The middleware is responsible for determining if the offerer can satisfy the subscriber's request, thereby establishing communication, or indicating an incompatibility error. Ensuring that publish/subscribe pairs meet the level-of-service contracts guarantees predictable operation. Information about some common QoS parameters is presented below.

- ❑ **Deadline:** Periodic publishers can indicate the speed at which they can publish by offering guaranteed update deadlines. By setting a deadline, a compliant publisher promises to send a new update on each key at a minimum rate. Subscribers may then request data at that or any slower rate.
- ❑ **Reliability:** Publishers may offer levels of reliability, parameterized by the number of past issues they can store for the purpose of retrying transmissions. Subscribers may then request differing levels of reliable delivery, ranging from fast-but-unreliable "best effort" to highly reliable in-order delivery. This provides per-data stream reliability control.
- ❑ **Strength:** The middleware can automatically arbitrate between multiple publishers of the same data with a parameter called "strength." For each keyed data-object the subscriber receives data only from the strongest active publisher of that key. This provides automatic failover; if a strong publisher fails, all subscribers immediately receive updates from the backup (weaker) publishers.
- ❑ **Durability:** Publishers can declare "durability," a parameter that determines how long previously published data is saved. Late-joining subscribers to durable publications can then be updated with a snapshot containing the most current set of values for each Key.

Other QoS parameters control when the middleware detects nodes that have failed, suggest latency budgets, set delivery order, attach user data, prioritize messages, set resource utilization limits, partition the system into namespaces, and more. The DDS QoS facilities offer extensive flexibility and communications control.

RTI DDS Toolkit for LabVIEW includes a set of predefined QoS profiles. These profiles are embedded in *RTI DDS Toolkit for LabVIEW* and cannot be modified. You can inherit from them. For your convenience, you can find an XML file that shows you these profiles in **C:/Program Files¹/National Instruments/LabVIEW 20xx/vi.lib/_RTI DDS Toolkit for LabVIEW_internal_deps/RTI_LABVIEW_CONFIG.documentationONLY.xml** (where 20xx depends on your LabVIEW version). As the filename suggests, this file is for documentation purposes only. This file is not

1. On 64-bit systems, the folder is "Program Files (x86)"

loaded by the *RTI DDS Toolkit for LabVIEW*, so updating it will not affect the embedded QoS profiles.

On RTI's Community Forum (<http://community.rti.com>), you can find more information about QoS properties and XML configuration, as well as the XSD schema.

2.4 DDS—Example Application

An air traffic control system provides sufficient details and requirements for an example application. An air traffic control system may monitor and direct all flights over an entire continent. The data distributed in such a system is in the form of aircraft tracks, which provides positional information (e.g., course, speed, etc.) about an airplane. Components of an air traffic control system would include radar systems, airplanes and air traffic control centers that provide current flight status information through real-time displays.

Managing the correct distribution of data in such a system can be complex. Each radar system can track many different airplanes, and each airplane may be tracked by more than one radar system. Real-time access to this information is needed for displays at air-traffic control centers so that air traffic controllers can make informed decisions. Air traffic controllers in the north-east may only want aircraft track information in their area, so only a subset of data needs to be provided to them. Based on current local conditions (e.g., air traffic, weather, etc.) air traffic controllers may issue flight plan updates to the pilot in order to route around inclement weather and other airplanes. Though a specific plane does not need flight plans from all other air planes, it would be useful to have information about planes in the immediate vicinity.

Defining the air traffic control system in terms of publishers, subscribers and QoS parameters reveals that DDS is a natural fit to address this data distribution problem. Each radar system can be thought of as a publisher that publishes the "tracks" Topic which describes an airplane's positional information. Each airplane that the radar system is tracking can be thought of as an "instance" of the track Topic identified by a unique Key attribute (e.g., the Airline name and flight number). The real-time controller displays subscribe to the tracks Topic and publish "flight plan" Topic updates back to the specific airplane. QoS parameters can be used to manage and control deterministic behaviors and fault tolerance capabilities of the system.

Chapter 3 A Simple Read/Write Example

The best way to learn about *RTI DDS Toolkit for LabVIEW* is to begin building example applications. The following example VIs provide a quick introduction to the capabilities:

- ❑ RTI Connex DDS Read String Example.vi
- ❑ RTI Connex DDS Write String Example.vi

After reading this chapter, we recommend completing the lessons in [Chapter 4: Tutorial](#) for a more in-depth look at the capabilities of *RTI DDS Toolkit for LabVIEW*.

Note: The instructions for this example assume you are already familiar with LabVIEW.

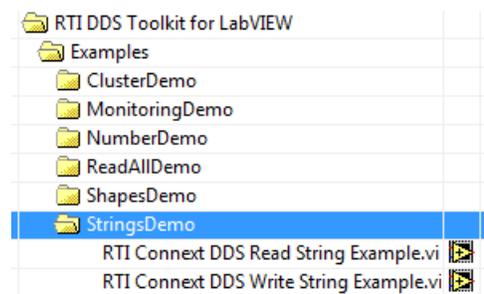
Before continuing, please make sure you have the following software installed:

- ❑ LabVIEW (32-bit) for Windows (see the *Release Notes* for supported versions)
- ❑ *RTI DDS Toolkit for LabVIEW*

If you are using a computer that does not have an active network interface, see [Appendix A](#).

We will start with the *StringsDemo* example VIs. To access the examples:

1. Launch LabVIEW.
2. From the LabVIEW **Help** menu, select **Find Examples...**
3. Select the **Browse according to: Directory Structure** radio button
4. Scroll down and open the **RTI DDS Toolkit for LabVIEW** folder
5. Open the **Examples** folder
6. Open the **StringsDemo** folder

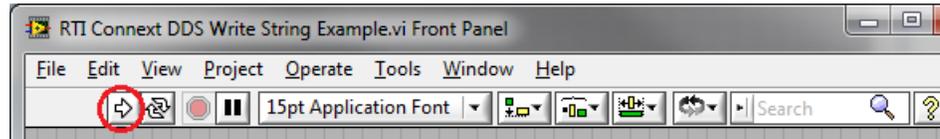


Notes:

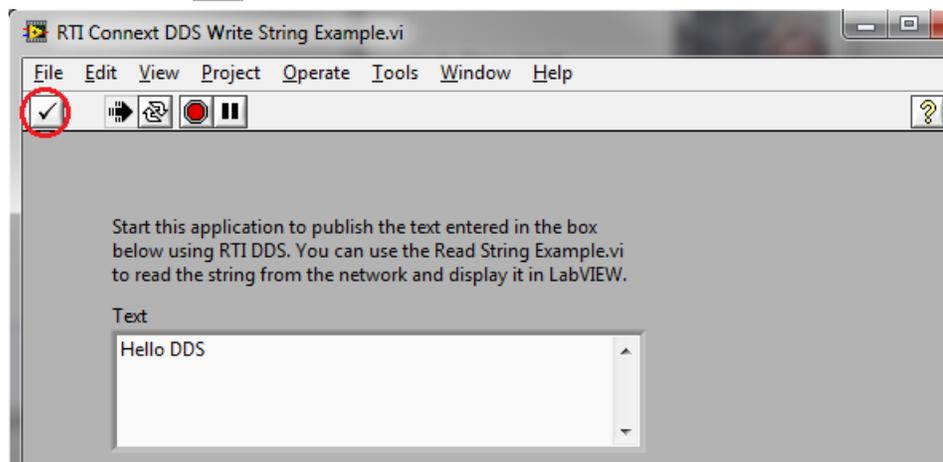
- ❑ If you see an error after opening one of the examples (such as “This application has failed to start because its side by side configuration is incorrect”), see [Section 3.4.4](#).
- ❑ If the example VI seems blocked (the stop button toggles, data does not transfer, etc.), you may have a linking issue in the VI. This issue is very likely for LabVIEW 2010 users. [Section 3.4.1](#) explains how to resolve this.

3.1 Publishing a String in DDS

1. Open the **RTI Connexx DDS Write String Example.vi** by double-clicking on it in the NI Example Finder (select **Help, Find Examples...**).
2. Click the **Run**  button in the LabVIEW toolbar.



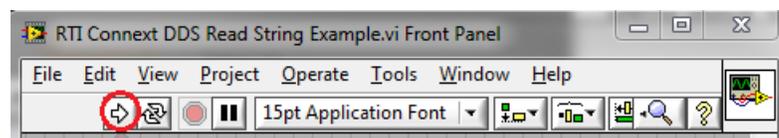
3. From the LabVIEW Front Panel, enter some text (such as **Hello DDS**) in the **Text** field and click the **Enter Text**  button in the LabVIEW toolbar.



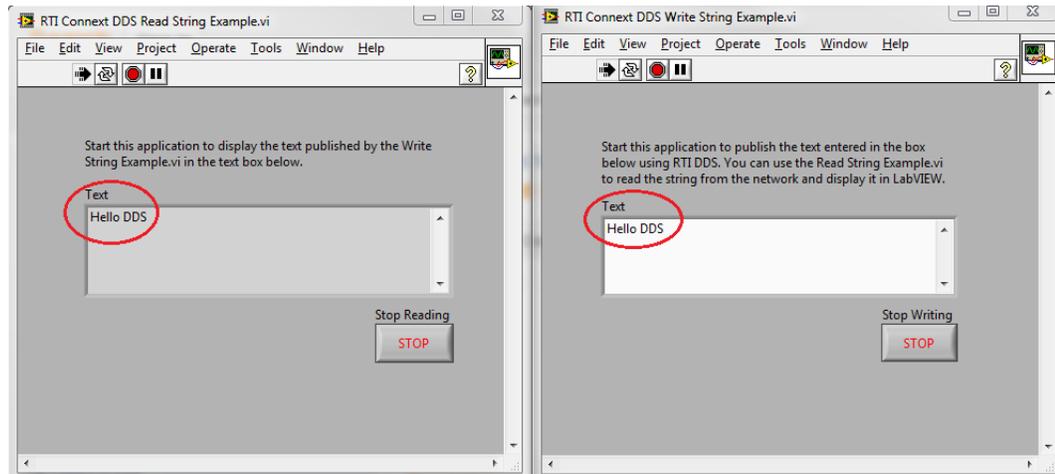
You are now writing (publishing) the string using DDS. Next we will read it from the **RTI Connexx DDS Read String Example.vi**.

3.2 Subscribing to a String in DDS

1. Open the **RTI Connexx DDS Read String Example.vi** by double-clicking on it in the NI Example Finder (select **Help, Find Examples...**).
2. Click on the **Run**  button in the LabVIEW toolbar.



3. Verify that it is reading the same string that is being published from the **RTI Connex DDS Write String Example.vi**.



While both VIs are running, you can verify that if you change the text in the *Text* control of the **RTI Connex DDS Write String Example.vi**, you will read the new text in the **RTI Connex DDS Read String Example.vi**. Remember to use the LabVIEW **Enter Text** button in the toolbar (rather than pressing Enter or Return on your keyboard).

Note: Under the DDS publish/subscribe paradigm, knowing the location of the distributed applications is handled by the middleware. In this example, we are running both the **RTI Connex DDS Write String Example.vi** and the **RTI Connex DDS Read String Example.vi** on the same computer, using the Shared Memory transport for inter-application communication. However, if you were to run these examples on different computers (with a functional LAN connection), DDS would automatically handle the communication across the network.

3.3 What is Happening?

To better understand how this demonstration is implemented, let's review the code for these two VIs:

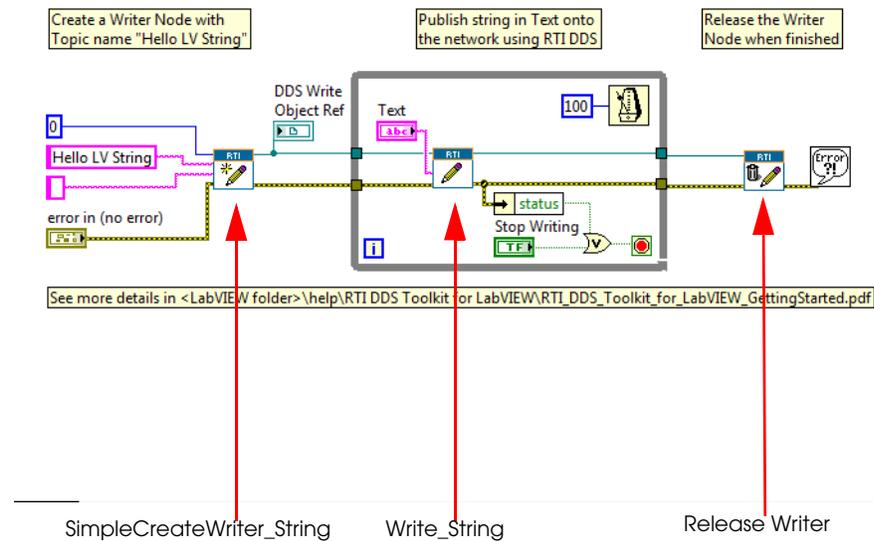
Publisher side

The **RTI Connex DDS Write String Example.vi** uses three *RTI DDS Toolkit for LabVIEW* subVIs:

- **Simple Create Writer:** Creates a *Writer* object for text (strings) and initializes it according to the VI configuration parameters.
- **Write:** Receives as input: the reference from the *Writer* object (Create Writer) and the text to be published (the *Text* control). It will continue publishing the text within a LabVIEW loop until an error occurs or the *Stop Writing* control is pressed.
- **Release Writer:** When the *Stop Writing* control is pressed, the *Release Writer* subVI will execute and release the *Writer* object.

For details on these subVIs, see [Writer \(Section A.2.1\)](#).

If you open the Block Diagram (in the RTI Connex DDS Write String Example window, select **Window, Show Block Diagram**), it will look like this:



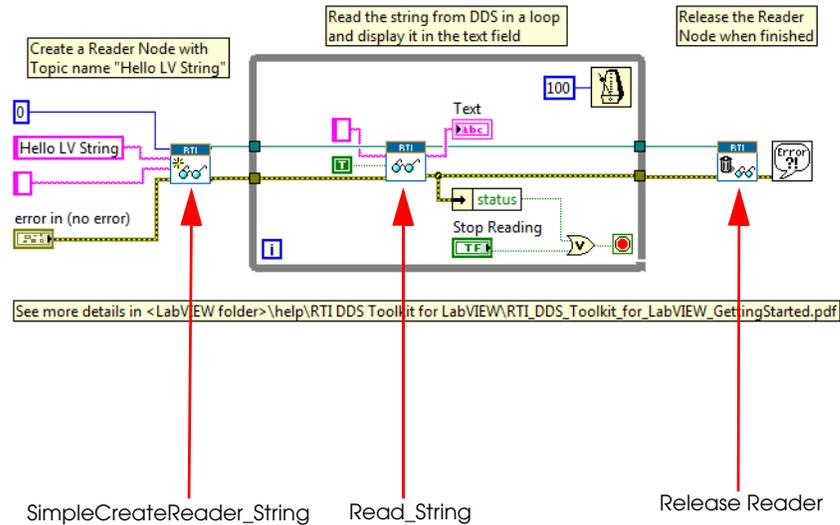
Subscriber side

The **RTI Connex DDS Read String Example.vi** uses three *RTI DDS Toolkit for LabVIEW* subVIs:

- **Simple Create Reader:** Creates a *Reader* object for text (strings) and initializes it according to the VI configuration parameters.
- **Read:** Receives as input the reference from the *Reader* object (*Create Reader*). Outputs the *Text* indicator. It continues subscribing to the text within a LabVIEW loop until an error occurs or the *Stop Reading* control is pressed.
- **Release Reader:** When *Stop Reading* control is pressed, the *Release Reader* subVI will execute and release the *Reader* object.

For details on these subVIs, see [Reader \(Section A.2.2\)](#).

If you open the Block Diagram (in the RTI Connex DDS Read String Example window, select **Window, Show Block Diagram**), it will look like this:



3.4 Usage Notes

3.4.1 Preventing 'Application Failed to Start' Error when Opening Example VIs

If you see an error when LabVIEW tries to load the *RTI DDS Toolkit for LabVIEW* DLL (such as "This application has failed to start because its side by side configuration is incorrect.") after opening any of the example VIs, you need to install the *Microsoft Visual C++ 2008 Redistributable Package (x86)*. This package provides the run-time components of the Visual C++ Libraries that are required to run applications developed with Visual C++ on a computer that does not have the Visual C++ 2008 development environment. You can download this package from <http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=29>

3.4.2 Communicating Unbounded Entities.

By default, strings in the *RTI DDS Toolkit for LabVIEW* are bounded so their maximum length is 1024 characters. However, if you set the Advanced Reader/Writer Configuration flag **forceUnboundedString** to **true**, they are created with a length equivalent to the maximum integer (2,147,483,647) (see [Lesson 6—Used Nested and Multiple Keys \(Section 4.6\)](#)). Despite that, DDS only sends the actual data the string contains, automatically reducing the sample size.

However, if you create a DataWriter of an unbounded type, it will not communicate with a DataReader of a bounded type out of the box. *RTI DDS Toolkit for LabVIEW* sets the following property in all its DomainParticipants:

```
<participant_qos>
  <property_qos>
    <value>
      <element>
        <name>
          dds.type_consistency.ignore_sequence_bounds
        </name>
        <value>1</value>
      </element>
    </property_qos>
  </participant_qos>
```

This property allows bounded DataReaders to communicate with unbounded DataWriters. Set this property in your external DDS applications that need to communicate with *RTI DDS Toolkit for LabVIEW* applications.

To Achieve Backward Compatibility:

If you need to create a bounded string, do not set to true the flag **forceUnboundedString** in the Advanced Reader/Writer Configuration controls. Setting this flag will force all strings to be unbounded.

3.4.3 Preventing 'Type Code Incorrect' Error when Working with Arrays

If you are forcing the usage of arrays, you may get an error when reading/writing them. To prevent this error, use sequences instead. Sequences, as well as LabVIEW arrays, can be resized and will not cause this error. Sequences are the default mapping of LabVIEW arrays.

If you must use arrays:

When using an array as the input or output for one of the *RTI DDS Toolkit for LabVIEW* subVIs, you will need to initialize the array to its maximum size. Arrays within clusters must also be initialized to their maximum size. The resize functionality available in LabVIEW is not compatible with *RTI DDS Toolkit for LabVIEW*.

To increase the size of an array, drag down on the bottom of the last element until you've reached the largest number of elements you need. Then assign a default value to each new element. It is usually sufficient to add one element at the end of the array.

3.4.4 Troubleshooting with Ping and Spy

If data is not flowing between the writer and reader, we suggest running the *Connex DDS Ping* and *Spy* utilities; they can show you what data is flowing through the network. These utilities are provided with the *Connex DDS core*¹.

If you do not have *Connex DDS* installed, you can download *RTI Connex DDS Professional* from www.rti.com/downloads. Once you've installed *RTI Connex DDS Professional*, you can access DDS Ping and DDS Spy from *RTI Launcher*² (in the Utilities tab).

For help using Ping and Spy, see the *Connex DDS API Reference HTML* documentation. Open `<Connex DDS core installation directory>/ndds.<version>/ReadMe.html`. The documentation

1. In the `<Connex DDS installation directory>/ndds.<version>/scripts`, look for `rtiddsping` and `rtiddsspy`.

2. *RTI Launcher* is a GUI-based tool provided with *RTI Connex DDS Professional*.

is also available here: <http://community.rti.com/documentation>. Choose an API (C, C++, .NET, or Java), then select **Modules**, **Programming Tools**.

Chapter 4 Tutorial

This tutorial will help you become familiar with several key capabilities of *RTI DDS Toolkit for LabVIEW*. The tutorial assumes you have the following software installed:

- ❑ National Instruments LabVIEW 2010 (32-bit) or later for Windows
- ❑ *RTI DDS Toolkit for LabVIEW* for National Instruments LabVIEW

The tutorial includes these lessons:

- ❑ [Lesson 1—Using DDS to Publish and Subscribe to Simple Data \(Numeric\) \(Section 4.1\)](#)
- ❑ [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\) \(Section 4.2\)](#)
- ❑ [Lesson 3—Filtering Data \(Section 4.3\)](#)
- ❑ [Lesson 4—Reading Only New Samples \(Section 4.4\)](#)
- ❑ [Lesson 5—Using Keyed Types \(RTI Shapes Demo\) \(Section 4.5\)](#)
- ❑ [Lesson 6—Used Nested and Multiple Keys \(Section 4.6\)](#)
- ❑ [Lesson 7—Reading All Samples \(Reliable Communication\) \(Section 4.7\)](#)
- ❑ [Lesson 8—Debugging Your RTI Connex DDS Application Using a Monitoring Profile \(Section 4.8\)](#)
- ❑ [Lesson 9—Using the RTI DDS Toolkit on a cRIO-9068 Target \(Section 4.9\)](#)

We encourage you to follow along and perform the steps in each lesson yourself—there is no better teacher than hands-on experience. However, completed solutions are provided; see [Section 4.10](#).

Notes:

- ❑ These lessons assume you are familiar with LabVIEW.
- ❑ For debugging information, see [Enabling Debugging Mode \(Section E.1\)](#)

4.1 Lesson 1—Using DDS to Publish and Subscribe to Simple Data (Numeric)

In this first lesson, you will become familiar with the *RTI DDS Toolkit for LabVIEW* functions and capabilities by creating two LabVIEW VIs that can publish and subscribe to data. You can run these VIs on the same computer or separate computers connected to the same local area net-

work. *RTI DDS Toolkit for LabVIEW* will automatically discover the location of each application and handle communication in either scenario without any changes to the VIs.

4.1.1 Developing a VI to Publish Simple Data (Numeric)

Let's start by developing a VI to publish a simple data type: the value of a double-precision numeric control, a LabVIEW Numeric (DBL).

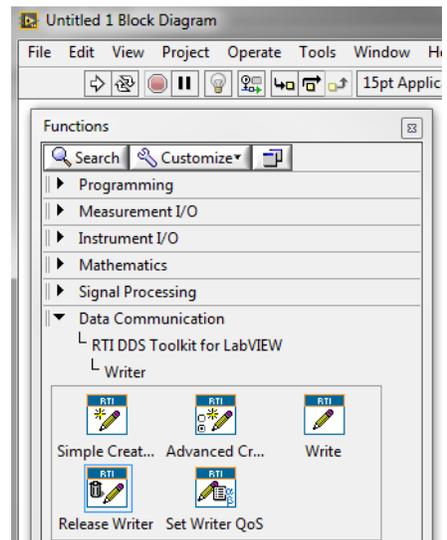
4.1.1.1 Create a Writer Object to Publish a Numeric (DBL)

1. Launch LabVIEW and create a new VI. (In LabVIEW 2010, select *File, New...*, **Blank VI**. In LabVIEW 2011 and 2012, select **File, New VI**.) Save the new VI with the name **Tutorial_Write_Double.vi**.
2. Open the Block Diagram's Functions Palette (right-click on an open area) and select **Data Communication, RTI DDS Toolkit for LabVIEW, Writer**; drag and drop the *Simple Create Writer* subVI  into the Block Diagram.
3. The *Simple Create Writer* subVI has the following input parameters:
 - domain id
 - topic name
 - data type
 - error in (no error)

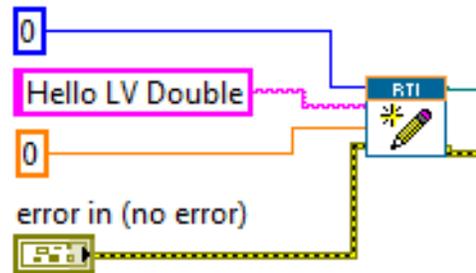
For details on these parameters, see [Writer \(Section A.2.1\)](#).

We will use this subVI to create a *Writer* object that can publish a data type of Numeric (DBL). We will use domain ID 0 and our Topic Name will be **Hello LV Double**. To begin:

- a. Right-click on the *Create Writer* subVI and select **Select Type, Numeric (DBL)**
- b. Right-click on each input node (except **error in (no error)**) and select **Create, Constant**. This will create a default constant for that input parameter. Set each input parameter as follows (by right-click on each and select **Edit...**):
 - domain id = 0
 - topic name = Hello LV Double
 - data type = 0
- c. For **error in**, right-click and select **Create, Control**.



The resulting Block Diagram should look similar to this:



4.1.1.2 Publish a Numeric (DBL)

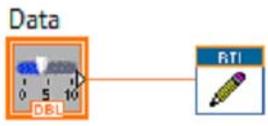
The next step is to add the functionality to publish values to the DDS network. We will use the *Write* subVI.

1. Open the Functions Palette and select **Data Communication, RTI DDS Toolkit for LabVIEW, Writer, Write**; drag and drop the *Write* subVI  into the Block Diagram.

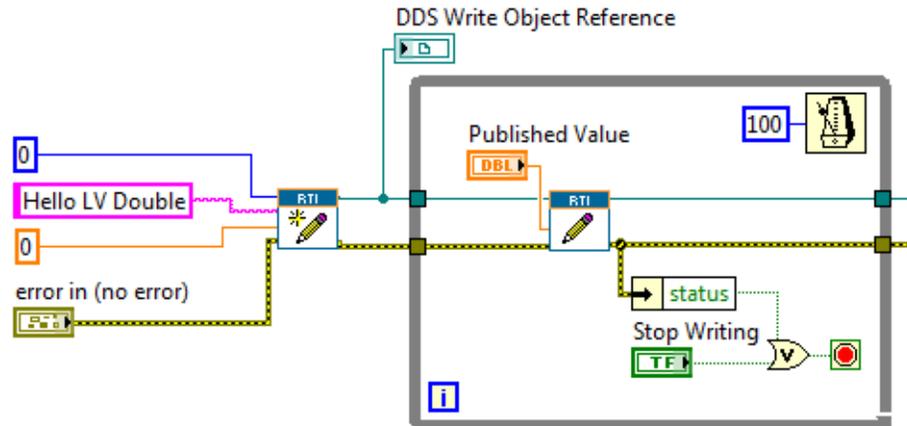
The *Write* subVI has the following input parameters:

- dds write object ref in
- data
- error in

For details on these parameters, see [Writer \(Section A.2.1\)](#).

2. Wire the **dds write object ref** output of the *Create Writer* subVI (from [Section 4.1.1.1](#)) to the **dds write object ref in** input of the *Write* subVI.
3. We will publish the value of a *Horizontal Pointer Slide* control (numeric control). Drop a *Horizontal Pointer Slide* control onto the Front Panel from the Controls Palette. In the Block Diagram, wire the *Pointer Slide* to the *Write* subVI's **Data** input node. Rename the slide control to **Data**.
 
4. To continuously publish the *Pointer Slide* value, add a *While Loop* around the *Write* subVI in the Block Diagram. From the Functions Palette:
 - a. Select **Programming, Structures, While Loop**.
 - b. Use the left mouse button to drag and include both the *Write* subVI and the *Horizontal Pointer Slide* control in the *While Loop*.
 - c. You may also add a *Wait Until Next ms Interval* subVI (under **Programming, Timing** from the Functions Palette) inside the *While Loop* if you want to specify a rate at which *Write* will publish the value.

5. Add a *Stop Button* boolean to the Front Panel and wire it to the *While Loop* stop function in the Block Diagram. The resulting Block Diagram should look similar to this:



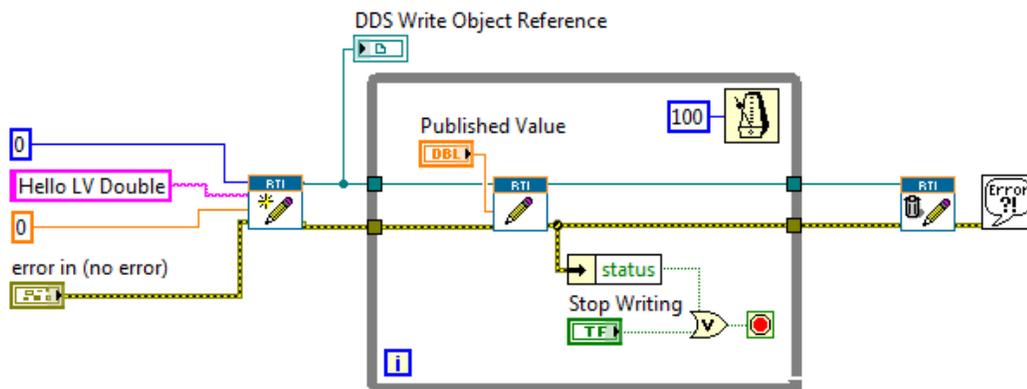
4.1.1.3 Release the Writer Object

The final step in our **Tutorial_Write_Double.vi** is to release the DDS entities and reclaim the system resources when the *While Loop* is terminated. To do this, we use the *Release Writer* subVI in the Block Diagram.

1. From the Functions Palette, select **Data Communication, RTI DDS Toolkit for LabVIEW, Writer, Release Writer**; drag and drop the *Release Writer* subVI  into the Block Diagram.
2. Configure its input parameters:
 - dds write object ref in
 - error in

For details on these parameters, see [Writer \(Section A.2.1\)](#).

Wire the *Write* subVI's output to the *Release Writer*'s inputs. The resulting Block Diagram should look similar to this:



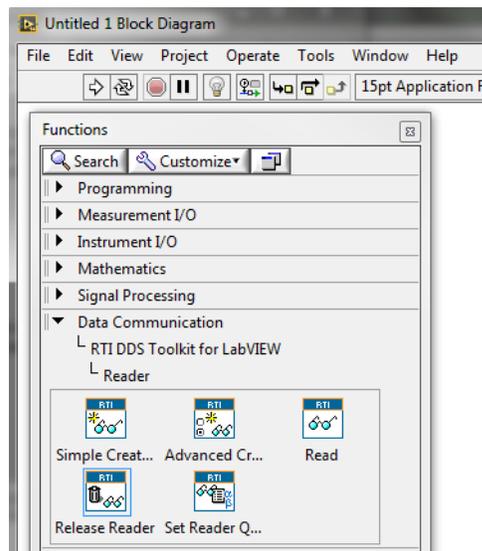
3. Save the file **Tutorial_Write_Double.vi**.
4. We recommend including error handling in your VIs. Take the above figure as an example: we use error handler's *status* to control the loop exit condition.

4.1.2 Creating a VI to Subscribe to Simple Data (Numeric)

In [Section 4.1.1](#), you learned how to develop a LabVIEW VI to use DDS to publish a simple data type, the value of a numeric (DBL). In the second part of the lesson, you will see how to develop an equivalent VI to read the published data.

4.1.2.1 Create a Reader Object to Subscribe to a Numeric (DBL)

1. Launch LabVIEW and create a new VI. (In LabVIEW 2010, select **File, New...**, **Blank VI**. In LabVIEW 2011 and 2012, select **File, New VI**.) Save the new VI with the name **Tutorial_Read_Double.vi**.
2. Open the Functions Palette (right-click on an open area in the Block Diagram), then select **Data Communication, RTI DDS Toolkit for LabVIEW, Reader, Create Reader**; drag and drop the *Simple Create Reader* subVI  into the Block Diagram



3. The *Simple Create Reader* subVI has the following input parameters:
 - domain id
 - topic name
 - data type
 - error in (no error)

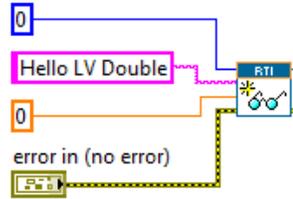
For details on these parameters, see [Reader \(Section A.2.2\)](#).

We will use this subVI to create a *Reader* object that can subscribe to a data type of Numeric (DBL). We will use domain ID 0 and our Topic Name will be **Hello LV Double**. To begin:

- a. Right-click on the *Create Reader* subVI and select **Select Type, Numeric (DBL)**.
- b. Right-click on each input node (except **error in (no error)**) and select **Create, Constant**. This will create a default constant for that input parameter. Set each input parameter as follows (by right-click on each and select **Edit...**):
 - domain id = 0
 - topic name = Hello LV Double
 - data type = 0

- c. Right-click on **error in** and select **Create, Control**.

The resulting Block Diagram should look similar to this:



4.1.2.2 Subscribe to a Numeric (DBL)

The next step is to add the functionality to subscribe to the values from the DDS network. We will use the *Read* subVI.

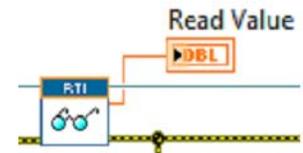
1. To insert the *Read* subVI into your Block Diagram, open the Functions Palette and:
 - a. Select **Data Communication, RTI DDS Toolkit for LabVIEW, Reader, Read**; drag and drop the *Read* subVI  into the Block Diagram.
 - b. Right-click on the *Read* subVI and select **Select Type, Numeric (DBL)**.

Read takes the following input parameters.

- dds read object ref in
- query condition
- only_new_samples
- error in (no error)

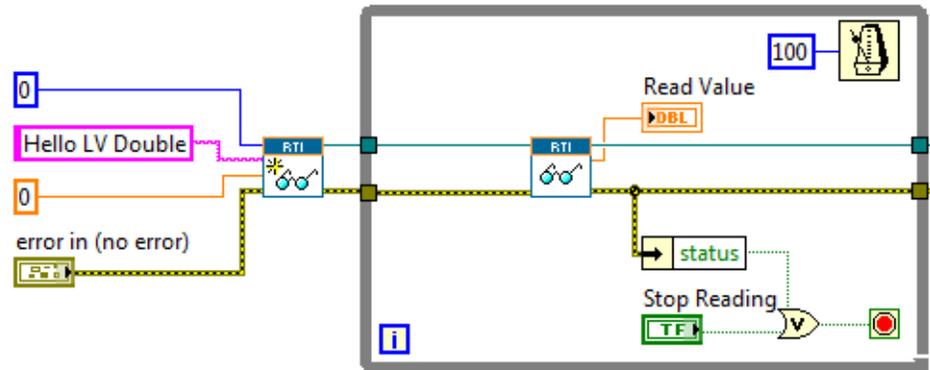
For details on these parameters, see [Writer \(Section A.2.1\)](#).

2. Wire the *Create Reader* subVI's **dds read object ref** output node to the *Read* subVI's **dds read object ref in** input node.
3. In this example, we will subscribe to the Numeric (DBL) published by the **Tutorial_Write_Double.vi**. To display the data, drop a *Vertical Fill Slide* control onto the Front Panel from the Controls Palette. In the Block Diagram, right-click on the *Vertical Fill Slide* control and select **Change to Indicator**, then wire the *Read* subVI's **data** output node to the *Vertical Fill Slide*.
4. We want to continuously subscribe to the Numeric (DBL). To do so, add a *While Loop* around *Read* in the Block Diagram. From the Functions Palette:



- a. Select **Programming, Structures, While Loop**.
- b. Use the left mouse button to drag and include both the *Read* subVI and the *Vertical Fill Slide* control in the *While Loop*.
- c. You may also add a *Wait Until Next ms Interval* function (in the Functions Palette, under **Programming, Timing**) inside the *While Loop* if you want to specify a rate at which *Read* will subscribe to the data.

5. Add a *Stop Button* boolean to the Front Panel and wire the boolean to the *While Loop* stop function in the Block Diagram. The resulting Block Diagram should look similar to this:



4.1.2.3 Release the Reader Object

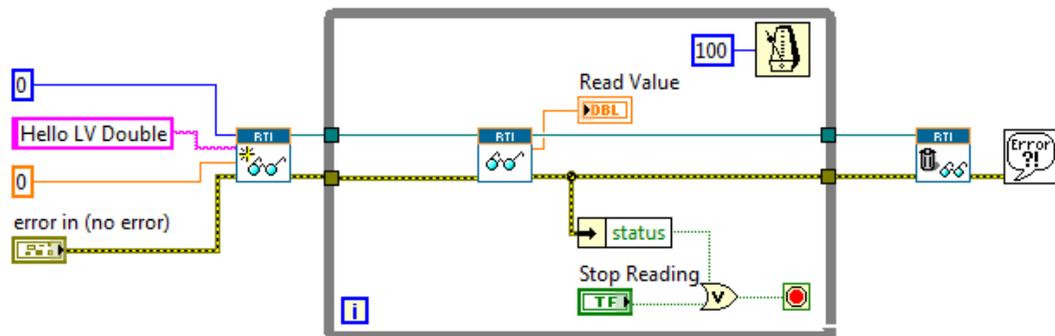
The final step in our **Tutorial_Read_Double.vi** is to release the DDS entities and reclaim the system resources when the *While Loop* execution is terminated. To do this, we use the *Release Reader* subVI in the Block Diagram.

1. From the Functions Palette, select **Data Communication, RTI DDS Toolkit for LabVIEW, Reader, Release Reader**; drag and drop the *Release Reader* subVI  into the Block Diagram.
2. Configure its input parameters:
 - dds read object ref in
 - error in

For details on these parameters, see [Reader \(Section A.2.2\)](#).

Wire the *Read* subVI's outputs to corresponding inputs in the *Release Reader* subVI.

The resulting Block Diagram for **Tutorial_Read_Double.vi** should look similar to this:

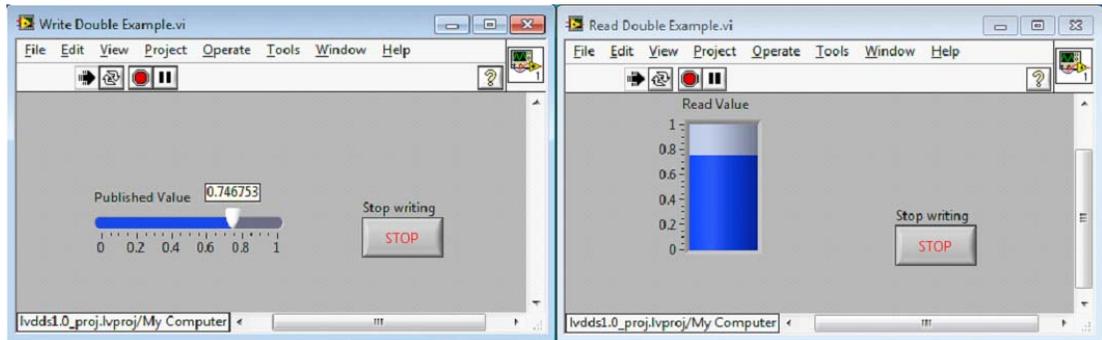


3. Save the file **Tutorial_Read_Double.vi**.
4. We recommend including error handling to your VIs. Please see [Section 4.2](#) and [Section 4.3](#) for further details.

4.1.3 Testing

Now that both VIs are ready, we can verify that they work as expected.

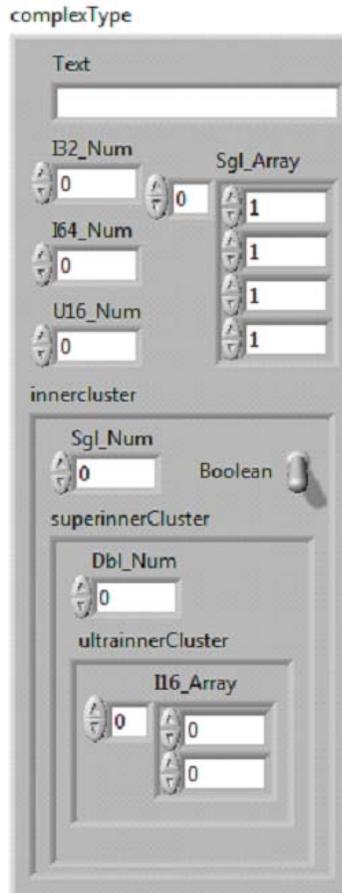
1. Open both VIs, **Tutorial_Write_Double.vi** and **Tutorial_Read_Double.vi**, and click the **Run** arrow button  in the toolbar in each.
2. Verify that you are reading exactly the same Numeric (DBL) value in **Tutorial_Read_Double.vi** that is being published from **Tutorial_Write_Double.vi**.



While both VIs are running, you can change the value of the *Horizontal Fill Slide* control in **Tutorial_Write_Double.vi** and see how the *Vertical Fill Slide* indicator displays the new values in **Tutorial_Read_Double.vi**.

These VIs might execute in the same computer or on separate computers connected to the same local area network. Either way, *RTI DDS Toolkit for LabVIEW* will allow the VIs communicate without any changes to the application VIs. This capability is known as 'location transparency.'

4.2 Lesson 2—Using Templates to Publish and Subscribe to Complex Data (Clusters)

Figure 4.1 **Complex Type**

In this lesson, you will become familiar with the *RTI DDS Toolkit for LabVIEW* functions and capabilities to publish and subscribe to complex types such as clusters or enumerators.

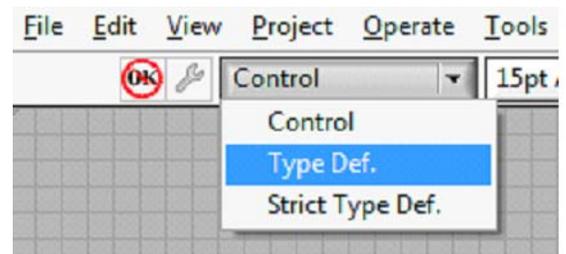
Note: Only 32-bit enumerators are supported. To change the representation, right-click in the enum and select Representation—>32.

We are going to focus on the cluster use-case. Let's begin by developing a VI that can publish the cluster defined in [Figure 4.1](#).

First, we will define a new type (a LabVIEW Type-Def) for this cluster:

1. Launch LabVIEW and create a new Custom Control: Select **File, New..., Other Files, Custom Control**.

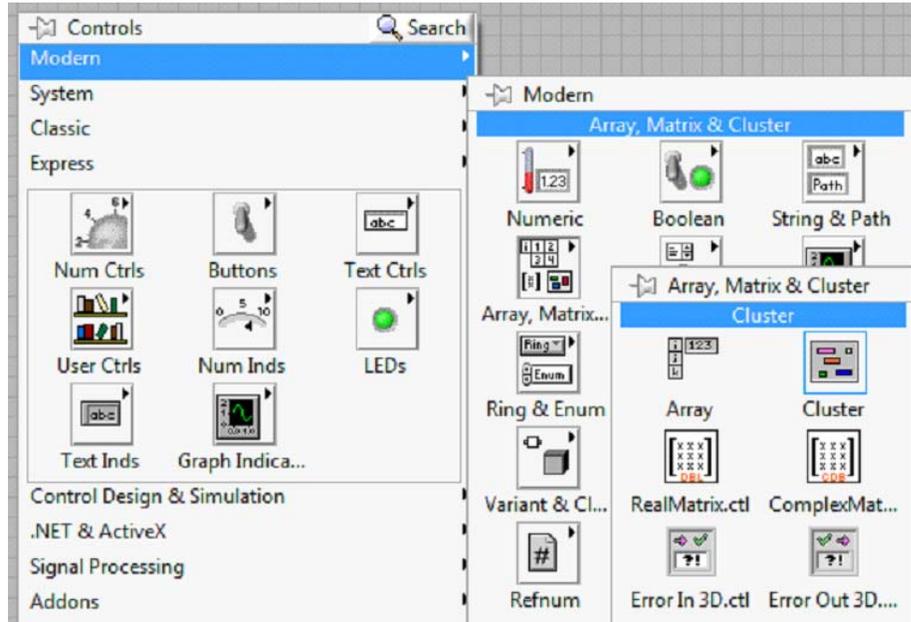
2. Choose **Type Def.** from the Control drop-down list in the toolbar:



3. Draw an empty cluster. From the Controls Palette:
 - a. Select **Modern**
 - b. Select **Array, Matrix & Cluster**
 - c. Select **Cluster**
 - d. Rename the cluster **complexType** (right-click and select **Properties**).

Note: See [Preventing 'Type Code Incorrect' Error when Working with Arrays \(Section 3.4.3\)](#).

- Fill the **complexType** cluster as shown in [Figure 4.1](#). This process is simple: drag the following controls from the Palette:



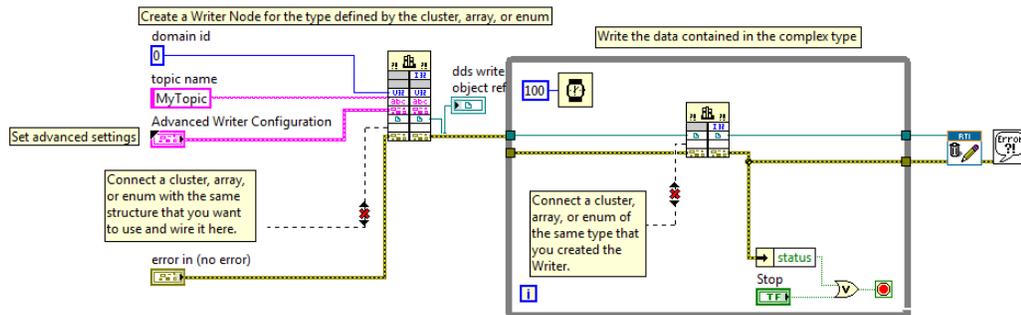
- String Control labeled as **Text**.
 - Numeric Control with Representation I32 labeled as **I32_Num** (once you have selected a Numeric Control, right-click on it and select **Representation** and change it to I32).
 - Numeric Control with Representation I64 labeled as **I64_Num**.
 - Numeric Control with Representation U16 labeled as **U16_Num**.
 - Array of Numeric Controls with Representation SGL labeled as **Sgl_Array**.
Note: LabVIEW arrays are mapped as bounded DDS sequences (or arrays if the flag **forceArrayMapping** is marked in the Advanced Reader/Writer Configuration control). The sequence bound or length is calculated from the LabVIEW array size. Make sure you declare your array to be the maximum size you will need.
 - Cluster inside the first one labeled as **innercluster**. Fill innercluster as shown in [Figure 4.1](#).
- When the cluster definition is complete, save this new control type as **Tutorial_Cluster.ctl**.

4.2.1 Completing the VI to Publish a Cluster

Next we will develop a VI to publish this cluster.

- In the Block Diagram's Functions Palette, select **Data Communication, RTI DDS Toolkit for LabVIEW, Complex-Type Templates, Advanced Writer Template**. Drop the template into the Block Diagram.

For details on these complex-type templates, see [Complex-Type Templates \(Section A.2.3\)](#).



2. Save this template as a new VI with the name **Tutorial_Write_Cluster.vi**.
3. Although there are several parameters already set with default values, there are also two input parameters which must be specified to complete the Block Diagram code:

- **Data type** input for the *Create* Call Library Function (CLF)
- **Data** input for the *Write* CLF

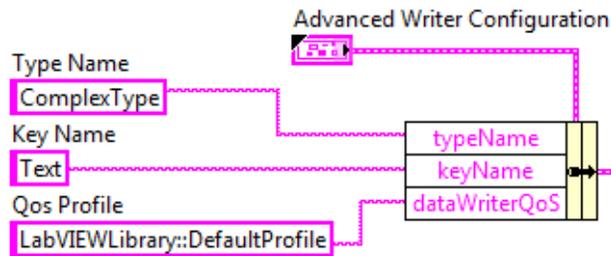
Both of these inputs need to be connected to a control of the type created at the beginning of this lesson: **complexType**. To do so:

- a. In the Front Panel, right-click on an empty spot of the panel and select **Select a Control...**
- b. Navigate until you find **Tutorial Cluster.ctl**, which was saved earlier in this lesson. Drop the control into the Front Panel.
- c. Copy the new control to create a second instance.
- d. In the Block Diagram, connect one of the newly created controls to **Data Type** in the *Create* CLF and connect the other new control to **Data** in the *Write* CLF.

Note: Make sure the LabVIEW arrays have the correct length. By default, only the cluster connected to the Create subVI needs to have the maximum length. If you are using mapping your arrays as DDS Arrays, you will also need the cluster connect to the Write subVI to have the maximum length (see [Preventing 'Type Code Incorrect' Error when Working with Arrays \(Section 3.4.3\)](#)).

4. Change the advanced setting using the **Advanced Writer Configuration** control.
 - a. Disconnect the Advanced Writer Configuration from the Call Library Function.
 - b. Right-click on the **Advanced Writer Configuration** and select 'Cluster,Class,& Variant Palette' --> 'Unbundle by Name'.
 - c. Create three fields in **Unbundle by Name**. And select values **typeName**, **keyName** and, optionally, **dataWriterQoS**.

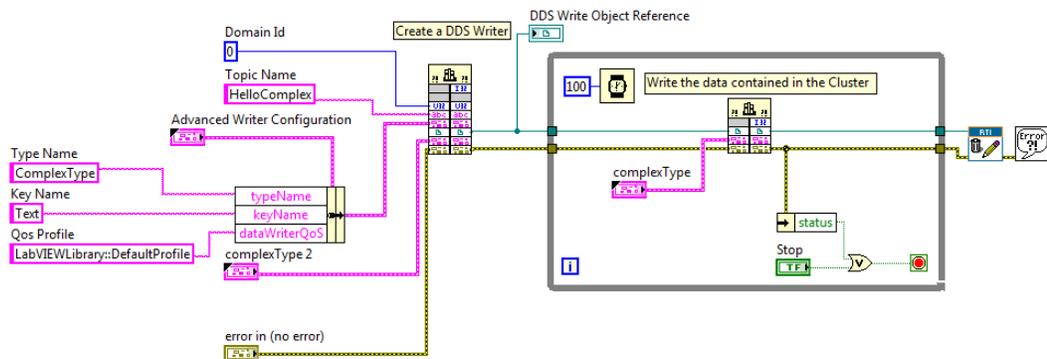
- d. Set **typeName** to **ComplexType** and **keyName** to **Text**. Optionally, set the QoS Profile to be **LabVIEWLibrary::DefaultProfile**.



Note: For details on Advanced Settings, see [Chapter 6: Advanced Concepts and Settings](#).

5. Change the **Topic Name** to **HelloComplex**.

The resulting Block Diagram should look similar to this:



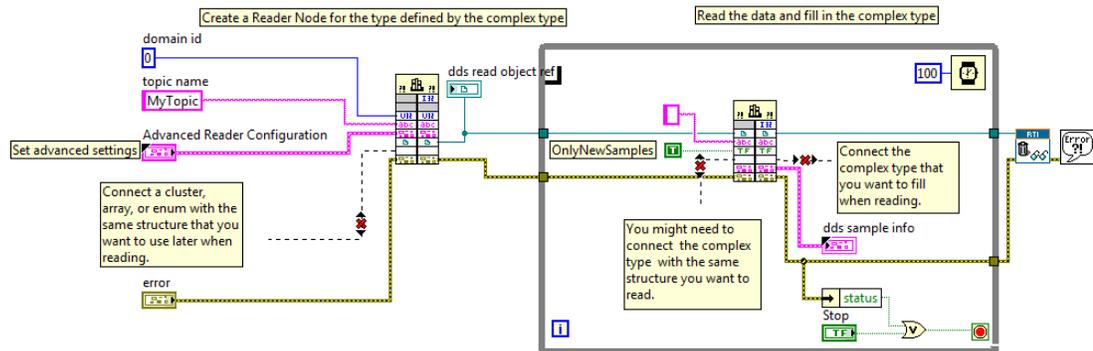
6. Save the file **Tutorial_Write_Cluster.vi**.

4.2.2 Completing the VI to Subscribe to a Cluster

In [Section 4.2.1](#), we developed a LabVIEW VI to publish a complex data type (cluster), using DDS. In this section, we will demonstrate how to develop an equivalent VI to subscribe to that cluster using DDS.

1. Launch LabVIEW. In the Block Diagram from the Functions Palette, select **Data Communication, RTI DDS Toolkit for LabVIEW, Complex-Type Templates, Advanced Reader Template**. Drop the template into the Block Diagram.

For details on these complex-type templates, see [Complex-Type Templates \(Section A.2.3\)](#).



2. Save it as a new VI named **Tutorial_Read_Cluster.vi**.
3. Although there are several parameters already set with default values, there are also an input and an output parameters which must be specified to complete the Block Diagram code:

- **data type** input for the *Create CLF*
- **data** input for the *Read CLF*

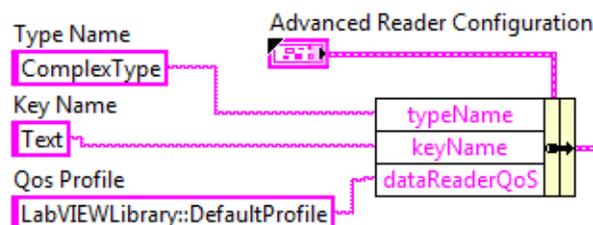
Both of these parameters need to be connected to an indicator/control of the type created at the beginning of this lesson: `complexType`. To do so:

- a. In the Front Panel, right click in an empty spot of the panel and select **Select a Control...**
- b. Navigate until you find **Tutorial Cluster.ctl**, which was saved earlier in this lesson. Drop the control into the Front Panel.
- c. Copy the new control to create a second instance. Select it and change it to be an indicator by right-clicking on it and selecting **Change to Indicator**.
- d. In the Block Diagram; connect the new control to **Data Type** in the *Create CLF* and the new indicator to **Data** in the *Read CLF*.

Note: Make sure the LabVIEW arrays have the correct length. By default, only the cluster connected to the Create subVI needs to have the maximum length. If you are using mapping your arrays as DDS Arrays, you will also need the cluster connect to the Write subVI to have the maximum length (see [Preventing 'Type Code Incorrect' Error when Working with Arrays \(Section 3.4.3\)](#)).

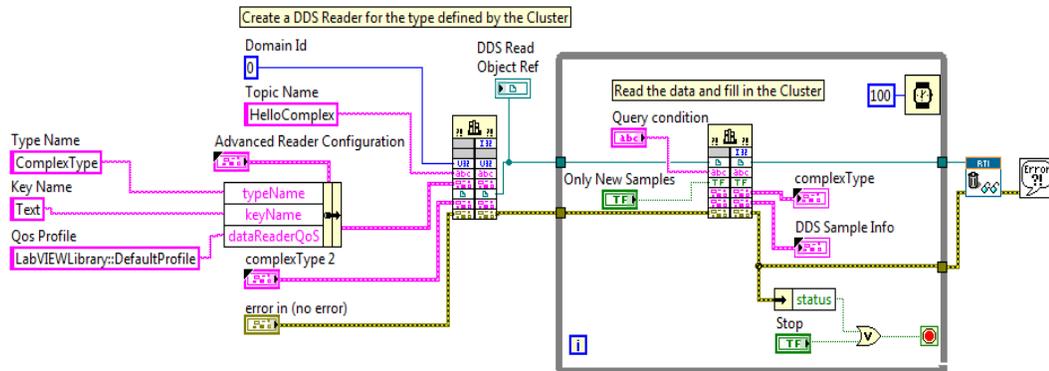
4. Change the advanced setting using the **Advanced Reader Configuration** control. Set `typeName` to **ComplexType** and set `keyName` to **Text**.

Note: For details on Advanced Settings, see [Chapter 6: Advanced Concepts and Settings](#).



5. Change the **Topic Name** to **HelloComplex**.
6. Optionally, wire a **DDS Sample Info** indicator to the *Read* subVI.

The resulting Block Diagram should look similar to this:



7. Save the file **Tutorial_Read_Cluster.vi**.

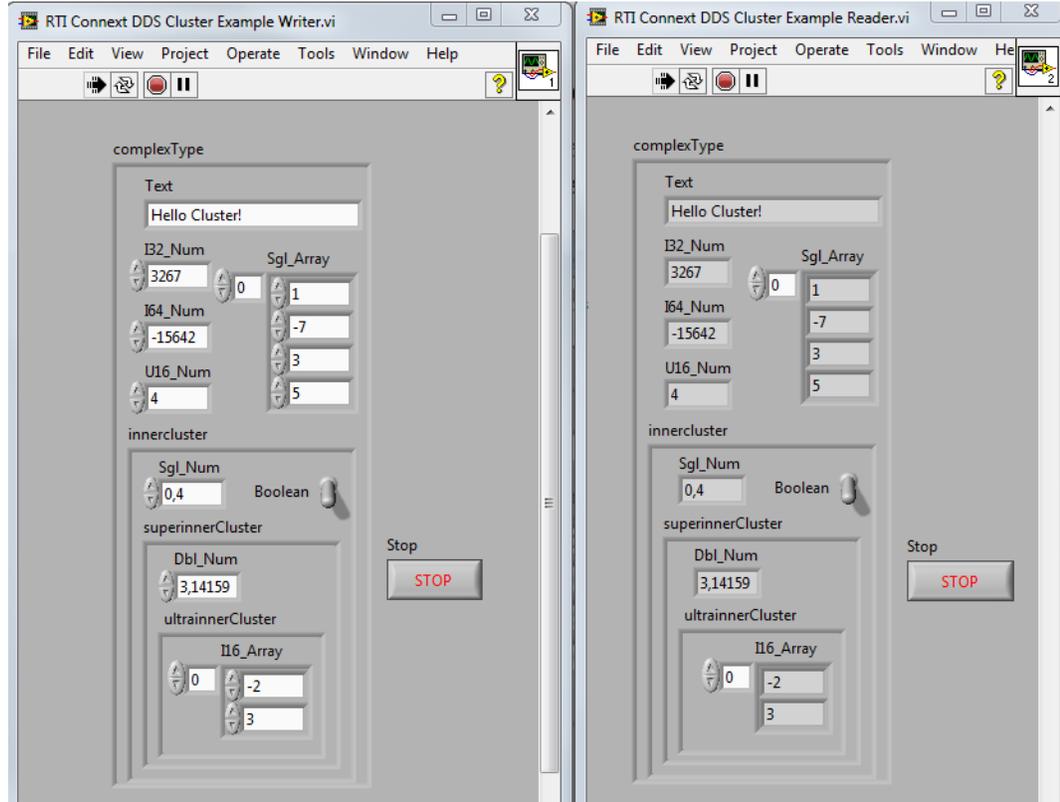
Note: If LabVIEW displays a wiring error, you will need to create a new constant for this cluster type. Wire the constant as the input of the *Read* subVI's **Data** input node (on the left hand side of the *Read* function block). After LabVIEW recognizes the type, the error will be correct. Then you should delete the constant and verify that the wire connected remains valid.

4.2.3 Testing

Now that both VIs are ready, you are ready to verify they work as expected.

1. Open **Tutorial_Read_Cluster.vi** and **Tutorial_Write_Cluster.vi** and run each VI.

- Verify that you can read exactly the same values for each member of the cluster in the **Tutorial_Read_Cluster.vi** being published from **Tutorial_Write_Cluster.vi**.



With both VIs running, you can change the value of the published cluster in **Tutorial_Write_Cluster.vi** and see the values update.

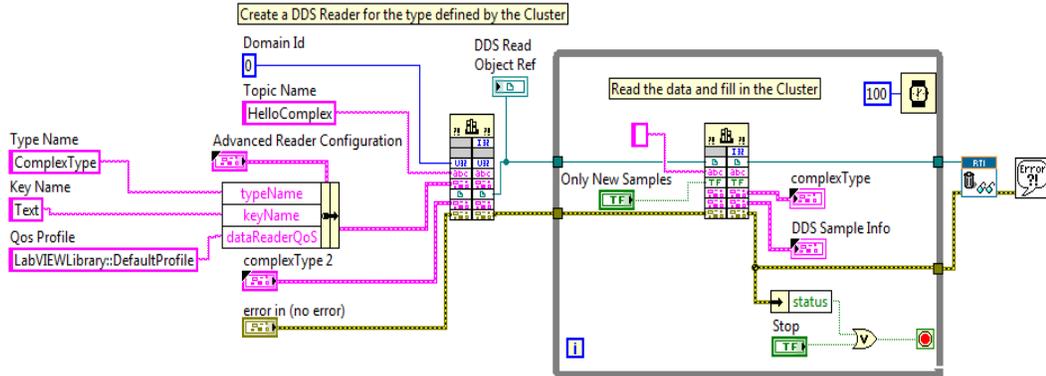
- Modify **Read CLFN input only new samples** to be **false**. Then modify the value in **Text** on the **Writer**. You will see it flicker in the **Reader** side between the previous and current values. This is the expected behavior because **Text** is the key of our cluster. This means that a new sample is created for each **Text** value provided. Even after reading the sample, it is still alive, so it can be reached from the **Reader**. See [Section 4.4](#) to learn more about this.

4.3 Lesson 3—Filtering Data

In this lesson we will learn how a subscriber can filter data available on the DDS network. This lesson assumes you have successfully completed [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\)](#) (Section 4.2).

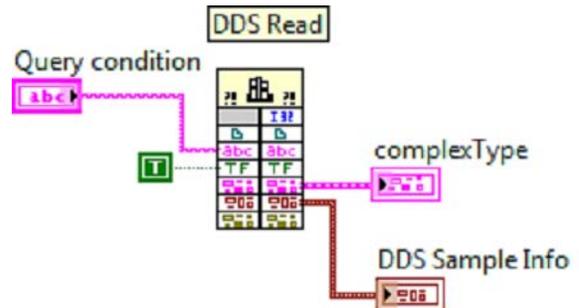
- Open **Tutorial_Read_Cluster.vi** from Lesson 2 and save it as a new VI named **Tutorial_Filter_Cluster.vi**.

The Block Diagram should look similar to this:



With DDS, you can filter network data by subscribing to only the Topics of interest. Additionally, DDS provides the capability to filter data within a Topic by specifying a query condition for the data to match. The syntax of this query condition is similar to standard SQL queries. We will demonstrate how to filter data with various query conditions.

2. Replace the *Read* subVI's **query condition** input constant with a text control that we can modify while executing the VI. Right-click on the constant wired to the **query condition** input of the *Read* subVI.
3. Select **Change to Control**.



4. Verify that the new *Query condition* text control is available on the Front Panel, as seen to the right.
5. Save to file **Tutorial_Filter_Cluster.vi**.

Now we can use filters to specify a *Query condition* at run time and subscribe to only the Topic data we desire. Let's test how it works:

6. Run **Tutorial_Write_Cluster.vi** to begin publishing the complex data type (cluster).
7. Run **Tutorial_Filter_Read.vi**. As you will see, all the published data is read by the **Tutorial_Read_Cluster.vi**. This is because the *Query condition* text control is blank and no query condition is being applied.

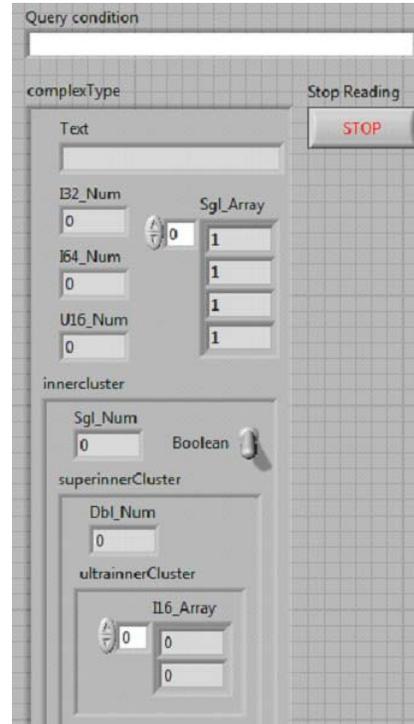
Note: DDS is content aware. That is, each Topic and its data type(s) are known by the middleware. This provides robust application support through capabilities such as content filtering, queries, and advanced tooling.

We will now filter data by content; for example, only read those samples where the cluster field is equal to "valid text":

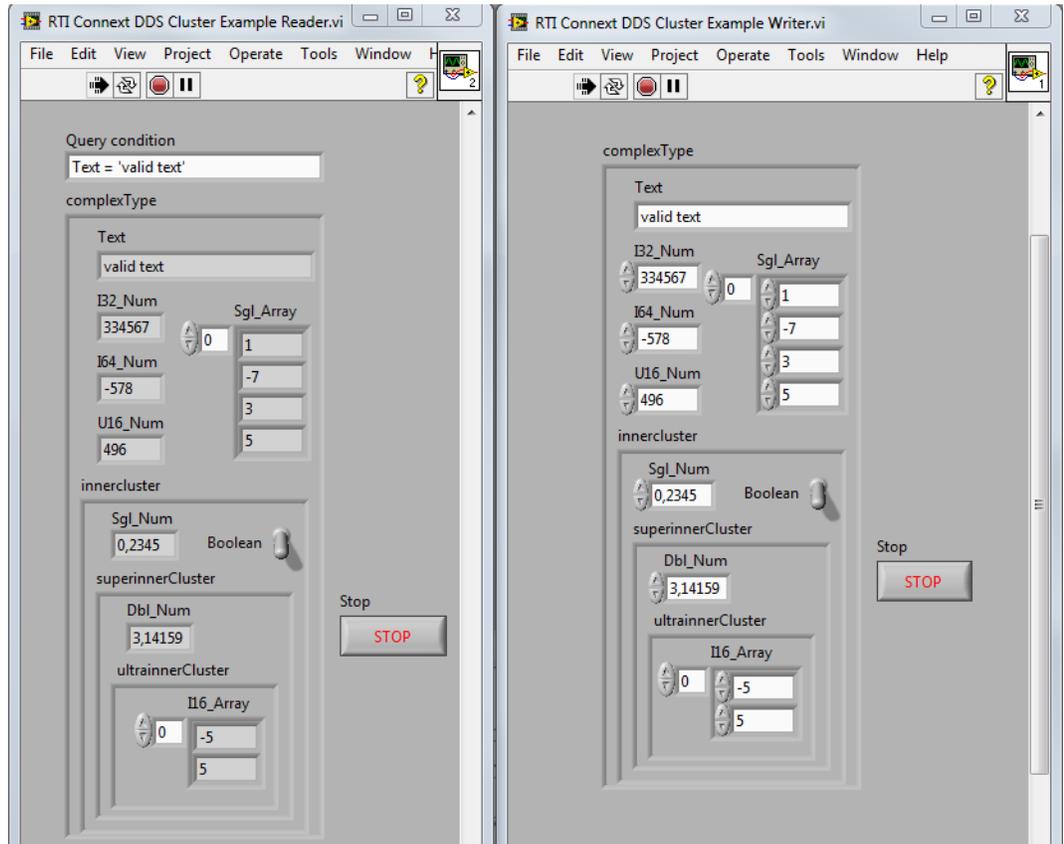
8. With the VIs running, enter the following filter text in the *Query condition* text control

```
"Text = 'valid text'"
```

Note: See the screenshot below for exact *Query condition* entry.



9. Change the **Text** data in **Tutorial_Write_Cluster.vi** to “valid text” and modify the value of some of the other types. Verify that you are reading “valid text” and get updated values of the other types in the reader VI.

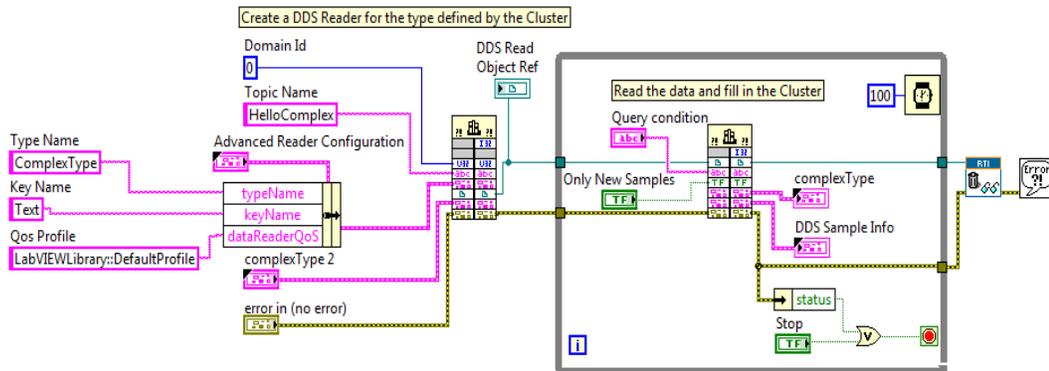


10. Verify that when you enter any other text into the writer VI **Text** field, you do not see “valid text” or the updated values of other types in the reader VI.
11. Here are a few other example query conditions you can try:
- “I32_Num > 0”
 - “innercluster.Boolean = TRUE”
 - “innercluster.Boolean = TRUE and Text = ‘valid text’”
 - “innercluster.Boolean = TRUE or Text = ‘valid text’”

4.4 Lesson 4—Reading Only New Samples

In this lesson you will learn how a subscriber can read every received data or only those that have not been read yet. This lesson assumes you have successfully completed [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\)](#) (Section 4.2).

1. Open **Tutorial_Read_Cluster.vi** from [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\)](#) (Section 4.2) and save as a new VI with the name **Tutorial_Only_New_Read.vi**. The Block Diagram should look similar to this:

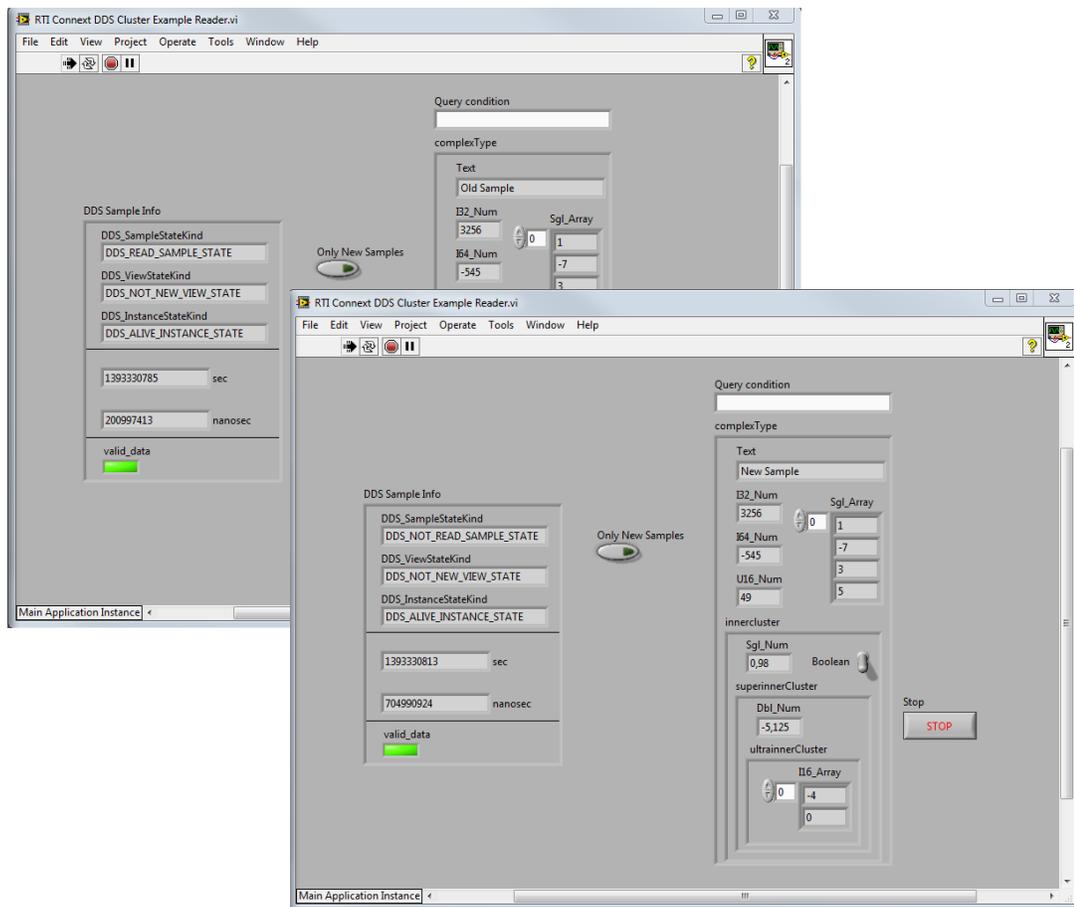


With DDS, you can select whether you want to subscribe to all the available samples in the **Reader** queue or just to the new ones. Using the **Read** subVI's *Only New Samples* input, we can modify this behavior. When set to **true**, only those samples that have not been read before are returned. On the other hand, **false** indicates we want to re-read old samples, even if we read them in the past. This lesson will demonstrate how this feature may affect your system.

2. Replace the *Read* subVI's *Only New Samples* input constant with a boolean control that we can modify while executing the VI. Right-click the constant wired to the *Only New Samples* input of the *Read* subVI.
 - a. Select **Change to Control**.
 - b. Verify that the new *Only New Samples* boolean control is available on the Front Panel.
 - c. Save to file **Tutorial_Only_New_Read.vi**.

Now you can specify whether you want to subscribe to new samples or to any available one. Let's test how it works:

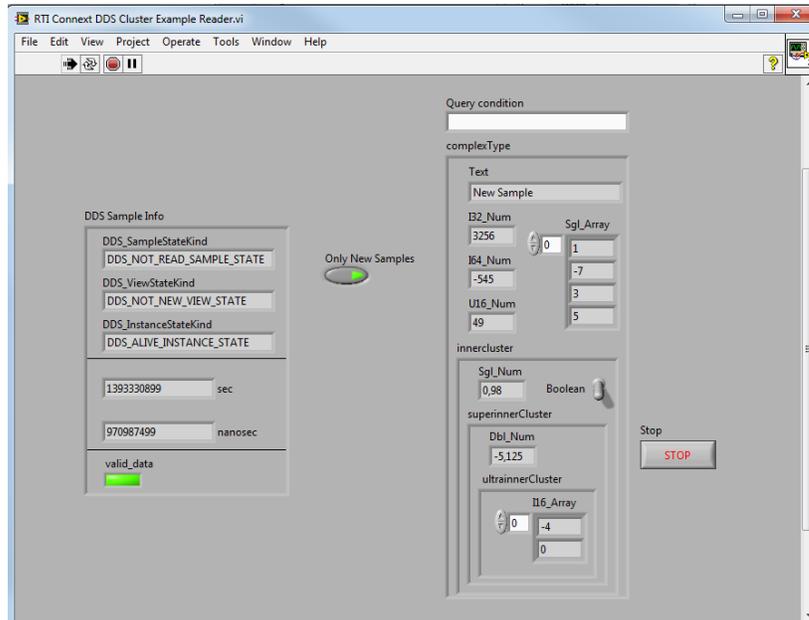
3. If the DDS Sample Info is not visible on the Front Panel, make it visible by right-clicking on it in the Block Diagram and selecting: **Show indicator**.
4. Set *Only New Samples* to false.
5. Run **Tutorial_Only New_Read.vi** and **Tutorial_Write_Cluster.vi**. As you will see, all the published data is read by **Tutorial_Read_Cluster.vi**.
6. Modify the **Text** field, which is a key, in the *Writer*. The values in the *Reader* will flicker from the new value to the previous one. In fact, in the DDS Sample Info control, you will see that the data that is no longer published has its **DDS_SampleStateKind** set to `DDS_READ_SAMPLE_STATE`, while the new one value is set to `DDS_NOT_READ_SAMPLE_STATE`. Now we are reading any alive sample published by the *Writer*, even if we had already read it.



7. Change the *Only New Samples* control to **True**. Now we are only reading the latest published value. Take into account that only one data sample is read each time we call the

Read subVI (see [Lesson 7—Reading All Samples \(Reliable Communication\)](#) (Section 4.7)).

Note: A different approach is to use Exclusive Readers and 'take' to guarantee that the data will only be read once (see [Default Configuration: DDS Entities Created by Simple Create subVIs](#) (Section 6.1) and [Writing and Reading using Strict Reliability](#) (Section 4.7.2)).



4.5 Lesson 5—Using Keyed Types (RTI Shapes Demo)

In this lesson, we will explain the value of Keys in our data-type definition and introduce the powerful concept of DDS Topic instances.

We will use *RTI Shapes Demo* in this lesson. *RTI Shapes Demo* is a powerful example application to demonstrate the many capabilities of DDS as well as an easy way to quickly communicate with an external DDS application.

Shapes Demo can publish and subscribe to colored, moving shapes (squares, circles, and triangles). It supports a wide range of QoS parameters.

To complete this lesson, you need to install *Shapes Demo*, which you can download from www.rti.com/downloads. The *Shapes Demo User's Manual* is included with the installation.

Note: *Shapes Demo* uses a default domain ID of 0, which is the same domain ID used by the example VIs in this document. If you use a different domain ID for the VIs, you will also need to change the domain ID for *Shapes Demo* (see the *Shapes Demo User's Manual* for instructions).

4.5.1 Working with Shapes Demo

Shapes Demo allows you to publish and subscribe different shapes (the DDS Topic for this example). A 'ShapeType' data type is defined as a structure with four members:

- ❑ color (string) – it will also be used as the Key for the ShapeType
- ❑ x (Long, an I32 in LabVIEW)

- y (Long, an I32 in LabVIEW)
- shapessize (Long, an I32 in LabVIEW)

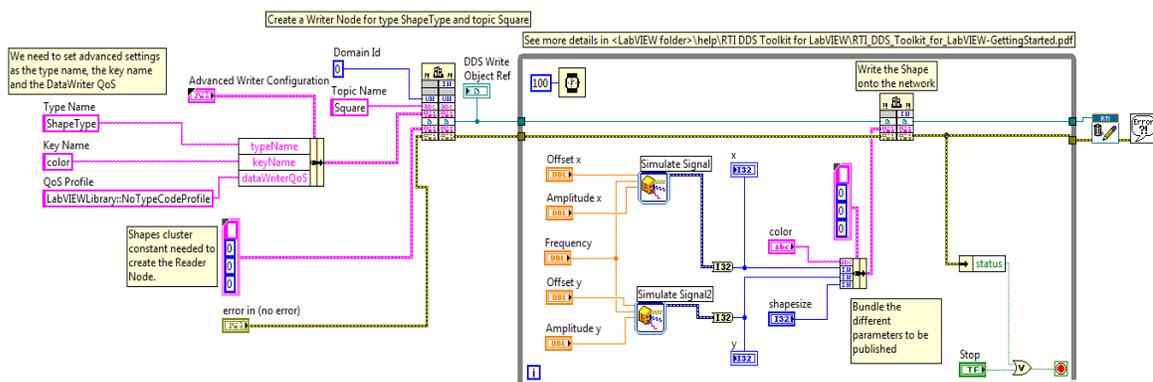
Shapes Demo can publish three different Topics of type ShapeType:

- Square
- Circle
- Triangle

4.5.2 Publishing a Shape (Square)

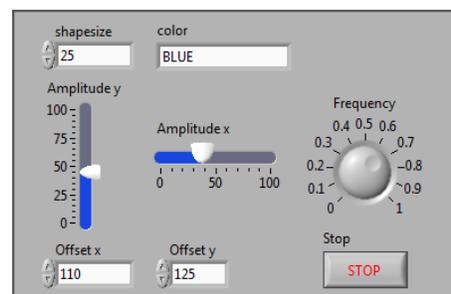
We will use LabVIEW to publish a square in domain 0. Additionally, we will generate two sine functions for the ShapeType X and Y coordinates in order to move the square in a circular or elliptical pattern.

1. Open **RTI Connex DDS Shapes Writer.vi** from the LabVIEW examples **ShapesDemo** directory under **RTI DDS Toolkit for LabVIEW**. (Instructions for finding the examples are in [Section 1.7.](#))
2. Open the Block Diagram and note that the VI is creating a *Writer* object to publish a ShapeType data with Topic Square. The VI uses *Simulate Signal* functions to generate the X and Y coordinates of each square before the square is published.

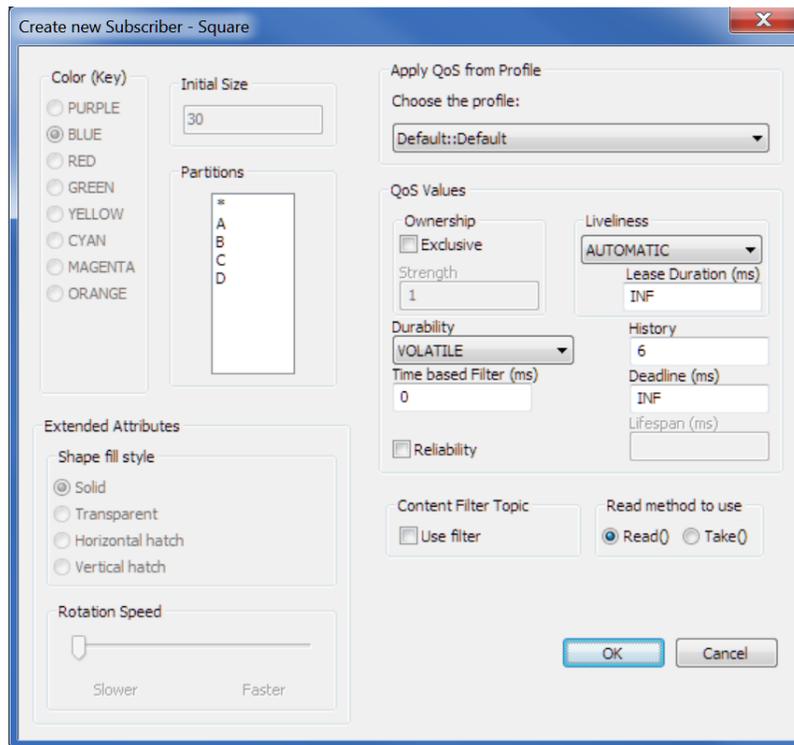


(Note: This example uses **LabVIEWLibrary::NoTypeCodeProfile** in order to make it compatible with *RTI Shapes Demo*, which uses a different string length. See the Compatibility section of the *Release Notes* for further details.)

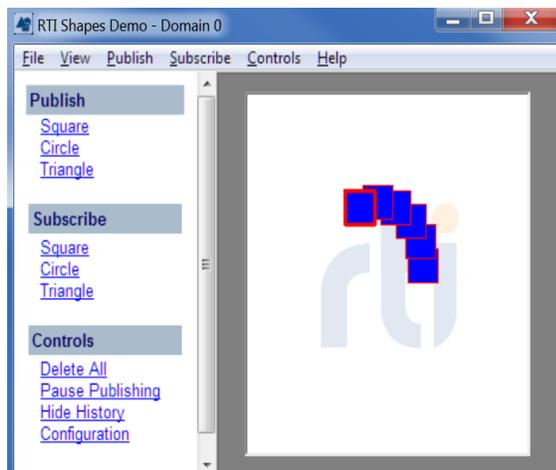
3. On the Front Panel, you can change these parameters of the *Simulate Signal* function: **shapessize**, **color**, **Amplitude y**, **Amplitude x**, **Frequency**, **Offset x** and **Offset y**.



4. Launch *Shapes Demo* and select the **Square** option under the Subscribe heading. You will see the dialog below. Select **OK**.

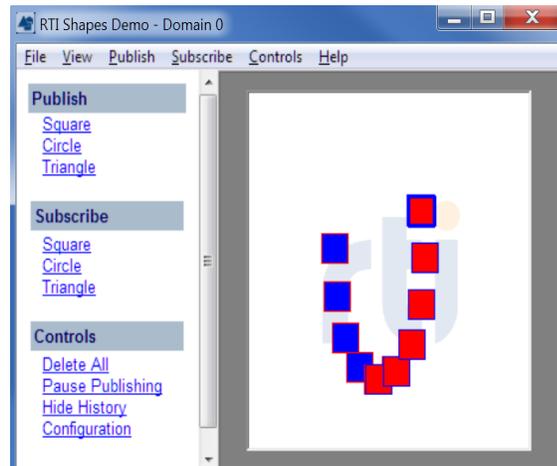


5. Run **RTI Connex DDS Shapes Writer.vi** and verify that *Shapes Demo* displays a blue square moving in circles.



6. Use the Front Panel to make changes to the X and Y amplitude and the frequency control. You should see the effects in the *Shapes Demo* window. The X and Y amplitude control the square's trajectory, the frequency varies the square's speed.

- Change the shape size and color to vary all the parameters. While the size can be any value, we suggest using values between 0 and 100. The color can be: PURPLE, BLUE, RED, GREEN, YELLOW, CYAN, MAGENTA, or ORANGE.



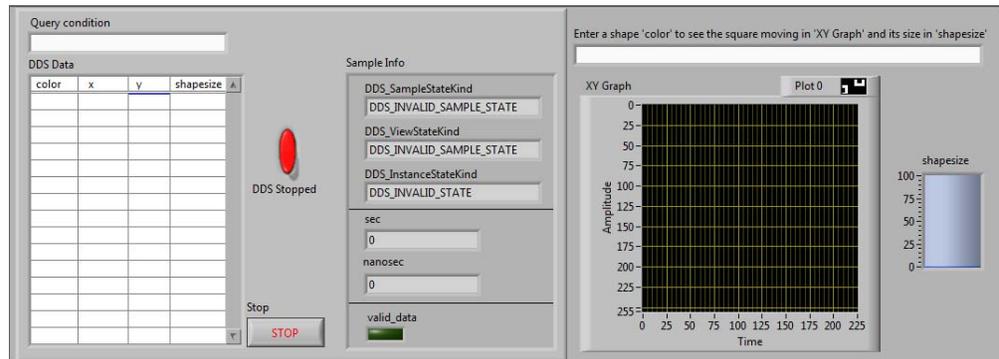
Note: When you change the square's color, you will still see the blue square. This is because we defined Square as the Topic and Color as the Topic Key (instance). Using Keys allows the definition of a single Topic with multiple instances. When you change the color, you are publishing a new instance of the Square Topic of the type ShapeType.

4.5.3 Subscribing to Shapes

Instead of using *Shapes Demo* to subscribe to the published shapes, let's create our own **RTI Connex DDS Shapes Reader** in LabVIEW.

- Open **RTI Connex DDS Shapes Reader.vi** from the LabVIEW examples **ShapesDemo** directory under **RTI DDS Toolkit for LabVIEW**.
- On the Front Panel, you will see two parts:
 - On the left, the VI shows a table, **DDS Data**, in which the read shapes will be shown. We also see a switch (**DDS Stopped**). By clicking on that switch, the VI will start reading samples from DDS and add them to the table. In addition, we can see the information of the currently read sample using **Sample Info**. We can use the Query condition text box on top to filter data, as explained in [Lesson 3—Filtering Data \(Section 4.3\)](#). Finally, we have the Stop button that stops the whole VI.

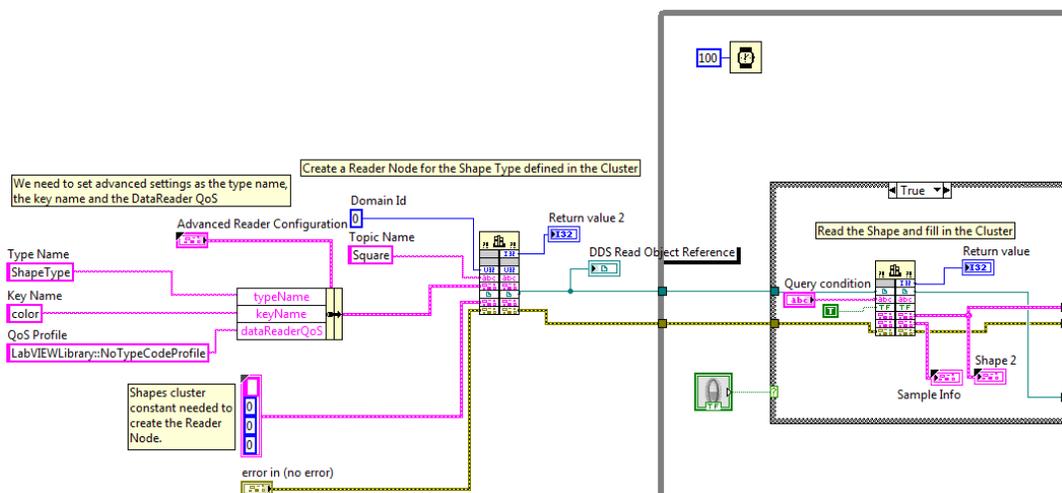
- On the right, we have a text box in which we can select one of the shapes using its key, that is, its color. To select the shape, just add the color as shown in the color column in **DDS Data**. Once selected, the position of the shape will be shown in **XY Graph** in real time, while its size will be shown in **Shape size**.



3. Open the Block Diagram and review the three different processes:

a. Creating the *Reader* object and reading:

- A *Reader* object is created to subscribe to the type **ShapeType** and the Topic **Square**, also providing a correct **ShapesDemo** cluster in the **data type** pin.
- Once created, the *Reader* object reads data from DDS using the Query Condition introduced in the Front Panel.
- Those data, however, are only read if the **DDS Stopped** switch is changed to **DDS Running** by clicking on it (i.e., if it is true).
- Sample Info** is filled with the information of the currently read sample.



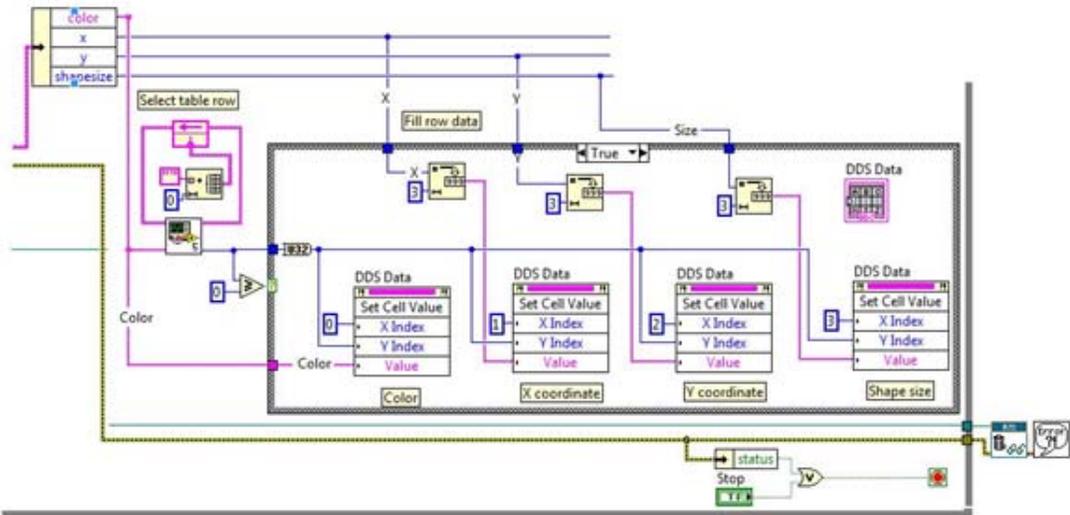
b. Storing data in the table:

- Each read datum is unbundled to extract the individual components. Each of these components goes in a different column in the **DDS Data** table.

Note: Due to a known issue in 'Set Cell Value' calls, plot properties cannot be modified at run time. See more details here: http://www.ni.com/product-documentation/52188/en/#407633_by_Date.

- Since each row corresponds to a unique instance, we select the table row using the cluster's key, i.e., the color.

- When you push the Stop button, the Reader object is released.

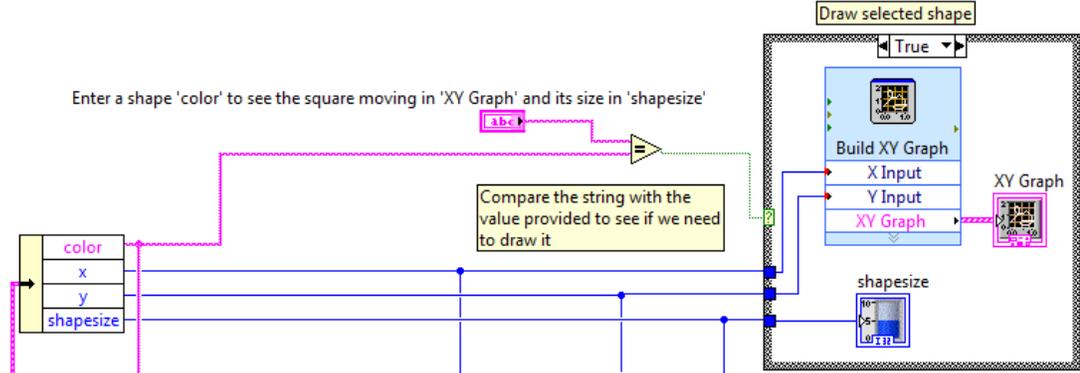


(Note: This example uses `LabVIEWLibrary::NoTypeCodeProfile` in order to make it compatible with *RTI Shapes Demo*, which uses a different string length. See the Compatibility section of the *Release Notes* for further details.)

c. Showing selected instance in the XY Graph:

If a color is selected in the text box on the right of the Front Panel, any read sample of that color will appear in the correct X and Y positions in XY Graph. Valid colors are: PURPLE, BLUE, RED, GREEN, YELLOW, CYAN, MAGENTA, and ORANGE.

The size of that shape will be shown in **shapeseize**.



4.6 Lesson 6—Used Nested and Multiple Keys

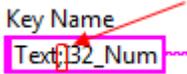
The previous lesson highlighted the value of using keys in your type definitions. Now let's see how to provide multiple keys for a single data type. This lesson assumes you have successfully completed [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\)](#) (Section 4.2). You can also use the provided example, *RTI Connex DDS Cluster Example Reader/Writer.vi*.

4.6.1 Adding Multiple Top-Level Fields as Keys

1. Open **Tutorial_Read_Cluster.vi** from Lesson 2 and save it as a new VI named **Tutorial_MultipleKey_Read_Cluster.vi**.

As you can see in the figure to the right, our cluster is quite complex and includes many fields. In [Lesson 5—Using Keyed Types \(RTI Shapes Demo\) \(Section 4.5\)](#), we marked **Text** as a key. Depending on the application, we may want to mark other fields as key. Suppose we want **I32_Num** to be a key too. That will make **Text** and **I32_Num** keys.

2. To mark both **Text** and **I32_Num** as keys, modify the **Key Name** string to include both fields, separated by a semicolon (;).



3. Click run.

If you use one of the RTI tools such as *RTI Monitor* to view the published/subscribed type, you can see that the equivalent IDL for this use case would be:

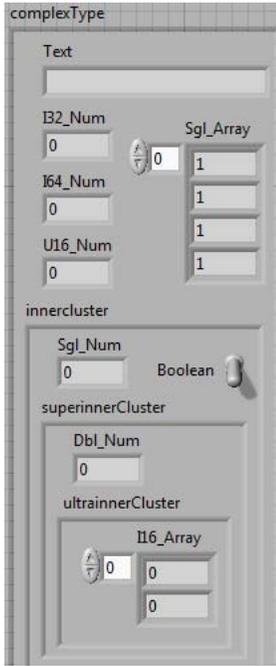
```

struct superinnerClusterType{
    double Dbl_Num;
    ultrainnerClusterType ultrainnerCluster;
};
struct ultrainnerClusterType{
    sequence<short,2> I16_Array;
};
struct ComplexType{
    string<1024> Text; //@key
    long I32_Num; //@key
    long long I64_Num;
    unsigned short U16_Num;
    sequence<float,4> Sgl_Array;
    innerclusterType innercluster;
};
struct innerclusterType{
    float Sgl_Num;
    boolean Boolean;
    superinnerClusterType superinnerCluster;
};

```

Note: The key name specification is case sensitive.

4. Repeat this process using **Tutorial_Write_Cluster.vi**, so they can communicate with each other.



4.6.2 Adding Internal Cluster Fields as Keys (Nested Keys)

For a field inside a cluster, use its fully qualified name. This name consists of the cluster name followed by a period (.) and then the field name. For instance, to refer to **Sgl_Num**, use the string **innercluster.Sgl_Num**. For **Dbl_Num**, its fully qualified name is **innercluster.superinnerCluster.Dbl_Num**.

1. Open **Tutorial_Read_Cluster.vi** from [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\)](#) (Section 4.2) and save it as a new VI named **Tutorial_NestedKey_Read_Cluster.vi**.
2. Replace the **Key Name** string with the following value:

Key Name

Text;I32_Num;innercluster.Sgl_Num;innercluster.superinnerCluster.Dbl_Num

3. Click run.

If you use one of the RTI tools such as *RTI Monitor* to view the published/subscribed type, you can see that the equivalent IDL for this use case would be:

```
struct superinnerClusterType{
    double Dbl_Num; //@key
    ultrainnerClusterType ultrainnerCluster;
};
struct ultrainnerClusterType{
    sequence<short,2> I16_Array;
};
struct ComplexType{
    string<1024> Text; //@key
    long I32_Num; //@key
    long long I64_Num;
    unsigned short U16_Num;
    sequence<float,4> Sgl_Array;
    innerclusterType innercluster; //@key
};
struct innerclusterType{
    float Sgl_Num; //@key
    boolean Boolean;
    superinnerClusterType superinnerCluster; //@key
};
```

Notice that **innercluster** and **superinnercluster** are both marked as keys. This is done automatically by the toolkit and is needed for a correct key specification.

Remember that the key name specification is case sensitive.

4.7 Lesson 7—Reading All Samples (Reliable Communication)

This lesson explains how to use LabVIEW to read all the available samples in our Reader. This lesson focuses on sending information reliably. There are two different approaches: using the default *RTI DDS Toolkit* behavior (see [Default Configuration: DDS Entities Created by Simple Create subVIs](#) (Section 6.1)) or using exclusive Reader nodes.

The first approach is explained in [Writing and Reading Reliably Using the Default Configuration](#) (Section 4.7.1). The latter approach is explained in [Writing and Reading using Strict Reliability](#) (Section 4.7.2).

4.7.1 Writing and Reading Reliably Using the Default Configuration

In our QoS file, there is an already prepared profile to enable this kind of communication: **ReliableProfile**.

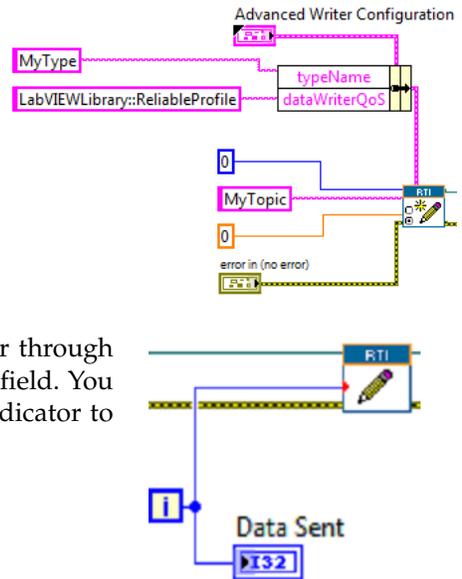
4.7.1.1 Writing Reliably

1. Open a blank VI and open the Block Diagram.

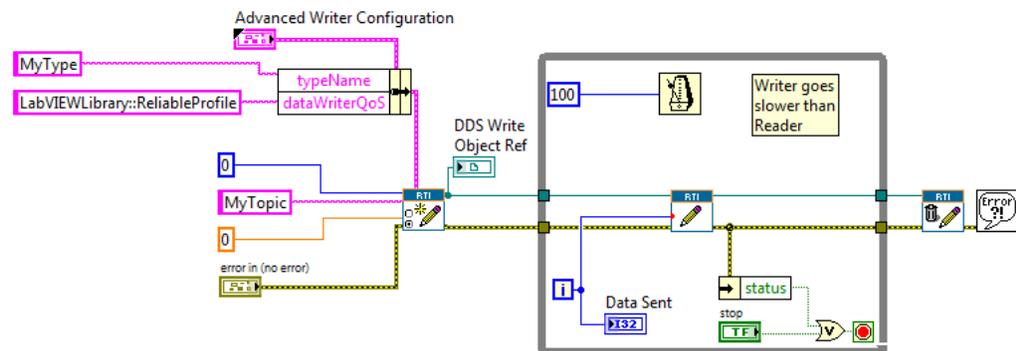
Add an *Advanced Create Writer* subVI and fill in the parameters to create a *Writer* object of doubles, as shown in the figure. Pay attention to the new QoS Profile.

For details on the *Advanced Create Writer* subVI, see [Chapter 6: Advanced Concepts and Settings](#).

2. Create a *While Loop* and put a *Write* subVI inside it. We are going to send the loop counter through DDS, so attach that counter to the *Writer's data* field. You can also visualize that value by attaching an indicator to the counter.



3. Add a *Release Writer* subVI and complete the VI as shown in the following figure. Pay special attention to the *Wait* function.

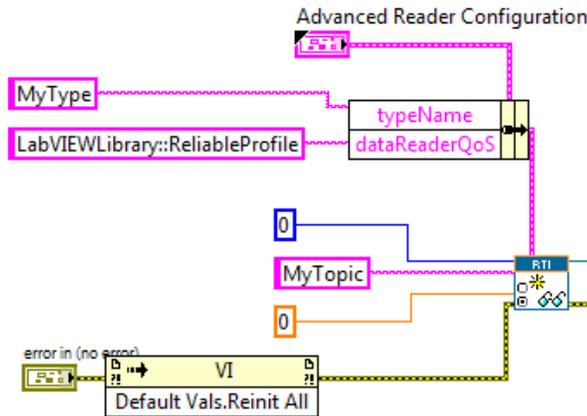


4. Save it as **Tutorial_Write_Reliable.vi**.

4.7.1.2 Reading Reliably

1. Open a blank VI and create an indicator of an array of doubles. Show the vertical scrollbar of the array in the array properties, i.e., right-click in the array, select **Properties** and check the **Show Vertical Scroll Bar** option.

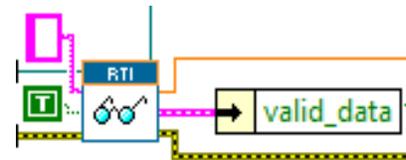
2. Add an **Advanced Create Reader** subVI and fill in the parameters to create a **Reader** of doubles, as shown in the following figure. Pay close attention to the new QoS Profile.



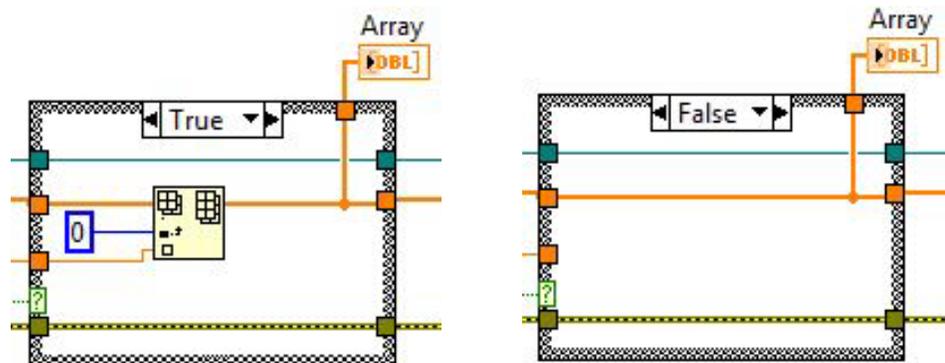
For details on the **Advanced Create Reader** subVI, see [Chapter 6: Advanced Concepts and Settings](#).

3. Optionally, add an **Invoke note** to call the method **Reinitialize All to Default**. This function resets all the controls and indicators in the VI to the default value. To include it, follow these steps:
 - a. Find **Invoke Node** under **Programming, Application Control**.
 - b. Right click in the invoke node and go to **Select Class, VI Server, VI, VI**.
 - c. Click in the method label and navigate to **Default Values, Reinitialize All to Default**.
4. Now we need to read data and discard those values that are not valid. For that:
 - a. Add a **Read** subVI inside a While Loop.
 - b. Connect the **Read** subVI to the **Create Reader** subVI.
 - c. Set **Only New Samples** to **true**.
 - d. Attach an **unbundle** function to the DDS Sample Info cluster and select **valid_data**. This field will be true if the data is a valid one.

For details on the *Read* subVI, see [Reader \(Section A.2.2\)](#).

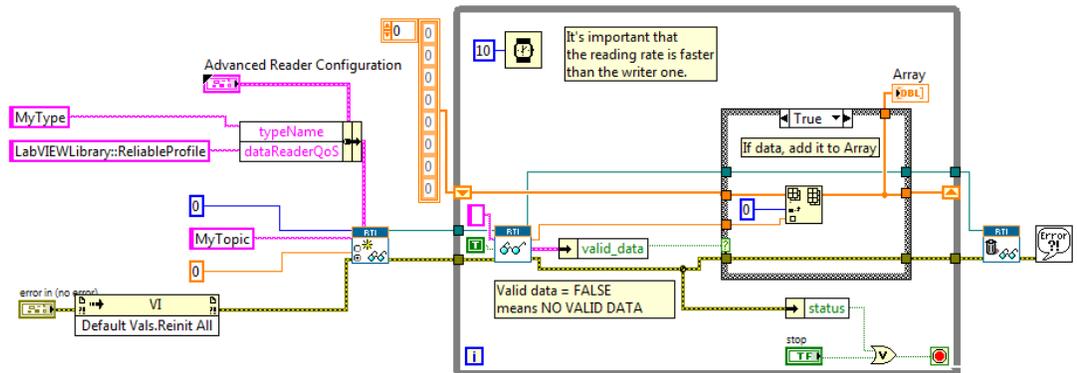


5. If the data is valid, insert it in the array. Otherwise, ignore the data:



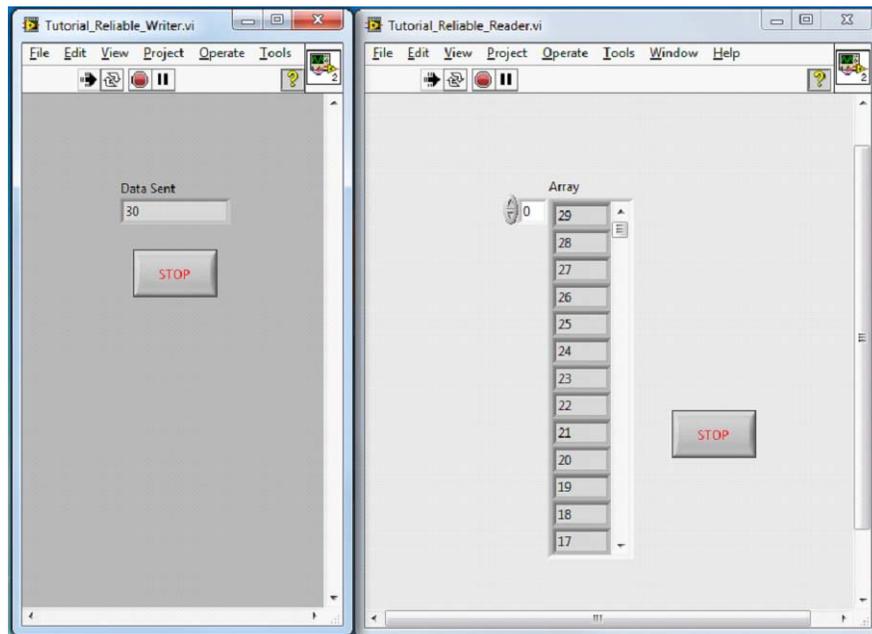
- a. Create a **Case Structure** from **Programming, Structures** and connect the output of **valid_data** to the question mark.

7. Add a **Release Reader** subVI and an **Error Dialog**. The final Block Diagram should look like the following figure. Pay attention to the reading ratio, it needs to be faster than the writer one or increase **Reader History Depth** in the XML Configuration File.



For details on the **Release Reader** subVI, see [Reader \(Section A.2.2\)](#).

8. Save it as **Tutorial_Read_Reliable.vi**.



9. Run the **Reader** and **Writer**. You will see how all the data transferred by the **Writer** arrives at the **Reader**.

4.7.2 Writing and Reading using Strict Reliability

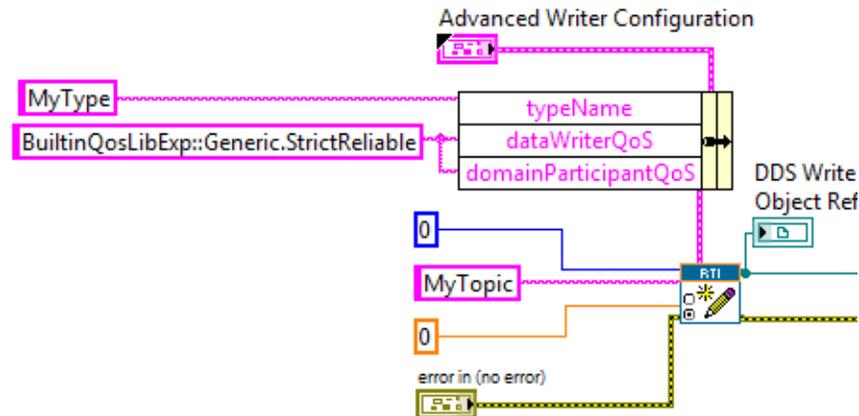
[Writing and Reading Reliably Using the Default Configuration \(Section 4.7.1\)](#) assumes you are using the default configuration of *RTI DDS Toolkit for LabVIEW*. As explained in [Chapter 6: Advanced Concepts and Settings](#), this configuration uses shared DataReaders, so a more strict reliability (KEEP_ALL History QoS kind and History QoS depth > 1), is not allowed.

If you need strict reliability on your system, you can do it using exclusive readers and the builtin QoS profile: **BuiltinQosLibExp::Generic.StrictReliable**. This profile is defined internally in *RTI*

Connex DDS (for details on Built-in profiles, see the RTI Community Forum: <http://community.rti.com/examples/built-qos-profiles>).

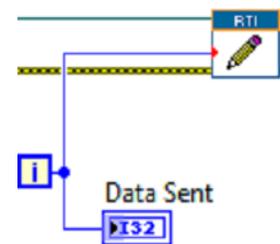
4.7.2.1 Writing in Strictly Reliable Mode

1. Open a blank VI and open the Block Diagram.
2. Add a *Create Advanced Writer* subVI and fill in the parameters to create a *Writer* object of doubles. Make sure you set the QoS profiles as shown in the following figure:

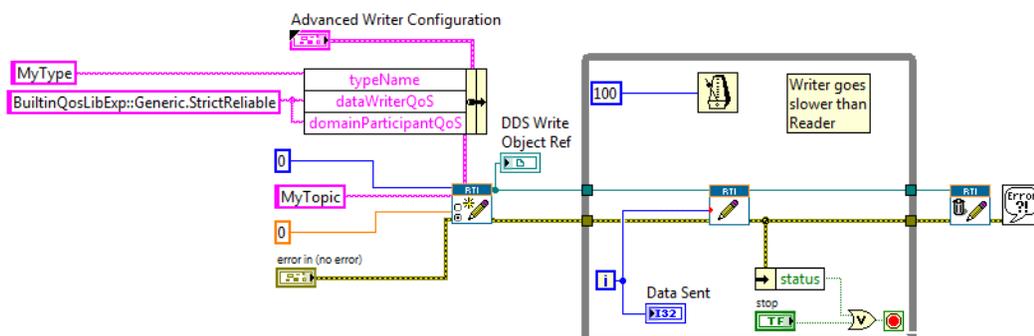


For details on the *Create Advanced Writer* subVI, see [Chapter 6: Advanced Concepts and Settings](#).

3. Create a *While Loop* and put it inside a *Write* subVI. We are going to send the loop counter through DDS, so attach that counter to the *Writer's data* field. You can also visualize that value by attaching an indicator to the counter.



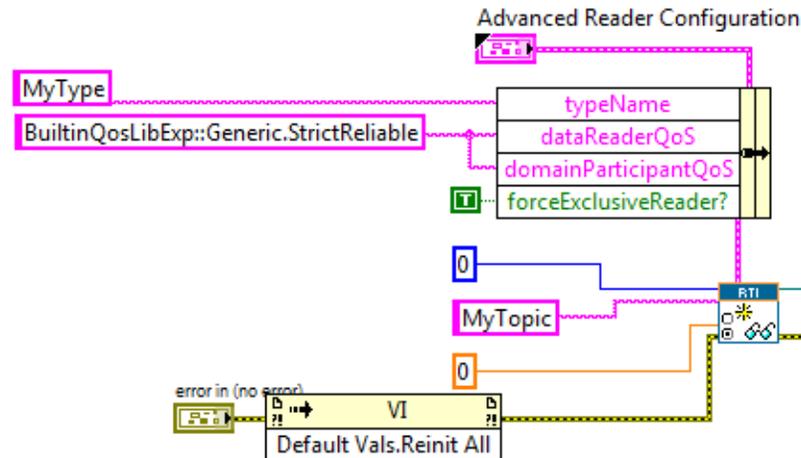
4. Add a *Release Writer* subVI and complete the VI as shown in the following figure. Pay special attention to the *Wait* function.



5. Save it as `Tutorial_Write_StrictReliable.vi`.

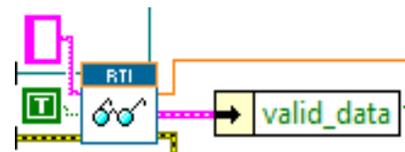
4.7.2.2 Reading in Strictly Reliable Mode

1. Open a blank VI and create an indicator of an array of doubles. Show the vertical scroll bar of the array in the array properties, i.e., right-click in the array, select **Properties** and check the **Show Vertical Scroll Bar** option.
2. Add an *Advanced Create Reader* subVI and fill in the parameters to create a *Reader* of doubles, as shown in the following figure. Make sure you set the QoS profiles and the **forceExclusiveReader?** as shown in the following figure.



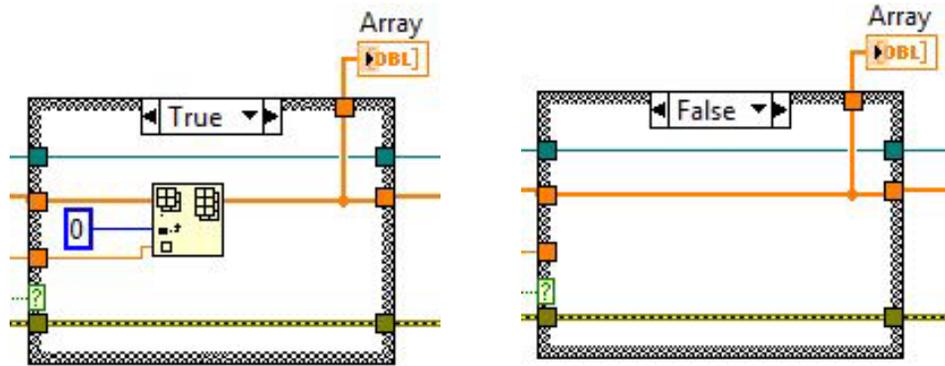
For details on the *Create Advanced Writer* subVI, see [Chapter 6: Advanced Concepts and Settings](#).

3. Optionally, add an *Invoke* note to call the method **Reinitialize All to Default**. This function resets all the controls and indicators in the VI to the default value. To include it, follow these steps:
 - a. Find **Reinitialize All to Default** under **Programming, Application Control**.
 - b. Right click in the invoke node and go to **Select Class, VI Server, VI, VI**.
 - c. Click in the method label and navigate to **Default Values, Reinitialize All to Default**.
 - d. Connect it as shown in the previous figure.
4. Add a *Read* subVI inside a *While Loop*. Connect the *Read* subVI to the *Create Reader* subVI. Set **Only New Samples** to **True**. Then attach an *unbundle* function to the *DDS Sample Info* cluster to check whether the data is valid or not.

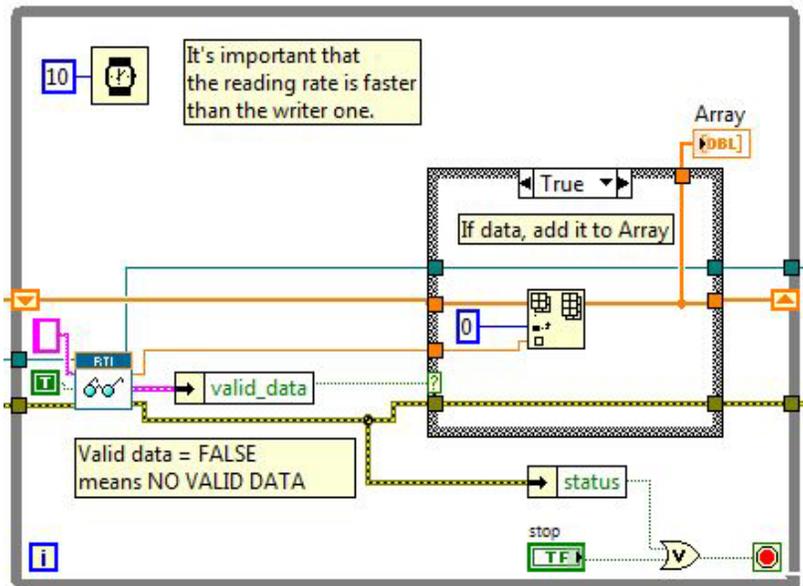


For details on the *Read* subVI, see [Reader \(Section A.2.2\)](#).

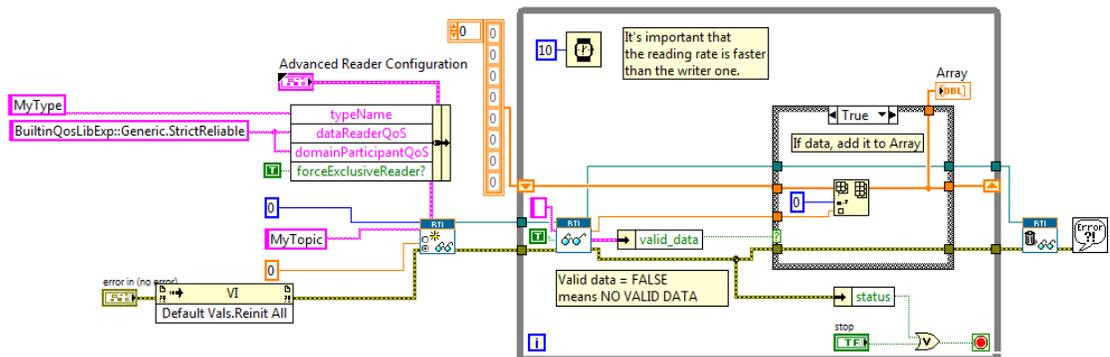
- If the data is valid, insert it in the array. Otherwise, ignore the data:



- Attach the exit of the *If Case* to the *Loop Case*. Then replace it with a shift register by right-clicking on it and selecting **Replace with Shift Register**. Place the input shift register on the left side of the loop and connect it as an input in the *If Case* as shown below.



- Add a *Release Reader* subVI and an *Error Dialog*. The final Block Diagram should look like the following figure. Pay attention to the reading ratio, it needs to be faster than the writer one or increase **Reader History Depth in the XML Configuration File.**



For details on the *Release Reader* subVI, see [Reader \(Section A.2.2\)](#).

8. Save it as **Tutorial_Read_StrictReliable.vi**.
9. Run the *Reader* and *Writer*. You will see how all the data transferred by the *Writer* arrives at the *Reader*.

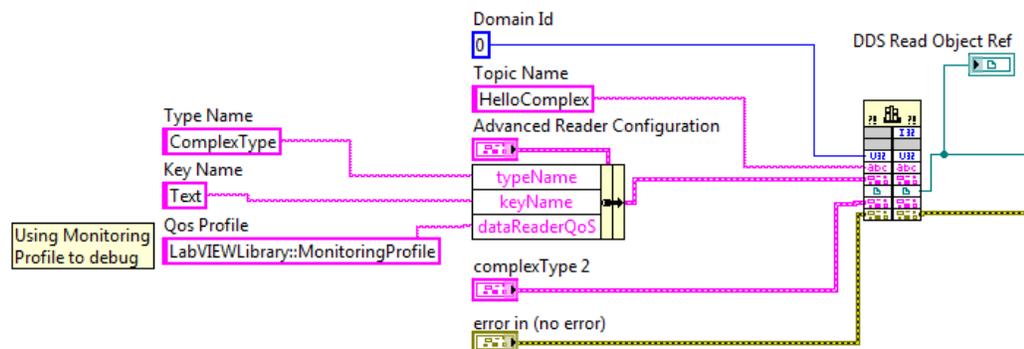
4.8 Lesson 8—Debugging Your RTI Connex DDS Application Using a Monitoring Profile

In this lesson, you will become familiar with the *RTI DDS Toolkit for LabVIEW* QoS profiles and debugging capabilities. *RTI DDS Toolkit for LabVIEW* provides several predefined QoS profiles. You can see the contents of these profiles in the file `C:/Program Files1/National Instruments/LabVIEW 20xx/vi.lib/_RTI DDS Toolkit for LabVIEW_internal_deps/RTI_LABVIEW_CONFIG.documentationONLY.xml` (where 20xx depends on your LabVIEW version). In this example we will use the monitoring profile that enables *RTI Monitoring Library*. For more details about *RTI Monitoring Library*, see the RTI website (www.rti.com/products/tools/index.html).

4.8.1 Adapting a VI to Use RTI Monitoring Library

Let's begin by opening the Reader VI created in [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\) \(Section 4.2\)](#): **Tutorial_Read_Cluster.vi**. Or you can use the solution to that lesson mentioned in [Section 4.10](#).

1. Save the VI with a different name, such as **MonitoringReader.vi**, by selecting **Save as...** in the **File** menu.
2. In the Block Diagram, change the **qos profile** input of the *Create Reader* subVI to **LabVIEWLibrary::MonitoringProfile**.



3. Save the VI again.

4.8.2 Output Provided by RTI Monitor

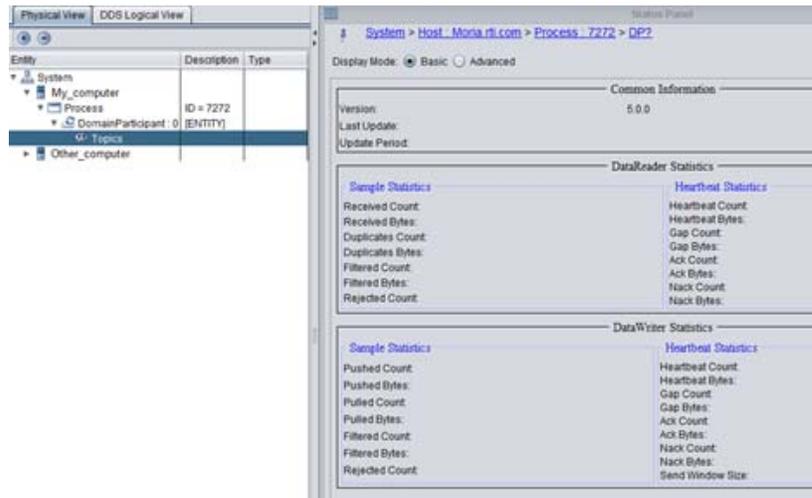
Now that we have the Monitoring profile loaded in our VI, we can run *RTI Monitor* to debug our application.

1. On 64-bit systems, the folder is "Program Files (x86)"

RTI Monitor is included in *RTI Connex DDS Professional*. You can download a free trial from <http://www.rti.com/downloads/index.html>. For information about *RTI Monitor*, see <http://www.rti.com/products/tools/monitor.html>.

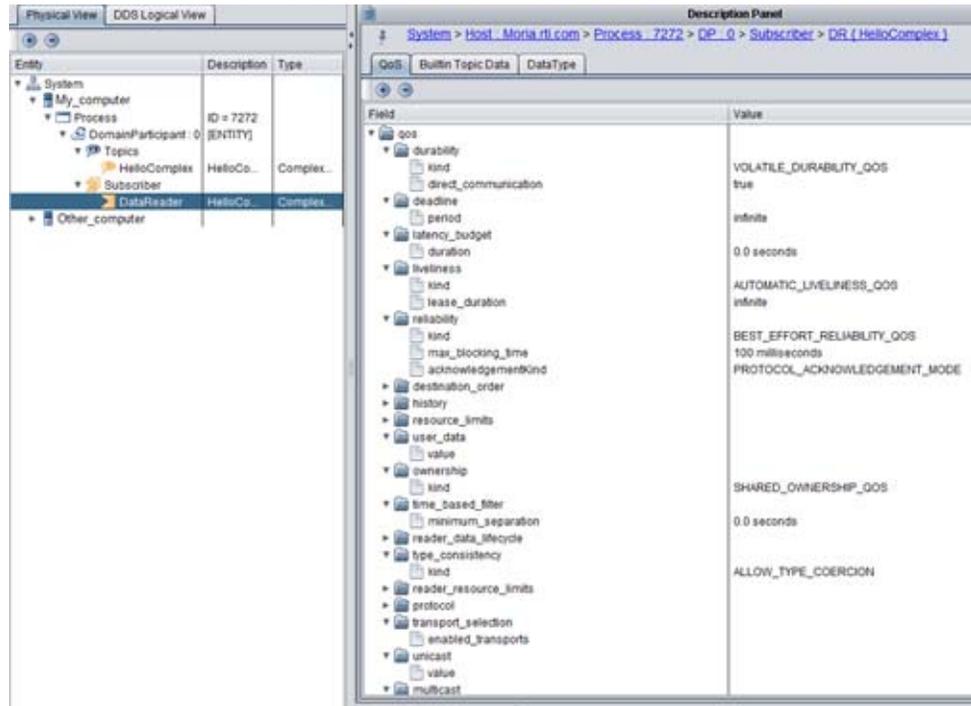
Important: Your `Path` environment variable must include the location of the *RTI Monitoring Library DLL*, `rtimonitoring.dll`, that is noted in [Appendix D](#). Make sure you are not loading *RTI Monitoring Library* from another location.

1. Start *RTI Monitor*; when prompted, join domain 0.
2. Run the original `Tutorial_Read_Cluster.vi`. This example does not enable the monitoring libraries, so *Monitor* will not show useful information. The following snapshot shows the output from *Monitor* when the monitoring libraries are *not* enabled.



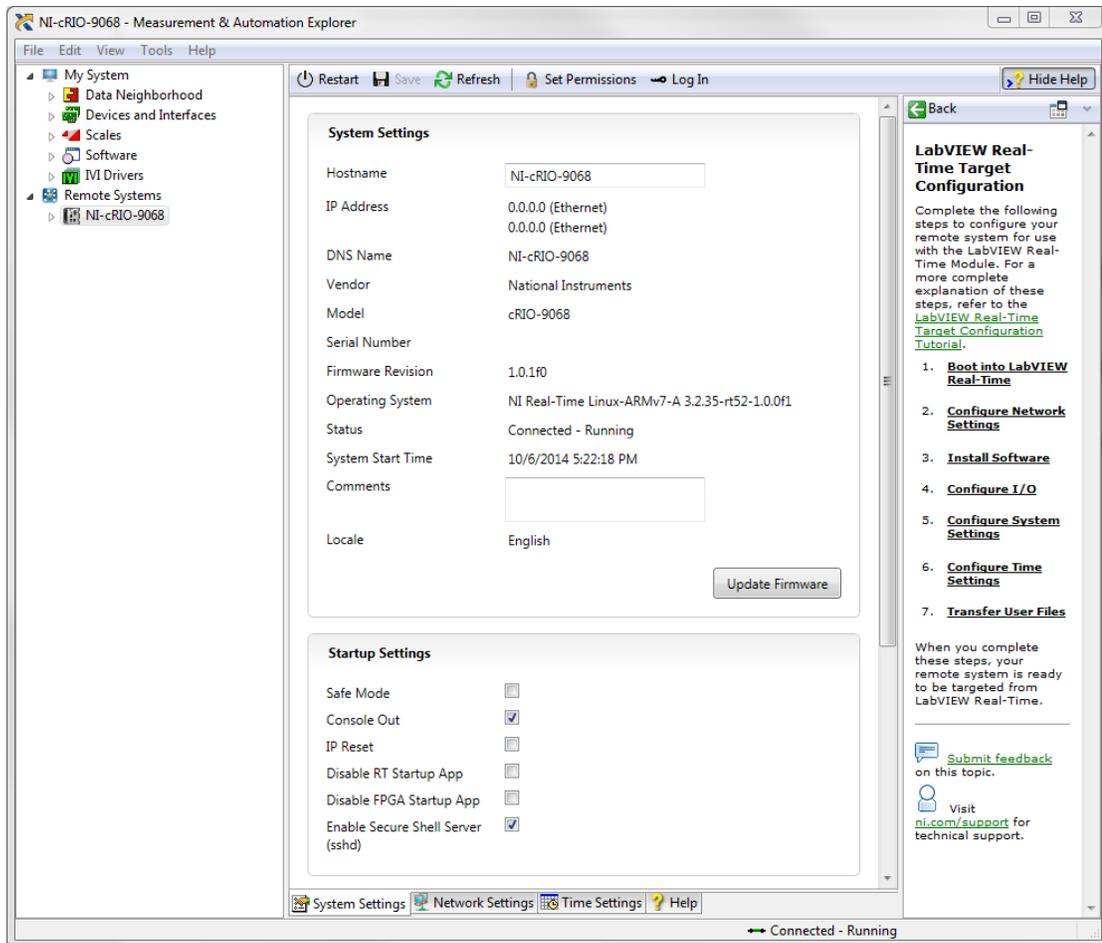
3. Stop `Tutorial_Read_Cluster.vi` and make sure that all the entities are released. To do so, close all VIs containing *RTI DDS Toolkit for LabVIEW* subVIs. You can also run the *Release Unused Entities* subVI ten seconds after stopping all the VIs running in the same domain as `Tutorial_Reader_Cluster.vi`.

4. Run **MonitoringReader.vi** and go back to *Monitor*. Now you can see more information such as the topic name, the number of subscribers and publishers, the QoS profile, etc.



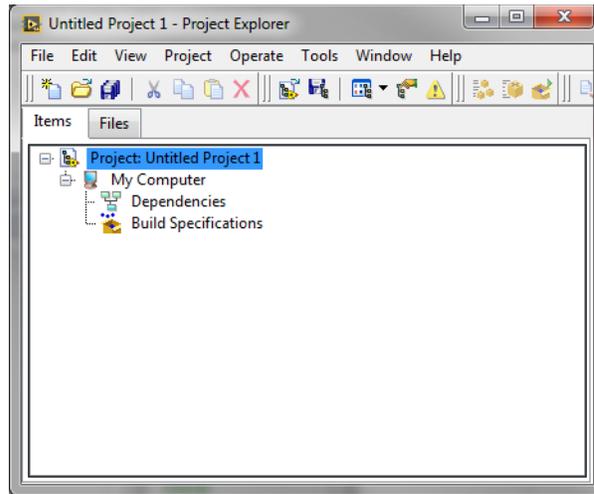
4.9 Lesson 9—Using the RTI DDS Toolkit on a cRIO-9068 Target

1. Make sure the cRIO is up and running. You can use NI MAX to do so.

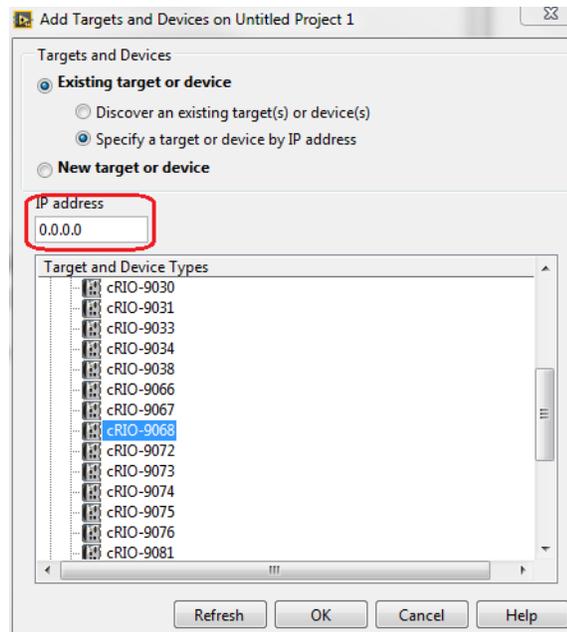


2. Follow the installation instructions in [Installing RTI DDS Toolkit for LabVIEW Support Files on a Target \(Section 1.2.1\)](#).

3. Create an empty project in LabVIEW by choosing **File, New Project** or **File, Create Project**, depending on your LabVIEW version.



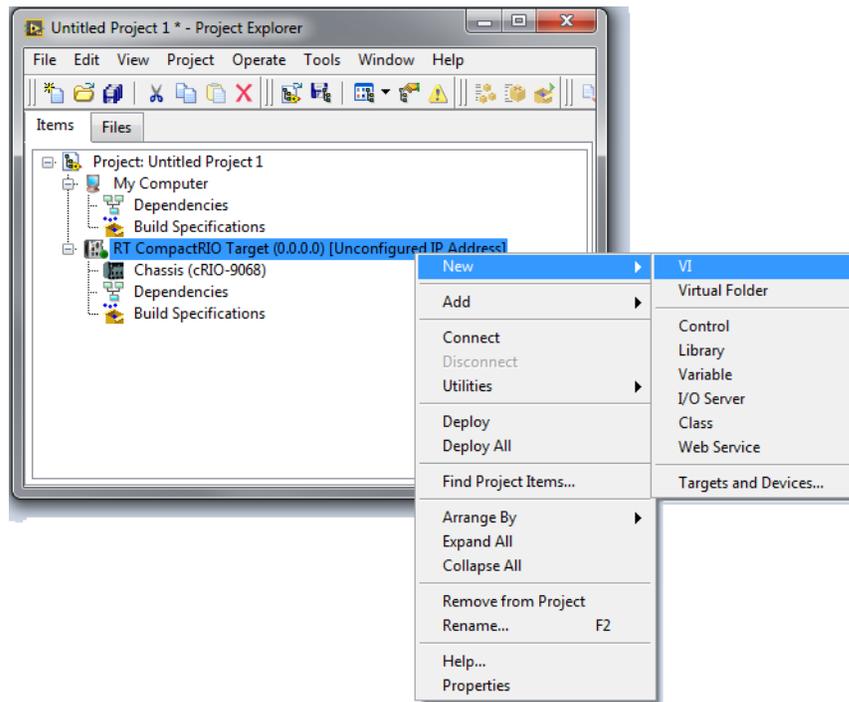
4. Right-click the top-level project item in the Project Explorer window, seen in blue in the above image. Select **New, Targets and Devices** from the shortcut menu to display the Add Targets and Devices dialog box.



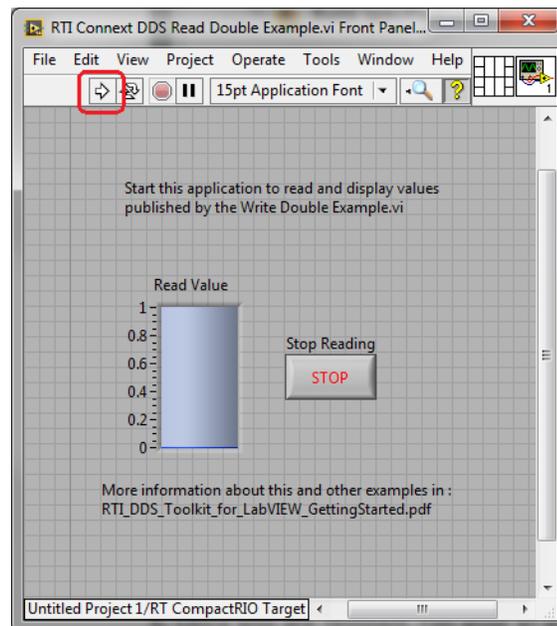
5. Select **Existing target or device** and **Specify a target or device by IP address**. Set the correct IP address. Open the Real-Time CompactRIO list and select your device. Click **OK**.

Note: You need to be in the same subnet to find your target.

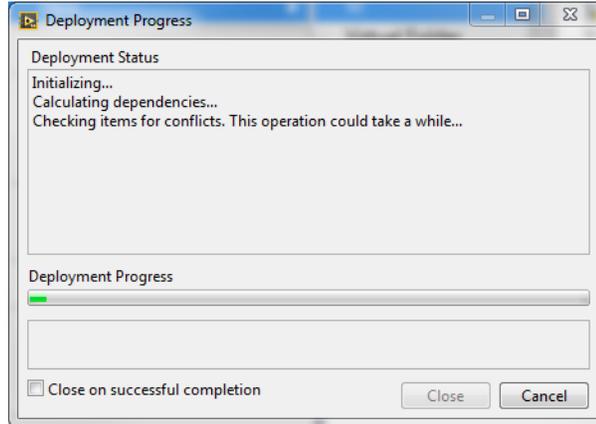
- Right-click on your new target and select **New, VI**. You can also add an existing one by selecting **Add, File....**



- Create your application using *RTI DDS Toolkit for LabVIEW* as mentioned in the previous lessons. Save it and the project.
- Once you are finished, run your VI as usual by clicking on the white arrow.

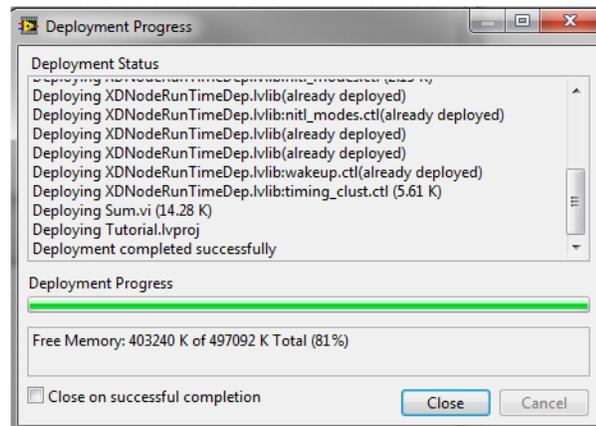


9. LabVIEW will show the Deployment Progress window and will send the VI to your target. This process may take a while, depending on your VI's complexity.



Note: If you get an error related to not being able to find `rtilvdds.dll`, reinstall the RTI DDS Toolkit for LabVIEW cRIO support files.

10. Once deployed, you will see a window like this:



11. Click **Close** and work with your VI as you normally would.

4.10 Reviewing Completed Solutions

You can find completed solutions to many of the lessons in this chapter here:

- ❑ [Lesson 1—Using DDS to Publish and Subscribe to Simple Data \(Numeric\) \(Section 4.1\)](#)
 \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\Examples\NumberDemo
- ❑ [Lesson 2—Using Templates to Publish and Subscribe to Complex Data \(Clusters\) \(Section 4.2\)](#)
 \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\Examples\ClusterDemo
- ❑ [Lesson 3—Filtering Data \(Section 4.3\)](#)
 \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\Examples\ClusterDemo
- ❑ [Lesson 4—Reading Only New Samples \(Section 4.4\)](#)

- `\LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\Examples\ClusterDemo`
- ❑ [Lesson 5—Using Keyed Types \(RTI Shapes Demo\) \(Section 4.5\)](#)
 - `\LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\Examples\ShapesDemo`
- ❑ [Lesson 7—Reading All Samples \(Reliable Communication\) \(Section 4.7\)](#)
 - `\LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\Examples\ReadAllDemo`
- ❑ [Lesson 9—Using the RTI DDS Toolkit on a cRIO-9068 Target \(Section 4.9\)](#)
 - `\LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\cRIO-9068Project` (Note: This project is compatible with LabVIEW 2013 and higher)

Chapter 5 Loading Quality of Service Profiles

This chapter describes how to load personalized QoS profiles in *RTI DDS Toolkit for LabVIEW*.

QoS profiles provide a way to configure your DDS application and define most aspects of the DDS paradigm and the underlying communication mechanisms.

- ❑ *RTI DDS Toolkit for LabVIEW* includes a set of predefined QoS profiles. These profiles solve general use-cases such as a Reliable Communication or including *RTI Monitoring Library*. These profiles are embedded in *RTI DDS Toolkit for LabVIEW* and cannot be modified. You can inherit from them.

For your convenience, you can find an XML file that shows you these profiles in **C:/Program Files¹/National Instruments/LabVIEW 20xx/vi.lib/_RTI DDS Toolkit for LabVIEW_internal_deps/RTI_LABVIEW_CONFIG.documentationONLY.xml** (where 20xx depends on your LabVIEW version). As the filename suggests, this file is for documentation purposes only. This file is not loaded by the *RTI DDS Toolkit for LabVIEW*, so updating it will not affect the embedded QoS profiles.

- ❑ *RTI Connex DDS* also includes several predefined QoS profiles. You can use these directly from LabVIEW as starting points when creating your own QoS profiles. To access these builtin profiles, use their library name and profile name (for instance, `Built-inQosLib::Generic.Monitoring.Common`). For more information, consult the *RTI Connex DDS Core Libraries User's Manual* (see the chapter on *Configuring QoS with XML*).

For information on the format and contents of a QoS profile, consult the *RTI Connex DDS Core Libraries User's Manual* (see the chapter on *Configuring QoS with XML*).

The provided profiles are illustrative and might not fulfill all the desired functionalities. To adjust them to your needs, you can create your own XML configuration file (for instance, **USER_QOS_PROFILES.xml**). You can define several libraries and profiles in each unique XML file, then refer to their names in subVI calls. For instance, `LabVIEWLibrary::DefaultProfile` references the `DefaultProfile`, which you can see in **RTI_LABVIEW_CONFIG.documentationONLY.xml**.

Once you have defined your desired QoS settings and stored them in a file (or files), *RTI DDS Toolkit for LabVIEW* will load the settings automatically if you point it to the correct file; there are two ways to do this. We strongly recommend the first approach, which provides a more versatile solution.

- ❑ **Environment variable `NDDS_QOS_PROFILES` (recommended):**

1. On 64-bit systems, the folder is "Program Files (x86)"

You can define the environment variable `NDDS_QOS_PROFILES` and have it point to the XML file that you want to load. You can specify multiple locations for a single XML document via URL groups. The syntax of a URL group is: `[URL1 | URL2 | URL2 | ... | URLn]`.

For example:

```
[file://C:/DDS_config/USER_QOS_PROFILES.xml |  
file://C:/DDS_config/alternative_default_dds.xml]
```

❑ **Working directory (not recommended):**

You can save a file called `USER_QOS_PROFILES.xml` in the working directory of LabVIEW.

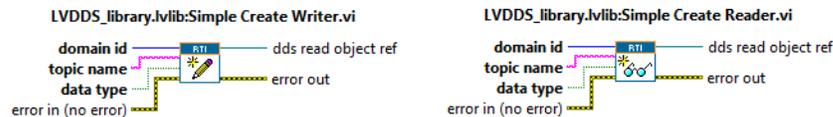
The working directory in LabVIEW depends on the application kind. If you are running a VI from LabVIEW, the working directory is the one where the LabVIEW.exe file is, such as `C:/Program Files (x86)/National Instruments/LabVIEW 2012/`. However, if your application is an independent one, it will use the Run-Time Engine to execute and the working directory will be `C:/Program Files (x86)/National Instruments/Shared/LabVIEW Run-Time/2012/`.

Chapter 6 Advanced Concepts and Settings

This chapter explains some advanced concepts and describes how to configure advanced parameters in *RTI DDS Toolkit for LabVIEW*.

When configuring an *RTI Connex* DDS application, there are many parameters that allow you to customize your application. Some of them can be configured by executing using QoS profiles (see Chapter 5. Loading Quality of Service Profiles). Others need to be configured at compile time, such as the topic name and domain ID.

When using *RTI DDS Toolkit for LabVIEW*, you can decide to hide some of that customization to simplify your application, or adapt your settings to match your needs. The first approach requires you to use the *Simple Create* subVIs.¹ These subVIs only need the mandatory parameters needed for the creation of DataReaders and DataWriters: domain id, topic name and data type.



The second approach is to use a more versatile create subVI: *Advanced Create Reader/Writer*. In the following sections we will explain the different parameters that can be provided to customize your application.

6.1 Default Configuration: DDS Entities Created by Simple Create subVIs

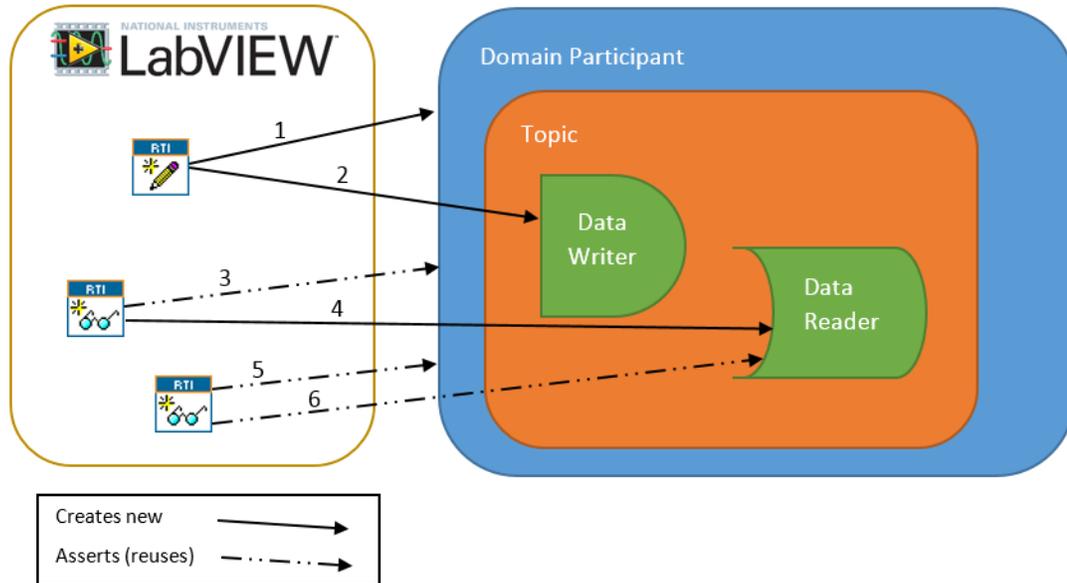
RTI DDS Toolkit for LabVIEW has been designed to reduce the number of DDS Entities created and, therefore, minimize the memory and CPU overloads. For example:

- Only one DomainParticipant is created per domain.
- The implicit Publisher and Subscriber are reused, avoiding the creation of new ones.
- Only one DataReader/DataWriter is created per Topic.

1. When creating complex-type Readers and Writers, you will need to use the Simple Create Reader/Writer Templates that can be found in the Function palette: **Data Communication, RTI DDS Toolkit for LabVIEW, Complex-Type Templates**.

When you call the *Simple Create* subVIs or templates, we internally search for an existing DomainParticipant in the **domain**, an existing **Topic** with the correct topic name, and an existing DataReader or DataWriter of the correct **data type**.

As an example, consider this scenario.



First we create a *Writer* VI. Internally, we are creating a DomainParticipant (1), a Topic, and a DataWriter (2). Then, if we create a Reader VI in the same LabVIEW instance, the DomainParticipant and the Topic are reused (3) and only a DataReader is created (4). When a second or third DataReader VIs are created, the DomainParticipant (5), the Topic AND the DataReader are reused (6). This way, all Reader VIs share the same queue.

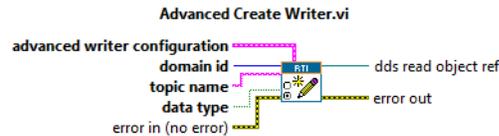
For most applications, this configuration is sufficient. However, there are several considerations when using shared Entities that may force you to create additional ones:

- If you set the flag ONLY_NEW_SAMPLES to 'true' when reading, only one of the Reader nodes will get the data. This is due to all the Readers sharing the same DataReader.
- Shared DataReaders use 'read' instead of 'take' when getting new data. This prevents shared DataReaders from using Strict Reliable QoS profile.
- If your application have several Writer nodes for the same Topic, the DataWriter resources need to be adapted to handle the data produced by all the Writer nodes.
- If you need to create DomainParticipants, DataReaders or DataWriters with different QoS properties, you will need to use the Advanced Create subVIs and force the creation of those Entities.
- If you need to set different transport properties, you will need to create different DomainParticipants.

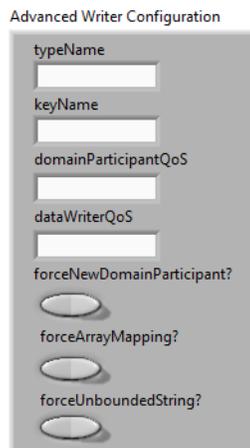
Take into account that a larger number of DDS Entities requires more resources and will affect performance. So we strongly recommend that you avoid using additional entities whenever possible.

6.2 How to Configure Advanced Writer Settings

In the Writer subpalette you can find an *Advanced Create Writer*.² This subVI is similar to the *Simple Create Writer*, but it has an additional parameter: the *Advanced Writer Configuration* cluster. You can find this cluster in the Control Palette: **Addons, RTI DDS Toolkit for LabVIEW, Types, RTI DDS Advanced Writer Configuration**.



As you can see in the figure, the cluster allows you to configure the following parameters:



- typeName**: Defines the name used to register the type in the wire.
- keyName**: List of fields of a data type that will be marked as key (see Lessons 5 and 6 of the Chapter 4, Tutorial).
- domainParticipantQoS**: full qualified name (Library::Profile) that will be used as QoS profile when creating the DomainParticipant. If there is an existing DomainParticipant in the domain and no new DomainParticipant is forced (forceNewDomainParticipant equals false), this setting has no effect. Therefore, the DomainParticipant QoS properties remain unchanged.
- dataWriterQoS**: full qualified name (Library::Profile) that will be used as QoS profile when creating the DataWriter.
- forceNewDomainParticipant?**: If this flag is true, a new DomainParticipant is created even if a valid one existed for the domain. This may affect the performance.³
- forceArrayMapping?**: By default, LabVIEW arrays are mapped as DDS sequences. If you need your data to use DDS arrays, set this flag to true. This will affect to all LabVIEW arrays in the data.

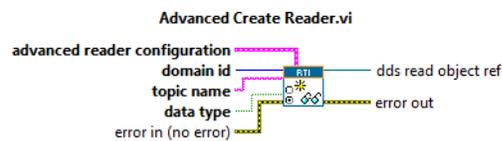
2. For complex types, use the Advanced Reader Template in the function palette: **Data Communication, RTI DDS Toolkit for LabVIEW, Complex-Type Templates**.

3. Read this article on the creation of multiple DomainParticipants: <http://community.rti.com/best-practices/create-few-domainparticipants-possible>

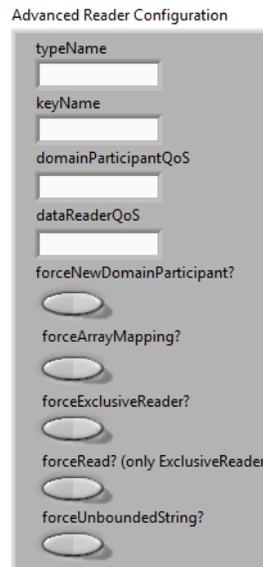
- ❑ **forceUnboundedString?:** By default, strings are created with a length of 1024 characters. If this flag is set to true, all strings are created as unbounded (their maximum length corresponds to the maximum 32-bit integer). This configuration optimizes the sample size, sending only the actual data while removing the 1024-character limitation in previous versions of the *RTI DDS Toolkit for LabVIEW*. This will affect all strings in the data.

6.3 How to Configure Advanced Reader Settings

In the Reader subpalette, you can find an *Advanced Create Reader*.⁴ This subVI is similar to the *Simple Create Reader*, but it has an additional parameter: the *Advanced Reader Configuration* cluster. You can find this cluster in the Control Palette: **Addons, RTI DDS Toolkit for LabVIEW, Types, RTI DDS Advanced Reader Configuration**.



As you can see in the figure, the cluster allows you to configure the following parameters:



- ❑ **typeName:** The name used to register the type in the wire.
- ❑ **keyName:** List of fields in a data type that will be marked as key (see [Lesson 5—Using Keyed Types \(RTI Shapes Demo\) \(Section 4.5\)](#) and [Lesson 6—Used Nested and Multiple Keys \(Section 4.6\)](#)).
- ❑ **domainParticipantQoS:** The fully qualified name (Library::Profile) that will be used as the QoS profile when creating the DomainParticipant. If there is an existing DomainParticipant in the domain and no new DomainParticipant is forced (forceNewDomainParticipant equals false), this setting has no effect. Therefore, the DomainParticipant QoS properties remain unchanged.

4. For complex types, use the Advanced Reader Template in the function palette: **Data Communication, RTI DDS Toolkit for LabVIEW, Complex-Type Templates**.

- ❑ **dataReaderQoS**: The fully qualified name (Library::Profile) that will be used as the QoS profile when creating the DataReader.
- ❑ **forceNewDomainParticipant?**: If this flag is true, a new DomainParticipant is created even if a valid one existed for the domain. This may affect performance.⁵
- ❑ **forceArrayMapping?**: By default, LabVIEW arrays are mapped as DDS sequences. If you need your data to use DDS arrays, set this flag to true. This will affect all LabVIEW arrays in the data.
- ❑ **forceExclusiveReader?**: By default, Reader Nodes of the same topic (and with the same QoS profile) share a DataReader. To avoid this behavior, set this flag to true and a new DataReader will be created. If you need all your Reader Nodes to have their own DataReader, make sure all of them are created setting this flag to true.
- ❑ **forceRead?**: By default, exclusive Readers call to the function **take** when getting the data. This allows you to use Strict Reliable QoS profile. If you want to use **read** instead, set this flag to true.
- ❑ **forceUnboundedString?**: By default, strings are created with a length of 1024 characters. If this flag is set to true, all strings are created as unbounded (their maximum length corresponds to the maximum 32-bit integer). This configuration optimizes the sample size, sending only the actual data while removing the 1024-character limitation in previous versions of the *RTI DDS Toolkit for LabVIEW*. This will affect all strings in the data.

If you need to use Strict Reliability QoS profile, make sure your *Reader* node is exclusive and **forceRead** is set to false (the default value).

5. Read this article on the creation of multiple DomainParticipants: <http://community.rti.com/best-practices/create-few-domainparticipants-possible>

Appendix A VI Descriptions

A.1 Controls Palette Types

In the Front Panel's Controls Palette, in the Addons section, under *RTI DDS Toolkit for LabVIEW*, you will find the following:

DDS Write Object Ref: Reference to a Writer node that has been created with the *Create Writer* subVI.

| | |
|----------------|-----|
| DDS Object Ref | U32 |
|----------------|-----|

DDS Read Object Ref: Reference to a Reader node that has been created with the *Create Reader* subVI.

| | |
|----------------|-----|
| DDS Object Ref | U32 |
|----------------|-----|

DDS Sample Info: This cluster is returned by the *Read* subVI and shows information about the current sample. `valid_data` is 1 if the read data is valid, otherwise it is 0.

| | |
|-----------------------|----------|
| DDS_SampleStateKind | U32 Enum |
| DDS_ViewStateKind | U32 Enum |
| DDS_InstanceStateKind | U32 Enum |
| sec | I32 |
| nanosec | U32 |
| valid_data | Boolean |

DDS State Info: This cluster contains general statistics from *RTI DDS Toolkit for LabVIEW*. It includes the current number of nodes (both Reader and Writer ones), DomainParticipants, DataReaders, DataWriters, and Topics. It also provides historical information such as the last execution's nodes.

| | |
|-------------------------------|-----|
| Last number of LVDDS Nodes | I32 |
| Current number of LVDDS Nodes | I32 |
| Peak number of LVDDS Nodes | I32 |
| Number of Participants | I32 |
| Number of DataReaders | I32 |
| Number of DataWriters | I32 |
| Number of Topics | I32 |

RTI DDS Advanced Reader Configuration: This cluster contains the advanced parameters for the Reader Creation. Use this control with the Create Advanced Reader subVI to provide optional parameters when creating a new Reader.

| | |
|-----------------------------------|---------|
| typeName | String |
| keyName | String |
| domainParticipantQoS | String |
| dataReaderQos | String |
| forceNewDomainParticipant? | Boolean |
| forceArrayMapping? | Boolean |
| forceExclusiveReader? | Boolean |
| forceRead? (only ExclusiveReader) | Boolean |
| forceUnboundedString? | Boolean |

RTI DDS Advanced Writer Configuration: This cluster contains the advanced parameters for the Writer Creation. Use this control with the Create Advanced Writer subVI to provide optional parameters when creating a new Writer.

| | |
|----------------------------|---------|
| typeName | String |
| keyName | String |
| domainParticipantQoS | String |
| dataWriterQos | String |
| forceNewDomainParticipant? | Boolean |
| forceArrayMapping? | Boolean |
| forceUnboundedString? | Boolean |

A.2 Functions Palette

In the Block Diagram's Functions Palette, in the Data Communication section, under *RTI DDS Toolkit for LabVIEW*, you will find the following:

- [Writer \(Section A.2.1\)](#)
- [Reader \(Section A.2.2\)](#)
- [Complex-Type Templates \(Section A.2.3\)](#)

A.2.1 Writer

Simple Create Writer: Creates a Writer node able to write data to the DDS network. Use the reference generated by this subVI as input to the *Write* subVI to send data using DDS. Use the *Release Writer* subVI to release the allocated memory.

Input parameters

| | |
|---------------------|---|
| domain id | ID of the domain the application intends to join |
| topic name | Name of Topic for which the application will write data |
| data type | Control of the data type to be published |
| error in (no error) | LabVIEW Error cluster in (optional) |

❑ **Output parameters**

| | |
|----------------------|---|
| dds write object ref | Reference to new <i>DDS Writer</i> object |
| error out | LabVIEW Error cluster out (optional) |

Advanced Create Writer: This subVI creates a Writer node able to write data to the DDS network. Introduce advanced configurations by using the control *RTI DDS Advanced Writer Configuration.ctl*. Use the reference generated by this subVI as input to the Write subVI to send data using DDS. Use the Release Writer subVI to release the allocated memory.

❑ **Input parameters**

| | |
|-------------------------------|--|
| advanced writer configuration | Controls of type RTI DDS Advanced Writer Configuration that contains the optional parameters |
| domain id | ID of the domain the application intends to join |
| topic name | Name of Topic for which the application will write data |
| data type | Control of the data type to be published |
| error in (no error) | LabVIEW Error cluster in (optional) |

❑ **Output parameters**

| | |
|----------------------|--------------------------------------|
| dds write object ref | Reference to new DDS Writer object |
| error out | LabVIEW Error cluster out (optional) |

Write: Publishes data into a DDS network. It takes a Writer node (generated by *Advanced/Simple Create Writer*) as an input parameter. The data type of the data to be written must be the same as the data type attached to the *Advanced/Simple Create Writer* subVI.

❑ **Input parameters**

| | |
|-------------------------|---|
| dds write object ref in | Reference to <i>DDS Writer</i> object to be used |
| data | Control with the data to be published by DDS. Must be of the same type as specified in the Data Type input for the <i>Advanced/Simple Create Writer</i> . |
| error in | LabVIEW Error cluster in (optional) |

❑ **Output parameters**

| | |
|--------------------------|--|
| dds write object ref out | Reference to <i>DDS Writer</i> object used |
| error out | LabVIEW Error cluster out (optional) |

Release Writer: Releases the memory allocated for a Writer node and prepares the contained entities to be deleted if nothing else is using them. To force the release of the contained entities, use 'Release Unused Entities' 10 seconds after releasing the Writer node.

❑ **Input parameters**

| | |
|----------------------|--|
| dds write object ref | Reference to <i>DDS Writer</i> object to be released |
| error in | LabVIEW Error cluster in (optional) |

❑ **Output parameters**

| | |
|-----------|--------------------------------------|
| error out | LabVIEW Error cluster out (optional) |
|-----------|--------------------------------------|

Set Writer QoS: Applies a new QoS profile to an existing Writer node. If the current QoS cannot be modified at run time, the Writer node remains unchanged.

❑ **Input parameters**

| | |
|-------------------------|--|
| dds write object ref in | Reference to <i>DDS Writer</i> object whose QoS Profile will be changed |
| qos profile | QoS profile to be applied. The expected value is a string providing the QoS library and profile to be read from the XML file (see Appendix D for details on where this file is located). |
| error in | LabVIEW Error cluster in (optional) |

❑ **Output parameters**

| | |
|--------------------------|--|
| dds write object ref out | Reference to <i>DDS Writer</i> object used |
| error out | LabVIEW Error cluster out (optional) |

A.2.2 Reader

Simple Create Reader: Creates a Reader node that is able to read data from the DDS network. Use the reference generated by this subVI as input to the *Read* subVI to get data from DDS and store it in the appropriate LabVIEW data. Use the *Release Reader* subVI to release the allocated memory.

❑ **Input parameters**

| | |
|---------------------|--|
| domain id | ID of the domain the application intends to join |
| topic name | Name of the topic for which the application will read data |
| data type | Control of the same data type to be read |
| error in (no error) | LabVIEW Error cluster in (optional) |

❑ **Output parameters**

| | |
|---------------------|---|
| dds read object ref | Reference to new <i>DDS Reader</i> object |
| error out | LabVIEW Error cluster out (optional) |

Advanced Create Reader: This subVI creates a Reader node able to read data from the DDS network. Introduce advanced configurations by using the control *RTI DDS Advanced Reader Configuration.ctl*. Use the reference generated by this subVI as input to the *Read* subVI to get data from DDS and store it in the appropriate LabVIEW data. Use the *Release Reader* subVI to release the allocated memory.

❑ **Input parameters**

| | |
|-------------------------------|--|
| advanced reader configuration | Control of type <i>RTI DDS Advanced Reader Configuration</i> that contains the optional parameters |
| domain id | ID of the domain the application intends to join |
| topic name | Name of the topic for which the application will read data |
| data type | Control of the same data type to be read |
| error in (no error) | LabVIEW Error cluster in (optional) |

❑ Output parameters

| | |
|---------------------|---|
| dds read object ref | Reference to new <i>DDS Reader</i> object |
| error out | LabVIEW Error cluster out (optional) |

Read: Gets data from the DDS network. It takes a Reader node (generated by the *Advanced/Sample Create Reader* subVI) as an input parameter. The data is stored in the appropriate LabVIEW data, which is provided as an output parameter.

❑ Input parameters

| | |
|------------------------|--|
| dds read object ref in | Reference to <i>DDS Reader</i> object to be used |
| query condition | Query expression to use when filtering the read samples; empty means no filtering |
| only_new_samples | Specifies whether to read only the new (unviewed) samples (true) or all the available ones (false) |
| error in (no error) | LabVIEW Error cluster in (optional) |

❑ Output parameters

| | |
|-------------------------|---|
| dds read object ref out | Reference to <i>DDS Reader</i> object used |
| data | Indicator that will be filled with the data read from DDS. Must be of the same type as the one specified in the Data Type input of the <i>Advanced/Sample Create Reader</i> subVI |
| dds sample info | DDS Sample Info cluster containing information about the sample read. |
| error out | LabVIEW Error cluster out (optional) |

Release Reader: Releases memory allocated for a Reader node and prepares the contained entities to be deleted if nothing else is using them. To force the release of the contained entities, use 'Release Unused Entities' 10 seconds after releasing the Reader node.

❑ Input parameters

| | |
|------------------------|--|
| dds read object ref in | Reference to <i>DDS Reader</i> object to be released |
| error in | LabVIEW Error cluster in (optional) |

❑ Output parameters

| | |
|-----------|--------------------------------------|
| error out | LabVIEW Error cluster out (optional) |
|-----------|--------------------------------------|

Set Reader QoS: Applies a new QoS profile to an existing Reader node. If the current QoS cannot be modified at run time, the Reader node remains unchanged.

❑ Input parameters

| | |
|------------------------|--|
| dds read object ref in | Reference to <i>DDS Reader</i> object whose QoS profile will be changed. |
| qos profile | QoS profile to be applied. The expected value is a string providing the QoS library and profile to be read from the XML file (see Appendix D for details on where this file is located). |
| error in | LabVIEW Error cluster in (optional) |

❑ Output parameters

| | |
|-------------------------|--|
| dds read object ref out | Reference to <i>DDS Reader</i> object used |
| error out | LabVIEW Error cluster out (optional) |

A.2.3 Complex-Type Templates

Simple Reader Template: Use this template to subscribe (read) to a complex type (cluster, array or enum) from a DDS network using RTI DDS Toolkit for LabVIEW. Follow the information in the Block Diagram and attach the cluster, array, or enum in the appropriate locations.

Advanced Reader Template: Use this template to subscribe (read) to a complex type (cluster, array or enum) from a DDS network using RTI DDS Toolkit for LabVIEW. Follow the information in the Block Diagram and attach the cluster, array, or enum in the appropriate locations.

Use the *RTI DDS Advanced Reader Configuration* control to provide additional configuration.

Simple Writer Template: Use this template to publish (write) a complex type (cluster, array, or enum) into a DDS network using RTI DDS Toolkit for LabVIEW. Follow the information in the Block Diagram and attach the cluster, array, or enum in the appropriate locations.

Advanced Writer Template: Use this template to publish (write) a complex type (cluster, array, or enum) into a DDS network using RTI DDS Toolkit for LabVIEW. Follow the information in the Block Diagram and attach the cluster, array, or enum in the appropriate locations.

Use the *RTI DDS Advanced Writer Configuration* control to provide additional configuration.

A.3 Tools

DDS Release Unused Entities: Releases all the entities generated by the *Create Reader/Writer* subVIs that are not currently in use. An entity is considered ‘not in use’ if no node has linked it in the last 10 seconds. This is a useful way to resolve some of the errors produced when creating new Reader/Writer nodes.

❑ Input parameters

| | |
|----------|--------------------------|
| error in | LabVIEW Error cluster in |
|----------|--------------------------|

❑ Output parameters

| | |
|------------|--|
| error code | <i>RTI DDS Toolkit for LabVIEW</i> Error Code (optional) |
| error out | LabVIEW Error cluster out (optional) |

Get DDS State: Returns general statistics from *RTI DDS Toolkit for LabVIEW*. This includes the current number of nodes (both Reader and Writer ones), DomainParticipants, DataReaders, DataWriters, and Topics. It also provides historical information such as the last execution's nodes.

❑ Input parameters

None

❑ Output parameters

| | |
|-----------|------------------------|
| dds state | DDS State Info Cluster |
|-----------|------------------------|

DDS Time to LV Time: Converts a UNIX timestamp (in seconds) to a LabVIEW Time Stamp.

Input parameters

x DBL

Output parameters

time stamp Cluster

Appendix B Creation and Release of DDS Entities

The table below explains when *RTI DDS Toolkit for LabVIEW* creates and releases DDS entities.

When an entity is released, *RTI DDS Toolkit for LabVIEW* deletes all ‘unused’ entities in the system. An entity is considered ‘unused’ when 10 seconds have passed since the last subVI using it was released.

All entities (including the *DomainParticipant*) are created with the QoS values specified in the QoS Profile input to the *Create Writer/Reader* functions.

Note: You can see when entities are created and released in the Debugging window. See [Enabling Debugging Mode \(Section E.1\)](#).

| DDS Entity | Is Created When... | Is Released When... |
|---------------------------------|--|--|
| DomainParticipant | The <i>Create Writer/Reader</i> functions are called from LabVIEW and there is not already another valid <i>DomainParticipant</i> . If the <i>forceNewDomainParticipant</i> flag is true in the Advanced Create subVIs, a new Domain Participant is created. | <ul style="list-style-type: none"> An execution ends and no <i>DDS Reader</i> or <i>Writer</i> objects have used the <i>DomainParticipant</i> for 10 seconds. The <i>DDS Release Unused Entities</i> function is called from LabVIEW and no <i>DDS Reader</i> or <i>Writer</i> objects are using the <i>DomainParticipant</i>. |
| Topic ‘x’ | The <i>Create Writer/Reader</i> functions are called from LabVIEW and there is not already another valid <i>Topic</i> . | <ul style="list-style-type: none"> An execution ends and no <i>DDS Reader</i> or <i>Writer</i> objects have used the <i>Topic</i> for 10 seconds. The <i>DDS Release</i> function is called from LabVIEW and there are no <i>DDS Reader</i> or <i>Writer</i> objects using the <i>Topic</i>. |
| Subscriber | Never. <i>RTI DDS Toolkit for LabVIEW</i> uses an implicit subscriber for each <i>DomainParticipant</i> . | Never. |
| Publisher | Never. <i>RTI DDS Toolkit for LabVIEW</i> uses an implicit publisher for each <i>DomainParticipant</i> . | Never. |
| <i>DataReader</i> for Topic ‘x’ | The <i>Create Reader</i> function is called and there is not already another valid <i>DataReader</i> . If the <i>forceExclusiveReader</i> flag is true in the Advanced Create Reader, a new Data Reader is created. | <ul style="list-style-type: none"> An execution ends and no <i>DDS Reader</i> or <i>Writer</i> objects have used the <i>DataReader</i> for 10 seconds. The <i>DDS Release Unused Entities</i> function is called from LabVIEW and no <i>DDS Reader</i> or <i>Writer</i> objects are using the <i>DataReader</i>. |

| DDS Entity | Is Created When... | Is Released When... |
|---------------------------------|---|--|
| <i>DataWriter</i> for Topic 'x' | The <i>DDS Create Writer</i> function is called from LabVIEW and there is not already another valid <i>DataWriter</i> . | <ul style="list-style-type: none"> • An execution ends and no <i>DDS Reader</i> or <i>Writer</i> objects have used the <i>DataWriter</i> for 10 seconds. • The <i>DDS Release Unused Entities</i> function is called from LabVIEW and no <i>DDS Reader</i> or <i>Writer</i> objects are using the <i>DataWriter</i>. |

Appendix C Supported Data Types and Corresponding IDL

RTI DDS Toolkit for LabVIEW supports these simple and complex data types:

❑ NUMERIC

- INT8^a
- INT16
- INT32
- INT64
- FLOAT/SINGLE
- DOUBLE
- UINT8^a
- UINT16
- UINT32
- UINT64
- 32-BIT ENUM

a. INT8 and UINT8 are both mapped as octets. We recommend using UINT8, since octets are not signed.

❑ BOOLEAN

❑ TEXT (STRING)

❑ ARRAYS OF TYPE

- NUMERIC (INT8, INT16, INT32, UINT8, UINT16, UINT32, FLOAT, DOUBLE)

❑ CLUSTER WITH ANY COMBINATION OF:

- NUMERIC
- BOOLEAN
- TEXT (STRING)
- ARRAY
- CLUSTER

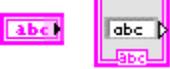
For other DDS applications to communicate with VIs that use *RTI DDS Toolkit for LabVIEW*, you need to use compatible data types in both applications.

- ❑ Simple types have fixed IDLs that are listed in [Table C.1](#).
- ❑ Clusters use a direct mapping of their configuration into a C struct, see [Section C.1](#).

Table C.1 Simple Data Types and Corresponding IDL

| Data Type | Sample Entry in IDL |
|--|---|
| INT8  | <pre>struct Int8Struct{ octet value; };</pre> |
| INT16  | <pre>struct Int16Struct{ short value; };</pre> |
| INT32  | <pre>struct Int32Struct{ long value; };</pre> |
| INT64  | <pre>struct Int64Struct{ long long value; };</pre> |
| UINT8  | <pre>struct UnsignedInt8Struct{ octet value; };</pre> |
| UINT16  | <pre>struct UnsignedInt16Struct{ unsigned short value; };</pre> |
| UINT32  | <pre>struct UnsignedInt32Struct{ unsigned long value; };</pre> |
| UINT64  | <pre>struct UnsignedInt64Struct{ unsigned long long value; };</pre> |
| FLOAT  | <pre>struct FloatStruct{ float value; };</pre> |
| DOUBLE  | <pre>struct DoubleStruct{ double value; };</pre> |
| BOOLEAN  | <pre>struct BooleanStruct{ boolean value; };</pre> |

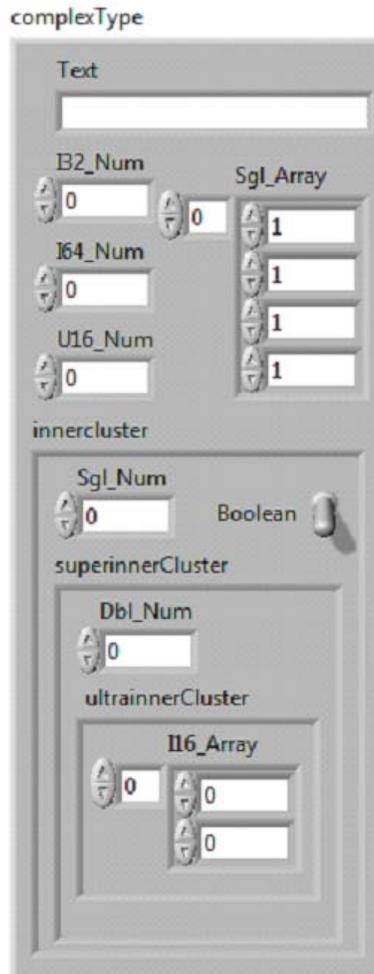
Table C.1 Simple Data Types and Corresponding IDL

| Data Type | Sample Entry in IDL |
|---|--|
| <p>STRING</p>  | <p>Default:</p> <pre>struct DDS_String{ string<1024> value; };</pre> <p>Forcing use of unbounded string:</p> <pre>struct DDS_String{ string value; };</pre> |
| <p>ARRAY of the above types (This example uses INT16 and nDim elements.)</p> | <p>Default:</p> <pre>struct ArrayStruct { sequence<short, nDim> value; }</pre> <p>Forcing use of array:</p> <pre>struct ArrayStruct { short value[nDim]; }</pre> |

C.1 Corresponding IDL for Complex Data Types

C.1.1 Clusters

The IDL representation for a cluster depends on its structure and the type name provided in the *Create* subVI.



For example, using the cluster in the figure on the left, assume the type name is **MyTypeName**. The corresponding IDL would be as follows:

```
struct MyTypeName{
    string<1024>1 Text; //@key
    long I32_Num; //@key
    long long I64_Num;
    unsigned short U16_Num;
    sequence<float,4> Sgl_Array;
    innerclusterType innercluster;
};
struct superinnerClusterType{
    double Dbl_Num;
    ultrainnerClusterType ultrainnerCluster;
};
struct ultrainnerClusterType{
    sequence<short,2> I16_Array;
};
struct innerclusterType{
    float Sgl_Num;
    boolean Boolean;
    superinnerClusterType superinnerCluster;
};
```

Note that inner clusters add “Type” to their name to avoid repeating the same name in both type and member. Also note that all the names of the components are joined by underscores instead of using spaces. This prevents compiling errors in other languages such as C, C++, Java or .Net. Please consider interoperability with these languages and avoid invalid names in the cluster components.

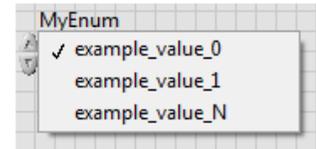
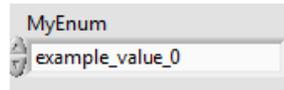
C.1.2 Enums

The IDL representation for an enum depends on the elements it is composed of. Remember that only 32-bit enums are supported.

1. If `forceUnboundedString?` is set to `true`, IDL correspondence will be `string Text`. And you will need to run the `rtiddsgen` with the option `-unboundedSupport`.

For example, the enum in the figure on the right would have the following IDL representation for a Type Name "MyType":

```
struct EnumStruct{
    MyTypeEnum MyType;
}
enum MyTypeEnum {
    example_value_0 = 0,
    example_value_1 = 1,
    example_value_N = 2
};
```

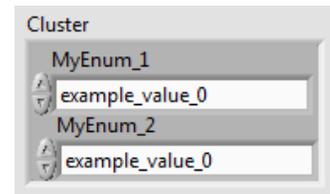


When the enum is inside a cluster, the representation is slightly different, so several enums can be contained in the same cluster. For the cluster on the right (containing two instances of the enum used in the previous example), the corresponding IDL would be:

```
struct MyType{
    MyEnum_1Enum MyEnum_1;
    MyEnum_2Enum MyEnum_2;
};

enum MyEnum_2Enum {
    example_value_0 = 0,
    example_value_1 = 1,
    example_value_N = 2
};

enum MyEnum_1Enum {
    example_value_0 = 0,
    example_value_1 = 1,
    example_value_N = 2
};
```



Appendix D File Folders Installed within LabVIEW

D.1 File Folders on Windows Systems

RTI DDS Toolkit for LabVIEW adds the following files to LabVIEW's folders.

In the paths shown below, **LabVIEW 20xx** is:

- ❑ **C:\Program Files¹\National Instruments\LabVIEW 20xx**

Where *xx* represents the LabVIEW version number (LabVIEW 2010, LabVIEW 2011, etc.)

- ❑ DLL's
 - \LabVIEW 20xx\vi.lib_RTI DDS Toolkit for LabVIEW_internal_deps
- ❑ Control Types and VIs
 - \LabVIEW 20xx\vi.lib\RTI DDS Toolkit for LabVIEW\Types
 - \LabVIEW 20xx\vi.lib\RTI DDS Toolkit for LabVIEW\VIs
- ❑ Templates
 - \LabVIEW 20xx\templates\ RTI DDS Toolkit for LabVIEW\Templates
- ❑ QoS Profile (for documentation purposes only)
 - \LabVIEW 20xx\vi.lib_RTI DDS Toolkit for LabVIEW_internal_deps\RTI_LABVIEW_CONFIG.documentationONLY.xml
- ❑ Examples
 - \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\ClusterDemo
 - \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\NumberDemo
 - \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\ReadAllDemo
 - \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\ShapesDemo
 - \LabVIEW 20xx\examples\RTI DDS Toolkit for LabVIEW\StringsDemo
- ❑ Standalone application QoS Profile
 - C:\Program Files¹\National Instruments\Shared\LabVIEW Run-Time\20xx

1. On 64-bit systems, the folder is "Program Files (x86)"

D.2 File Folders on the cRIO-9068

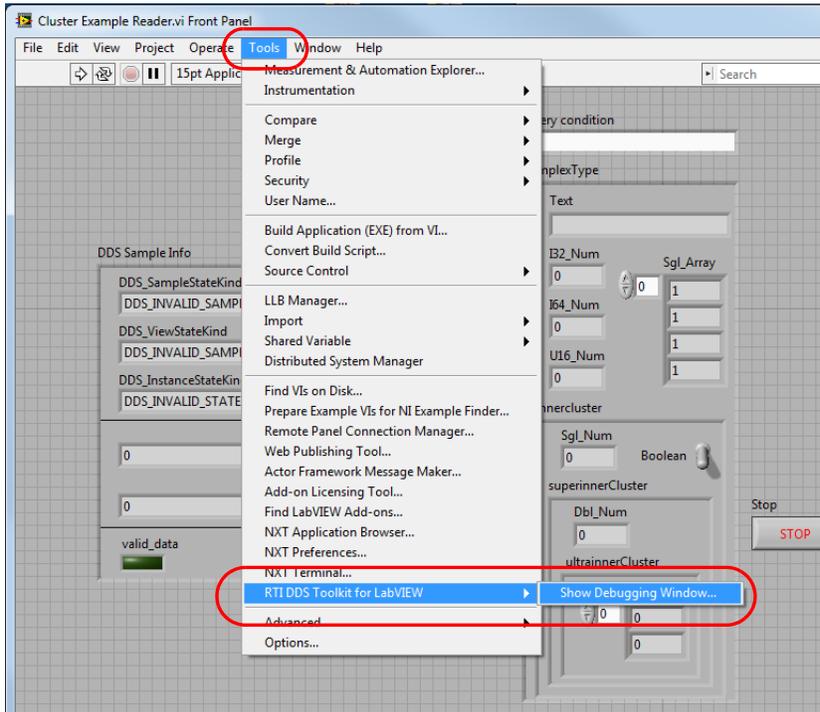
- ❑ Libraries
 - `/usr/local/rtd/lib`
- ❑ License
 - `/home/lvuser/rtd/rtd_license.dat`
- ❑ QoS profile
 - `/home/lvuser/rtd/RTI_LABVIEW_CONFIG.documentationONLY.xml`

Appendix E Troubleshooting

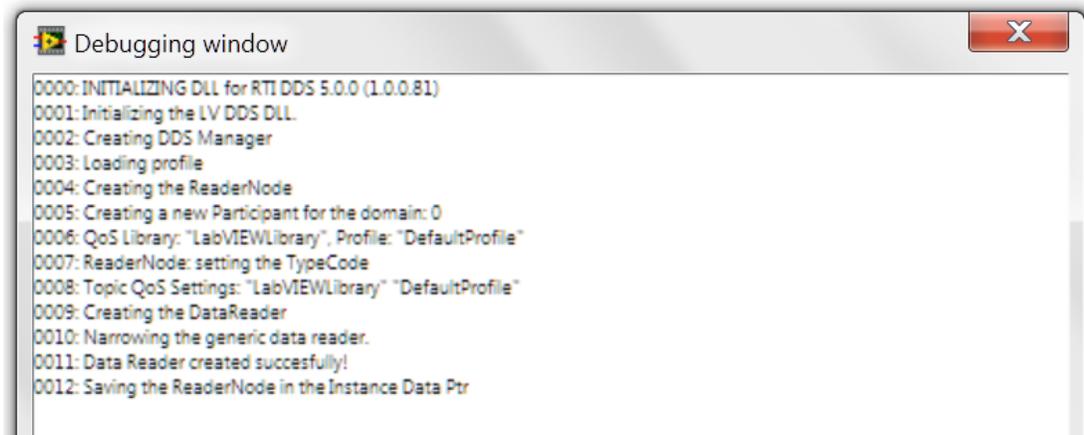
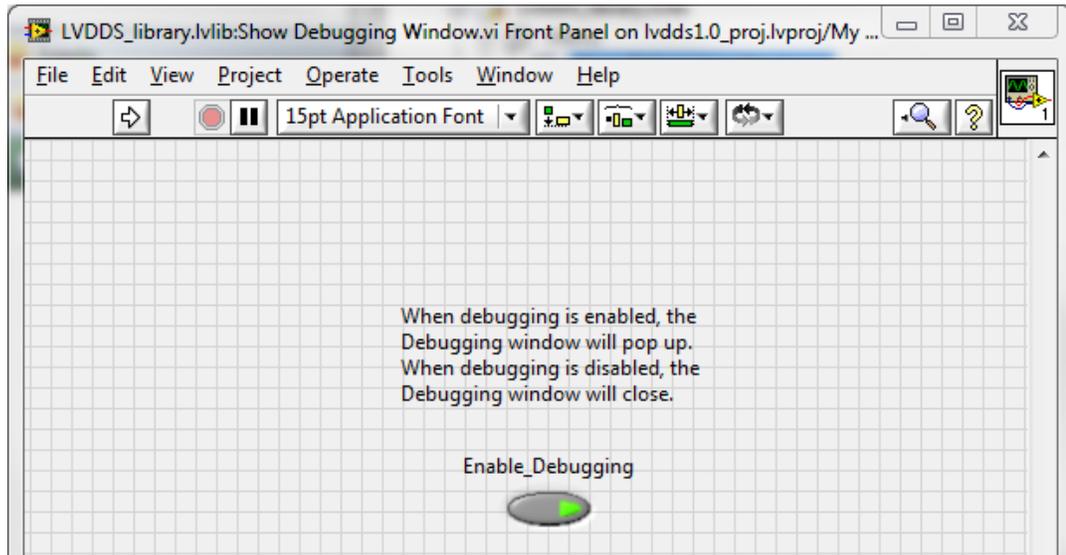
E.1 Enabling Debugging Mode

To debug your VI, you can use the Debugging window, which provides information about the creation and destruction of the different DDS entities.

To enable the Debugging window:
From the VI, select **Tools, RTI DDS Toolkit for LabVIEW, Show Debugging Window.**



Selecting **Show Debugging Window** will execute the Debugging Window subVI, which will display a Debugging window.



To disable debug mode and close the Debugging window, run the above subVI with the **Enable_debugging** switch in the FALSE position.

E.2 Error Codes and Possible Solutions

Table 3.2 shows error codes and possible solutions.

Table 3.2 Error Codes

| Error Code | Error Message | Possible Reason(s) | Additional Information |
|------------|---|---|--|
| 5001 | Something failed in a previous stage (wired error input) | <i>RTI DDS Toolkit for LabVIEW</i> found an error status in the input error cluster. It might be due to an error in the previous stage. | |
| 5002 | Error handling the provided LabVIEW Data | Check that the type of all transferred/received data is the same and is similar to the one connected to the data type in the <i>Create Reader/Writer</i> subVIs. | LabVIEW data connected to the data type pin in the <i>Create Reader</i> or <i>Create Writer</i> does not correspond with the type sent/received or is missing. |
| 5003 | Unable to delete the contained entities of a participant | It is likely that another application is still using an entity of that Participant. Close all the instances before trying to delete the contained entities. | You can also delete the unused contained entities by using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) |
| 5004 | Unable to delete a participant | It is likely that another application is still using that Participant. Close all the instances before trying to delete it. | |
| 5005 | Unable to finalize the DomainParticipantFactory. | It is likely that another application is still using the DomainParticipantFactory. Close all the instances before trying to delete it. | |
| 5006 | Bad QoS settings (Library::Profile) | QoS setting format is incorrect or does not match with any of the ones existing in the XML file. Check that format is correct (Library::Profile), the XML file exists, and it contains a correct configuration. | |
| 5007 | Unable to assert (find or create) a Participant. | Possible error in the QoS configuration. You can also use the default configuration by attaching an empty string as input to the <i>Create Reader/Writer</i> subVI. This might be caused because there is no active network interface in the system. | Review the QoS profile for the Participant. Modify the QoS profile to work without an active network interface as explained in Running without an Active Network Interface (Section E.3) . |
| 5008 | Unable to register the type because there exists another entity with same configuration | This might be caused by an unused entity that has not been released. Close the current VI and release unused entities using the <i>DDS Release Unused Entities</i> subVI (in <i>RTI DDS Toolkit for LabVIEW, Tools</i>). Then re-open the current VI. | |
| 5009 | Unable to get the Participant QoS for a given profile. | Possible error in the QoS configuration. Check that format is correct (Library::Profile), the XML file exists and it contains that profile. You can also use the default configuration by attaching an empty string as input to the <i>Create Reader/Writer</i> subVI. | Review the QoS profile for the Participant. |
| 5010 | Unable to update the number of applications accessing to the Participant (client count property). | This might cause a memory leak when releasing the participant. | |

Table 3.2 Error Codes

| Error Code | Error Message | Possible Reason(s) | Additional Information |
|------------|---|--|--|
| 5011 | Unable to set the QoS Properties to the participant. | Check that the QoS configuration provided is correct. You can also use the default configuration by attaching an empty string as input to the <i>Create Reader/Writer</i> subVI. | Review the QoS profile for the Participant. |
| 5012 | Unable to get the description of the topic. | Check that the Reader/Writer was correctly created (no previous errors). | |
| 5013 | Type connected to the Read/Write function is incompatible with the current implementation or different than the one in the Create subVI | Check that the correct type is connected to the Create subVI. A correct Type Definition is (Library::Type). String length and array size need to be compatible between the Create and the Read/Write subVIs. | If you recently modified the type, releasing the unused entities or reopening the VI might solve the problem. Remember that LabVIEW arrays of more than one dimension cannot be mapped as sequences. |
| 5014 | Unable to assert (find or create) a Topic. | Check that the QoS profile exists in the XML file and that configuration provided is correct. You can also use the default configuration by attaching an empty string as input to the <i>Create Reader/Writer</i> subVI. | Review the QoS profile for the Topic. Make sure you are selecting the correct settings (Library::Profile). |
| 5015 | Unable to get the implicit publisher. | Implicit publisher is needed to create the Writer. Check that the participant configuration is correct and that there are no previous errors. | Review the QoS profile for the Publisher. Make sure you are selecting the correct settings (Library::Profile). You can also use the default QoS setting by attaching an empty string to the qos profile pin of the <i>Create Writer</i> subVI. |
| 5016 | Unable to get all the Data Writers in the given participant. | It might be due to a memory restriction (not enough memory available to recover the existing Data Writers). Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this problem. | |
| 5017 | Unable to create the Data Writer. | Check that the QoS configuration provided for the Data Writer is correct. | |
| 5018 | Unable to get the QoS Properties from a Data Writer. | Check that <i>Create Writer</i> was successful and that the reference passed to the <i>Write</i> function is the one provided as output from the <i>Create</i> function. It might also be a problem in the QoS setting provided (use default ones as a safest option). | Review the QoS profile for the Data Writer. Make sure you are selecting the correct settings (Library::Profile). You can also use the default QoS setting by attaching an empty string to the qos profile pin of the <i>Create Writer</i> subVI. |
| 5019 | Unable to set the QoS Properties for a Data Writer. | Check that <i>Create Writer</i> was successful and that the reference passed to the <i>Write/Set_QoS_Setting</i> function is the correct one. It might also be a problem in the QoS setting provided (use default ones as a safest option). | |
| 5020 | Unable to update the number of applications using a Data Writer. | This might cause a memory leak when releasing the Data Writer. | |

Table 3.2 Error Codes

| Error Code | Error Message | Possible Reason(s) | Additional Information |
|------------|--|---|---|
| 5021 | Unable to narrow the Dynamic Data Writer. | This is an unexpected error. Contact labview@rti.com or visit our Community Portal at http://community.rti.com to view current solutions and forum entries. | |
| 5022 | Unable to get the implicit subscriber. | Implicit subscriber is needed to create the Reader. Check that the participant configuration is correct and that there are no previous errors. | Review the QoS profile for the Subscriber. Make sure you are selecting the correct settings (Library::Profile). You can also use the default QoS setting by attaching an empty string to the qos profile pin of the <i>Create Reader</i> subVI. |
| 5023 | Unable to get all the Data Writers in the given participant. | It might be due to a memory restriction (not enough memory available to recover the existing Data Writers). Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5024 | Unable to create the Data Reader. | Check that the QoS configuration provided for the Data Reader is correct. | Review the QoS profile for the Data Reader). |
| 5025 | Unable to get the QoS Properties from a Data Reader. | Check that <i>Create Reader</i> was successful and that the reference passed to the <i>Read</i> function is the correct one. It might also be a problem in the QoS setting provided (use default ones as a safest option). | Make sure you are selecting the correct settings (Library::Profile). You can also use the default QoS setting by attaching an empty string to the qos profile pin of the <i>Create Reader</i> or <i>Create Writer</i> subVI. |
| 5026 | Unable to set the QoS Properties for the Data Reader. | | |
| 5027 | Unable to update the number of applications using a Data Reader. | This might cause a memory leak when releasing the Data Reader. | |
| 5028 | Unable to narrow the Dynamic Data Writer. | This is an unexpected error. Contact labview@rti.com or visit our Community Portal at http://community.rti.com to view current solutions and forum entries. | |
| 5029 | Unable to delete a Topic. | It is likely that another instance of LabVIEW is still using that Topic. Close all LabVIEW instances before trying to delete it. | |
| 5030 | Unable to delete a Data Reader (or its contained entities). | It is likely that another instance of LabVIEW is still using that Data Reader or its entities. Close all LabVIEW instances before trying to delete it. | You can also delete the unused contained entities by using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools). |
| 5031 | Unable to delete a Data Writer (or its contained entities). | It is likely that another instance of LabVIEW is still using that Data Writer or its entities. Close all LabVIEW instances before trying to delete it. | |

Table 3.2 Error Codes

| Error Code | Error Message | Possible Reason(s) | Additional Information |
|------------|---|---|--|
| 5032 | Unable to initialize the DDS Dynamic Data. | There was a problem when allocating memory. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5033 | Unable to initialize the Reader Node. | There was a problem when allocating memory. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5034 | Unable to initialize the DDS Manager. | Check that the DLL was correctly loaded (a message can be found in the Debug Window). | |
| 5035 | Invalid reference to a Reader or Writer Node. | Please use the appropriate <i>Create</i> subVI to generate a correct reference and connect it to the <i>Read/Write</i> subVI. | Pay special attention to the data type. |
| 5036 | Unable to read data from Data Reader. | Check that the Query Condition is correctly set. | * will return everything. A regular expression will also work (for instance: Text='hello'). |
| 5037 | Unable to initialize the Writer Node. | There was a problem when allocating memory. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5038 | Unable to write data. | Data Writer timed out or ran out of resources. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. Check that you attached a valid indicator/storage to the write output. | |
| 5039 | Unable to initialize the semaphore for the DLL. | There was a problem when allocating memory. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5040 | Unable to create the Query Condition to filter Read subVI. | Check that the Query Condition is correctly set. To read everything, set it to * or leave it empty. | A regular expression will also work (for instance: Text='hello'). |
| 5041 | The type connected to the Create subVI is not supported in the current version. | The <i>Getting Started Guide</i> provides more information about the supported types. | See Appendix C: Supported Data Types and Corresponding IDL . |
| 5042 | Unable to unregister the Type Code. | Other applications might be using it. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |

Table 3.2 Error Codes

| Error Code | Error Message | Possible Reason(s) | Additional Information |
|------------|---|--|--|
| 5043 | The LabVIEW Data Type connected has changed. | The LabVIEW Type changed but wasn't correctly initialized (using Create subVI). You might need to close the VI and re-open it to removed unused entities. | This error happens if you created and run the Reader/Writer and then you modified the type connected to the create subVI. Close and re-open the VI or use the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools). |
| 5044 | Unable to get all the available Topics. | It might be due to a memory restriction (not enough memory available to recover the existing Topics). Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5045 | Warning: Unable to delete one or several DDS Entities. | Other instances of LabVIEW are currently using one or several of the DDS Entities. | This is not an error, just a warning. Closing all running VIs should release all the remaining DDS Entities. |
| 5046 | Unable to get the Topic's QoS. | Check that the Topic's QoS provided was correct and that the Topic was initialized using the <i>Create Reader</i> or <i>Create Writer</i> subVI. | Review the QoS profile for the Topic. Make sure you are selecting the correct settings (Library::Profile). |
| 5047 | Unable to set the Topic's QoS. | | You can also use the default QoS setting by attaching an empty string to the qos profile pin of the <i>Create Reader</i> or <i>Create Writer</i> subVI. |
| 5048 | Unable to access library handler. | The <i>RTI DDS Toolkit for LabVIEW</i> dynamic library was not loaded correctly. On the cRIO, please verify the license file under /home/lvuser/rti . | For details on the license file, see License Management on the cRIO (Section 1.4.2) . |
| 5049 | Unable to take the semaphore | Another thread may already be using the DLL. | |
| 5050 | Unable to recover participant's default QoS | Internal error due to default configuration issues. Contact labview@rti.com or visit our Community Portal at http://community.rti.com to view current solutions and forum entries. | |
| 5051 | Unable to load QoS profiles from the embedded configuration or external XML files | Error in QoS properties. Verify all profiles loaded by the NDDS_QOS_PROFILES environment variable. | Make sure you are selecting the correct settings (Library::Profile). You can also use the default QoS setting by attaching an empty string to the qos profile pin of the <i>Create Reader</i> or <i>Create Writer</i> subVI. |
| 5052 | Incorrect type name. | Usual format is Library::Type . Avoid using spaces. | |
| 5053 | One of the required parameters of the subVI is missing | Required parameters for <i>Create</i> subVIs: domain_id , topic_name , type_name , data_type ; for <i>Read/Write</i> subVIs: ref_in and data ; for <i>Release</i> : ref_in . | These pins are also required for the clusters even if you use Call Library Function (CLF) calls instead of a subVI. |
| 5054 | Unable to access to the Type Code Factory. | Another application has finalized the TypeCode Factory and there was an error while reinitializing it. Retry. | |

Table 3.2 Error Codes

| Error Code | Error Message | Possible Reason(s) | Additional Information |
|------------|--|---|--|
| 5055 | Unable to add a new member to the Type Code. | The cluster used is incompatible. Make sure all field labels exist and are compatible with text-based languages: no spaces. Make sure all used types are supported. | See Appendix C: Supported Data Types and Corresponding IDL for details on the supported types. |
| 5056 | Unable to create the Type Code. | The attached cluster is incompatible with the supported one and cannot be created. | |
| 5057 | Unable to set the Dynamic Data. | Check that the correct data type is connected to the subVI (pay special attention to <i>Create Reader/Writer</i> ones). | |
| 5058 | Unable to get the Dynamic Data. | Check that the correct data type is connected to the subVI (pay special attention to <i>Read/Write</i> ones). | |
| 5050 | Invalid profile provided to the Set QoS subVI. | There may be an incompatible QoS Policy. Check that the provided profile exists. Once created, some QoS settings cannot be modified. Try using that QoS Policy in the <i>Create</i> subVI. | Review the QoS profile for the <i>Reader/Writer</i> . Some QoS setting cannot be applied once the <i>Reader/Writer</i> is created unless you completely delete it. Close and reopen the VI or use the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools). |
| 5060 | Unable to give the semaphore. | | This might block another thread from using the <i>RTI DDS Toolkit for LabVIEW API</i> . |
| 5061 | Unable to lock/unlock the Participant to create the Reader. | Another application was already deleting the Participant. Removing unused entities or closing the VIs might fix this problem. | You can also delete the unused contained entities by using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW Tools). |
| 5062 | Reached the maximum number of participants allowed in the system. | Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5063 | Unable to create the system clock. | This is an unexpected error. Contact labview@rti.com or visit our Community Portal at http://community.rti.com to view current solutions and forum entries. | |
| 5064 | Unable to create the Type Support needed to register a type. | There was a problem when allocating memory. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |
| 5065 | Unable to assign that type name to the Topic because it is currently in use. | The type name provided is already registered and used by some entities. Using the <i>DDS Release Unused Entities</i> subVI (in RTI DDS Toolkit for LabVIEW, Tools) might fix this. | |

Table 3.2 Error Codes

| Error Code | Error Message | Possible Reason(s) | Additional Information |
|------------|---|---|---|
| 5066 | The attached enum is not a 32-bit one. Only 32-bit enumerators are supported. | The current implementation only supports 32-bit enumerators. Change the enumerator representation or use an 8-bit or 16-bit integer. | To change the representation, right-click in the indicator/control and select Representation→U32. |
| 5067 | Unable to create the key with the provided string. Might be a memory allocation problem. | KeyName should be a string containing the key names separated by semicolons (;). The fields inside a cluster can be provided in the form 'cluster.field'. | See Section 4.6 for further details. |
| 5068 | Unable to create Data Reader with KEEP_ALL history kind. Use case not supported. | Use the shipped profile 'LabVIEWLibrary::ReliableProfile' to use Reliable Communication. Take into account that Strict Reliability is not currently supported. If you would like to use this feature, please contact labview@rti.com. | Current implementation uses 'read' instead of 'take', so strictly reliable communication is not compatible. |
| 5069 | Incompatible configuration: History depth > 1 needs 'only_new_samples' flag in the Read subVI to be 'true'. | Using a depth bigger than 1 for the history property and not setting the 'only_new_samples' could cause that samples stayed unread. Change the QoS configuration or set the flag to 'true'. | Review the QoS profile for the Data Reader. |
| 5070 | Unable to extract information from the Advanced Writer Configuration control. | Make sure you are using the cluster 'RTI DDS Advanced Writer Configuration.cti' contained in LVDDS_Library. | |
| 5071 | Unable to extract information from the Advanced Reader Configuration control. | Make sure you are using the cluster 'RTI DDS Advanced Reader Configuration.cti' contained in LVDDS_Library. | |

E.3 Running without an Active Network Interface

To use *RTI DDS Toolkit for LabVIEW* on a computer that does not have an active network interface, you have two choices:

- ❑ Change the QoS profile to use only the Shared Memory transport. As described in the *RTI Connex DDS Core Libraries User's Manual* (see the chapter on *Configuring QoS with XML*), you need to set up this QoS properties in all your profiles:

```

<participant_qos>
  <transport_builtin>
    <mask>SHMEM</mask>
  </transport_builtin>
  <discovery>
    <initial_peers>
      <element>builtin.shmem://</element>
    </initial_peers>
  </discovery>
</participant_qos>

```

- ❑ Another option is to install the Microsoft Loopback Adapter, which simulates the existence of a network interface. For an example on how to install the Loopback Adapter for Windows XP, see <http://support.microsoft.com/kb/839013>.