ADLINK

VORTEX

OpenSplice LabVIEW Guide

Release 6.x

Contents

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Introduction

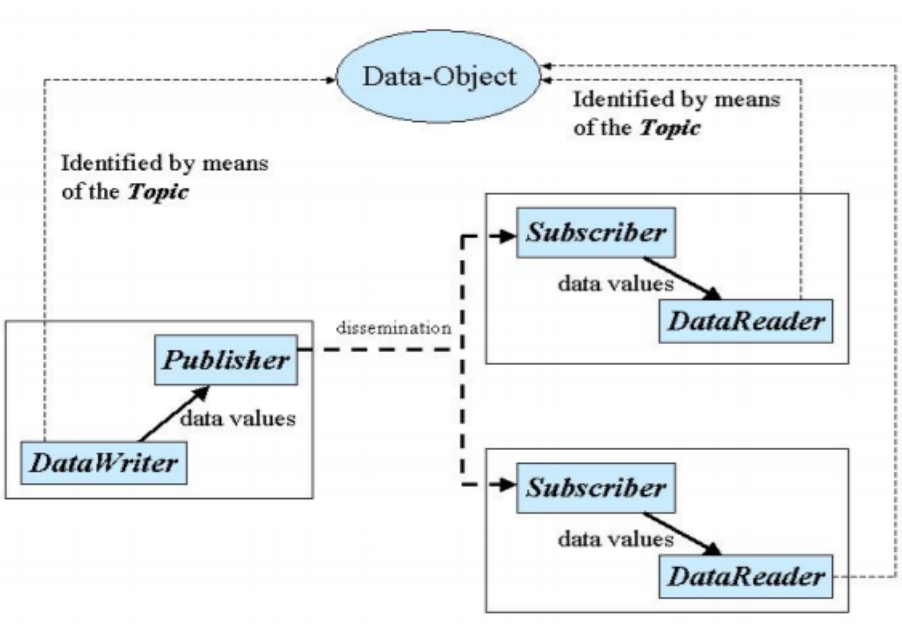
The DDS LabVIEW Integration provides users with DDS custom virtual instruments (VIs) to model DDS communication between LabVIEW and pure DDS applications.

1.1 DDS

What is DDS?

"The Data Distribution Service (DDS™) is a middleware protocol and API standard for data-centric connectivity from the Object Management Group® (OMG®). It integrates the components of a system together, providing low-latency data connectivity, extreme reliability, and a scalable architecture that business and mission-critical Internet of Things (IoT) applications need."

"The main goal of DDS is to share the right data at the right place at the right time, even between time-decoupled publishers and consumers. DDS implements global data space by carefully replicating relevant portions of the logically shared dataspace." DDS specification



Further Documentation

http://portals.omg.org/dds/

http://ist.adlinktech.com/

1.2 LabVIEW

What is LabVIEW?

"LabVIEW is systems engineering software for applications that require test, measurement, and control with rapid access to hardware and data insights. The LabVIEW programming environment simplifies hardware integration for engineering applications so that you have a consistent way to acquire data from NI and third-party hardware. The LabVIEW programming environment simplifies hardware integration for engineering applications so that you have a consistent way to acquire data from NI and third-party hardware. LabVIEW reduces the complexity of programming, so you can focus on your unique engineering problem. LabVIEW enables you to immediately visualize results with built-in, drag-and-drop engineering user interface creation and integrated data viewers. To turn your acquired data into real business results, you can develop algorithms for data analysis and advanced control with included math and signal processing IP or reuse your own libraries from a variety of tools. To ensure compatibility with other engineering tools, LabVIEW can interoperate with, and reuse libraries from, other software and open-source languages."

http://www.ni.com/en-ca/shop/labview/buy-labview.html

2

Installation

This section describes the procedure to install the Vortex DDS LabVIEW Integration on a Linux or Windows platform.

2.1 System Requirements

- Operating System: Windows or Linux
- LabVIEW 2017 installed

2.2 OpenSplice (OSPL) and DDS LabVIEW Installation

Steps:

1. Install OSPL. The DDS LabVIEW Integration is included in this installer.
2. Setup OSPL license. Copy the license.lic file into the appropriate license directory.

   /INSTALLDIR/ADLINK/Vortex_v2/license
3. LabVIEW installation files are contained in a tools/labview folder.

   Example: */INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.linux/tools/labview*

2.3 OpenSplice (OSPL) Configuration

By default OSPL uses single process configuration.

2.4 DDS LabVIEW Installation

2.4.1 Linux

1. Open a command shell and navigate to

   /INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.linux/tools/labview
2. Unzip the “adlink-dds-labview-linux-install.tar.gz”.
3. Run the install_vortex_dds_ubuntu.sh script as a super user.

   sudo ./install_vortex_dds_ubuntu.sh

   NOTE: The installer sets the default LabVIEW installation path to /usr/local/natinst/LabVIEW-2017-64. To override this installation directory, run the install script and pass the install directory as an argument:

   sudo ./install_vortex_dds_ubuntu.sh /path/to/your/LabVIEW/installation

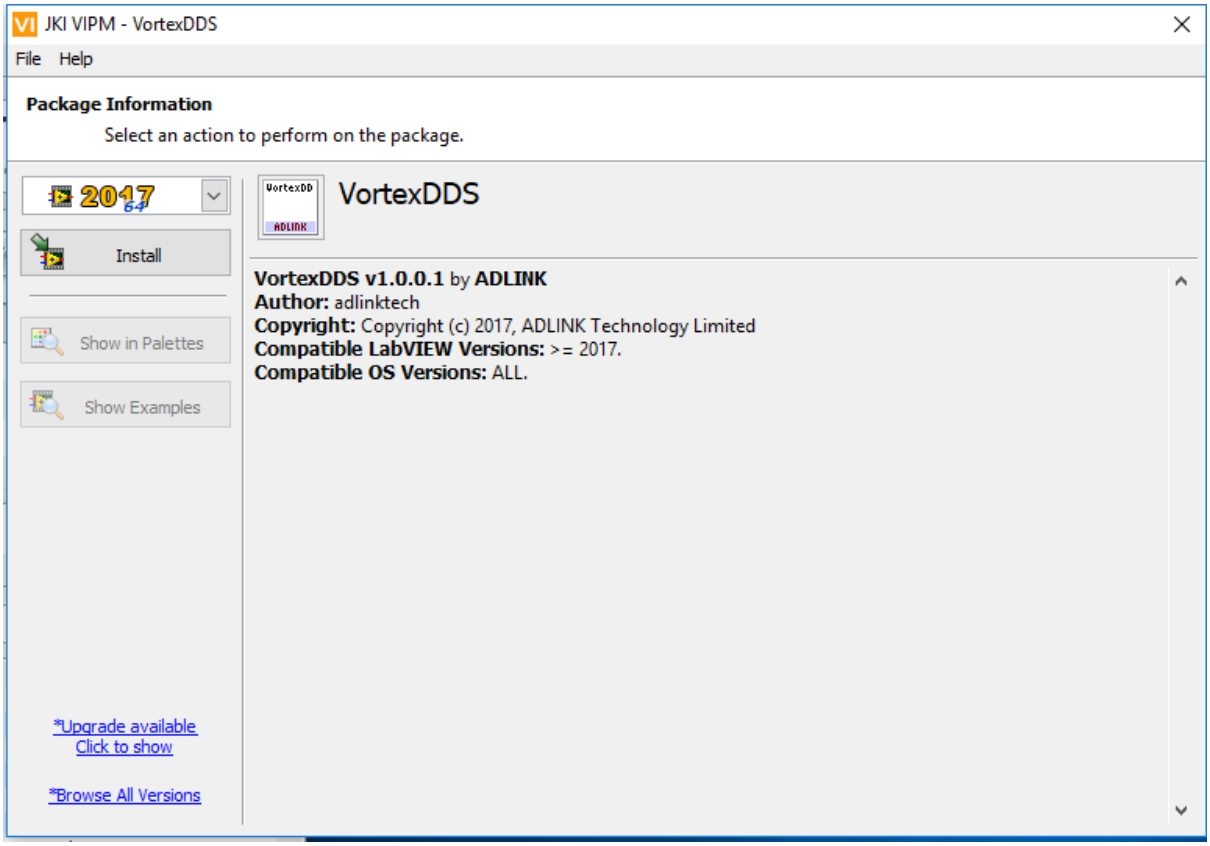
4. LabVIEW will open and allow the installation Virtual Instrument (VI) run to completion.
5. After the installation is complete close LabVIEW. Installation takes effect the next time you start LabVIEW.

2.4.2 Windows

1. In a file browser, navigate to

   /INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.windows/tools/labview

2. Double click on the file "adlink_lib_vortexdds-1.0.0.1". This will bring up the VI Package Manager installer dialog box. Select the LabVIEW version to install (32-bit or 64-bit). Select **Install**.



3. After the installation is complete close LabVIEW. Installation takes effect the next time you start LabVIEW.

2.5 Running LabVIEW

Steps:

1. Open command shell and run script to setup environment variables.

   Linux

   - Open a Linux terminal.
   - Navigate to directory containing release.com file.

     /INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.linux
   - Run release.com. (Type in ". release.com" at command line.)

   Windows

   - Open a command prompt.
   - Navigate to directory containing release.bat file.

     INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.win64
   - Run release.bat. (Type in "release.bat" at command line.)

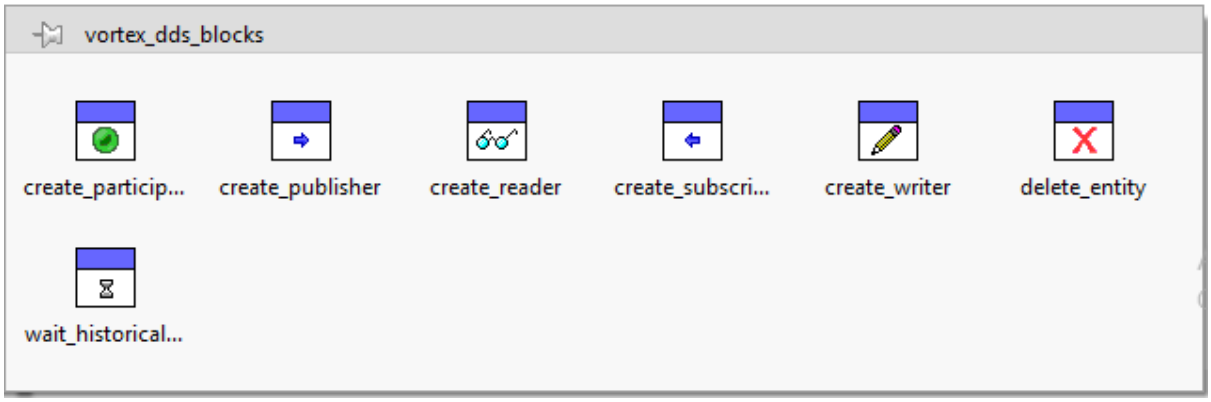
2. Start LabVIEW using the **SAME** command shell used in Step 1.

   NOTE: If LabVIEW is NOT started from a command shell with the correct OSPL environment variables set, errors will occur when attempting to use DDS LabVIEW virtual instruments.

3

Vortex DDS Virtual Instruments (VIs)

The DDS LabVIEW Integration provides a function palette with custom virtual instruments (VIs) to model reading and writing data with DDS.



The Vortex DDS LabVIEW VIs are included in **VortexDDS** functions palette.

The following DDS VIs are provided:

- create_participant.vi
- create_publisher.vi
- create_subscriber.vi
- create_writer.vi
- create_reader.vi
- wait_historical_data.vi
- delete_entity.vi

3.1 DDS VIs usage

The typical way to model a DDS application in LabVIEW is as follows:

- model your DDS topics using IDL
- using the LabVIEW IDLPP process generate DDS Topic, Read and Write VIs from the IDL file
- add the generated VIs to your LabVIEW project
- create a DDS LabVIEW application using the VortexDDS functions palette and the generated VIs from the previous step

3.2 QoS Profiles

In DDS - "The Data-Distribution Service (DDS) relies on the usage of QoS. A QoS (Quality of Service) is a set of characteristics that controls some aspect of the behavior of the DDS Service."

Each DDS entity VI has an associated QoS profile. By default, the OSPL default profile is used. An XML file that specifies QoS profiles can be used to set the QoS of a DDS entity.

The QoS profile of an entity is set using the **qos_uri** and **qos_profile** terminals.

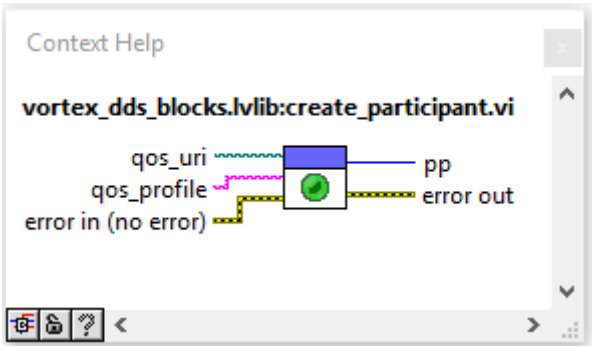
Please see section *QoS Provider* for more information.

3.3 create_participant.vi

The create_participant VI represents a DDS domain participant entity.

In DDS - "A domain participant represents the local membership of the application in a domain. A domain is a distributed concept that links all the applications able to communicate with each other. It represents a communication plane: only the publishers and subscribers attached to the same domain may interact."

The domain id is the OSPL default domain id specified in the OSPL configuration file (file pointed by "OSPL_URI" environment variable).

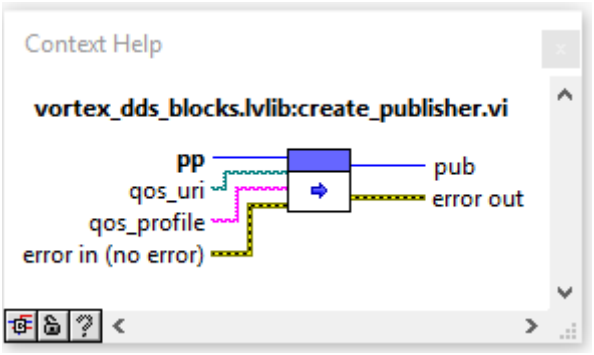


Terminal Type	Optional	Name	Description	Output consumed by
Output	no	pp	DDS Domain Participant entity instance	create_publisher.vi create_subscriber.vi RegisterTopic.vi
Input	yes	qos_uri	QoS file uri	
Input	yes	qos_profile	Name of QoS profile	
Input	yes	error in (no error)	Input Error cluster	
Output	yes	error out	Error out cluster	

3.4 create_publisher.vi

The create_publisher VI represents a DDS publisher entity.

In DDS, a publisher is "an object responsible for data distribution. It may publish data of different data types."

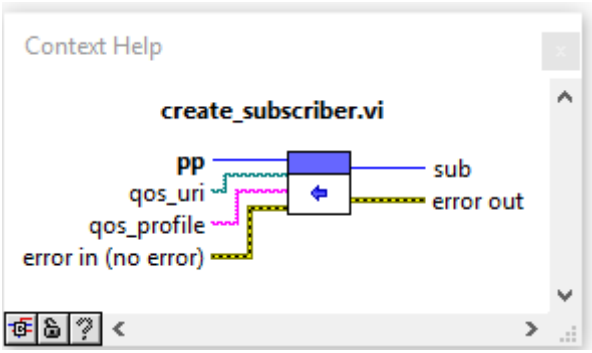


Terminal Type	Optional	Name	Description	Output consumed by
Input	no	pp	DDS Domain Participant entity instance	
Input	yes	qos_uri	QoS file uri	
Input	yes	qos_profile	Name of QoS profile	
Input	yes	error in (no error)	Input Error cluster	
Output	no	pub	DDS publisher entity instance	create_writer.vi
Output	yes	error out	Error out cluster	

3.5 create_subscriber.vi

The create_subscriber VI represents a DDS subscriber entity.

In DDS, a subscriber is "an object responsible for receiving published data and making it available to the receiving application. It may receive and dispatch data of different specified types."

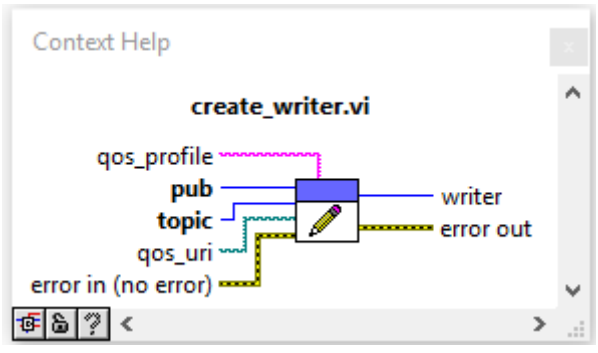


Terminal Type	Optional	Name	Description	Output consumed by
Input	no	pp	DDS Domain Participant entity instance	
Input	yes	qos_uri	QoS file uri	
Input	yes	qos_profile	Name of QoS profile	
Input	yes	error in (no error)	Input Error cluster	
Output	no	sub	DDS subscriber entity instance	create_reader.vi
Output	yes	error out	Error out cluster	

3.6 create_writer.vi

The create_writer VI represents a DDS data writer entity.

In DDS - "The DataWriter is the object the application must use to communicate to a publisher the existence and value of data-objects of a given type."

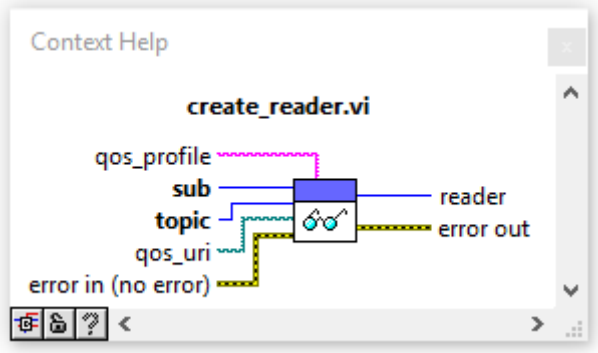


Terminal Type	Optional	Name	Description	Output consumed by
Input	no	pub	DDS publisher entity instance	
Input	no	topic	DDS Topic entity instance	
Input	yes	qos_uri	QoS file uri	
Input	yes	qos_profile	Name of QoS profile	
Input	yes	error in (no error)	Input Error cluster	
Output	no	writer	DDS writer entity instance	write.vi
Output	yes	error out	Error out cluster	

3.7 create_reader.vi

The create_reader VI represents a DDS data reader entity.

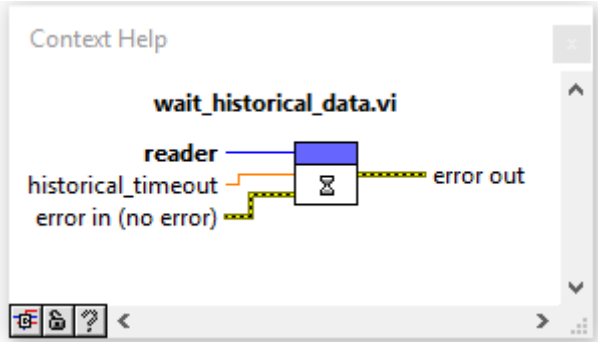
In DDS - "To access the received data, the application must use a typed DataReader attached to the subscriber."



Terminal Type	Optional	Name	Description	Output consumed by
Input	no	sub	DDS subscriber entity instance	
Input	no	topic	DDS Topic entity instance	
Input	yes	qos_uri	QoS file uri	
Input	yes	qos_profile	Name of QoS profile	
Input	yes	error in (no error)	Input Error cluster	
Output	no	reader	DDS reader entity instance	read.vi
Output	yes	error out	Error out cluster	

3.8 wait_historical_data.vi

The wait_historical_data VI specifies that the Reader will wait for historical data to arrive. The timeout terminal is for setting time period (in seconds) determining how long the Reader should wait for the historical data. If the timeout is reached, then any remaining historical data may be interleaved with new data.

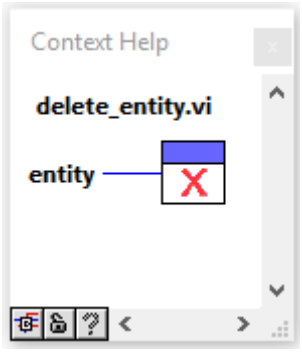


Terminal Type	Optional	Name	Description	Output consumed by
Input	no	reader	DDS Reader entity instance	
Input	yes	historical_timeout	wait for historical data timeout (seconds)	
Input	yes	error in (no error)	Input Error cluster	
Output	yes	error out	Error out cluster	

3.9 delete_entity.vi

The delete_entity VI is used to delete a DDS entity. Connect the DDS participant to the entity terminal to delete the participant (pp) in a LabVIEW DDS application.

> *NOTE: If the user application VI stops due to an error and does not run to completion, the participant entity is not deleted and leaks occur. The participants are deleted once the user closes LabVIEW.*



Terminal Type	Optional	Name	Description	Output consumed by
Input	no	entity	DDS entity instance	

4

LabVIEW Generation from IDL

While creating a DDS application in LabVIEW, the user must create Topic VIs which map to DDS topic types. In addition to registering a topic, the user neeeds to create DDS Read and DDS Write VIs. LabVIEW data is represented in clusters. The DDS Read and Write VIs have terminals that require a LabVIEW cluster. On data writes, the LabVIEW clusters are converted to DDS topic types and on data reads, the DDS topic types are converted to LabVIEW clusters.

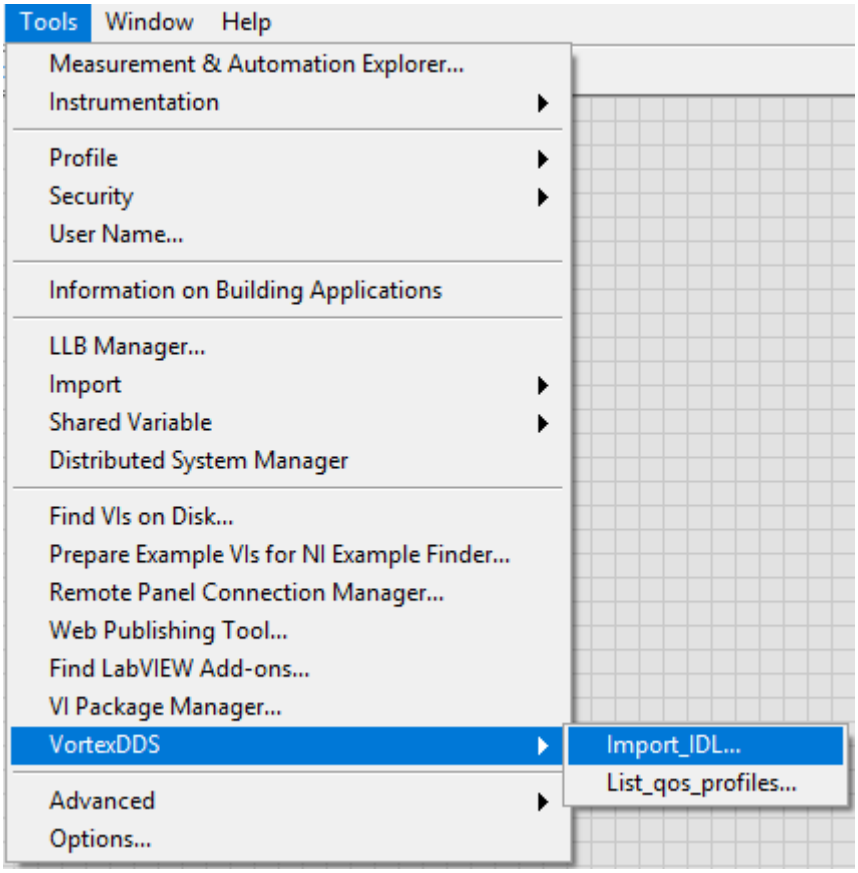
The user can generate the LabVIEW clusters and DDS VIs from an IDL file.

The DDS LabVIEW Integration supports generation of LabVIEW typedefs and VIs from IDL. This chapter describes the details of the IDL-LabVIEW binding.

4.1 Generating LabVIEW VIs from an IDL File IDLPP

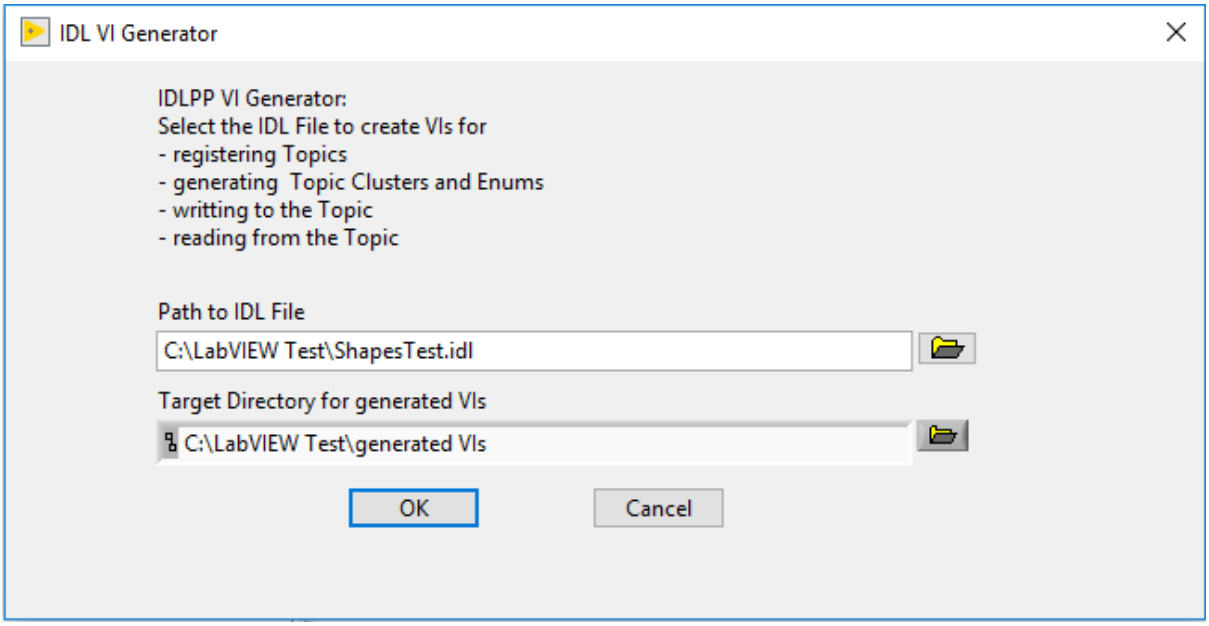
DDS Topic Types can be described in an IDL file. The LabVIEW IDL generation is done using the **Import_IDL** Tools menu in LabVIEW.

Tools/VortexDDS/Import_IDL

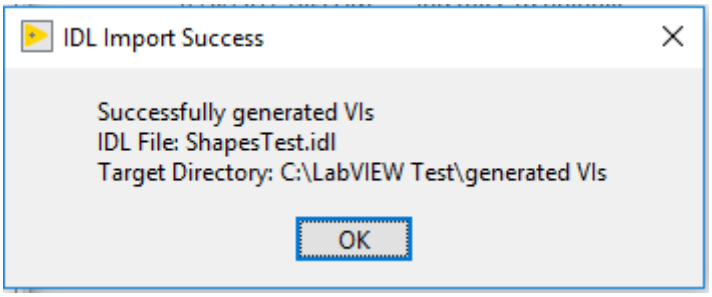


In the IDL file, ensure that any topic structures have the OSPL specific annotation *pragma keylist* defined. This value is added as a **keylist constant** to the *key* terminal of the generated RegisterTopic.vi.

Select the IDL file and a folder for the generated VIs.



Upon successful generation the VIs are located in the folder that was chosen. A dialog box appears indicating the path of the generated VIs and the IDL file.



4.2 Generated Artifacts

The following table defines the LabVIEW artifacts generated from IDL concepts:

IDL Concept	LabVIEW Concept	Comment
module		Appended to the name of each VI contained in the module
enum	enum	a LabVIEW .ctl file.
enum value	enum value	
struct	cluster	a LabVIEW .ctl file.
field	cluster field	
sequence	array	
array	array	

Datatype mappings

The following table shows the LabVIEW equivalents to IDL primitive types:

DDS IDL	LabVIEW Type
boolean	Boolean
char	int8
octet	uint8
short	int16
unsigned short	uint16
long	int32
unsigned long	uint32
long long	int64
unsigned long long	uint64
float	single-precision floating point
double	double-precision floating point
string	String
Unsupported DDS data types	
wchar	*not supported*
wstring	*not supported*
any	*not supported*
long double	*not supported*
union	*not supported*
inheritance	*not supported*

Generated VIs and controls

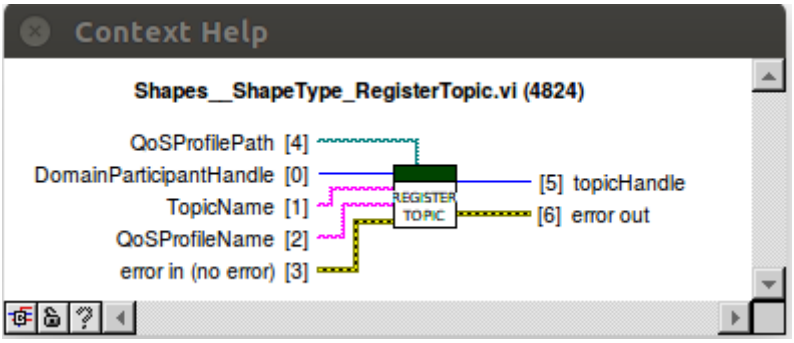
For each struct in the IDL file, the following VIs and controls are generated:

- RegisterTopic.vi
- Write.vi
- Read.vi
- CicoTable.vi (Copy-in copy-out)
- Topic cluster.ctl (corresponds to each struct in IDL File)
- Enum.ctl (corresponds to each enum in IDL File)

The “moduleName_structName” is appended to the name of each VI and control that is generated.

4.3 RegisterTopic.vi

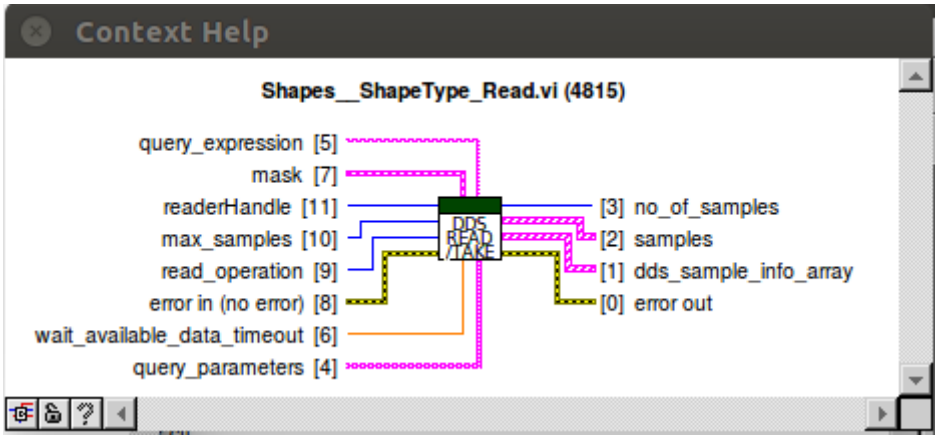
The RegisterTopic.vi represents a DDS topic type. The DDS topic corresponds to a single data type. In DDS, data is distributed by publishing and subscribing topic data samples.



Terminal Type	Optional	Name	Description	Output consumed by
Input	no	DomainParticipantHandle	DDS Domain Participant entity instance	
Input	no	TopicName	DDS Topic Name	
Input	yes	QosProfilePath	QoS file uri	
Input	yes	QoSProfileName	Name of QoS profile	
Input	yes	error in (no error)	Input Error cluster	
Output	no	topicHandle	DDS Topic entity instance	create_reader.vi create_writer.vi
Output	yes	error out	Error out cluster	

4.4 Read.vi

The DDS Read.vi is used to read DDS samples from a specific topic.



Terminal Type	Optional	Name	Description	Output consumed by
Input	no	readerHandle	DDS Reader entity instance	
Input	yes	mask	read_condition masks LabVIEW cluster	
Input	yes	max_samples	maximum number of samples to read	
Input	yes	read_operation	READ or TAKE default operation is TAKE	
Input	yes	query_expression	expression to filter samples based on a query	
Input	yes	query_parameters	parameters for the query expression	
Input	yes	wait_available_data_timeout	wait for data available timeout (seconds)	
Input	yes	error in (no error)	Input Error cluster	
Output	yes	no_of_samples	Number of samples read	user
Output	no	samples	LabVIEW cluster	user
Output	yes	dds_sample_info_array	sample information	user
Output	yes	error out	Error out cluster	

4.4.1 Filters

The filtering of incoming samples can happen based on a query and/or on a sample read condition(s).

Query

query_expression: The expression is a SQL condition.

query_parameters: Each parameter element must be an array element.

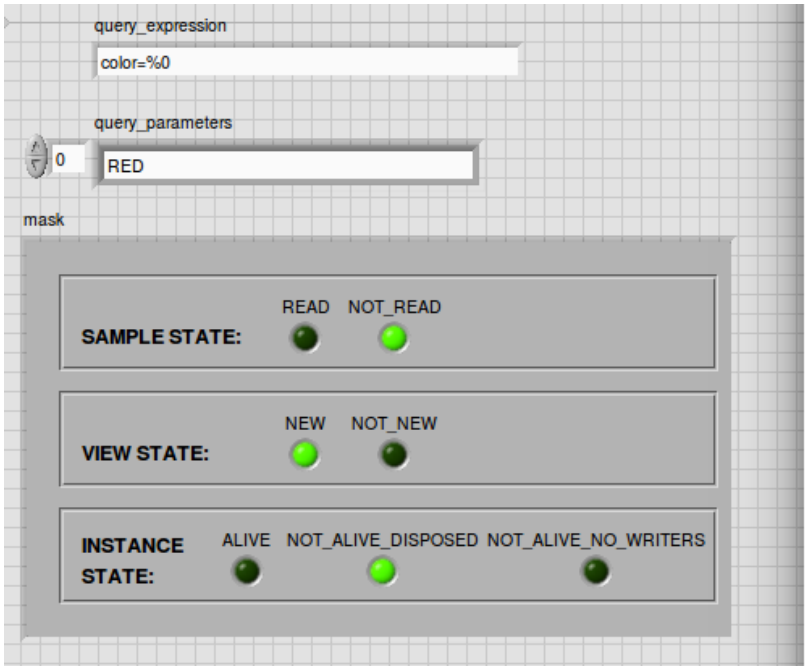
Note: Query expressions are only validated at runtime. If they are incorrect, errors will occur while running the VI.

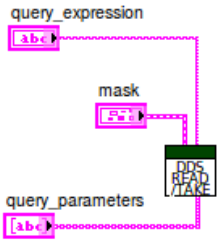
Read Condition

The read condition mask specified will filter the samples that are read or take(n).

Example: For a reader, the Sample State has **Not Read** selected and **Read** deselected.

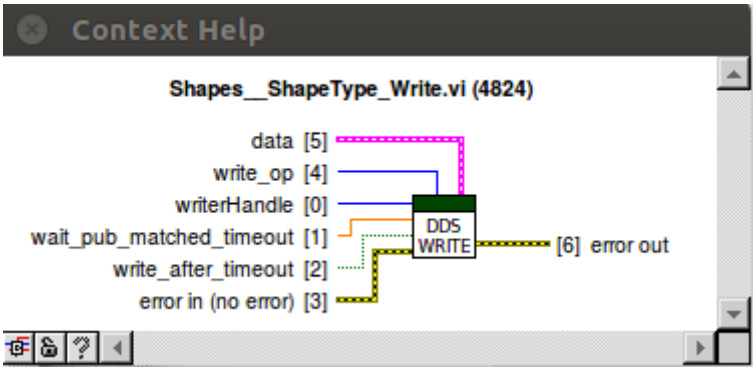
Only samples with a Sample State **Not Read** will be processed with read or take. Any samples with the **Read** sample state will not be read or take(n).





4.5 Write.vi

The DDS Write.vi is used to write DDS samples to a specific topic.



Terminal Type	Optional	Name	Description	Output consumed by
Input	no	writerHandle	DDS Writer entity instance	
Input	yes	write_op	write operation: WRITE, DISPOSE, WRITE_DISPOSE Default operation: WRITE	
Input	no	data	samples LabVIEW cluster	DDS
Input	yes	wait_pub_matched_timeout	wait for publication matched timeout (seconds)	
Input	yes	write_after_timeout	write samples after timeout	
Input	yes	error in (no error)	Input Error cluster	
Output	yes	error out	Error out cluster	

5

QoS Provider

Each Vortex DDS virtual instrument (VI) has a QoS file uri terminal and a QoS profile terminal. These terminals are used to set the QoS profile. By default, the OSPL default profile is used. In DDS - The Data-Distribution Service (DDS) relies on the usage of QoS. A QoS (Quality of Service) is a set of characteristics that controls some aspect of the behavior of the DDS Service.

Each DDS VI has an associated QoS profile. By default, the OSPL default profile is used. An XML file that specifies QoS profiles can be used to set the QoS of a DDS block.

The following section explains how the QoS is set for a DDS entity using the QoS Provider.

5.1 QoS Provider File

Quality of Service for DDS entities is set using XML files based on the XML schema file DDS_QoSProfile.xsd. These XML files contain one or more QoS profiles for DDS entities.

Note: Sample QoS Profile XML files can be found in the LabVIEW DDS examples directories.

5.2 QoS Profile

A QoS profile consists of a name. The file contains QoS elements for one or more DDS entities. A skeleton file without any QoS values is displayed below to show the structure of the file.

```
<dds xmlns="http://www.omg.org/dds/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
            xsi:schemaLocation="file:DDS_QoSProfile.xsd">
    <qos_profile name="DDS QoS Profile Name">
        <datareader_qos></datareader_qos>
        <datawriter_qos></datawriter_qos>
        <domainparticipant_qos></domainparticipant_qos>
        <subscriber_qos></subscriber_qos>
        <publisher_qos></publisher_qos>
        <topic_qos></topic_qos>
    </qos_profile>
</dds>
```

Example: Specify Publisher Partition

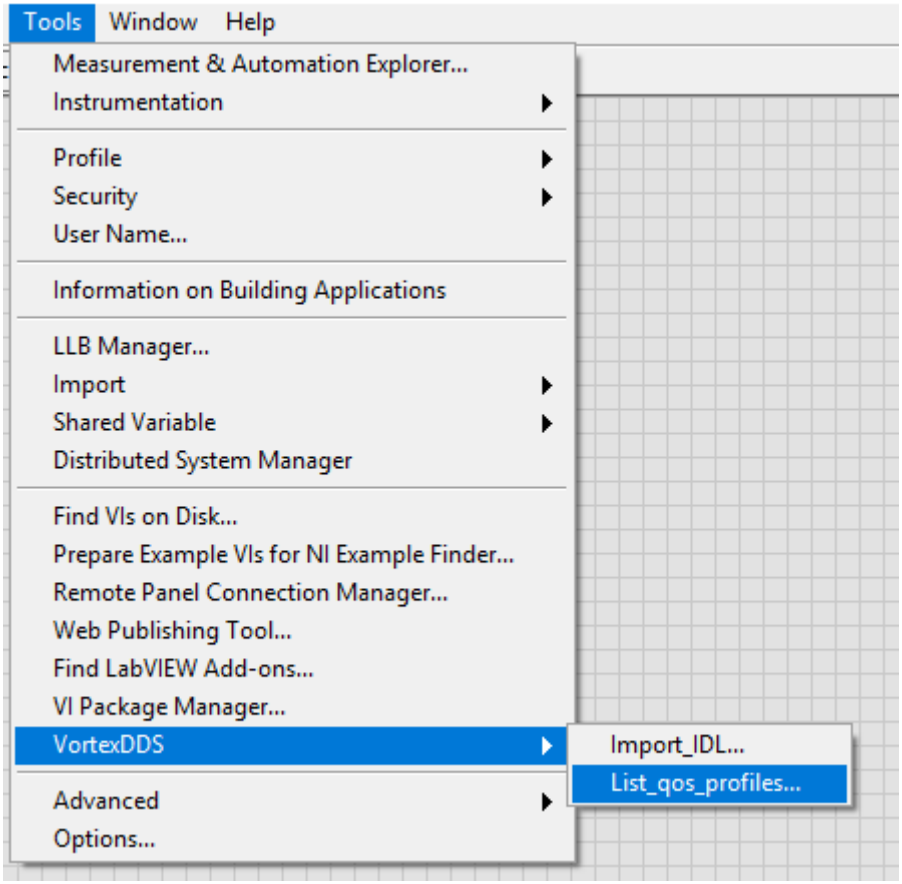
The example below specifies the publisher's partitions as A and B.

```
<publisher_qos>
    <partition>
        <name>
            <element>A</element>
            <element>B</element>
        </name>
    </partition>
</publisher_qos>
```

5.3 Setting QoS Profile in LabVIEW

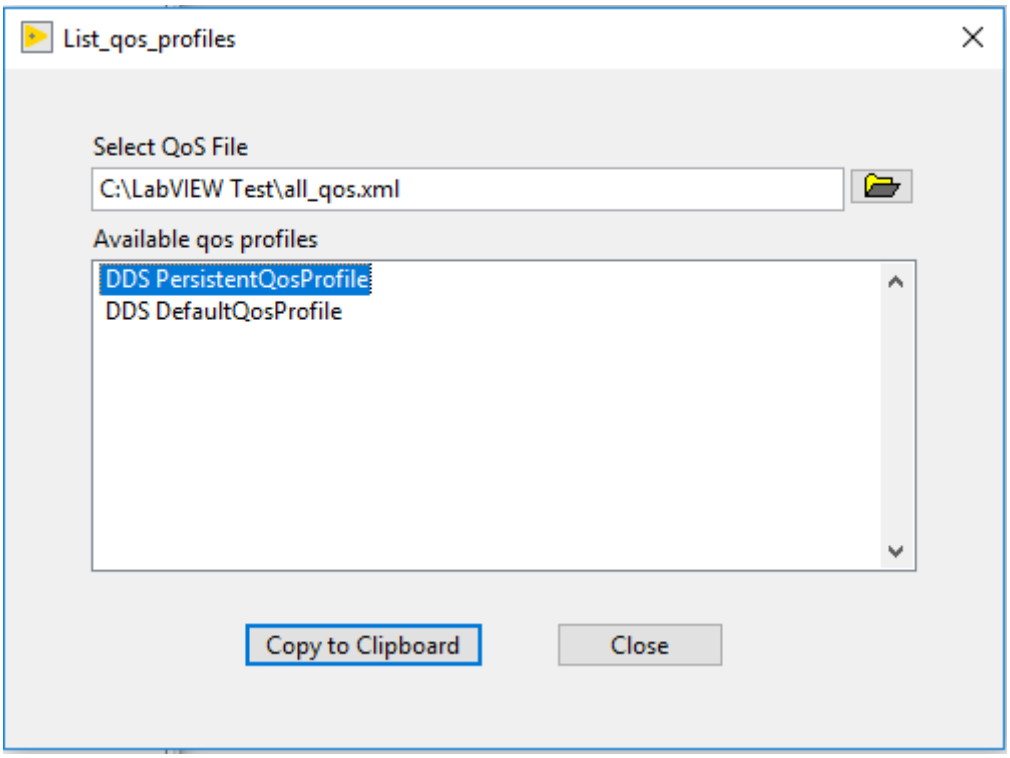
The QoS Profiles from the XML file can be obtained using the **List_qos_profiles** Tools menu in LabVIEW.

Tools/VortexDDS/List_qos_profiles

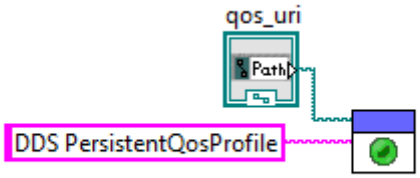


Steps to set the QoS Profile

1. A QoS Provider file can be selected by browsing to the XML file from the **List_qos_profiles** dialog box. Once a valid QoS file is chosen the **Available qos profiles** table is populated with the list of qos profiles that are available in the QoS XML file. If there are QoS profiles found in the file, then **Copy to Clipboard** button will be enabled.
2. Select the QoS Profile that you want to use and click on **Copy to Clipboard**.



3. In your VI, create a String constant and press Ctrl + V. Connect this String constant to the DDS VI **qos_profile** terminal. Set the **qos_uri** as a LabVIEW control or constant and navigate to the path of the QoS Provider file.



The **qos_profile** and **qos_uri** are optional terminals. If they are not set then the default QoS settings will be used.

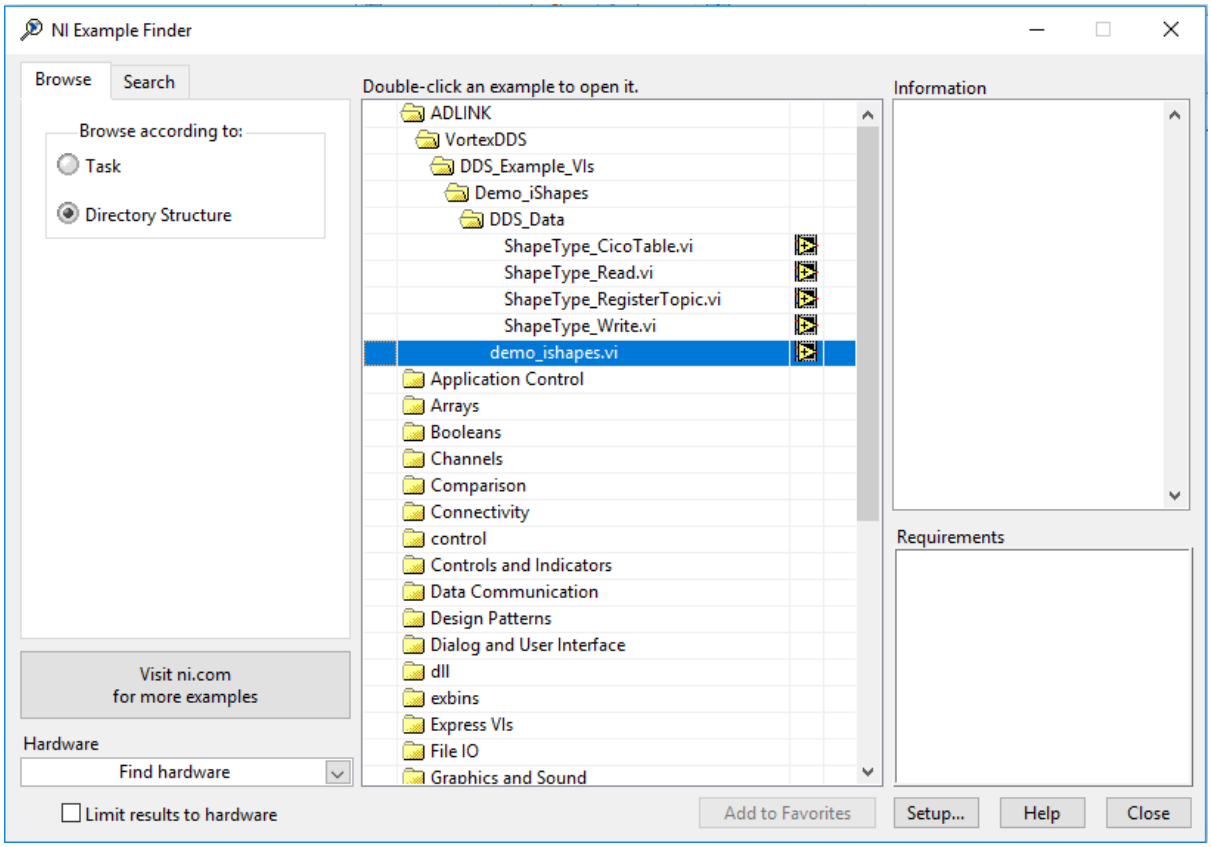
Note: Seeing the QoS Profile in the list only guarantees the QoS Profile exists in the file. It does not mean the qos tag exists for the entity. The user is responsible for verifying the entity qos tag exists in the file.

6

Demo iShapes Example

A simple demo iShapes example is provided to demonstrates the basic capabilities of the LabVIEW DDS integration. It displays DDS communication between LabVIEW and pure DDS applications.

The demo_ishapes.vi example (LabVIEW application) can be found using the **NI Example Finder** in LabVIEW:

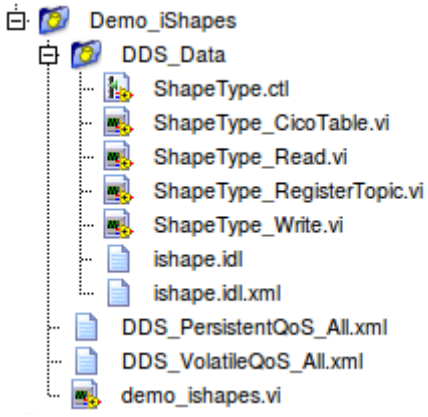


The demo_ishapes.exe (DDS application) can be found in the following directory.

OSPL_HOME/bin/demo_ishapes.exe

6.1 Example Files

An explanation of what each example file does is provided below.



DDS_Data Folder

This folder contains the idl file and artifacts generated from idlpp process.

ishape.idl

- Defines the ShapeType in idl
- Used to generate the LabVIEW DDS VIs via idlpp

ishape.idl.xml

- Defines the topic descriptor from idl file

ShapeType_CicoTable.vi

- Defines the copy-in, copy-out table information for mapping IDL to LabVIEW types

ShapeType.ctl

- Defines a ShapeType cluster in LabVIEW; generated from idlpp
- The ShapeType represents a DDS topic type
- ShapeType specifies 4 properties: color, x, y, shapesize

ShapeType_Read.vi

- DDS Read ShapeType samples

ShapeType_Write.vi

- DDS Write ShapeType samples

ShapeType_Topic.vi

- DDS Register ShapeType topic

DDS_PersistentQoS_All.xml

- XML file that specifies the DDS QoS (quality of service) settings for RegisterTopic

DDS_VolatileQoS_All.xml

- XML file that specifies the DDS QoS (quality of service) settings for Reader and Writer entities

demo_ishapes.vi

- Creates a participant on the default DDS domain
- Registers a ShapeType Topic to Read and to Write to one of the three topics: Circle, Square or Triangle

- Subscribes to the shape and color from demo_ishapes.exe DDS application
- As soon as they match, demo_ishapes.vi publishes to the DDS application and follows the subscribed shape

6.2 Steps to run example

Steps:

1. Open command shell and run script to setup environment variables.

   Linux

   - Open a Linux terminal.
   - Navigate to directory containing release.com file.

     /INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.linux

   - Run release.com. (Type in ". release.com" at command line.)

   Windows

   - Open a command prompt.
   - Navigate to directory containing release.bat file.

     INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.win64

   - Run release.bat. (Type in "release.bat" at command line.)

2. Navigate to the directory that contains demo_ishapes.exe DDS application and run the application using the command shell used in Step 1.

   Linux

   /INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.linux/bin

   - Run demo_ishapes.exe (Type in "./demo_ishapes.exe &" at command line)

   Windows

   INSTALLDIR/ADLINK/Vortex_v2/Device/VortexOpenSplice/6.9.x/HDE/x86_64.win64/bin

   - Run demo_ishapes.exe (Type in "demo_ishapes.exe &" at command line)

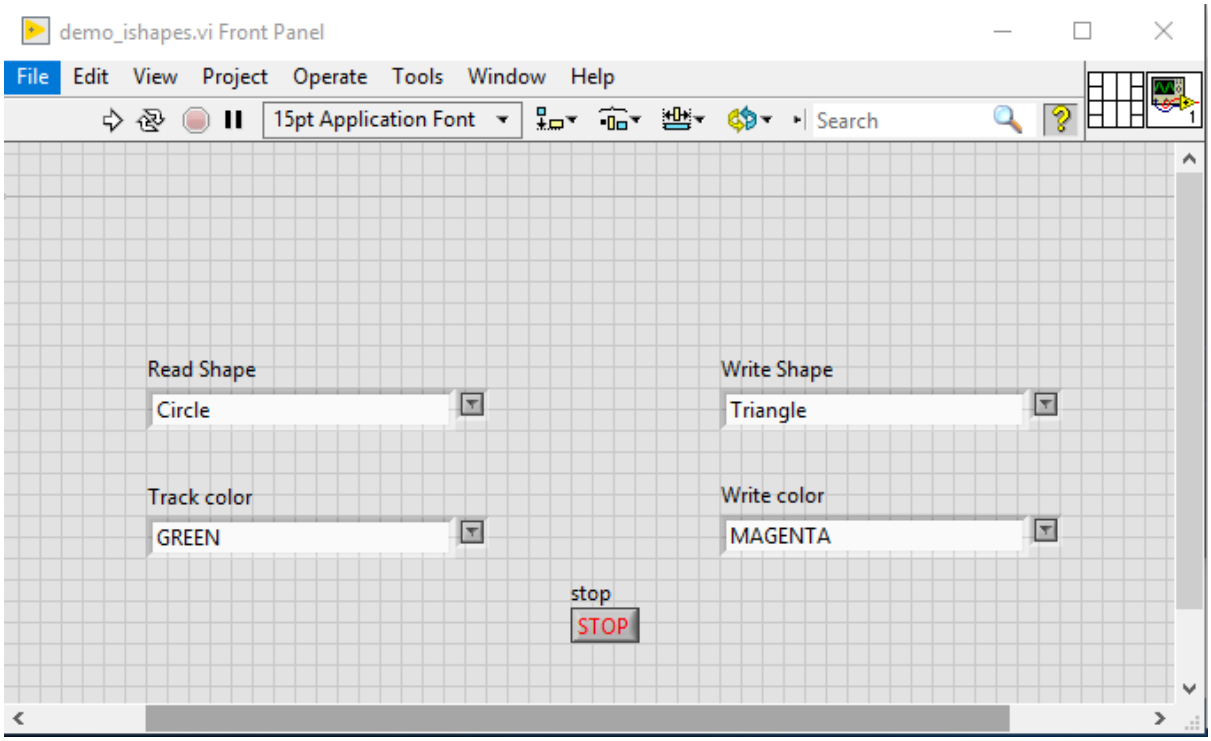
3. Start LabVIEW using the **SAME** command shell used in Step 1. Open the demo_ishapes.vi using the **NI Example Finder** in LabVIEW.

   NOTE: If LabVIEW and the demo_ishapes.exe application are NOT started from a command shell with the correct OSPL environment variables set, the example will not work.

4. In the LabVIEW demo_ishapes.vi application make the following selections:

   Read Shape: Circle Track color: GREEN

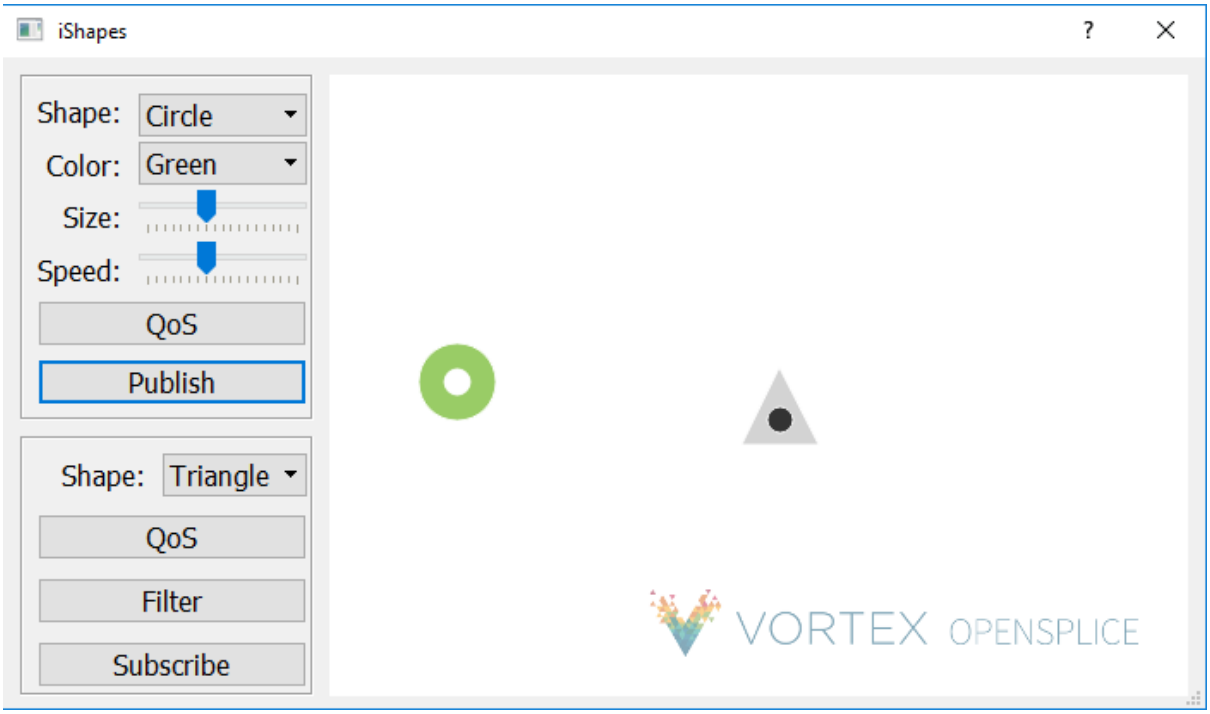
   Write Shape: Triangle Write color: MAGENTA



5. In the demo_ishapes.exe DDS application make the following selections:

   Shape: Circle Color: Green Click **Publish**

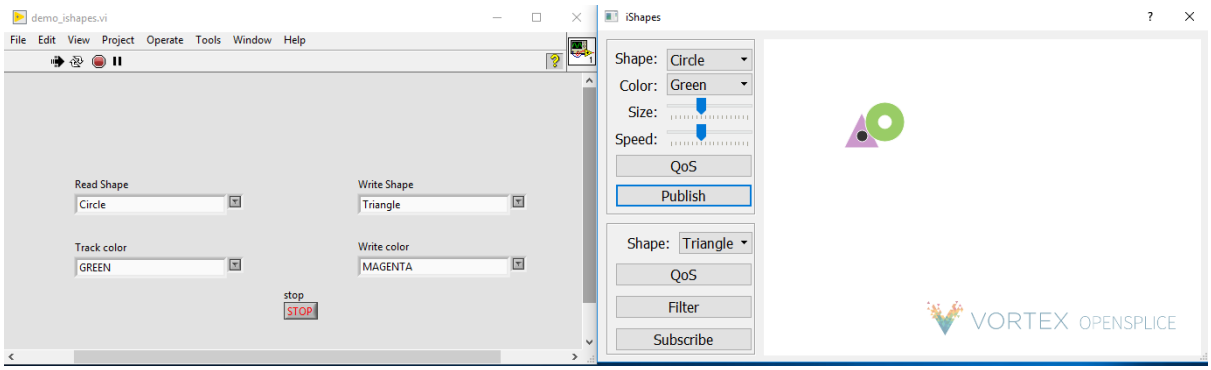
   Shape: Triangle Click **Subscribe**



6. Run the LabVIEW demo_ishapes.vi application
7. To stop the LabVIEW application, click on **STOP** on the front panel of the demo_ishapes.vi.

6.3 Output

LabVIEW application publishes samples to the DDS application. In the demo_ishapes.exe application, the Triangle follows the Circle.



7

Contacts & Notices

7.1 Contacts

ADLINK Technology Corporation
400 TradeCenter
Suite 5900
Woburn, MA
01801
USA
Tel: +1 781 569 5819

ADLINK Technology Limited
The Edge
5th Avenue
Team Valley
Gateshead
NE11 0XA
UK
Tel: +44 (0)191 497 9900

ADLINK Technology SARL
28 rue Jean Rostand
91400 Orsay
France
Tel: +33 (1) 69 015354

Web: http://ist.adlinktech.com/

Contact: http://ist.adlinktech.com

E-mail: ist_info@adlinktech.com

LinkedIn: https://www.linkedin.com/company/79111/

Twitter: https://twitter.com/ADLINKTech_usa

Facebook: https://www.facebook.com/ADLINKTECH

7.2 Notices