

# Monitor, Control, Record and Replay Your DDS System

## OpenSplice DDS Tools-Ecosystem - Overview & Demo

**J.H. van 't Hag**  
OpenSplice Product Manager  
OMG DDS Co-Author  
PrismTech  
[Hans.vanthag@prismtech.com](mailto:Hans.vanthag@prismtech.com)

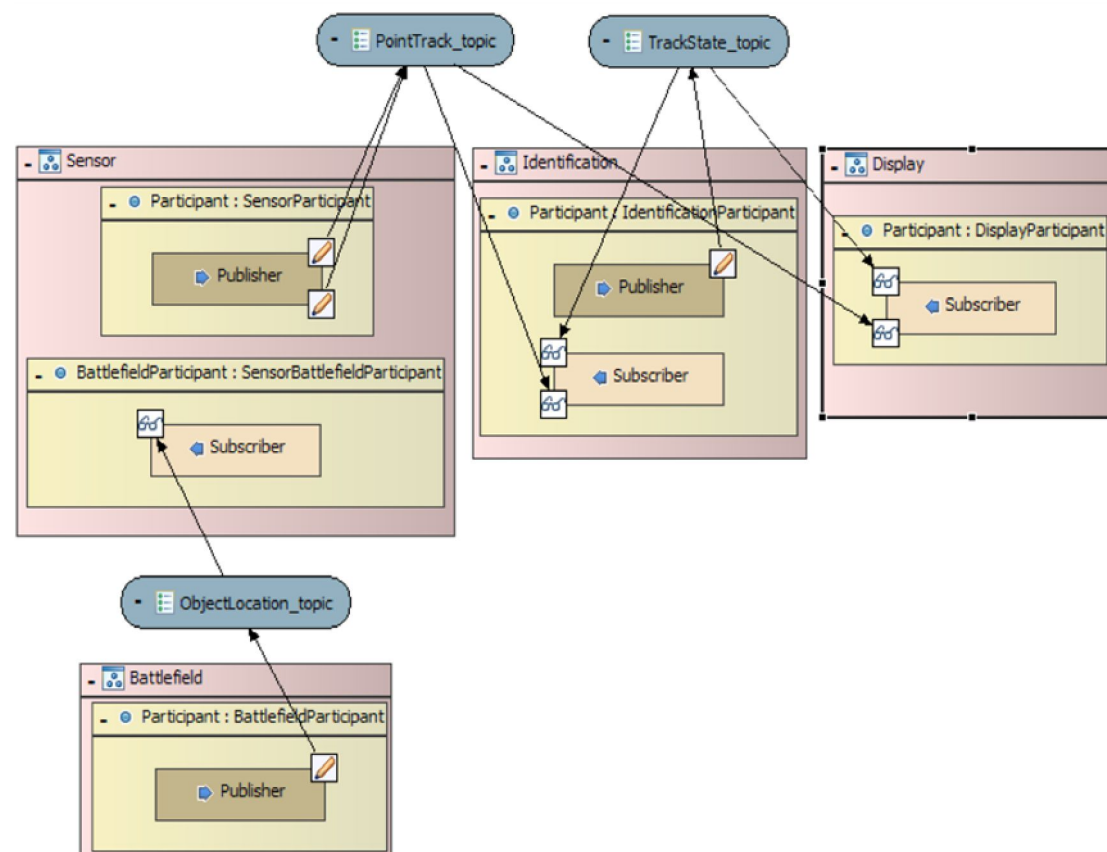
# Abstract

- Integrating, Operating and Troubleshooting large-scale distributed systems can be quite hard if you are not equipped with the right set of tools. OpenSplice DDS provides an ecosystem of tools that allow (1) monitoring the key resource and performance indicators of a DDS-based system, (2) controlling the behaviour of your distributed system by dynamically changing the key QoS parameters, and (3) controlling the record and replay of any data flowing in your system. This presentation will highlight and demonstrate how OpenSplice DDS tooling ecosystem can greatly simplify the integration, operation and troubleshooting of distributed applications

# OpenSplice Tools

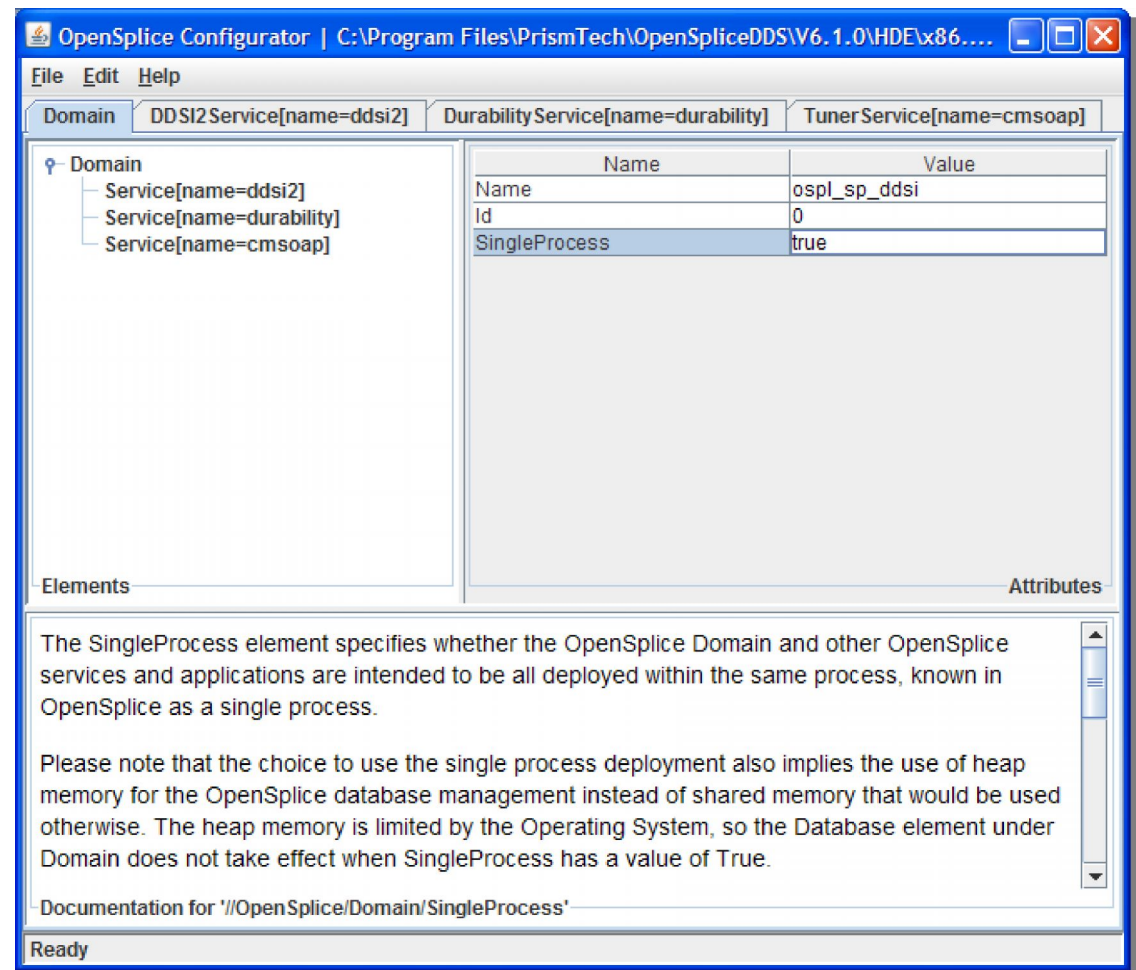
# OpenSplice Modeler

- ❑ Eclipse-based MDD tool
- ❑ Information Modeling
  - ❑ Importing IDL
  - ❑ Modeling topics (with type and QoS)
  - ❑ Annotating Topics with QoS
- ❑ Application Modeling
  - ❑ Graphical Modeling of DDS entities →
  - ❑ C++ / Java code-generation
- ❑ Videos on OpenSpliceTube
  - ❑ <http://www.youtube.com/user/OpenSpliceTube>



# Total Control: OpenSplice Configurator

- ❑ **The** reference tool for configuring OpenSplice DDS
- ❑ Rich **online guide** to configuration options
- ❑ **Context help** and parameter validation
- ❑ **100% Java**



# OpenSplice Tester

## “Black-Box” DDS system testing

### □ Automated testing of DDS systems

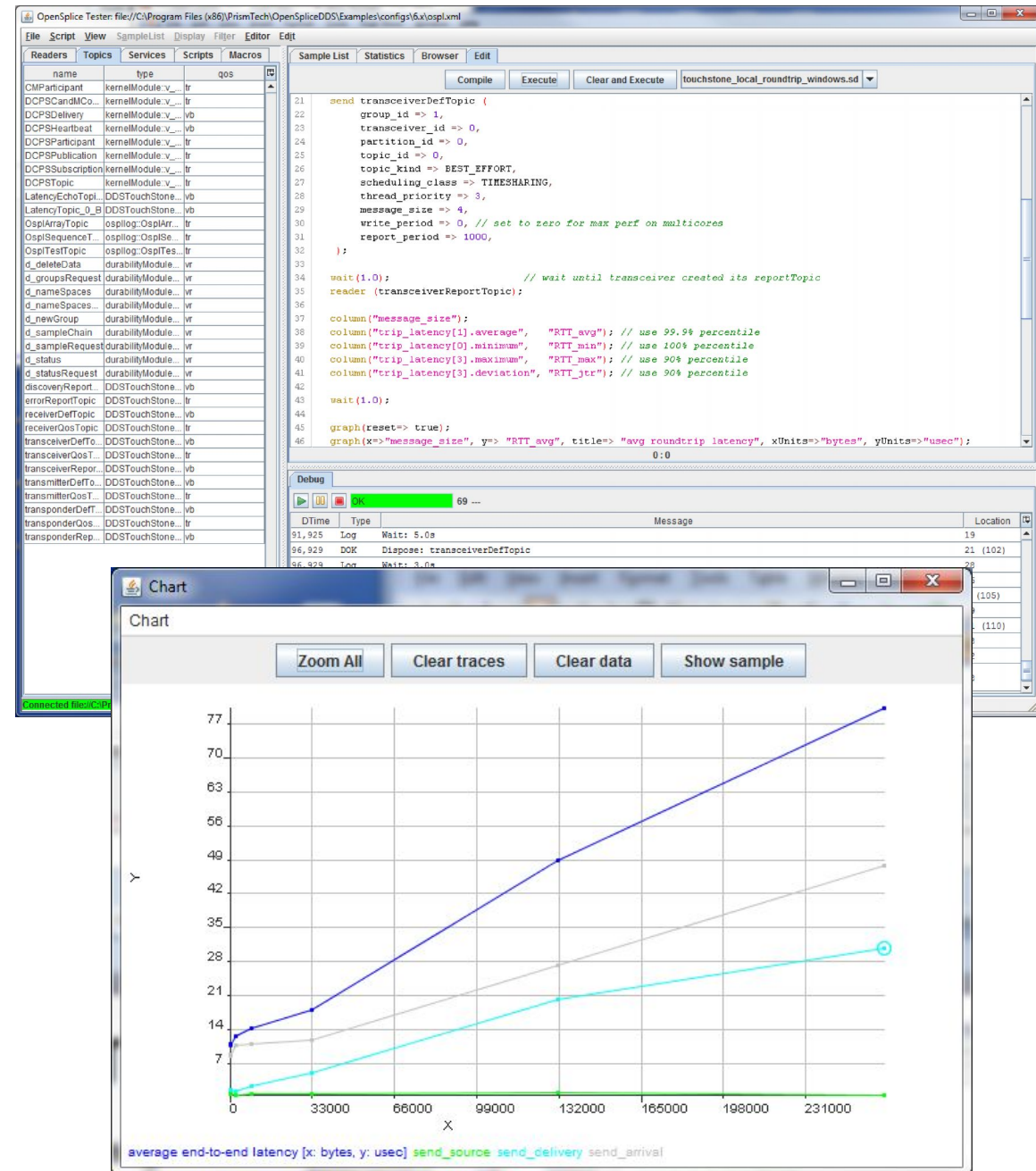
- Dynamic Discovery of DDS Entities
- Domain-specific scripting languages
- Batch execution of regression tests

### □ Debugging of distributed DDS systems

- System browser of DDS participants
  - Connectivity & QoS conflict monitoring
- One-click definition of monitoring timeline
  - Analysis/comparison of topic data
  - Virtual topic-attributes to ease analysis
- Statistics monitoring
- 1-click spawning of Tuner to ‘attach’ to a remote process / federation

### □ Integrated IDE

- Syntax highlighting editor
- One-click relations between script/logs/timeline



# OpenSplice Tuner

## □ “Whitebox” debug/tuning Tool

- Looking ‘inside’ a federation and/or application
- Different perspectives (participant, topic, partition)

## □ Monitoring & Tuning

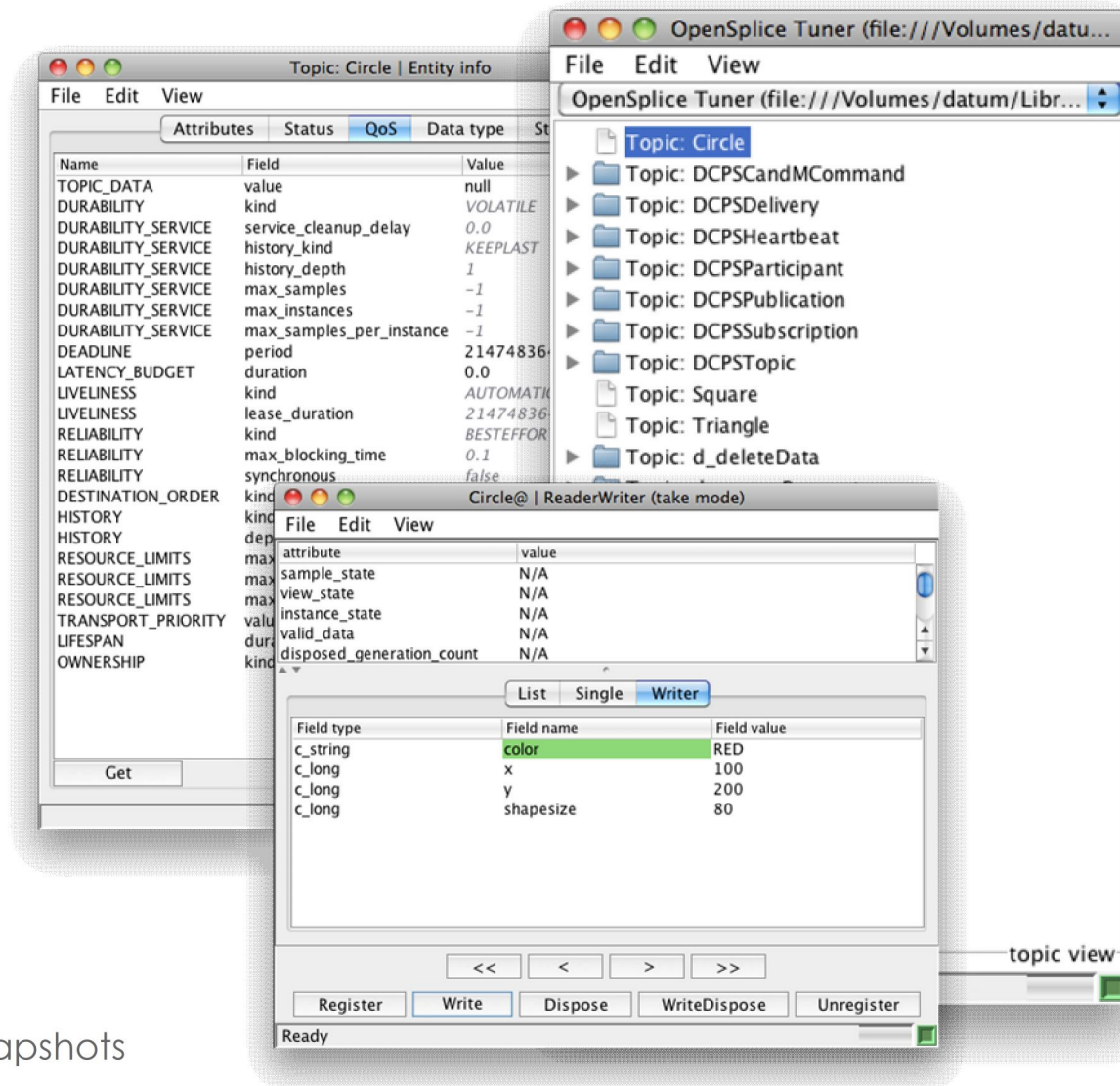
- Inspect and Tune the app’s DDS entities
- Make snapshots of reader-caches
- Detect and resolve QoS Mismatch
- Inspect Statistics

## □ Reading & Writing

- Read/Write data for arbitrary topics

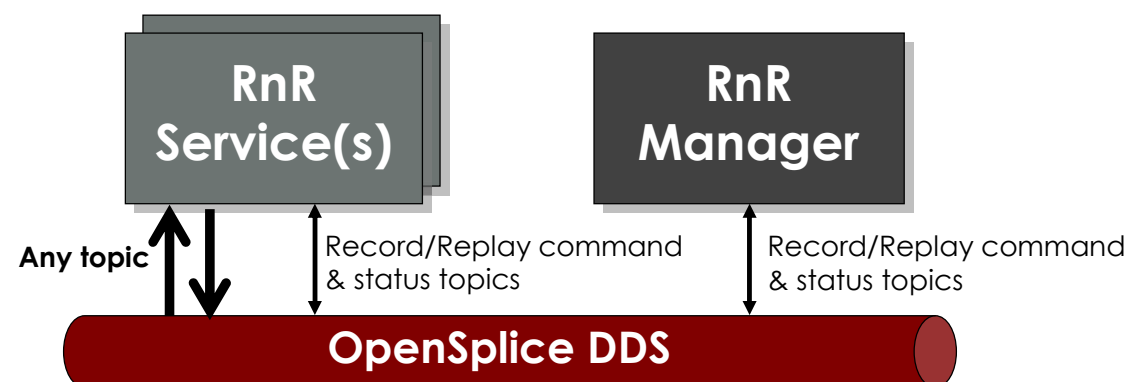
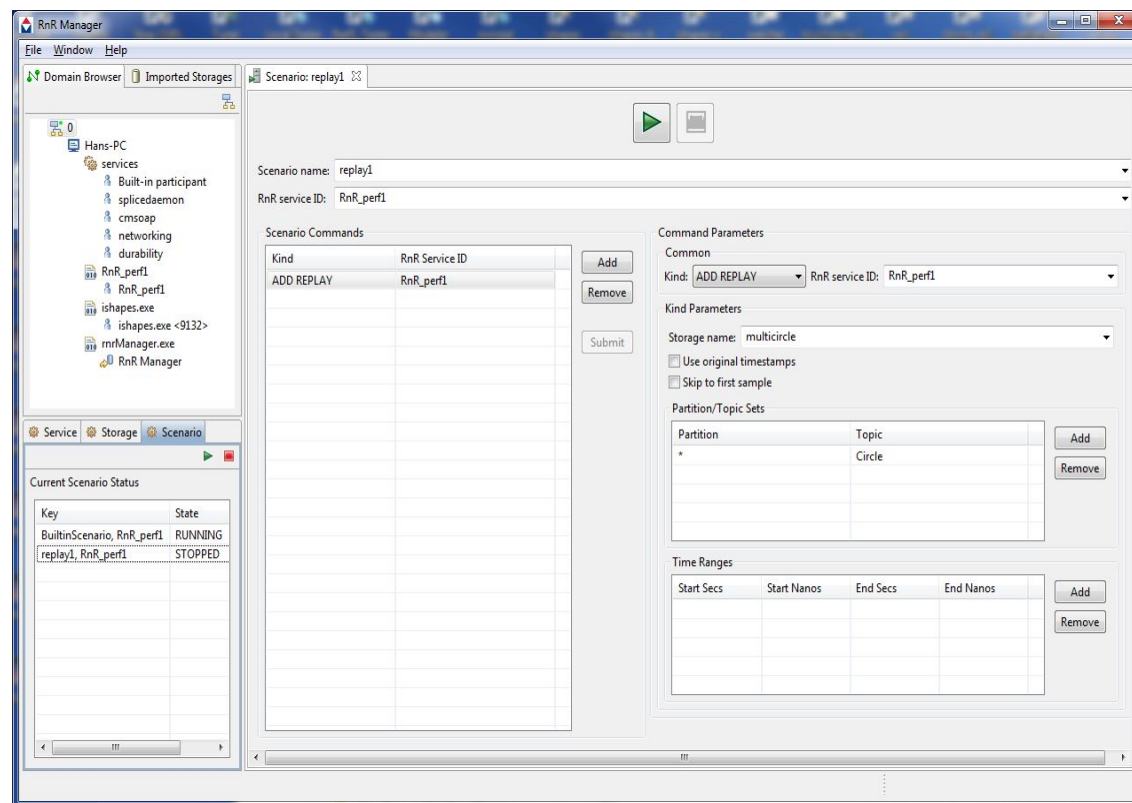
## □ Import & Export

- Inject Topic Definitions
- export and import XML-based reader/writer snapshots



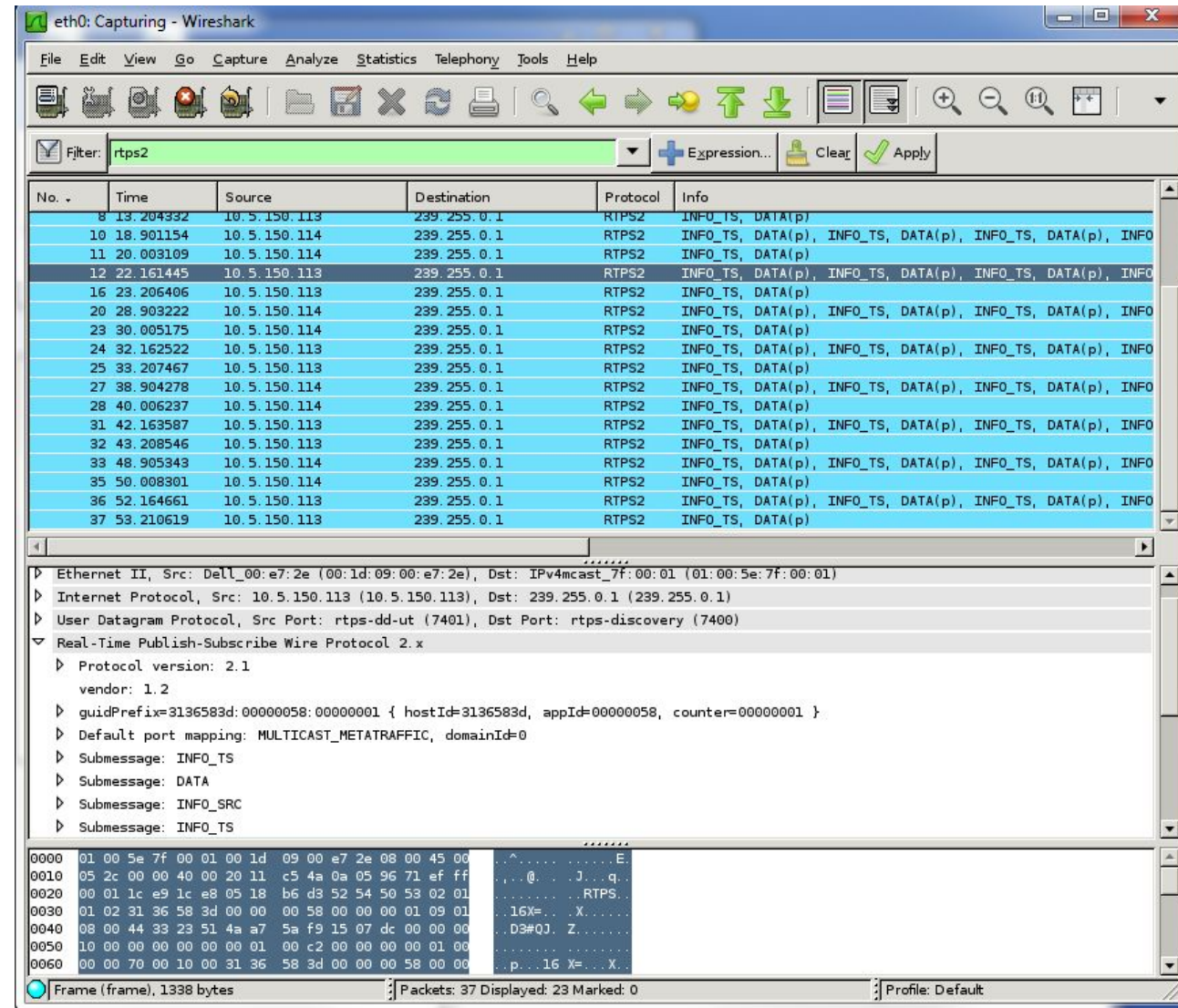
# OpenSplice RnR

- ❑ **Dynamic recording** of any topic-data in a DDS system
- ❑ **Selective replay** with variable speed
- ❑ **Distributed control** by topic-based API ('command' & 'status' topics)
- ❑ **Seamless integration** with OpenSplice Tester (topic-based API)
- ❑ Dedicated **RnR-Manager** graphical GUI for scenario-definition and data import/analysis



# Wireshark

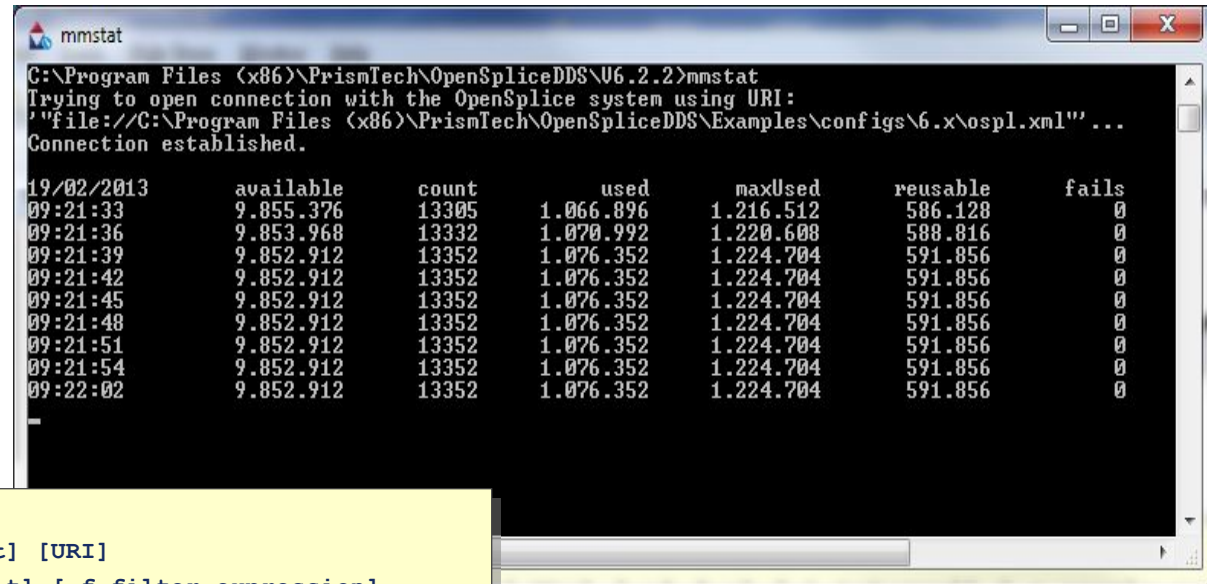
- ❑ **Wireshark Packet Dissector**
- ❑ Watch what goes on the **wire**
- ❑ Inspect **DDSI-RTPS** and/or **RT-Networking** packets being exchanged between applications
- ❑ Native Rtnetworking dissector support available in **source-distribution**



❑ OpenSpliceDDS\V6.3.0\HDE\x86.win32\tools\wireshark-plugins\ospl (see README)

# mmStat

## Shared-Memory Statistics viewer



```

C:\Program Files (x86)\PrismTech\OpenSpliceDDS\U6.2.2>mmstat
Trying to open connection with the OpenSplice system using URI:
'file:///C:/Program Files (x86)/PrismTech/OpenSpliceDDS/Examples/configs/6.x\ospl.xml' ...
Connection established.
  
```

|            | available | count | used      | maxUsed   | reusable | fails |
|------------|-----------|-------|-----------|-----------|----------|-------|
| 19/02/2013 |           |       |           |           |          |       |
| 09:21:33   | 9.855.376 | 13305 | 1.066.896 | 1.216.512 | 586.128  | 0     |
| 09:21:36   | 9.853.968 | 13332 | 1.070.992 | 1.220.608 | 588.816  | 0     |
| 09:21:39   | 9.852.912 | 13352 | 1.076.352 | 1.224.704 | 591.856  | 0     |
| 09:21:42   | 9.852.912 | 13352 | 1.076.352 | 1.224.704 | 591.856  | 0     |
| 09:21:45   | 9.852.912 | 13352 | 1.076.352 | 1.224.704 | 591.856  | 0     |
| 09:21:48   | 9.852.912 | 13352 | 1.076.352 | 1.224.704 | 591.856  | 0     |
| 09:21:51   | 9.852.912 | 13352 | 1.076.352 | 1.224.704 | 591.856  | 0     |
| 09:21:54   | 9.852.912 | 13352 | 1.076.352 | 1.224.704 | 591.856  | 0     |
| 09:22:02   | 9.852.912 | 13352 | 1.076.352 | 1.224.704 | 591.856  | 0     |

```
mmstat -h
```

```
mmstat [-M|m] [-e] [-a] [-i interval] [-s sample_count] [URI]
```

```
mmstat [-t|T] [-i interval] [-s sample_count] [-l limit] [-f filter_expression]
[URI]
```

### Mode:

- m Show memory statistics (default mode)
- M Show memory statistics difference
- t Show meta object references
- T Show meta object references difference
- h Show this help
- e Extended mode, shows bar for allocated memory
- a Show pre-allocated memory as well.
- i interval Display interval (in milliseconds)
- s sample\_count Stop after sample\_count samples
- l limit Show only object count >= limit
- f filter\_expr Show only meta objects which name passes the filter expression

Demo's

# Tester: QoS conflict detection

OpenSplice Tester: http://perf1.perfnet.ptnl:50000

File Script View SampleList Display Filter Editor Edit

Readers Topics Services Scripts Macros

| name                | type                    | qos |
|---------------------|-------------------------|-----|
| CMPParticipant      | kernelModule::v_part... | tr  |
| Circle              | ShapeType               | pb  |
| DCPSCandMComma...   | kernelModule::v_con...  | tr  |
| DCPSDelivery        | kernelModule::v_deli... | vb  |
| DCPSHeartbeat       | kernelModule::v_hea...  | vb  |
| DCPSParticipant     | kernelModule::v_part... | tr  |
| DCPSPublication     | kernelModule::v_pub...  | tr  |
| DCPSSubscription    | kernelModule::v_sub...  | tr  |
| DCPSTopic           | kernelModule::v_topi... | tr  |
| OspIArrayTopic      | ospilog::OspIArrayTo... | tr  |
| OspISequenceTopic   | ospilog::OspISeque...   | tr  |
| OspITestTopic       | ospilog::OspITestTo...  | tr  |
| Square              | ShapeType               | pb  |
| Triangle            | ShapeType               | pb  |
| d_deleteData        | durabilityModule2::d... | vr  |
| d_groupsRequest     | durabilityModule2::d... | vr  |
| d_nameSpaces        | durabilityModule2::d... | vr  |
| d_nameSpacesRequ... | durabilityModule2::d... | vr  |
| d_newGroup          | durabilityModule2::d... | vr  |
| d_sampleChain       | durabilityModule2::d... | vr  |
| d_sampleRequest     | durabilityModule2::d... | vr  |
| d_status            | durabilityModule2::d... | vr  |
| d_statusRequest     | durabilityModule2::d... | vr  |
| rr_scenario         | RnR::Command            | pr  |
| rr_scenarioStatus   | RnR::ScenarioStatus     | tr  |
| rr_serviceStatus    | RnR::ServiceStatus      | tr  |
| rr_storageStatus    | RnR::StorageStatus      | tr  |

Sample List Statistics Browser Edit

Refresh Add readers Add writers

Show disposed participants

Nodes

- perf1.perfnet.ptnl
  - SHMEM
  - services
    - cmsoap<5508>
    - OpenSplice Tester (perf1.pe
  - RnR\_perf1<5509>
- perf2.perfnet.ptnl
  - SHMEM
  - services
    - ishapes<18161>
- perf3.perfnet.ptnl
  - ishapes<27761>

All participants

- RnR\_perf1 (perf1.perfnet.ptnl)
- OpenSplice Tester (perf1.perfnet.ptnl)
- ishapes <27761> (perf3.perfnet.ptnl)
- ishapes <18161> (perf2.perfnet.ptnl)

Topics

- CMPParticipant
- Circle
- DCPSCandMCommand
- DCPSDelivery
- DCPSHeartbeat
- DCPSParticipant
- DCPSPublication

Refresh

Debug

DTime Type Message

Connected http://perf1.perfnet.ptnl:50000 | networking,cmsoap,durability,R ... 1,spliceddaemon

OpenSplice | DDS - iShapes Demo

simd-cxx

Shape: Circle

Color: Blue

Size: [Slider]

Speed: [Slider]

QoS

Publish

Shape: Circle

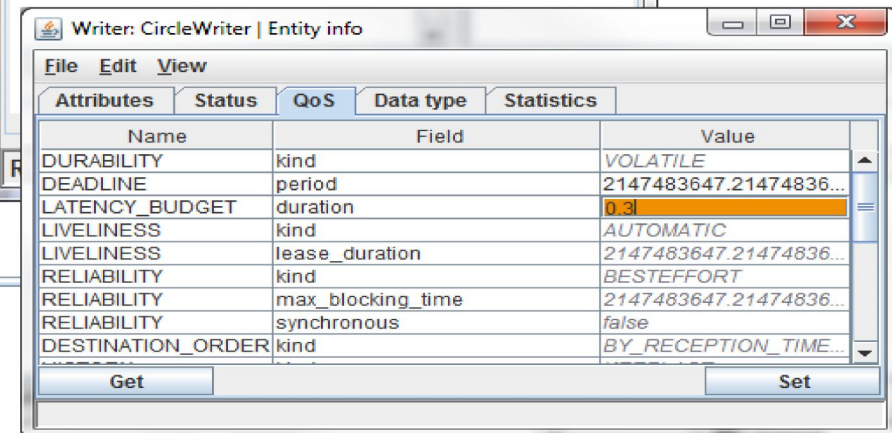
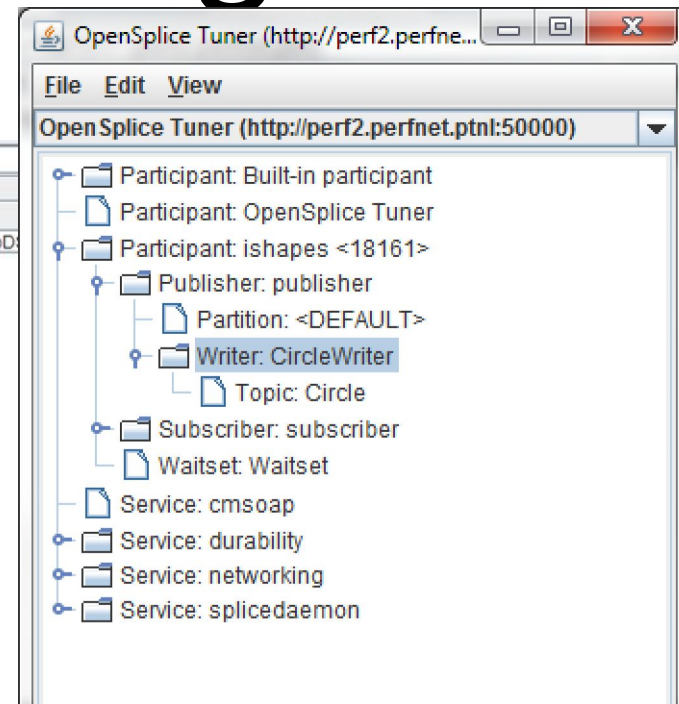
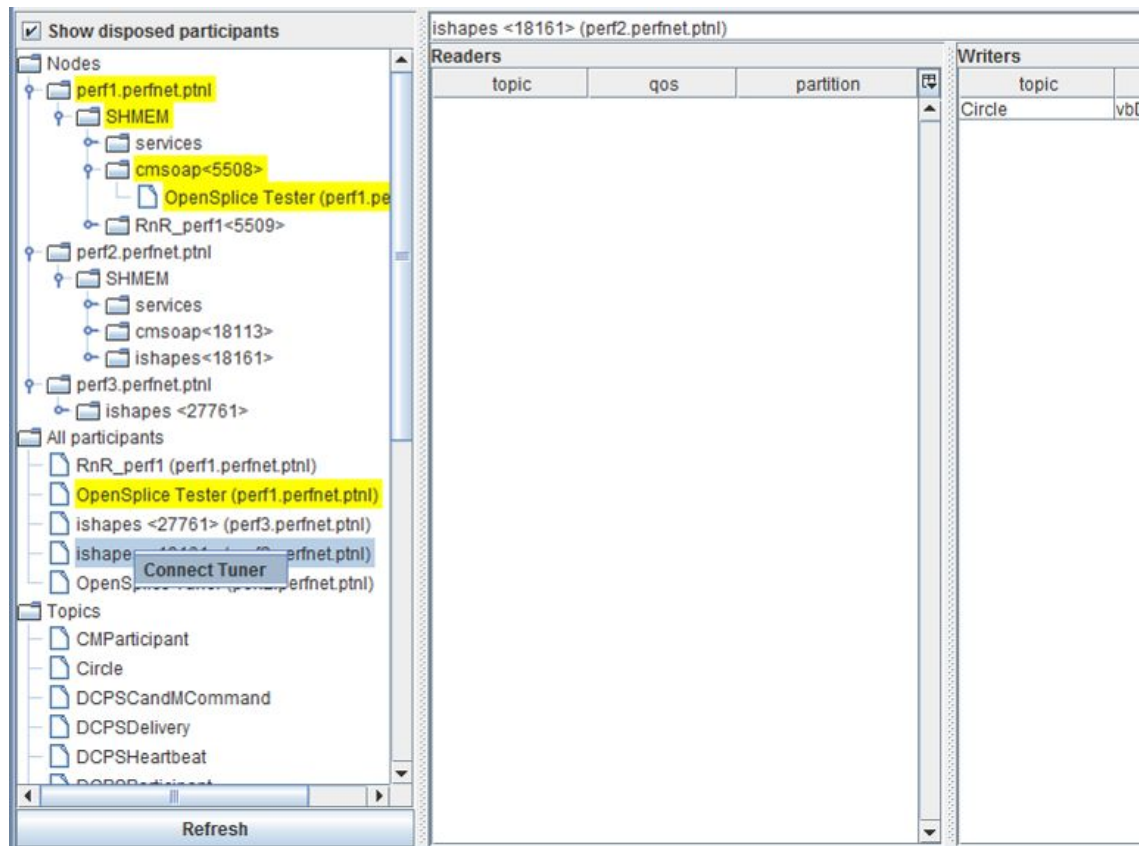
QoS

Filter

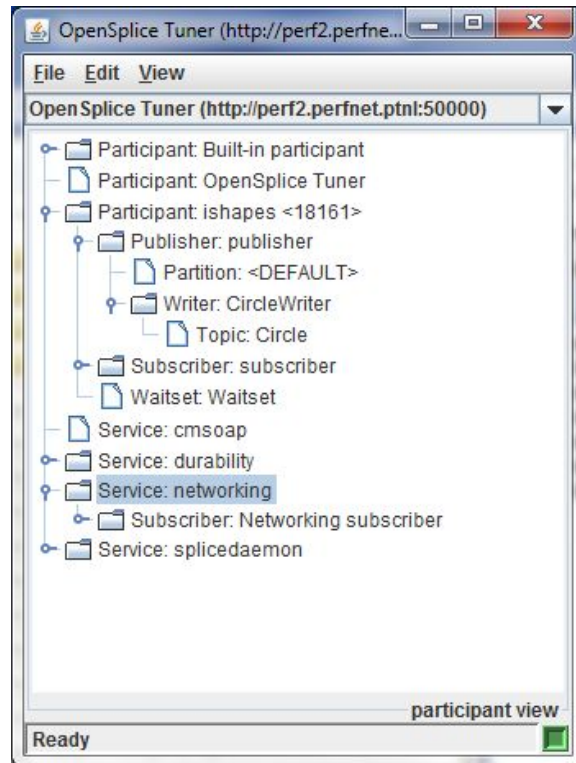
Subscribe

OpenSplice|DDS

# Tuner: QoS Tuning



# Tuner: Statistics Monitoring



The screenshot shows the "Statistics" tab for the "networking" service. The table displays various performance metrics:

| Name                                               | Field     | Value         |
|----------------------------------------------------|-----------|---------------|
| numberOfErrors                                     | lastReset | 0s. 0 ns.(... |
| channelsCount                                      |           | 0             |
| channels.size                                      |           | 2             |
| channels.[Reliable].numberOfMessagesSent           |           | 64            |
| channels.[Reliable].numberOfBytesSent              |           | 390           |
| channels.[Reliable].numberOfPacketsSent            |           | 145160        |
| channels.[Reliable].numberOfMessagesFragmented     |           | 388           |
| channels.[Reliable].numberOfMessagesPacked         |           | 28            |
| channels.[Reliable].numberOfKnownNodes             |           | 50            |
| channels.[Reliable].numberOfBytesResent            |           |               |
| channels.[Reliable].numberOfPacketsResent          |           |               |
| channels.[Reliable].numberOfBytesInResendBuffer    |           |               |
| channels.[Reliable].numberOfPacketsInResendBuffer  |           |               |
| channels.[Reliable].maxNumberOfBytesResentToOne... |           |               |
| channels.[Reliable].maxNumberOfPacketsResentToO... |           |               |
| channels.[Reliable].numberOfMessagesReceived       |           |               |
| channels.[Reliable].numberOfBytesReceived          |           |               |
| channels.[Reliable].numberOfPacketsReceived        |           |               |
| channels.[Reliable].numberOfPacketsLost            |           |               |
| channels.[Reliable].numberOfAcksSent               |           |               |
| channels.[Reliable].numberOfMessagesDelivered      |           |               |

The screenshot shows the "Statistics" tab for the "networking" service, displaying BestEffort statistics:

| Name                                                | Field | Value   |
|-----------------------------------------------------|-------|---------|
| channels.[BestEffort].numberOfMessagesSent          |       | 13839   |
| channels.[BestEffort].numberOfBytesSent             |       | 1822404 |
| channels.[BestEffort].numberOfPacketsSent           |       | 7020    |
| channels.[BestEffort].numberOfMessagesFragmented    |       | 0       |
| channels.[BestEffort].numberOfMessagesPacked        |       | 6819    |
| channels.[BestEffort].numberOfKnownNodes            |       | 0       |
| channels.[BestEffort].numberOfBytesResent           |       | 0       |
| channels.[BestEffort].numberOfPacketsResent         |       | 0       |
| channels.[BestEffort].numberOfBytesInResendBuffer   |       | 1300    |
| channels.[BestEffort].numberOfPacketsInResendBuffer |       | 1       |
| channels.[BestEffort].maxNumberOfBytesResentToOn... |       | 0       |
| channels.[BestEffort].maxNumberOfPacketsResentTo... |       | 0       |
| channels.[BestEffort].numberOfMessagesReceived      |       | 571     |
| channels.[BestEffort].numberOfBytesReceived         |       | 109632  |
| channels.[BestEffort].numberOfPacketsReceived       |       | 571     |
| channels.[BestEffort].numberOfPacketsLost           |       | 0       |
| channels.[BestEffort].numberOfAcksSent              |       | 0       |
| channels.[BestEffort].numberOfMessagesDelivered     |       | 571     |
| channels.[BestEffort].numberOfBytesDelivered        |       | 0       |
| channels.[BestEffort].numberOfMessagesNotInterested |       | 0       |
| channels.[BestEffort].numberOfBytesNotInterested    |       | 0       |
| channels.[BestEffort].nofFreePacketBuffers          |       | 1       |

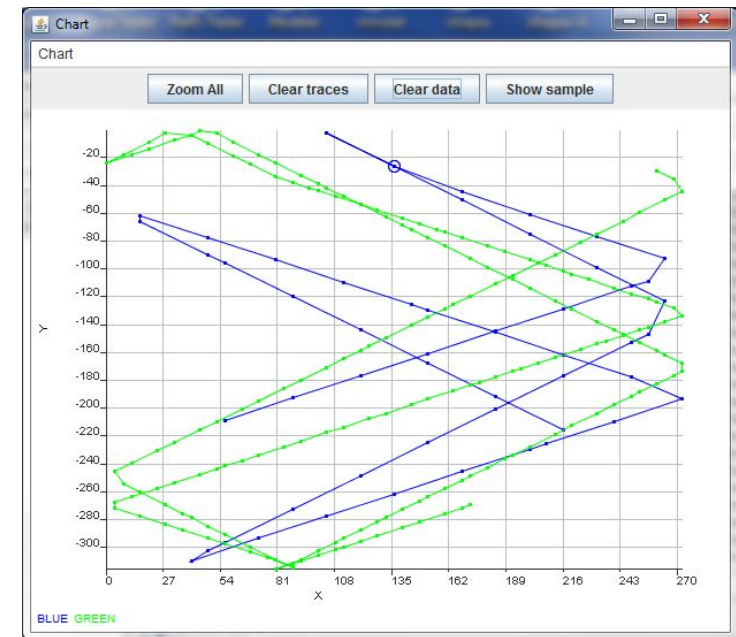
# Tester: Data-Capture

```

ishapes_fields.txt - Notepad
File Edit Format View Help
#!js
miny
Circle
sample.getFieldvalue("y") * -1

nextfield
miny
Square
sample.getFieldvalue("y") * -1

nextfield
miny
Triangle
sample.getFieldvalue("y") * -1
    
```



OpenSplice Tester: http://perf1.perfnet.ptnl:50000

File Script View SampleList Display Filter Editor Edit

Services Scripts Macros

Readers Topics

Select all Deselect all

| Re...                               | Sh...                               | Topic  | Count | qos       | partition |
|-------------------------------------|-------------------------------------|--------|-------|-----------|-----------|
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Circle | 1320  | -vbDS(... |           |

| DTime (ms) | Topic  | State | Key   | Src                                  | color | x   | miny   |
|------------|--------|-------|-------|--------------------------------------|-------|-----|--------|
| 57761      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 96  | -10.0  |
| 57801      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 92  | -7.0   |
| 57881      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 84  | -1.0   |
| 57961      | Circle | alive | BLUE  | ishapes <18161> (perf2.perfnet.ptnl) | BLUE  | 48  | -217.0 |
| 57961      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 84  | -3.0   |
| 58001      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 88  | -6.0   |
| 58081      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 96  | -12.0  |
| 58161      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 104 | -18.0  |
| 58201      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 108 | -21.0  |
| 58281      | Circle | alive | BLUE  | ishapes <18161> (perf2.perfnet.ptnl) | BLUE  | 16  | -241.0 |
| 58281      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 116 | -27.0  |
| 58361      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 124 | -33.0  |
| 58401      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 128 | -36.0  |
| 58481      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 136 | -42.0  |
| 58561      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 144 | -48.0  |
| 58601      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 148 | -51.0  |
| 58601      | Circle | alive | BLUE  | ishapes <18161> (perf2.perfnet.ptnl) | BLUE  | 16  | -245.0 |
| 58681      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 156 | -57.0  |
| 58761      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 164 | -63.0  |
| 58801      | Circle | alive | GREEN | ishapes <18161> (perf2.perfnet.ptnl) | GREEN | 168 | -66.0  |

Debug

DTime Type Message Location

Connected http://perf1.perfnet.ptnl:50000 networking,cmsoap,durability,R... 1,splicedaemon

OpenSplice | DDS - iShapes Demo

simd-cxx

Shape: Circle

Color: Blue

Size: [Slider]

Speed: [Slider]

QoS

Publish

Shape: Circle

QoS

Filter

Subscribe

OpenSplice|DDS

# Tester: Scripted Record/Replay

OpenSplice Tester: http://perf1.perfnet.ptnl:50000

File Script View SampleList Display Filter Editor Edit

Readers Topics Services Scripts Macros

Script

miss\_fail.sd  
miss\_fail\_timeout.sd  
pingpong1  
pingpong10  
read.sd  
read\_fail.sd  
read\_fail\_disposed.sd  
read\_fail\_timeout.sd  
read\_fail\_timeout\_query.sd  
read\_last\_fail\_disposed.sd  
read\_query.sd  
repeat.sd  
repeat\_multiple.sd  
repeat\_simple.sd  
repeat\_until\_dispose.sd  
rmi-1.sd  
rmi-2.sd  
rmi-3.sd  
rnr\_init\_default  
rnr\_init\_multicircle  
rnr\_record\_all  
rnr\_record\_multicircle  
rnr\_replay\_all  
rnr\_replay\_multicircle  
rnr\_stop\_record\_all  
rnr\_stop\_record\_multicircle  
rnr\_stop\_replay\_all  
rnr\_stop\_replay\_multicircle  
rr\_conditional\_shapes  
scenario\_call.sd  
scripts.zip  
send\_periodic.md  
set\_instruction.sd  
test1.sd  
test\_interface.sd  
timeout\_fail.sd  
timeout\_var\_fail.sd  
touchstone.sd  
touchstone\_init\_local\_linux.sd  
touchstone\_init\_local\_roundtrip\_linux.sd  
touchstone\_init\_local\_roundtrip\_windows.sd  
touchstone\_init\_local\_windows.sd  
touchstone\_local\_linux.sd  
touchstone\_local\_roundtrip\_linux.sd  
touchstone\_local\_roundtrip\_windows.sd

Sample List Statistics Browser Edit

Compile Execute Clear and Execute rnr\_init\_multicircle

```

1 scenario init_multicircle
2
3 // create readers for relevant topics so we can observe them on the timeline
4 reader (rr_serviceStatus);
5 reader (rr_scenarioStatus);
6 reader (rr_storageStatus);
7
8 // create scenario (-sample) for recording circles
9 send rr_scenario(
10     scenarioName => record_multicircle,
11     rnrId => RnR_perf1,
12     kind.switch => RR_RECORD_COMMAND,
13     kind.record.storage => multicircle_record,
14     kind.record.interestExpr[0] => "*.Circle",
15     kind.record.interestExpr[1] => "__BUILT-IN PARTITION__DCPSTopic", // allows topic to be re-
16 );
17
18 // create scenario (-sample) for replaying circles
19 send rr_scenario(
20     scenarioName => replay_multicircle,
21     rnrId => RnR_perf1,
22     kind.switch => RR_REPLAY_COMMAND,
23     kind.replay.storage => multicircle,
24     kind.replay.interestExpr[0] => "*.Circle",
25     kind.replay.interestExpr[1] => "__BUILT-IN PARTITION__DCPSTopic", // re-create topics (such as Circle) on replay
26 );
27
28 end scenario
29

```

8:5

Debug

OK 19

| DTime | Type | Message              | Location  |
|-------|------|----------------------|-----------|
| 0,030 | Scen | rnr_init_multicircle |           |
| 0,500 | SOK  | Send: rr_scenario    | 9 (5595)  |
| 0,553 | SOK  | Send: rr_scenario    | 19 (5600) |
| 0,553 | EOK  | Execution finished   |           |

Connected http://perf1.perfnet.ptnl:50000 networking.cmssoap.durability.R... 1.splicedemon

Sample: rr\_scenario

|                  |                                        |
|------------------|----------------------------------------|
| source_timestamp | 1361268033s.478335132ns                |
| daytime          | 11:00:33.478 (00 19)                   |
| insert_latency   | -83041ns                               |
| relative_time    | 0.450                                  |
| view_state       | new                                    |
| sample_state     | not_read                               |
| instance_state   | alive                                  |
| valid_data       | valid_data                             |
| state            | NEW, NOT_READ                          |
| partition        | RecordAndReplay                        |
| source           | OpenSplice Tester (perf1.perfnet.ptnl) |
| qos              | 2a75a9dc.00000296                      |

| Field                                  | value                           |
|----------------------------------------|---------------------------------|
| scenarioName                           | record_multicircle              |
| rnrId                                  | RnR_perf1                       |
| kind.switch                            | RR_RECORD_COMMAND               |
| kind.record.storage                    | multicircle_record              |
| kind.record.interestExpr[0]            | *.Circle                        |
| kind.record.interestExpr[1]            | __BUILT-IN PARTITION__DCPSTopic |
| kind.record.max_samples_per_instanc... | 0                               |
| kind.record.max_samples_per_second     | 0                               |
| kind.record.max_samples                | 0                               |

| Sample        | << | >> |
|---------------|----|----|
| Same topic    | << | >> |
| Same instance | << | >> |

# RnR-Manager: Graphical Recording & Replay

The screenshot displays the RnR Manager application interface, which is used for graphical recording and replay of DDS data. The interface is divided into several panes and sections:

- Domain Browser:** A tree view on the left showing the network topology, including nodes like 'Hans-PC', 'services', 'RnR\_perfl', 'ishapes.exe', 'rnrManager.exe', and 'OpenSplice Tester'.
- Scenario Configuration:** The main area for setting up a scenario. It includes fields for 'Scenario name' (replay\_multicircle), 'RnR service ID' (RnR\_perfl), and 'Command Parameters' (Kind: REPLAY SPEED, RnR service ID: RnR\_perfl). There are also 'Add', 'Remove', and 'Submit' buttons.
- Current Scenario Status:** A table showing the status of various scenarios.
- Current Storage Status:** A table showing the status of storage locations.
- Query Parameters:** A section for configuring query parameters, including 'Field Selection' (a list of fields to be displayed), 'Time Range' (specifying the time range for the samples), 'Load' (specifying the number of samples to load), and 'ORDER BY' (specifying the fields to order the data).

**Current Scenario Status Table:**

| Key                           | State   |
|-------------------------------|---------|
| BuiltinScenario, RnR_perfl    | RUNNING |
| record_multicircle, RnR_perfl | STOPPED |
| replay_multicircle, RnR_perfl | RUNNING |

**Current Storage Status Table:**

| Key                    | State | File Name                       |
|------------------------|-------|---------------------------------|
| default, RnR_perfl     | READY | ../RnR_storages/default.dat     |
| multicircle, RnR_perfl | OPEN  | ../RnR_storages/multicircle.dat |

**Query Parameters Section:**

- Field Selection:** A list of fields to be displayed in the data table. The selected fields are: Record and Replay, org.omg.dds::demo::ShapeType, color (c\_string), x (c\_long), y (c\_long), shapeSize (c\_long), kernelModule::v\_topicInfo, and Message.
- Time Range (message.writeTime):** Specify the time range for the samples. The selected range is: Start Time 03/15/13 14:49:49:233, End Time 03/15/13 14:56:00:003. The time range is defined by Seconds and Nanos values.
- Load:** Specify the number of samples to incrementally load into memory. The selected load size is 10000.
- ORDER BY:** Specify the fields to order the data. The selected fields are: message.writeTime.seconds, message.writeTime.nanoseconds.

# Visualization Options

# Tuner/Tester/Scada-'Osp|Vis'/Excel

