



OMD ON-BOARDING TOOLS USER GUIDE

**HKEX Orion Market Data Platform
Securities Market & Index Datafeed Products
/ Derivatives Market Datafeed Products**

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DOCUMENT HISTORY

Distribution Version

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V3.0	2 Jun 2022	Update for OS 7.9 version and data compression

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1 Introduction

This document specifies the On-boarding Tools of the HKEX Orion Market Data Platform ("OMD")

The OMD On-boarding tools provide testing facilities and simulated market data (canned data) for OMD Information Vendors and Exchange Participants (clients). This facilitates the development, enhancement and testing of the client's systems which receive and process data from OMD. The OMD On-boarding tools are intended to help clients ensure their readiness for the implementation before joining the Open Test, Readiness Test and Market Rehearsal (MR) as required by HKEX.

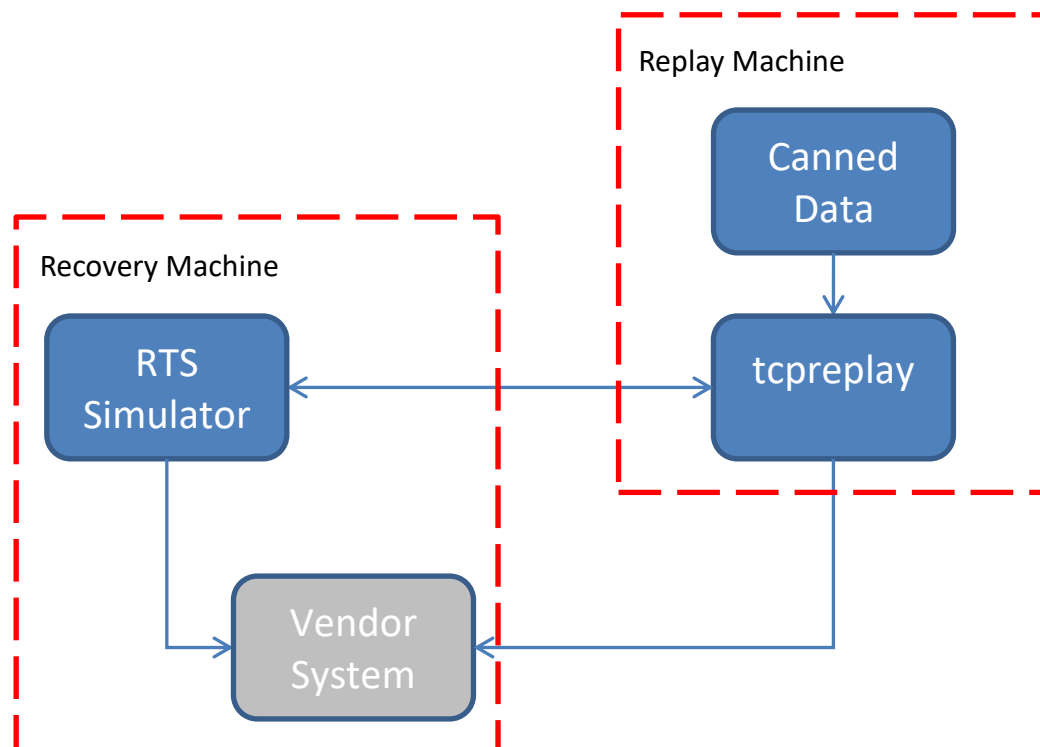
OMD On-boarding tools support clients' capacity and performance tests via allowing canned data to be replayed at various fixed rates. Clients can also make use of the OMD On-boarding tools for testing their own system development and enhancements. By distributing different set of canned data to the clients, HKEX aims to support the clients in testing their systems' readiness for various implementations of OMD initiatives.

Table 1. Acronyms used in this document

HKEX	Hong Kong Exchanges and Clearing Limited
OMD	Orion Market Data Platform
RTS	ReTransmission Servers
XDP	eXchange Data Publisher

1.1 System Relationship Diagram

The relationship diagram between the OMD and clients' application systems and the system's components are listed below.



1.2 OMD On-Boarding Tools Components

Component	Description
RTS Simulator	Facilitates testing of client's software on OMD retransmission services including retransmission request, retransmission response, logon, logon response and the processing of the missed messages requested as sent via unicast connection. There are 4 RTS simulators running by default to provide the resilience service.
tcpreplay	Broadcasts OMD canned data via multicast over the network The following functions are available: <ul style="list-style-type: none">- Rate control in packets per second- Broadcasts on both A&B lines
Canned Data	Fictitious trading data to facilitate testing <ul style="list-style-type: none">- Separate files may exist for different testing purpose (e.g. volume test or functional test)- The canned data will be injected by the tcpreplay to simulate the OMD production/testing environment.

2 System Requirement and Installation

2.1 Hardware Requirements

2 connected machines (Replay Machine and Recovery Machine) each with the following specification

- 64-bit AMD or Intel processor
- 16 GB RAM
- 20 GB available disk space

2.2 Software Requirements

- Red Hat Enterprise Linux (RHEL) 7.9 64-bit Edition, or CentOS 7.9 64-bit
- root / sudo access
- tcpdump
- tcpreplay (Replay Machine only)

2.3 Installation Procedures

(a) Replay Machine

Step	Description
1.	Copy the 'cannedDataLocalizingTool.tar.gz' directory from the provided media to the desired host. Here is an example command: <pre>cp -r /*Path to CDROM*/ cannedDataLocalizingTool.tar.gz /home/userid</pre>
2.	Extract the TAR/GZIP file to the correct directory: <pre>tar xvzf cannedDataLocalizingTool.tar.gz</pre>
3.	To verify the installation was successful, the following command will show the contents of the install directory: <pre>ls /home/userid/cannedDataLocalizingTool</pre> <p>If successful, the directory will contain:</p> <pre>common.sh pcapPreparationTool.sh preparePlaybackCacheFile.sh rewriteChecksum.sh updateIpMacAddress.sh</pre>
4.	Install tcpreplay 4.1.2 or above Please refer to the installation instruction provided by tcpreplay.

(b) Recovery Machine

Step	Description
1.	<p>Copy the 'onboardingTools_3.0.tgz' directory from the provided media to the desired host. Here is an example command:</p> <pre>cp -r /*Path to CDROM*/onboardingTools_3.0.tgz /home/userid</pre>
2.	<p>Extract the TAR/GZIP file to the correct directory:</p> <pre>tar xvzf onboardingTools_3.0.tgz -C /opt</pre> <p>*Note* - the tools will not work if they are not in the correct directory structure.</p>
3.	<p>Add the correct directory permissions:</p> <pre>chown -R {userid:usergroup} /opt/hkex</pre> <p>Where userid & usergroup are system account that using to run the onboarding tools.</p>
4.	<p>To verify the installation was successful, the following command will show the contents of the install directory:</p> <pre>ls /opt/hkex/xdp/release/</pre> <p>If successful, the directory will contain:</p> <pre>bin config lib logs profile.umd</pre>

2.4 Configuration

The On-boarding Tools package is designed to playback data from the Replay machine, and to run recovery service (RTS Simulator) on the Recovery machine. The client application can be run on the Recovery machine connected to recovery service via the loopback interface (a virtual software device created by the kernel) or can be run on separate machine connected to recovery service via TCP connection.

Since the network connection between Replay machine and Recovery machine is different in each setup, it is required to modify the recovery service configuration so as to fit the interface available on the Replay machine. This section will detail how to do that.

(a) Configuration Files

The configuration for the RTS Simulators are stored in below files under '/opt/hkex/xdp/release/config' directory.

OMD-C RTS Simulators

- omdc-rts-common.xml
- omdc-rts-01.xml
- omdc-rts-02.xml
- omdc-rts-03.xml
- omdc-rts-04.xml

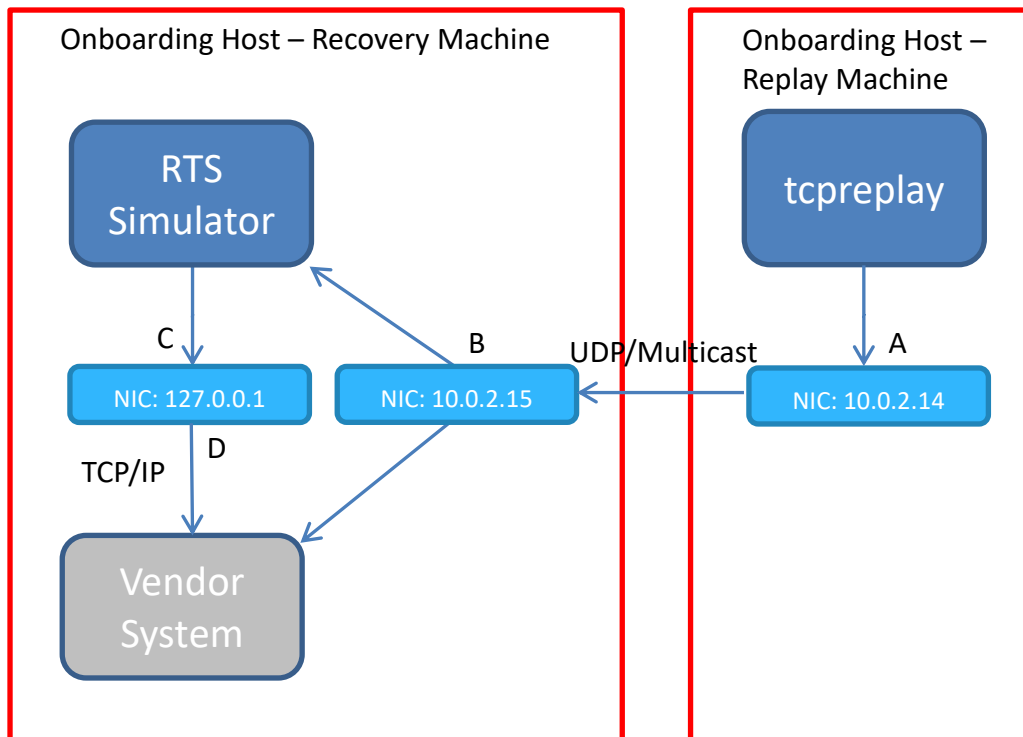
OMD-D RTS Simulators

- omdd-rts-common.xml
- omdd-rts-01.xml
- omdd-rts-02.xml
- omdd-rts-03.xml
- omdd-rts-04.xml

Each set of the configuration files control the setting of four RTS simulators that are running in parallel to provide the resilience service. Here is the procedure to show how to setup the environment.

Step	Description
1.	<p>Edit the RTS Simulator's configuration. Open the RTS configuration xml, at the top there is a "User Settings" section.</p> <p>Below is a description of the relevant parameters.</p> <p><u>omd[c d]-rts-common.xml</u></p> <p>Point B - This defines the network interface where the RTS Simulator listens for market data from the tcp replay. This should nearly always be set to the interface connected to Point A, which is detailed in the next step.</p> <p><i><DefaultMulticastInterface1></i> - The primary (A line) interface that the RTS Simulator listens to for multicast data from the tcp replay.</p> <p><i><DefaultMulticastInterface2></i> - The secondary (B line) interface that the RTS Simulator listens to for multicast data from the tcp replay. This can be the same as the primary interface for this test.</p> <p>Point D - This is where the RTS Simulator list of clients is defined, the IP address here is per client and has to be the IP address that the corresponding user is going to login from.</p> <p><i><IpAddress></i> - The RTS clients IP address.</p> <p><u>omd[c d]-rts-[01-04].xml</u></p> <p>Point C - This is where the RTS Simulator interface to the client is defined, the IP address here can be any valid network interface on the host.</p> <p><i><RtsTcpIpAddress></i> - The TCP/IP address that the RTS Simulator will listen for client connections on.</p> <p><i><RtsTcpPort></i> - The TCP/IP port the RTS Simulator will listen for client connections on.</p> <p>Firstly, points B & C need to be defined.</p> <ul style="list-style-type: none"> For customers running client application on Recovery Machine please refer to Example 1 – Client Application on Recovery Machine. For customers running client application on a separate machine please refer to Example 2 – Client Application not on Recovery Machine. <p>Once the values have been set accordingly save the configuration file.</p>
2.	<p>Point A - is the network interface that is the source of market data for both the client and the RTS Simulator.</p>
3.	<p>The following examples show the network diagram and the corresponding simulator settings for illustration purpose.</p>

(b) Example 1 – Client Application on Recovery Machine



Example 1, Configuration for client application on the Recovery Machine**The default RTS listen ports are 6969, 6970, 6971 and 6972 in omd[c|d]-rts-[01-04].xml**omdc-rts-common.xml

```
<!-- Begin of User Settings -->
<!-- Point B -->
  <Parameter>
    <Name>DefaultMulticastInterface1</Name>
    <Value>10.0.2.15</Value>
  </Parameter>

  <Parameter>
    <Name>DefaultMulticastInterface2</Name>
    <Value>10.0.2.15</Value>
  </Parameter>

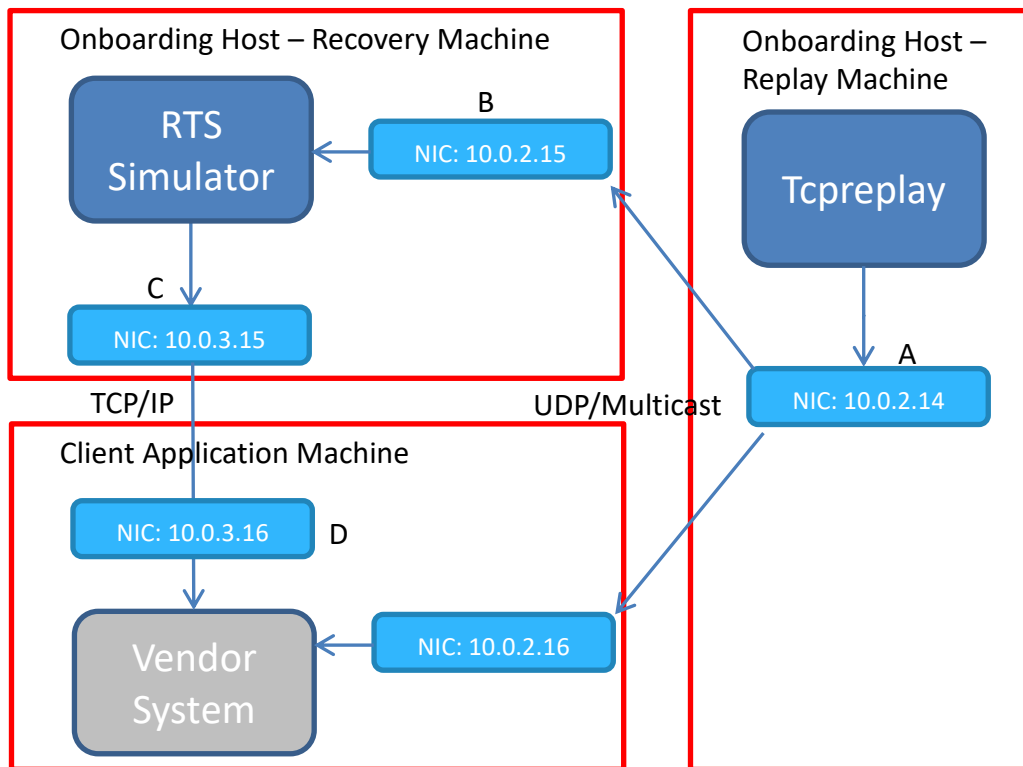
<!-- Point D -->
  <ClientList>
    <Client>
      <UserName>test01</UserName>
      <IpAddresses>127.0.0.1</IpAddresses>
      <MaximumGap>100</MaximumGap>
      <MaximumRequests>1000</MaximumRequests>
      <MaximumMessages>10000</MaximumMessages>
      <Parameter>
        <Name>Channels</Name>
        <Value>1</Value>
        <Value>2</Value>
        <Value>3</Value>
        <Value>4</Value>
        <Value>10</Value>
      </Parameter>
    </Client>
  </ClientList>
<!-- End of User Settings -->
```

omdc-rts-01.xml

```
<!-- Begin of User Settings -->
<!-- Point C -->
  <Parameter>
    <Name>RtsTcpIpAddress</Name>
    <Value>127.0.0.1</Value>
  </Parameter>

  <Parameter>
    <Name>RtsTcpPort</Name>
    <Value>6969</Value>
  </Parameter>
<!-- End of User Settings -->
```

(c) Example 2 – Client Application not on Recovery machine



Example 2, Configuration for client application not on the Recovery Machineomdc-rts-common.xml

```
<!-- Begin of User Settings -->
<!-- Point B -->
  <Parameter>
    <Name>DefaultMulticastInterface1</Name>
    <Value>10.0.2.15</Value>
  </Parameter>

  <Parameter>
    <Name>DefaultMulticastInterface2</Name>
    <Value>10.0.2.15</Value>
  </Parameter>

<!-- Point D -->
  <ClientList>
    <Client>
      <UserName>test01</UserName>
      <IpAddresses>10.0.3.16</IpAddresses>
      <MaximumGap>100</MaximumGap>
      <MaximumRequests>1000</MaximumRequests>
      <MaximumMessages>10000</MaximumMessages>
      <Parameter>
        <Name>Channels</Name>
        <Value>1</Value>
        <Value>2</Value>
        <Value>3</Value>
        <Value>4</Value>
        <Value>10</Value>
      </Parameter>
    </Client>
  </ClientList>
<!-- End of User Settings -->
```

omdc-rts-01.xml

```
<!-- Begin of User Settings -->
<!-- Point C -->
  <Parameter>
    <Name>RtsTcpIpAddress</Name>
    <Value>10.0.3.15</Value>
  </Parameter>

  <Parameter>
    <Name>RtsTcpPort</Name>
    <Value>6969</Value>
  </Parameter>
<!-- End of User Settings -->
```

3 Operational Procedures

3.1 Starting OMD On-boarding tools

Start OMD Environment on Recovery Machine

Step	Description
1.	<p>Start in the OMD path:</p> <pre>cd /opt/hkex/xdp/release</pre>
2.	<p>Source the profile, this will set various environment variables which are based on the install path:</p> <pre>source profile.omd</pre> <p>Change directory to the 'bin' directory:</p> <pre>cd bin</pre>
3a.	<p>To start OMD-C ReTransmission Server:</p> <pre>./start_simulation.sh</pre> <p>The script will output the following to the screen if successful:</p> <pre>Using default log directory: /opt/hkex/xdp/release//logs Starting OMD-C ReTransmission Server Instance 1 Starting OMD-C ReTransmission Server Instance 2 Starting OMD-C ReTransmission Server Instance 3 Starting OMD-C ReTransmission Server Instance 4</pre>
3b.	<p>To start OMD-D ReTransmission Server:</p> <pre>./start_simulation.sh omdd</pre> <p>The script will output the following to the screen if successful:</p> <pre>Using default log directory: /opt/hkex/xdp/release//logs Starting OMD-D ReTransmission Server Instance 1 Starting OMD-D ReTransmission Server Instance 2 Starting OMD-D ReTransmission Server Instance 3 Starting OMD-D ReTransmission Server Instance 4</pre>
4.	<p>To verify that the processes are running, check that their log files are updating via:</p> <pre>ls /opt/hkex/xdp/release/logs</pre> <p>Once these processes are running, it is possible to receive OMD data from the Replay Machine and utilize the retransmission server, which will be populated by the data being sent by the tcpreplay. At the end of the replay file, the tcpreplay will cease broadcasting data and the playback.sh script should be executed once more.</p>

Play back Canned Data on Replay Machine

Step	Description
1.	<p>Start in the Canned Data Localizing Tool path:</p> <pre>cd /home/userid/cannedDataLocalizingTool</pre>
2.	<p>Execute the Canned Data Localizing Script:</p> <pre>./pcapPreparationTool.sh <Canned Data File Name></pre> <p>During the execution the script will ask runner to select the interface to be used for the data playback. After selection, a script "playback.sh" will be generated.</p> <p>The script will output the following to the screen if successful:</p> <pre>===== NIC # NIC IP MAC Address ===== 1 eth0 10.1.65.50 e8:39:35:eb:97:98 2 eth1 10.1.88.50 e8:39:35:eb:97:9a 3 eth2 10.0.8.50 e8:39:35:eb:97:9c 4 eth3 10.1.89.50 e8:39:35:eb:97:9e 5 eth4 10.1.66.50 f4:ce:46:a9:eb:8c 6 eth5 10.70.12.50 f4:ce:46:a9:eb:8d 7 eth6 10.1.90.50 f4:ce:46:a9:eb:8e 8 eth7 10.0.9.50 f4:ce:46:a9:eb:8f ===== Input Source NIC # above for playback Line A and Line B data : 1 Selected NIC (Line A) # eth0 10.1.65.50 e8:39:35:eb:97:98 (1) Selected NIC (Line B) # eth0 10.1.65.50 e8:39:35:eb:97:98 (1) ##### ##### # Start preparing the pcap files ##### ##### 1. Update the source IP and MAC address tcprewrite --pnat=10.1.65.0/24:10.1.65.50 --enet-smac=e8:39:35:eb:97:98 -- infile=pcap/omdc-20130913.pcap --outfile=pcap/omdc-20130913.pcap.tmp tcprewrite --pnat=10.1.66.0/24:10.1.66.50 --enet-smac=f4:ce:46:a9:eb:8c -- infile=pcap/omdc-20130913.pcap.tmp --outfile=pcap/omdc-20130913.pcap_PLAYBACK 2. Recalculate IPv4/TCP/UDP header checksums tcprewrite -C -i pcap/omdc-20130913.pcap PLAYBACK -o pcap/omdc- 20130913.pcap_PLAYBACK.rewrite 3. Prepare cache file for tcpreplay to playback Line A / B tcpyprep -e e8:39:35:eb:97:98 -i pcap/omdc-20130913.pcap PLAYBACK.rewrite -o pcap/omdc-20130913.pcap_PLAYBACK.rewrite.tag ##### ##### Update pcap file completed SUCCESSFULLY. You can now playback the file with ./playback.sh => ./playback.sh (sudo tcpreplay -i eth0 -I eth4 -x 10 -c pcap/omdc- 20130913.pcap_PLAYBACK.rewrite.tag pcap/omdc-20130913.pcap_PLAYBACK.rewrite) *Note* - the Canned Data File can be found in the root path of the provided media, with extension "pcap".</pre>
3.	<p>Playback data using the generated playback script.</p> <pre>./playback.sh</pre>

3.2 Retransmission Server

The retransmission server simulators are started via the 'start_simulation.sh' script. The server is communicated with via a simple TCP/IP protocol.

The retransmission servers operates using IP: 127.0.0.1, Port: 6969 / 6970 / 6971 / 6972 and UserName: test01.

3.3 Log Files

Log files only serve to indicate that the process is up (it is still writing to the log file) and how much data it is receiving. Log files can be found in the 'logs' directory.

Each Retransmission Server produces a log file. The log file will be rotated when the file size reaches 10MB. Let us take OMD-C RTS simulator instance 1 as example, the log files are 'omdc-rts-01.log' and 'omdc-rts-01.log1'. Most recent information is kept in the 'omdc-rts-01.log' and then rolled into the 'omdc-rts-01.log1' file when it is updated.

Example 3, OMD-C Retransmission Server Log: omdc-rts-01.log

```
2022/06/07 14:49:52 Info: *****
2022/06/07 14:49:52 Info: xdp-rts: Version [0.0-1] Build Date [20/05/2022]
2022/06/07 14:49:52 Info: *****
2022/06/07 14:49:52 Info: Started at: Tue Jun 7 14:49:52 2022
2022/06/07 14:49:52 Info: Hostname: domddev102
2022/06/07 14:49:52 Info: Configuration file: omdc-rts-01.xml
```

Example 4, OMD-C Retransmission Server Log: omdc-rts-01.log

```
2022/06/07 14:47:21 Info: LineDataBlock.mc1 | 5 | 5 | 6975 |
2022/06/07 14:47:21 Info: LineDataBlock.mc2 | 5 | 5 | 6975 |
2022/06/07 14:47:21 Info: LineDataBlock.mc3 | 5 | 5 | 6975 |
2022/06/07 14:47:21 Info: LineDataBlock.mc4 | 5 | 5 | 6975 |
2022/06/07 14:47:21 Info: LineDataBlock.mc10 | 5 | 5 | 6975 |
```

We have highlighted three key log messages here to search for in the files as the initialization is particularly long.

Example 3 indicates the successful starting of the process, which host it is running on, and that it has found its configuration file.

Example 4 shows that the Retransmission server is receiving data on the channels.

Remark: The Retransmission Server Log primarily facilitates HKEX checking when there are queries related to the OMD retransmission service in the On-boarding tools raised by the Clients. The two examples quoted here are sufficient for the Clients to health check the normal running of the Retransmission Server, Clients are not required to check other messages as logged in the Log file.

3.4 Changing Market Data

It may be desirable to switch between various sets of market data that we have released.

This can be achieved by re-running the Canned Data Localization Script with the new data as described in section 3.1, and then replaying data using the newly generated playback.sh.

3.5 Shutdown of OMD

The shutdown of OMD is very simple. A script has been provided to shut down all tools.

Step	Description
1.	Run the following: <code>stop_simulation.sh</code>

3.6 Performance Testing

tcpreplay can control the message rate at which the canned data file is replayed. Therefore, the OMD On-boarding tools are also capable of being used to test system performance, namely throughput. Clients can modify the playback.sh generated by the Canned Data Localizing script to add argument for specifying the packet rate (--pps), replay multiplier (--multiplier) or the playback bandwidth (--mbps) in the play back.

Clients can use the following table as a guide to set the packet rate in their testing:

Datafeed	Packet Rate	Expected Message Volume (bandwidth)
SS	905	16Mbps
SP	2497	30Mbps
SF	7362	60Mbps
Index	164	1Mbps

It is expected that before the Readiness Test that clients have stressed their systems to the equivalent message bandwidth of the market data package that they have chosen.

The packet rates recommended for different OMD Datafeed Products for testing the client system in handling the stated message volume are for reference only. It may not drive the expected message volume but will be as close as possible. The recommended packet rates only apply to the canned data we provided and may be different for different sets of canned data.

Remarks:

1. Multiple logons to the RTS Simulator using the same socket is not supported by the On-boarding Tools.
2. Clients should avoid using two applications (or two instances of the same application) to log-in the RTS Simulator using the same UserName which will result in all further login attempts on that UserName being refused.
3. Please refer to tcpreplay documentation regarding the control of packet replay rate.

Appendix A – FAQ and Troubleshooting

Reporting Issues

In the event that the software is not working as expected please verify the following:

- Run 'uname -a' to ensure the Red Hat or Cent OS version is 7.9.
- Run 'free -m' and ensure there is at least 15GB free memory, and 16GB total system RAM
- Run the package on its default configuration and verify data flow as described in Section 3.

Include the results of these tests in your email to the support group.

FAQ

1. Why our xdp-rts process dies immediately after startup?

This is usually caused by not enough free memory; occasionally the OS will report this in the 'dmesg' log, but not always. The xdp-rts process allocates a large amount of its memory on initialization.

2. We encountered 'undefined symbol', 'symbol lookup error' and 'library not found', how can we proceed?

These errors are found when the package is installed on the wrong version of Red Hat or Cent OS.

3. Why our login is rejected?

This is possibly due to the following reasons:

- the packet header is not sent as required at the start of the login string or
- the packet size is sent big endian instead of little endian per Interface Specification or
- the packet is space terminated instead of NULL terminated.

Example valid login hex string:

20 00 01 30 01 00 00 00 00 00 00 00 00 00 00 00 10 00 65 00 74 65 73 74 30 31 00 00 00 00 00 00

The packet header is highlighted.

Questions related to Network setup

i. Client Application on Recovery Machine

4. Why our system can receive data but RTS Simulator responding with 'MESSAGES_NOT_AVAILABLE'?

The RTS Simulator is still configured to listen to loopback address

Please verify that both the "Point A" and "Point B" are set to the same value in the RTS configuration xml files.

5. Why our system is unable to connect to the RTS Simulator or login rejected?

The "Point C" or "Point D" IP address has been updated incorrectly in the RTS configuration xml files.

Please verify that the "Point C" IP address has been updated correctly in the RTS configuration xml files and is not currently set to the loopback address. Also please verify that the "Point D" IP address has been updated correctly in the RTS configuration xml files and is not currently set to the loopback address. This address should be set to the source address of the connection to the retransmission server.

6. Why the RTS Simulator rejects the login from our system?

Please refer to Question 5 above for details.

ii. Client Application not on Recovery Machine**7. Why our system can receive data but RTS Simulator responding with 'MESSAGES_NOT_AVAILABLE'?**

This is possibly due to the following reasons:

- *The RTS Simulator still configured to listen to loopback address, verify that both the "Point A" and "Point B" are set to the same value in the RTS configuration xml files. In this setup the value for "Point C" is likely different from A & B. The RTS Simulator still needs to listen to traffic from the tcp replay, even if responses are sent and received sent via another so A and B need to be the same interface.*
- *The RTS Simulator still configured to listen an address that cannot consume the tcp replay traffic, verify that both the "Point A" and "Point B" are set to the same value in the RTS configuration xml files.*

8. Why our system is unable to connect to the RTS Simulator or login rejected?

The "Point C" or "Point D" IP address has been updated incorrectly in the RTS configuration xml files.

Please verify that the Point C IP address has been updated correctly in the RTS configuration xml files and is not currently set to the loopback address. Also please verify that the Point D IP address has been updated correctly in the RTS configuration xml files and is not currently set to the loopback address. This address should be set to the source address of the connection to the retransmission request.

9. Why the RTS Simulator rejects the login from our system?

Please refer to Question 8 above for details.

Appendix B – Multicast Channel Configuration (Securities Market, Index Datafeed, and Stock Connect Market)

The multicast channel IDs presented here are for testing purposes only. Clients should not assume that the multicast channel IDs in production will be identical to those presented here.

Channel ID	Multicast Address & Port	Message Type	OMD Securities Standard (SS)	OMD Securities Premium (SP)	OMD Securities FullTick (SF)	OMD Index (Index)	OMD Stock Connect Market (SCM)
1	239.1.1.1/51000 239.1.127.1/51000	Market Definition (10) Security Definition (11) Liquidity Provider (13) Currency Rate(14)	●	●	●		
2	239.1.1.1/51001 239.1.127.1/51001	Trading Session Status (20)	●	●	●		
3	239.1.1.1/51002 239.1.127.1/51002	Market Turnover (61)	●	●			
4	239.1.1.1/51003 239.1.127.1/51003	News (22)	●	●			
9	239.1.1.1:51008 239.1.127.1:51008	Disaster Recovery Signal (105)	●	●	●		

Channel ID	Multicast Address & Port	Message Type	OMD Securities Standard (SS)	OMD Securities Premium (SP)	OMD Securities FullTick (SF)	OMD Index (Index)	OMD Stock Connect Market (SCM)
10	239.1.1.2/51000 239.1.127.2/51000	Trade Ticker (52) Nominal Price (40) Indicative Equilibrium Price (41) Closing Price (62) Aggregate Order Book Update (53) Statistics (60) Yield (44) Broker Queue (54) VCMT Ticker (23) Reference Price (43) Order Imbalance (56) Security Status (21)	●				
20	239.1.1.3/51000 239.1.127.3/51000	Trade (50)		●			
21	239.1.1.3/51001 239.1.127.3/51001	Cancel (51)		●			
22	239.1.1.3/51002 239.1.127.3/51002	Nominal Price (40)		●			
23	239.1.1.3/51003 239.1.127.3/51003	Indicative Equilibrium Price (41)		●			
24	239.1.1.3/51004 239.1.127.3/51004	Closing Price (62)		●			
25	239.1.1.3/51005 239.1.127.3/51005	Aggregate Order		●			
26	239.1.1.3/51006 239.1.127.3/51006			●			
27	239.1.1.3/51007 239.1.127.3/51007			●			

Channel ID	Multicast Address & Port	Message Type	OMD Securities Standard (SS)	OMD Securities Premium (SP)	OMD Securities FullTick (SF)	OMD Index (Index)	OMD Stock Connect Market (SCM)
28	239.1.1.3/51008 239.1.127.3/51008	Book Update (53) Statistics (60) Yield (44) VCM Trigger (23) Reference Price (43) Order Imbalance (56) Security Status (21)		●			
30	239.1.1.4/51000 239.1.127.4/51000	Trade (50)			●		
31	239.1.1.4/51001 239.1.127.4/51001	Trade Cancel (51)			●		
32	239.1.1.4/51002 239.1.127.4/51002	Add Order (30)			●		
33	239.1.1.4/51003 239.1.127.4/51003	Modify Order (31)			●		
34	239.1.1.4/51004 239.1.127.4/51004	Delete Order (32)			●		
35	239.1.1.4/51005 239.1.127.4/51005	Indicative Equilibrium Price (41)			●		
36	239.1.1.4/51006 239.1.127.4/51006	VCM			●		
37	239.1.1.4/51007 239.1.127.4/51007	Trigger (23)			●		
38	239.1.1.4/51008 239.1.127.4/51008	Reference Price (43) Order Imbalance (56) Security Status (21)			●		
41	239.1.1.5/51000 239.1.127.5/51000	Index Definition (70)				●	
42	239.1.1.6/51000 239.1.127.6/51000	Index Data (71)				●	
43	239.1.1.7/51000 239.1.127.7/51000					●	
44	239.1.1.7/51001 239.1.127.7/51001					●	

Channel ID	Multicast Address & Port	Message Type	OMD Securities Standard (SS)	OMD Securities Premium (SP)	OMD Securities FullTick (SF)	OMD Index (Index)	OMD Stock Connect Market (SCM)
49	239.1.1.7:51008 239.1.127.7:51008	Disaster Recovery Signal (105)				●	
60	239.1.1.8/51000 239.1.127.8/51000	Broker Queue (54)		▲	▲		
70	239.1.1.9/51000 239.1.127.9/51000	Add Odd Lot	▲	▲	▲		
71	239.1.1.9/51001 239.1.127.9/51001	Order (33)	▲	▲	▲		
72	239.1.1.9/51002 239.1.127.9/51002	Delete Odd Lot	▲	▲	▲		
73	239.1.1.9/51003 239.1.127.9/51003	Order (34)	▲	▲	▲		
74	239.1.1.9/51004 239.1.127.9/51004		▲	▲	▲		
75	239.1.1.9/51005 239.1.127.9/51005		▲	▲	▲		
76	239.1.1.9/51006 239.1.127.9/51006		▲	▲	▲		
77	239.1.1.9/51007 239.1.127.9/51007		▲	▲	▲		
78	239.1.1.9/51008 239.1.127.9/51008		▲	▲	▲		
80	239.1.1.121/51000 239.1.127.121/51000	Stock Connect Daily Quota Balance (80) Stock Connect Market Turnover (81)					▲
81	239.1.1.121/51001 239.1.127.121/51001	Stock Connect Market Turnover (81)					▲

● □ Product-related channel

▲ □ Complimentary service

Examples of multicast channels to be subscribed by clients for different OMD products:

- SS clients need to subscribe to multicast channels #1, #2, #3, #4 & #10 for full set of SS market data.
- SP clients need to subscribe to multicast channels #1, #2, #3, #4 & #20 - 28 for full set of SP market data
- SF clients need to subscribe to multicast channels #1, #2 & #30 - 38 for full set of SF market data
- Index clients need to subscribe to multicast channels #41, #42, #43 & #44 for full set of Index market data

- Clients subscribing SP, SF & Index products need to subscribe to multicast channels #1, #2, #3, #4, #20 - 28, #30 - 38, #41, #42, #43 & #44
- Client subscribing SS, SP, SF products need to subscribe multicast channel #9 to receive the DR signal
- Client subscribing Index product need to subscribe multicast channel #49 to receive the DR signal
-

Note: Though the canned data created follows the production configuration, depending on the order and trade activities, some channels (Channels 4, 23-28, 33-38) may have minimal or no trading data just heartbeats. This is expected behaviour.

Appendix C – Multicast Channel Configuration (Derivatives Market Datafeed)

The multicast channel IDs presented here are for testing purposes only. Clients should not assume that the multicast channel IDs in production will be identical to those presented here.

Channel ID	Partition	Multicast Address & Port	Message Type	OMD Derivatives Standard (DS) Non-SOM	OMD Derivatives Standard (DS) SOM	OMD Derivatives Premium (DP) Non-SOM	OMD Derivatives Premium (DP) SOM	OMD Derivatives Full Tick (DF) Non-SOM	OMD Derivatives Full Tick (DF) SOM	OMD Derivatives Trade Tick (DS_T) Non-SOM	OMD Derivatives Trade Tick (DS_T) SOM
101	1	239.1.1.128/51001 239.1.127.128/51001	Series Definition Base (303) Combination Definition (305)	●		●		●			
102	1	239.1.1.133/51001 239.1.127.133/51001			●		●		●		
111	1	239.1.1.129/51001 239.1.127.129/51001	Trade (350)							●	
112	1	239.1.1.134/51001 239.1.127.134/51001									●
121	1	239.1.1.130/51001 239.1.127.130/51001	Calculated Opening Price (364) Add Order (330) Modify Order (331) Delete Order (332) Orderbook Clear (335) Trade (350)					●			
122	1	239.1.1.135/51001 239.1.127.135/51001							●		

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Channel ID	Partition	Multicast Address & Port	Message Type	(DS) Non-SOM	(DS) SOM	(DP) Non-SOM	(DP) SOM	(DF) Non-SOM	(DF) SOM	(DS_T) Non-SOM	(DS_T) SOM
131	1	239.1.1.131/51001 239.1.127.131/51001	Calculated Opening Price (364)			●					
132	1	239.1.1.136/51001 239.1.127.136/51001	Aggregate Order Book Update (353) Trade (350)				●				
134	1	239.1.1.132/51001 239.1.127.132/51001	Calculated Opening Price (364)	●							
135	1	239.1.1.137/51001 239.1.127.137/51001	Aggregate Order Book Update (353)		●						
151		239.1.1.128/51003 239.1.127.128/51003	Commodity Definition (301) Class Definition (302)	●		●		●			
152		239.1.1.133/51003 239.1.127.133/51003	Series Definition Extended (304)		●		●		●		
161		239.1.1.128/51004 239.1.127.128/51004	Market Status (320) Series Status (321)	●		●		●			
162		239.1.1.133/51004 239.1.127.133/51004	Commodity Status (322)		●		●		●		
164		239.1.1.128/51005 239.1.127.128/51005	Quote Request (336)	●		●		●			
165		239.1.1.133/51005 239.1.127.133/51005			●		●		●		
167		239.1.1.139/51000 239.1.127.139/51000	Trade (350) Trade Amendment (356)			●		●		●	
168		239.1.1.140/51000 239.1.127.140/51000					●		●		●
171		239.1.1.132/51003 239.1.127.132/51003	Trade Statistic (360)	●							
172		239.1.1.137/51003 239.1.127.137/51003			●						

Channel ID	Partition	Multicast Address & Port	Message Type	(DS) Non-SOM	(DS) SOM	(DP) Non-SOM	(DP) SOM	(DF) Non-SOM	(DF) SOM	(DS_T) Non-SOM	(DS_T) SOM
174		239.1.1.141/51001 239.1.127.141/51001	Series Statistics (363)			●					
175		239.1.1.142/51001 239.1.127.142/51001					●				
177		239.1.1.144/51000 239.1.127.144/51000	Market Alert (323)	●	●	●	●	●	●		
178		239.1.1.144:51006 239.1.127.144:51006	Disaster Recovery Signal (105)	●	●	●	●	●	●		
191		239.1.1.150/51000 239.1.127.150/51000	Open Interest (366)	●		●					
192		239.1.1.149/51000 239.1.127.149/51000			●		●				
194		239.1.1.141/51000 239.1.127.141/51000	Implied Volatility (367)			●					
195		239.1.1.142/51000 239.1.127.142/51000					●				
201	2	239.1.1.128/51002 239.1.127.128/51002	Series Definition Base (303) Combination Definition (305)	●		●		●			
211	2	239.1.1.129/51002 239.1.127.129/51002	Trade (350)							●	
221	2	239.1.1.130/51002 239.1.127.130/51002	Calculated Opening Price (364) Add Order (330) Modify Order (331) Delete Order (332) Orderbook Clear (335) Trade (350)					●			

Channel ID	Partition	Multicast Address & Port	Message Type	(DS) Non-SOM	(DS) SOM	(DP) Non-SOM	(DP) SOM	(DF) Non-SOM	(DF) SOM	(DS_T) Non-SOM	(DS_T) SOM
231	2	239.1.1.131/51002 239.1.127.131/51002	Calculated Opening Price (364) Aggregate Order Book Update (353) Trade (350)			●					
234	2 & 3	239.1.1.132/51002 239.1.127.132/51002	Calculated Opening Price (364) Aggregate Order Book Update (353)	●							
301	3	239.1.1.128/51006 239.1.127.128/51006	Series Definition Base (303) Combination Definition (305)	●		●		●			
311	3	239.1.1.129/51003 239.1.127.129/51003	Trade (350)							●	
321	3	239.1.1.130/51003 239.1.127.130/51003	Calculated Opening Price (364) Add Order (330) Modify Order (331) Delete Order (332) Orderbook Clear (335) Trade (350)					●			
331	3	239.1.1.131/51003 239.1.127.131/51003	Calculated Opening Price (364) Aggregate Order Book Update (353) Trade (350)			●					

Appendix D – Multicast Channel Configuration (Derivatives Market Datafeed Lite)

Channel ID	Partition	Multicast Address & Port	Message Type	OMD Derivatives Lite (Lite) Non-SOM - Price Depth Feed	OMD Derivatives Lite (Lite) SOM - Price Depth Feed
101	1	239.1.1.128/51001 239.1.127.128/51001	Series Definition Base (303)	●	
102	1	239.1.1.133/51001 239.1.127.133/51001	Combination Definition (305)		●

Channel ID	Partition	Multicast Address & Port	Message Type	(Lite) non-SOM - Price Depth Feed	(Lite) SOM - Price Depth Feed
137	1	239.1.1.151/51001 239.1.127.151/51001	Calculated Opening Price (364)	●	
138	1	239.1.1.152/51001 239.1.127.152/51001	Aggregate Order Book Update (353)		●
151		239.1.1.128/51003 239.1.127.128/51003	Commodity Definition (301) Class Definition (302)	●	
152		239.1.1.133/51003 239.1.127.133/51003	Series Definition Extended (304)		●
161		239.1.1.128/51004 239.1.127.128/51004	Market Status (320) Series Status (321)	●	
162		239.1.1.133/51004 239.1.127.133/51004	Commodity Status (322)		●
164		239.1.1.128/51005 239.1.127.128/51005	Quote Request (336)	●	
165		239.1.1.133/51005 239.1.127.133/51005			●
179		239.1.1.151/51003 239.1.127.151/51003	Trade Statistic (360)	●	
180		239.1.1.152/51003 239.1.127.152/51003			●
177		239.1.1.144/51000 239.1.127.144/51000	Market Alert (323)	●	●
178		239.1.1.144/51006 239.1.127.144/51006	Disaster Recovery Signal (105)	●	●
191		239.1.1.150/51000 239.1.127.150/51000	Open Interest (366)	●	
192		239.1.1.149/51000 239.1.127.149/51000			●
201	2	239.1.1.128/51002 239.1.127.128/51002	Series Definition Base (303) Combination Definition (305)	●	
237	2 & 3	239.1.1.151/51002 239.1.127.151/51002	Calculated Opening Price (364) Aggregate Order Book Update (353)	●	

Channel ID	Partition	Multicast Address & Port	Message Type	(Lite) non-SOM - Price Depth Feed	(Lite) SOM - Price Depth Feed
301	3	239.1.1.128/51006 239.1.127.128/51006	Series Definition Base (303) Combination Definition (305)	●	

Channel ID	Partition	Multicast Address & Port	Message Type	(Lite) - Order Feed
639	1	239.1.1.180/51001 239.1.127.180/51001	Add Order (330)	●
739	2	239.1.1.180/51002 239.1.127.180/51002		●
839	3	239.1.1.180/51003 239.1.127.180/51003		●