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# Exercise 11. Implementing a basic cluster

## Estimated time

01:00

## Overview

In this exercise, you use IBM MQ Explorer to create a cluster of four queue managers. You then test the cluster by using the cluster mechanism to send messages between queues on all queue managers in the cluster.

## Objectives

After completing this exercise, you should be able to:

- Use IBM MQ Explorer to define a simple queue manager cluster
- Use the IBM MQ sample programs to test a cluster environment

## Introduction

In this exercise you use IBM MQ Explorer to create a basic cluster that is named CLUS1 with four queue managers:

- Full repository queue manager QMC1 on localhost(9001)
- Full repository queue manager QMC2 on localhost(9002)
- QMC3 on localhost(9003)
- QMC4 on localhost(9004)

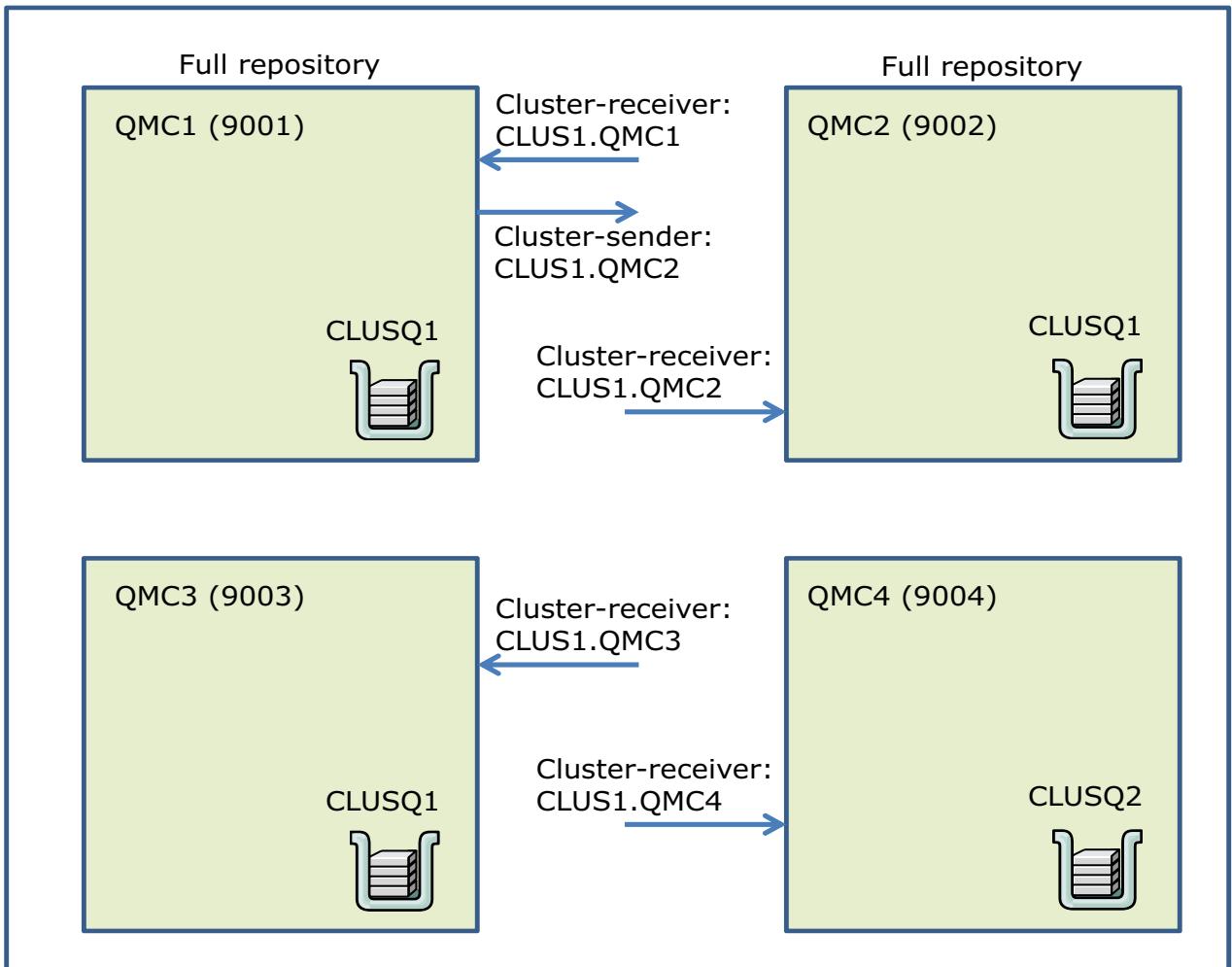
You also define the following channel definitions:

- One cluster-receiver (CLUSRCVR) channel to each queue manager in the cluster
- One cluster-sender (CLUSSDR) channel between the full repository queue managers, QMC1 and QMC2

After you create the queue managers and the cluster, you define local queues that are used for cluster queues as follows:

- CLUSQ1 on QMC1, QMC2, QMC3
- CLUSQ2 on QMC4

Cluster = CLUS1



## Requirements

- IBM MQ and IBM MQ Explorer
- `data.txt` file in the `C:\labfiles\Lab11\data` directory (on Windows) or  
`/home/localuser/labfiles/Lab11/data` directory (on Linux)

## Exercise instructions

### Part 1: Defining the cluster queue managers, channels, and queues

In this part of the exercise, you use IBM MQ Explorer to define the cluster queue managers, channels, and clustered queues. You also use IBM MQ Explorer to verify your configuration.

- \_\_\_ 1. If it is not already running, start IBM MQ Explorer.
- \_\_\_ 2. Stop any existing queue managers that are running.
- \_\_\_ 3. Using IBM MQ Explorer, create the following queue managers as described in the table. Accept the default values for any properties that are not listed in the table.

Queue manager	Listener port	Dead-letter queue
name	number	
QMC1	9001	SYSTEM.DEAD.LETTER.QUEUE
QMC2	9002	SYSTEM.DEAD.LETTER.QUEUE
QMC3	9003	SYSTEM.DEAD.LETTER.QUEUE
QMC4	9004	SYSTEM.DEAD.LETTER.QUEUE

- \_\_\_ 4. Create the queue manager cluster.
  - \_\_\_ a. In the **IBM MQ Explorer - Navigator** view, right-click **Queue Manager Clusters** and then click **New > Queue manager cluster**.
  - \_\_\_ b. For the cluster name, enter **CLUS1** and then click **Next**.
  - \_\_\_ c. For the first full repository queue manager, select **QMC1** and then click **Next**.



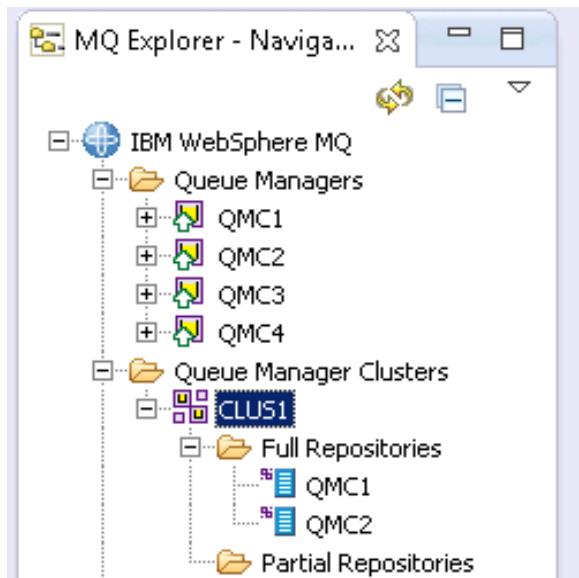
#### Information

The MQSC command to define QMC1 as a full repository queue manager is:

```
ALTER QMGR REPOS(CLUS1)
```

- \_\_\_ d. For the second full repository queue manager, select **QMC2** from the list and then click **Next**.
- \_\_\_ e. Click **Next** to define the cluster channels.
- \_\_\_ f. Change the name of cluster-receiver channel for QMC1 to **CLUS1.QMC1** and the connection name to **localhost(9001)** and then click **Next**.
- \_\_\_ g. Change the name of cluster-receiver channel for QMC2 to **CLUS1.QMC2** and the connection name to **localhost(9002)** and then click **Finish**.

- 5. Expand the **Queue Managers Clusters** folder in the IBM MQ Explorer and verify that you have a cluster that is named CLUS1 with QMC1 and QMC2 listed as full repositories.



- 6. Select the full repository queue manager QMC1 under the **Full Repositories** folder.  
— 7. Verify that QMC1 has one cluster-receiver channel that is named CLUS1.QMC1 and one cluster-sender channel that is named CLUS1.QMC2.

The screenshot shows the IBM MQ Explorer interface with two windows. The left window is the "MQ Explorer - Navigator" showing the same tree structure as before. The right window is titled "MQ Explorer - Content" and displays "Repository data for queue manager QMC1". It has tabs for Cluster Queues, Cluster Topics, Cluster-sender Channels, and Cluster-receiver Channels. The Cluster-receiver Channels tab is selected, showing a list with one item: "CLUS1.QMC1". Below this list is a diagram showing an arrow pointing to a box labeled "1" next to the icon for "QMC1". At the bottom is a table:

Channel name	Cluster queue manager	Queue manager type	Definition type	Xmit protocol
CLUS1.QMC1	QMC1	Repository	Cluster-receiver	TCP

- 8. Use IBM MQ Explorer to add QMC3 to the cluster as partial repositories.
- Right-click **CLUS1** in the **MQ Explorer-Navigator** view and then click **Add Queue Manager to Cluster**.
  - Select **QMC3** and then click **Next**.
  - Select **Partial repository** and then click **Next**.
  - Change the name of the cluster-receiver channel to **CLUS1.QMC3** and the connection name to **localhost(9003)**. Click **Next**.
  - Select **QMC1** as the full repository queue manager and then click **Next**.

- \_\_ f. Accept the default to use the cluster-receiver channel **CLUS1.QMC1**. Click **Next**.
- \_\_ g. Verify your configuration in the summary and then click **Finish**.



## Information

To use MQSC to add a partial repository to a cluster, you would define a cluster-receiver channel for QMC3 and define a cluster-sender channel that points to one of the full repository queue managers.

The equivalent MQSC commands to add QMC3 to the cluster as a partial repository are:

```
DEFINE CHANNEL(CLUS1.QMC3) CHLTYPE(CLUSRCVR) TRPTYPE(TCP) +
CONNAME('localhost(9003)') CLUSTER(CLUS1)
```

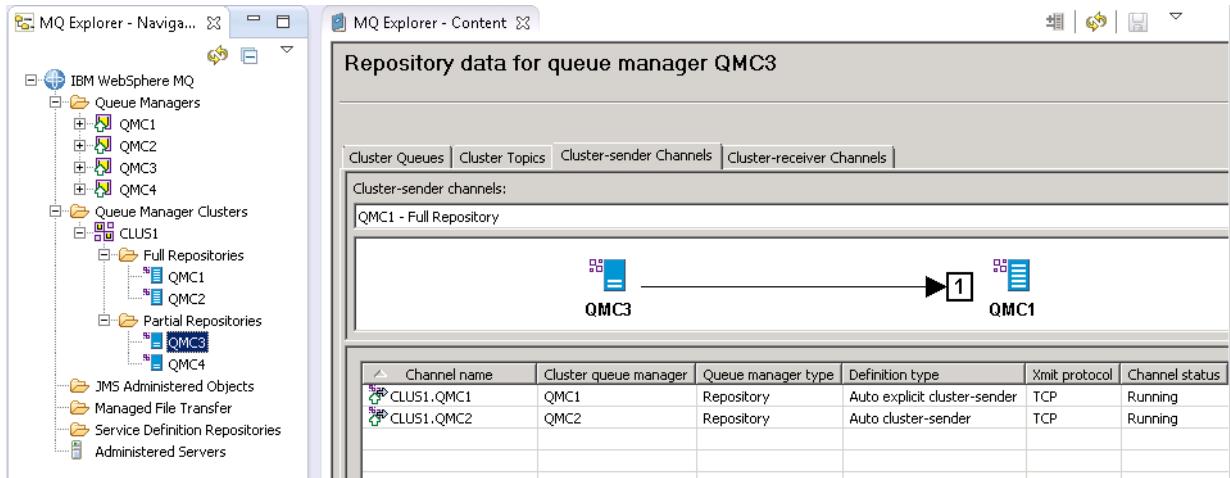
```
DEFINE CHANNEL(CLUS1.QMC1) CHLTYPE(CLUSSDR) TRPTYPE(TCP) +
CONNAME('localhost(9001)') CLUSTER(CLUS1)
```

- \_\_ 9. Use MQ Explorer to add QMC4 to the cluster as a partial repository.
  - \_\_ a. Right-click **CLUS1** in **MQ Explorer-Navigator** view and then click **Add Queue Manager to Cluster**.
  - \_\_ b. Select **QMC4** and then click **Next**.
  - \_\_ c. Select **Partial repository** and then click **Next**.
  - \_\_ d. Create a cluster-receiver channel that is named **CLUS1.QMC4** and the connection **localhost(9004)**.
  - \_\_ e. Select QMC1 as the full repository queue manager.
  - \_\_ f. Accept the default to use the cluster-receiver channel **CLUS1.QMC1**. Click **Next**.
  - \_\_ g. Verify your configuration in the summary and then click **Finish**.
- \_\_ 10. Select QMC1 under the **Full Repositories** folder and verify that cluster-sender channels were automatically defined between the partial repositories QMC3 and QMC4 and the full repository QMC1.

Channel name	Cluster queue manager	Queue manager type	Definition type	Xmit.protocol	Channel status
CLUS1.QMC2	QMC2	Repository	Auto explicit cluster-sender	TCP	Running
CLUS1.QMC3	QMC3	Normal	Auto cluster-sender	TCP	Running
CLUS1.QMC4	QMC4	Normal	Auto cluster-sender	TCP	Running

- 11. Select QMC3 under the **Partial Repositories** folder and verify that QMC3 has cluster-sender channels to both full repositories (QMC1 and QMC2).

Notice that the channel to the second full repository (QMC2) was automatically defined.



- 12. Create a cluster queue that is named **CLUSQ1** on QMC1.
- a. Expand QMC1 under the **Queue Managers** folder in the **MQ Explorer - Navigator** view.
  - b. Right-click **Queues** and then click **New > Local Queue**.
  - c. Enter **CLUSQ1** for the queue name and then click **Next**.
  - d. On the **Cluster** properties page, click **Shared in cluster** and enter **CLUS1** for the cluster name and then click **Finish**.

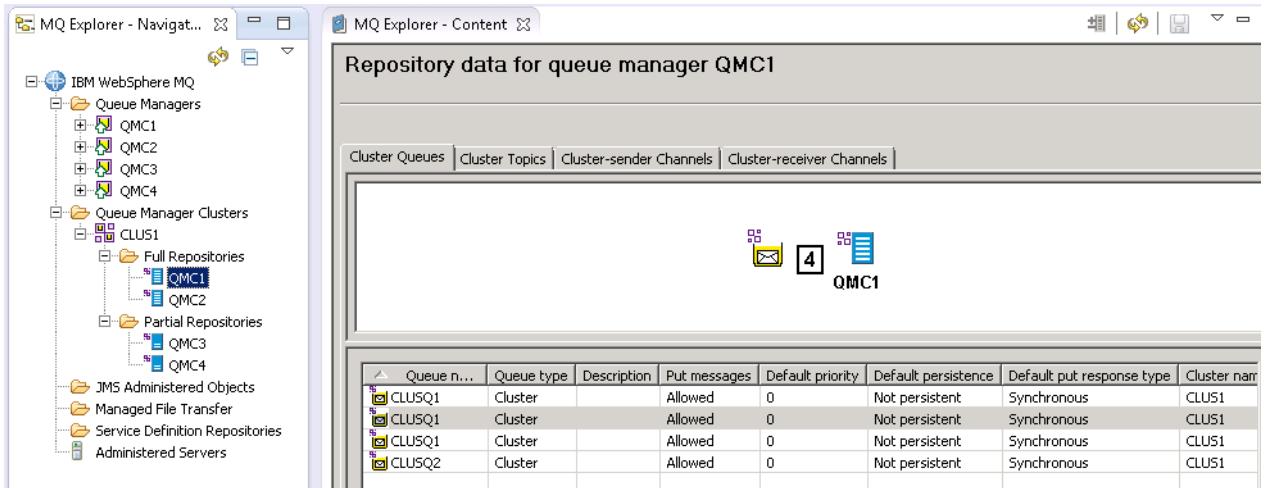


### Information

The MQSC command for creating a cluster queue is: **DEF QL(CLUSQ1) CLUSTER(CLUS1)**.

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- 13. Follow the procedure in Step 12 and create the following queues on QMC2, QMC3, QMC4:
    - On QMC2, create a cluster queue on CLUS1 that is named **CLUSQ1**.
    - On QMC3, create a cluster queue on CLUS1 that is named **CLUSQ1**.
    - On QMC4, create a cluster queue on CLUS1 that is named **CLUSQ2**.
  - 14. Select **QMC1** under the **Full Repositories** folder and then click the **Cluster Queues** tab to verify that you have a cluster queue on each queue manager.

You should have a cluster queue that is named **CLUSQ1** on QMC1, QMC2, and QMC3 and a cluster queue that is named **CLUSQ2** on QMC4.



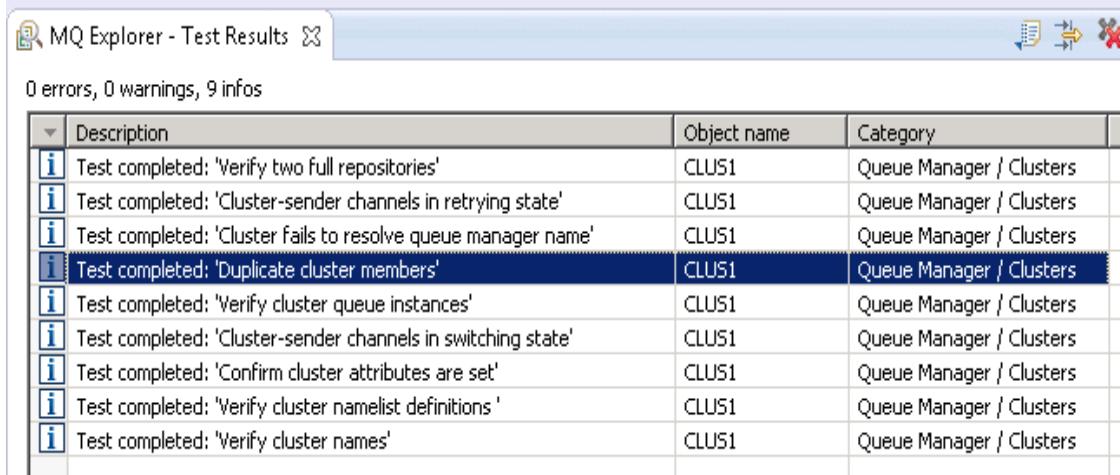
## Part 2: Testing the cluster

In this scenario, CLUSQ1 is defined locally on three queue managers: QMC1, QMC2, and QMC3.

In the most basic scenario, by using the default configuration all messages that are put to the cluster queue CLUSQ1 are put on the local manager.

- 1. Test the cluster object definitions and verify that no errors or potential problems exist.
  - a. In the **MQ Explorer - Navigator** view, right-click **CLUS1** and then click **Test > Run Default Tests**.
  - b. Test results are displayed in the **Test Results** view. The cluster default tests include the following tests:
    - **Verify two full repositories:** Checks that all clusters have at least two queue managers that maintain full repositories of the cluster.
    - **Cluster-sender channels in retrying state:** Checks whether any of the manually defined cluster-sender channels are still in a *Retrying* state.
    - **Cluster fails to resolve queue manager name:** Checks that clusters can successfully resolve all queue manager names.
    - **Duplicate cluster members:** Checks whether any cluster memberships list the same queue manager more than one time.
    - **Verify cluster queue instances:** Verifies that all instances of a cluster queue have the same attributes.
    - **Cluster-sender channels in switching state:** Checks whether any of the manually defined cluster-sender channels are still in a *Switching* state.
    - **Confirm that cluster attributes are set:** Checks that all cluster channels have a cluster value.

- **Verify cluster namelist definitions:** Verifies the cluster namelist attributes of queues, channels, and queue managers. The test displays errors if matching namelists cannot be found, or if a namelist is empty.
- **Verify cluster names:** Checks the cluster name attributes of queues, channels, and queue managers. The test checks for names that are similar enough to cause confusion, for example, names that are identical except for capitalization.



The screenshot shows the 'MQ Explorer - Test Results' window. The title bar says 'MQ Explorer - Test Results'. Below it, a message says '0 errors, 0 warnings, 9 infos'. A table lists nine test results, all of which are informational (info icon) and pertain to CLUS1, categorized under 'Queue Manager / Clusters'.

Description	Object name	Category
Test completed: 'Verify two full repositories'	CLUS1	Queue Manager / Clusters
Test completed: 'Cluster-sender channels in retrying state'	CLUS1	Queue Manager / Clusters
Test completed: 'Cluster fails to resolve queue manager name'	CLUS1	Queue Manager / Clusters
Test completed: 'Duplicate cluster members'	CLUS1	Queue Manager / Clusters
Test completed: 'Verify cluster queue instances'	CLUS1	Queue Manager / Clusters
Test completed: 'Cluster-sender channels in switching state'	CLUS1	Queue Manager / Clusters
Test completed: 'Confirm cluster attributes are set'	CLUS1	Queue Manager / Clusters
Test completed: 'Verify cluster namelist definitions '	CLUS1	Queue Manager / Clusters
Test completed: 'Verify cluster names'	CLUS1	Queue Manager / Clusters

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- 2. Use the sample program `amqspput` and the supplied text file `data.txt` to write 15 messages to the cluster queue CLUSQ1.



## Windows

Type: `amqspput CLUSQ1 QMC1 < C:\labfiles\Lab11\data\data.txt`



## Linux

Type: `amqspput CLUSQ1 QMC1 < /home/localuser/labfiles/Lab11/data/data.txt`

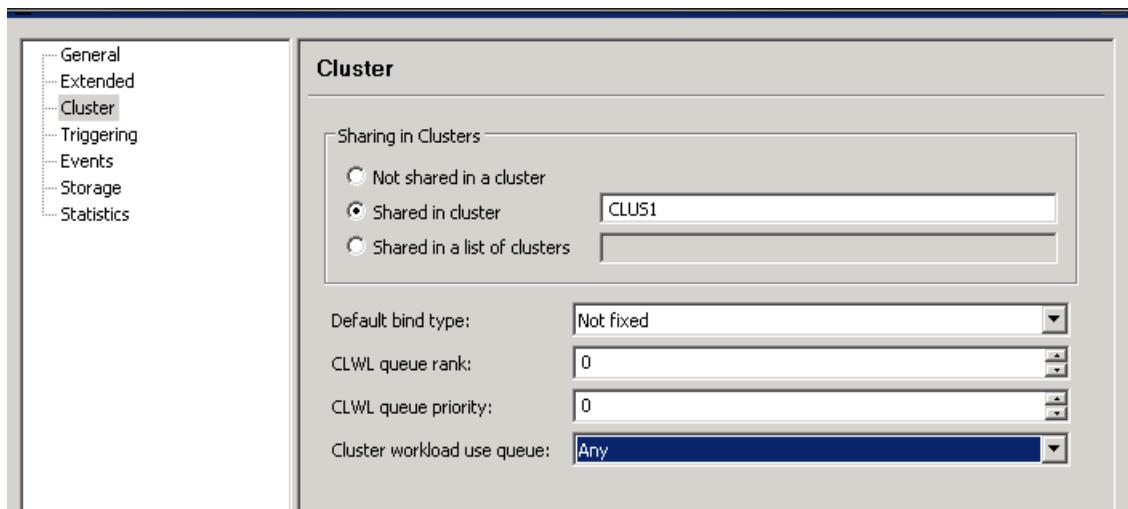
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- 3. Use IBM MQ Explorer to view the queue depth of CLUSQ1 on QMC1, QMC2, and QMC3.

What do you notice? You should see that all 15 messages were put to the queue manager QMC1.

The default queue definition has the **Default bind type** (DEFBIND) set to **Open** and the **Cluster workload use queue** (CLWLUSEQ) set to **Queue manager**. These settings explain why all the messages were placed onto one queue manager.

- DEFBIND(OPEN) binds the queue handle to a specific instance of the cluster queue when the queue is opened.
- CLWLUSEQ(QMGR) means that the CLWLUSEQ attribute of the queue manager definition specifies the behavior. By default, it is LOCAL and the target of an MQPUT is the local queue instance, if one exists.

- 4. Change the queue definition for CLUSQ1 queue on QMC1, QMC2, and QMC3 so that **Default bind type** is set to **Not fixed** and **Cluster workload use queue** is set to **Any**.
  - a. Right-click **CLUSQ1** on the **Queue** view and then click **Properties**.
  - b. Click **Cluster** to display the **Cluster** properties.
  - c. Change **Default bind type** set to **Not fixed** so that the queue handle is not bound to any one instance of the cluster queue.
  - d. Change **Cluster workload use queue** to **Any** so that any queue can be used.
  - e. Click **Apply** and then click **OK**.



### Information

The MQSC command for changing the cluster queue properties is:

```
ALTER QL(CLUSQ1) DEFBIND(NOTFIXED) CLQLUSEQ(ANY)
```

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- 5. Use IBM MQ Explorer to clear the messages from CLUSQ1 on queue manager QMC1.
  - 6. Repeat Step 2 to use the `amqspput` sample program with the `data.txt` file to put 15 messages to the cluster queue CLUSQ1.
  - 7. View the queue depth of CLUSQ1 on QMC1, QMC2, and QMC3.

You should see that the messages are now distributed between all three instances of the CLUSQ1 queue on the three queue managers.

## Exercise cleanup

Stop the cluster queue managers: QMC1, QMC2, QMC3, and QMC4

## End of exercise

## Exercise review and wrap-up

In the first part of the exercise, you used MQ Explorer to create a cluster with two full repository queue managers and two partial repository queue managers. You then created cluster queues on each queue manager and tested the cluster.