

8.0

*Administering IBM MQ*



**Note**

Before using this information and the product it supports, read the information in [“Notices” on page 359](#).

This edition applies to version 8 release 0 of IBM® MQ and to all subsequent releases and modifications until otherwise indicated in new editions.

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# Administering IBM MQ


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Administering queue managers and associated resources includes the tasks that you perform frequently to activate and manage those resources. Choose the method you prefer to administer your queue managers and associated resources.

You can administer IBM MQ objects locally or remotely, see [“Local and remote administration” on page 8](#).


There are a number of different methods that you can use to create and administer your queue managers and their related resources in IBM MQ. These methods include command-line interfaces, a graphical user interface, and an administration API. See the sections and links in this topic for more information about each of these interfaces.

There are different sets of commands that you can use to administer IBM MQ depending on your platform:

- [“IBM MQ control commands” on page 5](#)
- [“IBM MQ Script \(MQSC\) commands” on page 5](#)
- [“Programmable Command Formats \(PCFs\)” on page 6](#)
-  [“IBM i Control Language \(CL\)” on page 6](#)

There are also the other following options for creating and managing IBM MQ objects:

- [“The MQ Explorer” on page 6](#)
- [“The Windows Default Configuration application” on page 7](#)
- [“The Microsoft Cluster Service \(MSCS\)” on page 7](#)

 For information about the administration interfaces and options on IBM MQ for z/OS®, see [“Administering IBM MQ for z/OS” on page 247](#).

You can automate some administration and monitoring tasks for both local and remote queue managers by using PCF commands. These commands can also be simplified through the use of the IBM MQ Administration Interface (MQAI) on some platforms. For more information about automating administration tasks, see [“Automating administration tasks” on page 8](#).

## IBM MQ control commands

Control commands allow you to perform administrative tasks on queue managers themselves.

IBM MQ for Windows, UNIX and Linux® systems provides the *control commands* that you issue at the system command line.

The control commands are described in [Creating and managing queue managers on distributed platforms](#). For the command reference for the control commands, see [IBM MQ Control commands](#).

## IBM MQ Script (MQSC) commands

Use MQSC commands to manage queue manager objects, including the queue manager itself, queues, process definitions, namelists, channels, client connection channels, listeners, services, and authentication information objects.



You issue MQSC commands to a queue manager by using the `runmqsc` command. You can do this interactively, issuing commands from a keyboard, or you can redirect the standard input device (stdin) to run a sequence of commands from an ASCII text file. In both cases, the format of the commands is the same.

You can run the `runmqsc` command in three modes, depending on the flags set on the command:


- *Verification mode*, where the MQSC commands are verified on a local queue manager, but are not run

- *Direct mode*, where the MQSC commands are run on a local queue manager
- *Indirect mode*, where the MQSC commands are run on a remote queue manager

Object attributes specified in MQSC commands are shown in this section in uppercase (for example, RQMNAME), although they are not case-sensitive. MQSC command attribute names are limited to eight characters.

MQSC commands are available on all platforms  , including IBM i, and z/OS. MQSC commands are summarized in [Comparing command sets](#).

On Windows, UNIX or Linux, you can use the MQSC as single commands issued at the system command line. To issue more complicated, or multiple commands, the MQSC can be built into a file that you run from the Windows, UNIX or Linux system command line. MQSC can be sent to a remote queue manager. For full details, see [Building command scripts](#).

 On IBM i, to issue the commands on an IBM i server, create a list of commands in a Script file, and then run the file by using the STRMQMMQSC command.

#### Notes:

1. Do not use the QTEMP library as the input library to STRMQMMQSC, as the usage of the QTEMP library is limited. You must use another library as an input file to the command.
2. On IBM i, MQSC responses to commands issued from a script file are returned in a spool file.

“Script (MQSC) Commands” on page 73 contains a description of each MQSC command and its syntax.

See “Performing local administration tasks using MQSC commands” on page 72 for more information about using MQSC commands in local administration.

## Programmable Command Formats (PCFs)

Programmable Command Formats (PCFs) define command and reply messages that can be exchanged between a program and any queue manager (that supports PCFs) in a network. You can use PCF commands in a systems management application program for administration of IBM MQ objects: authentication information objects, channels, channel listeners, namelists, process definitions, queue managers, queues, services, and storage classes. The application can operate from a single point in the network to communicate command and reply information with any queue manager, local, or remote, using the local queue manager.

For more information about PCFs, see “Introduction to Programmable Command Formats” on page 9.

For definition of PCFs and structures for the commands and responses, see [Programmable command formats reference](#).

## IBM i Control Language (CL)



This language can be used to issue administration commands to IBM MQ for IBM i. The commands can be issued either at the command line or by writing a CL program. These commands perform similar functions to PCF commands, but the format is different. CL commands are designed exclusively for servers and CL responses are designed to be human-readable, whereas PCF commands are platform independent and both command and response formats are intended for program use.

For full details of the IBM i Control Language (CL), see [IBM MQ for IBM i CL commands](#).

## The MQ Explorer

Using the MQ Explorer, you can perform the following actions:

- Define and control various resources including queue managers, queues, process definitions, namelists, channels, client connection channels, listeners, services, and clusters.

- Start or stop a local queue manager and its associated processes.
- View queue managers and their associated objects on your workstation or from other workstations.
- Check the status of queue managers, clusters, and channels.
- Check to see which applications, users, or channels have a particular queue open, from the queue status.

On Windows and Linux systems, you can start MQ Explorer by using the system menu, the MQExplorer executable file, or the **strmqcfcg** command.

On Linux, to start the MQ Explorer successfully, you must be able to write a file to your home directory, and the home directory must exist.

See [“Administration using the MQ Explorer” on page 59](#) for more information.

You can use MQ Explorer to administer remote queue managers on other platforms including z/OS, for details and to download the SupportPac MS0T, see <https://www.ibm.com/support/docview.wss?uid=swg24021041>.

## The Windows Default Configuration application

You can use the Windows Default Configuration program to create a *starter* (or default) set of IBM MQ objects. A summary of the default objects created is listed in [Table 1: Objects created by the Windows default configuration application](#).

## The Microsoft Cluster Service (MSCS)

Microsoft Cluster Service (MSCS) enables you to connect servers into a *cluster*, giving higher availability of data and applications, and making it easier to manage the system. MSCS can automatically detect and recover from server or application failures.

It is important not to confuse clusters in the MSCS sense with IBM MQ clusters. The distinction is:

### IBM MQ clusters

are groups of two or more queue managers on one or more computers, providing automatic interconnection, and allowing queues to be shared among them for load balancing and redundancy.

### MSCS clusters

Groups of computers, connected together and configured in such a way that, if one fails, MSCS performs a *failover*, transferring the state data of applications from the failing computer to another computer in the cluster and reinitiating their operation there.

[Supporting the Microsoft Cluster Service \(MSCS\)](#) provides detailed information about how to configure your IBM MQ for Windows system to use MSCS.

### Related concepts

[“Administering local IBM MQ objects” on page 67](#)

This section tells you how to administer local IBM MQ objects to support application programs that use the Message Queue Interface (MQI). In this context, local administration means creating, displaying, changing, copying, and deleting IBM MQ objects.

[“Administering remote IBM MQ objects” on page 125](#)

[“Administering IBM i” on page 175](#)

Introduces the methods available to you to administer IBM MQ on IBM i.

[“Administering IBM MQ for z/OS” on page 247](#)

Administering queue managers and associated resources includes the tasks that you perform frequently to activate and manage those resources. Choose the method you prefer to administer your queue managers and associated resources.

### Related information

[IBM MQ technical overview](#)

[Planning](#)

 [Planning your IBM MQ environment on z/OS](#)

[Configuring](#)

 [Configuring z/OS](#)

[Transactional support scenarios](#)

[Considerations when contact is lost with the XA resource manager](#)

## Local and remote administration

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You can administer IBM MQ objects locally or remotely.

*Local administration* means carrying out administration tasks on any queue managers you have defined on your local system. You can access other systems, for example through the TCP/IP terminal emulation program **telnet**, and carry out administration there. In IBM MQ, you can consider this as local administration because no channels are involved, that is, the communication is managed by the operating system.

IBM MQ supports administration from a single point of contact through what is known as *remote administration*. This allows you to issue commands from your local system that are processed on another system and applies also to the IBM MQ Explorer. For example, you can issue a remote command to change a queue definition on a remote queue manager. You do not have to log on to that system, although you do need to have the appropriate channels defined. The queue manager and command server on the target system must be running.

Some commands cannot be issued in this way, in particular, creating or starting queue managers and starting command servers. To perform this type of task, you must either log onto the remote system and issue the commands from there or create a process that can issue the commands for you. This restriction applies also to the IBM MQ Explorer.

[“Administering remote IBM MQ objects” on page 125](#) describes the subject of remote administration in greater detail.

## How to use IBM MQ control commands

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This section describes how to use the IBM MQ control commands.

If you want to issue control commands, your user ID must be a member of the mqm group for most control commands. For more information about this, see [Authority to administer IBM MQ on UNIX, Linux and Windows systems](#). In addition, note the following environment-specific information:

### IBM MQ for Windows

All control commands can be issued from a command line. Command names and their flags are not case sensitive: you can enter them in uppercase, lowercase, or a combination of uppercase and lowercase. However, arguments to control commands (such as queue names) are case sensitive.

In the syntax descriptions, the hyphen (-) is used as a flag indicator. You can use the forward slash (/) instead of the hyphen.

### IBM MQ for UNIX and Linux systems

All IBM MQ control commands can be issued from a shell. All commands are case-sensitive.

A subset of the control commands can be issued using the IBM MQ Explorer.

For more information, see [The IBM MQ control commands](#)

## Automating administration tasks

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You might decide that it would be beneficial to your installation to automate some administration and monitoring tasks. You can automate administration tasks for both local and remote queue managers using



programmable command format (PCF) commands. This section assumes that you have experience of administering IBM MQ objects.

## PCF commands

IBM MQ programmable command format (PCF) commands can be used to program administration tasks into an administration program. In this way, from a program you can manipulate queue manager objects (queues, process definitions, namelists, channels, client connection channels, listeners, services, and authentication information objects), and even manipulate the queue managers themselves.

PCF commands cover the same range of functions provided by MQSC commands. You can write a program to issue PCF commands to any queue manager in the network from a single node. In this way, you can both centralize and automate administration tasks.

Each PCF command is a data structure that is embedded in the application data part of an IBM MQ message. Each command is sent to the target queue manager using the MQI function MQPUT in the same way as any other message. Providing the command server is running on the queue manager receiving the message, the command server interprets it as a command message and runs the command. To get the replies, the application issues an MQGET call and the reply data is returned in another data structure. The application can then process the reply and act accordingly.

**Note:** Unlike MQSC commands, PCF commands and their replies are not in a text format that you can read.

Briefly, these are some of the things needed to create a PCF command message:

### Message descriptor

This is a standard IBM MQ message descriptor, in which:

- Message type (*MsgType*) is MQMT\_REQUEST.
- Message format (*Format*) is MQFMT\_ADMIN.

### Application data

Contains the PCF message including the PCF header, in which:

- The PCF message type (*Type*) specifies MQCFT\_COMMAND.
- The command identifier specifies the command, for example, *Change Queue* (MQCMD\_CHANGE\_Q).

For a complete description of the PCF data structures and how to implement them, see [“Introduction to Programmable Command Formats”](#) on page 9.

## PCF object attributes

Object attributes in PCF are not limited to eight characters as they are for MQSC commands. They are shown in this guide in italics. For example, the PCF equivalent of RQMNAME is *RemoteQMgrName*.

## Escape PCFs



Escape PCFs are PCF commands that contain MQSC commands within the message text. You can use PCFs to send commands to a remote queue manager. For more information about escape PCFs, see [Escape](#).

## Introduction to Programmable Command Formats

Programmable Command Formats (PCFs) define command and reply messages that can be exchanged between a program and any queue manager (that supports PCFs) in a network. PCFs simplify queue manager administration and other network administration. They can be used to solve the problem of complex administration of distributed networks especially as networks grow in size and complexity.

The Programmable Command Formats described in this product documentation are supported by:

- IBM MQ for AIX®

- IBM MQ for HP-UX
-  IBM MQ for IBM i
- IBM MQ for Linux
- IBM MQ for Solaris
- IBM MQ for Windows
-  IBM MQ for z/OS
- IBM WebSphere® MQ for HP Integrity NonStop Server

## The problem PCF commands solve

The administration of distributed networks can become complex. The problems of administration continue to grow as networks increase in size and complexity.

Examples of administration specific to messaging and queuing include:

- Resource management.  
For example, queue creation and deletion.
- Performance monitoring.  
For example, maximum queue depth or message rate.
- Control.  
For example, tuning queue parameters such as maximum queue depth, maximum message length, and enabling and disabling queues.
- Message routing.  
Definition of alternative routes through a network.

IBM MQ PCF commands can be used to simplify queue manager administration and other network administration. PCF commands allow you to use a single application to perform network administration from a single queue manager within the network.

## What are PCFs?

PCFs define command and reply messages that can be exchanged between a program and any queue manager (that supports PCFs) in a network. You can use PCF commands in a systems management application program for administration of IBM MQ objects: authentication information objects, channels, channel listeners, namelists, process definitions, queue managers, queues, services, and storage classes. The application can operate from a single point in the network to communicate command and reply information with any queue manager, local, or remote, using the local queue manager.

Each queue manager has an administration queue with a standard queue name and your application can send PCF command messages to that queue. Each queue manager also has a command server to service the command messages from the administration queue. PCF command messages can therefore be processed by any queue manager in the network and the reply data can be returned to your application, using your specified reply queue. PCF commands and reply messages are sent and received using the normal Message Queue Interface (MQI).


For a list of the available PCF commands, including their parameters, see [Definitions of the Programmable Command Formats](#).

## Using Programmable Command Formats

You can use PCFs in a systems management program for IBM MQ remote administration.

This section includes:

- [“PCF command messages” on page 11](#)

- [“Responses” on page 13](#)
-  [“Extended responses” on page 15](#)
- [Rules for naming IBM MQ objects](#)
- [“Authority checking for PCF commands” on page 17](#)


## PCF command messages

PCF command messages consist of a PCF header, parameters identified in that header and also user-defined message data. The messages are issued using Message Queue interface calls.

Each command and its parameters are sent as a separate command message containing a PCF header followed by a number of parameter structures; for details of the PCF header, see [MQCFH - PCF header](#), and for an example of a parameter structure, see [MQCFST - PCF string parameter](#). The PCF header identifies the command and the number of parameter structures that follow in the same message. Each parameter structure provides a parameter to the command.

Replies to the commands, generated by the command server, have a similar structure. There is a PCF header, followed by a number of parameter structures. Replies can consist of more than one message but commands always consist of one message only.

On platforms other than z/OS, the queue to which the PCF commands are sent is always

called the `SYSTEM.ADMIN.COMMAND.QUEUE`.  On z/OS, commands are sent to `SYSTEM.COMMAND.INPUT`, although `SYSTEM.ADMIN.COMMAND.QUEUE` can be an alias for it. The command server servicing this queue sends the replies to the queue defined by the *ReplyToQ* and *ReplyToQMGr* fields in the message descriptor of the command message.

## How to issue PCF command messages

Use the normal Message Queue Interface (MQI) calls, `MQPUT`, `MQGET`, and so on, to put and retrieve PCF command and response messages to and from their queues.

### Note:

Ensure that the command server is running on the target queue manager for the PCF command to process on that queue manager.

For a list of supplied header files, see [IBM MQ COPY, header, include and module files](#).

## Message descriptor for a PCF command

The IBM MQ message descriptor is fully documented in [MQMD - Message descriptor](#).

A PCF command message contains the following fields in the message descriptor:

### Report

Any valid value, as required.

### MsgType

This field must be `MQMT_REQUEST` to indicate a message requiring a response.


### Expiry

Any valid value, as required.

### Feedback

Set to `MQFB_NONE`

### Encoding

If you are sending to  IBM i, Windows, UNIX or Linux systems, set this field to the encoding used for the message data; conversion is performed if necessary.

### CodedCharSetId

If you are sending to



IBM i,

Windows, UNIX or Linux systems, set this field to the coded character-set identifier used for the message data; conversion is performed if necessary.

**Format**

Set to MQFMT\_ADMIN.

**Priority**

Any valid value, as required.

**Persistence**

Any valid value, as required.

**MsgId**

The sending application can specify any value, or MQMI\_NONE can be specified to request the queue manager to generate a unique message identifier.

**CorrelId**

The sending application can specify any value, or MQCI\_NONE can be specified to indicate no correlation identifier.

**ReplyToQ**

The name of the queue to receive the response.

**ReplyToQMgr**

The name of the queue manager for the response (or blank).

**Message context fields**

These fields can be set to any valid values, as required. Normally the Put message option MQPMO\_DEFAULT\_CONTEXT is used to set the message context fields to the default values.

If you are using a version-2 MQMD structure, you must set the following additional fields:

**GroupId**

Set to MQGI\_NONE

**MsgSeqNumber**

Set to 1

**Offset**

Set to 0

**MsgFlags**

Set to MQMF\_NONE

**OriginalLength**

Set to MQOL\_UNDEFINED

**Sending user data**

The PCF structures can also be used to send user-defined message data. In this case the message descriptor *Format* field must be set to MQFMT\_PCF.

***Sending and receiving PCF messages in a specified queue***

**Sending PCF messages to a specified queue**

To send a message to a specified queue, the mqPutBag call converts the contents of the specified bag into a PCF message and sends the message to the specified queue. The contents of the bag are unchanged after the call.

As input to this call, you must supply:

- An MQI connection handle.
- An object handle for the queue on which the message is to be placed.

- A message descriptor. For more information about the message descriptor, see [MQMD - Message descriptor](#).
- Put Message Options using the MQPMO structure. For more information about the MQPMO structure, see [MQPMO - Put-message options](#).
- The handle of the bag to be converted to a message.

**Note:** If the bag contains an administration message and the mqAddInquiry call was used to insert values into the bag, the value of the MQIASY\_COMMAND data item must be an INQUIRE command recognized by the MQAI.

For a full description of the mqPutBag call, see [mqPutBag](#).

## Receiving PCF messages from a specified queue

To receive a message from a specified queue, the mqGetBag call gets a PCF message from a specified queue and converts the message data into a data bag.

As input to this call, you must supply:

- An MQI connection handle.
- An object handle of the queue from which the message is to be read.
- A message descriptor. Within the MQMD structure, the Format parameter must be MQFMT\_ADMIN, MQFMT\_EVENT, or MQFMT\_PCF.

**Note:** If the message is received within a unit of work (that is, with the MQGMO\_SYNCPOINT option) and the message has an unsupported format, the unit of work can be backed out. The message is then reinstated on the queue and can be retrieved using the MQGET call instead of the mqGetBag call. For more information about the message descriptor, see [MQGMO - Get-message options](#).

- Get Message Options using the MQGMO structure. For more information about the MQGMO structure, see [MQMD - Message Descriptor](#).
- The handle of the bag to contain the converted message.

For a full description of the mqGetBag call, see [mqGetBag](#).

## Responses

In response to each command, the command server generates one or more response messages. A response message has a similar format to a command message.

The PCF header has the same command identifier value as the command to which it is a response (see [MQCFH - PCF header](#) for details). The message identifier and correlation identifier are set according to the report options of the request.

If the PCF header type of the command message is MQCFT\_COMMAND, standard responses only are generated. Such commands are supported on all platforms except z/OS. Older applications do not support PCF on z/OS ; the IBM MQ Windows Explorer is one such application (however, the Version 6.0 or later IBM MQ Explorer does support PCF on z/OS ).

If the PCF header type of the command message is MQCFT\_COMMAND\_XR, either extended or standard responses are generated. Such commands are supported on z/OS and some other platforms. Commands issued on z/OS generate only extended responses. On other platforms, either type of response might be generated.

If a single command specifies a generic object name, a separate response is returned in its own message for each matching object. For response generation, a single command with a generic name is treated as multiple individual commands (except for the control field MQCFC\_LAST or MQCFC\_NOT\_LAST). Otherwise, one command message generates one response message.

Certain PCF responses might return a structure even when it is not requested. This structure is shown in the definition of the response ( [Definitions of the Programmable Command Formats](#) ) as *always returned*.

The reason that, for these responses, it is necessary to name the objects in the response to identify which object the data applies.

## Message descriptor for a response

A response message has the following fields in the message descriptor:

### ***MsgType***

This field is MQMT\_REPLY.

### ***MsgId***

This field is generated by the queue manager.

### ***CorrelId***

This field is generated according to the report options of the command message.

### ***Format***

This field is MQFMT\_ADMIN.

### ***Encoding***

Set to MQENC\_NATIVE.

### ***CodedCharSetId***

Set to MQCCSI\_Q\_MGR.

### ***Persistence***

The same as in the command message.

### ***Priority***

The same as in the command message.

The response is generated with MQPMO\_PASS\_IDENTITY\_CONTEXT.

## Standard responses

Command messages with a header type of MQCFT\_COMMAND, standard responses are generated. Such commands are supported on all platforms except z/OS.

There are three types of standard response:

- OK response
- Error response
- Data response

## OK response

This response consists of a message starting with a command format header, with a *CompCode* field of MQCC\_OK or MQCC\_WARNING.

For MQCC\_OK, the *Reason* is MQRC\_NONE.

For MQCC\_WARNING, the *Reason* identifies the nature of the warning. In this case the command format header might be followed by one or more warning parameter structures appropriate to this reason code.

In either case, for an inquire command further parameter structures might follow as described in the following sections.

## Error response

If the command has an error, one or more error response messages are sent (more than one might be sent even for a command that would normally have only a single response message). These error response messages have MQCFC\_LAST or MQCFC\_NOT\_LAST set as appropriate.

Each such message starts with a response format header, with a *CompCode* value of MQCC\_FAILED and a *Reason* field that identifies the particular error. In general, each message describes a different error. In addition, each message has either zero or one (never more than one) error parameter structures following

the header. This parameter structure, if there is one, is an MQCFIN structure, with a *Parameter* field containing one of the following:

- MQIACF\_PARAMETER\_ID

The *Value* field in the structure is the parameter identifier of the parameter that was in error (for example, MQCA\_Q\_NAME).

- MQIACF\_ERROR\_ID

This value is used with a *Reason* value (in the command format header) of MQRC\_UNEXPECTED\_ERROR. The *Value* field in the MQCFIN structure is the unexpected reason code received by the command server.

- MQIACF\_SELECTOR

This value occurs if a list structure (MQCFIL) sent with the command contains a duplicate selector or one that is not valid. The *Reason* field in the command format header identifies the error, and the *Value* field in the MQCFIN structure is the parameter value in the MQCFIL structure of the command that was in error.

- MQIACF\_ERROR\_OFFSET

This value occurs when there is a data compare error on the Ping Channel command. The *Value* field in the structure is the offset of the Ping Channel compare error.

- MQIA\_CODED\_CHAR\_SET\_ID

This value occurs when the coded character-set identifier in the message descriptor of the incoming PCF command message does not match that of the target queue manager. The *Value* field in the structure is the coded character-set identifier of the queue manager.

The last (or only) error response message is a summary response, with a *CompCode* field of MQCC\_FAILED, and a *Reason* field of MQRCCF\_COMMAND\_FAILED. This message has no parameter structure following the header.

## Data response

This response consists of an OK response (as described earlier) to an inquire command. The OK response is followed by additional structures containing the requested data as described in [Definitions of the Programmable Command Formats](#).

Applications must not depend upon these additional parameter structures being returned in any particular order.

## Extended responses

Commands issued on z/OS generate extended responses.

There are three types of extended response:

- Message response, with type MQCFT\_XR\_MSG
- Item response, with type MQCFT\_XR\_ITEM
- Summary response, with type MQCFT\_XR\_SUMMARY

Each command can generate one, or more, sets of responses. Each set of responses comprises one or more messages, numbered sequentially from 1 in the *MsgSeqNumber* field of the PCF header. The *Control* field of the last (or only) response in each set has the value MQCFC\_LAST. For all other responses in the set, this value is MQCFC\_NOT\_LAST.

Any response can include one, or more, optional MQCFBS structures in which the *Parameter* field is set to MQBACF\_RESPONSE\_SET, the value being a response set identifier. Identifiers are unique and identify the set of responses which contain the response. For every set of responses, there is an MQCFBS structure that identifies it.

Extended responses have at least two parameter structures:

- An MQCFBS structure with the *Parameter* field set to MQBACF\_RESPONSE\_ID. The value in this field is the identifier of the set of responses to which the response belongs. The identifier in the first set is arbitrary. In subsequent sets, the identifier is one previously notified in an MQBACF\_RESPONSE\_SET structure.
- An MQCFST structure with the *Parameter* field set to MQCACF\_RESPONSE\_Q\_MGR\_NAME, the value being the name of the queue manager from which the set of responses come.

Many responses have additional parameter structures, and these structures are described in the following sections.

You cannot determine in advance how many responses there are in a set other than by getting responses until one with MQCFC\_LAST is found. Neither can you determine in advance how many sets of responses there are as any set might include MQBACF\_RESPONSE\_SET structures to indicate that additional sets are generated.

## Extended responses to Inquire commands

Inquire commands normally generate an item response (type MQCFT\_XR\_ITEM) for each item found that matches the specified search criteria. The item response has a *CompCode* field in the header with a value of MQCC\_OK, and a *Reason* field with a value of MQRC\_NONE. It also includes other parameter structures describing the item and its requested attributes, as described in [Definitions of the Programmable Command Formats](#).

If an item is in error, the *CompCode* field in the header has a value of MQCC\_FAILED and the *Reason* field identifies the particular error. Additional parameter structures are included to identify the item.

Certain Inquire commands might return general (not name-specific) message responses in addition to the item responses. These responses are informational, or error, responses of the type MQCFT\_XR\_MSG.

If the Inquire command succeeds, there might, optionally, be a summary response (type MQCFT\_XR\_SUMMARY), with a *CompCode* value of MQCC\_OK, and a *Reason* field value of MQRC\_NONE.

If the Inquire command fails, item responses might be returned, and there might optionally be a summary response (type MQCFT\_XR\_SUMMARY), with a *CompCode* value of MQCC\_FAILED, and a *Reason* field value of MQRCCF\_COMMAND\_FAILED.

## Extended responses to commands other than Inquire

Successful commands generate message responses in which the *CompCode* field in the header has a value of MQCC\_OK, and the *Reason* field has a value of MQRC\_NONE. There is always at least one message; it might be informational (MQCFT\_XR\_MSG) or a summary (MQCFT\_XR\_SUMMARY). There might optionally be additional informational (type MQCFT\_XR\_MSG) messages. Each informational message might include a number of additional parameter structures with information about the command; see the individual command descriptions for the structures that can occur.

Commands that fail generate error message responses (type MQCFT\_XR\_MSG), in which the *CompCode* field in the header has a value of MQCC\_FAILED and the *Reason* field identifies the particular error. Each message might include a number of additional parameter structures with information about the error: see the individual error descriptions for the structures that can occur. Informational message responses might be generated. There might, optionally, be a summary response (MQCFT\_XR\_SUMMARY), with a *CompCode* value of MQCC\_FAILED, and a *Reason* field value of MQRCCF\_COMMAND\_FAILED.

## Extended responses to commands using CommandScope

If a command uses the *CommandScope* parameter, or causes a command using the *CommandScope* parameter to be generated, there is an initial response set from the queue manager where the command was received. Then a separate set, or sets, of responses is generated for each queue manager to which the command is directed (as if multiple individual commands were issued). Finally, there is a response set from the receiving queue manager which includes an overall summary response (type MQCFT\_XR\_SUMMARY). The MQCACF\_RESPONSE\_Q\_MGR\_NAME parameter structure identifies the queue manager that generates each set.



The initial response set has the following additional parameter structures:

- MQIACF\_COMMAND\_INFO (MQCFIN). Possible values in this structure are MQCMDI\_CMDSCOPE\_ACCEPTED or MQCMDI\_CMDSCOPE\_GENERATED.
- MQIACF\_CMDSCOPE\_Q\_MGR\_COUNT (MQCFIN). This structure indicates the number of queue managers to which the command is sent.

### **Authority checking for PCF commands**

When a PCF command is processed, the *UserIdentifier* from the message descriptor in the command message is used for the required IBM MQ object authority checks. Authority checking is implemented differently on each platform as described in this topic.

The checks are performed on the system on which the command is being processed; therefore this user ID must exist on the target system and have the required authorities to process the command. If the message has come from a remote system, one way of achieving the ID existing on the target system is to have a matching user ID on both the local and remote systems.

## **IBM MQ for IBM i**



In order to process any PCF command, the user ID must have *dsp* authority for the IBM MQ object on the target system.

In addition, IBM MQ object authority checks are performed for certain PCF commands, as shown in [Table 1 on page 19](#).

In most cases these checks are the same checks as those checks performed by the equivalent IBM MQ CL commands issued on a local system. See the [Setting up security on IBM i](#), for more information about the mapping from IBM MQ authorities to IBM i system authorities, and the authority requirements for the IBM MQ CL commands. Details of security concerning exits are given in the [Link level security using a security exit](#) documentation.

**To process any of the following commands** the user ID must be a member of the group profile QMQMADM:

- Ping Channel
- Change Channel
- Copy Channel
- Create Channel
- Delete Channel
- Reset Channel
- Resolve Channel
- Start Channel
- Stop Channel
- Start Channel Initiator
- Start Channel Listener

## **IBM MQ for Windows, UNIX and Linux systems**



In order to process any PCF command, the user ID must have *dsp* authority for the queue manager object on the target system. In addition, IBM MQ object authority checks are performed for certain PCF commands, as shown in [Table 1 on page 19](#).

**To process any of the following commands** the user ID must belong to group *mqm*.

**Note:** For Windows **only**, the user ID can belong to group *Administrators* or group *mqm*.

- Change Channel
- Copy Channel
- Create Channel
- Delete Channel
- Ping Channel
- Reset Channel
- Start Channel
- Stop Channel
- Start Channel Initiator
- Start Channel Listener
- Resolve Channel
- Reset Cluster
- Refresh Cluster
- Suspend Queue Manager
- Resume Queue Manager

### **IBM WebSphere MQ for HP Integrity NonStop Server**

In order to process any PCF command, the user ID must have *dsp* authority for the queue manager object on the target system. In addition, IBM MQ object authority checks are performed for certain PCF commands, as shown in [Table 1 on page 19](#).

**To process any of the following commands** the user ID must belong to group *mqm*:

- Change Channel
- Copy Channel
- Create Channel
- Delete Channel
- Ping Channel
- Reset Channel
- Start Channel
- Stop Channel
- Start Channel Initiator
- Start Channel Listener
- Resolve Channel
- Reset Cluster
- Refresh Cluster
- Suspend Queue Manager
- Resume Queue Manager

## IBM MQ Object authorities

Table 1. Windows, HP Integrity NonStop Server,  IBM i, UNIX and Linux systems - object authorities

Command	IBM MQ object authority	Class authority (for object type)
Change Authentication Information	dsp and chg	n/a
Change Channel	dsp and chg	n/a
Change Channel Listener	dsp and chg	n/a
Change Client Connection Channel	dsp and chg	n/a
Change Namelist	dsp and chg	n/a
Change Process	dsp and chg	n/a
Change Queue	dsp and chg	n/a
Change Queue Manager	chg <i>see Note 3 and Note 5</i>	n/a
Change Service	dsp and chg	n/a
Clear Queue	clr	n/a
Copy Authentication Information	dsp	crt
Copy Authentication Information (Replace) <i>see Note 1</i>	<i>from: dsp to: chg</i>	crt
Copy Channel	dsp	crt
Copy Channel (Replace) <i>see Note 1</i>	<i>from: dsp to: chg</i>	crt
Copy Channel Listener	dsp	crt
Copy Channel Listener (Replace) <i>see Note 1</i>	<i>from: dsp to: chg</i>	crt
Copy Client Connection Channel	dsp	crt
Copy Client Connection Channel (Replace) <i>see Note 1</i>	<i>from: dsp to: chg</i>	crt
Copy Namelist	dsp	crt
Copy Namelist (Replace) <i>see Note 1</i>	<i>from: dsp to: dsp and chg</i>	crt
Copy Process	dsp	crt
Copy Process (Replace) <i>see Note 1</i>	<i>from: dsp to: chg</i>	crt
Copy Queue	dsp	crt
Copy Queue (Replace) <i>see Note 1</i>	<i>from: dsp to: dsp and chg</i>	crt
Create Authentication Information	<i>(system default authentication information) dsp</i>	crt

Table 1. Windows, HP Integrity NonStop Server,  IBM i, UNIX and Linux systems - object authorities (continued)

Command	IBM MQ object authority	Class authority (for object type)
Create Authentication Information (Replace) <i>see Note 1</i>	(system default authentication information) dsp to: chg	crt
Create Channel	(system default channel) dsp	crt
Create Channel (Replace) <i>see Note 1</i>	(system default channel) dsp to: chg	crt
Create Channel Listener	(system default listener) dsp	crt
Create Channel Listener (Replace) <i>see Note 1</i>	(system default listener) dsp to: chg	crt
Create Client Connection Channel	(system default channel) dsp	crt
Create Client Connection Channel (Replace) <i>see Note 1</i>	(system default channel) dsp to: chg	crt
Create Namelist	(system default namelist) dsp	crt
Create Namelist (Replace) <i>see Note 1</i>	(system default namelist) dsp to: dsp and chg	crt
Create Process	(system default process) dsp	crt
Create Process (Replace) <i>see Note 1</i>	(system default process) dsp to: chg	crt
Create Queue	(system default queue) dsp	crt
Create Queue (Replace) <i>see Note 1</i>	(system default queue) dsp to: dsp and chg	crt
Create Service	(system default queue) dsp	crt
Create Service (Replace) <i>see Note 1</i>	(system default queue) dsp to: chg	crt
Delete Authentication Information	dsp and dlt	n/a
Delete Authority Record	(queue manager object) chg <i>see Note 4</i>	<i>see Note 4</i>
Delete Channel	dsp and dlt	n/a
Delete Channel Listener	dsp and dlt	n/a
Delete Client Connection Channel	dsp and dlt	n/a
Delete Namelist	dsp and dlt	n/a
Delete Process	dsp and dlt	n/a
Delete Queue	dsp and dlt	n/a
Delete Service	dsp and dlt	n/a
Inquire Authentication Information	dsp	n/a
Inquire Authority Records	<i>see Note 4</i>	<i>see Note 4</i>

Table 1. Windows, HP Integrity NonStop Server,  IBM i, UNIX and Linux systems - object authorities (continued)

Command	IBM MQ object authority	Class authority (for object type)
Inquire Channel	dsp	n/a
Inquire Channel Listener	dsp	n/a
Inquire Channel Status (for <b>ChannelType</b> MQCHT_CLSSDR)	inq	n/a
Inquire Client Connection Channel	dsp	n/a
Inquire Namelist	dsp	n/a
Inquire Process	dsp	n/a
Inquire Queue	dsp	n/a
Inquire Queue Manager	see note 3	n/a
Inquire Queue Status	dsp	n/a
Inquire Service	dsp	n/a
Ping Channel	ctrl	n/a
Ping Queue Manager	see note 3	n/a
Refresh Queue Manager	(queue manager object) chg	n/a
Refresh Security (for <b>SecurityType</b> MQSECTYPE_SSL)	(queue manager object) chg	n/a
Reset Channel	ctrlx	n/a
Reset Queue Manager	(queue manager object) chg	n/a
Reset Queue Statistics	dsp and chg	n/a
Resolve Channel	ctrlx	n/a
Set Authority Record	(queue manager object) chg see Note 4	see Note 4
Start Channel	ctrl	n/a
Stop Channel	ctrl	n/a
Stop Connection	(queue manager object) chg	n/a
Start Listener	ctrl	n/a
Stop Listener	ctrl	n/a
Start Service	ctrl	n/a
Stop Service	ctrl	n/a
Escape	see Note 2	see Note 2

**Notes:**

1. This command applies if the object to be replaced does exist, otherwise the authority check is as for Create, or Copy without Replace.

2. The required authority is determined by the MQSC command defined by the escape text, and it is equivalent to one of the previous commands.
3. In order to process any PCF command, the user ID must have dsp authority for the queue manager object on the target system.
4. This PCF command is authorized unless the command server has been started with the -a parameter. By default the command server starts when the Queue Manager is started, and without the -a parameter. See the System Administration Guide for further information.
5. Granting a user ID *chg* authority for a queue manager gives the ability to set authority records for all groups and users. Do not grant this authority to ordinary users or applications.

IBM MQ also supplies some channel security exit points so that you can supply your own user exit programs for security checking. Details are given in [Displaying a channel manual](#).

## IBM MQ for z/OS



See [Task 1: Identify the z/OS system parameters](#) for information about authority checking on z/OS.

## Using the MQAI to simplify the use of PCFs

The MQAI is an administration interface to IBM MQ that is available on AIX, HP-UX, IBM i, Linux, Solaris, and Windows.

The MQAI performs administration tasks on a queue manager through the use of *data bags*. Data bags allow you to handle properties (or parameters) of objects in a way that is easier than using PCFs.

The advantages of using the MQAI are as follows:

### Simplify the use of PCF messages

The MQAI is an easier way to administer IBM MQ. If you use the MQAI, you do not have to write your own PCF messages. This avoids the problems associated with complex data structures.

To pass parameters in programs written using MQI calls, the PCF message must contain the command, and details of the string or integer data. To create this configuration manually, you have to add several statements in your program for every structure, and you have to allocate memory space. This task can be long and laborious.

Programs written using the MQAI pass parameters into the appropriate data bag, and you need only one statement for each structure. The use of the MQAI data bags removes the need for you to handle arrays and allocate storage, and provides some degree of isolation from the details of the PCF.

### Handle error conditions more easily

It is difficult to get return codes back from PCF commands. The MQAI makes it easier for the program to handle error conditions.

After you have created and populated your data bag, you can send an administration command message to the command server of a queue manager, using the `mqExecute` call. This call waits for any response messages. The `mqExecute` call handles the exchange with the command server, and returns responses in a *response bag*.

For more information about the MQAI, see [“Introduction to the IBM MQ Administration Interface \(MQAI\)” on page 23](#).

### Related information

[IBM MQ Administration Interface reference](#)

# Introduction to the IBM MQ Administration Interface (MQAI)

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IBM MQ Administration Interface (MQAI) is a programming interface to IBM MQ. It performs administration tasks on an IBM MQ queue manager using data bags to handle properties (or parameters) of objects in a way that is easier than using Programmable Command Formats (PCFs).

## MQAI concepts and terminology

The MQAI is a programming interface to IBM MQ, using the C language and also Visual Basic for Windows. It is available on platforms other than z/OS.

It performs administration tasks on an IBM MQ queue manager using data bags. Data bags allow you to handle properties (or parameters) of objects in a way that is easier than using the other administration interface, Programmable Command Formats (PCFs). The MQAI offers easier manipulation of PCFs than using the MQGET and MQPUT calls.

For more information about data bags, see [“Data bags” on page 49](#). For more information about PCFs, see [“Introduction to Programmable Command Formats” on page 9](#)

## Use of the MQAI

You can use the MQAI to:

- Simplify the use of PCF messages. The MQAI is an easy way to administer IBM MQ; you do not have to write your own PCF messages and thus avoid the problems associated with complex data structures.
- Handle error conditions more easily. It is difficult to get return codes back from the IBM MQ script (MQSC) commands, but the MQAI makes it easier for the program to handle error conditions.
- Exchange data between applications. The application data is sent in PCF format and packed and unpacked by the MQAI. If your message data consists of integers and character strings, you can use the MQAI to take advantage of IBM MQ built-in data conversion for PCF data. This avoids the need to write data-conversion exits. For more information on using MQAI to administer IBM MQ and to exchange data between applications, see [“Using the MQAI to simplify the use of PCFs” on page 22](#).

## Examples of using the MQAI

The list shown gives some example programs that demonstrate the use of MQAI. The samples perform the following tasks:

1. Create a local queue. [“Sample C program for creating a local queue \(amqsaicq.c\)” on page 24](#)
2. Display events on the screen using a simple event monitor. [“Sample C program for displaying events using an event monitor \(amqsaicm.c\)” on page 28](#)
3. Print a list of all local queues and their current depths. [“Sample C program for inquiring about queues and printing information \(amqsailq.c\)” on page 40](#)
4. Print a list of all channels and their types. [“Sample C program for inquiring about channel objects \(amqsaicl.c\)” on page 35](#)


## Building your MQAI application

To build your application using the MQAI, you link to the same libraries as you do for IBM MQ. For information on how to build your IBM MQ applications, see [Building a procedural application](#).

## Hints and tips for configuring IBM MQ using MQAI

The MQAI uses PCF messages to send administration commands to the command server rather than dealing directly with the command server itself. Tips for configuring IBM MQ using the MQAI can be found in [“Hints and tips for configuring IBM MQ” on page 44](#)

## IBM MQ Administration Interface (MQAI)

IBM MQ for Windows, AIX,  IBM i, Linux, HP-UX, and Solaris support the IBM MQ Administration Interface (MQAI). The MQAI is a programming interface to IBM MQ that gives you an alternative to the MQI, for sending and receiving PCFs.

The MQAI uses *data bags* which allow you to handle properties (or parameters) of objects more easily than using PCFs directly by way of the MQAI.

The MQAI provides easier programming access to PCF messages by passing parameters into the data bag, so that only one statement is required for each structure. This access removes the need for the programmer to handle arrays and allocate storage, and provides some isolation from the details of PCF.

The MQAI administers IBM MQ by sending PCF messages to the command server and waiting for a response.

The MQAI is described in the second section of this manual. See the [Using Java](#) documentation for a description of a component object model interface to the MQAI.

### Sample C program for creating a local queue (amqsaicq.c)

The sample C program amqsaicq.c creates a local queue using the MQAI.

```

/*****
/*
/* Program name: AMQSAICQ.C
/*
/*
/* Description: Sample C program to create a local queue using the
/* IBM MQ Administration Interface (MQAI).
/*
/*
/* Statement: Licensed Materials - Property of IBM
/*
/*
/* 84H2000, 5765-B73
/* 84H2001, 5639-B42
/* 84H2002, 5765-B74
/* 84H2003, 5765-B75
/* 84H2004, 5639-B43
/*
/* (C) Copyright IBM Corp. 1999, 2022
/*
*****/
/*
/* Function:
/* AMQSAICQ is a sample C program that creates a local queue and is an
/* example of the use of the mqExecute call.
/*
/* - The name of the queue to be created is a parameter to the program.
/*
/* - A PCF command is built by placing items into an MQAI bag.
/* These are:-
/* - The name of the queue
/* - The type of queue required, which, in this case, is local.
/*
/* - The mqExecute call is executed with the command MQCMD_CREATE_Q.
/* The call generates the correct PCF structure.
/* The call receives the reply from the command server and formats into
/* the response bag.
/*
/* - The completion code from the mqExecute call is checked and if there
/* is a failure from the command server then the code returned by the
/* command server is retrieved from the system bag that is
/* embedded in the response bag to the mqExecute call.
/*
/* Note: The command server must be running.
/*
*****/
/*
/* AMQSAICQ has 2 parameters - the name of the local queue to be created
/* - the queue manager name (optional)
/*
*****/
*****/
```



```

/* Includes                                                                    */
/*****                                                                    */
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <ctype.h>

#include <cmqc.h> /* MQI */
#include <cmqcfh.h> /* PCF */
#include <cmqbc.h> /* MQAI */

void CheckCallResult(MQCHAR *, MQLONG , MQLONG );
void CreateLocalQueue(MQHCONN, MQCHAR *);

int main(int argc, char *argv[])
{
    MQHCONN hConn; /* handle to IBM MQ connection */
    MQCHAR QMName[MQ_Q_MGR_NAME_LENGTH+1]=""; /* default QMgr name */
    MQLONG connReason; /* MQCONN reason code */
    MQLONG compCode; /* completion code */
    MQLONG reason; /* reason code */

    /*****
    /* First check the required parameters */
    /*****
    printf("Sample Program to Create a Local Queue\n");
    if (argc < 2)
    {
        printf("Required parameter missing - local queue name\n");
        exit(99);
    }

    /*****
    /* Connect to the queue manager */
    /*****
    if (argc > 2)
        strncpy(QMName, argv[2], (size_t)MQ_Q_MGR_NAME_LENGTH);
        MQCONN(QMName, &hConn, &compCode, &connReason);

    /*****
    /* Report reason and stop if connection failed */
    /*****
    if (compCode == MQCC_FAILED)
    {
        CheckCallResult("MQCONN", compCode, connReason);
        exit( (int)connReason);
    }

    /*****
    /* Call the routine to create a local queue, passing the handle to the
    /* queue manager and also passing the name of the queue to be created.
    /*****
    CreateLocalQueue(hConn, argv[1]);

    /*****
    /* Disconnect from the queue manager if not already connected
    /*****
    if (connReason != MQRC_ALREADY_CONNECTED)
    {
        MQDISC(&hConn, &compCode, &reason);
        CheckCallResult("MQDISC", compCode, reason);
    }
    return 0;

}

/*****
/*
/* Function: CreateLocalQueue
/* Description: Create a local queue by sending a PCF command to the command
/* server.
/*
/*
/*****
/*
/* Input Parameters: Handle to the queue manager
/* Name of the queue to be created
/*
/*
/* Output Parameters: None
/*
/*
/* Logic: The mqExecute call is executed with the command MQCMD_CREATE_Q.
/* The call generates the correct PCF structure.
/* The default options to the call are used so that the command is sent*/

```

```

/*      to the SYSTEM.ADMIN.COMMAND.QUEUE.      */
/*      The reply from the command server is placed on a temporary dynamic */
/*      queue.      */
/*      The reply is read from the temporary queue and formatted into the */
/*      response bag.      */
/*      */
/*      The completion code from the mqExecute call is checked and if there */
/*      is a failure from the command server then the code returned by the */
/*      command server is retrieved from the system bag that is      */
/*      embedded in the response bag to the mqExecute call.      */
/*      */
/*****
void CreateLocalQueue(MQHCONN hConn, MQCHAR *qName)
{
    MQLONG reason;          /* reason code      */
    MQLONG compCode;        /* completion code */
    MQHBBAG commandBag = MQHB_UNUSABLE_HBBAG; /* command bag for mqExecute */
    MQHBBAG responseBag = MQHB_UNUSABLE_HBBAG; /* response bag for mqExecute */
    MQHBBAG resultBag;      /* result bag from mqExecute */
    MQLONG mqExecuteCC;     /* mqExecute completion code */
    MQLONG mqExecuteRC;     /* mqExecute reason code */

    printf("\nCreating Local Queue %s\n", qName);

    /*****/
    /* Create a command Bag for the mqExecute call. Exit the function if the */
    /* create fails.      */
    /*****/
    mqCreateBag(MQCBO_ADMIN_BAG, &commandBag, &compCode, &reason);
    CheckCallResult("Create the command bag", compCode, reason);
    if (compCode != MQCC_OK)
        return;

    /*****/
    /* Create a response Bag for the mqExecute call, exit the function if the */
    /* create fails.      */
    /*****/
    mqCreateBag(MQCBO_ADMIN_BAG, &responseBag, &compCode, &reason);
    CheckCallResult("Create the response bag", compCode, reason);
    if (compCode != MQCC_OK)
        return;

    /*****/
    /* Put the name of the queue to be created into the command bag. This will */
    /* be used by the mqExecute call.      */
    /*****/
    mqAddString(commandBag, MQCA_Q_NAME, MQBL_NULL_TERMINATED, qName, &compCode,
        &reason);
    CheckCallResult("Add q name to command bag", compCode, reason);

    /*****/
    /* Put queue type of local into the command bag. This will be used by the */
    /* mqExecute call.      */
    /*****/
    mqAddInteger(commandBag, MQIA_Q_TYPE, MQQT_LOCAL, &compCode, &reason);
    CheckCallResult("Add q type to command bag", compCode, reason);

    /*****/
    /* Send the command to create the required local queue.      */
    /* The mqExecute call will create the PCF structure required, send it to */
    /* the command server and receive the reply from the command server into */
    /* the response bag.      */
    /*****/
    mqExecute(hConn,          /* IBM MQ connection handle */
        MQCMD_CREATE_Q,      /* Command to be executed */
        MQHB_NONE,          /* No options bag */
        commandBag,          /* Handle to bag containing commands */
        responseBag,         /* Handle to bag to receive the response */
        MQHO_NONE,          /* Put msg on SYSTEM.ADMIN.COMMAND.QUEUE */
        MQHO_NONE,          /* Create a dynamic q for the response */
        &compCode,          /* Completion code from the mqExecute */
        &reason);           /* Reason code from mqExecute call */

    if (reason == MQRC_CMD_SERVER_NOT_AVAILABLE)
    {
        printf("Please start the command server: <strmqcsv QMgrName>\n");
        MQDISC(&hConn, &compCode, &reason);
        CheckCallResult("MQDISC", compCode, reason);
        exit(98);
    }
}

```

```

/*****
/* Check the result from mqExecute call and find the error if it failed. */
/*****
if ( compCode == MQCC_OK )
    printf("Local queue %s successfully created\n", qName);
else
{
    printf("Creation of local queue %s failed: Completion Code = %d
           qName, compCode, reason);
    if (reason == MQRCCF_COMMAND_FAILED)
    {
        /*****
        /* Get the system bag handle out of the mqExecute response bag. */
        /* This bag contains the reason from the command server why the */
        /* command failed. */
        /*****
        mqInquireBag(responseBag, MQHA_BAG_HANDLE, 0, &resultBag, &compCode,
                    &reason);
        CheckCallResult("Get the result bag handle", compCode, reason);

        /*****
        /* Get the completion code and reason code, returned by the command */
        /* server, from the embedded error bag. */
        /*****
        mqInquireInteger(resultBag, MQIASY_COMP_CODE, MQIND_NONE, &mqExecuteCC,
                        &compCode, &reason);
        CheckCallResult("Get the completion code from the result bag",
                        compCode, reason);
        mqInquireInteger(resultBag, MQIASY_REASON, MQIND_NONE, &mqExecuteRC,
                        &compCode, &reason);
        CheckCallResult("Get the reason code from the result bag", compCode,
                        reason);
        printf("Error returned by the command server: Completion code = %d :
              Reason = %d\n", mqExecuteCC, mqExecuteRC);
    }
}
/*****
/* Delete the command bag if successfully created. */
/*****
if (commandBag != MQHB_UNUSABLE_HBAG)
{
    mqDeleteBag(&commandBag, &compCode, &reason);
    CheckCallResult("Delete the command bag", compCode, reason);
}

/*****
/* Delete the response bag if successfully created. */
/*****
if (responseBag != MQHB_UNUSABLE_HBAG)
{
    mqDeleteBag(&responseBag, &compCode, &reason);
    CheckCallResult("Delete the response bag", compCode, reason);
}
} /* end of CreateLocalQueue */

/*****
/*
/* Function: CheckCallResult
/*
/*****
/*
/* Input Parameters:  Description of call
/*                   Completion code
/*                   Reason code
/*
/* Output Parameters: None
/*
/*
/* Logic: Display the description of the call, the completion code and the
/*        reason code if the completion code is not successful
/*
/*****
void CheckCallResult(char *callText, MQLONG cc, MQLONG rc)
{
    if (cc != MQCC_OK)
        printf("%s failed: Completion Code = %d :
              Reason = %d\n", callText, cc, rc);
}

```

## Sample C program for displaying events using an event monitor (amqsaiem.c)

The sample C program amqsaiem.c demonstrates a basic event monitor using the MQAI.

```
*****/
/*
/* Program name: AMQSAIEM.C
/*
/* Description: Sample C program to demonstrate a basic event monitor
/*               using the IBM MQ Admin Interface (MQAI).
/* Licensed Materials - Property of IBM
/*
/* 63H9336
/* (c) Copyright IBM Corp. 1999, 2022. All Rights Reserved.
/*
/* US Government Users Restricted Rights - Use, duplication or
/* disclosure restricted by GSA ADP Schedule Contract with
/* IBM Corp.
*****/
/*
/* Function:
/* AMQSAIEM is a sample C program that demonstrates how to write a simple
/* event monitor using the mqGetBag call and other MQAI calls.
/*
/* The name of the event queue to be monitored is passed as a parameter
/* to the program. This would usually be one of the system event queues:-
/* SYSTEM.ADMIN.QMGR.EVENT Queue Manager events
/* SYSTEM.ADMIN.PERFM.EVENT Performance events
/* SYSTEM.ADMIN.CHANNEL.EVENT Channel events
/* SYSTEM.ADMIN.LOGGER.EVENT Logger events
/*
/* To monitor the queue manager event queue or the performance event queue,
/* the attributes of the queue manager need to be changed to enable
/* these events. For more information about this, see Part 1 of the
/* Programmable System Management book. The queue manager attributes can
/* be changed using either MQSC commands or the MQAI interface.
/* Channel events are enabled by default.
/*
/* Program logic
/* Connect to the Queue Manager.
/* Open the requested event queue with a wait interval of 30 seconds.
/* Wait for a message, and when it arrives get the message from the queue
/* and format it into an MQAI bag using the mqGetBag call.
/* There are many types of event messages and it is beyond the scope of
/* this sample to program for all event messages. Instead the program
/* prints out the contents of the formatted bag.
/* Loop around to wait for another message until either there is an error
/* or the wait interval of 30 seconds is reached.
/*
*****/
/* AMQSAIEM has 2 parameters - the name of the event queue to be monitored
/* - the queue manager name (optional)
/*
*****/

/* Includes
*****/
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <ctype.h>

#include <cmqc.h> /* MQI
#include <cmqcfc.h> /* PCF
#include <cmqbc.h> /* MQAI

/* Macros
*****/
#define MQAT_DEFAULT == MQAT_WINDOWS_NT
#define Int64 "I64"
#elif defined(MQ_64_BIT)
#define Int64 "l"
#else
#define Int64 "ll"
#endif
#endif
```

```

/*****
/* Function prototypes
*****/
void CheckCallResult(MQCHAR *, MQLONG , MQLONG);
void GetQEvents(MQHCONN, MQCHAR *);
int PrintBag(MQHBAG);
int PrintBagContents(MQHBAG, int);

/*****
/* Function: main
*****/
int main(int argc, char *argv[])
{
    MQHCONN hConn; /* handle to connection */
    MQCHAR QMName[MQ_Q_MGR_NAME_LENGTH+1]=""; /* default QM name */
    MQLONG reason; /* reason code */
    MQLONG connReason; /* MQCONN reason code */
    MQLONG compCode; /* completion code */

    /*****
    /* First check the required parameters
    *****/
    printf("Sample Event Monitor (times out after 30 secs)\n");
    if (argc < 2)
    {
        printf("Required parameter missing - event queue to be monitored\n");
        exit(99);
    }

    /*****
    /* Connect to the queue manager
    *****/
    if (argc > 2)
        strncpy(QMName, argv[2], (size_t)MQ_Q_MGR_NAME_LENGTH);
    MQCONN(QMName, &hConn, &compCode, &connReason);
    /*****
    /* Report the reason and stop if the connection failed
    *****/
    if (compCode == MQCC_FAILED)
    {
        CheckCallResult("MQCONN", compCode, connReason);
        exit( (int)connReason);
    }

    /*****
    /* Call the routine to open the event queue and format any event messages
    /* read from the queue.
    *****/
    GetQEvents(hConn, argv[1]);

    /*****
    /* Disconnect from the queue manager if not already connected
    *****/
    if (connReason != MQRC_ALREADY_CONNECTED)
    {
        MQDISC(&hConn, &compCode, &reason);
        CheckCallResult("MQDISC", compCode, reason);
    }

    return 0;
}

/*****
/*
/* Function: CheckCallResult
*****/
/*
*****/
/*
*****/
/* Input Parameters: Description of call
/* Completion code
/* Reason code
*****/
/* Output Parameters: None
*****/
/* Logic: Display the description of the call, the completion code and the
/* reason code if the completion code is not successful
*****/
void CheckCallResult(char *callText, MQLONG cc, MQLONG rc)
{
    if (cc != MQCC_OK)

```

```

        printf("%s failed: Completion Code = %d : Reason = %d\n",
               callText, cc, rc);
    }

/*****
/*
/* Function: GetQEvents
/*
/*
/*****
/*
/* Input Parameters:  Handle to the queue manager
/*                    Name of the event queue to be monitored
/*
/* Output Parameters: None
/*
/* Logic:  Open the event queue.
/*         Get a message off the event queue and format the message into
/*         a bag.
/*         A real event monitor would need to be programmed to deal with
/*         each type of event that it receives from the queue. This is
/*         outside the scope of this sample, so instead, the contents of
/*         the bag are printed.
/*         The program waits for 30 seconds for an event message and then
/*         terminates if no more messages are available.
/*
/*****
void GetQEvents(MQHCONN hConn, MQCHAR *qName)
{
    MQLONG openReason;          /* MQOPEN reason code          */
    MQLONG reason;              /* reason code                */
    MQLONG compCode;            /* completion code            */
    MQHOBJ eventQueue;          /* handle to event queue      */

    MQHBAG eventBag = MQHB_UNUSABLE_HBAG; /* event bag to receive event msg */
    MQOD  od = {MQOD_DEFAULT};           /* Object Descriptor          */
    MQMD  md = {MQMD_DEFAULT};           /* Message Descriptor         */
    MQGMO gmo = {MQGMO_DEFAULT};         /* get message options        */
    MQLONG bQueueOK = 1;                 /* keep reading msgs while true */

    /*****
    /* Create an Event Bag in which to receive the event.
    /* Exit the function if the create fails.
    /*****
    mqCreateBag(MQCB0_USER_BAG, &eventBag, &compCode, &reason);
    CheckCallResult("Create event bag", compCode, reason);
    if (compCode != MQCC_OK)
        return;

    /*****
    /* Open the event queue chosen by the user
    /*****
    strncpy(od.ObjectName, qName, (size_t)MQ_Q_NAME_LENGTH);
    MQOPEN(hConn, &od, MQ00_INPUT_AS_Q_DEF+MQ00_FAIL_IF QUIESCING, &eventQueue,
           &compCode, &openReason);
    CheckCallResult("Open event queue", compCode, openReason);

    /*****
    /* Set the GMO options to control the action of the get message from the
    /* queue.
    /*****
    gmo.WaitInterval = 30000;             /* 30 second wait for message */
    gmo.Options = MQGMO_WAIT + MQGMO_FAIL_IF QUIESCING + MQGMO_CONVERT;
    gmo.Version = MQGMO_VERSION_2;        /* Avoid need to reset Message ID */
    gmo.MatchOptions = MQMO_NONE;         /* and Correlation ID after every */
                                         /* mqGetBag

    /*****
    /* If open fails, we cannot access the queue and must stop the monitor.
    /*****
    if (compCode != MQCC_OK)
        bQueueOK = 0;

    /*****
    /* Main loop to get an event message when it arrives
    /*****
    while (bQueueOK)
    {
        printf("\nWaiting for an event\n");

        /*****
        /* Get the message from the event queue and convert it into the event
        /* bag.
        /*****

```

```

/*****
mqGetBag(hConn, eventQueue, &md, &gmo, eventBag, &compCode, &reason);

/*****
/* If get fails, we cannot access the queue and must stop the monitor. */
/*****
if (compCode != MQCC_OK)
{
    bQueueOK = 0;

    /*****
    /* If get fails because no message available then we have timed out, */
    /* so report this, otherwise report an error. */
    /*****
    if (reason == MQRC_NO_MSG_AVAILABLE)
    {
        printf("No more messages\n");
    }
    else
    {
        CheckCallResult("Get bag", compCode, reason);
    }
}

/*****
/* Event message read - Print the contents of the event bag */
/*****
else
{
    if ( PrintBag(eventBag) )
        printf("\nError found while printing bag contents\n");

    } /* end of msg found */
} /* end of main loop */
/*****
/* Close the event queue if successfully opened */
/*****
if (openReason == MQRC_NONE)
{
    MQCLOSE(hConn, &eventQueue, MQCO_NONE, &compCode, &reason);
    CheckCallResult("Close event queue", compCode, reason);
}

/*****
/* Delete the event bag if successfully created. */
/*****
if (eventBag != MQHB_UNUSABLE_HBAG)
{
    mqDeleteBag(&eventBag, &compCode, &reason);
    CheckCallResult("Delete the event bag", compCode, reason);
}

} /* end of GetQEvents */

/*****
/*
/* Function: PrintBag
/*
/*****
/*
/* Input Parameters: Bag Handle
/*
/*
/* Output Parameters: None
/*
/*
/* Returns: Number of errors found
/*
/*
/* Logic: Calls PrintBagContents to display the contents of the bag.
/*
/*
/*****

int PrintBag(MQHBAG dataBag)
{
    int errors;

    printf("\n");
    errors = PrintBagContents(dataBag, 0);
    printf("\n");

    return errors;
}

/*****

```

```

/*                                                                    */
/* Function: PrintBagContents                                          */
/*                                                                    */
/*****                                                                    */
/* Input Parameters:  Bag Handle                                     */
/*                   Indentation level of bag                      */
/*                                                                    */
/* Output Parameters: None                                           */
/*                                                                    */
/* Returns:          Number of errors found                         */
/*                                                                    */
/* Logic: Count the number of items in the bag                     */
/*       Obtain selector and item type for each item in the bag.   */
/*       Obtain the value of the item depending on item type and display the */
/*       index of the item, the selector and the value.           */
/*       If the item is an embedded bag handle then call this function again */
/*       to print the contents of the embedded bag increasing the */
/*       indentation level.                                         */
/*                                                                    */
/*****                                                                    */
int PrintBagContents(MQHBAG dataBag, int indent)
{
    /*****                                                                    */
    /* Definitions                                                         */
    /*****                                                                    */
    #define LENGTH 500          /* Max length of string to be read*/
    #define INDENT 4           /* Number of spaces to indent   */
                                /* embedded bag display         */

    /*****                                                                    */
    /* Variables                                                           */
    /*****                                                                    */
    MQLONG  itemCount;          /* Number of items in the bag   */
    MQLONG  itemType;          /* Type of the item             */
    int     i;                 /* Index of item in the bag     */
    MQCHAR  stringVal[LENGTH+1]; /* Value if item is a string    */
    MQBYTE  byteStringVal[LENGTH]; /* Value if item is a byte string */
    MQLONG  stringLength;      /* Length of string value       */
    MQLONG  ccsid;             /* CCSID of string value        */
    MQINT32 iValue;            /* Value if item is an integer  */
    MQINT64 i64Value;          /* Value if item is a 64-bit    */
                                /* integer                      */
    MQLONG  selector;          /* Selector of item             */
    MQHBAG  bagHandle;         /* Value if item is a bag handle */
    MQLONG  reason;            /* reason code                   */
    MQLONG  compCode;          /* completion code              */
    MQLONG  trimLength;        /* Length of string to be trimmed */
    int     errors = 0;        /* Count of errors found        */
    char     blanks[] = "    "; /* Blank string used to        */
                                /* indent display               */

    /*****                                                                    */
    /* Count the number of items in the bag                             */
    /*****                                                                    */
    mqCountItems(dataBag, MQSEL_ALL_SELECTORS, &iItemCount, &compCode, &reason);

    if (compCode != MQCC_OK)
        errors++;
    else
    {
        printf("
        printf("
        printf("
    }

    /*****                                                                    */
    /* If no errors found, display each item in the bag               */
    /*****                                                                    */
    if (!errors)
    {
        for (i = 0; i < itemCount; i++)
        {
            /*****                                                                    */
            /* First inquire the type of the item for each item in the bag */
            /*****                                                                    */
            mqInquireItemInfo(dataBag,          /* Bag handle */
                              MQSEL_ANY_SELECTOR, /* Item can have any selector*/
                              i,                /* Index position in the bag */
                              &selector,        /* Actual value of selector */

```



```

                                /* returned by call */
                                /* Actual type of item */
                                /* returned by call */
                                /* Completion code */
                                /* Reason Code */
                                &itemType,
                                &compCode,
                                &reason);

if (compCode != MQCC_OK)
    errors++;

switch(itemType)
{
case MQITEM_INTEGER:
    /******
    /* Item is an integer. Find its value and display its index,
    /* selector and value.
    /******
    mqInquireInteger(dataBag, /* Bag handle
                                MQSEL_ANY_SELECTOR, /* Allow any selector
                                i, /* Index position in the bag
                                &iValue, /* Returned integer value
                                &compCode, /* Completion code
                                &reason); /* Reason Code

    if (compCode != MQCC_OK)
        errors++;
    else
        printf("%.s %-2d %-4d (%d)\n",
                indent, blanks, i, selector, iValue);
    break

case MQITEM_INTEGER64:
    /******
    /* Item is a 64-bit integer. Find its value and display its
    /* index, selector and value.
    /******
    mqInquireInteger64(dataBag, /* Bag handle
                                MQSEL_ANY_SELECTOR, /* Allow any selector
                                i, /* Index position in the bag
                                &i64Value, /* Returned integer value
                                &compCode, /* Completion code
                                &reason); /* Reason Code

    if (compCode != MQCC_OK)
        errors++;
    else
        printf("%.s %-2d %-4d (%"Int64"d)\n",
                indent, blanks, i, selector, i64Value);
    break;

case MQITEM_STRING:
    /******
    /* Item is a string. Obtain the string in a buffer, prepare
    /* the string for displaying and display the index, selector,
    /* string and Character Set ID.
    /******
    mqInquireString(dataBag, /* Bag handle
                                MQSEL_ANY_SELECTOR, /* Allow any selector
                                i, /* Index position in the bag
                                LENGTH, /* Maximum length of buffer
                                stringVal, /* Buffer to receive string
                                &stringLength, /* Actual length of string
                                &ccsid, /* Coded character set id
                                &compCode, /* Completion code
                                &reason); /* Reason Code

    /******
    /* The call can return a warning if the string is too long for
    /* the output buffer and has been truncated, so only check
    /* explicitly for call failure.
    /******
    if (compCode == MQCC_FAILED)
        errors++;
    else
    {
        /******
        /* Remove trailing blanks from the string and terminate with
        /* a null. First check that the string should not have been
        /* longer than the maximum buffer size allowed.
        /******
        if (stringLength > LENGTH)
            trimLength = LENGTH;
    }
}

```

```

        else
            trimLength = stringLength;
            mqTrim(trimLength, stringVal, stringVal, &compCode, &reason);
            printf("%.s %-2d    %-4d    '%s' %d\n",
                indent, blanks, i, selector, stringVal, ccsid);
        }
        break;

case MQITEM_BYTE_STRING:
    /******
    /* Item is a byte string. Obtain the byte string in a buffer, */
    /* prepare the byte string for displaying and display the */
    /* index, selector and string. */
    /******
    mqInquireByteString(dataBag, /* Bag handle */
        MQSEL_ANY_SELECTOR, /* Allow any selector */
        i, /* Index position in the bag */
        LENGTH, /* Maximum length of buffer */
        byteStringVal, /* Buffer to receive string */
        &stringLength, /* Actual length of string */
        &compCode, /* Completion code */
        &reason); /* Reason Code

    /******
    /* The call can return a warning if the string is too long for */
    /* the output buffer and has been truncated, so only check */
    /* explicitly for call failure. */
    /******
    if (compCode == MQCC_FAILED)
        errors++;
    else
    {
        printf("%.s %-2d    %-4d    X'",
            indent, blanks, i, selector);

        for (i = 0 ; i < stringLength ; i++)
            printf("

        printf("\n");
    }
    break;

case MQITEM_BAG:
    /******
    /* Item is an embedded bag handle, so call the PrintBagContents*/
    /* function again to display the contents. */
    /******
    mqInquireBag(dataBag, /* Bag handle */
        MQSEL_ANY_SELECTOR, /* Allow any selector */
        i, /* Index position in the bag */
        &bagHandle, /* Returned embedded bag handle */
        &compCode, /* Completion code */
        &reason); /* Reason Code

    if (compCode != MQCC_OK)
        errors++;
    else
    {
        printf("%.s %-2d    %-4d    (%d)\n", indent, blanks, i,
            selector, bagHandle);
        if (selector == MQHA_BAG_HANDLE)
            printf("
        else
            printf("
            PrintBagContents(bagHandle, indent+INDENT);
        }
        break;

    default:
        printf("

    }
}
}
return errors;
}

```

## Sample C program for inquiring about channel objects (amqsaicl.c)

The sample C program amqsaicl.c inquires channel objects using the MQAI.

```

/*****
/*
/* Program name: AMQSAICL.C
/*
/* Description: Sample C program to inquire channel objects
/*               using the IBM MQ Administration Interface (MQAI)
/*
/* <N_OCO_COPYRIGHT>
/* Licensed Materials - Property of IBM
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/* (c) Copyright IBM Corp. 2008, 2022 All Rights Reserved.
/*
/* US Government Users Restricted Rights - Use, duplication or
/* disclosure restricted by GSA ADP Schedule Contract with
/* IBM Corp.
/* <NOC_COPYRIGHT>
*****/
/*
/* Function:
/* AMQSAICL is a sample C program that demonstrates how to inquire
/* attributes of the local queue manager using the MQAI interface. In
/* particular, it inquires all channels and their types.
/*
/* - A PCF command is built from items placed into an MQAI administration
/* bag.
/* These are:-
/*   - The generic channel name "*"
/*   - The attributes to be inquired. In this sample we just want
/*     name and type attributes
/*
/* - The mqExecute MQCMD_INQUIRE_CHANNEL call is executed.
/* The call generates the correct PCF structure.
/* The default options to the call are used so that the command is sent
/* to the SYSTEM.ADMIN.COMMAND.QUEUE.
/* The reply from the command server is placed on a temporary dynamic
/* queue.
/* The reply from the MQCMD_INQUIRE_CHANNEL is read from the
/* temporary queue and formatted into the response bag.
/*
/* - The completion code from the mqExecute call is checked and if there
/* is a failure from the command server, then the code returned by the
/* command server is retrieved from the system bag that has been
/* embedded in the response bag to the mqExecute call.
/*
/* Note: The command server must be running.
*****/
/*
/* AMQSAICL has 2 parameter - the queue manager name (optional)
/*                          - output file (optional) default varies
*****/

/*****
/* Includes
*****/
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <ctype.h>
#if (MQAT_DEFAULT == MQAT_OS400)
#include <recio.h>
#endif

#include <cmqc.h>           /* MQI
#include <cmqcf.h>         /* PCF
#include <cmqbc.h>         /* MQAI
#include <cmqxc.h>         /* MQCD

/*****
/* Function prototypes
*****/
void CheckCallResult(MQCHAR *, MQLONG , MQLONG);

/*****
```

```

/* DataTypes                                                                    */
/*****                                                                    */
#if (MQAT_DEFAULT == MQAT_OS400)
typedef _RFILE OUTFILEHDL;
#else
typedef FILE OUTFILEHDL;
#endif

/*****                                                                    */
/* Constants                                                                    */
/*****                                                                    */
#if (MQAT_DEFAULT == MQAT_OS400)
const struct
{
    char name[9];
} ChlTypeMap[9] =
{
    "SDR", /* MQCHT_SENDER */
    "SVR", /* MQCHT_SERVER */
    "RCVR", /* MQCHT_RECEIVER */
    "RQSTR", /* MQCHT_REQUESTER */
    "ALL", /* MQCHT_ALL */
    "CLTCN", /* MQCHT_CLNTCONN */
    "SVRCONN", /* MQCHT_SVRCONN */
    "CLUSRCVR", /* MQCHT_CLUSRCVR */
    "CLUSSDR", /* MQCHT_CLUSSDR */
};
#else
const struct
{
    char name[9];
} ChlTypeMap[9] =
{
    "sdr", /* MQCHT_SENDER */
    "svr", /* MQCHT_SERVER */
    "rcvr", /* MQCHT_RECEIVER */
    "rqstr", /* MQCHT_REQUESTER */
    "all", /* MQCHT_ALL */
    "cltconn", /* MQCHT_CLNTCONN */
    "svrcn", /* MQCHT_SVRCONN */
    "clusrcvr", /* MQCHT_CLUSRCVR */
    "clusdr", /* MQCHT_CLUSSDR */
};
#endif

/*****                                                                    */
/* Macros                                                                    */
/*****                                                                    */
#if (MQAT_DEFAULT == MQAT_OS400)
#define OUTFILE "QTEMP/AMQSAICL(AMQSAICL)"
#define OPENOUTFILE(hdl, fname) \
    (hdl) = _Ropen((fname), "wr", rtrncode="Y");
#define CLOSEOUTFILE(hdl) \
    _Rclose((hdl));
#define WRITEOUTFILE(hdl, buf, buflen) \
    _Rwrite((hdl), (buf), (buflen));
#elif (MQAT_DEFAULT == MQAT_UNIX)
#define OUTFILE "/tmp/amqsaicl.txt"
#define OPENOUTFILE(hdl, fname) \
    (hdl) = fopen((fname), "w");
#define CLOSEOUTFILE(hdl) \
    fclose((hdl));
#define WRITEOUTFILE(hdl, buf, buflen) \
    fwrite((buf), (buflen), 1, (hdl)); fflush((hdl));
#else
#define OUTFILE "amqsaicl.txt"
#define OPENOUTFILE(fname) \
    fopen((fname), "w");
#define CLOSEOUTFILE(hdl) \
    fclose((hdl));
#define WRITEOUTFILE(hdl, buf, buflen) \
    fwrite((buf), (buflen), 1, (hdl)); fflush((hdl));
#endif

#define ChlType2String(t) ChlTypeMap[(t)-1].name

/*****                                                                    */
/* Function: main                                                                    */
/*****                                                                    */

```

```

int main(int argc, char *argv[])
{
    /******
    /* MQAI variables
    /******
    MQHCONN hConn; /* handle to MQ connection
    MQCHAR qmName[MQ_Q_MGR_NAME_LENGTH+1]=""; /* default QMgr name
    MQLONG reason; /* reason code
    MQLONG connReason; /* MQCONN reason code
    MQLONG compCode; /* completion code
    MQHBAG adminBag = MQHB_UNUSABLE_HBAG; /* admin bag for mqExecute
    MQHBAG responseBag = MQHB_UNUSABLE_HBAG; /* response bag for mqExecute
    MQHBAG cAttrBag; /* bag containing chl attributes
    MQHBAG errorBag; /* bag containing cmd server error
    MQLONG mqExecuteCC; /* mqExecute completion code
    MQLONG mqExecuteRC; /* mqExecute reason code
    MQLONG chlNameLength; /* Actual length of chl name
    MQLONG chlType; /* Channel type
    MQLONG i; /* loop counter
    MQLONG numberOfBags; /* number of bags in response bag
    MQCHAR chlName[MQ_OBJECT_NAME_LENGTH+1]; /* name of chl extracted from bag
    MQCHAR OutputBuffer[100]; /* output data buffer
    OUTFILEHDL *outfp = NULL; /* output file handle

    /******
    /* Connect to the queue manager
    /******
    if (argc > 1)
        strncpy(qmName, argv[1], (size_t)MQ_Q_MGR_NAME_LENGTH);
    MQCONN(qmName, &hConn, &compCode, &connReason);

    /******
    /* Report the reason and stop if the connection failed.
    /******
    if (compCode == MQCC_FAILED)
    {
        CheckCallResult("Queue Manager connection", compCode, connReason);
        exit( (int)connReason);
    }

    /******
    /* Open the output file
    /******
    if (argc > 2)
    {
        OPENOUTFILE(outfp, argv[2]);
    }
    else
    {
        OPENOUTFILE(outfp, OUTFILE);
    }

    if(outfp == NULL)
    {
        printf("Could not open output file.\n");
        goto MOD_EXIT;
    }

    /******
    /* Create an admin bag for the mqExecute call
    /******
    mqCreateBag(MQCBO_ADMIN_BAG, &adminBag, &compCode, &reason);
    CheckCallResult("Create admin bag", compCode, reason);

    /******
    /* Create a response bag for the mqExecute call
    /******
    mqCreateBag(MQCBO_ADMIN_BAG, &responseBag, &compCode, &reason);
    CheckCallResult("Create response bag", compCode, reason);

    /******
    /* Put the generic channel name into the admin bag
    /******
    mqAddString(adminBag, MQCACH_CHANNEL_NAME, MQBL_NULL_TERMINATED, "*",
        &compCode, &reason);
    CheckCallResult("Add channel name", compCode, reason);

    /******
    /* Put the channel type into the admin bag
    /******
    mqAddInteger(adminBag, MQIACH_CHANNEL_TYPE, MQCHT_ALL, &compCode, &reason);
    CheckCallResult("Add channel type", compCode, reason);

```

```

/*****
/* Add an inquiry for various attributes */
/*****
mqAddInquiry(adminBag, MQIACH_CHANNEL_TYPE, &compCode, &reason);
CheckCallResult("Add inquiry", compCode, reason);

/*****
/* Send the command to find all the channel names and channel types. */
/* The mqExecute call creates the PCF structure required, sends it to */
/* the command server, and receives the reply from the command server into */
/* the response bag. The attributes are contained in system bags that are */
/* embedded in the response bag, one set of attributes per bag. */
/*****
mqExecute(hConn, /* MQ connection handle */
          MQCMD_INQUIRE_CHANNEL, /* Command to be executed */
          MQHB_NONE, /* No options bag */
          adminBag, /* Handle to bag containing commands */
          responseBag, /* Handle to bag to receive the response */
          MQHO_NONE, /* Put msg on SYSTEM.ADMIN.COMMAND.QUEUE */
          MQHO_NONE, /* Create a dynamic q for the response */
          &compCode, /* Completion code from the mqexecute */
          &reason); /* Reason code from mqexecute call */

/*****
/* Check the command server is started. If not exit. */
/*****
if (reason == MQRC_CMD_SERVER_NOT_AVAILABLE)
{
    printf("Please start the command server: <strmqcsv QMgrName="">\n");
    goto MOD_EXIT;
}

/*****
/* Check the result from mqExecute call. If successful find the channel */
/* types for all the channels. If failed find the error. */
/*****
if ( compCode == MQCC_OK ) /* Successful mqExecute */
{
    /*****
    /* Count the number of system bags embedded in the response bag from the */
    /* mqExecute call. The attributes for each channel are in separate bags. */
    /*****
    mqCountItems(responseBag, MQHA_BAG_HANDLE, &numberOfBags,
                &compCode, &reason);
    CheckCallResult("Count number of bag handles", compCode, reason);

    for ( i=0; i<numberOfbags; i++)
    {
        /*****
        /* Get the next system bag handle out of the mqExecute response bag. */
        /* This bag contains the channel attributes */
        /*****
        mqInquireBag(responseBag, MQHA_BAG_HANDLE, i, &cAttrsBag,
                    &compCode, &reason);
        CheckCallResult("Get the result bag handle", compCode, reason);

        /*****
        /* Get the channel name out of the channel attributes bag */
        /*****
        mqInquireString(cAttrsBag, MQCACH_CHANNEL_NAME, 0, MQ_OBJECT_NAME_LENGTH,
                      chlName, &chlNameLength, NULL, &compCode, &reason);
        CheckCallResult("Get channel name", compCode, reason);

        /*****
        /* Get the channel type out of the channel attributes bag */
        /*****
        mqInquireInteger(cAttrsBag, MQIACH_CHANNEL_TYPE, MQIND_NONE, &chlType,
                        &compCode, &reason);
        CheckCallResult("Get type", compCode, reason);

        /*****
        /* Use mqTrim to prepare the channel name for printing. */
        /* Print the result. */
        /*****
        mqTrim(MQ_CHANNEL_NAME_LENGTH, chlName, chlName, &compCode, &reason);
        sprintf(OutputBuffer, "%-20s%-9s", chlName, ChlType2String(chlType));
        WRITEOUTFILE(outfp, OutputBuffer, 29)
    }
}

else /* Failed mqExecute */

```

```

    {
        printf("Call to get channel attributes failed: Cc = %ld : Rc = %ld\n",
               compCode, reason);
        /******
        /* If the command fails get the system bag handle out of the mqexecute */
        /* response bag. This bag contains the reason from the command server */
        /* why the command failed. */
        /******
        if (reason == MQRCCF_COMMAND_FAILED)
        {
            mqInquireBag(responseBag, MQHA_BAG_HANDLE, 0, &errorBag,
                        &compCode, &reason);
            CheckCallResult("Get the result bag handle", compCode, reason);

            /******
            /* Get the completion code and reason code, returned by the command */
            /* server, from the embedded error bag. */
            /******
            mqInquireInteger(errorBag, MQIASY_COMP_CODE, MQIND_NONE, &mqExecuteCC,
                            &compCode, &reason);
            CheckCallResult("Get the completion code from the result bag",
                            compCode, reason);
            mqInquireInteger(errorBag, MQIASY_REASON, MQIND_NONE, &mqExecuteRC,
                            &compCode, &reason);
            CheckCallResult("Get the reason code from the result bag",
                            compCode, reason);
            printf("Error returned by the command server: Cc = %ld : Rc = %ld\n",
                   mqExecuteCC, mqExecuteRC);
        }
    }

MOD_EXIT:
    /******
    /* Delete the admin bag if successfully created. */
    /******
    if (adminBag != MQHB_UNUSABLE_HBAG)
    {
        mqDeleteBag(&adminBag, &compCode, &reason);
        CheckCallResult("Delete the admin bag", compCode, reason);
    }

    /******
    /* Delete the response bag if successfully created. */
    /******
    if (responseBag != MQHB_UNUSABLE_HBAG)
    {
        mqDeleteBag(&responseBag, &compCode, &reason);
        CheckCallResult("Delete the response bag", compCode, reason);
    }

    /******
    /* Disconnect from the queue manager if not already connected */
    /******
    if (connReason != MQRC_ALREADY_CONNECTED)
    {
        MQDISC(&hConn, &compCode, &reason);
        CheckCallResult("Disconnect from Queue Manager", compCode, reason);
    }

    /******
    /* Close the output file if open */
    /******
    if (outfp != NULL)
        CLOSEOUTFILE(outfp);

    return 0;
}

/******
/*
/* Function: CheckCallResult */
/*
/*
/******
/*
/* Input Parameters: Description of call */
/* Completion code */
/* Reason code */
/*
/* Output Parameters: None */
/*
/* Logic: Display the description of the call, the completion code and the */

```

```

/*      reason code if the completion code is not successful      */
/*      */
/*****
void CheckCallResult(char *callText, MQLONG cc, MQLONG rc)
{
    if (cc != MQCC_OK)
        printf("%s failed: Completion Code = %ld : Reason = %ld\n", callText,
               cc, rc);
}

```

## Sample C program for inquiring about queues and printing information (amqsailq.c)

The sample C program amqsailq.c inquires the current depth of the local queues using the MQAI.

```

/*****
/*
/* Program name: AMQSAILQ.C
/*
/* Description: Sample C program to inquire the current depth of the local
/*               queues using the IBM MQ Administration Interface (MQAI)
/*
/* Statement:    Licensed Materials - Property of IBM
/*
/*               84H2000, 5765-B73
/*               84H2001, 5639-B42
/*               84H2002, 5765-B74
/*               84H2003, 5765-B75
/*               84H2004, 5639-B43
/*
/*               (C) Copyright IBM Corp. 1999, 2022
/*
/*****
/*
/* Function:
/* AMQSAILQ is a sample C program that demonstrates how to inquire
/* attributes of the local queue manager using the MQAI interface. In
/* particular, it inquires the current depths of all the local queues.
/*
/* - A PCF command is built by placing items into an MQAI administration
/*   bag.
/*   These are:-
/*     - The generic queue name "*"
/*     - The type of queue required. In this sample we want to
/*       inquire local queues.
/*     - The attribute to be inquired. In this sample we want the
/*       current depths.
/*
/* - The mqExecute call is executed with the command MQCMD_INQUIRE_Q.
/*   The call generates the correct PCF structure.
/*   The default options to the call are used so that the command is sent
/*   to the SYSTEM.ADMIN.COMMAND.QUEUE.
/*   The reply from the command server is placed on a temporary dynamic
/*   queue.
/*   The reply from the MQCMD_INQUIRE_Q command is read from the
/*   temporary queue and formatted into the response bag.
/*
/* - The completion code from the mqExecute call is checked and if there
/*   is a failure from the command server, then the code returned by
/*   command server is retrieved from the system bag that has been
/*   embedded in the response bag to the mqExecute call.
/*
/* - If the call is successful, the depth of each local queue is placed
/*   in system bags embedded in the response bag of the mqExecute call.
/*   The name and depth of each queue is obtained from each of the bags
/*   and the result displayed on the screen.
/*
/* Note: The command server must be running.
/*
/*****
/*
/* AMQSAILQ has 1 parameter - the queue manager name (optional)
/*
/*****
/* Includes

```



```

/*****/
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <ctype.h>

#include <cmqc.h> /* MQI */
#include <cmqcfc.h> /* PCF */
#include <cmqbc.h> /* MQAI */

/*****/
/* Function prototypes */
/*****/
void CheckCallResult(MQCHAR *, MQLONG , MQLONG);

/*****/
/* Function: main */
/*****/
int main(int argc, char *argv[])
{
    /*****/
    /* MQAI variables */
    /*****/
    MQHCONN hConn; /* handle to IBM MQ connection */
    MQCHAR qmName[MQ_Q_MGR_NAME_LENGTH+1]=""; /* default QMgr name */
    MQLONG reason; /* reason code */
    MQLONG connReason; /* MQCONN reason code */
    MQLONG compCode; /* completion code */
    MQHBAG adminBag = MQHB_UNUSABLE_HBAG; /* admin bag for mqExecute */
    MQHBAG responseBag = MQHB_UNUSABLE_HBAG; /* response bag for mqExecute */
    MQHBAG qAttrsBag; /* bag containing q attributes */
    MQHBAG errorBag; /* bag containing cmd server error */
    MQLONG mqExecuteCC; /* mqExecute completion code */
    MQLONG mqExecuteRC; /* mqExecute reason code */
    MQLONG qNameLength; /* Actual length of q name */
    MQLONG qDepth; /* depth of queue */
    MQLONG i; /* loop counter */
    MQLONG numberOfBags; /* number of bags in response bag */
    MQCHAR qName[MQ_Q_NAME_LENGTH+1]; /* name of queue extracted from bag*/

    printf("Display current depths of local queues\n\n");

    /*****/
    /* Connect to the queue manager */
    /*****/
    if (argc > 1)
        strncpy(qmName, argv[1], (size_t)MQ_Q_MGR_NAME_LENGTH);
    MQCONN(qmName, &hConn, &compCode, &connReason);

    /*****/
    /* Report the reason and stop if the connection failed. */
    /*****/
    if (compCode == MQCC_FAILED)
    {
        CheckCallResult("Queue Manager connection", compCode, connReason);
        exit( (int)connReason);
    }

    /*****/
    /* Create an admin bag for the mqExecute call */
    /*****/
    mqCreateBag(MQCBO_ADMIN_BAG, &adminBag, &compCode, &reason);
    CheckCallResult("Create admin bag", compCode, reason);

    /*****/
    /* Create a response bag for the mqExecute call */
    /*****/
    mqCreateBag(MQCBO_ADMIN_BAG, &responseBag, &compCode, &reason);
    CheckCallResult("Create response bag", compCode, reason);

    /*****/
    /* Put the generic queue name into the admin bag */
    /*****/
    mqAddString(adminBag, MQCA_Q_NAME, MQBL_NULL_TERMINATED, "*",
        &compCode, &reason);
    CheckCallResult("Add q name", compCode, reason);

    /*****/
    /* Put the local queue type into the admin bag */
    /*****/
    mqAddInteger(adminBag, MQIA_Q_TYPE, MQQT_LOCAL, &compCode, &reason);
    CheckCallResult("Add q type", compCode, reason);
}

```

```

/*****
/* Add an inquiry for current queue depths */
/*****
mqAddInquiry(adminBag, MQIA_CURRENT_Q_DEPTH, &compCode, &reason);
CheckCallResult("Add inquiry", compCode, reason);

/*****
/* Send the command to find all the local queue names and queue depths. */
/* The mqExecute call creates the PCF structure required, sends it to */
/* the command server, and receives the reply from the command server into */
/* the response bag. The attributes are contained in system bags that are */
/* embedded in the response bag, one set of attributes per bag. */
/*****
mqExecute(hConn, /* IBM MQ connection handle */
          MQCMD_INQUIRE_Q, /* Command to be executed */
          MQHQB_NONE, /* No options bag */
          adminBag, /* Handle to bag containing commands */
          responseBag, /* Handle to bag to receive the response */
          MQHO_NONE, /* Put msg on SYSTEM.ADMIN.COMMAND.QUEUE */
          MQHO_NONE, /* Create a dynamic q for the response */
          &compCode, /* Completion code from the mqExecute */
          &reason); /* Reason code from mqExecute call */

/*****
/* Check the command server is started. If not exit. */
/*****
if (reason == MQRC_CMD_SERVER_NOT_AVAILABLE)
{
    printf("Please start the command server: <strmqcsv QMgrName>\n");
    MQDISC(&hConn, &compCode, &reason);
    CheckCallResult("Disconnect from Queue Manager", compCode, reason);
    exit(98);
}

/*****
/* Check the result from mqExecute call. If successful find the current */
/* depths of all the local queues. If failed find the error. */
/*****
if ( compCode == MQCC_OK ) /* Successful mqExecute */
{
    /*****
    /* Count the number of system bags embedded in the response bag from the */
    /* mqExecute call. The attributes for each queue are in a separate bag. */
    /*****
    mqCountItems(responseBag, MQHA_BAG_HANDLE, &numberOfBags, &compCode,
                  &reason);
    CheckCallResult("Count number of bag handles", compCode, reason);

    for ( i=0; i<numberOfBags; i++)
    {
        /*****
        /* Get the next system bag handle out of the mqExecute response bag. */
        /* This bag contains the queue attributes */
        /*****
        mqInquireBag(responseBag, MQHA_BAG_HANDLE, i, &qAttrsBag, &compCode,
                     &reason);
        CheckCallResult("Get the result bag handle", compCode, reason);

        /*****
        /* Get the queue name out of the queue attributes bag */
        /*****
        mqInquireString(qAttrsBag, MQCA_Q_NAME, 0, MQ_Q_NAME_LENGTH, qName,
                       &qNameLength, NULL, &compCode, &reason);
        CheckCallResult("Get queue name", compCode, reason);

        /*****
        /* Get the depth out of the queue attributes bag */
        /*****
        mqInquireInteger(qAttrsBag, MQIA_CURRENT_Q_DEPTH, MQIND_NONE, &qDepth,
                        &compCode, &reason);
        CheckCallResult("Get depth", compCode, reason);

        /*****
        /* Use mqTrim to prepare the queue name for printing. */
        /* Print the result. */
        /*****
        mqTrim(MQ_Q_NAME_LENGTH, qName, qName, &compCode, &reason)
        printf("%4d %-48s\n", qDepth, qName);
    }
}

```

```

else                                     /* Failed mqExecute */
{
    printf("Call to get queue attributes failed: Completion Code = %d :
           Reason = %d\n", compCode, reason);

    /******
    /* If the command fails get the system bag handle out of the mqExecute */
    /* response bag. This bag contains the reason from the command server */
    /* why the command failed. */
    /******
    if (reason == MQRCCF_COMMAND_FAILED)
    {
        mqInquireBag(responseBag, MQHA_BAG_HANDLE, 0, &errorBag, &compCode,
                     &reason);
        CheckCallResult("Get the result bag handle", compCode, reason);

        /******
        /* Get the completion code and reason code, returned by the command */
        /* server, from the embedded error bag. */
        /******
        mqInquireInteger(errorBag, MQIASY_COMP_CODE, MQIND_NONE, &mqExecuteCC,
                         &compCode, &reason);
        CheckCallResult("Get the completion code from the result bag",
                        compCode, reason);
        mqInquireInteger(errorBag, MQIASY_REASON, MQIND_NONE, &mqExecuteRC,
                         &compCode, &reason);
        CheckCallResult("Get the reason code from the result bag",
                        compCode, reason);
        printf("Error returned by the command server: Completion Code = %d :
               Reason = %d\n", mqExecuteCC, mqExecuteRC);
    }
}

/******
/* Delete the admin bag if successfully created. */
/******
if (adminBag != MQHB_UNUSABLE_HBAG)
{
    mqDeleteBag(&adminBag, &compCode, &reason);
    CheckCallResult("Delete the admin bag", compCode, reason);
}

/******
/* Delete the response bag if successfully created. */
/******
if (responseBag != MQHB_UNUSABLE_HBAG)
{
    mqDeleteBag(&responseBag, &compCode, &reason);
    CheckCallResult("Delete the response bag", compCode, reason);
}

/******
/* Disconnect from the queue manager if not already connected */
/******
if (connReason != MQRRC_ALREADY_CONNECTED)
{
    MQDISC(&hConn, &compCode, &reason);
    CheckCallResult("Disconnect from queue manager", compCode, reason);
}
return 0;
}

*****
* Function: CheckCallResult */
* */
* */
*****
* Input Parameters: Description of call */
* Completion code */
* Reason code */
* */
* Output Parameters: None */
* */
* Logic: Display the description of the call, the completion code and the */
* reason code if the completion code is not successful */
* */
*****
void CheckCallResult(char *callText, MQLONG cc, MQLONG rc)
{
    if (cc != MQCC_OK)

```

```
printf("%s failed: Completion Code = %d : Reason = %d\n",
      callText, cc, rc);
}
```

## Hints and tips for configuring IBM MQ

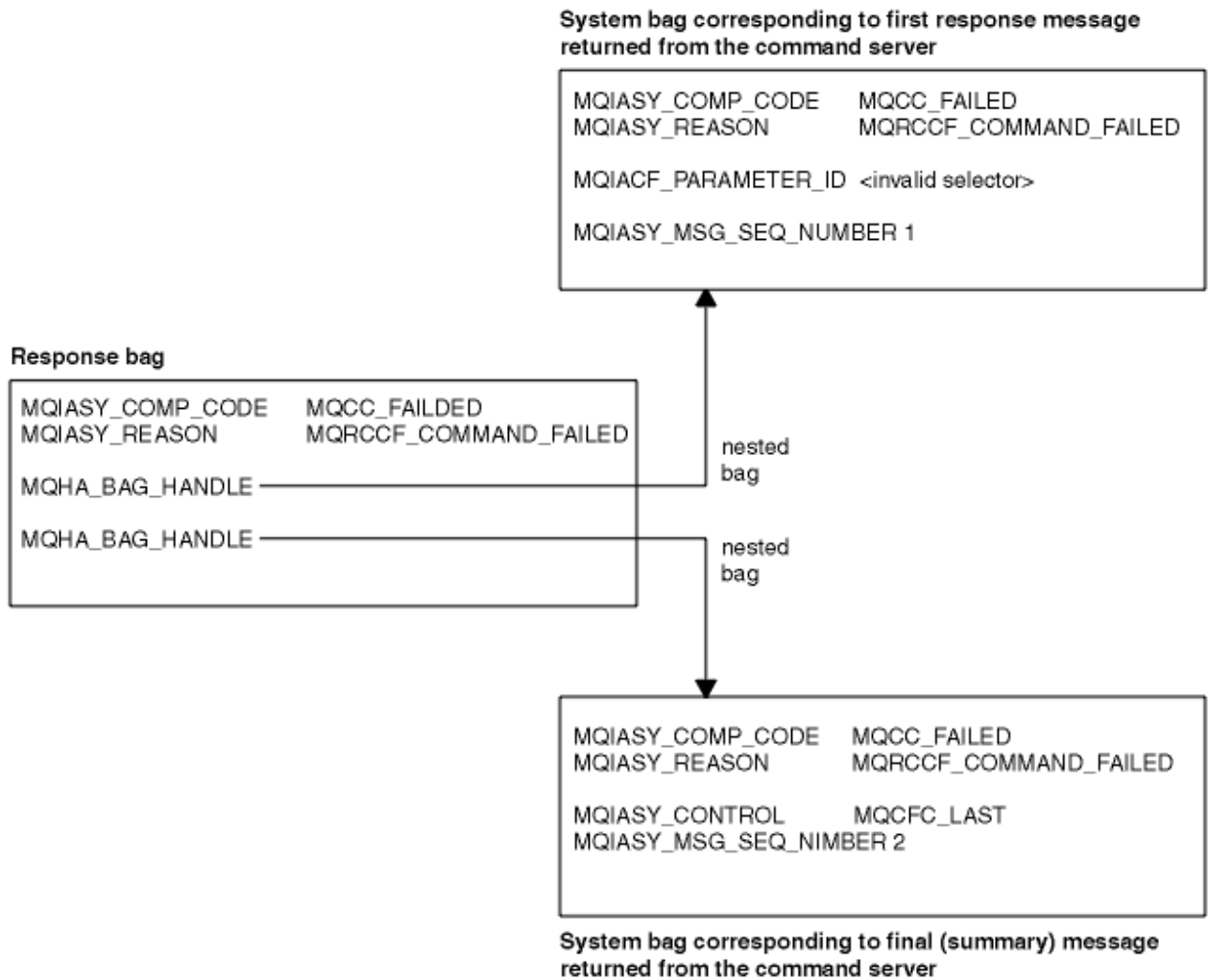
Programming hints and tips when using MQAI.

The MQAI uses PCF messages to send administration commands to the command server rather than dealing directly with the command server itself. Here are some tips for configuring IBM MQ using the MQAI:

- Character strings in IBM MQ are blank padded to a fixed length. Using C, null-terminated strings can normally be supplied as input parameters to IBM MQ programming interfaces.
- To clear the value of a string attribute, set it to a single blank rather than an empty string.
- Consider in advance the attributes that you want to change and inquire on just those attributes.
- Certain attributes cannot be changed, for example a queue name or a channel type. Ensure that you attempt to change only those attributes that can be modified. Refer to the list of required and optional parameters for the specific PCF change object. See [Definitions of the Programmable Command Formats](#).
- If an MQAI call fails, some detail of the failure is returned to the response bag. Further detail can then be found in a nested bag that can be accessed by the selector MQHA\_BAG\_HANDLE. For example, if an mqExecute call fails with a reason code of MQRCCF\_COMMAND\_FAILED, this information is returned in the response bag. A possible reason for this reason code is that a selector specified was not valid for the type of command message and this detail of information is found in a nested bag that can be accessed by a bag handle.

For more information on MQExecute, see [“Sending administration commands to the command server using the mqExecute call” on page 57](#)

The following diagram shows this scenario:



## Advanced topics

Information on indexing, data conversion and use of message descriptor

- Indexing

Indexes are used when replacing or removing existing data items from a bag to preserve insertion order. Full details on indexing can be found in [“Indexing in the MQAI”](#) on page 45.

- Data conversion

The strings contained in an MQAI data bag can be in a variety of coded character sets and these can be converted using the `mqSetInteger` call. Full details on data conversion can be found in [“Data conversion in the MQAI”](#) on page 46.

- Use of the message descriptor

MQAI generates a message descriptor which is set to an initial value when the data bag is created. Full details of the use of the message descriptor can be found in [“Use of the message descriptor in the MQAI”](#) on page 48.

### *Indexing in the MQAI*

Indexes are used when replacing or removing existing data items from a bag. There are three types of indexing, which allows data items to be retrieved easily.

Each selector and value within a data item in a bag have three associated index numbers:

- The index relative to other items that have the same selector.

- The index relative to the category of selector (user or system) to which the item belongs.
- The index relative to all the data items in the bag (user and system).

This allows indexing by user selectors, system selectors, or both as shown in [Figure 1 on page 46](#).

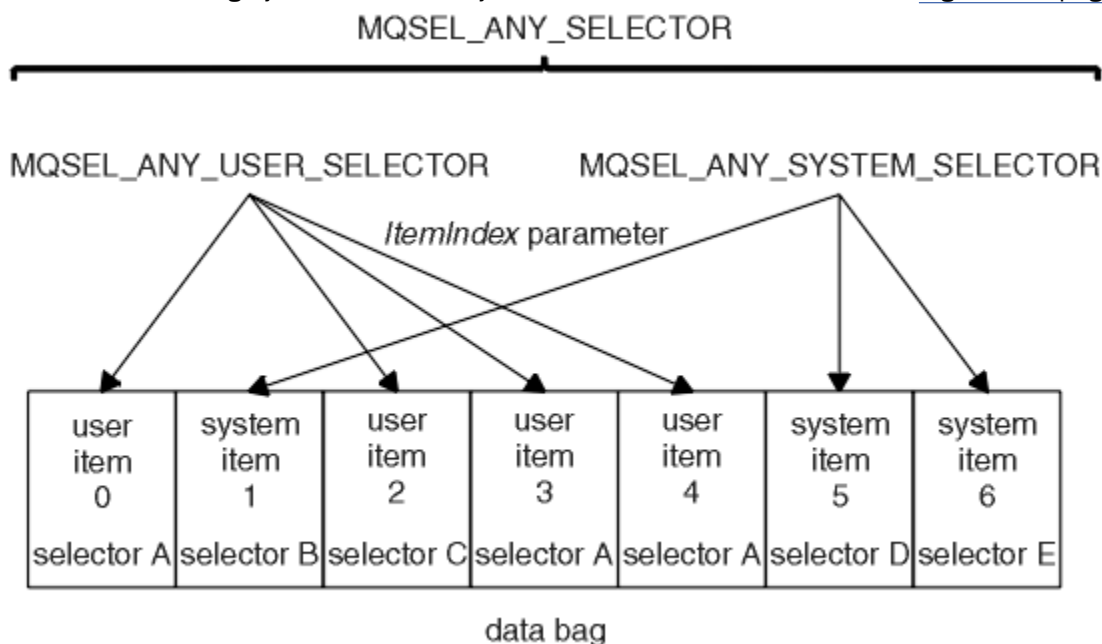


Figure 1. Indexing

In [Figure 1 on page 46](#), user item 3 (selector A) can be referred to by the following index pairs:

<b>Selector</b>	<b>ItemIndex</b>
selector A	1
MQSEL_ANY_USER_SELECTOR	2
MQSEL_ANY_SELECTOR	3

The index is zero-based like an array in C; if there are 'n' occurrences, the index ranges from zero through 'n-1', with no gaps.

Indexes are used when replacing or removing existing data items from a bag. When used in this way, the insertion order is preserved, but indexes of other data items can be affected. For examples of this, see [Changing information within a bag](#) and [Deleting data items](#).

The three types of indexing allow easy retrieval of data items. For example, if there are three instances of a particular selector in a bag, the mqCountItems call can count the number of instances of that selector, and the mqInquire\* calls can specify both the selector and the index to inquire those values only. This is useful for attributes that can have a list of values such as some of the exits on channels.

### **Data conversion in the MQAI**

The strings contained in an MQAI data bag can be in a variety of coded character sets. These strings can be converted using the mqSetInteger call.

Like PCF messages, the strings contained in an MQAI data bag can be in a variety of coded character sets. Usually, all of the strings in a PCF message are in the same coded character set; that is, the same set as the queue manager.

Each string item in a data bag contains two values; the string itself and the CCSID. The string that is added to the bag is obtained from the *Buffer* parameter of the mqAddString or mqSetString call. The CCSID is obtained from the system item containing a selector of MQIASY\_CODED\_CHAR\_SET\_ID. This is known as the *bag CCSID* and can be changed using the mqSetInteger call.

When you inquire the value of a string contained in a data bag, the CCSID is an output parameter from the call.

Table 2 on page 47 shows the rules applied when converting data bags into messages and vice versa:

<i>Table 2. CCSID processing</i>			
<b>MQAI call</b>	<b>CCSID</b>	<b>Input to call</b>	<b>Output to call</b>
<b>mqBagToBuffer</b>	Bag CCSID ( <u>1</u> )	Ignored	Unchanged
<b>mqBagToBuffer</b>	String CCSIDs in bag	Used	Unchanged
<b>mqBagToBuffer</b>	String CCSIDs in buffer	Not applicable	Copied from string CCSIDs in bag
<b>mqBufferToBag</b>	Bag CCSID ( <u>1</u> )	Ignored	Unchanged
<b>mqBufferToBag</b>	String CCSIDs in buffer	Used	Unchanged
<b>mqBufferToBag</b>	String CCSIDs in bag	Not applicable	Copied from string CCSIDs in buffer
<b>mqPutBag</b>	MQMD CCSID	Used	Unchanged ( <u>2</u> )
<b>mqPutBag</b>	Bag CCSID ( <u>1</u> )	Ignored	Unchanged
<b>mqPutBag</b>	String CCSIDs in bag	Used	Unchanged
<b>mqPutBag</b>	String CCSIDs in message sent	Not applicable	Copied from string CCSIDs in bag
<b>mqGetBag</b>	MQMD CCSID	Used for data conversion of message	Set to CCSID of data returned ( <u>3</u> )
<b>mqGetBag</b>	Bag CCSID ( <u>1</u> )	Ignored	Unchanged
<b>mqGetBag</b>	String CCSIDs in message	Used	Unchanged
<b>mqGetBag</b>	String CCSIDs in bag	Not applicable	Copied from string CCSIDs in message
<b>mqExecute</b>	Request-bag CCSID	Used for MQMD of request message ( <u>4</u> )	Unchanged
<b>mqExecute</b>	Reply-bag CCSID	Used for data conversion of reply message ( <u>4</u> )	Set to CCSID of data returned ( <u>3</u> )
<b>mqExecute</b>	String CCSIDs in request bag	Used for request message	Unchanged
<b>mqExecute</b>	String CCSIDs in reply bag	Not applicable	Copied from string CCSIDs in reply message

**Notes:**

1. Bag CCSID is the system item with selector MQIASY\_CODED\_CHAR\_SET\_ID.
2. MQCCSI\_Q\_MGR is changed to the actual queue manager CCSID.
3. If data conversion is requested, the CCSID of data returned is the same as the output value. If data conversion is not requested, the CCSID of data returned is the same as the message value. Note that no message is returned if data conversion is requested but fails.
4. If the CCSID is MQCCSI\_DEFAULT, the queue manager's CCSID is used.

## Use of the message descriptor in the MQAI

The message descriptor that the MQAI generates is set to an initial value when the data bag is created.

The PCF command type is obtained from the system item with selector MQIASY\_TYPE. When you create your data bag, the initial value of this item is set depending on the type of bag you create:

Table 3. PCF command type	
Type of bag	Initial value of MQIASY_TYPE item
MQCBO_ADMIN_BAG	MQCFT_COMMAND
MQCBO_COMMAND_BAG	MQCFT_COMMAND
MQCBO_*	MQCFT_USER

When the MQAI generates a message descriptor, the values used in the *Format* and *MsgType* parameters depend on the value of the system item with selector MQIASY\_TYPE as shown in [Table 3 on page 48](#).

Table 4. Format and MsgType parameters of the MQMD		
PCF command type	Format	MsgType
MQCFT_COMMAND	MQFMT_ADMIN	MQMT_REQUEST
MQCFT_REPORT	MQFMT_ADMIN	MQMT_REPORT
MQCFT_RESPONSE	MQFMT_ADMIN	MQMT_REPLY
MQCFT_TRACE_ROUTE	MQFMT_ADMIN	MQMT_DATAGRAM
MQCFT_EVENT	MQFMT_EVENT	MQMT_DATAGRAM
MQCFT_*	MQFMT_PCF	MQMT_DATAGRAM

[Table 4 on page 48](#) shows that if you create an administration bag or a command bag, the *Format* of the message descriptor is MQFMT\_ADMIN and the *MsgType* is MQMT\_REQUEST. This is suitable for a PCF request message sent to the command server when a response is expected back.

Other parameters in the message descriptor take the values shown in [Table 5 on page 48](#).

Table 5. Message descriptor values	
Parameter	Value
<i>StrucId</i>	MQMD_STRUC_ID
<i>Version</i>	MQMD_VERSION_1
<i>Report</i>	MQRO_NONE
<i>MsgType</i>	see <a href="#">Table 4 on page 48</a>
<i>Expiry</i>	30 seconds (note “1” on <a href="#">page 49</a> )
<i>Feedback</i>	MQFB_NONE
<i>Encoding</i>	MQENC_NATIVE
<i>CodedCharSetId</i>	depends on the bag CCSID (note “2” on <a href="#">page 49</a> )
<i>Format</i>	see <a href="#">Table 4 on page 48</a>
<i>Priority</i>	MQPRI_PRIORITY_AS_Q_DEF
<i>Persistence</i>	MQPER_NOT_PERSISTENT
<i>MsgId</i>	MQMI_NONE



Table 5. Message descriptor values (continued)	
Parameter	Value
<i>CorrelId</i>	MQCI_NONE
<i>BackoutCount</i>	0
<i>ReplyToQ</i>	see note “3” on page 49
<i>ReplyToQMgr</i>	blank

#### Notes:

1. This value can be overridden on the mqExecute call by using the *OptionsBag* parameter. For information about this, see [mqExecute](#).
2. See “Data conversion in the MQAI” on page 46.
3. Name of the user-specified reply queue or MQAI-generated temporary dynamic queue for messages of type MQMT\_REQUEST. Blank otherwise.

## Data bags

A data bag is a means of handling properties or parameters of objects using the MQAI.

### Data Bags

- The data bag contains zero or more *data items*. These data items are ordered within the bag as they are placed into the bag. This is called the *insertion order*. Each data item contains a *selector* that identifies the data item and a *value* of that data item that can be either an integer, a 64-bit integer, an integer filter, a string, a string filter, a byte string, a byte string filter, or a handle of another bag. Data items are described in details in “Data item” on page 52

There are two types of selector; *user selectors* and *system selectors*. These are described in [MQAI Selectors](#). The selectors are usually unique, but it is possible to have multiple values for the same selector. In this case, an *index* identifies the particular occurrence of selector that is required. Indexes are described in “Indexing in the MQAI” on page 45.

A hierarchy of these concepts is shown in [Figure 1](#).

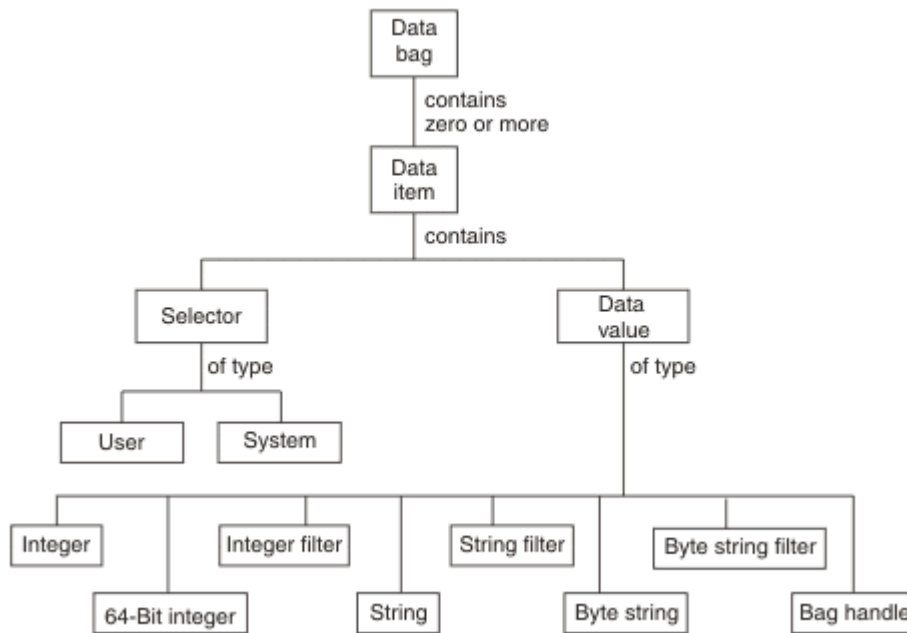


Figure 2. Hierarchy of MQAI concepts

The hierarchy has been explained in a previous paragraph.

## Types of data bag

You can choose the type of data bag that you want to create depending on the task that you wish to perform:

### user bag

A simple bag used for user data.

### administration bag

A bag created for data used to administer IBM MQ objects by sending administration messages to a command server. The administration bag automatically implies certain options as described in [“Creating and deleting data bags” on page 51](#).

### command bag

A bag also created for commands for administering IBM MQ objects. However, unlike the administration bag, the command bag does not automatically imply certain options although these options are available. For more information about options, see [“Creating and deleting data bags” on page 51](#).

### group bag

A bag used to hold a set of grouped data items. Group bags cannot be used for administering IBM MQ objects.

In addition, the **system bag** is created by the MQAI when a reply message is returned from the command server and placed into a user's output bag. A system bag cannot be modified by the user.

Using Data Bags The different ways of using data bags are listed in this topic:

## Using Data Bags

The different ways of using data bags are shown in the following list:

- You can create and delete data bags [“Creating and deleting data bags” on page 51](#).
- You can send data between applications using data bags [“Putting and receiving data bags” on page 51](#).
- You can add data items to data bags [“Adding data items to bags” on page 52](#).

- You can add an inquiry command within a data bag [“Adding an inquiry command to a bag”](#) on page 53.
- You can inquire within data bags [“Inquiring within data bags”](#) on page 54.
- You can count data items within a data bag [“Counting data items”](#) on page 56.
- You can change information within a data bag [“Changing information within a bag”](#) on page 54.
- You can clear a data bag [“Clearing a bag using the mqClearBag call”](#) on page 55.
- You can truncate a data bag [“Truncating a bag using the mqTruncateBag call”](#) on page 55.
- You can convert bags and buffers [“Converting bags and buffers”](#) on page 56.

## ***Creating and deleting data bags***

### **Creating data bags**

To use the MQAI, you first create a data bag using the mqCreateBag call. As input to this call, you supply one or more options to control the creation of the bag.

The *Options* parameter of the MQCreateBag call lets you choose whether to create a user bag, a command bag, a group bag, or an administration bag.

To create a user bag, a command bag, or a group bag, you can choose one or more further options to:

- Use the list form when there are two or more adjacent occurrences of the same selector in a bag.
- Reorder the data items as they are added to a PCF message to ensure that the parameters are in their correct order. For more information on data items, see [“Data item”](#) on page 52.
- Check the values of user selectors for items that you add to the bag.

Administration bags automatically imply these options.

A data bag is identified by its handle. The bag handle is returned from mqCreateBag and must be supplied on all other calls that use the data bag.

For a full description of the mqCreateBag call, see [mqCreateBag](#).

### **Deleting data bags**

Any data bag that is created by the user must also be deleted using the mqDeleteBag call. For example, if a bag is created in the user code, it must also be deleted in the user code.

System bags are created and deleted automatically by the MQAI. For more information about this, see [“Sending administration commands to the command server using the mqExecute call”](#) on page 57. User code cannot delete a system bag.

For a full description of the mqDeleteBag call, see [mqDeleteBag](#).

### ***Putting and receiving data bags***

Data can also be sent between applications by putting and getting data bags using the mqPutBag and mqGetBag calls. This lets the MQAI handle the buffer rather than the application. The mqPutBag call converts the contents of the specified bag into a PCF message and sends the message to the specified queue and the mqGetBag call removes the message from the specified queue and converts it back into a data bag. Therefore, the mqPutBag call is the equivalent of the mqBagToBuffer call followed by MQPUT, and the mqGetBag is the equivalent of the MQGET call followed by mqBufferToBag.

For more information on sending and receiving PCF messages in a specific queue, see [“Sending and receiving PCF messages in a specified queue”](#) on page 12

**Note:** If you choose to use the mqGetBag call, the PCF details within the message must be correct; if they are not, an appropriate error results and the PCF message is not returned.

## **Data item**

Data items are used to populate data bags when they are created. These data items can be user or system items.

These user items contain user data such as attributes of objects that are being administered. System items should be used for more control over the messages generated: for example, the generation of message headers. For more information about system items, see [“System items” on page 52](#).

## **Types of Data Items**

When you have created a data bag, you can populate it with integer or character-string items. You can inquire about all three types of item.

The data item can either be integer or character-string items. Here are the types of data item available within the MQAI:

- Integer
- 64-bit integer
- Integer filter
- Character-string
- String filter
- Byte string
- Byte string filter
- Bag handle

## **Using Data Items**

These are the following ways of using data items:

- [“Counting data items” on page 56](#).
- [“Deleting data items” on page 56](#).
- [“Adding data items to bags” on page 52](#).
- [“Filtering and querying data items” on page 53](#).

### *System items*

System items can be used for:

- The generation of PCF headers. System items can control the PCF command identifier, control options, message sequence number, and command type.
- Data conversion. System items handle the character-set identifier for the character-string items in the bag.

Like all data items, system items consist of a selector and a value. For information about these selectors and what they are for, see [MQAI Selectors](#).

System items are unique. One or more system items can be identified by a system selector. There is only one occurrence of each system selector.

Most system items can be modified (see [“Changing information within a bag” on page 54](#)), but the bag-creation options cannot be changed by the user. You cannot delete system items. (See [“Deleting data items” on page 56](#).)

### *Adding data items to bags*

When a data bag is created, you can populate it with data items. These data items can be user or system items. For more information about data items, see [“Data item” on page 52](#).

The MQAI lets you add integer items, 64-bit integer items, integer filter items, character-string items, string filter, byte string items, and byte string filter items to bags and this is shown in [Figure 3 on page](#)

53. The items are identified by a selector. Usually one selector identifies one item only, but this is not always the case. If a data item with the specified selector is already present in the bag, an additional instance of that selector is added to the end of the bag.

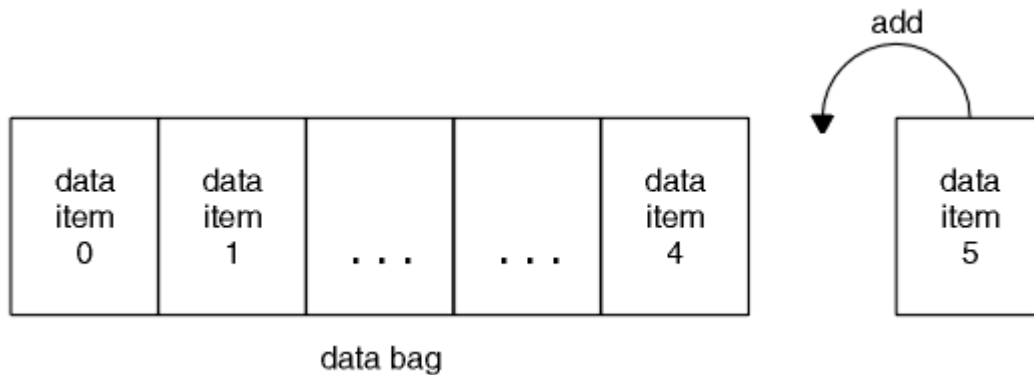


Figure 3. Adding data items

Add data items to a bag using the mqAdd\* calls:

- To add integer items, use the mqAddInteger call as described in [mqAddInteger](#)
- To add 64-bit integer items, use the mqAddInteger64 call as described in [mqAddInteger64](#)
- To add integer filter items, use the mqAddIntegerFilter call as described in [mqAddIntegerFilter](#)
- To add character-string items, use the mqAddString call as described in [mqAddString](#)
- To add string filter items, use the mqAddStringFilter call as described in [mqAddStringFilter](#)
- To add byte string items, use the mqAddByteString call as described in [mqAddByteString](#)
- To add byte string filter items, use the mqAddByteStringFilter call as described in [mqAddByteStringFilter](#)

For more information on adding data items to a bag, see [“System items” on page 52](#).

#### Adding an inquiry command to a bag

The mqAddInquiry call is used to add an inquiry command to a bag. The call is specifically for administration purposes, so it can be used with administration bags only. It lets you specify the selectors of attributes on which you want to inquire from IBM MQ.

For a full description of the mqAddInquiry call, see [mqAddInquiry](#).

#### Filtering and querying data items

When using the MQAI to inquire about the attributes of IBM MQ objects, you can control the data that is returned to your program in two ways.

- You can **filter** the data that is returned using the mqAddInteger and mqAddString calls. This approach lets you specify a *Selector* and *ItemValue* pair, for example:

```
mqAddInteger(inputbag, MQIA_Q_TYPE, MQQT_LOCAL)
```

This example specifies that the queue type (*Selector*) must be local (*ItemValue*) and this specification must match the attributes of the object (in this case, a queue) about which you are inquiring.

Other attributes that can be filtered correspond to the PCF Inquire\* commands that can be found in [“Introduction to Programmable Command Formats” on page 9](#). For example, to inquire about the attributes of a channel, see the Inquire Channel command in this product documentation. The "Required parameters" and "Optional parameters" of the Inquire Channel command identify the selectors that you can use for filtering.

- You can **query** particular attributes of an object using the mqAddInquiry call. This specifies the selector in which you are interested. If you do not specify the selector, all attributes of the object are returned.

Here is an example of filtering and querying the attributes of a queue:

```
/* Request information about all queues */
mqAddString(adminbag, MQCA_Q_NAME, "*")

/* Filter attributes so that local queues only are returned */
mqAddInteger(adminbag, MQIA_Q_TYPE, MQQT_LOCAL)

/* Query the names and current depths of the local queues */
mqAddInquiry(adminbag, MQCA_Q_NAME)
mqAddInquiry(adminbag, MQIA_CURRENT_Q_DEPTH)

/* Send inquiry to the command server and wait for reply */
mqExecute(MQCMD_INQUIRE_Q, ...)
```

For more examples of filtering and querying data items, see [“Examples of using the MQAI” on page 23](#).

### *Inquiring within data bags*

You can inquire about:

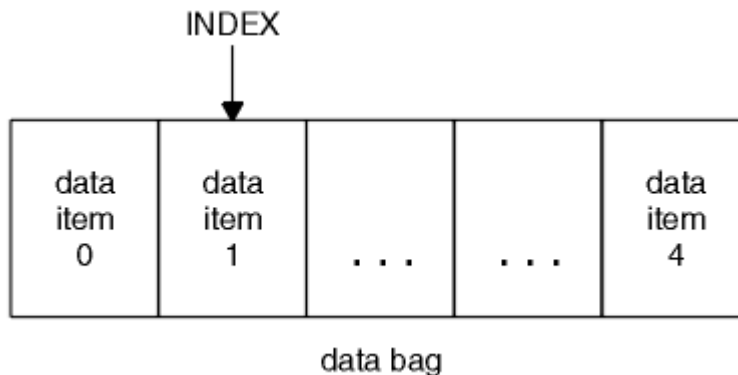
- The value of an integer item using the mqInquireInteger call. See [mqInquireInteger](#).
- The value of a 64-bit integer item using the mqInquireInteger64 call. See [mqInquireInteger64](#).
- The value of an integer filter item using the mqInquireIntegerFilter call. See [mqInquireIntegerFilter](#).
- The value of a character-string item using the mqInquireString call. See [mqInquireString](#).
- The value of a string filter item using the mqInquireStringFilter call. See [mqInquireStringFilter](#).
- The value of a byte string item using the mqInquireByteString call. See [mqInquireByteString](#).
- The value of a byte string filter item using the mqInquireByteStringFilter call. See [mqInquireByteStringFilter](#).
- The value of a bag handle using the mqInquireBag call. See [mqInquireBag](#).

You can also inquire about the type (integer, 64-bit integer, integer filter, character string, string filter, byte string, byte string filter or bag handle) of a specific item using the mqInquireItemInfo call. See [mqInquireItemInfo](#).

### *Changing information within a bag*

The MQAI lets you change information within a bag using the mqSet\* calls. You can:

1. Modify data items within a bag. The index allows an individual instance of a parameter to be replaced by identifying the occurrence of the item to be modified (see [Figure 4 on page 54](#)).



*Figure 4. Modifying a single data item*

2. Delete all existing occurrences of the specified selector and add a new occurrence to the end of the bag. (See [Figure 5 on page 55](#).) A special index value allows **all** instances of a parameter to be replaced.

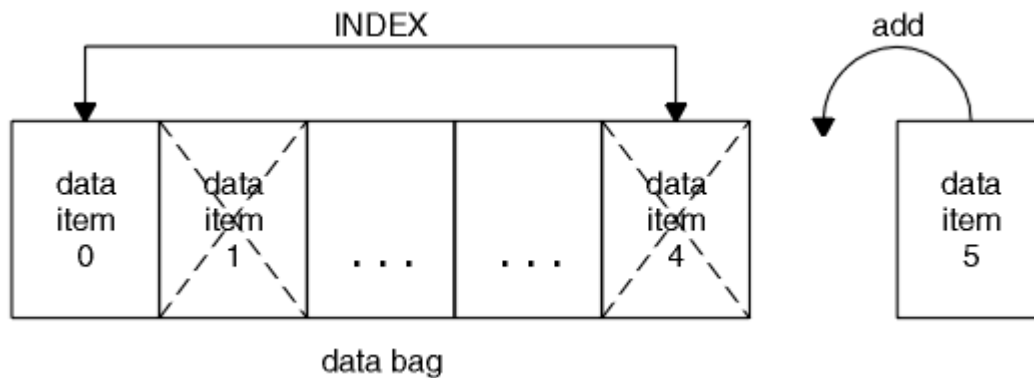


Figure 5. Modifying all data items

**Note:** The index preserves the insertion order within the bag but can affect the indices of other data items.

The `mqSetInteger` call lets you modify integer items within a bag. The `mqSetInteger64` call lets you modify 64-bit integer items. The `mqSetIntegerFilter` call lets you modify integer filter items. The `mqSetString` call lets you modify character-string items. The `mqSetStringFilter` call lets you modify string filter items. The `mqSetByteString` call lets you modify byte string items. The `mqSetByteStringFilter` call lets you modify byte string filter items. Alternatively, you can use these calls to delete all existing occurrences of the specified selector and add a new occurrence at the end of the bag. The data item can be a user item or a system item.

For a full description of these calls, see:

- [mqSetInteger](#)
- [mqSetInteger64](#)
- [mqSetIntegerFilter](#)
- [mqSetString](#)
- [mqSetStringFilter](#)
- [mqSetByteString](#)
- [mqSetByteStringFilter](#)

#### *Clearing a bag using the `mqClearBag` call*

The `mqClearBag` call removes all user items from a user bag and resets system items to their initial values. System bags contained within the bag are also deleted.

For a full description of the `mqClearBag` call, see [mqClearBag](#).

#### *Truncating a bag using the `mqTruncateBag` call*

The `mqTruncateBag` call reduces the number of user items in a user bag by deleting the items from the end of the bag, starting with the most recently added item. For example, it can be used when using the same header information to generate more than one message.

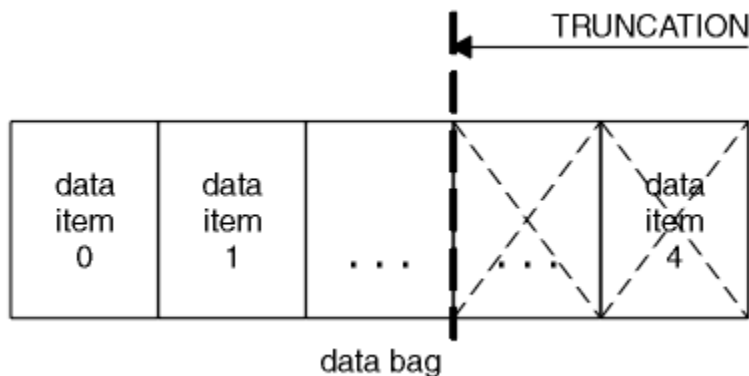


Figure 6. Truncating a bag

For a full description of the `mqTruncateBag` call, see [mqTruncateBag](#).

#### Converting bags and buffers

To send data between applications, firstly the message data is placed in a bag. Then, the data in the bag is converted into a PCF message using the `mqBagToBuffer` call. The PCF message is sent to the required queue using the `MQPUT` call. This is shown in Figure 7 on page 56. For a full description of the `mqBagToBuffer` call, see [mqBagToBuffer](#).

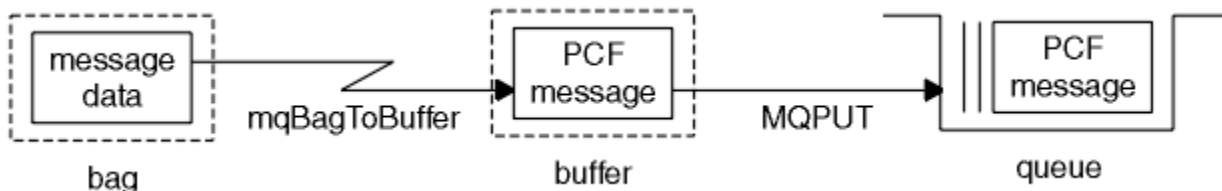


Figure 7. Converting bags to PCF messages

To receive data, the message is received into a buffer using the `MQGET` call. The data in the buffer is then converted into a bag using the `mqBufferToBag` call, providing the buffer contains a valid PCF message. This is shown in Figure 8 on page 56. For a full description of the `mqBufferToBag` call, see [mqBufferToBag](#).

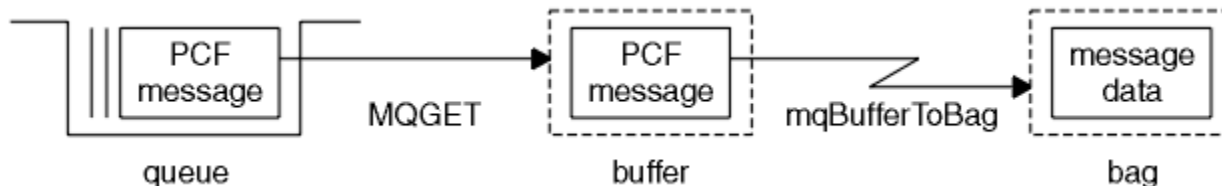


Figure 8. Converting PCF messages to bag form

#### Counting data items

The `mqCountItems` call counts the number of user items, system items, or both, that are stored in a data bag, and returns this number. For example, `mqCountItems( Bag, 7, ...)`, returns the number of items in the bag with a selector of 7. It can count items by individual selector, by user selectors, by system selectors, or by all selectors.

**Note:** This call counts the number of data items, not the number of unique selectors in the bag. A selector can occur multiple times, so there might be fewer unique selectors in the bag than data items.

For a full description of the `mqCountItems` call, see [mqCountItems](#).

#### Deleting data items

You can delete items from bags in a number of ways. You can:

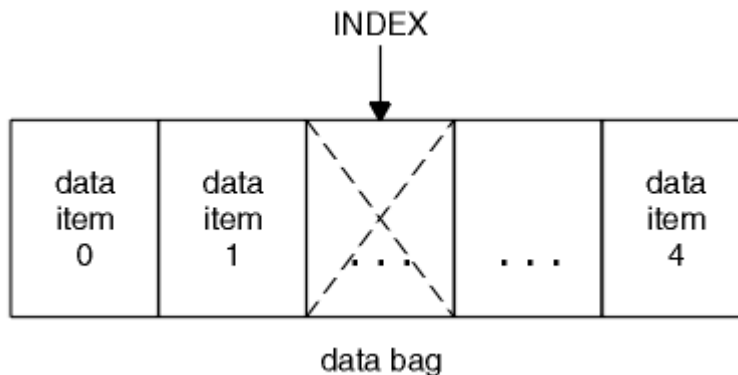


- Remove one or more user items from a bag. For detailed information, see [“Deleting data items from a bag using the mqDeleteItem call”](#) on page 57.
- Delete **all** user items from a bag, that is, *clear* a bag. For detailed information see [“Clearing a bag using the mqClearBag call”](#) on page 55.
- Delete user items from the end of a bag, that is, *truncate* a bag. For detailed information, see [“Truncating a bag using the mqTruncateBag call”](#) on page 55.

#### *Deleting data items from a bag using the mqDeleteItem call*

The mqDeleteItem call removes one or more user items from a bag. The index is used to delete either:

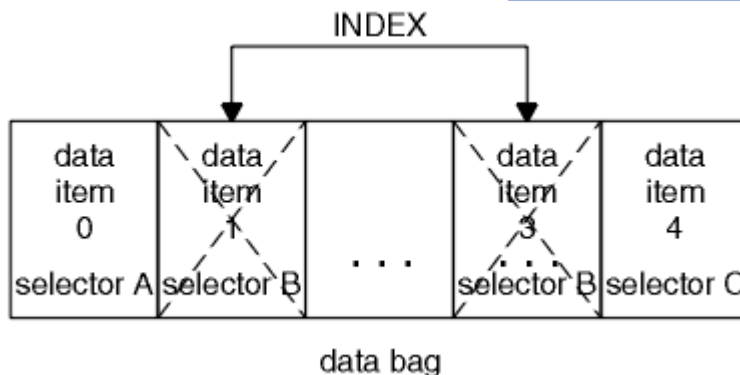
1. A single occurrence of the specified selector. (See [Figure 9 on page 57.](#))



*Figure 9. Deleting a single data item*

or

2. All occurrences of the specified selector. (See [Figure 10 on page 57.](#))



*Figure 10. Deleting all data items*

**Note:** The index preserves the insertion order within the bag but can affect the indices of other data items. For example, the mqDeleteItem call does not preserve the index values of the data items that follow the deleted item because the indices are reorganized to fill the gap that remains from the deleted item.

For a full description of the mqDeleteItem call, see [mqDeleteItem](#).

## **Sending administration commands to the command server using the mqExecute call**

When a data bag has been created and populated, an administrative command message can be sent to the command server of a queue manager using the mqExecute call. This handles the exchange with the command server and returns responses in a bag.

After you have created and populated your data bag, you can send an administration command message to the command server of a queue manager. The easiest way to do this is by using the mqExecute call.

The mqExecute call sends an administration command message as a nonpersistent message and waits for any responses. Responses are returned in a response bag. These might contain information about attributes relating to several IBM MQ objects or a series of PCF error response messages, for example. Therefore, the response bag could contain a return code only or it could contain *nested bags*.

Response messages are placed into system bags that are created by the system. For example, for inquiries about the names of objects, a system bag is created to hold those object names and the bag is inserted into the user bag. Handles to these bags are then inserted into the response bag and the nested bag can be accessed by the selector MQHA\_BAG\_HANDLE. The system bag stays in storage, if it is not deleted, until the response bag is deleted.

The concept of *nesting* is shown in Figure 11 on page 58.

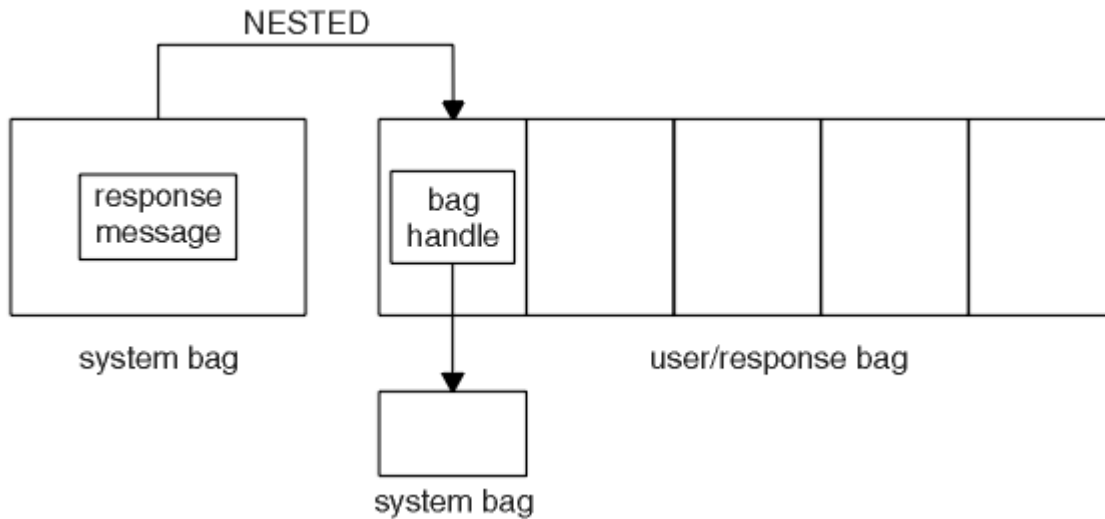


Figure 11. Nesting

As input to the mqExecute call, you must supply:

- An MQI connection handle.
- The command to be executed. This should be one of the MQCMD\_\* values.

**Note:** If this value is not recognized by the MQAI, the value is still accepted. However, if the mqAddInquiry call was used to insert values into the bag, this parameter must be an INQUIRE command recognized by the MQAI. That is, the parameter should be of the form MQCMD\_INQUIRE\_\*.

- Optionally, a handle of the bag containing options that control the processing of the call. This is also where you can specify the maximum time in milliseconds that the MQAI should wait for each reply message.
- A handle of the administration bag that contains details of the administration command to be issued.
- A handle of the response bag that receives the reply messages.

The following are optional:

- An object handle of the queue where the administration command is to be placed.

If no object handle is specified, the administration command is placed on the SYSTEM.ADMIN.COMMAND.QUEUE belonging to the currently connected queue manager. This is the default.

- An object handle of the queue where reply messages are to be placed.

You can choose to place the reply messages on a dynamic queue that is created automatically by the MQAI. The queue created exists for the duration of the call only, and is deleted by the MQAI on exit from the mqExecute call.

For examples uses of the mqExecute call, see [Example code](#)

## Administration using the MQ Explorer

---

The MQ Explorer allows you to perform local or remote administration of your network from a computer running Windows, or Linux x86-64 only.

IBM MQ for Windows and IBM MQ for Linux x86-64 provide an administration interface called the MQ Explorer to perform administration tasks as an alternative to using control or MQSC commands. [Comparing command sets](#) shows you what you can do using the MQ Explorer.

The MQ Explorer allows you to perform local or remote administration of your network from a computer running Windows, or Linux x86-64, by pointing the MQ Explorer at the queue managers and clusters you are interested in. The platforms and levels of IBM MQ that can be administered using the MQ Explorer are described in [“Remote queue managers”](#) on page 60.

To configure remote IBM MQ queue managers so that MQ Explorer can administer them, see [“Prerequisite software and definitions”](#) on page 61.

It allows you to perform tasks, typically associated with setting up and fine-tuning the working environment for IBM MQ, either locally or remotely within a Windows or Linux x86-64 system domain.

On Linux, the MQ Explorer might fail to start if you have more than one Eclipse installation. If this happens, start the MQ Explorer using a different user ID to the one you use for the other Eclipse installation.

On Linux, to start the MQ Explorer successfully, you must be able to write a file to your home directory, and the home directory must exist.

## What you can do with the IBM MQ Explorer

This is a list of the tasks that you can perform using the IBM MQ Explorer.

With the IBM MQ Explorer, you can:

- Create and delete a queue manager (on your local machine only).
- Start and stop a queue manager (on your local machine only).
- Define, display, and alter the definitions of IBM MQ objects such as queues and channels.
- Browse the messages on a queue.
- Start and stop a channel.
- View status information about a channel, listener, queue, or service objects.
- View queue managers in a cluster.
- Check to see which applications, users, or channels have a particular queue open.
- Create a new queue manager cluster using the *Create New Cluster* wizard.
- Add a queue manager to a cluster using the *Add Queue Manager to Cluster* wizard.
- Manage the authentication information object, used with Secure Sockets Layer (SSL) channel security.
- Create and delete channel initiators, trigger monitors, and listeners.
- Start or stop the command servers, channel initiators, trigger monitors, and listeners.
- Set specific services to start automatically when a queue manager is started.
- Modify the properties of queue managers.
- Change the local default queue manager.
- Invoke the **strmqikm** (ikeyMan) GUI to manage secure sockets layer (SSL) certificates, associate certificates with queue managers, and configure and setup certificate stores (on your local machine only).
- Create JMS objects from IBM MQ objects, and IBM MQ objects from JMS objects.
- Create a JMS Connection Factory for any of the currently supported types.

- Modify the parameters for any service, such as the TCP port number for a listener, or a channel initiator queue name.
- Start or stop the service trace.

You perform administration tasks using a series of *Content Views* and *Property dialogs*.

### **Content View**

A Content View is a panel that can display the following:

- Attributes, and administrative options relating to IBM MQ itself.
- Attributes, and administrative options relating to one or more related objects.
- Attributes, and administrative options for a cluster.

### **Property dialogs**

A property dialog is a panel that displays attributes relating to an object in a series of fields, some of which you can edit.

You navigate through the IBM MQ Explorer using the *Navigator view*. The Navigator allows you to select the Content View you require.

## **Remote queue managers**

There are two exceptions to the supported queue managers that you can connect to.

From a Windows or Linux (x86 and x86-64 platforms) system, the IBM MQ Explorer can connect to all supported queue managers with the following exceptions:

- IBM MQ for z/OS queue managers earlier than Version 6.0.
- Currently supported MQSeries® V2 queue managers.

The IBM MQ Explorer handles the differences in the capabilities between the different command levels and platforms. However, if it encounters an attribute that it does not recognize, the attribute will not be visible.

If you intend to remotely administer a V6.0 or later queue manager on Windows using the IBM MQ Explorer on an IBM MQ V5.3 computer, you must install Fix Pack 9 (CSD9) or later on your IBM MQ for Windows V5.3 computer.

If you intend to remotely administer a V5.3 queue manager on iSeries using the IBM MQ Explorer on an IBM MQ V6.0 or later computer, you must install Fix Pack 11 (CSD11) or later on your IBM MQ for iSeries V5.3 computer. This fix pack corrects connection problems between the IBM MQ Explorer and the iSeries queue manager.

## **Deciding whether to use the IBM MQ Explorer**

When deciding whether to use the IBM MQ Explorer at your installation, consider the information listed in this topic.

You need to be aware of the following points:

### **Object names**

If you use lowercase names for queue managers and other objects with the IBM MQ Explorer, when you work with the objects using MQSC commands, you must enclose the object names in single quotation marks, or IBM MQ does not recognize them.

### **Large queue managers**

The IBM MQ Explorer works best with small queue managers. If you have a large number of objects on a single queue manager, you might experience delays while the IBM MQ Explorer extracts the required information to present in a view.

### **Clusters**

IBM MQ clusters can potentially contain hundreds or thousands of queue managers. The IBM MQ Explorer presents the queue managers in a cluster using a tree structure. The physical size of a cluster

does not affect the speed of the IBM MQ Explorer dramatically because the IBM MQ Explorer does not connect to the queue managers in the cluster until you select them.

## Setting up the IBM MQ Explorer

This section outlines the steps you need to take to set up the IBM MQ Explorer.

- [“Prerequisite software and definitions” on page 61](#)
- [“Security” on page 61](#)
- [“Showing and hiding queue managers and clusters” on page 65](#)
- [“Cluster membership” on page 65](#)
- [“Data conversion” on page 66](#)

### Prerequisite software and definitions

Ensure that you satisfy the following requirements before trying to use the MQ Explorer.

The MQ Explorer can connect to remote queue managers using the TCP/IP communication protocol only.

Check that:

1. A command server is running on every remotely administered queue manager.
2. A suitable TCP/IP listener object must be running on every remote queue manager. This object can be the IBM MQ listener or, on UNIX and Linux systems, the inetd daemon.
3. A server-connection channel, by default named SYSTEM.ADMIN.SVRCONN, exists on all remote queue managers.

You can create the channel using the following MQSC command:

```
DEFINE CHANNEL(SYSTEM.ADMIN.SVRCONN) CHLTYPE(SVRCONN)
```

This command creates a basic channel definition. If you want a more sophisticated definition (to set up security, for example), you need additional parameters. For more information, see [DEFINE CHANNEL](#).

4. The system queue, SYSTEM.MQEXPLORER.REPLY.MODEL, must exist.

### Security

If you are using IBM MQ in an environment where it is important for you to control user access to particular objects, you might need to consider the security aspects of using the IBM MQ Explorer.

#### ***Authorization to use the IBM MQ Explorer***

Any user can use the IBM MQ Explorer, but certain authorities are required to connect, access, and manage queue managers.

To perform local administrative tasks using the IBM MQ Explorer, a user is required to have the necessary authority to perform the administrative tasks. If the user is a member of the mqm group, the user has authority to perform all local administrative tasks.

To connect to a remote queue manager and perform remote administrative tasks using the IBM MQ Explorer, the user executing the IBM MQ Explorer is required to have the following authorities:

- CONNECT authority on the target queue manager object
- INQUIRE authority on the target queue manager object
- DISPLAY authority to the target queue manager object
- INQUIRE authority to the queue, SYSTEM.MQEXPLORER.REPLY.MODEL
- DISPLAY authority to the queue, SYSTEM.MQEXPLORER.REPLY.MODEL
- INPUT (get) authority to the queue, SYSTEM.MQEXPLORER.REPLY.MODEL
- OUTPUT (put) authority to the queue, SYSTEM.ADMIN.COMMAND.QUEUE

- INQUIRE authority on the queue, SYSTEM.ADMIN.COMMAND.QUEUE
- Authority to perform the action selected

**Note:** INPUT authority relates to input to the user from a queue (a get operation). OUTPUT authority relates to output from the user to a queue (a put operation).

To connect to a remote queue manager on IBM MQ for z/OS and perform remote administrative tasks using the IBM MQ Explorer, the following must be provided:

- A RACF® profile for the system queue, SYSTEM.MQEXPLORER.REPLY.MODEL
- A RACF profile for the queues, AMQ.MQEXPLORER.\*

In addition, the user executing the IBM MQ Explorer is required to have the following authorities:

- RACF UPDATE authority to the system queue, SYSTEM.MQEXPLORER.REPLY.MODEL
- RACF UPDATE authority to the queues, AMQ.MQEXPLORER.\*
- CONNECT authority on the target queue manager object
- Authority to perform the action selected
- READ authority to all the hlq.DISPLAY.object profiles in the MQCMD class

For information about how to grant authority to IBM MQ objects, see [Giving access to an IBM MQ object on UNIX or Linux systems and Windows](#).

If a user attempts to perform an operation that they are not authorized to perform, the target queue manager invokes authorization failure procedures and the operation fails.

The default filter in the IBM MQ Explorer is to display all IBM MQ objects. If there are any IBM MQ objects that a user does not have DISPLAY authority to, authorization failures are generated. If authority events are being recorded, restrict the range of objects that are displayed to those objects that the user has DISPLAY authority to.

### ***Security for connecting to remote queue managers***

You must secure the channel between the IBM MQ Explorer and each remote queue manager.

The IBM MQ Explorer connects to remote queue managers as an MQI client application. This means that each remote queue manager must have a definition of a server-connection channel and a suitable TCP/IP listener. If you do not secure your server connection channel it is possible for a malicious application to connect to the same server connection channel and gain access to the queue manager objects with unlimited authority. In order to secure your server connection channel either specify a non-blank value for the MCAUSER attribute of the channel, use channel authentication records, or use a security exit.

**The default value of the MCAUSER attribute is the local user ID.** If you specify a non-blank user name as the MCAUSER attribute of the server connection channel, all programs connecting to the queue manager using this channel run with the identity of the named user and have the same level of authority. This does not happen if you use channel authentication records.

### ***Using a security exit with the IBM MQ Explorer***

You can specify a default security exit and queue manager specific security exits using the IBM MQ Explorer.

You can define a default security exit, which can be used for all new client connections from the IBM MQ Explorer. This default exit can be overridden at the time a connection is made. You can also define a security exit for a single queue manager or a set of queue managers, which takes effect when a connection is made. You specify exits using the IBM MQ Explorer. For more information, see the IBM MQ Help Center.

## Using the MQ Explorer to connect to a remote queue manager using SSL-enabled MQI channels

The MQ Explorer connects to remote queue managers using an MQI channel. If you want to secure the MQI channel using SSL security, you must establish the channel using a client channel definition table.

For information how to establish an MQI channel using a client channel definition table, see [Overview of IBM MQ MQI clients](#).

When you have established the channel using a client channel definition table, you can use the MQ Explorer to connect to a remote queue manager using SSL-enabled MQI channel, as described in [“Tasks on the system that hosts the remote queue manager” on page 63](#) and [“Tasks on the system that hosts the MQ Explorer” on page 63](#).

### Tasks on the system that hosts the remote queue manager

On the system hosting the remote queue manager, perform the following tasks:

1. Define a server connection and client connection pair of channels, and specify the appropriate value for the `SSLCIPH` attribute on the server connection on both channels. For more information about the `SSLCIPH` attribute, see [Protecting channels with SSL](#).
2. Send the channel definition table `AMQCLCHL.TAB`, which is found in the queue manager's `@ipcc` directory, to the system hosting the MQ Explorer.
3. Start a TCP/IP listener on a designated port.
4. Place both the CA and personal SSL certificates into the SSL directory of the queue manager:
  - `/var/mqm/qmgrs/+QMNAME+/SSL` for UNIX and Linux systems
  - `C:\Program Files\IBM\WebSphere MQ\qmgrs\+QMNAME+\SSL` for Windows systemsWhere `+QMNAME+` is a token representing the name of the queue manager.
5. Create a key database file of type CMS named `key.kdb`. Stash the password in a file either by checking the option in the **strmqikm** (iKeyman) GUI, or by using the `-stash` option with the **runmqckm** commands.
6. Add the CA certificates to the key database created in the previous step.
7. Import the personal certificate for the queue manager into the key database.

For more detailed information about working with the Secure Sockets Layer on Windows systems, see [Working with SSL or TLS on UNIX, Linux and Windows systems](#).

### Tasks on the system that hosts the MQ Explorer

On the system hosting the MQ Explorer, perform the following tasks:

1. Create a key database file of type JKS named `key.jks`. Set a password for this key database file.

The MQ Explorer uses Java keystore files (JKS) for SSL security, and so the keystore file being created for configuring SSL for the MQ Explorer must match this.
2. Add the CA certificates to the key database created in the previous step.
3. Import the personal certificate for the queue manager into the key database.
4. On Windows and Linux systems, start MQ Explorer by using the system menu, the `MQExplorer` executable file, or the **strmqcfg** command.
5. From the MQ Explorer toolbar, click **Window -> Preferences**, then expand **IBM MQ Explorer** and click **SSL Client Certificate Stores**. Enter the name of, and password for, the JKS file created in step 1 of [“Tasks on the system that hosts the MQ Explorer” on page 63](#), in both the Trusted Certificate Store and the Personal Certificate Store, then click **OK**.
6. Close the **Preferences** window, and right-click **Queue Managers**. Click **Show/Hide Queue Managers**, and then click **Add** on the **Show/Hide Queue Managers** screen.
7. Type the name of the queue manager, and select the **Connect directly** option. Click next.

8. Select **Use client channel definition table (CCDT)** and specify the location of the channel table file that you transferred from the remote queue manager in step 2 in [“Tasks on the system that hosts the remote queue manager”](#) on page 63 on the system hosting the remote queue manager.
9. Click **Finish**. You can now access the remote queue manager from the MQ Explorer.

### Connecting through another queue manager

The IBM MQ Explorer allows you to connect to a queue manager through an intermediate queue manager, to which the IBM MQ Explorer is already connected.

In this case, the IBM MQ Explorer puts PCF command messages to the intermediate queue manager, specifying the following:

- The *ObjectQMgrName* parameter in the object descriptor (MQOD) as the name of the target queue manager. For more information on queue name resolution, see the [Name resolution](#).
- The *UserIdentifier* parameter in the message descriptor (MQMD) as the local userId.

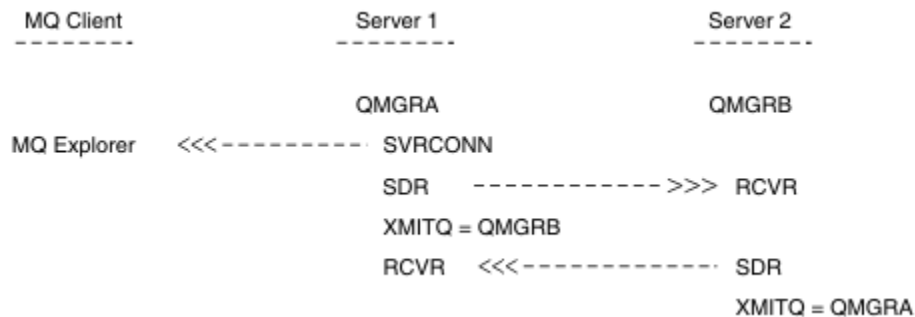
If the connection is then used to connect to the target queue manager via an intermediate queue manager, the userId is flowed in the *UserIdentifier* parameter of the message descriptor (MQMD) again. In order for the MCA listener on the target queue manager to accept this message, either the MCAUSER attribute must be set, or the userId must already exist with put authority.

The command server on the target queue manager puts messages to the transmission queue specifying the userId in the *UserIdentifier* parameter in the message descriptor (MQMD). For this put to succeed the userId must already exist on the target queue manager with put authority.

The following example shows you how to connect a queue manager, through an intermediate queue manager, to the IBM MQ Explorer.

Establish a remote administration connection to a queue manager. Verify that the:

- Queue manager on the server is active and has a server-connection channel (SVRCONN) defined.
- Listener is active.
- Command server is active.
- SYSTEM.MQ EXPLORER.REPLY.MODEL queue has been created and that you have sufficient authority.
- Queue manager listeners, command servers, and sender channels are started.



In this example:

- IBM MQ Explorer is connected to queue manager QMGRA (running on Server1) using a client connection.
- Queue manager QMGRB on Server2 can be now connected to IBM MQ Explorer through an intermediate queue manager (QMGRA)
- When connecting to QMGRB with IBM MQ Explorer, select QMGRA as the intermediate queue manager

In this situation, there is no direct connection to QMGRB from IBM MQ Explorer; the connection to QMGRB is through QMGRA.



Queue manager QMGRB on Server2 is connected to QMGRA on Server1 using sender-receiver channels. The channel between QMGRA and QMGRB must be set up in such a way that remote administration is possible; see [“Preparing channels and transmission queues for remote administration”](#) on page 128.

## Showing and hiding queue managers and clusters

The MQ Explorer can display more than one queue manager at a time. From the Show/Hide Queue Manager panel (selectable from the menu for the Queue Managers tree node), you can choose whether you display information about another (remote) machine. Local queue managers are detected automatically.

To show a remote queue manager:

1. Right-click the **Queue Managers** tree node, then select **Show/Hide Queue Managers**.
2. Click **Add**. The Show/Hide Queue Managers panel is displayed.
3. Enter the name of the remote queue manager and the host name or IP address in the fields provided.  
The host name or IP address is used to establish a client connection to the remote queue manager using either its default server connection channel, SYSTEM.ADMIN.SVRCONN, or a user-defined server connection channel.
4. Click **Finish**.

The Show/Hide Queue Managers panel also displays a list of all visible queue managers. You can use this panel to hide queue managers from the navigation view.

If the MQ Explorer displays a queue manager that is a member of a cluster, the cluster is detected, and displayed automatically.

To export the list of remote queue managers from this panel:

1. Close the Show/Hide Queue Managers panel.
2. Right-click the highest **IBM MQ** tree node in the Navigation pane of the MQ Explorer, then select **Export MQ Explorer Settings**
3. Click **MQ Explorer > MQ Explorer Settings**
4. Select **Connection Information > Remote queue managers**.
5. Select a file to store the exported settings in.
6. Finally, click **Finish** to export the remote queue manager connection information to the specified file.

To import a list of remote queue managers:

1. Right-click the highest **IBM MQ** tree node in the Navigation pane of the MQ Explorer, then select **Import MQ Explorer Settings**
2. Click **MQ Explorer > MQ Explorer Settings**
3. Click **Browse**, and navigate to the path of the file that contains the remote queue manager connection information.
4. Click **Open**. If the file contains a list of remote queue managers, the **Connection Information > Remote queue managers** box is selected.
5. Finally, click **Finish** to import the remote queue manager connection information into the IBM MQ Explorer.

## Cluster membership

IBM MQ Explorer requires information about queue managers that are members of a cluster.

If a queue manager is a member of a cluster, then the cluster tree node will be populated automatically.

If queue managers become members of clusters while the IBM MQ Explorer is running, then you must maintain the IBM MQ Explorer with up-to-date administration data about clusters so that it can communicate effectively with them and display correct cluster information when requested. In order to do this, the IBM MQ Explorer needs the following information:

- The name of a repository queue manager
- The connection name of the repository queue manager if it is on a remote queue manager

With this information, the IBM MQ Explorer can:

- Use the repository queue manager to obtain a list of queue managers in the cluster.
- Administer the queue managers that are members of the cluster and are on supported platforms and command levels.

Administration is not possible if:

- The chosen repository becomes unavailable. The IBM MQ Explorer does not automatically switch to an alternative repository.
- The chosen repository cannot be contacted over TCP/IP.
- The chosen repository is running on a queue manager that is running on a platform and command level not supported by the IBM MQ Explorer.

The cluster members that can be administered can be local, or they can be remote if they can be contacted using TCP/IP. The IBM MQ Explorer connects to local queue managers that are members of a cluster directly, without using a client connection.

## Data conversion

The IBM MQ Explorer works in CCSID 1208 (UTF-8). This enables the IBM MQ Explorer to display the data from remote queue managers correctly. Whether connecting to a queue manager directly, or by using an intermediate queue manager, the IBM MQ Explorer requires all incoming messages to be converted to CCSID 1208 (UTF-8).

An error message is issued if you try to establish a connection between the IBM MQ Explorer and a queue manager with a CCSID that the IBM MQ Explorer does not recognize.

Supported conversions are described in [Code page conversion](#).

## Extending the MQ Explorer

IBM MQ for Windows and IBM MQ for Linux x86-64 provide an administration interface called the MQ Explorer to perform administration tasks as an alternative to using control or MQSC commands.

**This information applies to IBM MQ for Windows, and IBM MQ for Linux x86-64 platforms only.**

The MQ Explorer presents information in a style consistent with that of the Eclipse framework and the other plug-in applications that Eclipse supports.

Through extending the MQ Explorer, system administrators have the ability to customize the MQ Explorer to improve the way they administer IBM MQ.

For more information, see *Extending the MQ Explorer* in the MQ Explorer product documentation.

## Using the IBM MQ Taskbar application ( Windows only)

The IBM MQ Taskbar application displays an icon in the Windows system tray on the server. The icon provides you with the current status of IBM MQ and a menu from which you can perform some simple actions.

On Windows, the IBM MQ icon is in the system tray on the server and is overlaid with a color-coded status symbol, which can have one of the following meanings:

### Green

Working correctly; no alerts at present

### Blue

Indeterminate; IBM MQ is starting up or shutting down

## Yellow

Alert; one or more services are failing or have already failed

To display the menu, right-click the IBM MQ icon. From the menu you can perform the following actions:

- Click **Open** to open the IBM MQ Alert Monitor
- Click **Exit** to exit the IBM MQ Taskbar application
- Click **IBM MQ Explorer** to start the IBM MQ Explorer
- Click **Stop IBM MQ** to stop IBM MQ
- Click **About IBM MQ** to display information about the IBM MQ Alert Monitor

## The IBM MQ alert monitor application ( Windows only)

The IBM MQ alert monitor is an error detection tool that identifies and records problems with IBM MQ on a local machine.

The alert monitor displays information about the current status of the local installation of an IBM MQ server. It also monitors the Windows Advanced Configuration and Power Interface (ACPI) and ensures the ACPI settings are enforced.

From the IBM MQ alert monitor, you can:

- Access the IBM MQ Explorer directly
- View information relating to all outstanding alerts
- Shut down the IBM MQ service on the local machine
- Route alert messages over the network to a configurable user account, or to a Windows workstation or server

## Administering local IBM MQ objects

---

This section tells you how to administer local IBM MQ objects to support application programs that use the Message Queue Interface (MQI). In this context, local administration means creating, displaying, changing, copying, and deleting IBM MQ objects.

In addition to the approaches detailed in this section you can use the IBM MQ Explorer to administer local IBM MQ objects; see [“Administration using the MQ Explorer” on page 59](#).

This section contains the following information:

- [Application programs using the MQI](#)
- [“Performing local administration tasks using MQSC commands” on page 72](#)
- [“Working with queue managers” on page 80](#)
- [“Working with local queues” on page 82](#)
- [“Working with alias queues” on page 87](#)
- [“Working with model queues” on page 106](#)
- [“Working with services” on page 113](#)
- [“Managing objects for triggering” on page 120](#)

## Starting and stopping a queue manager

Use this topic as an introduction to stopping and starting a queue manager.

### Starting a queue manager

To start a queue manager, use the `strmqm` command as follows:

```
strmqm saturn.queue.manager
```

On IBM MQ for Windows and IBM MQ for Linux (x86 and x86-64 platforms) systems, you can start a queue manager as follows:

1. Open the IBM MQ Explorer.
2. Select the queue manager from the Navigator View.
3. Click **Start**. The queue manager starts.

If the queue manager start-up takes more than a few seconds IBM MQ issues information messages intermittently detailing the start-up progress.

The `strmqm` command does not return control until the queue manager has started and is ready to accept connection requests.

### Starting a queue manager automatically

In IBM MQ for Windows you can start a queue manager automatically when the system starts using the IBM MQ Explorer. For more information, see [“Administration using the MQ Explorer” on page 59](#).

### Stopping a queue manager

Use the `endmqm` command to stop a queue manager.

**Note:** You must use the `endmqm` command from the installation associated with the queue manager that you are working with. You can find out which installation a queue manager is associated with using the `dspmq -o installation` command.

For example, to stop a queue manager called QMB, enter the following command:

```
endmqm QMB
```

On IBM MQ for Windows and IBM MQ for Linux (x86 and x86-64 platforms) systems, you can stop a queue manager as follows:

1. Open the IBM MQ Explorer.
2. Select the queue manager from the Navigator View.
3. Click **Stop**. . . . The End Queue Manager panel is displayed.
4. Select **Controlled**, or **Immediate**.
5. Click **OK**. The queue manager stops.

### Quiesced shutdown

By default, the `endmqm` command performs a quiesced shutdown of the specified queue manager. This might take a while to complete. A quiesced shutdown waits until all connected applications have disconnected.

Use this type of shutdown to notify applications to stop. If you issue:

```
endmqm -c QMB
```

you are not told when all applications have stopped. (An `endmqm -c QMB` command is equivalent to an `endmqm QMB` command.)

However, if you issue:

```
endmqm -w QMB
```

the command waits until all applications have stopped and the queue manager has ended.

## Immediate shutdown

For an immediate shutdown any current MQI calls are allowed to complete, but any new calls fail. This type of shutdown does not wait for applications to disconnect from the queue manager.

For an immediate shutdown, type:

```
endmqm -i QMB
```

## Preemptive shutdown

**Note:** Do not use this method unless all other attempts to stop the queue manager using the **endmqm** command have failed. This method can have unpredictable consequences for connected applications.

If an immediate shutdown does not work, you must resort to a *preemptive* shutdown, specifying the `-p` flag. For example:

```
endmqm -p QMB
```

This stops the queue manager immediately. If this method still does not work, see [“Stopping a queue manager manually”](#) on page 69 for an alternative solution.

For a detailed description of the **endmqm** command and its options, see [endmqm](#).

## If you have problems shutting down a queue manager

Problems in shutting down a queue manager are often caused by applications. For example, when applications:

- Do not check MQI return codes properly
- Do not request notification of a quiesce
- Terminate without disconnecting from the queue manager (by issuing an MQDISC call)

If a problem occurs when you stop the queue manager, you can break out of the **endmqm** command using Ctrl-C. You can then issue another **endmqm** command, but this time with a flag that specifies the type of shutdown that you require.

## Stopping a queue manager manually

If the standard methods for stopping queue managers fail, try the methods described here.

The standard way of stopping queue managers is by using the **endmqm** command. To stop a queue manager manually, use one of the procedures described in this section. For details of how to perform operations on queue managers using control commands, see [Creating and managing queue managers on distributed platforms](#).

## Stopping queue managers in IBM MQ for Windows

How to end the processes and the IBM MQ service, to stop queue managers in IBM MQ for Windows.

To stop a queue manager running under IBM MQ for Windows:

1. List the names (IDs) of the processes that are running, by using the Windows Task Manager.
2. End the processes by using Windows Task Manager, or the **taskkill** command, in the following order (if they are running):

AMQZMUC0	Critical process manager
AMQZXMA0	Execution controller
AMQZFUMA	OAM process
AMQZLAA0	LQM agents
AMQZLSA0	LQM agents
AMQZMUFO	Utility Manager
AMQZMGR0	Process controller
AMQZMUR0	Restartable process manager
AMQFQPUB	Publish Subscribe process
AMQFCXBA	Broker worker process
AMQRMPPA	Process pooling process
AMQCRSTA	Non-threaded responder job process
AMQCRS6B	LU62 receiver channel and client connection
AMQRRMFA	The repository process (for clusters)
AMQPCSEA	The command server
RUNMQTRM	Invoke a trigger monitor for a server
RUNMQDLQ	Invoke dead-letter queue handler
RUNMQCHI	The channel initiator process
RUNMQLSR	The channel listener process
AMQXSSVN	Shared memory servers

3. Stop the IBM MQ service from **Administration tools > Services** on the Windows Control Panel.
4. If you have tried all methods and the queue manager has not stopped, reboot your system.

The Windows Task Manager and the **tasklist** command give limited information about tasks. For more information to help to determine which processes relate to a particular queue manager, consider using a tool such as *Process Explorer* (procexp.exe), available for download from the Microsoft website at <https://www.microsoft.com>.

### ***Stopping queue managers in IBM MQ for UNIX and Linux systems***

How to end the processes and the IBM MQ service, to stop queue managers in IBM MQ for UNIX and Linux. You can try the methods described here if the standard methods for stopping and removing queue managers fail.

To stop a queue manager running under IBM MQ for UNIX and Linux systems:

1. Find the process IDs of the queue manager programs that are still running by using the **ps** command. For example, if the queue manager is called QMNAME, use the following command:

```
ps -ef | grep QMNAME
```

2. End any queue manager processes that are still running. Use the **kill** command, specifying the process IDs discovered by using the **ps** command.

End the processes in the following order:

amqzmuc0	Critical process manager
amqzxma0	Execution controller
amqzfuma	OAM process
amqzlaa0	LQM agents
amqzlsa0	LQM agents
amqzmuf0	Utility Manager
amqzmur0	Restartable process manager
amqzmgr0	Process controller
amqfqpub	Publish Subscribe process
amqfcxba	Broker worker process
amqrmppa	Process pooling process
amqcrsta	Non-threaded responder job process
amqcrs6b	LU62 receiver channel and client connection
amqrrmfa	The repository process (for clusters)
amqpcsea	The command server
runmqtrm	Invoke a trigger monitor for a server
runmqdlq	Invoke dead-letter queue handler
runmqchi	The channel initiator process
runmqlsr	The channel listener process

**Note:** You can use the **kill -9** command to end processes that fail to stop.

If you stop the queue manager manually, FFST might be taken, and FDC files placed in /var/mqm/errors. Do not regard this as a defect in the queue manager.

The queue manager will restart normally, even after you have stopped it using this method.

## Stopping MQI channels

When you issue a STOP CHANNEL command against a server-connection channel, you can choose what method to use to stop the client-connection channel. This means that a client channel issuing an MQGET wait call can be controlled, and you can decide how and when to stop the channel.

The STOP CHANNEL command can be issued with three modes, indicating how the channel is to be stopped:

### Quiesce

Stops the channel after any current messages have been processed.

If sharing conversations is enabled, the IBM MQ MQI client becomes aware of the stop request in a timely manner; this time is dependent upon the speed of the network. The client application becomes aware of the stop request as a result of issuing a subsequent call to IBM MQ.

### Force

Stops the channel immediately.

### Terminate

Stops the channel immediately. If the channel is running as a process, it can terminate the channel's process, or if the channel is running as a thread, its thread.

This is a multi-stage process. If mode terminate is used, an attempt is made to stop the server-connection channel, first with mode quiesce, then with mode force, and if necessary with mode

terminate. The client can receive different return codes during the different stages of termination. If the process or thread is terminated, the client receives a communication error.

The return codes returned to the application vary according to the MQI call issued, and the STOP CHANNEL command issued. The client will receive either an MQRC\_CONNECTION\_QUIESCING or an MQRC\_CONNECTION\_BROKEN return code. If a client detects MQRC\_CONNECTION\_QUIESCING it should try to complete the current transaction and terminate. This is not possible with MQRC\_CONNECTION\_BROKEN. If the client does not complete the transaction and terminate fast enough it will get CONNECTION\_BROKEN after a few seconds. A STOP CHANNEL command with MODE(FORCE) or MODE(TERMINATE) is more likely to result in a CONNECTION\_BROKEN than with MODE(QUIESCE).

### Related information

[MQI channels](#)

## Performing local administration tasks using MQSC commands

This section introduces you to MQSC commands and tells you how to use them for some common tasks.

If you use IBM MQ for Windows or IBM MQ for Linux (x86 and x86-64 platforms), you can also perform the operations described in this section using the IBM MQ Explorer. See [“Administration using the MQ Explorer”](#) on page 59 for more information.

You can use MQSC commands to manage queue manager objects, including the queue manager itself, queues, process definitions, channels, client connection channels, listeners, services, namelists, clusters, and authentication information objects. This section deals with queue managers, queues, and process definitions; for an overview of channel, client connection channel, and listener objects, see [Objects](#). For information about all the MQSC commands for managing queue manager objects, see [“Script \(MQSC\) Commands”](#) on page 73.

You issue MQSC commands to a queue manager using the `runmqsc` command. (For details of this command, see [runmqsc](#).) You can do this interactively, issuing commands from a keyboard, or you can redirect the standard input device ( `stdin`) to run a sequence of commands from an ASCII text file. In both cases, the format of the commands is the same. (For information about running the commands from a text file, see [“Running MQSC commands from text files”](#) on page 76.)

You can run the `runmqsc` command in three ways, depending on the flags set on the command:

- Verify a command without running it, where the MQSC commands are verified on a local queue manager, but are not run.
- Run a command on a local queue manager, where the MQSC commands are run on a local queue manager.
- Run a command on a remote queue manager, where the MQSC commands are run on a remote queue manager.

You can also run the command followed by a question mark to display the syntax.

Object attributes specified in MQSC commands are shown in this section in uppercase (for example, RQMNAME), although they are not case-sensitive. MQSC command attribute names are limited to eight characters. MQSC commands are available on other platforms, including IBM i and z/OS.

From IBM MQ 8.0, you can set a prompt of your choice by using the MQPROMPT environment variable. In addition to plain text, the MQPROMPT variable also allows environment variables to be inserted, by using `+VARNAME+` notation, in the same manner as IBM MQ service object definitions (see [“Defining a service object”](#) on page 114). For example:

```
sh> export MQPROMPT="+USER+ @ +QMNAME+ @ +MQ_HOST_NAME+> "
sh> runmqsc MY.QMGR
5724-H72 (C) Copyright IBM Corp. 1994, 2022.
Starting MQSC for queue manager MY.QMGR.
username @ MY.QMGR @ aix1> DISPLAY QMSTATUS
```

MQSC commands are detailed in the [MQSC commands](#) section.



## Related information

[runmqsc \(run MQSC commands\)](#)


## Script (MQSC) Commands


MQSC commands provide a uniform method of issuing human-readable commands on IBM MQ platforms. For information about *programmable command format* (PCF) commands, see [“Introduction to Programmable Command Formats”](#) on page 9.

The general format of the commands is shown in [The MQSC commands](#).

You should observe the following rules when using MQSC commands:

- Each command starts with a primary parameter (a verb), and this is followed by a secondary parameter (a noun). This is then followed by the name or generic name of the object (in parentheses) if there is one, which there is on most commands. Following that, parameters can usually occur in any order; if a parameter has a corresponding value, the value must occur directly after the parameter to which it relates.

**Note:**  On z/OS, the secondary parameter does not have to be second.




- Keywords, parentheses, and values can be separated by any number of blanks and commas. A comma shown in the syntax diagrams can always be replaced by one or more blanks. There must be at least one blank immediately preceding each parameter (after the primary parameter)  except on z/OS.
- Any number of blanks can occur at the beginning or end of the command, and between parameters, punctuation, and values. For example, the following command is valid:

```
ALTER QLOCAL ('Account' )      TRIGDPTH ( 1)
```

Blanks within a pair of quotation marks are significant.

- Additional commas can appear anywhere where blanks are allowed and are treated as if they were blanks (unless, of course, they are inside strings enclosed by quotation marks).
- Repeated parameters are not allowed. Repeating a parameter with its "NO" version, as in REPLACE NOREPLACE, is also not allowed.
- Strings that contain blanks, lowercase characters or special characters other than:
  - Period (.)
  - Forward slash (/)
  - Underscore (\_)
  - Percent sign (%)

must be enclosed in single quotation marks, unless they are:

-  Issued from the IBM MQ for z/OS operations and control panels
- Generic values ending with an asterisk  (on IBM i these must be enclosed in single quotation marks)
- A single asterisk (for example, TRACE(\*))  (on IBM i these must be enclosed in single quotation marks)
- A range specification containing a colon (for example, CLASS(01:03))


If the string itself contains a single quotation mark, the single quotation mark is represented by two single quotation marks. Lowercase characters not contained within quotation marks are folded to uppercase.

- On platforms other than z/OS, a string containing no characters (that is, two single quotation marks with no space in between) is interpreted as a blank space enclosed in single quotation marks, that is,

interpreted in the same way as (' '). The exception to this is if the attribute being used is one of the following:

- TOPICSTR
- SUB
- USERDATA
- SELECTOR

then two single quotation marks with no space are interpreted as a zero-length string.

 On z/OS, if you want a blank space enclosed in single quotation marks, you must enter it as such (' '). A string containing no characters ('') is the same as entering ().

- In v7.0, any trailing blanks in those string attributes which are based on MQCHARV types, such as SELECTOR, sub user data, are treated as significant which means that 'abc ' does not equal 'abc'.
- A left parenthesis followed by a right parenthesis, with no significant information in between, for example

```
NAME ( )
```

is not valid except where specifically noted.

- Keywords are not case sensitive: ALTER, alter, and ALTER are all acceptable. Anything that is not contained within quotation marks is folded to uppercase.
- Synonyms are defined for some parameters. For example, DEF is always a synonym for DEFINE, so DEF QLOCAL is valid. Synonyms are not, however, just minimum strings; DEFI is not a valid synonym for DEFINE.

**Note:** There is no synonym for the DELETE parameter. This is to avoid accidental deletion of objects when using DEF, the synonym for DEFINE.

For an overview of using MQSC commands for administering IBM MQ, see [“Performing local administration tasks using MQSC commands” on page 72](#).

MQSC commands use certain special characters to have certain meanings. For more information about these special characters and how to use them, see [Characters with special meanings](#).

To find out how you can build scripts using MQSC commands, see [Building command scripts](#).

For an explanation of the symbols in the z/OS column, see [Using commands on z/OS](#).

For the full list of MQSC commands, see [The MQSC commands](#).

### Related information

[Building command scripts](#)

## IBM MQ object names

How to use object names in MQSC commands.

In examples, we use some long names for objects. This is to help you identify the type of object you are dealing with.

When you issue MQSC commands, you need specify only the local name of the queue. In our examples, we use queue names such as:

```
ORANGE.LOCAL.QUEUE
```

The LOCAL.QUEUE part of the name is to illustrate that this queue is a local queue. It is **not** required for the names of local queues in general.

We also use the name `saturn.queue.manager` as a queue manager name. The `queue.manager` part of the name is to illustrate that this object is a queue manager. It is *not* required for the names of queue managers in general.

## Case-sensitivity in MQSC commands

MQSC commands, including their attributes, can be written in uppercase or lowercase. Object names in MQSC commands are folded to uppercase (that is, `QUEUE` and `queue` are not differentiated), unless the names are enclosed within single quotation marks. If quotation marks are not used, the object is processed with a name in uppercase. See [Characters with special meanings](#) for more information.

The `runmqsc` command invocation, in common with all IBM MQ control commands, is case sensitive in some IBM MQ environments. See [Using control commands](#) for more information.

## Standard input and output

The *standard input device*, also referred to as `stdin`, is the device from which input to the system is taken. Typically this is the keyboard, but you can specify that input is to come from a serial port or a disk file, for example. The *standard output device*, also referred to as `stdout`, is the device to which output from the system is sent. Typically this is a display, but you can redirect output to a serial port or a file.

On operating-system commands and IBM MQ control commands, the `<` operator redirects input. If this operator is followed by a file name, input is taken from the file. Similarly, the `>` operator redirects output; if this operator is followed by a file name, output is directed to that file.

## Using MQSC commands interactively

You can use MQSC commands interactively by using a command window or shell.

To use MQSC commands interactively, open a command window or shell and enter:

```
runmqsc
```

In this command, a queue manager name has not been specified, so the MQSC commands are processed by the default queue manager. If you want to use a different queue manager, specify the queue manager name on the **runmqsc** command. For example, to run MQSC commands on queue manager `jupiter.queue.manager`, use the command:

```
runmqsc jupiter.queue.manager
```

After this, all the MQSC commands you type in are processed by this queue manager, assuming that it is on the same node and is already running.

Now you can type in any MQSC commands, as required. For example, try this one:

```
DEFINE QLOCAL (ORANGE.LOCAL.QUEUE)
```

For commands that have too many parameters to fit on one line, use continuation characters to indicate that a command is continued on the following line:

- A minus sign (-) indicates that the command is to be continued from the start of the following line.
- A plus sign (+) indicates that the command is to be continued from the first nonblank character on the following line.

Command input terminates with the final character of a nonblank line that is not a continuation character. You can also terminate command input explicitly by entering a semicolon (;). (This is especially useful if you accidentally enter a continuation character at the end of the final line of command input.)

## Feedback from MQSC commands

When you issue MQSC commands, the queue manager returns operator messages that confirm your actions or tell you about the errors you have made. For example:

```
AMQ8006: IBM MQ queue created.
```

This message confirms that a queue has been created.

```
AMQ8405: Syntax error detected at or near end of command segment below:-
```

```
AMQ8426: Valid MQSC commands are:
```

```
ALTER  
CLEAR  
DEFINE  
DELETE  
DISPLAY  
END  
PING  
REFRESH  
RESET  
RESOLVE  
RESUME  
START  
STOP  
SUSPEND  
4 : end
```

This message indicates that you have made a syntax error.

These messages are sent to the standard output device. If you have not entered the command correctly, refer to [MQSC commands](#) for the correct syntax.

## Ending interactive input of MQSC commands

To stop working with MQSC commands, enter the END command.

Alternatively, you can use the EOF character for your operating system.

## Running MQSC commands from text files

Running MQSC commands interactively is suitable for quick tests, but if you have very long commands, or are using a particular sequence of commands repeatedly, consider redirecting stdin from a text file.

“[Standard input and output](#)” on page 75 contains information about stdin and stdout. To redirect stdin from a text file, first create a text file containing the MQSC commands using your usual text editor. When you use the runmqsc command, use the redirection operators. For example, the following command runs a sequence of commands contained in the text file myprog.in:

```
runmqsc < myprog.in
```

Similarly, you can also redirect the output to a file. A file containing the MQSC commands for input is called an MQSC command file. The output file containing replies from the queue manager is called the output file.

To redirect both stdin and stdout on the runmqsc command, use this form of the command:

```
runmqsc < myprog.in > myprog.out
```

This command invokes the MQSC commands contained in the MQSC command file myprog.in. Because we have not specified a queue manager name, the MQSC commands run against the default queue manager. The output is sent to the text file myprog.out. [Figure 12 on page 77](#) shows an extract from

the MQSC command file `myprog.in` and [Figure 13 on page 78](#) shows the corresponding extract of the output in `myprog.out`.

To redirect `stdin` and `stdout` on the `runmqsc` command, for a queue manager (`saturn.queue.manager`) that is not the default, use this form of the command:

```
runmqsc saturn.queue.manager < myprog.in > myprog.out
```

## MQSC command files

MQSC commands are written in human-readable form, that is, in ASCII text. [Figure 12 on page 77](#) is an extract from an MQSC command file showing an MQSC command (`DEFINE QLOCAL`) with its attributes. [MQSC commands](#) contains a description of each MQSC command and its syntax.

```
.  
. .  
DEFINE QLOCAL(ORANGE.LOCAL.QUEUE) REPLACE +  
DESCR(' ') +  
PUT(ENABLED) +  
DEFPRTY(0) +  
DEFPSIST(NO) +  
GET(ENABLED) +  
MAXDEPTH(5000) +  
MAXMSGL(1024) +  
DEFSOPT(SHARED) +  
NOHARDENBO +  
USAGE(NORMAL) +  
NOTRIGGER;  
. .  
.
```

*Figure 12. Extract from an MQSC command file*

For portability among IBM MQ environments, limit the line length in MQSC command files to 72 characters. The plus sign indicates that the command is continued on the next line.

## MQSC command reports

The **runmqsc** command returns a report, which is sent to `stdout`. The report contains:

- A header identifying MQSC commands as the source of the report:

```
Starting MQSC for queue manager jupiter.queue.manager.
```

Where `jupiter.queue.manager` is the name of the queue manager.

- An optional numbered listing of the MQSC commands issued. By default, the text of the input is echoed to the output. Within this output, each command is prefixed by a sequence number, as shown in [Figure 13 on page 78](#). However, you can use the `-e` flag on the `runmqsc` command to suppress the output.
- A syntax error message for any commands found to be in error.
- An *operator message* indicating the outcome of running each command. For example, the operator message for the successful completion of a `DEFINE QLOCAL` command is:

```
AMQ8006: IBM MQ queue created.
```

- Other messages resulting from general errors when running the script file.

- A brief statistical summary of the report indicating the number of commands read, the number of commands with syntax errors, and the number of commands that could not be processed.

**Note:** The queue manager attempts to process only those commands that have no syntax errors.

```
Starting MQSC for queue manager jupiter.queue.manager.
.
.
12:  DEFINE QLOCAL('ORANGE.LOCAL.QUEUE') REPLACE +
:    DESCR(' ') +
:    PUT(ENABLED) +
:    DEFPRTY(0) +
:    DEFPSIST(NO) +
:    GET(ENABLED) +
:    MAXDEPTH(5000) +
:    MAXMSGL(1024) +
:    DEFSOPT(SHARED) +
:    NOHARDENBO +
:    USAGE(NORMAL) +
:    NOTRIGGER;
AMQ8006: IBM MQ queue created.
.
.
.
```

*Figure 13. Extract from an MQSC command report file*

## Running the supplied MQSC command files

The following MQSC command files are supplied with IBM MQ:

### **amqscos0.tst**

Definitions of objects used by sample programs.

### **amqscic0.tst**

Definitions of queues for CICS® transactions.

In IBM MQ for Windows, these files are located in the directory `MQ_INSTALLATION_PATH\tools\mqsc\samples`. `MQ_INSTALLATION_PATH` represents the high-level directory in which IBM MQ is installed.

On UNIX and Linux systems these files are located in the directory `MQ_INSTALLATION_PATH/samp`. `MQ_INSTALLATION_PATH` represents the high-level directory in which IBM MQ is installed.

The command that runs them is:

```
runmqsc < amqscos0.tst >test.out
```

## Using runmqsc to verify commands

You can use the `runmqsc` command to verify MQSC commands on a local queue manager without actually running them. To do this, set the `-v` flag in the `runmqsc` command, for example:

```
runmqsc -v < myprog.in > myprog.out
```

When you invoke `runmqsc` against an MQSC command file, the queue manager verifies each command and returns a report without actually running the MQSC commands. This allows you to check the syntax of the commands in your command file. This is particularly important if you are:

- Running a large number of commands from a command file.
- Using an MQSC command file many times over.

The returned report is similar to that shown in [Figure 13 on page 78](#).

You cannot use this method to verify MQSC commands remotely. For example, if you attempt this command:

```
runmqsc -w 30 -v jupiter.queue.manager < myprog.in > myprog.out
```

the -w flag, which you use to indicate that the queue manager is remote, is ignored, and the command is run locally in verification mode. 30 is the number of seconds that IBM MQ waits for replies from the remote queue manager.

## Running MQSC commands from batch files

If you have very long commands, or are using a particular sequence of commands repeatedly, consider redirecting stdin from a batch file.

To redirect stdin from a batch file, first create a batch file containing the MQSC commands using your usual text editor. When you use the runmqsc command, use the redirection operators. The following example:

1. Creates a test queue manager, TESTQM
2. Creates a matching CLNTCONN and listener set to use TCP/IP port 1600
3. Creates a test queue, TESTQ
4. Puts a message on the queue, using the amqspc sample program

```
export MYTEMPQM=TESTQM
export MYPOR=1600
export MQCHLLIB=/var/mqm/qmgrs/$MYTEMPQM/@ipcc

crtmqm $MYTEMPQM
stimqm $MYTEMPQM
runmqslr -m $MYTEMPQM -t TCP -p $MYPOR &

runmqsc $MYTEMPQM << EOF
DEFINE CHANNEL(NTL) CHLTYPE(SVRCONN) TRPTYPE(TCP)
DEFINE CHANNEL(NTL) CHLTYPE(CLNTCONN) QMNAME('$MYTEMPQM') CONNAME('hostname($MYPOR)')
ALTER CHANNEL(NTL) CHLTYPE(CLNTCONN)
DEFINE QLOCAL(TESTQ)
EOF

amqspc TESTQ $MYTEMPQM << EOF
hello world
EOF

endmqm -i $MYTEMPQM
```

Figure 14. Example script for running MQSC commands from a batch file

## Resolving problems with MQSC commands

If you cannot get MQSC commands to run, use the information in this topic to see if any of these common problems apply to you. It is not always obvious what the problem is when you read the error that a command generates.

When you use the runmqsc command, remember the following:

- Use the < operator to redirect input from a file. If you omit this operator, the queue manager interprets the file name as a queue manager name, and issues the following error message:

```
AMQ8118: IBM MQ queue manager does not exist.
```

- If you redirect output to a file, use the **>** redirection operator. By default, the file is put in the current working directory at the time `runmqsc` is invoked. Specify a fully-qualified file name to send your output to a specific file and directory.
- Check that you have created the queue manager that is going to run the commands, by using the following command to display all queue managers:

```
dspmq
```

- The queue manager must be running. If it is not, start it; (see [Starting a queue manager](#)). You get an error message if you try to start a queue manager that is already running.
- Specify a queue manager name on the `runmqsc` command if you have not defined a default queue manager, or you get this error:

```
AMQ8146: IBM MQ queue manager not available.
```

- You cannot specify an MQSC command as a parameter of the `runmqsc` command. For example, this is not valid:

```
runmqsc DEFINE QLOCAL(FRED)
```

- You cannot enter MQSC commands before you issue the `runmqsc` command.
- You cannot run control commands from `runmqsc`. For example, you cannot issue the `strmqm` command to start a queue manager while you are running MQSC commands interactively. If you do this, you receive error messages similar to the following:

```
runmqsc
.
.
Starting MQSC for queue manager jupiter.queue.manager.

1 : strmqm saturn.queue.manager
AMQ8405: Syntax error detected at or near end of cmd segment below:-s

AMQ8426: Valid MQSC commands are:
ALTER
CLEAR
DEFINE
DELETE
DISPLAY
END
PING
REFRESH
RESET
RESOLVE
RESUME
START
STOP
SUSPEND
2 : end
```

## Working with queue managers

Examples of MQSC commands that you can use to display or alter queue manager attributes.

### Displaying queue manager attributes

To display the attributes of the queue manager specified on the **`runmqsc`** command, use the following MQSC command:

```
DISPLAY QMGR
```

Typical output from this command is shown in [Figure 15 on page 81](#)



```

DISPLAY QMGR
  1 : DISPLAY QMGR
AMQ8408: Display Queue Manager details.
QMNAME(QM1)
ACCTINT(1800)
ACCTQ(OFF)
ACTVCONO (DISABLED)
ALTDATE(2012-05-27)
AUTHOREV(DISABLED)
CHAD(DISABLED)
CHADEXIT( )
CLWLDATA( )
CLWLEN(100)
CLWLUSEQ(LOCAL)
CMDLEVEL(800)
CONFIGEV(DISABLED)
CRTIME(16.14.01)
DEFXMITQ( )
DISTL(YES)
IPADDRV(IPV4)
LOGGERSV(DISABLED)
MAXHANDS(256)
MAXPROPL(NOLIMIT)
MAXUMSGS(10000)
MONCHL(OFF)
PARENT( )
PLATFORM(WINDOWSNT)
PSNPMMSG(DISCARD)
PSSYNCP(1FPER)
PSMODE(ENABLED)
REPOS( )
ROUTEREC(MSG)
SCMDSERV(QMGR)
SSLCRYP( )
SSLFIPS(NO)
MQ\Data\qmgrs\QM1\ssl\key)
SSLKEYC(0)
STATCHL(OFF)
STATMQI(OFF)
STRSTPEV(ENABLED)
TREELIFE(1800)
ACCTCONO(DISABLED)
ACCTMQI(OFF)
ACTIVREC(MSG)
ACTVTRC (OFF)
ALTTIME(16.14.01)
CCSID(850)
CHADEV(DISABLED)
CHLEV(DISABLED)
CLWLEXIT( )
CLWLMRUC(999999999)
CMDEV(DISABLED)
COMMANDQ(SYSTEM.ADMIN.COMMAND.QUEUE)
CRDATE(2011-05-27)
DEADQ( )
DESCR( )
INHIBTEV(DISABLED)
LOCALEV(DISABLED)
MARKINT(5000)
MAXMSGL(4194304)
MAXPRTY(9)
MONACLS(QMGR)
MONQ(OFF)
PERFMEV(DISABLED)
PSRTYCNT(5)
PSNPRES(NORMAL)
QMID(QM1_2011-05-27_16.14.01)
REMOVEDV(DISABLED)
REPOSNL( )
SCHINIT(QMGR)
SSLCLRLNL( )
SSLEV(DISABLED)
SSLKEYR(C:\Program Files\IBM\WebSphere
STATACLS(QMGR)
STATINT(1800)
STATQ(OFF)
SYNCP
TRIGINT(999999999)

```

Figure 15. Typical output from a DISPLAY QMGR command

**Note:** SYNCP is a read only queue manager attribute.

The ALL parameter is the default on the DISPLAY QMGR command. It displays all the queue manager attributes. In particular, the output tells you the default queue manager name, the dead-letter queue name, and the command queue name.

You can confirm that these queues exist by entering the command:

```
DISPLAY QUEUE (SYSTEM.*)
```

This displays a list of queues that match the stem SYSTEM.\*. The parentheses are required.

## Altering queue manager attributes

To alter the attributes of the queue manager specified on the **runmqsc** command, use the MQSC command ALTER QMGR, specifying the attributes and values that you want to change. For example, use the following commands to alter the attributes of jupiter.queue.manager:

```
runmqsc jupiter.queue.manager
ALTER QMGR DEADQ (ANOTHERDLQ) INHIBTEV (ENABLED)
```

The ALTER QMGR command changes the dead-letter queue used, and enables inhibit events.

## Related information

[Attributes for the queue manager](#)

## Working with local queues

This section contains examples of some MQSC commands that you can use to manage local, model, and alias queues.

See [MQSC commands](#) for detailed information about these commands.

### Defining a local queue

For an application, the local queue manager is the queue manager to which the application is connected. Queues managed by the local queue manager are said to be local to that queue manager.

Use the MQSC command DEFINE QLOCAL to create a local queue. You can also use the default defined in the default local queue definition, or you can modify the queue characteristics from those of the default local queue.

**Note:** The default local queue is named SYSTEM.DEFAULT.LOCAL.QUEUE and it was created on system installation.

For example, the DEFINE QLOCAL command that follows defines a queue called ORANGE.LOCAL.QUEUE with these characteristics:

- It is enabled for gets, enabled for puts, and operates on a priority order basis.
- It is an *normal* queue; it is not an initiation queue or transmission queue, and it does not generate trigger messages.
- The maximum queue depth is 5000 messages; the maximum message length is 4194304 bytes.

```
DEFINE QLOCAL (ORANGE.LOCAL.QUEUE) +  
DESCR('Queue for messages from other systems') +  
PUT (ENABLED) +  
GET (ENABLED) +  
NOTRIGGER +  
MSGDLVSQ (PRIORITY) +  
MAXDEPTH (5000) +  
MAXMSGL (4194304) +  
USAGE (NORMAL);
```

**Note:**

1. With the exception of the value for the description, all the attribute values shown are the default values. We have shown them here for purposes of illustration. You can omit them if you are sure that the defaults are what you want or have not been changed. See also [“Displaying default object attributes”](#) on page 82.
2. USAGE (NORMAL) indicates that this queue is not a transmission queue.
3. If you already have a local queue on the same queue manager with the name ORANGE.LOCAL.QUEUE, this command fails. Use the REPLACE attribute if you want to overwrite the existing definition of a queue, but see also [“Changing local queue attributes”](#) on page 84.

### Displaying default object attributes

You can use the DISPLAY QUEUE command to display attributes that were taken from the default object when an IBM MQ object was defined.

When you define an IBM MQ object, it takes any attributes that you do not specify from the default object. For example, when you define a local queue, the queue inherits any attributes that you omit in the

definition from the default local queue, which is called SYSTEM.DEFAULT.LOCAL.QUEUE. To see exactly what these attributes are, use the following command:

```
DISPLAY QUEUE (SYSTEM.DEFAULT.LOCAL.QUEUE)
```

The syntax of this command is different from that of the corresponding DEFINE command. On the DISPLAY command you can give just the queue name, whereas on the DEFINE command you have to specify the type of the queue, that is, QLOCAL, QALIAS, QMODEL, or QREMOTE.

You can selectively display attributes by specifying them individually. For example:

```
DISPLAY QUEUE (ORANGE.LOCAL.QUEUE) +  
MAXDEPTH +  
MAXMSGL +  
CURDEPTH;
```

This command displays the three specified attributes as follows:

```
AMQ8409: Display Queue details.  
QUEUE(ORANGE.LOCAL.QUEUE)      TYPE(QLOCAL)  
CURDEPTH(0)                     MAXDEPTH(5000)  
MAXMSGL(4194304)
```

CURDEPTH is the current queue depth, that is, the number of messages on the queue. This is a useful attribute to display, because by monitoring the queue depth you can ensure that the queue does not become full.

## Copying a local queue definition

You can copy a queue definition using the LIKE attribute on the DEFINE command.

For example:

```
DEFINE QLOCAL (MAGENTA.QUEUE) +  
LIKE (ORANGE.LOCAL.QUEUE)
```

This command creates a queue with the same attributes as our original queue ORANGE.LOCAL.QUEUE, rather than those of the system default local queue. Enter the name of the queue to be copied **exactly** as it was entered when you created the queue. If the name contains lowercase characters, enclose the name in single quotation marks.

You can also use this form of the DEFINE command to copy a queue definition, but substitute one or more changes to the attributes of the original. For example:

```
DEFINE QLOCAL (THIRD.QUEUE) +  
LIKE (ORANGE.LOCAL.QUEUE) +  
MAXMSGL(1024);
```

This command copies the attributes of the queue ORANGE.LOCAL.QUEUE to the queue THIRD.QUEUE, but specifies that the maximum message length on the new queue is to be 1024 bytes, rather than 4194304.

### Note:

1. When you use the LIKE attribute on a DEFINE command, you are copying the queue attributes only. You are not copying the messages on the queue.
2. If you define a local queue, without specifying LIKE, it is the same as DEFINE LIKE(SYSTEM.DEFAULT.LOCAL.QUEUE).

## Changing local queue attributes

You can change queue attributes in two ways, using either the ALTER QLOCAL command or the DEFINE QLOCAL command with the REPLACE attribute.

In “Defining a local queue” on page 82, the queue called ORANGE.LOCAL.QUEUE was defined. Suppose, for example, that you want to decrease the maximum message length on this queue to 10,000 bytes.

- Using the ALTER command:

```
ALTER QLOCAL (ORANGE.LOCAL.QUEUE) MAXMSGL(10000)
```

This command changes a single attribute, that of the maximum message length; all the other attributes remain the same.

- Using the DEFINE command with the REPLACE option, for example:

```
DEFINE QLOCAL (ORANGE.LOCAL.QUEUE) MAXMSGL(10000) REPLACE
```

This command changes not only the maximum message length, but also all the other attributes, which are given their default values. The queue is now put enabled whereas previously it was put inhibited. Put enabled is the default, as specified by the queue SYSTEM.DEFAULT.LOCAL.QUEUE.

If you **decrease** the maximum message length on an existing queue, existing messages are not affected. Any new messages, however, must meet the new criteria.

## Clearing a local queue

You can use the CLEAR command to clear a local queue.

To delete all the messages from a local queue called MAGENTA.QUEUE, use the following command:

```
CLEAR QLOCAL (MAGENTA.QUEUE)
```

**Note:** There is no prompt that enables you to change your mind; once you press the Enter key the messages are lost.

You cannot clear a queue if:

- There are uncommitted messages that have been put on the queue under sync point.
- An application currently has the queue open.

## Deleting a local queue

You can use the MQSC command DELETE QLOCAL to delete a local queue.

A queue cannot be deleted if it has uncommitted messages on it. However, if the queue has one or more committed messages and no uncommitted messages, it can be deleted only if you specify the PURGE option. For example:

```
DELETE QLOCAL (PINK.QUEUE) PURGE
```

Specifying NOPURGE instead of PURGE ensures that the queue is not deleted if it contains any committed messages.

## Browsing queues

IBM MQ provides a sample queue browser that you can use to look at the contents of the messages on a queue. The browser is supplied in both source and executable formats.

`MQ_INSTALLATION_PATH` represents the high-level directory in which IBM MQ is installed.

In IBM MQ for Windows, the file names and paths for the sample queue browser are as follows:

**Source**

*MQ\_INSTALLATION\_PATH\tools\c\samples\*

**Executable**

*MQ\_INSTALLATION\_PATH\tools\c\samples\bin\amqsbcg.exe*

In IBM MQ for UNIX and Linux, the file names and paths are as follows:

**Source**

*MQ\_INSTALLATION\_PATH/samp/amqsbcg0.c*

**Executable**

*MQ\_INSTALLATION\_PATH/samp/bin/amqsbcg*

The sample requires two input parameters, the queue name and the queue manager name. For example:

```
amqsbcg SYSTEM.ADMIN.QMGREVENT.tpp01 saturn.queue.manager
```

Typical results from this command are shown in [Figure 16 on page 86](#).

```

AMQSBCG0 - starts here
*****

MQOPEN - 'SYSTEM.ADMIN.QMGR.EVENT'

MQGET of message number 1
****Message descriptor****

  StrucId : 'MD ' Version : 2
  Report  : 0 MsgType : 8
  Expiry  : -1 Feedback : 0
  Encoding : 546 CodedCharSetId : 850
  Format   : 'MQEVENT '
  Priority : 0 Persistence : 0
  MsgId    : X'414D512073617475726E2E71756575650005D30033563DB8'
  CorrelId : X'0000000000000000000000000000000000000000000000000000000000000000'
  BackoutCount : 0
  ReplyToQ      : '
  ReplyToQMgr   : 'saturn.queue.manager'
  ** Identity Context
  UserIdentifier : '
  AccountingToken :
  X'0000000000000000000000000000000000000000000000000000000000000000'
  ApplIdentityData : '
  ** Origin Context
  PutApplType      : '7'
  PutApplName      : 'saturn.queue.manager'
  PutDate          : '19970417' PutTime : '15115208'
  ApplOriginData   : '

  GroupId : X'0000000000000000000000000000000000000000000000000000000000000000'
  MsgSeqNumber : '1'
  Offset       : '0'
  MsgFlags     : '0'
  OriginalLength : '104'

**** Message ****

length - 104 bytes

00000000: 0700 0000 2400 0000 0100 0000 2C00 0000 '.....→.....'
00000010: 0100 0000 0100 0000 0100 0000 AE08 0000 '.....'
00000020: 0100 0000 0400 0000 4400 0000 DF07 0000 '.....D.....'
00000030: 0000 0000 3000 0000 7361 7475 726E 2E71 '....0...saturn.q'
00000040: 7565 7565 2E6D 616E 6167 6572 2020 2020 'ueue.manager'
00000050: 2020 2020 2020 2020 2020 2020 2020 2020 '
00000060: 2020 2020 2020 2020

No more messages
MQCLOSE
MQDISC

```

Figure 16. Typical results from queue browser

## Related information

[The Browser sample program](#)

## Enabling large queues

IBM MQ supports queues larger than 2 GB.

On Windows systems, support for large files is available without any additional enablement. On AIX, HP-UX, Linux, and Solaris systems, you need to explicitly enable large file support before you can create queue files larger than 2 GB. See your operating system documentation for information on how to do this.

Some utilities, such as tar, cannot cope with files greater than 2 GB. Before enabling large file support, check your operating system documentation for information on restrictions on utilities you use.

For information about planning the amount of storage you need for queues, visit the IBM MQ website for platform-specific performance reports: [http://www.ibm.com/support/docview.wss?rs=171&uid=swg27007150&loc=en\\_US&cs=utf-8&lang=en#1](http://www.ibm.com/support/docview.wss?rs=171&uid=swg27007150&loc=en_US&cs=utf-8&lang=en#1)

## Working with alias queues

You can define an alias queue to refer indirectly to another queue or topic.

**V 8.0.0.6**



**Attention:** Distribution lists do not support the use of alias queues that point to topic objects. From Version 8.0.0, Fix Pack 6, if an alias queue points to a topic object in a distribution list, IBM MQ returns MQRC\_ALIAS\_BASE\_Q\_TYPE\_ERROR.

The queue to which an alias queue refers can be any of the following:

- A local queue (see [“Defining a local queue” on page 82](#) ).
- A local definition of a remote queue (see [“Creating a local definition of a remote queue” on page 132](#) ).
- A topic.

An alias queue is not a real queue, but a definition that resolves to a real (or target) queue at run time. The alias queue definition specifies the target queue. When an application makes an MQOPEN call to an alias queue, the queue manager resolves the alias to the target queue name.

An alias queue cannot resolve to another locally defined alias queue. However, an alias queue can resolve to alias queues that are defined elsewhere in clusters of which the local queue manager is a member. See [Name resolution](#) for further information.

Alias queues are useful for:

- Giving different applications different levels of access authorities to the target queue.
- Allowing different applications to work with the same queue in different ways. (Perhaps you want to assign different default priorities or different default persistence values.)
- Simplifying maintenance, migration, and workload balancing. (Perhaps you want to change the target queue name without having to change your application, which continues to use the alias.)

For example, assume that an application has been developed to put messages on a queue called MY.ALIAS.QUEUE. It specifies the name of this queue when it makes an MQOPEN request and, indirectly, if it puts a message on this queue. The application is not aware that the queue is an alias queue. For each MQI call using this alias, the queue manager resolves the real queue name, which could be either a local queue or a remote queue defined at this queue manager.

By changing the value of the TARGQ attribute, you can redirect MQI calls to another queue, possibly on another queue manager. This is useful for maintenance, migration, and load-balancing.

### Defining an alias queue

The following command creates an alias queue:

```
DEFINE QALIAS (MY.ALIAS.QUEUE) TARGET (YELLOW.QUEUE)
```

This command redirects MQI calls that specify MY.ALIAS.QUEUE to the queue YELLOW.QUEUE. The command does not create the target queue; the MQI calls fail if the queue YELLOW.QUEUE does not exist at run time.

If you change the alias definition, you can redirect the MQI calls to another queue. For example:

```
ALTER QALIAS (MY.ALIAS.QUEUE) TARGET (MAGENTA.QUEUE)
```

This command redirects MQI calls to another queue, MAGENTA.QUEUE.

You can also use alias queues to make a single queue (the target queue) appear to have different attributes for different applications. You do this by defining two aliases, one for each application. Suppose there are two applications:

- Application ALPHA can put messages on YELLOW.QUEUE, but is not allowed to get messages from it.
- Application BETA can get messages from YELLOW.QUEUE, but is not allowed to put messages on it.

The following command defines an alias that is put enabled and get disabled for application ALPHA:

```
DEFINE QALIAS (ALPHAS.ALIAS.QUEUE) +  
TARGET (YELLOW.QUEUE) +  
PUT (ENABLED) +  
GET (DISABLED)
```

The following command defines an alias that is put disabled and get enabled for application BETA:

```
DEFINE QALIAS (BETAS.ALIAS.QUEUE) +  
TARGET (YELLOW.QUEUE) +  
PUT (DISABLED) +  
GET (ENABLED)
```

ALPHA uses the queue name ALPHAS.ALIAS.QUEUE in its MQI calls; BETA uses the queue name BETAS.ALIAS.QUEUE. They both access the same queue, but in different ways.

You can use the LIKE and REPLACE attributes when you define queue aliases, in the same way that you use these attributes with local queues.

## Using other commands with alias queues

You can use the appropriate MQSC commands to display or alter alias queue attributes, or to delete the alias queue object. For example:

Use the following command to display the alias queue's attributes:

```
DISPLAY QUEUE (ALPHAS.ALIAS.QUEUE)
```

Use the following command to alter the base queue name, to which the alias resolves, where the `force` option forces the change even if the queue is open:

```
ALTER QALIAS (ALPHAS.ALIAS.QUEUE) TARGQ(ORANGE.LOCAL.QUEUE) FORCE
```

Use the following command to delete this queue alias:

```
DELETE QALIAS (ALPHAS.ALIAS.QUEUE)
```

You cannot delete an alias queue if an application currently has the queue open. See [MQSC commands](#) for more information about this, and other alias queue commands.

## Working with dead-letter queues

Each queue manager typically has a local queue to use as a dead-letter queue, so that messages that cannot be delivered to their correct destination can be stored for later retrieval. You tell the queue manager about the dead-letter queue, and specify how messages found on a dead-letter queue are to be processed. Using dead-letter queues can affect the sequence in which messages are delivered, so you might choose not to use them.

To tell the queue manager about the dead-letter queue, specify a dead-letter queue name on the `crtmqm` command (`crtmqm -u DEAD.LETTER.QUEUE`, for example), or by using the `DEADQ` attribute on the `ALTER QMGR` command to specify one later. You must define the dead-letter queue before using it.



A sample dead-letter queue called `SYSTEM.DEAD.LETTER.QUEUE` is available with the product. This queue is automatically created when you create the queue manager. You can modify this definition if required, and rename it.

A dead-letter queue has no special requirements except that:

- It must be a local queue
- Its `MAXMSGL` (maximum message length) attribute must enable the queue to accommodate the largest messages that the queue manager has to handle **plus** the size of the dead-letter header (MQDLH)

Using dead-letter queues can affect the sequence in which messages are delivered, so you might choose not to use them. You set the `USEDLQ` channel attribute to determine whether the dead-letter queue is used when messages cannot be delivered. This attribute can be configured so that some functions of the queue manager use the dead-letter queue, while other functions do not. For more information about the use of the `USEDLQ` channel attribute on different MQSC commands, see [DEFINE CHANNEL](#), [DISPLAY CHANNEL](#), [ALTER CHANNEL](#), and [DISPLAY CLUSQMGR](#).

IBM MQ provides a dead-letter queue handler that allows you to specify how messages found on a dead-letter queue are to be processed or removed. See [“Processing messages on a dead-letter queue”](#) on page 89.

### Related information

[Dead-letter queues](#)

[Undelivered messages troubleshooting](#)

## Processing messages on a dead-letter queue

To process messages on a dead-letter queue (DLQ), MQ supplies a default DLQ handler. The handler matches messages on the DLQ against entries in a rules table that you define.

Messages can be put on a DLQ by queue managers, message channel agents (MCAs), and applications. All messages on the DLQ must be prefixed with a *dead-letter header* structure, MQDLH. Messages put on the DLQ by a queue manager or a message channel agent always have this header; applications putting messages on the DLQ must supply this header. The *Reason* field of the MQDLH structure contains a reason code that identifies why the message is on the DLQ.

All IBM MQ environments need a routine to process messages on the DLQ regularly. IBM MQ supplies a default routine, called the *dead-letter queue handler* (the DLQ handler), which you invoke using the `runmqdlq` command.

Instructions for processing messages on the DLQ are supplied to the DLQ handler by means of a user-written *rules table*. That is, the DLQ handler matches messages on the DLQ against entries in the rules table; when a DLQ message matches an entry in the rules table, the DLQ handler performs the action associated with that entry.

### Related information

[Dead-letter queues](#)

[Undelivered messages troubleshooting](#)

### ***The IBM MQ for IBM i dead-letter queue handler***

Use this information to learn about, and how to invoke, the dead-letter queue handler.

A *dead-letter queue* (DLQ), sometimes referred to as an *undelivered-message queue*, is a holding queue for messages that cannot be delivered to their destination queues. Every queue manager in a network should have an associated DLQ.

**Note:** It is often preferable to avoid placing messages on a DLQ. For information about the use and avoidance of DLQs, see [“Working with dead-letter queues”](#) on page 88.

Queue managers, message channel agents, and applications can put messages on the DLQ. All messages on the DLQ must be prefixed with a *dead-letter header* structure, MQDLH. Messages put on the DLQ by a queue manager or by a message channel agent always have an MQDLH. Always supply an MQDLH to

applications putting messages on the DLQ. The *Reason* field of the MQDLH structure contains a reason code that identifies why the message is on the DLQ.

In all IBM MQ environments, there must be a routine that runs regularly to process messages on the DLQ. IBM MQ supplies a default routine, called the *dead-letter queue handler* (the DLQ handler), which you invoke using the STRMQMDLQ command. A user-written *rules table* supplies instructions to the DLQ handler, for processing messages on the DLQ. That is, the DLQ handler matches messages on the DLQ against entries in the rules table. When a DLQ message matches an entry in the rules table, the DLQ handler performs the action associated with that entry.

## Invoking the DLQ handler

Use the STRMQMDLQ command to invoke the DLQ handler. You can name the DLQ that you want to process and the queue manager that you want to use in two ways:

- As parameters to STRMQMDLQ from the command prompt. For example:

```
STRMQMDLQ UDLMSGQ(ABC1.DEAD.LETTER.QUEUE) SRCMBR(QRULE) SRCFILE(library/QTXTSRC)
MQMNAME(MY.QUEUE.MANAGER)
```

- In the rules table. For example:

```
INPUTQ(ABC1.DEAD.LETTER.QUEUE)
```

**Note:** The rules table is a member within a source physical file that can take any name.

The examples apply to the DLQ called ABC1.DEAD.LETTER.QUEUE, owned by the default queue manager.

If you do not specify the DLQ or the queue manager as shown, the default queue manager for the installation is used along with the DLQ belonging to that queue manager.

The STRMQMDLQ command takes its input from the rules table.

You must be authorized to access both the DLQ itself, and any message queues to which messages on the DLQ are forwarded, in order to run the DLQ handler. You must also be authorized to assume the identity of other users, for the DLQ to put messages on queues with the authority of the user ID in the message context.

## Related information

[Dead-letter queues](#)

[Undelivered messages troubleshooting](#)

### *The DLQ handler rules table*

The DLQ handler rules table defines how the DLQ handler is to process messages that arrive on the DLQ.

The DLQ handler rules table defines how the DLQ handler is to process messages that arrive on the DLQ. There are two types of entry in a rules table:

- The first entry in the table, which is optional, contains *control data*.
- All other entries in the table are *rules* for the DLQ handler to follow. Each rule consists of a *pattern* (a set of message characteristics) that a message is matched against, and an *action* to be taken when a message on the DLQ matches the specified pattern. There must be at least one rule in a rules table.

Each entry in the rules table comprises one or more keywords.

## Control data

This section describes the keywords that you can include in a control-data entry in a DLQ handler rules table. Note the following:

- The default value for a keyword, if any, is underlined.

- The vertical line (|) separates alternatives. You can specify only one of these.
- All keywords are optional.

#### **INPUTQ ( *QueueName* | ' ' )**

The name of the DLQ you want to process:

1. Any UDLMMSGQ value (or \*DFT) you specify as a parameter to the **STRMQMDLQ** command overrides any INPUTQ value in the rules table.
2. If you specify a blank UDLMMSGQ value as a parameter to the **STRMQMDLQ** command, the INPUTQ value in the rules table is used.
3. If you specify a blank UDLMMSGQ value as a parameter to the **STRMQMDLQ** command, and a blank INPUTQ value in the rules table, the system default dead-letter queue is used.

#### **INPUTQM ( *QueueManagerName* | ' ' )**

The name of the queue manager that owns the DLQ named on the INPUTQ keyword.

If you do not specify a queue manager, or you specify INPUTQM(' ') in the rules table, the system uses the default queue manager for the installation.

#### **RETRYINT ( *Interval* | 60 )**

The interval, in seconds, at which the DLQ handler should attempt to reprocess messages on the DLQ that could not be processed at the first attempt, and for which repeated attempts have been requested. By default, the retry interval is 60 seconds.

#### **WAIT ( YES | NO | *nnn* )**

Whether the DLQ handler should wait for further messages to arrive on the DLQ when it detects that there are no further messages that it can process.

##### **YES**

Causes the DLQ handler to wait indefinitely.

##### **NO**

Causes the DLQ handler to terminate when it detects that the DLQ is either empty or contains no messages that it can process.

##### ***nnn***

Causes the DLQ handler to wait for *nnn* seconds for new work to arrive before terminating, after it detects that the queue is either empty or contains no messages that it can process.

Specify WAIT (YES) for busy DLQs, and WAIT (NO) or WAIT ( *nnn* ) for DLQs that have a low level of activity. If the DLQ handler is allowed to terminate, re-invoke it using triggering.

You can supply the name of the DLQ as an input parameter to the **STRMQMDLQ** command, as an alternative to including control data in the rules table. If any value is specified both in the rules table and on input to the **STRMQMDLQ** command, the value specified on the **STRMQMDLQ** command takes precedence.

**Note:** If a control-data entry is included in the rules table, it must be the first entry in the table.

#### *Rules (patterns and actions)*

Use this information to understand the DLQ rules.

Here is an example rule from a DLQ handler rules table:

```
PERSIST(MQPER_PERSISTENT) REASON (MQRC_PUT_INHIBITED) +  
ACTION (RETRY) RETRY (3)
```

This rule instructs the DLQ handler to make 3 attempts to deliver to its destination queue any persistent message that was put on the DLQ because MQPUT and MQPUT1 were inhibited.

This section describes the keywords that you can include in a rule. Note the following:

- The default value for a keyword, if any, is underlined. For most keywords, the default value is \* (asterisk), which matches any value.
- The vertical line (|) separates alternatives. You can specify only one of these.

- All keywords except ACTION are optional.

This section begins with a description of the pattern-matching keywords (those against which messages on the DLQ are matched). It then describes the action keywords (those that determine how the DLQ handler is to process a matching message).

#### *The pattern-matching keywords*

The pattern-matching keywords are described in the following example. Use them to specify values against which messages on the DLQ are matched. All pattern-matching keywords are optional.

#### **APPLIDAT ( *ApplIdentityData* | \* )**

The *ApplIdentityData* value of the message on the DLQ, specified in the message descriptor, MQMD.

#### **APPLNAME ( *PutApplName* | \* )**

The name of the application that issued the MQPUT or MQPUT1 call, as specified in the *PutApplName* field of the message descriptor, MQMD, of the message on the DLQ.

#### **APPLTYPE ( *PutApplType* | \* )**

The *PutApplType* value specified in the message descriptor, MQMD, of the message on the DLQ.

#### **DESTQ ( *QueueName* | \* )**

The name of the message queue for which the message is destined.

#### **DESTQM ( *QueueManagerName* | \* )**

The queue manager name for the message queue for which the message is destined.

#### **FEEDBACK ( *Feedback* | \* )**

When the *MsgType* value is MQMT\_REPORT, *Feedback* describes the nature of the report.

You can use symbolic names. For example, you can use the symbolic name MQFB\_COA to identify those messages on the DLQ that require confirmation of their arrival on their destination queues.

#### **FORMAT ( *Format* | \* )**

The name that the sender of the message uses to describe the format of the message data.

#### **MSGTYPE ( *MsgType* | \* )**

The message type of the message on the DLQ.

You can use symbolic names. For example, you can use the symbolic name MQMT\_REQUEST to identify those messages on the DLQ that require replies.

#### **PERSIST ( *Persistence* | \* )**

The persistence value of the message. (The persistence of a message determines whether it survives restarts of the queue manager.)

You can use symbolic names. For example, you can use the symbolic name MQPER\_PERSISTENT to identify those messages on the DLQ that are persistent.

#### **REASON ( *ReasonCode* | \* )**

The reason code that describes why the message was put to the DLQ.

You can use symbolic names. For example, you can use the symbolic name MQRC\_Q\_FULL to identify those messages placed on the DLQ because their destination queues were full.

#### **REPLYQ ( *QueueName* | \* )**

The reply-to queue name specified in the message descriptor, MQMD, of the message on the DLQ.

#### **REPLYQM ( *QueueManagerName* | \* )**

The queue manager name of the reply-to queue specified in the REPLYQ keyword.

#### **USERID ( *UserIdentifier* | \* )**

The user ID of the user who originated the message on the DLQ, as specified in the message descriptor, MQMD.

### *The action keywords*

The action keywords are described. Use them to determine how a matching message is processed.

#### **ACTION (DISCARD|IGNORE|RETRY|FWD)**

The action taken for any message on the DLQ that matches the pattern defined in this rule.

##### **DISCARD**

Causes the message to be deleted from the DLQ.

##### **IGNORE**

Causes the message to be kept on the DLQ.

##### **RETRY**

Causes the DLQ handler to try again to put the message on its destination queue.

##### **FWD**

Causes the DLQ handler to forward the message to the queue named on the FWDQ keyword.

You must specify the ACTION keyword. The number of attempts made to implement an action is governed by the RETRY keyword. The RETRYINT keyword of the control data controls the interval between attempts.

#### **FWDQ ( QueueName |&DESTQ|&REPLYQ)**

The name of the message queue to which the message is forwarded when you select the ACTION keyword.

##### **QueueName**

The name of a message queue. FWDQ(' ') is not valid.

##### **&DESTQ**

Take the queue name from the *DestQName* field in the MQDLH structure.

##### **&REPLYQ**

Take the queue name from the *ReplyToQ* field in the message descriptor, MQMD.

You can specify REPLYQ (?) in the message pattern to avoid error messages, when a rule specifying FWDQ (&REPLYQ) matches a message with a blank *ReplyToQ* field.

#### **FWDQM ( QueueManagerName |&DESTQM|&REPLYQM|' ')**

The queue manager of the queue to which a message is forwarded.

##### **QueueManagerName**

The queue manager name for the queue to which the message is forwarded when you select the ACTION (FWD) keyword.

##### **&DESTQM**

Take the queue manager name from the *DestQMGrName* field in the MQDLH structure.

##### **&REPLYQM**

Take the queue manager name from the *ReplyToQMGr* field in the message descriptor, MQMD.

''

FWDQM(' '), which is the default value, identifies the local queue manager.

#### **HEADER ( YES |NO)**

Whether the MQDLH should remain on a message for which ACTION (FWD) is requested. By default, the MQDLH remains on the message. The HEADER keyword is not valid for actions other than FWD.

#### **PUTAUT ( DEF |CTX)**

The authority with which messages should be put by the DLQ handler:

##### **DEF**

Puts messages with the authority of the DLQ handler itself.

##### **CTX**

Causes the messages to be put with the authority of the user ID in the message context. You must be authorized to assume the identity of other users, if you specify PUTAUT (CTX).

## RETRY ( *RetryCount* | 1 )

The number of times, in the range 1 - 999,999,999, to attempt an action (at the interval specified on the RETRYINT keyword of the control data).

**Note:** The count of attempts made by the DLQ handler to implement any particular rule is specific to the current instance of the DLQ handler; the count does not persist across restarts. If you restart the DLQ handler, the count of attempts made to apply a rule is reset to zero.

### *Rules table conventions*

The rules table must adhere to the following conventions regarding its syntax, structure, and contents.

- A rules table must contain at least one rule.
- Keywords can occur in any order.
- A keyword can be included once only in any rule.
- Keywords are not case sensitive.
- A keyword and its parameter value must be separated from other keywords by at least one blank or comma.
- Any number of blanks can occur at the beginning or end of a rule, and between keywords, punctuation, and values.
- Each rule must begin on a new line.
- For portability, the significant length of a line must not be greater than 72 characters.
- Use the plus sign (+) as the last non-blank character on a line to indicate that the rule continues from the first non-blank character in the next line. Use the minus sign (-) as the last non-blank character on a line to indicate that the rule continues from the start of the next line. Continuation characters can occur within keywords and parameters.

For example:

```
APPLNAME ( ' ABC+  
D ' )
```

results in 'ABCD'.

```
APPLNAME ( ' ABC -  
D ' )
```

results in 'ABC D'.

- Comment lines, which begin with an asterisk (\*), can occur anywhere in the rules table.
- Blank lines are ignored.
- Each entry in the DLQ handler rules table comprises one or more keywords and their associated parameters. The parameters must follow these syntax rules:
  - Each parameter value must include at least one significant character. The delimiting quotation marks in values enclosed in quotation marks are not considered significant. For example, these parameters are valid:

FORMAT ( ' ABC ' )	3 significant characters
FORMAT (ABC)	3 significant characters
FORMAT ( ' A ' )	1 significant character
FORMAT (A)	1 significant character
FORMAT ( ' ' )	1 significant character

These parameters are invalid because they contain no significant characters:

FORMAT ( ' ' )

FORMAT ( )

FORMAT ( )

FORMAT

- Wildcard characters are supported. You can use the question mark (?) in place of any single character, except a trailing blank. You can use the asterisk (\*) in place of zero or more adjacent characters. The asterisk (\*) and the question mark (?) are **always** interpreted as wildcard characters in parameter values.
- You cannot include wildcard characters in the parameters of these keywords: ACTION, HEADER, RETRY, FWDQ, FWDQM, and PUTAUT.
- Trailing blanks in parameter values, and in the corresponding fields in the message on the DLQ, are not significant when performing wildcard matches. However, leading and embedded blanks within strings in quotation marks are significant to wildcard matches.
- Numeric parameters cannot include the question mark (?) wildcard character. You can include the asterisk (\*) in place of an entire numeric parameter, but the asterisk cannot be included as part of a numeric parameter. For example, these are valid numeric parameters:

MSGTYPE ( 2 )                      Only reply messages are eligible

MSGTYPE ( \* )                      Any message type is eligible

MSGTYPE ( ' \* ' )                  Any message type is eligible

However, MSGTYPE ( ' 2 \* ' ) is not valid, because it includes an asterisk (\*) as part of a numeric parameter.

- Numeric parameters must be in the range 0-999 999 999. If the parameter value is in this range, it is accepted, even if it is not currently valid in the field to which the keyword relates. You can use symbolic names for numeric parameters.
- If a string value is shorter than the field in the MQDLH or MQMD to which the keyword relates, the value is padded with blanks to the length of the field. If the value, excluding asterisks, is longer than the field, an error is diagnosed. For example, these are all valid string values for an 8-character field:

' ABCDEFGH '                      8 characters

' A \* C \* E \* G \* I '              5 characters excluding asterisks

' \* A \* C \* E \* G \* I \* K \* M \* O \* '      8 characters excluding asterisks

- Strings that contain blanks, lowercase characters, or special characters other than period (.), forward slash (/), underscore (\_), and percent sign (%) must be enclosed in single quotation marks. Lowercase characters not enclosed in quotation marks are folded to uppercase. If the string includes a quotation mark, two single quotation marks must be used to denote both the beginning and the end of the quotation. When the length of the string is calculated, each occurrence of double quotation marks is counted as a single character.

#### *Processing the rules table*

The DLQ handler searches the rules table for a rule with a pattern that matches a message on the DLQ.

The search begins with the first rule in the table, and continues sequentially through the table. When a rule with a matching pattern is found, the rules table attempts the action from that rule. The DLQ handler increments the retry count for a rule by 1 whenever it attempts to apply that rule. If the first attempt fails, the attempt is repeated until the count of attempts made matches the number specified on the RETRY keyword. If all attempts fail, the DLQ handler searches for the next matching rule in the table.

This process is repeated for subsequent matching rules until an action is successful. When each matching rule has been attempted the number of times specified on its RETRY keyword, and all attempts have failed, ACTION (IGNORE) is assumed. ACTION (IGNORE) is also assumed if no matching rule is found.

**Note:**

1. Matching rule patterns are sought only for messages on the DLQ that begin with an MQDLH. Messages that do not begin with an MQDLH are reported periodically as being in error, and remain on the DLQ indefinitely.
2. All pattern keywords can default, so that a rule can consist of an action only. Note, however, that action-only rules are applied to all messages on the queue that have MQDLHs and that have not already been processed in accordance with other rules in the table.
3. The rules table is validated when the DLQ handler starts, and errors flagged at that time. (Error messages issued by the DLQ handler are described in [Reason codes](#).) You can make changes to the rules table at any time, but those changes do not come into effect until the DLQ handler is restarted.
4. The DLQ handler does not alter the content of messages, of the MQDLH, or of the message descriptor. The DLQ handler always puts messages to other queues with the message option MQPMO\_PASS\_ALL\_CONTEXT.
5. Consecutive syntax errors in the rules table might not be recognized, because the validation of the rules table eliminates the generation of repetitive errors.
6. The DLQ handler opens the DLQ with the MQOO\_INPUT\_AS\_Q\_DEF option.
7. Multiple instances of the DLQ handler can run concurrently against the same queue, using the same rules table. However, it is more usual for there to be a one-to-one relationship between a DLQ and a DLQ handler.

*Ensuring that all DLQ messages are processed*

The DLQ handler keeps a record of all messages on the DLQ that have been seen but not removed.

If you use the DLQ handler as a filter to extract a small subset of the messages from the DLQ, the DLQ handler still keeps a record of those messages on the DLQ that it did not process. Also, the DLQ handler cannot guarantee that new messages arriving on the DLQ will be seen, even if the DLQ is defined as first-in first-out (FIFO). If the queue is not empty, the DLQ is periodically re-scanned to check all messages.

For these reasons, try to ensure that the DLQ contains as few messages as possible. If messages that cannot be discarded or forwarded to other queues (for whatever reason) are allowed to accumulate on the queue, the workload of the DLQ handler increases and the DLQ itself is in danger of filling up.

You can take specific measures to enable the DLQ handler to empty the DLQ. For example, try not to use ACTION (IGNORE), which leaves messages on the DLQ. (Remember that ACTION (IGNORE) is assumed for messages that are not explicitly addressed by other rules in the table.) Instead, for those messages that you would otherwise ignore, use an action that moves the messages to another queue. For example:

```
ACTION (FWD) FWDQ (IGNORED.DEAD.QUEUE) HEADER (YES)
```

Similarly, make the final rule in the table a catchall to process messages that have not been addressed by earlier rules in the table. For example, the final rule in the table could be something like this:

```
ACTION (FWD) FWDQ (REALLY.DEAD.QUEUE) HEADER (YES)
```

This causes messages that fall through to the final rule in the table to be forwarded to the queue REALLY.DEAD.QUEUE, where they can be processed manually. If you do not have such a rule, messages are likely to remain on the DLQ indefinitely.

*An example DLQ handler rules table*

Here is an example rules table that contains a single control-data entry and several rules:

```
*****
*   An example rules table for the STRMQMDLQ command   *
*****
* Control data entry
* -----
* If no queue manager name is supplied as an explicit parameter to
```



```

* STRMQMDLQ, use the default queue manager for the machine.
* If no queue name is supplied as an explicit parameter to STRMQMDLQ,
* use the DLQ defined for the local queue manager.
*
inputqm(' ') inputq(' ')

* Rules
* -----
* We include rules with ACTION (RETRY) first to try to
* deliver the message to the intended destination.

* If a message is placed on the DLQ because its destination
* queue is full, attempt to forward the message to its
* destination queue. Make 5 attempts at approximately
* 60-second intervals (the default value for RETRYINT).

REASON(MQRC_Q_FULL) ACTION(RETRY) RETRY(5)

* If a message is placed on the DLQ because of a put inhibited
* condition, attempt to forward the message to its
* destination queue. Make 5 attempts at approximately
* 60-second intervals (the default value for RETRYINT).

REASON(MQRC_PUT_INHIBITED) ACTION(RETRY) RETRY(5)

* The AAAA corporation is always sending messages with incorrect
* addresses. When we find a request from the AAAA corporation,
* we return it to the DLQ (DEADQ) of the reply-to queue manager
* (&REPLYQM).
* The AAAA DLQ handler attempts to redirect the message.

MSGTYPE(MQMT_REQUEST) REPLYQM(AAAA.*) +
ACTION(FWD) FWDQ(DEADQ) FWDQM(&REPLYQM)

* The BBBB corporation never does things by half measures. If
* the queue manager BBBB.1 is unavailable, try to
* send the message to BBBB.2

DESTQM(bbbb.1) +
action(fwd) fwdq(&DESTQ) fwdqm(bbbb.2) header(no)

* The CCCC corporation considers itself very security
* conscious, and believes that none of its messages
* will ever end up on one of our DLQs.
* Whenever we see a message from a CCCC queue manager on our
* DLQ, we send it to a special destination in the CCCC organization
* where the problem is investigated.

REPLYQM(CCCC.*) +
ACTION(FWD) FWDQ(ALARM) FWDQM(CCCC.SYSTEM)

* Messages that are not persistent run the risk of being
* lost when a queue manager terminates. If an application
* is sending nonpersistent messages, it must be able
* to cope with the message being lost, so we can afford to
* discard the message.

PERSIST(MQPER_NOT_PERSISTENT) ACTION(DISCARD)

* For performance and efficiency reasons, we like to keep
* the number of messages on the DLQ small.
* If we receive a message that has not been processed by
* an earlier rule in the table, we assume that it
* requires manual intervention to resolve the problem.
* Some problems are best solved at the node where the
* problem was detected, and others are best solved where
* the message originated. We do not have the message origin,
* but we can use the REPLYQM to identify a node that has
* some interest in this message.
* Attempt to put the message onto a manual intervention
* queue at the appropriate node. If this fails,
* put the message on the manual intervention queue at
* this node.

REPLYQM('?*') +
ACTION(FWD) FWDQ(DEADQ.MANUAL.INTERVENTION) FWDQM(&REPLYQM)

ACTION(FWD) FWDQ(DEADQ.MANUAL.INTERVENTION)

```

## Invoking the DLQ handler

Invoke the DLQ handler using the `runmqdlq` command. You can name the DLQ you want to process and the queue manager you want to use in two ways.

The two ways are as follows:

- As parameters to `runmqdlq` from the command prompt. For example:

```
runmqdlq ABC1.DEAD.LETTER.QUEUE ABC1.QUEUE.MANAGER <qrulc.rul
```

- In the rules table. For example:

```
INPUTQ(ABC1.DEAD.LETTER.QUEUE) INPUTQM(ABC1.QUEUE.MANAGER)
```

The examples apply to the DLQ called `ABC1.DEAD.LETTER.QUEUE`, owned by the queue manager `ABC1.QUEUE.MANAGER`.

If you do not specify the DLQ or the queue manager as shown, the default queue manager for the installation is used along with the DLQ belonging to that queue manager.

The `runmqdlq` command takes its input from `stdin`; you associate the rules table with `runmqdlq` by redirecting `stdin` from the rules table.

To run the DLQ handler you must be authorized to access both the DLQ itself and any message queues to which messages on the DLQ are forwarded. For the DLQ handler to put messages on queues with the authority of the user ID in the message context, you must also be authorized to assume the identity of other users.

For more information about the `runmqdlq` command, see [runmqdlq](#).

### Related information

[Dead-letter queues](#)

[Undelivered messages troubleshooting](#)

#### *The sample DLQ handler, amqsdlq*

In addition to the DLQ handler invoked using the `runmqdlq` command, IBM MQ provides the source of a sample DLQ handler, `amqsdlq`, with a function that is similar to that provided by `runmqdlq`.

You can customize `amqsdlq` to provide a DLQ handler that meets your requirements. For example, you might decide that you want a DLQ handler that can process messages without dead-letter headers. (Both the default DLQ handler and the sample, `amqsdlq`, process only those messages on the DLQ that begin with a dead-letter header, `MQDLH`. Messages that do not begin with an `MQDLH` are identified as being in error, and remain on the DLQ indefinitely.)

`MQ_INSTALLATION_PATH` represents the high-level directory in which IBM MQ is installed.

In IBM MQ for Windows, the source of `amqsdlq` is supplied in the directory:

```
MQ_INSTALLATION_PATH\tools\c\samples\dlq
```

and the compiled version is supplied in the directory:

```
MQ_INSTALLATION_PATH\tools\c\samples\bin
```

In IBM MQ for UNIX and Linux systems, the source of `amqsdlq` is supplied in the directory:

```
MQ_INSTALLATION_PATH/samp/dlq
```

and the compiled version is supplied in the directory:

```
MQ_INSTALLATION_PATH/samp/bin
```

You can also compile **amqsd1q** in client mode. For more information, see [Writing client procedural applications](#), [Building applications for IBM MQ MQI clients](#), and [Running applications in the IBM MQ MQI client environment](#).

### **The DLQ handler rules table**

The DLQ handler rules table defines how the DLQ handler is to process messages that arrive on the DLQ.

There are two types of entry in a rules table:

- The first entry in the table, which is optional, contains *control data*.
- All other entries in the table are *rules* for the DLQ handler to follow. Each rule consists of a *pattern* (a set of message characteristics) that a message is matched against, and an *action* to be taken when a message on the DLQ matches the specified pattern. There must be at least one rule in a rules table.

Each entry in the rules table comprises one or more keywords.

#### **Related information**

[Dead-letter queues](#)

[Undelivered messages troubleshooting](#)

#### *Control data*

This section describes the keywords that you can include in a control-data entry in a DLQ handler rules table.

#### **Note:**

- The vertical line (|) separates alternatives, only one of which can be specified.
- All keywords are optional.

#### **INPUTQ ( *QueueName* | ' ' )**

The name of the DLQ you want to process:

1. Any INPUTQ value you supply as a parameter to the `runmqdlq` command overrides any INPUTQ value in the rules table.
2. If you do not specify an INPUTQ value as a parameter to the `runmqdlq` command, but you **do** specify a value in the rules table, the INPUTQ value in the rules table is used.
3. If no DLQ is specified or you specify INPUTQ(' ') in the rules table, the name of the DLQ belonging to the queue manager with the name that is supplied as a parameter to the `runmqdlq` command is used.
4. If you do not specify an INPUTQ value as a parameter to the `runmqdlq` command or as a value in the rules table, the DLQ belonging to the queue manager named on the INPUTQM keyword in the rules table is used.

#### **INPUTQM ( *QueueManagerName* | ' ' )**

The name of the queue manager that owns the DLQ named on the INPUTQ keyword:

1. Any INPUTQM value you supply as a parameter to the `runmqdlq` command overrides any INPUTQM value in the rules table.
2. If you do not specify an INPUTQM value as a parameter to the `runmqdlq` command, the INPUTQM value in the rules table is used.
3. If no queue manager is specified or you specify INPUTQM(' ') in the rules table, the default queue manager for the installation is used.

#### **RETRYINT ( *Interval* | 60 )**

The interval, in seconds, at which the DLQ handler should reprocess messages on the DLQ that could not be processed at the first attempt, and for which repeated attempts have been requested. By default, the retry interval is 60 seconds.

#### **WAIT ( **YES** | **NO** | *nnn* )**

Whether the DLQ handler should wait for further messages to arrive on the DLQ when it detects that there are no further messages that it can process.

**YES**

The DLQ handler waits indefinitely.

**NO**

The DLQ handler ends when it detects that the DLQ is either empty or contains no messages that it can process.

***nnn***

The DLQ handler waits for *nnn* seconds for new work to arrive before ending, after it detects that the queue is either empty or contains no messages that it can process.

Specify WAIT (YES) for busy DLQs, and WAIT (NO) or WAIT ( *nnn* ) for DLQs that have a low level of activity. If the DLQ handler is allowed to terminate, invoke it again using triggering. For more information about triggering, see [Starting IBM MQ applications using triggers](#).

An alternative to including control data in the rules table is to supply the names of the DLQ and its queue manager as input parameters to the `runmqdlq` command. If you specify a value both in the rules table and as input to the `runmqdlq` command, the value specified on the `runmqdlq` command takes precedence.

If you include a control-data entry in the rules table, it must be the **first** entry in the table.

*Rules (patterns and actions)*

A description of the pattern-matching keywords (those against which messages on the DLQ are matched), and the action keywords (those that determine how the DLQ handler is to process a matching message). An example rule is also provided.

**The pattern-matching keywords**

The pattern-matching keywords, which you use to specify values against which messages on the DLQ are matched, are as follows. (All pattern-matching keywords are optional):

**APPLIDAT ( *ApplIdentityData* | \* )**

The *ApplIdentityData* value specified in the message descriptor, MQMD, of the message on the DLQ.

**APPLNAME ( *PutAppName* | \* )**

The name of the application that issued the MQPUT or MQPUT1 call, as specified in the *PutAppName* field of the message descriptor, MQMD, of the message on the DLQ.

**APPLTYPE ( *PutApplType* | \* )**

The *PutApplType* value, specified in the message descriptor, MQMD, of the message on the DLQ.

**DESTQ ( *QueueName* | \* )**

The name of the message queue for which the message is destined.

**DESTQM ( *QueueManagerName* | \* )**

The name of the queue manager of the message queue for which the message is destined.

**FEEDBACK ( *Feedback* | \* )**

When the *MsgType* value is MQFB\_REPORT, *Feedback* describes the nature of the report.

You can use symbolic names. For example, you can use the symbolic name MQFB\_COA to identify those messages on the DLQ that need confirmation of their arrival on their destination queues.

**FORMAT ( *Format* | \* )**

The name that the sender of the message uses to describe the format of the message data.

**MSGTYPE ( *MsgType* | \* )**

The message type of the message on the DLQ.

You can use symbolic names. For example, you can use the symbolic name MQMT\_REQUEST to identify those messages on the DLQ that need replies.

**PERSIST ( *Persistence* | \* )**

The persistence value of the message. (The persistence of a message determines whether it survives restarts of the queue manager.)

You can use symbolic names. For example, you can use the symbolic name MQPER\_PERSISTENT to identify messages on the DLQ that are persistent.

**REASON ( *ReasonCode* | \* )**

The reason code that describes why the message was put to the DLQ.

You can use symbolic names. For example, you can use the symbolic name MQRC\_Q\_FULL to identify those messages placed on the DLQ because their destination queues were full.

**REPLYQ ( *QueueName* | \* )**

The name of the reply-to queue specified in the message descriptor, MQMD, of the message on the DLQ.

**REPLYQM ( *QueueManagerName* | \* )**

The name of the queue manager of the reply-to queue, as specified in the message descriptor, MQMD, of the message on the DLQ.

**USERID ( *UserIdentifier* | \* )**

The user ID of the user who originated the message on the DLQ, as specified in the message descriptor, MQMD, of the message on the DLQ.

## The action keywords

The action keywords, used to describe how a matching message is to be processed, are as follows:

**ACTION (DISCARD|IGNORE|RETRY|FWD)**

The action to be taken for any message on the DLQ that matches the pattern defined in this rule.

**DISCARD**

Delete the message from the DLQ.

**IGNORE**

Leave the message on the DLQ.

**RETRY**

If the first attempt to put the message on its destination queue fails, try again. The RETRY keyword sets the number of tries made to implement an action. The RETRYINT keyword of the control data controls the interval between attempts.

**FWD**

Forward the message to the queue named on the FWDQ keyword.

You must specify the ACTION keyword.

**FWDQ ( *QueueName* |&DESTQ|&REPLYQ)**

The name of the message queue to which to forward the message when ACTION (FWD) is requested.

***QueueName***

The name of a message queue. FWDQ(' ') is not valid.

**&DESTQ**

Take the queue name from the *DestQName* field in the MQDLH structure.

**&REPLYQ**

Take the queue name from the *ReplyToQ* field in the message descriptor, MQMD.

To avoid error messages when a rule specifying FWDQ (&REPLYQ) matches a message with a blank *ReplyToQ* field, specify REPLYQ (?) in the message pattern.

**FWDQM ( *QueueManagerName* |&DESTQM|&REPLYQM|' ')**

The queue manager of the queue to which to forward a message.

***QueueManagerName***

The name of the queue manager of the queue to which to forward a message when ACTION (FWD) is requested.

**&DESTQM**

Take the queue manager name from the *DestQMGrName* field in the MQDLH structure.

**&REPLYQM**

Take the queue manager name from the *ReplyToQMgr* field in the message descriptor, MQMD.

''

FWDQM(' '), which is the default value, identifies the local queue manager.

**HEADER ( YES | NO )**

Whether the MQDLH should remain on a message for which ACTION (FWD) is requested. By default, the MQDLH remains on the message. The HEADER keyword is not valid for actions other than FWD.

**PUTAUT ( DEF | CTX )**

The authority with which messages should be put by the DLQ handler:

**DEF**

Put messages with the authority of the DLQ handler itself.

**CTX**

Put the messages with the authority of the user ID in the message context. If you specify PUTAUT (CTX), you must be authorized to assume the identity of other users.

**RETRY ( *RetryCount* | 1 )**

The number of times, in the range 1 - 999,999,999, to try an action (at the interval specified on the RETRYINT keyword of the control data). The count of attempts made by the DLQ handler to implement any particular rule is specific to the current instance of the DLQ handler; the count does not persist across restarts. If the DLQ handler is restarted, the count of attempts made to apply a rule is reset to zero.

**Example rule**

Here is an example rule from a DLQ handler rules table:

```
PERSIST(MQPER_PERSISTENT) REASON (MQRC_PUT_INHIBITED) +
ACTION (RETRY) RETRY (3)
```

This rule instructs the DLQ handler to make three attempts to deliver to its destination queue any persistent message that was put on the DLQ because MQPUT and MQPUT1 were inhibited.

All keywords that you can use on a rule are described in the rest of this section. Note the following:

- The default value for a keyword, if any, is underlined. For most keywords, the default value is \* (asterisk), which matches any value.
- The vertical line (|) separates alternatives, only one of which can be specified.
- All keywords except ACTION are optional.

*Rules table conventions*

The syntax, structure and contents of the DLQ handler rules table must adhere to these conventions.

The rules table must adhere to the following conventions:

- A rules table must contain at least one rule.
- Keywords can occur in any order.
- A keyword can be included only once in any rule.
- Keywords are not case-sensitive.
- A keyword and its parameter value must be separated from other keywords by at least one blank or comma.
- There can be any number of blanks at the beginning or end of a rule, and between keywords, punctuation, and values.
- Each rule must begin on a new line.

- On Windows systems, the last rule in the table must end with a carriage return/line feed character. You can achieve this by ensuring that you press the Enter key at the end of the rule, so that the last line of the table is a blank line.
- For reasons of portability, the significant length of a line must not be greater than 72 characters.
- Use the plus sign (+) as the last nonblank character on a line to indicate that the rule continues from the first nonblank character in the next line. Use the minus sign (-) as the last nonblank character on a line to indicate that the rule continues from the start of the next line. Continuation characters can occur within keywords and parameters.

For example:

```
APPLNAME('ABC+
D')
```

results in 'ABCD', and

```
APPLNAME('ABC-
D')
```

results in 'ABC D'.

- Comment lines, which begin with an asterisk (\*), can occur anywhere in the rules table.
- Blank lines are ignored.
- Each entry in the DLQ handler rules table comprises one or more keywords and their associated parameters. The parameters must follow these syntax rules:
  - Each parameter value must include at least one significant character. The delimiting single quotation marks in values that are enclosed in quotation marks are not considered to be significant. For example, these parameters are valid:

FORMAT('ABC')	3 significant characters
FORMAT(ABC)	3 significant characters
FORMAT('A')	1 significant character
FORMAT(A)	1 significant character
FORMAT(' ')	1 significant character

These parameters are invalid because they contain no significant characters:

```
FORMAT(' ')
FORMAT( )
FORMAT()
FORMAT
```

- Wildcard characters are supported. You can use the question mark (?) instead of any single character, except a trailing blank; you can use the asterisk (\*) instead of zero or more adjacent characters. The asterisk (\*) and the question mark (?) are **always** interpreted as wildcard characters in parameter values.
- Wildcard characters cannot be included in the parameters of these keywords: ACTION, HEADER, RETRY, FWDQ, FWDQM, and PUTAUT.
- Trailing blanks in parameter values, and in the corresponding fields in the message on the DLQ, are not significant when performing wildcard matches. However, leading and embedded blanks within strings that are enclosed in single quotation marks are significant to wildcard matches.

- Numeric parameters cannot include the question mark (?) wildcard character. You can use the asterisk (\*) instead of an entire numeric parameter, but not as part of a numeric parameter. For example, these are valid numeric parameters:

MSGTYPE(2)	Only reply messages are eligible
MSGTYPE(*)	Any message type is eligible
MSGTYPE(' * ')	Any message type is eligible

However, MSGTYPE(' 2\* ') is not valid, because it includes an asterisk (\*) as part of a numeric parameter.

- Numeric parameters must be in the range 0-999 999 999. If the parameter value is in this range, it is accepted, even if it is not currently valid in the field to which the keyword relates. You can use symbolic names for numeric parameters.
- If a string value is shorter than the field in the MQDLH or MQMD to which the keyword relates, the value is padded with blanks to the length of the field. If the value, excluding asterisks, is longer than the field, an error is diagnosed. For example, these are all valid string values for an 8 character field:

'ABCDEFGH'	8 characters
'A*C*E*G*I'	5 characters excluding asterisks
'*A*C*E*G*I*K*M*O* '	8 characters excluding asterisks

- Enclose strings that contain blanks, lowercase characters, or special characters other than period (.), forward slash (/), underscore (\_), and percent sign (%) in single quotation marks. Lowercase characters not enclosed in single quotation marks are folded to uppercase. If the string includes a quotation, use two single quotation marks to denote both the beginning and the end of the quotation. When the length of the string is calculated, each occurrence of double quotation marks is counted as a single character.

### ***How the rules table is processed***

The DLQ handler searches the rules table for a rule where the pattern matches a message on the DLQ.

The search begins with the first rule in the table, and continues sequentially through the table. When the DLQ handler finds a rule with a matching pattern, it takes the action from that rule. The DLQ handler increments the retry count for a rule by 1 whenever it applies that rule. If the first try fails, the DLQ handler tries again until the number of tries matches the number specified on the RETRY keyword. If all attempts fail, the DLQ handler searches for the next matching rule in the table.

This process is repeated for subsequent matching rules until an action is successful. When each matching rule has been attempted the number of times specified on its RETRY keyword, and all attempts have failed, ACTION (IGNORE) is assumed. ACTION (IGNORE) is also assumed if no matching rule is found.

#### **Note:**

1. Matching rule patterns are sought only for messages on the DLQ that begin with an MQDLH. Messages that do not begin with an MQDLH are reported periodically as being in error, and remain on the DLQ indefinitely.
2. All pattern keywords can be allowed to default, such that a rule can consist of an action only. Note, however, that action-only rules are applied to all messages on the queue that have MQDLHs and that have not already been processed in accordance with other rules in the table.
3. The rules table is validated when the DLQ handler starts, and errors are flagged at that time. You can make changes to the rules table at any time, but those changes do not come into effect until the DLQ handler restarts.
4. The DLQ handler does not alter the content of messages, the MQDLH, or the message descriptor. The DLQ handler always puts messages to other queues with the message option MQPMO\_PASS\_ALL\_CONTEXT.



5. Consecutive syntax errors in the rules table might not be recognized because the rules table is designed to eliminate the generation of repetitive errors during validation.
6. The DLQ handler opens the DLQ with the MQOO\_INPUT\_AS\_Q\_DEF option.
7. Multiple instances of the DLQ handler can run concurrently against the same queue, using the same rules table. However, it is more usual for there to be a one-to-one relationship between a DLQ and a DLQ handler.

## Related information

[Dead-letter queues](#)

[Undelivered messages troubleshooting](#)

### *Ensuring that all DLQ messages are processed*

The DLQ handler keeps a record of all messages on the DLQ that have been seen but not removed.

If you use the DLQ handler as a filter to extract a small subset of the messages from the DLQ, the DLQ handler still has to keep a record of those messages on the DLQ that it did not process. Also, the DLQ handler cannot guarantee that new messages arriving on the DLQ are seen, even if the DLQ is defined as first-in-first-out (FIFO). If the queue is not empty, the DLQ is periodically re-scanned to check all messages.

For these reasons, try to ensure that the DLQ contains as few messages as possible; if messages that cannot be discarded or forwarded to other queues (for whatever reason) are allowed to accumulate on the queue, the workload of the DLQ handler increases and the DLQ itself can fill up.

You can take specific measures to enable the DLQ handler to empty the DLQ. For example, try not to use ACTION (IGNORE), which leaves messages on the DLQ. (Remember that ACTION (IGNORE) is assumed for messages that are not explicitly addressed by other rules in the table.) Instead, for those messages that you would otherwise ignore, use an action that moves the messages to another queue. For example:

```
ACTION (FWD) FWDQ (IGNORED.DEAD.QUEUE) HEADER (YES)
```

Similarly, make the final rule in the table a catchall to process messages that have not been addressed by earlier rules in the table. For example, the final rule in the table could be something like this:

```
ACTION (FWD) FWDQ (REALLY.DEAD.QUEUE) HEADER (YES)
```

This forwards messages that fall through to the final rule in the table to the queue REALLY . DEAD . QUEUE, where they can be processed manually. If you do not have such a rule, messages are likely to remain on the DLQ indefinitely.

## ***An example DLQ handler rules table***

An example rules table for the runmqdlq command, containing a single control-data entry and several rules.

```
*****
*   An example rules table for the runmqdlq command   *
*****
* Control data entry
* -----
* If no queue manager name is supplied as an explicit parameter to
* runmqdlq, use the default queue manager for the machine.
* If no queue name is supplied as an explicit parameter to runmqdlq,
* use the DLQ defined for the local queue manager.
*
inputqm(' ') inputq(' ')

* Rules
* -----
* We include rules with ACTION (RETRY) first to try to
* deliver the message to the intended destination.
* If a message is placed on the DLQ because its destination
* queue is full, attempt to forward the message to its
* destination queue. Make 5 attempts at approximately
```

```

* 60-second intervals (the default value for RETRYINT).

REASON(MQRC_Q_FULL) ACTION(RETRY) RETRY(5)

* If a message is placed on the DLQ because of a put inhibited
* condition, attempt to forward the message to its
* destination queue. Make 5 attempts at approximately
* 60-second intervals (the default value for RETRYINT).

REASON(MQRC_PUT_INHIBITED) ACTION(RETRY) RETRY(5)

* The AAAA corporation are always sending messages with incorrect
* addresses. When we find a request from the AAAA corporation,
* we return it to the DLQ (DEADQ) of the reply-to queue manager
* (&REPLYQM).
* The AAAA DLQ handler attempts to redirect the message.

MSGTYPE(MQMT_REQUEST) REPLYQM(AAAA.*) +
ACTION(FWD) FWDQ(DEADQ) FWDQM(&REPLYQM)

* The BBBB corporation never do things by half measures. If
* the queue manager BBBB.1 is unavailable, try to
* send the message to BBBB.2

DESTQM(bbbb.1) +
action(fwd) fwdq(&DESTQ) fwdqm(bbbb.2) header(no)

* The CCCC corporation considers itself very security
* conscious, and believes that none of its messages
* will ever end up on one of our DLQs.
* Whenever we see a message from a CCCC queue manager on our
* DLQ, we send it to a special destination in the CCCC organization
* where the problem is investigated.

REPLYQM(CCCC.*) +
ACTION(FWD) FWDQ(ALARM) FWDQM(CCCC.SYSTEM)

```

```

* Messages that are not persistent run the risk of being
* lost when a queue manager terminates. If an application
* is sending nonpersistent messages, it should be able
* to cope with the message being lost, so we can afford to
* discard the message. PERSIST(MQPER_NOT_PERSISTENT) ACTION(DISCARD)
* For performance and efficiency reasons, we like to keep
* the number of messages on the DLQ small.
* If we receive a message that has not been processed by
* an earlier rule in the table, we assume that it
* requires manual intervention to resolve the problem.
* Some problems are best solved at the node where the
* problem was detected, and others are best solved where
* the message originated. We don't have the message origin,
* but we can use the REPLYQM to identify a node that has
* some interest in this message.
* Attempt to put the message onto a manual intervention
* queue at the appropriate node. If this fails,
* put the message on the manual intervention queue at
* this node.

REPLYQM('?*') +
ACTION(FWD) FWDQ(DEADQ.MANUAL.INTERVENTION) FWDQM(&REPLYQM)

ACTION(FWD) FWDQ(DEADQ.MANUAL.INTERVENTION)

```

## Related information

[Dead-letter queues](#)

[Undelivered messages troubleshooting](#)

[runmqdlq \(run dead-letter queue handler\)](#)

## Working with model queues

A queue manager creates a *dynamic queue* if it receives an MQI call from an application specifying a queue name that has been defined as a model queue. The name of the new dynamic queue is generated by the queue manager when the queue is created. A *model queue* is a template that specifies the attributes of any dynamic queues created from it. Model queues provide a convenient method for applications to create queues as required.

## Defining a model queue

You define a model queue with a set of attributes in the same way that you define a local queue. Model queues and local queues have the same set of attributes, except that on model queues you can specify whether the dynamic queues created are temporary or permanent. (Permanent queues are maintained across queue manager restarts, temporary ones are not.) For example:

```
DEFINE QMODEL (GREEN.MODEL.QUEUE) +
DESCR('Queue for messages from application X') +
PUT (DISABLED) +
GET (ENABLED) +
NOTRIGGER +
MSGDLVSQ (FIFO) +
MAXDEPTH (1000) +
MAXMSGL (2000) +
USAGE (NORMAL) +
DEFTYPE (PERMDYN)
```

This command creates a model queue definition. From the DEFTYPE attribute, you can see that the actual queues created from this template are permanent dynamic queues. Any attributes not specified are automatically copied from the SYSYSTEM.DEFAULT.MODEL.QUEUE default queue.

You can use the LIKE and REPLACE attributes when you define model queues, in the same way that you use them with local queues.

## Using other commands with model queues

You can use the appropriate MQSC commands to display or alter a model queue's attributes, or to delete the model queue object. For example:

Use the following command to display the model queue's attributes:

```
DISPLAY QUEUE (GREEN.MODEL.QUEUE)
```

Use the following command to alter the model to enable puts on any dynamic queue created from this model:

```
ALTER QMODEL (BLUE.MODEL.QUEUE) PUT(ENABLED)
```

Use the following command to delete this model queue:

```
DELETE QMODEL (RED.MODEL.QUEUE)
```

## Working with administrative topics

Use MQSC commands to manage administrative topics.

See [MQSC commands](#) for detailed information about these commands.

### Related concepts

[“Defining an administrative topic” on page 108](#)

Use the MQSC command **DEFINE TOPIC** to create an administrative topic. When defining an administrative topic you can optionally set each topic attribute.

[“Displaying administrative topic object attributes” on page 108](#)

Use the MQSC command **DISPLAY TOPIC** to display an administrative topic object.

[“Changing administrative topic attributes” on page 109](#)

You can change topic attributes in two ways, using either the **ALTER TOPIC** command or the **DEFINE TOPIC** command with the **REPLACE** attribute.

[“Copying an administrative topic definition” on page 109](#)

You can copy a topic definition using the LIKE attribute on the **DEFINE** command.

[“Deleting an administrative topic definition” on page 110](#)

You can use the MQSC command **DELETE TOPIC** to delete an administrative topic.

### Related information

[Administrative topic objects](#)

## Defining an administrative topic

Use the MQSC command **DEFINE TOPIC** to create an administrative topic. When defining an administrative topic you can optionally set each topic attribute.

Any attribute of the topic that is not explicitly set is inherited from the default administrative topic, SYSTEM.DEFAULT.TOPIC, that was created when the system installation was installed.

For example, the **DEFINE TOPIC** command that follows, defines a topic called **ORANGE.TOPIC** with these characteristics:

- Resolves to the topic string ORANGE. For information about how topic strings can be used, see [Combining topic strings](#).
- Any attribute that is set to ASPARENT uses the attribute as defined by the parent topic of this topic. This action is repeated up the topic tree as far as the root topic, SYSTEM.BASE.TOPIC is found. For more information, see [Topic trees](#).

```
DEFINE TOPIC (ORANGE.TOPIC) +  
TOPICSTR (ORANGE) +  
DEFPRTY(ASPARENT) +  
NPMMSGDLV(ASPARENT)
```

### Note:

- Except for the value of the topic string, all the attribute values shown are the default values. They are shown here only as an illustration. You can omit them if you are sure that the defaults are what you want or have not been changed. See also [“Displaying administrative topic object attributes” on page 108](#).
- If you already have an administrative topic on the same queue manager with the name ORANGE.TOPIC, this command fails. Use the REPLACE attribute if you want to overwrite the existing definition of a topic, but see also [“Changing administrative topic attributes” on page 109](#)

## Displaying administrative topic object attributes

Use the MQSC command **DISPLAY TOPIC** to display an administrative topic object.

To display all topics, use:

```
DISPLAY TOPIC(ORANGE.TOPIC)
```

You can selectively display attributes by specifying them individually. For example:

```
DISPLAY TOPIC(ORANGE.TOPIC) +  
TOPICSTR +  
DEFPRTY +  
NPMMSGDLV
```

This command displays the three specified attributes as follows:

```
AMQ8633: Display topic details.  
TOPIC(ORANGE.TOPIC)                                TYPE(LOCAL)  
TOPICSTR(ORANGE)                                    DEFPRTY(ASPARENT)  
NPMMSGDLV(ASPARENT)
```

To display the topic ASPARENT values as they are used at Runtime use [DISPLAY TPSTATUS](#). For example, use:

```
DISPLAY TPSTATUS(ORANGE) DEFPRTY NPMSGDLV
```

The command displays the following details:

```
AMQ8754: Display topic status details.  
TOPICSTR(ORANGE)          DEFPRTY(0)  
NPMSGDLV(ALLAVAIL)
```

When you define an administrative topic, it takes any attributes that you do not specify explicitly from the default administrative topic, which is called SYSTEM.DEFAULT.TOPIC. To see what these default attributes are, use the following command:

```
DISPLAY TOPIC (SYSTEM.DEFAULT.TOPIC)
```

## Changing administrative topic attributes

You can change topic attributes in two ways, using either the **ALTER TOPIC** command or the **DEFINE TOPIC** command with the **REPLACE** attribute.

If, for example, you want to change the default priority of messages delivered to a topic called ORANGE.TOPIC, to be 5, use either of the following commands.

- Using the **ALTER** command:

```
ALTER TOPIC(ORANGE.TOPIC) DEFPRTY(5)
```

This command changes a single attribute, that of the default priority of message delivered to this topic to 5; all other attributes remain the same.

- Using the **DEFINE** command:

```
DEFINE TOPIC(ORANGE.TOPIC) DEFPRTY(5) REPLACE
```

This command changes the default priority of messages delivered to this topic. All the other attributes are given their default values.

If you alter the priority of messages sent to this topic, existing messages are not affected. Any new message, however, use the specified priority if not provided by the publishing application.

## Copying an administrative topic definition

You can copy a topic definition using the LIKE attribute on the **DEFINE** command.

For example:

```
DEFINE TOPIC (MAGENTA.TOPIC) +  
LIKE (ORANGE.TOPIC)
```

This command creates a topic, MAGENTA.TOPIC, with the same attributes as the original topic, ORANGE.TOPIC, rather than those of the system default administrative topic. Enter the name of the topic to be copied exactly as it was entered when you created the topic. If the name contains lowercase characters, enclose the name in single quotation marks.

You can also use this form of the **DEFINE** command to copy a topic definition, but make changes to the attributes of the original. For example:

```
DEFINE TOPIC(BLUE.TOPIC) +
```

```
TOPICSTR(BLUE) +  
LIKE(ORANGE.TOPIC)
```

You can also copy the attributes of the topic BLUE.TOPIC to the topic GREEN.TOPIC and specify that when publications cannot be delivered to their correct subscriber queue they are not placed onto the dead-letter queue. For example:

```
DEFINE TOPIC(GREEN.TOPIC) +  
TOPICSTR(GREEN) +  
LIKE(BLUE.TOPIC) +  
USEDLQ(NO)
```

## Deleting an administrative topic definition

You can use the MQSC command **DELETE TOPIC** to delete an administrative topic.

```
DELETE TOPIC(ORANGE.TOPIC)
```

Applications will no longer be able to open the topic for publication or make new subscriptions using the object name, ORANGE.TOPIC. Publishing applications that have the topic open are able to continue publishing the resolved topic string. Any subscriptions already made to this topic continue receiving publications after the topic has been deleted.

Applications that are not referencing this topic object but are using the resolved topic string that this topic object represented, 'ORANGE' in this example, continue to work. In this case they inherit the properties from a topic object higher in the topic tree. For more information, see [Topic trees](#).

## Working with subscriptions

Use MQSC commands to manage subscriptions.

Subscriptions can be one of three types, defined in the **SUBTYPE** attribute:

### ADMIN

Administratively defined by a user.

### PROXY

An internally created subscription for routing publications between queue managers.

### API

Created programmatically, for example, using the MQI MQSUB call.

See [MQSC commands](#) for detailed information about these commands.

### Related concepts

[“Defining an administrative subscription” on page 111](#)

Use the MQSC command **DEFINE SUB** to create an administrative subscription. You can also use the default defined in the default local subscription definition. Or, you can modify the subscription characteristics from those of the default local subscription, SYSTEM.DEFAULT.SUB that was created when the system was installed.

[“Displaying attributes of subscriptions” on page 111](#)

You can use the **DISPLAY SUB** command to display configured attributes of any subscription known to the queue manager.

[“Changing local subscription attributes” on page 112](#)

You can change subscription attributes in two ways, using either the **ALTER SUB** command or the **DEFINE SUB** command with the **REPLACE** attribute.

[“Copying a local subscription definition” on page 113](#)

You can copy a subscription definition using the **LIKE** attribute on the **DEFINE** command.

[“Deleting a subscription” on page 113](#)

You can use the MQSC command **DELETE SUB** to delete a local subscription.

## Defining an administrative subscription

Use the MQSC command **DEFINE SUB** to create an administrative subscription. You can also use the default defined in the default local subscription definition. Or, you can modify the subscription characteristics from those of the default local subscription, `SYSTEM.DEFAULT.SUB` that was created when the system was installed.

For example, the **DEFINE SUB** command that follows defines a subscription called `ORANGE` with these characteristics:

- Durable subscription, meaning that it persists over queue manager restart, with unlimited expiry.
- Receive publications made on the `ORANGE` topic string, with the message priorities as set by the publishing applications.
- Publications delivered for this subscription are sent to the local queue `SUBQ`, this queue must be defined before the definition of the subscription.

```
DEFINE SUB (ORANGE) +  
TOPICSTR (ORANGE) +  
DESTCLAS (PROVIDED) +  
DEST (SUBQ) +  
EXPIRY (UNLIMITED) +  
PUBPRTY (AS PUB)
```

### Note:

- The subscription and topic string name do not have to match.
- Except for the values of the destination and topic string, all the attribute values shown are the default values. They are shown here only as an illustration. You can omit them if you are sure that the defaults are what you want or have not been changed. See also [“Displaying attributes of subscriptions” on page 111](#).
- If you already have a local subscription on the same queue manager with the name `ORANGE`, this command fails. Use the **REPLACE** attribute if you want to overwrite the existing definition of a queue, but see also [“Changing local subscription attributes” on page 112](#).
- If the queue `SUBQ` does not exist, this command fails.

## Displaying attributes of subscriptions

You can use the **DISPLAY SUB** command to display configured attributes of any subscription known to the queue manager.

For example, use:

```
DISPLAY SUB (ORANGE)
```

You can selectively display attributes by specifying them individually. For example:

```
DISPLAY SUB (ORANGE) +  
SUBID +  
TOPICSTR +  
DURABLE
```

This command displays the three specified attributes as follows:

```
AMQ8096: IBM MQ subscription inquired.  
SUBID(414D5120414141202020202020202020EE921E4E20002A03)  
SUB(ORANGE) TOPICSTR(ORANGE)  
DURABLE(YES)
```

TOPICSTR is the resolved topic string on which this subscriber is operating. When a subscription is defined to use a topic object the topic string from that object is used as a prefix to the topic string provided when making the subscription. SUBID is a unique identifier assigned by the queue manager when a subscription is created. This is a useful attribute to display because some subscription names might be long or in a different character sets for which it might become impractical.

An alternate method for displaying subscriptions is to use the SUBID:

```
DISPLAY SUB +  
SUBID(414D51204141412020202020202020EE921E4E20002A03) +  
TOPICSTR +  
DURABLE
```

This command gives the same output as before:

```
AMQ8096: IBM MQ subscription inquired.  
SUBID(414D51204141412020202020202020EE921E4E20002A03)  
SUB(ORANGE) TOPICSTR(ORANGE)  
DURABLE(YES)
```

Proxy subscriptions on a queue manager are not displayed by default. To display them specify a **SUBTYPE** of PROXY or ALL.

You can use the [DISPLAY SBSTATUS](#) command to display the Runtime attributes. For example, use the command:

```
DISPLAY SBSTATUS(ORANGE) NUMMSGs
```

The following output is displayed:

```
AMQ8099: IBM MQ subscription status inquired.  
SUB(ORANGE)  
SUBID(414D51204141412020202020202020EE921E4E20002A03)  
NUMMSGs(0)
```

When you define an administrative subscription, it takes any attributes that you do not specify explicitly from the default subscription, which is called SYSTEM.DEFAULT.SUB. To see what these default attributes are, use the following command:

```
DISPLAY SUB (SYSTEM.DEFAULT.SUB)
```

## Changing local subscription attributes

You can change subscription attributes in two ways, using either the **ALTER SUB** command or the **DEFINE SUB** command with the **REPLACE** attribute.

If, for example, you want to change the priority of messages delivered to a subscription called ORANGE to be 5, use either of the following commands:

- Using the ALTER command:

```
ALTER SUB(ORANGE) PUBPRTY(5)
```

This command changes a single attribute, that of the priority of messages delivered to this subscription to 5; all other attributes remain the same.

- Using the DEFINE command:

```
DEFINE SUB (ORANGE) PUBPRTY(5) REPLACE
```



This command changes not only the priority of messages delivered to this subscription, but all the other attributes which are given their default values.

If you alter the priority of messages sent to this subscription, existing messages are not affected. Any new messages, however, are of the specified priority.

## Copying a local subscription definition

You can copy a subscription definition using the **LIKE** attribute on the **DEFINE** command.

For example:

```
DEFINE SUB (BLUE) +  
LIKE (ORANGE)
```

You can also copy the attributes of the sub REAL to the sub THIRD.SUB, and specify that the correlID of delivered publications is THIRD, rather than the publishers correlID. For example:

```
DEFINE SUB(THIRD.SUB) +  
LIKE(BLUE) +  
DESTCORL(ORANGE)
```

## Deleting a subscription

You can use the MQSC command **DELETE SUB** to delete a local subscription.

```
DELETE SUB(ORANGE)
```

You can also delete a subscription using the SUBID:

```
DELETE SUB SUBID(414D51204141412020202020202020EE921E4E20002A03)
```

## Checking messages on a subscription

### About this task

When a subscription is defined it is associated with a queue. Published messages matching this subscription are put to this queue.

Note that the following **runmqsc** commands show only those subscriptions that received messages.

To check for messages currently queued for a subscription perform the following steps:

### Procedure

1. To check for messages queued for a subscription type **DISPLAY SBSTATUS(<sub\_name>)** **NUMMSGs**, see [“Displaying attributes of subscriptions”](#) on page 111.
2. If the **NUMMSGs** value is greater than zero identify the queue associated with the subscription by typing **DISPLAY SUB(<sub\_name>)DEST**.
3. Using the name of the queue returned you can view the messages by following the technique described in [“Browsing queues”](#) on page 84.

## Working with services

Service objects are a means by which additional processes can be managed as part of a queue manager. With services, you can define programs that are started and stopped when the queue manager starts and ends. IBM MQ services are always started under the user ID of the user who started the queue manager.

Service objects can be either of the following types:

### **Server**

A server is a service object that has the parameter `SERVTYPE` specified as `SERVER`. A server service object is the definition of a program that is executed when a specified queue manager is started. Server service objects define programs that typically run for a long time. For example, a server service object can be used to execute a trigger monitor process, such as `runmqtrm`.

Only one instance of a server service object can run concurrently. The status of running server service objects can be monitored using the MQSC command, `DISPLAY SVSTATUS`.

### **Command**

A command is a service object that has the parameter `SERVTYPE` specified as `COMMAND`. Command service objects are similar to server service objects, however multiple instances of a command service object can run concurrently, and their status cannot be monitored using the MQSC command `DISPLAY SVSTATUS`.

If the MQSC command, `STOP SERVICE`, is executed no check is made to determine whether the program started by the MQSC command, `START SERVICE`, is still active before executing the stop program.

## **Defining a service object**

You define a service object with various attributes.

The attributes are as follows:

### **SERVTYPE**

Defines the type of the service object. Possible values are as follows:

#### **SERVER**

A server service object.

Only one instance of a server service object can be executed at a time. The status of server service objects can be monitored using the MQSC command, `DISPLAY SVSTATUS`.

#### **COMMAND**

A command service object.

Multiple instances of a command service object can be executed concurrently. The status of a command service objects cannot be monitored.

### **STARTCMD**

The program that is executed to start the service. A fully qualified path to the program must be specified.

### **STARTARG**

Arguments passed to the start program.

### **STDERR**

Specifies the path to a file to which the standard error (stderr) of the service program should be redirected.

### **STDOUT**

Specifies the path to a file to which the standard output (stdout) of the service program should be redirected.

### **STOPCMD**

The program that is executed to stop the service. A fully qualified path to the program must be specified.

### **STOPARG**

Arguments passed to the stop program.

### **CONTROL**

Specifies how the service is to be started and stopped:

**MANUAL**

The service is not to be started automatically or stopped automatically. It is controlled by use of the START SERVICE and STOP SERVICE commands. This is the default value.

**QMGR**

The service being defined is to be started and stopped at the same time as the queue manager is started and stopped.

**STARTONLY**

The service is to be started at the same time as the queue manager is started, but is not requested to stop when the queue manager is stopped.

**Related concepts**

[“Managing services” on page 115](#)

By using the CONTROL parameter, an instance of a service object can be either started and stopped automatically by the queue manager, or started and stopped using the MQSC commands START SERVICE and STOP SERVICE.

**Managing services**

By using the CONTROL parameter, an instance of a service object can be either started and stopped automatically by the queue manager, or started and stopped using the MQSC commands START SERVICE and STOP SERVICE.

When an instance of a service object is started, a message is written to the queue manager error log containing the name of the service object and the process ID of the started process. An example log entry for a server service object starting follows:

```
02/15/2005 11:54:24 AM - Process(10363.1) User(mqm) Program(amqzmgr0)
Host(HOST_1) Installation(Installation1)
VRMF(7.1.0.0) QMgr(A.B.C)
AMQ5028: The Server 'S1' has started. ProcessId(13031).

EXPLANATION:
The Server process has started.
ACTION:
None.
```

An example log entry for a command service object starting follows:

```
02/15/2005 11:53:55 AM - Process(10363.1) User(mqm) Program(amqzmgr0)
Host(HOST_1) Installation(Installation1)
VRMF(7.1.0.0) QMgr(A.B.C)
AMQ5030: The Command 'C1' has started. ProcessId(13030).

EXPLANATION:
The Command has started.
ACTION:
None.
```

When an instance server service stops, a message is written to the queue manager error logs containing the name of the service and the process ID of the ending process. An example log entry for a server service object stopping follows:

```
02/15/2005 11:54:54 AM - Process(10363.1) User(mqm) Program(amqzmgr0)
Host(HOST_1) Installation(Installation1)
VRMF(7.1.0.0) QMgr(A.B.C)
AMQ5029: The Server 'S1' has ended. ProcessId(13031).

EXPLANATION:
The Server process has ended.
ACTION:
None.
```

**Related reference**

[“Additional environment variables” on page 116](#)

When a service is started, the environment in which the service process is started is inherited from the environment of the queue manager. It is possible to define additional environment variables to be set in the environment of the service process by adding the variables you want to define to one of the `service.env` environment override files.

## Additional environment variables

When a service is started, the environment in which the service process is started is inherited from the environment of the queue manager. It is possible to define additional environment variables to be set in the environment of the service process by adding the variables you want to define to one of the `service.env` environment override files.

### Note:

There are two possible files to which you can add environment variables:

- The machine scope `service.env` file, which is located in `/var/mqm` on UNIX and Linux systems, or in the data directory selected during installation on Windows systems.
- The queue manager scope `service.env` file, which is located in the queue manager data directory. For example, the location of the environment override file for a queue manager named `QMNAME` is:
  - On UNIX and Linux systems, `/var/mqm/qmgrs/QMNAME/service.env`
  - On Windows systems, `C:\ProgramData\IBM\MQ\qmgrs\QMNAME\service.env`

Both files are processed, if available, with definitions in the queue manager scope file taking precedence over those definitions in the machine scope file.

Any environment variable can be specified in `service.env`. For example, if the IBM MQ service runs a number of commands, it might be useful to set the `PATH` user variable in the `service.env` file. The values that you set the variable to can't be environment variables; for example `CLASSPATH=%CLASSPATH%` is incorrect. Similarly, on Linux `PATH=$PATH:/opt/mqm/bin` would give unexpected results.

`CLASSPATH` must be capitalized, and the class path statement can contain only literals. Some services (Telemetry for example) set their own class path. The `CLASSPATH` defined in `service.env` is added to it.

The format of the variables defined in the file, `service.env` is a list of name and value variable pairs. Each variable must be defined on a new line, and each variable is taken as it is explicitly defined, including white space. An example of the file, `service.env` follows:

```
#####
##
## <N_OCO_COPYRIGHT>
## Licensed Materials - Property of IBM
##
## 63H9336
## (C) Copyright IBM Corporation 2005, 2022
##
## <NOC_COPYRIGHT>
##
#####
## *****
## Module Name: service.env
## Type : IBM MQ service environment file
## Function : Define additional environment variables to be set
## for SERVICE programs.
## Usage : <VARIABLE>=<VALUE>
##
#####
MYLOC=/opt/myloc/bin
MYTMP=/tmp
TRACEDIR=/tmp/trace
MYINITQ=ACCOUNTS.INITIATION.QUEUE
```

### Related reference

[“Replaceable inserts on service definitions” on page 117](#)

In the definition of a service object, it is possible to substitute tokens. Tokens that are substituted are automatically replaced with their expanded text when the service program is executed. Substitute tokens can be taken from the following list of common tokens, or from any variables that are defined in the file, `service.env`.

## Replaceable inserts on service definitions

In the definition of a service object, it is possible to substitute tokens. Tokens that are substituted are automatically replaced with their expanded text when the service program is executed. Substitute tokens can be taken from the following list of common tokens, or from any variables that are defined in the file, `service.env`.

The following are common tokens that can be used to substitute tokens in the definition of a service object:

### **MQ\_INSTALL\_PATH**

The location where IBM MQ is installed.

### **MQ\_DATA\_PATH**

The location of the IBM MQ data directory:

- On UNIX and Linux systems, the IBM MQ data directory location is `/var/mqm/`
- On Windows systems, the location of the IBM MQ data directory is the data directory selected during the installation of IBM MQ

### **QMNAME**

The current queue manager name.

### **MQ\_SERVICE\_NAME**

The name of the service.

### **MQ\_SERVER\_PID**

This token can only be used by the `STOPARG` and `STOPCMD` arguments.

For server service objects this token is replaced with the process id of the process started by the `STARTCMD` and `STARTARG` arguments. Otherwise, this token is replaced with 0.

### **MQ\_Q\_MGR\_DATA\_PATH**

The location of the queue manager data directory.

### **MQ\_Q\_MGR\_DATA\_NAME**

The transformed name of the queue manager. For more information on name transformation, see [Understanding IBM MQ file names](#).

To use replaceable inserts, insert the token within + characters into any of the `STARTCMD`, `STARTARG`, `STOPCMD`, `STOPARG`, `STDOUT` or `STDERR` strings. For examples of this, see [“Examples on using service objects” on page 117](#).

## Examples on using service objects

The services in this section are written with UNIX style path separator characters, except where otherwise stated.

### ***Using a server service object***

This example shows how to define, use, and alter, a server service object to start a trigger monitor.

1. A server service object is defined, using the following MQSC command:

```
DEFINE SERVICE(S1) +
CONTROL(QMGR) +
SERVTYPE(SERVER) +
STARTCMD(' +MQ_INSTALL_PATH+bin/runmqtrm') +
STARTARG('-m +QMNAME+ -q ACCOUNTS.INITIATION.QUEUE') +
STOPCMD(' +MQ_INSTALL_PATH+bin/amqsstop') +
STOPARG('-m +QMNAME+ -p +MQ_SERVER_PID+')
```

Where:

+MQ\_INSTALL\_PATH+ is a token representing the installation directory.

+QMNAME+ is a token representing the name of the queue manager.

ACCOUNTS.INITIATION.QUEUE is the initiation queue.

amqsstop is a sample program provided with IBM MQ which requests the queue manager to break all connections for the process id. amqsstop generates PCF commands, therefore the command server must be running.

+MQ\_SERVER\_PID+ is a token representing the process id passed to the stop program.

See “Replaceable inserts on service definitions” on page 117 for a list of the common tokens.

2. An instance of the server service object will execute when the queue manager is next started. However, we will start an instance of the server service object immediately with the following MQSC command:

```
START SERVICE(S1)
```

3. The status of the server service process is displayed, using the following MQSC command:

```
DISPLAY SVSTATUS(S1)
```

4. This example now shows how to alter the server service object and have the updates picked up by manually restarting the server service process. The server service object is altered so that the initiation queue is specified as JUPITER.INITIATION.QUEUE. The following MQSC command is used:

```
ALTER SERVICE(S1) +  
STARTARG('-m +QMNAME+ -q JUPITER.INITIATION.QUEUE')
```

**Note:** A running service will not pick up any updates to its service definition until it is restarted.

5. The server service process is restarted so that the alteration is picked up, using the following MQSC commands:

```
STOP SERVICE(S1)
```

Followed by:

```
START SERVICE(S1)
```

The server service process is restarted and picks up the alterations made in “4” on page 118.

**Note:** The MQSC command, STOP SERVICE, can only be used if a STOPCMD argument is specified in the service definition.

### ***Using a command service object***

This example shows how to define a command service object to start a program that writes entries to the operating system's system log when a queue manager is started or stopped.

1. The command service object is defined, using the following MQSC command:

```
DEFINE SERVICE(S2) +  
CONTROL(QMGR) +  
SERVTYPE(COMMAND) +  
STARTCMD('/usr/bin/logger') +  
STARTARG('Queue manager +QMNAME+ starting') +  
STOPCMD('/usr/bin/logger') +  
STOPARG('Queue manager +QMNAME+ stopping')
```

Where:

logger is the UNIX and Linux system supplied command to write to the system log.

+QMNAME+ is a token representing the name of the queue manager.

### ***Using a command service object when a queue manager ends only***

This example shows how to define a command service object to start a program that writes entries to the operating system's system log when a queue manager is stopped only.

1. The command service object is defined, using the following MQSC command:

```
DEFINE SERVICE(S3) +  
CONTROL(QMGR) +  
SERVTYPE(COMMAND) +  
STOPCMD('/usr/bin/logger') +  
STOPARG('Queue manager +QMNAME+ stopping')
```

Where:

logger is a sample program provided with IBM MQ that can write entries to the operating system's system log.

+QMNAME+ is a token representing the name of the queue manager.

### ***More on passing arguments***

This example shows how to define a server service object to start a program called runserv when a queue manager is started.

This example is written with Windows style path separator characters.

One of the arguments that is to be passed to the starting program is a string containing a space. This argument needs to be passed as a single string. To achieve this, double quotation marks are used as shown in the following command to define the command service object:

1. The server service object is defined, using the following MQSC command:

```
DEFINE SERVICE(S1) SERVTYPE(SERVER) CONTROL(QMGR) +  
STARTCMD('C:\Program Files\Tools\runserv.exe') +  
STARTARG('-m +QMNAME+ -d "C:\Program Files\Tools\"') +  
STDOUT('C:\Program Files\Tools\+MQ_SERVICE_NAME+.out')  
  
DEFINE SERVICE(S4) +  
CONTROL(QMGR) +  
SERVTYPE(SERVER) +  
STARTCMD('C:\Program Files\Tools\runserv.exe') +  
STARTARG('-m +QMNAME+ -d "C:\Program Files\Tools\"') +  
STDOUT('C:\Program Files\Tools\+MQ_SERVICE_NAME+.out')
```

Where:

+QMNAME+ is a token representing the name of the queue manager.

"C:\Program Files\Tools\" is a string containing a space, which will be passed as a single string.

### ***Autostarting a Service***

This example shows how to define a server service object that can be used to automatically start the Trigger Monitor when the queue manager starts.

1. The server service object is defined, using the following MQSC command:

```
DEFINE SERVICE(TRIG_MON_START) +  
CONTROL(QMGR) +  
SERVTYPE(SERVER) +  
STARTCMD('runmqtim') +  
STARTARG('-m +QMNAME+ -q +IQNAME+')
```

Where:

+QMNAME+ is a token representing the name of the queue manager.

+IQNAME+ is an environment variable defined by the user in one of the service.env files representing the name of the initiation queue.

## Managing objects for triggering

IBM MQ enables you to start an application automatically when certain conditions on a queue are met. For example, you might want to start an application when the number of messages on a queue reaches a specified number. This facility is called *triggering*. You have to define the objects that support triggering.

Triggering described in detail in [Starting IBM MQ applications using triggers](#).

### Defining an application queue for triggering

An application queue is a local queue that is used by applications for messaging, through the MQI. Triggering requires a number of queue attributes to be defined on the application queue.

Triggering itself is enabled by the *Trigger* attribute (TRIGGER in MQSC commands). In this example, a trigger event is to be generated when there are 100 messages of priority 5 or greater on the local queue MOTOR.INSURANCE.QUEUE, as follows:

```
DEFINE QLOCAL (MOTOR.INSURANCE.QUEUE) +  
PROCESS (MOTOR.INSURANCE.QUOTE.PROCESS) +  
MAXMSGL (2000) +  
DEFPSIST (YES) +  
INITQ (MOTOR.INS.INIT.QUEUE) +  
TRIGGER +  
TRIGTYPE (DEPTH) +  
TRIGDPTH (100)+  
TRIGMPRI (5)
```

where:

**QLOCAL (MOTOR.INSURANCE.QUEUE)**

Is the name of the application queue being defined.

**PROCESS (MOTOR.INSURANCE.QUOTE.PROCESS)**

Is the name of the process definition that defines the application to be started by a trigger monitor program.

**MAXMSGL (2000)**

Is the maximum length of messages on the queue.

**DEFPSIST (YES)**

Specifies that messages on this queue are persistent by default.

**INITQ (MOTOR.INS.INIT.QUEUE)**

Is the name of the initiation queue on which the queue manager is to put the trigger message.

**TRIGGER**

Is the trigger attribute value.

**TRIGTYPE (DEPTH)**

Specifies that a trigger event is generated when the number of messages of the required priority (TRIGMPRI) reaches the number specified in TRIGDPTH.

**TRIGDPTH (100)**

Is the number of messages required to generate a trigger event.

**TRIGMPRI (5)**

Is the priority of messages that are to be counted by the queue manager in deciding whether to generate a trigger event. Only messages with priority 5 or higher are counted.

### Defining an initiation queue

When a trigger event occurs, the queue manager puts a trigger message on the initiation queue specified in the application queue definition. Initiation queues have no special settings, but you can use the following definition of the local queue MOTOR.INS.INIT.QUEUE for guidance:



```

DEFINE QLOCAL(MOTOR.INS.INIT.QUEUE) +
GET (ENABLED) +
NOSHARE +
NOTRIGGER +
MAXMSGL (2000) +
MAXDEPTH (1000)

```

## Defining a process

Use the **DEFINE PROCESS** command to create a process definition. A process definition defines the application to be used to process messages from the application queue. The application queue definition names the process to be used and thereby associates the application queue with the application to be used to process its messages. This is done through the **PROCESS** attribute on the application queue **MOTOR.INSURANCE.QUEUE**. The following MQSC command defines the required process, **MOTOR.INSURANCE.QUOTE.PROCESS**, identified in this example:

```

DEFINE PROCESS (MOTOR.INSURANCE.QUOTE.PROCESS) +
DESCR ('Insurance request message processing') +
APPLTYPE (UNIX) +
APPLICID ('/u/admin/test/IRMP01') +
USERDATA ('open, close, 235')

```

Where:

### **MOTOR.INSURANCE.QUOTE.PROCESS**

Is the name of the process definition.

### **DESCR ('Insurance request message processing')**

Describes the application program to which this definition relates. This text is displayed when you use the **DISPLAY PROCESS** command. This can help you to identify what the process does. If you use spaces in the string, you must enclose the string in single quotation marks.

### **APPLTYPE (UNIX)**

Is the type of application to be started.

### **APPLICID ('/u/admin/test/IRMP01')**

Is the name of the application executable file, specified as a fully qualified file name. In Windows systems, a typical **APPLICID** value would be `c:\appl\test\irmp01.exe`.

### **USERDATA ('open, close, 235')**

Is user-defined data, which can be used by the application.

## Displaying attributes of a process definition

Use the **DISPLAY PROCESS** command to examine the results of your definition. For example:

```

DISPLAY PROCESS (MOTOR.INSURANCE.QUOTE.PROCESS)

24 : DISPLAY PROCESS (MOTOR.INSURANCE.QUOTE.PROCESS) ALL
AMQ8407: Display Process details.
DESCR ('Insurance request message processing')
APPLICID ('/u/admin/test/IRMP01')
USERDATA (open, close, 235)
PROCESS (MOTOR.INSURANCE.QUOTE.PROCESS)
APPLTYPE (UNIX)

```

You can also use the MQSC command **ALTER PROCESS** to alter an existing process definition, and the **DELETE PROCESS** command to delete a process definition.

## Using the dmpmqmsg utility between two systems

The **dmpmqmsg** utility (formerly **qload**) is incorporated into the product in Version 8.0. Formerly the **qload** utility has been available as SupportPac MO03.

### Overview

The **dmpmqmsg** utility allows you to copy or move the contents of a queue, or its messages, to a file. This file can be saved away as required and used at some later point to reload the messages back onto the queue.

**Important:** The file has a specific format understood by the utility. However, the file is human-readable, so that you can update it in an editor before you reload it. If you do edit the file you must not change its format.

Possible uses are:

- Saving the messages that are on a queue, to a file. Possibly for archiving purposes, and later reload back to a queue.
- Reloading a queue with messages you previously saved to a file.
- Removing old messages from a queue.
- 'Replaying' test messages from a stored location, even maintaining the correct time between the messages if required.



**Attention:** SupportPac MO03 used the **-l** parameter for specifying local or client binding. **-l** has been replaced by the **-c** parameter.

**-P** is now used for codepage information instead of **-c**.

See [dmpmqmsg](#) for further information on the command and the available parameters.

### Example of using the dmpmqmsg utility on Linux, using a Windows machine

You have a queue manager on a Linux machine that has messages on a queue (*Q1*) that you want to move into another queue (*Q2*) in the same queue manager. You want to initiate the **dmpmqmsg** utility from a Windows machine.

Queue (*Q1*) has four messages that have been added by using the sample **amqspu**t (local queue manager) or **amqspu**tc (remote queue manager) application.

On the Linux machine you see:

```
display q1(Q1) CURDEPTH
2 : display q1(Q1) CURDEPTH
AMQ8409: Display Queue details.
      QUEUE(Q1)
      TYPE(LOCAL)
      CURDEPTH(4)
```

Set the MQSERVER environment variable to point to the queue manager in Linux. For example:

```
set MQSERVER=SYSTEM.DEF.SVRCONN/TCP/veracruz.x.com(1414)
```

where *veracruz* is the name of the machine.

Run the **dmpmqmsg** utility to read from the queue, *Q1*, and store the output in `c:\temp\mqqload.txt`.

Connect as a remote client to the queue manager, *QM\_VER*, running in the Linux host and port established by MQSERVER. You achieve the connection as a remote client by using the attribute: **-c**.

```
dmpmqmsg -m QM_VER -i Q1 -f c:\temp\mqqload.txt -c
```

```
Read      - Files:    0  Messages:    4  Bytes:    22
Written - Files:    1  Messages:    4  Bytes:    22
```

The output file `c:\temp\mqqlload.txt` contains text, using a format that the **dmpmqmsg** utility understands.

On the Windows machine, issue the **dmpmqmsg** command (using the `-o` option instead of the `-i` option) to load queue (Q2) on the Linux machine from a file on the Windows machine:

```
dmpmqmsg -m QM_VER -o Q2 -f c:\temp\mqqlload.txt -c
Read      - Files:    1  Messages:    4  Bytes:    22
Written - Files:    0  Messages:    4  Bytes:    22
```

On the Linux machine, note that there are now four messages in the queue that have been restored from the file.

```
display ql(Q2) CURDEPTH
        6 : display ql(Q2) CURDEPTH
AMQ8409: Display Queue details.
        QUEUE(Q2)
        TYPE(QLLOCAL)
        CURDEPTH(4)
```

On the Linux machine,

Delete the messages from the original queue.

```
clear qllocal(Q1)
        4 : clear qllocal(Q1)
AMQ8022: IBM MQ queue cleared.
```

Confirm that there are no more messages on the original queue:

```
display ql(Q1) CURDEPTH
        5 : display ql(Q1) CURDEPTH
AMQ8409: Display Queue details.
        QUEUE(Q1)
        TYPE(QLLOCAL)
        CURDEPTH(0)
```

See [dmpmqmsg](#) for a description of the command and its parameters.

### Related concepts

[“Examples of using the dmpmqmsg utility” on page 123](#)

Simple ways in which you can use the **dmpmqmsg** utility (formerly **qload**). This utility is incorporated into the product in Version 8.0.

## Examples of using the dmpmqmsg utility

Simple ways in which you can use the **dmpmqmsg** utility (formerly **qload**). This utility is incorporated into the product in Version 8.0.

Formerly the **qload** utility was available as SupportPac MO03.

### Unload a queue to a file

Use the following options on the command line to save the messages that are on a queue, into a file:

```
dmpmqmsg -m QM1 -i Q1 -f c:\myfile
```

This command takes a copy of the messages from the queue and saves them in the file specified.

## Unload a queue to a series of files

You can unload a queue to a series of files by using an insert character in the file name. In this mode each message is written to a new file:

```
dmpmqmsg -m QM1 -i Q1 -f c:\myfile%n
```

This command unloads the queue to files, myfile1, myfile2, myfile3, and so on.

## Load a queue from a file

To reload a queue with the messages you saved in [“Unload a queue to a file” on page 123](#), use the following options on the command line:

```
dmpmqmsg -m QM1 -o Q1 -f c:\myfile%n
```

This command unloads the queue to files, myfile1, myfile2, myfile3, and so on.

## Load a queue from a series of files

You can load a queue from a series of files by using an insert character in the file name. In this mode each message is written to a new file:

```
dmpmqmsg -m QM1 -o Q1 -f c:\myfile%n
```

This command loads the queue to files, myfile1, myfile2, myfile3, and so on.

## Copy the messages from one queue to another queue

Replace the file parameter in [“Unload a queue to a file” on page 123](#), with another queue name and use the following options:

```
dmpmqmsg -m QM1 -i Q1 -o Q2
```

This command allows the messages from one queue to be copied to another queue.

## Copy the first 100 messages from one queue to another queue

Use the command in the previous example and add the `-r#10` option:

```
dmpmqmsg -m QM1 -i Q1 -o Q2 -r#10
```

## Move the messages from one queue to another queue

A variation on [“Load a queue from a file” on page 124](#). Note the distinction between using `-i` (lowercase) which only browses a queue, and `-I` (uppercase) which destructively gets from a queue:

```
dmpmqmsg -m QM1 -I Q1 -o Q2
```

## Move messages older than one day from one queue to another queue

This example shows the use of age selection. Messages can be selected that are older than, younger than, or within a range of ages.

```
dmpmqmsg -m QM1 -I Q1 -o Q2 -T1440
```

## Display the ages of messages currently on a queue

Use the following options on the command line:

```
dmpmqmsg -m QM1 -i Q1 -f stdout -dT
```

## Work with the message file

Having unloaded the message from your queue, as in [“Unload a queue to a file”](#) on page 123, you might want to edit the file.

You might also want to change the format of the file to use one of the display options that you did not specify at the time you unloaded the queue.

You can use the **dmpmqmsg** utility to reprocess the file into the desired format even after the unload of the queue has taken place. Use the following options on the command line.

```
dmpmqmsg -f c:\oldfile -f c:\newfile -dA
```

See [dmpmqmsg](#) for a description of the command and its parameters.

## Administering remote IBM MQ objects

---

This section tells you how to administer IBM MQ objects on a remote queue manager using MQSC commands, and how to use remote queue objects to control the destination of messages and reply messages.

This section describes:

- [“Channels, clusters, and remote queuing”](#) on page 125
- [“Remote administration from a local queue manager”](#) on page 127
- [“Creating a local definition of a remote queue”](#) on page 132
- [“Using remote queue definitions as aliases”](#) on page 137
- [“Data conversion”](#) on page 137

## Channels, clusters, and remote queuing

A queue manager communicates with another queue manager by sending a message and, if required, receiving back a response. The receiving queue manager could be:

- On the same machine
- On another machine in the same location (or even on the other side of the world)
- Running on the same platform as the local queue manager
- Running on another platform supported by IBM MQ

These messages might originate from:

- User-written application programs that transfer data from one node to another
- User-written administration applications that use PCF commands or the MQAI
- The IBM MQ Explorer.
- Queue managers sending:
  - Instrumentation event messages to another queue manager
  - MQSC commands issued from a `runmqsc` command in indirect mode (where the commands are run on another queue manager)

Before a message can be sent to a remote queue manager, the local queue manager needs a mechanism to detect the arrival of messages and transport them consisting of:

- At least one channel
- A transmission queue
- A channel initiator

For a remote queue manager to receive a message, a listener is required.

A channel is a one-way communication link between two queue managers and can carry messages destined for any number of queues at the remote queue manager.

Each end of the channel has a separate definition. For example, if one end is a sender or a server, the other end must be a receiver or a requester. A simple channel consists of a *sender channel definition* at the local queue manager end and a *receiver channel definition* at the remote queue manager end. The two definitions must have the same name and together constitute a single message channel.

If you want the remote queue manager to respond to messages sent by the local queue manager, set up a second channel to send responses back to the local queue manager.

Use the MQSC command `DEFINE CHANNEL` to define channels. In this section, the examples relating to channels use the default channel attributes unless otherwise specified.

There is a message channel agent (MCA) at each end of a channel, controlling the sending and receiving of messages. The MCA takes messages from the transmission queue and puts them on the communication link between the queue managers.

A transmission queue is a specialized local queue that temporarily holds messages before the MCA picks them up and sends them to the remote queue manager. You specify the name of the transmission queue on a *remote queue definition*.

You can allow an MCA to transfer messages using multiple threads. This process is known as *pipelining*. Pipelining enables the MCA to transfer messages more efficiently, improving channel performance. See [Attributes of channels](#) for details of how to configure a channel to use pipelining.

[“Preparing channels and transmission queues for remote administration” on page 128](#) tells you how to use these definitions to set up remote administration.

For more information about setting up distributed queuing in general, see [Distributed queuing components](#).

## Remote administration using clusters

In an IBM MQ network using distributed queuing, every queue manager is independent. If one queue manager needs to send messages to another queue manager, it must define a transmission queue, a channel to the remote queue manager, and a remote queue definition for every queue to which it wants to send messages.

A *cluster* is a group of queue managers set up in such a way that the queue managers can communicate directly with one another over a single network without complex transmission queue, channel, and queue definitions. Clusters can be set up easily, and typically contain queue managers that are logically related in some way and need to share data or applications. Even the smallest cluster reduces system administration costs.

Establishing a network of queue managers in a cluster involves fewer definitions than establishing a traditional distributed queuing environment. With fewer definitions to make, you can set up or change your network more quickly and easily, and reduce the risk of making an error in your definitions.

To set up a cluster, you need one cluster sender (CLUSDR) and one cluster receiver (CLUSRCVR) definition for each queue manager. You do not need any transmission queue definitions or remote queue definitions. The principles of remote administration are the same when used within a cluster, but the definitions themselves are greatly simplified.

## Remote administration from a local queue manager

This section tells you how to administer a remote queue manager from a local queue manager using MQSC and PCF commands.

Preparing the queues and channels is essentially the same for both MQSC and PCF commands. In this section, the examples show MQSC commands, because they are easier to understand. For more information about writing administration programs using PCF commands, see [“Using Programmable Command Formats”](#) on page 10.

You send MQSC commands to a remote queue manager either interactively or from a text file containing the commands. The remote queue manager might be on the same machine or, more typically, on a different machine. You can remotely administer queue managers in other IBM MQ environments, including UNIX and Linux systems, Windows systems, IBM i, and z/OS.

To implement remote administration, you must create specific objects. Unless you have specialized requirements, the default values (for example, for maximum message length) are sufficient.

### Preparing queue managers for remote administration

How to use MQSC commands to prepare queue managers for remote administration.

Figure 17 on page 127 shows the configuration of queue managers and channels that you need for remote administration using the **runmqsc** command. The object `source.queue.manager` is the source queue manager from which you can issue MQSC commands and to which the results of these commands (operator messages) are returned. The object `target.queue.manager` is the name of the target queue manager, which processes the commands and generates any operator messages.

**Note:** If you are using **runmqsc** with the **-w** option, `source.queue.manager` **must** be the default queue manager. For further information on creating a queue manager, see [crtmqm](#).

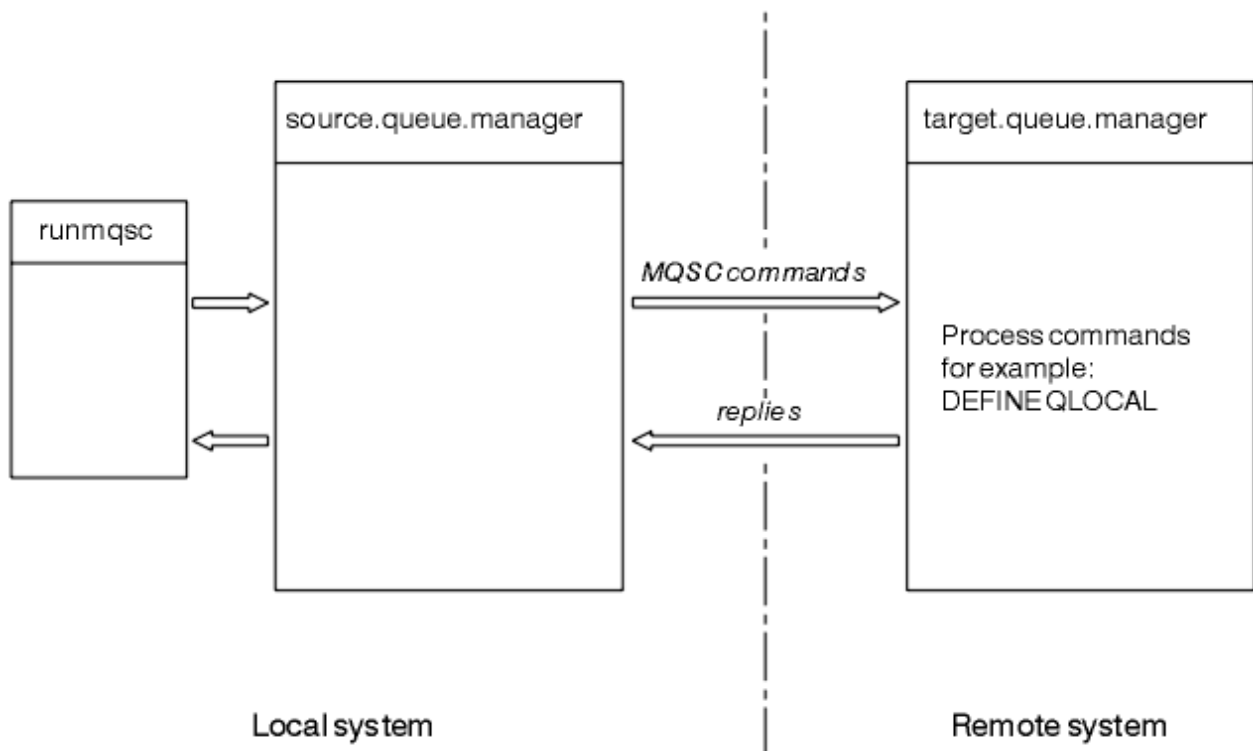


Figure 17. Remote administration using MQSC commands

On both systems, if you have not already done so:

- Create the queue manager and the default objects, using the **crtmqm** command.
- Start the queue manager, using the **strmqm** command.

On the target queue manager:

- The command queue, SYSTEM.ADMIN.COMMAND.QUEUE, must be present. This queue is created by default when a queue manager is created.

You have to run these commands locally or over a network facility such as Telnet.

## Preparing channels and transmission queues for remote administration

How to use MQSC commands to prepare channels and transmission queues for remote administration.

To run MQSC commands remotely, set up two channels, one for each direction, and their associated transmission queues. This example assumes that you are using TCP/IP as the transport type and that you know the TCP/IP address involved.

The channel `source.to.target` is for sending MQSC commands from the source queue manager to the target queue manager. Its sender is at `source.queue.manager` and its receiver is at `target.queue.manager`. The channel `target.to.source` is for returning the output from commands and any operator messages that are generated to the source queue manager. You must also define a transmission queue for each channel. This queue is a local queue that is given the name of the receiving queue manager. The XMITQ name must match the remote queue manager name in order for remote administration to work, unless you are using a queue manager alias. [Figure 18 on page 128](#) summarizes this configuration.

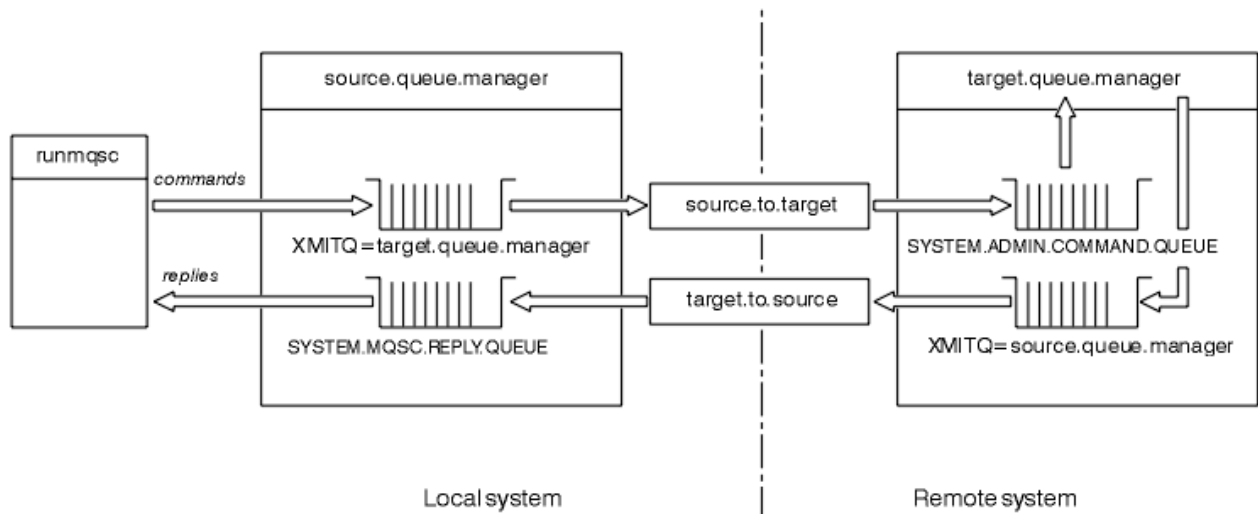


Figure 18. Setting up channels and queues for remote administration

See [Configuring distributed queuing](#) for more information about setting up channels.

## Defining channels, listeners, and transmission queues

On the source queue manager (`source.queue.manager`), issue the following MQSC commands to define the channels, listener, and the transmission queue:

1. Define the sender channel at the source queue manager:

```
DEFINE CHANNEL ('source.to.target') +  
CHLTYPE(SDR) +  
CONNAME (RXH5498) +  
XMITQ ('target.queue.manager') +  
TRPTYPE(TCP)
```

2. Define the receiver channel at the source queue manager:

```
DEFINE CHANNEL ('target.to.source') +  
CHLTYPE(RCVR) +  
TRPTYPE(TCP)
```



3. Define the listener on the source queue manager:

```
DEFINE LISTENER ('source.queue.manager') +  
TRPTYPE (TCP)
```

4. Define the transmission queue on the source queue manager:

```
DEFINE QLOCAL ('target.queue.manager') +  
USAGE (XMITQ)
```

Issue the following commands on the target queue manager (`target.queue.manager`), to create the channels, listener, and the transmission queue:

1. Define the sender channel on the target queue manager:

```
DEFINE CHANNEL ('target.to.source') +  
CHLTYPE(SDR) +  
CONNAME (RHX7721) +  
XMITQ ('source.queue.manager') +  
TRPTYPE(TCP)
```

2. Define the receiver channel on the target queue manager:

```
DEFINE CHANNEL ('source.to.target') +  
CHLTYPE(RCVR) +  
TRPTYPE(TCP)
```

3. Define the listener on the target queue manager:

```
DEFINE LISTENER ('target.queue.manager') +  
TRPTYPE (TCP)
```

4. Define the transmission queue on the target queue manager:

```
DEFINE QLOCAL ('source.queue.manager') +  
USAGE (XMITQ)
```

**Note:** The TCP/IP connection names specified for the CONNAME attribute in the sender channel definitions are for illustration only. This is the network name of the machine at the *other* end of the connection. Use the values appropriate for your network.

### ***Starting the listeners and channels***

How to use MQSC commands to start listeners and channels.

Start both listeners by using the following MQSC commands:

1. Start the listener on the source queue manager, `source.queue.manager`, by issuing the following MQSC command:

```
START LISTENER ('source.queue.manager')
```

2. Start the listener on the target queue manager, `target.queue.manager`, by issuing the following MQSC command:

```
START LISTENER ('target.queue.manager')
```

Start both sender channels by using the following MQSC commands:

1. Start the sender channel on the source queue manager, `source.queue.manager`, by issuing the following MQSC command:

```
START CHANNEL ('source.to.target')
```

2. Start the sender channel on the target queue manager, `target.queue.manager`, by issuing the following MQSC command:

```
START CHANNEL ('target.to.source')
```

#### *Automatic definition of channels*

You enable automatic definition of receiver and server-connection definitions by updating the queue manager object using the MQSC command, `ALTER QMGR` (or the PCF command `Change Queue Manager`).

If IBM MQ receives an inbound attach request and cannot find an appropriate receiver or server-connection channel, it creates a channel automatically. Automatic definitions are based on two default definitions supplied with IBM MQ: `SYSTEM.AUTO.RECEIVER` and `SYSTEM.AUTO.SVRCONN`.

For more information about creating channel definitions automatically, see [Preparing channels](#). For information about automatically defining channels for clusters, see [Working with auto-defined channels](#).

## Managing the command server for remote administration

How to start, stop, and display the status of the command server. A command server is mandatory for all administration involving PCF commands, the MQAI, and also for remote administration.

Each queue manager can have a command server associated with it. A command server processes any incoming commands from remote queue managers, or PCF commands from applications. It presents the commands to the queue manager for processing and returns a completion code or operator message depending on the origin of the command.

**Note:** For remote administration, ensure that the target queue manager is running. Otherwise, the messages containing commands cannot leave the queue manager from which they are issued. Instead, these messages are queued in the local transmission queue that serves the remote queue manager. Avoid this situation.

There are separate control commands for starting and stopping the command server. Providing the command server is running, users of IBM MQ for Windows or IBM MQ for Linux (x86 and x86-64 platforms) can perform the operations described in the following sections using the IBM MQ Explorer. For more information, see [“Administration using the MQ Explorer” on page 59](#).

## Starting the command server

Depending on the value of the queue manager attribute, `SCMDSERV`, the command server is either started automatically when the queue manager starts, or must be started manually. The value of the queue manager attribute can be altered using the MQSC command `ALTER QMGR` specifying the parameter `SCMDSERV`. By default, the command server is started automatically.

If `SCMDSERV` is set to `MANUAL`, start the command server using the command:

```
stimqcsv saturn.queue.manager
```

where `saturn.queue.manager` is the queue manager for which the command server is being started.

## Displaying the status of the command server

For remote administration, ensure that the command server on the target queue manager is running. If it is not running, remote commands cannot be processed. Any messages containing commands are queued in the target queue manager's command queue.

To display the status of the command server for a queue manager, issue the following MQSC command:

```
DISPLAY QMSTATUS CMDSERV
```

## Stopping a command server

To end the command server started by the previous example use the following command:

```
endmqcsv saturn.queue.manager
```

You can stop the command server in two ways:

- For a controlled stop, use the `endmqcsv` command with the `-c` flag, which is the default.
- For an immediate stop, use the `endmqcsv` command with the `-i` flag.

**Note:** Stopping a queue manager also ends the command server associated with it.

## Issuing MQSC commands on a remote queue manager

You can use a particular form of the `runmqsc` command to run MQSC commands on a remote queue manager.

The command server **must** be running on the target queue manager, if it is going to process MQSC commands remotely. (This is not necessary on the source queue manager). For information on how to start the command server on a queue manager, see [“Managing the command server for remote administration” on page 130](#).

On the source queue manager, you can then run MQSC commands interactively in indirect mode by typing:

```
runmqsc -w 30 target.queue.manager
```

This form of the `runmqsc` command, with the `-w` flag, runs the MQSC commands in indirect mode, where commands are put (in a modified form) on the command server input queue and executed in order.

When you type in an MQSC command, it is redirected to the remote queue manager, in this case, `target.queue.manager`. The timeout is set to 30 seconds; if a reply is not received within 30 seconds, the following message is generated on the local (source) queue manager:

```
AMQ8416: MQSC timed out waiting for a response from the command server.
```

When you stop issuing MQSC commands, the local queue manager displays any timed-out responses that have arrived and discards any further responses.

The source queue manager defaults to the default local queue manager. If you specify the `-m LocalQmgrName` option in the `runmqsc` command, you can direct the commands to be issued by way of any local queue manager.

In indirect mode, you can also run an MQSC command file on a remote queue manager. For example:

```
runmqsc -w 60 target.queue.manager < mycomds.in > report.out
```

where `mycomds.in` is a file containing MQSC commands and `report.out` is the report file.

## Suggested method for issuing commands remotely

When you are issuing commands on a remote queue manager, consider using the following approach:

1. Put the MQSC commands to be run on the remote system in a command file.
2. Verify your MQSC commands locally, by specifying the `-v` flag on the `runmqsc` command.

You cannot use `runmqsc` to verify MQSC commands on another queue manager.

3. Check that the command file runs locally without error.
4. Run the command file on the remote system.

## If you have problems using MQSC commands remotely

If you have difficulty in running MQSC commands remotely, make sure that you have:

- Started the command server on the target queue manager.
- Defined a valid transmission queue.
- Defined the two ends of the message channels for both:
  - The channel along which the commands are being sent.
  - The channel along which the replies are to be returned.
- Specified the correct connection name (CONNAME) in the channel definition.
- Started the listeners before you started the message channels.
- Checked that the disconnect interval has not expired, for example, if a channel started but then shut down after some time. This is especially important if you start the channels manually.
- Sent requests from a source queue manager that do not make sense to the target queue manager (for example, requests that include parameters that are not supported on the remote queue manager).

See also [“Resolving problems with MQSC commands”](#) on page 79.

## Working with queue managers on z/OS

You can issue MQSC commands to a z/OS queue manager from a queue manager on the platforms described in this guide. However, to do this, you must modify the `runmqsc` command and the channel definitions at the sender.

In particular, you add the `-x` flag to the `runmqsc` command on the source node to specify that the target queue manager is running under z/OS:

```
runmqsc -w 30 -x target.queue.manager
```

## Creating a local definition of a remote queue

A local definition of a remote queue is a definition on a local queue manager that refers to a queue on a remote queue manager.

You do not have to define a remote queue from a local position, but the advantage of doing so is that applications can refer to the remote queue by its locally-defined name instead of having to specify a name that is qualified by the ID of the queue manager on which the remote queue is located.

## Understanding how local definitions of remote queues work

An application connects to a local queue manager and then issues an `MQOPEN` call. In the open call, the queue name specified is that of a remote queue definition on the local queue manager. The remote queue definition supplies the names of the target queue, the target queue manager, and optionally, a transmission queue. To put a message on the remote queue, the application issues an `MQPUT` call, specifying the handle returned from the `MQOPEN` call. The queue manager uses the remote queue name and the remote queue manager name in a transmission header at the start of the message. This information is used to route the message to its correct destination in the network.

As administrator, you can control the destination of the message by altering the remote queue definition.

The following example shows how an application puts a message on a queue owned by a remote queue manager. The application connects to a queue manager, for example, `saturn.queue.manager`. The target queue is owned by another queue manager.

On the MQOPEN call, the application specifies these fields:

Field value	Description
<i>ObjectName</i> CYAN.REMOTE.QUEUE	Specifies the local name of the remote queue object. This defines the target queue and the target queue manager.
<i>ObjectType</i> (Queue)	Identifies this object as a queue.
<i>ObjectQmgrName</i> Blank or saturn.queue.manager	This field is optional.  If blank, the name of the local queue manager is assumed. (This is the queue manager on which the remote queue definition exists.)

After this, the application issues an MQPUT call to put a message onto this queue.

On the local queue manager, you can create a local definition of a remote queue using the following MQSC commands:

```
DEFINE QREMOTE (CYAN.REMOTE.QUEUE) +
DESCR ('Queue for auto insurance requests from the branches') +
RNAME (AUTOMOBILE.INSURANCE.QUOTE.QUEUE) +
RQMNAME (jupiter.queue.manager) +
XMITQ (INQUOTE.XMIT.QUEUE)
```

where:

**QREMOTE (CYAN.REMOTE.QUEUE)**

Specifies the local name of the remote queue object. This is the name that applications connected to this queue manager must specify in the MQOPEN call to open the queue AUTOMOBILE.INSURANCE.QUOTE.QUEUE on the remote queue manager jupiter.queue.manager.

**DESCR ('Queue for auto insurance requests from the branches')**

Provides additional text that describes the use of the queue.

**RNAME (AUTOMOBILE.INSURANCE.QUOTE.QUEUE)**

Specifies the name of the target queue on the remote queue manager. This is the real target queue for messages sent by applications that specify the queue name CYAN.REMOTE.QUEUE. The queue AUTOMOBILE.INSURANCE.QUOTE.QUEUE must be defined as a local queue on the remote queue manager.

**RQMNAME (jupiter.queue.manager)**

Specifies the name of the remote queue manager that owns the target queue AUTOMOBILE.INSURANCE.QUOTE.QUEUE.

**XMITQ (INQUOTE.XMIT.QUEUE)**

Specifies the name of the transmission queue. This is optional; if the name of a transmission queue is not specified, a queue with the same name as the remote queue manager is used.

In either case, the appropriate transmission queue must be defined as a local queue with a *Usage* attribute specifying that it is a transmission queue (USAGE(XMITQ) in MQSC commands).

## An alternative way of putting messages on a remote queue

Using a local definition of a remote queue is not the only way of putting messages on a remote queue. Applications can specify the full queue name, including the remote queue manager name, as part of the MQOPEN call. In this case, you do not need a local definition of a remote queue. However, this means that applications must either know, or have access to, the name of the remote queue manager at run time.

## Using other commands with remote queues

You can use MQSC commands to display or alter the attributes of a remote queue object, or you can delete the remote queue object. For example:

- To display the remote queue's attributes:

```
DISPLAY QUEUE (CYAN.REMOTE.QUEUE)
```

- To change the remote queue to enable puts. This does not affect the target queue, only applications that specify this remote queue:

```
ALTER QREMOTE (CYAN.REMOTE.QUEUE) PUT(ENABLED)
```

- To delete this remote queue. This does not affect the target queue, only its local definition:

```
DELETE QREMOTE (CYAN.REMOTE.QUEUE)
```

**Note:** When you delete a remote queue, you delete only the local representation of the remote queue. You do not delete the remote queue itself or any messages on it.

## Defining a transmission queue

A transmission queue is a local queue that is used when a queue manager forwards messages to a remote queue manager through a message channel.

The channel provides a one-way link to the remote queue manager. Messages are queued at the transmission queue until the channel can accept them. When you define a channel, you must specify a transmission queue name at the sending end of the message channel.

The MQSC command attribute USAGE defines whether a queue is a transmission queue or a normal queue.

## Default transmission queues

When a queue manager sends messages to a remote queue manager, it identifies the transmission queue using the following sequence:

1. The transmission queue named on the XMITQ attribute of the local definition of a remote queue.
2. A transmission queue with the same name as the target queue manager. (This value is the default value on XMITQ of the local definition of a remote queue.)
3. The transmission queue named on the DEFXMITQ attribute of the local queue manager.

For example, the following MQSC command creates a default transmission queue on `source.queue.manager` for messages going to `target.queue.manager`:

```
DEFINE QLOCAL ('target.queue.manager') +  
DESCR ('Default transmission queue for target qm') +  
USAGE (XMITQ)
```

Applications can put messages directly on a transmission queue, or indirectly through a remote queue definition. See also [“Creating a local definition of a remote queue” on page 132](#).

## Checking that async commands for distributed networks have finished

Many commands are asynchronous when used in a distributed network. Depending on the command, and the network state when it is issued, it can take a significant amount of time to finish. The queue manager

does not issue a message on completion, so you need other ways of checking that the command has finished.

## About this task

Almost any configuration change that you make to a cluster is likely to complete asynchronously. This is because of the internal administration and updating cycles that operate within clusters. For publish/subscribe hierarchies, any configuration change that affects subscriptions is likely to complete asynchronously. This is not always obvious from the name of the command.

The following MQSC commands might all complete asynchronously. Each of these commands has a PCF equivalent, and most are also available from within MQ Explorer . When run on a small network with no workload, these commands typically complete within a few seconds. However, this is not the case for larger and busier networks. Also, the **REFRESH CLUSTER** command might take much longer, particularly when it is issued on multiple queue managers at the same time.

To have confidence that these commands have finished, check that the expected objects exist on the remote queue managers.

## Procedure

- [ALTER QMGR](#)

For the [ALTER QMGR PARENT](#) command, use `DISPLAY PUBSUB TYPE(PARENT) ALL` to track the status of the requested parent relationship.

For the [ALTER QMGR REPOS](#) and [ALTER QMGR REPOSNL](#) commands, use `DISPLAY CLUSQMGR QMTYPE` to confirm completion.

- [DEFINE CHANNEL](#), [ALTER CHANNEL](#), and [DELETE CHANNEL](#)

For all parameters listed in the table [ALTER CHANNEL parameters](#), use the `DISPLAY CLUSQMGR` command to monitor when changes have been propagated to the cluster.

- [DEFINE NAMELIST](#), [ALTER NAMELIST](#), and [DELETE NAMELIST](#).

If you use a **NAMELIST** on the **CLUSNL** attribute of a **QMGR** object, a queue or a cluster channel might affect that object. Monitor as appropriate for the affected object.

Changes to `SYSTEM.QPUBSUB.QUEUE.NAMELIST` might affect creation or cancellation of proxy subscriptions in a publish/subscribe hierarchy. Use the `DISPLAY SUB SUBTYPE(PROXY)` command to monitor this.

- [DEFINE queues](#), [ALTER queues](#), and [DELETE queues](#).

For all parameters listed in the table [Parameters that can be returned by the DISPLAY QUEUE command](#), use the `DISPLAY QCLUSTER` command to monitor when changes have been propagated to the cluster.

- [DEFINE SUB](#), and [DELETE SUB](#)

When you define the first subscription on a topic string, you might create proxy subscriptions in a publish/subscribe hierarchy or publish/subscribe cluster. Similarly, when you delete the last subscription on a topic string, you might cancel proxy subscriptions in a publish/subscribe hierarchy or publish/subscribe cluster.

To check that a command defining or deleting a subscription has finished, check whether or not the expected proxy subscription exists on other queue managers in the distributed network. If you are using *direct routing* in a cluster, check that the expected proxy subscription exists on the other partial repositories in the cluster. If you are using *topic host routing* in a cluster, check that the expected proxy subscription exists on the matching topic hosts. Use the following MQSC command:

```
DISPLAY SUB(*) SUBTYPE(PROXY)
```

Use the same check for the following equivalent subscribe and unsubscribe MQI calls, when they are issued in a cluster or hierarchy:

- Subscribe by using `MQSUB`.
- Unsubscribe by using `MQCLOSE` with `MQCO_REMOVE_SUB`.
- DEFINE TOPIC, ALTER TOPIC, and DELETE TOPIC  
To check that a command defining, altering or deleting a clustered topic has finished, display the topic in the other partial repositories in the cluster (if you are using *direct routing*) or on the other topic hosts (if you are using *topic host routing*).

For all parameters listed in the table Parameters that can be returned by the DISPLAY TOPIC command, use the `DISPLAY TCLUSTER` command to monitor when changes have been propagated to the cluster.

**Note:**

- The **CLUSTER** parameter can affect creation or cancellation of proxy subscriptions in a publish/subscribe cluster.
- The **PROXYSUB** and **SUBSCOPE** parameters can affect creation or cancellation of proxy subscriptions in a publish/subscribe hierarchy or publish/subscribe cluster.
- Use the `DISPLAY SUB SUBTYPE(PROXYSUB)` command to monitor this.
- REFRESH CLUSTER

If you are running the **REFRESH CLUSTER** command, poll the cluster command queue depth. Wait for it to reach zero, and remain at zero, before looking for the objects.

1. Use the following MQSC command to check that the cluster command queue depth is zero.

```
DISPLAY QL(SYSTEM.CLUSTER.COMMAND.QUEUE) CURDEPTH
```

2. Repeat the check until the queue depth reaches zero, and remains at zero in the subsequent check.

The **REFRESH CLUSTER** command removes and recreates objects, and in large configurations can take a significant time to complete. See REFRESH CLUSTER considerations for publish/subscribe clusters.

- REFRESH QMGR TYPE(PROXYSUB)

To check that the **REFRESH QMGR TYPE(PROXYSUB)** command has finished, check that the proxy subscriptions have been corrected on other queue managers in the distributed network. If you are using *direct routing* in a cluster, check that the proxy subscriptions have been corrected on the other partial repositories in the cluster. If you are using *topic host routing* in a cluster, check that the expected proxy subscriptions have been corrected on the matching topic hosts. Use the following MQSC command:

```
DISPLAY SUB(*) SUBTYPE(PROXYSUB)
```

- RESET CLUSTER

To check that the **RESET CLUSTER** command has completed, use `DISPLAY CLUSQMGR`.

- RESET QMGR TYPE(PUBSUB)

To check that the **RESET QMGR** command has completed, use `DISPLAY PUBSUB TYPE(PARENT | CHILD)`.

**Note:** The **RESET QMGR** command might cause cancellation of proxy subscriptions in a publish/subscribe hierarchy or publish/subscribe cluster. Use the `DISPLAY SUB SUBTYPE(PROXYSUB)` command to monitor this.

- You might also want to monitor other system queues that, as and when commands complete, tend towards a queue depth of zero.



For example, you might want to monitor the `SYSTEM.INTER.QMGR.CONTROL` queue, and the `SYSTEM.INTER.QMGR.FANREQ` queue. See [Monitoring proxy subscription traffic in clusters](#) and [Balancing producers and consumers in publish/subscribe networks](#).

## What to do next

If these checks do not confirm that an asynchronous command has finished, an error might have occurred. To investigate, first check the log for the queue manager on which the command was issued, then (for a cluster) check the cluster full repository logs.

## Related information

 [Asynchronous behavior of CLUSTER commands on z/OS](#)

## Using remote queue definitions as aliases

In addition to locating a queue on another queue manager, you can also use a local definition of a remote queue for Queue manager aliases and reply-to queue aliases. Both types of alias are resolved through the local definition of a remote queue. You must set up the appropriate channels for the message to arrive at its destination.

### Queue manager aliases

An alias is the process by which the name of the target queue manager, as specified in a message, is modified by a queue manager on the message route. Queue manager aliases are important because you can use them to control the destination of messages within a network of queue managers.

You do this by altering the remote queue definition on the queue manager at the point of control. The sending application is not aware that the queue manager name specified is an alias.

For more information about queue manager aliases, see [What are aliases?](#).

### Reply-to queue aliases

Optionally, an application can specify the name of a reply-to queue when it puts a *request message* on a queue.

If the application that processes the message extracts the name of the reply-to queue, it knows where to send the *reply message*, if required.

A reply-to queue alias is the process by which a reply-to queue, as specified in a request message, is altered by a queue manager on the message route. The sending application is not aware that the reply-to queue name specified is an alias.

A reply-to queue alias lets you alter the name of the reply-to queue and optionally its queue manager. This in turn lets you control which route is used for reply messages.

For more information about request messages, reply messages, and reply-to queues, see [Types of message](#) and [Reply-to queue and queue manager](#).

For more information about reply-to queue aliases, see [Reply-to queue aliases and clusters](#).

## Data conversion

Message data in IBM MQ defined formats (also known as *built-in formats*) can be converted by the queue manager from one coded character set to another, provided that both character sets relate to a single language or a group of similar languages.

For example, conversion between coded character sets with identifiers (CCSIDs) 850 and 500 is supported, because both apply to Western European languages.

For EBCDIC newline (NL) character conversions to ASCII, see [All queue managers](#).

Supported conversions are defined in [Data conversion](#).

## When a queue manager cannot convert messages in built-in formats

The queue manager cannot automatically convert messages in built-in formats if their CCSIDs represent different national-language groups. For example, conversion between CCSID 850 and CCSID 1025 (which is an EBCDIC coded character set for languages using Cyrillic script) is not supported because many of the characters in one coded character set cannot be represented in the other. If you have a network of queue managers working in different national languages, and data conversion among some of the coded character sets is not supported, you can enable a default conversion. Default data conversion is described in [“Default data conversion” on page 138](#).

### File ccsid.tbl

The file ccsid.tbl is used for the following purposes:

- In IBM MQ for Windows it records all the supported code sets.
- On AIX and HP-UX platforms, the supported code sets are held internally by the operating system.
- For all other UNIX and Linux platforms, the supported code sets are held in conversion tables provided by IBM MQ.
- It specifies any additional code sets. To specify additional code sets, you need to edit ccsid.tbl (guidance on how to do this is provided in the file).
- It specifies any default data conversion.

You can update the information recorded in ccsid.tbl; you might want to do this if, for example, a future release of your operating system supports additional coded character sets.

In IBM MQ for Windows, ccsid.tbl is located in directory `C:\Program Files\IBM\WebSphere MQ\conv\table` by default.

In IBM MQ for UNIX and Linux systems, ccsid.tbl is located in directory `/var/mqm/conv/table`.

### Default data conversion

If you set up channels between two machines on which data conversion is not normally supported, you must enable default data conversion for the channels to work.

To enable default data conversion, edit the ccsid.tbl file to specify a default EBCDIC CCSID and a default ASCII CCSID. Instructions on how to do this are included in the file. You must do this on all machines that will be connected using the channels. Restart the queue manager for the change to take effect.

The default data-conversion process is as follows:

- If conversion between the source and target CCSIDs is not supported, but the CCSIDs of the source and target environments are either both EBCDIC or both ASCII, the character data is passed to the target application without conversion.
- If one CCSID represents an ASCII coded character set, and the other represents an EBCDIC coded character set, IBM MQ converts the data using the default data-conversion CCSIDs defined in ccsid.tbl.

**Note:** Try to restrict the characters being converted to those that have the same code values in the coded character set specified for the message and in the default coded character set. If you use only the set of characters that is valid for IBM MQ object names (as defined in [Naming IBM MQ objects](#)) you will, in general, satisfy this requirement. Exceptions occur with EBCDIC CCSIDs 290, 930, 1279, and 5026 used in Japan, where the lowercase characters have different codes from those used in other EBCDIC CCSIDs.

### Converting messages in user-defined formats

The queue manager cannot convert messages in user-defined formats from one coded character set to another. If you need to convert data in a user-defined format, you must supply a data-conversion exit for each such format. Do not use default CCSIDs to convert character data in user-defined formats. For more information about converting data in user-defined formats and about writing data conversion exits, see the [Writing data-conversion exits](#).

## Changing the queue manager CCSID

When you have used the CCSID attribute of the ALTER QMGR command to change the CCSID of the queue manager, stop and restart the queue manager to ensure that all running applications, including the command server and channel programs, are stopped and restarted.

This is necessary because any applications that are running when the queue manager CCSID is changed continue to use the existing CCSID.

## Administering IBM MQ Telemetry

---

IBM MQ Telemetry is administered using MQ Explorer or at a command line. Use the explorer to configure telemetry channels, control the telemetry service, and monitor the MQTT clients that are connected to IBM MQ. Configure the security of IBM MQ Telemetry using JAAS, SSL and the IBM MQ object authority manager.

### Administering using MQ Explorer

Use the explorer to configure telemetry channels, control the telemetry service, and monitor the MQTT clients that are connected to IBM MQ. Configure the security of IBM MQ Telemetry using JAAS, SSL and the IBM MQ object authority manager.

### Administering using the command line

IBM MQ Telemetry can be completely administered at the command line using the IBM MQ [MQSC](#) commands.

The IBM MQ Telemetry documentation also has sample scripts that demonstrate the basic usage of the IBM MQ Telemetry Transport v3 Client application.

Read and understand the samples in [IBM MQ Telemetry Transport sample programs](#) in the [Developing applications for IBM MQ Telemetry](#) section before using them.

#### Related information

[IBM MQ Telemetry](#)

[MQXR properties](#)

## Configuring a queue manager for telemetry on Linux and AIX

Follow these manual steps to configure a queue manager to run IBM MQ Telemetry. You can run an automated procedure to set up a simpler configuration using the IBM MQ Telemetry support for MQ Explorer.

### Before you begin

1. See [Installing IBM MQ Telemetry](#) for information on how to install IBM MQ and the IBM MQ Telemetry feature.
2. Create and start a queue manager. The queue manager is referred to as *qMgr* in this task.
3. As part of this task you configure the telemetry (MQXR) service. The MQXR property settings are stored in a platform-specific properties file: `mqxr_unix.properties`. You do not normally need to edit the MQXR properties file directly, because almost all settings can be configured through MQSC admin commands or MQ Explorer. If you do decide to edit the file directly, stop the queue manager before you make your changes. See [MQXR properties](#).

### About this task

The IBM MQ Telemetry support for MQ Explorer includes a wizard, and a sample command procedure `sampleMQM`. They set up an initial configuration using the guest user ID; see [Verifying the installation of IBM MQ Telemetry by using MQ Explorer and IBM MQ Telemetry Transport sample programs](#).

Follow the steps in this task to configure IBM MQ Telemetry manually using different authorization schemes.

## Procedure

1. Open a command window at the telemetry samples directory.

The telemetry samples directory is `/opt/mqm/mqxr/samples`.

2. Create the telemetry transmission queue.

```
echo "DEFINE QLOCAL('SYSTEM.MQTT.TRANSMIT.QUEUE') USAGE(XMITQ) MAXDEPTH(100000)" | runmqsc qMgr
```

When the telemetry (MQXR) service is first started, it creates `SYSTEM.MQTT.TRANSMIT.QUEUE`.

It is created manually in this task, because `SYSTEM.MQTT.TRANSMIT.QUEUE` must exist before the telemetry (MQXR) service is started, to authorize access to it.

3. Set the default transmission queue for `qMgr`

```
echo ALTER QMGR DEFQMITQ('SYSTEM.MQTT.TRANSMIT.QUEUE') | runmqsc qMgr
```

*Figure 19. Set default transmission queue*

When the telemetry (MQXR) service is first started, it does not alter the queue manager to make `SYSTEM.MQTT.TRANSMIT.QUEUE` the default transmission queue.

To make `SYSTEM.MQTT.TRANSMIT.QUEUE` the default transmission queue alter the default transmission queue property. Alter the property using the MQ Explorer or with the command in [Figure 19](#) on page 140.

Altering the default transmission queue might interfere with your existing configuration. The reason for altering the default transmission queue to `SYSTEM.MQTT.TRANSMIT.QUEUE` is to make sending messages directly to MQTT clients easier. Without altering the default transmission queue you must add a remote queue definition for every client that receives MQ Explorer messages; see [“Sending a message to a client directly”](#) on page 144.

4. Follow a procedure in [“Authorizing MQTT clients to access IBM MQ objects”](#) on page 146 to create one or more user IDs. The user IDs have the authority to publish, subscribe, and send publications to MQTT clients.
5. Install the telemetry (MQXR) service

```
cat  
installMQXRService_unix.mqsc | runmqsc qMgr
```

6. Start the service

```
echo "START SERVICE(SYSTEM.MQXR.SERVICE)" | runmqsc qMgr
```

The telemetry (MQXR) service is started automatically when the queue manager is started.

It is started manually in this task, because the queue manager is already running.

7. Using MQ Explorer, configure telemetry channels to accept connections from MQTT clients.

The telemetry channels must be configured such that their identities are one of the user IDs defined in step 4.

See also [DEFINE CHANNEL \(MQTT\)](#).

8. Verify the configuration by running the sample client.

For the sample client to work with your telemetry channel, the channel must authorize the client to publish, subscribe, and receive publications. The sample client connects to the telemetry channel on port 1883 by default. See also [IBM MQ Telemetry Transport sample programs](#).

### Example

Figure 20 on page 141 shows the **runmqsc** command to create the `SYSTEM.MQXR.SERVICE` manually on Linux.

```
DEF      SERVICE(SYSTEM.MQXR.SERVICE) +
CONTROL(QMGR) +
DESCR('Manages clients using MQXR protocols such as MQTT') +
SERVTYPE(SERVER) +
STARTCMD('+MQ_INSTALL_PATH+/mqxr/bin/runMQXRService.sh') +
STARTARG('-m +QMNAME+ -d "+MQ_Q_MGR_DATA_PATH+" -g "+MQ_DATA_PATH+"') +
STOPCMD('+MQ_INSTALL_PATH+/mqxr/bin/endMQXRService.sh') +
STOPARG('-m +QMNAME+') +
STDOUT('+MQ_Q_MGR_DATA_PATH+/mqxr.stdout') +
STDERR('+MQ_Q_MGR_DATA_PATH+/mqxr.stderr')
```

Figure 20. *installMQXRService\_unix.mqsc*

## Configuring a queue manager for telemetry on Windows

Follow these manual steps to configure a queue manager to run IBM MQ Telemetry. You can run an automated procedure to set up a simpler configuration using the IBM MQ Telemetry support for MQ Explorer.

### Before you begin

1. See [Installing IBM MQ Telemetry](#) for information on how to install IBM MQ, and the IBM MQ Telemetry feature.
2. Create and start a queue manager. The queue manager is referred to as *qMgr* in this task.
3. As part of this task you configure the telemetry (MQXR) service. The MQXR property settings are stored in a platform-specific properties file: `mqxr_win.properties`. You do not normally need to edit the MQXR properties file directly, because almost all settings can be configured through MQSC admin commands or MQ Explorer. If you do decide to edit the file directly, stop the queue manager before you make your changes. See [MQXR properties](#).

### About this task

The IBM MQ Telemetry support for MQ Explorer includes a wizard, and a sample command procedure `sampleMQM`. They set up an initial configuration using the guest user ID; see [Verifying the installation of IBM MQ Telemetry by using MQ Explorer](#) and [IBM MQ Telemetry Transport sample programs](#).

Follow the steps in this task to configure IBM MQ Telemetry manually using different authorization schemes.

### Procedure

1. Open a command window at the telemetry samples directory.  
The telemetry samples directory is *WMQ program installation directory\mqxr\samples*.
2. Create the telemetry transmission queue.

```
echo DEFINE QLOCAL('SYSTEM.MQTT.TRANSMIT.QUEUE') USAGE(XMITQ) MAXDEPTH(100000) | runmqsc qMgr
```

When the telemetry (MQXR) service is first started, it creates `SYSTEM.MQTT.TRANSMIT.QUEUE`.

It is created manually in this task, because `SYSTEM.MQTT.TRANSMIT.QUEUE` must exist before the telemetry (MQXR) service is started, to authorize access to it.

### 3. Set the default transmission queue for *qMgr*

```
echo ALTER QMGR DEFXMITQ('SYSTEM.MQTT.TRANSMIT.QUEUE') | runmqsc qMgr
```

*Figure 21. Set default transmission queue*

When the telemetry (MQXR) service is first started, it does not alter the queue manager to make `SYSTEM.MQTT.TRANSMIT.QUEUE` the default transmission queue.

To make `SYSTEM.MQTT.TRANSMIT.QUEUE` the default transmission queue alter the default transmission queue property. Alter the property using the MQ Explorer or with the command in [Figure 21 on page 142](#).

Altering the default transmission queue might interfere with your existing configuration. The reason for altering the default transmission queue to `SYSTEM.MQTT.TRANSMIT.QUEUE` is to make sending messages directly to MQTT clients easier. Without altering the default transmission queue you must add a remote queue definition for every client that receives IBM MQ messages; see [“Sending a message to a client directly” on page 144](#).

4. Follow a procedure in [“Authorizing MQTT clients to access IBM MQ objects” on page 146](#) to create one or more user IDs. The user IDs have the authority to publish, subscribe, and send publications to MQTT clients.
5. Install the telemetry (MQXR) service

```
type  
installMQXRService_win.mqsc | runmqsc qMgr
```

### 6. Start the service

```
echo START SERVICE(SYSTEM.MQXR.SERVICE) | runmqsc qMgr
```

The telemetry (MQXR) service is started automatically when the queue manager is started.

It is started manually in this task, because the queue manager is already running.

### 7. Using MQ Explorer, configure telemetry channels to accept connections from MQTT clients.

The telemetry channels must be configured such that their identities are one of the user IDs defined in step 4.

See also [DEFINE CHANNEL \(MQTT\)](#).

### 8. Verify the configuration by running the sample client.

For the sample client to work with your telemetry channel, the channel must authorize the client to publish, subscribe, and receive publications. The sample client connects to the telemetry channel on port 1883 by default. See also [IBM MQ Telemetry Transport sample programs](#).

## Creating `SYSTEM.MQXR.SERVICE` manually

[Figure 22 on page 142](#) shows the `runmqsc` command to create the `SYSTEM.MQXR.SERVICE` manually on Windows.

```
DEF      SERVICE(SYSTEM.MQXR.SERVICE) +  
CONTROL(QMGR) +  
DESCR('Manages clients using MQXR protocols such as MQTT') +  
SERVTYPE(SERVER) +  
STARTCMD('+MQ_INSTALL_PATH+\\mqxr\\bin\\runMQXRService.bat') +  
STARTARG('-m +QMNAME+ -d "+MQ_Q_MGR_DATA_PATH+\\." -g "+MQ_DATA_PATH+\\."') +  
STOPCMD('+MQ_INSTALL_PATH+\\mqxr\\bin\\endMQXRService.bat') +  
STOPARG('-m +QMNAME+') +  
STDOUT('+MQ_Q_MGR_DATA_PATH+\\mqxr.stdout') +  
STDERR('+MQ_Q_MGR_DATA_PATH+\\mqxr.stderr')
```

*Figure 22. installMQXRService\_win.mqsc*

## Configure distributed queuing to send messages to MQTT clients

IBM MQ applications can send MQTT v3 clients messages by publishing to subscription created by a client, or by sending a message directly. Whichever method is used, the message is placed on `SYSTEM.MQTT.TRANSMIT.QUEUE`, and sent to the client by the telemetry (MQXR) service. There are a number of ways to place a message on `SYSTEM.MQTT.TRANSMIT.QUEUE`.

### Publishing a message in response to an MQTT client subscription

The telemetry (MQXR) service creates a subscription on behalf of the MQTT client. The client is the destination for any publications that match the subscription sent by the client. The telemetry services forwards matching publications back to the client.

An MQTT client is connected to IBM MQ as a queue manager, with its queue manager name set to its `ClientIdentifier`. The destination for publications to be sent to the client is a transmission queue, `SYSTEM.MQTT.TRANSMIT.QUEUE`. The telemetry service forwards messages on `SYSTEM.MQTT.TRANSMIT.QUEUE` to MQTT clients, using the target queue manager name as the key to a specific client.

The telemetry (MQXR) service opens the transmission queue using `ClientIdentifier` as the queue manager name. The telemetry (MQXR) service passes the object handle of the queue to the `MQSUB` call, to forward publications that match the client subscription. In the object name resolution, the `ClientIdentifier` is created as the remote queue manager name, and the transmission queue must resolve to `SYSTEM.MQTT.TRANSMIT.QUEUE`. Using standard IBM MQ object name resolution, `ClientIdentifier` is resolved as follows; see [Table 6 on page 143](#).

#### 1. `ClientIdentifier` matches nothing.

`ClientIdentifier` is a remote queue manager name. It does not match the local queue manager name, a queue manager alias, or a transmission queue name.

The queue name is not defined. Currently, the telemetry (MQXR) service sets `SYSTEM.MQTT.PUBLICATION.QUEUE` as the name of the queue. An MQTT v3 client does not support queues, so the resolved queue name is ignored by the client.

The local queue manager property, `Default transmission queue`, name must be set to `SYSTEM.MQTT.TRANSMIT.QUEUE`, so that the publication is put on `SYSTEM.MQTT.TRANSMIT.QUEUE` to be sent to the client.

#### 2. `ClientIdentifier` matches a queue manager alias named `ClientIdentifier`.

`ClientIdentifier` is a remote queue manager name. It matches the name of a queue manager alias.

The queue manager alias must be defined with `ClientIdentifier` as the remote queue manager name.

By setting the transmission queue name in the queue manager alias definition it is not necessary for the default transmission to be set to `SYSTEM.MQTT.TRANSMIT.QUEUE`.

Table 6. Name resolution of an MQTT queue manager alias					
	Input		Output		
<b><i>ClientIdentifier</i></b>	<b>Queue manager name</b>	<b>Queue name</b>	<b>Queue manager name</b>	<b>Queue name</b>	<b>Transmission queue</b>
Matches nothing	<i>ClientIdentifier</i>	<i>undefined</i>	<i>ClientIdentifier</i>	<i>undefined</i>	Default transmission queue.  <code>SYSTEM.MQTT.TRANSMIT.QUEUE</code>

Table 6. Name resolution of an MQTT queue manager alias (continued)					
	Input		Output		
<i>ClientIdentifier</i>	Queue manager name	Queue name	Queue manager name	Queue name	Transmission queue
Matches a queue manager alias named <i>ClientIdentifier</i>	<i>ClientIdentifier</i>	<i>undefined</i>	<i>ClientIdentifier</i>	<i>undefined</i>	SYSTEM.MQTT.TRANSMIT.QUEUE

For further information about name resolution, see [Name resolution](#).

Any IBM MQ program can publish to the same topic. The publication is sent to its subscribers, including MQTT v3 clients that have a subscription to the topic.

If an administrative topic is created in a cluster, with the attribute CLUSTER(*clusterName*), any application in the cluster can publish to the client; for example:

```
echo DEFINE TOPIC('MQTTExamples') TOPICSTR('MQTT Examples') CLUSTER(MQTT) REPLACE | runmqsc qMgr
```

Figure 23. Defining a cluster topic on Windows

**Note:** Do not give SYSTEM.MQTT.TRANSMIT.QUEUE a cluster attribute.

MQTT client subscribers and publishers can connect to different queue managers. The subscribers and publishers can be part of the same cluster, or connected by a publish/subscribe hierarchy. The publication is delivered from the publisher to the subscriber using IBM MQ.

## Sending a message to a client directly

An alternative to a client creating a subscription and receiving a publication that matches the subscription topic, send a message to an MQTT v3 client directly. MQTT V3 client applications cannot send messages directly, but other application, such as IBM MQ applications, can.

The IBM MQ application must know the *ClientIdentifier* of the MQTT v3 client. Because MQTT v3 clients do not have queues, the target queue name is passed to the MQTT v3 application client *messageArrived* method as a topic name. For example, in an MQI program, create an object descriptor with the client as the *ObjectQmgrName*:

```
MQOD.ObjectQmgrName = ClientIdentifier ;
MQOD.ObjectName = name ;
```

Figure 24. MQI Object descriptor to send a message to an MQTT v3 client destination

If the application is written using JMS, create a point-to-point destination; for example:

```
javax.jms.Destination jmsDestination =
(javax.jms.Destination)jmsFactory.createQueue
("queue://ClientIdentifier/name");
```

Figure 25. JMS destination to send a message to an MQTT v3 client



To send an unsolicited message to an MQTT client use a remote queue definition. The remote queue manager name must resolve to the `ClientIdentifier` of the client. The transmission queue must resolve to `SYSTEM.MQTT.TRANSMIT.QUEUE`; see [Table 7 on page 145](#). The remote queue name can be anything. The client receives it as a topic string.

Table 7. Name resolution of an MQTT client remote queue definition				
Input		Output		
Queue name	Queue manager name	Queue name	Queue manager name	Transmission queue
Name of remote queue definition	Blank or local queue manager name	Remote queue name used as a topic string	<code>ClientIdentifier</code>	<code>SYSTEM.MQTT.TRANSMIT.QUEUE</code>

If the client is connected, the message is sent directly to the MQTT client, which calls the `messageArrived` method; see [messageArrived method](#).

If the client has disconnected with a persistent session, the message is stored in `SYSTEM.MQTT.TRANSMIT.QUEUE`; see [MQTT stateless and stateful sessions](#). It is forwarded to the client when the client reconnects to the session again.

If you send a non-persistent message it is sent to the client with "at most once" quality of service, `QoS=0`. If you send a persistent message directly to a client, by default, it is sent with "exactly once" quality of service, `QoS=2`. As the client might not have a persistence mechanism, the client can reduce the quality of service it accepts for messages sent directly. To reduce the quality of service for messages sent directly to a client, make a subscription to the topic `DEFAULT.QoS`. Specify the maximum quality of service the client can support.

## MQTT client identification, authorization, and authentication

The telemetry (MQXR) service publishes, or subscribes to, IBM MQ topics on behalf of MQTT clients, using MQTT channels. The IBM MQ administrator configures the MQTT channel identity that is used for IBM MQ authorization. The administrator can define a common identity for the channel, or use the `Username` or `ClientIdentifier` of a client connected to the channel.

The telemetry (MQXR) service can authenticate the client using the `Username` supplied by the client, or by using a client certificate. The `Username` is authenticated using a password provided by the client.

To summarize: Client identification is the selection of the client identity. Depending on the context, the client is identified by the `ClientIdentifier`, `Username`, a common client identity created by the administrator, or a client certificate. The client identifier used for authenticity checking does not have to be the same identifier that is used for authorization.

MQTT client programs set the `Username` and `Password` that are sent to the server using an MQTT channel. They can also set the SSL properties that are required to encrypt and authenticate the connection. The administrator decides whether to authenticate the MQTT channel, and how to authenticate the channel.

To authorize an MQTT client to access IBM MQ objects, authorize the `ClientIdentifier`, or `Username` of the client, or authorize a common client identity. To permit a client to connect to IBM MQ, authenticate the `Username`, or use a client certificate. Configure JAAS to authenticate the `Username`, and configure SSL to authenticate a client certificate.

If you set a `Password` at the client, either encrypt the connection using VPN, or configure the MQTT channel to use SSL, to keep the password private.

It is difficult to manage client certificates. For this reason, if the risks associated with password authentication are acceptable, password authentication is often used to authenticate clients.

If there is a secure way to manage and store the client certificate it is possible to rely on certificate authentication. However, it is rarely the case that certificates can be managed securely in the types of

environments that telemetry is used in. Instead, the authentication of devices using client certificates is complemented by authenticating client passwords at the server. Because of the additional complexity, the use of client certificates is restricted to highly sensitive applications. The use of two forms of authentication is called two-factor authentication. You must know one of the factors, such as a password, and have the other, such as a certificate.

In a highly sensitive application, such as a chip-and-pin device, the device is locked down during manufacture to prevent tampering with the internal hardware and software. A trusted, time-limited, client certificate is copied to the device. The device is deployed to the location where it is to be used. Further authentication is performed each time the device is used, either using a password, or another certificate from a smart card.

## MQTT client identity and authorization

Use the client ID, Username, or a common client identity for authorization to access IBM MQ objects.

The IBM MQ administrator has three choices for selecting the identity of the MQTT channel. The administrator makes the choice when defining or modifying the MQTT channel used by the client. The identity is used to authorize access to IBM MQ topics. The choice is made in the following order:

1. The client ID (see [USECLNTID](#) ).
2. An identity the administrator provides for the channel (the MCAUSER of the channel. See [MCAUSER](#) ).
3. If neither of the previous choices applies, the Username passed from the MQTT client ( Username is an attribute of the `MqttConnectOptions` class. It must be set before the client connects to the service. Its default value is null).

**Avoid trouble:** The identity chosen by this process is thereafter referred to, for example by the `DISPLAY CHSTATUS (MQTT)` command, as the MCAUSER of the client. Be aware that this is not necessarily the same identity as the MCAUSER of the channel that is referred to in choice (2).

Use the IBM MQ **setmqaut** command to select which objects, and which actions, are authorized to be used by the identity associated with the MQTT channel. For example, the following code authorizes a channel identity `MQTTClient`, provided by the administrator of queue manager `QM1`:

```
setmqaut -m QM1 -t q -n SYSTEM.MQTT.TRANSMIT.QUEUE -p MQTTClient -all +put
setmqaut -m QM1 -t topic -n SYSTEM.BASE.TOPIC -p MQTTClient -all +pub +sub
```

## Authorizing MQTT clients to access IBM MQ objects

Follow these steps to authorize MQTT clients to publish and subscribe to IBM MQ Objects. The steps follow four alternative access control patterns.

### Before you begin

MQTT clients are authorized to access objects in IBM MQ by being assigned an identity when they connect to a telemetry channel. The IBM MQ Administrator configures the telemetry channel using IBM MQ Explorer to give a client one of three types of identity:

1. `ClientIdentifier`
2. `Username`
3. A name the administrator assigns to the channel.

Whichever type is used, the identity must be defined to IBM MQ as a principal by the installed authorization service. The default authorization service on Windows or Linux is called the Object Authority Manager (OAM). If you are using the OAM, the identity must be defined as a user ID.

Use the identity to give a client, or collection of clients, permission to publish or subscribe to topics defined in IBM MQ. If an MQTT client has subscribed to a topic, use the identity to give it permission to receive the resulting publications.

It is hard to manage a system with tens of thousands of MQTT clients, each requiring individual access permissions. One solution is to define common identities, and associate individual MQTT clients with one of the common identities. Define as many common identities as you require to define different combinations of permissions. Another solution is to write your own authorization service that can deal more easily with thousands of users than the operating system.

You can combine MQTT clients into common identities in two ways, using the OAM:

1. Define multiple telemetry channels, each with a different user ID that the administrator allocates using IBM MQ Explorer. Clients connecting using different TCP/IP port numbers are associated with different telemetry channels, and are assigned different identities.
2. Define a single telemetry channel, but have each client select a Username from a small set of user IDs. The administrator configures the telemetry channel to select the client Username as its identity.

In this task, the identity of the telemetry channel is called *mqttUser*, regardless of how it is set. If collections of clients use different identities, use multiple *mqttUsers*, one for each collection of clients. As the task uses the OAM, each *mqttUser* must be a user ID.

## About this task

In this task, you have a choice of four access control patterns that you can tailor to specific requirements. The patterns differ in their granularity of access control.

- [“No access control” on page 147](#)
- [“Coarse-grained access control” on page 147](#)
- [“Medium-grained access control” on page 148](#)
- [“Fine-grained access control” on page 148](#)

The result of the models is to assign *mqttUsers* sets of permissions to publish and subscribe to IBM MQ, and receive publications from IBM MQ.

### *No access control*

MQTT clients are given IBM MQ administrative authority, and can perform any action on any object.

## Procedure

1. Create a user ID *mqttUser* to act as the identity of all MQTT clients.
2. Add *mqttUser* to the mqm group; see [Adding a user to a group on Windows](#) , or [Adding a user to a group on Linux](#)

### *Coarse-grained access control*

MQTT clients have authority to publish and subscribe, and to send messages to MQTT clients. They do not have authority to perform other actions, or to access other objects.

## Procedure

1. Create a user ID *mqttUser* to act as the identity of all MQTT clients.
2. Authorize *mqttUser* to publish and subscribe to all topics and to send publications to MQTT clients.

```
setmqaut -m qMgr -t topic -n SYSTEM.BASE.TOPIC -p mqttUser -all +pub +sub
setmqaut -m qMgr -t q -n SYSTEM.MQTT.TRANSMIT.QUEUE -p mqttUser -all +put
```

### Medium-grained access control

MQTT clients are divided into different groups to publish and subscribe to different sets of topics, and to send messages to MQTT clients.

## Procedure

1. Create multiple user IDs, *mqttUsers*, and multiple administrative topics in the publish/subscribe topic tree.
2. Authorize different *mqttUsers* to different topics.

```
setmqaut -m qMgr -t topic -n topic1 -p mqttUserA -all +pub +sub  
setmqaut -m qMgr -t topic -n topic2 -p mqttUserB -all +pub +sub
```

3. Create a group *mqtt*, and add all *mqttUsers* to the group.
4. Authorize *mqtt* to send topics to MQTT clients.

```
setmqaut -m qMgr -t q -n SYSTEM.MQTT.TRANSMIT.QUEUE -p mqtt -all +put
```

### Fine-grained access control

MQTT clients are incorporated into an existing system of access control, that authorizes groups to perform actions on objects.

## About this task

A user ID is assigned to one or more operating system groups depending on the authorizations it requires. If IBM MQ applications are publishing and subscribing to the same topic space as MQTT clients, use this model. The groups are referred to as Publish *X*, Subscribe *Y*, and *mqtt*

### Publish *X*

Members of Publish *X* groups can publish to *topicX*.

### Subscribe *Y*

Members of Subscribe *Y* groups can subscribe to *topicY*.

### mqtt

Members of the *mqtt* group can send publications to MQTT clients.

## Procedure

1. Create multiple groups, Publish *X* and Subscribe *Y* that are allocated to multiple administrative topics in the publish/subscribe topic tree.
2. Create a group *mqtt*.
3. Create multiple user IDs, *mqttUsers*, and add the users to any of the groups, depending on what they are authorized to do.
4. Authorize different Publish *X* and Subscribe *X* groups to different topics, and authorize the *mqtt* group to send messages to MQTT clients.

```
setmqaut -m qMgr -t topic -n topic1 -p Publish X -all +pub  
setmqaut -m qMgr -t topic -n topic1 -p Subscribe X -all +pub +sub  
setmqaut -m qMgr -t q -n SYSTEM.MQTT.TRANSMIT.QUEUE -p mqtt -all +put
```

## MQTT client authentication using a password

Authenticate the Username using the client password. You can authenticate the client using a different identity to the identity used to authorize the client to publish and subscribe to topics.

The telemetry (MQXR) service uses JAAS to authenticate the client Username. JAAS uses the Password supplied by the MQTT client.

The IBM MQ administrator decides whether to authenticate the Username, or not to authenticate at all, by configuring the MQTT channel a client connects to. Clients can be assigned to different channels, and each channel can be configured to authenticate its clients in different ways. Using JAAS, you can configure which methods must authenticate the client, and which can optionally authenticate the client.

The choice of identity for authentication does not affect the choice of identity for authorization. You might want to set up a common identity for authorization for administrative convenience, but authenticate each user to use that identity. The following procedure outlines the steps to authenticate individual users to use a common identity:

1. The IBM MQ administrator sets the MQTT channel identity to any name, such as MQTTClientUser, using IBM MQ Explorer.
2. The IBM MQ administrator authorizes MQTTClient to publish and subscribe to any topic:

```
setmqaut -m QM1 -t q -n SYSTEM.MQTT.TRANSMIT.QUEUE -p MQTTClient -all +put
setmqaut -m QM1 -t topic -n SYSTEM.BASE.TOPIC -p MQTTClient -all +pub +sub
```

3. The MQTT client application developer creates an MqttConnectOptions object and sets Username and Password before connecting to the server.
4. The security developer creates a JAAS LoginModule to authenticate the Username with the Password and includes it in the JAAS configuration file.
5. The IBM MQ administrator configures the MQTT channel to authenticate the Username of the client using JAAS.

## MQTT client authentication using SSL

Connections between the MQTT client and the queue manager are always initiated by the MQTT client. The MQTT client is always the SSL client. Client authentication of the server and server authentication of the MQTT client are both optional.

By providing the client with a private signed digital certificate, you can authenticate the MQTT client to WebSphere MQ. The WebSphere MQ Administrator can force MQTT clients to authenticate themselves to the queue manager using SSL. You can only request client authentication as part of mutual authentication.

As an alternative to using SSL, some kinds of Virtual Private Network (VPN), such as IPsec, authenticate the endpoints of a TCP/IP connection. VPN encrypts each IP packet that flows over the network. Once such a VPN connection is established, you have established a trusted network. You can connect MQTT clients to telemetry channels using TCP/IP over the VPN network.

Client authentication using SSL relies upon the client having a secret. The secret is the private key of the client in the case of a self-signed certificate, or a key provided by a certificate authority. The key is used to sign the digital certificate of the client. Anyone in possession of the corresponding public key can verify the digital certificate. Certificates can be trusted, or if they are chained, traced back through a certificate chain to a trusted root certificate. Client verification sends all the certificates in the certificate chain provided by the client to the server. The server checks the certificate chain until it finds a certificate it trusts. The trusted certificate is either the public certificate generated from a self-signed certificate, or a root certificate typically issued by a certificate authority. As a final, optional, step the trusted certificate can be compared with a "live" certificate revocation list.

The trusted certificate might be issued by a certificate authority and already included in the JRE certificate store. It might be a self-signed certificate, or any certificate that has been added to the telemetry channel keystore as a trusted certificate.

**Note:** The telemetry channel has a combined keystore/truststore that holds both the private keys to one or more telemetry channels, and any public certificates needed to authenticate clients. Because an SSL channel must have a keystore, and it is the same file as the channel truststore, the JRE certificate store is never referenced. The implication is that if authentication of a client requires a CA root certificate, you must place the root certificate in the keystore for the channel, even if the CA root certificate is already in the JRE certificate store. The JRE certificate store is never referenced.

Think about the threats that client authentication is intended to counter, and the roles the client and server play in countering the threats. Authenticating the client certificate alone is insufficient to prevent unauthorized access to a system. If someone else has got hold of the client device, the client device is not necessarily acting with the authority of the certificate holder. Never rely on a single defense against unwanted attacks. At least use a two-factor authentication approach and supplement possession of a certificate with knowledge of private information. For example, use JAAS, and authenticate the client using a password issued by the server.

The primary threat to the client certificate is that it gets into the wrong hands. The certificate is held in a password protected keystore at the client. How does it get placed in the keystore? How does the MQTT client get the password to the keystore? How secure is the password protection? Telemetry devices are often easy to remove, and then can be hacked in private. Must the device hardware be tamper-proof? Distributing and protecting client-side certificates is recognized to be hard; it is called the key-management problem.

A secondary threat is that the device is misused to access servers in unintended ways. For example, if the MQTT application is tampered with, it might be possible to use a weakness in the server configuration using the authenticated client identity.

To authenticate an MQTT client using SSL, configure the telemetry channel, and the client.

### **Related concepts**

[“Telemetry channel configuration for MQTT client authentication using SSL” on page 150](#)

The IBM MQ administrator configures telemetry channels at the server. Each channel is configured to accept a TCP/IP connection on a different port number. SSL channels are configured with passphrase protected access to key files. If an SSL channel is defined with no passphrase or key file, the channel does not accept SSL connections.

### **Related information**

[MQTT client configuration for client authentication using SSL](#)

### ***Telemetry channel configuration for MQTT client authentication using SSL***

The IBM MQ administrator configures telemetry channels at the server. Each channel is configured to accept a TCP/IP connection on a different port number. SSL channels are configured with passphrase protected access to key files. If an SSL channel is defined with no passphrase or key file, the channel does not accept SSL connections.

Set the property, `com.ibm.mq.MQTT.ClientAuth` of an SSL telemetry channel to `REQUIRED` to force all clients connecting on that channel to provide proof that they have verified digital certificates. The client certificates are authenticated using certificates from certificate authorities, leading to a trusted root certificate. If the client certificate is self-signed, or is signed by a certificate that is from a certificate authority, the publicly signed certificates of the client, or certificate authority, must be stored securely at the server.

Place the publicly signed client certificate or the certificate from the certificate authority in the telemetry channel keystore. At the server, publicly signed certificates are stored in the same key file as privately signed certificates, rather than in a separate truststore.

The server verifies the signature of any client certificates it is sent using all the public certificates and cipher suites it has. The server verifies the key chain. The queue manager can be configured to test the certificate against the certificate revocation list. The queue manager revocation namelist property is `SSLCRLNL`.

If any of the certificates a client sends is verified by a certificate in the server keystore, then the client is authenticated.

The IBM MQ administrator can configure the same telemetry channel to use JAAS to check the `UserName` or `ClientIdentifier` of the client with the client `Password`.

You can use the same keystore for multiple telemetry channels.

Verification of at least one digital certificate in the password protected client keystore on the device authenticates the client to the server. The digital certificate is only used for authentication by IBM

MQ. It is not used to verify the TCP/IP address of the client, or set the identity of the client for authorization or accounting. The identity of the client adopted by the server is either the Username or ClientIdentifier of the client, or an identity created by the IBM MQ administrator.

You can also use SSL cipher suites for client authentication. If you plan to use SHA-2 cipher suites, see [“System requirements for using SHA-2 cipher suites with MQTT channels” on page 152.](#)

### **Related concepts**

[“Telemetry channel configuration for channel authentication using SSL” on page 151](#)

The IBM MQ administrator configures telemetry channels at the server. Each channel is configured to accept a TCP/IP connection on a different port number. SSL channels are configured with passphrase protected access to key files. If an SSL channel is defined with no passphrase or key file, the channel does not accept SSL connections.

### **Related information**

[DEFINE CHANNEL \(MQTT\)](#)

[ALTER CHANNEL \(MQTT\)](#)

[CipherSpecs and CipherSuites](#)

## **Telemetry channel authentication using SSL**

Connections between the MQTT client and the queue manager are always initiated by the MQTT client. The MQTT client is always the SSL client. Client authentication of the server and server authentication of the MQTT client are both optional.

The client always attempts to authenticate the server, unless the client is configured to use a CipherSpec that supports anonymous connection. If the authentication fails, then the connection is not established.

As an alternative to using SSL, some kinds of Virtual Private Network (VPN), such as IPsec, authenticate the endpoints of a TCP/IP connection. VPN encrypts each IP packet that flows over the network. Once such a VPN connection is established, you have established a trusted network. You can connect MQTT clients to telemetry channels using TCP/IP over the VPN network.

Server authentication using SSL authenticates the server to which you are about to send confidential information to. The client performs the checks matching the certificates sent from the server, against certificates placed in its truststore, or in its JRE cacerts store.

The JRE certificate store is a JKS file, cacerts. It is located in JRE InstallPath\lib\security\. It is installed with the default password changeit. You can either store certificates you trust in the JRE certificate store, or in the client truststore. You cannot use both stores. Use the client truststore if you want to keep the public certificates the client trusts separate from certificates other Java applications use. Use the JRE certificate store if you want to use a common certificate store for all Java applications running on the client. If you decide to use the JRE certificate store review the certificates it contains, to make sure you trust them.

You can modify the JSSE configuration by supplying a different trust provider. You can customize a trust provider to perform different checks on a certificate. In some OGSi environments that have used the MQTT client, the environment provides a different trust provider.

To authenticate the telemetry channel using SSL, configure the server, and the client.

## **Telemetry channel configuration for channel authentication using SSL**

The IBM MQ administrator configures telemetry channels at the server. Each channel is configured to accept a TCP/IP connection on a different port number. SSL channels are configured with passphrase protected access to key files. If an SSL channel is defined with no passphrase or key file, the channel does not accept SSL connections.

Store the digital certificate of the server, signed with its private key, in the keystore that the telemetry channel is going to use at the server. Store any certificates in its key chain in the keystore, if you want to transmit the key chain to the client. Configure the telemetry channel using IBM MQ explorer to use SSL.

Provide it with the path to the keystore, and the passphrase to access the keystore. If you do not set the TCP/IP port number of the channel, the SSL telemetry channel port number defaults to 8883.

You can also use SSL cipher suites for channel authentication. If you plan to use SHA-2 cipher suites, see [“System requirements for using SHA-2 cipher suites with MQTT channels” on page 152](#).

#### **Related concepts**

[“Telemetry channel configuration for MQTT client authentication using SSL” on page 150](#)

The IBM MQ administrator configures telemetry channels at the server. Each channel is configured to accept a TCP/IP connection on a different port number. SSL channels are configured with passphrase protected access to key files. If an SSL channel is defined with no passphrase or key file, the channel does not accept SSL connections.

#### **Related information**

[DEFINE CHANNEL \(MQTT\)](#)

[ALTER CHANNEL \(MQTT\)](#)

[CipherSpecs and CipherSuites](#)

## **System requirements for using SHA-2 cipher suites with MQTT channels**

If you use a version of Java that supports SHA-2 cipher suites, you can use these suites to secure your MQTT (telemetry) channels and client apps.

For IBM MQ 8.0, which includes the telemetry (MQXR) service, the minimum Java version is Java 7 from IBM, SR6. SHA-2 cipher suites are supported by default in Java 7 from IBM, SR4 onwards. You can therefore use SHA-2 cipher suites with the telemetry (MQXR) service to secure your MQTT (telemetry) channels.

If you are running an MQTT client with a different JRE, you need to ensure that it also supports the SHA-2 cipher suites.

#### **Related concepts**

[“Telemetry channel configuration for channel authentication using SSL” on page 151](#)

The IBM MQ administrator configures telemetry channels at the server. Each channel is configured to accept a TCP/IP connection on a different port number. SSL channels are configured with passphrase protected access to key files. If an SSL channel is defined with no passphrase or key file, the channel does not accept SSL connections.

#### **Related information**

[Telemetry \(MQXR\) service](#)

[DEFINE CHANNEL \(MQTT\)](#)

[ALTER CHANNEL \(MQTT\)](#)

## **Publication privacy on telemetry channels**

The privacy of MQTT publications sent in either direction across telemetry channels is secured by using SSL to encrypt transmissions over the connection.

MQTT clients that connect to telemetry channels use SSL to secure the privacy of publications transmitted on the channel using symmetric key cryptography. Because the endpoints are not authenticated, you cannot trust channel encryption alone. Combine securing privacy with server or mutual authentication.

As an alternative to using SSL, some kinds of Virtual Private Network (VPN), such as IPsec, authenticate the endpoints of a TCP/IP connection. VPN encrypts each IP packet that flows over the network. Once such a VPN connection is established, you have established a trusted network. You can connect MQTT clients to telemetry channels using TCP/IP over the VPN network.

For a typical configuration, which encrypts the channel and authenticates the server, consult [“Telemetry channel authentication using SSL” on page 151](#).

Encrypting SSL connections without authenticating the server exposes the connection to man-in-the-middle attacks. Although the information you exchange is protected against eavesdropping, you do not



know who you are exchanging it with. Unless you control the network, you are exposed to someone intercepting your IP transmissions, and masquerading as the endpoint.

You can create an encrypted SSL connection, without authenticating the server, by using a Diffie-Hellman key exchange CipherSpec that supports anonymous SSL. The master secret, shared between the client and server, and used to encrypt SSL transmissions, is established without exchanging a privately signed server certificate.

Because anonymous connections are insecure, most SSL implementations do not default to using anonymous CipherSpecs. If a client request for SSL connection is accepted by a telemetry channel, the channel must have a keystore protected by a passphrase. By default, since SSL implementations do not use anonymous CipherSpecs, the keystore must contain a privately signed certificate that the client can authenticate.

If you use anonymous CipherSpecs, the server keystore must exist, but it need not contain any privately signed certificates.

Another way to establish an encrypted connection is to replace the trust provider at the client with your own implementation. Your trust provider would not authenticate the server certificate, but the connection would be encrypted.

## SSL configuration of MQTT Java clients and telemetry channels

Configure SSL to authenticate the telemetry channel and the MQTT Java client, and encrypt the transfer of messages between them. MQTT Java clients use Java Secure Socket Extension (JSSE) to connect telemetry channels using SSL. As an alternative to using SSL, some kinds of Virtual Private Network (VPN), such as IPsec, authenticate the endpoints of a TCP/IP connection. VPN encrypts each IP packet that flows over the network. Once such a VPN connection is established, you have established a trusted network. You can connect MQTT clients to telemetry channels using TCP/IP over the VPN network.

You can configure the connection between a Java MQTT client and a telemetry channel to use the SSL protocol over TCP/IP. What is secured depends on how you configure SSL to use JSSE. Starting with the most secured configuration, you can configure three different levels of security:

1. Permit only trusted MQTT clients to connect. Connect an MQTT client only to a trusted telemetry channel. Encrypt messages between the client and the queue manager; see [“MQTT client authentication using SSL” on page 149](#)
2. Connect an MQTT client only to a trusted telemetry channel. Encrypt messages between the client and the queue manager; see [“Telemetry channel authentication using SSL” on page 151](#).
3. Encrypt messages between the client and the queue manager; see [“Publication privacy on telemetry channels” on page 152](#).

## JSSE configuration parameters

Modify JSSE parameters to alter the way an SSL connection is configured. The JSSE configuration parameters are arranged into three sets:

1. [IBM MQ Telemetry channel](#)
2. [MQTT Java client](#)
3. [JRE](#)

Configure the telemetry channel parameters using IBM MQ Explorer. Set the MQTT Java Client parameters in the `MqttConnectionOptions.SSLProperties` attribute. Modify JRE security parameters by editing files in the JRE security directory on both the client and server.

### IBM MQ Telemetry channel

Set all the telemetry channel SSL parameters using IBM MQ Explorer.

#### **ChannelName**

ChannelName is a required parameter on all channels.

The channel name identifies the channel associated with a particular port number. Name channels to help you administer sets of MQTT clients.

### **PortNumber**

PortNumber is an optional parameter on all channels. It defaults to 1883 for TCP channels, and 8883 for SSL channels.

The TCP/IP port number associated with this channel. MQTT clients are connected to a channel by specifying the port defined for the channel. If the channel has SSL properties, the client must connect using the SSL protocol; for example:

```
MQTTClient mqttClient = new MqttClient( "ssl://www.example.org:8884", "clientId1");
mqttClient.connect();
```

### **KeyFileName**

KeyFileName is a required parameter for SSL channels. It must be omitted for TCP channels.

KeyFileName is the path to the Java keystore containing digital certificates that you provide. Use JKS, JCEKS or PKCS12 as the type of keystore on the server.

Identify the keystore type by using one of the following file extensions:

- .jks
- .jceks
- .p12
- .pkcs12

A keystore with any other file extension is assumed to be a JKS keystore.

You can combine one type of keystore at the server with other types of keystore at the client.

Place the private certificate of the server in the keystore. The certificate is known as the server certificate. The certificate can be self-signed, or part of a certificate chain that is signed by a signing authority.

If you are using a certificate chain, place the associated certificates in the server keystore.

The server certificate, and any certificates in its certificate chain, are sent to clients to authenticate the identity of the server.

If you have set ClientAuth to Required, the keystore must contain any certificates necessary to authenticate the client. The client sends a self-signed certificate, or a certificate chain, and the client is authenticated by the first verification of this material against a certificate in the keystore. Using a certificate chain, one certificate can verify many clients, even if they are issued with different client certificates.

### **PassPhrase**

PassPhrase is a required parameter for SSL channels. It must be omitted for TCP channels.

The passphrase is used to protect the keystore.

### **ClientAuth**

ClientAuth is an optional SSL parameter. It defaults to no client authentication. It must be omitted for TCP channels.

Set ClientAuth if you want the telemetry (MQXR) service to authenticate the client, before permitting the client to connect to the telemetry channel.

If you set ClientAuth, the client must connect to the server using SSL, and authenticate the server. In response to setting ClientAuth, the client sends its digital certificate to the server, and any other certificates in its keystore. Its digital certificate is known as the client certificate. These certificates are authenticated against certificates held in the channel keystore, and in the JRE cacerts store.

## CipherSuite

CipherSuite is an optional SSL parameter. It defaults to try all the enabled CipherSpecs. It must be omitted for TCP channels.

If you want to use a particular CipherSpec, set CipherSuite to the name of the CipherSpec that must be used to establish the SSL connection.

The telemetry service and MQTT client negotiate a common CipherSpec from all the CipherSpecs that are enabled at each end. If a specific CipherSpec is specified at either or both ends of the connection, it must match the CipherSpec at the other end.

Install additional ciphers by adding additional providers to JSSE.

## Federal Information Processing Standards (FIPS)

FIPS is an optional setting. By default it is not set.

Either in the properties panel of the queue manager, or using **runmqsc**, set SSLFIPS. SSLFIPS specifies whether only FIPS-certified algorithms are to be used.

## Revocation namelist

Revocation namelist is an optional setting. By default it is not set.

Either in the properties panel of the queue manager, or using **runmqsc**, set SSLCRLNL. SSLCRLNL specifies a namelist of authentication information objects which are used to provide certificate revocation locations.

No other queue manager parameters that set SSL properties are used.

## MQTT Java client

Set SSL properties for the Java client in `MqttConnectionOptions.SSLProperties`; for example:

```
java.util.Properties sslClientProperties = new Properties();
sslClientProperties.setProperty("com.ibm.ssl.keyStoreType", "JKS");
com.ibm.micro.client.mqttv3.MqttConnectOptions conOptions = new MqttConnectOptions();
conOptions.setSSLProperties(sslClientProperties);
```

The names and values of specific properties are described in the `MqttConnectOptions` class. For links to client API documentation for the MQTT client libraries, see [MQTT client programming reference](#).

## Protocol

Protocol is optional.

The protocol is selected in negotiation with the telemetry server. If you require a specific protocol you can select one. If the telemetry server does not support the protocol the connection fails.

## ContextProvider

ContextProvider is optional.

## KeyStore

KeyStore is optional. Configure it if `ClientAuth` is set at the server to force authentication of the client.

Place the digital certificate of the client, signed using its private key, into the keystore. Specify the keystore path and password. The type and provider are optional. JKS is the default type, and IBMJCE is the default provider.

Specify a different keystore provider to reference a class that adds a new keystore provider. Pass the name of the algorithm used by the keystore provider to instantiate the `KeyManagerFactory` by setting the key manager name.

## TrustStore

TrustStore is optional. You can place all the certificates you trust in the JRE cacerts store.

Configure the truststore if you want to have a different truststore for the client. You might not configure the truststore if the server is using a certificate issued by a well known CA that already has its root certificate stored in cacerts.

Add the publicly signed certificate of the server or the root certificate to the truststore, and specify the truststore path and password. JKS is the default type, and IBMJCE is the default provider.

Specify a different truststore provider to reference a class that adds a new truststore provider. Pass the name of the algorithm used by the truststore provider to instantiate the TrustManagerFactory by setting the trust manager name.

## JRE

Other aspects of Java security that affect the behavior of SSL on both the client and server are configured in the JRE. The configuration files on Windows are in *Java Installation Directory\jre\lib\security*. If you are using the JRE shipped with IBM MQ the path is as shown in the following table:

Table 8. Filepaths by platform for JRE SSL configuration files	
Platform	Filepath
Windows	<i>WMQ Installation Directory\java\jre\lib\security</i>
Other UNIX and Linux platforms	<i>WMQ Installation Directory/java/jre64/jre/lib/security</i>

## Well-known certificate authorities

The cacerts file contains the root certificates of well-known certificate authorities. The cacerts is used by default, unless you specify a truststore. If you use the cacerts store, or do not provide a truststore, you must review and edit the list of signers in cacerts to meet your security requirements.

You can open cacerts using the IBM MQ command `strmqikm`, which runs the IBM Key Management utility. Open cacerts as a JKS file, using the password `changeit`. Modify the password to secure the file.

## Configuring security classes

Use the `java.security` file to register additional security providers and other default security properties.

## Permissions

Use the `java.policy` file to modify the permissions granted to resources. `javaws.policy` grants permissions to `javaws.jar`

## Encryption strength

Some JREs ship with reduced strength encryption. If you cannot import keys into keystores, reduced strength encryption might be the cause. Either, try starting **ikkeyman** using the **strmqikm** command, or download strong, but limited jurisdiction files from [IBM developer kits, Security information](#).

**Important:** Your country of origin might have restrictions on the import, possession, use, or re-export to another country, of encryption software. Before downloading or using the unrestricted policy files, you must check the laws of your country. Check its regulations, and its policies concerning the import, possession, use, and re-export of encryption software, to determine if it is permitted.

## Modify the trust provider to permit the client to connect to any server

The example illustrates how to add a trust provider and reference it from the MQTT client code. The example performs no authentication of the client or server. The resulting SSL connection is encrypted without being authenticated.

The code snippet in [Figure 26 on page 157](#) sets the `AcceptAllProviders` trust provider and trust manager for the MQTT client.

```
java.security.Security.addProvider(new AcceptAllProvider());
java.util.Properties sslClientProperties = new Properties();
sslClientProperties.setProperty("com.ibm.ssl.trustManager", "TrustAllCertificates");
sslClientProperties.setProperty("com.ibm.ssl.trustStoreProvider", "AcceptAllProvider");
conOptions.setSSLProperties(sslClientProperties);
```

*Figure 26. MQTT Client code snippet*

```
package com.ibm.mq.id;
public class AcceptAllProvider extends java.security.Provider {
    private static final long serialVersionUID = 1L;
    public AcceptAllProvider() {
        super("AcceptAllProvider", 1.0, "Trust all X509 certificates");
        put("TrustManagerFactory.TrustAllCertificates",
            AcceptAllTrustManagerFactory.class.getName());
    }
}
```

*Figure 27. AcceptAllProvider.java*

```
protected static class AcceptAllTrustManagerFactory extends
    javax.net.ssl.TrustManagerFactorySpi {
    public AcceptAllTrustManagerFactory() {}
    protected void engineInit(java.security.KeyStore keystore) {}
    protected void engineInit(
        javax.net.ssl.ManagerFactoryParameters parameters) {}
    protected javax.net.ssl.TrustManager[] engineGetTrustManagers() {
        return new javax.net.ssl.TrustManager[] { new AcceptAllX509TrustManager() };
    }
}
```

*Figure 28. AcceptAllTrustManagerFactory.java*

```
protected static class AcceptAllX509TrustManager implements
    javax.net.ssl.X509TrustManager {
    public void checkClientTrusted(
        java.security.cert.X509Certificate[] certificateChain,
        String authType) throws java.security.cert.CertificateException {
        report("Client authtype=" + authType);
        for (java.security.cert.X509Certificate certificate : certificateChain) {
            report("Accepting:" + certificate);
        }
    }
    public void checkServerTrusted(
        java.security.cert.X509Certificate[] certificateChain,
        String authType) throws java.security.cert.CertificateException {
        report("Server authtype=" + authType);
        for (java.security.cert.X509Certificate certificate : certificateChain) {
            report("Accepting:" + certificate);
        }
    }
    public java.security.cert.X509Certificate[] getAcceptedIssuers() {
        return new java.security.cert.X509Certificate[0];
    }
    private static void report(String string) {
        System.out.println(string);
    }
}
```

*Figure 29. AcceptAllX509TrustManager.java*

## Telemetry channel JAAS configuration

Configure JAAS to authenticate the Username sent by the client.

The IBM MQ administrator configures which MQTT channels require client authentication using JAAS. Specify the name of a JAAS configuration for each channel that is to perform JAAS authentication. Channels can all use the same JAAS configuration, or they can use different JAAS configurations. The configurations are defined in *WMQData directory\qmgrs\qMgrName\mqxr\jaas.config*.

The *jaas.config* file is organized by JAAS configuration name. Under each configuration name is a list of Login configurations; see [Figure 30 on page 159](#).

JAAS provides four standard Login modules. The standard NT and UNIX Login modules are of limited value.

### **JndiLoginModule**

Authenticates against a directory service configured under JNDI (Java Naming and Directory Interface).

### **Krb5LoginModule**

Authenticates using Kerberos protocols.

### **NTLoginModule**

Authenticates using the NT security information for the current user.

### **UnixLoginModule**

Authenticates using the UNIX security information for the current user.

The problem with using `NTLoginModule` or `UnixLoginModule` is that the telemetry (MQXR) service runs with the `mqm` identity, and not the identity of the MQTT channel. `mqm` is the identity passed to `NTLoginModule` or `UnixLoginModule` for authentication, and not the identity of the client.

To overcome this problem, write your own Login module, or use the other standard Login modules. A sample `JAASLoginModule.java` is supplied with IBM MQ Telemetry. It is an implementation of the `javax.security.auth.spi.LoginModule` interface. Use it to develop your own authentication method.

Any new `LoginModule` classes you provide must be on the class path of the telemetry (MQXR) service. Do not place your classes in IBM MQ directories that are in the class path. Create your own directories, and define the whole class path for the telemetry (MQXR) service.

You can augment the class path used by the telemetry (MQXR) service by setting class path in the `service.env` file. `CLASSPATH` must be capitalized, and the class path statement can only contain literals. You cannot use variables in the `CLASSPATH`; for example `CLASSPATH=%CLASSPATH%` is incorrect. The telemetry (MQXR) service sets its own classpath. The `CLASSPATH` defined in `service.env` is added to it.

The telemetry (MQXR) service provides two callbacks that return the Username and the Password for a client connected to the MQTT channel. The Username and Password are set in the `MqttConnectOptions` object. See [Figure 31 on page 159](#) for an example of how to access Username and Password.

### **Examples**

An example of a JAAS configuration file with one named configuration, `MQXRConfig`.

```
MQXRConfig {
samples.JAASLoginModule required debug=true;
//com.ibm.security.auth.module.NTLoginModule required;
//com.ibm.security.auth.module.Krb5LoginModule required
//      principal=principal@your_realm
//      useDefaultCcache=TRUE
//      renewTGT=true;
//com.sun.security.auth.module.NTLoginModule required;
//com.sun.security.auth.module.UnixLoginModule required;
//com.sun.security.auth.module.Krb5LoginModule required
//      useTicketCache="true"
//      ticketCache="${user.home}/${}/tickets";
};
```

Figure 30. Sample *jaas.config* file

An example of a JAAS Login module coded to receive the Username and Password provided by an MQTT client.

```
public boolean login()
throws javax.security.auth.login.LoginException {
    javax.security.auth.callback.Callback[] callbacks =
    new javax.security.auth.callback.Callback[2];
    callbacks[0] = new javax.security.auth.callback.NameCallback("NameCallback");
    callbacks[1] = new javax.security.auth.callback.PasswordCallback(
    "PasswordCallback", false);
    try {
        callbackHandler.handle(callbacks);
        String username = ((javax.security.auth.callback.NameCallback) callbacks[0])
        .getName();
        char[] password = ((javax.security.auth.callback.PasswordCallback) callbacks[1])
        .getPassword();
        // Accept everything.
        if (true) {
            loggedIn = true;
        } else
            throw new javax.security.auth.login.FailedLoginException("Login failed");

        principal= new JAASPrincipal(username);

    } catch (java.io.IOException exception) {
        throw new javax.security.auth.login.LoginException(exception.toString());
    } catch (javax.security.auth.callback.UnsupportedCallbackException exception) {
        throw new javax.security.auth.login.LoginException(exception.toString());
    }

    return loggedIn;
}
```

Figure 31. Sample *JAASLoginModule.Login()* method

## Related information

[AuthCallback MQXR class](#)

[Resolving problem: JAAS login module not called by the telemetry service](#)

## ▶ V8.0.0.4 Administering IBM MQ Light

You can administer MQ Light using MQ Explorer or at a command line. Use the Explorer to configure channels and monitor the MQ Light clients that are connected to IBM MQ. Configure the security of MQ Light using TLS and JAAS.

### Before you start

For information about installing AMQP on your platform, see [Choosing what to install](#). Install the AMQP Service component by using the IBM MQ V8.0.0.4 manufacturing refresh, not the V8.0.0.4 Fix Pack. You cannot install the AMQP component on a version of the queue manager earlier than V8.0.0.4.

### Administering using MQ Explorer

Use the Explorer to configure AMQP channels and monitor the MQ Light clients that are connected to IBM MQ. You can configure the security of MQ Light using TLS and JAAS.

### Administering using the command line

You can administer MQ Light at the command line using the IBM MQ [MQSC](#) commands.

## ▶ V8.0.0.4 Viewing IBM MQ objects in use by MQ Light clients

You can view the different IBM MQ resources in use by MQ Light clients, for example connections and subscriptions.

### Connections

When the AMQP service is started new Hconns are created and connected to the queue manager. This pool of Hconns is used when MQ Light clients publish messages. You can view the Hconns by using the **DISPLAY CONN** command. For example:

```
DISPLAY CONN(*) TYPE(CONN) WHERE (APPLDESC LK 'WebSphere MQ Advanced Message Queuing Protocol')
```

This command also shows any client-specific Hconns. The Hconns that have a blank client ID attribute are the Hconns used in the pool

When an MQ Light client connects to an AMQP channel, a new Hconn is connected to the queue manager. This Hconn is used to consume messages asynchronously for the subscriptions that the MQ Light client has created. You can view the Hconn used by a particular MQ Light client using the **DISPLAY CONN** command. For example:

```
DISPLAY CONN(*) TYPE(CONN) WHERE (CLIENTID EQ 'recv_abcd1234')
```

### Subscriptions created by clients

When an MQ Light client subscribes to a topic, a new IBM MQ subscription is created. The subscription name includes the following information:

- The name of the client. If the client joined a shared subscription, the name of the share is used
- The topic pattern that the client subscribed to
- A prefix. The prefix is `private` if the client created a non-shared subscription, or `share` if the client joined a shared subscription

To view the subscriptions in use by a particular MQ Light client, run the **DISPLAY SUB** command and filter on the `private` prefix:

```
DISPLAY SUB(':private:*')
```



To view the shared subscriptions that are in use by multiple clients, run the **DISPLAY SUB** command and filter on the share prefix:

```
DISPLAY SUB('/:share:*')
```

Because shared subscriptions can be used by multiple MQ Light clients, you might want to view the clients currently consuming messages from the shared subscription. You can do this by listing the Hconns that currently have a handle open on the subscription queue. To view the clients currently using a share, complete the following steps:

1. Find the queue name that the shared subscription uses as a destination. For example:

```
DISPLAY SUB('/:private:recv_e298452:public') DEST
5 : DISPLAY SUB('/:private:recv_e298452:public') DEST
AMQ8096: WebSphere MQ subscription inquired.
SUBID(414D5120514D31202020202020202020707E0A565C2D0020)
SUB('/:private:recv_e298452:public')
DEST(SYSTEM.MANAGED.DURABLE.560A7E7020002D5B)
```

2. Run the **DISPLAY CONN** command to find the handles open on that queue:

```
DISPLAY CONN(*) TYPE(HANDLE) WHERE (OBJNAME
EQ SYSTEM.MANAGED.DURABLE.560A7E7020002D5B)
21 : DISPLAY CONN(*) TYPE(HANDLE) WHERE (OBJNAME EQ
SYSTEM.MANAGED.DURABLE.560A7E7020002D5B)

AMQ8276: Display Connection details.
CONN(707E0A56642B0020)
EXTCONN(414D5143514D31202020202020202020)
TYPE(HANDLE)

OBJNAME(SYSTEM.BASE.TOPIC)      OBJTYPE(TOPIC)

OBJNAME(SYSTEM.MANAGED.DURABLE.560A7E7020002961)
OBJTYPE(QUEUE)
```

3. For each of the handles, view the MQ Light client ID that has the handle open:

```
DISPLAY CONN(707E0A56642B0020) CLIENTID
23 : DISPLAY CONN(707E0A56642B0020) CLIENTID

AMQ8276: Display Connection details.
CONN(707E0A56642B0020)
EXTCONN(414D5143514D31202020202020202020)
TYPE(CONN)
CLIENTID(recv_8f02c9d)
DISPLAY CONN(707E0A565F290020) CLIENTID
24 : DISPLAY CONN(707E0A565F290020) CLIENTID
AMQ8276: Display Connection details.
CONN(707E0A565F290020)
EXTCONN(414D5143514D31202020202020202020)
TYPE(CONN)
CLIENTID(recv_86d8888)
```

## **MQ Light client identification, authorization, and authentication**

Like other IBM MQ client applications, you can secure AMQP connections in a number of ways.

You can use the following security features to secure AMQP connections to IBM MQ:

- [Channel authentication records](#)
- [Connection authentication](#)
- Channel MCA user configuration
- IBM MQ authority definitions
- [TLS connectivity](#)

From a security perspective, establishing a connection consists of the following two steps:

- Deciding whether the connection should continue
- Deciding which IBM MQ identity the application assumes for later authority checks

The following information outlines different IBM MQ configurations and the steps that are worked through when an AMQP client tries to make a connection. Not all IBM MQ configurations use all of the steps described. For example, some configurations do not use TLS for connections inside the company firewall and some configurations use TLS but do not use client certificates for authentication. Many environments do not use custom or custom JAAS modules.

## Establishing a connection

The following steps describe what happens when a connection is being established by an AMQP client. The steps determine whether the connection continues and which IBM MQ identity the application assumes for authority checks:

1. If the client opens a TLS connection to IBM MQ and provides a certificate, the queue manager attempts to validate the client certificate.
2. If the client provides user name and password credentials, an AMQP SASL frame is received by the queue manager and MQ CONNAUTH configuration is checked.
3. MQ channel authentication rules are checked (for example, whether the IP address and TLS certificate DN are valid)
4. Channel MCAUSER is asserted, unless channel authentication rules determine otherwise.
5. If a JAAS module has been configured, it is invoked
6. MQ CONNECT authority check applied to resulting MQ user ID.
7. Connection established with an assumed IBM MQ identity.

## Publishing a message

The following steps describe what happens when a message is being published by an AMQP client. The steps determine whether the connection continues and which IBM MQ identity the application assumes for authority checks:

1. AMQP link attach frame arrives at queue manager. IBM MQ publish authority for the specified topic string is checked for the MQ user identity established during connection.
2. Message is published to specified topic string.

## Subscribing to a topic pattern

The following steps describe what happens when an AMQP client subscribes to a topic pattern. The steps determine whether the connection continues and which IBM MQ identity the application assumes for authority checks:

1. AMQP link attach frame arrives at queue manager. IBM MQ subscribe authority for the specified topic pattern is checked for the MQ user identity established during connection.
2. Subscription is created.

## MQ Light client identity and authorization

Use the MQ Light client ID, the MQ Light user name, or a common client identity defined on the channel or in a channel authentication rule, for authorization to access IBM MQ objects.

The administrator makes the choice when defining or modifying the AMQP channel, by configuring the queue manager CONNAUTH setting, or by defining channel authentication rules. The identity is used to authorize access to IBM MQ topics. The choice is made based on the following:

1. The channel USECLNTID attribute.

2. The ADOPTCTX attribute of the queue manager CONNAUTH rule.
3. The MCAUSER attribute defined on the channel.
4. The USERSRC attribute of a matching channel authentication rule.

**Avoid trouble:** The identity chosen by this process is thereafter referred to, for example by the DISPLAY CHSTATUS (AMQP) command, as the MCAUSER of the client. Be aware that this is not necessarily the same identity as the MCAUSER of the channel that is referred to in choice (2).

Use the IBM MQ **setmqaut** command to select which objects, and which actions, are authorized to be used by the identity associated with the AMQP channel. For example, the following commands authorize a channel identity AMQPCli<sub>ent</sub>, provided by the administrator of queue manager QM1:

```
setmqaut -m QM1 -t topic -n SYSTEM.BASE.TOPIC -p AMQPClient -all +pub +sub
```

and

```
setmqaut -m QM1 -t qmgr -p AMQPClient -all +connect
```

#### **V 8.0.0.4 MQ Light client authentication using a password**

Authenticate the MQ Light user name using the client password. You can authenticate the client using a different identity from the identity used to authorize the client to publish and subscribe to topics.

The AMQP service can use MQ CONNAUTH or JAAS to authenticate the client user name. If one of these is configured, the password provided by the client is verified by the MQ CONNAUTH configuration or the JAAS module.

The following procedure outlines example steps to authenticate individual users against the local OS users and passwords and, if successful, adopt the common identity AMQPUser<sub>r</sub>:

1. The IBM MQ administrator sets the AMQP channel MCAUSER identity to any name, such as AMQPUser<sub>r</sub>, using IBM MQ Explorer.
2. The IBM MQ administrator authorizes AMQPUser<sub>r</sub> to publish and subscribe to any topic:

```
setmqaut -m QM1 -t topic -n SYSTEM.BASE.TOPIC -p AMQPUserr -all +pub +sub +connect
```

3. The IBM MQ administrator configures an IDPWOS CONNAUTH rule to check the user name and password presented by the client. The CONNAUTH rule should set CHCKCLNT(REQUIRED) and ADOPTCTX(NO).

**Note:** You are recommended to use channel authentication rules and to set the MCAUSER channel attribute to a user who has no privileges, to allow more control over connections to the queue manager.

#### **V 8.0.0.4 Publication privacy on channels**

The privacy of AMQP publications sent in either direction across AMQP channels is secured by using TLS to encrypt transmissions over the connection.

AMQP clients that connect to AMQP channels use TLS to secure the privacy of publications transmitted on the channel using symmetric key cryptography. Because the endpoints are not authenticated, you cannot trust channel encryption alone. Combine securing privacy with server or mutual authentication.

As an alternative to using TLS, some kinds of Virtual Private Network (VPN), such as IPsec, authenticate the endpoints of a TCP/IP connection. VPN encrypts each IP packet that flows over the network. Once such a VPN connection is established, you have established a trusted network. You can connect AMQP clients to AMQP channels using TCP/IP over the VPN network.

Encrypting TLS connections without authenticating the server exposes the connection to man-in-the-middle attacks. Although the information you exchange is protected against eavesdropping, you do not

know who you are exchanging it with. Unless you control the network, you are exposed to someone intercepting your IP transmissions, and masquerading as the endpoint.

You can create an encrypted TLS connection, without authenticating the server, by using a Diffie-Hellman key exchange CipherSpec that supports anonymous TLS. The master secret, shared between the client and server, and used to encrypt TLS transmissions, is established without exchanging a privately signed server certificate.

Because anonymous connections are insecure, most TLS implementations do not default to using anonymous CipherSpecs. If a client request for TLS connection is accepted by an AMQP channel, the channel must have a keystore protected by a passphrase. By default, since TLS implementations do not use anonymous CipherSpecs, the keystore must contain a privately signed certificate that the client can authenticate.

If you use anonymous CipherSpecs, the server keystore must exist, but it need not contain any privately signed certificates.

Another way to establish an encrypted connection is to replace the trust provider at the client with your own implementation. Your trust provider would not authenticate the server certificate, but the connection would be encrypted.

## **V 8.0.0.4** Configuring MQ Light clients with TLS

You can configure MQ Light clients to use TLS to protect data flowing across the network and to authenticate the identity of the queue manager the client connects to.

To use TLS for the connection from an MQ Light client to an AMQP channel, you must ensure the queue manager has been configured to TLS. [Configuring SSL on queue managers](#) describes how to configure the keystore that a queue manager reads TLS certificates from.

When the queue manager has been configured with a keystore, you must configure the TLS attributes on the AMQP channel that clients will connect to. AMQP channels have four attributes related to TLS configuration as follows:

### **SSLCAUTH**

The SSLCAUTH attribute is used to specify whether the queue manager should require an MQ Light client to present a client certificate to verify its identity.

### **SSLCIPH**

The SSLCIPH attribute specifies the cipher the channel should use to encode data in the TLS flow.

### **SSLPEER**

The SSLPEER attribute is used to specify the distinguished name (DN) a client certificate must match if a connection is to be allowed.

### **CERTLABL**

The CERTLABL specifies the certificate the queue manager should present to the client. The queue manager's keystore can contain multiple certificates. This attribute allows you to specify the certificate to be used for connections to this channel. If no CERTLABL is specified, the certificate in the queue manager key repository with the label corresponding to the queue manager CERTLABL attribute is used.

When you have configured your AMQP channel with the TLS attributes, you must restart the AMQP service using the following command:

```
STOP SERVICE(SYSTEM.AMQP.SERVICE) START SERVICE(SYSTEM.AMQP.SERVICE)
```

When an MQ Light client connects to an AMQP channel protected by TLS, the client verifies the identity of the certificate presented by the queue manager. To do this you must configure your MQ Light client with a truststore containing the queue manager's certificate. The steps to do this vary depending on the MQ Light client you are using.

- For the MQ Light client for Node JS API documentation, see <https://www.npmjs.com/package/mqlight>

- For the MQ Light client for Java API documentation, see <https://mqlight.github.io/java-mqlight/>
- For the MQ Light client for Ruby documentation, see <https://www.rubydoc.info/github/mqlight/ruby-mqlight/>
- For the MQ Light client for Python documentation, see <https://python-mqlight.readthedocs.org/en/latest/>

## **V 8.0.0.4** Disconnecting MQ Light clients from the queue manager

If you want to disconnect MQ Light from the queue manager, either run the PURGE CHANNEL command or stop the connection to the MQ Light client.

- Run the **PURGE CHANNEL** command. For example:

```
PURGE CHANNEL(MYAMQP) CLIENTID('recv_28dbb7e')
```

- Alternatively, stop the connection that the MQ Light client is using to disconnect the client by completing the following steps:

1. Find the connection that the client is using by running the **DISPLAY CONN** command. For example:

```
DISPLAY CONN(*) TYPE(CONN) WHERE (CLIENTID EQ 'recv_28dbb7e')
```

The command output is as follows:

```
DISPLAY CONN(*) TYPE(CONN) WHERE(CLIENTID EQ 'recv_28dbb7e')
40 : DISPLAY CONN(*) TYPE(CONN) WHERE(CLIENTID EQ 'recv_28dbb7e')
AMQ8276: Display Connection details.
CONN(707E0A565F2D0020)
EXTCONN(414D5143514D31202020202020202020)
TYPE(CONN)
CLIENTID(recv_28dbb7e)
```

2. Stop the connection. For example:

```
STOP CONN(707E0A565F2D0020)
```

## Administering multicast

Use this information to learn about the IBM MQ Multicast administration tasks such as reducing the size of multicast messages and enabling data conversion.

### Getting started with multicast

Use this information to get started with IBM MQ Multicast topics and communication information objects.

#### About this task

IBM MQ Multicast messaging uses the network to deliver messages by mapping topics to group addresses. The following tasks are a quick way to test if the required IP address and port are correctly configured for multicast messaging.

#### Creating a COMMINFO object for multicast

The communication information (COMMINFO) object contains the attributes associated with multicast transmission. For more information about the COMMINFO object parameters, see [DEFINE COMMINFO](#).

Use the following command-line example to define a COMMINFO object for multicast:

```
DEFINE COMMINFO(MC1) GRPADDR(group address) PORT(port number)
```

where *MC1* is the name of your COMMINFO object, *group address* is your group multicast IP address or DNS name, and the *port number* is the port to transmit on (The default value is 1414).

A new COMMINFO object called *MC1* is created; This name is the name that you must specify when defining a TOPIC object in the next example.

### Creating a TOPIC object for multicast

A topic is the subject of the information that is published in a publish/subscribe message, and a topic is defined by creating a TOPIC object. TOPIC objects have two parameters which define whether they can be used with multicast or not. These parameters are: **COMMINFO** and **MCAST**.

- **COMMINFO** This parameter specifies the name of the multicast communication information object. For more information about the COMMINFO object parameters, see [DEFINE COMMINFO](#).
- **MCAST** This parameter specifies whether multicast is allowable at this position in the topic tree.

Use the following command-line example to define a TOPIC object for multicast:

```
DEFINE TOPIC(ALLSPORTS) TOPICSTR('Sports') COMMINFO(MC1) MCAST(ENABLED)
```

A new TOPIC object called *ALLSPORTS* is created. It has a topic string *Sports*, its related communication information object is called *MC1* (which is the name you specified when defining a COMMINFO object in the previous example), and multicast is enabled.

### Testing the multicast publish/subscribe

After the TOPIC and COMMINFO objects have been created, they can be tested using the amqspubc sample and the amqssubc sample. For more information about these samples see [The Publish/Subscribe sample programs](#).

1. Open two command-line windows; The first command line is for the amqspubc publish sample, and the second command line is for the amqssubc subscribe sample.
2. Enter the following command at command line 1:

```
amqspubc Sports QM1
```

where *Sports* is the topic string of the TOPIC object defined in an earlier example, and *QM1* is the name of the queue manager.

3. Enter the following command at command line 2:

```
amqssubc Sports QM1
```

where *Sports* and *QM1* are the same as used in step “2” on page 166.

4. Enter `Hello world` at command line 1. If the port and IP address that are specified in the COMMINFO object are configured correctly; the amqssubc sample, which is listening on the port for publications from the specified address, outputs `Hello world` at command line 2.

## IBM MQ Multicast topic topology

Use this example to understand the IBM MQ Multicast topic topology.

IBM MQ Multicast support requires that each subtree has its own multicast group and data stream within the total hierarchy.

The *classful network* IP addressing scheme has designated address space for multicast address. The full multicast range of IP address is 224.0.0.0 to 239.255.255.255, but some of these addresses are reserved. For a list of reserved address either contact your system administrator or see <https://>

[www.iana.org/assignments/multicast-addresses](http://www.iana.org/assignments/multicast-addresses) for more information. It is recommended that you use the locally scoped multicast address in the range of 239.0.0.0 to 239.255.255.255.

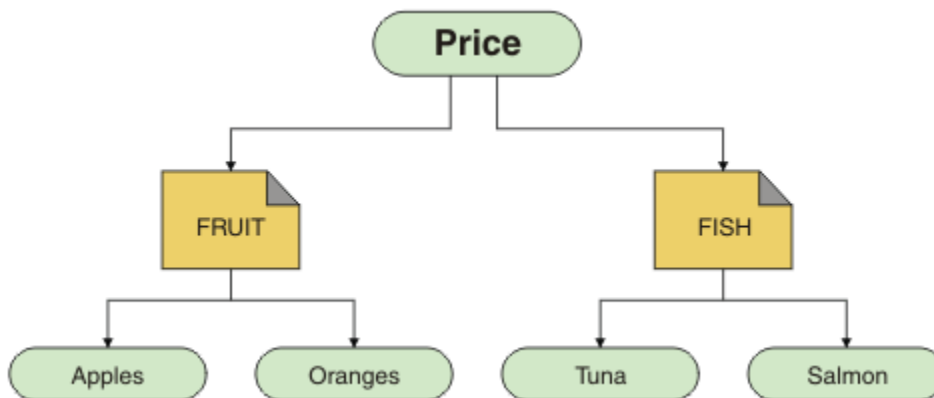
In the following diagram, there are two possible multicast data streams:

```
DEF COMMINFO(MC1) GRPADDR(239.XXX.XXX.XXX
)
DEF COMMINFO(MC2) GRPADDR(239.YYY.YYY.YYY)
```

where 239.XXX.XXX.XXX and 239.YYY.YYY.YYY are valid multicast addresses.

These topic definitions are used to create a topic tree as shown in the following diagram:

```
DEFINE TOPIC(FRUIT) TOPICSTRING('Price/FRUIT') MCAST(ENABLED) COMMINFO(MC1)
DEFINE TOPIC(FISH) TOPICSTRING('Price/FISH') MCAST(ENABLED) COMMINFO(MC2)
```



Each multicast communication information (COMMINFO) object represents a different stream of data because their group addresses are different. In this example, the FRUIT topic is defined to use COMMINFO object MC1, the FISH topic is defined to use COMMINFO object MC2, and the Price node has no multicast definitions.

IBM MQ Multicast has a 255 character limit for topic strings. This limitation means that care must be taken with the names of nodes and leaf-nodes within the tree; if the names of nodes and leaf-nodes are too long, the topic string might exceed 255 characters and return the [2425 \(0979\) \(RC2425\): MQRC\\_TOPIC\\_STRING\\_ERROR](#) reason code. It is recommended to make topic strings as short as possible because longer topic strings might have a detrimental effect on performance.

## Controlling the size of multicast messages

Use this information to learn about the IBM MQ message format, and reduce the size of IBM MQ messages.

IBM MQ messages have a number of attributes associated with them which are contained in the message descriptor. For small messages, these attributes might represent most of the data traffic and can have a significant detrimental effect on the transmission rate. IBM MQ Multicast enables the user to configure which, if any, of these attributes are transmitted along with the message.

The presence of message attributes, other than topic string, depends on whether the COMMINFO object states that they must be sent or not. If an attribute is not transmitted, the receiving application applies a default value. The default MQMD values are not necessarily the same as the MQMD\_DEFAULT value, and are described later in this topic [“Multicast message attributes”](#) on page 168.

The COMMINFO object contains the MCPROP attribute which controls how many of the MQMD fields and user properties flow with the message. By setting the value of this attribute to an appropriate level, you can control the size of the IBM MQ Multicast messages:

## MCPROP

The multicast properties control how many of the MQMD properties and user properties flow with the message.

### ALL

All user properties and all the fields of the MQMD are transmitted.

### REPLY

Only user properties, and MQMD fields that deal with replying to the messages, are transmitted. These properties are:

- MsgType
- MessageId
- CorrelId
- ReplyToQ
- ReplyToQmgr

### USER

Only the user properties are transmitted.

### NONE

No user properties or MQMD fields are transmitted.

### COMPAT

This value causes the transmission of the message to be done in a compatible mode to RMM, which allows some inter-operation with the current XMS applications and IBM Integration Bus RMM applications.

## Multicast message attributes

Use this reference information to understand IBM MQ Multicast message attributes.

Message attributes can come from various places, such as the MQMD, the fields in the MQRFH2, and message properties.

The following table shows what happens when messages are sent subject to the value of MCPROP (described previously in this section), and the default value used when an attribute is not sent.

Table 9. Messaging attributes and how they relate to multicast		
Attribute	Action when using multicast	Default if not transmitted
TopicString	Always Included	Not applicable
MQMQ StrucId	Not transmitted	Not applicable
MQMD Version	Not transmitted	Not applicable
Report	Included if not default	0
MsgType	Included if not default	MQMT_DATAGRAM
Expiry	Included if not default	0
Feedback	Included if not default	0
Encoding	Included if not default	MQENC_NORMAL(equiv)
CodedCharSetId	Included if not default	1208
Format	Included if not default	MQRFH2
Priority	Included if not default	4
Persistence	Included if not default	MQPER_NOT_PERSISTENT
MsgId	Included if not default	Null



Table 9. Messaging attributes and how they relate to multicast (continued)

Attribute	Action when using multicast	Default if not transmitted
CorrelId	Included if not default	Null
BackoutCount	Included if not default	0
ReplyToQ	Included if not default	Blank
ReplyToQMgr	Included if not default	Blank
UserIdentifier	Included if not default	Blank
AccountingToken	Included if not default	Null
PutAppIType	Included if not default	MQAT_JAVA
PutAppIName	Included if not default	Blank
PutDate	Included if not default	Blank
PutTime	Included if not default	Blank
ApplOriginData	Included if not default	Blank
GroupID	Excluded	Not applicable
MsgSeqNumber	Excluded	Not applicable
Offset	Excluded	Not applicable
MsgFlags	Excluded	Not applicable
OriginalLength	Excluded	Not applicable
UserProperties	Included	Not applicable

#### Related information

ALTER COMMINFO

[DEFINE COMMINFO](#)

## Enabling data conversion for Multicast messaging

Use this information to understand how data conversion works for IBM MQ Multicast messaging.

IBM MQ Multicast is a shared, connectionless protocol, and so it is not possible for each client to make specific requests for data conversion. Every client subscribed to the same multicast stream receives the same binary data; therefore, if IBM MQ data conversion is required, the conversion is performed locally at each client.

In a mixed platform installation, it might be that most of the clients require the data in a format that is not the native format of the transmitting application. In this situation the **CCSID** and **ENCODING** values of the multicast COMMINFO object can be used to define the encoding of the message transmission for efficiency.

IBM MQ Multicast supports data conversion of the message payload for the following built in formats:

- MQADMIN
- MQEVENT
- MQPCF
- MQRFH
- MQRFH2
- MQSTR

In addition to these formats, you can also define your own formats and use an [MQDXP - Data-conversion exit parameter](#) data conversion exit.

For information about programming data conversions, see [Data conversion in the MQI for multicast messaging](#).

For more information about data conversion, see [Data conversion](#).

For more information about data conversion exits and ClientExitPath, see [ClientExitPath stanza of the client configuration file](#).

## Multicast application monitoring

Use this information to learn about administering and monitoring IBM MQ Multicast.

The status of the current publishers and subscribers for multicast traffic (for example, the number of messages sent and received, or the number of messages lost) is periodically transmitted to the server from the client. When status is received, the [COMMEV](#) attribute of the COMMINFO object specifies whether or not the queue manager puts an event message on the SYSTEM.ADMIN.PUBSUB.EVENT. The event message contains the status information received. This information is an invaluable diagnostic aid in finding the source of a problem.

Use the MQSC command **DISPLAY CONN** to display connection information about the applications connected to the queue manager. For more information on the **DISPLAY CONN** command, see [DISPLAY CONN](#).

Use the MQSC command **DISPLAY TPSTATUS** to display the status of your publishers and subscribers. For more information on the **DISPLAY TPSTATUS** command, see [DISPLAY TPSTATUS](#).

### COMMEV and the multicast message reliability indicator

The *reliability indicator*, used in conjunction with the **COMMEV** attribute of the COMMINFO object, is a key element in the monitoring of IBM MQ Multicast publishers and subscribers. The reliability indicator (the **MSGREL** field that is returned on the Publish or Subscribe status commands) is an IBM MQ indicator that illustrates the percentage of transmissions that have no errors. Sometimes messages have to be retransmitted due to a transmission error, which is reflected in the value of **MSGREL**. Potential causes of transmission errors include slow subscribers, busy networks, and network outages. **COMMEV** controls whether event messages are generated for multicast handles that are created using the COMMINFO object and is set to one of three possible values:

#### DISABLED

Event messages are not written.

#### ENABLED

Event messages are always written, with a frequency defined in the COMMINFO **MONINT** parameter.

#### EXCEPTION

Event messages are written if the message reliability is under the reliability threshold. A message reliability level of 90% or less indicates that there might be a problem with the network configuration, or that one or more of the Publish/Subscribe applications is running too slowly:

- A value of **MSGREL (100, 100)** indicates that there have been no issues in either the short term, or the long-term time frame.
- A value of **MSGREL (80, 60)** indicates that 20% of the messages are currently having issues, but that it is also an improvement on the long-term value of 60.

Clients might continue transmitting and receiving multicast traffic even when the unicast connection to the queue manager is broken, therefore the data might be out of date.

## Multicast message reliability

Use this information to learn how to set the IBM MQ Multicast subscription and message history.

A key element of overcoming transmission failure with multicast is the buffering of transmitted data (a history of messages to be kept at the transmitting end of the link) by IBM MQ. This process means

that no buffering of messages is required in the putting application process because IBM MQ provides the reliability. The size of this history is configured via the communication information (COMMINFO) object, as described in the following information. A bigger transmission buffer means that there is more transmission history to be retransmitted if needed, but due to the nature of multicast, 100% assured delivery cannot be supported.

The IBM MQ Multicast message history is controlled in the communication information (COMMINFO) object by the **MSGHIST** attribute:

#### **MSGHIST**

This value is the amount of message history in kilobytes that is kept by the system to handle retransmissions in the case of NACKs (negative acknowledgments).

A value of 0 gives the least level of reliability. The default value is 100 KB.

The IBM MQ Multicast new subscription history is controlled in the communication information (COMMINFO) object by the **NSUBHIST** attribute:

#### **NSUBHIST**

The new subscriber history controls whether a subscriber joining a publication stream receives as much data as is currently available, or receives only publications made from the time of the subscription.

##### **NONE**

A value of NONE causes the transmitter to transmit only publication made from the time of the subscription. NONE is the default value.

##### **ALL**

A value of ALL causes the transmitter to retransmit as much history of the topic as is known. In some circumstances, this situation can give a similar behavior to retained publications.

**Note:** Using the value of ALL might have a detrimental effect on performance if there is a large topic history because all the topic history is retransmitted.

#### **Related information**

[DEFINE COMMINFO](#)

[ALTER COMMINFO](#)

## **Advanced multicast tasks**

Use this information to learn about advanced IBM MQ Multicast administration tasks such as configuring .ini files and interoperability with IBM MQ LLM.

For considerations for security in a Multicast installation, see [Multicast security](#).

## **Bridging between multicast and non-multicast publish/subscribe domains**

Use this information to understand what happens when a non-multicast publisher publishes to an IBM MQ Multicast enabled topic.

If a non-multicast publisher publishes to a topic that is defined as **MCAST** enabled and **BRIDGE** enabled, the queue manager transmits the message out over multicast directly to any subscribers that might be listening. A multicast publisher cannot publish to topics that are not multicast enabled.

Existing topics can be multicast enabled by setting the **MCAST** and **COMMINFO** parameters of a topic object. See [Initial multicast concepts](#) for more information about these parameters.

The COMMINFO object **BRIDGE** attribute controls publications from applications that are not using multicast. If **BRIDGE** is set to ENABLED and the **MCAST** parameter of the topic is also set to ENABLED, publications from applications that are not using multicast are bridged to applications that do. For more information on the **BRIDGE** parameter, see [DEFINE COMMINFO](#).

## Configuring the .ini files for Multicast

Use this information to understand the IBM MQ Multicast fields in the .ini files.

Additional IBM MQ Multicast configuration can be made in an ini file. The specific ini file that you must use is dependent on the type of applications:

- Client: Configure the *MQ\_DATA\_PATH* /mqclient.ini file.
- Queue manager: Configure the *MQ\_DATA\_PATH* /qmgrs/QMNAME/qm.ini file.

where *MQ\_DATA\_PATH* is the location of the IBM MQ data directory ( /var/mqm/mqclient.ini ), and *QMNAME* is the name of the queue manager to which the .ini file applies.

The .ini file contains fields used to fine-tune the behavior of IBM MQ Multicast:

```
Multicast:
Protocol      = IP | UDP
IPVersion     = IPv4 | IPv6 | ANY | BOTH
LimitTransRate = DISABLED | STATIC | DYNAMIC
TransRateLimit = 100000
SocketTTL     = 1
Batch         = NO
Loop          = 1
Interface     = <IPAddress>
FeedbackMode  = ACK | NACK | WAIT1
HeartbeatTimeout = 20000
HeartbeatInterval = 2000
```

### Protocol

#### UDP

In this mode, packets are sent using the UDP protocol. Network elements cannot provide assistance in the multicast distribution as they do in IP mode however. The packet format remains compatible with PGM. This is the default value.

#### IP

In this mode, the transmitter sends raw IP packets. Network elements with PGM support assist in the reliable multicast packet distribution. This mode is fully compatible with the PGM standard.

### IPVersion

#### IPv4

Communicate using the IPv4 protocol only. This is the default value.

#### IPv6

Communicate using the IPv6 protocol only.

#### ANY

Communicate using IPv4, IPv6, or both, depending on which protocol is available.

#### BOTH

Supports communication using both IPv4 and IPv6.

### LimitTransRate

#### DISABLED

There is no transmission rate control. This is the default value.

#### STATIC

Implements static transmission rate control. The transmitter would not transmit at a rate exceeding the rate specified by the TransRateLimit parameter.

#### DYNAMIC

The transmitter adapts its transmission rate according to the feedback it gets from the receivers. In this case the transmission rate limit cannot be more than the value specified by the TransRateLimit parameter. The transmitter tries to reach an optimal transmission rate.

### TransRateLimit

The transmission rate limit in Kbps.

**SocketTTL**

The value of SocketTTL determines if the multicast traffic can pass through a router, or the number of routers it can pass through.

**Batch**

Controls whether messages are batched or sent immediately. There are 2 possible values:

- *NO* The messages are not batched, they are sent immediately.
- *YES* The messages are batched.

**Loop**

Set the value to 1 to enable multicast loop. Multicast loop defines whether the data sent is looped back to the host or not.

**Interface**

The IP address of the interface on which multicast traffic flows. For more information and troubleshooting, see: [Testing multicast applications on a non-multicast network](#) and [Setting the appropriate network for multicast traffic](#)

**FeedbackMode****NACK**

Feedback by negative acknowledgments. This is the default value.

**ACK**

Feedback by positive acknowledgments.

**WAIT1**

Feedback by positive acknowledgments where the transmitter waits for only 1 ACK from any of the receivers.

**HeartbeatTimeout**

The heartbeat timeout in milliseconds. A value of 0 indicates that the heartbeat timeout events are not raised by the receiver or receivers of the topic. The default value is 20000.

**HeartbeatInterval**

The heartbeat interval in milliseconds. A value of 0 indicates that no heartbeats are sent. The heartbeat interval must be considerably smaller than the **HeartbeatTimeout** value to avoid false heartbeat timeout events. The default value is 2000.

**Multicast interoperability with IBM MQ Low Latency Messaging**

Use this information to understand the interoperability between IBM MQ Multicast and IBM MQ Low Latency Messaging (LLM).

Basic payload transfer is possible for an application using LLM, with another application using multicast to exchange messages in both directions. Although multicast uses LLM technology, the LLM product itself is not embedded. Therefore it is possible to install both LLM and IBM MQ Multicast, and operate and service the two products separately.

LLM applications that communicate with multicast might need to send and receive message properties. The IBM MQ message properties and MQMD fields are transmitted as LLM message properties with specific LLM message property codes as shown in the following table:

Table 10. IBM MQ message properties to IBM MQ LLM property mappings			
IBM MQ property	IBM MQ LLM property type	LLM property kind	LLM property code
MQMD.Report	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1001
MQMD.MsgType	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1002
MQMD.Expiry	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1003
MQMD.Feedback	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1004

Table 10. IBM MQ message properties to IBM MQ LLM property mappings (continued)			
IBM MQ property	IBM MQ LLM property type	LLM property kind	LLM property code
MQMD.Encoding	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1005
MQMD.CodedCharSetId	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1006
MQMD.Format	RMM_MSG_PROP_BYTES	LLM_PROP_KIND_String	-1007
MQMD.Priority	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1008
MQMD.Persistence	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1009
MQMD.MsgId	RMM_MSG_PROP_BYTES	LLM_PROP_KIND_ByteArray	-1010
MQMD.BackoutCount	RMM_MSG_PROP_INT32	LLM_PROP_KIND_Int32	-1012
MQMD.ReplyToQ	RMM_MSG_PROP_BYTES	LLM_PROP_KIND_String	-1013
MQMD.ReplyToQMger	RMM_MSG_PROP_BYTES	LLM_PROP_KIND_String	-1014
MQMD.PutDate	RMM_MSG_PROP_BYTES	LLM_PROP_KIND_String	-1020
MQMD.PutTime	RMM_MSG_PROP_BYTES	LLM_PROP_KIND_String	-1021
MQMD.ApplOriginData	RMM_MSG_PROP_BYTES	LLM_PROP_KIND_String	-1022
MQPubOptions	RMM_MSG_PROP_INT32	LLM_PROP_KIND_int32	-1053

For more information about LLM, see the LLM product documentation: [IBM MQ Low Latency Messaging](#).

## Administering HP Integrity NonStop Server

Use this information to learn about administration tasks for the IBM MQ client for HP Integrity NonStop Server.

Two administration tasks are available to you:

1. Manually starting the TMF/Gateway from Pathway.
2. Stopping the TMF/Gateway from Pathway.

### Manually starting the TMF/Gateway from Pathway

You can allow Pathway to automatically start the TMF/Gateway on the first enlistment request, or you can manually start the TMF/Gateway from Pathway.

#### Procedure

To manually start the TMF/Gateway from Pathway, enter the following PATHCOM command:

```
START SERVER <server_class_name>
```

If a client application makes an enlistment request before the TMF/Gateway completes recovery of in-doubt transactions, the request is held for up to 1 second. If recovery does not complete within that time, the enlistment is rejected. The client then receives an MQRC\_UOW\_ENLISTMENT\_ERROR error from use of a transactional MQI.

## Stopping the TMF/Gateway from Pathway

This task describes how to stop the TMF/Gateway from Pathway, and how to restart the TMF/Gateway after you stop it.

### Procedure

1. To prevent any new enlistment requests being made to the TMF/Gateway, enter the following command:

```
FREEZE SERVER <server_class_name>
```

2. To trigger the TMF/Gateway to complete any in-flight operations and to end, enter the following command:

```
STOP SERVER <server_class_name>
```

3. To allow the TMF/Gateway to restart either automatically on first enlistment or manually, following steps [1](#) and [2](#), enter the following command:

```
THAW SERVER <server_class_name>
```

Applications are prevented from making new enlistment requests and it is not possible to issue the **START** command until you issue the **THAW** command.

## IBM i Administering IBM i

Introduces the methods available to you to administer IBM MQ on IBM i.

Administration tasks include creating, starting, altering, viewing, stopping, and deleting clusters, processes, and IBM MQ objects (queue managers, queues, namelists, process definitions, channels, client connection channels, listeners, services, and authentication information objects).

See the following links for details of how to administer IBM MQ for IBM i:

- [“Managing IBM MQ for IBM i using CL commands” on page 176](#)
- [“Alternative ways of administering IBM MQ for IBM i” on page 189](#)
- [“Work management” on page 194](#)

### Related concepts

[“Availability, backup, recovery, and restart” on page 201](#)

Use this information to understand how IBM MQ for IBM i uses the IBM i journaling support to help its backup and restore strategy.

### Related reference

[“Quiescing IBM MQ for IBM i” on page 243](#)

This section explains how to quiesce (end gracefully) IBM MQ for IBM i

### Related information

[Changing configuration information on IBM i](#)

[Understanding IBM MQ for IBM i queue manager library names](#)

[Setting up security on IBM i](#)

[The dead letter queue handler on IBM i](#)

[Determining problems with IBM MQ for IBM i applications](#)

[Installable services and components on IBM i](#)

[System and default objects on IBM i](#)

## Managing IBM MQ for IBM i using CL commands

Use this information to understand the IBM MQ IBM i commands.

Most groups of IBM MQ commands, including those associated with queue managers, queues, topics, channels, namelists, process definitions, and authentication information objects can be accessed using the relevant **WRK\*** command.

The principal command in the set is **WRKMQM**. This command allows you, for example, to display a list of all the queue managers on the system, together with status information. Alternatively, you can process all queue-manager specific commands using various options against each entry.

From the **WRKMQM** command you can select specific areas of each queue manager, for example, working with channels, topics or queues, and from there select individual objects.

### Recording IBM MQ application definitions

When you create or customize IBM MQ applications, it is useful to keep a record of all IBM MQ definitions created. This record can be used for:

- Recovery purposes
- Maintenance
- Rolling out IBM MQ applications

You can record IBM MQ application definitions in 1 of 2 ways:

1. Creating CL programs to generate your IBM MQ definitions for the server.
2. Creating MQSC text files as SRC members to generate your IBM MQ definitions using the cross-platform IBM MQ command language.

For further details about defining queue objects, see [“Script \(MQSC\) Commands” on page 73](#) and [“Using Programmable Command Formats” on page 10](#).

### Before you start using the IBM MQ for IBM i using CL commands

Use this information to start the IBM MQ subsystem and create a local queue manager.

#### Before you begin

Ensure that the IBM MQ subsystem is running (using the command `STRSBS QMQM/QMQM`), and that the job queue associated with that subsystem is not held. By default, the IBM MQ subsystem and job queue are both named QMQM in library QMQM.

#### About this task

Using the IBM i command line to start a queue manager

#### Procedure

1. Create a local queue manager by issuing the `CRTMQM` command from an IBM i command line.  
When you create a queue manager, you have the option of making that queue manager the default queue manager. The default queue manager (of which there can only be one) is the queue manager to which a CL command applies, if the queue manager name parameter (MQMNAME) is omitted.
2. Start a local queue manager by issuing the `STRMQM` command from an IBM i command line.  
If the queue manager startup takes more than a few seconds IBM MQ will show status messages intermittently detailing the start up progress. For more information on these messages see [Reason codes](#).



## What to do next

You can stop a queue manager by issuing the ENDMQM command from the IBM i command line, and control a queue manager by issuing other IBM MQ commands from an IBM i command line.

Remote queue managers cannot be started remotely but must be created and started in their systems by local operators. An exception to this is where remote operating facilities (outside IBM MQ for IBM i) exist to enable such operations.

The local queue administrator cannot stop a remote queue manager.

**Note:** As part of quiescing an IBM MQ system, you have to quiesce the active queue managers. This is described in [“Quiescing IBM MQ for IBM i”](#) on page 243.

## Creating IBM MQ for IBM i objects

Use this information to understand the methods for creating IBM MQ objects for IBM i.

### Before you begin

The following tasks suggest various ways in which you can use IBM MQ for IBM i from the command line.

### About this task

There are two online methods to create IBM MQ objects, which are:

### Procedure

1. Using a Create command, for example: The **Create MQM Queue** command: **CRTMQMQ**
2. Using a Work with MQM object command, followed by F6, for example: The **Work with MQM Queues** command: **WRKMQMQ**

## What to do next

For a list of all commands see [IBM MQ for IBM i CL commands](#).

**Note:** All MQM commands can be submitted from the Message Queue Manager Commands menu. To display this menu, type GO CMDMQM on the command line and press the Enter key.

The system displays the prompt panel automatically when you select a command from this menu. To display the prompt panel for a command that you have typed directly on the command line, press F4 before pressing the Enter key.

### *Creating a local queue using the CRTMQMQ command*

### Procedure

1. Type CHGMQM on the command line and press the F4 key.
2. On the **Create MQM Queue panel**, type the name of the queue that you want to create in the Queue name field. To specify a mixed case name, you enclose the name in apostrophes.
3. Type \*LCL in the Queue type field.
4. Specify a queue manager name, unless you are using the default queue manager, and press the Enter key. You can overwrite any of the values with a new value. Scroll forward to see further fields. The options used for clusters are at the end of the list of options.
5. When you have changed any values, press the Enter key to create the queue.

## Creating a local queue using the WRKMQMQ command

### Procedure

1. Type WRKMQMQ on the command line.
2. Enter the name of a queue manager.
3. If you want to display the prompt panel, press F4. The prompt panel is useful to reduce the number of queues displayed, by specifying a generic queue name or queue type.
4. Press Enter and the **Work with MQM Queues panel** is displayed. You can overtype any of the values with a new value. Scroll forward to see further fields. The options used for clusters are at the end of the list of options.
5. Press F6 to create a new queue; this takes you to the **CRTMQMQ** panel. See “[Creating a local queue using the CRTMQMQ command](#)” on page 177 for instructions on how to create the queue. When you have created the queue, the **Work with MQM Queues panel** is displayed again. The new queue is added to the list when you press F5=Refresh.

## Altering queue manager attributes

### About this task

To alter the attributes of the queue manager specified on the **CHGMQM** command, specifying the attributes and values that you want to change. For example, use the following options to alter the attributes of `jupiter.queue.manager`:

### Procedure

Type **CHGMQM** on the command line and press the F4 key.

### Results

The command changes the dead-letter queue used, and enables inhibit events.

## Working with local queues

This section contains examples of some of the commands that you can use to manage local queues. All the commands shown are also available using options from the **WRKMQMQ command panel**.

### Defining a local queue

For an application, the local queue manager is the queue manager to which the application is connected. Queues that are managed by the local queue manager are said to be local to that queue manager.

Use the command **CRTMQMQ QTYPE \*LCL** to create a definition of a local queue and also to create the data structure that is called a queue. You can also modify the queue characteristics from those of the default local queue.

In this example, the queue we define, `orange.local.queue`, is specified to have these characteristics:

- It is enabled for gets, disabled for puts, and operates on a first-in-first-out (FIFO) basis.
- It is an *ordinary* queue, that is, it is not an initiation queue or a transmission queue, and it does not generate trigger messages.
- The maximum queue depth is 1000 messages; the maximum message length is 2000 bytes.

The following command does this on the default queue manager:

```
CRTMQMQ QNAME('orange.local.queue') QTYPE(*LCL)
TEXT('Queue for messages from other systems')
PUTENBL(*NO)
GETENBL(*YES)
TRGENBL(*NO)
```

```
MSGDLYSEQ(*FIFO)
MAXDEPTH(1000)
MAXMSGL(2000)
USAGE(*NORMAL)
```

**Note:**

1. USAGE \*NORMAL indicates that this queue is not a transmission queue.
2. If you already have a local queue with the name `orange.local.queue` on the same queue manager, then this command fails. Use the REPLACE \*YES attribute if you want to overwrite the existing definition of a queue, but see also [“Changing local queue attributes” on page 180](#).

## Defining a dead-letter queue

Each queue manager must have a local queue to be used as a dead-letter queue so that messages that cannot be delivered to their correct destination can be stored for later retrieval. You must explicitly tell the queue manager about the dead-letter queue. You can do this by specifying a dead-letter queue on the **CRTMQM** command, or you can use the **CHGMQM** command to specify one later. You must also define the dead-letter queue before it can be used.

A sample dead-letter queue called `SYSTEM.DEAD.LETTER.QUEUE` is supplied with the product. This queue is automatically created when you create the queue manager. You can modify this definition if required. There is no need to rename it, although you can if you like.

A dead-letter queue has no special requirements except that:

- It must be a local queue.
- Its MAXMSGL (maximum message length) attribute must enable the queue to accommodate the largest messages that the queue manager has to handle **plus** the size of the dead-letter header (MQDLH).

IBM MQ provides a dead-letter queue handler that allows you to specify how messages found on a dead-letter queue are to be processed or removed. For further information, see [The IBM MQ for IBM i dead-letter queue handler](#).

## Displaying default object attributes

When you define an IBM MQ object, it takes any attributes that you do not specify from the default object. For example, when you define a local queue, the queue inherits any attributes that you omit in the definition from the default local queue, which is called `SYSTEM.DEFAULT.LOCAL.QUEUE`. To see exactly what these attributes are, use the following command:

```
DSPMQMQ QNAME(SYSTEM.DEFAULT.LOCAL.QUEUE) MQMNAME(MYQUEUEMANAGER)
```

## Copying a local queue definition

You can copy a queue definition using the **CPYMQMQ** command. For example:

```
CPYMQMQ FROMQ('orange.local.queue') TOQ('magenta.queue') MQMNAME(MYQUEUEMANAGER)
```

This command creates a queue with the same attributes as our original queue `orange.local.queue`, rather than those of the system default local queue.

You can also use the **CPYMQMQ** command to copy a queue definition, but substituting one or more changes to the attributes of the original. For example:

```
CPYMQMQ FROMQ('orange.local.queue') TOQ('third.queue') MQMNAME(MYQUEUEMANAGER)
MAXMSGL(1024)
```

This command copies the attributes of the queue `orange.local.queue` to the queue `third.queue`, but specifies that the maximum message length on the new queue is to be 1024 bytes, rather than 2000.

**Note:** When you use the **CPYMQMQ** command, you copy the queue attributes only, not the messages on the queue.

## Changing local queue attributes

You can change queue attributes in two ways, using either the **CHGMQMQ** command or the **CPYMQMQ** command with the **REPLACE \*YES** attribute. In “Defining a local queue” on page 178, you defined the queue `orange.local.queue`. If, for example, you need to increase the maximum message length on this queue to 10,000 bytes.

- Using the **CHGMQMQ** command:

```
CHGMQMQ QNAME('orange.local.queue') MQMNAME(MYQUEUEMANAGER) MAXMSGLEN(10000)
```

This command changes a single attribute, that of the maximum message length; all the other attributes remain the same.

- Using the **CRTMQMQ** command with the **REPLACE \*YES** option, for example:

```
CRTMQMQ QNAME('orange.local.queue') QTYPE(*LCL) MQMNAME(MYQUEUEMANAGER)  
MAXMSGLEN(10000) REPLACE(*YES)
```

This command changes not only the maximum message length, but all the other attributes, which are given their default values. The queue is now put enabled whereas previously it was put inhibited. Put enabled is the default, as specified by the queue `SYSTEM.DEFAULT.LOCAL.QUEUE`, unless you have changed it.

If you **decrease** the maximum message length on an existing queue, existing messages are not affected. Any new messages, however, must meet the new criteria.

## Clearing a local queue

To delete all the messages from a local queue called `magenta.queue`, use the following command:

```
CLRMQMQ QNAME('magenta.queue') MQMNAME(MYQUEUEMANAGER)
```

You cannot clear a queue if:

- There are uncommitted messages that have been put on the queue under syncpoint.
- An application currently has the queue open.

## Deleting a local queue

Use the command **DLTMQMQ** to delete a local queue.

A queue cannot be deleted if it has uncommitted messages on it, or if it is in use.

## Enabling large queues

IBM MQ supports queues larger than 2 GB. See your operating system documentation for information on how to enable IBM i to support large files.

The IBM i product documentation can be found here: <https://publib.boulder.ibm.com/iserries/>

Some utilities might not be able to cope with files greater than 2 GB. Before enabling large file support, check your operating system documentation for information on restrictions on such support.

## Working with alias queues

This section contains examples of some of the commands that you can use to manage alias queues. All the commands shown are also available using options from the **WRKMQMQ command panel**.

An alias queue (sometimes known as a queue alias) provides a method of redirecting MQI calls. An alias queue is not a real queue but a definition that resolves to a real queue. The alias queue definition contains a target queue name, which is specified by the TGTQNAME attribute.

When an application specifies an alias queue in an MQI call, the queue manager resolves the real queue name at run time.

For example, an application has been developed to put messages on a queue called `my.alias.queue`. It specifies the name of this queue when it makes an **MQOPEN** request and, indirectly, if it puts a message on this queue. The application is not aware that the queue is an alias queue. For each MQI call using this alias, the queue manager resolves the real queue name, which could be either a local queue or a remote queue defined at this queue manager.

By changing the value of the TGTQNAME attribute, you can redirect MQI calls to another queue, possibly on another queue manager. This is useful for maintenance, migration, and load-balancing.

### Defining an alias queue

The following command creates an alias queue:

```
CRTMQMQ QNAME('my.alias.queue') QTYPE(*ALS) TGTQNAME('yellow.queue')
MQMNAME(MYQUEUEMANAGER)
```

This command redirects MQI calls that specify `my.alias.queue` to the queue `yellow.queue`. The command does not create the target queue; the MQI calls fail if the queue `yellow.queue` does not exist at run time.

If you change the alias definition, you can redirect the MQI calls to another queue. For example:

```
CHGMQMQ QNAME('my.alias.queue') TGTQNAME('magenta.queue') MQMNAME(MYQUEUEMANAGER)
```

This command redirects MQI calls to another queue, `magenta.queue`.

You can also use alias queues to make a single queue (the target queue) appear to have different attributes for different applications. You do this by defining two aliases, one for each application. Suppose there are two applications:

- Application ALPHA can put messages on `yellow.queue`, but is not allowed to get messages from it.
- Application BETA can get messages from `yellow.queue`, but is not allowed to put messages on it.

You can do this using the following commands:

```
/* This alias is put enabled and get disabled for application ALPHA */
CRTMQMQ QNAME('alphas.alias.queue') QTYPE(*ALS) TGTQNAME('yellow.queue')
PUTENBL(*YES) GETENBL(*NO) MQMNAME(MYQUEUEMANAGER)

/* This alias is put disabled and get enabled for application BETA */
CRTMQMQ QNAME('betas.alias.queue') QTYPE(*ALS) TGTQNAME('yellow.queue')
PUTENBL(*NO) GETENBL(*YES) MQMNAME(MYQUEUEMANAGER)
```

ALPHA uses the queue name `alphas.alias.queue` in its MQI calls; BETA uses the queue name `betas.alias.queue`. They both access the same queue, but in different ways.

You can use the **REPLACE \*YES** attribute when you define alias queues, in the same way that you use these attributes with local queues.

## Using other commands with alias queues

You can use the appropriate commands to display or change alias queue attributes. For example:

```
* Display the alias queue's attributes */
DSPMQMQ QNAME('alphas.alias.queue') MQMNAME(MYQUEUEMANAGER)

/* ALTER the base queue name, to which the alias resolves. */
/* FORCE = Force the change even if the queue is open. */

CHQMCMQ QNAME('alphas.alias.queue') TGTQNAME('orange.local.queue') FORCE(*YES)
MQMNAME(MYQUEUEMANAGER)
```

## Working with model queues

This section contains examples of some of the commands that you can use to manage model queues. All the commands shown are also available using options from the **WRKMCMQ command panel**.

A queue manager creates a dynamic queue if it receives an MQI call from an application specifying a queue name that has been defined as a model queue. The name of the new dynamic queue is generated by the queue manager when the queue is created. A model queue is a template that specifies the attributes of any dynamic queues created from it.

Model queues provide a convenient method for applications to create queues as they are required.

### Defining a model queue

You define a model queue with a set of attributes in the same way that you define a local queue. Model queues and local queues have the same set of attributes, except that on model queues you can specify whether the dynamic queues created are temporary or permanent. (Permanent queues are maintained across queue manager restarts, temporary ones are not). For example:

```
CRTMQMQ QNAME('green.model.queue') QTYPE(*MDL) DFNTYPE(*PERMDYN)
```

This command creates a model queue definition. From the DFNTYPE attribute, the actual queues created from this template are permanent dynamic queues. The attributes not specified are automatically copied from the `SYSIBM.DEFAULT.MODEL.QUEUE` default queue.

You can use the `REPLACE *YES` attribute when you define model queues, in the same way that you use them with local queues.

## Using other commands with model queues

You can use the appropriate commands to display or alter a model queue's attributes. For example:

```
/* Display the model queue's attributes */
DSPMQMQ MQMNAME(MYQUEUEMANAGER) QNAME('green.model.queue')

/* ALTER the model queue to enable puts on any */
/* dynamic queue created from this model. */

CHGMCMQ MQMNAME(MYQUEUEMANAGER) QNAME('blue.model.queue') PUTENBL(*YES)
```

## Working with triggering

Use this information to learn about triggering and process definitions.

IBM MQ provides a facility for starting an application automatically when certain conditions on a queue are met. One example of the conditions is when the number of messages on a queue reaches a specified number. This facility is called *triggering* and is described in detail in [Triggering channels](#).

## What is triggering?

The queue manager defines certain conditions as constituting trigger events. If triggering is enabled for a queue and a trigger event occurs, the queue manager sends a trigger message to a queue called an initiation queue. The presence of the trigger message on the initiation queue indicates that a trigger event has occurred.

Trigger messages generated by the queue manager are not persistent. This has the effect of reducing logging (thereby improving performance), and minimizing duplicates during restart, so improving restart time.

## What is the trigger monitor?

The program which processes the initiation queue is called a trigger-monitor application, and its function is to read the trigger message and take appropriate action, based on the information contained in the trigger message. Normally this action would be to start some other application to process the queue which caused the trigger message to be generated. From the point of view of the queue manager, there is nothing special about the trigger-monitor application - it is another application that reads messages from a queue (the initiation queue).

## Altering the job submission attributes of the trigger monitor

The trigger monitor supplied as command **STRMQMTRM** submits a job for each trigger message using the system default job description, QDFTJOBBD. This has limitations in that the submitted jobs are always called QDFTJOBBD and have the attributes of the default job description including the library list, \*SYSVAL. IBM MQ provides a method for overriding these attributes. For example, it is possible to customize the submitted jobs to have more meaningful job names as follows:

1. In the job description specify the description you want, for example logging values.
2. Specify the Environment Data of the process definition used in the triggering process:

```
CHGMQMPRC PRCNAME(MY_PROCESS) MQMNAME(MHA3) ENVDATA ('JOBBD(MYLIB/TRIGJOBBD)')
```

The Trigger Monitor performs a SBMJOB using the specified description.

It is possible to override other attributes of the SBMJOB by specifying the appropriate keyword and value in the Environment Data of the process definition. The only exception to this is the CMD keyword because this attribute is filled by the trigger monitor. An example of the command to specify the Environment Data of the process definition where both the job name and description are to be altered follows:

```
CHGMQMPRC PRCNAME(MY_PROCESS) MQMNAME(MHA3) ENVDATA ('JOBBD(MYLIB/TRIGJOB)  
JOB(TRIGGER)')
```

## Defining an application queue for triggering

An application queue is a local queue that is used by applications for messaging, through the MQI. Triggering requires a number of queue attributes to be defined on the application queue. Triggering itself is enabled by the TRGENBL attribute.

In this example, a trigger event is to be generated when there are 100 messages of priority 5 or higher on the local queue motor.insurance.queue, as follows:

```
CRTMQMQ MQMNAME(MYQUEUEMANAGER) QNAME('motor.insurance.queue') QTYPE(*LCL)  
PRCNAME('motor.insurance.quote.process') MAXMSGLEN(2000)  
DFTMSGPST(*YES) INITQNAME('motor.ins.init.queue')  
TRGENBL(*YES) TRGTYP(*DEPTH) TRGDEPTH(100) TRGMSGPTY(5)
```

where the parameters are:

**MQMNAME (MYQUEUEMANAGER)**

The name of the queue manager.

**QNAME ('motor.insurance.queue')**

The name of the application queue being defined.

**PRCNAME ('motor.insurance.quote.process')**

The name of the application to be started by a trigger monitor program.

**MAXMSGL (2000)**

The maximum length of messages on the queue.

**DFTMSGPST (\*YES)**

Messages on this queue are persistent by default.

**INITQNAME ('motor.ins.init.queue')**

The name of the initiation queue on which the queue manager is to put the trigger message.

**TRGENBL (\*YES)**

The trigger attribute value.

**TRGTYPE (\*DEPTH)**

A trigger event is generated when the number of messages of the required priority ( **TRGMSGPTY** ) reaches the number specified in **TRGDEPTH**.

**TRGDEPTH (100)**

The number of messages required to generate a trigger event.

**TRGMSGPTY (5)**

The priority of messages that are to be counted by the queue manager in deciding whether to generate a trigger event. Only messages with priority 5 or higher are counted.

**Defining an initiation queue**

When a trigger event occurs, the queue manager puts a trigger message on the initiation queue specified in the application queue definition. Initiation queues have no special settings, but you can use the following definition of the local queue `motor.ins.init.queue` for guidance:

```
CRTMQMQ MQMNAME(MYQUEUEMANAGER) QNAME('motor.ins.init.queue') QTYPE(*LCL)
GETENBL(*YES) SHARE(*NO) TRGTYPE(*NONE)
MAXMSGL(2000)
MAXDEPTH(1000)
```

**Creating a process definition**

Use the **CRTMQMPRC** command to create a process definition. A process definition associates an application queue with the application that is to process messages from the queue. This is done through the **PRCNAME** attribute on the application queue `motor.insurance.queue`. The following command creates the required process, `motor.insurance.quote.process`, identified in this example:

```
CRTMQMPRC MQMNAME(MYQUEUEMANAGER) PRCNAME('motor.insurance.quote.process')
TEXT('Insurance request message processing')
APPTYPE(*OS400) APPID(MQTEST/TESTPROG)
USRDATA('open, close, 235')
```

where the parameters are:

**MQMNAME (MYQUEUEMANAGER)**

The name of the queue manager.

**PRCNAME ('motor.insurance.quote.process')**

The name of the process definition.



**TEXT('Insurance request message processing')**

A description of the application program to which this definition relates. This text is displayed when you use the **DSPMQMPRC** command. This can help you to identify what the process does. If you use spaces in the string, you must enclose the string in single quotation marks.

**APPTYPE(\*OS400)**

The type of application to be started.

**APPID(MQTEST/TESTPROG)**

The name of the application executable file, specified as a fully qualified file name.

**USRDATA('open, close, 235')**

User-defined data, which can be used by the application.

**Displaying your process definition**

Use the **DSPMQMPRC** command to examine the results of your definition. For example:

```
MQMNAME(MYQUEUEMANAGER) DSPMQMPRC('motor.insurance.quote.process')
```

You can also use the **CHGMQMPRC** command to alter an existing process definition, and the **DLTMQMPRC** command to delete a process definition.

**Displaying your process definition**

Use the **DSPMQMPRC** command to examine the results of your definition. For example:

```
MQMNAME(MYQUEUEMANAGER) DSPMQMPRC('motor.insurance.quote.process')
```

You can also use the **CHGMQMPRC** command to alter an existing process definition, and the **DLTMQMPRC** command to delete a process definition.

**Communicating between two systems**

The following example illustrates how to set up two IBM MQ for IBM i systems, using CL commands, so that they can communicate with one another.

The systems are called SYSTEMA and SYSTEMB, and the communications protocol used is TCP/IP.

Carry out the following procedure:

1. Create a queue manager on SYSTEMA, calling it QMGRA1.

```
CRTMQM    MQMNAME(QMGRA1) TEXT('System A - Queue +
Manager 1') UDLMSGQ(SYSTEM.DEAD.LETTER.QUEUE)
```

2. Start this queue manager.

```
STRMQM    MQMNAME(QMGRA1)
```

3. Define the IBM MQ objects on SYSTEMA that you need to send messages to a queue manager on SYSTEMB.

```
/* Transmission queue */
CRTMQMQ   QNAME(XMITQ.TO.QMGRB1) QTYPE(*LCL) +
MQMNAME(QMGRA1) TEXT('Transmission Queue +
to QMGRB1') MAXDEPTH(5000) USAGE(*TMQ)

/* Remote queue that points to a queue called TARGETB */
/* TARGETB belongs to queue manager QMGRB1 on SYSTEMB */
CRTMQMQ   QNAME(TARGETB.ON.QMGRB1) QTYPE(*RMT) +
MQMNAME(QMGRA1) TEXT('Remote Q pointing +
at Q TARGETB on QMGRB1 on Remote System +
```

```

SYSTEMB') RMTQNAME(TARGETB) +
RMTMQMNAME(QMGRB1) TMQNAME(XMITQ.TO.QMGRB1)

/* TCP/IP sender channel to send messages to the queue manager on SYSTEMB*/
CRTMQMCHL CHLNAME(QMGRA1.TO.QMGRB1) CHLTYPE(*SDR) +
MQMNAME(QMGRA1) TRPTYPE(*TCP) +
TEXT('Sender Channel From QMGRA1 on +
SYSTEMA to QMGRB1 on SYSTEMB') +
CONNAME(SYSTEMB) TMQNAME(XMITQ.TO.QMGRB1)

```

4. Create a queue manager on SYSTEMB, calling it QMGRB1.

```

CRTMQM    MQMNAME(QMGRB1) TEXT('System B - Queue +
Manager 1') UDLMSGQ(SYSTEM.DEAD.LETTER.QUEUE)

```

5. Start the queue manager on SYSTEMB.

```

STRMQM    MQMNAME(QMGRB1)

```

6. Define the IBM MQ objects that you need to receive messages from the queue manager on SYSTEMA.

```

/* Local queue to receive messages on */
CRTMQMQ    QNAME(TARGETB) QTYPE(*LCL) MQMNAME(QMGRB1) +
TEXT('Sample Local Queue for QMGRB1')

/* Receiver channel of the same name as the sender channel on SYSTEMA */
CRTMQMCHL CHLNAME(QMGRA1.TO.QMGRB1) CHLTYPE(*RCVR) +
MQMNAME(QMGRB1) TRPTYPE(*TCP) +
TEXT('Receiver Channel from QMGRA1 to +
QMGRB1')

```

7. Finally, start a TCP/IP listener on SYSTEMB so that the channel can be started. This example uses the default port of 1414.

```

STRMQMLSR MQMNAME(QMGRB1)

```

You are now ready to send test messages between SYSTEMA and SYSTEMB. Using one of the supplied samples, put a series of messages to your remote queue on SYSTEMA.

Start the channel on SYSTEMA, either by using the command STRMQMCHL , or by using the command WRKMQMCHL and entering a start request (Option 14) against the sender channel.

The channel should go to RUNNING status and the messages are sent to queue TARGETB on SYSTEMB.

Check your messages by issuing the command:

```

WRKMQMMSG QNAME(TARGETB) MQMNAME(QMGRB1) .

```

## Sample resource definitions

This sample contains the AMQSAMP4 sample IBM i CL program.

```

/*****/
/*
/* Program name: AMQSAMP4
/*
/* Description: Sample CL program defining MQM queues
/*              to use with the sample programs
/*              Can be run, with changes as needed, after
/*              starting the MQM
/*
/* <N_OCO_COPYRIGHT>
/* Licensed Materials - Property of IBM
/*
/* 63H9336
/* (c) Copyright IBM Corp. 1993, 2022. All Rights Reserved.
/*
/*****

```

```

/* US Government Users Restricted Rights - Use, duplication or */
/* disclosure restricted by GSA ADP Schedule Contract with */
/* IBM Corp. */
/* <NOC_COPYRIGHT> */
/* */
/***** */
/* Function: */
/* */
/* AMQSAMP4 is a sample CL program to create or reset the */
/* MQI resources to use with the sample programs. */
/* */
/* This program, or a similar one, can be run when the MQM */
/* is started - it creates the objects if missing, or resets */
/* their attributes to the prescribed values. */
/* */
/* */
/* */
/* Exceptions signaled: none */
/* Exceptions monitored: none */
/* */
/* AMQSAMP4 takes a single parameter, the Queue Manager name */
/* */
/***** */
QSYS/PGM PARM(&QMGRNAME)

/***** */
/* Queue Manager Name Parameter */
/***** */
QSYS/DCL VAR(&QMGRNAME) TYPE(*CHAR)

/***** */
/* EXAMPLES OF DIFFERENT QUEUE TYPES */
/* */
/* Create local, alias and remote queues */
/* */
/* Uses system defaults for most attributes */
/* */
/***** */
/* Create a local queue */
CRTMQMQ QNAME('SYSTEM.SAMPLE.LOCAL') +
MQMNAME(&QMGRNAME) +
QTYPE(*LCL) REPLACE(*YES) +
+
TEXT('Sample local queue') /* description */+
SHARE(*YES) /* Shareable */+
DFTMSGPST(*YES) /* Persistent messages OK */

/* Create an alias queue */
CRTMQMQ QNAME('SYSTEM.SAMPLE.ALIAS') +
MQMNAME(&QMGRNAME) +
QTYPE(*ALS) REPLACE(*YES) +
+
TEXT('Sample alias queue') +
DFTMSGPST(*YES) /* Persistent messages OK */+
TGTQNAME('SYSTEM.SAMPLE.LOCAL')

/* Create a remote queue - in this case, an indirect reference */
/* is made to the sample local queue on OTHER queue manager */
CRTMQMQ QNAME('SYSTEM.SAMPLE.REMOTE') +
MQMNAME(&QMGRNAME) +
QTYPE(*RMT) REPLACE(*YES) +
+
TEXT('Sample remote queue')/* description */+
DFTMSGPST(*YES) /* Persistent messages OK */+
RMTQNAME('SYSTEM.SAMPLE.LOCAL') +
RMTMQMNAME(OTHER) /* Queue is on OTHER */

/* Create a transmission queue for messages to queues at OTHER */
/* By default, use remote node name */
CRTMQMQ QNAME('OTHER') /* transmission queue name */+
MQMNAME(&QMGRNAME) +
QTYPE(*LCL) REPLACE(*YES) +
TEXT('Transmission queue to OTHER') +
USAGE(*TMQ) /* transmission queue */

/***** */
/* SPECIFIC QUEUES AND PROCESS USED BY SAMPLE PROGRAMS */
/* */
/* Create local queues used by sample programs */

```

```

/* Create MQI process associated with sample initiation queue */
/*
/*****
/* General reply queue */
CRTMQMQ QNAME('SYSTEM.SAMPLE.REPLY') +
MQMNAME(&QMGRNAME) +
QTYPE(*LCL) REPLACE(*YES) +
+
TEXT('General reply queue') +
DFTMSGPST(*NO) /* Not Persistent */

/* Queue used by AMQSINQ4 */
CRTMQMQ QNAME('SYSTEM.SAMPLE.INQ') +
MQMNAME(&QMGRNAME) +
QTYPE(*LCL) REPLACE(*YES) +
+
TEXT('Queue for AMQSINQ4') +
SHARE(*YES) /* Shareable */+
DFTMSGPST(*NO) /* Not Persistent */+
+
TRGENBL(*YES) /* Trigger control on */+
TRGTYPE(*FIRST)/* Trigger on first message*/+
PRCNAME('SYSTEM.SAMPLE.INQPROCESS') +
INITQNAME('SYSTEM.SAMPLE.TRIGGER')

/* Queue used by AMQSSET4 */
CRTMQMQ QNAME('SYSTEM.SAMPLE.SET') +
MQMNAME(&QMGRNAME) +
QTYPE(*LCL) REPLACE(*YES) +
+
TEXT('Queue for AMQSSET4') +
SHARE(*YES) /* Shareable */+
DFTMSGPST(*NO)/* Not Persistent */+
+
TRGENBL(*YES) /* Trigger control on */+
TRGTYPE(*FIRST)/* Trigger on first message*/+
PRCNAME('SYSTEM.SAMPLE.SETPROCESS') +
INITQNAME('SYSTEM.SAMPLE.TRIGGER')

/* Queue used by AMQSECH4 */
CRTMQMQ QNAME('SYSTEM.SAMPLE.ECHO') +
MQMNAME(&QMGRNAME) +
QTYPE(*LCL) REPLACE(*YES) +
+
TEXT('Queue for AMQSECH4') +
SHARE(*YES) /* Shareable */+
DFTMSGPST(*NO)/* Not Persistent */+
+
TRGENBL(*YES) /* Trigger control on */+
TRGTYPE(*FIRST)/* Trigger on first message*/+
PRCNAME('SYSTEM.SAMPLE.ECHOPROCESS') +
INITQNAME('SYSTEM.SAMPLE.TRIGGER')

/* Initiation Queue used by AMQSTRG4, sample trigger process */
CRTMQMQ QNAME('SYSTEM.SAMPLE.TRIGGER') +
MQMNAME(&QMGRNAME) +
QTYPE(*LCL) REPLACE(*YES) +
TEXT('Trigger queue for sample programs')

/* MQI Processes associated with triggered sample programs */
/*
/***** Note - there are versions of the triggered samples *****/
/***** in different languages - set APPID for these *****/
/***** process to the variation you want to trigger *****/
/*
CRTMQMPRC PRCNAME('SYSTEM.SAMPLE.INQPROCESS') +
MQMNAME(&QMGRNAME) +
REPLACE(*YES) +
+
TEXT('Trigger process for AMQSINQ4') +
ENVDATA('JOBPTY(3)') /* Submit parameter */+
/** Select the triggered program here **/ +
APPID('QMOM/AMQSINQ4') /* C +
/* APPID('QMOM/AMQ0INQ4') /* COBOL */+
/* APPID('QMOM/AMQ3INQ4') /* RPG - ILE */

CRTMQMPRC PRCNAME('SYSTEM.SAMPLE.SETPROCESS') +
MQMNAME(&QMGRNAME) +
REPLACE(*YES) +
+
TEXT('Trigger process for AMQSSET4') +
ENVDATA('JOBPTY(3)') /* Submit parameter */+

```

```

/** Select the triggered program here      **/      +
APPID('QMOM/AMQSSET4') /* C */      +
/* APPID('QMOM/AMQOSET4') /* COBOL */      +
/* APPID('QMOM/AMQ3SET4') /* RPG - ILE */

CRTMQMPRC PRCNAME('SYSTEM.SAMPLE.ECHOPROCESS')      +
MQMNAME(&QMGRNAME)      +
REPLACE(*YES)      +
+
TEXT('Trigger process for AMQSECH4')      +
ENVDATA('JOBPTY(3)') /* Submit parameter */      +
/** Select the triggered program here      **/      +
APPID('QMOM/AMQSECH4') /* C */      +
/* APPID('QMOM/AMQOECH4') /* COBOL */      +
/* APPID('QMOM/AMQ3ECH4') /* RPG - ILE */

/*****/
/*                                          */
/* Normal return.                          */
/*                                          */
/*****/
SNDPGMMSG MSG('AMQSAMP4 Completed creating sample +
objects for ' *CAT &QMGRNAME)
RETURN
ENDPGM

/*****/
/*                                          */
/* END OF AMQSAMP4                          */
/*                                          */
/*****/

```

## Alternative ways of administering IBM MQ for IBM i

Use this information to learn about IBM MQ for IBM i, MQSC commands, PCF commands, and remote administration.

You can use IBM MQ instrumentation events to monitor the operation of queue managers. See [Instrumentation events](#) for information about IBM MQ instrumentation events and how to use them.

You normally use IBM i CL commands to administer IBM MQ for IBM i. See [“Managing IBM MQ for IBM i using CL commands”](#) on page 176 for an overview of these commands.

Using CL commands is the preferred method of administering the system. However, you can use various other methods. This section gives an overview of those methods and includes the following topics:

### Local and remote administration

You administer IBM MQ for IBM i objects locally or remotely.

*Local administration* means carrying out administration tasks on any queue managers that you have defined on your local system. In IBM MQ, you can consider this as local administration because no IBM MQ channels are involved, that is, the communication is managed by the operating system. To perform this type of task, you must either log onto the remote system and issue the commands from there, or create a process that can issue the commands for you.

IBM MQ supports administration from a single point through what is known as *remote administration*. Remote administration consists of sending programmable command format (PCF) control messages to the SYSTEM.ADMIN.COMMAND.QUEUE on the target queue manager.

There are a number of ways of generating PCF messages. These are:

1. Writing a program using PCF messages. See [“Administration using PCF commands”](#) on page 191.
2. Writing a program using the MQAI, which sends out PCF messages. See [“Using the MQAI to simplify the use of PCFs”](#) on page 22.
3. Using the IBM MQ Explorer, available with IBM MQ for Windows, which allows you to use a graphical user interface (GUI) and generates the correct PCF messages. See [“Using the IBM MQ Explorer with IBM MQ for IBM i”](#) on page 192.

4. Use **STRMQMQSC** to send commands indirectly to a remote queue manager. See [“Administration using MQSC commands”](#) on page 190.

For example, you can issue a remote command to change a queue definition on a remote queue manager.

Some commands cannot be issued in this way, in particular, creating or starting queue managers and starting command servers. To perform this type of task, you must either log onto the remote system and issue the commands from there or create a process that can issue the commands for you.

## Administration using MQSC commands

Use this information to learn about MQSC commands, and how to use them to administer IBM MQ for IBM i.

IBM MQ script (MQSC) commands are written in human-readable form, that is, in EBCDIC text. You use MQSC commands to manage queue manager objects, including the queue manager itself, queues, process definitions, namelists, channels, client connection channels, listeners, services, topics, and authentication information objects.

You issue MQSC commands to a queue manager using the **STRMQMQSC** IBM MQ CL command. This method is a batch method only, taking its input from a source physical file in the server library system. The default name for this source physical file is QMQSC.



**Attention:** Do not use the QTEMP library as the source library to STRMQMQSC, as the usage of the QTEMP library is limited. You must use another library as an input file to the command.

IBM MQ for IBM i does not supply a source file called QMQSC. To process MQSC commands you must create the QMQSC source file in a library of your choice, by issuing the following command:

```
CRTSRCPF FILE(MYLIB/QMQSC) RCDLEN(240) TEXT('IBM MQ - MQSC Source')
```

MQSC source is held in members within this source file. To work with the members enter the following command:

```
WRKMBRPDM MYLIB/QMQSC
```

You can now add new members and maintain existing ones

You can also enter MQSC commands interactively, by issuing RUNMQSC or:

1. Typing in the queue manager name and pressing the Enter key to access the **WRKMQM** results panel.
2. Selecting F23=More options on this panel.
3. Selecting option 26 against an active queue manager on the panel shown in [Figure 32 on page 191](#).

To end such an MQSC session, type end .

[Figure 32 on page 191](#) is an extract from an MQSC command file showing an MQSC command (DEFINE QLOCAL) with its attributes.

```

.
.
DEFINE QLOCAL(ORANGE.LOCAL.QUEUE) REPLACE +
DESCR(' ') +
PUT(ENABLED) +
DEFPRTY(0) +
DEFPSIST(NO) +
GET(ENABLED) +
MAXDEPTH(5000) +
MAXMSGL(1024) +
DEFSOPT(SHARED) +
NOHARDENBO +
USAGE(NORMAL) +
NOTRIGGER;
.
.

```

Figure 32. Extract from the MQSC command file, myprog.in

For portability among IBM MQ environments, limit the line length in MQSC command files to 72 characters. The plus sign indicates that the command is continued on the next line.

Object attributes specified in MQSC are shown in this section in uppercase (for example, RQMNAME), although they are not case-sensitive.

**Note:**

1. The format of an MQSC file does not depend on its location in the file system.
2. MQSC attribute names are limited to eight characters.
3. MQSC commands are available on other platforms, including z/OS.

For a description of each MQSC command and its syntax, see [“Script \(MQSC\) Commands” on page 73](#).

## Administration using PCF commands

The purpose of IBM MQ programmable command format (PCF) commands is to allow administration tasks to be programmed into an administration program. In this way you can create queues and process definitions, and change queue managers, from a program.

PCF commands cover the same range of functions provided by MQSC commands. However, unlike MQSC commands, PCF commands and their replies are not in a text format that you can read.

You can write a program to issue PCF commands to any queue manager in the network from a single node. In this way, you can both centralize and automate administration tasks.

Each PCF command is a data structure that is embedded in the application data part of an IBM MQ message. Each command is sent to the target queue manager using the MQI function MQPUT in the same way as any other message. The command server on the queue manager receiving the message interprets it as a command message and runs the command. To get the replies, the application issues an MQGET call and the reply data is returned in another data structure. The application can then process the reply and act accordingly.

Briefly, these are some of the things the application programmer must specify to create a PCF command message:

### Message descriptor

This is a standard IBM MQ message descriptor, in which:

- Message type (*MsgType*) is MQMT\_REQUEST.
- Message format (*Format*) is MQFMT\_ADMIN.

### Application data

Contains the PCF message including the PCF header, in which:

- The PCF message type (*Type*) specifies MQCFT\_COMMAND.

- The command identifier specifies the command, for example, *Change Queue* (MQCMD\_CHANGE\_Q).

Escape PCFs are PCF commands that contain MQSC commands within the message text. You can use PCFs to send commands to a remote queue manager. See [“Using the MQAI to simplify the use of PCFs”](#) on page 22 for further information.

For a complete description of the PCF data structures and how to implement them, see [Structures for commands and responses](#).

## Using the IBM MQ Explorer with IBM MQ for IBM i

Use this information to administer IBM MQ for IBM i using the IBM MQ Explorer.

IBM MQ for Windows (x86 platform), and IBM MQ for Linux (x86 and x86-64 platforms) provide an administration interface called the IBM MQ Explorer to perform administration tasks as an alternative to using CL, control, or MQSC commands.

The IBM MQ Explorer allows you to perform local or remote administration of your network from a computer running Windows (x86 platform), or Linux (x86 and x86-64 platforms), by pointing the IBM MQ Explorer at the queue managers and clusters you are interested in. The platforms and levels of IBM MQ that can be administered using the IBM MQ Explorer are described in [Remote queue managers](#).

With the IBM MQ Explorer, you can:

- Start and stop a queue manager (on your local machine only).
- Define, display, and alter the definitions of IBM MQ objects such as queues, topics, and channels.
- Browse the messages on a queue.
- Start and stop a channel.
- View status information about a channel.
- View queue managers in a cluster.
- Check to see which applications, users, or channels have a particular queue open.
- Create a new queue manager cluster using the **Create New Cluster** wizard.
- Add a queue manager to a cluster using the **Add Queue Manager to Cluster** wizard.
- Manage the authentication information object, used with Secure Sockets Layer (SSL) channel security.

Using the online guidance, you can:

- Define and control various resources including queue managers, queues, channels, process definitions, client connection channels, listeners, topics, services, namelists, and clusters.
- Start or stop a queue manager and its associated processes.
- View queue managers and their associated objects on your workstation or from other workstations.
- Check the status of queue managers, clusters, and channels.

Ensure that you have satisfied the following requirements before attempting to use the IBM MQ Explorer to manage IBM MQ on a server machine. Check that:

1. A command server is running for **any** queue manager being administered, started on the server by the CL command **STRMQMSVR**.
2. A suitable TCP/IP listener exists for every remote queue manager. This is the IBM MQ listener started by the **STRMQMLSR** command.
3. The server connection channel, called `SYSTEM.ADMIN.SVRCONN`, exists on every remote queue manager. You **must** create this channel yourself. It is mandatory for every remote queue manager being administered. Without it, remote administration is not possible.
4. Verify that the `SYSTEM.MQEXPLORER.REPLY.MODEL` queue exists.



## Managing the command server for remote administration

Use this information to learn about the remote administration of IBM MQ IBM i command server.

Each queue manager can have a command server associated with it. A command server processes any incoming commands from remote queue managers, or PCF commands from applications. It presents the commands to the queue manager for processing and returns a completion code or operator message depending on the origin of the command.

A command server is mandatory for all administration involving PCFs, the MQAI, and also for remote administration.

**Note:** For remote administration, you must ensure that the target queue manager is running. Otherwise, the messages containing commands cannot leave the queue manager from which they are issued. Instead, these messages are queued in the local transmission queue that serves the remote queue manager. Avoid this situation if at all possible.

There are separate control commands for starting and stopping the command server. You can perform the operations described in the following sections using the IBM MQ Explorer.

### Starting and stopping the command server

To start the command server, use this CL command:

```
STRMQMCSVR MQMNAME('saturn.queue.manager')
```

where `saturn.queue.manager` is the queue manager for which the command server is being started.

To stop the command server, use one of the following CL commands:

1. 

```
ENDMQMCSVR MQMNAME('saturn.queue.manager') OPTION(*CNTRLD)
```

to perform a controlled stop, where `saturn.queue.manager` is the queue manager for which the command server is being stopped. This is the default option, which means that the `OPTION(*CNTRLD)` can be omitted.

2. 

```
ENDMQMCSVR MQMNAME('saturn.queue.manager') OPTION(*IMMED)
```

to perform an immediate stop, where `saturn.queue.manager` is the queue manager for which the command server is being stopped.

### Displaying the status of the command server

For remote administration, ensure that the command server on the target queue manager is running. If it is not running, remote commands cannot be processed. Any messages containing commands are queued in the target queue manager's command queue `SYSTEM.ADMIN.COMMAND.QUEUE`.

To display the status of the command server for a queue manager, called here `saturn.queue.manager`, the CL command is:

```
DSPMQMCSVR MQMNAME('saturn.queue.manager')
```

Issue this command on the target machine. If the command server is running, the panel shown in [Figure 33 on page 194](#) appears:

```

Display MQM Command Server (DSPMQMCSVR)

Queue manager name . . . . . > saturn.queue.manager
MQM Command Server Status. . . . > RUNNING

F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys

```

Figure 33. Display MQM Command Server panel

## Work management

This information describes the way in which IBM MQ handles work requests, and details the options available for prioritizing and controlling the jobs associated with IBM MQ.

### Warning

Do **not** alter IBM MQ work management objects unless you fully understand the concepts of IBM i and IBM MQ work management.

Additional information regarding subsystems and job descriptions can be found under [Work Management](#) in the IBM i product documentation. Pay particular attention to the sections on [Starting jobs](#) and [Batch jobs](#).

IBM MQ for IBM i incorporates the IBM i UNIX environment and IBM i threads. Do **not** make any changes to the objects in the Integrated File System (IFS).

During normal operations, an IBM MQ queue manager starts a number of batch jobs to perform different tasks. By default these batch jobs run in the QMQM subsystem that is created when IBM MQ is installed.

Work management refers to the process of tailoring IBM MQ tasks to obtain the optimum performance from your system, or to make administration simpler.

For example, you can:

- Change the run-priority of jobs to make one queue manager more responsive than another.
- Redirect the output of a number of jobs to a particular output queue.
- Make all jobs of a certain type run in a specific subsystem.
- Isolate errors to a subsystem.

Work management is carried out by creating or changing the job descriptions associated with the IBM MQ jobs. You can configure work management for:

- An entire IBM MQ installation.
- Individual queue managers.
- Individual jobs for individual queue managers.

### Description of IBM MQ tasks

This is a table of the IBM MQ jobs and a brief description of each.

When a queue manager is running, you see some or all of the following batch jobs running under the QMQM user profile in the IBM MQ subsystem. The jobs are described briefly in [Table 11 on page 195](#).

You can view all jobs connected to a queue manager using option 22 on the **Work with Queue Manager** (WRKMQM) panel. You can view listeners using the WRKMQMLSR command.

<i>Table 11. IBM MQ tasks.</i>	
<b>Job name</b>	<b>Function</b>
AMQALMPX	The checkpoint processor that periodically takes journal checkpoints.
AMQZMUC0	Utility manager. This job executes critical queue manager utilities, for example the journal chain manager.
AMQZXMA0	The execution controller that is the first job started by the queue manager. It handles MQCONN requests, and starts agent processes to process IBM MQ API calls.
AMQZFUMA	Object authority manager (OAM).
AMQZLAA0	Queue manager agents that perform most of the work for applications that connect to the queue manager using MQCNO_STANDARD_BINDING.
AMQZLSA0	Queue manager agent.
AMQZMUFO	Utility Manager
AMQZMGRO	Process controller. This job is used to start up and manage listeners and services.
AMQZMURO	Utility manager. This job executes critical queue manager utilities, for example the journal chain manager.
AMQFQPUB	Queued publish/subscribe daemon.
AMQFCXBA	Broker worker job.
RUNMQBRK	Broker control job.
AMQRMPPA	Channel process pooling job.
AMQCRSTA	TCP/IP-invoked channel responder.
AMQCRS6B	LU62 receiver channel and client connection (see note).
AMQRRMFA	Repository manager for clusters.
AMQCLMAA	Non-threaded TCP/IP listener.
AMQPCSEA	PCF command processor that handles PCF and remote administration requests.
RUNMQTRM	Trigger monitor.
RUNMQDLQ	Dead letter queue handler.
RUNMQCHI	The channel initiator.
RUNMQCHL	Sender channel job that is started for each sender channel.
RUNMQLSR	Threaded TCP/IP listener.
AMQRCMLA	Channel MQSC and PCF command processor.

**Note:** The LU62 receiver job runs in the communications subsystem and takes its runtime properties from the routing and communications entries that are used to start the job. See [Initiated end \(Receiver\)](#) for more information.

## IBM MQ for IBM i work management objects

When IBM MQ is installed, various objects are supplied in the QMQM library to assist with work management. These objects are the ones necessary for IBM MQ jobs to run in their own subsystem.

Sample job descriptions are provided for two of the IBM MQ batch jobs. If no specific job description is provided for an IBM MQ job, it runs with the default job description QMQMJOB.

The work management objects that are supplied when you install IBM MQ are listed in [Table 12 on page 196](#) and the objects created for a queue manager are listed in [Table 13 on page 196](#)

**Note:** The work management objects can be found in the QMQM library and the queue manager objects can be found in the queue manager library.

Table 12. Work management objects		
Name	Type	Description
AMQALMPX	*JOB	The job description that is used by the checkpoint process
AMQZLAA0	*JOB	The job description that is used by the IBM MQ agent processes
AMQZLSA0	*JOB	The isolated bindings queue manager agent
AMQZXMA0	*JOB	The job description that is used by IBM MQ execution controllers
QMQM	*SBS	The subsystem in which all IBM MQ jobs run
QMQM	*JOB	The job queue attached to the supplied subsystem
QMQMJOB	*JOB	The default IBM MQ job description, used if there is not a specific job description for a job
QMQMSG	*MSG	The default message queue for IBM MQ jobs.
QMQMRUN20	*CLS	A class description for high priority IBM MQ jobs
QMQMRUN35	*CLS	A class description for medium priority IBM MQ jobs
QMQMRUN50	*CLS	A class description for low priority IBM MQ jobs

Table 13. Work management objects created for a queue manager		
Name	Type	Description
AMQA000000	*JRNRCV	Local journal receiver
AMQAJRN	*JRN	Local journal
AMQJRNINF	*USRSPC	User space that is updated with the latest journal receivers required for startup and media recovery of a queue manager. This user space can be queried by an application to determine which journal receivers require archiving and which can be safely deleted.
AMQAJRNMSG	*MSG	Local journal message queue
AMQCRC6B	*PGM	Program to start the LU6.2 connection
AMQRFOLD	*FILE	Migrated queue manager channel definition file
QMQMSG	*MSG	Queue manager message queue

## How IBM MQ uses the work management objects

This information describes the way in which IBM MQ uses the work management objects, and provides configuration examples.



**Attention:** Do not alter the job queue entry settings in the QMQM subsystem to limit the number of jobs allowed in the subsystem by priority. If you attempt to do this, you can stop essential IBM MQ jobs from running after they are submitted and cause the queue manager startup to fail.

To understand how to configure work management, you must first understand how IBM MQ uses job descriptions.

The job description used to start the job controls many attributes of the job. For example:

- The job queue on which the job is queued and on which subsystem the job runs.
- The routing data used to start the job and class that the job uses for its runtime parameters.
- The output queue that the job uses for print files.

The process of starting an IBM MQ job can be considered in three steps:

1. IBM MQ selects a job description.

IBM MQ uses the following technique to determine which job description to use for a batch job:

- a. Look in the queue manager library for a job description with the same name as the job. See [Understanding IBM MQ for IBM i queue manager library names](#) for further details about the queue manager library.
- b. Look in the queue manager library for the default job description QMQMJOB.
- c. Look in the QMQM library for a job description with the same name as the job.
- d. Use the default job description, QMQMJOB, in the QMQM library.

2. The job is submitted to the job queue.

Job descriptions supplied with IBM MQ have been set up, by default, to put jobs on to job queue QMQM in library QMQM. The QMQM job queue is attached to the supplied QMQM subsystem, so by default the jobs start running in the QMQM subsystem.

3. The job enters the subsystem and goes through the routing steps.

When the job enters the subsystem, the routing data specified on the job description is used to find routing entries for the job.

The routing data must match one of the routing entries defined in the QMQM subsystem, and this defines which of the supplied classes (QMQRUN20, QMQRUN35, or QMQRUN50) is used by the job.

**Note:** If IBM MQ jobs do not appear to be starting, make sure that the subsystem is running and the job queue is not held,

If you have modified the IBM MQ work management objects, make sure everything is associated correctly. For example, if you specify a job queue other than QMQM/QMQM on the job description, make sure that an ADDJOBQ is performed for the subsystem, that is, QMQM.

You can create a job description for each job documented in [Table 11 on page 195](#) using the following worksheet as an example:

```
What is the queue manager library name? _____
Does job description AMQZXA0 exist in the queue manager library? Yes No
Does job description QMQMJOB exist in the queue manager library? Yes No
Does job description AMQZXA0 exist in the QMQM library? Yes No
Does job description QMQMJOB exist in the QMQM library? Yes No
```

If you answer No to all these questions, create a global job description QMQMJOB in the QMQM library.

## The IBM MQ message queue

An IBM MQ message queue, QMQMMSG, is created in each queue manager library. Operating system messages are sent to this queue when queue manager jobs end and IBM MQ sends messages to the queue. For example, to report which journal receivers are needed at startup. Keep the number of messages in this message queue at a manageable size to make it easier to monitor.

## Default system examples

These examples show how an unmodified IBM MQ installation works when some of the standard jobs are submitted at queue manager startup time.

First, the AMQZXMA0 execution controller job starts.

1. Issue the **STRMQM** command for queue manager TESTQM.
  2. IBM MQ searches the queue manager library QMTESTQM, firstly for job description AMQZXMA0, and then job description QMQMJOB.
- Neither of these job descriptions exist, so IBM MQ looks for job description AMQZXMA0 in the product library QMQM. This job description exists, so it is used to submit the job.
3. The job description uses the IBM MQ default job queue, so the job is submitted to job queue QMQM/QMQM.
  4. The routing data on the AMQZXMA0 job description is QMQMRUN20, so the system searches the subsystem routing entries for one that matches that data.
- By default, the routing entry with sequence number 9900 has comparison data that matches QMQMRUN20, so the job is started with the class defined on that routing entry, which is also called QMQMRUN20.
5. The QMQM/QMQMRUN20 class has run priority set to 20, so the AMQZXMA0 job runs in subsystem QMQM with the same priority as most interactive jobs on the system.

Next, the AMQALMPX checkpoint process job starts.

1. IBM MQ searches the queue manager library QMTESTQM, firstly for job description AMQALPMX, and then job description QMQMJOB.
- Neither of these job descriptions exist, so IBM MQ looks for job descriptions AMQALMPX and QMQMJOB in the product library QMQM.
- Job description AMQALMPX does not exist but QMQMJOB does, so QMQMJOB is used to submit the job.
- Note:** The QMQMJOB job description is always used for IBM MQ jobs that do not have their own job description.
2. The job description uses the IBM MQ default job queue, so the job is submitted to job queue QMQM/QMQM.
  3. The routing data on the QMQMJOB job description is QMQMRUN35, so the system searches the subsystem routing entries for one that matches that data.
- By default, the routing entry with sequence number 9910 has comparison data that matches QMQMRUN35, so the job is started with the class defined on that routing entry, which is also called QMQMRUN35.
4. The QMQM/QMQMRUN35 class has run priority set to 35, so the AMQALMPX job runs in subsystem QMQM with a lower priority than most interactive jobs on the system, but higher priority than most batch jobs.

## Configuring work management examples

Use this information to learn how you can change and create IBM MQ job descriptions to change the runtime attributes of IBM MQ jobs.

The key to the flexibility of IBM MQ work management lies in the two-tier way that IBM MQ searches for job descriptions:

- If you create or change job descriptions in a queue manager library, those changes override the global job descriptions in QMQM, but the changes are *local* and affect that particular queue manager alone.
  - If you create or change global job descriptions in the QMQM library, those job descriptions affect all queue managers on the system, unless overridden locally for individual queue managers.
1. The following example increases the priority of channel control jobs for an individual queue manager.

To make the repository manager and channel initiator jobs, AMQRRMFA and RUNMQCHI, run as quickly as possible for queue manager TESTQM, carry out the following steps:

- a. Create local duplicates of the QMQM/QMQMJOB job description with the names of the IBM MQ processes that you want to control in the queue manager library. For example:

```
CRTDUPOBJ OBJ(QMQMJOB) FROMLIB(QMQM) OBJTYPE(*JOB) TOLIB(QMTESTQM)
NEWOBJ (RUNMQCHI)
CRTDUPOBJ OBJ(QMQMJOB) FROMLIB(QMQM) OBJTYPE(*JOB) TOLIB(QMTESTQM)
NEWOBJ (AMQRRMFA)
```

- b. Change the routing data parameter on the job description to ensure that the jobs use the QMQMRUN20 class.

```
CHGJOB JOB(QMTESTQM/RUNMQCHI) RTGDTA('QMQMRUN20')
CHGJOB JOB(QMTESTQM/AMQRRMFA) RTGDTA('QMQMRUN20')
```

The AMQRRMFA and RUNMQCHI jobs for queue manager TESTQM now:

- Use the new local job descriptions in the queue manager library
  - Run with priority 20, because the QMQMRUN20 class is used when the jobs enter the subsystem.
2. The following example defines a new run priority class for the QMQM subsystem.
- a. Create a duplicate class in the QMQM library, to allow other queue managers to access the class, by issuing the following command:

```
CRTDUPOBJ OBJ(QMQMRUN20) FROMLIB(QMQM) OBJTYPE(*CLS) TOLIB(QMQM)
NEWOBJ (QMQMRUN10)
```

- b. Change the class to have the new run priority by issuing the following command:

```
CHGCLS CLS(QMQM/QMQMRUN10) RUNPTY(10)
```

- c. Add the new class definition to the subsystem by issuing the following command:

```
ADDRTGE SBSD(QMQM/QMQM) SEQNBR(8999) CMPVAL('QMQMRUN10') PGM(QSYS/QCMD)
CLS(QMQM/QMQMRUN10)
```

**Note:** You can specify any numeric value for the routing sequence number, but the values must be in sequential order. This sequence number tells the subsystem the order in which routing entries are to be searched for a routing data match.

- d. Change the local or global job description to use the new priority class by issuing the following command:

```
CHGJOB JOB(QMQMlibname/QMQMJOB) RTGDTA('QMQMRUN10')
```

Now all the queue manager jobs associated with the QMLibraryname use a run priority of 10.

3. The following example runs a queue manager in its own subsystem

To make all the jobs for queue manager TESTQM run in the QBATCH subsystem, carry out the following steps:

- a. Create a local duplicate of the QMQM/QMQMJOBBD job description in the queue manager library with the command

```
CRTDUPOBJ OBJ(QMQMJOBBD) FROMLIB(QMQM) OBJTYPE(*JOBBD) TOLIB(QMTESTQM)
```

- b. Change the job queue parameter on the job description to ensure that the jobs use the QBATCH job queue.

```
CHGJOBBD JOBBD(QMTESTQM/QMQMJOBBD) JOBQ(*LIBL/QBATCH)
```

**Note:** The job queue is associated with the subsystem description. If you find that the jobs are staying on the job queue, verify that the job queue definition is defined on the SBSDB. Use the DSPSBSDB command for the subsystem and take option 6, "Job queue entries".

All jobs for queue manager TESTQM now:

- Use the new local default job description in the queue manager library
- Are submitted to job queue QBATCH.

To ensure that jobs are routed and prioritized correctly:

- Either create routing entries for the IBM MQ jobs in subsystem QBATCH, or
- Rely on a catch-all routing entry that calls QCMD, irrespective of what routing data is used.

This option works only if the maximum active jobs option for job queue QBATCH is set to \*NOMAX. The system default is 1.

4. The following example creates another IBM MQ subsystem

- a. Create a duplicate subsystem in the QMQM library by issuing the following command:

```
CRTDUPOBJ OBJ(QMQM) FROMLIB(QMQM) OBJTYPE(*SBSDB) TOLIB(QMQM) NEWOBJ(QMQM2)
```

- b. Remove the QMQM job queue by issuing the following command:

```
RMVJOBQE SBSDB(QMQM/QMQM2) JOBQ(QMQM/QMQM)
```

- c. Create a new job queue for the subsystem by issuing the following command:

```
CRTJOBQ JOBQ(QMQM/QMQM2) TEXT('Job queue for IBM MQ Queue Manager')
```

- d. Add a job queue entry to the subsystem by issuing the following command:

```
ADDJOBQE SBSDB(QMQM/QMQM2) JOBQ(QMQM/QMQM2) MAXACT(*NOMAX)
```

- e. Create a duplicate QMQMJOBBD in the queue manager library by issuing the following command:

```
CRTDUPOBJ OBJ(QMQMJOBBD) FROMLIB(QMQM) OBJTYPE(*JOBBD) TOLIB(QMLibraryname)
```

- f. Change the job description to use the new job queue by issuing the following command:

```
CHGJOBBD JOBBD(QMLibraryname/QMQMJOBBD) JOBQ(QMQM/QMQM2)
```

- g. Start the subsystem by issuing the following command:



```
STRSBS SBSD(QMQM/QMQM2)
```

**Note:**

- a. You can specify the subsystem in any library. If for any reason the product is reinstalled, or the QMQM library is replaced, any changes you made are removed.
  - b. All the queue manager jobs associated with the QMlibraryname now run under subsystem QMQM2.
5. The following example collects all output for a job type.

To collect all the checkpoint process, AMQALMPX, job logs for multiple queue managers onto a single output queue, carry out the following steps:

- a. Create an output queue, for example

```
CRTOUTQ OUTQ(MYLIB/CHKPTLOGS)
```

- b. Create a global duplicate of the QMQM/QMQMJOB job description, using the name of the IBM MQ process that you want to control, for example

```
CRTDUPOBJ OBJ(QMQMJOB) FROMLIB(QMQM) OBJTYPE(*JOB) NEWOBJ(AMQALMPX)
```

- c. Change the output queue parameter on the job description to point to your new output queue, and change the job logging level so that all messages are written to the job log.

```
CHGJOB JOB(QMQM/AMQALMPX) OUTQ(MYLIB/CHKPTLOGS) LOG(4 00 *SECLVL)
```

All IBM MQ AMQALMPX jobs, for all queue managers, use the new global AMQALMPX job description, provided that there are no local overriding job descriptions in the local queue manager library.

All job log spool files for these jobs are now written to output queue CHKPTLOGS in library MYLIB.

**Note:**

- a. The preceding example works only if the QPJOBLOG, or any print file, has a value of \*JOB for its output queue parameter. In the preceding example, the QSYS/QPDJOBLOG file needs OUTQ set to \*JOB.
- b. To change a system print file, use the CHGPRTF command. For example:

```
CHGPRTF PRTF(QJOBLOG) OUTQ(*JOB)
```

The \*JOB option indicates that your job descriptions must be used.

- c. You can send any spool files associated with the IBM MQ jobs to a particular output queue. However, verify that the print file being used has the appropriate value for the OUTQ parameter.

## Availability, backup, recovery, and restart

Use this information to understand how IBM MQ for IBM i uses the IBM i journaling support to help its backup and restore strategy.

You must be familiar with standard IBM i backup and recovery methods, and with the use of journals and their associated journal receivers on IBM i, before reading this section. For information on these topics, see [Backup and recovery](#).

To understand the backup and recovery strategy, you first need to understand how IBM MQ for IBM i organizes its data in the IBM i file system and the integrated file system (IFS).

IBM MQ for IBM i holds its data in an individual library for each queue manager instance, and in stream files in the IFS file system.

The queue manager specific libraries contain journals, journal receivers, and objects required to control the work management of the queue manager. The IFS directories and files contain IBM MQ configuration files, the descriptions of IBM MQ objects, and the data they contain.

Every change to these objects, that is recoverable across a system failure, is recorded in a journal *before* it is applied to the appropriate object. This has the effect that such changes can be recovered by replaying the information recorded in the journal.

You can configure IBM MQ for IBM i to use multiple queue manager instances on different servers to provide increased queue manager availability and speed up recovery in the case of a server or queue manager failure.

## IBM MQ for IBM i journals

Use this information to understand how IBM MQ for IBM i uses journals in its operation to control updates to local objects.

Each queue manager library contains a journal for that queue manager, and the journal has the name QM *GRLIB*/AMQ *A* JRN, where QM *GRLIB* is the name of the queue manager library, and *A* is a letter, *A* in the case of a single instance queue manager, that is unique to the queue manager instance.

QM *GRLIB* takes the name QM, followed by the name of the queue manager in a unique form. For example, a queue manager named TEST has a queue manager library named QMTEST. The queue manager library can be specified when creating a queue manager using the **CRTMQM** command.

Journals have associated journal receivers that contain the information being journaled. The receivers are objects to which information can only be appended and will fill up eventually.

Journal receivers use up valuable disk space with out-of-date information. However, you can place the information in permanent storage to minimize this problem. One journal receiver is attached to the journal at any particular time. If the journal receiver reaches its predetermined threshold size, it is detached and replaced by a new journal receiver. You can specify the threshold of journal receivers when you create a queue manager using **CRTMQM** and the **THRESHOLD** parameter.

The journal receivers associated with the local IBM MQ for IBM i journal exist in each queue manager library, and adopt a naming convention as follows:

```
AMQ Annnnnn
```

where

***A***

is a letter A-Z. It is A for single instance queue managers. It varies for different instances of a multi-instance queue manager.

***nnnnn***

is decimal 00000 to 99999 that is incremented by 1 for the next journal in the sequence.

***r***

is decimal 0 to 9, that is incremented by 1 each time a receiver is restored.

The sequence of the journals is based on date. However, the naming of the next journal is based on the following rules:

1. AMQA*r*nnnnnn goes to AMQA*r*(nnnnn+1), and nnnnn wraps when it reaches 99999. For example, AMQA099999 goes to AMQA000000, and AMQA999999 goes to AMQA900000.
2. If a journal with a name generated by rule 1 already exists, the message CPI70E3 is sent to the QSYSOPR message queue and automatic receiver switching stops.

The currently-attached receiver continues to be used until you investigate the problem and manually attach a new receiver.

3. If no new name is available in the sequence (that is, all possible journal names are on the system) you need to do both of the following:

- a. Delete journals no longer needed (see [“Journal management” on page 207](#)).
- b. Record the journal changes into the latest journal receiver using (**RCDMQMIMG**) and then repeat the previous step. This allows the old journal receiver names to be reused.

The AMQAJRN journal uses the MNGRCV(\*SYSTEM) option to enable the operating system to automatically change journal receivers when the threshold is reached. For more information on how the system manages receivers, see *IBM i Backup and Recovery*.

The journal receiver's default threshold value is 100,000 KB. You can set this to a larger value when you create the queue manager. The initial value of the LogReceiverSize attribute is written to the LogDefaults stanza of the mqsd.ini file.

When a journal receiver extends beyond its specified threshold, the receiver is detached and a new journal receiver is created, inheriting attributes from the previous receiver. Changes to the LogReceiverSize or LogASP attributes after a queue manager has been created are ignored when the system automatically attaches a new journal receiver

See [Changing configuration information on IBM i](#) for further details on configuring the system.

If you need to change the size of journal receivers after the queue manager has been created, create a new journal receiver and set its owner to QMQM using the following commands:

```
CRTJRNRCV JRNRCV(QM GRLIB/AMQ Arnnnnn) THRESHOLD(xxxxxx) +
TEXT('MQM LOCAL JOURNAL RECEIVER')
CHGOBJOWN OBJ(QM GRLIB/AMQ Arnnnnn) OBJTYPE(*JRNRCV) NEWOWN(QMQM)
```

where

**QMGRLIB**

Is the name of your queue manager library

**A**

Is the instance identifier (usually A).

**rrnnnnn**

Is the next journal receiver in the naming sequence described previously

**xxxxxx**

Is the new receiver threshold (in KB)

**Note:** The maximum size of the receiver is governed by the operating system. To check this value look at the THRESHOLD keyword on the **CRTJRNRCV** command.

Now attach the new receiver to the AMQAJRN journal with the command:

```
CHGJRN JRN(QMGRLIB/AMQ A JRN) JRNRCV(QMGRLIB/AMQ Annnnnn)
```

See [“Journal management” on page 207](#) for details on how to manage these journal receivers.

## IBM MQ for IBM i journal usage

Use this information to understand how IBM MQ for IBM i uses journals in its operation to control updates to local objects.

Persistent updates to message queues happen in two stages. The records representing the update are first written to the journal, then the queue file is updated.

The journal receivers can therefore become more up to date than the queue files. To ensure that restart processing begins from a consistent point, IBM MQ uses checkpoints.

A checkpoint is a point in time when the record described in the journal is the same as the record in the queue. The checkpoint itself consists of the series of journal records needed to restart the queue manager. For example, the state of all transactions (that is, units of work) active at the time of the checkpoint.

Checkpoints are generated automatically by IBM MQ. They are taken when the queue manager starts and shuts down, and after a certain number of operations are logged.

You can force a queue manager to take a checkpoint by issuing the RCDMQMIMG command against all objects on a queue manager and displaying the results, as follows:

```
RCDMQMIMG OBJ(*ALL) OBJTYPE(*ALL) MQMNAME(<Q_MGR_NAME>) DSPJRNDTA(*YES)
```

As the queues handle further messages, the checkpoint record becomes inconsistent with the current state of the queues.

When IBM MQ is restarted, it locates the latest checkpoint record in the log. This information is held in the checkpoint file that is updated at the end of every checkpoint. The checkpoint record represents the most recent point of consistency between the log and the data. The data from this checkpoint is used to rebuild the queues as they existed at the checkpoint time. When the queues are re-created, the log is then played forward to bring the queues back to the state they were in before system failure or close down.

To understand how IBM MQ uses the journal, consider the case of a local queue called TESTQ in the queue manager TEST. This is represented by the IFS file:

```
/QIBM/UserData/mqm/qmgrs/TEST/queues
```

If a specified message is put on this queue, and then retrieved from the queue, the actions that take place are shown in Figure 34 on page 204.

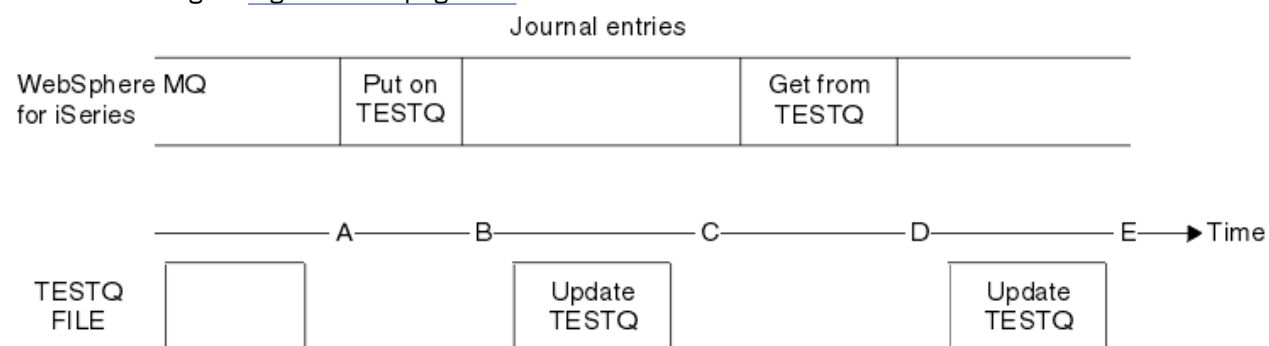


Figure 34. Sequence of events when updating MQM objects

The five points, A through E, shown in the diagram represent points in time that define the following states:

- A** The IFS file representation of the queue is consistent with the information contained in the journal.
- B** A journal entry is written to the journal defining a Put operation on the queue.
- C** The appropriate update is made to the queue.
- D** A journal entry is written to the journal defining a Get operation from the queue.
- E** The appropriate update is made to the queue.

The key to the recovery capabilities of IBM MQ for IBM i is that the user can save the IFS file representation of TESTQ as at time A, and subsequently recover the IFS file representation of TESTQ as at time E, by restoring the saved object and replaying the entries in the journal from time A onwards.

This strategy is used by IBM MQ for IBM i to recover persistent messages after system failure. IBM MQ remembers a particular entry in the journal receivers, and ensures that on startup it replays the entries in

the journals from this point onwards. This startup entry is periodically recalculated so that IBM MQ only has to perform the minimum necessary replay on the next startup.

IBM MQ provides individual recovery of objects. All persistent information relating to an object is recorded in the local IBM MQ for IBM i journals. Any IBM MQ object that becomes damaged or corrupt can be completely rebuilt from the information held in the journal.

For more information on how the system manages receivers, see [“Availability, backup, recovery, and restart” on page 201](#).

## Media images

Use this information to understand media images, and recovery from media images.

An IBM MQ object of long duration can represent a large number of journal entries, going back to the point at which it was created. To avoid this, IBM MQ for IBM i has the concept of a *media image* of an object.

This media image is a complete copy of the IBM MQ object recorded in the journal. If an image of an object is taken, the object can be rebuilt by replaying journal entries from this image onwards. The entry in the journal that represents the replay point for each IBM MQ object is referred to as its *media recovery entry*. IBM MQ keeps track of the:

- Media recovery entry for each queue manager object.
- Oldest entry from within this set (see error message AMQ7462 in [“Journal management” on page 207](#) for details).

Images of the \*CTLG object and the \*MQM object are taken regularly because these objects are crucial to queue manager restart.

Images of other objects are taken when convenient. By default, images of **all** objects are taken when a queue manager is shut down using the **ENDMQM** command with parameter ENDCCTJOB(\*YES). This operation can take a considerable amount of time for very large queue managers. If you need to shut down quickly, specify parameter RCDQMIMG(\*NO) with ENDCCTJOB(\*YES). In such cases, you are recommended to record a complete media image in the journals after the queue manager has been restarted, using the following command:

```
RCDQMIMG OBJ(*ALL) OBJTYPE(*ALL) MQMNAME(<Q_MGR_NAME>)
```

IBM MQ automatically records an image of an object, if it finds a convenient point at which an object can be compactly described by a small entry in the journal. However, this might never happen for some objects, for example, queues that consistently contain large numbers of messages.

Rather than allow the date of the oldest media recovery entry to continue for an unnecessarily long period, use the IBM MQ command RCDQMIMG, which enables you to take an image of selected objects manually.

## Recovery from media images

IBM MQ automatically recovers some objects from their media image if it is found that they are corrupt or damaged. In particular, this applies to the special \*MQM and \*CTLG objects as part of the normal queue manager startup. If any syncpoint transaction was incomplete at the time of the last shutdown of the queue manager, any queue affected is also recovered automatically, in order to complete the startup operation.

You must recover other objects manually, using the IBM MQ command RCRMQOBJ. This command replays the entries in the journal to re-create the IBM MQ object. Should an IBM MQ object become damaged, the only valid actions are to delete it or re-create it by this method. Note, however, that nonpersistent messages cannot be recovered in this fashion.

## Checkpoints

Checkpoints are taken at various times to provide a known consistent start point for recovery.

The checkpoint process AMQALMPX is responsible for taking the checkpoint at the following points:

- Queue manager startup (STRMQM).
- Queue manager shutdown (ENDMQM).
- After a period of time has elapsed since the last checkpoint (the default period is 30 minutes) and a minimum number of log records have been written since the previous checkpoint (the default value is 100).
- After a number of log records have been written. The default value is 10 000.
- After the journal threshold size has been exceeded and a new journal receiver has been automatically created.
- When a full media image is taken with:

```
RCDMQMIMG OBJ(*ALL) OBJTYPE(*ALL) MQMNAME(<Q_MGR_NAME>) DSPJRNDTA(*YES)
```

## Backups of IBM MQ for IBM i data

Use this information to understand the two types of IBM MQ backup for each queue manager.

For each queue manager, there are two types of IBM MQ backup to consider:

- Data and journal backup.

To ensure that both sets of data are consistent, do this only after shutting down the queue manager.

- Journal backup.

You can do this while the queue manager is active.

For both methods, you need to find the names of the queue manager IFS directory and the queue manager library. You can find these in the IBM MQ configuration file (mq.ini). For more information, see [The QueueManager stanza](#).

Use the following procedures to do both types of backup:

### Data and journal backup of a particular queue manager

**Note: Do not use a save-while-active request when the queue manager is running. Such a request cannot complete unless all commitment definitions with pending changes are committed or rolled back. If this command is used when the queue manager is active, the channel connections might not end normally. Always use the following procedure.**

1. Create an empty journal receiver, using the command:

```
CHGJRN JRN(QMTEST/AMQAJRN) JRNRCV(*GEN)
```

2. Use the **RCDMQMIMG** command to record an MQM image for all IBM MQ objects, and then force a checkpoint using the command:

```
RCDMQMIMG OBJ(*ALL) OBJTYPE(*ALL) DSPJRNDTA(*YES) MQMNAME(TEST)
```

3. End channels and ensure that the queue manager is not running. If your queue manager is running, stop it with the **ENDMQM** command.
4. Backup the queue manager library by issuing the following command:

```
SAVLIB LIB(QMTEST)
```

5. Back up the queue manager IFS directories by issuing the following command:

```
SAV DEV(...) OBJ(('QIBM/UserData/mqm/qmgrs/test'))
```

### Journal backup of a particular queue manager

Because all relevant information is held in the journals, as long as you perform a full save at some time, partial backups can be performed by saving the journal receivers. These record all changes since the time of the full backup and are performed by issuing the following commands:

1. Create an empty journal receiver, using the command:

```
CHGJRN JRN(QMTEST/AMQAJRN) JRNRCV(*GEN)
```

2. Use the **RCDMQMIMG** command to record an MQM image for all IBM MQ objects, and then force a checkpoint using the command:

```
RCDMQMIMG OBJ(*ALL) OBJTYPE(*ALL) DSPJRNDTA(*YES) MQMNAME(TEST)
```

3. Save the journal receivers using the command:

```
SAVOBJ OBJ(AMQ*) LIB(QMTEST) OBJTYPE(*JRNRCV) .....
```

A simple backup strategy is to perform a full backup of the IBM MQ libraries every week, and perform a daily journal backup. This, of course, depends on how you have set up your backup strategy for your enterprise.

### Journal management

As part of your backup strategy, take care of your journal receivers. It is useful to remove journal receivers from the IBM MQ libraries for various reasons:

- To release space; this applies to all journal receivers
- To improve the performance when starting (STRMQM)
- To improve the performance of recreating objects (RCRMQMOBJ)

Before deleting a journal receiver, you must take care that you have a backup copy and that you no longer need the journal receiver.

Journal receivers can be removed from the queue manager library *after* they have been detached from the journals and saved, provided that they are available for restoration if needed for a recovery operation.

The concept of journal management is shown in [Figure 35 on page 208](#).

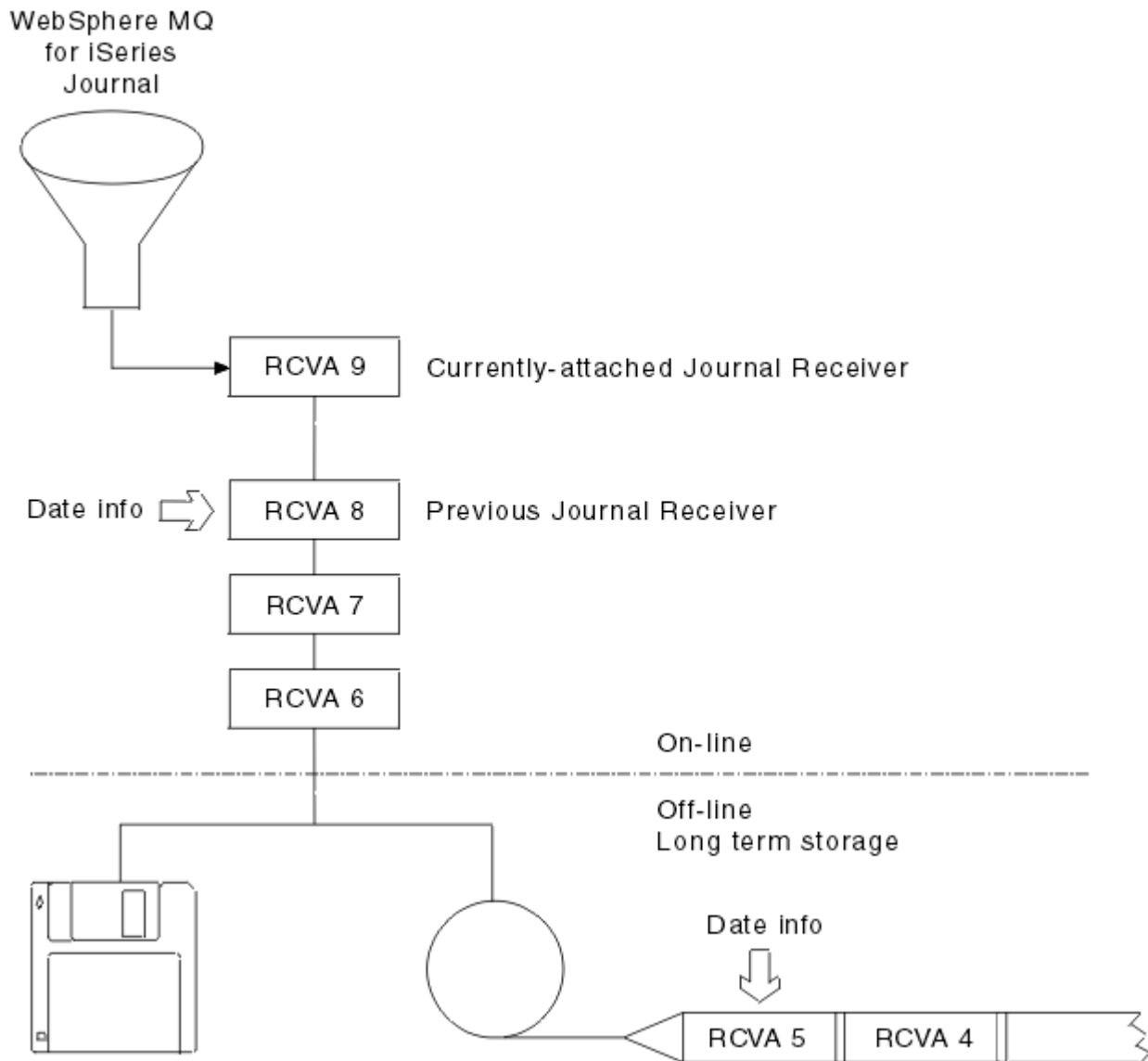


Figure 35. IBM MQ for IBM i journaling

It is important to know how far back in the journals IBM MQ is likely to need to go, in order to determine when a journal receiver that has been backed up can be removed from the queue manager library, and when the backup itself can be discarded.

IBM MQ issues two messages to the queue manager message queue (QMQMMSG in the queue manager library) to help determine this time. These messages are issued when it starts, when it changes a local journal receiver, and you use RCDQMIMG to force a checkpoint. The two messages are:

#### AMQ7460

Startup recovery point. This message defines the date and time of the startup entry from which IBM MQ replays the journal in the event of a startup recovery pass. If the journal receiver that contains this record is available in the IBM MQ libraries, this message also contains the name of the journal receiver containing the record.

#### AMQ7462

Oldest media recovery entry. This message defines the date and time of the oldest entry to use to re-create an object from its media image.

The journal receiver identified is the oldest one required. Any other IBM MQ journal receivers with older creation dates are no longer needed. If only stars are displayed, you need to restore backups from the date indicated to determine which is the oldest journal receiver.



When these messages are logged, IBM MQ also writes a user space object to the queue manager library that contains only one entry: the name of the oldest journal receiver that needs to be kept on the system. This user space is called AMQJRNINF, and the data is written in the format:

```
JJJJJJJJJJLLLLLLLLLLLLYYYYMMDDHHMMSSmmm
```

where:

**JJJJJJJJJJ**

Is the oldest receiver name that IBM MQ still needs.

**LLLLLLLLLL**

Is the journal receiver library name.

**YYYY**

Is the year of the oldest journal entry that IBM MQ needs.

**MM**

Is the month of the oldest journal entry that IBM MQ needs.

**DD**

Is the day of the oldest journal entry that IBM MQ needs.

**HH**

Is the hour of the oldest journal entry that IBM MQ needs.

**SS**

Is the seconds of the oldest journal entry that IBM MQ needs.

**mmm**

Is the milliseconds of the oldest journal entry that IBM MQ needs.

When the oldest journal receiver has been deleted from the system, this user space contains asterisks (\*) for the journal receiver name.

**Note:** Periodically performing RCDQMIMG OBJ(\*ALL) OBJTYPE(\*ALL) DSPJRNDTA(\*YES) can save startup time for IBM MQ and reduce the number of local journal receivers you need to save and restore for recovery.

IBM MQ for IBM i does not refer to the journal receivers unless it is performing a recovery pass either for startup, or for recreating an object. If it finds that a journal it requires is not present, it issues message AMQ7432 to the queue manager message queue (QMQMMSG), reporting the time and date of the journal entry it requires to complete the recovery pass.

If this happens, restore all journal receivers that were detached after this date from the backup, to allow the recovery pass to succeed.

Keep the journal receiver that contains the startup entry, and any subsequent journal receivers, available in the queue manager library.

Keep the journal receiver containing the oldest Media Recovery Entry, and any subsequent journal receivers, available at all times, and either present in the queue manager library or backed-up.

When you force a checkpoint:

- If the journal receiver named in AMQ7460 is not advanced, this indicates that there is an incomplete unit of work that needs to be committed or rolled back.
- If the journal receiver named in AMQ7462 is not advanced, this indicates that there are one or more damaged objects.

### ***Restoring a complete queue manager (data and journals)***

Use this information to restore one or more queue managers from a backup or from a remote machine.

If you need to recover one or more IBM MQ queue managers from a backup, perform the following steps.

1. Quiesce the IBM MQ queue managers.

2. Locate your latest backup set, consisting of your most recent full backup and subsequently backed up journal receivers.
3. Perform a RSTLIB operation, from the full backup, to restore the IBM MQ data libraries to their state at the time of the full backup, by issuing the following commands:

```
RSTLIB LIB(QMQRLIB1) .....
RSTLIB LIB(QMQRLIB2) .....
```

If a journal receiver was partially saved in one journal backup, and fully saved in a subsequent backup, restore only the fully saved one. Restore journals individually, in chronological order.

4. Perform an RST operation to restore the IBM MQ IFS directories to the IFS file system, using the following command:

```
RST DEV(...) OBJ((' /QIBM/UserData/mqm/qmgrs/testqm')) ...
```

5. Start the message queue manager. This replays all journal records written since the full backup and restores all the IBM MQ objects to the consistent state at the time of the journal backup.

If you want to restore a complete queue manager on a different machine, use the following procedure to restore everything from the queue manager library. (We use TEST as the sample queue manager name.)

1. CRTMQM TEST
2. DLTLIB LIB(QMTEST)
3. RSTLIB SAVLIB(QMTEST) DEV(\*SAVF) SAVF(QMGRLIBSAV)
4. Delete the following IFS files:

```
/QIBM/UserData/mqm/qmgrs/TEST/QMQMCHKPT
/QIBM/UserData/mqm/qmgrs/TEST/qmanager/QMQMOBJCAT
/QIBM/UserData/mqm/qmgrs/TEST/qmanager/QMANAGER
/QIBM/UserData/mqm/qmgrs/TEST/queues/SYSTEM.AUTH.DATA.QUEUE/q
/QIBM/UserData/mqm/qmgrs/TEST/queues/SYSTEM.CHANNEL.INITQ/q
/QIBM/UserData/mqm/qmgrs/TEST/queues/SYSTEM.CLUSTER.COMMAND.QUEUE/q
/QIBM/UserData/mqm/qmgrs/TEST/queues/SYSTEM.CLUSTER.REPOSITORY.QUEUE/q
/QIBM/UserData/mqm/qmgrs/TEST/queues/SYSTEM.CLUSTER.TRANSMIT.QUEUE/q
/QIBM/UserData/mqm/qmgrs/TEST/queues/SYSTEM.PENDING.DATA.QUEUE/q
/QIBM/UserData/mqm/qmgrs/TEST/queues/SYSTEM.ADMIN.COMMAND.QUEUE/q
```

5. STRMQM TEST
6. RCRMQMOBJ OBJ(\*ALL) OBJTYPE(\*ALL) MQMNAME(TEST)

### ***Restoring journal receivers for a particular queue manager***

Use this information to understand the different ways to restore journal receivers.

The most common action is to restore a backed-up journal receiver to a queue manager library, if a receiver that has been removed is needed again for a subsequent recovery function.

This is a simple task, and requires the journal receivers to be restored using the standard IBM i RSTOBJ command:

```
RSTOBJ OBJ(QMQMDATA/AMQA000005) OBJTYPE(*JRNRCV) .....
```

A series of journal receivers might need to be restored, rather than a single receiver. For example, AMQA000007 is the oldest receiver in the IBM MQ libraries, and both AMQA000005 and AMQA000006 need to be restored.

In this case, restore the receivers individually in reverse chronological order. This is not always necessary, but is good practice. In severe situations, you might need to use the IBM i command WRKJRNA to associate the restored journal receivers with the journal.

When restoring journals, the system automatically creates an attached journal receiver with a new name in the journal receiver sequence. However, the new name generated might be the same as a journal receiver you need to restore. Manual intervention is needed to overcome this problem; to create a new name journal receiver in sequence, and new journal before restoring the journal receiver.

For example, consider the problem with saved journal AMQAJRN and the following journal receivers:

- AMQA000000
- AMQA100000
- AMQA200000
- AMQA300000
- AMQA400000
- AMQA500000
- AMQA600000
- AMQA700000
- AMQA800000
- AMQA900000

When restoring journal AMQAJRN to a queue manager library, the system automatically creates journal receiver AMQA000000. This automatically generated receiver conflicts with one of the existing journal receivers (AMQA000000) you want to restore, which you cannot restore.

The solution is:

1. Manually create the next journal receiver (see [“IBM MQ for IBM i journals”](#) on page 202 ):

```
CRTJRNRCV JRNRCV(QMQRLIB/AMQA9000001) THRESHOLD(XXXXX)
```

2. Manually create the journal with the journal receiver:

```
CRTJRN JRN(QMGRLIB/AMQAJRN) MNGRCV(*SYSTEM) +  
JRNRCV(QMGRLIB/AMQA9000001) MSGQ(QMGRLIB/AMQAJRNMSG)
```

3. Restore the local journal receivers AMQA000000 to AMQA900000.

## Multi-instance queue managers

Multi-instance queue managers improve availability by automatically switching to a standby server if the active server fails. The active and standby servers are multiple instances of the same queue manager; they share the same queue manager data. If the active instance fails you need to transfer its journal to the standby that takes over so that the queue manager can rebuild its queues.

Configure the IBM i systems you are running multi-instance queue managers on so that, if the active queue manager instance fails, the journal it is using is available to the standby instance that takes over. You can design your own configuration and administration tasks to make the journal from the active instance available to the instance that takes over. If you do not want to lose messages, your design must ensure the standby journal is consistent with the active journal at the point of failure. You can adapt your design from one of the two configurations that are described with examples in subsequent topics that do maintain consistency.

1. Mirror the journal from the system that is running the active queue manager instance to the systems that are running standby instances.
2. Place the journal in an Independent Auxiliary Storage Pool (IASP) that is transferable from the system running the active instance to a standby instance.

The first solution requires no additional hardware or software as it uses basic ASPs. The second solution requires switchable IASPs which need IBM i clustering support that is available as a separately priced IBM i License Product 5761-SS1 Option 41.

## ***Reliability and availability***

Multi-instance queue managers aim to improve the availability of applications. Technological and physical constraints mean you need different solutions to meet the demands of disaster recovery, backing up queue managers and continuous operation.

In configuring for reliability and availability you trade off a large number of factors, resulting in four distinct design points:

### **Disaster recovery**

Optimized for recovery after a major disaster that destroys all your local assets.

Disaster recovery on IBM i is often based on geographic mirroring of IASP.

### **Backup**

Optimized for recovery after a localized failure, commonly a human error or some unforeseen technical problem.

IBM MQ provides backup queue managers to back up queue managers periodically. You could also use asynchronous replication of queue manager journals to improve the currency of the backup.

### **Availability**

Optimized for restoring operations quickly giving the appearance of a nearly uninterrupted service following foreseeable technical failures such as a server or disk failure.

Recovery is typically measured in minutes, with detection sometimes taking longer than the recovery process. A multi-instance queue manager assists you in configuring for *availability*.

### **Continuous operation**

Optimized for providing an uninterrupted service.

Continuous operation solutions have to solve the detection problem, and nearly always involve submitting the same work through more than one system and either using the first result, or if correctness is a major consideration, comparing at least two outcomes.

A multi-instance queue manager assists you in configuring for *availability*. One instance of the queue manager is active at a time. Switching over to a standby instance takes from a little more than ten seconds to a fifteen minutes or more, depending on how the system is configured, loaded and tuned.

A multi-instance queue manager can give the appearance of a nearly uninterrupted service if used with reconnectable IBM MQ MQI clients, which are able to continue processing without the application program necessarily being aware of a queue manager outage; see the topic [Automated client reconnection](#).

## ***Components of a high availability solution***

Construct a high availability solution using multi-instance queue managers by providing robust networked storage for queue manager data, journal replication or robust IASP storage for queue manager journals, and using reconnectable clients, of applications configured as restartable queue manager services.

A multi-instance queue manager reacts to the detection of queue manager failure by resuming the startup of another queue manager instance on another server. To complete its startup, the instance needs access to the shared queue manager data in networked storage, and to its copy of the local queue manager journal.

To create a high availability solution, you need to manage the availability of the queue manager data, the currency of the local queue manager journal, and either build reconnectable client applications, or deploy your applications as queue manager services to restart automatically when the queue manager resumes. Automatic client reconnect is not supported by IBM MQ classes for Java.

## **Queue manager data**

Place queue manager data onto networked storage that is shared, highly available and reliable, possibly by using RAID level 1 disks or greater. The file system needs to meet the requirements for a shared file system for multi-instance queue managers; for more information about the requirements for shared file

systems, see [Requirements for shared file systems](#). Network File System Version 4 (NFS4) is a protocol that meets these requirements.

## Queue manager journals

You also need to configure the IBM i journals used by the queue manager instances so that the standby instance is able to restore its queue manager data to a consistent state. For uninterrupted service, this means you must restore the journals to their state when the active instance failed. Unlike backup or disaster recovery solutions, restoring journals to an earlier checkpoint is not sufficient.

You cannot physically share journals between multiple IBM i systems on networked storage. To restore queue manager journals to the consistent state at the point of failure, you either need to transfer the physical journal that was local to the active queue manager instance at the time of failure to the new instance that has been activated, or maintain mirrors of the journal on running standby instances. The mirrored journal is a remote journal replica that has been kept exactly in sync with the local journal belonging to the failed instance.

Three configurations are starting points for designing how you manage the journals for a multi-instance queue manager,

1. Using synchronized journal replication (journal mirroring) from the active instance ASP, to the standby instances ASPs.
2. Transferring an IASP you have configured to hold the queue manager journal from the active instance to the standby instance that is taking over as the active instance.
3. Using synchronized secondary IASP mirrors.

See ASP options, for more information on putting queue manager data onto an iASP, in the IBM MQ IBM i CRTMQM command.

Also, see [High availability](#) in the IBM i information in IBM Documentation, and [Administrator > High Availability](#).

## Applications

To build a client to automatically reconnect to the queue manager when the standby queue manager resumes, connect your application to the queue manager using MQCONN and specify MQCNO\_RECONNECT\_Q\_MGR in the **MQCNO** Options field. See, [High availability sample programs](#) for three sample programs using reconnectable clients, and [Application recovery](#) for information about designing client applications for recovery.

### *Creating a network share for queue manager data using NetServer*

Create a network share on an IBM i server for storing queue manager data. Set up connections from two servers, which are going to host queue manager instances, to access the network share.

## Before you begin

- You require three IBM i servers for this task. The network share is defined on one of the servers, GAMMA. The other two servers, ALPHA and BETA, are to connect to GAMMA.
- Install IBM MQ on all three servers.
- Install the System i® Navigator; see [System i Navigator](#).

## About this task

- Create the queue manager directory on GAMMA and set the correct ownership and permissions for the user profiles QMQM and QMQMADM. The directory and permission are easily created by installing IBM MQ on GAMMA.
- Use System i Navigator to create a share to the queue manager data directory on GAMMA.
- Create directories on ALPHA and BETA that point to the share.

## Procedure

1. On GAMMA, create the directory to host the queue manager data with the QMQM user profile as the owner, and QMQMADM as the primary group.

### Tip:

A quick and reliable way to create the directory with the correct permissions is to install IBM MQ on GAMMA.

Later, if you do not want to run IBM MQ on GAMMA, uninstall IBM MQ. After uninstallation, the directory `/QIBM/UserData/mqm/qmgrs` remains on GAMMA with the owner QMQM user profile, and QMQMADM the primary group.

The task uses the `/QIBM/UserData/mqm/qmgrs` directory on GAMMA for the share.

2. Start the System i Navigator **Add connection** wizard and connect to the GAMMA system.
  - a) Double-click the **System i Navigator** icon on your Windows desktop.
  - b) Click **Yes** to create a connection.
  - c) Follow the instructions in the **Add Connection** wizard and create a connection from the IBM i system to GAMMA.

The connection to GAMMA is added to **My Connections**.

3. Add a new file share on GAMMA.
  - a) In the **System i Navigator** window, click the File Shares folder in My Connections/GAMMA/File Systems.
  - b) In the **My Tasks** window, click **Manage IBM i NetServer shares**.

A new window, **IBM i NetServer - GAMMA**, opens on your desktop and shows shared objects.
  - c) Right-click the Shared Objects folder > **File > New > File**.

A new window, **IBM i NetServer File Share - GAMMA**, opens.
  - d) Give the share a name, WMQ for example.
  - e) Set the access control to Read/Write.
  - f) Select the **Path name** by browsing to the `/QIBM/UserData/mqm/qmgrs` directory you created earlier, and click **OK**.

The **IBM i NetServer File Share - GAMMA** window closes, and WMQ is listed in the shared objects window.

4. Right click **WMQ** in the shared objects window. Click **File > Permissions**.

A window opens, **Qmgrs Permissions - GAMMA**, for the object `/QIBM/UserData/mqm/qmgrs`.

- a) Check the following permissions for QMQM, if they are not already set:

- Read
- Write
- Execute
- Management
- Existence
- Alter
- Reference

- b) Check the following permissions for QMQMADM, if they are not already set:

- Read
- Write
- Execute
- Reference

- c) Add other user profiles that you want to give permissions to `/QIBM/UserData/mqm/qmgrs`.

For example, you might give the default user profile (Public) Read and Execute permissions to /QIBM/UserData/mqm/qmgrs.

5. Check that all the user profiles that are granted access to /QIBM/UserData/mqm/qmgrs on GAMMA have the same password as they do on the servers that access GAMMA.

In particular, ensure that the QMQM user profiles on other servers, which are going to access the share, have the same password as the QMQM user profile on GAMMA.

**Tip:** Click the My Connections/GAMMA/Users and Groups folder in the System i Navigator to set the passwords. Alternatively, use the **CHFUSRPRF** and **CHGPWD** commands.

## Results

Check you can access GAMMA from other servers using the share. If you are doing the other tasks, check you can access GAMMA from ALPHA and BETA using the path /QNTC/GAMMA/WMQ. If the /QNTC/GAMMA directory does not exist on ALPHA or BETA then you must create the directory. Depending on the NetServer domain, you might have to IPL ALPHA or BETA before creating the directory.

```
CRTDIR DIR('/QNTC/GAMMA')
```

When you have checked that you have access to /QNTC/GAMMA/WMQ from ALPHA or BETA, issuing the command, `CRTMQM MQMNAME('QM1') MQMDIRP('/QNTC/GAMMA/WMQ')` creates /QIBM/UserData/mqm/qmgrs/QM1 on GAMMA.

## What to do next

Create a multi-instance queue manager by following the steps in either of the tasks, [“Creating a multi-instance queue manager using journal mirroring and NetServer”](#) on page 225 or [“Converting a single instance queue manager to a multi-instance queue manager using NetServer and journal mirroring”](#) on page 229.

## Fail over performance

The time it takes to detect a queue manager instance has failed, and then to resume processing on a standby can vary between tens of seconds to fifteen minutes or more depending on the configuration. Performance needs to be a major consideration in designing and testing a high availability solution.

There are advantages and disadvantages to weigh up in deciding whether to configure a multi-instance queue manager to use journal replication, or to use an IASP. Mirroring requires the queue manager to write synchronously to a remote journal. From a hardware point of view, this need not affect performance, but from a software perspective there is a greater pathlength involved in writing to a remote journal than just to a local journal, and this might be expected to reduce the performance of a running queue manager to some extent. However, when the standby queue manager takes over, the delay in synchronizing its local journal from the remote journal maintained by the active instance before it failed, is typically small in comparison to the time it takes for IBM i to detect and transfer the IASP to the server running the standby instance of the queue manager. IASP transfer times can be as much as ten to fifteen minutes rather than being completed in seconds. The IASP transfer time depends on the number of objects that need to be *varied-on* when the IASP is transferred to the standby system and the size of the access paths, or indexes, that need to be merged.

When the standby queue manager takes over, the delay in synchronizing its local journal from the remote journal maintained by the active instance before it failed, is typically small in comparison to the time it takes for IBM i to detect and transfer the independent ASP to the server running the standby instance of the queue manager. Independent ASP transfer times can be as much as ten to fifteen minutes rather than being completed in seconds. The independent ASP transfer time depends on the number of objects that need to be *varied-on* when the independent ASP is transferred to the standby system and the size of the access paths, or indices, that need to be merged.

However, transferring the journal is not the only factor influencing the time it takes for the standby instance to fully resume. You also need to consider the time it takes for the network file system to release the lock on queue manager data that signals to the standby instance to try to continue with its

start-up, and also the time it takes to recover queues from the journal so that the instance is able to start processing messages again. These other sources of delay all add to the time it takes to start a standby instance. The total time to switch over consists of the following components,

#### **Failure detection time**

The time it takes for NFS to release the lock on the queue manager data, and the standby instance to continue its startup process.

#### **Transfer time**

In the case of an HA cluster, the time it takes IBM i to transfer the IASP from the system hosting the active instance to the standby instance, and in the case of journal replication, the time it takes to update the local journal at the standby with the data from the remote replica.

#### **Restart time**

The time it takes for the newly active queue manager instance to rebuild its queues from the latest checkpoint in its restored journal and to resume processing messages.

#### **Note:**

If the standby instance that has taken over is configured to synchronously replicate to the previously active instance, the startup could be delayed. The new activated instance might be unable to replicate to its remote journal, if the remote journal is on the server that hosted the previously active instance, and the server has failed.

The default time to wait for a synchronous response is one minute. You can configure the maximum delay before the replication times out. Alternatively, you can configure standby instances to start using asynchronous replication to the failed active instance. Later you switch the to synchronous replication, when the failed instance is running on standby again. The same consideration applies to using synchronous independent ASP mirrors.

You can make separate baseline measurements for these components to help you assess the overall time to failover, and to factor into your decision which configuration approach to use. In making the best configuration decision you also need to consider how other applications on the same server will failover, and whether there are backup or disaster recovery processes that already use IASP.

IASP transfer times can be shortened by tuning your cluster configuration:

1. User profiles across systems in the cluster should have the same GID and UID to eliminate the need for the vary-on process to change UIDs and GIDs.
2. Minimize the number of database objects in the system and basic user disk pools, as these need to be merged to create the cross-reference table for the disk-pool group.
3. Further performance tips can be found in the IBM Redbook, *Implementing PowerHA® for IBM i, SG24-7405*.

A configuration using basic ASPs, journal mirroring, and a small configuration should switch over in the order of tens of seconds.

### ***Overview of combining IBM i clustering capabilities with IBM MQ clustering***

Running IBM MQ on IBM i, and exploiting the IBM i clustering capabilities can provide a more comprehensive High Availability solution, than using only IBM MQ clustering.

To have this capability, you need to set up:

1. Clusters on your IBM i machine; see [“IBM i clusters” on page 217](#)
2. An independent auxiliary storage pool (IASP), into which you move the queue manager; see [“Independent auxiliary storage pools \(IASPs\)” on page 217](#)
3. A cluster resource group (CRG); see [“Device cluster resource groups” on page 217](#), in which you define the:
  - Recovery domain
  - IASP
  - Exit program; see [“Device CRG exit program” on page 217](#)



## IBM i clusters

An IBM i cluster is a collection of instances, that is IBM i computers or partitions, that are logically linked together.

The purpose of this grouping is to allow for each instance to be backed up, eliminating a single point of failure and increasing application and data resiliency. With a cluster created, the various cluster resource group (CRG) types can be configured to manage applications, data, and devices in the cluster.

See [Creating a cluster](#) and the [Create Cluster \(CRTCLU\)](#) command for further information.

## Independent auxiliary storage pools (IASPs)

An IASP is a type of user ASP that serves as an extension of single-level storage. It is a piece of storage that, due to its independence from the system storage, can be easily manipulated without having to IPL the system.

An IASP can be easily switched to another operating system instance or replicated to a target IASP on another operating system instance. Two methods can be used to switch an IASP between instances:

- The first method requires all the computers in the cluster, and the switchable disk tower containing the IASP, to be connected using a High Speed Link (HSL) loop.
- The second method requires the operating system instances to be partitions on the same IBM i computer where input/output processors (IOPs) can be switched between partitions. No special hardware is needed to be able to replicate an IASP. The replication is performed using TCP/IP over the network.

See the [Configure Device ASP \(CFGDEVASP\)](#) command for more information.

## Device cluster resource groups

There are several types of cluster resource groups (CRGs). For more information about the different types of CRGs available, see [Cluster resource group](#).

This topic concentrates on a device CRG. A device CRG:

- Describes and manages device resources such as independent auxiliary storage pools (IASPs).
- Defines the recovery domain of the cluster nodes
- Assigns a device, and
- Assigns the exit program that will handle cluster events.

The recovery domain denotes which cluster node will be considered as the primary node. The rest of the nodes are considered to be backups. The backup nodes are also ordered in the recovery domain, specifying which node is the first backup, the second backup, and so on, depending on how many nodes there are in the recovery domain.

In the event of a primary node failure, the exit program is run on all nodes in the recovery domain. The exit program running on the first backup can then make the necessary initializations to make this node the new primary node.

See [Creating device CRGs](#) and the [Create Cluster Resource Group \(CRTCRG\)](#) command for more information.

## Device CRG exit program

The operating system cluster resource service calls a device CRG exit program when an event occurs in one of the nodes the recovery domain defines; for example, a failover or switchover event.

A failover event occurs when the primary node of the cluster fails and the CRGs are switched with all the resources they manage, and a switchover event occurs when a specific CRG is manually switched from the primary node to the backup node.

Either way, the exit program is in charge of initializing and starting all the programs that were running on the previous primary node, which converts the first backup node into the new primary node.

For example, with IBM MQ, the exit program should be in charge of starting the IBM MQ subsystem (QMQM), and queue managers. Queue managers should be configured to automatically start listeners and services, such as trigger monitors.

## Switchable IASP configuration

IBM MQ can be set up to take advantage of the clustering capabilities of IBM i. To do this:

1. Create an IBM i cluster between the data center systems
2. Move the queue manager to an IASP.

[“Moving, or removing, a queue manager to, or from, an independent auxiliary storage pool” on page 219](#) contains some sample code to help you carry out this operation.

3. You need to create a CRG defining the recovery domain, the IASP, and the exit program.

[“Configuring a device cluster resource group” on page 218](#) contains some sample code to help you carry out this operation.

### Related concepts

[“Independent ASPs and high availability” on page 238](#)

Independent ASPs enable applications and data to be moved between servers. The flexibility of independent ASPs means they are the basis for some IBM i high availability solutions. In considering whether to use an ASP or independent ASP for the queue manager journal, you should consider other high availability configuration based on independent ASPs.

*Configuring a device cluster resource group*

An example program to set up a device Cluster resource group (CRG).

## About this task

In the following example, note that:

- [PRIMARY SITE NAME] and [BACKUP SITE NAME] could be any two distinct strings of eight characters or fewer.
- [PRIMARY IP] and [BACKUP IP] are the IPs to be used for mirroring.

## Procedure

1. Identify the name of the cluster.
2. Identify the CRG exit program name and library.
3. Determine the name of the primary node and backup nodes to be defined by this CRG.
4. Identify the IASP to be managed by this CRG, and make sure it has been created under the primary node.
5. Create a device description in the backup nodes by using the command:

```
CRTDEVASP DEVD([IASP NAME]) RSRNAME([IASP NAME])
```

6. Add the takeover IP address to all the nodes by using the command:

```
ADDTCPIFC INTNETADR(' [TAKEOVER IP]') LIND([LINE DESC])  
SUBNETMASK(' [SUBNET MASK]') AUTOSTART(*NO)
```

7. Start the takeover IP address only in the primary node by using the command:

```
STRTCPIFC INTNETADR(' [TAKEOVER IP]')
```

8. Optional: If your IASP is switchable, call this command:

```
CRTCRG CLUSTER([CLUSTER NAME]) CRG([CRG NAME]) CRGTYPE(*DEV) EXITPGM([EXIT LIB]/[EXIT NAME])
USRPRF([EXIT PROFILE]) RCYDMN(([PRIMARY NODE] *PRIMARY) ([BACKUP NAME] *BACKUP))
EXITPGMFMT(EXTP0200) CFGOBJ([IAPS NAME] *DEV *ONLINE '[TAKEOVER IP]')
```

9. Optional: If your IASP is to be mirrored, call this command:

```
CRTCRG CLUSTER([CLUSTER NAME]) CRG([CRG NAME]) CRGTYPE(*DEV) EXITPGM([EXIT LIB]/[EXIT NAME])
USRPRF([EXIT PROFILE]) RCYDMN(([PRIMARY NODE] *PRIMARY *LAST [PRIMARY SITE NAME] ('[PRIMARY IP]'))
[BACKUP NAME] *BACKUP *LAST [BACKUP SITE NAME] ('[BACKUP IP]')) EXITPGMFMT(EXTP0200)
CFGOBJ([IAPS NAME] *DEV *ONLINE '[TAKEOVER IP]')
```

*Moving, or removing, a queue manager to, or from, an independent auxiliary storage pool*

An example program to move a queue manager to an independent auxiliary storage pool (IASP) and commands to remove a queue manager from an IASP.

## About this task

In the following example, note that:

- [MANAGER NAME] is the name of your queue manager.
- [IASP NAME] is the name of your IASP.
- [MANAGER LIBRARY] is the name of your queue manager library.
- [MANAGER DIRECTORY] is the name of your queue manager directory.

## Procedure

1. Identify your primary node and your backup nodes.
2. Carry out the following procedure on your primary node:

- a) Make sure your queue manager has ended.
- b) Make sure your IASP is vary on by using the command

```
VRYCFG CFGOBJ([IASP NAME]) CFGTYPE(*DEV) STATUS(*ON)
```

- c) Create the queue managers directory under the IASP.

There will be a directory under root with the name of your IASP, which is:

```
QSH CMD('mkdir -p /[IASP_NAME]/QIBM/UserData/mqm/qmgrs/')
```

- d) Move the IFS objects of your manager to the queue managers directory you have just created under the IASP using the following command:

```
QSH CMD('mv /QIBM/UserData/mqm/qmgrs/[MANAGER NAME]
/[IASP NAME]/QIBM/UserData/mqm/qmgrs')
```

- e) Create a temporary save file named MGRLIB by using the command:

```
CRTSAVF QGPL/MGRLIB
```

- f) Save your queue manager library to the MGRLIB save file, by using the following command:

```
SAVLIB LIB([MANGER LIBRARY]) DEV(*SAVF) SAVF(QGPL/MGRLIB)
```

- g) Delete the queue manager library by using the following command, and ignore all the inquiry messages:

```
DLTLIB [MANAGER LIBRARY]
```

- h) Restore your queue manager library to the IASP by using the following command:

```
RSTLIB SAVLIB([MANAGER LIBRARY]) DEV(*SAVF) SAVF(QGPL/MGRLIB)
RSTASPDEV([IASP NAME])
```

- i) Delete the temporary save file by using the following command:

```
DLTF FILE(QGPL/MGRLIB)
```

- j) Create a symbolic link to the queue manager IFS objects under the IASP, by using the following command:

```
ADDLNK OBJ('/[IASP NAME]/QIBM/UserData/mqm/qmgrs/[MANAGER NAME]')
NEWLNK('/QIBM/UserData/mqm/qmgrs/[MANAGER NAME]')
```

- k) Attach to the IASP by using the following command:

```
SETASPGRP [IASP NAME]
```

- l) Start your queue manager by using the command:

```
STRMQM [MANAGER NAME]
```

3. Carry out the following procedure on your backup node, or nodes:

- a) Create a temporary queue manager directory by using the following command:

```
QSH CMD('mkdir -p /[IASP NAME]/QIBM/UserData/mqm/qmgrs/[MANAGER NAME]')
```

- b) Create a symbolic link to the queue manager temporary directory by using the following command:

```
ADDLNK OBJ('/[IASP NAME]/QIBM/UserData/mqm/qmgrs/[MANAGER NAME]')
NEWLNK('/QIBM/UserData/mqm/qmgrs/[MANAGER NAME]')
```

- c) Delete the temporary directory by using the following command:

```
QSH CMD('rm -r /[IASP NAME]')
```

- d) Add the following at the end of the file `/QIBM/UserData/mqm/mqs.ini`:

```
QueueManager:
Name=[MANAGER NAME]
Prefix=/QIBM/UserData/mqm
Library=[MANAGER LIBRARY]
Directory=[MANAGER DIRECTORY]
```

4. To remove a queue manager from an IASP, issue the following commands:

- VRYCFG CFGOBJ([IASP NAME]) CFGTYPE(\*DEV) STATUS(\*ON)
- SETASPGRP [IASP NAME]
- ENDMQM [MANAGER NAME]
- DLTMQM [MANAGER NAME]

### ***Mirrored journal configuration for ASP***

Configure a robust multi-instance queue manager using synchronous replication between mirrored journals.

A mirrored queue manager configuration uses journals that are created in basic or independent auxiliary storage pools (ASP).

On IBM i, queue manager data is written to journals and to a file system. Journals contain the master copy of queue manager data. Journals are shared between systems using either synchronous or asynchronous journal replication. A mix of local and remote journals are required to restart a queue manager instance. Queue manager restart reads journal records from the mix of local and remote journals on the server, and the queue manager data on the shared network file system. The data in the file system

speeds up restarting the queue manager. Checkpoints are stored in the file system, marking points of synchronization between the file system and the journals. Journal records stored before the checkpoint are not required for typical queue manager restarts. However, the data in the file system might not be up to date, and journal records after the checkpoint are used to complete the queue manager restart. The data in the journals attached to the instance are kept up to date so that the restart can complete successfully.

But even the journal records might not be up to date, if the remote journal on the standby server was being asynchronously replicated, and the failure occurred before it was synchronized. In the event that you decide to restart a queue manager using a remote journal that is not synchronized, the standby queue manager instance might either reprocess messages that were deleted before the active instance failed, or not process messages that were received before the active instance failed.

Another, rare possibility, is that the file system contains the most recent checkpoint record, and an unsynchronized remote journal on the standby does not. In this case the queue manager does not restart automatically. You have a choice of waiting until the remote journal is synchronized, or cold starting the standby queue manager from the file system. Even though, in this case, the file system contains a more recent checkpoint of the queue manager data than the remote journal, it might not contain all the messages that were processed before the active instance failed. Some messages might be reprocessed, and some not processed, after a cold restart that is out of synchronization with the journals.

With a multi-instance queue manager, the file system is also used to control which instance of a queue manager is active, and which is the standby. The active instance acquires a lock to the queue manager data. The standby waits to acquire the lock, and when it does, it becomes the active instance. The lock is released by the active instance, if it ends normally. The lock is released by the file system if the file system detects the active instance has failed, or cannot access the file system. The file system must meet the requirements for detecting failure; see [Requirements for shared file systems](#).

The architecture of multi-instance queue managers on IBM i provides automatic restart following server or queue manager failure. It also supports restoration of queue manager data following failure of the file system where the queue manager data is stored.

In [Figure 36 on page 222](#), if ALPHA fails, you can manually restart QM1 on beta, using the mirrored journal. By adding the multi-instance queue manager capability to QM1, the standby instance of QM1 resumes automatically on BETA if the active instance on ALPHA fails. QM1 can also resume automatically if it is the server ALPHA that fails, not just the active instance of QM1. Once BETA becomes the host of the active queue manager instance, the standby instance can be started on ALPHA.

[Figure 36 on page 222](#) shows a configuration that mirrors journals between two instances of a queue manager using NetServer to store queue manager data. You might expand the pattern to include more journals, and hence more instances. Follow the journal naming rules explained in the topic, [“IBM MQ for IBM i journals” on page 202](#). Currently the number of running instances of a queue manager is limited to two, one is active and one is in standby.

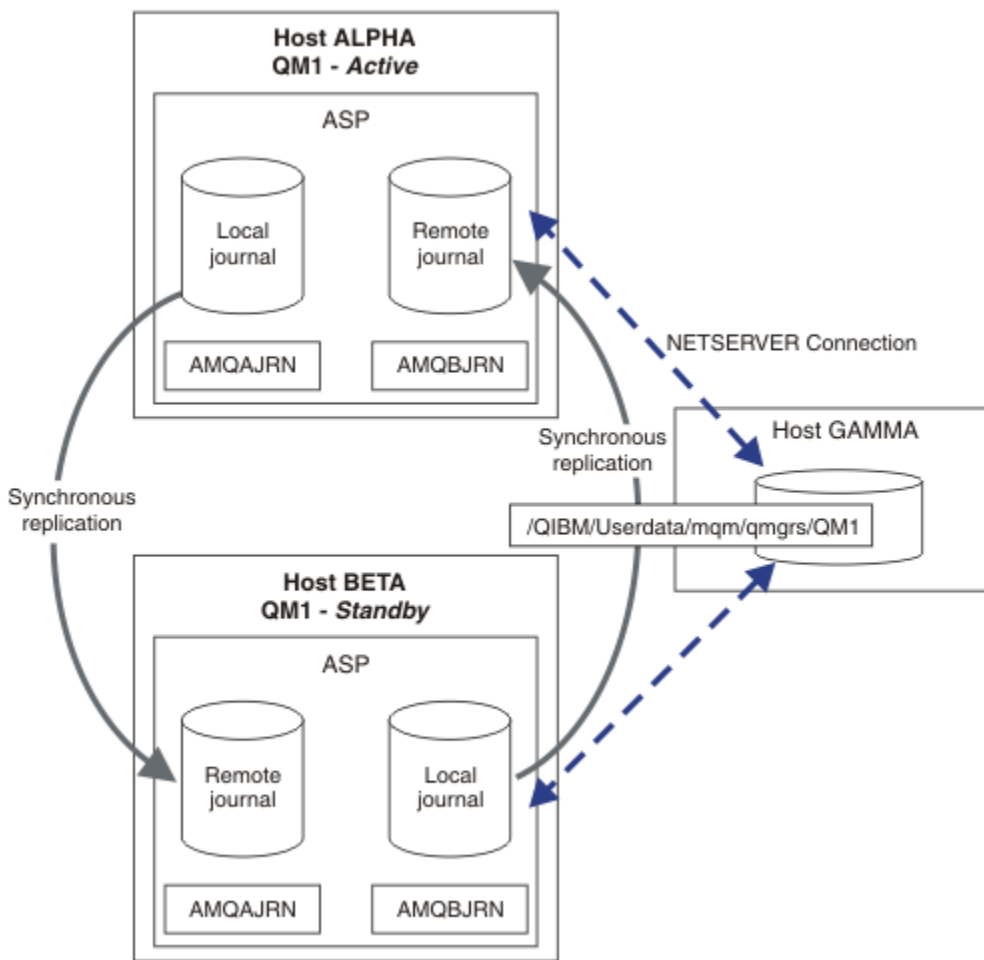


Figure 36. Mirror a queue manager journal

The local journal for QM1 on host ALPHA is called AMQAJRN (or more fully, QMQM1/AMQAJRN) and on BETA the journal is QMQM1/AMQBJRN. Each local journal replicates to remote journals on all other instances of the queue manager. If the queue manager is configured with two instances, a local journal is replicated to one remote journal.

### \*SYNC or \*ASync remote journal replication

IBM i journals are mirrored using either synchronous ( \*SYNC ) or asynchronous ( \*ASync ) journaling; see [Remote journal management](#).

The replication mode in [Figure 36 on page 222](#) is \*SYNC, not \*ASync. \*ASync is faster, but if a failure occurs when the remote journal state is \*ASyncPEND, the local and remote journal are not consistent. The remote journal must catch up with the local journal. If you choose \*SYNC, then the local system waits for the remote journal before returning from a call that requires a completed write. The local and remote journals generally remain consistent with one another. Only if the \*SYNC operation takes longer than a designated time <sup>1</sup>, and remote journaling is deactivated, do the journals get out of synchronization. An error is logged to the journal message queue and to QSYSOPR. The queue manager detects this message, writes an error to the queue manager error log, and deactivates remote replication of the queue manager journal. The active queue manager instance resumes without remote journaling to this journal. When the remote server is available again, you must manually reactivate synchronous remote journal replication. The journals are then resynchronized.

<sup>1</sup> The designated time is 60 seconds on IBM i Version 5 and in the range 1 - 3600 seconds on IBM i 6.1 onwards.

A problem with the \*SYNC / \*SYNC configuration illustrated in Figure 36 on page 222 is how the standby queue manager instance on BETA takes control. As soon as the queue manager instance on BETA writes its first persistent message, it attempts to update the remote journal on ALPHA. If the cause of control passing from ALPHA to BETA was the failure of ALPHA, and ALPHA is still down, remote journaling to ALPHA fails. BETA waits for ALPHA to respond, and then deactivates remote journaling and resumes processing messages with only local journaling. BETA has to wait a while to detect that ALPHA is down, causing a period of inactivity.

The choice between setting remote journaling to \*SYNC or \*ASYNCR is a trade-off. Table 14 on page 223 summarizes the trade-offs between using \*SYNC and \*ASYNCR journaling between a pair of queue managers:

Table 14. Remote journaling options			
Active	Standby	*SYNC	*ASYNCR
*SYNC		<ol style="list-style-type: none"> <li>1. Consistent switchover and failover</li> <li>2. The standby instance does not resume immediately after failover.</li> <li>3. Remote journaling must be available all the time</li> <li>4. Queue manager performance depends on remote journaling</li> </ol>	<ol style="list-style-type: none"> <li>1. Consistent switchover and failover</li> <li>2. Remote journaling must be switched to *SYNC when standby server available</li> <li>3. Remote journaling must remain available after it has been restarted</li> <li>4. Queue manager performance depends on remote journaling</li> </ol>
*ASYNCR		<ol style="list-style-type: none"> <li>1. Not a sensible combination</li> </ol>	<ol style="list-style-type: none"> <li>1. Some messages might be lost or duplicated after a failover or switchover</li> <li>2. Standby instance need not be available all the time for the active instance to continue without delay.</li> <li>3. Performance does not depend on remote journaling</li> </ol>

#### \*SYNC / \*ASYNCR

The active queue manager instance uses \*SYNC journaling, and when the standby queue manager instance starts, it immediately tries to use \*SYNC journaling.

1. The remote journal is transactionally consistent with the local journal of the active queue manager. If the queue manager is switched over to the standby instance, it can resume immediately. The standby instance normally resumes without any loss or duplication of messages. Messages are only lost or duplicated if remote journaling failed since the last checkpoint, and the previously active queue manager cannot be restarted.
2. If the queue manager fails over to the standby instance, it might not be able to start immediately. The standby queue manager instance is activated with \*SYNC journaling. The cause of the failover might prevent remote journaling to the server hosting the standby instance. The queue manager waits until the problem is detected before processing any persistent messages. An error is logged to the journal message queue and to QSYSOPR. The queue manager detects this message, writes an error to the queue manager error log, and deactivates remote replication of the queue manager journal. The active queue manager instance resumes without remote journaling to this journal. When the remote server is available again, you must manually reactivate synchronous remote journal replication. The journals are then resynchronized.
3. The server to which the remote journal is replicated must always be available to maintain the remote journal. The remote journal is typically replicated to the same server that hosts the standby queue manager. The server might become unavailable. An error is logged to the journal message queue and to QSYSOPR. The queue manager detects this message, writes an error to the queue

manager error log, and deactivates remote replication of the queue manager journal. The active queue manager instance resumes without remote journaling to this journal. When the remote server is available again, you must manually reactivate synchronous remote journal replication. The journals are then resynchronized.

4. Remote journaling is slower than local journaling, and substantially slower if the servers are separated by a large distance. The queue manager must wait for remote journaling, which reduces queue manager performance.

The \*SYNC / \*SYNC configuration between a pair of servers has the disadvantage of a delay in resuming the standby instance after failover. The \*SYNC / \*ASYNCR configuration does not have this problem.

\*SYNC / \*SYNC does guarantee no message loss after switchover or failover, as long as a remote journal is available. If you want to reduce the risk of message loss after failover or switchover you have two choices. Either stop the active instance if the remote journal becomes inactive, or create remote journals on more than one server.

#### **\*SYNC / \*ASYNCR**

The active queue manager instance uses \*SYNC journaling, and when the standby queue manager instance starts, it uses \*ASYNCR journaling. Shortly after the server hosting the new standby instance becomes available, the system operator must switch the remote journal on the active instance to \*SYNC. When the operator switches remote journaling from \*ASYNCR to \*SYNC the active instance pauses if the status of the remote journal is \*ASYNCPEND. The active queue manager instance waits until remaining journal entries are transferred to the remote journal. When the remote journal has synchronized with the local journal, the new standby is transactionally consistent again with the new active instance. From the perspective of the management of multi-instance queue managers, in a \*SYNC / \*ASYNCR configuration the IBM i system operator has an additional task. The operator must switch remote journaling to \*SYNC in addition to restarting the failed queue manager instance.

1. The remote journal is transactionally consistent with the local journal of the active queue manager. If the active queue manager instance is switched over, or fails over to the standby instance, the standby instance can then resume immediately. The standby instance normally resumes without any loss or duplication of messages. Messages are only lost or duplicated if remote journaling failed since the last checkpoint, and the previously active queue manager cannot be restarted.
2. The system operator must switch remote journal from \*ASYNCR to \*SYNC shortly after the system hosting the active instance becomes available again. The operator might wait for the remote journal to catch up before switching the remote journal to \*SYNC. Alternatively the operator might switch the remote instance to \*SYNC immediately, and force the active instance to wait until the standby instance journal has caught up. When remote journaling is set to \*SYNC, the standby instance is generally transactionally consistent with the active instance. Messages are only lost or duplicated if remote journaling failed since the last checkpoint, and the previously active queue manager cannot be restarted.
3. When the configuration has been restored from a switchover or failover, the server on which the remote journal is hosted must be available all the time.

Choose \*SYNC / \*ASYNCR when you want the standby queue manager to resume quickly after a failover. You must restore the remote journal setting to \*SYNC on the new active instance manually. The \*SYNC / \*ASYNCR configuration matches the normal pattern of administering a pair of multi-instance queue managers. After one instance has failed, there is a time before the standby instance is restarted, during which the active instance cannot fail over.

#### **\*ASYNCR / \*ASYNCR**

Both the servers hosting the active and standby queue managers are configured to use \*ASYNCR remote journaling.

1. When switchover or failover take place, the queue manager continues with the journal on the new server. The journal might not be synchronized when the switchover or failover takes place. Consequently messages might be lost or duplicated.
2. The active instance runs, even if the server hosting the standby queue manager is not be available. The local journal is replicated asynchronously with the standby server when it is available.



3. The performance of the local queue manager is unaffected by remote journaling.

Choose \*ASYNC / \*ASYNC if performance is your principal requirement, and you are prepared to loose or duplicate some messages after failover or switchover.

#### **\*ASYNC / \*SYNC**

There is no reason to use this combination of options.

### **Queue manager activation from a remote journal**

Journals are either replicated synchronously or asynchronously. The remote journal might not be active, or it might be catching up with the local journal. The remote journal might be catching up, even if it is synchronously replicated, because it might have been recently activated. The rules that the queue manager applies to the state of the remote journal it uses during start-up are as follows.

1. Standby startup fails if it must replay from the remote journal on the standby and the journal status is \*FAILED or \*INACTPEND.
2. When activation of the standby begins, the remote journal status on the standby must be either \*ACTIVE or \*INACTIVE. If the state is \*INACTIVE, it is possible for activation to fail, if not all the journal data has been replicated.

The failure occurs if the queue manager data on the network file system has a more recent checkpoint record than present in the remote journal. The failure is unlikely to happen, as long as the remote journal is activated well within the default 30 minute maximum interval between checkpoints. If the standby queue manager does read a more recent checkpoint record from the file system, it does not start.

You have a choice: Wait until the local journal on the active server can be restored, or cold start the standby queue manager. If you choose to cold start, the queue manager starts with no journal data, and relies on the consistency and completeness of the queue manager data in the file system.

**Note:** If you cold start a queue manager, you run the risk of losing or duplicating messages after the last checkpoint. The message transactions were written to the journal, but some of the transactions might not have been written to the queue manager data in the file system. When you cold start a queue manager, a fresh journal is started, and transactions not written to the queue manager data in the file system are lost.

3. The standby queue manager activation waits for the remote journal status on the standby to change from \*ASYNCPEND or \*SYNCPEND to \*ASYNC or \*SYNC. Messages are written to the job log of the execution controller periodically.

**Note:** In this case activation is waiting on the remote journal local to the standby queue manager that is being activated. The queue manager also waits for a time before continuing without a remote journal. It waits when it tries to write synchronously to its remote journal (or journals) and the journal is not available.

4. Activation stops if the journal status changes to \*FAILED or \*INACTPEND.

The names and states of the local and remote journals to be used in the activation are written to the queue manager error log.

#### *Creating a multi-instance queue manager using journal mirroring and NetServer*

Create a multi-instance queue manager to run on two IBM i servers. The queue manager data is stored on a third IBM i server using NetServer. The queue manager journal is mirrored between the two servers using remote journaling. The **ADDQMJRNR** command is used to simplify creating the remote journals.

### **Before you begin**

1. The task requires three IBM i servers. Install IBM MQ on two of them, ALPHA and BETA in the example. IBM MQ must be at least at version 7.0.1.1.
2. The third server is an IBM i server, connected by NetServer to ALPHA and BETA. It is used to share the queue manager data. It does not have to have an IBM MQ installation. It is useful to install IBM MQ on the server as a temporary step, to set up the queue manager directories and permissions.

3. Make sure that the QMQM user profile has the same password on all three servers.
4. Install IBM i NetServer; see [i5/OS NetServer](#).

## About this task

Perform the following steps to create the configuration shown in [Figure 37 on page 228](#). The queue manager data is connected using IBM i NetServer.

- Create connections from ALPHA and BETA to the directory share on GAMMA that is to store the queue manager data. The task also sets up the necessary permissions, user profiles and passwords.
- Add Relational Database Entries (RDBE) to the IBM i systems that are going to run queue manager instances. The RDBE entries are used to connect to the IBM i systems used for remote journaling.
- Create the queue manager QM1 on the IBM i server, ALPHA.
- Add the queue manager control information for QM1 on the other IBM i server, BETA.
- Create remote journals on both the IBM i servers for both queue manager instances. Each queue manager writes to the local journal. The local journal is replicated to the remote journal. The command, **ADDQMJRN** simplifies adding the journals and the connections.
- Start the queue manager, permitting a standby instance.

## Procedure

1. Do the task, [“Creating a network share for queue manager data using NetServer”](#) on page 213.

As a result, ALPHA and BETA have a share, /QNTC/GAMMA/WMQ, that points to /QIBM/UserData/mqm/qmgrs on GAMMA. The user profiles QMQM and QMQMADM have the necessary permissions, and QMQM has matching passwords on all three systems.

2. Add Relational Database Entries (RDBE) to the IBM i systems that are going to host queue manager instances.
  - a) On ALPHA create the connection to BETA.

```
ADDRDBDIRE RDB(BETA) RMTLOCNAME(BETA *IP) RMTAUTMTH(*USRIDPWD)
```

- b) On BETA create the connections to ALPHA.

```
ADDRDBDIRE RDB(ALPHA) RMTLOCNAME(ALPHA *IP) RMTAUTMTH(*USRIDPWD)
```

3. Create the queue manager QM1 on ALPHA, saving the queue manager data on GAMMA.

```
CRTMQM MQMNAME(QM1) UDLMSGQ(SYSTEM.DEAD.LETTER.QUEUE)
MQMDIRP(' /QNTC/GAMMA/WMQ ')
```

The path, /QNTC/GAMMA/WMQ , uses NetServer to create the queue manager data in /QIBM/UserData/mqm/qmgrs.

4. Run **ADDQMJRN** on ALPHA. The command adds a remote journal on BETA for QM1.

```
ADDQMJRN MQMNAME(QM1) RMTJRNRDB(BETA)
```

QM1 creates journal entries in its local journal on ALPHA when the active instance of QM1 is on ALPHA. The local journal on ALPHA is replicated to the remote journal on BETA.

5. Use the command, **DSPF**, to inspect the IBM MQ configuration data created by **CRTMQM** for QM1 on ALPHA.

The information is needed in the next step.

In this example, the following configuration is created in /QIBM/UserData/mqm/mqs.ini on ALPHA for QM1:

```
Name=QM1
Prefix=/QIBM/UserData/mqm
Library=QMOM1
Directory=QM1
DataPath= /QNTC/GAMMA/WMQ /QM1
```

6. Create a queue manager instance of QM1 on BETA using the **ADDQMINF** command. Run the following command on BETA to modify the queue manager control information in /QIBM/UserData/mqm/mqs.ini on BETA.

```
ADDQMINF MQMNAME(QM1)
PREFIX('/QIBM/UserData/mqm')
MQMDIR(QM1)
MQMLIB(QMOM1)
DATAPATH('/QNTC/GAMMA/WMQ /QM1')
```

**Tip:** Copy and paste the configuration information. The queue manager stanza is the same on ALPHA and BETA.

7. Run **ADDQMJRN** on BETA. The command adds a local journal on BETA and a remote journal on ALPHA for QM1.

```
ADDQMJRN MQMNAME(QM1) RMTJRNRDB(ALPHA)
```

QM1 creates journal entries in its local journal on BETA when the active instance of QM1 is on BETA. The local journal on BETA is replicated to the remote journal on ALPHA.

**Note:** As an alternative, you might want to set up remote journaling from BETA to ALPHA using asynchronous journaling.

Use this command to set up asynchronous journaling from BETA to ALPHA, instead of the command in step “7” on page 227.

```
ADDQMJRN MQMNAME (QM1) RMTJRNRDB (ALPHA) RMTJRNDLV (*ASYNC)
```

If the server or journaling on ALPHA is the source of the failure, BETA starts without waiting for new journal entries to be replicated to ALPHA.

Switch the replication mode to \*SYNC, using the **CHGMQMJRN** command, when ALPHA is online again.

Use the information in “[Mirrored journal configuration for ASP](#)” on page 220 to decide whether to mirror the journals synchronously, asynchronously, or a mixture of both. The default is to replicate synchronously, with a 60 second wait period for a response from the remote journal.

8. Verify that the journals on ALPHA and BETA are enabled and the status of remote journal replication is \*ACTIVE.
  - a) On ALPHA:

```
WRKMQMJRN MQMNAME(QM1)
```

- b) On BETA:

```
WRKMQMJRN MQMNAME(QM1)
```

9. Start the queue manager instances on ALPHA and BETA.

- a) Start the first instance on ALPHA, making it the active instance. Enabling switching over to a standby instance.

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

b) Start the second instance on BETA, making it the standby instance.

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

## Results

Use **WRKMQM** to check queue manager status:

1. The status of the queue manager instance on ALPHA should be \*ACTIVE.
2. The status of the queue manager instance on BETA should be \*STANDBY.

## Example

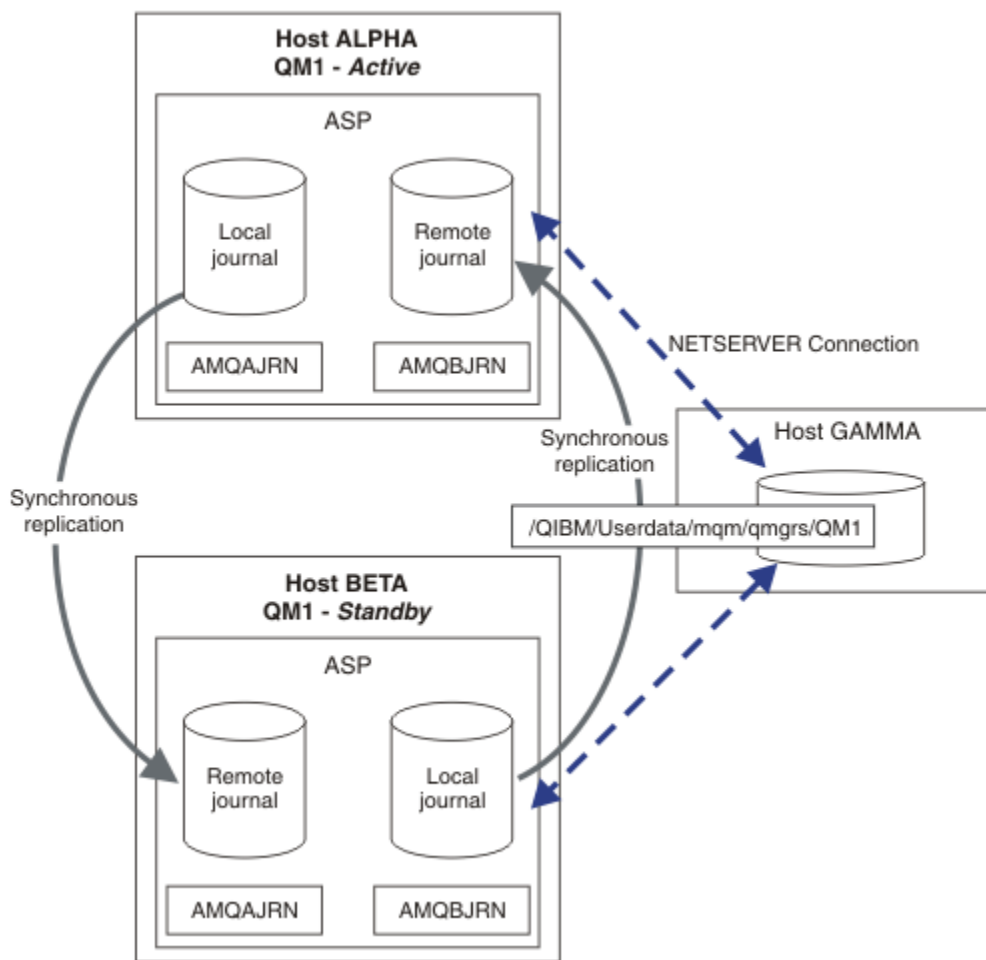


Figure 37. Mirrored journal configuration

## What to do next

- Verify that the active and standby instances switch over automatically. You can run the sample high availability sample programs to test the switch over; see [High availability sample programs](#). The sample programs are 'C' clients. You can run them from a Windows or Unix platform.

1. Start the high availability sample programs.
2. On ALPHA, end the queue manager requesting switch over:

```
ENDMQM MQMNAME(QM1) OPTION(*IMMED) ALSWITCH(*YES)
```

3. Check that the instance of QM1 on BETA is active.
4. Restart QM1 on ALPHA

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

- Look at alternative high availability configurations:
  1. Use NetServer to place the queue manager data on a Windows server.
  2. Instead of using remote journaling to mirror the queue manager journal, store the journal on an independent ASP. Use IBM i clustering to transfer the independent ASP from ALPHA to BETA.

#### *Converting a single instance queue manager to a multi-instance queue manager using NetServer and journal mirroring*

Convert a single instance queue manager to a multi-instance queue manager. Move the queue manager data to a network share connected by NetServer. Mirror the queue manager journal to a second IBM i server using remote journaling.

### Before you begin

1. The task requires three IBM i servers. The existing IBM MQ installation, on the server ALPHA in the example, must be at least at Version 7.0.1.1. ALPHA is running a queue manager called QM1 in the example.
2. Install IBM MQ on the second IBM i server, BETA in the example.
3. The third server is an IBM i server, connected by NetServer to ALPHA and BETA. It is used to share the queue manager data. It does not have to have an IBM MQ installation. It is useful to install IBM MQ on the server as a temporary step, to set up the queue manager directories and permissions.
4. Make sure that the QMQM user profile has the same password on all three servers.
5. Install IBM i NetServer; see [i5/OS NetServer](#).

### About this task

Perform the following steps to convert a single instance queue manager to the multi-instance queue manager shown in [Figure 38 on page 233](#). The single instance queue manager is deleted in the task, and then recreated, storing the queue manager data on the network share connected by NetServer. This procedure is more reliable than moving the queue manager directories and files to the network share using the **CPY** command.

- Create connections from ALPHA and BETA to the directory share on GAMMA that is to store the queue manager data. The task also sets up the necessary permissions, user profiles and passwords.
- Add Relational Database Entries (RDBE) to the IBM i systems that are going to run queue manager instances. The RDBE entries are used to connect to the IBM i systems used for remote journaling.
- Save the queue manager logs and definitions, stop the queue manager, and delete it.
- Recreate the queue manager, storing the queue manager data on the network share on GAMMA.
- Add the second instance of the queue manager to the other server.
- Create remote journals on both the IBM i servers for both queue manager instances. Each queue manager writes to the local journal. The local journal is replicated to the remote journal. The command, **ADDQMJRNL** simplifies adding the journals and the connections.
- Start the queue manager, permitting a standby instance.

#### Note:

In step “4” on page 230 of the task, you delete the single instance queue manager, QM1. Deleting the queue manager deletes all the persistent messages on queues. For this reason, complete processing all the messages stored by the queue manager, before converting the queue manager. If processing all the messages is not possible, back up the queue manager library before step “4” on page 230. Restore the queue manager library after step “5” on page 230.

**Note:**

In step “5” on page 230 of the task, you recreate QM1. Although the queue manager has the same name, it has a different queue manager identifier. Queue manager clustering uses the queue manager identifier. To delete and recreate a queue manager in a cluster, you must first remove the queue manager from the cluster; see [Removing a queue manager from a cluster: Alternative method](#) or [Removing a queue manager from a cluster](#). When you have recreated the queue manager, add it to the cluster. Although it has the same name as before, it appears to be a new queue manager to the other queue managers in the cluster.

## Procedure

1. Do the task, “[Creating a network share for queue manager data using NetServer](#)” on page 213.

As a result, ALPHA and BETA have a share, /QNTC/GAMMA/WMQ, that points to /QIBM/UserData/mqm/qmgrs on GAMMA. The user profiles QMQM and QMQMADM have the necessary permissions, and QMQM has matching passwords on all three systems.

2. Add Relational Database Entries (RDBE) to the IBM i systems that are going to host queue manager instances.

- a) On ALPHA create the connection to BETA.

```
ADDRDBDIRE RDB(BETA) RMTLOCNAME(BETA *IP) RMTAUTMTH(*USRIDPWD)
```

- b) On BETA create the connections to ALPHA.

```
ADDRDBDIRE RDB(ALPHA) RMTLOCNAME(ALPHA *IP) RMTAUTMTH(*USRIDPWD)
```

3. Create the scripts that recreate the queue manager objects.

```
QSAVEQMGR LCLQMGRNAM(QM1) FILENAME('*CURLIB/QMQSC(QM1)')  
OUTPUT(*REPLACE) MAKEAUTH(*YES) AUTHFN('*CURLIB/QMAUT(QM1)')
```

4. Stop the queue manager and delete it.

```
ENDMQM MQMNAME(QM1) OPTION(*IMMED) ENDCCTJOB(*YES) RCDMQMIMG(*YES) TIMEOUT(15)  
DLTMQM MQMNAME(QM1)
```

5. Create the queue manager QM1 on ALPHA, saving the queue manager data on GAMMA.

```
CRTMQM MQMNAME(QM1) UDLMSGQ(SYSTEM.DEAD.LETTER.QUEUE)  
MQMDIRP('/QNTC/GAMMA/WMQ')
```

The path, /QNTC/GAMMA/WMQ , uses NetServer to create the queue manager data in /QIBM/UserData/mqm/qmgrs.

6. Recreate the queue manager objects for QM1 from the saved definitions.

```
STRMQMQSC SRCMBR(QM1) SRCFILE(*CURLIB/QMQSC) MQMNAME(QM1)
```

7. Apply the authorizations from the saved information.

- a) Compile the saved authorization program.

```
CRTCLPGM PGM(*CURLIB/QM1) SRCFILE(*CURLIB/QMAUT)
SRCMBR(QM1) REPLACE(*YES)
```

- b) Run the program to apply the authorizations.

```
CALL PGM(*CURLIB/QM1)
```

- c) Refresh the security information for QM1.

```
RFRMQMAUT MQMNAME(QM1)
```

8. Run **ADDQMJRN** on ALPHA. The command adds a remote journal on BETA for QM1.

```
ADDQMJRN MQMNAME(QM1) RMTJRN RDB(BETA)
```

QM1 creates journal entries in its local journal on ALPHA when the active instance of QM1 is on ALPHA. The local journal on ALPHA is replicated to the remote journal on BETA.

9. Use the command, **DSPF**, to inspect the IBM MQ configuration data created by **CRTMQM** for QM1 on ALPHA.

The information is needed in the next step.

In this example, the following configuration is created in `/QIBM/UserData/mqm/mqs.ini` on ALPHA for QM1:

```
Name=QM1
Prefix=/QIBM/UserData/mqm
Library=QM1
Directory=QM1
DataPath= /QNTC/GAMMA/WMQ /QM1
```

10. Create a queue manager instance of QM1 on BETA using the **ADDQMINF** command. Run the following command on BETA to modify the queue manager control information in `/QIBM/UserData/mqm/mqs.ini` on BETA.

```
ADDQMINF MQMNAME(QM1)
PREFIX('/QIBM/UserData/mqm')
MQMDIR(QM1)
MQMLIB(QM1)
DATAPATH('/QNTC/GAMMA/WMQ /QM1')
```

**Tip:** Copy and paste the configuration information. The queue manager stanza is the same on ALPHA and BETA.

11. Run **ADDQMJRN** on BETA. The command adds a local journal on BETA and a remote journal on ALPHA for QM1.

```
ADDQMJRN MQMNAME(QM1) RMTJRN RDB(ALPHA)
```

QM1 creates journal entries in its local journal on BETA when the active instance of QM1 is on BETA. The local journal on BETA is replicated to the remote journal on ALPHA.

**Note:** As an alternative, you might want to set up remote journaling from BETA to ALPHA using asynchronous journaling.

Use this command to set up asynchronous journaling from BETA to ALPHA, instead of the command in step “7” on page 227.

```
ADDQMJRN MQMNAME(QM1) RMTJRN RDB(ALPHA) RMTJRN DLV(*ASYNCR)
```

If the server or journaling on ALPHA is the source of the failure, BETA starts without waiting for new journal entries to be replicated to ALPHA.

Switch the replication mode to \*SYNC, using the **CHGMQMJRN** command, when ALPHA is online again.

Use the information in [“Mirrored journal configuration for ASP”](#) on page 220 to decide whether to mirror the journals synchronously, asynchronously, or a mixture of both. The default is to replicate synchronously, with a 60 second wait period for a response from the remote journal.

12. Verify that the journals on ALPHA and BETA are enabled and the status of remote journal replication is \*ACTIVE.

a) On ALPHA:

```
WRKMQMJRN MQMNAME(QM1)
```

b) On BETA:

```
WRKMQMJRN MQMNAME(QM1)
```

13. Start the queue manager instances on ALPHA and BETA.

a) Start the first instance on ALPHA, making it the active instance. Enabling switching over to a standby instance.

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

b) Start the second instance on BETA, making it the standby instance.

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

## Results

Use **WRKMQM** to check queue manager status:

1. The status of the queue manager instance on ALPHA should be \*ACTIVE.
2. The status of the queue manager instance on BETA should be \*STANDBY.



## Example

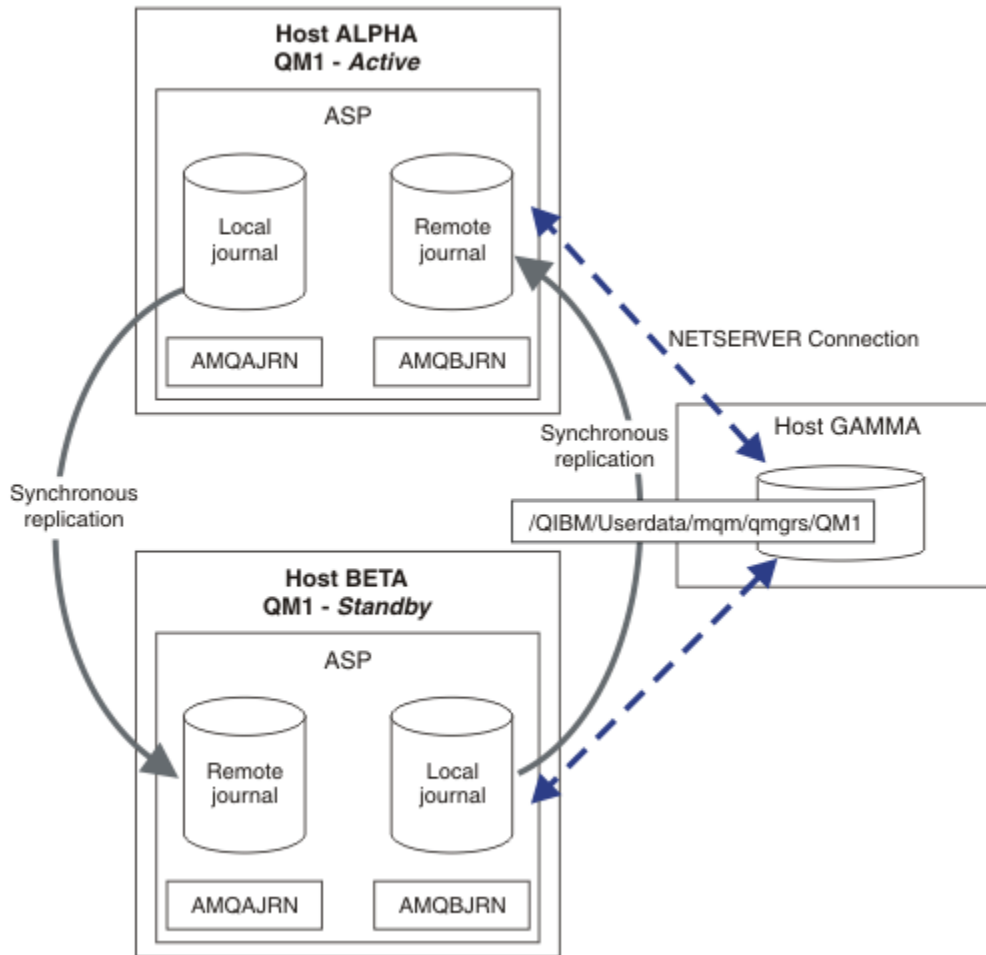


Figure 38. Mirrored journal configuration

## What to do next

- Verify that the active and standby instances switch over automatically. You can run the sample high availability sample programs to test the switch over; see [High availability sample programs](#). The sample programs are 'C' clients. You can run them from a Windows or Unix platform.

- Start the high availability sample programs.
- On ALPHA, end the queue manager requesting switch over:

```
ENDMQM MQMNAME(QM1) OPTION(*IMMED) ALSWITCH(*YES)
```

- Check that the instance of QM1 on BETA is active.
- Restart QM1 on ALPHA

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

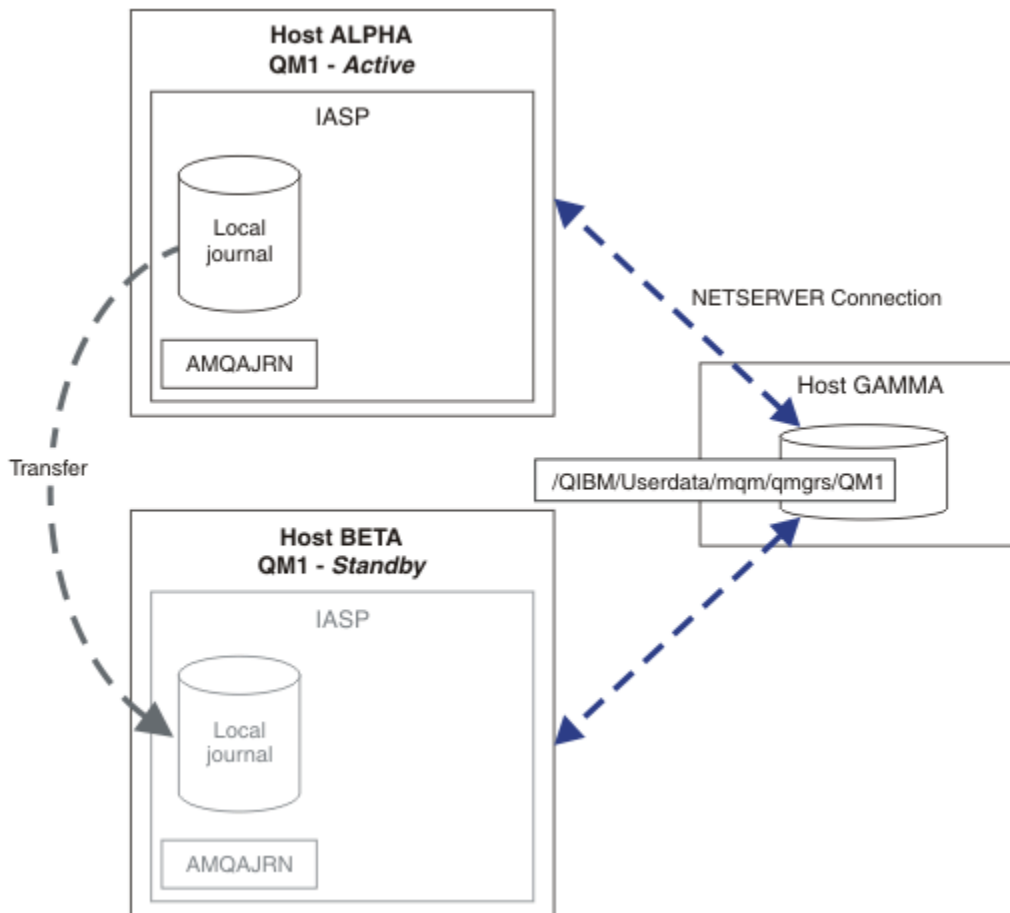
- Look at alternative high availability configurations:
  - Use NetServer to place the queue manager data on a Windows server.

2. Instead of using remote journaling to mirror the queue manager journal, store the journal on an independent ASP. Use IBM i clustering to transfer the independent ASP from ALPHA to BETA.

### **Switched independent ASP journal configuration**

You do not need to replicate an independent ASP journal to create a multi-instance queue manager configuration. You do need to automate a means to transfer the independent ASP from the active queue manager to the standby queue manager. There are alternative high availability solutions possible using an independent ASP, not all of which require using a multi-instance queue manager.

When using an independent ASP you do not need to mirror the queue manager journal. If you have installed cluster management, and the servers hosting the queue manager instances are in the same cluster resource group, then the queue manager journal can be transferred automatically to another server within a short distance of the active server, if the host running the active instance fails. You can also transfer the journal manually, as part of a planned switch, or you can write a command procedure to transfer the independent ASP programmatically.



*Figure 39. Transfer a queue manager journal using an independent ASP*

For multi-instance queue manager operation, queue manager data must be stored on a shared file system. The file system can be hosted on a variety of different platforms. You cannot store multi-instance queue manager data on an ASP or independent ASP.

The shared file system performs two roles in the configuration: The same queue manager data is shared between all instances of the queue manager. The file system must have a robust locking protocol that ensures only one instance of the queue manager has access to queue manager data once it has started. If the queue manager fails, or the communications to the file server breaks, then the file system must release the lock to the queue manager data held by the active instance that is no longer communicating with the file system. The standby queue manager instance can then gain read/write access

to the queue manager data. The file system protocol must conform to a set of rules to work correctly with multi-instance queue managers; see [“Components of a high availability solution”](#) on page 212.

The locking mechanism serializes the start queue manager command and controls which instance of the queue manager is active. Once a queue manager becomes active, it rebuilds its queues from the local journal that you, or the HA cluster, has transferred to the standby server. Reconnectable clients that are waiting for reconnection to the same queue manager get reconnected, and any inflight transactions are backed out. Applications that are configured to start as queue manager services are started.

You need to ensure that the local journal from the failed active queue manager instance on the independent ASP is transferred to the server that hosts the newly activated standby queue manager instance, either by configuring the cluster resource manager, or transferring the independent ASP manually. Using independent ASPs does not preclude configuring remote journals and mirroring, if you decide to use independent ASP for backup and disaster recovery, and use remote journal mirroring for multi-instance queue manager configuration.

If you have chosen to use an independent ASP, there are alternative highly available configurations you might consider. The background to these solutions are described in [“Independent ASPs and high availability”](#) on page 238.

1. Rather than use multi-instance queue managers, install and configure a single instance queue manager entirely on an independent ASP, and use IBM i high availability services to fail the queue manager over. You would probably need to augment the solution with a queue manager monitor to detect whether the queue manager has failed independently of the server. This is the basis of the solution provided in, *Supportpac MC41: Configuring IBM MQ for iSeries for High Availability*.
2. Use independent ASPs and cross site mirroring (XSM) to mirror the independent ASP rather than switching the independent ASP on the local bus. This extends the geographic range of the independent ASP solution to as far as the time taken to write log records over a long distance allows.

#### *Creating a multi-instance queue manager using an independent ASP and NetServer*

Create a multi-instance queue manager to run on two IBM i servers. The queue manager data is stored on an IBM i server using NetServer. The queue manager journal is stored on an independent ASP. Use IBM i clustering or a manual procedure to transfer the independent ASP containing the queue manager journal to the other IBM i server.

### **Before you begin**

1. The task requires three IBM i servers. Install IBM MQ on two of them, ALPHA and BETA in the example. IBM MQ must be at least at version 7.0.1.1.
2. The third server is an IBM i server, connected by NetServer to ALPHA and BETA. It is used to share the queue manager data. It does not have to have an IBM MQ installation. It is useful to install IBM MQ on the server as a temporary step, to set up the queue manager directories and permissions.
3. Make sure that the QMQM user profile has the same password on all three servers.
4. Install IBM i NetServer; see [i5/OS NetServer](#).
5. Create procedures to transfer the independent ASP from the failed queue manager to the standby that is taking over. You might find some of the techniques in *SupportPac MC41: Configuring IBM MQ for iSeries for High Availability* helpful in designing your independent ASP transfer procedures.

### **About this task**

Perform the following steps to create the configuration shown in [Figure 40 on page 237](#). The queue manager data is connected using IBM i NetServer.

- Create connections from ALPHA and BETA to the directory share on GAMMA that is to store the queue manager data. The task also sets up the necessary permissions, user profiles and passwords.
- Create the queue manager QM1 on the IBM i server, ALPHA.
- Add the queue manager control information for QM1 on the other IBM i server, BETA.
- Start the queue manager, permitting a standby instance.

## Procedure

1. Do the task, [“Creating a network share for queue manager data using NetServer”](#) on page 213.

As a result, ALPHA and BETA have a share, /QNTC/GAMMA/WMQ, that points to /QIBM/UserData/mqm/qmgrs on GAMMA. The user profiles QMQM and QMQMADM have the necessary permissions, and QMQM has matching passwords on all three systems.

2. Create the queue manager QM1 on ALPHA, saving the queue manager data on GAMMA.

```
CRTMQM MQMNAME(QM1) UDLSGQ(SYSTEM.DEAD.LETTER.QUEUE)
MQMDIR(' /QNTC/GAMMA/WMQ ')
```

The path, /QNTC/GAMMA/WMQ , uses NetServer to create the queue manager data in /QIBM/UserData/mqm/qmgrs.

3. Use the command, **DSPF**, to inspect the IBM MQ configuration data created by **CRTMQM** for QM1 on ALPHA.

The information is needed in the next step.

In this example, the following configuration is created in /QIBM/UserData/mqm/mqs.ini on ALPHA for QM1:

```
Name=QM1
Prefix=/QIBM/UserData/mqm
Library=QM1
Directory=QM1
DataPath= /QNTC/GAMMA/WMQ /QM1
```

4. Create a queue manager instance of QM1 on BETA using the **ADDQMINF** command. Run the following command on BETA to modify the queue manager control information in /QIBM/UserData/mqm/mqs.ini on BETA.

```
ADDQMINF MQMNAME(QM1)
PREFIX(' /QIBM/UserData/mqm ')
MQMDIR(QM1)
MQMLIB(QM1)
DATAPATH(' /QNTC/GAMMA/WMQ /QM1 ')
```

**Tip:** Copy and paste the configuration information. The queue manager stanza is the same on ALPHA and BETA.

5. Start the queue manager instances on ALPHA and BETA.
  - a) Start the first instance on ALPHA, making it the active instance. Enabling switching over to a standby instance.

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

- b) Start the second instance on BETA, making it the standby instance.

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

## Results

Use **WRKMQM** to check queue manager status:

1. The status of the queue manager instance on ALPHA should be \*ACTIVE.
2. The status of the queue manager instance on BETA should be \*STANDBY.

## Example

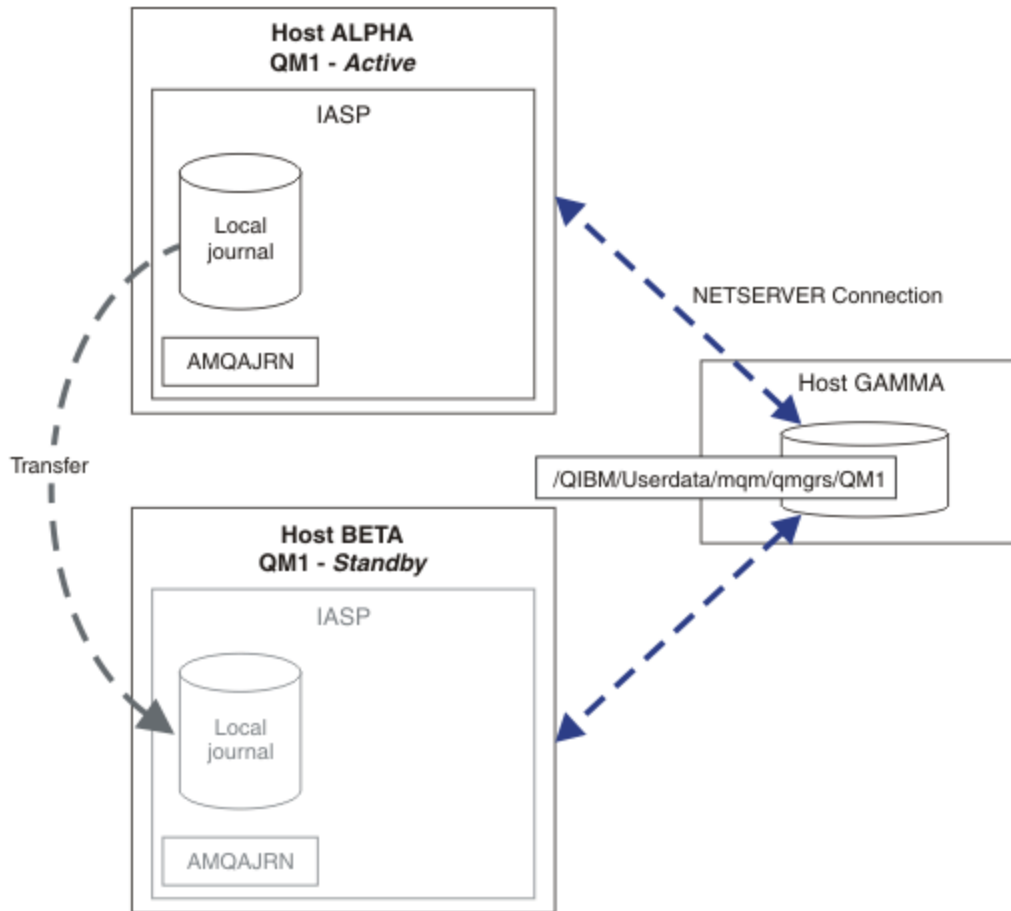


Figure 40. Transfer a queue manager journal using an independent ASP

## What to do next

- Verify that the active and standby instances switch over automatically. You can run the sample high availability sample programs to test the switch over; see [High availability sample programs](#). The sample programs are 'C' clients. You can run them from a Windows or Unix platform.

1. Start the high availability sample programs.
2. On ALPHA, end the queue manager requesting switch over:

```
ENDMQM MQMNAME(QM1) OPTION(*IMMED) ALSWITCH(*YES)
```

3. Check that the instance of QM1 on BETA is active.
4. Restart QM1 on ALPHA

```
STRMQM MQMNAME(QM1) STANDBY(*YES)
```

- Look at alternative high availability configurations:
  1. Use NetServer to place the queue manager data on an IBM i server.
  2. Instead of using an independent ASP to transfer the queue manager journal to the standby server, use remote journaling to mirror the journal onto the standby server.

### *Independent ASPs and high availability*

Independent ASPs enable applications and data to be moved between servers. The flexibility of independent ASPs means they are the basis for some IBM i high availability solutions. In considering whether to use an ASP or independent ASP for the queue manager journal, you should consider other high availability configuration based on independent ASPs.

Auxiliary storage pools (ASPs) are a building block of IBM i architecture. Disk units are grouped together to form a single ASP. By placing objects in different ASPs you can protect data in one ASP from being affected by disk failures in another ASP.

Every IBM i server has at least one *basic* ASP, known as the system ASP. It is designated as ASP1, and sometimes known as \*SYSBAS. You can configure up to 31 additional basic *user* ASPs that are indistinguishable from the system ASP from the application's point of view, because they share the same namespace. By using multiple basic ASPs to distribute applications over many disks you can improve performance and reduce recovery time. Using multiple basic ASPs can also provide some degree of isolation against disk failure, but it does not improve reliability overall.

Independent ASPs are a special type of ASP. They are often called independent disk pools. Independent disk pools are key component of IBM i high availability. You can store data and applications that regard themselves as independent from the current system to which they are connected on independent disk storage units. You can configure switchable or non-switchable independent ASPs. From an availability perspective you are generally only concerned with switchable independent ASPs, which can be transferred automatically from server to server. As a result you can move the applications and data on the independent ASP from server to server.

Unlike basic user ASPs, independent ASPs do not share the same namespace as the system ASP. Applications that work with user ASPs require changes to work with an independent ASP. You need to verify your software, and third-party software you use, works in an independent ASP environment.

When the independent ASP is attached to a different server the namespace of the independent ASP has to be combined with the namespace of the system ASP. This process is called *varying-on* the independent ASP. You can vary-on an independent ASP without IPLing the server. Clustering support is required to transfer independent ASPs automatically from one server to another.

## **Building reliable solutions with independent ASPs**

Journaling to an independent ASP, rather than journaling to an ASP and using journal replication, provides an alternative means to provide the standby queue manager with a copy of the local journal from the failed queue manager instance. To automatically transfer the independent ASP to another server you need to have installed and configured clustering support. There are a number of high-availability solutions for independent ASPs based on the cluster support, and low level disk mirroring, that you can combine with, or substitute for, using multi-instance queue managers.

The following list describes the components that are needed to build a reliable solution based on independent ASPs.

### **Journaling**

Queue managers, and other applications, use local journals to write persistent data safely to disk to protect against loss of data in memory due to server failure. This is sometimes termed point-in-time consistency. It does not guarantee the consistency of multiple updates that take place over a period of time.

### **Commitment control**

By using global transactions, you can coordinate updates to messages and databases so that the data written to the journal is consistent. It gives consistency over a period of time by using a two-phase commit protocol.

### **Switched disk**

Switched disks are managed by the device cluster resource group (CRG) in an HA cluster. CRG switches independent ASPs automatically to a new server in the case of an unplanned outage. CRGs are geographically limited to the extent of the local IO bus.

By configuring your local journal on a switchable independent ASP, you can transfer the journal to a different server, and resume processing messages. No changes to persistent messages made without syncpoint control, or committed with syncpoint control, are lost, unless the independent ASP fails.

If you use both journaling and commitment control on switchable independent ASPs, you can transfer database journals and queue manager journals to a different server and resume processing transactions with no loss of consistency or committed transactions.

### **Cross-site mirroring (XSM)**

XSM mirrors the primary independent ASP to a geographically remote secondary independent ASP across a TCP/IP network, and transfers control automatically in case of a failure. You have a choice of configuring a synchronous or asynchronous mirror. Synchronous mirroring reduces the performance of the queue manager because data is mirrored before the write operations on the production system complete, but it does guarantee the secondary independent ASP is up to date. Whereas if you use asynchronous mirroring you cannot guarantee that the secondary independent ASP is up to date. Asynchronous mirroring does maintain the consistency of the secondary independent ASP.

There are three XSM technologies.

#### **Geographic mirroring**

Geographic mirroring is an extension of clustering, enabling you to switch independent ASPs across a wide area. It has both synchronous and asynchronous modes. You can guarantee high availability only in synchronous mode, but the separation of independent ASPs might impact performance too much. You can combine geographic mirroring with switched disk to provide high availability locally and disaster recovery remotely.

#### **Metro mirroring**

Metro mirroring is a device level service that provides fast local synchronous mirroring over longer distances than the local bus. You can combine it with a multi-instance queue manager to give you high availability of the queue manager, and by having two copies of the independent ASP, high availability of the queue manager journal.

#### **Global mirroring**

Global mirroring is device level service that provides asynchronous mirroring, and is suitable for backing up and disaster recovery over longer distances, but is not a normal choice for high availability, because it only maintains point in time consistency rather than currency.

The key decision points you should consider are,

### **ASP or independent ASP?**

You do not need to run an IBM i HA cluster to use multi-instance queue managers. You might choose independent ASPs, if you are already using independent ASPs, or you have availability requirements for other applications that require independent ASPs. It might be worth combining independent ASPs with multi-instance queue managers to replace queue manager monitoring as a means of detecting queue manager failure.

### **Availability?**

What is the recovery time objective (RTO)? If you require the appearance of near uninterrupted behavior, then which solution has the quickest recovery time?

### **Journal availability?**

How do you eliminate the journal as a single point of failure. You might adopt a hardware solution, using RAID 1 devices or better, or you might combine or use a software solution using replica journals or disk mirroring.

### **Distance?**

How far apart are the active and standby queue manager instances. Can your users tolerate the performance degradation of replicating synchronously over distances greater than about 250 meters?

### **Skills?**

There is work to be done to automate the administrative tasks involved in maintaining and exercising the solution regularly. The skills required to do the automation are different for the solutions based on ASPs and independent ASPs.

## Deleting a multi-instance queue manager

Before you delete a multi-instance queue manager, stop remote journaling, and remove queue manager instances.

### Before you begin

1. In this example, two instances of the QM1 queue manager are defined on the servers ALPHA and BETA. ALPHA is the active instance and BETA is the standby. The queue manager data associated with the queue manager QM1 is stored on the IBM i server GAMMA, using NetServer. See [“Creating a multi-instance queue manager using journal mirroring and NetServer”](#) on page 225.
2. ALPHA and BETA must be connected so that any remote journals that are defined can be deleted by IBM MQ.
3. Verify that the /QNTC directory and server directory file share can be accessed, using the system commands **EDTF** or **WRKLNK**

### About this task

Before you delete a multi-instance queue manager from a server using the **DLTMQM** command, remove any queue manager instances on other servers using the **RMVMQMINF** command.

When you remove a queue manager instance using the **RMVMQMINF** command, local and remote journals prefixed with AMQ, and associated with the instance, are deleted. Configuration information about the queue manager instance, local to the server, is also deleted.

Do not run the **RMVMQMINF** command on the server holding the remaining instance of the queue manager. Doing so prevents **DLTMQM** from working correctly.

Delete the queue manager using the **DLTMQM** command. Queue manager data is removed from the network share. Local and remote journals prefixed with AMQ and associated with the instance are deleted. **DLTMQM** also deletes configuration information about the queue manager instance, local to the server.

In the example, there are only two queue manager instances. IBM MQ supports a running multi-instance configuration that has one active queue manager instance and one standby instance. If you have created additional queue manager instances to use in running configurations, remove them, using the **RMVMQMINF** command, before deleting the remaining instance.

### Procedure

1. Run the **CHGMQMJRN RMTJRNSTS** (\*INACTIVE) command on each server to make remote journaling between the queue manager instances inactive.

a) On ALPHA:

```
CHGMQMJRN MQMNAME('QM1')
RMTJRNRDB('BETA') RMTJRNSTS(*INACTIVE)
```

b) On BETA:

```
CHGMQMJRN MQMNAME('QM1')
RMTJRNRDB('ALPHA') RMTJRNSTS(*INACTIVE)
```

2. Run the **ENDMQM** command on ALPHA, the active queue manager instance, to stop both instances of QM1.

```
ENDMQM MQMNAME(QM1) OPTION(*IMMED) INSTANCE(*ALL) ENDCCTJOB(*YES)
```

3. Run the **RMVMQMINF** command on ALPHA to remove the queue manager resources for the instance from ALPHA and BETA.



```
RMVMQMINF MQMNAME(QM1)
```

**RMVMQMINF** removes the queue manager configuration information for QM1 from ALPHA. If the journal name is prefixed by AMQ, it deletes the local journal associated with QM1 from ALPHA. If the journal name is prefixed by AMQ and a remote journal has been created, it also removes the remote journal from BETA.

4. Run the **DLTMQM** command on BETA to delete QM1.

```
DLTMQM MQMNAME(QM1)
```

**DLTMQM** deletes the queue manager data from the network share on GAMMA. It removes the queue manager configuration information for QM1 from BETA. If the journal name is prefixed by AMQ, it deletes the local journal associated with QM1 from BETA. If the journal name is prefixed by AMQ and a remote journal has been created, it also removes the remote journal from ALPHA.

## Results

**DLTMQM** and **RMVMQMINF** delete the local and remote journals created by **CRTMQM** and **ADDQMQRN**. The commands also delete the journal receivers. The journals and journal receivers must follow the naming convention of having names starting with AMQ. **DLTMQM** and **RMVMQMINF** remove the queue manager objects, queue manager data, and the queue manager configuration information from `mq5.ini`.

## What to do next

An alternative approach is to issue the following commands after deactivating journaling in step [“1”](#) on [page 240](#) and before ending the queue manager instances. Or, if you have not followed the naming convention, you must delete the journals and journal receivers by name.

1. On ALPHA:

```
RMVMQMQRN MQMNAME('QM1') RMTJRNRDB('BETA')
```

2. On BETA:

```
RMVMQMQRN MQMNAME('QM1') RMTJRNRDB('ALPHA')
```

After deleting the journals, continue with the rest of the steps.

## ***Backing up a multi-instance queue manager***

The procedure shows you how to back up queue manager objects on the local server and the queue manager data on the network file server. Adapt the example to back up data for other queue managers.

## Before you begin

In this example, the queue manager data associated with the queue manager QM1 is stored on the IBM i server called GAMMA, using NetServer. See [“Creating a multi-instance queue manager using journal mirroring and NetServer”](#) on [page 225](#). IBM MQ is installed on the servers, ALPHA and BETA. The queue manager, QM1, is configured on ALPHA and BETA.

## About this task

IBM i does not support saving data from a remote directory. Save the queue manager data on a remote file system using the backup procedures local to the file system server. In this task, the network file system is on an IBM i server, GAMMA. The queue manager data is backed up in a save file on GAMMA.

If the network file system was on Windows or Linux, you might store the queue manager data in a compressed file, and then save it. If you have a back-up system, such as Tivoli Storage Manager, use it to back up the queue manager data.

## Procedure

1. Create a save file on ALPHA for the queue manager library associated with QM1.

Use the queue manager library name to name the save file.

```
CRTSAVF FILE(QGPL/QMQM1)
```

2. Save the queue manager library in the save file on ALPHA.

```
SAVLIB LIB(QMQM1) DEV(*SAVF) SAVF(QGPL/QMQM1)
```

3. Create a save file for the queue manager data directory on GAMMA.

Use the queue manager name to name the save file.

```
CRTSAVF FILE(QGPL/QMDQM1)
```

4. Save the copy of the queue manager data from the local directory on GAMMA.

```
SAV DEV('/QSYS.LIB/QGPL.LIB/QMDQM1.FILE') OBJ('/QIBM/Userdata/mqm/qmgrs/QM1')
```

## Commands to set up multi-instance queue managers

IBM MQ has commands to simplify configuring journal replication, adding new queue manager instances, and configuring queue managers to use independent ASP.

The journal commands to create and manage local and remote journals are,

### ADDQMJRNL

With this command you can create named local and remote journals for a queue manager instance, and configure whether replication is synchronous or asynchronous, what the synchronous timeout is, and if the remote journal is to be activated immediately.

### CHGMQMJRNL

The command modifies the timeout, status and delivery parameters affecting replica journals.

### RMVQMJRNL

Removes named *remote* journals from a queue manager instance.

### WRKMQMJRNL

Lists the status of local and remote journals for a local queue manager instance.

Add and manage additional queue manager instances using the following commands, which modify the `mqs.ini` file.

### ADDQMINF

The command uses information you extracted from the `mqs.ini` file with `DSPMQMINF` command to add a new queue manager instance on a different IBM i server.

### RMVQMINF

Remove a queue manager instance. Use this command either to remove an instance of an existing queue manager, or to remove the configuration information for a queue manager that has been deleted from a different server.

The **CRTMQM** command has three parameters to assist configuring a multi-instance queue manager,

### MQMDIRP (\*DFT | *directory-prefix*)

Use this parameter to select a mount point that is mapped to queue manager data on networked storage.

**ASP ( \*SYSTEM | \*ASPDEV | *auxiliary-storage-pool-number* )**

Specify \*SYSTEM, or an *auxiliary-storage-pool-number* to place the queue manager journal on the system or a basic user ASP. Select the \*ASPDEV option, and also set a device name using the **ASPDEV** parameter, to place the queue manager journal on an independent ASP.

**ASPDEV ( \*ASP | *device-name* )**

Specify a *device-name* of a primary or secondary independent ASP device. Selecting \*ASP has the same result as specifying **ASP** ( \*SYSTEM ).

**Performance and disk failover considerations**

Use different auxiliary storage pools to improve performance and reliability.

If you use a large number of persistent messages or large messages in your applications, the time spent writing these message to disk becomes a significant factor in the performance of the system.

Ensure that you have sufficient disk activation to cope with this possibility, or consider a separate Auxiliary Storage Pool (ASP) in which to hold your queue manager journal receivers.

You can specify which ASP your queue manager library and journals are stored on when you create your queue manager using the ASP parameter of **CRTMQM**. By default, the queue manager library and journals and IFS data are stored in the system ASP.

ASPs allow isolation of objects on one or more specific disk units. This can also reduce the loss of data because of a disk media failure. In most cases, only the data that is stored on disk units in the affected ASP is lost.

You are recommended to store the queue manager library and journal data in separate user ASPs to that of the root IFS file system to provide failover and reduce disk contention.

For more information, see [Backup and recovery](#).

**Using SAVLIB to save IBM MQ libraries**

You cannot use SAVLIB LIB(\*ALLUSR) to save the IBM MQ libraries, because these libraries have names beginning with Q.

You can use SAVLIB LIB(QM\*) to save all the queue manager libraries, but only if you are using a save device other than \*SAVF. For DEV(\*SAVF), you must use a SAVLIB command for each and every queue manager library on your system.

**Quiescing IBM MQ for IBM i**

This section explains how to quiesce (end gracefully) IBM MQ for IBM i

To quiesce IBM MQ for IBM i:

1. Sign on to a new interactive IBM MQ for IBM i session, ensuring that you are not accessing any objects.
2. Ensure that you have:
  - \*ALLOBJ authority, or object management authority for the QMQM library
  - Sufficient authority to use the ENDSBS command
3. Advise all users that you are going to stop IBM MQ for IBM i.
4. How you then proceed depends on whether you want to shut down (quiesce) a single queue manager (where others might exist) (see [“Shutting down a single queue manager for IBM MQ for IBM i” on page 244](#)) or all the queue managers (see [“Shutting down all queue managers for IBM MQ for IBM i” on page 245](#)).

**ENDMQM parameter ENDCCTJOB(\*YES)**

The ENDMQM parameter ENDCCTJOB(\*YES) works differently in IBM MQ for IBM i V6.0 and later compared to previous versions.

On previous versions, when you specify ENDCCTJOB(\*YES), MQ forcibly terminates your applications for you.

On IBM MQ for IBM i V6.0 or later, when you specify ENDCCTJOB(\*YES), your applications are not terminated but are instead disconnected from the queue manager.

If you specify ENDCCTJOB(\*YES) and you have applications that are not written to detect that a queue manager is ending, the next time a new MQI call is issued, the call will return with a MQRC\_CONNECTION\_BROKEN (2009) error.

As an alternative to using ENDCCTJOB(\*YES), use the parameter ENDCCTJOB(\*NO) and use WRKMQM option 22 (Work with jobs) to manually end any application jobs that will prevent a queue manager restart.

## Shutting down a single queue manager for IBM MQ for IBM i

Use this information to understand the three types of shutdown.

In the procedures that follow, we use a sample queue manager name of QMgr1 and a sample subsystem name of SUBX. Replace these names with your own values if necessary.

### Planned shutdown

Planned shutdown of a queue manager on IBM i

1. Before shutdown, execute:

```
RCDMQMIMG OBJ(*ALL) OBJTYPE(*ALL) MQMNAME(QMgr1) DSPJRNTA(*YES)
```

2. To shut down the queue manager, execute:

```
ENDMQM MQMNAME(QMgr1) OPTION(*CNTRLD)
```

If QMgr1 does not end, the channel or applications are probably busy.

3. If you must shut down QMgr1 immediately, execute the following:

```
ENDMQM MQMNAME(QMgr1) OPTION(*IMMED)  
ENDCCTJOB(*YES) TIMEOUT(15)
```

### Unplanned shutdown

1. To shut down the queue manager, execute:

```
ENDMQM MQMNAME(QMgr1) OPTION(*IMMED)
```

If QMgr1 does not end, the channel or applications are probably busy.

2. If you need to shut down QMgr1 immediately, execute the following:

```
ENDMQM MQMNAME(QMgr1) OPTION(*IMMED)  
ENDCCTJOB(*YES) TIMEOUT(15)
```

### Shutdown under abnormal conditions

1. To shut down the queue manager, execute:

```
ENDMQM MQMNAME(QMgr1) OPTION(*IMMED)
```

If QMgr1 does not end, continue with step 3 providing that:

- QMgr1 is in its own subsystem, or
  - You can end all queue managers that share the same subsystem as QMgr1. Use the unplanned shutdown procedure for all such queue managers.
2. When you have taken all the steps in the procedure for all the queue managers sharing the subsystem ( SUBX in our examples), execute:

```
ENDSBS SUBX *IMMED
```

If this command fails to complete, shut down all queue managers, using the unplanned shutdown procedure, and perform an IPL on your machine.

**Warning:** Do not use ENDJOBABN for IBM MQ jobs that fail to end as result of ENDJOB or ENDSBS, unless you are prepared to perform an IPL on your machine immediately after.

3. Start the subsystem by executing:

```
STRSBS SUBX
```

4. Shut down the queue manager immediately, by executing:

```
ENDMQM MQMNAME(QMgr1) OPTION(*IMMED)  
ENDCCTJOB(*YES) TIMEOUT(10)
```

5. Restart the queue manager by executing:

```
STRMQM MQMNAME(QMgr1)
```

If this fails, and you:

- Have restarted your machine by performing an IPL, or
- Have only a single queue manager

Tidy up IBM MQ shared memory by executing:

```
ENDMQM MQMNAME(*ALL) OPTION(*IMMED)  
ENDCCTJOB(*YES) TIMEOUT(15)
```

before repeating step 5.

If the queue manager restart takes more than a few seconds, IBM MQ adds status messages intermittently to the job log detailing the startup progress.

If you still have problems restarting your queue manager, contact IBM support. Any further action you might take could damage the queue manager, leaving IBM MQ unable to recover.

## Shutting down all queue managers for IBM MQ for IBM i

Use this information to understand the three types of shutdown.

The procedures are almost the same as for a single queue manager, but using \*ALL instead of the queue manager name where possible, and otherwise using a command repeatedly using each queue manager name in turn. Throughout the procedures, we use a sample queue manager name of QMgr1 and a sample subsystem name of SUBX. Replace these with your own.

### Planned shutdown

1. One hour before shutdown, execute:

```
RCDMQMIMG OBJ(*ALL) OBJTYPE(*ALL) MQMNAME(QMgr1) DSPJRNTA(*YES)
```

Repeat this for every queue manager that you want to shut down.

2. To shut down the queue manager, execute:

```
ENDMQM MQMNAME(QMgr1) OPTION(*CNTRLD)
```

Repeat this for every queue manager that you want to shut down; separate commands can run in parallel.

If any queue manager does not end within a reasonable time (for example 10 minutes), proceed to step 3.

3. To shut down all queue managers immediately, execute the following:

```
ENDMQM MQMNAME(*ALL) OPTION(*IMMED)  
ENDCCTJOB(*YES) TIMEOUT(15)
```

## Unplanned shutdown

1. To shut down a queue manager, execute:

```
ENDMQM MQMNAME(QMgr1) OPTION(*IMMED)
```

Repeat this for every queue manager that you want to shut down; separate commands can run in parallel.

If queue managers do not end, the channel or applications are probably busy.

2. If you need to shut down the queue managers immediately, execute the following:

```
ENDMQM MQMNAME(*ALL) OPTION(*IMMED)  
ENDCCTJOB(*YES) TIMEOUT(15)
```

## Shutdown under abnormal conditions

1. To shut down the queue managers, execute:

```
ENDMQM MQMNAME(QMgr1) OPTION(*IMMED)
```

Repeat this for every queue manager that you want to shut down; separate commands can run in parallel.

2. End the subsystems ( SUBX in our examples), by executing:

```
ENDSBS SUBX *IMMED
```

Repeat this for every subsystem that you want to shut down; separate commands can run in parallel.

If this command fails to complete, perform an IPL on your system.

**Warning:** Do not use ENDJOBABN for jobs that fail to end as result of ENDJOB or ENDSBS, unless you are prepared to perform an IPL on your system immediately after.

3. Start the subsystems by executing:

```
STRSBS SUBX
```

Repeat this for every subsystem that you want to start.

4. Shut the queue managers down immediately, by executing:

```
ENDMQM MQMNAME(*ALL) OPTION(*IMMED)
ENDCCTJOB(*YES) TIMEOUT(15)
```

5. Restart the queue managers by executing:

```
STRMQM MQMNAME(QMgr1)
```

Repeat this for every queue manager that you want to start.

If any queue manager restart takes more than a few seconds IBM MQ will show status messages intermittently detailing the startup progress.

If you still have problems restarting any queue manager, contact IBM support. Any further action you might take could damage the queue managers, leaving MQSeries or IBM MQ unable to recover.

## **Administering IBM MQ for z/OS**

Administering queue managers and associated resources includes the tasks that you perform frequently to activate and manage those resources. Choose the method you prefer to administer your queue managers and associated resources.

IBM MQ for z/OS can be controlled and managed by a set of utilities and programs provided with the product. You can use the IBM MQ Script (MQSC) commands or Programmable Command Formats (PCFs) to administer IBM MQ for z/OS. For information about using commands for IBM MQ for z/OS, see [“Issuing commands to IBM MQ for z/OS”](#) on page 247.

IBM MQ for z/OS also provides a set of utility programs to help you with system administration. For information about the different utility programs and how to use them, see [“The IBM MQ for z/OS utilities”](#) on page 255.

For details of how to administer IBM MQ for z/OS and the different administrative tasks you might have to undertake, see the following links:

### **Related concepts**

[“Administering local IBM MQ objects”](#) on page 67

This section tells you how to administer local IBM MQ objects to support application programs that use the Message Queue Interface (MQI). In this context, local administration means creating, displaying, changing, copying, and deleting IBM MQ objects.

[“Administering remote IBM MQ objects”](#) on page 125

[“Administering IBM MQ”](#) on page 5

Administering queue managers and associated resources includes the tasks that you perform frequently to activate and manage those resources. Choose the method you prefer to administer your queue managers and associated resources.

### **Related information**

[IBM MQ for z/OS concepts](#)

[Planning](#)

[Planning your IBM MQ environment on z/OS](#)

[Configuring](#)

[Configuring z/OS](#)

[Programmable command formats reference](#)

[MQSC reference](#)

[Using the IBM MQ for z/OS utilities](#)

## **Issuing commands to IBM MQ for z/OS**

You can use IBM MQ script commands (MQSC) in batch or interactive mode to control a queue manager.

IBM MQ for z/OS supports MQSC commands, which can be issued from the following sources:

- The z/OS console or equivalent (such as SDSF/TSO).
- The initialization input data sets.
- The supplied batch utility, CSQUTIL, processing a list of commands in a sequential data set.
- A suitably authorized application, by sending a command as a message to the command input queue. The application can be any of the following:
  - A batch region program
  - A CICS application
  - An IMS application
  - A TSO application
  - An application program or utility on another IBM MQ system

[Table 16 on page 251](#) summarizes the MQSC commands and the sources from which they can be issued.

Much of the functionality of these commands is available in a convenient way from the IBM MQ for z/OS operations and controls panels.

Changes made to the resource definitions of a queue manager using the commands (directly or indirectly) are preserved across restarts of the IBM MQ subsystem.

IBM MQ for z/OS also supports Programmable Command Format (PCF) commands. These simplify the creation of applications for the administration of IBM MQ. MQSC commands are in human-readable text form, whereas PCF enables applications to create requests and read the replies without having to parse text strings. Like MQSC commands, applications issue PCF commands by sending them as messages to the command input queue. For more information about using PCF commands and for details of the commands, see the [Programmable command formats reference](#) documentation.

## Private and global definitions

When you define an object on IBM MQ for z/OS, you can choose whether you want to share that definition with other queue managers (a *global* definition), or whether the object definition is to be used by one queue manager only (a *private* definition). This is called the object *disposition*.

### Global definition

If your queue manager belongs to a queue-sharing group, you can choose to share any object definitions you make with the other members of the group. This means that you have to define an object once only, reducing the total number of definitions required for the whole system.

Global object definitions are held in a *shared repository* (a Db2® shared database), and are available to all the queue managers in the queue-sharing group. These objects have a disposition of GROUP.

### Private definition

If you want to create an object definition that is required by one queue manager only, or if your queue manager is not a member of a queue-sharing group, you can create object definitions that are not shared with other members of a queue-sharing group.

Private object definitions are held on page set zero of the defining queue manager. These objects have a disposition of QMGR.

You can create private definitions for all types of IBM MQ objects except CF structures (that is, channels, namelists, process definitions, queues, queue managers, storage class definitions, and authentication information objects), and global definitions for all types of objects except queue managers.

IBM MQ automatically copies the definition of a group object to page set zero of each queue manager that uses it. You can alter the copy of the definition temporarily if you want, and IBM MQ allows you to refresh the page set copies from the repository copy if required.

IBM MQ always tries to refresh the page set copies from the repository copy on start up (for channel commands, this is done when the channel initiator restarts), or if the group object is changed.



**Note:** The copy of the definition is refreshed from the definition of the group, only if the definition of the group has changed after you created the copy of the definition.

This ensures that the page set copies reflect the version on the repository, including any changes that were made when the queue manager was inactive. The copies are refreshed by generating DEFINE REPLACE commands, therefore there are circumstances under which the refresh is not performed, for example:

- If a copy of the queue is open, a refresh that changes the usage of the queue fails.
- If a copy of a queue has messages on it, a refresh that deletes that queue fails.
- If a copy of a queue would require ALTER with FORCE to change it.

In these circumstances, the refresh is not performed on that copy, but is performed on the copies on all other queue managers.

If the queue manager is shut down and then restarted stand-alone, any local copies of objects are deleted, unless for example, the queue has associated messages.

There is a third object disposition that applies to local queues only. This allows you to create shared queues. The definition for a shared queue is held on the shared repository and is available to all the queue managers in the queue-sharing group. In addition, the messages on a shared queue are also available to all the queue managers in the queue sharing group. This is described in [Shared queues and queue-sharing groups](#). Shared queues have an object disposition of SHARED.

The following table summarizes the effect of the object disposition options for queue managers started stand-alone, and as a member of a queue-sharing group.

Disposition	Stand-alone queue manager	Member of a queue-sharing group
QMGR	Object definition held on page set zero.	Object definition held on page set zero.
GROUP	Not allowed.	Object definition held in the shared repository. Local copy held on page set zero of each queue manager in the group.
SHARED	Not allowed.	Queue definition held in the shared repository. Messages available to any queue manager in the group.

## Manipulating global definitions

If you want to change the definition of an object that is held in the shared repository, you need to specify whether you want to change the version on the repository, or the local copy on page set zero. Use the object disposition as part of the command to do this.

## Directing commands to different queue managers

You can use the *command scope* to control on which queue manager the command runs.

You can choose to execute a command on the queue manager where it is entered, or on a different queue manager in the queue-sharing group. You can also choose to issue a particular command in parallel on all the queue managers in a queue-sharing group. This is possible for both MQSC commands and PCF commands.

This is determined by the *command scope*. The command scope is used with the object disposition to determine which version of an object you want to work with.

For example, you might want to alter some of the attributes of an object, the definition of which is held in the shared repository.

- You might want to change the version on one queue manager only, and not make any changes to the version on the repository or those in use by other queue managers.
- You might want to change the version in the shared repository for future users, but leave existing copies unchanged.
- You might want to change the version in the shared repository, but also want your changes to be reflected immediately on all the queue managers in the queue-sharing group that hold a copy of the object on their page set zero.

Use the command scope to specify whether the command is executed on this queue manager, another queue manager, or all queue managers. Use the object disposition to specify whether the object you are manipulating is in the shared repository (a group object), or is a local copy on page set zero (a queue manager object).

You do not have to specify the command scope and object disposition to work with a shared queue because every queue manager in the queue-sharing group handles the shared queue as a single queue.

## Command summary

Use this topic as a reference of the main MQSC and PCF commands.

Table 15 on page 250 summarizes the MQSC and PCF commands that are available on IBM MQ for z/OS to alter, define, delete and display IBM MQ objects.

<i>Table 15. Summary of the main MQSC and PCF commands by object type</i>				
<b>MQSC command</b>	<b>ALTER</b>	<b>DEFINE</b>	<b>DISPLAY</b>	<b>DELETE</b>
<b>PCF command</b>	<b>Change</b>	<b>Create/Copy</b>	<b>Inquire</b>	<b>Delete</b>
AUTHINFO	X	X	X	X
CFSTATUS			X	
CFSTRUCT	X	X	X	X
CHANNEL	X	X	X	X
CHSTATUS			X	
NAMELIST	X	X	X	X
PROCESS	X	X	X	X
QALIAS	M	M	M	M
QCLUSTER			M	
QLOCAL	M	M	M	M
QMGR	X		X	
QMODEL	M	M	M	M
QREMOTE	M	M	M	M
QUEUE	P	P	X	P
QSTATUS			X	
STGCLASS	X	X	X	X

### Key to table symbols:

- M = MQSC only
- P = PCF only
- X = both

There are many other MQSC and PCF commands which allow you to manage other IBM MQ resources, and carry out other actions in addition to those summarized in [Table 15 on page 250](#).

[Table 16 on page 251](#) shows every MQSC command, and where each command can be issued from:

- CSQINP1 initialization input data set
- CSQINP2 initialization input data set
- z/OS console (or equivalent)
- SYSTEM.COMMAND.INPUT queue and command server (from applications, CSQUTIL, or the CSQINPX initialization input data set)

<i>Table 16. Sources from which to run MQSC commands</i>				
<b>Command</b>	<b>CSQINP1</b>	<b>CSQINP2</b>	<b>z/OS console</b>	<b>Command input queue and server</b>
ALTER AUTHINFO		X	X	X
ALTER BUFFPOOL		X	X	X
ALTER CFSTRUCT		X	X	X
ALTER CHANNEL		X	X	X
ALTER NAMELIST		X	X	X
ALTER PSID			X	X
ALTER PROCESS		X	X	X
ALTER QALIAS		X	X	X
ALTER QLOCAL		X	X	X
ALTER QMGR		X	X	X
ALTER QMODEL		X	X	X
ALTER QREMOTE		X	X	X
ALTER SECURITY	X	X	X	X
ALTER STGCLASS		X	X	X
ALTER SUB		X	X	X
ALTER TOPIC		X	X	X
ALTER TRACE	X	X	X	X
ARCHIVE LOG	X	X	X	X
BACKUP CFSTRUCT			X	X
CLEAR QLOCAL		X	X	X
DEFINE AUTHINFO		X	X	X
DEFINE BUFFPOOL	X	X		
DEFINE CFSTRUCT		X	X	X
DEFINE CHANNEL		X	X	X
DEFINE LOG			X	X
DEFINE NAMELIST		X	X	X

Table 16. Sources from which to run MQSC commands (continued)

Command	CSQINP1	CSQINP2	z/OS console	Command input queue and server
DEFINE PROCESS		X	X	X
DEFINE PSID	X		X	X
DEFINE QALIAS		X	X	X
DEFINE QLOCAL		X	X	X
DEFINE QMODEL		X	X	X
DEFINE QREMOTE		X	X	X
DEFINE STGCLASS		X	X	X
DEFINE SUB			X	X
DEFINE TOPIC		X	X	X
DELETE AUTHINFO		X	X	X
DELETE BUFFPOOL			X	X
DELETE CFSTRUCT		X	X	X
DELETE CHANNEL			X	X
DELETE NAMELIST		X	X	X
DELETE PROCESS		X	X	X
DELETE PSID			X	X
DELETE QALIAS		X	X	X
DELETE QLOCAL		X	X	X
DELETE QMODEL		X	X	X
DELETE QREMOTE		X	X	X
DELETE STGCLASS		X	X	X
DELETE SUB		X	X	X
DELETE TOPIC		X	X	X
DISPLAY ARCHIVE	X	X	X	X
DISPLAY AUTHINFO		X	X	X
DISPLAY CFSTATUS			X	X
DISPLAY CFSTRUCT		X	X	X
DISPLAY CHANNEL		X	X	X
DISPLAY CHSTATUS			X	X
DISPLAY CLUSQMGR			X	X
DISPLAY CMDSERV	X	X	X	X
DISPLAY CONN		X	X	X
DISPLAY CHINIT		X	X	X

Table 16. Sources from which to run MQSC commands (continued)

Command	CSQINP1	CSQINP2	z/OS console	Command input queue and server
DISPLAY GROUP		X	X	X
DISPLAY LOG	X	X	X	X
DISPLAY NAMELIST		X	X	X
DISPLAY PROCESS		X	X	X
DISPLAY QALIAS		X	X	X
DISPLAY QCLUSTER		X	X	X
DISPLAY QLOCAL		X	X	X
DISPLAY QMGR		X	X	X
DISPLAY QMODEL		X	X	X
DISPLAY QREMOTE		X	X	X
DISPLAY QSTATUS		X	X	X
DISPLAY QUEUE		X	X	X
DISPLAY SECURITY			X	X
DISPLAY STGCLASS		X	X	X
DISPLAY SUB		X	X	X
DISPLAY TOPIC		X	X	X
DISPLAY SYSTEM	X	X	X	X
DISPLAY THREAD		X	X	X
DISPLAY TRACE	X	X	X	X
DISPLAY USAGE		X	X	X
MOVE QLOCAL		X	X	X
PING CHANNEL			X	X
RECOVER BSDS	X	X	X	X
RECOVER CFSTRUCT			X	X
REFRESH CLUSTER		X	X	X
REFRESH QMGR		X	X	X
REFRESH SECURITY		X	X	X
RESET CHANNEL			X	X
RESET CLUSTER		X	X	X
RESET QSTATS		X	X	X
RESET TPIPE			X	X
RESOLVE CHANNEL			X	X
RESOLVE INDOUBT		X	X	X

Table 16. Sources from which to run MQSC commands (continued)

Command	CSQINP1	CSQINP2	z/OS console	Command input queue and server
RESUME QMGR			X	X
RVERIFY SECURITY		X	X	X
SET ARCHIVE	X	X	X	X
SET LOG	X	X	X	X
SET SYSTEM	X	X	X	X
START CHANNEL			X	X
START CHINIT		X	X	X
START CMDSERV	X	X	X	
START LISTENER			X	X
START QMGR			X	
START TRACE	X	X	X	X
STOP CHANNEL			X	X
STOP CHINIT			X	X
STOP CMDSERV	X	X	X	
STOP LISTENER			X	X
STOP QMGR			X	X
STOP TRACE	X	X	X	X
SUSPEND QMGR			X	X

In MQSC commands, each command description identifies the sources from which that command can be run.

## Initialization commands

Initialization commands can be used to control the queue manager startup.

Commands in the initialization input data sets are processed when IBM MQ is initialized on queue manager startup. Three types of command can be issued from the initialization input data sets:

- Commands to define IBM MQ entities that cannot be defined elsewhere, for example DEFINE BUFFPOOL.

These commands must reside in the data set identified by the DD name CSQINP1. They are processed before the restart phase of initialization. They cannot be issued through the console, operations and control panels, or an application program. The responses to these commands are written to the sequential data set that you refer to in the CSQOUT1 statement of the started task procedure.

- Commands to define IBM MQ objects that are recoverable after restart. These definitions must be specified in the data set identified by the DD name CSQINP2. They are stored in page set zero. CSQINP2 is processed after the restart phase of initialization. The responses to these commands are written to the sequential data set that you refer to in the CSQOUT2 statement of the started task procedure.
- Commands to manipulate IBM MQ objects. These commands must also be specified in the data set identified by the DD name CSQINP2. For example, the IBM MQ-supplied sample contains an ALTER

QMGR command to specify a dead-letter queue for the subsystem. The response to these commands is written to the CSQOUT2 output data set.

**Note:** If IBM MQ objects are defined in CSQINP2, IBM MQ attempts to redefine them each time the queue manager is started. If the objects already exist, the attempt to define them fails. If you need to define your objects in CSQINP2, you can avoid this problem by using the REPLACE parameter of the DEFINE commands, however, this overrides any changes that were made during the previous run of the queue manager.

Sample initialization data set members are supplied with IBM MQ for z/OS. They are described in [Sample definitions supplied with IBM MQ](#).

## Initialization commands for distributed queuing

You can also use the CSQINP2 initialization data set for the START CHINIT command. If you need a series of other commands to define your distributed queuing environment (for example, starting listeners), IBM MQ provides a third initialization input data set, called CSQINPX, that is processed as part of the channel initiator started task procedure.

The MQSC commands contained in the data set are executed at the end of channel initiator initialization, and output is written to the data set specified by the CSQOUTX DD statement. You might use the CSQINPX initialization data set to start listeners for example.

A sample channel initiator initialization data set member is supplied with IBM MQ for z/OS. It is described in [Sample definitions supplied with IBM MQ](#).

## Initialization commands for publish/Subscribe

If you need a series of commands to define your publish/subscribe environment (for example, when defining subscriptions), IBM MQ provides a fourth initialization input data set, called CSQINPT.

The MQSC commands contained in the data set are executed at the end of publish/subscribe initialization, and output is written to the data set specified by the CSQOUTT DD statement. You might use the CSQINPT initialization data set to define subscriptions for example.

A sample publish/subscribe initialization data set member is supplied with IBM MQ for z/OS. It is described in [Sample definitions supplied with IBM MQ](#).

## The IBM MQ for z/OS utilities

IBM MQ for z/OS provides a set of utility programs that you can use to help with system administration.

IBM MQ for z/OS supplies a set of utility programs to help you perform various administrative tasks, including the following:

- Manage message security policies.
- Perform backup, restoration, and reorganization tasks.
- Issue commands and process object definitions.
- Generate data-conversion exits.
- Modify the bootstrap data set.
- List information about the logs.
- Print the logs.
- Set up Db2 tables and other Db2 utilities.
- Process messages on the dead-letter queue.

## The message security policy utility

The message security policy utility (CSQ0UTIL) runs as a stand-alone utility to manage message security policies. See [The message security policy utility \(CSQ0UTIL\)](#) for more information.

## The CSQUTIL utility

This is a utility program provided to help you with backup, restore and reorganize tasks. See [The CSQUTIL utility](#) for more information.

## The data conversion exit utility

The IBM MQ for z/OS data conversion exit utility ( **CSQUCVX** ) runs as a stand-alone utility to create data conversion exit routines.

## The change log inventory utility

The IBM MQ for z/OS change log inventory utility program (**CSQJU003**) runs as a stand-alone utility to change the bootstrap data set (BSDS). You can use the utility to perform the following functions:

- Add or delete active or archive log data sets.
- Supply passwords for archive logs.

## The print log map utility

The IBM MQ for z/OS print log map utility program ( **CSQJU004** ) runs as a stand-alone utility to list the following information:

- Log data set name and log RBA association for both copies of all active and archive log data sets. If dual logging is not active, there is only one copy of the data sets.
- Active log data sets available for new log data.
- Contents of the queue of checkpoint records in the bootstrap data set (BSDS).
- Contents of the archive log command history record.
- System and utility time stamps.

## The log print utility

The log print utility program ( **CSQ1LOGP** ) is run as a stand-alone utility. You can run the utility specifying:

- A bootstrap data set (BSDS)
- Active logs (with no BSDS)
- Archive logs (with no BSDS)

## The queue-sharing group utility

The queue-sharing group utility program ( **CSQ5PQSG** ) runs as a stand-alone utility to set up Db2 tables and perform other Db2 tasks required for queue-sharing groups.

## The active log preformat utility

The active log preformat utility ( **CSQJUFMT** ) formats active log data sets before they are used by a queue manager. If the active log data sets are preformatted by the utility, log write performance is improved on the queue manager's first pass through the active logs.



## The dead-letter queue handler utility

The dead-letter queue handler utility program ( **CSQUDLQH** ) runs as a stand-alone utility. It checks messages that are on the dead-letter queue and processes them according to a set of rules that you supply to the utility.

## The CSQUTIL utility

The CSQUTIL utility program is provided with IBM MQ for z/OS to help you perform backup, restoration, and reorganization tasks, and to issue commands and process object definitions.

For more information about the CSQUTIL utility program, see [IBM MQ utility program \(CSQUTIL\)](#). By using this utility program, you can invoke the following functions:

### **COMMAND**

To issue MQSC commands, to record object definitions, and to make client-channel definition files.

### **COPY**

To read the contents of a named IBM MQ for z/OS message queue or the contents of all the queues of a named page set, and put them into a sequential file and retain the original queue.

### **COPYPAGE**

To copy whole page sets to larger page sets.

### **EMPTY**

To delete the contents of a named IBM MQ for z/OS message queue or the contents of all the queues of a named page set, retaining the definitions of the queues.

### **FORMAT**

To format IBM MQ for z/OS page sets.

### **LOAD**

To restore the contents of a named IBM MQ for z/OS message queue or the contents of all the queues of a named page set from a sequential file created by the COPY function.

### **PAGEINFO**

To extract page set information from one or more page sets.

### **RESETPAGE**

To copy whole page sets to other page set data sets and reset the log information in the copy.

### **SCOPY**

To copy the contents of a queue to a data set while the queue manager is offline.

### **SDEFS**

To produce a set of define commands for objects while the queue manager is offline.

### **SLOAD**

To restore messages from the destination data set of an earlier COPY or SCOPY operation. SLOAD processes a single queue.

### **SWITCH**

To switch or query the transmission queue associated with cluster-sender channels.

### **XPARM**

To convert a channel initiator parameter load module into queue manager attributes (for migration purposes).

## Operating IBM MQ for z/OS

Use these basic procedures to operate IBM MQ for z/OS.

You can also perform the operations described in this section using the IBM MQ Explorer, which is distributed with IBM MQ for Windows, IBM MQ for Linux (x86 and x86-64 platforms) and SupportPac MS0T. For more information, see [“Administration using the MQ Explorer” on page 59](#) and [IBM Support & downloads](#).

This section contains information about the following topics:

## Issuing queue manager commands

You can issue IBM MQ control commands from a z/OS console or with the utility program CSQUTIL. Commands can use command prefix string (CPF) to indicate which IBM MQ subsystem processes the command.

You can control most of the operational environment of IBM MQ using the IBM MQ commands. IBM MQ for z/OS supports both the MQSC and PCF types of these commands. This topic describes how to specify attributes using MQSC commands, and so it refers to those commands and attributes using their MQSC command names, rather than their PCF names. For details of the syntax of the MQSC commands, see [The MQSC commands](#). For details of the syntax of the PCF commands, see [“Using Programmable Command Formats” on page 10](#). If you are a suitably authorized user, you can issue IBM MQ commands from:

- The initialization input data sets (described in [“Initialization commands” on page 254](#)).
- A z/OS console, or equivalent, such as SDSF
- The z/OS master get command routine, MGCRE (SVC 34)
- The IBM MQ utility, CSQUTIL (described in [IBM MQ utility program](#).)
- A user application, which can be:
  - A CICS program
  - A TSO program
  - A z/OS batch program
  - An IMS program

See [“Writing programs to administer IBM MQ” on page 277](#) for information about this.

Much of the functionality of these commands is provided in a convenient way by the operations and control panels, accessible from TSO and ISPF, and described in [“Introducing the operations and control panels” on page 263](#).

For further information, see

- [“Issuing commands from a z/OS console or its equivalent” on page 258](#)
  - [Command prefix strings](#)
  - [Using the z/OS console to issue commands](#)
  - [Command responses](#)
- [Issuing commands from the utility program CSQUTIL](#)

## Issuing commands from a z/OS console or its equivalent

You can issue all IBM MQ commands from a z/OS console or its equivalent. You can also issue IBM MQ commands from anywhere where you can issue z/OS commands, such as SDSF or by a program using the MGCRE macro.

The maximum amount of data that can be displayed as a result of a command typed in at the console is 32 KB.

### Note:

1. You cannot issue IBM MQ commands using the IMS/SSR command format from an IMS terminal. This function is not supported by the IMS adapter.
2. The input field provided by SDSF might not be long enough for some commands, particularly those commands for channels.

## Command prefix strings

Each IBM MQ command must be prefixed with a command prefix string (CPF), as shown in [Figure 41 on page 259](#).

Because more than one IBM MQ subsystem can run under z/OS, the CPF is used to indicate which IBM MQ subsystem processes the command. For example, to start the queue manager for a subsystem called CSQ1, where CPF is ' +CSQ1 ', you issue the command +CSQ1 START QMGR from the operator console. This CPF must be defined in the subsystem name table (for the subsystem CSQ1). This is described in [Defining command prefix strings \(CPFs\)](#). In the examples, the string ' +CSQ1 ' is used as the command prefix.

## Using the z/OS console to issue commands

You can type simple commands from the z/OS console, for example, the DISPLAY command in [Figure 41 on page 259](#). However, for complex commands or for sets of commands that you issue frequently, the other methods of issuing commands are better.

```
+CSQ1 DISPLAY QUEUE(TRANSMIT.QUEUE.PROD) TYPE(QLLOCAL)
```

*Figure 41. Issuing a DISPLAY command from the z/OS console*

## Command responses

Direct responses to commands are sent to the console that issued the command. IBM MQ supports the *Extended Console Support* (EMCS) function available in z/OS, and therefore consoles with 4 byte IDs can be used. Additionally, all commands except START QMGR and STOP QMGR support the use of Command and Response Tokens (CARTs) when the command is issued by a program using the MGCRC macro.

## Issuing commands from the utility program CSQUTIL

You can issue commands from a sequential data set using the COMMAND function of the utility program CSQUTIL. This utility transfers the commands, as messages, to the *system-command input queue* and waits for the response, which is printed together with the original commands in SYSPRINT. For details of this, see [IBM MQ utility program](#).

### ***Starting and stopping a queue manager***

Use this topic as an introduction to stopping and starting a queue manager.

This section describes how to start and stop a queue manager. It contains information about the following topics:

- [“Before you start IBM MQ” on page 260](#)
- [“Starting a queue manager” on page 260](#)
- [“Stopping a queue manager” on page 262](#)

Starting and stopping a queue manager is relatively straightforward. When a queue manager stops under normal conditions, its last action is to take a termination checkpoint. This checkpoint, and the logs, give the queue manager the information it needs to restart.

This section contains information about the START and STOP commands, and contains a brief overview of start-up after an abnormal termination has occurred.

## Before you start IBM MQ

After you have installed IBM MQ, it is defined as a formal z/OS subsystem. This message appears during any initial program load (IPL) of z/OS:

```
CSQ3110I +CSQ1 CSQ3UR00 - SUBSYSTEM ssnm INITIALIZATION COMPLETE
```

where *ssnm* is the IBM MQ subsystem name.

From now on, you can start the queue manager for that subsystem *from any z/OS console that has been authorized to issue system control commands*; that is, a z/OS SYS command group. You must issue the START command from the authorized console, you cannot issue it through JES or TSO.

If you are using queue-sharing groups, you must start RRS first, and then Db2, before you start the queue manager.

## Starting a queue manager

You start a queue manager by issuing a START QMGR command. However, you cannot successfully use the START command unless you have appropriate authority. See the [Setting up security on z/OS](#) for information about IBM MQ security. Figure 42 on page 260 shows examples of the START command. (Remember that you must prefix an IBM MQ command with a command prefix string (CPF).)

```
+CSQ1  START QMGR
+CSQ1  START QMGR PARM(NEWLOG)
```

*Figure 42. Starting the queue manager from a z/OS console*

See [START QMGR](#) for information about the syntax of the START QMGR command.

You cannot run the queue manager as a batch job or start it using a z/OS command START. These methods are likely to start an address space for IBM MQ that then ends abnormally. Nor can you start a queue manager from the CSQUTIL utility program or a similar user application.

You can, however, start a queue manager from an APF-authorized program by passing a START QMGR command to the z/OS MGCRC (SVC 34) service.

If you are using queue-sharing groups, the associated Db2 systems and RRS must be active when you start the queue manager.

### Start options

When you start a queue manager, a system parameter module is loaded. You can specify the name of the system parameter module in one of two ways:

- With the PARM parameter of the /cpf START QMGR command, for example

```
/cpf START QMGR PARM(CSQ1ZPRM)
```

- With a parameter in the startup procedure, for example, code the JCL EXEC statement as

```
//MQM EXEC PGM=CSQYASCP,PARM='ZPARM(CSQ1ZPRM)'
```

A system parameter module provides information specified when the queue manager was customized.

You can also use the ENVPARM option to substitute one or more parameters in the JCL procedure for the queue manager.

For example, you can update your queue manager startup procedure, so that the DDname CSQINP2 is a variable. This means that you can change the CSQINP2 DDname without changing the startup procedure. This is useful for implementing changes, providing backouts for operators, and queue manager operations.

Suppose your start-up procedure for queue manager CSQ1 looked like [Figure 43 on page 261](#).

```
//CSQ1MSTR PROC INP2=NORM
//MQMESA EXEC PGM=CSQYASCP
//STEPLIB DD DISP=SHR,DSN=thlqual.SCSQANLE
//          DD DISP=SHR,DSN=thlqual.SCSQAUTH
//          DD DISP=SHR,DSN=db2qual.SDSNLOAD
//BDS1 DD DISP=SHR,DSN=myqual.BSDS01
//BDS2 DD DISP=SHR,DSN=myqual.BSDS02
//CSQP0000 DD DISP=SHR,DSN=myqual.PSID00
//CSQP0001 DD DISP=SHR,DSN=myqual.PSID01
//CSQP0002 DD DISP=SHR,DSN=myqual.PSID02
//CSQP0003 DD DISP=SHR,DSN=myqual.PSID03
//CSQINP1 DD DISP=SHR,DSN=myqual.CSQINP(CSQ1INP1)
//CSQINP2 DD DISP=SHR,DSN=myqual.CSQINP(CSQ1&INP2.)
//CSQOUT1 DD SYSOUT=*
//CSQOUT2 DD SYSOUT=*
```

*Figure 43. Sample start-up procedure*

If you then start your queue manager with the command:

```
+CSQ1 START QMGR
```

the CSQINP2 used is a member called CSQ1NORM.

However, suppose you are putting a new suite of programs into production so that the next time you start queue manager CSQ1, the CSQINP2 definitions are to be taken from member CSQ1NEW. To do this, you would start the queue manager with this command:

```
+CSQ1 START QMGR ENVPARM('INP2=NEW')
```

and CSQ1NEW would be used instead of CSQ1NORM. Note: z/OS limits the KEYWORD=value specifications for symbolic parameters (as in INP2=NEW) to 255 characters.

### Starting after an abnormal termination

IBM MQ automatically detects whether restart follows a normal shutdown or an abnormal termination.

Starting a queue manager after it ends abnormally is different from starting it after the STOP QMGR command has been issued. After STOP QMGR, the system finishes its work in an orderly way and takes a termination checkpoint before stopping. When you restart the queue manager, it uses information from the system checkpoint and recovery log to determine the system status at shutdown.

However, if the queue manager ends abnormally, it terminates without being able to finish its work or take a termination checkpoint. When you restart a queue manager after an abend, it refreshes its knowledge of its status at termination using information in the log, and notifies you of the status of various tasks. Normally, the restart process resolves all inconsistent states. But, in some cases, you must take specific steps to resolve inconsistencies.

## User messages on start-up

When you start a queue manager successfully, the queue manager produces a set of startup messages.

## Stopping a queue manager

Before stopping a queue manager, all IBM MQ-related write-to-operator-with-reply (WTOR) messages must receive replies, for example, getting log requests. Each command in [Figure 44 on page 262](#) terminates a running queue manager.

```
+CSQ1  STOP QMGR
+CSQ1  STOP QMGR MODE(QUIESCE)
+CSQ1  STOP QMGR MODE(FORCE)

+CSQ1  STOP QMGR MODE(RESTART)
```

*Figure 44. Stopping a queue manager*

The command STOP QMGR defaults to STOP QMGR MODE(QUIESCE).

In QUIESCE mode, IBM MQ does not allow any new connection threads to be created, but allows existing threads to continue; it terminates only when all threads have ended. Applications can request to be notified in the event of the queue manager quiescing. Therefore, use the QUIESCE mode where possible so that applications that have requested notification have the opportunity to disconnect. See [What happens during termination](#) for details.

If the queue manager does not terminate in a reasonable time in response to a STOP QMGR MODE(QUIESCE) command, use the DISPLAY CONN command to determine whether any connection threads exist, and take the necessary steps to terminate the associated applications. If there are no threads, issue a STOP QMGR MODE(FORCE) command.

The STOP QMGR MODE(QUIESCE) and STOP QMGR MODE(FORCE) commands deregister IBM MQ from the MVS Automatic Restart Manager (ARM), preventing ARM from restarting the queue manager automatically. The STOP QMGR MODE(RESTART) command works in the same way as the STOP QMGR MODE(FORCE) command, except that it does not deregister IBM MQ from ARM. This means that the queue manager is eligible for immediate automatic restart.

If the IBM MQ subsystem is not registered with ARM, the STOP QMGR MODE(RESTART) command is rejected and the following message is sent to the z/OS console:

```
CSQY205I ARM element arm-element is not registered
```

If this message is not issued, the queue manager is restarted automatically. For more information about ARM, see [“Using the z/OS Automatic Restart Manager \(ARM\)” on page 332](#).

**Only cancel the queue manager address space if STOP QMGR MODE(FORCE) does not terminate the queue manager.**

If a queue manager is stopped by either canceling the address space or by using the command STOP QMGR MODE(FORCE), consistency is maintained with connected CICS or IMS systems. Resynchronization of resources is started when a queue manager restarts and is completed when the connection to the CICS or IMS system is established.

**Note:** When you stop your queue manager, you might find message IEF352I is issued. z/OS issues this message if it detects that failing to mark the address space as unusable would lead to an integrity exposure. You can ignore this message.

### Stop messages

After issuing a STOP QMGR command, you get the messages CSQY009I and CSQY002I, for example:

```
CSQY009I +CSQ1 ' STOP QMGR' COMMAND ACCEPTED FROM  
USER(userid), STOP MODE(FORCE)  
CSQY002I +CSQ1 QUEUE MANAGER STOPPING
```

Where *userid* is the user ID that issued the STOP QMGR command, and the MODE parameter depends on that specified in the command.

When the STOP command has completed successfully, the following messages are displayed on the z/OS console:

```
CSQ9022I +CSQ1 CSQYASCP ' STOP QMGR' NORMAL COMPLETION  
CSQ3104I +CSQ1 CSQ3EC0X - TERMINATION COMPLETE
```

If you are using ARM, and you did not specify MODE(RESTART), the following message is also displayed:

```
CSQY204I +CSQ1 ARM Deregister for element arm-element type  
arm-element-type successful
```

You cannot restart the queue manager until the following message has been displayed:

```
CSQ3100I +CSQ1 CSQ3EC0X - SUBSYSTEM ssnm READY FOR START COMMAND
```

## Introducing the operations and control panels

You can use the IBM MQ operations and control panels to perform administration tasks on IBM MQ objects. Use this topic as an introduction to the commands, and control panels.

You use these panels for defining, displaying, altering, or deleting IBM MQ objects. Use the panels for day-to-day administration and for making small changes to objects. If you are setting up or changing many objects, use the COMMAND function of the CSQUTIL utility program.

The operations and control panels support the controls for the channel initiator (for example, to start a channel or a TCP/IP listener), for clustering, and for security. They also enable you to display information about threads and page set usage.

The panels work by sending MQSC type IBM MQ commands to a queue manager, through the system command input queue.

### Note:

1. The z/OS IBM MQ operations and controls panels (CSQOREXX) might not support all new function and parameters added from version 7 onwards. For example, there are no panels for the direct manipulation of topic objects or subscriptions.

Using one of the following supported mechanisms allows you to administer publish/subscribe definitions and other system controls that are not directly available from other panels:

- a. IBM MQ Explorer
- b. z/OS console
- c. Programmable Command Format (PCF) messages
- d. COMMAND function of CSQUTIL

Note that the generic **Command** action in the CSQOREXX panels allows you to issue any valid MQSC command, including SMDS related commands. You can use all the commands that the COMMAND function of CSQUTIL issues.

2. You cannot issue the IBM MQ commands directly from the command line in the panels.
3. To use the operations and control panels, you must have the correct security authorization; this is described in the [User IDs for command security and command resource security](#).
4. You cannot provide a user ID and password using CSQUTIL, or the CSQOREXX panels. Instead, if you user ID has UPDATE authority to the BATCH profile in MQCONN, you can bypass the **CHKLOCL** (*REQUIRED* setting. See [Using \*\*CHKLOCL\*\* on locally bound applications](#) for more information.

### ***Invocation and rules for the operations and control panels***

You can control IBM MQ and issue control commands through the ISPF panels.

### **How to access the IBM MQ operations and control panels**

If the ISPF/PDF primary options menu has been updated for IBM MQ, you can access the IBM MQ operations and control panels from that menu. For details about updating the menu, see the [Task 20: Set up the operations and control panels](#).

You can access the IBM MQ operations and control panels from the TSO command processor panel (typically option 6 on the ISPF/PDF primary options menu). The name of the exec that you run to do this is CSQOREXX. It has two parameters; `thlqual` is the high-level qualifier for the IBM MQ libraries to be used, and `langletter` is the letter identifying the national language libraries to be used (for example, E for U.S. English). The parameters can be omitted if the IBM MQ libraries are permanently installed in your ISPF setup. Alternatively, you can issue CSQOREXX from the TSO command line.

These panels are designed to be used by operators and administrators with a minimum of formal training. Read these instructions with the panels running and try out the different tasks suggested.

**Note:** While using the panels, temporary dynamic queues with names of the form SYSTEM.CSQOREXX.\* are created.

### **Rules for the operations and control panels**

See [Rules for naming IBM MQ objects](#) about the general rules for IBM MQ character strings and names. However, there are some rules that apply only to the operations and control panels:

- Do not enclose strings, for example descriptions, in single or double quotation marks.
- If you include an apostrophe or quotation mark in a text field, you do not have to repeat it or add an escape character. The characters are saved exactly as you type them; for example:

This is Maria's queue

The panel processor doubles them for you to pass them to IBM MQ. However, if it has to truncate your data to do this, it does so.

- You can use uppercase or lowercase characters in most fields, and they are folded to uppercase characters when you press Enter. The exceptions are:



- Storage class names and coupling facility structure names, which must start with uppercase A through Z and be followed by uppercase A through Z or numeric characters.
- Certain fields that are not translated. These include:
  - Application ID
  - Description
  - Environment data
  - Object names (but if you use a lowercase object name, you might not be able to enter it at a z/OS console)
  - Remote system name
  - Trigger data
  - User data
- In names, leading blanks and leading underscores are ignored. Therefore, you cannot have object names beginning with blanks or underscores.
- Underscores are used to show the extent of blank fields. When you press Enter, trailing underscores are replaced by blanks.
- Many description and text fields are presented in multiple parts, each part being handled by IBM MQ independently. This means that trailing blanks are retained and the text is not contiguous.

### **Blank fields**

When you specify the **Define** action for an IBM MQ object, each field on the define panel contains a value. See the general help (extended help) for the display panels for information about where IBM MQ gets the values. If you type over a field with blanks, and blanks are not allowed, IBM MQ puts the installation default value in the field or prompts you to enter the required value.

When you specify the **Alter** action for an IBM MQ object, each field on the alter panel contains the current value for that field. If you type over a field with blanks, and blanks are not allowed, the value of that field is unchanged.

### ***Objects and actions***

The operations and control panels offer you many different types of object and a number of actions that you can perform on them.

The actions are listed on the initial panel and enable you to manipulate the objects and display information about them. These objects include all the IBM MQ objects, together with some extra ones. The objects fall into the following categories.

- [Queues, processes, authentication information objects, namelists, storage classes and CF structures](#)
- [Channels](#)
- [Cluster objects](#)
- [Queue manager and security](#)
- [Connections](#)
- [System](#)

Refer to [Actions](#) for a cross reference table of the actions which can be taken with the IBM MQ objects.

### **Queues, processes, authentication information objects, namelists, storage classes and CF structures**

These are the basic IBM MQ objects. There can be many of each type. They can be listed, listed with filter, defined, and deleted, and have attributes that can be displayed and altered, using the LIST or DISPLAY, LIST with FILTER, DEFINE LIKE, MANAGE, and ALTER actions. (Objects are deleted using the MANAGE action.)

This category consists of the following objects:

QLOCAL	Local queue
QREMOTE	Remote queue
QALIAS	Alias queue for indirect reference to a queue
QMODEL	Model queue for defining queues dynamically
QUEUE	Any type of queue
QSTATUS	Status of a local queue
PROCESS	Information about an application to be started when a trigger event occurs
AUTHINFO	Authentication information: definitions required to perform Certificate Revocation List (CRL) checking using LDAP servers
NAMELIST	List of names, such as queues or clusters
STGCLASS	Storage class
CFSTRUCT	coupling facility (CF) structure
CFSTATUS	Status of a CF structure

## Channels

Channels are used for distributed queuing. There can be many of each type, and they can be listed, listed with filter, defined, deleted, displayed, and altered. They also have other functions available using the START, STOP and PERFORM actions. PERFORM provides reset, ping, and resolve channel functions.

This category consists of the following objects:

CHANNEL	Any type of channel
SENDER	Sender channel
SERVER	Server channel
RECEIVER	Receiver channel
REQUESTER	Requester channel
CLUSRCVR	Cluster-receiver channel
CLUSDR	Cluster-sender channel
SVRCONN	Server-connection channel
CLNTCONN	Client-connection channel
CHSTATUS	Status of a channel connection

## Cluster objects

Cluster objects are created automatically for queues and channels that belong to a cluster. The base queue and channel definitions can be on another queue manager. There can be many of each type, and names can be duplicated. They can be listed, listed with filter, and displayed. PERFORM, START, and STOP are also available through the LIST actions.

This category consists of the following objects:

CLUSQ	Cluster queue, created for a queue that belongs to a cluster
CLUSCHL	Cluster channel, created for a channel that belongs to a cluster
CLUSQMGR	Cluster queue manager, the same as a cluster channel but identified by its queue manager name

Cluster channels and cluster queue managers do have the PERFORM, START and STOP actions, but only indirectly through the DISPLAY action.

### Queue manager and security

Queue manager and security objects have a single instance. They can be listed, and have attributes that can be displayed and altered (using the LIST or DISPLAY, and ALTER actions), and have other functions available using the PERFORM action.

This category consists of the following objects:

MANAGER	Queue manager: the PERFORM action provides suspend and resume cluster functions
SECURITY	Security functions: the PERFORM action provides refresh and reverify functions

### Connection

Connections can be listed, listed with filter and displayed.

This category consists only of the connection object, CONNECT.

### System

A collection of other functions. This category consists of the following objects:

SYSTEM	System functions
CONTROL	Synonym for SYSTEM

The functions available are:

LIST or DISPLAY	Display queue-sharing group, distributed queuing, page set, or data set usage information.
PERFORM	Refresh or reset clustering
START	Start the channel initiator or listeners
STOP	Stop the channel initiator or listeners

### Actions

The actions that you can perform for each type of object are shown in the following table:

Table 17. Valid operations and control panel actions for IBM MQ objects								
Object	Alter	Define like	Manage (1)	List or Display	List with Filter	Perform	Start	Stop
AUTHINFO	X	X	X	X	X			
CFSTATUS				X				
CFSTRUCT	X	X	X	X	X			
CHANNEL	X	X	X	X	X	X	X	X
CHSTATUS				X	X			
CLNTCONN	X	X	X	X	X			
CLUSCHL				X	X	X(2)	X(2)	X(2)
CLUSQ				X	X			
CLUSQMGR				X	X	X(2)	X(2)	X(2)
CLUSRCVR	X	X	X	X	X	X	X	X

Table 17. Valid operations and control panel actions for IBM MQ objects (continued)

Object	Alter	Define like	Manage (1)	List or Display	List with Filter	Perform	Start	Stop
CLUSSDR	X	X	X	X	X	X	X	X
CONNECT				X	X			
CONTROL				X		X	X	X
MANAGER	X			X		X		
NAMELIST	X	X	X	X	X			
PROCESS	X	X	X	X	X			
QALIAS	X	X	X	X	X			
QLOCAL	X	X	X	X	X			
QMODEL	X	X	X	X	X			
QREMOTE	X	X	X	X	X			
QSTATUS				X	X			
QUEUE	X	X	X	X	X			
RECEIVER	X	X	X	X	X	X	X	X
REQUESTER	X	X	X	X	X	X	X	X
SECURITY	X			X		X		
SENDER	X	X	X	X	X	X	X	X
SERVER	X	X	X	X	X	X	X	X
SVRCONN	X	X	X	X	X		X	X
STGCLASS	X	X	X	X	X			
SYSTEM				X		X	X	X

**Note:**

1. Provides Delete and other functions
2. Using the List or Display action

**Object dispositions**

You can specify the *disposition* of the object with which you need to work. The disposition signifies where the object **definition** is kept, and how the object behaves.

The disposition is significant only if you are working with any of the following object types:

- queues
- channels
- processes
- namelists
- storage classes
- authentication information objects

If you are working with other object types, the disposition is disregarded.

Permitted values are:

**Q**

QMGR. The object definitions are on the page set of the queue manager and are accessible only by the queue manager.

**C**

COPY. The object definitions are on the page set of the queue manager and are accessible only by the queue manager. They are local copies of objects defined as having a disposition of GROUP.

**P**

PRIVATE. The object definitions are on the page set of the queue manager and are accessible only by the queue manager. The objects have been defined as having a disposition of QMGR or COPY.

**G**

GROUP. The object definitions are in the shared repository, and are accessible by all queue managers in the queue-sharing group.

**S**

SHARED. This disposition applies only to local queues. The queue definitions are in the shared repository, and are accessible by all queue managers in the queue-sharing group.

**A**

ALL. If the action queue manager is either the target queue manager, or \*, objects of **all** dispositions are included; otherwise, objects of QMGR and COPY dispositions only are included. This is the default.

### ***Selecting a queue manager, defaults, and levels using the ISPF control panel***

You can use the CSQOREXX exec in ISPF to control your queue managers.

While you are viewing the initial panel, you are not connected to any queue manager. However, as soon as you press Enter, you are connected to the queue manager, or a queue manager in the queue-sharing group named in the **Connect name** field. You can leave this field blank; this means that you are using the default queue manager for batch applications. This is defined in CSQBDEFV (see [Task 19: Set up Batch, TSO, and RRS adapters](#) for information about this).

Use the **Target queue manager** field to specify the queue manager where the actions you request are to be performed. If you leave this field blank, it defaults to the queue manager specified in the **Connect name** field. You can specify a target queue manager that is not the one you connect to. In this case, you would normally specify the name of a remote queue manager object that provides a queue manager alias definition (the name is used as the *ObjectQMgrName* when opening the command input queue). To do this, you must have suitable queues and channels set up to access the remote queue manager.

The **Action queue manager** allows you to specify a queue manager that is in the same queue-sharing group as the queue manager specified in the **Target queue manager** field to be the queue manager where the actions you request are to be performed. If you specify \* in this field, the actions you request are performed on all queue managers in the queue-sharing group. If you leave this field blank, it defaults to the value specified in the **Target queue manager** field. The **Action queue manager** field corresponds to using the CMDSCOPE command modifier described in [The MQSC commands](#).

### **Queue manager defaults**

If you leave any queue manager fields blank, or choose to connect to a queue-sharing group, a secondary window opens when you press Enter. This window confirms the names of the queue managers you will be using. Press Enter to continue. When you return to the initial panel after having made some requests, you find fields completed with the actual names.

### **Queue manager levels**

The Operations and Control panels work satisfactorily only with queue managers that are running on z/OS, and with command levels that match that of the panels, currently 710 or 800.

If these conditions are not met, it is likely that actions work only partially, incorrectly, or not at all, and that the replies from the queue manager are not recognized.

If the action queue manager is not at command level 800, some fields are not displayed, and some values cannot be entered. A few objects and actions are disallowed. In such cases, a secondary window opens asking for you to confirm that you want to proceed.

### ***Using the function keys and command line with the ISPF control panels***

To use the panels, you must use the function keys or enter the equivalent commands in the ISPF control panel command area.

- Function keys
  - Processing your actions
  - “Displaying IBM MQ user messages” on page 270
  - Canceling your actions
  - Getting help
- Using the command line

## **Function keys**

The function keys have special settings for IBM MQ. (This means that you cannot use the ISPF default values for the function keys; if you have previously used the KEYLIST OFF ISPF command anywhere, you must type KEYLIST ON in the command area of any operations and control panel and then press Enter to enable the IBM MQ settings.)

These function key settings can be displayed on the panels, as shown in [Figure 45 on page 271](#). If the settings are not shown, type PFSHOW in the command area of any operations and control panel and then press Enter. To remove the display of the settings, use the command PFSHOW OFF.

The function key settings in the operations and control panels conform to CUA standards. Although you can change the key setting through normal ISPF procedures (such as the KEYLIST utility), you are not recommended to do so.

**Note:** Using the PFSHOW and KEYLIST commands affects any other logical ISPF screens that you have, and their settings remain when you leave the operations and control panels.

### **Processing your actions**

Press Enter to carry out the action requested on a panel. The information from the panel is sent to the queue manager for processing.

Each time you press Enter in the panels, IBM MQ generates one or more operator messages. If the operation was successful, you get confirmation message CSQ9022I, otherwise you get some error messages.

### **Displaying IBM MQ user messages**

Press function key F10 in any panel to see the IBM MQ user messages.

### **Canceling your actions**

On the initial panel, both F3 and F12 exit the operations and control panels and return you to ISPF. No information is sent to the queue manager.

On any other panel, press function keys F3 or F12 to leave the current panel **ignoring any data you have typed since last pressing Enter**. Again, no information is sent to the queue manager.

- F3 takes you straight back to the initial panel.
- F12 takes you back to the previous panel.

### **Getting help**

Each panel has help panels associated with it. The help panels use the ISPF protocols:

- Press function key F1 on any panel to see general help (extended help) about the task.
- Press function key F1 with the cursor on any field to see specific help about that field.

- Press function key F5 from any field help panel to get the general help.
- Press function key F3 to return to the base panel, that is, the panel from which you pressed function key F1.
- Press function key F6 from any help panel to get help about the function keys.

If the help information carries on into a second or subsequent pages, a **More** indicator is displayed in the upper-right of the panel. Use these function keys to navigate through the help pages:

- F11 to get to the next help page (if there is one).
- F10 to get back to the previous help page (if there is one).

## Using the command line

You never need to use the command line to issue the commands used by the operations and control panels because they are available from function keys. The command line is provided to allow you to enter normal ISPF commands (like PFSHOW).

The ISPF command PANELID ON displays the name of the current CSQOREXX panel.

The command line is initially displayed in the default position at the bottom of the panels, regardless of what ISPF settings you have. You can use the SETTINGS ISPF command from any of the operations and control panels to change the position of the command line. The settings are remembered for subsequent sessions with the operations and control panels.

## Using the operations and control panels

Use this topic to investigate the initial control panel displayed from CSQOREXX

Figure 45 on page 271 shows the panel that is displayed when you start a panel session.

```

IBM MQ for z/OS - Main Menu
Complete fields. Then press Enter.

Action . . . . . 1      0. List with filter      4. Manage
                        1. List or Display      5. Perform
                        2. Define like         6. Start
                        3. Alter              7. Stop
                        8. Command

Object type . . . . . CHANNEL +
Name . . . . . *
Disposition . . . . . A  Q=Qmgr, C=Copy, P=Private, G=Group,
                        S=Shared, A=All

Connect name . . . . . MQ1C - local queue manager or group
Target queue manager . . . MQ1C
                        - connected or remote queue manager for command input
Action queue manager . . . MQ1C - command scope in group
Response wait time . . . 30 5 - 999 seconds

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Command ==>
F1=Help      F2=Split      F3=Exit      F4=Prompt      F9=SwapNext F10=Messages
F12=Cancel

```

Figure 45. The IBM MQ operations and control initial panel

From this panel you can perform actions such as:

- Choose the local queue manager you want and whether you want the commands issued on that queue manager, on a remote queue manager, or on another queue manager in the same queue-sharing group as the local queue manager. Over type the queue manager name if you need to change it.
- Select the action you want to perform by typing in the appropriate number in the **Action** field.
- Specify the object type that you want to work with. Press function key F1 for help about the object types if you are not sure what they are.
- Specify the disposition of the object type that you want to work with.
- Display a list of objects of the type specified. Type in an asterisk (\*) in the **Name** field and press Enter to display a list of objects (of the type specified) that have already been defined on the action queue manager. You can then select one or more objects to work with in sequence. All the actions are available from the list.

**Note:** You are recommended to make choices that result in a list of objects being displayed, and then work from that list. Use the **Display** action, because that is allowed for all object types.

## Using the Command Facility

Use the editor to enter or amend MQSC commands to be passed to the queue manager.

From the primary panel, CSQOPRIA, select option **8 Command**, to start the Command Facility.

You are presented with an edit session of a sequential file, *prefix.CSQUTIL.COMMANDS*, used as input to the CSQUTIL COMMAND function; see [Issuing commands to IBM MQ](#).

You do not need to prefix commands with the command prefix string (CPF).

You can continue MQSC commands on subsequent lines by terminating the current line with the continuation characters **+** or **-**. Alternatively, use line edit mode to provide long MQSC commands or the values of long attribute values within the command.

### line edit

To use line edit, move the cursor to the appropriate line in the edit panel and use **F4** to display a single line in a scrollable panel. A single line can be up to 32 760 bytes of data.

To leave line edit:

- **F3 exit** saves changes made to the line and exits
- **F12 cancel** returns to the edit panel discarding changes made to the line.

To discard changes made in the edit session, use **F12 cancel** to terminate the edit session leaving the contents of the file unchanged. Commands are not executed.

### Executing commands

When you have finished entering MQSC commands, terminate the edit session with **F3 exit** to save the contents of the file and invoke CSQUTIL to pass the commands to the queue manager. The output from command processing is held in file *prefix.CSQUTIL.OUTPUT*. An edit session opens automatically on this file so that you can view the responses. Press **F3 exit** to exit this session and return to the main menu.

## Working with IBM MQ objects

Many of the tasks described in this documentation involve manipulating IBM MQ objects. The object types are queue managers, queues, process definitions, namelists, channels, client connection channels, listeners, services, and authentication information objects.

- [Defining simple queue objects](#)
- [Defining other types of objects](#)
- [Working with object definitions](#)
- [Working with namelists](#)

### Defining simple queue objects

To define a new object, use an existing definition as the basis for it. You can do this in one of three ways:

- By selecting an object that is a member of a list displayed as a result of options selected on the initial panel. You then enter action type 2 ( **Define like** ) in the action field next to the selected object. Your new object has the attributes of the selected object, except the disposition. You can then change any attributes in your new object as you require.
- On the initial panel, select the **Define like** action type, enter the type of object that you are defining in the **Object type** field, and enter the name of a specific existing object in the **Name** field. Your new object has the same attributes as the object you named in the **Name** field, except the disposition. You can then change any attributes in your new object definition as you require.



- By selecting the **Define like** action type, specifying an object type and then leaving the **Name** field blank. You can then define your new object and it has the default attributes defined for your installation. You can then change any attributes in your new object definition as you require.

**Note:** You do not enter the name of the object you are defining on the initial panel, but on the **Define** panel you are presented with.

The following example demonstrates how to define a local queue using an existing queue as a template.

### Defining a local queue

To define a local queue object from the operations and control panels, use an existing queue definition as the basis for your new definition. There are several panels to complete. When you have completed all the panels and you are satisfied that the attributes are correct, press Enter to send your definition to the queue manager, which then creates the actual queue.

Use the **Define like** action either on the initial panel or against an object entry in a list displayed as a result of options selected on the initial panel.

For example, starting from the initial panel, complete these fields:

<b>Action</b>	2 (Define like)
<b>Object type</b>	QLOCAL
<b>Name</b>	QUEUE.YOU.LIKE. This is the name of the queue that provides the attributes for your new queue.

Press Enter to display the **Define a Local Queue** panel. The queue name field is blank so that you can supply the name for the new queue. The description is that of the queue upon which you are basing this new definition. Over type this field with your own description for the new queue.

The values in the other fields are those of the queue upon which you are basing this new queue, except the disposition. You can over type these fields as you require. For example, type Y in the **Put enabled** field (if it is not already Y) if suitably authorized applications can put messages on this queue.

You get field help by moving the cursor into a field and pressing function key F1. Field help provides information about the values that can be used for each attribute.

When you have completed the first panel, press function key F8 to display the second panel.

#### Hints:

1. Do *not* press Enter at this stage, otherwise the queue will be created before you have a chance to complete the remaining fields. (If you do press Enter prematurely, do not worry; you can always alter your definition later on.)
2. Do not press function keys F3 or F12, or the data you typed will be lost.

Press function key F8 repeatedly to see and complete the remaining panels, including the trigger definition, event control, and backout reporting panels.

### When your local queue definition is complete

When your definition is complete, press Enter to send the information to the queue manager for processing. The queue manager creates the queue according to the definition you have supplied. If you do not want the queue to be created, press function key F3 to exit and cancel the definition.

### Defining other types of objects

To define other types of object, use an existing definition as the base for your new definition as explained in [Defining a local queue](#).

Use the **Define like** action either on the initial panel or against an object entry in a list displayed as a result of options selected on the initial panel.

For example, starting from the initial panel, complete these fields:

<b>Action</b>	2 (Define like)
<b>Object type</b>	QALIAS, NAMELIST, PROCESS, CHANNEL, and other resource objects.
<b>Name</b>	Leave blank or enter the name of an existing object of the same type.

Press Enter to display the corresponding DEFINE panels. Complete the fields as required and then press Enter again to send the information to the queue manager.

Like defining a local queue, defining another type of object generally requires several panels to be completed. Defining a namelist requires some additional work, as described in [“Working with namelists”](#) on page 274.

## Working with object definitions

When an object has been defined, you can specify an action in the **Action** field, to alter, display, or manage it.

In each case, you can either:

- Select the object you want to work with from a list displayed as a result of options selected on the initial panel. For example, having entered 1 in the **Action** field to display objects, Queue in the **Object type** field, and \* in the **Name** field, you are presented with a list of all queues defined in the system. You can then select from this list the queue with which you need to work.
- Start from the initial panel, where you specify the object you are working with by completing the **Object type** and **Name** fields.

### Altering an object definition

To alter an object definition, specify action 3 and press Enter to see the ALTER panels. These panels are very similar to the DEFINE panels. You can alter the values you want. When your changes are complete, press Enter to send the information to the queue manager.

### Displaying an object definition

If you want to see the details of an object without being able to change them, specify action 1 and press Enter to see the DISPLAY panels. Again, these panels are similar to the DEFINE panels except that you cannot change any of the fields. Change the object name to display details of another object.

### Deleting an object

To delete an object, specify action 4 (Manage) and the **Delete** action is one of the actions presented on the resulting menu. Select the **Delete** action.

You are asked to confirm your request. If you press function key F3 or F12, the request is canceled. If you press Enter, the request is confirmed and passed to the queue manager. The object you specified is then deleted.

**Note:** You cannot delete most types of channel object unless the channel initiator is started.

## Working with namelists

When working with namelists, proceed as you would for other objects.

For the actions DEFINE LIKE or ALTER, press function key F11 to add names to the list or to change the names in the list. This involves working with the ISPF editor and all the normal ISPF edit commands are available. Enter each name in the namelist on a separate line.

When you use the ISPF editor in this way, the function key settings are the normal ISPF settings, and **not** those used by the other operations and control panels.

If you need to specify lowercase names in the list, specify CAPS(OFF) on the editor panel command line. When you do this, all the namelists that you edit in the future are in lowercase until you specify CAPS(ON).

When you have finished editing the namelist, press function key F3 to end the ISPF edit session. Then press Enter to send the changes to the queue manager.

**Attention:** If you do not press Enter at this stage but press function key F3 instead, you lose any updates that you have typed in.

## Implementing the system using multiple cluster transmission queues

It makes no difference if the channel is used in a single cluster, or an overlapping cluster. When the channel is selected and started, the channel selects the transmission queue depending on the definitions.

### About this task

See [“Using the automatic definition of queues and switching” on page 275](#) if you are using the DEFCLXQ option.

See [“Changing your cluster-sender channels using a phased approach” on page 275](#) if you are using a staged approach.

### *Using the automatic definition of queues and switching*

Use this option if you are planning on using the DEFCLXQ option. There will be a queue created for every channel, and every new channel.

### Procedure

1. Review the definition of the SYSTEM.CLUSTER.TRANSMIT.MODEL.QUEUE and change the attributes if required.

This queue is defined in member SCSQPROC(csq4insx).

2. Create the SYSTEM.CLUSTER.TRANSMIT.MODEL.QUEUE model queue.
3. Apply security policies for this model queue, and the SYSTEM.CLUSTER.TRANSMIT.\*\* queues.

For z/OS the channel initiator started task user ID needs:

- Control access to CLASS(MQADMIN) for

```
ssid.CONTEXT.SYSTEM.CLUSTER.TRANSMIT.channelname
```

- Update access to CLASS(MQQUEUE) for

```
ssid.SYSTEM.CLUSTER.TRANSMIT.channelname
```

### *Changing your cluster-sender channels using a phased approach*

This process allows you to move to the new cluster-sender channels at various times to suit the needs of your enterprise.

### Before you begin

- Identify your business applications, and which channels are used.
- For the queues you use, display the clusters they are in.
- Display the channels to show the connection names, the names of the remote queue managers, and which clusters the channel supports.

### About this task

- Create a transmission queue. On z/OS you might want to consider which page set you use for the queue.
- Set up security policy for the queue.
- Change any queue monitoring to include this queue name.

- Decide which channels are to use this transmission queue. The channels should have a similar name, so generic characters ' \* ' in the CLCHNAME identify the channel.
- When you are ready to use the new function, alter the transmission queue to specify the name of the channels to use this transmission queue. For example CLUSTER1.TOPARIS, or CLUSTER1.\* or \*.TOPARIS
- Start the channels

## Procedure

1. Use the DIS CLUSQMGR(yyyy) XMITQ command to display the cluster sender channels defined in the cluster, where yyyy is the name of the remote queue manager.
2. Set up the security profile for the transmission queue and give the queue access to the channel initiator.
3. Define the transmission queue to be used, and specify USAGE(XMITQ) INDXTYPE( CORRELID ) SHARE and CLCHNAME(*value*)

The channel initiator started task user ID needs the following access:

```
alter class(MQADMIN) ssid.CONTEXT.SYSTEM.CLUSTER.TRANSMIT.channel
update class(MQQUEUE ssid.SYSTEM.CLUSTER.TRANSMIT.channel
```

and the user ID using the SWITCH command needs the following access:

```
alter cl(MQADMIN) ssid.QUEUE.queueName
```

4. Stop and restart the channels.

The channel change occurs when the channel starts using an MQSC command, or you use CSQUTIL. You can identify which channels need to be restarted using the SWITCH CHANNEL(\*) STATUS of CSQUTIL

If you have problems when the channel is started, stop the channel, resolve the problems, and restart the channel.

Note that you can change the CLCHNAME attribute as often as you need to.

The value of CLCHNAME used is the one when the channel is started, so you can change the CLCHNAME definition while the channel continues to use the definitions from the time that it started. The channel uses the new definition when it is restarted.

## Undoing a change

You need to have a process to backout a change if it the results are not as you expect.

## What can go wrong?

If the new transmission queue is not what you expect:

1. Check the CLCHNAME is as you expect
2. Review the job log to check if the switch process has finished. If not, wait and check the new transmission queue of the channel later.

If you are using multiple cluster transmission queues, it is important that you design the transmission queues definitions explicitly and avoid complicated overlapping configuration. In this way, you can make sure that if there are problems, you can go back to the original queues and configuration.

If you encounter problems during the move to using a different transmission queue, you must resolve any problems before you can proceed with the change.

An existing change request must complete before a new change request can be made. For example, you:

1. Define a new transmission queue with a maximum depth of one and there are 10 messages waiting to be sent.

2. Change the transmission queue to specify the channel name in the CLCHNAME parameter.
3. Stop and restart the channel. The attempt to move the messages fails and reports the problems.
4. Change the CLCHNAME parameter on the transmission queue to be blank.
5. Stop and restart the channel. The channel continues to try and complete the original request, so the channel continues to use the new transmission queue.
6. Need to resolve the problems and restart the channel so the moving of messages completes successfully.

Next time the channel is restarted it picks up any changes, so if you had set CLCHNAME to blanks, the channel will not use the specified transmission queue.

In this example, changing the CLCHNAME on the transmission queue to blanks does not necessarily mean that the channel uses the SYSTEM.CLUSTER.TRANSMIT queue, as there might be other transmission queues whose CLCHNAME parameter match the channel name. For example, a generic name, or the queue manager attribute DEFCLXQ might be set to channel, so the channel uses a dynamic queue instead of the SYSTEM.CLUSTER.TRANSMIT queue.

## Writing programs to administer IBM MQ

You can write your own application programs to administer a queue manager. Use this topic to understand the requirements for writing your own administration programs.

### Start of General-use programming interface information

This set of topics contains hints and guidance to enable you to issue IBM MQ commands from an IBM MQ application program.

**Note:** In this topic, the MQI calls are described using C-language notation. For typical invocations of the calls in the COBOL, PL/I, and assembler languages, see [Function calls manual](#).

### Understanding how it all works

In outline, the procedure for issuing commands from an application program is as follows:

1. Build an IBM MQ command into a type of IBM MQ message called a *request message*. The command can be in MQSC or PCF format.
2. Send (use MQPUT ) this message to a special queue called the system-command input queue. The IBM MQ command processor runs the command.
3. Retrieve (use MQGET ) the results of the command as *reply messages* on the reply-to queue. These messages contain the user messages that you need to determine whether your command was successful and, if it was, what the results were.

Then it is up to your application program to process the results.

This set of topics contains:

## Preparing queues for administration programs

Administration programs require a number of predefined queues for system command input and receiving responses.

This section applies to commands in the MQSC format. For the equivalent in PCF, see [“Using Programmable Command Formats”](#) on page 10.

Before you can issue any MQPUT or MQGET calls, you must first define, and then open, the queues you are going to use.

### Defining the system-command input queue

The system-command input queue is a local queue called `SYSTEM.COMMAND.INPUT`. The supplied `CSQINP2` initialization data set, `thlqual.SCSQPROC(CSQ4INSG)`, contains a default definition for the system-command input queue. For compatibility with IBM MQ on other platforms, an alias of this queue, called `SYSTEM.ADMIN.COMMAND.QUEUE` is also supplied. See [Sample definitions supplied with IBM MQ](#) for more information.

## Defining a reply-to queue

You must define a reply-to queue to receive reply messages from the IBM MQ command processor. It can be any queue with attributes that allow reply messages to be put on it. However, for normal operation, specify these attributes:

- `USAGE(NORMAL)`
- `NOTRIGGER` (unless your application uses triggering)

Avoid using persistent messages for commands, but if you choose to do so, the reply-to queue must not be a temporary dynamic queue.

The supplied `CSQINP2` initialization data set, `thlqual.SCSQPROC(CSQ4INSG)`, contains a definition for a model queue called `SYSTEM.COMMAND.REPLY.MODEL`. You can use this model to create a dynamic reply-to queue.

**Note:** Replies generated by the command processor can be up to 15 000 bytes in length.

If you use a permanent dynamic queue as a reply-to queue, your application should allow time for all `PUT` and `GET` operations to complete before attempting to delete the queue, otherwise `MQRC2055` (`MQRC_Q_NOT_EMPTY`) can be returned. If this occurs, try the queue deletion again after a few seconds.

## Opening the system-command input queue

Before you can open the system-command input queue, your application program must be connected to your queue manager. Use the MQI call `MQCONN` or `MQCONNX` to do this.

Then use the MQI call `MQOPEN` to open the system-command input queue. To use this call:

1. Set the *Options* parameter to `MQOO_OUTPUT`
2. Set the `MQOD` object descriptor fields as follows:

**ObjectType**

`MQOT_Q` (the object is a queue)

**ObjectName**

`SYSTEM.COMMAND.INPUT`

**ObjectQMgrName**

If you want to send your request messages to your local queue manager, leave this field blank. This means that your commands are processed locally.

If you want your IBM MQ commands to be processed on a remote queue manager, put its name here. You must also have the correct queues and links set up, as described in [Distributed queuing and clusters](#).

## Opening a reply-to queue

To retrieve the replies from an IBM MQ command, you must open a reply-to queue. One way of doing this is to specify the model queue, `SYSTEM.COMMAND.REPLY.MODEL` in an `MQOPEN` call, to create a permanent dynamic queue as the reply-to queue. To use this call:

1. Set the *Options* parameter to `MQOO_INPUT_SHARED`
2. Set the `MQOD` object descriptor fields as follows:

**ObjectType**

`MQOT_Q` (the object is a queue)

**ObjectName**

The name of the reply-to queue. If the queue name you specify is the name of a model queue object, the queue manager creates a dynamic queue.

**ObjectQMGrName**

To receive replies on your local queue manager, leave this field blank.

**DynamicQName**

Specify the name of the dynamic queue to be created.

## Using the command server

The command server is an IBM MQ component that works with the command processor component. You can send formatted messages to the command server which interprets the messages, runs the administration requests, and sends responses back to your administration application.

The command server reads request messages from the system-command input queue, verifies them, and passes the valid ones as commands to the command processor. The command processor processes the commands and puts any replies as reply messages on to the reply-to queue that you specify. The first reply message contains the user message CSQN205I. See “Interpreting the reply messages from the command server” on page 282 for more information. The command server also processes channel initiator and queue-sharing group commands, wherever they are issued from.

### Identifying the queue manager that processes your commands

The queue manager that processes the commands you issue from an administration program is the queue manager that owns the system-command input queue that the message is put onto.

### Starting the command server

Normally, the command server is started automatically when the queue manager is started. It becomes available as soon as the message CSQ9022I 'START QMGR' NORMAL COMPLETION is returned from the START QMGR command. The command server is stopped when all the connected tasks have been disconnected during the system termination phase.

You can control the command server yourself using the START CMDSERV and STOP CMDSERV commands. To prevent the command server starting automatically when IBM MQ is restarted, you can add a STOP CMDSERV command to your CSQINP1 or CSQINP2 initialization data sets. However, this is not recommended as it prevents any channel initiator or queue-sharing group commands being processed.

The STOP CMDSERV command stops the command server as soon as it has finished processing the current message, or immediately if no messages are being processed.

If the command server has been stopped by a STOP CMDSERV command in the program, no other commands from the program can be processed. To restart the command server, you must issue a START CMDSERV command from the z/OS console.

If you stop and restart the command server while the queue manager is running, all the messages that are on the system-command input queue when the command server stops are processed when the command server is restarted. However, if you stop and restart the queue manager after the command server is stopped, only the persistent messages on the system-command input queue are processed when the command server is restarted. All nonpersistent messages on the system-command input queue are lost.

### Sending commands to the command server

For each command, you build a message containing the command, then put it onto the system-command input queue.

## Building a message that includes IBM MQ commands

You can incorporate IBM MQ commands in an application program by building request messages that include the required commands. For each such command you:

1. Create a buffer containing a character string representing the command.
2. Issue an MQPUT call specifying the buffer name in the *buffer* parameter of the call.

The simplest way to do this in C is to define a buffer using 'char'. For example:

```
char message_buffer[ ] = "ALTER QLOCAL(SALES) PUT(ENABLED)";
```

When you build a command, use a null-terminated character string. Do not specify a command prefix string (CPF) at the start of a command defined in this way. This means that you do not have to alter your command scripts if you want to run them on another queue manager. However, you must take into account that a CPF is included in any response messages that are put onto the reply-to queue.

The command server folds all lowercase characters to uppercase unless they are inside quotation marks.

Commands can be any length up to a maximum 32 762 characters.

## Putting messages on the system-command input queue

Use the MQPUT call to put request messages containing commands on the system-command input queue. In this call you specify the name of the reply-to queue that you have already opened.

To use the MQPUT call:

1. Set these MQPUT parameters:

### **Hconn**

The connection handle returned by the MQCONN or MQCONNX call.

### **Hobj**

The object handle returned by the MQOPEN call for the system-command input queue.

### **BufferLength**

The length of the formatted command.

### **Buffer**

The name of the buffer containing the command.

2. Set these MQMD fields:

### **MsgType**

MQMT\_REQUEST

### **Format**

MQFMT\_STRING or MQFMT\_NONE

If you are not using the same code page as the queue manager, set *CodedCharSetId* as appropriate and set MQFMT\_STRING, so that the command server can convert the message. Do not set MQFMT\_ADMIN, as that causes your command to be interpreted as PCF.

### **ReplyToQ**

Name of your reply-to queue.

### **ReplyToQMgr**

If you want replies sent to your local queue manager, leave this field blank. If you want your IBM MQ commands to be sent to a remote queue manager, put its name here. You must also have the correct queues and links set up, as described in [Distributed queuing and clusters](#).

3. Set any other MQMD fields, as required. You should normally use nonpersistent messages for commands.



4. Set any *PutMsgOpts* options, as required.

If you specify MQPMO\_SYNCPOINT (the default), you must follow the MQPUT call with a syncpoint call.

### Using MQPUT1 and the system-command input queue

If you want to put just one message on the system-command input queue, you can use the MQPUT1 call. This call combines the functions of an MQOPEN , followed by an MQPUT of one message, followed by an MQCLOSE , all in one call. If you use this call, modify the parameters accordingly. See [Putting one message on a queue using the MQPUT1 call](#) for details.

## Retrieving replies to your commands

The command server sends a response to a reply queue for each request message it receives. Any administration application must receive, and handle the reply messages.

When the command processor processes your commands, any reply messages are put onto the reply-to queue specified in the MQPUT call. The command server sends the reply messages with the same persistence as the command message it received.

### Waiting for a reply

Use the MQGET call to retrieve a reply from your request message. One request message can produce several reply messages. For details, see [“Interpreting the reply messages from the command server” on page 282.](#)

You can specify a time interval that an MQGET call waits for a reply message to be generated. If you do not get a reply, use the checklist beginning in topic [“If you do not receive a reply” on page 283.](#)

To use the MQGET call:

1. Set these parameters:

#### **Hconn**

The connection handle returned by the MQCONN or MQCONNX call.

#### **Hobj**

The object handle returned by the MQOPEN call for the reply-to queue.

#### **Buffer**

The name of the area to receive the reply.

#### **BufferLength**

The length of the buffer to receive the reply. This must be a minimum of 80 bytes.

2. To ensure that you only get the responses from the command that you issued, you must specify the appropriate *MsgId* and *CorrelId* fields. These depend on the report options, MQMD\_REPORT, you specified in the MQPUT call:

#### **MQRO\_NONE**

Binary zero, '00...00' (24 nulls).

#### **MQRO\_NEW\_MSG\_ID**

Binary zero, '00...00' (24 nulls).

This is the default if none of these options has been specified.

#### **MQRO\_PASS\_MSG\_ID**

The *MsgId* from the MQPUT .

#### **MQRO\_NONE**

The *MsgId* from the MQPUT call.

#### **MQRO\_COPY\_MSG\_ID\_TO\_CORREL\_ID**

The *MsgId* from the MQPUT call.

This is the default if none of these options has been specified.

## **MQRO\_PASS\_CORREL\_ID**

The *CorrelId* from the MQPUT call.

For more details on report options, see [Report options and message flags](#).

3. Set the following *GetMsgOpts* fields:

### **Options**

MQGMO\_WAIT

If you are not using the same code page as the queue manager, set MQGMO\_CONVERT, and set *CodedCharSetId* as appropriate in the MQMD.

### **WaitInterval**

For replies from the local queue manager, try 5 seconds. Coded in milliseconds, this becomes 5 000. For replies from a remote queue manager, and channel control and status commands, try 30 seconds. Coded in milliseconds, this becomes 30 000.

## **Discarded messages**

If the command server finds that a request message is not valid, it discards this message and writes the message *CSQN205I* to the named reply-to queue. If there is no reply-to queue, the *CSQN205I* message is put onto the dead-letter queue. The return code in this message shows why the original request message was not valid:

**00D5020F** It is not of type MQMT\_REQUEST.

**00D50210** It has zero length.

**00D50212** It is longer than 32 762 bytes.

**00D50211** It contains all blanks.

**00D5483E** It needed converting, but *Format* was not MQFMT\_STRING.

**Other** See [Command server codes](#)

## **The command server reply message descriptor**

For any reply message, the following MQMD message descriptor fields are set:

*MsgType* MQMT\_REPLY

*Feedback* MQFB\_NONE

*Encoding* MQENC\_NATIVE

*Priority* As for the MQMD in the message you issued.

*Persistence* As for the MQMD in the message you issued.

*CorrelId* Depends on the MQPUT report options.

*ReplyToQ* None.

The command server sets the *Options* field of the MQPMO structure to MQPMO\_NO\_SYNCPOINT. This means that you can retrieve the replies as they are created, rather than as a group at the next syncpoint.

## **Interpreting the reply messages from the command server**

Each request message correctly processed by IBM MQ produces at least two reply messages. Each reply message contains a single IBM MQ user message.

The length of a reply depends on the command that was issued. The longest reply you can get is from a DISPLAY NAMELIST, and that can be up to 15 000 bytes in length.

The first user message, CSQN205I, always contains:

- A count of the replies (in decimal), which you can use as a counter in a loop to get the rest of the replies. The count includes this first message.
- The return code from the command preprocessor.
- A reason code, which is the reason code from the command processor.

This message does not contain a CPF.

For example:

```
CSQN205I      COUNT=      4, RETURN=0000000C, REASON=00000008
```

The COUNT field is 8 bytes long and is right-justified. It always starts at position 18, that is, immediately after 'COUNT='. The RETURN field is 8 bytes long in character hexadecimal and is immediately after 'RETURN=' at position 35. The REASON field is 8 bytes long in character hexadecimal and is immediately after 'REASON=' at position 52.

If the RETURN= value is 00000000 and the REASON= value is 00000004, the set of reply messages is incomplete. After retrieving the replies indicated by the CSQN205I message, issue a further MQGET call to wait for a further set of replies. The first message in the next set of replies is again CSQN205I, indicating how many replies there are, and whether there are still more to come.

See the [IBM MQ for z/OS messages, completion, and reason codes](#) documentation for more details about the individual messages.

If you are using a non-English language feature, the text and layout of the replies are different from those shown here. However, the size and position of the count and return codes in message CSQN205I are the same.

## If you do not receive a reply

There are a series of steps you can take if you do not receive a response to request to the command server.

If you do not receive a reply to your request message, work through this checklist:

- Is the command server running?
- Is the *WaitInterval* long enough?
- Are the system-command input and reply-to queues correctly defined?
- Were the MQOPEN calls to these queues successful?
- Are both the system-command input and reply-to queues enabled for MQPUT and MQGET calls?
- Have you considered increasing the MAXDEPTH and MAXMSGL attributes of your queues?
- Are you are using the *CorrelId* and *MsgId* fields correctly?
- Is the queue manager still running?
- Was the command built correctly?
- Are all your remote links defined and operating correctly?
- Were the MQPUT calls correctly defined?
- Has the reply-to queue been defined as a temporary dynamic queue instead of a permanent dynamic queue? (If the request message is persistent, you must use a permanent dynamic queue for the reply.)

When the command server generates replies but cannot write them to the reply-to queue that you specify, it writes them to the dead-letter queue.

## Passing commands using MGCRE

With appropriate authorization, an application program can make requests to multiple queue managers using a z/OS service routine.

If you have the correct authorization, you can pass IBM MQ commands from your program to multiple queue managers by the MGCRE (SVC 34) z/OS service. The value of the CPF identifies the particular queue manager to which the command is directed. For information about CPFs, see [User IDs for command security and command resource security](#) and [“Issuing queue manager commands”](#) on page 258.

If you use MGCRE, you can use a Command and Response Token (CART) to get the direct responses to the command.

## Examples of commands and their replies

Use this topic as a series of examples of commands to the command server and the responses from the command server.

Here are some examples of commands that could be built into IBM MQ messages, and the user messages that are the replies. Unless otherwise stated, each line of the reply is a separate message.

- [Messages from a DEFINE command](#)
- [Messages from a DELETE command](#)
- [Messages from DISPLAY commands](#)
- [Messages from commands with CMDSCOPE](#)
- [Messages from commands that generate commands with CMDSCOPE](#)

### Messages from a DEFINE command

The following command:

```
DEFINE QLOCAL(Q1)
```

produces these messages:

```
CSQN205I    COUNT=      2, RETURN=00000000, REASON=00000000  
CSQ9022I +CSQ1 CSQMMSGP ' DEFINE QLOCAL' NORMAL COMPLETION
```

These reply messages are produced on normal completion.

### Messages from a DELETE command

The following command:

```
DELETE QLOCAL(Q2)
```

produces these messages:

```
CSQN205I    COUNT=      4, RETURN=00000000, REASON=00000008  
CSQM125I +CSQ1 CSQMUQLC QLOCAL (Q2) QSGDISP(QMGR) WAS NOT FOUND  
CSQM090E +CSQ1 CSQMUQLC FAILURE REASON CODE X'00D44002'  
CSQ9023E +CSQ1 CSQMUQLC ' DELETE QLOCAL' ABNORMAL COMPLETION
```

These messages indicate that a local queue called Q2 does not exist.

## Messages from DISPLAY commands

The following examples show the replies from some DISPLAY commands.

### Finding out the name of the dead-letter queue

If you want to find out the name of the dead-letter queue for a queue manager, issue this command from an application program:

```
DISPLAY QMGR DEADQ
```

The following three user messages are returned, from which you can extract the required name:

```
CSQN205I    COUNT=      3, RETURN=00000000, REASON=00000000
CSQM409I +CSQ1 QMNAME(CSQ1) DEADQ(SYSTEM.DEAD.QUEUE      )
CSQ9022I +CSQ1 CSQMDRTS ' DISPLAY QMGR' NORMAL COMPLETION
```

## Messages from the DISPLAY QUEUE command

The following examples show how the results from a command depend on the attributes specified in that command.

### Example 1

You define a local queue using the command:

```
DEFINE QLOCAL(Q1) DESCR('A sample queue') GET(ENABLED) SHARE
```

If you issue the following command from an application program:

```
DISPLAY QUEUE(Q1) SHARE GET DESCR
```

these three user messages are returned:

```
CSQN205I    COUNT=      3, RETURN=00000000, REASON=00000000
CSQM401I +CSQ1 QUEUE(Q1                                ) TYPE(
QLOCAL ) QSGDISP(QMGR  )
DESCR(A sample queue
) SHARE GET(ENABLED )
CSQ9022I +CSQ1 CSQMMSG ' DISPLAY QUEUE' NORMAL COMPLETION
```

**Note:** The second message, CSQM401I, is shown here occupying four lines.

### Example 2

Two queues have names beginning with the letter A:

- A1 is a local queue with its PUT attribute set to DISABLED.
- A2 is a remote queue with its PUT attribute set to ENABLED.

If you issue the following command from an application program:

```
DISPLAY QUEUE(A*) PUT
```

these four user messages are returned:

```
CSQN205I    COUNT=    4, RETURN=00000000, REASON=00000000
CSQM401I +CSQ1 QUEUE(A1                                ) TYPE(
QLOCAL ) QSGDISP(QMGR    )
PUT(DISABLED )
CSQM406I +CSQ1 QUEUE(A2                                ) TYPE(
QREMOTE ) PUT(ENABLED )
CSQ9022I +CSQ1 CSQMMSG ' DISPLAY QUEUE' NORMAL COMPLETION
```

**Note:** The second and third messages, CSQM401I and CSQM406I, are shown here occupying three and two lines.

### Messages from the DISPLAY NAMELIST command

You define a namelist using the command:

```
DEFINE NAMELIST(N1) NAMES(Q1,SAMPLE_QUEUE)
```

If you issue the following command from an application program:

```
DISPLAY NAMELIST(N1) NAMES NAMCOUNT
```

the following three user messages are returned:

```
CSQN205I    COUNT=    3, RETURN=00000000, REASON=00000000
CSQM407I +CSQ1 NAMELIST(N1                              ) QS
GDISP(QMGR ) NAMCOUNT(    2) NAMES(Q1
,SAMPLE_QUEUE
CSQ9022I +CSQ1 CSQMMSG ' DISPLAY NAMELIST' NORMAL COMPLETION
```

**Note:** The second message, CSQM407I, is shown here occupying three lines.

### Messages from commands with CMDSCOPE

The following examples show the replies from commands that have been entered with the CMDSCOPE attribute.

#### Messages from the ALTER PROCESS command

The following command:

```
ALT PRO(V4) CMDSCOPE(*)
```

produces the following messages:

```

CSQN205I COUNT= 2, RETURN=00000000, REASON=00000004
CSQN137I !MQ25 'ALT PRO' command accepted for CMDSCOPE(*), sent to 2
CSQN205I COUNT= 5, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'ALT PRO' command responses from MQ26
CSQM125I !MQ26 CSQMMSGP PROCESS(V4) QSGDISP(QMGR) WAS NOT FOUND
CSQM090E !MQ26 CSQMMSGP FAILURE REASON CODE X'00D44002'
CSQ9023E !MQ26 CSQMMSGP 'ALT PRO' ABNORMAL COMPLETION
CSQN205I COUNT= 3, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'ALT PRO' command responses from MQ25
CSQ9022I !MQ25 CSQMMSGP 'ALT PRO' NORMAL COMPLETION
CSQN205I COUNT= 2, RETURN=0000000C, REASON=00000008
CSQN123E !MQ25 'ALT PRO' command for CMDSCOPE(*) abnormal completion

```

These messages tell you that the command was entered on queue manager MQ25 and sent to two queue managers (MQ25 and MQ26). The command was successful on MQ25 but the process definition did not exist on MQ26, so the command failed on that queue manager.

### Messages from the **DISPLAY PROCESS** command

The following command:

```
DIS PRO(V*) CMDSCOPE(*)
```

produces the following messages:

```

CSQN205I COUNT= 2, RETURN=00000000, REASON=00000004
CSQN137I !MQ25 'DIS PRO' command accepted for CMDSCOPE(*), sent to 2
CSQN205I COUNT= 5, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'DIS PRO' command responses from MQ26
CSQM408I !MQ26 PROCESS(V2) QSGDISP(COPY)
CSQM408I !MQ26 PROCESS(V3) QSGDISP(QMGR)
CSQ9022I !MQ26 CSQMDRTS 'DIS PROCESS' NORMAL COMPLETION
CSQN205I COUNT= 7, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'DIS PRO' command responses from MQ25
CSQM408I !MQ25 PROCESS(V2) QSGDISP(COPY)
CSQM408I !MQ25 PROCESS(V2) QSGDISP(GROUP)
CSQM408I !MQ25 PROCESS(V3) QSGDISP(QMGR)
CSQM408I !MQ25 PROCESS(V4) QSGDISP(QMGR)
CSQ9022I !MQ25 CSQMDRTS 'DIS PROCESS' NORMAL COMPLETION
CSQN205I COUNT= 2, RETURN=00000000, REASON=00000000
CSQN122I !MQ25 'DIS PRO' command for CMDSCOPE(*) normal completion

```

These messages tell you that the command was entered on queue manager MQ25 and sent to two queue managers (MQ25 and MQ26). Information is displayed about all the processes on each queue manager with names starting with the letter V.

### Messages from the **DISPLAY CHSTATUS** command

The following command:

```
DIS CHS(VT) CMDSCOPE(*)
```

produces the following messages:

```

CSQN205I COUNT= 2, RETURN=00000000, REASON=00000004
CSQN137I !MQ25 'DIS CHS' command accepted for CMDSCOPE(*), sent to 2
CSQN205I COUNT= 4, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'DIS CHS' command responses from MQ25
CSQM422I !MQ25 CHSTATUS(VT) CHLDISP(PRIVATE) CONNAME( ) CURRENT STATUS(STOPPED)
CSQ9022I !MQ25 CSQXDRTS 'DIS CHS' NORMAL COMPLETION
CSQN205I COUNT= 4, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'DIS CHS' command responses from MQ26
CSQM422I !MQ26 CHSTATUS(VT) CHLDISP(PRIVATE) CONNAME( ) CURRENT STATUS(STOPPED)
CSQ9022I !MQ26 CSQXDRTS 'DIS CHS' NORMAL COMPLETION
CSQN205I COUNT= 2, RETURN=00000000, REASON=00000000
CSQN122I !MQ25 'DIS CHS' command for CMDSCOPE(*) normal completion

```

These messages tell you that the command was entered on queue manager MQ25 and sent to two queue managers (MQ25 and MQ26). Information is displayed about channel status on each queue manager.

### Messages from the STOP CHANNEL command

The following command:

```
STOP CHL(VT) CMDSCOPE(*)
```

produces these messages:

```

CSQN205I COUNT= 2, RETURN=00000000, REASON=00000004
CSQN137I !MQ25 'STOP CHL' command accepted for CMDSCOPE(*), sent to 2
CSQN205I COUNT= 3, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'STOP CHL' command responses from MQ25
CSQM134I !MQ25 CSQMTCHL STOP CHL(VT) COMMAND ACCEPTED
SQN205I COUNT= 3, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'STOP CHL' command responses from MQ26
CSQM134I !MQ26 CSQMTCHL STOP CHL(VT) COMMAND ACCEPTED
CSQN205I COUNT= 3, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'STOP CHL' command responses from MQ26
CSQ9022I !MQ26 CSQXCRPS 'STOP CHL' NORMAL COMPLETION
CSQN205I COUNT= 3, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'STOP CHL' command responses from MQ25
CSQ9022I !MQ25 CSQXCRPS 'STOP CHL' NORMAL COMPLETION
CSQN205I COUNT= 2, RETURN=00000000, REASON=00000000
CSQN122I !MQ25 'STOP CHL' command for CMDSCOPE(*) normal completion

```

These messages tell you that the command was entered on queue manager MQ25 and sent to two queue managers (MQ25 and MQ26). Channel VT was stopped on each queue manager.

### Messages from commands that generate commands with CMDSCOPE

The following command:

```
DEF PRO(V2) QSGDISP(GROUP)
```

produces these messages:



```

CSQN205I COUNT=      3, RETURN=00000000, REASON=00000004
CSQM122I !MQ25 CSQMMSGP ' DEF PRO' COMPLETED FOR QSGDISP(GROUP)
CSQN138I !MQ25 'DEFINE PRO' command generated for CMDSCOPE(*), sent to 2
CSQN205I COUNT=      3, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'DEFINE PRO' command responses from MQ25
CSQ9022I !MQ25 CSQMMSGP ' DEFINE PROCESS' NORMAL COMPLETION
CSQN205I COUNT=      3, RETURN=00000000, REASON=00000004
CSQN121I !MQ25 'DEFINE PRO' command responses from MQ26
CSQ9022I !MQ26 CSQMMSGP ' DEFINE PROCESS' NORMAL COMPLETION
CSQN205I COUNT=      2, RETURN=00000000, REASON=00000000
CSQN122I !MQ25 'DEFINE PRO' command for CMDSCOPE(*) normal completion

```

These messages tell you that the command was entered on queue manager MQ25. When the object was created on the shared repository, another command was generated and sent to all the active queue managers in the queue-sharing group (MQ25 and MQ26).

## z/OS

## Managing IBM MQ resources on z/OS

Use the links in this topic to find out how to manage the resources used by IBM MQ for z/OS, for example, managing log files, data sets, page sets, buffer pools, and coupling facility structures.

Use the following links for details of the different administrative tasks you might have to complete while using IBM MQ for z/OS:

- [“Managing the logs” on page 290](#)
- [“Managing the bootstrap data set \(BSDS\)” on page 297](#)
- [“Managing page sets” on page 305](#)
- [“How to back up and recover page sets” on page 311](#)
- [“How to back up and restore queues using CSQUTIL” on page 314](#)
- [“Managing buffer pools” on page 314](#)
- [“Managing queue-sharing groups and shared queues” on page 316](#)

### Related concepts

[“Administering IBM MQ for z/OS” on page 247](#)

Administering queue managers and associated resources includes the tasks that you perform frequently to activate and manage those resources. Choose the method you prefer to administer your queue managers and associated resources.

[“Issuing commands to IBM MQ for z/OS” on page 247](#)

You can use IBM MQ script commands (MQSC) in batch or interactive mode to control a queue manager.

[“Recovery and restart” on page 323](#)

Use this topic to understand the recovery and restart mechanisms used by IBM MQ.

### Related reference

[“The IBM MQ for z/OS utilities” on page 255](#)

IBM MQ for z/OS provides a set of utility programs that you can use to help with system administration.

### Related information

[IBM MQ for z/OS concepts](#)

[Planning your IBM MQ environment on z/OS](#)

[Configuring z/OS](#)

[Programmable command formats reference](#)

[MQSC reference](#)

[Using the IBM MQ for z/OS utilities](#)

## Managing the logs

Use this topic to understand how to manage your IBM MQ log files, including the log archiving process, using log record compression, log record recovery, and printing log records.

This topic describes the tasks involved in managing the IBM MQ logs. It contains these sections:

### ***Archiving logs with the ARCHIVE LOG command***

An authorized operator can archive the current IBM MQ active log data sets whenever required using the ARCHIVE LOG command.

When you issue the ARCHIVE LOG command, IBM MQ truncates the current active log data sets, then runs an asynchronous offload process, and updates the BSDS with a record of the offload process.

The ARCHIVE LOG command has a MODE(QUIESCE) option. With this option, IBM MQ jobs and users are quiesced after a commit point, and the resulting point of consistency is captured in the current active log before it is offloaded.

Consider using the MODE(QUIESCE) option when planning a backup strategy for off site recovery. It creates a system-wide point of consistency, which minimizes the number of data inconsistencies when the archive log is used with the most current backup page set copy during recovery. For example:

```
ARCHIVE LOG MODE(QUIESCE)
```

If you issue the ARCHIVE LOG command without specifying a TIME parameter, the quiesce time period defaults to the value of the QUIESCE parameter of the CSQ6ARVP macro. If the time required for the ARCHIVE LOG MODE(QUIESCE) to complete is less than the time specified, the command completes successfully; otherwise, the command fails when the time period expires. You can specify the time period explicitly by using the TIME option, for example:

```
ARCHIVE LOG MODE(QUIESCE) TIME(60)
```

This command specifies a quiesce period of up to 60 seconds before ARCHIVE LOG processing occurs.

**Attention:** Using the TIME option when time is critical can significantly disrupt IBM MQ availability for all jobs and users that use IBM MQ resources.

By default, the command is processed asynchronously from the time you submit the command. (To process the command synchronously with other IBM MQ commands use the WAIT(YES) option with QUIESCE, but be aware that the z/OS console is locked from IBM MQ command input for the entire QUIESCE period.)

During the quiesce period:

- Jobs and users on the queue manager are allowed to go through commit processing, but are suspended if they try to update any IBM MQ resource after the commit.
- Jobs and users that only read data can be affected, since they might be waiting for locks held by jobs or users that were suspended.
- New tasks can start, but they cannot update data.

The output from the DISPLAY LOG command uses the message CSQV400I to indicate that a quiesce is in effect. For example:

```

CSQJ322I +CSQ1 DISPLAY LOG report ...
Parameter      Initial value      SET value
-----
INBUFF         60
OUTBUFF        4000
MAXRTU         2
MAXARCH        2
TWOACTV        YES
TWOARCH        YES
TWOBSDS        YES
OFFLOAD        YES
WRTHRSH        20
DEALLCT        0
End of LOG report
CSQJ370I +CSQ1 LOG status report ...
Copy %Full DSName
1          68  VICY.CSQ1.LOGCOPY1.DS01
2          68  VICY.CSQ1.LOGCOPY2.DS01
Restarted at 2014-04-15 09:49:30 using RBA=000000000891B000
Latest RBA=000000000891CCF8
Offload task is AVAILABLE
Full logs to offload - 0 of 4
CSQV400I +CSQ1 ARCHIVE LOG QUIESCE CURRENTLY ACTIVE
CSQ9022I +CSQ1 CSQJC001 ' DISPLAY LOG' NORMAL COMPLETION

```

When all updates are quiesced, the quiesce history record in the BSDS is updated with the date and time that the active log data sets were truncated, and with the last-written RBA in the current active log data sets. IBM MQ truncates the current active log data sets, switches to the next available active log data sets, and issues message CSQJ311I stating that the offload process started.

If updates cannot be quiesced before the quiesce period expires, IBM MQ issues message CSQJ317I, and ARCHIVE LOG processing terminates. The current active log data sets are not truncated, nor switched to the next available log data sets, and the offload process is not started.

Whether the quiesce was successful or not, all suspended users and jobs are then resumed, and IBM MQ issues message CSQJ312I, stating that the quiesce is ended and update activity is resumed.

If ARCHIVE LOG is issued when the current active log is the last available active log data set, the command is not processed, and IBM MQ issues the following message:

```

CSQJ319I - csect-name CURRENT ACTIVE LOG DATA SET IS THE LAST
AVAILABLE ACTIVE LOG DATA SET. ARCHIVE LOG PROCESSING
WILL BE TERMINATED

```

If [ARCHIVE LOG](#) is issued when another ARCHIVE LOG command is already in progress, the new command is not processed, and IBM MQ issues the following message:

```

CSQJ318I - ARCHIVE LOG COMMAND ALREADY IN PROGRESS

```

For information about the messages issued during archiving, see [Messages for IBM MQ for z/OS](#).

### Restarting the log archive process after a failure

If there is a problem during the log archive process (for example, a problem with allocation or tape mounts), the archiving of the active log might be suspended. You can cancel the archive process and restart it by using the ARCHIVE LOG CANCEL OFFLOAD command. This command cancels any offload processing currently in progress, and restarts the archive process. It starts with the oldest log data set that has not been archived, and proceeds through all active log data sets that need offloading. Any log archive operations that have been suspended are restarted.

Use this command only if you are sure that the current log archive task is no longer functioning, or if you want to restart a previous attempt that failed. This is because the command might cause an abnormal termination of the offload task, which might result in a dump.

### **Controlling archiving and logging**

You can control compression, printing, archiving, recovery and logging with using the CSQ6LOGP, CSQ6ARVP, and CSQ6SYSP macros. Note, that changes to private objects only are logged in IBM MQlogs. Changes to GROUP objects (like shared inbound channels) are also logged, because the definitions are propagated around the group and held locally.

Many aspects of archiving and logging are controlled by parameters set using the CSQ6LOGP, CSQ6ARVP and CSQ6SYSP macros of the system parameter module when the queue manager is customized. See [Task 17: Tailor your system parameter module](#) for details of these macros.

Some of these parameters can be changed while a queue manager is running using the IBM MQ MQSC SET LOG, SET SYSTEM and SET ARCHIVE commands. They are shown in [Table 18 on page 292](#):

<i>Table 18. Archiving and logging parameters that can be changed while a queue manager is running</i>	
<b>SET command</b>	<b>Parameters</b>
LOG	WRTHRSH, MAXARCH, DEALLCT, MAXRTU, COMPLOG
ARCHIVE	All
SYSTEM	LOGLOAD

You can display the settings of all the parameters using the MQSC [DISPLAY LOG](#), [DISPLAY ARCHIVE](#) and [DISPLAY SYSTEM](#) commands. These commands also show status information about archiving and logging.

### **Controlling log compression**

You can enable and disable the compression of log records using either

- The SET and DISPLAY LOG commands in MQSC; see [The MQSC commands](#)
- Invoking PCF interface. See [“Introduction to Programmable Command Formats” on page 9](#)
- Using the CSQ6LOGP macro in the system parameter module; see [Using CSQ6LOGP](#)

### **Printing log records**

You can extract and print log records using the CSQ1LOGP utility. For instructions, see [The log print utility](#).

### **Recovering logs**

Normally, you do not need to back up and restore the IBM MQ logs, especially if you are using dual logging. However, in rare circumstances, such as an I/O error on a log, you might need to recover the logs. Use Access Method Services to delete and redefine the data set, and then copy the corresponding dual log into it.

### **Discarding archive log data sets**

You can discard your archive log data sets and choose to discard the logs automatically or manually.

You must keep enough log data to be able to perform unit of work recovery, page set media recovery if a page set is lost, or CF structure media recovery if a CF structure is lost. Do not discard archive log data sets that might be required for recovery; if you discard these archive log data sets you might not be able to perform required recovery operations.

If you have confirmed that your archive log data sets can be discarded, you can do this in either of the following ways:

- [Automatic archive log data set deletion](#)
- [Manually deleting archive log data sets](#)

## Automatic archive log data set deletion

You can use a DASD or tape management system to delete archive log data sets automatically. The retention period for IBM MQ archive log data sets is specified by the retention period field ARCRETN in the CSQ6ARVP installation macro (see the [Using CSQ6ARVP](#) for more information).

The default for the retention period specifies that archive logs are to be kept for 9999 days (the maximum). **You can change the retention period but you must ensure that you can accommodate the number of backup cycles that you have planned for.**

IBM MQ uses the retention period value as the value for the JCL parameter RETPD when archive log data sets are created.

The retention period set by the MVS™/DFP storage management subsystem (SMS) can be overridden by this IBM MQ parameter. Typically, the retention period is set to the smaller value specified by either IBM MQ or SMS. The storage administrator and IBM MQ administrator must agree on a retention period value that is appropriate for IBM MQ.

**Note:** IBM MQ does not have an automated method to delete information about archive log data sets from the BSDS, because some tape management systems provide external manual overrides of retention periods. Therefore, information about an archive log data set can still be in the BSDS long after the data set retention period has expired and the data set has been scratched by the tape management system. Conversely, the maximum number of archive log data sets might have been exceeded and the data from the BSDS might have been dropped before the data set has reached its expiration date.

If archive log data sets are deleted automatically, remember that the operation does not update the list of archive logs in the BSDS. You can update the BSDS with the change log inventory utility, as described in [“Changing the BSDS” on page 299](#). The update is not essential. Recording old archive logs wastes space in the BSDS, but does no other harm.

## Manually deleting archive log data sets

You must keep all the log records as far back as the lowest RBA identified in messages CSQI024I and CSQI025I. This RBA is obtained using the DISPLAY USAGE command that you issued when creating a point of recovery using [Method 1: Full backup](#).

**Read [Creating a point of recovery for non-shared resources before discarding any logs](#).**

### Locate and discard archive log data sets

Having established the minimum log RBA required for recovery, you can find archive log data sets that contain only earlier log records by performing the following procedure:

1. Use the print log map utility to print the contents of the BSDS. For an example of the output, see [The print log map utility](#).
2. Find the sections of the output titled "ARCHIVE LOG COPY n DATA SETS". If you use dual logging, there are two sections. The columns labeled STARTRBA and ENDRBA show the range of RBAs contained in each volume. Find the volumes with ranges that include the minimum RBA you found with messages CSQI024I and CSQI025I. These are the earliest volumes you need to keep. If you are using dual-logging, there are two such volumes.

If no volumes have an appropriate range, one of the following cases applies:

- The minimum RBA has not yet been archived, and you can discard all archive log volumes.

- The list of archive log volumes in the BSDS wrapped around when the number of volumes exceeded the number allowed by the MAXARCH parameter of the CSQ6LOGP macro. If the BSDS does not register an archive log volume, that volume cannot be used for recovery. Therefore, consider adding information about existing volumes to the BSDS. For instructions, see [“Changes for archive logs” on page 301](#).

Also consider increasing the value of MAXARCH. For information, see the [Using CSQ6LOGP](#).

3. Delete any archive log data set or volume with an ENDRBA value that is less than the STARTRBA value of the earliest volume you want to keep. If you are using dual logging, delete both such copies.

Because BSDS entries wrap around, the first few entries in the BSDS archive log section might be more recent than the entries at the bottom. Look at the combination of date and time and compare their ages. Do not assume that you can discard all entries *above* the entry for the archive log containing the minimum LOGRBA.

Delete the data sets. If the archives are on tape, erase the tapes. If they are on DASD, run a z/OS utility to delete each data set. Then, if you want the BSDS to list only existing archive volumes, use the change log inventory utility (CSQJU003) to delete entries for the discarded volumes. See [“Changes for archive logs” on page 301](#) for an example.

### ***The effect of log shunting***

Long running transactions can cause unit of work log records which span log data sets. IBM MQ handles this scenario by using log shunting, a technique which moves the log records to optimize the quantity of log data retained, and queue manager restart time.

When a unit of work is considered to be long, a representation of each log record is written further down the log. This is known as *log shunting*. It is described more fully in [Log files](#).

The queue manager uses these shunted log records instead of the originals after a failure, to ensure unit of work integrity. There are two benefits to this:

- the quantity of log data which must be retained for unit of work coordination is reduced
- less log data must be traversed at queue manager restart time, so the queue manager is restarted more quickly

Shunted log records do not contain sufficient information for media recovery operations.

Data held in the log is used for two distinct purposes; media recovery and unit of work coordination. If a media failure occurs which affects either a CF structure or page set, the queue manager can recover the media to the point of failure by restoring a prior copy and updating this using data contained in the log. Persistent activity performed in a unit of work is recorded on the log so that in the event of a failure, it can either be backed out or locks can be recovered on changed resources. The quantity of log data you need to retain to enable queue manager recovery is affected by these two elements.

For media recovery, you must retain sufficient log data to be able to perform media recovery from at least the most recent media copy and to be able to back out. (Your site may stipulate the ability to recover from older backups.) For unit of work integrity, you must retain the log data for your oldest in flight or indoubt units of work.

To assist you with managing the system, the queue manager detects old units of work at each log archive and reports them in messages CSQJ160 and CSQJ161. An internal task reads unit of work log information for these old units of work and rewrites it in a more succinct form to the current position in the log. Message CSQR026 indicates when this has happened. The MQSC command DISPLAY USAGE TYPE(DATASET) can also help you to manage the retention of log data. The command reports 3 pieces of recovery information:

1. how much of the log must be retained for unit of work recovery
2. how much of the log must be retained for media recovery of page sets
3. for a queue manager in a queue-sharing group, how much of the log must be retained for media recovery of CF structures

For each of these, an attempt is made to map the oldest log data required into a data set. As new units of work start and stop, we would expect (1) to move to a more recent position in the log. If it is not moving, the long running UOW messages warn you that there is an issue. (2) relates to page set media recovery if the queue manager were to be shut down now and restarted. It does not know about when you last backed up your page sets, or which backup you might have to use if there was a page set failure. It normally moves to a more recent position in the log during checkpoint processing as changes held in the buffer pools are written to the page sets. In (3), the queue manager does know about CF structure backups taken either on this queue manager or on other queue managers in the queue sharing group. However, CF structure recovery requires a merge of log data from all queue managers in the queue-sharing group which have interacted with the CF structure since the last backup. This means that the log data is identified by a log record sequence number, (or LRSN), which is timestamp based and so applicable across the entire queue-sharing group rather than an RBA which would be different on different queue managers in the queue-sharing group. It normally moves to a more recent position in the log as BACKUP CFSTRUCT commands are performed on either this or other queue managers in the queue-sharing group.

### ***Resetting the queue manager's log***

Use this topic to understand how to reset the queue manager's log.

You must not allow the queue manager log RBA to wrap around from the end of the log RBA range to 0, as this leads to a queue manager outage and all persistent data will become unrecoverable. The end of the log RBA is either a value of FFFFFFFFFF (if 6-byte RBAs as in use), or FFFFFFFFFFFFFFFF (if 8-byte RBAs are in use).

The queue manager issues messages CSQI045I, CSQI046E, CSQI047E, CSQJ031D, and CSQJ032E to indicate that the used log range is significant and that you should plan to take action to avoid an unplanned outage.

The queue manager terminates with reason code 00D10257 when the RBA value reaches FFF800000000 (if 6-byte log RBAs are in use) or FFFFFFFC000000000 (if 8-byte log RBAs are in use).

If 6-byte log RBAs are in use, consider converting the queue manager to use 8-byte log RBAs rather than resetting the queue manager's log, following the process described in [Implementing the larger log Relative Byte Address](#). Converting a queue manager to use 8-byte log RBAs requires a shorter outage than resetting the log, and increases the period of time before you have to reset the log.

Message CSQJ034I, issued during queue manager initialization, indicates the end of the log RBA range for the queue manager as configured, and can be used to determine whether 6-byte or 8-byte log RBAs are in use.

The procedure to follow to reset the queue manager's log is as follows:

1. Resolve any unresolved units of work. The number of unresolved units of work is displayed at queue manager startup in message CSQR005I as the INDOUBT count. At each checkpoint, and at queue manager shutdown, the queue manager automatically issues the command

**DISPLAY CONN(\*) TYPE(CONN) ALL WHERE(UOWSTATE EQ UNRESOLVED)** to provide information about unresolved units of work.

See [How in-doubt units of recovery are resolved](#) for information on resolving units of recovery. The ultimate recourse is to use the **RESOLVE INDOUBT** MQSC command to manually resolve indoubt units of recovery.

2. Shutdown the queue manager cleanly.

You can use either **STOP QMGR** or **STOP QMGR MODE(FORCE)** as both these commands flush any changed pages from bufferpools to the pagesets.

3. If a queue manager is part of a queue sharing group, take CFSTRUCT backups on other queue managers for all structures in the queue sharing group. This ensures that the most recent backups are not in this queue manager's log, and that this queue manager's log is not required for CFSTRUCT recovery.



4. Define new logs and BSDS using CSQJU003 (see [The change log inventory utility](#) for more information on using the change log inventory utility).
5. Run **CSQUTIL RESETPAGE** against all the page sets for this queue manager (see [Copying a page and resetting the log](#) for more information on using this function). Note that page set RBAs can be reset independently, so multiple concurrent jobs (for example, one per page set) can be submitted to reduce the elapsed time for this step.
6. Restart the queue manager

### Related concepts

[“Implementing the larger log Relative Byte Address” on page 296](#)

Previous releases of IBM MQ for z/OS used a 6-byte log RBA to identify the location of data within the log. In IBM MQ 8.0, the log RBA can be 8 bytes long, increasing the period of time before you have to reset the log.

### **Implementing the larger log Relative Byte Address**

Previous releases of IBM MQ for z/OS used a 6-byte log RBA to identify the location of data within the log. In IBM MQ 8.0, the log RBA can be 8 bytes long, increasing the period of time before you have to reset the log.

This new feature needs to be explicitly enabled. See [Planning to increase the maximum addressable log range](#) for considerations when planning to enable 8 byte log RBA.

Perform these instructions, in the order shown, to enable 8 byte log RBA on a single IBM MQ for z/OS queue manager:

1. Enable IBM MQ 8.0 new functions using [OPMODE](#).

For queue managers in a queue-sharing group, you do not need to take a total queue-sharing group outage. You can stop each queue manager in turn, enable it for OPMODE=(NEWFUNC,800) and restart it.

Once all queue managers in the queue sharing group are running with OPMODE(NEWFUNC,800), perform the following steps for each queue manager in the queue-sharing group until all queue managers are running with the new BSDS.

2. Allocate new BSDS data sets with similar attributes to the current BSDS. You can tailor sample CSQ4BSDS and delete any irrelevant statement, or you can use your existing JCL, but change the BSDS name to something like ++HLQ++.NEW.BSDS01.

#### Notes:

- a. Check the attributes of your new BSDS. The only attribute that might change is the size of the BSDS.
- b. The new BSDS contains more data than the current BSDS, therefore, you must ensure that the new data sets are allocated with sufficient available space. See [Planning your logging environment](#), and the associated topics, for the recommended values when defining a new BSDS.
3. Shut down the queue manager cleanly.
4. Run the [BSDS conversion utility \(CSQJUCNV\)](#) to convert the existing BSDS to the new BSDS data sets. This usually takes a few seconds to run.

Your existing BSDS will not be changed during this process, and you can use that for the initialization of the queue manager in the case of an unsuccessful conversion.

5. Rename the current BSDS to become the old BSDS, and the new BSDS to become the current BSDS, so that the new data sets are used when you next restart the queue manager. You can use the DFSMS Access Method Services ALTER command, for example:

```
ALTER '++HLQ++.BSDS01' NEWNAME('++HLQ++.OLD.BSDS01')
ALTER '++HLQ++.NEW.BSDS01' NEWNAME('++HLQ++.BSDS01')
```

Ensure that you also issue commands to rename both the data and index portions of the VSAM cluster.



6. Restart the queue manager. It should start in the same amount of time as it would have done when using 6 byte log RBA.

If the queue manager does not restart successfully due to a failure to access the converted BSDS, attempt to identify the cause of the failure, resolve the problem and retry the operation. If required, contact your IBM support center for assistance.

If necessary, the change can be backed out at this point by:

- a. Renaming the current BSDS to become the new BSDS.
- b. Renaming the old BSDS to become the current BSDS.
- c. Restarting the queue manager.

Once the queue manager has been successfully restarted with the converted BSDS, do not attempt to start the queue manager using the old BSDS.

7. Message CSQJ034I is issued during queue manager initialization to indicate the end of the log RBA for the queue manager as configured. Confirm that the end of the log RBA range displayed is FFFFFFFFFFFFFFFF. This indicates that 8 byte log RBA is in use.

**Note:** In order to enable an 8 byte log RBA on a new IBM MQ 8.0 queue manager, before it is first started, you must first create an empty version 1 format BSDS and use that as input to the BSDS conversion utility to produce a version 2 format BSDS. See [Create the bootstrap and log datasets](#) for information on how you carry out this process.

#### **Related information**

[Planning to increase the maximum addressable log range](#)

[Larger log Relative Byte Address](#)

[The BSDS conversion utility \(CSQJUCNV\)](#)

## **Managing the bootstrap data set (BSDS)**

The bootstrap data set (BSDS) is used to reference log data sets, and log records. Use this topic to understand how you can examine, change, and recover the BSDS.

For more information, see [The bootstrap data set](#).

This topic describes the tasks involved in managing the bootstrap data set. It contains these sections:

- [“Finding out what the BSDS contains” on page 297](#)
- [“Changing the BSDS” on page 299](#)
- [“Recovering the BSDS” on page 302](#)

### ***Finding out what the BSDS contains***

You can use the print log map utility (CSQJU004) to examine the contents of the BSDS.

The print log map utility (CSQJU004) is a batch utility that lists the information stored in the BSDS. For instructions on running it, see [The print log map utility](#).

The BSDS contains:

- [Time stamps](#)
- [Active log data set status](#)

### **Time stamps in the BSDS**

The output of the print log map utility shows the time stamps, which are used to record the date and time of various system events, that are stored in the BSDS.

The following time stamps are included in the header section of the report:

## **SYSTEM TIMESTAMP**

Reflects the date and time the BSDS was last updated. The BSDS time stamp can be updated when:

- The queue manager starts.
- The write threshold is reached during log write activities. Depending on the number of output buffers you have specified and the system activity rate, the BSDS might be updated several times a second, or might not be updated for several seconds, minutes, or even hours. For details of the write threshold, see the WRTHRS parameter of the CSQ6LOGP macro in [Using CSQ6LOGP](#).
- IBM MQ drops into a single BSDS mode from its normal dual BSDS mode due to an error. This can occur when a request to get, insert, point to, update, or delete a BSDS record is unsuccessful. When this error occurs, IBM MQ updates the time stamp in the remaining BSDS to force a time stamp mismatch with the disabled BSDS.

## **UTILITY TIMESTAMP**

The date and time the contents of the BSDS were altered by the change log inventory utility (CSQJU003).

The following time stamps are included in the active and archive log data sets portion of the report:

### **Active log date**

The date the active log entry was created in the BSDS, that is, when the CSQJU003 NEWLOG was done.

### **Active log time**

The time the active log entry was created in the BSDS, that is, when the CSQJU003 NEWLOG was done.

### **Archive log date**

The date the archive log entry was created in the BSDS, that is, when the CSQJU003 NEWLOG was done or the archive itself was done.

### **Archive log time**

The time the archive log entry was created in the BSDS, that is, when the CSQJU003 NEWLOG was done or the archive itself was done.

## **Active log data set status**

The BSDS records the status of an active log data set as one of the following:

### **NEW**

The data set has been defined but never used by IBM MQ, or the log was truncated to a point before the data set was first used. In either case, the data set starting and ending RBA values are reset to zero.

### **REUSABLE**

Either the data set has been defined but never used by IBM MQ, or the data set has been offloaded. In the print log map output, the start RBA value for the last REUSABLE data set is equal to the start RBA value of the last archive log data set.

### **NOT REUSABLE**

The data set contains records that have not been offloaded.

### **STOPPED**

The offload processor encountered an error while reading a record, and that record could not be obtained from the other copy of the active log.

### **TRUNCATED**

Either:

- An I/O error occurred, and IBM MQ has stopped writing to this data set. The active log data set is offloaded, beginning with the starting RBA and continuing up to the last valid record segment in the truncated active log data set. The RBA of the last valid record segment is lower than the ending RBA of the active log data set. Logging is switched to the next available active log data set, and continues uninterrupted.

or

- An ARCHIVE LOG function has been called, which has truncated the active log.

The status appears in the output from the print log map utility.

### ***Changing the BSDS***

You do not have to take special steps to keep the BSDS updated with records of logging events because IBM MQ does that automatically.

However, you might want to change the BSDS if you do any of the following:

- Add more active log data sets.
- Copy active log data sets to newly allocated data sets, for example, when providing larger active log allocations.
- Move log data sets to other devices.
- Recover a damaged BSDS.
- Discard outdated archive log data sets.

You can change the BSDS by running the change log inventory utility (CSQJU003). Only run this utility when the queue manager is inactive, or you might get inconsistent results. The action of the utility is controlled by statements in the SYSIN data set. This section shows several examples. For complete instructions, see [The change log inventory utility](#).

You can copy an active log data set only when the queue manager is inactive because IBM MQ allocates the active log data sets as exclusive (DISP=OLD) at queue manager startup.

#### *Changes for active logs*

Use this topic to understand how you can change the active logs using the BSDS.

You can add to, delete from, and record entries in the BSDS for active logs using the change log utility. Examples only are shown here; replace the data set names shown with the ones you want to use. For more details of the utility, see [The change log inventory utility](#).

See these sections for more information:

- [Adding record entries to the BSDS](#)
- [Deleting information about the active log data set from the BSDS](#)
- [Recording information about the log data set in the BSDS](#)
- [Increasing the size of the active log](#)
- [The use of CSQJUFMT](#)

### **Adding record entries to the BSDS**

If an active log has been flagged as "stopped", it is not reused for logging; however, it continues to be used for reading. Use the access method services to define new active log data sets, then use the change log inventory utility to register the new data sets in the BSDS. For example, use:

```
NEWLOG DSN=MQM111.LOGCOPY1.DS10,COPY1
NEWLOG DSN=MQM111.LOGCOPY2.DS10,COPY2
```

If you are copying the contents of an old active log data set to the new one, you can also give the RBA range and the starting and ending time stamps on the NEWLOG function.

### **Deleting information about the active log data set from the BSDS**

To delete information about an active log data set from the BSDS, you could use:

```
DELETE DSN=MQM111.LOGCOPY1.DS99
DELETE DSN=MQM111.LOGCOPY2.DS99
```

## Recording information about the log data set in the BSDS

To record information about an existing active log data set in the BSDS, use:

```
NEWLOG DSN=MQM111.LOGCOPY1.DS10,COPY2,STARTIME=19930212205198,
ENDTIME=19930412205200,STARTRBA=6400,ENDRBA=94FF
```

You might need to insert a record containing this type of information in the BSDS because:

- The entry for the data set has been deleted, but is needed again.
- You are copying the contents of one active log data set to another data set.
- You are recovering the BSDS from a backup copy.

## Increasing the size of the active log

There are two methods of achieving this process.

1. When the queue manager is active:
  - a. Define new larger log data sets using JCL.
  - b. Add the new log data sets to the active queue manager using the MQSC DEFINE LOG command.
  - c. Use the MQSC ARCHIVE LOG command to move the current active log, to be a new larger log.
  - d. Wait for the archive of the smaller active log dataset to complete.
  - e. Shutdown the queue manager, using the CSQJU003 utility to remove the old small active logs.
  - f. Restart the queue manager.
2. When the queue manager is inactive:
  - a. Stop the queue manager. This step is required because IBM MQ allocates all active log data sets for its exclusive use when it is active.
  - b. Use Access Method Services ALTER with the NEWNAME option to rename your active log data sets.
  - c. Use Access Method Services DEFINE to define larger active log data sets.

By reusing the old data set names, you do not have to run the change log inventory utility to establish new names in the BSDSs. The old data set names and the correct RBA ranges are already in the BSDSs.
  - d. Use Access Method Services REPRO to copy the old (renamed) data sets into their appropriate new data sets.

**Note:** This step can take a long time, so your enterprise could be out of action for this period.
  - e. Start the queue manager.

If all your log data sets are the same size, your system will be operationally more consistent and efficient. If the log data sets are not the same size, it is more difficult to track your system's logs, and so space can be wasted.

## The use of CSQJUFMT

Do not run a CSQJUFMT format when increasing the size of an active log.

If you run CSQJUFMT (in order to provide a performance advantage the first time the queue manager writes to the new active log) you receive messages:

```
IEC070I 203-204,XS95GTLX,REPRO02,OUTPUT,B857,SPMG02, 358
IEC070I MG.W.MG4E.LOGCOPY1.DS02,MG.W.MG4E.LOGCOPY1.DS02.DATA,
IDC3302I ACTION ERROR ON MG.W.MG4E.LOGCOPY1.DS02
IDC3351I ** VSAM I/O RETURN CODE IS 28 - RPLFDBWD = X'2908001C'
IDC31467I MAXIMUM ERROR LIMIT REACHED.

IDC0005I NUMBER OF RECORDS PROCESSED WAS 0
```

In addition, if you use the Access Method Services REPRO, ensure that you define a new empty log.

If you use REPRO to copy the old (renamed) data set into its respective new data set, the default is NOREPLACE.

This means that REPRO does not replace a record that is already on the designated data set. When formatting is done on the data set, the RBA value is reset. The net result is a data set that is not empty after formatting.

### *Changes for archive logs*

Use this topic to understand how to change the archive logs.

You can add to, delete from, and change the password of, entries in the BSDS for archive logs. Examples only are shown here; replace the data set names shown with the ones you want to use. For more details of the utility, see [The change log inventory utility](#).

- [Adding an archive log](#)
- [Deleting an archive log](#)
- [Changing the password of an archive log](#)

### **Adding an archive log**

When the recovery of an object depends on reading an existing archive log data set, the BSDS must contain information about that data set so that IBM MQ can find it. To register information about an existing archive log data set in the BSDS, use:

```
NEWLOG DSNAME=CSQARC1.ARCHLOG1.E00021.T2205197.A0000015,COPY1VOL=CSQV04,
UNIT=TAPE,STARTRBA=3A190000,ENDRBA=3A1F0FFF,CATALOG=NO
```

### **Deleting an archive log**

To delete an entire archive log data set on one or more volumes, use:

```
DELETE DSNAME=CSQARC1.ARCHLOG1.E00021.T2205197.A0000015,COPY1VOL=CSQV04
```

### **Changing the password of an archive log**

If you change the password of an existing archive log data set, you must also change the information in the BSDS.

1. List the BSDS, using the print log map utility.
2. Delete the entry for the archive log data set with the changed password, using the DELETE function of the CSQJU003 utility (see topic [The change log inventory utility](#)).
3. Name the data set as for a new archive log data set. Use the NEWLOG function of the CSQJU003 utility (see topic [The change log inventory utility](#)), and give the new password, the starting and ending RBAs, and the volume serial numbers (which can be found in the print log map utility output, see [The print log map utility](#)).

To change the password for new archive log data sets, use:

```
ARCHIVE PASSWORD= password
```

To stop placing passwords on new archive log data sets, use:

```
ARCHIVE NOPASSWD
```

**Note:** Only use the ARCHIVE utility function if you do not have an external security manager.

### *Changing the high-level qualifier (HLQ) for the logs and BSDS*

Use this topic to understand the procedure required to change the high-level qualifier (HLQ).

## **Before you begin**

You must end the queue manager normally before copying any of the logs or data sets to the new data sets. This is to ensure that the data is consistent and no recovery is needed during restart.

## **About this task**

This task provides information about how to change the HLQ for the logs and BSDS. To do this, follow these steps:

## **Procedure**

1. Run the log print utility CSQJU004 to record the log data set information. This information is needed later.
2. You can either:
  - a) run DSS backup and restore with rename on the log and BSDS data sets to be renamed, or
  - b) use AMS DEFINE and REPRO to create the HLQ data sets and copy the data from the old data sets.
3. Modify the MSTR and CHIN procedures to point to the new data sets.
4. Delete the old log information in the new copy of the BSDS using CSQJU003.
5. Define the new log data sets to the new BSDS using the NEWLOG function of CSQJU003.  
Keep all information about each log the same, apart from the HLQ.
6. The new BSDS should reflect the same information that was recorded for the old logs in the old BSDS.  
The HLQ should be the only thing that has changed.

## **What to do next**

Compare the CSQJU004 output for the old and new BSDS to ensure that they look EXACTLY the same (except for the HLQs) before starting the queue manager.

**Note:** Care must be taken when performing these operations. Incorrect actions might lead to unrecoverable situations. Check the PRINT LOG MAP UTILITY output and make sure that all the information needed for recovery or restart has been included.

## **Recovering the BSDS**

If IBM MQ is operating in dual BSDS mode and one BSDS becomes damaged, forcing IBM MQ into single BSDS mode, IBM MQ continues to operate without a problem (until the next restart).

To return the environment to dual BSDS mode:

1. Use Access Method Services to rename or delete the damaged BSDS and to define a new BSDS with the same name as the damaged BSDS. Example control statements can be found in job CSQ4BREC in thlqual.SCSQPROC.

2. Issue the IBM MQ command RECOVER BSDS to make a copy of the valid BSDS in the newly allocated data set and to reinstate dual BSDS mode.

If IBM MQ is operating in single BSDS mode and the BSDS is damaged, or if IBM MQ is operating in dual BSDS mode and both BSDSs are damaged, the queue manager stops and does not restart until the BSDS data sets are repaired. In this case:

1. Locate the BSDS associated with the most recent archive log data set. The data set name of the most recent archive log appears on the job log in the last occurrence of message CSQJ003I, which indicates that offload processing has been completed successfully. In preparation for the rest of this procedure, it is a good practice to keep a log of all successful archives noted by that message:

- If archive logs are on DASD, the BSDS is allocated on any available DASD. The BSDS name is like the corresponding archive log data set name; change only the first letter of the last qualifier, from A to B, as in this example:

**Archive log name**

CSQ.ARCHLOG1. **A** 0000001

**BSDS copy name**

CSQ.ARCHLOG1. **B** 0000001

- If archive logs are on tape, the BSDS is the first data set of the first archive log volume. The BSDS is not repeated on later volumes.
2. If the most recent archive log data set has no copy of the BSDS (for example, because an error occurred when offloading it), locate an earlier copy of the BSDS from earlier offload processing.
  3. Rename *damaged* BSDSs using the Access Method Services ALTER command with the NEWNAME option. If you want to delete a damaged BSDS, use the Access Method Services DELETE command. For each damaged BSDS, use Access Method Services to define a new BSDS as a replacement data set. Job CSQ4BREC in thlqual.SCSQPROC contains Access Method Services control statements to define a new BSDS.
  4. Use the Access Method Services REPRO command to copy the BSDS from the archive log to one of the replacement BSDSs you defined in step “3” on page 303. Do not copy any data to the second replacement BSDS, you do that in step “5” on page 304.

- a. Print the contents of the replacement BSDS.

Use the print log map utility (CSQJU004) to print the contents of the replacement BSDS. This enables you to review the contents of the replacement BSDS before continuing your recovery work.

- b. Update the archive log data set inventory in the replacement BSDS.

Examine the output from the print log map utility and check that the replacement BSDS does not contain a record of the archive log from which the BSDS was copied. If the replacement BSDS is an old copy, its inventory might not contain all archive log data sets that were created more recently. The BSDS inventory of the archive log data sets must be updated to reflect the current subsystem inventory.

Use the change log inventory utility (CSQJU003) NEWLOG statement to update the replacement BSDS, adding a record of the archive log from which the BSDS was copied. If the archive log data set is password-protected, use the PASSWORD option of the NEWLOG function. Also, if the archive log data set is cataloged, ensure that the CATALOG option of the NEWLOG function is properly set to CATALOG=YES. Use the NEWLOG statement to add any additional archive log data sets that were created later than the BSDS copy.

- c. Update passwords in the replacement BSDS.

The BSDS contains passwords for the archive log data sets and for the active log data sets. To ensure that the passwords in the replacement BSDS reflect the current passwords used by your installation, use the change log inventory ARCHIVE utility function with the PASSWORD option.

- d. Update the active log data set inventory in the replacement BSDS.

In unusual circumstances, your installation might have added, deleted, or renamed active log data sets since the BSDS was copied. In this case, the replacement BSDS does not reflect the actual number or names of the active log data sets your installation currently has in use.

If you need to delete an active log data set from the replacement BSDS log inventory, use the change log inventory utility DELETE function.

If you need to add an active log data set to the replacement BSDS log inventory, use the change log inventory utility NEWLOG function. Ensure that the RBA range is specified correctly on the NEWLOG function. If the active log data set is password-protected, use the PASSWORD option.

If you need to rename an active log data set in the replacement BSDS log inventory, use the change log inventory utility DELETE function, followed by the NEWLOG function. Ensure that the RBA range is specified correctly on the NEWLOG function. If the active log data set is password-protected, use the PASSWORD option.

e. Update the active log RBA ranges in the replacement BSDS.

Later, when the queue manager restarts, it compares the RBAs of the active log data sets listed in the BSDS with the RBAs found in the actual active log data sets. If the RBAs do not agree, the queue manager does not restart. The problem is magnified when an old copy of the BSDS is used. To solve this problem, use the change log inventory utility (CSQJU003) to adjust the RBAs found in the BSDS using the RBAs in the actual active log data sets. You do this by:

- Using the print log records utility (CSQ1LOGP) to print a summary report of the active log data set. This shows the starting and ending RBAs.
- Comparing the actual RBA ranges with the RBA ranges you have just printed, when the RBAs of all active log data sets are known.

If the RBA ranges are equal for all active log data sets, you can proceed to the next recovery step without any additional work.

If the RBA ranges are not equal, adjust the values in the BSDS to reflect the actual values. For each active log data set that needs to have the RBA range adjusted, use the change log inventory utility DELETE function to delete the active log data set from the inventory in the replacement BSDS. Then use the NEWLOG function to redefine the active log data set to the BSDS. If the active log data sets are password-protected, use the PASSWORD option of the NEWLOG function.

f. If only two active log data sets are specified for each copy of the active log, IBM MQ can have difficulty during queue manager restart. The problem can arise when one of the active log data sets is full and has not been offloaded, while the second active log data set is close to filling. In this case, add a new active log data set for each copy of the active log and define each new active log data set in the replacement BSDS log inventory.

Use the Access Method Services DEFINE command to define a new active log data set for each copy of the active log and use the change log inventory utility NEWLOG function to define the new active log data sets in the replacement BSDS. You do not need to specify the RBA ranges on the NEWLOG statement. However, if the active log data sets are password-protected, use the PASSWORD option of the NEWLOG function. Example control statements to accomplish this task can be found in job CSQ4LREC in thlqual.SCSQPROC.

5. Copy the updated BSDS to the second new BSDS data set. The BSDSs are now identical.

Use the print log map utility (CSQJU004) to print the contents of the second replacement BSDS at this point.

6. See [Active log problems](#) for information about what to do if you have lost your current active log data set.
7. Restart the queue manager using the newly constructed BSDS. IBM MQ determines the current RBA and what active logs need to be archived.



## Managing page sets

Use this topic to understand how to manage the page sets associated with a queue manager.

This topic describes how to add, copy, and generally manage the page sets associated with a queue manager. It contains these sections:

- [“How to change the high-level qualifier \(HLQ\) for the page sets” on page 305](#)
- [“How to add a page set to a queue manager” on page 305](#)
- [“What to do when one of your page sets becomes full” on page 306](#)
- [“How to balance loads on page sets” on page 306](#)
- [How to increase the size of a page set](#)
- [“How to reduce a page set” on page 309](#)
- [“How to reintroduce a page set” on page 310](#)
- [“How to back up and recover page sets” on page 311](#)
- [“How to delete page sets” on page 314](#)
- [“How to back up and restore queues using CSQUTIL” on page 314](#)

See [Page sets](#) for a description of page sets, storage classes, buffers, and buffer pools, and some of the performance considerations that apply.

### How to change the high-level qualifier (HLQ) for the page sets

This task gives information on how to change the HLQ for the page sets. To perform this task, do the following:

1. Define the new HLQ page sets.
2. If the size allocation is the same as the old page sets, copy the existing page set using REPRO to the empty new HLQ page sets. If you are increasing the size of the page sets, use the FORMAT function of CSQUTIL to format the destination page set. For more information, see [Formatting page sets \(FORMAT\)](#).
3. Use the COPYPAGE function of CSQUTIL to copy all the messages from the source page set to the destination page set. For more information, see [Expanding a page set \(COPYPAGE\)](#).
4. Change the CSQP00xx DD statement in the queue manager procedure to point to the new HLQ page sets.

Restart the queue manager and verify the changes to the page sets.

### How to add a page set to a queue manager

This description assumes that you have a queue manager that is already running. You might need to add a page set if, for example, your queue manager has to cope with new applications using new queues.

To add a new page set, use the following procedure:

1. Define and format the new page set. You can use the sample JCL in `thlqual.SCSQPROC(CSQ4PAGE)` as a basis. For more information, see [Formatting page sets \(FORMAT\)](#).  
Take care not to format any page sets that are in use, unless this is what you intend. If so, use the FORCE option of the FORMAT utility function.
2. Use the DEFINE PSID command with the DSN option to associate the page set with a buffer pool.
3. Add the appropriate storage class definitions for your page set by issuing DEFINE STGCLASS commands.
4. Optionally, to document how your queue manager is configured:

- a. Add the new page set to the started task procedure for your queue manager.
- b. Add a definition for the new page set to your CSQINP1 initialization data set.
- c. Add a definition for the new storage class to your CSQ4INYP initialization data set member.

For details of the DEFINE PSID and DEFINE STGCLASS commands, see [DEFINE PSID](#) and [DEFINE STGCLASS](#).

## What to do when one of your page sets becomes full

You can find out about the utilization of page sets by using the IBM MQ command DISPLAY USAGE. For example, the command:

```
DISPLAY USAGE PSID(03)
```

displays the current state of the page set 03. This tells you how many free pages this page set has.

If you have defined secondary extents for your page sets, they are dynamically expanded each time they fill up. Eventually, all secondary extents are used, or no further disk space is available. If this happens, an application receives the return code MQRC\_STORAGE\_MEDIUM\_FULL.

If an application receives a return code of MQRC\_STORAGE\_MEDIUM\_FULL from an MQI call, this is a clear indication that there is not enough space remaining on the page set. If the problem persists or is likely to recur, you must do something to solve it.

You can approach this problem in a number of ways:

- Balance the load between page sets by moving queues from one page set to another.
- Expand the page set. See [“How to increase the size of a page set”](#) on page 308 for instructions.
- Redefine the page set so that it can expand beyond 4 GB to a maximum size of 64 GB. See [Defining a page set to be larger than 4 GB](#) for instructions.

## How to balance loads on page sets

Load balancing on page sets means moving the messages associated with one or more queues from one page set to another, less used, page set. Use this technique if it is not practical to expand the page set.

To identify which queues are using a page set, use the appropriate IBM MQ commands. For example, to find out which queues are mapped to page set 02, first, find out which storage classes map to page set 02, by using the command:

```
DISPLAY STGCLASS(*) PSID(02)
```

Then use the following command to find out which queues use which storage class:

```
DISPLAY QUEUE(*) TYPE(QLOCAL) STGCLASS
```

## Moving a non-shared queue

To move queues and their messages from one page set to another, use the MQSC MOVE QLOCAL command (described in [MOVE QLOCAL](#)). When you have identified the queue or queues that you want to move to a new page set, follow this procedure for each of these queues:

1. Ensure that the queue you want to move is not in use by any applications (that is, IPPROCS and OPPOCS values from the DISPLAY QSTATUS command are zero) and that it has no uncommitted messages (the UNCOM value from the DISPLAY QSTATUS command is NO).

**Note:** The only way to ensure that this state continues is to change the security authorization of the queue temporarily. See [Profiles for queue security](#) for more information.

If you cannot do this, later stages in this procedure might fail if applications start to use the queue despite precautionary steps such as setting PUT(DISABLED). However, messages can never be lost by this procedure.

2. Prevent applications from putting messages on the queue being moved by altering the queue definition to disable MQPUT s. Change the queue definition to PUT(DISABLED).
3. Define a temporary queue with the same attributes as the queue that is being moved, using the command:

```
DEFINE QL(TEMP_QUEUE) LIKE(Queue_To_Move) PUT(ENABLED) GET(ENABLED)
```

**Note:** If this temporary queue already exists from a previous run, delete it before doing the define.

4. Move the messages to the temporary queue using the following command:

```
MOVE QLOCAL(Queue_To_Move) TOQLOCAL(TEMP_QUEUE)
```

5. Delete the queue you are moving, using the command:

```
DELETE QLOCAL(Queue_To_Move)
```

6. Define a new storage class that maps to the required page set, for example:

```
DEFINE STGCLASS(NEW) PSID(nn)
```

Add the new storage class definition to the CSQINP2 data sets ready for the next queue manager restart.

7. Redefine the queue that you are moving, by changing the storage class attribute:

```
DEFINE QL(Queue_To_Move) LIKE(TEMP_QUEUE) STGCLASS(NEW)
```

When the queue is redefined, it is based on the temporary queue created in step “3” on [page 307](#).

8. Move the messages back to the new queue, using the command:

```
MOVE QLOCAL(TEMP) TOQLOCAL(Queue_To_Move)
```

9. The queue created in step “3” on [page 307](#) is no longer required. Use the following command to delete it:

```
DELETE QL(TEMP_QUEUE)
```

10. If the queue being moved was defined in the CSQINP2 data sets, change the STGCLASS attribute of the appropriate DEFINE QLOCAL command in the CSQINP2 data sets. Add the REPLACE keyword so that the existing queue definition is replaced.

Figure 46 on page 308 shows an extract from a load balancing job.

```
//UTILITY EXEC PGM=CSQUTIL,PARM=('CSQ1')
//STEPLIB DD DSN=thlqua1.SCSQANLE,DISP=SHR
// DD DSN=thlqua1.SCSQAUTH,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
COMMAND DDNAME(MOVEQ)
/*
//MOVEQ DD *
ALTER QL(Queue_TO_MOVE) PUT(DISABLED)
DELETE QL(TEMP_QUEUE) PURGE
DEFINE QL(TEMP_QUEUE) LIKE(Queue_TO_MOVE) PUT(ENABLED) GET(ENABLED)
MOVE QLOCAL(Queue_TO_MOVE) TOQLOCAL(TEMP_QUEUE)
DELETE QL(Queue_TO_MOVE)
DEFINE STGCLASS(NEW) PSID(2)
DEFINE QL(Queue_TO_MOVE) LIKE(TEMP_QUEUE) STGCLASS(NEW)
MOVE QLOCAL(TEMP_QUEUE) TOQLOCAL(Queue_TO_MOVE)
DELETE QL(TEMP_QUEUE)
/*
```

Figure 46. Extract from a load balancing job for a page set

## How to increase the size of a page set

You can initially allocate a page set larger than 4 GB, See [Defining a page set to be larger than 4 GB](#)

A page set can be defined to be automatically expanded as it becomes full by specifying EXPAND(SYSTEM) or EXPAND(USER). If your page set was defined with EXPAND(NONE), you can expand it in either of two ways:

- Alter its definition to allow automatic expansion. See [Altering a page set to allow automatic expansion](#)
- Create a new, larger page set and copy the messages from the old page set to the new one. See [Moving messages to a new, larger page set](#)

### Defining a page set to be larger than 4 GB

IBM MQ can use a page set up to 64 GB in size, provided the data set is defined with 'extended addressability' to VSAM. Extended addressability is an attribute which is conferred by an SMS data class. In the example shown in the following sample JCL, the management class 'EXTENDED' is defined to SMS with 'Extended addressability'. If your existing page set is not currently defined as having extended addressability, use the following method to migrate to an extended addressability format data set.

1. Stop the queue manager.
2. Use Access Method Services to rename the existing page set.
3. Define a destination page set, the same size as the existing page set, but with DATACLASS(EXTENDED).

**Note:** Extended-format data sets must be SMS managed. These are the mechanisms for requesting extended format for VSAM data sets:

- Using a data class that has a DSNTYPE value of EXT and the subparameter R or P to indicate required or preferred.
- Coding DSNTYPE=EXTREQ (extended format is required) or DSNTYPE=EXTPREF (extended format is preferred) on the DD statement.
- Coding the LIKE= parameter on the DD statement to refer to an existing extended format data set.

For more information, see [Restrictions on Defining Extended-Format Data Sets](#).

4. Use the COPYPAGE function of CSQUTIL to copy all the messages from the source page set to the destination page set. See [Expanding a page set \(COPYPAGE\)](#) for more details.
5. Restart the queue manager.
6. Alter the page set to use system expansion, to allow it to continue growing beyond its current allocation.

The following JCL shows example Access Method Services commands:

```
//S1      EXEC PGM=IDCAMS
//SYSPRINT DD  SYSOUT=*
//SYSIN      DD  *
ALTER 'VICY.CSQ1.PAGE01' -
NEWNAME('VICY.CSQ1.PAGE01.OLD')
ALTER 'VICY.CSQ1.PAGE01.DATA' -
NEWNAME('VICY.CSQ1.PAGE01.DATA.OLD')
DEFINE CLUSTER (NAME('VICY.CSQ1.PAGE01') -
MODEL('VICY.CSQ1.PAGE01.OLD') -
DATACLAS(EXTENDED))
/*
```

### Altering a page set to allow automatic expansion

Use the ALTER PSID command with the EXPAND(USER) or EXPAND(SYSTEM) options. See [ALTER PSID](#) and [Expanding a page set \(COPYPAGE\)](#) for general information on expanding page sets.

### Moving messages to a new, larger page set

This technique involves stopping and restarting the queue manager. This deletes any nonpersistent messages that are not on shared queues at restart time. If you have nonpersistent messages that you do not want to be deleted, use load balancing instead. For more details, see [“How to balance loads on page sets” on page 306](#). In this description, the page set that you want to expand is referred to as the *source* page set; the new, larger page set is referred to as the *destination* page set.

Follow these steps:

1. Stop the queue manager.
2. Define the destination page set, ensuring that it is larger than the source page set, with a larger secondary extent value.
3. Use the FORMAT function of CSQUTIL to format the destination page set. See [Formatting page sets \(FORMAT\)](#) for more details.
4. Use the COPYPAGE function of CSQUTIL to copy all the messages from the source page set to the destination page set. See [Expanding a page set \(COPYPAGE\)](#) for more details.
5. Restart the queue manager using the destination page set by doing one of the following:
  - Change the queue manager started task procedure to reference the destination page set.
  - Use Access Method Services to delete the source page set and then rename the destination page set, giving it the same name as that of the source page set.

#### Attention:

Before you delete any IBM MQ page set, be sure that you have made the required backup copies.

### How to reduce a page set

Prevent all users, other than the IBM MQ administrator, from using the queue manager. For example; by changing the access security settings.

If you have a large page set that is mostly empty (as shown by the DISPLAY USAGE command), you might want to reduce its size. The procedure to do this involves using the COPY, FORMAT, and LOAD functions of CSQUTIL (see [IBM MQ utility program](#)). This procedure does not work for page set zero (0), as it is not

practical to reduce the size of this page set; the only way to do so is by reinitializing your queue manager (see [“Reinitializing a queue manager” on page 331](#) ). The prerequisite of this procedure is to try and remove all users from the system so that all UOWs are complete and the page sets are consistent.

1. Use the STOP QMGR command with the QUIESCE or FORCE attribute to stop the queue manager.
2. Run the SCOPY function of CSQUTIL with the PSID option, to copy all message data from the large page set and save them in a sequential data set.
3. Define a new smaller page set data set to replace the large page set.
4. Run the FORMAT TYPE(NEW) function of CSQUTIL against the page set that you created in step [“3” on page 310](#).
5. Restart the queue manager using the page set created in step [“3” on page 310](#).
6. Run the LOAD function of CSQUTIL to load back all the messages saved during step [“2” on page 310](#).
7. Allow all users access to the queue manager.
8. Delete the old large page set.

## How to reintroduce a page set

In certain scenarios it is useful to be able to bring an old page set online again to the queue manager. Unless specific action is taken, when the old page set is brought online the queue manager will recognize that the page set recovery RBA stored in the page set itself and in the checkpoint records is old, and will therefore automatically start media recovery of the page set to bring it up to date.

Such media recovery can only be performed at queue manager restart, and is likely to take a considerable length of time, especially if archive logs held on tape must be read. However, normally in this circumstance, the page set has been offline for the intervening period and so the log contains no information pertinent to the page set recovery.

The following three choices are available:

### **Allow full media recovery to be performed.**

1. Stop the queue manager.
2. Ensure definitions are available for the page set in both the started task procedure for the queue manager and in the CSQINP1 initialization data set.
3. Restart the queue manager.

### **Allow any messages on the page set to be destroyed.**

This choice is useful where a page set has been offline for a long time (some months, for example) and it has now been decided to reuse it for a different purpose.

1. Format the page set using the FORMAT function of CSQUTIL with the TYPE(NEW) option.
2. Add definitions for the page set to both the started task procedure for the queue manager and the CSQINP1 initialization data set.
3. Restart the queue manager.

Using the TYPE(NEW) option for formatting clears the current contents of the page set and tells the queue manager to ignore any historical information in the checkpoint about the page set.

### **Bring the page set online avoiding the media recovery process.**

Use this technique only if you are sure that the page set has been offline since a clean shutdown of the queue manager. This choice is most appropriate where the page set has been offline for a short period, typically due to operational issues such as a backup running while the queue manager is being started.

1. Format the page set using the FORMAT function of CSQUTIL with the TYPE(REPLACE) option.
2. Either add the page set back into the queue manager dynamically using the DEFINE PSID command with the DSN option or allow it to be added at a queue manager restart.

Using the TYPE(REPLACE) option for formatting checks that the page set was cleanly closed by the queue manager, and marks it so that media recovery will not be performed. No other changes are made to the contents of the page set.

## How to back up and recover page sets

There are different mechanisms available for back up and recovery. Use this topic to understand these mechanisms.

This section describes the following topics:

- [“Creating a point of recovery for non-shared resources” on page 311](#)
- [“Backing up page sets” on page 312](#)
- [“Recovering page sets” on page 313](#)
- [How to delete page sets](#)

For information about how to create a point of recovery for shared resources, see [“Recovering shared queues” on page 318](#).

## Creating a point of recovery for non-shared resources

IBM MQ can recover objects and non-shared persistent messages to their current state if both:

1. Copies of page sets from an earlier point exist.
2. All the IBM MQ logs are available to perform recovery from that point.

These represent a point of recovery for non-shared resources.

Both objects and messages are held on page sets. Multiple objects and messages from different queues can exist on the same page set. For recovery purposes, objects and messages cannot be backed up in isolation, so a page set must be backed up as a whole to ensure the correct recovery of the data.

The IBM MQ recovery log contains a record of all persistent messages and changes made to objects. If IBM MQ fails (for example, due to an I/O error on a page set), you can recover the page set by restoring the backup copy and restarting the queue manager. IBM MQ applies the log changes to the page set from the point of the backup copy.

There are two ways of creating a point of recovery:

### Full backup

Stop the queue manager, which forces all updates on to the page sets.

This allows you to restart from the point of recovery, using only the backed up page set data sets and the logs from that point on.

### Fuzzy backup

Take *fuzzy* backup copies of the page sets without stopping the queue manager.

If you use this method, and your associated logs later become damaged or lost, you cannot use the fuzzy page set backup copies to recover. This is because the fuzzy page set backup copies contain an inconsistent view of the state of the queue manager and are dependent on the logs being available. If the logs are not available, you need to return to the last set of backup page set copies taken while the subsystem was inactive ( [Method 1](#) ) and accept the loss of data from that time.

### Method 1: Full backup

This method involves shutting the queue manager down. This forces all updates on to the page sets so that the page sets are in a consistent state.

1. Stop all the IBM MQ applications that are using the queue manager (allowing them to complete first). This can be done by changing the access security or queue settings, for example.

2. When all activity has completed, display and resolve any in-doubt units of recovery. (Use the commands `DISPLAY CONN` and `RESOLVE INDOUBT`, as described in [DISPLAY CONN](#) and [RESOLVE INDOUBT](#).)

This brings the page sets to a consistent state; if you do not do this, your page sets might not be consistent, and you are effectively doing a fuzzy backup.

3. Issue the `ARCHIVE LOG` command to ensure that the latest log data is written out to the log data sets.
4. Issue the `STOP QMGR MODE(QUIESCE)` command. Record the lowest RBA value in the `CSQI024I` or `CSQI025I` messages (see [CSQI024I](#) and [CSQI025I](#) for more information). You should keep the log data sets starting from the one indicated by the RBA value up to the current log data set.
5. Take backup copies of all the queue manager page sets (see [“Backing up page sets”](#) on page 312).

## Method 2: Fuzzy backup

This method does not involve shutting the queue manager down. Therefore, updates might be in virtual storage buffers during the backup process. This means that the page sets are not in a consistent state, and can only be used for recovery with the logs.

1. Issue the `DISPLAY USAGE TYPE(ALL)` command, and record the RBA value in the `CSQI024I` or `CSQI025I` messages (see [CSQI024I](#) and [CSQI025I](#) for more information).
2. Take backup copies of the page sets (see [“Backing up page sets”](#) on page 312).
3. Issue the `ARCHIVE LOG` command, to ensure that the latest log data is written out to the log data sets. To restart from the point of recovery, you must keep the log data sets starting from the log data set indicated by the RBA value up to the current log data set.

## Backing up page sets

To recover a page set, IBM MQ needs to know how far back in the log to go. IBM MQ maintains a log RBA number in page zero of each page set, called the *recovery log sequence number* (LSN). This number is the starting RBA in the log from which IBM MQ can recover the page set. When you back up a page set, this number is also copied.

If the copy is later used to recover the page set, IBM MQ must have access to all the log records from this RBA value to the current RBA. That means you must keep enough of the log records to enable IBM MQ to recover from the oldest backup copy of a page set you intend to keep.

Use `ADRDSSU COPY` function to copy the page sets.

For more information, see the [COPY DATASET Command Syntax for Logical Data Set](#) documentation.

For example:

```
//STEP2 EXEC PGM=ADRDSSU,REGION=6M
//SYSPRINT DD SYSOUT=H
//SYSIN DD *
COPY -
DATASET(INCLUDE(SCENDATA.MQPA.PAGESET.*)) -
RENAMEU(SCENDATA.MQPA.PAGESET.** , SCENDATA.MQPA.BACKUP1.** ) -
SPHERE -
REPUNC -
FASTREPLICATION(PREF ) -
CANCELERROR -
TOL(ENQF)
/*
//
```

If you copy the page set while the queue manager is running you must use a copy utility that copies page zero of the page set first. If you do not do this you could corrupt the data in your page set.

If the process of dynamically expanding a page set is interrupted, for example by power to the system being lost, you can still use `ADRDSSU` to take a backup of a page set.



If you perform an Access Method Services IDCAMS LISTCAT ENT('page set data set name') ALLOC, you will see that the HI-ALLOC-RBA is higher than the HI-USED-RBA.

The next time this page set fills up it is extended again, if possible, and the pages between the high used RBA and the highest allocated RBA are used, along with another new extent.

## Backing up your object definitions

You should also back up copies of your object definitions. To do this, use the MAKEDEF feature of the CSQUTIL COMMAND function (described in [Issuing commands to IBM MQ \(COMMAND\)](#)).

Back up your object definitions whenever you take a backup copy of your queue manager, and keep the most current version.

## Recovering page sets

If the queue manager has terminated due to a failure, the queue manager can normally be restarted with all recovery being performed during restart. However, such recovery is not possible if any of your page sets or log data sets are not available. The extent to which you can now recover depends on the availability of backup copies of page sets and log data sets.

To restart from a point of recovery you must have:

- A backup copy of the page set that is to be recovered.
- If you used the "fuzzy" backup process described in ["Method 2: Fuzzy backup"](#) on page 312, the log data set that included the recorded RBA value, the log data set that was made by the ARCHIVE LOG command, and all the log data sets between these.
- If you used full backup, but you do not have the log data sets following that made by the ARCHIVE LOG command, you do **not** need to run the FORMAT TYPE(REPLACE) function of the CSQUTIL utility against all your page sets.

To recover a page set to its current state, you must also have all the log data sets and records since the ARCHIVE LOG command.

There are two methods for recovering a page set. To use either method, the queue manager must be stopped.

### Simple recovery

This is the simpler method, and is appropriate for most recovery situations.

1. Delete the page set you want to restore from backup.
2. Use the ADRDSSU COPY function to recover your page set from the backup copy..

Alternatively, you can rename your backup copy to the original name, or change the CSQP00xx DD statement in your queue manager procedure to point to your backup page set. However, if you then lose or corrupt the page set, you will no longer have a backup copy to restore from.

3. Restart the queue manager.
4. When the queue manager has restarted successfully, you can restart your applications
5. Reinstate your normal backup procedures for the restored page.

### Advanced recovery

This method provides performance advantages if you have a large page set to recover, or if there has been much activity on the page set since the last backup copy was taken. However, it requires more manual intervention than the simple method, which might increase the risk of error and the time taken to perform the recovery.

1. Delete and redefine the page set you want to restore from backup.

2. Use ADRDSSU to copy the backup copy of the page set into the new page set. Define your new page set with a secondary extent value so that it can be expanded dynamically.

Alternatively, you can rename your backup copy to the original name, or change the CSQP00xx DD statement in your queue manager procedure to point to your backup page set. However, if you then lose or corrupt the page set, you will no longer have a backup copy to restore from.

3. Change the CSQINP1 definitions for your queue manager to make the buffer pool associated with the page set being recovered as large as possible. By making the buffer pool large, you might be able to keep all the changed pages resident in the buffer pool and reduce the amount of I/O to the page set.
4. Restart the queue manager.
5. When the queue manager has restarted successfully, stop it (using quiesce) and then restart it using the normal buffer pool definition for that page set. After this second restart completes successfully, you can restart your applications
6. Reinstall your normal backup procedures for the restored page.

### **What happens when the queue manager is restarted**

When the queue manager is restarted, it applies all changes made to the page set that are registered in the log, beginning at the restart point for the page set. IBM MQ can recover multiple page sets in this way. The page set is dynamically expanded, if required, during media recovery.

During restart, IBM MQ determines the log RBA to start from by taking the lowest value from the following:

- Recovery LSN from the checkpoint log record for each page set.
- Recovery LSN from page zero in each page set.
- The RBA of the oldest incomplete unit of recovery in the system at the time the backup was taken.

All object definitions are stored on page set zero. Messages can be stored on any available page set.

**Note:** The queue manager cannot restart if page set zero is not available.

### **How to delete page sets**

You delete a page set by using the DELETE PSID command; see [DELETE PSID](#) for details of this command.

You cannot delete a page set that is still referenced by any storage class. Use DISPLAY STGCLASS to find out which storage classes reference a page set.

The data set is deallocated from IBM MQ but is not deleted. It remains available for future use, or can be deleted using z/OS facilities.

Remove the page set from the started task procedure for your queue manager.

Remove the definition of the page set from your CSQINP1 initialization data set.

### **How to back up and restore queues using CSQUTIL**

Use this topic as a reference for further information about back up and restore using CSQUTIL.

You can use the CSQUTIL utility functions for backing up and restoring queues. To back up a queue, use the COPY or SCOPY function to copy the messages from a queue onto a data set. To restore the queue, use the complementary function LOAD or SLOAD. For more information, see [IBM MQ utility program](#).

### **Managing buffer pools**

Use this topic if you want to change or delete your buffer pools.

This topic describes how to alter and delete buffer pools. It contains these sections:

- [“How to change the number of buffers in a buffer pool” on page 315](#)

- [“How to delete a buffer pool” on page 315](#)

Buffer pools are defined during queue manager initialization, using `DEFINE BUFFPOOL` commands issued from the initialization input data set CSQINP1. Their attributes can be altered in response to business requirements while the queue manager is running, using the processes detailed in this topic. The queue manager records the current buffer pool attributes in checkpoint log records. These are automatically restored on subsequent queue manager restart, unless the buffer pool definition in CSQINP1 includes the `REPLACE` attribute.

Use the `DISPLAY USAGE` command to display the current buffer attributes.

You can also define buffer pools dynamically using the `DEFINE PSID` command with the `DSN` option.

If you change buffer pools dynamically, you should also update their definitions in the initialization data set CSQINP1.

See [Planning on z/OS](#) for a description of page sets, storage classes, buffers, and buffer pools, and some of the performance considerations that apply.

**Note:** Buffer pools use significant storage. When you increase the size of a buffer pool or define a new buffer pool ensure that sufficient storage is available. For more information, see [Address space storage](#).

## How to change the number of buffers in a buffer pool

If a buffer pool is too small, the condition can result in message `CSQP020E` on the console, you can allocate more buffers to it using the `ALTER BUFFPOOL` command as follows:

1. Determine how much space is available for new buffers by looking at the `CSQY220I` messages in the log. The available space is reported in MB. As a buffer has a size of 4 KB, each MB of available space allows you to allocate 256 buffers. Do not allocate all the free space to buffers, as some is required for other tasks.

If the buffer pool uses fixed 4 KB pages, that is, its `PAGECLAS` attribute is `FIXED4KB`, ensure that there is sufficient real storage available on the LPAR.

2. If the reported free space is inadequate, release some buffers from another buffer pool using the command

```
ALTER BUFFPOOL(buf-pool-id) BUFFERS(integer)
```

where *buf-pool-id* is the buffer pool from which you want to reclaim space and *integer* is the new number of buffers to be allocated to this buffer pool, which must be smaller than the original number of buffers allocated to it.

3. Add buffers to the buffer pool you want to expand using the command

```
ALTER BUFFPOOL(buf-pool-id) BUFFERS(integer)
```

where *buf-pool-id* is the buffer pool to be expanded and *integer* is the new number of buffers to be allocated to this buffer pool, which must be larger than the original number of buffers allocated to it.

## How to delete a buffer pool

When a buffer pool is no longer used by any page sets, delete it to release the virtual storage allocated to it.

You delete a buffer pool using the `DELETE BUFFPOOL` command. The command fails if any page sets are using this buffer pool.

See [“How to delete page sets” on page 314](#) for information about how to delete page sets.

## Managing queue-sharing groups and shared queues

IBM MQ can use different types of shared resources, for example queue-sharing groups, shared queues, and the coupling facility. Use this topic to review the procedures needed to manage these shared resources.

This section contains information about the following topics:

- [“Managing queue-sharing groups” on page 316](#)
- [“Managing shared queues” on page 317](#)
- [“Managing group objects” on page 322](#)
- [“Managing the coupling facility” on page 323](#)

### Managing queue-sharing groups

You can add or remove a queue manager to a queue-sharing group, and manage the associated Db2 tables.

This topic has sections about the following tasks:

- [“Adding a queue-sharing group to the Db2 tables” on page 316](#)
- [“Adding a queue manager to a queue-sharing group” on page 316](#)
- [“Removing a queue manager from a queue-sharing group” on page 316](#)
- [“Removing a queue-sharing group from the Db2 tables” on page 317](#)
- [“Validating the consistency of Db2 definitions” on page 317](#)

### Adding a queue-sharing group to the Db2 tables

To add a queue-sharing group to the Db2 tables, use the ADD QSG function of the queue-sharing group utility (CSQ5PQSG). This program is described in [The queue-sharing group utility](#). A sample is provided in thlqual.SCSQPROC(CSQ45AQS).

### Adding a queue manager to a queue-sharing group

A queue manager can be added to a queue-sharing group and this topic describes some of the limitations.

To add a queue manager to a queue-sharing group, use the ADD QMGR function of the queue-sharing group utility (CSQ5PQSG). This program is described in [The queue-sharing group utility](#). A sample is provided in thlqual.SCSQPROC(CSQ45AQM).

The queue-sharing group must exist before you can add queue managers to it.

Queue-sharing groups have a name of up to four characters. The name must be unique in your network, and must be different from any queue manager names.

A queue manager can only be a member of one queue-sharing group.

**Note:** To add a queue manager to an existing queue-sharing group containing queue managers running earlier versions of IBM MQ, you must first apply the coexistence PTF for the highest version of IBM MQ in the group to every earlier version queue manager in the group.

### Removing a queue manager from a queue-sharing group

You can only remove a queue manager from a queue-sharing group if the queue manager's logs are not needed by another process. The logs are needed if they contain:

- the latest backup of one of the coupling facility (CF) application structures used by the queue-sharing group
- data needed by a future restore process, that is, the queue manager has used a recoverable structure since the time described by the last backup exclusion interval value.

If either or both of these points apply, the queue manager cannot be removed. To determine which queue managers' logs are needed for a future restore process, use the MQSC DISPLAY CFSTATUS command with the TYPE(BACKUP) option (for details of this command, see [DISPLAY CFSTATUS](#)).

If the queue manager logs are not needed, take the following steps to remove the queue manager from the queue-sharing group:

1. Resolve any indoubt units of work involving this queue manager.
2. Shut the queue manager down cleanly using STOP QMGR MODE(QUIESCE).
3. Wait for an interval at least equivalent to the value of the EXCLINT parameter you will specify in the BACKUP CFSTRUCT command in the next step.
4. On another queue manager, run a CF structure backup for each recoverable CF structure by using the MQSC BACKUP CFSTRUCT command and specifying an EXCLINT value as required in the previous step.
5. Use the REMOVE QMGR function of the CSQ5PQSG utility to remove the queue manager from the queue-sharing group. This program is described in [The queue-sharing group utility](#). A sample is provided in thlqual.SCSQPROC(CSQ45RQM).
6. Before restarting the queue manager, reset the QSGDATA system parameter to its default value. See [Using CSQ6SYSP](#) for information about how to tailor your system parameters.

Note, that when removing the last queue manager in a queue sharing group, you must use the FORCE option, rather than REMOVE. This removes the queue manager from the queue sharing group, while not performing the consistency checks of the queue manager logs being required for recovery. You should only perform this operation if you are deleting the queue sharing group.

## Removing a queue-sharing group from the Db2 tables

To remove a queue-sharing group from the Db2 tables, use the REMOVE QSG function of the queue-sharing group utility (CSQ5PQSG). This program is described in [The queue-sharing group utility](#). A sample is provided in thlqual.SCSQPROC(CSQ45RQS).

You can only remove a queue-sharing group from the common Db2 data-sharing group tables after you have removed all the queue managers from the queue-sharing group (as described in [“Removing a queue manager from a queue-sharing group”](#) on page 316 ).

When the queue-sharing group record is deleted from the queue-sharing group administration table, all objects and administrative information relating to that queue-sharing group are deleted from other IBM MQ Db2 tables. This includes shared queue and group object information.

## Validating the consistency of Db2 definitions

Problems for shared queues within a queue-sharing group can occur if the Db2 object definitions have, for any reason, become inconsistent.

To validate the consistency of the Db2 object definitions for queue managers, CF structures, and shared queues, use the VERIFY QSG function of the queue-sharing group utility (CSQ5PQSG). This program is described in [The queue-sharing group utility](#).

## Managing shared queues

Use this topic to understand how to recover, move, and migrate shared queues.

This section describes the following tasks:

- [“Recovering shared queues”](#) on page 318

- [“Moving shared queues” on page 318](#)
- [“Migrating non-shared queues to shared queues” on page 321](#)
- [Suspending a Db2 connection](#)

## Recovering shared queues

IBM MQ can recover persistent messages on shared queues if all:

- Backups of the CF structures containing the messages have been performed.
- All the logs for all queue managers in the queue-sharing group are available, to perform recovery from the point the backups are taken.
- Db2 is available and the structure backup table is more recent than the most recent CF structure backup.

The messages on a shared queue are stored in a coupling facility (CF) structure. Persistent messages can be put onto shared queues, and like persistent messages on non-shared queues, they are copied to the queue manager log. The MQSC [BACKUP CFSTRUCT](#) and [RECOVER CFSTRUCT](#) commands are provided to allow the recovery of a CF structure in the unlikely event of a coupling facility failure. In such circumstances, any nonpersistent messages stored in the affected structure are lost, but persistent messages can be recovered. Any further application activity using the structure is prevented until the structure has been recovered.

To enable recovery, you must back up your coupling facility list structures frequently using the MQSC [BACKUP CFSTRUCT](#) command. The messages in the CF structure are written onto the active log data set of the queue manager making the backup. It writes a record of the backup to Db2: the name of the CF structure being backed up, the name of the queue manager doing the backup, the RBA range for this backup on that queue manager log, and the backup time. Back up CF list structures even if you are not actively using shared queues, for example, if you have set up a queue-sharing group intending to use it in the future.

You can recover a CF structure by issuing an MQSC [RECOVER CFSTRUCT](#) command to the queue manager that can perform the recovery; you can use any queue manager in the queue-sharing group. You can specify a single CF structure to be recovered, or you can recover several CF structures simultaneously.

As noted previously, it is important that you back up your CF list structures frequently, otherwise recovering a CF structure can take a long time. Moreover, the recovery process cannot be canceled.

The definition of a shared queue is kept in a Db2 database and can therefore be recovered if necessary using standard Db2 database procedures. See [Shared queues and queue-sharing groups](#) for more information.

## Moving shared queues

This section describes how to perform load balancing by moving a shared queue from one coupling facility structure to another. It also describes how to move a non-shared queue to a shared queue, and how to move a shared queue to a non-shared queue.

When you move a queue, you need to define a temporary queue as part of the procedure. This is because every queue must have a unique name, so you cannot have two queues of the same name, even if the queues have different queue dispositions. IBM MQ tolerates having two queues with the same name (as in step [“2” on page 319](#)), but you cannot use the queues.

- Moving a queue from one coupling facility structure to another
- Moving a non-shared queue to a shared queue
- Moving a shared queue to a non-shared queue

## Moving a queue from one coupling facility structure to another

To move queues and their messages from one CF structure to another, use the MQSC [MOVE QLOCAL](#) command. When you have identified the queue or queues that you want to move to a new CF structure, use the following procedure to move each queue:

1. Ensure that the queue you want to move is not in use by any applications, that is, the queue attributes IPPROCS and OPPROCS are zero on all queue managers in the queue-sharing group.
2. Prevent applications from putting messages on the queue being moved by altering the queue definition to disable MQPUT s. Change the queue definition to PUT(DISABLED).
3. Define a temporary queue with the same attributes as the queue that is being moved using the following command:

```
DEFINE QL(TEMP_QUEUE) LIKE(Queue_To_Move) PUT(ENABLED) GET(ENABLED) QSGDISP(QMGR)
```

**Note:** If this temporary queue exists from a previous run, delete it before doing the define.

4. Move the messages to the temporary queue using the following command:

```
MOVE QLOCAL(Queue_To_Move) TOQLOCAL(TEMP_QUEUE)
```

5. Delete the queue you are moving, using the command:

```
DELETE QLOCAL(Queue_To_Move)
```

6. Redefine the queue that is being moved, changing the CFSTRUCT attribute, using the following command:

```
DEFINE QL(Queue_To_Move) LIKE(TEMP_QUEUE) CFSTRUCT(NEW) QSGDISP(SHARED)
```

When the queue is redefined, it is based on the temporary queue created in step “3” on [page 319](#).

7. Move the messages back to the new queue using the command:

```
MOVE QLOCAL(TEMP) TOQLOCAL(Queue_To_Move)
```

8. The queue created in step “3” on [page 319](#) is no longer required. Use the following command to delete it:

```
DELETE QL(TEMP_QUEUE)
```

9. If the queue being moved was defined in the CSQINP2 data sets, change the CFSTRUCT attribute of the appropriate DEFINE QLOCAL command in the CSQINP2 data sets. Add the REPLACE keyword so that the existing queue definition is replaced.

[Figure 47 on page 320](#) shows a sample job for moving a queue from one CF structure to another.

```
//UTILITY EXEC PGM=CSQUTIL,PARM=('CSQ1')
//STEPLIB DD DSN=thlqua1.SCSQANLE,DISP=SHR
//      DD DSN=thlqua1.SCSQAUTH,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
COMMAND DDNAME(MOVEQ)
/*
//MOVEQ DD *
ALTER QL(Queue_TO_MOVE) PUT(DISABLED)
DELETE QL(TEMP_QUEUE) PURGE
DEFINE QL(TEMP_QUEUE) LIKE(Queue_TO_MOVE) PUT(ENABLED) GET(ENABLED) QSGDISP(QMGR)
MOVE QLOCAL(Queue_TO_MOVE) TOQLOCAL(TEMP_QUEUE)
DELETE QL(Queue_TO_MOVE)
DEFINE QL(Queue_TO_MOVE) LIKE(TEMP_QUEUE) CFSTRUCT(NEW) QSGDISP(SHARED)
MOVE QLOCAL(TEMP_QUEUE) TOQLOCAL(Queue_TO_MOVE)
DELETE QL(TEMP_QUEUE)
/*
```

*Figure 47. Sample job for moving a queue from one CF structure to another*

### Moving a non-shared queue to a shared queue

The procedure for moving a non-shared queue to a shared queue is like the procedure for moving a queue from one CF structure to another (see [“Moving a queue from one coupling facility structure to another”](#) on page 319 ). Figure 48 on page 320 gives a sample job to do this.

**Note:** Remember that messages on shared queues are subject to certain restrictions on the maximum message size, message persistence, and queue index type, so you might not be able to move some non-shared queues to a shared queue.

```
//UTILITY EXEC PGM=CSQUTIL,PARM=('CSQ1')
//STEPLIB DD DSN=thlqua1.SCSQANLE,DISP=SHR
//      DD DSN=thlqua1.SCSQAUTH,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
COMMAND DDNAME(MOVEQ)
/*
//MOVEQ DD *
ALTER QL(Queue_TO_MOVE) PUT(DISABLED)
DELETE QL(TEMP_QUEUE) PURGE
DEFINE QL(TEMP_QUEUE) LIKE(Queue_TO_MOVE) PUT(ENABLED) GET(ENABLED)
MOVE QLOCAL(Queue_TO_MOVE) TOQLOCAL(TEMP_QUEUE)
DELETE QL(Queue_TO_MOVE)
DEFINE QL(Queue_TO_MOVE) LIKE(TEMP_QUEUE) CFSTRUCT(NEW) QSGDISP(SHARED)
MOVE QLOCAL(TEMP_QUEUE) TOQLOCAL(Queue_TO_MOVE)
DELETE QL(TEMP_QUEUE)
/*
```

*Figure 48. Sample job for moving a non-shared queue to a shared queue*

### Moving a shared queue to a non-shared queue

The procedure for moving a shared queue to a non-shared queue is like the procedure for moving a queue from one CF structure to another (see [“Moving a queue from one coupling facility structure to another”](#) on page 319 ).

Figure 49 on page 321 gives a sample job to do this.



```
//UTILITY EXEC PGM=CSQUTIL,PARM=('CSQ1')
//STEPLIB DD DSN=thlqual.SCSQANLE,DISP=SHR
//      DD DSN=thlqual.SCSQAUTH,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
COMMAND DDNAME(MOVEQ)
/*
//MOVEQ DD *
ALTER QL(Queue_TO_MOVE) PUT(DISABLED)
DELETE QL(TEMP_QUEUE) PURGE
DEFINE QL(TEMP_QUEUE) LIKE(Queue_TO_MOVE) PUT(ENABLED) GET(ENABLED) QSGDISP(QMGR)
MOVE QLOCAL(Queue_TO_MOVE) TOQLOCAL(TEMP_QUEUE)
DELETE QL(Queue_TO_MOVE)
DEFINE QL(Queue_TO_MOVE) LIKE(TEMP_QUEUE) STGCLASS(NEW) QSGDISP(QMGR)
MOVE QLOCAL(TEMP_QUEUE) TOQLOCAL(Queue_TO_MOVE)
DELETE QL(TEMP_QUEUE)
/*
```

*Figure 49. Sample job for moving a shared queue to a non-shared queue*

## Migrating non-shared queues to shared queues

There are two stages to migrating non-shared queues to shared queues:

- Migrating the first (or only) queue manager in the queue-sharing group
- Migrating any other queue managers in the queue-sharing group

### Migrating the first (or only) queue manager in the queue-sharing group

Figure 48 on page 320 shows an example job for moving a non-shared queue to a shared queue. Do this for each queue that needs migrating.

#### Note:

1. Messages on shared queues are subject to certain restrictions on the maximum message size, message persistence, and queue index type, so you might not be able to move some non-shared queues to a shared queue.
2. You must use the correct index type for shared queues. If you migrate a transmission queue to be a shared queue, the index type must be MSGID.

If the queue is empty, or you do not need to keep the messages that are on it, migrating the queue is simpler. Figure 50 on page 321 shows an example job to use in these circumstances.

```
//UTILITY EXEC PGM=CSQUTIL,PARM=('CSQ1')
//STEPLIB DD DSN=thlqual.SCSQANLE,DISP=SHR
//      DD DSN=thlqual.SCSQAUTH,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
COMMAND DDNAME(MOVEQ)
/*
//MOVEQ DD *
DELETE QL(TEMP_QUEUE) PURGE
DEFINE QL(TEMP_QUEUE) LIKE(Queue_TO_MOVE) PUT(ENABLED) GET(ENABLED)
DELETE QL(Queue_TO_MOVE)
DEFINE QL(Queue_TO_MOVE) LIKE(TEMP_QUEUE) CFSTRUCT(NEW) QSGDISP(SHARED)
DELETE QL(TEMP_QUEUE)
/*
```

*Figure 50. Sample job for moving a non-shared queue without messages to a shared queue*

### Migrating any other queue managers in the queue-sharing group

1. For each queue that does not have the same name as an existing shared queue, move the queue as described in [Figure 48 on page 320](#) or [Figure 50 on page 321](#).
2. For queues that have the same name as an existing shared queue, move the messages to the shared queue using the commands shown in [Figure 51 on page 322](#).

```
MOVE QLOCAL(Queue_To_Move) QSGDISP(QMGR) TOQLOCAL(Queue_To_Move)  
DELETE QLOCAL(Queue_To_Move) QSGDISP(QMGR)
```

*Figure 51. Moving messages from a non-shared queue to an existing shared queue*

### Suspending a connection to Db2

If you want to apply maintenance or service to the Db2 tables or package related to shared queues without stopping your queue manager, you must temporarily disconnect queue managers in the data sharing group (DSG) from Db2.

To do this:

1. Use the MQSC command [SUSPEND QMGR FACILITY\( Db2\)](#).
2. Do the binds.
3. Reconnect to Db2 using the MQSC command [RESUME QMGR FACILITY\( Db2 \)](#)

Note that there are restrictions on the use of these commands.



**Attention:** While the Db2 connection is suspended, the following operations will not be available. Therefore, you need to do this work during a time when your enterprise is at its least busy.

- Access to Shared queue objects for administration (define, delete, alter)
- Starting shared channels
- Storing messages in Db2
- Backup or recover CFSTRUCT

### Managing group objects

Use this topic to understand how to work with group objects.

IBM MQ automatically copies the definition of a group object to page set zero of each queue manager that uses it. You can alter the copy of the definition temporarily, and IBM MQ allows you to refresh the page set copies from the repository copy. IBM MQ always tries to refresh the page set copies from the repository copy on start-up (for channel objects, this is done when the channel initiator restarts). This ensures that the page set copies reflect the version on the repository, including any changes that were made when the queue manager was inactive.

There are circumstances under which the refresh is not performed, for example:

- If a copy of the queue is open, a refresh that would change the usage of the queue fails.
- If a copy of a queue has messages on it, a refresh that would delete that queue fails.

In these circumstances, the refresh is not performed on that copy, but is performed on the copies on all other queue managers. Check for and correct any problems with copy objects after adding, changing, or deleting a group object, and at queue manager or channel initiator restart.

## Managing the coupling facility

Use this topic to understand how to add or remove coupling facility (CF) structures.

This section describes the following tasks:

- [“Adding a coupling facility structure” on page 323](#)
- [“Removing a coupling facility structure” on page 323](#)

### Adding a coupling facility structure

There are no IBM MQ actions required when you add a coupling facility structure. The information about setting up the coupling facility in [Task 10: Set up the coupling facility](#) describes the rules for naming coupling facility structures, and how to define structures in the CFRM policy data set.

### Removing a coupling facility structure

To remove a coupling facility structure, follow this procedure:

- Use the following command to get a list of all the queues using the coupling facility structure that you want to delete:

```
DISPLAY QUEUE(*) QSGDISP(SHARED) CFSTRUCT(structure-name)
```

- Delete all the queues that use the structure.
- Stop and restart each queue manager in the queue-sharing group in turn to disconnect IBM MQ and Db2 from the structure and delete information about it. (You do not need to stop all the queue managers at once; just one at a time.)
- Remove the structure definition from your CFRM policy data set and run the IXCMIAPU utility. (This is the reverse of customization task 10 (set up the coupling facility) described in [Task 10: Set up the coupling facility](#).)

## Recovery and restart

Use this topic to understand the recovery and restart mechanisms used by IBM MQ.

### Restarting IBM MQ

After a queue manager terminates there are different restart procedures needed depending on how the queue manager terminated. Use this topic to understand the different restart procedures that you can use.

This topic contains information about how to restart your queue manager in the following circumstances:

- [“Restarting after a normal shutdown” on page 323](#)
- [“Restarting after an abnormal termination” on page 324](#)
- [“Restarting if you have lost your page sets” on page 324](#)
- [“Restarting if you have lost your log data sets” on page 324](#)
- [Restarting if you have lost your CF structures](#)

### Restarting after a normal shutdown

If the queue manager was stopped with the STOP QMGR command, the system finishes its work in an orderly way and takes a termination checkpoint before stopping. When you restart the queue manager, it uses information from the system checkpoint and recovery log to determine the system status at shutdown.

To restart the queue manager, issue the START QMGR command as described in [“Starting and stopping a queue manager”](#) on page 259.

## Restarting after an abnormal termination

IBM MQ automatically detects whether restart follows a normal shutdown or an abnormal termination.

Starting the queue manager after it has terminated abnormally is different from starting it after the STOP QMGR command has been issued. If the queue manager terminates abnormally, it terminates without being able to finish its work or take a termination checkpoint.

To restart the queue manager, issue the START QMGR command as described in [“Starting and stopping a queue manager”](#) on page 259. When you restart a queue manager after an abnormal termination, it refreshes its knowledge of its status at termination using information in the log, and notifies you of the status of various tasks.

Normally, the restart process resolves all inconsistent states. But, in some cases, you must take specific steps to resolve inconsistencies. This is described in [“Recovering units of work manually”](#) on page 337.

## Restarting if you have lost your page sets

If you have lost your page sets, you need to restore them from your backup copies before you can restart the queue manager. This is described in [“How to back up and recover page sets”](#) on page 311.

The queue manager might take a long time to restart under these circumstances because of the length of time needed for media recovery.

## Restarting if you have lost your log data sets

If, after stopping a queue manager (using the STOP QMGR command), both copies of the log are lost or damaged, you can restart the queue manager providing you have a consistent set of page sets (produced using [Method 1: Full backup](#)).

Follow this procedure:

1. Define new page sets to correspond to each existing page set in your queue manager. See [Task 15: Define your page sets](#) for information about page set definition.  
Ensure that each new page set is larger than the corresponding source page set.
2. Use the FORMAT function of CSQUTIL to format the destination page set. See [Formatting page sets](#) for more details.
3. Use the RESETPAGE function of CSQUTIL to copy the existing page sets or reset them in place, and reset the log RBA in each page. See [Copying a page set and resetting the log](#) for more information about this function.
4. Redefine your queue manager log data sets and BSDS using CSQJU003 (see [The change log inventory utility](#)).
5. Restart the queue manager using the new page sets. To do this, you do one of the following:
  - Change the queue manager started task procedure to reference the new page sets. See [Task 6: Create procedures for the IBM MQ queue manager](#) for more information.
  - Use Access Method Services to delete the old page sets and then rename the new page sets, giving them the same names as the old page sets.

**Attention:** Before you delete any IBM MQ page set, ensure that you have made the required backup copies.

If the queue manager is a member of a queue-sharing group, GROUP and SHARED object definitions are not normally affected by lost or damaged logs. However, if any shared-queue messages are involved in a unit of work that was covered by the lost or damaged logs, the effect on such uncommitted messages is unpredictable.

**Note:** If logs are damaged and the queue manager is a member of a queue-sharing group, the ability to recover shared persistent messages might be lost. Issue a BACKUP CFSTRUCT command immediately on another active queue manager in the queue-sharing group for all CF structures with the RECOVER(YES) attribute.

## Restarting if you have lost your CF structures

You do not need to restart if you lose your CF structures, because the queue manager does not terminate.

### **Alternative site recovery**

You can recover a single queue manager or a queue-sharing group, or consider disk mirroring.

See the following sections for more details:

- [Recovering a single queue manager at an alternative site](#)
- [Recovering a queue-sharing group.](#)
  - [CF structure media recovery](#)
  - [Backing up the queue-sharing group at the prime site](#)
  - [Recovering a queue-sharing group at the alternative site](#)
- [Using disk mirroring](#)

## Recovering a single queue manager at an alternative site

If a total loss of an IBM MQ computing center occurs, you can recover on another queue manager or queue-sharing group at a recovery site. (See [“Recovering a queue-sharing group at the alternative site”](#) on page 328 for the alternative site recovery procedure for a queue-sharing group.)

To recover on another queue manager at a recovery site, you must regularly back up the page sets and the logs. As with all data recovery operations, the objectives of disaster recovery are to lose as little data, workload processing (updates), and time, as possible.

At the recovery site:

- The recovery queue managers **must** have the same names as the lost queue managers.
- The system parameter module (for example, CSQZPARM) used on each recovery queue manager must contain the same parameters as the corresponding lost queue manager.

When you have done this, reestablish all your queue managers as described in the following procedure. This can be used to perform disaster recovery at the recovery site for a single queue manager. It assumes that all that is available are:

- Copies of the archive logs and BSDSs created by normal running at the primary site (the active logs will have been lost along with the queue manager at the primary site).
- Copies of the page sets from the queue manager at the primary site that are the same age or older than the most recent archive log copies available.

You can use dual logging for the active and archive logs, in which case you need to apply the BSDS updates to both copies:

1. Define new page set data sets and load them with the data in the copies of the page sets from the primary site.
2. Define new active log data sets.

3. Define a new BSDS data set and use Access Method Services REPRO to copy the *most recent* archived BSDS into it.
4. Use the print log map utility CSQJU004 to print information from this most recent BSDS. At the time this BSDS was archived, the most recent archived log you have would have just been truncated as an active log, and does not appear as an archived log. Record the STARTRBA and ENDRBA of this log.
5. Use the change log inventory utility, CSQJU003, to register this latest archive log data set in the BSDS that you have just restored, using the STARTRBA and ENDRBA recorded in Step “4” on page 326.
6. Use the DELETE option of CSQJU003 to remove all active log information from the BSDS.
7. Use the NEWLOG option of CSQJU003 to add active logs to the BSDS, do not specify STARTRBA or ENDRBA.
8. Use CSQJU003 to add a restart control record to the BSDS. Specify CRESTART CREATE, ENDRBA=highrba, where highrba is the high RBA of the most recent archive log available (found in Step “4” on page 326 ), plus 1.

The BSDS now describes all active logs as being empty, all the archived logs you have available, and no checkpoints beyond the end of your logs.

9. Restart the queue manager with the START QMGR command. During initialization, an operator reply message such as the following is issued:

```
CSQJ245D +CSQ1 RESTART CONTROL INDICATES TRUNCATION AT RBA highrba.
REPLY Y TO CONTINUE, N TO CANCEL
```

Type Y to start the queue manager. The queue manager starts, and recovers data up to ENDRBA specified in the CRESTART statement.

See [Using the IBM MQ utilities](#) for information about using CSQJU003 and CSQJU004.

[Figure 52 on page 326](#) shows sample input statements for CSQJU003 for steps 6, 7, and 8:

```
* Step 6
DELETE DSNAME=MQM2.LOGCOPY1.DS01
DELETE DSNAME=MQM2.LOGCOPY1.DS02
DELETE DSNAME=MQM2.LOGCOPY1.DS03
DELETE DSNAME=MQM2.LOGCOPY1.DS04
DELETE DSNAME=MQM2.LOGCOPY2.DS01
DELETE DSNAME=MQM2.LOGCOPY2.DS02
DELETE DSNAME=MQM2.LOGCOPY2.DS03
DELETE DSNAME=MQM2.LOGCOPY2.DS04

* Step 7
NEWLOG DSNAME=MQM2.LOGCOPY1.DS01,COPY1
NEWLOG DSNAME=MQM2.LOGCOPY1.DS02,COPY1
NEWLOG DSNAME=MQM2.LOGCOPY1.DS03,COPY1
NEWLOG DSNAME=MQM2.LOGCOPY1.DS04,COPY1
NEWLOG DSNAME=MQM2.LOGCOPY2.DS01,COPY2
NEWLOG DSNAME=MQM2.LOGCOPY2.DS02,COPY2
NEWLOG DSNAME=MQM2.LOGCOPY2.DS03,COPY2
NEWLOG DSNAME=MQM2.LOGCOPY2.DS04,COPY2

* Step 8
CRESTART CREATE, ENDRBA=063000
```

*Figure 52. Sample input statements for CSQJU003*

The things you need to consider for restarting the channel initiator at the recovery site are like those faced when using ARM to restart the channel initiator on a different z/OS image. See [“Using ARM in an IBM MQ network” on page 335](#) for more information. Your recovery strategy should also cover recovery of the IBM MQ product libraries and the application programming environments that use IBM MQ ( CICS , for example).

Other functions of the change log inventory utility (CSQJU003) can also be used in disaster recovery scenarios. The HIGHRBA function allows the update of the highest RBA written and highest RBA offloaded values within the bootstrap data set. The CHECKPT function allows the addition of new checkpoint queue records or the deletion of existing checkpoint queue records in the BSDS.

**Attention: These functions might affect the integrity of your IBM MQ data.** Only use them in disaster recovery scenarios under the guidance of IBM service personnel.

### Fast copy techniques

If copies of all the page sets and logs are made while the queue manager is frozen, the copies will be a consistent set that can be used to restart the queue manager at an alternative site. They typically enable a much faster restart of the queue manager, as there is little media recovery to be performed.

Use the SUSPEND QMGR LOG command to freeze the queue manager. This command flushes buffer pools to the page sets, takes a checkpoint, and stops any further log write activity. Once log write activity has been suspended, the queue manager is effectively frozen until you issue a RESUME QMGR LOG command. While the queue manager is frozen, the page sets and logs can be copied.

By using copying tools such as FLASHCOPY or SNAPSHOT to rapidly copy the page sets and logs, the time during which the queue manager is frozen can be reduced to a minimum.

Within a queue-sharing group, however, the SUSPEND QMGR LOG command might not be such a good solution. To be effective, the copies of the logs must all contain the same point in time for recovery, which means that the SUSPEND QMGR LOG command must be issued on all queue managers within the queue-sharing group simultaneously, and therefore the entire queue-sharing group will be frozen for some time.

## Recovering a queue-sharing group

In the event of a prime site disaster, you can restart a queue-sharing group at a remote site using backup data sets from the prime site. To recover a queue-sharing group you need to coordinate the recovery across all the queue managers in the queue-sharing group, and coordinate with other resources, primarily Db2. This section describes these tasks in detail.

- [CF structure media recovery](#)
- [Backing up the queue-sharing group at the prime site](#)
- [Recovering a queue-sharing group at the alternative site](#)

### CF structure media recovery

Media recovery of a CF structure used to hold persistent messages on a shared queue, relies on having a backup of the media that can be forward recovered by the application of logged updates. Take backups of your CF structures periodically using the MQSC BACKUP CFSTRUCT command. All updates to shared queues (MQGET s and MQPUT s) are written on the log of the queue manager where the update is performed. To perform media recovery of a CF structure you must apply logged updates to that backup from the logs of **all** the queue managers that have used that CF structure. When you use the MQSC RECOVER CFSTRUCT command, IBM MQ automatically merges the logs from relevant queue managers, and applies the updates to the most recent backup.

The CF structure backup is written to the log of the queue manager that processed the BACKUP CFSTRUCT command, so there are no additional data sets to be collected and transported to the alternative site.

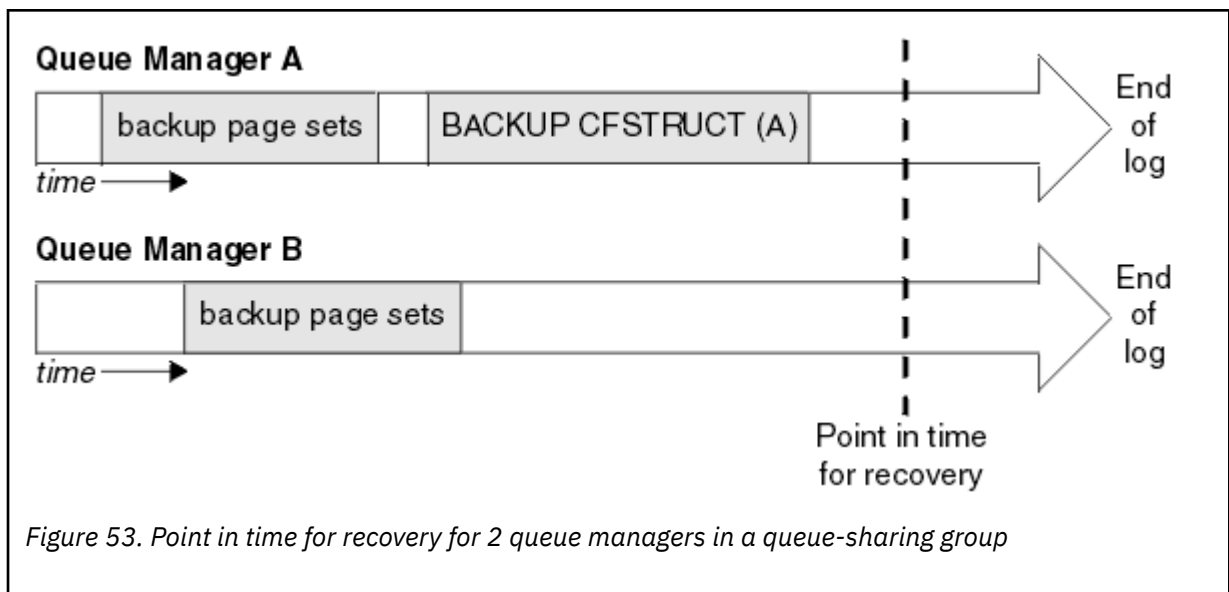
### Backing up the queue-sharing group at the prime site

At the prime site you need to establish a consistent set of backups on a regular basis, which can be used in the event of a disaster to rebuild the queue-sharing group at an alternative site. For a single queue manager, recovery can be to an arbitrary point in time, typically the end of the logs available at

the remote site. However, where persistent messages have been stored on a shared queue, the logs of all the queue managers in the queue-sharing group must be merged to recover shared queues, as any queue manager in the queue-sharing group might have performed updates (MQPUT s or MQGET s) on the queue.

For recovery of a queue-sharing group, you need to establish a point in time that is within the log range of the log data of all queue managers. However, as you can only **forward** recover media from the log, this point in time must be after the BACKUP CFSTRUCT command has been issued and after any page set backups have been performed. (Typically, the point in time for recovery might correspond to the end of a business day or week.)

The following diagram shows time lines for two queue managers in a queue-sharing group. For each queue manager, fuzzy backups of page sets are taken (see [Method 2: Fuzzy backup](#)). On queue manager A, a BACKUP CFSTRUCT command is issued. Subsequently, an ARCHIVE LOG command is issued on each queue manager to truncate the active log, and copy it to media offline from the queue manager, which can be transported to the alternative site. End of log identifies the time at which the ARCHIVE LOG command was issued, and therefore marks the extent of log data typically available at the alternative site. The point in time for recovery must lie between the end of any page set or CF structure backups, and the earliest end of log available at the alternative site.



IBM MQ records information associated with the CF structure backups in a table in Db2. Depending on your requirements, you might want to coordinate the point in time for recovery of IBM MQ with that for Db2, or it might be sufficient to take a copy of the IBM MQ CSQ.ADMIN\_B\_STRBACKUP table after the BACKUP CFSTRUCT commands have finished.

To prepare for a recovery:

1. Create page set backups for each queue manager in the queue-sharing group.
2. Issue a BACKUP CFSTRUCT command for each CF structure with the RECOVER(YES) attribute. You can issue these commands from a single queue manager, or from different queue managers within the queue-sharing group to balance the workload.
3. Once all the backups have completed, issue an ARCHIVE LOG command to switch the active log and create copies of the logs and BSDS of each queue manager in the queue-sharing group.
4. Transport the page set backups, the archived logs, the archived BSDS of all the queue managers in the queue-sharing group, and your chosen Db2 backup information, off-site.

### Recovering a queue-sharing group at the alternative site

Before you can recover the queue-sharing group, you need to prepare the environment:



1. If you have old information in your coupling facility from practice startups when you installed the queue-sharing group, you need to clean this out first:

**Note:** If you do not have old information in the coupling facility, you can omit this step.

- a. Enter the following z/OS command to display the CF structures for this queue-sharing group:

```
D XCF,STRUCTURE,STRNAME= qsgname
```

- b. For all structures that start with the queue-sharing group name, use the z/OS command SETXCF FORCE CONNECTION to force the connection off those structures:

```
SETXCF FORCE,CONNECTION,STRNAME= strname,CONNAME=ALL
```

- c. Delete all the CF structures using the following command for each structure:

```
SETXCF FORCE,STRUCTURE,STRNAME= strname
```

2. Restore Db2 systems and data-sharing groups.
3. Recover the CSQ.ADMIN\_B\_STRBACKUP table so that it contains information about the most recent structure backups taken at the prime site.

**Note:** It is important that the STRBACKUP table contains the most recent structure backup information. Older structure backup information might require data sets that you have discarded as a result of the information given by a recent DISPLAY USAGE TYPE(DATASET) command, which would mean that your recovered CF structure would not contain accurate information.

4. Run the ADD QMGR command of the CSQ5PQSG utility for every queue manager in the queue-sharing group. This will restore the XCF group entry for each queue manager.

When you run the utility in this scenario, the following messages are normal:

```
CSQU566I Unable to get attributes for admin structure, CF not found
or not allocated
CSQU546E Unable to add QMGR queue_manager_name entry,
already exists in DB2 table CSQ.ADMIN_B_QMGR
CSQU148I CSQ5PQSG Utility completed, return code=4
```

To recover the queue managers in the queue-sharing group:

1. Define new page set data sets and load them with the data in the copies of the page sets from the primary site.
2. Define new active log data sets.
3. Define a new BSDS data set and use Access Method Services REPRO to copy the *most recent* archived BSDS into it.
4. Use the print log map utility CSQJU004 to print information from this most recent BSDS. At the time this BSDS was archived, the most recent archived log you have would have just been truncated as an active log, and does not appear as an archived log. Record the STARTRBA, STARTLRSN, ENDRBA, and ENDLRSN values of this log.
5. Use the change log inventory utility, CSQJU003, to register this latest archive log data set in the BSDS that you have just restored, using the values recorded in Step “4” on page 329.
6. Use the DELETE option of CSQJU003 to remove all active log information from the BSDS.
7. Use the NEWLOG option of CSQJU003 to add active logs to the BSDS, do not specify STARTRBA or ENDRBA.

8. Calculate the *recoverylrsn* for the queue-sharing group. The *recoverylrsn* is the lowest of the ENDLRSNs across all queue managers in the queue-sharing group (as recorded in Step “4” on page 329 ), minus 1. For example, if there are two queue managers in the queue-sharing group, and the ENDLRSN for one of them is B713 3C72 22C5, and for the other is B713 3D45 2123, the *recoverylrsn* is B713 3C72 22C4.
9. Use CSQJU003 to add a restart control record to the BSDS. Specify:

```
CRESTART CREATE,ENDLRSN= recoverylrsn
```

where *recoverylrsn* is the value you recorded in Step “8” on page 330.

The BSDS now describes all active logs as being empty, all the archived logs you have available, and no checkpoints beyond the end of your logs.

You must add the CRESTART record to the BSDS for each queue manager within the queue-sharing group.

10. Restart each queue manager in the queue-sharing group with the START QMGR command. During initialization, an operator reply message such as the following is issued:

```
CSQJ245D +CSQ1 RESTART CONTROL INDICATES TRUNCATION AT RBA highrba.  
REPLY Y TO CONTINUE, N TO CANCEL
```

Reply Y to start the queue manager. The queue manager starts, and recovers data up to ENDRBA specified in the CRESTART statement.

At IBM

WebSphere MQ 7.0.1 and later, the first queue manager started can rebuild the admin structure partitions for other members of the queue sharing group as well as its own, and it is no longer necessary to restart each queue manager in the queue sharing group at this stage.

11. When the admin structure data for all queue managers has been rebuilt, issue a RECOVER CFSTRUCT command for each CF application structure.

If you issue the RECOVER CFSTRUCT command for all structures on a single queue manager, the log merge process is only performed once, so is quicker than issuing the command on a different queue manager for each CF structure, where each queue manager has to perform the log merge step.

When conditional restart processing is used in a queue sharing group, IBM WebSphere MQ 7.0.1 and later queue managers, performing peer admin rebuild, check that peers BSDS contain the same CRESTART LRSN as their own. This is to ensure the integrity of the rebuilt admin structure. It is therefore important to restart other peers in the QSG, so they can process their own CRESTART information, before the next unconditional restart of any member of the group.

## Using disk mirroring

Many installations now use disk mirroring technologies such as IBM Metro Mirror (formerly PPRC) to make synchronous copies of data sets at an alternative site. In such situations, many of the steps detailed become unnecessary as the IBM MQ page sets and logs at the alternative site are effectively identical to those at the prime site. Where such technologies are used, the steps to restart a queue sharing group at an alternative site may be summarized as:

- Clear IBM MQ CF structures at the alternative site. (These often contain residual information from any previous disaster recovery exercise).
- Restore Db2 systems and all tables in the database used by the IBM MQ queue sharing group.

- Restart queue managers. Before IBM WebSphere MQ 7.0.1, it is necessary to restart each queue manager defined in the queue sharing group as each queue manager recovers its own partition of the admin structure during queue manager restart. After each queue manager has been restarted, those not on their 'home' LPAR can be shut down again. For IBM WebSphere MQ 7.0.1 and later, the first queue manager started rebuilds the admin structure partitions for other members of the queue sharing group as well as its own, and it is no longer necessary to restart each queue manager in the queue sharing group.
- After the admin structure has been rebuilt, recover the application structures.

### ***Reinitializing a queue manager***

If the queue manager has terminated abnormally you might not be able to restart it. This could be because your page sets or logs have been lost, truncated, or corrupted. If this has happened, you might have to reinitialize the queue manager (perform a cold start).

### **Attention**

**Only perform a cold start if you cannot restart the queue manager any other way.** Performing a cold start enables you to recover your queue manager and your object definitions; you will **not** be able to recover your message data. Check that none of the other restart scenarios described in this topic work for you before you do this.

When you have restarted, all your IBM MQ objects are defined and available for use, but there is no message data.

**Note:** Do not reinitialize a queue manager while it is part of a cluster. You must first remove the queue manager from the cluster (using RESET CLUSTER commands on the other queue managers in the cluster), then reinitialize it, and finally reintroduce it to the cluster as a new queue manager.

This is because during reinitialization, the queue manager identifier (QMID) is changed, so any cluster object with the old queue manager identifier must be removed from the cluster.

For further information see the following sections:

- [Reinitializing a queue manager that is not in a queue-sharing group](#)
- [Reinitializing queue managers in a queue-sharing group](#)

### **Reinitializing a queue manager that is not in a queue-sharing group**

To reinitialize a queue manager, follow this procedure:

1. Prepare the object definition statements that to be used when you restart the queue manager. To do this, either:
  - If page set zero is available, use the CSQUTIL SDEFS function (see [Producing a list of IBM MQ define commands](#) ). You must get definitions for all object types (authentication information objects, CF structures, channels, namelists, processes, queues, and storage classes).
  - If page set zero is not available, use the definitions from the last time you backed up your object definitions.
2. Redefine your queue manager data sets (do not do this until you have completed step “1” on [page 331](#) ).

See [creating the bootstrap and log data sets](#) and [defining your page sets](#) for more information.

3. Restart the queue manager using the newly defined and initialized log data sets, BSDS, and page sets. Use the object definition input statements that you created in step “1” on [page 331](#) as input in the CSQINP2 initialization input data set.

### **Reinitializing queue managers in a queue-sharing group**

In a queue-sharing group, reinitializing a queue manager is more complex. It might be necessary to reinitialize one or more queue managers because of page set or log problems, but there might also be problems with Db2 or the coupling facility to deal with. Because of this, there are a number of alternatives:

#### **Cold start**

Reinitializing the entire queue-sharing group involves forcing all the coupling facilities structures, clearing all object definitions for the queue-sharing group from Db2, deleting or redefining the logs and BSDS, and formatting page sets for all the queue managers in the queue-sharing group.

#### **Shared definitions retained**

Delete or redefine the logs and BSDS, format page sets for all queue managers in the queue-sharing group, and force all the coupling facilities structures. On restart, all messages will have been deleted. The queue managers re-create COPY objects that correspond to GROUP objects that still exist in the Db2 database. Any shared queues still exist and can be used.

#### **Single queue manager reinitialized**

Delete or redefine the logs and BSDS, and format page sets for the single queue manager (this deletes all its private objects and messages). On restart, the queue manager re-creates COPY objects that correspond to GROUP objects that still exist in the Db2 database. Any shared queues still exist, as do the messages on them, and can be used.

#### **Point in time recovery of a queue-sharing group**

This is the alternative site disaster recovery scenario.

Shared objects are recovered to the point in time achieved by Db2 recovery (described in [A Db2 system fails](#)). Each queue manager can be recovered to a point in time achievable from the backup copies available at the alternative site.

Persistent messages can be used in queue-sharing groups, and can be recovered using the MQSC RECOVER CFSTRUCT command. Note that this command recovers to the time of failure. However, there is no recovery of nonpersistent shared queue messages; they are lost unless you have made backup copies independently using the COPY function of the CSQUTIL utility program.

It is not necessary to try to restore each queue manager to the same point in time because there are no interdependencies between the local objects on different queue managers (which are what is actually being recovered), and the queue manager resynchronization with Db2 on restart creates or deletes COPY objects as necessary on a queue manager by queue manager basis.

## **Using the z/OS Automatic Restart Manager (ARM)**

Use this topic to understand how you can use ARM to automatically restart your queue managers.

This section contains information about the following topics:

- [“What is the ARM?” on page 332](#)
- [“ARM policies” on page 333](#)
- [“Using ARM in an IBM MQ network” on page 335](#)

### **What is the ARM?**

The z/OS Automatic Restart Manager (ARM) is a z/OS recovery function that can improve the availability of your queue managers. When a job or task fails, or the system on which it is running fails, ARM can restart the job or task without operator intervention.

If a queue manager or a channel initiator has failed, ARM restarts it on the same z/OS image. If z/OS, and hence a whole group of related subsystems and applications have failed, ARM can restart all the failed systems automatically, in a predefined order, on another z/OS image within the sysplex. This is called a *cross-system restart*.

Restart the channel initiator by ARM only in exceptional circumstances. If the queue manager is restarted by ARM, restart the channel initiator from the CSQINP2 initialization data set (see [“Using ARM in an IBM MQ network”](#) on page 335 ).

You can use ARM to restart a queue manager on a different z/OS image within the sysplex in the event of z/OS failure. The network implications of IBM MQ ARM restart on a different z/OS image are described in [“Using ARM in an IBM MQ network”](#) on page 335.

To enable automatic restart:

- Set up an ARM couple data set.
- Define the automatic restart actions that you want z/OS to perform in an *ARM policy*.
- Start the ARM policy.

Also, IBM MQ must register with ARM at startup (this happens automatically).

**Note:** If you want to restart queue managers in different z/OS images automatically, you must define every queue manager as a subsystem in each z/OS image on which that queue manager might be restarted, with a sysplex wide unique four character subsystem name.

### ARM couple data sets

Ensure that you define the couple data sets required for ARM, and that they are online and active before you start any queue manager for which you want ARM support. IBM MQ automatic ARM registration fails if the couple data sets are not available at queue manager startup. In this situation, IBM MQ assumes that the absence of the couple data set means that you do not want ARM support, and initialization continues.

See the *z/OS MVS Setting up a Sysplex* manual for information about ARM couple data sets.

### ARM policies

The Automatic Restart Manager policies are user-defined rules that control ARM functions that can control any restarts of a queue manager.

ARM functions are controlled by a user-defined *ARM policy*. Each z/OS image running a queue manager instance that is to be restarted by ARM must be connected to an ARM couple data set with an active ARM policy.

IBM provides a default ARM policy. You can define new policies, or override the policy defaults by using the *administrative data utility* (IXCMIAPU) provided with z/OS. The *z/OS MVS Setting up a Sysplex* manual describes this utility, and includes full details of how to define an ARM policy.

Figure 54 on page 333 shows an example of an ARM policy. This sample policy restarts any queue manager within a sysplex, if either the queue manager failed, or a whole system failed.

```
//IXCMIAPU EXEC PGM=IXCMIAPU,REGION=2M
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
DATA TYPE(ARM)
DEFINE POLICY NAME(ARMPOL1) REPLACE(YES)
RESTART_GROUP(DEFAULT)
ELEMENT(*)
RESTART_ATTEMPTS(0) /* Jobs not to be restarted by ARM */
RESTART_GROUP(GROUP1)
ELEMENT(SYSMQMGRM*) /* These jobs to be restarted by ARM */
/*
```

Figure 54. Sample ARM policy

For more information see:

- [Defining an ARM policy](#)

- [Activating an ARM policy](#)
- [Registering with ARM](#)

## Defining an ARM policy

Set up your ARM policy as follows:

- Define RESTART\_GROUPS for each queue manager instance that also contain any CICS or IMS subsystems that connect to that queue manager instance. If you use a subsystem naming convention, you might be able to use the '?' and '\*' wild-card characters in your element names to define RESTART\_GROUPS with minimum definition effort.
- Specify TERMTYPE(ELEMTERM) for your channel initiators to indicate that they will be restarted only if the channel initiator has failed and the z/OS image has not failed.
- Specify TERMTYPE(ALLTERM) for your queue managers to indicate that they will be restarted if either the queue manager has failed or the z/OS image has failed.
- Specify RESTART\_METHOD(BOTH, PERSIST) for both queue managers and channel initiators. This tells ARM to restart using the JCL it saved (after resolution of system symbols) during the last startup. It tells ARM to do this irrespective of whether the individual element failed, or the z/OS image failed.
- Accept the default values for all the other ARM policy options.

## Activating an ARM policy

To start your automatic restart management policy, issue the following z/OS command:

```
SETXCF START,POLICY,TYPE=ARM,POLNAME= mypol
```

When the policy is started, all systems connected to the ARM couple data set use the same active policy. Use the SETXCF STOP command to disable automatic restarts.

## Registering with ARM

IBM MQ registers automatically as an *ARM element* during queue manager startup (subject to ARM availability). It deregisters during its shutdown phase, unless requested not to.

At startup, the queue manager determines whether ARM is available. If it is, IBM MQ registers using the name SYSMQMGR *ssid*, where *ssid* is the four character queue manager name, and SYSMQMGR is the element type.

The STOP QMGR MODE(QUIESCE) and STOP QMGR MODE(FORCE) commands deregister the queue manager from ARM (if it was registered with ARM at startup). This prevents ARM restarting this queue manager. The STOP QMGR MODE(RESTART) command does not deregister the queue manager from ARM, so it is eligible for immediate automatic restart.

Each channel initiator address space determines whether ARM is available, and if so registers with the element name SYSMQCH *ssid*, where *ssid* is the queue manager name, and SYSMQCH is the element type.

The channel initiator is always deregistered from ARM when it stops normally, and remains registered only if it ends abnormally. The channel initiator is always deregistered if the queue manager fails.

## Using ARM in an IBM MQ network

You can set up your queue manager so that the channel initiators and associated listeners are started automatically when the queue manager is restarted.

To ensure fully automatic queue manager restart on the same z/OS image for both LU 6.2 and TCP/IP communication protocols:

- Start your listeners automatically by adding the appropriate START LISTENER command to the CSQINPX data set.
- Start your channel initiator automatically by adding the appropriate START CHINIT command to the CSQINP2 data set.

For restarting a queue manager with TCP/IP or LU6.2, see

- [“Restarting on a different z/OS image with TCP/IP” on page 335](#)
- [“Restarting on a different z/OS image with LU 6.2” on page 336](#)

See [Task 13: Customize the initialization input data sets](#) for information about the CSQINP2 and CSQINPX data sets.

## Restarting on a different z/OS image with TCP/IP

If you are using TCP/IP as your communication protocol, and you are using virtual IP addresses, you can configure these to recover on other z/OS images, allowing channels connecting to that queue manager to reconnect without any changes. Otherwise, you can reallocate a TCP/IP address after moving a queue manager to a different z/OS image only if you are using clusters or if you are connecting to a queue-sharing group using a WLM dynamic Domain Name System (DNS) logical group name.

- [When using clustering](#)
- [When connecting to a queue-sharing group](#)

### When using clustering

z/OS ARM responds to a system failure by restarting the queue manager on a different z/OS image in the same sysplex; this system has a different TCP/IP address to the original z/OS image. The following explains how you can use IBM MQ clusters to reassign a queue manager's TCP/IP address after it has been moved by ARM restart to a different z/OS image.

When a client queue manager detects the queue manager failure (as a channel failure), it responds by reallocating suitable messages on its cluster transmission queue to a different server queue manager that hosts a different instance of the target cluster queue. However, it cannot reallocate messages that are bound to the original server by affinity constraints, or messages that are in doubt because the server queue manager failed during end-of-batch processing. To process these messages, do the following:

1. Allocate a different cluster-receiver channel name and a different TCP/IP port to each z/OS queue manager. Each queue manager needs a different port so that two systems can share a single TCP/IP stack on a z/OS image. One of these is the queue manager originally running on that z/OS image, and the other is the queue manager that ARM will restart on that z/OS image following a system failure. Configure each port on each z/OS image, so that ARM can restart any queue manager on any z/OS image.
2. Create a different channel initiator command input file (CSQINPX) for each queue manager and z/OS image combination, to be referenced during channel initiator startup.

Each CSQINPX file must include a START LISTENER PORT(port) command specific to that queue manager, and an ALTER CHANNEL command for a cluster-receiver channel specific to that queue manager and z/OS image combination. The ALTER CHANNEL command needs to set the connection name to the TCP/IP name of the z/OS image on which it is restarted. It must include the port number specific to the restarted queue manager as part of the connection name.



The start-up JCL of each queue manager can have a fixed data set name for this CSQINPX file, and each z/OS image must have a different version of each CSQINPX file on a non-shared DASD volume.

If an ARM restart occurs, IBM MQ advertises the changed channel definition to the cluster repository, which in turn publishes it to all the client queue managers that have expressed an interest in the server queue manager.

The client queue manager treats the server queue manager failure as a channel failure, and tries to restart the failed channel. When the client queue manager learns the new server connection-name, the channel restart reconnects the client queue manager to the restarted server queue manager. The client queue manager can then resynchronize its messages, resolve any in-doubt messages on the client queue manager's transmission queue, and normal processing can continue.

### **When connecting to a queue-sharing group**

When connecting to a queue-sharing group through a TCP/IP dynamic Domain Name System (DNS) logical group name, the connection name in your channel definition specifies the logical group name of your queue-sharing group, not the host name or IP address of a physical machine. When this channel starts, it connects to the dynamic DNS and is then connected to one of the queue managers in the queue-sharing group. This process is explained in [Setting up communication for IBM MQ for z/OS using queue-sharing groups](#).

In the unlikely event of an image failure, one of the following occurs:

- The queue managers on the failing image de-register from the dynamic DNS running on your sysplex. The channel responds to the connection failure by entering RETRYING state and then connects to the dynamic DNS running on the sysplex. The dynamic DNS allocates the inbound request to one of the remaining members of the queue-sharing group that is still running on the remaining images.
- If no other queue manager in the queue-sharing group is active and ARM restarts the queue manager and channel initiator on a different image, the group listener registers with dynamic DNS from this new image. This means that the logical group name (from the connection name field of the channel) connects to the dynamic DNS and is then connected to the same queue manager, now running on a different image. No change was required to the channel definition.

For this type of recovery to occur, the following points must be noted:

- On z/OS, the dynamic DNS runs on one of the z/OS images in the sysplex. If this image were to fail, the dynamic DNS needs to be configured so that there is a secondary name server active in the sysplex, acting as an alternative to the primary name server. Information about primary and secondary dynamic DNS servers can be found in the *OS/390® SecureWay CS IP Configuration* manual.
- The TCP/IP group listener might have been started on a particular IP address that might not be available on this z/OS image. If so, the listener might need to be started on a different IP address on the new image. If you are using virtual IP addresses, you can configure these to recover on other z/OS images so that no change to the START LISTENER command is required.

### **Restarting on a different z/OS image with LU 6.2**

If you use only LU 6.2 communication protocols, carry out the following procedure to enable network reconnect after automatic restart of a queue manager on a different z/OS image within the sysplex:

- Define each queue manager within the sysplex with a unique subsystem name.
- Define each channel initiator within the sysplex with a unique LUNAME. This is specified in both the queue manager attributes and in the START LISTENER command.

**Note:** The LUNAME names an entry in the APPC side table, which in turn maps this to the actual LUNAME.



- Set up a shared APPC side table, which is referenced by each z/OS image within the sysplex. This should contain an entry for each channel initiator's LUNAME. See the *MVS Planning: APPC/MVS Management* manual for information about this.
- Set up an APPCPM xx member of SYS1.PARMLIB for each channel initiator within the sysplex to contain an LUADD to activate the APPC side table entry for that channel initiator. These members should be shared by each z/OS image. The appropriate SYS1.PARMLIB member is activated by a z/OS command SET APPC= xx, which is issued automatically during ARM restart of the queue manager (and its channel initiator) on a different z/OS image, as described in the following text.
- Use the LU62ARM queue manager attribute to specify the xx suffix of this SYS1.PARMLIB member for each channel initiator. This causes the channel initiator to issue the required z/OS command SET APPC= xx to activate its LUNAME.

Define your ARM policy so that it restarts the channel initiator only if it fails while its z/OS image stays up; the user ID associated with the XCFAS address space must be authorized to issue the IBM MQ command START CHINIT. Do not restart the channel initiator automatically if its z/OS image also fails, instead use commands in the CSQINP2 and CSQINPX data sets to start the channel initiator and listeners.

## Recovering units of work manually

You can manually recover units of work CICS, IMS, RRS, or other queue managers in a queue-sharing group. You can use queue manager commands to display the status of the units of work associated with each connection to the queue manager.

This topic contains information about the following subjects:

- [“Displaying connections and threads” on page 337](#)
- [“Recovering CICS units of recovery manually” on page 338](#)
- [“Recovering IMS units of recovery manually” on page 341](#)
- [“Recovering RRS units of recovery manually” on page 343](#)
- [“Recovering units of recovery on another queue manager in the queue-sharing group” on page 343](#)

## Displaying connections and threads

You can use the [DISPLAY CONN](#) command to get information about connections to queue managers and their associated units of work. You can display active units of work to see what is currently happening, or to see what needs to be terminated to allow the queue manager to shut down, and you can display unresolved units of work to help with recovery.

### Active units of work

To display only active units of work, use

```
DISPLAY CONN(*) WHERE(UOWSTATE EQ ACTIVE)
```

### Unresolved units of work

An unresolved unit of work, also known as an "in-doubt thread", is one that is in the second pass of the two-phase commit operation. Resources are held in IBM MQ on its behalf. To display unresolved units of work, use

```
DISPLAY CONN(*) WHERE(UOWSTATE EQ UNRESOLVED)
```

External intervention is needed to resolve the status of unresolved units of work. This might only involve starting the recovery coordinator ( CICS, IMS, or RRS) or might involve more, as described in the following sections.

### ***Recovering CICS units of recovery manually***

Use this topic to understand what happens when the CICS adapter restarts, and then explains how to deal with any unresolved units of recovery that arise.

### **What happens when the CICS adapter restarts**

Whenever a connection is broken, the adapter has to go through a *restart phase* during the *reconnect process*. The restart phase resynchronizes resources. Resynchronization between CICS and IBM MQ enables in-doubt units of work to be identified and resolved.

Resynchronization can be caused by:

- An explicit request from the distributed queuing component
- An implicit request when a connection is made to IBM MQ

If the resynchronization is caused by connecting to IBM MQ, the sequence of events is:

1. The connection process retrieves a list of in-doubt units of work (UOW) IDs from IBM MQ.
2. The UOW IDs are displayed on the console in CSQC313I messages.
3. The UOW IDs are passed to CICS.
4. CICS initiates a resynchronization task (CRSY) for each in-doubt UOW ID.
5. The result of the task for each in-doubt UOW is displayed on the console.

You need to check the messages that are displayed during the connect process:

#### **CSQC313I**

Shows that a UOW is in doubt.

#### **CSQC400I**

Identifies the UOW and is followed by one of these messages:

- CSQC402I or CSQC403I shows that the UOW was resolved successfully (committed or backed out).
- CSQC404E, CSQC405E, CSQC406E, or CSQC407E shows that the UOW was not resolved.

#### **CSQC409I**

Shows that all UOWs were resolved successfully.

#### **CSQC408I**

Shows that not all UOWs were resolved successfully.

#### **CSQC314I**

Warns that UOW IDs highlighted with a \* are not resolved automatically. These UOWs must be resolved explicitly by the distributed queuing component when it is restarted.

[Figure 55 on page 339](#) shows an example set of restart messages displayed on the z/OS console.

```

CSQ9022I +CSQ1 CSQYASCP ' START QMGR' NORMAL COMPLETION
+CSQC323I VICIC1 CSQCQCON CONNECT received from TERMID=PB62 TRANID=CKCN
+CSQC303I VICIC1 CSQCCON CSQCSERV loaded. Entry point is 850E8918
+CSQC313I VICIC1 CSQCCON UOWID=VICIC1.A6E5A6F0E2178D25 is in doubt
+CSQC313I VICIC1 CSQCCON UOWID=VICIC1.A6E5A6F055B2AC25 is in doubt
+CSQC313I VICIC1 CSQCCON UOWID=VICIC1.A6E5A6EFFF060D425 is in doubt
+CSQC313I VICIC1 CSQCCON UOWID=VICIC1.A6E5A6F07AB56D22 is in doubt
+CSQC307I VICIC1 CSQCCON Successful connection to subsystem VC2
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008BAD18) connect
successful
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008BAA10) connect
successful
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008BA708) connect
successful
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008CAE88) connect
successful
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008CAB80) connect
successful
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008CA878) connect
successful
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008CA570) connect
successful
+CSQC472I VICIC1 CSQCSERV Server subtask (TCB address=008CA268) connect
successful
+CSQC403I VICIC1 CSQCTRUE Resolved BACKOUT for
+CSQC400I VICIC1 CSQCTRUE UOWID=VICIC1.A6E5A6F0E2178D25
+CSQC403I VICIC1 CSQCTRUE Resolved BACKOUT for
+CSQC400I VICIC1 CSQCTRUE UOWID=VICIC1.A6E5A6F055B2AC25
+CSQC403I VICIC1 CSQCTRUE Resolved BACKOUT for
+CSQC400I VICIC1 CSQCTRUE UOWID=VICIC1.A6E5A6F07AB56D22
+CSQC403I VICIC1 CSQCTRUE Resolved BACKOUT for
+CSQC400I VICIC1 CSQCTRUE UOWID=VICIC1.A6E5A6EFFF060D425
+CSQC409I VICIC1 CSQCTRUE Resynchronization completed successfully

```

Figure 55. Example restart messages

The total number of CSQC313I messages should equal the total number of CSQC402I plus CSQC403I messages. If the totals are not equal, there are UOWs that the connection process cannot resolve. Those UOWs that cannot be resolved are caused by problems with CICS (for example, a cold start) or with IBM MQ, or by distributing queuing. When these problems have been fixed, you can initiate another resynchronization by disconnecting and then reconnecting.

Alternatively, you can resolve each outstanding UOW yourself using the RESOLVE INDOUBT command and the UOW ID shown in message CSQC400I. You must then initiate a disconnect and a connect to clean up the *unit of recovery descriptors* in CICS. You need to know the correct outcome of the UOW to resolve UOWs manually.

All messages that are associated with unresolved UOWs are locked by IBM MQ and no Batch, TSO, or CICS task can access them.

If CICS fails and an emergency restart is necessary, *do not* vary the GENERIC APPLID of the CICS system. If you do and then reconnect to IBM MQ, data integrity with IBM MQ cannot be guaranteed. This is because IBM MQ treats the new instance of CICS as a different CICS (because the APPLID is different). In-doubt resolution is then based on the wrong CICS log.

## How to resolve CICS units of recovery manually

If the adapter ends abnormally, CICS and IBM MQ build in-doubt lists either dynamically or during restart, depending on which subsystem caused the abend.

**Note:** If you use the DFH\$INDB sample program to show units of work, you might find that it does not always show IBM MQ UOWs correctly.

When CICS connects to IBM MQ, there might be one or more units of recovery that have not been resolved.

One of the following messages is sent to the console:

- CSQC404E
- CSQC405E
- CSQC406E
- CSQC407E
- CSQC408I

For details of what these messages mean, see the [CICS adapter and Bridge messages](#) messages.

CICS retains details of units of recovery that were not resolved during connection startup. An entry is purged when it no longer appears on the list presented by IBM MQ.

Any units of recovery that CICS cannot resolve must be resolved manually using IBM MQ commands. This manual procedure is rarely used within an installation, because it is required only where operational errors or software problems have prevented automatic resolution. *Any inconsistencies found during in-doubt resolution must be investigated.*

To resolve the units of recovery:

1. Obtain a list of the units of recovery from IBM MQ using the following command:

```
+CSQ1  DISPLAY CONN( * ) WHERE(UOWSTATE EQ UNRESOLVED)
```

You receive the following message:

```
CSQM201I +CSQ1 CSQMDRTC DISPLAY CONN DETAILS
CONN(BC85772CBE3E0001)
EXTCONN(C3E2D8C3C7D9F0F94040404040404040)
TYPE(CONN)
CONNOPTS(
MQCNO_STANDARD_BINDING
)
UOWLOGDA(2005-02-04)
UOWLOGTI(10.17.44)
UOWSTDA(2005-02-04)
UOWSTTI(10.17.44)
UOWSTATE(UNRESOLVED)
NID(IYRCSQ1 .BC8571519B60222D)
EXTURID(BC8571519B60222D)
QMURID(0000002BDA50)
URTYPE(CICS)
USERID(MQTEST)
APPLTAG(IYRCSQ1)
ASID(0000)
APPLTYPE(CICS)
TRANSID(GP02)
TASKNO(0000096)
END CONN DETAILS
```

For CICS connections, the NID consists of the CICS applid and a unique number provided by CICS at the time the syncpoint log entries are written. This unique number is stored in records written to both the CICS system log and the IBM MQ log at syncpoint processing time. This value is referred to in CICS as the *recovery token*.

2. Scan the CICS log for entries related to a particular unit of recovery.

Look for a PREPARE record for the task-related installation where the recovery token field (JCSRMTKN) equals the value obtained from the network ID. The network ID is supplied by IBM MQ in the DISPLAY CONN command output.

The PREPARE record in the CICS log for the units of recovery provides the CICS task number. All other entries on the log for this CICS task can be located using this number.

You can use the CICS journal print utility DFHJUP when scanning the log. For details of using this program, see the *CICS Operations and Utilities Guide*.

3. Scan the IBM MQ log for records with the NID related to a particular unit of recovery. Then use the URID from this record to obtain the rest of the log records for this unit of recovery.

When scanning the IBM MQ log, note that the IBM MQ startup message CSQJ001I provides the start RBA for this session.

The print log records program (CSQ1LOGP) can be used for that purpose.

4. If you need to, do in-doubt resolution in IBM MQ.

IBM MQ can be directed to take the recovery action for a unit of recovery using an IBM MQ [RESOLVE INDOUBT](#) command.

To recover all threads associated with a specific *connection-name*, use the NID(\*) option.

The command produces one of the following messages showing whether the thread is committed or backed out:

```
CSQV414I +CSQ1 THREAD network-id COMMIT SCHEDULED
CSQV415I +CSQ1 THREAD network-id ABORT SCHEDULED
```

When performing in-doubt resolution, CICS and the adapter are not aware of the commands to IBM MQ to commit or back out units of recovery, because only IBM MQ resources are affected. However, CICS keeps details about the in-doubt threads that could not be resolved by IBM MQ. This information is purged either when the list presented is empty, or when the list does not include a unit of recovery of which CICS has details.

### ***Recovering IMS units of recovery manually***

Use this topic to understand what happens when the IMS adapter restarts, and then explains how to deal with any unresolved units of recovery that arise.

## **What happens when the IMS adapter restarts**

Whenever the connection to IBM MQ is restarted, either following a queue manager restart or an IMS / START SUBSYS command, IMS initiates the following resynchronization process:

1. IMS presents the list of unit of work (UOW) IDs that it believes are in doubt to the IBM MQ IMS adapter one at a time with a resolution parameter of Commit or Backout.
2. The IMS adapter passes the resolution request to IBM MQ and reports the result back to IMS.
3. Having processed all the IMS resolution requests, the IMS adapter gets from IBM MQ a list of all UOWs that IBM MQ still holds in doubt that were initiated by the IMS system. These are reported to the IMS master terminal in message CSQQ008I.

**Note:** While a UOW is in doubt, any associated IBM MQ message is locked by IBM MQ and is not available to any application.

### **How to resolve IMS units of recovery manually**

When IMS connects to IBM MQ, IBM MQ might have one, or more in-doubt units of recovery that have not been resolved.

If IBM MQ has in-doubt units of recovery that IMS did not resolve, the following message is issued at the IMS master terminal:

```
CSQQ008I nn units of recovery are still in doubt in queue manager qmgr-name
```

If this message is issued, IMS was either cold-started or it was started with an incomplete log tape. This message can also be issued if IBM MQ or IMS terminates abnormally because of a software error or other subsystem failure.

After receiving the CSQQ008I message:

- The connection remains active.
- IMS applications can still access IBM MQ resources.
- Some IBM MQ resources remain locked out.

If the in-doubt thread is not resolved, IMS message queues can start to build up. If the IMS queues fill to capacity, IMS terminates. You must be aware of this potential difficulty, and you must monitor IMS until the in-doubt units of recovery are fully resolved.

### Recovery procedure

Use the following procedure to recover the IMS units of work:

1. Force the IMS log closed, using /SWI OLDS, and then archive the IMS log. Use the utility, DFSERA10, to print the records from the previous IMS log tape. Type X'3730' log records indicate a phase-2 commit request and type X'38' log records indicate an abort request. Record the requested action for the last transaction in each dependent region.
2. Run the DL/I batch job to back out each PSB involved that has not reached a commit point. The process might take some time because transactions are still being processed. It might also lock up a number of records, which could affect the rest of the processing and the rest of the message queues.
3. Produce a list of the in-doubt units of recovery from IBM MQ using the following command:

```
+CSQ1 DISPLAY CONN(*) WHERE(UOWSTATE EQ UNRESOLVED)
```

You receive the following message:

```
CSQM201I +CSQ1 CSQMDRTC DISPLAY CONN DETAILS
CONN(BC45A794C4290001)
EXTCONN(C3E2D8C3E2C5C3F240404040404040)
TYPE(CONN)
CONNOPTS(
MQCNO_STANDARD_BINDING
)
UOWLOGDA(2005-02-15)
UOWLOGTI(16.39.43)
UOWSTDA(2005-02-15)
UOWSTTI(16.39.43)
UOWSTATE(UNRESOLVED)
NID(IM8F .BC45A794D3810344)
EXTURID(
0000052900000000
)
QMURID(00000354B76E)
URTYPE(IMS)
USERID(STCPI)
APPLTAG(IM8F)
ASID(0000)
APPLTYPE(IMS)
PSTID(0004)
PSBNAME(GP01MPP)
```

For IMS, the NID consists of the IMS connection name and a unique number provided by IMS. The value is referred to in IMS as the *recovery token*. For more information, see the *IMS Customization Guide*.

4. Compare the NIDs (IMSID plus OASN in hexadecimal) displayed in the DISPLAY THREAD messages with the OASNs (4 bytes decimal) shown in the DFSERA10 output. Decide whether to commit or back out.
5. Perform in-doubt resolution in IBM MQ with the `RESOLVE INDOUBT` command, as follows:

```
RESOLVE INDOUBT( connection-name )  
ACTION(COMMIT|BACKOUT)  
NID( network-id )
```

To recover all threads associated with *connection-name*, use the NID(\*) option. The command results in one of the following messages to indicate whether the thread is committed or backed out:

```
CSQV414I  THREAD network-id COMMIT SCHEDULED  
CSQV415I  THREAD network-id BACKOUT SCHEDULED
```

When performing in-doubt resolution, IMS and the adapter are not aware of the commands to IBM MQ to commit or back out in-doubt units of recovery because only IBM MQ resources are affected.

### ***Recovering RRS units of recovery manually***

Use this topic to understand the how to determine if there are in-doubt RRS units of recovery, and how to manually resolve those units of recovery.

When RRS connects to IBM MQ, IBM MQ might have one, or more in-doubt units of recovery that have not been resolved. If IBM MQ has in-doubt units of recovery that RRS did not resolve, one of the following messages is issued at the z/OS console:

- CSQ3011I
- CSQ3013I
- CSQ3014I
- CSQ3016I

Both IBM MQ and RRS provide tools to display information about in-doubt units of recovery, and techniques for manually resolving them.

In IBM MQ, use the DISPLAY CONN command to display information about in-doubt IBM MQ threads. The output from the command includes RRS unit of recovery IDs for those IBM MQ threads that have RRS as a coordinator. This can be used to determine the outcome of the unit of recovery.

Use the RESOLVE INDOUBT command to resolve the IBM MQ in-doubt thread manually. This command can be used to either commit or back out the unit of recovery after you have determined what the correct decision is.

### ***Recovering units of recovery on another queue manager in the queue-sharing group***

Use this topic to identify, and manually recover units of recovery on other queue managers in a queue-sharing group.

If a queue manager that is a member of a queue-sharing group fails and cannot be restarted, other queue managers in the group can perform peer recovery, and take over from it. However, the queue manager might have in-doubt units of recovery that cannot be resolved by peer recovery because the final disposition of that unit of recovery is known only to the failed queue manager. These units of recovery are resolved when the queue manager is eventually restarted, but until then, they remain in doubt.

This means that certain resources (for example, messages) might be locked, making them unavailable to other queue managers in the group. In this situation, you can use the DISPLAY THREAD command to display these units of work on the inactive queue manager. If you want to resolve these units of recovery manually to make the messages available to other queue managers in the group, you can use the RESOLVE INDOUBT command.

When you issue the DISPLAY THREAD command to display units of recovery that are in doubt, you can use the QMNAME keyword to specify the name of the inactive queue manager. For example, if you issue the following command:

```
+CSQ1 DISPLAY THREAD(*) TYPE(INDOUBT) QMNAME(QM01)
```

You receive the following messages:

```
CSQV436I +CSQ1 INDOUBT THREADS FOR QM01 -
NAME    THREAD-XREF    URID NID
USER1   000000000000000000000000 CSQ:0001.0
USER2   000000000000000000000000 CSQ:0002.0
DISPLAY THREAD REPORT COMPLETE
```

If the queue manager specified is active, IBM MQ does not return information about in-doubt threads, but issues the following message:

```
CSQV435I CANNOT USE QMNAME KEYWORD, QM01 IS ACTIVE
```

Use the IBM MQ command RESOLVE INDOUBT to resolve the in-doubt threads manually. Use the QMNAME keyword to specify the name of the inactive queue manager in the command.

This command can be used to commit or back out the unit of recovery. The command resolves the shared portion of the unit of recovery only; any local messages are unaffected and remain locked until the queue manager restarts, or reconnects to CICS, IMS, or RRS batch.

## IBM MQ and IMS

IBM MQ provides two components to interface with IMS, the IBM MQ - IMS adapter, and the IBM MQ - IMS bridge. These components are commonly called the IMS adapter, and the IMS bridge.

### Operating the IMS adapter

Use this topic to understand how to operate the IMS adapter, which connects IBM MQ to IMS systems.

**Note:** The IMS adapter does not incorporate any operations and control panels.

This topic contains the following sections:

- [“Controlling IMS connections” on page 345](#)
- [“Connecting from the IMS control region” on page 345](#)
- [“Displaying in-doubt units of recovery” on page 347](#)
- [“Controlling IMS dependent region connections” on page 349](#)
- [“Disconnecting from IMS” on page 351](#)
- [“Controlling the IMS trigger monitor” on page 351](#)



## Controlling IMS connections

Use this topic to understand the IMS operator commands which control and monitor the connection to IBM MQ.

IMS provides the following operator commands to control and monitor the connection to IBM MQ:

### **/CHANGE SUBSYS**

Deletes an in-doubt unit of recovery from IMS.

### **/DISPLAY OASN SUBSYS**

Displays outstanding recovery elements.

### **/DISPLAY SUBSYS**

Displays connection status and thread activity.

### **/START SUBSYS**

Connects the IMS control region to a queue manager.

### **/STOP SUBSYS**

Disconnects IMS from a queue manager.

### **/TRACE**

Controls the IMS trace.

For more information about these commands, see the *IMS/ESA® Operator's Reference* manual for the level of IMS that you are using.

IMS command responses are sent to the terminal from which the command was issued. Authorization to issue IMS commands is based on IMS security.

## Connecting from the IMS control region

Use this topic to understand the mechanisms available to connect from IMS to IBM MQ.

IMS makes one connection from its control region to each queue manager that uses IMS. IMS must be enabled to make the connection in one of these ways:

- Automatically during either:
  - A cold start initialization.
  - A warm start of IMS, if the IBM MQ connection was active when IMS was shut down.
- In response to the IMS command:

```
/START SUBSYS sysid
```

where *sysid* is the queue manager name.

The command can be issued regardless of whether the queue manager is active.

The connection is not made until the first MQ API call to the queue manager is made. Until that time, the IMS command /DIS SUBSYS shows the status as 'NOT CONN'.

The order in which you start IMS and the queue manager is not significant.

IMS cannot re-enable the connection to the queue manager automatically if the queue manager is stopped with a STOP QMGR command, the IMS command /STOP SUBSYS, or an abnormal end. Therefore, you must make the connection by using the IMS command /START SUBSYS.

## Initializing the adapter and connecting to the queue manager

The adapter is a set of modules loaded into the IMS control and dependent regions, using the IMS external Subsystem Attach Facility.

This procedure initializes the adapter and connects to the queue manager:

1. Read the subsystem member (SSM) from IMS.PROCLIB. The SSM chosen is an IMS EXEC parameter. There is one entry in the member for each queue manager to which IMS can connect. Each entry contains control information about an IBM MQ adapter.

2. Load the IMS adapter.

**Note:** IMS loads one copy of the adapter modules for each IBM MQ instance that is defined in the SSM member.

3. Attach the external subsystem task for IBM MQ.

4. Run the adapter with the CTL EXEC parameter (IMSID) as the connection name.

The process is the same whether the connection is part of initialization or a result of the IMS command / START SUBSYS.

If the queue manager is active when IMS tries to make the connection, the following messages are sent:

- to the z/OS console:

```
DFS3613I ESS TCB INITIALIZATION COMPLETE
```

- to the IMS master terminal:

```
CSQQ000I IMS/TM imsid connected to queue manager ssnm
```

When IMS tries to make the connection and *the queue manager is not active*, the following messages are sent to the IMS master terminal each time an application makes an MQI call:

```
CSQQ001I IMS/TM imsid not connected to queue manager ssnm.  
Notify message accepted  
DFS3607I MQM1 SUBSYSTEM ID EXIT FAILURE, FC = 0286, RC = 08,  
JOBNAME = IMSEMPR1
```

If you get DFS3607I messages when you start the connection to IMS or on system startup, this indicates that the queue manager is not available. To prevent a large number of messages being generated, you must do one of the following:

1. Start the relevant queue manager.
2. Issue the IMS command:

```
/STOP SUBSYS
```

so that IMS does not expect to connect to the queue manager.

If you do neither, a DFS3607I message and the associated CSQQ001I message are issued each time a job is scheduled in the region and each time a connection request to the queue manager is made by an application.

## Thread attachment

In an MPP or IFP region, IMS makes a thread connection when the first application program is scheduled into that region, even if that application program does not make an IBM MQ call. In a BMP region, the thread connection is made when the application makes its first IBM MQ call (MQCONN or MQCONNX). This thread is retained for the duration of the region or until the connection is stopped.

For both the message driven and non-message driven regions, the recovery thread cross-reference identifier, *Thread-xref*, associated with the thread is:

```
PSTid + PSBname
```

where:

**PSTid**

Partition specification table region identifier

**PSBname**

Program specification block name

You can use connection IDs as unique identifiers in IBM MQ commands, in which case IBM MQ automatically inserts these IDs into any operator message that it generates.

***Displaying in-doubt units of recovery***

You can display in-doubt units of recovery and attempt to recover them.

The operational steps used to list and recover in-doubt units of recovery in this topic are for relatively simple cases only. If the queue manager ends abnormally while connected to IMS, IMS might commit or back out work without IBM MQ being aware of it. When the queue manager restarts, that work is termed *in doubt*. A decision must be made about the status of the work.

To display a list of in-doubt units of recovery, issue the command:

```
+CSQ1 DISPLAY CONN(*) WHERE(UOWSTATE EQ UNRESOLVED)
```

IBM MQ responds with a message like the following:

```
CSQM201I +CSQ1 CSQMDRTC DIS CONN DETAILS
CONN(BC0F6125F5A30001)
EXTCONN(C3E2D8C3C3E2D8F140404040404040)
TYPE(CONN)
CONNOPTS(
MQCNO_STANDARD_BINDING
)
UOWLOGDA(2004-11-02)
UOWLOGTI(12.27.58)
UOWSTDA(2004-11-02)
UOWSTTI(12.27.58)
UOWSTATE(UNRESOLVED)
NID(CSQ1CHIN.BC0F5F1C86FC0766)
EXTURID(0000000000000001F000000007472616E5F6964547565204E6F762020...)
QMURID(000000026232)
URTYPE(XA)
USERID( )
APPLTAG(CSQ1CHIN)
ASID(0000)
APPLTYPE(CHINIT)
CHANNEL( )
CONNAME( )
END CONN DETAILS
```

For an explanation of the attributes in this message, see the description of the [DISPLAY CONN](#) command.

## Recovering in-doubt units of recovery

To recover in-doubt units of recovery, issue this command:

```
+CSQ1 RESOLVE INDOUBT( connection-name ) ACTION(COMMIT|BACKOUT)
NID( net-node.number )
```

where:

***connection-name***

The IMS system ID.

**ACTION**

Indicates whether to commit (COMMIT) or back out (BACKOUT) this unit of recovery.

***net-node.number***

The associated net-node.number.

When you have issued the RESOLVE INDOUBT command, one of the following messages is displayed:

```
CSQV414I +CSQ1 THREAD network-id COMMIT SCHEDULED
CSQV415I +CSQ1 THREAD network-id BACKOUT SCHEDULED
```

## Resolving residual recovery entries

At given times, IMS builds a list of residual recovery entries (RREs). RREs are units of recovery about which IBM MQ might be in doubt. They arise in several situations:

- If the queue manager is not active, IMS has RREs that cannot be resolved until the queue manager is active. These RREs are not a problem.
- If the queue manager is active and connected to IMS, and if IMS backs out the work that IBM MQ has committed, the IMS adapter issues message CSQQ010E. If the data in the two systems must be consistent, there is a problem. For information about resolving this problem, see [“Recovering IMS units of recovery manually”](#) on page 341.
- If the queue manager is active and connected to IMS, there might still be RREs even though no messages have informed you of this problem. After the IBM MQ connection to IMS has been established, you can issue the following IMS command to find out if there is a problem:

```
/DISPLAY OASN SUBSYS sysid
```

To purge the RRE, issue one of the following IMS commands:

```
/CHANGE SUBSYS sysid RESET
/CHANGE SUBSYS sysid RESET OASN nnnn
```

where *nnnn* is the originating application sequence number listed in response to your +CSQ1 DISPLAY command. This is the schedule number of the program instance, giving its place in the sequence of

invocations of that program since the last IMS cold start. IMS cannot have two in-doubt units of recovery with the same schedule number.

These commands reset the status of IMS ; they do not result in any communication with IBM MQ.

### ***Controlling IMS dependent region connections***

You can control, monitor, and, when necessary, terminate connections between IMS and IBM MQ.

Controlling IMS dependent region connections involves the following activities:

- [Connecting from dependent regions](#)
- [Region error options](#)
- [Monitoring the activity on connections](#)
- [Disconnecting from dependent regions](#)

### **Connecting from dependent regions**

The IMS adapter used in the control region is also loaded into dependent regions. A connection is made from each dependent region to IBM MQ. This connection is used to coordinate the commitment of IBM MQ and IMS work. To initialize and make the connection, IMS does the following:

1. Reads the subsystem member (SSM) from IMS.PROCLIB.

A subsystem member can be specified on the dependent region EXEC parameter. If it is not specified, the control region SSM is used. If the region is never likely to connect to IBM MQ, to avoid loading the adapter, specify a member with no entries.

2. Loads the IBM MQ adapter.

For a batch message program, the load is not done until the application issues its first messaging command. At that time, IMS tries to make the connection.

For a message-processing program region or IMS fast-path region, the attempt is made when the region is initialized.

### **Region error options**

If the queue manager is not active, or if resources are not available when the first messaging command is sent from application programs, the action taken depends on the error option specified on the SSM entry. The options are:

**R**

The appropriate return code is sent to the application.

**Q**

The application ends abnormally with abend code U3051. The input message is re-queued.

**A**

The application ends abnormally with abend code U3047. The input message is discarded.

### **Monitoring the activity on connections**

A thread is established from a dependent region when an application makes its first successful IBM MQ request. You can display information about connections and the applications currently using them by issuing the following command from IBM MQ:

```
+CSQ1 DISPLAY CONN(*) ALL
```

The command produces a message like the following:

```
CONN(BC45A794C4290001)
EXTCONN(C3E2D8C3C3E2D8F140404040404040)
TYPE(CONN)
CONNOPTS(
MQCNO_STANDARD_BINDING
)
UOWLOGDA(2004-12-15)
UOWLOGTI(16.39.43)
UOWSTDA(2004-12-15)
UOWSTTI(16.39.43)
UOWSTATE(ACTIVE)
NID( )
EXTURID(
0000052900000000
)
QMURID(00000354B76E)
URTYPE(IMS)
USERID(STCPI)
APPLTAG(IM8F)
ASID(0049)
APPLTYPE(IMS)
PSTID(0004)
PSBNAME(GP01MPP)
```

For the control region, *thread-xref* is the special value CONTROL. For dependent regions, it is the PSTid concatenated with the PSBname. *auth-id* is either the user field from the job card, or the ID from the z/OS started procedures table.

For an explanation of the displayed list, see the description of message CSQV402I in the [IBM MQ for z/OS messages, completion, and reason codes](#) documentation.

IMS provides a display command to monitor the connection to IBM MQ. It shows which program is active on each dependent region connection, the LTERM user name, and the control region connection status. The command is:

```
/DISPLAY SUBSYS name
```

The status of the connection between IMS and IBM MQ is shown as one of:

```
CONNECTED
NOT CONNECTED
CONNECT IN PROGRESS
STOPPED
STOP IN PROGRESS
INVALID SUBSYSTEM NAME= name
SUBSYSTEM name NOT DEFINED BUT RECOVERY OUTSTANDING
```

The thread status from each dependent region is one of the following:

```
CONN
CONN, ACTIVE (includes LTERM of user)
```

## Disconnecting from dependent regions

To change values in the SSM member of IMS.PROCLIB, you disconnect a dependent region. To do this, you must:

1. Issue the IMS command:

```
/STOP REGION
```

2. Update the SSM member.
3. Issue the IMS command:

```
/START REGION
```

## Disconnecting from IMS

The connection is ended when either IMS or the queue manager terminates. Alternatively, the IMS master terminal operator can explicitly break the connection.

To terminate the connection between IMS and IBM MQ, use the following IMS command:

```
/STOP SUBSYS sysid
```

The command sends the following message to the terminal that issued it, typically the master terminal operator (MTO):

```
DFS058I STOP COMMAND IN PROGRESS
```

The IMS command:

```
/START SUBSYS sysid
```

is required to reestablish the connection.

**Note:** The IMS command `/STOP SUBSYS` is not completed if an IMS trigger monitor is running.

## Controlling the IMS trigger monitor

You can use the CSQQTRMN transaction to stop, and start the IMS trigger monitor.

The IMS trigger monitor (the CSQQTRMN transaction) is described in the [Setting up the IMS trigger monitor](#).

To control the IMS trigger monitor see:

- [Starting CSQQTRMN](#)
- [Stopping CSQQTRMN](#)

## Starting CSQQTRMN

1. Start a batch-oriented BMP that runs the program CSQQTRMN for each initiation queue you want to monitor.
2. Modify your batch JCL to add a DDname of CSQQUT1 that points to a data set containing the following information:

```
QMGRNAME=q_manager_name    Comment: queue manager name
INITQUEUEUENAME=init_q_name  Comment: initiation queue name
LTERM=lterm                 Comment: LTERM to remove error messages
CONSOLEMESSAGES=YES         Comment: Send error messages to console
```

where:

q_manager_name	The name of the queue manager (if this is blank, the default nominated in CSQQDEFV is assumed)
init_q_name	The name of the initiation queue to be monitored
lterm	The IMS LTERM name for the destination of error messages (if this is blank, the default value is MASTER).
CONSOLEMESSAGES= YES	Requests that messages sent to the nominated IMS LTERM are also sent to the z/OS console. If this parameter is omitted or misspelled, the default is NOT to send messages to the console.

3. Add a DD name of CSQQUT2 if you want a printed report of the processing of CSQQUT1 input.

### Note:

1. The data set CSQQUT1 is defined with LRECL=80. Other DCB information is taken from the data set. The DCB for data set CSQQUT2 is RECFM=VBA and LRECL=125.
2. You can put only one keyword on each record. The keyword value is delimited by the first blank following the keyword; this means that you can include comments. An asterisk in column 1 means that the whole input record is a comment.
3. If you misspell either of the QMGRNAME or LTERM keywords, CSQQTRMN uses the default for that keyword.
4. Ensure that the subsystem is started in IMS (by the /START SUBSYS command) before submitting the trigger monitor BMP job. If it is not started, your trigger monitor job terminates with abend code U3042.

## Stopping CSQQTRMN

Once started, CSQQTRMN runs until either the connection between IBM MQ and IMS is broken due to one of the following events:

- the queue manager ending
- IMS ending

or a z/OS STOP **jobname** command is entered.

## Controlling the IMS bridge

Use this topic to understand the IMS commands that you can use to control the IMS bridge.

There are no IBM MQ commands to control the IBM MQ-IMS bridge. However, you can stop messages being delivered to IMS in the following ways:



- For non-shared queues, by using the ALTER QLOCAL(xxx) GET(DISABLED) command for all bridge queues.
- For clustered queues, by using the SUSPEND QMGR CLUSTER(xxx) command. This is effective only when another queue manager is also hosting the clustered bridge queue.
- For clustered queues, by using the SUSPEND QMGR FACILITY(IMSBRIDGE) command. No further messages are sent to IMS, but the responses for any outstanding transactions are received from IMS.

To start sending messages to IMS again, issue the RESUME QMGR FACILITY(IMSBRIDGE) command.

You can also use the MQSC command DISPLAY SYSTEM to display whether the bridge is suspended.

See [MQSC commands](#) for details of these commands.

For further information see:

- [“Starting and stopping the IMS bridge” on page 353](#)
- [“Controlling IMS connections” on page 353](#)
- [Controlling bridge queues](#)
- [“Resynchronizing the IMS bridge” on page 354](#)
- [Working with tpipe names](#)
- [Deleting messages from IMS](#)
- [Deleting tpipes](#)
- [“IMS Transaction Expiration” on page 356](#)

## Starting and stopping the IMS bridge

Start the IBM MQ bridge by starting OTMA. Either use the IMS command:

```
/START OTMA
```

or start it automatically by specifying OTMA=YES in the IMS system parameters. If OTMA is already started, the bridge starts automatically when queue manager startup has completed. An IBM MQ event message is produced when OTMA is started.

Use the IMS command:

```
/STOP OTMA
```

to stop OTMA communication. When this command is issued, an IBM MQ event message is produced.

## Controlling IMS connections

IMS provides these operator commands to control and monitor the connection to IBM MQ:

### **/DEQUEUE TMEMBER *tmember* TPIPE *tpipe***

Removes messages from a Tpipe. Specify PURGE to remove all messages or PURGE1 to remove the first message only.

### **/DISPLAY OTMA**

Displays summary information about the OTMA server and clients, and client status.

### **/DISPLAY TMEMBER *name***

Displays information about an OTMA client.

### **/DISPLAY TRACE TMEMBER *name***

Displays information about what is being traced.

**/SECURE OTMA**

Sets security options.

**/START OTMA**

Enables communications through OTMA.

**/START TMEMBER *tmember* TPIPE *tpipe***

Starts the named Tpipe.

**/STOP OTMA**

Stops communications through OTMA.

**/STOP TMEMBER *tmember* TPIPE *tpipe***

Stops the named Tpipe.

**/TRACE**

Controls the IMS trace.

For more information about these commands, see the *IMS/ESA Operators Reference* manual for the level of IMS that you are using.

IMS command responses are sent to the terminal from which the command was issued. Authorization to issue IMS commands is based on IMS security.

## Controlling bridge queues

To stop communicating with the queue manager with XCF member name *tmember* through the bridge, issue the following IMS command:

```
/STOP TMEMBER tmember TPIPE ALL
```

To resume communication, issue the following IMS command:

```
/START TMEMBER tmember TPIPE ALL
```

The Tpipes for a queue can be displayed using the MQ DISPLAY QUEUE command.

To stop communication with the queue manager on a single Tpipe, issue the following IMS command:

```
/STOP TMEMBER tmember TPIPE tpipe
```

One or two Tpipes are created for each active bridge queue, so issuing this command stops communication with the IBM MQ queue. To resume communication, use the following IMS command :

```
/START TMEMBER tmember TPIPE tpipe
```

Alternatively, you can alter the attributes of the IBM MQ queue to make it get inhibited.

## Resynchronizing the IMS bridge

The IMS bridge is automatically restarted whenever the queue manager, IMS, or OTMA are restarted.

The first task undertaken by the IMS bridge is to resynchronize with IMS. This involves IBM MQ and IMS checking sequence numbers on every synchronized Tpipe. A synchronized Tpipe is used when persistent messages are sent to IMS from an IBM MQ - IMS bridge queue using commit mode zero (commit-then-send).

If the bridge cannot resynchronize with IMS, the IMS sense code is returned in message CSQ2023E and the connection to OTMA is stopped. If the bridge cannot resynchronize with an individual IMS Tpipe, the IMS sense code is returned in message CSQ2025E and the Tpipe is stopped. If a Tpipe has been cold started, the recoverable sequence numbers are automatically reset to 1.

If the bridge discovers mismatched sequence numbers when resynchronizing with a Tpipe, message CSQ2020E is issued. Use the IBM MQ command RESET TPIPE to initiate resynchronization with the IMS Tpipe. You need to provide the XCF group and member name, and the name of the Tpipe; this information is provided by the message.

You can also specify:

- A new recoverable sequence number to be set in the Tpipe for messages sent by IBM MQ, and to be set as the partner's receive sequence number. If you do not specify this, the partner's receive sequence number is set to the current IBM MQ send sequence number.
- A new recoverable sequence number to be set in the Tpipe for messages received by IBM MQ, and to be set as the partner's send sequence number. If you do not specify this, the partner's send sequence number is set to the current IBM MQ receive sequence number.

If there is an unresolved unit of recovery associated with the Tpipe, this is also notified in the message. Use the IBM MQ command RESET TPIPE to specify whether to commit the unit of recovery, or back it out. If you commit the unit of recovery, the batch of messages has already been sent to IMS, and is deleted from the bridge queue. If you back the unit of recovery out, the messages are returned to the bridge queue, to be later sent to IMS.

Commit mode 1 (send-then-commit) Tpipes are not synchronized.

### **Considerations for Commit mode 1 transactions**

In IMS, commit mode 1 (CM1) transactions send their output replies before sync point.

A CM1 transaction might not be able to send its reply, for example because:

- The Tpipe on which the reply is to be sent is stopped
- OTMA is stopped
- The OTMA client (that is, the queue manager) has gone away
- The reply-to queue and dead-letter queue are unavailable

For these reasons, the IMS application sending the message pseudo-abends with code U0119. The IMS transaction and program are not stopped in this case.

These reasons often prevent messages being sent into IMS, as well as replies being delivered from IMS. A U0119 abend can occur if:

- The Tpipe, OTMA, or the queue manager is stopped while the message is in IMS
- IMS replies on a different Tpipe to the incoming message, and that Tpipe is stopped
- IMS replies to a different OTMA client, and that client is unavailable.

Whenever a U0119 abend occurs, both the incoming message to IMS and the reply messages to IBM MQ are lost. If the output of a CM0 transaction cannot be delivered for any of these reasons, it is queued on the Tpipe within IMS.

### **Working with tpipe names**

Many of the commands used to control the IBM MQ - IMS bridge require the *tpipe* name. Use this topic to understand how you can find further details of the tpipe name.

You need *tpipe* names for many of the commands that control the IBM MQ - IMS bridge. You can get the *tpipe* names from DISPLAY QUEUE command and note the following points:

- *tpipe* names are assigned when a local queue is defined
- a local queue is given two *tpipe* names, one for sync and one for non-sync
- *tpipe* names will not be known to IMS until after some communication between IMS and IBM MQ specific to that particular local queue takes place
- For a *tpipe* to be available for use by the IBM MQ - IMS bridge its associated queue must be assigned to a Storage Class that has the correct XCF group and member name fields completed

## Deleting messages from IMS

A message that is destined for IBM MQ through the IMS bridge can be deleted if the Tmember/Tpipe is stopped. To delete one message for the queue manager with XCF member name *tmember*, issue the following IMS command:

```
/DEQUEUE TMEMBER tmember TPIPE tpipe PURGE1
```

To delete all the messages on the Tpipe, issue the following IMS command:

```
/DEQUEUE TMEMBER tmember TPIPE tpipe PURGE
```

## Deleting tpipes

You cannot delete IMS *tpipes* yourself. They are deleted by IMS at the following times:

- Synchronized *tpipes* are deleted when IMS is cold started.
- Non-synchronized *tpipes* are deleted when IMS is restarted.

## IMS Transaction Expiration

An expiration time is associated with a transaction; any IBM MQ message can have an expiration time associated with it. The expiration interval is passed from the application, to IBM MQ, using the MQMD.Expiry field. The time is the duration of a message before it expires, expressed as a value in tenths of a second. An attempt to perform the MQGET of a message, later than it has expired, results in the message being removed from the queue and expiry processing performed. The expiration time decreases as a message flows between queue managers on an IBM MQ network. When an IMS message is passed across the IMS bridge to OTMA, the remaining message expiry time is passed to OTMA as a transaction expiration time.

If a transaction has an expiration time specified, OTMA expires the input transactions in three different places in IMS:

- input message receiving from XCF
- input message enqueueing time
- application GU time

No expiration is performed after the GU time.

The transaction EXPRTIME can be provided by:

- IMS transaction definition
- IMS OTMA message header

- IMS DFSINSX0 user exit
- IMS CREATE or UPDATE TRAN commands

IMS indicates that it has expired a transaction by abending a transaction with 0243, and issuing a message. The message issued is either DFS555I in the non-shared-queues environment, or DFS2224I in the shared-queues environment.

## Operating IBM MQ Advanced Message Security

To enter commands for the IBM MQ Advanced Message Security address space, use the z/OS MODIFY command.

For example,

```
F qmgr AMSM, cmd
```

The following MODIFY commands are accepted:

Table 19. IBM MQ Advanced Message Security address space MODIFY commands		
Command	Option	Description
DISPLAY		Display version information
REFRESH	KEYRING POLICY ALL	Refresh the key ring certificates, security policies, or both.
SMFAUDIT	SUCCESS FAILURE ALL	Set whether SMF auditing is required when AMS successfully protects/unprotects messages, when AMS fails to protect/unprotect messages, or both.
SMFTYPE	0 - 255	Set the SMF record type to be generated when AMS protects/unprotects messages. To disable SMF auditing specify a record type of 0.

**Note:** To specify an option it must be separated by a comma. For example:

```
F qmgrAMSM,REFRESH KEYRING
F qmgrAMSM,SMFAUDIT ALL
F qmgrAMSM,SMFTYPE 180
```

REFRESH command.

An application issuing an MQOPEN call will pick up the changes. Existing applications continue to use the options from when that application opened the queue. To pick up the changes, an application has to close and reopen the queue.



## Notices

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