WebSphere MQ: Monitoring and Troubleshooting Techniques

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Agenda

Topics discussed in this workshop

• General considerations

• WebSphere MQ Monitoring
  – Introduction to WebSphere MQ monitoring
  – Usage of WebSphere MQ monitoring facilities
    • Event monitoring
    • Message monitoring
    • Accounting and statistics messages
    • Application activity trace
    • Real-time monitoring
  – Tooling

• WebSphere MQ Troubleshooting
  – Application Messages
  – First Failure Support Technology (FFST)
  – Logging
  – Common Reason Codes
  – Problem determination
  – IBM Assistance and Documentation

Impact2013

In this workshop we will:

- Concentrate on WebSphere MQ versions V7.1 and V7.5

- Basic monitoring with detailed reference section

Introduction to WebSphere MQ monitoring

WebSphere MQ offers a number of monitoring techniques to obtain statistics and other specific information about how your queue manager network is running. The monitoring information can help you to improve health & performance of your queue manager network by assisting you to:

- detect problems and to determine their causes

- confirm that your queue manager network is running correctly and so improving the efficiency

- generate messages when certain events occur, record message activity & determine the last known location of a message

- check various statistics of a queue manager network in real time

- generate an audit trail

- account for application resource usage

- perform capacity planning

Usage of monitoring facilities

• **Event monitoring** is the process of detecting occurrences of instrumentation events in a queue manager network.

• **Message monitoring** is the process of identifying the route a message has taken through a queue manager network. By identifying the types of activities, and the sequence of activities performed on behalf of a message, the message route can be determined.

• **Accounting and statistics messages** are generated by queue managers to record information about the MQI operations performed by WebSphere MQ applications, or to record information about the activities occurring in a WebSphere MQ system.

• **Application activity trace** produces detailed information about the behavior of applications connected to a queue manager..

• **Real-time monitoring** is a technique that allows you to determine the current state of queues and channels within a queue manager. The information returned is accurate at the moment the command was issued.

Usage of monitoring facilities

Event monitoring - **categories**:

• **Instrumentation events** are a logical combination of conditions that a queue manager or channel instance detects and puts a special message, called an event message, on an event queue.

- Errors
- Warnings

• **Performance events** relate to conditions that can affect the performance of applications that use a specified queue. The scope of performance events is the queue. MQPUT calls and MQGET calls on one queue do not affect the generation of performance events on another queue.

- Queue Depth Events
- Queue Service Interval Events

Usage of monitoring facilities

Event monitoring - **categories**:

• **Configuration events** are notifications that are generated when an object is created, changed, or deleted, and can also be generated by explicit requests.

• **Command events** are notifications that an MQSC, or PCF command has run successfully.

• **Logger events** are notifications that a queue manager has started writing to a new log extent.

Message monitoring - **categories**:

• **Activities and operations**: Activities are discrete actions that an application performs on behalf of a message. Activities consist of operations, which are single pieces of work that an application performs.

• **Message route techniques**: Activity recording and trace-route messaging are techniques that allow you to record activity information for a message as it is routed through a queue manager network.

• **Activity recording** is a technique for determining the routes that messages take through a queue manager network. To determine the route that a message has taken, the activities performed on behalf of the message are recorded.

• **Trace-route messaging** is a technique that uses trace-route messages to record activity information for a message. Trace-route messaging involves sending a trace-route message into a queue manager network.

• **WebSphere MQ display route application**: Use the WebSphere MQ display route application (dspmqrte) to work with trace-route messages and activity information related to a trace-route message, using a command-line interface.

Usage of monitoring facilities

Accounting and statistics messages - **categories**:

• **Accounting messages** record information about the MQI operations performed by WebSphere MQ applications. An accounting message is a PCF message that contains a number of PCF structures.

• **Statistics messages** record information about the activities occurring in a WebSphere MQ system. An statistics messages is a PCF message that contains a number of PCF structures.

• **Displaying accounting and statistics information**: to use the information recorded in accounting and statistics messages, run an application such as the amqsmon sample program to transform the recorded information into a suitable format

Application activity trace - categories:

• **MQI application activity trace information**: Use the queue manager attribute ACTVTRC to control the collection of MQI application activity trace information

• **MQCONNX options**: Use the ConnectOpts parameter on the MQCONNX call to enable or disable application activity reports on a per connection basis. If neither of these options is used then the activity trace behavior is defined by the Queue manager attribute ACTVTRC

• **Activity Trace configuration file**: The Activity Trace behavior is configured using a configuration file which follows the same stanza key and parameter-value pair format as the mqs.ini and qm.ini files. The activity trace configuration file is called mqat.ini

Usage of monitoring facilities

Real-time monitoring - categories:

• **Attributes that control real-time monitoring**: some queue and channel status attributes hold monitoring information, if real-time monitoring is enabled. If real-time monitoring is not enabled, no monitoring information is held in these monitoring attributes.

• **Displaying queue and channel monitoring data**: to display real-time monitoring information for a queue or channel, use either the WebSphere MQ Explorer or the appropriate MQSC command. Some monitoring fields display a comma-separated pair of indicator values, which help you to monitor the operation of your queue manager.

• **Monitoring queues & channels**: various monitoring options are available to determine the problem with a queue and the application that services that queue or with a transmission queue and the channel that services that queue

Monitoring: Tooling – SupportPacs / References

- **SupportPacs:**

  - Navigate to: http://www.ibm.com/support/docview.wss?uid=swg27007197

  - MH05: WebSphere MQ - Events Display Tool
  - MH04: WebSphere MQ - Queue Statistics Tool

- **References:**

  - Infocenter for WebSphere MQ V7.1
    http://publib.boulder.ibm.com/infocenter/wmqv7/v7r1/topic/com.ibm.mq.doc/zn00000_.htm

  - Infocenter for WebSphere MQ V7.5
    http://pic.dhe.ibm.com/infocenter/wmqv7/v7r5/topic/com.ibm.mq.doc/zn00000_.htm

- **Other IBM Tools:**

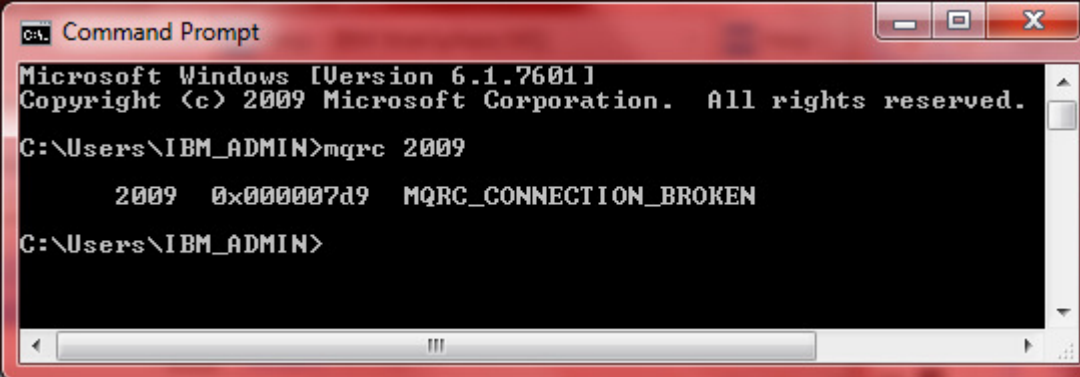 - IBM Tivoli Omegamon XE for Messaging

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  - Usage of WebSphere MQ monitoring facilities
    - ➢ Event monitoring
    - ➢ Message monitoring
    - ➢ Accounting and statistics messages
    - ➢ Application activity trace
    - ➢ Real-time monitoring
  - Tooling

- WebSphere MQ Troubleshooting
  - Application Messages
  - First Failure Support Technology (FFST)
  - Logging
  - Common Reason Codes
  - Problem determination
  - IBM Assistance and Documentation

Troubleshooting: Application Messages

- Application return codes
  - Reason Codes
    - ➢ Upon encountering an error, WebSphere MQ returns reason codes associated with the error encountered
    - ➢ Location of reason code errors
      - ▪ Command Line
      - ▪ SystemOut.Log (Java/JMS)
      - ▪ Application specific log files
    - ➢ Reason codes are 4 digits

  - Completion Codes
    - ➢ MQCC_OK – 0: Successful completion
    - ➢ MQCC_WARNING – 1:Warning(partial completion)
    - ➢ MQCC_FAILED - 2: Call failed

Application Reason Codes (continued)

- Determining the meaning of reason codes
  - MQRC utility
    - ➤ From command line, enter: mqrc XXXX
      - Where XXXX is the 4-digit reason code

```
Command Prompt

Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

C:\Users\IBM_ADMIN>mqrc 2009

    2009  0x000007d9   MQRC_CONNECTION_BROKEN

C:\Users\IBM_ADMIN>
```
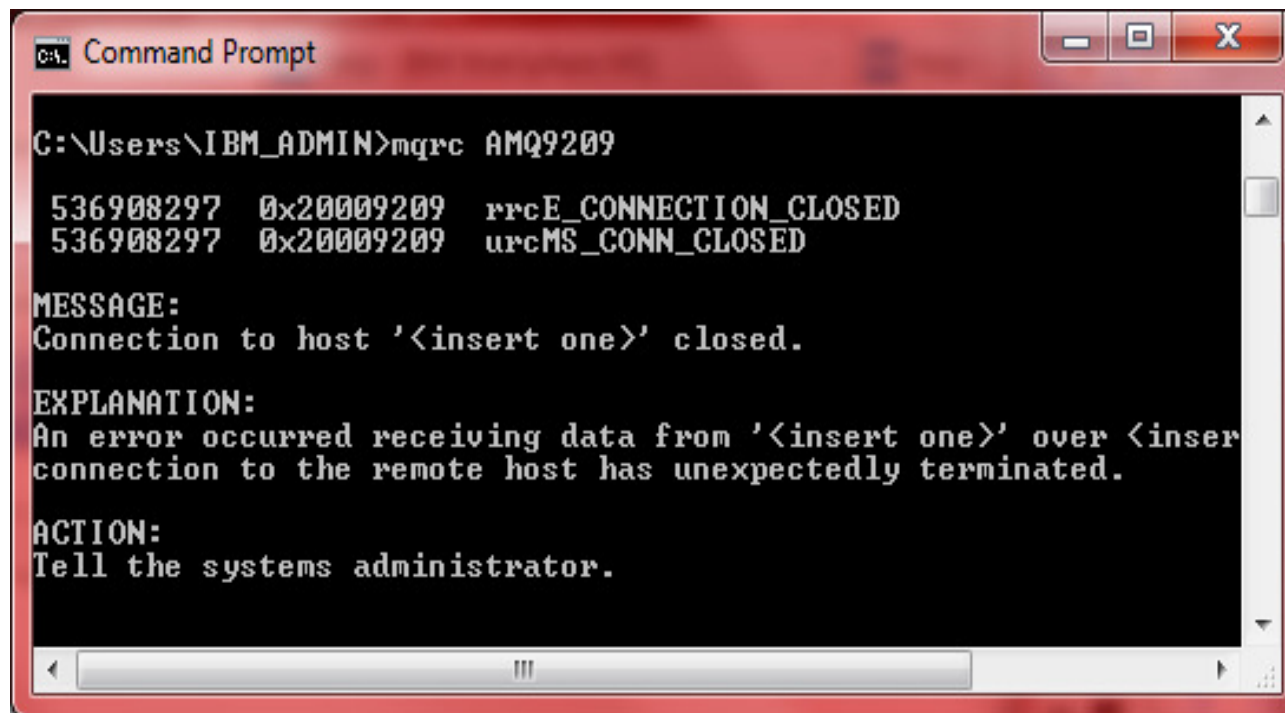
  - WebSphere MQ Information Center

    http://publib.boulder.ibm.com/infocenter/wmqv7/v7r0/topic/com.ibm.mq.amqza
    o.doc/fm12040_.htm

- Error logs
  - WebSphere MQ main error logs
    - ➢ <mqdir>\errors
    - ➢ Contains non-specific queue manager errors
      - ▪ Network

  - Queue manager error logs
    - ➢ <mqdir>\qmgrs\<qmgrname>\errors
    - ➢ Specific to queue manager
      - ▪ Startup/Shutdown

  - Diagnostic messages format is AMQXXXX
    - ➢ Where XXXX is the number associated with the error
      - ex. AMQ9209

  - Logs
    - ➢ AMQERR01.LOG
    - ➢ AMQERR02.LOG
    - ➢ AMQERR03.LOG

http://pic.dhe.ibm.com/infocenter/wmqv7/v7r5/topic/com.ibm.mq.doc/fm10190_.htm

Troubleshooting: Diagnostic Messages

- Determining the meaning of diagnostic messages
  - MQRC utility
    - From command line, enter: mqrc AMQXXXX
      - Where XXXX is the 4-digit reason code

```
Command Prompt

C:\Users\IBM_ADMIN>mqrc AMQ9209

 536908297  0x20009209  rrcE_CONNECTION_CLOSED
 536908297  0x20009209  urcMS_CONN_CLOSED

MESSAGE:
Connection to host '<insert one>' closed.

EXPLANATION:
An error occurred receiving data from '<insert one>' over <inser
connection to the remote host has unexpectedly terminated.

ACTION:
Tell the systems administrator.
```

Troubleshooting: First Failure Support Technology (FFST)

- Commonly known as FDC's

- FFST file names are AMQnnnnn.mm.FDC
  - Where nnnnn is the process ID
    - mm is the number starting with 0 unique to the process ID

- Located in the following directories:
  - /var/mqm/errors
  - C:\Program Files\IBM\WebSphere MQ\errors
  - /qibm/userdata/mqm/errors

- Produced only when serious issues occur

- Provides detailed information on the process at the time of failure

- Key Information:
  - Probe ID
  - Component
  - Major Error Code
  - Minor Error Code

Troubleshooting: Problem Determination

- Search for known issues using WebSphere MQ Support Portal

http://www.ibm.com/support/entry/portal/troubleshooting/software/websphere/websphere_mq

- Search methods
  - Reason Code
  - Diagnostic Messages
  - FFST key information
  - Problem Description

Troubleshooting: Problem Determination

- 2033 MQRC_NO_MESSAGE_AVAILABLE
    - No messages on the queue
        - ➢ Queue depth is 0

    - Message being retrieved is not located on the queue
        - ➢ Queue depth > 0
        - ➢ Verify messages are not on transmission queue

    - Message has expired
        - ➢ Queue depth > 0
        - ➢ Expired messages remain on queue until the MQGET is performed

    - MQPUT has not committed messages
        - ➢ Queue depth > 0
        - ➢ Unable to display messages in queue
        - ➢ Become available when putting application commits UOW

http://www-01.ibm.com/support/docview.wss?rs=171&uid=swg21232330

- Ensure the message which is being retrieved is available on the specified queue
  - If messages are not on the queue:
    - ➢ Check any transmission queues for message backups
    - ➢ If message is a reply message, determine if the remote application received an error
  - If message are on the queue:
    - ➢ Are there any uncommitted messages:
      - ▪ DISPLAY QSTATUS(Q1) TYPE(QUEUE) ALL
      - ▪ Check for UNCOM(YES) on the displayed queues
    - ➢ Messages may have arrived after the MQGET was performed
      - ▪ AMQSBCG QNAME QMANAGERNAME > textfile.txt
      - ▪ Search the text file for the specific parameters such as CorrelID
      - ▪ Verify the PutDate and PutTime parameters
    - ➢ Verify the Expiry Time
      - ▪ AMQSBCG QNAME QMANAGERNAME > textfile.txt
      - ▪ Search the text file for the specific parameters such as CorrelID
      - ▪ Verify the Expiry attribute
        - o -1 means Unlimited (never expires)
        - o >1 is the time remaining in milliseconds
        - o 0 means the message is expired

Troubleshooting: Common Reason Codes - MQRC 2035

- 2035 0x000007f3 MQRC_NOT_AUTHORIZED

- The user attempting to access a WebSphere MQ object does not have the appropriate authority
  - The user has not been granted authority using the setmqaut command
  - The authority granted is not valid for the activity being performed
  http://www.ibm.com/support/docview.wss?rs=171&uid=swg21166937

- Environment Variable Settings
  - Create more information on the authentication issue
    ➤ MQSAUTHERRORS – produces an FDC
    http://www.ibm.com/support/docview.wss?rs=171&uid=swg21377578
    ➤ MQS_REPORT_NOAUTH – generates an AMQ8077 error message in queue manager error logs
    http://www.ibm.com/support/docview.wss?uid=swg21299319

- Use dspmqaut (Distributed) or DSPMQMAUT (IBM i) command to diagnose
  - dspmqaut [-m QMgrName] [-n ObjName] -t ObjType (-p Principal | -g Group) [-s ServiceComponent]
  - DSPMQMAUT OBJ(SVR.LQ) OBJTYPE(*LCLQ) MQMNAME(MQAS04)

- Check Queue Manager error logs for AMQ8077 error
  - AMQ8077: Entity '<insert one>' has insufficient authority to access object '<insert two>'.
    EXPLANATION:
    The specified entity is not authorized to access the required object. The following requested permissions are unauthorized: <insert three>
    ACTION:
    Ensure that the correct level of authority has been set for this entity against the required object, or ensure that the entity is a member of a privileged group.

- Check the <mqdir>/errors directory for an FDC created
  - User exists on server
    Probe Id   :- ZF039010
    Component   :- zfu_as_checkobjectauthority
    Major Errorcode   :- **MQRC_NOT_AUTHORIZED**
    Probe Description :- AMQ6125: An internal WebSphere MQ error has occurred.

  - User does not exist on server
    - Probe Id   :- ZF039010
    - Component   :- zfu_as_checkobjectauthority
    - Major Errorcode   :- **MQRC_UNKNOWN_ENTITY**
    - Probe Description :- AMQ6125: An internal WebSphere MQ error has occurred.

- Use the setmqaut (Distributed) or GRTMQMAUT (IBM i) to set the appropriate authority

- 2080 0x00000820 MQRC_TRUNCATED_MSG_FAILED

  – The message attempted to be retrieved from queue using MQGET did
    not have a buffer length set within the application large enough to
    consume the message

  – Two options are available:
    ➢ Let the application fail and return the reason code 2080
    ➢ Handle the error message within the application

http://www.ibm.com/support/docview.wss?rs=171&uid=swg21167205

- Handle application reason code 2080 manually
  - ➤ Application will fail when the reason code 2080 occurs
    - Best option when:
      - o Messages are expected to be a specified length as noted in the application buffer length
      - o Alter the buffer length to handle the largest message

- Handle the error message within the application
  - ➤ Best option when:
    - Messages are varying in length
    - Handle the error by resetting the buffer length programmatically once the error has occurred
    - Reset the MQMD FORMAT, ENCODING, and CCSID to the original value

- Alter application to retrieve truncated messages
  - ➤ MQGET message option: MQGMO_ACCEPT_TRUNCATED_MSG
  - ➤ Best option when:
    - The data of the message is not necessary

- 2009 MQRC_CONNECTION_BROKEN
  - Queue manager ended while connected
  - MQGET with WAIT ends
  - Firewall terminating connection
  - Excessive amounts of JMS connections
  - Client Channels disconnect after the ClientIdle setting + 60 seconds

References:
  http://www.ibm.com/support/docview.wss?uid=swg21472342
  http://www.ibm.com/support/docview.wss?uid=swg21106218
  http://www.ibm.com/support/docview.wss?uid=swg21226703

- Review the MQ error logs for messages with AMQ92XX
  - Frequently seen error message
    - AMQ9206: Error sending data to host *<insert_3>*.
    - AMQ9208: Error on receive from host <host>.
    - AMQ9209: Connection to host <host> for channel <channel> closed.
    - AMQ9213: A communications error for *<insert_4>* occurred.

  - TCP/IP return code or detailed information provided in error message
    - http://msdn.microsoft.com/en-us/library/aa924071.aspx

  - Configure the Automatic Client Reconnect feature within the application

- Symptoms:
  - Messages back up on transmit queue
  - Reply messages response received beyond the expected timeframe

- Investigative Techniques
  - Messages on transmission queue
    - ➢ Ping the remote server for packet response times
    - ➢ Verify the status of sender/receiver channel
    - ➢ Review the error logs
    - ➢ Determine if any FFST (FDC) files are created
  - Messages on queue
    - ➢ Determine if the application retrieving messages is started
    - ➢ Determine if the application accesses external products (Database, Third-Party Products, etc)

- Documentation Required
  - WebSphere MQ trace

  http://www-01.ibm.com/support/docview.wss?uid=swg21174924

  - Network Trace (Consult with network team)

  - Application Trace (JMS, JAVA)
    - Java: http://www.ibm.com/support/docview.wss?uid=swg21174924#Javat
    - JMS: http://www.ibm.com/support/docview.wss?uid=swg21174924#JMStV7

- Request the network team to review network traces

- Use Editor to search AMQRMPPA.FMT WebSphere MQ trace files
  - WebSphere MQ API
    - ➢ MQPUT
    - ➢ MQGET
    - ➢ MQOPEN
    - ➢ MQCLOSE
  - Lines of Interest
    - ➢ 16:04:01.160764   10215.5   :   MQPUT >> (Start of message Put)
    - ➢ 16:04:01.162945   10215.5   :   MQPUT << (End of message Put)
    - Where '16:04:02.248593' is the timestamp
      - '10215.5' is the Process ID.Thread ID
      - 'MQPUT' or 'MQGET' is the MQ API
      - '>>' is the start of the API
      - '<<' is the completion of the API

- Ensure that the same thread is being followed when matching the start and end MQ API's

- Determine the time difference between the start and end times
  - End time of API – Start time of API
  - 16:04:01.162945 - 16:04:01.160764 = .002181
  - Small differences (less than 1 second)
    - ➢ MQ API's are functioning as expected
    - ➢ Typically signifies a latency outside of WebSphere MQ
  - Large differences (greater than 2 seconds)
    - ➢ MQ API's may be experiencing an issue
    - ➢ Send collected documentation to IBM for review

- Open a Problem Management Report (PMR) using the Service Request (SR) tool

    https://www.ibm.com/support/servicerequest/Home.action

- An IBM ID and Password is required

- SR tool documentation:
    http://www.ibm.com/software/websphere/support/d2w.html#srtool

- Automatic Documentation Collection
  - RUNMQRAS
    - ➢ Built-in WebSphere MQ utility on AIX, HP-UX, Linux, Solaris, and Unix
    - ➢ Availability
      - ▪ WebSphere MQ 7.0.1.8 or later
      - ▪ WebSphere MQ 7.1.0.1 or later
      - ▪ WebSphere MQ 7.5 or later
    - ➢ FTP capability directly to PMR
    - ➢ Network trace not available
    - ➢ Command Examples
      - ▪ All MQ documentation, no ftp to PMR, zip file in current directory
        - o runmqras
      - ▪ All MQ documentation, ftp to PMR 01234,567,890
        - o runmqras -ftp IBM -pmrno 01234,567,890
      - ▪ Specific Queue Manager, Additional Documentation (trace), no ftp to PMR
        - o Runmqras –section trace

    http://www.ibm.com/support/docview.wss?uid=swg21596499

    http://publib.boulder.ibm.com/infocenter/wmqv7/v7r1/topic/com.ibm.mq.doc/fa15580_.htm

  - IBM Support Assistant (ISA)
    - ➢ IBM Support Utility
    - ➢ http://www.ibm.com/support/docview.wss?uid=swg27012820

- Manual Documentation Collection
  - Place the following files into a zip file
    - ➢ Main Error logs and FDC files in <mqdir>/errors
    - ➢ Queue manager error logs in <mqdir>/QMGRS/qmgrname/errors
      - ▪ Where qmgrname is the name of your queue manager
    - ➢ WebSphere MQ version: dspmqver > dspmqver.out
    - ➢ Trace files located in the <mqdir>\trace
    - ➢ Network Traces (if applicable)
    - ➢ Application Traces (if applicable)

  - Manual Submit to IBM PMR
    - ➢ Service Request Tool
    - ➢ FTP
        http://www.ibm.com/support/docview.wss?uid=swg21392217#ecurep
    - ➢ Email
      - ▪ Websphere_support@ecurep.ibm.com
      - ▪ Include PMR number in Subject
    - ➢ Secure Upload using HTTPS
        http://www.ibm.com/support/docview.wss?uid=swg21392217#httpsForm

IBM WebSphere MQ Mustgather
http://www.ibm.com/support/docview.wss?uid=swg21229861

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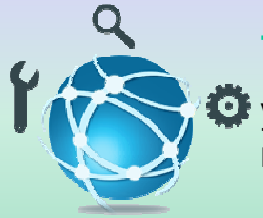
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> *- Keith Brooks--2013 Websphere and IBM Collaboration Solutions Champion* "

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Deeper Dive: Event Monitoring

- **Instrumentation events:**
  - On events, the queue manager puts an event message on the appropriate event queue
  - Event queues can be either local queues, alias queues, or as local definitions of remote queues.
  - Using local definitions of remote queue allows you to centralize your monitoring activities.
  - Transmission queues are not allowed for event messages due to the incompatible message format that is required for   transmission queues.
  - Retrieve event messages by writing a suitable MQI application program that performs the following steps:
    - ➢ Get the message from the queue.
    - ➢ Process the message to extract the event data.
    - ➢ Sample Application

    http://publib.boulder.ibm.com/infocenter/wmqv7/v7r1/topic/com.ibm.mq.doc/mo12390_.htm

- **Caveats:**
  - If an event occurs when the event queue is not available, the event message is lost. Reasons for an event queue not being available might be: The queue has not been defined, has been deleted, is full or has been put-inhibited.

Deeper Dive: Event Monitoring

Instrumentation events:

Event queue	Event types	ALTER QMGR parameter	
SYSTEM.ADMIN.QMGR.EVENT	Queue manager events	Authority (ENABLED)	AUTHOREV
		Inhibit	INHIBTEV (ENABLED)
		Local	LOCALEV (ENABLED)
		Remote (ENABLED)	REMOTEEV
		Start and Stop	STRSTPEV (ENABLED)
SYSTEM.ADMIN.CHANNEL.EVENT	Channel events	Channel	CHLEV (ENABLED)
		channel errors only	CHLEV (EXCEPTION)
		IMS Bridge	BRIDGEEV (ENABLED)
		SSL	SSLEV (ENABLED)
		Channel auto-def.	CHADEV(ENABLED)
SYSTEM.ADMIN.PERFM.EVENT	Performance events	PERFMEV (ENABLED)	
SYSTEM.ADMIN.CONFIG.EVENT	Configuration events	CONFIGEV (ENABLED)	
SYSTEM.ADMIN.COMMAND.EVENT	Command events	CMDEV (ENABLED)	
SYSTEM.ADMIN.LOGGER.EVENT	Logger events	LOGGEREV(ENABLED)	
SYSTEM.ADMIN.PUBSUB.EVENT	Events related to Publish/Subscribe	-	

- **Queue Manager Events**

    – Every queue manager event message that is generated is placed on the queue SYSTEM.ADMIN.QMGR.EVENT.

    – Events are generated for the following errors encountered:
        - ➢ Authority Issues
        - ➢ MQPUT or MQGET Inhibit
        - ➢ Local queue (ex. unknown queue, alias queue error, unknown alias queue)
        - ➢ Remote Queue or Queue Manager problems
        - ➢ Queue manager start or stop events

- Events are configured only on Queue Manager Properties

- **Channel Events**

  – Every channel event message that is generated is placed on the queue, SYSTEM.ADMIN.CHANNEL.EVENT.

  – Channels started or stopped using a command generates two events

  – Channel events are not produced:
    ➢ Client connections
    ➢ Starting the channel using a listener
    ➢ Using the runmqchl command
    ➢ Queue manager trigger message

  – Events are generated for SSL errors or warnings

  – Events are configured on the queue manager properties

Deeper Dive: Event Monitoring

- **Performance Events**

    – Every performance event message that is generated is placed on the queue,
      SYSTEM.ADMIN.PERFM.EVENT.

    – MQPUT calls and MQGET calls are generated within a unit of work regardless of whether it
      is committed or backed out.

    – MQPUT and MQGET calls on one queue do not affect the generation of performance events
      on another queue

    – System management programs can use the event data in the event message containing the
      names of the queue manager, the queue associated with the event and statistics related to
      the event.

    – Performance event statistics are reset when any of the following changes occur:
        ➢ A performance event occurs (statistics are reset on all active queue managers).
        ➢ A queue manager stops and restarts.
        ➢ The PCF command, Reset Queue Statistics, is issued from an application program.

    – Types of performance event data gathered:
        - **Queue service interval events** indicate whether an operation was performed on a queue within a
          user-defined time interval called the service interval.
        - **Queue depth events** are related to the queue depth, that is, the number of messages on the queue.

Deeper Dive: Event Monitoring

Performance events:

Event type	Queue service interval event	Queue attributes
Queue service interval events	Queue Service Interval High Queue Service Interval OK No queue service interval events	QSVCIEV (HIGH) QSVCIEV (OK) QSVCIEV (NONE)
Queue service interval events	Service interval	QSVCINT (tt) where tt is the service interval time in milliseconds.
Queue depth events	QDepthHighEvent	QDPHIEV(ENABLED)
Queue depth events	QDepthLowEvent	QDPLOEV(ENABLED)
Queue depth events	QDepthMaxEvent	QDPMAXEV(ENABLED)
Queue depth events	QDepthHighLimit	QDEPTHHI(pp) where pp is the percentage of the maximum queue depth
Queue depth events	QDepthLowLimit	QDEPTHLO(pp) where pp is the percentage of the maximum queue depth

- **Configuration Events**

  - Every configuration event message that is generated is placed on the queue SYSTEM.ADMIN.CONFIG.EVENT.

  - Configuration events notify you about changes to the attributes of an object. There are four types of configuration events:
    - ➢ Create object events
    - ➢ Change object events
    - ➢ Delete object events
    - ➢ Refresh object events

  - The event data contains the following information:
    - ➢ **Origin information** comprising the queue manager from where the change was made, the ID of the user that made the change, and how the change came about, for example by a console command.
    - ➢ **Context information**, being a replica of the context information in the message data from the command message and only included when the command was entered as a message on the SYSTEM.COMMAND.INPUT queue.
    - ➢ **Object identity** comprising the name, type and disposition of the object.
    - ➢ **Object attributes** comprising the values of all the attributes in the object.

  - In the case of change object events, two messages are generated, one with the information before the change, the other with the information after.

Deeper Dive: Event Monitoring

Configuration events:

A Configuration event message generated when CONFIGEV(ENABLED) and executing…	A Configuration event message NOT generated…
• DEFINE/ALTER/DELETE AUTHINFO • DEFINE/ALTER/DELETE CFSTRUCT • DEFINE/ALTER/DELETE CHANNEL • DEFINE/ALTER/DELETE NAMELIST • DEFINE/ALTER/DELETE PROCESS • DEFINE/ALTER/DELETE QLOCAL • DEFINE/ALTER/DELETE QMODEL/QALIAS/QREMOTE • DEFINE/ALTER/DELETE STGCLASS • DEFINE/ALTER/DELETE TOPIC • DEFINE MAXSMSGS • SET CHLAUTH • ALTER QMGR • MQSET call, other than for a temporary dynamic queue	• When a command or an MQSET call fails • When a queue manager encounters an error trying to put a configuration event on the event queue, in which case the command or MQSET call completes, but no event message is generated • For a temporary dynamic queue • When internal changes are made to the TRIGGER queue attribute • For the configuration event queue SYSTEM.ADMIN.CONFIG.EVENT, except by the REFRESH QMGR command • For REFRESH/RESET CLUSTER and RESUME/SUSPEND QMGR commands that cause clustering changes • When Creating or deleting a queue manager

- **Command Events**

  – Every command event message that is generated is placed on the command event queue, SYSTEM.ADMIN.COMMAND.EVENT.

  – Command events are notifications that an MQSC, or PCF command has run successfully and can be used to generate an audit trail of the commands that have run. The event data contains the following information:

    ➢ **Origin information** comprising the queue manager from where the change was made, the ID of the user that made the change, and how the change came about, for example by a console command.
    ➢ **Context information**, being a replica of the context information in the message data from the command message and only included when the command was entered as a message on the SYSTEM.COMMAND.INPUT queue.
    ➢ **Command information** containing the type of command that was issued.
    ➢ **Command data**
      o for PCF commands, a replica of the command data
      o for MQSC commands, the command text

  – **Note:** The command data format does not necessarily match the format of the original command. For example, on distributed platforms the command data format is always in PCF format, even if the original request was an MQSC command.

Deeper Dive: Event Monitoring

Command events:

A Command event message generate….	A Command event message NOT generated…
• When the CMDEV queue manager attribute is specified as ENABLED and an MQSC or PCF command runs successfully. • When the CMDEV queue manager attribute is specified as NODISPLAY and any command runs successfully, with the exception of DISPLAY commands (MQSC), and Inquire commands (PCF). • When you run the MQSC command, ALTER QMGR, or the PCF command, Change Queue Manager, and the CMDEV queue manager attribute meets either of the following conditions: • CMDEV is not specified as DISABLED after the change • CMDEV was not specified as DISABLED before the change • If a command runs against the command event queue, SYSTEM.ADMIN.COMMAND.EVENT, a command event is generated if the queue still exists and it is not put-inhibited.	• When a command fails • When a queue manager encounters an error trying to put a command event on the event queue, in which case the command runs regardless, but no event message is generated • For the MQSC command REFRESH QMGR TYPE (EARLY) • For the MQSC command START QMGR MQSC • For the MQSC command SUSPEND QMGR, if the parameter LOG is specified • For the MQSC command RESUME QMGR, if the parameter LOG is specified

- **Logger Events**

  – Every logger event message that is generated is placed on the logger event queue, SYSTEM.ADMIN.LOGGER.EVENT.

  – Logger events are notifications that a queue manager has started writing to a new log extent.

  – The event data contains the following information:
    - ➢ The name of the current log extent.
    - ➢ The name of the earliest log extent needed for restart recovery.
    - ➢ The name of the earliest log extent needed for media recovery.
    - ➢ The directory in which the log extents are located.

  – Sample Program to monitor log events
    - ➢ Located in <mqdir>\tools\c\samples\amqslog0.c

Note:
You can use the RESET QMGR MQSC command to request a queue manager to start writing to a new log extent

Deeper Dive: Event Monitoring

Logger events:

A Logger event message generate….	A Logger event message NOT generated…
• When the LOGGEREV queue manager attribute is specified as ENABLED and the queue manager starts writing to a new log extent or, on IBM®i, a journal receiver. • When the LOGGEREV queue manager attribute is specified as ENABLED and the queue manager starts. • When the LOGGEREV queue manager attribute is changed from DISABLED to ENABLED.	• When a queue manager is configured to use circular logging - in this case, the LOGGEREV queue manager attribute is set as DISABLED and cannot be altered. • When a queue manager encounters an error trying to put a logger event on the event queue, in which case the action that caused the event completes, but no event message is generated.

Deeper Dive: Message Monitoring

- **Activities and operations**: Activities are discrete actions that an application performs on behalf of a message. Activities consist of operations, which are single pieces of work that an application performs.

- **Message route techniques**: Activity recording and trace-route messaging are techniques that allow you to record activity information for a message as it is routed through a queue manager network.

- **Activity recording** is a technique for determining the routes that messages take through a queue manager network. To determine the route that a message has taken, the activities performed on behalf of the message are recorded.

- **Trace-route messaging** is a technique that uses trace-route messages to record activity information for a message. Trace-route messaging involves sending a trace-route message into a queue manager network.

- **WebSphere MQ display route application**: Use the WebSphere MQ display route application (dspmqrte) to work with trace-route messages and activity information related to a trace-route message, using a command-line interface.

- **Activity Recording**

  – Messages and / or queue managers explicitly need the specific report option specified for the requesting applications to generate activity reports on behalf of the message as it is routed through a queue manager network.

  – An activity report contains information about the activity that was performed on the message and needs to be arranged in order for a message route can be determined:

    ➢ **Determine the last known location of a message**: activity reports generated for the message as it was routed through a queue manager network can be studied to determine the last known location of the message.

    ➢ **Determine configuration issues with a queue manager network**: by studying the activity reports related to a number of messages enabled for activity recording it can become apparent that they have not taken the expected route. Reason for this might be a stopped channel, forcing the message to take an alternative route

Note: You can use activity recording in conjunction with trace-route messages by using the WebSphere MQ display route application.

Warning: Avoid enabling all messages in a queue manager network for activity recording. Messages enabled for activity recording can have many activity reports generated on their behalf. If every message in a queue manager network is enabled for activity recording, the queue manager network traffic can increase to an unacceptable level.

Deeper Dive: Message Monitoring

Activity recording:

Request activity reports for a message	Enable or disable the queue manager for activity recording	Ensure that your application uses the same algorithm as MCAs
In the message descriptor of the message, specify MQRO_ACTIVITY in the Report field. In the message descriptor of the message, specify the name of a reply-to queue in the ReplyToQ field.	**ALTER QMGR ACTIVREC(param)** where **param** can be: **MSG** - The queue manager is enabled for activity recording. Any activity reports generated are delivered to the reply-to queue specified in the message descriptor of the message. This is the default value. **QUEUE** - The queue manager is enabled for activity recording. Any activity reports generated are delivered to the local system queue SYSTEM.ADMIN.ACTIVITY.QUEUE. The system queue can also be used to forward activity reports to a common queue. **DISABLED** - The queue manager is disabled for activity recording. No activity reports are generated while in the scope of this queue manager.	Verify that the message has requested activity reports to be generated Verify that the queue manager where the message currently resides is enabled for activity recording Put the activity report on the queue determined by the ACTIVREC queue manager attribute

Deeper Dive: Message Monitoring

- **Trace-route messaging**

  – Messages explicitly need the specific report option specified, so requesting applications to generate activity reports on behalf of the message as it is routed through a queue manager network.

  – An activity report contains information about the activity that was performed on the trace-route message whilst being routed through the messaging network and can determine:

    ➤ **the last known location of a message**: A trace-route message is sent into a queue manager network with the same target destination as the original message, intending that it follows the same route. To increase the probability that the trace-route message follows the same route as the original message, you can modify the trace-route message to mimic the original message.

    ➤ **configuration issues with a queue manager network**: by studying the activity reports related to the trace-route message it can become apparent that they have not taken the expected route. Reason for this might be a stopped channel, forcing the message to take an alternative route.

Note: You can use the WebSphere MQ display route application to configure, generate, and put trace-route messages into a queue manager network.

Warning: *If you put a trace-route message to a distribution list, the results are undefined.*

Deeper Dive: Message Monitoring

Trace-route messaging:

Enabling queue managers for trace-route messaging	Enabling applications for trace-route messaging
ALTER QMGR ROUTEREC (param) where **param** can be: **MSG** - The queue manager is enabled for trace-route messaging. Applications within the scope of the queue manager can write activity information to the trace-route message. A trace-route reply message is generated, and delivered to the reply-to queue specified in the message descriptor of the trace-route message. **QUEUE** - The queue manager is enabled for trace-route messaging. Applications within the scope of the queue manager can write activity information to the trace-route message. A trace-route reply message is generated, and delivered to the local system queue SYSTEM.ADMIN.TRACE.ROUTE.QUEUE. **DISABLED** - The queue manager is disabled for trace-route messaging. Activity information is not accumulated in the the trace-route message, however the TraceRoute PCF group can be updated while in the scope of this queue manager.	1. Determine whether the message being processed is a trace-route message. 2. Determine whether activity information is to be recorded. 3. Determine whether the total number of activities performed on the trace-route message exceeds the value of the MaxActivities parameter. 4. If value of Accumulate is set as MQROUTE_ACCUMULATE_IN_MSG or MQROUTE_ACCUMULATE_AND_REPLY, and the queue manager is enabled for trace-route messaging, write an Activity PCF group to the end of the PCF block in the message data of a trace-route message. 5. Deliver the trace-route message to a local queue. 6. Generate a trace-route reply message 7. If the trace-route message requested an activity report and the queue manager is enabled for activity recording, generate an activity report. The activity report is put on the queue determined by the ACTIVREC queue manager attribute.

- **WebSphere MQ Display Route application**

    – Use the WebSphere MQ display route application (dspmqrte) on all WebSphere MQ Version 7.0 queue managers, to work with trace-route messages and activity information related to a trace-route message, using a command-line interface.

    – By putting a trace-route message into a queue manager network, activity information can be collected and used to determine the route that the trace-route message took. You can specify the characteristics of the trace-route messages as follows:
        ➢ The destination of the trace-route message.
        ➢ How the trace-route message mimics another message.
        ➢ How the trace-route message should be handled as it is routed through a queue manager network.
        ➢ Whether activity recording or trace-route messaging are used to record activity information.

    – If the WebSphere MQ display route application has put a trace-route message into a queue manager network, after the related activity information has been returned, the information can be ordered and displayed immediately.

    – Alternatively, the WebSphere MQ display route application can be used to order, and display, activity information related to a trace-route message that was previously generated.

WebSphere MQ display route application:

Parameter categories	Parameters
Queue manager connection: to specify the queue manager that the WebSphere MQ display route application connects to	-c (Specifies that the WebSphere® MQ display route application connects as a client application) -m QMgrName (The name of the queue manager to which the WebSphere MQ display route application connects)
Target destination: to specify the target destination of a trace-route message	-q TargetQName (TargetQName specifies the name of the target queue) -ts TargetTopicString (Specifies the topic string) -qm TargetQMgr (Qualifies the target destination) -o (Specifies that the target destination is not bound to a specific destination)
Publication topic: for publish/subscribe applications, specify the topic string of a trace-route message for the WebSphere MQ display route application to publish	-ts TopicName (Specifies a topic string to which the WebSphere® MQ display route application is to publish a trace-route message, and puts this application into topic mode)
Message mimicking: to configure a trace-route message to mimic a message	-l Persistence (Specifies the persistence of the generated trace-route message) -p Priority (Specifies the priority of the trace-route message) -xs Expiry (Specifies the expiry time for the trace-route message, in seconds) -ro ReportOption (Specifies report options for the trace-route message)

- **Accounting Messages**

  – Accounting messages are delivered to the system accounting queue (SYSTEM.ADMIN.ACCOUNTING.QUEUE).

  – An accounting message is a PCF message that contains a number of PCF structures.

  – For long running WebSphere MQ applications, intermediate accounting messages are generated as follows:
    - ➢ When the time since the connection was established exceeds the configured interval.
    - ➢ When the time since the last intermediate accounting message exceeds the configured interval.

  – **MQI accounting messages** contain information relating to the number of MQI calls made using a connection to a queue manager.

  – **Queue accounting messages** contain information relating to the number of MQI calls made using connections to a queue manager, grouped by queue. Each queue accounting message can contain up to 100 records, with every record relating to an activity performed by the application with respect to a specific queue. Accounting messages are recorded only for local queues. If an application makes an MQI call against an alias queue, the accounting data is recorded against the base queue, and, for a remote queue, the accounting data is recorded against the transmission queue.

Accounting messages:

Attribute categories	Queue and queue manager attributes
MQI accounting information	**ALTER QMGR ACCTMQI(param)** where **param** is: **ON -** MQI accounting information is collected for every connection to the queue manager. **OFF -** MQI accounting information is not collected. This is the default value.
Queue accounting information	Please refer to "**Event monitoring** - **Command events**"
MQCONNX options	Use the ConnectOpts parameter on the MQCONNX call to modify the collection of both MQI and queue accounting information at the connection level by overriding the effective values of the queue manager attributes ACCTMQI and ACCTQ To enable accounting overrides for individual connections use the following MQSC command: ALTER QMGR ACCTCONO(ENABLED)

Accounting message generation	1. Accounting messages are generated when an application disconnects from the queue manager:
	  • The application issues an MQDISC call
	  • The queue manager recognises that the application has terminated
	2. Intermediate accounting messages are written for long running WebSphere MQ applications when the interval since the connection was established or since the last intermediate accounting message that was written exceeds the configured interval. Use ALTER QMGR ACCTINT(sec) where sec are seconds.

Deeper Dive: Accounting and Statistics Messaging Impact2013

- ## Statistics Messages

  – Statistics messages are delivered to the system queue (SYSTEM.ADMIN.STATISTICS.QUEUE) at configured intervals and contain a number of PCF structures.

  – Statistics messages are in the following categories:
    - ➢ **MQI statistics messages** contain information relating to the number of MQI calls made during a configured interval. For example, the information can include the number of MQI calls issued by a queue manager.
    - ➢ **Queue statistics messages** contain information relating to the activity of a queue during a configured interval. The information includes the number of messages put on, and retrieved from, the queue, and the total number of bytes processed by a queue and are recorded only for local queues. If an application makes an MQI call against an alias queue, the statistics data is recorded against the base queue, and, for a remote queue, the statistics data is recorded against the transmission queue.
    - ➢ **Channel statistics messages** contain information relating to the activity of a channel during a configured interval. For example the information might be the number of messages transferred by the channel, or the number of bytes transferred by the channel.

Deeper Dive: Accounting and Statistics Messaging

Statistics Messages:

Attribute categories	Queue and queue manager attributes
MQI statistics information	**ALTER QMGR STATMQI (param)** where **param** is: **ON -** MQI statisticsinformation is collected for every connection to the queue manager. **OFF -** MQI statisticsinformation is not collected. This is the default value.
Queue statistics information	For queue based statistics Use ALTER QLOCAL(Q1) STATQ(param) or For queue manager based statistics Use ALTER QMGR STATQ(param)
Channel statistics information	To enable statistics information collection, with a medium level of detail, for the sender channel QM1.TO.QM2, use the following MQSC command: ALTER CHANNEL(QM1.TO.QM2) CHLTYPE(SDR) STATCHL(MEDIUM) To enable statistics information collection, at a medium level of detail, for all channels that specify the channel attribute STATCHL as QMGR, use the following MQSC command: ALTER QMGR STATCHL(MEDIUM) To enable statistics information collection, at a medium level of detail, for all automatically defined cluster-sender channels, use the following MQSC command: ALTER QMGR STATACLS(MEDIUM)
Statistics message generation	1. Statistics messages are generated at configured intervals, and when a queue manager shuts down in a controlled fashion. 2. The configured interval is controlled by the STATINT queue manager attribute, which specifies the interval, in seconds, between the generation of statistics messages. Use ALTER QMGR STATINT (sec) where sec are seconds. 3. To write the currently collected statistics data to the statistics queue before the statistics collection interval is due to expire, use the MQSC command RESET QMGR TYPE(STATISTICS). Issuing this command causes the collected statistics data to be written to the statistics queue and a new statistics data collection interval to begin.

Deeper Dive: Application Activity Trace

- **Activity Trace**

  - Activity records and Intermediate messages are written to the new system queue SYSTEM.ADMIN.TRACE.ACTIVITY.QUEUE.

  - Use MQCONNX options to control collection at the connection level.

  - Messages are normally written when the application disconnects from the queue manager.

  - For long running applications, intermediate messages will be written if the lifetime of the connection exceeds a user-defined timeout (ActivityInterval parameter), or after a user-defined number of operations(ActivityCount parameter), or when the size of the record approaches the largest message allowed on the trace queue.

  - When the timeout has expired or MQI count is reached then the activity data that has been accumulated so far is written as a message and the activity data is reset.

  - The activity trace messages are composed of an MQMD structure, a PCF (MQCFH) header structure followed by a number of PCF parameters.

NOTE: Enabling application activity trace can incur a performance penalty that can be reduced by tuning ActivityCount and ActivityInterval.

Deeper Dive: Application Activity Trace

Activity trace:

Attribute categories	Queue and queue manager attributes
MQI application activity trace	**ALTER QMGR** ACTVTRC **(param)** where **param** is: **ON -** API activity trace collection is switched on. **OFF -** API activity trace collection is switched off

MQCONNX options	Use the ConnectOpts parameter on the MQCONNX call to modify the collection of application activity trace.
	
	The ConnectOpts parameter can have the following values:
	
	MQCNO_ACTIVITY_ TRACE_DISABLED
	    Activity trace is turned off for the connection.
	
	MQCNO_ ACTIVITY_ TRACE_ENABLED
	    Activity trace is turned on for the connection.

Activity Trace configuration file	The Activity Trace behavior is configured using a configuration file which follows the same stanza key and parameter-value pair format as the mqs.ini and qm.ini files. The activity trace configuration file is called mqat.ini. On UNIX and Linux systems, mqat.ini is located in the queue manager data directory (the same location as the qm.ini file). On Windows systems, mqat.ini is located in the queue manager data directory, C:\Program Files\IBM\WebSphere MQ\qmgrs. Users running applications to be traced require permission to read this file.

- **Queues and Channels Monitoring**

    – You can enable or disable real-time monitoring for individual queues (MONQ) or channels (MONCH), or for multiple queues or channels.

    – To control many queues or channels together, enable or disable real-time monitoring at the queue manager level by using the queue manager attributes MONQ and MONCHL.

    – For all queue and channel objects with a monitoring attribute that is specified with the default value, QMGR, real-time monitoring is controlled at the queue manager level.

    – To control automatically defined cluster-sender channels, use the queue manager attribute, MONACLS.

    – For real-time monitoring of channels, you can set the MONCHL attribute to one of the three monitoring levels: low, medium, or high.

Caveats: *Collecting monitoring data might require some instructions that are relatively expensive computationally, such as obtaining system time. To reduce the effect of real-time monitoring, the medium and low monitoring options measure a sample of the data at regular intervals rather than collecting data all the time.*

NOTE: *as of WebSphere MQ Version 7.1, the Windows performance monitor can no longer be used to monitor the performance of local queues on Windows systems.*

Deeper Dive: Real-Time Monitoring

Queues & channels monitoring:

Displaying queue and channel monitoring data

Obtain real-time monitoring information as follows:

•To display real-time monitoring information for a queue, use either the WebSphere MQ Explorer or the MQSC command DISPLAY QSTATUS, specifying the optional parameter MONITOR.

•To display real-time monitoring information for a channel, use either the WebSphere MQ Explorer or the MQSC command DISPLAY CHSTATUS, specifying the optional parameter MONITOR.

```
DISPLAY QSTATUS(Q1) MONITOR              DISPLAY CHSTATUS(QM1.TO.QM2) MONITOR

displayed as follows:                    displayed as follows:
QSTATUS(Q1)                              CHSTATUS(QM1.TO.QM2)
TYPE(QUEUE)                              XMITQ(Q1)
MONQ(MEDIUM)                             CONNAME(127.0.0.1)
QTIME(11892157,24052785)                 CURRENT
MSGAGE(37)                               CHLTYPE(SDR)
LPUTDATE(2005-03-02)                     STATUS(RUNNING)
LPUTTIME(09.52.13)                       SUBSTATE(MQGET)
LGETDATE(2005-03-02)                     MONCHL(MEDIUM)
LGETTIME(09.51.02)                       XQTIME(755394737,755199260)
                                         NETTIME(13372,13372)
                                         EXITTIME(0,0)
                                         XBATCHSZ(50,50)
                                         COMPTIME(0,0)
                                         STOPREQ(NO)
                                         RQMNAME(QM2)
```

•The short term indicator is the first value in the pair and is calculated in a way such that more recent measurements are given a higher weighting and will have a greater effect on this value. This gives an indication of recent trend in measurements taken.

•The long term indicator in the second value in the pair and is calculated in a way such that more recent measurements are not given such a high weighting. This gives an indication of the longer term activity on performance of a resource.