



IBM Software Group

WebSphere MQ V7.1 Multi-Version - Environment Considerations and Management

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WebSphere MQ L2 Support
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WebSphere® Support Technical Exchange



Agenda

- Review of Part I
- Environment Considerations
 - ▶ Managing your environment
- Application Development
 - ▶ Building and running applications and exits
- Migrating Installations
 - ▶ Maintenance, upgrade and rollback strategies
- Multi-Version Implications
 - ▶ Failover and Clustering
 - ▶ Error logs, FFSTs and traces
- Summary

Review of Part I

- WebSphere MQ 7.1 allows multiple installations of the product on AIX, HP-UX, Linux®, Solaris and Windows®
- Each installation has a unique name and path which is stored in `/etc/opt/mqm/mqinst.ini` or the registry
- One pre-existing 7.0.1.6 or later installation is also allowed
- WebSphere MQ 7.1 provides new commands and updates some existing commands to manage installations
- All installations share the same data directory, but each queue manager is associated with only one installation

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MQSeries History

- MQSeries on Windows had no fixed install location
 - ▶ Variables like `LIB` and `PATH` were updated to point to MQ
- MQSeries used a fixed location on UNIX® and Linux
 - ▶ HP-UX, Linux and Solaris: `/opt/mqm`
 - ▶ AIX: `/usr/mqm`
- MQSeries provided symbolic links for convenience
 - ▶ **Commands:** `/usr/bin/strmqm -> /opt/mqm/bin/strmqm`
 - ▶ **32-bit libraries:** `/usr/lib/libmqm.so -> /opt/mqm/lib/libmqm.so`
 - ▶ **Header files:** `/usr/include/cmqc.h -> /opt/mqm/inc/cmqc.h`
- Many things “just worked” due to these symbolic links

```
gcc amqspu0.c -o amqspu -lmqm
```

WebSphere MQ History

- WebSphere MQ 6.0 added 64-bit application support in 2005
- 64-bit applications had to be built with explicit paths, but the Information Center recommended doing so for all programs

```
▶ gcc -m32 amqsput0.c -o amqsput32 -I /opt/mqm/inc -L /opt/mqm/lib  
-Wl,-rpath=/opt/mqm/lib -Wl,-rpath=/usr/lib -lmqm
```

```
▶ gcc -m64 amqsput0.c -o amqsput64 -I /opt/mqm/inc -L /opt/mqm/lib64  
-Wl,-rpath=/opt/mqm/lib64 -Wl,-rpath=/usr/lib -lmqm
```

- The 32-bit MQ links in `/usr/lib` sometimes caused problems

```
exec(): 0509-036 Cannot load program mqapp because of the following errors:  
0509-150 Dependent module /usr/lib/libmqmcs.a(shr.o) could not be loaded.  
0509-103 The module has an invalid magic number.
```

- The `dltmqlnk` and `crtmqlnk` commands made it possible to resolve such problems by removing or recreating these links

WebSphere MQ 7.1 Changes

- WebSphere MQ 7.1 does not install any links under `/usr`
- If you make an installation primary, some links are restored
 - ▶ Commands in `/usr/bin` and 32-bit libraries in `/usr/lib`
 - ▶ Header files links in `/usr/include` are not restored
 - ▶ The `instinfo.tsk` file enumerates the tasks which `setmqinst` runs to make an installation primary
- Some things that “just worked” now require an explicit choice
 - ▶ Use explicit paths when including headers/copybooks and when linking an application with MQ libraries
 - ▶ Ensure your `PATH` includes MQ to run its commands
- ✓ Try to avoid relying on any WebSphere MQ links under `/usr`

The setmqenv command

- WebSphere MQ 7.1 ships the `setmqenv` command to help you set your environment to work with an installation
- On UNIX and Linux, source `setmqenv` with the “dot” syntax
 - ▶ This ensures that changes affect your current shell
 - ▶ Use the path to `setmqenv` when sourcing it

```
. /usr/IBM/WMQ-PreProd01/usr/mqm/bin/setmqenv -n Development
```

- On Windows you can run `setmqenv` like any other command
 - ▶ In most cases you will need to use quotation marks

```
"C:\Program Files (x86)\IBM\WebSphere MQ_1\bin\setmqenv" -n QA
```


Using setmqenv

- ▶ `dspmqr`
Name: WebSphere MQ
Version: 7.1.0.0
InstName: Bronx
InstDesc: Created 24 February by justinf
InstPath: /usr/IBM/WMQ-7.1.0-B/usr/mqm
- ▶ `endmqm -i Pelham`
WebSphere MQ queue manager 'Pelham' ended.
- ▶ `strmqm Canarsie`
AMQ5691: Queue manager 'Canarsie' is associated with a different installation ('Brooklyn').
- ▶ `./usr/IBM/WMQ-7.1.0-M/usr/mqm/bin/setmqenv -n Brooklyn`
- ▶ `dspmqr`
Name: WebSphere MQ
Version: 7.1.0.0
InstName: Brooklyn
InstDesc: Created 22 February by justinf
InstPath: /usr/IBM/WMQ-7.1.0-K/usr/mqm
- ▶ `strmqm Canarsie`
WebSphere MQ queue manager 'Canarsie' started.

Alternatives to `setmqenv`

- You can build `setmqenv` alternatives based on `crtmqenv`
- One such alternative called `wmq71profile` is available
 - ▶ The WebSphere MQ support site has the TechNote with documentation and download instructions
- Major features of `wmq71profile`
 - ▶ Designed to be sourced by users' login profiles
 - ▶ Defines a `setmqenv` function which users can run, but does not otherwise alter the environment
 - ▶ Runs the user's personal `.wmqprofile`, if they have one
 - ▶ Can automatically switch WebSphere MQ commands to the appropriate installation (no more AMQ5691 errors)
 - ▶ Generates debug output if you set `IBM_WMQ_DEBUG=1`

The wmq71profile script

- Source the `wmq71profile` from your login profile, e.g.
 - ▶ `. /etc/opt/mqm/wmq71profile`
- Run `setmqenv` at any time to modify your environment
- No sourcing (no “dot”) and no path to `setmqenv` is required
- The syntax is the same as the WebSphere MQ command
 - ▶ `setmqenv -n Installation1`
 - ▶ `setmqenv -r`
- With an additional `-z` flag to enable command switching
 - ▶ `setmqenv -z -n Staging`

Using wmq71profile

- ▶ `setmqenv -zn Manhattan`
- ▶ `dspmqr`
Name: WebSphere MQ
Version: 7.1.0.0
InstName: Manhattan
InstDesc: Created 18 February by justinf
InstPath: /usr/IBM/WMQ-7.1.0-M/usr/mqm
- ▶ `strmqm Pelham`
WebSphere MQ queue manager 'Pelham' started.
- ▶ `dmpmqcfg -m Canarsie -o mqsc | runmqsc Pelham`
242 MQSC commands read.
No commands have a syntax error.
- ▶ `endmqm -i Canarsie`
WebSphere MQ queue manager 'Canarsie' ended.
- ▶ `dspmqr`
Name: WebSphere MQ
Version: 7.1.0.0
InstName: Manhattan
InstDesc: Created 18 February by justinf
InstPath: /usr/IBM/WMQ-7.1.0-M/usr/mqm

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How Things Work

- Developers link programs with the WebSphere MQ libraries
 - ▶ Those libraries must be found when running the program
- Windows
 - ▶ Variables like `LIB` and `PATH` point to WebSphere MQ
 - ▶ WebSphere MQ .NET assemblies are in the GAC
- UNIX and Linux
 - ▶ The `LD_LIBRARY_PATH`, `LIBPATH`, or `SHLIB_PATH` variables can force libraries to be found in the MQ directories (usually)
 - ▶ The system will look for MQ libraries using the built-in runtime library path (as recommended by MQ since 2005)
 - ▶ Failing that, the system will look in `/usr/lib` which historically has been enough to make 32-bit MQ programs work

Trouble Brewing

- If WebSphere MQ 7.1 is co-existing with 7.0.1.6+, existing applications will continue to use the 7.0 libraries
 - ✓ Connections to 7.0 queue managers will work
 - ✗ Connections to other installations will fail with reason code 2059 (MQRC_Q_MGR_NOT_AVAILABLE)
- If the only installation is a non-primary MQ 7.1 installed in a non-default location, applications may fail to run:
 - ✗ `mqapp: error while loading shared libraries:
libmqm.so: cannot open shared object file:
No such file or directory`

Trouble Averted

- ✓ Ensure your program can find the WebSphere MQ 7.1 libraries, since they can connect to all queue managers
- ① Rebuild the program with MQ 7.1 in its runtime library path
- ② Or run `setmqenv` to point to an MQ 7.1 installation
(and on Linux and UNIX specify either the `-k` or `-l` flag)
- ③ Or run `setmqenv -i` to make MQ 7.1 the primary installation
- ④ Or install WebSphere MQ 7.1 in the default location
- ⑤ Or create links to satisfy the program's runtime library path
- ⑥ Or modify the program's runtime library path (e.g. `chrpath`)

Checking the Runtime Library Path

- AIX: `dump -H -X any /path/to/mqapp`

```

***Import File Strings***
INDEX  PATH                                     BASE                                     MEMBER
0      /usr/mqm/lib64:/usr/vac/lib:/usr/lib/threads:/usr/lib:/lib
1      libc_r.a                               shr_64.o
2      libpthreads.a                          shr_xpg5_64.o
3      libmqm_r.a                              libmqm_r.o

```

- HP-UX: `chatr /path/to/mqapp`

```

shared library dynamic path search:
LD_LIBRARY_PATH      disabled first
SHLIB_PATH           disabled second
embedded path        enabled third
/opt/mqm/lib64:/usr/lib/hpux_64:/opt/mqm/lib64:/usr/lib/hpux64:

```

- ▶ You can also enable and disable `LD_LIBRARY_PATH` and `SHLIB_PATH`

```
chatr +s enable|disable /path/to/mqapp
```



Checking the Runtime Library Path

- Linux: `readelf -d /path/to/mqapp`

```
Tag                Type                Name/Value
0x000000000000000f (RPATH)            Library rpath: [/opt/mqm/lib64]
0x000000000000001d (RUNPATH)           Library runpath: [/opt/mqm/lib64]
```

- Solaris: `/usr/ccs/bin/elfdump -d /path/to/mqapp`

```
Dynamic Section: .dynamic
      index tag value
[10]  RUNPATH 0x246 /opt/mqm/lib64:/usr/ccs/lib:/usr/lib:
[11]  RPATH   0x246 /opt/mqm/lib64:/usr/ccs/lib:/usr/lib:
```

- Windows: There are several graphical tools available for inspecting applications to see their dependencies, including the “depends.exe” utility

WebSphere MQ 7.1 Libraries

- The usual WebSphere MQ application libraries exist, but are thin veneers for the new `libmqe` library (`mqe.dll`)

```

-r-xr-xr-x 1 mqm  mqm      50325 Feb 20 15:01 libmqic.a
-r-xr-xr-x 1 mqm  mqm    187301 Feb 20 14:4  libmqjbnd.so
-r-xr-xr-x 1 mqm  mqm    49977 Feb 20 14:44 libmqm.a
-r-xr-xr-x 1 mqm  mqm    20062 Feb 20 14:49 libmqmcb.a
-r-xr-xr-x 1 mqm  mqm    18765 Feb 20 14:49 libmqmxa.a
-r-xr-xr-x 1 mqm  mqm    59059 Feb 20 14:48 libmqz.a

-r-xr-xr-x 1 mqm  mqm  17207623 Feb 20 14:43 libmqe.a

```

- WebSphere MQ server built apps now have the ability to call `MQCONN` with `MQCNO_CLIENT_BINDING`, since both the server and client implementations are in the `libmqe` library



Installation Switching

- The new `libmqe` library is self-contained, so `libmqe` from one installation can safely load `libmqe` from another
- The `libmqe` libraries share information using the module `libmqzsd` (`mqzsd.dll`) under `$MQ_DATA_PATH/shared`
- Applications using `libmqm` and other libraries are switched over to the right installation's `libmqe` or to MQ 7.0.1.6+
- ✓ Once you use MQ 7.1 libraries, all installations are available
- ✗ There are restrictions on `MQCNO_FASTPATH_BINDING` applications documented in the Information Center

Exits

- Exits are binaries which WebSphere MQ loads and invokes in order to modify the behavior of channels, API calls, &c.
- Exits which made MQI calls had to be linked with MQ libraries
 - ▶ Do such exits have to be relinked for each installation?
- You can do so and copy your installation-specific exits to:

```
$MQ_DATA_PATH/exits/$MQ_INSTALLATION_NAME
```

```
$MQ_DATA_PATH/exits64/$MQ_INSTALLATION_NAME
```

- WebSphere MQ 7.1 will load installation-specific exits first



The MQIEP Structure

- WebSphere MQ 7.1 provides a new header called `cmqec.h` which defines a new structure called MQIEP
- The MQIEP structure contains pointers to the MQI functions and it is passed to every exit that can make MQI calls
 - ▶ E.g. `MQGET()` is available as `MQIEP->MQGET_Call()`
- Exits which use MQIEP do not need to be linked with libraries like `libmqm` and can therefore be used by all installations
- ✓ Modify your exit programs to use MQIEP and install them in `$MQ_DATA_PATH/exits` and `$MQ_DATA_PATH/exits64`

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IBM® V.R.M.F Terminology

- WebSphere MQ on distributed platforms uses a four digit value called V.R.M.F to indicate the software level
- Version: 7.0.0.0
 - ▶ A licensed IBM program usually with significant changes
 - ▶ Each new version starts a 5 year maintenance clock
- Release: 7.1.0.0
 - ▶ Indicates smaller changes, and restarts the 5 year clock
- Modification: 7.1.2.0
 - ▶ Full install with fixes and potentially with new functionality
- Fix: 7.1.2.3
 - ▶ An update containing cumulative maintenance fixes

WebSphere MQ Command Level

- Each WebSphere MQ queue manager has a `CMDLEVEL` attribute which indicates the functions it supports
- The command level corresponds to the installation V.R.M and can be seen but not altered in `runmqsc` and the MQ Explorer
 - ▶ `DISPLAY QMGR CMDLEVEL`
`AMQ8408: Display Queue Manager details.`
`QMNAME(RICH) CMDLEVEL(710)`
- Only `strmqm` can increase the command level
- This process is called **migration**

Enabling New Function

- Migration is the **one-way** process of updating the internal structure of a queue manager for a new command level
- `strmqm` automatically migrates queue managers to a new Version and Release (e.g. CMDLEVEL 701 → 710)
- `strmqm` no longer changes the Modification level automatically
 - ▶ New function in the Modification is disabled by default
 - ▶ `dspmqrver` will indicate the new MaxCmdLevel value
- ✓ You must choose to migrate the queue manager in order to take advantage of new functions in a Modification level

```
strmqm -e CMDLEVEL=712 RICH
```

Single-Stage Upgrade

- Before WebSphere MQ 7.1, upgrading was very linear
 1. Stop all queue managers and their applications
 2. Uninstall the old WebSphere MQ version (optional)
 3. Install the new WebSphere MQ version
 4. Start the queue managers to migrate them

- WebSphere MQ 7.1 calls this a “single-stage” upgrade
 - ▶ Single-stage upgrade from MQ 7.0.1.6+ is supported
 - ▶ Single-stage upgrade is the only path for MQ versions from 6.0.0.0 through 7.0.1.5

- ✗ Queue managers are offline for the duration of the process

- ✓ Simple, familiar, and has the fewest configuration changes



Side-by-Side Upgrade

- WebSphere MQ 7.1 offers a new upgrade for 7.0.1.6+
 1. Install the new WebSphere MQ version to a different location
 - ✓ Your existing queue managers can still be running
 2. Verify the new installation to ensure it works properly
 3. Stop all queue managers and their applications
 4. Uninstall the old WebSphere MQ version
 5. Run `setmqinst -i` to make the installation primary (optional)
 6. Run `setmqm` to associate each queue manager with the new WebSphere MQ 7.1 installation (optional)
 7. Run `strmqm` to start and migrate each queue manager
- Any unassociated queue managers will be automatically assigned to the new installation by `strmqm`
- ✓ Reduces down time and allows verification before switching

Multi-Stage Upgrade

- WebSphere MQ 7.1 offers one more option for 7.0.1.6+
 1. Install the new WebSphere MQ version to a different directory
 - ✓ Your existing queue managers can still be running
 2. Verify the new installation to ensure it works properly
 3. Migrate each queue manager on your own schedule
 - ① Stop the queue manager and its applications
 - ② Run `setmqm` to associate it with the new installation
 - ③ Run `strmqm` to start and migrate the queue manager
 4. Uninstall the old WebSphere MQ version when you choose
- ✗ You cannot make 7.1 primary while MQ 7.0.1.6+ is installed
- ✓ Minimizes down time by staggering queue manager migration

Applying and Removing Maintenance

- The same upgrade options are available for maintenance
 - ▶ Single-stage is the traditional way of applying maintenance
 - ▶ Side-by-side and multi-stage allow you to prepare and verify a new maintenance level before switching to it
 - ▶ The Information Center calls this “staging maintenance”
- You can stage multiple maintenance levels or alternate between two installations, updating each one in turn
- You can move queue managers between maintenance levels, subject to the restrictions described on the next page
- ✓ Stage your maintenance and use `setmqm` to move queue managers quickly and easily between maintenance levels



Maintenance and Command Levels

- You can move queue managers to new maintenance levels and back again as long as the V.R.M.F \geq CMDLEVEL
 - ▶ This works: 7.1.0.0 → 7.1.0.1 → 7.1.0.2 → 7.1.0.0
 - ▶ This too: 7.1.0.0 → 7.1.2.3 → 7.1.5.7 → 7.1.1.2
(but only if you did not set CMDLEVEL > 711 using `strmqm`)
 - ▶ Not this: 7.1.0.0 → 7.1.0.3 → 7.2.0.0 → 7.1.0.3
 - ✗ `strmqm` will fail with an error message
- ✓ Take a backup of the queue manager before migrating to a new command level and revert to that backup if necessary
- ✗ You cannot go back to an earlier command level unless you took a backup of the queue manager before migrating

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Failover Implications

- Multi-Instance Queue Managers
 - ▶ You must have compatible versions on both systems supporting the multi-instance queue manager
 - ▶ V.R.M.F must be \geq CMDLEVEL on both systems
 - ✓ Best practice: Use the same V.R.M.F and installation name on both systems to avoid confusion

- Microsoft® Cluster Server
 - ▶ MSCS does not support multiple MQ installations
 - ✓ Requirement: You must not install a second installation on a system which is configured for MSCS

Clustering Implications

- WebSphere MQ clusters are completely unaffected by multi-version installation
- WebSphere MQ clusters already support queue managers of different command levels
- Whether those command levels are installed on a single system (multi-version) or different systems is immaterial
- ✓ Best Practice: Migrate full repositories to a new command level, then the partial repositories, to use new features



Error Logs

- WebSphere MQ writes informational and error messages to `AMQERR01.LOG`, `AMQERR02.LOG`, and `AMQERR03.LOG`
- The `AMQERR01.LOG` file contains the most recent messages
- Every queue manager has an `errors` directory with logs
- Every machine has a top-level `errors` directory as well
 - ▶ UNIX & Linux: `$MQ_DATA_PATH/errors`
(`/var/mqm/errors`)
 - ▶ Windows: `%MQ_DATA_PATH%\errors`

Error Log Example

- Messages now include the installation name and V.R.M.F
 - ▶ Any message missing these details is 7.0 or older

```
----- amqiset0.c : 915 -----  
02/29/12 20:07:38 - Process(5505210.1) User(mqm) Program(setmqinst)  
                    Host(sun3) Installation(Test1) VRMF(7.1.0.0)  
AMQ8584: Insufficient permission to update installation  
configuration.
```

EXPLANATION:

An attempt was made to update the WebSphere MQ installation configuration for installation 'Test1' path '/opt/IBM/WMQ/test' but the request was rejected as the current user does not have sufficient authority to make the update.

ACTION:

Issue the command from a user with sufficient authority to update the installation configuration.

First Failure Support Technology

- WebSphere MQ processes write detailed debugging information to their own file named `AMQxxxxxx.0.FDC` when they encounter unexpected conditions
- The file name includes the process ID: `AMQ12345.0.FDC`
- All installations write FDCs to the top-level `errors` directory
 - ▶ UNIX & Linux: `$MQ_DATA_PATH/errors`
(`/var/mqm/errors`)
 - ▶ Windows: `%MQ_DATA_PATH%\errors`

FFST Example

- FFST headers in FDC files include the installation name and path

```
+-----+
| WebSphere MQ First Failure Symptom Report
| =====
|
| Date/Time           :- Tue March 06 2012 15:00:34 EST
| Host Name           :- aix1
| Operating System    :- AIX 6.1
| LVLS                :- 7.1.0.0
| Product Long Name   :- WebSphere MQ for AIX
| Installation Path :- /opt/IBM/WMQ/test
| Installation Name :- Test1 (2)
| Probe Id            :- XC332255
| Component            :- xlsWaitEvent
| SCCS Info           :- lib/cs/unix/amqxerrx.c, 1.253
| Line Number         :- 5791
| Program Name        :- amqzmuc0
| Process              :- 12910660
| Thread              :- 1
| QueueManager        :- IBMTTEST
| Major Errorcode     :- OK
| Probe Type          :- INCORROUT
| Probe Description   :- AMQ6109: An internal WebSphere MQ error has occurred.
|
+-----+
```

Analyzing FFSTs

- The `ffstsummary` tool can produce a chronological list of FFSTs based on the FDC files in the current directory
- Now `ffstsummary` includes the installation name
 - ▶ A blank installation is `Installation0 (7.0)` or an old FDC

```

AMQ7798882.0.FDC 2012/01/18 15:09:33.854687-5 Installation1 amqzmuc0
7798882 1 ZX085061 amqzmuc0 xecP_E_INVALID_PID OK

AMQ7798882.0.FDC 2012/01/18 15:09:33.908609-5 Installation1 amqzmuc0
7798882 1 ZX085131 amqzmuc0 zrcE_UNEXPECTED_ERROR OK

AMQ8847418.0.FDC 2012/02/23 16:06:04.165946-5 _____ strmqcsv
8847418 2 XC338001 xehAsySignalHandler xecE_W_UNEXPECTED_ASYNC_SIGNAL OK

AMQ24969328.0.FDC 2012/02/23 16:41:08.780440-5 Development01 amqrmppa
2496928 7 CO052000 cciTcpReceive rrcE_BAD_DATA_RECEIVED OK

```

Traces

- WebSphere MQ processes can write information about their activity to files named `AMQxxxxxx.0.TRC` (and `.TRS`)
- Except on Windows, these files must be formatted into a readable form using the `dspmqrtc` program
- You can generate a summary of traces with: `dspmqrtc -s`
- All installations write traces to the top-level `trace` directory
 - ▶ UNIX & Linux: `$MQ_DATA_PATH/trace`
(`/var/mqm/trace`)
 - ▶ Windows: `%MQ_DATA_PATH%\trace`

Controlling Trace

- Each installation has its own independent trace status
- The `strmqtrc` and `endmqtrc` programs change the trace status for their own installation only, including:
 - ▶ Early trace: `strmqtrc -e`
 - ▶ “All” trace: `endmqtrc -a`
- Applications can connect to multiple queue managers in different installations simultaneously
 - ▶ You can trace their activity in each installation separately
 - ▶ Or enable trace in multiple installations to see all activity
- To check the trace status for an installation: `strmqtrc -s`



Trace Example

- Formatted traces now include a header with installation details

```
+-----+
| WebSphere MQ Formatted Trace V3
| =====
| Date/Time           :- 03/06/12 09:22:12 EST
| UTC Time            :- 1331043732.769625
| UTC Time Offset     :- 5 (EST)
| Host Name           :- ibmaix1
| Operating System    :- AIX 6.1
| LVLS                :- 7.1.0.0
| Product Long Name   :- WebSphere MQ for AIX
| CMVC Level          :- p000-L111015
| Installation Path :- /usr/IBM/WMQ-7.1.0-A/usr/mqmqm
| Installation Name :- Test1 (2)
| Effective UserID    :- 7100 (mqmq)
| Real UserID         :- 7067 (ibmusr)
| Program Name        :- amqzmuf0
| Addressing Mode     :- 64-bit
| Process             :- 10289308
| QueueManager        :- IBMTEST
| Reentrant           :- 1
+-----+
```

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- WebSphere MQ Problem Determination Webcast
<http://www-01.ibm.com/support/docview.wss?uid=swg27009878>

Additional WebSphere Product Resources

- Learn about upcoming WebSphere Support Technical Exchange webcasts, and access previously recorded presentations at:
http://www.ibm.com/software/websphere/support/supp_tech.html
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Questions and Answers

