WebSphere MQ Disaster Recovery

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Introduction

- Availability is a very large subject
- You can have the best technology in the world, but you have to manage it correctly
- Technology is not a substitute for good planning and testing!

What is DR – Wikipedia Version

- Disaster recovery is the process, policies and procedures related to preparing for recovery or continuation of technology infrastructure critical to an organization after a natural or human-induced disaster. Disaster recovery is a subset of business continuity. While business continuity involves planning for keeping all aspects of a business functioning in the midst of disruptive events, disaster recovery focuses on the IT or technology systems that support business functions.

What is DR

- Getting applications running after a major (often whole-site) failure or loss
- It is not about High Availability although often the two are related and share design and implementation choices
  - "HA is having 2, DR is having them a long way apart"
  - More seriously, HA is about keeping things running, while DR is about recovering when HA has failed.
- Requirements driven by business, and often by regulators
  - Data integrity, timescales, geography …
- One major decision point: cost
  - How much does DR cost you, even if it's never used?
  - How much are you prepared to lose

Disaster Recovery vs High Availability

- Designs for HA typically involve a single site for each component of the overall architecture
- Designs for DR typically involve separate sites
- Designs for HA (and CA) typically require no data loss
- Designs for DR typically can have limited data loss
- Designs for HA typically involve high-speed takeover
- Designs for DR typically can permit several hours down-time

Local Recovery

"MQ has failed"

- Don't restart queue manager until you know why it failed
  - You can probably do one restart attempt safely, but don't continually retry
  - When running under an HA coordinator, have retry counts
- At least ensure you take a backup of the queue manager data, log files, and any error logs/FDCs/dumps
  - So it can be investigated later
  - Might be possible for IBM to recover messages
  - Consider taking these copies as part of an HA failover procedure
- While trying restart/recovery procedures, consider a PMR
  - Often see "cold start" as first reaction at some customers
  - If you have a support contract, open PMR before trying cold start
    - IBM may have an alternative
    - IBM may ask you to start collecting documentation
  - Do not make everything a Sev1

First Manual Restart

- Restart your queue manager
  - Only clean the IPC (shared memory/semaphores) if IBM requests it
    - This should never be necessary
    - Remove calls to ipcrm or amqiclen from any startup/failover scripts
  - Start as simply as possible
    - strmqm –ns QM1
  - Monitor the restart, look for FDC's
  - If OK, then end the qmgr and restart normally

- What if the restart fails?
  - Option to escalate to cold start
  - Further escalation to rebuilding queue manager

Cold Starting WMQ

- Typical reason: hardware (most likely disk) failure or logs deleted by mistaken administrator
- Symptoms: Cannot start queue manager because logs unavailable or corrupt files

- "Cold start" is a technique to restart without needing logs

- What does a cold start cost you?
  - In-flight transactions will not be automatically rolled-back
  - In-doubt transactions will be forgotten
  - Ability to recover messages from the logs
  - Possible loss of messages
  - Possible duplication of already-processed messages

Cold Starts on Distributed Platforms

- These instructions are for Distributed platforms
  - Similar tasks are done on z/OS
- Basic idea is to replace your 'bad' logs with 'good' logs
  - By creating a dummy queue manager and using its logs instead
  - Logs do not contain queue manager name
- Other considerations
  - Is this queue manager part of a WMQ cluster?
    - This shouldn't matter, but may want to resynchronise repositories
    - In case any updates were in-flight when system failed
  - Is this queue manager under the control of an HA cluster?
    - Failover will not help if the shared disks/files are corrupt
    - Disable failover in the HA system until recovery complete

Cold Start – Procedure (1)

- Create a queue manager EXACTLY like the one that failed
  - Use qm.ini to work out parameters to crtmqm command

```
Log:
   LogPrimaryFiles=10
   LogSecondaryFiles=10
   LogFilePages=65535
   LogType=CIRCULAR
```

- Issue the crtmqm command
  - crtmqm -lc -lf 65535 -lp 10 -ls 10 –ld /tmp/mqlogs TEMP.QMGR
  - Make sure there is enough space for the new log files in that directory
- Name of the dummy queue manager is irrelevant
  - Only care about getting the log files

Cold Start – Procedure (2)

- Don't start this dummy queue manager, just create it
- Replace old logs and amqhlctl.lfh with the new ones
  ```
  cd /var/mqm/log
  mv QM1 QM1.SAVE
  mv /tmp/mqlogs/TEMP!QMGR QM1
  ```
  - Note the "mangled" directory name … this is normal
- Data in the queues is preserved if messages are persistent
- Object definitions are also preserved
  - Objects contain their own definitions in their files
  - Mapping between files and object names held in QMQMOBJCAT

Rebuilding a Queue Manager

- A rebuild creates a replacement queue manager
  - Same object definitions
  - But loss of message data and channel sequence numbers
- Replacement queue manager has a new QMID
  - MQ Explorer saves QMID in its list of known queue managers
  - Will allow you to connect, but requires confirmation that the new qmid is expected
- Recommend issuing RESET CLUSTER at full repository to remove the old QMID before bringing the replacement online

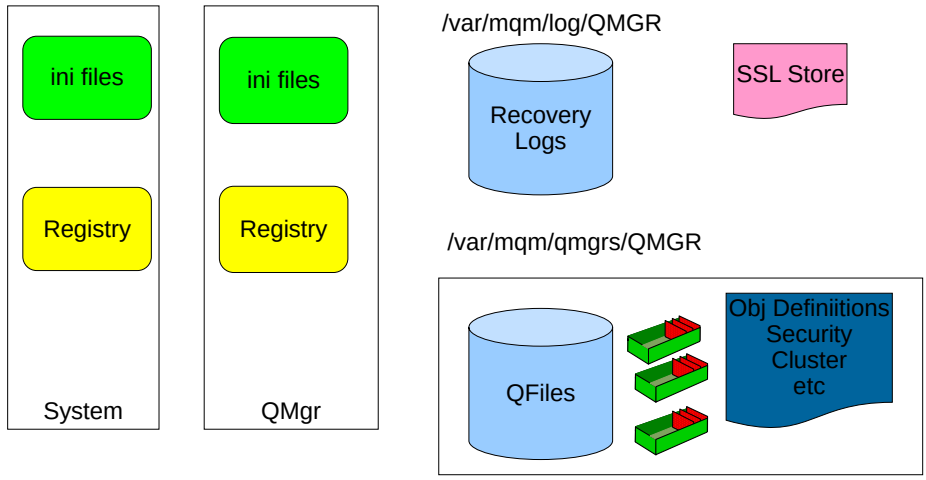
Rebuilding a Queue Manager

- Make sure you have a backup of the definitions
  - Either through a tool such as Omegamon Configuration Manager
  - Or by manually creating the backup – MAKEDEF, dumpmqcfg or MS03
- Make sure you know which version of WMQ is installed
  - And you have the install images for the code
- Make sure you've got the security configuration
  - Windows SIDs?
- Also any customisation in the qm.ini file (or registry)
- And sometimes exits might have external configuration
  - Don't forget to have the binaries available - often separately installed

Recovering Messages

- It might be possible to recover messages after rebuilding a queue manager
- While queue manager is stopped, copy the qfile from the damaged system
- No guarantees, and transactional operations may be inconsistent
  - But it might be good enough

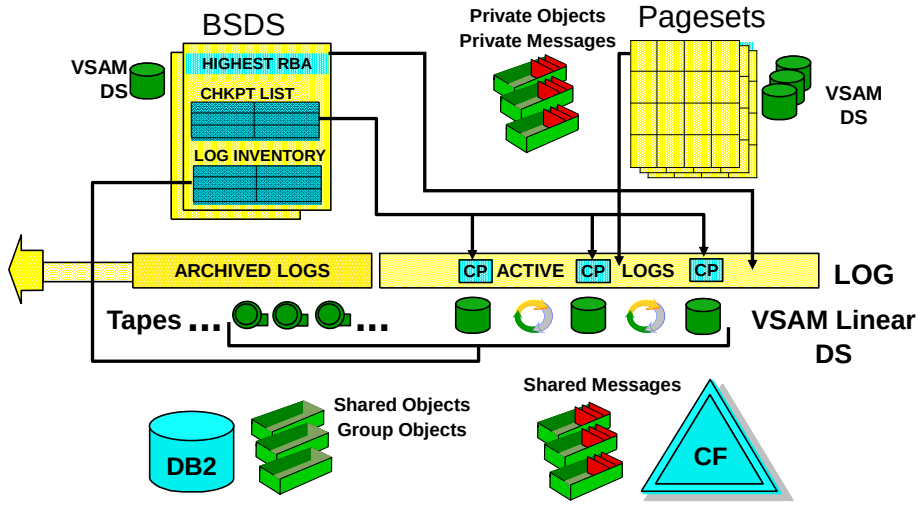
What makes a Queue Manager on Dist?



Backups

- At minimum, backup definitions at regular intervals
  - Include ini files and security settings
- One view is there is no point to backing up messages
  - They will be obsolete if they ever need to be restored
  - Distributed platforms – data backup only possible when qmgr stopped
- Use rcdmqimg on Distributed platforms to take images
  - Channel sync information is recovered even for circular logs
- Backup everything before upgrading code levels
  - On Distributed, you cannot go back
- Exclude queue manager data from normal system backups
  - Some backup products interfere with WMQ processing

What makes a Queue Manager on z/OS?



What makes up a Queue Manager?

- Queue manager started task procedure
  - Specifies MQ libraries to use, location of BSDS and pagesets and INP1, INP2 members start up processing
- System Parameter Module – zParm
  - Configuration settings for logging, trace and connection environments for MQ
- BSDS: Vital for Queue Manager start up
  - Contains info about log RBAs, checkpoint information and log dataset names
- Active and Archive Logs: Vital for Queue Manager start up
  - Contain records of all recoverable activity performed by the Queue Manager
- Pagesets
  - Updates made “lazily” and brought “up to date” from logs during restart
  - Start up with an old pageset (restored backup) is not really any different from start up after queue manager failure
  - Backup needs to copy page 0 of pageset first (don’t do volume backup!)
- DB2 Configuration information & Group Object Definitions
- Coupling Facility Structures
  - Hold QSG control information and MQ messages

Backing Up a z/OS Queue Manager

- Keep copies of ZPARM, MSTR procedure, product datasets and INP1/INP2 members
- Use dual BSDS, dual active and dual archive logs
- Take backups of your pagesets
  - This can be done while the queue manager is running (fuzzy backups)
  - Make sure you backup Page 0 first, REPRO or ADRDSSU logical copy
- DB2 data should be backed up as part of the DB2 backup procedures
- CF application structures should be backed up on a regular basis
  - These are made in the logs of the queue manager where the backup was issued

Remote Recovery

Topologies

- Sometimes a data centre is kept PURELY as the DR site
- Sometimes 2 data centres are in daily use; back each other up for disasters
  - Normal workload distributed to the 2 sites
  - These sites are probably geographically distant
- Another variation has 2 data centres “near” each other
  - Often synchronous replication
  - With a 3rd site providing a long-distance backup
- And of course further variations and combinations of these

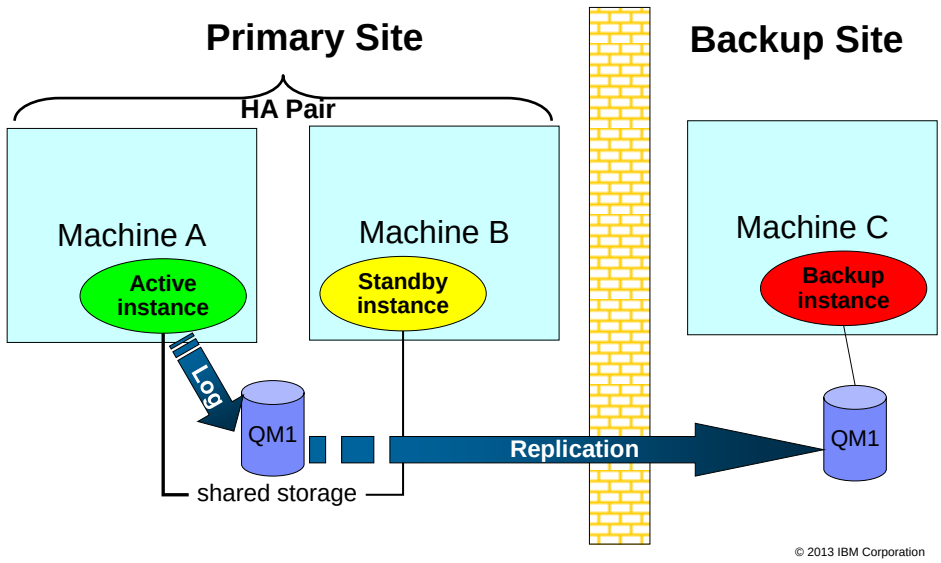
Queue Manager Connections

- DR topologies have little difference for individual queue managers
- But they do affect overall design
  - Where do applications connect to
  - How are messages routed
- Clients need ClntConn definitions that reach any machine
- Will be affected by how you manage network
  - Do DNS names move with the site?
  - Do IP addresses move with the site?
- Some sites always put IP addresses in CONNAME; others use hostname
  - No rule on which is better

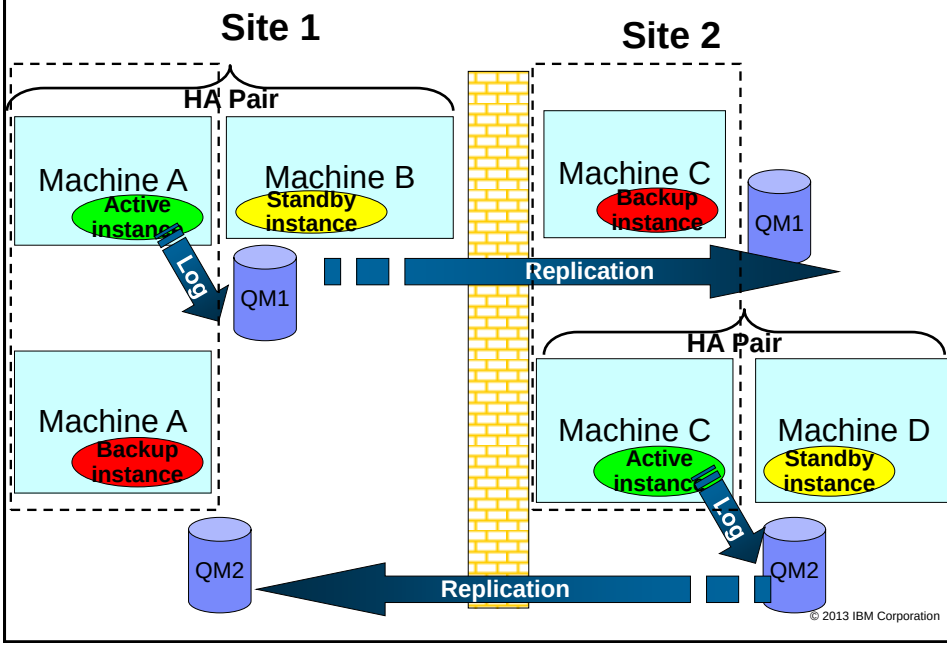
Disk replication

- Disk replication can be used for WMQ disaster recovery
- Either synchronous or asynchronous disk replication is OK
  - Synchronous:
    - No data loss if disaster occurs
    - Performance is impacted by replication delay
    - Limited by distance (eg 100km)
  - Asynchronous:
    - Some limited data loss if disaster occurs
    - It is critical that queue manager data and logs are replicated in the same consistency group if replicating both
- Disk replication cannot be used between the active and standby instances of a multi-instance queue manager
  - Could be used to replicate to a DR site in addition though

Combining HA and DR



Combining HA and DR – “Active/Active”



Backup Queue Manager - Objective

- Feature introduced in WMQ V6
- Prepares a queue manager for restart/recovery
  - Without needing to replay all logs at a critical time
  - For Windows, Unix and System i
- “Backup” queue manager takes the place of original
  - New QMID but contains original definitions and messages

Backup Queue Manager - Procedure

- Configure queue manager with linear logging
- Create a queue manager at the primary site
  - Create an identical one at the DR site – the backup queue manager
- Ship full, inactive log files from active QM to the DR site
  - Can use disk replication to do this
  - Or modify SupportPac or sample programs for log management to copy files at the same time as deleting/archiving local logs
- Replay log files on the backup QM to bring it up to date
  - Do this at regular intervals
  - strmqm -r
- If disaster occurs, activate the backup queue manager
  - strmqm -a
- For more control, can force filling of current log file
  - MQSC RESET QMGR TYPE(ADVANCELOG)

Integration with other products

- May want to have consistency with other data resources
  - For example, databases and app servers
- Only way for guaranteed consistency is disk replication where all logs are in same group
  - Otherwise transactional state might be out of sync
- DB2 can use WMQ as part of its own replication strategy
  - InfoSphere Replication Server

Planning and Testing

Planning for Recovery

- Write a DR plan
  - Document everything – to tedious levels of detail
  - Include actual commands, not just a description of the operation
    - Not “Stop MQ”, but “as mqm, run /usr/local/bin/stopmq.sh US.PROD.01”
- And test it frequently
  - Recommend twice a year
  - Record time taken for each task
- Remember that the person executing the plan in a real emergency might be under-skilled and over-pressured
  - Plan for no access to phones, email, online docs …
- Each test is likely to show something you’ve forgotten
  - Update the plan to match
  - You’re likely to have new applications, hardware, software …
- May have different plans for different disaster scenarios

Example Exercises from MQ Development

- Different groups have different activities that must continue
  - Realistic scenarios can help show what might not be available
- From the WMQ development lab …
- Most of the change team were told there was a virulent disease and they had to work from home
  - Could they continue to support customers
- If Hursley machine room was taken out by a plane missing its landing at Southampton airport
  - Could we carry on developing the WMQ product
  - Source code libraries, build machines, test machines …
  - Could fixes be produced
- (A common one) Someone hit emergency power-off button

Networking Considerations

- DNS - You will probably redirect hostnames to a new site
  - But will you also keep the same IP addresses?
  - Including NAT when routing to external partners?
  - Affects CONNAME
- Include external organisations in your testing
  - 3rd parties may have firewalls that do not recognize your DR servers
- LOCLADDR configuration
  - Not normally used by MQ, but firewalls, IPT and channel exits may inspect it
  - May need modification if a machine changes address
- Clustering needs special consideration
  - Easy to accidentally join the real cluster and start stealing messages
  - Ideally keep network separated, but can help by:
    - Not giving backup 'live' security certs
    - Not starting chinit address space (z/OS)
    - Not allowing channel initiators to start (distributed)
    - Use CHLAUTH rules
- Backup will be out of sync with the cluster
  - REFRESH CLUSTER() resolves updates

A Real MQ Network Story

- Customer did an IP move during a DR test
- Forgot to do the IP move back when they returned to prime systems
- Didn't have monitoring in place that picked this up until users complained about lack of response

APPLICATIONS AND AUTO-RECONNECTION

HA applications – MQ connectivity

- If an application loses connection to a queue manager, what does it do?
  - End abnormally
  - Handle the failure and retry the connection
  - Reconnect automatically thanks to application container
    - WebSphere Application Server contains logic to reconnect JMS clients
  - Use MQ automatic client reconnection

Automatic client reconnection

- MQ client automatically reconnects when connection broken
  - MQI C clients and standalone JMS clients
  - JMS in app servers (EJB, MDB) does not need auto-reconnect
- Reconnection includes reopening queues, remaking subscriptions
  - All MQI handles keep their original values
- Can reconnect to same queue manager or another, equivalent queue manager
- MQI or JMS calls block until connection is remade
  - By default, will wait for up to 30 minutes
  - Long enough for a queue manager failover (even a really *slow* one)

Automatic client reconnection

- Can register event handler to observe reconnection

- Not all MQI is seamless, but majority repaired transparently
  - Browse cursors revert to the top of the queue
  - Nonpersistent messages are discarded during restart
  - Nondurable subscriptions are remade and may miss some messages
  - In-flight transactions backed out

- Tries to keep dynamic queues with same name
  - If queue manager doesn't restart, reconnecting client's TDQs are kept for a while in case it reconnects
  - If queue manager does restart, TDQs are recreated when it reconnects

Automatic client reconnection

- Enabled in application code, ini file or CLNTCONN definition
  - MQI: MQCNO_RECONNECT, MQCNO_RECONNECT_Q_MGR
  - JMS: Connection factory properties

- Plenty of opportunity for configuration
  - Reconnection timeout
  - Frequency of reconnection attempts

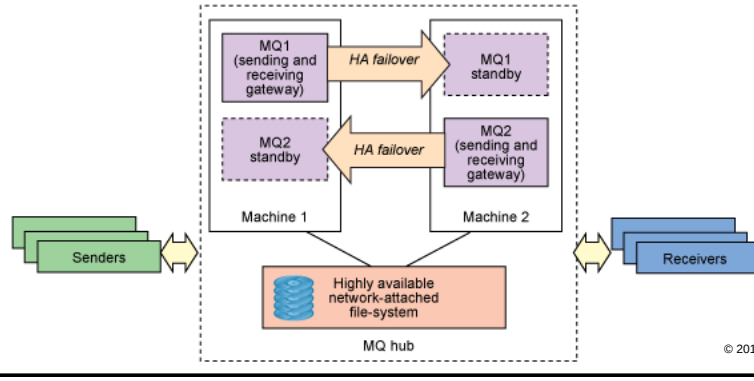
- Requires:
  - Threaded client
  - 7.0.1 server – including z/OS
  - Full-duplex client communications (SHARECNV >= 1)

Client Configurations for Availability

- Use wildcarded queue manager names in CCDT
  - Gets weighted distribution of connections
  - Selects a “random” queue manager from an equivalent set
- Use multiple addresses in a CONNAME
  - Could potentially point at different queue managers
  - More likely pointing at the same queue manager in a multi-instance setup
- Use automatic reconnection
- Pre-connect Exit from V7.0.1.4
- Use IP routers to select address from a list
  - Based on workload or anything else known to the router

Application Patterns for availability

- Article describing examples of how to build a hub topology supporting:
  - Continuous availability to send MQ messages, with no single point of failure
  - Linear horizontal scale of throughput, for both MQ and the attaching applications
  - Exactly once delivery, with high availability of individual persistent messages
  - Three messaging styles: Request/response, fire-and-forget, and pub/sub
- http://www.ibm.com/developerworks/websphere/library/techarticles/1303_broadhurst/1303_broadhurst.html



Other Resources

- Applications may need to deal with replay or loss of data.
  - Decide whether to clear queues down to a known state, or enough information elsewhere to manage replays
- Order of recovery may change with different product releases
  - Every time you install a new version of a product revisit your DR plan
- What do you really need to recover
  - DR site might be lower-power than primary site
  - Some apps might not be critical to the business
  - But some might be unrecognised prereqs

If a Real Disaster Hits

- Hopefully you never need it. But if the worst happens:
- Follow your tested plan
  - Don't try shortcuts
- But also, if possible:
  - Get someone to take notes and keep track of the time tasks took
  - Prepare to attend post mortem meetings on steps you took to recover
  - Accept all offers of assistance
- And afterwards:
  - Update your plan for the next time

Summary

- Various ways of recovering queue managers
- Plan what you need to recover for WMQ
- Plan the relationship with other resources
- Test your plan