IBM MQ on z/OS & Distributed: Are they like oil and water?

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Introduction

- One objective of MQ is isolating apps from needing to understand platforms
  - There is a common API that can be expressed in many languages
- Another objective is to have (reasonably) common operational model
  - Much of admin is the same on all platforms
- But it’s not all the same
  - One dichotomy has always been whether to be natural to MQ-ness or behave like other things on the platform
  - Some features don’t make sense on some platforms
    - For example, .Net interface is only on Windows (and from 9.1.2, on Linux with .Net core)
  - Some features have not been implemented everywhere for other reasons
- So there are differences, and that is what this presentation will cover
- This is based on V9.2

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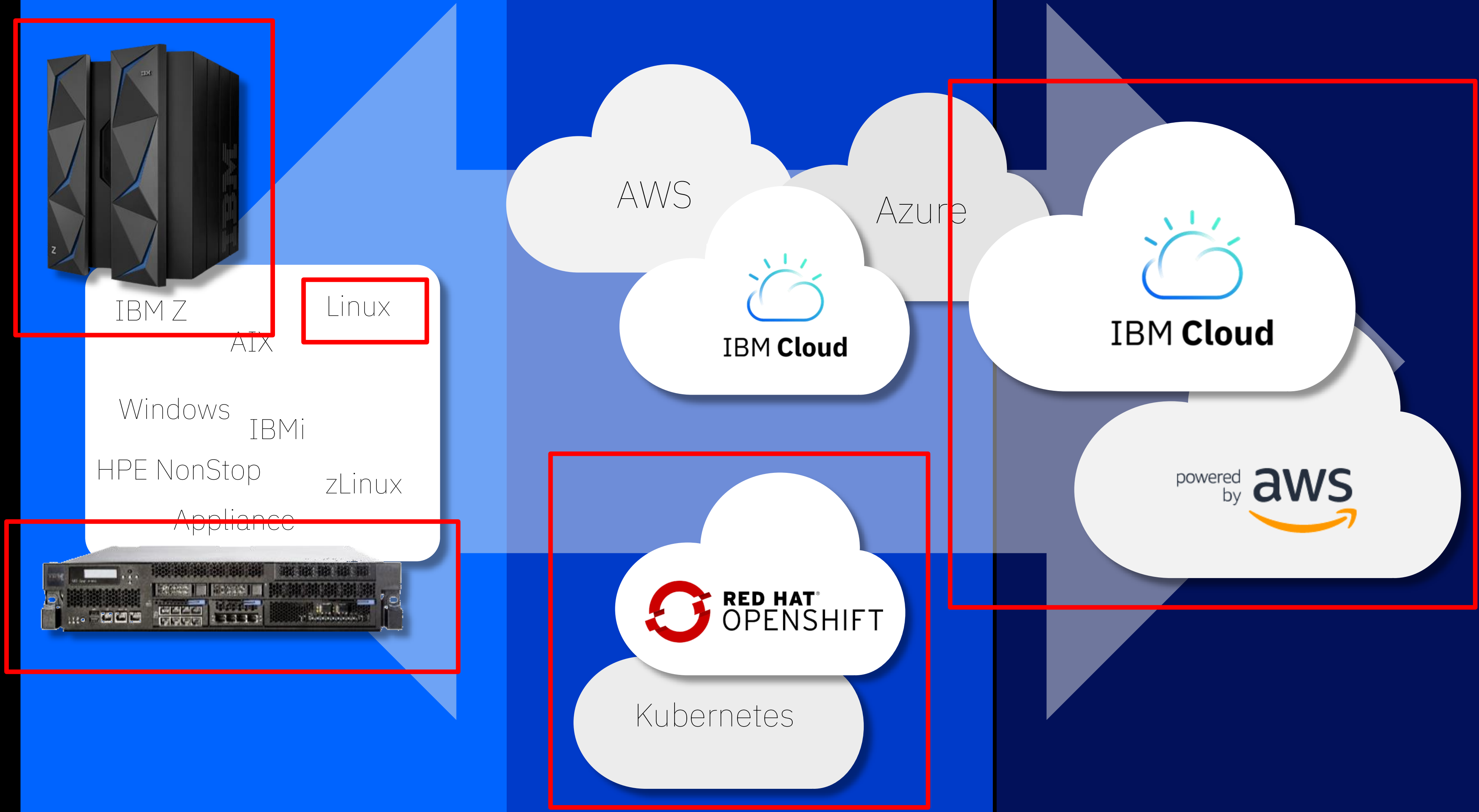

Code Streams

- There are essentially two implementations of MQ from the Hursley lab
  - z/OS
  - Distributed (Windows, Unix, Linux, i)
  - There are some further subspecies variants like VSE or NSS
- Within Distributed implementation, there are some platform unique features
  - Newer environments demand some unique features
  - Most platform-unique code abstracts OS facilities like locking or NLS or threads
- Internal architecture (eg tasks, threads) very different
  - But we won't discuss much of that. Understanding externals is more important
- In the early days, some code was written for one and then “ported”
  - In particular, the channel code
  - Meant double-fixing, and re-porting for each release
- Some code is now truly common
  - Just one copy of the source part shared between both
  - New features generally use common code where feasible

Sections

- Setting up
- Application Programming
- Administration

How this presentation works

- Lyn will talk about z/OS in this color

- Mark will talk about Distributed in this colour

Setting Up

Getting started

- Lots of differences in initial installation and setup

- Getting the code on the box is part of the job
  - MQ uses native installation techniques for all platforms
  - Needs a suitably-authorised person to do that installation
    - SMPE for z/OS, installp for AIX, rpm for Linux etc
  - Firmware on appliance, container images for cloud

- But other differences primarily due to
  - Security
  - Storage

- Share philosophy of needing no more features than is found on the system
  - So no prereq software for core capabilities of MQ
  - Product ships components that are needed such as gskit or Liberty
  - But can exploit things that we know are there
    - For example, on z/OS we use the system-provided TLS or RRS
  - Some extended capabilities may have additional prereqs
    - Shared Queues need DB2

Security

- On Distributed, MQ implements its own authorisation mechanism
  - There is no generally-accepted standard interface on these systems
- And mostly relies on the existence of certain userids
  - There are differences even between individual platforms
  - Certified container runs under random id!

- On z/OS, MQ exploits the common authorization interface, SAF
  - And so the z/OS security administrator has to be involved
  - Define the profiles etc.

- Will look more at security later on

Storage (Distributed)

- On Distributed, MQ uses directories such as /var/mqm/qmgrs and /var/mqm/logs
  - The system administrator will probably allocate filesystems and mount them
  - These days, likely to have separate SAN administrator
- Each queue has its own file within the filesystem
  - To store the message data
  - Each queue can now hold 255TB (!)
  - From 9.1.5, maximum queue file size is configurable
- Queues do not interfere with each other's storage requirements
  - Subject to max size of filesystem
- Logs can be LINEAR or CIRCULAR
  - Choice made when qmgr is created (though you can switch later)
  - With linear logging, you then used to need a job to remove old log files (can now be automatic)
  - MQ does not directly implement dual-logging; relies on RAID/replicated filesystems
  - Appliance is only circular

Storage (z/OS)

- Private Queues are handled via pagesets and bufferpools
- Multiple queues may use the same pageset and bufferpool
  - Can lead to storage contention
  - V8 increased number of bufferpools to match number of pagesets
- No direct equivalent of circular logging but constraints can be applied to achieve a similar effect
  - Semi-circular?
  - Active logs are ‘almost like circular’, with offloading to archive logs
  - Log shunting
- Logs are managed via the BSDS (Bootstrap Dataset)
- MQ understands and implements Dual Logging
- Tool provided to format and extract messages from log

Shared Queues

- A z/OS-unique feature
  - Multiple queue managers can see the same physical queue
  - Continuous processing of messages from a queue even when one LPAR fails

- Relies on the Coupling Facility hardware
  - And relies on DB2 Data Sharing
  - Messages reside in the CF or in auxiliary storage

- Results in several unique possibilities
  - Inter-qmgr communication without standard channels
  - Dynamic selection of which qmgr to connect to

- Effects appear in many places
  - For example, single MQSC command can be issued to multiple queue managers giving multiple responses

Application Programming

with the MQI

MQI and other APIs

- The MQI is the core application programming interface
- Other APIs are built on top including JMS, XMS
  - Even the REST Messaging API
- The other Object Oriented APIs are either stabilised or deprecated
  - including Base Java classes, C++
- JMS/XMS mostly hide platform differences but do not give access to full capabilities of MQI
  - Though one unique feature is "delayed delivery"
- Understanding how application uses the APIs can be key for performance and PD

General

- Default codepages and encoding differ by platform
- Always use the header files for your platform
  - Don't be tempted to cross-compile
- Maximum lengths of fields may vary
- Language support may vary
  - Assembler only on z/OS
  - Go, Node.JS on Distributed
  - And some APIs: MQAI only on Distributed
- MQI return codes may be different
  - Often because underlying storage mechanisms have different error conditions
  - For example, Coupling Facility errors on shared queues
- z/OS does not – in general - have MQ clients
  - Some parameters to some verbs only apply in client environments
  - For example, the MQCD passed during MQCONNX

API - Connections

- MQCONN/MQCONNX
  - Verbs not required for CICS transactions
    - ➢ MQHC_DEF_HCONN can be used for subsequent verbs in applications
  - ConnTag is available to control serialization
    - ➢ An application (especially an MCA) can tell if another instance of itself is already running
    - ➢ On either the same local qmgr or any other in the QSG
  - Group connection to QSG

  - Lots of client-only options for connection
    - ➢ MQCD can be specified
    - ➢ Reconnect options
  - MQCNO_SHARED options for multi-threaded applications
    - ➢ Controls whether an hConn can be (serially) used by other threads in the same process
  - Fastpath binding
  - Control of accounting
    - ➢ When accounting information is being collected, some apps may request exclusion
  - Application name can be explicitly set

API - Disconnections

- MQDISC
  - Always recommended

  - Rollback when application abends
    - Although definition of "abend" is not clear in every case
    - CICS and IMS do make it clear!
    - A JVM has been known to return OK to the operating system even when the user's code has caused a fatal exception

  - Rollback when not used and application ends

  - Internally, normal rollback (ie not on restart) can be handled entirely from in-memory state
  - Internally, rollback requires reading the log files

API - Objects

- MQOPEN
  - Default dynamic queue names begin with CSQ.* or AMQ.*
  - Distributed can open multiple queues simultaneously via Distribution List
    - ~~"Noone uses this~~"
    - Publish/Subscribe preferred cross-platform model
- MQCLOSE
  - No platform differences in practice
- MQSET
  - Follows the same rules as MQSC attributes for platforms
- MQINQ
  - Follows the same rules as MQSC attributes for platforms

API - Messages

- MQPUT/MQPUT1
  - Messages can be automatically segmented
    - ➢ But Message groups are cross-platform
  - Distributed supports "Reference messages" which can avoid putting large amounts of data on a queue
- MQGET
  - z/OS has "get with signal" to asyncronously notify app when messages appear
    - ➢ MQCB is now preferred cross-platform model
  - z/OS has MARK_SKIP_BACKOUT for simpler processing of poison messages
    - ➢ Bad messages can be moved to an application-specific DLQ while backing out other resource changes
  - Distributed can get portions of messages via segmentation
  - Waiting Getter – z/OS only NP messages; Dist can work with P messages (but both require out of sync)
    - ➢ Internal optimisation (no direct application control) but can lead to unexpectedly skewed workload
- MQSUB
  - No platform differences
- MQSUBRQ
  - No platform differences

API – Flow control

- MQCB
  - Definition of the callback function in MQCBD varies by environment
  - eg C function pointer, CICS program name

- MQCTL
  - Not in IMS adapter
  - In CICS, cannot use MQOP_START – use MQOP_START_WAIT
  - On z/OS, apps must be authorized to use USS to use MQOP_START

- MQSTAT
  - Client applications only
  - But usable regardless of server platform

API - Properties

- MQDLTMP
- MQBUFMH
- MQCRTMH
- MQDLTMH
- MQMHBUF
- MQSETMP
- MQINQMP

- No platform differences

API - Transactions

- MQBEGIN
  - Only available on Distributed local bindings (not client)
  - z/OS always has a transaction manager available
- MQCMIT
  - On all platforms when not running under external TM
- MQBACK
  - On all platforms when not running under external TM

- Default for MQ transactional behaviour **is different**
  - MQI on Distributed assumes NO_SYNCPOINT
  - MQI on z/OS assumes SYNCPOINT
  - Always specify syncpoint options on MQI calls
- Environments for two-phase transactions differ
  - On z/OS, RRS CICS and IMS are all available for transaction management
  - On Distributed, XA is available as the standard interface (JTA for JEE)
    - ➢ And MQ can act as a transaction manager

Administration

Object Definitions

- Attributes and ini files
  - Some items are queue manager attributes on one platform but not other
  - z/OS has lots related to its storage

- Some unique object types
  - z/OS has STGCLASS and CFSTRUCT
  - Distributed has SERVICES and COMMINFO

- Startup
  - CSQZPARM is assembled/linked and other inputs run during startup
    - ➢ Reset configuration, define default objects etc
  - On Distributed, standard objects are created by qmgr creation and updated during migration
    - ➢ Now supports automatic MQSC and ini file operations during qmgr startup

Object Attributes – Queue Manager

- Apart from shared queue and storage-related attributes …
  - Various events differ as shown in other charts
  - Some z/OS attributes are available in qm.ini for Distributed
    - In particular MaxChannel, MaxActiveChannel
- z/OS only
  - EXPIRYINT
  - CHIDISPS, CHIADAPS
  - ACTCHL, MAXCHL
  - ADOPTCHK, ADOPTMCA
  - DNSGROUP, DNSWLM
  - GROUPUR, IGQ, IGQAUT, IGQUSER
  - LSTRTMR,LU62ARM, LU62CHL, OPORTMIN, OPORTMAX, RCVTMIN, RCVTTYPE, TCPCHL, TCPNAME, TCPKEEP, TCPSTACK
  - SCYCASE
  - SSLTASKS
  - TRAXSTR, TRAXTBL
- Distributed only
  - ACCTCONO, ACCTINT, ACCTMQI, ACCTQ
  - ACTIVREC
  - CCSID
  - CERTVPOL
  - CHAD
  - SCHINIT, SCMDSERV
  - IMGINTVL, IMGLOGLN, IMGRCOVO, IMGRCOVQ, IMGSCHED

Object Attributes – Queues and Channels

- Apart from shared queue and storage-related attributes …
- Queue
  - DEFTYPE(SHAREDYN) z/OS
  - HARDENBO only effective on z/OS
  - INDXTYPE z/OS
  - DISTL
  - NPMCLASS
  - SCOPE Distributed only, but obsolete
  - STATQ
  - MAXFSIZE
  - TriggerData for transmission queues can be blank on Distributed, names channel on z/OS
- Channel
  - CONNAME 48 characters on z/OS, 264 elsewhere
  - Format of exit names and exit data is platform-specific
  - PUTAUT ONLYMCA/ALTMCA
  - KAINT only effective on z/OS
  - Default protocol for channels still LU62
    - ➢ Distributed don't need to use TRPTYPE on many MQSC commands

Queue Manager operations

- Message Expiry
  - z/OS has explicit config for timing of task to remove expired messages
  - Distributed has a similar task but no documented configuration
- Security Cache Scavenger
  - z/OS has parameters to control authority cache lifetime
  - No equivalent on Distributed; use REFRESH SECURITY explicit command
- Storage Scavengers
  - z/OS has tasks to release bufferpool and pageset storage
  - Distributed will release queue file storage at intervals
- Queue Indexing
  - z/OS has explicit indexes on queues to assist with retrieval patterns
  - Distributed has hashing to perform similar role but no documented configuration

Intercommunication and Clusters

- Channels are essentially the same
  - Still claims to support some obsolete protocols

- Clustering is essentially the same across all platforms
  - Including capability for multiple cluster transmission queues

- Uniform Clusters from V9.1 (automatic client rebalancing)

- MQTT, AMQP channels

Security (1)

- Authentication
  - Distributed supports userid validation in operating system and explicit LDAP
  - z/OS supports userid validation in operating system

- SSL/TLS configuration
  - Distributed (mostly) qmgr uses gskit toolkit
  - z/OS qmgr uses System SSL
  - Can lead to discrepancies in crypto algorithms supported
    - ➢ As example, there was lag between all platforms supporting TLS13
  - Different versions support different algorithms
  - And there may also be client-related discrepancies
    - ➢ Java programs rely on JSSE implementations – CipherSpec/Suite names vary by JRE
    - ➢ .Net programs usually use Microsoft inbuilt implementations
    - ➢ NSS uses OpenSSL
  - There is a good common overlap between all of these, but not identical sets
  - Current versions significantly reduce the options on all platforms after vulnerabilities & deprecations

Security (2) – Access Control

- z/OS
  - Uses system-provided interface for authorization
    - ➢ SAF is common API to RACF, Top Secret, ACF2
  - Has to work with the 4 permissions available in SAF
  - No distinction between PUT and GET
    - ➢ Often alias queues are used to isolate permissions
  - Granular control of "impersonation" (setting context, alt-user)
  - One operation may result in several authorization queries

- Distributed
  - MQ-provided authorisation interface
    - ➢ Implemented in the OAM – OS or LDAP-based
  - Many permissions on objects
  - Global controls on impersonation
    - ➢ If you have authority to use alt-user, there are no constraints on which user
  - Well-known "mqm" id for full authority
    - ➢ Cloud runs slightly differently with no "mqm" id in the container but essentially the same
  - Allows user names that are not known outside of the queue manager

Security (3) – Advanced Message Security

- Protection of at-rest message data defined by policies
  - MQSC SET POLICY, command line setmqspl
  - CSQ0UTIL which then requires a refresh/restart to take effect

- Distributed MQ supports "MCA Interception" for client connections
  - AMS processing done in SVRCONN environment

- z/OS has "MCA Interception" for queue manager connections
  - AMS processing done in CHINIT

Commands

- Basic OS-level operations are different
  - Create, start, stop, delete queue manager procedures
  - Distributed has command-line interface
  - z/OS has JCL

- Issuing configuration commands like ALTER QLOCAL
  - Distributed has runmqsc shell
  - z/OS has ISPF panels for most commands
  - And the +cpf commands for runmqsc equivalence
  - MQ Explorer is product-provided common GUI
  - REST API and MQ Console for administration available on all

- OpenShift environment has MQ Operator
  - Configured with YAML files

- Common programming interface (PCF) for configuration commands
  - z/OS requires an "extended" format which may have multiple sets of responses
    - Supporting a Queue Sharing Group environment
  - Distributed supports the same format but not as the default
  - Differences are hidden in the Java PCF classes

MQSC Commands

- Some commands not available in all platforms
- RESET QSTATS is only on z/OS
  - PCF available on all platforms
- ARCHIVE LOG is only on z/OS even though Distributed also have logs
- DISPLAY SYSTEM
- MOVE QLOCAL
  - Use dmpmqmsg
- DISPLAY QMSTATUS, APSTATUS only on Distributed
- STOP CONN only on Distributed
  - All platforms have STOP CHL to kill client connections
- Some z/OS MQSC have command-line equivalents on Distributed
  - STOP QMGR == endmqm

Monitoring

- Many queue manager event messages are common
  - For example, queue full
- But not every event is on every platform
  - Authorisation, Logging, and Channel auto-definition events are Distributed only
  - IMS Bridge events are only on z/OS
- Recording queue manager and application activity is very different
  - z/OS has SMF 115 and 116 records
  - Distributed has accounting, statistics and application activity events
- Some statistics (eg Generated Messages) may have different definitions
- DIS QSTATUS(*) UNCOM
  - A number
  - Yes/No
- Distributed accounting and stats events are analogous to SMF 116
  - Resource statistics publications are closer to SMF 115
- Application Activity Trace Events

We will talk more about monitoring in the Problem Determination presentation later

Problem Determination

- On Distributed, there are several places to look for PD information
  - Diagnostic logs written to /var/mqm/errors and /var/mqm/qmgrs/<qmgr>/errors
  - Diagnostic logs can be written in JSON
  - FFST written to /var/mqm/errors for serious errors
  - Trace provided by MQ commands and written to /var/mqm/trace

We will talk more about this in the Problem Determination presentation later

- On z/OS, also numerous places to follow the clues:
  - The MSTR and CHIN JES log
    - ➢ Should always be the first place to look
  - MQ API trace (aka user parameter trace) – a GTF trace
  - SMF 115 statistical information
  - SMF 116 class(3) accounting (task related) data
  - A dump for serious problems

Backup

- MAKEDEF and dmpmqcfg are tools to backup configuration
  - From V8, have dmpmqmsg to backup messages

- On Distributed, backup of log files is done by stopping qmgr and copying /var/mqm/log directory
  - rcdmqimg takes images of queues into logs

- On z/OS, full and fuzzy backups of pagesets are supported

- CFSTRUCT backup required for QSG
  - takes image of structure into logs

High Availability and Disaster Recovery

- Shared queues on z/OS for continuous processing
- On Distributed, MQ provides multi-instance
  - Not on z/OS because ARM is provided
- On Linux x64, MQ provides RDQM
  - For HA and DR
  - Very similar to appliance-provided capability (built on same core technology)
- New: NativeHA on CloudPak for Integration
  - Replicated/replayed logs
- Cross-site DR will usually use disk replication for any platform
  - RDQM
  - zHyperwrite for best performance of z/OS

Summary

- Title asks about oil and water

- Perhaps (olive) oil and (balsamic) vinegar is better description
  - Blending together

Any questions?