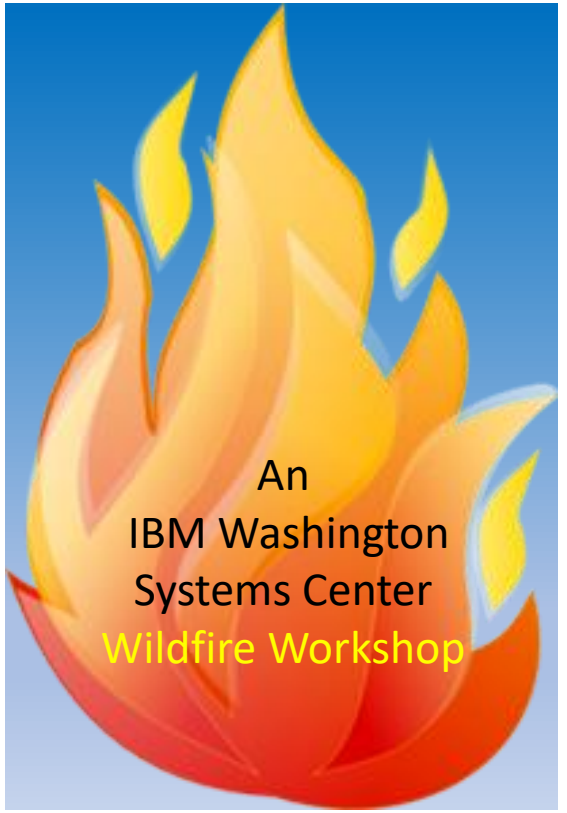
MQPERF1

MQ Statistics – The Big 4 Sources



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Need to know

- All the samples shown are derived from test and actual customer data that has been submitted for review by the WSC. In the case of customer data, all object names have been changed.

- All samples shown are the results of using MQSMFCSV, loading the data to either MYSQL or Db2 and using some of the WSC's standard queries against the data. If using different tooling the field names may be different but should be obvious enough based on the name.
  - If additional information on MQSMFCSV is needed, please see: https://github.com/ibm-messaging/mq-smf-csv

- This presentation does not cover the layout of the records and every field. It is intended for those who are already familiar with the records themselves,

What are the ‘Big 4’ in Statistics?

- In the MQ Statistics there is reporting from many of the Queue Manager internal processes.
- For individual queue managers the critical statistics that should be looked at regularly include:
  - Buffer Pools
  - Log Manager
  - Message Manager
  - Data Manager

Buffer Manager Data

Buffer Manager

- The Buffer Manager's purpose is to avoid I/O as much as possible
  - Non-persistent messages may not have any I/O
    - Messages that can be kept in memory buffers have lower CPU costs, higher throughput
  - Persistent messages always have I/O to the MQ logs
    - But may not have to be written to pagesets
  - The SMF data will show if that purpose is being fulfilled
    - These are the QPST records as mapped by macro CSQDQPST in hlq.SCSQMACS

So how do I know when I have a problem with buffer pools?

- Even if the buffer pools are above the bar, there can still be issues
- Tuning is a matter of I/O avoidance when possible
- Short On Storage (aka Suspend No Buffers)
  - The SOS (QPSTSOS) value is greater than zero
  - Zero free pages are available
  - Access to the buffer pool is suspended, until pages are freed
- Immediate Write
  - The immediate write count (QPSTIMW) is greater than zero
  - This is the number of actual write operations

So how do I know when I have a problem with buffer pools?

- Synchronous Write Threshold
  - The synchronous write threshold (QPSTDMC) count is greater than zero
  - The buffer pool is at 5% free pages or fewer
  - This is the number of time the condition is hit during the interval

- Asynchronous write threshold reached
  - The asynchronous write threshold (QPSTDWT) count is not zero
  - The threshold is at 15% free pages
  - For an on-line buffer pool, this can be an issue as I/O avoidance is the name of the game
  - For a batch buffer pool, this is expected

Defer Write Thold Reached
734
534
182
179
156
148
123
117

Buffer Manager – No Buffers and High Use Percentage

LPAR	Interval Duration	Buffer Pool	Buffer Count	Lowest Stealable	Highest Used	Highest Used Percent	Current Stealable	Suspend No Buffers	Location	Pagefixed ?
MQZ1	896	3	100000	4997	95003	95	24809	0	Above	Paged
MQZ1	896	3	100000	4998	95002	95	15404	0	Above	Paged
MQZ1	896	3	100000	4999	95001	95	19370	0	Above	Paged
MQZ1	896	3	100000	4992	95008	95	25001	0	Above	Paged
MQZ1	896	3	100000	4997	95003	95	18849	0	Above	Paged
MQZ1	896	3	100000	4996	95004	95	24756	0	Above	Paged
MQZ1	896	3	100000	4998	95002	95	24998	0	Above	Paged
MQZ1	896	3	100000	4998	95002	95	17596	0	Above	Paged
MQZ1	896	3	100000	4997	95003	95	15393	0	Above	Paged
MQZ1	896	3	100000	4998	95002	95	24761	0	Above	Paged
MQZ1	896	3	100000	4999	95001	95	25014	0	Above	Paged
MQZ1	896	3	100000	4995	95005	95	19462	0	Above	Paged
MQZ1	896	3	100000	4998	95002	95	25006	0	Above	Paged
MQZ1	896	3	100000	5263	94737	94.73	16951	0	Above	Paged
MQZ1	896	3	100000	5401	94599	94.59	17940	0	Above	Paged
MQZ1	896	3	100000	9182	90818	90.81	19047	0	Above	Paged
MQZ1	896	3	100000	13143	86857	86.85	19369	0	Above	Paged
MQZ1	896	3	100000	15393	84607	84.6	15393	0	Above	Paged
MQZ1	896	3	100000	15392	84608	84.6	15393	0	Above	Paged
MQZ1	896	3	100000	15392	84608	84.6	99999	0	Above	Paged
MQZ1	896	3	100000	15392	84608	84.6	15392	0	Above	Paged

Buffer Manager – Lots of I/O

DASD Read	Set Write Pages	Pages Written	DASD Write	Sync Writes
682917	16514424	2350967	147302	391
480042	13167182	1286958	80478	46
216333	26710330	1899236	118811	116
483311	24992237	2825900	176750	140
799627	27512782	3571587	223332	115
239498	27112226	2566329	160614	233
206126	30146462	2428770	151980	194
603459	24529158	2527266	158646	738
228938	23455084	1322486	82676	22
107400	20827079	1358693	84968	53
170414	25451358	1623838	101533	46
9106	17636613	1323335	82970	279
212021	9022529	1086765	68190	285
43120	17849585	366800	22925	0
33674	23817644	1345232	84077	0
171	6495394	135840	8490	0

(682,917 + 147,302)/896 = 926.6

Buffer pool KPIs – Lots of I/O

NOTES

- The actual I/O that is being done affects the CPU consumption of the queue manager and performance of the applications using the buffer pools. These metrics cannot be taken individually to give the health of the system but when used in combination and reviewed over time do tell whether the system is appropriately configured or needs adjustment.
- As shown in this example and as expected, when the highest used percentage is rising, and the BP is already constrained, more I/O to the pageset(s) is done.
- In this example, I/O is expected as this is a batch process, but the number of operations may be high for this environment. If calculated out per second it would be 830,219 DASD read and write requests across the interval duration of 896 seconds, or 926.6 per second.
- This is of course just for one pool in a busy queue manager. For the complete I/O picture, looking at all the buffer pool I/O that is going on within a queue manager at busy intervals is necessary.
- Whether this is an impactful number depends on the storage subsystem and management. If this is growing over time a discussion with that group is necessary especially when message volumes are expected to grow. It also depends on whether the I/O associated with this buffer pool is to one or more pagesets. If there is more than one pageset associated with this pool, I/O can be done in parallel.
- The number of sync writes also needs to be looked at – these are writes that must take place synchronously due to current processing, the size of the message as compared to the number of available buffers, etc.

Buffer Manager – Get Pages Ratio

Getp Old Requests	Getp New Requests	GPO Requests/ GPN Requests
5745	10	574.5
5744	10	574.4
5753	12	479.42
5594	17	329.06
5777	18	320.94
5776	18	320.89
5793	22	263.32
5797	23	252.04
5806	24	241.92
5800	24	241.67

- The ratio of getting ‘old’ pages to getting new pages is used as an indicator of queues being scanned for specific matches.
  - High ratios of Get Old to Get New pages when there is a low volume of activity do not indicate problems
    - In the example shown the ratios show hundreds of get old pages to get new pages – but the Message Manager reported MQGETs during these intervals are quite low
    - High volume periods are more critical to review
  - In other time periods where there is more activity, the ratio generally runs at about 5 to 1
    - Take note of this and examine the Task accounting data to see which queues are being scanned
  - Check for CSQI004I messages in the JES log

Buffer Manager – Addressing the issues

- How to address buffer pool size problems:
  - Add more pages
  - Move queues to underutilized buffer pools
  - Move queues to new buffer pools, associated page set(s), and storage classes
  - When the workload is too high – a new queue manager
- Addressing High I/O
  - If the buffer pool is less than 25,000 pages adding additional pages may help resolve the problem
  - If the buffer pool is large (over 75,000 pages) consider moving the BP above the bar and page fixing it
    - That won't reduce the I/O, but it will make it faster and less expensive.
- Addressing Message Scrolling
  - If applications are using get with a match option for an MQMD field, make sure the queue is indexed
  - If applications are matching using message properties, keep the queues as empty as possible

So how do I anticipate a problem with buffer pools?

- Make sure there is adequate head room in the buffer pool
  - If an online buffer pool is approaching the asynchronous write threshold (15% free pages) regularly, then it may need to be expanded or queues moved
    - One ‘bad day’ for a single queue could mean trouble for any application using that pool
  - If ANY buffer pool is approaching the synchronous write threshold (5% free pages) regularly, it needs to be expanded or queues moved
  - A lightly loaded buffer pool is a happy buffer pool!
- Planning tips:
  - Look out for a change in message sizes
    - Sometimes not well communicated from application development
      - Does not typically cause an error
  - Look out for changes in usage patterns
    - Adding new locations
    - Connecting client application directly to z/OS
    - New applications

Log Manager Data

Log Manager – Log Task Busy

- Logger Task Busy
  - Information about how many microseconds the logger task was idle was added in V8, QJSTSLPTU
  - The task busy percentage is calculated based on the interval duration and QJSTSLPTU
  - If consistently above 95%, then workload should be examined
    - In the example shown, the customer is anticipating growth, so a recommendation was to plan a workload split

Log Task Busy Percent
82.74%
80.85%
79.59%
79.40%
78.02%
77.98%
77.41%
77.27%
76.79%
76.72%

Log Manager – Unavailable buffers and Checkpoints

- Unavailable buffer count AKA ‘Wait for buffer’ – QJSTWRF – documented as ‘should be zero’
  - However, for many busy queue managers that count is almost never zero for a peak period
  - I (Lyn Elkins) tend not to take this so seriously, unless the number exceeds 10 per second
- Checkpoints
  - LOGLOAD – the queue manager attribute that controls the number of log records written before taking an internal checkpoint
  - Prior to V9, the number of checkpoints was only the count of those instances
  - Post V9, the number of checkpoints is the LOGLOAD generated checkpoints AND the log switch generated checkpoints

Unavailable Buffer Count
4
3
1
1
1
1
1
1

Checkpoints
189
177
176
172
164
162
162
158
157
145

Log Manager – Reading the logs

- Reads
  - Reading the log buffers, active and archive logs indicates that transactions are backing out work
  - And while logs are being read, there is no writing going on!
  - If this is rare, it can safely be ignored
  - If it is typical, investigation required
    - May need to gather the task accounting data to determine what task is doing this
    - Recently saw an issue with a new client attached application that was experiencing regular channel time outs

INTERVAL_DURATION	UNAVAILABLE_BUFFER_COUNT	LOG_READ_OUTPUT_BUFFER	LOG_READ_ACTIVE_LOG	LOG_READ_ARCHIVE_LOG	TOTAL_LOG_READS	TAPE_CONTENTION_DELAYS	CHECKPOINTS	LOG_CI	MB_PER_SECOND
1795	0	623	4461	0	5084	0	10	2821634	6.14
1789	0	417	3337	0	3754	0	9	2825604	6.17
1796	0	540	2638	0	3178	0	12	3453542	7.51
1792	0	511	2307	0	2818	0	10	2972254	6.48
1789	0	449	2082	0	2531	0	10	2818718	6.15
1773	0	392	1952	0	2344	0	12	3445866	7.59
1798	0	424	1835	0	2259	0	10	3061346	6.65
1787	0	518	1725	0	2243	0	8	2460906	5.38
1797	0	381	1824	0	2205	0	14	4037442	8.78
1797	0	581	1597	0	2178	0	9	2778470	6.04
1791	0	306	1841	0	2147	0	11	3259292	7.11

Log Manager – Long I/O times

- In this example there are a number of very long log I/O response times
- Reported in microseconds, this is going as high as 1.4+ seconds – impacting persistent message speed.
- The average I/O time over the week was around 65,000 microseconds – so these are well out of line
- Not shown here was the log number, the long I/Os were not always on the same log - but many were
- This needs to be investigated by the folks who manage the I/O subsystem.

MB_PerSecond	IO_Total_Time_1_1_us	IO_Total_Suspend_Time_1_1_us	IO_Max_Duration_1_1_us
0.18	10597717	11065671	1434308
0.15	12716669	13221591	1390594
0.1	8684189	8952939	1340836
0.2	8898824	9208455	1003748
0.12	9603396	10015326	975297
0.14	13584386	14137813	958608
0.2	12086895	12575309	943756
0.13	8770048	9094084	933591
0.18	16134054	16813463	919142
0.17	11199830	11660753	842476
0.2	12952539	13415911	834920
0.2	14622726	15273655	781723
0.15	10658564	11090891	679185
0.11	9726687	10149635	677612
0.21	19876884	20659627	513114
0.21	13723385	14223804	447616
0.22	14733487	15284274	445473
0.19	14649385	15139950	433519

So how do I anticipate a problem with message logging?

- Like the buffer manager, some issues can be avoided with care and planning.
  - As mentioned, when the log task is approaching saturation during peak periods it is time to plan a workload division
  - Check the location and the results of the BACKUP CFSTRUCT commands:
    - Log manager bottlenecks can be relieved by moving this command to a less log active queue manager
  - If log I/O durations are trending upwards, work with the DASD management team
  - Monitor checkpoint activity – if increasing over time
    - Check log file sizes
    - If > 1 per second, plan to split workload

- Planning tips:
  - Look out for a change in message sizes
    - Sometimes not well communicated from application development
      - Often causes more frequent log switches and checkpoints
  - Look out for changes in usage patterns
    - Adding new locations
    - Connecting client application directly to z/OS
    - New applications

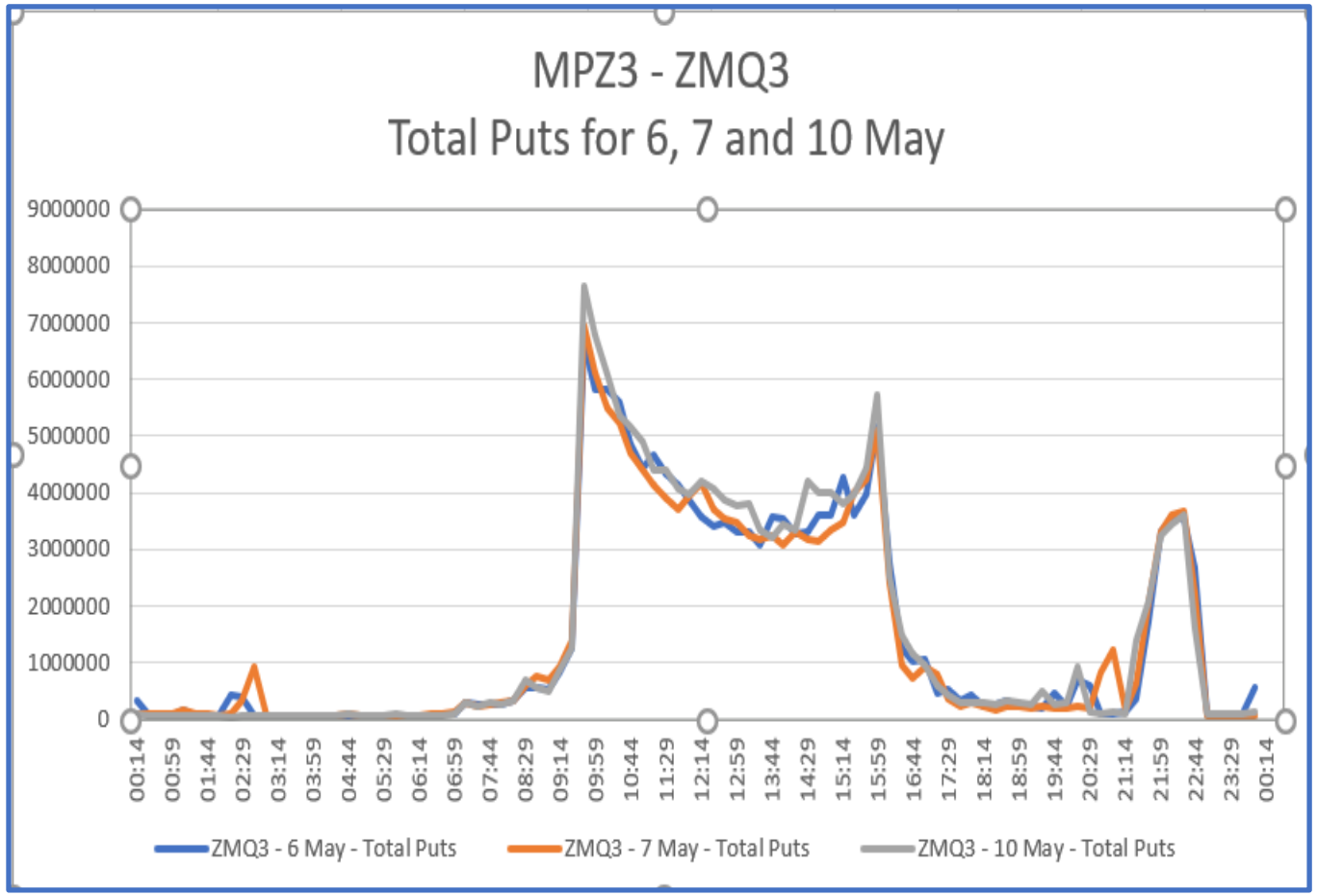
Message Manager Data

Message Manager – counting the API requests

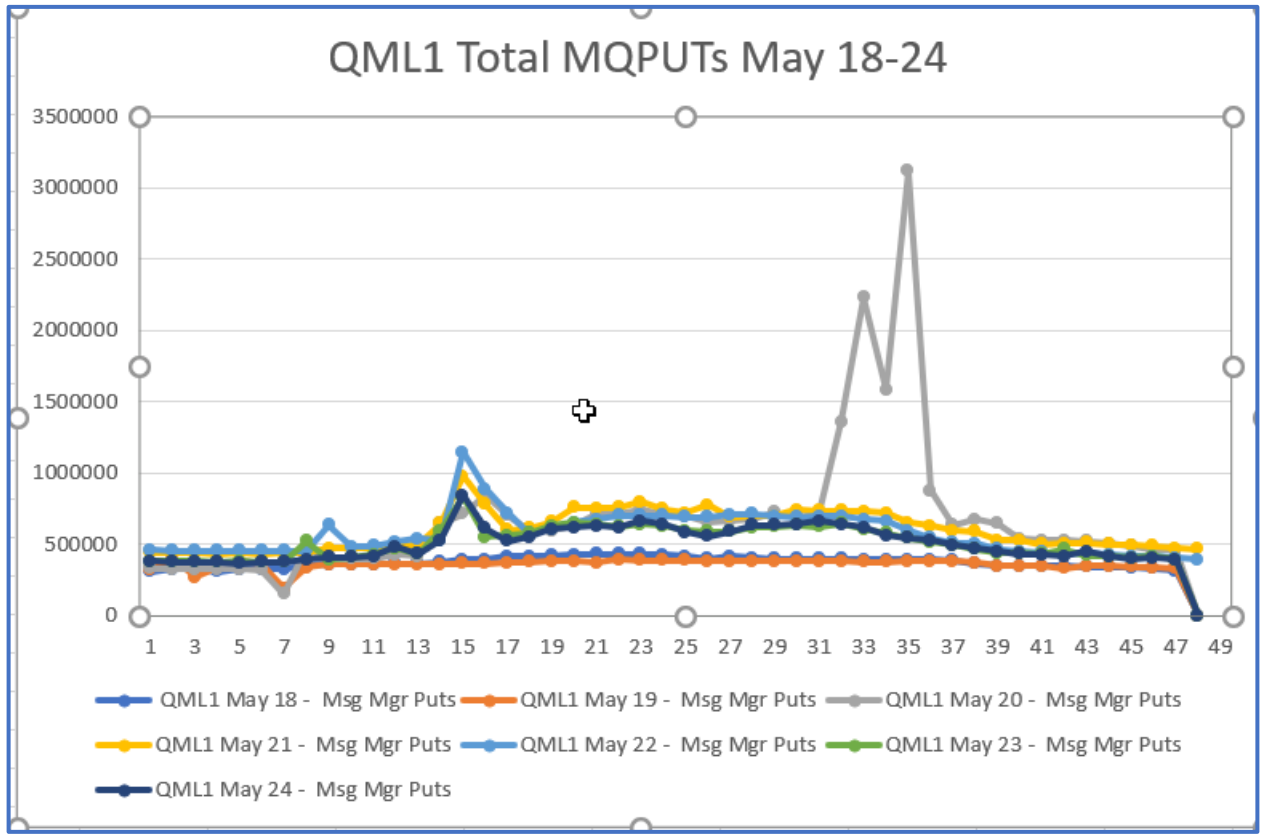
- The message manager statistics are primarily counts of requests:
  - How many MQOPEN, MQCLOSE, MQPUT, MQPUT1, MQCLOSE, etc.
  - This is a raw count of requests
- There are no counts of commands, also processed by the message manager.
- In addition to the API request counts, in 9.0.3 four fields added called ‘put statistics’:
  - QMSTSPP – Successful persistent message put, both MQPUT and MQPUT1s are counted
  - QMSTSNP – Successful nonpersistent message put, both MQPUT and MQPUT1s are counted
  - QMSTPBP – Total persistent bytes put during the interval
  - QMSTNBP – Total nonpersistent bytes put during the interval

Message Manager - High Put Volumes

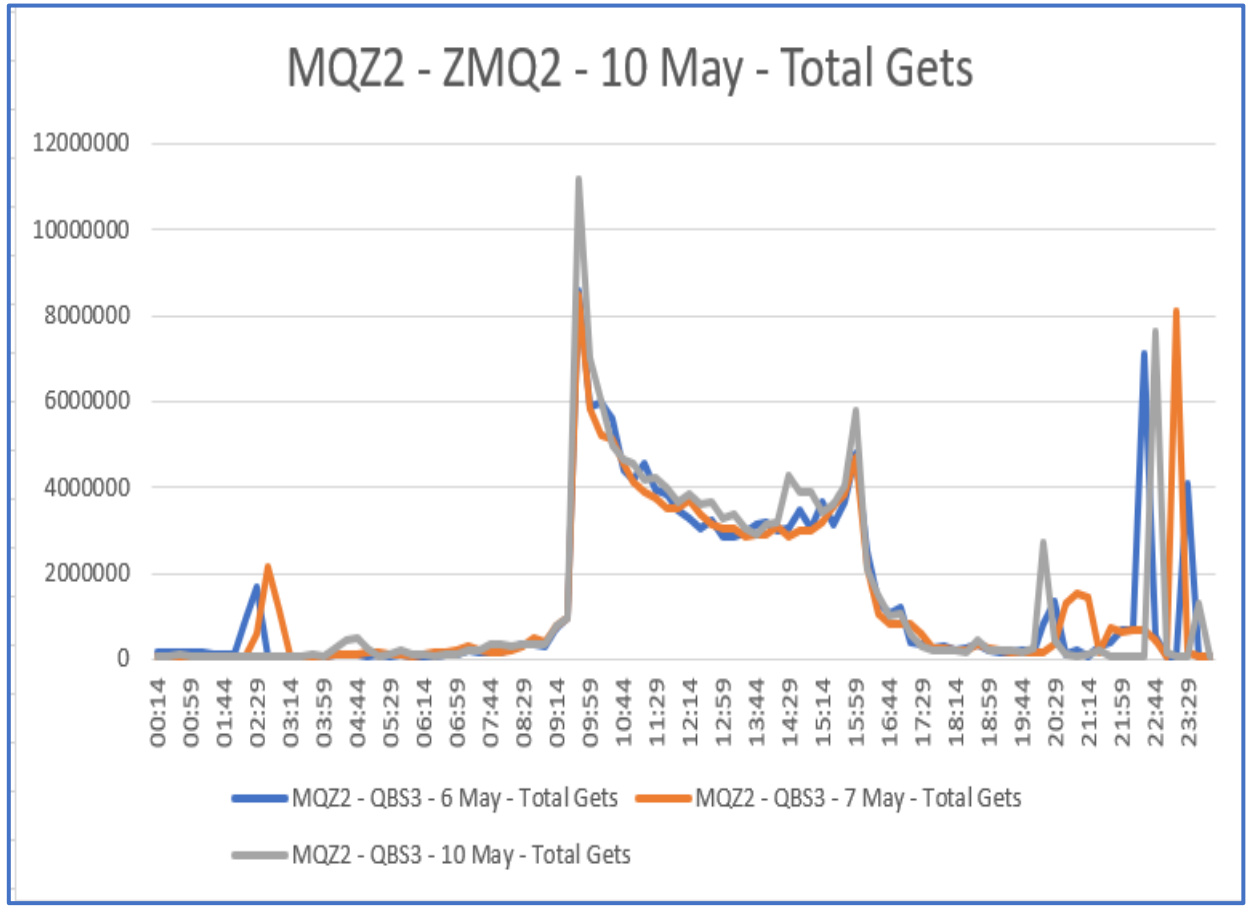
- Note the clear pattern of use for this queue manager
  - All 3 days reported the same peaks.



Message Manager - High Put Volumes



Message Manager - High Get Volumes



- Like the sample of high puts, there is a clear pattern of MQGETs requested.
- However, the count of MQGET requests is often multiple times the actual number of MQGETs that are fulfilled.
  - And there are no new Get statistics in the QMST records

Message Manager - High Publication Volumes

Put	Put1	Total Puts	Pubs
1248409	10708	1259117	509812
4517726	2467	4520193	486173
867594	2444	870038	363346
2278003	4021	2282024	294978
1970257	4142	1974399	292599

Total Pub Request Count	Total Pub API Count	Administrative Pubs - Total	High point of Pubs	Pubs - Low Point	Pubs with no Subscriber to Topic
650818	0	650818	36	1	1254
14965	0	14965	36	1	819
11953	0	11953	36	1	489
12347	0	12347	36	1	486
14562	0	14562	36	1	480
60071	0	60071	36	1	474
11688	0	11688	36	1	465
7863	0	7863	36	1	453
18180	0	18180	36	1	360

- The message manager is reporting high volumes of publications, that is putting to a topic.
  - When we see high numbers, we look at the publication data from the QTST records
- From there we can see that:
  - All publications are administrative
    - But they do not have to be
  - Note the 'Pubs with No Subscriber'

Data Manager & Message Manager Data

Data Manager – Other counts

- The data manager statistics include counts of object requests and requests passed from the MM. What we look at includes:
  - The count of object creates
    - High numbers of object creates typically indicates use of temporary dynamic queues
  - The count of object deletes
    - Often this will be multiple times the object creates value

OBJECT CREATE	OBJECT DELETE
12	480
11	568
10	388
9	387
9	560
8	386
8	385
8	444
8	432

Data Manager – Comparison to MM counts - PUTs

- The data manager statistics include counts of requests passed from the MM. What we look at includes:
  - The counts of puts passed from the MM to the DM, factors influencing the difference
    - Put to Waiting Getter – MM does not pass those to DM, counts will be lower
    - Triggering – MM creates the trigger messages, increasing the DM count
    - Events – these may or may not be counted
    - Publications to active subscribers – the MQPUT request to a topic may result in many messages, increasing the DM count
    - Publications to no subscribers – the MQPUT request to a topic may result in zero messages, decreasing the DM count

Message Mgr MQPUTs	Message Mgr MQPUT1s	Total Message Mgr Puts	Data Mgr MQPUTs	PUT Difference
117386	35976	153362	119619	33743
156486	6835	163321	156620	6701
318745	5932	324677	318781	5896
129497	5933	135430	129678	5752
145609	5028	150637	145758	4879
175299	3937	179236	175322	3914
36064	3792	39856	36096	3760
170582	2946	173528	170597	2931
29279	2733	32012	29329	2683
132597	2703	135300	132706	2594

Message Mgr MQPUTs	Message Mgr MQPUT1s	Total Message Mgr Puts	Data Mgr MQPUTs	PUT Difference
18650	24	18674	18681	-7
76666	8	76674	76680	-6
23467	9	23476	23480	-4
65251	13	65264	65268	-4
170780	25	170805	170809	-4
24188	12680	36868	36871	-3

Data Manager – Comparison to MM counts - GETs

- The data manager statistics include counts of requests passed from the MM. What we look at includes:
  - The counts of gets passed from the MM to the DM, factors influencing the difference
    - If the queue has zero depth
    - If the get includes a match option for an indexable field
    - If the get includes a match on a property value

Message Mgr MQGETs	Data Mgr MQGETs	MQGET Difference
412889	197868	215021
309108	126524	182584
269343	117371	151972
356140	212571	143569
254988	126907	128081
228162	106673	121489
330755	214017	116738
313602	202473	111129
258655	157270	101385
284143	183912	100231
265893	165789	100104
271541	171698	99843

Message Mgr MQGETs	Data Mgr MQGETs	MQGET Difference
155475	157369	-1894
21695	22928	-1233
262911	263796	-885
18243	19096	-853
18792	19583	-791
19261	20043	-782
20695	21431	-736
128096	128825	-729

Summary

- MP1B is the first tool in looking at the SMF data
- For many queue managers regular examination of the ‘big three’ reports can be a leading indicator of tuning work that may be necessary, or tell you where the problems are
- But these are not the only reports that may be needed!