IBM MQ 9.1

Managed File Transfer Performance Report for Windows – Huge File size Scenario

Configuration and Measurements for the following products:

IBM MQ MFT 9.1

IBM Corporation
IBM MQ Performance Team
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First Edition, September 2018.
This edition applies to the Managed File Transfer component of IBM MQ for Windows V9.1.0 (and to all subsequent releases and modifications until otherwise indicated in new editions).

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How this document is arranged

Performance Headlines
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Chapter 2 details the performance headlines for the two scenarios (client and bindings). Each scenario is detailed fully with diagrams in this section. The headline tests show how the Chunk Size property for an agent, and show the effect of transferring files as a group of transfers verses transferring files as a single transfer.

We detail the time taken for each transfer to complete, and the associated CPU utilisation for the hardware in use.

Tuning Recommendations
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Chapter 3 discusses the appropriate tuning that should be applied to both the IBM MQ network and Managed File Transfer agents.

Measurement Environment
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Chapter 4 gives an overview of the environment used to gather the performance results. This includes a detailed description of the hardware and software.

Contents

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1 Overview

The Managed File Transfer (MFT) component of IBM MQ is a managed file transfer product that uses IBM MQ as its transport layer. This is the first performance report on Windows and so there is no comparison to make between versions.

This performance report details IBM MQ MFT in a range of scenarios, giving the reader information on transfer times and CPU utilisation. The report is based on measurements taken from Intel hardware, running Windows Server 2016 operating systems.

At the end of each block of results is a summary of the findings. It should be noted that results obtained and the inferences made depend on the test infrastructure hardware and any change could alter the results significantly. The reader is urged to use the findings in this report only as guidelines.

2 Performance Headlines

This performance report specifically targets to understand how the MFT's performance is while transferring single large files. The measurements for the performance headlines are based on the time taken to transfer a single large file and the associated CPU cost. A single performance measurement will use individual files with the size of the files varying as follows:

- 1 GB
- 5 GB
- 10 GB
- 15 GB
- 20 GB
- 25 GB
- 30 GB

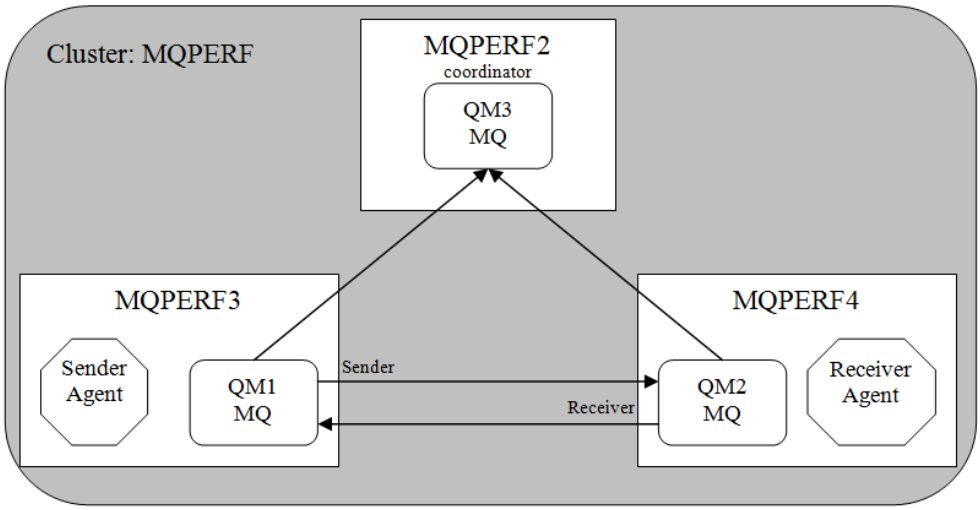
For example, when using a 10 GB file then the test will transfer a single file of that particular size in a single performance run. Each test varies the file size, demonstrating the cost of the extremely big size of the file on transfer time and CPU usage.

All files were transferred using binary mode. Each file transferred was the same size for a given performance run but contained random data. Transfers were submitted using the documented XML format.

The results are laid out in the chapters 2.1 and 2.2. Each test case has its own results table and associated graph. The first set of tables and figures show the reader the results of transfer time & transfer rate for a particular file size. At the end of the chapter is a summary that highlights the best mode of transfer is discussed with the comparative numbers.

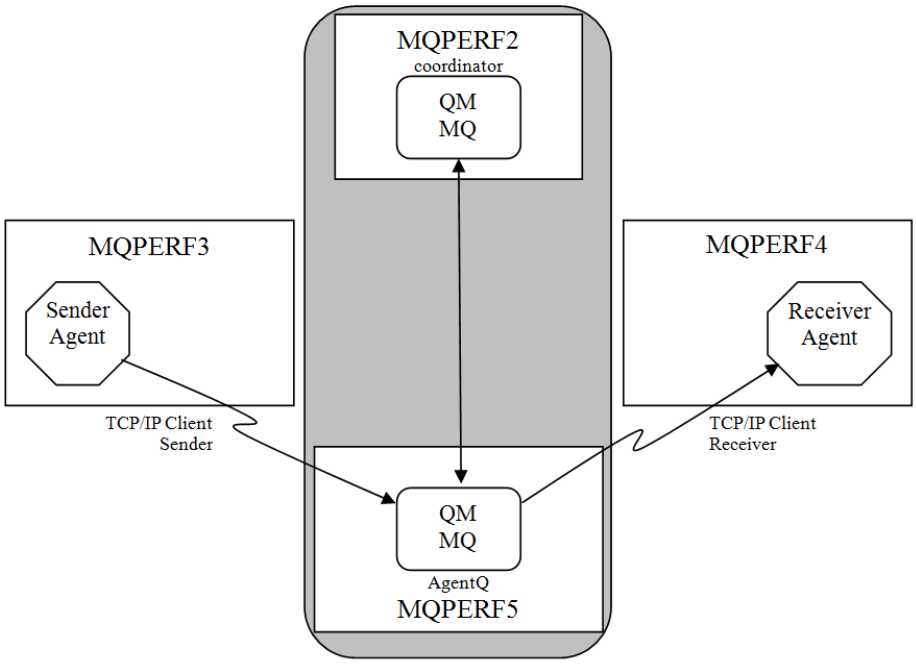
Agents Connecting in Bindings Mode

In this scenario each agent is connected to a local queue manager in *bindings* mode. The two local queue managers and a third coordinating queue manager are clustered (cluster name is 'MQPERF'). The two local queue managers are connected via Sender/Receiver channel pairs. A third queue manager is located on another machine, and is used as the coordination Queue Manager. The following diagram details the exact scenario:



Agents Connecting in Client Mode

In this scenario each agent is connected to the same single remote queue manager in client mode. A second queue manager is placed on forth machine to act as the coordination queue manager. This coordination queue manager is not highly utilised as it is not directly involved in the transfers and so will have little or no effect on the Sender CPU values that are collected. The coordinator queue manager and agent queue manager are clustered (cluster name is 'MQPERF'). The following diagram details the exact scenario:



In the following sections, the transfer speeds, CPU costs and transfer rates are grouped by mode of setup of participant machines.

2.1 Agents Connecting in Bindings Mode

The table and chart below shows the relevant times and CPU utilisation for seven different file sizes.

Tests – Bindings Mode	Coord-CPU	Agent1-CPU	Agent2-CPU	Average Transfer Time	Transfer Rate
Source: 1 GB Single Transfer	11%	11%	10%	25.18 s	325.37 Mb
Source: 5 GB Single Transfer	13%	22%	2%	131.84 s	310.69 Mb
Source: 10 GB Single Transfer	14%	26%	2%	265.49 s	308.56 Mb
Source: 15 GB Single Transfer	13%	28%	1%	366.57 s	335.22 Mb
Source: 20 GB Single Transfer	12%	26%	1%	456.28 s	359.08 Mb
Source: 25 GB Single Transfer	13%	28%	1%	570.78 s	358.81 Mb
Source: 30 GB Single Transfer	15%	24%	1%	663.34 s	430.57 Mb

Table 1 Bindings mode single instance transfers

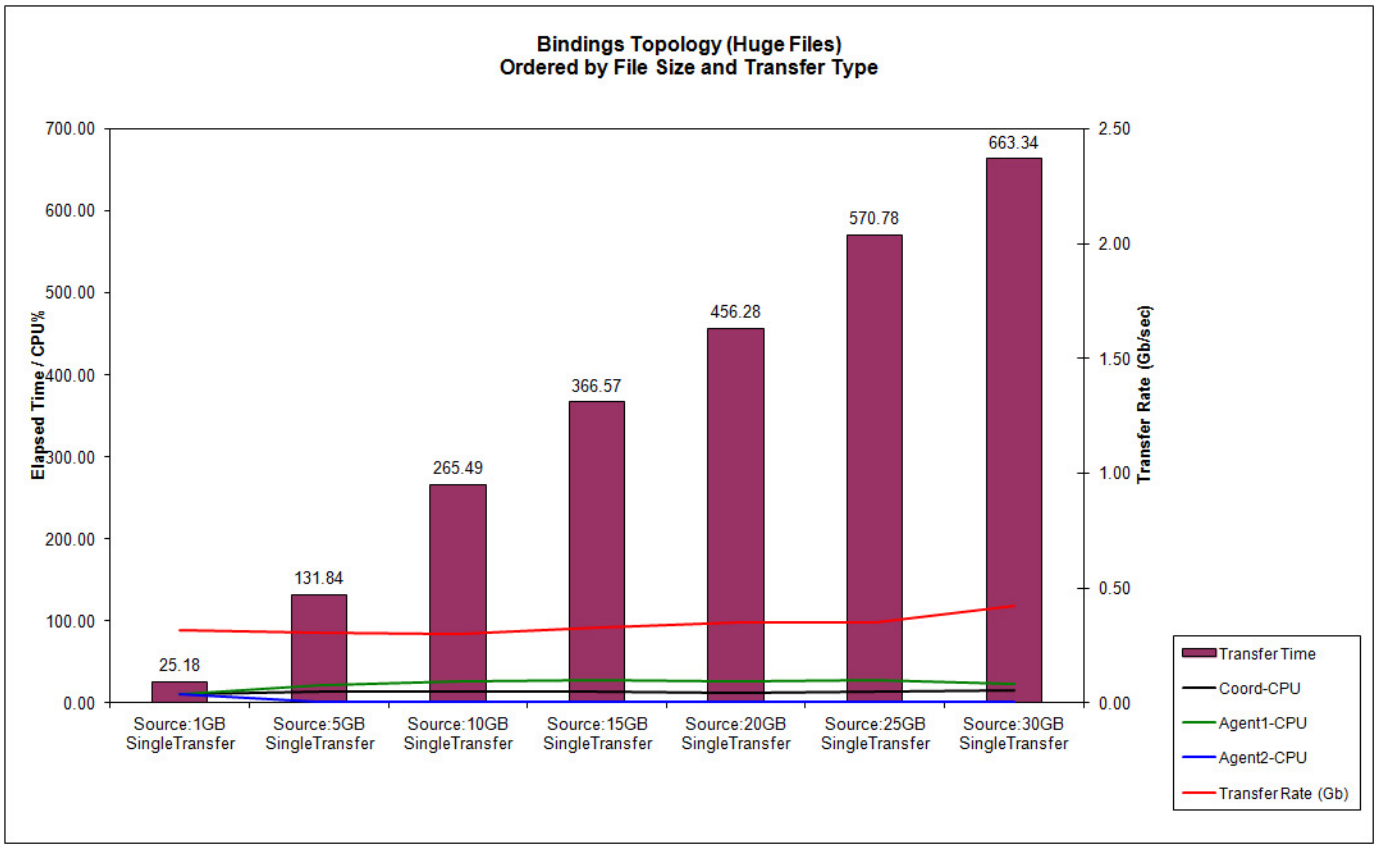


Figure 1 Chart for Bindings Mode single instance transfers

2.2 Agents Connecting in Client Mode

The table and chart below shows the relevant times and CPU utilisation for seven different file sizes.

Tests – Clients Mode	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Average Transfer Time	Transfer Rate
Source: 1 GB Single Transfer	6%	9%	15%	3%	50.19 s	163.23 Mb
Source: 5 GB Single Transfer	6%	9%	14%	1%	253.76 s	161.41 Mb
Source: 10 GB Single Transfer	5%	10%	20%	1%	548.58 s	149.33 Mb
Source: 15 GB Single Transfer	7%	10%	20%	1%	768.30 s	159.94 Mb
Source: 20 GB Single Transfer	8%	10%	20%	1%	926.13 s	176.91 Mb
Source: 25 GB Single Transfer	10%	11%	21%	1%	1,227.17 s	166.89 Mb
Source: 30 GB Single Transfer	11%	10%	25%	1%	1,409.61 s	200.27 Mb

Table 2 Clients mode single instance transfers

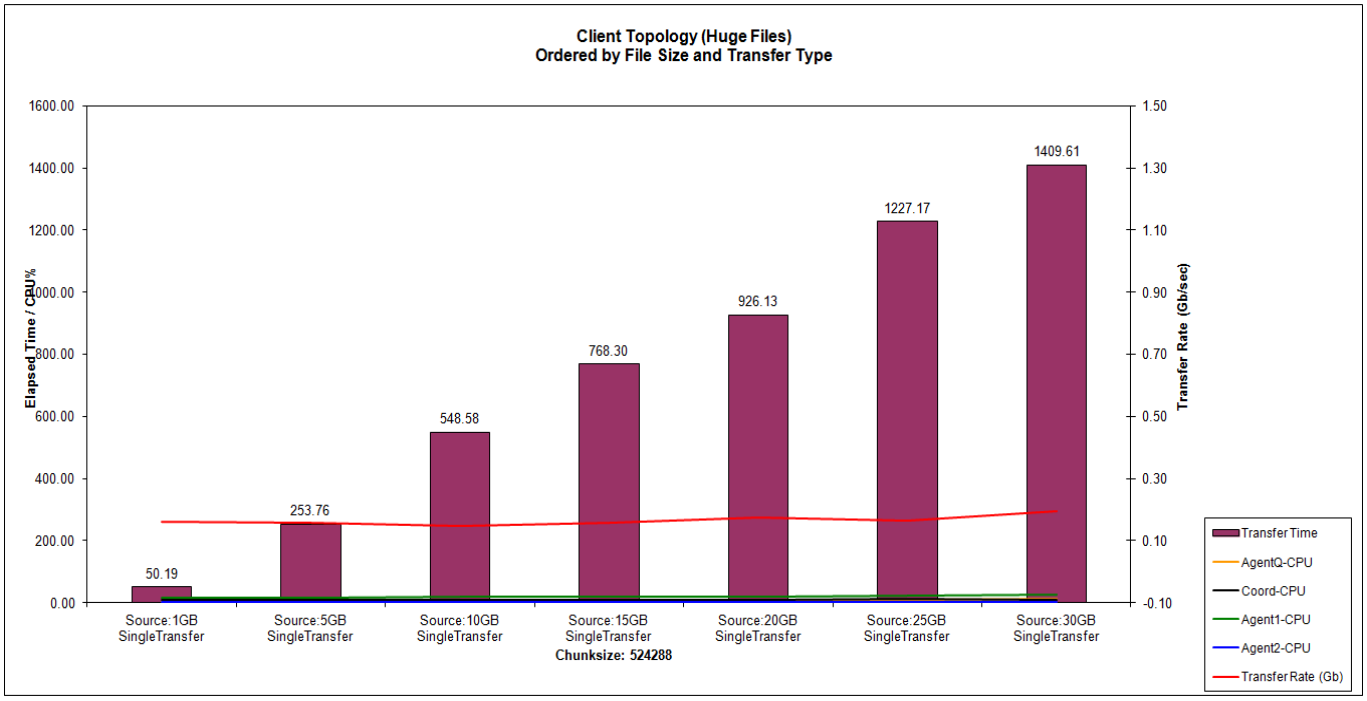


Figure 2 Chart for Clients mode single instance transfers

2.2.1 Test Summary for Bindings Vs Client's mode

Looking at the results, we try to compare between transfer speeds between bindings mode and clients mode of transfers. For this below tables prove important. A graph following these would give us a fair idea of the comparison between the two types of transfers.

Bindings Mode - v910	Transfer Time - Bindings Mode (in seconds)	Transfer Rate-Bindings Mode (in Gb/s)
Source: 1 GB Single Transfer	25.18 s	0.32
Source: 5 GB Single Transfer	131.84 s	0.30
Source: 10 GB Single Transfer	265.49 s	0.30
Source: 15 GB Single Transfer	366.57 s	0.33
Source: 20 GB Single Transfer	456.28 s	0.35
Source: 25 GB Single Transfer	570.78 s	0.35
Source: 30 GB Single Transfer	663.34 s	0.42

Table 3 Summary of Bindings mode transfers

Clients Mode - v910	Transfer Time - Clients Mode (in seconds)	Transfer Rate - Clients Mode (in Gb/s)
Source: 1 GB Single Transfer	50.19 s	0.16
Source: 5 GB Single Transfer	253.76 s	0.16
Source: 10 GB Single Transfer	548.58 s	0.15
Source: 15 GB Single Transfer	768.30 s	0.16
Source: 20 GB Single Transfer	926.13 s	0.17
Source: 25 GB Single Transfer	1227.17 s	0.16
Source: 30 GB Single Transfer	1409.61 s	0.20

Table 4 Summary of Clients mode transfers

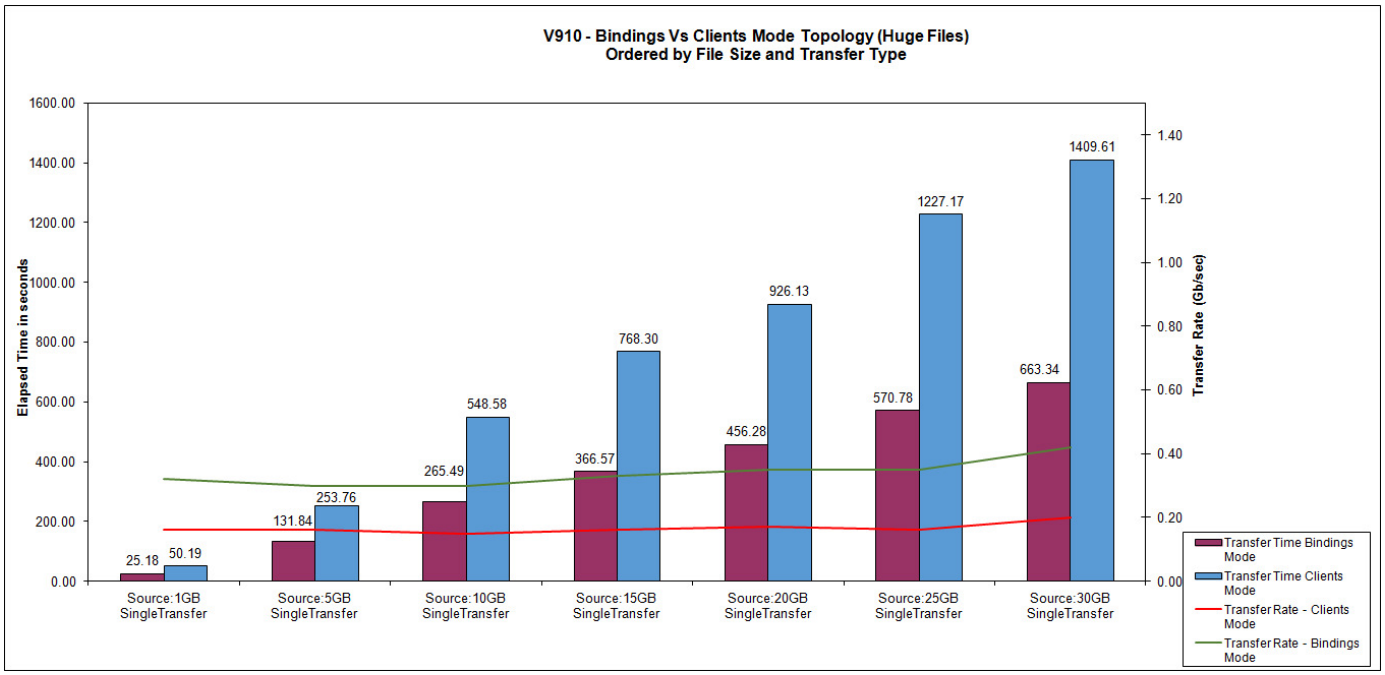


Figure 3 Chart to compare between transfer speeds between bindings mode and clients mode of transfers

Test	Transfer Time - Bindings Mode	Transfer Time - Clients Mode	Percentage Increase
Source: 1 GB Single Transfer	25.18 s	50.19 s	**99.32%**
Source: 5 GB Single Transfer	131.84 s	253.76 s	**92.48%**
Source: 10 GB Single Transfer	265.49 s	548.58 s	**106.63%**
Source: 15 GB Single Transfer	366.57 s	768.3 s	**109.6%**
Source: 20 GB Single Transfer	456.28 s	926.13 s	**102.97%**
Source: 25 GB Single Transfer	570.78 s	1227.17 s	**114.99%**
Source: 30 GB Single Transfer	663.34 s	1409.61 s	**112.5%**

Table 5 Table displaying the percentage increase in transfer speeds from bindings mode and clients mode of transfers

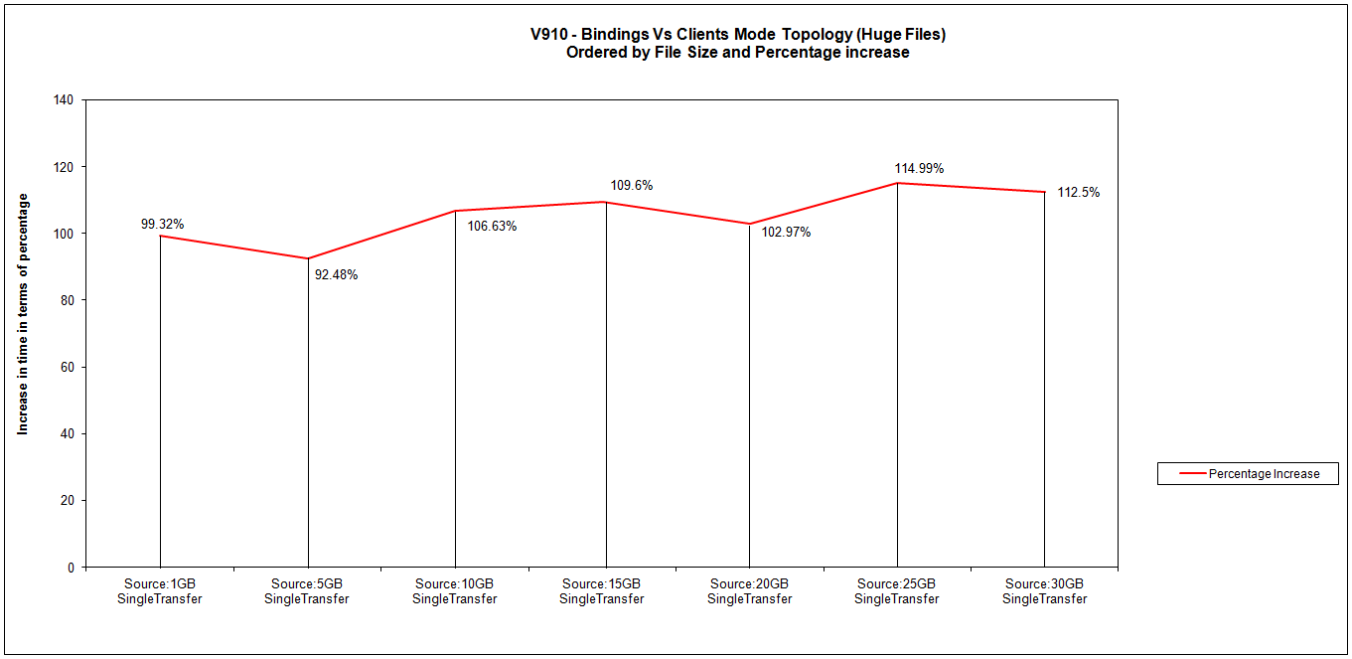


Figure 4 Chart displaying the percentage increase in transfer speeds from bindings mode and clients mode of transfers

3 Tuning Recommendations

3.1 IBM MQ Setup

Readers of this performance guide should make themselves familiar with the IBM MQ Performance Support packs that are continually released. In this case it would be for MQ 9.1 windows of particular interest.

For this performance report, advice was taken from the aforementioned (MPL3) and applied to the queue managers created accordingly. Queue managers were created using the following crtmqm command:

```
crtmqm -q -u SYSTEM.DEAD.LETTER.QUEUE -lp 16 -lf 16384 <QueueManagerName>
```

Once the queue manager was created, tuning parameters were added to the queue managers' qm.ini as follows:

```
Channels:
MQIBindType=FASTPATH

TuningParameters:
DefaultPQBufferSize=1045876
DefaultQBufferSize=1048576
```

Note that the qm.ini was updated before the queue manager was started (and therefore before the IBM MQ Managed File Transfer objects were created).

By increasing the amount of memory available to queues for persistent and non-persistent messages, you can help to avoid writing messages out to disk unnecessarily. Turning on FASTPATH for channels removes the channel process, and enables the channel to run within the main queue manager process. Please consult your documentation to understand what this means for your IBM MQ installation.

For more information on tuning a IBM MQ queue manager, please refer to the Support packs mentioned above.

3.2 IBM MQ Managed File Transfer Setup

When running agents for this performance report, the following environment property was used:

```
export FTE_JVM_PROPERTIES="Xmx2048M Xms2048M"
```

This property was set before starting an agent and sets the starting and maximum JVM heap size to be 2 GB. These values were used to ensure that the agent had sufficient memory to allocate when running the multiple transfer scenarios.

There is a property agentWindowSize that can be used to control the amount of sync-points committed, and the number of acknowledgements sent between two agents when transferring files. This property has a default value of 10. This means that for every 10 chunks of data sent over IBM MQ, the sending agent will take an internal checkpoint, and wait to receive an acknowledgement from the receiving agent before sending more data. The property's default value was determined after extensive performance work during the development of previous versions. Increasing this property increases the amount of data that could potentially need to be retransmitted if a recovery is required, and is not recommended for unreliable networks.

3.3 IBM MQ MFT: Transfer Recommendations

The following are a list of bullet pointed recommendations when planning your IBM MQ Managed File Transfer network.

- As seen in the observations, it is evident that the bindings mode architecture is the most efficient way of transferring huge files as compared to the client's mode architecture.

- Hence in case of a large file transfer in consideration, an agent connecting to its local queue manager, running on the same machine and transferring the file is best preferred.

- Multiple smaller files place the agent under strain due to the operating system open/close costs associated with more files. Where possible configure your file creation processes to generate archives of smaller files, enabling IBM MQ MFT to use less open/close calls.

- In comparison to ftp huge file transfers, mft transfers are very efficient.

- Test your typical transfers using a range of agentChunkSize parameters. Depending on the underlying hardware, you may find an optimum value for your setup.

- Reading and writing to physical disk is often going to be the performance bottleneck. For agents that will see a large number of incoming and outgoing transfers it would be best if high performance disks were used to read data from and write data to.

- When configuring your MQ network, use the appropriate IBM MQ Performance Report to apply optimal settings for your platform.

- Ensure that you have sufficient RAM for your agents. The performance tests used 8GB of RAM, it is recommended that you read your Operating System guide on memory usage and plan accordingly.

4 Measurement Environment

4.1 Agents

- IBM MQ Managed File Transfer Version 9.1 was used for this report.
- Default properties were used for agents.
- Agents were reading/writing files to the local file system, not the SAN.

4.2 IBM MQ

- IBM MQ Version 9.1 was used for all machines.
- Queue managers created in accordance with Performance report.

4.3 Operating System

- Windows Server 2016 Standard 64 bit.

4.4 Hardware

System:	MQPERF2, MQPERF3 and MQPERF4
Machine Type:	x64 based Processor, virtual
Processor:	Westmere E56xx/L56xx/X56xx (Nehalem-C) 2.39GHz
Architecture:	4 CPU
Memory (RAM):	8 GB
Disk:	Internal disk hosting OS – 250 GB

System:	MQPERF5
Machine Type:	x64 based Processor, virtual
Processor:	Westmere E56xx/L56xx/X56xx (Nehalem-C) 2.39GHz
Architecture:	8 CPU
Memory (RAM):	16 GB
Disk:	Internal disk hosting OS – 400 GB