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WebSphere MQ 7.5

Managed File Transfer Performance Report for Windows

Configuration and Measurements for the following products:

WebSphere MQ 7.5

IBM Corporation
WebSphere MQ Performance Team
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First Edition, November 2012.
This edition applies to WebSphere MQ File Transfer Edition for Windows V7.5 (and to all subsequent releases and modifications until otherwise indicated in new editions).

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How this document is arranged

Performance Headlines
Pages: 2-13

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
Pages: 14-16

Chapter 3 discusses the appropriate tuning that should be applied to both the WebSphere 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 WebSphere MQ is a managed file transfer product that uses WebSphere 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 WebSphere 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 2003/2008 operating systems.

While producing this document, identical tests were run using MQ File Transfer Edition V7.4.0.1[1]. From those results it was concluded that the majority of the tests were close enough in all respects to the WebSphere MQ V7.5 MFT component to preclude their inclusion in this report.

There was no code page conversion required between the machines and the tests only measured text messages.

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 – this is particularly true for results were all of the values are very close.

[1] WebSphere MQ File Transfer Edition was previously a separate product, which now forms the integrated managed file transfer capability, available for optional installation, within WebSphere MQ V7.5.

2 Performance Headlines

The measurements for the performance headlines are based on the time taken to transfer a set of files and the associated CPU cost. A single performance measurement will use 1GB worth of files, with the size of the files varying as follows:

- 1MB
- 10MB
- 100MB

For example, when using a 1MB file then the test will transfer 1000 files in a single performance run. Each test varies the file size, but keeping the same overall MB transferred constant thus demonstrating the cost of the open and close file operations on transfer time and CPU usage.

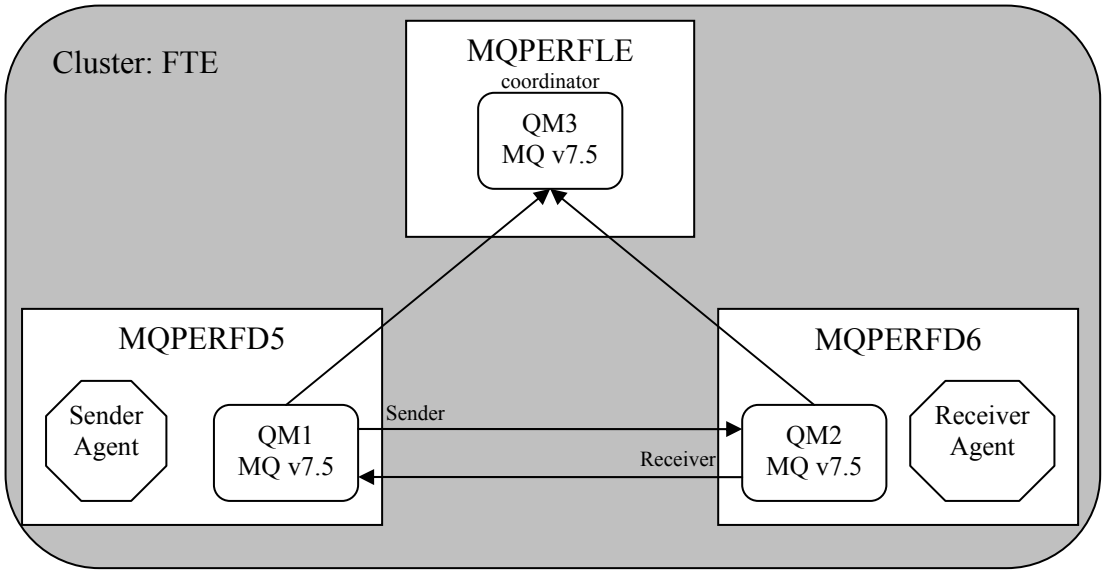
The performance headlines demonstrate the effect of altering the agent's Chunk Size property (see http://pic.dhe.ibm.com/infocenter/wmqv7/v7r5/index.jsp "WebSphere MQ Managed File Transfer→Reference→Configuring→The agent.properties file" for more details on setting this property). The Chunk Size defines the size of the MQ message that the agent will use to transfer the files. The following Chunk Sizes (defined in bytes) have been used:

- 65536
- 131072
- 262144 (this is the agent's default value)
- 524288

To demonstrate the multithreaded capability of the agent, a multiple transfer test was run and compared to a single transfer run. The multiple transfer test divides the number of files transferred in the single transfer test by ten and submitted them at the same time.
All files were transferred using text mode as opposed to 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.

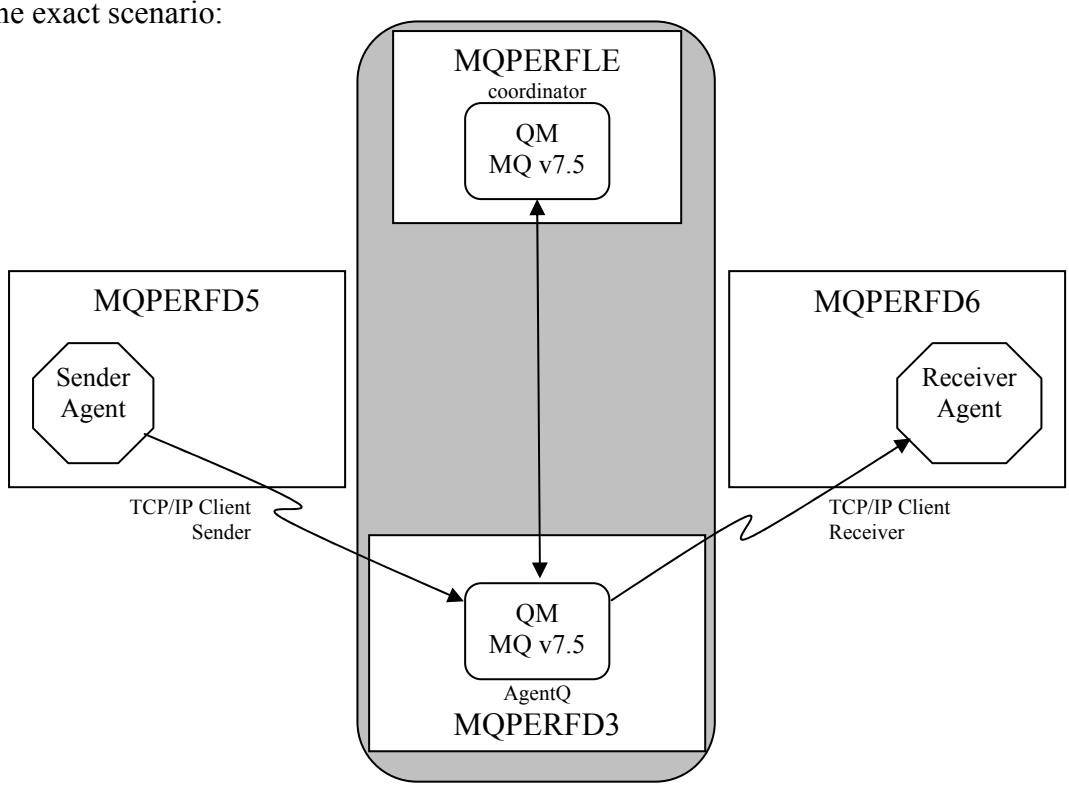
The results are laid out in the chapters 2.1 and 2.2. Each test case has its own results table and associated graph. The first set of tables and figures show the reader the results for each chunk size (agentChunkSize) property has on the transfer time for a particular file size. At the end of the chapter is a summary that highlights the best combinations of chunk size and file size for single and multiple threaded tests.

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 'FTE'). 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 'FTE'). The following diagram details the exact scenario:



In the following sections, the transfer speeds and CPU costs are grouped by chunk size and show the comparative costs for single and multithreaded transfers.

2.1 Agents Connecting in Bindings Mode

2.1.1 65635 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	20%	14%	1%	93.43 s	87.68 Mb
Source:10MB Single Transfer	15%	16%	1%	67.47 s	121.42 Mb
Source:100MB Single Transfer	16%	16%	1%	65.32 s	125.41 Mb
Source:1MB Multi Transfer	22%	25%	1%	81.17 s	100.92 Mb
Source:10MB Multi Transfer	20%	21%	1%	70.83 s	115.65 Mb
Source:100MB Multi Transfer	21%	21%	1%	68.46 s	119.66 Mb

Table 1 65635 byte chunk size values for Single and Multiple instance transfers

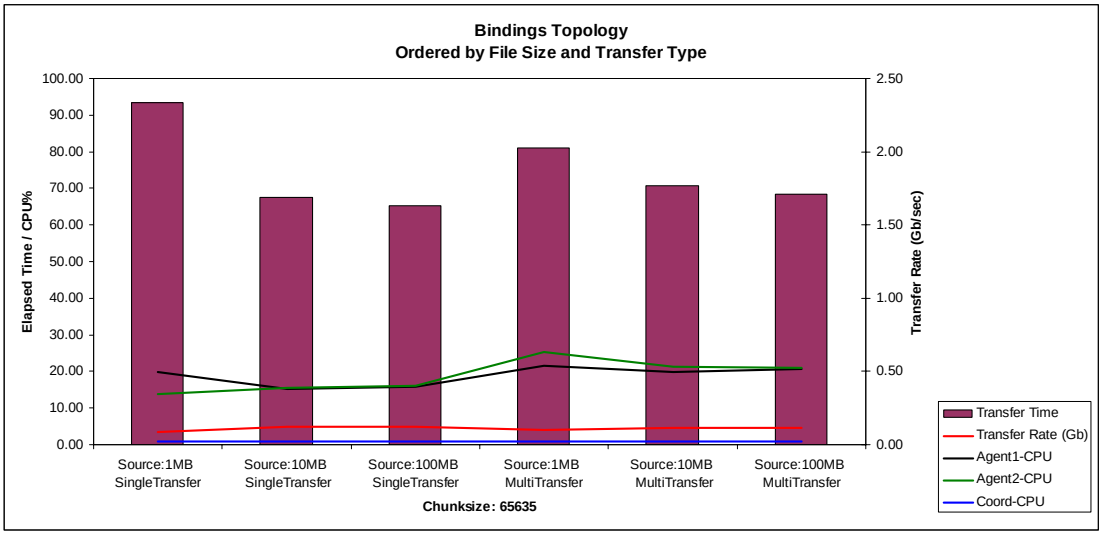


Figure 1 65635 byte chunk size values for Single and Multiple instance transfers

2.1.2 131072 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	22.91%	16.29%	0.77%	89.58 s	91.45 Mb
Source:10MB Single Transfer	16.63%	29.45%	0.79%	68.36 s	119.84 Mb
Source:100MB Single Transfer	19.65%	20.42%	0.70%	56.55 s	144.86 Mb
Source:1MB Multi Transfer	21.29%	24.48%	0.86%	86.01 s	95.25 Mb
Source:10MB Multi Transfer	22.19%	22.08%	0.68%	70.66 s	115.93 Mb
Source:100MB Multi Transfer	22.68%	22.44%	0.76%	69.55 s	117.78 Mb

Table 2 131072 byte chunk size values for Single and Multiple instance transfers

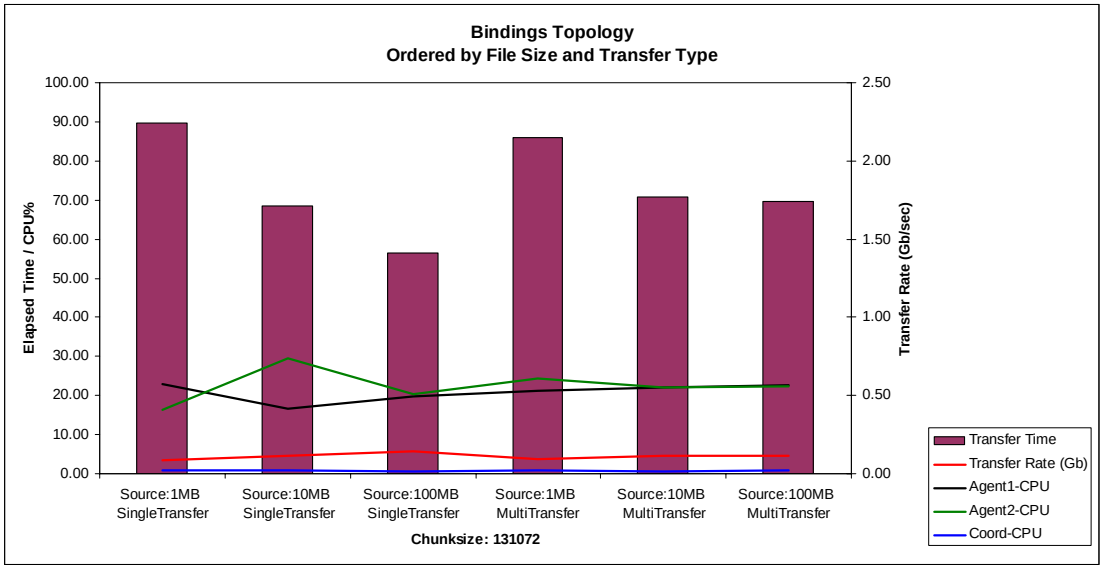


Figure 2 131072 byte chunk size values for Single and Multiple instance transfers

2.1.3 262144 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	22%	16%	1%	101.19 s	80.95 Mb
Source:10MB Single Transfer	20%	20%	1%	58.92 s	139.04 Mb
Source:100MB Single Transfer	19%	19%	1%	65.66 s	124.76 Mb
Source:1MB Multi Transfer	23%	26%	1%	85.00 s	96.38 Mb
Source:10MB Multi Transfer	24%	24%	1%	70.22 s	116.67 Mb
Source:100MB Multi Transfer	24%	25%	1%	67.71 s	120.99 Mb

Table 3 262144 byte chunk size values for Single and Multiple instance transfers

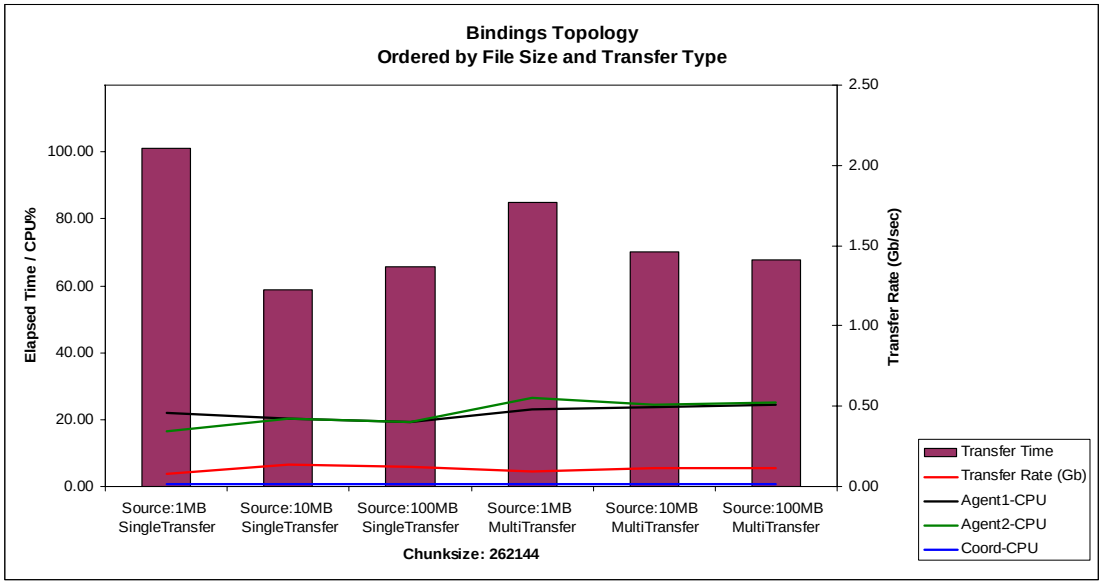


Figure 3 262144 byte chunk size values for Single and Multiple instance transfers

2.1.4 524228 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	20%	11%	1%	88.28 s	92.80 Mb
Source:10MB Single Transfer	18%	9%	1%	58.54 s	139.93 Mb
Source:100MB Single Transfer	19%	10%	1%	61.53 s	133.14 Mb
Source:1MB Multi Transfer	25%	19%	1%	83.23 s	98.42 Mb
Source:10MB Multi Transfer	24%	14%	1%	70.37 s	116.41 Mb
Source:100MB Multi Transfer	34%	13%	1%	67.34 s	121.64 Mb

Table 4 524228 byte chunk size values for Single and Multiple instance transfers

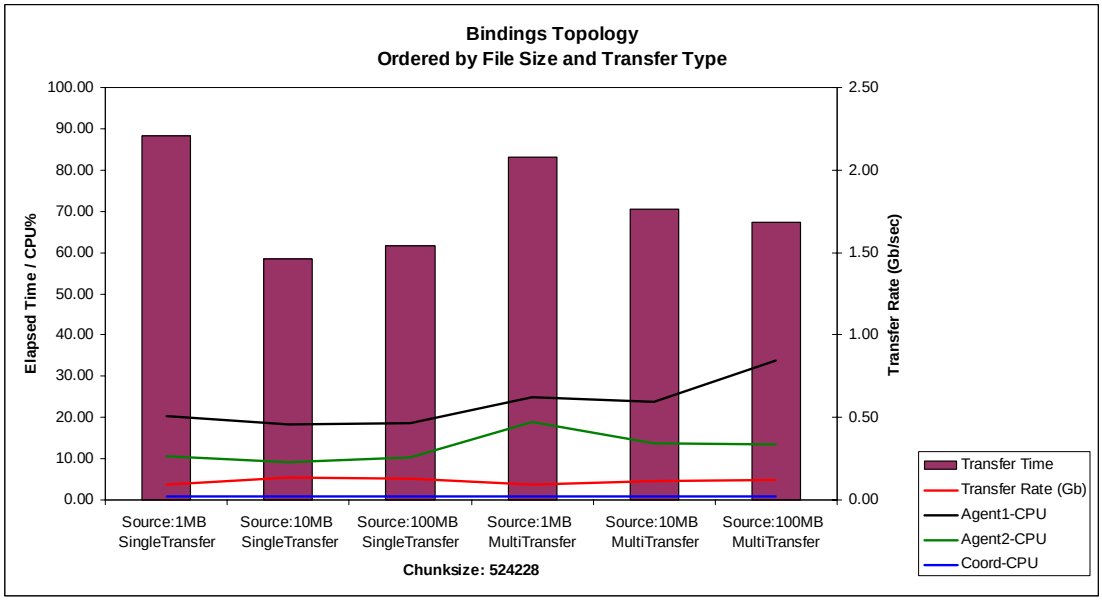


Figure 4 524228 byte chunk size values for Single and Multiple instance transfers

2.1.5 Test Summary

Looking across the results, the quickest transfers were attained at the following chunk sizes, file sizes and transfer types.

File Size and Transfer Type	Transfer Time	Chunk size
1MB Single Instance Transfer	88.28 s	524228 Bytes
10MB Single Instance Transfer	58.54 s	524228 Bytes
100MB Single Instance Transfer	56.55 s	131072 Bytes
1MB Multi Instance Transfer	81.17 s	65635 Bytes
10MB Multi Instance Transfer	70.22 s	262144 Bytes
100MB Multi Instance Transfer	67.34 s	524228 Bytes

Table 5 Best transfer speeds for Single and Multiple instance transfers

The table of results above show that generally, for single transfers the larger the chunk size, the quicker the test completed. This would not be expected to continue much beyond 512KB.
For multiple client transfers there is no optimum chunk size. The transfer times are generally not as fast as the single threaded results – this could be due to a number of factors, but is more likely to be due to a combination of factors such as the Agent machines only have a small number of cores and/or the Agent CPU levels are less than 50% so there could be limitations due to the machine's I/O capabilities.

2.2 Agents Connecting in Client Mode

2.2.1 65635 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	AgentQ-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	18%	6%	15%	1%	110.69 s	77.68 Mb
Source:10MB Single Transfer	15%	2%	15%	1%	76.84 s	113.93 Mb
Source:100MB Single Transfer	9%	1%	16%	1%	74.88 s	117.01 Mb
Source:1MB Multi Transfer	18%	11%	15%	1%	88.92 s	98.95 Mb
Source:10MB Multi Transfer	16%	4%	16%	1%	75.62 s	116.47 Mb
Source:100MB Multi Transfer	17%	4%	16%	1%	76.32 s	115.02 Mb

Table 6 65635 byte chunk size values for Single and Multiple instance transfers

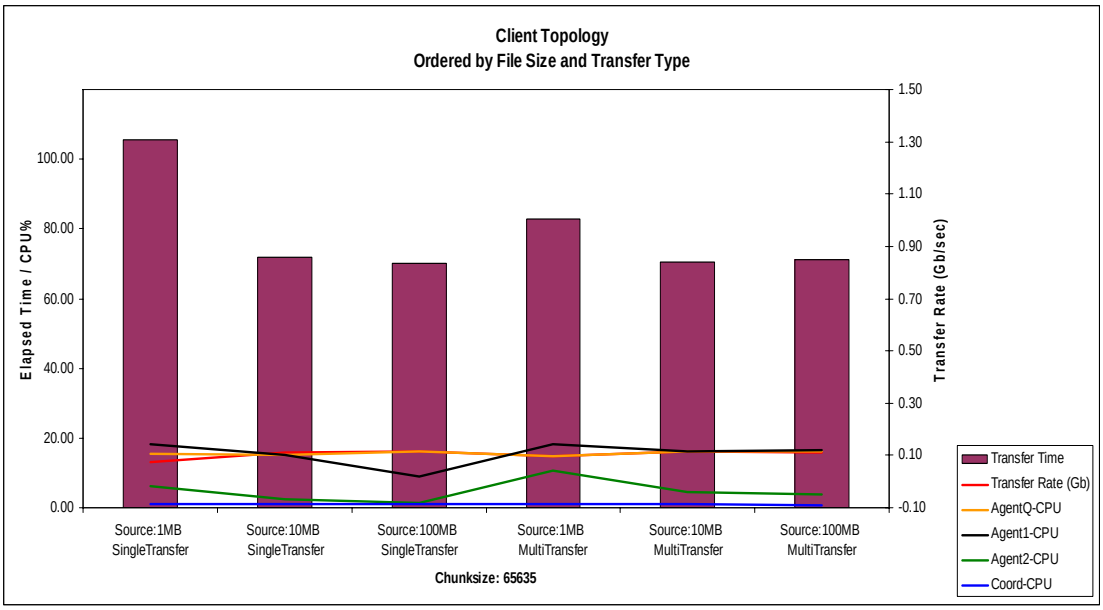


Figure 5 65635 byte chunk size values for Single and Multiple instance transfers

2.2.2 131072 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	AgentQ-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	45%	38%	43%	2%	102.76 s	83.79 Mb
Source:10MB Single Transfer	11%	2%	15%	1%	79.14 s	110.62 Mb
Source:100MB Single Transfer	11%	1%	15%	1%	77.44 s	112.79 Mb
Source:1MB Multi Transfer	17%	10%	15%	2%	88.04 s	99.27 Mb
Source:10MB Multi Transfer	18%	4%	17%	1%	78.47 s	112.15 Mb
Source:100MB Multi Transfer	16%	4%	16%	1%	73.99 s	120.10 Mb

Table 7 131072 byte chunk size values for Single and Multiple instance transfers

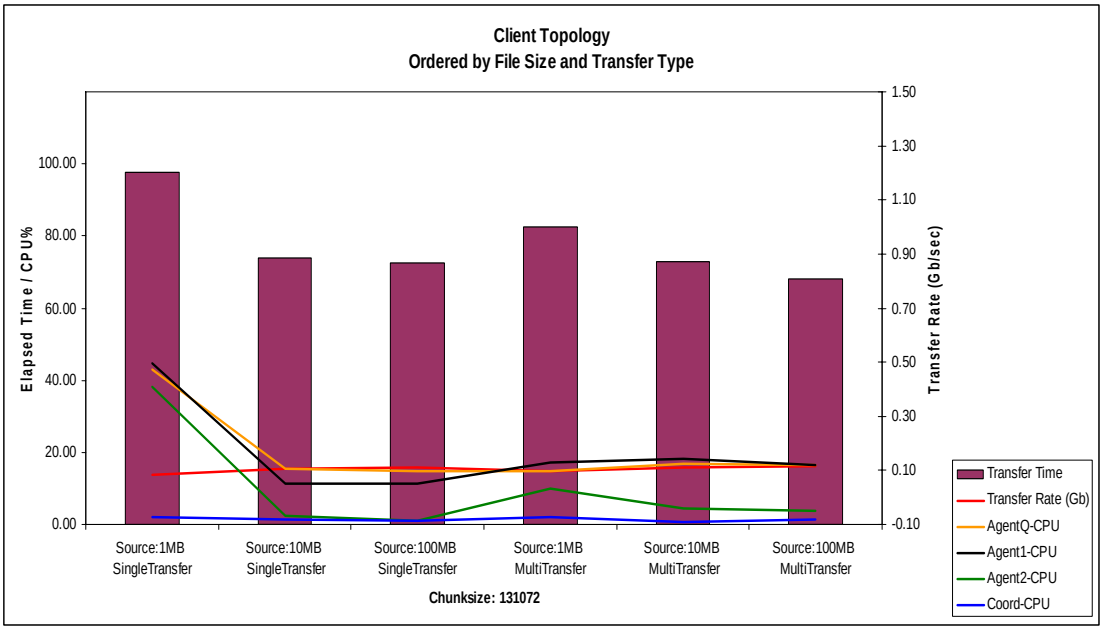


Figure 6 131072 byte chunk size values for Single and Multiple instance transfers

2.2.3 262144 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	AgentQ-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	18%	8%	23%	2%	100.62 s	85.67 Mb
Source:10MB Single Transfer	8%	2%	16%	2%	68.02 s	130.54 Mb
Source:100MB Single Transfer	12%	2%	15%	2%	76.58 s	114.24 Mb
Source:1MB Multi Transfer	18%	10%	14%	1%	89.24 s	98.10 Mb
Source:10MB Multi Transfer	18%	5%	17%	2%	76.11 s	115.23 Mb
Source:100MB Multi Transfer	16%	4%	17%	1%	75.01 s	117.84 Mb

Table 8 262144 byte chunk size values for Single and Multiple instance transfers

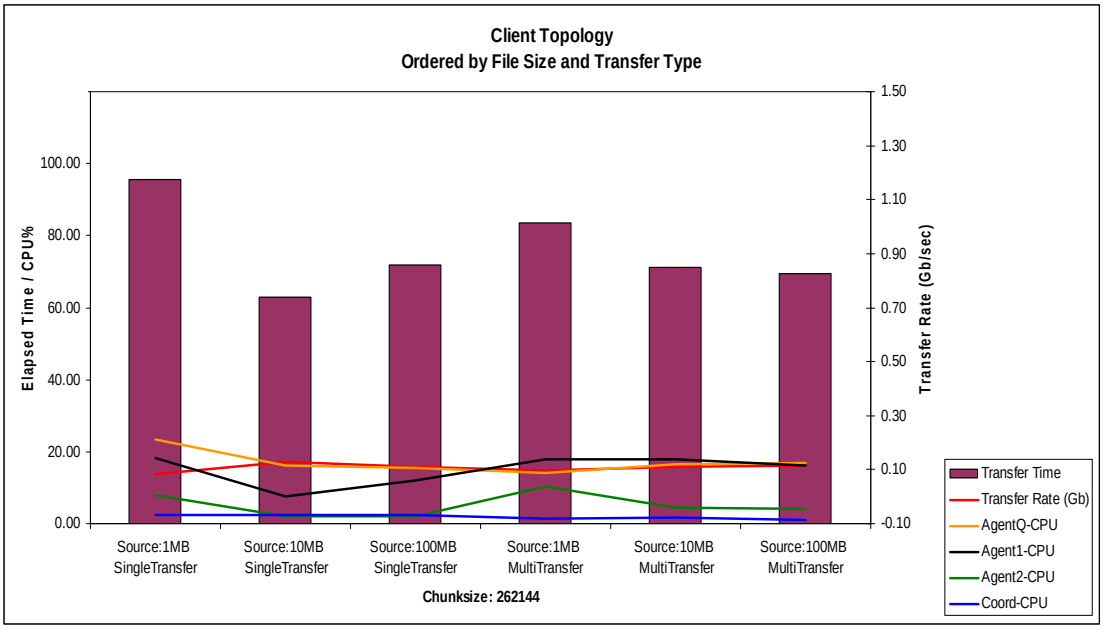


Figure 7 262144 byte chunk size values for Single and Multiple instance transfers

2.2.4 524228 ChunkSize

The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

Test	Agent1-CPU	Agent2-CPU	AgentQ-CPU	Coord-CPU	Transfer Time	Transfer Rate
Source:1MB Single Transfer	16%	18%	1%	6%	90.38 s	95.79 Mb
Source:10MB Single Transfer	16%	17%	1%	4%	68.16 s	129.05 Mb
Source:100MB Single Transfer	16%	17%	1%	4%	75.09 s	121.01 Mb
Source:1MB Multi Transfer	17%	16%	1%	2%	86.36 s	102.17 Mb
Source:10MB Multi Transfer	17%	27%	1%	2%	73.37 s	120.73 Mb
Source:100MB Multi Transfer	16%	30%	1%	2%	71.79 s	122.94 Mb

Table 9 524228 byte chunk size values for Single and Multiple instance transfers

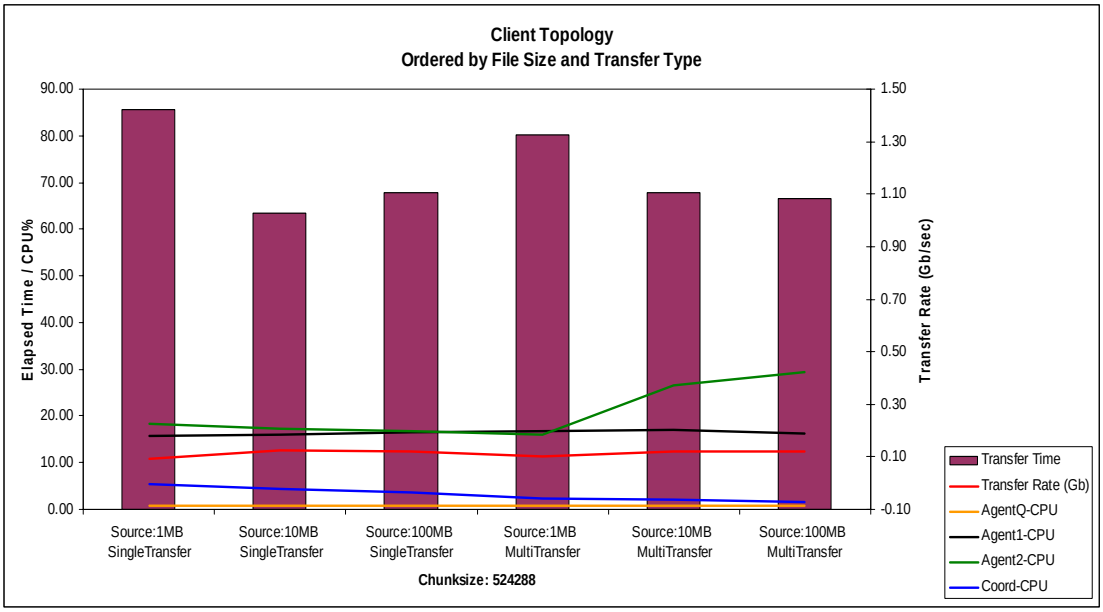


Figure 8 524228 byte chunk size values for Single and Multiple instance transfers

2.2.5 Test Summary

Looking across the results, the quickest transfers were attained at the following chunk sizes, file sizes and transfer types.

File Size and Transfer Type	Transfer Time	Chunk size
1MB Single Instance Transfer	85.52 s	524288 Bytes
10MB Single Instance Transfer	62.76 s	262144 Bytes
100MB Single Instance Transfer	67.70 s	524288 Bytes
1MB Multi Instance Transfer	80.18 s	524288 Bytes
10MB Multi Instance Transfer	67.85 s	524288 Bytes
100MB Multi Instance Transfer	66.64 s	524288 Bytes

Table 10 Best transfer speeds for Single and Multiple instance transfers

For single instance transfer, as with agent bindings, agents connecting in client mode have the best transfer time for larger chunk sizes. The difference is that there is now an overwhelming advantage for larger chunk sizes for multiple instance transfers.
With an agent chunk size value of 512KB, we can see that multiple bindings and multiple client scenarios are almost identical in transfer time. The addition of the off-board MQ queue manager instance altered the CPU utilisation as expected, but did not give a decrease in transfer time.

3 Tuning Recommendations

3.1 WebSphere MQ Setup

Readers of this performance guide should make themselves familiar with the WebSphere MQ Performance Supportpacs that are continually released. They can be found here: http://www.ibm.com/support/docview.wss?rs=171&uid=swg27007197#1. Of particular interest for Windows is the Supportpac MPL3 for MQ Version 7.5.

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 WebSphere 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 WebSphere MQ installation.

For more information on tuning a WebSphere MQ queue manager, please refer to the Supportpacs mentioned above.

The use of high performance disks (SAN for example) is recommended for a WebSphere MQ installation. Separating out your log and queue directory structures from the regular file system is a well documented best practice that helps to create a queue manager that responds well to high throughput scenarios.

3.2 WebSphere 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 2GB. These values were used to ensure that the agent had sufficient memory to allocate when running the multiple transfer scenarios.

As demonstrated in the results, altering the agentChunkSize can have a significant impact on both CPU utilisation and transfer time. There is another 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 WebSphere 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 version 7.0.1. 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 WebSphere MQ MFT: Transfer Recommendations

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

- Send large numbers of files over multiple transfers, rather then a single large transfer. This will increase the efficiency of the I/O involved in transferring the files, which will ultimately decrease the transfer time.

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

- 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 WebSphere MQ MFT to use less open/close calls.

- 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. This is demonstrated by the multiple/client and multiple/bindings scenarios. Due to the use of internal disks for WebSphere MQ, Client connectivity actually outperformed Bindings. This behaviour can be explained because the Agents reading/writing to the physical disks at the same time as a local MQ instance, causing an I/O bottleneck.

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

- Ensure that you have sufficient RAM for your agents. The performance tests used 2GB of RAM, it is recommended that you read your Operating System guide on memory usage and plan accordingly.

4 Measurement Environment

4.1 Agents

- WebSphere MQ Managed File Transfer Version 7.5 was used for this report.
- Default properties were used for agents, except for agentChunkSize.
- Agents were reading/writing files to a SAN, no the local file system.

4.2 WebSphere MQ

- WebSphere MQ Version 7.5 was used for all machines.
- Queue managers created in accordance with Performance report.
- Queue and Log files systems were mounted on SAN disks.

4.3 Operating System

- Windows Server 2003/2008 64bit.

4.4 Hardware

System x3850:	MQPERFD3, MQPERFD5 and MQPERFD6
Machine Type:	8864-4RG
Processor:	3.33GHz
Architecture:	4 CPU
Memory (RAM):	4 GB
Disk:	Internal disk hosting OS. 2 external SAN partitions hosting Queues and Logs
Network:	10Gb Ethernet Adapter (onboard)

System x3850 X5:	MQPERFLE
Machine Type:	7143-B7G
Processor:	2.4GHz, 4 x E7-8870 10-core Xeon, 30MB shared L3 cache
Architecture:	44 CPU
Memory (RAM):	32 GB
Disk:	Internal disk hosting OS. 2 external SAN partitions hosting Queues and Logs
Network:	10Gb Ethernet Adapter (onboard)