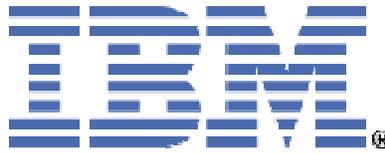


IBM MQ 9.0.5 Managed File Transfer Performance Report for Windows

Configuration and Measurements for the following products:

IBM MQ MFT 9.0.5



IBM Corporation
IBM MQ Performance Team
June 2018



IBM MQ Managed File Transfer V9.0.5 Performance Report

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First Edition, November 2018.

This edition applies to the Managed File Transfer component of IBM MQ for Windows V9.0.5.0 (and to all subsequent releases and modifications until otherwise indicated in new editions).

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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

Pages: 36-38

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

Measurement Environment

Pages: 39-40

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

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

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 2GB 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 2000 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

https://www.ibm.com/support/knowledgecenter/en/SSFKSJ_9.0.0/com.ibm.wmqfte.doc/properties.htm

“Managed File Transfer—► MFT Reference —► MFT configuration reference —► 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

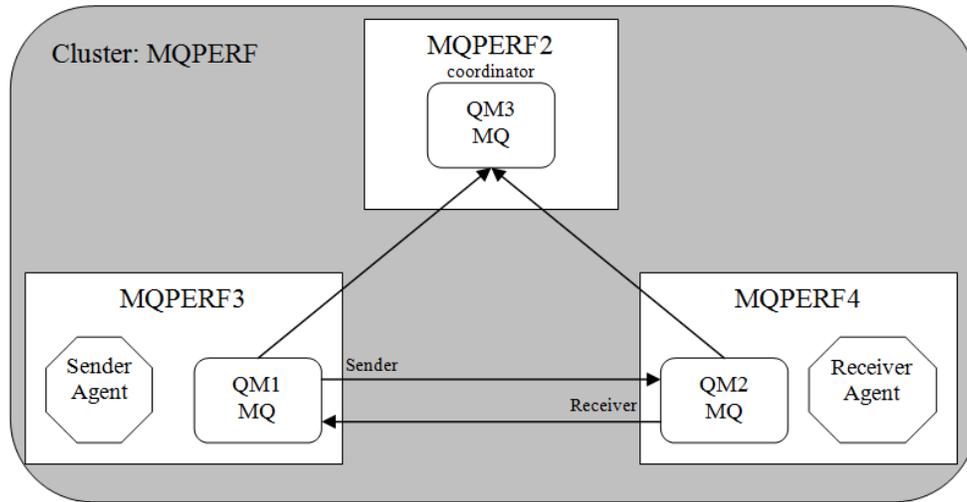
To demonstrate the multithreaded capability of the agent, a multiple transfer test was run and compared to a single transfer run. The multiple transfer test divides the number of files transferred in the single transfer test by ten and submitted them at the same time.

All files were transferred using text mode as well as 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.

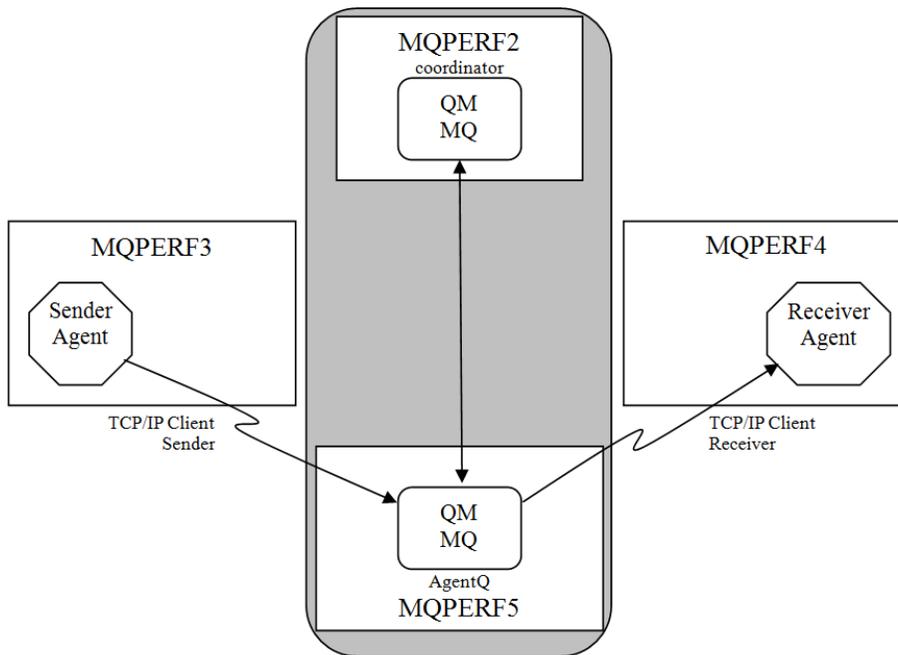
Agents Connecting in Bindings Mode

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 '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 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 65636 ChunkSize

2.1.1.1 Text Mode

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

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 15% | 14% | 113.61 s | 144.21 Mb |
| Source:10MB SingleTransfer | 2% | 15% | 15% | 49.49 s | 331.08 Mb |
| Source:100MB SingleTransfer | 2% | 18% | 15% | 44.00 s | 372.34 Mb |
| Source:1MB MultiTransfer | 2% | 30% | 33% | 35.91 s | 456.23 Mb |
| Source:10MB MultiTransfer | 3% | 39% | 42% | 19.65 s | 833.75 Mb |
| Source:100MB MultiTransfer | 2% | 43% | 44% | 16.89 s | 970.25 Mb |

Table 1 65636 byte chunk size values for Single and Multiple instance transfers text mode

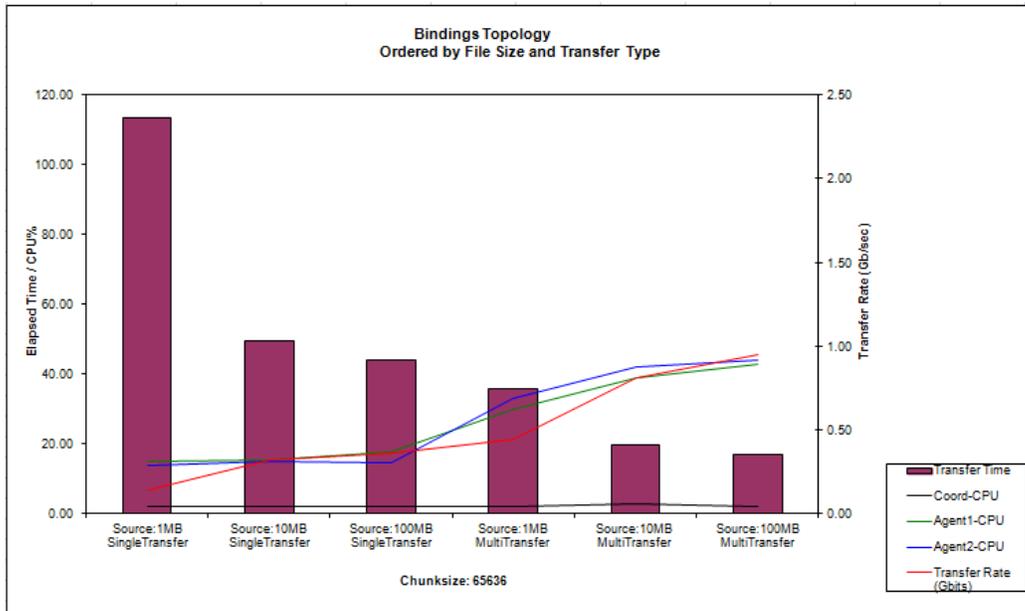


Figure 1 65636 byte chunk size values for Single and Multiple instance transfers – text mode

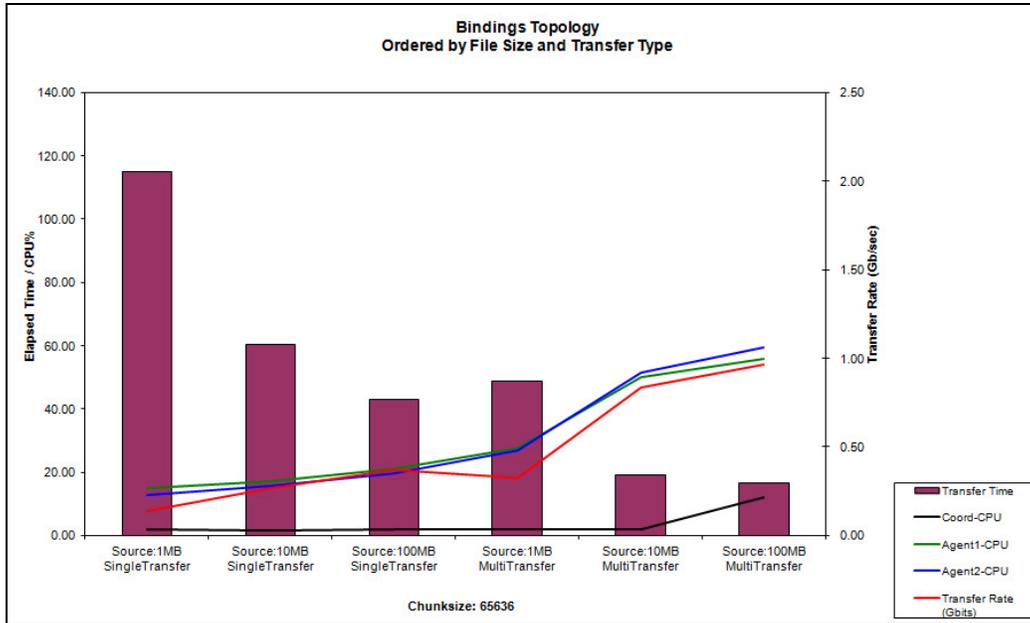
Text Mode with MD5 checksum

2.1.1.2 Text Mode with MD5 checksum

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

IBM MQ Managed File Transfer V9.0.5 Performance Report

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 15% | 13% | 114.87 s | 142.63 Mb |
| Source:10MB SingleTransfer | 2% | 17% | 16% | 60.35 s | 271.47 Mb |
| Source:100MB SingleTransfer | 2% | 21% | 20% | 42.90 s | 381.89 Mb |
| Source:1MB MultiTransfer | 2% | 28% | 27% | 48.78 s | 335.87 Mb |
| Source:10MB MultiTransfer | 2% | 50% | 51% | 19.20 s | 853.19 Mb |
| Source:100MB MultiTransfer | 12% | 56% | 59% | 16.58 s | 987.96 Mb |

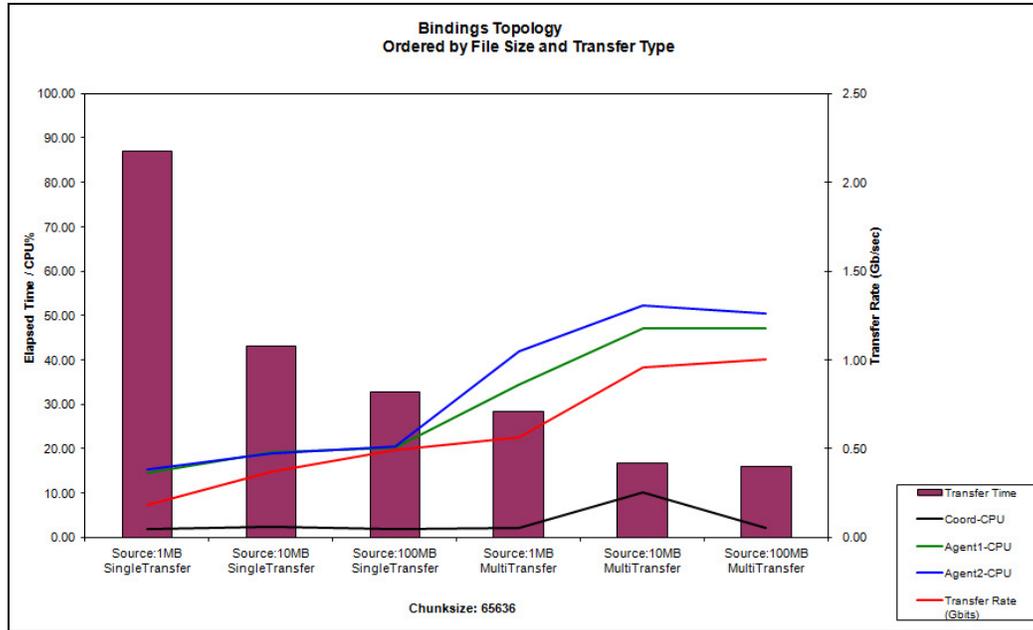


2.1.1.3 Binary Mode

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

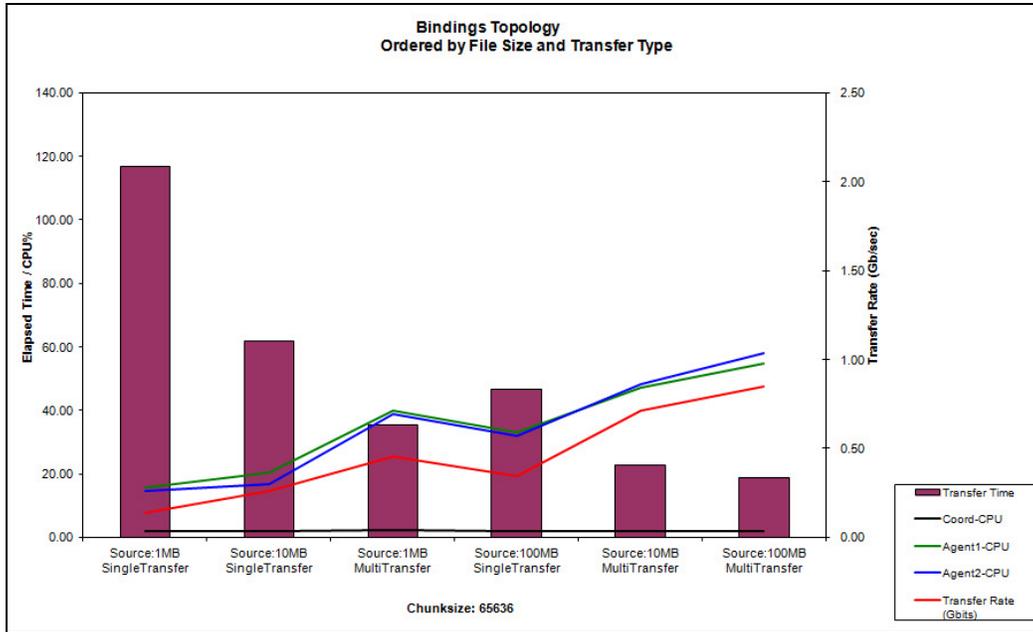
| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 15% | 15% | 86.93 s | 188.47 Mb |
| Source:10MB SingleTransfer | 2% | 19% | 19% | 43.06 s | 380.50 Mb |
| Source:100MB SingleTransfer | 2% | 20% | 20% | 32.66 s | 501.71 Mb |
| Source:1MB MultiTransfer | 2% | 35% | 42% | 28.38 s | 577.27 Mb |
| Source:10MB MultiTransfer | 10% | 47% | 52% | 16.66 s | 983.30 Mb |
| Source:100MB MultiTransfer | 2% | 47% | 50% | 15.94 s | 1,027.70 Mb |

Table 2 65636 byte chunk size values for Single and Multiple instance transfers – binary mode



2.1.1.4 Binary Mode with MD5 checksum

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 16% | 15% | 116.68 s | 140.42 Mb |
| Source:10MB SingleTransfer | 2% | 20% | 17% | 61.64 s | 265.80 Mb |
| Source:1MB MultiTransfer | 2% | 40% | 39% | 35.33 s | 463.69 Mb |
| Source:100MB SingleTransfer | 2% | 33% | 32% | 46.66 s | 351.12 Mb |
| Source:10MB MultiTransfer | 2% | 47% | 48% | 22.54 s | 726.96 Mb |
| Source:100MB MultiTransfer | 2% | 55% | 58% | 18.81 s | 871.20 Mb |



2.1.2 131072 ChunkSize

2.1.2.1 Text Mode

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

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 13% | 11% | 106.68 s | 153.58 Mb |
| Source:10MB SingleTransfer | 2% | 16% | 14% | 53.72 s | 304.96 Mb |
| Source:100MB SingleTransfer | 2% | 17% | 15% | 41.68 s | 393.07 Mb |
| Source:1MB MultiTransfer | 2% | 23% | 25% | 45.23 s | 362.22 Mb |
| Source:10MB MultiTransfer | 2% | 39% | 40% | 18.40 s | 890.61 Mb |
| Source:100MB MultiTransfer | 2% | 43% | 43% | 16.35 s | 1,001.92 Mb |

Table 3 131072 byte chunk size values for Single and Multiple instance transfers

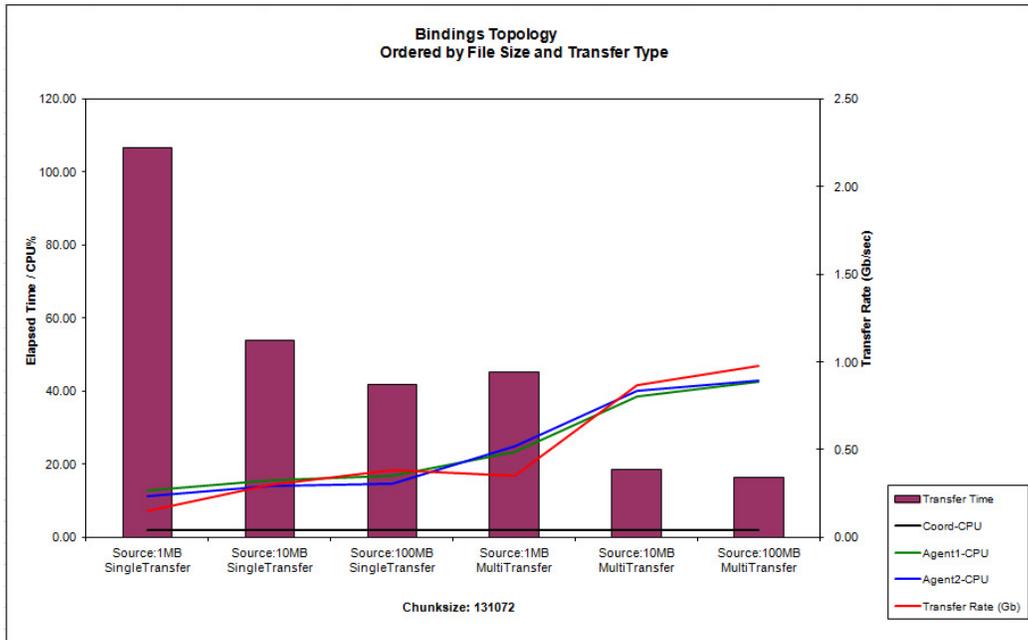
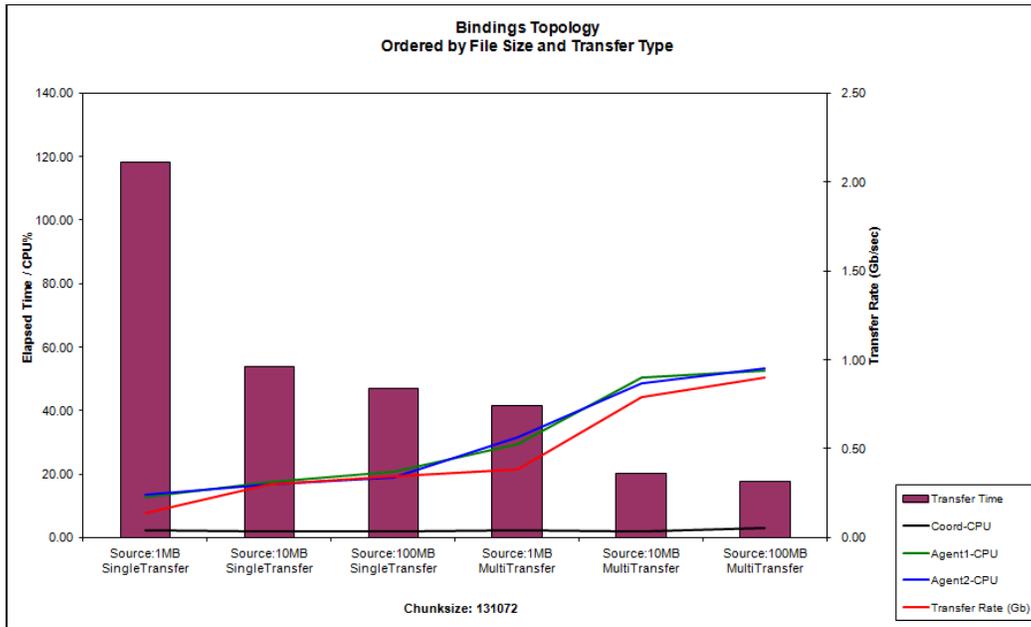


Figure 2 131072 byte chunk size values for Single and Multiple instance transfers

2.1.2.2 Text Mode with MD5 checksum

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 13% | 14% | 118.10 s | 138.73 Mb |
| Source:10MB SingleTransfer | 2% | 18% | 17% | 53.92 s | 303.85 Mb |
| Source:100MB SingleTransfer | 2% | 21% | 19% | 46.81 s | 350.03 Mb |
| Source:1MB MultiTransfer | 2% | 29% | 31% | 41.64 s | 393.46 Mb |
| Source:10MB MultiTransfer | 2% | 50% | 49% | 20.27 s | 808.23 Mb |
| Source:100MB MultiTransfer | 3% | 52% | 53% | 17.77 s | 921.95 Mb |

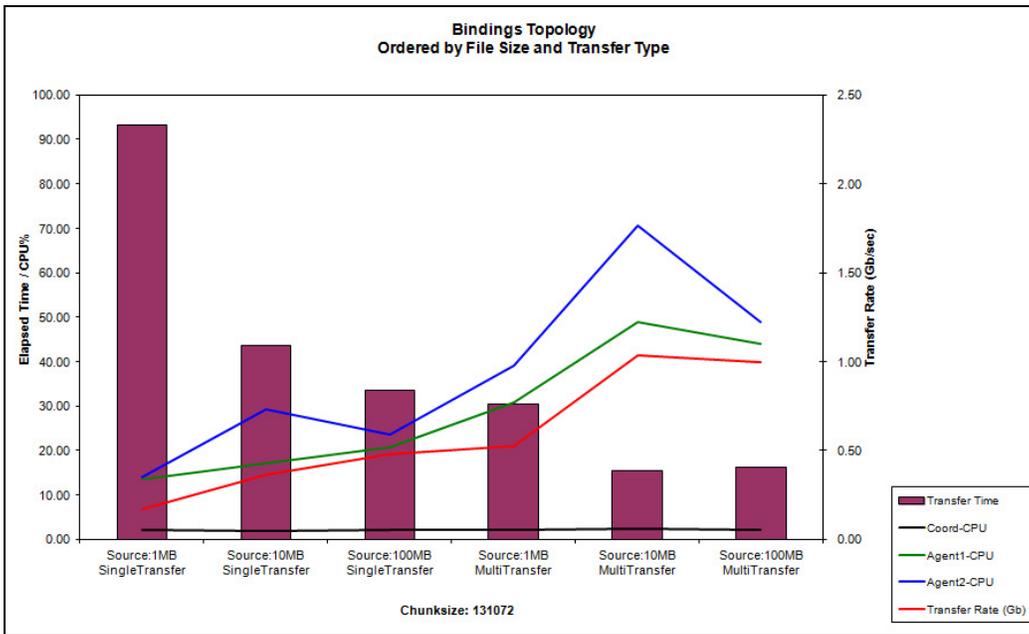


2.1.2.3 Binary Mode

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

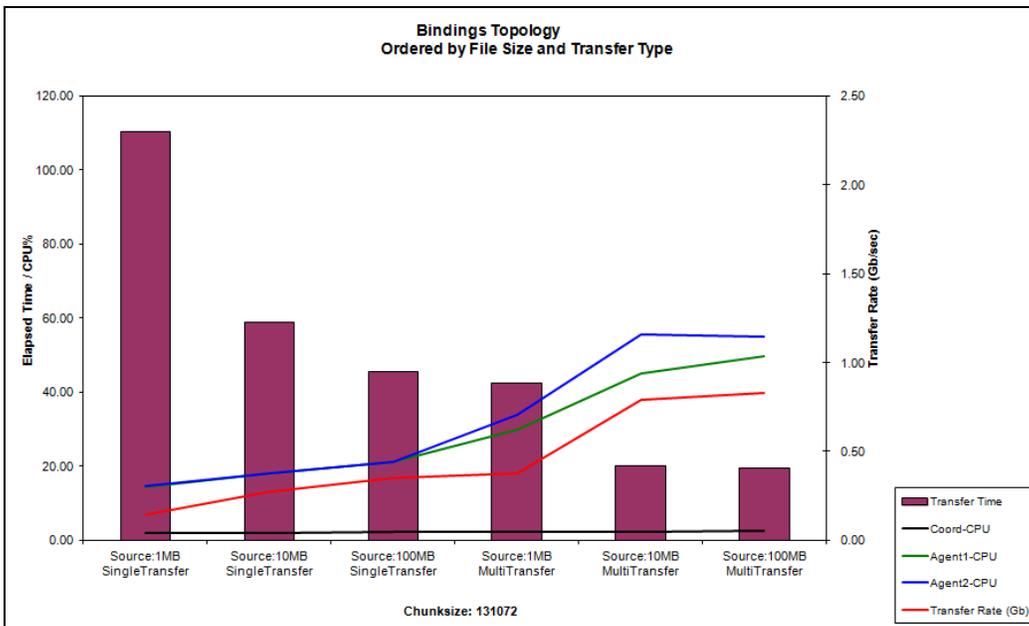
| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 14% | 14% | 93.19 s | 175.81 Mb |
| Source:10MB SingleTransfer | 2% | 17% | 29% | 43.67 s | 375.16 Mb |
| Source:100MB SingleTransfer | 2% | 21% | 24% | 33.48 s | 489.39 Mb |
| Source:1MB MultiTransfer | 2% | 31% | 39% | 30.35 s | 539.91 Mb |
| Source:10MB MultiTransfer | 2% | 49% | 71% | 15.43 s | 1,062.03 Mb |
| Source:100MB MultiTransfer | 2% | 44% | 49% | 16.10 s | 1,017.68 Mb |

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2.1.2.4 Binary Mode with MD5 checksum

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 14% | 15% | 110.25 s | 148.61 Mb |
| Source:10MB SingleTransfer | 2% | 18% | 18% | 58.97 s | 277.84 Mb |
| Source:100MB SingleTransfer | 2% | 21% | 21% | 45.55 s | 359.68 Mb |
| Source:1MB MultiTransfer | 2% | 30% | 34% | 42.46 s | 385.88 Mb |
| Source:10MB MultiTransfer | 2% | 45% | 55% | 20.20 s | 811.17 Mb |
| Source:100MB MultiTransfer | 2% | 50% | 55% | 19.32 s | 848.02 Mb |



262144 ChunkSize

2.1.2.5 Text Mode

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

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 13% | 12% | 109.46 s | 149.68 Mb |
| Source:10MB SingleTransfer | 2% | 15% | 13% | 56.87 s | 288.08 Mb |
| Source:100MB SingleTransfer | 2% | 17% | 14% | 44.48 s | 368.36 Mb |
| Source:1MB MultiTransfer | 2% | 24% | 25% | 43.62 s | 375.58 Mb |
| Source:10MB MultiTransfer | 4% | 37% | 37% | 20.14 s | 813.42 Mb |
| Source:100MB MultiTransfer | 2% | 43% | 40% | 17.58 s | 931.74 Mb |

Table 4 262144 byte chunk size values for Single and Multiple instance transfers

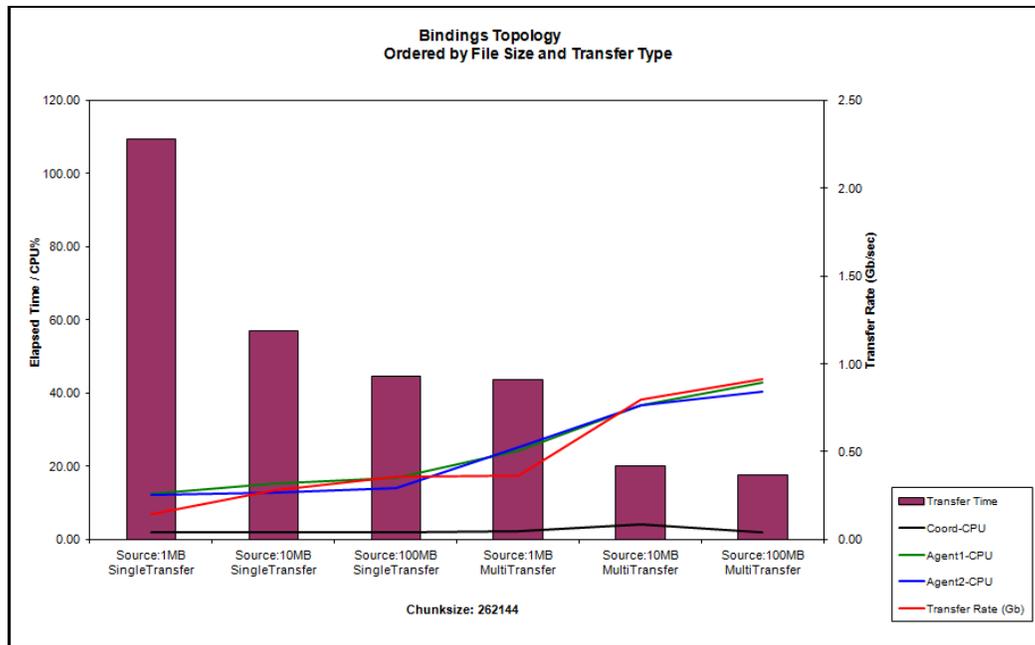
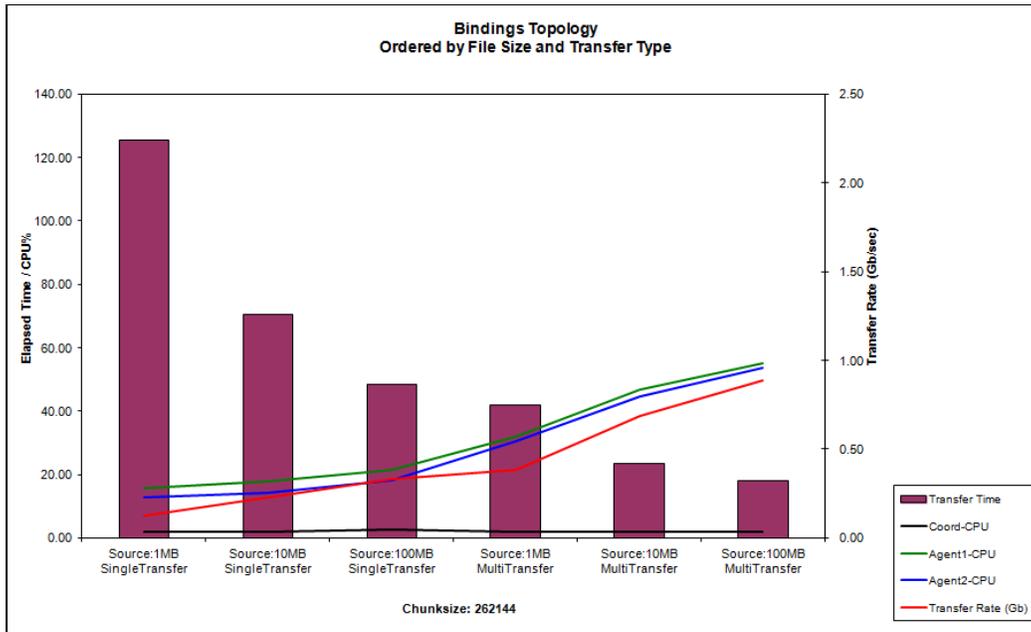


Figure 3 262144 byte chunk size values for Single and Multiple instance transfers

2.1.2.6 Text Mode with MD5 checksum

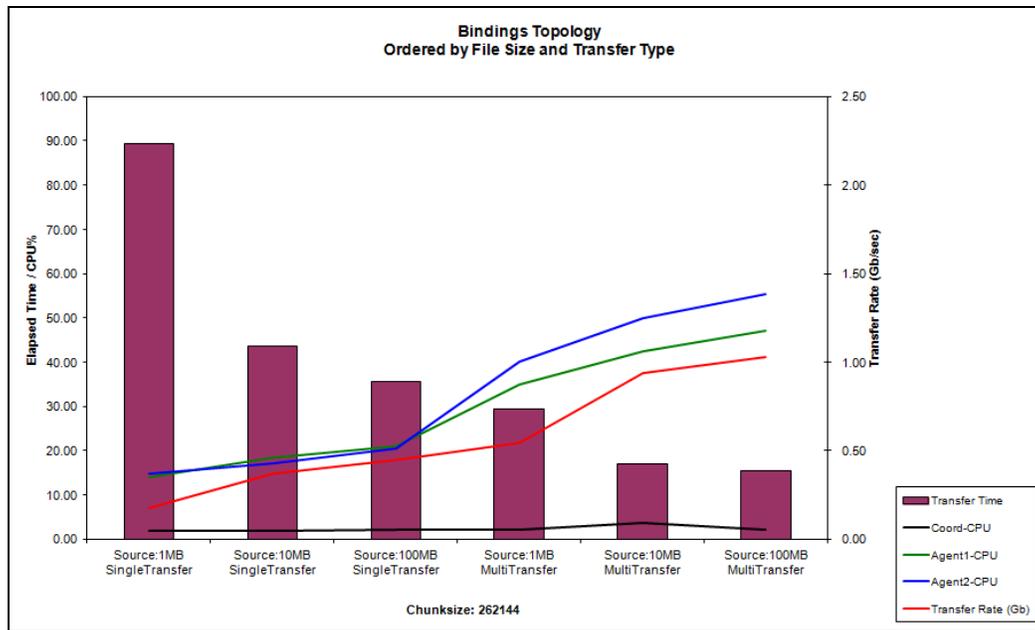
| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 16% | 13% | 125.35 s | 130.70 Mb |
| Source:10MB SingleTransfer | 2% | 18% | 14% | 70.49 s | 232.43 Mb |
| Source:100MB SingleTransfer | 3% | 21% | 18% | 48.50 s | 337.84 Mb |
| Source:1MB MultiTransfer | 2% | 32% | 30% | 41.75 s | 392.45 Mb |
| Source:10MB MultiTransfer | 2% | 47% | 45% | 23.30 s | 703.07 Mb |
| Source:100MB MultiTransfer | 2% | 55% | 53% | 18.09 s | 905.86 Mb |



2.1.2.7 Binary Mode

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

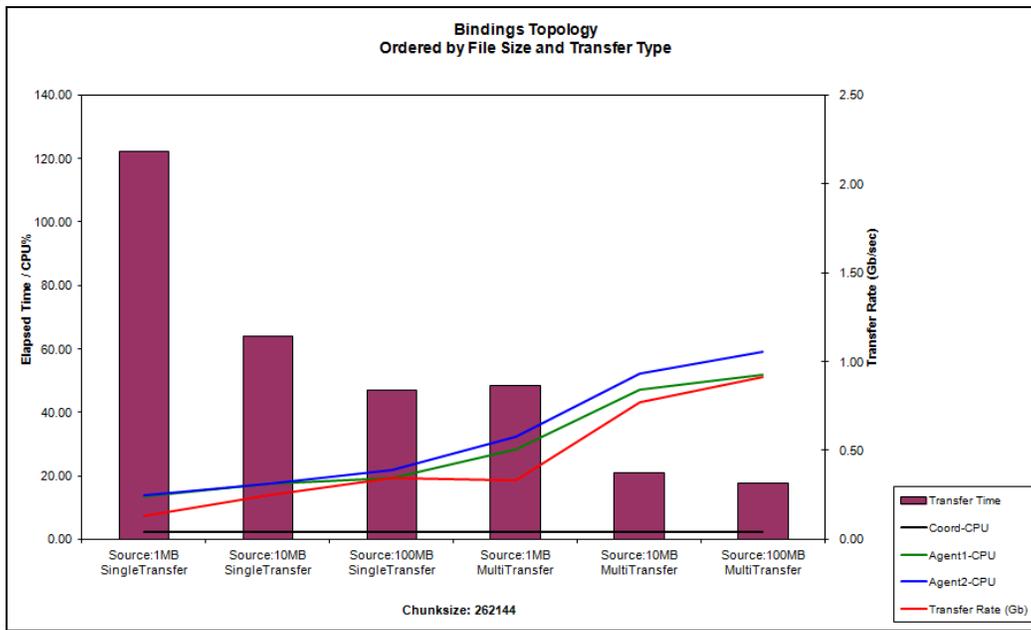
| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 14% | 15% | 89.44 s | 183.18 Mb |
| Source:10MB SingleTransfer | 2% | 18% | 17% | 43.59 s | 375.85 Mb |
| Source:100MB SingleTransfer | 2% | 21% | 20% | 35.65 s | 459.57 Mb |
| Source:1MB MultiTransfer | 2% | 35% | 40% | 29.28 s | 559.53 Mb |
| Source:10MB MultiTransfer | 4% | 43% | 50% | 17.02 s | 962.37 Mb |
| Source:100MB MultiTransfer | 2% | 47% | 55% | 15.50 s | 1,056.80 Mb |



2.1.2.8 Binary Mode with MD5 checksum

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 13% | 14% | 122.30 s | 133.97 Mb |
| Source:10MB SingleTransfer | 2% | 17% | 17% | 63.86 s | 256.56 Mb |
| Source:100MB SingleTransfer | 2% | 19% | 22% | 46.89 s | 349.38 Mb |
| Source:1MB MultiTransfer | 2% | 28% | 32% | 48.29 s | 339.31 Mb |
| Source:10MB MultiTransfer | 2% | 47% | 52% | 20.82 s | 786.92 Mb |
| Source:100MB MultiTransfer | 2% | 52% | 59% | 17.48 s | 937.05 Mb |

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2.1.3 524228 ChunkSize

2.1.3.1 Text Mode

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

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 3% | 13% | 11% | 113.01 s | 144.98 Mb |
| Source:10MB SingleTransfer | 2% | 16% | 16% | 51.78 s | 316.42 Mb |
| Source:100MB SingleTransfer | 2% | 17% | 15% | 45.76 s | 358.07 Mb |
| Source:1MB MultiTransfer | 2% | 26% | 26% | 42.22 s | 388.04 Mb |
| Source:10MB MultiTransfer | 3% | 36% | 36% | 20.23 s | 809.91 Mb |
| Source:100MB MultiTransfer | 2% | 36% | 39% | 19.65 s | 833.99 Mb |

Table 5 524228 byte chunk size values for Single and Multiple instance transfers

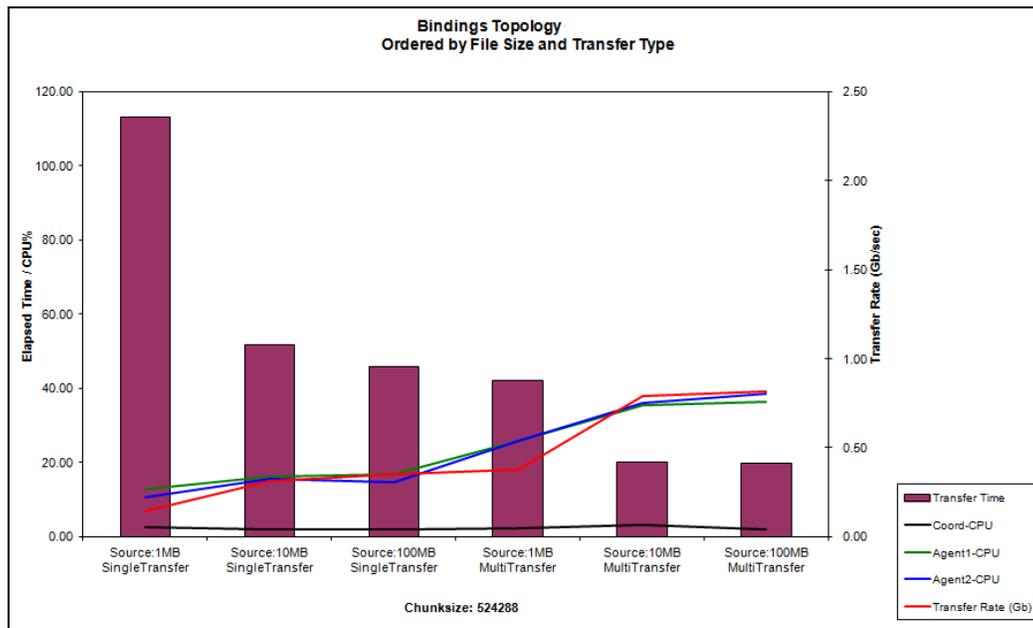
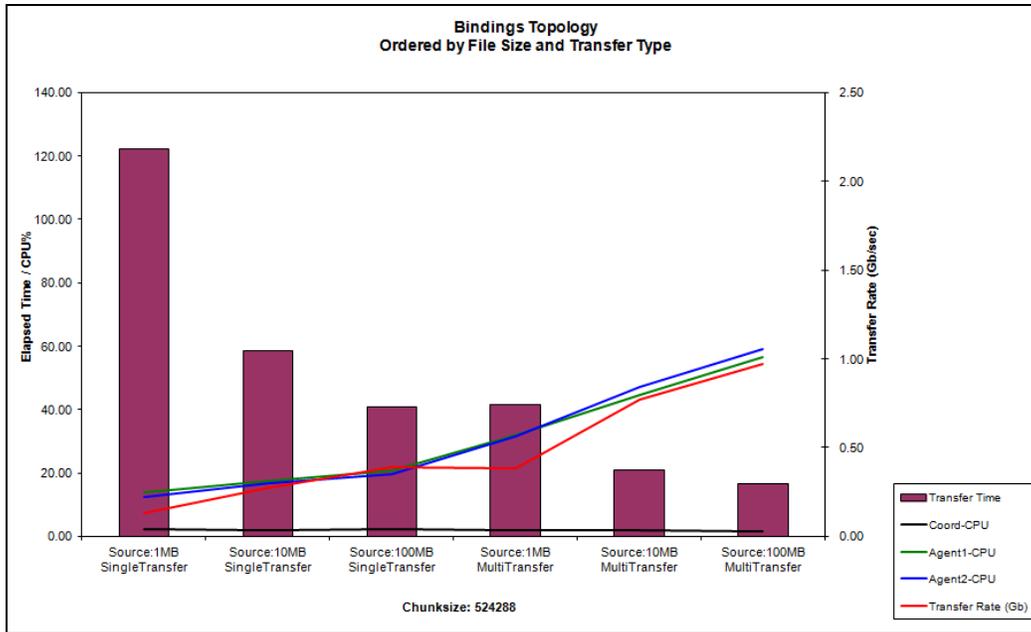


Figure 4 524228 byte chunk size values for Single and Multiple instance transfers

2.1.3.2 Text Mode with MD5 checksum

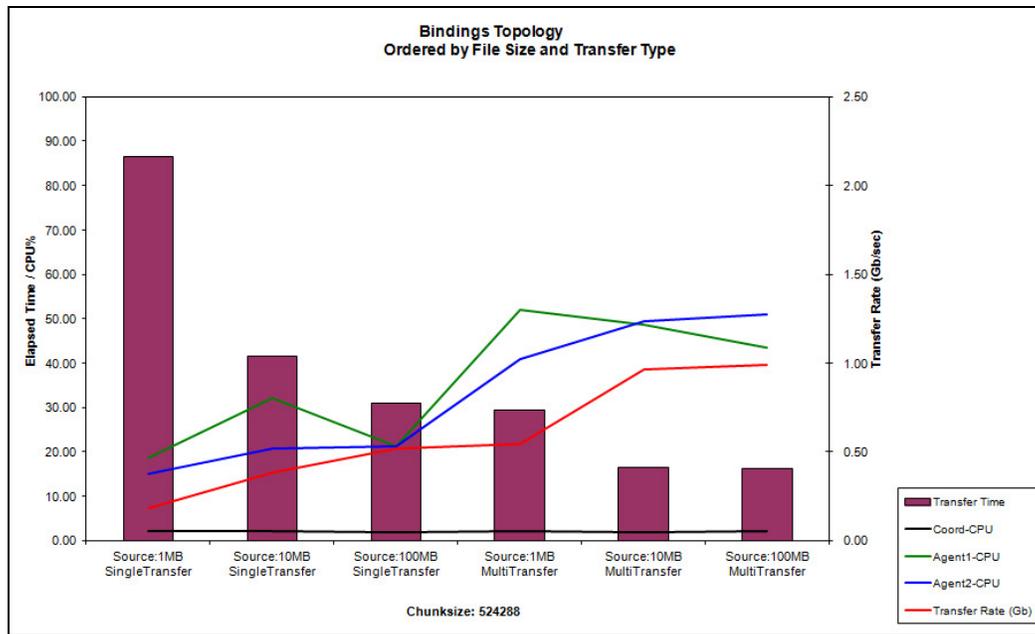
| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 14% | 13% | 122.08 s | 134.20 Mb |
| Source:10MB SingleTransfer | 2% | 18% | 17% | 58.60 s | 279.61 Mb |
| Source:100MB SingleTransfer | 2% | 21% | 20% | 40.80 s | 401.58 Mb |
| Source:1MB MultiTransfer | 2% | 32% | 31% | 41.44 s | 395.34 Mb |
| Source:10MB MultiTransfer | 2% | 45% | 47% | 20.77 s | 789.02 Mb |
| Source:100MB MultiTransfer | 2% | 57% | 59% | 16.45 s | 996.09 Mb |



2.1.3.3 Binary Mode

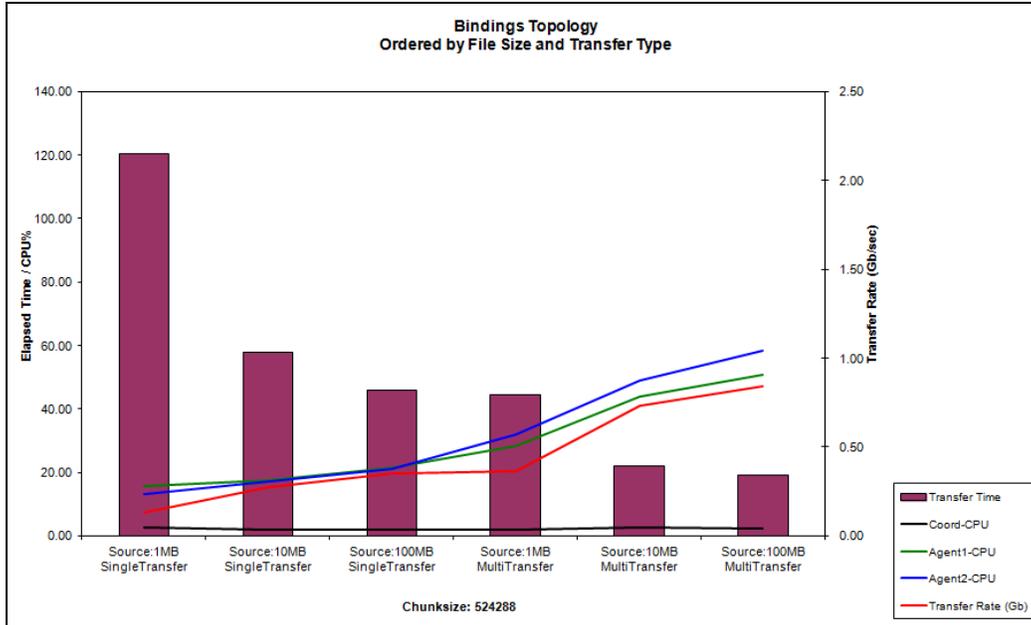
The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 2% | 19% | 15% | 86.56 s | 189.28 Mb |
| Source:10MB SingleTransfer | 2% | 32% | 21% | 41.61 s | 393.76 Mb |
| Source:100MB SingleTransfer | 2% | 21% | 21% | 30.98 s | 528.92 Mb |
| Source:1MB MultiTransfer | 2% | 52% | 41% | 29.38 s | 557.72 Mb |
| Source:10MB MultiTransfer | 2% | 49% | 49% | 16.55 s | 990.23 Mb |
| Source:100MB MultiTransfer | 2% | 43% | 51% | 16.12 s | 1,016.10 Mb |



2.1.3.4 Binary Mode with MD5 checksum

| Test | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 3% | 16% | 13% | 120.42 s | 136.05 Mb |
| Source:10MB SingleTransfer | 2% | 17% | 17% | 57.89 s | 283.02 Mb |
| Source:100MB SingleTransfer | 2% | 22% | 21% | 46.02 s | 356.05 Mb |
| Source:1MB MultiTransfer | 2% | 28% | 32% | 44.35 s | 369.44 Mb |
| Source:10MB MultiTransfer | 2% | 44% | 49% | 21.95 s | 746.55 Mb |
| Source:100MB MultiTransfer | 2% | 51% | 58% | 18.94 s | 864.93 Mb |



Test Summary for Bindings mode

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

2.1.3.5 Text Mode

| File Size and Transfer Type | Transfer Time | Chunk size |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 106.68 s | 131072 Bytes |
| Source:10MB SingleTransfer | 49.49 s | 65636 Bytes |
| Source:100MB SingleTransfer | 41.68 s | 131072 Bytes |
| Source:1MB MultiTransfer | 35.91 s | 65636 Bytes |
| Source:10MB MultiTransfer | 18.40 s | 131072 Bytes |
| Source:100MB MultiTransfer | 16.35 s | 131072 Bytes |

Best transfer speeds for Single and Multiple instance text mode transfers

2.1.3.6 Text Mode with MD5 checksum

| File Size and Transfer Type | Transfer Time | Chunk size |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 114.87 s | 65636 Bytes |
| Source:10MB SingleTransfer | 53.92 s | 131072 Bytes |
| Source:100MB SingleTransfer | 40.80 s | 524288 Bytes |
| Source:1MB MultiTransfer | 41.44 s | 524288 Bytes |
| Source:10MB MultiTransfer | 19.20 s | 65636 Bytes |
| Source:100MB MultiTransfer | 16.45 s | 524288 Bytes |

Best transfer speeds for Single and Multiple instance text mode transfers

2.1.3.7 Binary Mode

| File Size and Transfer Type | Transfer Time | Chunk size |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 86.56 s | 524288 Bytes |
| Source:10MB SingleTransfer | 41.61 s | 524288 Bytes |
| Source:100MB SingleTransfer | 30.98 s | 524288 Bytes |
| Source:1MB MultiTransfer | 28.38 s | 65636 Bytes |
| Source:10MB MultiTransfer | 15.43 s | 131072 Bytes |
| Source:100MB MultiTransfer | 15.50 s | 262144 Bytes |

Best transfer speeds for Single and Multiple instance text mode transfers

2.1.3.8 Binary Mode with MD5 checksum

| File Size and Transfer Type | Transfer Time | Chunk size |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 110.25 | 131072 Bytes |
| Source:10MB SingleTransfer | 57.89 | 524288 Bytes |
| Source:1MB MultiTransfer | 35.33 | 65636 Bytes |
| Source:100MB SingleTransfer | 42.46 | 131072 Bytes |
| Source:10MB MultiTransfer | 20.20 | 131072 Bytes |
| Source:100MB MultiTransfer | 17.48 | 262144 Bytes |

2.2 Agents Connecting in Client Mode

2.2.1 65636 ChunkSize

2.2.1.1 Text Mode

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

| | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 7% | 2% | 10% | 9% | 119.01 s | 137.67 Mb |
| Source:10MB SingleTransfer | 9% | 2% | 10% | 8% | 84.68 s | 193.49 Mb |
| Source:100MB SingleTransfer | 9% | 2% | 10% | 8% | 87.00 s | 188.32 Mb |
| Source:1MB MultiTransfer | 10% | 2% | 11% | 12% | 88.57 s | 184.98 Mb |
| Source:10MB MultiTransfer | 10% | 2% | 10% | 9% | 87.68 s | 186.86 Mb |
| Source:100MB MultiTransfer | 10% | 2% | 13% | 10% | 85.71 s | 191.17 Mb |

Table 6 65636 byte chunk size values for Single and Multiple instance transfers

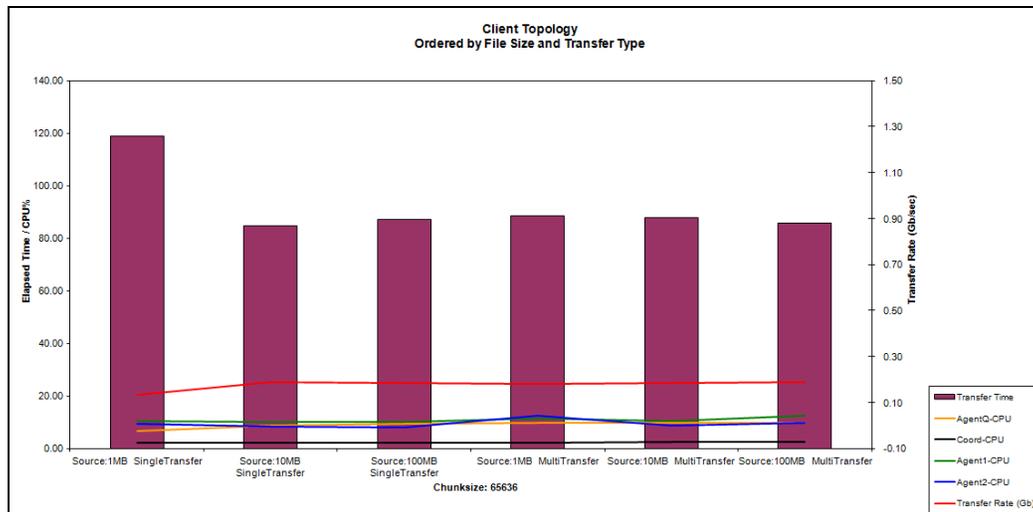
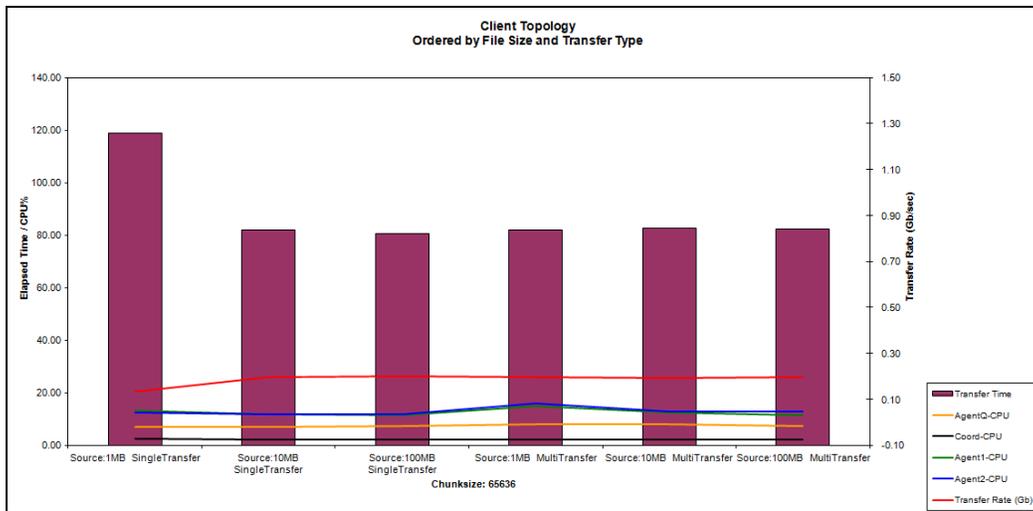


Figure 5 65636 byte chunk size values for Single and Multiple instance transfers

2.2.1.2 Text Mode with MD5 checksum

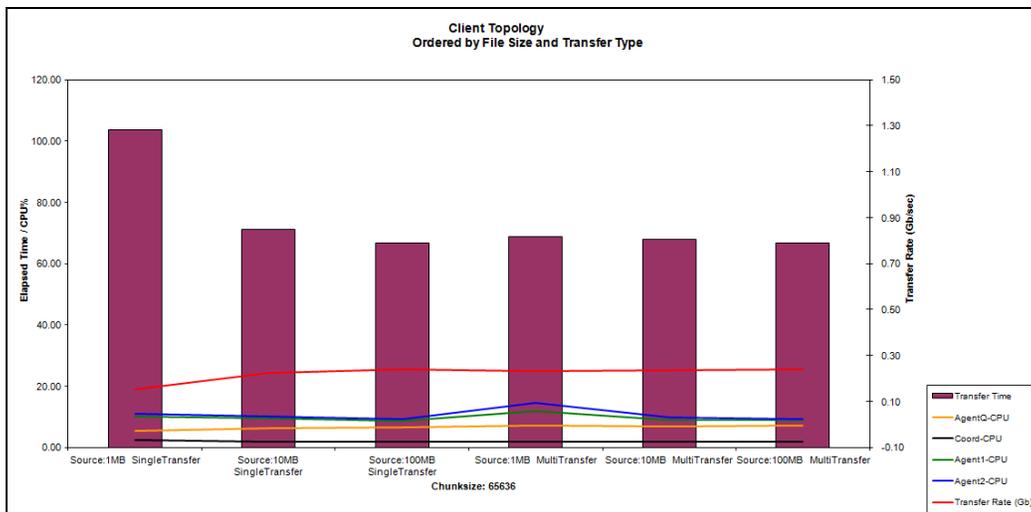
| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 7% | 3% | 13% | 12% | 118.84 s | 137.86 Mb |
| Source:10MB SingleTransfer | 7% | 2% | 12% | 12% | 82.12 s | 199.51 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 11% | 12% | 80.53 s | 203.45 Mb |
| Source:1MB MultiTransfer | 8% | 2% | 15% | 16% | 81.99 s | 199.83 Mb |
| Source:10MB MultiTransfer | 8% | 2% | 12% | 13% | 82.61 s | 198.32 Mb |
| Source:100MB MultiTransfer | 7% | 2% | 11% | 13% | 82.20 s | 199.31 Mb |



2.2.1.3 Binary Mode

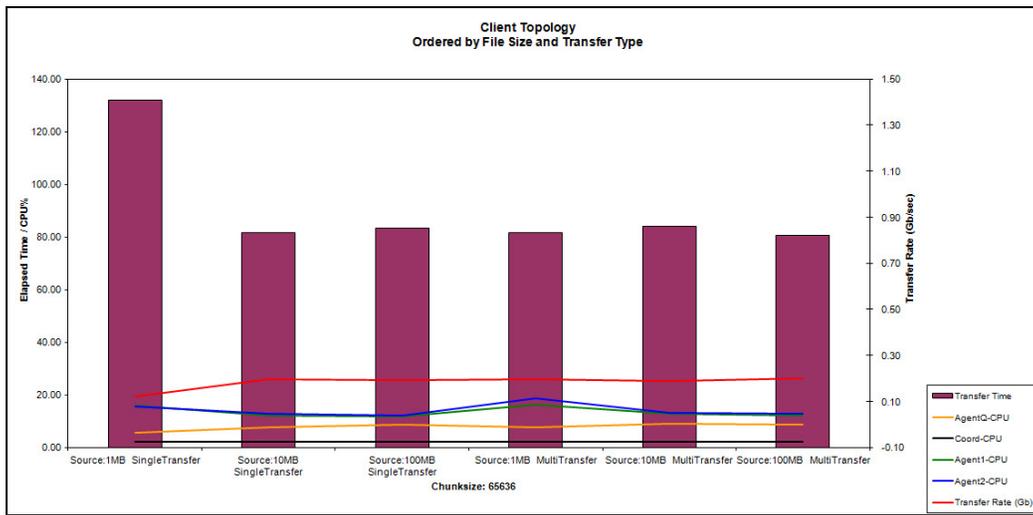
The table and chart below shows the relevant times and CPU utilisation for single and multi-application transfer with three different file sizes.

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 5% | 2% | 10% | 11% | 103.75 s | 157.92 Mb |
| Source:10MB SingleTransfer | 6% | 2% | 9% | 10% | 71.21 s | 230.08 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 9% | 9% | 66.83 s | 245.17 Mb |
| Source:1MB MultiTransfer | 7% | 2% | 12% | 14% | 68.67 s | 238.59 Mb |
| Source:10MB MultiTransfer | 7% | 2% | 9% | 10% | 67.77 s | 241.75 Mb |
| Source:100MB MultiTransfer | 7% | 2% | 9% | 9% | 66.82 s | 245.19 Mb |



2.2.1.4 Binary Mode with MD5 checksum

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 6% | 2% | 16% | 16% | 131.85 s | 124.26 Mb |
| Source:10MB SingleTransfer | 8% | 2% | 12% | 13% | 81.70 s | 200.53 Mb |
| Source:100MB SingleTransfer | 9% | 2% | 12% | 12% | 83.21 s | 196.89 Mb |
| Source:1MB MultiTransfer | 8% | 2% | 16% | 19% | 81.52 s | 200.99 Mb |
| Source:10MB MultiTransfer | 9% | 2% | 13% | 13% | 84.10 s | 194.81 Mb |
| Source:100MB MultiTransfer | 9% | 2% | 12% | 13% | 80.48 s | 203.57 Mb |



2.2.2 131072 ChunkSize

2.2.2.1 Text Mode

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

| | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 8% | 2% | 12% | 11% | 114.99 s | 142.49 Mb |
| Source:10MB SingleTransfer | 8% | 2% | 9% | 9% | 85.96 s | 190.60 Mb |
| Source:100MB SingleTransfer | 8% | 2% | 9% | 9% | 84.09 s | 194.83 Mb |
| Source:1MB MultiTransfer | 10% | 5% | 12% | 12% | 91.84 s | 178.39 Mb |
| Source:10MB MultiTransfer | 9% | 2% | 10% | 9% | 89.85 s | 182.35 Mb |
| Source:100MB MultiTransfer | 11% | 3% | 12% | 9% | 87.56 s | 187.12 Mb |

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

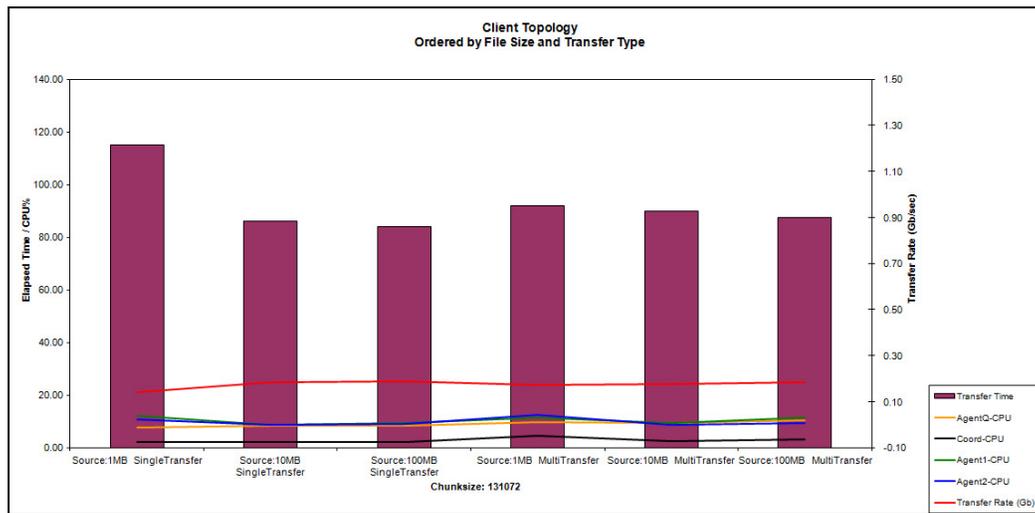
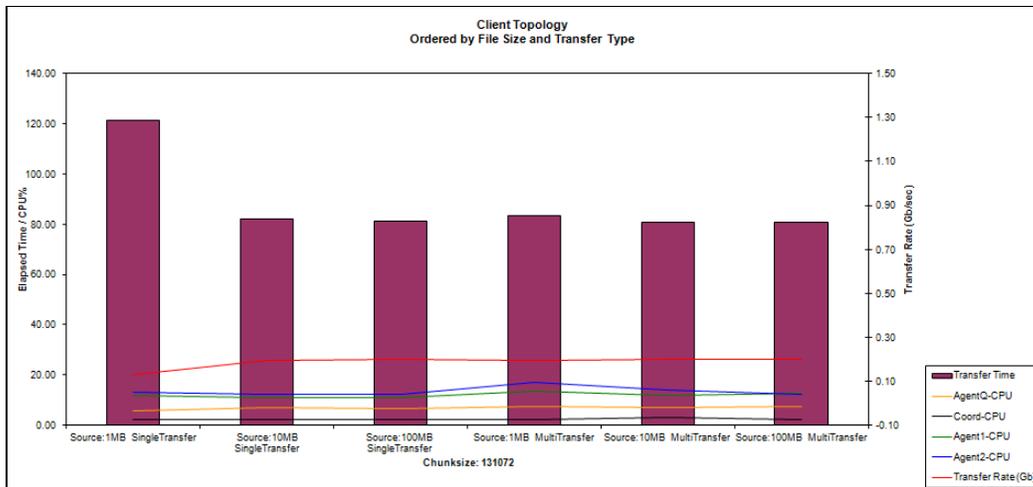


Figure 6 131072 byte chunk size values for Single and Multiple instance transfers

2.2.2.2 Text Mode with MD5 checksum

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 6% | 2% | 12% | 13% | 121.22 s | 135.16 Mb |
| Source:10MB SingleTransfer | 7% | 2% | 11% | 12% | 81.90 s | 200.05 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 11% | 12% | 81.11 s | 202.00 Mb |
| Source:1MB MultiTransfer | 8% | 2% | 14% | 17% | 83.17 s | 196.99 Mb |
| Source:10MB MultiTransfer | 7% | 3% | 12% | 14% | 80.81 s | 202.74 Mb |
| Source:100MB MultiTransfer | 7% | 2% | 13% | 12% | 80.90 s | 202.52 Mb |

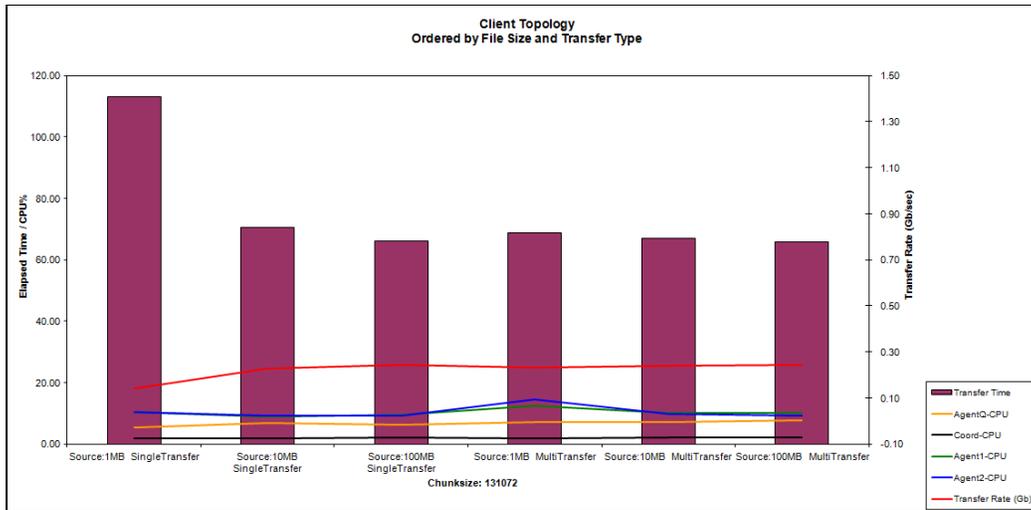


2.2.2.3 Binary Mode

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

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 5% | 2% | 10% | 10% | 113.11 s | 144.85 Mb |
| Source:10MB SingleTransfer | 7% | 2% | 9% | 9% | 70.49 s | 232.43 Mb |
| Source:100MB SingleTransfer | 6% | 2% | 10% | 9% | 66.22 s | 247.41 Mb |
| Source:1MB MultiTransfer | 7% | 2% | 12% | 15% | 68.91 s | 237.77 Mb |
| Source:10MB MultiTransfer | 7% | 2% | 10% | 10% | 66.97 s | 244.66 Mb |
| Source:100MB MultiTransfer | 8% | 2% | 10% | 9% | 65.85 s | 248.83 Mb |

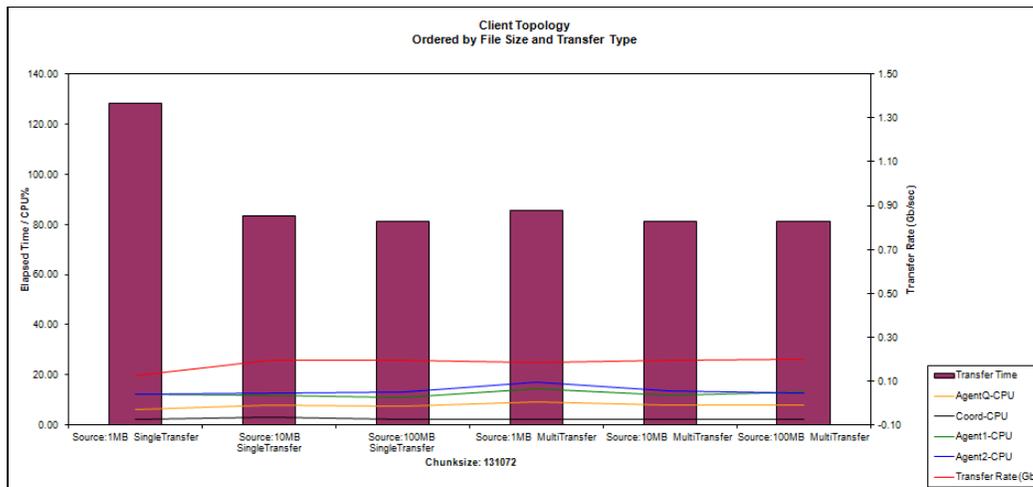
131072 byte chunk size values for Single and Multiple instance transfers



131072 byte chunk size values for Single and Multiple instance transfers

2.2.2.4 Binary Mode with MD5 checksum

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 6% | 2% | 12% | 12% | 128.12 s | 127.88 Mb |
| Source:10MB SingleTransfer | 8% | 3% | 12% | 13% | 83.23 s | 196.85 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 11% | 13% | 81.16 s | 201.88 Mb |
| Source:1MB MultiTransfer | 9% | 2% | 14% | 17% | 85.73 s | 191.11 Mb |
| Source:10MB MultiTransfer | 8% | 2% | 12% | 14% | 81.22 s | 201.71 Mb |
| Source:100MB MultiTransfer | 8% | 2% | 13% | 13% | 81.11 s | 202.00 Mb |



2.2.3 262144 ChunkSize

2.2.3.1 Text Mode

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

| | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 8% | 2% | 12% | 11% | 116.61 s | 140.50 Mb |
| Source:10MB SingleTransfer | 7% | 2% | 12% | 9% | 85.97 s | 190.58 Mb |
| Source:100MB SingleTransfer | 8% | 2% | 10% | 9% | 82.97 s | 197.46 Mb |
| Source:1MB MultiTransfer | 8% | 2% | 13% | 13% | 87.71 s | 186.79 Mb |
| Source:10MB MultiTransfer | 9% | 2% | 11% | 10% | 90.62 s | 180.80 Mb |
| Source:100MB MultiTransfer | 9% | 2% | 11% | 8% | 86.96 s | 188.42 Mb |

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

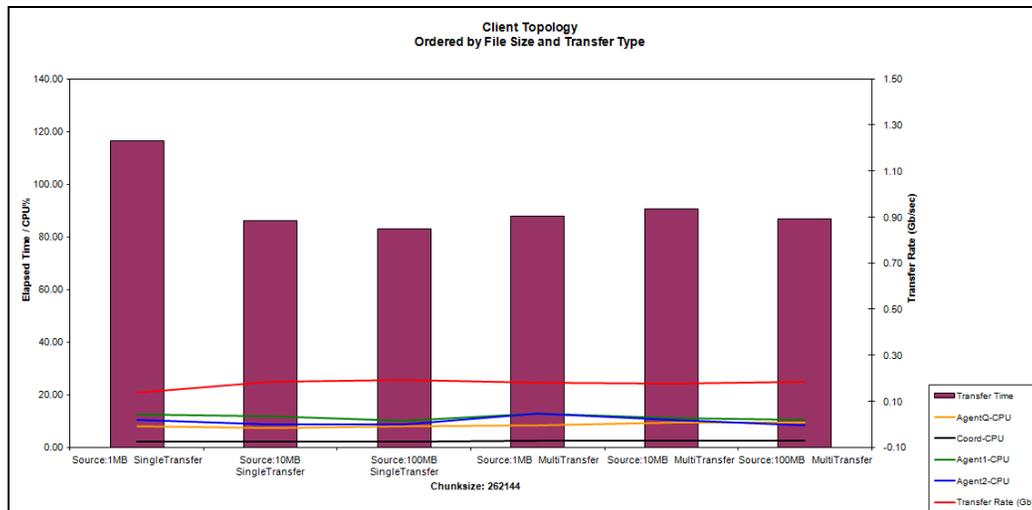
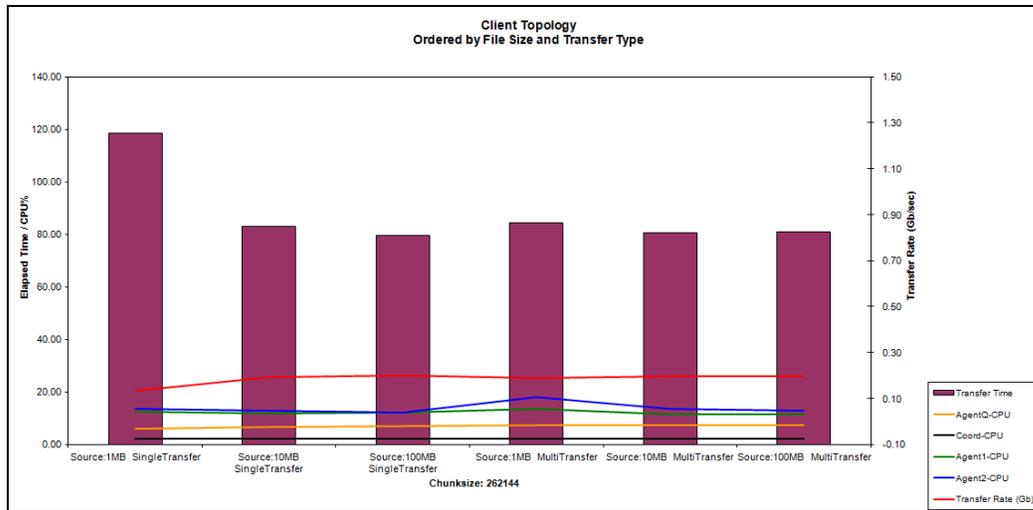


Figure 7 262144 byte chunk size values for Single and Multiple instance transfers

2.2.3.2 Text Mode with MD5 checksum

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 6% | 2% | 12% | 13% | 118.48 s | 138.29 Mb |
| Source:10MB SingleTransfer | 7% | 2% | 12% | 13% | 83.05 s | 197.29 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 12% | 12% | 79.63 s | 205.74 Mb |
| Source:1MB MultiTransfer | 7% | 2% | 14% | 18% | 84.35 s | 194.24 Mb |
| Source:10MB MultiTransfer | 7% | 2% | 12% | 14% | 80.74 s | 202.92 Mb |
| Source:100MB MultiTransfer | 7% | 2% | 11% | 13% | 80.93 s | 202.44 Mb |

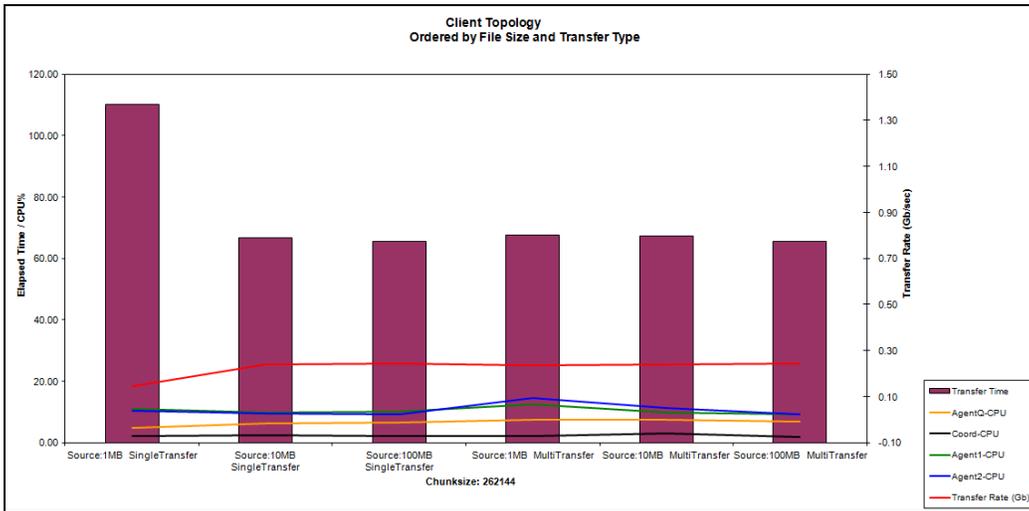


2.2.3.3 Binary Mode

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

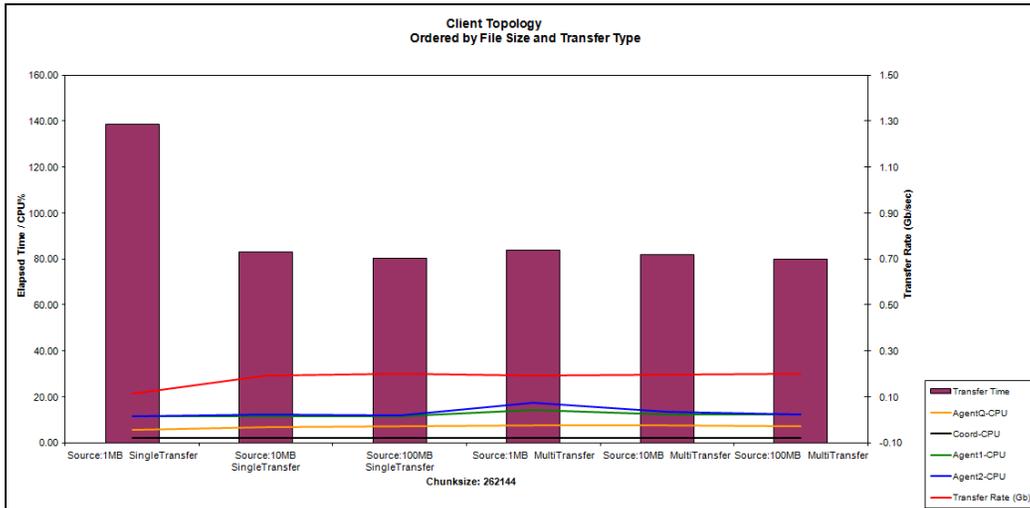
| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 5% | 2% | 11% | 11% | 110.10 s | 148.80 Mb |
| Source:10MB SingleTransfer | 6% | 3% | 10% | 9% | 66.72 s | 245.55 Mb |
| Source:100MB SingleTransfer | 6% | 2% | 10% | 9% | 65.42 s | 250.43 Mb |
| Source:1MB MultiTransfer | 7% | 2% | 12% | 15% | 67.60 s | 242.37 Mb |
| Source:10MB MultiTransfer | 7% | 3% | 10% | 11% | 67.17 s | 243.93 Mb |
| Source:100MB MultiTransfer | 7% | 2% | 9% | 9% | 65.40 s | 250.53 Mb |

IBM MQ Managed File Transfer V9.0.5 Performance Report



2.2.3.4 Binary Mode with MD5 checksum

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 6% | 2% | 11% | 12% | 138.64 s | 118.18 Mb |
| Source:10MB SingleTransfer | 7% | 2% | 11% | 12% | 82.93 s | 197.56 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 11% | 12% | 80.37 s | 203.85 Mb |
| Source:1MB MultiTransfer | 8% | 2% | 14% | 17% | 83.64 s | 195.89 Mb |
| Source:10MB MultiTransfer | 8% | 2% | 12% | 13% | 81.76 s | 200.39 Mb |
| Source:100MB MultiTransfer | 7% | 2% | 12% | 12% | 79.99 s | 204.83 Mb |



2.2.4 524228 ChunkSize

2.2.4.1 Text Mode

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

| | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 8% | 2% | 13% | 11% | 121.33 s | 135.04 Mb |
| Source:10MB SingleTransfer | 8% | 2% | 10% | 9% | 86.22 s | 190.02 Mb |
| Source:100MB SingleTransfer | 9% | 2% | 10% | 8% | 86.12 s | 190.25 Mb |
| Source:1MB MultiTransfer | 9% | 2% | 13% | 13% | 88.34 s | 185.46 Mb |
| Source:10MB MultiTransfer | 10% | 2% | 11% | 9% | 89.34 s | 183.38 Mb |
| Source:100MB MultiTransfer | 10% | 2% | 12% | 8% | 86.76 s | 188.85 Mb |

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

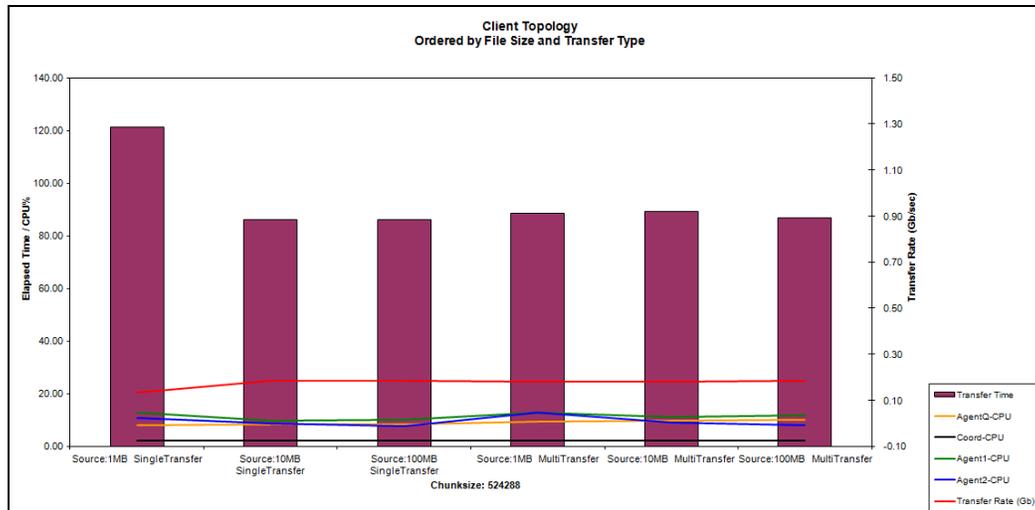
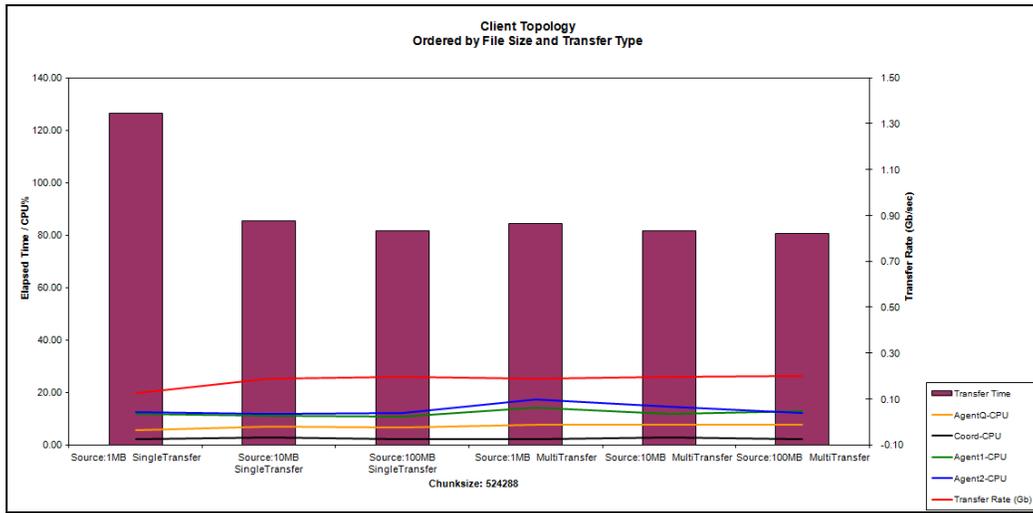


Figure 8 524228 byte chunk size values for Single and Multiple instance transfers

2.2.4.2 Text Mode with MD5 checksum

| | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 6% | 2% | 12% | 13% | 126.52 s | 129.50 Mb |
| Source:10MB SingleTransfer | 7% | 3% | 11% | 12% | 85.37 s | 191.92 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 11% | 12% | 81.63 s | 200.70 Mb |
| Source:1MB MultiTransfer | 8% | 2% | 14% | 17% | 84.26 s | 194.44 Mb |
| Source:10MB MultiTransfer | 8% | 3% | 12% | 15% | 81.55 s | 200.92 Mb |
| Source:100MB MultiTransfer | 8% | 2% | 13% | 12% | 80.67 s | 203.11 Mb |



2.2.4.3 Binary Mode

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

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 5% | 2% | 10% | 11% | 107.80 s | 151.98 Mb |
| Source:10MB SingleTransfer | 6% | 2% | 10% | 9% | 64.91 s | 252.40 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 9% | 9% | 65.16 s | 251.43 Mb |
| Source:1MB MultiTransfer | 7% | 2% | 12% | 15% | 66.41 s | 246.70 Mb |
| Source:10MB MultiTransfer | 7% | 2% | 10% | 10% | 64.69 s | 253.28 Mb |
| Source:100MB MultiTransfer | 7% | 2% | 10% | 10% | 63.96 s | 256.14 Mb |

Table 10 524228 byte chunk size values for Single and Multiple instance transfers

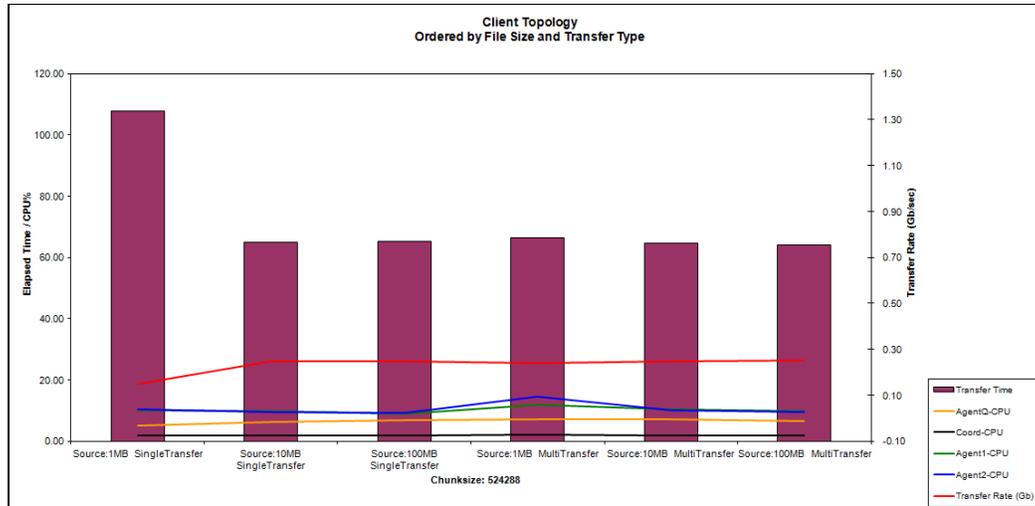
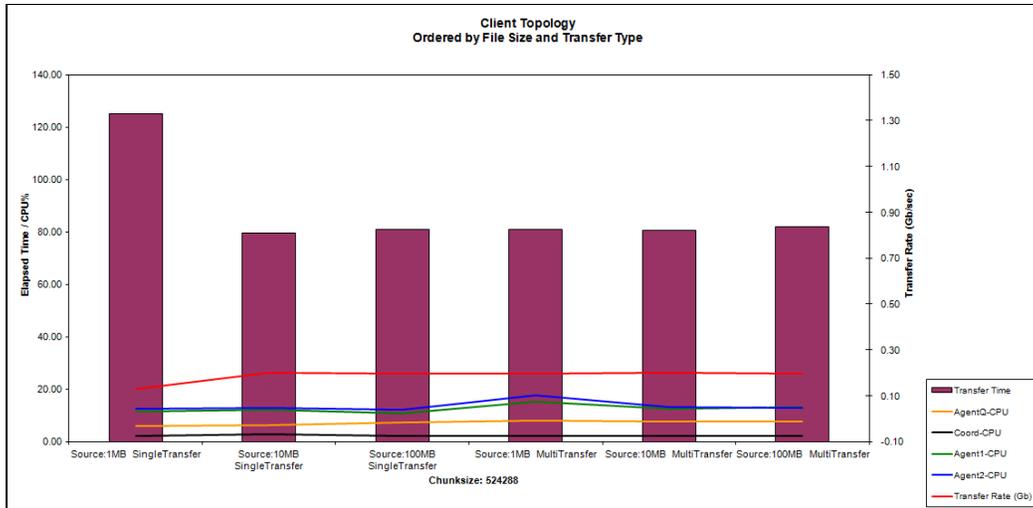


Figure 9 524228 byte chunk size values for Single and Multiple instance transfers

2.2.4.4 Binary Mode with MD5 checksum

| Test | AgentQ-CPU | Coord-CPU | Agent1-CPU | Agent2-CPU | Transfer Time | Transfer Rate |
|-----------------------------|------------|-----------|------------|------------|---------------|---------------|
| Source:1MB SingleTransfer | 6% | 2% | 12% | 12% | 125.15 s | 130.91 Mb |
| Source:10MB SingleTransfer | 6% | 3% | 12% | 13% | 79.38 s | 206.40 Mb |
| Source:100MB SingleTransfer | 7% | 2% | 11% | 12% | 81.03 s | 202.21 Mb |
| Source:1MB MultiTransfer | 8% | 2% | 15% | 17% | 80.97 s | 202.35 Mb |
| Source:10MB MultiTransfer | 8% | 2% | 12% | 13% | 80.42 s | 203.74 Mb |
| Source:100MB MultiTransfer | 8% | 2% | 13% | 13% | 82.07 s | 199.64 Mb |



2.2.5 Test Summary for Client's mode

2.2.5.1 Text Mode

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 |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 114.99 s | 131072 Bytes |
| Source:10MB SingleTransfer | 84.68 s | 65636 Bytes |
| Source:100MB SingleTransfer | 82.97 s | 262144 Bytes |
| Source:1MB MultiTransfer | 87.71 s | 262144 Bytes |
| Source:10MB MultiTransfer | 87.68 s | 65636 Bytes |
| Source:100MB MultiTransfer | 85.71 s | 65636 Bytes |

Table 11 Best transfer speeds for Single and Multiple instance transfers

2.2.5.2 Text Mode with MD5 checksum

| File Size and Transfer Type | Transfer Time | Chunk size |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 118.48 s | 262144 Bytes |
| Source:10MB SingleTransfer | 81.90 s | 131072 Bytes |
| Source:100MB SingleTransfer | 79.63 s | 262144 Bytes |
| Source:1MB MultiTransfer | 81.99 s | 65636 Bytes |
| Source:10MB MultiTransfer | 80.74 s | 262144 Bytes |
| Source:100MB MultiTransfer | 80.67 s | 524288 Bytes |

2.2.5.3 Binary Mode

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 |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 103.75 s | 65636 Bytes |
| Source:10MB SingleTransfer | 64.91 s | 524288 Bytes |
| Source:100MB SingleTransfer | 65.16 s | 524288 Bytes |
| Source:1MB MultiTransfer | 66.41 s | 524288 Bytes |
| Source:10MB MultiTransfer | 64.69 s | 524288 Bytes |
| Source:100MB MultiTransfer | 63.96 s | 524288 Bytes |

2.2.5.4 Binary Mode with MD5 checksum

| File Size and Transfer Type | Transfer Time | Chunk size |
|-----------------------------|---------------|--------------|
| Source:1MB SingleTransfer | 125.15 s | 524288 Bytes |
| Source:10MB SingleTransfer | 79.38 s | 524288 Bytes |
| Source:100MB SingleTransfer | 80.37 s | 262144 Bytes |
| Source:1MB MultiTransfer | 80.97 s | 524288 Bytes |
| Source:10MB MultiTransfer | 80.42 s | 524288 Bytes |
| Source:100MB MultiTransfer | 79.99 s | 262144 Bytes |

3 Tuning Recommendations

3.1 IBM MQ Setup

Readers of this performance guide should make themselves familiar with the IBM MQ Performance Supportpacs that are continually released. In this case it would be for MQ 9.0.5 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 Supportpacs 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 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 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.

- Send large numbers of files over multiple transfers, rather than 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 IBM 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.
- 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 9.0.5 was used for this report.
- Default properties were used for agents, except for agentChunkSize.
- Agents were reading/writing files to the local file system, not the SAN.

4.2 IBM MQ

- IBM MQ Version 9.0.5 was used for all machines.
- Queue managers created in accordance with Performance report.

4.3 Operating System

- Windows Server 2016 Standard 64bit.

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

