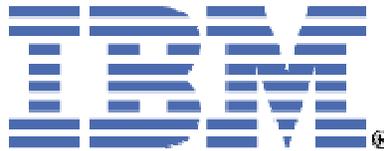


IBM MQ 9.0.5.0

Managed File Transfer Performance Report for Linux

Configuration and Measurements for the following products:

IBM MQ 9.0.5.0



IBM Corporation
IBM MQ Performance Team
June 2018



IBM MQ Managed File Transfer V9.0.5.0 Performance Report

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First Edition, November 2018.

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

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How this document is arranged

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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: 31-33

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

Measurement Environment

Pages: 34

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 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 the Red Hat Enterprise Linux operating system.

On each test an additional checksum calculation (MD5) test was performed. This did change the test throughputs and the results for 64 bit IBM MQ V9.0.5.0 have been included¹. It is also worth noting that there was no code page conversion required between the machines and that 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 where all of the values are very close.

¹ This document only reports Linux 64-bit results primarily because the differences between 32 and 64 bit operating system results were negligible and in the future, most customers will use a 64-bit OS. The MD5 checksum is optional but is a commonly used additional feature and has been included to demonstrate the overhead incurred. There is no relationship between the choice of using the 64-bit product and the inclusion of the MD5 results.

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 [IBM Knowledge center link \[https://www.ibm.com/support/knowledgecenter/en/SSFKSJ_9.0.0/com.ibm.wmqfte.doc/properties.htm\]\(https://www.ibm.com/support/knowledgecenter/en/SSFKSJ_9.0.0/com.ibm.wmqfte.doc/properties.htm\)](https://www.ibm.com/support/knowledgecenter/en/SSFKSJ_9.0.0/com.ibm.wmqfte.doc/properties.htm) IBM MQ 9.0.x ManagedFile Transfer—►MFT Reference—►MFT Configuring 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

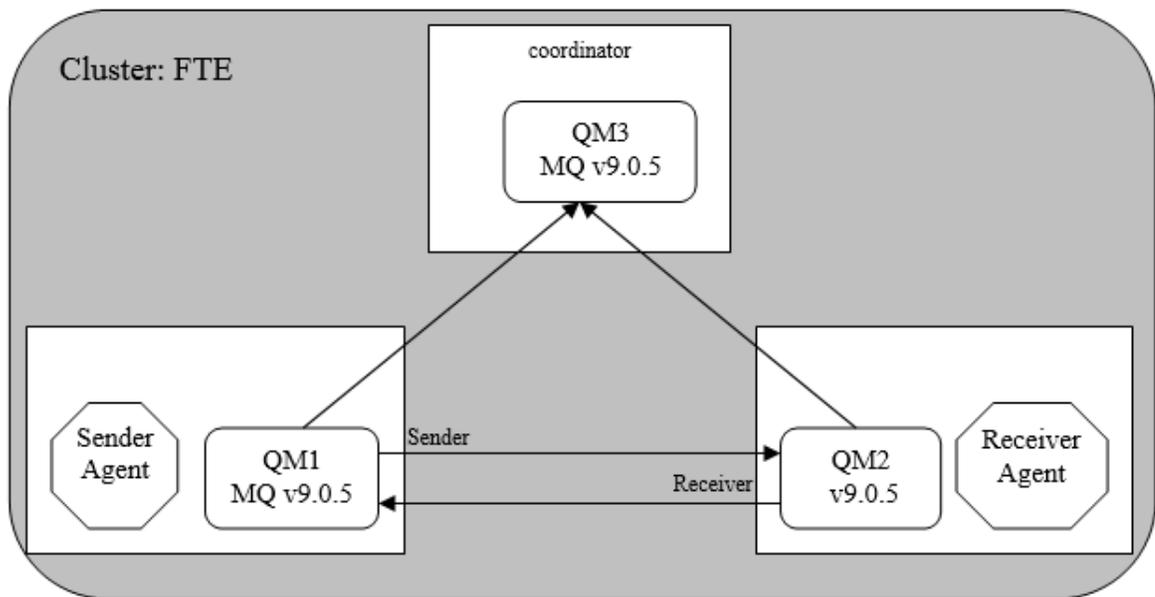
To demonstrate the multithreaded capability of the agent, a multiple transfer test were run and compared to the equivalent single transfer test. The multiple transfer test divides the number of files transferred in the single transfer test into ten threads. The threads were then run simultaneously.

All files were transferred in text mode and 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.

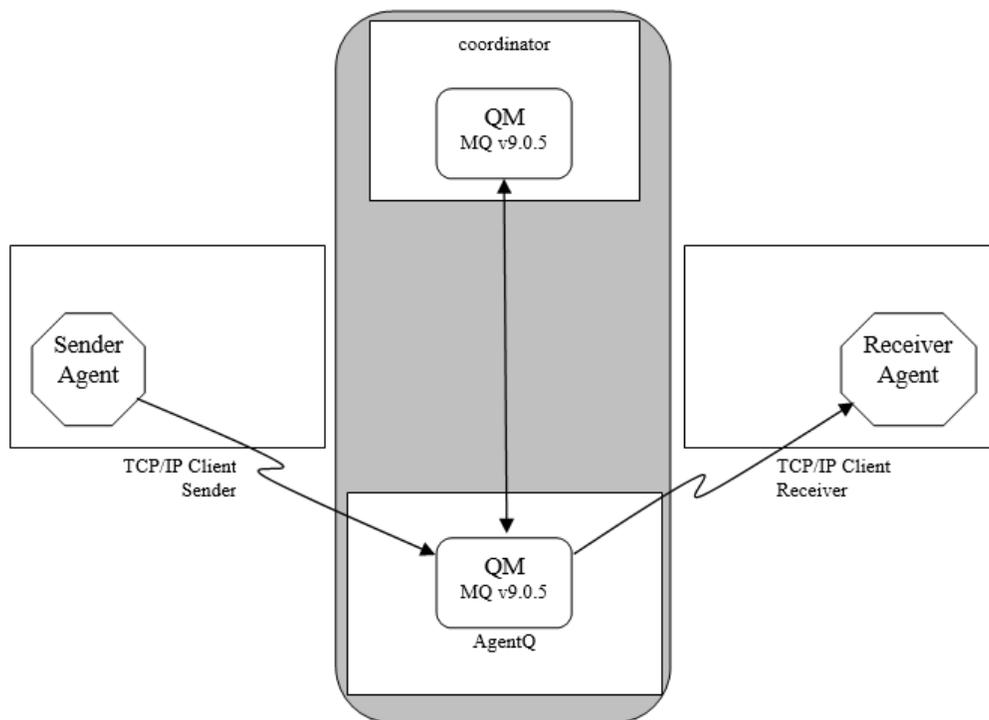
Agents Connecting in Bindings Mode

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

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.

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	13%	17%	86.11 s	190.27 Mb
Source:10MB SingleTransfer	0%	15%	19%	37.08 s	441.87 Mb
Source:100MB SingleTransfer	0%	19%	23%	22.30 s	734.73 Mb
Source:1MB MultiTransfer	1%	22%	38%	37.05 s	442.27 Mb
Source:10MB MultiTransfer	1%	39%	41%	13.52 s	1,212.04 Mb
Source:100MB MultiTransfer	0%	29%	31%	29.65 s	552.53 Mb

Table 1 Linux64 64KB chunk size for Single and Multiple instance transfers, text mode

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	14%	19%	91.02 s	180.00 Mb
Source:10MB SingleTransfer	0%	18%	21%	42.05 s	389.65 Mb
Source:100MB SingleTransfer	0%	23%	25%	29.49 s	555.60 Mb
Source:1MB MultiTransfer	1%	34%	45%	27.46 s	596.69 Mb
Source:10MB MultiTransfer	0%	11%	13%	70.64 s	231.95 Mb
Source:100MB MultiTransfer	1%	36%	34%	31.78 s	515.50 Mb

Table 2 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, text mode

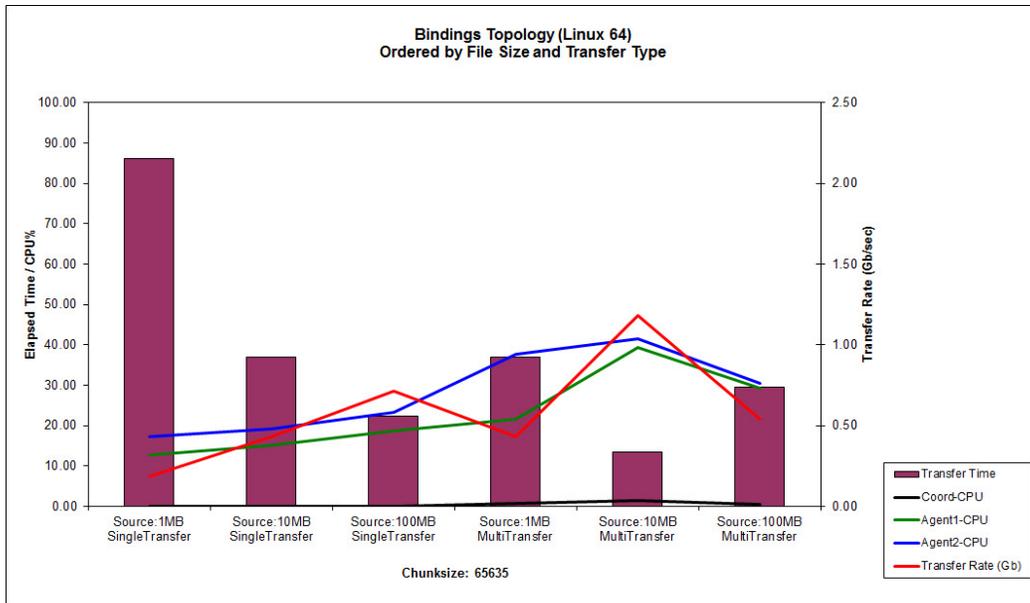


Figure 1 Linux64 64KB chunk size for Single and Multiple instance transfers, text mode

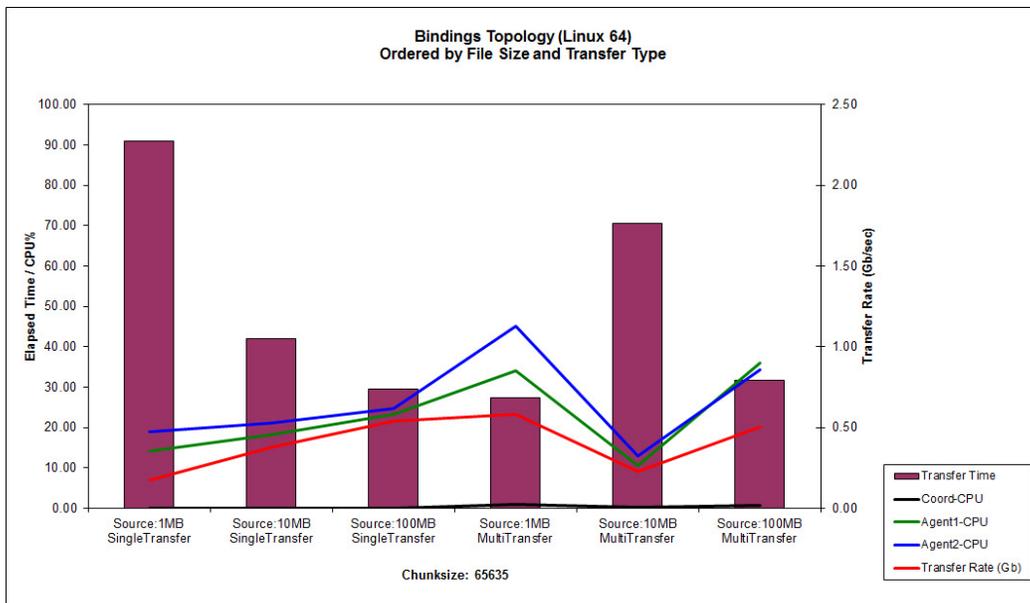


Figure 2 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, text mode

2.1.1.2 Binary Mode

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	12%	18%	79.46 s	206.20 Mb
Source:10MB SingleTransfer	0%	14%	20%	31.83 s	514.75 Mb
Source:100MB SingleTransfer	0%	17%	25%	21.95 s	746.54 Mb
Source:1MB MultiTransfer	1%	21%	40%	29.02 s	564.63 Mb
Source:10MB MultiTransfer	1%	39%	47%	11.17 s	1,466.39 Mb
Source:100MB MultiTransfer	1%	39%	47%	9.07 s	1,806.59 Mb

Table 3 Linux64 64KB chunk size for Single and Multiple instance transfers, binary mode

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	15%	20%	85.78 s	191.00 Mb
Source:10MB SingleTransfer	0%	18%	22%	41.28 s	396.89 Mb
Source:100MB SingleTransfer	0%	22%	24%	31.01 s	528.36 Mb
Source:1MB MultiTransfer	0%	22%	35%	50.35 s	325.40 Mb
Source:10MB MultiTransfer	1%	21%	25%	51.86 s	315.90 Mb
Source:100MB MultiTransfer	0%	22%	26%	51.55 s	317.82 Mb

Table 4 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, binary mode

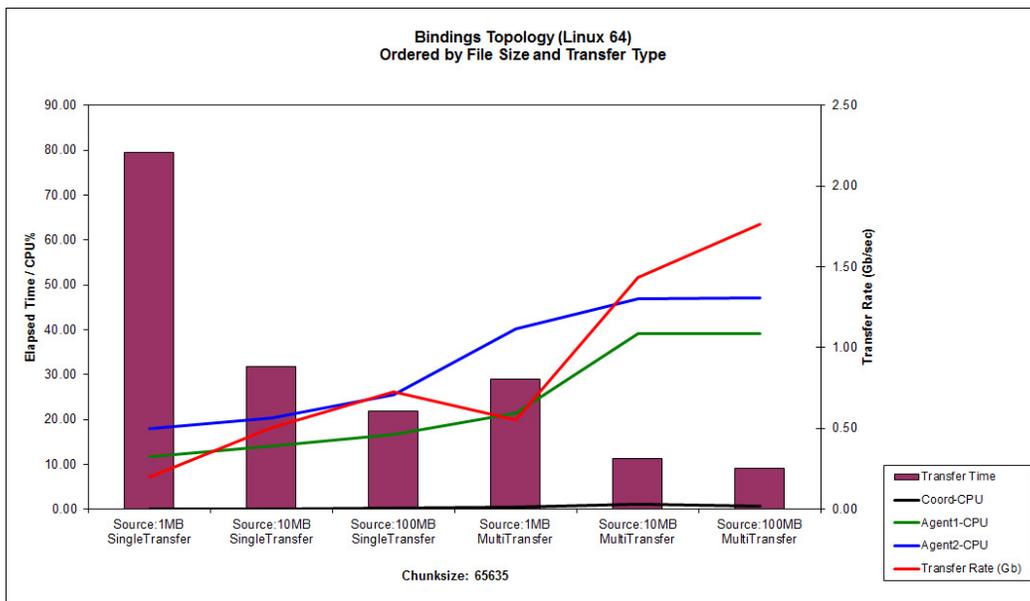


Figure 3 Linux64 64KB chunk size for Single and Multiple instance transfers, binary mode

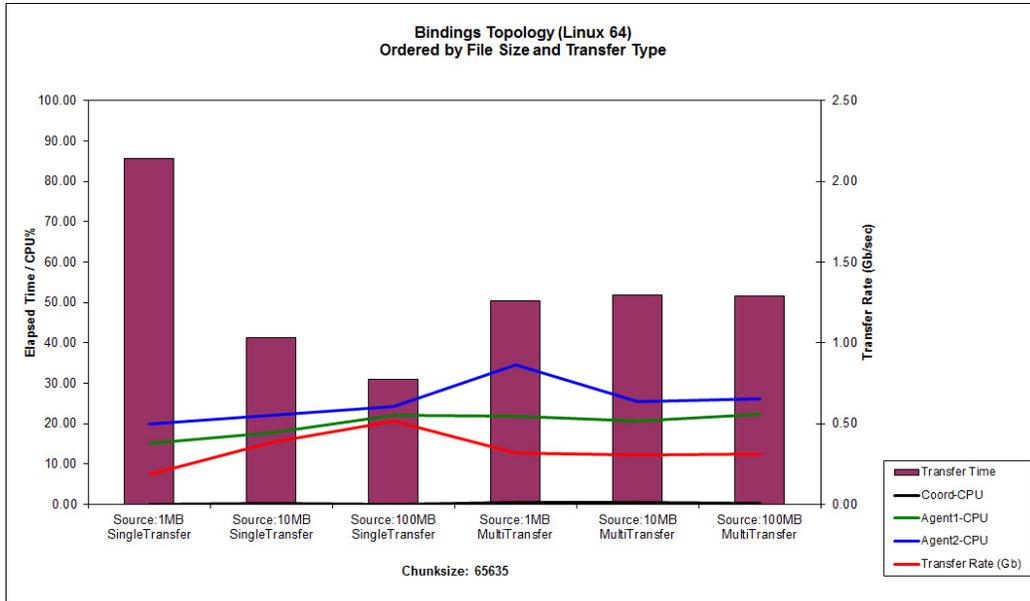


Figure 4 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, binary mode

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.

Linux64 - 131072	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	13%	18%	82.06 s	199.66 Mb
Source:10MB SingleTransfer	0%	17%	19%	34.94 s	468.88 Mb
Source:100MB SingleTransfer	0%	21%	21%	25.00 s	655.46 Mb
Source:1MB MultiTransfer	1%	24%	38%	32.91 s	497.80 Mb
Source:10MB MultiTransfer	1%	40%	42%	12.60 s	1,300.63 Mb
Source:100MB MultiTransfer	1%	36%	48%	11.66 s	1,405.63 Mb

Table 5 Linux64 128KB chunk size for Single and Multiple instance transfers, text mode

Linux64 - 131072	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	15%	19%	79.36 s	206.45 Mb
Source:10MB SingleTransfer	0%	19%	21%	40.68 s	402.71 Mb
Source:100MB SingleTransfer	0%	22%	24%	29.73 s	551.16 Mb

IBM MQ Managed File Transfer V9.0.5.0 Performance Report

Source:1MB MultiTransfer	0%	15%	19%	76.05 s	215.45 Mb
Source:10MB MultiTransfer	0%	11%	13%	69.88 s	234.46 Mb
Source:100MB MultiTransfer	1%	38%	40%	30.44 s	538.19 Mb

Table 6 Linux64-MD5 128KB chunk size for Single and Multiple instance transfers, text mode

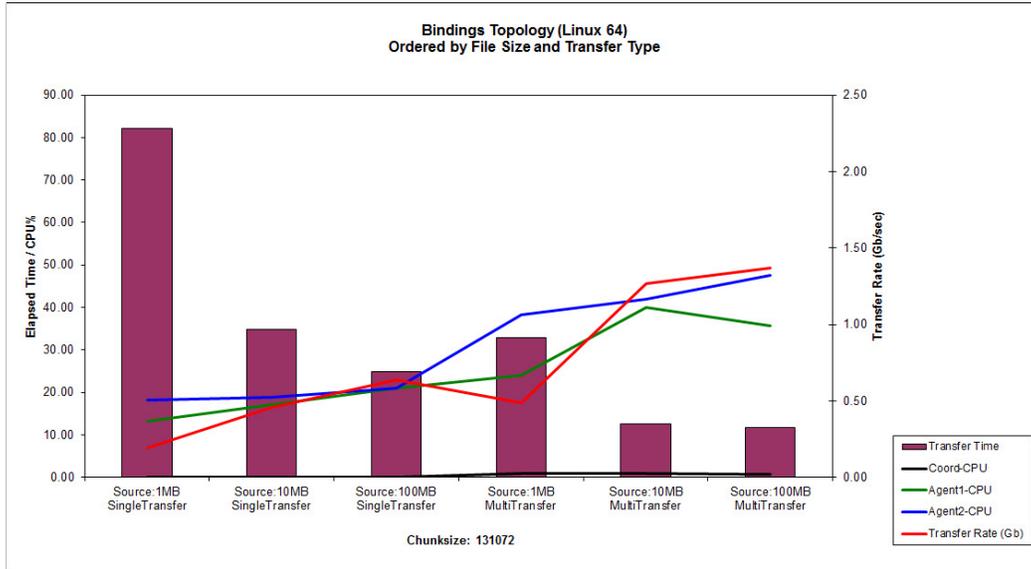


Figure 5 Linux64 128KB chunk size for Single and Multiple instance transfers, text mode

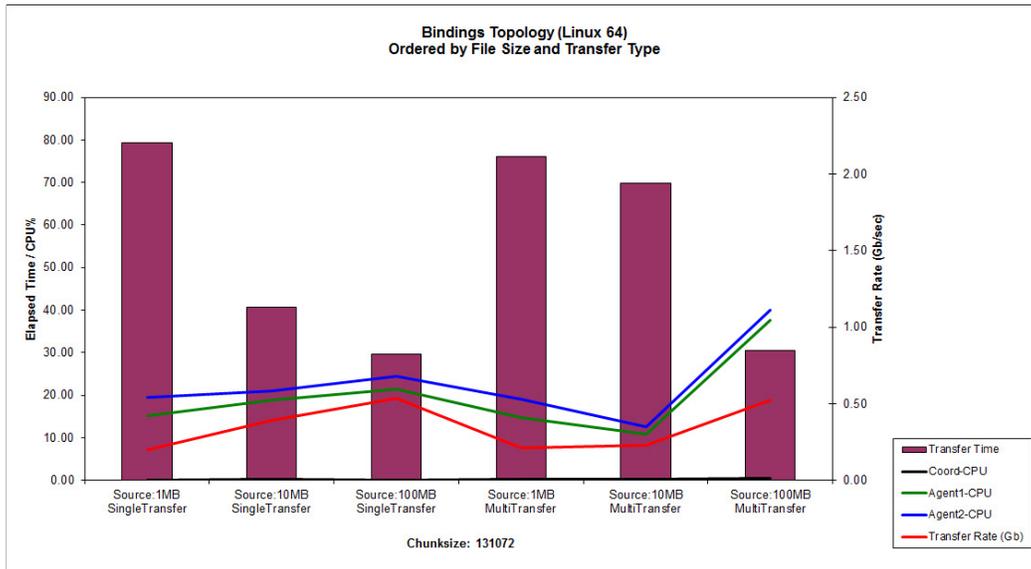


Figure 6 Linux64 MD5 128KB chunk size for Single and Multiple instance transfers, text mode

2.1.2.2 Binary Mode

Linux64 - 131072	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	12%	17%	82.41 s	198.80 Mb
Source:10MB SingleTransfer	0%	15%	22%	29.91 s	547.83 Mb
Source:100MB SingleTransfer	0%	19%	24%	20.17 s	812.48 Mb
Source:1MB MultiTransfer	1%	23%	40%	27.42 s	597.57 Mb
Source:10MB MultiTransfer	1%	36%	46%	11.10 s	1,476.08 Mb
Source:100MB MultiTransfer	1%	34%	48%	11.48 s	1,426.80 Mb

Table 7 Linux64 128KB chunk size for Single and Multiple instance transfers, binary mode

Linux64 - 131072	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	15%	19%	81.85 s	200.16 Mb
Source:10MB SingleTransfer	0%	18%	22%	38.79 s	422.42 Mb
Source:100MB SingleTransfer	0%	22%	25%	27.74 s	590.56 Mb
Source:1MB MultiTransfer	1%	22%	35%	47.21 s	347.04 Mb
Source:10MB MultiTransfer	1%	47%	52%	14.19 s	1,154.97 Mb
Source:100MB MultiTransfer	0%	23%	24%	49.83 s	328.82 Mb

Table 8 Linux64-MD5 128KB chunk size for Single and Multiple instance transfers, binary mode

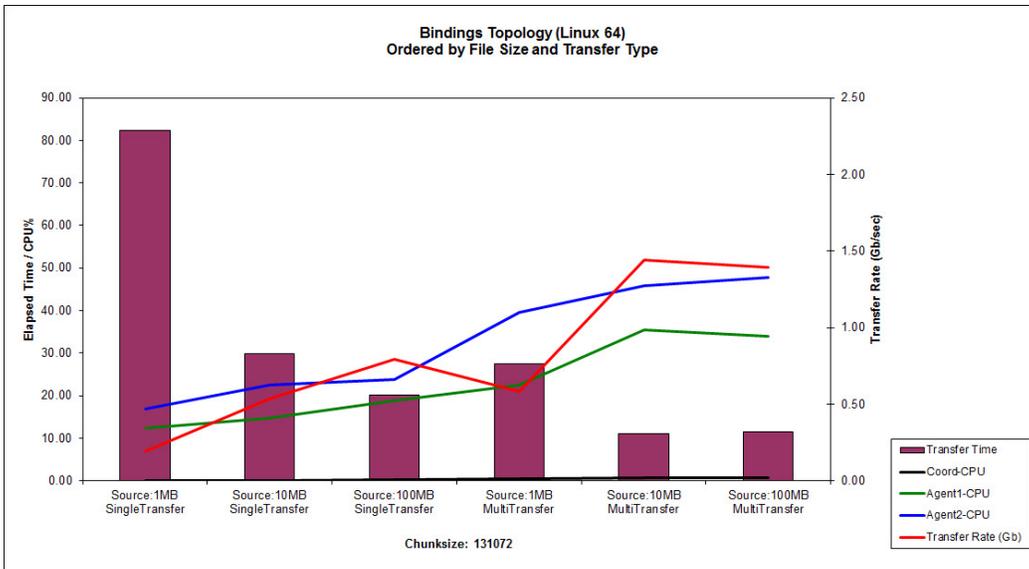


Figure 7 Linux64 128KB chunk size for Single and Multiple instance transfers, binary mode

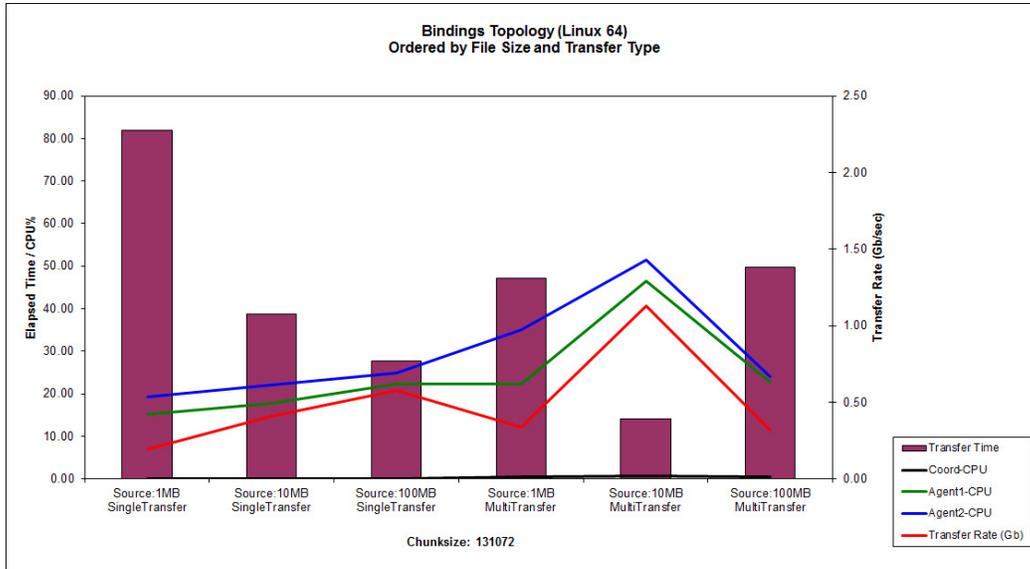


Figure 8 Linux64 MD5 128KB chunk size for Single and Multiple instance transfers, binary mode

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.

2.1.3.1 Text Mode

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	13%	17%	87.25 s	187.78 Mb
Source:10MB SingleTransfer	0%	16%	20%	36.99 s	442.87 Mb
Source:100MB SingleTransfer	0%	19%	21%	28.15 s	582.05 Mb
Source:1MB MultiTransfer	0%	21%	37%	40.38 s	405.72 Mb
Source:10MB MultiTransfer	1%	29%	33%	31.27 s	523.97 Mb
Source:100MB MultiTransfer	1%	39%	43%	11.74 s	1,395.81 Mb

Table 9 Linux64 256KB chunk size for Single and Multiple instance transfers, text mode

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	16%	19%	81.72 s	200.49 Mb
Source:10MB SingleTransfer	0%	17%	23%	36.44 s	449.56 Mb
Source:100MB SingleTransfer	0%	20%	26%	26.13 s	626.92 Mb
Source:1MB MultiTransfer	0%	21%	27%	63.95 s	256.22 Mb
Source:10MB MultiTransfer	1%	31%	37%	32.20 s	508.86 Mb
Source:100MB MultiTransfer	1%	24%	25%	47.83 s	342.58 Mb

Table 10 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, text mode

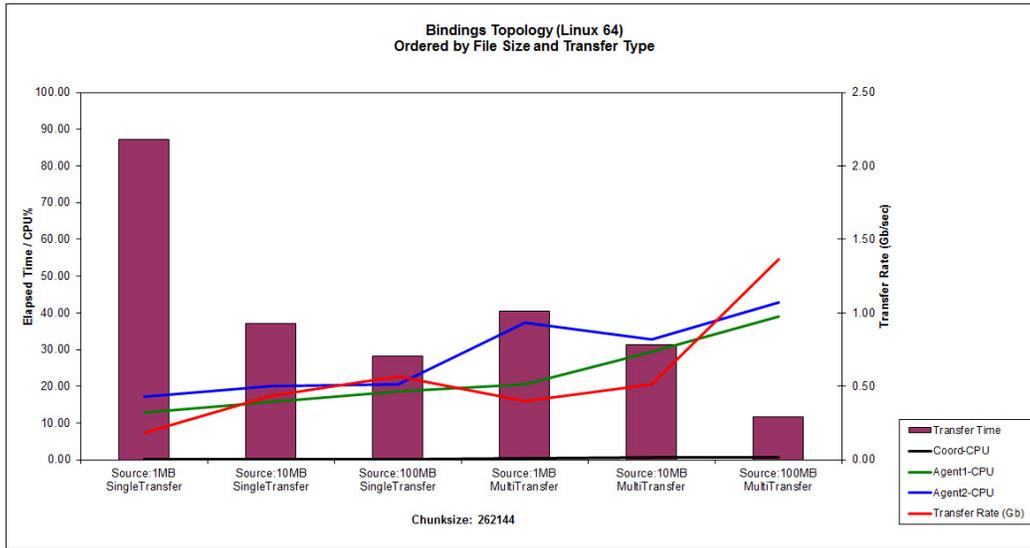


Figure 9 Linux64 256KB chunk size for Single and Multiple instance transfers, text mode

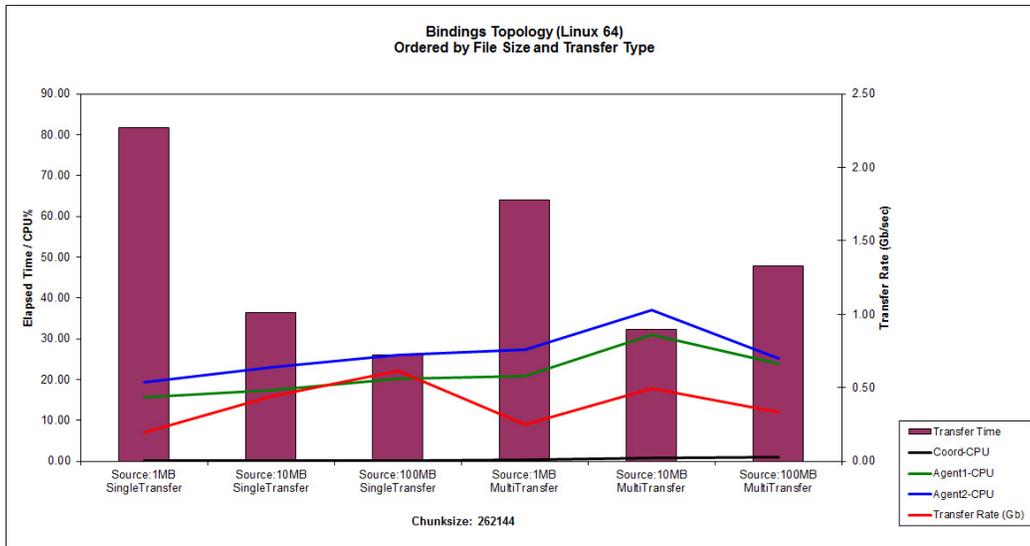


Figure 10 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, text mode

2.1.3.2 Binary Mode

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	12%	18%	75.68 s	216.49 Mb
Source:10MB SingleTransfer	0%	14%	21%	31.52 s	519.88 Mb
Source:100MB SingleTransfer	0%	18%	26%	20.19 s	811.37 Mb
Source:1MB MultiTransfer	1%	24%	40%	28.00 s	585.14 Mb
Source:10MB MultiTransfer	1%	35%	44%	12.17 s	1,345.86 Mb
Source:100MB MultiTransfer	1%	35%	44%	9.22 s	1,777.52 Mb

Table 11 Linux64 256KB chunk size for Single and Multiple instance transfers, binary mode

Linux64	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	15%	19%	86.17 s	190.14 Mb
Source:10MB SingleTransfer	0%	18%	22%	39.71 s	412.60 Mb
Source:100MB SingleTransfer	0%	23%	25%	30.66 s	534.42 Mb
Source:1MB MultiTransfer	1%	24%	38%	43.74 s	374.58 Mb
Source:10MB MultiTransfer	0%	12%	13%	71.14 s	230.31 Mb
Source:100MB MultiTransfer	0%	12%	12%	68.15 s	240.41 Mb

Table 12 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, binary mode

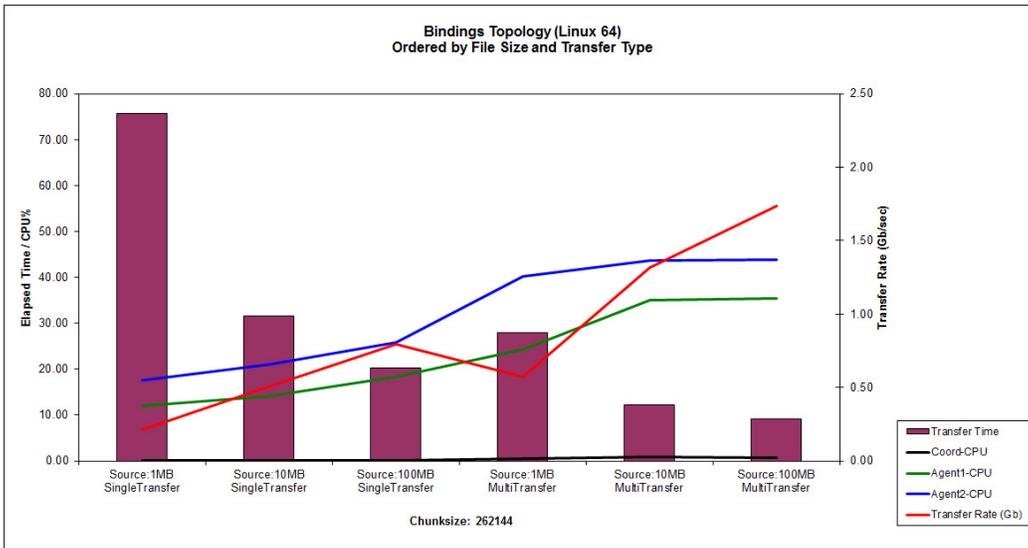


Figure 11 Linux64 256KB chunk size for Single and Multiple instance transfers, binary mode

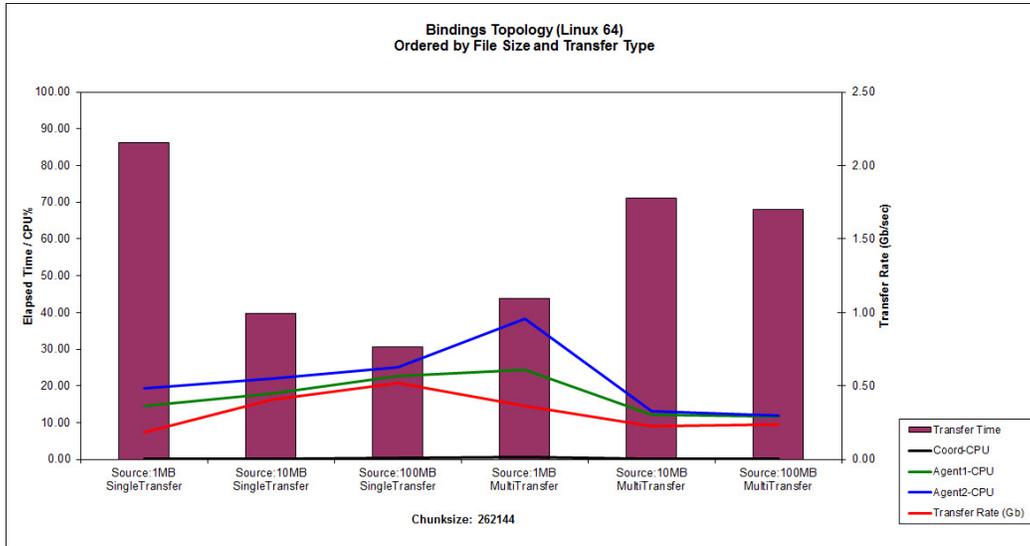


Figure 12 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, binary mode

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.

2.1.4.1 Text Mode

Linux64 - 524228	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	12%	17%	76.52 s	214.12 Mb
Source:10MB SingleTransfer	0%	17%	20%	26.69 s	613.93 Mb
Source:100MB SingleTransfer	0%	23%	22%	16.83 s	973.63 Mb
Source:1MB MultiTransfer	1%	22%	36%	33.99 s	482.04 Mb
Source:10MB MultiTransfer	2%	40%	44%	10.87 s	1,506.76 Mb
Source:100MB MultiTransfer	1%	38%	44%	9.57 s	1,711.78 Mb

Table 13 Linux64 512KB chunk size for Single and Multiple instance transfers, text mode

Linux64 - 524228	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	14%	19%	79.04 s	207.28 Mb
Source:10MB SingleTransfer	0%	18%	22%	35.33 s	463.79 Mb
Source:100MB SingleTransfer	0%	23%	24%	24.37 s	672.25 Mb

IBM MQ Managed File Transfer V9.0.5.0 Performance Report

Source:1MB MultiTransfer	1%	23%	33%	47.20 s	347.14 Mb
Source:10MB MultiTransfer	1%	24%	26%	47.89 s	342.12 Mb
Source:100MB MultiTransfer	1%	52%	46%	12.25 s	1,337.25 Mb

Table 14 Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, text mode

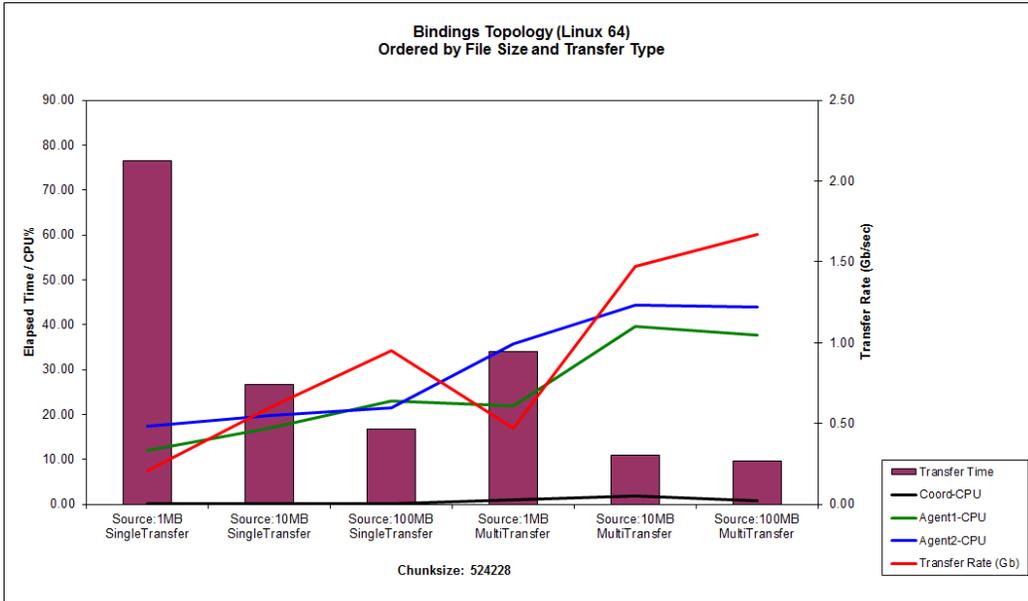


Figure 13 Linux64 512KB chunk size for Single and Multiple instance transfers, text mode

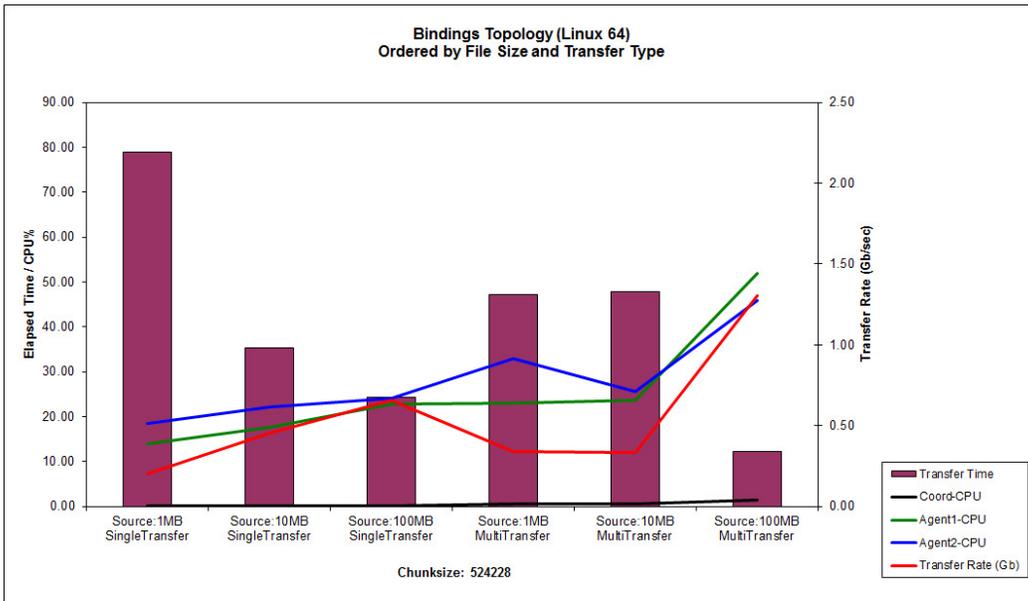


Figure 14 Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, text mode

2.1.4.2 Binary Mode

Linux64 - 524228	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	12%	17%	67.53 s	242.63 Mb
Source:10MB SingleTransfer	0%	16%	21%	24.09 s	680.01 Mb
Source:100MB SingleTransfer	0%	24%	26%	14.09 s	1,163.14 Mb
Source:1MB MultiTransfer	0%	22%	40%	26.70 s	613.63 Mb
Source:10MB MultiTransfer	1%	36%	41%	10.95 s	1,495.85 Mb
Source:100MB MultiTransfer	1%	43%	39%	8.11 s	2,020.80 Mb

Table 15 Linux64 512KB chunk size for Single and Multiple instance transfers, binary mode

Linux64 - 524228	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	0%	13%	19%	77.98 s	210.10 Mb
Source:10MB SingleTransfer	0%	18%	22%	35.69 s	459.09 Mb
Source:100MB SingleTransfer	0%	22%	24%	23.86 s	686.56 Mb
Source:1MB MultiTransfer	1%	27%	43%	31.66 s	517.56 Mb
Source:10MB MultiTransfer	1%	48%	51%	12.96 s	1,264.65 Mb
Source:100MB MultiTransfer	1%	35%	38%	29.39 s	557.51 Mb

Table 16 Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, binary mode

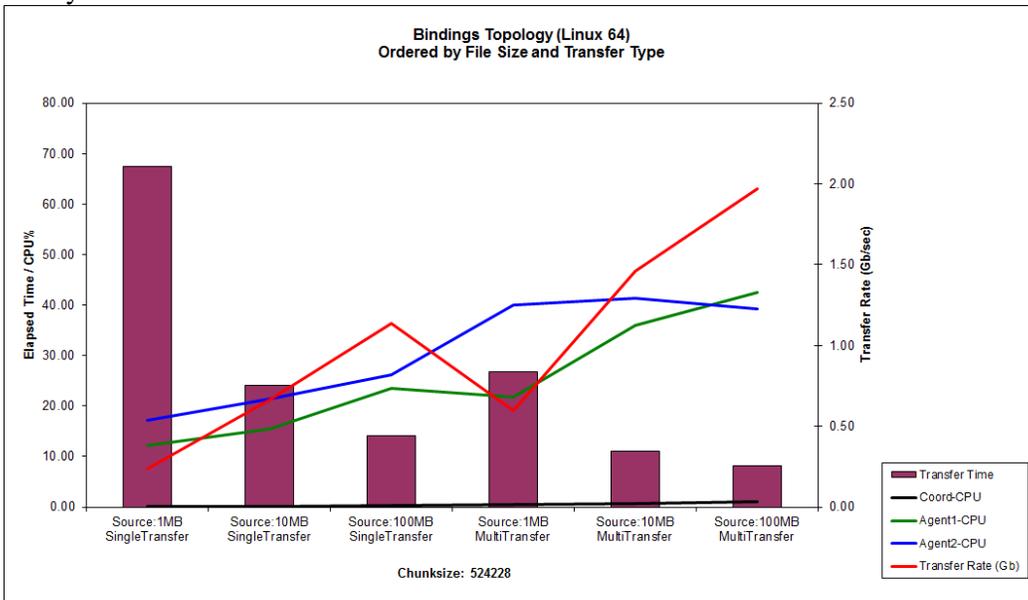
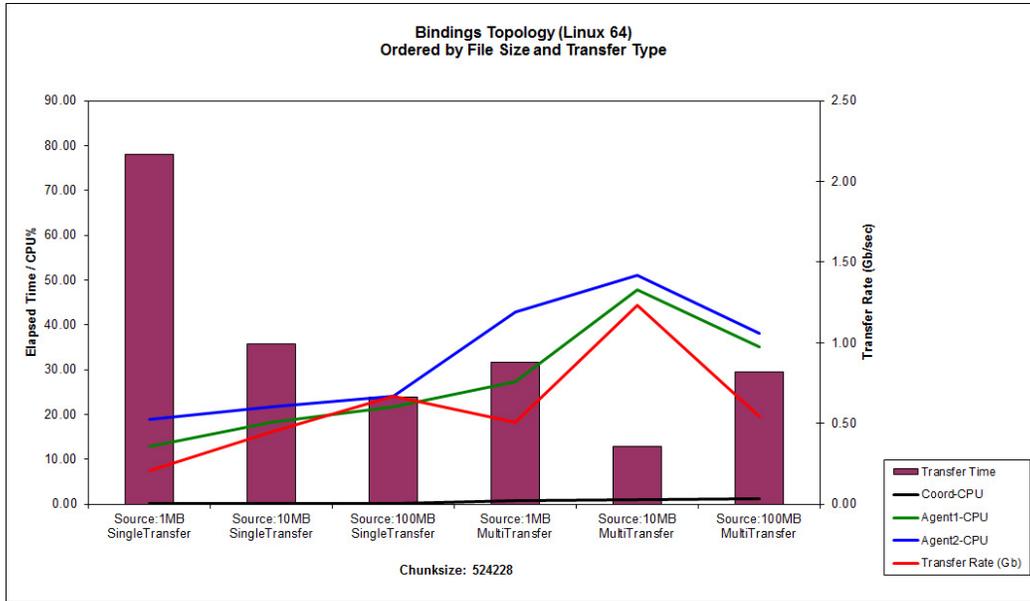


Figure 15 Linux64 512KB chunk size for Single and Multiple instance transfers, binary mode



Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, binary mode

2.1.5 Test Summary

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

2.1.5.1 Text Mode

File Size and Transfer Type	Transfer Time	Chunk size
Source:1MB SingleTransfer	76.52	524228
Source:10MB SingleTransfer	26.69	524228
Source:100MB SingleTransfer	16.83	524228
Source:1MB MultiTransfer	32.91	131072
Source:10MB MultiTransfer	10.87	524228
Source:100MB MultiTransfer	9.57	524228

Table 17 Linux64 Best transfer speeds for Single and Multiple instance transfers, text mode

File Size and Transfer Type	Transfer Time	Chunk size
Source:1MB SingleTransfer	79.04	524228
Source:10MB SingleTransfer	35.33	524228
Source:100MB SingleTransfer	24.37	524228
Source:1MB MultiTransfer	27.46	65635
Source:10MB MultiTransfer	32.20	262144
Source:100MB MultiTransfer	12.25	524228

Table 18 Linux64-MD5 Best transfer speeds for Single & Multiple instance transfers, text mode

2.1.5.2 Binary Mode

File Size and Transfer Type	Transfer Time	Chunk size
Source:1MB SingleTransfer	67.53	524228
Source:10MB SingleTransfer	24.09	524228
Source:100MB SingleTransfer	14.09	524228
Source:1MB MultiTransfer	26.70	524228
Source:10MB MultiTransfer	10.95	524228
Source:100MB MultiTransfer	8.11	524228

Table 19 Linux64 Best transfer speeds for Single and Multiple instance transfers, text mode

File Size and Transfer Type	Transfer Time	Chunk size
Source:1MB SingleTransfer	77.98	524228
Source:10MB SingleTransfer	35.69	524228
Source:100MB SingleTransfer	23.86	524228
Source:1MB MultiTransfer	31.66	524228
Source:10MB MultiTransfer	12.96	524228
Source:100MB MultiTransfer	29.39	524228

Table 20 Linux64-MD5 Best transfer speeds for Single & Multiple instance transfers, text mode

The table of results above (tables 17,18,19 and 20) show that generally, for single and multiple transfers the larger the chunk size, better the performance.

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.

2.2.1.1 Text Mode

Linux64 - 65635	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	6%	0%	9%	17%	89.59 s	182.88 Mb
Source:10MB SingleTransfer	5%	0%	6%	10%	62.50 s	262.13 Mb
Source:100MB SingleTransfer	6%	0%	5%	8%	61.45 s	266.61 Mb
Source:1MB MultiTransfer	7%	1%	10%	23%	60.82 s	269.39 Mb
Source:10MB MultiTransfer	6%	0%	8%	11%	58.77 s	278.80 Mb
Source:100MB MultiTransfer	5%	0%	6%	9%	57.54 s	284.74 Mb

Table 21 Linux64 64KB chunk size for Single and Multiple instance transfers, text mode

IBM MQ Managed File Transfer V9.0.5.0 Performance Report

Linux64 - 65635	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	5%	0%	11%	17%	103.75 s	157.92 Mb
Source:10MB SingleTransfer	6%	0%	11%	14%	63.30 s	258.85 Mb
Source:100MB SingleTransfer	4%	0%	10%	12%	61.67 s	265.68 Mb
Source:1MB MultiTransfer	6%	0%	15%	28%	60.94 s	268.83 Mb
Source:10MB MultiTransfer	6%	0%	10%	14%	59.31 s	276.26 Mb
Source:100MB MultiTransfer	5%	0%	10%	12%	59.44 s	275.65 Mb

Table 22 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, text mode

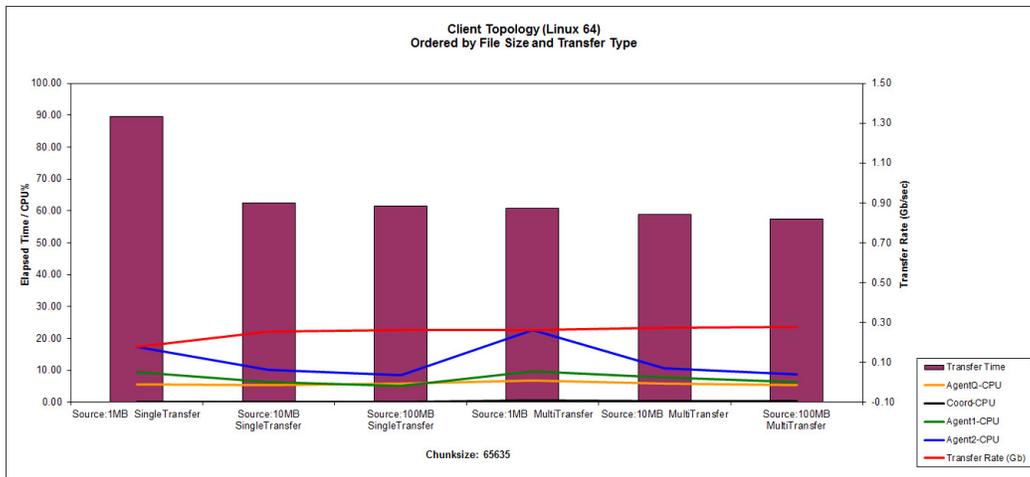


Figure 16 Linux64 64KB chunk size for Single and Multiple instance transfers, text mode

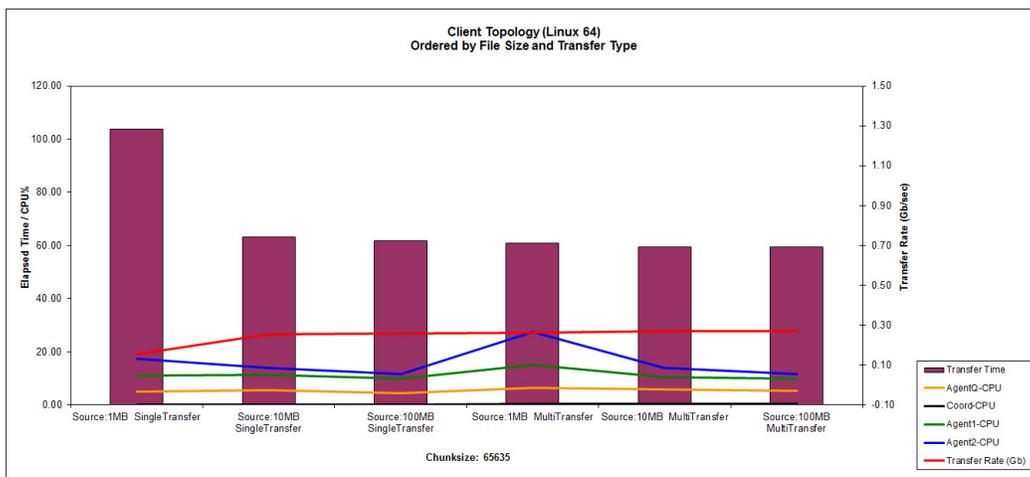


Figure 17 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, text mode

2.2.1.2 Binary Mode

Linux64 - 65635	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	5%	0%	11%	18%	74.06 s	221.24 Mb
Source:10MB SingleTransfer	5%	0%	6%	11%	59.76 s	274.17 Mb
Source:100MB SingleTransfer	4%	0%	5%	9%	58.43 s	280.38 Mb
Source:1MB MultiTransfer	6%	0%	9%	20%	59.41 s	275.76 Mb
Source:10MB MultiTransfer	6%	0%	7%	10%	57.94 s	282.77 Mb
Source:100MB MultiTransfer	5%	0%	6%	8%	57.34 s	285.72 Mb

Table 23 Linux64 64KB chunk size for Single and Multiple instance transfers, binarymode

Linux64 - 65635	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	5%	0%	12%	20%	84.27 s	194.42 Mb
Source:10MB SingleTransfer	5%	0%	10%	15%	61.17 s	267.84 Mb
Source:100MB SingleTransfer	5%	0%	9%	13%	59.57 s	275.04 Mb
Source:1MB MultiTransfer	6%	0%	14%	25%	59.26 s	276.48 Mb
Source:10MB MultiTransfer	6%	0%	11%	15%	58.77 s	278.76 Mb
Source:100MB MultiTransfer	6%	0%	10%	13%	58.03 s	282.34 Mb

Table 24 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, binary mode

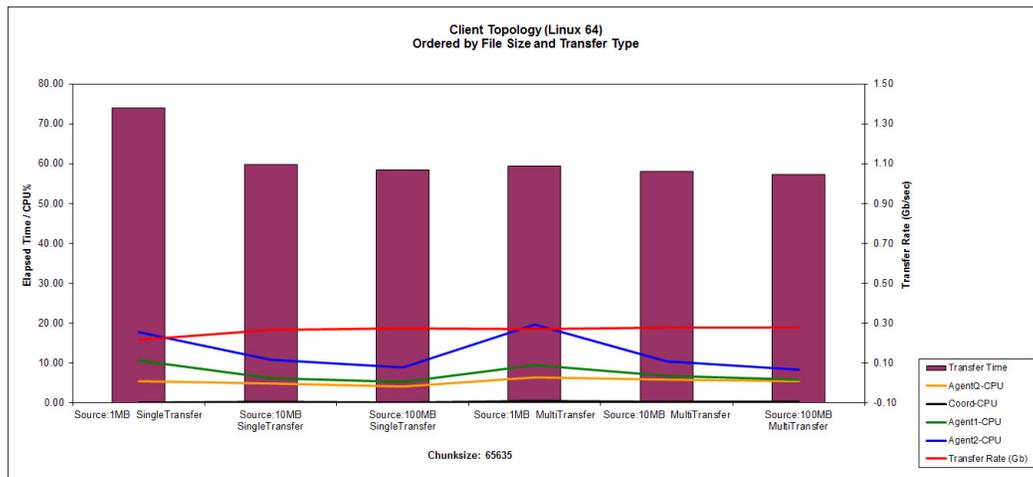


Figure 18 Linux64 64KB chunk size for Single and Multiple instance transfers, binary mode

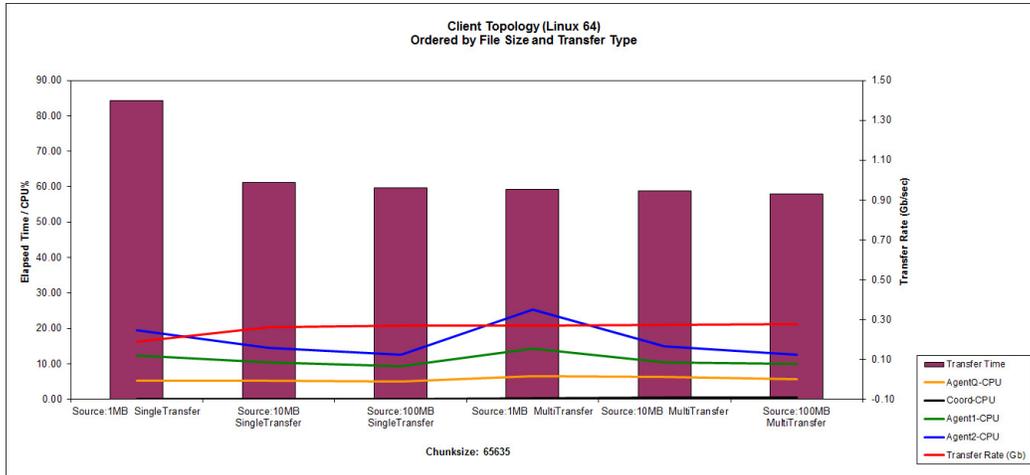


Figure 19 Linux64-MD5 64KB chunk size for Single and Multiple instance transfers, binary mode

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.

2.2.2.1 Text Mode

Linux64 - 131072	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	6%	0%	11%	17%	79.24 s	206.77 Mb
Source:10MB SingleTransfer	5%	0%	7%	10%	62.85 s	260.70 Mb
Source:100MB SingleTransfer	4%	0%	5%	8%	60.91 s	268.98 Mb
Source:1MB MultiTransfer	6%	0%	10%	20%	61.12 s	268.08 Mb
Source:10MB MultiTransfer	6%	0%	7%	10%	59.85 s	273.75 Mb
Source:100MB MultiTransfer	5%	0%	6%	8%	58.30 s	281.03 Mb

Table 25 Linux64 128KB chunk size for Single and Multiple instance transfers

Linux64 - 131072	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	6%	0%	12%	18%	86.45 s	189.53 Mb
Source:10MB SingleTransfer	5%	0%	10%	14%	62.18 s	263.50 Mb
Source:100MB SingleTransfer	5%	0%	9%	11%	62.45 s	262.37 Mb
Source:1MB MultiTransfer	7%	1%	16%	25%	58.34 s	280.85 Mb
Source:10MB MultiTransfer	6%	0%	10%	14%	61.03 s	268.45 Mb

MultiTransfer						
Source:100MB						
MultiTransfer	5%	1%	10%	12%	59.92 s	273.44 Mb

Table 26 Linux64-MD5 128KB chunk size for Single and Multiple instance transfers

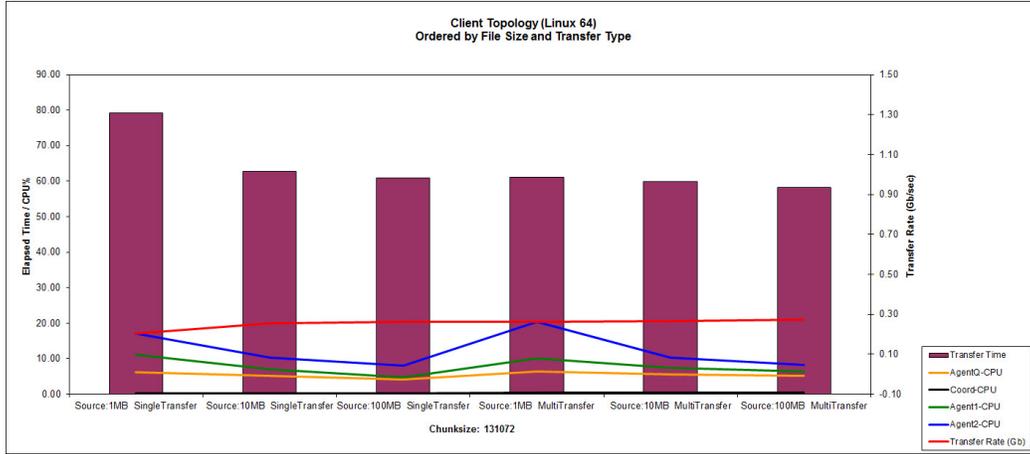


Figure 20 Linux64 128KB chunk size for Single and Multiple instance transfers

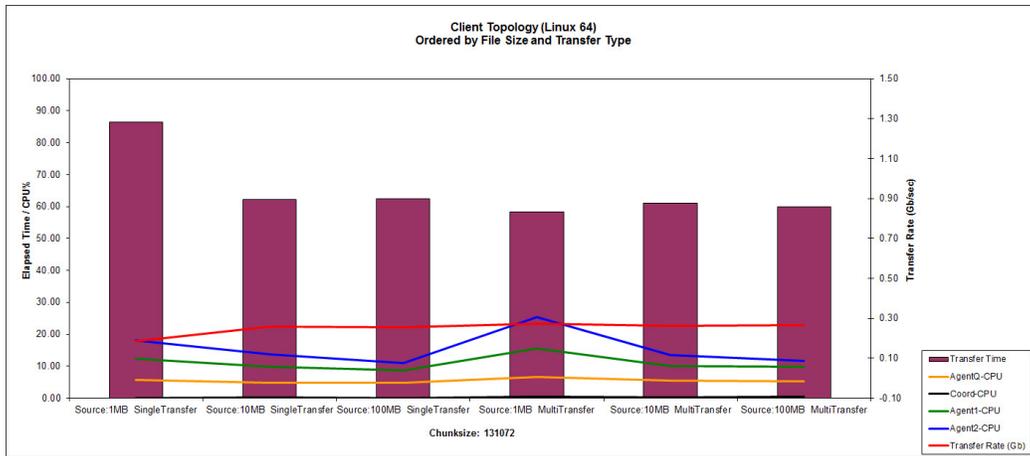


Figure 21 Linux64-MD5 128KB chunk size for Single and Multiple instance transfers

2.2.2.2 Binary Mode

Linux64 - 131072	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	6%	0%	11%	17%	71.62 s	228.75 Mb
Source:10MB SingleTransfer	5%	0%	6%	10%	59.03 s	277.55 Mb
Source:100MB SingleTransfer	4%	0%	5%	8%	58.72 s	279.00 Mb
Source:1MB MultiTransfer	6%	0%	10%	19%	59.03 s	277.58 Mb
Source:10MB MultiTransfer	6%	0%	7%	10%	57.91 s	282.94 Mb
Source:100MB MultiTransfer	6%	0%	7%	9%	57.31 s	285.90 Mb

Table 27 Linux64 128KB chunk size for Single and Multiple instance transfers

Linux64 - 131072	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	5%	0%	11%	18%	94.09 s	174.13 Mb
Source:10MB SingleTransfer	5%	0%	10%	15%	59.63 s	274.76 Mb
Source:100MB SingleTransfer	5%	0%	11%	13%	58.11 s	281.93 Mb
Source:1MB MultiTransfer	6%	0%	14%	26%	58.86 s	278.38 Mb
Source:10MB MultiTransfer	6%	0%	12%	15%	56.61 s	289.41 Mb
Source:100MB MultiTransfer	6%	1%	10%	12%	56.81 s	288.40 Mb

Table 28 Linux64-MD5 128KB chunk size for Single and Multiple instance transfers

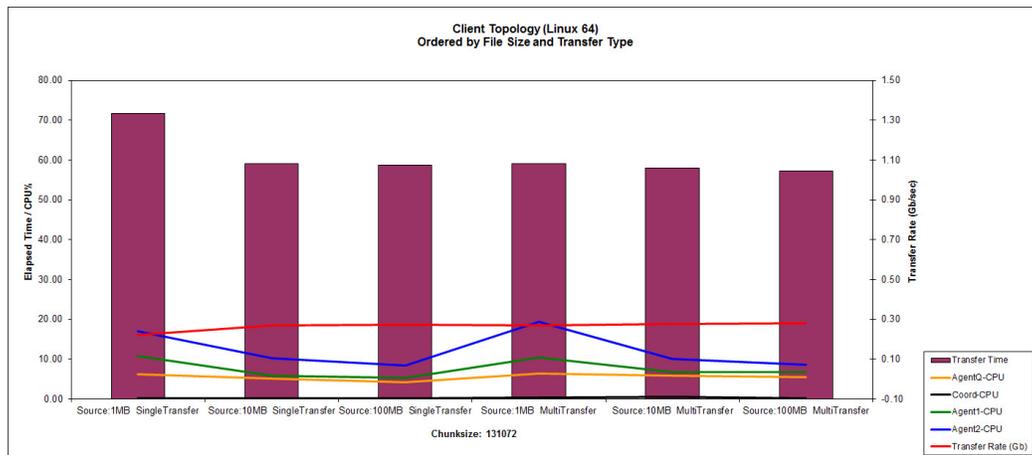


Figure 22 Linux64 128KB chunk size for Single and Multiple instance transfers

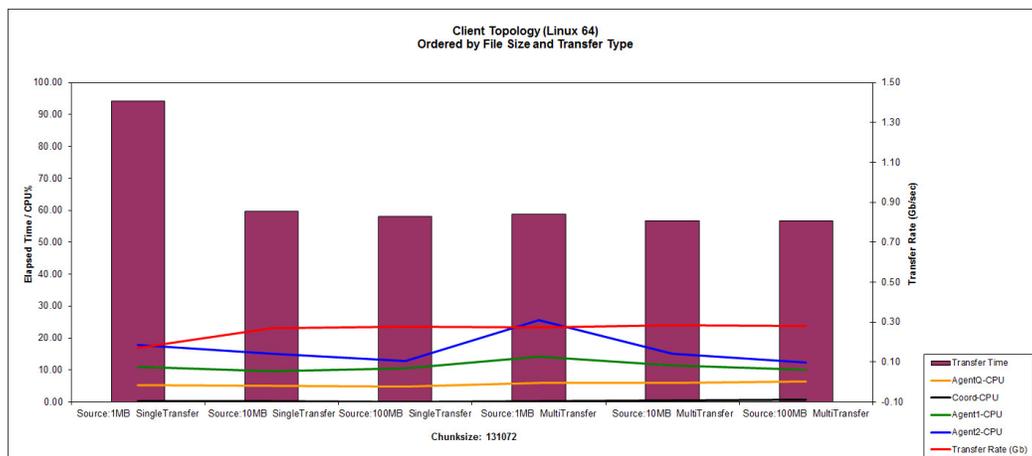


Figure 23 Linux64-MD5 128KB chunk size for Single and Multiple instance transfers

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.

2.2.3.1 Text Mode

Linux64 - 262144	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	6%	0%	10%	17%	80.23 s	204.21 Mb
Source:10MB SingleTransfer	6%	0%	7%	10%	62.83 s	260.75 Mb
Source:100MB SingleTransfer	5%	0%	6%	9%	57.73 s	283.80 Mb
Source:1MB MultiTransfer	6%	0%	10%	22%	59.69 s	274.48 Mb
Source:10MB MultiTransfer	6%	0%	7%	10%	66.27 s	247.22 Mb
Source:100MB MultiTransfer	7%	0%	6%	8%	58.47 s	280.21 Mb

Table 29 Linux64 256KB chunk size for Single and Multiple instance transfers, text mode

Linux64 - 262144	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	5%	0%	12%	17%	94.73 s	172.95 Mb
Source:10MB SingleTransfer	5%	0%	9%	13%	63.04 s	259.92 Mb
Source:100MB SingleTransfer	4%	0%	9%	12%	58.83 s	278.49 Mb
Source:1MB MultiTransfer	6%	0%	13%	23%	61.10 s	268.16 Mb
Source:10MB MultiTransfer	6%	0%	11%	14%	57.78 s	283.55 Mb
Source:100MB MultiTransfer	5%	0%	11%	12%	57.49 s	284.97 Mb

Table 30 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, text mode

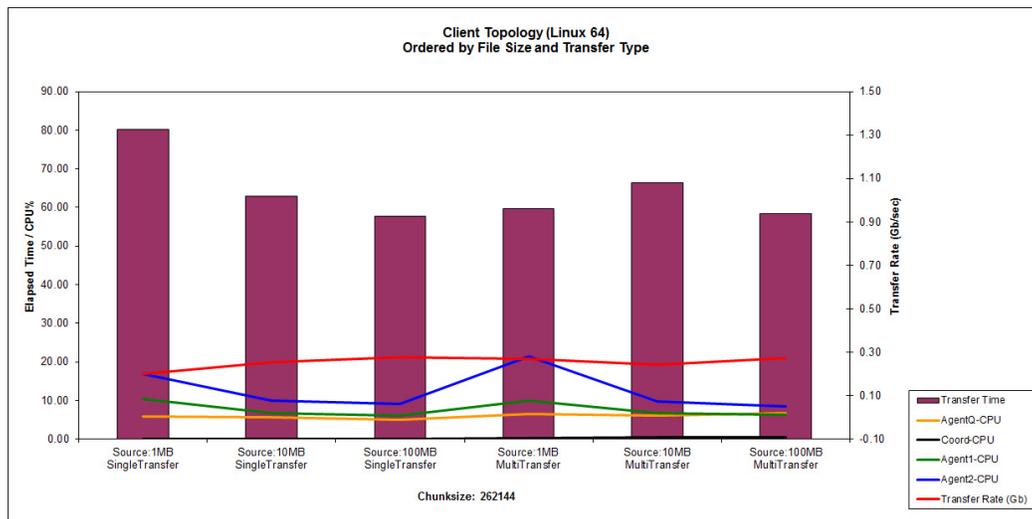


Figure 24 Linux64 256KB chunk size for Single and Multiple instance transfers, text mode

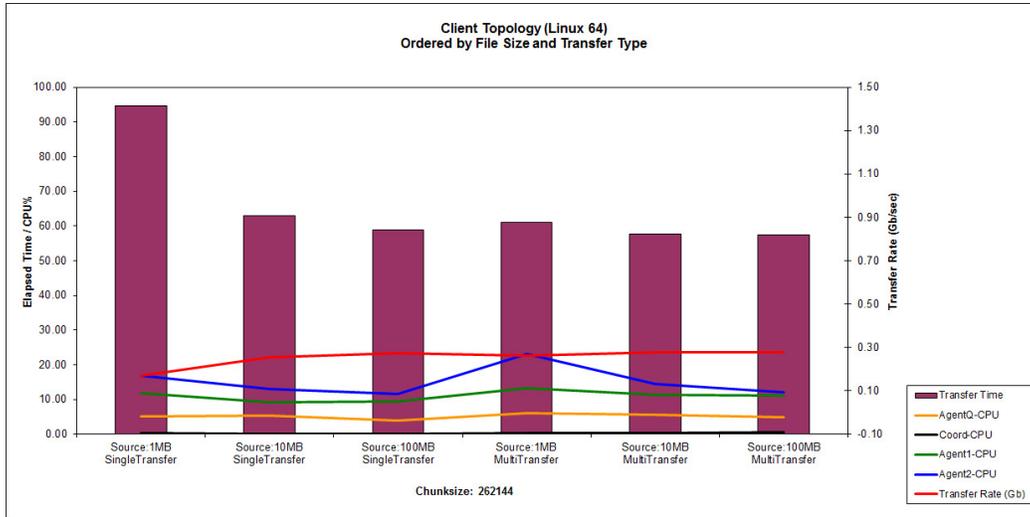


Figure 25 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, text mode

2.2.3.2 Binary Mode

Linux64 - 262144	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	6%	0%	11%	17%	71.47 s	229.24 Mb
Source:10MB SingleTransfer	5%	0%	6%	11%	59.22 s	276.66 Mb
Source:100MB SingleTransfer	4%	0%	5%	9%	58.23 s	281.34 Mb
Source:1MB MultiTransfer	6%	1%	10%	20%	57.77 s	283.63 Mb
Source:10MB MultiTransfer	5%	0%	7%	11%	57.30 s	285.91 Mb
Source:100MB MultiTransfer	5%	0%	6%	8%	56.24 s	291.32 Mb

Table 31 Linux64 256KB chunk size for Single and Multiple instance transfers, binary mode

Linux64 - 262144	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	5%	0%	12%	18%	88.34 s	185.47 Mb
Source:10MB SingleTransfer	5%	0%	11%	15%	59.22 s	276.67 Mb
Source:100MB SingleTransfer	5%	0%	10%	13%	56.83 s	288.32 Mb
Source:1MB MultiTransfer	7%	0%	14%	27%	57.60 s	284.43 Mb
Source:10MB MultiTransfer	5%	0%	12%	15%	56.93 s	287.80 Mb
Source:100MB MultiTransfer	6%	0%	10%	13%	55.48 s	295.34 Mb

Table 32 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, binary mode

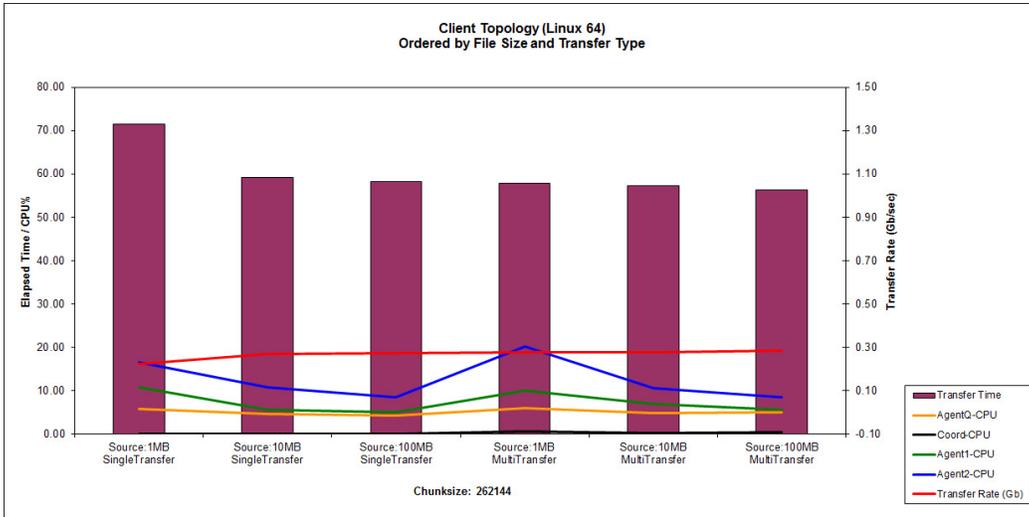


Figure 26 Linux64 256KB chunk size for Single and Multiple instance transfers, binary mode

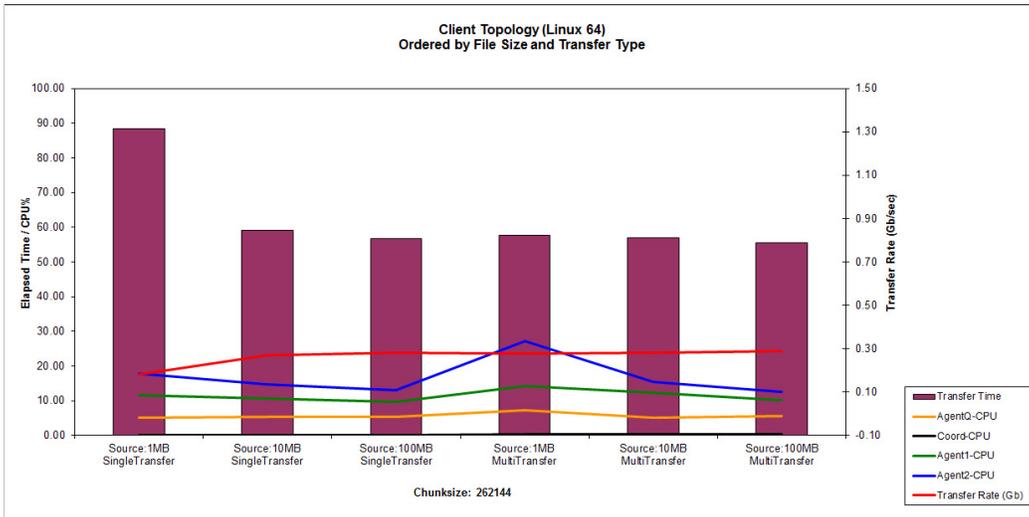


Figure 27 Linux64-MD5 256KB chunk size for Single and Multiple instance transfers, binary mode

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.

2.2.4.1 Text Mode

Linux64 - 524288	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source: 1MB SingleTransfer	4%	0%	10%	16%	85.92 s	190.69 Mb
Source: 10MB SingleTransfer	4%	0%	6%	10%	59.04 s	277.49 Mb

IBM MQ Managed File Transfer V9.0.5.0 Performance Report

Source:100MB SingleTransfer	4%	0%	6%	6%	58.60 s	279.58 Mb
Source:1MB MultiTransfer	6%	0%	11%	25%	57.40 s	285.44 Mb
Source:10MB MultiTransfer	4%	0%	8%	9%	57.88 s	283.09 Mb
Source:100MB MultiTransfer	4%	0%	6%	7%	55.90 s	293.11 Mb

Table 33 Linux64 512KB chunk size for Single and Multiple instance transfers, text mode

Linux64 - 524288	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	4%	0%	11%	18%	83.59 s	196.00 Mb
Source:10MB SingleTransfer	4%	0%	10%	14%	54.93 s	298.29 Mb
Source:100MB SingleTransfer	3%	0%	10%	11%	55.59 s	294.72 Mb
Source:1MB MultiTransfer	5%	1%	16%	26%	54.26 s	301.97 Mb
Source:10MB MultiTransfer	4%	0%	11%	14%	55.36 s	295.95 Mb
Source:100MB MultiTransfer	5%	0%	11%	11%	55.17 s	296.98 Mb

Table 34 Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, text mode

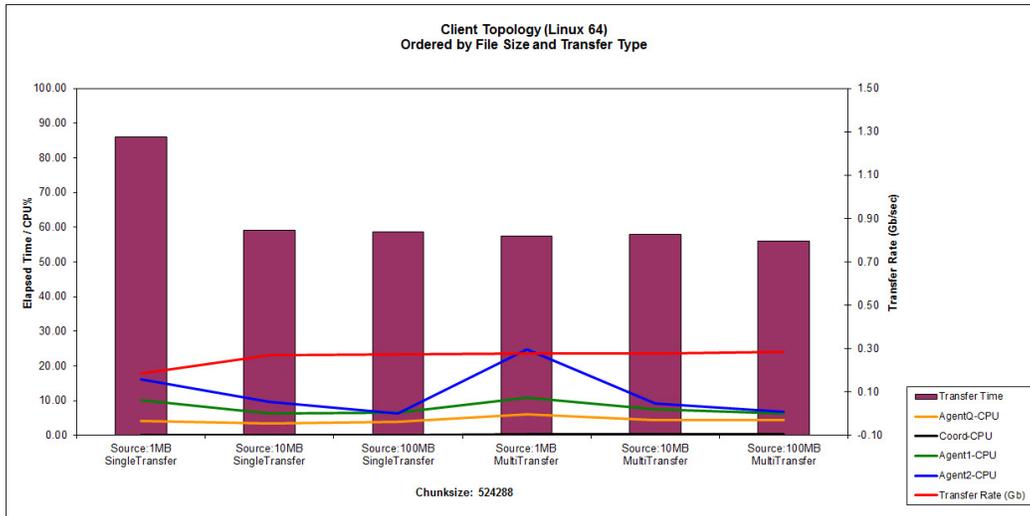


Figure 28 Linux64 512KB chunk size for Single and Multiple instance transfers, text mode

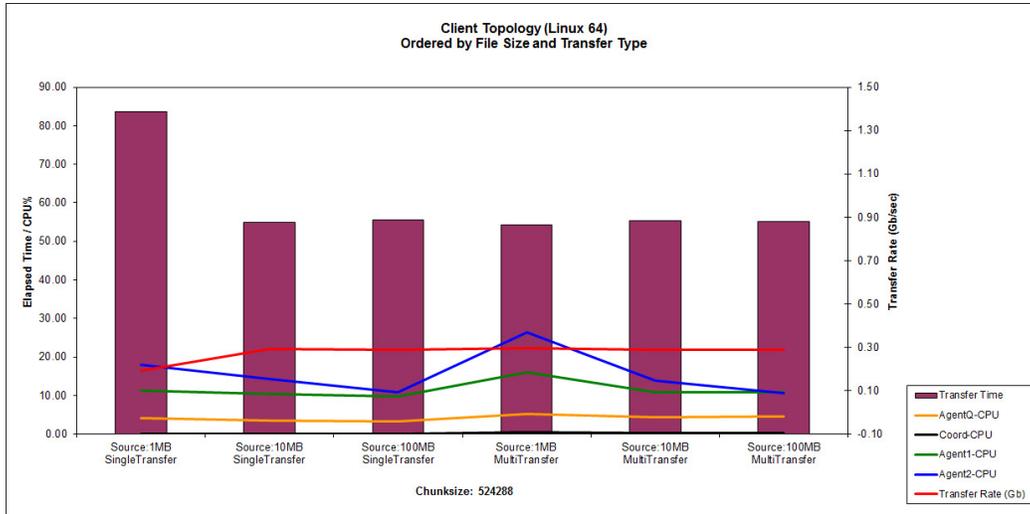


Figure 29 Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, text mode

2.2.4.2 Binary Mode

Linux64 - 524288	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	5%	0%	12%	18%	62.29 s	263.05 Mb
Source:10MB SingleTransfer	4%	0%	6%	10%	56.47 s	290.16 Mb
Source:100MB SingleTransfer	3%	0%	6%	7%	54.14 s	302.63 Mb
Source:1MB MultiTransfer	5%	0%	11%	22%	54.98 s	297.98 Mb
Source:10MB MultiTransfer	5%	0%	7%	10%	54.11 s	302.82 Mb
Source:100MB MultiTransfer	4%	0%	6%	7%	52.42 s	312.56 Mb

Table 35 Linux64 512KB chunk size for Single and Multiple instance transfers, binary mode

Linux64 - 524288	AgentQ-CPU	Coord-CPU	Agent1-CPU	Agent2-CPU	Transfer Time	Transfer Rate
Source:1MB SingleTransfer	4%	0%	12%	19%	77.99 s	210.09 Mb
Source:10MB SingleTransfer	4%	0%	11%	15%	53.68 s	305.22 Mb
Source:100MB SingleTransfer	4%	0%	10%	12%	52.57 s	311.63 Mb
Source:1MB MultiTransfer	6%	0%	15%	27%	54.88 s	298.54 Mb
Source:10MB MultiTransfer	5%	0%	11%	15%	54.09 s	302.90 Mb
Source:100MB MultiTransfer	5%	0%	11%	12%	51.90 s	315.67 Mb

Table 36 Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, binary mode

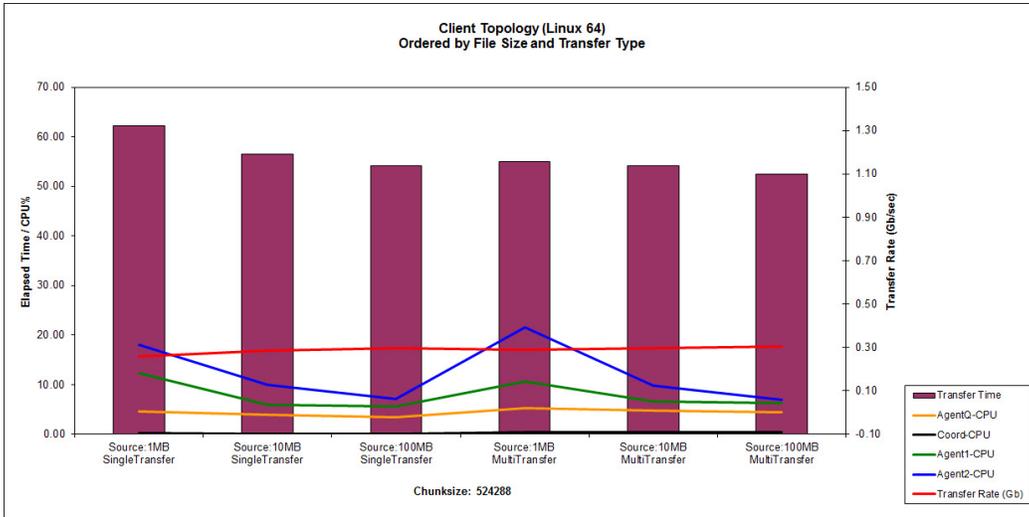


Figure 30 Linux64 512KB chunk size for Single and Multiple instance transfers, binary mode

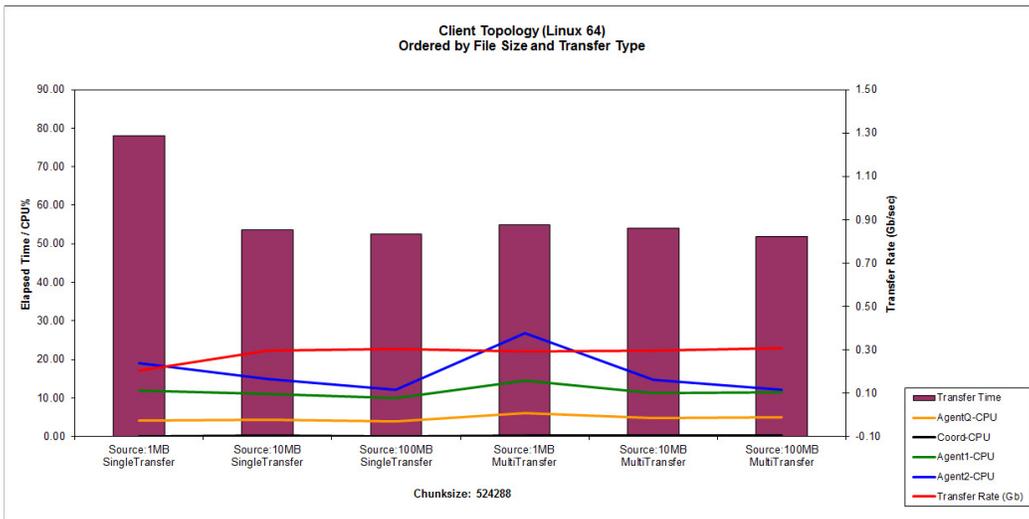


Figure 31 Linux64-MD5 512KB chunk size for Single and Multiple instance transfers, binary mode

2.2.5 Test Summary

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

2.2.5.1 Text Mode

Best	Time(l)	Chunksize
Source:1MB SingleTransfer	79.24	Chunksize: 131072
Source:10MB SingleTransfer	59.04	Chunksize: 524288
Source:100MB SingleTransfer	57.73	Chunksize: 262144
Source:1MB MultiTransfer	57.40	Chunksize: 524288
Source:10MB MultiTransfer	57.88	Chunksize: 524288
Source:100MB MultiTransfer	55.90	Chunksize: 524288

Table 37 Linux64 Best transfer speeds for Single and Multiple instance transfers

Best	Time(l)	Chunksize
Source:1MB SingleTransfer	83.59	Chunksize: 524288
Source:10MB SingleTransfer	54.93	Chunksize: 524288
Source:100MB SingleTransfer	55.59	Chunksize: 524288
Source:1MB MultiTransfer	54.26	Chunksize: 524288
Source:10MB MultiTransfer	55.36	Chunksize: 524288
Source:100MB MultiTransfer	55.17	Chunksize: 524288

Table 38 Linux64-MD5 Best transfer speeds for Single & Multiple instance transfers

2.2.5.2 Binary Mode

Best	Time(l)	Chunksize
Source:1MB SingleTransfer	62.29	Chunksize: 524288
Source:10MB SingleTransfer	56.47	Chunksize: 524288
Source:100MB SingleTransfer	54.14	Chunksize: 524288
Source:1MB MultiTransfer	54.98	Chunksize: 524288
Source:10MB MultiTransfer	54.11	Chunksize: 524288
Source:100MB MultiTransfer	52.42	Chunksize: 524288

Table 39 Linux64 Best transfer speeds for Single and Multiple instance transfers

Best	Time(l)	Chunksize
Source:1MB SingleTransfer	77.99	Chunksize: 524288
Source:10MB SingleTransfer	53.68	Chunksize: 524288
Source:100MB SingleTransfer	52.57	Chunksize: 524288
Source:1MB MultiTransfer	54.88	Chunksize: 524288
Source:10MB MultiTransfer	54.09	Chunksize: 524288
Source:100MB MultiTransfer	51.90	Chunksize: 524288

Table 40 Linux64-MD5 Best transfer speeds for Single & Multiple instance transfers

Agents connecting in client mode also have the better performance for larger chunk sizes as seen in agents connecting in bindings mode,

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. They can be found here: <http://www.ibm.com/support/docview.wss?rs=171&uid=swg27007197#1>. Of particular interest for Linux is Supportpac MPL7 for MQ Version 9.0.5.0.

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.

The use of high performance disks (SAN for example) is recommended for a IBM MQ installation. Separating out your `/var/mqm/log` directory structure 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 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 syncpoints 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. 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 Managed File Transfer: 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 agent. 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

- IBM MQ Managed File Transfer Version 9.0.5.0 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 9.0.5.0 was used for the coordination queue manager.
- Queue managers created in accordance with Performance report.

4.3 Operating System

- Red Hat Enterprise Linux Server release 7.3 (Maipo).

4.4 Hardware

Machine Type:	VMware Virtual
Architecture:	GenuineIntel @ 2393.970 MHz
Processor:	4 CPU
Memory (RAM):	16 GB