

# **IBM Integration Bus v9 for AIX Performance Information Report**

*Version 1.0*

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Before using this report, be sure to read the general information under "Notices".

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This edition applies to IBM Integration Bus v9 for AIX and to all subsequent releases and modifications until otherwise indicated in new editions.

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## Notices

The performance information provided in this report illustrates key processing characteristics of IBM Integration Bus version 9. It is intended for Architects, Systems Programmers, Analysts and Programmers wanting to understand the performance characteristics of IBM Integration Bus v9. You can use this information to understand the performance characteristics of IBM Integration Bus version 9. The data provided will assist you with sizing solutions. Please, note that it is assumed that the reader is familiar with the concepts and operation of IBM Integration Bus v9.

This information has been obtained by measuring the message throughput that is possible for a number of different types of message processing. The term "message" is used in a generic sense, and can mean any request or response into or out of an integration node, regardless of the transport or protocol.

The performance data contained in this report was measured in a controlled environment and results obtained in other environments might vary significantly. For more details on the measurement environments used, see the message throughput section for each platform.

The performance measurements focus on the throughput capabilities of the broker using different message formats and processing node types. The aim of the measurements is to help you understand the rate at which messages can be processed in different situations as well as helping you to understand the relative costs of the different node types and approaches to message processing.

You should not attempt to make any direct comparisons of the test results in this report with what may appear to be similar tests in previous performance reports. This is because the contents of the test messages are significantly different as is the processing in the tests. It is not meaningful to make such comparisons. In many cases the hardware, operating system and prerequisite software are also different, making any direct comparisons invalid.

Some optimizations of the test environment and procedures have been implemented to minimize the effect of logging for example and to ensure that messages do not accumulate on output queues which has a detrimental effect on message throughput. These are detailed under Tuning.

In many of the tests the user logic used is minimal so the results presented represent the best throughput that can be achieved for that node type. This should be borne in mind when sizing IBM Integration Bus.

References in this document to IBM products or programs do not imply that IBM intends to make these available in all countries in which IBM operates.

Information contained in this report has not been submitted to any formal IBM test and is distributed "as is". The use of this information and the implementation of any of the techniques is the responsibility of the customer. Much depends on the ability of the customer to evaluate these data and project the results to their operational environment.

## Trademarks and service marks

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WebSphere Message Broker  
DB2

The following terms are trademarks of other companies:

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Windows  
Microsoft Corporation

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## Summary of Amendments

<b>Date</b>	<b>Changes</b>
01/07/14	Initial Release

## Use Case Descriptions

This section contains a description of the processing in each of the use cases which are used to characterize the performance of IBM Integration Bus v9.

Use case	Description
Aggregation	Measures the performance of an integration solution that splits an incoming XML message into 4 messages, and then performs a four message aggregation using the Aggregation nodes that are supplied with IBM Integration Bus
Coordinated request-reply	Measures the performance of an integration solution that communicates through the use of WebSphere MQ messages in a request/reply processing pattern.
Data Warehouse	Measures the performance of an integration solution that archives data into a database.
Large messaging	Measures the performance of an integration solution that processes messages that contain repeating structures and writes each repeating instance as a separate WebSphere MQ message while minimizing overall memory requirements.
Message routing	Measures the performance of an integration solution that routes messages to WebSphere MQ queues, based on data stored in a database.
Transforming a message	Measures the performance of an integration solution that transforms a message by using ESQL
SOAP Provider	Measures the performance of an integration solution that receives a SOAP request and responds with a SOAP message.
SOAP Consumer	Measures the performance of an integration solution that receives a SOAP over HTTP request message, makes a synchronous call to an external service provider, and delivers a reply message.
File out and file in	Measures the performance of an integration solution that handles files either in the middle of a flow or to initiate a transformation.

## Aggregation Use Case

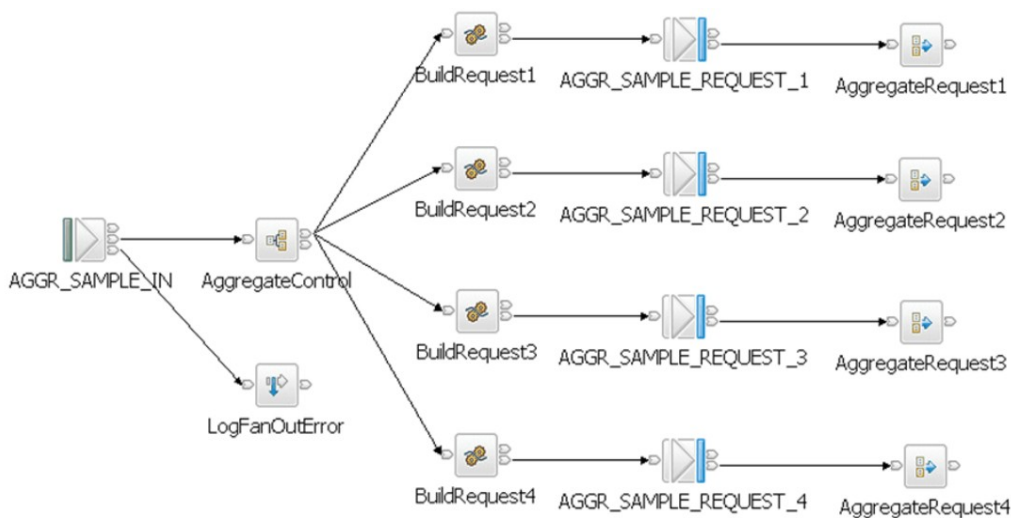
The aggregation use case is used to measure the performance of an integration solution that splits an incoming XML message into 4 messages, and then performs a four message aggregation using the Aggregation nodes that are supplied with IBM Integration Bus. For example, this scenario represents the type of processing that is required when travel is booked, and arrangements for a flight, hotel, car and money must be made. Requests to four different applications are made and the replies are consolidated into a single reply.

The Aggregation use case demonstrates a simple four-way aggregation operation, using the AggregateControl, AggregateRequest, and AggregateReply nodes. It contains three message flows to implement a four-way aggregation:

- FanOut
- RequestReplyApp
- FanIn

### FanOut message flow

This flow takes the incoming request message, generates four different request messages, sends them out on request/reply, and starts the tracking of the aggregation operation.



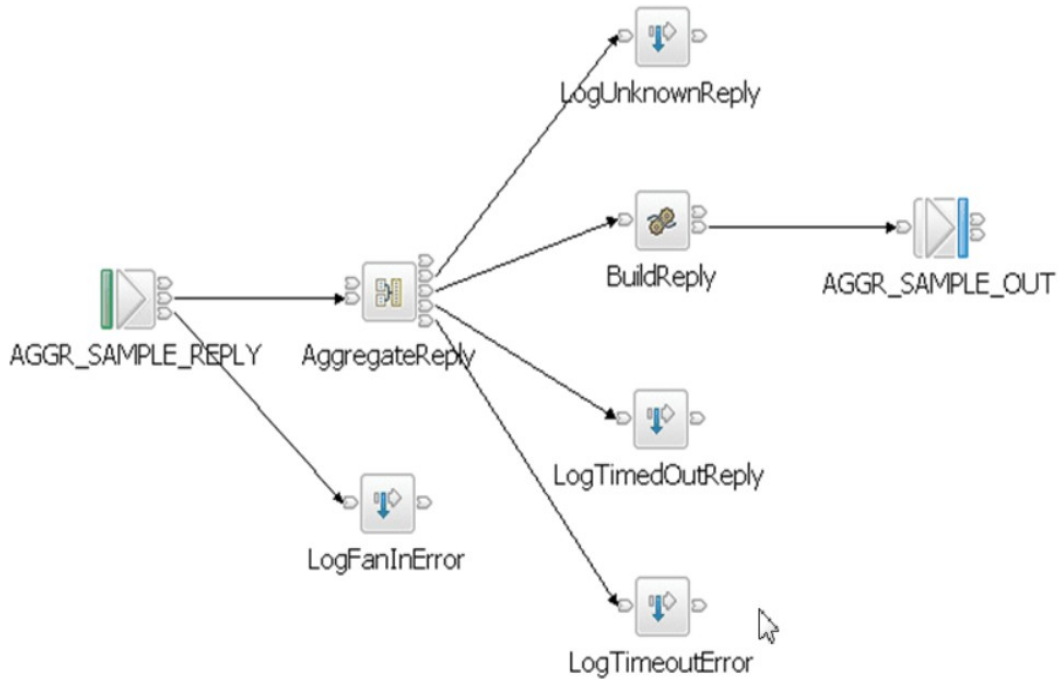
### RequestReplyApp message flow

This flow is used to simulate the back-end service applications that typically processes the request messages from the aggregation operation.



### ***FanIn message flow***

This flow receives all the replies from the RequestReplyApp flow, and aggregates them into a single output message. The output message from the AggregateReply node cannot be output directly by an MQOutput node without some processing so a Compute node is added to process the data into a format where it can be written to a queue.



## ***Coordinated Request-Reply Use Case***

The Coordinated Request-Reply use case is based on the scenario of a contemporary and established application communicating through the use of WebSphere MQ messages in a request/reply processing pattern.

- The contemporary application uses self-defining XML messages and issues a request message.
- The established application uses Custom Wire Format (CWF) messages.

The Coordinated Request-Reply application receives a request message, processes it and delivers a reply message. For the applications to successfully communicate, the message formats must be transformed for both the request and reply messages.

The processing in this use case consists of three message flows and one message set. The message flows are the following:

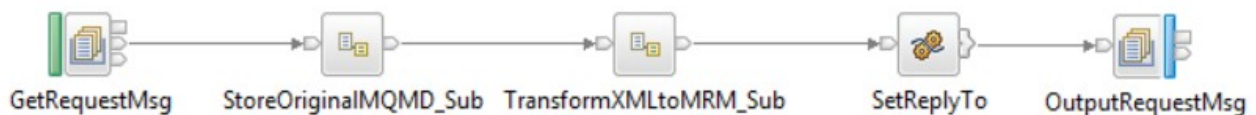
- Request
- Backend Reply
- Reply

The Coordinated Request Reply message set project contains a sample MSET message set with the message definition SaleListMessage. This message set is used to convert the request message from XML format to CWF, and to convert the reply message from CWF to XML. The message set is used by both applications.

### ***Request Message Flow***

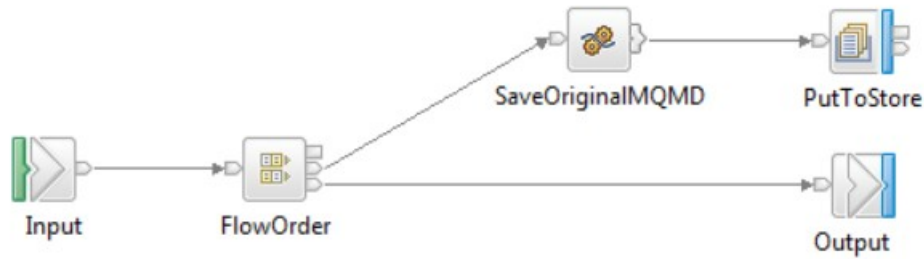
The request message flow performs the following processing:

- Reads a WebSphere MQ message containing an XML payload.
- Converts the message into the equivalent CWF format.
- Creates a WebSphere MQ message containing the transformed message.
- Saves the original ReplyToQ and ReplyToQMgr details in a separate WebSphere MQ message for subsequent retrieval by the Reply message flow.
- Sets the ReplyToQ and ReplyToQMgr details to be the input of the Reply message flow.
- Sends the message to the Backend Reply message flow.





### Store Original MQMD subflow



### Transform XML to MRM subflow

The TransformXMLtoMRM message flow contains an Input node, a Mapping node, and an Output node.



The TransformXMLtoMRM subflow completes the following actions:

- Receives a message that contains an XML payload
- Copies the message headers from the input message to the output message tree
- Converts the input message from XML format to CWF
- Sets the message set, type, and format for the output message
- Creates a message that contains the transformed message
- Sends the output message back to the main flow

### ***Backend Reply Message Flow***

The backend reply message flows performs the following processing:

- Reads a WebSphere MQ message.
- Adds the time the message was modified to the payload of the message.
- Writes a WebSphere MQ message.



### ***Reply Message Flow***

The reply message flow performs the following processing:

- Reads the reply WebSphere MQ message containing a message in CWF format.
- Converts the message payload from CWF into the equivalent XML format.
- Obtains the ReplyToQ and ReplyToQ Mgr of the original request message by reading the WebSphere MQ message which was used to store this information in the Request message flow. This is done by using the MQGET node.
- Creates a WebSphere MQ message containing the transformed message and the retrieved

ReplyToQ and ReplyToQMgr values.

- Writes an output message that contains a payload in XML format



### Transform MRM to XML subflow

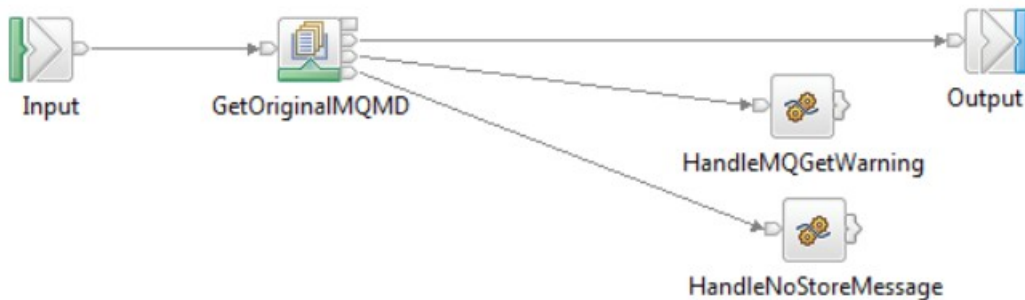
The TransformMRMtoXML message flow contains an Input node, a Mapping node, and an Output node.



The TransformMRMtoXML subflow completes the following actions:

- Receives a message that contains an MRM payload
- Copies the message headers from the input message to the output message tree
- Converts the input message from MRM format to XML
- Creates a message that contains the transformed message
- Sends the output message back to the main flow

### Restore Original MQMD subflow



## Data Warehouse Use Case

The Data Warehouse use case demonstrates a scenario in which a message flow is used to archive data, such as sales data, into a database. The data is stored for later analysis by another message flow or application.

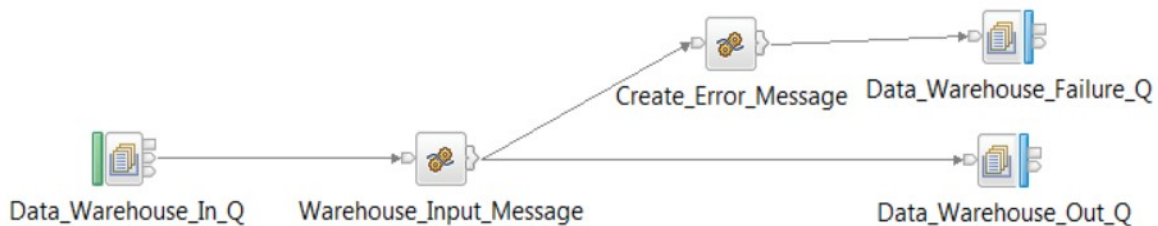
Because the sales data is analyzed at a later date, the storage of the messages has been organized in a way that makes it easy to select records for specified times. The date and time at which the WebSphere MQ message containing the sales record was written are stored as separate column values when the message is inserted into the database.

The database table contains four columns:

- The message data, which is the payload of the WebSphere MQ message stored as a BLOB.
- The date on which the WebSphere MQ message was created.
- The time when the WebSphere MQ message was created.
- A time stamp created by the database to record the time when the record was inserted.

By storing the data in this way, it is possible to retrieve records from specific periods; for example, 9:00 a.m. to 12:00 p.m. and 12:01 p.m. and 5:00 p.m., which would allow a comparison of morning and afternoon sales to be made.

The processing in the Data Warehouse use case consists of a single message flow:



This message flow performs the data archiving. It reads a WebSphere MQ message from a queue containing the data to archive and inserts the data into a database.

The DataWarehouse message flow performs the following processing:

- Reads a WebSphere MQ message containing an XML payload, which is the data to be archived.
- Converts a portion of the message tree to a BLOB ready for insertion into the database.
- Inserts the message BLOB along with the date and time at which the WebSphere MQ message was written into a database.
- Sends a WebSphere MQ confirmation message to signal successful insertion of the message into the database.

## Large Messaging Use Case

The Large Messaging use case is based on the scenario of end-of-day processing of sales data.

- Messages recording the details of sales through the day are batched together in the store for transmission to the IT center.
- On receipt at the IT center, the batched messages are split into their constituent parts for subsequent processing.

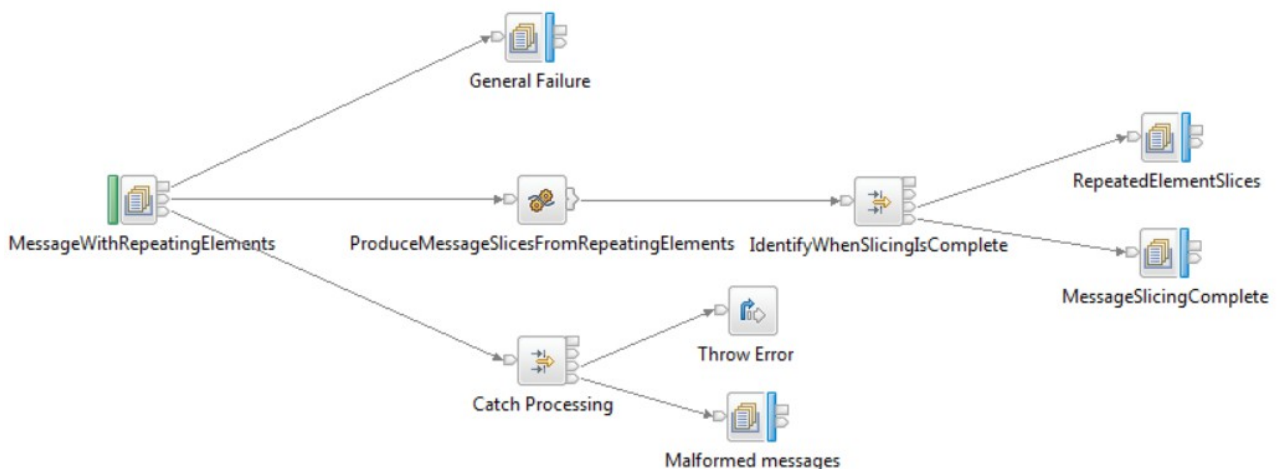
The Large Messaging application process messages that contain repeating structures. It writes each repeating instance of the SaleList structure as a separate WebSphere MQ message while minimizing overall memory requirements.

- Message splitting is achieved by using the XMLwithRepeat\_to\_singleXML\_slicer message flow.
- The message flow implements a memory saving technique by using a mutable message tree.
- Each of the individual messages representing a sale has the same structure.
- The input and output messages are implemented as self-defining XML messages.
- Each input message consists of three parts:
  - A header, which contains the number of repetitions of the repeating SaleList structure that follows.
  - The body, which contains the repetitions of the repeating SaleList structure.
  - The trailer, which contains the time the message was processed.

### Large Messaging Message Flow

The large messaging message flow XMLwithRepeat\_to\_singleXML\_slicer.msgflow performs the following processing:

- Reads a WebSphere MQ message containing an XML payload.
- Formats a WebSphere MQ message for each instance of the SaleList structure.
- Writes the WebSphere MQ messages to the output queue.
- Produces a WebSphere MQ message to signal completion of the processing when the final element has been processed.



## ***Transforming a Message by using ESQL Use Case***

IBM Integration Bus version 9 provides different techniques to transform a message. This use case is focus on message transformation by using ESQL.

This use case is based on a sales processing scenario. At the time of a sale, the customer's name, the code for the product, a description of the product, its category, the unit price, and quantity purchased are recorded. Each customer might purchase several items. A list with all the customer orders is created. The sample application transforms the incoming message and produces an invoice statement for each customer included in the list.

The messages used for input and output are self-defining XML messages. Each message consists of three parts:

- A header, which contains a count of the number of repetitions of the repeating SaleList structure that follows.
- The body, which contains the repetitions of the repeating SaleList structure.
- The trailer, which contains the time the message was processed.

The transformation and production of the statement for each customer within a SaleList is achieved with a single message flow.

### Transformation with ESQL Message Flow

The message flow performs the following processing:

- Reads a WebSphere MQ message containing an XML payload.
- Parses the input message and produces an invoice for each customer. This is achieved with a single Compute node containing ESQL.
- Produces a WebSphere MQ output message containing an XML payload.



## ***SOAP Consumer Use Case***

The SOAP consumer use case is based on a sales processing scenario. At the time of a sale, the customer's name, the code for the product, a description of the product, its category, the unit price, and quantity purchased are recorded. Each customer might purchase several items. At the end of each day, the sales of each store are consolidated in a single list that is sent to the company's billing system. The billing system responds with any currency updates that should be applied per purchase order.

The SOAP consumer application receives a SOAP over HTTP request message, makes a synchronous call to an external service provider, and delivers a reply message. For the applications to successfully communicate, the message formats must be transformed for both the request and reply messages.

The messages used for input and output are self-defining XML messages. Each message consists of three parts:

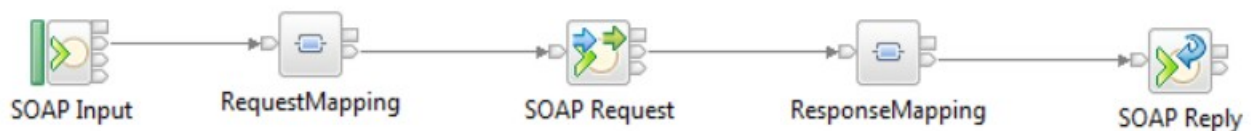
- A header, which contains a count of the number of repetitions of the repeating SaleList structure that follows.
- The body, which contains the repetitions of the repeating SaleList structure.
- The trailer, which contains the time the message was processed.

The transformation and calling to an the billing system (external service provider) is achieved with a single message flow.

### SOAP Consumer Message Flow

The message flow performs the following processing:

- Receives a SOAP over HTTP message.
- Transforms a message by using a message map prior to calling the external service provider.
- Calls synchronously an external service provider.
- Transforms the response from the service provider.
- Sends a SOAP message as a response to the initial call.



## ***SOAP Provider Use Case***

The SOAP provider use case is based on a sales processing scenario. At the time of a sale, the customer's name, the code for the product, a description of the product, its category, the unit price, and quantity purchased are recorded. Each customer might purchase several items. At the end of each day, the sales of each store are consolidated in a single list. Any store can call this service to obtain the consolidated number of sales for the day, and the time at which the request was made.

The SOAP provider application receives a SOAP over HTTP request message, calculates the number of sales to record, and responds with the total number of sales for the day and the time at which the service was called.

The messages used for input and output are self-defining XML messages. Each message consists of three parts:

- A header, which contains a count of the number of repetitions of the repeating SaleList structure that follows.
- The body, which contains the repetitions of the repeating SaleList structure.
- The trailer, which contains the time the message was processed.

The transformation and calling to an the billing system (external service provider) is achieved with a single message flow.

### SOAP Provider Message Flow

The message flow performs the following processing:

- Receives a SOAP over HTTP message.
- Transforms the message by using a Mapping node.
- Sends a SOAP message as a response to the initial call.



## Message Routing Use Case

The message routing use case shows how a database table can be used to store routing information, which a message flow can then use to route messages to WebSphere MQ queues. It implements a routing table, and uses shared variables to route messages in a message flow.

### Database definition

The database table contains five columns:

- The first three columns contain look-up information that is derived from the incoming message.
- The last two columns contain the details of the queue and queue manager to which the message is routed.

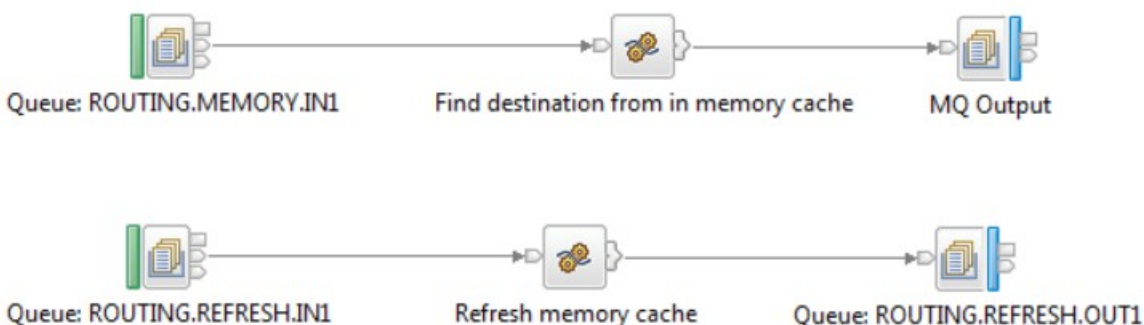
The columns are shown in the following table:

Column	Description
Variable1	The first variable that is used in looking up the destination queue (This variable is hard-coded in the sample and is not derived from the XML message).
Variable2	The second variable that is used in looking up the destination queue (This variable is derived from the XML message by using the Initial field).
Variable3	The third variable used in looking up the destination queue (This variable is derived from the XML message by using the Surname field).
Queue_manager	The destination queue manager name.
Queue_name	The destination queue name.

### Routing Using Memory Cache Message Flow

The message flow performs the following processing:

- Reads a WebSphere MQ message containing an XML payload.
- Creates a destination list based on data that is held in shared variables.
- Produces a WebSphere MQ output message. The destination of the message is specified in the destination list.





## ***File Out, File In Use case***

The File out and File in use case demonstrates how to output a message to a file part way through a message flow, and how to read a file and output a message to a WebSphere MQ queue.

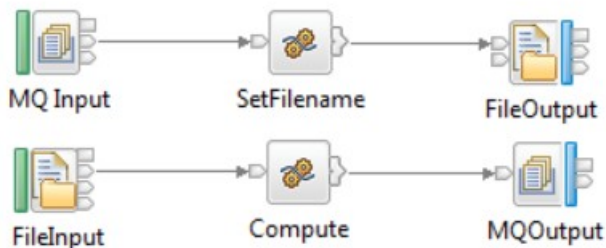
The File out and File in use case uses the following nodes:

- The FileOutput Node is used to write messages as files to the file system. You can create a new file from a single message or to replace the contents of an existing file with a message. The records can be created directly from messages, and can be padded to a fixed length, or separated from other records by a delimiter character.
- The FileInput Node is used to process messages that are read from files. One or more messages can be read from a single file, and each message is propagated as a separate flow transaction. The part of a file that generates one message flow transaction is called a record. A file can be a single record, or a series of records. Properties on the node specify how the FileInput node determines the records in a file.

### File out and File in Message Flow

The file out and file in message flow performs the following processing:

- When a message arrives at the MQ queue, a compute node sets the name of the file name, and the message is output to a file in the file system.
- When a file becomes available in the directory from which the FileInput node is reading, the file is read, and transformed into an MQ message, that is then output to an MQ queue.



## Message Throughput

This section illustrates the message throughput per platform that is possible with IBM Integration Bus V9 for a number of common processing use cases.

The performance results provide data on CPU utilization and I/O contention:

- CPU is limited by the speed of the CPU.
- I/O is limited by the speed of the I/O subsystem.

There was no error processing and no error conditions set in any of the measurements.

All messages were successfully passed from one node to another through the Out or True terminal.

No messages were passed through the Failure terminal of a node.

### *Information provided*

The results provided in this section include the following performance data:

**Message Size:** Records the approximate size of the message that is used as input to the test, not including the message header. This is the size of the XML or equivalent non-XML message payload.

**Persistent State:** Indicates whether the messages used in the test is persistent or not. This state can have the following two values:

- The value Full Persistent is used to indicate that the message tested is persistent.

This value is applicable only to WebSphere MQ messages.

If a message is persistent, WebSphere MQ ensures that the message is not lost when a failure occurs, by copying it to disk.

- The value Non Persistent is used for other type of messages.

**Message Rate:** Indicates the number of round trips or message flow invocations per second.

**% CPU Busy:** Indicates the percentage of CPU usage on the server machine. This includes the total of CPU used by all processes: IBM Integration Bus, WebSphere MQ queue manager, database manager and others. The rate is expressed as a percentage of the CPU's capacity that is used by all processors on the server machine.

**CPU ms/msg:** Indicates the overall CPU cost per message, that is, the CPU milliseconds per message.

You can calculate the value of the CPU cost per message by using the following formula:

$((\text{Number of cores} * 1000) * (\% \text{ of CPU} / 100)) / \text{Message Rate}$ .

This cost includes IBM Integration Bus, WebSphere MQ, DB2, and any operating system costs.

Note: The results are specific to the system on from which they have been obtained. If you want to project (or predict) message processing capacity for other systems, you must make a suitable adjustment to allow for differences in the capacity of the two systems.

## ***Performance Results***

Typically, as the message size increases, the message rate decreases, and the cost of CPU per message increases.

Persistent MQ messages are written to the MQ log on disk. This causes an overhead in CPU and IO costs and a reduction in message rate. The speed of disk on which the MQ log is configured becomes a key factor. See [Tuning](#) for more information.

For details on the measurement environment, see [Measurement environment](#).

When planning a system, it is important to understand the complexities of the processing required so that adequate resources can be provided to meet the requirements of the particular situation.

*Message Throughput: Aggregation use case*

**Aggregation use case results**

Msg Size	Non Persistent			Full Persistent		
	Message Rate	% CPU Busy	CPU ms/msg	Message Rate	% CPU Busy	CPU ms/msg
256b	3786.2	100.0	2.113	2465.2	90.5	2.936
2kB	3389.5	100.0	2.360	2296.9	92.0	3.205
20kB	1637.6	97.3	4.755	1205.1	83.7	5.558
200kB	267.6	95.4	28.525	256.9	95.1	29.611
2000kB	27.8	96.4	277.710	26.0	95.9	294.985
20000kB	1.6	84.1	4203.500	1.6	85.3	4238.509

*Message Throughput: Coordinated request/reply use case*

**Coordinated Request/Reply use case results**

Msg Size	Non Persistent			Full Persistent		
	Message Rate	% CPU Busy	CPU ms/msg	Message Rate	% CPU Busy	CPU ms/msg
256b	5271.0	97.6	1.481	3965.5	89.9	1.814
2kB	2831.3	96.0	2.712	2541.7	96.5	3.036
20kB	525.4	97.1	14.789	507.3	96.7	15.250
200kB	56.3	95.2	135.366	56.1	97.3	138.802
2000kB	5.8	97.7	1348.000	5.6	95.4	1372.230
20000kB	0.6	85.4	12417.455	0.4	59.6	13251.111

*Message Throughput: Data Warehouse use case*

**Data Warehouse use case results**

Msg Size	Non Persistent			Full Persistent		
	Message Rate	% CPU Busy	CPU ms/msg	Message Rate	% CPU Busy	CPU ms/msg
256b	1941.7	14.7	0.606	2002.6	20.5	0.820
2kB	1134.1	10.2	0.717	1240.7	15.2	0.982
20kB	3485.8	66.2	1.519	3089.8	65.2	1.689
200kB	632.1	96.1	12.166	619.8	95.4	12.313
2000kB	62.6	90.5	115.636	62.8	92.1	117.400
20000kB	5.8	82.2	1130.309	5.0	81.2	1299.680

### *Message Throughput: Large messaging use case*

#### **Large Messaging use case results**

Msg Size	Non Persistent			Full Persistent		
	Message Rate	% CPU Busy	CPU ms/msg	Message Rate	% CPU Busy	CPU ms/msg
256b	19979.5	98.9	0.396	9932.0	81.0	0.653
2kB	11564.7	95.8	0.663	6394.4	74.9	0.937
20kB	2015.7	95.2	3.779	1313.3	84.0	5.115
200kB	217.5	96.0	35.305	141.6	85.9	48.558
2000kB	21.5	96.0	358.042	13.2	75.6	458.364
20000kB	2.0	86.9	3441.584	1.1	70.1	4964.956

### *Message Throughput: Transforming a message use case*

#### **Transforming a message by using ESQL use case results**

Msg Size	Non Persistent			Full Persistent		
	Message Rate	% CPU Busy	CPU ms/msg	Message Rate	% CPU Busy	CPU ms/msg
256b	34404.6	99.6	0.232	15977.2	80.6	0.404
2kB	15722.2	95.0	0.483	12031.2	94.2	0.627
20kB	2783.4	95.0	2.730	2593.0	96.5	2.976
200kB	287.2	96.0	26.743	283.1	96.0	27.128
2000kB	28.8	95.0	263.797	28.6	94.4	264.232
20000kB	2.8	90.6	2617.473	2.4	85.3	2855.230

### *Message Throughput: SOAP Consumer use case*

#### **SOAP Consumer use case results**

Msg Size	Non Persistent		
	Message Rate	% CPU Busy	CPU ms/msg
256b	6269.4	95.0	1.212
2kB	5226.9	96.0	1.469
20kB	2129.1	95.4	3.583
200kB	287.4	95.9	26.686
2000kB	29.9	99.0	264.529
20000kB	1.0	32.0	2509.804

*Message Throughput: SOAP Provider use case*

**SOAP Provider use case results**

Msg Size	Non Persistent		
	Message Rate	% CPU Busy	CPU ms/msg
256b	12167.8	96.0	0.631
2kB	9991.7	96.0	0.769
20kB	4105.3	95.5	1.861
200kB	477.4	82.1	13.762
2000kB	44.5	79.8	143.428
20000kB	3.1	50.1	1279.744

*Message Throughput: Message routing use case*

**Message Routing use case results**

Msg Size	Non Persistent			Full Persistent		
	Message Rate	% CPU Busy	CPU ms/msg	Message Rate	% CPU Busy	CPU ms/msg
256b	40214.1	99.1	0.197	18025.6	81.5	0.362
2kB	38498.5	99.6	0.207	12077.8	57.0	0.378
20kB	22811.2	87.2	0.306	5312.3	36.9	0.555
200kB	2924.7	33.3	0.910	1044.5	18.6	1.422
2000kB	251.6	23.0	7.314	106.2	13.5	10.172
20000kB	18.8	20.1	85.586	9.9	13.8	111.498

*Message Throughput: File out and file in use case*

**File out and file in use case results**

Msg Size	Non Persistent		
	Message Rate	% CPU Busy	CPU ms/msg
256b	1320.2	24.6	1.493
2kB	1347.5	24.2	1.435
20kB	1262.2	25.0	1.586
200kB	1042.7	35.5	2.724
2000kB	294.4	71.3	19.366
20000kB	25.6	59.3	185.262

## **Measurement environment**

All throughput measurements were taken on a single server machine. The client type and machine on which they ran varied with the test. The details are given below.

### ***Server Machine***

The hardware consisted of:

IBM pSeries 780 with 2 x Quad-Core Power7 3.86GHz processors and SMT4 activated (4 hardware threads per core) giving 8 physical cores in total

143 GB SAS Hard Drive

SAN comprising

8Gbps Brocade DCX director

IBM San Volume Controller (2145-8G4 nodes)

IBM DS8700

24 GB RAM

10 GB Ethernet Card

The software consisted of:

AIX 7.1 (Simultaneous Multi-Threading (SMT) was enabled)

WebSphere MQ V7.5.0.1

IBM Integration Bus V9

DB2 V9.7

### ***Client Machine***

The hardware consisted of:

IBM xSeries HS22 with 2 x Hex-Core Intel(R) Xeon(R) X5670

2.93 GHz processors with HyperThreading turned on

One 135 GB SCSI hard drive formatted with NTFS

32 GB RAM

10 GB Ethernet card

The software consisted of:

Microsoft Windows Server 2008 R2

WebSphere MQ V7.5.0.1

IBM Java v7

### ***Network Configuration***

The client and server machines were connected using a full duplex 10 Gigabit Ethernet LAN with a single hub.

## Tuning

### *Tuning IBM Integration Bus*

If you are planning to create and maintain a small, stand-alone system with limited requirements for availability and performance, it is possible to achieve this relatively quickly. However, if you are planning a large or complex system, or if you have specific requirements for high availability or performance, it is worth taking time to understand the factors that can influence your design and the techniques that you can use to optimize it.

- You can use message flow design and coding techniques to optimize the performance of your message flows.

When you design a message flow, you can optimize performance by limiting the number of times that each of the following actions occurs:

- Parsing
  - Tree navigation and copying
  - Accessing resources
  - Processing logic
- You can analyze statistical information for your message flows and modify aspects of your run time configuration to optimize your solution performance.
  - You can configure the run time environment for maximum performance. You can review the performance planning information, and decide which actions you can take to improve performance.
  - You can configure your message flows to make the best use of computer resources, especially if you will process large messages.

<b>Tuning IBM Integration Bus version 9</b>	
Performance planning	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ae24000_.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ae24000_.htm?lang=en</a>
Message flow design	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ac00320_.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ac00320_.htm?lang=en</a>
Code design	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/bj28671_.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/bj28671_.htm?lang=en</a>
Tuning message flow performance	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/bz90300_.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/bz90300_.htm?lang=en</a>
Tuning the IBM Integration Bus run time	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ae67800_.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ae67800_.htm?lang=en</a>



System resources for message flow development	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ac00340_.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/ac00340_.htm?lang=en</a>
Analyze resource performance	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/bj43300_.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKHH_9.0.0/com.ibm.etools.mft.doc/bj43300_.htm?lang=en</a>

## Configuration changes adopted in the different environments to obtain performance results

To obtain the performance results for the different use cases, the following configuration has been implemented in the different measurement environments:

- MQ Transactional Support
  - ◆ By default, the transaction parameter on the MQInput node is set to automatic. This is the preferred value to use for transaction mode unless there is a specific requirement to use a particular value. Persistent messages are processed within transactional control and non persistent messages are not.
- SOAP and HTTP Tuning
  - ◆ Clients sending data to an integration node (broker) are configured to use persistent HTTP connections. The TCP/IP MaxKeepAlives property is set to 0
  - ◆ In the integration server (execution group), persistent connections are set for the SocketConnectionManager and HTTPConnector objects. The TCP/IP MaxKeepAlives property is set to 0.
  - ◆ In the integration server and HTTP listener, the TCP/IP tcpNoDelay property is set to true for the HTTPConnector and SocketConnectionManager objects.
  - ◆ In the integration server and HTTP listener, the maxThreads property value is set to 2000 for the HTTPConnector object.
  - ◆ The JVM heap is set to 1GB to allow processing of large messages.

You use the `mqsichangeproperties` command to configure the IBM Integration Bus components.

## **WebSphere MQ Tuning**

For information on WebSphere MQ tuning, see the article [Configuring and tuning WebSphere MQ for performance on Windows and UNIX](http://www.ibm.com/developerworks/websphere/library/techarticles/0712_dunn/0712_dunn.html).

[http://www.ibm.com/developerworks/websphere/library/techarticles/0712\\_dunn/0712\\_dunn.html](http://www.ibm.com/developerworks/websphere/library/techarticles/0712_dunn/0712_dunn.html)

### **Configuration changes adopted in the different environments to obtain performance results**

To obtain the performance results, the following changes are required for all the queue managers used in the different environments:

#### **Buffer Sizes**

Increase the value of DefaultQBufferSize and DefaultPQBufferSize to 50MB for the input and output queues used in the tests. This is the maximum supported and is used because in most tests, messages of up to 20MB are used. When you use smaller messages all of the time, a smaller value is likely to be more appropriate.

#### **Persistent Messaging**

Modify the MQ log parameters to test persistent messages:

- Set LogBufferPages to 4096
- Set LogFilePages to 65535
- Set LogType to circular
- Set LogPrimaryFiles to 15
- Set LogSecondaryFiles to 1

#### **Logging**

Set circular logging for all WebSphere MQ queue managers used in the tests.

#### **TCP**

Set the following TCP/IP values for the TCP stanza in the queue manager .ini file:

- SndBuffSize=70000
- RcvBuffSize=70000
- RcvSndBuffSize=70000
- RcvRcvBuffSize=70000
- Blocking=YES

## ***I/O***

The WebSphere MQ queue manager log is located on a SAN disk with a non-volatile fast write cache used for the disk on which the log was located. Such disks are consistently capable of I/O times of 1 ms compared with a time of 6 ms for a 10,000 RPM SCSI disk.

When you use a disk with a fast write cache, it is important that it has a non-volatile capability because the log data is critical to the integrity of your queue manager.

## ***Tuning DB2***

DB2 is the database used in the performance tests.

To obtain the performance results in the different environments, the following configuration changes are required:

- Set the TCP/IP loopback adapter to 2.
- Place the database data and log files on a dedicated file system that is located on a SAN disk with fast write non-volatile cache. This is done to minimise I/O times and improve the capacity of the log.
- Configure the database by using the following commands:

```
db2 update db cfg for userdb using logprimary 10
```

```
db2 update db cfg for userdb using logfilsiz 250000
```

```
db2 update db cfg for userdb using logbufsz 4096
```

## Evaluation method

This section outlines the software components that are used to produce the measurements which are contained in the report.

Point to Point Message Processing is used to test the following transports:

- MQ
- JMS
- HTTP
- SOAP

Different configurations are used to generate and consume input and output messages due to different test cases using different types of input and output messages.

### *Message Generation and Consumption*

The Performance Harness for JMS is a multi-threaded WebSphere MQ Client program written in Java that is used as follows:

- To generate input messages for the different test cases.
- To consume output messages.

The following PerfHarness modules are used for point to point testing:

- mqjava.Requestor . for MQ Messages
- http.Requestor . for Sending SOAP and HTTP messages
- jms.r11.Requestor . for sending and receiving JMS Messages

**Note:** The Performance Harness for JMS is used to generate and consume messages. The tool is useful as a simple way to send and receive messages. The documentation for the tool contains examples of how to run it to send and receive messages. More information about the currently available version can be found at AlphaWorks.

[https://www.ibm.com/developerworks/community/groups/service/html/communityview?communityUuid=18d10b14-e2c8-4780-bace-9af1fc463cc0&open&S\\_TACT=105AGX21&S\\_CMP=AWRSS](https://www.ibm.com/developerworks/community/groups/service/html/communityview?communityUuid=18d10b14-e2c8-4780-bace-9af1fc463cc0&open&S_TACT=105AGX21&S_CMP=AWRSS)

## ***MQ Transport***

- Both persistent and non persistent MQ messages are generated using the Performance Harness program.
- Persistent messages are sent as part of a transaction which is committed after every message.
- A number of threads (typically 20) are run in the multi-threaded client to ensure that there are always messages on the input queue waiting to be processed. This is important when measuring message throughput.
- Each thread sends a message and then waits to receive a reply on the output queue.
- Any thread within the client program is able to retrieve any message which has been processed by a message flow.
- No use is made of the WebSphere MQ correlation identifiers to limit consumption of a message to the thread which created it.
- As soon as a thread receives a reply, it sends another message.
- The message content is the same for all threads and all messages.

## ***JMS Transport***

- JMS messages are generated using the Performance Harness program.
- Non persistent JMS Bytes messages are sent to a JMS Destination.
- The connection factory for the client uses the MQ Client transport to send messages.
- The JMS destination is mapped to an MQ Queue.
- The JMS Input node is configured to read from this MQ queue.
- The connection factory for the nodes uses the MQ Bindings transport for connection.
- The message flow places the reply message on another MQ JMS queue. This output queue is where the client receives the reply.
- A number of threads (typically 20) are run in the multi-threaded client to ensure that there are always messages on the input queue waiting to be processed. This is important when measuring message throughput.
- Each thread sends a message and then waits to receive a reply on the output queue.
- Any thread within the client program is able to retrieve any message which has been processed by a message flow.
- No use is made of the JMS correlation identifiers to limit consumption of a message to the thread which created it.
- When a thread receives a reply, it sends another message.
- The message content is the same for all threads and all messages.

## ***SOAP and HTTP transport***

- SOAP and HTTP messages are generated using the Performance Harness program.
- Messages are sent through persistent HTTP connections. This means that each thread reuses the same TCPIP socket for each request. Each client thread has its own TCPIP socket connection to send and receive data.
- When a thread receives a reply, it sends another message.
- The message content is the same for all threads and all messages.

## ***Machine Configuration***

- The Performance Harness for JMS used to generate and consume messages for the message flows runs on a single client machine.
- IBM Integration Bus v9, its dedicated WebSphere MQ queue manager, and the database are all located on the server machine.
- There is a single client machine.
- For MQ and JMS performance tests, messages are transmitted from the client machine to the server machine over WebSphere MQ SVRCONN channels. The messages are received on the server by using the WebSphere MQ queue manager listener process. This was run as a trusted MQ application in order to improve message throughput.
- Messages are transmitted from the client machines to the server machine by using the WebSphere MQ transport, SOAP/HTTP, or JMS depending on the test use case.
- The client and the server machine are configured with sufficient memory to ensure that no paging takes place during the performance tests.

## ***Reported Message Rates***

- For tests that do not involve publish/subscribe, the message rates reported are the number of invocations of the message flow per second.
- For tests involving several message flows, such as the message aggregation tests, the rate reported is the number of complete operations or aggregations per second. Fan-out and fan-in processing is counted as one operation rather than separate operations.
- For tests using the JMS nodes, the message rate is the number of message flow invocations per second.
- The message rates quoted are an average taken over the measurement period. The start time used correspond to the time when the system initialization period has completed.

## Useful links

This section contains links to information about IBM Integration Bus, previously known as WebSphere Message Broker, and associated products.

### IBM Integration Bus

IBM Integration Bus v9 Announcement letter	<a href="http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=ca&amp;infotype=an&amp;appname=iSource&amp;supplier=877&amp;letternum=ENUSZP13-0164">http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=ca&amp;infotype=an&amp;appname=iSource&amp;supplier=877&amp;letternum=ENUSZP13-0164</a>
IBM Integration Bus v9 for zOS	<a href="http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=897/ENUS213-136&amp;infotype=AN&amp;subtype=CA">http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=897/ENUS213-136&amp;infotype=AN&amp;subtype=CA</a>
IBM Integration Bus Support page	<a href="http://www-947.ibm.com/support/entry/portal/product/webSphere/webSphere_message_broker?productContext=-2089662493">http://www-947.ibm.com/support/entry/portal/product/webSphere/webSphere_message_broker?productContext=-2089662493</a>
IBM Integration Bus v9 product documentation	<a href="http://www-01.ibm.com/support/knowledgecenter/SSMKH_H_9.0.0/com.ibm.etools.msgbroker.helphome.doc/help_home_msgbroker.htm?lang=en">http://www-01.ibm.com/support/knowledgecenter/SSMKH_H_9.0.0/com.ibm.etools.msgbroker.helphome.doc/help_home_msgbroker.htm?lang=en</a>
IBM Integration Bus v9 Fixes	<a href="http://www-933.ibm.com/support/fixcentral/swg/identifyFixes?query.parent=null&amp;query.product=ibm~WebSphere~Integration%20Bus&amp;query.release=All&amp;query.platform=All">http://www-933.ibm.com/support/fixcentral/swg/identifyFixes?query.parent=null&amp;query.product=ibm~WebSphere~Integration%20Bus&amp;query.release=All&amp;query.platform=All</a>
IBM Integration Bus SupportPacs	<a href="http://www-01.ibm.com/support/docview.wss?rs=171&amp;uid=swg27007197#2">http://www-01.ibm.com/support/docview.wss?rs=171&amp;uid=swg27007197#2</a>
WebSphere Message Broker Performance reports	<a href="http://www-01.ibm.com/support/docview.wss?rs=171&amp;uid=swg27007150&amp;loc=en_US&amp;cs=utf-8&amp;lang=en#2">http://www-01.ibm.com/support/docview.wss?rs=171&amp;uid=swg27007150&amp;loc=en_US&amp;cs=utf-8&amp;lang=en#2</a>
IBM Integration Bus @ developerWorks	<a href="http://www.ibm.com/developerworks/webSphere/zones/businessintegration/wmb.html">http://www.ibm.com/developerworks/webSphere/zones/businessintegration/wmb.html</a>
IBM Integration Community Blog	<a href="https://www.ibm.com/developerworks/community/blogs/c7e1448b-9651-456c-9924-f78bec90d2c2/?lang=en">https://www.ibm.com/developerworks/community/blogs/c7e1448b-9651-456c-9924-f78bec90d2c2/?lang=en</a>
IBM Integration Community Wiki	<a href="https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/W37b629a0f7aa_4709_9506_bba2a096693d">https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/W37b629a0f7aa_4709_9506_bba2a096693d</a>



## Related products:

WebSphere MQ SupportPacs	<a href="http://www-01.ibm.com/support/docview.wss?rs=171&amp;uid=swg27007197#1">http://www-01.ibm.com/support/docview.wss?rs=171&amp;uid=swg27007197#1</a>
WebSphere MQ	<a href="http://www-01.ibm.com/software/websphere/ibm-mq.html">http://www-01.ibm.com/software/websphere/ibm-mq.html</a>
Business process Management (BPM)	<a href="http://www-03.ibm.com/software/products/en/category/bpm-software">http://www-03.ibm.com/software/products/en/category/bpm-software</a>

## Tools

The Performance Harness for JMS was used to generate and consume messages. The tool is useful as a simple way to send and receive messages. The documentation for the tool contains examples of how to run it to send and receive messages.

More information about the currently available version can be found at developerWorks .

[https://www.ibm.com/developerworks/community/groups/service/html/communityview?communityUuid=18d10b14-e2c8-4780-bace-9af1fc463cc0&open&S\\_TACT=105AGX21&S\\_CMP=AWRSS](https://www.ibm.com/developerworks/community/groups/service/html/communityview?communityUuid=18d10b14-e2c8-4780-bace-9af1fc463cc0&open&S_TACT=105AGX21&S_CMP=AWRSS)

## Feedback

This report and other tools that are produced by the performance group are produced in order to help you understand the performance characteristics of IBM Integration Bus and to assist you with sizing.

It is important that the reports and tools are effective in what they do and it is very useful to have feedback on the content and style of the information which is produced. Your comments, both positive and negative, are therefore welcome.

Your answers to the following questions are particularly interesting:

- What are your most common performance questions?
- Do the reports provide what is needed?
- Is there any other performance information which is required to help you do your job?
- Would you like to see any other aspects of WMB performance discussed?

Please supply feedback to us at the following e-mail addresses:

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Marisa Lopez ([lopezdsr@uk.ibm.com](mailto:lopezdsr@uk.ibm.com))