WebSphere Message Broker

End user Application Support

Version 6 Release 1

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Note
Before you use this information and the product that it supports, read the information in the Notices appendix.

This edition applies to version 6, release 1, modification 0, fix pack 4 of IBM WebSphere Message Broker and to all subsequent releases and modifications until otherwise indicated in new editions.

Contents

About this topic collection

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Part 1. End user Application Support

Supporting end-user applications

You can connect a variety of end-user applications to WebSphere® Message Broker using a variety of transports.

End-user applications can connect to the broker using one of the following transports:
- WebSphere MQ clients connect using the WebSphere MQ Enterprise Transport. SAP clients also use this transport.
- WebSphere MQ Everyplace® clients connect using the WebSphere MQ Mobile Transport.
- Multicast JMS clients connect using the WebSphere MQ Multicast Transport.
- Real-time JMS clients connect using the WebSphere MQ Real-time Transport.
- SCADA clients connect using the WebSphere MQ Telemetry Transport.
- Web services clients connect using the WebSphere MQ Web Services Transport.
- JMS clients connect using the WebSphere Broker JMS Transport.
- Additional clients can connect using alternative transports if you have installed user-defined nodes and parsers that support them.

The topics in this section provide further information for particular clients including special tasks that you must complete to enable communication between end-user applications and WebSphere Message Broker brokers, and examples of supported scenarios and configurations.
- "End-user application support"
- "Enabling WebSphere MQ applications" on page 10
- "Enabling WebSphere MQ Everyplace applications" on page 12
- "Enabling WebSphere MQ Telemetry Transport applications" on page 13
- Working with Web services

End-user application support

You can connect a variety of end-user applications to the WebSphere Message Broker brokers, and take advantage of the routing, aggregation, and transformation facilities that it provides.

WebSphere Message Broker supports two application communication models:
1. Point-to-point
2. Publish/subscribe

These are defined in "Application communication models" on page 4.

Applications that use these models can connect to the broker using the following transports and protocols:
- "WebSphere MQ Enterprise Transport" on page 19
- "WebSphere MQ Mobile Transport" on page 21
- "WebSphere MQ Multicast Transport" on page 21
- "WebSphere MQ Real-time Transport" on page 22
- "WebSphere MQ Telemetry Transport" on page 23
- "WebSphere Broker HTTP Transport" on page 51
- "WebSphere Broker JMS Transport" on page 54

You can configure message flows to support these communication models and clients connecting over any one of these transports. Your message flows can be

specific to one protocol, or can receive messages from applications communicating across one protocol and deliver messages to applications connecting across any one or more alternative protocols, with the broker providing automatic conversion between these protocols. You can also provide point-to-point and publish/subscribe support in a single message flow.

All message flows can support messages crossing from all transports to all other supported transports. Therefore, if you start the message flow with an input node that supports messages from clients that connect through one transport, you can end it with any of the supported output nodes (including user-defined output nodes); you do not have to include the corresponding output node.

Examples:

- You can design the flow to receive WebSphere MQ messages and generate output messages to SCADA devices, or to receive messages from SCADA devices and generate output messages for real-time or multicast application clients. However, certain restrictions apply depending on the transport being used: for example, messages published persistently through an MQInput node are not guaranteed to be delivered to the subscribers over WebSphere MQ Real-time Transport, because this transport does not support assured delivery.
- You can create a message flow that receives a message from a WebSphere MQ application. The message flow constructs a publication message from its contents, and publishes the message through a Publication node from where real-time subscribers who use JMS can register their interest in the publications. The message flow can also include an MQReply or MQOutput node to provide a confirmation message that indicates to another application that the publication has been implemented.

Application communication models

Applications can use the services of a broker by sending messages to it and receiving messages from it, from one of the supported transport protocols. The way that they do this depends on the protocol itself, the programming interface that they use, and the communication model that they adopt.

WebSphere Message Broker supports two end-user application communication models:

1. "Point-to-point"
2. "Publish/subscribe" on page 7

A single application can mix the two styles, if appropriate. In a mixed scenario, the message flow that processes the messages for this application contains at least one output node and at least one publication node, in addition to one or more input nodes.

The programming interfaces that you can code in your applications are described in "Application programming interfaces" on page 7.

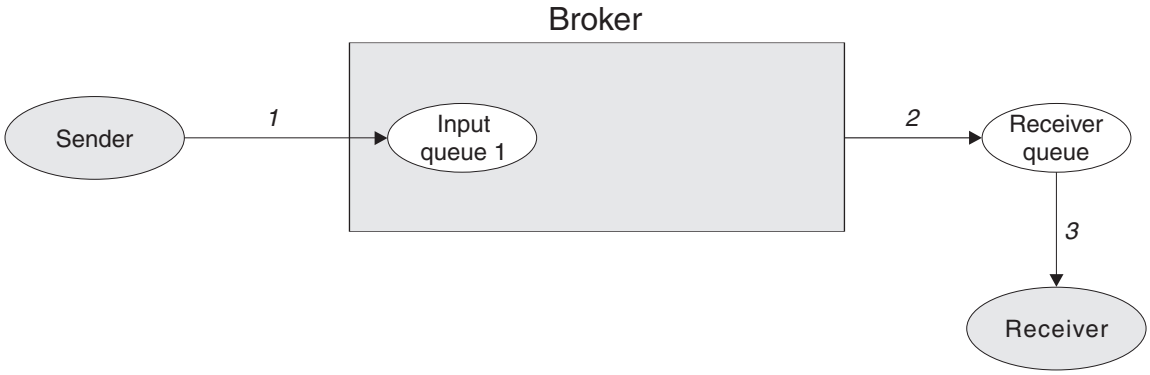
Point-to-point

Point-to-point applications use a request/reply or client/server model, or broadcast a message to many target applications using *distribution lists*. Other applications send one-way *send-and-forget* or *datagram* traffic. They exchange information with known partners. Each application is aware of the identity of the one or more

applications with which it is communicating. You can create and configure message flows to process both send-and-forget and request/reply messages, and deploy them to your brokers.

The text and diagrams below illustrate the send-and-forget and request/reply models. The diagrams assume that the applications are using the WebSphere MQ Enterprise Transport protocol. The model is identical for other protocols, although the resource through which a message is sent or received will not be a WebSphere MQ queue.

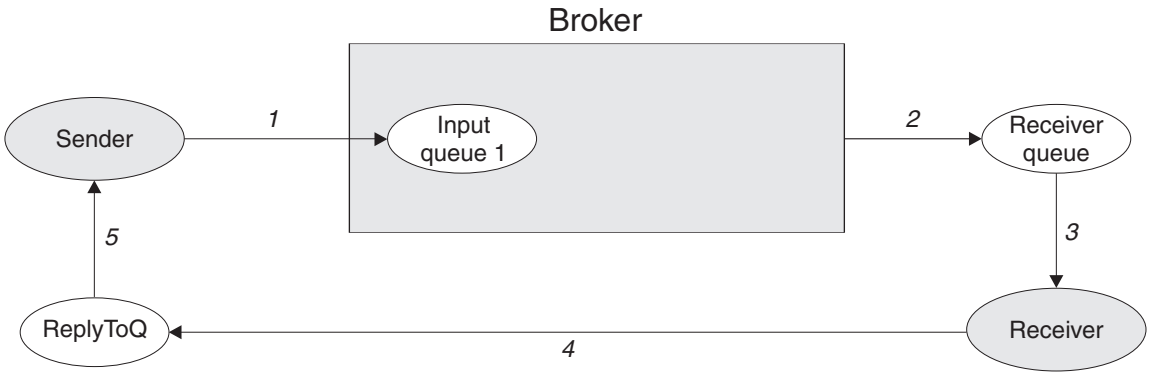
In the send-and-forget model, an application sends a message but does not expect a reply. Another application might optionally receive a message as a result of the message sent by the first application. It is possible that no message is sent by the message flow (for example, if the sending message just requested a database update). In the diagram, the sender puts a message onto the input queue of a message flow at the broker (1). The output from the message flow is put onto the receiver's queue (2), from where the receiver can get it (3).



With request/reply messaging, after the receiver receives a request message it sends a reply back to the sender. The request message is handled as described for send-and-forget messages. There are two possibilities for the reply:

1. The receiver sends the reply message directly back to the sender, without involving the broker. The message is sent to the *ReplyToQ* in the message descriptor (MQMD) of the request message, which is passed unchanged by the broker. (If your applications are not using WebSphere MQ, you must use some other technique to determine the reply destination.)

   In the diagram below, the sender puts a message onto the input queue of a message flow at the broker (1). The output from the message flow is put onto the receiver's queue (2), from where the receiver gets it (3). The receiver sends the reply directly to the ReplyToQ of the sender (4), from where the sender can get it (5).



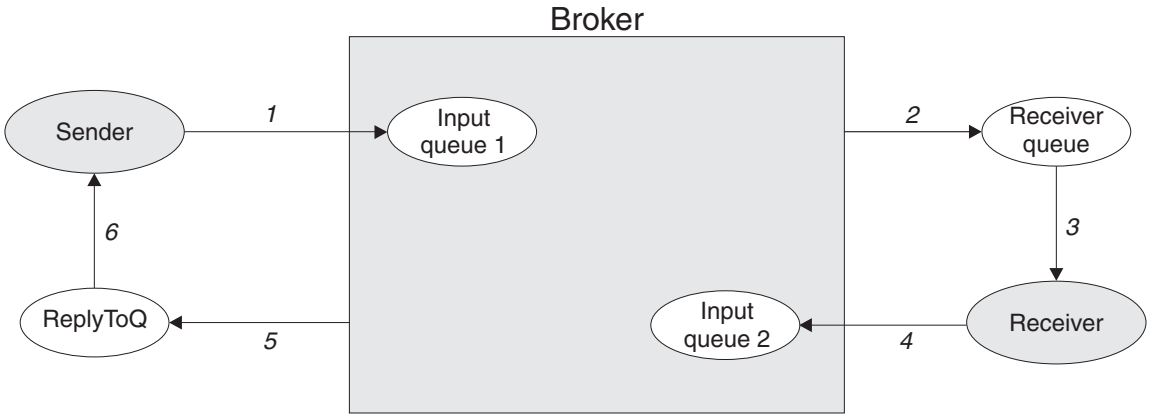
2. The receiver sends the reply message to a reply message flow in the broker, so that it can be processed before reaching the sender. In this case, the broker must replace the sender's *ReplyToQ* in the MQMD of the request message with the input queue name of the reply message flow.

   The output of this reply message flow must go to the sender's *ReplyToQ*. If the name is fixed, there is no problem; if it is not, some means of associating this queue with the reply message is needed.

   You can do this, for example, by including a Database or DataInsert node in the first message flow that stores the reply destination information, which can be retrieved by the second message flow.

   Alternatively, the relevant details in the message descriptor can be copied into a folder in the MQRFH2 header, and carried with the message.

   In the diagram below, the sender puts a message onto the input queue of the first message flow at the broker (1). The output from the message flow is put onto the receiver's queue (2), from where the receiver gets it (3). The receiver sends the reply to the input queue of the second message flow at the broker (4). After processing the reply, the broker sends it to the ReplyToQ of the sender (5), from where the sender can get it (6). (In this case, the output node of the second message flow needs to know the ReplyToQ of the sender.)



Existing applications that you have written using the point-to-point model can run unchanged in a WebSphere Message Broker environment if they use one of the supported protocols to communicate with the broker.

You can enhance and extend your existing application function by using the facilities of the broker to include additional partners. For example, an application that handles similar data but in a different format can participate because the

original message can be transformed by a message flow in the broker into the expected format, without the need to change the sending or receiving application.

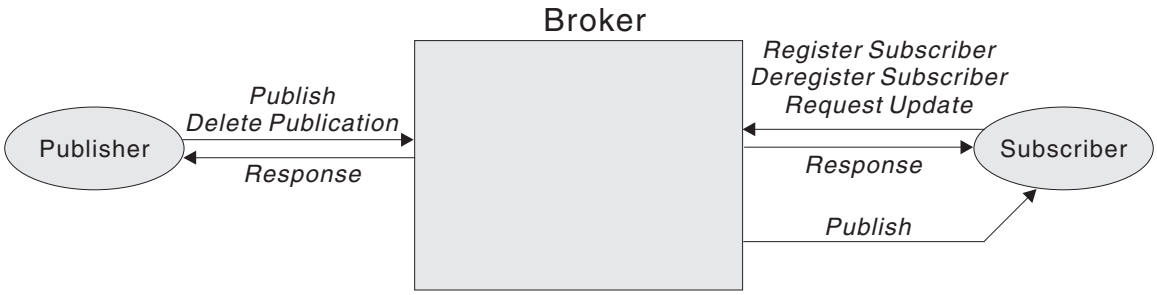
If you identify a message that needs additional application processing, you can create another copy of the message in the message flow, and send it to a new application developed to provide that processing. The original applications are unaware of the new action on the message and continue to work unchanged.

Publish/subscribe

The publish/subscribe application communication model involves applications known as publishers and applications known as subscribers. Publishers make messages available by publishing on specific topics. Subscribers receive messages by subscribing to topics. An individual application can be both a publisher and a subscriber.

Messages published by any one publisher can be received by any number of subscribers. Subscribers might also receive messages, on the same or different topics, from any number of publishers.

In this diagram, the publisher can send Publish or Delete Publication messages to the broker. The broker forwards the Publish message to subscribers that have a matching subscription. The subscriber can send Register Subscriber, Deregister Subscriber, or Request Update messages to the broker. Optional Response messages from the broker are sent to the publisher and subscriber.



If you have existing end-user applications that are written to the publish/subscribe model, for example using the MQI or AMI, you can probably integrate these applications into a WebSphere Message Broker broker domain without change.

You can also modify these applications, or write new ones, to take advantage of the sophisticated publish/subscribe processing that is provided, particularly for subscribers.

The publish/subscribe model, and the processing provided by WebSphere Message Broker, is described fully in further topics available through the related links.

Application programming interfaces

WebSphere Message Broker supports several programming interfaces that are in use by messaging applications today; it does not provide any unique programming interfaces.

- Message Queue Interface (MQI)

The MQI provides a small number of calls that allow an application to interact with other applications in a network of WebSphere MQ queue managers. The calls support a large range of parameters that allow a rich choice of processing options for each and every message.

Client applications using the MQI can run on any supported WebSphere MQ operating system, and therefore any limitations that are enforced for language or function are defined by the relevant product for that operating system.

The MQI is described in the *Application Programming Reference* and *Application Programming Guide* sections in the WebSphere MQ Version 7 information center online or WebSphere MQ Version 6 information center online. Details are also provided of the programming language and operating system support available for clients that use this interface.

- Application Messaging Interface (AMI)

  The AMI is designed to simplify the application programmer's task by centralizing the selection of optional parameters outside the application program. It also provides support for the more advanced functions available from the message broker. The AMI is designed for general messaging applications with and without a broker.

  The principal functions of the AMI are administrator-defined packets of options known as policies and services. An application specifies a service to determine the underlying messaging support required, and associates a policy with sending or receiving a message to control attributes for message processing, such as priority.

  The policies and services mean that the application does not have to understand details of the MQRFH2 header and the MQI interface.

  Client applications using the AMI are restricted to the operating systems and programming languages supported by this interface. The AMI is defined in the *Publish/Subscribe User's Guide* section in the WebSphere MQ Version 7 information center online or WebSphere MQ Version 6 information center online.

- Java™ Message Service (JMS)

  The JMS is an application programming interface that provides Java language functions for handling messages. Developed by messaging vendors, including IBM® in partnership with Sun Microsystems, Inc., the JMS API provides a common interface to access different enterprise messaging systems, including WebSphere MQ. This interface is appropriate for point-to-point and publish/subscribe applications.

  Messaging clients in JMS are called *JMS clients*, and the messaging system is called the *JMS provider*. A *JMS application* is a business system that comprises JMS clients and at least one JMS provider. Client applications using the JMS interface are written in the Java programming language, and are therefore restricted to the levels of JVM that are supported on the operating system in question.

  For more information, see the *Using Java* section in the WebSphere MQ Version 7 information center online or WebSphere MQ Version 6 information center online.

- WebSphere MQ Everyplace programming calls

  These calls are described in "WebSphere MQ Mobile Transport" on page 21.

- SCADA device protocol publication messages.

  These messages are described in "WebSphere MQ Telemetry Transport" on page 23.

If you have existing end-user applications that are written to these interfaces, they can typically run unchanged in a broker environment. You must create the message

flows to interact with these applications from the supported protocols, using the appropriate input and output nodes. WebSphere Message Broker provides built-in input and output nodes for its supported protocols and you can create your own user-defined nodes to support additional protocols if you choose.

You can also create new end-user applications to interact with the broker.

Message headers

WebSphere Message Broker provides parsers for a large number of WebSphere MQ headers, and can therefore accept messages that contain these headers from the WebSphere MQ Enterprise Transport, WebSphere MQ Mobile Transport, and WebSphere MQ Telemetry Transport protocols.

Messages must include a WebSphere MQ Message Descriptor (MQMD) as the first header, which must precede user or application data in every message. The MQMD contains basic control information that must travel with the message, including:

- The message identifier
- The destination of the reply, if one is to be sent
- Reply and report options (for example, confirm on delivery report)
- The format of any following data in the message

When a message is processed by a WebSphere Message Broker broker, it typically (but not necessarily) has one or more additional headers. The header following the MQMD is always identified in the format field within the MQMD, and itself contains another format field to identify either the header that follows, or the format of the user data.

The additional headers can include:

MQRFH
: The Rules and Formatting header is used by WebSphere MQ Publish/Subscribe.

MQRFH2
: The MQRFH2 is an updated version of MQRFH and allows Unicode strings to be transported without translation, and it can carry numeric data types. The MQRFH2 header carries a description of the message contents, so that WebSphere Message Broker can select the correct message parser when content-based processing is carried out on the message. In addition, this header contains publish/subscribe command messages.

  Messages created by the SCADAInput node always include and MQRFH2 header.

  Use the MQRFH2 header in all new applications written for the WebSphere Message Broker environment that use a supported protocol based on WebSphere MQ technology. The MQRFH2 header should be immediately before the body of the message (that is, the last header).

  If an MQRFH2 header is not included (which is normally the case of the application uses a supported protocol that is not based on WebSphere MQ technology), you must configure the message flow that processes its messages to specify the message characteristics (by setting the input node properties).

Enabling WebSphere MQ applications

If you want to connect WebSphere MQ client applications to the broker, you must define and secure the required resources.

- "Defining WebSphere MQ resources"
- "Securing WebSphere MQ resources" on page 11

Defining WebSphere MQ resources

An application client can run on a computer anywhere in the WebSphere MQ network. If your applications use WebSphere MQ facilities to connect to the broker, and to interact with it (by using the MQI and AMI), you must set up the WebSphere MQ resources that they require.

The way that you set up applications is identical to that for clients for an WebSphere MQ server. To support client connections to a broker:

1. If the application runs on the same computer as the broker, it can establish a local connection with the broker's queue manager using MQCONN, and you do not have to define any WebSphere MQ resources to support it.
2. If the application runs on the same computer as another queue manager in the WebSphere MQ network, it can establish a local connection to that queue manager. In this scenario, you must define the appropriate resource to support communications between the queue manager to which the client has connected and the queue manager that hosts the broker that provides the required service.
3. If the application runs on a computer that does not support a queue manager, it must make a client connection to a queue manager on another computer:
   - The broker's queue manager

     You must set up the appropriate client connection and server connection definitions to support this option.
   - Another queue manager in the network

     You must set up the appropriate client connection and server connection definitions to support this option, and ensure that definitions are in place to support communications between the queue manager to which the client has connected and the queue manager that hosts the broker that provides the required service.

An application can get messages only from queues that are owned by the queue manager to which it is connected (this restriction is true for all WebSphere MQ applications). Therefore, if an application expects to receive messages from a queue populated by a service within a particular broker and owned by that broker's queue manager, it must connect to that broker's queue manager (using a local or WebSphere MQ client connection).

An application that puts messages, however, can be connected to any queue manager in the WebSphere MQ network, provided that the queue manager can resolve the target destination in some way. In all cases, the queue manager to which the client application is connected must know the location of the queue or queues to which the application puts messages (for example, using remote queue definitions).

When you define a WebSphere MQ queue as a node for a message flow, you must not give it a name that starts with SYSTEM_BROKER. Names that include these characters are reserved for queues that are defined for internal use by WebSphere Message Broker components.

If your application is a subscriber that receives messages published by other applications, it can specify a temporary dynamic queue as its subscriber queue. If it does so, the broker automatically deregisters the subscription when the queue is deleted.

For more details about applications, putting and getting messages, and the use of WebSphere MQ clients, see the *Clients* and *Application Programming Guide* sections of the WebSphere MQ Version 7 information center online or WebSphere MQ Version 6 information center online.

Securing WebSphere MQ resources

Secure the WebSphere MQ resources that your broker domain configuration requires.

This information does not apply to z/OS®.

Runtime components depend on a number of WebSphere MQ resources to operate successfully. You must control access to these resources to ensure that the components can access the resources on which they depend, and that these same resources are protected from other users.

Some authorizations are granted on your behalf when commands are issued. Others depend on the configuration of your broker domain.

- When you issue the command mqsicreatebroker, it grants put and get authority on your behalf to the group mqbrkrs for the following queues:
  - SYSTEM.BROKER.ADAPTER.FAILED
  - SYSTEM.BROKER.ADAPTER.INPROGRESS
  - SYSTEM.BROKER.ADAPTER.NEW
  - SYSTEM.BROKER.ADAPTER.PROCESSED
  - SYSTEM.BROKER.ADAPTER.UNKNOWN
  - SYSTEM.BROKER.ADMIN.QUEUE
  - SYSTEM.BROKER.AGGR.CONTROL
  - SYSTEM.BROKER.AGGR.REPLY
  - SYSTEM.BROKER.AGGR.REQUEST
  - SYSTEM.BROKER.AGGR.TIMEOUT
  - SYSTEM.BROKER.AGGR.UNKNOWN
  - SYSTEM.BROKER.CONTROL.QUEUE
  - SYSTEM.BROKER.EDA.COLLECTIONS
  - SYSTEM.BROKER.EDA.EVENTS
  - SYSTEM.BROKER.EXECUTIONGROUP.QUEUE
  - SYSTEM.BROKER.EXECUTIONGROUP.REPLY
  - SYSTEM.BROKER.INTERBROKER.MODEL.QUEUE
  - SYSTEM.BROKER.INTERBROKER.QUEUE
  - SYSTEM.BROKER.MODEL.QUEUE
  - SYSTEM.BROKER.TIMEOUT.QUEUE
  - SYSTEM.BROKER.WS.ACK
  - SYSTEM.BROKER.WS.INPUT
  - SYSTEM.BROKER.WS.REPLY
- When you issue the command mqsicreateconfigmgr it grants put and get authority on your behalf to the group mqbrkrs for the following queues:
  - SYSTEM.BROKER.CONFIG.QUEUE
  - SYSTEM.BROKER.CONFIG.REPLY
  - SYSTEM.BROKER.ADMIN.REPLY
  - SYSTEM.BROKER.SECURITY.REPLY
  - SYSTEM.BROKER.MODEL.QUEUE

- When you issue the command mqsicreateusernameserver, it grants put and get authority on your behalf to the group mqbrkrs for the following queues:
  - SYSTEM.BROKER.SECURITY.QUEUE
  - SYSTEM.BROKER.MODEL.QUEUE
- If you have created components to run on different queue managers, the transmission queues that you define to handle the message traffic between the queue managers must have put and setall authority granted to the local mqbrkrs group, or to the service user ID of the component supported by the queue manager on which the transmission queue is defined.
- When you start the workbench, it connects to the Configuration Manager by using a WebSphere MQ client/server connection. For details of WebSphere MQ channel security, see "Setting up WebSphere MQ client security" in the *Clients* section of the WebSphere MQ Version 7 information center online or WebSphere MQ Version 6 information center online.
- When you create and deploy a message flow that includes nodes which reference WebSphere MQ queues, grant get, inq, and put authority to the user ID under which the broker is running.

Enabling WebSphere MQ Everyplace applications

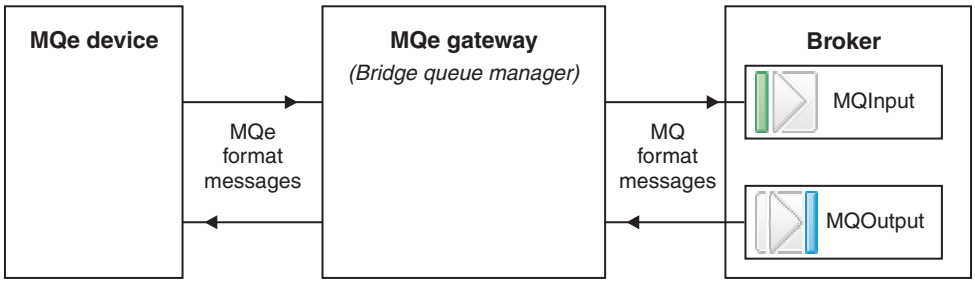
WebSphere MQ Mobile Transport is a service that connects mobile and wireless applications that use WebSphere MQ Everyplace.

WebSphere MQ Everyplace is an application designed primarily for messaging to, from, and between pervasive devices. These are typically small, handheld devices, such as mobile phones and PDAs.

The operation of WebSphere MQ Everyplace is different from that of WebSphere Message Broker, which means that there are different concepts involved in using a broker to operate with WebSphere MQ Everyplace. In particular, the message format is different, and messages must be converted.

Communication between WebSphere MQ Everyplace and a broker is achieved through the use of an external MQe Gateway (also called a *bridge-queue-manager*). WebSphere MQ Everyplace must be installed separately, and its MQe Gateway configured appropriately. Your flows use MQInput and MQOutput nodes to communicate with the gateway using MQ format messages. The gateway then communicates with MQe devices using MQe format messages.

The following diagram illustrates this visually:



For help with configuring WebSphere MQ Everyplace, see the documentation supplied with that product.

If you have message flows containing MQe nodes from a previous version broker and you want to use them, see how to migrate them in Migrating a message flow that contains WebSphere MQ Everyplace nodes.

Enabling WebSphere MQ Telemetry Transport applications

If you want to connect WebSphere MQ Telemetry Transport client applications to the broker, review the following guidance information:
- Designing applications
- An example message flow

The following SupportPacs are available from the WebSphere MQ SupportPacs Web page, and provide additional information to help you develop WebSphere MQ Telemetry Transport applications:
- IA92 Java implementation of WebSphere MQ Telemetry Transport
- IA93 C implementation of WebSphere MQ Telemetry Transport

Designing Telemetry applications

When you create a message flow to receive messages from Telemetry clients, you must include at least one SCADAInput node. Configure the node's properties to define the port on which it listens for new messages. If your message flow sends messages to Telemetry clients, you must include either a Publication node, or a SCADAOutput node (the Publication node includes an embedded SCADAOutput node).

You must deploy message flows that contain SCADAInput and SCADAOutput nodes to a single execution group within a broker. If you send messages to Telemetry clients through a Publication node, the message flow that contains that node must also be in the same execution group as a SCADAInput node, even if you do not have a message flow that receives messages from Telemetry clients. This is because the properties of the SCADAInput node identify the TCP/IP port that is used for communication with the clients, and the characteristics of how messages are handled.

Starting and stopping listeners

Start and stop a WebSphere MQ Telemetry Transport listener using a publish message with the topic `$SYS/SCADA/MQIsdpListener/<port_number>`. Set the Payload part of the message set to ON or OFF. Replace `<port_number>` with the single port that you want to start or stop, or with `all` to start or stop all ports on the system that are designated as SCADA ports.

Improving message handling

The number of messages that are handled by a message flow depends both on message throughput and on response times. Review the guidance in Optimizing message flow response times and Optimizing message flow throughput. In addition, you must consider the Quality of Service that you choose for messages received from, or published to, Telemetry clients. This is described in "Choosing Quality of Service."

Choosing Quality of Service

Quality of Service determines the reliability of message delivery. Review the circumstances of the messages that are processed; in some situations, message loss

might be acceptable. For other scenarios, message delivery might need to be guaranteed. The Quality of Service options, QoS0, QoS1, and QoS2, are described in “WebSphere MQ Telemetry Transport Quality of Service levels and flows” on page 24.

If you choose to guarantee message delivery, the broker must take additional actions to preserve the message until it is certain that it has been delivered. This affects broker and client performance, so you must balance the need for speed of message processing with the need to ensure message delivery.

If you choose QoS1 or QoS2, which indicates the message must be delivered at least, or only, once, the broker and client must provide a certain level of acknowledgment. The broker must store the message so that it can resend it if the appropriate acknowledgments are not received.

The broker stores messages in its database. This can affect message handling if the broker is unable to complete input to or output from the database when required; the broker might stop processing messages if this happens. If your broker database is DB2, turn off DB2 *next key locking* to avoid these deadlock problems. Issue the following command in a DB2 command window to make this change:

```
db2set DB2_RR_TO_RS=YES_OVERRIDE_RI
```

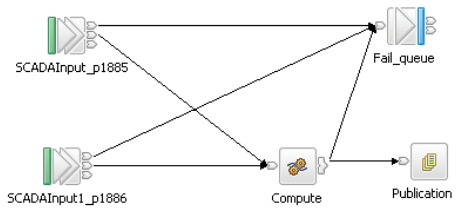
Restart the DB2 database manager for this change to take effect.

If you choose QoS0, message delivery is not guaranteed. The broker does not store the messages.

An example message flow to support Telemetry clients

This example message flow includes two SCADAInput nodes configured to listen on different TCP/IP ports. When a message is received without error, the input node propagates it to a Compute node that manipulates the input message content and generates a number of output messages. The Compute node propagates the output messages to a Publication node which publishes them to registered subscribers that use the WebSphere MQ protocol. Any errors in the flow are propagated to an MQOutput node, which records the error messages on a queue to be processed later.

The Telemetry clients generate events, for example to indicate a change of state, or to confirm that they are still active. The clients are programmed to batch up events and send them to the broker every 15 minutes. The message flow is designed to extract individual event messages from the batch message and publish these.



The Compute node has been configured with ESQL that splits the batched input message into individual event messages. A WHILE loop iterates over each message in the batch. The MQMD is copied from the input message to each output

message. Relevant fields are copied from the input tree to the output tree. Each output message is a JMSText message which is built by setting the User properties in the usr folder within the MQRFH2 header. Each message is passed to the Publication node by a PROPAGATE statement.

Here is an example input batch message that contains two events:

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited by Mary Bright -->
<events d_tstamp="20040417103118">
  <StateChange topic="LCUnit/12345/StateChange"
    d_tstamp="20040417104439" i_state="1" i_old_state="0">
    <![CDATA[Changing state from 'Starting' to 'Payload' because
    'The startup routine is complete']]&gt;
  </StateChange>
  <Heartbeat topic="LCUnit/12345/Heartbeat"
    d_tstamp="20040417105126" i_state="1">
    <d_tstamp>20040417104948</d_tstamp>
    <i_state>1</i_state>
  </Heartbeat>
</events>
```

The ESQL module that processes messages of this format is shown below:

```
CREATE COMPUTE MODULE messageflow_Compute
   CREATE FUNCTION Main() RETURNS BOOLEAN
   BEGIN
 DECLARE BatchTime CHAR;
 SET BatchTime = InputRoot.XMLNS.events.d_tstamp;
 DECLARE Count INTEGER CARDINALITY(InputRoot.XMLNS.events.*[]);
 DECLARE I INTEGER 2;

 WHILE I <= Count DO
  SET OutputRoot.Properties.MessageDomain = 'XMLNS';
  SET OutputRoot.XMLNS = NULL;
  SET OutputRoot.MQMD = InputRoot.MQMD;
  SET OutputRoot.MQRFH2.CodedCharSetId = 1208;
  SET OutputRoot.MQRFH2.(MQRFH2.Field)Format = 'MQSTR   ';
  SET OutputRoot.MQRFH2.(MQRFH2.Field)NameValueCCSID = 1208;
  SET OutputRoot.MQRFH2.psc.Topic = InputRoot.XMLNS.events.*[I].topic;
  SET OutputRoot.MQRFH2.usr.*[] = InputRoot.XMLNS.events.*[I].(XML.Attribute)*[];
  SET OutputRoot.MQRFH2.usr.b_time = BatchTime;
  SET OutputRoot.XMLNS.Body.Text = InputRoot.XMLNS.events.*[I].(XML.CDataSection)*'
  SET I = I + 1;
  PROPAGATE;
 END WHILE;

 RETURN FALSE;
   END;
END MODULE;
```

The message flow has two input nodes to increase the message handling capability. You can use any number of input nodes. You can also change the message flow property *Additional Instances* to increase the number of processes that service the message flow. If you have many hundreds of clients, you might find that you have to handle a high message load on two or more brokers. Use one or more of these techniques to find an acceptable level of message processing.

This example shows only one way in which Telemetry client messages can be handled. Change this message flow, or create a new one, to meet your own Telemetry requirements.

Part 2. Reference

End-user application support

You can use a number of different protocols to connect your applications to brokers.

The following reference information helps you to enable your end-user applications for use with WebSphere Message Broker:
- "WebSphere MQ Enterprise Transport"
- "WebSphere MQ Mobile Transport" on page 21
- "WebSphere MQ Multicast Transport" on page 21
- "WebSphere MQ Real-time Transport" on page 22
- "WebSphere MQ Telemetry Transport" on page 23
- "WebSphere Broker HTTP Transport" on page 51
- "WebSphere Broker JMS Transport" on page 54

For information about application compiler support, and connectivity between applications and brokers, refer to the relevant information for your operating system. For WebSphere MQ applications, further information is provided for each operating system in the *Quick Beginnings* section of the WebSphere MQ Version 7 information center online or WebSphere MQ Version 6 information center online.

Application transports

You can connect your applications to the broker by using one of the supported transport protocols.
- "WebSphere MQ Enterprise Transport"
- "WebSphere MQ Mobile Transport" on page 21
- "WebSphere MQ Multicast Transport" on page 21
- "WebSphere MQ Real-time Transport" on page 22
- "WebSphere MQ Telemetry Transport" on page 23
- "WebSphere MQ Web Services Transport" on page 51
- "WebSphere Broker Adapters Transport" on page 51
- "WebSphere Broker File Transport" on page 51
- "WebSphere Broker HTTP Transport" on page 51
- "WebSphere Broker JMS Transport" on page 54

WebSphere MQ Enterprise Transport

WebSphere MQ Enterprise Transport is a service that connects applications to messaging middleware.

The WebSphere MQ Enterprise Transport is the transport used by WebSphere MQ. The WebSphere MQ Enterprise Transport supports WebSphere MQ applications that connect to WebSphere Message Broker to benefit from message routing and transformation options.

The WebSphere MQ Enterprise Transport provides all the reliable messaging features available in WebSphere MQ. This transport provides persistent and non-persistent messaging and supports transactions. To use the WebSphere MQ Enterprise Transport, you must deploy a message flow that contains an MQInput node to your broker. If this message flow sends output messages to other WebSphere MQ applications, it must also include an MQOutput, MQReply, or Publication node.

The WebSphere MQ Enterprise Transport is a queued transport; applications communicate with the broker by writing data to and reading data from message queues. Use the WebSphere MQ Enterprise Transport when you require assured delivery of messages or need to use transactional support.

Because WebSphere MQ Enterprise Transport is a more robust option, it does not offer the same levels of performance and scalability as the WebSphere MQ Real-time Transport.

WebSphere MQ Enterprise Transport is used by WebSphere MQ clients or application programs that are written to the Application Messaging Interface (AMI) or Message Queue Interface (MQI). The client uses the services provided by the message flows deployed within one or more brokers in the broker domain by interacting with the queues serviced by those message flows.

The queue specified in the MQInput node determines the queue on which the broker receives publications from publishing applications. Subscribers connect to the broker by sending a registration request to the broker's SYSTEM.BROKER.CONTROL.QUEUE. The subscriber specifies a queue on which they want to receive any publications on the registered topic in the registration request.

All WebSphere Message Broker applications, like WebSphere MQ applications, can use all the supported WebSphere MQ interfaces to put messages to the message flow queues. In fact, every WebSphere MQ application is a potential WebSphere Message Broker application.

These applications use one of two techniques to gain access to the broker's services:

- An application can use a WebSphere MQ client connection. You can use all the WebSphere MQ clients supported by Version 6.0 or later. You can therefore connect applications running in a wide variety of environments into your broker domain. An application running on the same system as the queue manager to which it connects can also use a client connection.
- An application running on the same system as a broker can use a local connection to the queue manager that hosts that broker. If it uses this method, the client must execute on the same system. It can connect to a queue manager supporting a broker, or to any other queue manager in the WebSphere MQ network that has a defined path to the broker's queue manager. (This option is not possible on z/OS, where clients are not supported.)

Multiple applications can communicate using separate local queue managers by using WebSphere MQ intercommunication (*remote queue definitions*, or *clustering*). For more details, see "Concepts of intercommunication" in the *Intercommunication* section of the WebSphere MQ information center.

WebSphere Message Broker does not impose any particular conditions or restrictions on applications.

Receiving applications can get the messages put to the output queue or queues of a message flow when they have been processed by that message flow. The applications must be connected, either by a client/server connection, or across a local connection, to the queue manager that owns the queue or queues defined as the target for their messages. If the message flow provides a publish/subscribe service, the Publication node puts the messages to the queue specified by the subscriber as its local receiver queue.

Applications that connect using WebSphere MQ Enterprise Transport use a mixture of point-to point and publish/subscribe models.

The following built-in nodes are provided to support this protocol:
- MQInput
- MQOutput
- MQReply
- MQGet
- Publication

WebSphere MQ Mobile Transport

WebSphere MQ Mobile Transport is a service that connects mobile and wireless applications that use WebSphere MQ Everyplace.

The operation of WebSphere MQ Everyplace is different from that of WebSphere Message Broker, which means that there are different concepts involved in using a broker to operate with WebSphere MQ Everyplace. In particular, the message format is different, and messages must be converted.

This transport cannot be used directly with the broker; instead WebSphere MQ Everyplace is installed separately, and an MQe Gateway configured on it that acts as an intermediary between MQe devices and the broker.

For more details on how to do this, see "Enabling WebSphere MQ Everyplace applications" on page 12.

For help with configuring WebSphere MQ Everyplace, see the documentation supplied with that product.

If you have message flows containing MQe nodes from a previous version broker and you want to use them, see how to migrate them in Migrating a message flow that contains WebSphere MQ Everyplace nodes.

WebSphere MQ Multicast Transport

WebSphere MQ Multicast Transport is a service that connects dedicated JMS application clients and is optimized for high volume, one-to-many publish/subscribe topologies.

WebSphere Message Broker provides support to allow these clients to communicate with other applications through message flows in a broker.

Applications that connect using WebSphere MQ Multicast Transport and the JMS API use predominantly the publish/subscribe model. The applications must be multicast-enabled to use this protocol.

The ability to communicate with a broker means that JMS application multicast clients can communicate with applications that use other supported protocols and transports.

To use the WebSphere MQ Multicast Transport, you must deploy a message flow that contains a Real-timeOptimizedFlow node or a Real-timeInput node to your broker. The message flow can send output messages to other real-time applications, using either the Real-timeOptimizedFlow or the Publication node.

This protocol is a non-queued transport: applications communicate with the broker by writing data directly to TCP/IP ports and the input nodes are configured with a TCP/IP port number on which the broker listens for incoming connections. Client applications that use the WebSphere MQ Multicast Transport connect to this port.

The following built-in nodes are provided to support this protocol:
- Real-timeInput
- Real-timeOptimizedFlow
- Publication

WebSphere MQ Real-time Transport

WebSphere MQ Real-time Transport is a lightweight protocol optimized for use with nonpersistent messaging. It is used exclusively by Java Message Service (JMS) clients, and provides high levels of scalability and message throughput.

These clients participate in publish/subscribe scenarios, sending messages over IP connections to other internet and intranet applications. WebSphere Message Broker provides support to allow these clients to communicate with other applications through message flows in a broker.

WebSphere MQ Real-time Transport is suited for applications and environments where you need to send large numbers of messages, or where messages are to be sent to large numbers of client applications. Use this protocol for applications that must rely on the quality of service provided by TCP/IP but do not need persistent delivery. For example, you can use this protocol in situations where a piece of data is updated very frequently, such as updating a scoreboard for a sporting event or updating a share price on a stock ticker. Because this is a lightweight protocol, it offers higher levels of performance for nonpersistent messaging than WebSphere MQ Enterprise Transport. The WebSphere MQ Real-time Transport does not provide any facilities for persistent messaging or durable subscriptions.

To use the WebSphere MQ Real-time Transport, you deploy a message flow that contains a Real-timeOptimizedFlow node or a Real-timeInput node to your broker. (The Real-timeInput node is an input node and the Real-timeOptimizedFlow node is a complete message flow that provides a high performance publish/subscribe message flow.) The message flow can send output messages to other real-time applications, using either the Real-timeOptimizedFlow or the Publication node.

This protocol is a non-queued transport: applications communicate with the broker by writing data directly to TCP/IP ports, and the input nodes are configured with a TCP/IP port number on which the broker listens for incoming connections. Client applications that use the WebSphere MQ Real-time Transport connect to this port.

You can generate WSDL files from message set definitions that you have created in the workbench, and use these files with tools such as WebSphere Studio Application Developer Integration Edition or Microsoft® Visual Studio.NET to build JMS client applications that connect to WebSphere Message Broker. When you generate the WSDL file, you can specify one or more of the following bindings to be created:
- SOAP over HTTP
- SOAP over JMS
- JMS TextMessage

The first of these is supported using the WebSphere MQ Web Services Transport. The other two are supported using the WebSphere MQ Real-time Transport.

Applications that connect using WebSphere MQ Real-time Transport and the JMS API use predominantly the publish/subscribe model.

The following built-in nodes support this protocol:
- Real-timeInput
- Real-timeOptimizedFlow
- Publication

WebSphere MQ Telemetry Transport

WebSphere MQ Telemetry Transport is a lightweight publish/subscribe protocol flowing over TCP/IP for remote sensors and control devices through low bandwidth communications.

This protocol is used by specialized applications on small footprint devices that require a low bandwidth communication, typically for remote data acquisition and process control.

A typical system might comprise several hundred client devices communicating with a single WebSphere Message Broker, where each client is identified by a unique ID. A single broker can manage a maximum of approximately 2000 clients.

Client applications use WebSphere MQ Telemetry Transport to send messages to SCADAInput nodes and receive messages from Publication or SCADAOutput nodes in a message flow.

WebSphere Message Broker uses the SCADAInput node to receive messages from WebSphere MQ Telemetry Transport client applications. The node interacts with a TCP/IP port to receive the messages.

Output is typically returned to the client application using a Publication node which embeds a SCADAOutput node. The Publication node filters and sends output from a message flow to subscribers who have registered an interest in a particular set of topics. If an application is using WebSphere MQ, the Publication node puts the message to the WebSphere MQ queue on the queue manager. For WebSphere MQ Telemetry Transport applications, the embedded SCADAOutput node routes the message to a subscribing WebSphere MQ Telemetry Transport client using a TCP/IP port.

z/OS SCADAInput nodes are available on all platforms except z/OS.

It is unlikely that you will use the SCADAOutput node directly, unless you write your own publication node for advanced applications.

Unlike WebSphere MQ and WebSphere MQ Everyplace, WebSphere MQ Telemetry Transport does not provide any security, although you can encrypt data, if required.

The transport is described in the following topics:
- Quality of Service levels and flows
- Message format
- Command messages

WebSphere MQ Telemetry Transport Quality of Service levels and flows

WebSphere MQ Telemetry Transport delivers messages according to the levels defined in a Quality of Service (QoS). The levels are described below:

QoS level 0 At most once delivery

The message is delivered according to the best efforts of the underlying TCP/IP network. A response is not expected and no retry semantics are defined in the protocol. The message arrives at the broker either once or not at all.

The table below shows the QoS level 0 protocol flow.

Client	Message and direction	Broker
QoS = 0	PUBLISH ---------->	**Action:** Publish message to subscribers

QoS level 1 At least once delivery

The receipt of a message by the broker is acknowledged by a PUBACK message. If there is an identified failure of either the communications link or the sending device, or the acknowledgment message is not received after a specified period of time, the sender resends the message with the DUP bit set in the message header. The message arrives at the broker at least once. Both SUBSCRIBE and UNSUBSCRIBE messages use QoS level 1.

A message with QoS level 1 has a Message ID in the message header.

The table below shows the QoS level 1 protocol flow.

Client	Message and direction	Broker
QoS = 1 DUP = 0 Message ID = x	PUBLISH ---------->	**Actions:** • Store message in database • Publish message to subscribers
Action: Discard message	PUBACK <----------	

If the client does not receive a PUBACK message (either within a time period defined in the application, or if a failure is detected and the communications session is restarted), the client resends the PUBLISH message with the DUP flag set.

When it receives a duplicate message from the client, the broker republishes the message to the subscribers, and sends another PUBACK message.

QoS level 2 Exactly once delivery

Additional protocol flows above QoS level 1 ensure that duplicate messages are not delivered to the receiving application. This is the highest level of delivery, for use when duplicate messages are not acceptable. There is an increase in network traffic, but it is usually acceptable because of the importance of the message content.

A message with QoS level 2 has a Message ID in the message header.

The table below shows the QoS level 2 protocol flow.

Client	Message and direction	Broker
QoS = 2 DUP = 0 Message ID = x	PUBLISH ---------->	**Action:** Store message in database
	PUBREC <----------	Message ID = x
Message ID = x	PUBREL ---------->	**Actions:** • Update database • Publish message to subscribers
Action: Discard message	PUBCOMP <----------	Message ID = x

If a failure is detected, or after a defined time period, each part of the protocol flow is retried with the DUP bit set. The additional protocol flows ensure that the message is delivered to subscribers once only.

Because QoS1 and QoS2 indicate that messages must be delivered, the broker stores messages in a database. If the broker has problems accessing this data, messages might be lost. For more details, and actions you can take to reduce these problems, see "Designing Telemetry applications" on page 13.

Assumptions for QoS levels 1 and 2:

In any network, it is possible for devices or communication links to fail. If this happens, one end of the link might not know what is happening at the other end; these are known as *in doubt* windows. In these scenarios assumptions have to be made about the reliability of the devices and networks involved in message delivery.

WebSphere MQ Telemetry Transport assumes that the client and broker are generally reliable, and that the communications channel is more likely to be unreliable. If the client device fails, it is typically a catastrophic failure, rather than a transient one. The possibility of recovering data from the device is low. Some devices have non-volatile storage, for example flash ROM. The provision of more persistent storage on the client device protects the most critical data from some modes of failure.

Beyond the basic failure of the communications link, the failure mode matrix becomes complex, resulting in more scenarios than the specification for WebSphere MQ Telemetry Transport can handle.

The time delay (retry interval) before resending a message that has not been acknowledged is specific to the application, and is not defined by the protocol specification.

WebSphere MQ Telemetry Transport message format

The message header for each WebSphere MQ Telemetry Transport command message contains a fixed header. Some messages also require a variable header and a payload. The format for each part of the message header is described in the following topics:

- Fixed header

- Payload
- Variable header

WebSphere MQ Telemetry Transport fixed header:

The message header for each WebSphere MQ Telemetry Transport command message contains a fixed header. The table below shows the fixed header format.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type				DUP flag	QoS level		RETAIN
byte 2	Remaining Length							

Byte 1

Contains the Message Type and Flags (Dup, QoS level, and RETAIN) fields.

Byte 2

(At least one byte) contains the Remaining Length field.

The fields are described in the following sections. All data values are in big-endian order: higher order bytes precede lower order bytes. A 16-bit word is presented on the wire as Most Significant Byte (MSB), followed by Least Significant Byte (LSB).

Message Type:

Position: byte 1, bits 7-4.

Represented as a 4-bit unsigned value. The enumerations for this version of the protocol are shown in the table below.

Mnemonic	Enumeration	Description
Reserved	0	Reserved
CONNECT	1	Client request to connect to Broker
CONNACK	2	Connect Acknowledgment
PUBLISH	3	Publish message
PUBACK	4	Publish Acknowledgment
PUBREC	5	Publish Received (assured delivery part 1)
PUBREL	6	Publish Release (assured delivery part 2)
PUBCOMP	7	Publish Complete (assured delivery part 3)
SUBSCRIBE	8	Client Subscribe request
SUBACK	9	Subscribe Acknowledgment
UNSUBSCRIBE	10	Client Unsubscribe request
UNSUBACK	11	Unsubscribe Acknowledgment
PINGREQ	12	PING Request
PINGRESP	13	PING Response
DISCONNECT	14	Client is Disconnecting
Reserved	15	Reserved

Flags:

The remaining bits of byte 1 contain the fields DUP, QoS, and RETAIN. The bit positions are encoded to represent the flags as shown in the table below.

Bit position	Name	Description
3	DUP	Duplicate delivery
2-1	QoS	Quality of Service
0	RETAIN	RETAIN flag

DUP

Position: byte 1, bit 3.

This flag is set when the client or broker attempts to re-deliver a PUBLISH message. This applies to messages where the value of QoS is greater than zero (0), and an acknowledgment is required. When the DUP bit is set, the variable header includes a Message ID.

QoS

Position: byte 1, bits 2-1.

This flag indicates the level of assurance for delivery of a PUBLISH message. The QoS levels are shown in the table below.

QoS value	bit 2	bit 1	Description		
0	0	0	At most once	Fire and Forget	<=1
1	0	1	At least once	Acknowledged delivery	>=1
2	1	0	Exactly once	Assured delivery	=1
3	1	1	Reserved		

RETAIN

Position: byte 1, bit 0.

When set, the Retain flag indicates that the broker holds the message, and sends it as an initial message to new subscribers to this topic. This means that a new client connecting to the broker can quickly establish the current number of topics. This is useful where publishers send messages on a "report by exception" basis, and it might be some time before a new subscriber receives data on a particular topic. The data has a value of retained or Last Known Good (LKG).

After sending a SUBSCRIBE message to one or more topics, a subscriber receives a SUBACK message, followed by one message for each newly subscribed topic that has a retained value. The retained value is published from the broker to the subscriber with the Retain flag set and with the same QoS with which it was originally published, and is therefore subject to the usual QoS delivery assurances. The Retain flag is set in the message to the subscribers, to distinguish it from "live" data so that it is handled appropriately by the subscriber.

Because a broker might no longer hold a previously Retained PUBLISH message, there is no guarantee that the subscriber will receive an initial Retained PUBLISH message on a topic.

Remaining Length:

Position: byte 2.

Represents the number of bytes remaining within the current message, including data in the variable header and the payload.

The variable length encoding scheme uses a single byte for messages up to 127 bytes long. Longer messages are handled as follows. Seven bits of each byte encode the Remaining Length data, and the eighth bit indicates any following bytes in the representation. Each byte encodes 128 values and a "continuation bit". For example, the number 64 decimal is encoded as a single byte, decimal value 64, hex 0x40. The number 321 decimal (=128x2 + 65) is encoded as two bytes, least significant first. The first byte is 2+128 = 130. Note that the top bit is set to indicate at least one following byte. The second byte is 65.

The protocol limits the number of bytes in the representation to a maximum of four. This allows applications to send messages of up to 268 435 455 (256 MB). The representation of this number on the wire is: 0xFF, 0xFF, 0xFF, 0x7F.

The table below shows the Remaining Length values represented by increasing numbers of bytes.

Digits	From	To
1	0 (0x00)	127 (0x7F)
2	128 (0x80, 0x01)	16 383 (0xFF, 0x7F)
3	16 384 (0x80, 0x80, 0x01)	2 097 151 (0xFF, 0xFF, 0x7F)
4	2 097 152 (0x80, 0x80, 0x80, 0x01)	268 435 455 (0xFF, 0xFF, 0xFF, 0x7F)

The algorithm for encoding a decimal number (X) into the variable length encoding scheme is as follows:

```
do
  digit = X MOD 128
  x = X DIV 128
  // if there are more digits to encode, set the top bit of this digit
  if ( X> 0 )
    digit = digit OR 0x80
  endif
  'output' digit
while ( X> 0 )
```

where `MOD` is the modulo operator (`%` in C), `DIV` is integer division (`/` in C), and `OR` is bit-wise or (`|` in C).

The algorithm for decoding the Remaining Length field is as follows:

```
multiplier = 1
     value = 0
     do
          digit = 'next digit from stream'
          value += (digit AND 127) * multiplier;
          multiplier *= 128;
     while ((digit AND 128) != 0);
```

where `AND` is the bit-wise and operator (`&` in C).

When this algorithm terminates, `value` contains the Remaining Length in bytes.

Remaining Length encoding is not part of the variable header. The number of bytes used to encode the Remaining Length does not contribute to the value of the Remaining Length. The variable length ″extension bytes″ are part of the fixed header, not the variable header.

WebSphere MQ Telemetry Transport payload:

The following types of WebSphere MQ Telemetry Transport command message have a payload in the message header:

CONNECT
The payload contains one or three UTF-8 encoded strings. The first string uniquely identifies the client to the broker. The second string is the Will topic, and the third string is the Will message. The second and third strings are present only if the Will flag is set in the CONNECT Flags byte.

SUBSCRIBE
The payload contains a list of topic names to which the client can subscribe, and the QoS level. These strings are UTF-encoded.

SUBACK
The payload contains a list of granted QoS levels. These are the QoS levels at which the administrators for the broker have permitted the client to subscribe to a particular Topic Name. Granted QoS levels are listed in the same order as the topic names in the corresponding SUBSCRIBE message.

The payload part of a PUBLISH message contains application-specific data only. No assumptions are made about the nature or content of the data, and this part of the message is treated as a BLOB.

If you want an application to apply compression to the payload data, you need to define in the application the appropriate payload flag fields to handle the compression details. You cannot define application-specific flags in the fixed or variable headers.

WebSphere MQ Telemetry Transport variable header:

The message header for some types of WebSphere MQ Telemetry Transport command message contains a variable header. It resides between the fixed header and the payload.

The format of the variable header fields are described in the following topics, in the order in which they must appear in the header:

The variable length Remaining Length field is not part of the variable header. The bytes of the Remaining Length field do not contribute to the byte count of the Remaining Length value. This value only takes account of the variable header and the payload. See Fixed header for more information.
- Protocol name
- Protocol version
- Connect flags
- Keep Alive timer
- Connect return code
- Topic name
- Message identifier

WebSphere MQ Telemetry Transport protocol name:

The protocol name is present in the variable header of a WebSphere MQ Telemetry Transport CONNECT message. This field is a UTF-encoded string that represents the protocol name MQIsdp, capitalized as shown.

WebSphere MQ Telemetry Transport protocol version:

The protocol version is present in the variable header of a CONNECT message.

The field is an 8-bit unsigned value that represents the revision level of the protocol used by the client. The value of the Protocol version field for the current version of the protocol, 3 (0x03), is shown in the table below.

bit	7	6	5	4	3	2	1	0
	Protocol Version							
	0	0	0	0	0	0	1	1

WebSphere MQ Telemetry Transport connect flags:

The Clean start, Will, Will QoS, and Retain flags are present in the variable header of a CONNECT message.

Clean start flag:

Position: bit 1 of the Connect flags byte.

Returns the client to a known, "clean" state with the broker. If the flag is set, the broker discards any outstanding messages, deletes all subscriptions for the client, and resets the Message ID to 1. The client proceeds without the risk of any data from previous connections interfering with the current connection. The format of the Clean start flag is shown in the table below.

bit	7	6	5	4	3	2	1	0
	Reserved	Reserved	Will Retain	Will QoS		Will Flag	Clean Start	Reserved
	x	x	x	x	x	x		x

Bits 7, 6, and 0 of this byte are not used in the current version of the protocol. They are reserved for future use.

Will flag:

Position: bit 2 of the Connect flags byte.

The Will message defines that a message is published on behalf of the client by the broker when either an I/O error is encountered by the broker during communication with the client, or the client fails to communicate within the Keep Alive timer schedule. Sending a Will message is not triggered by the broker receiving a DISCONNECT message from the client.

If the Will flag is set, the Will QoS and Will Retain fields must be present in the Connect flags byte, and the Will Topic and Will Message fields must be present in the payload.

The format of the Will flag is shown in the table below.

bit	7	6	5	4	3	2	1	0
	Reserved	Reserved	Will Retain	Will QoS		Will Flag	Clean Start	Reserved
	x	x	x	x	x		x	x

Bits 7, 6, and 0 of this byte are not used in the current version of the protocol. They are reserved for future use.

Will QoS:

Position: bits 4 and 3 of the Connect flags byte.

A connecting client specifies the QoS level in the Will QoS field for a Will message that is sent in the event that the client is disconnected involuntarily. The Will message is defined in the payload of a CONNECT message.

If the Will flag is set, the Will QoS field is mandatory, otherwise its value is disregarded.

The value of Will QoS is 0 (0x00), 1 (0x01), or 2 (0x02). The Will QoS flag is shown in the table below.

bit	7	6	5	4	3	2	1	0
	Reserved	Reserved	Will Retain	Will QoS		Will Flag	Clean Start	Reserved
	x	x	x			1	x	x

Bits 7, 6, and 0 of this byte are not used in the current version of the protocol. They are reserved for future use.

Will Retain flag:

Position: bit 5 of the Connect flags byte.

The Will Retain flag indicates whether or not broker should retain the Will message which is published by the broker on behalf of the client in the event that the client is disconnected unexpectedly.

The Will Retain flag is mandatory if the Will flag is set, otherwise, it is disregarded. The format of the Will Retain flag is shown in the table below.

bit	7	6	5	4	3	2	1	0
	Reserved	Reserved	Will Retain	Will QoS		Will Flag	Clean Start	Reserved
	x	x		x	x	1	x	x

Bits 7, 6, and 0 of this byte are not used in the current version of the protocol. They are reserved for future use.

WebSphere MQ Telemetry Transport Keep Alive timer:

The Keep Alive timer is present in the variable header of a WebSphere MQ Telemetry Transport CONNECT message.

The Keep Alive timer, measured in seconds, defines the maximum time interval between messages received from a client. It enables the broker to detect that the network connection to a client has dropped, without having to wait for the long TCP/IP timeout. The client has a responsibility to send a message within each Keep Alive time period. In the absence of a data-related message during the time period, the client sends a PINGREQ message, which the broker acknowledges with a PINGRESP message.

If the broker does not receive a message from the client within one and a half times the Keep Alive time period (the client is allowed ″grace″ of half a time period), it disconnects the client as if the client had sent a DISCONNECT message. This action does not impact any of the client's subscriptions. See "DISCONNECT Disconnect notification" on page 36 for more details.

The Keep Alive timer is a 16-bit value that represents the number of seconds for the time period. The actual value is application-specific, but a typical value is a few minutes. The maximum value is approximately 18 hours. A value of zero (0) means the client is not disconnected.

The format of the Keep Alive timer is shown in the table below. The ordering of the 2 bytes of the Keep Alive Timer is MSB, then LSB (big-endian).

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	Keep Alive MSB							
	Keep Alive LSB							

WebSphere MQ Telemetry Transport connect return code:

The connect return code is resent in the variable header of a WebSphere MQ Telemetry Transport CONNACK message.

This field defines a one byte unsigned return code. The meanings of the values, shown in the tables below, are specific to the message type. A return code of zero (0) usually indicates success.

Enumeration	**HEX**	**Meaning**
0	0x00	Connection Accepted
1	0x01	Connection Refused: unacceptable protocol version
2	0x02	Connection Refused: identifier rejected
3	0x03	Connection Refused: broker unavailable
4-255		Reserved for future use

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	Return Code							

WebSphere MQ Telemetry Transport topic name:

The topic name is present in the variable header of a WebSphere MQ Telemetry Transport PUBLISH message.

The topic name is the key that identifies the information channel to which payload data is published. Subscribers use the key to identify the information channels on which they want to receive published information.

The topic name is a UTF-encoded string. See “WebSphere MQ Telemetry Transport and UTF-8” on page 50 for more information. Topic name has an upper length limit of 32,767 characters.

WebSphere MQ Telemetry Transport message identifier:

The message identifier is present in the variable header of the following WebSphere MQ Telemetry Transport messages: PUBLISH, PUBACK, PUBREC, PUBREL, PUBCOMP, SUBSCRIBE, SUBACK, UNSUBSCRIBE, UNSUBACK.

The Message Identifier (Message ID) field is only present in messages where the QoS bits in the fixed header indicate QoS levels 1 or 2. See Quality of Service levels and flows for more information.

The Message ID is a 16-bit unsigned integer. It typically increases by exactly one from one message to the next, but is not required to do so. This assumes that there are never more than 65,535 messages ″in flight″ between one particular client-broker pair at any time.

The ordering of the two bytes of the Message Identifier is MSB, then LSB (big-endian).

Do not use Message ID 0. It is reserved as an invalid Message ID.

bit	7	6	5	4	3	2	1	0
	Message Identifier MSB							
	Message Identifier LSB							

WebSphere MQ Telemetry Transport command messages

Follow the links below for details of the supported WebSphere MQ Telemetry Transport command messages.

- “CONNACK Acknowledge connection request”
- “CONNECT Client requests a connection to a broker” on page 34
- “DISCONNECT Disconnect notification” on page 36
- “PINGREQ PING request” on page 37
- “PINGRESP PING response” on page 37
- “PUBACK Publish acknowledgment” on page 38
- “PUBCOMP Assured publish complete (part 3)” on page 39
- “PUBLISH Publish message” on page 40
- “PUBREC Assured publish received (part 1)” on page 42
- “PUBREL Assured Publish Release (part 2)” on page 43
- “SUBACK Subscription acknowledgment” on page 44
- “SUBSCRIBE Subscribe to named topics” on page 45
- “UNSUBACK Unsubscribe acknowledgment” on page 47
- “UNSUBSCRIBE Unsubscribe from named topics” on page 48

CONNACK Acknowledge connection request:

The CONNACK message is the message sent by the broker in response to a CONNECT request from a client.

Fixed header:

The fixed header format is shown in the table below.

bit	7	6	5	4	3	2	1	0
byte 1	Message type (2)				DUP flag	QoS flags		RETAIN
	0	0	1	0	x	x	x	x
byte 2	Remaining Length (2)							
	0	0	0	0	0	0	1	0

The DUP, QoS and RETAIN flags are not used in the CONNACK message.

Variable header:

The variable header format is shown in the table below.

	Description	7	6	5	4	3	2	1	0
Topic Name Compression Response									
byte 1	Reserved values. Not used.	x	x	x	x	x	x	x	x
Connect Return Code									
byte 2	Return Code								

The values for the one byte unsigned Connect return code field are shown in the table below.

Enumeration	HEX	Meaning
0	0x00	Connection Accepted
1	0x01	Connection Refused: unacceptable protocol version
2	0x02	Connection Refused: identifier rejected
3	0x03	Connection Refused: broker unavailable
4-255		Reserved for future use

Return code 2 (identifier rejected) is sent if the unique client identifier is not between 1 and 23 characters in length.

Payload:

There is no payload.

CONNECT Client requests a connection to a broker:

When a TCP/IP socket connection is established between the client and the broker, a protocol level session is required. It is assumed that the direction of connection is client to broker, and that the client supports broker listener functionality.

Fixed header:

The fixed header format is shown in the table below.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (1)				DUP flag	QoS level		RETAIN
	0	0	0	1	x	x	x	x
byte 2	Remaining Length							

The DUP, QoS, and RETAIN flags are not used in the CONNECT message.

Remaining Length is the length of the variable header (12 bytes) and the length of the Payload. This can be a multibyte field.

Variable header:

An example of the format of the variable header is shown in the table below.

	Description	7	6	5	4	3	2	1	0
Protocol Name									
byte 1	Length MSB (0)	0	0	0	0	0	0	0	0
byte 2	Length LSB (6)	0	0	0	0	0	1	1	0
byte 3	'M'	0	1	0	0	1	1	0	1
byte 4	'Q'	0	1	0	1	0	0	0	1
byte 5	'I'	0	1	0	0	1	0	0	1
byte 6	's'	0	1	1	1	0	0	1	1
byte 7	'd'	0	1	1	0	0	1	0	0
byte 8	'p'	0	1	1	1	0	0	0	0
Protocol Version Number									
byte 9	Version (3)	0	0	0	0	0	0	1	1
Connect Flags									
byte 10	Will RETAIN (0) Will QoS (01) Will flag (1) Clean Start (1)	x	x	0	0	1	1	1	x
Keep Alive timer									
byte 11	Keep Alive MSB (0)	0	0	0	0	0	0	0	0
byte 12	Keep Alive LSB (10)	0	0	0	0	1	0	1	0

Clean Start flag
Set (1).

Keep Alive timer
Set to 10 seconds (0x000A).

Will message
- Will flag is set (1)
- Will QoS field is 1
- Will RETAIN flag is clear (0)

Payload:

The payload of the CONNECT message contains one or three UTF-encoded strings. If the Will flag is set in the Connect flags byte in the variable header, the payload must contain all three UTF-encoded strings:

Client Identifier

The first UTF-encoded string. The Client Identifier (Client ID) is between 1 and 23 characters long, and uniquely identifies the client to the broker. It must be unique across all clients connecting to a single broker, and is the key in handling Message IDs messages with QoS levels 1 and 2. If the Client ID contains more than 23 characters, the broker responds to the CONNECT message with a CONNACK return code 2: Identifier Rejected.

Will Topic

The second UTF-encoded string. The Will Message is published to the Will Topic. The QoS level is defined by the Will QoS field, and the RETAIN status is defined by the Will RETAIN flag in the variable header.

Will Message

The third UTF-encoded string. The Will Message defines the content of the message that is published to the Will Topic if the client is unexpectedly disconnected.

Although the Will Message is UTF-encoded in the CONNECT message, when it is published to the Will Topic only the bytes of the message are sent, not the first two length bytes. The message sent when the broker executes the Will Message is raw ASCII, not UTF-encoded.

Response:

The broker sends a CONNACK message in response to a CONNECT message from a client.

If the client does not receive a CONNACK message from the broker within a ″reasonable″ amount of time, the client closes the TCP/IP socket connection, and restarts the session by opening a socket to the broker and issuing a CONNECT message. A ″reasonable″ amount of time depends on the type of application and the communications infrastructure.

DISCONNECT Disconnect notification:

The DISCONNECT message is sent from the client to the broker to indicate that it is about to close its TCP/IP connection. This allows for a clean disconnection, rather than just dropping the line.

Sending the DISCONNECT message does not affect existing subscriptions. They are persistent until they either explicitly unsubscribed, or if there is a clean start. The broker retains QoS 1 and QoS 1 messages for topics to which the client is unsubscribed until the client reconnects. QoS 0 messages are not retained, since they are delivered on a best efforts basis.

Fixed header:

The fixed header format is shown in the table below.

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
byte 1	Message Type (14)				DUP flag	QoS level		RETAIN

bit	7	6	5	4	3	2	1	0
	1	1	1	0	x	x	x	x
byte 2	Remaining Length (0)							
	0	0	0	0	0	0	0	0

The DUP, QoS, and RETAIN flags are not used in the DISCONNECT message.

Payload:

There is no payload.

Variable header:

There is no variable header.

PINGREQ PING request:

The PINGREQ message is an ″are you alive″ message that is sent from or received by a connected client.

Fixed header:

The table below shows the fixed header format.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (12)				DUP flag	QoS level		RETAIN
	1	1	0	0	x	x	x	x
byte 2	Remaining Length (0)							
	0	0	0	0	0	0	0	0

The DUP, QoS, and RETAIN flags are not used.

Variable Header:

There is no variable header.

Payload:

There is no payload.

Response:

The response to a PINGREQ message is a PINGRESP message.

PINGRESP PING response:

A PINGRESP message is the response to a PINGREQ message and means ″yes I am alive″. Keep Alive messages flow in either direction, sent either by a connected client or the broker.

Fixed header:

The table below shows the fixed header format:

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (13)				DUP flag	QoS level		RETAIN
	1	1	0	1	x	x	x	x
byte 2	Remaining Length (0)							
	0	0	0	0	0	0	0	0

The DUP, QoS, and RETAIN flags are not used.

Payload:

There is no payload.

Variable header:

There is no variable header.

PUBACK Publish acknowledgment:

A PUBACK message is the response to a PUBLISH message with QoS level 1. A PUBACK message is sent by a broker in response to a PUBLISH message from a publishing client, and by a subscriber in response to a PUBLISH message from the broker.

Fixed header:

The table below shows the format of the fixed header.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (4)				DUP flag	QoS level		RETAIN
	0	1	0	0	x	x	x	x
byte 2	Remaining Length (2)							
	0	0	0	0	0	0	1	0

QoS level
Not used.

DUP flag
Not used.

RETAIN flag
Not used.

Remaining Length field
This is the length of the variable header (2 bytes). It can be a multibyte field.

Variable header:

Contains the Message Identifier (Message ID) for the PUBLISH message that is being acknowledged. The table below shows the format of the variable header.

bit	7	6	5	4	3	2	1	0
byte 1	Message ID MSB							

bit	7	6	5	4	3	2	1	0
byte 2	Message ID LSB							

Payload:

There is no payload.

Actions:

When the client receives the PUBACK message, it discards the original message, because it is also received (and logged) by the broker.

PUBCOMP Assured publish complete (part 3):

This message is either the response from the broker to a PUBREL message from a publisher, or the response from a subscriber to a PUBREL message from the broker. It is the fourth and last message in the QoS 2 protocol flow.

Fixed header:

The table below shows the fixed header format.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (7)				DUP flag	QoS level		RETAIN
	0	1	1	1	x	x	x	x
byte 2	Remaining Length (2)							
	0	0	0	0	0	0	1	0

QoS level
Not used.

DUP flag
Not used.

RETAIN flag
Not used.

Remaining Length field
The length of the variable header (2 bytes). It can be a multibyte field.

Variable header:

The variable header contains the same Message ID as the acknowledged PUBREL message.

bit	7	6	5	4	3	2	1	0
byte 1	Message ID MSB							
byte 2	Message ID LSB							

Payload:

There is no payload.

Actions:

When the client receives a PUBCOMP message, it discards the original message because it has been delivered, exactly once, to the broker.

PUBLISH Publish message:

A PUBLISH message is sent by a client to a broker for distribution to interested subscribers. Each PUBLISH message is associated with a topic name (also known as the Subject or Channel). This is a hierarchical name space that defines a taxonomy of information sources for which subscribers can register an interest. A message that is published to a specific topic name is delivered to connected subscribers for that topic.

To maintain symmetry, if a client subscribes to one or more topics, any message published to those topics are sent by the broker to the client as a PUBLISH message.

Fixed header:

The table below shows the fixed header format.

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
byte 1	Message type (3)				DUP flag	QoS level		RETAIN
	0	0	1	1	0	0	1	0
byte 2	Remaining Length							

QoS level
Set to 1.

DUP flag
Set to zero (0). This means that the message is being sent for the first time.

For messages with QoS level 1 or level 2 that are being re-sent because a failure has been detected, the DUP bit is set to 1. This indicates to the broker that the message might duplicate a message that has already been received. The significance of this information to the broker depends upon the QoS level. The DUP bit is not used for messages with QoS level 0.

RETAIN flag
Set to zero. This means do not retain.

Remaining Length field
The length of the variable header plus the length of the payload. It can be a multibyte field.

Variable header:

The variable header contains the following fields:

Topic name
A UTF-encoded string.

Message ID
Present for messages with QoS level 1 and QoS level 2.

Typically, the protocol library is responsible for generating the Message ID and passing it back to the publishing application, possibly as a return handle. This approach avoids the risk of multiple applications, or publishing threads, running on a single client generating duplicate Message IDs.

A Message ID must not be used in the variable header for messages with QoS level 0.

The Message ID is a 16-bit unsigned integer, which typically increases by exactly one from one message to the next, but is not required to do so. The ordering of the 2 bytes of the Message Identifier is MSB, then LSB (big-endian).

Message ID 0 (that is, 0x0000) is reserved as an invalid Message ID, and must not be used.

The table below shows an example variable header for a PUBLISH message.

Field	**Value**
Topic Name:	″a/b″
QoS level	1
Message ID:	10

The format of the variable header in this case is shown in the table below.

	Description	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Topic Name									
byte 1	Length MSB (0)	0	0	0	0	0	0	0	0
byte 2	Length LSB (3)	0	0	0	0	0	0	1	1
byte 3	′a′ (0x61)	0	1	1	0	0	0	0	1
byte 4	′/′ (0x2F)	0	0	1	0	1	1	1	1
byte 5	′b′ (0x62)	0	1	1	0	0	0	1	0
Message Identifier									
byte 6	Message ID MSB (0)	0	0	0	0	0	0	0	0
byte 7	Message ID LSB (10)	0	0	0	0	1	0	1	0

Payload:

Contains the data for publishing. The content and format of the data is application specific. The Remaining Length field in the fixed header includes both the variable header length and the payload length.

Response:

The response to a PUBLISH message depends on the QoS level. The table below shows the expected responses.

QoS Level	**Expected response**
QoS 0	None
QoS 1	PUBACK
QoS 2	PUBREC

Actions:

PUBLISH messages can be sent either from a publisher to the broker, or from the broker to a subscriber. The action of the recipient when it receives a message depends on the QoS level of the message:

QoS 0 Make the message available to any interested parties.

QoS 1 Log the message to persistent storage, make it available to any interested parties, and return a PUBACK message to the sender.

QoS 2 Log the message to persistent storage, do not make it available to interested parties yet, and return a PUBREC message to the sender.

If the broker receives the message, interested parties means subscribers to the topic of the PUBLISH message. If a subscriber receives the message, interested parties means the application on the client which has subscribed to one or more topics, and is waiting for a message from the broker.

PUBREC Assured publish received (part 1):

A PUBREC message is the response to a PUBLISH message with QoS level 2. It is the second message of the QoS level 2 protocol flow. A PUBREC message is sent by the broker in response to a PUBLISH message from a publishing client, or by a subscriber in response to a PUBLISH message from the broker.

Fixed header:

The table below shows the fixed header format.

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
byte 1	Message Type (5)				DUP flag	QoS level		RETAIN
	0	1	0	1	x	x	x	x
byte 2	Remaining Length (2)							
	0	0	0	0	0	0	1	0

QoS level
Not used.

DUP flag
Not used.

RETAIN flag
Not used.

Remaining Length field
The length of the variable header (2 bytes). It can be a multibyte field.

Variable header:

The variable header contains the Message ID for the acknowledged PUBLISH. The table below shows the format of the variable header.

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
byte 1	Message ID MSB							
byte 2	Message ID LSB							

Payload:

There is no payload.

Actions:

When it receives a PUBREC message, the recipient sends a PUBREL message to the sender with the same Message ID as the PUBREC message.

PUBREL Assured Publish Release (part 2):

A PUBREL message is the response either from a publisher to a PUBREC message from the broker, or from the broker to a PUBREC message from a subscriber. It is the third message in the QoS 2 protocol flow.

Fixed header:

The table below shows the fixed header format.

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
byte 1	Message Type (6)				DUP flag	QoS level		RETAIN
	0	1	1	0	x	x	x	x
byte 2	Remaining Length (2)							
	0	0	0	0	0	0	1	0

QoS level
Not used.

DUP flag
Not used.

RETAIN flag
Not used.

Remaining Length field
The length of the variable header (2 bytes). It can be a multibyte field.

Variable header:

The variable header contains the same Message ID as the PUBREC message that is being acknowledged. The table below shows the format of the variable header.

bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
byte 1	Message ID MSB							
byte 2	Message ID LSB							

Payload:

There is no payload.

Actions:

When the broker receives a PUBREL message from a publisher, the broker makes the original message available to interested subscribers, and sends a PUBCOMP message with the same Message ID to the publisher. When a subscriber receives a PUBREL message from the broker, the subscriber makes the message available to the subscribing application and sends a PUBCOMP message to the broker.

SUBACK Subscription acknowledgment:

A SUBACK message is sent by the broker to the client to confirm receipt of a SUBSCRIBE message.

A SUBACK message contains a list of granted QoS levels. These are the levels at which the administrators for the broker permit the client to subscribe to a specific topic name. In the current version of the protocol, the broker always grants the QoS level requested by the subscriber. The order of granted QoS levels in the SUBACK message matches the order of the topic Nnames in the corresponding SUBSCRIBE message.

Fixed header:

The table below shows the format of the fixed header.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (9)				DUP flag	QoS level		RETAIN
	1	0	0	1	x	x	x	x
byte 2	Remaining Length							

QoS level
Not used.

DUP flag
Not used.

RETAIN flag
Not used.

Remaining Length field
The length of the variable header. It can be a multibyte field.

Variable header:

The variable header contains the Message ID for the SUBSCRIBE message that is being acknowledged. The table below shows the format of the variable header.

bit	7	6	5	4	3	2	1	0
byte 1	Message ID MSB							
byte 2	Message ID LSB							

Payload:

The payload contains a vector of granted QoS levels. Each level corresponds to a topic name in the corresponding SUBSCRIBE message. The order of QoS levels in the SUBACK message matches the order of topic name and Requested QoS pairs in the SUBSCRIBE message. The Message ID in the variable header enables you to match SUBACK messages with the corresponding SUBSCRIBE messages.

The table below shows the Granted QoS field encoded in a byte.

bit	7	6	5	4	3	2	1	0
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	QoS level	

bit	7	6	5	4	3	2	1	0
	x	x	x	x	x	x		

The upper 6 bits of this byte are not used in the current version of the protocol. They are reserved for future use.

The table below shows an example payload.

Granted QoS	0
Granted QoS	2

The table below shows the format of this payload.

	Description	7	6	5	4	3	2	1	0
Requested QoS									
byte 1	Granted QoS (0)	x	x	x	x	x	x	0	0
Granted QoS									
byte 2	Granted QoS (2)	x	x	x	x	x	x	1	0

SUBSCRIBE Subscribe to named topics:

The SUBSCRIBE message allows a client to register an interest in one or more topic names with the broker. Messages published to these topics are delivered from the broker to the client as PUBLISH messages. The SUBSCRIBE message also specifies the QoS level at which the subscriber wants to receive published messages.

Fixed header:

The table below shows the fixed header format.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (8)				DUP flag	QoS level		RETAIN
	1	0	0	0	0	0	1	x
byte 2	Remaining Length							

QoS level
SUBSCRIBE messages use QoS level 1 to acknowledge multiple subscription requests. The corresponding SUBACK message is identified by matching the Message ID. This also handles SUBSCRIBE messages retries in the same way as PUBLISH messages.

DUP flag
In this example the DUP flag is set to zero (0) to indicate that the message is being sent for the first time. If this message is being re-sent because a SUBACK message has not arrived after a specified timeout period, the DUP bit is set to indicate to the broker that it might be a duplicate of a message already received.

RETAIN flag
Not used.

Remaining Length field
The length of the payload. It can be a multibyte field.

Variable header:

The variable header contains a Message ID because a SUBSCRIBE message has a QoS level of 1.

Typically, the protocol library generates the Message ID, and passes it back to the publishing application, for example as a return handle. This prevents multiple applications, or multiple publishing threads, running on a single client from generating duplicate Message IDs.

Message ID 0 (0x0000) is reserved as an invalid Message ID, and must not be used. The Message ID is a 16-bit unsigned integer, which typically increases by exactly one from one message to the next, but is not required to do so. The two bytes of the Message ID are ordered as MSB, followed by LSB (big-endian).

The table below shows an example format for the variable header with a Message ID of 10.

	Description	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Message Identifier									
byte 1	Message ID MSB (0)	0	0	0	0	0	0	0	0
byte 2	Message ID LSB (10)	0	0	0	0	1	0	1	0

Payload:

The payload of a SUBSCRIBE message contains a list of topic names to which the client wants to subscribe, and the QoS level at which the client wants to receive the messages. The strings are UTF-encoded, and the QoS level occupies 2 bits of a single byte. These topic/QoS pairs are packed contiguously as shown in the example payload in the table below.

Topic name	"a/b"
Requested QoS	1
Topic name	"c/d"
Requested QoS	2

Topic names in a SUBSCRIBE message are not compressed.

The format of the example payload is shown in the table below.

	Description	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Topic name									
byte 1	Length MSB (0)	0	0	0	0	0	0	0	0
byte 2	Length LSB (3)	0	0	0	0	0	0	1	1
byte 3	'a' (0x61)	0	1	1	0	0	0	0	1
byte 4	'/' (0x2F)	0	0	1	0	1	1	1	1
byte 5	'b' (0x62)	0	1	1	0	0	0	1	0

	Description	7	6	5	4	3	2	1	0
Requested QoS									
byte 6	Requested QoS (1)	x	x	x	x	x	x	0	1
Topic Name									
byte 7	Length MSB (0)	0	0	0	0	0	0	0	0
byte 8	Length LSB (3)	0	0	0	0	0	0	1	1
byte 9	'c' (0x63)	0	1	1	0	0	0	1	1
byte 10	'/' (0x2F)	0	0	1	0	1	1	1	1
byte 11	'd' (0x64)	0	1	1	0	0	1	0	0
Requested QoS									
byte 12	Requested QoS (2)	x	x	x	x	x	x	1	0

Assuming that the requested QoS level is granted, the client receives PUBLISH messages at less than or equal to this level, depending on the QoS level of the original message from the publisher. For example, if a client has a QoS level 1 subscription to a particular topic, then a QoS level 0 PUBLISH message to that topic is delivered to the client at QoS level 0. A QoS level 2 PUBLISH message to the same topic is downgraded to QoS level 1 for delivery to the client.

A corollary to this is that subscribing to a topic at QoS level 2 is equivalent to saying "I would like to receive messages on this topic at the QoS at which they are published".

The Requested QoS field is encoded in the byte following each UTF-encoded topic name as shown in the table below.

bit	7	6	5	4	3	2	1	0
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	QoS level	
	x	x	x	x	x	x		

The upper 6 bits of this byte are not used in the current version of the protocol. They are reserved for future use.

Response:

When it receives a SUBSCRIBE message from a client, the broker responds with a SUBACK message.

UNSUBACK Unsubscribe acknowledgment:

The UNSUBACK message is sent by the broker to the client to confirm receipt of an UNSUBSCRIBE message.

Fixed header:

The table below shows the fixed header format.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (11)				DUP flag	QoS level		RETAIN
	1	0	1	1	x	x	x	x

bit	7	6	5	4	3	2	1	0
byte 2	Remaining length (2)							
	0	0	0	0	0	0	1	0

QoS level
Not used.

DUP flag
Not used.

RETAIN flag
Not used.

Remaining Length
The length of the Variable Header (2 bytes).

Variable header:

The variable header contains the Message ID for the UNSUBSCRIBE message that is being acknowledged. The table below shows the format of the variable header.

bit	7	6	5	4	3	2	1	0
byte 1	Message ID MSB							
byte 2	Message ID LSB							

Payload:

There is no payload.

UNSUBSCRIBE Unsubscribe from named topics:

An UNSUBSCRIBE message is sent by the client to the broker to unsubscribe from named topics.

Fixed header:

The table below shows an example fixed header format.

bit	7	6	5	4	3	2	1	0
byte 1	Message Type (10)				DUP flag	QoS level		RETAIN
	1	0	1	0	0	0	1	x
byte 2	Remaining Length							

QoS level
The level of QoS is 1 to acknowledge multiple unsubscribe requests. The corresponding UNSUBACK message is identified by the Message ID. Retries are handled in the same way as PUBLISH messages.

DUP flag
In this example the DUP flag is set to zero (0) to indicate that the message is being sent for the first time.

If this message is being re-sent because a SUBACK message has not arrived after a specified timeout period, the DUP bit is set to indicate to the broker that it might be a duplicate of a message already received.

RETAIN flag
Not used.

Remaining Length
This is the length of the Payload. It can be a multibyte field.

Variable header:

The variable header contains a Message ID because an UNSUBSCRIBE message has a QoS level of 1.

Typically, the protocol library generates the Message ID, and passes it back to the publishing application, for example as a return handle. This prevents multiple applications, or multiple publishing threads, running on a single client from generating duplicate Message IDs.

Message ID 0 (0x0000) is reserved as an invalid Message ID, and must not be used. The Message ID is a 16-bit unsigned integer, which typically increases by exactly one from one message to the next, but is not required to do so. The two bytes of the Message ID are ordered as MSB, followed by LSB (big-endian).

The table below shows an example format for the variable header with a Message ID of 10.

	Description	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Message Identifier									
byte 1	Message ID MSB (0)	0	0	0	0	0	0	0	0
byte 2	Message ID LSB (10)	0	0	0	0	1	0	1	0

Payload:

The client unsubscribes from the list of topics named in the payload. The strings are UTF-encoded and are packed contiguously. Topic names in a UNSUBSCRIBE message are not compressed. The table below shows an example payload.

Topic Name	″a/b″
Topic Name	″c/d″

The table below shows the format of this payload.

	Description	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Topic Name									
byte 1	Length MSB (0)	0	0	0	0	0	0	0	0
byte 2	Length LSB (3)	0	0	0	0	0	0	1	1
byte 3	’a’ (0x61)	0	1	1	0	0	0	0	1
byte 4	’/’ (0x2F)	0	0	1	0	1	1	1	1
byte 5	’b’ (0x62)	0	1	1	0	0	0	1	0
Topic Name									
byte 6	Length MSB (0)	0	0	0	0	0	0	0	0
byte 7	Length LSB (3)	0	0	0	0	0	0	1	1

	Description	7	6	5	4	3	2	1	0
byte 8	'c' (0x63)	0	1	1	0	0	0	1	1
byte 9	'/' (0x2F)	0	0	1	0	1	1	1	1
byte 10	'd' (0x64)	0	1	1	0	0	1	0	0

Response:

The broker sends an UNSUBACK to a client in response to an UNSUBSCRIBE message.

WebSphere MQ Telemetry Transport and UTF-8

UTF-8 is an efficient encoding of Unicode character-strings that optimizes the encoding of ASCII characters in support of text-based communications.

The WebSphere MQ Telemetry Transport protocol uses a subset of UTF-8. Only single byte (non-extended) characters are supported.

The UTF string format is shown in the table below.

bit	7	6	5	4	3	2	1	0
byte 1	Message Length MSB							
byte 2	Message Length LSB							
bytes 3 ...	Encoded Character Data							

Message Length is the number of bytes of encoded string characters, not the number of characters. For ASCII strings, however, these are the same. The format of encoded characters for ASCII codes 0x01 to 0x7F are shown in the table below.

bit	7	6	5	4	3	2	1	0
	0	ASCII code of character						

For example, the ASCII text string OTWP is encoded in UTF-8 as shown in the table below.

bit	7	6	5	4	3	2	1	0
byte 1	Message Length MSB (0x00)							
	0	0	0	0	0	0	0	0
byte 2	Message Length LSB (0x04)							
	0	0	0	0	0	1	0	0
byte 3	'O' (0x4F)							
	0	1	0	0	1	1	1	1
byte 4	'T' (0x54)							
	0	1	0	1	0	1	0	0
byte 5	'W' (0x57)							
	0	1	0	1	0	1	1	1
byte 6	'P' (0x50)							

bit	7	6	5	4	3	2	1	0
	0	1	0	1	0	0	0	0

The Java writeUTF() and readUTF() data stream methods use this format.

WebSphere MQ Web Services Transport

WebSphere MQ Web Services Transport is a service that connects HTTP compliant application clients to brokers.

WebSphere Broker Adapters Transport

WebSphere Broker Adapters Transport is a service that connects applications to Enterprise Information Systems (such as SAP Software, PeopleSoft Enterprise, and Siebel Business Application systems).

WebSphere Broker File Transport

WebSphere Broker File Transport is a service that connects applications to data maintained in files.

WebSphere Broker HTTP Transport

The HTTP transport connects applications by using the HTTP protocol. Message flows use the HTTPInput, HTTPReply, and HTTPRequest nodes to access the HTTP transport.

Message flows can use the HTTP transport to work with:
- SOAP-based Web services
- Other Web services standards, such as REST or XML-RPC
- General HTTP messaging, where the payload might, or might not, be XML

However, in the case of SOAP-based Web services, several advantages exist if you use the SOAP domain instead of the regular transport nodes: HTTPInput, HTTPReply, and HTTPRequest. The SOAP domain and nodes give you the following advantages:
- Support for WS-Addressing, WS-Security and SOAP headers
- A common SOAP logical tree format, independent of the bitstream format
- Runtime checking against WSDL

For more information about WebSphere Broker HTTP transport, see the following topics:
- "HTTP message format"
- "HTTP headers" on page 52
- "Web services example messages" on page 53

For help with using HTTPS, see Implementing SSL authentication.

For more information about the SOAP domain for Web services, see WebSphere Message Broker and Web services.

HTTP message format

An HTTP message contains components that are appropriate to its type.

The bit stream containing headers and body is parsed and represented within the message tree when an input request is received by an HTTPInput node, or when a response from a Web service is received by the HTTPRequest node. A bit stream is

created by parsers from the appropriate parts of the message tree when a reply is sent to the client by the HTTPReply node, or when a message is sent by the HTTPRequest node. For further details about these actions, see the individual node descriptions.

HTTP headers

When an HTTPInput or HTTPRequest node receives a message, it parses the HTTP headers to create elements in the message tree. When an HTTPReply or HTTPRequest node sends a message, it parses the HTTP headers from the message tree into a bit stream.

The HTTP headers in a message depend on the type of message that is processed. There are four message types recognized in a message flow, and a parser is associated with each of these.

1. Input. An input message is received by the HTTPInput node from a client. The HTTP headers in the input message (data up to and including the CRLFCRLF) are parsed by the HTTPInput parser and are included in the message tree under the correlation name HTTPInput. The headers shown in the following table are expected in an input message; others might also be present.

Header	Content	Example
Host	The host name to which the client issued the message.	localhost
Content-Length	The length of the body of the input message in decimal (that follows the CRLFCRLF after the last header).	520
Content-Type	The type of the body data.	text/xml; charset=utf-8
SOAPAction		"" (empty string)

   The headers in the following table might also be automatically generated by the HTTPInput node depending on the request.

Header	Content	Example
X-Original-HTTP-Command	An expanded version of the original inbound request	POST http://localhost:7800/Wss001/services/Wss001 HTTP/1.1
X-Remote-Addr	The IP address of the client (or proxy if the client is connecting through a proxy)	127.0.0.1
X-Remote-Host	The host name or address of the client (or proxy if the client is connecting through a proxy)	localhost
X-Server-Name	The broker's machine name	localhost
X-Server-Port	The broker's port	7800
X-Query-String	The query string if present in the inbound URL (optional)	a=b&x=y
X-Scheme	The scheme through which the client is connected, either http or https	http

2. Reply. A reply message is sent by the HTTPReply node to the client that sent the corresponding input message. The headers in the reply message are created in the message tree under the correlation name HTTPReply, which is also the

name of the parser used to parse that part of the message tree to a bit stream. You can choose to create your own HTTPReply header in a Compute node, or you can configure the HTTPReply node to create it by using default values, or values taken from the HTTPReply or HTTPResponse trees in the input message, or both. (You can set the HTTPReply Status Code in the local environment; for more information, see the instructions for setting the HTTP Status Code for a reply in Working with HTTP flows.) If the HTTPReply node creates a default HTTPReply header, it contains the headers and values shown in the following table.

Header	Value
Content-Length (if present in the input message)	The calculated length of the reply message body in decimal.
Content-Type	text/xml; charset=*ccsid of the message body*

3. Request. A request message is sent by the HTTPRequest node. The HTTP headers in this message must be created in the message tree under the correlation name HTTPRequest, and are parsed by the HTTPRequest parser when the message tree is parsed to a bit stream. You can choose to create your own HTTPRequest header in a Compute node, or you can configure the HTTPRequest node to create it using default values, or values taken from the HTTPInput or HTTPRequest trees in the input message, or both. If the HTTPRequest node creates a default HTTPRequest header, it contains the headers and values shown in the following table.

Header	Value
Host	Value set in the *Default Web Service URL* property.
Content-Length	The calculated length of the request message body in decimal.
Content-Type	text/xml; charset=*ccsid of the message body*
SOAPAction	"" (empty string)

4. Response. A response message is received by the HTTPRequest node from the application to which the corresponding request message was sent. The HTTP headers in the response message (data up to and including the CRLFCRLF) are parsed by the HTTPResponse parser and are included in the message tree under the correlation name HTTPResponse. The header shown in the following table is expected in a response message (though not required); others might also be present.

Header	Content	Example
Content-Length	The length of the response message body in decimal.	1585

"Web services example messages" provides example messages that include these headers.

Web services example messages

Examples of complete HTTP messages show typical content is specific scenarios.

The following examples show complete HTTP messages. The first message is a request sent by an HTTPRequest node to a Web service that provides a lookup

service:

```
POST /greenpages/servlet/rpcrouter HTTP/1.0
Host: localhost
Content-Type: text/xml; charset=utf-8
Content-Length: 520
SOAP Action: ""
Cookie: JSESSIONID=0000B5OSLFIUDMQZFAUXKHD5ZDQ:-1

<?xml version='1.0' encoding='UTF-8'?>
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schema.xmlsoap.org.soap/envelope/"
                   xmlns:xsi="http://www.w3/2001/XMLSchema-instance"
                   xmlns:xsd="http://www.w3/2001/XMLSchema">
<SOAP-ENV:Body>
<ns1:getUserByName xmlns:ns1="http://tempuri.org/imb.GreenPages"
                   SOAP-ENV:encodingStyle="http:/schemas.xmlsoap.org/soap/encoding/">
<nameField xsl:type="xsd:string">bloggs, joe</nameField>
</ns1:getUserByName>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

The `Cookie` is an example of a value that can be retrieved from the HTTPRequest tree.

The second message is the corresponding Web service response returned to the HTTPRequest node:

```
HTTP/1.0 200 OK
Server: WebSphere Application Server/4.0
Content-Type: text/xml; charset=utf-8
Content-Length: 1585
Content-Language: en
Connection: close

<?xml version='1.0' encoding='UTF-8'?>
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schema.xmlsoap.org.soap/envelope/"
                   xmlns:xsi="http://www.w3/2001/XMLSchema-instance"
                   xmlns:xsd="http://www.w3/2001/XMLSchema">
<SOAP-ENV:Body>
<ns1:getUserByNameResponse xmlns:ns1="http://tempuri.org/imb.GreenPages"
                   SOAP-ENV:encodingStyle="http:/schemas.xmlsoap.org/soap/encoding/">
<return xmlns:ns2="http://www.greenpages.com/schemas/GreenPagesRemoteInterface"
        xsi:type="ns2:imb.UserRecord">
<fullName xsi:type="xsd:string">Joseph Bloggs</fullName>
<empNum xsi:type="xsd:int">65874</empNum>
<deskPhone xsi:type="xsd:string">(718)545-3623</deskPhone>
</return>
</ns1:getUserByNameResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

For more information about HTTP return codes, see HTTP Response codes.

WebSphere Broker JMS Transport

Use the WebSphere Broker JMS Transport to send and receive JMS messages. The WebSphere Broker JMS Transport uses JMS as the connection protocol for sending and receiving messages in a Java environment.

The WebSphere Broker JMS Transport can be used to support the following operations:

- Receive a JMS message as input.
- Create a JMS message for output.

- Work with message flows that do not expect JMS messages.

The exchange of JMS messages is implemented by two built-in nodes, the JMSInput node and the JMSOutput node. These two nodes allow a message flow to receive messages from JMS destinations, or to send messages to JMS destinations. These destinations are accessible through a connection to a JMS provider.

Two transformation nodes allow the JMSInput and JMSOutput nodes to work with nodes that expect a propagated message to contain an MQMD (and MQRFH2) header. These nodes are the JMSMQTransform node and the MQJMSTransform node:

- The JMSMQTransform node takes the output of the JMSInput node and produces a message that can be handled by an MQOutput node.
- The MQJMSTransform node transforms a message with an MQMD (and optional MQRFH2) header into a message that is expected by the JMSOutput node.

You can include JMS nodes in applications where messages are produced and consumed from a variety of JMS destinations. In sending and receiving messages, the JMS nodes behave like JMS clients.

The JMS nodes work with the WebSphere MQ JMS provider, WebSphere Application Server Version 6.0, the IBM Service Integration Bus, and any JMS provider that conforms to the Java Message Service Specification, version 1.1. WebSphere Message Broker supports Java 5 (also known as Java 1.5).

To use the WebSphere Broker JMS Transport, you must deploy a message flow that contains a JMSInput node or a JMSOutput node. You can also include a JMSMQTransform node or an MQJMSTransform node.

The JMS messages must conform to the Java Message Service Specification, version 1.1.

The following topics contain information about JMS, JMS messages, and JMS messages in WebSphere Message Broker:

- "JMS message structure" on page 61
- "JMS message types" on page 62
- "Representation of messages across the JMS Transport" on page 63
- "JMS message as input" on page 65
- "JMS message for output" on page 70
- "JNDI administered objects" on page 71

For information about the JMS transport, configurable properties for the JMS nodes, and troubleshooting, look at the following topics:

- "JMS provision" on page 72
- "JMS brokering" on page 72
  - "JMS Transactionality" on page 72
  - "JMS message selector" on page 74
  - "JMS properties for application communication models" on page 76
  - "JMS message domain properties" on page 76
- "Troubleshooting JMS nodes" on page 77

The following sample is provided to help you start using the WebSphere Broker JMS Transport:

- JMS Nodes sample

You can view samples only when you use the information center that is integrated with the Message Broker Toolkit.

Support for JMS messages

In previous versions of WebSphere Message Broker, the support for JMS messages extended only to JMS provision. In WebSphere Message Broker Version 6.1, brokering value has been added to enable the broker to behave like a JMS client.

JMS provision

In previous versions of WebSphere Message Broker, the WebSphere MQ Real-time Transport enabled support for JMS provision; the built in nodes, Real-timeInput node, Real-timeOptimizedFlow node, and Publication node, allow JMS applications to communicate with applications that use other supported protocols and transports.

In this implementation, the Real-time node acts as a server for a JMS client, where the client can be WebSphere MQ.

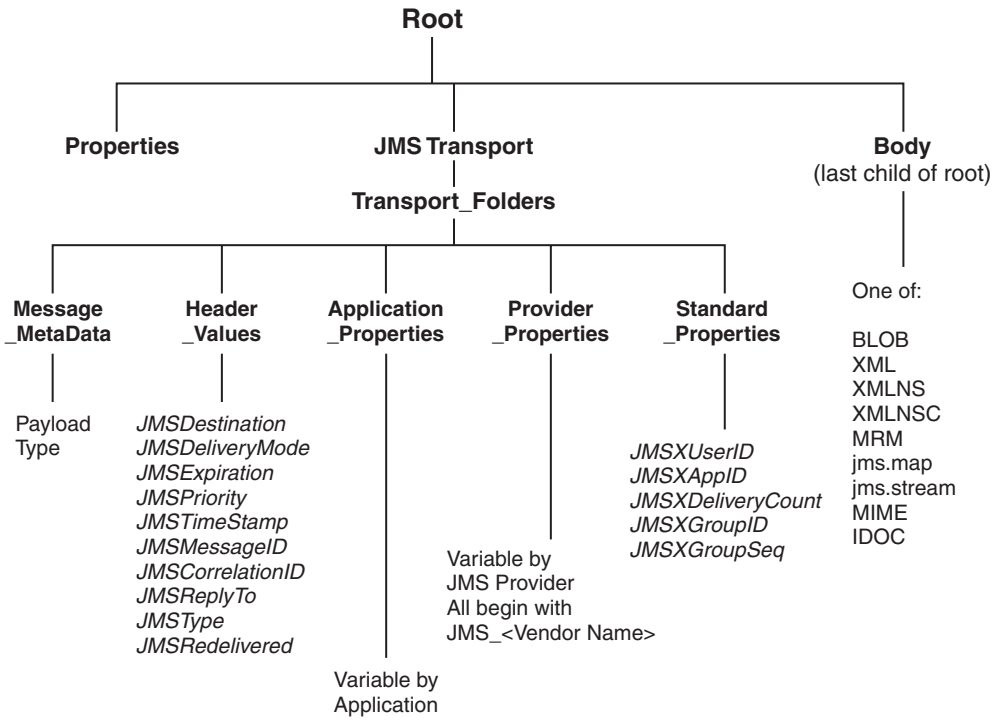
JMS brokering

WebSphere Message Broker Version 6.1 adds brokering value to a JMS network. Four new built-in nodes, JMSInput node, JMSOutput node, JMSMQTransform node, and MQJMSTransform node, provide support for the broker to act like a JMS client. JMS messages can be sent and received, and can be transformed into other message formats.

Simplified JMS message representation

At the JMSInput node, a message is received as a Java object and not as a bit stream wire format (as would be the case with an MQInput node). The message does not populate an MQMD and RFH2 header, but instead populates a new message tree that represents a JMS message in a more native way.

To represent a JMS message in a message tree, a new canonical form has been created. This new message tree allows for representation of JMS message header data, and message properties. The JMS message tree is in a format that is recognizable to Java programmers.



For details about the structure and content of the JMS message tree, see "Representation of messages across the JMS Transport" on page 63.

JMS message transformation

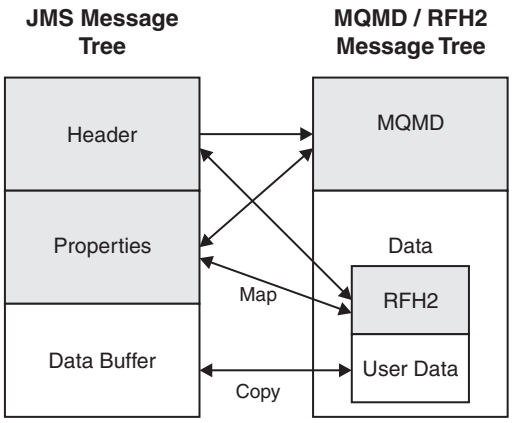
The JMSInput and JMSOutput nodes expect JMS messages, and therefore expect a native JMS message tree representation.

You can use the following nodes to transform messages between a WebSphere MQ JMS message tree and a JMS message tree:

- JMSMQTransform node
- MQJMSTransform node

These nodes do not have any configurable properties. The JMSMQTransform node transforms a native JMS message tree to a WebSphere MQ JMS message tree, and the MQJMSTransform node performs the transformation in the opposite direction.

The following diagram provides an overview of the mapping scheme that is used:



This mapping diagram uses the same scheme as the WebSphere MQ JMS provider to convert between a JMS message and an MQMD or MQRFH2 message.

When transforming between a WebSphere MQ message tree and a native JMS message tree, the transformation nodes copy elements from different parts of a message tree:

- The following fields are copied from the JMS message to the MQMD, if they exist in the incoming JMS message:

JMS field	MQMD field
JMSMessageID	MsgId
JMSCorrelationID	CorrelId
JMSPriority	Priority
JMSDeliveryMode	Persistence
JMSQApplid	PutApplName
JMSUser	UserIdentifier
JMSXDeliveryCount	BackoutCount - 1
JMSTimeStamp	PutDate, PutTime

- The following fields are copied from the JMS message to the MQRFH2 JMS folder:

JMS field	MQRFH2 JMS field
JMSDestination	Dst
JMSDeliveryMode	Dlv
JMSExpiration	Exp
JMSPriority	Pri
JMSTimestamp	Tms
JMSCorrelationID	Cid
JMSReplyTo	Rto

- The following fields are copied from the MQMD to the JMS message:

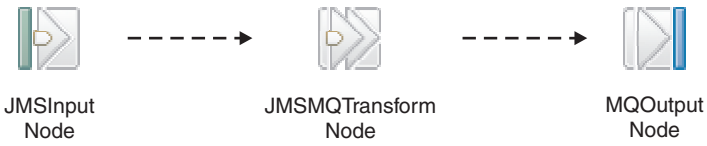
MQMD field	JMS field
Expiry	JMSExpiration

MQMD field	JMS field
Persistence	JMSDeliveryMode
Priority	JMSPriority
MsgId	JMSMessageID
CorrelId	JMSCorrelationID
BackoutCount = 0	JMSRedelivered = false
BackoutCount > 0	JMSRedelivered = true
GroupId	JMSGroupid
MsgSeqNumber	JMSGroupseq
UserIdentifier	JMSUser
PutApplName	JMSApplid
PutDate, PutTime	JMSTimeStamp

- The following fields are copied from the MQRFH2 JMS folder to the JMS message:

MQRFH2 JMS field	JMS field
Dst	JMSDestination
Dlv	JMSDeliveryMode
Pri	JMSPriority
Cid	JMSCorrelationID
Rto	JMSReplyTo

Example message flow scenario: JMSInput node to MQOutput node



1. A JMSInput node is configured to subscribe to topic ABC.
2. An application that is connected to the JMS server publishes on topic ABC.
3. A publication is received at the JMSInput node.
4. The node extracts data from the JMS message.
5. The JMS message is passed to the JMSMQTransform node where the message is converted to a WebSphere MQ message.
6. The MQOutput node receives the WebSphere MQ message, and publishes the message on a WebSphere MQ queue.

The final destination is a WebSphere MQ queue, therefore the message must pass through a JMSMQTransform node to convert the message tree to a WebSphere MQ JMS format before it reaches the MQOutput node.

Example message flow scenario: MQInput node to JMSOutput node

1. An MQInput node receives a message from a WebSphere MQ queue.
2. The MQInput node creates a WebSphere MQ message.
3. The MQ message is passed to the MQJMSTransform node where the message tree is converted to a JMS format.
4. The JMSOutput node receives the JMS message and publishes the JMS message on topic XYZ.

Additional examples

These examples show some of the solutions that you can achieve when you use the JMS Transport. Other solutions are possible; for example, the message can be passed to a Compute node or a JavaCompute node and the contents can be modified as required.

Look at the following sample for examples of the JMS nodes being used in message flows:

- JMS Nodes sample

You can view samples only when you use the information center that is integrated with the Message Broker Toolkit.

Connection to different JMS providers

The JMSInput and JMSOutput nodes are compatible with, and work with, any JMS provider that conforms to the Java Message Service Specification, version 1.1. If you want these nodes to participate in coordinated transactions, the JMS provider must support the XAResource interface as defined in the Java Message Service Specification, version 1.1.

JMS message structure

The following figure depicts the JMS message structure:

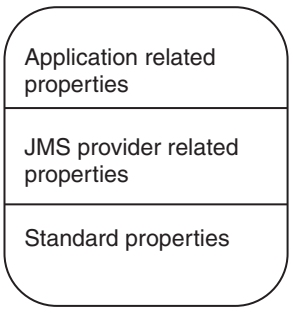
Header

A header must be present in every JMS message, and it is assigned automatically. Most of the values in the header are set by the JMS provider when the message is put to a JMS destination. Some values can be declared by the JMS client when it creates a JMS session, or when it creates the message consumer or producer; for example, *JMSDeliveryMode*, *JMSExpiration*, *JMSReplyTo*, and *JMSCorrelationID* are created when the JMS client creates a JMS session or creates the message consumer or producer.

The data elements of each header comprise name-value pairs and they can be any of the Java following types: Boolean, byte, short, char, long, int, float, double, string or byte[ ].

Properties

The properties are optional and can be divided into the following subsections:



- *Application related properties*

A Java application can assign application related properties, and these are set before the message is delivered. The property names of the application are meaningful only to the sending and receiving applications.

- *Provider related properties*

  Every JMS provider can define proprietary properties that can be set either by the client or automatically by the provider. Provider related properties are prefixed with *JMS_* followed by the vendor name and the specific property name. For example, the WebSphere MQ JMS client sets the provider property to be *JMS_IBM_MsgType*.

- *Standard properties*

  These properties are set by the JMS provider when a message is sent. The JMS provider vendor can choose to not support any standard properties, to support some standard properties, or to support all standard properties. Standard property names start with *JMSX*; for example: *JMSXUserid* or *JMSXDeliveryCount*.

The properties are handled as name-value pairs and they can be any of the Java following types: Boolean, byte, short, char, long, int, float, double, string or byte[ ].

Payload

The payload type defines the JMS message. It can be one of the six JMS message types that are described in "JMS message types."

JMS does not define a wire format. The Java Message Service Specification, version 1.1 describes the physical representation of how a message is structured.

JMS message types

JMS defines six message interface types; a base message type and five subtypes. The message types are defined according to the type of the message *payload*, where the payload is the body of a message that holds the content. JMS specifies only the interface and does not specify the implementation. This allows for vendor specific implementation and transportation of messages while using a common interface.

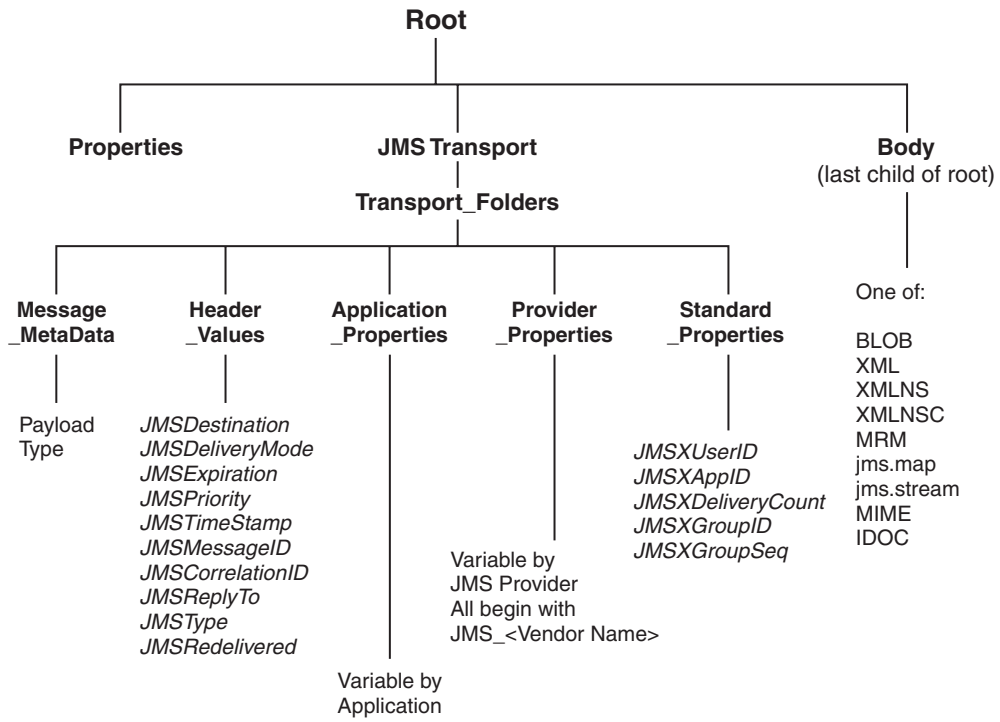
The following table describes the six message types:

Message type	Description
Message	The base class. This message type is used for event notification and does not have a payload.
BytesMessage	The payload is stored as an array of bytes. This message type is useful for exchanging data in an application's native format and when JMS is used as a transport between two systems, where the JMS client does not know the message payload type.
TextMessage	Data is stored as a string. This message type is useful for exchanging simple text messages and for more complex character data, such as XML documents.

StreamMessage	A Stream message is a sequence of primitive Java types. The message object keeps track of the order and the types of these primitives within the stream. Formal conversion rules apply; for example, an exception is thrown if a JMS application tries to read a double value as a short value. Refer to the Java Message Service Specification, version 1.1 for a full list of the conversion rules. `21ABCDEFGH32.345` is an example of a StreamMessage payload. It consists of the following three fields: • an Integer, `21` • a String, `ABCDEFGH` • a Float, `32.345` If the data structure is unknown, the generic method `readObject()` can be used to return the next object in the stream. If the structure of the data is known, the JMS client can be specific about the type of object being accessed.
MapMessage	The payload of a MapMessage is stored as a set of name-value pairs. The name is defined as a string and the value is typed. The MapMessage is useful for delivering keyed data that can change from one message to the next. `NumberOfCopies:5` is an example of a MapMessage payload, where `NumberOfCopies` is the key and `5` is the value. Data can be accessed by using `getMapNames()`, which returns a Java Enumeration object. It is possible to iterate through the MapMessage by using `hasMoreElements()` to retrieve the mapped name-value pairs.
ObjectMessage	The Object message carries a serializable Java Object as its payload. It is useful for exchanging Java objects.

Representation of messages across the JMS Transport

The following figure depicts the JMS message tree that is propagated from the JMSInput node and can be propagated to the JMSOutput and JMSReply nodes. The JMSOutput and JMSReply nodes populate details of the JMS message that is sent to the LocalEnvironment WrittenDestination folder, as described in JMSOutput node.



JMSTransport

- *Header_Values* subfolder:

  This subfolder is mandatory and is always created.
- Properties subfolders:

  JMS message properties are optional; if they are present in the message, they are stored in the appropriate properties subfolder.
- *Message_MetaData* subfolder:

  This subfolder is included to preserve the payload type of the JMS message. The folder is used by the JMSOutput node when it creates a JMS message. The payload type can be one of the following values:

Message type	Payload values
Base JMS message with no payload	jms_none
TextMessage	jms_text
BytesMessage	jms_bytes
MapMessage	jms_map
StreamMessage	jms_stream
ObjectMessage	jms_object

Body

The message payload is stored in the body folder, which is the last child of Root. The payload is transferred by using one of the following message domain parsers:

- XML
- XMLNS
- XMLNSC

- BLOB
- JMSMap
- JMSStream
- MRM
- MIME
- IDOC

JMS message as input

The JMS message is a Java object and therefore it is not possible to parse the message as a bit stream. When the message is received, the header data, property data, and payload data are extracted by using the JMS API. For information on the header, properties, and payload of JMS messages, refer to "JMS message structure" on page 61.

The following topics describe how the different parts of the JMS message are obtained, and how the message is parsed:

- "JMS input message header and property data"
- "JMS Message payload" on page 67
- "JMS message payload and appropriate parser" on page 68
- "Order of precedence for deriving the message domain" on page 69

JMS input message header and property data:
Header data

This section describes how the JMSInput node obtains header and property data from JMS messages.

The JMSInput node extracts header data from messages by using JMS API methods. Header data is stored as name-value pairs in the *Header_Values* folder. The API methods return the value; for example, to get the value for the header field *JMSTimestamp*, the JMSInput node uses the `getJMSTimestamp( )` method. A similar method is provided for each of the following fixed header fields:

- JMSDestination
- JMSDeliveryMode
- JMSExpiration
- JMSPriority
- JMSTimeStamp
- JMSMessageID
- JMSCorrelationID
- JMSReplyTo
- JMSType
- JMSRedelivered

Property data

In a similar way to how the header data is obtained, the JMSInput node extracts property data from messages by using JMS API methods. Property data is stored as name-value pairs in the properties folders. The API method returns a value for every property name with which it is supplied.

XML representation of header and property data

The JMSInput node uses the header and property data to create an XML representation of the JMSTransport folders. The node passes the XML data to the JMSTransport parser as a byte array. The byte array is then used to populate or to refresh the elements in the message tree. The JMSTransport parser is a new parser type.

Preservation of Java type

A scheme is not required to preserve knowledge of the Java type because the header value Java types are fixed and known. The JMS message properties are optional, therefore a scheme is required to preserve the Java type of the property values. The scheme used is that which is implemented by the WebSphere MQ JMS client and the Real-timeInput node.

Java type information is represented as a metadata in the form of a keyword `dt='DataType'`where *Datatype* is a string. The Java type is passed in the XML as part of the element name `<ElementName dt='DataType'>Value</ElementName>`. *Datatype* can be any of the following values:

Datatype value	Definition
String	Any sequence of characters, excluding `<` and `&`
Boolean	The character `0` or `1`, where `1` is equal to ″true″
bin.hex	Hexadecimal digits representing octets
I1	A number, expressed using the digits 0..9, with optional sign (no fractions or exponent). Must lie in the range -128 to 127 inclusive.
I2	A number, expressed using the digits 0..9, with optional sign (no fractions or exponent). Must lie in the range -32768 to 32767 inclusive.
I4	A number, expressed using the digits 0..9, with optional sign (no fractions or exponent). Must lie in the range -2147483648 to 2147483647 inclusive.
I8	A number, expressed using the digits 0..9, with optional sign (no fractions or exponent). Must lie in the range -9223372036854775808 to 9223372036854775807 inclusive.
int	A number, expressed using the digits 0..9, with optional sign (no fractions or exponent). Must lie in the same range as the datatype value`I8`. This number can be used in place of one of the `I*` types if the sender does not want to associate a particular precision with the property.
R4	A floating point number, expressed using the digits 0..9, optional sign, optional fractional digits, optional exponent. Magnitude <= 3.40282347E+38, and>= 1.175E-37

R8	A floating point number, expressed using the digits 0..9, optional sign, optional fractional digits, optional exponent. Magnitude <= 1.7976931348623E+308, and>= 2.225E-307

JMS Message payload:

How payload is extracted from the JMS message for each of the JMS Message types.

The payload for some of the JMS message types can be extracted as a whole from the message object by using the JMS API. The payload is passed as a bit stream to a broker parser. This is true for the following message types:

- BytesMessage
- TextMessage
- ObjectMessage

  Additional processing is required to deal with the ObjectMessage payload because the JMS ObjectMessage payload is a serialized Java Object.

  The JMSInput node obtains the payload by calling `getObject( )` on the message. `getObject( )` returns a de-serialized object of the original class. This class definition must be made available to the JMSInput node, and you should ensure that it is accessible through the broker's Java class path. (The class path is defined in the mqsiprofile batch file, which is in the broker's executable directory; for example, on Windows®, this is `mqsiprofile.cmd` in the *`install_dir`*`/bin` directory.) The JMSInput node invokes the BLOB parser, which creates the message body by using a bit stream that is created from the object.

  The Java Object can be subsequently re-serialized in a JavaCompute node or a user-defined extension, and is updated by using its method calls.

The payload for MapMessage and StreamMessage can be extracted only as individual elements and must be reformatted by the JMSInput node before it can be used to create the message body.

- **MapMessage payload**

  The JMSMap domain is a synonym for the broker XML parser, which expects a stream of XML data. MapMessage payload data however, is extracted as sets of name-value pairs from the message object. The JMS API is used to obtain the name-value pairs.

  The JMSInput node appends each name-value pair to a bit stream as an XML element and value, and preserves the type of the value by using the `dt=` attribute.

  The following example shows the XML that is generated by the JMSInput node for the MapMessage payload:

```
<map>
    <Item_8_of_10_Char dt='char'>A</Item_8_of_10_Char>
     <Item_5_of_10_Double dt='r8'>999999.0</Item_5_of_10_Double>
     <Item_10_of_10_String>Last Map Item</Item_10_of_10_String>
     <Item_9_of_10_Boolean dt='boolean'>0</Item_9_of_10_Boolean>
     <Item_2_of_10_Integrer dt='i4'>999</Item_2_of_10_Integrer>
     <Item_3_of_10_Short dt='i2'>9999</Item_3_of_10_Short>
     <Item_7_of_10_Byte dt='i1'>9</Item_7_of_10_Byte>
     <Item_6_of_10_Float dt='r4'>2.24</Item_6_of_10_Float>
     <Item_1_of_10_String>P2P Map Msg Number:1</Item_1_of_10_String>
     <Item_4_of_10_Long dt='i8'>99999</Item_4_of_10_Long>
          </map>
```

In this example, the message contains 10 fields. The field names have been generated by a JMS Client application, and take the form `item_n_of_x_t`, where:

- `n` is the sequence number in which the item was added to the message,
- `x` is the total number of items in the map,
- `t` is the type of the value.

The map data is not returned from the JMS API the order in which it was received.

- **StreamMessage payload**

  The StreamMessage payload data is a sequence of fields, where each field has a specific type. The fields do not have associated names and so a default element name `elt` is used to generate the XML elements. Similar to the MapMessage, the JMS API allows for fields only to be retrieved individually. The JMSInput node extracts fields from the JMS message and appends each to a bit stream in XML format.

  The following is an example of the XML that is generated by the JMSInput node for the StreamMessage payload:

```
<stream>
     <elt>P2P Stream Message  Number :7</elt>
     <elt dt='i4'>999</elt>
     <elt dt='i2'>9999</elt>
     <elt dt='i8'>99999</elt>
     <elt dt='r8'>999999.0</elt>
     <elt dt='r4'>2.24</elt>
     <elt dt='i1'>9</elt>
     <elt dt='char'>A</elt>
     <elt dt='boolean'>0</elt>
     <elt>Last Stream Item</elt>
</stream>
```

  In this example, 10 typed values are added to the StreamMessage by a JMS client application.

JMS message payload and appropriate parser:

Configure the JMSInput node properties to specify the type of JMS message that the node expects to receive.

When the JMSInput node creates a message body from the JMS message payload, the appropriate parser for that payload is determined. Therefore, the JMSInput node must know the type of JMS message that it expects to receive. A JMS message is defined by the payload type, and the JMSInput node extracts the payload from the JMS message by using the JMS API.

The following JMSInput node properties allow you to specify the type of JMS message that the node expects to receive:

- Message Domain
- Message Set
- Message Type
- Message Format

The Message Domain can be set to one of the following values:

Domain	Usage

blank	This corresponds to the blank domain in an MQInput node. The node derives the Message Domain from the JMSType header field providing that the value conforms to a proprietary URI format, see "Order of precedence for deriving the message domain." If the JMSType value is blank or does not match this URI format, the node sets the Message Domain according to the JMS Message Java Class type. Refer to "Order of precedence for deriving the message domain" for more information.
BLOB	The node expects bit stream data from ByteMessage, ObjectMessage, or TextMessage.
XML	The node expects a TextMessage with an XML payload.
XMLNS	The node expects a TextMessage with an XMLNS payload.
XMLNSC	The node expects a TextMessage with an XMLNSC payload.
MRM	The node expects to receive a TextMessage or ByteMessage. If the message set, type, and format are not supplied in the JMSInput node then the JMSType header field must be set.
JMSMap	The node expects to receive a MapMessage only.
JMSStream	The node expects to receive a StreamMessage only.
MIME	The node expects a TextMessage or ByteMessage with a MIME (Multipurpose Internet Mail Extension).
IDOC	The node expects a TextMessage or ByteMessage with an IDOC payload.

Order of precedence for deriving the message domain:

How the JMSInput node derives the message domain and JMS message type.

When a JMS message is received by the JMSInput node, the message domain is derived according to the following criteria and in the following order of precedence:

1. The Message Domain property is set to a specific domain type.

   In this case, the node expects to receive only the following JMS message types:

Message domain	**Valid JMS message types**				
	BytesMessage	TextMessage	MapMessage	StreamMessage	ObjectMessage
BLOB	X	X			X
XML		X			
XMLNS		X			
XMLNSC		X			
MRM	X	X			
JMSMap			X		
JMSStream				X	
MIME	X	X			
IDOC	X	X			

If a JMS message type is received, which is not valid for the message domain that is configured in the JMSInput node, the node issues a warning and backs out the message either to the source JMS provider destination, or to the backout destination.

2. The Message domain property is left blank (default). The JMSType header value from the JMS input message is set according to the URI format shown below. The domain in the mcd: string can be upper case or lower case.

JMSType	Broker domain
mcd://MRM/[set]/[type]/[?format=fmt]	MRM
mcd://XML	XML
mcd://XMLNS	XMLNS
mcd://XMLNSC/[set]	XMLNSC
mcd://IDOC/[set]/[?format=fmt]	IDOC
mcd://MIME	MIME

If a JMS message type is received, which is not valid for the message domain configured in the JMSType header, the node issues a warning and backs out the message either to the source JMS provider destination, or to the backout destination.

Messages received in the MRM domain

Messages that are received in the MRM domain must have a JMSType header field that is set in accordance with the following format (which is also used in JMS provision):

```
mcd://MRM/[set]/[type]/[?format=fmt]
```

For example,

```
mcd://MRM/SWIFTXML2005/{http://SWIFT/2005}:Document/?format=SWIFT
```

If the JMSType field does not conform to this format, the message is handled in the BLOB domain.

For details of the [type] syntax, refer to Specifying namespaces in the Message Type property.

3. The Message Domain property is left blank (default) and the JMSType header value from the JMS input message is also left blank.

The message domain is set according to the JMS message Java Class as follows:

JMS message type	Message domain
TextMessage	XML
BytesMessage	BLOB
MapMessage	JMSMap
StreamMessage	JMSStream
ObjectMessage	BLOB

JMS message for output

When the JMSOutput node receives a JMS message, it invokes the JMSTransport parser to return an XML bit stream containing the JMSTransport section of the message. The node extracts the *Message_MetaData* and obtains the payload type information to identify which JMS message type to create for output. If the *Message_MetaData* folder is not present, the output node creates a BytesMessage by default.

Header data

The JMSOutput node extracts the JMS header data from the XML string and uses this data to populate the values for the JMS header fields in the message.

Property data

The JMSOutput node extracts the property values from the XML string. The XML elements contain type information that identifies which Java Object type to create for each property value.

Message payload

The message payload is obtained from the JMS message as a bit stream. For TextMessage and BytesMessage payloads, the bit stream can be passed to the JMS API directly to create the appropriate payload.

For MapMessage and StreamMessage payloads, the individual elements must be extracted from the XML bit stream. The output node calls the appropriate JMS API method to create the map or stream fields in the message.

For an ObjectMessage payload, the JMSOutput node re-serializes the bit stream payload by using the object class. The object class must be available in the broker's Java class path. The class path is defined in the mqsiprofile batch file, which is in the broker's executable directory; for example, on Windows, this is `mqsiprofile.cmd` in the *`install_dir`*`/bin` directory.

Sending JMS messages

JMSOutput node produces and supports:

Sending a datagram message
A message with sufficient information to reach its destination, but without an expectation of there being a response as defined in the node attributes.

Sending a Reply message
The message is treated as a reply as defined by the *JMSReplyTo* property value.

Sending a Request message
The JMSOutput node sends a message to a defined JMS destination with the expectation of a response from the recipient.

See Using the Message Destination Mode for more information on how you perform these tasks.

Message publication

The message is published to the JMS destination that has been specified as an attribute of the JMSOutput node. However, if the *JMSReplyTo* header field is set in the JMS message, the JMSOutput node treats the message as a reply to a previous request, and publishes the message to the JMS destination of the previous request.

JNDI administered objects

JNDI (Java Naming and Directory Interface) is a standard Java extension that provides a uniform API for accessing a variety of directory and naming services.

JMS clients use JNDI to browse a naming service in order to obtain references to administered objects. *Administered objects* are JMS connection factory and JMS destination objects, where JMS destination objects are topics and queues. Administered objects are created and configured by a system administrator.

To create and configure JNDI administered objects, refer to the JMS provider documentation. If you are using the WebSphere MQ JMS provider, see the sample JMSAdmin definitions file that is included with WebSphere MQ and refer to the *WebSphere MQ Using Java* book.

Location of JNDI administered objects

JNDI administered objects are stored in the bindings. This can be either file system based or LDAP based. LDAP (Lightweight Directory Access Protocol) is a software protocol that enables anyone to locate organizations, individuals, and other resources; for example, locating files and devices in a network, either on the public Internet or on a corporate intranet.

LDAP is part of X.500, which is a standard for directory services in a network.

Naming service

A naming service associates names with distributed objects so that the administered objects are located by using names and not complex network addresses. JNDI provides an abstraction that hides the specifics of the naming service, which makes client applications more portable.

A JMS client specifies a *JNDI InitialContext* to obtain a JNDI connection to the JMS messaging server. The InitialContext is the starting point in any JNDI lookup and acts like the root of a file system. The JMS directory service that is being used determines the properties that are used to create an InitialContext.

JMS provision

For information about JMS provision in WebSphere Message Broker, see the general support statement and the details provided in the node descriptions, in the following list.

- "Support for JMS messages" on page 56
- Real-timeInput node
- Real-timeOptimizedFlow node
- Publication node
- "WebSphere MQ Real-time Transport" on page 22

JMS brokering

This section contains information to help you configure the properties on the JMSInput and JMSOutput nodes.

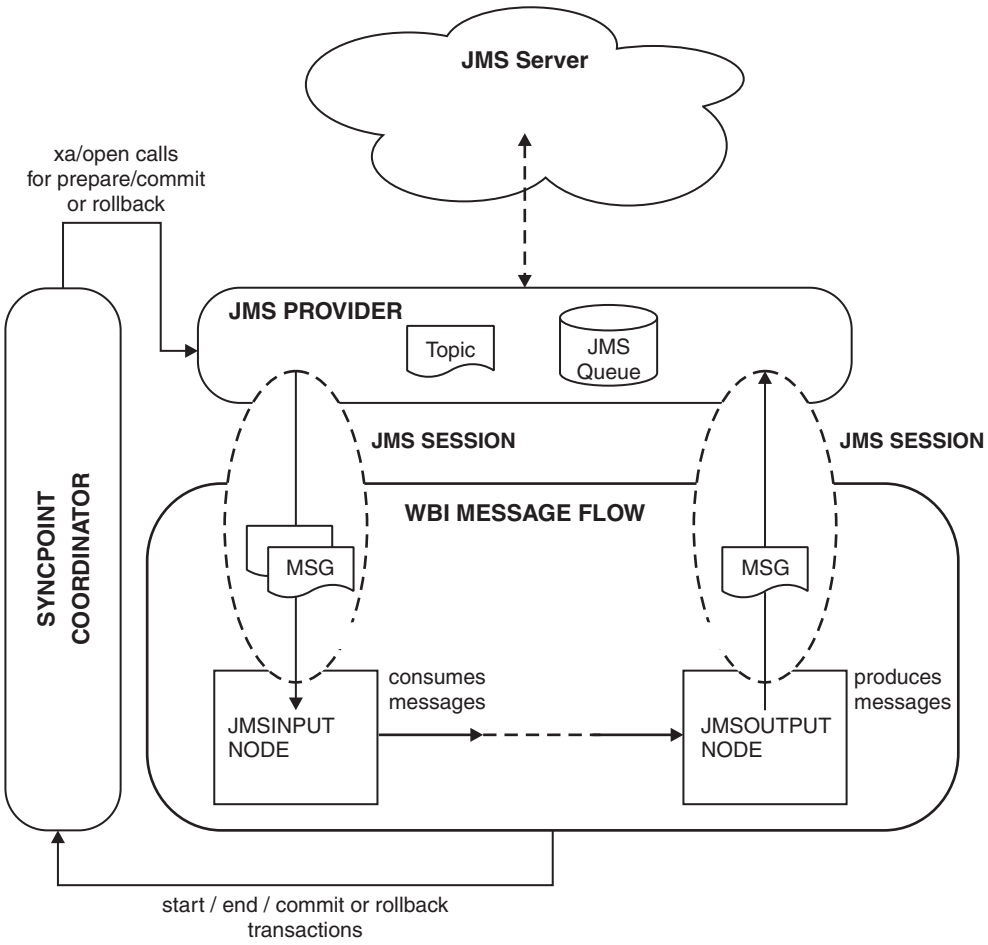
The two transformation nodes, JMSMQTransform and MQJMSTransform do not have configurable properties.

- "JMS Transactionality"
- "JMS message selector" on page 74
- "JMS properties for application communication models" on page 76
- "JMS message domain properties" on page 76

JMS Transactionality:

JMS destinations that supply messages to a JMSInput node, or receive messages from a JMSOutput node, can be sync-point coordinated as part of a message flow global transaction.

Transactions involving the sync-point coordinator



In this diagram, messages are consumed from a topic by a JMSInput node, and are produced to a JMS queue by a JMSOutput node. The nodes are connected to, and are in session with, a JMS provider. Any message flow input node can inform the external sync-point coordinator when a message flow transaction starts and ends, and whether any resources that have been affected by the flow should be committed or rolled back.

The sync-point coordinator sends XA/Open compliant requests to all participating resource managers to inform them to prepare. Any changes are either committed or rolled back. Resource managers, for example, WebSphere MQ, DB2® and any XA compliant JMS provider can participate in a global transaction.

The external sync-point coordinator is WebSphere MQ on operating systems other than z/OS, and RRS (Resource Recovery Services) on z/OS.

The JMSInput node and JMSOutput node can participate in a global transaction only if the JMS provider to which they connect supports the XA/Open interface through the JMS `XAResource` Class. An example JMS provider is the WebSphere MQ Java Client.

You can specify a generic connection factory (`recoverXAQCF`) for recovery of XA coordinated transactions.

In-doubt transactions

In-doubt transactions can occur when a resource manager does not reply to a call from the sync-point manager, where the call is to commit or to rollback resources. During start up of the broker's WebSphere MQ queue manager, an initial recovery step is taken to ensure that any in-doubt transactions are resolved before the broker message flows start to process new input. A JMS provider that participates in broker global transactions is included in this recovery step.

On operating systems other than z/OS, WebSphere MQ requires an administration task to be carried out before deployment. This task registers a broker component, which is a shared library, with the queue manager by referring the shared library to a switch file.

When the broker's WebSphere MQ queue manager starts up, it loads the switch file. The switch file forwards XA/Open transaction calls from the sync-point coordinator to the JMS Provider. This ensures that the JMS resources that participate in the transaction can be coordinated in synchronization with other resource managers that are involved in the same transaction.

Additional configuration is required to enable global transaction support for the JMSInput and JMSOutput nodes; see Configuring JMSInput and JMSOutput nodes to support global transactions.

JMS message selector:

A message selector allows a JMS consumer to be more selective about the messages that it receives from a particular topic or queue.

A message selector uses message properties and headers as criteria in conditional expressions. These expressions use Boolean logic to declare which messages should be delivered to a client, such as the JMSInput node.

The following table demonstrates the construction of a message selector. It comprises an identifier, such as the *JMSPriority* header, or an application controlled property *myProperty1*. The selector string must specify an operator followed by a literal.

Element	Valid values
Identifiers	• Property or header field reference (such as *JMSPriority*, *myProperty1*) • The following values are not possible: NULL, TRUE, FALSE, NOT, AND, OR, BETWEEN, LIKE, IN, IS
Operators	AND, OR, LIKE, BETWEEN, =, <>, <,>, <=, >=, IS NULL, IS NOT NULL

Literals	• The two Boolean literals, TRUE and FALSE • Exact number literals that have no decimal point; for example, +25, -399, 40 • Approximate number literals. These literals can use scientific notation or decimal; for example, -21.4E4, 5E2, +34.4928

The JMSInput node provides a free format string *PropertySelector*, to specify selectors that filter or include application properties. The node also has properties for specific header properties, where the identifier is implicit and is generated by the node. For the header selectors, the operator and literal part of the string must be specified.

If more than one selector is specified the node generates a composite selector string, where the individual selector strings are concatenated with the `AND` operator, and each selector string part is wrapped with parentheses.

The following are examples for each of the selector properties:

Selector property	**Description**
PropertySelector	`OrderValue> 100.00` This string is used directly as shown.
TimeStamp	`BETWEEN 1057576423231 AND 10575788993265` Messages that are put between these two Java times only (where Java time is milliseconds since 01 Jan 1970) is delivered to the JMSInput node. In this case, the string generated is prefixed with the identifier *JMSTimestamp*.
Delivery Mode	`PERSISTENT` This setting means that only messages marked by the sender as being `PERSISTENT` should be delivered to the JMSInput node. In this case, the string that is generated is prefixed with the identifier *JMSDeliveryMode*.
Priority	`>= 5 AND <= 8` This setting means that only messages marked by the sender as having a priority `5`, `6`, `7`, or `8` should be delivered to the JMSInput node. In this case, the string generated is prefixed with the identifier *JMSPriority*.
Message ID	`> WMBRK123456` This setting returns messages with a Message ID that is greater than the value specified. In this case, the string generated is prefixed with the identifier *JMSMessageID*.
Redelivered	`FALSE` This setting means that messages that have not been redelivered should be received by the node. In this case, the string generated is prefixed with the identifier *JMSRedlivered*.

Correlation ID	= WMBRKABCDEFG This setting returns messages whose Correlation ID is equal to the value WMBRKBABCDEFG. In this case, the string generated is prefixed with the identifier *JMSCorrelationID*.

JMS properties for application communication models:

JMS clients can operate with both publish/subscribe and point-to-point messages. The publish/subscribe and point-to-point application communication models use virtual channels called *destinations*. In the publish/subscribe model, the destinations are *topics*. For the point-to-point model, the destinations are known as *queues*.

The following application communication model properties can be configured for JMSInput and JMSOutput nodes:

Property	Description
Connection Factory Name	A string name that is passed to JNDI to look up the administered connection factory object. The connection factory object is used to create a connection to the JMS destination. • For a client operating as a publish/subscribe client, the connection factory name is for a TopicConnectionFactory. • For a client operating as a point-to-point client, the connection factory name is for a QueueConnectionFactory.
Subscription Topic	The string name that is passed to JNDI to look up the JMS topic destination. The topic is used to create a JMS session when the node is being used to process publish/subscribe messages.
Durable Subscription ID	This is a JMSInput node property only. It is a string identifier that is specified if the node is to subscribe to a durable subscription topic. A durable subscription is one that outlasts the client's connection to a message server. When a durable subscriber is disconnected from the server, the server stores messages that are published. Therefore, when the durable subscriber reconnects, the message server sends all the unexpired messages. Durable subscriptions cannot be unsubscribed from a message flow. A separate administration task unsubscribes a previously registered durable subscription. Some JMS providers supply an administration tool to perform this action.
Source Queue	The string name that is passed to JNDI to look up the JMS queue destination. The queue is used to create a JMS session when the node is being used to process point-to-point messages.

The Subscription Topic and Source Queue properties are mutually exclusive because they configure the node to work with either the publish/subscribe message model or the point-to-point message model.

A Durable subscription ID is not valid without a Subscriber Topic property.

JMS message domain properties:

The JMSInput node can receive message payloads that correspond to all of the JMS message types that are specified in the Java Message Service Specification, version 1.1. For more information, see "JMS message types" on page 62.

Set the JMSInput node properties to specify how the message payload is to be parsed. For more information, see JMSInput node and “Order of precedence for deriving the message domain” on page 69.

The JMSOutput node does not have any message domain properties.

Troubleshooting JMS nodes

Review possible problems with JMS nodes.

The following errors might occur:

- “Managing badly formed messages”
- “Diagnosing problems when using globally coordinated transactions:”
- “Problems with JNDI Administered Objects” on page 78

In all cases of error, if the underlying cause is a JMSException that has been thrown by the JMS provider, the broker bip event message includes the text message from the JMSException to help your diagnosis.

Managing badly formed messages:

If a message cannot be processed by the JMSInput node, or has been rolled back as part of a global transaction, the message is backed out to the source destination. The message is then redelivered to the JMSInput node.

To prevent badly formed messages from interrupting the processing of valid messages, the node properties can be configured as follows:

Backout Destination	This property specifies a JMS destination where backed out messages are routed if the JMS message property *JMSX_DeliveryCount*, which is set by the JMS provider, exceeds the backout threshold. The JMS destination must be applicable to the message model being used by the node; for example, if a subscription topic has been configured on the node, the JMS destination must also be a topic.
Backout Threshold	This property specifies the integer value that controls a message is sent to the backout destination. A threshold value of 3 means that, if the JMSInput node receives a Message where the value of the *JMSX_DeliveryCount* property exceeds 3, the message is sent to the backout destination and is removed from the source destination.

Diagnosing problems when using globally coordinated transactions::

In addition to the broker service trace, another trace log is provided to diagnose problems that could occur when a JMSInput or JMSOutput node participates in a global message flow transaction. That is, at least one JMSInput or JMSOutput node in the message flow has the Transaction Mode property set to global and the message flow property Coordinated Transaction set to yes.

To capture the trace log, complete the following steps:

1. Define an environment variable called *XAJMS_TRACEFILE* that is available to the broker queue manager.
2. Set the value of the environment variable. This value must be a character string that represents the location and file name of the trace log. For example, on Windows, the variable could be configured as follows:

   ```
   XAJMS_TRACEFILE = c:\JMSSwitchLog
   ```
3. When the broker queue manager starts, it performs a recovery step to resolve any previous broker transactions that the JMS provider considers to be in-doubt. This queue manager process writes to two trace logs during this stage. The two trace logs are:
   - *XAJMS_TRACEFILE valuePID*.txt, where *PID* is the process ID of the queue manager start process. This file is produced from the broker's JMSSwitch library; see "JMS Transactionality" on page 72 for more information.

     Using the above example value for the variable produces a file called JMSSwitchLog2596.txt, where the queue manager start up process ID was 2596.
   - *XAJMS_TRACEFILEXARecoveryTrace*.txt which is produced by the broker's recovery component that connects to the JMS provider.
4. After the broker's queue manager has completed recovery, the broker starts and creates a file called *XAJMS_TRACEFILE valuePID*.txt, where *PID* is the process ID of the queue manager start process. This file is produced from the broker's JMSSwitch library, see "JMS Transactionality" on page 72 for more information.

Neither of these trace files require extra formatting.

This problem is not applicable on z/OS.

Problems with JNDI Administered Objects:

Description of problem: The JMSInput or JMSOutput node is unable to obtain the Initial Context Factory or a JNDI administered object such as the Connection Factory or JMS destination, and a BIP4640 message is issued.

Corrective action

1. Verify that the JNDI bindings have been correctly built, and can be reached at the location specified in the node.
2. Check that the values specified in the node for the Initial Context, Connection Factory Name, and Source Queue or Destination Queue exist in the JNDI bindings.
3. Ensure that the correct keyword is used to match the location of the bindings:
   - file:// when the administered objects have been created in a .bindings file
   - ldap:// when the administered objects exist in an LDAP directory
   - iiop:// when corba is used to access the administered objects
4. When the bindings are file based do not specify the .bindings filename in the node property.
5. Ensure that the Initial Context Factory name does not include a filepath.
6. Ensure that a JMS destination (Topic or Source Queue or Destination Queue) specified in the node property exists in the JNDI administered objects.

7. Ensure that the JMS Provider Java `.jar` files have been placed into the broker shared-classes directory on distributed platforms, or on z/OS that these `.jar` files have been defined to the broker CLASSPATH and any native libraries defined in the broker LIBPATH.

The JMS Nodes continue to attempt to obtain the JNDI administered objects. Correct any problems and rebuild the bindings. The JMS node should automatically detect the changes and attempt to start.

Description of problem: A JMSInput or JMSOutput node is unable to connect for a JMS provider and issues a BIP4648 message.

Corrective action:

1. Verify that the JMS Provider server is running. If it is offline, start the server.
2. Verify that the JMS Provider server is available from the broker environment.
3. Ensure that the JMS Provider Java `.jar` files have been placed into the broker shared-classes directory on distributed platforms, or that on z/OS, that these `.jar` files have been defined to the broker CLASSPATH and any native libraries defined in the broker LIBPATH.

The JMS nodes continue to attempt to connect to the JMS provider. Correct any problems and the JMS node should automatically detect the changes and attempt to connect to the provider.

Description of problem: A JMSInput or JMSOutput node is unable to obtain a JMS destination and issues a BIP4642 message.

Corrective action

1. Investigate the cause of the problem described by the JMS exception message that might be included in the BIP event message.
2. Check that the name of the JMS destination that is defined in the relevant node property (Topic or Source Queue or Destination Queue) has been correctly defined in the JNDI administered objects.
3. Verify that the underlying system resource used by the JMS provider for the JMS destination has been configured correctly

Part 3. Appendixes

Appendix. Notices for WebSphere Message Broker

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