Artix™

Router Guide

Version 4.1, September 2006

Making Software Work Together™

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Preface

What is Covered in this Book

This book discusses how to use the Artix routing service. It covers how the routing service directs message, the WSDL extensions used to define routing rules, and how to deploy an instance of the routing service.

Who Should Read this Book

This book is intended for any user who needs to use the Artix routing service to connect endpoints in a SOA. It is expected that the reader have a basic understanding of Service Oriented design concepts and WSDL.

How to Use this Book

If you are new to Artix or just want an overview of the routing service you should read the "Introduction".

If you are interested in learning how to write routing rules you should read the following chapters:

- "Compatibility of Ports and Operations"
- "Creating a Basic Route"
- "Adding Operation-Based Rules to a Route"
- "Adding Attribute-Based Rules to a Route"
- "Adding Content-Based Rules to a Route"
- "Linking Routes"
- "Creating Routes Using Artix Tools"

If you are interested in configuring the routing service and optimizing its performance you should read the following chapters:

- "Deploying an Artix Router"

- "Routing Messages Containing Endpoint References"

If you are interested in using the advanced features of the router you should read "Using Advanced Routing Features".

The Artix Library

The Artix documentation library is organized in the following sections:

- Getting Started
- Designing Artix Solutions
- Configuring and Managing Artix Solutions
- Using Artix Services
- Integrating Artix Solutions
- Integrating with Management Systems
- Reference
- Artix Orchestration

Getting Started

The books in this section provide you with a background for working with Artix. They describe many of the concepts and technologies used by Artix. They include:

- Release Notes contains release-specific information about Artix.
- Installation Guide describes the prerequisites for installing Artix and the procedures for installing Artix on supported systems.
- Getting Started with Artix describes basic Artix and WSDL concepts.
- Using Artix Designer describes how to use Artix Designer to build Artix solutions.
- Artix Technical Use Cases provides a number of step-by-step examples of building common Artix solutions.

Designing Artix Solutions

The books in this section go into greater depth about using Artix to solve real-world problems. They describe how to build service-oriented architectures with Artix and how Artix uses WSDL to define services:

- Building Service-Oriented Infrastructures with Artix provides an overview of service-oriented architectures and describes how they can be implemented using Artix.

- Writing Artix Contracts describes the components of an Artix contract. Special attention is paid to the WSDL extensions used to define Artix-specific payload formats and transports.

Developing Artix Solutions

The books in this section how to use the Artix APIs to build new services:

- Developing Artix Applications in C++ discusses the technical aspects of programming applications using the C++ API.
- Developing Advanced Artix Plug-ins in C++ discusses the technical aspects of implementing advanced plug-ins (for example, interceptors) using the C++ API.
- Developing Artix Applications in Java discusses the technical aspects of programming applications using the Java API.

Configuring and Managing Artix Solutions

This section includes:

- Configuring and Deploying Artix Solutions explains how to set up your Artix environment and how to configure and deploy Artix services.
- Managing Artix Solutions with JMX explains how to monitor and manage an Artix runtime using Java Management Extensions.

Using Artix Services

The books in this section describe how to use the services provided with Artix:

- Artix Router Guide explains how to integrate services using the Artix router.
- Artix Locator Guide explains how clients can find services using the Artix locator.
- Artix Session Manager Guide explains how to manage client sessions using the Artix session manager.
- Artix Transactions Guide, C++ explains how to enable Artix C++ applications to participate in transacted operations.
- Artix Transactions Guide, Java explains how to enable Artix Java applications to participate in transacted operations.
- Artix Security Guide explains how to use the security features in Artix.

Integrating Artix Solutions

The books in this section describe how to integrate Artix solutions with other middleware technologies.

- Artix for CORBA provides information on using Artix in a CORBA environment.
- Artix for J2EE provides information on using Artix to integrate with J2EE applications.

For details on integrating with Microsoft's .NET technology, see the documentation for Artix Connect.

Integrating with Management Systems

The books in this section describe how to integrate Artix solutions with a range of enterprise and SOA management systems. They include:

- IBM Tivoli Integration Guide explains how to integrate Artix with the IBM Tivoli enterprise management system.
- BMC Patrol Integration Guide explains how to integrate Artix with the BMC Patrol enterprise management system.
- CA-WSDM Integration Guide explains how to integrate Artix with the CA-WSDM SOA management system.
- AmberPoint Integration Guide explains how to integrate Artix with the AmberPoint SOA management system.

Reference

These books provide detailed reference information about specific Artix APIs, WSDL extensions, configuration variables, command-line tools, and terms. The reference documentation includes:

- Artix Command Line Reference
- Artix Configuration Reference
- Artix WSDL Extension Reference
- Artix Java API Reference
- Artix C++ API Reference
- Artix .NET API Reference
- Artix Glossary

Artix Orchestration

These books describe the Artix support for Business Process Execution Language (BPEL), which is available as an add-on to Artix. These books include:

- Artix Orchestration Release Notes
- Artix Orchestration Installation Guide
- Understanding Artix Orchestration
- Artix Orchestration Administration Console Help.

Getting the Latest Version

The latest updates to the Artix documentation can be found at http://www.iona.com/support/docs.

Compare the version dates on the web page for your product version with the date printed on the copyright page of the PDF edition of the book you are reading.

Searching the Artix Library

You can search the online documentation by using the **Search** box at the top right of the documentation home page:

http://www.iona.com/support/docs

To search a particular library version, browse to the required index page, and use the **Search** box at the top right, for example:

http://www.iona.com/support/docs/artix/4.0/index.xml

You can also search within a particular book. To search within a HTML version of a book, use the **Search** box at the top left of the page. To search within a PDF version of a book, in Adobe Acrobat, select **Edit**|**Find**, and enter your search text.

Artix Online Help

Artix Designer and Artix Orchestration Designer include comprehensive online help, providing:

- Step-by-step instructions on how to perform important tasks
- A full search feature
- Context-sensitive help for each screen

There are two ways that you can access the online help:

- Select **Help|Help Contents** from the menu bar. The help appears in the contents panel of the Eclipse help browser.
- Press **F1** for context-sensitive help.

In addition, there are a number of cheat sheets that guide you through the most important functionality in Artix Designer and Artix Orchestration Designer. To access these, select **Help|Cheat Sheets**.

Artix Glossary

The Artix Glossary is a comprehensive reference of Artix terms. It provides quick definitions of the main Artix components and concepts. All terms are defined in the context of the development and deployment of Web services using Artix.

Additional Resources

The IONA Knowledge Base contains helpful articles written by IONA experts about Artix and other products.

The IONA Update Center contains the latest releases and patches for IONA products.

If you need help with this or any other IONA product, go to IONA Online Support.

Comments, corrections, and suggestions on IONA documentation can be sent to docs-support@iona.com .

Document Conventions

Typographical conventions

This book uses the following typographical conventions:

`Fixed width`

Fixed width (courier font) in normal text represents portions of code and literal names of items such as classes, functions, variables, and data structures. For example, text might refer to the `IT_Bus::AnyType` class.

Constant width paragraphs represent code examples or information a system displays on the screen. For example:

```
#include <stdio.h>
```

Fixed width italic	Fixed width italic words or characters in code and commands represent variable values you must supply, such as arguments to commands or path names for your particular system. For example: `% cd /users/`*`YourUserName`*
Italic	Italic words in normal text represent *emphasis* and introduce *new terms*.
Bold	Bold words in normal text represent graphical user interface components such as menu commands and dialog boxes. For example: the **User Preferences** dialog.

Keying Conventions

This book uses the following keying conventions:

No prompt	When a command's format is the same for multiple platforms, the command prompt is not shown.
`%`	A percent sign represents the UNIX command shell prompt for a command that does not require root privileges.
`#`	A number sign represents the UNIX command shell prompt for a command that requires root privileges.
`>`	The notation > represents the MS-DOS or Windows command prompt.
. . . . . .	Horizontal or vertical ellipses in format and syntax descriptions indicate that material has been eliminated to simplify a discussion.
`[]`	Brackets enclose optional items in format and syntax descriptions.
`{}`	Braces enclose a list from which you must choose an item in format and syntax descriptions.
`|`	In format and syntax descriptions, a vertical bar separates items in a list of choices enclosed in `{}` (braces). In graphical user interface descriptions, a vertical bar separates menu commands (for example, select **File**|**Open**).

CHAPTER 1

Introduction

The Artix routing service provides message routing based on operations, ports, message attributes, or message content.

In this chapter

This chapter discusses the following topics:

Features of the Routing Service

Overview

An Artix router redirects messages based on rules defined in an Artix contract. The routing functionality is provided by an Artix plug-in and configuration. This means that neither the client nor the server endpoints need to be modified, nor are they are aware that routing is occurring. An Artix router is sometimes referred to as an Artix *switch*.

Routes

The most basic Artix routes are between two endpoints that are described by the `port` element of a WSDL contract. You can refine your routes using the following types of additional rules:

- Operation-based
- Attribute-based
- Content-based

Operation-based

Operation-based rules allow you to refine a route by specifying a particular operation on which the router will filter messages. By adding an operation-based rule to a route, you direct the router to only act upon messages that originate due to an invocation on a particular operation of the specified port. Messages are routed between logical operations whose arguments are equivalent.

For more information see "Adding Operation-Based Rules to a Route" on page 33.

Attribute-based

Attribute-based routing rules allow you to refine a routing by specifying values in the message header to be inspected. By adding attribute-based rules to a route, you can direct the router to only redirect messages based on certain values specified in the message header.

For more information see "Adding Attribute-Based Rules to a Route" on page 37.

Content-based

Content-based routing rules allow to refine a route by inspecting the contents a message. Adding a content-based rule lets you route messages based on the value of particular elements of a message. The routes are defined using simple XPATH expressions that query the message content and select a destination based on the result.

For more information see "Adding Content-Based Rules to a Route" on page 41.

Advanced features

In addition, you can specify routes that give you the following advanced capabilities:

- Failover
- Load balancing
- Message broadcasting (fanout)

For more information see "Using Advanced Routing Features" on page 51.

Routing Contracts

Overview

A router's contract must include definitions for the source services and destination services. The contract also defines the routes that connect the source endpoints to the destination endpoints. These routing rules is all that is required to implement a route.

Routing contract requirements

A contract for the routing service is very similar to a contract for any other Artix service. It is a WSDL document that defines the types, interfaces, data mappings, and networking information that defines an endpoint. Because the routing service bridges two, or more endpoints, it requires that all of the information for the endpoints it bridges are defined. In addition, a routing service contract contains information specifying the routing rules for connecting the defined endpoints.

A contract for the routing service must specify the following:

- all of the types passed between all of the endpoints being connected.
- all of the messages that can be passed between the endpoints being connected.
- an interface definition for each of the endpoints being connected.

  Note: A routing service contract may have only one interface definition because multiple endpoints can share the same interface.

- a binding definition for each endpoint being connected.
- the connection information for all of the endpoints being connected.
- at least one set of routing rules to define how messages are routed between the connected endpoints.

Routing namespace

The WSDL extension used to specify routes in an Artix contract are defined in the namespace `http://schemas.iona.com/routing`. When describing routes in an Artix contract you must add the following to your contract's definition element:

```
<definitions ...
  xmlns:routing="http://schemas.iona.com/routing"
  ...>
```

Common routing extensions

The most commonly used of the routing extensions are:

routing:route is the root element of any route defined in the contract.

routing:source specifies the port that acts as the source for messages that are to be routed.

routing:destination specifies the port to which messages will be routed.

You do not need to do any programming and your applications need not be aware that any routing is taking place.

Router Deployment Patterns

Overview

An Artix router does not require that any Artix-specific code be compiled or linked into existing applications. An Artix router is created by loading the Artix `routing` plug-in into an Artix process. The recommended way to deploy a router is to use the Artix container (see *Deploying Artix Solutions*).

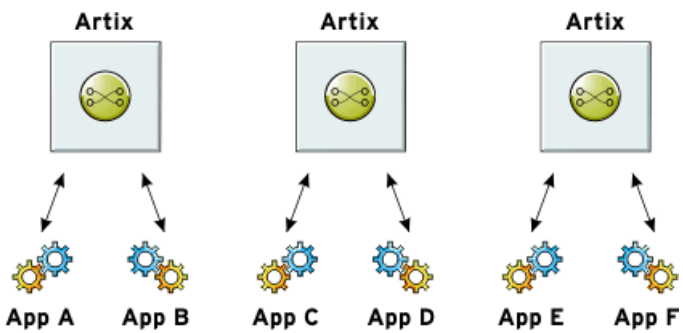
Artix router can be deployed in a number of ways. Two common deployment patterns are:

- Deploying multiple routers—each bridging between two applications.
- Deploying one router—it bridges between all applications in a domain.

Deploying multiple routers

This approach simplifies designing integration solutions, and provides faster processing of each message (shown in Figure 1). Using this approach, the Artix contract describing the interaction of the applications is simpler. It contains only the logical interfaces shared by the two applications, the bindings for each payload format, and the routing rules.

Figure 1: *Using Multiple Artix Routers for Single Routes*

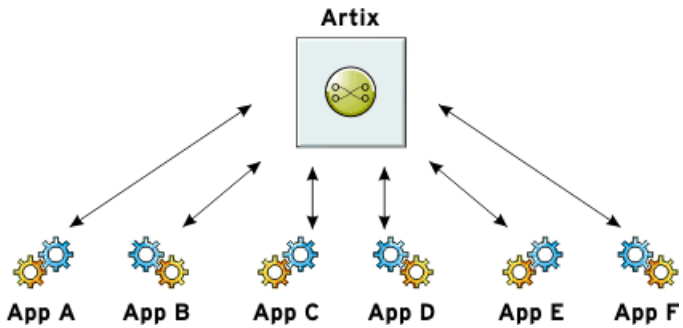


Because most applications use only one network transport, the number of ports is minimal and the routing rules are simple. Keeping the contract simple also enhances the performance of each router because it has less processing to do. In this approach, each router's resource usage can be limited by tailoring its configuration to optimize the router for the integration task that it is responsible for.

Deploying one router

This approach limits the number of external services required in your deployment environment (shown in Figure 2). This can simplify monitoring and installation of deployments. It also reduces the number of moving parts in an integration solution.

Figure 2: *Using a Single Artix Router for Multiple Routes*



Using this approach, you can use a single WSDL contract that includes all the information for all routes. In this case, the contract information that describes the interaction of the applications is more complex. It contains the logical interfaces shared by multiple applications, the bindings for each payload format, and the routing rules.

Alternatively, you can also specify that a single router uses multiple WSDL files, each of which describes a single route, or a number of routes. These could be the same WSDL contracts used in multiple router deployment, however, they are all deployed in the same router process. The configuration that identifies the WSDL file containing the routing details is specified using a list, which can include a collection of multiple WSDL files. For more information, see "Configuring an Artix Router" on page 70.

Compatibility of Ports and Operations

The source endpoint and destination endpoint of a route must be able to consume the routed messages.

Overview

The routing service can route messages between endpoints that expect similar messages. The endpoints can use different message transports and different payload formats, but the messages must be logically identical. For example, if you have a baseball scoring service that is hosted on a mainframe, it might send data using fixed record length fields over a WebSphere MQ queue. Using a router, you can route the score data to a reporting service that consumes SOAP messages over HTTP.

Using the most basic routing rules, the destination endpoint must have a matching logical operation defined for each of the logical operations defined for the source endpoint. If you add an operation-based rule, the restriction on the endpoints is relaxed. The source endpoint and the destination endpoint must have one logical operation that uses messages with the same logical description.

Routing between endpoints

Routing between endpoints is rough grained in that the routing rules are defined on the `port` elements of an Artix contract and do not look at the individual logical operations defined in the logical interface, defined by a `portType` element, for which the `port` element defines an endpoint. Therefore, basic routing rules require that the endpoints between which messages are routed must have compatible logical interface descriptions.

For two endpoints to have compatible logical interfaces the following conditions must be met:

- The `portType` element defining the destination's logical interface must contain a matching `operation` element for each `operation` element in the `portType` element defining the source's logical interface. Matching `operation` elements must have the same value in their `name` attribute.
- Each of the matching `operation` elements must have the same number of `input`, `output`, and `fault` elements.
- Each of the matching `operation` elements' `input` elements must be associated to a logical message, defined by a `message` element, whose sequence of part `elements` have matching types.
- Each of the matching `operation` elements' `output` elements must be associated to a logical message whose sequence of part `elements` have matching types.
- Each of the matching `operation` elements' `fault` elements must be associated to a logical message whose sequence of part `elements` have matching types.

For example, given the two logical interfaces defined in Example 1 you could construct a route from an endpoint bound to `baseballScorePortType` to an endpoint bound to `baseballGamePortType`. However, you could not create a route from an endpoint bound to `finalScorePortType` to an endpoint bound to `baseballGamePortType` because the message types used for the `getScore` operation do not match.

Example 1: *Logical interface compatibility example*

```
<message name="scoreRequest>
  <part name="gameNumber" type="xsd:int"/>
</message>
```

Example 1: *Logical interface compatibility example*

```
<message name="baseballScore">
  <part name="homeTeam" type="xsd:int"/>
  <part name="awayTeam" type="xsd:int"/>
  <part name="final" type="xsd:boolean"/>
</message>
<message name="finalScore">
  <part name="home" type="xsd:int"/>
  <part name="away" type="xsd:int"/>
  <part name="winningTeam" type="xsd:string"/>
</message>
<message name="winner">
  <part name="winningTeam" type="xsd:string"/>
</message>
<portType name="baseballGamePortType">
  <operation name="getScore">
    <input message="tns:scoreRequest" name="scoreRequest"/>
    <output message="tns:basballScore" name="baseballScore"/>
  </operation>
  <operation name="getWinner">
    <input message="tns:scoreRequest" name="winnerRequest"/>
    <output message="tns:winner" name="winner"/>
  </operation>
</portType>
<portType name="baseballScorePortType">
  <operation name="getScore">
    <input message="tns:scoreRequest" name="scoreRequest"/>
    <output message="tns:basballScore" name="baseballScore"/>
  </operation>
</portType>
<portType name="finalScorePortType">
  <operation name="getScore">
    <input message="tns:scoreRequest" name="scoreRequest"/>
    <output message="tns:finalScore" name="finalScore"/>
  </operation>
</portType>
```

Routing between operations

Operation-based routing rules check for compatibility based on the `operation` elements of an endpoint's logical interface description. Therefore, messages can be routed between any two compatible logical operations.

The following conditions must be met for operations to be compatible:

- The operations must have the same number of `input`, `output`, and `fault` elements.

- The logical messages must have the same sequence of part types.

For example, if you added the logical interface in Example 2 to the interfaces in Example 1 on page 26, you could specify a route from `getFinalScore` defined in `fullScorePortType` to `getScore` defined in `finalScorePortType`. You could also define a route from `getScore` defined in `fullScorePortType` to `getScore` defined in `baseballScorePortType`.

Example 2: *Operation-based routing interface*

```
<portType name="fullScorePortType">
  <operation name="getScore">
    <input message="tns:scoreRequest" name="scoreRequest"/>
    <output message="tns:basballScore" name="baseballScore"/>
  </operation>
  <operation name="getFinalScore">
    <input message="tns:scoreRequest" name="scoreRequest"/>
    <output message="tns:finalScore" name="finalScore"/>
  </operation>
</portType>
```

Creating a Basic Route

The simplest route directs messages between two endpoints without any conditions.

Overview

Basic routing rules simply specify the source endpoint, or endpoints, for the messages and the destination endpoint to which messages are routed. All messages received by the source endpoint are routed to the destination endpoint.

To describe a basic routing rule you use three elements:

- routing:route
- routing:source
- routing:destination

routing:route

The `routing:route` element is the root element of each route you describe in your contract. It takes one required attribute, `name`, that specifies a unique identifier for the route. The `routing:route` element also has an optional attribute, `multiRoute`, which is discussed in "Using Advanced Routing Features" on page 51.

routing:source

The `routing:source` element specifies the endpoint on which the route listens for messages. A route can have several `routing:source` elements as long as they all meet the compatibility rules discussed in "Routing between endpoints" on page 26.

The `routing:source` element requires two attributes described in Table 1.

Table 1: *Required Attributes for routing:source*

Attribute	Description
`service`	Specifies the name of the `service` element in which the source endpoint is defined.
`port`	Specifies the name of the `port` element defining the source endpoint.

routing:destination

The `routing:destination` element specifies the endpoint to which the source messages are routed. The destination endpoint must be compatible with the source endpoint. For a discussion of the compatibility rules see "Routing between endpoints" on page 26.

In standard routing only one destination is allowed per route. Multiple destinations are allowed in conjunction with the `rouitng:route` element's `multiRoute` attribute that is discussed in "Using Advanced Routing Features" on page 51.

The `routing:destination` element requires two attributes described in Table 2..

Table 2: *Required Attributes for routing:destination*

Attribute	Description
`service`	Specifies the name of the `service` element in which the destination endpoint is defined.
`port`	Specifies the name of the `port` element defining the destination endpoint.

Example

For example, to define a route from `baseballScorePortType` to `baseballGamePortType`, defined in Example 1 on page 26, your Artix contract would contain the elements in Example 3.

Example 3: *Port-based routing example*

```
1  <service name="baseballScoreService">
     <port binding="tns:baseballScoreBinding"
           name="baseballScorePort">
       <soap:address location="http://localhost:8991"/>
     </port>
   </service>
   <service name="baseballGameService">
     <port binding="tns:baseballGameBinding"
           name="baseballGamePort">
       <tibrv:port serverSubject="com.mycompany.baseball"/>
     </port>
   </service>
2  <routing:route name="baseballRoute">
     <routing:source service="tns:baseballScoreService"
                     port="tns:baseballScorePort"/>
     <routing:destination service="tns:baseballGameService"
                          port="tns:baseballGamePort"/>
   </routing:route>
```

There are two sections to the contract fragment shown in Example 3:

1. The logical interfaces must be bound to physical ports in `service` elements of the Artix contract.
2. The route, `baseballRoute`, is defined with the appropriate `service` and `port` attributes.

Adding Operation-Based Rules to a Route

Operation-based rules narrow the scope used to define the source of the messages to a specific operation.

Overview

Operation-based routing rules refine a route by narrowing the source of routed messages to specific logical operation. Any message not related to the specified logical operation will be unaffected by the route.

Adding an operation-based rule

To specify an operation-based routing rule you need to specify one additional element to your route description: `routing:operation`. The `routing:operation` element takes one required attribute, `name`, that specifies the value of the `name` attribute of an `operation` element in the source endpoint's logical interface. The specified `operation` element becomes the source of messages that are routed. Messages corresponding to other logical operations will not be routed.

The `routing:operation` element also has one optional attribute, `target`, that specifies the value of the `name` attribute of an `operation` element in the destination endpoint's logical interface. The specified `operation` element becomes the destination of messages redirected by the route. If a target is specified, messages are routed between the two operations. If no target is

specified, the source operation's name is used as the name of the target operation. The source and target operations must meet the compatibility requirements discussed in "Routing between operations" on page 27.

You can specify any number of `routing:operation` elements in a route. They must be specified after all of the `routing:source` elements and before any `routing:destination` elements.

How operation-based rules are applied

Operation-based routing rules apply to all of the `routing:source` elements in the route. Therefore, if an operation-based routing rule is specified, a message will be routed if all of the following are true:

- The message is received from one of the endpoints specified in a `routing:source` element.
- The operation name associated with the received message is specified in one of the `routing:operation` elements.

If there are multiple operation-based rules in the route, the message will be routed to the destination specified by the first the matching operation's `target` attribute.

Example

For example, to route messages from the `getFinalScore` operation defined in `fullScorePortType`, shown in Example 2 on page 28, to the `getScore` operation defined in `finalScorePortType`, shown in Example 1 on page 26, your Artix contract would contain the elements in Example 4.

Example 4: *Operation to Operation Routing*

```
1  <service name="fullScoreService">
     <port binding="tns:fullScoreBinding"
           name="fullScorePort">
       <mq:server QueueManager="BBQM"
                  QueueName="MLBQueue"
                  ReplyQueueManager="BBRQM"
                  ReplyQueueName="MLBScoreQueue"/>
     </port>
   </service>
   <service name="finalScoreSerice">
     <port binding="tns:finalScoreBinding"
           name="finalScorePort">
       <soap:address location="http://artie.com/finalScoreServer"/>
     </port>
   </service>
```

Example 4: *Operation to Operation Routing*

```
2 <routing:route name="scoreRoute">
    <routing:source service="tns:fullScoreService"
                    port="tns:fullScorePort"/>
    <routing:operation name="getFinalScore" target="getScore"/>
    <routing:destination service="tns:finalScoreService"
                         port="tns:finalScorePort"/>
  </routing:route>
```

There are two sections to the contract fragment shown in Example 4:

1. The logical interfaces must be bound to physical endpoints in `service` elements of the Artix contract.
2. The route, `scoreRoute`, is defined using the `routing:operation` element.

You could also create a route between the operation `getScore`, defined in `baseballGamePortType`, and an endpoint bound to `baseballScorePortType`. See Example 1 on page 26.The resulting contract would include the fragment shown in Example 5.

Example 5: *Operation to Port Routing Example*

```
<service name="baseballGameService">
  <port binding="tns:baseballGameBinding"
        name="baseballGamePort">
    <soap:address location="http://localhost:8991"/>
  </port>
</service>
<service name="baseballScoreService">
  <port binding="tns:baseballScoreBinding"
        name="baseballScorePort">
    <iiop:address location="file:\\score.ref"/>
  </port>
</service>
<routing:route name="scoreRoute">
  <routing:source service="tns:baseballGameService"
                  port="tns:baseballGamePort"/>
  <routing:operation name="getScore"/>
  <routing:destination service="tns:baseballScoreService"
                       port="tns:baseballScorePort"/>
</routing:route>
```

Note that the `routing:operation` element only uses the `name` attribute. In this case the logical interface bound to `baseballScorePort`, `baseballScorePortType`, must contain an operation `getScore` that has matching messages as discussed in "Routing between operations" on page 27.

CHAPTER 5

Adding Attribute-Based Rules to a Route

Attribute-based rules refine a route by selecting the messages to be routed based on the transport attributes set in a message's header.

Overview

Artix allows you to route messages based on the transport attributes set in a message's header when using HTTP or WebSphere MQ. You can also route messages based on security settings and the CORBA principle.

Adding attribute-based rules

Rules the select messages based on message header transport attributes are defined in `routing:transportAttribute` elements in the route definition. Transport attribute rules are defined after all of the operation-based routing rules and before any destinations are listed.

The criteria for determining if a message meets an attribute-based rule are specified in sub-elements of the `routing:tranportAttribute` element. A message passes the rule if it meets each criterion specified in the listed sub-element.

Defining the attributes

Each sub-element requires the two attributes defined in Table 3.

Table 3: *Required Attributes for Attribute Selection Elements*

Attribute	Description
`contextName`	Specifies the context defining the transport attribute being evaluated.
`contextAttributeName`	Specifies the name of the transport attribute being evaluated.

The `contextName` attribute is specified using the QName of the context in which the attribute is defined. The contexts shipped with Artix are described in Table 4.The `contextAttributeName` is also a QName and is relative to the context specified. For example, `UserName` is a valid attribute name for any of the HTTP contexts, but not for the MQ contexts.

Table 4: *Context QNames*

Context QName	Details
`http-conf:HTTPServerIncomingContexts`	Contains the attributes for HTTP messages being received by a service.
`corba:corba_input_attributes`	Contains the data stored in the CORBA principle.
`mq:IncomingMessageAttributes`	Contains the attributes for MQ messages being received by a service.
`bus-security`	Contains the attributes used by the IONA security service to secure your services.

Most sub-elements have a `value` attribute that can be tested. When dealing with string comparisons all elements have an optional `ignorecase` attribute that can have the values `yes` or `no` (`no` is the default). Each of the sub-elements can occur zero or more times, in any order:

routing:equals applies to string or numeric attributes. For strings, the `ignorecase` attribute may be used.

routing:greater applies only to numeric attributes and tests whether the attribute is greater than the value.

routing:less applies only to numeric attributes and tests whether the attribute is less than the value.

routing:startswith applies to string attributes and tests whether the attribute starts with the specified value.

routing:endswith applies to string attributes and tests whether the attribute ends with the specified value.

routing:contains applies to string or list attributes. For strings, it tests whether the attribute contains the value. For lists, it tests whether the value is a member of the list. The `contains` element accepts the optional `ignorecase` attribute for both strings and lists.

routing:empty applies to string or list attributes. For lists, it tests whether the list is empty. For strings, it tests for an empty string.

routing:nonempty applies to string or list attributes. For lists, it passes if the list is not empty. For strings, it passes if the string is not empty.

For information on the transport attributes for HTTP and WebSphere MQ see Writing Artix Contracts.

Example

Example 6 shows a route using attribute-based rules based on HTTP header attributes. Only messages sent to the server whose `UserName` is equal to `JohnQ` will be passed through to the destination port.

Example 6: *Transport Attribute Rules*

```
<routing:route name="httpTransportRoute">
  <routing:source service="tns:httpService"
                  port="tns:httpPort"/>
  <routing:transportAttributes>
    <routing:equals
              contextName="http-conf:HTTPServerIncomingContexts"
              contextAttributeName="UserName"
              value="JohnQ"/>
  </routing:transportAttributes>
  <routing:destination service="tns:httpDest"
                       port="tns:httpDestPort"/>
</routing:route>
```

Adding Content-Based Rules to a Route

Content-based routing rules evaluate the contents of a message and routes it based on the results.

Procedure

To create a content-based route rule in your contract you need to do the following things:

1. Add an expression to select message content using a `routing:expression` element.
2. Add a new route to you contract using a `routing:route` element.
3. Add a source endpoint to your route using a `routing:source` element.
4. Specify the expression to use as a routing criteria using a `routing:query` element.
5. Add one or more `routing:destination` elements as children to the `routing:query` element.
6. If you want to add a default destination endpoint, add a `routing:destination` element as a child of the `routing:route` element.

In this section

This section discusses the following topics:

The Router's Message Representation

Overview

The router receives messages in a number of wire formats. It uses the information provided in the `binding` element of its contract to turn the raw message into an XML message that can be evaluated. Before you can write an expression to select content from a message passing through the router, you need to understand how the router sees the message.

Doc-literal style contracts

If your contract is constructed using the recommended doc-literal style, the router sees the message as an instance of the element specified as the message part. For example, if your service was defined by the WSDL fragment in Example 7, the router would see a message with the root element `ticket`.

Example 7: *Doc-literal WSDL Fragment*

```
<definitions targetNamespace="vehicle.demo.example"
             xmlns:tns="vehicle.demo.example"
             ...>
  <types ...>
  ...
    <complexType name="vehicleType">
      <sequence>
        <element name="vin" type="xsd:string" />
        <element name="model" type="xsd:string" />
      </sequence>
    </complexType>
    <complexType name="ticketType">
      <sequence>
        <element name="vehicle" type="vehicleType" />
        <element name="name" type="xsd:string" />
        <element name="parkTime" type="xsd:string" />
      </sequence>
    </complexType>
    <element name="ticket" type="ticketType" />
    ...
  </types>
...
<message name="ticketRequest">
  <part name="myTicket" element="xsd1:ticket" />
</message>
```

Example 7: *Doc-literal WSDL Fragment*

```
...
<portType name="parkingLotMeter">
  <operation name="register">
    <input name="parkedCar" message="tns:ticketRequest"/>
    ...
  </operation>
...
</portType>
...
```

Example 8 shows an example of the message that the router would process given the WSDL in Example 7.

Example 8: *Doc-literal Router Message*

```
<ns1:parkedCar xmlns:ns1="vehicle.demo.example">
  <ticket>
    <vehicle>
      <VIN>0123456789</VIN>
      <model>Prius</model>
    </vehicle>
    <name>Old MacDonald</name>
    <time>19:00</time>
  </ticket>
</ns1:parkedCar>
```

Non-standard contracts

When you use non-standard messages in your contract, the router sees the message as a virtual XML document that is reconstructed from the WSDL definitions in the contract. The mapping is done as follows:

1. The name of the message's root element is the QName of the `message` element referred to by the operation's `input` element.
2. Each `part` element of the message referenced by the `input` element is mapped to an element derived from the `name` attribute of the `part` element.
3. If the `part` element is of a complex type, or an element of a complex type, the type's elements appear inside of the element corresponding to the `part` element.

For example, if you had a service defined by the WSDL fragment in Example 9 and were going to route requests to the register operation, the router would scan an XML document constructed using the message `ticketRequest`, which is the input message.

Example 9: *Non-standard WSDL Fragment*

```
<definitions targetNamespace="vehicle.demo.example"
             xmlns:tns="vehicle.demo.example"
             ...>
  <types ...>
  ...
    <complexType name="vehicleType">
      <element name="vin" type="xsd:string" />
      <element name="model" type="xsd:string" />
    </complexType>
  ...
  </types>
...
<message name="ticketRequest">
  <part name="vehicle" type="xsd1:vehicleType"/>
  <part name="name" type="xsd:string"/>
  <part name="parkTime" type="xsd:string" />
</message>
...
<portType name="parkingLotMeter">
  <operation name="register">
    <input name="parkedCar" message="tns:ticketRequest"/>
    ...
  </operation>
...
</portType>
...
```

When the router reconstructs the message, it the input message's name, given in the `input` element, as the name of the XML document's root element. It uses the message parts and the schema types to recreate the remaining elements in the XML document. The resulting XML document would look like Example 10.

Example 10: *Router Message*

```
<ns1:parkedCar xmlns:ns1="vehicle.demo.example">
  <vehicle>
    <VIN>0123456789</VIN>
    <model>Prius</model>
  </vehicle>
  <name>Old MacDonald</name>
  <time>19:00</time>
</ns1:parkedCar>
```

Using element names

You can configure the transformer to use the element name of the message parts instead of the value of the `part` element's `name` attribute. For more information see Configuring and Deploying Artix Solutions.

Specifying Evaluation Expressions

Overview

The router uses expressions to evaluate a message's content and route it. These expressions are written using the XPath grammar.

Writing XPath expressions

XPath is a standard grammar for addressing the parts of an XML document. The Artix router uses XPath expressions to extract the content of a message for evaluation. For example, if you wanted to write an XPath expression to extract the data stored in the `model` element of the XML document in Example 10 you could use the XPath expression `parkedCar\vehicle\model` which translates into select the `model` element whose parent is a `vehicle` element and has a `parkedCar` element as a parent.

You could also use the XPath expression `\\model` which translates into select all of the `model` elements that are a descendent of the root element. If there were multiple `model` elements, the expression would select them all and return a string representing the node set of `model` elements.

For more information on XPath see the specification at http://www.w3.org/TR/xpath or see the tutorial at http://www.w3schools.com/xpath.

Adding expressions to a contract

You add an expression to your contract using a `routing:expression` element. The `routing:expression` element requires the two attributes described in Table 5.

Table 5: *Required Attributes for routing:expression*

Attribute	Description
`name`	Specifies a unique identifier by which the expression is referred to when used in a route definition.
`evaluator`	Specifies the type of expression being used to select the content.

Note: XPath is the only supported grammar and is specified using the string `xpath`.

Example

Example 11 shows an example of adding an expression to an Artix contract.

Example 11: *Expression in an Artix Contract*

```
<routing:expression name="widgetSize" evaluator="xpath">
  /*/widgetOrderform/type
</routing:expression>
```

The expression selects the `type` child element of the `widgetOrderForm` element in the message. The `widgetOrderForm` element is not the root element of the message. It is generated from one of the `part` elements defined in the contract.

Adding a Content-Based Rule to a Route

Using expressions in a route

To use the expression to route messages, you need to add it to the route. This is done using the `routing:query` element. The `routing:query` element is a child of the `routing:route` element and must follow a single `routing:source` element. It has one attribute, `expression`, that specifies the name of the expression used to select a destination endpoint.

Specifying destinations for a content based routing rule

The destinations that can be selected by the expression are specified using `routing:destination` elements that are children of the `routing:query` element. When used in content-based routing rules, the `routing:destination` elements use the `value` attribute. The `value` attribute specifies the value of the expression that will select the destination endpoint.

For example, the route shown in Example 12 specifies a content-based routing rule that uses the expressing defined in Example 11 and has three possible destination endpoints.

Example 12: *Content-Based Routing Rule*

```
<routing:route name="sizeRoute">
  <routing:source service="tns:orderService" />
  <routing:query expression="tns:widgetSize">
    <routing:destination value="small"
                         service="tns:smallService" />
    <routing:destination value="med" service="tns:medService" />
    <routing:destination value="big" service="tns:bigService" />
  </routing:query>
</routing:route>
```

If the value of the message's `type` element is `med`, the message will be routed to the endpoint defined by the contract's `service` element whose `name` attribute equals `medService`.

Adding a default destination

To add a default destination for a content based routing rule, you simply add a `routing:destination` element after the `routing:query` element. If none of the destination endpoints specified by the content-based routing rule are

selected, the first destination after the `routing:query` element is selected. Example 13 shows a content-based routing rule with a default destination endpoint.

Example 13: *Content-Based Routing Rule with a Default Destination*

```
<routing:route name="sizeRoute">
  <routing:source service="tns:orderService" />
  <routing:query expression="tns:widgetSize">
    <routing:destination value="small"
                         service="tns:smallService" />
    <routing:destination value="med" service="tns:medService" />
    <routing:destination value="big" service="tns:bigService" />
  </routing:query>
  <routing:destination service="tns:miscService" />
</routing:route>
```

CHAPTER 7

Using Advanced Routing Features

The router has a number of advanced features that use multiple destinations.

Overview

Artix routing also supports the following advanced routing capabilities:

- Load balancing between a number of endpoints.
- Broadcasting a message to a number of destinations.
- Specifying a failover service to which messages are routed.

All of these features use the optional `multiRoute` attribute on the `rotuing:route` element.

In this chapter

This chapter discusses the following topics:

Load Balancing

Overview

The router can load balance requests across a number of endpoints without requiring any special configuration or programming. It uses a round-robin algorithm to route requests, that match a routing rule, to one of the specified destination endpoints.

Specifying router based load balancing

Router-based load balancing rules are defined using the `routing:route` element's `multiRoute` attribute. To define a failover route you set the `multiRoute` attribute to `loadBalance`. Within the route definition you define a message source as you would for any other route. You also specify a number of destination endpoints to which messages will be routed. Using a round-robin algorithm the router will direct each request from the source endpoint to one of the specified destination endpoints.

Example

For example, if you had three endpoints that could process requests for baseball scores and wanted to balance the request load among them, you could create a route similar to the one shown in Example 14.

Example 14: *Router Based Load Balancing*

```
<routing:route name="scoreRoute" nultiRoute="loadBalance">
  <routing:source service="tns:baseballGameService"
                  port="tns:baseballGamePort"/>
  <routing:operation name="getScore"/>
  <routing:destination service="tns:baseballScoreService1"
                       port="tns:baseballScorePort"/>
  <routing:destination service="tns:baseballScoreService2"
                       port="tns:baseballScorePort"/>
  <routing:destination service="tns:baseballScoreService3"
                       port="tns:baseballScorePort"/>
</routing:route>
```

Using this route, each time a new request was received for the `getScore` operation, the router would direct it to whichever endpoint was next in the rotation. So, the first request would be routed to `baseballScoreService1`, the second request would be routed to `baseballScoreService2`, the third request would be routed `baseballScoreService3`, and so forth.

Message Broadcasting

Overview

Using the router, you can broadcast a message to multiple endpoints. For example, you could deploy an endpoint whose function is to generate shutdown warnings to all services deployed in a network. You could simplify the development of this service by using an Artix router to intercept a single warning message and broadcast it to the other services. In this way, you would only need to change the router's contract when you add or remove services.

Defining broadcasting rules

You define rules by setting the `multiRoute` attribute in the `routing:route` element to `fanout` in your route definition. This causes routed messages to be transmitted to all of the endpoints specified by the route's `routing:destination` elements.

There are three restrictions to using the fanout method of message broadcasting:

- All of the source endpoints and destination endpoints must be oneways. In other words, they cannot have any output messages.
- The source endpoints and destination endpoints cannot have any fault messages.
- The input messages of the source endpoints and destination endpoints must meet the compatibility requirements as described in "Compatibility of Ports and Operations" on page 25.

Example

Example 15 shows an Artix contract fragment describing a route for broadcasting a message to a number of endpoints.

Example 15: *Fanout Broadcasting*

```
<message name="statusAlert">
  <part name="alertType" type="xsd:int"/>
  <part name="alertText" type="xsd:string"/>
</message>
```

Example 15: *Fanout Broadcasting*

```
<portType name="statusGenerator">
  <operation name="eventHappens">
    <input message="tns:statusAlert" name="statusAlert"/>
  </operation>
</portType>
<portType name="statusChecker">
  <operation name="eventChecker">
    <input message="tns:statusAlert" name="statusAlert"/>
  </operation>
</portType>
<service name="statusGeneratorService">
  <port binding="tns:statusGeneratorBinding"
        name="statusGeneratorPort">
    <soap:address location="http:\\localhost:8081"/>
  </port>
</service>
<service name="statusCheckerService">
  <port binding="tns:statusCheckerBinding"
        name="statusCheckerPort1">
    <corba:address location="file:\\status1.ref"/>
  </port>
  <port binding="tns:statusCheckerBinding"
        name="statusCheckerPort2">
    <tuxedo:server>
      <tuxedo:service name="personalInfoService">
        <tuxedo:input operation="infoRequest"/>
      </tuxedo:service>
    </tuxedo:server>
  </port>
</service>
<routing:route name="statusBroadcast" multiRoute="fanout">
  <routing:source service="tns:statusGeneratorService"
                  port="tns:statusGeneratorPort"/>
  <routing:operation name="eventHappens" target="eventChecker"/>
  <routing:destination service="tns:statusCheckerService"
                       port="tns:statusCheckerPort1"/>
  <routing:destination service="tns:statusCheckerService"
                       port="tns:statusCheckerPort2"/>
</routing:route>
```

Failover Routing

Overview

The Artix router can provide a basic level of high-availability by allowing you to create routes that define failover scenarios. The router will automatically redirect messages to a new endpoint if the current destination fails. The router will attempt to send a request to all the destinations in a route before throwing an exception back to the client.

Defining the failover rules

To define a failover route you set the `routing:route` element's `multiRoute` attribute to `failover`. When you designate a route as failover, the routed message's target is selected using a round-robin algorithm. If the first target in the list is unable to receive the message, it is routed to the second target. The route will traverse the destination list until either one of the target services can receive the message or the end of the list is reached. On the next failure, the router will start searching from the last position on the list. So if the message was routed to the second entry on the list to deal with an initial failure, the router will start directing requests to the third entry on the list to handle the second failure. When the end of the list is reached, the router will start at the beginning again. If the router is unsuccessful in delivering a message after trying each service in the failover route once, the router will report that the message is undeliverable.

Example

Given the route shown in Example 16, the message will first be routed to `destinationPortA`. If service on `destinationPortA` cannot receive the message, it is routed to `destinationPortB`.

Example 16: *Failover Route*

```
<routing:route name="failoverRoute" multiRoute="failover">
  <routing:source service="tns:sourceService"
                  port="tns:sourcePort"/>
  <routing:destination service="tns:destinationServiceA"
                       port="tns:destinationPortA"/>
  <routing:destination service="tns:destinationServiceB"
                       port="tns:destinationPortB"/>
  <routing:destination service="tns:destinationServiceC"
                       port="tns:destinationPortC"/>
</routing:route>
```

If `destinationPortB` fails at some future point, the messages are then routed to `destinationPortC`. If `destinationPortC` cannot receive messages, the router will then try `destinationPortA`. If `destinationPortA` is not available, the router will try `destinationPortB`. If `destinationPortB` is unavailable, the router will report that the message cannot be delivered.

Linking Routes

It is possible to create complex routes by linking together several types of routes.

Overview

There are occasions, particularly when using content-based routing or using one of the multi-endpoint routing features, when you need to link together a number of routing criteria. Using the routing service you can do this by linking together a number of routes. For example, you may want to route orders for customers in Brazil to a local endpoint, but you also want the orders to automatically fail-over to a alternative endpoint. You can do this by creating a content-based route that specifies a fail-over route as a destination.

Specifying a route as a destination

You link routes together by specifying one route as the destination of another route. When the destination specifying the linked route is selected, the message is passed through the second route to determine its destination. The second route may also contain destinations that contain linked routes. The message will pass through each linked route in order until a destination containing an endpoint is selected.

To specify a linked route as a destination you replace the `service` attribute and the `port` attribute in a `routing:destination` element with the `route` attribute. The value of the `route` attribute must correspond to the name of another route in the contract. The specified route becomes linked with the destination and any message that selects this destination will be processed through it.

Example

Imagine that your company had order processing centers in several cities and you needed to route orders to the processing center closest to the delivery address. You could implement this using a content-based route as shown in Example 17.

Example 17: *Content-Based Route*

```
<routing:expression name="zipCode" evaluator="xpath">
  tns:placeWidgetOrder/widgetOrderForm/shippingAddress/zipCode
</routing:expression>
<routing:route name="zipCodeRoute">
  <routing:source service="tns:widgetOrderService"
                  port="tns:SOAPPort" />
  <routing:query expression="tns:zipCode">
    <routing:destination value="02452"
                         service="tns:widgetOrderServiceEast"
                         port="walthamPort" />
    <routing:destination value="91105"
                         service="tns:widgetOrderServiceWest"
                         port="passadenaPort" />
  </routing:query>
</routing:route>
```

If you needed to add a fail-over mechanism to ensure that the orders were processed by a different processing center in the event of a failure, you could simply add two linked routes for the destination of the content-based route as shown in Example 18.

Example 18: *Linked Routes*

```
<routing:expression name="zipCode" evaluator="xpath">
  tns:placeWidgetOrder/widgetOrderForm/shippingAddress/zipCode
</routing:expression>
<routing:route name="walthamRoute" multiRoute="failover">
  <routing:destination service="tns:widgetOrderServiceEast"
                       port="walthamPort" />
  <routing:destination service="tns:widgetOrderServiceWest"
                       port="passadenaPort" />
</routing:route>
```

Example 18: *Linked Routes*

```
<routing:route name="passadenaRoute" multiRoute="failover">
  <routing:destination service="tns:widgetOrderServiceWest"
                       port="passadenaPort" />
  <routing:destination service="tns:widgetOrderServiceEast"
                       port="walthamPort" />
</routing:route>
<routing:route name="zipCodeRoute">
  <routing:source service="tns:widgetOrderService"
                  port="tns:SOAPPort" />
  <routing:query expression="tns:zipCode">
    <routing:destination value="02452"
                         route="tns:walthamRoute" />
    <routing:destination value="91105"
                         route="tns:passadenaRoute" />
  </routing:query>
</routing:route>
```

Example 18 expands on Example 17 by adding two routes: `walthamRoute` and `passadenaRoute`. Both of these routes will not perform any routing on their own because they lack `routing:source` elements. They are instead used as destinations for the content-based route called `zipCodeRoute`. In Example 17, the content-based route simply routed to one endpoint for each destination. In Example 18, the route's destinations are linked routes. If the first destination is selected, the message is routed through the fail-over route `walthamRoute`. If the second destination is selected, the message is routed through the fail-over route `passadenaRoute`.

CHAPTER 9

Creating Routes Using Artix Tools

Artix provides both GUI and command-line tools for creating routes.

In this chapter

This chapter discusses the following topics:

Creating Routes with Artix Designer

Overview

The Artix Designer provides wizards for creating and editing routes in your contracts. It also creates the artifacts needed to deploy an instance of the routing service to implement the routes.

Creating a route

To add a new route to a contract you select **Artix Designer|New Route** from the Designer's menu. This starts a wizard that walks you through the process of creating a new route. The route wizard uses the information in the current contract to populate the required fields to assist in creating valid routes.

Editing a route

To edit a route using Artix Designer you use the **Edit Route...** option from the context menu available when a route is selected. This option opens the route wizard populated with the settings for the selected route. You edit the route by changing the values.

Deploying the routing service

The designer provides two ways of deploying an instance of the routing service:

- Create a project that deploys a router using the **Artix Router** template.
- Selecting the **Router** radio button when configuring the deployment options for your project.

More information

For a detailed discussion of using the Artix Designer see the Designer's on-line help. It is accessible by selecting **Help|Help Contents** from the Designer's menu.

Creating Routes from the Command Line

Overview

If you do not wish to use the Artix Designer or want to add routes to contracts as part of a makefile, you can use the `wsdltorouting` command line tool. `wsdltorouting` will import an existing contract and generate a new contract containing the specified routing instructions. The imported contract must contain the specified source endpoint and destination endpoint, otherwise the tool will generate an error.

Usage

To generate a route using the command line tool, use the following command.

```
wsdltorouting [-rn name][-ssn service][-spn port]
              [-dsn service][-dpn port][-on operation]
              [-ta attribute] [-d dir][-o file]
              [-L file][-quiet][verbose][-h][-v] wsdlurl
```

`wsdltorouting` has the following options.

`-rn` *`name`*	Specifies the name of the generated route. If no name is given a unique name will be generated for the route.
`-ssn` *`service`*	Specifies the name of the `service` element to use as the source of the route.
`-spn` *`port`*	Specifies the name of the `port` element to use as the source of the route.
`-dsn` *`service`*	Specifies the name of the `service` element to use as the destination of the route.
`-dpn` *`port`*	Specifies the name of the `port` element to use as the destination of the route.
`-on` *`operation`*	Specifies the name of the operation to use for the route. If the route is port-based, you do not need to use this flag.
`-ta` *`attribute`*	Specifies a transport attribute to use in defining the route. For details on how to specify the transport attributes, see "Specifying transport attributes" on page 64.
`-d` *`dir`*	Specifies the output directory for the generated contract.
`-o` *`file`*	Specifies the filename of the generated contract.

`-L file`	Specifies the location of your Artix license file. The default behavior is to check `IT_PRODUCT_DIR\etc\license.txt`.
`-quiet`	Specifies that the tool runs in quiet mode.
`-verbose`	Specifies that the tool runs in verbose mode.
`-h`	Displays the tool's usage statement.
`-v`	Displays the tool's version.

Specifying transport attributes

When using `wsdltorouting`, transport attributes are specified using four comma-separated values. The first value specifies the name of the attribute's context. The second value specifies the name of the attribute. The third value is the condition used to evaluate the attribute. The fourth value is the values against which the attribute is evaluated.

Table 6 shows the valid context names to use in specifying a transport attribute.

Table 6: *Context Names Used with wsdltorouting*

Context Name	Artix Context
`HTTP_SERVER_INCOMING_CONTEXTS`	HTTP properties received as part of a client request
`CORBA_CONTEXT_ATTRIBUTES`	CORBA transport properties
`SECURITY_SERVER_CONTEXT`	Properties used to configure security settings

For more information on the properties available in the contexts see either Developing Artix Applications in C++ or Developing Artix Applications in Java.

Table 7 shows the valid condition entries used in specifying transport attributes when using `wsdltorouting`.

Table 7: *Conditions Used with wsdltorouting*

Condition	WSDL Equivalent
`equals`	routing:equals
`startswith`	routing:startswith

Table 7: *Conditions Used with wsdltorouting*

Condition	WSDL Equivalent
endswith	routing:endswith
contains	routing:contains
empty	routing:empty
nonempty	routing:nonempty
greater	routing:greater
less	routing:less

Example

If you had a contract that contained the services `itchy` and `scratchy`, both with an equivalent operation `gouge`, you could use the command shown in Example 19 to add a route to your contract.

Example 19: *Adding a Route with wsdltorouting*

```
wsdltorouting -rn itchyGougeScratchy -ssn itchy -spn gougerPort
        -dsn scratchy -dpn gougedPort -on gouge
        -ta HTTP_SERVER_INCOMING_CONTEXTS,UserName,equals,Goering
        itchyscratchy.wsdl
```

The resulting route is shown in Example 20.

Example 20: *Route from wsdltorouting*

```
<routing:route name="itchyGougeScratchy">
  <routing:source service="tns:itchy"
                  port="tns:gougerPort"/>
  <routing:operation name="gouge"/>
  <routing:transportAttributes>
    <routing:equals
              contextName="http-conf:HTTPServerIncomingContexts"
              contextAttributeName="UserName"
              value="Goering"/>
  </routing:transportAttributes>
  <routing:destination service="tns:scratchy"
                       port="gougedPort"/>
</routing:route>
```

CHAPTER 10

Deploying an Artix Router

An instance of the Artix router can be deployed either as part of an application's configuration or directly into an Artix container.

In this chapter

This chapter discusses the following topics:

Enabling Artix Routing

Overview

There are two approaches to enabling an Artix router:

- Using configuration variables.
- Using an Artix deployment descriptor.

Using configuration

You can configure an Artix router by adding the `routing` plug-in to the `orb_plugins` list, and specifying the location of the contract using the `plugins:routing:wsdl_url` entry. See "Configuring an Artix Router" on page 70 for full details.

This configuration-based approach can be used with an Artix container. Alternatively, you can also deploy a router into any Artix process. For example, this might be useful if you want to write CORBA clients and use Artix APIs.

You can also specify additional configuration variables to optimize performance. See "Optimizing Router Performance" on page 77.

Using a deployment descriptor

You can only use a deployment descriptor to define routes if you are using the container to host the router. The advantage of this approach is that you do not need a dedicated configuration scope.

Another advantage to this approach is that you can deploy additional routes into the process without stopping and restarting the host process, which would be necessary in the configuration approach.

When using the deployment descriptor approach, you must deploy each router instance separately; whereas with the configuration approach, all router instances are loaded automatically on startup. See "Deploying a Router Using a Deployment Descriptor" on page 73 for full details.

Selecting a host process

Although any Artix process can be used for Artix routing, the preferred approach is to use the Artix container as the host process.

When using the Artix container server process (`it_container`), you have the option of using either the configuration approach, or the deployment descriptor approach.

In addition, you can also use the container's client application (`it_container_admin`) to manage the deployed route.

Note: If you use an Artix client or server process to host the `routing` plug-in, you can only use configuration to specify routing details. You can not use a deployment descriptor.

Disabling a router

To undeploy a router, you must stop and restart the process hosting the router. This applies to both the configuration and deployment descriptor approach.

Using the configuration approach, you must edit the `plugins:routing:wsdl_url` entry, removing the contract describing the routes you wanted to undeploy.

Using the deployment descriptor approach, you would then either not redeploy that particular contract, or you would remove its corresponding deployment descriptor from the persistent deployment directory. See Configuring and Deploying Artix Solutions for full details.

Configuring an Artix Router

Overview

Because Artix's routing functionality is implemented as an Artix plug-in, you can make any Artix application a router by adding routing rules to its contract, and by specifying configuration settings in an Artix configuration file.

This section explains how to configure the `routing` plug-in, and specify the location of the router's contract.

Setting the orb_plugins list

Artix routers must include the `routing` plug-in name in its `orb_plugins` list, for example:

```
orb_plugins = ["xmlfile_log_stream", "soap", "at_http", ... ,
   "routing"];
```

Note: You do not need to add the `routing` plug-in if you have defined routes in a deployment descriptor (see "Deploying a Router Using a Deployment Descriptor" on page 73).

Plug-ins related to bindings, and transports are not required. These are loaded automatically when the `routing` plug-in parses the contract.

Note: The `routing` plug-in must always be the last plug-in listed in the `orb_plugins` list.

Setting the WSDL contract

You must configure the location of the contract, or contracts, that the router gets its routing information from. You can do this using the `plugins:routing:wsdl_url` variable. This variable specifies the contracts that the router parses for routing rules. The following is a simple example:

```
plugins:routing:wsdl_url="../../etc/router.wsdl";
```

The location of the contract is relative to the location from which the Artix router is started.

The following example contains multiple routing contracts:

```
plugins:routing:wsdl_url=["route1.wsdl", "../route2.wsdl",
                          "/artix/routes/route3"];
```

In this example, the router expects that `route1.wsdl` is located in the directory that it was started in, and that `route2.wsdl` is located one directory level higher.

Defining a single route in configuration

This is the simple approach used by the `routing` demos (for example, `routing\operation_based`).

Run the host process under a dedicated configuration scope. In this scope, include the `routing` plug-in name in the `orb_plugins` list, and use the `plugins:routing:wsdl_url` variable to specify the location the contract containing the routing rules.

The required configuration is illustrated in Example 21, where `demos.operation_based.router` is the scope under which the host process runs.

Example 21: *Simple Router Configuration*

```
demos {
 operation_based {
    orb_plugins = ["xmlfile_log_stream", "soap", "at_http"];

     router {
      #the routing plug-in implements the routing functionality
      orb_plugins = ["routing"];
```

Example 21: *Simple Router Configuration*

```
      #the path to the WSDL file that includes the routing element
       plugins:routing:wsdl_url="../../etc/route.wsdl";
     };
   };
};
```

This router can then be deployed in the container server using the following command:

```
it_container -ORBname demos.operation_based.router
   -ORBdomain_name operation_based  -ORBconfig_domains_dir
   ../../etc -publish
```

Defining multiple routes in configuration

There are two approaches to using configuration to deploy multiple routes into the same host process. The first is to specify multiple routes in a single contract. Using this approach the configuration is the same as that shown in Example 21. Using this approach sacrifices the modularity of your routes for ease of configuration.

The second approach is to place your routes in multiple contracts. Using this approach you must list multiple entries for the `plugins:routing:wsdl_url` variable, as shown in the following example:

```
plugins:routing:wsdl_url= ["../../etc/route1.wsdl",
   "../../etc/route2.wsdl"];
```

In this case, each contract may include one, or more, routes. When listing multiple contracts, use the list format for specifying configuration variables

Further information

For details of optional router configuration settings, see "Optimizing Router Performance" on page 77.

For details of all the configuration options available for the `routing` plug-in, see the Artix Configuration Reference.

Deploying a Router Using a Deployment Descriptor

Overview

This section explains how to deploy a router into an Artix container using a deployment descriptor. This approach is illustrated in the `advanced\container\deploy_routes` demo.

Defining multiple routes

In the `deploy_routes` demo, the Artix container process starts under the global configuration scope defined in the `artix.cfg` configuration file.

Note: In this case, the `routing` plug-in is not loaded during startup because it is not listed in the `orb_plugins` configuration entry.

The extract shown in Example 22 is from one of the contracts used in the `advanced\container\deploy_routes` demo.

Example 22: *Deploy Routes Contract*

```
<?xml version="1.0" encoding="UTF-8"?>
<definitions name="BaseService"
    targetNamespace="http://www.iona.com/bus/demos/router"
    xmlns="http://schemas.xmlsoap.org/wsdl/"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    xmlns:tns="http://www.iona.com/bus/demos/router"
    xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
    xmlns:corba="http://schemas.iona.com/bindings/corba"
    xmlns:routing="http://schemas.iona.com/routing">

    <portType name="GoodbyeServicePortType">
       <operation name="say_goodbye">
           <input message=… name=…/>
           <output message=… name=…/>
       </operation>
    </portType>
```

Example 22: *Deploy Routes Contract*

```
    <binding name="SOAPGoodbyeServiceBinding" type="tns:GoodbyeServicePortType">
        <soap:binding style="rpc" transport="http://schemas.xmlsoap.org/soap/http"/>
        <operation name="say_goodbye">
            <soap:operation …/>
             …
        </operation>
    </binding>

    <binding name="CORBAGoodbyeServiceBinding" type="tns:GoodbyeServicePortType">
        <corba:binding repositoryID="IDL:GoodbyeServicePortType:1.0"/>
            <operation name="say_goodbye">
            …
           </operation>
    </binding>

    <service name="SOAPHTTPService">
        <port binding="tns:SOAPGoodbyeServiceBinding" name="SOAPHTTPPort">
            <soap:address location=…/>
        </port>
    </service>

    <service name="CORBASoapService">
        <port binding="tns:CORBAGoodbyeServiceBinding" name="CORBASoapPort">
            <corba:policy poaname=…/>
            <corba:address location=…/>
        </port>
    </service>

    <routing:route name="CorbaToSoap">
        <routing:source port="CORBASoapPort" service="tns:CORBASoapService"/>
        <routing:destination port="SOAPHTTPPort" service="tns:SOAPHTTPService"/>
    </routing:route>
</definitions>
```

The corresponding deployment descriptor is shown in Example 23.

Example 23: *Deploy Routes Deployment Descriptor*

```
<?xml version="1.0" encoding="utf-8"?>
<m1:deploymentDescriptor xmlns:m1="http://schemas.iona.com/deploy">

   <service xmlns:servicens="http://www.iona.com/bus/demos/router"> servicens:CORBASoapService
   </service>

   <wsdl_location>
    ../../routes/soap_route.wsdl
   </wsdl_location>

   <plugin>
      <name>routing</name>
      <type>Cxx</type>
      <implementation>it_routing</implementation>
      <provider_namespace>
          http://schemas.iona.com/routing
      </provider_namespace>
   </plugin>
</m1:deploymentDescriptor>
```

In the example deployment descriptor, the opening `service` element specifies the `targetNamespace` as an attribute and the source service name as the element value. This information links the deployment descriptor to a specific service. The `wsdl_location` element provides the path to the contract that includes the related route. The `plugin` element includes the information needed to load the `routing` plug-in.

In the `advanced\container\deploy_plugin` demo, each contract includes only one route. However, a contract can include multiple routes and be referenced in the `wsdl_location` element in multiple deployment descriptors. In this scenario, each deployment descriptor uniquely identifies a source service using the content in the opening `service` element.

Deploying multiple routes

In the `deploy_routes` demo, the container client application (`it_container_admin`) is used to deploy two routes, each of which is specified in a dedicated deployment descriptor file. For example:

```
it_container_admin -deploy -file
   ../../routes/deployCORBASoapService.xml
it_container_admin -deploy -file
   ../../routes/deployCORBAHTTPService.xml
```

Each deployment descriptor describes a single router, which is identified by the `targetNamespace` assigned to the contract that contains the route and the name of the source service.

Specifying persistent deployment

With the deployment descriptor approach, you can specify a persistent deployment directory. When you initially deploy each contract, a copy of the deployment descriptor is placed into this directory.

When you restart the container, it automatically redeploys all the contracts identified in these deployment descriptors. In this case, the effect is the same as the configuration approach (that is, all routes are deployed during the startup).

Further information

For more details on the Artix container, deployment descriptors, and persistent deployment, see *Deploying Artix Solutions*.

For working examples of the `routing` plug-in deployed in an Artix container, see any of the demos in the following directory:

InstallDir\\artix*Version*\demos\routing

Alternatively, for a more advanced example, see:

InstallDir\artix*Version*\demos\advanced\container\deploy_routes

Optimizing Router Performance

Overview

This section describes how to configure the following router optimizations in an Artix configuration file:

- Setting router pass-through
- Setting CORBA bypass

Setting router pass-through

By default a router instance to passes along messages without processing if the source and destination of the route use the same binding. You can change this behavior by setting `plugins:routing:use_pass_through` to `false`.

When the router passes a message in its default pass-through mode it copies the message buffer directly from the source endpoint to the destination endpoint. This has a number of implications:

- Reference proxification does not occur.
- Request level handlers are not called.
- Server-side message level handlers are not called.
- Authentication and authorization are skipped regardless of the security settings.

If you want all messages to go through the router and be fully processed, set this variable to `false`.

WARNING: Do *not* enable pass-through in a secure router. When pass-through is enabled, the authentication and authorization steps are skipped. Therefore, you must always set `plugins:routing:use_pass_through` to `false` in a secure router. See IONA Security Advisory, ISA130905.

Setting CORBA bypass

For CORBA integrations, you can use location forwarding to connect CORBA clients directly to CORBA servers, and thus bypass the Artix `routing` plug-in entirely.

Set the `plugins:routing:use_bypass` configuration variable to `true` to specify that the router sends CORBA `LocateReply` messages back to the client. The default is `false`.

Further information

For more information on Artix router optimizations, see the Artix Configuration Reference.

CHAPTER 11

Routing Messages Containing Endpoint References

When routing messages containing endpoint references Artix creates proxies for the referenced endpoint.

In this chapter

This chapter discusses the following topics:

Service Lifecycles

Overview

When the Artix router uses dynamic proxy services, you can configure garbage collection of old proxies. Dynamic proxies are used when the router bridges endpoints that have patterns such as callback, factory, or any interaction that passes references to other endpoints. When the router encounters a reference in a message, it proxifies the reference into one that a receiving application can use. For example, an IOR from a CORBA server cannot be used by a SOAP client, so the router dynamically creates a new route for the SOAP client.

However, dynamic proxies persist in the router memory and can have a negative effect on performance. To overcome this, Artix provides service life cycle garbage collection, which cleans up old proxy services that are no longer used. This garbage collection service cleans up unused proxies when a threshold has been reached on a least recently used basis.

Configuring service lifecycle

To configure service garbage collection for the Artix router, perform the following steps:

1. Add the `service_lifecycle` plug-in to the `orb_plugins` list:

```
orb_plugins = ["xmlfile_log_stream", "service_lifecycle",
   "routing"];
```

2. Configure the service lifecycle cache size:

```
plugins:service_lifecycle:max_cache_size = "30";
```

Writing client applications

When writing client applications, you must also make allowances for the garbage collection service; in particular, ensure that exceptions are handled appropriately.

For example, a client might attempt to proxify to an endpoint that has already been garbage collected. To prevent this, do either of the following:

- Handle the exception, get a new reference, and continue. However, in some cases, this might not be possible if the endpoint has state.
- Set `max_cache_size` to a reasonable limit to ensure that all your clients can be accommodated. For example, if you always expect to support 20 concurrent clients, each with a transient service session, you might wish to configure the `max_cache_size` to `30`.

You do not want to impact any clients, and must ensure that an endpoint is no longer needed when it is garbage collected. However, if you set `max_cache_size` too high, this might use up too much router memory and have a negative impact on performance. For example, a suggested range for this setting is `30-100`.

Routing References to Transient Servants

Overview

Applications create transient servants by cloning a `service` element defined in your contract. The cloned `service` element uses the same interface, binding, and transport as the `service` element in the contract. However, it has a unique QName and a unique address. So, a transient servant's `service` element only exists in the memory of the application that created it and possesses no link back to the `service` element from which it was cloned.

Because a transient servant does not have a `service` element in the physical contract and no link to one, the router, when it receives a reference to a transient servant, has no concrete information about how to create a proxy for the referenced servant. The router must make a best guess about which `service` element in its contract to use as the template for the proxy to the transient servant. To do this, the router chooses the first compatible `service` element in its contract.

Compatibility of services

A `service` element is considered compatible with a transient servant if it uses the same interface, binding, and transport as the transient servant. For example, if a transient servant was created using the `service` element, whose `name` attribute is set to `templateVendor`, in Example 24 it would be compatible with `IIOPVendor`. However, it would not be compatible with `SOAPVendor` because `SOAPVendor` uses a different transport than `templateVendor`. Also, if `IIOPVendor` was defined using different transport properties, such as having a defined POA name, transient servants created from `templateVendor` would not be compatible.

Example 24: *Contract with a Service Template*

```
<definitions ...>
  ...
  <message name="mangoRequest">
    <part name="num" type="xsd:int"/>
  </message>
  <message name="mangoPrice">
    <part name="cost" type="xsd:float"/>
  </message>
```

Example 24: *Contract with a Service Template*

```
  <portType name="fruitVendor">
    <operation name="sellMangos">
      <input name="num" message="tns:mangoRequest"/>
      <output name="price" message="tns:mangoPrice"/>
    </operation>
  </portType>
  <binding name="fruitVendorBinding" type="tns:fruitVendor">
    <soap:binding style="rpc"
                transport="http://schemas.xmlsoap.org/soap/http"/>
    <operation name="sellMangos">
      <soap:operation soapAction="" style="rpc"/>
      <input name="num">
        <soap:body
       encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
        namespace="http://fruitVendor.com" use="encoded"/>
      </input>
      <output name="cost">
        <soap:body
       encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
        namespace="http://fruitVendor.com" use="encoded"/>
      </output>
    </operation>
  </binding>
  <service name="templateVendor">
    <port binding="tns:fruitVendorBinding"
          name="transientVendor">
      <iiop:address location="ior:"/>
    </port>
  </service>
  <service name="SOAPVendor">
    <port binding="tns:fruitVendorBinding"
          name="SOAPVendorPort">
      <soap:address location="lcoalhost:5150"/>
    </port>
  </service>
  <service name="IIOPVendor">
    <port binding="tns:fruitVendorBinding"
          name="IIOPVendorPort">
      <iiop:address location="file:///objref.ior"/>
    </port>
  </service>
</definitions>
```

Contract design issues

The router's means of selecting a compatible `service` element to create proxies for transient servants can result in odd behavior if you use the same interface to create both static servants and transient servants. When passing references to these servants through the router, the potential exists for the router to select the static servant to create proxies for the transient servants. When this happens, the router will silently redirect all of the messages to the servant defined by the static `service` element.

To avoid this situation be sure to place the `service` elements used to create transient servants before the `service` elements that will be used to create static servants. This will ensure that the router will find the transient servant's `service` elements.

Preventing bloat

Because the router creates a new proxy for each transient reference that passes through it, the router can suffer from memory bloating. To prevent bloating, you can specify two properties in the router's runtime configuration:

- the maximum number of proxified references the router maintains
- the maximum number of unproxified references the router maintains

The `plugins:routing:proxy_cache_size` variable specifies the number of proxified references the router maintains. The default is 50.

The `plugins:routing:reference_cache_size` variable specifies number of unproxified server references maintained by the router. The default is unbounded.

For example, take a SOAP-HTTP client and CORBA server banking system with 1,500 accounts. By default, the 50 most recently used accounts are present in the router as proxified references. The next 1450 most recently used are unproxified references.

For more information about configuring a router see Configuring and Deploying Artix Solutions.

Error Handling

The routing service reports errors back to the message originator.

Initialization errors

Errors that can be detected when the routing service is initializing, such as routing between incompatible endpoints and some kinds of route ambiguity, are logged and an exception is raised. This exception aborts the initialization and shuts down the service.

Runtime errors

Errors that are detected at runtime are reported as exceptions and returned to the message originator; for example “no route” or “ambiguous routes”.

The destination endpoint does not receive any notification that a message failed to be forwarded to it. If your endpoints require such notification, you need to implement a mechanism to deliver the notification outside the scope of the routed operation.

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