Oracle® Service Architecture Leveraging Tuxedo (SALT)

Programming Guide

11*g* Release 1 (11.1.1.2)

April 2011

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Introduction to Oracle SALT Programming

Data Type Mapping and Message Conversion

Web Service Client Programming

Web Application Server Programming

Oracle Tuxedo ATMI Programming for Web Services

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Oracle SALT SCA Programming

Introduction to Oracle SALT Programming

This section includes the following topics:

- Oracle SALT Web Services Programming
- Oracle SALT SCA Programming

Oracle SALT Web Services Programming

Oracle SALT provides bi-directional connectivity between Oracle Tuxedo applications and Web service applications. Existing Oracle Tuxedo services can be easily exposed as Web Services without requiring additional programming tasks. Oracle SALT generates a WSDL file that describes the Oracle Tuxedo Web service contract so that any standard Web service client toolkit can be used to access Oracle Tuxedo services.

Web service applications (described using a WSDL document) can be imported as if they are standard Oracle Tuxedo services and invoked using Oracle Tuxedo ATMIs from various Oracle Tuxedo applications (for example, Oracle Tuxedo ATMI clients, ATMI servers, Jolt clients, COBOL clients, .NET wrapper clients and so on).

Oracle SALT Proxy Service

Oracle SALT proxy services are Oracle Tuxedo service entries advertised by the Oracle SALT Gateway, GWWS. The proxy services are converted from the Web service application WSDL file. Each WSDL file `wsdl:operation` object is mapped as one SALT proxy service.

The Oracle SALT proxy service is defined using the Service Metadata Repository service definition syntax. These service definitions must be loaded into the Service Metadata Repository. To invoke an proxy service from an Oracle Tuxedo application, you must refer to the Oracle Tuxedo Service Metadata Repository to get the service contract description.

For more information, see "Oracle Tuxedo ATMI Programming for Web Services".

Oracle SALT Message Conversion

To support Oracle Tuxedo application and Web service application integration, the Oracle SALT gateway converts SOAP messages into Oracle Tuxedo typed buffers, and vice versa. The message conversion between SOAP messages and Oracle Tuxedo typed buffers is subject to a set of SALT pre-defined basic data type mapping rules.

When exposing Oracle Tuxedo services as Web services, a set of Tuxedo-to-XML data type mapping rules are defined. The message conversion process conforms to Tuxedo-to-XML data type mapping rules is called "Inbound Message Conversion".

When importing external Web services as SALT proxy services, a set of XML-to-Tuxedo data type mapping rules are defined. The message conversion process conforms to XML-to-Tuxedo data type mapping rules is called "Outbound Message Conversion".

For more information about SALT message conversion and data type mapping, see "Understanding Oracle SALT Message Conversion".

Oracle SALT Programming Tasks Quick Index

Table 1-1 lists a quick index of Oracle SALT programming tasks. You can locate your programming tasks first and then click on the corresponding link for detailed description.

Table 1-1 Oracle SALT Programming Tasks Quick Index

	Tasks	Refer to ...
Invoking Oracle Tuxedo services (inbound) through Oracle SALT	Develop Web service client programs for Oracle Tuxedo services invocation	"Oracle SALT Web Service Client Programming Tips" on page 3-2
	Understand inbound message conversion and data type mapping rules	"Understanding Oracle SALT Message Conversion" on page 2-2 "Tuxedo-to-XML Data Type Mapping for Oracle Tuxedo Services" on page 2-3
	Develop inbound message conversion plug-in	"Programming Message Conversion Plug-ins" on page 6-7
Invoking external Web services (outbound) through Oracle SALT	Understand the general outbound service programming concepts	"Oracle Tuxedo ATMI Programming for Web Services" on page 5-1
	Understand outbound message conversion and data type mapping rules	"Understanding Oracle SALT Message Conversion" on page 2-2 "XML-to-Tuxedo Data Type Mapping for External Web Services" on page 2-29
	Develop outbound message conversion plug-in	"Programming Message Conversion Plug-ins" on page 6-7
	Develop your own plug-in to map Oracle Tuxedo user name with user name for outbound HTTP basic authentication	"Programming Outbound Authentication Plug-Ins" on page 6-17

Oracle SALT SCA Programming

SCA components run on top of the Oracle Tuxedo infrastructure using ATMI binding allowing you to better blend high-output, high-availability and scalable applications in your SOA environment. The Oracle Tuxedo SCA container is built on top of Tuscany SCA Native and Tuscany SDO C++ ((Assembly: 0.96, Client and Implementation Model 0.95) and SDO (2.01)).

The ATMI binding implementation provides native Oracle Tuxedo communications between SCA components as well as SCA components and Oracle Tuxedo programs (clients and servers). Runtime checks are encapsulated in an exception defined in a header (`tuxsca.h`) provided with the ATMI binding. This exception (`ATMIBindingException`), is derived from

`ServiceRuntimeException` (so that programs not aware of the ATMI binding can still catch `ServiceRuntimeException`) and thrown back to the caller.

SCA deployment is handled by the following build commands:

- `buildscaclient`
- `buildscacomponent`
- `buildscaserver`

SCA clients can be stand-alone or part of a server, similar to Oracle Tuxedo ATMI clients. Components are first built using `buildscacomponent` and then Oracle Tuxedo-enabled using `buildscaserver`. SCA administration is performed using common Oracle Tuxedo commands (for example, `tmadmin`), and the `scaadmin` command for SCA-specific tasks.

For more information, see:

- Oracle SALT Administration Guide
- Oracle SALT Reference Guide
- SCA Service Component Architecture Client and Implementation Model Specification for C++

Data Type Mapping and Message Conversion

This topic contains the following sections:

- Overview of Data Type Mapping and Message Conversion
- Understanding Oracle SALT Message Conversion
- Tuxedo-to-XML Data Type Mapping for Oracle Tuxedo Services
- XML-to-Tuxedo Data Type Mapping for External Web Services

Overview of Data Type Mapping and Message Conversion

Oracle SALT supports bi-directional data type mapping between WSDL messages and Oracle Tuxedo typed buffers. For each service invocation, GWWS server converts each message between Oracle Tuxedo typed buffer and SOAP message payload. SOAP message payload is the XML effective data encapsulated within the `<soap:body>` element. For more information, see "Understanding Oracle SALT Message Conversion".

For native Oracle Tuxedo services, each Oracle Tuxedo buffer type is described using an XML Schema in the SALT generated WSDL document. Oracle Tuxedo service request/response buffers are represented in regular XML format. For more information, see "Tuxedo-to-XML Data Type Mapping for Oracle Tuxedo Services".

For external Web services, each WSDL message is mapped as an Oracle Tuxedo FML32 buffer structure. An Oracle Tuxedo application invokes SALT proxy service using FML32 buffers as input/output. For more information see, "XML-to-Tuxedo Data Type Mapping for External Web Services".

Understanding Oracle SALT Message Conversion

Oracle SALT message conversion is the message transformation process between SOAP XML data and Oracle Tuxedo typed buffer. Oracle SALT introduces two types message conversion rules: Inbound Message Conversion and Outbound Message Conversion.

Inbound Message Conversion

Inbound message conversion process is the SOAP XML Payload and Oracle Tuxedo typed buffer conversion process conforms to the "Tuxedo-to-XML data type mapping rules". Inbound message conversion process happens in the following two phases:

- When GWWS accepts SOAP requests for legacy Oracle Tuxedo services;
- When GWWS accepts response typed buffer from legacy Oracle Tuxedo service.

Oracle SALT encloses Oracle Tuxedo buffer content with element `<inbuf>`, `<outbuf>` and/or `<errbuf>` in the SOAP message, the content included within element `<inbuf>`, `<outbuf>` and/or `<errbuf>` is called "Inbound XML Payload".

Outbound Message Conversion

Outbound message conversion process is the SOAP XML Payload and Oracle Tuxedo typed buffer conversion process conforms to the "Tuxedo-to-XML data type mapping rules". Outbound message conferring process happens in the following two phases:

- When GWWS accepts request typed buffer sent from an Oracle Tuxedo application;
- When GWWS accepts SOAP response message from external Web service.

Table 2-1 compares an inbound message conversion process and an outbound message conversion process.

Table 2-1 Inbound Message Conversion vs. Outbound Message Conversion

Inbound Message Conversion	Outbound Message Conversion
SOAP message payload is encapsulated with <inbuf>, <outbuf> or <errbuf>	SOAP message payload is the entire <soap:body>

Table 2-1 Inbound Message Conversion vs. Outbound Message Conversion

Inbound Message Conversion	Outbound Message Conversion
Transformation according to “Tuxedo-to-XML data type mapping rules”	Transformation according to “XML-to-Tuxedo data type mapping rules”
All Oracle Tuxedo buffer types are involved	Only Oracle Tuxedo FML32 buffer type is involved

Tuxedo-to-XML Data Type Mapping for Oracle Tuxedo Services

Oracle SALT provides a set of rules for describing Oracle Tuxedo typed buffers in an XML document as shown in Table 2-2. These rules are exported as XML Schema definitions in SALT WSDL documents. This simplifies buffer conversion and does not require previous Oracle Tuxedo buffer type knowledge.

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`STRING`	Oracle Tuxedo STRING typed buffers are used to store character strings that terminate with a NULL character. Oracle Tuxedo STRING typed buffers are self-describing.	xsd:string In the SOAP message, the XML element that encapsulates the actual string data, must be defined using `xsd:string` directly. **Notes:** • The `STRING` data type can be specified with a max data length in the Oracle Tuxedo Service Metadata Repository. If defined in Oracle Tuxedo, the corresponding SOAP message also enforces this maximum. The GWWS server validates the actual message byte length against the definition in Oracle Tuxedo Service Metadata Repository. A SOAP fault message is returned if the message byte length exceeds supported maximums. • If GWWS server receives a SOAP message other than “UTF-8”, the corresponding string value is in the same encoding.

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

<table>
<tr><th>Oracle Tuxedo Buffer Type</th><th>Description</th><th>XML Schema Mapping for SOAP Message</th></tr>
<tr><td><code>CARRAY (Mapping with SOAP Message plus Attachments)</code></td><td>Oracle Tuxedo <code>CARRAY</code> typed buffers store character arrays, any of which can be NULL. <code>CARRAY</code> buffers are used to handle data opaquely and are not self-describing.</td><td>The <code>CARRAY</code> buffer raw data is carried within a MIME multipart/related message, which is defined in the “SOAP Messages with Attachments’ specification.

The two data formats supported for MIME Content-Type attachments are:
• <code>application/octet-stream</code>
  – For Apache Axis
• <code>text/xml</code>
  – For Oracle WebLogic Server

The format depends on which Web service client-side toolkit is used.

Note: The SOAP with Attachment rule is only interoperable with Oracle WebLogic Server and Apache Axis.

Note: CARRAY data types can be specified with a max byte length. If defined in Oracle Tuxedo, the corresponding SOAP message is enforced with this limitation. The GWWS server validates the actual message byte length against the definition in the Oracle Tuxedo Service Metadata Repository.</td></tr>
</table>

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`CARRAY` `(Mapping with base64Binary)`	Oracle Tuxedo CARRAY typed buffers store character arrays, any of which can be NULL. CARRAY buffers are used to handle data opaquely and are not self-describing.	`xsd:base64Binary` The CARRAY data bytes must be encoded with `base64Binary` before it can be embedded in a SOAP message. Using `base64Binary` encoding with this opaque data stream saves the original data and makes the embedded data well-formed and readable. In the SOAP message, the XML element that encapsulates the actual CARRAY data, must be defined with `xsd:base64Binary` directly. **Note:** CARRAY data type can be specified with a max byte length. If defined in Oracle Tuxedo, the corresponding SOAP message is enforced with this limitation. The GWWS server validates the actual message byte length against the definition in the Oracle Tuxedo Service Metadata Repository.

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`MBSTRING`	Oracle Tuxedo `MBSTRING` typed buffers are used for multibyte character arrays. Oracle Tuxedo `MBSTRING` buffers consist of the following three elements: • Code-set character encoding • Data length • Character array of the encoding.	`xsd:string` The XML Schema built-in type, `xsd:string`, represents the corresponding type for buffer data stored in a SOAP message. The GWWS server only accepts “UTF-8” encoded XML documents. If the Web service client wants to access Oracle Tuxedo services with `MBSTRING` buffer, the mbstring payload must be represented as “UTF-8” encoding in the SOAP request message. **Note:** The GWWS server transparently passes the “UTF-8” character set string to the Oracle Tuxedo service using `MBSTRING` Typed buffer format.The actual Oracle Tuxedo services handles the UTF-8 string. For any Oracle Tuxedo response `MBSTRING` typed buffer (with any encoding character set), The GWWS server automatically transforms the string into “UTF-8” encoding and sends it back to the Web service client.

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`MBSTRING` (cont.)		**Limitation:** Oracle Tuxedo `MBSTRING` data type can be specified with a max byte length in the Oracle Tuxedo Service Metadata Repository. The GWWS server checks the byte length of the converted `MBSTRING` buffer value. **Note:** Max byte length value is not used to enforce the character number contained in the SOAP message.

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`XML`	Oracle Tuxedo XML typed buffers store XML documents.	`xsd:anyType` The XML Schema built-in type, `xsd:anyType`, is the corresponding type for XML documents stored in a SOAP message. It allows you to encapsulate any well-formed XML data within the SOAP message. **Limitation:** The GWWS server validates that the actual XML data is well-formed. It will not do any other enforcement validation, such as Schema validation. Only a single root XML buffer is allowed to be stored in the SOAP body; the GWWS server checks for this. The actual XML data must be encoded using the “UTF-8” character set. Any original XML document prolog information cannot be carried within the SOAP message. XML data type can specify a max byte data length. If defined in Oracle Tuxedo, the corresponding SOAP message must also enforce this limitation. **Note:** The Oracle SALT WSDL generator will not have `xsd:maxLength` restrictions in the generated WSDL document, but the GWWS server will validate the byte length according to the Oracle Tuxedo Service Metadata Repository definition.
`X_C_TYPE`	`X_C_TYPE` buffer types are equivalent to VIEW buffer types.	See `VIEW/VIEW32`

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
X_COMMON	X_COMMON buffer types are equivalent to VIEW buffer types, but are used for compatibility between COBOL and C programs. Field types should be limited to short, long, and string	See VIEW/VIEW32
X_OCTET	X_OCTET buffer types are equivalent to CARRAY buffer types	See CARRAY xsd:base64Binary

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`VIEW/VIEW32`	Oracle Tuxedo VIEW and VIEW32 typed buffers store C structures defined by Oracle Tuxedo applications. VIEW structures are defined by using VIEW definition files. A VIEW buffer type can define multiple fields. VIEW supports the following field types: • `short` • `int` • `long` • `float` • `double` • `char` • `string` • `carray` VIEW32 supports all the VIEW field types and mbstring.	Each VIEW or VIEW32 data type is defined as an XML Schema complex type. Each VIEW field should be one or more sub-elements of the XML Schema complex type. The name of the sub-element is the VIEW field name. The occurrence of the sub-element depends on the count attribute of the VIEW field definition. The value of the sub-element should be in the VIEW field data type corresponding XML Schema type. The the field types and the corresponding XML Schema type are listed as follows: • `short` maps to `xsd:short` • `int` maps to `xsd:int` • `long` maps to `xsd:long` • `float` maps to `xsd:float` • `double` maps to `xsd:double` • `char` (defined as byte in Oracle Tuxedo Service Metadata Repository definition) maps to `xsd:byte` • `char` (defined as char in Oracle Tuxedo Service Metadata Repository definition) maps to `xsd:string` (with restrictions `maxlength=1`) • `string` maps to `xsd:string` • `carray` maps to `xsd:base64Binary` • `mbstring` maps to `xsd:string`

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`VIEW/VIEW32 (cont.)`		For more information, see "VIEW/VIEW32 Considerations" on page 2-23.

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`FML/FML32`	Oracle Tuxedo FML and FML32 type buffers are proprietary Oracle Oracle Tuxedo system self-describing buffers. Each data field carries its own identifier, an occurrence number, and possibly a length indicator. FML supports the following field types: • `FLD_CHAR` • `FLD_SHORT` • `FLD_LONG` • `FLD_FLOAT` • `FLD_DOUBLE` • `FLD_STRING` • `FLD_CARRAY` FML32 supports all the FML field types and `FLD_PTR`, `FLD_MBSTRING`, `FLD_FML32`, and `FLD_VIEW32`.	FML/FML32 buffers can only have basic data-dictionary-like definitions for each basic field data. A particular FML/FML32 buffer definition should be applied for each FML/FML32 buffer with a different type name. Each FML/FML32 field should be one or more sub-elements within the FML/FML32 buffer XML Schema type. The name of the sub-element is the FML field name. The occurrence of the sub-element depends on the count and required count attribute of the FML/FML32 field definition. The e field types and the corresponding XML Schema type are listed below: • `short` maps to `xsd:short` • `int` maps to `xsd:int` • `long` maps to `xsd:long` • `float` maps to `xsd:float` • `double` maps to `xsd:double` • `char` (defined as byte in Oracle Tuxedo Service Metadata Repository definition) maps to `xsd:byte` • `char` (defined as char in Oracle Tuxedo Service Metadata Repository definition) maps to `xsd:string` • `string` maps to `xsd:string` • `carray` maps to `xsd:base64Binary` • `mbstring` maps to `xsd:string`

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`FML/FML32` (cont.)		• `view32` maps to `tuxtype:view <viewname>` • `fml32` maps to `tuxtype:fml32 <svcname>_p<SeqNum>` To avoid multiple embedded FML32 buffers in an FML32 buffer, a unique sequence number (<SeqNum>) is used to distinguish the embedded FML32 buffers. **Note:** `ptr` is not supported. For limitations and considerations regarding mapping `FML/FML32` buffers, refer to “FML/FML32 Considerations” on page 2-27.

Oracle Tuxedo STRING Typed Buffers

Oracle Tuxedo `STRING` typed buffers are used to store character strings that end with a NULL character. Oracle Tuxedo `STRING` typed buffers are self-describing.

Listing 2-1 shows a SOAP message for a `TOUPPER` Oracle Tuxedo service example that accepts a `STRING` typed buffer.

Listing 2-1 Soap Message for a String Typed Buffer in TOUPPER Service

```
<?xml … encoding=”UTF-8” ?>
   ……
   <SOAP:body>
      <m:TOUPPER xmlns:m=”urn:......”>
           <inbuf>abcdefg</inbuf>
      </m:TOUPPER>
   </SOAP:body>
```

The XML Schema for <inbuf> is:

```
<xsd:element  name=”inbuf” type=”xsd:string” />
```

Oracle Tuxedo CARRAY Typed Buffers

Oracle Tuxedo CARRAY typed buffers are used to store character arrays, any of which can be NULL. They are used to handle data opaquely and are not self-describing. Oracle Tuxedo `CARRAY` typed buffers can map to `xsd:base64Binary` or MIME attachments. The default is `xsd:base64Binary`.

Mapping Example Using base64Binary

Listing 2-2 shows the SOAP message for the `TOUPPER` Oracle Tuxedo service, which accepts a `CARRAY` typed buffer using `base64Binary` mapping.

Listing 2-2 Soap Message for a CARRAY Typed Buffer Using base64Binary Mapping

```
<SOAP:body>
       <m:TOUPPER xmlns:m=”urn:......”>
              <inbuf>QWxhZGRpbjpvcGVuIHNlc2FtZQ==</inbuf>
       </m:TOUPPER>
</SOAP:body>
```

The XML Schema for <inbuf> is:

```
<xsd:element  name=”inbuf” type=”xsd:base64Binary” />
```

Mapping Example Using MIME Attachment

Listing 2-3 shows the SOAP message for the `TOUPPER` Oracle Tuxedo service, which accepts a `CARRAY` typed buffer as a MIME attachment.

Listing 2-3 Soap Message for a CARRAY Typed Buffer Using MIME Attachment

```
MIME-Version: 1.0
Content-Type: Multipart/Related; boundary=MIME_boundary; type=text/xml;
    start="<claim061400a.xml@example.com>"
```

```
Content-Description: This is the optional message description.

--MIME_boundary
Content-Type: text/xml; charset=UTF-8
Content-Transfer-Encoding: 8bit
Content-ID: <claim061400a.xml@ example.com>

<?xml version='1.0' ?>
<SOAP-ENV:Envelope
xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
<SOAP-ENV:Body>
..
<m:TOUPPER xmlns:m=”urn:…”>
<inbuf href="cid:claim061400a.carray@example.com"/>
</m:TOUPPER>
..
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>

--MIME_boundary
Content-Type: text/xml
Content-Transfer-Encoding: binary
Content-ID: <claim061400a. carray @example.com>

...binary carray data…
--MIME_boundary--
The WSDL for carray typed buffer will look like the following:
<wsdl:definitions …>
<wsdl:types …>
       <xsd:schema …>
              <xsd:element name=”inbuf” type=”xsd:base64Binary” />
       </xsd:schema>
</wsdl:types>

……

<wsdl:binding …>
    <wsdl:operation name=”TOUPPER”>
```

```
            <soap:operation …>
            <input>
                  <mime:multipartRelated>
                       <mime:part>
                            <soap:body parts=”…” use=”…”/>
                       </mime:part>
                       <mime:part>
                            <mime:content part=”…” type=”text/xml”/>
                       </mime:part>
                  </mime:multipartRelated>
            </input
            ……
     </wsdl:operation>
</wsdl:binding>

</wsdl:definitions>
```

Oracle Tuxedo MBSTRING Typed Buffers

Oracle Tuxedo `MBSTRING` typed buffers are used for multibyte character arrays. Oracle Tuxedo `MBSTRING` typed buffers consist of the following three elements:

- code-set character encoding
- data length
- character array encoding.

Note: You cannot embed multibyte characters with non “UTF-8” code sets in the SOAP message directly.

Listing 2-4 shows the SOAP message for the `MBSERVICE` Oracle Tuxedo service, which accepts an `MBSTRING` typed buffer.

Listing 2-4 SOAP Message for an MBSIRING Buffer

```
<?xml encoding=”UFT-8”?>
  <SOAP:body>
```

```
<m:MBSERVICE xmlns:m=”http://......”>
    <inbuf> こんにちは </infuf>
</m:MBSERVICE>
```

The XML Schema for <inbuf> is:

```
<xsd:element  name=”inbuf” type=”xsd:string” />
```

WARNING: Oracle SALT converts the Japanese character "—" (EUC-JP 0xa1bd, Shift-JIS 0x815c) into UTF-16 0x2015.

If you use another character set conversion engine, the EUC-JP or Shift-JIS multibyte output for this character may be different. For example, the Java il8n character conversion engine, converts this symbol to UTF-16 0x2014. The result is the also same when converting to UTF-8, which is the Oracle SALT default.

If you use another character conversion engine and Japanese "—" is included in `MBSTRING`, Oracle Tuxedo server-side `MBSTRING` auto-conversion cannot convert it back into Shift-JIS or EUC-JP.

Oracle Tuxedo XML Typed Buffers

Oracle Tuxedo XML typed buffers store XML documents.

Listing 2-5 shows the Stock Quote XML document.

Listing 2-6 shows the SOAP message for the `STOCKINQ` Oracle Tuxedo service, which accepts an `XML` typed buffer.

Listing 2-5 Stock Quote XML Document

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- "Stock Quotes". -->
<stockquotes>
  <stock_quote>
     <symbol>BEAS</symbol>
     <when>
       <date>01/27/2001</date>
       <time>3:40PM</time>
```

```
      </when>
      <change>+2.1875</change>
      <volume>7050200</volume>
  </stock_quote>
</stockquotes>
```

Then part of the SOAP message will look like the following:

Listing 2-6 SOAP Message for an XML Buffer

```
<SOAP:body>
       <m: STOCKINQ xmlns:m="urn:......">
       <inbuf>
       <stockquotes>
              <stock_quote>
                     <symbol>BEAS</symbol>
                     <when>
                     <date>01/27/2001</date>
                     <time>3:40PM</time>
                     </when>
                     <change>+2.1875</change>
                     <volume>7050200</volume>
              </stock_quote>
       </stockquotes>
       </inbuf>
       </m: STOCKINQ >
</SOAP:body>
```

The XML Schema for `<inbuf>` is:

```
<xsd:element  name="inbuf" type="xsd:anyType" />
```

Note: If a default namespace is contained in a Oracle Tuxedo XML typed buffer and returned to the GWWS server, the GWWS server converts the default namespace to a regular name. Each element is then prefixed with this name.

For example, if an Oracle Tuxedo service returns a buffer having a default namespace to the GWWS server as shown in Listing 2-7, the GWWS server converts the default namespace to a regular name as shown in Listing 2-8.

Listing 2-7 Default Namespace Before Sending to GWWS Server

```
<Configuration xmlns="http://www.bea.com/Tuxedo/Salt/200606">
       <Servicelist id="simpapp">
              <Service name="toupper"/>
       </Servicelist>
       <Policy/>
       <System/>
       <WSGateway>
          <GWInstance id="GWWS1">
              <HTTP address="//myhost:8080"/>
         </GWInstance>
       </WSGateway>
</Configuration>
```

Listing 2-8 GWWS Server Converts Default Namespace to Regular Name

```
       <dom0:Configuration
       xmlns:dom0="http://www.bea.com/Tuxedo/Salt/200606">
              <dom0:Servicelist dom0:id="simpapp">
                     <dom0:Service dom0:name="toupper"/>
              </dom0:Servicelist>
              <dom0:Policy></<dom0:Policy>
              <dom0:System></<dom0:System>
              <dom0:WSGateway>
                <dom0:GWInstance dom0:id="GWWS1">
                     <dom0:HTTP dom0:address="//myhost:8080"/>
                </dom0:GWInstance>
              </dom0:WSGateway>
       </dom0:Configuration>
```

Oracle Tuxedo VIEW/VIEW32 Typed Buffers

Oracle Tuxedo VIEW and VIEW32 typed buffers are used to store C structures defined by Oracle Tuxedo applications. You must define the VIEW structure with the VIEW definition files. A VIEW buffer type can define multiple fields.

Listing 2-9 shows the `MYVIEW` VIEW definition file.

Listing 2-10 shows the SOAP message for the `MYVIEW` Oracle Tuxedo service, which accepts a `VIEW` typed buffer.

Listing 2-9 VIEW Definition File for MYVIEW Service

```
VIEW MYVIEW
#type      cname       fbname        count        flag        size        null
float      float1       -             1            -           -            0.0
double     double1      -             1            -           -            0.0
long       long1        -             3            -           -           0
string     string1      -             2            -           20          '\0'
END
```

Listing 2-10 SOAP Message for a VIEW Typed Buffer

```
<SOAP:body>
       <m: STOCKINQ xmlns:m="http://......">
              <inbuf>
                     <float1>12.5633</float1>
                     <double1>1.3522E+5</double1>
                     <long1>1000</long1>
                     <long1>2000</long1>
                     <long1>3000</long1>
                     <string1>abcd</string1>
                     <string1>ubook</string1>
              </inbuf>
       </m: STOCKINQ >
</SOAP:body>
```

The XML Schema for `<inbuf>` is shown in Listing 2-11.

Listing 2-11 XML Schema for a VIEW Typed Buffer

```
<xsd:complexType name=” view_MYVIEW”>
  <xsd:sequence>
       <xsd:element name=”float1” type=”xsd:float” />
       <xsd:xsd:element name=”double1” type=”xsd:double” />
       <xsd:element name=”long1” type=”xsd:long” minOccurs=”3” />
       <xsd:element name=”string1” type=”xsd:string minOccurs=”3” />
  </xsd:sequence>
</xsd: complexType >
<xsd:element  name=”inbuf” type=”tuxtype:view_MYVIEW” />
```

VIEW/VIEW32 Considerations

The following considerations apply when converting Oracle Tuxedo VIEW/VIEW32 buffers to and from XML.

- You must create an environment for converting XML to and from `VIEW/VIEW32`. This includes setting up a VIEW directory and system VIEW definition files. These definitions are automatically loaded by the GWWS server.
- The GWWS server provides strong consistency checking between the Oracle Tuxedo Service Metadata Repository `VIEW/VIEW32` parameter definition and the `VIEW/VIEW32` definition file at start up.

  If an inconsistency is found, the GWWS server cannot start. Inconsistency messages are printed in the ULOG file.
- `tmwsdlgen` also provides strong consistency checking between the Oracle Tuxedo Service Metadata Repository `VIEW/VIEW32` parameter definition and the `VIEW/VIEW32` definition file at start up. If an inconsistency is found, the GWWS server will not start. Inconsistency messages are printed in the ULOG file.

  If the VIEW definition file cannot be loaded, `tmwsdlgen` attempts to use the Oracle Tuxedo Service Metadata Repository definitions to compose the WSDL document.

- Because `dec_t` is not supported, if you define VIEW fields with type `dec_t`, the service cannot be exported as a Web service and an error message is generated when the Oracle SALT configuration file is loading.
- Although the Oracle Tuxedo Service Metadata Repository may define a size attribute for “string/ mbstring” typed parameters (which represents the maximum byte length that is allowed in the Oracle Tuxedo typed buffer), Oracle SALT does not expose such restriction in the generated WSDL document.
- When a VIEW32 embedded MBString buffer is requested and returned to the GWWS server, the GWWS miscalculates the required MBString length and reports that the input string exceeds the VIEW32 maxlength. This is because the header is included in the transfer encoding information. You must include the header size when defining the VIEW32 field length.
- The Oracle Tuxedo primary data type “long” is indefinite between 32-bit and 64-bit scope, depending on the platform. However, the corresponding `xsd:long` schema type is used to describe 64-bit numeric values.

  If the GWWS server runs in 32-bit mode, and the Web service client sends `xsd:long` typed data that exceeds the 32-bit value range, you may get a SOAP fault.

Oracle Tuxedo FML/FML32 Typed Buffers

Oracle Tuxedo FML and FML32 typed buffer are proprietary Oracle Tuxedo system self-describing buffers. Each data field carries its own identifier, an occurrence number, and possibly a length indicator.

FML Data Mapping Example

Listing 2-12 shows the SOAP message for the `TRANSFER` Tuxedo service, which accepts an `FML` typed buffer.

The request fields for service `LOGIN` are:

```
ACCOUNT_ID       1       long            /* 2 occurrences, The withdrawal
account is 1st, and the deposit account is 2nd  */
AMOUNT               2       float            /* The amount to transfer */
```

Part of the SOAP message is as follows:

Listing 2-12 SOAP Message for an FML Typed Buffer

```
<SOAP:body>
       <m:TRANSFER xmlns:m=”urn:......”>
              <inbuf>
                     <ACCOUNT_ID>40069901</ACCOUNT_ID>
                     <ACCOUNT_ID>40069901</ACCOUNT_ID>
                     <AMOUNT>200.15</AMOUNT>
              </inbuf>
       </m:TRANSFER >
</SOAP:body>
```

The XML Schema for <inbuf> is shown in Listing 2-13.

Listing 2-13 XML Schema for an FML Typed Buffer

```
<xsd:complexType name=” fml_TRANSFER_In”>
  <xsd:sequence>
       <xsd:element name=”ACCOUNT_ID” type=”xsd:long” minOccurs=”2”/>
       <xsd:element name=” AMOUNT” type=”xsd:float” />
  </xsd:sequence>
</xsd: complexType >
<xsd:element  name=”inbuf” type=”tuxtype: fml_TRANSFER_In” />
```

FML32 Data Mapping Example

Listing 2-14 shows the SOAP message for the TRANSFER Oracle Tuxedo service, which accepts an FML32 typed buffer.

The request fields for service LOGIN are:

```
CUST_INFO           1      fml32        /* 2 occurrences, The withdrawal
customer is 1st, and the deposit customer is 2nd  */
ACCOUNT_INFO   2        fml32         /* 2 occurrences, The withdrawal
account is 1st, and the deposit account is 2nd  */
AMOUNT              3       float            /* The amount to transfer */
```

Each embedded `CUST_INFO` includes the following fields:

```
CUST_NAME       10       string
CUST_ADDRESS    11       carray
CUST_PHONE      12       long
```

Each embedded `ACCOUNT_INFO` includes the following fields:

```
ACCOUNT_ID       20       long
ACCOUNT_PW       21       carray
```

Part of the SOAP message will look as follows:

Listing 2-14 SOAP Message for Service with FML32 Buffer

```
<SOAP:body>
   <m:STOCKINQ xmlns:m=”urn:......”>
       <inbuf>
              <CUST_INFO>
                     <CUST_NAME>John</CUST_NAME>
                     <CUST_ADDRESS>Building 15</CUST_ADDRESS>
                     <CUST_PHONE>1321</CUST_PHONE>
              </CUST_INFO>
              <CUST_INFO>
                     <CUST_NAME>Tom</CUST_NAME>
                     <CUST_ADDRESS>Building 11</CUST_ADDRESS>
                     <CUST_PHONE>1521</CUST_PHONE>
              </CUST_INFO>
              <ACCOUNT_INFO>
                     <ACCOUNT_ID>40069901</ACCOUNT_ID>
                     <ACCOUNT_PW>abc</ACCOUNT_PW>
              </ACCOUNT_INFO>
              <ACCOUNT_INFO>
                     <ACCOUNT_ID>40069901</ACCOUNT_ID>
                     <ACCOUNT_PW>zyx</ACCOUNT_PW>
              </ACCOUNT_INFO>

              <AMOUNT>200.15</AMOUNT>
       </inbuf>
```

```
   </m: STOCKINQ >
</SOAP:body>
```

The XML Schema for `<inbuf>` is shown in Listing 2-15.

Listing 2-15 XML Schema for an FML32 Buffer

```
<xsd:complexType name=”fml32_TRANSFER_In”>
  <xsd:sequence>
     <xsd:element name=”CUST_INFO” type=”tuxtype:fml32_TRANSFER_p1” 
minOccurs=”2”/>
     <xsd:element name=”ACCOUNT_INFO” type=”tuxtype:fml32_TRANSFER_p2” 
minOccurs=”2”/>
     <xsd:element name=”AMOUNT” type=”xsd:float” />
  /xsd:sequence>
</xsd:complexType >

<xsd:complexType name=”fml32_TRANSFER_p1”>
     <xsd:element name=”CUST_NAME” type=”xsd:string” />
     <xsd:element name=”CUST_ADDRESS” type=”xsd:base64Binary” />
     <xsd:element name=”CUST_PHONE” type=”xsd:long” />
</xsd:complexType>

<xsd:complexType name=”fml32_TRANSFER_p2”>
     <xsd:element name=”ACCOUNT_ID” type=”xsd:long” />
     <xsd:element name=”ACCOUNT_PW” type=”xsd:base64Binary” />
</xsd:complexType>

<xsd:element  name=”inbuf” type=”tuxtype: fml32_TRANSFER_In” />
```

FML/FML32 Considerations

The following considerations apply to converting Oracle Tuxedo `FML/FML32` buffers to and from XML.

- You must create an environment for converting XML to and from `FML/FML32`. This includes an FML field table file directory and system FML field definition files. These definitions are automatically loaded by the GWWS. FML typed buffers can be handled only if the environment is set up correctly.
- `FML32` Field type `FLD_PTR` is not supported.
- The GWWS server provides strong consistency checking between the Oracle Tuxedo Service Metadata Repository `FML/FML32` parameter definition and `FML/FML32` definition file during start up.

  If an `FML/32` field is found that is not in accordance with the environment setting, or the field table field data type definition is different from the parameter data type definition in the Oracle Tuxedo Service Metadata Repository, the GWWS cannot start. Inconsistency messages are printed in the ULOG file.
- The `tmwsdlgen` command checks for consistency between the Oracle Tuxedo Service Metadata Repository `FML/FML32` parameter definition and `FML/FML32` definition file. If inconsistencies are found, it issue a warning and allow inconsistencies.

  If an `FML/32` field is found that is not in accordance with the environment setting, or the field table field data type definition is different from the parameter data type definition in the Oracle Tuxedo Service Metadata Repository, `tmwsdlgen` attempts to use Oracle Tuxedo Service Metadata Repository definitions to compose the WSDL document.
- Although the Oracle Tuxedo Service Metadata Repository may define a size attribute for "string/ mbstring" typed parameters, which represents the maximum byte length that is allowed in the Oracle Tuxedo typed buffer, Oracle SALT does not expose such restriction in the generated WSDL document.
- Oracle Tuxedo primary data type "long" is indefinite between 32-bit and 64-bit scope according to different platforms. But the corresponding `xsd:long` schema type is used to describe 64-bit numeric value. The following scenario generates a SOAP fault:

  The GWWS runs in 32-bit mode, and a Web service client sends a `xsd:long` typed data which exceeds the 32-bit value range.

Oracle Tuxedo X_C_TYPE Typed Buffers

Oracle Tuxedo `X_C_TYPE` typed buffers are equivalent, and have a similar WSDL format to, Oracle Tuxedo VIEW typed buffers.They are transparent for SOAP clients. However, even though usage is similar to the Oracle Tuxedo VIEW buffer type, SALT administrators must configure the Oracle Tuxedo Service Metadata Repository for any particular Oracle Tuxedo service that uses this buffer type.

Note: All View related considerations also take effect for X_C_TYPE typed buffer.

Oracle Tuxedo X_COMMON Typed Buffers

Oracle Tuxedo X_COMMON typed buffers are equivalent to Oracle Tuxedo VIEW typed buffers. However, they are used for compatibility between COBOL and C programs. Field types should be limited to short, long, and string.

Oracle Tuxedo X_OCTET Typed Buffers

Oracle Tuxedo `X_OCTET` typed buffers are equivalent to `CARRAY`.

Note: Oracle Tuxedo `X_OCTET` typed buffers can only map to `xsd:base64Binary` type. SALT 1.1 does not support `MIME` attachment binding for Oracle Tuxedo `X_OCTET` typed buffers.

Custom Typed Buffers

Oracle SALT provides a plug-in mechanism that supports custom typed buffers. You can validate the SOAP message against your own XML Schema definition, allocate custom typed buffers, and parse data into the buffers and other operations.

XML Schema built-in type `xsd:anyType` is the corresponding type for XML documents stored in a SOAP message. While using custom typed buffers, you should define and represent the actual data into an XML format and transfer between the Web service client and Oracle Tuxedo Web service stack. As with XML typed buffers, only a single root XML buffer can be stored in the SOAP body. The GWWS checks this for consistency.

For more plug-in information, see “Using Oracle SALT Plug-Ins” on page 6-1.

XML-to-Tuxedo Data Type Mapping for External Web Services

Oracle SALT maps each `wsdl:message` as an Oracle Tuxedo `FML32` buffer structure. Oracle SALT defines a set of rules for representing the XML Schema definition using `FML32`. To invoke external Web Services, customers need to understand the exact `FML32` structure that converted from the external Web Service XML Schema definition of the corresponding message.

The following sections describe detailed WSDL message to Oracle Tuxedo `FML32` buffer mapping rules:

- XML Schema Built-In Simple Data Type Mapping

- XML Schema User Defined Data Type Mapping
- WSDL Message Mapping

XML Schema Built-In Simple Data Type Mapping

Table 2-3 shows the supported XML Schema Built-In Simple Data Type and the corresponding Oracle Tuxedo `FML32` Field Data Type.

Table 2-3 Supported XML Schema Built-In Simple Data Type

XML Schema Built-In Simple Type	Oracle Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Oracle Tuxedo Program	Note
`xsd:byte`	`FLD_CHAR`	`char`	
`xsd:unsignedByte`	`FLD_CHAR`	`unsigned char`	
`xsd:boolean`	`FLD_CHAR`	`char`	Value Pattern `[ 'T' | 'F' ]`
`xsd:short`	`FLD_SHORT`	`short`	
`xsd:unsignedShort`	`FLD_SHORT`	`unsigned short`	
`xsd:int`	`FLD_LONG`	`long`	
`xsd:unsignedInt`	`FLD_LONG`	`unsigned long`	
`xsd:long`	`FLD_LONG`	`long`	In a 32-bit Oracle Tuxedo program, the C primitive type `long` *cannot* represent all `xsd:long` valid value.
`xsd:unsignedLong`	`FLD_LONG`	`unsigned long`	In a 32-bit Oracle Tuxedo program, the C primitive type `unsigned long` *cannot* represent all `xsd:long` valid value.
`xsd:float`	`FLD_FLOAT`	`float`	

Table 2-3 Supported XML Schema Built-In Simple Data Type

XML Schema Built-In Simple Type	Oracle Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Oracle Tuxedo Program	Note
`xsd:double`	`FLD_DOUBLE`	`double`	
`xsd:string` (and all `xsd:string` derived built-in type, such as `xsd:token`, `xsd:Name`, etc.)	`FLD_STRING` `FLD_MBSTRING`	`char [ ]` (Null-terminated string)	`xsd:string` can be optionally mapped as `FLD_STRING` or `FLD_MBSTRING` using wsdlcvt.
`xsd:base64Binary`	`FLD_CARRAY`	`char [ ]`	
`xsd:hexBinary`	`FLD_CARRAY`	`char [ ]`	
All other built-in data types (Data / Time related, decimal / Integer related, any URI, QName, NOTATION)	`FLD_STRING`	`char [ ]`	You should comply with the value pattern of the corresponding XML built-in data type. Otherwise, server-side Web service will reject the request.

The following samples demonstrate how to prepare data in a Oracle Tuxedo program for XML Schema Built-In Simple Types.

- XML Schema Built-In Type Sample - xsd:boolean
- XML Schema Built-In Type Sample - xsd:unsignedInt
- XML Schema Built-In Type Sample - xsd:string
- XML Schema Built-In Type Sample - xsd:hexBinary
- XML Schema Built-In Type Sample - xsd:date

Table 2-4 XML Schema Built-In Type Sample - xsd:boolean

XML Schema Definition

```
<xsd:element name="flag" type="xsd:boolean" />
```

Table 2-4 XML Schema Built-In Type Sample - xsd:boolean

Corresponding FML32 Field Definition (FLD_CHAR)
`# Field_name Field_type Field_flag Field_comments` `flag char -`
C Pseudo Code

`char c_flag;`
`FBFR32 * request;`
`...`
`c_flag = 'T'; /* Set True for boolean data */`
`Fadd32( request, flag, (char *)&c_flag, 0);`

Table 2-5 XML Schema Built-In Type Sample - xsd:unsignedInt

XML Schema Definition
`<xsd:element name="account" type="xsd:unsignedInt" />`
Corresponding FML32 Field Definition (FLD_LONG)
`# Field_name Field_type Field_flag Field_comments` `account long -`
C Pseudo Code

`unsigned long acc;`
`FBFR32 * request;`
`...`
`acc = 102377; /* Value should not exceed value scope of unsigned int*/`
`Fadd32( request, account, (char *)&acc, 0);`

Table 2-6 XML Schema Built-In Type Sample - xsd:string

XML Schema Definition
`<xsd:element name="message" type="xsd:string" />`
Corresponding FML32 Field Definition (FLD_MBSTRING)

Table 2-6 XML Schema Built-In Type Sample - xsd:string

#	Field_name	Field_type	Field_flag	Field_comments
	message	**mbstring**	**-**	

C Pseudo Code

```
FBFR32 * request;
FLDLEN32 len, mbsize = 1024;
char * msg, * mbmsg;
msg = calloc( ... ); mbmsg = malloc(mbsize);
...
strncpy(msg, "...", len); /* The string is UTF-8 encoding */
Fmbpack32("utf-8", msg, len, mbmsg, &mbsize, 0); /* prepare mbstring*/
Fadd32( request, message, mbmsg, mbsize);
```

Table 2-7 XML Schema Built-In Type Sample - xsd:hexBinary

XML Schema Definition

```
<xsd:element name="mem_snapshot" type="xsd:hexBinary" />
```

Corresponding FML32 Field Definition (FLD_MBSTRING)

#	Field_name	Field_type	Field_flag	Field_comments
	mem_snapshot	**carray**	**-**	

C Pseudo Code

```
FBFR32 * request;
FLDLEN32 len;
char * buf;
buf = calloc( ... );
...
memcpy(buf, "...", len); /* copy the original memory */
Fadd32( request, mem_snapshot, buf, len);
```

Table 2-8 XML Schema Built-In Type Sample - xsd:date

XML Schema Definition
`<xsd:element name="IssueDate" type="xsd:date" />`
Corresponding FML32 Field Definition (FLD_STRING)
`# Field_name Field_type Field_flag Field_comments` `IssueDate string -`
C Pseudo Code

`FBFR32 * request;`
`char date[32];`
`...`
`strcpy(date, "2007-06-04+8:00"); /* Set the date value correctly */`
`Fadd32( request, IssueDate, date, 0);`

XML Schema User Defined Data Type Mapping

Table 2-9 lists the supported XML Schema User Defined Simple Data Type and the corresponding Oracle Tuxedo FML32 Field Data Type.

Table 2-9 Supported XML Schema User Defined Data Type

XML Schema User Defined Data Type	Oracle Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Oracle Tuxedo Program	Note
`<xsd:anyType>`	`FLD_MBSTRING`	`char []`	Oracle Tuxedo Programmer should prepare entire XML document enclosing with the element tag.
`<xsd:simpleType>` derived from built-in primitive simple data types	Equivalent FML32 Field Type of the primitive simple type (see Table 2-3)	Equivalent C Primitive Data Type of the primitive simple type (see Table 2-3)	Facets defined with `<xsd:restriction>` are not enforced at Oracle Tuxedo side.

Table 2-9 Supported XML Schema User Defined Data Type

XML Schema User Defined Data Type	Oracle Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Oracle Tuxedo Program	Note
`<xsd:simpleType>` defined with `<xsd:list>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliancy is not enforced at Oracle Tuxedo side.
`<xsd:simpleType>` defined with `<xsd:union>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliancy is not enforced at Oracle Tuxedo side.
`<xsd:complexType>` defined with `<xsd:simpleContent>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliancy is not enforced at Oracle Tuxedo side.
`<xsd:complexType>` defined with `<xsd:complexContent>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliancy is not enforced at Oracle Tuxedo side.
`<xsd:complexType>` defined with shorthand `<xsd:complexContent>`, sub-elements composited with `sequence` or `all`	`FLD_FML32`	`FBFR32 * embedded fml32 buffer`	Each sub-element of the complex type is defined as an embedded FML32 field.
`<xsd:complexType>` defined with shorthand `<xsd:complexContent>`, sub-elements composited with `choice`	`FML_FML32`	`FBFR32 * embedded fml32 buffer`	Each sub-element of the complex type is defined as an embedded FML32 field. Oracle Tuxedo programmer should only add one sub field into the fml32 buffer.

The following samples demonstrate how to prepare data in an Oracle Tuxedo program for XML Schema User Defined Data Types:

- XML Schema User Defined Type Sample - xsd:simpleType Derived from Primitive Simple Type
- XML Schema User Defined Type Sample - xsd:simpleType Defined with xsd:list

Table 2-10 XML Schema User Defined Type Sample - xsd:simpleType Derived from Primitive Simple Type

XML Schema Definition

```
<xsd:element name="Grade" type="Alphabet" />
<xsd:simpleType name="Alphabet">
       <xsd:restriction base="xsd:string">
              <xsd:maxLength value="1" />
              <xsd:pattern value="[A-Z]" />
       </xsd:restriction>
</xsd:simpleType>
```

Corresponding FML32 Field Definition (FLD_STRING)

```
#      Field_name     Field_type     Field_flag     Field_comments
       Grade          string         -
```

C Pseudo Code

```
char grade[2];
FBFR32 * request;
...
grade[0] = 'A'; grade[1] = '\0';
Fadd32( request, Grade, (char *)grade, 0);
```

Table 2-11 XML Schema User Defined Type Sample - xsd:simpleType Defined with xsd:list

XML Schema Definition (Target Namespace "urn:sample.org")

```
<xsd:element name="Users" type="namelist" />
<xsd:simpleType name="namelist">
       <xsd:list itemType="xsd:NMTOKEN">
</xsd:simpleType>
```

Table 2-11 XML Schema User Defined Type Sample - xsd:simpleType Defined with xsd:list

Corresponding FML32 Field Definition (FLD_MBSTRING)
`# Field_name Field_type Field_flag Field_comments` `Users mbstring -`
C Pseudo Code

```
char * user[5];
char users[...];
char * mbpacked;
FLDLEN32 mbsize = 1024;
FBFR32 * request;
...
sprintf(users, “<n1:Users xmlns:n1=\”urn:sample.org\”>”);
for ( i = 0 ; i < 5 ; i++ ) {
        strcat(users, user[i]);
        strcat(users, “ “);
}
strcat(users, “</n1:Users>“);
...
mbpacked = malloc(mbsize);
/* prepare mbstring*/
Fmbpack32(“utf-8”, users, strlen(users), mbpacked, &mbsize, 0);
Fadd32( request, Users, mbpacked, mbsize);
```

WSDL Message Mapping

Oracle Tuxedo FML32 buffer type is always used in mapping WSDL messages.

Table 2-12 lists the WSDL message mapping rules defined by Oracle SALT.

Table 2-12 WSDL Message Mapping Rules

WSDL Message Definition	Oracle Tuxedo Buffer/Field Definition	Note
`<wsdl:input>` message	Oracle Tuxedo Request Buffer (Input buffer)	
`<wsdl:output>` message	Oracle Tuxedo Response Buffer with `TPSUCCESS` (Output buffer)	

Table 2-12 WSDL Message Mapping Rules

WSDL Message Definition	Oracle Tuxedo Buffer/Field Definition	Note
`<wsdl:fault>` message	Oracle Tuxedo Response Buffer with TPFAIL (error buffer)	
Each message part defined in `<wsdl:input>` or `<wsdl:output>`	Mapped as top level field in the Oracle Tuxedo FML32 buffer. Field type is the equivalent FML32 field type of the message part XML data type. (See Table 2-3 and Table 2-9)	
`<faultcode>` in SOAP 1.1 fault message	Mapped as a fixed top level `FLD_STRING` field (`faultcode`) in the Oracle Tuxedo error buffer: `faultcode string - -`	This mapping rule applies for SOAP 1.1 only.
`<faultstring>` in SOAP 1.1 fault message	Mapped as a fixed top level `FLD_STRING` field (`faultstring`) in the Oracle Tuxedo error buffer: `faultstring string - -`	This mapping rule applies for SOAP 1.1 only.
`<faultactor>` in SOAP 1.1 fault message	Mapped as a fixed top level `FLD_STRING` field (`faultactor`) in the Oracle Tuxedo error buffer: `faultactor string - -`	This mapping rule applies for SOAP 1.1 only.

`<Code>` in SOAP 1.2 fault message	Mapped as a fixed top level `FLD_FML32` field (`Code`) in the Oracle Tuxedo error buffer, which containing two fixed sub `FLD_STRING` fields (`Value` and `Subcode`):
	`Code fml32 - -`
	`Value string - -`
	`Subcode string - -`
		This mapping rule applies for SOAP 1.2 only.

`<Reason>` in SOAP 1.2 fault message	Mapped as a fixed top level `FLD_FML32` field (`Reason`) in the Oracle Tuxedo error buffer, which containing zero or more fixed sub `FLD_STRING` field (`Text`):
	`Reason fml32 - -`
	`Text string - -`
		This mapping rule applies for SOAP 1.2 only.

Table 2-12 WSDL Message Mapping Rules

WSDL Message Definition	Oracle Tuxedo Buffer/Field Definition	Note
`<Node>` in SOAP 1.2 fault message	Mapped as a fixed top level `FLD_STRING` field (`Node`) in the Oracle Tuxedo error buffer: `Node string - -`	This mapping rule applies for SOAP 1.2 only.
`<Role>` in SOAP 1.2 fault message	Mapped as a fixed top level `FLD_STRING` field (`Role`) in the Oracle Tuxedo error buffer: `Role string - -`	This mapping rule applies for SOAP 1.2 only.
`<detail>` in SOAP fault message	Mapped as a fixed top level `FLD_FML32` field in the Oracle Tuxedo error buffer: `detail fml32 - -`	This mapping rule applies for both SOAP 1.1 and SOAP 1.2.
Each message part defined in `<wsdl:fault>`	Mapped as a sub field of "`detail`" field in the Oracle Tuxedo FML32 buffer. Field type is the equivalent FML32 field type of the message part XML data type. (See Table 2-3 and Table 2-9)	This mapping rule applies for both SOAP 1.1 and SOAP 1.2.

Web Service Client Programming

This section contains the following topics:

- Overview
- Oracle SALT Web Service Client Programming Tips
- Web Service Client Programming References

Overview

Oracle SALT is a configuration-driven product that publishes existing Oracle Tuxedo application services as industry-standard Web services. From a Web services client-side programming perspective, Oracle SALT used in conjunction with the Oracle Tuxedo framework is a standard Web service provider. You only need to use the Oracle SALT WSDL file to develop a Web service client program.

To develop a Web service client program, do the following steps:

1. Generate or download the Oracle SALT WSDL file. For more information, see Configuring Oracle SALT in the *Oracle SALT Administration Guide*.
2. Use a Web service client-side toolkit to parse the SALT WSDL document and generate client stub code. For more information, see Oracle SALT Web Service Client Programming Tips.
3. Write client-side application code to invoke a Oracle SALT Web service using the functions defined in the client-generated stub code.
4. Compile and run your client application.

Oracle SALT Web Service Client Programming Tips

This section provides some useful client-side programming tips for developing Web service client programs using the following Oracle SALT-tested programming toolkits:

- Oracle WebLogic Web Service Client Programming Toolkit
- Apache Axis for Java Web Service Client Programming Toolkit
- Microsoft .NET Web Service Client Programming Toolkit

For more information, see Interoperability Considerations in the *Oracle SALT Administration Guide*.

Notes: You can use any SOAP toolkit to develop client software.

The sample directories for the listed toolkits can be found *after* Oracle SALT is installed.

Oracle WebLogic Web Service Client Programming Toolkit

WebLogic Server provides the `clientgen` utility which is a built-in application server component used to develop Web service client-side java programs. The invocation can be issued from standalone java program and server instances. For more information, see `http://edocs.bea.com/wls/docs91/webserv/client.html#standalone_invoke`.

Besides traditional synchronous message exchange mode, Oracle SALT also supports asynchronous and reliable Web service invocation using WebLogic Server. Asynchronous communication is defined by the WS-Addressing specification. Reliable message exchange conforms to the WS-ReliableMessaging specification.

Tip: Use the WebLogic specific WSDL document for HTTP MIME attachment support.

Oracle SALT can map Oracle Tuxedo `CARRAY` data to SOAP request `MIME` attachments. This is beneficial when the binary data stream is large since `MIME` binding does not need additional encoding wrapping. This can help save CPU cycles and network bandwidth.

Another consideration, in an enterprise service oriented environment, is that binary data might be used to guide high-level data routing and transformation work. Encoded data can be problematic. To enable the `MIME` data binding for Oracle Tuxedo `CARRAY` data, a special flag must be specified in the `WSDL` document generation options; both for online downloading and using the `tmwsdlgen` command utility.

Online Download:
`http://salt.host:portnumber//wsdl?mappolicy=raw&toolkit=wls`

`tmwsdlgen` Utility
`tmwsdlgen -c WSDF_FILE -m raw -t wls`

Apache Axis for Java Web Service Client Programming Toolkit

Oracle SALT supports the AXIS `wsdl2java` utility which generates java stub code from the WSDL document. The AXIS Web service programming model is similar to WebLogic.

Tip: **1. Use the AXIS specific WSDL document for HTTP MIME attachment support.**

Oracle SALT supports HTTP MIME transportation for Oracle Tuxedo `CARRAY` data. A special option must be specified for WSDL online downloading and the `tmwsdlgen` utility.

Online Download:
`http://salt.host:portnumber//wsdl?mappolicy=raw&toolkit=axis`

`tmwsdlgen` Utility
`tmwsdlgen -c WSDF_FILE -m raw -t axis`

Tip: **2. Disable multiple-reference format in AXIS when RPC/encoded style is used**.

AXIS may send a multi-reference format SOAP message when RPC/encoded style is specified for the WSDL document. Oracle SALT does not support multiple-reference format. You can disable AXIS multiple-reference format as shown in Listing 3-1:

Listing 3-1 Disabling AXIS Multiple-Reference Format

```
TuxedoWebServiceLocator  service = new TuxedoWebServiceLocator();
service.getEngine().setOption("sendMultiRefs", false);¦
```

Tip: **3. Use Apache Sandensha project with Oracle SALT for WS-ReliableMessaging communication.**

Interoperability was tested for WS-ReliableMessaging between Oracle SALT and the Apache Sandensha project. The Sandensha asynchronous mode and `send offer` must be set in the code.

A sample Apache Sandensha asynchronous mode and `send offer` code example is shown in Listing 3-2:

Listing 3-2 Sample Apache Sandensha Asynchronous Mode and "send offer" Code Example

```
/* Call the service */
           TuxedoWebService  service = new TuxedoWebServiceLocator();

       Call call = (Call) service.createCall();
           SandeshaContext ctx = new SandeshaContext();

           ctx.setAcksToURL("http://127.0.0.1:" + defaultClientPort +
"/axis/services/RMService");
       ctx.setReplyToURL("http://127.0.0.1:" + defaultClientPort  +
"/axis/services/RMService");
       ctx.setSendOffer(true);
       ctx.initCall(call, targetURL, "urn:wsrm:simpapp",
Constants.ClientProperties.IN_OUT);

       call.setUseSOAPAction(true);
       call.setSOAPActionURI("ToUpperWS");
       call.setOperationName(new
javax.xml.namespace.QName("urn:pack.simpappsimpapp_typedef.salt11",
"ToUpperWS"));
       call.addParameter("inbuf", XMLType.XSD_STRING, ParameterMode.IN);
       call.setReturnType(org.apache.axis.encoding.XMLType.XSD_STRING);

           String input = new String();
           String output = new String();
       int i;
           for (i = 0; i < 3; i++ ) {
                      input = "request" + "_" + String.valueOf(i);
```

```
                System.out.println("Request:"+input);
                     output = (String) call.invoke(new Object[]{input});
                     System.out.println("Reply:" + output);

              }

ctx.setLastMessage(call);
       input = "request" + "_" + String.valueOf(i);
       System.out.println("Request:"+input);
           output = (String) call.invoke(new Object[]{input});
```

Microsoft .NET Web Service Client Programming Toolkit

Microsoft .Net 1.1/2.0 provides `wsdl.exe` in the .Net SDK package. It is a free development Microsoft toolkit. In the Oracle SALT `simpapp` sample, a .Net program is provided in the `simpapp/dnetclient` directory.

.Net Web service programming is easy and straightforward. Use the `wsdl.exe` utility and the Oracle SALT WSDL document to generate the stub code, and then reference the .Net object contained in the stub code/binary in business logic implementations.

Tip: **1. Do not use .Net program MIME attachment binding for CARRAY.**

Microsoft does not support SOAP communication MIME binding. Avoid using the WSDL document with MIME binding for CARRAY in .Net development.

Oracle SALT supports `base64Binary` encoding for CARRAY data (the default WSDL document generation.)

Tip: **2. Some RPC/encoded style SOAP messages are not understood by the GWWS server.**

When the Oracle SALT WSDL document is generated using RPC/encoded style, .Net sends out SOAP messages containing `soapenc:arrayType`. Oracle SALT does not support `soapenc:arrayType` using RPC/encoded style. A sample RPC/encoded style-generated WSDL document is shown in Listing 3-3.

Listing 3-3 Sample RPC/encoded Style-Generated WSDL Document

```
<wsdl:types>
                     <xsd:schema attributeFormDefault="unqualified"
elementFormDefault="qualified"
targetNamespace="urn:pack.TuxAll_typedef.salt11">
                            <xsd:complexType name="fml_TFML_In">
                                   <xsd:sequence>
                                          <xsd:element maxOccurs="60"
minOccurs="60" name="tflong" type="xsd:long"></xsd:element>
                                          <xsd:element maxOccurs="80"
minOccurs="80" name="tffloat" type="xsd:float"></xsd:element>
                                   </xsd:sequence>
                            </xsd:complexType>
                            <xsd:complexType name="fml_TFML_Out">
                                   …
</xsd:complexType>
                     </xsd:schema>
              </wsdl:types>
```

Workaround: Use Document/literal encoded style for .Net client as recommended by Microsoft.

Tip: **3. Error message regarding `xsd:base64Binary` in RPC/encoded style.**

If `xsd:base64Binary` is used in the Oracle SALT WSDL document in RPC/encoded style, `wsdl.exe` can generate stub code, but the client program might report a runtime error as follows:

`System.InvalidOperationException:'base64Binary'` is an invalid value for the `SoapElementAttribute.DataType` property. The property may only be specified for primitive types.

Workaround: This is a .Net framework issue.
Use Document/literal encoded style for .Net client as recommended by Microsoft.

Web Service Client Programming References

Online References

- Oracle WebLogic 10.0 Web Service Client Programming References

  Invoking a Web service from a Stand-alone Client: Main Steps

- Apache Axis 1.3 Web Service Client Programming References

  Consuming Web Services with Axis

  Using WSDL with Axis

- Microsoft .NET Web Service Programming References

  Building Web Services

Web Application Server Programming

This section contains the following topics:

- Overview
- Developing Native Oracle Tuxedo Web Applications
- Developing Python Web Applications
- Developing Ruby Web Applications
- Developing PHP Web Applications

Overview

Oracle SALT adds features that enable Web Applications to run in Oracle Tuxedo and be accessed easily through HTTP server plug-ins. Using HTTP servers such as Apache 2, Oracle HTTP Server and iPlanet, you can directly expose applications to the World Wide Web. HTTP servers must use Oracle Tuxedo-specific plug-ins (referred to as `mod_tuxedo`) that translates HTTP requests into Oracle Tuxedo requests, and translates Oracle Tuxedo responses into HTTP responses.

Applications can be written in C or C++ using a Gateway Interface similar to CGI but specific to Oracle Tuxedo servers and their mode of communication, or in dynamic languages such as PHP, Python and Ruby. Using dynamic languages, programs are not aware that they are running in Oracle Tuxedo, which allows re-using application frameworks such as Symfony (PHP), Django (Python) or Rails (Ruby) directly into an Oracle Tuxedo-based environment.

Developing Native Oracle Tuxedo Web Applications

While mod_tuxedo provides the Oracle Tuxedo client part of Web requests serving, on the Oracle Tuxedo side one of the methods of processing the requests is to access them directly. This is permitted by documenting the format of the received buffer, which is an Oracle Tuxedo FML32 typed buffer.

This method allows you to generate dynamic HTTP content by developing Oracle Tuxedo services and leverage Oracle Tuxedo RASP and integration capabilities in doing so.

The relevant elements of an HTTP request are exposed (Method name, Query string URL, File name, POST data, etc.). As well as the return data to mod_tuxedo (HTTP Response Headers (if necessary), HTML document).

For more information, see Appendix H: Oracle SALT HTTP FML32 Buffer Format in the Oracle SALT reference Guide.

The development process is similar to developing a regular Oracle Tuxedo service that generates HTML code, the difference being that developing RESTful services adheres to a set of conventions or rules governing the behavior of the service (a service processing GET should behave differently than when processing PUT). RESTful services are generally not designed to be accessed using an HTML browser (that is, similar to SOAP services).

The data flow is as follows:

- An Apache2 or OHS process is configured to handle certain URLs using the mod_tuxedo module.
- mod_tuxedo intercepts the request.
- mod_tuxedo formats the request and sends it to an Oracle Tuxedo service, which name is derived from the SCRIPT_NAME value. In the examples that follow, the service in question is named TUXSVC.
- The Oracle Tuxedo service receives the data and processes it accordingly:
  - REQUEST_METHOD contains the REST operation: GET, PUT, POST or DELETE.
  - PATH_INFO may contain the resource accessed. In this example, it contains "/1234". The program can parse this value according to a documented convention between client and server to obtain the account number.
  - QUERY_STRING or POST_DATA (for GET or POST) may contain additional parameters. Pre-determined conventions govern what the parameters look like and what they contain. This is determined by service developers and published as application

documentation so client programs can be developed to communicate with these services.

- The Oracle Tuxedo service composes a response which is implicitly sent back to `mod_tuxedo`.
  - The format of the response is up to you:
    - "XML
    - "CSV (comma-separated values)
    - JSON
    - …
- `mod_tuxedo` sends the response back to the client program.

The different components are shown in Listing 4-1 through Listing 4-4

Listing 4-1 Configure OHS or Apache2 (httpd.conf excerpt)

```
<Location "/ACCOUNT">

    <IfModule mod_tuxedo.c>
        SetHandler tuxedo-script
        Tuxconfig "/home/maurice/src/tests/secsapp/work/tuxconfig"
    </IfModule>

</Location>
```

Write the Oracle Tuxedo service as shown in Listing 4-2

Listing 4-2 Oracle Tuxedo Service

```
void
ACCOUNT(TPSVCINFO *rqst)
```

```
{
    char val[1024]; /* TODO: query size first */
    long len;
    int rc;

    /* Fetch PATH_INFO value, which contains the resource */
    len = sizeof(val);
    rc = Fget32((FBFR32 *)inbuf, PATH_INFO, 0, (char *)val, &len);
    if (rc < 0) {
        /* Handle error */
    }

    /* Variable 'val' contains resource name, process it */
    ...

    /* Fetch QUERY_STRING, which optionally contains
       additional parameters */
    len = sizeof(val);
    rc = Fget32((FBFR32 *)inbuf, QUERY_STRING, 0, (char *)val, &len);
    if (rc < 0) {
        /* Handle error */
    }

    /* Depending on method, do processing */
    len = sizeof(val);
    rc = Fget32((FBFR32 *)inbuf, REQUEST_METHOD, 0, (char *)val, &len);
    if (rc < 0) {
```

```
        /* Handle error */
    }

    if (strcmp(val, "GET") == 0) {
        ...
    } else if (strcmp(val, "PUT") == 0) {
        ...
    } else if (strcmp(val, "POST") == 0) {
       /* Get POST_DATA, parse it */
        ...
    } else if (strcmp(val, "DELETE") == 0) {
        ...
    }

    /* Compose return document, using xml or JSON */
    ...

    /* Return result document */
    tpreturn(TPSUCCESS, 0, result, 0L, 0);
}
```

Example URL/response:

Method: GET

Request URL: `http://myhost/ACCOUNT/1234`

Response (XML) as shown in Listing 4-3.

Note: XML generation can be done using existing `libtxml`.

Listing 4-3 XML Response

```
<account id="1234">
    <balance value="10000"/>
    <customer name="John Smith"/>
</account>
```

Response (JSON) as shown in Listing 4-4.

Note: JSON generation can be done using JSON-C, a free and redistributable JSON implementation in C (MIT license), provided as source code. Many libraries exist in a number of languages including PHP, Perl, Python, Ruby, Java, etc.

Listing 4-4 JSON Response

```
[
    "account": {
        "id": "1234",
        "balance": {
            "value": "10000"
         },
         "customer": {
            "name": "John Smith"
         }
    }
]
```

Developing Python Web Applications

Similar to how PHP applications can run inside the `WEBHNDLR` Oracle Tuxedo System Server, Oracle SALT allows writing applications for the Web in Python.Unlike PHP (where all scripts are designed to run in a CGI-like model), Python require running using a specific Web layer.

This layer is designated as WSGI (Web Server Gateway Interface) and is built into the language. It actually is a Python specification (PEP 333). In Python, although applications may be written for WSGI, complete application frameworks are available (conforming to WSGI. Django seems to be the most popular).

The following sections describe how to configure `WEBHNDLR` to run Python WSGI applications (including using the Django framework).

- Prerequisites
- Usage
- Example(s)

Prerequisites

- A Python 2.5.5 or higher installation.
- Python must be built with shared-libraries enabled. This is usually the case for out-of-the-box installations. If you are building from source, the `--enable-shared` options must be used in the configure step.
- There are no known database or third-party library support restrictions.

Usage

A simple WSGI application example is shown in Listing 4-5

Listing 4-5 WSGI Application Example

```
import cgi


def application(environ, start_response):

    form = cgi.FieldStorage(fp=environ['wsgi.input'],
```

```
                            environ=environ,
                            keep_blank_values=1)
    write = start_response('200 OK', [('Content-type', 'text/html')])
    if form.getvalue('name'):
        write('<html><head><title>Hello!</title></head>\n')
        write('<body>\n')
        write('<h1>Hello %s!</h1>\n' % form['name'].value)
    else:
        write('<html><head><title>Who is there?</title></head>\n')
        write('<body>\n')
        write('<h1>Who is there?</h1>\n')
    write('<form action="%s" method="POST">\n' % environ['SCRIPT_NAME'])
    write('What is your name?<br>\n')
    write('<input type="text" name="name" value="%s"><br>\n'
          % cgi.escape(form.getvalue('name', ''), 1))
    write('<input type="submit" value="That is my name"></form>\n')
    write('</body></html>\n')
    return None
```

With frameworks such as Django, this is performed in a handler script that is not seen by the application developer.

Any Python WSGI application may run inside the `WEBHNDLR` System Server by performing the following steps:

1. Configure Apache (or OHS) to forward requests to `WEBHNDLR`. This may require additional configuration to indicate the path to necessary static files (for example, images, CSS stylesheets or javascript files).
2. Add the application path to the `PYTHONPATH` environment variable.

3. `Set APP_CONFIG` for `WEBHNDLR` to load the application or middleware handler (for frameworks like Django).

For more information, see `WEBHNDLR(5)` in the Oracle SALT Reference Guide.

Example(s)

Stand-Alone Script/Application

Listing 4-6 shows an Apache configuration for a WSGI application example.

Listing 4-6 Stand-Alone Script/Application Example

```
<VirtualHost 10.143.7.223:2280>

DocumentRoot "/media/src/tests"

<Directory "/media/src/tests">

<IfModule mod_tuxedo.c>

    SetHandler tuxedo-script

    Tuxconfig "/media/src/TUX11g/web/tests/tuxconfig"

    TuxService PYWEB

</IfModule>

</Directory>

</VirtualHost>
```

The ubbconfig file and setting for a standalone WSGI application are located in a script named `test_app.py (==module)`, in the `/media/src/tests` directory (`PYTHONPATH` must contain `/media/src/tests`):

```
WEBHNDLR    SRVGRP=PHPGRP   SRVID=1 MIN=5 MAX=8
   CLOPT="-A -- -l Python -S PYWEB "
```

Before booting `WEBHNDLR`, you must either

- set `APP_CONFIG` to `test_app` (`'export APP_CONFIG=test_app'` on Unix), or

- use an ENVFILE with the value APP_CONFIG=test_app.

Django-Based Application

For an Apache Django-based application you must note the RewriteEngine rules and Alias. These are there to indicate the location of static files (for example, CSS, images or javascript), and also map the root URL to the application (see last RewriteRule) as shown in Listing 4-7.

Listing 4-7 Django-Based Application

```
<VirtualHost 10.143.7.223:2280>
DocumentRoot "/media/src/test_django/mysite"
Alias /media /usr/lib/python2.5/site-packages/django/contrib/admin/media
<Directory "/media/src/test_django/mysite">
    <IfModule mod_tuxedo.c>
        SetHandler tuxedo-script
        Tuxconfig "/media/src/TUX11g/web/tests/tuxconfig"
        TuxService PYWEB
    </IfModule>
</Directory>

    RewriteEngine On
    RewriteRule ^/(media.*)$ /$1 [QSA,L,PT]
    RewriteCond %{REQUEST_FILENAME} !-f
    RewriteRule ^/(.*)$ /mysite/$1 [QSA,L]
</VirtualHost>
```

The environment variable DJANGO_SETTINGS_MODULE must be set before booting WEBHNDLR. For example, for an application named mysite:

```
DJANGO_SETTINGS_MODULE=mysite.settings
```

The `PYTHONPATH` setting for a Django example, called `mysite` and located in the `/media/src/test_django` directory:

```
PYTHONPATH=/media/src/test_django
```

The ubbconfig setting for the Django example mentioned here:

```
WEBHNDLR    SRVGRP=PHPGRP   SRVID=1 MIN=5 MAX=8
        CLOPT="-A -- -l Python -S PYWEB"
```

Before booting `WEBHNDLR`, you must either:

- set `APP_CONFIG` to `django.core.handlers.wsgi` (WSGIHandler) (`'export APP_CONFIG="django.core.handlers.wsgi` (WSGIHandler)"' on Unix), or
- use an `ENVFILE` with the value `APP_CONFIG=" django.core.handlers.wsgi` (WSGIHandler)".

Developing Ruby Web Applications

Similar to how PHP applications can run inside the `WEBHNDLR` Oracle Tuxedo System Server, Oracle SALT allows writing applications for the Web in Ruby.Unlike PHP (where all scripts are designed to run in a CGI-like model), Ruby requires running using a specific Web layer.

There is an equivalent to WSGI (called Rack), which is done in the form of a library that installs separately. In Ruby, although applications may be written on top of Rack directly, complete application frameworks are available such as Rails. A rack application is an interface between application and servers for Ruby (similar to WSGI). It is usually installed as an add-on to the language, and is a pre-requisite to application server environments such as Rails. The sections below describe how to configure `WEBHNDLR` to run Ruby Rack-conformant applications, including using the Rails framework.

- Prerequisites
- Usage
- Example(s)

Prerequisites

- A Ruby 1.9.x installation.

- Ruby must be built with shared-libraries enabled. This is usually the case for out-of-the-box installations. If building from source the '`--enable-shared`' options must be used in the configuration.
- Rails 2.x or 3.0.x libraries.
- There are no known database or third-party library support restrictions.

Usage

Listing 4-8 shows a simple Rack application example.

Listing 4-8 Simple Rack Application Example

```
class HelloWorld
  def call(env)
    [200, {"Content-Type" => "text/plain"}, ["Hello world!"]]
  end
end
```

With frameworks like Ruby, this is performed in a handler script that is not seen by the application developer.

The script in Listing 4-8 is passed to the handler using a RackUp script that allows adding more functionality (such as pretty exceptions, LINT wrappers, etc.) to the application.

A RackUp script example loading the application is shown in Listing 4-9.

Listing 4-9 RackUp Script Example

```
require 'hello'

use Rack::ShowExceptions
run HelloWorld.new
```

Any Ruby Rack-compliant application may run inside the `WEBHNDLR` system server by performing the following steps:

1. Configure Apache (or OHS) to forward requests to `WEBHNDLR`. This may require additional configuration to indicate the path to necessary static files (for example, CSS stylesheets or javascript files).
2. Configure `WEBHNDLR` to load the application or middleware handler (for frameworks like Rails).

Example(s)

Ruby Rack Lobster

Listing 4-10 shows an Apache (or OHS) configuration example.

Listing 4-10 Apache (or OHS) Configuration Example

```
<VirtualHost 10.143.7.223:2380>
    DocumentRoot "/media/src/tests"
    <Directory "/media/src/tests">
        <IfModule mod_tuxedo.c>
            SetHandler tuxedo-script
            Tuxconfig "/media/src/TUX11g/web/tests/tuxconfig"
            TuxService RBWEB
        </IfModule>
    </Directory>
</VirtualHost>
```

The ubbconfig file `WEBHNDLR` setting is as follows:

```
WEBHNDLR    SRVGRP=PHPGRP   SRVID=1 MIN=5 MAX=8
        CLOPT="-A -- -l Ruby -S RBWEB"
```

Set `APP_CONFIG`.

Ruby Rails Application

For an Apache (or OHS) configuration, you must note e the `RewriteEngine` rules and `AddHandler` directive (as opposed to `SetHandler`). These are there to re-direct the HTTP server to static files (CSS, images, javascript, etc.) as shown in Listing 4-11.

Listing 4-11 Ruby Rails Application

```
<VirtualHost 10.143.7.223:2380>
SetEnv RAILS_RELATIVE_URL_ROOT /media/src/rails_test
DocumentRoot "/media/src/rails_test/public"

RewriteEngine On

RewriteRule ^(/stylesheets/.*)$ - [L]
RewriteRule ^(/javascripts/.*)$ - [L]
RewriteRule ^(/images/.*)$ - [L]

RewriteRule ^$ index.html [QSA]
RewriteRule ^([^.]+)$ $1.html [QSA]
RewriteCond %{REQUEST_FILENAME} !-f

RewriteRule ^/(.*)$ /rails3.tuxrb [QSA,L]

<Directory "/media/src/rails_test/public">
Allow from All
<IfModule mod_tuxedo.c>
    AddHandler tuxedo-script .tuxrb
    Tuxconfig "/media/src/TUX11g/web/tests/tuxconfig"
    TuxService RBWEB
```

```
</IfModule>

</Directory>


</VirtualHost>
```

The ubbconfig file `WEBHNDLR` setting (assuming the Rails application has been set up in the `/media/src/rails_test` directory and is named `RailsTest`) is as follows:

```
WEBHNDLR    SRVGRP=PHPGRP   SRVID=1 MIN=5 MAX=8
CLOPT="-A -- -l Ruby -S RBWEB'. That is, remove the "-a /media..."
portion
```

Before booting `WEBHNDLR`, you must either:

- set `APP_CONFIG` to path to rack up script ('`export APP_CONFIG=" /media/src/rails_test/config.ru"'` on Unix), or use an `ENVFILE` with the value `APP_CONFIG=" /media/src/rails_test/config.ru"`.

Developing PHP Web Applications

PHP scripts are directly supported by `WEBHNDLR` and no specific changes are required for applications to run in an Oracle Tuxedo environment. Configuring the location of PHP scripts in the HTTP server is sufficient. Once the framework is configured to run PHP scripts in `WEBHNDLR`, PHP applications are automatically supported.

For more information, see `WEBHNDLR(5)` in the Oracle SALT Command Reference Guide.

Prerequisites

Usage

Example(s)

Prerequisites

- PHP 5.3.2 or higher installation.
- PHP must be built using the --enable-embed configure option.
- There are no known database or third-party library support restrictions.

Usage

PHP scripts are directly supported by `WEBHNDLR`; no specific changes are required for applications to run in an Oracle Tuxedo environment. Configuring the location of PHP scripts in the HTTP server is sufficient. Once the framework is configured to run PHP scripts in `WEBHNDLR`, PHP applications are automatically supported.

Example(s)

Place a script named "`test.php`" (as shown in Listing 4-12) in the document root folder of the HTTP server:

Listing 4-12 test. php Script

```
-- listing x-x test.php script
<?php
phpinfo();
?>
--
```

Point your browser to: `http://<your_host>:<port>/test.php`.

See Also

- Oracle SALT Administration Guide
- Oracle SALT Reference Guide

Oracle Tuxedo ATMI Programming for Web Services

This chapter contains the following topics:

- Overview
- Converting WSDL Model Into Oracle Tuxedo Model
- Invoking SALT Proxy Services

Overview

Oracle SALT allows you to import external Web Services into Oracle Tuxedo Domains. To import external Web services into Oracle Tuxedo application, a WSDL file must first be loaded and converted. The Oracle SALT WSDL conversion utility, `wsdlcvt`, translates each `wsdl:operation` into a Oracle SALT proxy service. The translated SALT proxy service can be invoked directly through standard Oracle Tuxedo ATMI functions.

Oracle SALT proxy service calls are sent to the GWWS server. The request is translated from Oracle Tuxedo typed buffers into the SOAP message, and then sent to the corresponding external Web Service. The response from an external Web Service is translated into Oracle Tuxedo typed buffers and returned to the Oracle Tuxedo application. The GWWS acts as the proxy intermediary.

If an error occurs during the service call, the GWWS server sets the error status using `tperrno`, which can be retrieved by Oracle Tuxedo applications. This enables you to detect and handle the SALT proxy service call error status.

Converting WSDL Model Into Oracle Tuxedo Model

Oracle SALT provides a WSDL conversion utility, wsdlcvt, that converts external WSDL files into Oracle Tuxedo specific definition files so that you can develop Oracle Tuxedo ATMI programs to access services defined in the WSDL file.

WSDL-to-Tuxedo Object Mapping

Oracle SALT converts WSDL object models into Oracle Tuxedo models using the following rules:

- Only SOAP over HTTP binding are supported, each binding is defined and saved as a WSBinding object in the WSDF file.
- Each operation in the SOAP bindings is mapped as one Oracle Tuxedo style service, which is also called a SALT proxy service. The operation name is used as the Oracle Tuxedo service name and indexed in the Oracle Tuxedo Service Metadata Repository.

  Note: If the operation name exceeds the Oracle Tuxedo service name length limitation (15 characters), you must manually set a unique short Oracle Tuxedo service name in the metadata respository and set the `<Service> tuxedoRef` attribute in the WSDF file.

  For more information, see Oracle SALT Web Service Definition File Reference in the *Oracle SALT Reference Guide*.

- Other Web service external application protocol information is saved in the generated WSDF file (including SOAP protocol version, SOAP message encoding style, accessing endpoints, and so).
- XML Schema definitions embedded in the WSDL file are copied and saved in separate .xsd files.
- Each `wsdl:operation` object and its input/output message details are converted as an Oracle Tuxedo service definition conforms to the Oracle Tuxedo Service Metadata Repository input syntax.

Table 5-1 lists detailed mapping relationships between the WSDL file and Oracle Tuxedo definition files.

Table 5-1 WSDL Model / Oracle Tuxedo Model Mapping Rules

WSDL Object	Oracle Tuxedo/SALT Definition File	Oracle Tuxedo/SALT Definition Object
`/wsdl:binding`	SALT Web Service Definition File (WSDF)	`/WSBinding`
`/wsdl:portType`		`/WSBinding/Servicegroup`
`/wsdl:binding/soap:binding`		`/WSBinding/SOAP`
`/wsdl:portType/operation`	Metadata Input File (MIF)	`/WSBinding/service`
`/wsdl:types/xsd:schema`	FML32 Field Defintion Table	`Field name type`

Invoking SALT Proxy Services

The following sections include information on how to invoke the converted SALT proxy service from an Oracle Tuxedo application:

- Oracle SALT Supported Communication Pattern
- Oracle Tuxedo Outbound Call Programming: Main Steps
- Managing Error Code Returned from GWWS
- Handling Fault Messages in an Oracle Tuxedo Outbound Application

Oracle SALT Supported Communication Pattern

Oracle SALT only supports the Oracle Tuxedo Request/Response communication patterns for outbound service calls. An Oracle Tuxedo application can request the SALT proxy service using the following communication Oracle Tuxedo ATMIs:

- `tpcall(1)` / `tpacall(1)` / `tpgetreply(1)`

  These basic ATMI functions can be called with an Oracle Tuxedo typed buffer as input parameter. The return of the call will also carry an Oracle Tuxedo typed buffer. All these buffers will conform to the converted outside Web service interface. `tpacall`/`tpgetreply` is not related to SOAP async communication.

- `tpforward(1)`

  Oracle Tuxedo server applications can use this function to forward an Oracle Tuxedo request to a specified SALT proxy service. The response buffer is sent directly to client application's response queue as if it's a traditional native Oracle Tuxedo service.

- `TMQFORWARD` enabled queue-based communication.

  Oracle Tuxedo system server TMQFORWARD can accept queued requests and send them to Oracle SALT proxy services that have the same name as the queue.

Oracle SALT does not support the following Oracle Tuxedo communication patterns:

- Conversational communication
- Event-based communication

Oracle Tuxedo Outbound Call Programming: Main Steps

When the GWWS is booted and Oracle SALT proxy services are advertised, you can create an Oracle Tuxedo application to call them. To develop a program to access SALT proxy services, do the following:

- Check the Oracle Tuxedo Service Metadata Repository definition to see what the SALT proxy service interface is.
- Locate the generated FML32 field table files. Modify the FML32 field table to eliminate conflicting field names and assign a valid base number for the index.

  Note: The wsdlcvt generated FML32 field table files are always used by GWWS. you must make sure the field name is unique at the system level. If two or more fields are associated with the same field name, change the field name. Do not forget to change Oracle Tuxedo Service Metadata Repository definition accordingly.

  The base number of field index in the generated FML32 field table must be changed from the invalid default value to a correct number to ensure all field index in the table is unique at the entire system level.

- Generate FML32 header files with mkfldhdr32(1).
- Boot the GWWS with correct FML32 environment variable settings.
- Write a skeleton C source file for the client to call the outbound service (refer to Oracle Tuxedo documentation and the Oracle Tuxedo Service Metadata Repository generated

pseudo-code if necessary). You can use `tpcall(1)` or `tpacall(1)` for synchronous or asynchronous communication, depending on the requirement.

- For FML32 buffers, you need to add each FML32 field (conforming to the corresponding Oracle SALT proxy service input buffer details) defined in the Oracle Tuxedo Service Metadata Repository, including FML32 field sequence and occurrence. The client source may include the generated header file to facilitate referencing the field name.
- Get input buffer ready, user can handle the returned buffer, which should be of the type defined in Metadata.
- Compile the source to generate executable.
- Test the executable.

Managing Error Code Returned from GWWS

If the GWWS server encounters an error accessing external Web services, `tperrno` is set accordingly so the Oracle Tuxedo application can diagnose the failure. Table 5-2 lists possible Oracle SALT proxy service `tperrno` values.

Table 5-2 Error Code Returned From GWWS/Tuxedo Framework

TPERRNO	Possible Failure Reason
`TPENOENT`	Requested SALT proxy service is not advertised by GWWS
`TPESVCERR`	The HTTP response message returned from external Web service application is not valid The SOAP response message returned from external Web service application is not well-formed.
`TPEPERM`	Authentication failure.
`TPEITYPE`	Message conversion failure when converting Oracle Tuxedo request typed buffer into XML payload of the SOAP request message.
`TPEOTYPE`	Message conversion failure when converting XML payload of the SOAP response message into Oracle Tuxedo response typed buffer.
`TPEOS`	Request is rejected because of system resource limitation
`TPETIME`	Timeout occurred. This timeout can either be a BBL blocktime, or a SALT outbound call timeout.

Table 5-2 Error Code Returned From GWWS/Tuxedo Framework

TPERRNO	Possible Failure Reason
TPSVCFAIL	External Web service returns SOAP fault message
TPESYSTEM	GWWS internal errors. Check ULOG for more information.

Handling Fault Messages in an Oracle Tuxedo Outbound Application

All rules listed in used to map WSDL input/output message into Oracle Tuxedo Metadata inbuf/outbuf definition. WSDL file default message can also be mapped into Oracle Tuxedo Metadata errbuf, with some amendments to the rules:

Rules for fault mapping:

There are two modes for mapping Metadata `errbuf` into SOAP Fault messages: Tux Mode and XSD Mode.

- Tux Mode is used to convert Oracle Tuxedo original error buffers returned with TPFAIL. The error buffers are converted into XML payload in the SOAP fault `<detail>` element.
- XSD Mode is used to represent SOAP fault and WSDL file fault messages defined with Oracle Tuxedo buffers. The mapping rule includes:
  – Each service in XSD mode (`servicemode=webservice`) always has an `errbuf` in Metadata, with type=FML32.
  – `errbuf` is a FML32 buffer. It is a complete descriptionof the SOAP:Fault message that may appear in correspondence (which is different for SOAP 1.1 and 1.2). The `errbuf` definition content is determined by the SOAP version and WSDL fault message both.
  – Parameter detail/Detail (1.1/1.2) is an FML32 field that represents the `wsdl:part` defined in a `wsdl:fault` message (when `wsdl:fault` is present). Each part is defined as a `param(field)` in the FML32 field. The mapping rules are the same as for input/output buffer. The difference is that each param `requiredcount` is 0, which means it may not appear in the SOAP fault message.
  – Other elements that appear in `soap:fault` message are always defined as a filed in `errbuf`, with `requiredcount` equal to 1 or 0 (depending on whether the element is required or optional).

- Each part definition in the Metadata controls converting a `<detail>` element in the soap fault message into a field in the error buffer.

Table 5-3 lists the outbound SOAP fault errbuf definitions.

Table 5-3 Outbound SOAP Fault Errbuf Definition

Meta Parameter	SOAP Version	Type	Required	Memo
`faultcode`	1.1	string	Yes	
`faultstring`	1.1	string	Yes	
`faultactor`	1.1	string	No	
`detail`	1.1	fml32	No	If no wsdl:fault is defined, this field will contain an XML field.
`Code`	1.2	fml32	Yes	Contain Value and optional Subcode
`Reason`	1.2	fml32	Yes	Contains multiple Text
`Node`	1.2	string	No	
`Role`	1.2	string	No	
`Detail`	1.2	fml32	No	same as detail field

Using Oracle SALT Plug-Ins

This chapter contains the following topics:

- Understanding Oracle SALT Plug-Ins
- Programming Message Conversion Plug-ins
- Programming Outbound Authentication Plug-Ins

Understanding Oracle SALT Plug-Ins

The Oracle SALT GWWS server is a configuration-driven process which, for most basic Web service applications, does not require any programming tasks. However, Oracle SALT functionality can be enhanced by developing plug-in interfaces which utilize custom typed buffer data and customized shared libraries to extend the GWWS server.

A plug-in interface is a set of functions exported by a shared library that can be loaded and invoked by GWWS processes to achieve special functionality. Oracle SALT provides a plug-in framework as a common interface for defining and implementing a plug-in interface. Plug-in implementation is carried out by a shared library which contains the actual functions. The plug-in implementation library is configured in the SALT Deployment file and is loaded dynamically during GWWS server startup.

Plug-In Elements

Four plug-in elements are required to define a plug-in interface:

- Plug-In ID

- Plug-In Name
- Plug-In Implementation Functions
- Plug-In Register Functions

Plug-In ID

The plug-in ID element is a string used to identify a particular plug-in interface function. Multiple plug-in interfaces can be grouped with the same Plug-in ID for a similar function. Plug-in ID values are predefined by Oracle SALT. Arbitrary string values are not permitted.

Oracle SALT 10*g*R3 supports the `P_CUSTOM_TYPE` and `P_CREDENMAP` plug-in ID, which is used to define plug-in interfaces for custom typed buffer data handling, and map Oracle Tuxedo user ID and group ID into username/password that HTTP Basic Authentication needs.

Plug-In Name

The plug-in Name differentiates one plug-in implementation from another within the same Plug-in ID category.

For the `P_CUSTOM_TYPE` Plug-in ID, the plug-in name is used to indicate the actual custom buffer type name. When the GWWS server attempts to convert data between Oracle Tuxedo custom typed buffers and an XML document, the plug-in name is the key element that searches for the proper plug-in interface.

Plug-In Implementation Functions

Actual business logic should reflect the necessary functions defined in a plug-in vtable structure. Necessary functions may be different for different plug-in ID categories.

For the `P_CREDENMAP` ID category, one function needs to be implemented:

- int `(* gwws_pi_map_http_basic) (char * domain, char * realm, char * t_userid, char * t_grpid, Cred_UserPass * credential);`

For more information, see "Programming Outbound Authentication Plug-Ins".

Plug-In Register Functions

Plug-in Register functions are a set of common functions (or rules) that a plug-in interface must implement so that the GWWS server can invoke the plug-in implementation. Each plug-in interface must implement three register function These functions are:

- Information Providing Function
- Initiating Function
- Exiting Function
- vtable Setting Function

Information Providing Function

This function is optional. If it is used, it is first invoked after the plug-in shared library is loaded during GWWS server startup. If you want to implement more than one interface in one plug-in library, you must implement this function and return the counts, IDs, and names of the interfaces in the library.

Returning a `0` value indicates the function has executed successfully. Returning a value other than `0` indicates failure. If this functions fails, the plug-in is not loaded and the GWWS server will not start.

The function uses the following syntax:

```
int _ws_pi_get_Id_and_Names(int * count, char **ids, char **names);
```

You must return the total count of implementation in the library in arguments `count`. The arguments `IDs` and `names` should contains all implemented interface `IDs` and `names`, separated by a semicolon ";".

Initiating Function

The initiating function is invoked after all the implemented interfaces in the plug-in shared library are determined. You can initialize data structures and set up global environments that can be used by the plug-ins.

Returning a `0` value indicates the initiating function has executed successfully. Returning a value other than `0` indicates initiation has failed. If plug-in interface initiation fails, the GWWS server will not start.

The initiating function uses the following syntax:

```
int _ws_pi_init_@ID@_@Name@(char * params, void **priv_ptr);
```

`@ID@` indicates the actual plug-in ID value. `@Name@` indicates the actual plug-in name value. For example, the initiating function of a plug-in with `P_CUSTOM_TYPE` as a plug-in ID and `MyType` as a plug-in name is: `_ws_pi_init_P_CUSTOM_TYPE_MyType (char * params, void **priv_ptr)`.

Exiting Function

The exiting function is called before closing the plug-in shared library when the GWWS server shuts down. You should release all reserved plug-in resources.

The exiting function uses the following syntax:

```
int _ws_pi_exit_@ID@_@Name@(void * priv);
```

`@ID@` indicates the actual plug-in ID value. `@Name@` indicates the actual plug-in name value. For example, the initiating exiting function name of a plug-in with `P_CUSTOM_TYPE` as a plug-in ID and `MyType` as a plug-in name is: `_ws_pi_exit_P_CUSTOM_TYPE_MyType(void * priv)`.

vtable Setting Function

`vtable` is a particular C structure that stores the necessary function pointers for the actual businesss logic of a plug-in interface. In other words, a valid plug-in interface must implement all the functions defined by the corresponding vtable.

The vtable setting function uses the following syntax:

```
int _ws_pi_set_vtbl_@ID@_@Name@(void * priv);
```

`@ID@` indicates the actual plug-in ID value. `@Name@` indicates the actual plug-in name value. For example, the vtable setting function of a plug-in with `P_CUSTOM_TYPE` as a plug-in ID and `MyType` as a plug-in name is: `_ws_pi_set_vtbl_P_CUSTOM_TYPE_MyType(void * priv)`.

The `vtable` structures may be different for different plug-in ID categories. For the Oracle SALT 10*g*R3 release, `P_CUSTOM_TYPE` and `P_CREDENMAP` are the only valid plug-in IDs.

The vtable structures for available plug-in interfaces are shown in Listing 6-1.

Listing 6-1 VTable Structure

```
struct credmap_vtable {
       int (* gwws_pi_map_http_basic) (char * domain, char * realm, char *
t_userid, char * t_grpid, Cred_UserPass * credential); /* used for HTTP
Basic Authentication */
       /* for future use */
       void * unused_1;
       void * unused_2;
       void * unused_3;
};
```

`struct credmap_vtable` indicates that one function need to be implemented for a `P_CREDENMAP` plug-in interface. For more information, see "Programming Outbound Authentication Plug-Ins".

The function input parameter `void * priv` points to a concrete vtable instance. You should set the vtable structure with the actual functions within the vtable setting function.

An example of setting the vtable structure with the actual functions within the vtable setting function is shown in Listing 6-2.

Listing 6-2 Setting the vtable Structure with Actual Functions within the vtable Setting Function

```
int _DLLEXPORT_ _ws_pi_set_vtbl_P_CREDENMAP_TEST (void * vtbl)
{
        struct credmap_vtable * vtable;
        if ( ! vtbl )
                return -1;

        vtable = (struct credmap_vtable *) vtbl;

        vtable->gwws_pi_map_http_basic = Credmap_HTTP_Basic;
        return 0;
}
```

Developing a Plug-In Interface

To develop a comprehensive plug-in interface, do the following steps:

1. Develop a shared library to implement the plug-in interface
2. Define the plug-in interface in the SALT configuration file

Developing a Plug-In Shared Library

To develop a plug-in shared library, do the following steps:

1. Write C language plug-in implementation functions for the actual business logic. These functions are not required to be exposed from the shared library. For more information, see "Plug-In Implementation Functions".

2. Write C language plug-in register functions that include: the initiating function, the exiting function, the vtable setting function, and the information providing function if necessary. These register functions need to be exported so that they can be invoked from the GWWS server. For more information, see "Plug-In Register Functions".

3. Compile all the above functions into one shared library.

Defining a Plug-In Interface in SALT Configuration File

To define a plug-in shared library that is loaded by the GWWS server, the corresponding plug-in library path must be configured in the SALT deployment file. For more information, see Setting Up a Oracle SALT Application in the *Oracle SALT Administration Guide*.

An example of how to define plug-in information in the Oracle SALT deployment file is shown in Listing 6-3.

Listing 6-3 Defined Plug-In in the Oracle SALT Deployment File

```
<?xml version="1.0" encoding="UTF-8"?>
<Deployment xmlns="http://www.bea.com/Tuxedo/SALTDEPLOY/2007">
       . . . . . . .
       . . . . . . .
       <System>
              <Plugin>
                     <Interface
                            id=”P_CREDENMAP”
                            name=”TEST”
                            library=”credmap_plugin.dll” />
              </Plugin>
       </System>
</Deployment>
```

Notes: To define multiple plug-in interfaces, multiple `<Interface>` elements must be specified. Each `<Interface>` element indicates one plug-in interface.

Multiple plug-in interfaces can be built into one shared library file.

Programming Message Conversion Plug-ins

Oracle SALT defines a complete set of default data type conversion rules to convert between Oracle Tuxedo buffers and SOAP message payloads. However, the default data type conversion rules may not meet all your needs in transforming SOAP messages into Oracle Tuxedo typed buffers or vice versa. To accommodate special application requirements, Oracle SALT supports customized message level conversion plug-in development to extend the default message conversion.

Note: The SALT 10*g*R3 Message Conversion Plug-in is an enhanced successor of the SALT 1.1 Custom Buffer Type Conversion Plug-in.

The following topics are included in this section:

How Message Conversion Plug-ins Work

Message Conversion Plug-in is a SALT supported Plug-in defined within the SALT plug-in framework. All Message Conversion Plug-in instances have the same Plug-In ID, "`P_CUSTOM_TYPE`". Each particular Message Conversion Plug-in instance may implement two functions, one is used to convert SOAP message payloads to Oracle Tuxedo buffers, and the other is used to convert Oracle Tuxedo buffers to SOAP message payloads. These two function prototypes are defined in Listing 6-4.

Listing 6-4 vtable structure for SALT Plug-in "P_CUSTOM_TYPE" (C Language)

```
/* custtype_pi_ex.h */
struct custtype_vtable {
       CustomerBuffer * (* soap_in_tuxedo__CUSTBUF) (void * xercesDOMTree,
```

```
CustomerBuffer * tuxbuf, CustType_Ext * extinfo)
        int (* soap_out_tuxedo__CUSTBUF) (void ** xercesDOMTree,
CustomerBuffer * tuxbuf, CustType_Ext * extinfo)
        ......
}
```

The function pointer `(* soap_in_tuxedo__CUSTBUF)` points to the customized function that converts the SOAP message payload to Oracle Tuxedo typed buffer.

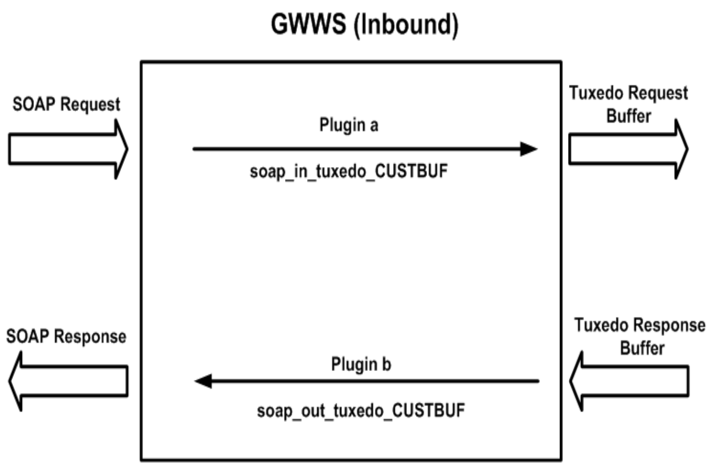
The function pointer `(* soap_out_tuxedo__CUSTBUF)` points to the customized function that converts the Oracle Tuxedo typed buffer to SOAP message payload.

You may implement both functions defined in the message conversion plug-in vtable structure if needed. You may also implement one function and set the other function with a NULL pointer.

How Message Conversion Plug-in Works in an Inbound Call Scenario

An inbound call scenario is an external Web service program that invokes an Oracle Tuxedo service through the Oracle SALT gateway. Figure 6-1 depicts message streaming between a Web service client and an Oracle Tuxedo domain.

Figure 6-1 Message Conversion Plug-in Works in an Inbound Call Scenario



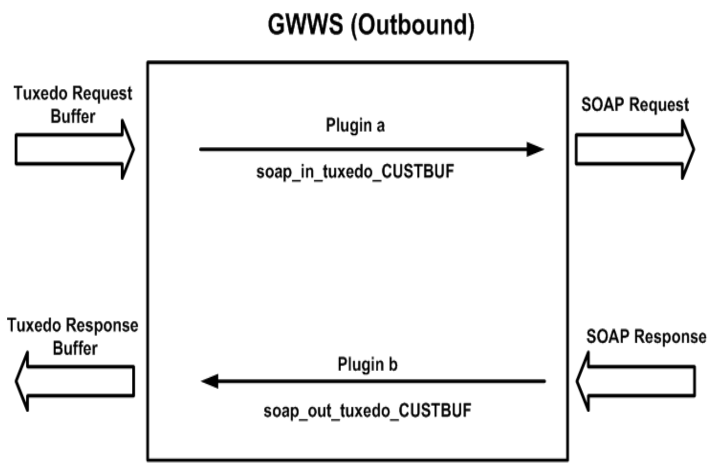
When a SOAP request message is delivered to the GWWS server, GWWS tries to find if there is a message conversion plug-in instance associated with the input message conversion of the target service. If there is an associated instance, the GWWS invokes the customized `(*soap_in_tuxedo__CUSTBUF)` function implemented in the plug-in instance.

When an Oracle Tuxedo response buffer is returned from the Oracle Tuxedo service, GWWS tries to find if there is a message conversion plug-in instance associated with the output message conversion of the target service. If there is an associated instance, GWWS invokes the customized `(*soap_out_tuxedo__CUSTBUF)` function implemented in the plug-in instance.

How Message Conversion Plug-in Works in an Outbound Call Scenario

An outbound call scenario is an Oracle Tuxedo program that invokes an external Web service through the Oracle SALT gateway. Figure 6-2 depicts message streaming between an Oracle Tuxedo domain and a Web service application.

Figure 6-2 Message Conversion Plug-in Works in an Outbound Call Scenario



When an Oracle Tuxedo request buffer is delivered to the GWWS server, GWWS tries to find if there is a message conversion plug-in instance associated with the input message conversion of the target service. If there is an associated instance, GWWS invokes the customized `(*soap_out_tuxedo__CUSTBUF)` function implemented in the plug-in instance.

When a SOAP response message is returned from the external Web service application, GWWS tries to find if there is a message conversion plug-in instance associated with the output message conversion of the target service. If there is an associated instance, GWWS invokes the customized `(*soap_in_tuxedo__CUSTBUF)` function implemented in the plug-in instance.

When Do We Need Message Conversion Plug-in

Table 6-1 lists several message conversion plug-in use cases.

Table 6-1 Message Conversion Plug-in Use Cases

	Scenario Description	soap_in_tuxedo_CUSTBUF	soap_out_tuxedo_CUSTBUF
Oracle Tuxedo Originated Service	A SOAP message payload is being transformed into a custom typed buffer	Required	N/A
	A custom typed buffer is being transformed into a SOAP message payload	N/A	Required
	An Oracle Tuxedo service input and/or output buffer is associated with a customized XML schema definition, when a SOAP message payload is being transformed into this buffer	Non XML typed buffer: Required XML typed buffer: Optional	N/A
	An Oracle Tuxedo service input and/or output buffer is associated with a customized XML schema definition, when this buffer is being transformed into a SOAP message payload	N/A	Non XML typed buffer: Required XML typed buffer:Optional
	All other general cases when a SOAP message payload is being transformed to an Oracle Tuxedo buffer	Optional	N/A
	All other general cases when an Oracle Tuxedo buffer is being transformed into a SOAP message payload	N/A	Optional

Table 6-1 Message Conversion Plug-in Use Cases

	Scenario Description	soap_in_tuxedo_CUSTBUF	soap_out_tuxedo_CUSTBUF
Web Service Originated Service	All cases when an Oracle Tuxedo buffer is being transformed to a SOAP message payload	N/A	Optional
	All cases when a SOAP message payload is being transformed into an Oracle Tuxedo buffer	Optional	N/A

From Table 6-1, the following message conversion plug-ins general rules are applied.

- If an Oracle Tuxedo originated service consumes custom typed buffer, the message conversion plug-in is required. Oracle Tuxedo framework does not understand the detailed data structure of the custom typed buffer, therefore SALT default data type conversion rules cannot be applied.
- If the input and/or output (no matter returned with `TPSUCCESS` or `TPFAIL`) buffer of an Oracle Tuxedo originated service is associated with an external XML Schema, you should develop the message conversion plug-ins to handle the transformation manually, unless you are sure that the SALT default buffer type-based conversion rules can handle it correctly.
  - For example, if you associate your own XML Schema with an Oracle Tuxedo service FML32 typed buffer, you must provide a message conversion plug-in since SALT default data mapping routines may not understand the SOAP message payload structure when trying to convert into the FML typed buffer. Contrarily, the SOAP message payload structure converted from the FML typed buffer may be tremendously different from the XML shape defined via your own XML Schema.
  - If you associate your own XML Schema with an Oracle Tuxedo service XML typed buffer, most of time you do not have to provide a message conversion plug-in. This is because SALT just passes the XML data as is in both message conversion directions.

    For more information about how to associate external XML Schema definition with the input, output and error buffer of an Oracle Tuxedo Service, see “Defining Tuxedo Service Contract with Service Metadata Repository” in the *Oracle SALT Administration Guide*.
- You can develop message conversion plug-ins for any message level conversion to replace SALT default message conversion routines as needed.

Developing a Message Conversion Plug-in Instance

Converting a SOAP Message Payload to an Oracle Tuxedo Buffer

The following function should be implemented in order to convert a SOAP XML payload to an Oracle Tuxedo buffer:

```
CustomerBuffer * (* soap_in_tuxedo__CUSTBUF) (void * xercesDOM,
CustomerBuffer *a, CustType_Ext * extinfo);
```

Synopsis

```
#include <custtype_pi_ex.h>
```

```
CustomerBuffer * myxml2buffer (void * xercesDOM, CustomerBuffer *a,
CustType_Ext * extinfo);
```

`myxml2buffer` is an arbitrary customized function name.

Description

The implemented function should have the capability to parse the given XML buffer and convert concrete data items to an Oracle Tuxedo custom typed buffer instance.

The input parameter, `char * xmlbuf`, indicates a NULL terminated string with the XML format data stream. Please note that the XML data is the actual XML payload for the custom typed buffer, *not* the whole SOAP envelop document or the whole SOAP body document.

The input parameter, `char * type`, indicates the custom typed buffer type name, this parameter is used to verify that the GWWS server expected custom typed buffer handler matches the current plug-in function.

The output parameter, `CustomerBuffer *a`, is used to store the allocated custom typed buffer instance. An Oracle Tuxedo custom typed buffer must be allocated by this plug-in function via the ATMI function `tpalloc()`. Plug-in code is not responsible to free the allocated custom typed buffer, it is automatically destroyed by the GWWS server if it is not used.

Diagnostics

If successful, this function must return the pointer value of input parameter `CustomerBuffer * a`.

If it fails, this function returns NULL as shown in Listing 6-5.

Listing 6-5 Converting XML Effective Payload to Oracle Tuxedo Custom Typed Buffer Pseudo Code

```
CustomerBuffer * myxml2buffer (void * xercesDOM, CustomerBuffer *a,
CustType_Ext * extinfo)
{
        // casting the input void * xercesDOM to class DOMDocument object
        DOMDocument * DOMTree =

        // allocate custom typed buffer via tpalloc
        a->buf = tpalloc("MYTYPE", "MYSUBTYPE", 1024);
        a->len = 1024;

        // fetch data from DOMTree and set it into custom typed buffer
        DOMTree ==> a->buf;
        if ( error ) {
                release ( DOMTree );
                tpfree(a->buf);
                a->buf = NULL;
                a->len = 0;
                return NULL;
        }

        release ( DOMTree );

        return a;
}
```

Tip: Oracle Tuxedo bundled Xerces library can be used for XML parsing. Tuxedo 8.1 bundles Xerces 1.7 and Tuxedo 9.1 bundles Xerces 2.5

Converting an Oracle Tuxedo Buffer to a SOAP Message Payload

The following function should be implemented in order to convert a custom typed buffer to SOAP XML payload:

```
int (*soap_out_tuxedo__CUSTBUF)(char ** xmlbuf, CustomerBuffer * a,  char * type);
```

Synopsis

```
#include <custtype_pi_ex.h>

int * mybuffer2xml (char ** xmlbuf, CustomerBuffer *a, char * type);
```

`"mybuffer2xml"` is the function name can be specified with any valid string upon your need.

Description

The implemented function has the capability to convert the given custom typed buffer instance to the single root XML document used by the SOAP message.

The input parameter, `CustomerBuffer *a`, is used to store the custom typed buffer response instance. Plug-in code is not responsible to free the allocated custom typed buffer, it is automatically destroyed by the GWWS server if it is not used.

The input parameter, `char * type`, indicates the custom typed buffer type name, this parameter can be used to verify if the SALT GWWS server expected custom typed buffer handler matches the current plug-in function.

The output parameter, `char ** xmlbuf`, is a pointer that indicates the newly converted XML payload. The XML payload buffer must be allocated by this function and use the `malloc ()` system API. Plug-in code is not responsible to free the allocated XML payload buffer, it is automatically destroyed by the GWWS server if it is not used.

Diagnostics

If successful, this function must returns 0.

If it fails, this function must return -1 as shown in Listing 6-6.

Listing 6-6 Converting Oracle Tuxedo Custom Typed Buffer to SOAP XML Pseudo Code

```
int mybuffer2xml (void ** xercesDom, CustomerBuffer *a, CustType_Ext *
extinfo)
{
        // Use DOM implementation to create the xml payload
        DOMTree = CreateDOMTree( );

        if ( error )
                return -1;
```

```
        // fetch data from custom typed buffer instance,
        // and add data to DOMTree according to the client side needed
        // XML format

        a->buf ==> DOMTree;

        // allocate xmlbuf buffer via malloc
        * xmlbuf = malloc( expected_len(DOMTree) );
        if ( error ) {
               release ( DOMTree );
               return -1;
        }

        // casting the DOMDocument to void * pointer and returned
        DOMTree >> (* xmlbuf);
        if ( error ) {
               release ( DOMTree );
               free ( (* xmlbuf) );
               return -1;
        }

        return 0;
}
```

WARNING: GWWS framework is responsible to release the DOMDocument created inside the plug-in function. To avoid double release, programmers must pay attention to the following Xerces API usage:

If the DOMDocument is constructed from an XML string through `XercesDOMParser::parse() API`. You must use `XercesDOMParser::adoptDocument()` to get the pointer of the DOMDocument object. You must not use `XercesDOMParser::getDocument()` to get the pointer of the DOMDocument object because the DOMDocument object is maintained by the XercesDOMParser object and is released when deleting the XercesDOMParser object if you do not de-couple the

DOMDocument from the XercesDOMParser via the `XercesDOMParser::getDocument()` function.

SALT 1.1 Custom Buffer Type Conversion Plug-in Compatibility

SALT 1.1 Custom Buffer Type Conversion Plug-in provides the customized message conversion mechanism only for Oracle Tuxedo custom buffer types.

Table 6-2 compares the SALT Message Conversion Plug-in and the SALT 1.1 Custom Buffer Type Conversion Plug-in.

Table 6-2 SALT 10*g*R3 Message Conversion Plug-in / SALT 1.1 Custom Buffer Type Conversion Plug-in Comparison

SALT 1.1 Custom Buffer Type Plug-in	SALT 10*g*R3 Message Conversion Plug-in
Plug-in ID is "`P_CUSTOM_TYPE`"	Plug-in ID is "`P_CUSTOM_TYPE`"
Plug-in Name must be the same as the supported custom buffer type name	Plug-in Name can be any meaningful value, which is only used to distinguish from other plug-in instances.
Only supports message conversion between SOAP message payload and Oracle Tuxedo custom buffer types	Supports message conversion between SOAP message payload and any kind of Oracle Tuxedo buffer type
Buffer type level association. Each plug-in instance must be named the same as the supported custom buffer type name. Each custom buffer type can only have one plug-in implementation. One custom buffer type can associate with a plug-in instance, and used by all the services	Message level association. Each Oracle Tuxedo service can associate plug-in instances with its input and/or output buffers respectively through the plug-in instance name.
SOAP message payload is saved as a NULL terminated string for plug-in programming	SOAP message payload is saved as a Xerces DOM Document for plug-in programming

Please note that the SALT 1.1 Custom Buffer Type Plug-in shared library cannot be used directly in SALT 10*g*R3. You must perform the following tasks to upgrade it to a SALT 10*g*R3 message conversion plug-in:

1. Re-implement function (*soap_in_tuxedo__CUSTBUF) and (*soap_out_tuxedo__CUSTBUF) according to new SALT 10*g*R3 message conversion plug-in vtable function prototype API. The major change is that SOAP message payload is saved as an Xerces class DOMDocument object instead of the old string value.
2. Re-compile your functions as the shared library and configure this shared library in the SALT Deployment file so that it can be loaded by GWWS servers.

Tip: You do not have to manually associate the upgraded message conversion plug-ins with service buffers. If a custom typed buffer is involved in the message conversion at runtime, GWWS can automatically search a message conversion plug-in that has the same name as the buffer type name if no explicit message conversion plug-in interface is configured.

Programming Outbound Authentication Plug-Ins

When an Oracle Tuxedo client accesses Web services via SOAP/HTTP, the client may be required to send a username and password to the server to perform HTTP Basic Authentication. The Oracle Tuxedo clients uses tpinit() to send a username and password when registering to the Oracle Tuxedo domain. However, this username is used by Oracle Tuxedo and is not the same as the one used by the Web service (the password may be different as well).

To map the usernames, Oracle SALT provides a plug-in interface (Credential-Mapping Interface) that allows you to choose which username and password is sent to the Web service.

How Outbound Authentication Plug-Ins Work

When an Oracle Tuxedo client calls a Web service, it actually calls the GWWS server that declares the Web service as an Oracle Tuxedo service. The user id and group id (defined in tpusr and tpgrp files) are sent to the GWWS. The GWWS then checks whether the Web service has a configuration item <Realm>. If it does, the GWWS:

tries to invoke the vtable gwws_pi_map_http_basic function to map the Oracle Tuxedo userid into the username and password for the HTTP Realm of the server.

- for successful calls, encodes the returned username and password with Base64 and sends it in the HTTP header field “Authorization: Basic” if the call is successful
- for failed calls, returns a failure to the Oracle Tuxedo Client without invoking the Web service.

Implementing a Credential Mapping Interface Plug-In

Using the following scenario:

- An existing Web service, `myservice`, sited on http://www.abc.com/webservice, requires HTTP Basic Authentication. The username is "test", the password is "1234," and the realm is "myrealm".
- After converting the Web service WSDL into the SALT configuration file (using `wsdlcvt)`, add the <Realm>myrealm</Ream> element to the endpoint definition in the WSDF file.

Perform the following steps to implement a Oracle SALT plug-in interface:

1. Write the functions to map the "myrealm" Oracle Tuxedo `UID/GID` to `username/password` on www.abc.com.

- Use `Credmap_HTTP_Basic();`

  This function is used to return the HTTP username/password. The function prototype defined in `credmap_pi_ex.h`

2. Write the following three plug-in register functions. For more information, see "Plug-In Register Functions".

- `_ws_pi_init_P_CREDENMAP_TEST(char * params, void ** priv_ptr);`

  This function is invoked when the GWWS server attempts to load the plug-in shared library during startup.

- `_ws_pi_exit_P_CREDENMAP_TEST(void * priv);`

  This function is invoked when the GWWS server unloads the plug-in shared library during the shutdown phase.

- `_ws_pi_set_vtbl_P_CREDENMAP_TEST(void * vtbl);`

  Set the `gwws_pi_map_http_basic` entry in vtable structure `credmap_vtable` with the `Credmap_HTTP_Basic()` function implemented in step 1.

3. You can also write the optional function

- `_ws_pi_get_Id_and_Names(int * params, char ** ids, char ** names);`

  This function is invoked when the GWWS server attempts to load the plug-in shared library during startup to determine what library interfaces are implemented. For more information, see "Plug-In Register Functions".

4. Compile the previous four or five functions into one shared library, `credmap_plugin.so`.
5. Configure the plug-in interface in the SALT deployment file.

Configure the plug-in interface as shown in Listing 6-7.

Listing 6-7 Custom Typed Buffer Plug-In Interface

```
<?xml version="1.0" encoding="UTF-8"?>
<Deployment xmlns="http://www.bea.com/Tuxedo/SALTDEPLOY/2007">
       . . . . . . .
       . . . . . . .
       <System>
              <Plugin>
                     <Interface
                            id=”P_CREDENMAP”
                            name=”TEST”
                            library=”credmap_plugin.dll” />
              </Plugin>
       </System>
</Deployment>
```

Mapping the Oracle Tuxedo UID and HTTP Username

The following function should be implemented in order to return username/password for HTTP Basic Authentication:

```
typedef int (* GWWS_PI_CREDMAP_PASSTEXT) (char * domain, char * realm, char
* t_userid, char * t_grpid, Cred_UserPass * credential);
```

Synopsis

```
#include <credmap_pi_ex.h>
typedef struct Cred_UserPass_s {
    char username[UP_USERNAME_LEN];
    char password[UP_PASSWORD_LEN];
} Cred_UserPass;
int gwws_pi_map_http_basic (char * domain, char * realm, char * t_uid, char
* t_gid, Cred_UserPass * credential);
```

The "gwws_pi_map_http_basic" function name can be specified with any valid string as needed.

Description

The implemented function has the capability to determine authorization credentials (usernames and passwords) used for authorizing users with a given Oracle Tuxedo uid and gid for a given domain and realm.

The input parameters, `char * domain` and `char * realm`, represent the domain name and HTTP Realm that the Web service belongs to. The plug-in code must use them to determine the scope to find appropriate credentials.

The input parameters, `char * t_uid` and `char * t_gid`, are strings that contain Oracle Tuxedo user ID and group ID number values respectively. These two parameters may be used to find the username.

The output parameter, `Cred_UserPass * credential`, is a pointer that indicates a pre-allocated buffer storing the returned username/password. The plug-in code is not responsible to allocate the buffer.

Notes: Oracle Tuxedo user ID is available only when `*SECURITY` is set as `USER_AUTH` or higher in the UBBCONFIG file. Group ID is available when `*SECURITY` is set as ACL or higher. The default is “0”.

Diagnostics

If successful, this function returns 0. If it fails, it returns -1 as shown in Listing 6-8.

Listing 6-8 Credential Mapping for HTTP Basic Authentication Pseudo Code

```
int Credmap_HTTP_Basic(char * domain, char * realm, char * t_uid, char *
t_gid, Cred_UserPass * credential)
{
       // Use domain and realm to determine scope
       credentialList = FindAllCredentialForDomainAndRealm(domain, realm);

       if ( error happens )
              return -1;

       // find appropriate credential in the scope
```

```
        foreach cred in credentialList {
                if (t_uid and t_gid match) {
                        *credential = cred;
                        return 0;
                }
        }
        if ( not found and no default credential) {
                return -1;
        }

        *credential = default_credential;
        return 0;
}
```

Tip: The credentials can be stored in the database with domain and realm as the key or index.

Oracle SALT SCA Programming

This chapter contains the following topics:

Overview

One important aspect of Service Component Architecture (SCA) is the introduction of a new programming model. As part of the Oracle Tuxedo architecture, SCA allows you to better blend high-output, high-availability and scalable applications in an SOA environment.

SCA components run on top of the Oracle Tuxedo infrastructure using ATMI binding. The ATMI binding implementation provides native Oracle Tuxedo communications between SCA components, as well as SCA components and Oracle Tuxedo programs (clients and servers).

In addition to the programming model, the Service Component Definition Language (SCDL) describes what components can perform in terms of interactions between each other, and instructs the framework to set-up necessary links (wires).

SCA Utilities

The following utilities are used in conjunction with Oracle SALT SCA programming:

- `buildscaclient`: Builds client processes that call SCA components.
- `buildscacomponent`: Builds SCA components.
- `buildscaserver`: Builds an Oracle Tuxedo server containing SCA components.
- `SCAHOST`: Generic server for Python, Ruby or PHP SCA components.
- `scatuxgen`: Generates Oracle Tuxedo Service Metadata Repository interface information from an SCA interface.
- `scastructc32,scastructc`: Structure description file compiler.
- `scastructdis32, scastructdis`: Binary structure and view files disassembler.
- `tuxscagen`: Generates SCA, SCDL, and server-side interface files for Oracle Tuxedo services.

For more information, see the Oracle SALT Command Reference.

SCA Client Programming

The runtime reference binding extension is the implementation of the client-side aspect of the SCA container. It encapsulates the necessary code used to call other services, SCA components, Oracle Tuxedo servers or even Web services, transparently from an SCA-based component.

SCA Client Programming Steps

Developing SCA client programs requires the following steps:

1. Setting Up the Client Directory Structure
2. Developing the Client Application
3. Composing the SCDL Descriptor
4. Building the Client Application
5. Running the Client Application
6. Handling TPFAIL Data

Setting Up the Client Directory Structure

You must define the applications physical representation. Strict SCA client applications are SCA component types. Listing 7-1shows the directory structure used to place SCA components in an application.

Listing 7-1 SCA Component Directory Structure

```
myApplication/ (top-level directory, designated by the APPDIR environment
variable)
    root.composite (SCDL top-level composite, contains the list of
components in this application)
    myClient/ (directory containing actual client component described in
this section)
        myClient.composite (SCDL for the client component)
        myClient.cpp (client program source file)
        TuxService.h (interface of component called by client program)
```

Listing 7-2 shows an example of typical `root.composite` content.

Listing 7-2 root.composite Content

```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
       name="simple.app">
       <component name="myClientComponent">
              <implementation.composite name="myClient"/>
       </component>
</composite>
```

The `implementation.composite@name` parameter references the directory that contains the component named '`myClientComponent`'. This value is required at runtime. For more information, see Running the Client Application.

Developing the Client Application

Client programs are required to implement a call to a single API. This following call is required in order to set up the SCA runtime:

...

CompositeContext theContext = CompositeContext::getCurrent();

...

Actual calls are based on an interface. This interface is usually developed along with the component being called. In the case of existing Oracle Tuxedo ATMI services, this interface can be generated by accessing the Oracle Tuxedo METADATA repository. For more information, see the Oracle SALT Administration Guide and tuxscagen, `scatuxgen` in the Oracle SALT Reference Guide.

In the case of calling external Web services, an interface matching the service WSDL must be provided. For more information, see SCA Data Type Mapping for the correspondence between WSDL types and C++ types.

Listing 7-3 shows an interface example.

Listing 7-3 Interface Example

```
#include <string>
/**
       *  Tuxedo service business interface
```

```
*/
class TuxService
{
public:
virtual std::string TOUPPER(const std::string inputString) = 0;
};
```

In the interface shown in Listing 7-3, a single method `TOUPPER` is defined. It takes a single parameter of type `std::string`, and returns a value of type `std::string`. This interface needs to be located in its own `.h` file, and is referenced by the client program by including the `.h` file.

Listing 7-4 shows an example of a succession of calls required to perform an invocation.

Listing 7-4 Invocation Call Example

```
// SCA definitions
// These also include a Tuxedo-specific exception definition:
ATMIBindingException
#include "tuxsca.h"
// Include interface
#include "TuxService.h"
...
       // A client program uses the CompositeContext class
       CompositeContext theContext = CompositeContext::getCurrent();
...
       // Locate Service
       TuxService* toupperService =
              (TuxService *)theContext.locateService("TOUPPER");
...
       // Perform invocation
       const std::string result = toupperService->TOUPPER("somestring");
...
```

Notes: The invocation itself is equivalent to making a local call (as if the class were in another file linked in the program itself).

For detailed code examples, see the SCA samples located in following directories:

- UNIX samples: `$TUXDIR/samples/salt/sca`
- Windows samples: `%TUXDIR%\samples\salt\sca`

Composing the SCDL Descriptor

The link between the local call and the actual component is made by defining a binding in the SCDL side-file. For example, Listing 7-4 shows a call to an existing Oracle Tuxedo ATMI service, the SCDL descriptor shown in Listing 7-5 should be used. This SCDL is contained in a file called `<componentname>.composite`.

Listing 7-5 SCDL Descriptor

```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
          name="simpapp.client">
     <reference name="TOUPPER">
        <interface.cpp header="TuxService.h"/>
        <binding.atmi requires="legacy">
           <inputBufferType target="TOUPPER">STRING</inputBufferType>
           <outputBufferType target="TOUPPER">STRING</outputBufferType>
        </binding.atmi>
    </reference>
</composite>
```

This composite file indicates that a client component may perform a call to the `TOUPPER` reference, and that this call is performed using the ATMI binding. In effect, this results in a `tpcall()` to the "`TOUPPER`" Oracle Tuxedo service. This Oracle Tuxedo service may be an actual existing Oracle Tuxedo ATMI service, or another SCA component exposed using the ATMI binding. For more information, see SCA Component Programming.

The `inputBufferType` and `outputBufferType` elements are used to determine the type of Oracle Tuxedo buffer used to exchange data. For more information, see SCA Data Type Mapping and the ATMI Binding Element Reference for a description of all possible values that can be used in the `binding.atmi` element.

Building the Client Application

Once all the elements are in place, the client program is built using the `buildscaclient` command. You must do the following steps:

1. Navigate to the directory containing the client source and SCDL composite files
2. Execute the following command:

   `$ buildscaclient -c myClientComponent -s . -f myClient.cpp`

   This command verifies the SCDL code, and builds the following required elements:

   - A shared library (or DLL on Windows) containing generated proxy code
   - The client program itself

If no syntax or compilation error is found, the client program is ready to use.

Running the Client Application

To execute the client program, the following environment variables are required:

- `APPDIR` - designates the application directory; in the case of SCA this typically contains the top-level SCDL composite.
- `SCA_COMPONENT` - the default SCA component (the value '`myClientComponent`' in the example shown in Listing 7-2). It tells the SCA runtime where to start when looking for services in the `locateService()` call.

Invoking Existing Oracle Tuxedo Services

Access to existing Oracle Tuxedo ATMI services from an SCA client program can be simplified using the examples shown in Listing 7-6, Listing 7-7, and Listing 7-8.

Note: These examples can also be used for server-side SCA components.

Starting from a Oracle Tuxedo `METADATA` repository entry as shown in Listing 7-6, the `tuxscagen` command can be used to generate interface and SCDL.

Listing 7-6 SCA Components Calling an Existing Oracle Tuxedo Service

```
service=TestString
tuxservice=ECHO
servicetype=service
```

```
inbuf=STRING
outbuf=STRING

service=TestCarray
tuxservice=ECHO
servicetype=service
inbuf=CARRAY
outbuf=CARRAY
```

Listing 7-7 Generated Header

```
#ifndef ECHO_h
#define ECHO_h
#include <string>
#include <tuxsca.h>
class ECHO
{
public:
    virtual std::string TestString(const std::string arg) = 0;
    virtual std::string TestCarray(const struct carray_t * arg) = 0; };
#endif /* ECHO_h */
```

Listing 7-8 Generated SCDL Reference

```
<?xml version="1.0" encoding="UTF-8"?>
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
name="ECHO">
  <reference name="ECHO">
    <interface.cpp header="ECHO.h"/>
    <binding.atmi requires="legacy">
      <serviceType target="TestString">RequestResponse</serviceType>
      <inputBufferType target="TestString">STRING</inputBufferType>
      <outputBufferType target="TestString">STRING</outputBufferType>
      <serviceType target="TestCarray">RequestResponse</serviceType>
      <inputBufferType target="TestCarray">CARRAY</inputBufferType>
      <outputBufferType target="TestCarray">CARRAY</outputBufferType>
```

```
    </binding.atmi>
  </reference>
</composite>
```

The steps used to invoke these services are identical to the examples shown in Listing 7-6 through Listing 7-8.

Handling TPFAIL Data

Invoking a non-SCA Oracle Tuxedo ATMI service may return an error, but still send back data by using `tpreturn(TPFAIL, …)`. When this happens, an SCA client or component is interrupted by the `ATMIBindingException` type.

The data returned by the service, if present, can be obtained by using the `ATMIBindingException.getData()` API. For more information see, TPFAIL Return Data.

The example in Listing 7-9 corresponds to a `binding.atmi` definition as shown in Listing 7-10.

Listing 7-9 Invocation Interruption Example

```
...
        try {
          const char* result = toupperService->charToup("someInput");
        } catch (tuscany::sca::atmi::ATMIBindingException& abe) {
          // Returns a pointer to data corresponding to
          // mapping defined in <errorBufferType> element
          // in SCDL
          const char* *result = (const char **)abe.getData();
          if (abe.getData() == NULL) {
              // No data was returned
          } else {
              // Process data returned
              ...
          }
        } catch (tuscany::sca::ServiceInvocationException& sie) {
          // Other type of exception is returned
```

```
        }
...
```

Listing 7-10 /binding.atmi Definition

```
...
        <binding.atmi requires="legacy">
              <inputBufferType target="charToup">STRING</inputBufferType>
              <outputBufferType
target="charToup">STRING</outputBufferType>
              <errorBufferType target="charToup">STRING</errorBufferType>
<binding.atmi/>
...
```

Other returned data types must be cast to the corresponding type. For example, an invocation returning a `commonj::sdo::DataObjectPtr` as shown in Listing 7-11.

Listing 7-11 SCDL Invocation Example

```
...
       <errorBufferType target="myMethod">FML32/myType</errorBufferType>
...
```

The `ATMIBindingException.getData()` result is shown in Listing 7-12.

Listing 7-12 ATMIBindingException.getData() Results

```
...
              catch (tuscany::sca::atmi::ATMIBindingException& abe) {
              const commonj::sdo::DataObjectPtr *result =
              (const commonj::sdo::DataObjectPtr *)abe.getData();
...
```

The rules for returning `TPFAIL` data to the calling application are as follows:

- For each `<errorBufferType>`, a canonical type is defined, where `<errorBufferType>` is converted. When the `<errorBufferType>` is equal to the `<outputBufferType>`, the canonical type is the same C++ type that is returned in a successful service implementation.
- When the `<errorBufferType>` is different from the `<outputBufferType>`, the canonical type is as follows:
  - For `STRING` buffers, a C++ `char*` or `char[ ]`data type.
  - For `MBSTRING` buffers, a C++ `wchar_t*` or `wchar_t[ ]`.
  - For `CARRAY` buffers, a C++ CARRAY_PTR.
  - For `X_OCTET` buffers, a C++ X_OCTET_PTR.
  - For XML buffers, a C++ XML_PTR.
  - For FML, FML32, VIEW, VIEW32, X_COMMON, and X_C_TYPE buffers, a C++ `commonj::sdo::DataObjectPtr`.
- In each case, the value returned by `getData()` is a pointer to one of the types listed above.

For more conversion rules between Oracle Tuxedo buffer types and C++ data information, see SCA Data Type Mapping.

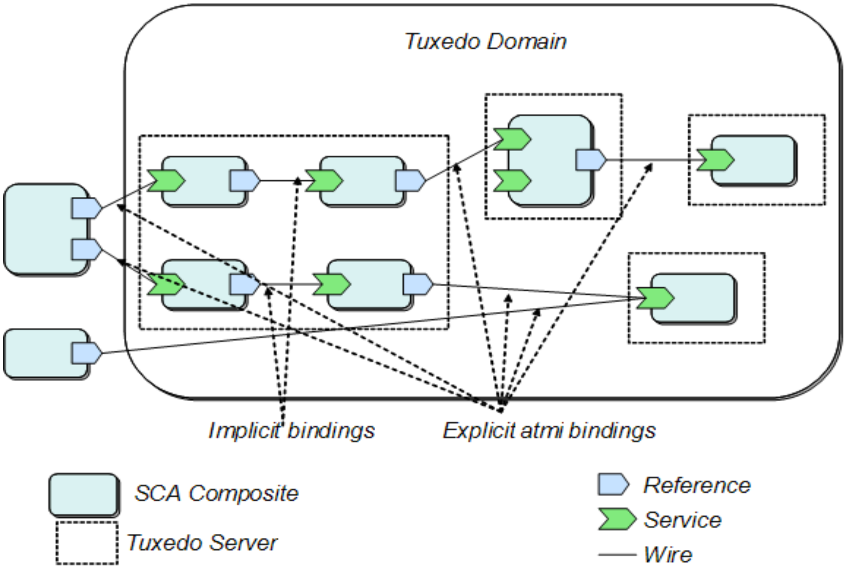
SCA Component Programming

The SCA Component terminology designates SCA runtime artifacts that can be invoked by other SCA or non-SCA runtime components. In turn, these SCA Components can perform calls to other SCA or non-SCA components. This is different from strict SCA clients which can only make calls to other SCA or non-SCA components, but cannot be invoked.

The Oracle SALT SCA container provides the capability of hosting SCA components in an Oracle Tuxedo server environment. This allows you to take full advantage of proven Oracle Tuxedo qualities: *reliability*, *scalability* and *performance*.

Figure 7-1 summarizes SCA components and Oracle Tuxedo server mapping rules.

Figure 7-1 SCA Component and Oracle Tuxedo Server Mapping Rules



While SCA components using Oracle Tuxedo references do not require special processing, SCA components offering services must still be handled in an Oracle Tuxedo environment.

The mapping is as follows:

- An SCA composite declaring one or more services with a `<binding.atmi>` definition maps to a single Oracle Tuxedo server advertising the same number of services as the SCA composite.
- There can be more than one composite.
- Composites can be nested.
- Promotion handling:
  - A composite promoting a service contained in a nested component results in the promoted service being advertised as an Oracle Tuxedo service.
  - A service declared in a component, but not promoted, is not advertised.
- The resulting Oracle Tuxedo server advertises as many services as there are `binding.atmi` sections in the SCDL definition

- Interfaces may declare multiple methods. Each method is linked to an Oracle Tuxedo native service using the `/binding.atmi/@map` attribute. A method not declared via the `/binding.atmi/@map` attribute is not accessible through Oracle Tuxedo. The use of duplicate service names are detected at server generation time, so that Oracle Tuxedo service names-to-interface method mapping in a single Oracle Tuxedo server instance is 1:1.
- A generated Oracle Tuxedo server acts as a proxy for SCA components. An instance of this generated server corresponds to an SCA composite as defined in the SCDL configuration. Such servers are deployed as necessary by the Oracle Tuxedo administrator.

SCA composites are deployed in an Oracle Tuxedo application by configuring instances of generated SCA servers in the `UBBCONFIG` file. Multiple instances are allowed. Multi-threading capabilities are also allowed and controllable using already-existing Oracle Tuxedo features.

SCA Component Programming Steps

The steps required for developing SCA component programs are as follows:

1. Setting Up the Component Directory
2. Developing the Component Implementation
3. Composing the SCDL Descriptor
4. Compiling and Linking the Components
5. Building the Oracle Tuxedo Server Host

Setting Up the Component Directory

You must first define the applications physical representation. Listing 7-13 shows the directory structure used to place SCA components in an application:

Listing 7-13 SCA Component Directory Structure

```
myApplication/ (top-level directory, designated by the APPDIR environment variable)
    root.composite (SCDL top-level composite, contains the list of components in this application)
    myComponent/ (directory containing actual component described in this section)
```

```
myComponent.composite (SCDL for the component)
myComponent.componentType
myComponentImpl.cpp (component implementation source file)
TuxService.h (interface of component being exposed)
TuxServiceImpl.h (component implementation definitions)
```

Listing 7-14 shows typical `root.composite` content.

Listing 7-14 root.composite Content

```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
       name="simple.app">
       <component name="myComponent">
              <implementation.composite name="myComponent"/>
       </component>
</composite>
```

The `implementation.composite@name` parameter references the directory that contains the `'myComponent'` component.

Developing the Component Implementation

Components designed to be called by other components do not need to be aware of the SCA runtime. There are, however, limitations in terms of interface capabilities, such as:

- C++ classes (other than `std::string` and `commonj::sdo::DataObjectPtr`) cannot be used as parameters or return values
- Parameter arrays are not supported

  For more information, see SCA Data Type Mapping.

Listing 7-15 shows an example of an interface implemented for a client program.

Listing 7-15 Component Implementation Interface

```
#include <string>
/**
  *  Tuxedo service business interface
  */
  class TuxService
  {
  public:
       virtual std::string TOUPPER(const std::string inputString) = 0;
  };
```

The component implementation then generally consists of two source files (as shown Listing 7-16 and Listing 7-17 respectively):

- component implementation definitions, contained in a `<servicename>Impl.h file`, and
- component implementation, contained in a `<servicename>Impl.cpp file`

Listing 7-16 Example (TuxServiceImpl.h):

```
#include "TuxService.h"

      /**
       * TuxServiceImpl component implementation class
       */
      class TuxServiceImpl:  public TuxService
      {
      public:
       virtual std::string toupper(const std::string inputString);
      };
```

Listing 7-17 Example (TuxServiceImpl.cpp):

```
#include "TuxServiceImpl.h"
 #include "tuxsca.h"

using namespace std;
using namespace osoa::sca;

/**
* TuxServiceImpl component implementation
*/
std::string TuxServiceImpl::toupper(const string inputString)
{
    string result = inputString;

    int len = inputString.size();

    for (int i = 0; i < len; i++) {
       result[i] = std::toupper(inputString[i]);
    }

    return result;
}
```

Additionally, a side-file (`componentType`), is required. It contains the necessary information for the SCA wrapper generation and possibly proxy code (if this component calls another component).

This `componentType` file (`<componentname>Impl.componentType`)is an SCDL file type. Listing 7-18 shows an example of a `componentType` file (`TuxServiceImpl.componentType`).

Listing 7-18 componentType File Example

```
<?xml version="1.0" encoding="UTF-8"?>
 <componentType xmlns="http://www.osoa.org/xmlns/sca/1.0" >
       <service name="TuxService">
```

```
            <interface.cpp header="TuxService.h"/>
       </service>
 </componentType>
```

Composing the SCDL Descriptor

The link between the local implementation and the actual component is made by defining a binding in the SCDL side-file. For example, for the file type in Listing 7-18 to be exposed as an Oracle Tuxedo ATMI service, the SCDL in Listing 7-19 should be used. This SCDL is contained in a file called `<componentname>.composite` (for example, `myComponent.composite`).

Listing 7-19 Example SCDL Descriptor

```
<?xml version="1.0" encoding="UTF-8"?>
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0" name="myComponent">
  <service name="TuxService">
   <interface.cpp header="TuxService.h"/>
        <binding.atmi requires="legacy"/>
   <map target="toupper">TUXSVC</map>
   <inputBufferType target="toupper">STRING</inputBufferType>
   <outputBufferType target="toupper">STRING</outputBufferType>
          <reference>MYComponent</reference>
    </service>
    <component name="MYComponent">
      <implementation.cpp library="TuxService" header="TuxServiceImpl.h"/>
    </component>
</composite>
```

This composite file indicates that the service, `mySVC`, can be invoked via the Oracle Tuxedo infrastructure. It further indicates that the `toupper()` method is advertised as the `TUXSVC` service in the Oracle Tuxedo system. Once initialized, another SCA component may now call this service, as well as a non-SCA Oracle Tuxedo ATMI client.

The `inputBufferType` and `outputBufferType` elements are used to determine the type of Oracle Tuxedo buffer used to exchange data. For more information, see SCA Data Type Mapping and the ATMI Binding Element Reference for a description of all possible values that can be used in the `binding.atmi` element.

Note: The `mycomponent.componentType` service name should be same as the composite file, otherwise an exception is thrown.

Compiling and Linking the Components

Once all the elements are in place, the component is built using the `buildscacomponent` command. The steps are as follows:

1. Navigate to the `APPDIR` directory. The component and side files should be in its own directory one level down
2. Execute the following command:

   ```
   $ buildscacomponent -c myComponent -s . -f TuxServiceImpl.cpp
   ```

   This command verifies the SCDL code, and builds the following required elements:

   - A shared library (or DLL on Windows) containing generated proxy code

Building the Oracle Tuxedo Server Host

In order for components to be supported in an Oracle Tuxedo environment, a host Oracle Tuxedo server must be built. This is achieved using the `buildscaserver` command.

For example: `$ buildscaserver -c myComponent -s . -o mySCAServer`

When the command is executed, `mySCAServer` is ready to be used. It automatically locates the component(s) to be deployed according to the SCDL, and performs the appropriate Oracle Tuxedo/SCA associations.

SCA Python, Ruby, and PHP Programming

This section contains the following topics:

- SCA Python, Ruby, and PHP Programming Overview

SCA Python, Ruby, and PHP Programming Overview

Integration of Python, Ruby or PHP scripts in an environment such as Oracle Tuxedo via SALT, is intended for providing additional flexibility in terms of program development.

Python, Ruby, and PHP are comparable object-oriented scripting languages that offer many advantages over C/C++:

- No compilation
- Dynamic data typing
- Garbage collection
- Existing libraries of utility functions and objects

SALT SCA Python, Ruby, and PHP support provides a set of APIs to perform SCA calls from Python, Ruby or PHP client programs, and language extensions to call Python, Ruby or PHP components. For more information, see Python, Ruby, and PHP Client Programming and Python, Ruby, and PHP Component Programming.

The `buildscaclient`, `buildscaserver` and `buildscacomponent` commands do not need adapting for use with Python, Ruby or PHP programs, as they are not be required to produce executables or component libraries.

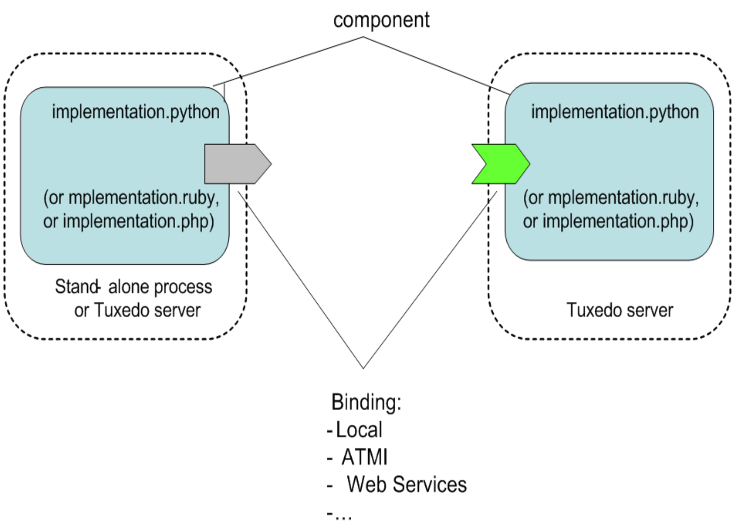
Note: A system server, `SCAHOST`, is provided to correctly marshal requests and responses to and from Python, Ruby or PHP scripts. It contains Python, Ruby, and PHP scripts exposed as SCA services (via the Oracle Tuxedo Metadata Repository). The definitions describe the parameters and return types of the corresponding exposed Python, Ruby or PHP functions.

For more information, see Python, Ruby, and PHP Data Type Mappingfor Service Metadata Repository entry examples.

Available bindings are used from Python, Ruby or PHP programs, or are used to invoke Python, Ruby or PHP components. Like C++, the Python, Ruby, and PHP language extension is binding-independent.

Figure 7-2 provides an overview of the SALT SCA environment Python, Ruby, and PHP support architecture.

Figure 7-2 SALT SCA Python, Ruby, and PHP Programming Support Architecture



Python, Ruby, and PHP Client Programming

- SCDL Clients
- Python Clients
- Ruby Clients
- PHP Clients

SCDL Clients

From a client component perspective, the SCDL code only has to mention the referenced component and possibly the binding used (that is, no interface element is required).

For example, the following snippet allows a Python, Ruby or PHP client to make an invocation to an SCA component via ATMI binding, and using the default buffer type (STRING input, STRING output):

```
<reference name="CalculatorComponent">
```

```
    <binding.atmi/>
</reference>
```

Python Clients

To invoke an SCA component from a Python program, you must do the following:

1. Import the SCA library using the following command:

   ```
   import sca
   ```

2. Use the following API to locate the service:

   ```
   calc = sca.locateservice("CalculatorComponent")
   ```

   The `calc` object is used to invoke the “add” operation (for example, `result = calc.add(val1, val2)`).

Ruby Clients

To invoke an SCA component from a Ruby program, you must do the following:

1. Load the Ruby proxy extension:

   ```
   require("sca_ruby")
   ```

2. Use the following API to locate the service:

   ```
   calculator = SCA::locateService("CalculatorComponent")
   ```

   The calculator object is used to invoke the “add” operation (for example, `x = calculator.add(3, 2)`).

PHP Clients

To invoke an SCA component from a PHP program, you must do the following:

1. users will have to first load the SCA library as follows:

   ```
   <?php
   dl('sca.so');
   ```

2. Use the following API to locate the service:

   ```
   $svc = Sca::locateService("uBikeService");
   ```

   At this point the svc object can be used to invoke the searchBike operation, for instance:

```
$ret = $svc->searchBike('YELLOW');
```

Python, Ruby, and PHP Component Programming

- SCDL Components
- Python Components
- Ruby Components
- PHP Components

SCDL Components

In order to use Python, Ruby or PHP scripts in SCA as components, you must use the `implementation.python`, `implementation.ruby` and `implementation.php` parameters.

Note: `implementation.python` `implementation.ruby` and `implementation.php` usage is similar to the `implementation.cpp` element (see Listing 7-19 and Listing 7-31); the difference is that the `interface.python` and `interface.ruby` elements, or `.componentType` are not required.

Their syntax and attributes are as follows:

- `implementation.python`

  ```
  <implementation.python
       module="string"
       scope="scope"? >
  <implementation.python/>
  ```

  The `implementation.python` element has the following attributes:

  – module: string (1..1)

    Name of the Python module (`.py` file) containing the operation(s) that this component offers in the form of module-level function(s).

  – scope: PythonImplementationScope(0..1)

    Identifies the scope of the component implementation. The default is stateless, indicating that there is no correlation between implementation instances used to dispatch service requests. A composite value indicates that all service requests are dispatched to the same implementation instance for the lifetime of the containing composite.

- `implementation.ruby`

```
<implementation.ruby
     script="string"
     class="string"
     scope="scope"? >
<implementation.ruby/>
```

The implementation.ruby element has the following attributes:

- script: string(1..1)

  Name of the Ruby script (`.rb` file) containing the operation(s) that the component offers in the form of methods of a class contained in the script file. The name of the script is its full name (that is, it also includes the `.rb` extension).

- class: string(1..1)

  Name of the Ruby class (`.rb` file) containing the operation(s) that the component offers.

- scope: RubyImplementationScope(0..1)

  Identifies the scope of the component implementation. The default is stateless, indicating that there is no correlation between implementation instances used to dispatch service requests. A composite value indicates that all service requests are dispatched to the same implementation instance for the lifetime of the containing composite.

- `implementation.php`

```
<implementation.php
     script="string"
     class="string"
     scope="scope"? >
<implementation.php/>
```

The implementation.php element has the following attributes:

- script: string(1..1)

  Name of the PHP script (`.php` file) containing the operation(s) that this component will offer, in the form of methods of a class contained in the script file. The name of the script is its full name, i.e. it also includes the `.php` extension.

- class: string(1..1)

  Name of the PHP class (`.php` file) containing the operation(s) that this component will offer.

- scope: PHPImplementationScope(0..1)

Identifies the scope of the component implementation. The default is stateless, indicating that there is no correlation between implementation instances used to dispatch service requests. A value of composite indicates that all service requests are dispatched to the same implementation instance for the lifetime of the containing composite.

Listing 7-20 shows an example of a Python component in an SCA composite accessible using the ATMI binding. In this example, runtime looks for a Python component located in a file named `ToupperService.py` in the same location as the composite file.

Similarly, a Ruby component is required in a file named `ToupperService.rb`, in the same location as the composite file.

Listing 7-20 Python Component in an SCA Composite

```
<?xml version="1.0" encoding="UTF-8"?>

<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
              name="simpapp.server">

       <service name="SCASVC">
              <binding.atmi/>
              <reference>ToupperServiceComponent</reference>
</service>

<component name="ToupperServiceComponent">
       <implementation.python module="ToupperService"
                                   scope="composite"/>
</component>

</composite>
```

Listing 7-21 shows an example of a PHPcomponent in an SCA composite accessible using the ATMI binding

Listing 7-21 PHP Component in an SCA Composite

```
<?xml version="1.0" encoding="UTF-8"?>

<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
              name="simpapp.PHP">

       <service name="TESTPHP">
         <!-- No interface, it is contained in TMMETADATA -->
         <binding.atmi>
           <map target="charToup">TOUPPHP</map>
           <inputBufferType target="charToup">STRING</inputBufferType>
           <outputBufferType target="charToup">STRING</outputBufferType>
         </binding.atmi>
         <reference>ToupperServiceComponent</reference>
</service>

<component name="ToupperServiceComponent">
       <implementation.php script="toupper.php"
                                   class="Toupper"/>
                                   scope="composite"/>
</component>

</composite>
```

Python Components

Python operations are exposed as module-level functions contained in a Python module file. For example, a `ToupperService.py` file would contain the code shown in Listing 7-22.

Listing 7-22 Python Module File

```
def charToup(val1):
    print "input: " + val1
    result = "result"
    print "Python - toupper"
    return result
```

Parameter and return values types are dynamically determined at runtime. Application exceptions are caught by the extension runtime and re-thrown as `tuscany::sca::ServiceInvocationException`.

During input, unsupported types or an error processing an input DataObject results in the following exception:
a `tuscany::sca::ServiceDataException`.

During output, simple return types are always processed. An error generating a DataObject (from XML data) results in the following exception:
`tuscany::sca::ServiceDataException`.

For more information, see Python, Ruby, and PHP Data Type Mapping.

Ruby Components

Ruby operations are exposed as methods of an implementation class contained in a Ruby script file (`.rb` extension). For example, a `ToupperService.rb` file would contain the code shown in Listing 7-23.

Listing 7-23 Ruby Script File

```
class ToupperService

  def initialize()
```

```
    print "Ruby - ToupperService.initialize\n"
  end

  def charToup(arg1)
    print "Ruby - ToupperService.div\n"
    arg1.ToUpper()
  end

end
```

Parameter and return values types are dynamically determined at runtime. Application exceptions are caught by the extension runtime and re-thrown as `tuscany::sca::ServiceInvocationException`.

During input, unsupported types or an error processing an input DataObject results in the following exception:
a `tuscany::sca::ServiceDataException`.

During output, simple return types are always processed. An error generating a DataObject (from XML data) results in the following exception: `tuscany::sca::ServiceDataException`.

For more information, see Python, Ruby, and PHP Data Type Mapping.

PHP Components

PHP operations are exposed as functions contained in a PHP class. For example, a `toupper.php` file would contain the code shown in Listing 7-24

Listing 7-24 PHP Class

```
<?php

class MyClass {

    public static function toupper(val) {

    print "PHP - toupper";

    return val.toupper();

  }
```

```
}
?>
```

Parameter and return values types are dynamically determined at runtime. Application exceptions are caught by the extension runtime and re-thrown as `tuscany::sca::ServiceInvocationException`.

During input, unsupported types or an error processing an input DataObject results in the following exception:
a `tuscany::sca::ServiceDataException`.

During output, simple return types are always processed. An error generating a DataObject (from XML data) results in the following exception: `tuscany::sca::ServiceDataException`.

For more information, see Python, Ruby, and PHP Data Type Mapping.

SCA Structure Support

This section contains the following topics:

- SCA Structure Support Overview
- Using SCA Structure Description Files
- Using tuxscagen to Generate Structures

Note: This section applies to application defined structures only. For information on Oracle SALT SCA defined structures, see SCA Data Type Mapping.

SCA Structure Support Overview

SCA Structure support provides:

- Additional C++ structure functionality
- Improved performance for applications processing data that can be placed in a structure without significant wasted space

You must use the `struct` data type specified in the SCA method parameter definition or in the definition of a return value from an SCA method as follows:

- `struct` *`structurename`* `*`

- `struct` *`structurename &`*

Elements within the structure can be any of the following simple data types/arrays that are supported as an SCA parameter:

- `bool`
- `char, unsigned char, signed char`
- `wchar_t`
- `short, unsigned short`
- `int, unsigned int`
- `long, unsigned long`
- `long long, unsigned long long`
- `float`
- `double`
- `long double`
- `struct` *`nestedstructurename`*
- `typedef`

Note: The `scagen` utility parses `typedef` and `struct` keywords. For more information, see the Oracle SALT Command Reference Guide.

SCA Structure Limitations

- The following cannot be specified as part of a structure"
  - `DataObjectPtr`
  - Point data types
  - `std::string` or a `std::wstring`
  - A union
  - `struct carray_t`, `struct_x_octet_t`, or `struct xml_t`
- CARRAY data is supported in the same way that it is supported for views
- `.h` and `.cpp` files referencing the use of structures are required to include a definition for the structure being used and for any nested structures contained within that structure.

Using SCA Structure Description Files

A structure description file may be used to describe the format of an SCA structure parameter. Structure description files are very similar to Oracle Tuxedo viewfiles, with additional capabilities added for SCA.

Note: The use of structure description files is optional, and is needed only when FML field names corresponding to structure elements are different from the names of the structure elements, or when some other non-default structure related feature is required. If an application wants to make use of an Associated Length Member, an Associated Count Member, or an application-specified default value for a structure element, it may choose to make use of a structure description file.

If no structure description file is provided for a particular structure, then the structure definition used in application code is used, and FML field names in SCA-ATMI mode are the same as structure element names. Since field numbers are generated automatically for SCA-SCA applications, these applications do not need to specify a structure description file.

The structure description file format is identical to the Oracle Tuxedo viewfile format, with the following exceptions:

- The type parameter in column 1 allows the additional values `bool`, `unsignedchar`, `signedchar`, `wchar_t`, `unsignedint`, `unsignedlong`, `longlong`, `unsignedlonglong`, `longdouble`, and `struct`.
- If the value in column1 is `struct`, then the `cname` value in column 2 is the name of a previously defined VIEW that describes a nested structure. In this case, the count value in column 4 may optionally be specified to specify the number of occurrences of the nested structure.

If a structure described in a structure description file is converted to (or from) an FML32 or FML buffer at runtime in an SCA-ATMI application, then the name of the corresponding FML field is the `fbname` value specified in column 3, if any, and is the `cname` value specified in column 2 (if no value is specified in column 3). When compiled, the structure description file produces a binary structure description file as shown in Listing 7-25. The binary structure header file is shown in shown in Listing 7-26.

Note: In an SCA-SCA application, FML32 field numbers are generated automatically.

Listing 7-25 SCA Structure Description File

```
VIEW empname
#TYPE       CNAME     FBNAME        COUNT      FLAG      SIZE      NULL
string      fname     EMP_FNAME       1          -        25         -
char        minit     EMP_MINI        1          -         -         -
string      lname     EMP LNAME       1          -        25         -
END

VIEW emp
struct         empname      ename     1          -         -         -
unsignedlong   id           EMP_ID    1          -         -         -
long           ssn          EMP_SSN   1          -         -         -
double         salaryhist   EMP_SAL   10         -         -         -
END
```

Listing 7-26 Binary Structure Header File

```
struct empname {
  char fname[25];
  char minit;
  char lname[25];
};

struct emp {
  struct empname ename;
  unsigned long id;
  long ssn;
  double salaryhist[10];
}
```

The `scastructc32` and `scastructc` commands are used to convert a source structure description file into a binary structure description file and to generate a header file describing the structure(s) in the structure description file. The `scastructdis32` and `scastructdis` commands accept the same arguments as `viewdis32` and `viewdis`. For more information, see the Oracle SALT Command Reference.

Notes: `scastructc32` and `scastructc` generate a binary file with suffix .V on Unix and suffix .VV on Windows.

If the structure description file contains no SCA extensions that are not available in Oracle Tuxedo views, then the magic value for the binary structure description file shall be the same as the magic value used by viewc32. If any SCA specific extensions are used, then a different magic value shall be used for the binary structure description file.

Using tuxscagen to Generate Structures

When invoked with the option `-S`, `tuxscagen` generates a structure for any function parameter or return value that would otherwise have been passed using `DataObjectPtr`.

Note: If `tuxscagen -S` is run, then simple data types are generated just as they would have been if `tuxscagen` were run without the `-S` option. It is possible to mix simple data types, structures, and other complex data types within a single metadata repository. In order to use simple data types in an application that also uses structures, it is not necessary to run tuxscagen without `-S`.

SCA Remote Protocol Support

SCA Oracle Tuxedo invocation supports the following remote protocols:

- /WS
- /Domains

/WS

SCA invocations made using the SCA container have the capability of being performed using the Oracle Tuxedo WorkStation protocol (/WS). This is accomplished by specifying the value `WorkStation` (not abbreviated so as not to confuse it with `WebServices`) in the `<remoteAccess>` element of the `<binding.atmi>` element.

Only reference-type invocations are be available in this mode. Service-type invocations may be performed using the /WS transparently (there is no difference in behavior or configuration, and setting the `<remoteAccess>` element to `WorkStation` for an SCA service has no effect).

Since native and `WorkStation` libraries cannot be mixed within the same process, client processes must be built differently depending on the type of remote access chosen.

Note: When using the value `propagatesTransaction` in `/binding.atmi/@requires`, the behavior of the ATMI binding does not actually perform any transaction propagation. It actually starts a transaction, since the use of this protocol is reserved for client-side access to Oracle Tuxedo (SCA or non-SCA) applications only. For more information, see ATMI Binding.

/Domains

SCA invocations made using the SCA container have the capability of being performed using the Oracle Tuxedo /Domains protocol. No additional configurations are necessary on `<binding.atmi>` declarations in SCDL files.

Note: /Domains interoperability configuration is controlled by the Oracle Tuxedo administrator.

The SCA service name configured for Oracle Tuxedo /Domains is as follows:

- SCA -> SCA mode - `/binding.atmi/service/@name` attribute followed by a '`/`' and method name
- Legacy mode (SCA -> Tux interop mode) - `/binding.atmi/service/@name` attribute.

For more information, see SCA and Oracle Tuxedo Interoperability.

SCA Binding

Oracle SALT supports

- ATMI Binding
- Java ATMI (JATMI) Binding
- Python, Ruby, and PHP Binding
- Web Services Binding

ATMI Binding

Oracle Tuxedo communications are configured in SCDL using a `<binding.atmi>` element. This allows you to specify configuration elements specific to the ATMI transport, such as the location of the TUXCONFIG file, the native Oracle Tuxedo buffer types used, Oracle Tuxedo-specific authentication or /WS (WorkStation) configuration elements, etc.

Listing 7-27 shows a summary of the `<binding.atmi>` element.

Note: `?` refers to a parameter that can be specified 0 or 1 times.

`*` refers to a parameter that can be specified 0 or more times.

For more information, see Appendix F: Oracle SALT SCA ATMI Binding Reference in the *Oracle SALT Reference Guide*.

Listing 7-27 ATMI Binding Pseudoschema

```
<binding.atmi requires="transactionalintent legacyintent"?>
       <tuxconfig>...</tuxconfig>?
       <map target="name">...</map>*
       <serviceType target="name">...</serviceType>*
       <inputBufferType target="name">...</inputBufferType>*
       <outputBufferType target="name">...</outputBufferType>*
       <errorBufferType target="name">...</errorBufferType>*
       <workStationParameters>?
              <networkAddress>...</networkAddress>?
              <secPrincipalName>...</secPrincipalName>?
              <secPrincipalLocation>...</secPrincipalLocation>?
              <secPrincipalPassId>...</secPrincipalPassId>?
              <encryptBits>...</encryptBits>?
       </workStationParameters>
       <authentication>?
              <userName>...</userName>?
              <clientName>...</clientName>?
              <groupName>...</groupName>?
              <passwordIdentifier>...</passwordIdentifier>?
              <userPasswordIdentifier>...
                                          </userPasswordIdentifier>?
       </authentication>
       <fieldTablesLocation>...</fieldTablesLocation>?
       <fieldTables>...</fieldTables>?
       <fieldTablesLocation32>...</fieldTablesLocation32>?
       <fieldTables32>...</fieldTables32>?
       <viewFilesLocation>...</viewFilesLocation>?
       <viewFiles>...</viewFiles>?
```

```
        <viewFilesLocation32>...</viewFilesLocation32>?
        <viewFiles32>...</viewFiles32>?
        <remoteAccess>...</remoteAccess>?
        <transaction timeout="xsd:long"/>?
</binding.atmi>
```

Java ATMI (JATMI) Binding

Java ATMI (JATMI) binding allows SCA clients written in Java to call Oracle Tuxedo services or SCA components. It provides one-way invocation of Oracle Tuxedo services based on the Oracle Tuxedo WorkStation protocol (/WS). The invocation is for outbound communication only from a Java environment to Oracle Tuxedo application acting as a server. Apart from a composite file for SCDL binding declarations, no external configuration is necessary. The service name, workstation address and authentication data are provided in the binding declaration.

Note: SSL is supported through the Oracle 11gR1 JCA Adapter. LLE is not currently supported.

Most of the Oracle Tuxedo CPP ATMI binding elements support JATMI binding and have the same usage. However, due to different underlying technology and running environment differences, some elements are not supported and some that are supported but have different element names.

The following Oracle Tuxedo CPP ATMI binding elements are not supported:

- `binding.atmi/tuxconfig`
- `binding.atmi/fieldTablesLocation`
- `binding.atmi/fieldTablesLocation32`
- `binding.atmi/viewFilesLocation`
- `binding.atmi/viewFilesLocation32`
- `binding.atmi/transaction`

The following Oracle Tuxedo CPP ATMI binding `workStationParameters` elements are not supported:

- `binding.atmi/workStationParameters/secPrincipalName`
- `binding.atmi/workStationParameters/secPrincipalLocation`
- `binding.atmi/workStationParameters/secPrincipalPassId`

- `binding.atmi/workStationParameters/encryptBits`

The following Oracle Tuxedo CPP ATMI binding element is supported in a limited fashion.

- `binding.atmi/remoteAccess`

  Note: Only the value "`WorkStation`" is allowed. If not specified, "`WorkStation`" is assumed.

All the classes in the elements mentioned below must be specified in Java CLASSPATH:

- `binding.atmi/fieldTables` - Specifies a comma-separated list of Java classes that are extended from the `weblogic.wtc.jatmi.TypedFML` base class.
- `binding.atmi/fieldTables32` - Specifies a comma-separated list of Java classes that are extended from the `weblogic.wtc.jatmi.TypedFML32` base class.
- `binding.atmi/viewFiles` - Specifies a comma-separated list of Java classes that are extended from the `weblogic.wtc.jatmi.TypedView` base class. These derived classes usually are generated from an Oracle Tuxedo VIEW file using the `weblogic.wtc.jatmi.viewj` compiler. These also includes derived from `weblogic.wtc.jatmi.TypedXCType` and `weblogic.wtc.jatmi.TypedXCommon`.

  For more information, see How to Use the viewj Compiler in the Oracle Tuxedo WebLogic Tuxedo Connector Programmer's Guide.

- `binding.atmi/viewFiles32` - Specifies a comma-separated list of Java classes that are extended from the `webogic.wtc.jatmi.TypedView32` base class. These derived classes usually are aslo generated from an Oracle Tuxedo VIEW file using the `weblogic.wtc.jatmi.viewj32` compiler.

Listing 7-28 shows an example of composite file for binding declaration of an Oracle Tuxedo service named "`ECHO`“.

Listing 7-28 ECHO Composite File

```
<?xml version="1.0" encoding="UTF-8"?>
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
xmlns:f="binding-atmi.xsd"
name="ECHO">
    <reference name="ECHO" promote="EchoComponent/ECHO">
       <interface.java interface="com.abc.sca.jclient.Echo" />
       <f:binding.atmi requires="legacy">
```

```
        <f:inputBufferType target="echoStr">STRING</f:inputBufferType>
          <f:outputBufferType target="echoStr">STRING</f:outputBufferType>
            <f:errorBufferType target="echoStr">STRING</f:errorBufferType>
             <f:workStationParameters>

<f:networkAddress>//STRIATUM:9999,//STRIATUM:1881</f:networkAddr
ess>
             </f:workStationParameters>
             <f:remoteAccess>WorkStation</f:remoteAccess>
         </f:binding.atmi>
    </reference>
    <component name="EchoComponent">
      <implementation.java class="com.abc.sca.jclient.EchoComponentImpl"
/>
    </component>
</component>
```

Listing 7-29 shows the interface for the example mentioned in Listing 7-28.

Listing 7-29 ECHO Interface

```
package com.abc.sca.jclient;

import com.oracle.jatmi.AtmiBindingException;

public interface Echo {
        String echoStr(String requestString) throws AtmiBindingException;
}
```

Listing 7-30 shows an example of an SCA client implementation.

Listing 7-30 SCA Client Implementation

```
package com.abc.sca.jclient;

import org.osoa.sca.annotations.Constructor;
import org.osoa.sca.annotations.Reference;
import com.oracle.jatmi.AtmiBindingException;

/**
* A simple client component that uses a reference with a JATMI binding.
*/
public class EchoComponentImpl implements Echo {

       private Echo echoReference;

        @Constructor
       public EchoComponentImpl(@Reference(name = "ECHO", required = true)
Echo
 echoReference) {
                this.echoReference = echoReference;
       }

        public String echoStr(String requestString) throws
AtmiBindingException {
                return echoReference.echoStr(requestString);
        }
}
```

Python, Ruby, and PHP Binding

The Python, Ruby, and PHP language extensions are binding-independent, meaning that binding extensions are not aware of the language of clients or components. Language extensions are not aware of the binding used.

Binding extensions are not modified to comply with Python, Ruby, and PHP program support. Note the following:

- If the data types defined in Python, Ruby or PHP binding do not match the Python, Ruby or PHP source files, then Oracle SALT will throw an exception.
- If a binding is configured with a data type that does not match what the Python, Ruby or PHP component is designed to handle, an exception is thrown by the Python, Ruby or PHP runtime (for example, `binding.atmi` configured with STRING Oracle Tuxedo buffers and a Python function handling numerical data).
- For a Python, Ruby or PHP client code mismatch with what binding is configured with, an exception occurs originating from the binding code.
- Since Python, Ruby, and PHP code is not compiled, any configuration mismatch between binding and component/client can only be detected at runtime.
- Python, Ruby or PHP programs with a *composite* scope require an Oracle Tuxedo server reload when the script is modified. A *stateless* scope allows dynamic reloading of modified scripts.
- In order to expose Python, Ruby or PHP scripts as Web services, the `SCAHOST` command must use the `-w` option in order to load the correct service binding during initialization.

  Note: `SCAHOST` does not allow mixing both ATMI and Web services binding types in one `SCAHOST` instance.

  For more information, see the Oracle SALT Command Reference.
- `TMMETADATA` server is required in order to expose Python, Ruby, and PHP components.

Python, Ruby, and PHP Binding Limitations

Using Python, Ruby, and PHP bindings have the following limitations:

- When using the ATMI binding for interoperability calls (that is, when `requires="legacy"` is set), mixing named and non-named parameters is not allowed (for example, Python: `def func(a, *b, **c)`, Ruby: `def func(a, *b, hash)`), since there is no mechanism to restore the parameter names.

  The names of the parameters must be configured in FML32 tables (ATMI binding), or by way of WSDL (Web services binding). It is not possible to interoperate with lists of non-named parameters because such calls cannot be accurately mapped to C++ or WSDL interfaces due to the lack of guaranteed ordering of `FML/FML32` Oracle Tuxedo buffers.

  The supported modes are:

  – Multiple parameters: `def func(a, b, c)` (same syntax for Python, Ruby, and PHP)

- Multiple parameters and list of parameters: `def func(a, *b)` (same syntax for Python and Ruby)
- Named parameters: PHP - `$svc->searchBike(array('COLOR' => 'RED', 'TYPE' => 'MTB'))`. For more information, see PHP Data Type Mapping.
- Dictionary or hash: Python: `def func(**a)`, Ruby: `def func(hash)`

Note: Python parameters defined with `**` are considered named parameters. Ruby parameters defined with `hash` are considered named parameters. For more information, see Python Parameters and Ruby Parameters.

- In SCA to SCA mode, the above limitation still concerns named parameters since the order of elements in a Python dictionary or Ruby hash is not guaranteed. To transmit a Python dictionary or Ruby hash, you must work in "legacy" mode.
- In SCA to SCA mode, using lists of parameters (excluding dictionaries or hashes) are supported since Oracle Tuxedo Service Metadata interfaces describe service-side lists of parameters/types (on the reference side parameters/types are self-described at runtime).
- Unicode strings are not supported; accordingly `MBSTRING` buffers or `FLD_MBSTRING` fields are not supported.

Web Services Binding

The Web services binding (`binding.ws`) leverages previously existing Oracle SALT capabilities by funneling Web service traffic through the GWWS gateway. SCA components are hosted in Oracle Tuxedo servers, and communications to and from those servers are performed using the GWWS gateway.

SCA clients using a Web services binding remain unchanged whether the server is running in an Oracle Tuxedo environment or a native Tuscany environment (for example, exposing the component using the Axis2 Web services binding).

Note: HTTPS is not currently supported.

When SCA components are exposed using the Web services binding (`binding.ws`), tooling performs the generation of WSDF information, metadata entries and FML32 field definitions.

When SCDL code of SCA components to be hosted in an Oracle Tuxedo domain (for example, service elements) contains <`binding.ws`> elements, the `buildscaserver` command generates an WSDF entry in a file named `service.wsdf` where '`service`' is the name of the service exposed. An accompanying `service.mif` and service`.fml32` field table files are also generated, based on the contents of the WSDL interface associated with the Web service. You must compose a WSDL interface. If no WSDL interface is found, an error message is generated.

Web services accessed from an Oracle Tuxedo domain using a Web services binding (for example, reference elements found in SCDL) require the following manual configuration steps:

1. Convert the WSDL file into a WSDF entry by using the `wsdlcvt` tool. Simultaneously, a Service Metadata Entry file (`.mif`), and fml32 mapping file are generated.
2. Make sure that the UBB source has the `TMMETADATA` and GWWS servers configured
3. Import the WSDF file into the `SALTDEPLOY` file
4. Convert the `SALTDEPLOY` file into binary using `wsloadcf`.
5. Load the Service Metadata Entry file (`.mif`) into the Service Metadata Repository using the `tmloadrepos` command.
6. Boot (or re-boot) the GWWS process to initiate the new deployment.

The Web services binding reference extension initiates the Web services call.

Listing 7-31 shows an SCA component service exposed as a Web service.

Listing 7-31 Example SCA Component Service Exposed as a Web Service

```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
       name="bigbank.account">
...
   <service name="AccountService">
       <interface.wsdl interface="http://www.bigbank.com/AccountService
              #wsdl.interface(AccountService)"/>
       <binding.ws/>
       <reference>AccountServiceComponent</reference>
   </service>

   <component name="AccountServiceComponent">
       <implementation.cpp
                     library="Account" header="AccountServiceImpl.h"/>
       <reference name="accountDataService">
              AccountDataServiceComponent
       </reference>
```

```
   </component>
...
</composite>
```

The steps required to expose the corresponding service are as follows:

1. Compose a WSDL interface matching the component interface.
2. Use `buildscacomponent` to build the application component runtime, similar to building a regular SCA component.
3. `buildscaserver -w` is used to convert SCDL code into a WSDF entry, and produce a deployable server (Oracle Tuxedo server + library + SCDL).

   The service from the above SCDL creates a WSDF entry as shown in Listing 7-32.

Listing 7-32 WSDF Entry

```
<Definition>
       <WSBinding id="AccountService_binding">
              <ServiceGroup id="AccountService">
                     <Service name="TuxAccountService"/>
              </ServiceGroup>
       </WSBinding>
</Definition>
```

4. `buildscaserver -w` also constructs a Service Metadata Repository entry based by parsing the SCDL and interface. The interface needs to be in WSDL form, and manually-composed in this release.
5. Make sure that the UBB source has the `TMMETADATA` and GWWS servers configured.
6. The Service Metadata Repository entry is loaded into the Service Metadata Repository using the `tmloadrepos` command.
7. The WSDF file must be imported into the `SALTDEPLOY` file and `SALTDEPLOY` converted into binary using `wsloadcf`.

8. The Service Metadata Entry file (`.mif`) is loaded into the Service Metadata Repository.

9. The Oracle Tuxedo server hosting the Web service is booted and made available.

10. The GWWS is rebooted to take into account the new deployment.

These steps are required, in addition to the `SALTDEPLOY` configuration, in order to set up the GWWS gateway for Web services processing (for example, configuration of `GWInstance`, Server Level Properties, etc.). When completed, Web service clients (SCA or other) have access to the Web service.

Listing 7-33 shows a reference accessing a Web service.

Listing 7-33 Example Reference Accessing a Web Service

```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
       name="bigbank.account">
...
       <reference name="StockQuoteWebService">
              <interface.wsdl interface="http://www.webserviceX.NET/#
                            wsdl.interface(StockQuoteSoap)"/>
              <binding.ws endpoint="http://www.webserviceX.NET/#
                            wsdl.endpoint(StockQuote/StockQuoteSoap)"/>
       </reference>
...
</composite>
```

The steps required to access the Web service are as follows:

1. A WSDL file is necessary. This is usually published by the Web Service provider.

2. The WSDL file must be converted into a WSDF entry using the `wsdlcvt` tool. At the same time a Service Metadata Entry file (`.mif`), and fml32 mapping file is generated.

3. The WSDF file must be imported into the `SALTDEPLOY` file and `SALTDEPLOY` converted into binary using `wsloadcf`.

4. The Service Metadata Entry file (`.mif`) is loaded into the Service Metadata Repository using the `tmloadrepos` command.

5. The GWWS process is rebooted to take into account the new deployment.

These steps are required, in addition to the SALTDEPLOY configuration, in order to set up the GWWS gateway for Web services processing (for example, configuration of GWInstance, Server Level Properties, etc.). When completed, the SCA client has access to the Web service.

The process is the same, whether the client is stand-alone SCA program or an SCA component (already a server) referencing another SCA component via the Web service binding.

SCA Data Type Mapping

Using ATMI binding leverages the Oracle Tuxedo infrastructure. Data exchanged between SCA components, or Oracle Tuxedo clients/services and SCA clients/components is performed using Oracle Tuxedo typed buffers. Table 7-1 through Table 7-10 summarize the correspondence between native types and Oracle Tuxedo buffers/types, as well as SOAP types when applicable.

In the example shown in Listing 7-34, implementations send and receive an Oracle Tuxedo STRING buffer. To the software (binding and reference extension implementations), the determination of the actual Oracle Tuxedo buffer to be used is provided by the contents of the /binding.atmi/inputBufferType, /binding.atmi/outputBufferType, or /binding.atmi/errorBufferType elements in the SCDL configuration, and the type of buffer returned (or sent) by a server (or client). It does not matter whether client or server is an ATMI program or an SCA component.

Notice that the Oracle Tuxedo simpapp service has its own namespace within namespace services. A C++ method toupper is associated with this service.

Listing 7-34 C++ Interface Example

```
#include <string>
namespace services
{
    namespace simpapp
    {
        /**
         *  business interface
         */
           class ToupperService
        {
        public:
```

```
        virtual std::string
           toupper(const std::string inputString) = 0;
        };

    } // End simpapp
} // End services
```

The following data type mapping rules apply:

- Run-Time Data Type Mapping
- SCA Utility Data Type Mapping

Run-Time Data Type Mapping

- Simple Oracle Tuxedo Buffer Data Mapping
- Complex Return Type Mapping
- Complex Oracle Tuxedo Buffer Data Mapping

Simple Oracle Tuxedo Buffer Data Mapping

The following are considered to be simple Oracle Tuxedo buffers:

- `STRING`
- `CARRAY (and X_OCTET)`
- `MBSTRING`
- `XML`

Table 7-1 lists simple Oracle Tuxedo buffer types that are mapped to SCA binding.

Table 7-1 Simple Oracle Tuxedo Buffer Type Data Mapping

C++ or STL Type	Java Type	Oracle Tuxedo Buffer Type	Notes
`char*`, `char array` or `std::string`	`java.lang.String`	`STRING`	
`CARRAY_T`	`byte[]` or `java.lang.Byte[]`	`CARRAY`	
`X_OCTET_T`	`byte[]` or `java.lang.Byte[]`	`X_OCTET`	
`XML_T`	`byte[]` or `java.lang.Byte[]`	`XML`	This type is passed as a C++ array within the data element of struct XML or as an array of java bytes. It is transformed to SDO.
`wchar_t *` or `wchar_t array`	`N/A`	`MBSTRING`	See Multibyte String Data Mapping
`std::wstring`	`java.lang.String`	`MBSTRING`	See Multibyte String Data Mapping

When a service called by an SCA client returns successfully, a pointer to the service return data is passed back to the Proxy stub generated by `buildscaclient`. The Proxy stub then de-references this pointer and returns the data to the application.

Table 7-1 can be interpreted as follows:

- When the reference or service binding extension runtime sees an Oracle Tuxedo `STRING` buffer, it looks for either a `char*`, `char array`, `std::string` parameter or `return` type (depending on the direction). If a different type is found, an exception is thrown with a message explaining what happened.
- When the reference or service binding extension runtime sees a `char*` (for example) as a single parameter or return type, it looks for STRING as the buffer type in the `binding.atmi` element. If a different Oracle Tuxedo buffer type is found, an exception is thrown with a message explaining what happened.

Multibyte String Data Mapping

Oracle Tuxedo uses multibyte strings to represent multibyte character data with encoding names based on `iconv` (as defined by Oracle Tuxedo). C++ uses a `wstring`, `wchar_t*`, or `wchar_t[]` data type to represent multibyte character data with encoding names (as defined by the C++ library).

Oracle Tuxedo and C++ sometimes use different names to represent a particular multibyte encoding. Mapping between Oracle Tuxedo encoding names and C++ encoding names is as follows:

- Receiving a Multibyte String Buffer

  When an SCA client or server receives an `MBSTRING` buffer or an `FML32` buffer with a `FLD_MBSTRING` field, it considers the encoding for that multibyte string to be the first locale from the following cases:

  a. Locale associated with the `FLD_MBSTRING` field, if present.

  Note: For more information, see Table 7-2.

  b. Locale associated with the `MBSTRING` or `FML32` buffer.

  c. Locale set in the environment of the SCA client or server.

  If case a or b is matched, Oracle Tuxedo invokes the `setlocale()` function for locale type `LC_CTYPE` with the locale for the received buffer. If `setlocale()` fails (indicating there is no such locale) and an alternate name has been associated with this locale in the optional `$TUXDIR/locale/setlocale_alias` file, Oracle Tuxedo attempts to set the `LC_CTYPE` locale to the alternate locale.

  The `$TUXDIR/locale/setlocale_alias` file may be optionally created by the Oracle Tuxedo administrator. If present, it contains a mapping of Oracle Tuxedo `MBSTRING` codeset names to an equivalent operating system locale accepted by the `setlocale()` function.

  Lines consist of an Oracle Tuxedo MBSTRING codeset name followed by whitespace and an OS locale name. Only the first line in the file corresponding to a particular `MBSTRING` codeset name are considered. Comment lines begin with `#`.

  The `$TUXDIR/locale/setlocale_alias` file is used by the SALT SCA software when converting `MBSTRING` data into C++ `wstring` or `wchar_t[]` data. If `setlocale()` fails when using the Oracle Tuxedo `MBSTRING` codeset name, then the SALT SCA software attempts to use the alias name, if present. For example, if the file contains a line '`GB2312 zh_CN.GB2312`' then if `setlocale(LC_CTYPE, 'GB2312')` fails, the SALT SCA software attempts `setlocale(LC_CTYPE, 'zh_CN.GB2312')`.

- Sending a Multibyte String Buffer

  When an SCA client or server converts a `wstring`, `wchar_t[]`, or `wchar_t*` to an `MBSTRING` buffer or a `FLD_MBSTRING` field, it uses the `TPMBENC` environment variable value as the locale to set when converting from C++ wide characters to a multibyte string. If the operating system does not recognize this locale, Oracle Tuxedo uses the alternate locale from the `$TUXDIR/locale/setlocale_alias` file, if any.

  Note: It is possible to transmit multibyte data retrieved from an `MBSTRING` buffer, an `FML32 FLD_MBSTRING` field, or a `VIEW32` mbstring field. It is also possible to transmit multibyte data entered using the SDO `setString()` method.

  However, it is not possible to enter multibyte characters directly into an XML document and transmit this data via SALT. This is because multibyte characters entered in XML documents are transcoded into multibyte strings, and SDO uses `wchar_t` arrays to represent multibyte characters.

Complex Return Type Mapping

The following C++ built-in types (used as return types) are considered complex and automatically encapsulated in an `FML/FML32` buffer as a single generic field following the complex buffer mapping rules described in Complex Oracle Tuxedo Buffer Data Mapping. This mechanism addresses the need for returning types where a corresponding Oracle Tuxedo buffer cannot be used.

Note: Interfaces returning any of the built-in types assume that `FML/FML32` is the output buffer type. The name of this generic field is `TUX_RTN`*`datatype`* based on the type of data being returned. `TUX_RTN`*`datatype`* fields are defined in the `Usysflds.h/Usysfl32.h` and `Usysflds/Usysfl32` shipped with Oracle Tuxedo.

- `bool` : maps to `TUX_RTNCHAR` field
- `char`: maps to `TUX_RTNCHAR` field
- `signed char`: maps to `TUX_RTNCHAR` field
- `unsigned char`: maps to `TUX_RTNCHAR` field
- `short`: maps to `TUX_RTNSHORT` field
- `unsigned short`: maps to `TUX_RTNSHORT` field
- `int`: maps to `TUX_RTNLONG` field
- `unsigned int`: maps to `TUX_RTNLONG` field

- `long`: maps to `TUX_RTNLONG` field
- `unsigned long`: maps to `TUX_RTNLONG` field
- `long long`: (maps to `TUX_RTNLONG` field
- `unsigned long long`: maps to `TUX_RTNLONG` field
- `float`: maps to `TUX_RTNFLOAT` field
- `double`: maps to `TUX_RTNDOUBLE` field
- long double: maps to `TUX_RTNDOUBLE` field

Complex Oracle Tuxedo Buffer Data Mapping

The following are considered to be complex Oracle Tuxedo buffers:

- `FML`
- `FML32`
- `VIEW (and X_* equivalents)`
- `VIEW32`

Table 7-2 lists the complex Oracle Tuxedo buffer types that are mapped to SCA binding.

For FML and FML32 buffers, parameter names in interfaces must correspond to field names, and follow the restrictions that apply to Oracle Tuxedo fields (length, characters allowed). When these interfaces are generated from metadata using `tuxscagen(1)`, the generated code contains the properly formatted parameter names.

If an application manually develops interfaces without parameter names, manually develops interfaces that are otherwise incorrect, or makes incompatible changes to SALT generated interfaces, then incorrect results are likely to occur.

VIEW (and `X_*` equivalents) and VIEW32 buffers require the use of SDO `DataObject` wrappers.

Listing 7-35 shows an interface example. The associated field definitions (following the interface) must be present in the process environment.

Table 7-2 Complex Oracle Tuxedo Buffer Type Data Mapping

C++, STL, or SDO type	Java Type	Oracle Tuxedo field type	Oracle Tuxedo view type	Notes
`bool`	`boolean or java.lang.Boolean`	`FLD_CHAR`	`char`	Maps to 'T' or 'F'. (This matches the mapping used elsewhere in SALT.)
`char, signed char, or unsigned char`	`byte or java.lang.Byte`	`FLD_CHAR`	`char`	
`short or unsigned short`	`short or java.lang.Short`	`FLD_SHORT`	`short`	An unsigned short is cast to a short before being converted to `FLD_SHORT` or `short`.
`int` or `unsigned int`	`int or java.lang.Integer`	`FLD_LONG`	`int`	An unsigned `int` being converted to FML or FML32 is cast to a long before being converted to `FLD_LONG` or `long`. An unsigned `int` being converted to a VIEW or VIEW32 member is cast to an `int`.
`long or unsigned long`	`long or java.lang.Long`	`FLD_LONG`	`long`	An exception is thrown if the value of a `64-bit long` does not fit into a `FLD_LONG` or `long` on a 32-bit platform. An unsigned long is cast to long before being converted to `FLD_LONG` or `long.`

Table 7-2 Complex Oracle Tuxedo Buffer Type Data Mapping

C++, STL, or SDO type	Java Type	Oracle Tuxedo field type	Oracle Tuxedo view type	Notes
long long or unsigned long long	N/A	FLD_LONG	long	An exception is thrown if the data value does not fit within a FLD_LONG or long. An unsigned long long is cast to long long before being converted to FLD_LONG or long.
float	float or java.lang.Float	FLD_FLOAT	float	
double	double or java.lang.Double	FLD_DOUBLE	double	
long double	N/A	FLD_DOUBLE	double	
char* or char array	N/A	FLD_STRING	string	
std::string	java.lang.String	FLD_STRING	string	
CARRAY_T or X_OCTET_T	class CARRAY	FLD_CARRAY	carray	Will map externally following GWWS rules. This departs from the OSOA spec. (which does not support them), and should be considered an improvement.
Bytes	N/A	FLD_CARRAY	Carray	This mapping is used when part of a DataObject
wchar_t* or wchar_t array	N/A	FLD_MBSTRING (FML32 only)	mbstring (VIEW32 only)	(Java char is Unicode and can range from -32768 to +32767.) See also Multibyte String Data Mapping

Table 7-2 Complex Oracle Tuxedo Buffer Type Data Mapping

C++, STL, or SDO type	Java Type	Oracle Tuxedo field type	Oracle Tuxedo view type	Notes
`std::wstring`	`java.lang.String`	`FLD_MBSTRING` (FML32 only)	`mbstring` (VIEW32 only)	See also Multibyte String Data Mapping
`commonj::sdo::DataObjectPtr`	`TypedFML32`	`FLD_FML32` (FML32 only)	N/A	Generate a data transformation exception, which is translated to an `ATMIBindingException` before being returned to the application, when: • Attempting to add such a field in an Oracle Tuxedo buffer other than FML32 • The data object is not typed (i.e., there is no corresponding schema describing it). See also Multibyte String Data Mapping
`commonj::sdo::DataObjectPtr`	`TypedView32`	`FLD_VIEW32` (FML32 only)	N/A	See also Multibyte String Data Mapping
`struct` *`structurename`*	N/A	`FLD_FML32` (FML32 only)	*`structurename`*	See also SCA Structure Support

Listing 7-35 Interface Example

```
...
int myService(int param1, float param2); ...
Field table definitions
#name          number type          flag comment
#----------------------------------------------------------
param1 20      int            -     Parameter 1
param2 30      float          -     Parameter 2
...
```

SDO Mapping

C++ method prototypes that use `commonj::sdo::DataObjectPtr` objects as parameter or return types are mapped to an `FML, FML32, VIEW, or VIEW32` buffer.

You must provide an XML schema that describes the SDO object. The schema is made available to the service or reference extension runtime by placing the schema file (`.xsd` file) in the same location as the SCDL composite file that contains the reference or service definition affected. The schema is used internally to associate element names and field names.

Note: When using view or view32, a schema type (for example, `complexType`) which name matches the view or view32 used is required.

For more information, see `mkfldfromschema` and `mkfld32fromschema` in the *SALT* 11*g* Release 1 (11.1.1.0) *Command Reference*.

For example, a C++ method prototype defined in a header such as:

```
long myMethod(commonj::sdo::DataObjectPtr data);
```

Listing 7-36 shows the associated schema.

Listing 7-36 Schema

```
<xsd:schema xmlns:xsd=http://www.w3.org/2001/XMLSchema
     xmlns="http://www.example.com/myExample"
     targetNamespace="http://www.example.com/myExample">

     <xsd:element name="bike" type="BikeType"/>
     <xsd:element name="comment" type="xsd:string"/>

     <xsd:complexType name="BikeType">
         <xsd:sequence>
             <xsd:element name="serialNO" type="xsd:string"/>
             <xsd:element name="name" type="xsd:string"/>
             <xsd:element name="type"  type="xsd:string"/>
             <xsd:element name="price"  type="xsd:float"/>
         </xsd:sequence>
```

```
    </xsd:complexType>
</xsd:schema>
```

Table 7-3 shows the generated field table.

Table 7-3 Generated Field Tables

NAME	NUMBER	TYPE	FLAG	Comment
bike	20	fml32	-	
comment	30	string	-	
serialNO	40	string	-	
name	50	string	-	
type	60	string	-	
price	70	float	-	

The following restrictions in XML schemas apply:

- Attributes cannot be specified and are ignored if specified
- Values in restrictions are ignored (their meaning is application-related), only the field name and type are generated
- When using XML schema types, only signed integral types are supported. See "SDO C++ Specification" for a list of available SDO primitive types.

SCA Utility Data Type Mapping

The `scatuxgen` and `tuxscagen` utilities are used to generate manual SCA data type mapping. The `scatuxgen` mapping rules are as follows:

- C++ Parameter/Return Type and Oracle Tuxedo Buffer Type Mapping
- C++ Parameter Type and Oracle Tuxedo Parameter Type Mapping
- C++ Parameter Type and Oracle Tuxedo Complex Type Mapping
- Parameter and Return Types to Parameter-Level Keyword Restrictions

Note: The mapping rules for `tuxscagen` are executed in the reverse direction (Oracle Tuxedo Buffer Type -> C++ Parameter Type).

C++ Parameter/Return Type and Oracle Tuxedo Buffer Type Mapping

Table 7-4 shows the correspondence between parameter/return types and Oracle Tuxedo buffer types (inbuf service-level keyword).

Table 7-4 'inbuf' Keyword Buffer Type Mapping Table

C++ Parameter Type	Oracle Tuxedo Buffer Type
`std::string or char*`	`STRING`
`struct carray_t`	`CARRAY`
`char`	`FML32`
`short`	`FML32`
`int`	`FML32`
`long`	`FML32`
`float`	`FML32`
`double`	`FML32`
`wchar_t[ ]`	`MBSTRING`
`struct xml_t`	`XML`
`struct x_octet_t`	`X_OCTET`
`commonj::sdo::DataObjectPtr`	`X_COMMON, X_C_TYPE, VIEW, VIEW32, FML, or FML32` depending on intputBufferType setting

Table 7-4 'inbuf' Keyword Buffer Type Mapping Table

C++ Parameter Type	Oracle Tuxedo Buffer Type
struct structurename	X_COMMON, X_C_TYPE, VIEW, VIEW32, FML, or FML32 depending on intputBufferType setting
multiple parameters, or one commonj::sdo::DataObjectPtr or struct structurename and no binding.atmi or no corresponding inputBufferType and the input buffer is not specified using a command line option	FML32

Table 7-5shows the correspondence between parameter/return types and Oracle Tuxedo buffer types (outbuf or err buf service-level keywords).

Table 7-5 outbuf' or 'errbuf' Keyword Buffer Type Mapping Table

C++ Return Type	Oracle Tuxedo Buffer Type
std::string or char*	STRING
struct carray_t	CARRAY
char	FML32
short	FML32
int	FML32
long	FML32
float	FML33
double	FML32
wchar_t[], wstring	MBSTRING
struct xml_t	XML
struct x_octet_t	X_OCTET

Table 7-5 outbuf' or 'errbuf' Keyword Buffer Type Mapping Table

C++ Return Type	Oracle Tuxedo Buffer Type
`commonj::sdo::DataObjectPtr`	`X_COMMON, X_C_TYPE, VIEW, VIEW32, FML or FML32` depending on the `binding.atmi/outputBufferType` or `binding.atmi/errorBufferType` setting.
`commonj::sdo::DataObjectPtr`	`FML32` if no binding.atmi is set, or binding.atmi is set and binding.atmi/outputBufferType or binding.atmi/errorBufferType aren't specified.
`struct structurename`	`X_COMMON, X_C_TYPE, VIEW, VIEW32, FML or FML32` depending on the binding.atmi/outputBufferType or binding.atmi/errorBufferType setting.
`struct` *`structurename`*	`FML32` if no binding.atmi is set, or binding.atmi is set and binding.atmi/outputBufferType or binding.atmi/errorBufferType are not specified.

C++ Parameter Type and Oracle Tuxedo Parameter Type Mapping

Table 7-7 shows how `scatuxgen` handles interface parameter types and converts them to an Oracle Tuxedo Service Metadata Repository parameter-level keyword value when more than one parameter is used in the method signature.

Table 7-6 Parameter-Level/Field Type Mapping Table

C++ Parameter Data Type	Oracle Tuxedo Parameter-Level Keyword (FML FIELD Type)
`char`	`byte(FLD_CHAR)`
`short`	`short(FLD_SHORT)`
`int`	`integer(FLD_LONG)`
`long`	`integer(FLD_LONG)`
`float`	`float(FLD_FLOAT)`
`double`	`double(FLD_DOUBLE)`
`std::string or char *`	`string(FLD_STRING)`
`struct carray_t`	`carray(FLD_CARRAY)`
`std::wstring`	`mbstring(FLD_MBSTRING)`

Table 7-6 Parameter-Level/Field Type Mapping Table

C++ Parameter Data Type	Oracle Tuxedo Parameter-Level Keyword (FML FIELD Type)
`commonj::sdo::DataObjectPtr`	`fml32(FLD_FML32)`
`struct` *`structurename`*	`fml32(FLD_FML32)`

C++ Parameter Type and Oracle Tuxedo Complex Type Mapping

This section contains the following topics:

- SDO Mapping
- C Struct Mapping

SDO Mapping

When a method takes an SDO object as an argument, or returns an SDO object, for example as follows: `commonj::sdo::DataObjectPtr myMethod(commonj::sdo::DataObjectPtr input)`.

The corresponding runtime type may be described by an XML schema as shown in Listing 7-37 and then referenced in the binding as shown in Listing 7-38.

Listing 7-37 XML Schema

```
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns="tuxedo"
targetNamespace="tuxedo">

    <xsd:complexType name="BikeInventory">
        <xsd:sequence>
           <xsd:element name="BIKES" type="Bike"
                        minOccurs="0" maxOccurs="unbounded"/>
           <xsd:element name="STATUS" type="xsd:string" maxOccurs="1"/>
        </xsd:sequence>
    </xsd:complexType>

    <xsd:complexType name="Bike">
        <xsd:sequence>
```

```
            <xsd:element name="SERIALNO" type="xsd:string"/>
            <xsd:element name="SKU" type="xsd:string"/>
            <xsd:element name="NAME" type="xsd:string"/>
            <xsd:element name="TYPE" type="xsd:string"/>
            <xsd:element name="PRICE" type="xsd:float"/>
            <xsd:element name="SIZE" type="xsd:int"/>
            <xsd:element name="INSTOCK" type="xsd:string"/>
            <xsd:element name="ORDERDATE" type="xsd:string"/>
            <xsd:element name="COLOR" type="xsd:string"/>
            <xsd:element name="CURSERIALNO" type="xsd:string"/>
        </xsd:sequence>
    </xsd:complexType>

</xsd:schema>
```

Listing 7-38 Binding

```
...
  <reference name="UBIK">
    <interface.cpp header="uBikeService.h"/>
    <binding.atmi>
       <inputBufferType>FML32/Bike</inputBufferType>
       <outputBufferType>FML32/BikeInventory</outputBufferType>
    </binding.atmi>
  </reference>
  ...
```

When such a schema is present, `scatuxgen` parses it and generates the corresponding parameter-level mapping entries as listed in Table 7-7.

Table 7-7 Parameter-level/Field Type Mapping

XML Schema element type	Oracle Tuxedo Parameter-Level Keyword (FML FIELD Type)
`xsd:byte`	`byte(FLD_CHAR)`
`xsd:short`	`short(FLD_SHORT)`
`xsd:int`	`integer(FLD_LONG)`
`xsd:long`	`integer(FLD_LONG)`
`xsd:float`	`float(FLD_FLOAT)`
`xsd:double`	`double(FLD_DOUBLE)`
`xsd:string`	`string(FLD_STRING)`
`xsd:string`	`mbstring(FLD_MBSTRING)` when -t option is specified
`xsd:base64binary`	`carray(FLD_CARRAY)`
`xsd:complexType`	`fml32(FLD_FML32)`
`xsd:minOccurs`	`requiredcount`
`xsd:maxOccurs`	`count`

C Struct Mapping

When a method takes a C struct as an argument, or returns a C struct (for example, as shown in Listing 7-39), `scatuxgen` parses it and generates the corresponding parameter-level mapping entries listed in Table 7-8.

Listing 7-39 C Struct

```
struct customer {
    char firstname[80];
    char lastname[80];
    char address[240];
};

struct id {
```

```
    int SSN;
    int zipCode;
};

struct customer* myMethod(struct *id input);
```

Table 7-8 Parameter-Level/Field Type Mapping

Struct Member Type	Oracle Tuxedo Parameter-Level Keyword (FML FIELD Type)
char, unsigned char, signed char	byte(FLD_CHAR)
char [ ]	string(FLD_STRING)
wchar_t [ ]	mbstring(FLD_MBSTRING)
short, unsigned short	short(FLD_SHORT)
int, unsigned int	integer(FLD_LONG)
long, unsigned long, long long, unsigned long long	integer(FLD_LONG)
float	float(FLD_FLOAT)
double, long double	double(FLD_DOUBLE)
struct *nestedstructname* (for more information, see SCA Structure Support)	fml32 (FLD_FML32)
array type	count=requiredcount=array specifier

Parameter and Return Types to Parameter-Level Keyword Restrictions

For parameter-level keywords, the Oracle Tuxedo buffer type/parameter type restrictions are consistent with the contents expected by `tmloadrepos`. An error message is returned when an attempt to match any combinations that are not listed in Table 7-9 and Table 7-10.

Table 7-9 Oracle Tuxedo Buffer Type/Parameter Type Restrictions (Part 1)

Parameter Type / Oracle Tuxedo Buffer	byte(char)	short	integer	float	double	String
CARRAY						
FML	X	X	X	X	X	X
FML32	X	X	X	X	X	X
VIEW	X	X	X	X	X	X
VIEW32	X	X	X	X	X	X
X_COMMON		X		X		X
X_C_TYPE	X	X	X	X	X	X
X_OCTET						
STRING						X
XML						X
MBSTRING						

Table 7-10 Oracle Tuxedo Buffer Type/Parameter Type Restrictions (Part 2)

Parameter Type / Oracle Tuxedo Buffer	carray	xml	view32	fml32	mbstring
CARRAY	X				
FML	X				
FML32	X	X	X	X	X

Table 7-10 Oracle Tuxedo Buffer Type/Parameter Type Restrictions (Part 2)

Parameter Type / Oracle Tuxedo Buffer	carray	xml	view32	fml32	mbstring
VIEW	X				
VIEW32	X				X
X_COMMON					
X_C_TYPE					
X_OCTET	X				
STRING					
XML		X			
MBSTRING	X				X

Python, Ruby, and PHP Data Type Mapping

The following sections describe the supported data types in Python, Ruby, and PHP clients or components with respect to the native, C/C++ based environment, and in order to give the correspondence for writing the Oracle Tuxedo Service Metadata Repository interface required by the ATMI binding. Corresponding Oracle Tuxedo buffer and field type are also indicated for uses with the ATMI or Web Services binding.

- Python Data Type Mapping
- Ruby Data Type Mapping
- PHP Data Type Mapping

Python Data Type Mapping

In Python, clients or components only use parameters and return values which types are listed in Table 7-11. Multiple parameters are supported (in the same way that multiple parameters are supported in C++), using FML32 Oracle Tuxedo buffers.

Note: Arrays are not supported as they are not supported by bindings or the C++ language extension.

Table 7-11 Supported Python, C++ and Oracle Tuxedo Buffer Types

Python parameter(s) or Return Type	C/C++ Native Type	ATMI Binding Type Buffer type/Field Type
`int`	`short, unsigned short`	`FML32/FLD_SHORT`
`long`	`short, unsigned short`	`FML32/FLD_SHORT`
`int`	`long, unsigned long`	`FML32/FLD_LONG`
`long`	`long, unsigned long`	`FML32/FLD_LONG`
`bool`	`bool`	`FML32/FLD_CHAR`
`float`	`float`	`FML32/FLD_FLOAT`
`float`	`double, long double`	`FML32/FLD_DOUBLE`
`string of length 1`	`char`	`FML32/FLD_CHAR`
`string`	`char *, std::string`	`STRING`
`xml`	`commonj::sdo::DataObject Ptr`	`FML32, VIEW, VIEW32`

Notes: int (short), long, int (long), float (float) are allowed in the C++ to Python direction only. The Python runtime catches any overflow situation (e.g.: when copying a C++ long into a Python int).

In order to map a string of length 1 to a `char*/std::string/STRING`, the originating Python variable will have to have 2 ending zeroes (for example, `'t = "a\x00"`).

Supported XML objects in Python must be `xml.etree.ElementTree objects`, (that is, the language extension converts `xml.etree.ElementTree` objects into `commonj::sdo::DataObjectPtr` objects, and `commonj::sdo::DataObjectPtr` objects into `xml.etree.ElementTree` objects.

Using lists and dictionaries are also supported, as detailed in Python Parameters and Dictionaries.

Note: Lists and dictionaries are allowed as parameters, but are not allowed to be returned.

Some limitations concerning multiple parameters and lists will stand with respect to using bindings. For more information, see Python, Ruby, and PHP Binding.

Python Parameters

You can use the list notation (*) to pass an undetermined number of parameters to/from a Python program. For example:

```
def test(*params)
    for p in params:
        print "parameter:", p
```

and an example of call: `test(1, 2, 3, 4, 5)`

This notation is equivalent to having an actual list of parameters, such as:

```
def test(parm1, parm2, parm3, parm4, parm5)
    ...
```

Individual supported types are limited to the types listed in Table 7-11.

Exposing a Python function as an SCA service with ATMI or Web services binding requires an interface. This interface is stored in the Oracle Tuxedo Service Metadata Repository as outlined in Python, Ruby, and PHP Component Programming.

When called, the Python function receives a list of parameters corresponding exactly to what the interface specifies. Any extra parameters passed by the client are ignored, and any type mismatch results in a data mapping exception.

Note: Using this notation is limited to local calls (no binding), or using ATMI binding between SCA components (that is, the `<binding.atmi>` element with no `requires="legacy"` attribute).

For local calls (no binding specified), or references, no interface is required.

Dictionaries

You can use the named parameters notation (**) to pass name/value pairs, also known as dictionaries, to/from Python programs. For example:

```
def test(**params):
    for p in params.keys():
        print "key:", p, " parameter:", params[p]
```

and an example of call: `test(a=1, b=2)`

Individual supported types are limited to the types listed in Table 7-11.

Exposing a Python function as an SCA service with the ATMI or Web Services binding requires an interface. This interface is stored in the Oracle Tuxedo Service Metadata Repository as outlined in Python, Ruby, and PHP Component Programming.

For example, consider the Oracle Tuxedo Service Metadata Repository entry shown in Listing 7-40

Listing 7-40 Oracle Tuxedo Service Metadata Repository Entry for Python

```
##
service=testPython2
tuxservice=TESTPT
inbuf=FML32
outbuf=FML32

param=NUMBER
type=long
access=in

param=TEXT
type=string
access=in

param=FNUMBER
type=double
access=in
##
```

When called, the Python function receives a list of parameters corresponding exactly to what the interface specifies. Any extra parameters passed by the client are ignored, and any type mismatch results in a data mapping exception.

The names of the parameters match the key names passed to the Python function. The interface is obtained by making an internal call to the `TMMETADATA` server. The `TMMETADATA` server must be running in order to make calls to Python, Ruby or PHP functions.

A Python function called with the interface is equivalent to the following Python call:

```
test(a=1, b=2)
```

Ruby Data Type Mapping

Table 7-12 lists supported Ruby, C/C++ and Oracle Tuxedo buffer types. Multiple parameters are supported (in the same way that multiple parameters are supported in C++), using FML32 Oracle Tuxedo buffers.

Arrays are not supported as they are not supported by bindings or the C++ language extension.

Table 7-12 Supported Ruby, C++ and Oracle Tuxedo Buffer Types

Ruby parameter or return type	C/C++ native type	ATMI binding type Buffer type/Field type
`Fixnum`	`short, unsigned short`	`FML32/FLD_SHORT`
`Fixnum`	`long, unsigned long`	`FML32/FLD_LONG`
`Bignum`	`double, long double`	`FML32/FLD_DOUBLE`
`True/false`	`bool`	`FML32/FLD_CHAR`
`Float`	`float`	`FML32/FLD_FLOAT`
`Float`	`double, long double`	`FML32/FLD_DOUBLE`
`String`	`char *, std::string`	`STRING`
`REXML Object`	`commonj::sdo::DataObject Ptr`	`FML32, VIEW, VIEW32`

Notes: Ruby runtime may catch an overflow exception.

Possible loss of precision when the Ruby Bignum is bigger than a C++ double.

Float (float) is allowed in C++ to Ruby direction only.

There is no mapping to single character (char/FLD_CHAR) possible in Ruby.

Supported XML objects in Ruby must be REXML (that is, the language extension converts `REXML::Document` objects into `commonj::sdo::DataObect` objects, and `commonj::sdo::DataObjectPtr` objects into `REXML::Document` objects.

Using variable argument lists and hashes are also be supported, as detailed in the following paragraphs.

Note: Variable argument lists and hashes are allowed as parameters, but are not allowed to be returned.

Some limitations concerning multiple parameters and lists will stand with respect to using bindings. For more information, see Python, Ruby, and PHP Binding.

Ruby Parameters

You can use the list notation (*) to pass an undetermined number of parameters to/from a Ruby script. For example:

```
def func(a, b, *otherargs)
    puts a
    puts b
    otherargs.each { |arg| puts arg }
end
```

which can be called like this: `func(1, 2, 3, 4, 5)`

Individual supported types are limited to the types listed in Table 7-12.

Exposing a Ruby function as an SCA service with the ATMI or Web Services binding requires an interface. This interface is stored in the Oracle Tuxedo Service Metadata Repository as outlined in Python, Ruby, and PHP Component Programming.

For example, consider the Oracle Tuxedo Service Metadata Repository entry shown in Listing 7-41

Listing 7-41 Oracle Tuxedo Service Metadata Repository Entry for Ruby

```
##
service=testRuby
tuxservice=TESTRU
inbuf=FML32
outbuf=FML32

param=first
type=char
access=in

param=next
```

```
type=long
access=in

param=last
type=string
access=in
##
```

When called, the Ruby function receives a list of parameters corresponding exactly to what the interface specifies. Any extra parameters passed by the client are ignored, and any type mismatch results in a data mapping exception.

Notes: Using this notation is limited to local calls (no binding), or with using the ATMI binding between SCA components (that is, the `<binding.atmi>` element with no `requires="legacy"` attribute).

Local calls (no binding specified), or references, do not require an interface.

Hash

You can use named parameters in the form of hash type parameters to pass name/value pairs to/from Ruby scripts. For example:

```
def func2(hash)
    hash.each_pair do |key, val|
        puts "#{key} -> #{val}"
    end
end
```

which can be called like this: `func2("first" => true, "next" => 5, "last" => "hi")`

Individual supported types are limited to the types listed inTable 7-12.

When exposing a Ruby function as an SCA service with the ATMI or Web Services binding, an interface is required. This interface is stored in the Oracle Tuxedo Service Metadata Repository as outlined in Python, Ruby, and PHP Component Programming.

When called, the Ruby function receives a list of parameters corresponding exactly to what the interface specifies. Any extra parameters passed by the client are ignored, and any type mismatch results in a data mapping exception.

The names of the parameters match the key names passed to the Ruby function (that is, a Ruby function called with the above interface is equivalent to the following Ruby client call:

```
func2("first" => true, "next" => 5, "last" => "hi")
```

where the values 'true', 5 and 'hi' are arbitrary, not the keys.

PHP Data Type Mapping

Table 7-13 lists supported Ruby, C/C++ and Oracle Tuxedo buffer types. Multiple parameters are supported (in the same way that multiple parameters are supported in C++), using FML32 Oracle Tuxedo buffers.

Arrays are not supported as they are not supported by bindings or the C++ language extension.

Table 7-13 Supported PHP, C++ and Oracle Tuxedo Buffer Types

PHP parameter(s) or return type	C/C++ native type	ATMI binding type Buffer type/Field type
integer	short, unsigned short	FML32/FLD_SHORT
integer	long, unsigned long	FML32/FLD_LONG
boolean	bool	FML32/FLD_CHAR
float1		
float	FML32/FLD_FLOAT	
float	double, long double	FML32/FLD_DOUBLE
string of length 1	char	FML32/FLD_CHAR
string	char *, std::string	STRING
string (return type, see below)	commonj::sdo::DataObject Ptr	FML32, VIEW, VIEW32
object of type SimpleXMLElement (parameter, see below)	commonj::sdo::DataObject Ptr	FML32, VIEW, VIEW32

Returning XML data in PHP is done by returning a STRING object which is then converted into a `SimpleXMLElement` as follows:

```
$ret = $svc->searchBike('YELLOW');
$xml = new SimpleXMLElement($ret, LIBXML_NOWARNING);
```

Once the XML object constructed, it will be accessed as follows:

```
echo "First serialno:".$xml->BIKES[0]->SERIALNO."\n";
echo "Second serialno:".$xml->BIKES[1]->SERIALNO."\n";
```

List of Parameters

You are permitted to pass an undetermined number of parameters when making an SCA reference using the PHP extension. For example:

```
test(1, 2, 3, 4, 5);
```

Individual supported types are limited to the types listed in Listing 7-13, with the exception of types originating from or becoming `commonj::sdo::DataObjectPtr objects`.

Note: Using this notation is limited to:

- local calls (no binding), or
- using the ATMI binding between SCA components (i.e., <binding.atmi> element with no requires="legacy" attribute). For local calls (no binding specified), or
- references

No interface is required.

Named Parameters

You can use named parameters to pass name/value pairs using the PHP SCA extension. For example:

```
$svc->searchBike(array('COLOR' => 'RED', 'TYPE' => 'MTB'));
```

Individual supported types are limited to the types listed in Table 7-13.

SCA Structure Data Type Mapping

In SCA-ATMI applications, an SCA structure parameter can be mapped to an `ATMI FML32, FML, VIEW32, VIEW, X_COMMON, or X_C_TYPE` data type, and this is the data type that is specified in the SCA composite file.

If a `VIEW32, VIEW, X_COMMON, or X_C_TYPE` data type is specified, then this view must exactly match the structure used as an SCA parameter or return type.

Note: In order for the view to exactly match the structure, the compilation of the view needs to produce the same structure with the same fields and same offsets as the structure used in the application.

SCA Structure and FML32 or FML Mapping

If the SCA structure parameter is mapped to `FML32` or `FML`, then the field type of the associated FML32 or FML field is a type that can be converted to and from the SCA structure data type For more informations, see SCA Data Type Mapping.

FML Field Naming Requirements

In SCA-SCA applications, fields are identified by field number, and FML32 field numbers are automatically generated. In the case of nested structures, field numbers are assigned as if the fields in the inner structure had occurred as flat fields in the outer structure in the place where the inner structure is defined in the outer structure.

In SCA-ATMI applications, the FML32 or FML field name associated with a structure element shall be obtained from the structure description file. For more information, see Using SCA Structure Description Files.

Long Element Truncation

When converting an FML32 or FML string, carray, or mbstring field to a structure element, any data that does not fit in the structure element is truncated (without warning) to the provided length.

For example, if a structure element is char `COMPANY_NAME[20]`; and FML field `COMPANY_NAME` with value "International Business Machines" is mapped to this structure element, then "International Busine" is copied to the structure element with no trailing null character.

SCA Structure and VIEW32, VIEW, X_OCTET, or X_C_TYPE Mapping

If an SCA structure is mapped to a `VIEW32, VIEW, X_OCTET, or X_C_TYPE` data type, then the structure used for the Oracle Tuxedo view-based type must exactly match the SCA structure, and is copied byte-by-byte. In other words, no marshalling of data is done when converting between an SCA structure, and a view. FML32 or FML should be used if data marshalling is required.

When an SCA structure is mapped to a view-based Oracle Tuxedo type, you cannot specify `bool`, `wchar_t`, `long long`, `unsigned long long`, `long double`, or nested structure data types within the SCA structure since corresponding data types do not exist within Oracle Tuxedo views. Elements corresponding to any Oracle Tuxedo Associated Count Member or Associated Length Member fields must be provided. Appropriate values for any such elements must also be provided by the application if converting an SCA structure to an Oracle Tuxedo view.

SCA Structure and Mbstring Mapping

An mbstring field type currently exists in VIEW32 (for more information, see `tpconvvmb32`). SCA structures treat the mbstring field type in the same way as in VIEW32. The encoding information is part of an mbstring structure element, and `Fmbunpack32()` and `Fmbpack32()` must be used in application programs using mbstring data in structures.

TPFAIL Return Data

You can specify a structure pointer as data returned on TPFAIL if the same structure pointer is also returned on successful output. Since SCA must store internal information describing the returned structure along with the application data, `<tuxsca.h>` is used to define the structure and `typedef` as shown in Listing 7-42.

Listing 7-42 <tuxsca.h> SCA Structure and Typedef Definition

```
struct scastruct_t {
  void *data;
  void *internalinfo;
};
typedef struct scastruct_t *SCASTRUCT_PTR;
```

If an application normally returns "`struct mystruct *`" data, it accesses TPFAIL data as shown in Listing 7-42.

Listing 7-43 TPFAIL Example

```
… catch (Tuscany::sca::atmi::ATMIBindingException& abe) {
  SCASTRUCT_PTR *scap = (SCASTRUCT_PTR *)abe.getData();
  struct mystruct *result = (struct mystruct *)scap->data;
}
```

SCA and Oracle Tuxedo Interoperability

Existing Oracle Tuxedo service interoperability is performed by using the `/binding.atmi/@requires` attribute with the legacy value. When a legacy value is specified, invocations are performed using the following behavior:

- If a `<map>` element is present in either a `<reference>` or a `<service>`, that value is used to determine which Oracle Tuxedo service is associated with the specified method name to call or advertise.

Otherwise:

- In a `<reference>` element: the value specified in the `/reference/@name` element is used to perform the Oracle Tuxedo call, with semantics according to the interface method used.
- In a `<service>` element: the Oracle Tuxedo service specified in the `/binding.atmi/map` element is advertised, and mapped to the method specified in the `/binding.atmi/map/@target` attribute.

Additionally, the `/binding.atmi/@requires` attribute is used to internally control data mapping, such that FML32 or FML field tables are not required.

Note: When *not* specified, communications are assumed to have SCA -> SCA semantics where the actual Oracle Tuxedo service name is constructed from `/service/@name` or `/reference/@name` and actual method name (see the pseudo schema shown Listing 7-27).

SCA Transactions

The ATMI binding schema supports SCA transaction policies by using the `/binding.atmi/@requires` attribute and three transaction values. These transaction values specify the transactional behavior that the binding extension follows when ATMI binding is used (see the pseudo schema shown Listing 7-27).

The transaction values are as follows:

- Not specified (no value)

  All transactional behavior is left up to the Oracle Tuxedo configuration. If the Oracle Tuxedo configuration supports transactions, then a transaction can be propagated if it exists.

  If the Oracle Tuxedo configuration does not support transactions and a transaction exists, then an error occurs.

Note: A transaction is not started if a transaction does not already exist.

- `suspendsTransaction`

  When specified, the transaction context is not propagated to the service called. For a `<service>`, the transaction (if present), is automatically suspended before invoking the application code, and resumed afterwards, regardless of the outcome of the invocation. For a `<reference>`, equivalent to making a `tpcall()` with the `TPNOTRAN` flag.

- `propagatesTransaction`

  Only applicable to `<reference>` elements, ignored for `<service>` elements. Starts a new transaction if one does not already exist, otherwise participate in existing transaction. Such a behavior can be obtained in a component or composite `<service>` by configuring it `AUTOTRAN` in the UBBCONFIG. An error is generated if an Oracle Tuxedo server hosts the SCA component implementation and is not configured in a transactional group in the UBBCONFIG.

SCA Security

SCA references pass credentials using the `<authentication>` element of the `binding.atmi` SCDL element.

SCA services can be ACL protected by referencing their internal name: `/binding.atmi/service/@name` attribute followed by a '`/`' and method name in SCA -> SCA mode, `/binding.atmi/service/@name` attribute in `legacy` mode (SCA -> Tux interop mode).

For more information, see SCA and Oracle Tuxedo Interoperability.

See Also

- Oracle SALT Administration Guide
- Oracle SALT Command Reference Guide
- SDO for C++ Specification V2.1

  http://www.osoa.org/download/attachments/36/CPP-SDO-Spec-v2.1.0-FINAL.pdf?version=2

- SCA Assembly Model V0.96:

  http://www.osoa.org/download/attachments/35/SCA_AssemblyModel_V096.pdf?version=1

- SCA Client and Implementation for C++ (V0.95):

http://www.osoa.org/download/attachments/35/SCA_ClientAndImplementationModelforCpp_V0.95.pdf?version=1