Oracle® Service Architecture Leveraging Tuxedo (SALT)

Programming Guide

10*g* Release 3 (10.3)

January 2009

ORACLE

Service Architecture Leveraging Tuxedo Programming Guide, 10*g* Release 3 (10.3)

CHAPTER 1

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

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

Oracle SALT Proxy Service

Oracle SALT proxy services are 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 a Tuxedo application, you must refer to the Tuxedo Service Metadata Repository to get the service contract description.

For more information, see “Tuxedo ATMI Programming for Web Services”.

Oracle SALT Message Conversion

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

When exposing 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 Tuxedo services (inbound) through Oracle SALT	Develop Web service client programs for 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 Tuxedo Services" on page 2-3
	Develop inbound message conversion plug-in	"Programming Message Conversion Plug-ins" on page 5-7
Invoking external Web services (outbound) through Oracle SALT	Understand the general outbound service programming concepts	"Tuxedo ATMI Programming for Web Services" on page 4-1
	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 2-27
	Develop outbound message conversion plug-in	"Programming Message Conversion Plug-ins" on page 5-7
	Develop your own plug-in to map Tuxedo user name with user name for outbound HTTP basic authentication	"Programming Outbound Authentication Plug-Ins" on page 5-17

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 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 Tuxedo communications between SCA components as well as SCA components and Tuxedo programs (clients and servers). Runtime checks will be 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 Tuxedo ATMI clients. Components are first built using `buildscacomponent` and then Tuxedo-enabled using `buildscaserver`. SCA administration is performed using common 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++

CHAPTER 2

Data Type Mapping and Message Conversion

This topic contains the following sections:

Overview of Data Type Mapping and Message Conversion

Oracle SALT supports bi-directional data type mapping between WSDL messages and Tuxedo typed buffers. For each service invocation, GWWS server converts each message between 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 Tuxedo services, each Tuxedo buffer type is described using an XML Schema in the SALT generated WSDL document. Tuxedo service request/response buffers are represented in regular XML format. For more information, see "Tuxedo-to-XML Data Type Mapping for Tuxedo Services".

For external Web services, each WSDL message is mapped as a Tuxedo FML32 buffer structure. A 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 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 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 Tuxedo services;
- When GWWS accepts response typed buffer from legacy Tuxedo service.

Oracle SALT encloses Tuxedo buffer content with element <inbuf>, <outbuf> and/or <errbuf> in the SOAP message, the content encluded 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 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 a 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 Tuxedo buffer types are involved	Only Tuxedo FML32 buffer type is involved

Tuxedo-to-XML Data Type Mapping for Tuxedo Services

Oracle SALT provides a set of rules for describing 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 Tuxedo buffer type knowledge.

Table 2-2 Tuxedo Buffer Mapping to XML Schema

Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`STRING`	Tuxedo STRING typed buffers are used to store character strings that terminate with a NULL character. 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 Tuxedo Service Metadata Repository. If defined in Tuxedo, the corresponding SOAP message also enforces this maximum. The GWWS server validates the actual message byte length against the definition in 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 Tuxedo Buffer Mapping to XML Schema

Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`CARRAY (Mapping with SOAP Message plus Attachments)`	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.	The CARRAY 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: • `application/octet-stream` – For Apache Axis • `text/xml` – 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 Tuxedo, the corresponding SOAP message is enforced with this limitation. The GWWS server validates the actual message byte length against the definition in the Tuxedo Service Metadata Repository.

Table 2-2 Tuxedo Buffer Mapping to XML Schema

Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
CARRAY (Mapping with base64Binary)	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 Tuxedo, the corresponding SOAP message is enforced with this limitation. The GWWS server validates the actual message byte length against the definition in the Tuxedo Service Metadata Repository.

Table 2-2 Tuxedo Buffer Mapping to XML Schema

Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
MBSTRING	Tuxedo MBSTRING typed buffers are used for multibyte character arrays. 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 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 Tuxedo service using MBSTRING Typed buffer format.The actual Tuxedo services handles the UTF-8 string. For any 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.
MBSTRING (cont.)		**Limitation:** Tuxedo MBSTRING data type can be specified with a max byte length in the 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 Tuxedo Buffer Mapping to XML Schema

Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
XML	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 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 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 Tuxedo Buffer Mapping to XML Schema

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 Tuxedo Buffer Mapping to XML Schema

Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
VIEW/VIEW32	Tuxedo VIEW and VIEW32 typed buffers store C structures defined by 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 Tuxedo Service Metadata Repository definition) maps to `xsd:byte` • `char` (defined as char in 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`
VIEW/VIEW32 (cont.)		For more information, see "VIEW/VIEW32 Considerations" on page 2-21.

Table 2-2 Tuxedo Buffer Mapping to XML Schema

Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
FML/FML32	Tuxedo FML and FML32 type buffers are proprietary 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 Tuxedo Service Metadata Repository definition) maps to `xsd:byte` • `char` (defined as char in 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 Tuxedo Buffer Mapping to XML Schema

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 2-25.

Tuxedo STRING Typed Buffers

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

Listing 2-1 shows a SOAP message for a TOUPPER 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" />
```

Tuxedo CARRAY Typed Buffers

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. 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` 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` 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>
```

Tuxedo MBSTRING Typed Buffers

Tuxedo MBSTRING typed buffers are used for multibyte character arrays. 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` 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, TUXEDO server-side MBSTRING auto-conversion cannot convert it back into Shift-JIS or EUC-JP.

Tuxedo XML Typed Buffers

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 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 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 a 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>
```

Tuxedo VIEW/VIEW32 Typed Buffers

Tuxedo VIEW and VIEW32 typed buffers are used to store C structures defined by 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` 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 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 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 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 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 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 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 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.

Tuxedo FML/FML32 Typed Buffers

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` 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 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 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 Tuxedo Service Metadata Repository, the GWWS cannot start. Inconsistency messages are printed in the ULOG file.
- The `tmwsdlgen` command checks for consistency between the 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 Tuxedo Service Metadata Repository, `tmwsdlgen` attempts to use Tuxedo Service Metadata Repository definitions to compose the WSDL document.
- Although the 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 Tuxedo typed buffer, Oracle SALT does not expose such restriction in the generated WSDL document.
- 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.

Tuxedo X_C_TYPE Typed Buffers

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

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

Tuxedo X_COMMON Typed Buffers

Tuxedo X_COMMON typed buffers are equivalent to 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.

Tuxedo X_OCTET Typed Buffers

Tuxedo X_OCTET typed buffers are equivalent to CARRAY.

Note: Tuxedo X_OCTET typed buffers can only map to `xsd:base64Binary` type. SALT 1.1 does not support MIME attachment binding for 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 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 5-1.

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

Oracle SALT maps each `wsdl:message` as a 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 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 Tuxedo FML32 Field Data Type.

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

XML Schema Built-In Simple Type	Tuxedo FML32 Field Data Type	C/C++ Primitive Type In 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 Tuxedo program, the C primitive type `long` *cannot* represent all `xsd:long` valid value.
`xsd:unsignedLong`	`FLD_LONG`	`unsigned long`	In a 32-bit Tuxedo program, the C primitive type `unsigned long` *cannot* represent all `xsd:long` valid value.
`xsd:float`	`FLD_FLOAT`	`float`	
`xsd:double`	`FLD_DOUBLE`	`double`	

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

XML Schema Built-In Simple Type	Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Tuxedo Program	Note
`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, anyURI, 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 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" />`
Corresponding FML32 Field Definition (FLD_CHAR)

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

#	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)

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

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

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" />
```

Table 2-8 XML Schema Built-In Type Sample - 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 Tuxedo FML32 Field Data Type.

Table 2-9 Supported XML Schema User Defined Data Type

XML Schema User Defined Data Type	Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Tuxedo Program	Note
<xsd:anyType>	FLD_MBSTRING	char []	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 Tuxedo side.
<xsd:simpleType> defined with <xsd:list>	FLD_MBSTRING	char []	Same as <xsd:anyType>. The Schema compliancy is not enforced at Tuxedo side.

Table 2-9 Supported XML Schema User Defined Data Type

XML Schema User Defined Data Type	Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Tuxedo Program	Note
<xsd:simpleType> defined with <xsd:union>	FLD_MBSTRING	char []	Same as <xsd:anyType>. The Schema compliancy is not enforced at Tuxedo side.
<xsd:complexType> defined with <xsd:simpleContent>	FLD_MBSTRING	char []	Same as <xsd:anyType>. The Schema compliancy is not enforced at Tuxedo side.
<xsd:complexType> defined with <xsd:complexContent>	FLD_MBSTRING	char []	Same as <xsd:anyType>. The Schema compliancy is not enforced at 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. Tuxedo programmer should only add one sub field into the fml32 buffer.

The following samples demonstrate how to prepare data in a 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>
```

Corresponding FML32 Field Definition (FLD_MBSTRING)

```
#     Field_name    Field_type    Field_flag    Field_comments
      Users         mbstring      -
```

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

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

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	Tuxedo Buffer/Field Definition	Note
<wsdl:input> message	Tuxedo Request Buffer (Input buffer)	
<wsdl:output> message	Tuxedo Response Buffer with TPSUCCESS (Output buffer)	
<wsdl:fault> message	Tuxedo Response Buffer with TPFAIL (error buffer)	

Table 2-12 WSDL Message Mapping Rules

WSDL Message Definition	Tuxedo Buffer/Field Definition	Note
Each message part defined in `<wsdl:input>` or `<wsdl:output>`	Mapped as top level field in the 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 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 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 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 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 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.

`<Node>` in SOAP 1.2 fault message	Mapped as a fixed top level `FLD_STRING` field (`Node`) in the Tuxedo error buffer: `Node string - -`	This mapping rule applies for SOAP 1.2 only.

Table 2-12 WSDL Message Mapping Rules

WSDL Message Definition	Tuxedo Buffer/Field Definition	Note
<Role> in SOAP 1.2 fault message	Mapped as a fixed top level FLD_STRING field (Role) in the 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 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 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.

CHAPTER 3

Web Service Client Programming

This section contains the following topics:

Overview

Oracle SALT is a configuration-driven product that publishes existing 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 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 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 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

CHAPTER 4

Tuxedo ATMI Programming for Web Services

This topic contains the following topics:

Overview

Oracle SALT allows you to import external Web Services into Tuxedo Domains. To import external Web services into 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 Tuxedo ATMI functions.

Oracle SALT proxy service calls are sent to the GWWS server. The request is translated from 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 Tuxedo typed buffers and returned to the 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 Tuxedo applications. This enables you to detect and handle the SALT proxy service call error status.

Converting WSDL Model Into Tuxedo Model

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

WSDL-to-Tuxedo Object Mapping

Oracle SALT converts WSDL object models into 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 Tuxedo style service, which is also called a SALT proxy service. The operation name is used as the Tuxedo service name and indexed in the Tuxedo Service Metadata Repository.

  Note: If the operation name exceeds the Tuxedo service name length limitation (15 characters), you must manually set a unique short 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 a Tuxedo service definition conforms to Tuxedo Service Metadata Repository input syntax.

Table 4-1 lists detailed mapping relationships between the WSDL file and Tuxedo definition files.

Table 4-1 WSDL Model / Tuxedo Model Mapping Rules

WSDL Object	Tuxedo/SALT Definition File	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 a Tuxedo application:

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

Oracle SALT Supported Communication Pattern

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

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

  These basic ATMI functions can be called with a Tuxedo typed buffer as input parameter. The return of the call will also carry a 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)`

Tuxedo server application can use this function to forward a 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 Tuxedo service.

- `TMQFORWARD` enabled queue-based communication.

  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 Tuxedo communication patterns:

- Conversational communication
- Event-based communication

Tuxedo Outbound Call Programming: Main Steps

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

- Check the 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 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 Tuxedo documentation and the 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 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 Tuxedo application can diagnose the failure. Table 4-2 lists possible Oracle SALT proxy service `tperrno` values.

Table 4-2 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 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 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 4-2 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 a Tuxedo Outbound Application

All rules listed in used to map WSDL input/output message into Tuxedo Metadata inbuf/outbuf definition. WSDL file default message can also be mapped into 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 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 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 thethe `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 4-3 lists the outbound SOAP fault errbuf definitions.

Table 4-3 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

CHAPTER 5

Using Oracle SALT Plug-Ins

This section contains the following topics:

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 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 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 will be 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 5-1.

Listing 5-1 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 5-2.

Listing 5-2 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 5-3.

Listing 5-3 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 Tuxedo buffers and SOAP message payloads. However, the default data type conversion rules may not meet all your needs in tranforming SOAP messages into 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 Tuxedo buffers, and the other is used to convert Tuxedo buffers to SOAP message payloads. These two function prototypes are defined in Listing 5-4 .

Listing 5-4 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 Tuxedo typed buffer.

The function pointer `(* soap_out_tuxedo__CUSTBUF)` points to the customized function that converts the 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 a Tuxedo service through the Oracle SALT gateway. Figure 5-1 depicts message streaming between a Web service client and a Tuxedo domain.

Figure 5-1 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 a Tuxedo response buffer is returned from the 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 a Tuxedo program that invokes an external Web service through the Oracle SALT gateway. Figure 5-2 depicts message streaming between a Tuxedo domain and a Web service application.

Figure 5-2 Message Conversion Plug-in Works in an Outbound Call Scenario

When a 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 5-1 lists several message conversion plug-in use cases.

Table 5-1 Message Conversion Plug-in Use Cases

	Scenario Description	soap_in_tuxedo_CUSTBUF	soap_out_tuxedo_CUSTBUF
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
	A 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
	A 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 a Tuxedo buffer	Optional	N/A
	All other general cases when a Tuxedo buffer is being transformed into a SOAP message payload	N/A	Optional

Table 5-1 Message Conversion Plug-in Use Cases

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

From Table 5-1, the following message conversion plug-ins general rules are applied.

- If a Tuxedo originated service consumes custom typed buffer, the message conversion plug-in is required. 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 a 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 a 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 a 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 a 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 a Tuxedo Buffer

The following function should be implemented in order to convert a SOAP XML payload to a 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 a 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. A 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 5-5.

Listing 5-5 Converting XML Effective Payload to 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: 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 a 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 5-6 .

Listing 5-6 Converting 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 do not use XercesDOMParser::getDocument() to get the pointer of the DOMDocument object because the DOMDocument object is maintained by the XercesDOMParser object and will be released when deleting the XercesDOMParser object if you do not de-couple the DOMDocument from the XercesDOMParser via 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 Tuxedo custom buffer types.

Table 5-2 compares the SALT Message Conversion Plug-in and the SALT 1.1 Custom Buffer Type Conversion Plug-in.

Table 5-2 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 Tuxedo custom buffer types	Supports message conversion between SOAP message payload and any kind of 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 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 a 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 Tuxedo clients uses `tpinit()` to send a username and password when registering to the Tuxedo domain. However, this username is used by 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 a Tuxedo client calls a Web service, it actually calls the GWWS server that declares the Web service as a 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 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 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” 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 5-7.

Listing 5-7 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 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 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 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: 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 5-8.

Listing 5-8 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.

CHAPTER 6

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 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 Tuxedo infrastructure using ATMI binding. The ATMI binding implementation provides native Tuxedo communications between SCA components, as well as SCA components and 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 instruct the framework to set-up necessary links (wires).

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 to call other services: SCA components, Tuxedo servers or even Web services, transparently from an SCA-based component.

SCA Client Programming Steps

The steps required for developing SCA client programs are:

1. Setting Up the Client Directory Structure
2. Developing the Client Application
3. Composing the SCDL Descriptor
4. Building the Client Application (Using buildscaclient)
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 6-1shows the directory structure used to place SCA components in an application.

Listing 6-1 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 6-2 provides an example of typical `root.composite` content.

Listing 6-2 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 individual components are listed here. The `implementation.composite@name` parameter references the directory that contains the component named '`myClientComponent`'. This last 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 Tuxedo ATMI services, this interface can be generated by accessing the Tuxedo METADATA repository, For more information, see `tuxscagen` in the SALT Reference Guide and the SALT SCA Administration Guide.

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

Listing 6-3 provide an interface example.

Listing 6-3 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 6-3, 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 6-4 shows an example of a succession of calls required to perform an invocation.

Listing 6-4 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, for the example shown in Listing 6-4 to call an existing Tuxedo ATMI service, the SCDL descriptor shown in Listing 6-5 should be used. This SCDL is contained in a file called `<componentname>.composite`.

Listing 6-5 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 will be performed using the ATMI binding. In effect, this results in a `tpcall()` to the "`TOUPPER`" Tuxedo service. This Tuxedo service may be an actual existing

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 Tuxedo buffer used to exchange data. For more information, see SCA ATMI Binding 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 (Using buildscaclient)

Once all the elements are in place, the client program can be built using provided `buildscaclient` command.

The program above can be built using 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 be used.

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 6-2). It tells the SCA runtime where to start when looking for services in the `locateService()` call.

Invoking Existing Tuxedo Services

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

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

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

Listing 6-6 SCA Components Calling an Existing Tuxedo Service

```
service=TestString
tuxservice=ECHO
servicetype=service
inbuf=STRING
outbuf=STRING

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

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

Handling TPFAIL Data

When invoking a non-SCA Tuxedo ATMI service, that service may return in error but still send back data by using the `tpreturn(TPFAIL, …)` API. 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()`.

The example in Listing 6-9 corresponds to a `binding.atmi` definition as shown in Listing 6-10.

Listing 6-9 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 6-10 /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 data types returned have to be cast to the corresponding type. For instance an invocation returning a `commonj::sdo::DataObjectPtr` such that, in SCDL as shown in Listing 6-11.

Listing 6-11 SCDL

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

The results of `ATMIBindingException.getData()` is shown in Listing 6-12.

Listing 6-12 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 follow:

- 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 on 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[ ]`datatype.
  - 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 the type above.

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

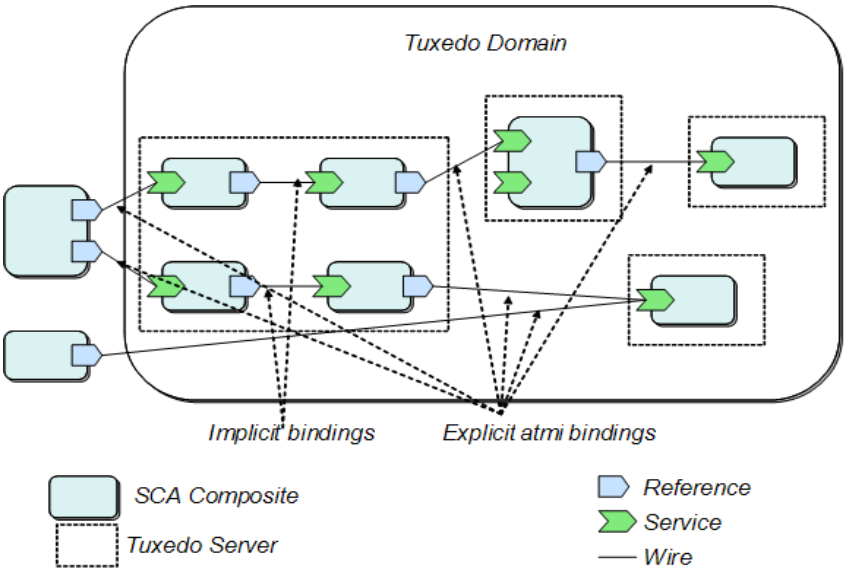
SCA Component Programming

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 as opposed to strict SCA clients which can only make calls to other SCA or non-SCA components, but cannot be invoked.

The SCA container in Oracle SALT offers 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 6-1 summarizes SCA components and Tuxedo server mapping rules.

Figure 6-1



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

The mapping is as follows:

- An SCA composite declaring one or more services with a `<binding.atmi>` definition maps to a single 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 a Tuxedo service.

  - a service declared in a component, but not promoted, is not advertised.

- The resulting 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 a Tuxedo native service by way of the `/binding.atmi/@map` attribute. A method not declared via the `/binding.atmi/@map` attribute is not accessible through Tuxedo. The use of duplicate service names are detected at server generation time, so that Tuxedo service names to interface method mapping in a single Tuxedo server instance is 1:1.
- A generated 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 Tuxedo administrator.

SCA composites are deployed in a 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 Tuxedo features.

SCA Component Programming Steps

The steps required for developing SCA component programs are:

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

Setting Up the Component Directory Structure

The first step is to define the applications physical representation. Listing 6-13 shows the directory structure employed to place SCA components in an application:

Listing 6-13 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)
        myComponentImpl.cpp (component implementation source file)
        TuxService.h (interface of component being exposed)
        TuxServiceImpl.h (component implementation definitions)
```

Listing 6-14 shows typical `root.composite` content.

Listing 6-14 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>
```

Here the individual components are listed. 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 structures and 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 ATMI Binding Data Type Mapping.

Listing 6-15 shows an example of an interface implemented for a client program.

Listing 6-15 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 6-16 and Listing 6-17 respectively):

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

Listing 6-16 Example (TuxServiceImpl.h):

```
#include "TuxService.h"

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

Listing 6-17 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 6-18 shows an example of a `componentType` file (`TuxServiceImpl.componentType`).

Listing 6-18 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 6-18 to be exposed as a Tuxedo ATMI service, the SCDL below in Listing 6-19 should be used. This SCDL is contained in a file called `<componentname>.composite` (for example, `myComponent.composite`).

Listing 6-19 Example SCDL Descriptor

```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0"
           name="simpapp.server">
    <service name="mySVC">
        <interface.cpp header="TuxService.h"/>
        <binding.atmi requires="legacy">
           <map target="toupper">TUXSVC</map>
           <inputBufferType target="toupper">STRING</inputBufferType>
           <outputBufferType target="toupper">STRING</outputBufferType>
        </binding.atmi>
        <reference>TuxServiceComponent</reference>
    </service>

    <component name="TuxServiceComponent">
      <implementation.cpp library="TuxSvc" header="TuxServiceImpl.h"/>
    </component>
</composite>
```

This composite file indicates that the service, `mySVC`, can be invoked via the 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 Tuxedo ATMI client.

The `inputBufferType` and `outputBufferType` elements are used to determine the type of Tuxedo buffer used to exchange data. For more information, see SCA ATMI Binding 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.

Compiling and Linking the Components

Once all the elements are in place, the component can be built using the `buildscacomponent` command.

The component above can be built using the following steps:

1. navigate to the `APPDIR` directory. The component and side files should be in its own directory one level down
2. execute the command below: `$ 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 Tuxedo Server Host

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

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

The `mySCAServer` is then ready to be used. It will automatically locate the component(s) to be deployed according to the SCDL, and perform the appropriate Tuxedo/SCA associations.

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 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 a 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 a 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 a 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 6-20 shows an SCA component service exposed as a Web service.

Listing 6-20 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 (Tuxedo server + library + SCDL).

   The service from the above SCDL creates a WSDF entry as shown in Listing 6-21.

Listing 6-21 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 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 6-22 shows a reference accessing a Web service.

Listing 6-22 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 Remote Protocol Support

Tuxedo SCA invocation support the following remote protocols:

- /WS
- /Domains
- Java ATMI (JATMI) Binding

/WS

SCA invocations made using the SCA container have the capability of being performed using the 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 Tuxedo (SCA or non-SCA) applications only. For more information, see SCA ATMI Binding.

/Domains

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

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

The SCA service name configured for 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 Tuxedo SCA Interoperability.

Java ATMI (JATMI) Binding

Java ATMI (JATMI) binding allows SCA clients written in Java to call Tuxedo services or SCA components. It provides one-way invocation of Tuxedo services based on the Tuxedo WorkStation protocol (/WS). The invocation is for outbound communication only from a Java environment to 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: Both SSL and LLE are not currently supported.

Most of the 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 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 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 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 a 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 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 a Tuxedo VIEW file using the `weblogic.wtc.jatmi.viewj32` compiler.

Listing 6-23 shows an example of composite file for binding declaration of a Tuxedo service named "`ECHO`".

Listing 6-23 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 6-24 shows the interface for the example mentioned above.

Listing 6-24 ECHO Interface

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

import com.oracle.jatmi.AtmiBindingException;

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

```
}
```

Listing 6-25 shows an example of an SCA client implementation.

Listing 6-25 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);
        }
}
```

Tuxedo SCA Interoperability

Existing 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 Tuxedo service 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 Tuxedo call, with semantics according to the interface method used.
- In a `<service>` element: the 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 Tuxedo service name is constructed from `/service/@name` or `/reference/@name` and actual method name (see the pseudo schema shown Listing 6-26).

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 6-26).

The transaction values are as follows:

- not specified (no value)

  All transactional behavior is left up to the Tuxedo configuration. If the Tuxedo configuration supports transactions, then one may be propagated if it exists. If the Tuxedo configuration does not support transactions and one exists then an error will occur. However, a transaction is not started if one does not already exist.

- `suspendsTransaction`

When specified, the transaction context will not be propagated to the service called. For a `<service>`, the transaction, if present, will be 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 will be generated if a Tuxedo server host the SCA component implementation and it 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).

See also, Tuxedo SCA Interoperability.

SCA ATMI Binding

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 Tuxedo buffer types used, Tuxedo-specific authentication or /WS (WorkStation) configuration elements, etc.

Listing 6-26 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 6-26 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>
```

SCA ATMI Binding Data Type Mapping

Using the ATMI binding leverages the Tuxedo infrastructure. As such, data exchanged between SCA components, or Tuxedo clients/services and SCA clients/components is performed using Tuxedo typed buffers. The tables below summarize the correspondence between native types and Tuxedo buffers/types, as well as SOAP types when applicable.

In the example shown Listing 6-27, implementations send and receive a Tuxedo STRING buffer. To the software (binding and reference extension implementations), the determination of the actual 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 Tuxedo `simpapp` service has its own `namespace` within `namespace services`. A C++ method `toupper` is associated with this service.

Listing 6-27 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:

- Simple Tuxedo Buffer Data Mapping
- Complex Tuxedo Buffer Data Mapping
- SDO Mapping

Simple Tuxedo Buffer Data Mapping

The following are considered to be simple Tuxedo buffers:

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

Table 6-1 lists simple Tuxedo buffer types that are mapped to SCA binding.

Table 6-1 Simple Tuxedo Buffer Type Data Mapping

C++ or STL Type	Java Type	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.

Table 6-1 Simple Tuxedo Buffer Type Data Mapping

C++ or STL Type	Java Type	Tuxedo Buffer Type	Notes
`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 6-1 can be interpreted as follows:

- When the reference or service binding extension runtime sees a 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 Tuxedo buffer type is found, an exception is thrown with a message explaining what happened.

Multibyte String Data Mapping

Tuxedo uses multibyte strings to represent multibyte character data, with encoding names based on `iconv` as defined by 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.

Tuxedo and C++ sometimes use different names to represent a particular multibyte encoding. Mapping between 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:

1. Locale associated with the FLD_MBSTRING field, if present.

   Note: For more information, see Table 6-2.

2. Locale associated with the MBSTRING or FML32 buffer.
3. Locale set in the environment of the SCA client or server.

If case 1 or 2 is matched, 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, Tuxedo attempts to set the `LC_CTYPE` locale to the alternate locale.

The `$TUXDIR/locale/setlocale_alias` file may be optionally created by the Tuxedo administrator. If present, it contains a mapping of Tuxedo MBSTRING codeset names to an equivalent operating system locale accepted by the `setlocale()` function.

Lines consist of a 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 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, Tuxedo uses the alternate locale from the `$TUXDIR/locale/setlocale_alias` file, if any.

Note: In SALT 10*g* Release 3 (10.3), it is possible to transmit multibyte data retrieved from a Tuxedo 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 10*g* Release 3 (10.3). 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 Tuxedo Buffer Data Mapping. This mechanism addresses the need for returning types where a corresponding Tuxedo buffer can not 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_RTNdatatype` based on the type of data being returned. `TUX_RTNdatatype` fields are defined in the `Usysflds.h/Usysfl32.h` and `Usysflds/Usysfl32` shipped with 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 Tuxedo Buffer Data Mapping

The following are considered to be complex Tuxedo buffers:

- FML
- FML32
- VIEW (and X_* equivalents)
- VIEW32

Table 6-2 lists the complex 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 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 6-28 shows an interface example. The associated field definitions (following the interface) must be present in the process environment.

Table 6-2 Complex Tuxedo Buffer Type Data Mapping

C++, STL, or SDO type	Java Type	Tuxedo field type	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`.

Table 6-2 Complex Tuxedo Buffer Type Data Mapping

C++, STL, or SDO type	Java Type	Tuxedo field type	Tuxedo view type	Notes
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.
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	

Table 6-2 Complex Tuxedo Buffer Type Data Mapping

C++, STL, or SDO type	Java Type	Tuxedo field type	Tuxedo view type	Notes
`std::string`	`java.lang.String`	`FLD_STRING`	`string`	
`struct CARRAY`	`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
`std::wstring`	`java.lang.String`	`FLD_MBSTRING (FML32 only)`	`mbstring (VIEW32 only)`	See also Multibyte String Data Mapping

Table 6-2 Complex Tuxedo Buffer Type Data Mapping

C++, STL, or SDO type	Java Type	Tuxedo field type	Tuxedo view type	Notes
`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 a 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

Listing 6-28 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 will be 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* 10*g* Release 3 (10.3) *Reference Guide*.

For example, a C++ method prototype defined in a header such as:

```
long myMethod(commonj::sdo::DataObjectPtr data);
```

Listing 6-29 shows the associated schema.

Listing 6-29 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 6-3 shows the generated field table.

Table 6-3 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 will be supported. See "SDO C++ Specification" for a list of available SDO primitive types.

See Also

- Oracle SALT Administration Guide
- Oracle SALT 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