Oracle® Service Architecture Leveraging Tuxedo (SALT)

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Oracle Service Architecture Leveraging Tuxedo (SALT) Programming Guide, Release 22c

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1 Introduction to SALT Programming

This chapter includes the following topics:

- SALT Web Services Programming

1.1 SALT Web Services Programming

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

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

- SALT Proxy Service
- SALT Message Conversion
- SALT Programming Tasks Quick Index
- REpresentational State Transfer (REST) Message Conversion

1.1.1 SALT Proxy Service

SALT proxy services are Oracle Tuxedo service entries advertised by the GWWS SALT Gateway. 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 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 proxy services from an Oracle Tuxedo application, you must refer to the Oracle Tuxedo Service Metadata Repository to get the service contract description.

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

1.1.2 SALT Message Conversion

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

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

For more information, see Understanding SALT Message Conversion

1.1.3 SALT Programming Tasks Quick Index

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

Table 1-1 Table 1-1 SALT Programming Tasks Quick Index

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

1.1.4 REpresentational State Transfer (REST) Message Conversion

The basic REST design principle establishes a one-to-one mapping between create, read, update, and delete (CRUD) operations and HTTP methods.

The REST principles around are as follows:

- Use HTTP methods explicitly.
- Expose directory structure-like URIs.
- Transfer XML, JavaScript Object Notation (JSON), or both.

For more information, see Data Type Mapping and Message conversion, and SALT configuration tool in the SALT Configuration Guide.

2 Data Type Mapping and Message Conversion

This chapter contains the following sections:

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

2.1 Overview of Data Type Mapping and Message Conversion

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

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

For external Web services, each WSDL message is mapped as an Oracle Tuxedo `FML32` buffer structure. An Oracle Tuxedo application invokes SALT proxy service using `FML32` buffers as input/output. For more information see, XML Schema Built-In Simple Data Type Mapping

SALT also supports non-SOAP data type mapping (i.e., REST over HTTP in both XML and JSON format. This is initiated when services are exposed as `HTTP/REST` services. For more information, see REST Data Mapping

2.2 Understanding SALT Message Conversion

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

- Inbound Message Conversion
- Outbound Message Conversion

2.2.1 Inbound Message Conversion

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

- When GWWS accepts SOAP requests for legacy Oracle Tuxedo services;

- When GWWS accepts response typed buffers from legacy Oracle Tuxedo services.

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

2.2.2 Outbound Message Conversion

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

- When GWWS accepts request typed buffers sent from an Oracle Tuxedo application;
- When GWWS accepts SOAP response messages from external Web services.

The following table compares inbound message conversion and outbound message conversion:

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>`
Transformation according to “Tuxedo-to-XML data type mapping rules”.	Transformation according to “XML-to-Tuxedo data type mapping rules”.
All Oracle Tuxedo buffer types are involved.	Only Oracle Tuxedo `FML32` buffer type is involved.

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

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

Table 2-2 Oracle Tuxedo Buffer Mapping to XML Schema

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

Table 2-2 (Cont.) Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`CARRAY` (`Mapping with SOAP Message plus Attachments`)	Oracle Tuxedo `CARRAY` typed buffers store character arrays, any of which can be `NULL`. `CARRAY` buffers are used to handle data opaquely and are not self-describing.	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 `CARRAY` data types can be specified with a max byte length. If defined in Oracle Tuxedo, the corresponding SOAP message is enforced with this limitation. The GWWS server validates the actual message byte length against the definition in the Oracle Tuxedo Service Metadata Repository.

Table 2-2 (Cont.) Oracle Tuxedo Buffer Mapping to XML Schema

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

Table 2-2 (Cont.) Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
`MBSTRING`	Oracle Tuxedo `MBSTRING` typed buffers are used for multibyte character arrays. Oracle Tuxedo `MBSTRING` buffers consist of the following three elements: • Code-set character encoding • Data length • Character array of the encoding.	`xsd:string` The XML Schema built-in type, `xsd:string`, represents the corresponding type for buffer data stored in a SOAP message. The GWWS server only accepts "`UTF-8`" encoded XML documents. If the Web service client wants to access Oracle Tuxedo services with `MBSTRING` buffer, the mbstring payload must be represented as "`UTF-8`" encoding in the SOAP request message. **Note:** The GWWS server transparently passes the "`UTF-8`" character set string to the Oracle Tuxedo service using `MBSTRING` Typed buffer format.The actual Oracle Tuxedo services handles the `UTF-8` string. For any Oracle Tuxedo response `MBSTRING` typed buffer (with any encoding character set), the GWWS server automatically transforms the string into "`UTF-8`" encoding and sends it back to the Web service client.
`MBSTRING (cont.)`	-	**Limitation:** Oracle Tuxedo `MBSTRING` data type can be specified with a max byte length in the Oracle Tuxedo Service Metadata Repository. The GWWS server checks the byte length of the converted `MBSTRING` buffer value. Max byte length value is not used to enforce the character number contained in the SOAP message.

Table 2-2 (Cont.) Oracle Tuxedo Buffer Mapping to XML Schema

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

Table 2-2 (Cont.) Oracle Tuxedo Buffer Mapping to XML Schema

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

Table 2-2 (Cont.) Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
VIEW/VIEW32 (cont.)	-	• bool maps to xsd:Boolean • unsigned char maps to xsd:unsignedByte • signed char maps to xsd:byte • wchar_t* or wchar_t array maps to xsd:string • unsigned int maps to xsd:unsignedInt • unsigned long maps to xsd:unsignedLong • long long maps to xsd:long • unsigned long long maps to xsd:unsignedLong • long double maps to xsd:double. Do not set the value of C importer option size of long double to 128 bit. This option does not import successfully; use the default 64 bit • VIEW32 maps to tuxtype:view <viewname> For more information, see VIEW/VIEW32 Considerations.
FML/FML32	Oracle Tuxedo FML and FML32 type buffers are proprietary Oracle Oracle Tuxedo system self-describing buffers. Each data field carries its own identifier, an occurrence number, and possibly a length indicator. FML supports the following field types: • FLD_CHAR • FLD_SHORT • FLD_LONG • FLD_FLOAT • FLD_DOUBLE • FLD_STRING • FLD_CARRAY FML32 supports all the FML field types and FLD_PTR, FLD_MBSTRING, FLD_FML32, and FLD_VIEW32.	FML/FML32 buffers can only have basic data-dictionary-like definitions for each basic field data. A particular FML/FML32 buffer definition should be applied for each FML/FML32 buffer with a different type name. Each FML/FML32 field should be one or more sub-elements within the FML/FML32 buffer XML Schema type. The name of the sub-element is the FML field name. The occurrence of the sub-element depends on the count and required count attribute of the FML/FML32 field definition. The e field types and the corresponding XML Schema type are listed below: • short maps to xsd:short • int maps to xsd:int • long maps to xsd:long • float maps to xsd:float • double maps to xsd:double • char (defined as byte in Oracle Tuxedo Service Metadata Repository definition) maps to xsd:byte • char (defined as char in Oracle Tuxedo Service Metadata Repository definition) maps to xsd:string • string maps to xsd:string • carray maps to xsd:base64Binary • mbstring maps to xsd:string

Table 2-2 (Cont.) Oracle Tuxedo Buffer Mapping to XML Schema

Oracle Tuxedo Buffer Type	Description	XML Schema Mapping for SOAP Message
FML/FML32 (cont.)	-	• view32 maps to tuxtype:view <viewname> • fml32 maps to tuxtype:fml32 <svcname>_p<SeqNum> To avoid multiple embedded FML32 buffers in an FML32 buffer, a unique sequence number (<SeqNum>) is used to distinguish the embedded FML32 buffers. **Note:** ptr is not supported. For limitations and considerations regarding mapping FML/FML32 buffers, refer to FML/FML32 Considerations.
RECORD	RECORD buffer type represents copybook record. RECORD types must have subtypes that designate individual record structures. Generated COBOL types: • RECORD • COMP-1 • COMP-2 • S9(18) • 9(18) • S9(9) • 9(9) • S9(4) • S9(10)V9(10) • X(1024) • @binary=true	Each RECORD data type is defined as an XML Schema complex type. Each RECORD field should be one or more sub-elements of the XML Schema complex type. The COBOL types and the corresponding XML Schema type are listed as follows: • RECORD maps to xsd:complexType • COMP-1 maps to xsd:float • COMP-2 maps to xsd:double • S9(18) maps to xsd:long • 9(18) maps to xsd:unsignedLong • S9(9) maps to xsd:int • 9(9) maps to xsd:unsignedInt • S9(4) maps to xsd:short • S9(10)V9(10) COMP-3 maps to xsd:decimal • X(1024) maps to xsd:string • @binary=true xsd:base64Binary
X_C_TYPE	X_C_TYPE buffer types are equivalent to VIEW buffer types.	See VIEW/VIEW32
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

- Oracle Tuxedo STRING Typed Buffers

- Oracle Tuxedo CARRAY Typed Buffers
- Oracle Tuxedo MBSTRING Typed Buffers
- Oracle Tuxedo XML Typed Buffers
- Oracle Tuxedo VIEW/VIEW32 Typed Buffers
- Oracle Tuxedo FML/FML32 Typed Buffers
- Oracle Tuxedo RECORD Typed Buffers
- Oracle Tuxedo X_C_TYPE Typed Buffers
- Oracle Tuxedo X_COMMON Typed Buffers
- Oracle Tuxedo X_OCTET Typed Buffers
- Custom Typed Buffers

2.3.1 Oracle Tuxedo STRING Typed Buffers

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

The following SOAP message is an example for the Oracle Tuxedo service `TOUPPER` that accepts a `STRING` typed buffer.

Example 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” />
```

The XML Schema for `<inbuf>` is:

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

2.3.2 Oracle Tuxedo CARRAY Typed Buffers

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

- Mapping Example Using base64Binary
- Mapping Example Using MIME Attachment

2.3.2.1 Mapping Example Using base64Binary

The following SOAP message is example of the `TOUPPER` Oracle Tuxedo service that accepts a `CARRAY` typed buffer using `base64Binary` mapping.

Example 2-2 Mapping Example Using base64Binary

```
<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” />
```

2.3.2.2 Mapping Example Using MIME Attachment

The following SOAP message is example of the `TOUPPER` Oracle Tuxedo service that accepts a `CARRAY` typed buffer as a MIME attachment.

Example 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>
```

2.3.3 Oracle Tuxedo MBSTRING Typed Buffers

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

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

> **Note:**
>
> You cannot embed multibyte characters with non "`UTF-8`" code sets in the SOAP message directly.

The following is an example of the SOAP message for the `MBSERVICE` Oracle Tuxedo service that accepts an `MBSTRING` typed buffer.

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

2.3.4 Oracle Tuxedo XML Typed Buffers

Following is an example of the Stock Quote XML document:

Example 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>
```

The following is an example of a SOAP message for the STOCKINQ Oracle Tuxedo service that accepts an XML typed buffer.

Example 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 an Oracle Tuxedo XML typed buffer and returned to the GWWS server, the GWWS server converts the default namespace to a regular name. Each element is then prefixed with this name.

The following is an example of an Oracle Tuxedo service that returns a buffer, which has a default namespace to the GWWS server:

Example 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>
```

The following is an example of the GWWS server converts the default namespace to a regular name:

Example 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>
```

2.3.5 Oracle Tuxedo VIEW/VIEW32 Typed Buffers

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

The following example shows the MYVIEW VIEW definition file.

Example 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
```

The following example shows message for the `MYVIEW` Oracle Tuxedo service that accepts a `VIEW` typed buffer.

Example 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 the example below:

Example 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

2.3.5.1 VIEW/VIEW32 Considerations

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

- You must create an environment for converting XML to and from `VIEW/VIEW32`. This includes setting up a `VIEW` directory and system `VIEW` definition files. These definitions are automatically loaded by the GWWS server.
- You must create an environment for converting XML to and from `VIEW/VIEW32`. This includes setting up a `VIEW` directory and system `VIEW` definition files. These definitions are automatically loaded by the GWWS server.
- The GWWS server provides strong consistency checking between the Oracle Tuxedo Service Metadata Repository `VIEW/VIEW32` parameter definition and the `VIEW/VIEW32` definition file at start up.
  If an inconsistency is found, the GWWS server cannot start. Inconsistency messages are printed in the `ULOG` file.
- `tmwsdlgen` also provides strong consistency checking between the Oracle Tuxedo Service Metadata Repository `VIEW/VIEW32` parameter definition and the `VIEW/VIEW32` definition file at start up. If an inconsistency is found, the GWWS server will not start. Inconsistency messages are printed in the `ULOG` file.
  If the `VIEW` definition file cannot be loaded, `tmwsdlgen` attempts to use the Oracle Tuxedo Service Metadata Repository definitions to compose the WSDL document.
- `Because dec_t` is not supported, if you define `VIEW` fields with type `dec_t`, the service cannot be exported as a Web service and an error message is generated when the SALT configuration file is loading.
- Although the Oracle Tuxedo Service Metadata Repository may define a size attribute for “`string/ mbstring`” typed parameters (which represents the maximum byte length that is allowed in the Oracle Tuxedo typed buffer), SALT does not expose such restriction in the generated WSDL document.
- When a `VIEW32` embedded MBString buffer is requested and returned to the GWWS server, the GWWS miscalculates the required `MBString` length and reports that the input string exceeds the `VIEW32` maxlength. This is because the header is included in the transfer encoding information. You must include the header size when defining the `VIEW32` field length.
- The Oracle Tuxedo primary data type “`long`” is indefinite between 32-bit and 64-bit scope, depending on the platform. However, the corresponding `xsd:long` schema type is used to describe 64-bit numeric values.

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

2.3.6 Oracle Tuxedo FML/FML32 Typed Buffers

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

- FML Data Mapping Example
- FML32 Data Mapping Example
- FML/FML32 Considerations

2.3.6.1 FML Data Mapping Example

Following is an example of a SOAP message for the `TRANSFER` Oracle Tuxedo service that 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 shown in the following example:

Example 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 in the following example:

Example 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" />
```

2.3.6.2 FML32 Data Mapping Example

The code example below shows the SOAP message for the `TRANSFER` Oracle Tuxedo service, which accepts an `FML32` typed buffer.

The request fields for service `LOGIN` are:

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

Each embedded `CUST_INFO` includes the following fields:

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

Each embedded ACCOUNT_INFO includes the following fields:

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

Part of the SOAP message is shown in the following example:

Example 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 the following example:

Example 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" />
```

2.3.6.3 FML/FML32 Considerations

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

- You must create an environment for converting XML to and from FML/FML32. This includes an FML field table file directory and system FML field definition files. These definitions are automatically loaded by the GWWS. FML typed buffers can be handled only if the environment is set up correctly.
- FML32 field type FLD_PTR is not supported.
- The GWWS server provides strong consistency checking between the Oracle Tuxedo Service Metadata Repository FML/FML32 parameter definition and FML/FML32 definition file during start up.
  If an FML/32 field is found that is not in accordance with the environment setting, or the field table field data type definition is different from the parameter data type definition in the Oracle Tuxedo Service Metadata Repository, the GWWS cannot start. Inconsistency messages are printed in the ULOG file.
- The tmwsdlgen command checks for consistency between the Oracle Tuxedo Service Metadata Repository FML/FML32 parameter definition and FML/FML32 definition file. If inconsistencies are found, it issues a warning and allows inconsistencies.
- If an FML/32 field is found that is not in accordance with the environment setting, or the field table field data type definition is different from the parameter data type definition in the Oracle Tuxedo Service Metadata Repository, tmwsdlgen attempts to use Oracle Tuxedo Service Metadata Repository definitions to compose the WSDL document.
- Although the Oracle Tuxedo Service Metadata Repository may define a size attribute for "string/mbstring" typed parameters, which represents the maximum byte length that is

allowed in the Oracle Tuxedo typed buffer, SALT does not expose such restriction in the generated WSDL document.

- Oracle Tuxedo primary data type "`long`" is indefinite between 32-bit and 64-bit scope according to different platforms. But the corresponding `xsd:long` schema type is used to describe 64-bit numeric value. The following scenario generates a SOAP fault:

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

2.3.7 Oracle Tuxedo RECORD Typed Buffers

Oracle Tuxedo RECORD typed buffers can describe COBOL copybook information.

The following example shows `the myRecord` COBOL copybook file:

Example 2-16   COBOL copybook myRecord

```
01 myRecord.
05 name occurs 1 times PIC X(10).
05 num occurs 1 times PIC S9(9) COMP-5.
05 subgroup occurs 1 times.
10 long1 PIC S9(9) COMP-5.
10 string1 PIC X(19).
```

Following is an example of a SOAP Message for a RECORD Typed Buffer:

Example 2-17   SOAP Message for a RECORD Typed Buffer

```
<soapenv:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:soapenv=http://
schemas.xmlsoap.org/soap/envelope/ xmlns:urn="urn:pack.TuxAll_typedef.salt11">
<soapenv:Header/>
<soapenv:Body>
<urn:QUERY soapenv:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
<inbuf xsi:type="urn:record_QUERY_In_myRecord">
<name>John</name>
<num xsi:type="xsd:int">999</num>
<subgroup xsi:type="urn:record_QUERY_In__p3">
<long1 xsi:type="xsd:int">1000</long1>
<string1>abcd</string1>
</subgroup>
</inbuf>
</urn:QUERY>
</soapenv:Body>
</soapenv:Envelope>
```

The XML Schema for `<inbuf>` is shown in the example below:

Example 2-18   Schema for a RECORD Typed Buffer

```
<xsd:complexType name="record_QUERY_In_myRecord">
<xsd:sequence>
<xsd:element maxOccurs="1" minOccurs="1" name="name">
<xsd:simpleType>
<xsd:restriction base="xsd:string">
```

```
<xsd:maxLength value="10"></xsd:maxLength>
</xsd:restriction>
</xsd:simpleType>
</xsd:element>
<xsd:element maxOccurs="1" minOccurs="1" name="num" type="xsd:int"></
xsd:element>
<xsd:element maxOccurs="1" minOccurs="1" name="subgroup"
type="tuxtype:record_QUERY_In__p3"></xsd:element>
</xsd:sequence>
</xsd:complexType>
<xsd:complexType name="record_QUERY_In__p3">
<xsd:sequence>
<xsd:element maxOccurs="1" minOccurs="1" name="long1" type="xsd:int"></
xsd:element>
<xsd:element maxOccurs="1" minOccurs="1" name="string1">
<xsd:simpleType>
<xsd:restriction base="xsd:string">
<xsd:maxLength value="19"></xsd:maxLength>
</xsd:restriction>
</xsd:simpleType>
</xsd:element>
</xsd:sequence>
</xsd:complexType
```

- REDEFINES Handling

2.3.7.1 REDEFINES Handling

Redefines are handled using the core RECORD implementation, which takes a cpy2record binary output with boolean expressions to perform choice decisions. GWWS leverages these capabilities when processing records and used them to determine the redefine member to select in the outgoing message (inbound reply and outbound request).

For incoming messages (inbound request and outbound reply) the choice should have been performed by the other side.

In order to make use of cpy2record binaries, GWWS loads the RECORD description files (for example,VIEW/VIEW32 compiled definitions), and rely on the RECORDFILES/RECORDDIR environment variables. By specifying keyword "union" in the MIF file, the items keep the REDEFINE relationship.

2.3.8 Oracle Tuxedo X_C_TYPE Typed Buffers

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

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

2.3.9 Oracle Tuxedo X_COMMON Typed Buffers

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

2.3.10 Oracle Tuxedo X_OCTET Typed Buffers

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

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

2.3.11 Custom Typed Buffers

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

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

For more plug-in information, see Using SALT Plug-Ins

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

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

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

- XML Schema Built-In Simple Data Type Mapping
- XML Schema User Defined Data Type Mapping
- WSDL Message Mapping

2.4.1 XML Schema Built-In Simple Data Type Mapping

The following table shows the supported XML Schema Built-In Simple Data Type and the corresponding Oracle Tuxedo `FML32` Field Data Type.

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

XML Schema Built-In Simple Type	Oracle Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Oracle Tuxedo Program	Note
xsd:byte	FLD_CHAR	char	-
xsd:unsignedByte	FLD_UCHAR	unsigned char	-
xsd:boolean	FLD_BOOL	char/bool	Value Pattern ['T' | 'F']
xsd:short	FLD_SHORT	short	-
xsd:unsignedShort	FLD_USHORT	unsigned short	-
xsd:int	FLD_LONG	long	-
xsd:unsignedInt	FLD_UINT	unsigned int	-
xsd:long	FLD_LONG	long	In a 32-bit Oracle Tuxedo program, the C primitive type long cannot represent all xsd:long valid value.
xsd:long	FLD_LLONG	long long	In a 32-bit Oracle Tuxedo program, the C primitive type long long can represent all xsd:long valid values.
xsd:unsignedLong	FLD_LONG	unsigned long	In a 32-bit Oracle Tuxedo program, the C primitive type unsigned long *cannot* represent all xsd:long valid value.
xsd:unsignedLong	FLD_ULONG	unsigned long long	In a 32-bit Oracle Tuxedo program, the C primitive type unsigned long *can* represent all xsd:unsignedLong valid values.
xsd:float	FLD_FLOAT	float	-
xsd:double	FLD_DOUBLE	double	-
xsd:string (and all xsd:string derived built-in type, such as xsd:token, xsd:Name, etc.)	FLD_STRING FLD_MBSTRING	char [ ] wchar_t [] (Null-terminated string)	xsd:string can be optionally mapped as FLD_STRING or FLD_MBSTRING using wsdlcvt
xsd:base64Binary	FLD_CARRAY	char[ ]	-
xsd:hexBinary	FLD_CARRAY	char [ ]	-
All other built-in data types (Data / Time related, decimal / Integer related, any URL, QName, NOTATION)	FLD_STRING	char [ ]	You should comply with the value pattern of the corresponding XML built-in data type. Otherwise, server-side Web service will reject the request.

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

- XML Schema Built-In Type Sample - xsd: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: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 -`
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 2-5 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	

Table 2-5 (Cont.) XML Schema Built-In Type Sample - xsd:hexBinary

XML Schema Definition	

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

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

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

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

2.4.2 XML Schema User Defined Data Type Mapping

The following lists the supported XML Schema User Defined Simple Data Type and the corresponding Oracle Tuxedo `FML32` Field Data Type.

Table 2-7 Supported XML Schema User Defined Data Type

XML Schema User Defined Data Type	Oracle Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Oracle Tuxedo Program	Note
`<xsd:anyType>`	`FLD_MBSTRING`	char []	You should prepare entire XML document enclosing with the element tag.

Table 2-7 (Cont.) Supported XML Schema User Defined Data Type

XML Schema User Defined Data Type	Oracle Tuxedo FML32 Field Data Type	C/C++ Primitive Type In Oracle Tuxedo Program	Note
`<xsd:simpleType> derived from built-in primitive simple data types`	`Equivalent FML32 Field Type of the primitive simple type` see Table 3-2)	Equivalent C Primitive Data Type of the primitive simple type Table 3-2	Facets defined with `<xsd:restriction>` are not enforced in Oracle Tuxedo.
`<xsd:simpleType>defined with <xsd:list>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliance is not enforced in Oracle Tuxedo.
`<xsd:simpleType> defined with <xsd:union>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliance is not enforced in Oracle Tuxedo.
`<xsd:complexType> defined with <xsd:simpleContent>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliance is not enforced in Oracle Tuxedo.
`<xsd:complexType> defined with <xsd:complexContent>`	`FLD_MBSTRING`	`char []`	Same as `<xsd:anyType>`. The Schema compliancy is not enforcedin Oracle Tuxedo.
`<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. You should only add one sub field into the fml32 buffer.
`<xsd:complexType>` with sub-elements composited with sequence. The complexType can contain attribute and elements.	`FLD_FML32`	`FBFR32 * embedded fml32 buffer`	Each sub-element of the complex type is defined as an embedded `FML32` field.

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

- XML Schema User Defined Type Sample - xsd:simpleType Derived from Primitive Simple Type
- XML Schema User Defined Type Sample - xsd:simpleType Defined with xsd:list
- External Service Schema Attribute Use Example

Table 2-8 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 2-9 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 -`
C Pseudo Code	

Table 2-9 (Cont.) XML Schema User Defined Type Sample - xsd:simpleType Defined with xsd:list

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

-	`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);`

Note:

In the following table, attributes are supported in External Web Services calls using the form `"<xs:attribute name="[name]" type="[type]"/>"` only. Qualifiers such as `"fixed="` are currently not supported."

Table 2-10 External Service Schema Attribute Use Example

XML Schema Definition	

-	`<xs:element name="add">`
	`<xs:complexType>`
	`<xs:sequence>`
	`<xs:element name="param0" nillable="true"`
	`type="xs:int"/>`
	`<xs:element name="param1" nillable="true"`
	`type="xs:int"/>`
	`</xs:sequence>`
	`<xs:attribute name="aType" type="xs:string"/>`
	`</xs:complexType>`
	`</xs:element>`

Corresponding FML32 Field Definition	

Table 2-10 (Cont.) External Service Schema Attribute Use Example

XML Schema Definition	
-	… #name rel-number type flags comment #---- ---------- ---- ------ ------- add 1 fml32 - fullname=add, schema=axis2:add aType 3 string - fullname=aType, schema=xs:string param0 4 long - fullname=param0, schema=xs:int param1 5 long - fullname=param1, schema=xs:int
Corresponding SALT Metadata Repository Definition	
-	… servicemode=webservice inbuf=FML32 outbuf=FML32 errbuf=FML32 param=add access=in paramschema=XSD_E:add@http://calc.sample type=fml32 (param=param0 access=in paramschema=XSD_E:param0@http://calc.sample type=long primetype=int param=param1 access=in paramschema=XSD_E:param1@http://calc.sample type=long primetype=int param=aType access=in paramschema=XSD_E:attribute:aType@http://calc.sample type=string primetype=string) …
Corresponding Sample Pseudo code	

Table 2-10 (Cont.) External Service Schema Attribute Use Example

<table>
<tr><th colspan="2">XML Schema Definition</th></tr>
<tr><td>-</td><td><pre>
FBFR32 *f, *fin;
long len;
FLDLEN32 len2;
long inputnum1, inputnum2;
char ret_val[25];
char ret_attr[25];
char *programName;
int counter;
...
char addType[25];
strcpy(addType,argv[1]);
Fadd32(fin, aType, addType, 0);
inputnum1 = atoi(argv[2]);
Fadd32(fin, param0, (char *)&inputnum1, 0);
inputnum1 = atoi(argv[2]);
Fadd32(fin, param0, (char *)&inputnum1, 0);
Fadd32(f, add, (char *)fin, 0)
tpcall("add", (char *)f, 0, (char **)&f, &len,
TPSIGRSTRT)
</pre></td></tr>
</table>

2.4.3 WSDL Message Mapping

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

The following table lists the WSDL message mapping rules defined by SALT.

Table 2-11 WSDL Message Mapping Rules

WSDL Message Definition	Oracle Tuxedo Buffer/Field Definition	Note
<wsdl:input> message	Oracle Tuxedo Request Buffer (Input buffer)	-
<wsdl:output> message	Oracle Tuxedo Response Buffer with TPSUCCESS (Output buffer)	-
<wsdl:fault message	Oracle Tuxedo Response Buffer with TPFAIL(error buffer)	-
Each message part defined in <wsdl:input> or <wsdl:output>	Mapped as top level field in the Oracle Tuxedo FML32 buffer. Field type is the equivalent FML32 field type of the message part XML data type. (See Table 3-3 and Table 3-7)	-
<faultcode> in SOAP 1.1 fault message	Mapped as a fixed top level FLD_STRING field (faultcode) in the Oracle Tuxedo error buffer: faultcode string -	This mapping rule applies for SOAP 1.1 only.

Table 2-11 (Cont.) WSDL Message Mapping Rules

WSDL Message Definition	Oracle Tuxedo Buffer/Field Definition	Note
`<faultstring>` in SOAP 1.1 fault message	Mapped as a fixed top level `FLD_STRING` field (`faultstring`) in the Oracle Tuxedo error buffer: `faultstring string - -`	This mapping rule applies for SOAP 1.1 only.
`<faultactor>` in SOAP 1.1 fault message	Mapped as a fixed top level `FLD_STRING` field (faultactor) in the Oracle Tuxedo error buffer: `faultactor string - -`	This mapping rule applies for SOAP 1.1 only.

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

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

`<Node>` in SOAP 1.2 fault message	Mapped as a fixed top level `FLD_STRING` field (`Node`) in the Oracle Tuxedo error buffer: `Node string - -`	This mapping rule applies for SOAP 1.2 only.
`<Role>` in SOAP 1.2 fault message	Mapped as a fixed top level `FLD_STRING` field (`Role`) in the Oracle Tuxedo error buffer: `Role string - -`	This mapping rule applies for SOAP 1.2 only.
`<detail>` in SOAP fault message	Mapped as a fixed top level `FLD_FML32` field in the Oracle Tuxedo error buffer: `detail fml32 - -`	This mapping rule applies for both SOAP 1.1 and SOAP 1.2.
Each message part defined in `<wsdl:fault>`	`Mapped as a sub field of "detail " field in the Oracle Tuxedo FML32 buffer`. Field type is the equivalent `FML32` field type of the message part XML data type. (See Table 3-2 and Table 3-7)	This mapping rule applies for both SOAP 1.1 and SOAP 1.2.

2.5 REST Data Mapping

> **Note:**
>
> If a `VIEW32` buffer is used as input of an Oracle Tuxedo service exposed as a RESTful service using `GET` or `DELETE`, and that `VIEW32` contains an `MBSTRING` type, some content must be specified in the calling query string as `MBSTRING` type fields cannot be defaulted.If not , the call results in an HTTP 500 error, with `TPEINVAL` being returned with the following `ULOG` message:

```
...
181356.hostname!server.5535.451673280.0: GP_CAT:1582: ERROR: Input codeset
encoding argument not defined
...
```

This section contains the following topics:

- Inbound Message Conversion
- Outbound Message Conversion

2.5.1 Inbound Message Conversion

This section contains the following topics:

- Query String Mapping
- JSON Data Mapping
- XML Data Mapping

2.5.1.1 Query String Mapping

For `GET` and `DELETE` methods, input data is passed as an HTTP query string.

Data passed as query string can be mapped within the limitations of query string representation:

- `keyword=value` model, when applicable. For simple buffer types the actual data may be passed directly, e.g.: `http://host:1234/myTOUPPER?inputstring`
- No nesting possibly of keyword/value pairs.
- No nesting possibly of keyword/value pairs.
- Encoding must be performed for some characters (space for instance).
- Limited amount of data. While GWWS does not impose any limit, the browser or client toolkit may.

The mapping is described below for the different types of buffers supported by Oracle Tuxedo

Table 2-12 Query String Mapping

Tuxedo Buffer Type	Query String Mapping	Notes
STRING	http://host:port/service?data	Data as is, possibly URL encoded, GWWS performs the decoding.
CARRAY	http://host:port/service?data	Data represented as base64 encoded string.
MBSTRING	http://host:port/service?data	Data represented as URL encoded of UTF-8 representation of the Oracle Tuxedo MBSTRING.
XML	http://host:port/service?data	XML fragment as is, URL encoded.
X_C_TYPE	Same as VIEW/VIEW32	-
X_COMMON	Same as VIEW/VIEW32	-
X_OCTET	Same as CARRAY	-
VIEW/VIEW32	http://host:port/service?value1&value2 or http://host:port/service?fieldname1=value1&fieldname2=value2	Actual values are converted from URL encoded string representations to their native types. GWWS attempts to convert values to the corresponding VIEW/VIEW32 member depending on the target type: number types from their string representation to their Oracle Tuxedo ones: • float notation for float and double VIEW/VIEW32 types • integer notation for int, long and other integer based types FLD_CHAR fields are translated from URL-encoded content(i.e., representable characters or their '%xx' representation string for all other types) The fieldname=value notation is used with: • FBNAME field name when configured in the view description. • CNAME value when no FBNAME is present in the view description. If neither FBNAME nor CNAME matches for this subtype, a mapping error is returned.
FML/FML32	http://host:port/service?fieldname1=value1&fieldname2=value2or, for multiple ocurrences:http://host:port/service?fieldname1=value1&fieldname1=value2	Actual values are converted from URL encoded string representations to their native types. GWWS attempts to convert values to the corresponding VIEWFML/VIEWFML32 member depending on the target type: number types from their string representation to their Oracle Tuxedo ones: • float notation for float and double VIEWFML/VIEWFML32 types • integer notation for int, long and other integer-based types • FLD_CHAR fields are translated from URL-encoded content (i.e., representable characters or their '%xx' representation • string for all other types

Table 2-12 (Cont.) Query String Mapping

Tuxedo Buffer Type	Query String Mapping	Notes
RECORD	http://host:port/service?value1&value2 or http://host:port/service?fieldname1=value1&fieldname2=value2	Actual values are converted from URL encoded string representations to their native types. GWWS attempts to convert values to the corresponding RECORD buffer member depending on the target type.

2.5.1.2 JSON Data Mapping

The different Oracle Tuxedo buffer types are converted into/from JSON as shown in the table below:

Table 2-13 JSON Data Mapping

Oracle Tuxedo Buffer Type	JSON equivalent/example	Notes
STRING	<buffer content>	-
CARRAY	<binary buffer content>	-
MBSTRING	<Multi-byte string>	In order to transmit encodings other than UTF-8, the "enableMultiEncoding" property must be set to "true" in the SALTDEPLOY configuration.
XML	<XML fragment as-is>	In order to transmit encodings other than UTF-8, the "enableMultiEncoding" property must be set to "true" in the SALTDEPLOY configuration.
X_C_TYPE	Same as VIEW/VIEW32	-
X_COMMON	Same as VIEW/VIEW32	-
X_OCTET	Same as CARRAY	-
VIEW/VIEW32	{'<fieldname>':'<fieldcontent>', '<fieldname>':'<fieldcontent>'} possibly nested {'<fieldname>':{'<fieldname>':'<fieldcontent>'}} JSON has the following primitive types: • boolean (true/false) • Number (int or double float) • String VIEW/VIEW32 field types are mapped as follows (Oracle Tuxedo type: JSON type):	See VIEW/VIEW32 considerations and examples for fieldname mapping details. Some types may be truncated if represented in their primitive types (long long, long double), in that case they are rendered as JSON strings.

Table 2-13 (Cont.) JSON Data Mapping

Oracle Tuxedo Buffer Type	JSON equivalent/example	Notes
-	• `short`: Number • `int`: Number • `long`: Number • `float`: Number • `double`: Number • `char`: String • `string`: String • `carray`: String (base64 encoded) • `bool`: boolean • `unsigned char`: String • `signed char`: String • `wchar_t*` or `wchar_t`: String • `unsigned int`: Number • `unsigned long`: Number • `long long`: String (See notes below table) • `unsigned long long`: String (See notes) • `long double`: String (See notes below table) • `mbstring`: String • `view32`: nested JSON record	-

Table 2-13 (Cont.) JSON Data Mapping

Oracle Tuxedo Buffer Type	JSON equivalent/example	Notes
FML/FML32	{'<fieldname>':'<fieldcontent>', '<fieldname>':'<fieldcontent>'} possibly nested, FML32 only: {'<fieldname>': {'<fieldname>':'<fieldcontent>'}} FML/FML32 field types are mapped as follows (Oracle Tuxedo type: JSON type): • FLD_SHORT: Number • FLD_LONG: Number • FLD_FLOAT: Number • FLD_DOUBLE: Number • FLD_CHAR: String or character 'T' for JSON true or 'F' for JSON false • FLD_STRING: String • FLD_CARRRAY: String (base64 encoded) • FLD_MBSTRING: String • FLD_VIEW32: JSON nested record, see VIEW/VIEW32 mapping for individual types • FLD_FML32: JSON object	Nested FLD_VIEW32: the name of the view subtype must be the name of the embedded VIEW32. For Example: VIEW32 example.v definition file: VIEW v32example char flag1 - 1 - - - string str - 1 100 - - ... JSON content (EVIEW32 is a FLD_VIEW32 fml32 type): {"EVIEW32" : {"v32example": {"flag1":"x", "str":"somestring"} } }

Table 2-13 (Cont.) JSON Data Mapping

Oracle Tuxedo Buffer Type	JSON equivalent/example	Notes
RECORD	{'<fieldname>':'<fieldcontent>', '<fieldname>':'<fieldcontent>'} possibly nested {'<fieldname>': {'<fieldname>':'<fieldcontent>'}} Generated COBOL field types will be mapped as follows (Tuxedo type: JSON type): Generated COBOL types: • RECORD: nested JSON record • COMP-1: Number • COMP-2: Number • S9(18): Number • 9(18): Number • S9(9): Number • 9(9): Number • S9(4): Number • S9(10)V9(10)COMP-3L: Number • X(1024): String • @binary=true: String	-

Note:

Non-structured buffer types (`STRING`, `CARRAY`, `X_OCTET` and `MBSTRING`) will not wrap data as JSON objects, the data is transmitted as is.
JSON internally handles all floating point types differently than XML. XML conversion floating point conversion may incur some precision loss over similar JSON conversions. This is currently a limitation.

- VIEW/VIEW32 Considerations
- FML/FML32 Considerations

2.5.1.2.1 VIEW/VIEW32 Considerations

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

- You must create an environment for converting XML to and from `VIEW/VIEW32`. This includes setting up a `VIEW` directory and system `VIEW` definition files. These definitions are automatically loaded by the GWWS server.

2.5.1.2.2 FML/FML32 Considerations

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

- You must create an environment for converting XML to and from `FML/FML32`. This includes an FML field table file directory and system FML field definition files. These definitions are automatically loaded by the GWWS. FML typed buffers can be handled only if the environment is set up correctly.

> **Note:**
>
> `FML32` Field type `FLD_PTR` is not supported.

2.5.1.3 XML Data Mapping

XML data mapping is performed using similar rules as the mapping used in SOAP mode.

The following differences are to be noted:

- Floating point numbers without decimal value get represented as integers, for example: 10.0 is printed as 10. This is currently a limitation.
- No namespaces are generated or processed, since REST mode does not use interfaces.
- Simple buffers (`STRING`, `CARRAY`, `MBSTRING` and `XML`) are sent and received as is, without any XML processing. The behavior is identical to JSON processing (i.e.,no mapping is necessary)_.
- `FML` and `FML32` requests are wrapped by a root element (which name is ignored, as long as the XML is formed properly), and replies are wrapped in an element with the same name as the subtype as specified in the `REST/Service/Method/@inputbuffer` attribute of the SALTDEPLOY configuration file, or `<root>` element, since there is not necessarily one if subtype is not configured. `VIEW`, `VIEW32`, `X_COMMON` and `X_C_TYPE` buffers are the subtype name as root element name.

The different Oracle Tuxedo buffer types are converted into/from XML as shown in the following table:

Table 2-14 XML Data Mapping

Tuxedo Buffer Type	Description	REST XML Mapping Example
`STRING`	Oracle Tuxedo `STRING` typed buffers are used to store character strings that terminate with a `NULL` character. Oracle Tuxedo `STRING` typed buffers are self-describing.	HELLO WORLD!
`CARRAY`	Oracle Tuxedo `CARRAY` typed buffers store character arrays, any of which can be `NULL`. `CARRAY` buffers are used to handle data opaquely and are not self-describing.	Binary content

Table 2-14 (Cont.) XML Data Mapping

Tuxedo Buffer Type	Description	REST XML Mapping Example
`MBSTRING`	Oracle Tuxedo `MBSTRING` typed buffers are used for multibyte character arrays. Oracle Tuxedo `MBSTRING` buffers consist of the following three elements: • Code-set character encoding • Data length • Character array of the encoding. In order to transmit encodings other than `UTF-8`, the "`enableMultiEncoding`" property must be set to "`true`" in the SALTDEPLOY configuration.	Multi-byte string encoded according to Content-Type setting.
`XML`	Oracle Tuxedo `XML` typed buffers store XML documents. 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 payload; the GWWS server checks for this. Any original XML document prologue information cannot be carried within the payload. In order to transmit encodings other than UTF-8, the "`enableMultiEncoding`" property must be set to "true" in the SALTDEPLOY configuration.	XML fragment as is
`X_C_TYPE`	Same as `VIEW/VIEW32`	-
`X_COMMON`	Same as `VIEW/VIEW32`	-
`X_OCTET`	Same as `CARRAY`	-

Table 2-14 (Cont.) XML Data Mapping

Tuxedo Buffer Type	Description	REST XML Mapping Example
VIEW/VIEW32	Oracle Tuxedo VIEW and VIEW32 typed buffers store C structures defined by Oracle Tuxedo applications. VIEW structures are defined by using VIEW definition files. A VIEW buffer type can define multiple fields. VIEW supports the following field types: • short • int • long • float • double • char • string • carray (represented as base64 encoded content) • bool • unsigned char • signed char • wchar_t* or wchar_t • unsigned int • unsigned long • long long • unsigned long long • long double VIEW32 supports all the VIEW field types, mbstring, and embedded VIEW32 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.	<VIEW> <viewfieldname> fieldcontent </viewfieldname> </VIEW> <VIEW> <viewfieldname> fieldcontent </viewfieldname> </VIEW>

Table 2-14 (Cont.) XML Data Mapping

Tuxedo Buffer Type	Description	REST XML Mapping Example
FML/FML32	Oracle Tuxedo FML and FML32 type buffers are proprietary Oracle Oracle Tuxedo system self-describing buffers. Each data field carries its own identifier, an occurrence number, and possibly a length indicator. FML supports the following field types: • FLD_CHAR • FLD_SHORT • FLD_LONG • FLD_FLOAT • FLD_DOUBLE • FLD_STRING • FLD_CARRAY (as base64 encoded content) • FML32 supports all the FML field types and FLD_PTR, FLD_MBSTRING, FLD_FML32, and FLD_VIEW32.	Nested FLD_VIEW32: the name of the view subtype must be the name of the embedded VIEW32. For Example: VIEW32 example.v definition file: VIEW v32example char flag1 - 1 --- string str - 1 - 100 XML content (EVIEW32 is a FLD_VIEW32 fml32 type): <EVIEW32> <v32example> <flag1>x</flag1> <str>somestring</str> </v32example> </EVIEW32>
RECORD	RECORD buffer type represents copybook record. RECORD types must have subtypes that designate individual record structures. Generated COBOL types: • RECORD • COMP-1 • COMP-2 • S9(18) • 9(18) • S9(9) • 9(9) • S9(4) • S9(10)V9(10) • X(1024) • @binary=true	<myRecord> <name>aaa</name> <num>1000</num> <subgroup> <long1> 3000 </long1> <string1> www </string1> </subgroup> </myRecord>

> **Note:**
>
> Non-structured buffer types (STRING, CARRAY, X_OCTET and MBSTRING) do not wrap data as XML objects, the data is transmitted as is.

- VIEW/VIEW32 Considerations:
- FML/FML32 Considerations

2.5.1.3.1 VIEW/VIEW32 Considerations:

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

- You must create an environment for converting XML to and from `VIEW/VIEW32`. This includes setting up a `VIEW` directory and system `VIEW` definition files. These definitions are automatically loaded by the GWWS server.

2.5.1.3.2 FML/FML32 Considerations

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

- You must create an environment for converting XML to and from `FML/FML32`. This includes an `FML` field table file directory and system `FML` field definition files. These definitions are automatically loaded by the GWWS. `FML` typed buffers can be handled only if the environment is set up correctly.

> **Note:**
>
> FML32 Field type `FLD_PTR` is not supported.

2.5.2 Outbound Message Conversion

This section contains the following topics:

- Query String Mapping
- JSON Data Mapping
- XML Data Mapping

2.5.2.1 Query String Mapping

> **Note:**
>
> Attempting to use embedded `FML32` and `VIEW32` fields will result in a `TPEPROTO` error in this mode.

For `GET` and `DELETE` methods, requested data is passed as an HTTP query string. For example:http://host:1234/banking?account=1234

Data passed as query string can be mapped within the limitations of query string representation:

- `keyword=value` model, when applicable. For simple buffer types the actual data may be passed directly(for example, http://host:1234/svc?inputstring).
- No nesting of keyword/value pairs.
- Encoding must be performed for some characters (“space” for instance)

- Limited amount of data. While GWWS does not impose any limit, the browser or client toolkit may.

The mapping is as described in Table below for different types of buffers supported by OracleTuxedo.

Table 2-15 Query String Mapping

Tuxedo Buffer Type	Query String Mapping	Notes
`STRING`	http://host:port/path?data	Data as is possibly URL encoded, GWWS will perform the encoding.
`CARRAY`	http://host:port/path?data	Data represented as base64 encoded string.
`MBSTRING`	http://host:port/path?data	Data represented as URL encoded of `UTF-8` representation of the Tuxedo `MBSTRING`.
`XML`	\\http://host:port/path?data	XML fragment as is, URL encoded.
`X_C_TYPE`	Same as `VIEW/VIEW32`	-
`X_COMMON`	Same as `VIEW/VIEW32`	-
`X_OCTET`	Same as `CARRAY`	-
`VIEW/VIEW32`	http://host:port/path?value1&value2 or http://host:port/service?fieldname1=value1&fieldname2=value2	GWWS attempts to convert values to the corresponding `VIEW/VIEW32` member depending on the target type: number types from their string representation to their Oracle Tuxedo ones: • float notation for `float` and double `VIEW/VIEW32` types • integer notation for `int`, `long` and other integer based types • `FLD_CHAR` fields are translated from URL-encoded content, i.e. representable characters or their '`%xx`' representation • `string` for all other types The `fieldname=value` notation is used with: • `FBNAME` field name when one is configured in the view description. • If neither `FBNAME` nor `CNAME` matches for this subtype a mapping error is returned.

Table 2-15 (Cont.) Query String Mapping

Tuxedo Buffer Type	Query String Mapping	Notes
FML/FML32	http://host:port/path?fieldname1=value1&fieldname2=value2 or, for multiple occurrences: http://host:port/service?fieldname1=value1&fieldname1=value2	Actual values are converted from URL encoded string representations to their native types. GWWS attempts to convert values to the corresponding FML/FML32 member depending on the target type: number types from their string representation to their Tuxedo ones: • float notation for float and double FML/FML32 types • integer notation for int, long and other integer-based types • FLD_CHAR fields are translated from URL-encoded content (i.e., representable characters or their '%xx' representation • string for all other types
RECORD	http://host:port/path?value1&value2 orhttp://host:port/service?fieldname1=value1&fieldname2=value2	GWWS attempts to convert values to the corresponding RECORD member depending on the target type.

2.5.2.2 JSON Data Mapping

The different Tuxedo buffer types are converted into/from JSON as shown in the table below:

Table 2-16 JSON Data Mapping

Oracle Tuxedo Buffer Type	JSON equivalent/example	Notes
STRING	<buffer content>	-
CARRAY	<binary buffer content>	-
MBSTRING	<Multi-byte string>	In order to transmit encodings other than UTF-8, the "enableMultiEncoding" property must be set to "true" in the SALTDEPLOY configuration.
XML	<XML fragment as-is>	In order to transmit encodings other than UTF-8, the "enableMultiEncoding" property must be set to "true" in the SALTDEPLOY configuration.
X_C_TYPE	Same as VIEW/VIEW32	-
X_COMMON	Same as VIEW/VIEW32	-
X_OCTET	Same as CARRAY	-

Table 2-16 (Cont.) JSON Data Mapping

Oracle Tuxedo Buffer Type	JSON equivalent/example	Notes

`VIEW/VIEW32`	`{'<fieldname>':'<fieldcontent>', '<fieldname>':'<fieldcontent>}`
	
	possibly nested:
	`{<fieldname>': {'<fieldname>':'<fieldcontent>'}}`
	JSON has the following primitive types:
	boolean (true/false)
	Number (int or double float)
	String
	VIEW/VIEW32 field types will be mapped as follows (Tuxedo type: JSON type):
	• `short`: Number
	• `int`: Number
	• `long`: Number
	• `float`: Number
	• `double`: Number
	• `char`: String
	• `string`: String
	• `carray`
	• `bool`: boolean
	• `unsigned char`: String
	• `signed char`: String
	• `wchar_t*` or `wchar_t`: String
	• `unsigned int`: Number
	• `unsigned long`: Number
		-

-	• `long double`: String (See notes) • mbstring: String • `view32`: nested JSON record	See `VIEW/VIEW32` considerations and examples for fieldname mapping details. Some types may be truncated if represented in their primitive types (`long long`, `long double`), in that case they will be rendered as JSON strings.

Table 2-16 (Cont.) JSON Data Mapping

Oracle Tuxedo Buffer Type	JSON equivalent/example	Notes
FML/FML32	{'<fieldname>':'<fieldcontent>','<fieldname>':'<fieldcontent>'} possibly nested, FML32 only: {'<fieldname>': {'<fieldname>':'<fieldcontent>'}} FML/FML32 field types are mapped as follows (Tuxedo type: JSON type): • FLD_SHORT: Number • FLD_LONG: Number • FLD_FLOAT: Number • FLD_DOUBLE: Number • FLD_CHAR: String or character 'T' for JSON true or 'F' for JSON false • FLD_CARRRAY: String (base64 encoded) • FLD_MBSTRING: String • FLD_VIEW32: JSON nested record, see VIEW/VIEW32 mapping for individual types	Nested FLD_VIEW32: the name of the view subtype must be the name of the embedded VIEW32. For Example: VIEW32example .v definition file: VIEW v32 example charflag1 - 1 --- string str - 1 100 - - JSON content (EVIEW32 is a FLD_VIEW32 fml32 type): {"EVIEW32" : {"v32example": {"flag1":"x", "str":"somestring"} } }
RECORD	{'<fieldname>':'<fieldcontent>','<fieldname>':'<fieldcontent>'} possibly nested: {'<fieldname>': {'<fieldname>':'<fieldcontent>'}} RECORD buffer field types are mapped as follows (Tuxedo type: JSON type): RECORD: Number COMP-1: Number COMP-2: Number S9(18): Number 9(18): Number S9(9): Number 9(9): Number S9(4): Number S9(10)V9(10)COMP-3L: Number X(1024): String @binary=true: String	-

Note:

- Non-structured buffer types (`STRING`, `CARRAY`, `X_OCTET` and `MBSTRING`) will not wrap data as JSON objects, the data is transmitted as is. The content-type setting is ignored for those buffer types with respect to data mapping.
- JSON internally handles all floating point types differently than XML. XML conversion floating point conversion may incur some precision loss over similar JSON conversions. This is currently a limitation.

2.5.2.2.1 VIEW/VIEW32 Considerations:

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

- You must create an environment for converting XML to and from `VIEW/VIEW32`. This includes setting up a `VIEW` directory and system `VIEW` definition files. These definitions are automatically loaded by the GWWS server.

2.5.2.2.2 FML/FML32 Considerations

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

- You must create an environment for converting XML to and from `FML/FML32`. This includes an FML field table file directory and system FML field definition files. These definitions are automatically loaded by the GWWS. `FML` typed buffers can be handled only if the environment is set up correctly.

Note:

`FML32` Field type `FLD_PTR` is not supported.

2.5.2.2.3 Conversion Examples:

Example 2-19   VIEW Description File

```
VIEW empname
#TYPE CNAME FBNAME COUNT FLAG SIZE NULL
char fname EMP_FNAME 1 - 25 -
char minit EMP_MINIT 1 - 1 -
char lname EMP_LNAME 1 - 25 -
END

VIEW emp
struct empname ename 1 - - -
unsignedlong id EMP_ID 1 - - -
```

```
long ssn EMP_SSN 1 - - -
double salaryhist EMP_SAL 10 - - -
END
```

Corresponding header file after compilation

Example 2-20 Compilation

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

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

Example 2-21 JSON Content

```
{
"ename":
{
"EMP_FNAME":"John",
"EMP_MINIT":"R",
"EMP_LNAME":"Smith"
},
"EMP_ID":1234,
"EMP_SSN":123456789,
"EMP_SAL":
[10000.0,
11000.0,
12000.0,
13000.0,
14000.0,
15000.0,
16000.0,
17000.0,
18000.0,
19000.0]
}
}
```

Without `FBNAME`(names specified in the view file), the content is represented using the `CNAME` values. Since nesting cannot be expressed without field names because the field name is also the subtype name for the nested view, only structures with 1 level are represented.

For example:

Example 2-22 VIEW Description

```
VIEW empname
#TYPE CNAME FBNAME COUNT FLAG SIZE NULL
char fname - 1 - 25 -
char minit - 1 - 1 -
char lname - 1 - 25 -
END
```

Corresponding header file after compilation

Example 2-23 Compilation

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

Example 2-24 JSON Content Example

```
{
"fname":"John",
"minit":"R",
"lname":"Smith"
}
```

Example 2-25 Field Table

```
#name rel-number type flags comment

BIKES 1 fml32 -
COLOR 2 string -
CURSERIALNO 3 string -
INSTOCK 4 string -
NAME 5 string -
ORDERDATE 6 string -
PRICE 7 float -
SERIALNO 8 string -
SIZE 9 long -
SKU 10 string -
TYPE 11 string -
```

Example 2-26 JSON Content

```
"BIKES":
[
{"COLOR":"BLUE",
"CURSERIALNO":"AZ123",
"INSTOCK":"Y",
"NAME":"CUTTER",
"ORDERDATE":"11/03/2012",
"PRICE":1234.55,
"SERIALNO":"123456",
```

```
"SIZE":52,
"SKU":"CU521234",
"TYPE":"ROAD"},
{"COLOR":"RED",
"CURSERIALNO":"BZ123",
"INSTOCK":"Y",
"NAME":"ROCKGLIDER",
"ORDERDATE":"11/06/2012",
"PRICE":1455.55,
"SERIALNO":"123457",
"SIZE":16,
"SKU":"RG161234",
"TYPE":"MTB"},
]
}
}
```

Record example.

Example 2-27 COBOL copybook

```
01 myRecord.
05 name occurs 1 times PIC X(10).
05 num occurs 1 times PIC S9(9) COMP-5.
05 subgroup occurs 1 times.
10 long1 PIC S9(9) COMP-5.
10 string1 PIC X(19).
```

Example 2-28 Result

```
{
"name": "aaa",
"num": 1000,
"subgroup": {
"long1": 3000,
"string1": "wwww"
}
}
```

2.5.2.3 XML Data Mapping

XML data mapping is performed using similar rules as the mapping used in SOAP mode.

> **Note:**
>
> - Floating point numbers without decimal value get represented as integers, for example: 10.0 is printed as 10. This is currently a limitation.
> - No namespaces is generated or processed, since HTTP mode does not use interfaces.
> - Simple buffers (`STRING`, `CARRAY`, `MBSTRING`, and XML) are sent and received as is, without any XML processing. The behavior is identical to JSON processing (i.e.,no mapping is necessary.
> - `FML` and `FML32` requests must be wrapped by a root element (which name is ignored, as long as the XML is formed properly), and replies are wrapped in an element with the same name as the subtype as specified in the `HTTP/Service/@outputbuffer` attribute of the `SALTDEPLOY` configuration file, or `<root>` element if subtype is not configured. `VIEW`, VIEW32, `X_COMMON`, and `X_C_TYPE` buffers use the subtype name as the root element name.

The different Oracle Tuxedo buffer types are converted into/from XML in the following manner as shown in table below:

Table 2-17 XML Data Mapping

Oracle Tuxedo Buffer Type	Description	HTTP XML Mapping Example
`STRING`	Oracle Tuxedo `STRING` typed buffers are used to store character strings that terminate with a `NULL` character. Oracle Tuxedo `STRING` typed buffers are self-describing.	HELLO WORLD!
`CARRAY`	Oracle Tuxedo `CARRAY` typed buffers store character arrays, any of which can be `NULL`. `CARRAY` buffers are used to handle data opaquely and are not self-describing.	Binary content
`MBSTRING`	Oracle Tuxedo `MBSTRING` typed buffers are used for multibyte character arrays. Oracle Tuxedo `MBSTRING` buffers consist of the following three elements: - Code-set character encoding - Data length - Character array of the encoding. In order to transmit encodings other than UTF-8, the "`enableMultiEncoding`" property must be set to "`true`" in the SALTDEPLOY configuration.	Multi-byte string encoded according to Content-Type setting.

Table 2-17 (Cont.) XML Data Mapping

Oracle Tuxedo Buffer Type	Description	HTTP XML Mapping Example
`XML`	Oracle Tuxedo `XML` typed buffers store XML documents. 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 payload; the GWWS server checks for this. Any original XML document prologue information cannot be carried within the payload. In order to transmit encodings other than `UTF-8`, the "`enableMultiEncoding`" property must be set to "`true`" in the SALTDEPLOY configuration.	XML fragment as-is
`X_C_TYPE`	Same as `VIEW/VIEW32`	-
`X_COMMON`	Same as `VIEW/VIEW32`	-
`X_OCTET`	Same as `CARRAY`	-

Table 2-17 (Cont.) XML Data Mapping

Oracle Tuxedo Buffer Type	Description	HTTP XML Mapping Example
VIEW/VIEW32	Oracle Tuxedo VIEW and VIEW32 typed buffers store C structures defined by Oracle Tuxedo applications. VIEW structures are defined by using VIEW definition files. A VIEW buffer type can define multiple fields. VIEW supports the following field types: • short • int • long • float • double • char • string • carray (represented as base64 encoded content) • bool • unsigned char • signed char • wchar_t* wchar_t • unsigned int • unsigned long • long long • unsigned long long • long double	<VIEW> <viewfieldname> fieldcontent </viewfieldname> </VIEW>
-	VIEW32 supports all the VIEW field types, mbstring, and embedded VIEW32 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.	-

Table 2-17 (Cont.) XML Data Mapping

Oracle Tuxedo Buffer Type	Description	HTTP XML Mapping Example

`FML/FML32`	Oracle Tuxedo `FML` and `FML32` type buffers are proprietary Oracle Oracle Tuxedo system self-describing buffers. Each data field carries its own identifier, an occurrence number, and possibly a length indicator.
	FML supports the following field types:
	• `FLD_CHAR`
	• `FLD_SHORT`
	• `FLD_LONG`
	• `FLD_FLOAT`
	• `FLD_DOUBLE`
	• `FLD_STRING`
	• `FLD_CARRAY` (as base64 encoded content)
	`FML32` supports all the FML field types and `FLD_PTR`, `FLD_MBSTRING`, `FLD_FML32`, and `FLD_VIEW32`.
		Nested `FLD_VIEW32`: the name of the view subtype must be the name of the embedded `VIEW32`. For Example:
		
		`VIEW32 example.v definition file:`
		`VIEW v32example`
		`char flag1 - 1 ---`
		`string str - 1 - 100`
		`XML content (EVIEW32 is a FLD_VIEW32 fml32 type):`
		`<EVIEW32>`
		`<v32example>`
		`<flag1>x</flag1>`
		`<str>somestring</str>`
		`</v32example>`
		`</EVIEW32>`

`RECORD`	`RECORD` buffer type represents copybook record. `RECORD` types must have subtypes that designate individual record structures.
	Generated COBOL types:
	• `RECORD`
	• `COMP-1`
	• `COMP-2`
	• `S9(18)`
	• `9(18)`
	• `S9(9)`
	• `9(9)`
	• `S9(4)`
	• `S9(10)V9(10)`
	• `X(1024)`
	• `@binary=true`
		`<myRecord>`
		`  <name>aaa</name>`
		`  <num>1000</num>`
		`  <subgroup>`
		`    <long1> 3000 </ long1>`
		`    <string1> www </ string1>`
		`  </subgroup>`
		`</myRecord>`

> **Note:**
>
> Non-structured buffer types (`STRING`, `CARRAY`, `X_OCTET` and `MBSTRING`) will not wrap data as XML objects, the data is transmitted as is.

- VIEW/VIEW32 Considerations:
- FML/FML32 Considerations

2.5.2.3.1 VIEW/VIEW32 Considerations:

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

- You must create an environment for converting XML to and from `VIEW/VIEW32`. This includes setting up a `VIEW` directory and system `VIEW` definition files. These definitions are automatically loaded by the GWWS server.

2.5.2.3.2 FML/FML32 Considerations

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

- You must create an environment for converting XML to and from `FML/FML32`. This includes an FML field table file directory and system FML field definition files. These definitions are automatically loaded by the GWWS. `FML` typed buffers can be handled only if the environment is set up correctly.

> **Note:**
>
> `FML32` Field type `FLD_PTR` is not supported.

3
Web Service Client Programming

This chapter contains the following topics:

- Overview
- SALT Web Service Client Programming Tips

3.1 Overview

SALT is a configuration-driven product that publishes existing Oracle Tuxedo application services as industry-standard Web services. From a Web services client-side programming perspective, SALT (used in conjunction with the Oracle Tuxedo framework), is a standard Web service provider. You only need to use the 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 SALT WSDL file. For more information, see Configuring SALT
2. Use a Web service client-side toolkit to parse the SALT WSDL document, and generate client stub code. For more information, see SALT Web Service Client Programming Tips.
3. Write client-side application code to invoke a SALT Web service using the functions defined in the client-generated stub code.
4. Compile and run your client application.

- Representational State Transfer (REST) Support

3.1.1 Representational State Transfer (REST) Support

With REST enabled, requests received on a REST port are processed as follows by GWWS.

URIs must comply with the following pattern:

```
<REST service name>
```

Where the Oracle Tuxedo service name is the name of the REST service invoked (for example, `TOUPPER`).

Data format and input Oracle Tuxedo buffer types are specified using the following HTTP header:

- content-type:
  Set to `application/json`:indicates that JSON is used to transfer data to/from HTTP client.

  Set to `application/xml:` indicates that XML is used to transfer data to/from HTTP client.

> **Note:**
>
> `application/json` and `application/xml` will only apply to structured buffer types (`VIEW`, `VIEW32`, `FML`, `FML32`, `X_C_TYPE` and `X_COMMON`. To use simple buffers and `POST` or `PUT`, you must set Content-type to appropriate values ("`text/plain`" for `STRING`, "`application/octet-stream`" for `CARRAY`, etc.).

- Oneway (in and out)
- ATMI and SCA Support
- Examples

3.1.1.1 Oneway (in and out)

If no data is input, the Oracle Tuxedo service is invoked with a `NULL` Oracle Tuxedo buffer. Similarly, if the Oracle Tuxedo service does not return any data, the response also contains no data (which is a valid use-case).

3.1.1.2 ATMI and SCA Support

There is no restriction in the type of Oracle Tuxedo service being exposed as REST (whether ATMI or SCA). To use SCA components, you must conform to SCA data mapping conventions as found in SCA Data Type Mapping. Name mapping may apply, as outlined in SCA and Oracle Tuxedo Interoperability.

3.1.1.3 Examples

Following is a list of examples:

- Example: .h interface
- Example: SCDL Descriptor
- Example: SALTDEPLOY REST Service Definition
- Example: URL used to invoke service
- Example: Response

3.1.1.3.1 Example: .h interface

Example 3-1   h interface

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

3.1.1.3.2 Example: SCDL Descriptor

Example 3-2   SCDL Descriptor

```
<composite xmlns="http://www.osoa.org/xmlns/sca/1.0" name="myComponent">
<service name="TuxService">
<interface.cpp header="TuxService.h"/>
<binding.atmi/>
<inputBufferType>STRING</inputBufferType>
<outputBufferType>STRING</outputBufferType>
<reference>MYComponent</reference>
</service>

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

3.1.1.3.3 Example: SALTDEPLOY REST Service Definition

Example 3-3   SALTDEPLOY REST Service Definition

```
<REST>
<Network http="myhost:1234"/>
<Service name="testSCA">
<Method name="GET"
reposservice=""
service="TuxService/TOUPPER"
inputbuffer="STRING"/>
</Service>
...
</REST>
```

3.1.1.3.4 Example: URL used to invoke service

```
http://myhost:1234/testSCA?teststring
```

3.1.1.3.5 Example: Response

```
HTTP/1.1 200 OK

Content-Type: text/xmlTESTSTRING
```

3.2 SALT Web Service Client Programming Tips

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

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

Note:

You can use any SOAP toolkit to develop client software.
The sample directories for the listed toolkits can be found *after* SALT is installed.

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

3.2.1 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 programs and server instances. For more information, see Developing JAX-WS Web Services for Oracle WebLogic Server.

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

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

Online Download:

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

`tmwsdlgen` **Utility**

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

3.2.2 Apache Axis for Java Web Service Client Programming Toolkit

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:

- **Use the AXIS specific WSDL document for HTTP MIME attachment support**
  SALT supports HTTP MIME transportation for Oracle Tuxedo `CARRAY` data. A special option must be specified for WSDL online downloading and the `tmwsdlgen` utility.

  Online Download:

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

  `tmwsdlgen` **Utility**

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

- **Disable multiple-reference format in AXIS when RPC/encoded style is used**

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

- **Use Apache Sandensha project with** SALT **for WS-ReliableMessaging communication.**
  Interoperability has been tested for WS-ReliableMessaging between 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 the example below:

Example 3-4 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});
```

3.2.3 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 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 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:

- **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.

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

- **Some RPC/encoded style SOAP messages are not understood by the GWWS server.**
  When the SALT WSDL document is generated using RPC/encoded style, .Net sends out SOAP messages containing `soapenc:arrayType`. SALT does not support `soapenc:arrayType` using RPC/encoded style. A sample RPC/encoded style-generated WSDL document is shown in example below:

  Example: 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.

- **Error message regarding `xsd:base64Binary` in RPC/encoded style.**
  If `xsd:base64Binary` is used in the SALT WSDL document using RPC/encoded style, `wsdl.exe` can generate stub code; however, 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.

3.2.4 Web Service Client Programming References

Following is a list of online references to help you in programming a SALT application:

- Oracle WebLogic 12.2.1.4 Web Service Client Programming References
  Oracle WebLogic 12.2.1.4 Documentation
- 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

4
Oracle Tuxedo ATMI Programming for Web Services

This chapter contains the following topics:

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

4.1 Overview

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

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

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

4.2 Converting WSDL Model Into Oracle Tuxedo Model

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

- WSDL-to-Tuxedo Object Mapping

4.2.1 WSDL-to-Tuxedo Object Mapping

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

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

> **Note:**
>
> If the operation name exceeds the Oracle Tuxedo service name length limitation (255 characters), you must manually set a unique short Oracle Tuxedo service name in the metadata respository and set the <Service> tuxedoRef attribute in the WSDF.

For more information, see SALT Web Service Definition File Reference in the 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, etc.).
- 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 theOracle Tuxedo service definition conforms to the Oracle Tuxedo Service Metadata Repository input syntax.

The following table lists detailed mapping relationships between the `WSDL` file and Oracle Tuxedo definition files.

Table 4-1 WSDL Model / Oracle Tuxedo Model Mapping Rules

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

4.3 Invoking SALT Proxy Services

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

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

4.3.1 SALT Supported Communication Patterns

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

- `tpcall(3c)` / `tpacall(3c)` / `tpgetreply(3c)`

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

- `tpgetcallinfo(3c)/tpsecallinfo(3c)`
  `tpgetcallinfo()` retrieves HTTP headers associated with an application buffer using the GWWS gateway in `FML32` format; `tpsetcallinfo()` performs the reverse (i.e., attach `FML32` formatted HTTP headers to an application buffer to be sent to a remote HTTP (possibly SOAP) server).
- `tpforward(3c)`
  Oracle Tuxedo server applications can use this function to forward an Oracle Tuxedo request to a specified SALT proxy service. The response buffer is sent directly to the client application response queue as if it is a traditional native Oracle Tuxedo service.
- `TMQFORWARD` enabled queue-based communication.
  Oracle Tuxedo system server `TMQFORWARD` can accept queued requests, and sends them to SALT proxy services that have the same name as the queue.

For more information, see Oracle Tuxedo ATMI C Functions and File Formats, Data Descriptions, MIBs, and System Processes Reference

SALT does not support the following Oracle Tuxedo communication patterns:

- Conversational communication
- Event-based communication

4.3.2 Oracle Tuxedo Outbound Call Programming: Main Steps

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

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

> **Note:**
>
> The `wsdlcvt` generated FML32 field table files are always used by GWWS. You must make sure the field name is unique at the system level. If two or more fields are associated with the same field name, change the field name. Do not forget to change Oracle Tuxedo Service Metadata Repository definition accordingly. The base number field index in the generated FML32 field table must be changed from the invalid default value to a correct number to ensure all field indexes in the table are unique at the entire system level.

3. Generate `FML32` header files with mkfldhdr32(1)
4. Boot the GWWS with correct `FML32` environment variable settings.
5. Write a skeleton C source file for the client to call the outbound service (refer to Oracle Tuxedo documentation and the Oracle Tuxedo Service Metadata Repository generated pseudo-code if necessary). You can use `tpcall(1)` or `tpacall(1)` for synchronous or asynchronous communication, depending on the requirement.

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

4.3.3 Managing Error Code Returned from GWWS

If the GWWS server encounters an error accessing external Web services, `tperrno` is set accordingly so the Oracle Tuxedo application can diagnose the failure. The following table lists possible 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 Oracle Tuxedo request typed buffer into XML payload of the SOAP request message.
`TPEOTYPE`	Message conversion failure when converting XML payload of the SOAP response message into Oracle Tuxedo response typed buffer.
`TPEOS`	Request is rejected because of system resource limitation.
`TPETIME`	Timeout occurred. This timeout can either be a BBL blocktime, or a SALT outbound call timeout.
`TPSVCFAIL`	External Web service returns SOAP fault message
`TPESYSTEM`	GWWS internal errors. Check `ULOG` for more information.

4.3.4 Handling Fault Messages in an Oracle Tuxedo Outbound Application

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

Rules for fault mapping:

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

- Tux Mode is used to convert Oracle Tuxedo original error buffers returned with `TPFAIL`. The error buffers are converted intothe XML payload in the SOAP fault `<detail>` element.

- XSD Mode is used to represent SOAP fault and WSDL file fault messages defined with Oracle Tuxedo buffers. The mapping rule includes:
  - Each service in XSD mode (servicemode=webservice), always has an errbuf in Metadata with type=FML32
  - errbuf is a FML32 buffer. It is a complete description of 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 both the SOAP version and WSDL fault message.
  - Parameter detail/Detail (1.1/1.2) is an FML32 field that represents the wsdl:part defined in a wsdl:fault message (when wsdl:fault is present). Each part is defined as a param(field) in the FML32 field. The mapping rules are the same as for input/output buffer. The difference is that each param requiredcount is 0 (which means it may not appear in the SOAP fault message).
  - Other elements that appear in soap:fault message are always defined as a file 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 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 contains an XML field.
Code	1.2	fml32	Yes	Contains 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

See Also:

Oracle Tuxedo ATMI C Functions

Oracle Tuxedo File Formats, Data Descriptions, MIBs, and System Processes

5 Using SALT Plug-Ins

This chapter contains the following topics:

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

5.1 Understanding SALT Plug-Ins

The SALT GWWS(5) server is a configuration-driven process which, for most basic Web service applications, does not require any programming tasks. However, 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. 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

5.1.1 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
- Developing a Plug-In Interface

5.1.1.1 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 SALT. Arbitrary string values are not permitted.

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

5.1.1.2 Plug-In Name

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

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

5.1.1.3 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 How Outbound Authentication Plug-Ins Work

5.1.1.4 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 functions. These functions are listed below:

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

5.1.1.4.1 Information Providing Function

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

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

The function uses the following syntax:

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

You must return the total count of implementation in the library in arguments `count`. The arguments `ids` and`names`should contain all implemented interface `ids` and `names`, separated by a semicolon “;”.

5.1.1.4.2 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)
```

.

5.1.1.4.3 Exiting Function

The exiting function is called before closing theplug-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).
```

.

5.1.1.4.4 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 this SALT 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 in the example below:

Example 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 must be implemented for a P_CREDENMAP plug-in interface. For more information, see How Outbound Authentication Plug-Ins Work

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

An example of setting the vtable structure with actual functions in the vtable setting function is shown in the example below:

Example 5-2 Setting the vtable Structure with Actual Functions in 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;
}
```

5.1.1.5 Developing a Plug-In Interface

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

- Developing a Plug-In Shared Library
- Defining a Plug-In Interface in the SALT Configuration File

5.1.1.5.1 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 Register 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.

5.1.1.5.2 Defining a Plug-In Interface in the 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 Creating the SALT Deployment File in the SALT *Configuration Guide*.

An example of how to define plug-in information in the SALT deployment file is shown below:

Example 5-3 Defined Plug-In in the 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>
```

> **Note:**
>
> 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.

5.2 Programming Message Conversion Plug-ins

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

> **Note:**
>
> The SALT 12cR2 Message Conversion Plug-in is an enhanced successor to the SALT 1.1 Custom Buffer Type Conversion Plug-in.

The following topics are included in this section:

- How Message Conversion Plug-ins Work
- When Do We Need Message Conversion Plug-in
- Developing a Message Conversion Plug-in Instance
- SALT 1.1 Custom Buffer Type Conversion Plug-in Compatibility

5.2.1 How Message Conversion Plug-ins Work

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

These two function prototypes are defined in the example below:

Example 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 Oracle Tuxedo typed buffer.

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

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

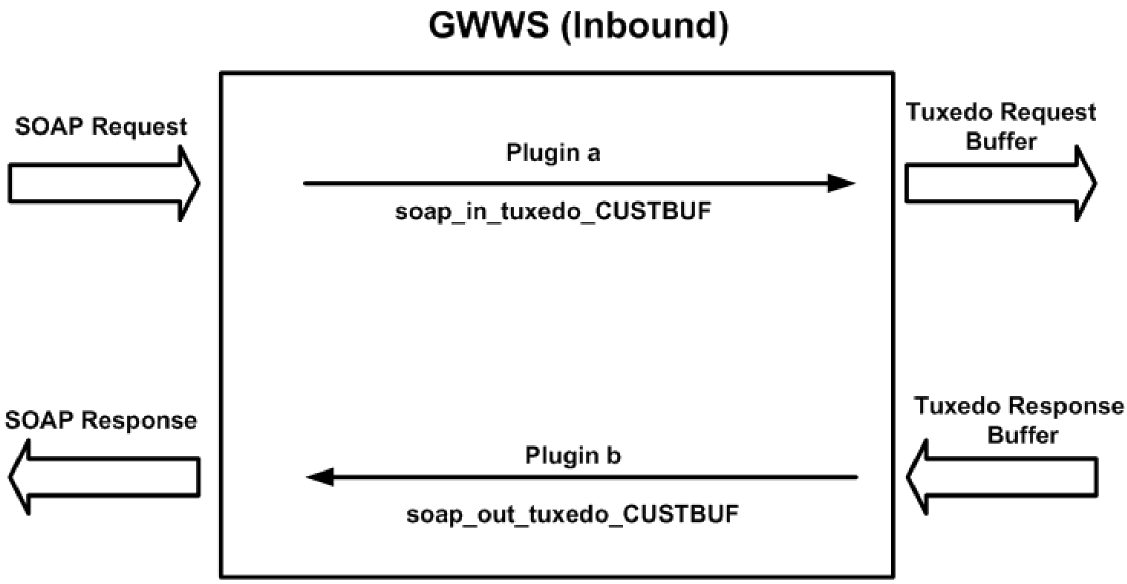
- How Message Conversion Plug-in Works in an Inbound Call Scenario
- How Message Conversion Plug-in Works in an Outbound Call Scenario

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

An inbound call scenario is an external Web service program that invokes an Oracle Tuxedo service through the SALT gateway. The following figure depicts message streaming between a Web service client and an Oracle Tuxedo domain.

The following figure Message Conversion Plug-in Works in an Inbound Call Scenario

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.

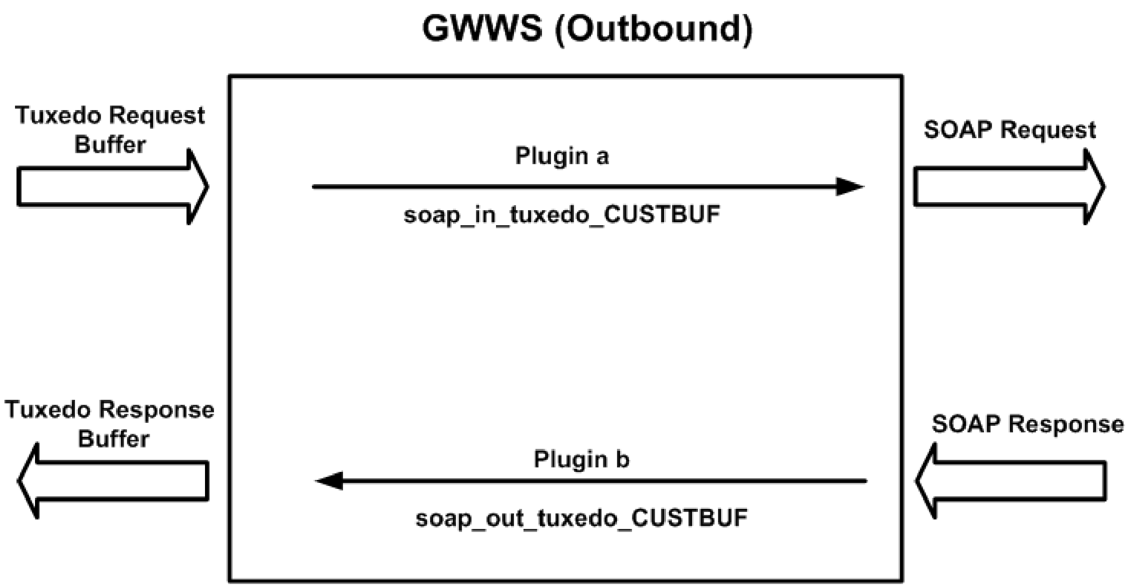
When an Oracle Tuxedo response buffer is returned from the Oracle Tuxedo service, GWWS tries to find if there is a message conversion plug-in instance associated with the output message conversion of the target service. If there is an associated instance, GWWS invokes the customized function (*soap_out_tuxedo__CUSTBUF),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

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

An outbound call scenario is an Oracle Tuxedo program that invokes an external Web service through the SALT gateway. Figure 5-2 depicts message streaming between an Oracle Tuxedo domain and a Web service application.

The following figure Message Conversion Plug-in Works in an Outbound Call Scenario

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



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

5.2.2 When Do We Need Message Conversion Plug-in

The following table 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
Oracle Tuxedo Originated Service	A SOAP message payload is transformed into a custom typed buffer	Required	N/A
	A custom typed buffer is transformed into a SOAP message payload.	N/A	Required
	An Oracle Tuxedo service input and/or output buffer is associated with a customized XML schema definition when a SOAP message payload is being transformed into this buffer.	Non XML typed buffer: Required XML typed buffer: Optional	N/A
	An Oracle Tuxedo service input and/or output buffer is associated with a customized XML schema definition when this buffer is being transformed into a SOAP message payload.	N/A	Non XML typed buffer: Required XML typed buffer:Optional

Table 5-1 (Cont.) Message Conversion Plug-in Use Cases

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

From the table above, the following message conversion plug-ins general rules are applied.

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

For more information, see Configuring a SALT Application

5.2.3 Developing a Message Conversion Plug-in Instance

This chapter contains the following topics:

- Converting a SOAP Message Payload to an Oracle Tuxedo Buffer
- Converting an Oracle Tuxedo Buffer to a SOAP Message Payload

5.2.3.1 Converting a SOAP Message Payload to an Oracle Tuxedo Buffer

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

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

- Synopsis
- Description
- Diagnostics

5.2.3.1.1 Synopsis

```
#include <custtype_pi_ex.h>
CustomerBuffer * myxml2buffer (void * xercesDOM, CustomerBuffer *a,
CustType_Ext * extinfo);
```

`myxml2buffer` is an arbitrary customized function name.

5.2.3.1.2 Description

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

The input parameter, `char * xmlbuf`, indicates a `NULL` terminated string with the XML format data stream.

> **Note:**
>
> 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 type buffer type name, this parameter is used to verify that the GWWS server expected custom typed buffer handler matches the current plug-in function.

The output parameter, `CustomerBuffer *a`, is used to store the allocated custom typed buffer instance. An Oracle Tuxedo custom typed buffer must be allocated by this plug-in function via the `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.

5.2.3.1.3 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 the example below:

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

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

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

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

       release ( DOMTree );

       return a;
}
```

> **Tip:**
>
> Oracle Tuxedo 22c bundles Xerces 3.2.3.

5.2.3.2 Converting an Oracle Tuxedo Buffer to a SOAP Message Payload

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

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

- Synopsis
- Description
- Diagnostics

5.2.3.2.1 Synopsis

```
#include <custtype_pi_ex.h>
CustomerBuffer * myxml2buffer (void * xercesDOM, CustomerBuffer *a,
CustType_Ext * extinfo);
```

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

5.2.3.2.2 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 uses `malloc()`. 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.

5.2.3.2.3 Diagnostics

If successful, this function must return `0`.

If it fails, this function must return `-1` as shown in the example:

Example 5-6 Converting Oracle Tuxedo Custom Typed Buffer to SOAP XML Pseudo Code

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

       if ( error )
              return -1;

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

       a->buf ==> DOMTree;

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

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

```
        return 0;
}
```

> **WARNING:**
>
> The GWWS framework is responsible for releasing the `DOMDocument` created inside the plug-in function. To avoid double release, you must pay attention to the following Xerces API usage:
> If the `DOMDocument` is constructed from an XML string through `XercesDOMParser::parse() API`. You must use `XercesDOMParser::adoptDocument()` to get the pointer of the `DOMDocument` object. You must not use `XercesDOMParser::getDocument()` to get the pointer of the `DOMDocument` object because the `DOMDocument` object is maintained by the `XercesDOMParser` object and is released when deleting the `XercesDOMParser` object if you do not de-couple the `DOMDocument` from the `XercesDOMParser` via the `XercesDOMParser::getDocument()` function.

5.2.4 SALT 1.1 Custom Buffer Type Conversion Plug-in Compatibility

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

Table 5-2 SALT 12cR2 Message Conversion Plug-in / SALT 1.1 Custom Buffer Type Conversion Plug-in Comparison

SALT 1.1 Custom Buffer Type Plug-in	SALT 12cR2 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 payloads and Oracle Tuxedo custom buffer types.	Supports message conversion between SOAP message payloads and any kind of Oracle Tuxedo buffer type.
Buffer type-level association. Each plug-in instance must be named the same as the supported custom buffer type name. Each custom buffer type can only have one plug-in implementation. One custom buffer type can associate with a plug-in instance, and used by all the services.	Message-level association. Each Oracle Tuxedo service can associate plug-in instances with its input and/or output buffers respectively through the plug-in instance name.
SOAP message payload is saved as a `NULL` terminated string for plug-in programming.	SOAP message payload is saved as a Xerces DOM Document for plug-in programming.

Note:

SALT 1.1 Custom Buffer Type Plug-in shared library cannot be used directly in SALT 12cR2. You must perform the following tasks to upgrade it to a SALT 12cR2 message conversion plug-in:

1. Re-implement function (*soap_in_tuxedo__CUSTBUF) and (*soap_out_tuxedo__CUSTBUF) according to the SALT message conversion plug-in `vtable` function prototype API. The major change is that the SOAP message payload is saved as an Xerces class DOMDocument object instead of the old string value.
2. Re-compile your functions as a 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.

5.3 Programming Outbound Authentication Plug-Ins

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

To map the usernames, 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
- Implementing a Credential Mapping Interface Plug-In
- Mapping the Oracle Tuxedo UID and HTTP Username

5.3.1 How Outbound Authentication Plug-Ins Work

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

- Tries to invoke the `vtable gwws_pi_map_http_basic` function to map the Oracle Tuxedo userid into the username and password for the HTTP Realm of the server.
- For successful calls, encodes the returned username and password with `Base64` and sends it to the HTTP header field “Authorization: Basic”.

- For failed calls, returns a failure to the Oracle Tuxedo Client without invoking the Web service.

5.3.2 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 SALT plug-in interface:

1. Write the functions to map the “`myrealm`” Oracle Tuxedo `UID/GID` to `username/password` on www.abc.com.
   - Use `Credmap_HTTP_Basic();`
     This function is used to return the HTTP username/password. The function prototype defined in `credmap_pi_ex.h`
2. Write the following three plug-in register functions. For more information, see Plug-In Register Functions
   - `_ws_pi_init_P_CREDENMAP_TEST(char * params, void ** priv_ptr);`

     This function is invoked when the GWWS server attempts to load the plug-in shared library during startup.
   - `_ws_pi_exit_P_CREDENMAP_TEST(void * priv);`
     This function is invoked when the GWWS server unloads the plug-in shared library during the shutdown phase.
   - `ws_pi_set_vtbl_P_CREDENMAP_TEST(void * vtbl);`
     Set the `gwws_pi_map_http_basic` entry in `vtable` structure `credmap_vtable` with the `Credmap_HTTP_Basic()` function implemented in step 1.
3. You can also write the optional function:
   - `_ws_pi_get_Id_and_Names(int * params, char ** ids, char ** names);`

     This function is invoked when the GWWS server attempts to load the plug-in shared library during startup to determine what library interfaces are implemented. For more information, see Plug-In Register Functions.
4. Compile the previous four or five functions into one shared library, `credmap_plugin.so`
5. Configure the plug-in interface in the SALT deployment file.
   Configure the plug-in interface as shown in the example below:

Example 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>
```

5.3.3 Mapping the Oracle Tuxedo UID and HTTP Username

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

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

- Synopsis
- Description
- Diagnostics

5.3.3.1 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.

5.3.3.2 Description

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

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

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

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

> **Note:**
>
> Oracle Tuxedo user ID is available only when *SECURITY is set as USER_AUTH or higher in the UBBCONFIG file. Group ID is available when *SECURITY is set as ACL or higher. The default is "0".

5.3.3.3 Diagnostics

If successful, this function returns 0. If it fails, it returns -1 as shown in the example below:

Example 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.