
CS 696

Introduction to Grid Computing:
Lecture #8

Mary Thomas

San Diego State

Tuesday, 13-Feb-07

Announcements

- Today:
 - More SOAP
- HW#2 has been posted
 - 3 problems (due on different dates)

Comments on XML-RPC

XML-RPC Request Format

payload



HEADER... .

```
<?xml version="1.0" encoding="UTF-8"?>
<methodCall>
  <methodName>dummy.addFloat</methodName>
  <params>
    <param>
      <value><float>3.14156</float></value>
    </param>
    <param>
      <value><float>450.0</float></value>
    </param>
  </params>
</methodCall>
```

Hint: to see the actual XML generated from web services libraries, you need to identify which library method will allow you see the 'raw' input and output streams being parsed by the server.

Telnet to XML-RPC Service: Error

```
[gidget:~] mthomas% telnet localhost 8000
Trying ::1...
telnet: connect to address ::1: Connection refused
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
POST /RPC HTTP/1.0
Host: localhost:8000
Content-Type: text/xml
Content-length: 231
[CRLF]
<?xml version="1.0" encoding="UTF-8"?>
<methodCall>
<methodName>addFloat</methodName>
<params>
<param>
<value><float>3.14156</float></value>
</param>
<param>
<value><float>45.0</float></value>
</param>
</params>
</methodCall>
```

```
<?xml version='1.0'?>
<methodResponse>
<fault>
<value><struct>
<member>
<name>faultCode</name>
<value><int>1</int></value>
</member>
<member>
<name>faultString</name>
<value><string>exceptions.UnboundLocalError:local
variable 'method'
referenced before assignment</string></value>
</member>
</struct></value>
</fault>
</methodResponse>
Connection closed by foreign host.
```

Telnet to XML-RPC Service: Successful request/response

CLIENT REQUEST

```
POST /RPC HTTP/1.1
Host: localhost:8000
Content-Type: text/xml
Content-length: 235
[CRLF]
<?xml version="1.0" encoding="UTF-8"?>
<methodCall>
<methodName>addFloat</methodName>
<params>
<param>
<value><float>3.14156<float></value>
</param>
<param>
<value><float>450.0</float></value>
</param>
</params>
</methodCall>
```

Errors were due to these lines.
Also, note that request sent float, while server parsed it into a double.

SERVER RESPONSE

```
HTTP/1.0 200 OK
Server: BaseHTTP/0.3 Python/2.3.5
Date: Sat, 10 Feb 2007 20:51:41 GMT
Content-type: text/xml
Content-length: 144

<?xml version='1.0'?>
<methodResponse>
<params>
<param>
<value><double>453.14159999999998</double></value>
</param>
</params>
</methodResponse>
```

acelMathServer.py: Capturing XML Stream

```
conn=xmlrpclib.ServerProxy(host)
f1,f2 = f3.1416, 4.5e2
args=(f1,f2)
response = xmlrpclib.dumps(args,'conn.addFloat')
print response
```

```
%python exmathclient.py
localhost - - [10/Feb/2007 14:58:01] "POST /RPC2 HTTP/1.0" 200
Client calling acelMathServer function: addDbl(f1,f2)
    adding 3.141600 + 450.000000 = 453.141600
trying dumps=====
<?xml version='1.0'?>
<methodCall>
<methodName>conn.addFloat</methodName>
<params>
<param>
<value><double>3.1415999999999999</double></value>
</param>
<param>
<value><double>450.0</double></value>
</param>
</params>
</methodCall>
```

The **xmlrpclib** contains methods for accessing its objects.

In this example, we instance the client and use the `xmlrpc.dumps(...)` method to see what the serialized form of the request message will be when sent to the server.

SOAP in Python

ZSI: Python Web Service Package

- Zolera SOAP Infrastructure (ZSI)
- Web services for Python programmers
 - both client and servers
 - includes SOAP, WSDL, UDDI, etc.
- Used by pyGridWare
- Downloads:
 - http://sourceforge.net/forum/forum.php?forum_id=660925
- Doc
 - <http://pywebsvcs.sourceforge.net/>

SOAPpy

■ INCLUDED

- General SOAP **Parser** based on sax.xml
- General SOAP **Builder**
- SOAP Proxy for RPC **client** code
- SOAP **Server** framework for RPC server code

■ Download, Docs & Project Links:

- <http://pywebsvcs.sourceforge.net/>

■ Requires:

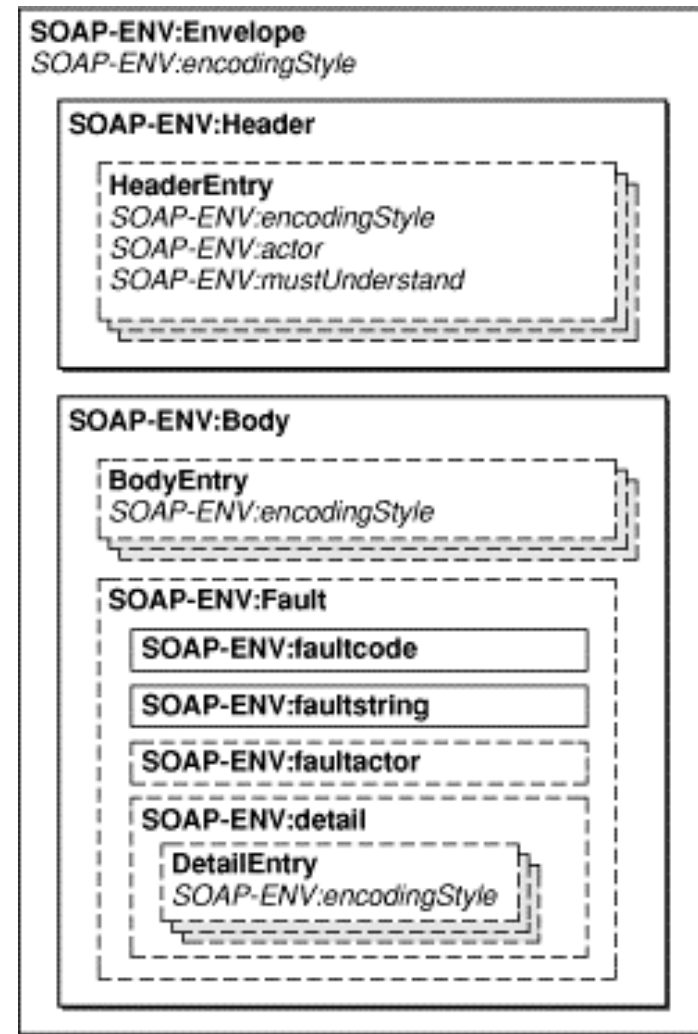
- fpconst 0.6.0 or later (docs have dead link)
 - <http://cheeseshop.python.org/pypi/fpconst/0.7.2>
- pyXML 0.8.3 or later
 - <http://pyxml.sourceforge.net>

SOAPpy Features

- Handles all SOAP 1.0 types
- Handles faults
- Allows namespace specification
- Allows SOAPAction specification
- Homogeneous typed arrays
- Supports multiple schemas
- Header support (mustUnderstand and actor)
- XML attribute support
- Multi-referencing support (Parser/Builder)
- Understands SOAP-ENC:root attribute
- Good interop, passes all client tests for Frontier, SOAP::LITE, SOAPRMI
- Encodings
- SSL clients (with Python compiled with OpenSSL support)
- SSL servers (with Python compiled with OpenSSL support and M2Crypto installed)
- Encodes XML tags per SOAP 1.2 name mangling specification (Gregory Warnes)
- Automatic stateful SOAP server support (Apache v2.x) (blunck2)
- WSDL client support
- WSDL server support

SOAP Components and Elements

- Components:
 - Formatting conventions
 - Transport/protocol binding
 - Encoding rules
 - RPC mechanism
- Elements:
 - **Envelope**: Required
 - **Header** [Optional] - use:
 - Transaction data
 - **Body**: Required, use:
 - Method call and its parameters



Skeleton SOAP Message

```
<?xml version="1.0"?>
<soap:Envelope
  xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
  soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
<soap:Header>
  ...
  ...
</soap:Header>
<soap:Body>
  ...
  ...
  <soap:Fault>
    ...
    ...
  </soap:Fault>
</soap:Body>
</soap:Envelope>
```

SOAP Envelope

- Root element of a SOAP message.
- Defines the XML document as a SOAP message
- The xmlns:soap Namespace:
 - message must have Envelope element associated with W3C namespace:
 - <http://www.w3.org/2001/12/soap-envelope>

```
<soap:Envelope  
  
    xmlns:soap="http://www.w3.org/2001/12/soap-envelope"  
  
    soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">  
<soap:Header>
```

SOAP Header

- Elements in SOAP Header define how a recipient should process the SOAP message
- Header elements must have attributes:
 - 3 attributes in namespace ("http://www.w3.org/2001/12/soap-envelope")
- *actor*: used to address Header element to endpoint
- *mustUnderstand true*: receiver processing Header must recognize element
- *encodingStyle*

```
<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
<soap:Header>
<m:Trans
xmlns:m="http://www.w3schools.com/transaction/"
soap:actor="http://www.w3schools.com/appml/">
234
</m:Trans>
</soap:Header>
```

SOAP Body

REQUEST:

```
<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap
-envelope"
soap:encodingStyle="http://www.w3.org/2001
/12/soap-encoding">
<soap:Body>
  <m:GetPrice
    xmlns:m="http://www.w3schools.com/pric
    es">
    <m:Item>Apples</m:Item>
  </m:GetPrice>
</soap:Body>
</soap:Envelope>
```

- Body is XML data
- User namespace defined
- Fault: defined by SOAP standard for errors

SOAP HTTP Binding

- HTTP Binding
- HTTP + XML = SOAP:
 - Content-type
- Protocol:
 - Client sends request
 - Server responds OK

```
POST /item HTTP/1.1
Host: 189.123.345.239
Content-Type: MIMEType;
  charset=character-
  encoding
Content-Length: 200

200 OK
Content-Type: text/plain
Content-Length: 200
```

SOAPpy: Stockquote Client

```
>>> from SOAPpy import SOAPProxy
>>> server =
SOAPProxy("http://services.xmethods.com/soap",
namespace="urn:xmethods-delayed-quotes")
>>> print server.getQuote(symbol="IBM")
98.92
```

SOAPpy: Package Contents

Client
Config
Errors
GSIServer
NS
Parser
SOAP
SOAPBuilder
Server
Types
URLopener
Utilities
WSDL
version
wstools (package)

API Documentation (basically what you see with the interpreter help() function:

<http://pywebsvcs.sourceforge.net/apidocs/>

SOAPProxy

`__getattr__(self, name)`

`__init__(self, proxy, namespace=None, soapaction=None, header=None, methodattrs=None,`

`transport=<class SOAPpy.Client.HTTPTransport>,`

`encoding='UTF-8', throw_faults=1,`

`unwrap_results=None, http_proxy=None,`

`config=<SOAPpy.Config.SOAPConfig instance>,`

`noroot=0, simplify_objects=None)`

`invoke(self, method, args)`

SOAPpy: Simple Hello Server/Client Code

```
import SOAPpy
def hello():
    return "Hello Mary Thomas"
#this must be a tuple argument
server = SOAPpy.SOAPServer(("localhost", 8888))
server.registerFunction(hello)
server.serve_forever( )
```

Server Code

Client Code

```
import SOAPpy
host = "localhost:8888"
print "Connection to server at %s" %
    host
server = SOAPpy.SOAPProxy(host)
print "sending request to run method
    hello()"
print server.hello()
```

SOAPpy: Simple Hello I/O

```
[mthomas% python helloSoapServer.py
Starting Server on host: http://localhost:8000
[1] 2957
mthomas%
mthomas% python helloSoapClient.py
Connection to server at localhost:8888
sending request to run method hello()
Hello Mary Thomas
```

Command line I/O

telnet session

```
import SOAPpy
host = "localhost:8888"
print "Connection to server at %s" %
      host
server = SOAPpy.SOAPProxy(host)
print "sending request to run method
      hello()"
print server.hello()
```

SOAPpy: Shutting down a server - Server

```
import SOAPpy
#SOAPpy.Config.debug=1
# global to shut down server
global quit
quit = 0
def echoDateTime(dt):
    return dt
def kill():
    global quit
    quit = 1
print "Starting SOAP Server...",
server =
SOAPpy.Server.SOAPServer(addr=("localhost",
8000))
server.registerFunction(echoDateTime)
server.registerFunction(kill)
print "Done."
while not quit:
    server.handle_request()
quit = 0
print "Server shut down."
```

SOAPpy: Shutting down a server - Client

```
import SOAPpy, time
server = SOAPpy.SOAPProxy("http://localhost:8000")
dt = SOAPpy.Types.dateTimeType(data=time.time())
dt_return = server.echoDateTime(dt)
print "sent: ", dt
print "rcv: ", dt_return
print "now, try to kill server\n"
server.kill()
```

```
sent: <SOAPpy.Types.dateTimeType at 16877768>
rcv: <SOAPpy.Types.arrayType Result at 17037832>:
[2007, 2, 16, 2, 24, 13.800008999999999]
now, try to kill server
```

Server Response XML

```
*** Outgoing HTTP headers *****
HTTP/1.0 200 OK
Server: <a href="http://pywebsvcs.sf.net">SOAPpy 0.12.0</a> (Python 2.3.5)
Date: Fri, 16 Feb 2007 02:30:50 GMT
Content-type: text/xml; charset="UTF-8"
Content-length: 783
```

```
*** Outgoing SOAP *****
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema"
>
<SOAP-ENV:Body>
<echoDateTimeResponse SOAP-ENC:root="1">
<Result SOAP-ENC:arrayType="xsd:ur-type[6]" xsi:type="SOAP-ENC:Array">
<item xsi:type="xsd:int">2007</item>
<item xsi:type="xsd:int">2</item>
<item xsi:type="xsd:int">16</item>
<item xsi:type="xsd:int">2</item>
<item xsi:type="xsd:int">30</item>
<item xsi:type="xsd:double">50.861835999999997</item>
</Result>
</echoDateTimeResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Client Request XML

Incoming HTTP headers *****

POST / HTTP/1.0

Host: localhost:8000

User-agent: SOAPpy 0.12.0 (pywebsvcs.sf.net)

Content-type: text/xml; charset="UTF-8"

Content-length: 520

SOAPAction: "echoDateTime"

Incoming SOAP *****

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

<SOAP-ENV:Envelope

 SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"

 xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"

 xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"

 xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"

 xmlns:xsd3="http://www.w3.org/2001/XMLSchema"

>

<SOAP-ENV:Body>

<echoDateTime SOAP-ENC:root="1">

<v1 xsi:type="xsd3:dateTime">2007-02-16T02:30:50.861836Z</v1>

</echoDateTime>

</SOAP-ENV:Body>

</SOAP-ENV:Envelope>

SOAPpy: XML Response

```
>>> from SOAPpy import SOAPProxy
>>> host = "http://localhost:8888"
>>> server = SOAPpy.SOAPProxy(host)
>>> server.config.dumpSOAPIn = 1
>>> server.config.dumpSOAPOut = 1
>>> server.hello()
```

```
*** Incoming SOAP *****
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema"
>
<SOAP-ENV:Body>
<helloResponse SOAP-ENC:root="1">
<Result xsi:type="xsd:string">Hello Mary Thomas</Result>
</helloResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Echo Server

```
from SOAPpy import *
# provide a mechanism to stop the server
run = 1
def quit():
    global run
    run=0;
# Simple echo
def echo(s):
    return s + s
addr = ('localhost', 9905)
print "Server listening at: %s://%s:%d/" % (prefix, addr[0],
addr[1])
Server = SOAPProxy("localhost:9905")
# register the methods
server.registerFunction(echo)
server.registerFunction(quit)
# Start the server
server.handle_request()
```

Echo Client

```
#!/usr/bin/env python.
import sys
sys.path.insert(1, "..")
from SOAPpy import *
# Uncomment to see outgoing HTTP headers and SOAP and incoming
Config.debug = 1
Config.dumpHeadersIn = 1
Config.dumpSOAPIn = 1
Config.dumpSOAPOut = 1
# ask for returned SOAP responses to be converted to basic python types
Config.simplify_objects = 1
pathserver = SOAPProxy("http://localhost:9905/ptest")
server = SOAPProxy("http://localhost:9905")
msg="Little Miss Sunshine, Beep Beep"
print server.echo(msg)
```

Client XML Request

```
*** Incoming HTTP headers *****
POST / HTTP/1.0
Host: localhost:9905
User-agent: SOAPpy 0.12.0 (pywebsvcs.sf.net)
Content-type: text/xml; charset="UTF-8"
Content-length: 504
SOAPAction: "echo"
*****

*** Incoming SOAP *****
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema"
>
  <SOAP-ENV:Body>
    <echo SOAP-ENC:root="1">
      <v1 xsi:type="xsd:string">Little Miss Sunshine, Beep Beep</v1>
    </echo>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

EchoClient: Server Response

```
*** Incoming HTTP headers *****
HTTP/1.? 200 OK
Server: <a href="http://pywebsvcs.sf.net">SOAPpy 0.12.0</a> (Python 2.3.5)
Date: Fri, 16 Feb 2007 02:54:29 GMT
Content-type: text/xml; charset="UTF-8"
Content-length: 509
*****

*** Incoming SOAP *****
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema"
>
<SOAP-ENV:Body>
<echo_echoResponse SOAP-ENC:root="1">
<Result xsi:type="xsd:string">Little Miss Sunshine, Beep Beep</Result>
</echo_echoResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Echo Server: Telnet Session

```
[gidget:cs696/soappy/echo] mthomas% telnet localhost 9905
Trying ::1...
telnet: connect to address ::1: Connection refused
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
POST / HTTP/1.0
Host: localhost:9905
User-agent: SOAPpy 0.12.0 (http://pywebsvcs.sf.net)
Content-type: text/xml; charset="UTF-8"
Content-length: 476
SOAPAction: "echo"
```

```
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema" >
<SOAP-ENV:Body>
<echo SOAP-ENC:root="1">
<v1 xsi:type="xsd:string">MOO</v1>
</echo>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Request sent to server

Response sent back from Server

```
HTTP/1.0 200 OK
Server: <a href="http://pywebsvcs.sf.net">SOAPpy 0.12.0</a> (Python 2.3.5)
Date: Fri, 16 Feb 2007 07:10:39 GMT
Content-type: text/xml; charset="UTF-8"
Content-length: 503

<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema"
>
<SOAP-ENV:Body>
<echoResponse SOAP-ENC:root="1">
<Result xsi:type="xsd:string">MOOMOO</Result>
</echoResponse>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
Connection closed by foreign host.
[gidget:cs696/soappy/echo] mthomas%
```

SOAPpy: Calling object methods

SERVER

```
...  
# An echo class  
class echoBuilder2:  
    def echo2(self, val):  
        return val * 3  
  
class echoBuilder:  
    def __init__(self):  
        self.prop = echoBuilder2()  
    def echo_ino(self, val):  
        return val + val  
  
...  
# Register a whole object  
o = echoBuilder()  
server.registerObject(o)  
...
```

CLIENT

```
...  
# ...in an object  
print server.echo_ino("moo")  
...  
# ...in an object in an object  
print server.prop.echo2("Ha! ")  
...
```

Request/Response

```
*** Incoming HTTP headers *****
POST / HTTP/1.0
Host: localhost:9905
User-agent: SOAPpy 0.12.0 (pywebsvcs.sf.net)
Content-type: text/xml; charset="UTF-8"
Content-length: 488
SOAPAction: "prop.echo2"
*** Outgoing SOAP *****
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema" >
<SOAP-ENV:Body>
<prop.echo2 SOAP-ENC:root="1">
<v1 xsi:type="xsd:string">Ha!</v1>
</prop.echo2>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Must know something about the internals of the class, such as the name of the object in the server code. This makes it cumbersome to develop client codes.

```
*** Outgoing HTTP headers *****
HTTP/1.0 200 OK
Server: <a href="http://pywebsvcs.sf.net">SOAPpy 0.12.0</a> (Python 2.3.5)
Date: Fri, 16 Feb 2007 07:38:36 GMT
Content-type: text/xml; charset="UTF-8"
Content-length: 518
*** Outgoing SOAP *****
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope
  SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/1999/XMLSchema" >
<SOAP-ENV:Body>
<prop.echo2Response SOAP-ENC:root="1">
<Result xsi:type="xsd:string">Ha!Ha!Ha!</Result>
</prop.echo2Response>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```