Web Services

Web Programming

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Outline

Web services

- Accessing remote functions
- RPC: remote procedure calls
- Web APIs
- Server/client can use different programming languages
- industry- and vendor-driven (OASIS instead of W3C)
- UDDI: service registration

Examples

Older technology: Network Time.
Computers synchronise their clocks over the network.
Special Protocol (NTP) required, used since before 1985.

Modern: Web Services provide one protocol for many services.

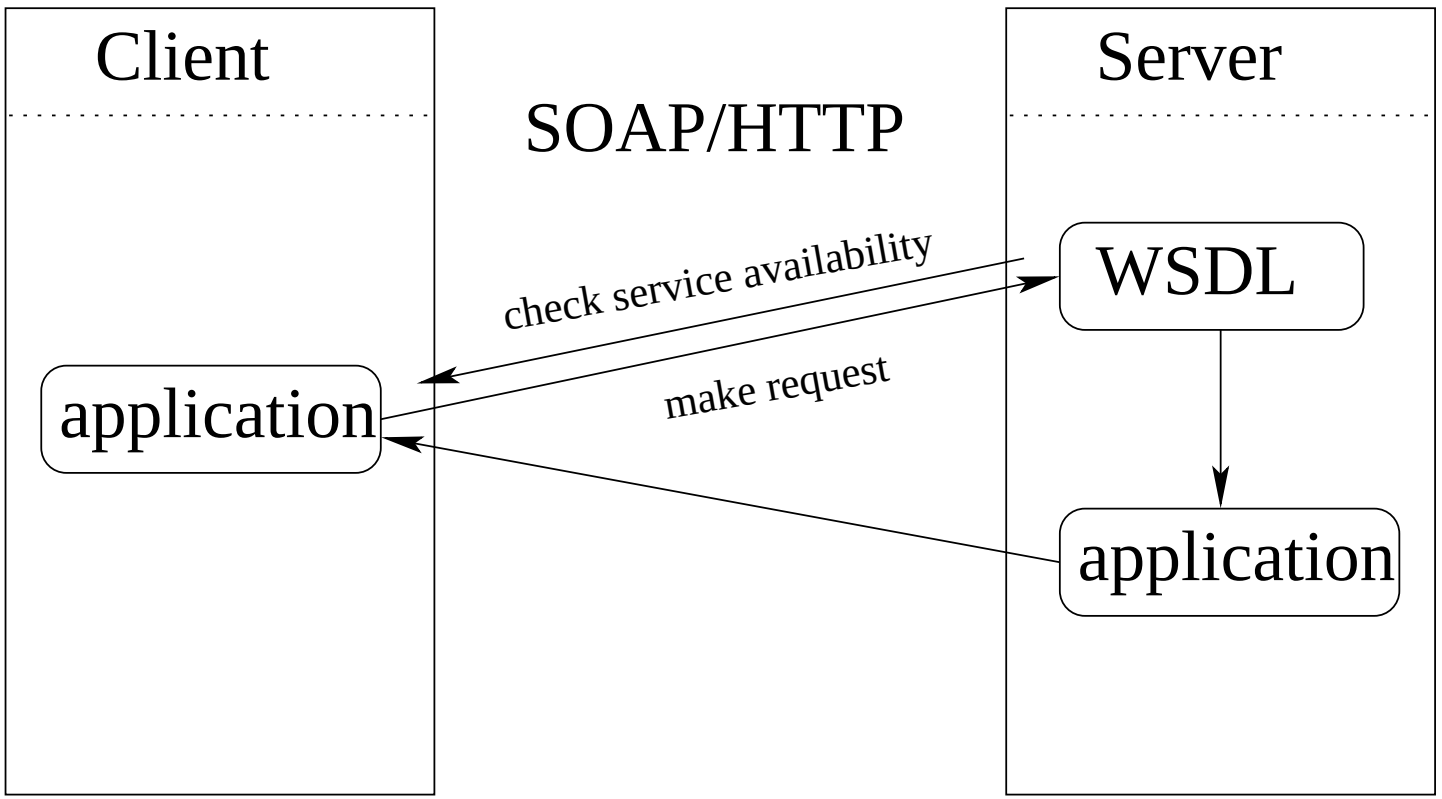
Examples:

- search engine APIs
- postal code look up
- Whois database
- Checking sport results, stock quotes etc

Technologies

- XML messages POSTed using SOAP
- Web Services Description Language (WSDL): machine-readable service description
- XML-RPC (older, simpler alternative to SOAP)
- REST (alternative to SOAP)

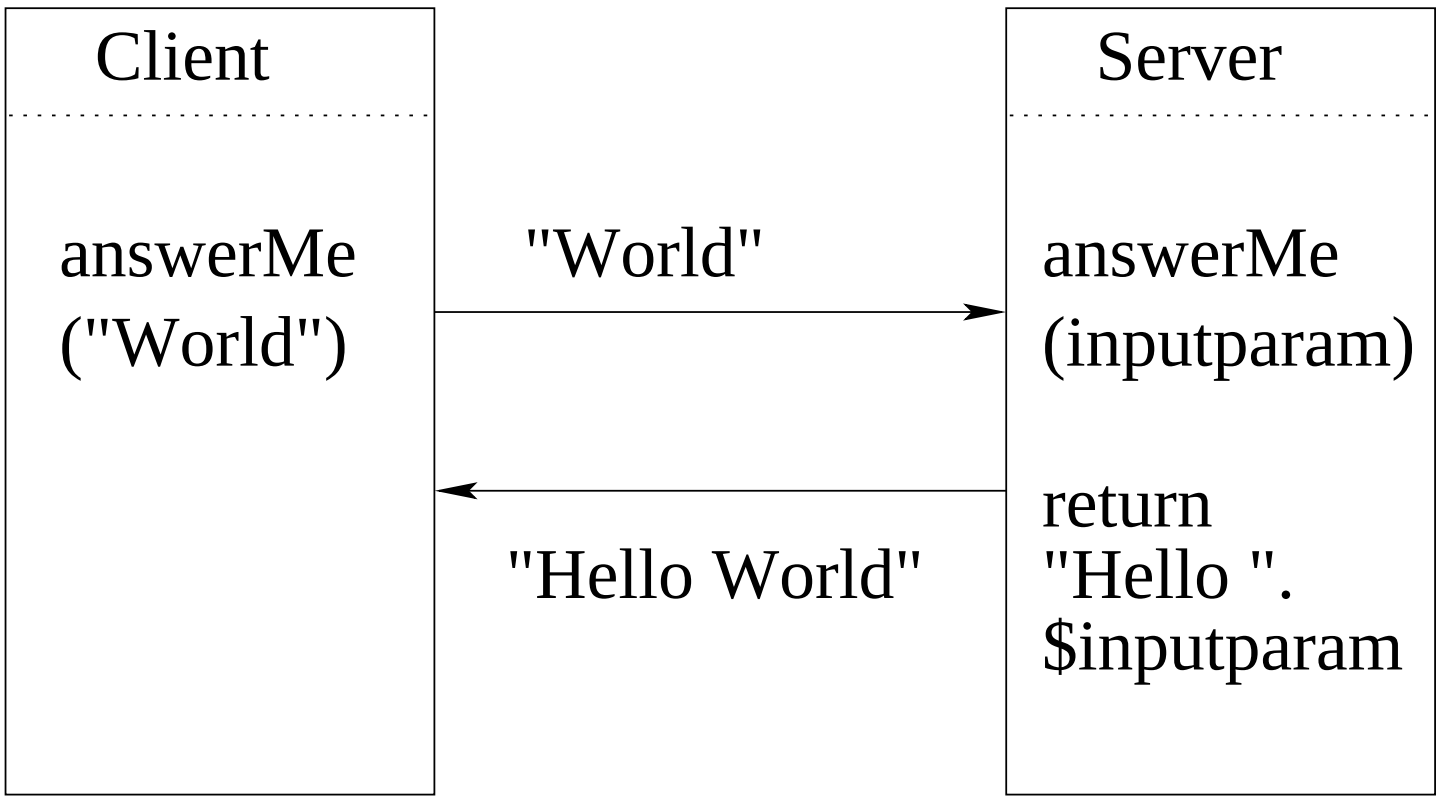
Architecture



Criticism

- complex to use, vendor-driven
- multiple standards and approaches
- each service requires custom-designed clients
- automatically created clients can be brittle

A PHP example



This simple method call ...

... requires a substantial amount of code:

- a PHP file for the service
- a file for the client
- a WSDL file

A PHP service

```
<?php
class WorldService {
      function answerMe($inputparam) {
           return "Hello ". $inputparam;
      }
}
ini_set("soap.wsdl_cache_enabled", "0");
$server = new SoapServer("helloworld.wsdl");
$server->setClass("WorldService");
$server->handle();
?>
```

A (non-WSDL) PHP client

```
<?php
$client = new SoapClient(NULL, array(
      "location" => "http:// ... /helloserver.php",
      "uri" => "something",
      "style" => SOAP_RPC,
      "use" => SOAP_ENCODED
      ));
print($client->__soapCall("answerMe",
      array(new SoapParam("World","inputparam"))));
?>
```

A (WSDL) PHP client

```
<?php
ini_set("soap.wsdl_cache_enabled", "0");
try {
      $client = new SoapClient("helloworld.wsdl");
      $result = $client->answerMe("World");
      print($result);
} catch (SoapFault $exception) {
      echo $exception;
}
?>
```

WSDL: input/output as messages

```
<?xml version ='1.0' encoding ='UTF-8' ?>
<definitions name='HelloWorld' ....
<message name='getHelloWorldRequest'>
      <part name='inputparam' type='xsd:string'/>
</message>
<message name='getHelloWorldResponse'>
      <part name='Result' type='xsd:string'/>
</message>
```

WSDL: methods as operations

```
<portType name='HelloWorldPortType'>
<operation name='answerMe'>
      <input message='tns:getHelloWorldRequest'/>
      <output message='tns:getHelloWorldResponse'/>
</operation>
</portType>
```

WSDL: binding an operation (method)

Here RPC over HTTP using SOAP

```
<binding name='HelloWorldBinding' type='tns:HelloWorldPortT
<soap:binding style='rpc'
transport='http://schemas.xmlsoap.org/soap/http'/>
<operation name='answerMe'>
...
```

WSDL: providing the server address

```
<service name='HelloWorldService'>
<port name='HelloWorldPort' binding='HelloWorldBinding'>
<soap:address location='http:// ... /helloserver.php'/>
</port>
</service>
</definitions>
```

WSDL

- Clearly, WSDL files should not be manually written.
- They can be automatically generated from the code of the service file.
- The clients can parse the WSDL file and automatically generate a list of the methods with data types offered by the service.
- Caching is used for efficiency.

Representational state transfer (REST)

- A style of software architecture for distributed hypermedia systems.
- A collection of network architecture principles.
- Each resource corresponds to a URI.
- Uses resources instead of states.

The "REST" concept was introduced in 2000 by Roy Fielding.

Examples

RPC:

```
exampleAppObject = new ExampleApp('example.com:1234')
exampleAppObject.removeUser('001')
```

REST Server code:

```
http://example.com/users/
http://example.com/users/001/
```

REST Client code:

```
userResource = new Resource('http://example.com/users/001')
userResource.delete()
```

Examples continued

REST uses HTTP GET, POST, PUT, DELETE etc for implementing its methods:

```
userResource = new Resource('http://example.com/users/001')
userResource.delete()
```

- If these methods are not available, the query string is used as well.
- Results are returned as XML or JSON.

REST versus RPC/SOAP

REST:

- Lightweight: uses less XML, easier to use.
- Requires less client-side software.
- Needs less additional frameworks on top of HTTP.
- Provides more long-term stability.
- Becauses resources are URIs, they can be bookmarked etc.

RPC/SOAP:

- RPC uses methods (which often hide underlying complexity).
- SOAP does more type checking.

Who uses what?

- Google used to use SOAP, but now uses AJAX.
- PayPal uses SOAP, but they also have an NVP (Name-Value-Pair) interface.
- Yahoo (including Flickr, del.icio.us, etc) uses REST.

Reminder: AJAX XMLHttpRequest

The XMLHttpRequest API allows to include remote content in Javascript. This uses the HTTP protocol and is used for data.

Other possibilities: include remote Javascript code (see next slide) or use IFrame.

Reminder: AJAX <script src...>

```
<script src='http://servername/username/scriptinclude'
type='text/javascript'></script>
```

The file 'scriptinclude' contains Javascript functions etc, but no html and no <script> tags.

Comparing AJAX to Web Services

- Which programming languages (client and server)?
- Security: who is at risk, client or server?
- Portability across different platforms?
- How easy/difficult to program?
- Stability, etc?
- Bandwidth, etc?