

Distributed Automation System based on Java and Web Services

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16.06.2006

CompSysTech'06

Multi-tier approach

- Installing and deploying the user interface is virtually instantaneous - only the Web interface in the middle tier needs to be updated.
- Without a "thick" client interface, it is easier to deploy, maintain, and modify applications - no matter where the client is located.
- Because the application itself is server-based, users always access the most up-to-date version.

Web Service Architecture

- Ubiquitous infrastructure – they operate over standard TCP/IP networks and use ubiquitous HTTP/SFTP for transport.
- Proven approaches – they use both message-oriented and RPC-based interaction which makes them flexible.
- XML – they do not need specific IDL for describing the interfaces and the data entities are self-describing.
- Business standards – Business-to-Business interaction is by means of standard documents and processes.

Enterprise portal technology

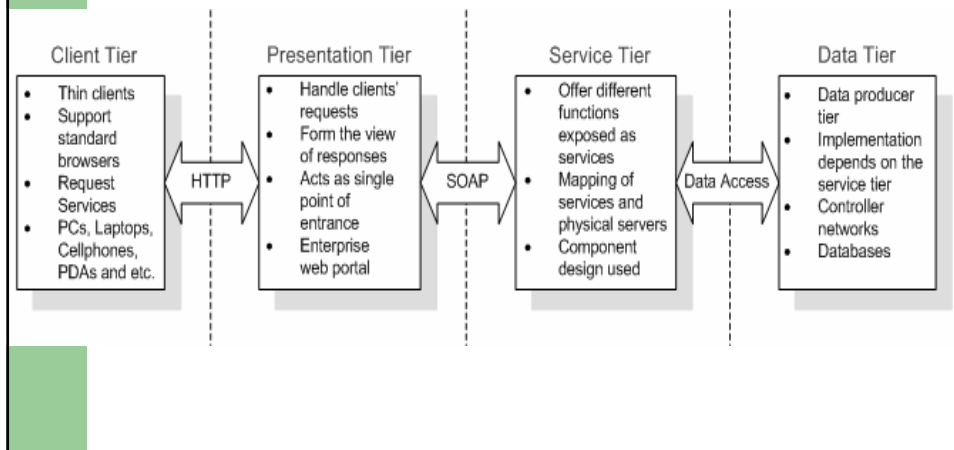
Motivation

- Spreading of enterprise resources over large distances;
- Complexity and expensiveness of modern software;

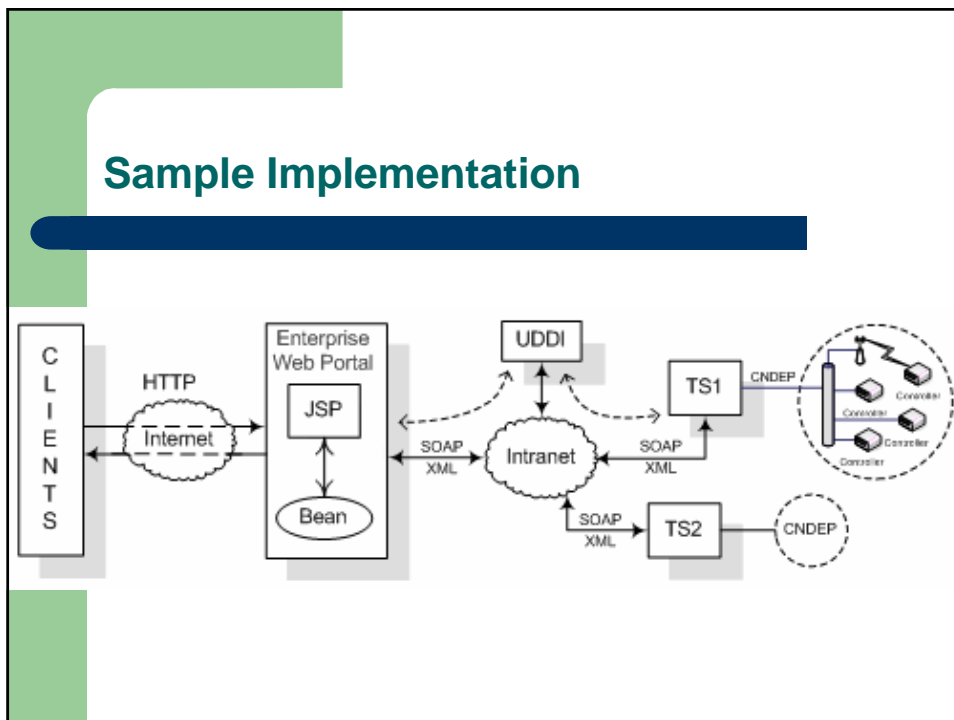
Benefits

- Provide a single point of entry for different type of clients;
- Can access Web services transparently from any device in virtually any location;
- Provide the ability to integrate disparate systems and leverage the functionality provided by those systems.

N-tier Model for Distributed Automation



Sample Implementation



Localization of Services

- Peer-to-Peer and Central Directory approaches
- Universal Description, Discovery and Implementation (UDDI) – part of the WSA specification
- Public and Private UDDI registries
- Dynamic binding is used simply to determine the location of well defined services

Portal – access Web Services

```
<JSP:useBean id="wsc" class="webServices.clients" />
```

Average Temperature:

```
<JSP:getProperty name="wsc"  
  property="avgTemperature" />
```

Average Humidity:

```
<JSP:getProperty name="wsc"  
  property="avgHumidity" />
```

SOAP request message

```
POST /axis/services/ProcessTemperatureSOAP HTTP/1.0
Content-Type: text/xml; charset=utf-8
Accept: application/soap+xml, application/dime, multipart/related, text/*
User-Agent: Axis/1.3
Host: 192.168.2.98
Cache-Control: no-cache
Content-Length: 506
```

```
<?xml version="1.0" encoding="UTF-8"?>
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soapenv:Body>
    <ns1:request soapenv:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
      <in0 xsi:type="soapenc:string">Average</in0>
    </ns1:request>
  </soapenv:Body>
</soapenv:Envelope>
```

SOAP reply message

```
HTTP/1.1 200 OK
Server: Apache-Coyote/1.1
Content-Type: text/xml; charset=utf-8
Date: Mon, 10 Apr 2006 09:16:54 GMT
Connection: close
```

```
<?xml version="1.0" encoding="utf-8"?>
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <soapenv:Body>
    <ns1:response soapenv:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
      <temperature xmlns="http://net-lab.tu-plovdiv.bg/ProcessTemperature/" ID="Data">
        <context-type>application/temperature</context-type>
        <data>24.82</data>
      </temperature>
    </ns1:response>
  </soapenv:Body>
</soapenv:Envelope>
```

Conclusions and Future Work

Conclusions

- Multi-tiered, well-proven architecture models, popular and standard technologies brings various advantages, added flexibility, scalability and increase its security and reliability
- The Service-oriented middleware used allows spreading the system over large distances (WAN)

Future Work

- Evaluation of request/response times
- Estimation of the effectiveness in a function of the server and network load
- Applying web services architecture to the Data tier – directly to the embedded devices

Acknowledgments

The presented work is supported by National Science Fund of Bulgaria project – “BY-966/2005”, entitled “Web Services and Data Integration in Distributed Automation and Information Systems in Internet Environment”, under the contract “BY-МИ-108/2005”.

