Web Services have the potential to change IT infrastructure of organizations
setting up a service-oriented architecture based on web services
process-oriented integration of existing systems
intra- and inter-organizational scenarios
approach for enterprise application integration (EAI)
development of complex cooperative processes
paradigm for the development of new software architectures
reuse of software components
redesign of monolithic enterprise resource planning (ERP)
increase the process-oriented interoperability and the flexibility of the technical infrastructure.

Web services and distributed objects
have some sort of description language
what to call, operations, signatures, return types, exceptions,
how to make an invocation.

compilers generate client stub and server skeleton
both have well-defined network interactions
both have a similar mechanism for registering and discovering available components.

Differences
Web services are usually designed for stateless computing.
Distributed objects enable stateful computing.

Web services are a technology supporting the integration on the Web.
Distributed objects are mainly for intranet.
**Definition:** A Web service (W3C) is a software system identified by a URI, whose public interfaces and bindings are defined and described using XML. Its definition can be discovered by other software systems. These systems may then interact with the Web service in a manner prescribed by its definition, using XML-based messages conveyed by Internet protocols.

A Web Service is a standardized way of integrating Web-based applications using XML, SOAP, WSDL and UDDI open standards over an Internet protocol backbone.

- **XML:** tag the data
- **SOAP:** transfer the data
- **WSDL:** describe the available services
- **UDDI:** list the available services.

**simplified view:** a web service is a remote procedure call over the internet using XML messages.

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**Web Services interoperability Stack**

**Basic Architecture**

**Roles**

**Operations of the Web Service Architecture**

**Basic Standard Technologies**

**Message Exchange Patterns**

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The basic Web service architecture models the interactions between three roles:

**Service Provider**
- processes a Web service request.

**Service Discovery Agency**
- agency through which a Web service description is published and made discoverable.

**Service Requestor**
- requests the execution of a Web service.

The service: a Web service is an interface; implementation of it is the service.

The service description: details of the interface and the implementation of the service.
Publish: a service needs to publish its description such that a requester can subsequently find it.

Find: the requester queries a registry for the required service and retrieves a service description.

Interact: a service needs to be invoked and the results are returned.

**Basic Standard Technologies**

Web services are based on 3 basic standards:
- WSDL: Web Services Description Language
- UDDI: Universal Description, Discovery and Integration
- SOAP: Simple Object Access Protocol

**Steps involved in providing and consuming a service**

1. a service provider describes its service using WSDL
2. a service requester queries the directory to locate a service and determine how to communicate with that service.
3. directory sends service description to service requester
4. service requester sends service request based on WSDL
5. service provider sends response based on WSDL

**Web Service Messages**

WSL uses XML to define messages.

```xml
<customerInfoRequest>
  <account id="1069">
    <name>Hunter</name>
    <phone>209-186035</phone>
  </account>
</customerInfoRequest>
```
In the peer-to-peer scenario, each Web service instance serves in both the service requestor and service provider roles.
Intermediaries may perform additional functions (besides the operations defined by the message exchange patterns) with a message such as routing, security, management.

Web services provide a standard means of communication among distributed software applications based on the Web technology. Standardization by the W3C community.

Motivation - Example

Service Oriented Architecture - SOA
Web Services - Characteristics
Web Services Architecture
Simple Object Access Protocol (SOAP)
Web Services Description Language (WSDL)
Universal Description, Discovery, and Integration (UDDI)
REST
Web Service Composition
Adopting Web Services
Mashups

Simple and lightweight XML-based mechanism for exchanging data between network applications. **SOAP** is a de-facto standard for XML messaging:

- relatively simple.
- flexible and extensible.
- based on XML.
- not bound to a specific protocol; use of Internet protocols such as HTTP, SMTP
- may be used for RPC or document transfer.

**SOAP** consists of three parts:

- an envelope
- a set of encoding rules.
- a convention for representing remote procedure calls and responses.

**SOAP Message**

Parts of SOAP
Exchange Model
Using SOAP in HTTP
SOAP RPC Conventions
Minimalist Infrastructure for Web Services
Exchange Model

One-way transmissions from a sender to a receiver.

A SOAP application receiving a SOAP message must process the message by performing the following actions:

1. Identify all parts of the SOAP message intended for that application; interpret the "SOAP actor" attribute of the SOAP header.
2. Verify that all mandatory parts are supported by the application for this message and process them accordingly.
3. If the SOAP application is not the ultimate destination of the message then remove all parts identified in step 1 before forwarding the message.

SOAP naturally follows the HTTP request/response message model providing SOAP request parameters in a HTTP request and SOAP response parameters in a HTTP response.

SOAP Message Embedded in HTTP Request

SOAP Message Embedded in HTTP Response

Using SOAP in HTTP

SOAP naturally follows the HTTP request/response message model providing SOAP request parameters in a HTTP request and SOAP response parameters in a HTTP response.

use of media type "text/xml".

SOAP Message Embedded in HTTP Request

SOAP Message Embedded in HTTP Response

SOAP request: processed by a servlet, CGI or standalone daemon running on a remote web server.
RPC interactions may be mapped to SOAP.

Example

Java Method

```java
class Example {
    public int addFive(int arg) {
        Request Message in SOAP
        <env:Envelope>
            <env:Body>
                <myNS:addFive xmlns:myNS="http://my-domain.de/"
                    encodingStyle="http://"/>
                <arg xsi:type="xsd:int">33</arg>
            </env:Body>
        </env:Envelope>

        Response Message in SOAP
        <env:Envelope>
            <env:Body>
                <myNS:addFiveResponse xmlns:myNS="http://my-domain.de/"
                    xmlns:rpc="http://www.w3.org/2003/05/soap-rpc"
                    encodingStyle="http://"/>
                <rpc:ret xsi:type="xsd:int">38</rpc:ret>
            </env:Body>
        </env:Envelope>
    }
}
```

Example

Minimalist Infrastructure for Web Services

1. providers advertise their services in a UDDI registry
2. clients look for services in a UDDI registry
   - statically: at development time
   - dynamically: at run-time
Mineralist Infrastructure for Web Services

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SOAP-Router

Routing is a process of delivering messages through a series of nodes or intermediaries, called **SOAP-Router** in the context of SOAP.

The SOAP Router is the entity that moves SOAP messages between internal and external networks.

Besides routing capabilities the SOAP-Router may provide value-added services such as logging, auditing and enforcement of security policies.

WS-Routing is a protocol that defines how SOAP messages can be delivered using various transports.