Distributed Object-Based Systems
The WWW Architecture
Web Services
Handout 11 Part(b)

EECS 591
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Optional Reading List

• “The Web Services Idea”

• “Understanding XML Web Services: The Web Services Idea”

• “Web Services: Building Reusable Web Components with SOAP and ASP .NET”

• W3C: Web Services Activities
  – http://www.w3.org/2002/ws/
The History of Universe Part I

• TREND #1: Shift from process-oriented programming to object-oriented programming in the mid to late 80’s

• TREND #2: client-server computing
  – introduction of RPC
  – DCE (early middleware and run-time environment) proposed to standardize distributed computing on client-server model → DCE failed but C/S model and object-orientation lived on

• TREND #3: TREND 1 and 2 came together.
  – UNIX community (and the rest of the world except MSFT) community proposed CORBA
  – Microsoft proposed DCOM and ActiveX
  – Both approaches continue to have followers

• TREND #4: WWW --- the mother of all client-server applications
  – WWW became the most popular document service known to mankind in the 90’s
  – Client-server model lives on … client-side and server-side scripts
  – CGI scripts enable execution of programs on servers (taking user data as input – HTML form) → program may fetch a document, or manipulate data from a DB to generate results, and send the document to the client on-the-fly to generate a document.

• TREND #5: Advances in OO programming languages and run-time environments
  – SUN introduced JAVA (MSFT later promoted C# after Java took off)

• TREND #6: toward network computing
  – server doesn’t have to do everything → first client-side scripts, then applets
  – it is possible to pass a pre-compiled program to the client to be executed in the browser address space (applets)
  – Servlet: is a pre-compiled program executing in the address space of the (web) server. (note: CGI scripts are executed as a separate process.)

• TREND #7: The WEB grows up → web services
  – XML introduced to define new documents and structure documents
  – A Web Service is just an object accessible over a network
  – Two competing models:
    .NET
The World Wide Web

Overall organization of the Web.

WWW Architectural Overview (1)

The principle of using server-side CGI programs.
Web Services

- The **Web model** has been more rapidly and widely adopted than any other approach to building distributed applications to date. The phenomenal success of the Web model can be attributed to one core characteristic: it is more loosely coupled than traditional distributed programming models like RPC, DCOM and CORBA.

- The simplicity of the interactions in the **Web programming model** makes it possible to build systems incrementally. Unlike tightly-coupled RPC and distributed object systems, which require all the pieces of an application be deployed at once, you can add clients and servers to Web-based systems as needed. You can establish connections to new applications fairly easily. And you can do all of this in a decentralized manner, without any central coordination beyond the registration of DNS names, and with a degree of interoperability, scalability and manageability that is remarkably high.

- The basic idea behind **Web services** is to adapt the loosely coupled Web programming model for use in applications that are not browser-based. The goal is to provide a platform for building distributed applications using software running on different operating systems and devices, written using different programming languages and tools from multiple vendors, all potentially developed and deployed independently.
Web services are Internet-based modular applications that perform a specific business task and conform to a specific technical format. A Web service can be anything from a restaurant review service to a real-time travel advisory to an entire airline ticket reservation process. The modular technical format ensures these self-contained business services (from the same or different companies) will mix and match easily to create a complete business process. Businesses can dynamically publish, discover and aggregate a range of Web services via the Internet; in this way, they can more easily and dynamically create innovative products, business processes, and value chains. Web services can be delivered to any customer device (cell phone, PDA, computer, etc.) and can be created or transformed from existing applications." – IBM

Web services generalize the idea of a Web site.
Web Services

**Definition:** A Web service 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. [W3C Web Services Architecture]

The basic architecture includes Web services technologies capable of:
- Exchanging messages
- Describing Web services
- Publishing and discovering Web service descriptions
Web Services

Web services provide a standard means of communication among different software applications, running on a variety of platforms and/or frameworks. The architecture presented in this document is intended to promote interoperability and extensibility among these various applications, platforms and frameworks in a manner that remains consistent with the architecture of the Web. [W3C]

Key Terms:
- Web Service Description Language (WSDL)
- Universal Discovery Description & Integration (UDDI).
- Networks used to access objects (RMI, RPC).
- Rules for how to ask an object to do something:
  - Marshalling: Extensible Markup Language – XML

Almost all definitions have these things in common:
- XML Web Services expose useful functionality to Web users through a standard Web protocol. In most cases, the protocol used is SOAP.
- XML Web services provide a way to describe their interfaces in enough detail to allow a user to build a client application to talk to them. This description is usually provided in an XML document called a Web Services Description Language (WSDL) document.
- XML Web services are registered so that potential users can find them easily. This is done with Universal Discovery Description and Integration (UDDI).

“We've defined an XML Web service as a software service exposed on the Web through SOAP, described with a WSDL file and registered in UDDI.” [Microsoft]