Lesson 1 – Introduction

Service Oriented Architectures

Module 1 - Basic technologies

Unit 1 – Introduction

Ernesto Damiani

Università di Milano

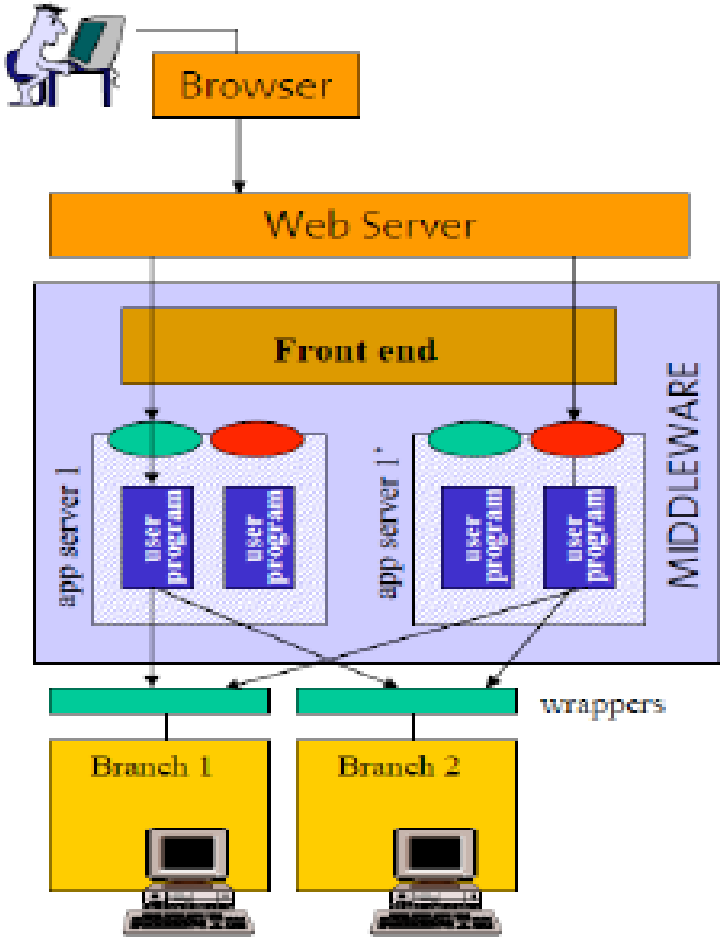
Course outline

- Web page: http://ra.crema.unimi.it
  - This is where all the lecture materials and additional pointers can be found
- Course syllabus (summary):
  - Web service basics
    - SOAP
    - WSDL
    - UDDI
  - Service Composition & BPEL
  - Messaging
  - Web 2.0 and REST
  - Mashups
  - SOA and integration architectures
  - Presentations from industry

Multi-tiered structure of Web applications (1)

- Multi-tiered architectures result from adding an additional layer to allow clients to access applications via a Web server
- The addition of the Web layer led to the notion of “application servers”, middleware platforms supporting access via the Web

Multi-tiered structure of Web applications (2)



HTTP parameter passing (1)

- The introduction of forms for allowing users to provide information to a web server required to modify HTML (and HTTP) but it provided a more advanced interface than just retrieving files

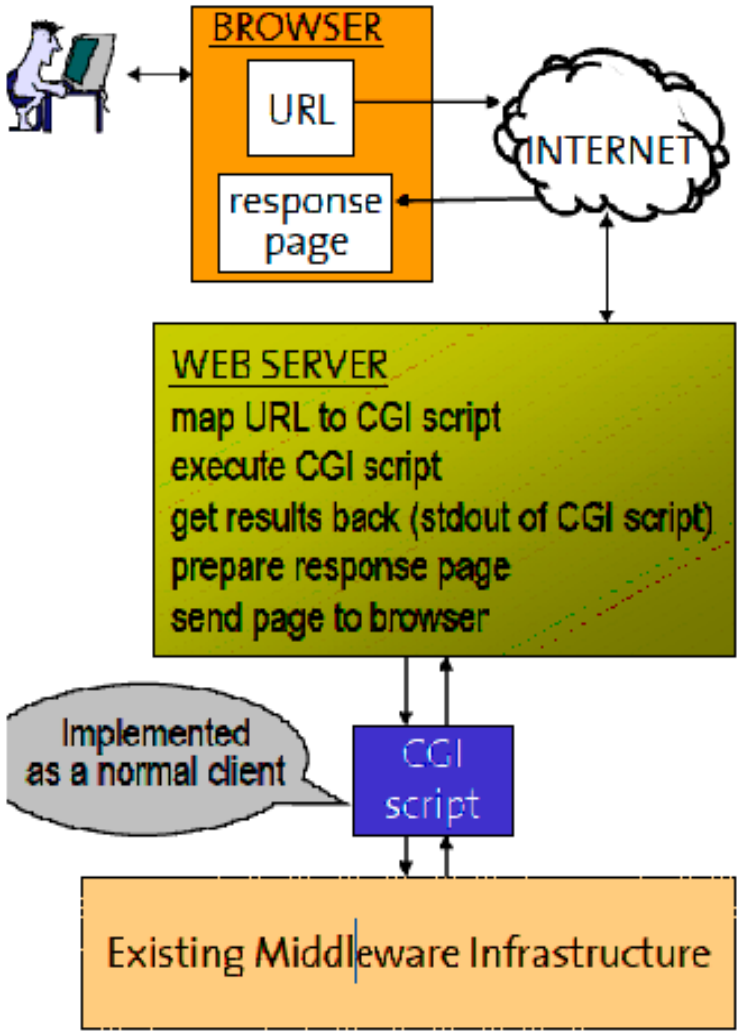
HTTP parameter passing (2)

- Exercise: explain the meaning of all lines of the following HTTP exchange
  - POST /cgi-bin/post-query HTTP/1.0
  - Accept: www/source
  - Accept: text/html
  - Accept: video/mpeg
  - Accept: image/jpeg
  - ...
  - Accept: application/postscript
  - User-Agent: Lynx/2.2 libwww/2.14
  - From: grobe@www.cc.ukans.edu
  - Content-type: application/x-www-form-urlencoded
  - Content-length: 150
  - * a blank line *
  - &name = E
  - &email= ernesto.damiani@unimi.it

CGI heritage (1)

- The earliest implementations of Web applications were built directly upon the existing systems.
- The CGI script (or program) acted as client in the traditional sense (for instance using RPC)
  - the user clicked in a given URL and the server invoked the corresponding script
  - the script executed, produced the results and passed them back to the server (usually as the address of a web page)
  - the server retrieved the page and send it to the browser

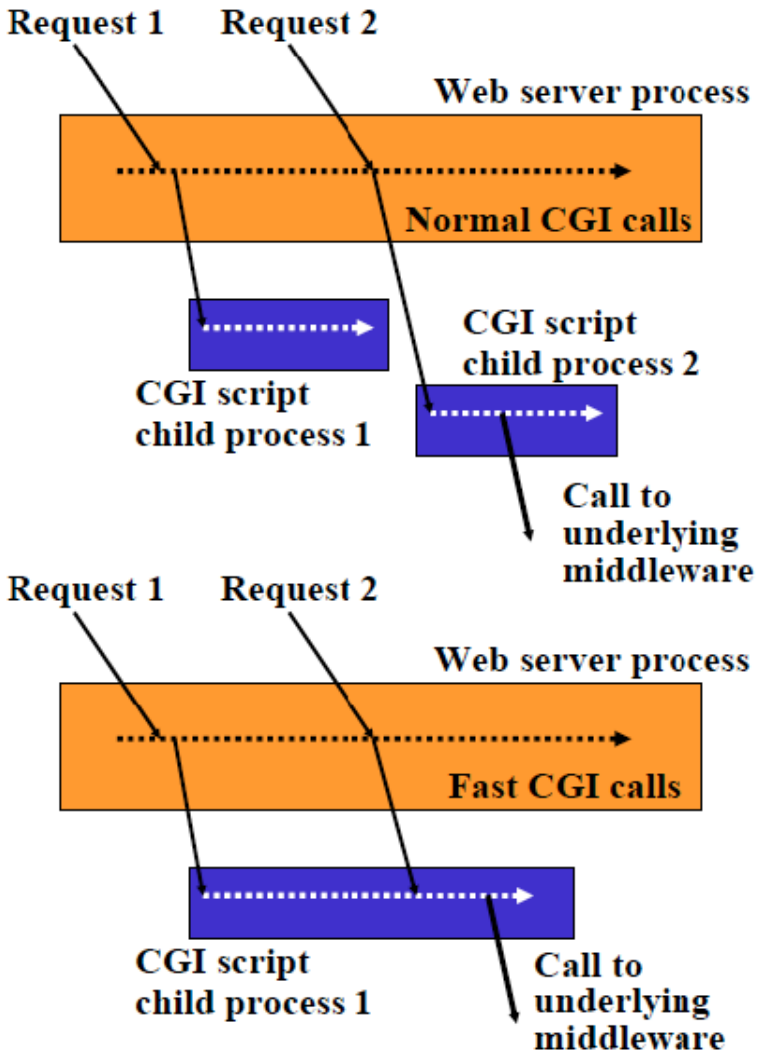
CGI heritage (2)



Why CGIs don’t scale (1)

- CGI have several problems that are not easy to solve:
  - CGI scripts are separate processes, requiring additional context switches when a call is made (and thereby adding to the overall delay)
  - Fast-CGI allows calls to be made to a single running process but it still requires two context switches
  - CGI is really a quick hack not designed for performance, security, scalability, etc.

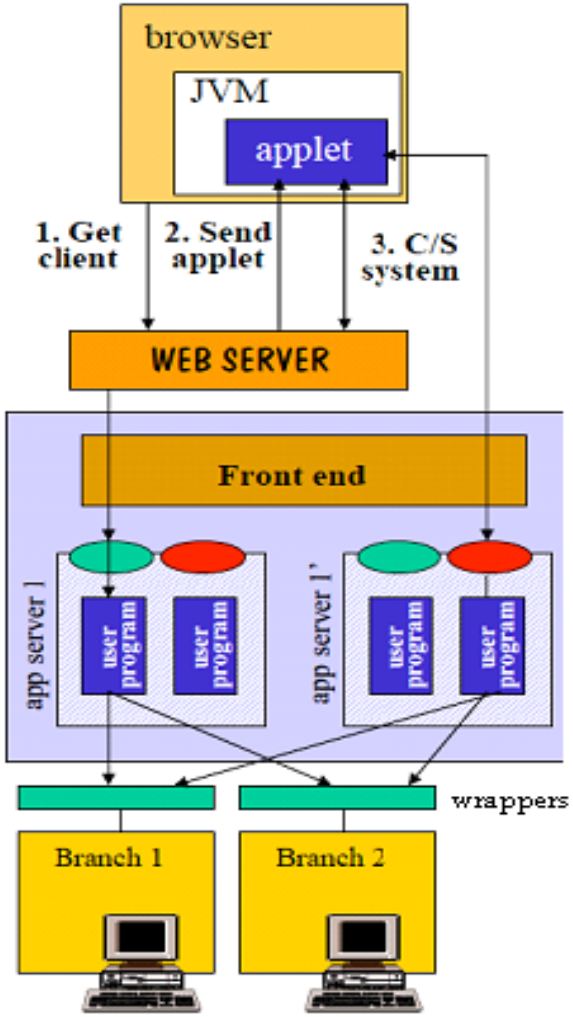
Why CGIs don't scale (2)



From thin to thick clients (1)

- A conventional web browser does not do much beyond displaying data
  - the processing power at the client is not used
- By adding a JVM (Java Virtual Machine) to the browser, now it becomes possible to dynamically download the client functionality (an applet) every time it is needed
  - The client becomes truly independent of the operating system and is always under the control of the server

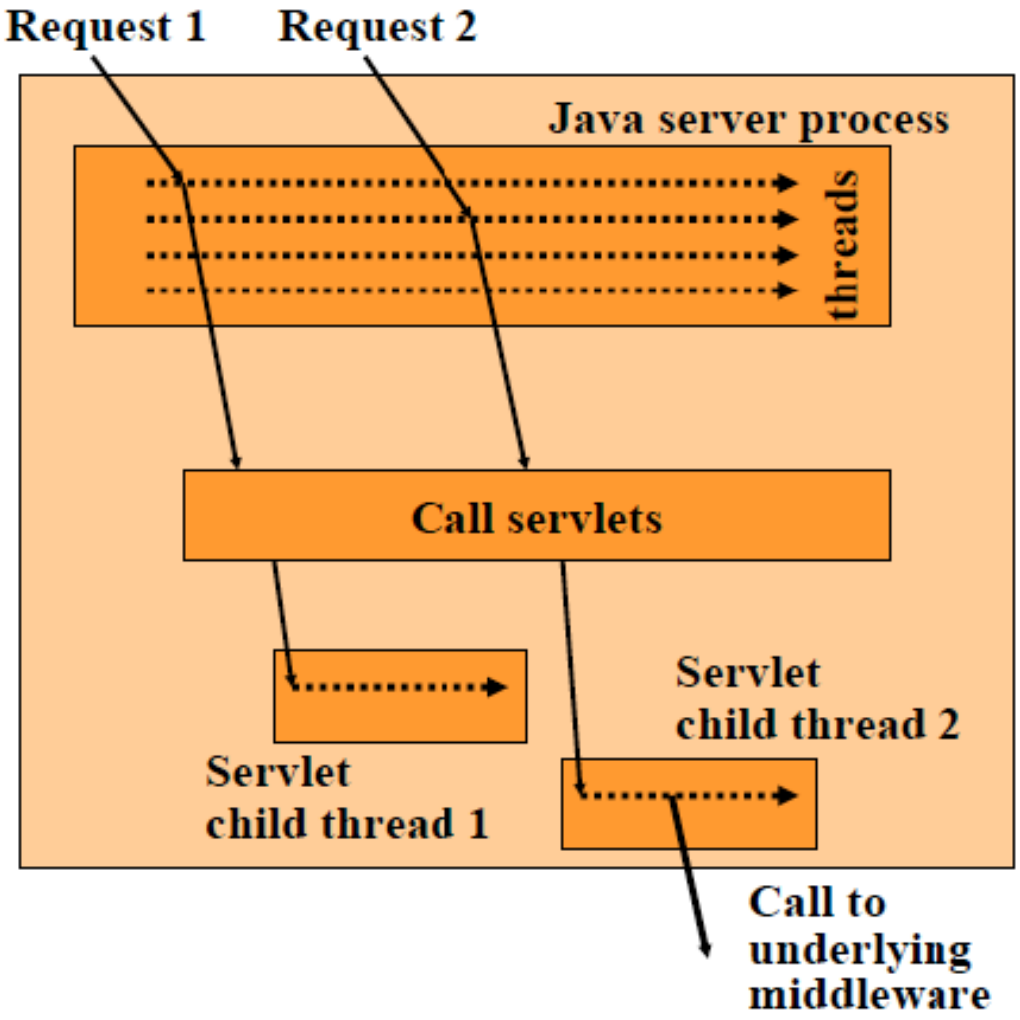
From thin to thick clients (2)



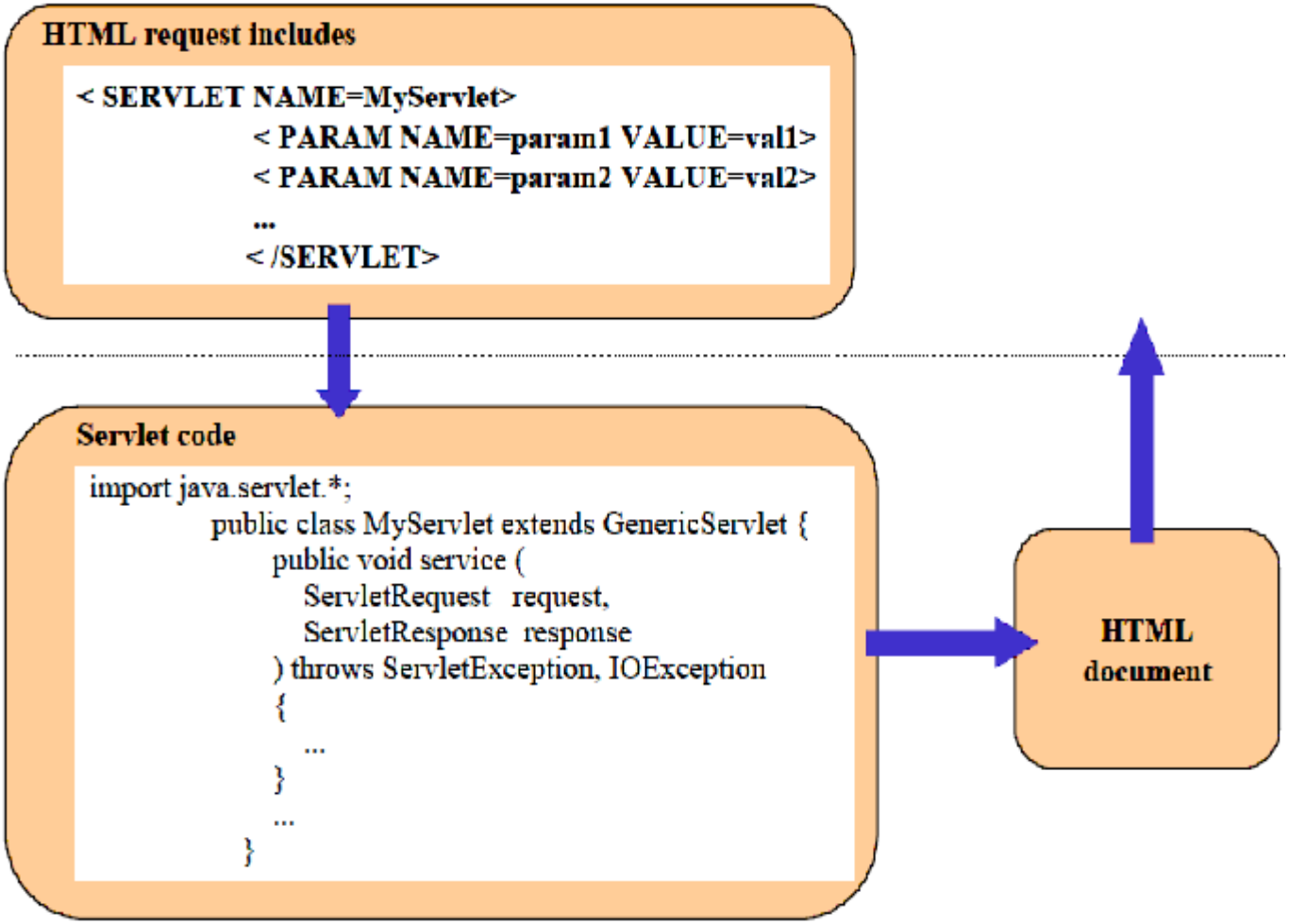
From CGI to servlets (1)

- Servlets have the same role as CGI scripts: they provide a way to invoke a program in response to an http request.
- BUT, servlets run as threads of the Java server process (not necessarily the web server) not as separate OS processes

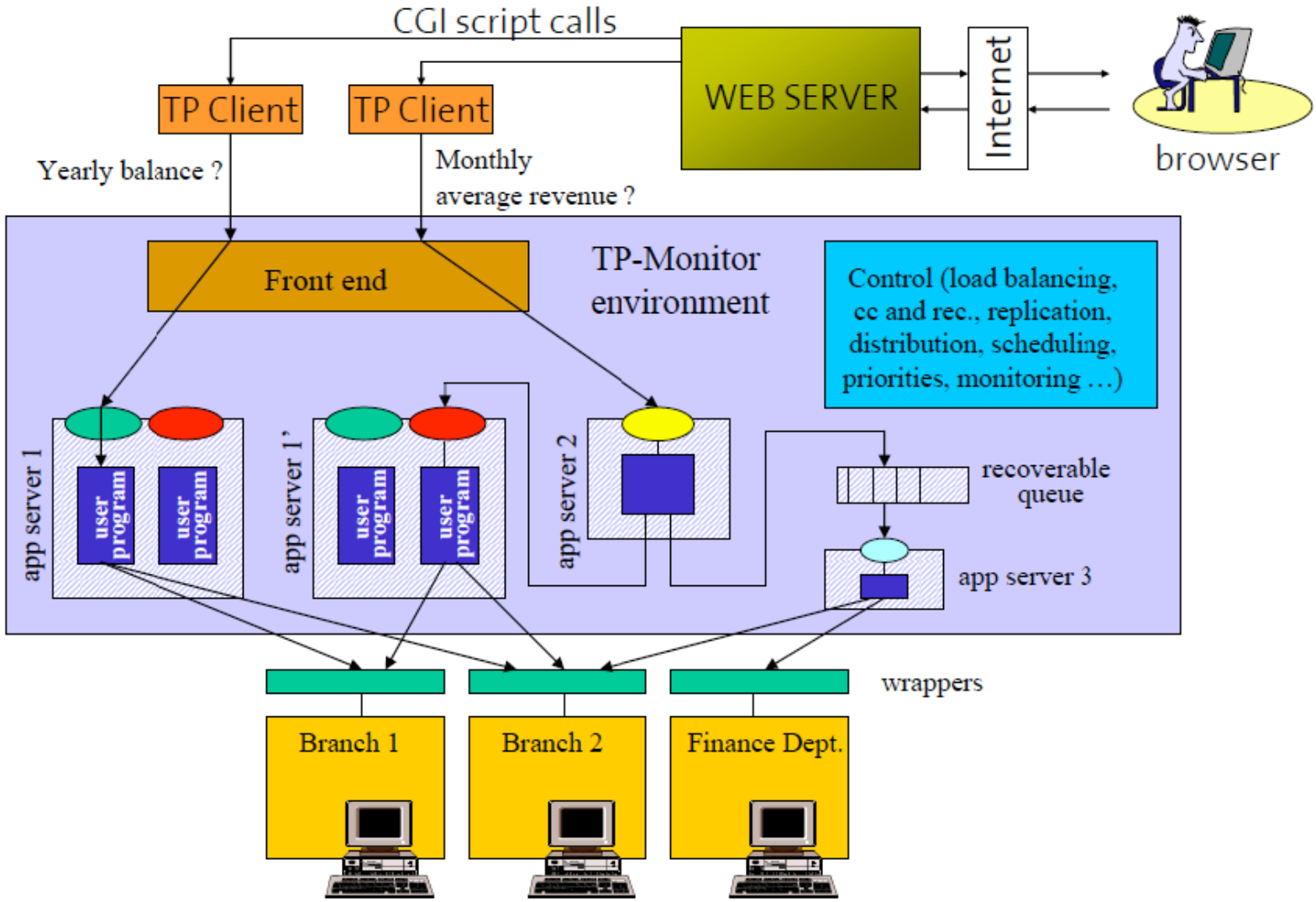
From CGI to servlets (2)



Launching a servlet



Web-based access to enterprise systems



A critical view of the business Web (1)

- HTTP was originally designed as a document exchange protocol (request a document, get the document, render/display it)
  - It is almost like e-mail (in fact, it uses RFC 822 compliant mail headers and MIME types)
  - The document format (HTML) was designed to cope with GUI problems

A critical view of the business Web (2)

- Interaction through document exchange can be very inefficient when the two sides of the interaction are programs (documents must be created, sent, parsed on arrival, etc.)
- The initial WWW model was biased towards the server
  - the client (the browser) does not do much beyond displaying the document
  - for complex applications, that meant much more traffic between client and server
    - high loads at the server as the number of users increases

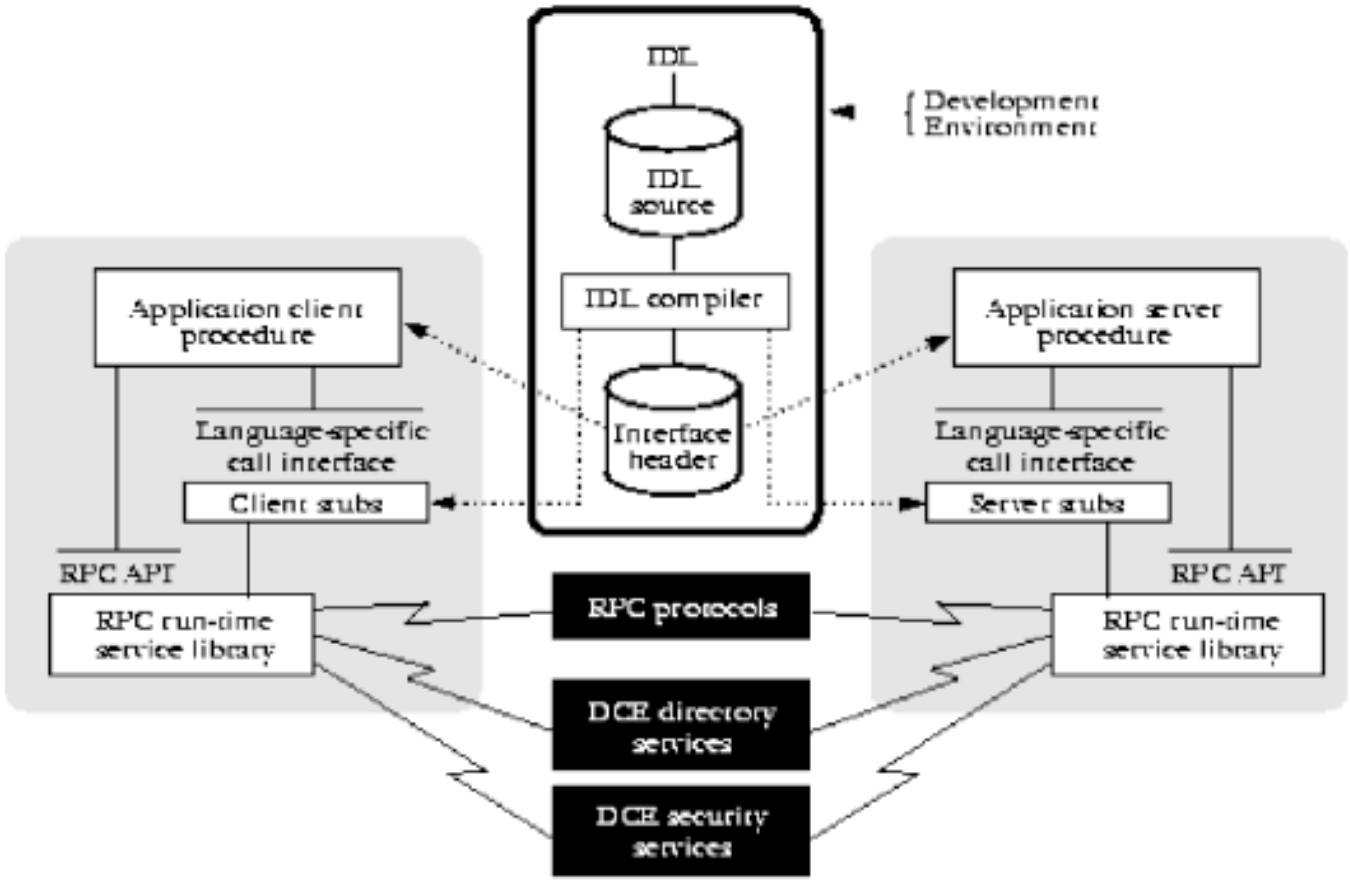
From Web-mediated application access to B2B (1)

- The basic idea behind B2B follows the client/server model
- A service provided by one company can be directly invoked by a client running in another company

From Web-mediated application access to B2B (2)

- Problems
  - joint development of client and server is not possible
  - the server and client are likely to be hidden behind firewalls
  - the interaction takes place among existing systems, it is not possible to assume the IT platforms will be uniform
  - the Internet is cheap but open to everybody (unlike leased lines that are expensive but private)
    - Existing systems/protocols are not really designed for such type of interactions

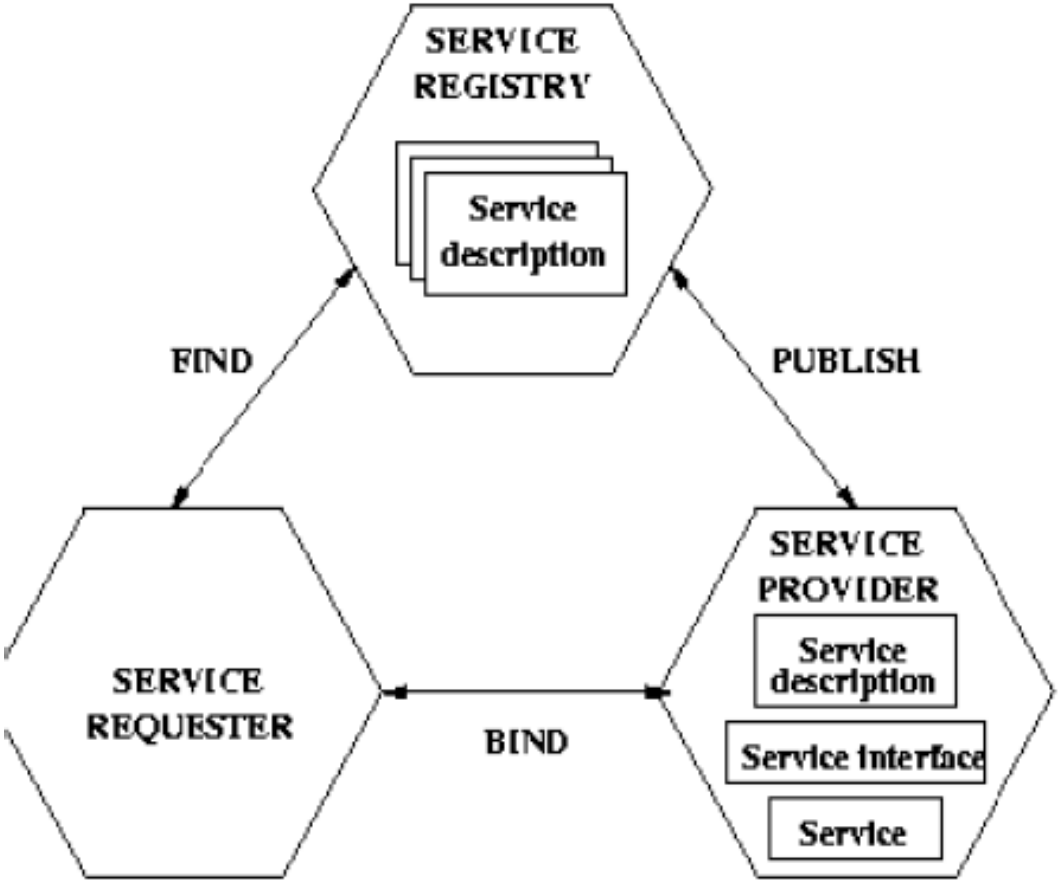
Predecessors: RPC remote calls



Web service architecture (1)

- IBM's Web service architecture composed of three elements:
  1. Service requester: the potential user of a service (the client)
  2. Service provider: the entity that implements the service and offers to carry it out on behalf of the requester (the server)
  3. Service registry: a place where available services are listed and that allows providers to advertise their services and requesters to lookup and query for services

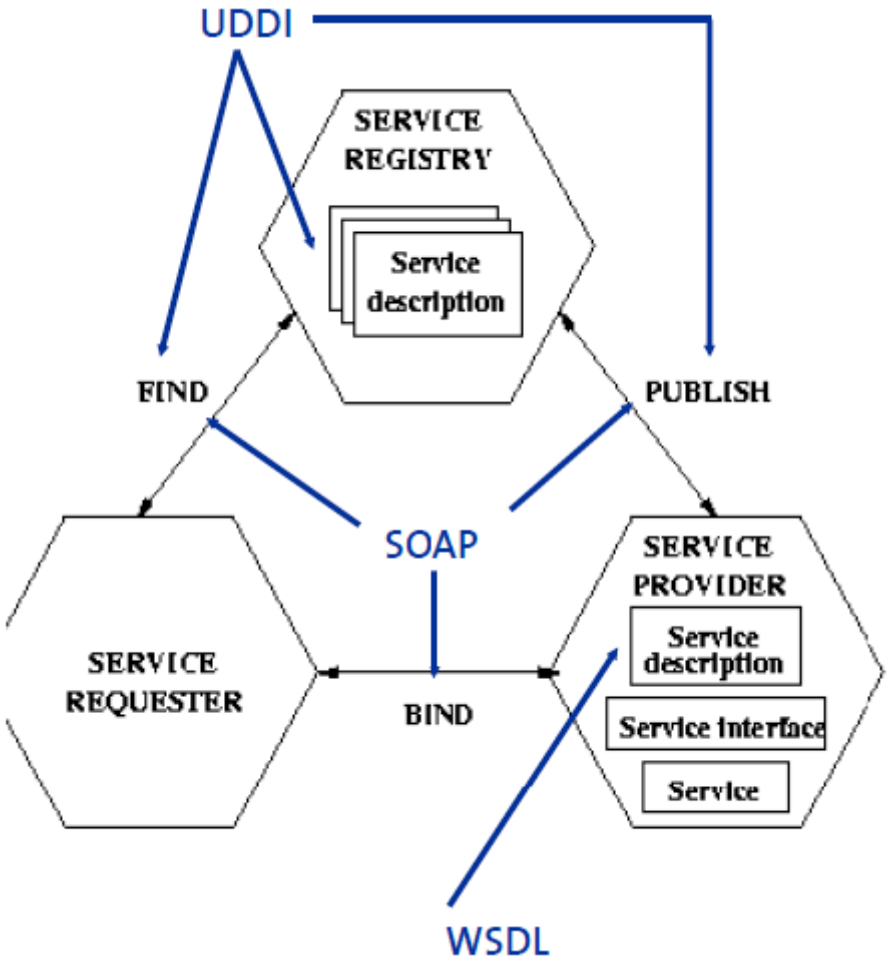
Web service architecture (2)



Main standards (1)

- The Web service architecture proposed by IBM is based on two key concepts:
  - architecture of existing synchronous middleware platforms
  - current specifications of SOAP, UDDI and WSDL
- It has a remarkable client/server flavor
- It reflects only what can be done with
  - SOAP (Simple Object Access Protocol)
  - UDDI (Universal Description and Discovery Protocol)
  - WSDL (Web Services Description Language)

Main standards (2)



WS benefits

- One important difference with conventional middleware is related to the standardization efforts at the W3C that guarantee:
  - Platform independence (Hardware, Operating System)
  - Use of existing networking infrastructure (HTTP)
  - Programming language neutrality (.NET talks with Java)
  - Portability across middleware tools of different Vendors
- Web services are “loosely coupled” components that foster software reuse
- WS technologies are composable and can be adopted incrementally

WS standards

Transport	HTTP, IIOP, SMTP, JMS		
Messaging	XML, **SOAP**		WS-Addressing
Description	XML Schema, **WSDL**		WS-Policy, SSDL
Discovery	**UDDI**		WS-MetadataExchange
Choreography	WSCL	WSCI	**WS-Coordination**
Business Processes	**WS-BPEL**	BPML	WSCDL
Stateful Resources	**WS-Resource Framework**		
Transactions	WS-CAF	**WS-Transactions** WS-Business Activities	
Reliable Messaging	**WS-Reliability**		**WS-ReliableMessaging**
Security	**WS-Security** **SAML, XACML**		WS-Trust, WS-Privacy **WS-SecureConversation**
Event Notification	WS-Notification		WS-Eventing
Management	**WSDM**		**WS-Management**
Data Access	OGSA-DAI		SDO

SOA vs WS

- Web services are about Interoperability
  - Standardization
  - Integration across heterogeneous, distributed systems
  - Service Oriented Architectures are about:
  - Large scale software design
  - Software Engineering
  - Architecture of distributed systems
- SOA is possible but more difficult without Web services
  - SOA introduces some radical changes to software:
    - Language independence (what matters is the interface)
    - Event based interaction (no longer synchronous models)
    - Message based exchanges (no RPC)
    - Composition and orchestration

Dynamic Binding

- WS Invocation Framework
  - Use WSDL to describe a service
  - Use WSIF to let the system decide what to do when the service is invoked:
    - If the call is to a local EJB then do nothing
    - If the call is to a remote EJB then use RMI
    - If the call is to a queue then use JMS
    - If the call is to a remote Web service then use SOAP and XML
- There is a single interface description, the system decides on the binding
  - This type of functionality is at the core of the notion of Service Oriented Architecture