

Introduction to the Internet and World Wide Web

Lesson 1

Instructional Objectives

- Explain what is referred to as the Internet.
- List and describe different technologies and services of the Internet
- Describe the World Wide Web.
- Describe various aspects of the World Wide Web and how it works.
- Explain how the HTTP protocol works.

1.1 What is the Internet?

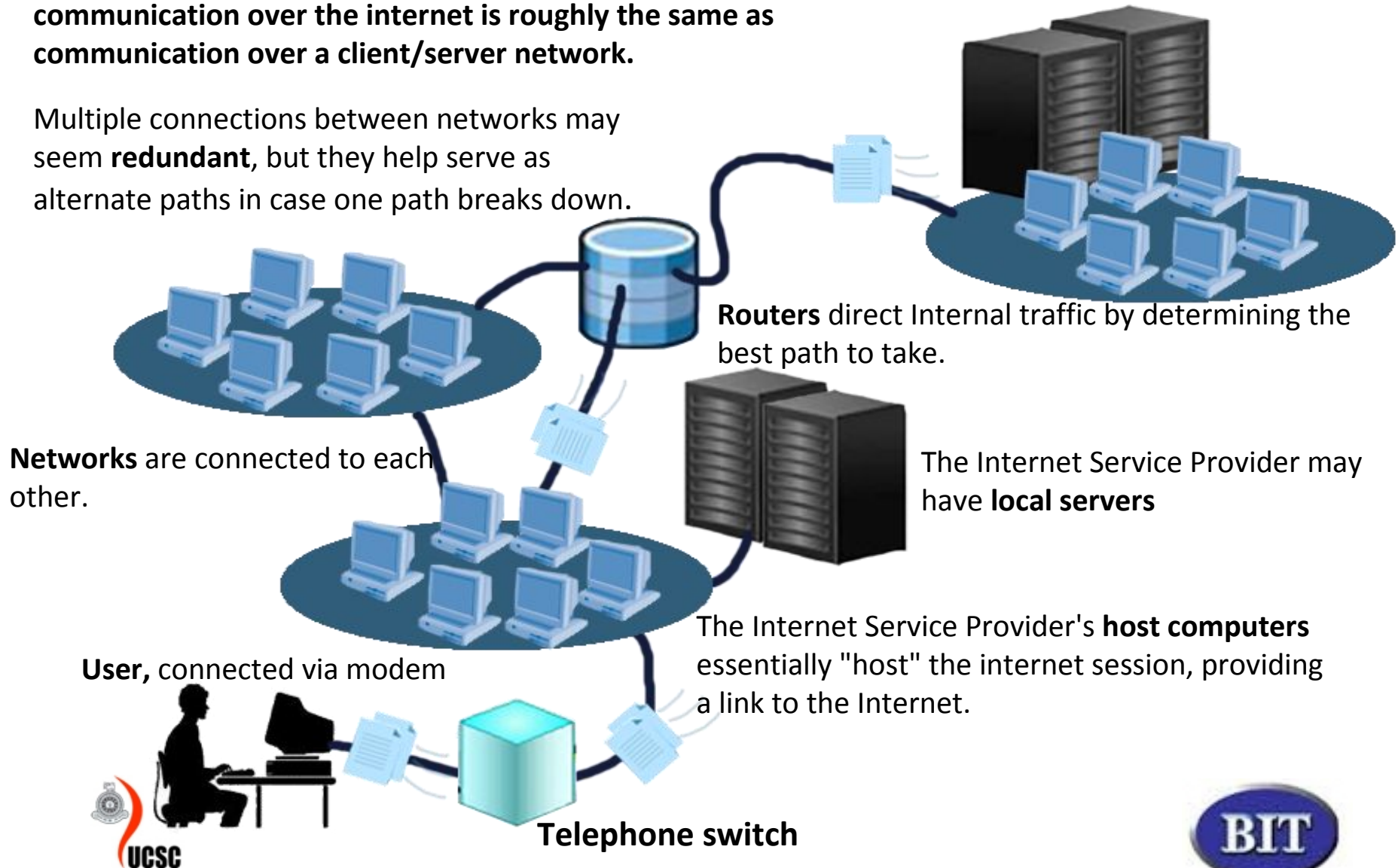
- The **Internet** is a global system of interconnected computer networks that use the standard Internet protocol suite (*TCP/IP*) to serve several billion users worldwide.
- It is a *network of networks* that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies.

1.1 What is the Internet? ...

Messages over Internet

communication over the internet is roughly the same as communication over a client/server network.

Multiple connections between networks may seem **redundant**, but they help serve as alternate paths in case one path breaks down.



1.1.1 Introduction to protocols and routing

- A **protocol** is a standard used to define a method of exchanging data over a computer network such as local area network, Internet, Intranet, etc. Each protocol has its own method of how data is formatted when sent and what to do with it once received, how that data is compressed or how to check for errors in data.
- One of the most common and known protocols is HTTP (HyperText Transfer Protocol), which is a protocol used to transmit data over the world wide web (Internet).

1.1.1 Introduction to protocols and routing

- **Routing** is the process of selecting paths in a network along which to send network traffic. Routing is performed for many kinds of networks, including the telephone network (circuit switching), electronic data networks (such as the Internet), and transportation networks. *(WIKI)*
- In internetworking, the process of moving a packet of data from source to destination.
- Routing is usually performed by a dedicated device called a router.
- Routing is a key feature of the Internet because it enables messages to pass from one computer to another and eventually reach the target machine.
- Each intermediary computer performs routing by passing along the message to the next computer. Part of this process involves analyzing a *routing table* to determine the best path.

1.1.2 Some service on the Internet

1.1.2.1 WWW

- The **World Wide Web** (abbreviated as **WWW** or **W3**, commonly known as **the web**) is a system of interlinked hypertext documents accessed via the Internet. With a web browser, one can view web pages that may contain text, images, videos, and other multimedia and navigate between them via hyperlinks.

1.1.2.2 Data transfer

- Digital data that is moved from one place to another.
- The data transfer rate (DTR) is the amount of digital data that is moved from one place to another in a given time.
- Data transfer is usually measured in bits per second. For example, a typical low-speed connection to the Internet may be 33.6 kilobits per second (Kbps).

1.1.2 Some service on the Internet

1.1.2.3 Communication

- The internet, since discovered as a powerful communication tool has grown, expanded and spread through out the world like wild fire.
- It has since become arguably the most powerful source of communication and resource.

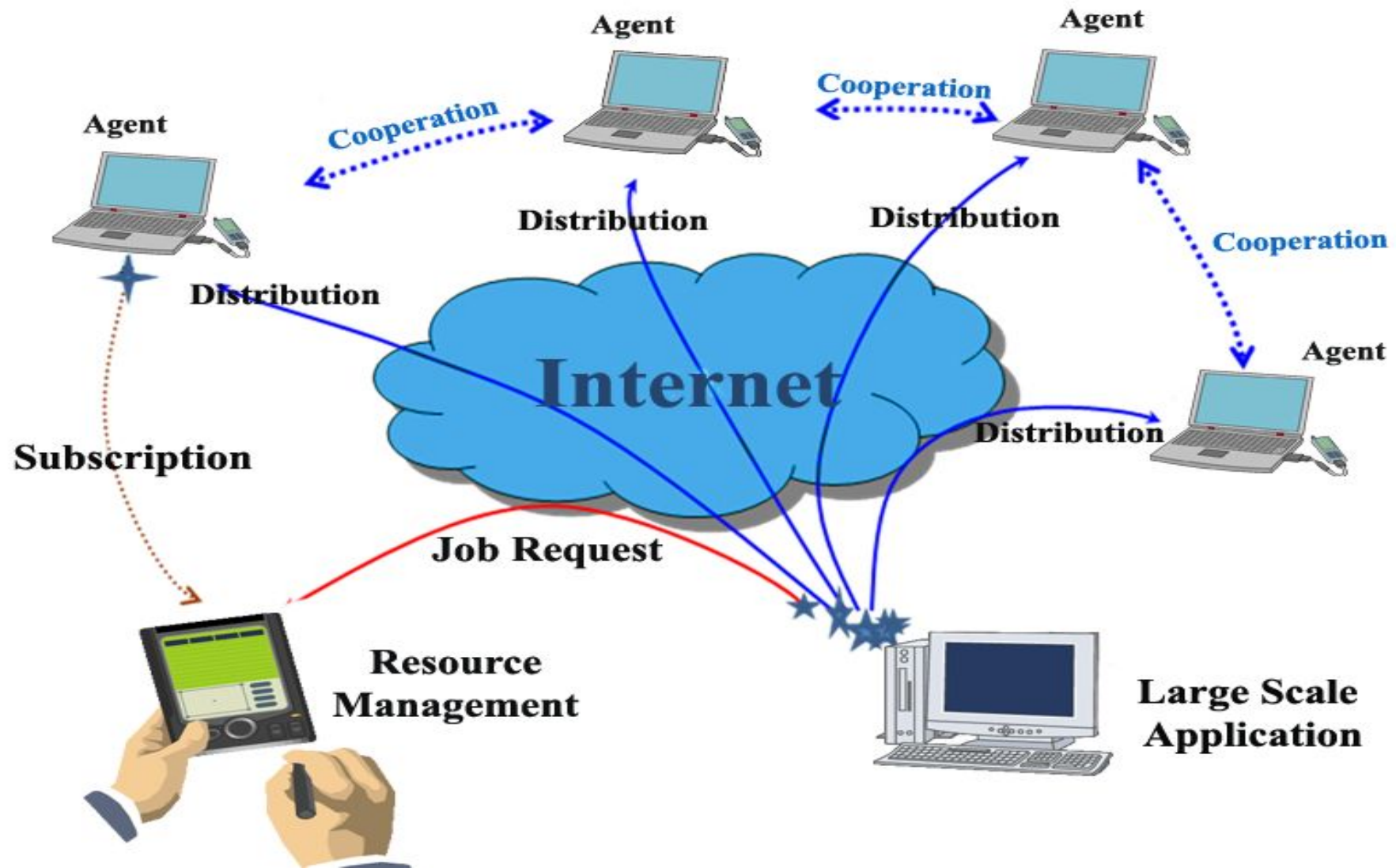
1.1.2.4 Distributed and Cloud Computing

- “ A **distributed system** consists of multiple autonomous computers that communicate through a computer network.
- “Distributed computing utilizes a network of many computers, each accomplishing a portion of an overall task, to achieve a computational result much more quickly than with a single computer.”
- “ Distributed computing is any computing that involves multiple computers remote from each other that each have a role in a computation problem or information processing.”

1.1.2.4 Distributed and Cloud Computing ...

- IT is one in which hardware or software components located at **networked computers** communicate and coordinate their actions only by **message passing**.
- In the term distributed computing, the word distributed means spread out across space.
- These networked computers may be in the same room, same campus, same country, or in different continents

1.1.2.4 Distributed and Cloud Computing ...



1.1.2.4 Cloud Computing

- Cloud Computing is a particular form of Distributed Computing which is crucially dependent on the concept of Virtualization.

1.1.3 Social aspects of the Internet

1.1.3.1 Social Networking

- A **social network** is a web site on the Internet that brings people together in a central location to talk, share ideas, share interests, make new friends, etc.
- This type of collaboration and sharing of data is often referred to as **social media**. Unlike traditional media that is often created by no more than 10 people, social media sites contain content that has been created by hundreds or even millions of different people.
- Below is a small list of some of the biggest social networks used today.

1.1.3 Social aspects of the Internet ...

1.1.3.1 Social Networking ...

- some of the biggest social networks used today are as follows;
 - **Facebook** (<http://www.facebook.com/>) - One of the most popular social networking websites on the Internet. Facebook is a popular destination for users to setup their own personal web pages, connect with friends, share pictures, share movies, talk about what you're doing, etc.
 - **LinkedIn** (<http://www.linkedin.com/>) - One of the best if not the best locations to connect with current and past co-workers and potentially future employers.
 - **Twitter** (<http://www.twitter.com/>) - Another fantastic service that allows users to post 140 character long posts from their phones and on the Internet. A fantastic way to get the pulse of what's going on around the world.
 - **YouTube** (<http://www.youtube.com/>) - A great network of users posting video blogs or Vlog's and other fun and interesting videos.

1.1.3 Social aspects of the Internet ...

1.1.3.2 e-Learning

- E-learning refers to the use of electronic media and information and communication technologies (ICT) in education. E-learning is broadly inclusive of all forms of educational technology in learning and teaching.
- E-learning is inclusive of, and is broadly synonymous with multimedia learning, technology-enhanced learning (TEL), computer-based instruction (CBI), computer-based training (CBT), computer-assisted instruction or computer-aided instruction (CAI), internet-based training (IBT), web-based training (WBT), online education, virtual education, virtual learning environments (VLE) (which are also called learning platforms), m-learning, and digital educational collaboration.
- These alternative names emphasize a particular aspect, component or delivery method.

1.1.3 Social aspects of the Internet ...

1.1.3.2 e-Learning ...

- E-learning includes numerous types of media that deliver text, audio, images, animation, and streaming video, and includes technology applications and processes such as audio or video tape, satellite TV, CD-ROM, and computer-based learning, as well as local intranet/extranet and web-based learning.
- E-learning can occur in or out of the classroom.
- It can be self-paced, asynchronous learning or may be instructor-led, synchronous learning.
- E-learning is suited to distance learning and flexible learning, but it can also be used in conjunction with face-to-face teaching, in which case the term blended learning is commonly used.

1.1.3 Social aspects of the Internet ...

1.1.3.3 e-Commerce

- Electronic commerce, commonly known as e-commerce or eCommerce, is a type of industry where the buying and selling of products or services is conducted over electronic systems such as the Internet and other computer networks.
- Electronic commerce draws on technologies such as mobile commerce, electronic funds transfer, supply chain management, Internet marketing, online transaction processing, electronic data interchange (EDI), inventory management systems, and automated data collection systems.

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1.1.3 Social aspects of the Internet ...

1.1.3.3 e-Commerce ...

- This is an effective and efficient way of communicating within an organization and one of the most effective and useful ways of conducting business.
- E-commerce can be divided into:
 - E-tailing or "virtual storefronts" on websites with online catalogs, sometimes gathered into a "virtual mall"
 - Buying or Selling on various websites and/or online marketplaces
 - The gathering and use of demographic data through Web contacts and social media
 - Electronic Data Interchange (EDI), the business-to-business exchange of data

1.1.3 Social aspects of the Internet ...

1.1.3.4 e-Governance

- The word “electronic” in the term e-Governance implies technology driven governance.
- E-Governance is the application of Information and Communication Technology (ICT) for delivering government services, exchange of information communication transactions, integration of various stand-alone systems and services between Government-to-Citizens (G2C), Government-to-Business(G2B),Government-to-Government(G2G) as well as back office processes and interactions within the entire government frame work.
- Through the e-Governance, the government services will be made available to the citizens in a convenient, efficient and transparent manner.
- The three main target groups that can be distinguished in governance concepts are Government, citizens and businesses/interest groups. In eGovernance there are no distinct boundaries.

1.1.3 Social aspects of the Internet ...

1.1.3.4 e-Governance ...

- Generally four basic models are available;
 - Government to Customer (Citizen),
 - Government to Employees,
 - Government to Government and
 - Government to Business;

1.1.3 Social aspects of the Internet ...

1.1.3.5 Telecommuting

- Telecommuting, remote work, or telework is a work arrangement in which employees do not commute to a central place of work.
- A person who telecommutes is known as a "telecommuter", "teleworker", and sometimes as a "home-sourced," or "work-at-home" employee. Many telecommuters work from home, while others, sometimes called "nomad workers", use mobile telecommunications technology to work from coffee shops or other locations which is facilitated through a broadband connection, computer or phone lines.
- According to a Reuters poll, approximately "one in five workers around the globe, particularly employees in the Middle East, Latin America and Asia, telecommute frequently and nearly 10 percent work from home every day".

1.1.3 Social aspects of the Internet ...

1.1.3.5 Telecommuting

- Telework has four dimensions in its definitional framework:
 - work location, that can be anywhere outside of centralized organizational work place
 - usage of ICTs (information and communication technologies) as technical support for telework
 - time distribution, referring to the amount of time replaced in the traditional workplace; and
 - the diversity of employment relationships between employer and employee, ranging from contract work to traditional full-time employment.

1.1.3.6 Politics and Activism

- Activism consists of efforts to promote, impede, or direct social, political, economic, or environmental change, or stasis.
- Activism can take a wide range of forms from writing letters to newspapers or politicians, political campaigning, economic activism such as boycotts or preferentially patronizing businesses, rallies, street marches, strikes, sit-ins, and hunger strikes.

1.1.3 Social aspects of the Internet ...

1.1.3.6 Politics and Activism

- With the change of social interactions and means of communication, political shifts are inevitable. Political campaigns, social movements and web revolutions are indicators that the Internet is already changing politics in terms of political communication, participation and mobilization, evoting .
- The Internet's impact on politics can be seen through the lances of political campaigns and rallies for various social issues.
- In the same way, Barack Obama used the Internet to win the 2008 Presidential elections by communicating his messages to voters over YouTube, Facebook and Twitter. Democrats succeeded in gathering millions of volunteers and small [donations through Internet campaigns](#).
- According to Dusty Trice, a democratic political consultant and new media strategist, the effectiveness of the 2012 election campaign can be measured by the number of [Facebook likes and tweets](#). It is interesting that the Internet has brought more transparency to politics, since once the information goes online, it is hardly possible to hide it or suppress its sharing.
- Hence, politicians have to be very careful about using the Internet as a tool of communication. Inferring from these observations, campaigning as a form of political participation is being transferred from streets and rallies, to social networks.

1.1.3 Social aspects of the Internet ...

1.1.3.7 Censorship

- **Internet censorship** is the [control or suppression of what can be accessed, published, or viewed](#) on the [Internet](#).
- It may be carried out by governments, private organizations at the behest of government, regulators, or on their own initiative.
- Individuals and organizations may engage in [self-censorship](#) for moral, religious, or business reasons, to conform to societal norms, due to intimidation, or out of fear of legal or other consequences.
- Opinions on the topic of Internet censorship vary, with arguments being made both for and against censorship.
- Moreover, the extent of Internet censorship varies on a country-to-country basis. While most democratic countries have moderate Internet censorship, other countries go as far as to limit the access of information such as news and suppress discussion among citizens.
- Internet censorship also occurs in response to or in anticipation of events such as elections, protests, and riots.
- Other areas of censorship includes copyrights, defamation, harassment, and obscene material.

1.2 What is the World Wide Web? ...

- It all started at CERN back in 1989.
- That is when Tim Berners-Lee wrote a proposal for a hypertext-based information management system, and distributed this proposal among the scientists at CERN.
- Robert Cailliau, who helped Berners-Lee reformat and redistribute the proposal, referring to the system as a 'World Wide Web'. By the end of 1990, Berners-Lee had implemented a server and a command-line
- Browser using the initial version of the *HyperText Transfer Protocol (HTTP)* that he designed for this system.
- By the middle of 1991, this server and browser were made available throughout CERN. Soon thereafter, the software was made available for anonymous FTP download on the Internet.
- Interest in HTTP and the Web grew, and many people downloaded the software. A newsgroup, *comp.infosystems.www*, was created to support discussion of this new technology. Just one year later, at the beginning of 1993, there were about 50 different sites running HTTP servers.

1.2 What is the World Wide Web? ...

- 1989-1990 – Tim Berners-Lee invents the World Wide Web at CERN
 - Means for transferring text and graphics simultaneously
 - Client/Server data transfer protocol
 - Communication via application level protocol
 - System ran on top of standard networking infrastructure

1.2 What is the World Wide Web? ...

- Structural Components
 - Clients/browsers – to dominant implementations
 - Servers – run on sophisticated hardware
 - Caches – many interesting implementations
 - Internet – the global infrastructure which facilitates data transfer
- Semantic Components
 - Hyper Text Transfer Protocol (HTTP)
 - Hyper Text Markup Language (HTML)
 - eXtensible Markup Language (XML)
 - Uniform Resource Identifiers (URIs)

1.3 How the Web works

- The network of web servers serves as the backbone of the World Wide Web.
- The Hypertext Transfer Protocol (HTTP) is used to gain access to the web.
- A web browser makes a request for a particular web page to the web server, which in turn responds with the requested web page and its contents. It then displays the web page as rendered by HTML or other web languages used by the page.
- Each resource on the web is identified by a globally unique identifier (URI) and each web page has a unique address, with the help of which a browser accesses it.
- With the help of the domain name system, a hierarchical naming system for computers and resources participating in the Internet, the URL is resolved into an IP address.

1.3.1 Web application architecture

- In computing, a **web-based application** is any application that uses a web browser as a client.
- The term may also mean a computer software application that is coded in a browser-supported programming language (such as JavaScript, combined with a browser-rendered markup language like HTML) and reliant on a common web browser to render the application executable.

What is Architecture

- ▶ Architecture describes structure: According to(Bassetal.1998),the architecture of a software system consists of its structures,the decomposition into components, and their interfaces and relationships. It describes both the static and the dynamic aspects of that software system, so that it can be considered a building design and flow chart for a software product.
- ▶ Architecture forms the transition from analysis to implementation: When we create architecture we try to break the functional requirements and quality requirements down into software components and their relationships and interfaces in an iterative approach. This process is supported by a number of approaches, such as the Unified Process(see Chapter10)

Developing architecture

- Primarily influenced by requirements

Functional requirement

- Clients
- Users
- Other stakeholders

Quality considerations, like

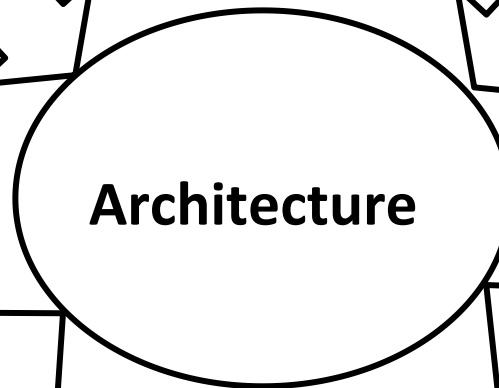
- Performance
- Scalability
- Reusability
- Other

Experience with

- Existing architecture
- Patterns
- Project Management
- Other

Technical aspects

- Operating system
- Middleware
- Legacy systems
- Other



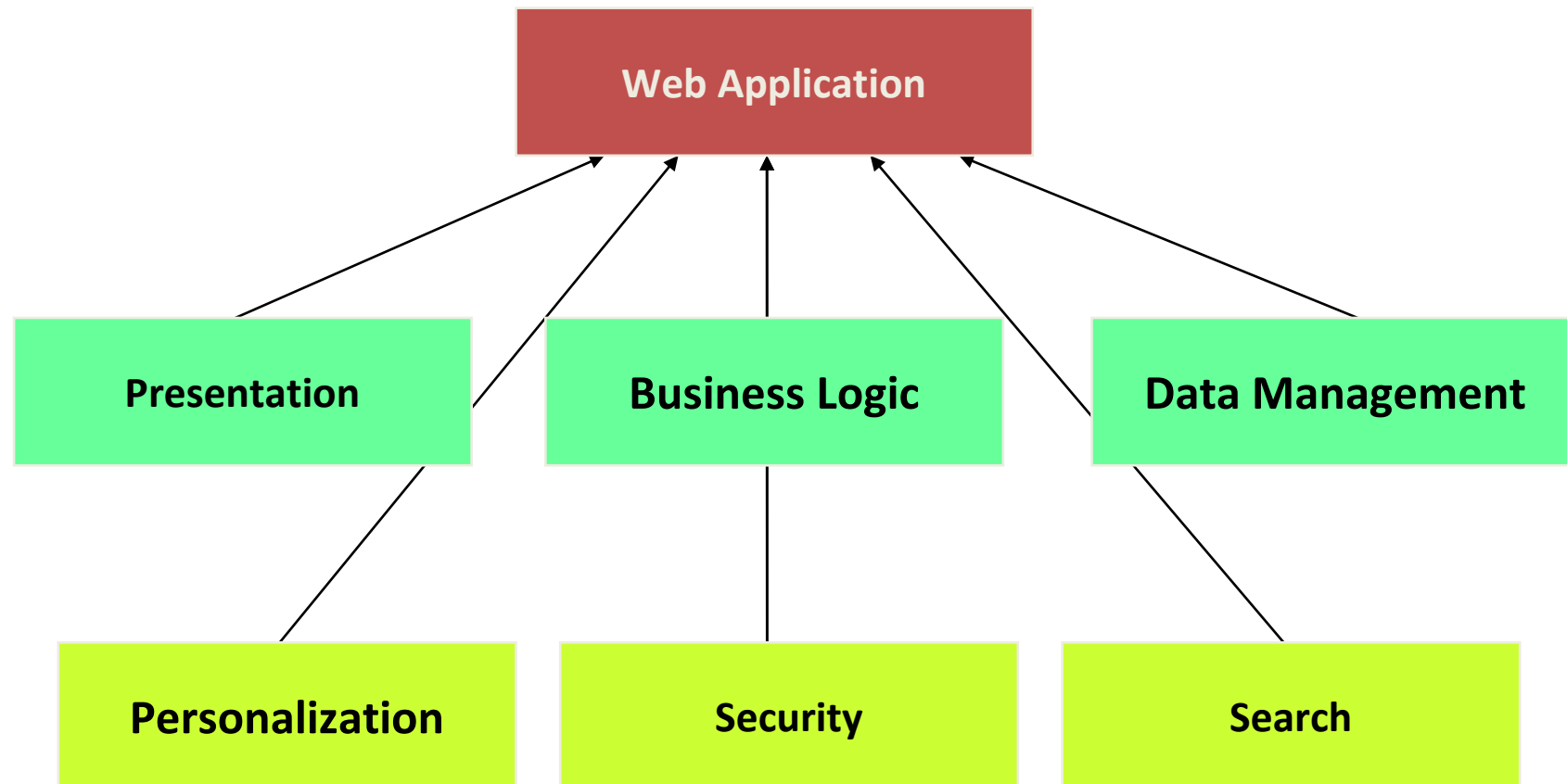
Architecture Types

- Layering Aspect
 - “Separation of concerns”
 - How many concurrent users are you serving?
 - Shared needs among multiple applications? (e.g., security)
- Data Aspect
 - What kind(s) of data are you delivering?
 - Structured vs. non-structured
 - On-demand vs. real-time
 - What are the bandwidth requirements?
 - Size & nature of data
 - Again, audience concerns

Architecture Types

- Web Platform Architecture (WPA)
 - Platform = Infrastructure
 - Hardware
 - Software modules & configurations
 - Choice of software platform (e.g., J2EE, .NET)
- Web Application Architecture (WAA)
 - Conceptual view of how key business processes and needs are separated & implemented
 - Often domain-specific
 - Greater complexity requires greater modularity

Example of a WAA

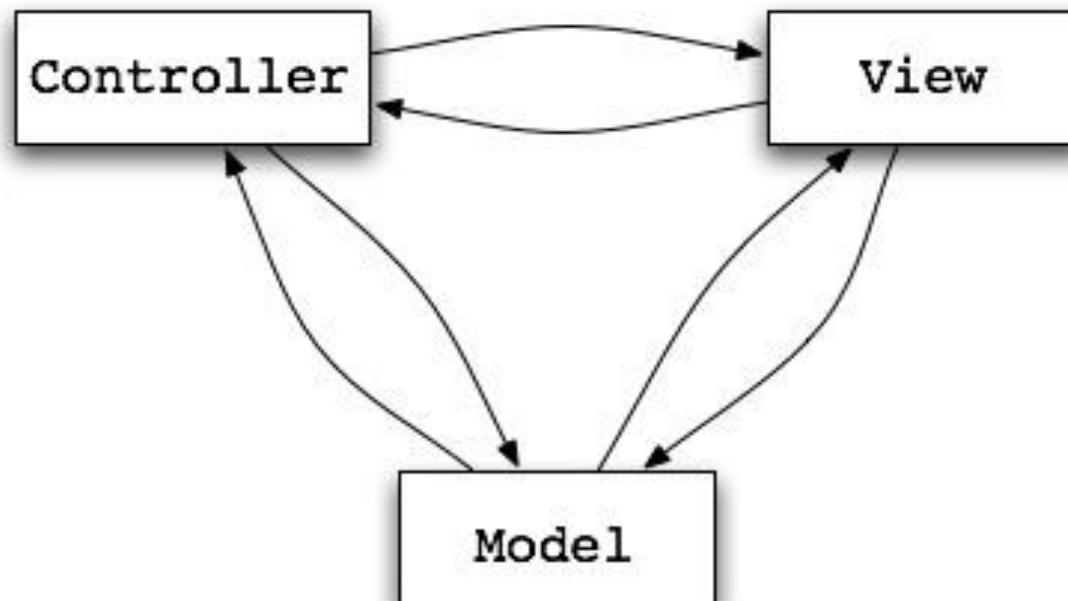


Generic Web (Platform) Architecture

- The Web “platform” is based on
 - TCP/IP
 - HTTP
 - HTML
- It’s essentially a Client/Server architecture!
 - In term of patterns one of the simplest one
- But still thing can get complex...
 - Components on the network (firewall, proxy, load balancer)
 - Components in the intranet (Web server, application server, data base, legacy systems, web services)

Model View Controller

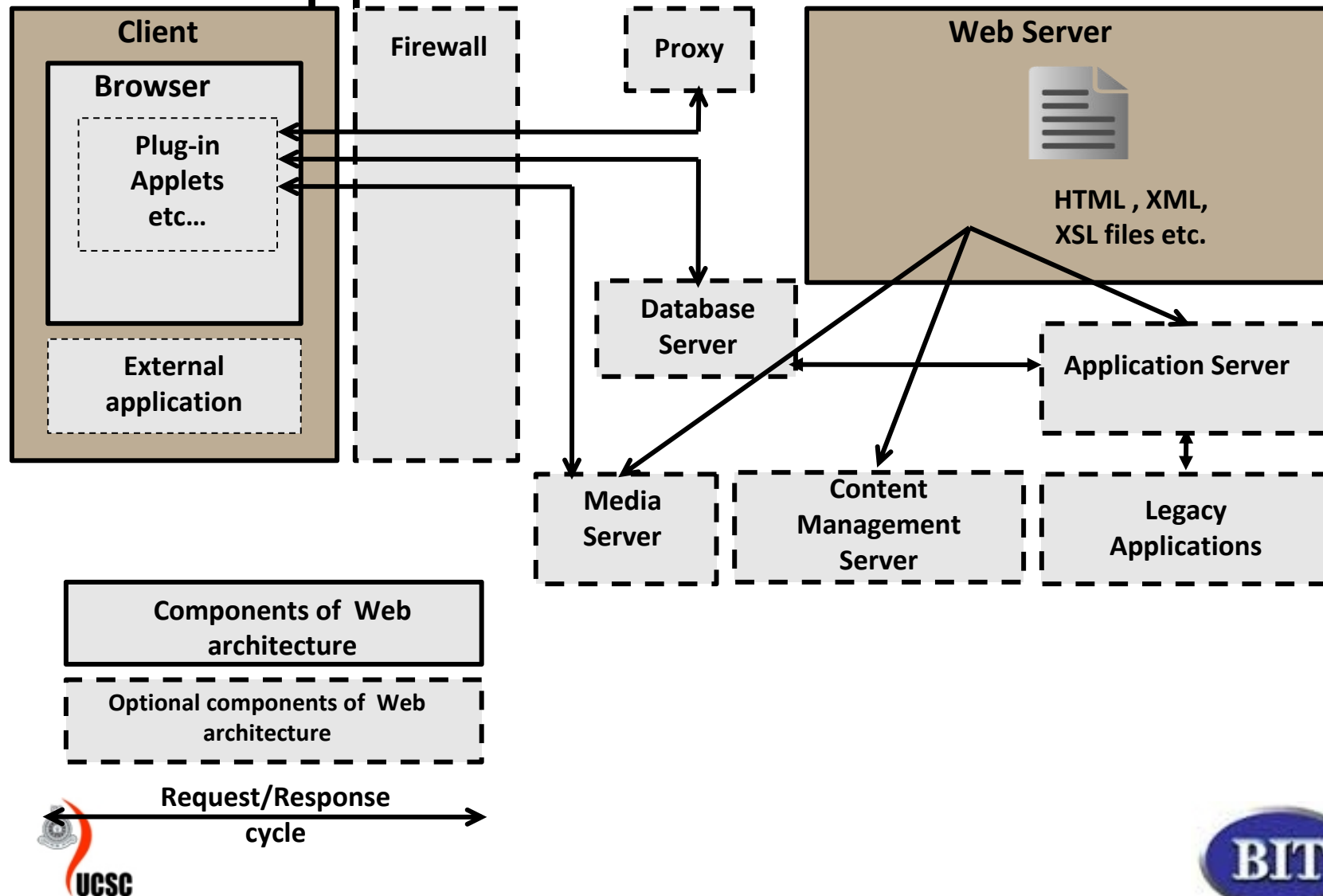
- Architectural Pattern from Smalltalk (1979)
- Decouples data and presentation
- Ease



Model View Controller

- Model
 - encapsulate application state
 - responds to state queries
 - exposes application functionality
 - notifies views of changes
- View
 - renders the models
 - requests updates from models
 - sends user interaction to controller
 - allows controller to select view
- Controller
 - defines application behavior
 - maps user actions to model updates
 - selects view for response
 - one for each functionality

Components of a Generic Web Application Architecture



Components of a Generic Web Application Architecture

- ▶ Client: Generally a browser(user agent) is controlled by a user to operate the Web application. The client's functionality can be expanded by installing plug-in sandapplets.
- ▶ Firewall: A piece of software regulating the communication between insecure networks (e.g.,the Internet)and secure networks(e.g.,corporate LANs). This communication is filtered by access rules.
- ▶ Proxy: A proxy is typically used to temporarily store Web pages in a cache. However , proxies can also assume other functionalities, e.g., adapting the contents for users (customization), or user tracking.
- ▶ Web server :A Web server is a piece of software that supports various Web protocols like HTTP and HTTPS, etc., to process client requests.
- ▶ Database server: This server normally supplies an organization's production data in structured form ,e.g., in tables.
- ▶ Media server: This component is primarily used for content streaming of non-structured bulk data(e.g.,audio or video).
- ▶ Content management server: Similar to a database server, a content management server holds contents to serve an application. These contents are normally available in the form of semi-structured data ,e.g., XML documents.
- ▶ Application server: An application server holds the functionality required by several applications, e.g., workflow or customization.
- ▶ Legacy application: A legacy application is an older system that should be integrated as an internal or external component.

Specifics of Web Application Architectures

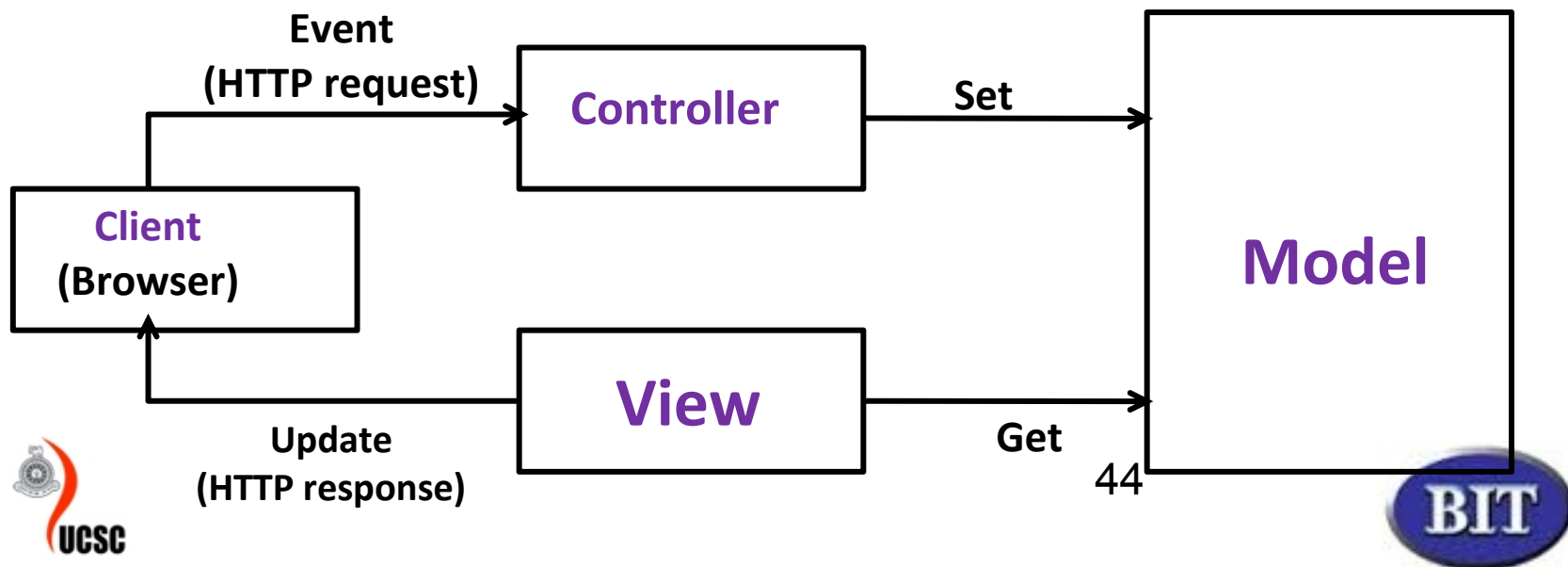
- ▶ Web app requirements are more demanding than SW systems
 - Changeability, performance, security, scalability, availability
- ▶ Thus distinguish web infrastructure (platform) and web application architecture
- ▶ Platform
- ▶ Problems
 - Using of wide range of different systems is increasingly difficult
 - Inhomogeneity (lack of uniformity)
 - Immaturity (lack of experience)

Web Architectures: Specifics

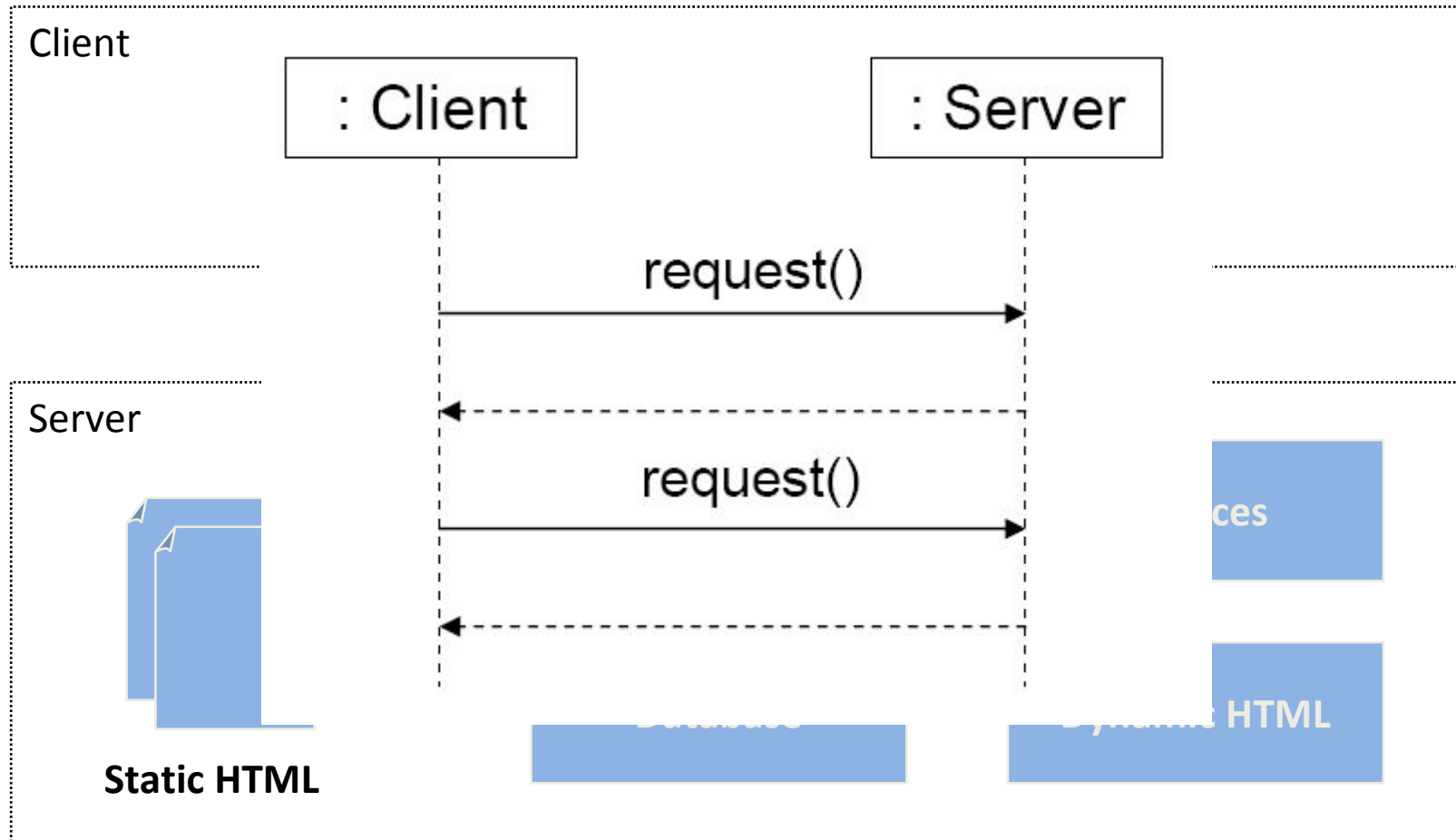
- Technological constraints
 - HTTP
- Broad variety of technical solutions
 - application servers, proxies, firewalls, legacy applications
 - checking of quality difficult
 - e.g., performance depends on various components, like database, network bandwidth, processor, memory, code, ...
 - improvement of quality difficult
 - e.g., code performance may not change overall performance substantially
- Technical solutions inhomogeneous and immature
 - short product life cycles
 - missing standards impede component integration from different manufactures
 - many solutions are open source: continuity of development, extendibility, ...
- Global access to Web applications
 - internationalization, cultural differences

Model-View-Controller 2 (MVC 2)

- **Model–view–controller (MVC)** is a software architecture pattern which separates the representation of information from the user's interaction with it.
- **Adaptation of MVC for the Web**
 - stateless connection between the client and the server
 - notification of view changes
 - re-querying the server to discover modification of application's state



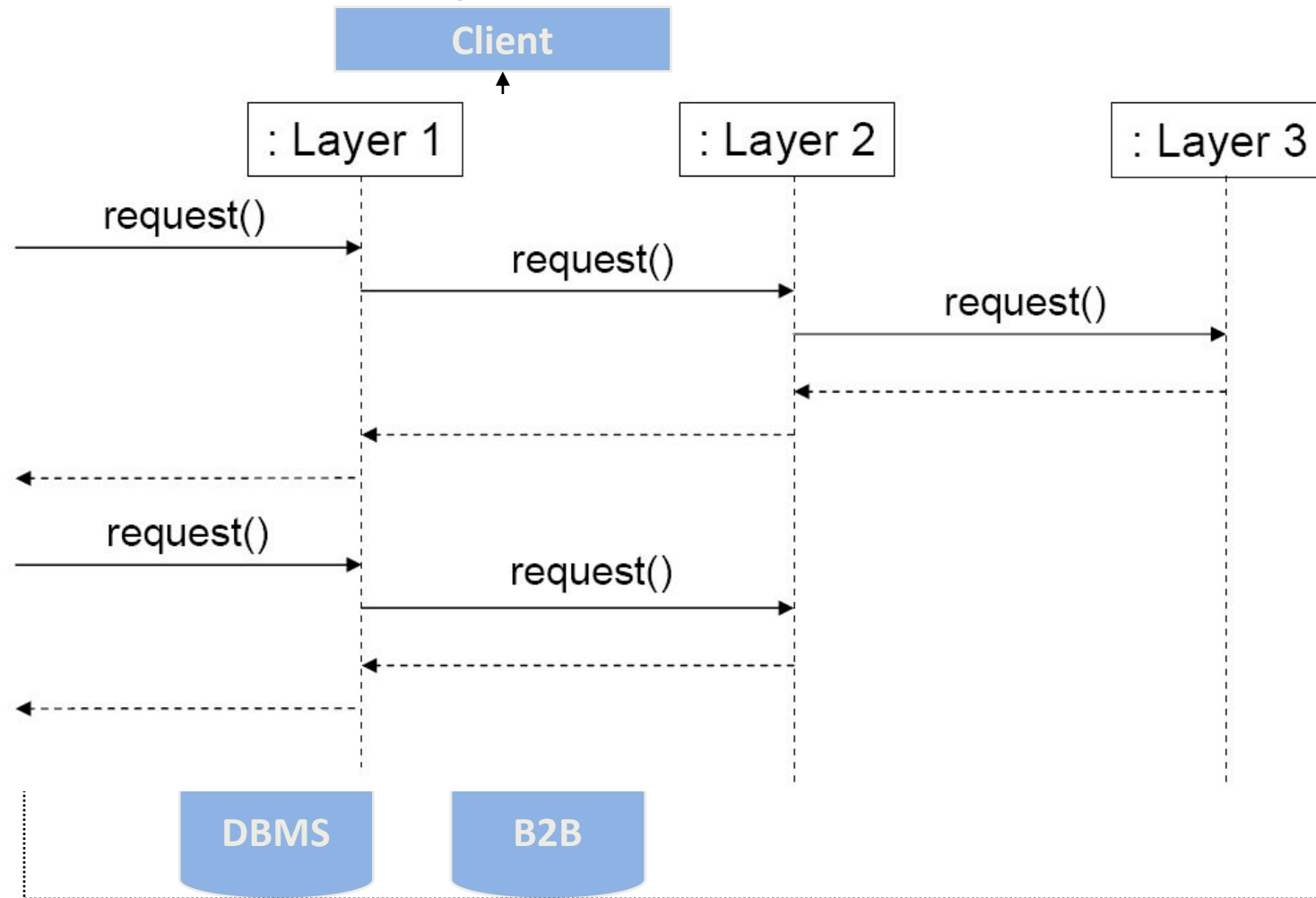
Client/Server (2-Layer)



N-tier/layer application architecture

- provides a model by which developers can create flexible and reusable applications.
- By segregating an application into tiers, developers acquire the option of modifying or adding a specific layer, instead of reworking the entire application.
- eg. A Three-tier architecture is typically composed of a presentation tier, a business or data access tier, and a data tier.
- While the concepts of layer and tier are often used interchangeably, one fairly common point of view is that there is indeed a difference.
- This view holds that a layer is a logical structuring mechanism for the elements that make up the software solution, while a tier is a physical structuring mechanism for the system infrastructure

N-Layer Architectures

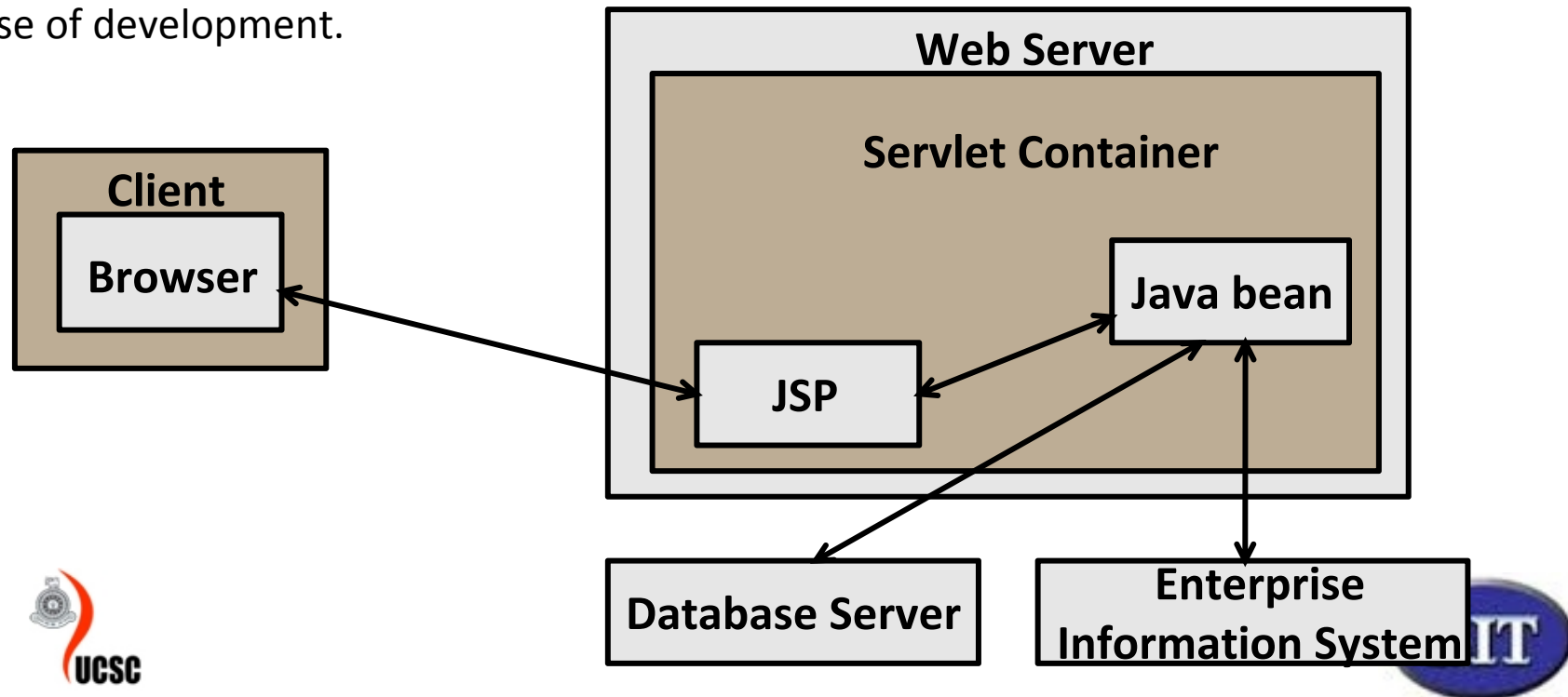


Why an N-Layer Architecture?

- Separating services in business layer promotes re-use among applications
 - Loose-coupling – changes reduce impact on overall system.
 - More maintainable (in terms of code)
 - More extensible (modular)
- Trade-offs
 - Needless complexity
 - More points of failure

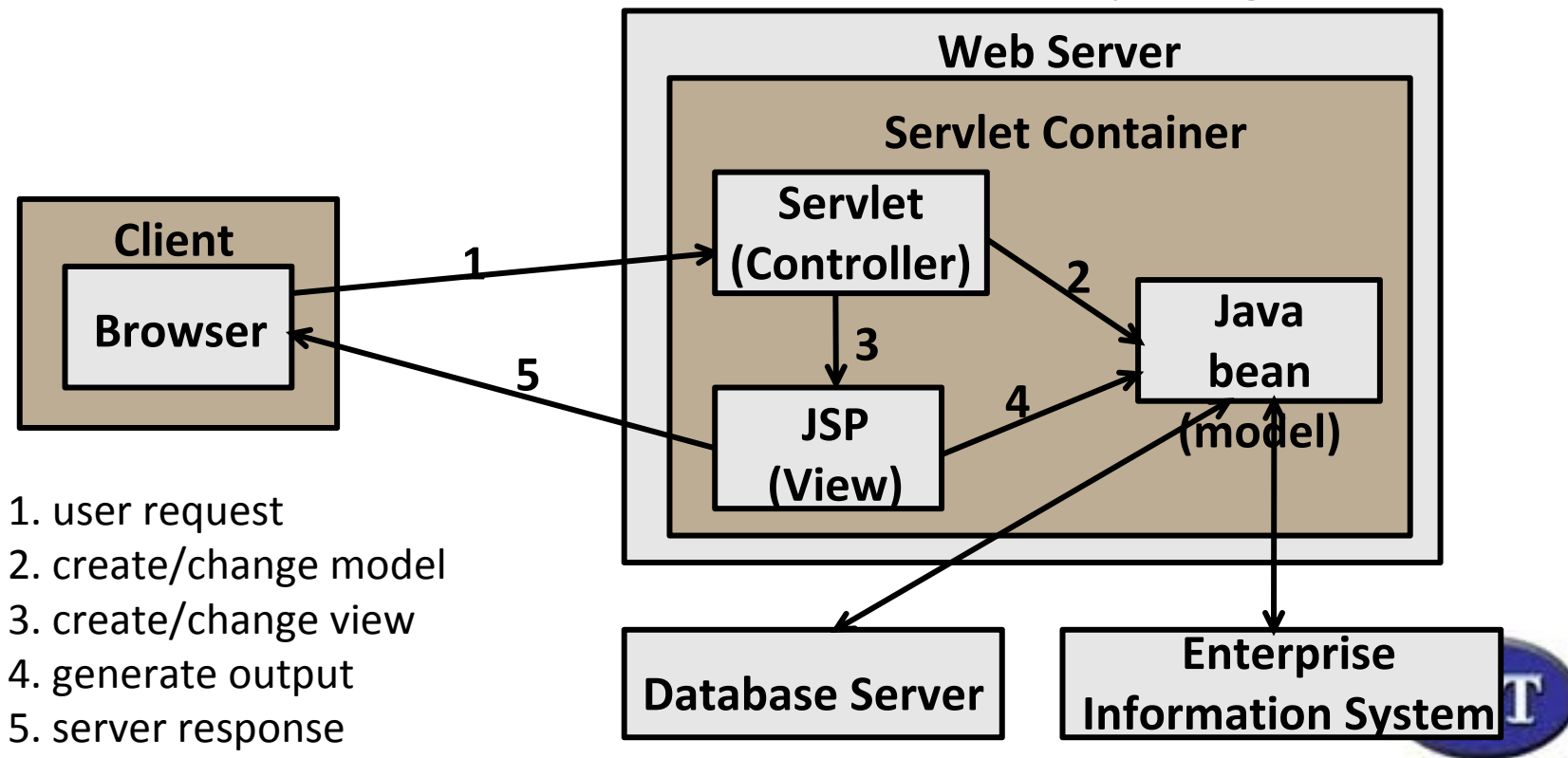
JSP-Model-1 Architecture

- In the design of Java Web applications, there are two commonly used design models, referred to as Model 1 and Model 2.
- In Model 1, a request is made to a JSP or servlet and then that JSP or servlet handles all responsibilities for the request, including processing the request, validating data, handling the business logic, and generating a response.
- The Model 1 architecture is commonly used in smaller, simple task applications due to its ease of development.



JSP-Model-2 Architecture

- Model 2 is a complex design pattern used in the design of Java Web applications which separates the display of content from the logic used to obtain and manipulate the content.
- Since Model 2 drives a separation between logic and display, it is usually associated with the Model-View-Controller (MVC) paradigm.

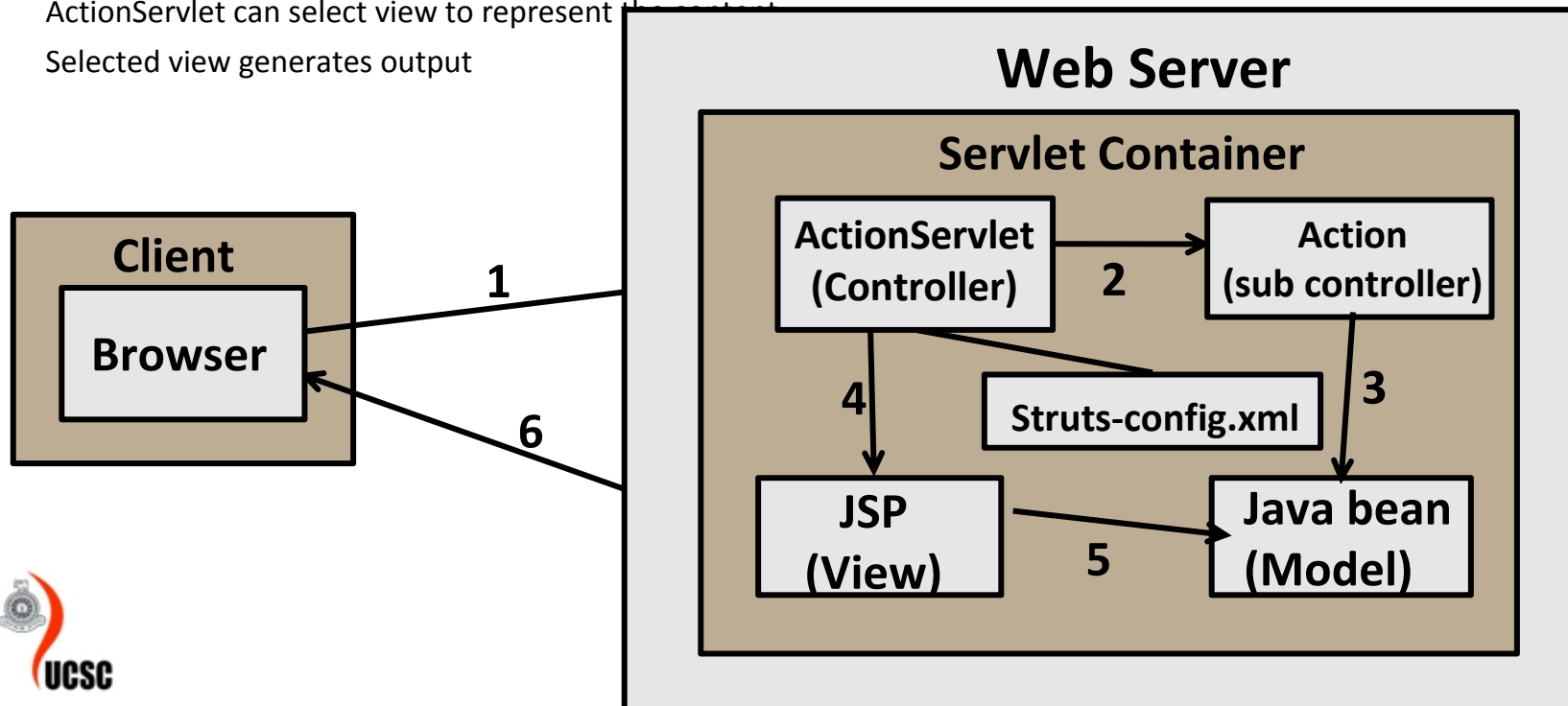


Struts

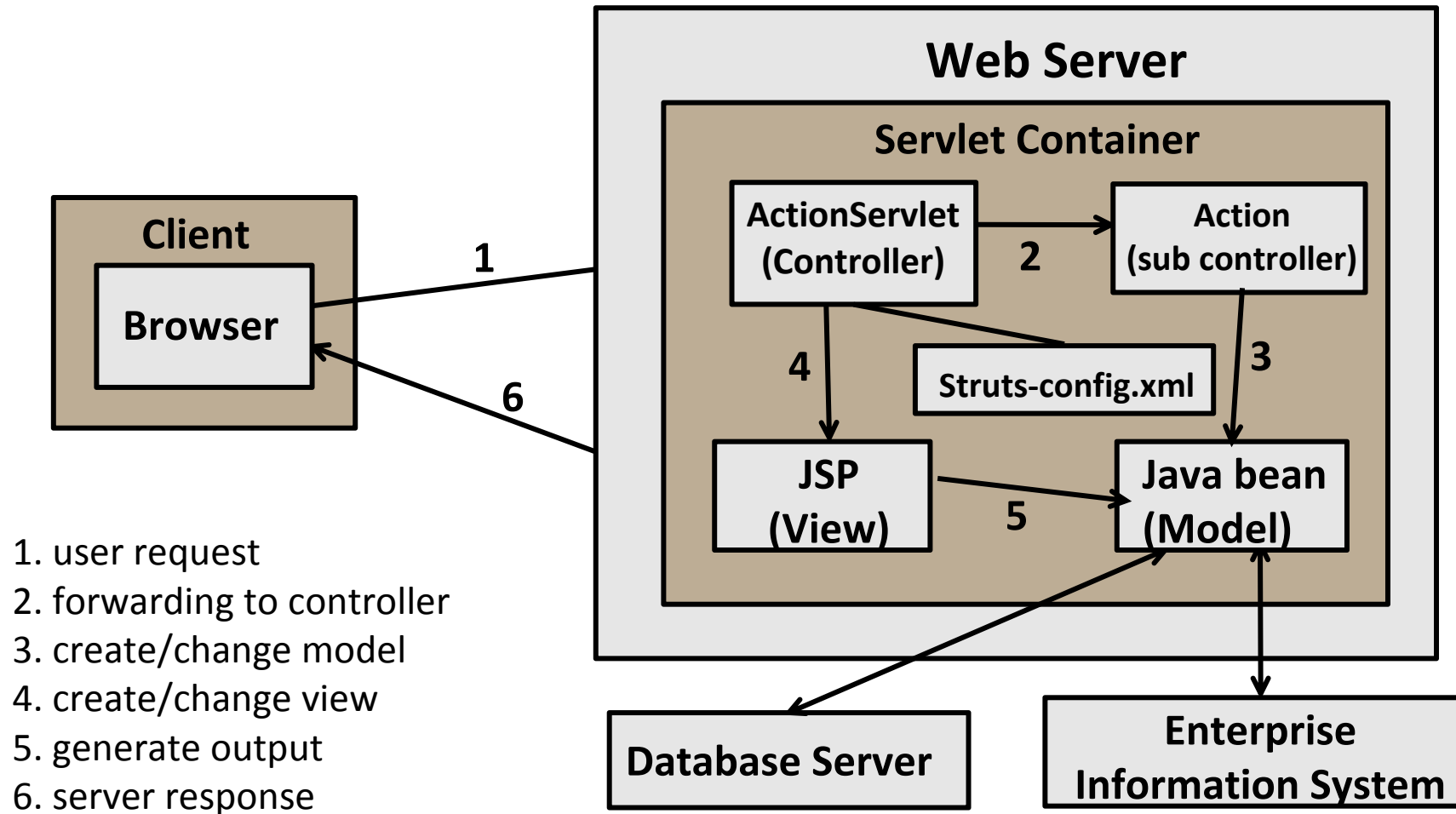
- **Apache Struts**
- Apache Struts is a free, open-source, MVC framework for creating elegant, modern Java web applications. It favors convention over configuration, is extensible using a plugin architecture, and ships with plugins to support REST, AJAX and JSON.

Struts

- ▶ Useful for error handling, internationalization
 - ▶ Uses XML configuration file
 - ▶ Control of the processing flow within the MVC pattern to **facilitate** the processing of client requests
 - ▶ **Allows to configure the view and model allocation in the configuration file.**
 - ▶ Contents can be presented more flexibly
1. Receive request and find the controller(Action) or application logic
 2. Forwarded to Action
 3. Select and create a model in the form of JavaBean
 4. ActionServlet can select view to represent the content
 5. Selected view generates output



Struts Architecture



1. user request
2. forwarding to controller
3. create/change model
4. create/change view
5. generate output
6. server response

Framework

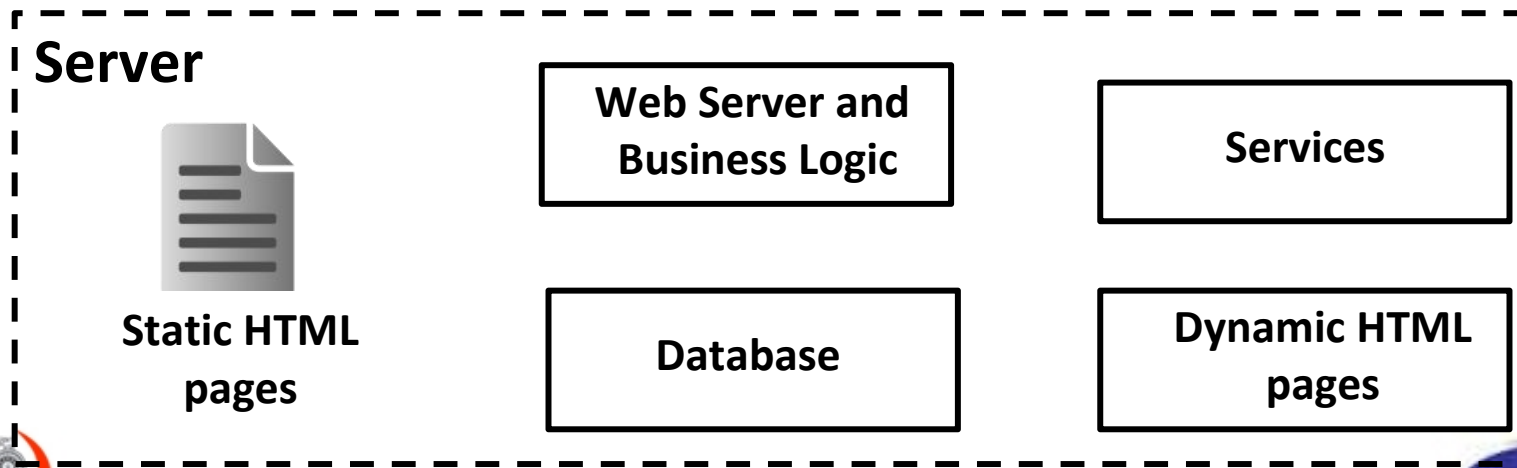
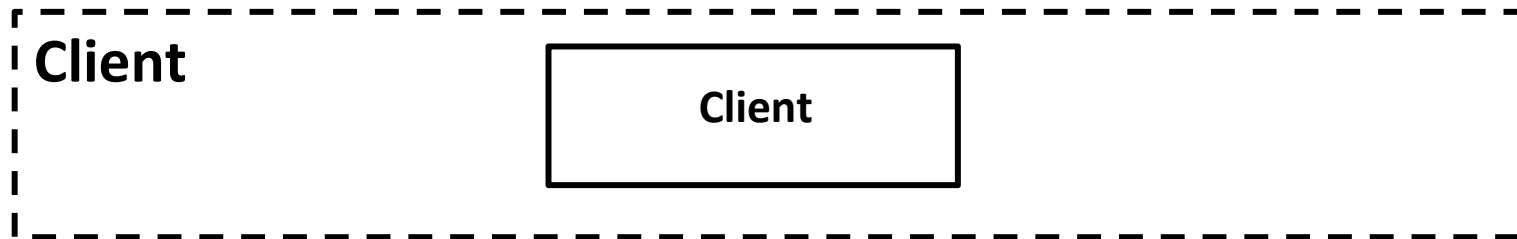
- Another option to reuse existing architecture knowledge
 - Contains architectural knowledge
- Framework is a reusable software system with general functionality already implemented.
- Have to be weighed against its disadvantage
 - High degree of training effort
 - Lack of standards
 - e.g ..

Categorizing architectures

- Layering aspect: SW systems are structured in several tiers to implement the principle of “separation of concerns”
- Data aspect: Data can be
 - Structured
 - Relational DB
 - XML
 - Non-structured
 - Multimedia contents
 - Images, audio, video

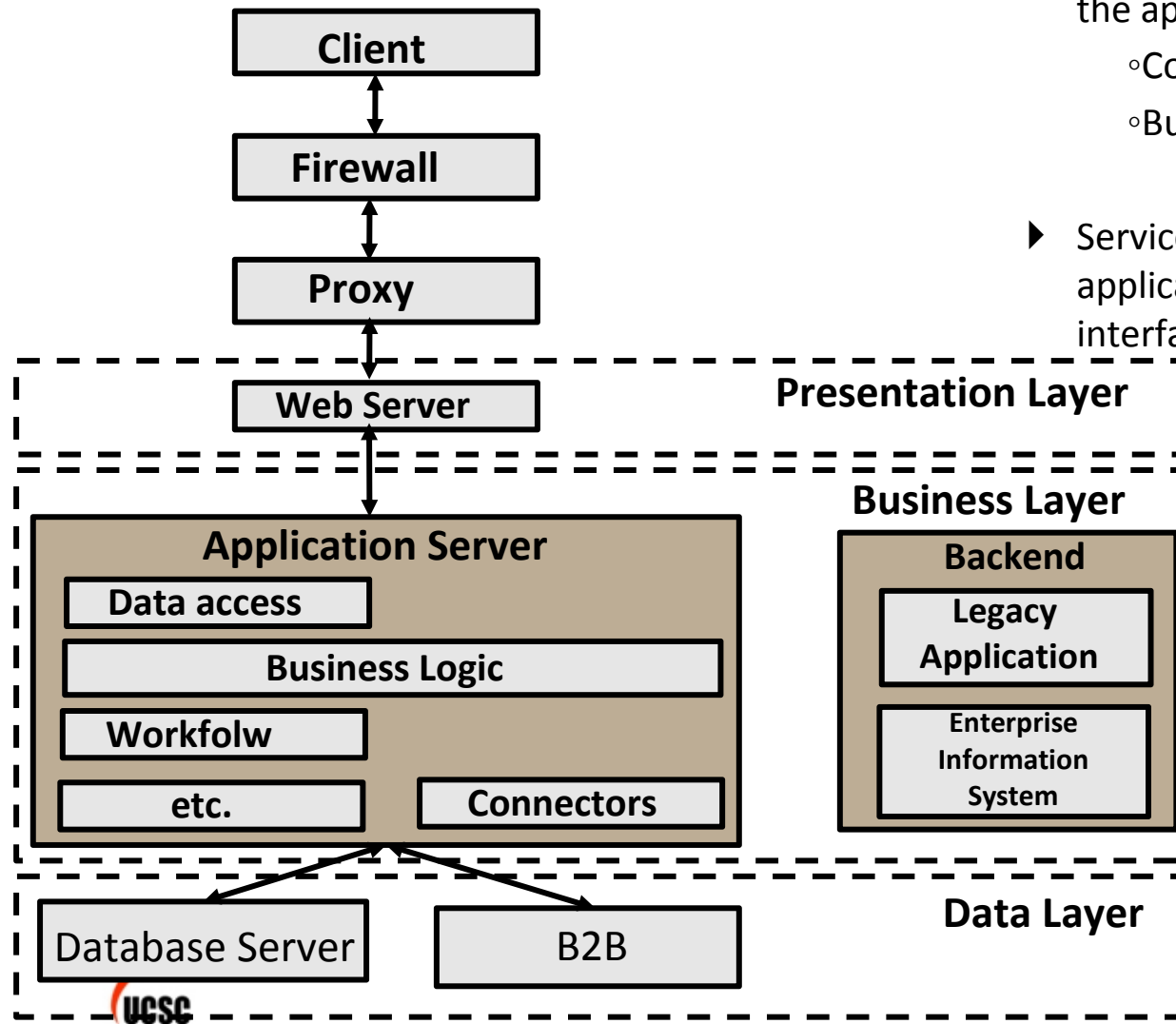
2 layered architecture

- The 2-layer architecture can take different forms with in the environment of Web applications.



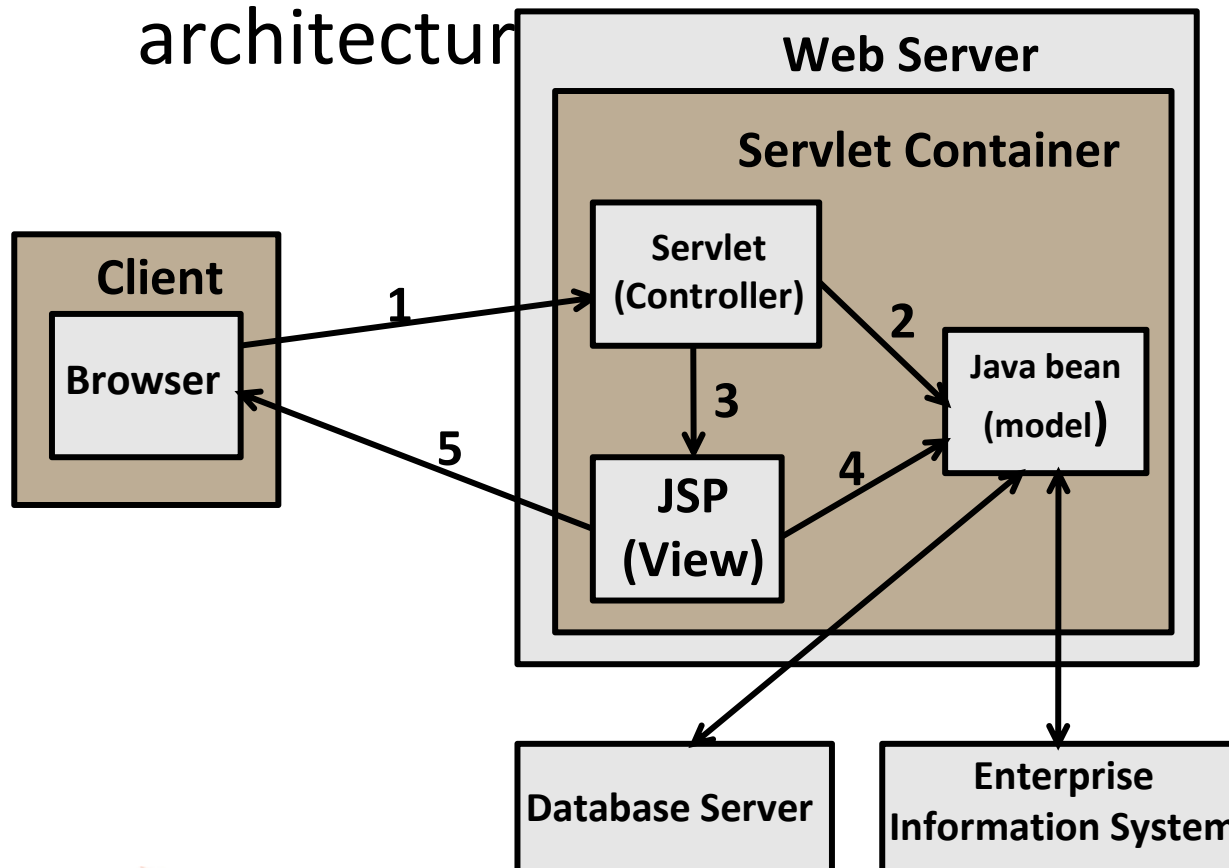
N layered architecture

- ▶ How to be embed services within the application server component
 - Costumization, workflow
 - Business logic
- ▶ Services are embedded in the application server with a defined interface



JSP model 2

- Based on MVC (Model view controller) architecture



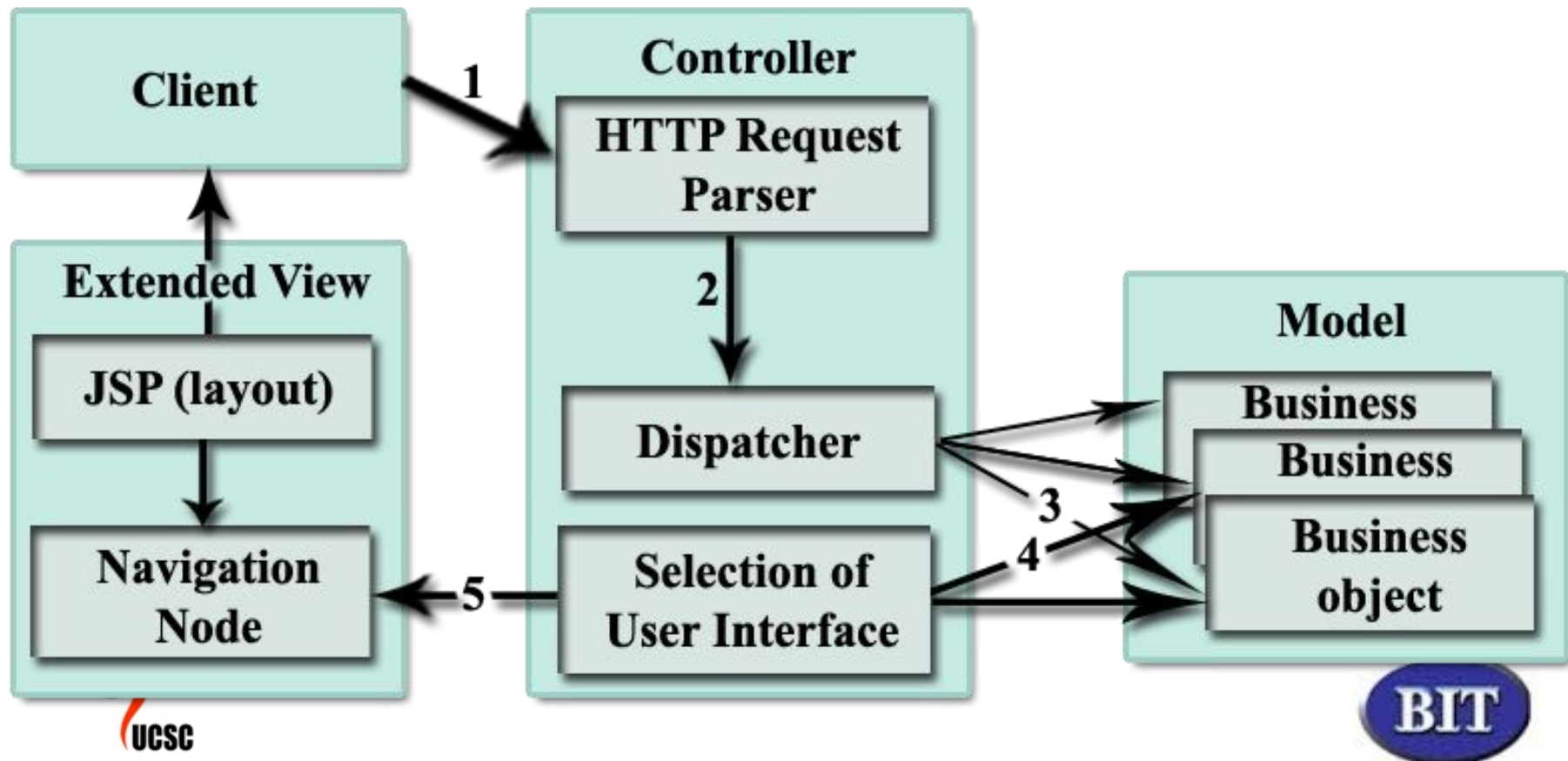
- ▶ Laying the foundation for the integration of navigation aspects, internationalization, and multi-platform delivery in Web application.
- ▶ View
 - ▶ Graphical presentation
 - ▶ JSP
- ▶ Controller
 - ▶ Flow and logic
 - ▶ Control
 - ▶ Logic(model)
 - ▶ View
- ▶ Parts of the model functionalities
 - ▶ Java bean
 - ▶ Software components

Object-Oriented Hypermedia Design Method (OOHDM)

- Based on the MVC architecture;
- Defines an architecture for implementing web applications.
- Allows separation of concerns: web designers, programmers;
- Eases maintenance and reuse;
- Covers both navigation (read-only) and fully functional applications;
- Based on the J2EE platform.
- Provides direct support for applications designed using the OOHDM approach.

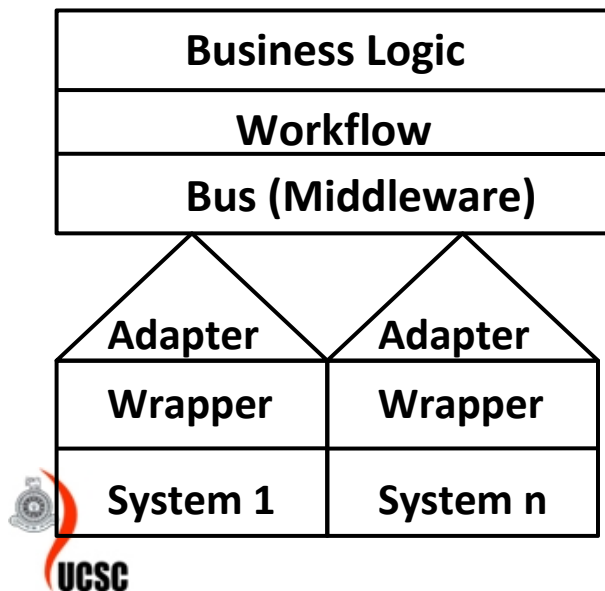
OOHDM Java 2

- Based on MVC (Model view controller) architecture
- Explicit navigation components
- User interfaces enriched by navigation aspects



Integration architecture

- ▶ Existing systems can be integrated on three levels
 - Presentation
 - Application logic
 - Content
- ▶ Key term: *Enterprise Application Integration*
 - Focuses on the integration of legacy(older) systems



- ▶ Emerged from business-to-business integration
- ▶ Point to point: exchange content to be integrated via external communication
- ▶ Data delivery: access to internal data directly (e.g., database access)
- ▶ Data integration: several applications use same data storage
- ▶ Delivery of functionalities: A legacy system allows to access functionalities (e.g., over an API)
- ▶ Reconstruction of functionalities: Access to functionalities is transparent to the client
- ▶ Porting : legacy systems are migrated onto Web platforms. replacing original

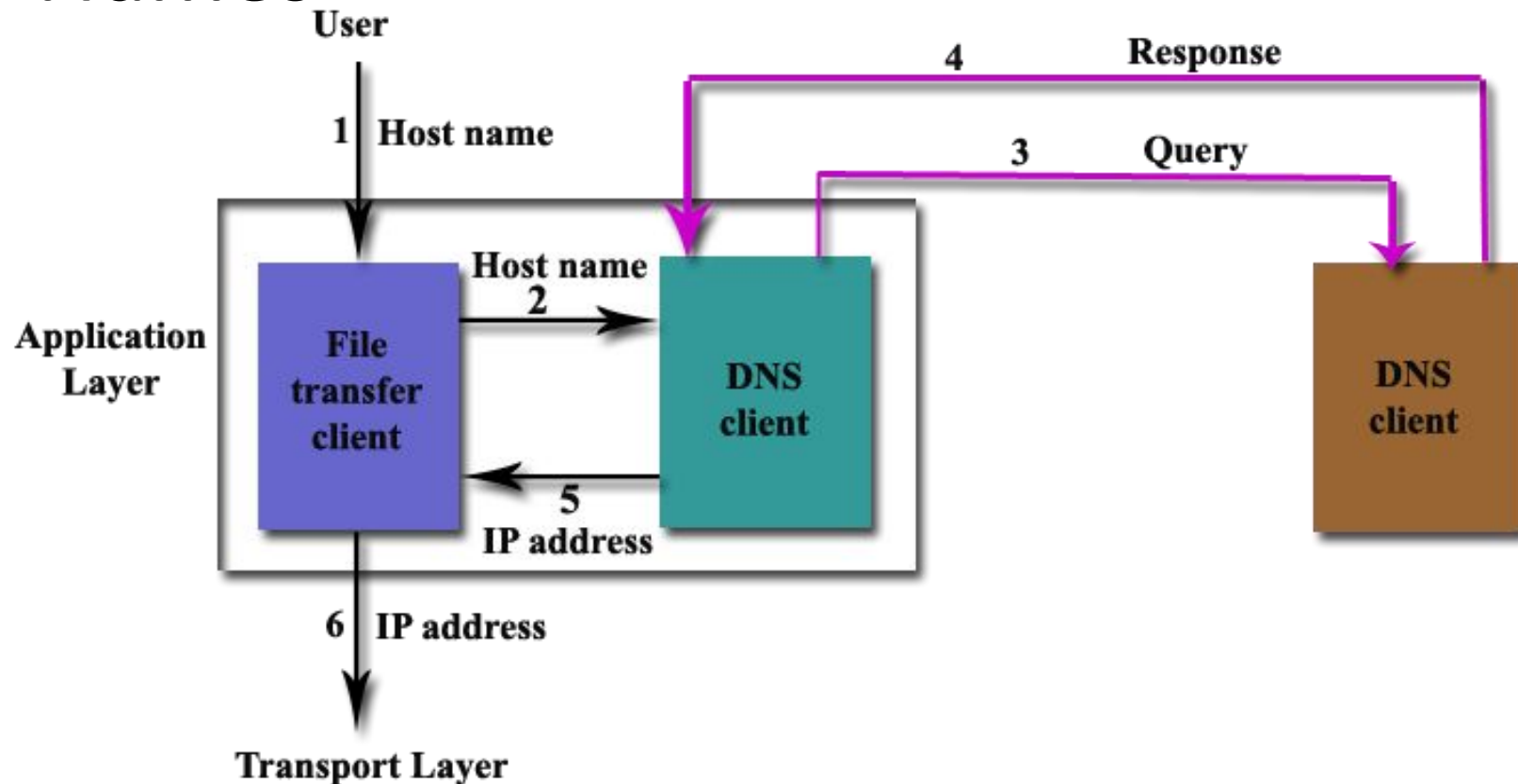
1.3.2 IP addresses and Domain

Names

- The domain name system (DNS) is an Internet-wide distributed database that translates between domain names and IP addresses
- DNS is a protocol that can be used in different platforms. In the Internet, the domain name space (tree) is divided into three different sections: generic domains, country domains, and the inverse domain
- People prefer to use easy-to-remember names instead of IP addresses
- Domain names are alphanumeric names for IP addresses e.g., neon.ece.utoronto.ca, www.google.com, ietf.org

1.3 How the Web works

1.3.2 IP addresses and Domain Names



1.3 How the Web works

1.3.2 IP addresses and Domain

Names

Label	Description
aero	Airlines and aerospace companies
biz	Business or firms (similar to “com”)
com	Commercial organization
coop	Cooperative business organization
edu	Educational institutions
gov	Government institutions
info	Information Service Providers
int	International Organizations
mil	Military groups
museum	Museums and other non profit organizations
name	Personal names(individuals)
net	Network support centers
org	Nonprofit organizations
pro	Professional individual organizations



1.3 How the Web works

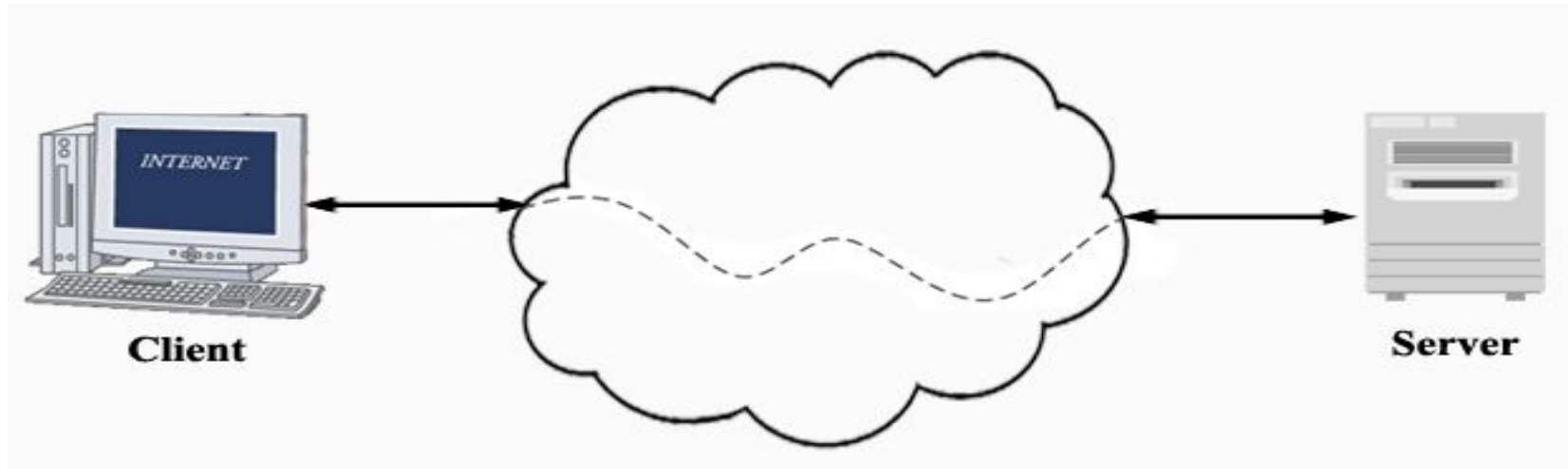
1.3.3 URL and URI

- Web resources need names/identifiers – Uniform Resource Identifiers (URIs)
 - Resource can reside anywhere on the Internet
- URIs are a somewhat abstract notion
 - A pointer to a resource to which request methods can be applied to generate potentially different responses
 - A request method is eg. fetching or changing the object
- Instance: <http://www.foo.com/index.html>
 - Protocol, server, resource
- Most popular form of a URI is the Uniform Resource Locator (URL)
 - Differences between URI and URL are beyond scope

1.3.4 The HTTP protocol and how it works

- HTTP: hypertext transfer protocol
 - The rules governing the conversation between a Web client and a Web server
- a protocol is the set of rules governing a conversation between people
- We have seen that the client and server carry on a machine-to-machine conversation
- A network protocol is the set of rules governing a conversation between a client and a server
- There are many protocols, HTTP is just one
- HTTP is the set of rules governing the format and content of the conversation between a Web client and server

HTTP is an application layer protocol



- The Web client and the Web server are application programs
- Application layer programs do useful work like retrieving Web pages, sending and receiving email or transferring files
- Lower layers take care of the communication details
- The client and server send messages and data without knowing anything about the communication network

Many application layer protocols are used on the Internet, HTTP is only one

Protocol	Application
HTTP: Hypertext Transfer	Retrieve and view Web pages
FTP: File Transfer	Copy files from client to server or from server to client
SMTP: Simple Mail Transport	Send email
POP: Post Office	Read email

The TCP/IP protocol layers

The application program is king – it gets work done using the lower level layers for communication between the client and server.

Application	Get useful work done – retrieve Web pages, copy files, send and receive email, etc.
Transport	Make client-server connections and optionally control transmission speed, check for errors, etc.
Internet	Route packets between networks
Data link	Route data packets within the local area network
Physical	Specify what medium connects two nodes, how binary ones and zeros are differentiated, etc,