

Java



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Server-side Programming

Internet

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Disclaimer

Material and Slides

Some of the material/slides are adapted from various:

- Presentations found on the internet;
- Books;
- Web sites;
- ...

Outline

Internet Concepts

World Wide Web (WWW)

Hypertext Transfer Protocol (HTTP)

Data Interchange

Web Services

Application Programming Interface (API)

Bibliography

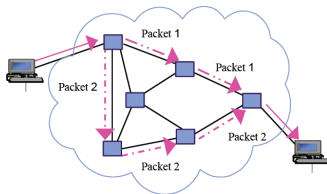
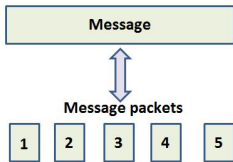
Internet Concepts

What is Internet? (I)

- The **Internet**, sometimes called simply "the Net," is a **worldwide system of computer networks**
 - A network of networks in which users at any one computer can get information from any other computer.
- It was conceived by the Advanced Research Projects Agency (ARPA) of the U.S. government in 1969 and was first known as the **ARPANet**.
- The initial purpose was to **communicate with and share computer resources** among mainly scientific users at the connected institutions
 - Create a network that would allow users of a research computer at one university to **talk to** research computers at other universities.

What is Internet? (II)

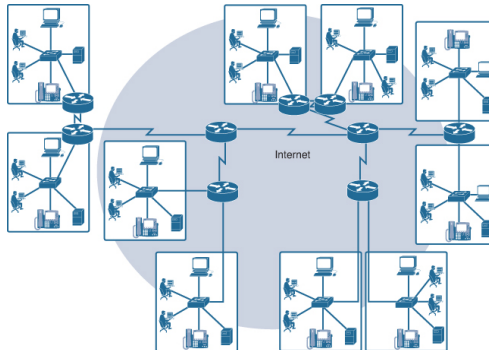
- ARPANET took advantage of the new idea of **sending information in small units called packets** that could be **routed on different paths** and reconstructed at their destination.



- A side benefit of ARPANet's design was that, because **messages could be routed or rerouted in more than one direction**, the network could continue to function even if parts of it were destroyed in the event of a military attack or other disaster.

What is Internet? (III)

- The **development of the TCP/IP protocols** in the 1970s made it possible to **expand the size of the network**, which now had become a **network of networks**, in an orderly (organized/structured) way.

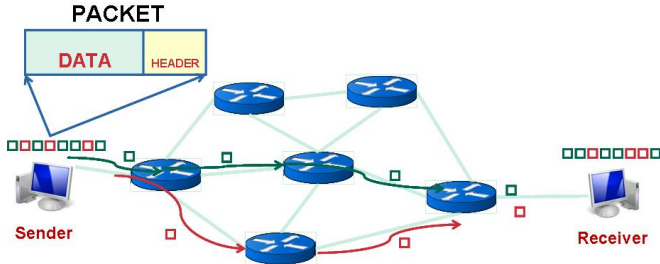


Transmission Control Protocol/Internet Protocol (TCP/IP) (I)

- The Internet is **built on the TCP/IP** family of protocols
 - What is a **network protocol**?
 - A network protocol defines rules and conventions for communication between network devices.
 - Network protocols include mechanisms for **devices to identify** and **make connections** with each other, as well as formatting rules that specify **how data is packaged into messages** sent and received.

TCP/IP (II)

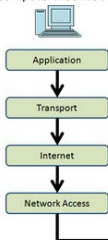
- TCP/IP is the most common **packet-switching technology**.
 - What is **packet-switching**?
 - Packet switching is the process of transmitting data in small units called as packets.



TCP/IP (III)

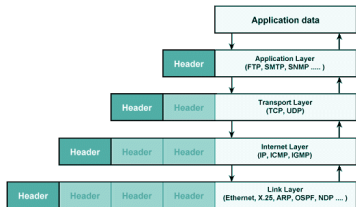
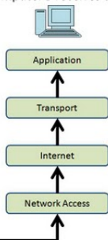
- It is a set of rules (**protocols**) governing communications among all computers on the Internet.
- More specifically, **TCP/IP dictates how information should be packaged** (turned into bundles of information called packets), sent, and received, as well as how to get to its destination.

Computer A sends data.



TCP/IP Model

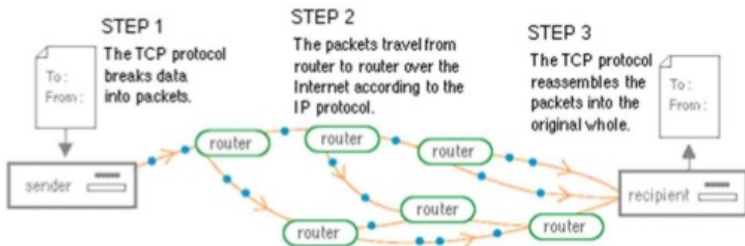
Computer B receives data.



TCP/IP (IV)

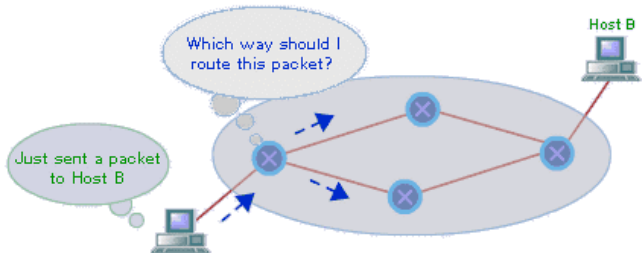
- The name TCP/IP is a **combination of two separate protocols**: Transmission Control Protocol (TCP) and Internet Protocol (IP).
 - The **IP** standard dictates the logistics of packets sent out over networks;
 - It tells packets where to go and how to get there.
 - The **TCP** is responsible for ensuring the reliable transmission of data across Internet-connected networks.
 - TCP checks packets for errors and submits requests for re-transmissions if any are found.

TCP/IP (V)



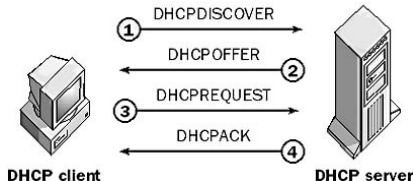
Network Connections

- Each **router** has connections to at least two networks, including its own home network.
- The router's **main function** is to **examine incoming datagrams/packets** from its own and other networks, and **send them out** again along the correct path according to the network number indicated by the each datagram's destination IP address.



What is an IP Address?

- An **IP address** allows computers to communicate with each other.
 - You can receive information, and send information, to other IP addresses - and they can send and receive information back.
- All the IP addresses together form a network.
 - Communication between devices is able to happen because IP addresses identify devices connecting with each other and allow the communication.
- Every computer provided by a network card has an IP address
 - **Static IP address**
 - **Dynamic IP address**, which means it is a temporary address.



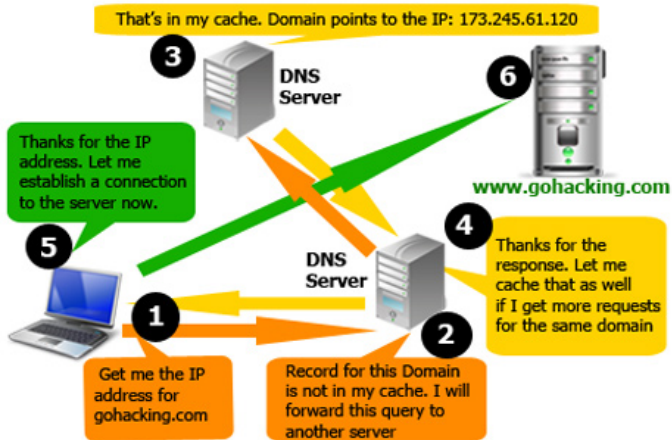
Domain Names

- Computers communicate by **IP addresses**
 - Much like you use a phone number to dial a specific person's phone.
- **Domain names** on the internet are much like entries in a phone book.
 - The phone book tells people looking for a business what the entries are just as a domain tells people (i.e. their computers) that a domain is hosted on the server.



- Without a domain you would not be able to use a domain name such as `www.gohacking.com`.

Domain Name System (DNS)

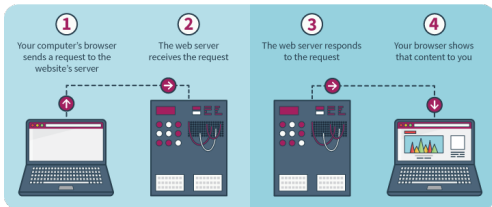


World Wide Web (WWW)

- The **World Wide Web** ("WWW" or simply the "Web") is a global information medium which users can read and write via computers connected to the Internet.
- The term is often mistakenly used as a synonym for the Internet itself, but the Web is a service that operates over the Internet, just as e-mail also does.
- The information is provided according to **HyperText Markup Language** (HTML).
- The **HyperText Transfer Protocol** (HTTP) establishes the rules to transport HTML data over Internet.

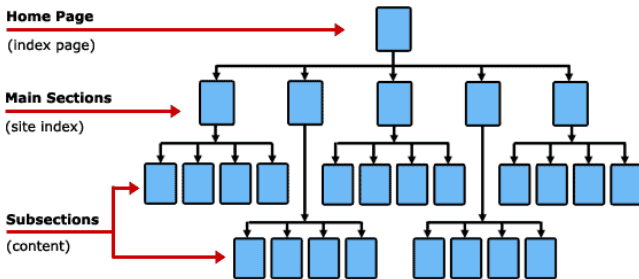
Web Hosting Servers and Web Sites

- **Web hosting** is a service that allows organizations and individuals to post a **web site** or **web page** onto the Internet.
 - A web host, or web hosting service provider, is a business that provides the technologies and services needed for the web site or web page to be viewed in the Internet.
 - **Web sites** are hosted, or stored, on special computers called **servers**.
- When Internet users want to view your web site, all they need to do is type your web site address or domain into their browser.

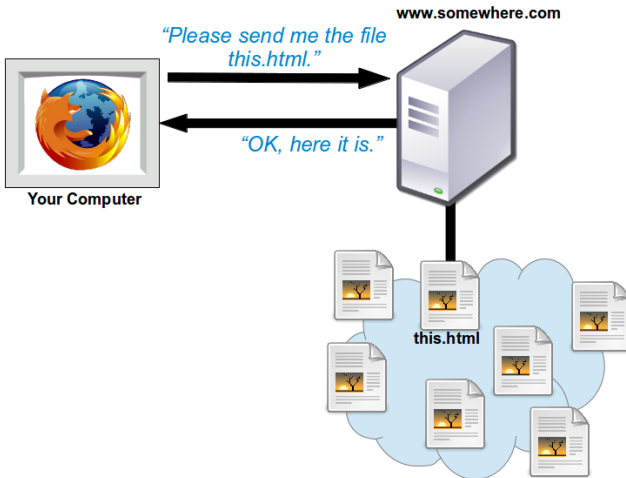


- A web site is a collection of related web pages, including multimedia content, typically identified with a common domain name, and published on at least one web server.

Basic Website Layout



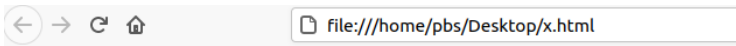
Web site (II)



Hypertext Markup Language (HTML)

- It is the standard markup language for creating web pages.

```
<html>
  <head>
  </head>
  <body>
    <h1>UPskill</h1>
    <p>
      UPskill students are very lazy. However, they are fun.
    </p>
  </body>
</html>
```



UPskill

UPskill students are very lazy. However, they are fun.

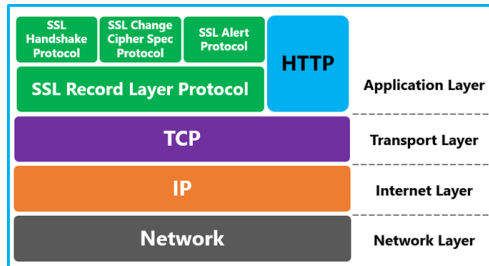
Hypertext Transfer Protocol (HTTP)

Hypertext Transfer Protocol (HTTP)(I)

- HTTP (Hypertext Transfer Protocol) is perhaps the most popular application protocol used in the Internet.

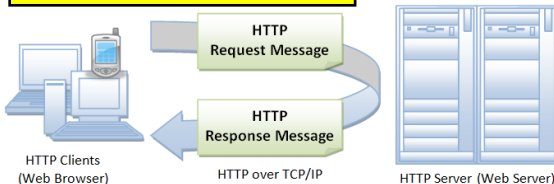


- It is an **application layer** protocol.



HTTP (II)

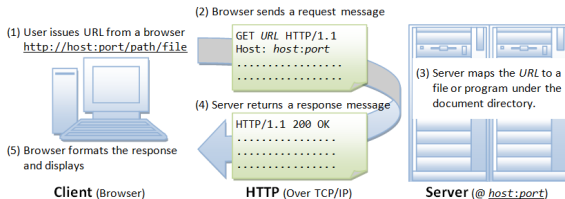
- It is an **asymmetric request-response client-server** protocol.



- A web client (web browser) sends a request message to a web server to view a web page.
- The web server receives that request and sends a response containing the web page information back to the web client.

HTTP (III)

- Whenever you issue a **Uniform Resource Locator (URL)** from your browser to get a web resource using HTTP, e.g. `http://www.nowhere123.com/index.html`, the **browser turns the URL into a request message** and sends it to the **HTTP server**.
- The **HTTP server interprets the request message**, and **returns you an appropriate response message**, which is either the resource you requested or an error message.

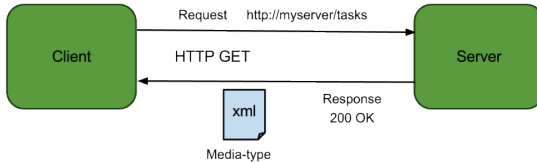


HTTP (IV)

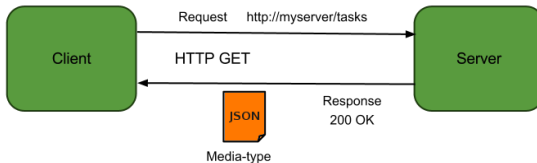
- HTTP protocol defines a set of **request methods**.
 - **GET**: A client can use the GET request to get a web resource from the server.
 - **POST**: Used to post data up to the web server (store data on the server).
 - **PUT**: Ask the server to update data stored on the server.
 - **DELETE**: Ask the server to delete the data stored on the server.
 - ...
- A web client can use one of these request methods to send a request message to an HTTP server.

Data Interchange

■ eXtensible Markup Language (XML)



■ JavaScript Object Notation (JSON)



■ The XML and JSON.

- Both are the two most common formats for data interchange in the Web today.

■ XML

```
<employees>
  <employee>
    <firstName>John</firstName>
    <lastName>Doe</lastName>
  </employee>
  <employee>
    <firstName>Anna</firstName>
    <lastName>Smith</lastName>
  </employee>
  <employee>
    <firstName>Peter</firstName>
    <lastName>Jones</lastName>
  </employee>
</employees>
```

■ JSON

```
{"employees":
 [
   { "firstName": "John", "lastName": "Doe" },
   { "firstName": "Anna", "lastName": "Smith" },
   { "firstName": "Peter", "lastName": "Jones" }
 ]
}
```

- XML, is the functional cousin to HTML.
 - Where **HTML is responsible for displaying data in a human-readable format** in a Web browser, for example, (machine-to-human)
 - **XML is responsible for representing the structure of that data before it is transported from one system to another (machine-to-machine).**
- XML is well-defined, widely supported and clearly structured.

- XML has worked and worked well in many different situations, but, in most cases, **JSON is now the preferred means of data marshalling**.
 - Marshalling is the process of transforming the memory representation of an object to a data format suitable for storage or transmission over network.
- The biggest reason that JSON is now being used over XML is that **JSON is inherently more efficient**.

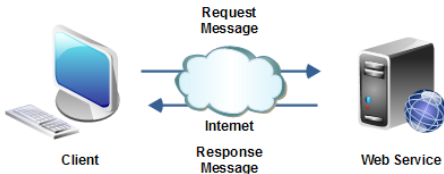
Web Services

What Are Web Services? (I)

- A **web service** is a service offered by an electronic device (such as computers) to another electronic device, communicating with each other via the World Wide Web (WWW), namely via HTTP.
 - **Web services are client and server applications that communicate over HTTP.**
- In a web service, web protocols such as HTTP, originally designed for **human-to-machine** communication, are utilized for **machine-to-machine** communication, more specifically for transferring machine readable file formats such as XML and JSON.
 - Web services **provide a standard means of interoperating** between software applications running on a variety of platforms and frameworks.

What Are Web Services? (II)

- A **web service** is a way for two machines to communicate with each other over a network.
 - A **web server** running on a computer **listens for requests** from other computers.
 - When a **request message from another computer is received**, over a network, the web service returns a **response message** with the requested resources.
 - This resource could be JSON, XML, an HTML file, Images, Audio Files, etc.

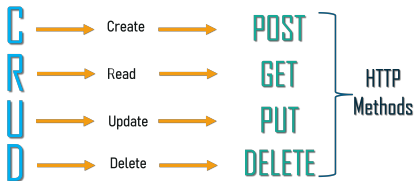


Types of Web Services

- Simple Object Access Protocol (SOAP) web services (will be no covered).
- **Representational State Transfer (RESTful)** web services.
 - REST defines a set of architectural principles:
 - Use HTTP methods explicitly.
 - Be stateless.
 - Expose directory structure-like URIs.
 - Transfer XML, JSON, or both.

RESTful Web services

- RESTful uses **HTTP methods** explicitly and in a way that's consistent with the protocol definition.
- This basic REST design principle establishes a one-to-one mapping between **Create, Read, Update, and Delete (CRUD)** operations and HTTP methods.
 - To create a resource on the server, use POST.
 - To retrieve a resource, use GET.
 - To change the state of a resource or to update it, use PUT.
 - To remove or delete a resource, use DELETE.



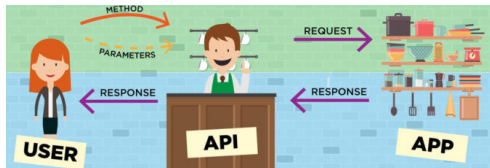
Application Programming Interface (API)

What is an API?

- An Application Programming Interface (API), is a set of definitions and protocols that allow one application to communicate with another application.



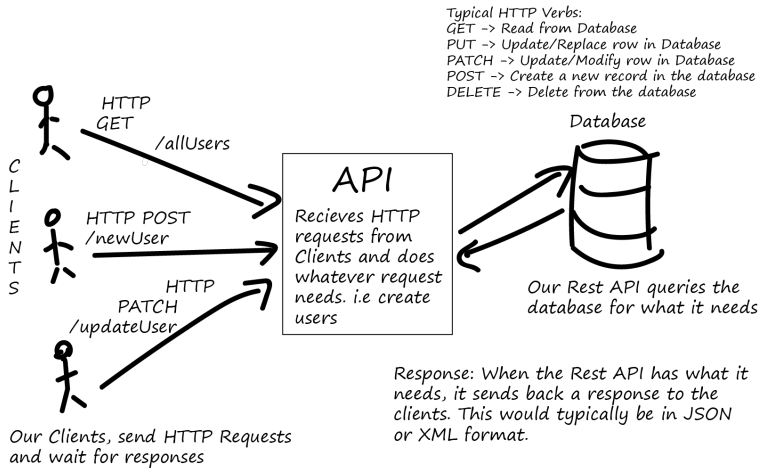
- An API is an interface that can be used to develop software that interacts with an existing application.
 - In practice, an API is **a set of functions and procedures** that allow you to access and build upon the data and functionality of an existing application.



API vs Web Service

- APIs and web services are not mutually exclusive.
- In fact, one is a subset of the other:
 - Every **web service is an API**
 - Since it exposes an application's data and/or functionality
 - But **not every API is a web service.**
- Web services require a network.
- APIs can be on- or offline
- APIs are protocol agnostic
 - APIs can use any protocols or design styles
- Web services use network protocols.

RESTful API



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