

E-Business Infrastructure

The

Internet, Web, and Mobile Platform

E-business infrastructure:

- The collection of **platforms**, networks, **products**, applications, and **databases**, **content** and the **business rules** governing the flow of data to **deliver e-business services** to employees, customers and partners (Mesenbourg)
- The methods for **publishing data and documents** accessed through **e-business applications**

Objectives

- Discuss the origins of the Internet.
- Identify the key technology concepts behind the Internet.
- Discuss the impact of the mobile platform and cloud computing.
- Describe the role of Internet protocols and utility programs.
- Explain the current structure of the Internet.
- Describe the potential capabilities of the Internet of the future.
- Understand how the Web works.
- Describe how Internet and Web features and services support e-commerce.
- Understand the impact of m-commerce applications

The Internet

What is the Internet

"Internet" refers to the **global information system** that

- i. is logically linked together by a *globally unique address space* based on the **Internet Protocol (IP)** or its subsequent extensions/follow-ons;
- ii. is able to support communications **using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite** or its subsequent extensions/follow-ons, and/or other IP-compatible protocols; and
- iii. provides, uses or makes accessible, either publicly or privately, high level **services** layered on the communications and related infrastructure

Summary: a network of networks that uses the **IP addressing scheme**, supports the **Transmission Control Protocol (TCP)**, and **makes services available** to users

Important Concepts

- Packet switching
- TCP/IP communications protocol
- Client/server computing.

Packet switching

- Messages broken down into packets
 - Include source and destination addresses and sequence number in message
 - Routed through routers:
 - special-purpose computer that interconnects the computer networks that make up the Internet and routes packets to their ultimate destination as they travel the Internet
 - Routers use routing algorithms

Reflection

- How does packet switching differ from circuit-switching?
- Explain advantages of packets switching over circuit switching

Transmission Control Protocol/Internet Protocol (TCP/IP)

TCP:

- Establishes connections among sending and receiving computers
- handles assembly and reassembly of packets

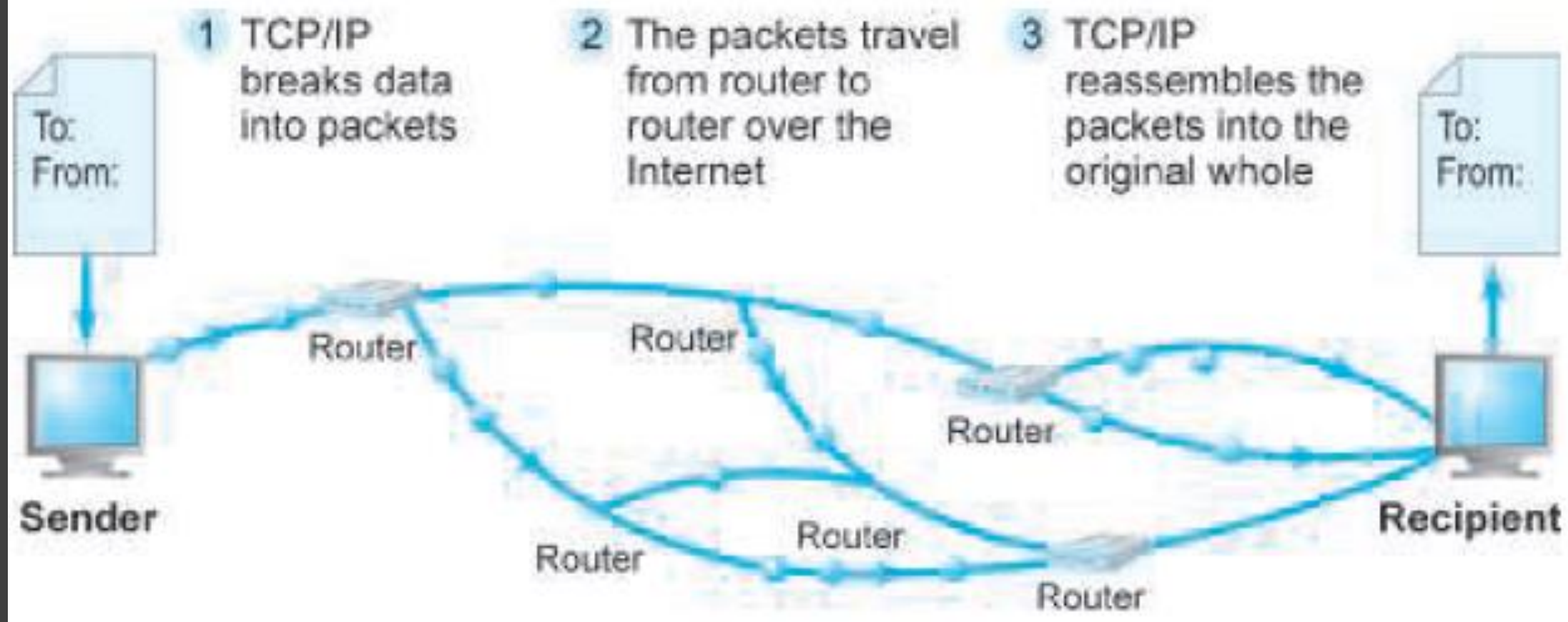
IP:

- Provides the Internet's addressing scheme and is responsible for delivery of packets

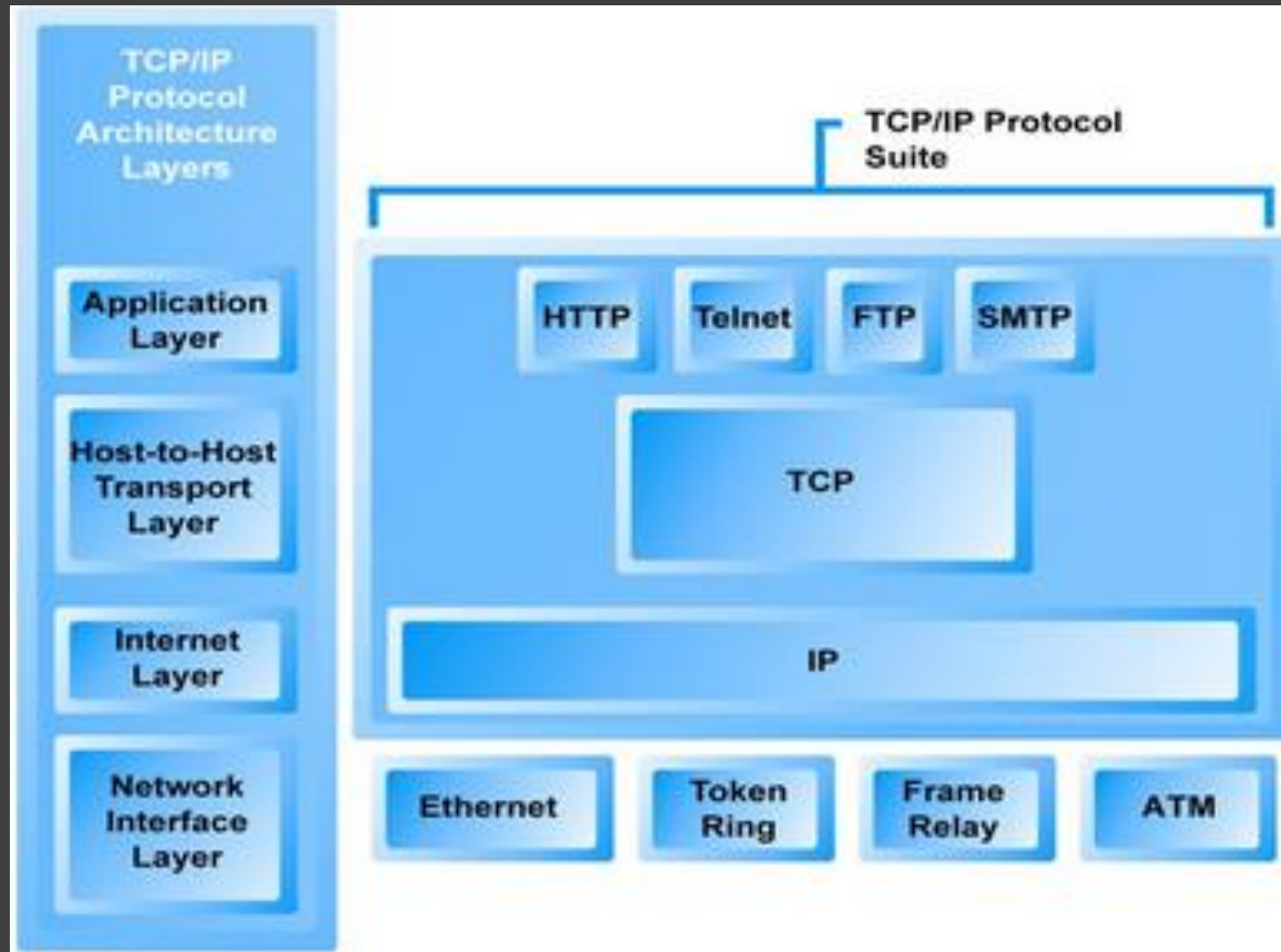
TCP/IP is divided into four separate layers, with each layer handling a different aspect of the communication problem

TCP/IP layers

1. Network Interface Layer
 - responsible for placing packets on and receiving them from the network medium
2. Internet Layer
 - responsible for addressing, packaging, and routing messages on the Internet
3. Transport Layer
 - responsible for providing communication with other protocols within TCP/IP suite
4. Application Layer
 - includes protocols used to provide user services or exchange data
 - BGP, HTTP, SMTP, FTP



TCP/IP layers



IPv4 Internet address

- Internet address expressed as a 32-bit number that appears as a series of four separate numbers marked off by periods, such as 64.49.254.91
- can support up to 2^{32} addresses

IPv6 Internet address

- Internet address expressed as a 128-bit number
- can support up to 2^{128} addresses

Domain Names, DNS, and URLs

Domain Name

- IP address expressed in natural language

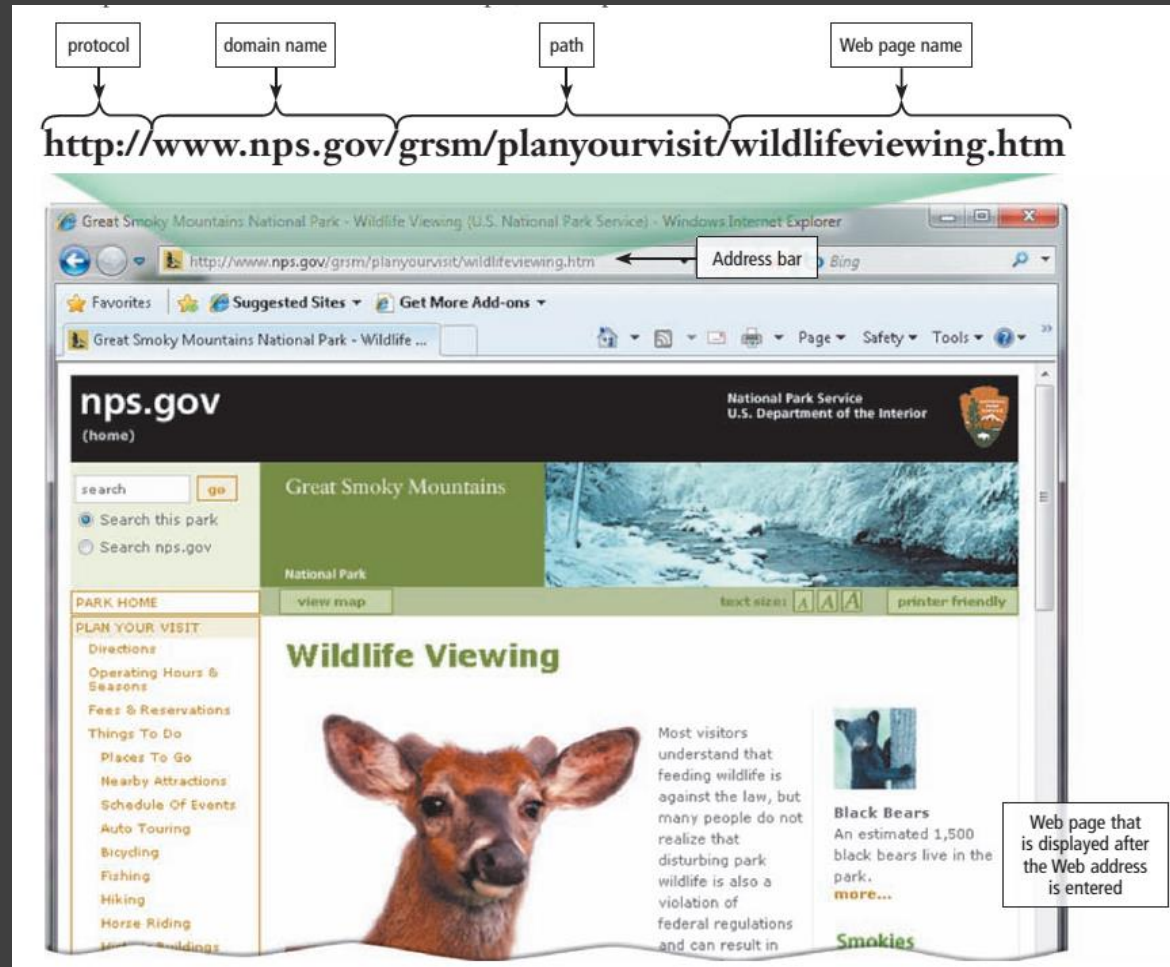
Domain Name System (DNS)

- system for expressing numeric IP addresses in natural language

Uniform Resource Locator (URL)

- the address used by a web browser to identify the location of content on the Web

Uniform Resource Locator (URL)



Evolution of the Internet

The history of the Internet can be segmented into three phases:

1. Innovation phase (*1961 to 1974*)
2. Institutionalization phase (*1975 to 1995*)
3. Commercialization phase (*1995 to present*)

Innovation phase

- Development of fundamental building blocks of the Internet:
 - packet-switching hardware
 - communications protocol called TCP/ IP
 - client/server computing

Institutionalization phase

- Implementation in government-supported demonstration projects and government departments
 - U.S. Department of Defense (DoD)
 - National Science Foundation (NSF)

Commercialization phase

- Increased investment by private companies to bring the Internet to millions of people worldwide

The Mobile platform

- The primary platform for e-business products and services is also changing to a mobile platform
- Smartphones are a disruptive technology
- Influences how, where, and when consumers shop and buy.

THE INTERNET “CLOUD COMPUTING” MODEL:

HARDWARE AND SOFTWARE AS A SERVICE

Cloud Computing: Definition

- A model of computing in which computer **processing**, **storage**, **software**, and **other services** are provided as a *shared pool of virtualized resources* over the Internet.

Cloud Computing: Essential Characteristics

- **On-demand self-service:**
 - Consumers can obtain computing capabilities such as server time or network storage as needed automatically on their own.
- **Ubiquitous network access:**
 - Cloud resources can be accessed using standard network and Internet devices, including mobile platforms.
- **Location-independent resource pooling:**
 - Computing resources are pooled to serve multiple users, with different virtual resources dynamically assigned according to user demand.
 - The user generally does not know where the computing resources are located.
- **Rapid elasticity:**
 - Computing resources can be rapidly provisioned, increased, or decreased to meet changing user demand.
- **Measured service:**
 - Charges for cloud resources are based on the amount of resources actually used.

Cloud Computing: Types of Services

Cloud computing consists of **three basic types of services**:

1. Infrastructure as a service (IaaS):

- Customers use **processing, storage, networking, and other computing resources from third-party providers** called cloud service providers (CSPs) to run their information systems.
 - **Example:** Amazon Web Services (AWS)

2. Software as a service (SaaS):

- Customers **use software hosted by the vendor on the vendor's cloud infrastructure** and delivered as a service over a network
 - **Example:** Google Apps

3. Platform as a service (PaaS):

- Customers **use infrastructure and programming tools supported by cloud service providers to develop their own applications**
 - **Example:** IBM Bluemix for software development and testing

Cloud Models

A cloud can be private, public, or hybrid

- Public cloud
 - third-party service providers that own and manage large, scalable data centers that offer computing, data storage, and high speed Internet **to multiple customers who pay for only the resources they use**
 - **Examples:** Google Drive, Dropbox, and Apple iCloud
- Private cloud
 - provides similar options as public cloud but only to a **single tenant**
 - might be managed by the organization or a third party
 - hosted either internally or externally
- Hybrid cloud
 - offers customers both a public cloud and a private cloud

Reflections!

Discuss factors influencing choices between the three models of cloud computing

What are the implications of cloud computing on e-business?

OTHER INTERNET PROTOCOLS AND UTILITY PROGRAMS

- HyperText Transfer Protocol (HTTP)
 - the Internet protocol used for transferring web pages
 - runs in the Application Layer of the TCP/IP model
- Simple Mail Transfer Protocol (SMTP)
 - the Internet protocol used to send mail to a server
- Post Office Protocol 3 (POP3)
 - a protocol used by the client to retrieve mail from an Internet server
- Internet Message Access Protocol (IMAP)
 - a more current e-mail protocol that allows users to search, organize, and filter their mail prior to downloading it from the server

- File Transfer Protocol (FTP)
 - Part of the TCP/IP protocol that permits users to transfer files from the server to their client computer, and vice versa
- Telnet
 - a terminal emulation program that runs in TCP/IP
- Secure Sockets Layer (SSL) /Transport Layer Security (TLS)
 - protocols that secure communications between the client and the server
- Ping
 - a program that allows you to check the connection between your client and the server
- Tracert
 - one of several route-tracing utilities that allow you to follow the path of a message you send from your client to a remote computer on the Internet

Layered architecture of the Internet

Conceptual architecture of the Internet

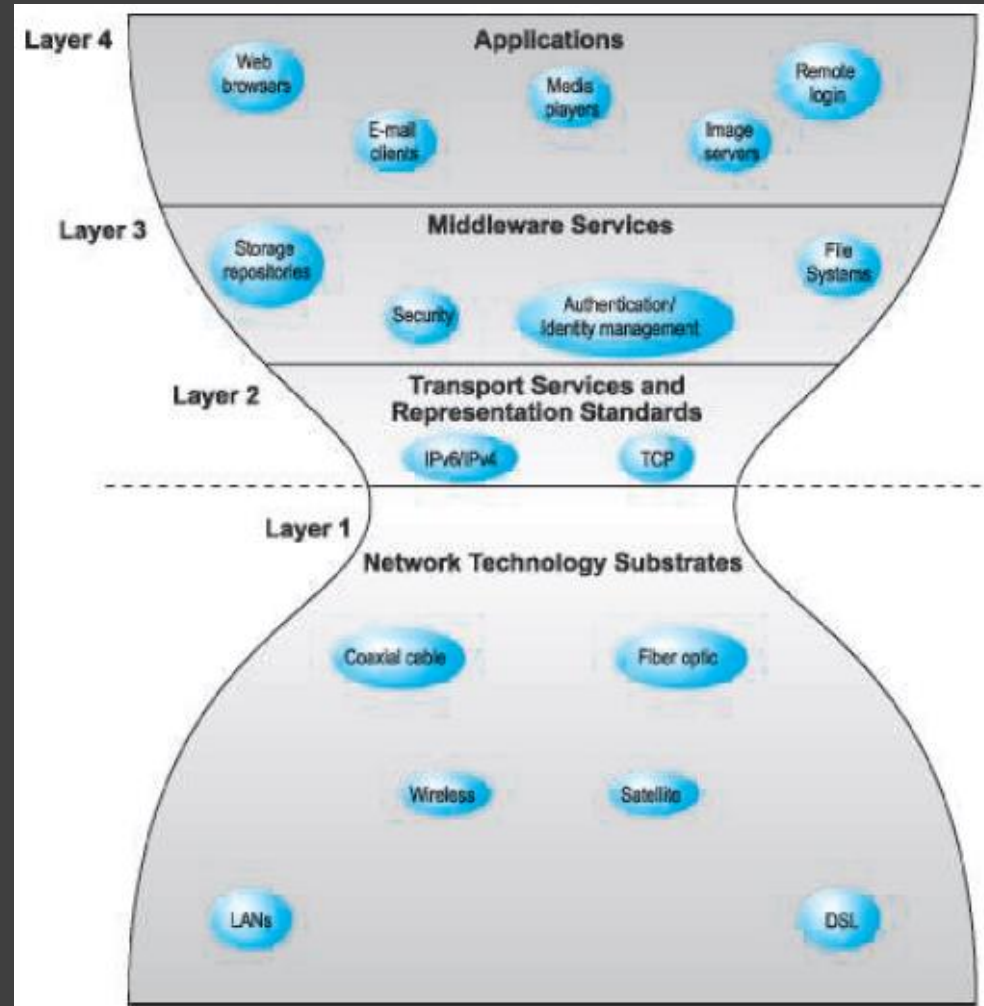
The Internet can be viewed conceptually as having four layers:

1. Network Technology Substrates
2. Transport Services and Representation Standards
3. Middleware Services
4. Applications

Conceptual architecture of the Internet

- Network Technology Substrate layer
 - layer of Internet technology that is composed of telecommunications networks and protocols
- Transport Services and Representation Standards layer
 - layer of Internet architecture that houses the TCP/IP protocol
- Applications layer
 - layer of Internet architecture that contains client applications
- Middleware Services layer
 - the “glue” that ties the applications to the communications networks and includes such services as security, authentication, addresses, and storage repositories

Conceptual architecture of the Internet



The Internet

Key terminologies and technologies

The Internet: key terminologies and technologies

Reading Assignment

- Internet backbone
- Internet Exchange Point (IXP)
- Services providers
- Intranets
- Internet governance

The Internet: key terminologies and technologies

- Backbone
 - high-bandwidth fiber-optic cables that transports data across the world
- Internet Bandwidth
 - measures how much data can be transferred over a communications medium within a fixed period of time
 - usually expressed in bits per second (bps), kilobits per second (Kbps), megabits per second (Mbps), or gigabits per second (Gbps)
- Internet Exchange Point (IXP)
 - hub where the backbone intersects with local and regional networks and where backbone owners connect with one another
- Tier 1, Tier 2 and Tier 3 ISPs
- There are two types of Internet service access: narrowband and broadband.

The Internet: key terminologies and technologies

- Digital Subscriber Line (DSL)
 - delivers high-speed access through ordinary telephone lines found in homes or businesses
- FiOS (fiber-optic service)
 - a form of DSL that provides speeds of up to 500 Mbps
- Cable Internet
 - piggybacks digital access to the Internet on top of the analog video cable providing television signals to a home
- T1
 - an international telephone standard for digital communication that offers guaranteed delivery at 1.54 Mbps
- T3
 - an international telephone standard for digital communication that offers guaranteed delivery at 45 Mbps
- Satellite Internet
 - high-speed broadband Internet access provided via satellite

LIMITATIONS OF THE CURRENT INTERNET

- *Bandwidth limitations.*
 - There is insufficient capacity throughout the backbone
- *Quality of service limitations*
 - **latency**—delays in messages caused by the uneven flow of information packets through the network
- *Network architecture limitations*
 - Example: responding to the same request from multiple users who may be in the same area
 - Compare model of communication with TV broadcasting
- *Wired Internet.*
 - The Internet is still largely based on cables—fiber-optic and coaxial copper cables

The World Wide Web (WWW)

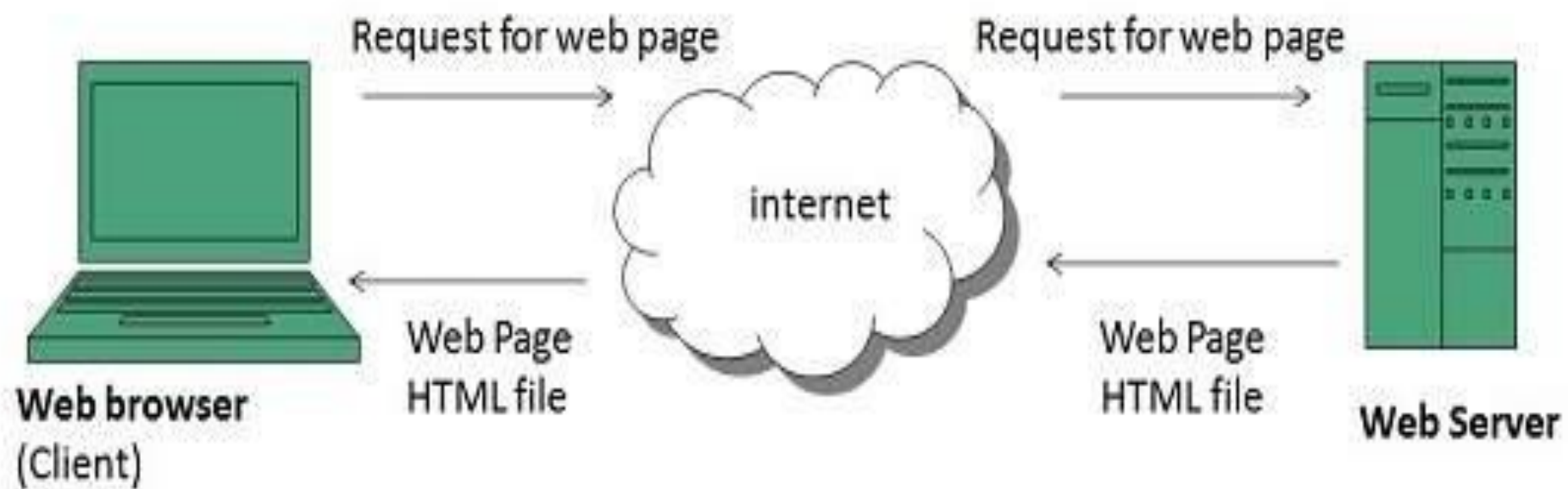
- Between 1989–1991, Dr. Tim Berners-Lee of the European Particle Physics Laboratory (CERN) created HTML
- HTML pages seen show in black and white until 1993
- In 1993 Marc Andreessen and colleagues developed a GUI-based web browser – **Mosaic**
- The graphical browser created the possibility of **universal computing**:
 - the sharing of files, information, graphics, sound, video, and other objects across all computer platforms in the world, regardless of operating system

- 1994 – founding of Netscape and creation of the browser Netscape Navigator
- Netscape initially charged for its software
- 1995 – Release of Internet Explorer
- In the following years, Netscape fell from a 100% market share to less than .5% in 2009
 - **Lesson:** *Innovators are usually not long-term winners, whereas smart followers often have the assets needed for long-term survival*

WWW OPERATION

WWW works on client- server approach. Following steps explains how the web works:

1. User enters the URL (say, <http://www.tutorialspoint.com>) of the web page in the address bar of web browser.
2. Then browser requests the Domain Name Server for the IP address corresponding to www.tutorialspoint.com.
3. After receiving IP address, browser sends the request for web page to the web server using HTTP protocol which specifies the way the browser and web server communicates.
4. Then web server receives request using HTTP protocol and checks its search for the requested web page. If found it returns it back to the web browser and close the HTTP connection.
5. Now the web browser receives the web page, It interprets it and display the contents of web page in web browser's window.



- Hypertext
 - a way of formatting pages with embedded links that connect documents to one another, and that also link pages to other objects such as sound, video, or animation files
- Domains:
 - common domain extensions (known as general top-level domains, or gTLDs) are officially sanctioned by ICANN -*The Internet Corporation for Assigned Names and Numbers*
 - Countries also have domain names, such as .mw, .uk, .au, and .fr (Malawi, United Kingdom, Australia, and France, respectively).
 - These are sometimes referred to as country-code top-level domains

EXAMPLES OF TOP-LEVEL DOMAINS			
GENERAL TOP-LEVEL DOMAIN (GTLD)	YEAR(S) INTRODUCED	PURPOSE	SPONSOR/ OPERATOR
.com	1980s	Unrestricted (but intended for commercial registrants)	VeriSign
.edu	1980s	U.S. educational institutions	Educause
.gov	1980s	U.S. government	U.S. General Services Administration
.mil	1980s	U.S. military	U.S. Department of Defense Network Information Center
.net	1980s	Unrestricted (but originally intended for network providers, etc.)	VeriSign
.org	1980s	Unrestricted (but intended for organizations that do not fit elsewhere)	Public Interest Registry (was operated by VeriSign until December 31, 2002)
.int	1998	Organizations established by international treaties between governments	Internet Assigned Numbers Authority (IANA)
.aero	2001	Air-transport industry	Société Internationale de Telecommunications Aeronautiques SC (SITA)
.biz	2001	Businesses	NeuLevel
.coop	2001	Cooperatives	DotCooperation LLC
.info	2001	Unrestricted use	Afilias LLC
.museum	2001	Museums	Museum Domain Name Association (MuseDoma)
.name	2001	For registration by individuals	Global Name Registry Ltd.

Markup Languages

- HyperText Markup Language (HTML)
 - GML that is relatively easy to use in web page design.
 - provides web page designers with a fixed set of markup “tags” that are used to format a web page
 - defines the structure and style of a document, including the headings, graphic positioning, tables, and text formatting
 - The most recent version of HTML is HTML5

Simple HTML document

```
<!DOCTYPE html>  
<html>  
  <body>  
  
    <h1>My First Heading</h1>  
  
    <p>My first paragraph.</p>  
  
  </body>  
</html>
```


Markup Languages

- eXtensible Markup Language (XML)
 - a markup language specification developed by the World Wide Web Consortium (W3C) that is **designed to describe data and information**
 - you can make up your own tags
 - ideal for storing and communicating many types of
 - data on the Web

Simple XML document

```
– <note>  
  <to>Tove</to>  
  <from>Jani</from>  
  <heading>Reminder</heading>  
  <body>Don't forget me this weekend!</body>  
</note>
```

Markup Languages

- **Really Simple Syndication (RSS)**
 - an XML format that allows users to have digital content, including text, articles, blogs, and podcast audio files, automatically sent to their computers over the Internet

WEB SERVERS AND CLIENTS

- Server
 - a computer attached to a network that stores files, controls peripheral devices, interfaces with the outside world—including the Internet
- Web server software
 - software that enables a computer to deliver web pages written in HTML to client computers on a network that request this service by sending an HTTP request
 - Examples: Apache, Microsoft's Internet Information Services (IIS)
- The term *web server* is also used to refer to the physical computer that runs web server software

- Database server
 - server designed to access specific information within a database
- Video server
 - server that serves video clips
- Ad server
 - server designed to deliver targeted banner ads
- Mail server
 - server that provides e-mail messages

- Web client
 - any computing device attached to the Internet that is capable of making HTTP requests and displaying HTML pages,
- Web browser
 - software program whose primary purpose is to display web pages

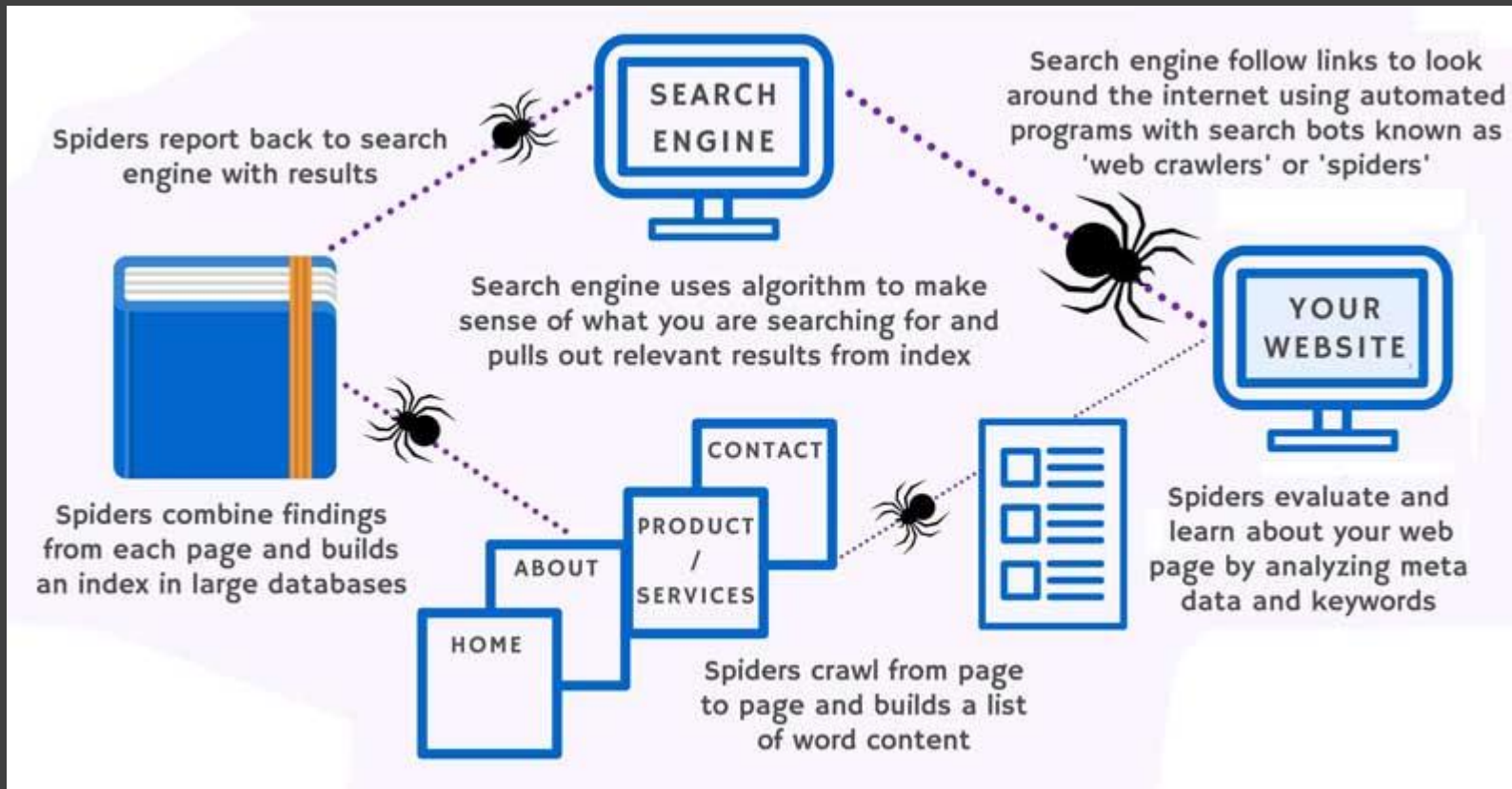
THE INTERNET AND THE WEB: FEATURES AND SERVICES

- The Internet and the Web have produced a number of powerful software applications upon which the foundations of e-business is built
- electronic mail (e-mail)
 - the most-used application of the Internet
 - Uses a series of protocols to enable messages containing text, images, sound, and video clips to be transferred from one Internet user to another
- attachment
 - a file inserted within an e-mail message

- Instant messaging (IM)
 - displays text entered almost instantaneously.
 - Recipients can then respond immediately to the sender the same way
 - Makes communication more like a live conversation than is possible through e-mail
- Online message board
 - a web application that allows Internet users to communicate with each other, although not in real time
 - A message board provides a container for various discussions (or “threads”) started (or “posted”)

- IP telephony
 - a general term for the technologies that use VoIP and the Internet's packet-switched network to transmit voice and other forms of audio communication over the Internet
- Voice over Internet Protocol (VoIP)
 - protocol that allows for transmission of voice and other forms of audio communication over the Internet
- Search engine
 - a software system that is designed to search for information on the World Wide Web.

How Do Search Engines Work?



Hicks, K. (2018)

Reading Assignment

- Read from Laudon (2018) chapter 3 on how the Google Search Engine works

WEB 2.0 APPLICATIONS AND SERVICES

- Online Social Networks
 - Services that support communication within networks of friends, colleagues, and entire professions
 - Examples: Facebook, Twitter, Instagram, LinkedIn, Pinterest
- Blog
 - personal web page that is created by an individual or corporation to communicate with readers
- Wikis
 - web applications that allows a user to easily add and edit content on a web page.
 - Example: Wikipedia - an online encyclopaedia
- Virtual reality (VR)
 - involves fully immersing users within a virtual world, typically through the use of a head-mounted display (HMD) connected to headphones and other devices
- Augmented reality (AR)
 - involves overlaying virtual objects over the real world, via smartphones, tablets or HMDs - head-mounted displays

INTELLIGENT PERSONAL ASSISTANTS

CASE STUDY: Akamai Technologies

Attempting to Keep Supply Ahead
of Demand

**Read the Akamai Technologies
Case Study from Laudon (2017)**

Case Study Questions

- 1. Why does Akamai need to geographically disperse its servers to deliver its customers' web content?
- 2. If you wanted to deliver software content over the Internet, would you sign up for Akamai's service? Why or why not?
- 3. Do you think Internet users should be charged based on the amount of bandwidth they consume, or on a tiered plan where users would pay in rough proportion to their usage?

References

- Hicks, K. (2018). How Do Search Engines Work? [Available from:] <https://www.hostgator.com/blog/how-search-engines-work/>
- Mesenbourg, T. L. "Measuring Electronic Business: Definitions, Underlying Concepts, and Measurement Plans