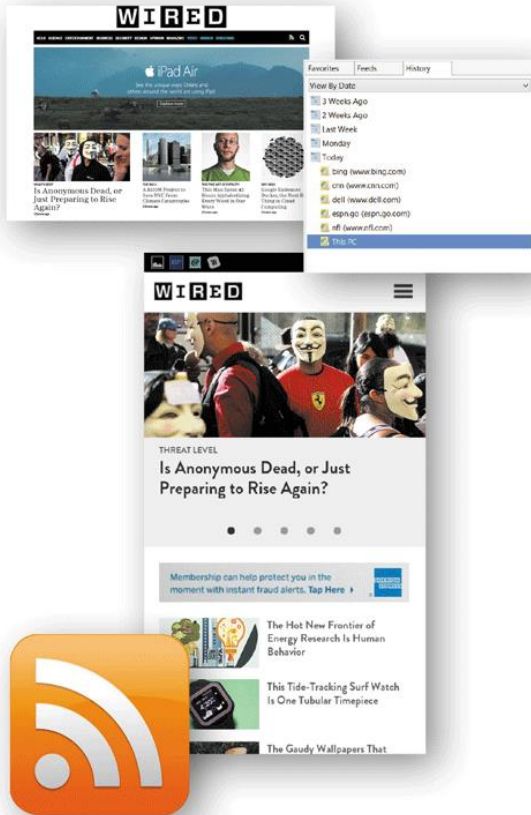


2

Browsing the Web

(Lecture 03)



Discovering the Internet, 5th Edition

Objectives

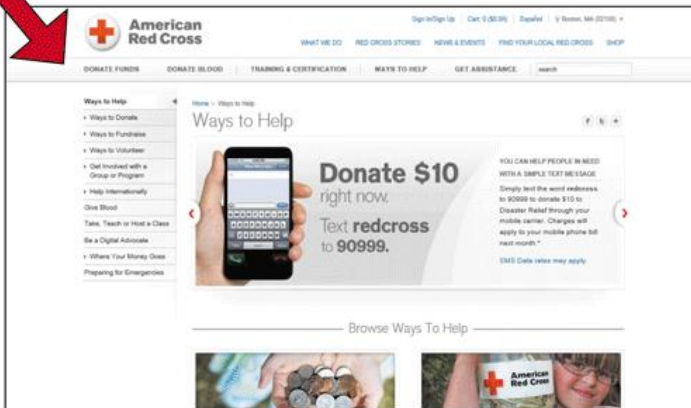
- Describe a website, common webpage characteristics, and web servers
- Explain the role IP addresses, domain names, and URLs play in locating webpages

Websites, Webpages, and Web Servers

➤ Websites

- Number of pages varies depending on site's purpose and type of content and services it provides
- **Home page** is the primary webpage at a website
- A **web portal**, or simply a **portal**, is a special type of website that offers access to a vast range of content and services

Websites, Webpages, and Web Servers

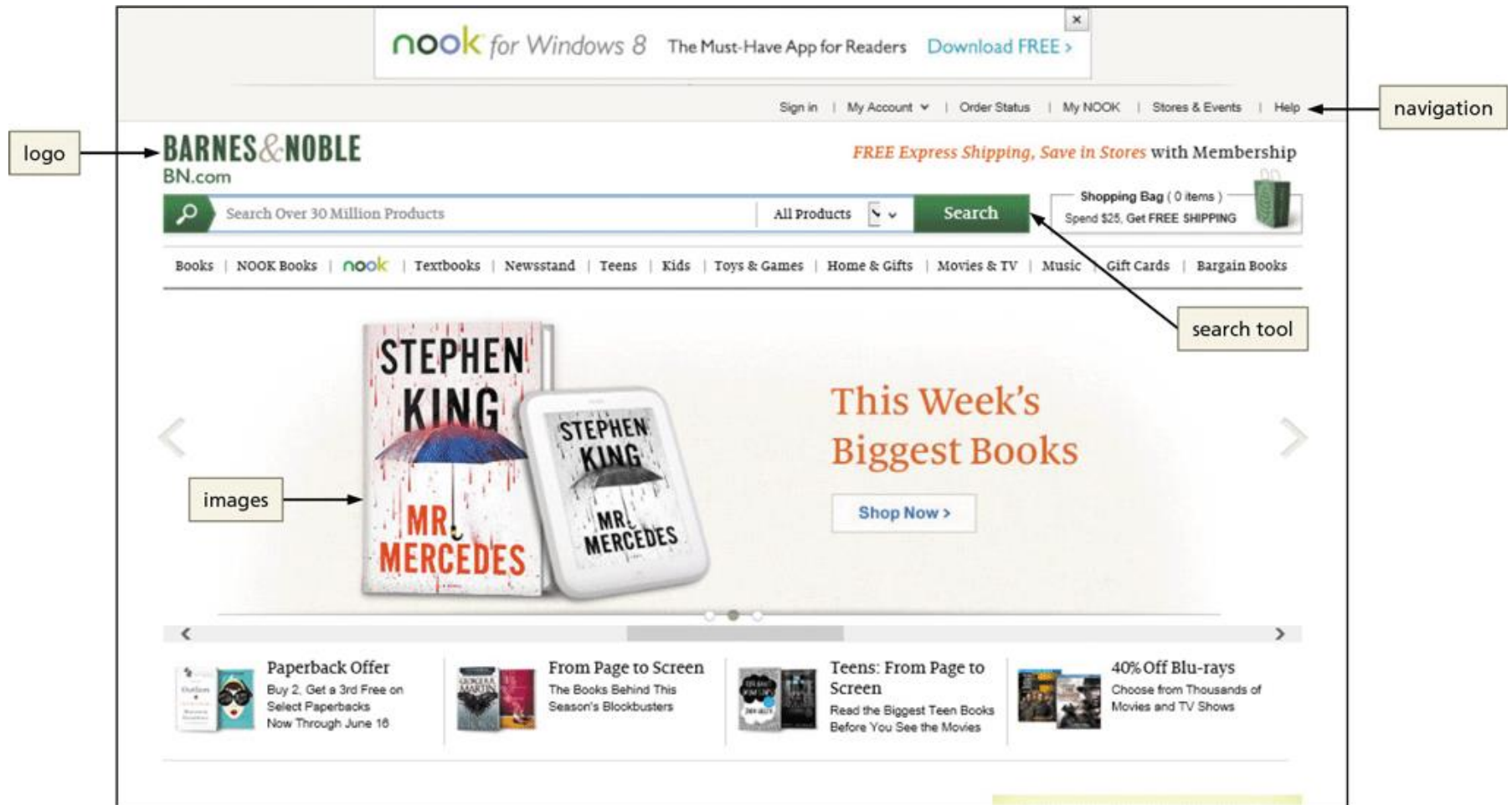


Websites, Webpages, and Web Servers

➤ Webpages

- Designed to attract visitors and hold their attention
- Common characteristics
 - Logo and/or name
 - Images and media
 - Links
 - Advertisements
 - Search tool
 - Connectivity links or icons
 - Copyright statement
 - Link to a privacy and security policy statement

Websites, Webpages, and Web Servers



Websites, Webpages, and Web Servers

➤ Web Servers

- Browser is a client that requests services from a web server
- **Server** “serves up” or provides the requested resources or services
 - Web browsing is example of **client/server computing**

Websites, Webpages, and Web Servers

➤ Web Servers (continued)

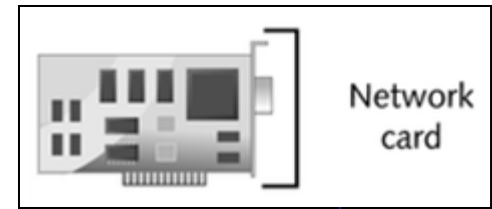
- Single web server can host multiple websites
- Larger websites may be stored across multiple web servers



Addressing on the Internet

- Methods used to identify devices and programs
 - Physical address
 - Permanently embedded in a network interface card
 - Identifies a device on a Local Area Network (LAN)
 - IP address
 - Identifies a computer, printer, or other device on the Internet
 - Domain name
 - An easy-to-remember word or phrase for an IP address

Physical Addresses



- Also called MAC (Media Access Control) address or adapter address
- 6-byte hex hardware addresses unique to each NIC card and assigned by manufacturers
- Often printed on the adapter
- Used at the Data Link layer for computers on the same network to communicate
- Computers on different networks use IP addresses to communicate

Network Interface Controller Card, Also known as network interface card or network card

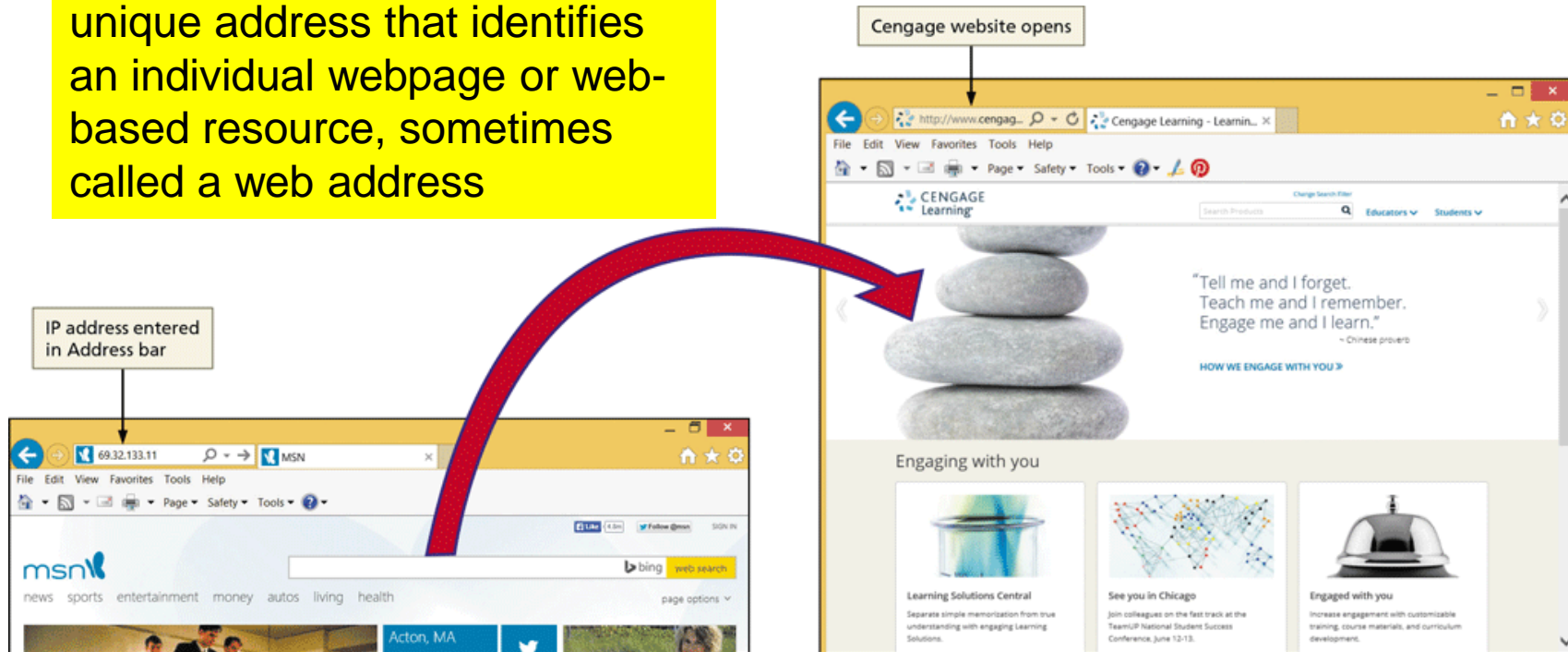
e.g. 01-2F-45-E7-69-AB or 01:2F:45:E7:69:AB

MAC Addresses

- The most absolute of addresses; they do not change as long as the NIC does not change
- All hosts on the same network must communicate by their MAC addresses, which are managed by the Data Link layer protocol that controls the network

Domain Names, IP Addresses, and URLs

Uniform Resource Locator – unique address that identifies an individual webpage or web-based resource, sometimes called a web address



Domain Names, IP Addresses, and URLs

➤ IP Address

- A unique number that identifies each computer or device connected to the Internet
- **Static IP addresses** seldom change
- **Dynamic IP addresses** are temporary
- A group of four numbers separated by a period or dot, such as 69.32.133.11
 - IPv4
 - IPv6

IPv6 addresses are denoted by eight groups of hexadecimal quartets separated by colons in between them.

An example of a valid IPv6 address:
2001:cdba:0000:0000:0000:0000:3257:9652

IP version 4 (IPv4)

- 32-bit addresses consisting of four 8-bit numbers separated by periods, used to uniquely identify a device on a network that uses TCP/IP protocols
- The first numbers identify the network; the last numbers identify the host
- Example: 206.96.103.114

Each of the four numbers separated by periods is called an octet (for 8 bits) $2^8=256$

Public, Private, and Reserved IP Addresses

- Public IP address
 - Available to the Internet
- Private IP address
 - Used on a private TCP/IP network that is isolated from the Internet
- Reserved IP address
 - Reserved for special use by TCP/IP

IP Address	How It Is Used
255.255.255.255	Broadcast messages
0.0.0.0	A currently unassigned IP address
127.0.0.1	Indicates your own workstation

Classes of IP Addresses

$$256 \times 256 \times 254 = 16,646,144$$

$$64 \times 256 = 16,384$$

$$256 \times 254 = 65,024$$

$$32 \times 256 \times 256 = 2,097,152$$

Classes of IP addresses

Class	Network Octets (blanks in the IP address are used for octets identifying hosts)	Total Number of Possible Networks or Licenses	Host Octets (blanks in the IP address are used for octets iden- tifying networks)	Total Number of Possible IP Addresses in Each Network
A	0.____.____.____ to 126.____.____.____	127	____.0.0.1 to ____.255.255.254	16,646,144
B	128.0.____.____ to 191.255.____.____	16,384	____.____.0.1 to ____.____.255.254	65,024
C	192.0.0.____ to 223.255.255.____	2,097,152	____.____.____.1 to ____.____.____.254	254

Octet	1	2	3	4
		Host		
	Network		Host	
	Network			Host

Class A

Class B

Class C

Class A address is assigned to large organizations with many hosts and heavy communication needs e.g. large educational, business and government

Class C address is assigned to small- to medium-sized organizations

Dynamically Assigned IP Addresses

- Used for the current session only; when the session is terminated, the IP address is returned to the list of available addresses
- Compare with static IP addresses, which are permanently assigned to workstations

Plans for New IP Addresses

1 US billion = 1,000,000,000

1 UK billion = 1,000,000,000,000

About to happen

$32 \times 4 = 128$

➤ IP version 6 (IPv6)

- A new scheme of IP addresses being developed due to the impending shortage of IP addresses
- Each address segment can have 32 bits, for a total of 128 bits for the entire address
- Can automatically assign an IP address to a network device

$2^{32} = 4.3$ US billion

An example of a valid IPv6 address:

2001:cdba:0000:0000:0000:0000:3257:9652

Address segment contains 32 bits

Ports

(TCP/IP Port Assignments)

Port number ranges from 0 to 65535

- Numbers used to address software or services running on a computer so that the process (service running on a host) can be found by TCP/IP
- Socket
 - Combination of IP address and port number

<http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml>

Standard Port Numbers

Some common TCP/IP port assignments for well-known services

Port	Service	Description
7	Ping	Verify two computers can communicate
20	FTP	File transfer data
21	FTP	File transfer control information
23	Telnet	Telnet used by UNIX computers
25	SMTP	Simple Mail Transfer Protocol; client sends e-mail
35	Printer	Private printer service
53	DNS	Domain Name Service
69	TFTP	Trivial FTP

TFTP is used for automated transfer of configuration or boot files between machines in a local environment. Compared to FTP, TFTP is extremely limited, providing no authentication, and is rarely used interactively by a user.

Standard Port Numbers

Common port no
for Web server

Network News Transfer Protocol

Some common TCP/IP port assignments for well-known services (continued)

Port	Service	Description
79	Finger	Provides information about users and their accounts
80	HTTP	World Wide Web protocol
109	POP2	Post Office Protocol, version 2; client receives e-mail
110	POP3	Post Office Protocol, version 3; client receives e-mail
119	NNTP	News servers
143	IMAP	Internet Message Access Protocol; newer protocol for clients to receive e-mail
161	SNMP	Simple Network Management Protocol; TCP/IP protocol that monitors and helps manage network traffic
2049	NFS	Network File System; a method of sharing (called mounting) a hard drive on a network so it appears to be a local drive

Network Masks

- Portion of the IP address that identifies the network
- Sometimes called a subnet mask
- Not used by all networks

Physically and Logically Dividing a Large Network

➤ Segmenting

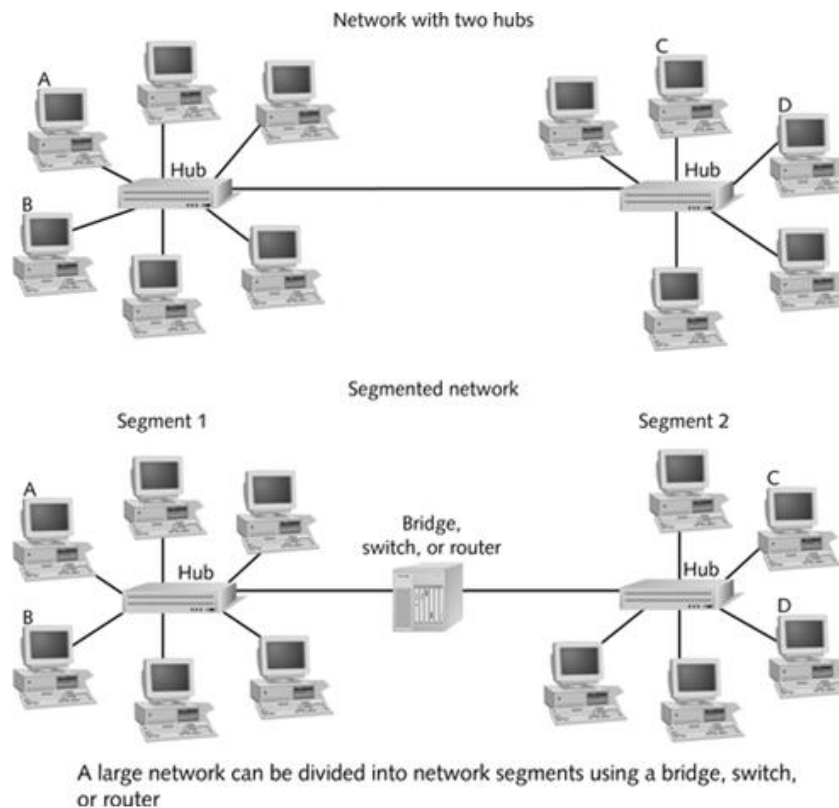
- Physically dividing the network using hardware devices (bridges, switches, routers)

➤ Subnetting

- Logically dividing the network using software settings

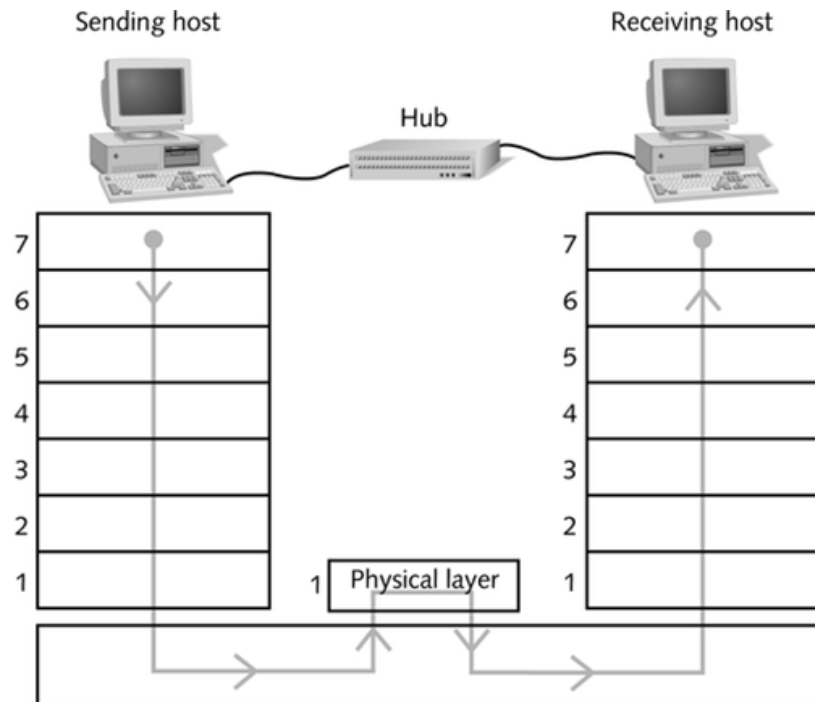
Segmenting a Network

- Use a bridge, switch, or router



Segmenting a Network

- Hub Operation
 - By Broadcasting

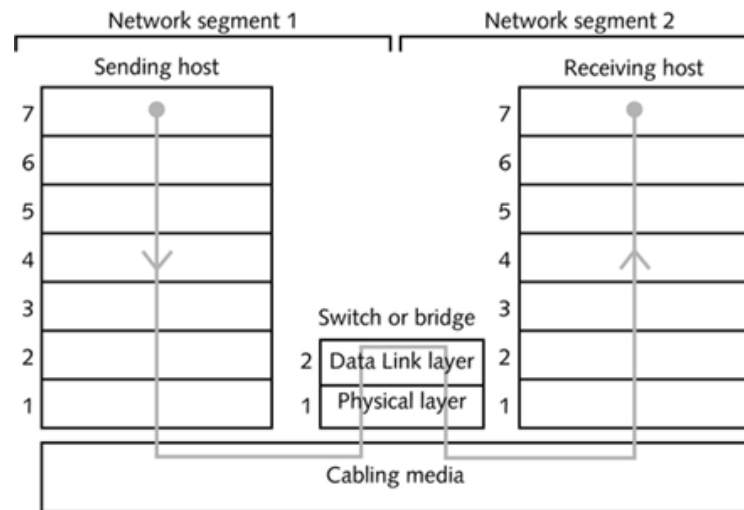


A hub operates at the Physical layer of the OSI model

Bridges and Switches

Media Access Control address is hard-coded on network card by network card manufacturer. It is a 6-byte hexadecimal address unique to each network card and assigned by network card manufacturer. For example, 00 00 0C 08 2F 35. It is also called physical address, adapter address, hardware address or Ethernet address.

- Use MAC addresses to determine where to send packets
- Work at the Data Link layer of the OSI model



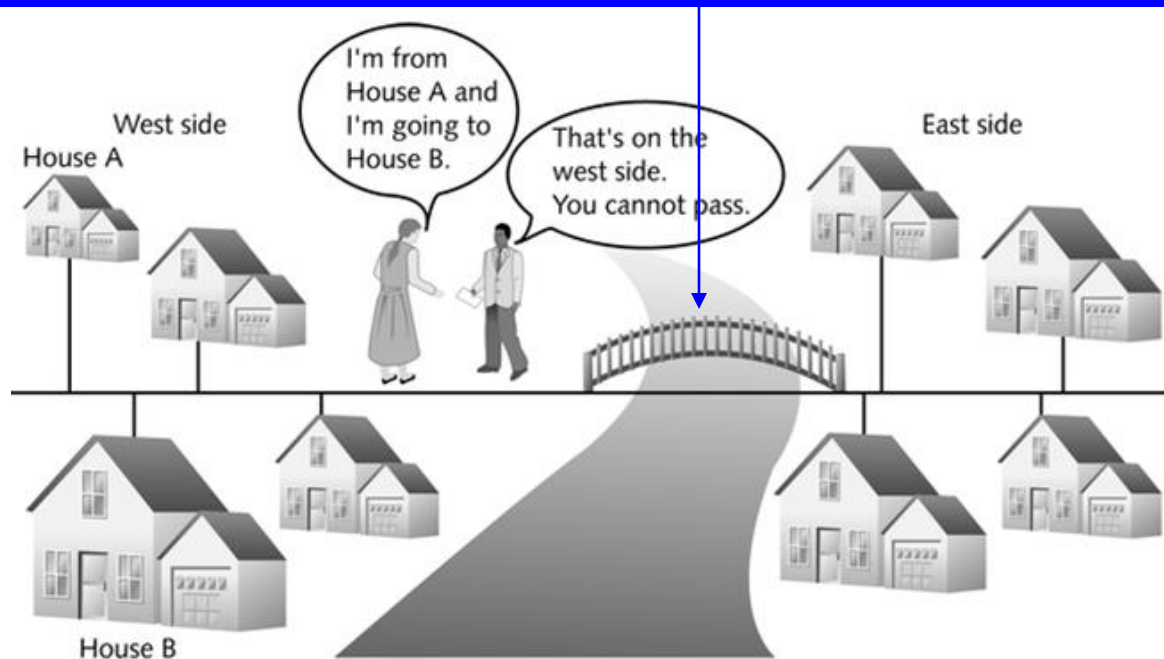
A switch or bridge works at OSI layer 2, the Data Link layer, where MAC addresses are used to send a data packet to the right network segment

Bridge

- Broadcasts messages to all networks to which it is connected except to the originating segment
- Effective at separating high-volume areas on a Local Area Network (LAN)
- Does not work well with large networks (produces unnecessary traffic)

Bridge

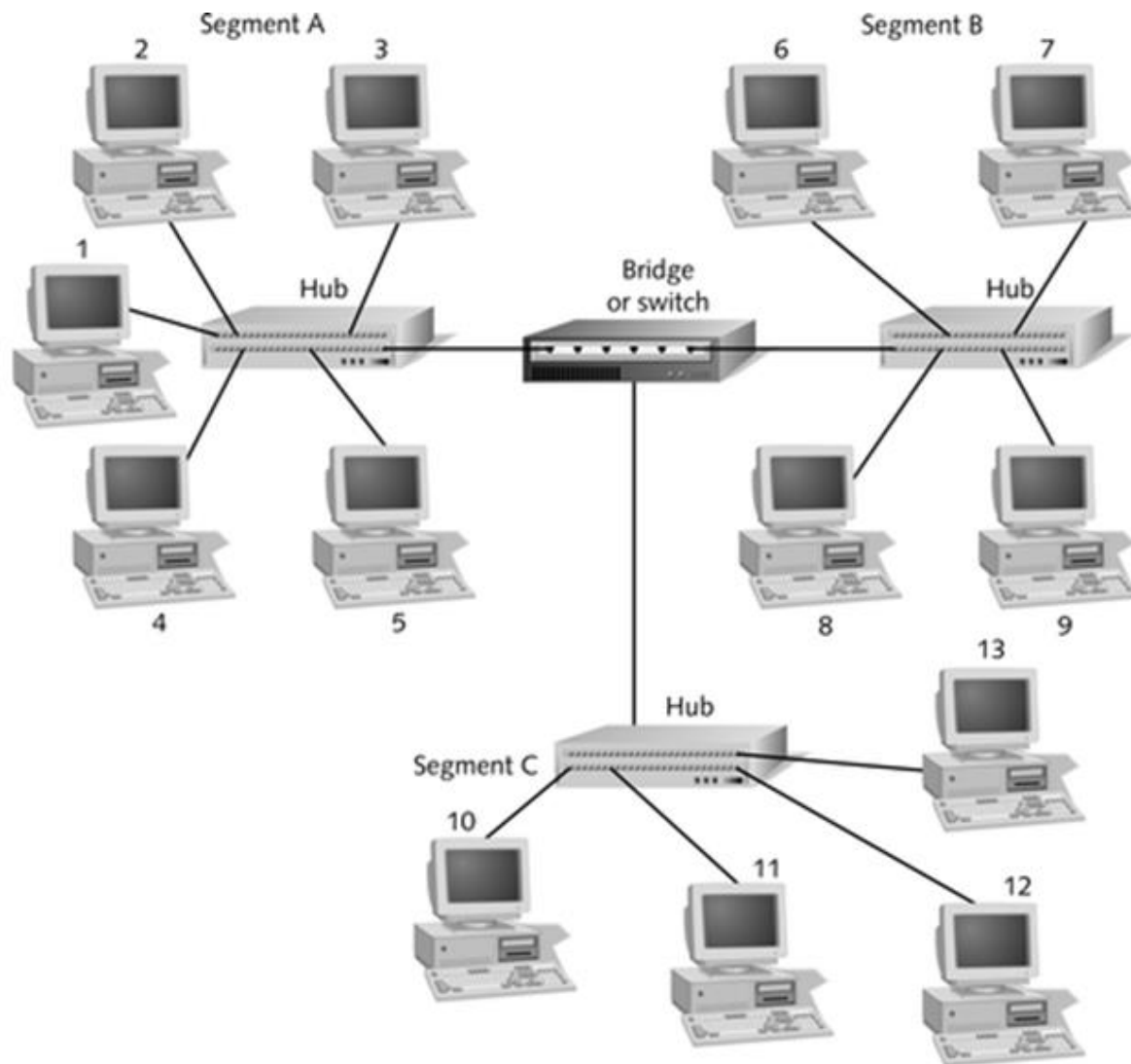
The bridge looks at the destination address where the traveler wants to go. The bridge then searches for the destination address in his routing table. If he finds the destination address in the table, the table gives the side the address is on. He then allows or refuses the traveler to pass based on that knowledge. If the bridge does not find the destination address in the routing table, he allows the traveler to cross. In addition, the bridge updates his routing table by information he has just learnt. By knowing that the traveler come from the west side and knowing the source address of the traveler, he enters this source address into its routing table as one address on the west side. At first, the bridge does not know much about addresses on each side, but as many travelers come from both sides of the bridge, his table becomes more complete, and the bridge can be more efficient at his job.



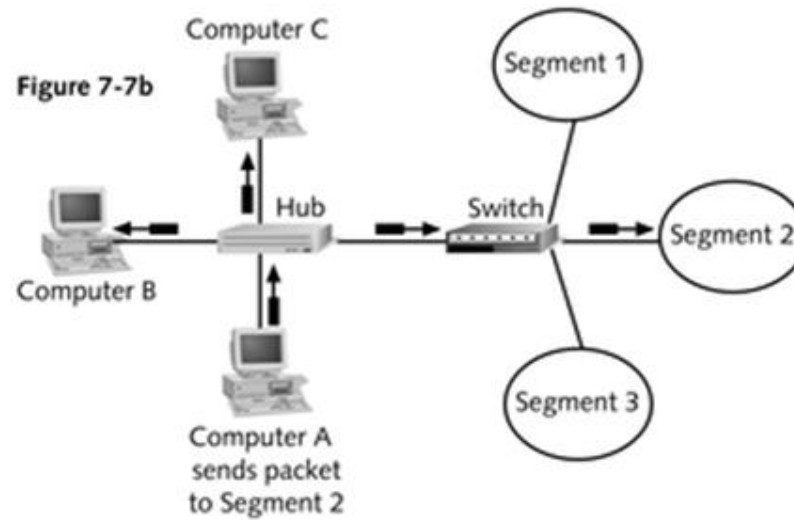
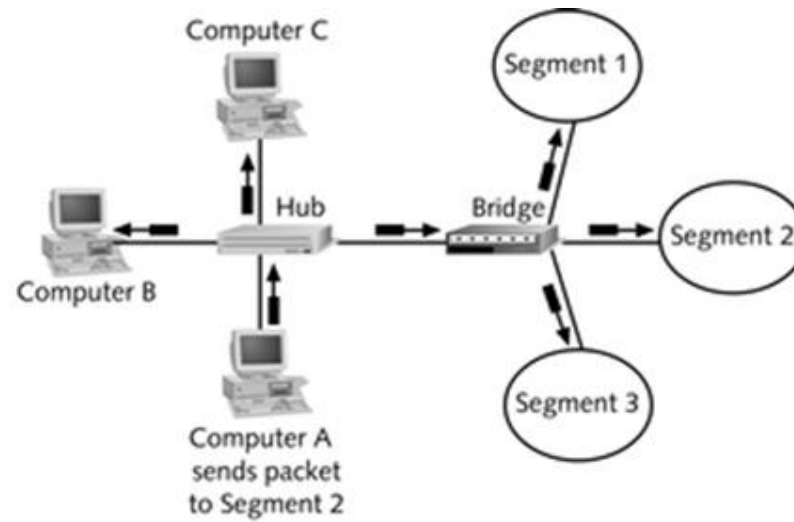
A bridge is an intelligent device operating at the Data Link layer of the OSI model

Switch

- Only sends a packet to the destination network
- More efficient than a bridge
- More intelligent than a bridge; knows which LAN a packet should be sent to (using routing tables)



A bridge or switch connects two or more segments and decides to allow or prevent the packet from passing through based on its destination MAC address



A switch is more intelligent than a bridge and can determine which network segment a packet needs to be sent to

Gateways

➤ Gateway

- Any device that connects two networks of differing protocols, or a device that provides a network access to other networks

➤ Default gateway

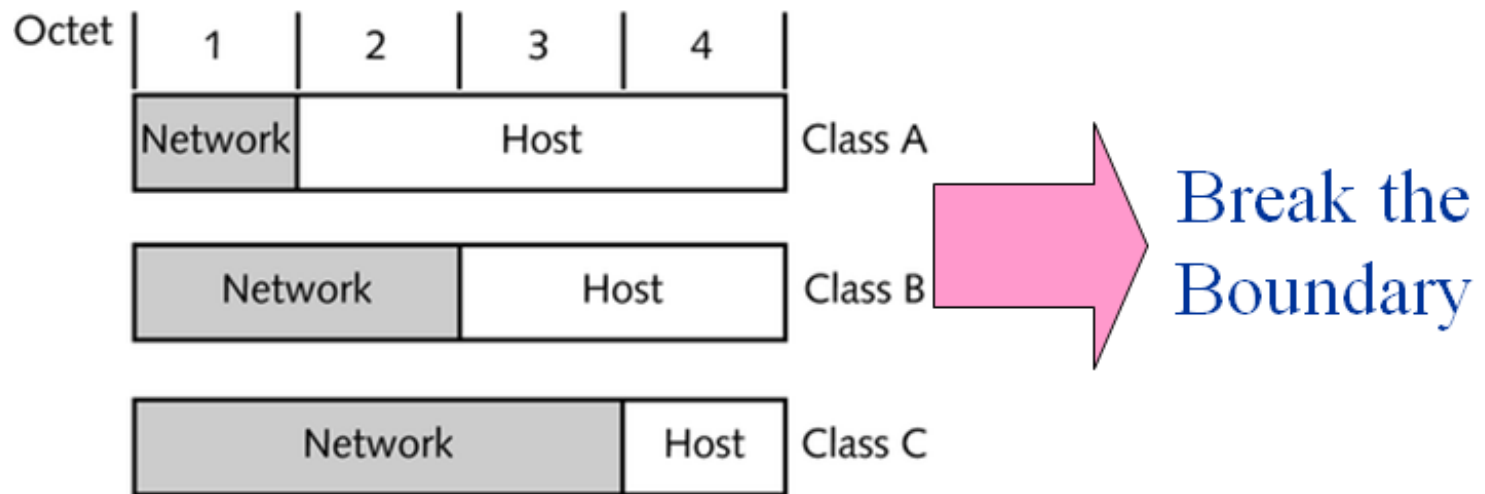
- The main gateway or unit that sends or receives packets addressed to other networks

➤ Alternate gateway

- An alternate router that is used if the default gateway is down

Subnetting

- Process of logically dividing a very large network into two or more networks based on IP addresses rather than MAC addresses to reduce congestion



The network portion and host portion for each class of IP address

Subnet Masks

- Define which portion of the host address within an IP address is being borrowed to define separate subnets within the network
- Used by a host to decide if a remote host is on its own network or another network
- If the destination host is on a remote network, the sending host sends the data to a device that sits as the gateway to other networks

Subnet Masks

AND

89	01011001
AND 255	<u>11111111</u>
	01011001

- A group of four 8-bit numbers separated by periods
- Use ones on the left to identify the subnet and zeroes on the right to identify the host for a given IP address
- A few bits at the beginning of the host portion of the IP address are borrowed from the host and used to identify the subnet
- The subnet mask tells how many of these bits are used for that purpose

Default subnet masks for classes of IP addresses

Class of IP Address	Subnet Mask	Sample IP Address	Network ID	Host ID
Class A	<u>11111111</u> .00000000.00000000.00000000	89.100.13.78	89	100.13.78
Class B	11111111.11111111.00000000.00000000	190.78.13.250	190.78	13.250
Class C	11111111.11111111.11111111.00000000	201.18.20.208	201.18.20	208

How to Select a Subnet Mask

All 1s in subnet – broadcast
All 0s in subnet – not used

- Base selection on the number of subnets needed and the number of hosts planned for each subnet

Some examples of subnet masks

Class IP Address	Subnet Mask in Decimal	Subnet Mask in Bits	Possible Number of Subnets	Possible Number of Hosts in One Subnet
Class A	255.192.0.0	11111111.11000000.00000000.00000000	2	4,194,302
Class A	255.252.0.0	11111111.11111100.00000000.00000000	62	262,142
Class B	255.255.248.0	11111111.11111111.11111000.00000000	30	2,046
Class B	255.255.252.0	11111111.11111111.11111100.00000000	62	1,022
Class C	255.255.255.192	11111111.11111111.11111111.11000000	2	62
Class C	255.255.255.252	11111111.11111111.11111111.11111100	62	2

$$2^6 - 2$$

$$2^2 - 2$$

$$2^2 - 2$$

$$2^{22} - 2$$

Assigning and Tracking Domain Names and IP Addresses

- Was under the authority of the U.S. Government
- Reorganized to give more authority and responsibility to the private sector; and regulated by the Internet Corporation for Assigned Names and Numbers (ICANN)

IP Addresses, Domain Names, and URLs

➤ Domain Names

- A text alias for one or more IP addresses
 - cengage.com is domain name for 69.32.133.79
- Domain Name System (DNS) uses name servers to resolve domain name to IP address
 - Managed by ICANN
 - TLD (.com, .biz, and so forth)
 - ccTLD (.us, .uk, and so forth)

Top-level Domain



Country-code Top-level Domain



Top-Level Domains

Top-Level Domains

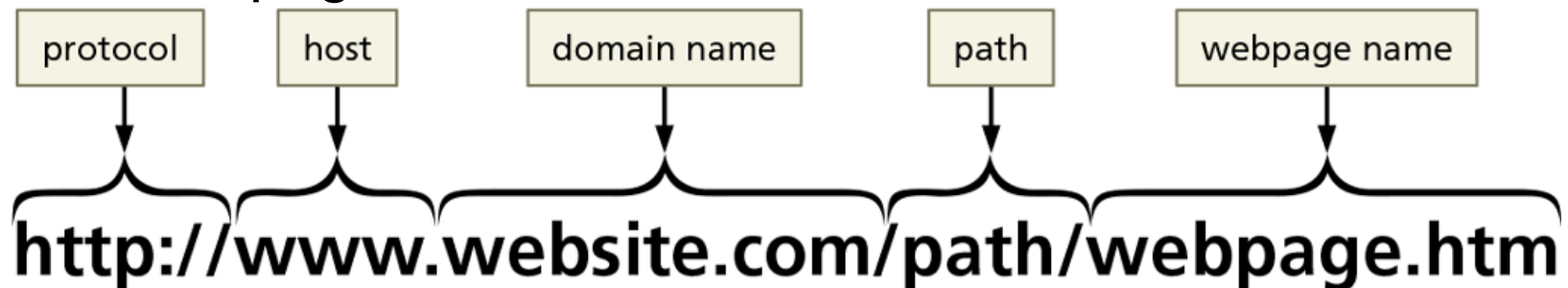
TLD Abbreviation	Type of Domain	TLD Abbreviation	Type of Domain
.com	Commercial firms	.aero	Aviation industry
.edu	Educational institutions	.biz	Businesses
.gov	Government entities	.coop	Cooperatives
.mil	U.S. military	.info	All uses
.net	Major networking centers	.museum	Museums
.org	Nonprofit organizations	.name	Individuals
.int	International organizations	.pro	Credentialed professionals
.mobi	Mobile products and services	.jobs	Human resources professionals
.travel	Travel industry	.asia	Pan-Asian and Asia Pacific community
.tel	Business and individual contact information	.cat	Catalan linguistic community

Figure 2-5 Domains in the DNS are grouped by type of organization or sponsoring group.

Domain Names, IP Addresses, and URLs

➤ Uniform Resource Locators (URLs)

- A unique web address
 - http:// protocol
 - host
 - domain name
 - path
 - webpage/resource name



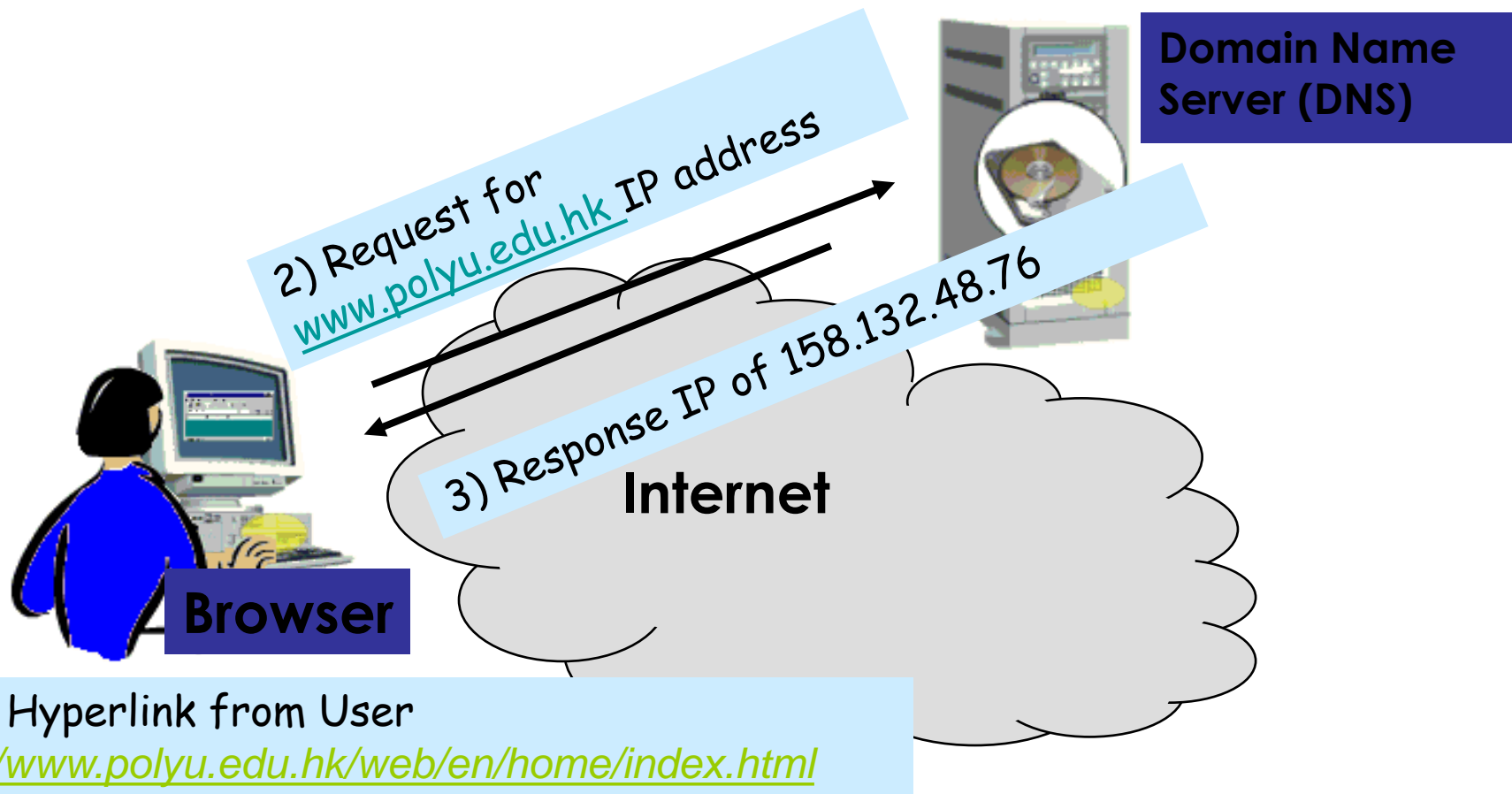
Protocols in URL

Protocol	Use	Example
ftp	File transfer	ftp://ftp.adobe.com/
http	Hypertext	http://www.hkcc-polyu.edu.hk
https	Hypertext secure	https://www.hkcc-polyu.edu.hk/en/home/index.html
mailto	Sending mail	mailto:sc.chan@cpce-polyu.edu.hk
news	Requesting news	news://netforum.netvigator.com

Before we can get the web page, what's happening behind the computer?

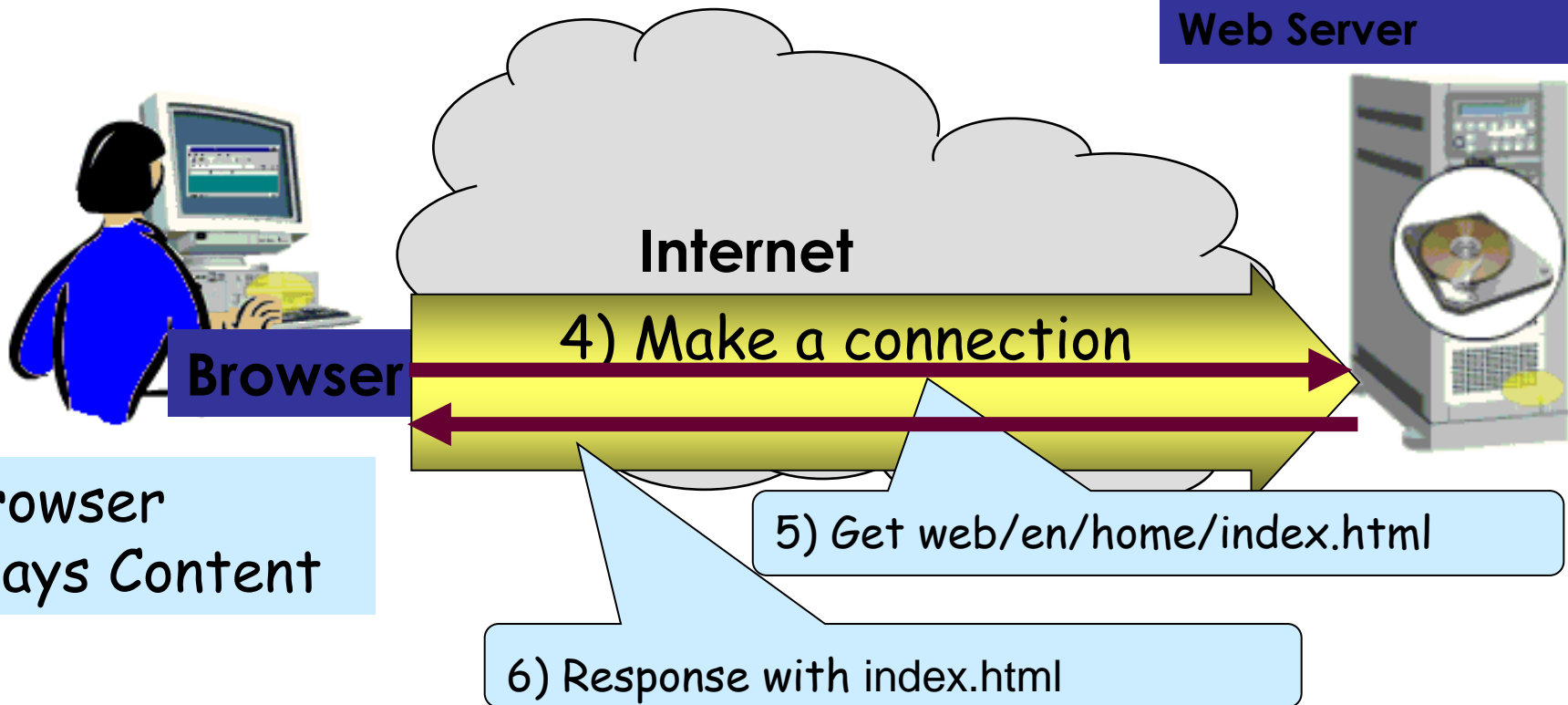


Internet Web Browsing Model



Internet Web Browsing Model

www.polyu.edu.hk
(158.132.48.76)
Web Server



7) Browser
Displays Content

5) Get web/en/home/index.html

6) Response with index.html

How to Create & Update Domain Names

- Purchase a domain name from a registrar of domain names
 - e.g.
 - www.networksolution.com
 - www.hkirc.hk