

Chapter 3

E-Commerce Infrastructure: The Internet, Web, and Mobile Platform

Learning Objectives

- Know the current structure of the Internet
了解Internet的現行架構
- Know how the Web works.
了解萬維網的工作原理
- Know how Internet and web features and services support e-commerce.
了解Internet、萬維網的特性和服務是如何保障電子商務正常運營的

Contents

- *The Internet: Technology Background*
- *The Internet Today*
- *The Web*
- *The Internet and the Web: Features and Services*

Part I:

The Internet: Technology Background

The Internet: Technology Background

- What is the Internet?
- Where did it come from, and how did it support the growth of the Web?
- What are the Internet's most important operating principles?

The Internet: Technology Background

- **Internet**
 - The Internet is **an interconnected network** of thousands of networks and millions of computers (sometimes called host computers or just hosts), linking businesses, educational institutions, government agencies, and individuals.
- Internet是一個由數千子網和數百萬台計算機（有時也稱為宿主計算機或主機）組成，將企業、教育機構、政府機構和個人連接在一起的**互聯網絡**。
- The word Internet is derived from the word internetwork, or the connecting together of two or more computer networks.

Internet一詞源自互聯網絡（internetwork）一詞衍生而來的，本是指兩個或多個計算機網絡之間的連接。

The Internet: Technology Background

- **Internet**
 - No single organization controls the Internet or how it functions, nor is it owned by anybody, yet it has provided the infrastructure for a transformation in commerce, scientific research, and culture.
Internet或其運作方式不受某個組織的控制，它也不歸任何人所有，但它為商務活動、科學研究和文化交流提供了基礎設施.
 - The Internet provides approximately 4 billion people around the world with services such as e-mail, apps, newsgroups, shopping, research, instant messaging, music, videos, and news (eMarketer, Inc., 2020a).
Internet向全世界的約40億人提供諸如電子郵件、應用程序、新聞組、購物、研究、即時通訊、音樂、視頻和新聞等服務(eMarketer, Inc., 2020a).

The Internet: Technology Background

- **World Wide Web (Web)**

- The Web is one of the Internet's most popular services, providing access to billions, perhaps trillions, of web pages.

萬維網是Internet上最受歡迎的服務之一，提供對數十億甚至數萬億網頁的訪問。

- Web pages are documents created in a programming language called HyperText Markup Language (HTML) that can contain text, graphics, audio, video, and other objects, as well as “hyperlinks” that permit users to jump easily from one page to another. Web pages are navigated using web browser software.

網頁是用超文本標記語言（HTML）創建的文檔，可以包含文本、圖形、音頻、視頻和其他對象，以及允許用戶輕鬆地從一個網頁跳轉到另一個網頁的“超鏈接”。使用網絡瀏覽器軟件完成網頁閑的導航。

1. The Evolution of the Internet 1961–Present

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

- Innovation Phase 創新階段, 1961–1974
- Institutionalization Phase 機構化階段, 1975–1995
- Commercialization Phase 商業化階段, 1995–present



1. The Evolution of the Internet 1961–Present

Innovation Phase, 1961–1974

- During this *phase*, the fundamental building blocks of the Internet—packet-switching hardware, a communications protocol called TCP/ IP, and client/server computing (all described more fully later in this section)—were conceptualized and then implemented in actual hardware and software.

在這個階段，Internet的基礎模塊（交換設備、TCP/IP 通信協議和客戶端/服務器計算架構）的概念被提出，然後在實際硬件和軟件之中加以應用。

- The Internet's original purpose was to link large mainframe computers on different college campuses. This kind of one-to-one communication between campuses was previously possible only via the telephone system or private networks owned by the large computer manufacturers.

Internet最初目的是連接不同大學校園的大型計算機。這種校園之間的一對一通信以前只能通過電話系統或大型計算機製造商的專用網絡來實現。

1. The Evolution of the Internet 1961–Present

Institutionalization Phase, 1975–1995

- Large institutions such as the U.S. Department of Defense (DoD) and the National Science Foundation (NSF) provided funding for the fledgling Internet.
美國國防部（DoD）和國家科學基金會（NSF）等大型機構為羽翼未豐的Internet提供資金支持.
- In 1986, the NSF assumed responsibility for the development of a civilian Internet (then called NSFNET)
1986年，美國國家科學基金會開始承擔開發民用Internet（後來稱為NSFNET）的責任.

1. The Evolution of the Internet 1961–Present

Commercialization Phase, 1995–present

- The U.S. government encouraged private corporations to take over and expand the Internet backbone as well as local service beyond military installations and college campuses to the rest of the population around the world.

美國政府鼓勵私營企業接管並將Internet主幹網絡和本地服務擴展到軍事設施和大學校園以外的世界其他地區。

YEAR	EVENT	SIGNIFICANCE
<i>INNOVATION PHASE 1961–1974</i>		
1961	Leonard Kleinrock (MIT) publishes a paper on "packet switching" networks.	The concept of packet switching is born.
1962	J. C. R. Licklider (MIT) writes a memo calling for an "Intergalactic Computer Network."	The vision of a global computer network is born.
1969	The first packet-switched message is sent on ARPANET from UCLA to Stanford.	The communications hardware underlying the Internet is implemented for the first time.
1972	E-mail is invented.	The first "killer app" of the Internet is born.
1973	Bob Metcalfe (Xerox PARC Labs) invents Ethernet and local area networks (LANs).	Ethernet and LANs enable the development of client/server computing .
1974	"Open architecture" networking and TCP/IP concepts are presented in a paper by Vint Cerf (Stanford) and Bob Kahn (BBN).	The paper provides the conceptual foundation for a single common communications protocol, TCP/IP , that could connect disparate LANs and computers, and a common addressing scheme for all computers connected to the network.
<i>INSTITUTIONALIZATION PHASE 1975–1995</i>		
1977	Lawrence Landweber envisions CSNET (Computer Science Network), a network for U.S. university and computer industry research groups.	CSNET is a major milestone on the path to the development of the global Internet.
1980	TCP/IP is officially adopted as the U.S. Department of Defense (DoD) standard communications protocol.	The DoD, the single-largest computing organization in the world at the time, validates TCP/IP.
1981	IBM introduces IBM PC, its first personal computer.	Personal desktop computers provide the foundation for access by millions of people to the Internet.
1984	Apple releases the HyperCard program as part of its Macintosh operating system.	The concept of "hyperlinked" documents that permit a user to jump from one page to another is commercially introduced.
1984	Domain Name System (DNS) is introduced.	DNS provides a user-friendly system for translating IP addresses into words that people can easily understand.
1989	Tim Berners-Lee (CERN) proposes a worldwide network of hyperlinked documents based on a common markup language called HTML—HyperText Markup Language.	The concept of an Internet-supported service called the World Wide Web based on HTML is born.
1993	Mosaic, the first graphical web browser, is invented.	Mosaic makes it easy for ordinary users to connect to HTML documents anywhere on the Web.
1994	Netscape, the first commercial web browser, becomes available; the first banner advertisements appear on Hotwired.com in October 1994.	The beginning of e-commerce .

YEAR	EVENT	SIGNIFICANCE
COMMERCIALIZATION PHASE 1995–PRESENT		
1995	Major telecommunications companies take over operation of the Internet backbone. Network Solutions (a private firm) is given a monopoly to assign Internet addresses.	The fully commercial civilian Internet is born.
1995	Jeff Bezos founds Amazon.	E-commerce begins in earnest.
1998	The Internet Corporation for Assigned Names and Numbers (ICANN) is created.	Governance over domain names and addresses passes to a private, nonprofit, international organization.
2007	The Apple iPhone is introduced.	The iPhone represents the beginning of the development of a viable mobile platform .
2008	Internet “cloud computing” becomes a billion-dollar industry.	Internet capacity is sufficient to support on-demand computing resources as well as software applications (cloud computing).
2011	ICANN expands the domain name system.	ICANN expands generic top-level domain names from about 300 to potentially thousands.
2012	World IPv6 Launch day.	IPv6 increases the pool of available Internet addresses, enabling continued expansion of the Internet.
2013	The Internet of Things (IoT) starts to become a reality.	Internet technology spreads beyond computers and mobile devices to anything that can be equipped with sensors, paving the way for an Internet of Things (IoT) .
2014	Apple introduces Apple Pay and Apple Watch.	Apple Pay becomes the first widely adopted mobile payment system; Apple Watch ushers in a new era of wearable Internet-connected technology.
2019	The commercial availability of 10 Gbps Internet access increases.	Advanced technologies such as virtual reality, augmented reality, artificial intelligence, and 4k streaming video drive demand for faster broadband access speeds.
2020	The Covid-19 pandemic sweeps the globe; Internet usage skyrockets.	The pandemic illustrates the resiliency of the Internet to cope with a tremendous surge in demand.
2021	Facebook rebrands as Meta.	Tremendous hype erupts over the concept of the metaverse: a reenvisioning of the Internet and Web as an immersive 3-D experience.
2022	SpaceX's Starlink takes the lead in the race to deploy low earth orbit (LEO) Internet access satellite systems.	LEO satellite systems can provide broadband Internet access to underserved areas and help bridge the digital divide.

2. The Internet: Key Technology Concepts

- In 1995, the U.S. Federal Networking Council (FNC) passed a resolution formally defining the term Internet as a network that uses the Internet Protocol (IP) addressing scheme, supports the Transmission Control Protocol (TCP), and makes services available to users.
1995年，美國聯邦網絡委員會通過了一項決議，正式將 Internet 定義為一個使用IP尋址方案、支持傳輸控制協議並向用戶提供服務的網絡.
- Three important concepts:
 - Packet switching 包交換
 - TCP/IP 傳輸控制協議/網際協議
 - Client/server computing 客戶機/服務器計算架構

2. The Internet: Key Technology Concepts

RESOLUTION OF THE FEDERAL NETWORKING COUNCIL

"The Federal Networking Council (FNC) agrees that the following language reflects our definition of the term '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 described herein."

Last modified on October 30, 1995.

2. The Internet: Key Technology Concepts

Packet switching

- Packet switching is a method of slicing digital messages into discrete units called packets, sending the packets along different communication paths as they become available, and then reassembling the packets once they arrive at their destination.

包交換(分組交換)是一種將數字消息分割成“包”並沿著不同的通信線路進行傳送，最後在目的地進行重組的數據傳送方法。

- Packet switching does not require a dedicated circuit, but can make use of any spare capacity that is available on any of several hundred circuits
包交換不需要專用傳輸線路，任何線路的閑置容量都可被其充分利用。

2. The Internet: Key Technology Concepts

TCP/IP

- TCP/IP is the core communications protocol for the Internet.
TCP/IP是Internet的核心通信協議.
- TCP/IP is an industry-standard suite of protocols for large internetworks. The purpose of TCP/IP is to provide high-speed communication network links.
TCP/IP是用于大型計算機互聯網絡的行業標準通信協議，其目的是提供高速通信的網絡鏈接.
- Transmission Control Protocol (TCP) establishes connections among sending and receiving computers and handles assembly of packets at point of transmission, and reassembly at receiving end.
傳輸控制協議建立了收發計算機之間的連接，在傳輸點處理數據包的組裝，在接收端處理重新組裝.
- IP provides the Internet's addressing scheme and is responsible for delivery of packets.
網際協議提供了Internet的尋址方案並負責數據包的傳遞.

2. The Internet: Key Technology Concepts

TCP/IP

- TCP/IP is divided into four separate layers:
 - The *Application Layer* includes a variety of protocols used to provide user services or exchange data. One of the most important is the Border Gateway Protocol (BGP), which enables the exchange of routing information among different autonomous systems on the Internet. BGP uses TCP as its transport protocol.
應用層包括許多負責為用戶提供服務或控制數據交換的協議。最重要的協議之一是邊界網關協議 (BGP)，它實現了Internet中不同自治系統之間的路由信息交換。BGP使用TCP作為其傳輸協議。
 - The *Transport Layer* is responsible for providing communication with other protocols (applications) within the TCP/IP protocol suite by acknowledging and sequencing the packets to and from the applications.
傳輸層負責在TCP/IP 協議簇內同具體的網絡應用進行雙向通信，完成數據包的確認和排序工作。

2. The Internet: Key Technology Concepts

TCP/IP

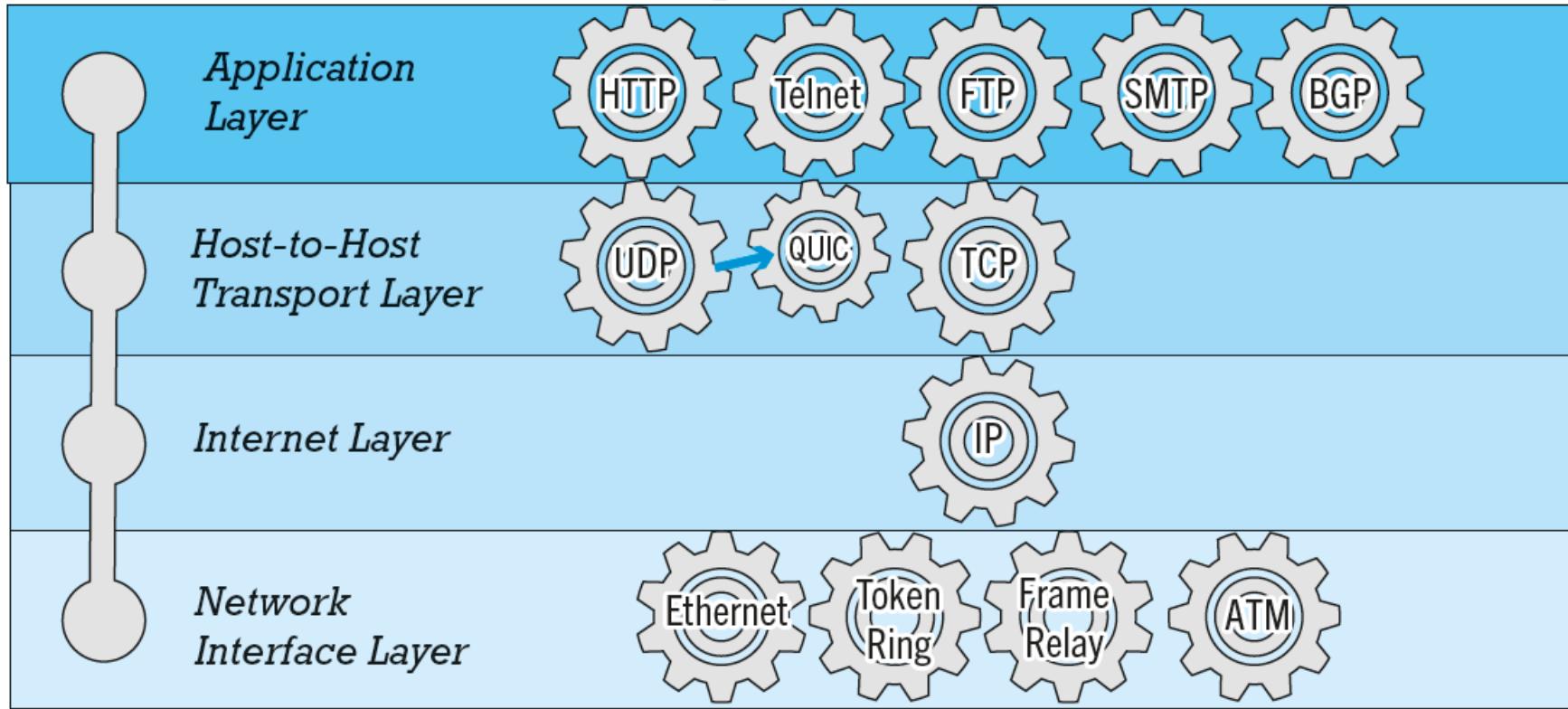
- TCP/IP is divided into four separate layers:
 - The *Internet Layer* is responsible for addressing, packaging, and routing messages on the Internet.
網絡層負責數據的尋址、打包和網間路由等工作.
 - The *Network Interface Layer* is responsible for placing packets on and receiving them from the network medium, which could be a LAN (Ethernet) or Token Ring network, or other network technology.
網絡接口層負責通過局域網(以太網)、令牌環網或其他網絡架構的任何網絡收發數據包.



TCP/IP Protocol Architecture Layers



TCP/IP Protocol Suite



TCP/IP is an industry-standard suite of protocols for large internetworks. The purpose of TCP/IP is to provide high-speed communication network links.

The TCP/IP Architecture and Protocol Suite

TCP/IP 協議架構和協議簇

2. The Internet: Key Technology Concepts

TCP/IP

➤ *Application Layer*

- HTTP: The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web.
超文本傳輸協議是一種用于分布式、協作式和超媒體信息系統的應用層協議。
HTTP是萬維網的數據通訊的基礎.
- Telnet: Telnet (“Telecommunications Network”) is a client/server application protocol that provides access to virtual terminals of remote systems on local area networks or the Internet.
Telnet是一種客戶端/服務器應用協議，它允許用戶通過互聯網或局域網連接到其他計算機.
- FTP: The File Transfer Protocol (FTP) is a application layer protocol used for the transfer of computer files from a server to a client on a computer network.
文件傳輸協議是在計算機網絡的客戶端和服務器間傳輸文件的應用層協議.

2. The Internet: Key Technology Concepts

TCP/IP

- SMTP: The Simple Mail Transfer Protocol (SMTP) is an Internet standard communication protocol for electronic mail transmission.
簡單郵件傳輸協議是一種用于電子郵件傳輸的互聯網標準通信協議.
- BGP: Border Gateway Protocol (BGP) is a standardized exterior gateway protocol designed to exchange routing and reachability information among autonomous systems (AS) on the Internet.
邊界網關協議是一種用來在路由選擇域之間交換網絡層可達性信息的路由選擇協議.

2. The Internet: Key Technology Concepts

TCP/IP

➤ *Transport Layer*

- UDP: UDP (User Datagram Protocol) is a key component of the Internet protocol suite and provides an alternative to TCP when the error-checking and correction functionality of TCP is not necessary.
用戶數據報協議是互聯網協議簇的關鍵部分，當不需要TCP的錯誤檢查和糾正功能時，它可以提供TCP的替代方案。
- QUIC: QUIC is a general-purpose network protocol built on top of UDP.
QUIC 是一種基于 UDP 構建的通用網絡協議。
- TCP: TCP (Transmission Control Protocol) establishes connections among sending and receiving computers and handles assembly and reassembly of packets.
傳輸控制協議在發送計算機和接收計算機之間建立連接，並處理數據包的組裝和重組。

2. The Internet: Key Technology Concepts

TCP/IP

➤ *Internet Layer*

- IP: IP (Internet Protocol) provides the Internet's addressing scheme and is responsible for the actual delivery of the packets.

互聯網協議提供互聯網的尋址方案並負責數據包的實際傳送。

2. The Internet: Key Technology Concepts

TCP/IP

➤ *Network Interface Layer*

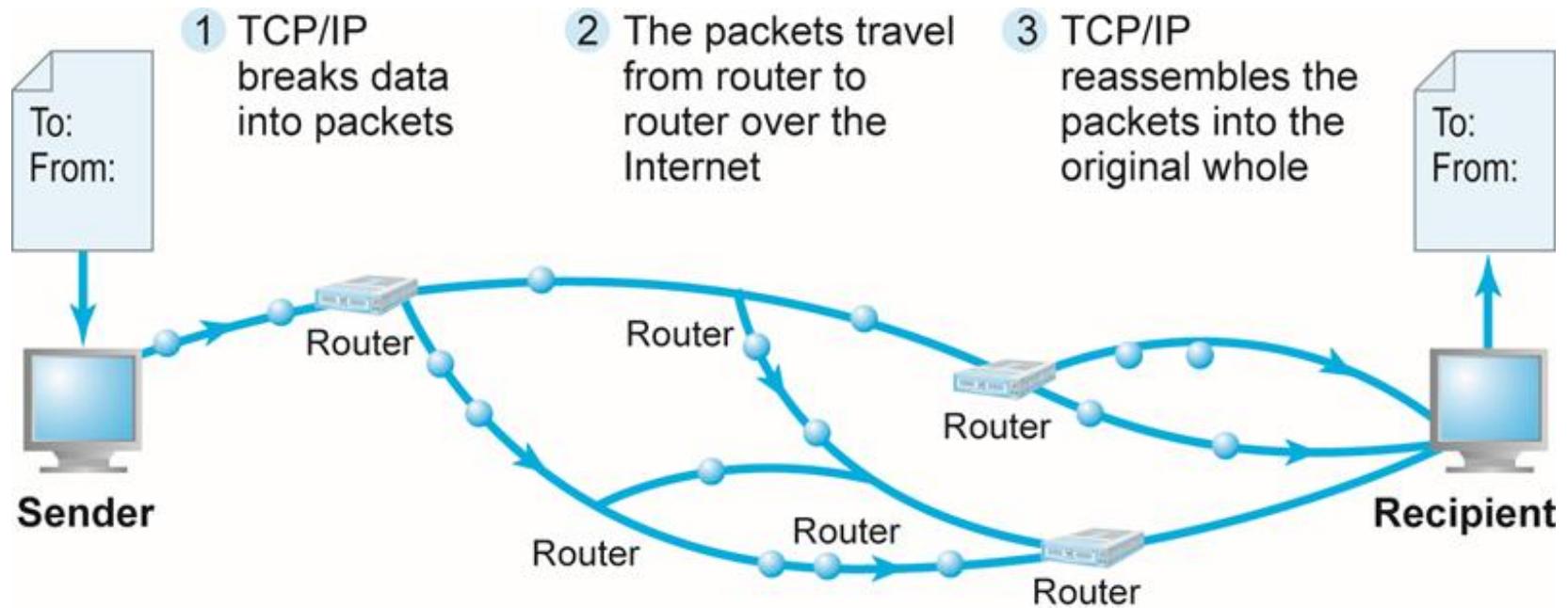
- Ethernet: Ethernet is one of the most widely used LAN (Local Area Network) technologies and is defined under IEEE standards 802.3.
Ethernet是最廣泛使用的 LAN 技術之一，由 IEEE 標準 802.3 定義.
- Token Ring is a computer networking technology used to build local area networks.
令牌環是一種用于構建局域網絡的計算機網絡方法.
- Frame Relay: Frame Relay is a standardized wide area network (WAN) technology that specifies the physical and data link layers of digital telecommunications channels using a packet switching methodology.
幘中繼是一種標準化的廣域網技術，它使用分組交換方法指定數字電信信道的物理層和數據鏈路層.
- ATM: ATM (Asynchronous Transfer Mode) is a cell-switching, connection-oriented technology.
异步傳輸模式是一種單元交換、面向連接的技術.

2. The Internet: Key Technology Concepts

IP Addresses

- Two versions of IP : IPv4 and IPv6.
 - An **IPv4 Internet address** is a 32-bit number that appears as a series of four separate numbers marked off by periods, such as 64.49.254.91. Each of the four numbers can range from 0–255. This addressing scheme supports up to about 4 billion addresses (2 to the 32nd power). In a typical Class C network, network identified by first three sets of numbers, a computer identified by last number.
IPv4 Internet地址有32位表示為用句點分割的四個獨立數字，例如 64.49.254.91。這四個數字中的每個數的範圍是0–255。這種編制方案支持多達近40億個地址 (2^{32})。在典型的C類網絡中，前三個數字用來標識網絡，最後一個數字用來識別某一台計算機。
 - An **IPv6 Internet address** is 128 bits, so it can support up to 2^{128} (3.4×10^{38}) addresses, many more than IPv4.
IPv6 Internet地址為128位，因此它最多可支持 2^{128} (3.4×10^{38}) 個地址，比IPv4多得多。

2. The Internet: Key Technology Concepts



Routing Internet Messages: TCP/IP and Packet Switching
Internet中的信息傳遞：TCP/IP協議與包交換

2. The Internet: Key Technology Concepts

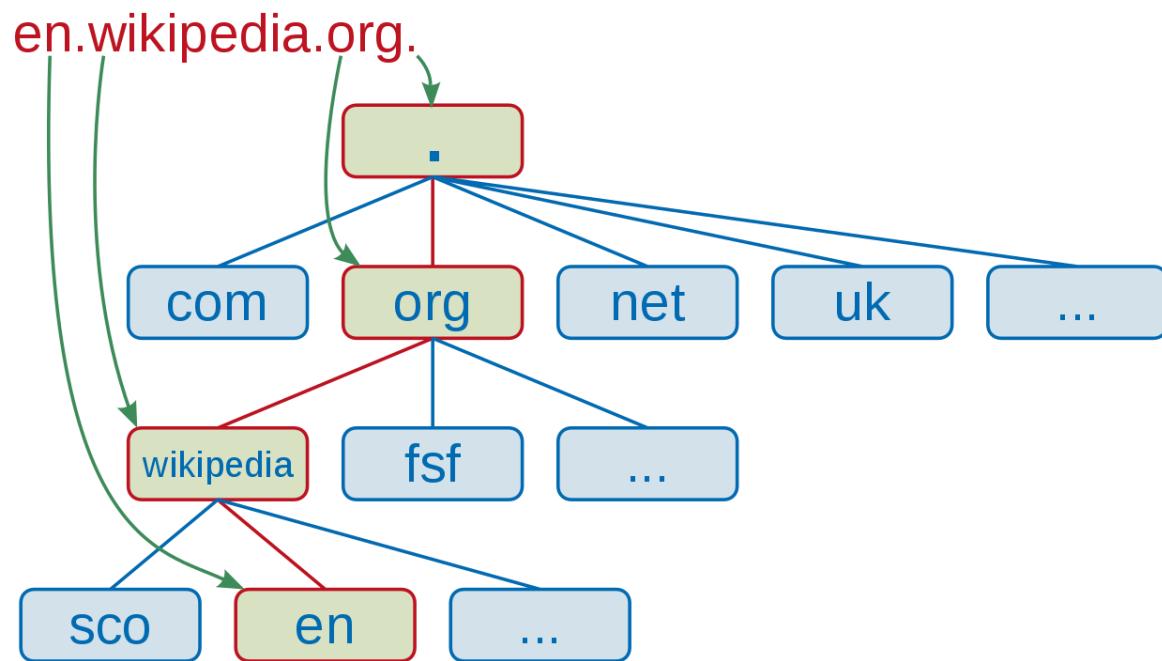
Domain Names, DNS, and URLs

- An IP address can be represented by a natural language convention called a **domain name**.
IP地址可以用稱為域名的自然語言約定來表示.
- The **Domain Name System (DNS)** allows expressions such as Google.com to stand for a numeric IP address (google.com's numeric IP is 172.217.12.206).
域名系統(DNS)允許諸如Google.com這樣的字符串代替數字形式的IP地址 (google.com的IP是172.217.12.206) .
- A **Uniform Resource Locator (URL)** is the address used by a web browser to identify the location of content on the Web and uses a domain name as part of the URL. A typical URL contains the protocol to be used when accessing the address, followed by its location.
统一资源定位器 (URL) 是用網絡浏览器识别網頁內容位置的地址，它也使用域名作为 URL 的一部分. 典型的URL包含访问地址时要使用的协议和訪問資源的位置.

e.g.: <https://www.pearson.com> refers to the IP address 159.182.41.80 with the domain name pearson.com and the protocol being used to access the address, HTTPS.

<https://www.pearson.com> 指向的 IP 地址是159.182.41.80， 域名為 pearson.com， 訪問該地址所使用的協議 HTTPS (超文本傳輸安全協議) .

2. The Internet: Key Technology Concepts



The hierarchical domain name system
域名系統的層次結構

2. The Internet: Key Technology Concepts

PIECES OF THE INTERNET PUZZLE: NAMES AND ADDRESSES

IP addresses	Every device connected to the Internet must have a unique address number called an Internet Protocol (IP) address.
Domain names	The Domain Name System allows expressions such as Pearsoned.com (Pearson Education's website) to stand for numeric IP locations.
DNS servers	DNS servers are databases that keep track of IP addresses and domain names on the Internet.
Root servers	Root servers are central directories that list all domain names currently in use for specific domains; for example, the .com root server. DNS servers consult root servers to look up unfamiliar domain names when routing traffic.

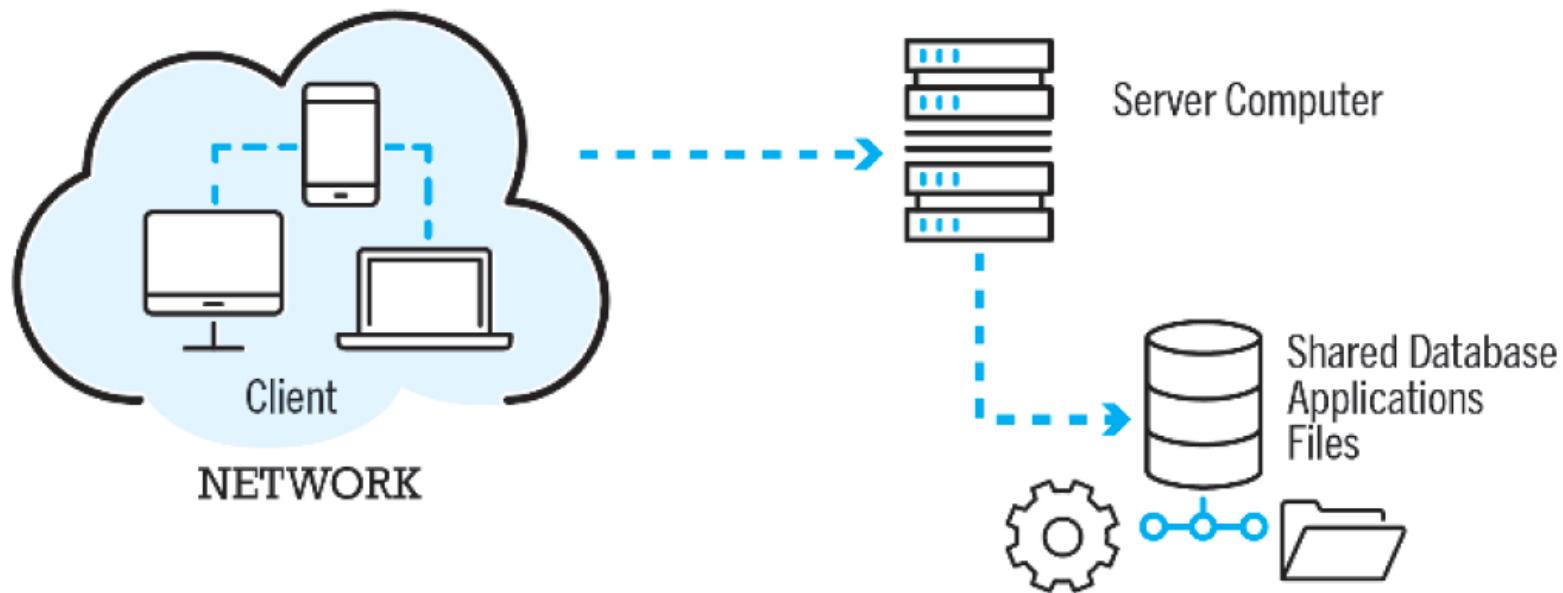
2. The Internet: Key Technology Concepts

Client/server computing

- **Client/server computing** is a model of computing in which **client** computers are connected in a network with one or more **servers**, which are computers that are dedicated to performing common functions that the client computers on the network need, such as **file storage, software applications, printing, and Internet access.**

客戶端/服務器計算是一種計算模型，其中客戶端計算機與與網絡中的一台或多台服務器進行連接，這些服務器是滿足客戶端計算機在網絡環境下產生的各種需求的計算機，例如文件存儲、軟件應用程序、打印和 Internet 訪問。

2. The Internet: Key Technology Concepts



Client/server computing model
客戶端/服務器計算模型

3. The Mobile Platform

- Accessing the Internet worldwide is through highly portable smartphones and tablet computers, and not traditional desktop or laptop PCs.
- Smartphones are a disruptive technology that radically alters the personal computing and e-commerce landscape.
- In 2019, about 3.3 billion people worldwide used a mobile phone to access the Internet (eMarketer, Inc., 2019b).
- The mobile platform has profound implications for e-commerce because it influences **how, where, and when** consumers shop and buy.

4. The Internet “Cloud Computing” Model

- **Cloud computing** is 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.
雲計算是一種基于網絡，將計算機處理、存儲、軟件和其他服務作爲虛擬資源，通過Internet實現用戶共享的計算模式.
- Consist of three types of services
 - Infrastructure as a service (IaaS) 基礎架構即服務
 - Software as a service (SaaS) 軟件即服務
 - Platform as a service (PaaS) 平台即服務

4. The Internet “Cloud Computing” Model

Infrastructure as a service (IaaS) 基礎架構即服務

- Customers use processing, storage, networking, and other computing resources from third-party providers called cloud service providers (CSPs) to run their information systems.

客戶使用第三方提供商即雲服務提供商 (CSP) 提供配置處理、存儲、網絡和其他計算資源來運行其信息系統。

e.g.: Amazon used the spare capacity of its information technology infrastructure to develop Amazon Web Services (AWS), which offers a cloud environment for a myriad of different IT infrastructure services.

亞馬遜利用其信息技術基礎設施的備用容量開發了Amazon Web Services，為各種不同的IT基礎架構服務提供了雲服務。

4. The Internet “Cloud Computing” Model

Software as a service (SaaS) 軟件即服務

- Customers use software hosted by the vendor on the vendor's cloud infrastructure and delivered as a service over a network.

客戶通過網絡訪問雲服務提供商在自己的雲基礎架構上運行的軟件軟件。

e.g.: Google Apps provides common business applications online, it charges users an annual subscription fee, although Google Apps also has a free version.

Google Apps在線提供常見的業務應用程序，它向用戶收取年度訂閱費，但Google Apps也有免費版。

4. The Internet “Cloud Computing” Model

Platform as a service (PaaS) 平台即服務

- Customers use infrastructure and programming tools supported by cloud service providers to develop their own applications.

客戶使用雲服務提供商提供的基礎架構和編程工具來開發自己的應用程序。

e.g.: IBM offers Bluemix for software development and testing on its cloud infrastructure.

IBM 在其雲基礎架構上提供用軟件開發和測試的Bluemix.

4. The Internet “Cloud Computing” Model

CLOUD COMPUTING MODELS COMPARED			
Type of Cloud	Description	Managed By	Uses
Public cloud	Third-party service offering computing, storage, and software services to multiple customers	Third-party service providers (CSPs)	Companies without major privacy concerns Companies seeking pay-as-you-go IT services Companies lacking IT resources and expertise
Private cloud	Cloud infrastructure operated solely for a single organization and hosted either internally or externally	In-house IT or private third-party host	Companies with stringent privacy and security requirements Companies that must have control over data sovereignty
Hybrid cloud	Combination of private and public cloud services that remain separate entities	In-house IT, private host, third-party providers	Companies requiring some in-house control of IT that are also willing to assign part of their IT infrastructures to a public cloud partition on their IT infrastructures

5. Other Internet Protocols and Programs

- Internet protocols
 - HTTP
 - E-mail: SMTP, POP3, IMAP
 - FTP, Telnet, SSL/TLS
- Programs
 - Ping
 - Tracert

5. Other Internet Protocols and Programs

- HTTP: **HyperText Transfer Protocol**, is the Internet protocol used to transfer web pages (described in the following section). HTTP was developed by the World Wide Web Consortium (W3C) and the Internet Engineering Task Force (IETF). HTTP runs in the Application Layer of the TCP/IP model.

超文本傳輸協議書專門用於傳輸網頁的Internet協議，是由萬維網連門和國際Internet工程任務組提出的，工作於TCP/IP協議中的應用層。

- SMTP: **Simple Mail Transfer Protocol** is the Internet protocol used to send e-mail to a server. SMTP is a relatively simple, text-based protocol that was developed in the early 1980s.

簡單郵件傳輸協議是專門負責向服務器發送電子郵件的Internet協議。SMTP是1980年代早期開發的一種相對簡單的基于文本的協議。

5. Other Internet Protocols and Programs

- POPO3, IMAP: **Post Office Protocol 3** is a protocol used by the client to retrieve mail from an Internet server, and then you can delete or retain the messages on the server. **Internet Message Access Protocol** a more current e-mail protocol that allows users to search, organize, and filter their mail prior to downloading it from the server.

第三方郵局協議是客戶端用來從Internet服務器取回電子郵件的協議，隨後可在服務器端刪除或保留。Internet消息訪問協議一種更常用的電子郵件協議，允許用戶在從服務器下載郵件之前搜索、整理和過濾。

- FTP: **File Transfer Protocol** is one of the original Internet services. FTP runs in TCP/IP's Application Layer and permits users to transfer files from a server to their client computer, and vice versa.

文件傳輸協議是最早出現的Internet服務之一。文件傳輸協議在TCP/IP應用層上工作，允許用戶將文件從服務器傳輸到客戶端計算機，反之亦然。

5. Other Internet Protocols and Programs

- Telnet: **Telnet** is a network protocol that also runs in TCP/IP's Application Layer and is used to allow remote login on another computer.

Telnet是一種網絡協議，運行在TCP/IP的應用層，用于允許在另一台計算機上遠程登錄。

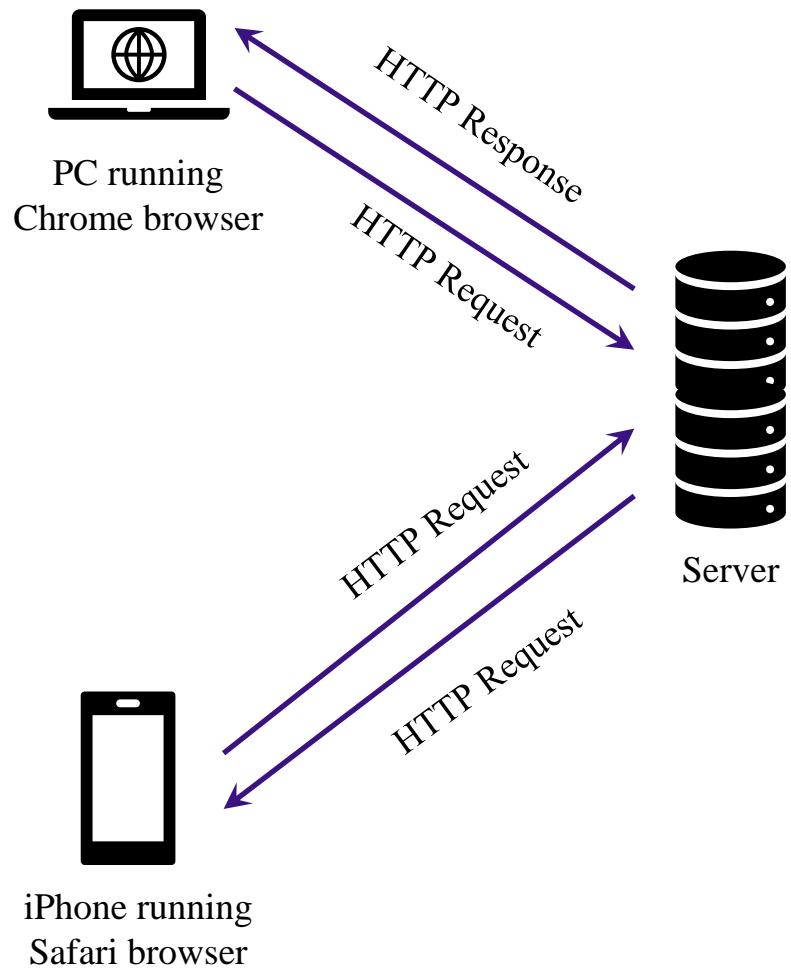
- SSL/TLS: **Secure Sockets Layer (SSL)/Transport Layer Security (TLS)** are protocols that operate between the Transport and Application Layers of TCP/IP and secure communications between the client and the server.

安全套接層協議 /安全傳輸層協議在TCP/IP的傳輸層和應用層間運行，用以保護客戶機和服務器之間的安全通信。

5. Other Internet Protocols and Programs

HTTP: HyperText Transfer Protocol

- Client/Server Model
 - Client: Browser that requests, receives (using HTTP protocol), and displays Web objects.
 - Server: Web server sends (using HTTP protocol) objects in response to requests.



5. Other Internet Protocols and Programs

SMTP: Simple Mail Transfer

POPO3, IMAP: Post Office Protocol 3, Internet Message Access Protocol

- SMTP is an email protocol for sending email messages from one email account to another via the internet. It is a part of the application layer of the TCP/IP protocol.

簡單郵件傳輸協議是一種電子郵件協議，通過互聯網將電子郵件從一個電子郵件帳戶發送到另一個電子郵件帳戶。它是TCP/IP協議應用層的一部分。

- IMAP (Internet Message Access Protocol) allows users to access and manage their emails directly on the email server.

互聯網消息訪問協議允許用戶直接在電子郵件服務器上訪問和管理他們的電子郵件。

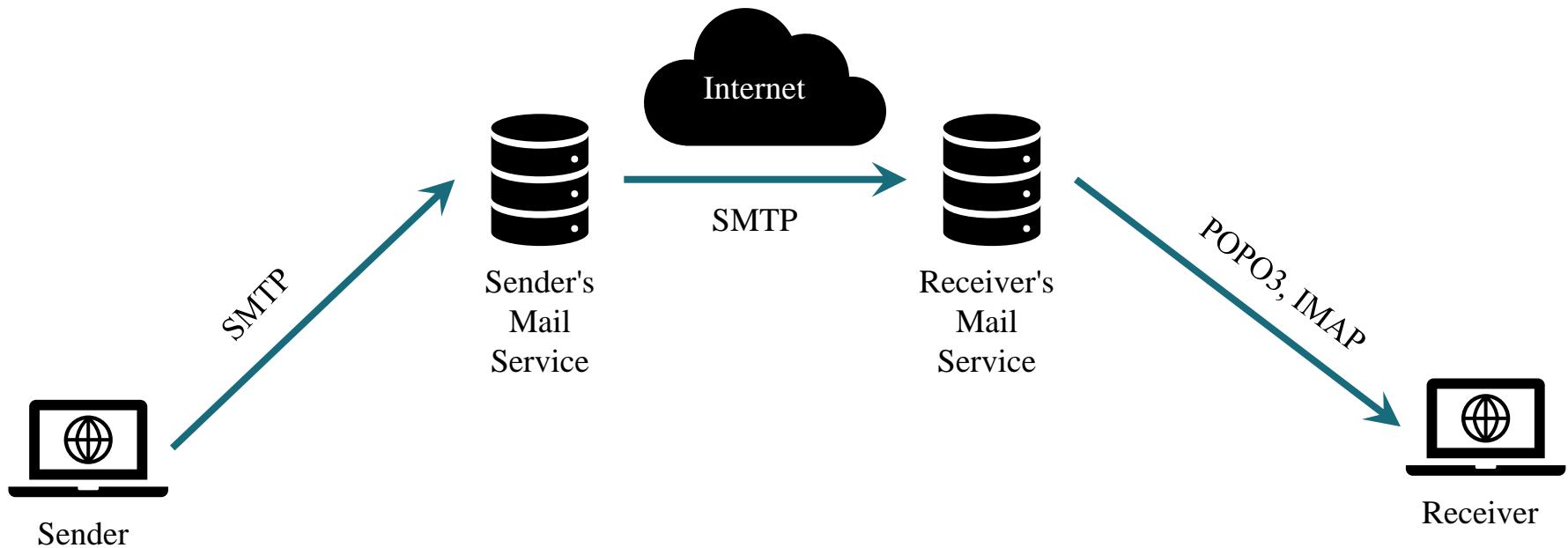
- POP (Post Office Protocol) downloads emails from the server to the client device.

郵局協議將電子郵件從服務器下載到客戶端設備。

5. Other Internet Protocols and Programs

SMTP: Simple Mail Transfer

POPO3, IMAP: Post Office Protocol 3, Internet Message Access Protocol



5. Other Internet Protocols and Programs

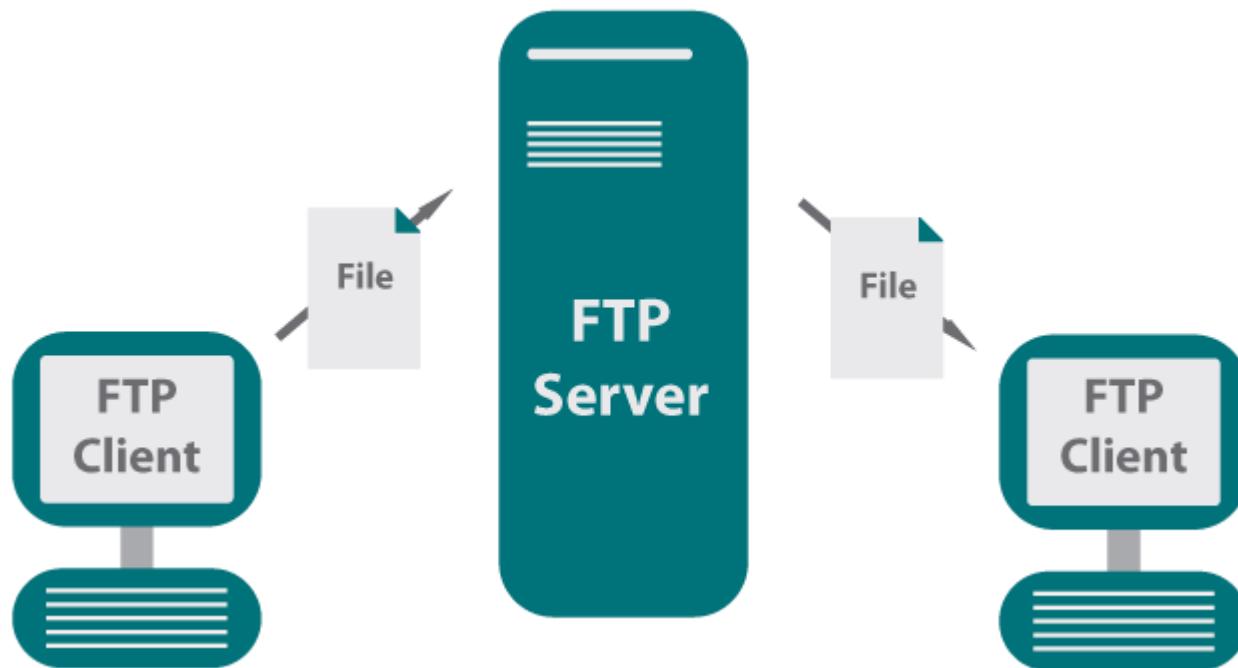
FTP: File Transfer Protocol

- FTP works on a client/server model. Files are uploaded from an FTP client to an FTP server where they can be accessed by an application or client. The FTP server runs a daemon that continuously listens for FTP requests from clients.

FTP 采用客戶端/服務器模型. 文件從 FTP 客戶端上傳到 FTP 服務器，然後應用程序或客戶端可以訪問這些文件. FTP 服務器運行守護進程，不斷監聽來自客戶端的 FTP 請求.

5. Other Internet Protocols and Programs

FTP: File Transfer Protocol



5. Other Internet Protocols and Programs

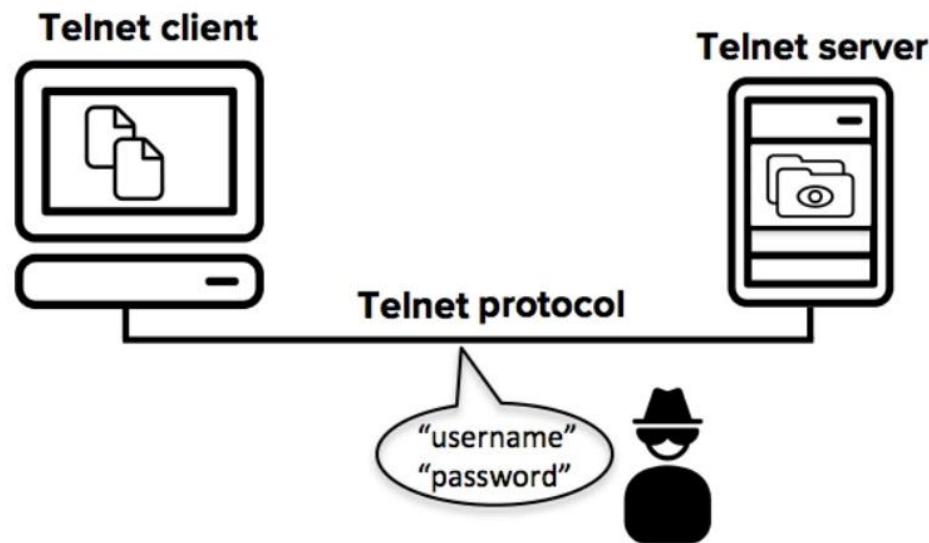
Telnet

- It is a client-server protocol, which means that a client device initiates the connection to a server device. The client sends commands to the server, and the server responds with output, allowing the user to interact with the remote system's command-line interface. It uses the Transmission Control Protocol as its underlying transport protocol.

它是一種客戶端-服務器協議，這意味著客戶端設備發起與服務器設備的連接。客戶端向服務器發送命令，服務器以輸出進行響應，從而允許用戶與遠程系統的命令行界面進行交互。它使用傳輸控制協議作為其底層傳輸協議。

5. Other Internet Protocols and Programs

Telnet



5. Other Internet Protocols and Programs

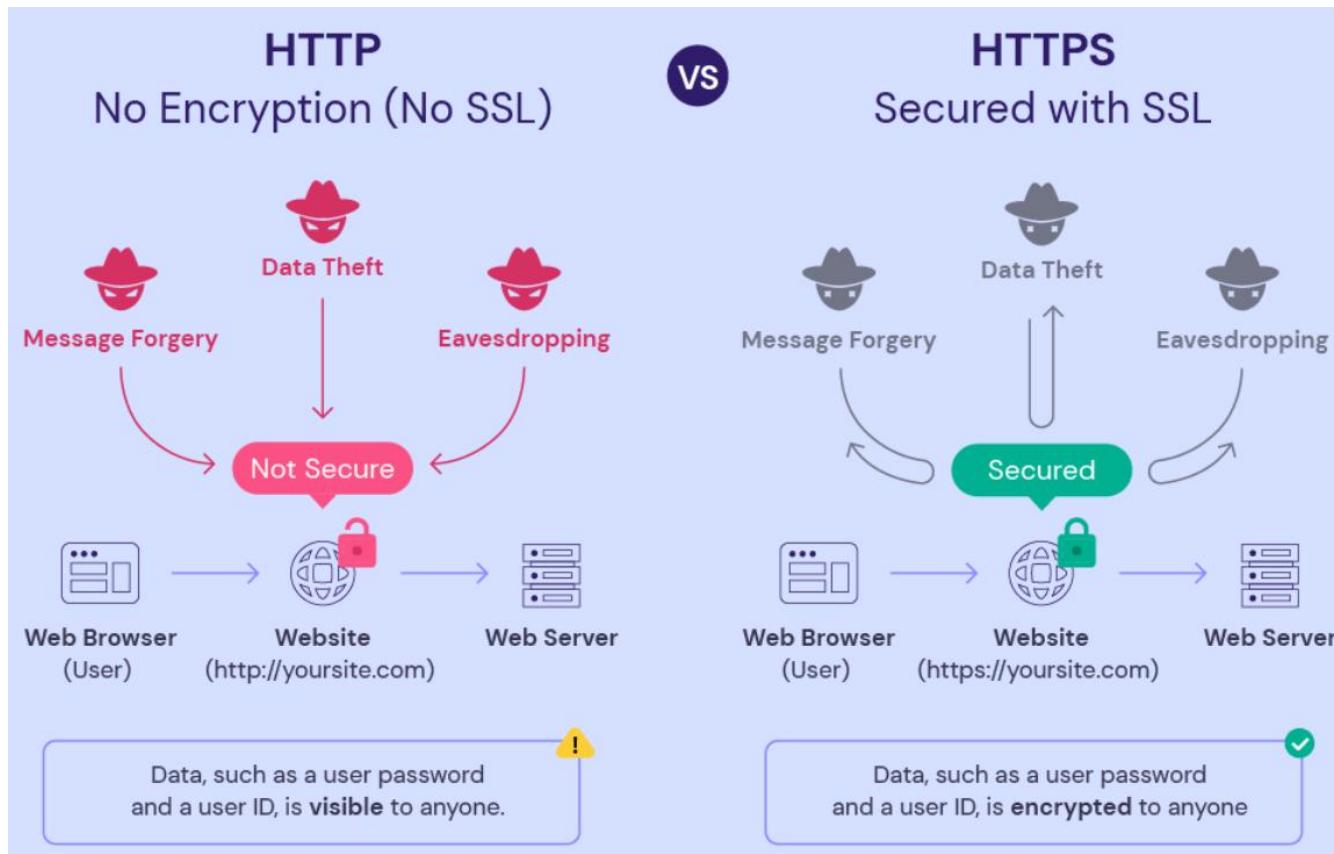
SSL/TLS: Secure Sockets Layer (SSL)/Transport Layer Security (TLS)

Secure Sockets Layer (SSL) is a communication protocol that creates a secure connection between two devices or applications on a network. It's important to establish trust and authenticate the other party before you share credentials or data over the Internet. SSL is technology your applications or browsers may have used to create a secure, encrypted communication channel over any network. However, SSL is an older technology that contains some security flaws. Transport Layer Security (TLS) is the upgraded version of SSL that fixes existing SSL vulnerabilities. TLS authenticates more efficiently and continues to support encrypted communication channels.

安全套接字層 (SSL) 是一種通信協議，用于在網絡上的兩個設備或應用程序之間建立安全連接。在通過 Internet 共享憑據或數據之前，重要的是要先建立信任並驗證對方身分。SSL是用戶的應用程序或瀏覽器可能用來在任何網絡上創建安全加密通信通道的技術。但是，SSL 是一種較舊的技術，存在一些安全漏洞。傳輸層安全性 (TLS) 是 SSL 的升級版本，可修復現有的 SSL 漏洞。TLS 的身份驗證效率更高，並繼續支持加密通信通道。

5. Other Internet Protocols and Programs

SSL/TLS: Secure Sockets Layer (SSL)/Transport Layer Security (TLS)



5. Other Internet Protocols and Programs

- Ping: **Packet InterNet Groper** is a utility program that allows you to check the connection between a client computer and a TCP/IP network. Ping will also tell you the time it takes for the server to respond, giving you some idea about the speed of the server and the Internet at that moment.

Packet InterNet Groper一個用來檢查客戶端計算機和TCP/IP網絡連接情況的使用程序。
Ping還會告訴服務器響應時間，幫助使用者估算服務器和網絡鏈接的速度。

- Tracert: **Tracert** is 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.

Tracert 是幾個常用的路由追蹤程序之一，可幫助使用者跟蹤數據從本地發往遠程計算機所通過的完成路徑。

5. Other Internet Protocols and Programs

```
命令提示符
C:\Users\lanti>ping www.must.edu.mo

正在 Ping www.must.edu.mo [172.16.130.18] 具有 32 字节的数据：
来自 172.16.130.18 的回复：字节=32 时间=6ms TTL=60
来自 172.16.130.18 的回复：字节=32 时间=3ms TTL=60
来自 172.16.130.18 的回复：字节=32 时间=3ms TTL=60
来自 172.16.130.18 的回复：字节=32 时间=7ms TTL=60

172.16.130.18 的 Ping 统计信息：
    数据包：已发送 = 4, 已接收 = 4, 丢失 = 0 (0% 丢失),
往返行程的估计时间(以毫秒为单位)：
    最短 = 3ms, 最长 = 7ms, 平均 = 4ms

C:\Users\lanti>
```

TTL (Time To Live)，指的是報文在網絡中能够“存活”的限制。就是當報文在網絡中轉發時，每經過一個路由點，就把預先設定的這個TTL數值減1，如果減到0了還是沒有傳送到目的主機，那麼就自動丟失。

5. Other Internet Protocols and Programs

A screenshot of a Windows Command Prompt window titled "命令提示符". The command `tracert 8.8.8.8` is entered, with a red arrow pointing to the target IP address. The output shows the traceroute path from the user's computer to Google's DNS server at 8.8.8.8, with 11 hops highlighted by a blue border and the final destination highlighted by an orange border. A red arrow points to the text "跟踪完成。" (Traceroute completed) at the bottom.

```
C:\Users\lanti>tracert 8.8.8.8 ←  
通过最多 30 个跃点跟踪  
到 dns.google [8.8.8.8] 的路由：  
1 5 ms 4 ms 3 ms 10.244.64.1  
2 15 ms 14 ms 14 ms 10.200.8.153  
3 3 ms 2 ms 2 ms 192.168.241.10  
4 15 ms 19 ms 11 ms 192.168.242.1  
5 19 ms 20 ms 21 ms z37l49.static.ctm.net [202.175.37.49]  
6 26 ms 22 ms 21 ms t26205-gw1.macau.ctm.net [202.175.26.205]  
7 28 ms 23 ms 22 ms s0146-pr5.macau.ctm.net [202.175.0.146]  
8 * 24 ms 24 ms 72.14.210.54  
9 16 ms 18 ms 30 ms 209.85.244.77  
10 23 ms 22 ms 23 ms 216.239.47.17  
11 23 ms 23 ms 23 ms dns.google [8.8.8.8]  
跟踪完成。←  
C:\Users\lanti>
```

5. Other Internet Protocols and Programs

```
命令提示符
C:\Users\lanti>tracert google.com ←
通过最多 30 个跃点跟踪
到 google.com [142.250.76.14] 的路由：
1  14 ms    3 ms    2 ms
2  9 ms    3 ms    4 ms
3  2 ms    2 ms    3 ms
4  8 ms    3 ms    3 ms
5  22 ms   22 ms   28 ms
6  22 ms   22 ms   22 ms
7  23 ms   *        24 ms
8  25 ms   23 ms   27 ms
9  24 ms   24 ms   26 ms
10  41 ms   38 ms   25 ms
11  26 ms   *        23 ms
10.244.64.1
10.200.8.153
192.168.241.10
192.168.242.1
z37l49.static.ctm.net [202.175.37.49]
t26205-gw1.macau.ctm.net [202.175.26.205]
s0146-pr5.macau.ctm.net [202.175.0.146]
72.14.210.54
209.85.244.23
72.14.232.155
nchkga-ac-in-f14.1e100.net [142.250.76.14]
跟踪完成。←
C:\Users\lanti>
```

5. Other Internet Protocols and Programs

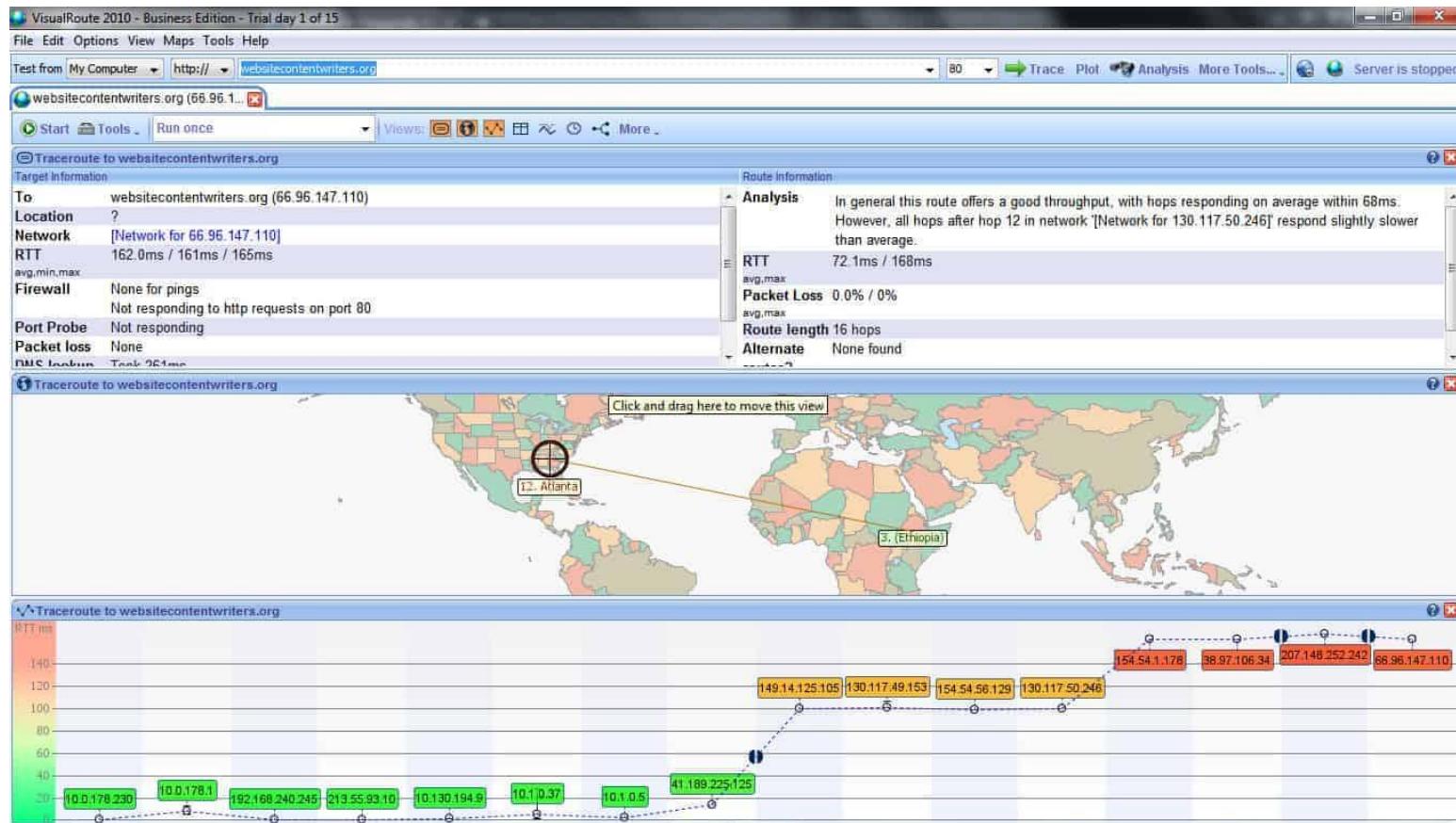
RED: For the first arrow, we have initiated the tracert command to the google.com router IP/domain or 8.8.8.8. The second arrow, the Tracert command, has been completed after hops.

YELLOW: The beginning column displays the hop number starting from 1 and incrementing with each hop along the route from your device to the destination. Each hop represents an intermediate device, such as a router, that the packet passes through while traveling to the final destination..

BLUE: The three center columns display the round-trip time in milliseconds (ms) for a packet to travel from your device to the router, at that specific hop, and back to your device. It's known as the "ping time" or "ping latency" and measures the delay in milliseconds for data to travel to the router and return. Network latency can be affected by factors such as network congestion, the quality of network links, and the distance between hops..

ORANGE: The end column displays either the IP address or the hostname of the router or intermediate device at that specific hop in the network path. In most cases, you'll see the IP address, but if reverse DNS lookup is successful, it displays the hostnames, which can help identify routers by name.

5. Other Internet Protocols and Programs



Part II:

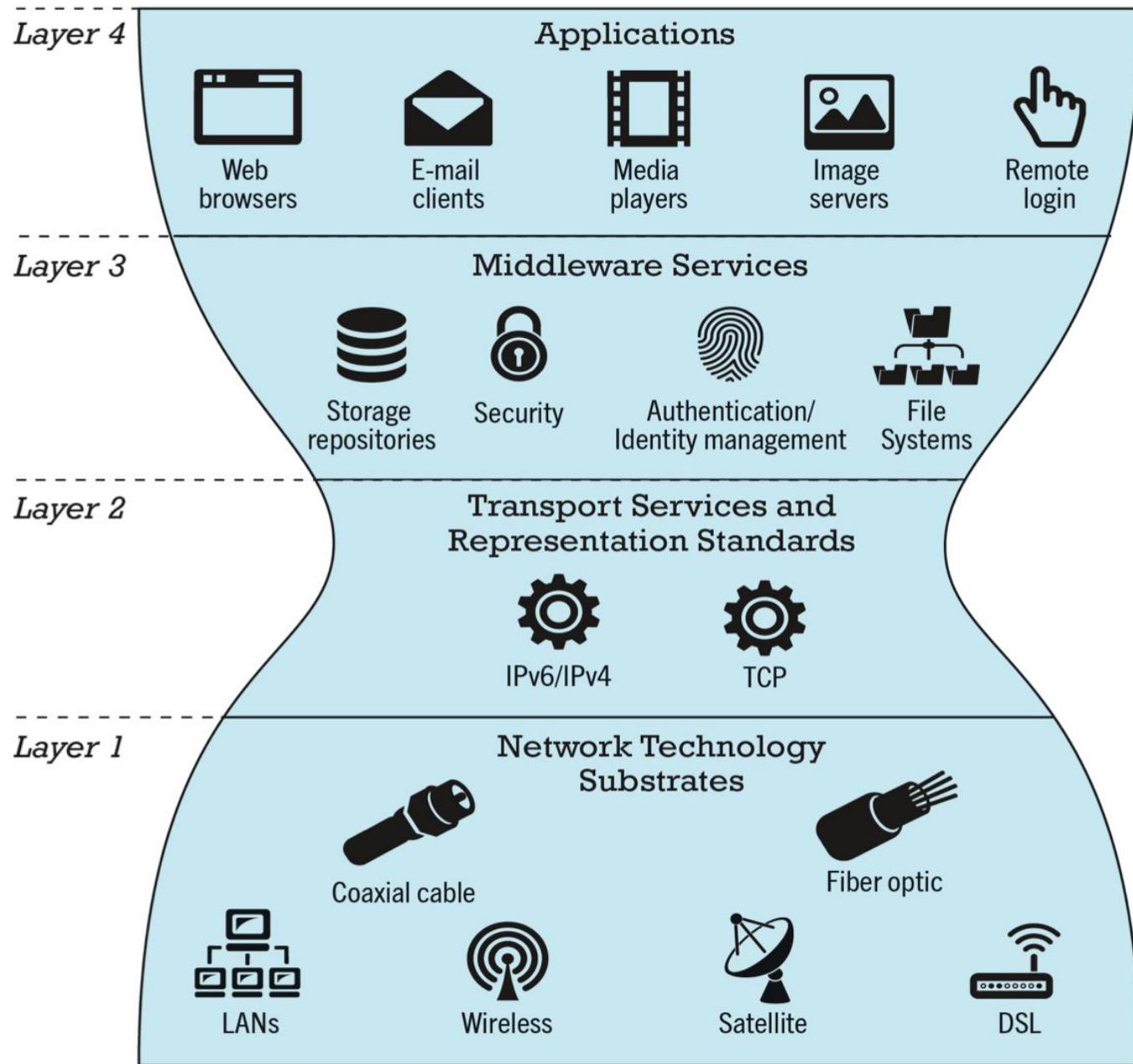
The Internet Today

The Internet Today

- In 2021, there were an estimated 4 billion Internet users worldwide.
2021年，全球大概有40億Internet用戶
- The Internet has four layers:
 - Network Technology Substrate Layer 網絡技術底層
 - Transport Services and Representation Standards Layer 傳輸服務和表示標準層
 - Middleware Services Layer 中間件服務層
 - Applications Layer 應用層

The Internet Today

- Network Technology Substrate Layer 網絡技術底層
 - It is composed of telecommunications networks and protocols.
該層由遠程通信網絡和協議構成。
- Transport Services and Representation Standards Layer 傳輸服務和表示標準層
 - It houses the TCP/IP protocol.
該層主要包括TCP/IP協議。
- Middleware Services Layer 中間件服務層
 - It is the glue that ties the applications to the communications networks and includes such services as security, authentication, addresses, and storage repositories.
該層是幫助客戶端應用與通信網絡進行溝通的橋梁，可以提供加密、認證、尋址和存儲等各種服務。
- Applications Layer 應用層
 - It contains client applications such as the Web, e-mail, and audio or video playback.
該層包括萬維網、電子郵件、音頻和視頻播放等各種客戶端應用。



1. The Internet Backbone

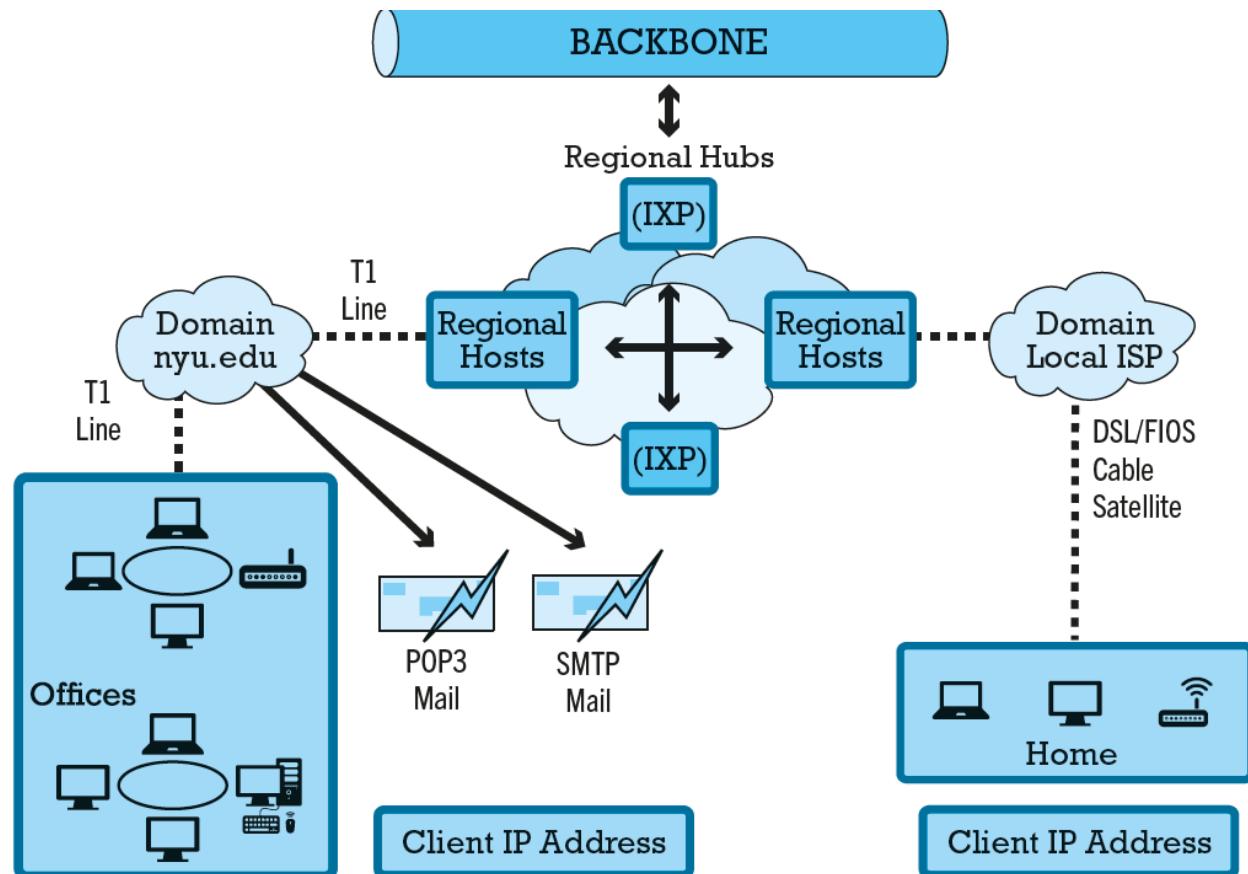
- The Internet's **backbone** is created by numerous privately owned networks comprised of high-bandwidth fiber-optic cable that are physically connected with each other and that transfer information from one private network to another. These long-haul fiber-optic networks are owned by firms referred to as **Tier 1 Internet Service Providers**.

Internet的主幹網由大量私有網絡交織而成，這些網絡由高帶寬光纖電纜連接，信息可從一個專有網絡傳輸到另一個。這些長途光纖網絡由被稱為一級Internet服務提供商的企業擁有。

1. The Internet Backbone

Today's Internet has a multi-tiered open network architecture featuring multiple backbones, regional hubs, campus/corporate area networks, and local client computers.

當前的互聯網具有多層開放網絡架構，主要由多個主幹網、區域網絡中心、校園/企業區域網絡和本地客戶端構成。



Internet Network Architecture

1. The Internet Backbone

- Tier 1 ISPs have “peering” arrangements with other Tier 1 ISPs to allow Internet traffic to flow through each other’s cables and equipment without charge. Tier 1 ISPs deal only with other Tier 1 or Tier 2 ISPs (described in the next section) and not with end consumers.

MAJOR U.S. TIER 1 (TRANSIT) INTERNET SERVICE PROVIDERS	
AT&T	NTT Communications (America)
CenturyLink	Sprint
Cogent Communications	Verizon
GTT Communications	Zayo Group

1. The Internet Backbone

- The **backbone** has been likened to a giant pipeline that transports data around the world in milliseconds.

主幹網就好比一條巨大的傳輸通道，可以讓數據在幾毫秒內傳輸到世界各地。

- The backbone has built-in redundancy so that if one part breaks down, data can be rerouted to another part of the backbone. **Redundancy** refers to multiple duplicate devices and paths in a network.

主幹網具有適當的冗餘設計，以備在局部發生故障時，可以通過主幹網的其他節點繼續發送數據。冗餘是指網絡中的重复设备和傳輸路径。

- Connections to other continents are made via a combination of undersea fiber-optic cable and satellite links.

全世界網絡的洲際互聯普遍采用海底光纜連接和衛星連接。

- Bandwidth measures how much data can be transferred over a communications medium within a fixed period of time and is usually expressed in bits per second (Bps), kilobits (thousands of bits) per second (Kbps), megabits (millions of bits) per second (Mbps), or gigabits (billions of bits) per second (Gbps).

帶寬是指在固定時間段內可以通過通信介質傳輸的數據量。衡量單位：每秒傳輸位數、每秒傳輸千位數、每秒傳輸兆位數、每秒傳輸千兆位數等。

2. Internet Exchange Points (IXPs)

- Internet Exchange Points (IXPs) are regional hubs where Tier 1 ISPs physically connect with one another and/or with regional Tier 2 ISPs [originally called Network Access Points (NAPs) or Metropolitan Area Exchanges (MAEs)].

Internet交換點[最初稱為網絡接入點或城域交換局]是一級ISP相互連接並與（或）區域性二級ISPs相連的區域樞紐。

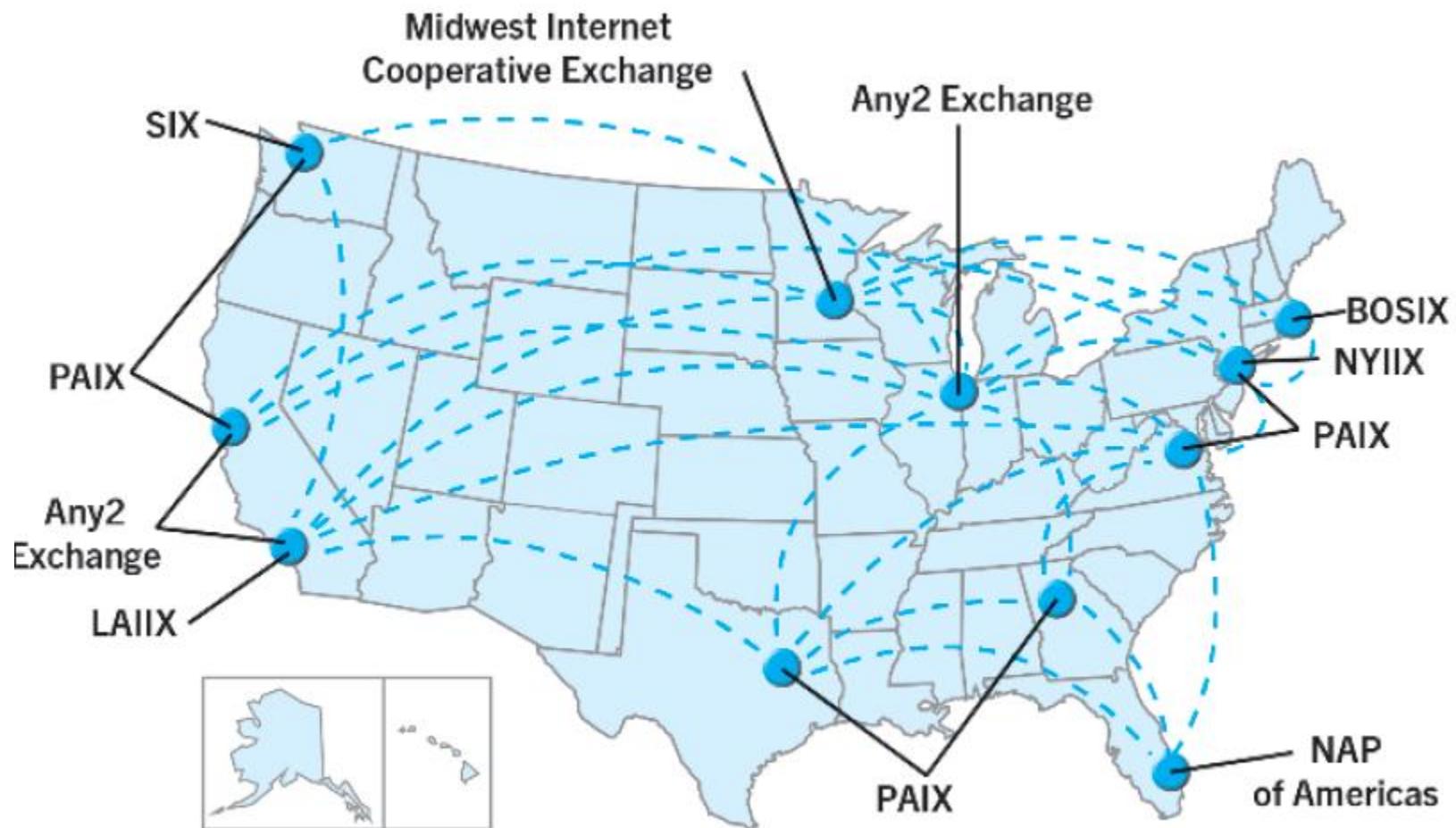
- Tier 2 ISPs provide Tier 3 ISPs with Internet access.

二級ISP為三級ISP提供Internet接入。

- Tier 2 ISPs exchange Internet traffic both through peering arrangements as well as by purchasing Internet transit, and they connect Tier 1 ISPs with Tier 3 ISPs. Tier 3 ISPs provide Internet access to consumers and business.

二級ISP通過對等操作和購買Internet傳輸完成Internet流量交換，並以此連接一級ISPs與三級ISPs。三級ISPs為消費者和企業提供Internet接入服務。

2. Internet Exchange Points (IXPs)



SOME MAJOR U.S. INTERNET EXCHANGE POINTS (IXPs)

2. Internet Exchange Points (IXPs)

- 中國大陸-在2000年左右，在上海、北京、廣州三地先行設立骨幹直連點和Internet交換中心，實現了Internet骨幹層面的互聯互通。從2019年起，開始啓動新型Internet交換中心試點，探索推動區域級網絡互聯，提升網間互通性能，應對數字時代業務發展需要。目前工業和信息化部結合我國Internet整體架構與產業發展特點，共正式批復浙江杭州、寧夏中衛、深圳前海與上海臨港四個新型Internet交換中心試點。



3. Tier 3 Internet Service Providers

- The firms that provide the lowest level of service in the multi-tiered Internet architecture by leasing Internet access to home owners, small businesses, and some large institutions are called **Tier 3 Internet Service Providers** that are retail providers.

在多層Internet架構中通過向家庭用戶、小型企業和一些大型機構出租Internet接入綫路來提供最低級別服務的企業被稱為三級Internet服務提供商，他們屬於零售企業。

- Type of Internet Services**

- Narrowband 窄寬
- Broadband 寬帶
- Digital subscriber line (DSL) 數字用戶綫路
- Cable Internet 有綫網絡
- Satellite Internet 衛星網絡

3. Tier 3 Internet Service Providers

Narrowband 窄寬

- **Narrow band** service is the traditional telephone modem connection now operating at 56.6 Kbps.

窄帶服務主要使用速度為 56.6 Kbps 的傳統電話調制解調器進行連接。

Broadband 寬帶

- **Broadband** refers to any communication technology that permits clients to play audio and video files at acceptable speeds (Benchmark speeds to 25 Mbps for downloads and 3 Mbps for uploads).

寬帶是指允許客戶端以可接受的速度播放音頻和視頻文件的通信技術（基準速度：下載速度為 25 Mbps，上傳速度為 3 Mbps）。

Digital subscriber line (DSL) 數字用戶線路

- **Digital subscriber line** delivers high-speed access through ordinary telephone lines found in homes or businesses (Service levels typically range from about .5 to 15 Mbps). An advanced form of DSL called **FiOS (fiber-optic service)** provides up to 500 Mbps to homes and businesses.

數字用戶線路通過家庭或企業中的普通電話線路提供高速接入（接入速度 0.5 到 15 Mbps）。一種稱為 FiOS（光纖服務）的進階版 DSL 為家庭和企業提供高達 500 Mbps 的速度。

3. Tier 3 Internet Service Providers

Cable Internet 有線網絡

- **Cable Internet** refers to a cable television technology that piggybacks digital access to the Internet using the same analog or digital video cable providing television signals to a home (typically 15 Mbps up to 300 Mbps).

有线網絡是指一种通過家庭接受電視信號的模擬視頻綫纜傳輸數字信號以接入Internet的有線技術（通常15 Mbps 到 300 Mbps）.

Satellite Internet 衛星網絡

- **Satellite Internet** is offered by satellite companies that provide high-speed broadband Internet access primarily to homes and offices located in rural areas where DSL or cable Internet access is not available.

衛星Internet由衛星公司提供，主要為無法使用 DSL 或有線Internet接入的郊區家庭和辦公室提供高速寬帶網絡接入.

3. Tier 3 Internet Service Providers

INTERNET ACCESS SERVICE CHOICES	
SERVICE	DOWNLOAD SPEED
Telephone modem	30–56 Kbps
DSL	1–35 Mbps
Fios	25–940 Mbps
Cable Internet	15–600 Mbps
Geostationary (GEO) Satellite	5–100 Mbps
Low-earth orbit (LEO) Satellite	50–150 Mbps
T1	1.54 Mbps
T3	45 Mbps

cable Internet

piggybacks digital access to the Internet on top of the video cable providing television signals to a home

satellite Internet

high-speed broadband Internet access provided via satellite

broadband

refers to any communication technology that permits clients to play streaming audio and video files at acceptable speeds

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

Digital Subscriber Line (DSL)

delivers high-speed access through ordinary telephone lines found in homes or businesses

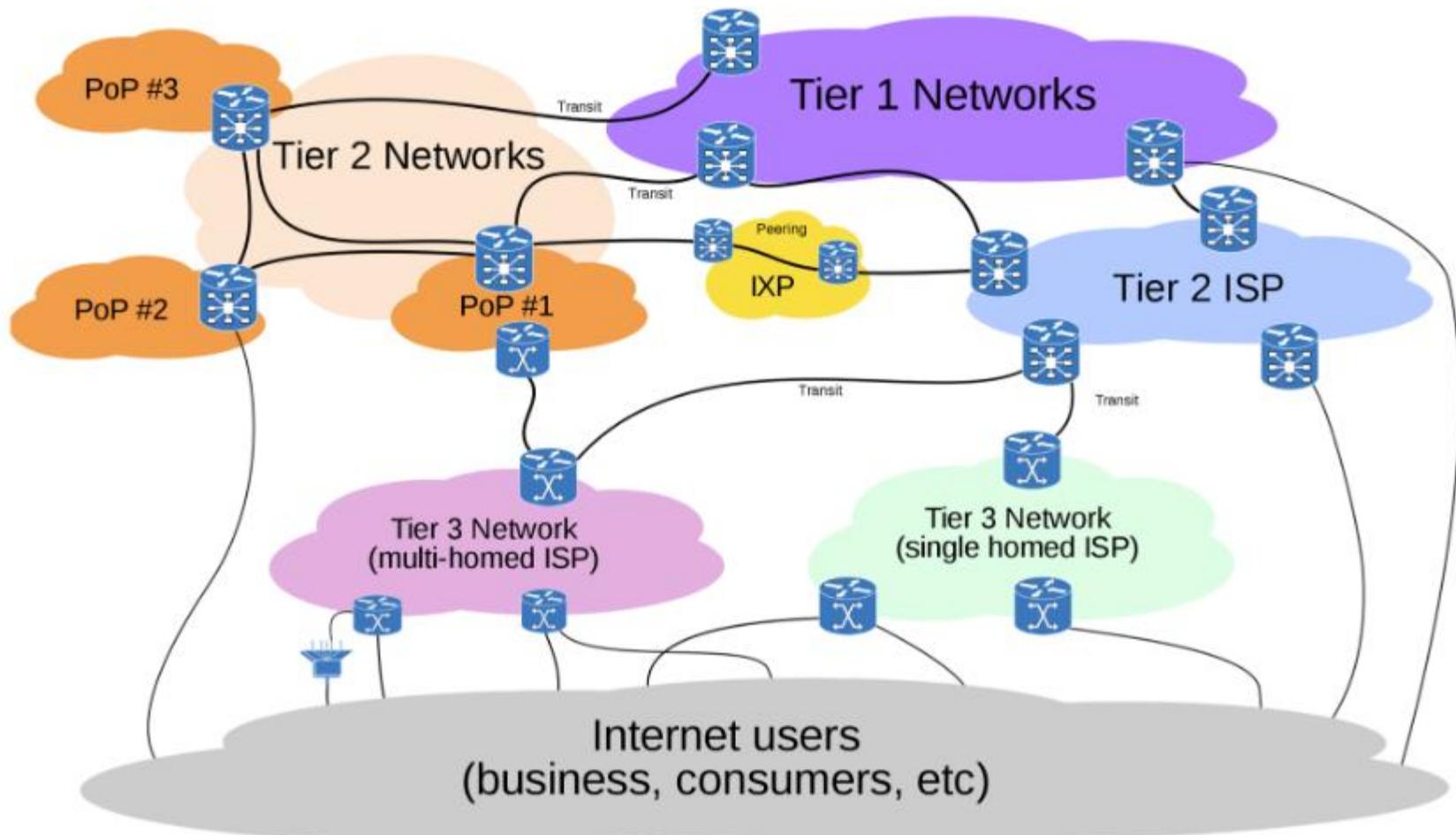
Fios (fiber-optic service)

a form of DSL that provides speeds of up to 940 Mbps

3. Tier 3 Internet Service Providers

TIME TO DOWNLOAD A 10-MEGABYTE FILE BY TYPE OF INTERNET SERVICE	
TYPE OF INTERNET SERVICE	TIME TO DOWNLOAD
Telephone modem @ 56 Kbps	25 minutes
DSL @ 1 Mbps	1.33 minutes
T1 @ 1.54 Mbps	52 seconds
Cable Internet @ 25 Mbps	3 seconds
T3 @ 45 Mbps	2 seconds
Cable Internet @ 100 Mbps	0.84 second
Cable Internet @ 1 Gbps	0.08 second

Three Tiers Internet



4. Campus/Corporate Area Networks

- **Campus/corporate area networks (CANs)** are generally local area networks operating within a single organization that leases access to the Web directly from regional and national carriers.

校園與公司局域網通常是在某一組織內運行的局域網絡，它們直接向區域和國家運營商處租用網絡接入線路實現網絡訪問。

- Connection speeds in campus area networks are in the range of 10–100 Mbps to the desktop.

校園網的連接速度在10–100 Mbps間。

5. Intranet

- Intranet 內部網
 - TCP/IP network located within a single organization for communications and processing
運行于單一組織內部，以網絡通信和信息處理為主要目的的TCP/IP網絡
 - Used by private and government organizations for internal networks
被企業和政府機構用來構建自己的內部網絡
 - All Internet applications can be used in private intranets
所有運行于Internet的應用程序都可在獨立的內部網中正常使用

6. Mobile Internet Access

- *Telephone-based wireless Internet access* connects the user to a global telephone system.

基于手機的無線Internet接入將用戶連接到全球電話系統。

TELEPHONE-BASED WIRELESS INTERNET ACCESS TECHNOLOGIES		
TECHNOLOGY	SPEED	DESCRIPTION
3G (Third Generation)	144 Kbps–2 Mbps	Enabled mobile browsing, e-mail, and instant messaging. Much slower than current technologies. U.S. cellular carriers will begin to shut down their legacy 3G networks in 2022 to free wireless spectrum space for 5G.
4G (Fourth Generation)	Up to 100 Mbps	True broadband on cellphone; lower latency than previous generations.
5G (Fifth Generation)	Up to 10 Gbps	Goals include 1–10 Gbps connectivity and sub-10-millisecond latency. Is expected to enable and/or enhance services such as autonomous driving, augmented reality, virtual reality, and the metaverse.

6. Mobile Internet Access

- *Wireless local area network (WLAN)-based Internet access.* WLANs are based on computer local area networks where the task is to connect client computers to server computers within local areas of, say, a few hundred meters

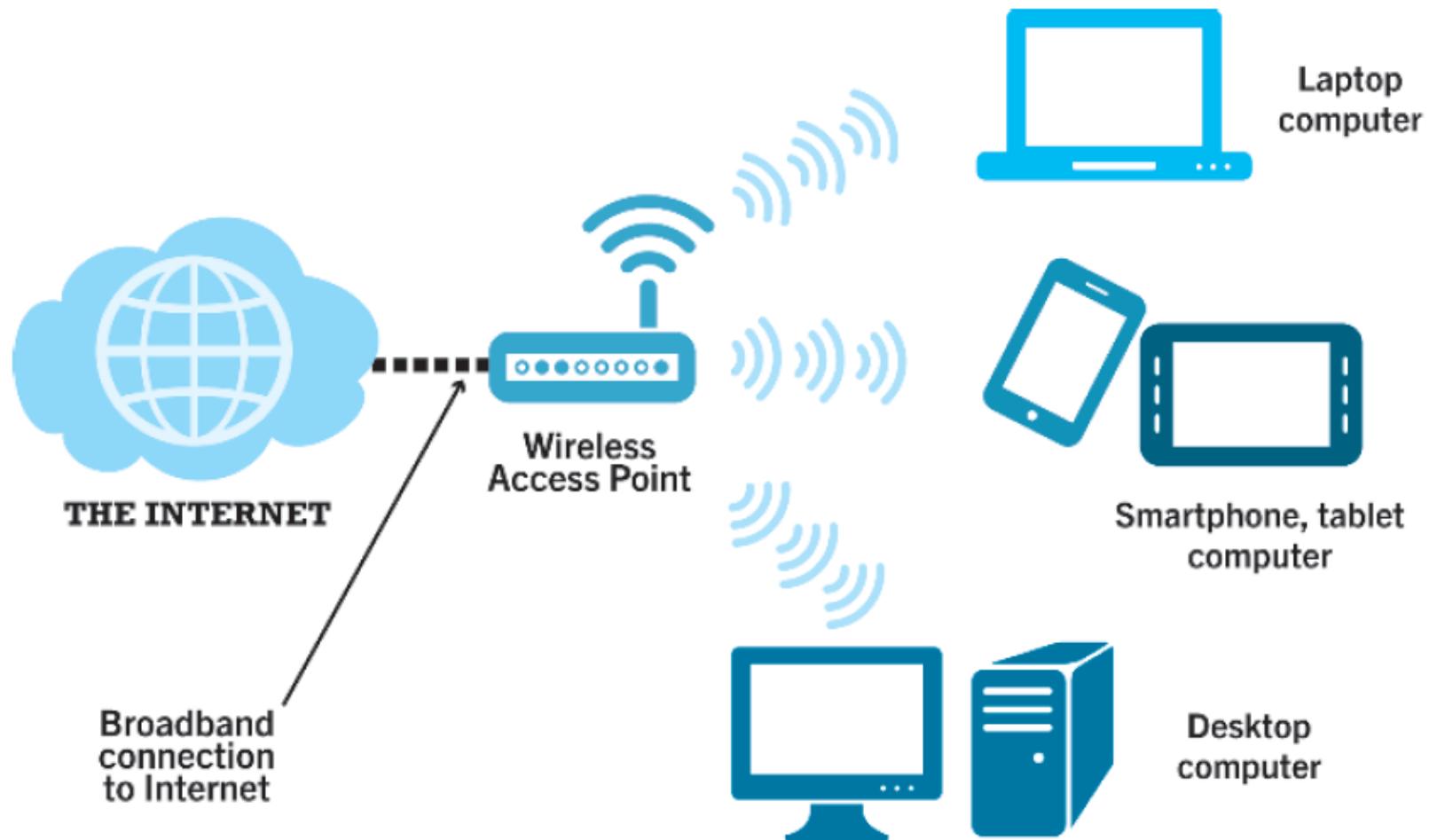
基于無線局域網 (WLAN) 的 Internet 訪問。 WLAN 基于計算機局域網，其任務是將客戶端計算機連接到本區域內的服務器計算機（例如幾百米）。

- Popularly known as Wi-Fi, Wi-Fi functions by sending radio signals that are broadcast over the airwaves using certain radio frequency ranges (2.4 GHz to 5.875 GHz, depending on the type of standard involved).

Wi-Fi 通過使用某些無線電頻率範圍 (2.4 GHz 到 5.875 GHz, 取決于所涉及的標準類型) 發送無線電信號來發揮作用。

TABLE 3.10 NETWORK-BASED WIRELESS INTERNET ACCESS TECHNOLOGIES		
TECHNOLOGY	RANGE/SPEED	DESCRIPTION
Wi-Fi (IEEE 802.11 a/b/g)	35–140 meters/11–54 Mbps	Early high-speed, fixed broadband wireless local area network standards for commercial and residential use
802.11n (Wi-Fi 4)	70–250 meters/up to 288 Mbps	Used multiple antennas to increase throughput and range
802.11ac (Wi-Fi 5)	35 meters/500 Mbps–1 Gbps	Enhanced version of 802.11n/Wi-Fi 4 that provides higher throughput
802.11ax (Wi-Fi 6)	35 meters/up to 10 Gbps	Successor to 802.11ac/Wi-Fi 5 operates over a greater range of frequencies and with higher throughput
802.11ad (WiGig)	less than 10 meters/up to 7 Gbps	High-speed, short-range Wi-Fi
WiMax (IEEE 802.16)	30 miles/50–70 Mbps	High-speed, medium-range, broadband wireless metropolitan area network
Bluetooth (wireless personal area network)	1–30 meters/1–3 Mbps	Modest-speed, low-power, short-range connection of digital devices

6. Mobile Internet Access



WI-FI NETWORKS

7. The Internet of Things (IoT)

- **The Internet of Things (IoT)** refers to the real-time collection of any objects or processes that need to be monitored, connected, and interacted through various information sensors, radio frequency identification technologies, global positioning systems, infrared sensors, laser scanners and other devices and technologies. Collect various required information such as sound, light, heat, electricity, mechanics, chemistry, biology, location, etc., and **realize the ubiquitous connection of objects and objects, objects and people through various possible network accesses**, and **realize the ubiquitous connection of objects and people**. Intelligent perception, recognition and management of the process. The Internet of Things is an information carrier **based on the Internet and traditional telecommunications networks**. It allows all ordinary physical objects that can be independently addressed to form an interconnected network.
- 物聯網是指通過各種信息傳感器、射頻識別技術、全球定位系統、紅外感應器、激光掃描器等各種裝置與技術，實時采集任何需要監控、連接互動的物體或過程，采集其聲、光、熱、電、力學、化學、生物、位置等各種需要的信息，通過各類可能的網絡接入，**實現物與物、物與人的泛在連接，實現對物品和過程的智能化感知、識別和管理**. 物聯網是一個基于Internet、傳統電信網等的信息承載體，它讓所有能够被獨立尋址的普通物理對象形成互聯互通的網絡..

8. Who Governs the Internet?

- Organizations that influence the Internet and monitor its operations include:
影响并監控Internet運行的组织包括：
 - Internet域名與地址管理機構
 - Internet工程工作組
 - Internet研究專門工作組
 - Internet工程指導組
 - Internet架構委員會
 - Internet學會
 - Internet管理論壇
 - 萬維網協會
 - Internet運營工作組

Part III:

Web

The Web

- Without the Web, there would be no e-commerce. The invention of the Web brought an extraordinary expansion of digital services including color text and pages, formatted text, pictures, animations, video, and sound. In short, the Web makes nearly all the rich elements of human expression needed to establish a commercial marketplace available to nontechnical computer users worldwide.

沒有萬維網，就沒有電子商務。萬維網的出現使得給數百萬非專業計算機用戶提供服務的數字應用實現了爆發式增長，包括彩色文本和頁面、格式化文本、圖片、動畫、視頻和聲音。簡而言之，萬維網幾乎具備面向非專業計算機用戶的電子商務所需的所有表現方式。

The Web

- Without the Web, there would be no e-commerce. The invention of the Web brought an extraordinary expansion of digital services to millions of amateur computer users.

離開萬維網，電子商務就無從談起，萬維網的出現使得數百萬非專業計算機用戶提供服務的數字應用實現了爆發式增長。

- 1989–1991: Web invented

萬維網出現

- Tim Berners-Lee at CERN

歐洲粒子物理實驗室的蒂姆·伯納斯李博士將萬維網變成現實

- HTML, HTTP, Web server, Web browser

HTML語言、HTTP協議、Web服務器和瀏覽器

The Web

- 1993: Mosaic web browser (a web browser with a graphical user interface)
具備圖形用戶界面的網絡瀏覽器 Mosaic
 - Created by Andreessen and others at the National Center for Supercomputing Applications (NCSA)
馬克·安德烈森和美國國家超級計算應用中心的工作人員共同發明
 - Runs on Windows, Macintosh, or Unix
在操作系統 (Windows、Macintosh)或UNIX主機中展現出來
- 1994: Andreessen and Jim Clark founded Netscape, which created the first commercial browser, Netscape Navigator
馬克·安德森和吉姆·克拉克創建了網景公司，網景公司推出了第一個商業瀏覽器 Netscape Navigator
- 1995: Microsoft Corporation released its own free version of a browser, called Internet Explorer
微軟公司正式發布了其獨立開發的瀏覽器 Internet Explorer

1. Hypertext

- Web pages can be accessed through the Internet because the web browser software can request web pages stored on an Internet host server using the HTTP protocol.
我們可以通過Internet訪問網頁，就是因為網絡瀏覽器可以使用HTTP協議將網絡服務器中存放的頁面內容下載到我們的電腦。
- **Hypertext** is 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. When clicking on a graphic and a video clip plays, you have clicked on a hyperlink.
超文本是通過嵌入的超鏈接，將不同文檔與其他資源（例如聲音、視頻或動畫）組織在一起的形式。當點擊圖形就播放視頻時，實際上點擊的是一個指向該視頻的超鏈接。
- When you type a web address in your browser such as <http://www.must.edu.mo>, your browser sends an HTTP request to the must.edu.mo server requesting the home page of must.edu.mo.

當在瀏覽器中鍵入網址時，例如 <http://www.must.edu.mo>，瀏覽器會向 must.edu.mo 網域的服務器發送一個 HTTP 請求，請求訪問must.edu.mo 的主頁。

1. Hypertext

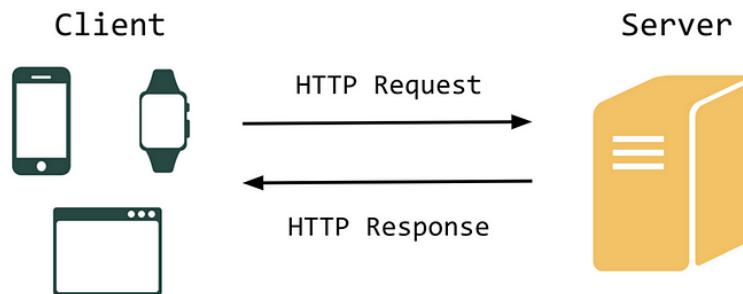
HTTP (or HTTPS) is the first set of letters at the start of every web address, followed by the domain name. The domain name specifies the organization's server computer that is housing the document. Most companies have a domain name that is the same as or closely related to their official corporate name. The directory path and document name are two more pieces of information within the web address that help the browser track down the requested page. Together, the address is called a Uniform Resource Locator, or URL. When typed into a browser, a URL tells the browser exactly where to look for the information.

HTTP（或 HTTPS）是所有網址的起始字段，之後才是域名。域名用于指定某一專門存放文件的組織的服務器計算機。大多數公司的域名與其官方公司名稱相同或密切相關。目錄路徑和文檔名稱是網址中的另外兩個重要信息，可幫助瀏覽器跟踪所請求的頁面。域名、目錄名稱和文檔名稱組合在一起就構成了一個完整的網址，稱為統一資源定位符（URL）。當在瀏覽器地址欄中輸入 URL 後，瀏覽器就能獲得網址的詳細信息。

1. Hypertext

HTTP is a protocol or set of communication rules for client-server communication. When you visit a website, your browser sends an HTTP request to the web server, which responds with an HTTP response. The web server and your browser exchange data as plaintext. In short, HTTP is the underlying technology that powers network communication. As the name suggests, hypertext transfer protocol secure (HTTPS) is a more secure version or an extension of HTTP. In HTTPS, the browser and server establish a secure, encrypted connection before transferring data.

超文本傳輸協議是一種用于客戶端與服務器通信的協議或一組通信規則。當訪問網站時，瀏覽器會向 Web 服務器發送 HTTP 請求，Web 服務器會以 HTTP 響應進行響應。Web 服務器和瀏覽器以純文本形式交換數據。換言之，超文本傳輸協議是支持網絡通信的底層技術。顧名思義，超文本傳輸安全協議是 HTTP 的更安全版本或擴展。在 HTTPS 中，瀏覽器和服務器在傳輸數據之前建立安全加密的連接。



1. Hypertext

Supposing we have a URL: <http://www.must.edu.mo/content/fi/123.html>

- **http = the protocol used to display web pages**
http表示顯示的網頁所使用的協議名稱
- **www.must.edu.mo = domain name**
www.must.edu.mo表示網域的域名
- **content/fi = the directory path that identifies where on the domain web server the page is stored**
content/fi表示域中存放網頁的服務器的一個具體目錄路徑
- **123.html = the document name and its format (an HTML page)**
123.html表示所請求的文檔名稱與文檔格式 (html表示請求HTML頁面)

1. Hypertext

The screenshot shows a web browser window with two tabs open, both titled "科技部政务服务平台". The address bar contains the URL <https://fuwu.most.gov.cn/html/tztg/xzxkzx/20220211/123124190.html>. The main content area displays the "全国一体化政务服务平台" logo and the "科学技术部政务服务平台" logo with the URL fuwu.most.gov.cn. Below the logos are five navigation links: 首页 (Home), 服务事项 (Service Items), 办事咨询 (Business Consultation), 在线办事 (Online Affairs), and 结果公示 (Result Disclosure). The page title is "通知通告 > 行政许可". A large blue header at the bottom reads "中国人类遗传资源国际合作临床试验备案情况公示 (2022年1月21日至2022年2月11日)". At the bottom right, the date "2022-02-11" is visible.

Examples of Top-Level Domains			
通用頂級 域名	推出年份	用途	贊助商/運營商
.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.
.pro	2002	Accountants, lawyers, physicians, and other professionals	RegistryPro Ltd
.jobs	2005	Job search	Employ Media LLC
.travel	2005	Travel search	Tralliance Corporation
.mobi	2005	Websites specifically designed for mobile phones	mTLD Top Level Domain, Ltd.
.cat	2005	Individuals, organizations, and companies that promote the Catalan language and culture	Fundació puntCAT
.asia	2006	Regional domain for companies, organizations, and individuals based in Asia	DotAsia Organization
.tel	2006	Telephone numbers and other contact information	ICM Registry

2. Markup Languages

Hypertext Markup Language (HTML)

- The most common web page formatting language is HTML, the concept behind document formatting actually had its roots in the 1960s with the development of **Generalized Markup Language (GML)**.
最常見的網頁格式化語言是 HTML，事實上，文檔格式化的思想起源于 1960 年代的通用標記語言。
- **HyperText Markup Language (HTML)** is a Generalized Markup Language (GML) that is relatively easy to use. HTML provides web page designers with a fixed set of markup “tags” that are used to format a web page.
超文本標記語言是一種相對易于使用的通用標記語言。HTML 為網頁設計者提供了一套用于格式化網頁的固定標記“標簽”。
- When these tags are inserted into a web page, they are read by the browser and interpreted into a page display.
當這些標簽被嵌入網頁中時，它們被瀏覽器讀取並被轉化為頁面顯示內容。

2. Markup Languages

Hypertext Markup Language (HTML)

- HTML defines the structure of a document, including the headings, graphic positioning, tables, and text formatting.
HTML定義了文檔的結構，包括標題、圖形位置、表格和文本格式.
- HTML is used in conjunction with **Cascading Style Sheets (CSS)**, which tells a web browser how to display the HTML elements on the screen. HTML provides the structure of the page, while CSS provides the style.
HTML與級聯樣式表結合使用，後者告訴網絡瀏覽器如何在屏幕上顯示HTML元素。
HTML提供頁面的結構，而級聯樣式表提供樣式.
- HTML web pages can be created with any text editor, such as Notepad or WordPad, using Microsoft Word (simply save the Word document as a web page), or any one of several web page development tools such as Microsoft Visual Studio or Adobe Dreamweaver CC.
HTML可以通過任何文本編輯器創建，如記事本、寫字板、Word（只需將Word文檔保存為網頁）或其他網頁開發工具（如Microsoft Visual Studio或Adobe DreamweaverCC）.

2. Markup Languages

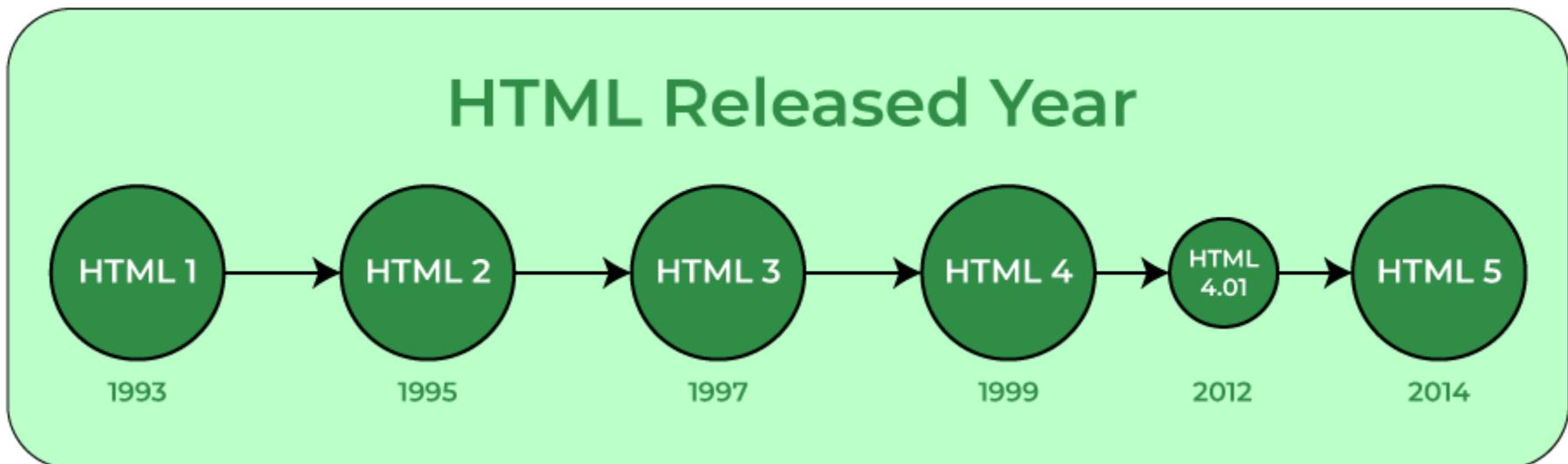
Hypertext Markup Language (HTML)

- The most recent version of HTML is **HTML5**.
HTML的最新版本是HTML5.
- HTML5 has become the de facto web page development standard, providing functionality that in the past was provided by plug-ins such as Adobe Flash. HTML5 enables not only video but also animations and interactivity with the assistance of CSS3 (the latest version of CSS), JavaScript, and HTML5 Canvas, an element used to draw graphics using JavaScript. HTML5 is also used in the development of mobile websites and mobile apps and is an important tool in both responsive web design and adaptive web delivery.

HTML5已經成爲當今的網頁開發標準，提供了過去由Adobe Flash等插件提供的功能。HTML5不僅支持視頻和動畫，還支持在CSS3（最新版本的CSS）、JavaScript和HTML5 Canvas（用于使用JavaScript 繪製圖形）的環境下的交互。HTML5也用于開發移動網站和移動應用程序，是響應式網頁設計和自適應網頁傳輸的重要工具。

2. Markup Languages

Hypertext Markup Language (HTML)



2. Markup Languages

HTML Page Structure

```
<!DOCTYPE html>           ← Tells version of HTML
<html>                  ← HTML Root Element
<head>                  ← Used to contain page HTML metadata
    <title>Page Title</title>   ← Title of HTML page
</head>

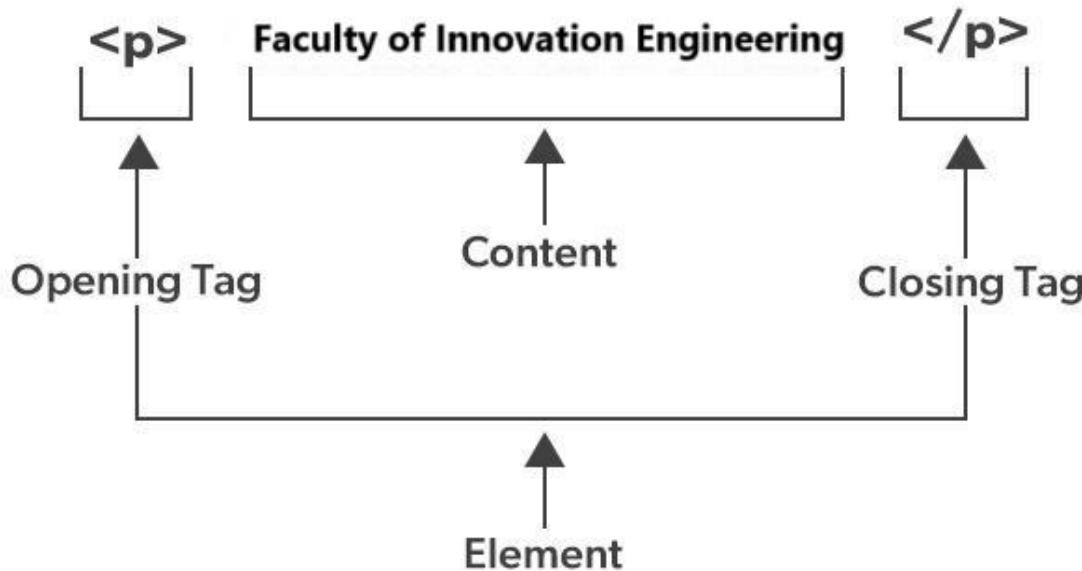
<body>                  ← Hold content of HTML
    <h2>Heading Content</h2>   ← HTML heading tag
    <p>Paragraph Content</p>    ← HTML paragraph tag
</body>

</html>
```

2. Markup Languages

- **<!DOCTYPE html>** – This is the document type declaration, not a tag. It declares that the document is an HTML5 document.
- **<html>** – This is called the HTML root element. All other elements are contained within it.
- **<head>** – The head tag contains the “behind the scenes” elements for a webpage. Elements within the head aren’t visible on the front end of a webpage. Typical elements inside the <head> include:
 - **<title>**: Defines the title displayed on the browser tab.
 - **<meta>**: Provides information like the character set or viewport settings.
 - **<link>**: Links external stylesheets or resources.
 - **<style>**: Embeds internal CSS styles.
 - **<script>**: Embeds JavaScript for functionality.
- **<title>** – The title is what is displayed on the top of your browser when you visit a website and contains the title of the webpage that you are viewing.
- **<h2>** – The <h2> tag is a second-level heading tag.
- **<p>** – The <p> tag represents a paragraph of text.
- **<body>** – The body tag is used to enclose all the visible content of a webpage. In other words, the body content is what the browser will show on the front end.

2. Markup Languages



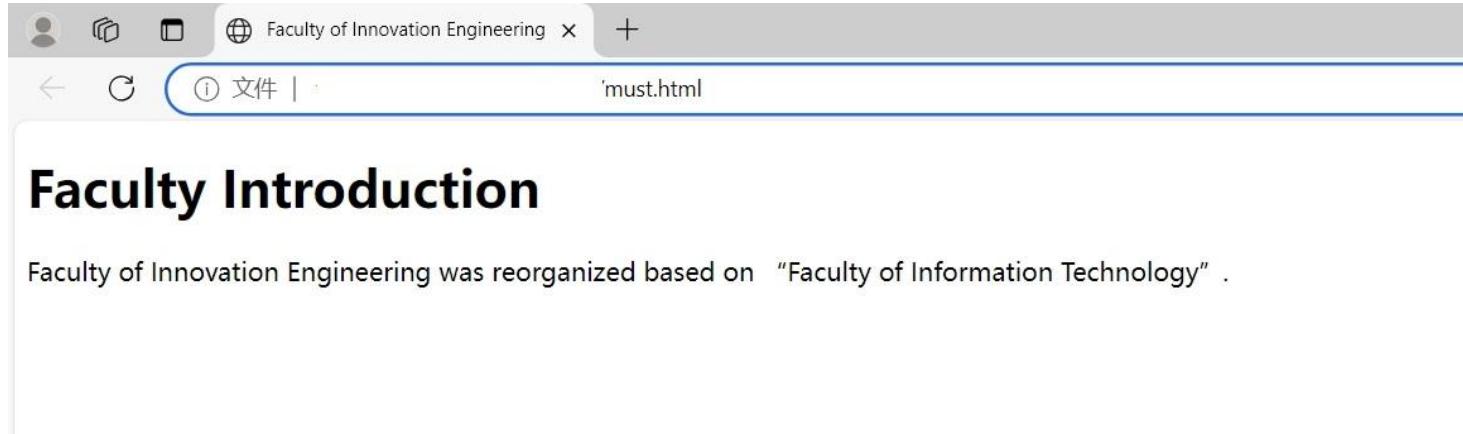
- HTML Element and HTML Tags are related but distinct. An HTML element is the complete structure, including the opening tag, content (if any), and the closing tag (if applicable).
HTML 元素和 HTML 標簽相關但又不同. HTML 元素是完整的結構，包括開始標簽、內容（如果有）和結束標簽（如果適用）.
- On the other hand, A tag is the actual keyword or name enclosed in angle brackets (<>) that tells the browser what kind of content to expect.
另一方面，標簽是用尖括號 (<>) 括起來的實際關鍵字或名稱，用于告訴瀏覽器預期什麼樣的內容.

2. Markup Languages

```
1 | <!DOCTYPE html>
2 | <html lang="en">
3 | <head>
4 |   <meta charset="UTF-8">
5 |   <meta name="viewport" content="width=device-width, initial-scale=1.0">
6 |   <meta name="keywords"/>
7 |   <meta name="description"/>
8 |   <title>澳門科技大學</title>
9 |   <!--<link th:href="@('/css/' + ${siteColor} + '/animate.css')" rel="stylesheet" />-->
10 |   <link rel="stylesheet" href="/must/css/common/header.css?20241028">
11 |   <link rel="stylesheet" href="/must/css/common/footer.css">
12 |   <link rel="stylesheet" href="/must/css/common/index.css?20241028">
13 |   <link rel="stylesheet" href="/must/css/common/top.css">
14 |   <link rel="stylesheet" href="/must/css/common/animate.css">
15 |   <link rel="stylesheet" href="/must/css/common/menu-list.css">
16 |   <link rel="stylesheet" href="/must/css/common/mobile-sub-menu.css">
17 |   <link rel="stylesheet" href="/must/css/home.css?20241028">
18 |   <link rel="stylesheet" href="/must/css/common/swiper-bundle.min.css">
19 |   <link rel="Shortcut Icon" href="/must/image/favicon.ico" type="image/x-icon" />
20 |   <!-- task#5001新加--给不同分辨率做适配 -->
21 |   <link rel="stylesheet" href="/must/css/adapt-style/home.css">
22 |   <link rel="stylesheet" href="/must/css/adapt-style/footer.css">
23 |   <link rel="stylesheet" href="/must/css/adapt-style/header.css?20250114" />
24 |   <!-- task#5112新加 -->
25 |   <link rel="stylesheet" href="/must/css/adapt-style/quick-link-school.css" />
26 |   <!-- 适配英文环境的样式 -->
27 |
28 |</head>
29 |<body>
30 |  <!--公共头部-->
31 |  <header id="header">
32 |    <!-- PC 公共头部 -->
33 |    <div class="pc-header pc-hidden">
34 |      <!-- 打开快速链接抽屉时的蒙层 -->
35 |      <div class="masking-layer hidden"></div>
36 |      <!-- <figure class="pr-16">
37 |        <a th:if="${site.logol != null}" th:target="${site.logol}">
38 |          <img class="header-logo" th:if="${site.logol != null}">
39 |        </a>
40 |      </figure> -->
```



2. Markup Languages



```
<!DOCTYPE html>
<html>
<head>
<title>Faculty of Innovation Engineering</title>
</head>
<body>
<h1>Faculty Introduction</h1>
<p>Faculty of Innovation Engineering was reorganized based on  
"Faculty of Information Technology".</p>
</body>
</html>
```

2. Markup Languages

Using CSS:

CSS can be added to HTML documents in 3 ways:

- **Inline** - by using the `style` attribute inside HTML elements
- **Internal** - by using a `<style>` element in the `<head>` section
- **External** - by using a `<link>` element to link to an external CSS file

2. Markup Languages

Using CSS - Inline CSS

- An inline CSS is used to apply a unique style to a single HTML element.
- An inline CSS uses the style attribute of an HTML element.
- The following example sets the text color of the `<h1>` element to blue, and the text color of the `<p>` element to red:

```
<h1 style="color:blue;">A Blue Heading</h1>
```

```
<p style="color:red;">A red paragraph.</p>
```

2. Markup Languages

Using CSS – Inline CSS



Faculty Introduction

Faculty of Innovation Engineering was reorganized based on "Faculty of Information Technology" .

```
<!DOCTYPE html>
<html>
<head>
<title>Faculty of Innovation Engineering</title>
</head>
<body>
<h1 style="color:blue;">Faculty Introduction</h1>
<p style="color:red;">Faculty of Innovation Engineering was reorganized
based on "Faculty of Information Technology".</p>
</body>
</html>
```

2. Markup Languages

Using CSS - Internal CSS

- An internal CSS is used to define a style for a single HTML page.
- An internal CSS is defined in the <head> section of an HTML page, within a <style> element.
- The following example sets the text color of ALL the <h1> elements (on that page) to blue, and the text color of ALL the <p> elements to red. In addition, the page will be displayed with a "powderblue" background color:

```
<!DOCTYPE html>
<html>
<head>
<title>Faculty of Innovation Engineering</title>
</head>
<style>
body {background-color: powderblue;}
h1 {color: blue;}
p {color: red;}
</style>
</head>
<body>

<h1>Faculty Introduction</h1>
<p>Faculty of Innovation Engineering was reorganized based on "Faculty of Information Technology".</p>

</body>
</html>
```



2. Markup Languages

Using CSS - External CSS

- An external style sheet is used to define the style for many HTML pages..
- To use an external style sheet, add a link to it in the <head> section of each HTML page.
- The external style sheet can be written in any text editor. The file must not contain any HTML code, and must be saved with a .css extension.

```
<!DOCTYPE html>
<html>
<head>
    <link rel="stylesheet" href="styles.css">
</head>
<body>

<h1>This is a heading</h1>
<p>This is a paragraph.</p>

</body>
</html>
```

2. Markup Languages

Using CSS - External CSS

- An external style sheet is used to define the style for many HTML pages..
- To use an external style sheet, add a link to it in the <head> section of each HTML page.
- The external style sheet can be written in any text editor. The file must not contain any HTML code, and must be saved with a .css extension.

Here is what the "styles.css" file looks like:

```
body {  
    background-color: powderblue;  
}  
h1 {  
    color: blue;  
}  
p {  
    color: red;  
}
```

2. Markup Languages



eXtensible Markup Language (XML)

- **eXtensible Markup Language (XML)** is a markup language specification developed by the W3C that is similar to HTML, but has a very different purpose. Whereas the purpose of HTML is to control the “look and feel” and display of data on the web page, XML is designed to describe data and information.

可擴展標記語言是由萬維網聯盟開發的標記語言規範，與HTML類似，但用途却截然不同。
HTML用于顯示網頁中的內容數據，控制網頁的外觀和用戶瀏覽時的感受，而XML則被設計用來對頁面中的數據和信息進行描述。

- XML is “extensible,” which means the tags used to describe and display data are defined by the user, whereas in HTML the tags are limited and predefined.
XML是“可擴展的”，這意味著描述用戶可自定義描述和顯示數據的標簽，而在 HTML 中，標簽是預先定義好的。
- When using XML, it needs to cooperate with HTML, HTML is used for information display in combination with XML, which is used for data description.
XML使用時需與HTML配合。XML描述數據，HTML負責把這些數據顯示在瀏覽器上。

2. Markup Languages

eXtensible Markup Language (XML)

```
<?xml version="1.0"?>
<note>
<to>George</to>
<from>Carol</from>
<heading>Just a Reminder</heading>
<body>Don't forget to order the groceries from FreshDirect!</body>
</note>
```

The first line in the sample document is the XML declaration, which is always included; it defines the XML version of the document. In this case, the document conforms to the 1.0 specification of XML. **The next line** defines the first element of the document (the root element): `<note>`. **The next four lines** define four child elements of the root (to, from, heading, and body). The last line defines the end of the root element.

示例文檔的第一行是 XML 聲明，存在于所有 XML 頁面中； 它定義了文檔的 XML 版本信息。該例中，文檔遵從 XML 1.0 版 規範。下一行定義文檔的第一個元素（根元素）：`<note>`。接下來的四行定義了根的四個子元素（`to`、`from`、`heading` 和 `body`）。最後一行定義了根元素的結尾。

2. Markup Languages

Really Simple Syndication (RSS)

- **Really Simple Syndication (RSS)** is an XML format that allows users to have digital content, including text, articles, blogs, and podcast audio files, automatically sent to their computers via the Internet.
簡易信息聚合是一種基于XML的格式，RSS允許用戶通過互聯網將數字內容（包括文本、文章、博客和播客、音頻文件）自動發送到他們的計算機上.
- An RSS aggregator software application that you install on your computer gathers material from the websites and blogs that you tell it to scan and brings new information from those sites to you.
你可以在你的電腦上安裝一個RSS應用程序，從網站和博客上收集資料，瀏覽網頁上最新發布的信息.

3. Web Servers and Web Clients

- Web server 網絡服務器
 - May refer to either web server software or physical server
指運行網絡服務器軟件的計算機
 - Specialized servers: Database servers, ad servers, and so on
專用服務器：數據庫服務器、廣告服務器等
- Web server software 網絡服務器軟件
 - Enables a computer to deliver web pages to clients on a network that request this service by sending an HTTP request
通過發送一個HTTP請求，使計算機能夠將網頁傳遞給網絡上請求此服務的客戶端電腦的專用軟件
 - Basic capabilities: Security services, FTP, search engine, data capture
基本功能：安全服務、文件傳輸協議、搜索引擎、數據采集
- Web client 網絡客戶機
 - Any computing device attached to the Internet that is capable of making HTTP requests and displaying HTML pages
指任何接入Internet並能發送HTTP請求和顯示HTML頁面的計算設備

3. Web Servers and Web Clients

BASIC FUNCTIONALITY PROVIDED BY WEB SERVER SOFTWARE	
FUNCTIONALITY	DESCRIPTION
Processing of HTTP requests	Receive and respond to client requests for HTML pages
Security services (Transport Layer Security [TLS])	Verify user name and password; process certificates and private/public key information required for credit card processing and other secure information
File transfer	Permits transfer of very large files from server to server via protocols such as FTP, FTPS, and SFTP
Search engine	Indexing of site content; keyword search capability
Data capture	Log file of all visits, time, duration, and referral source
E-mail	Ability to send, receive, and store e-mail messages
Site management tools	Calculate and display key site statistics such as unique visitors, page requests, and origin of requests; check links on pages

4. Web Browsers

- A web browser is a software program whose Primary purpose is to display web page, but may include added features, such as e-mail and newsgroups (an online discussion group or forum).

網絡瀏覽器是一種軟件程序，其主要目的是顯示網頁，可包括附加功能，例如電子郵件和新聞組（在線討論組或論壇）。

- Google's Chrome: 60% of desktop market, 39% mobile market
- Apple's Safari: 18% desktop, 55% mobile
- Edge: 12% desktop market

Part IV:

The Internet and Web: Features and Services

The Internet and Web: Features

- The Internet and the Web have spawned a number of powerful software applications upon which the foundations of e-commerce are built.

Internet和萬維網孕育了許多功能強大的軟件應用程序，而這些應用也為電子商務的蓬勃發展奠定了基礎。

- Communication tools 通信工具
- Search engines 搜索引擎
- Streaming media 流媒體
- Web 2.0 applications and services Web 2.0時代的特點與服務
- Virtual reality and augmented reality 虛擬現實和增強現實
- Intelligent personal assistants 智能私人助理

Communication Tools

The Internet and Web provide a number of communication tools that enable people around the globe to communicate with one another, both on a one-to-one basis as well as on a one-to-many basis. Communication tools include e-mail, messaging applications, online message boards (forums), Internet telephony applications, and video conferencing and video chatting.

互聯網和萬維網提供了許多通信工具，使世界各地的人能够以一對一和一對多的方式相互通信。這些通信工具包括電子郵件、消息應用程序、在綫留言板、網絡電話，以及視頻會議、視頻聊天等。

- E-mail (electronic mail)
 - E-mail uses a series of protocols to enable messages containing text, images, sound, and video clips to be transferred from one Internet user to another. In addition to text typed within the message, e-mail also allows attachments, which are files inserted within the e-mail message. The files can be documents, images, sounds, or video clips.

電子郵件使用一系列協議，這使得包含文本、圖像、聲音和視頻片段的消息能够從一個互聯網用戶傳輸到另一個互聯網用戶。除了在郵件本身的文本信息之外，電子郵件還允許插入各種附件，如文檔、圖像、聲音或視頻片段。

Communication Tools

- Messaging Applications
 - Instant messaging (IM) allows you to send messages in real time. IM displays text entered almost instantaneously. Recipients can then respond immediately to the sender the same way, making the communication more like a live conversation than is possible through e-mail.

即時消息允許實時發送消息. 即時消息幾乎可以即時地傳輸發件人的文本等. 同時，收件人也可以立即以同樣的方式回復發件人，使通信更像是一次實時對話.
- Online Message Boards
 - An online message board (also referred to as a forum, bulletin board, discussion board, discussion group, or simply a board or forum) is a web application that enables 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”) by members of the board and, depending on the permissions granted to board members by the board’s administrator, enables a person to start a thread and reply to other people’s threads.

在線留言板（也稱為論壇、公告板、討論板、討論組等）是一種允許互聯網用戶相互通信的網頁應用，但它所支持的通信方式非實時通信. 留言板為留言板成員發起（“發布”）的各種討論（“帖子”）提供了一個平臺，根據留言板管理員授予留言板成員的權限，用戶可以發布帖子和回復其他人的帖子.

Communication Tools

- IP Telephony
 - **IP telephony** is a general term for the technologies that use **Voice over Internet Protocol (VoIP)** and the Internet's packet-switched network to transmit voice, fax, and other forms of audio communication over the Internet. VoIP can be used over a traditional handset as well as over a mobile device. VoIP avoids the long-distance charges imposed by traditional phone companies.

IP電話是使用互聯網語音協議和包交換網絡在互聯網上實現語音、傳真和其他形式音頻通信的技術總稱. VoIP可以在傳統手機上使用，也可以在移動設備上使用. VoIP免去了傳統電話公司收取的長途費用.

- Video Conferencing and Video Chatting
 - Internet videoconferencing and video chatting is accessible to anyone with a broadband Internet connection and a web camera (webcam). Popular videoconferencing tools for businesses include Zoom, Webex (owned by Cisco), Microsoft Teams, GoToMeeting, and Fuze.

只要有寬帶互聯網接入和網絡攝像頭，任何人都能進行互聯網視頻會議和視頻聊天.面向企業的流行視頻會議工具包括 Zoom、Webex、Microsof Teams、Google Hangouts、GoToMeeting和FUSE.

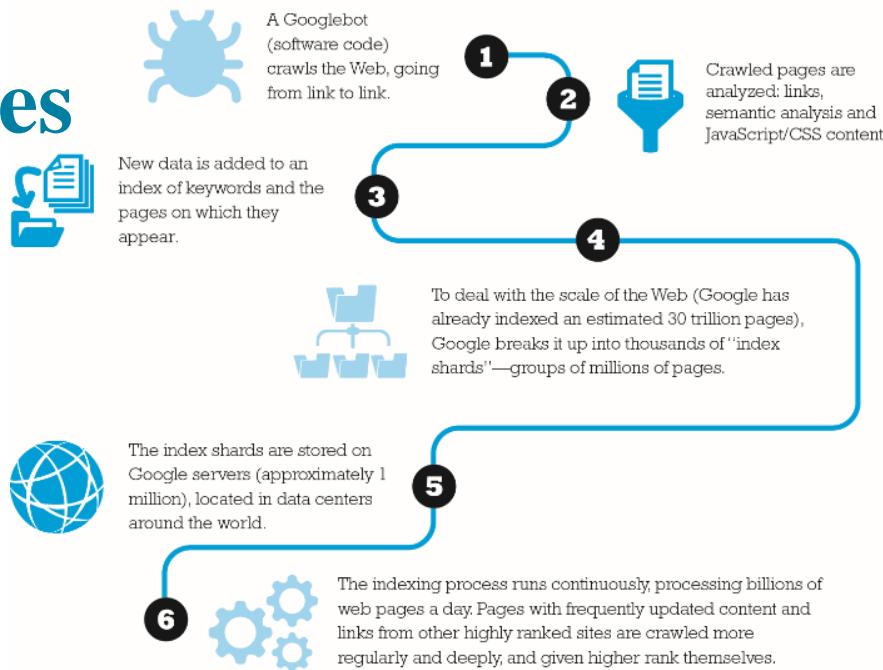
Search Engines

- Search engines identify web pages that appear to match keywords, also called queries, entered by a user and then provide a list of the best matches (search results).
搜索引擎能够識別與用戶輸入的關鍵詞（也稱為查詢）相匹配的網頁，然後提供最佳匹配的列表（搜索結果）。
- Also serve as:
 - Shopping tools
 - Advertising vehicles (search engine marketing)
 - Tool within e-commerce sites
- Baidu, Google, Bing, Yahoo

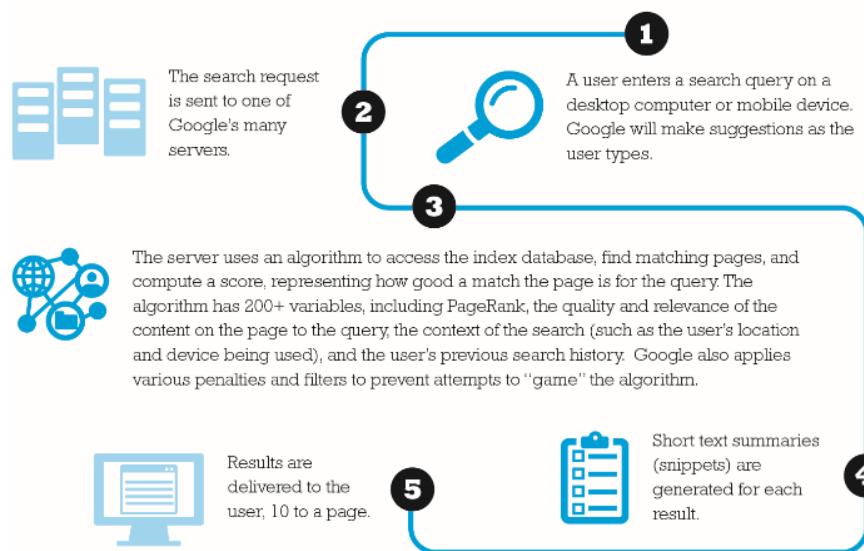
Search Engines

How Google Works

(A) Indexing the Web



(B) Processing a Search Query



Streaming Media

- When you download a file from the Web, the file is transferred from a web server and is stored on your computer for later use. **Streaming media** is an alternative to downloaded media and enables video, music, and other large-bandwidth files to be sent to a user in a variety of ways that enable the user to play the files as they are being delivered. In some situations, the files are broken into chunks and served by specialized media servers to client software that puts the chunks together and plays the video. In other situations, a single large file is delivered from a standard web server to a user who can begin playing the video before the entire file is delivered. Streamed files must be viewed in real time; they cannot be stored on client hard drives without special software. Streamed files are “played” by a software program, such as Microsoft Windows Media or via a service that provides an app, such as those provided by Netflix and many others.

當你從網絡下載文件時，該文件會從網絡服務器上傳輸並存儲在你的計算機上供以後使用。流媒體是下載媒體的一種替代方式，它允許以多種方式將視頻、音樂和其他要求大帶寬的文件發送給用戶，使用戶能够在文件傳輸時播放這些文件。在某些情況下，文件被分成塊，由專門的媒體服務器提供給客戶機軟件，客戶機軟件將這些塊放在一起並播放。在其他情況下，用戶從一個標準的網頁服務器上直接下載一個大的文件，可以邊下載邊播放。流媒體文件必須實時處理，無法存儲在客戶機的硬盤中。流媒體文件需要借助軟件如Microsoft Windows Media Player或通過網飛和許多其他公司提供的應用進行播放。

Web 2.0 Applications and Services

Web 2.0 applications and services are “social” in nature because they support communication among individuals within groups or social networks.

Web2.0應用和服務本質上是社交化的，因為它們支持發生在群體或社交網絡中的通信

- Online Social Networks
 - Services that support communication among networks of friends, peers
在線社交網絡服務支持朋友、同事乃至整個行業之間的信息交流.
- Blogs
 - Personal web page of chronological entries
按時間順序輸入的個人編輯的網頁
 - Enables web page publishing with no knowledge of HTML
在不瞭解HTML的情況下可以發布網頁
- Baidu Baike
 - Enables documents to be written collectively and collaboratively
文檔能够以集體和協作的方式編寫

Virtual Reality and Augmented Reality

- Virtual Reality
 - 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 that enable navigation through the experience and allowing users to feel as if they are actually present within the virtual world.

虛擬現實使用戶完全沉浸在虛擬世界，通常通過使用連接到耳機和其他交互設備的頭戴式顯示器營造一種身臨其境的感覺。
- Augmented Reality
 - Augmented reality (AR) involves overlaying virtual objects on top of the real world via smartphones, tablets, or HMDs.

增强現實通過智能手機、平板電腦或HMD將虛擬對象套接在現實世界中。
 - E.g., Pokémon GO

Virtual Reality and Augmented Reality

- Mixed Reality
 - Mixed reality (MR) is an enhanced version of augmented reality in which virtual images can interact with the real environments onto which they are overlaid. Microsoft's HoloLens, a head-mounted holographic computer, is an example of a device created to enable mixed reality.

混合現實是增強現實的升級版，其中虛擬圖像可以與真實環境交互。微軟的 HoloLens（一種頭戴式全息計算機）和 Magic Leap One MR 耳機是為實現 MR 而開發的兩個典型設備。
- Metaverse
 - The metaverse is envisioned as an immersive, visual, 3-D virtual reality in which users can connect, socialize, collaborate, and transact.

元宇宙被設想為一種沉浸式、視覺化的3D虛擬現實，用戶可以在其中進行連接、社交、協作和交易。

Intelligent Digital Assistants

- Having a conversation with a computer, having it understand you, and having it be able to carry out tasks according to your direction.
與計算機對話，讓它理解你並能够根據你的指示執行任務
- Using:
 - Natural language 自然語言
 - Conversational interface, verbal commands 對話界面、口頭命令
 - Situational awareness 情境意識
- Can handle requests for appointments, flights, routes, event scheduling, and more
可以處理預約航班、計算路線、活動安排等請求
 - Examples:
 - Apple's Siri
 - Google Now
 - Google Assistant

Mobile Apps

- Use of mobile apps has exploded
移動應用的使用量激增
 - Have become most popular entertainment media
已經成為最受歡迎的娛樂媒體
 - Always present shopping tool
隨時提供購物工具
 - Almost all top 100 brands have shopping app
幾乎所有排名前100的品牌都有購物應用程序
- Platforms
 - iPhone/iPad (iOS), Android, HarmonyOS
- App marketplaces
 - Google Play, Apple's App Store, Huawei Marketplace

Exercise (Part I)

1) Which of the following is *not* one of the basic technological foundations of the Internet?

- A) client/server computing
- B) FTP
- C) TCP/IP
- D) packet switching

2) The process of slicing digital messages into parcels, sending them along different communication paths as they become available, and reassembling them at the destination point is called _____.

3) _____ is the core communications protocol for the Internet.

Exercise (Part I)

4) The Internet Layer of TCP/IP is responsible for which of the following?

- A) placing packets on and receiving them from the network medium
- B) addressing, packaging, and routing messages
- C) providing communication with the application by acknowledging and sequencing the packets to and from the application
- D) providing a variety of applications with the ability to access the services of the lower layers

5) The _____ allows a natural language expression, such as Google.com, to represent a numeric IP address.

6) The address used by a browser to identify the location of content on the Web is called_____.

Exercise (Part I)

7) _____ is a model of computing in that computer processing, storage, software, and other services are provided as a shared pool of virtualized resources over the Internet.

8) Where does TLS operate within TCP/IP?

- A) between the Internet Layer and the Transport Layer
- B) between the Transport Layer and the Application Layer
- C) between the Network Interface Layer and the Transport Layer
- D) between the Internet Layer and the Application Layer

9) Which of the following are specialized computers that transmit message parcels along available Internet communication paths and on to their destinations?

- A) routers
- B) web servers
- C) IP servers
- D) packet servers

Exercise (Part I)

10) _____ are central directories that list all domain names currently in use for specific domains.

11) Which of the following was the original purpose of the Internet?

- A) to provide a network that would allow businesses to connect with consumers
- B) to link large mainframe computers on different college campuses.
- C) to develop military communications systems that could withstand nuclear war
- D) to enable government agencies to track civilian communications

12) TCP/IP operates in which layer of Internet architecture?

- A) Network Technology Substrate layer
- B) Middleware Services layer
- C) Transport Services and Representation Standards layer
- D) Applications layer

Exercise (Part I)

13) The Web runs _____ layer of Internet architecture.

14) The layer of Internet architecture that ties the applications to the communications network and includes such services as security and authentication is called the_____.

15) Which of the following is a utility program that allows you to track the path of a message sent from a client computer to a remote computer on the Internet?

- A) Telnet
- B) Ping
- C) IMAP
- D) Tracert

Exercise (Part II)

1) Which of the following is *not* a limitation of the current Internet?

- A) the continued reliance on cables and wires for connectivity
- B) limited bandwidth, which causes congestion and cannot adequately handle video and voice traffic
- C) architectural restrictions, which stipulate that numerous requests for the same file must each be answered individually, slowing network performance
- D) the difficulty in expanding capacity by adding servers and clients

2) ____ refers to delays in messages caused by the uneven flow of information packets through the network

3) The backbone of the Internet is formed by ____.

Exercise (Part II)

4) A(n) _____ allows users to easily add and edit content on a web page.

- A) wiki
- B) podcast
- C) blog
- D) RSS feed

5) The concept behind document formatting has its roots in which of the following?

- A) XML
- B) SGML
- C) HTML
- D) GML

6) In the address <http://www.company.com/clients.html>, the top-level domain is _____.

Exercise (Part II)

7) The major technologies used with wireless local area networks are:

- A) Wi-Fi and Bluetooth
- B) Wi-Fi and WiMax
- C) Bluetooth and 3G
- D) WiMax and 3G

8) Which of the following statements is true?

- A) WLAN-based Internet access derives from the same technological foundations as telephone-based wireless Internet access
- B) The Internet of Things (IoT) is based on sensors that collect data and connect to the Internet
- C) HTML is not used to format the structure and style of a web page
- D) Tier 3 ISPs provide long-haul fiber-optic networks that comprise the Internet's backbone

9) The _____ helps define the overall structure of the Internet.

- A) IAB
- B) IESG
- C) W3C
- D) ITU

Exercise (Part II)

10) An IPv4 address is expressed as a:

- A) 32-bit number that appears as a series of four separate numbers separated by semicolons
- B) 64-bit number that appears as a series of four separate numbers separated by semicolons
- C) 64-bit number that appears as a series of four separate numbers separated by periods
- D) 32-bit number that appears as a series of four separate numbers separated by periods

11) Which of the following is *not* an advantage of client/server computing over centralized mainframe computing?

- A) It is easy to expand capacity by adding servers and clients
- B) Each client added to the network increases the network's overall capacity and transmission speeds
- C) Client/server networks are less vulnerable, in part because the processing load is balanced over many powerful smaller computers rather than concentrated in a single huge computer
- D) There is less risk that a system will completely malfunction because backup or mirror servers can pick up the slack if one server goes down

Exercise (Part II)

12) ____ protocol is used to send mail to a server.

13) Which of the following statements about cloud computing is *not* true?

- A) A public cloud is typically used by companies with stringent privacy and security requirements
- B) Dropbox is an example of a public cloud
- C) Hybrid clouds offer both public and private cloud options
- D) A private cloud hosted internally or externally

14) _____ is used to allow remote login on another computer.

- A) Telnet
- B) FTP
- C) HTTP
- D) SSL

Exercise (Part II)

15) _____ is a utility program that allows you to check the connection between your client and a TCP/IP network.

16) Which of the following is a set of rules for transferring data?

- A) protocol
- B) packet
- C) router
- D) IP address

17) Which of the following is *not* a basic type of cloud computing service?

- A) IaaS
- B) PaaS
- C) SaaS
- D) FiOS

Exercise (Part II)

18) Which of the following protocols enables the exchange of routing information among different autonomous systems on the Internet?

- A) HTTP
- B) BGP
- C) FTP
- D) SMTP

19) When talking about the physical elements of the Internet, the term *redundancy* refers to:

- A) transmitting multiple copies of a single packet to safeguard against data loss
- B) the use of tiered high-speed switching computers to connect the backbone to regional and local networks
- C) delays in messages caused by the uneven flow of information through the network
- D) multiple duplicate devices and paths in a network built so that data can be rerouted if a breakdown occurs

Exercise (Part II)

20) You could expect to find the following services in a web server software package except:

- A) security services
- B) FTP
- C) search engine
- D) an RSS aggregator

21) All of the following are characteristics of HTML5 *except*:

- A) a video element that replaces plug-ins such as Flash, QuickTime, and RealPlayer
- B) use of CSS3
- C) ability to access built-in functionality of mobile devices, such as GPS and swiping
- D) support for digital rights management

22) The protocol that enables the transmission of voice and other forms of audio communication over the Internet is called _____.

What is latency, and how does it interfere with Internet functioning?

The following picture shows a HTML page, write its HTML code.

A screenshot of a web browser window titled "Faculty of Innovation Engineering". The address bar shows the URL "must.html". The page content includes a section titled "Faculty Introduction" with a brief history, followed by sections for "Vision and Mission", "Vision Statement", and "Mission Statements", each with their respective descriptions and lists of goals.

Faculty Introduction

Faculty of Innovation Engineering was reorganized based on "Faculty of Information Technology" .

Vision and Mission

Vision Statement

To be a Faculty of choice that is internationally recognized both for its innovative research and high-quality education programs in the Asia-Pacific region and beyond.

Mission Statements

The mission of Faculty of Innovation Engineering is to:

- (1) Promote the University' s core values of quality and innovation.
- (2) Innovate on advanced research relevant to the needs of society.
- (3) Foster an inter-disciplinary learning environment that is conducive to producing next-generation talents in scientific and engineering disciplines.
- (4) Transform knowledge into products and services to benefit the economic and social development in the region.

Draw the “hourglass” and layered architecture of the Internet.

What is TCP/IP? Draw the graph of TCP/IP architecture and protocol suite, and then briefly describe it.

Draw a graph to illustrate how TCP/IP and packet switching work together to send data over the Internet

Explain the current architecture of the Internet and draw the corresponding graph.