EEE F346

Data Communication & Networks: INTRODUCTION

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Protocol

The peer layers communicate by means of formatted blocks of data that obey a set of rules or conventions known as a **protocol**. The key features of a protocol are as follows: Syntax, Semantics and Synchronization

Typical tasks to be perform transfer of a file between two computers :
The source system must
(a) identify the desired destination system,
(b) ascertain that the destination system is prepared to receive data,
(c) must ascertain that the destination system is prepared to accept, and
(d) store the file and if the file formats are different, one or the other system must perform a translation function.

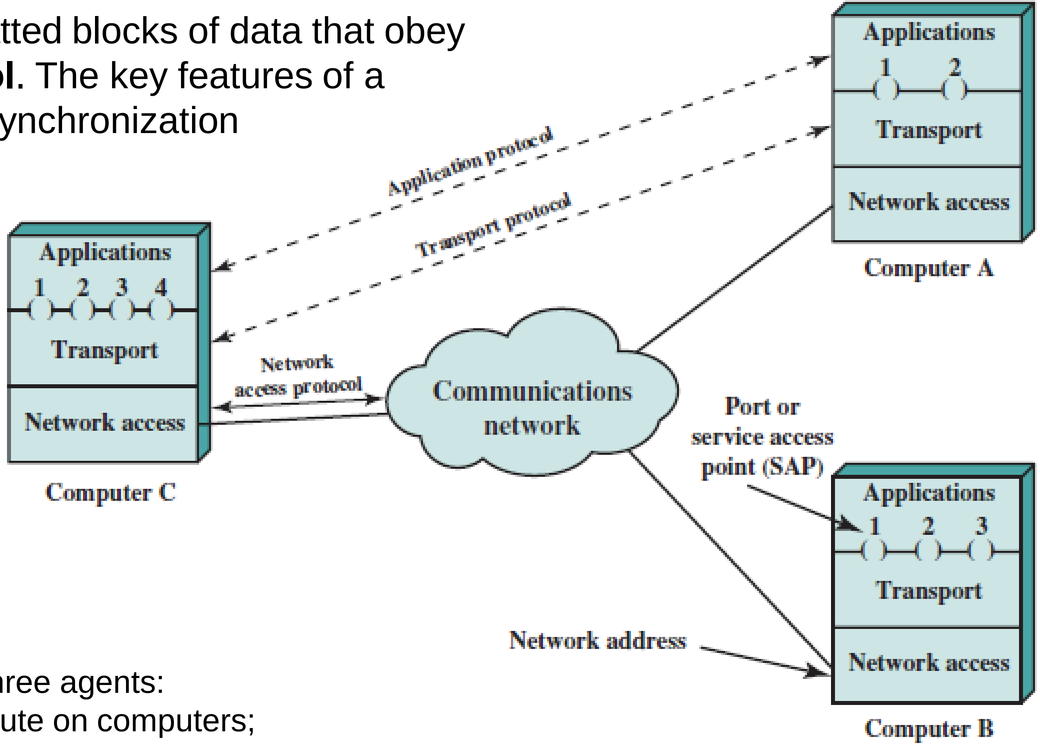


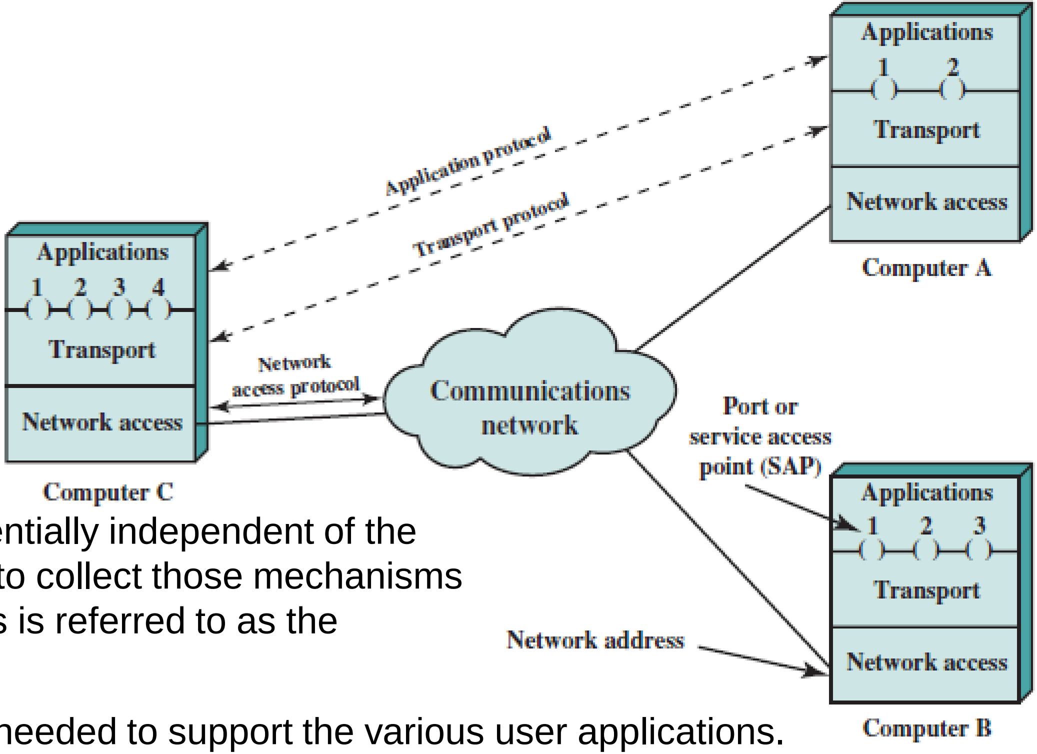
Figure 2.1 Protocol Architectures and Networks

Distributed data communications can be said to involve three agents: applications, computers, and networks. Applications execute on computers; Computers are connected to networks.

To perform communication tasks - three relatively independent layers:
network access layer, transport layer, and application layer.

The **network access layer** is concerned with the exchange of data between a computer and the network to which it is attached.
The source computer must provide the network with the address of the destination computer, so that the network may route the data to the appropriate destination.

IEEE 802 is a standard that specifies the access to a LAN



The mechanisms for providing reliability are essentially independent of the nature of the applications. Thus, it makes sense to collect those mechanisms in a common layer shared by all applications; this is referred to as the **transport** layer.

Finally, **the application layer** contains the logic needed to support the various user applications.

Figure 2.1 Protocol Architectures and Networks

Each application on a computer has an address that is unique within that computer; this allows the transport layer to support multiple applications at each computer. These latter addresses are known as **service access points (SAPs),** or **ports**, connoting the fact that each application is individually accessing the services of the transport layer.

Suppose that an application, associated with **port 1 at computer A**, wishes to send a message to another application, associated with **port 2 at computer B.**
The application at A hands the message over to its transport layer with instructions to send it to **port 2 on computer B**.
The transport layer hands the message over to the network access layer, which instructs the network to send the **message to computer B.**
Note that the network need not be told the identity of the destination port.
All that it needs to know is that the data are intended for **computer B.**

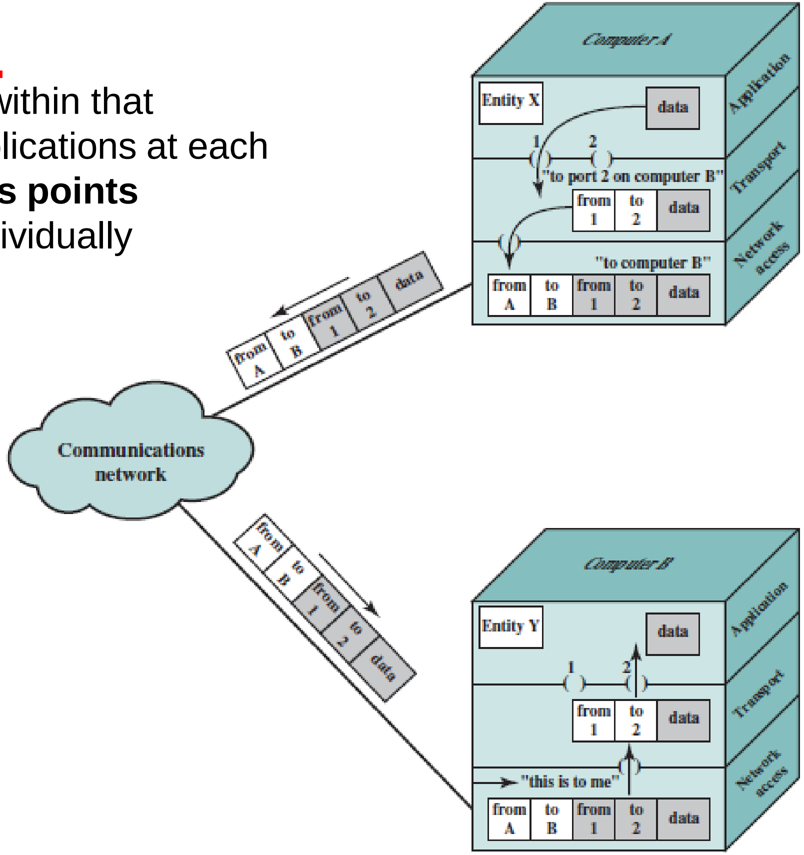


Figure 2.2 Protocols in a Simplified Architecture

The addition of control information to data is referred to as **encapsulation.** The combination of data from the next higher layer and control information is known as a **protocol data unit (PDU)**; in this case, it is referred to as a transport PDU. Transport PDUs are typically called **segments.** The header in each segment contains control information to be used by the peer transport protocol at computer B - Source port, Destination port, Sequence number, Error-detection code

The **network access protocol (NAP)** appends a network access header to the data it receives from the transport layer, creating a network access PDU, typically called a **packet.**
Fields of the header of a packet include source computer address, destination computer address, facilities requests such as priority.

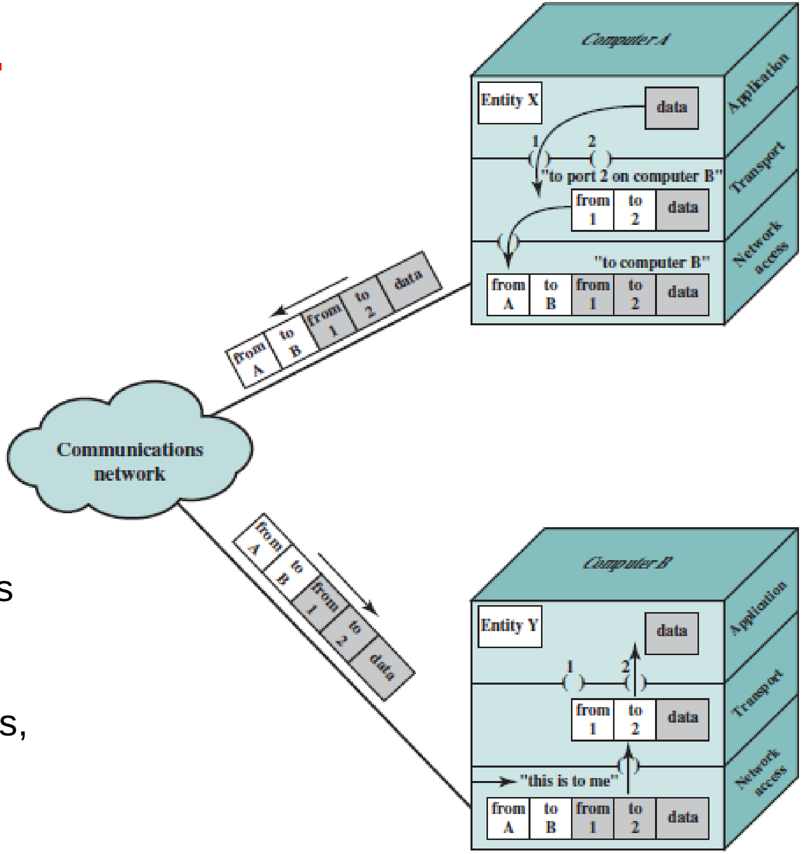


Figure 2.2 Protocols in a Simplified Architecture

Note that the transport header is not “visible” at the network access layer; the network access layer is not concerned with the contents of the transport segment.

The network accepts the network packet from A and delivers it to B. The network access module in B receives the packet, strips off the packet header, and transfers the enclosed transport segment to B’s transport layer module. The transport layer examines the segment header and, on the basis of the port field in the header, delivers the enclosed record to the appropriate application, in this case the file transfer module in B.

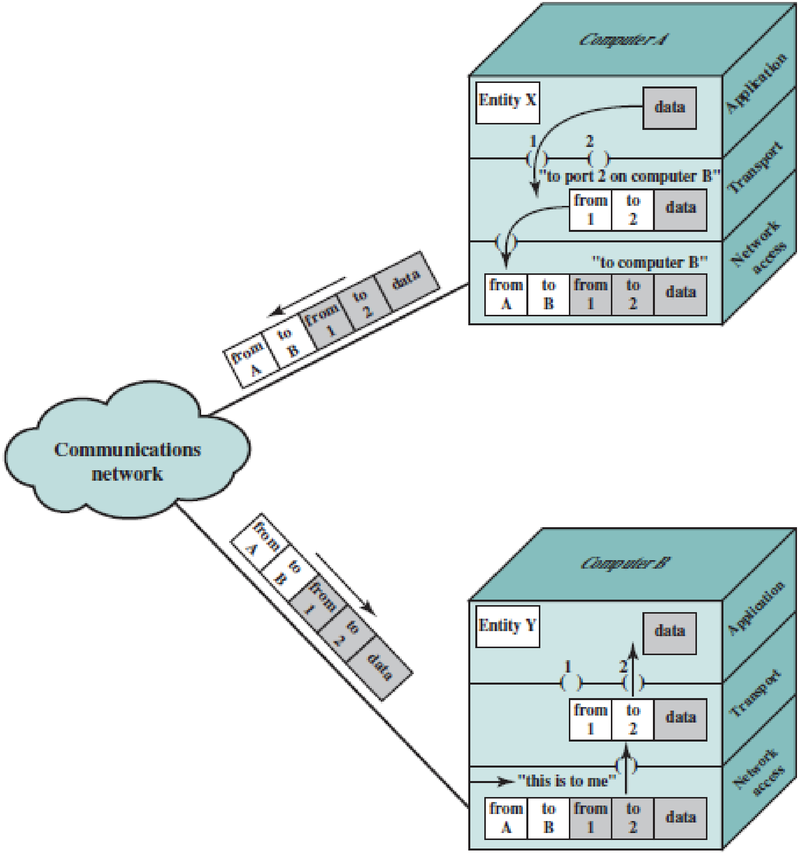


Figure 2.2 Protocols in a Simplified Architecture

Consider the transfer of data from an (N) entity to a peer (N) entity in another system. The following steps occur:

1. The source (N) entity invokes its (N - 1) entity with a **request primitive**. Associated with the primitive are the parameters needed, such as the data to be transmitted and the destination address.
2. The source (N - 1) entity prepares an (N - 1) PDU to be sent to its peer (N - 1) entity.
3. The destination (N - 1) entity delivers the data to the appropriate destination (N) entity via an **indication primitive**, which includes the data and source address as parameters.
4. If an acknowledgment is called for, the destination (N) entity issues **a response primitive** to its (N - 1) entity.
5. The (N - 1) entity conveys the acknowledgment in an (N - 1) PDU.
6. The acknowledgment is delivered to the (N) entity as a **confirm primitive.**

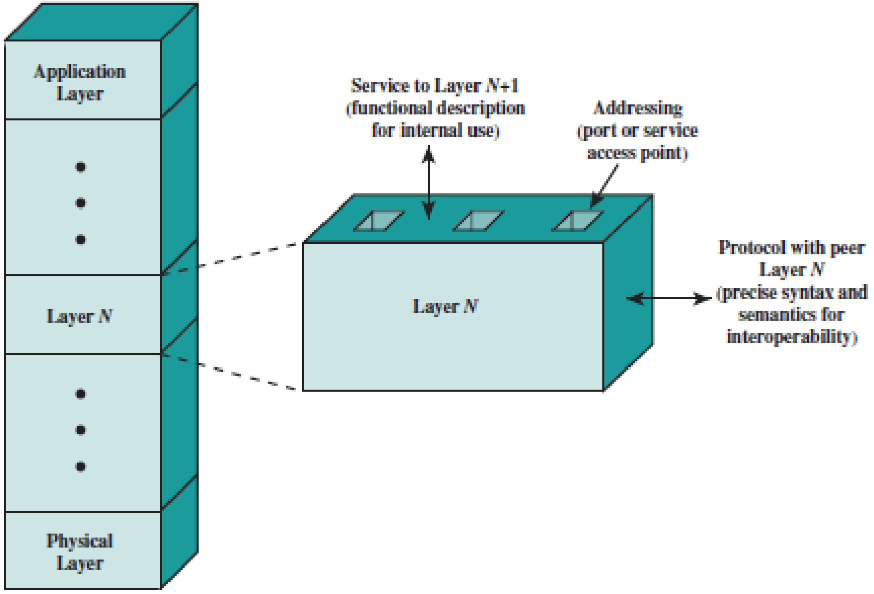


Figure 2.9 A Protocol Architecture as a Framework for Standardization

This sequence of events is referred to as a **confirmed service**, as the initiator receives confirmation that the requested service has had the desired effect at the other end.

If only request and indication primitives are involved (corresponding to steps 1 through 3), then the service dialog is a **non-confirmed** service; the initiator receives no confirmation that the requested action has taken place.

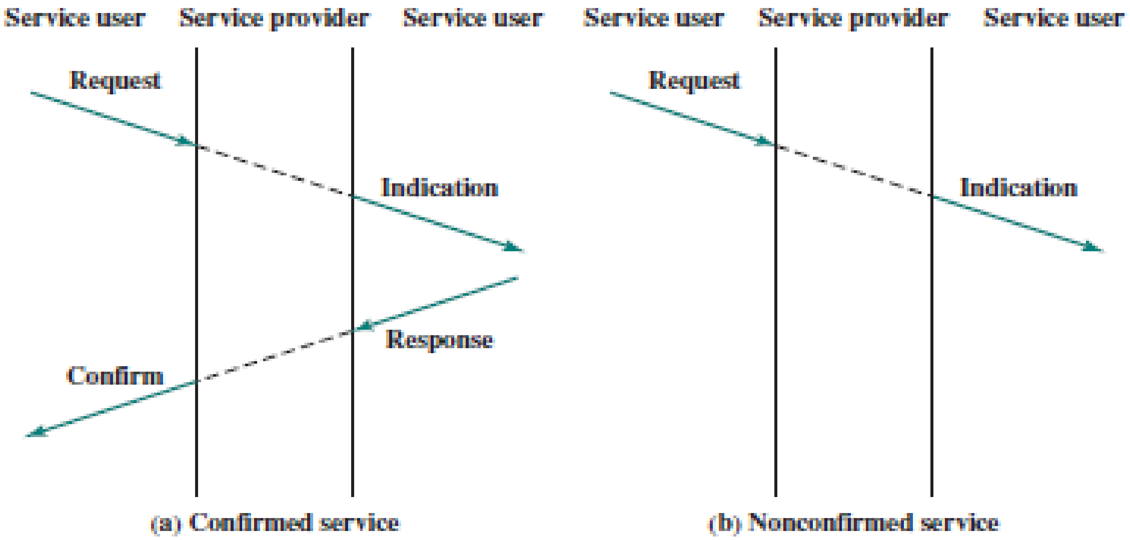


Figure 2.10 Time Sequence Diagrams for Service Primitives

With the increasing availability of broadband access to the Internet has come an increased interest in Web-based and Internet-based multimedia applications.

Table 2.2 Multimedia Terminology

Media	
Refers to the form of information and includes text, still images, audio, and video.	
Multimedia	
Human–computer interaction involving text, graphics, voice, and video. Multimedia also refers to storage devices that are used to store multimedia content.	
Streaming media	
Refers to multimedia files, such as video clips and audio, that begin playing immediately or within seconds after it is received by a computer from the Internet or Web. Thus, the media content is consumed as it is delivered from the server rather than waiting until an entire file is downloaded.	

Table 2.3 Domains of Multimedia Systems and Example Applications

Domain	Example Application
Information management	Hypermedia, multimedia-capable databases, content-based retrieval
Entertainment	Computer games, digital video, audio (MP3)
Telecommunication	Videoconferencing, shared workspaces, virtual communities
Information publishing/delivery	Online training, electronic books, streaming media

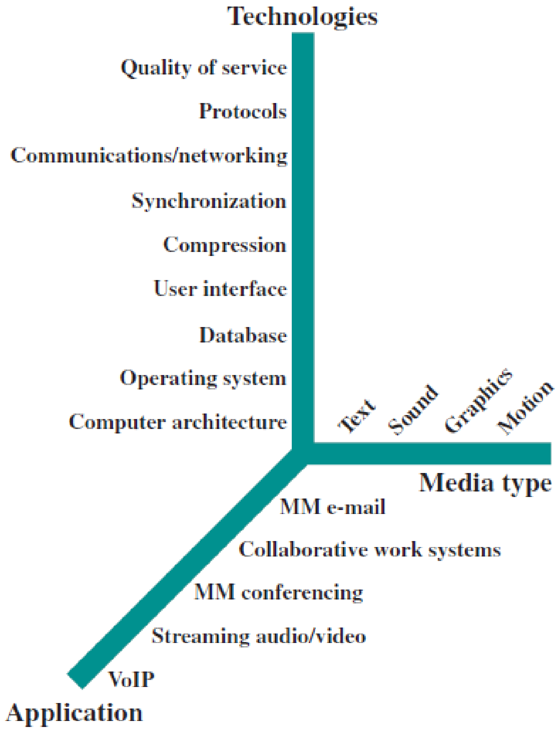
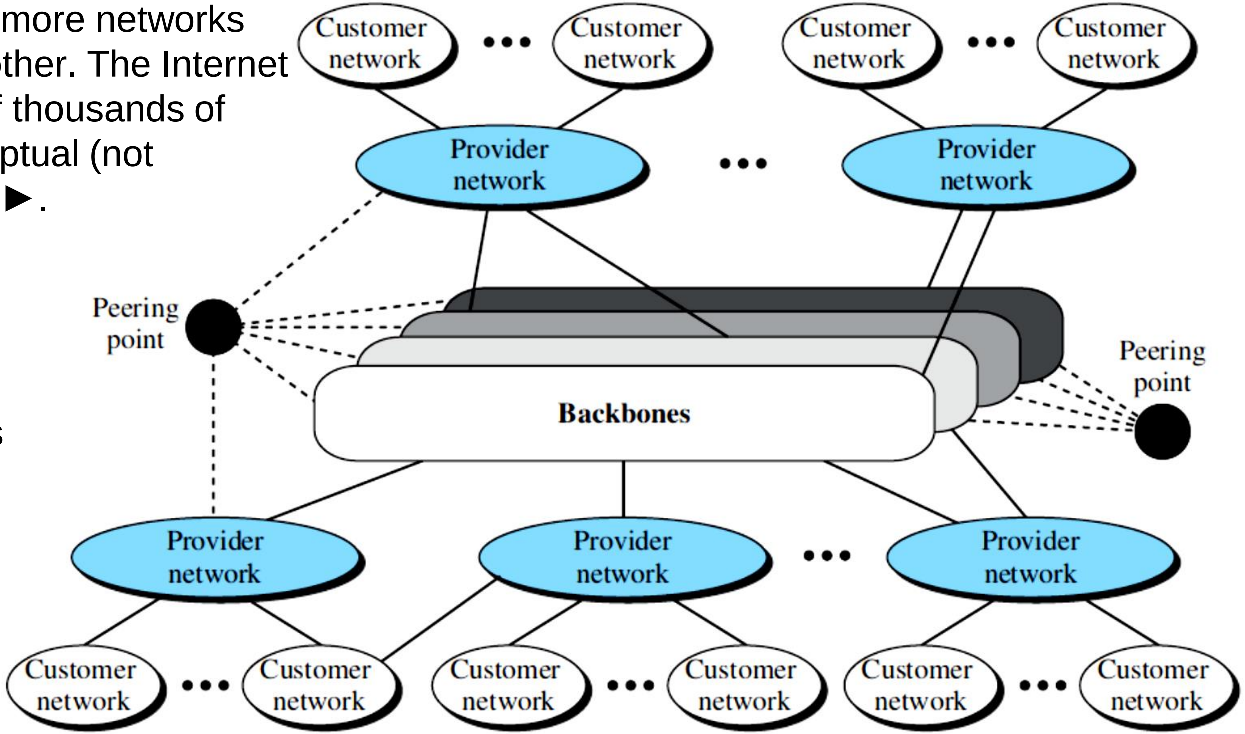


Figure 2.11 A Multimedia Taxonomy

Internet

An internet (lowercase i) is two or more networks that can communicate with each other. The Internet (uppercase I), and is composed of thousands of interconnected networks. A conceptual (not geographical) view of the Internet ►.



Backbones and provider networks are also called **Internet Service Providers (ISPs)**. The backbones are often referred to as **international ISPs**; the provider networks are often referred to as **national or regional ISPs**.

Internet

The purpose of the Internet, of course, is to interconnect end systems, called **hosts**; these include PCs, workstations, servers, mainframes, and so on. Most hosts that use the Internet are connected to a network, such as a LAN or a WAN. These networks are in turn connected by **router**s. Each router attaches to two or more networks. Some hosts, such as mainframes or servers, connect directly to a router rather than through a network.

The source host breaks the data to be sent into a sequence of packets, called **IP datagrams or IP packets**. Each router, as it receives a packet, makes a routing decision and forwards the packet along its way to the destination.

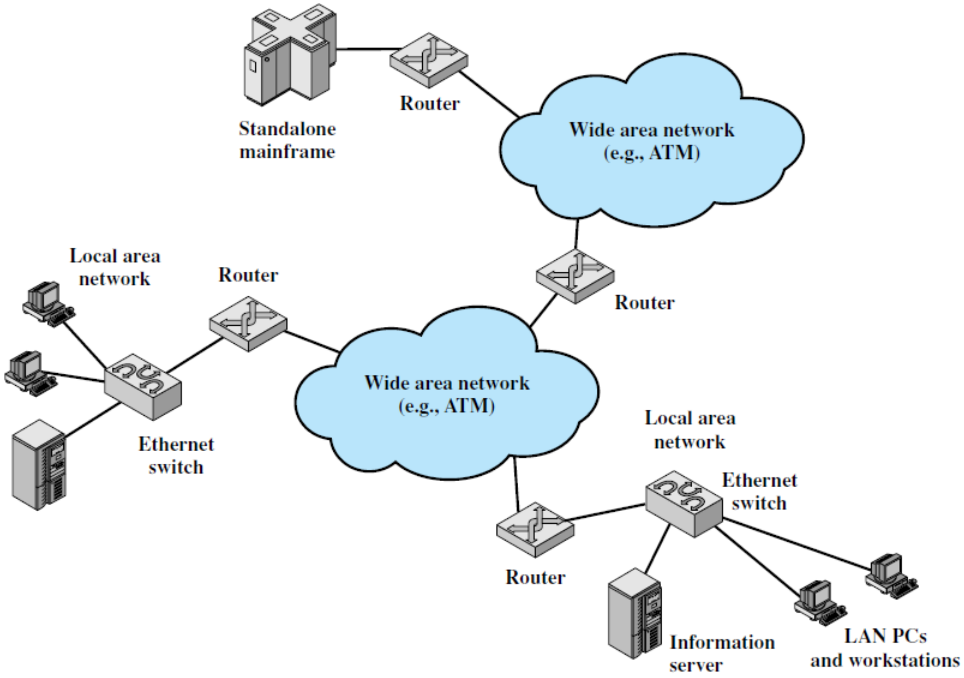


Figure 1.4 Key Elements of the Internet

Internet

Individual hosts and LANs are connected to an **Internet service provider** (ISP) through a **point of presence** (POP). The connection is made in a series of steps starting with the **customer premises equipment** (CPE). The CPE is the communications equipment located onsite with the host.

An ISP POP is the edge of the ISP's network; connections from users are accepted and authenticated here.

A **network access point** (NAP) is one of several major Internet interconnection points that serve to tie all the ISPs together.

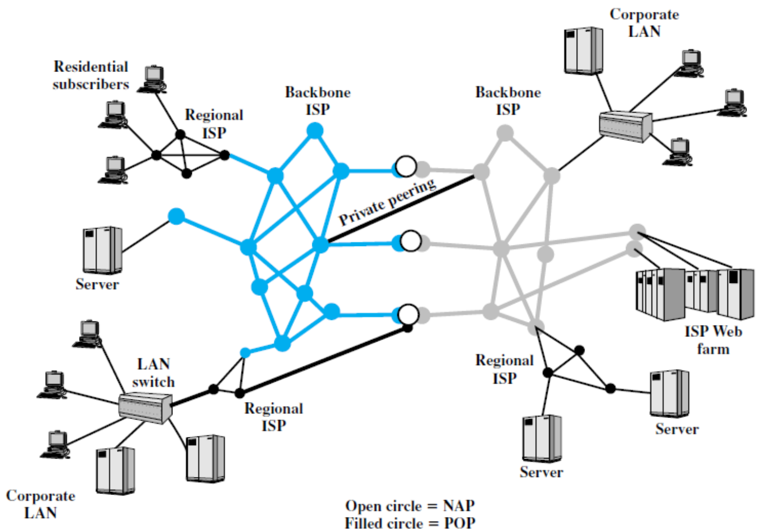


Figure 1.5 Simplified View of Portion of Internet

Internet

An individual residential user connected to an ISP through some sort of subscriber connection such as a dial-up modem (e.g. a 56-kbps modem); or a **digital subscriber line** (DSL), which provides a high-speed link over telephone lines and requires a special DSL modem; and a cable TV facility, which requires a cable modem.

ISP will consist of a number of interconnected servers connected to the Internet through a high-speed link i.e. SONET (**synchronous optical network**) line.

LAN implemented using a single Ethernet switch. The LAN is connected to the Internet through a firewall host that provides security services. In this example the firewall connects to the Internet through an ATM network

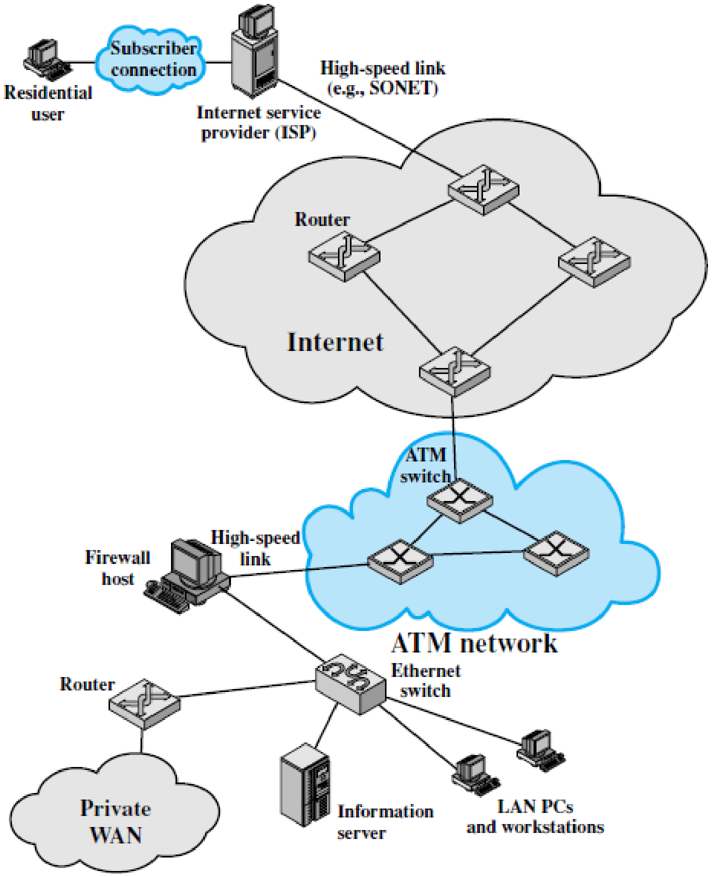


Figure 1.6 A Networking Configuration

Internet

At the center is an **IP backbone** network that consists of high performance routers, called **core routers**, interconnected with high-volume optical links.

At the periphery of an IP backbone are routers that provide connectivity to external networks and users. These routers are sometimes referred to as **edge routers,** or **aggregate routers**.

Two sections of the network connected via a private high-speed **asynchronous transfer mode** (ATM) WAN, with switches interconnected with optical links.

Mobile devices, such as smartphones and tablets, can connect to the Internet through **the public cellular network**, which has a high-speed connection, typically optical, to the Internet.

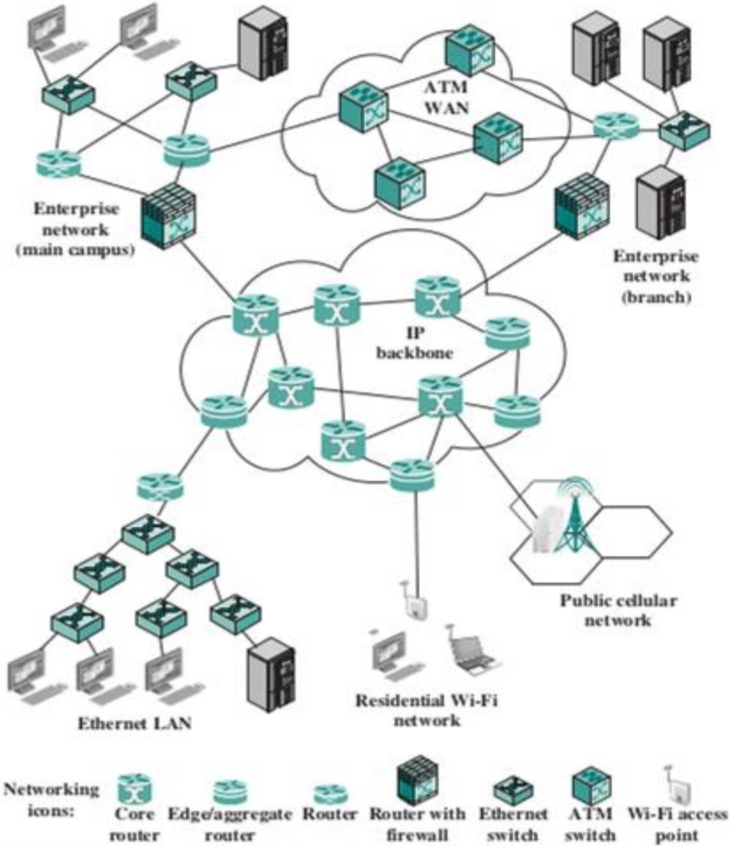


Figure 1.7 A Networking Configuration