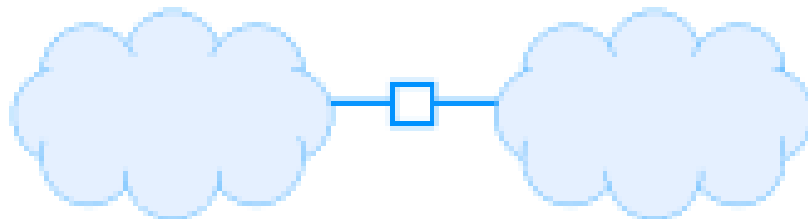


Internetworking

- *Internetworking* is a scheme for interconnecting multiple networks of dissimilar technologies
- Internetworking uses both hardware and software
 - Extra hardware is positioned between the connected networks
 - Extra software is installed on each attached computer.
- A system of interconnected networks is called an *internetwork* or an *internet* (note the lower-case “i”).

Routers

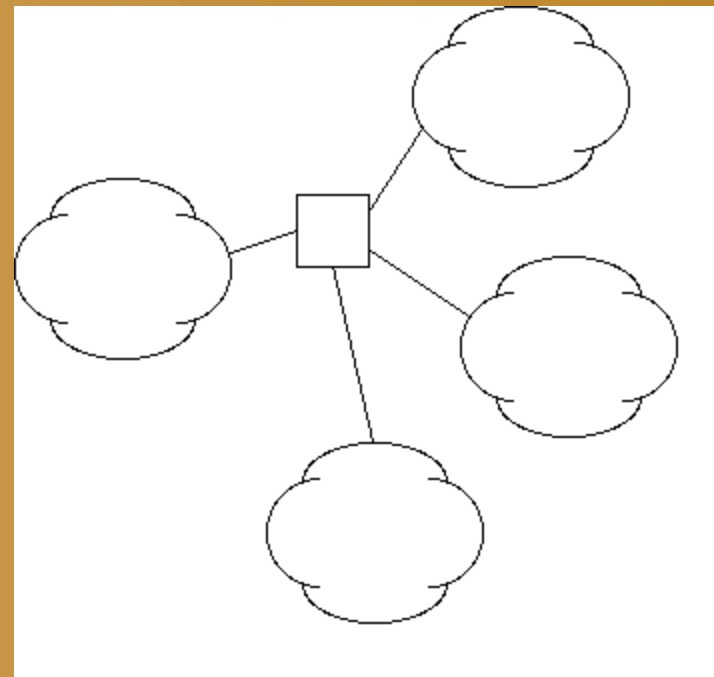
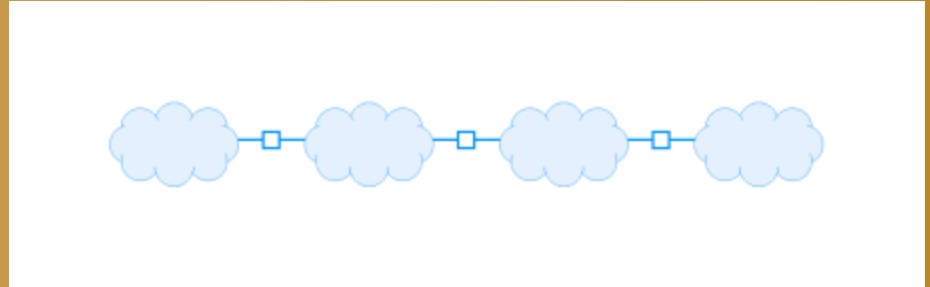
- A *router* is a hardware component used to interconnect networks
- A router has interfaces on multiple networks.
- Networks can use different technologies Router forwards packets between networks Transforms packets as necessary to meet standards for each network.



Internet Architecture


- An internetwork is composed of arbitrarily many networks interconnected by routers.

☒ Routers can have more than two interfaces.






Routers in an Organization

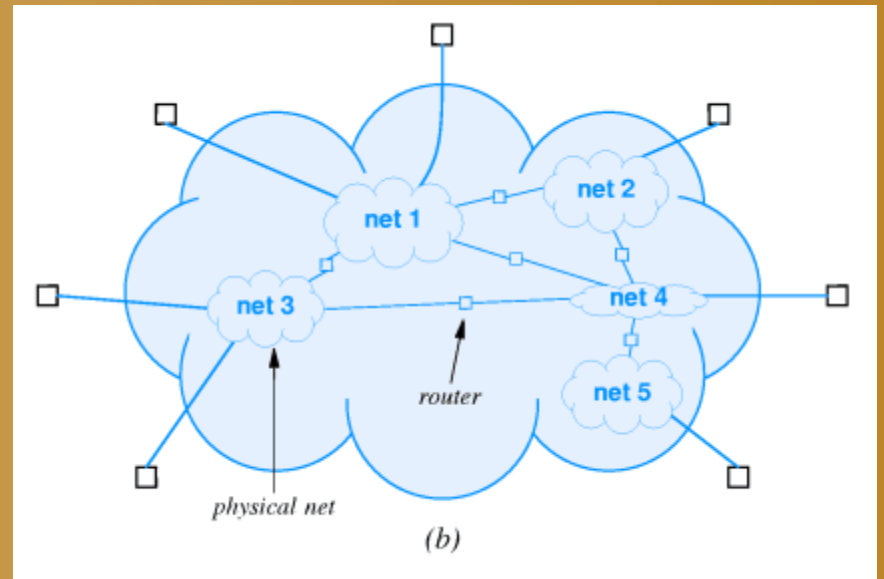
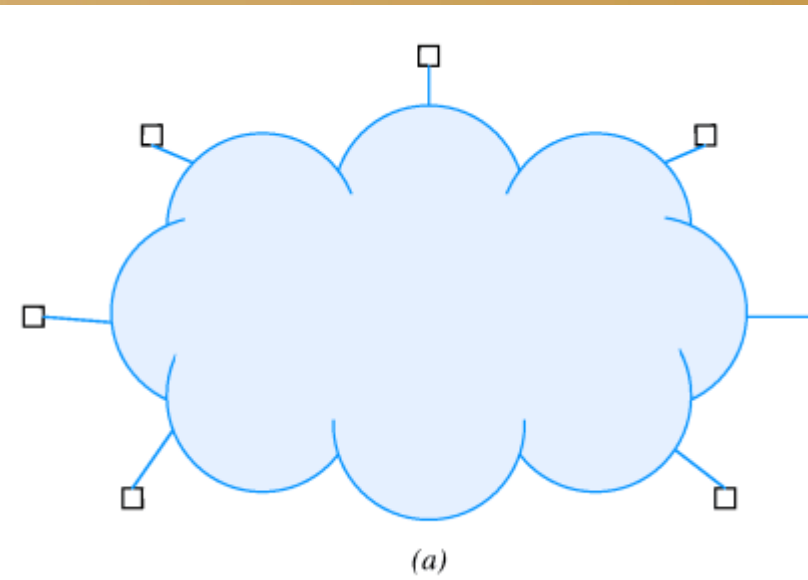
- It would be possible to interconnect all networks in an organization with a single router.
 - However, most organizations use multiple routers
 - Each router has finite capacity; a single router would have to handle *all* traffic across an entire organization.
 - Because internetworking technology can automatically route around failed components, using multiple routers increases reliability.
- 



A Virtual Network

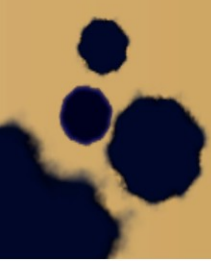
- Internetworking software builds a single, seamless *virtual network* out of multiple physical networks.
 - This provides
 - a universal addressing scheme, and
 - universal service.
 - All details of the physical networks are hidden from the users and the application programs.
- 

Illusion and Reality




The Illusion

The Reality






A Protocol Suite for Internetworking

- The *TCP/IP Internet Protocols* or, simply, *TCP/IP* is the mostly widely used internetworking protocol suite.
 - It is the first internetworking protocol suite.
 - The internet concept (originally called *catenet*) was developed in conjunction with TCP/IP.
 - The project was initially funded through ARPA.
 - It was later picked up by NSF.
 - Its origins are described in *Where Wizards Stay Up Late*
- 



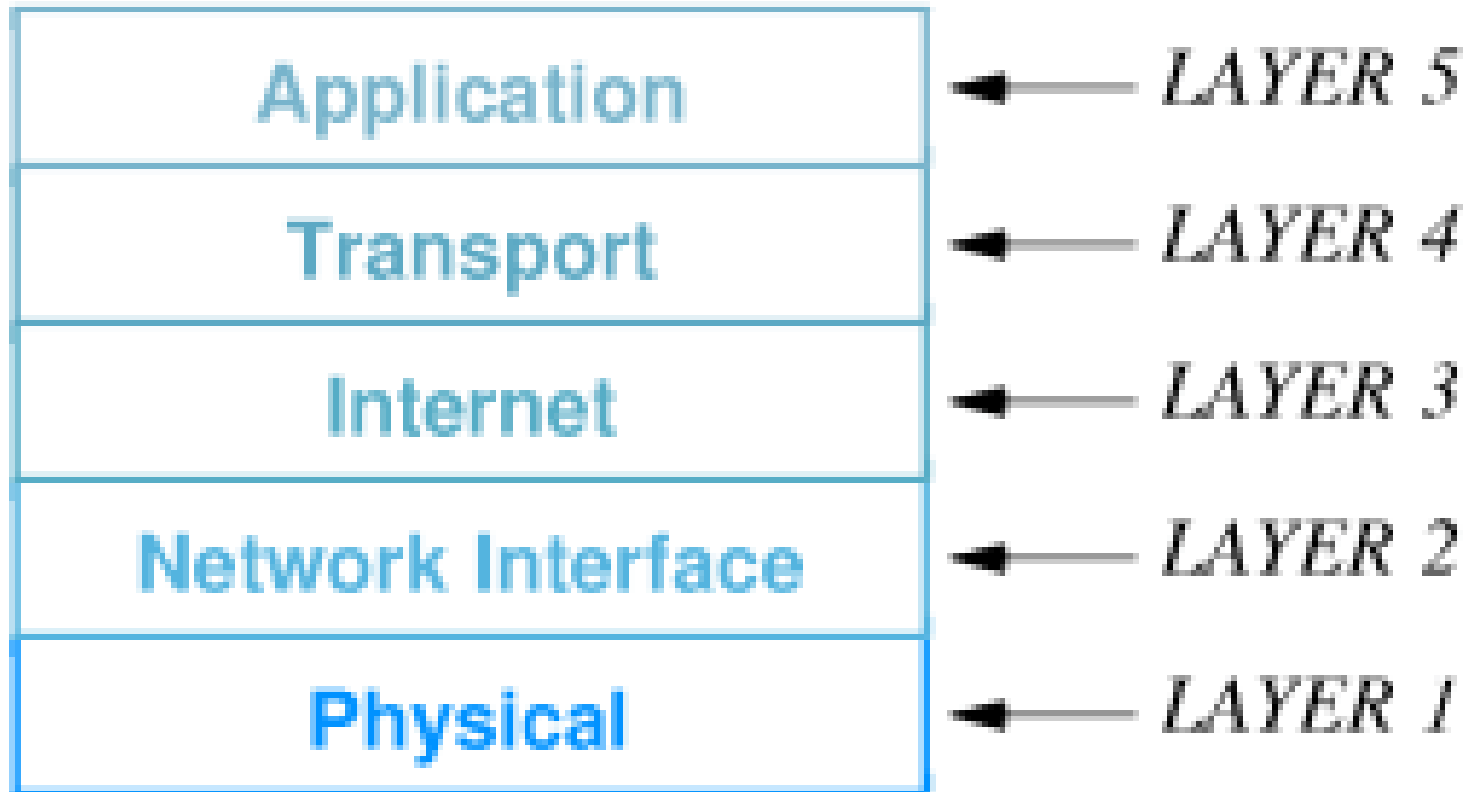
Internetworking Protocols

- Others include IPX, VINES, and AppleTalk.
 - TCP/IP is by far the most widely used internetworking protocol.
 - It is vendor and platform independent.
 - It is the protocol suite used in the *Internet* - 82 million computers in 210 countries (as of the date of textbook publication).
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TCP/IP Layering

- OSI 7-layer model does not include internetworking
- TCP/IP layering model includes five layers.
- Layer 5: Application - corresponds to ISO model layers 6 and 7; used for communication among applications.
- Layer 4: Transport - corresponds to layer 4 in the ISO model; provides reliable delivery of data.
- Layer 3: Internet - defines uniform format of packets forwarded across networks of different technologies and rules for forwarding packets in routers.
- Layer 2: Network - corresponds to layer 2 in the ISO model; defines formats for carrying packets in hardware frames.
- Layer 1: Hardware - corresponds to layer 1 in the ISO model; defines basic networking hardware.

The TCP/IP Layering Model



Hosts, Routers and Protocol Layers

- A *host computer* or *host* is any system attached to an internet that runs applications.
- Hosts may be supercomputers or toasters.
- TCP/IP allows any pair of hosts on an internet to communicate directly.
- Both hosts and routers have TCP/IP stacks.
 - Hosts typically have one interface and don't forward packets.
 - Routers don't need layers 4 and 5 for packet forwarding.



Summary

- An *internet* is a collection of physical networks interconnected into a single *virtual network*.
 - *Routers* provide the physical interconnection and forward packets between networks.
 - *Hosts* communicate across multiple network through packets forwarded by routers.
 - TCP/IP is the most widely used internetworking protocol suite.
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