

Internetworking: Concepts, Architecture, and Protocols

Motivation For Internetworking

- LANs
 - Low cost
 - Limited distance
- WANs
 - High cost
 - Unlimited distance

Heterogeneity Is Inevitable

- *No single networking technology best for all needs.*

Universal Service

- Fundamental concept in networking
- Pioneered by telephone system
- Arbitrary pair of computers can communicate
- Desirable
- Difficult in a heterogeneous world

Heterogeneity And Universal Service

- Incompatibilities among networks
 - Electrical properties
 - Signaling and data encoding
 - Packet formats
 - Addresses

The Bottom Line

- *Although universal service is highly desirable, incompatibilities among network hardware and physical addressing prevent an organization from building a bridged network that includes arbitrary technologies.*

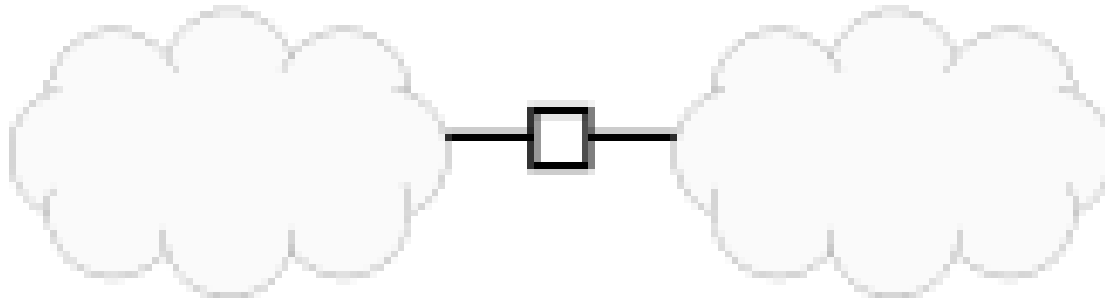
An Internetwork

- Begin with heterogeneous network technologies
- Connect the physical networks
- Create software to make resulting system appear homogeneous
- Called an *internetwork* or *internet*

Connecting Heterogeneous Networks

- Computer system used
 - Special-purpose
 - Dedicated
 - Works with LAN or WAN technologies
 - Known as
 - *Internet router*
 - *Internet gateway*

Illustration Of An Internet Router

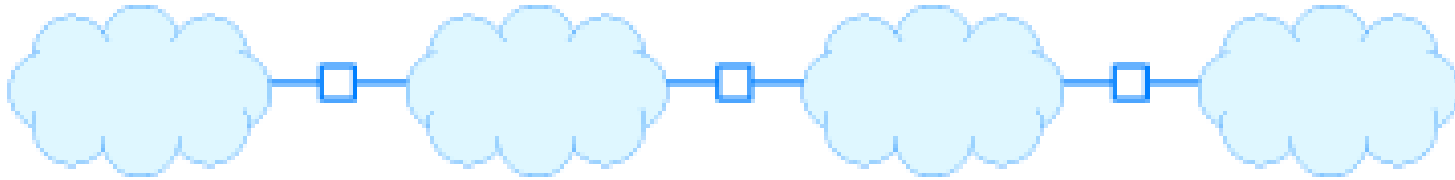


- Cloud denotes arbitrary network technology
- One interface per network

Important Idea

- *A router can interconnect networks that use different technologies, including different media and media access techniques, physical addressing schemes, or frame formats.*

Internet Architecture

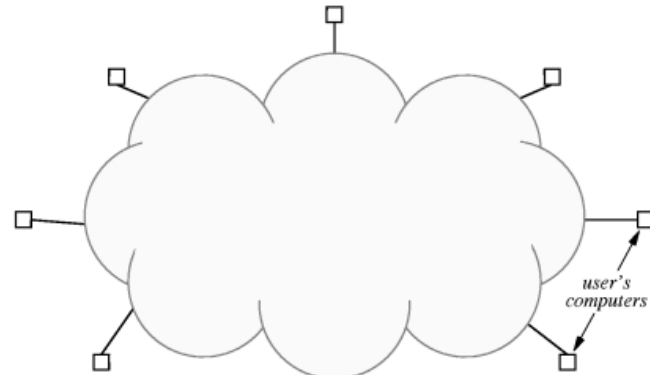


- Multiple
 - Networks
 - Routers interconnecting networks
- *Host* computer connects to a network
- Single router has insufficient
 - CPU power and memory
 - I/O capability

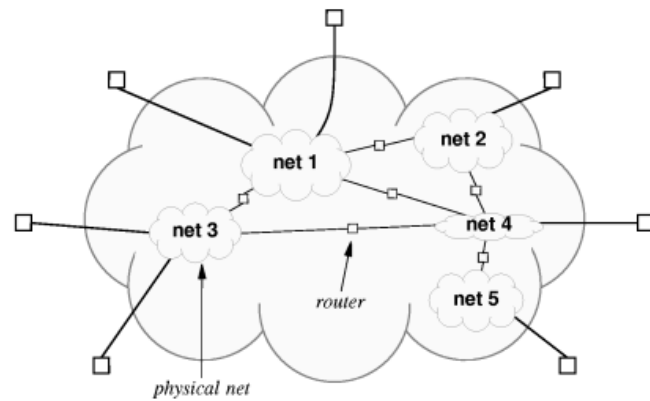
Internetworking

- Goal: communication system
 - Seamless
 - Uniform
 - General-purpose
 - Universal
 - Hides heterogeneity from user

The Internet Concept



(a)



(b)

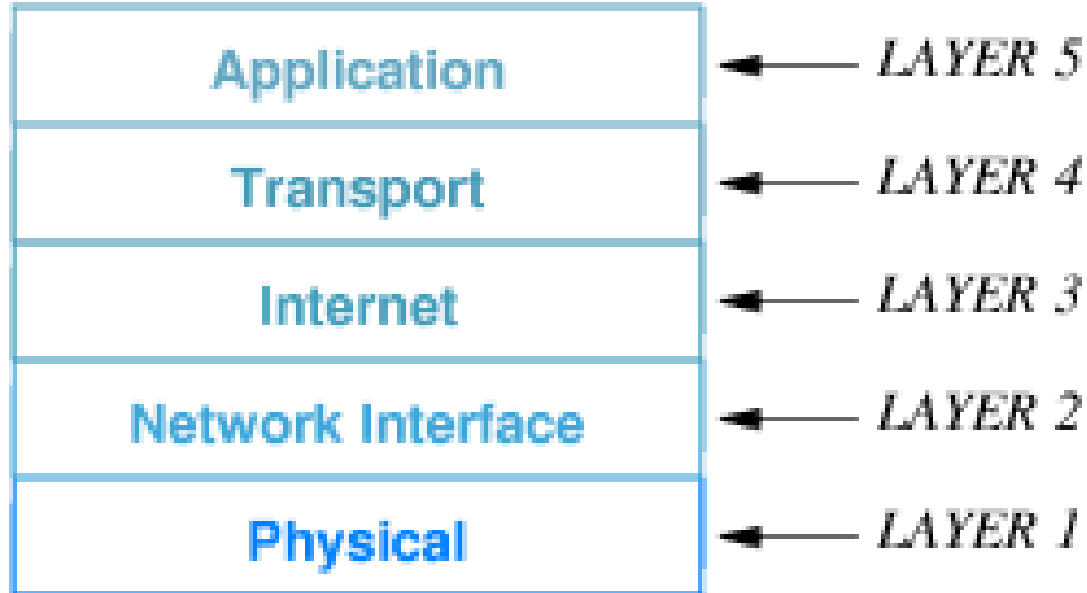
To Hide Heterogeneity

- Create “virtual” network
- Invent
 - Addressing scheme
 - Naming scheme
- Implement with
 - Protocol software
- Note: protocol software needed on both hosts and routers

Internet Protocols

- Known as TCP/IP
- Many protocols comprise *suite*
- Designed to work together
- Divided into five conceptual layers

Layering Used With TCP/IP



- Note: TCP/IP layering model replaces the old ISO model

TCP/IP Layers

- Layer 1: Physical
 - Basic network hardware
- Layer 2: Network Interface
 - MAC frame format
 - MAC addressing
 - Interface between computer and network (NIC)
- Layer 3: Internet
 - Facilities to send packets across internet composed of multiple routers

TCP/IP Layers (continued)

- Layer 4: Transport
 - Transport from an application on one computer to application on another
- Layer 5: Application
 - Everything else