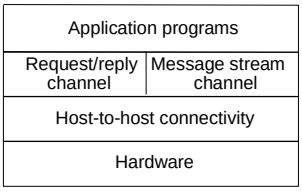
Lecture 2 (Jan 22, 2004)

Outline
- Protocol layering
- IP addresses

Layering

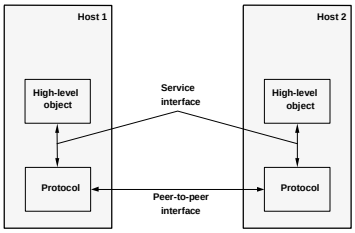
- Use abstractions to hide complexity
- Abstraction naturally lead to layering
- Alternative abstractions at each layer



Protocols

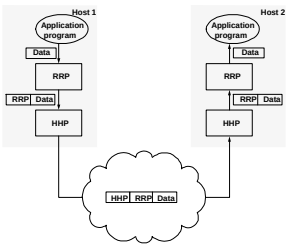
- Building blocks of a network architecture
- Each protocol object has two different interfaces
  - *service interface*: operations on this protocol
  - *peer-to-peer interface*: messages exchanged with peer
- Term "protocol" is overloaded
  - specification of peer-to-peer interface
  - module that implements this interface

Interfaces

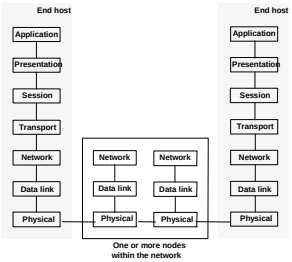


Machinery

- Multiplexing and Demultiplexing (demux key)
- Encapsulation (header/body)



ISO Architecture

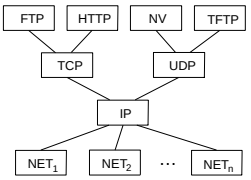


Internet Architecture

- Defined by Internet Engineering Task Force (IETF)
  1. Application: interacts with user to initiate data transfers (browser, media player, command line)
  2. Transport: reliable, in-order delivery of data (TCP and UDP)
  3. Network: addressing and routing (IP)
  4. Data Link: defines how hosts access physical media (Ethernet)
  5. Physical: defines how bits are represented on wire (Manchester)
- Information is passed between layers via encapsulation
  - Header information is attached to data passed down layers
- Multiplexing between layers
- Layers access other layers via API's (eg. sockets)
- Communication at a specific layer is enabled by a protocol

Hourglass Design

- Single protocol at network level insures packets will get from source to destination while allowing for flexibility

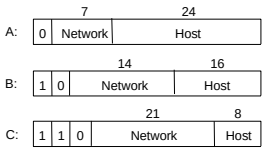


Addressing

- IP Address: byte-string that identifies a node
  - usually unique (some exceptions)
  - Dotted decimal notation: 128.92.54.32
- Types of addresses
  - unicast: node-specific
  - broadcast: all nodes on the network
  - multicast: some subset of nodes on the network

Global Addresses

- Properties
  - globally unique
  - hierarchical: network + host
- Dotted Decimal Notation
  - 120.3.2.4
  - 128.96.33.81
  - 192.12.69.77
- Address classes
  - A, B, C (shown)



- Network respresented as Network Part / Num. Bits
  - E.g. 120/8 or 128.96/16

Exercise: Find out about private addresses

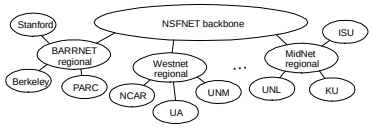
Other Addresses

- Private address:
  - 10.0.0.0 to 10.255.255.255
  - 172.16.0.0 to 172.16.255.255
  - 192.168.0.0 to 192.168.255.255
  - 169.254.0.0 to 16.254.255.255
- Class D: multicast addresses: 224.0.0.0 to 224.255.255.255

- Host part all 1's: broadcast in local network
- Host part all 0's: unspecified (not allowed)

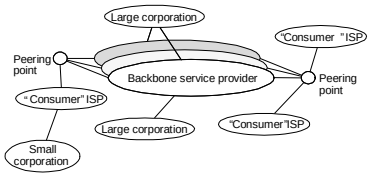
Internet Structure

Recent Past



Internet Structure

Today



Route Propagation

- Know a smarter router
  - hosts know local router
  - local routers know site routers
  - site routers know core router
  - core routers know everything
- Autonomous System (AS)
  - corresponds to an administrative domain
  - examples: University, company, backbone network
  - assign each AS a 16-bit number
- Two-level route propagation hierarchy
  - interior gateway protocol (each AS selects its own)
  - exterior gateway protocol (Internet-wide standard)