The TCP/IP Protocols

Overview

- overview
  - *Transmission Control Protocol/Internet Protocol*
  - from ARPANET
  - most widely implemented protocol
    - > 200 platforms
  - watershed BSD 4.3

Addressing

- addressing

  Domain Name System

  distributed human name to protocol address translation

  local servers for local part

    hsdndev.harvard.edu

    mghccc.mgh.harvard.edu

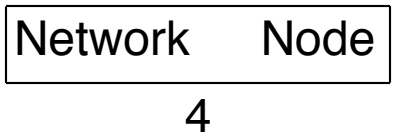
  no relationship required between IP address and name

Addresses

- addresses

  IP Addresses

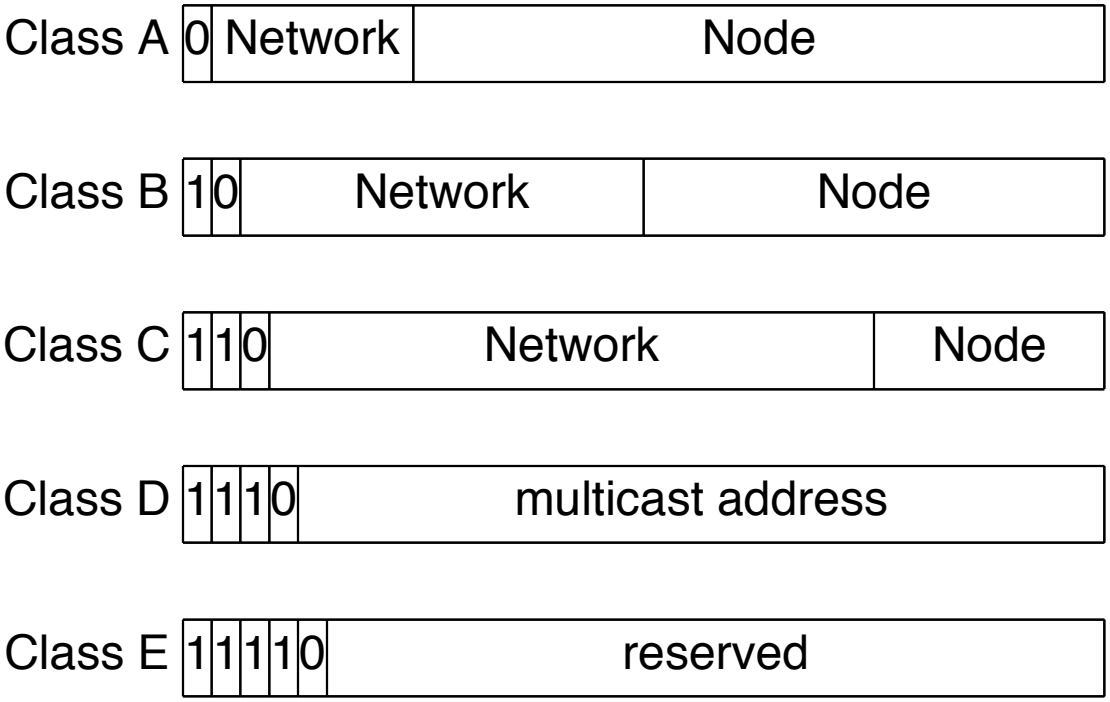
  4 octet - e.g. 128.103.8.36



division between "network part" & "host part" variable

can subdivide host part into *subnets*

5 classes



Subnets

- classed address to course resolution
  who needs 17,000,000 hosts on a net (Class A)?

- can subdivide node part of addresses
  produce ’subnet’ and smaller ’node’

- use mask to configure

- example - Class B address - 128.103.0.0
  if used as ’flat’ class B mask is 255.255.0.0
  if used with ’8 bit subnets’ mask is 255.255.255.0

CIDR

- Classless InterDomain Routing

- supernetting

- treat multiple nets as one
  - blocks of Class C addresses instead of a Class B
  - must be on a power of two boundary

- subdivide larger nets like Class A's
  - not supported in many routers yet

- new representation
  - 128.103/16
  - 128.103.3/24

TCP/IP, contd.

- broadcast addressing
  - protocol broadcast address
    - all bits on in host part of IP Address
      - e.g. 128.103.8.255
    - used in LANs
      - ARP, rwhod etc
  - protocol multicast addresses
    - Class D addresses
    - sound & video multicasts of IETF meeting

- address resolution
  - protocol address to MAC address using ARP
  - ARP broadcast to LAN, destination responds
    - with MAC address

IP Header

- fixed length base header
- variable number of options
- padded to 32 bit word alignment

Version

- 4 bit version number
- current version number = 4

Header Length

- 4 bit header length
- in 32 bit word chunks
- length field = 5 in minimum length header

Type of Service

- processing hints for routers
- e.g., interactive higher priority than file transfer
- values to be used listed in an RFC
- mostly ignored by host vendors

Total Length

- length of total datagram
  - including header

- max value = 65,535
  - too big for most media
  - datagram must be broken up by IP layer processing
    - fragmentation

Fragmentation

- fragmentation
  - like OSI
  - 2 octet *Identification* field to select original packet
  - 12 bit *Fragmentation Offset* to say where in original packet, 8 octet multiples
  - 1 bit *more fragments* bit, 0 in last fragment
  - 1 bit *do not fragment* bit

Loop Detection

1 octet *Time to Live (TTL)* field in header
set to value on transmission
decremented by routers
packet discarded if TTL reaches 0
    error message returned

Protocol

- 8 bit field indicates higher level protocol following header
  e.g. TCP or UDP

Header Checksum

- 1’s complement checksum of header fields
  - processed as 16 bit integers
  - create with checksum fields = 0

- not optional

Src & Dest Addresses

- IP Address of sending node
- IP Address of destination node

IP Header Options

- specify special functions
- not in every packet
- padded to 32 bit multiple
- option types
  - 0 end of options
  - 1 no operation
  - 2 security option
  - 3 loose source routing
  - 4 timestamp
  - 7 record route
  - 8 stream identifier (obsolete)
  - 9 strict source route

IP Routing

- routing
  - 2 general types
    - within Autonomous System (AS)
    - between AS
    - - some claim that two types are not needed
  - many protocols
  - can support protocol source routing

TCP/IP, contd.

- applications
  - file transfer & distributed file systems
    - File Transfer Protocol (FTP), Trivial File Transfer Protocol (TFTP), Network File System (NFS), Andrew File System (AFS), NETBIOS
  - electronic mail and news
    - Simple Mail Transfer Protocol (SMTP), Privacy Enhanced Mail (PEM), Post Office Protocol (POP), Network News Transfer Protocol (NNTP)
  - remote terminal emulation
    - TELNET, tn3270, rlogin
  - window systems
    - X-Window System

TCP/IP, contd.

- applications, contd.
  - time synchronization
    - time protocol (timed), network time protocol (NTP)
  - security systems
    - Kerberos
  - network management
    - Simple Network Management Protocol (SNMP), CMIP over TCP/IP (CMOT), ping, traceroute
  - distributed printer service
    - lpd
  - distributed computing
    - Distributed Computing Environment (DCE)

References

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