

IP address

Lecture 13:
Operating Systems and Networks
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recap

- ❑ interprocess communication across machines?
- ❑ application makes data > Application Layer (HTTP, FTP, SMTP, DNS, VoIP) > become message > Transport Layer (TCP, UDP) > become TCP/UDP datagrams > Internet layer (IP, ICMP) > become IP datagram > Network layer (Ethernet and X.25) > becomes Frame
- ❑ Frames are through physical medium
- ❑ reverse order at the destination!
- ❑ We looked at the IP layer

recap (RIP)

- *Variables:* Tl local table, Tr table received.
- *Send:* Each t seconds or when Tl changes, send Tl on each non-faulty outgoing link.
- *Receive:* Whenever a routing table Tr is received on link n :
 - for all rows Rr in Tr {
 - if ($Rr.link \neq n$) {
 - $Rr.cost = Rr.cost + 1$;
 - $Rr.link = n$;
 - if ($Rr.destination$ is not in Tl) add Rr to Tl ;
 - // add new destination to Tl
 - else for all rows Rl in Tl {
 - if ($Rr.destination = Rl.destination$ and
 $(Rr.cost < Rl.cost$ or $Rl.link = n$)) $Rl = Rr$;
 - // $Rr.cost < Rl.cost$: remote node has better route
 - // $Rl.link = n$: remote node is more authoritative

RIP (continue)

- When a link fails *cost* in the table is set to ∞
- Then, the cost in all table is set to ∞ ($1+\infty = \infty$)
- 3 timers: periodic, expiration, Garbage collection
- RIP is
 - slow in convergence
 - But, most of the time system stables fast
- RIP 2 addresses some of the above issues and also *Authentication* and *Multicasting* (send packets to all other router).

Congestion control

- When load on network high (80% capacity)
 - packet queues long, links blocked
- Strategies to address the problem
 - packet dropping
 - ❑ reliable of delivery at higher levels
 - ❑ Dropping some packets is better than others (MPEG)
 - reduce rate of transmission
 - ❑ nodes send choke packets (Ethernet)
 - ❑ transmission control (TCP)
 - transmit congestion information to each node
 - ❑ QoS guarantees (ATM)

Contents

- ❑ IP address classes
- ❑ Mask
- ❑ Private IP address
- ❑ subnet
- ❑ Classless Interdomain Address
- ❑ IPv6
- ❑ router gateway and all that

IP address

- ❑ identifies a computer
- ❑ IPv4 is 32 bits binary number
- ❑ four parts (octet) each 0 to 255=1111 1111
- ❑ used in ip_src and ip_dst in ip datagram
- ❑ finite number 2^{32} ... what if we run out?

IP address has two parts

- ❑ Network portion: part of IP address of where the device is located.
- ❑ Host ID portion: IP address that uniquely identifies the device on its network
computer, mobile phone, printer,

First octet give the class

class	1 st octet range	1 st octet highbits	No Networks	No hosts
A	1-126	0	126 ($2^7 - 2$)	16,777,214 ($2^{24} - 2$)
B	128-191	10	16,382 ($2^{14} - 2$)	65,534 ($2^{16} - 2$)
C	192-223	110	2,097,150 ($2^{21} - 2$)	254 ($2^8 - 2$)
D	224-239	1110	multicast	
E	240-254	1111	Experiment and	research

- ❑ first octet can NOT be 127 (kept for trouble shooting and testing your local system)
- ❑ local host: 127.0.0.1
- ❑ why 2 is subtracted?

*-cast

- ❑ multicast
- ❑ broadcast
- ❑ anycast

❑ back to ip address!

network Mask (or simply Mask)

- ☐ identifies the part of address which is network address
- ☐ class A: 255.0.0.0
- ☐ class B: 255.255.0.0
- ☐ class C: 255.255.255.0

Why word mask? ignore part of ip address that (in binary) correspond to 0.

What are important bits if mask is 190= (10111110)?

Answer: all except first and seventh

- ☐ Netmask is also used by protocols to decide if a packet is for internal machine or not. It should be handled within LAN or it should go to a router.
- ☐ Netmask is not put into packets, because it is only important for sending things NOT for receiving. Net mask are used for working out if computers are on the same network.

private IP address

All above are ip addresses given to machines and servers that are open to outside world.

- ❑ Private reserved addresses:

- ❑ If a packet with the address which private reserved and hits a router at the edge of organisation, it will not go out.

- ❑ class A: 10.0.0.0 to 10.255.255.255

- ❑ class B: 172.16.0.0 to 172.31.255.255

- ❑ Class C: 192.168.0.0 to 192.168.255.255

- ❑ There is another group (automatic, private, non-routables) We will see later. 169.254.0.0
169.254.255.255

Why private IP address?

- ❑ originally for testing and training.
- ❑ But we have lots of them? count them:
 - ❑ Class A (private) above is 16M addresses
 - ❑ Class B (private): 1M
 - ❑ Class C (private): 65K
- ❑ Some companies assign these reserved addresses for their internal use. On the firewall they use Network Address Translation (NAT) to extend the range of addresses used in IPv4
- ❑ How does NAT work?

Subnet

- ❑ process of dividing a large network to smaller interacting networks to increase efficiency and manageability.
- ❑ IP addresses are hierarchical by nature Network Id and host Id, but only at two layers. Allows create multilayers.

Other reasons for using subnets

- ❑ security: protect parts differently
- ❑ organisational and division of jobs: different department
- ❑ political: we want to be independent.

Example

- ☐ Consider a C class address 193.171.120.0.
- ☐ Mask is 255.255.255.0
- ☐ You have 8 bits 0000 0000 turned on for your addresses
- ☐ you can choose the first two bits for subnet 1100 0000 or the first three bits 1110 0000
- ☐ To do so I can use the subnet mask of 255.255.255.192.
- ☐ Why 192?
- ☐ cause $1100\ 0000(\text{base } 2) = 128 + 64 (\text{base } 10)$
- ☐ How many subnet I will have this case?
- ☐ Answer 4: 10... 01... 11.. 00... so the 254 addresses are divided into four subnets and within each I can have private address. Put a router in between them
- ☐ We wont go into how they are calculated, use a calculator?
<http://www.subnet-calculator.com/> be aware the more subnet the more broadcast and network addresses.

How to calculate subnet address?

- ❑ Given an IP address and a subnet mask calculate the subnet addresses:

Rules:

- ❑ if mask 255 corresponding part of the IP address repeated
- ❑ if mask 0 corresponding part of the IP address is set to zero
- ❑ otherwise bitwise “and” operation
- ❑ Example 156.72.56.5 with mask 255.255.200.0

❑ IP	181	92	56	5
❑ mask	255	255	200	0
subnet	181	72	8	0

Why 8?

- ❑ 56= (0011 1000)
- ❑ 200= (1100 1000)
- ❑ 0000 1000 which is 8