LIS565 Lecture 3

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Reading

Comer chapter 3 and 4

Hall chapter 2

Blank chapter 4 and last chapter

IP design

- Protocol to run on many different physical layers
- Upper layer (transport layer) gives datagrams ¡ 64k, usually 1.5k
- Datagram has a destination address
- Datagram to be transmitted to that address

IP is defined in RFC791

"The Internet protocol is designed for use in interconneceted systems of packet-switched computer connection networks. The Internet protocol provides for transmitting blocks of data called datagrams from sources to destinations. The Internet protocol also provides for fragmentation and reassembly of long datagram, if necessary, for transmission through 'small packet' networks."

...

"There are no mechanisms to augement end-to-end data reliability, flow control, sequencing, or other services commonly found in host-to-host protocols."

The IP number

- logical address of the host
  - assigned by the network admistrator where the host operates at the moment
  - your postal address is an example

The IP address

32 bit address
Example 1001 0100 0000 0100 0000 0010 0110 0111

usally written as four decimal number
each between 0 and 255

each address has a network part, and then a host part. The devision between the two parts

- is expressed by the network mask
- depends on the class of the network

The network mask

The network mask is an address of the form

1....10...0

i.e. starts with 1s only and the switches to 0s only

1111 1111 1111 1111 1111 1000 0000 0000

Classes

- Class A
  - starting with 0
  - 7 bit network
  - 24 bits for host
  - network mask is 255.000.000.000
- Class B
  - starting with 10
  - 14 bit network
  - 16 bit for host
  - network mask is 255.255.000.000

Classes continued

- Class C
  - starting with 110
  - 21 bit network
  - 8 bit for host
  - network mask is 255.255.255.000
- Class D
  - starting 1110
  - multicast address
- Class E
  - reserved for testing purposes

Converting the address to binary

Example address 148.4.2.231

1. Convert 148

148/2 = 74 remaider 0
74/2 = 37 remainder 0
37/2 = 18 remainder 1
18/2 = 9 remainder 0
9/2 = 4 remainder 1
4/2 = 2 remainder 0
2/2 = 1 remaider 0
1/2 = 0 remainder 1

reverse the remainders to get the result 10010100 fill up with 0 until you have 8 numbers.

Example address 148.4.2.231

2. Convert 4

4/2 = 2 remaider 0
2/2 = 1 remainder 0
1/2 = 0 remainder 1

reverse the remainders to get the result 100 fill up with 0 until you have 8 numbers, 00000100

3. Convert 2

2/2 = 1 remainder 0
1/2 = 0 remainder 1

reverse the remainders to get the result 10 fill up with 0s until you have 8 numbers, 00000010

Example address 148.4.2.231

4. Convert 231

231/2 = 115 remainder 1
115/2 = 57 remainder 1
57/2 = 28 remainder 1
28/2 = 14 remainder 0
14/2 = 7 remainder 0
7/2 = 3 remainder 1
3/2 = 1 remainder 1
1/2 = 0 remainder 0

reverse the remainders to get the result 01100111

So the complete number is

1001 0100 0000 0100 0000 0010 0110 0111

Special addresses

- 00000000000000000000000000000000
  - means this host
- 0...0 . Host
  - means a host on this network
- 11111111111111111111111111111111
  - broadcast on the local network
- Network . 11
  - broadcast to a remote network
- 127.anything
  - loopback

Subnetting

On any network, packet that does not go to the local network is send to a gateway for internet routing.

In order to avoid sending all the outgoing packets to the same machine, a large network may be split into subnets.

Example. You have a class C network. You wish to divide it into 5 subnets. What is the subnet mask?

Method to calculate subnet mask

Add 1 to the number of subnets that are needed.

Convert to binary, 6 is 110. This number is three bits long, we need three bits is the subnet mask

1111 1111 1111 1111 1111 1111 1110 0000

or in decimal

255 255 255 224

The first network has the address

193.168.2. with 0010 0000, i.e. 193.168.2.32
193.168.2. with 0100 0000, i.e. 193.168.2.64
193.168.2. with 0110 0000, i.e. 193.168.2.96
...

problems with IP numbers

Classful addressing wastes addresses, most networks given to organizations were too large for them.

When a network becomes to big for its class, all the addresses need changing. This is a big pain!

Devices (routers) that are connected to several networks need one address for each network.

The path taken by packets travelling to a host with multiple addresses depends on the destination address used.

IPv6 or IPng

Initially drafted in RFC1752.

Similar functionality and design

Test backbone “6BONE” operating since 1998.

Transition to last 10 years.

use of 128 bit addresses

IPv4 had 32 bit addresses, 4294967296 different numbers.

IPv6 had 128 bit addresses, 340282366920938463463374607431768211456 different numbers.

665570793866943898599 per square meter of the earth's surface.

Written as 8 blocks of 4 hex numbers

EFDC:BA62:7654:0000:EFDC:BA72:7654:3210

if one block has 0000 contents, it is replaced by 0

EFDC:BA62:7654:0:EFDC:BA72:7654:3210

shortening the address

example

1080:0000:0000:0000:0008:0800:0000:417A

first, remove all leading 0s:

1080:0:0:0:0008:0800:0:417A

then replace *one* occasion of :0:0...0: with ::

1080::0008:0800:0:417A

special addresses

example

0000:0000:0000:0000:0000:0000:0000:0000

means “no address”

0000:0000:0000:0000:0000:0000:0000:0001

means “this host”