I. Subnets and Subnet Masks

Week 13

- RFC 950 circa 1985
- recall classful addressing

Class A	N.H.H.H	1.xxx.xxx.xxx – 126.xxx.xxx.xxx	/8
Class B	N.N.H.H	128.0.xxx.xxx – 191.255.xxx.xxx	/16
Class C	N.N.N.H	192.0.0.xxx – 223.255.255.xxx	/24

- **natural** subnet masks

  Class A: 255.0.0.0
  Class B: 255.255.0.0
  Class C: 255.255.255.0

- subnet mask identifies the network portion of the IP address

Thus given IP addr: 198.22.17.239 (class C)

```
11000110  00011010  00010001  11101111      original address
11111111  11111111  11111111  00000000      Class C natural mask
--------------------------------------
11000110  00011010  00010001   00000000     network portion of the addr
```

II. Simple Example

- the WhizBang Widget company wants 2 networks

  1 for receiving: 60 people
  1 for sales: 110 people

  should they request 2 Class C network addrs?

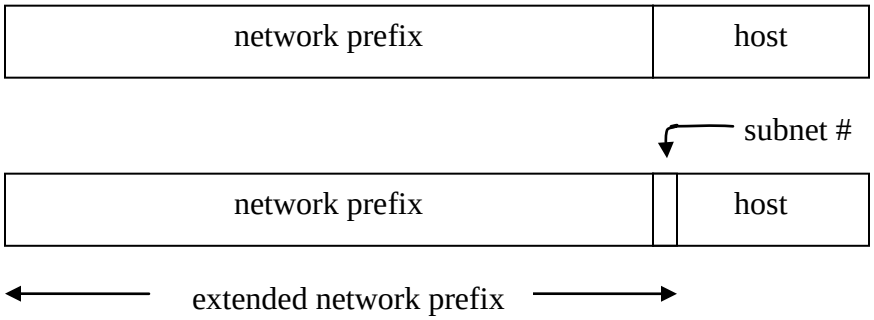
  how many hosts per network? 2^8 – 2 = 254

  will this work?

  254 – 60 = 194 extra
  254 – 110 = 144 extra thus 338 extra addresses → **BAD!**

- subnetting provides the ability to borrow/steal host or network bits

- how many bits to borrow to represent 2 separate networks?



- so starting with one Class C, and need to borrow 1 bit for subnet, we get an ENP consisting of 25 bits and a host size of 7 bits

- how many possible hosts per subnetwork now? 2^7 – 2 = 126

- will this work for WhizBang?

  subnet 1: 126 – 60 = 66 extra
  subnet 2: 126 – 110 = 16 extra thus 82 extra addresses = YES

- what if WhizBang wanted 4 subnetworks? No! Why?

- what is our subnet mask now?

  start with natural C: 255.255.255.?
  leftmost bit of 4th octet becomes 1, 10000000, so ? = 128

- always remember the network (or subnet) mask identifies the **network portion** of the IP address

III. Subnetting, cont.'d

Why subnetting?

No company with a Class B address would ever need 65 K hosts, but would likely need multiple internal networks.

Class B: xxx.xxx.0.0/16
xxx.xxx.0.0/255.255.0.0 ← natural mask

where the mask identifies the **network portion** of the address

Given the following: 129.137.0.0/22

- what is network class? B
- what is the natural mask? 255.255.0.0
- how many borrowed bits for the ENP? 6
- what is the subnet mask then?

  11111111.11111111.11111100.00000000

  128 + 64 + 32 + 16 + 8 + 4 → 255.255.252.0

  or 255 – 3

- how many subnets? 2^6 = 64
- how many hosts per subnet? 2^10 = 1024 – 2
- changing network boundaries **either** 1) increases the number of subnets and decreases the number of hosts, or 2) decreases the number of network space and increases the number of hosts

IV. Subnet Example 2

The XYZ Company has an allocated address of 200.10.10.0

- it wants 2 subnets, approximately 90 hosts per subnet. Is this possible?
- what is natural class? C
- how many bits to borrow, and from where? 1 from host side.
- what is natural mask? 255.255.255.0
- what is new subnet mask? 255.255.255.128
- how many hosts possible per subnet? 2^7 – 2 = 126
- what is network address for:

  Sub-NW 1: 200.10.10.0/25 (**0**0000000)
  Sub-NW 2: 200.10.10.128/25 (**1**0000000)

- what is host range for:

  Sub-NW 1: 200.10.10.1 – 200.10.10.126/25
  Sub-NW 2: 200.10.10.129 – 200.10.10.254/25

- what is the broadcast address for:

  Sub-NW 1: 200.10.10.127/25 (0**1111111**)
  Sub-NW 2: 200.10.10.255/25 (1**1111111**)