ICS 351: Today's plan

- proxy ARP
- netmask exercises
- network and subnetwork design

Proxy ARP

- given a router connected to two networks
- e.g. 192.168.10.0/24 and 192.168.11.0/24
- the router can forward everything between the two networks by simply replying to ARP requests for the "other side"
- in-class exercise: which MAC address does the ARP give in its replies?
- this generalizes to more than two networks
- but only works for networks directly connected to a single router

Static routing

- routing tables can be built by hand
- this works well when:
- o the routes are not changed very often, and
- o the network is small
- whenever equipment is configured manually, it is possible that there will be an error, e.g. a routing loop
- tools such as `traceroute` can be used to debug this

Netmask exercises

- write down decimal equivalents of these binary numbers:
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- 0000 0000
- 1000 0000
- 1100 0000
- 1110 0000
- 1111 0000
- 1111 1000
- 1111 1100
- 1111 1110
- 1111 1111
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- # for IP 128.171.11.23 with a 20-bit network mask, what is the network number?
- # repeat for a 21-bit, 22-bit, and 23-bit network mask
- # also compute the broadcast address for each of these cases

Network and Sub-network design considerations

- usually, we are given a range of IP addresses
- must decide how to subdivide them
- usually, the decision of which hosts to attach to which router interface is dictated by connectivity, security, or similar factors
- so must decide which subnetwork gets which addresses
- each subnetwork must have a size that is a power of two (e.g. 64 in prelab 3)
- two addresses in each subnetwork are reserved: all zeros host part gives the network number, all ones host part gives broadcast address
- so if a host part has n bits, the subnetwork can have at most 2^n - 2 hosts

Network and Sub-network design requirements

- each host in each subnetwork needs a unique IP number
- these can be assigned statically or dynamically
- server machines usually need static IP addresses, whereas client machines can use static or dynamic IP addresses
- static IP addresses must be assigned manually, changing them require overhead and sometimes causes user complaints
- dynamic IP addresses are assigned by DHCP, can be changed relatively easily
- (usually) we cannot easily get new IP numbers, and the future can be uncertain!

Rational Sub-network Design

- figure out network, subnetwork, and sub-sub-network (etc) topology
- figure out the minimum current size for each subnetwork
- if additional addresses are available, estimate future growth of each subnetwork
- dynamic addresses can be reassigned more easily, so it is OK to be more generous with dynamic addresses
- if the future is uncertain, adopt a reasonable policy, e.g. all subnetworks have 27-bit netmasks and subnetworks numbers are handed out as needed

Network Design Exercise

- three routers, A, B, and C, each connected to the other two
- router A is also connected to the wider internet
- router A connects to three other subnetworks:
- o X, with at least 10 static addresses and 20 dynamic addresses,
- o Y, with at least 50 dynamic addresses,
- o and Z, with at least 2 static addresses.
- router B connects to two other subnetworks:
- o H, with at least 5 static addresses but a good chance of future growth, and
- o K, with at least 30 dynamic addresses and 30 static addresses
- router C connects to two other subnetworks:
- o P, with at least 5 static addresses
- o Q, with at least 5 dynamic addresses
- You have been given the IP address range 10.11.12.0/24
- assign IP addresses for this network