

Basic Tools and Commands

ITL

Network Masks - Review

- Are always used to compare addresses
- Are **not** connected to an address, they are specified independently
- Are **not** transmitted in IP packets
- The two most common uses:
 - Define a “subnet”, i.e. a set of addresses that are mutually reachable (“local”) on a single set of hardware without the use of routers
 - Decide which route to use in a routing table (next lecture)

Addressing Example

- What is the subnet containing 132.235.67.19/29?
 - 132.235.67.19 -->
 - 132.235.67.<0 0 0 1 0 0 1 1> Cheat: 128 64 32 16 8 4 2 1
 - 132.235.67.<0 0 0 1 0 0 1 1>
- Network address
 - 132.235.67.<0 0 0 1 0 0 0 0>
 - 132.235.67.16
- Subnet Broadcast
 - 132.235.67.<0 0 0 1 0 1 1 1>
 - 132.235.67.23

Number of hosts

- Network 132.235.67.16/29
- Broadcast 132.235.67.23
- Number of addresses
 - $2^3 - 16 + 1 = 8$
- Number of hosts
 - $8 - 2 = 6$
- A quirky example: 132.235.67.16/31
 - broadcast 132.235.67.17
 - 2 addresses, 0 hosts!
 - /30 is the smallest usable subnet (4 addresses, 2 hosts)

A bigger subnet

- 132.235.66.0/23
 - 132.235.<0 1 0 0 0 0 1 0><0 0 0 0 0 0 0 0>
 - broadcast
 - 132.235.<0 1 0 0 0 0 1 1><1 1 1 1 1 1 1 1>
 - 132.235.67.255
- Addresses
 - $(67 - 66 + 1) * 256 = 512$ Or, 9 bits = $10^9 = 512$ addresses
- Hosts
 - $512 - 2 = 510$
- More in the routing lectures/labs

Configuring Workstations

- Reminder: we need to specify:
 - IP Address
 - Network Mask
 - Verify Broadcast Address (we will talk about that in a moment)
 - Default Route (aka Gateway)
 - Name servers (optional, but we will always add these)

Address Rules

- The host part of an IP address must not be all zero
 - Hint: determine the network address first
 - Count up by one from the network address to get the lowest usable host address
- An IP address with the host portion set to all Ones is a “Subnet Broadcast”; this is not a valid host address

Address Conventions

- Give a router the highest usable IP address in the subnet; i.e. the address one less than the broadcast.
- Start numbering hosts with the lowest available address, counting up.

Windows XP/2003/2008

- Enter all information into the GUI
 - Start->Settings->Network Connections
 - Properties (for the correct interface)
 - TCP/IP (v4 for 2008)
 - Properties
- Command line tool IPCONFIG
 - /all
 - other options (e.g. DHCP) later

Mac OS X

- System Preferences from the “Dock”
 - Select Network
 - Select the “Built In Ethernet” interface (from a pull-down menu in 10.4, side-bar in 10.5) (ifconfig will later show this as en0)
 - Fill in the property sheet (we will usually use “manual” addressing)
 - Click Apply

ifconfig and Mac OS

- On all Unix systems, ifconfig can set the properties network interfaces
 - Usually you create a configuration file on disk
 - During startup, the system calls ifconfig with the parameters given in the file
- Mac OS X
 - Uses a process called “configd” to dynamically change interfaces as configurations change and interface states change
 - Anything you do with ifconfig will likely be overwritten by configd

Linux

- ifconfig
 - ifconfig -a
 - shows all interfaces (including some you will never use)
 - ifconfig <name> inet <address>
 - ifconfig <name> netmask <mask>
 - or ifconfig <name> inet <address>/<prefix>
 - ifconfig <name> up
 - used if the interface was not configured before
- Note: This is not how you permanently configure a Linux machine; but very useful for testing and debugging. All changes you make with ifconfig are lost after a reboot.

Other Settings

- Default Gateway (Router)
 - Windows and Mac OS
 - In the property sheets
 - Linux command line
 - route add default gw <gateway-address>
 - Note that the keyword "gw" is not used by some other versions of "route"
 - check with netstat -rn
- Name Servers (132.235.64.1 and 132.235.64.2)
 - Windows and Mac OS: in the property sheets
 - Linux: set up for you (/etc/resolv.conf)

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You build it...

- ... and it does not work!
 - One: determine if a cabling problem is the cause
 - GUI status displays, ifconfig
 - Two: determine if a correct network path exists
 - ping (to things close-by first)
 - Three: Discover intermediate network gateways (routers) and determine the path of the packet.
 - traceroute, tracert
 - Note: there are no guarantees; diagnostics and real applications are different...

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Ethernet cabling

- Since Ethernet requires a "Carrier Sense" function, an Ethernet device can provide simple diagnostics
- "Link" indicator on hubs/switches and some NICs
- Workstation diagnostic utilities:
 - IPCONFIG in Windows NT/2000/XP
 - also a status icon in the system tray
 - Mac OS X: Network Status in System Settings
 - IFCONFIG in Unix
 - Gnome network indicator (top right)

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The IP built-in diagnostic

- ICMP - Internet Control Message Protocol
 - RFC 792
- Looks like a "transport" protocol on top of IP
- Used by routers and workstations to report errors

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Basic Connectivity - ping

- Program found in Unix and in Windows (command line and third-party GUI versions)
 - Builds and sends a series of ICMP “Echo” messages
 - Receiver of the message is obliged to return an ICMP “Echo Reply” preserving the original request packet content
 - NOTE: Because the packet content is undefined in the standard, ICMP Echo may be a “covert channel” from a security perspective, and sites may block ICMP.
 - Useful options:
 - ping -n ... (Unix) - prevents name lookups

tracert

- Used to determine the failure point if PING reports no connectivity
- Also used to map the packet path for more detailed diagnostics
- Available in Unix, in the Windows command prompt as TRACERT, and as third-party GUI
- Selectively triggers ICMP error messages and report these error message returns
 - Useful option: tracert -n (unix) no name lookup
 - On Windows you use -d