How the Internet Works

Router Setup & Maintenance

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How two people talk to one another

- If you are in a room full of people and want to talk with a specific person
  - Must know their name
  - Must identify person (shout out or broadcast discovery)
  - One person starts conversation (client & server)
  - Must speak same language (protocols)
- Or can call out name of person you want to talk with
- If not in same room (sending a letter)
  - Need address information
  - Put message in an envelop, address it, put in mail box
  - Post office does not need to know language of message, only the address

For two computer to talk

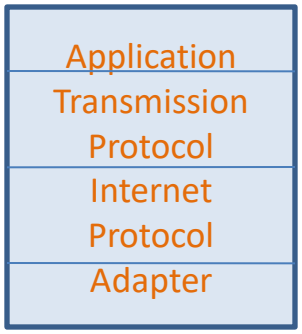
- Speak the same language (i.e., TCP/IP)
  - Use various protocols (standards) that are maintained by several organization(s)
- Computer that wants information (client) must know it's own address
- Know about the local network or default router
- Know the proper protocols for connecting to the other computer (server)
- Know address (or name which can be converted to a number) for server

Client / Server

- Server is just a service program running on a computer that starts up then waits for requests from clients, processes request, sends response back, waits for next client
  - i.e., Web Server Programs, Cloud Services
- Clients are just programs running on a computer that calls one or more Servers to get information
  - i.e., Browsers
  - Can even be on same computer as server

Inside every networked computer

- Communication stack & responsibilities



Browser implementing HTTP sending HTML messages

Transmission Control Protocol (TCP) – makes sure msg gets there

IP – does it's best to get message to destination (routing)

The Wire i.e., Ethernet, WiFi, Fibre, Radio

- Encapsulation of messages

- Each Header

Message encapsulation

- When sending
  - Each layer put message into envelop and adds header information
  - Passes message to next lower stack layer
  - Bottom layer sends message on wire
- When receiving
  - Each layer opens their envelop
  - Passes message up the stack according to header information
- Layers only “talk” with layers above and below

IP Addresses & Masking

- “Unique” address for every IP computer in world (Plus equipment on Mars and the moon and orbit)
- Assigned in blocks by an Internet authority on request
- IPv4 32 bit address usually displayed in dotted decimal format (i.e., 192.168.1.1)
- Masks used by IP code to define what portion of address block is on the local network (look something like 255.255.255.0 or 192.168.1.0/24)

IPv6

- Have run out of possible IPv4 addresses
- Slowly moving to IPv6 (from core out)

Private IP Addresses & NAT

- These IP addresses are only for private networks (not valid on Internet)
  - 10.0.0.0 to 10.255.255.255 16,777,216 addresses
  - 172.16.0.0 to 172.31.255.255 1,048,576
  - 192.168.0.0 to 192.168.255.255 65,536
- Network Address Translation (part of code running in router)
  - Changes private client addresses in encapsulated data (aware of and modifies the TCP & IP layers) to the public address of router (public IP address assigned by Suddenlink DHCP)
  - Remembers private address changes so that when response is received, it will change the response to match client
  - Forwards modified response to original requesting client

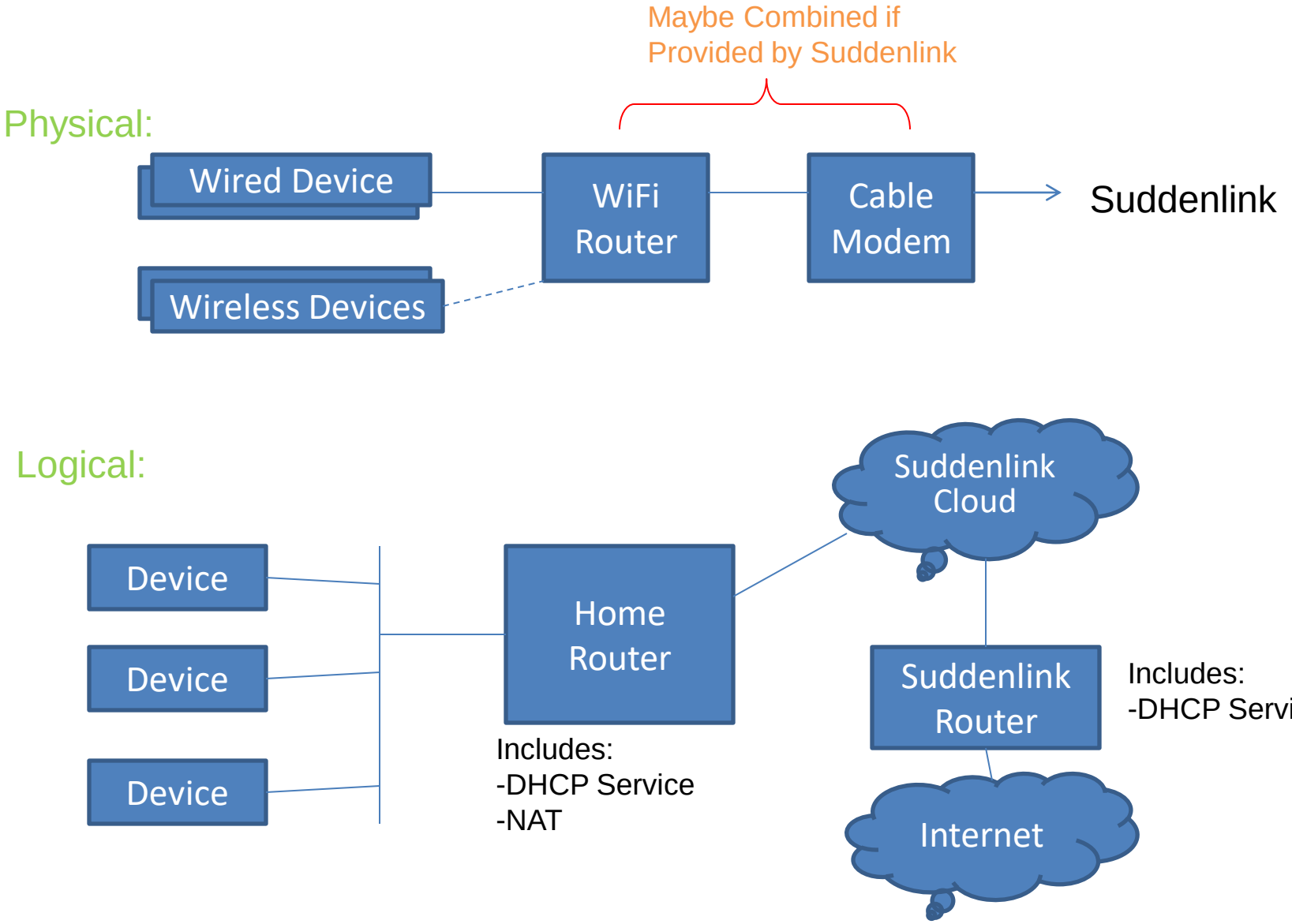
When computer starts up

- Either static address has been pre-assigned, or
- Broadcasts (shouts to all computers including routers on local network) to find a DHCP server program that can send it the appropriate configuration information:
  - DHCP server assigns temporary IP address & mask
  - DHCP server says which DNS servers to use
  - DHCP server says which default router to use

Domain Name Service (DNS)

- Hierarchy of servers that have tables of names and addresses
- Central (core) servers point to lower level DNS servers that have more specific information – "manually maintained table"
    - i.e., .google.com is at address x.x.x.x, .dell.com is at address y.y.y.y, .uk is at address z.z.z.z (likely in England)
- Google's DNS server (x.x.x.x) knows how to convert www.google.com, mail.google.com, etc.
- Every client DNS program
  - Knows about DNS server and alternate "closest" in hierarchy (i.e., Suddenlink maintains DNS servers)
  - Sends DNS request to primary (or to alternate if primary does not answer within a configured period of time)
  - If server does not know the answer it forwards the request to the next higher DNS server and will remember (cache) the response before sending the answer to the client. Cache of information is kept for 1-3 days in case same question comes up again.
  - If request gets to core servers they will pass the information downward for resolution.
  - Client DNS program sends response to requesting application – and client DNS will also cache information for pre-defined period of time (time-to-live).

Home Networks



New Router Setup

- When you get a new router or use the firmware factory reset button ***change*:**
  - the management userid & password (each manufacturer has known defaults)
  - the WiFi SSID and password
  - Disable remote management except for devices on internal network (you do not ever want someone on public Internet to manage your router)
  - Do not setup any port forwarding unless you are sure (port forwarding allows unknown clients from the Internet a path through the routers firewall)

Firmware Update

- See manufacturer's web site for latest release to fix known problems (most vendors do not update often)
  - Netgrear just updated all their router software after hack reported that allowed external sites to take over routers via hacking code sent to browsers
- To do:
  - Determine your PC's assigned network address and default router
  - Open browser on PC / MAC (preferably a wired vs. wireless device) and connect to default router address
  - Determine router model including version
  - Check manufacturers website to see if update available, if yes continue
  - Note down current router setting (the update process may erase)
  - Download the proper version and remember where it is on PC /MAC
  - Login in to router and go to firmware update section
  - "Browse" to downloaded file
  - Start updated process (can take about 5 minutes) – do not power off during update
  - Confirm router settings!

Open Source Router Software

- Open Source means that everyone has access to source code and hacks are far fewer that manufacturer's code
- Popular ones include:
  - DD-WRT
  - OpenWrt
- I prefer Gargoyle which is a an easy to use GUI that includes OpenWrt
- Firmware is installed the same way as for a router upgrade though you are very likely to lose existing configuration (look for the *model*-factory.bin not the *model*-sysupgrade.bin file (check documentation))

If you run into troubles

- Wait 5 minutes
- Power off then on
- Factory reset button
- Take router to Help Center