

Networking

UBNetDef, Fall 2021
Week 2

Lead Presenters:

Vasu Baldwa - ~85% Bar fight win rate

Lucas Crassidis - Amateur SUV Drifter

Administrivia

- Homework 1 should be submitted. If it isn't tell us now! DM @radhika right away
 - Grading will be lax, feedback for formatting will be provided
- Questions/Comments/Concerns w/HW1

Administrivia-two

- Lockdown sign up (Posted in Mattermost):
 - <https://forms.gle/LY91zP5kLWsrR38p9>
- Office hours schedule (Also on Mattermost):
 - Located in Jacobs 324

Name	Email	Chat Username	Office Hours
Vasu Baldwa	vasudevb@buffalo.edu	vasudevb	Thursdays, 5:30pm-6:30pm
Lucas Crassidis	lucasra@buffalo.edu	luke	Fridays, 4pm-5pm
Anthony JeanPierre	aj76@buffalo.edu	ant	Wednesdays, 10am-11am
Radhika Jois	radhikaj@buffalo.edu	radhikaj	Mondays, 5:30pm-6:30pm
Anthony Magrene	ammagren@buffalo.edu	magrene	Tuesdays, 11am-12pm

What is Networking?

- Connection between 2 or more devices
- Types of devices found on a network
 - Servers
 - Computers or programs that can manage access to a centralized resource or service on a network.
 - Used for websites, SQL databases, virtualization etc.
 - Clients
 - Device that connects to and uses the resources of a server
 - Smartphones, Laptops, IoT Speaker

What is Networking? (cont.)

- Devices (cont.)
 - Routers and Switches
 - “Administrators”. Help direct the flow of traffic.
- The internet is a “network or networks”
- All network communications happen via pre-defined protocols

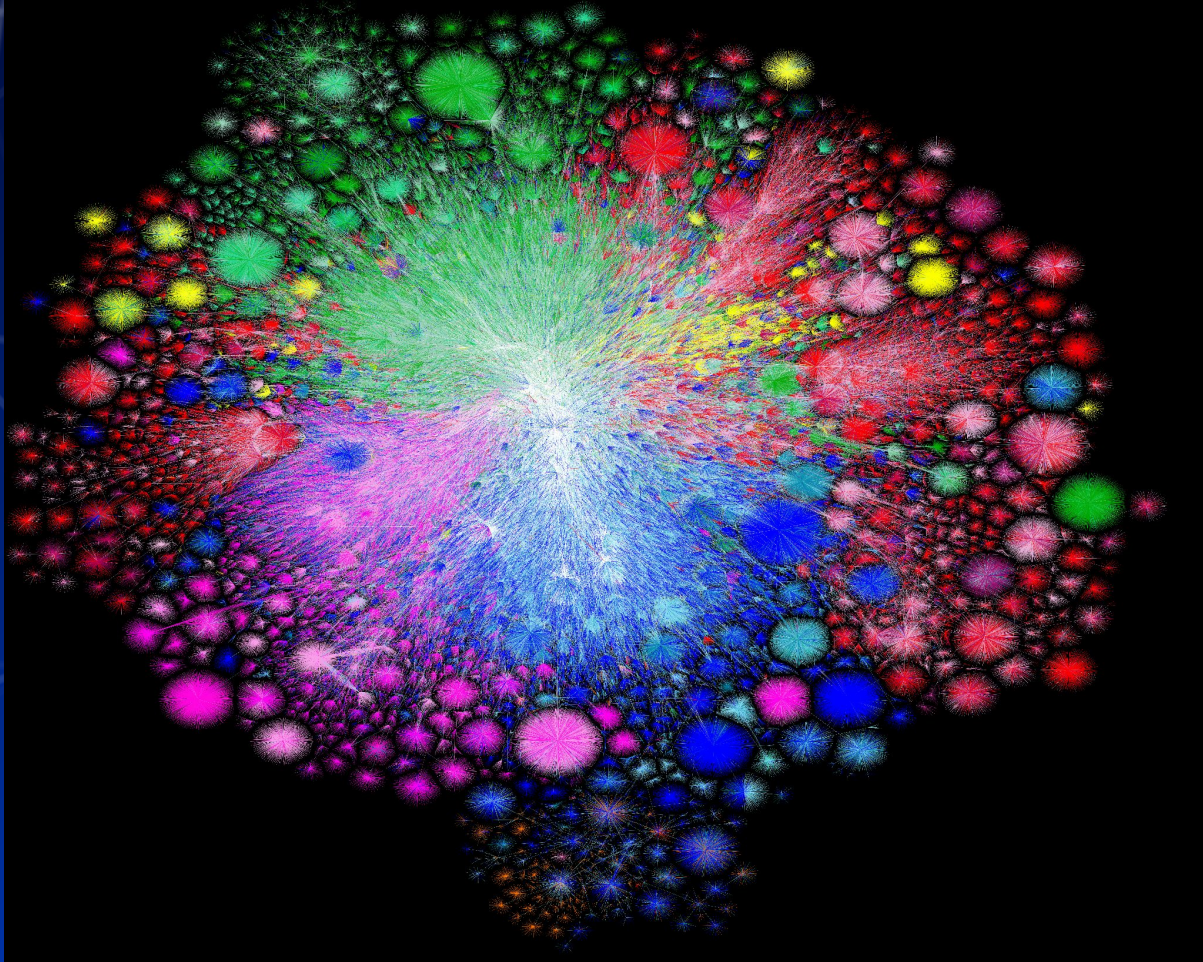


Image of the Internet, Jan 16th 2021. Opte.org

Networking Theory

There WILL be funny pictures (probably)

Types of Networks

- 2 Broad categories
 - Local Area Network (LAN)
 - Stuff connected at 1 physical location
 - Wide Area Network (WAN)
 - Network not tied to a single location



Types of Networks (cont.)

- Other special types of networks:
 - MAN, IAN, CAN
 - These are just specialized WANs
 - DMZ (Demilitarized Zone)
 - Physical or logical subnetwork that separates an internal LAN
 - Allows specific resources to be accessible from the internet while the rest of the devices on the LAN are inaccessible

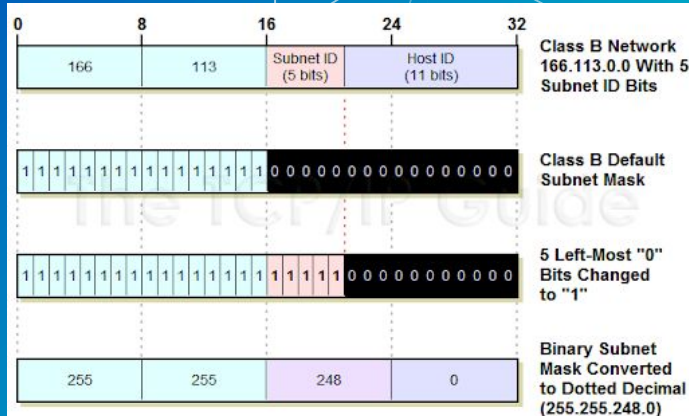
Networks and Your Computer

- Each computer has a “name” to differentiate it on the network
 - This name is called an IP address
 - Unique identifier separated by 4 periods
 - Ex)38.95.253.163
- 2 types of IP addresses
 - IPv4
 - What we use in class
 - Limited to ~4.3 billion addresses
 - IPv6
 - Has about 3.40×10^{36} (340 Undecillion) different addresses
 - Not required for this class.
- MAC addresses
 - Physical address (Based on your NIC)
 - Cannot change*

```
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . : tecad.fsu.edu.
Description . . . . . : Intel(R) Ethernet Connection (7) I219-LM
Physical Address. . . . . : C8-F7-50-6F-48-9F
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . : Yes
```

Subnetting

- Fault in IPv4, not enough addresses
- Way to break up networks into smaller networks
 - We use / to show what the subnet is
 - The number after the / will indicate how many computers there can be on the network
 - NOTE: the number after the / does not equal the actual number of computers that can be on the network
- Logical organization of connected network devices



In-Class #1

Check your computer's IP address

On Windows:

Google "What is my ip address"

Open PowerShell and type `ipconfig`

On Linux:

Google "What is my ip address"

Open terminal and type `ip a`

Now do the same on your VMs

Discussion: What do we notice?



Public vs Private Addresses

- Public Addresses
 - Used for intranet communication
 - UB is publicly addressed
- Private Addresses
 - Mainly home or internal company networks
 - Our infrastructure is privately addressed
 - 3 sets of them
 - 192.168.0.0 – 192.168.255.255
 - 172.16.0.0 – 172.31.255.255
 - 10.0.0.0 – 10.255.255.255

DHCP vs Static Addressing

- Static
 - Assign each IP address manually
 - IP Address does not change
- DHCP (Dynamic Host Configuration Protocol)
 - Preferred method for IPv4 assignments to host on large networks
 - Dynamically assigned addresses throughout the network
- We require the use of Static IPs in this class
 - Makes it easier to grade and more consistent from learner to learner
 - What are some other cases where Static IP's might be useful?

Ports

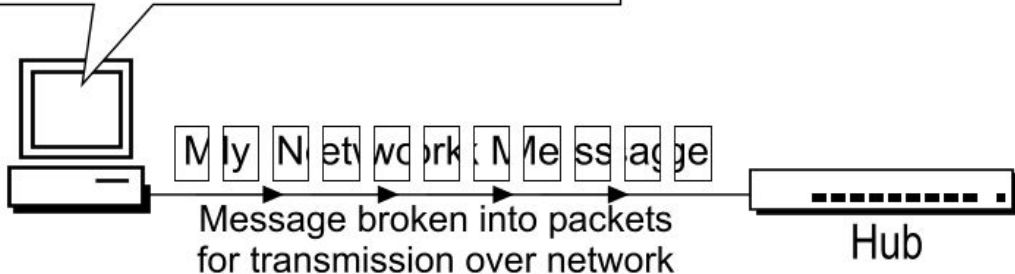
- Not physical sea-ports, they are digital!
- Associated with a protocol*
- Allows for services to communicate over the network
- Common ports:
 - HTTPS: 443
 - HTTP: 80, 8080
 - FTP: 21
 - SSH: 22
 - DNS: 53

*(A service can be assigned to any port, more on this in a few weeks)

Packets

- Collection of data to be sent over the network
- Made up of bits and makes up frames

My Network Message



Packets (cont.)

- What do they contain?
 - Source IP Address
 - Sending device
 - Source MAC Address
 - Destination Ip Address
 - Receiving device (used by routers to forward a packet to its destination)
 - Destination MAC address (used by switches to forward packets)
- Frame Check Sequence(FCS)
 - Checks for errors and if it is found then the packet are dropped

Break

We will resume class in ~5 mins

Sign up for Lockdown! Link on the website:
lockdown.ubnetdef.org

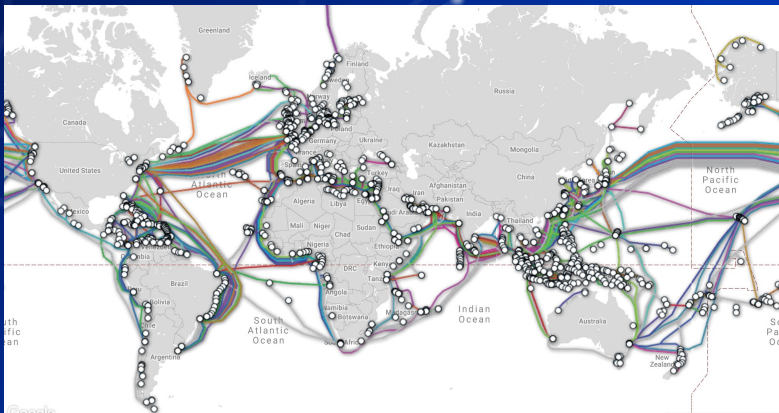
Questions?

Parts of a Network

Y'know, the things that go beep and boop

Cable Cabal

- Lots of wires makeup the real backbone of the internet.
 - Many are buried under the sea



Switches

- Transmits packets over the LAN
 - Based on MAC address
- Why?
 - Because if each computer was connected to each other we would have a mess of wires.
 - 42 computers on a network (like we have in B30) would mean 861 cables, with 41 cables per computer. Quite the mess!



Router

- Act as dispatchers, are responsible for sending and receiving packets to and from the internet
- Gateway address are the IP address of the router
- Modems
 - Allow for communication over underground wires.
 - 99% of the time included in the router itself.
 - Turn the digital signals into analog signal to send over the wires.



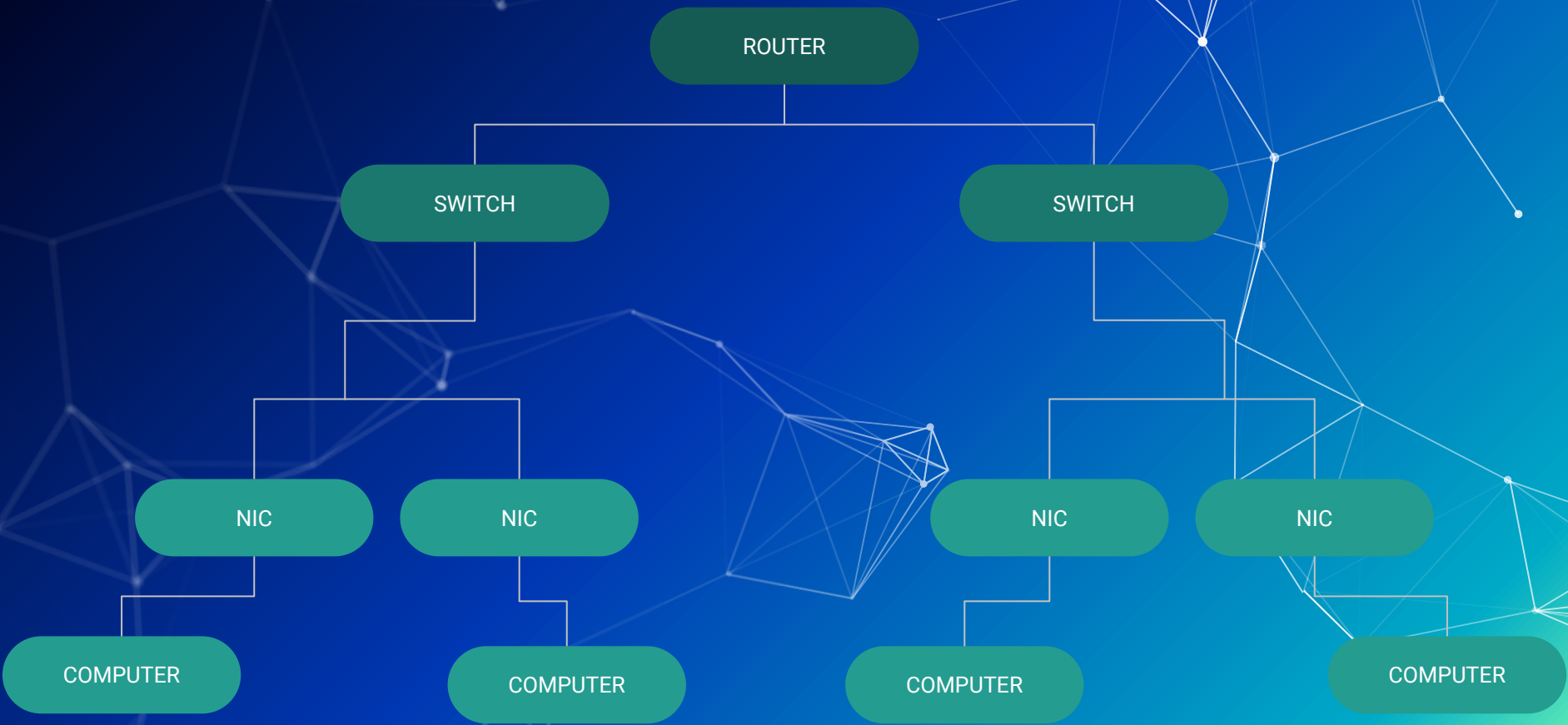
WAP (Not that one)

- Wireless Access Points
- Include a radio transmitter capable of connecting devices wirelessly
- Removes the need for manual wired connections
- Expands the bandwidth a router provides
- Note: they are different from routers, merely additional points of contact for devices

Firewalls

- Used to secure traffic sent, and restricts traffic entering the network
- Only permits authorized traffic to pass through the network
- Can potentially alarm users of suspicious or unusual behavior
- Cannot be used to protect against internal threats (i.e. employees)





Protocols

- Established set of rules for data transfer or functionality over a network
- Examples
 - DNS
 - DHCP
 - TCP/IP and UDP

Domain Name System (DNS)

- Translates an IP address to a name
- 8.8.8.8 translates to google.com
- 128.205.201.57 translate to buffalo.edu
- Created to help alleviate the need to remember these long IP addresses

TCP/IP

- Transmission Control Protocol / Internet Protocol
- Suite of protocols used to interconnect network devices on the internet
 - Specifies how much data is transferred over the internet
 - How it's broken-up
 - How it's transmitted

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Application

- To allow access to network resources

Transport

- To provide reliable process to process message delivery and error delivery

Internet

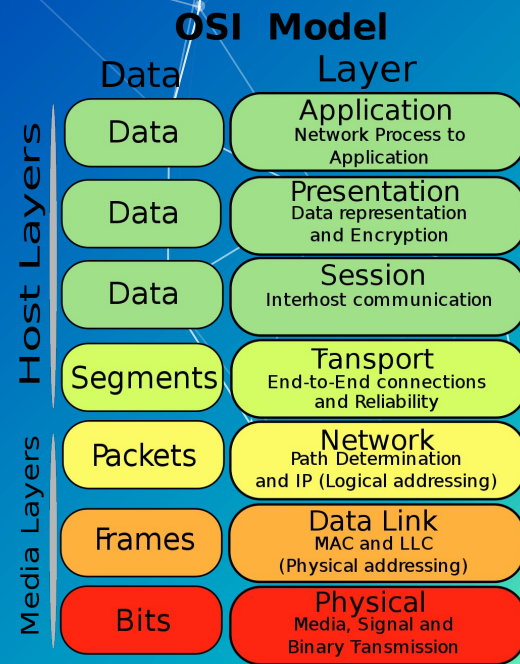
- To move packets from source to destination
- To provide internetworking

Network Interface

Responsible for the transmission for the between two device on the same network.

OSI Model

- Open Systems Interconnection Model
- Used for data network design, operation specifications and troubleshooting
- More advanced than the TCP/IP Model
 - 7 layers as opposed to 4 on the TCP/IP
- The most well known and used model currently



TCP vs UDP (Transport Layer)

■ TCP (Transmission Control Protocol)

- Reliable
- Connection Oriented
- 3 way handshake (SYN, SYN-ACK, ACK)
- Best for applications that require high reliability but not time sensitive
- Packets get organized in order specified, guaranteed data transfer in correct order

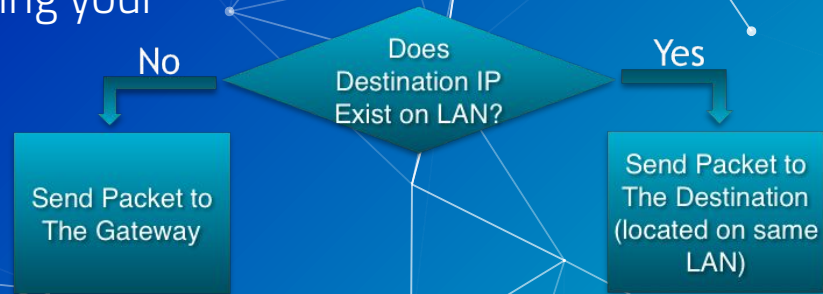
■ UDP (User Datagram Protocol)

- Not reliable
- Connectionless, relationship between programs ends after packets are sent
- Best for applications that require fast, efficient transmission
- Packets are independent of each other so there is no order
 - No guarantee that the packets will be received

Questions?

Flow of Packets

- IP Layer determines if the client you are sending your packet to resides on your LAN
 - By looking at your:
 - Client's IP address
 - Client's subnet mask
 - Destination IP address
- Switches handle the LAN traffic (layer 2 devices)
- LAN traffic is handled through MAC Addresses
- Address Resolution Protocol (ARP) request
 - What IP goes to what MAC address?
 - Is it in the ARP table? If not, forward to router or default gateway

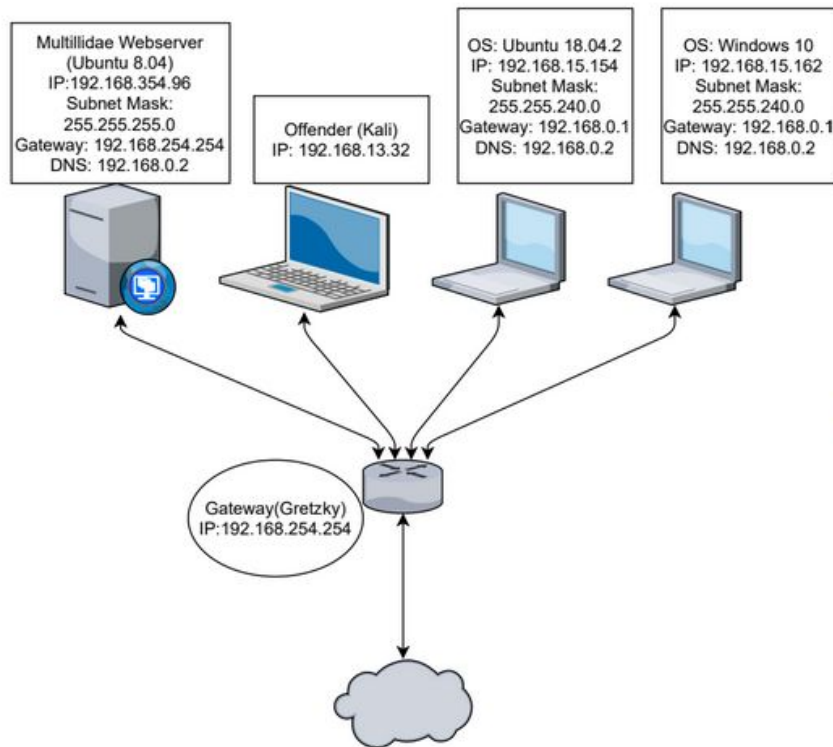


Topology

- A drawing that maps out the entire network
- Used to get a model of how the network is structured

More-Topo

- Let's build one together!
- Base it on our real world network we made in class



Questions?

Break

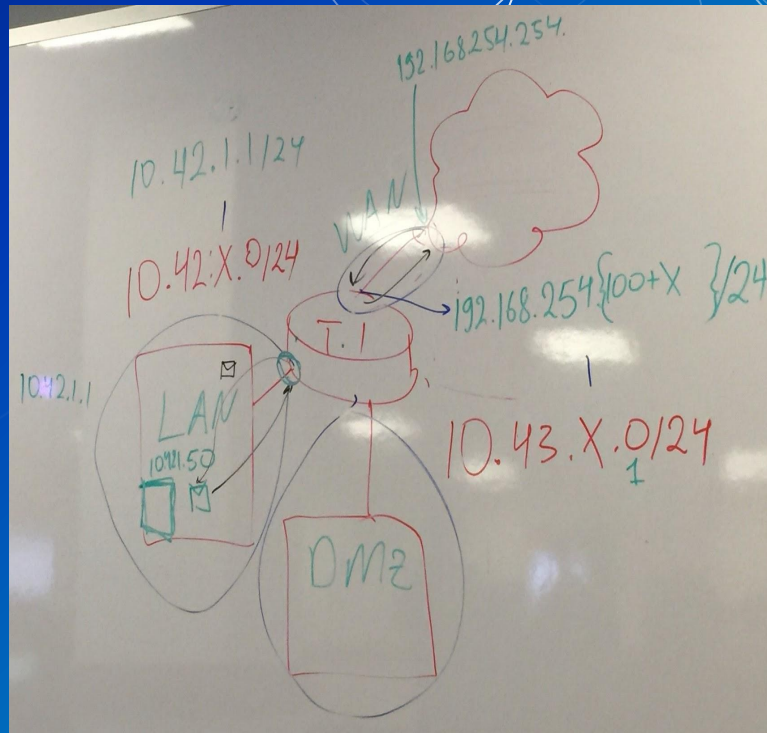
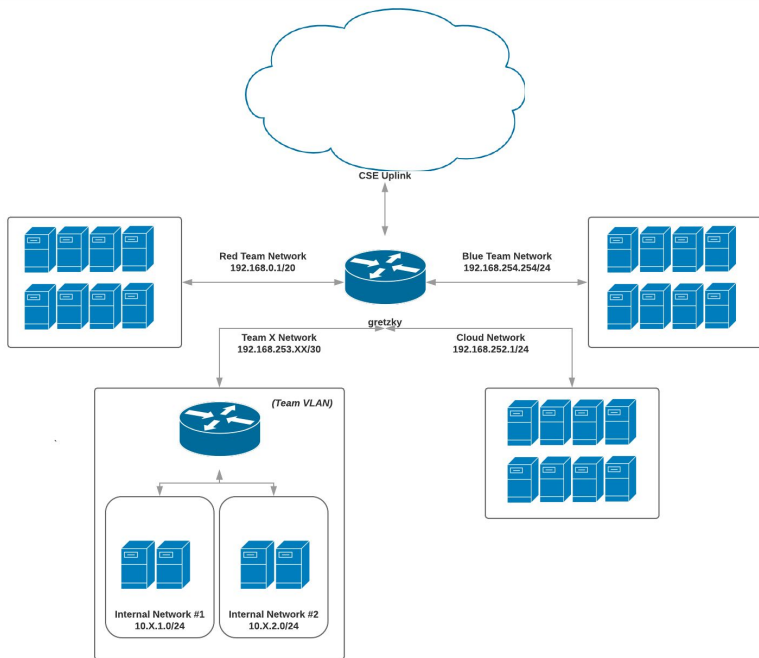
We will resume class in ~5 mins

Our Infrastructure Network

There be something in them internet tubes

CDR NETWORK DIAGRAM

James Droste | November 23, 2017



PfSense

- PfSense is a firewall and router that runs within its own virtual machine
- It will act as a gateway to the internet for all the VMs you use in future assignments
- Web-based front end (demo)
- Let's install PfSense!

Useful Commands

- **ping**: check your network connection
 - **ping 10.0.0.20** - will check if a device with this IP address is connected to the LAN network
- **ipconfig**: shows IP address information on Windows
 - Use the `ifconfig` command on Linux
- **nslookup**: display DNS server information
 - **nslookup 8.8.8.8** → dns.google

Homework Overview

insert funny lower 3rd here

Further Reading

- [A visual guide to subnetting](#)
- [A more in depth guide than what we've done](#)
- [Cisco Packet Tracer -> See how packets behave on a network](#)