



HACKSUMMER 21



Session 3

Networking



How Computers Communicate

- Signals over the wire
- Signal senders/receivers a called **network interfaces**
- Discrete chunks of information between 2 points
- How are they routed?
- How are they interpreted?

29 OCT 69	2100	LOADED OP. PROGRAM	CSK
		FOR BEN BARKER	
		BBN	
	22:30	Talked to SRS	CSK
		Host to Host	
		Left op. program	CSK
		running after sending	
		a host dead message	
		to imp.	

Log of first DARPA Net communication

A large, semi-transparent purple silhouette of Tux, the Linux mascot penguin, is centered in the background. The penguin is facing forward with its wings slightly out.

IP Networking

The Internet Protocol (IP)



- How most devices speak over the network
- Only one part of the networking stack
- IP addresses are assigned to each device on the network
- DHCP
 - **Dynamic Host Control Protocol:** assigns
- IPv4: xxx.xxx.xxx.xxx
- IPv6: xxxx:xxxx:xxxx:xxxx
- We'll focus on IPv4 addresses

IP(v4) Addresses

- 32 bits of information
- Separated into 4 8-bit sections (**octets**)
- 8 bits = 256 possible values
- So the total theoretical IP address space is 256^4
- We still ran out!
- We can re-use the same IP address in separate local networks
- These separate networks use smaller slices of this space called **subnets**

Subnets

- Your IP address might look like:
 - 192.168.0.XXX
 - The last octet is available, but the rest of the address is locked, or “masked”
- Subnet masks
 - 255.255.255.0: Last octet fully available
 - Also written as /24 as in 24 of 32 bits masked
- When traffic needs to leave the subnet, it does so via the **gateway**.

Routes/Gateways

- When a packet is addressed to an IP outside of the subnet, it is routed to the **Default Gateway** (usually)
- This will handle the next step in the routing
- Routing can be a long chain!
- Traceroute tells the story

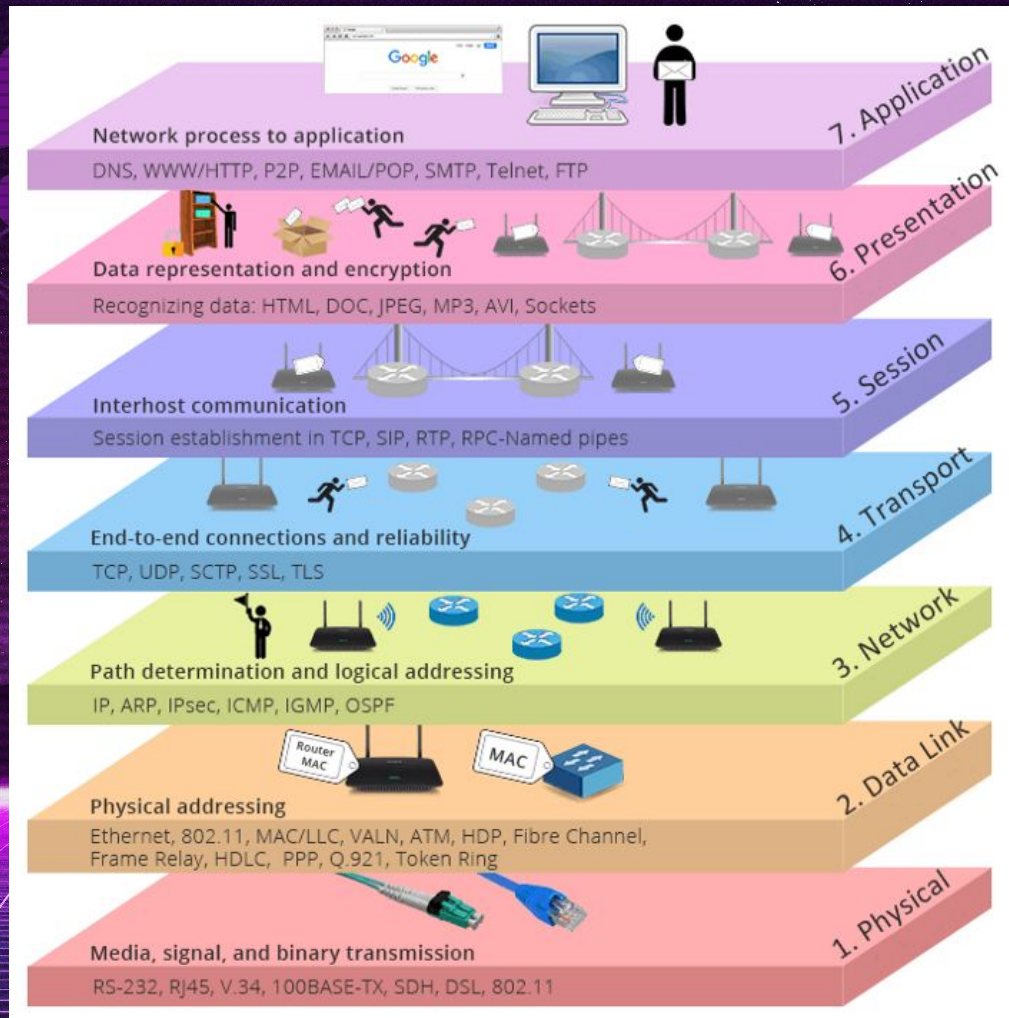
MAC Addresses

- The hardware identifier of the network interface
- Unique to each interface
- Not immutable
- Assigned by vendor
- IP networks map IP addresses to MAC addresses via **Address Resolution Protocol**



Networking is Layered

- The OSI model separates networking into abstract layers
- Not the only way to describe network data



Networking is Layered

- The TCP/IP model
- Generalizes more than OSI
- Notice the overlap?
- These models are for understanding, not purely technical

	OSI Model	TCP/IP Model	
7	Application	Process/ Application	4
6	Presentation		
5	Session		
4	Transport	Host-to-Host	3
3	Network	Internet	2
2	Data Link	Network Access	1
1	Physical		

A large, semi-transparent blue silhouette of Tux, the Linux mascot penguin, is centered in the background. The penguin is facing forward with its characteristic beak and eyes.

Tcpdump



Clients and Servers

Clients and Servers

A large, semi-transparent illustration of Tux, the Linux penguin mascot, is centered in the background. It is a black penguin with a yellow beak and eyes, standing on a dark, jagged horizon line. The background is a dark blue space with a grid of white lines that recede into the distance, creating a perspective effect.

- Since Linux is so often a server, we better learn how to set one up
- A single computer can be a server of many services
- Common examples of network services:
 - HTTP
 - FTP
 - SSH
 - IMAP/SMTP

Services and Ports



- **Client:** A computer accessing a service
- **Service:** something available over the network
- **Server:** the thing offering the service
- **Port:** A number identifying the service and directing traffic to the right destination on the server

The background is a dark purple space with a grid of lighter purple lines that recede into the distance, creating a perspective effect. In the center, there is a stylized, semi-transparent purple penguin, which is Tux, the Linux mascot. The penguin is facing forward with its arms slightly out. The text "Setting up a Web Server" is written in a bold, white, sans-serif font across the middle of the image, partially overlapping the penguin.

Setting up a Web Server