Internet 101

U.S. National Cybersecurity,
Technical Breakout #1
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Network vs. Internet

- a **network** is a system of computers that talk over some communication medium: phone line (analogue modem, DSL), cable, fiber etc.

- the **Internet** is a global network owned and operated by many different groups with often conflicting interests, ideals, goals, agendas, and policies

Today ...

- What makes up the Internet
- How the Internet works
- How the Internet doesn't work

.. and remember ... the information presented here is a GROSS oversimplification.

Core vs. Edge

- The Internet can be roughly broken into the “Core” and the “Edge”
- The Internet “Edge” is composed of computers used by people to send or receive content
- The “Core” are all the computers that move traffic between computers on the “Edge”

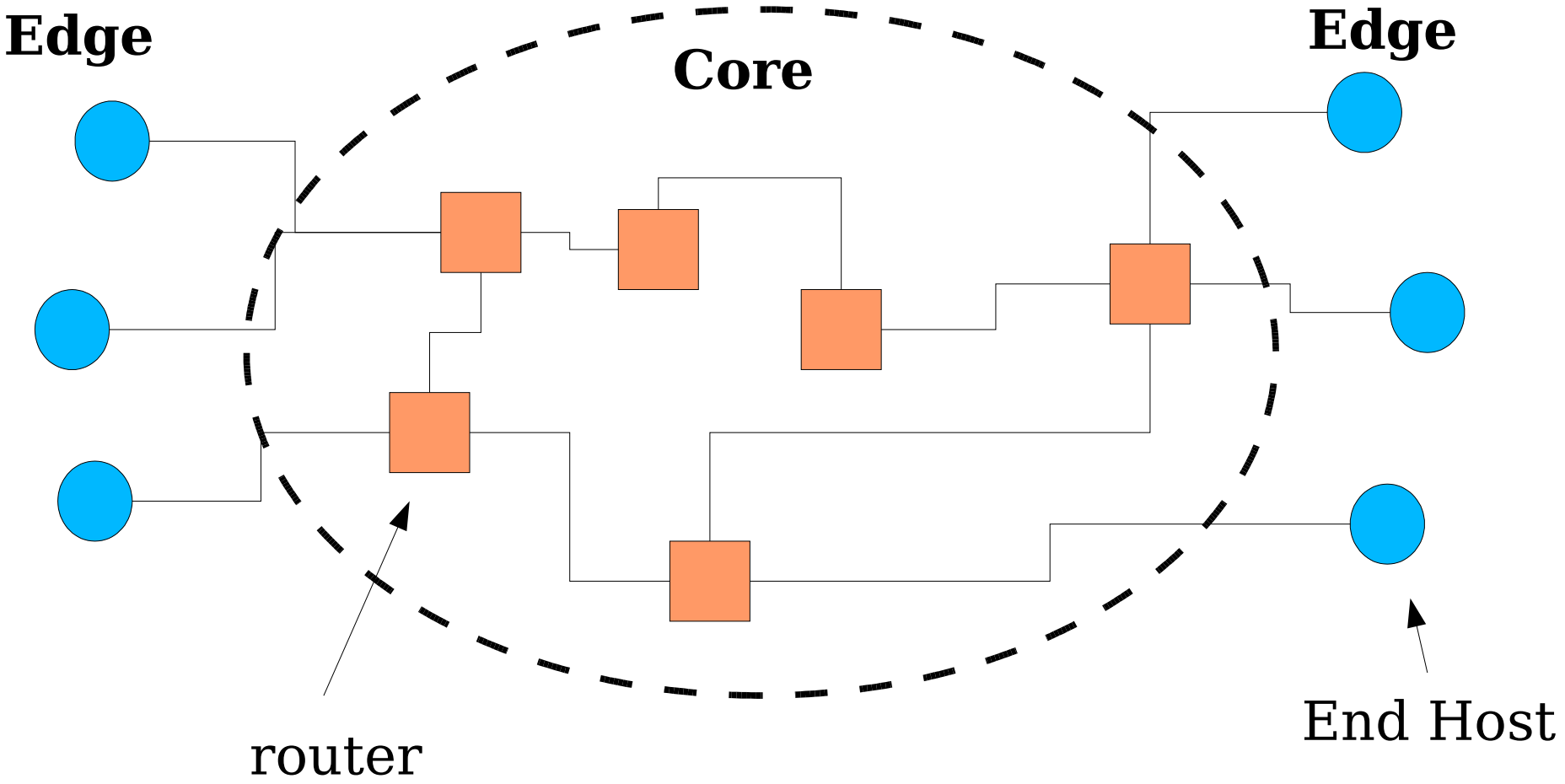
“Edge” Computers

- home computers
- computers that host web pages
- educational computers
- business computers
- governmental computers
- Internet Cafe's

“Core” computers

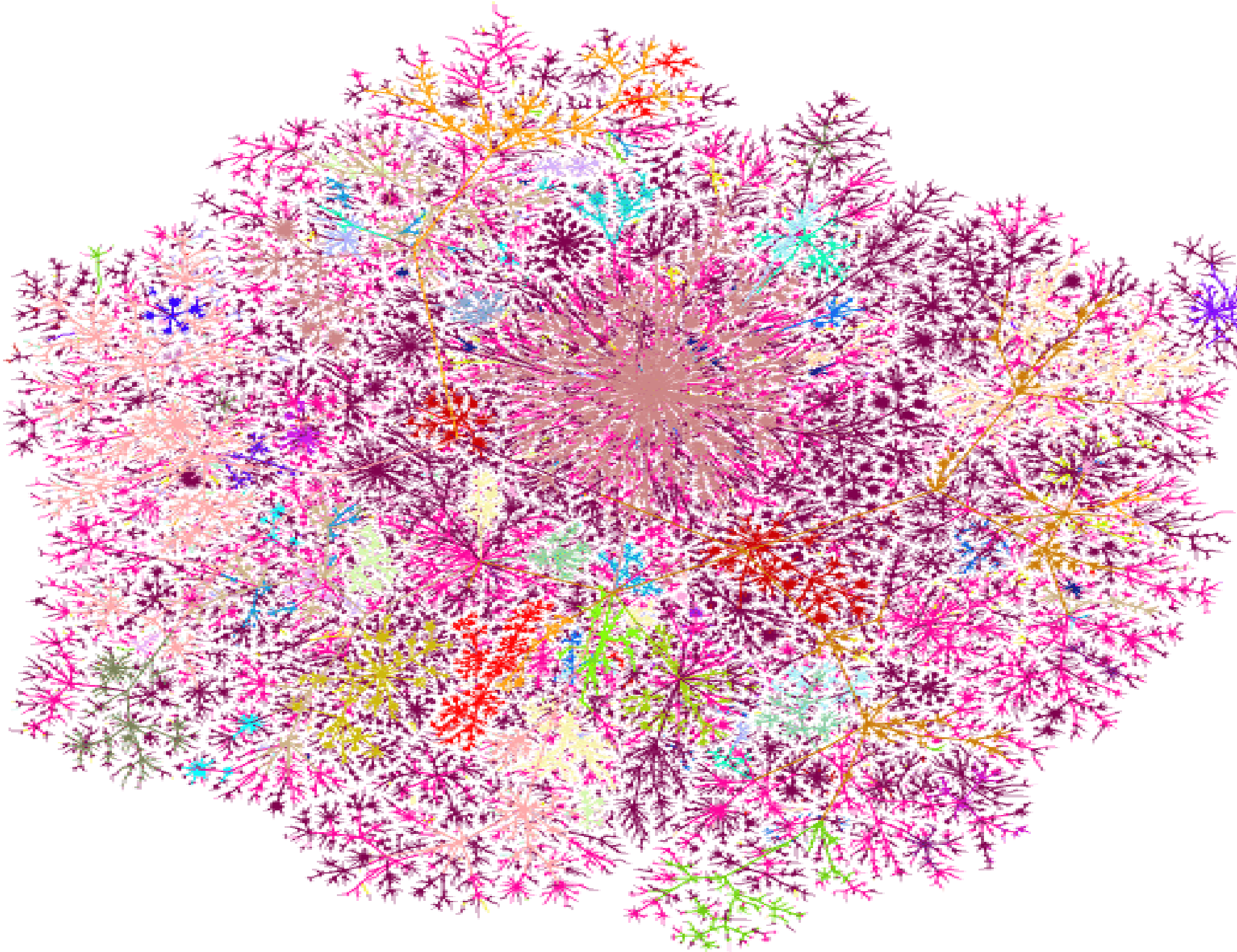
- Routers : try to figure out how traffic goes from point A to point B (on the Internet)
- In the core, routers use a mechanism called BGP to figure out where to send the packets next (this is a big technical and political rathole!)

Core vs. Edge



Who Owns the Core?

- Mostly owned by private companies (ISPs)
- Can think of Internet as an aggregation of smaller networks
- Companies are often multi-national
  (what might be the implications of this?)
- Many names you've heard of, AT&T, MCI, Sprint



Edge is you, me and aunt Bev
(and business, and gov and edu)

- Plug into Internet though an ISP
- ISP charges us to use their bandwidth
- ISPs charge other ISPs to lease lines

IP Addresses

- Any computer on the Internet can talk to any other (mostly)
  (yeeks! Once you plug in, everyone is your neighbor!)
- Computers “find” each other through virtual addresses” called “IP addresses”
- If someone knows the IP address of your computer, can talk to you

What are IP Addresses?

- Just numbers (with dots)
  123.114.23.4
  10.15.46.32

- Really just a value from 1 to (2^32 - 1) represented 4 in octets (chunks of 2^8)

IP Addresses Cont ...

Note: Since so many computers are on the Internet; a person, or computer program, can choose an IP at random (just a number remember!) and it will likely be assigned to a computer

- this process of iterating through lots of IP Addressess looking for a target is called “SCANNING”

How Computers Talk

- Send “packets” of information (called IP packets or IP datagrams)
- Packets contain IP address of recipient and sender, plus data

Packets in the Core

- Packets are moved or "routed" from the sender to the receiver based on the destination IP address
- Note that, routers (computers in the core) ONLY look at the destination
- Sources can lie about who they are: "source spoofing"

IP Packets Cannot be Used for Reliable Services

- If a computer (router, sender, end-host) is too busy, will drop packets
- If the header gets corrupted, packet gets dropped
- Data can get corrupted
- If a router dies, packets will get lost

Transmission Control Protocol (TCP)

- Almost all communications on the Internet use higher-level mechanism (TCP)
- TCP uses IP packets plus black magic to ensure...
  - Data will not be corrupted
  - Data will not be lost
  - Data will arrive in the order it was sent
- Plus! TCP black magic makes source forging REALLY hard!

(just fyi)

User Datagram Protocol (UDP)

- Sometimes want to send data quickly, and don't need so much magic
- Who cares if you loose a bullet or two while playing Quake?
- Who cares if bullets come out of order?
- Not used very often (except for DNS)

Servers

- Some computers are only used to house services such as web pages or email
- Typically only offer services and aren't used like home computers
- Often located as close to the core as possible (in some basement downtown)

Servers cont ...

- When connecting to a website, connecting to a server
- When getting your email, connecting to a server
- When listening to music online, connecting to a server

Clients

- Programs that connect to services on servers (used by you, me and Aunt Bev)
- Web browsers (mozilla, ie, safari etc.)
- Email clients (outlook, Eudora, …)

Domain Name System (DNS)

- IP addresses are hard to remember (and boring) ... why not use names instead?
- Computers in the core map names to IP addresses
  - www.google.com
  - www.stanford.edu
  - Called DNS servers
- “root” name servers most important!
  - Only 13!
  - Heavily guarded in unmarked buildings

Checking News on the Web

(putting it all together)

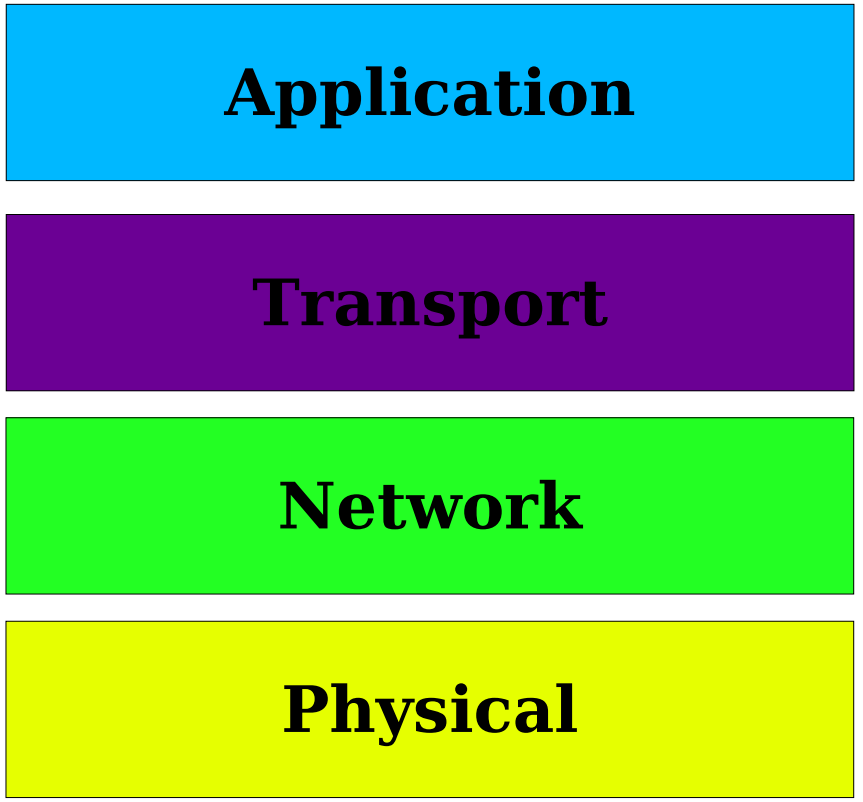
- Sit down at computer and load web browser
- Type in “news.google.com”
- My computer asks DNS server to map news.google.com to IP address
- DNS server responds with “64.233.167.99” (what could happen if server lies?!)
- Computer then uses TCP to ask Google's web server for news
- Google's web server responds
- I procrastinate

Ports

- A server can host multiple services (e.g. Web and email)
- Each service has a unique “port” (just another number) that clients connect to
- Ports are standardized on the Internet (80 www, 25 sending email, 21 ftp)
- Hackers see look to see what services are on a host by “port scanning”

The Layered Model

(another way to look at things)



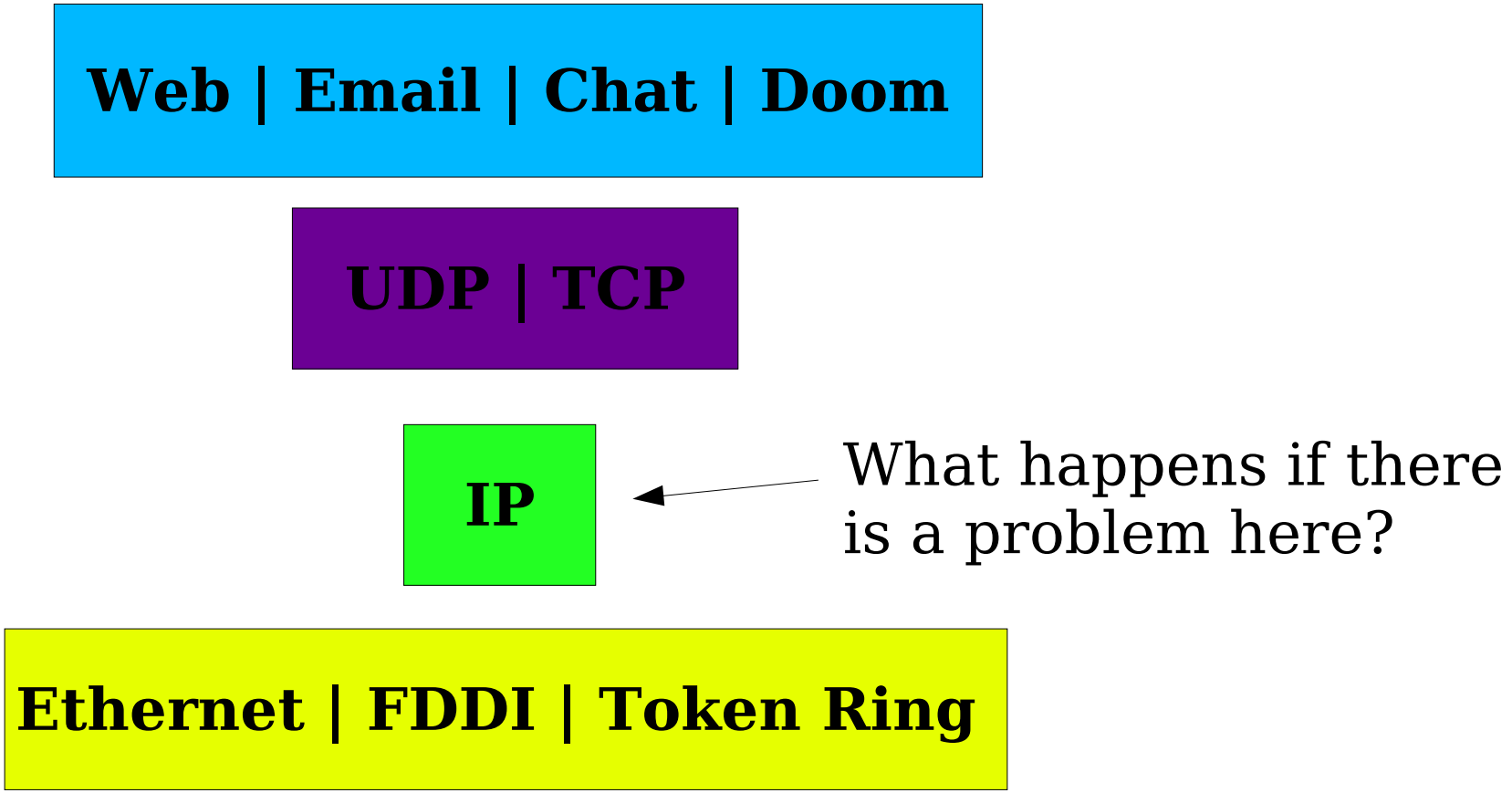
Web, email, ICQ

TCP/UDP

IP

Analogue modem, ethernet, fiber etc.

Has an Hour Glass Shape?

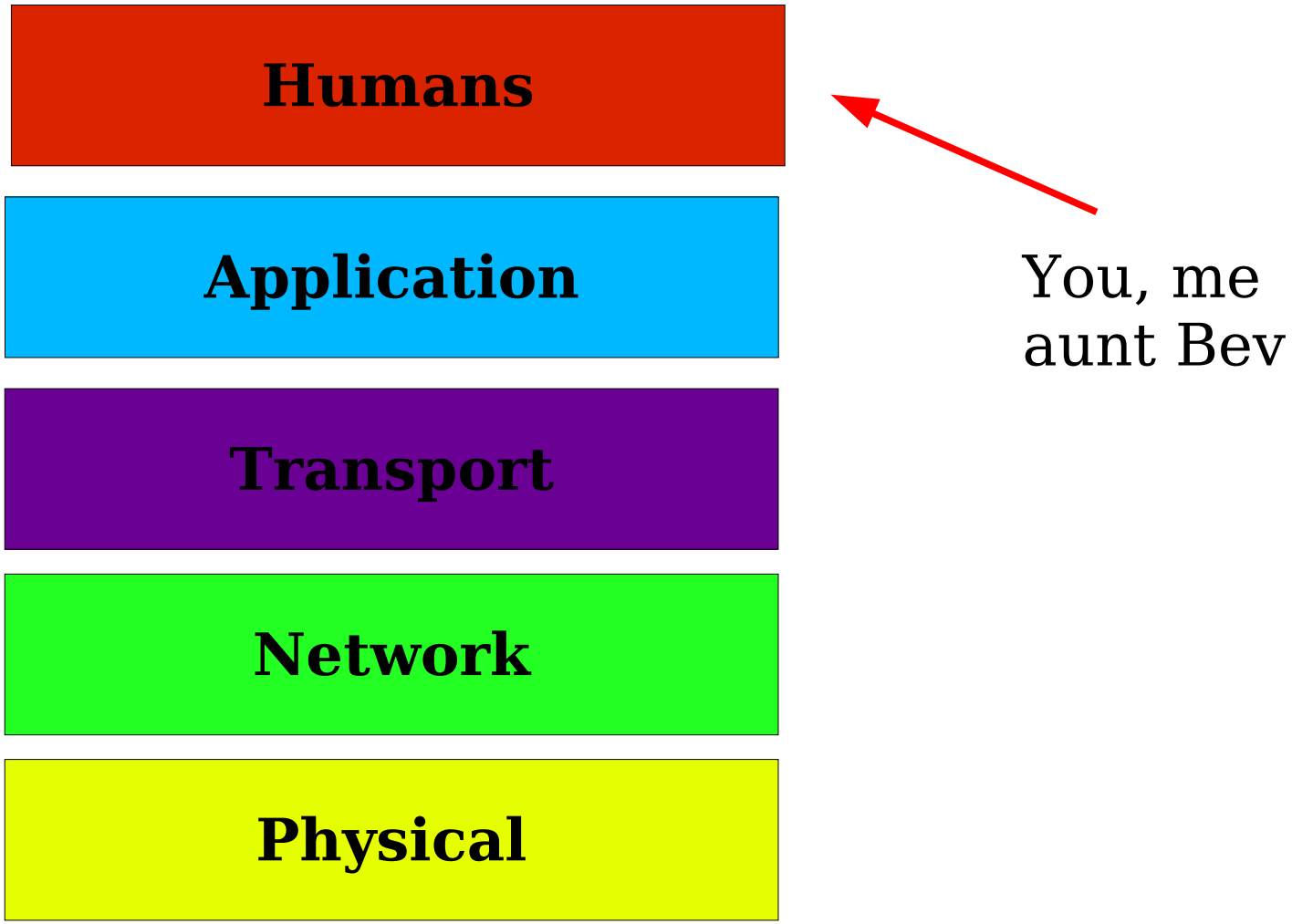


IP runs on everything, everything runs on IP

Each Layer Has its Own Vulnerabilities

- Physical
  - I chop your wires or bomb your building
- Network
  - I forge my source address
- Transport
  - I send too many TCP connection requests and freeze your computer
- Application
  - I send a bad request to your web server that makes it croak

Oh … and Don't Forget the Weakest Layer of All



Humans are Vulnerable!

- Susceptible to beer, chocolate and the opposite sex
- Not experts (and shouldn't be!)
- Often don't care

The End!