CSC4200/5200 – COMPUTER NETWORKING

NETWORK FUNDAMENTALS

Instructor: Susmit Shannigrahi
sshannigrahi@tntech.edu

Tennessee TECH

Chapter 1: Fundamentals

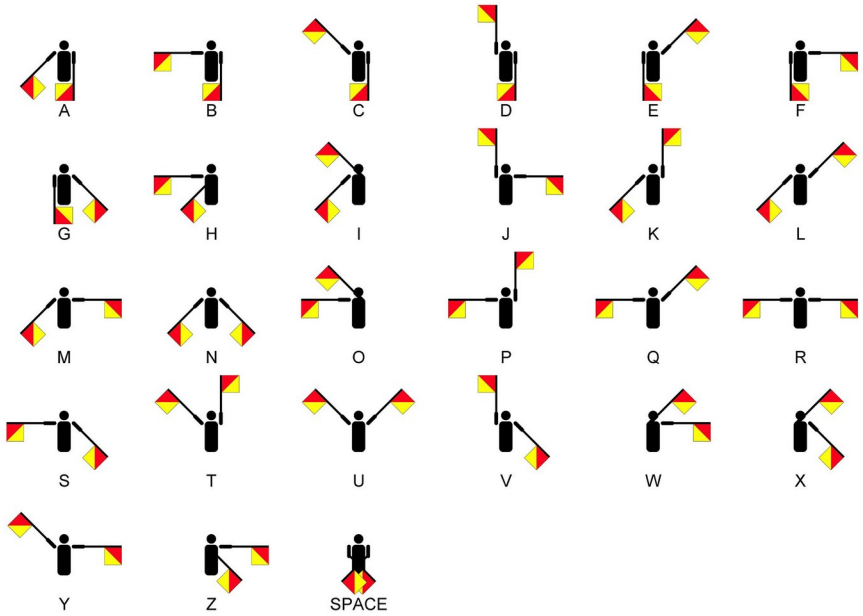
- Networking is ubiquitous
  - What did you use it for today?

- First things first:
  - Terminology
  - Basic tools
  - What does it take to build an Internet?

Communication

- Transmit meaningful information
- How do you transmit data?

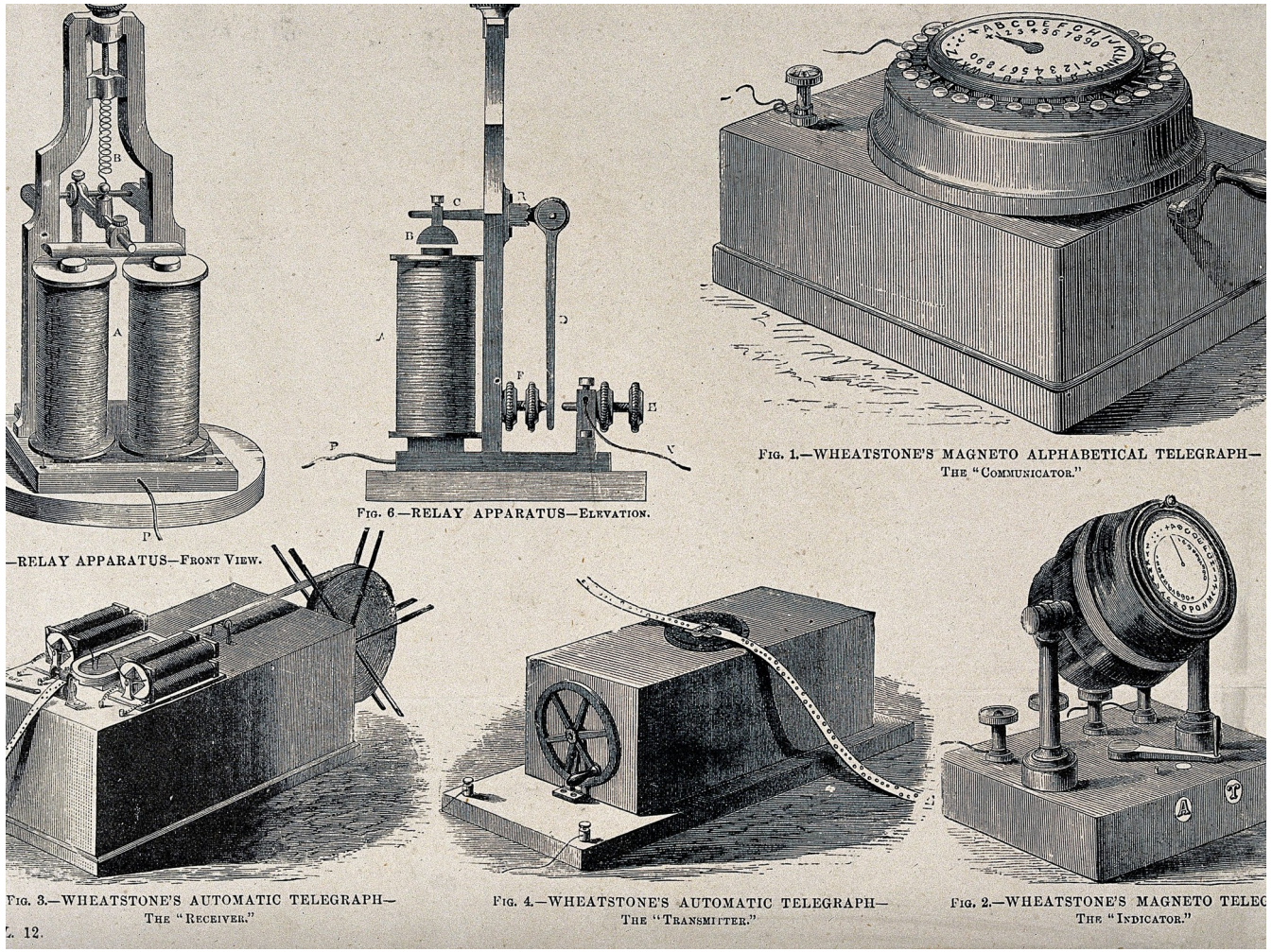
Before that...



Shortcomings

- Slow - Can not send too much data
- Translations involved
- Primitive – what happens in bad weather?

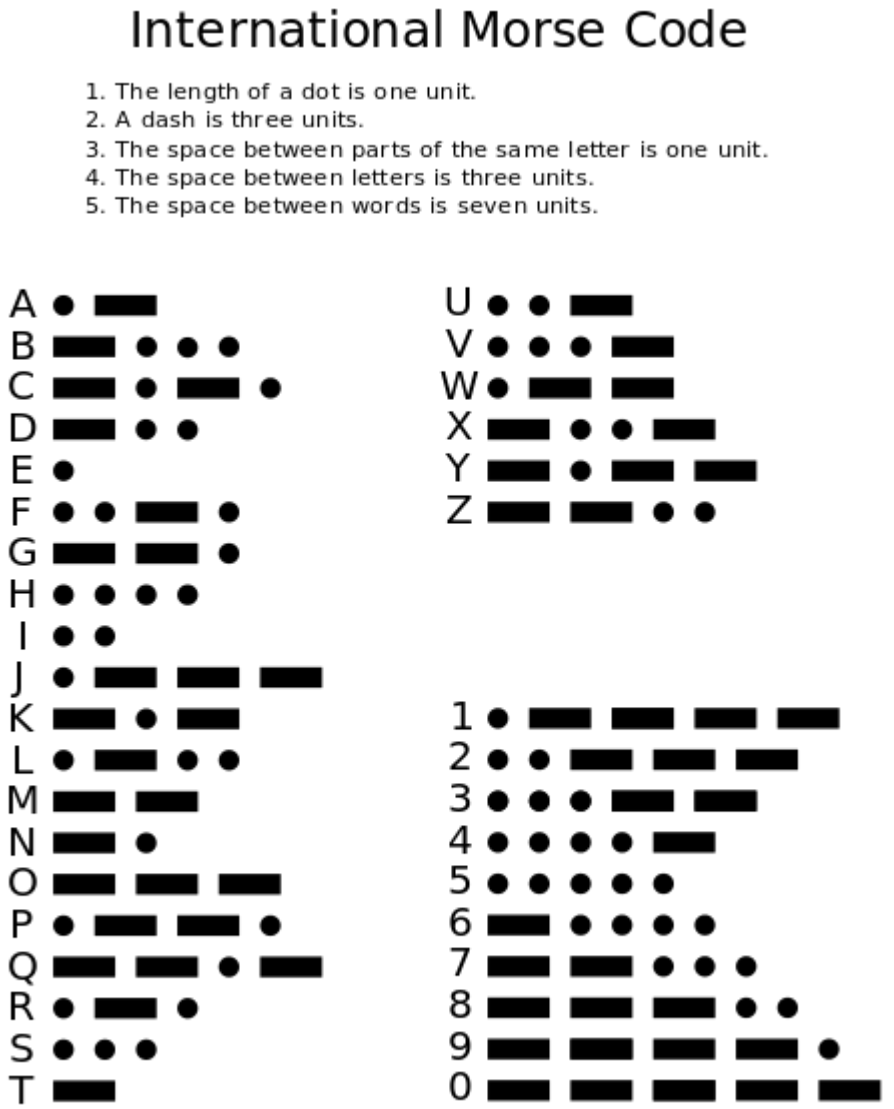
Telegraph



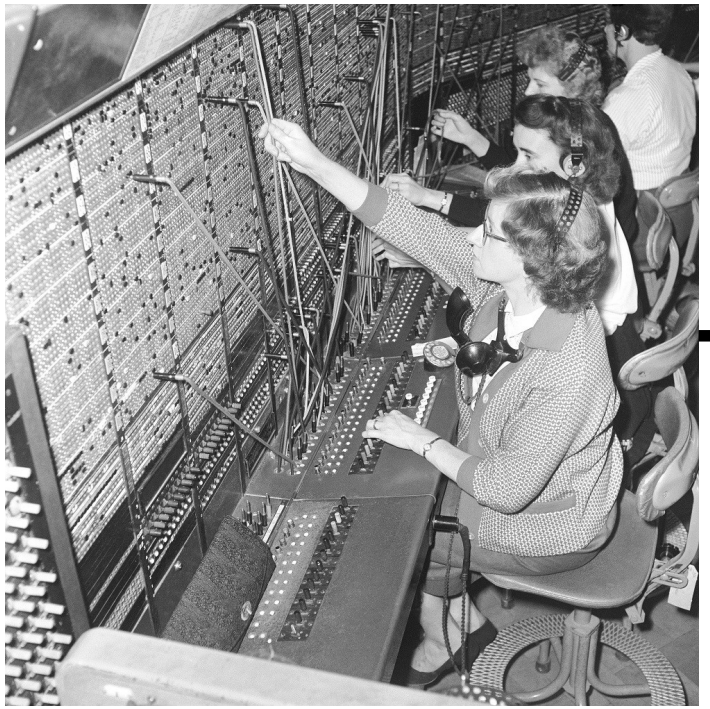
Sends electrical signals

Shortcomings

- Interference
- Low data volume
- Still need to translate



Old telephone networks

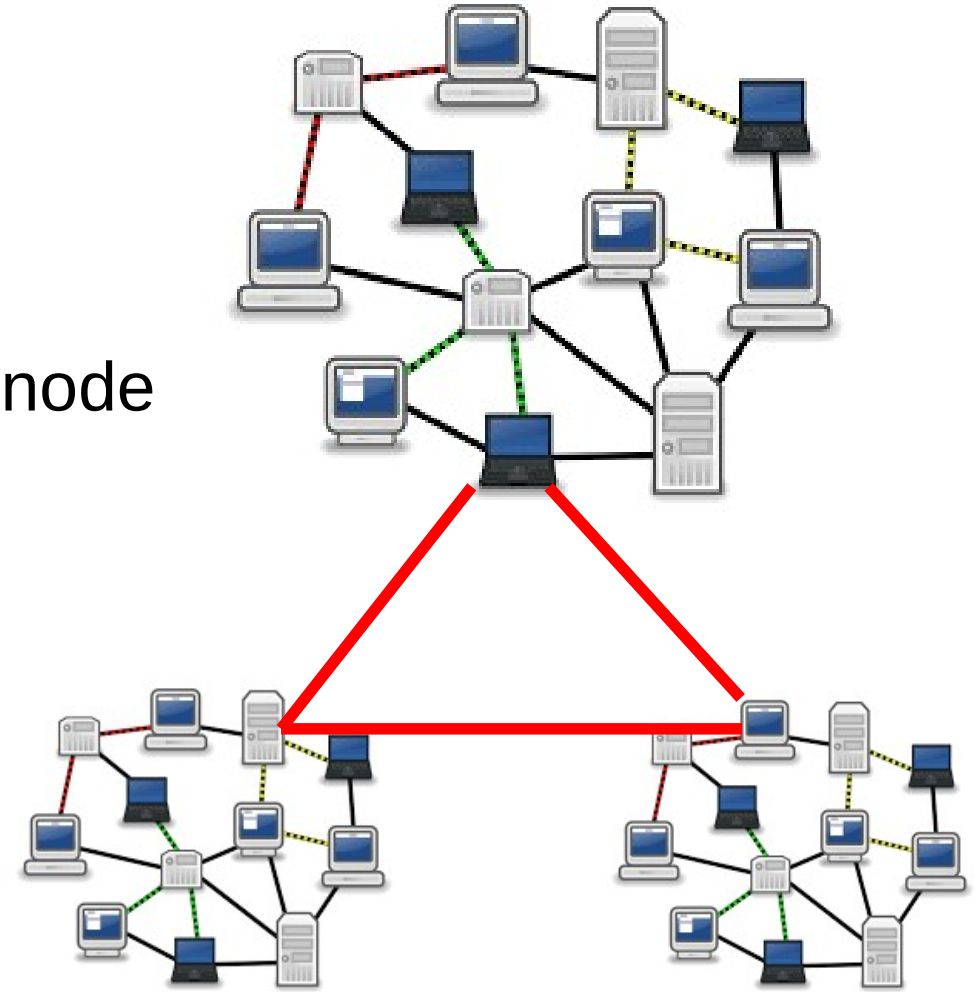


Great for voice!
Limitations?

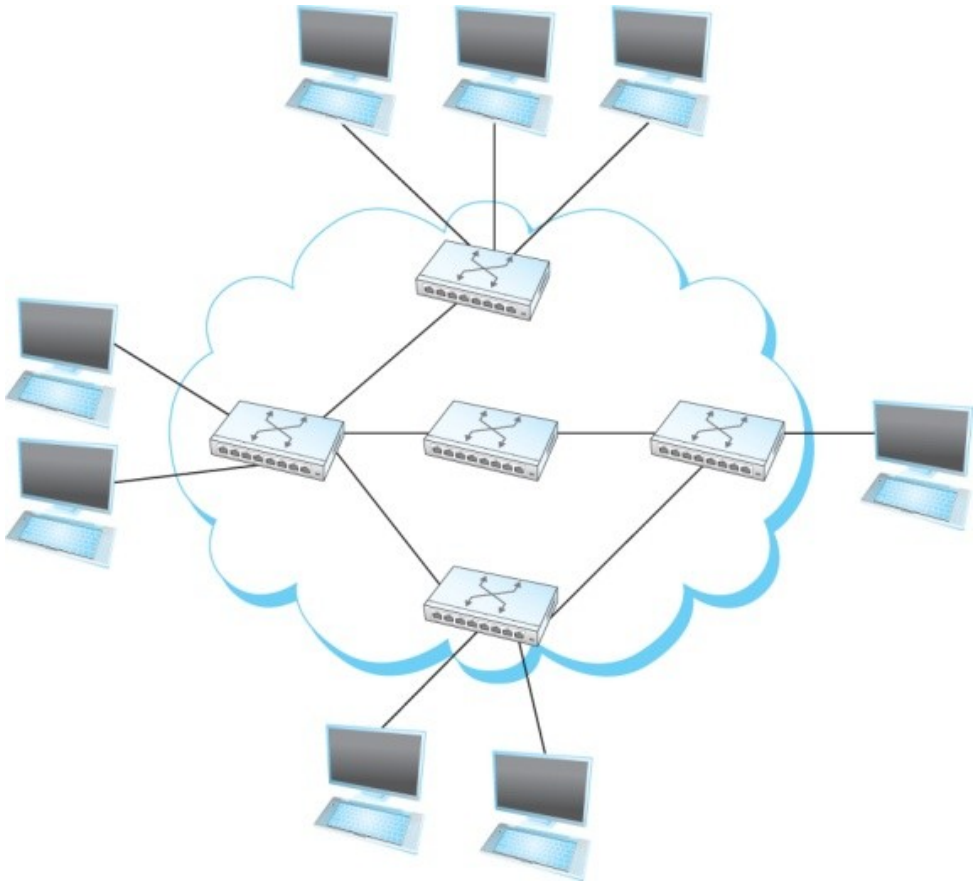
Internet

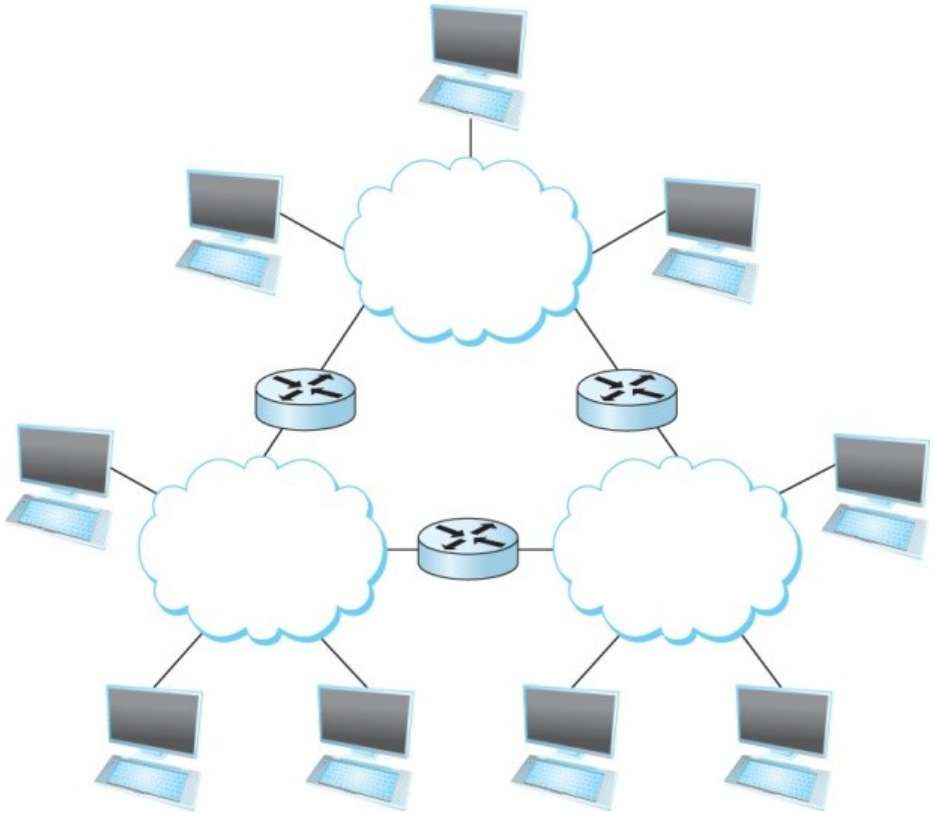
Links, Nodes, Network, Internet

- You can view the network as a graph
- Each device (a phone, a computer) is a node
- Each connection is a link
  - Wires = real links
  - Bluetooth, Radio, Infrared = virtual links
- Nodes + links = a network
  - Many connected networks = Internet

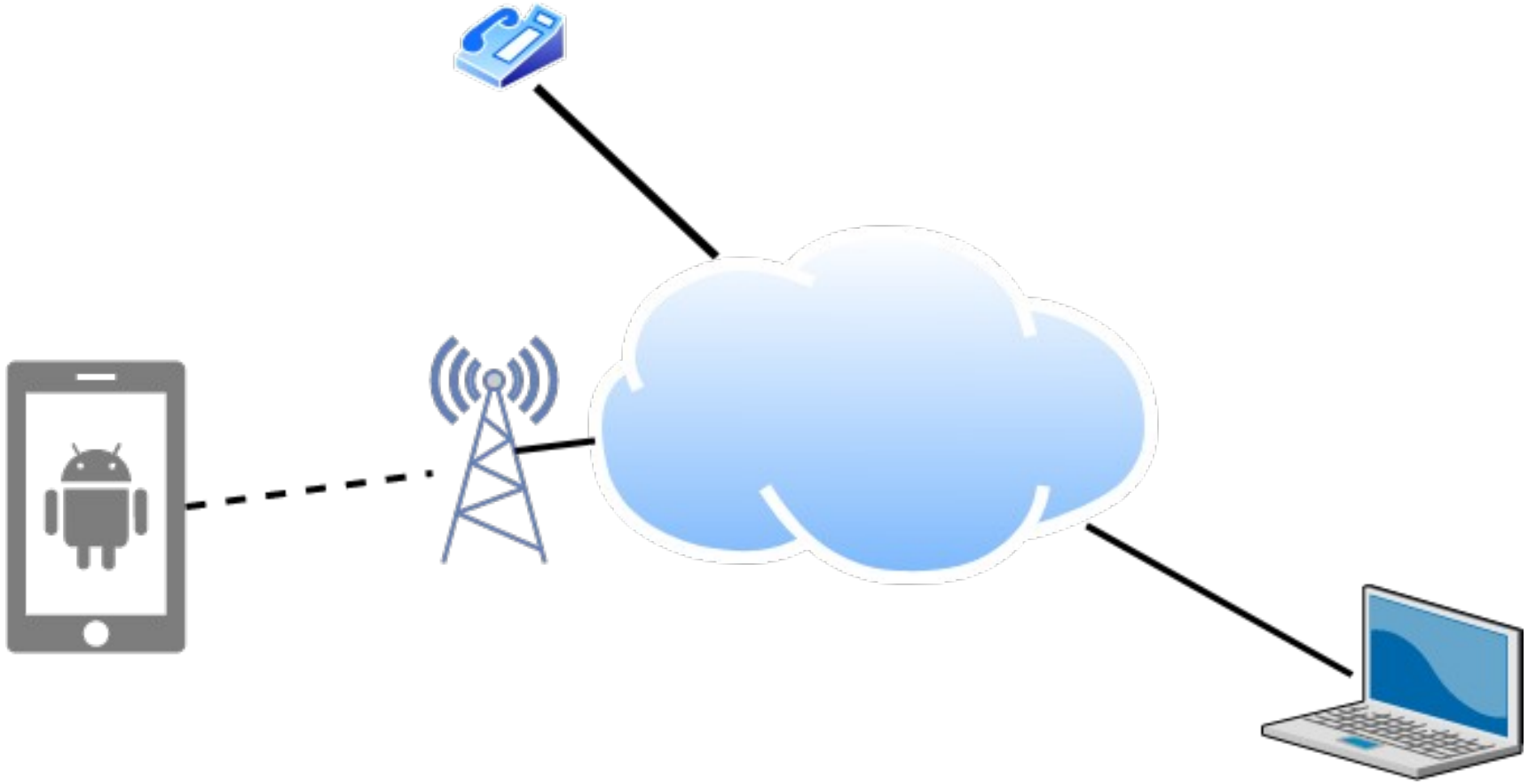


A Network and the Internet





Links, Nodes, Routers, Switches

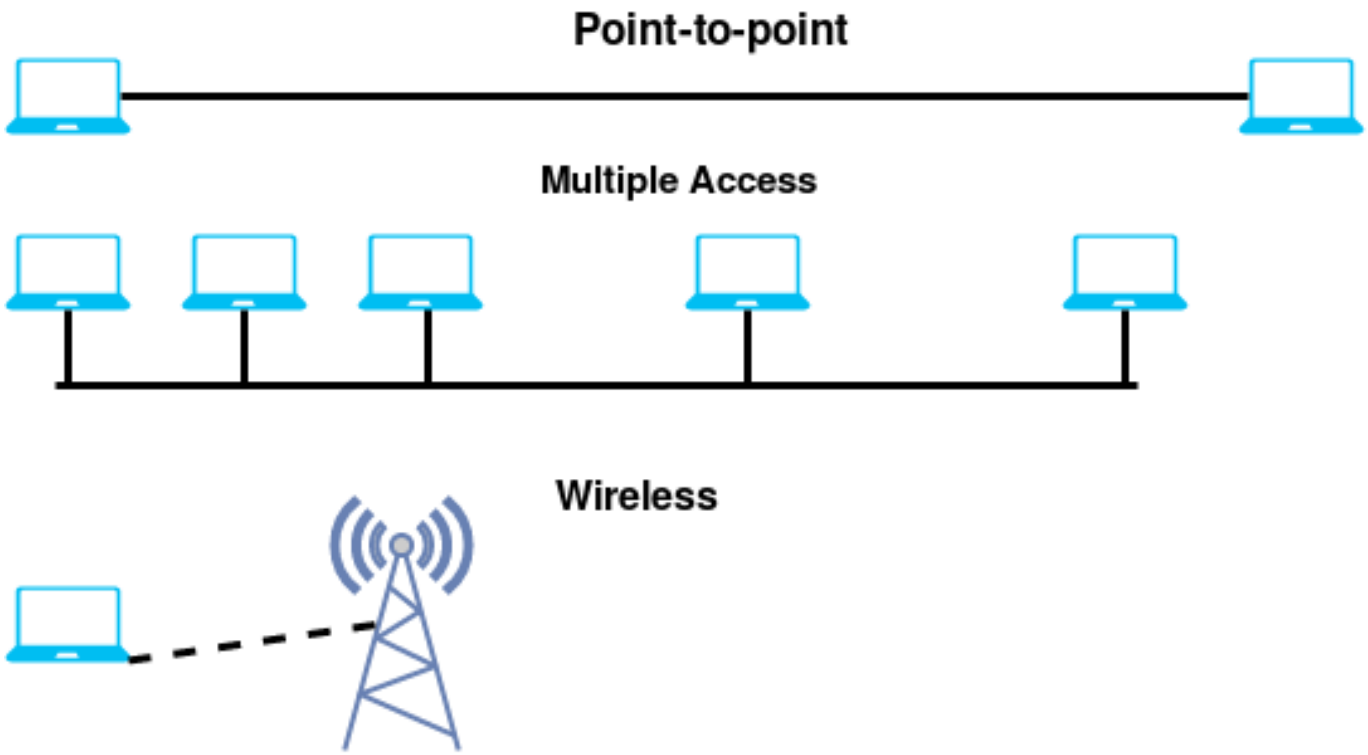


Client and Server

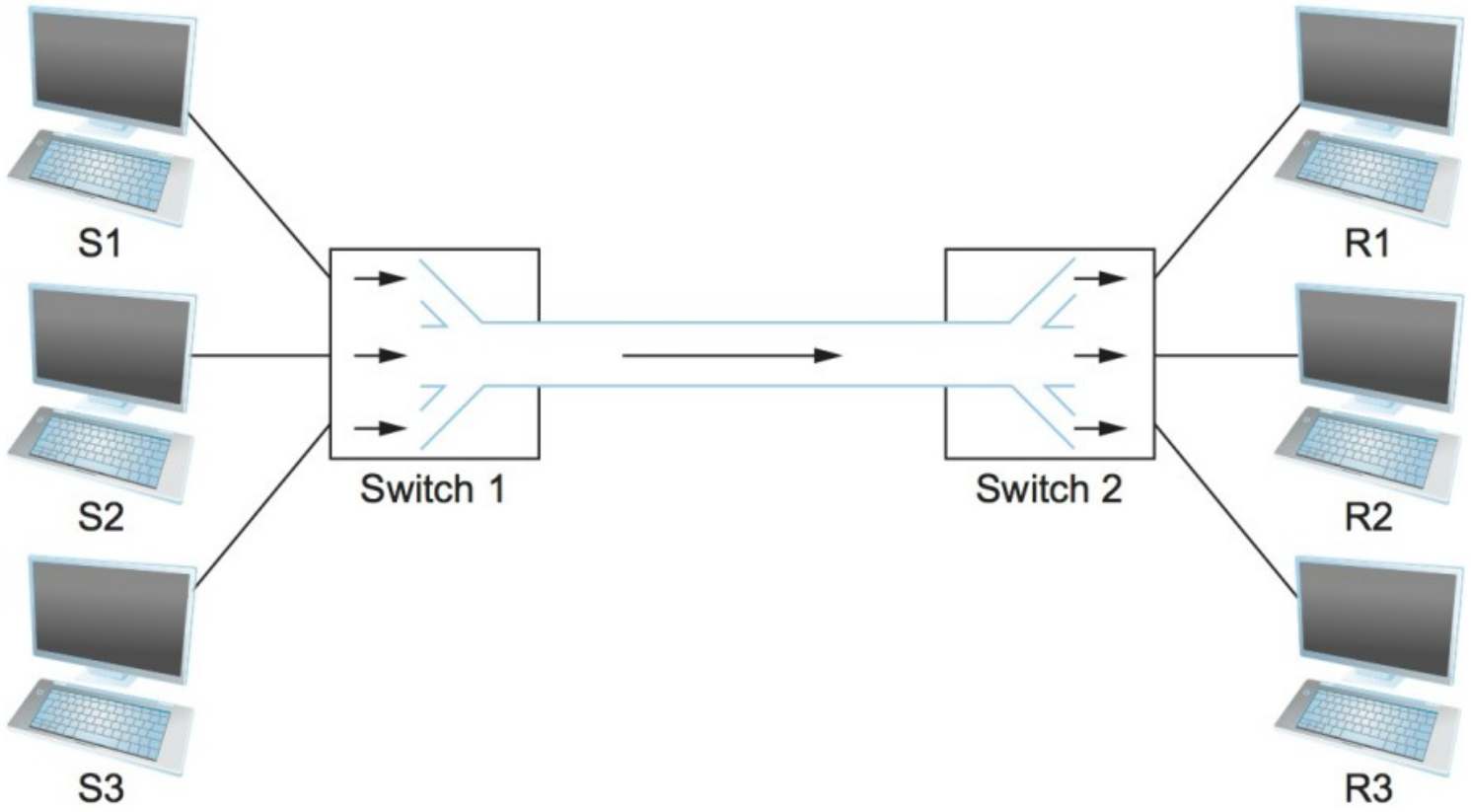
- My laptop with a browser = client
  - It requests a service
  - Email, chat, video, youtube
- A node running a program that serves the requests = server
  - Runs a service
  - Chat, video, messaging
- A node can both be a client and a server

Connectivity

-
- Point-to-Point
- Multiple access
- Wireless

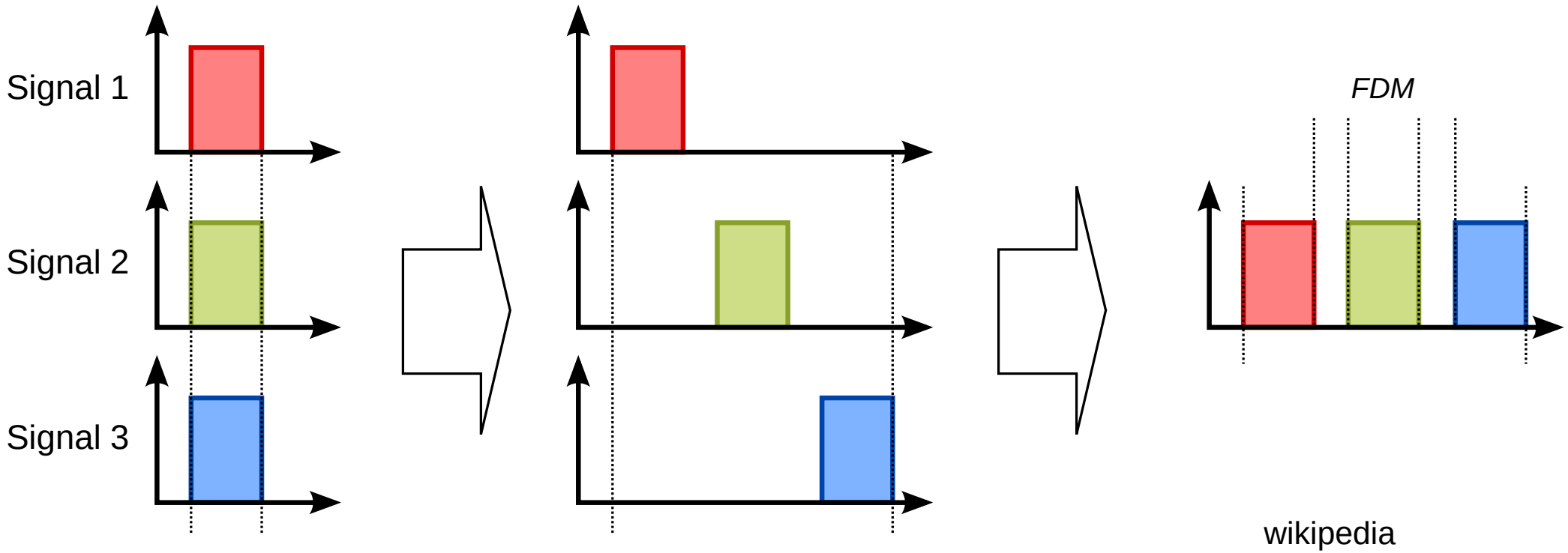


Circuit Switching



What are the problems?

Frequency Division Multiplexing for Circuit Switching

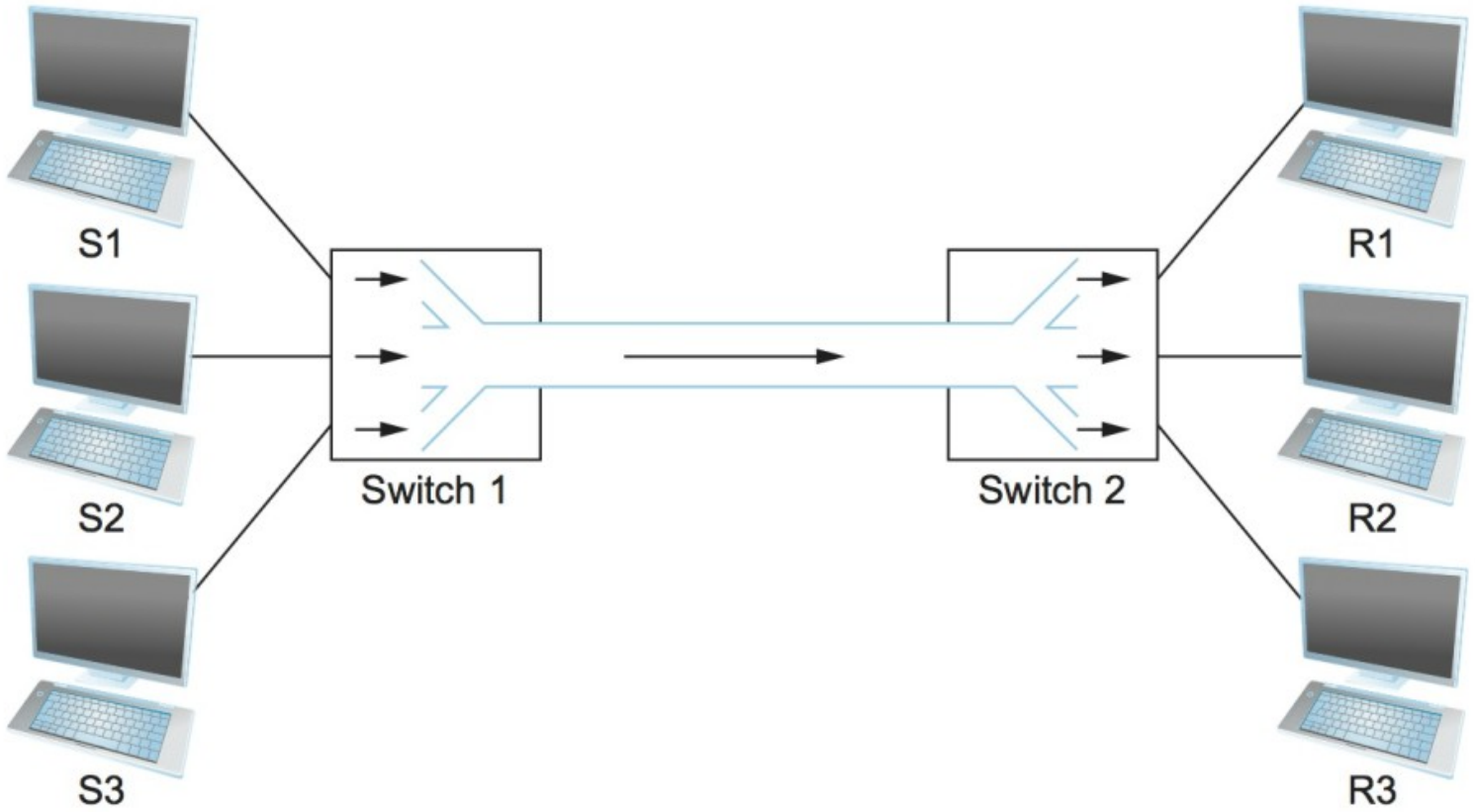


wikipedia

Time Division Multiplexing for Circuit Switching

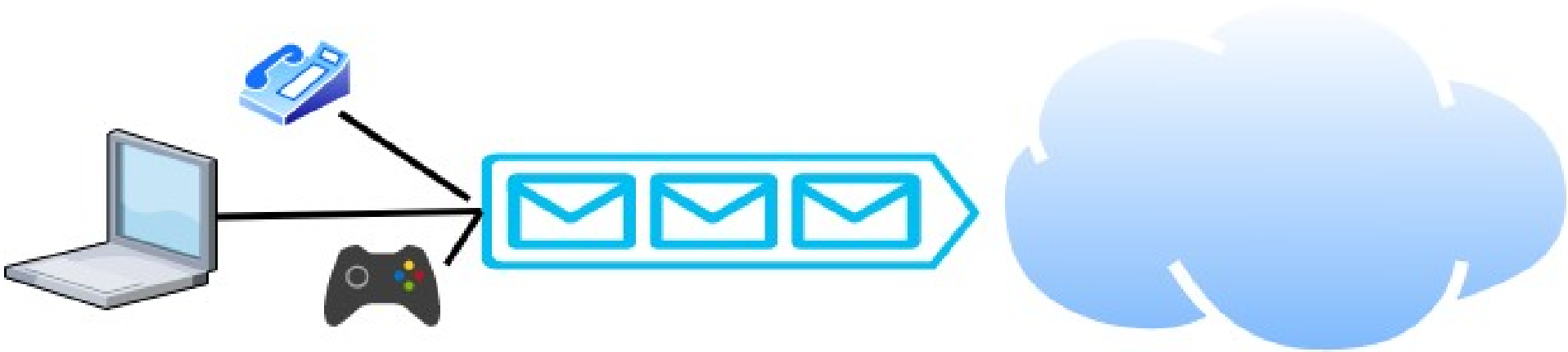
wikipedia

Circuit Switching – TDM and FDM



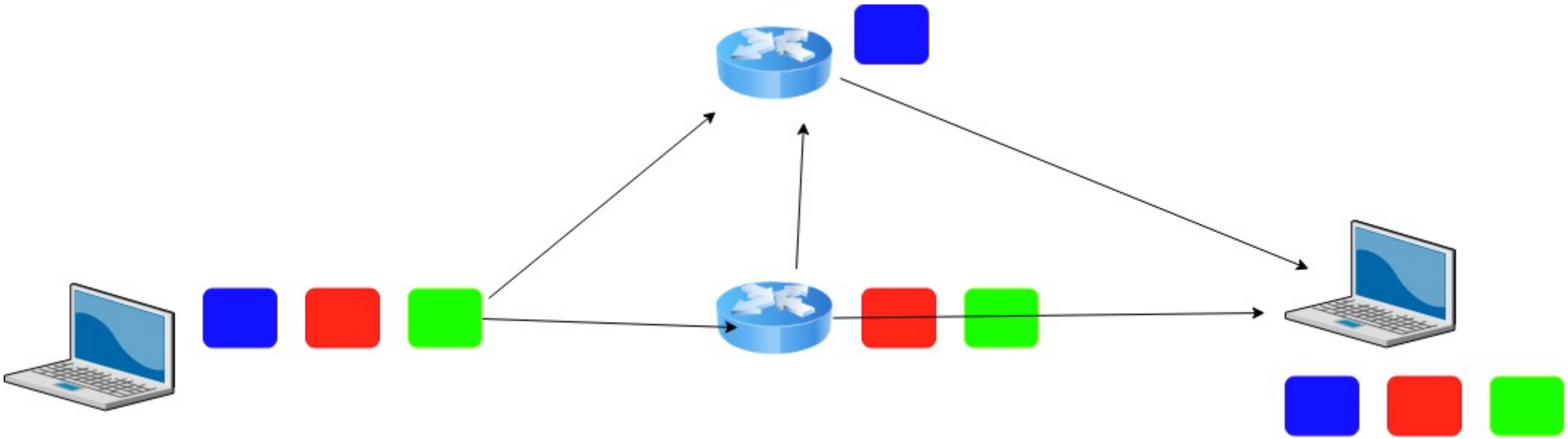
Problems solved? Or do they still exist?

Packet Switching

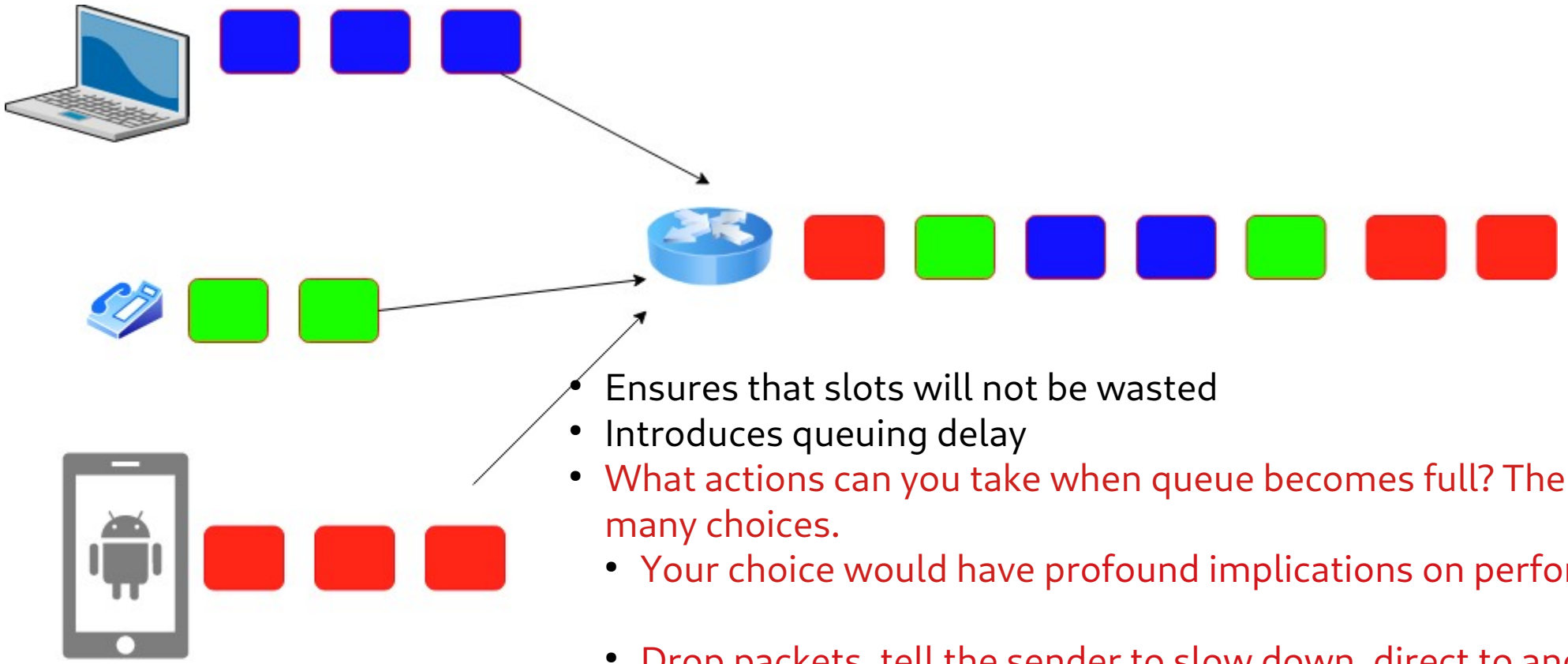


- Packets are low level components
- Multiple kind of traffic with different requirements
  - Gaming vs Phone
- Dumb network – How do you ensure quality of service?
- End points must be smart

Packet Switching

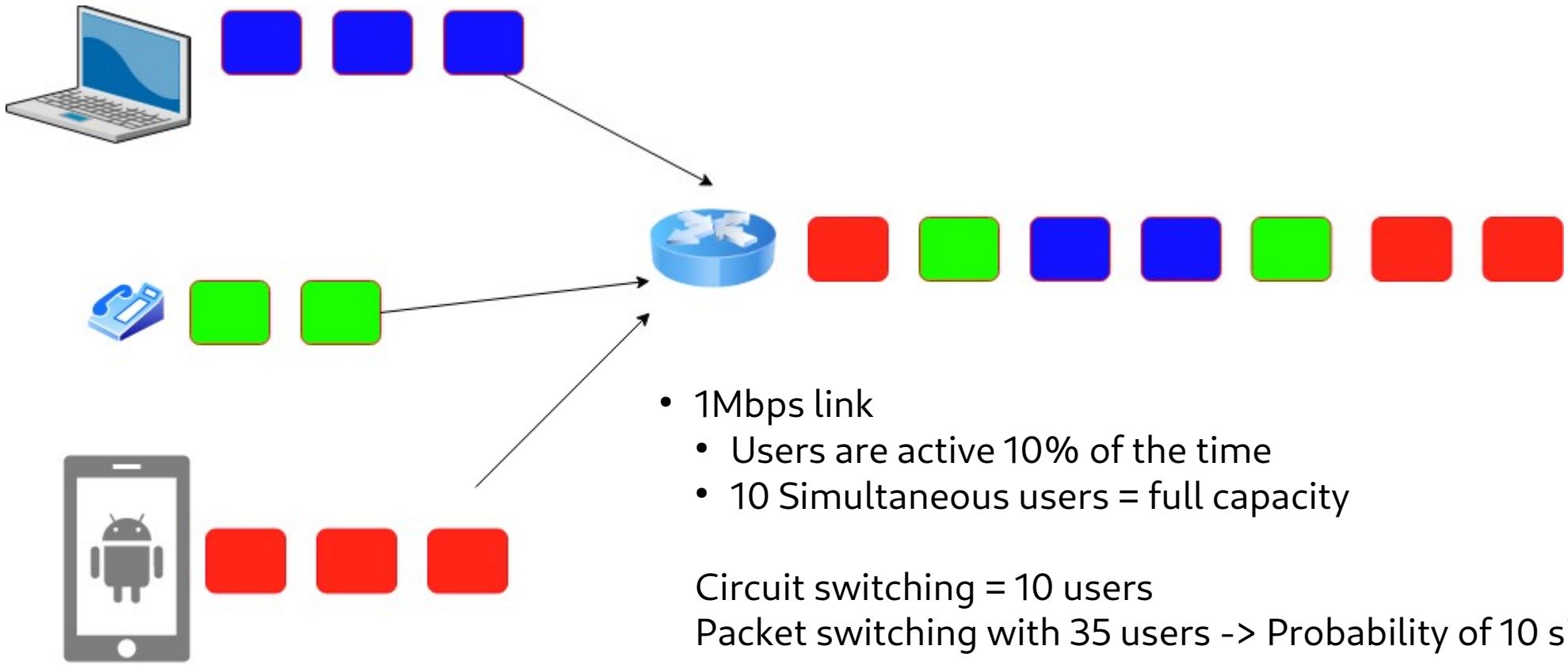


Statistical Multiplexing for Packet Switching



- Ensures that slots will not be wasted
- Introduces queuing delay
- What actions can you take when queue becomes full? There may be many choices.
  - Your choice would have profound implications on performance
  - Drop packets, tell the sender to slow down, direct to another routers

How many users can you support?



- 1Mbps link
  - Users are active 10% of the time
  - 10 Simultaneous users = full capacity

Circuit switching = 10 users
Packet switching with 35 users -> Probability of 10 sim. Users < 0.0004

https://math.stackexchange.com/questions/918861/probability-problem-in-networking

Circuit vs Packet Switching

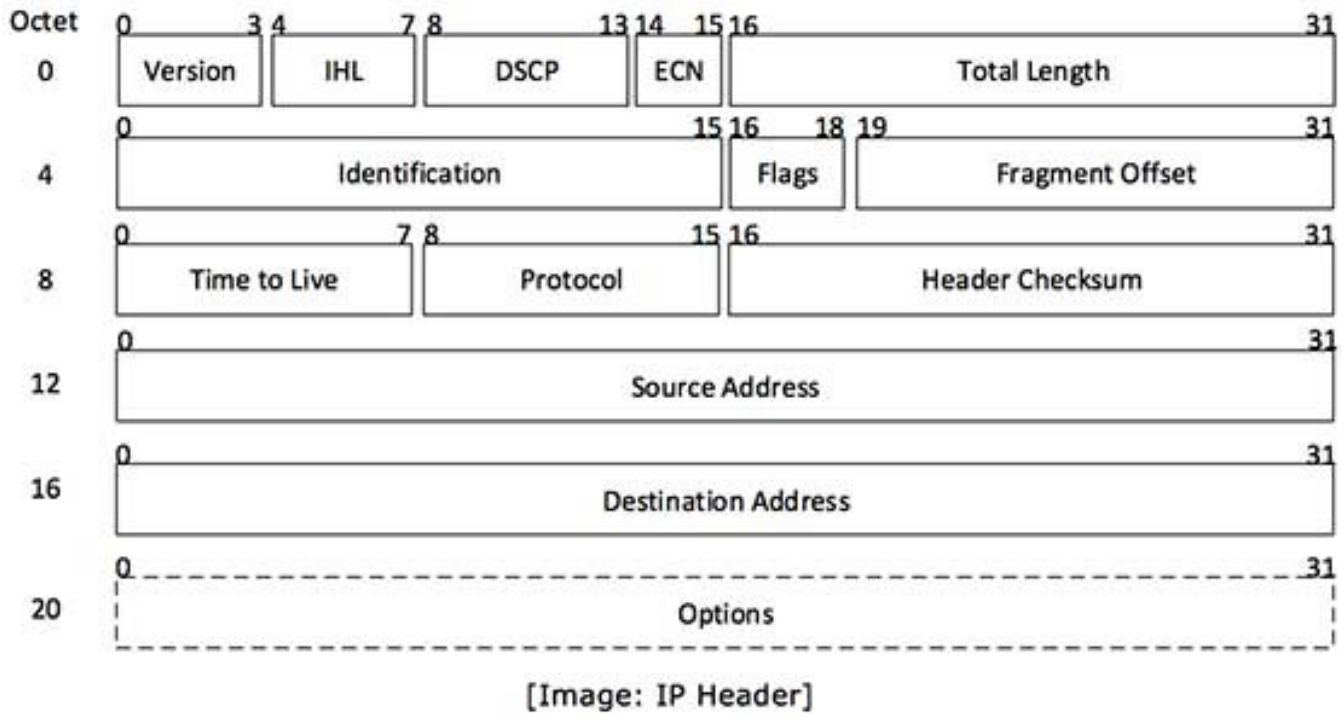
Circuit Switching

- Dedicated resource divided among participants
- Requires setup, guaranteed performance (unless the link breaks)

Packet Switching

- Shared resource
- Use small chunks of data (packets), send as soon as possible
- Store-and-forward packets

But What is a Packet?



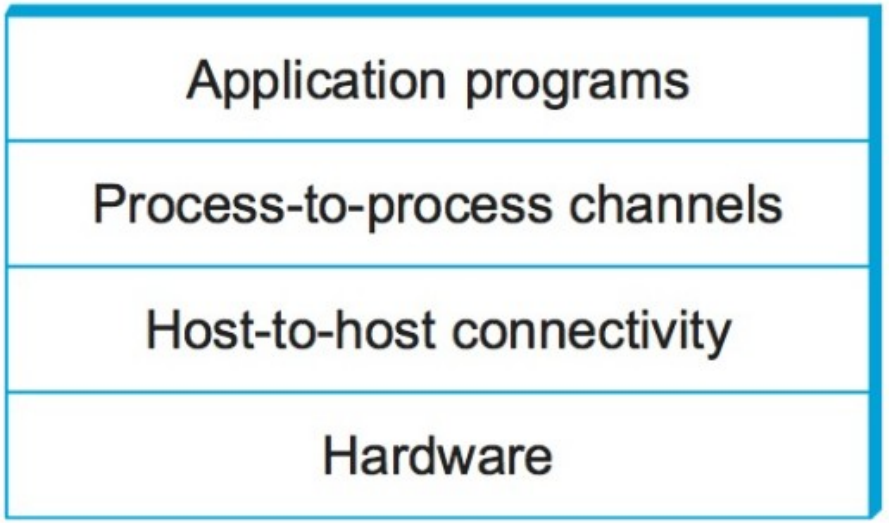
[Image: IP Header]

- Self-contained data unit
- Has two parts (generally)
  - Control information
  - Payload
- How do we transmit “Hello World?”
- How do we transmit a dictionary?

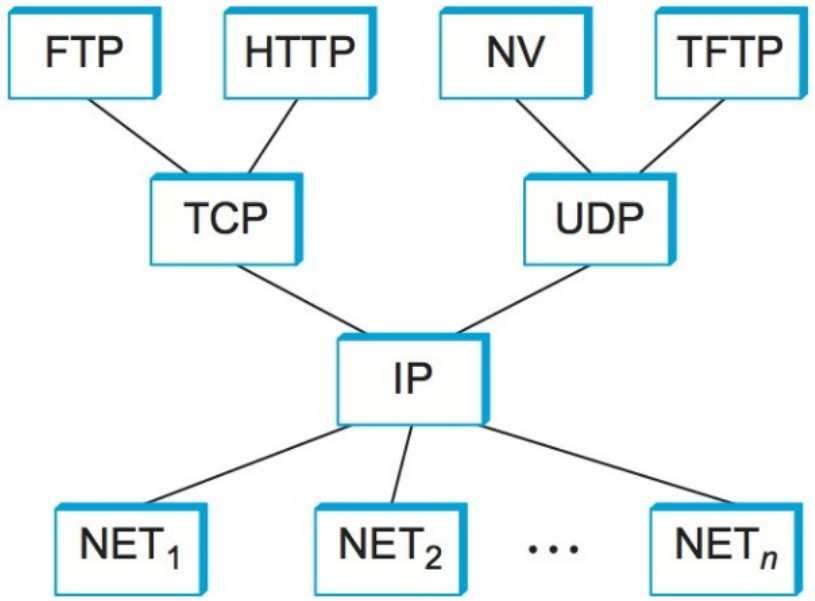
Network Architecture

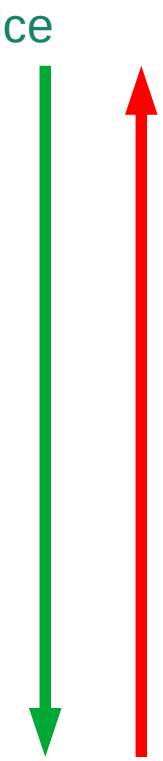
- What are the requirements from a network?

- Architecture = High-level blueprint
  - Protocols = Building blocks of the architecture
  - Layering = Break down the problem in smaller pieces



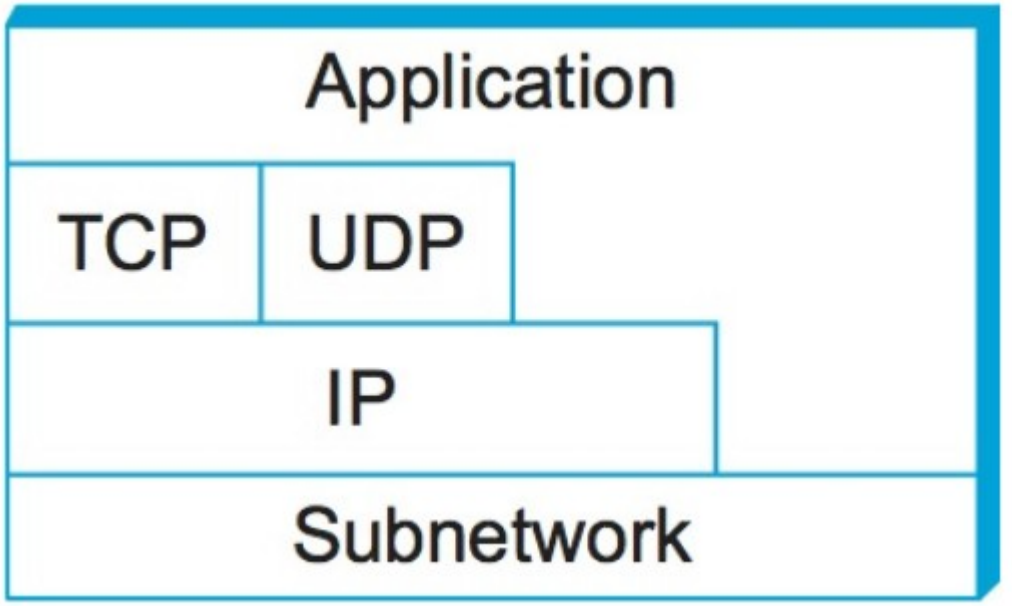
Network Layers





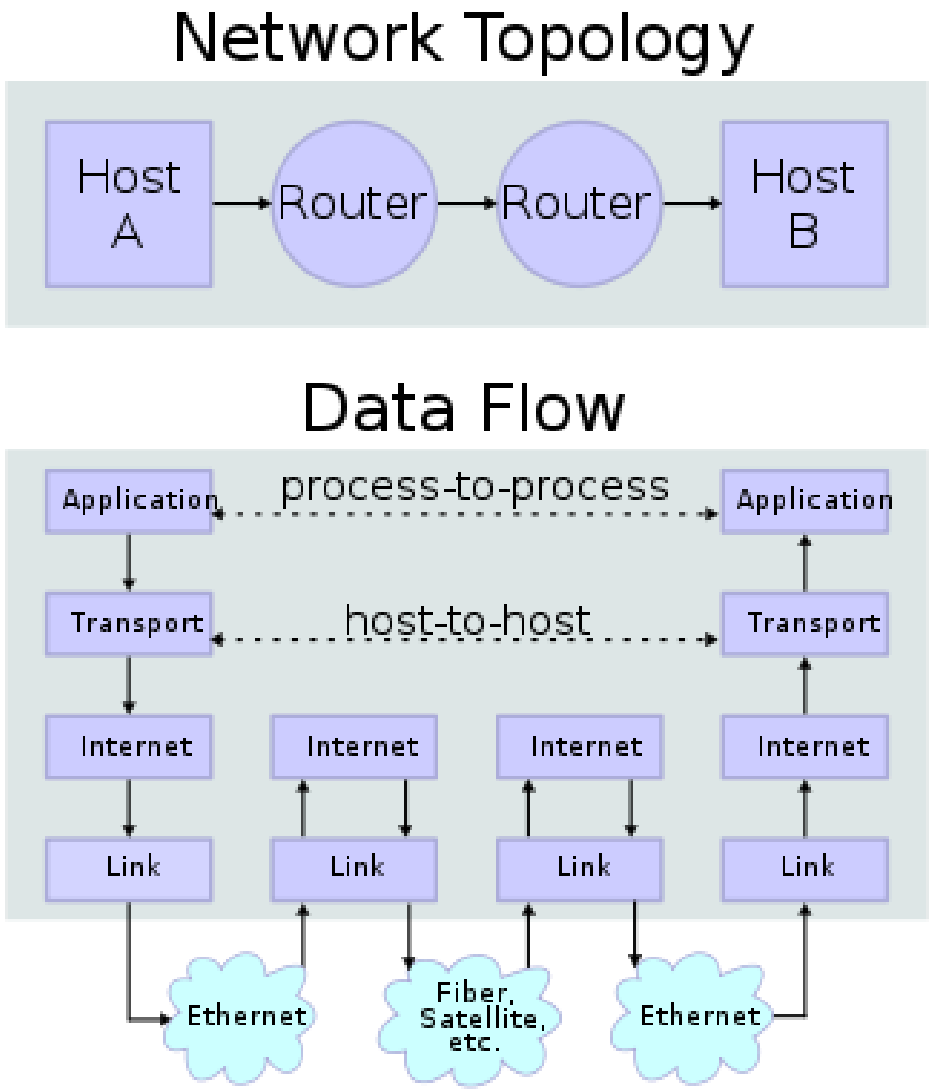
Use Service

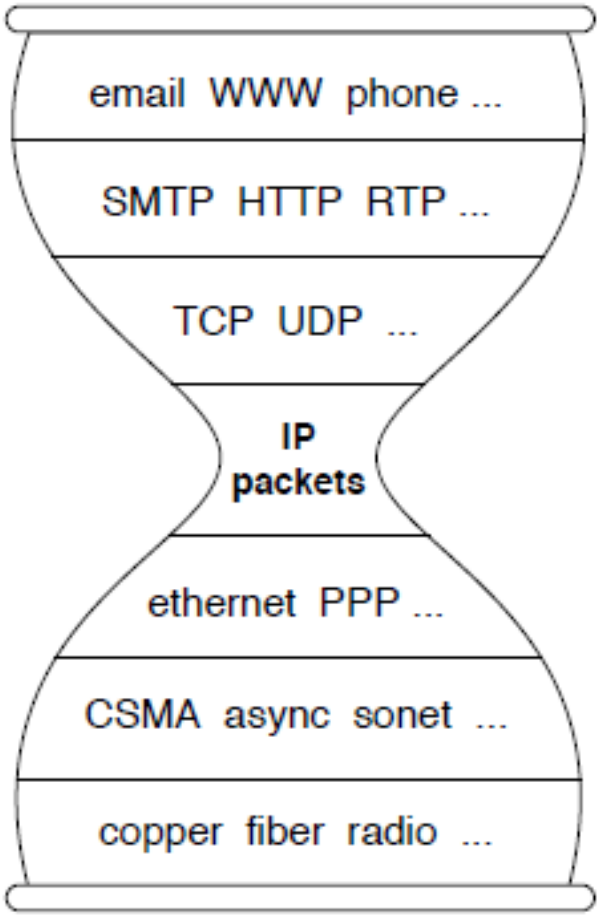
Export Service



- Makes it easier to divide functionality
- Hides implementation details
- Few other reasons?

IP Suite





wikipedia

We reject kings, presidents, and voting. We believe in rough consensus and running code. (David Clark, IETF, July 1992)

Reading Assignment

- Read the overview of Chapter 1 - “Problem: Building a Network”
  - https://book.systemsapproach.org/foundation/problem.html#problem-building-a-network
  - **About 5 minutes**

- Read Chapter 1.2
  - https://book.systemsapproach.org/foundation/architecture.html#architecture
  - **About 45 minutes**

- Reach Chapter 1.3
  - https://book.systemsapproach.org/foundation/architecture.html#architecture
  - **About 45 minutes**

CSC4200/5200 – COMPUTER NETWORKING

LOGISTICS

Tennessee TECH

COVID-19

- Follow the university protocols
  - Masks are not required but highly recommended
  - Lectures will be available on YouTube
  - Will also be live streamed via Zoom

Class website

- Class website: https://tntech-ngin.github.io/S22-CSC4200/
  - Syllabus
  - Grading policies
  - Homework and assignments
  - **First assignment already posted – Due January 18th**

- Instructor: Susmit Shannigrahi
  - Office hours: By appointment. I am (almost) always available on Slack/Email.
  - Email : sshannigrahi@tntech.edu

- GTA: Pallavi Zambare,
  - Email: pzambare42@tntech.edu, Office hours: TBD

Resources

- Class website:
  - https://tntech-ngin.github.io/csc4200/
- Slack: CSC4200-spring2022
  - Will add
- Zoom:
  - See on iLearn, Announcement section

Grading

- Homework – 15%
  - Every 2 weeks or so
- Projects + Demo – 35%
  - You will set up meetings with the TA to go over your code
- 3 exams – 35%
  - **approximately once every month (February, March, April) – 35%**
  - **Quarter-term, Midterm, Final**
- Class participation – 15%
  - **Participate in breakout sessions and discussions.**
  - **Class is not easy – you will not do well if you don’t participate.**

CSC5200

- Extra reading and writing assignments
  - Expect to read one paper each month and present it

Policies

- One late submission allowed (programming assignment), no questions asked. Homeworks are due on time.
  - Use it wisely
  - Max 7 days late
  - Submit to iLearn
- Other late submissions
  - Flat 50% deducted
- No make-up exams.
  - Your responsibility to find conflicts and work with the instructor to resolve them
- **No cheating or plagiarism**
  - **You will fail the class**

Exams

- 3 exams.

- **Open book**
  - **Will be challenging**
  - Memorizing will not help, you need to understand the topics

Programming Assignments

- Must run on Google Cloud VMs – Ubuntu-18.04 or newer
- Individual assignments
- C/C++/Python
  - **If you want to use other languages, that's okay**
  - **Talk to the GTA/Instructor first**

Logistics

- Slides and recordings will be posted on the class website in the evening
- Exams and announcements will be on iLearn
- Do not use iLearn email to reach me – use sshannigrahi@tntech.edu
- Use slack for instant messaging. I am almost always available on slack.
- Office hours are by appointment – email or ping me.

Logistics

- Grading
  - You will get your grades back with feedback in a week
  - If your code doesn’t work, the TA will try to reach you, but it is your responsibility to make sure your code works

Expectations from You

- Be communicative – if you need help, ask
- Get started on the assignments sooner – they will take time
- This class is not easy!
  - Especially you haven't learned the background material so far
- Need to work **outside class hours**
  - Expect to study and code about 5-10 hours a week
- Each lecture will have reading material