CSC4200/5200 – COMPUTER NETWORKING

NETWORK FUNDAMENTALS

Instructor: Susmit Shannigrahi
sshannigrahi@tntech.edu

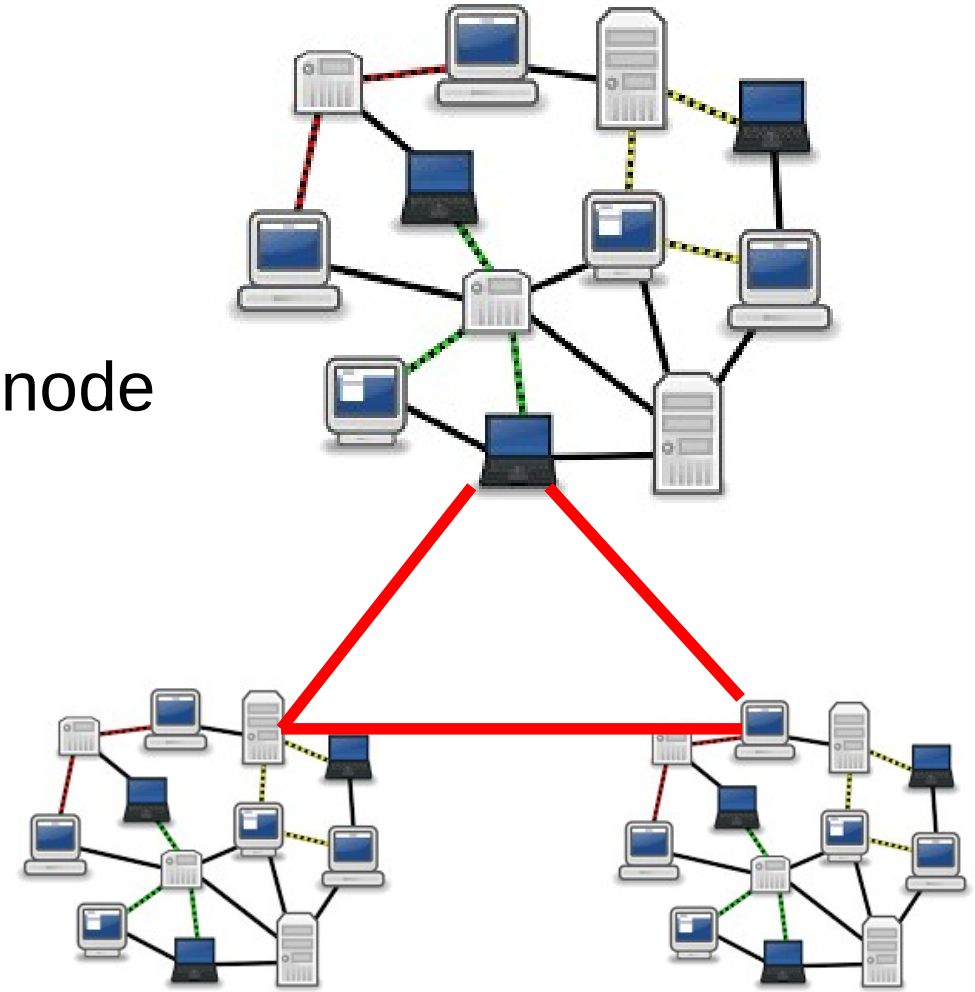
Chapter 1: Fundamentals

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

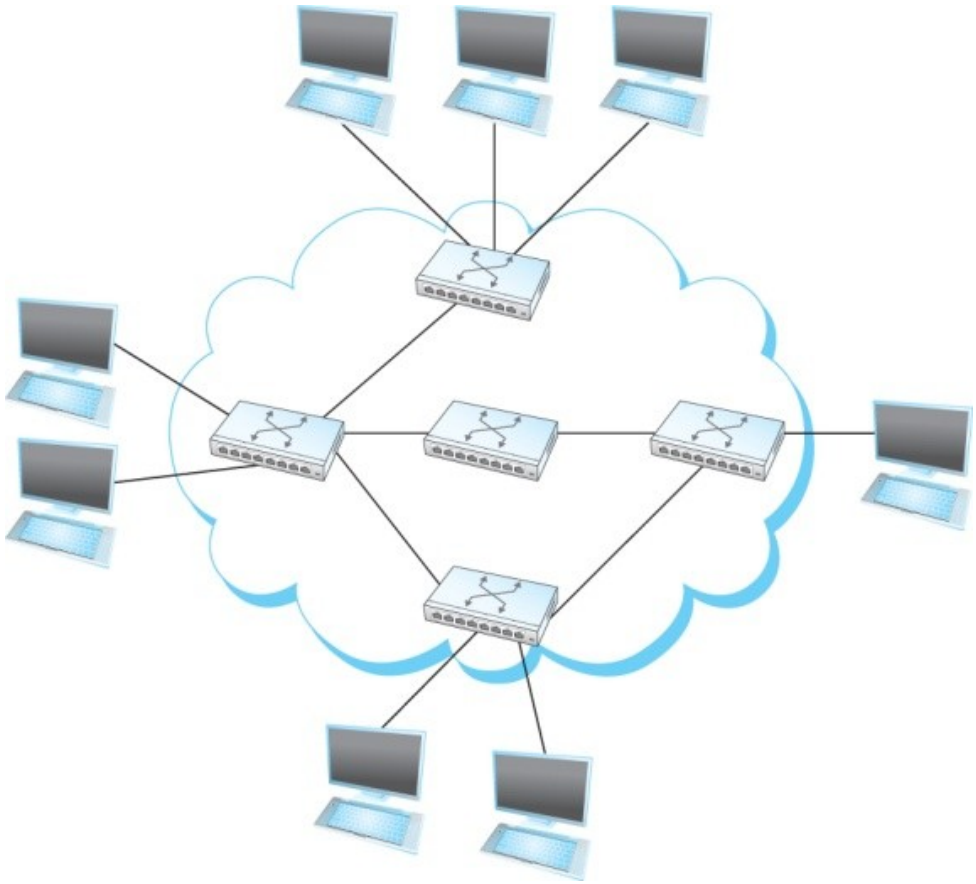
- First things first:
  - Terminology
  - Basic tools
  - What does it take to build an Internet?

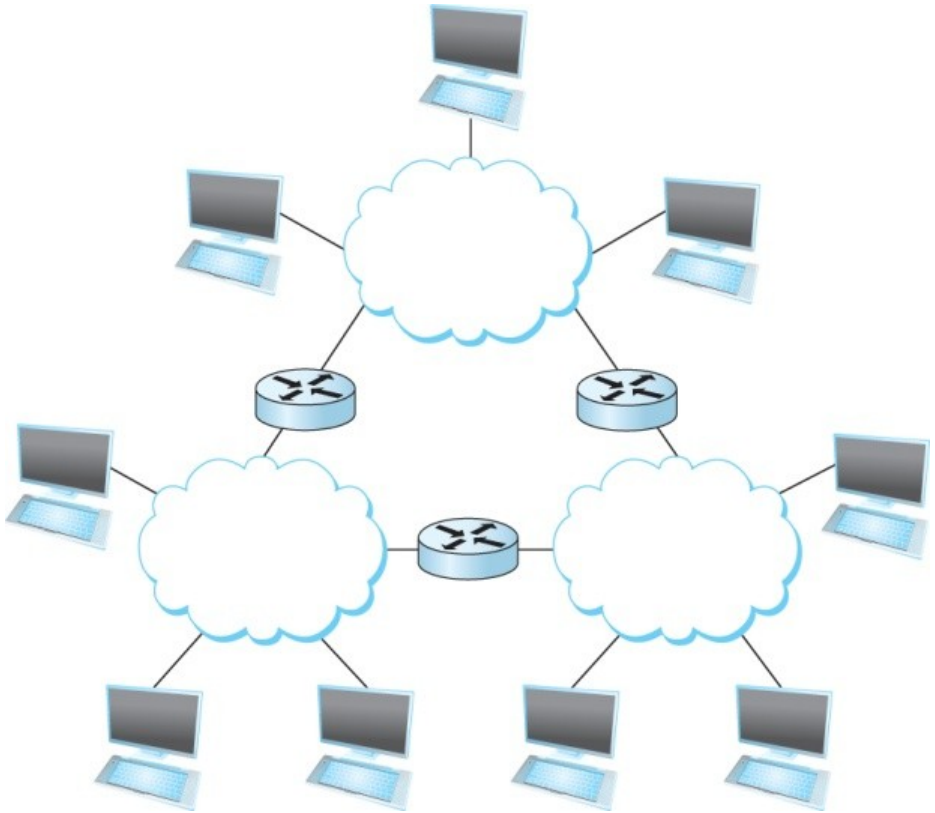
Links, Nodes, Network, Internet

- 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

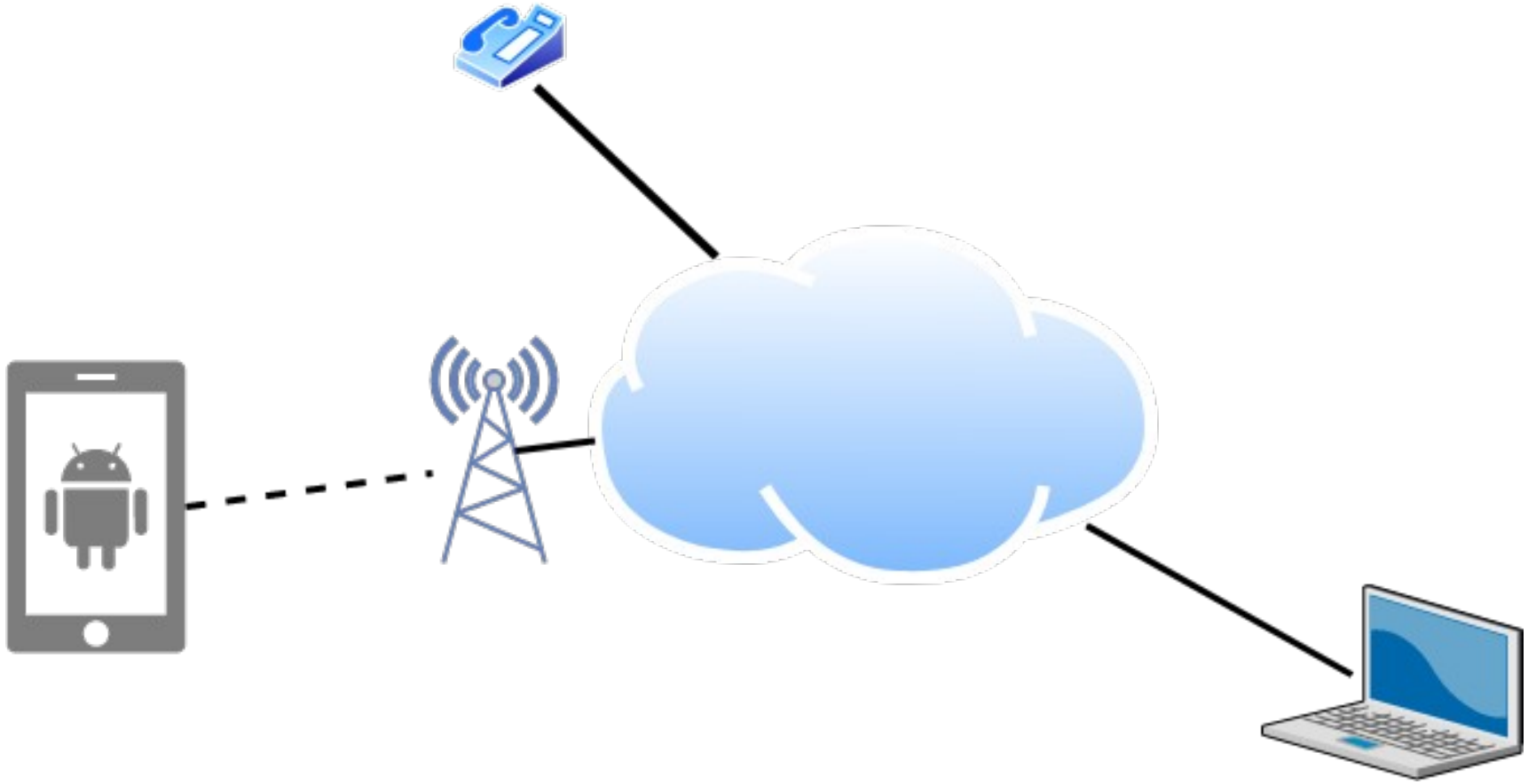


A Network and the Internet





Links, Nodes, Routers, Switches

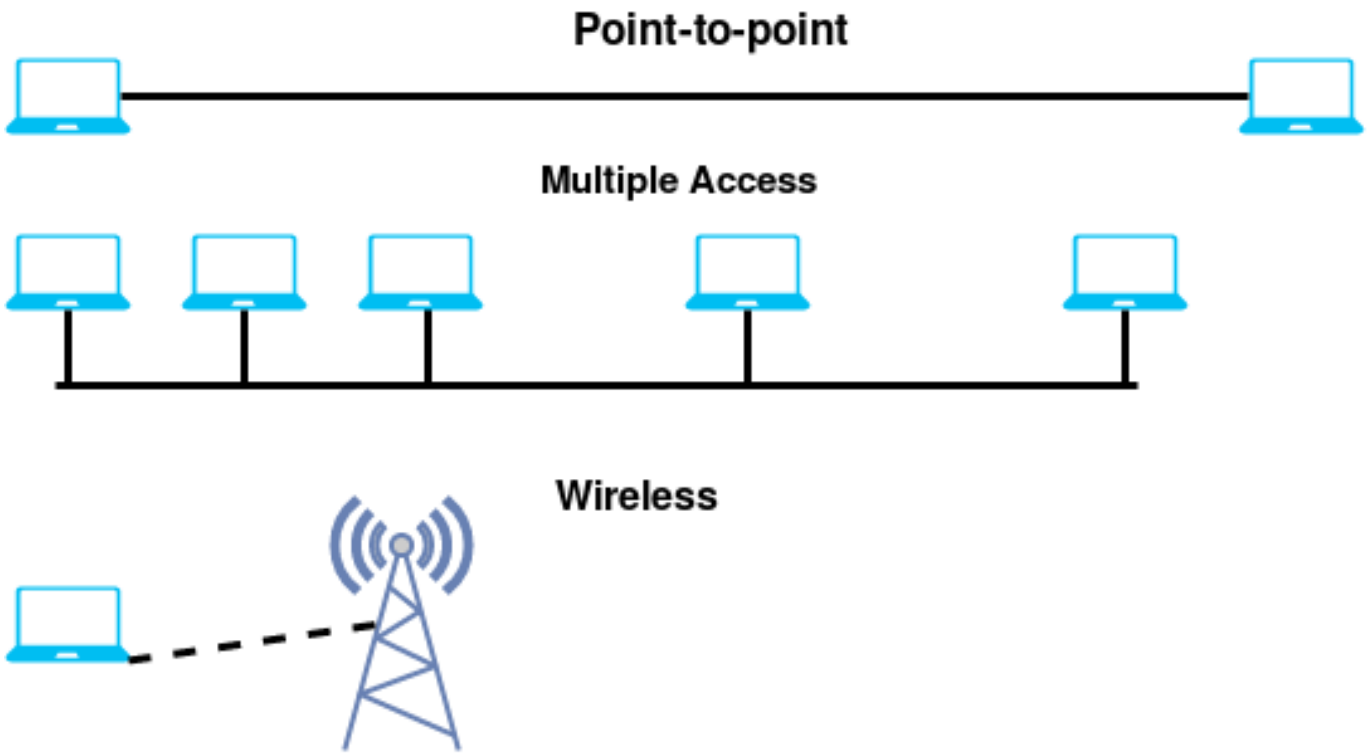


Client and Server

- 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

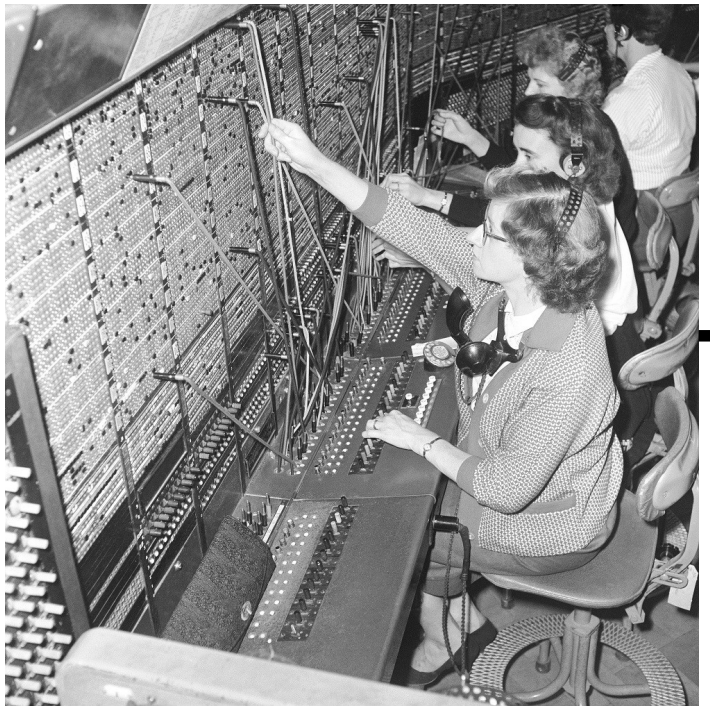
Connectivity

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



Circuit Switching – Old telephone networks

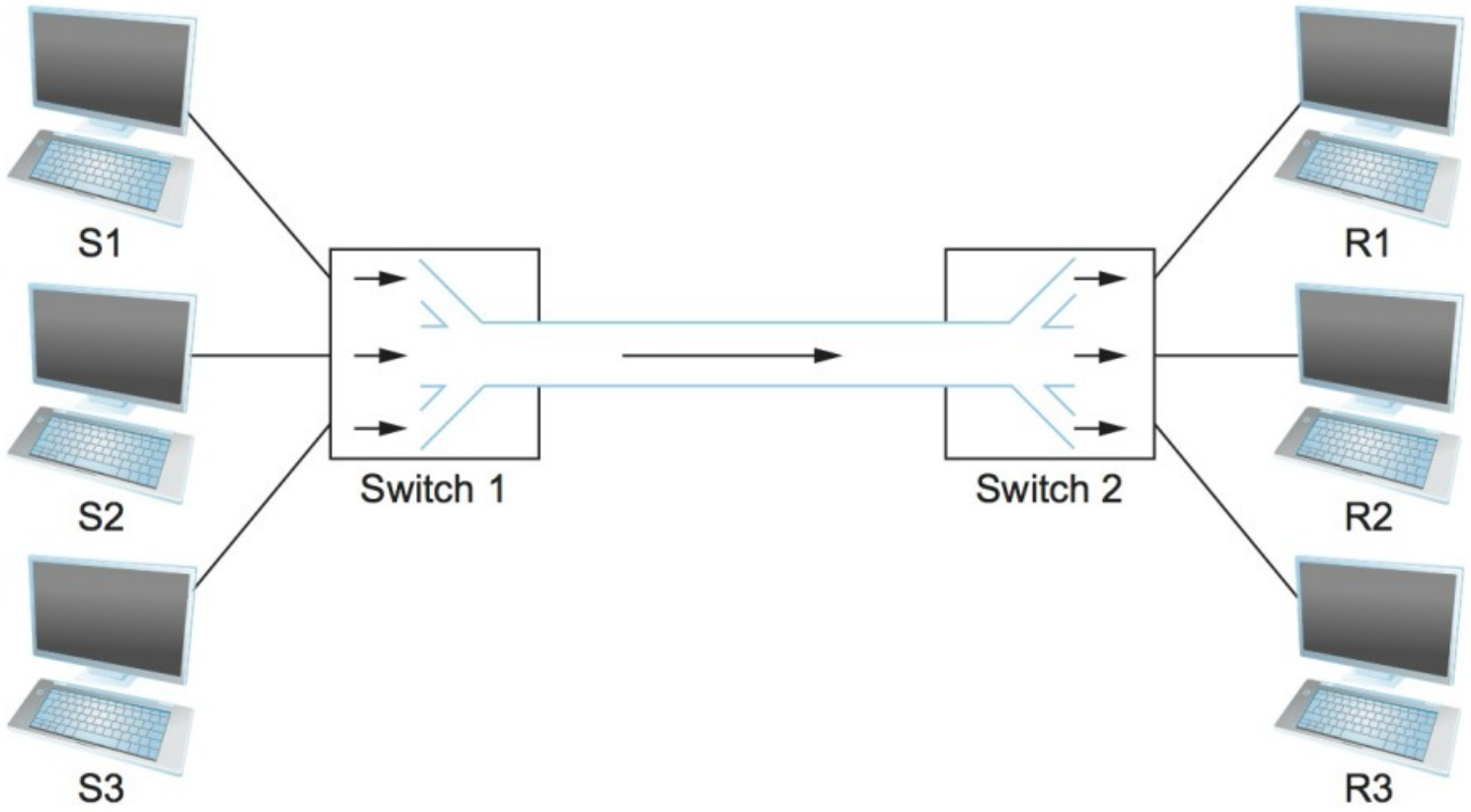
Operator, get me the navy



- Build physical wire:
  - Guaranteed resources
  - Great for voice

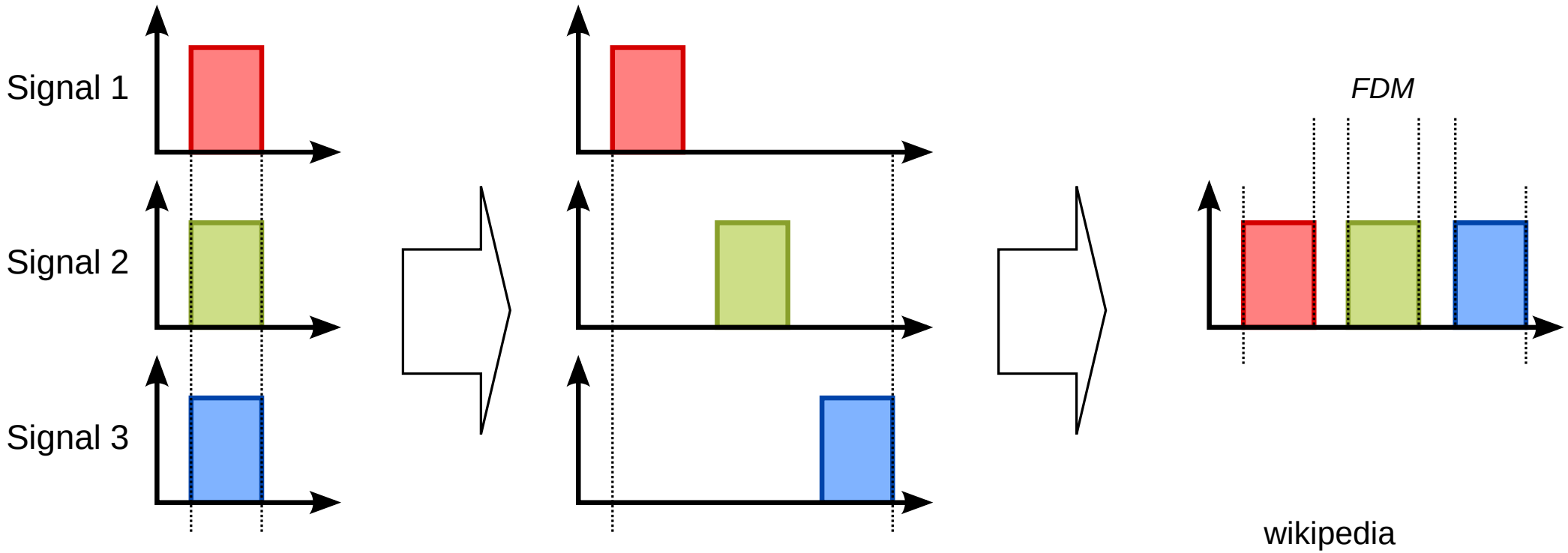
Why change a working system?

Circuit Switching



What are the problems?

Frequency Division Multiplexing for Circuit Switching



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Time Division Multiplexing for Circuit Switching

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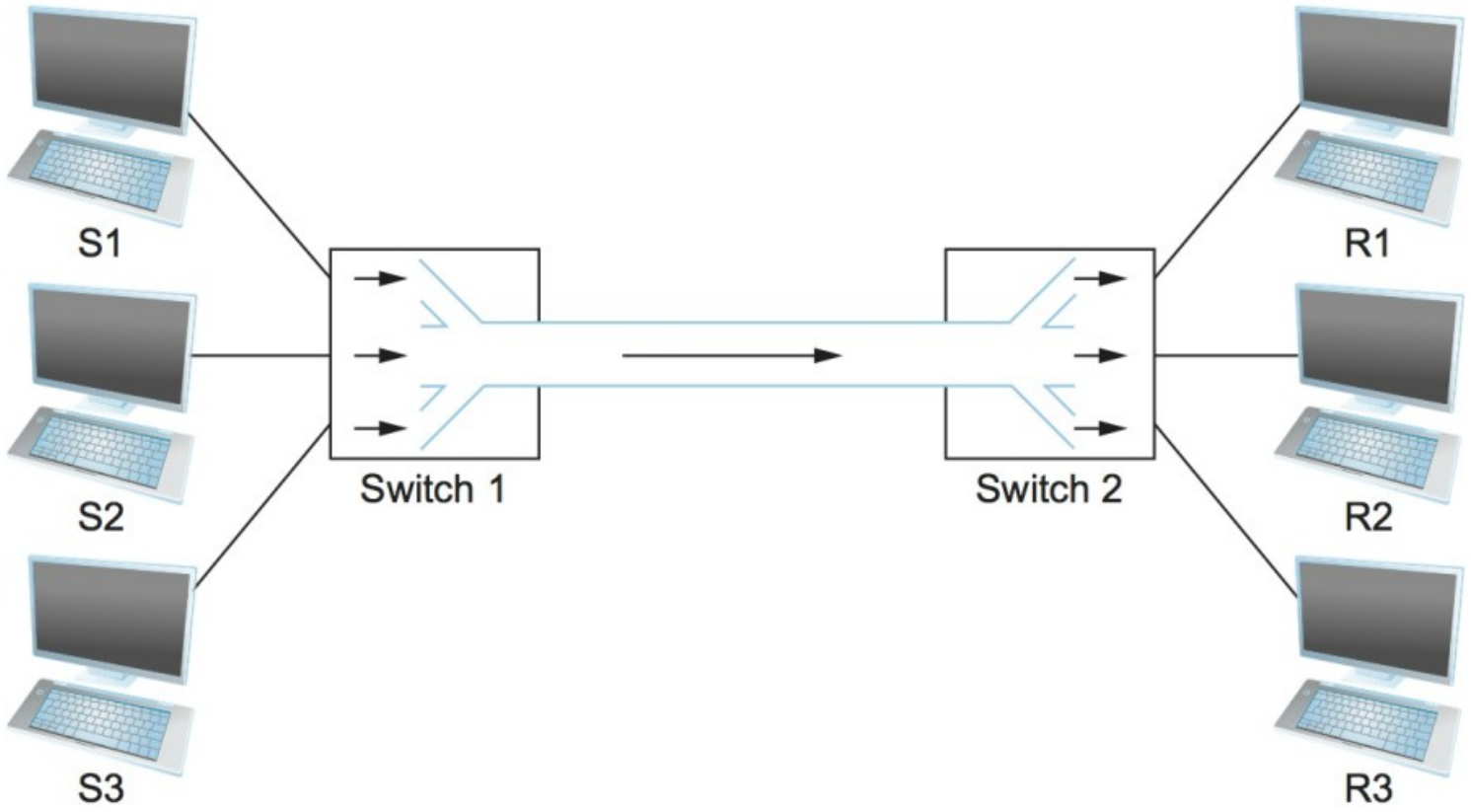
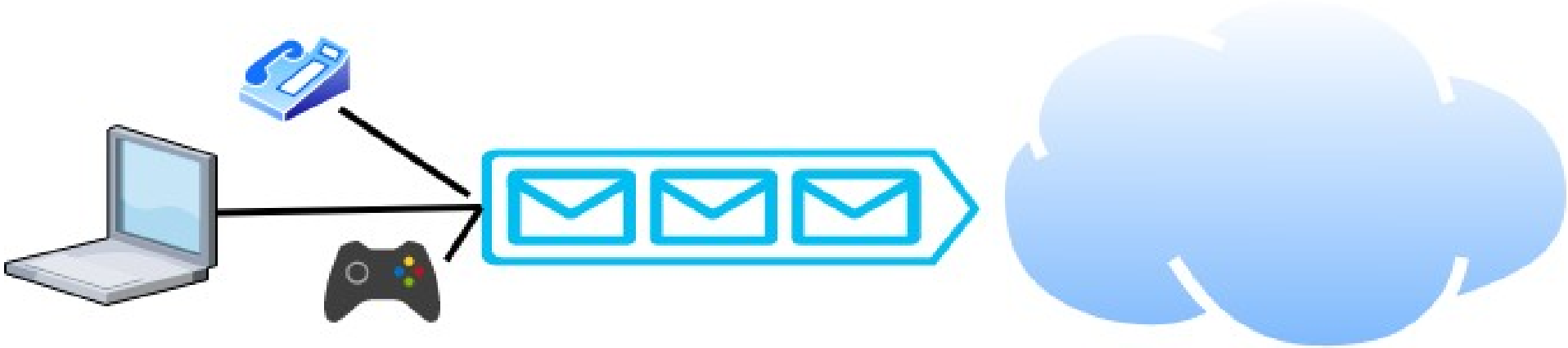
Circuit Switching – TDM and FDM



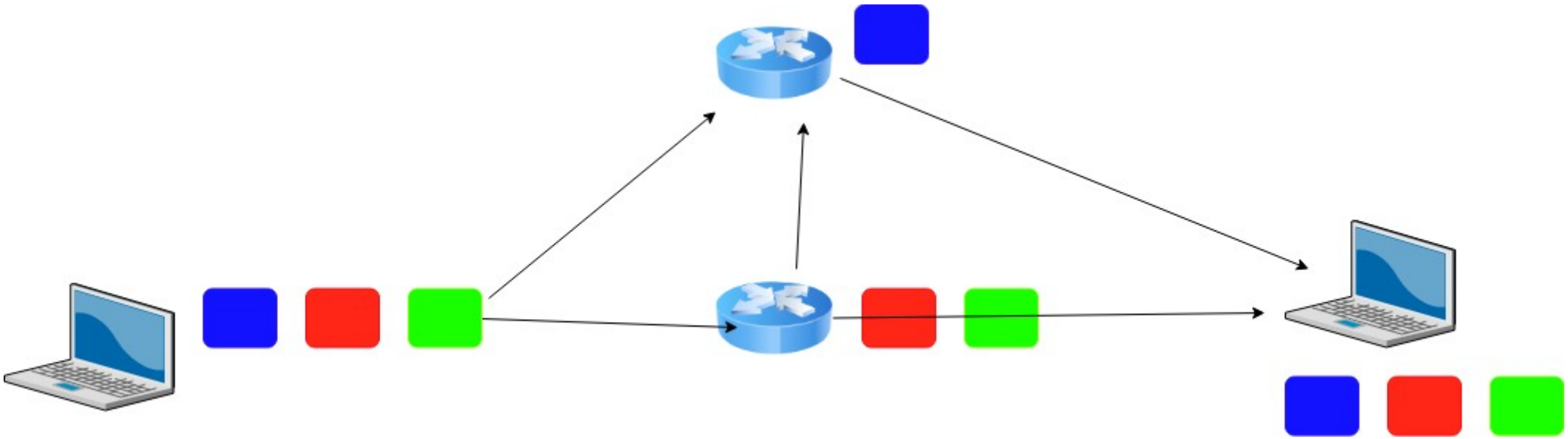
Problems solved? Or do they still exist?

Packet Switching

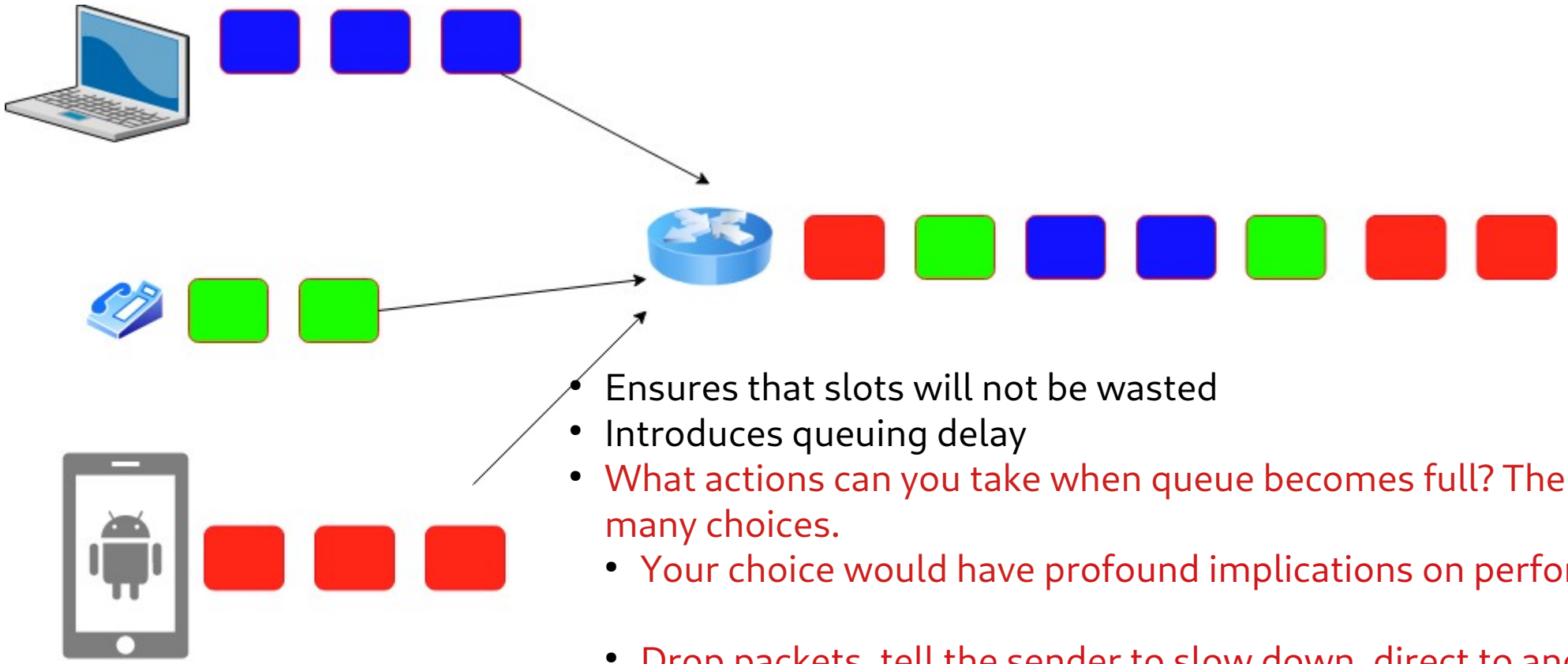


- Packets are low level components
- Multiple kind of traffic with different requirements
  - Gaming vs Phone
- Dumb network – How do you ensure quality of service?
- End points must be smart

Packet Switching

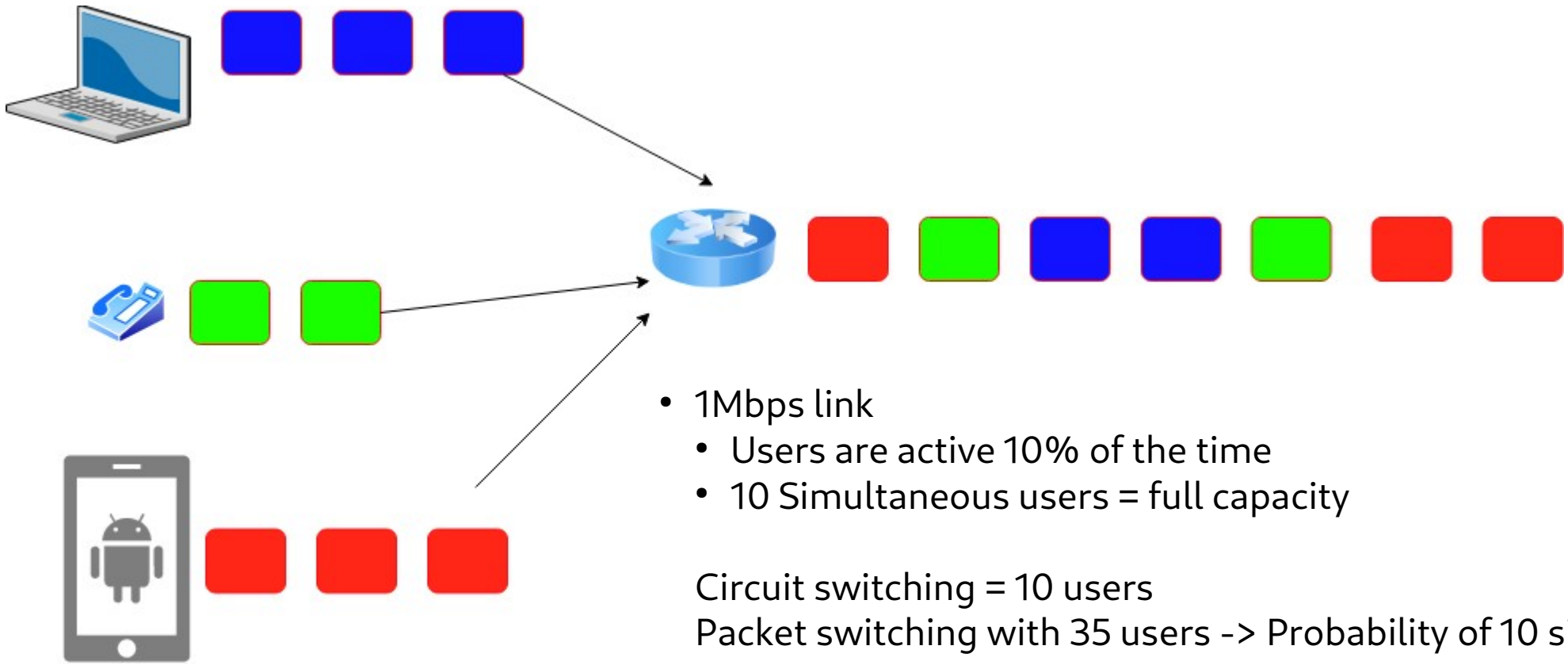


Statistical Multiplexing for Packet Switching



- 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

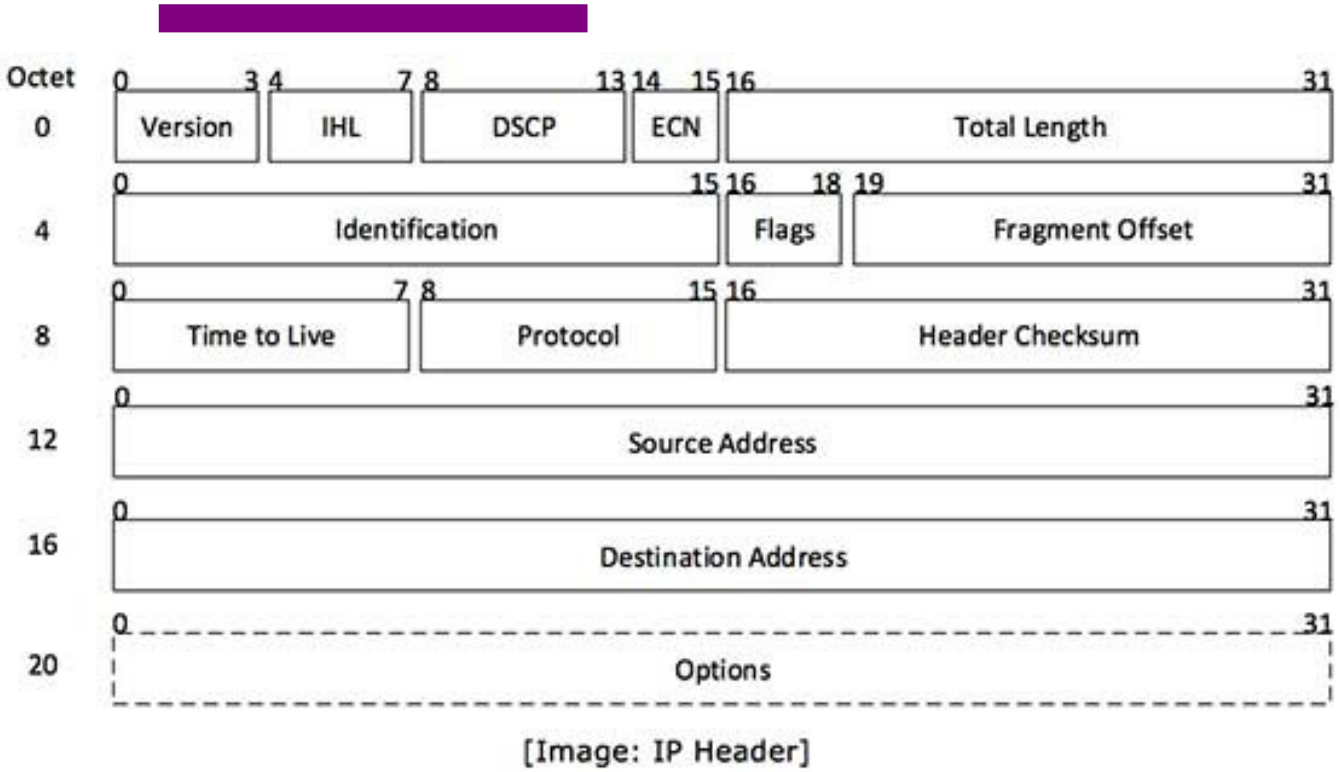
Circuit Switching

- 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?



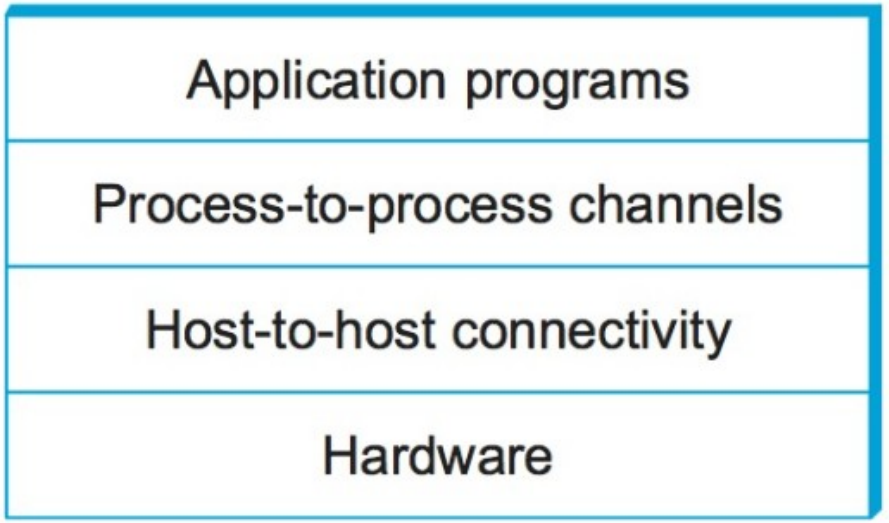
[Image: IP Header]

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

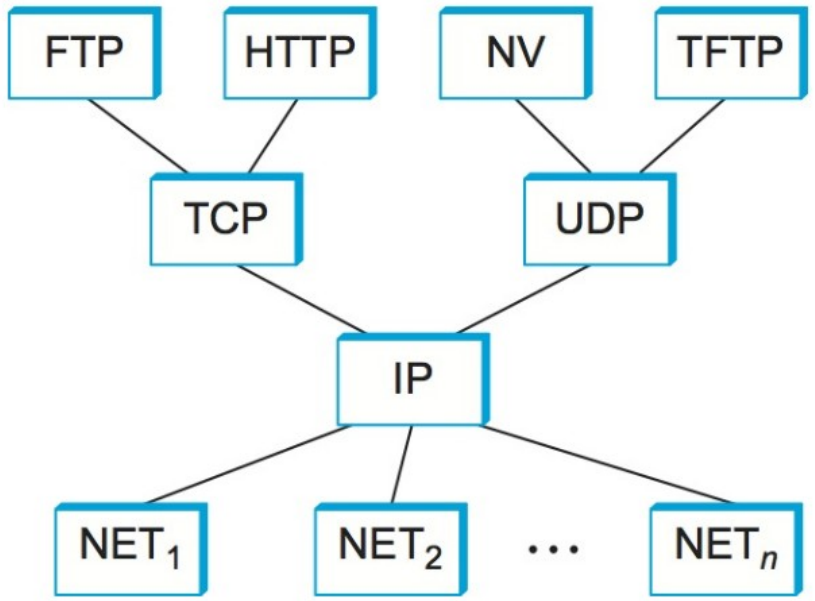
Network Architecture

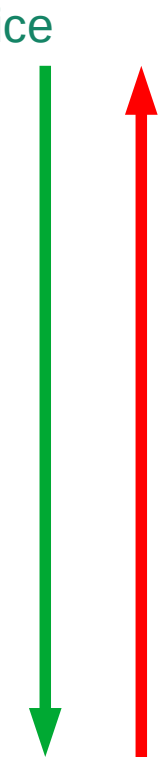
- What are the requirements from a network?

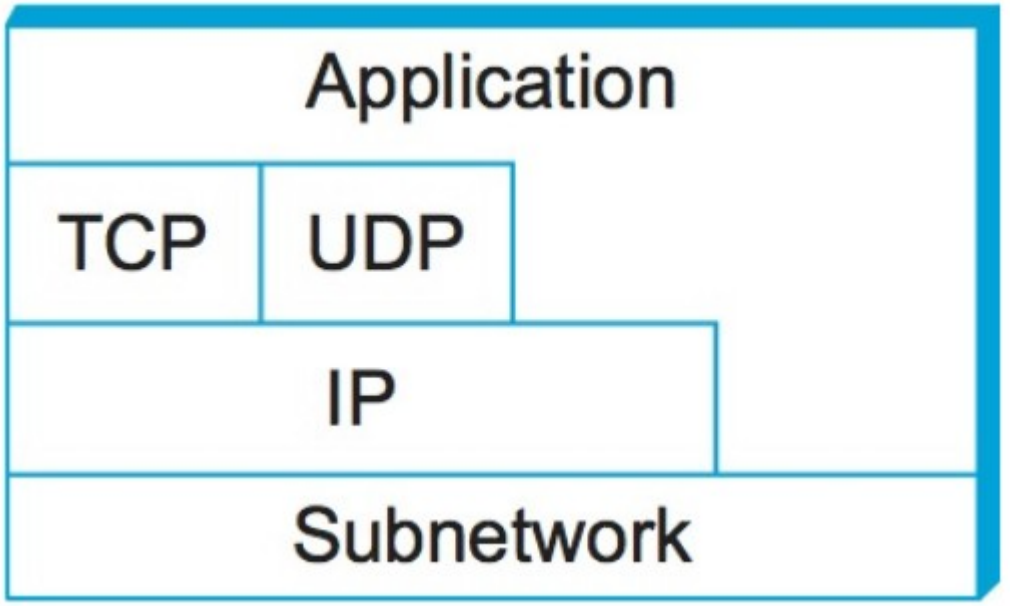
- Architecture = High-level blueprint
  - Protocols = Building blocks of the architecture
  - Layering = Break down the problem in smaller pieces



Network Layers

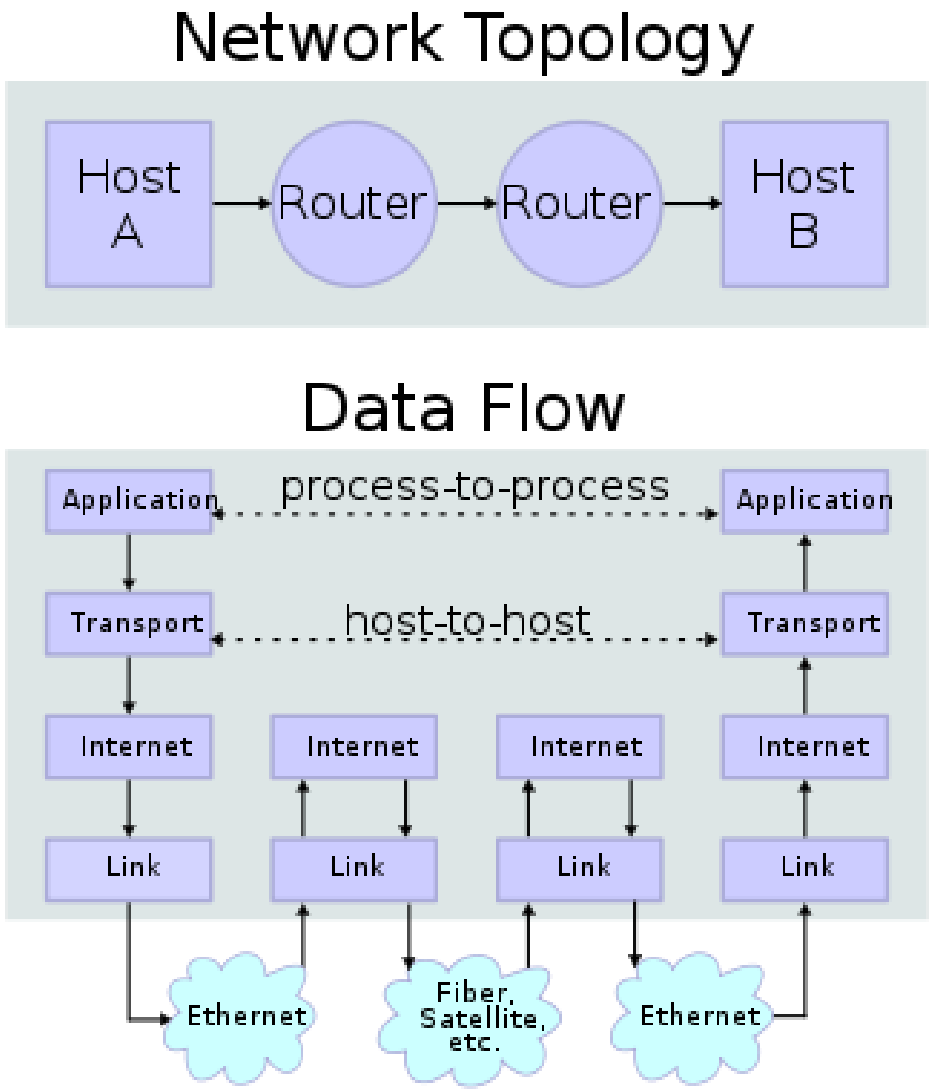


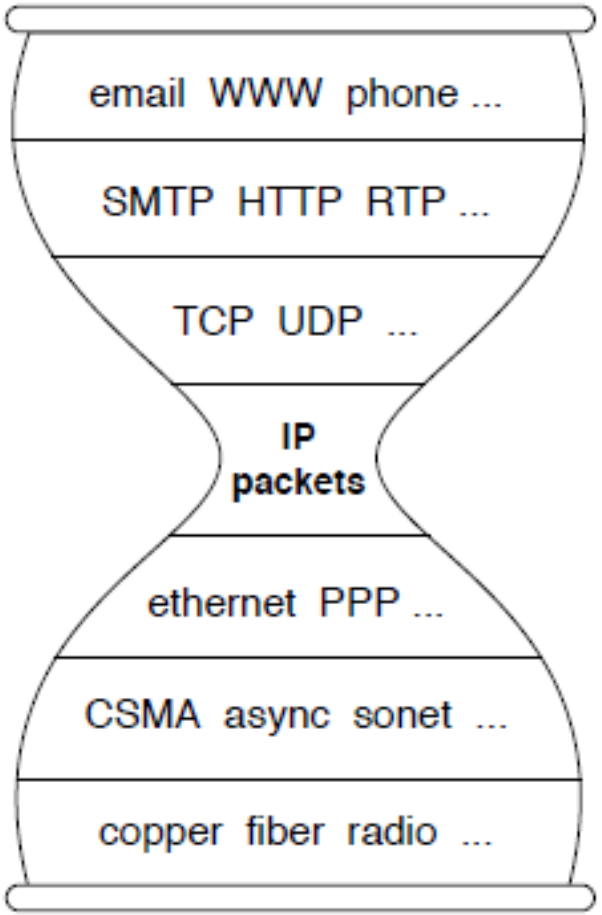




- Makes it easier to divide functionality
- Hides implementation details
- Few other reasons?

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**