

CS 181AG  
Lecture 1

# Overview

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Aug 29, 2022

# Hi, I'm Prof. Arthi

- I go by Prof. Arthi
- Pomona -> Microsoft -> UCLA -> Harvey Mudd
- I enjoy solving puzzles and playing tennis
- I would like to get to know you!

# What this course covers

- (Some) background on how the internet works
- Algorithms that make the internet run efficiently
- Current challenges + research directions related to the internet
- We can be flexible!

# Goals

- Learn to approach problems like a systems researcher
- Appreciate *and* critique decisions made in the evolution of the internet
- Practice reading papers + understand current networking challenges
- Good mental health

# Course website

- <https://www.cs.hmc.edu/~apadmanabhan/cs181ag-F22>

# Schedule

- Section 1: MW 1:15 – 2:30
- Section 2: MW 2:45 – 4:00
- Office hours: McGregor 321; F 2:00 – 4:00, one other slot TBD
  - At least for now, office hours will be in person
  - Or by appointment

# Lectures

- In person but will try to post recordings to the course website by evening
- Please raise your hand and ask questions at any time if anything is unclear
- Assignments will contain reading, and we will spend the first 10-15 min of class on Wednesdays discussing the reading

# Slack

- We'll be using Slack for discussions
- Feel free to post questions and other students and I can try to help you (but do not give away assignment answers)
- In person as well as on Slack, please be respectful and inclusive of all classmates



# Assignments

- Assigned Wednesday evening, due the following Tuesday at 10pm except midterm/break weeks
- Usually one programming problem, a few short answer questions, and one paper/article + short answer
- See assignments and submit solutions through Gradescope (code was in email)
- 5 “life happens” days – see me for extenuating circumstances

# Grading

- 10 assignments x 6 = 60%
- Midterm (1 hour take home Oct 25-28) = 15%
- Final (3 hour take home Dec 12-16) = 23%
- Participation = 2%
  - Drop by office hours in the first two weeks and introduce yourself
  - Fill out the mid-semester evaluation

# Textbook

- Network Algorithmics
  - George Varghese
  - Available online for free – link posted on course website

# Academic Honesty

- Please do work and study together. Discuss the readings. Post questions on slack
- Do not write up your solutions (neither code nor short answers) together.
- Some of the best information about the internet is on the internet. Feel free to Google **concepts** - look up more information and better understand readings to help with your assignments. Please do not look up your assignment questions online.

# Accessibility

- *HMC is committed to providing an inclusive learning environment and support for all students. Students with a disability (including mental health, chronic or temporary medical conditions) who may need accommodations in order to fully participate in this class are encouraged to contact the Office of Accessible Education at [access@g.hmc.edu](mailto:access@g.hmc.edu) to request accommodations. Students from the other Claremont Colleges should contact their home college's Accessible Education officer.*

# Please Provide Feedback

- I want you to get the most out of this course
- Open Feedback form

# What is the internet?

- Thousands of organizations operate their own networks and negotiate voluntary interconnection agreements. The internet is the largest, most popular network
- Decentralized network – nobody owns it
- internet ≠ web

# What are the parts of the internet?

- First mile: the larger internet – mostly fiber optic cables that carry data between data centers and consumers
- Last mile: the part that connects users (devices in homes, small businesses, etc) to the rest of the internet
- Middle mile: anchor institutions (large office, libraries, etc) that connect first and last miles



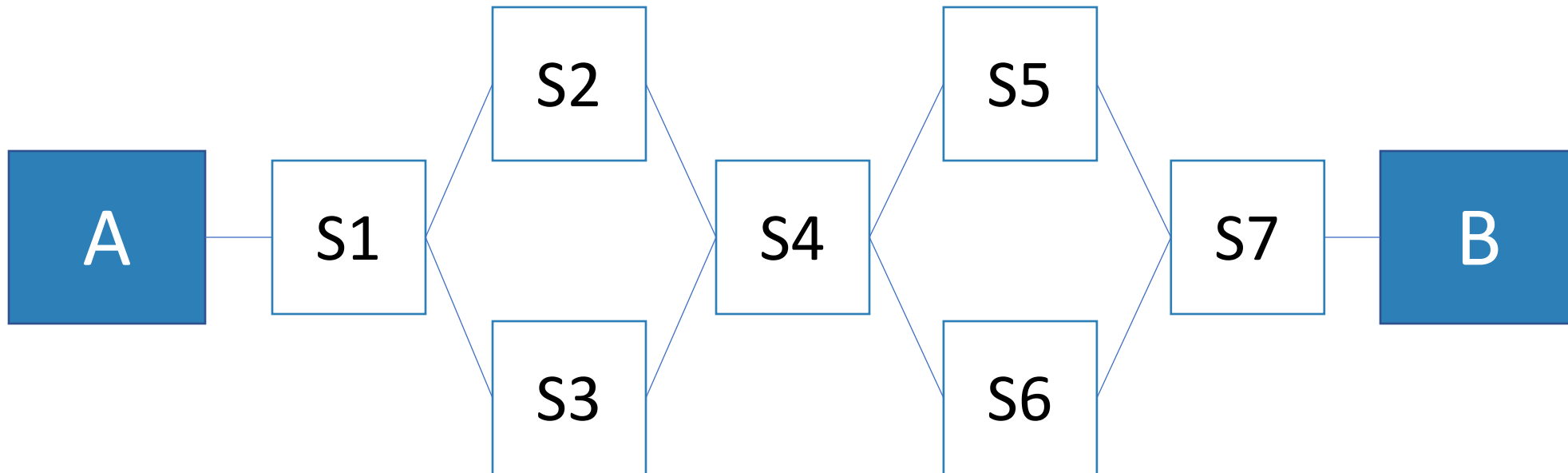


# Who built the internet?

- The internet was an iterative process with many contributors
- History lesson:
  - Launch of Sputnik -> US Government builds ARPA (now DARPA)
  - ARPA invests billions into better communication

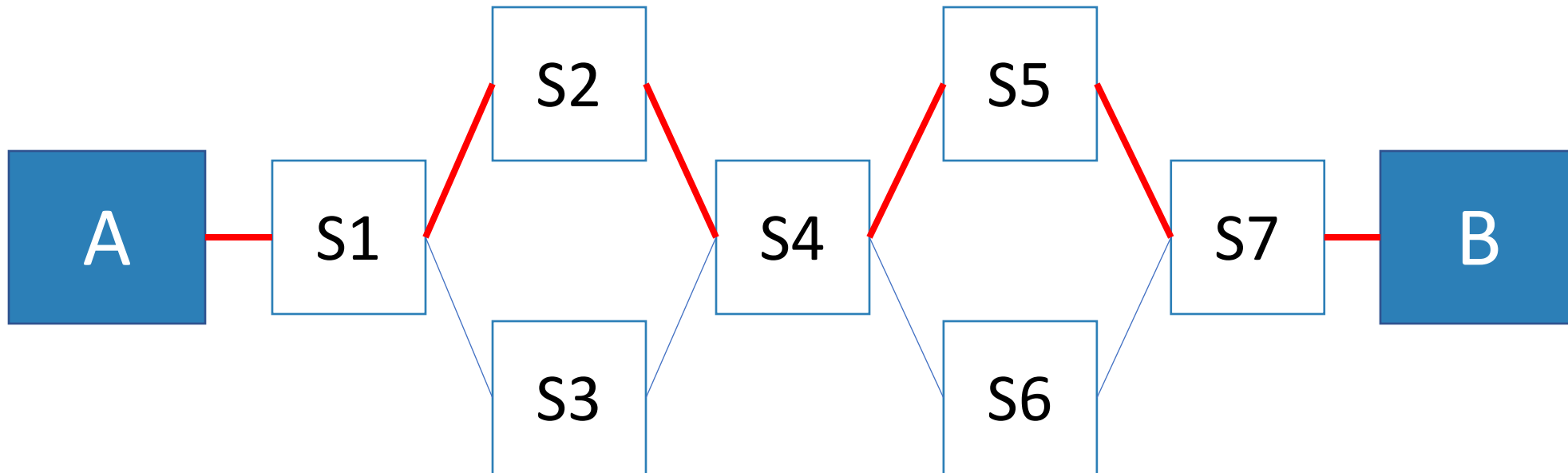
# Internet: The Early Days

- Originally based on telephone connections
- Switching: controlling or directing data towards a destination in a network



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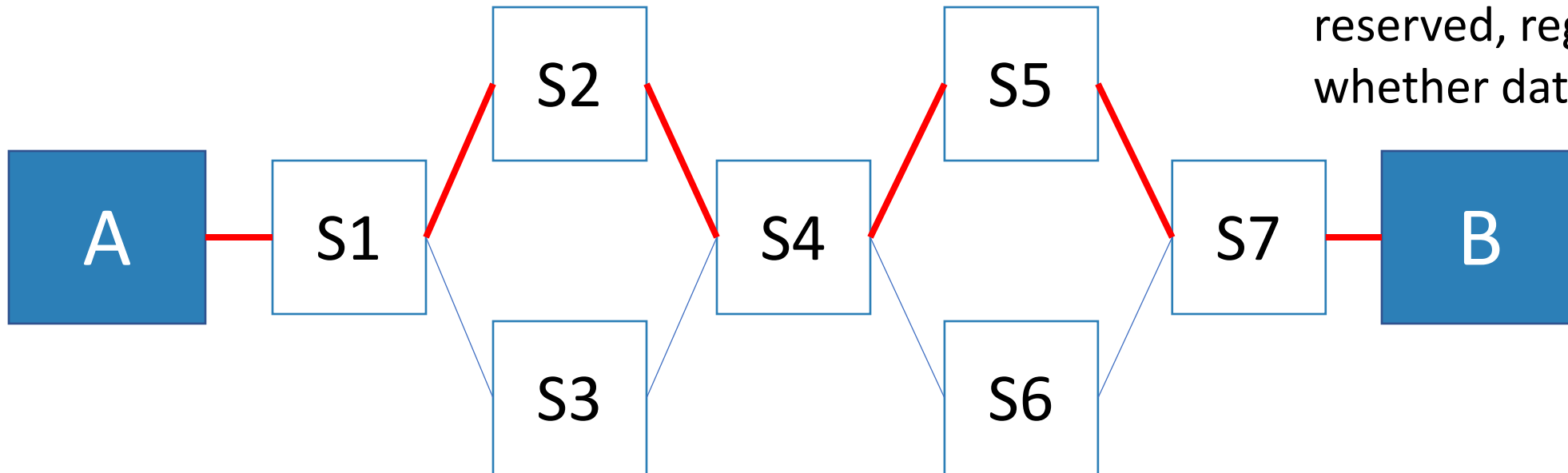
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# Internet: The Early Days

- Originally based on telephone connections
- Switching: controlling or directing data towards a destination in a network

**Circuit switching:** entire path is decided ahead of time and bandwidth is reserved, regardless of whether data is being sent



# Packet Switching

- Break up long messages into smaller chunks of data (packets) and send each packet individually, without reserving bandwidth
- Each packet might take a different path – it is receiver's job to put the long message back together
- “Best effort” performance: network will do its best to deliver each packet as fast as possible but no guarantees

# Dial-Up Modems

- In the early days, packets were sent over telephone networks
- “Hang up the phone. I need to send an email.”



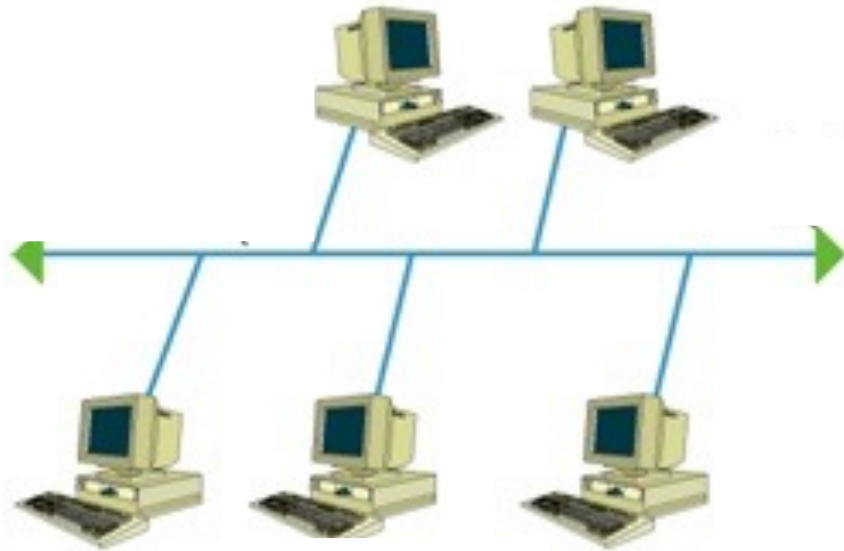
# Broadband Networks

- Now, packets are sent over mediums that can support many types of data (files, audio, video)
- Cables constitute the core of the internet
- Radio waves sometimes serve last hop



# Building out the internet

- **Single hop:** Start with one wire: how do multiple devices share a single wire to communicate with each other?

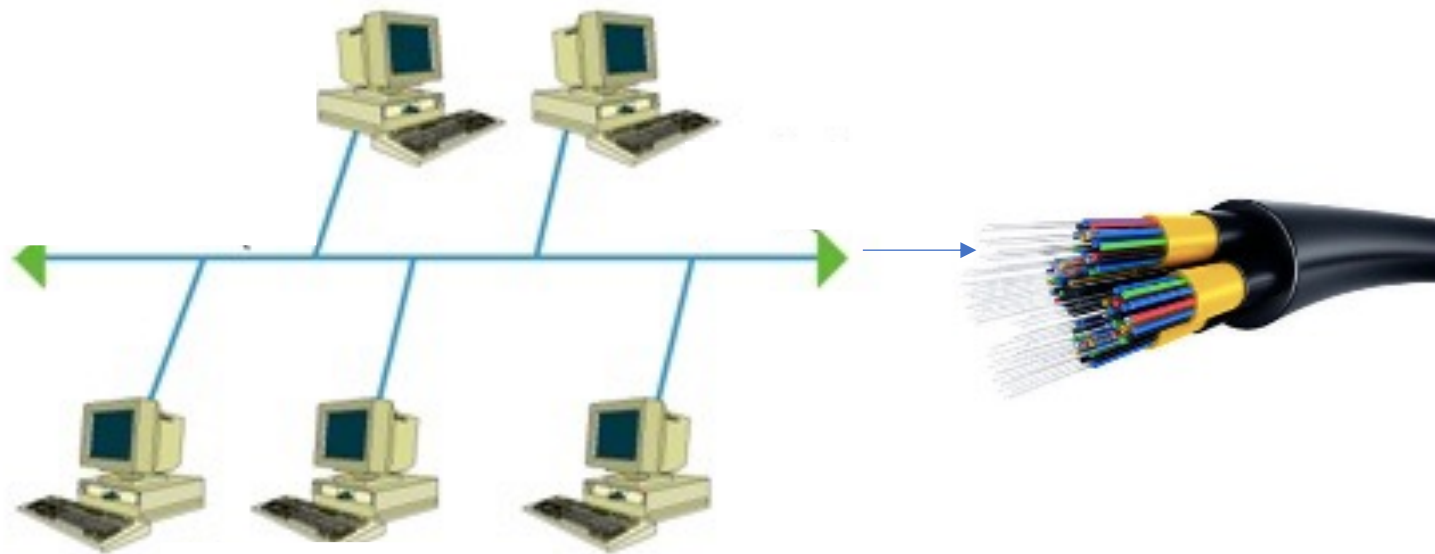


Data Link Layer



# Building out the internet

- **Physical Medium:** What is the wire itself made of? What about wireless mediums?



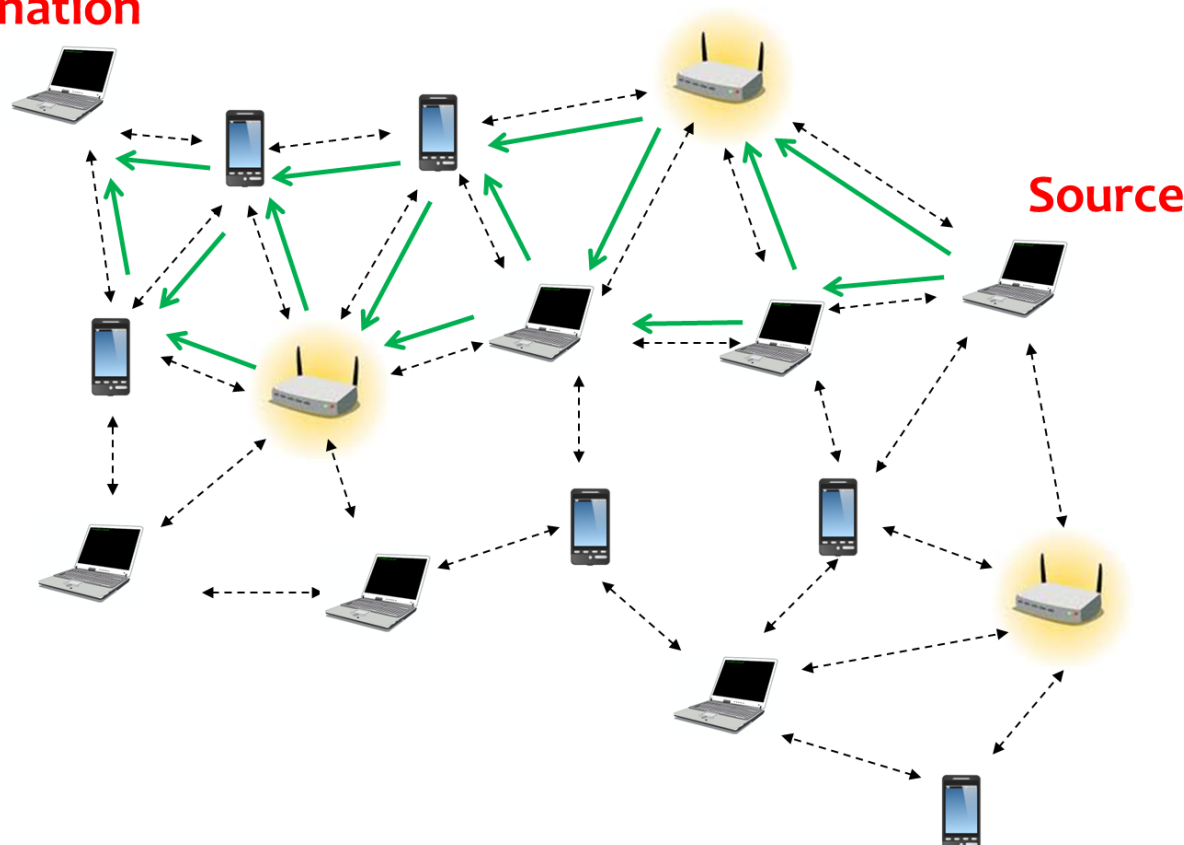
Data Link Layer

Physical Layer

# Building out the internet

- **Routing:** What path should data take? What if certain links are congested?

Destination



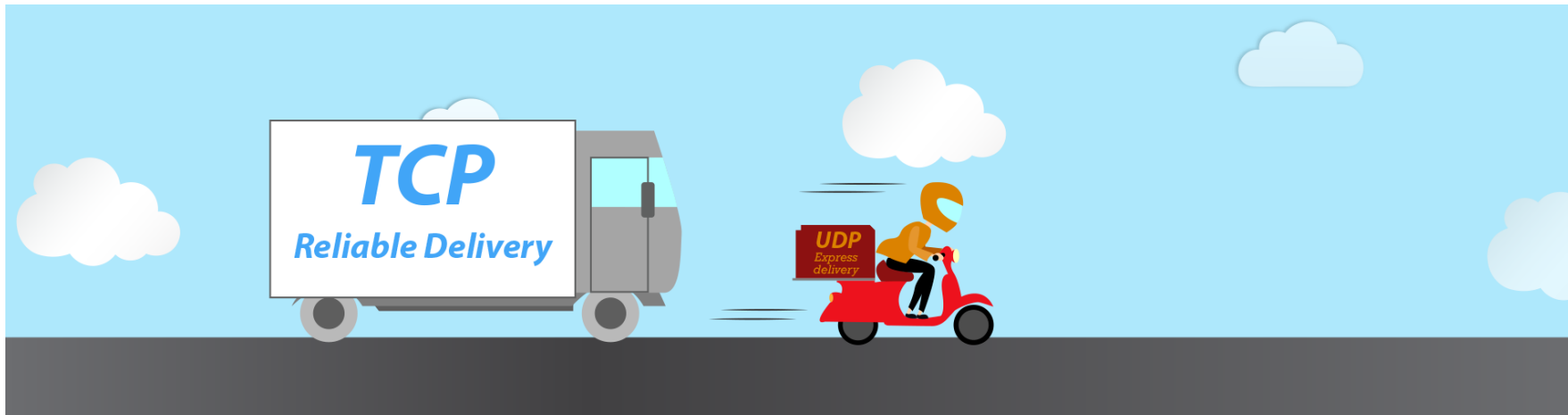
Network Layer

Data Link Layer

Physical Layer

# Building out the internet

- **End-to-end delivery:** How do we know the packet reached? If we broke a long message into many packets, how does receiver know how to put it back together?



Transport Layer

Network Layer

Data Link Layer

Physical Layer

# Building out the internet

- **User interaction:** How does an internet user interface with network services?



Application  
Layer

Transport Layer

Network Layer

Data Link Layer

Physical Layer

# Packet Headers

- Separate headers are added for each function:

