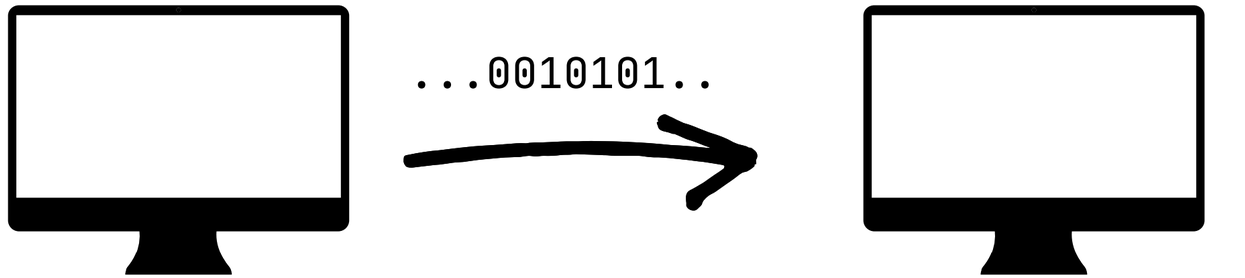
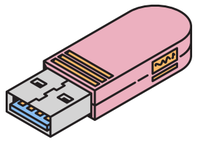
Dissecting The Internet

Sending Data



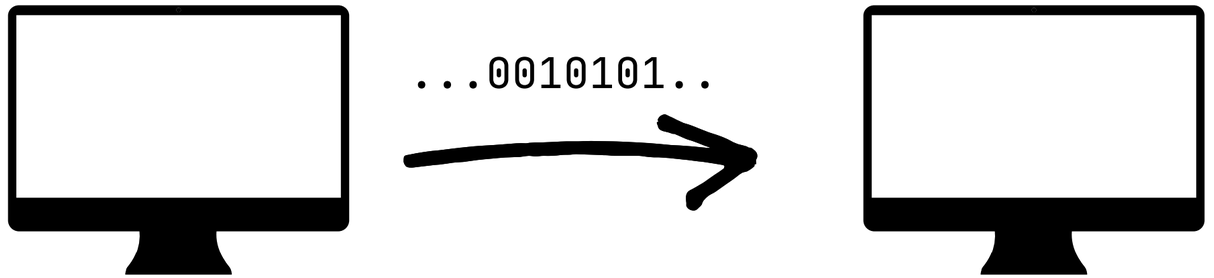
Your Device

Ahmed Device



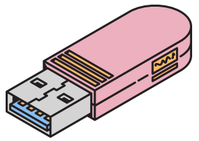
external
device

Sending Data



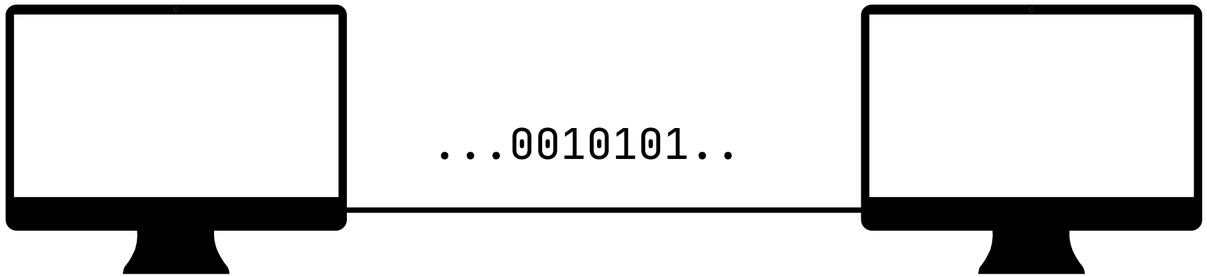
Your Device

Ahmed Device



external device

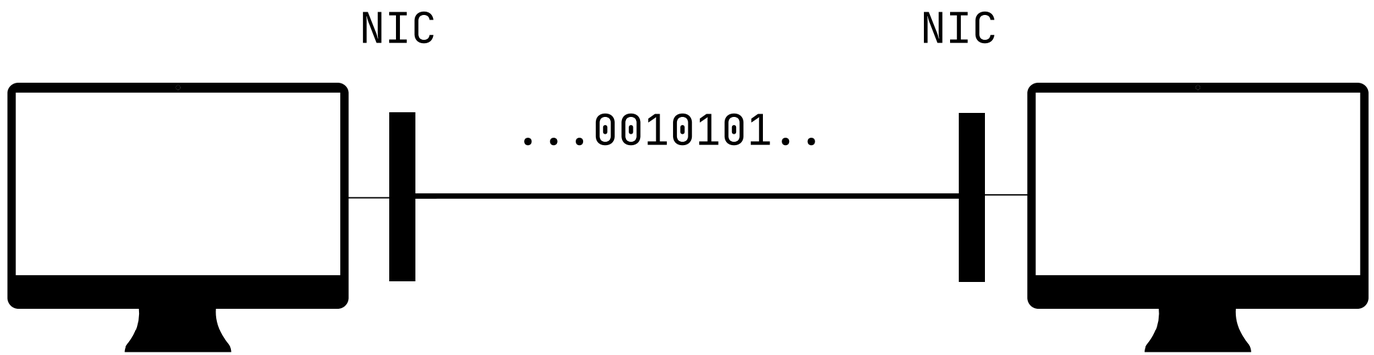
external device



Wires Waves Optical Fibers

Network Interface Card:

I/O Device For Communicating In Networks



OUR SYSETEM SO FAR

US data

Physical Layer

Problems

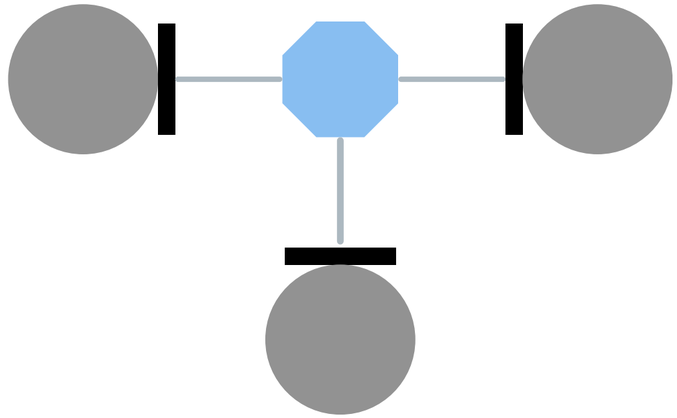
- **Corruption**

- **Collisions**

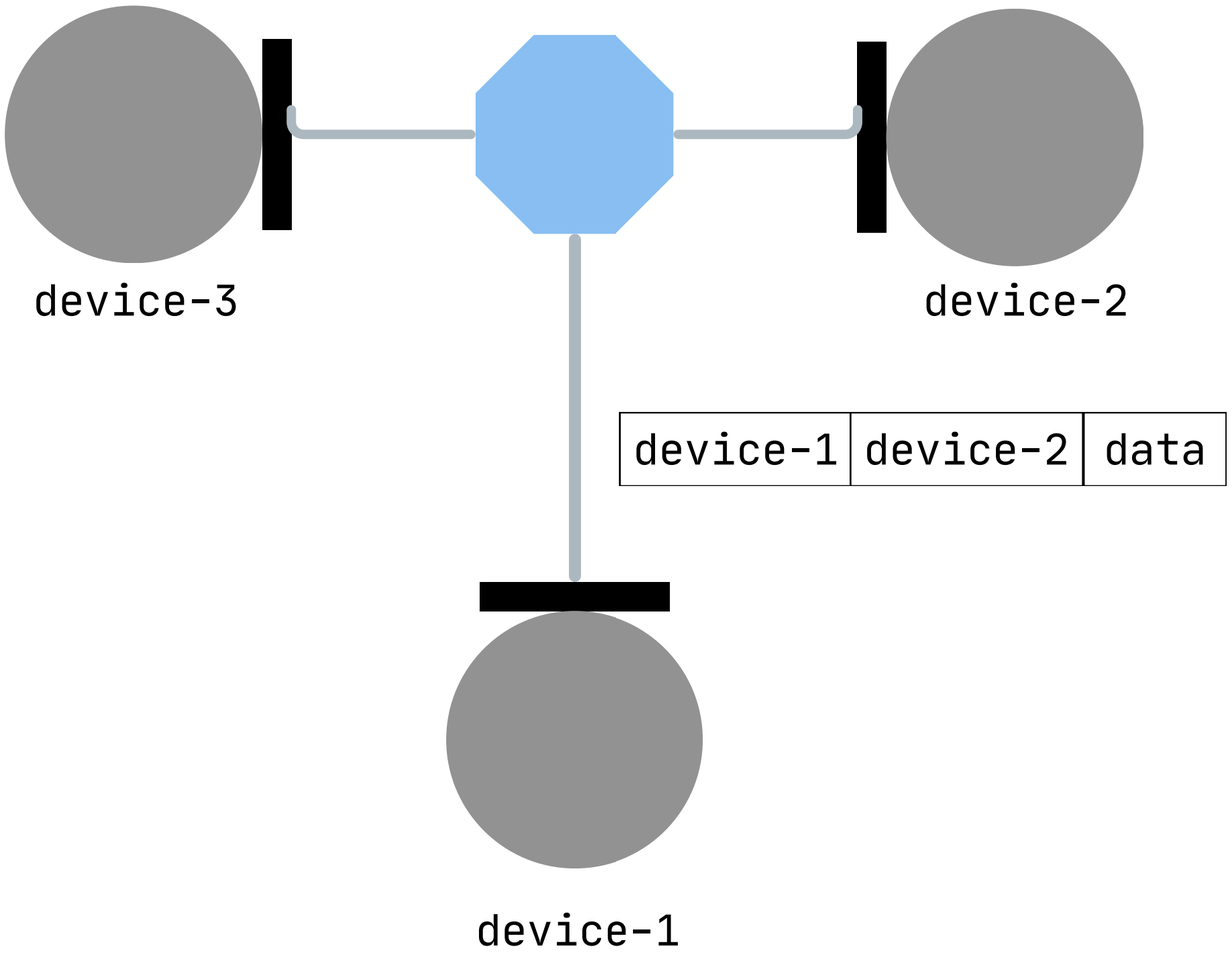
- **Many Devices**

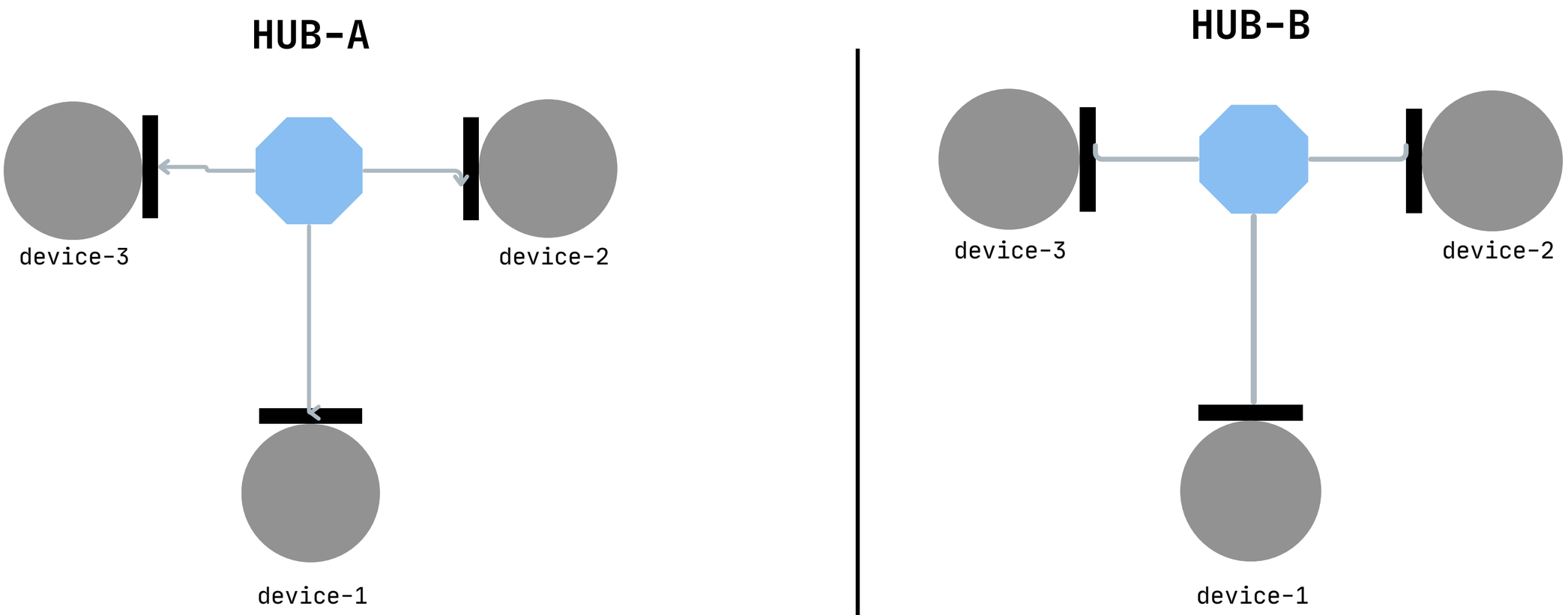
  Identification - Security

HUB



HUB-A





can you move device from HUB-B TO HUB-A?

NAMING COLLISIONS

MAC ADDRESS

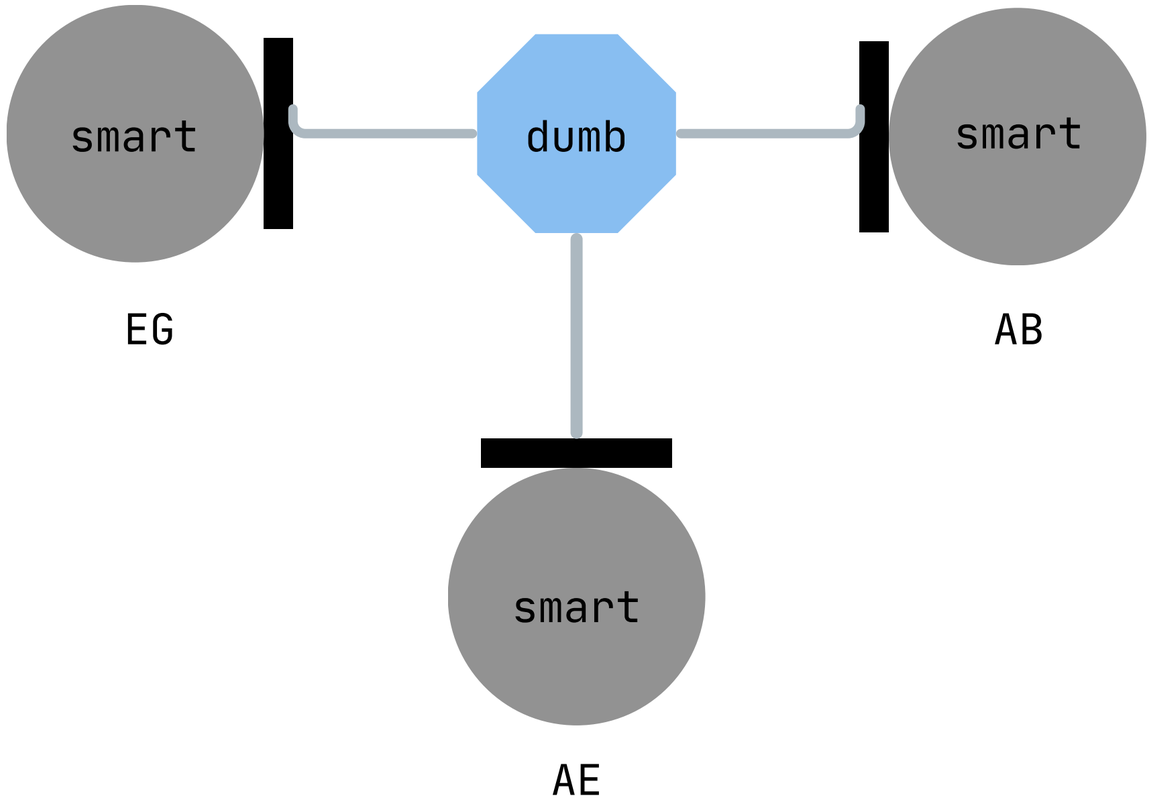
- Definition

A **MAC address** (short for **medium access control address**) is a unique identifier assigned to a network interface controller (NIC) for use as a network address in communications within a network segment. This use is common in most IEEE 802

Manufacturer Device-Id

42-bit ⟶ 281 trillion device

Security



Why not make it smart and delegate work to it?

SWITCH just a smart-hub that uses mac addressess

- Collisions
- Device Identification
- Abstracting Physical Layer
- Handling Corruptions

US data

Data-Link Layer Ethernet/WIFI Protocol

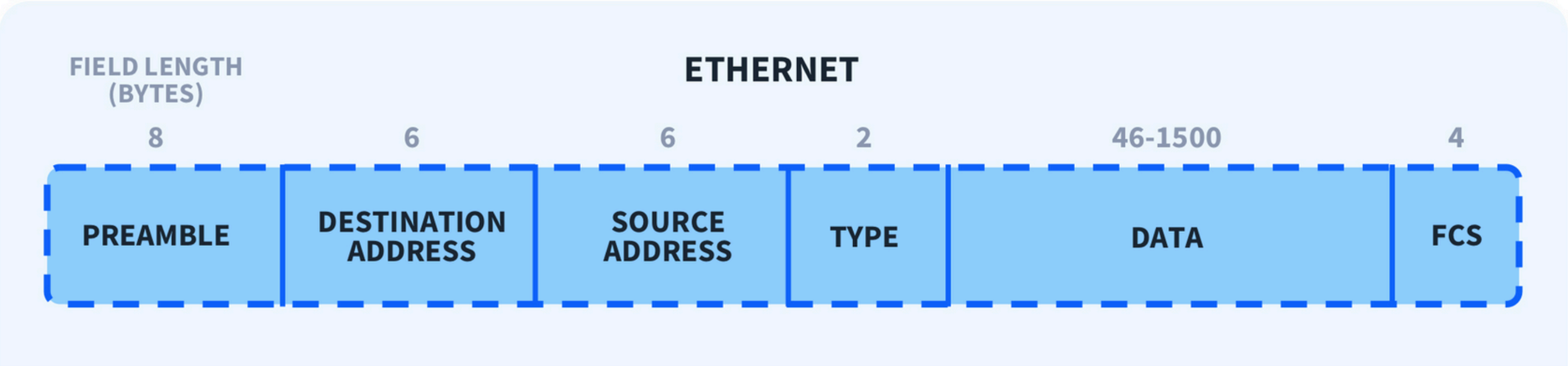
Physical Layer

US data

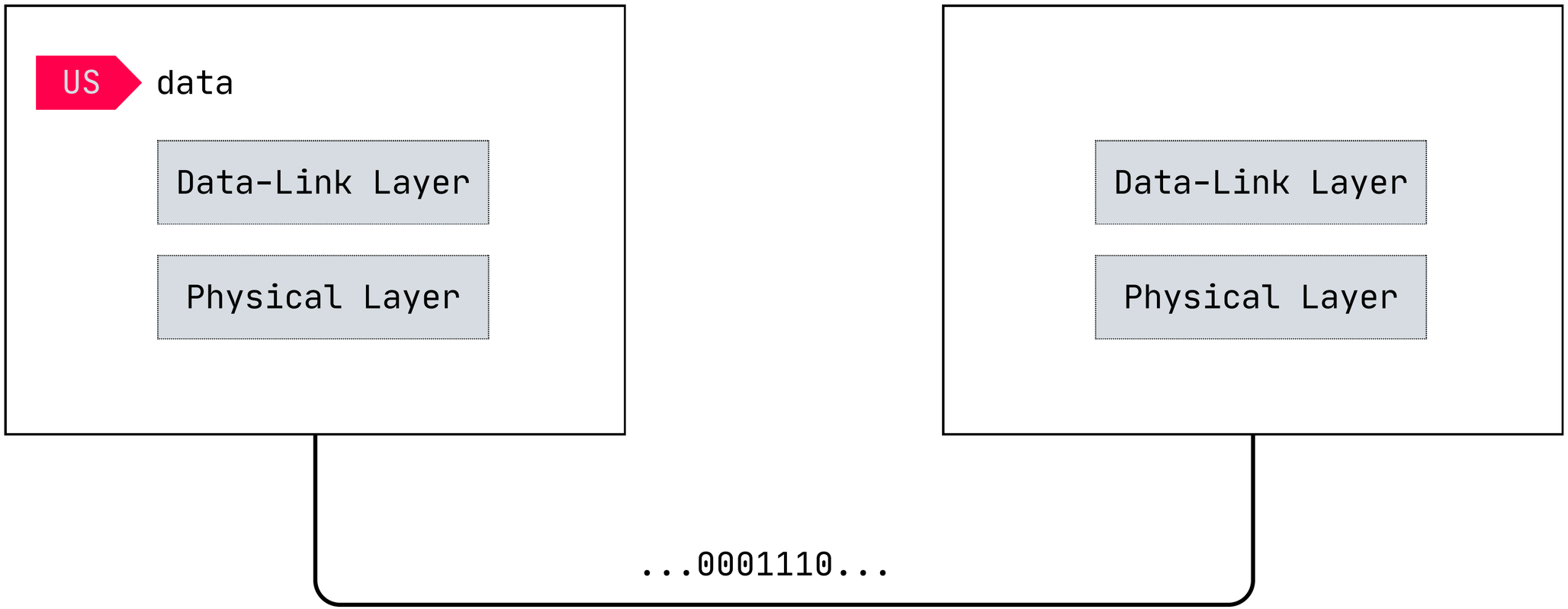
Data-Link Layer Ethernet/WIFI Protocol

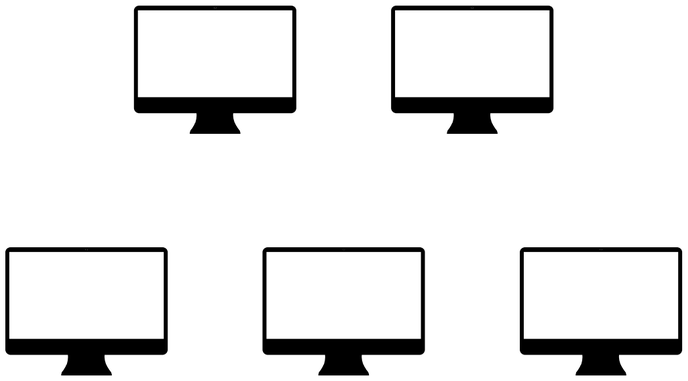
Physical Layer

- What is a protocol?
- What is an Ethernet Frame?



Journey In Our System





network machine

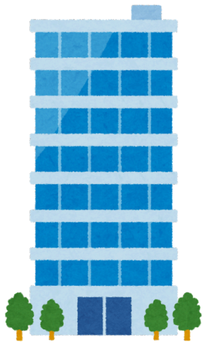
Local Area Network

network machine

The Internet

How Would We Connect These Devices?

- One Giant Switch?
    - No Comment

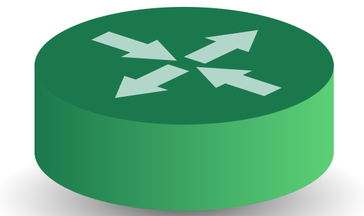


- Many Switches Connected Together?
    - Collision Domains?

- We need a mediator

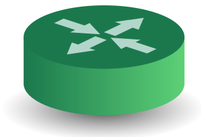
Router

A **router**[a] is a computer and networking device that forwards data packets between computer networks, including internetworks such as the global Internet.[2][3][4]



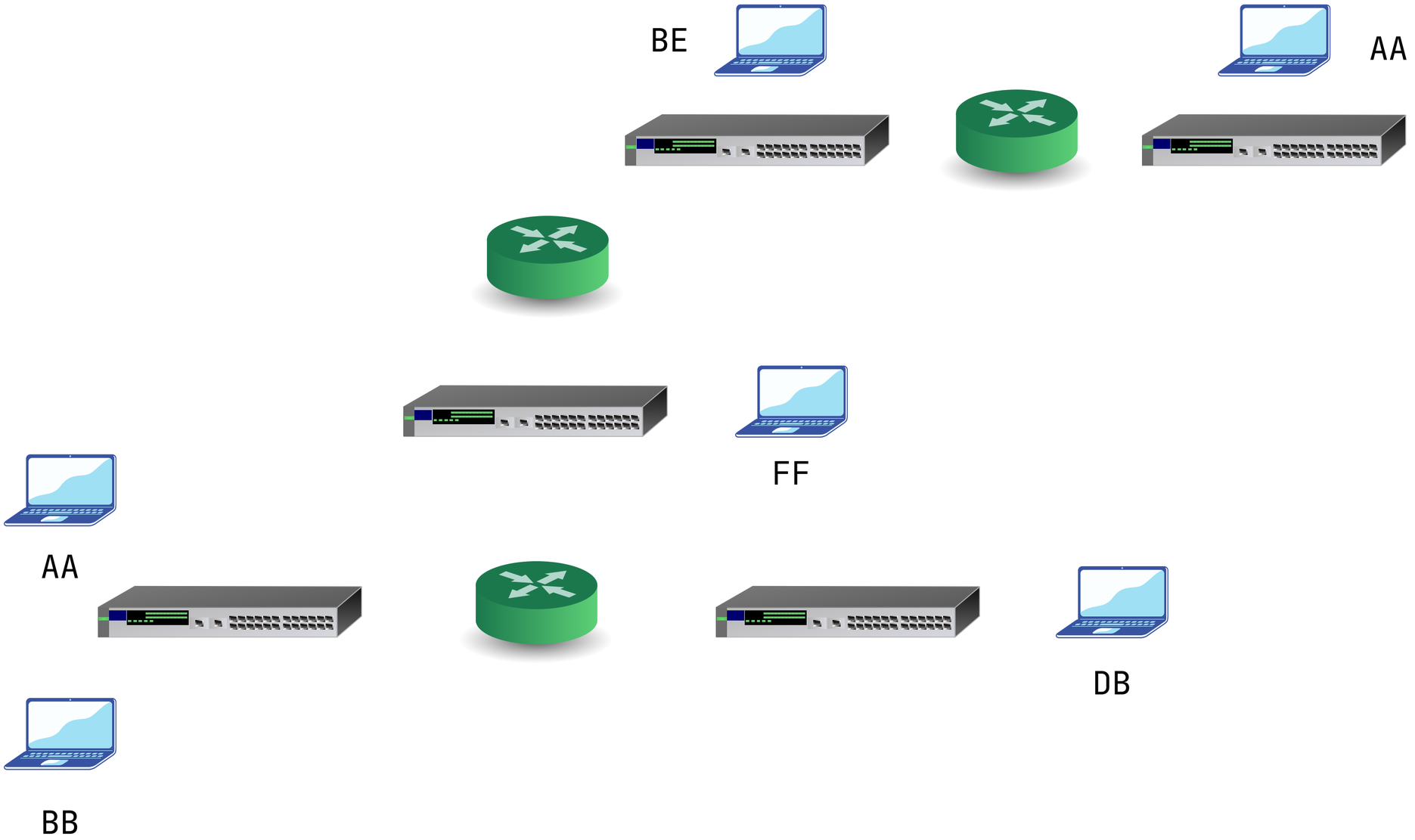
- Since it connects different networks it has at least two NICs one for each network

AA



BB

DB



What about more and more and networks?

What do we actually need?

Mac Addressess Limitations

Think of a mac address as your name (not exactly)

- We don’t need a name we need an address

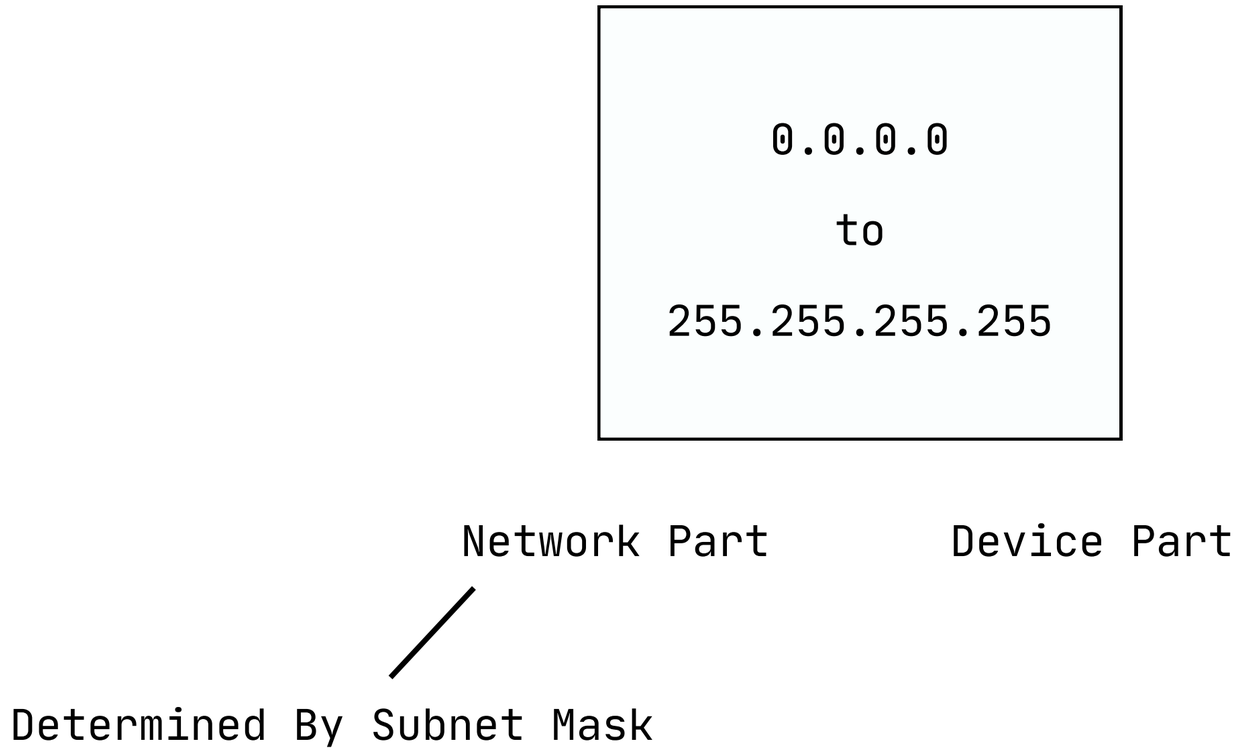
What do we need from that address?

- To be distributed in a systematic manner so that we can locate devices based on this address.

Let’s Say Hi to IP addresses

IP Address

- IPV4
  - 32-bit address : 4 billion Device
  - Integer Dotted Notation



IP Address

What is so special about IP addresses from Mac Addresses

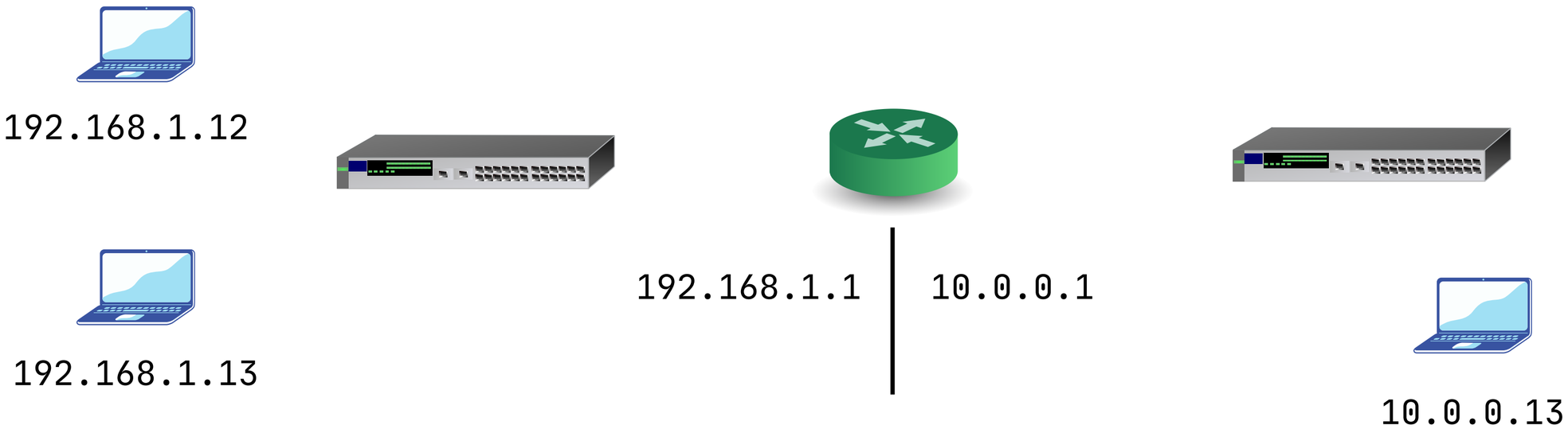
- IP addresses are associated with a network not a device
- IP addresses are distributed in a systematic way to organizations and companies

This is what allows geolocation by ip addressess

How all this work together?

Remember two things

- Mac Addresses are used from node to node
- IP Addresses are used by routers to route packets of data
- No replacement (they work together)



JOURNEY

192.168.1.12

192.168.1.13

192.168.1.1 | 10.0.0.1

10.0.0.13

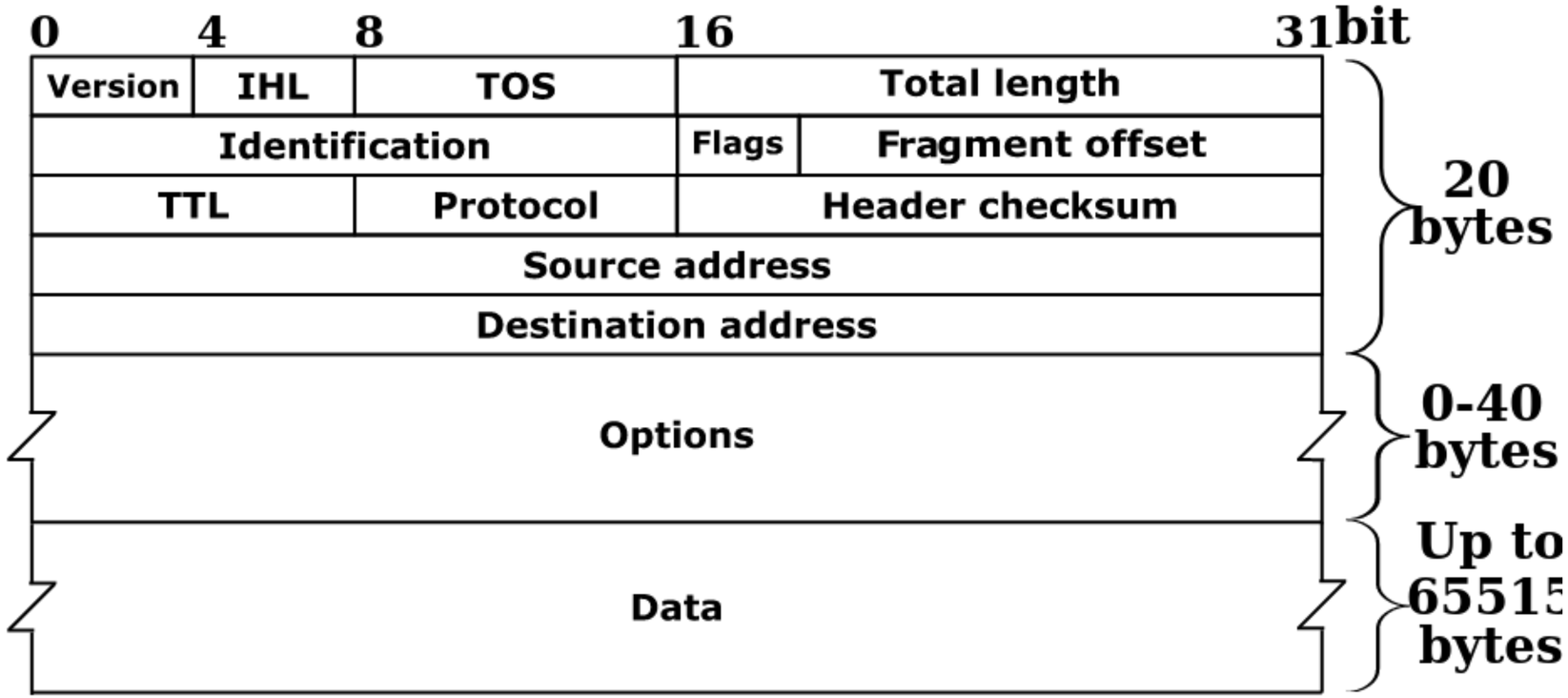
US data

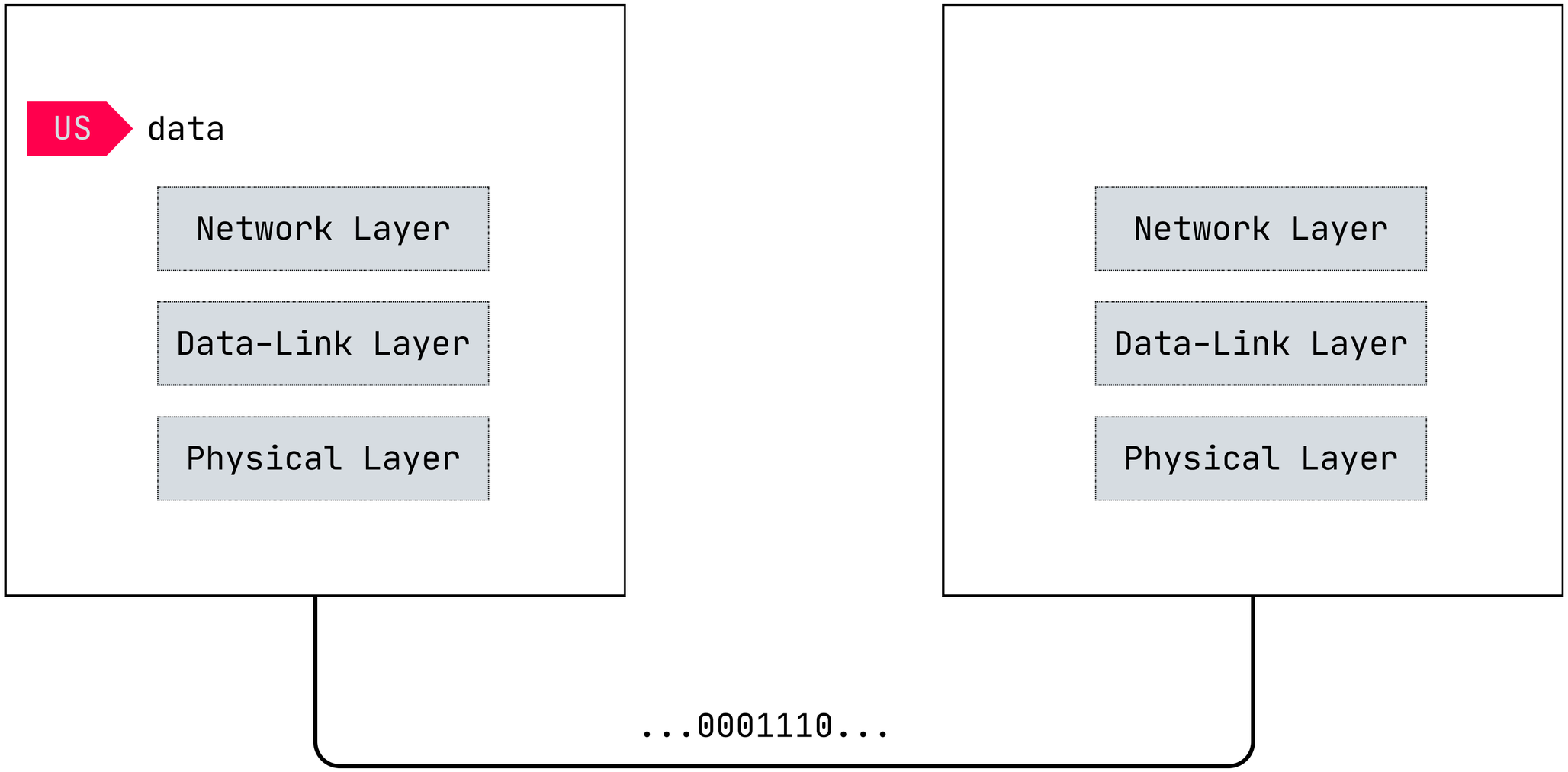
Network Layer — Internet Protocol

Data-Link Layer — Ethernet/WIFI Protocol

Physical Layer

- What is an IP packet?




US
data
Network Layer
Data-Link Layer
Physical Layer
Network Layer
Data-Link Layer
Physical Layer
...0001110...

What did we miss?

- We Got two devices to talk to each other
    - but is that we want?
- It will be fine if programs run just one program
    - But that is not the case! You of course don’t want whats-app messages to be confused with telegram messenger

- Guess What will we do?

we will introduce a new layer to our system

Transport Layer

How will we identify different programs?

- We don’t need a global unique identifier. You can’t actually do that even if you want.
- Identifier unique to a specific device

---

port number

16 bit : 65,535 port available

So mainly the transport data will contain a destination and a source port and the data you want to send and ......

Famous Transport Protocols

- TCP Protocol: Transmission Control Protocol
    - Connection Oriented
    - Reliable Data Transfer

- Connection Oriented

    Not a physical connection. Just keeps track of the other endpoint info and the connection status

    local socket info: IP - port
    remote socket info: IP - port
    Connection status: established - listen - ..

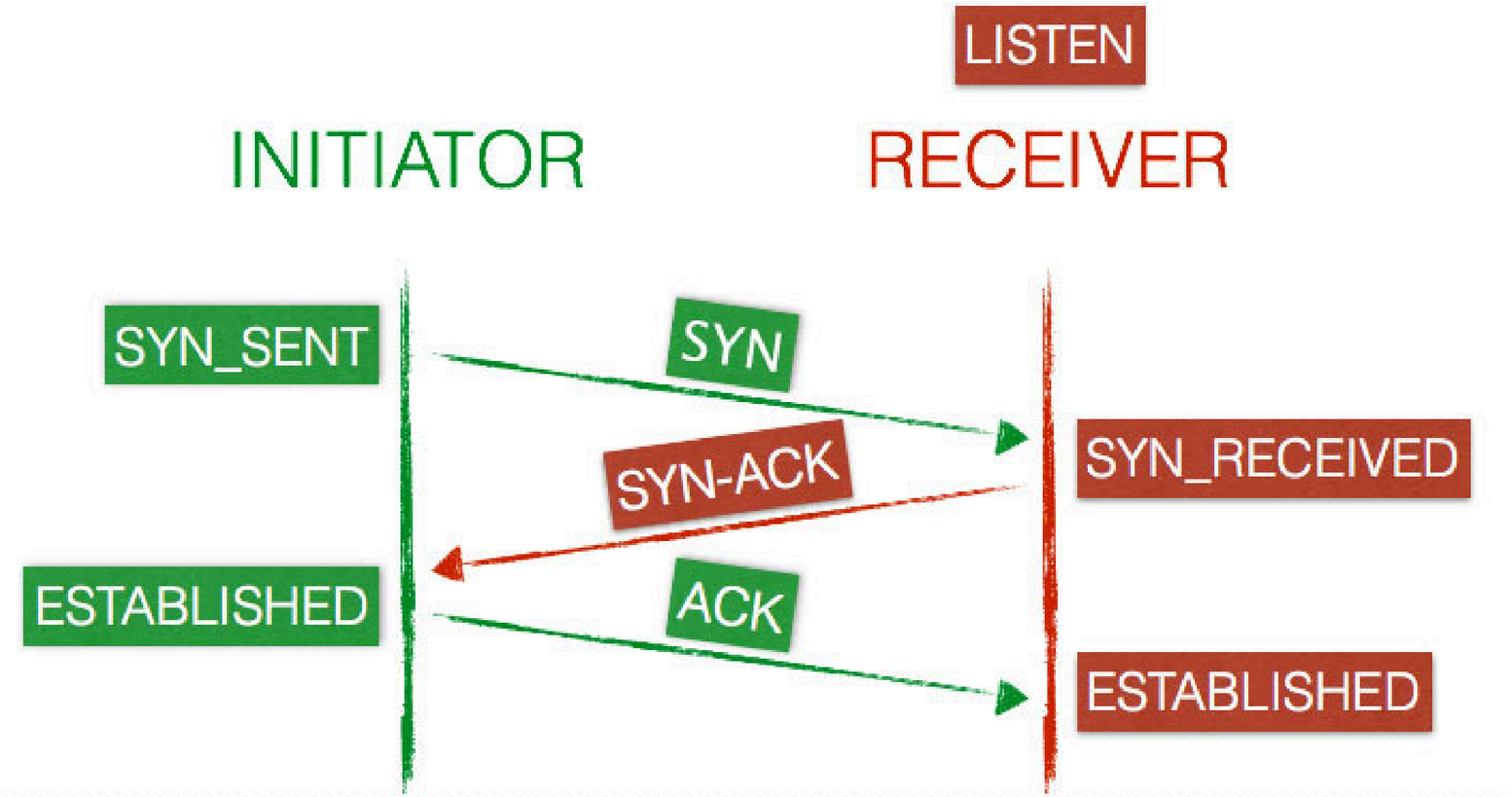
- **Reliable Data Transfer**

    - **What can happen?**
        - Packet lost in the way.
        - Packet corrupted along the way.
        - Out of order

    - **Solution?**
        - Retransmittion
        - Error Checking
        - Sequencing

Isn’t that already done on the data-link layer? think

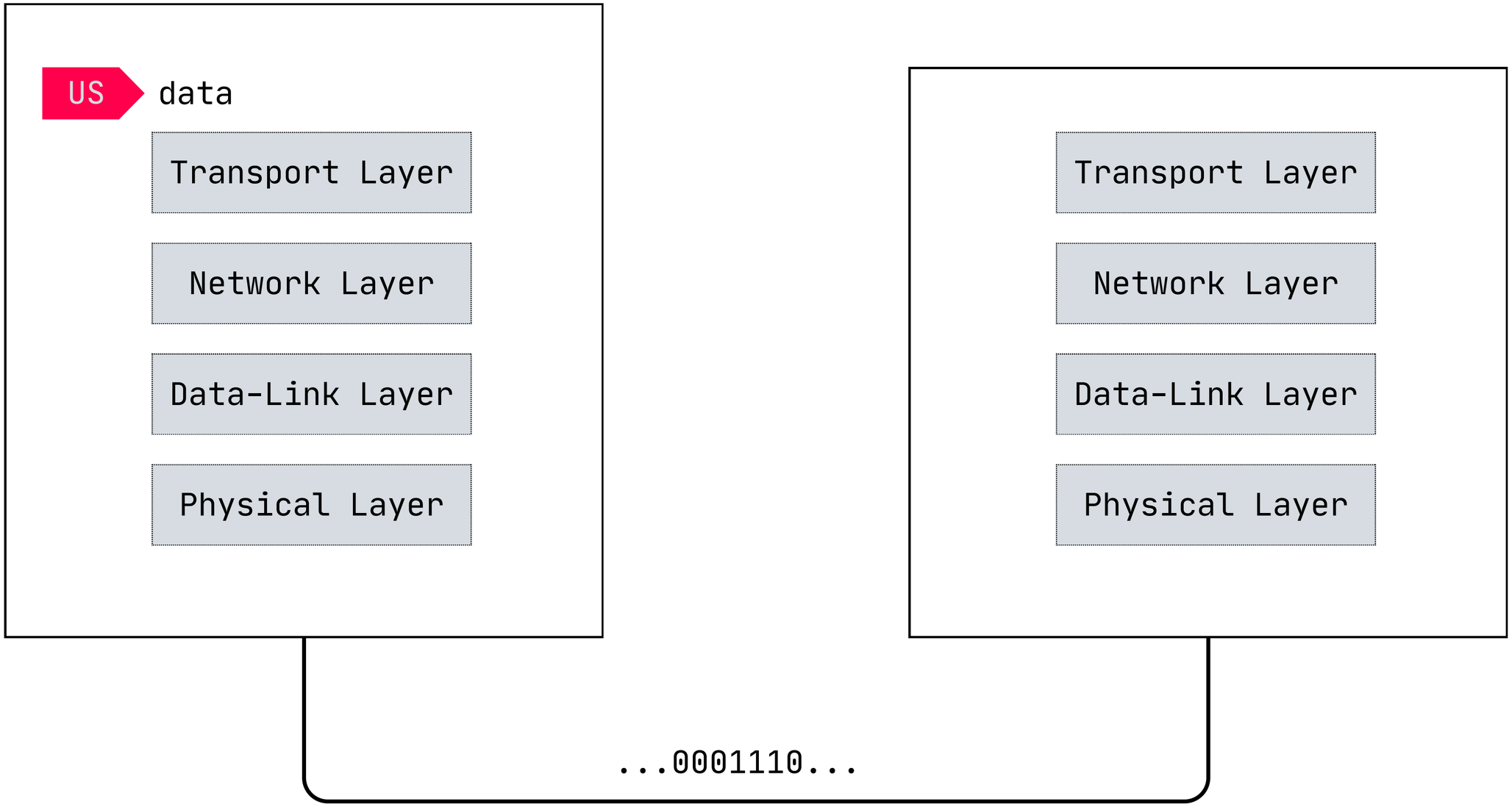
TCP Connection

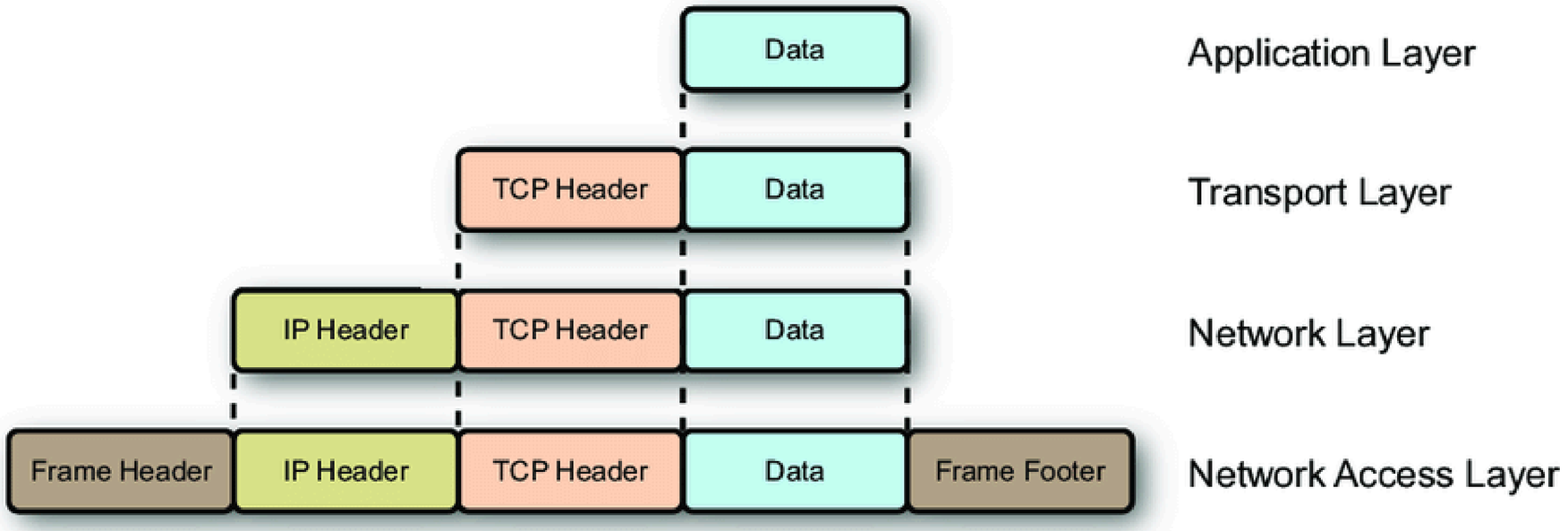


If TCP is that good? why do exist another protocol like UDP?

- UDP Protocol
    - Connectionless
    - No Acknowledgments
    - No Sequencing

WHY THE HELL WOULD WE USE SOMETHING LIKE THAT???

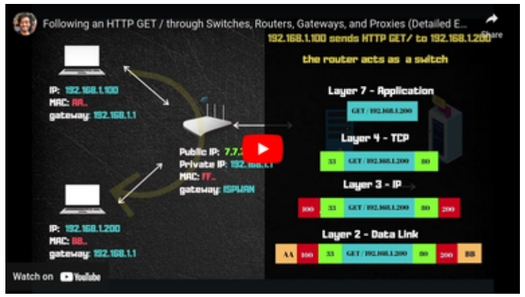

US
data
Transport Layer
Network Layer
Data-Link Layer
Physical Layer
Transport Layer
Network Layer
Data-Link Layer
Physical Layer
...0001110...


Data
Application Layer
TCP Header
Data
Transport Layer
IP Header
TCP Header
Data
Network Layer
Frame Header
IP Header
TCP Header
Data
Frame Footer
Network Access Layer

Resources

https://youtu.be/7IS7gigunyI?si=mDWBNzAKHjXdhqvx

https://youtu.be/qqRYkcta6IE?si=YbXMCOic7EG4ItuN

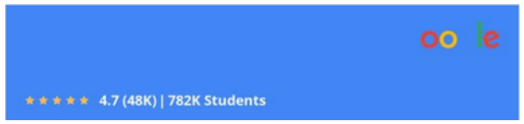


practical example

https://youtu.be/98B6P_QAh68?si=o8lyHITDa5Q7q1cY

complete course

https://youtube.com/playlist?list=PLIhvC56v63IJVXv0GJcl9vO5Z6znCVb1P&si=i2EEFE6aICDZJJqC



complete course

https://www.coursera.org/learn/computer-networking