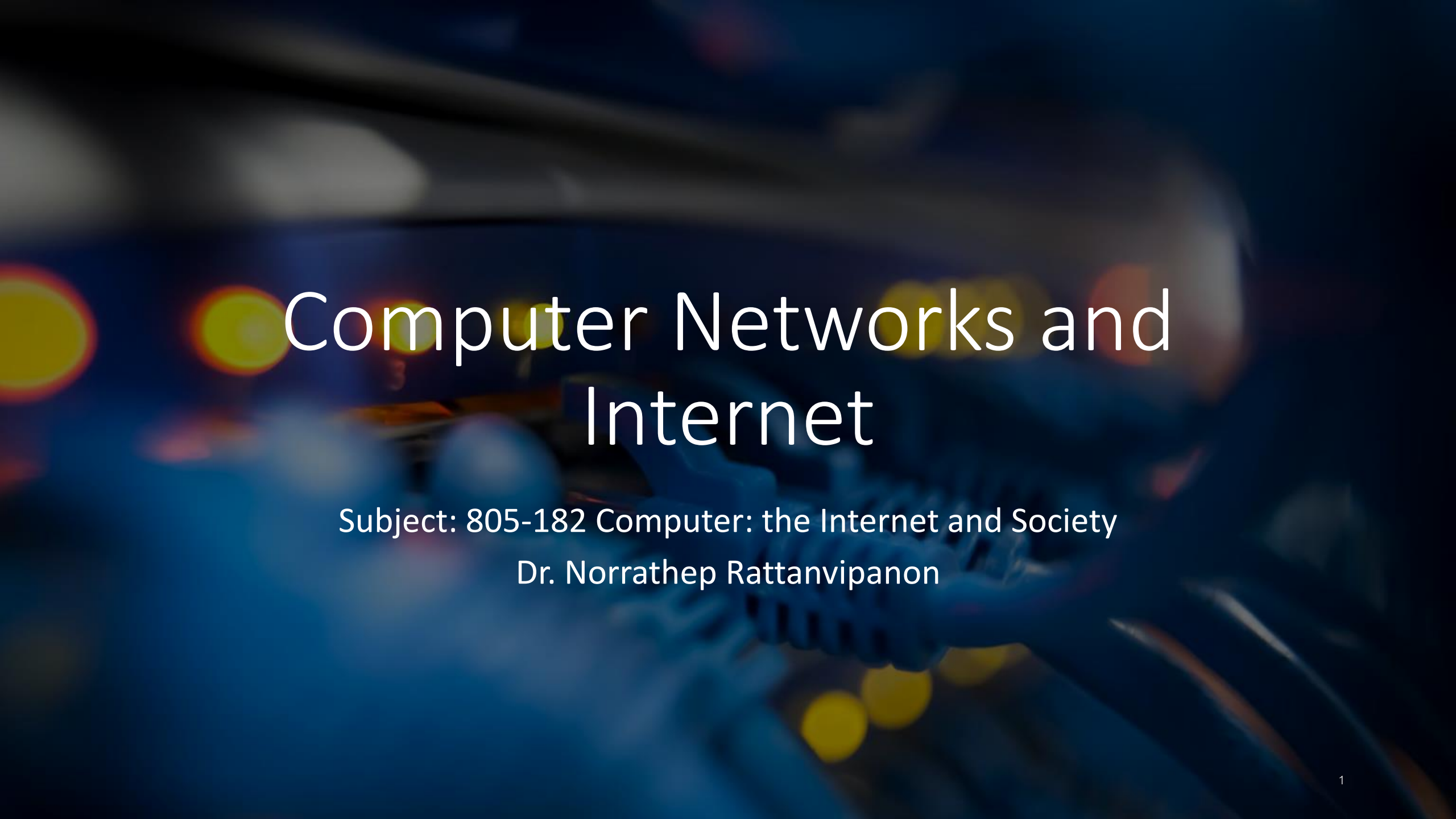


Computer Networks and Internet

Subject: 805-182 Computer: the Internet and Society

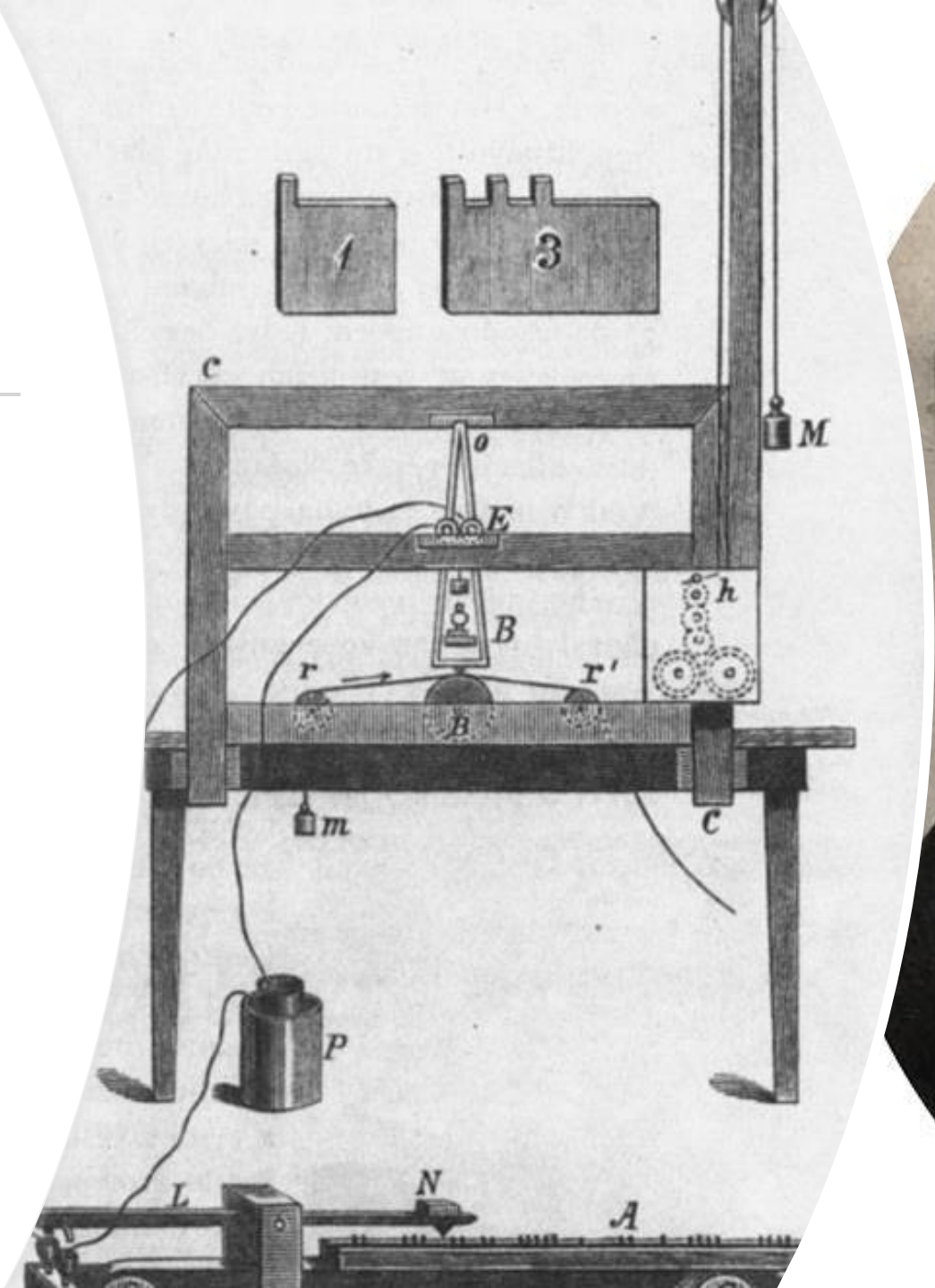
Dr. Norrathep Rattanvipanon

Question

What is the first technology for long-distance communication?

Telegram

The **first** telegram in the United States was sent by *Samuel Morse* on 11 January 1838, across two miles of wire at Speedwell Ironworks near Morristown, New Jersey.

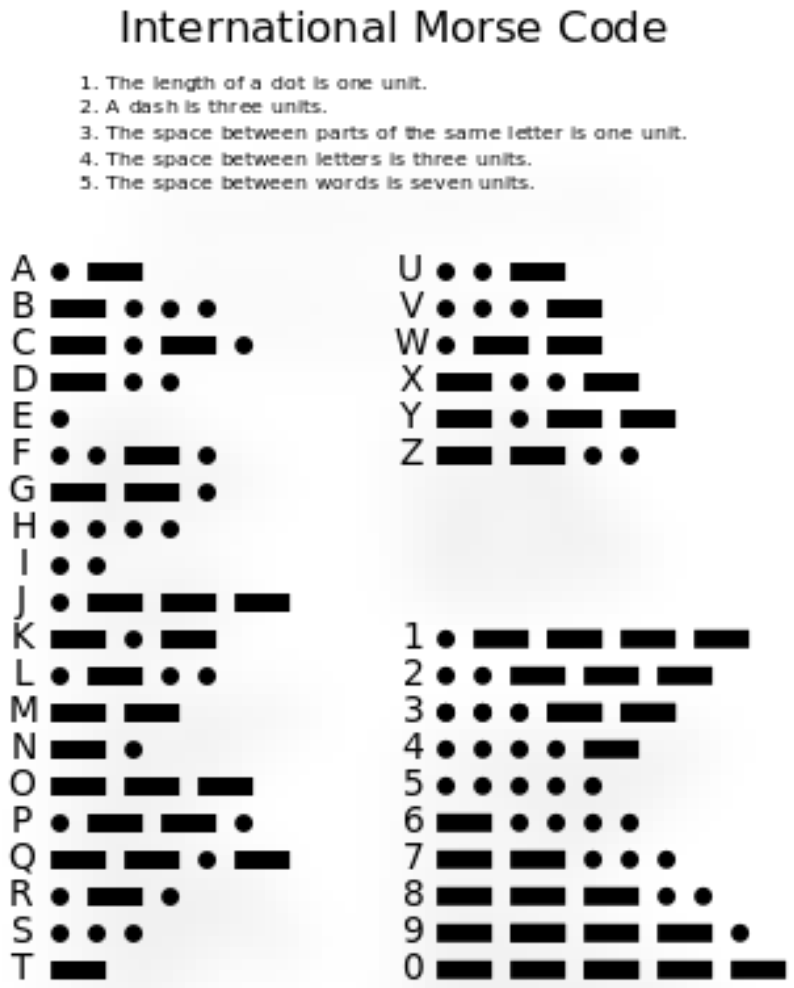


Did you know:

- Design of each alphabet in Morse code is based on how often it is used, e.g., E = 1 dot, I = 2 dots, etc.

- SOS, the internationally recognized distress signal, does not stand for any particular words. Instead, the letters were chosen because they are easy to transmit in Morse code: "S" is three dots, and "O" is three dashes.

https://www.history.com/topics/inventions/telegraph



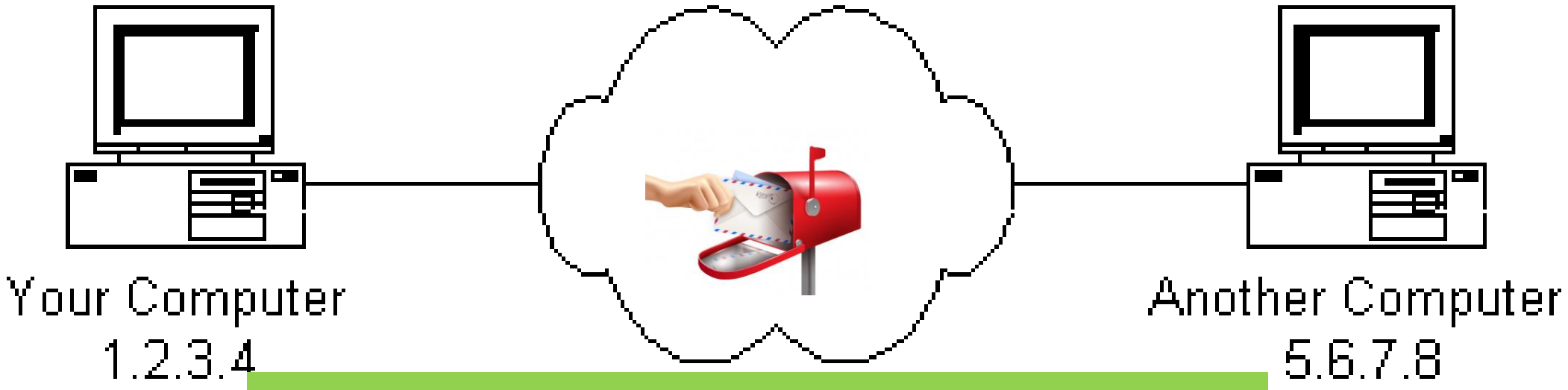
Communication Technology

- Local Area Network (LAN)
- Wi-Fi
- Cellular Network
- Bluetooth
- NFC
- Internet
- Etc.

What is a computer network?

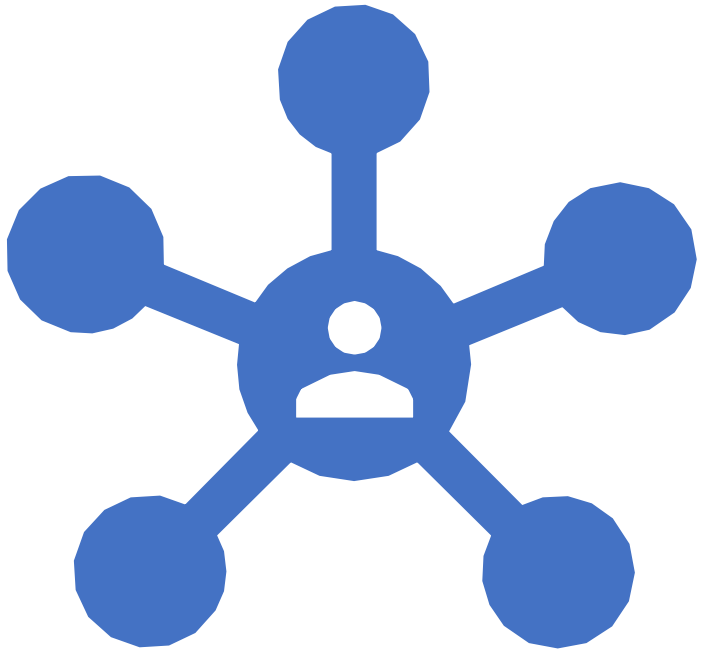
- A group of computers
- Communication medium/link
- Communication protocol

(Simplified) Internet



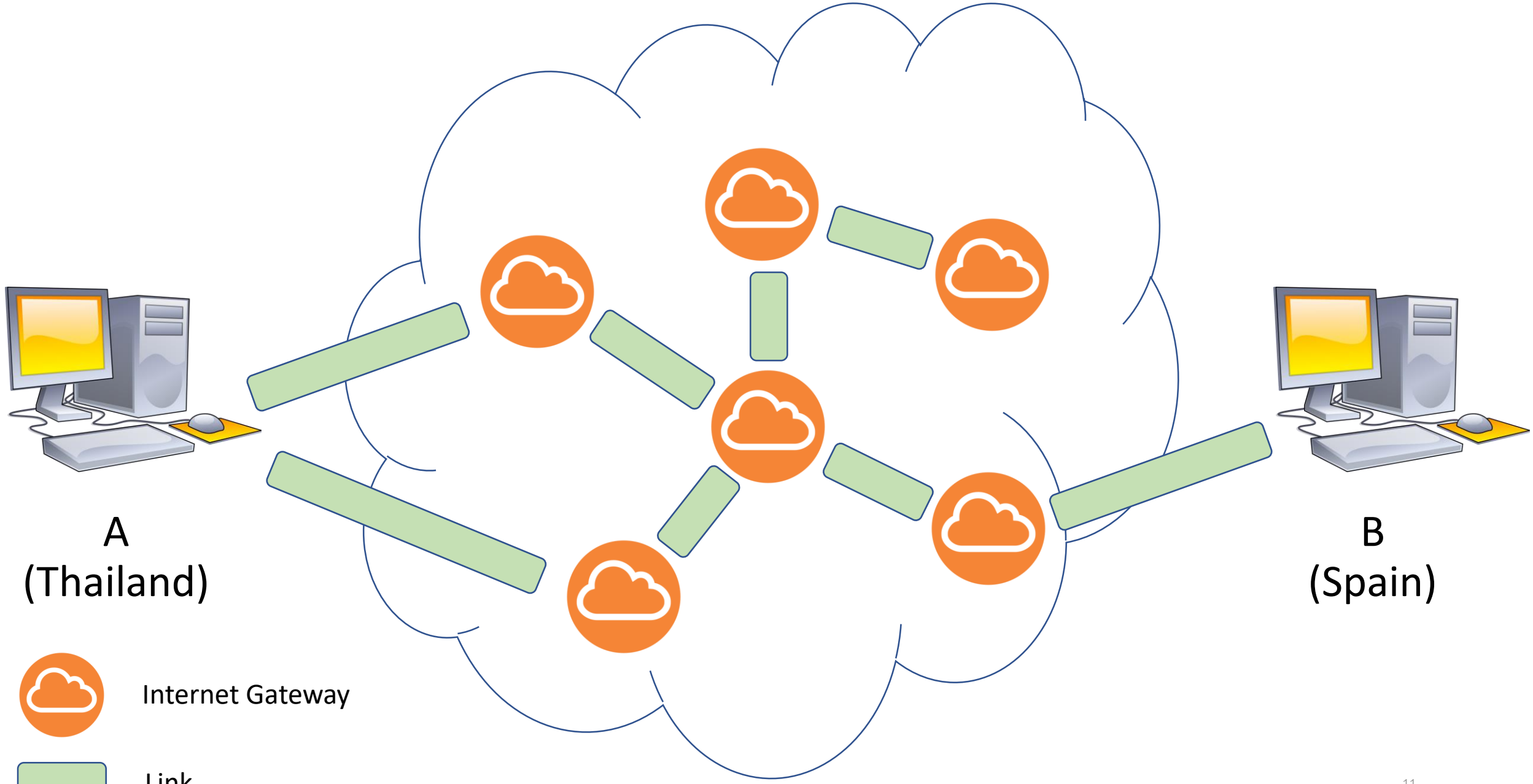
Imagine: sending a message in the internet
≈ sending a postcard/letter/package

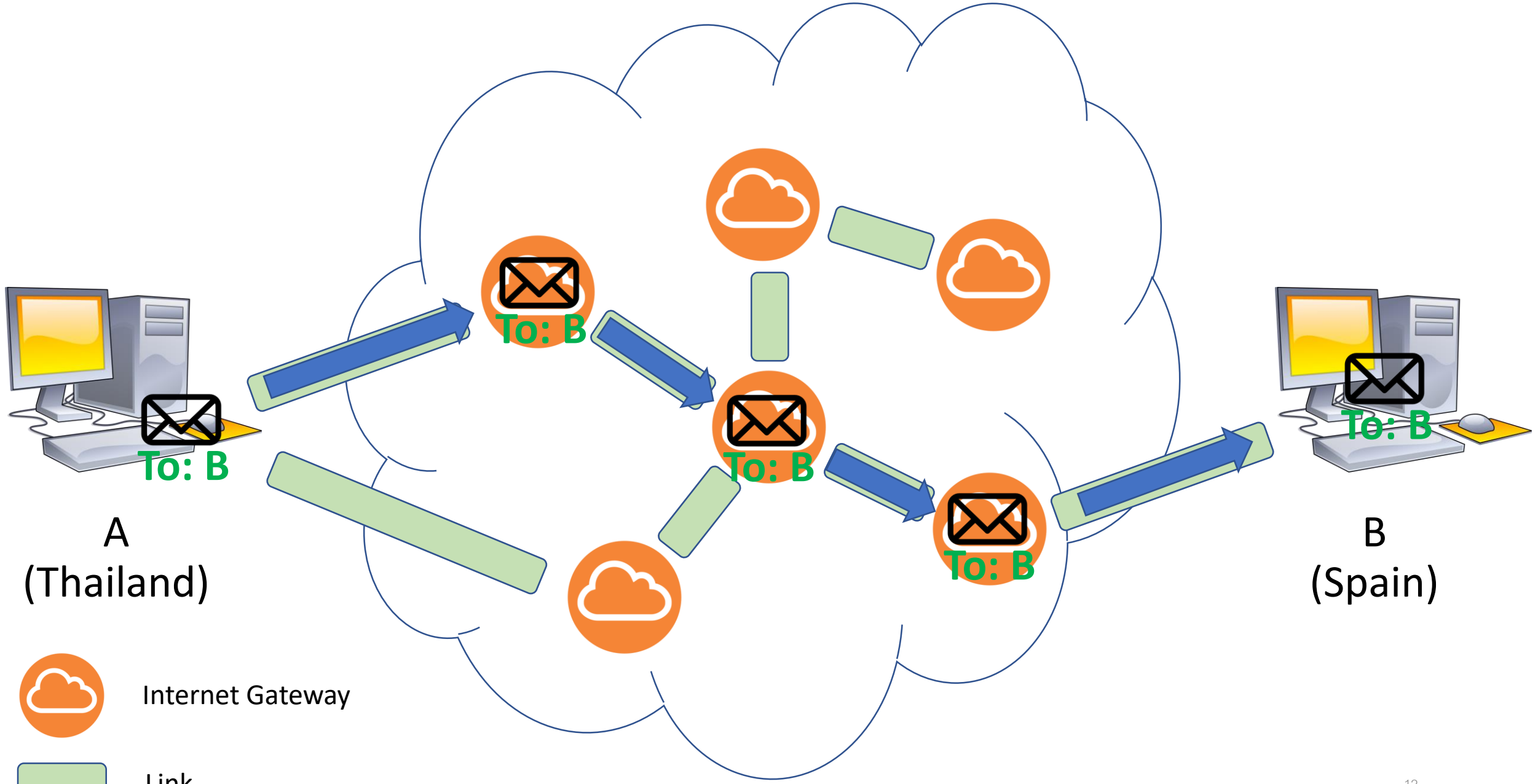
Webpage
A
(Thailand)
B
(Spain)

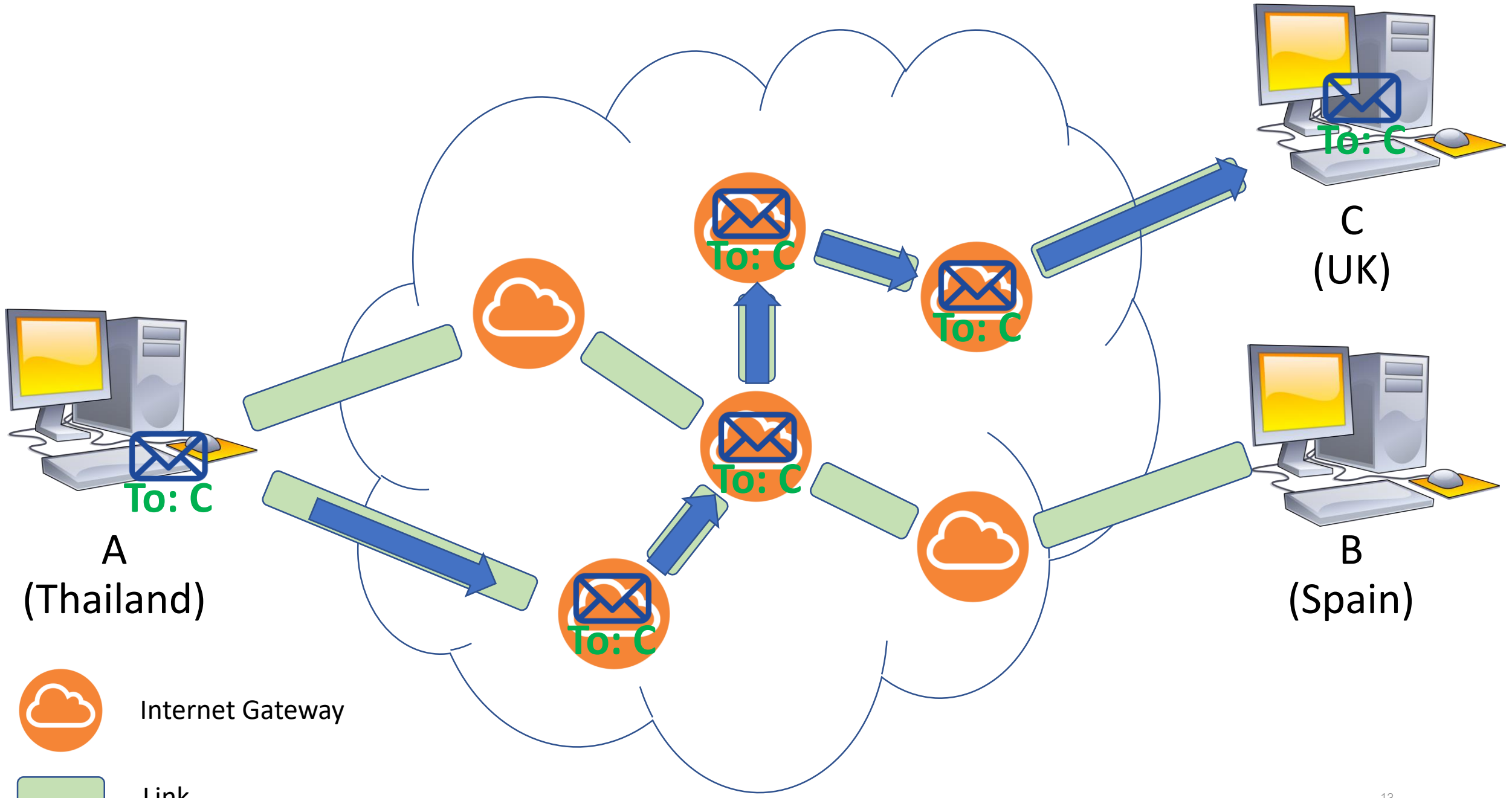


Internet is also a computer network

- A group of computers
- Communication medium/link
- Communication protocol

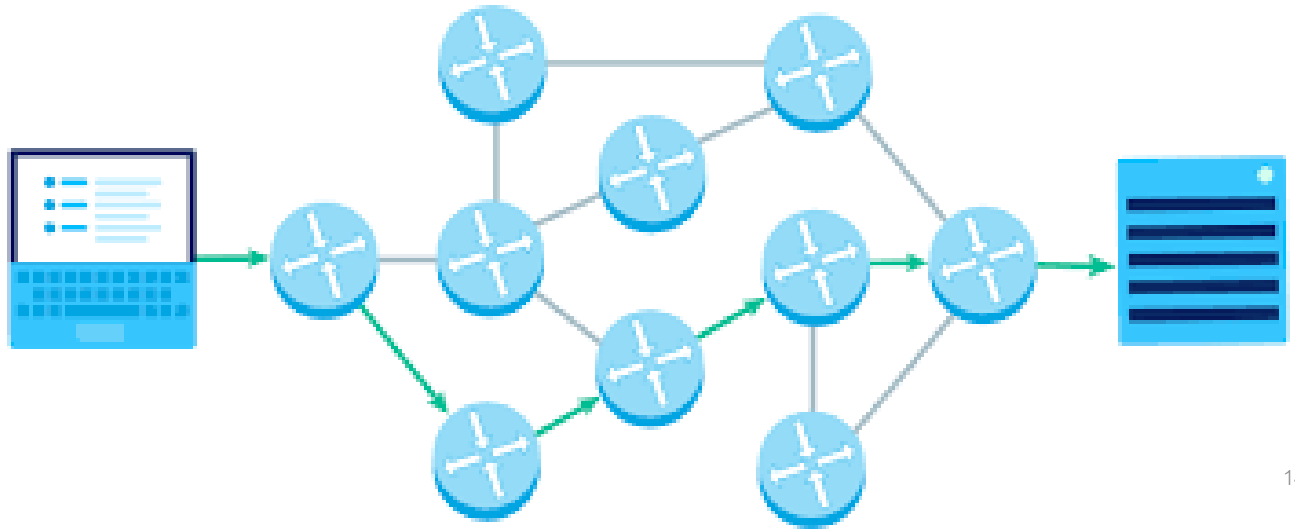

A
(Thailand)
B
(Spain)
Internet Gateway
Link


To: B
To: B
To: B
To: B
To: B
A
(Thailand)
B
(Spain)
Internet Gateway
Link


To: C
To: C
To: C
To: C
To: C
To: C
A
(Thailand)
C
(UK)
B
(Spain)
Internet Gateway
Link

Internet Routing

- How to select a forwarding path?
- Routing: process of determining a route from source to destination
- For each gateway, determine the next gateway based on information in *routing table*
  - Mostly based on distance to destination
  - But could use other policies, such as message's size.



IP address

- An identity of each device in the Internet
- IPv4: In the form of xxx.xxx.xxx.xxx, where xxx is at most 255, e.g., 127.190.23.55, 1.1.1.1 or 255.255.255.255
- Think of IP address as your student ID or national ID

123.456.789.12

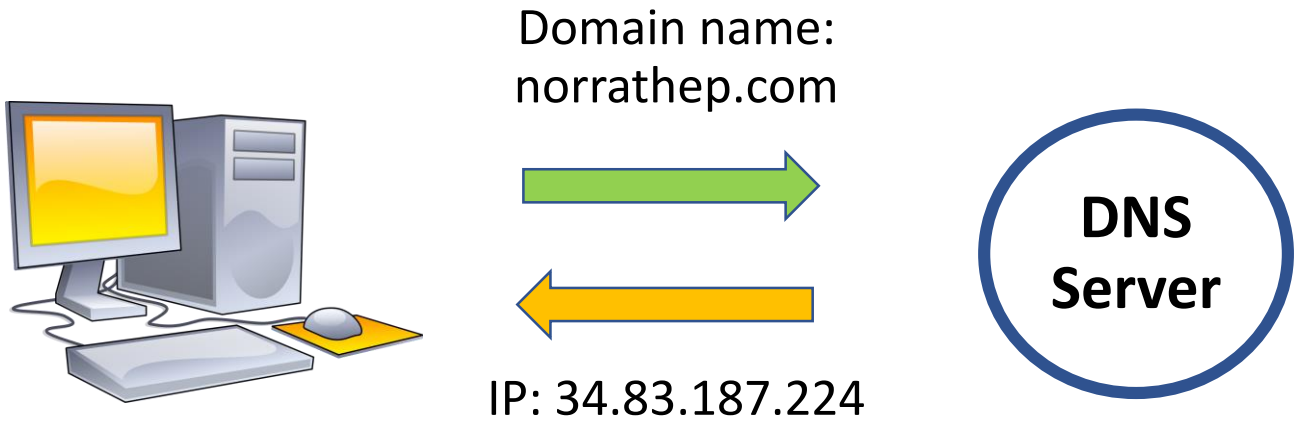
Task (15-minute): Answer the following questions?

How to check your computer's (public) IP address?

What website has this IP address: 34.83.187.224?

Domain Name System (DNS)

- Domain name: (rough definition) website name
  - Why do we need domain names? Aren't IP addresses good enough?
- DNS: A system that manages all domain names on the Internet
- Main component of DNS: DNS (name) server
  - "Resolve" (or translate) a domain name to the corresponding IP address



34.83.187.224

DNS Server

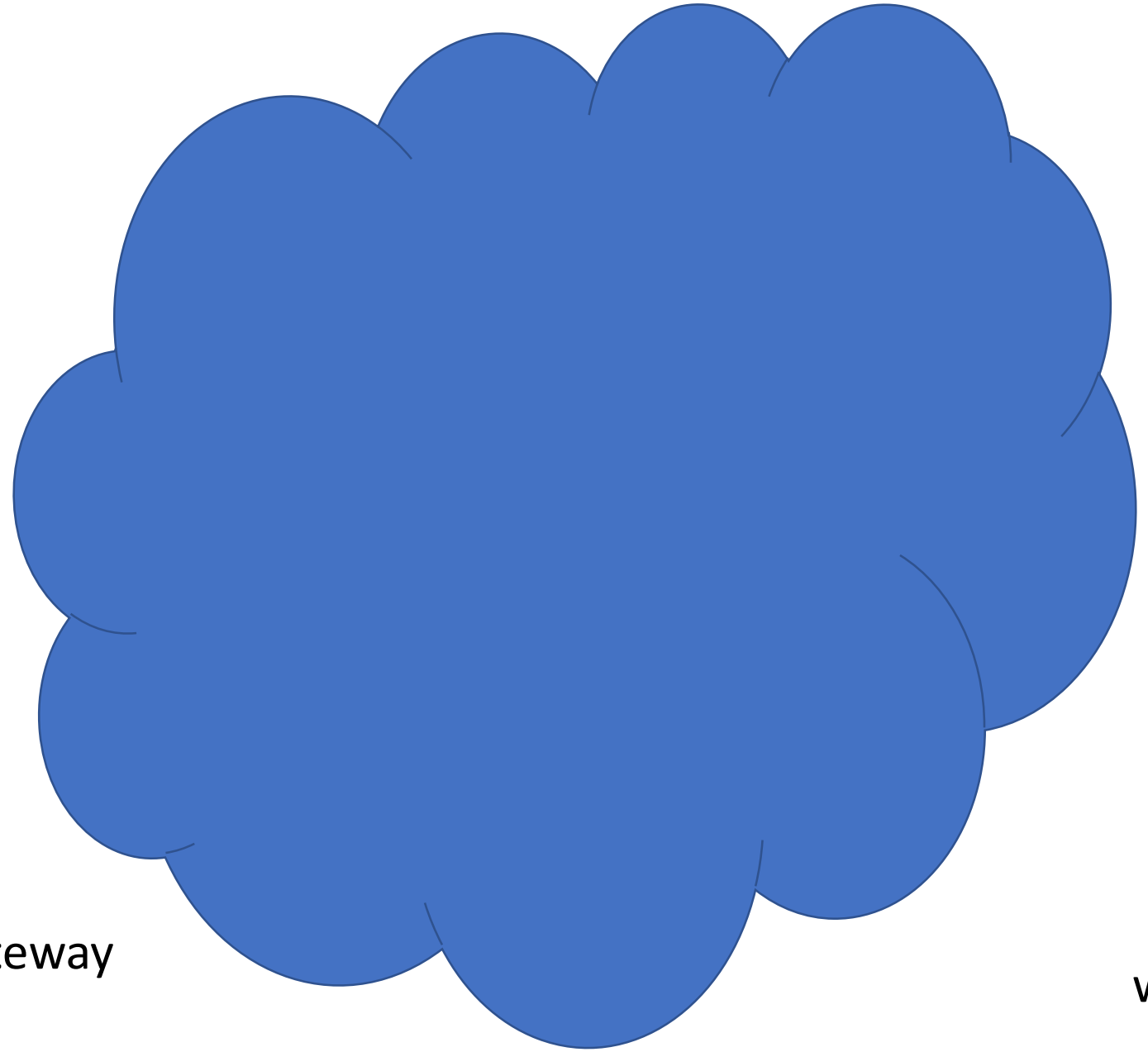
8.8.8.8

To: 8.8.8.8
What is IP address for www.norrathep.com?

128.23.52.6

34.83.187.224
www.norrathep.com

Internet Gateway



DNS Server

8.8.8.8

34.83.187.224

128.23.52.6

34.83.187.224
www.norrathep.com

Internet Gateway

Task (15-minute): Search for an online tool to answer questions

What is the most expensive domain name in the world?

What is a domain name for IP Address: 202.29.148.104?

What is an IP address for a domain name: www.baidu.com?

Hint: search for “DNS Lookup”

Recap: for you to access www.baidu.com

Your computer does the following in background:

1. Use internet routing to find a route from your computer to DNS server
2. Talk to DNS server via route from 1. to convert baidu.com domain name to public IP address
3. Use internet routing to find a route from your computer to Baidu's IP address
4. Send a request message via route from 3. to baidu's IP address asking to access its webpage
5. Baidu server sends webpage contents back to your computer

FAQ: Final Project & Proposal

- Team project
- Theme of the final project: **Impact of a specific technology on society**
- 4 Phases of Final Project:
    1. Proposal – Due July 10 (at most 1 page)
    2. Progress Report – Due Sept 7 (at most 1 page)
    3. Final Report – Due at the end of the semester (at most 10 pages)
    4. Final Presentation – Last week of the course (15-min presentation)
- Proposal MUST contain:
    1. Topic of your final project
    2. Plan on how to complete the project
    3. Estimated timeline for completing the project

Examples of Project Topics

- IoT in Industries
- AI and Gaming
- Future Internet Architectures
- Privacy Issues in Data-Centric Era
- Are We Ready for Online Education?
- Reality Check for Blockchain
- Etc.

My Suggestion For Proposal

The idea is to ensure that you can write the final report of your proposed topic in 10 pages. So, topic should not be too broad or too narrow.

1. Pick a technology your team is interested in, e.g, Internet-of-Things
2. Narrow down the scope of “society”, e.g., industries, business, gaming, government
3. Then, you have a good topic: Internet-of-Things in Industries

Don’t forget to write down names of all team members in Proposal ☺

Questions about Final Project & Proposal?

Homework: Communication Technology (5-minute, at most 10-minute)

Topic:

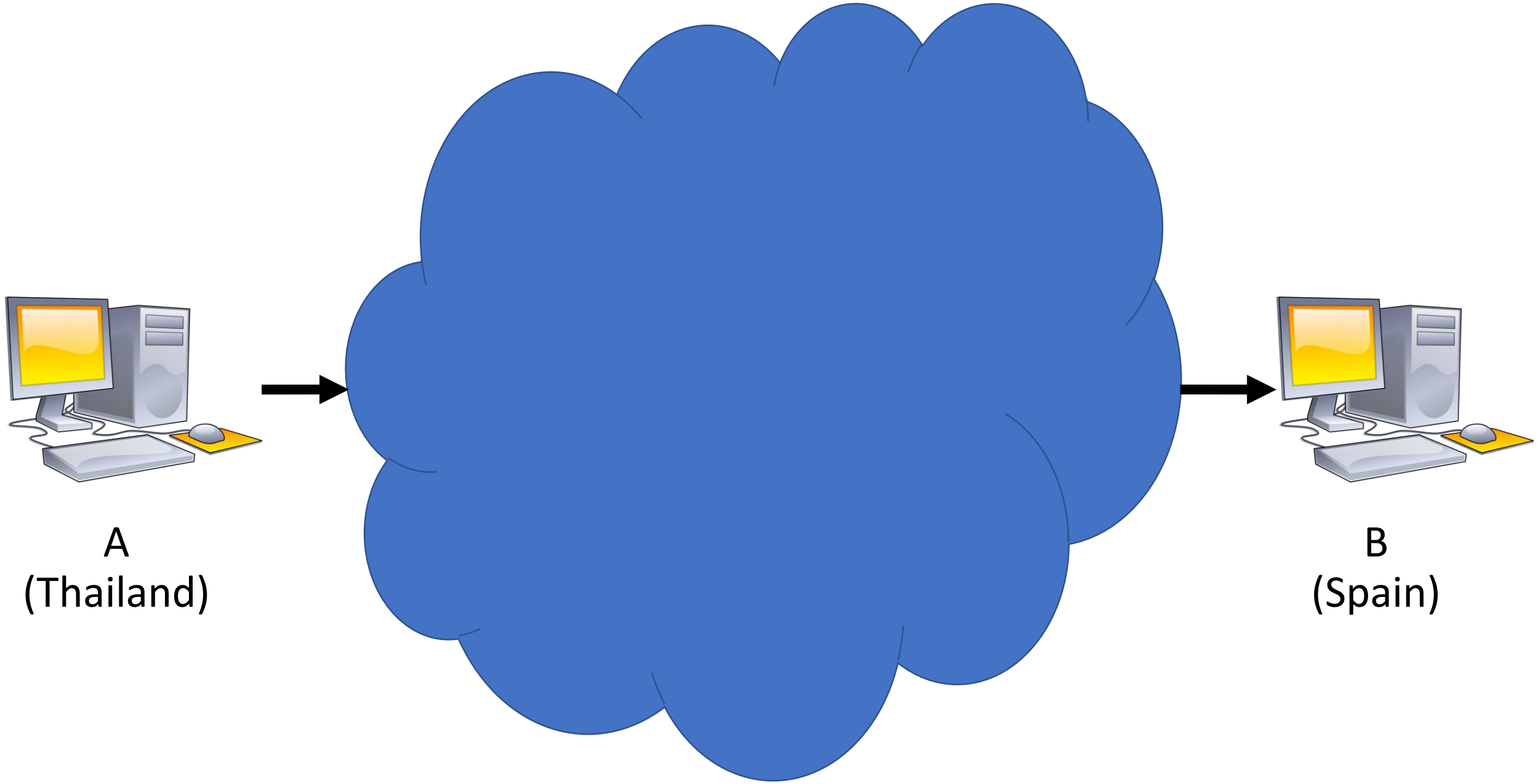
- Local Area Network (LAN)
- Wide Area Network (WAN)
- Metropolitan Area Network (MAN)
- 3G
- 4G
- 5G
- Near-Field Communication (NFC)
- Bluetooth

Find Answer:

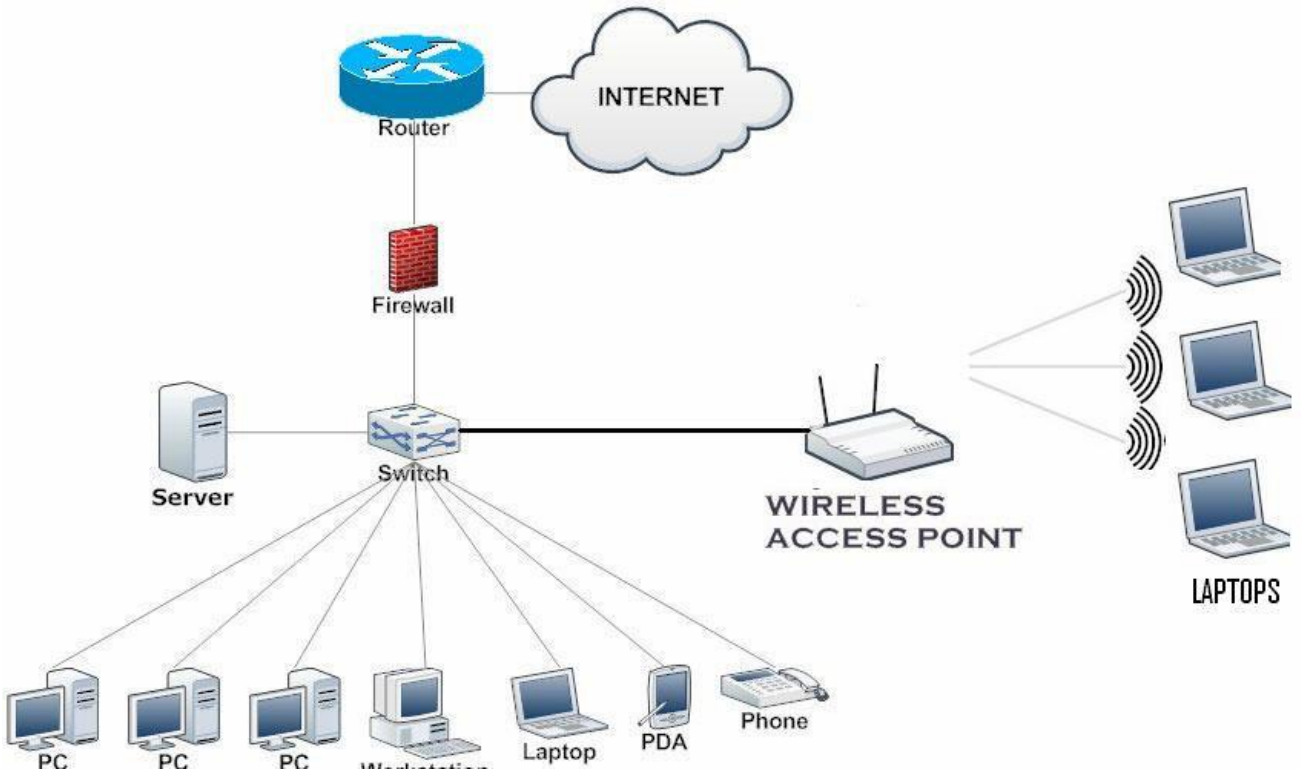
- Give a short description of this technology. (25%)
- What are the main features of such technology? (25%)
- What kind of devices (e.g., laptops/PC, smartphones, etc) can use this technology? (25%) (If your team has 4 members, you can ignore this question.)
- Pick one other communication technology. Compare and contrast them. (25%)

Team Selection

- HopeStar: Local Area Network (LAN)
- Return of the King: Wide Area Network (WAN)
- Boom: Metropolitan Area Network (MAN)
- ABC: 3G
- ZBC: 4G
- Flowers: 5G
- Storm: Bluetooth
- InformationAge: Near-Field Communication (NFC)


A
(Thailand)
B
(Spain)

Internet in reality



- Your device does not connect to the Internet directly
- Usually connect via a router
- Then connect to ISP (Internet Service Provider)

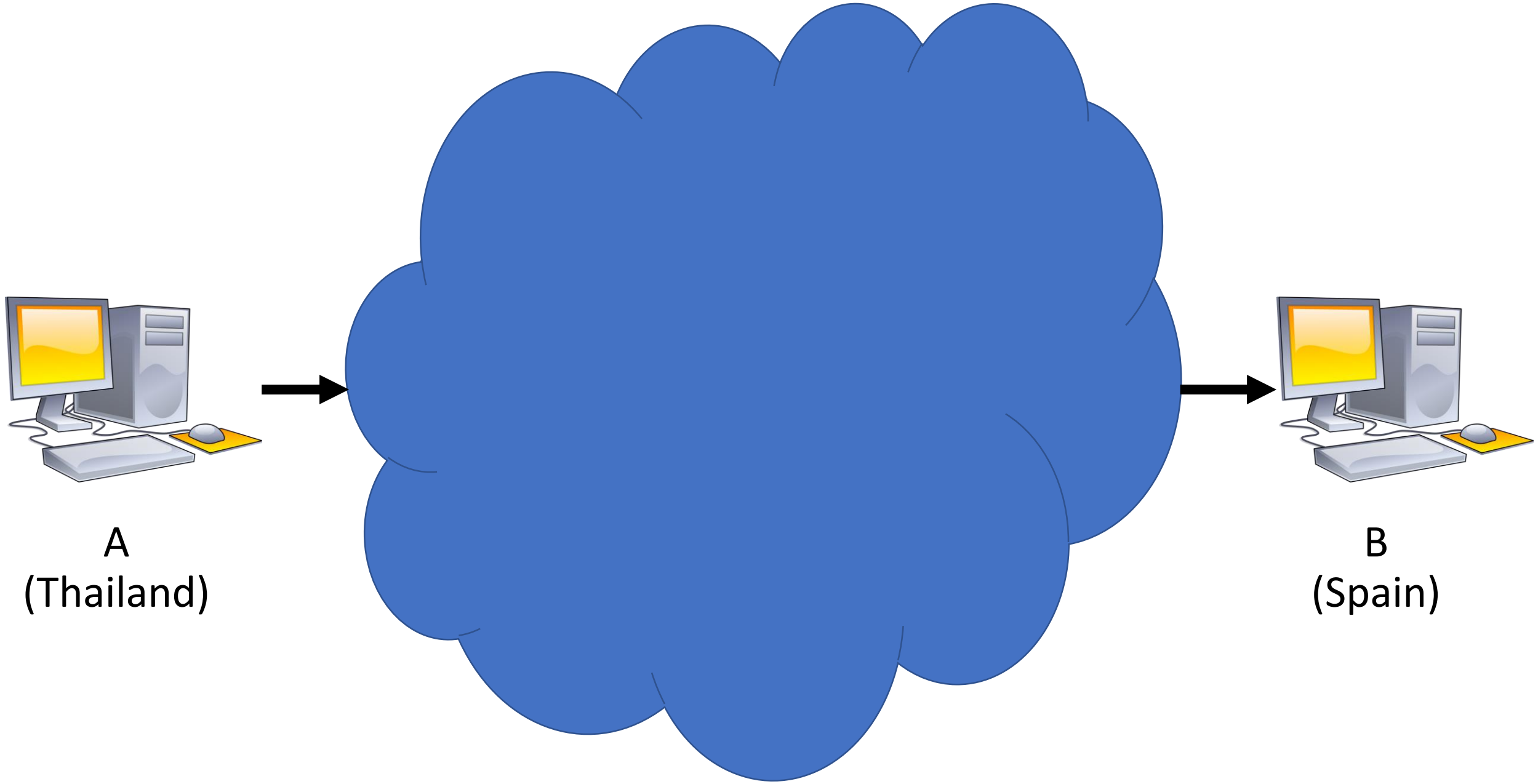
What are some examples of ISP (Internet Service Provider)?

In China

- China Unicom
- China Mobile
- China Telecom

In Thailand

- DTAC
- True
- TOT
- CAT Telecom


A
(Thailand)
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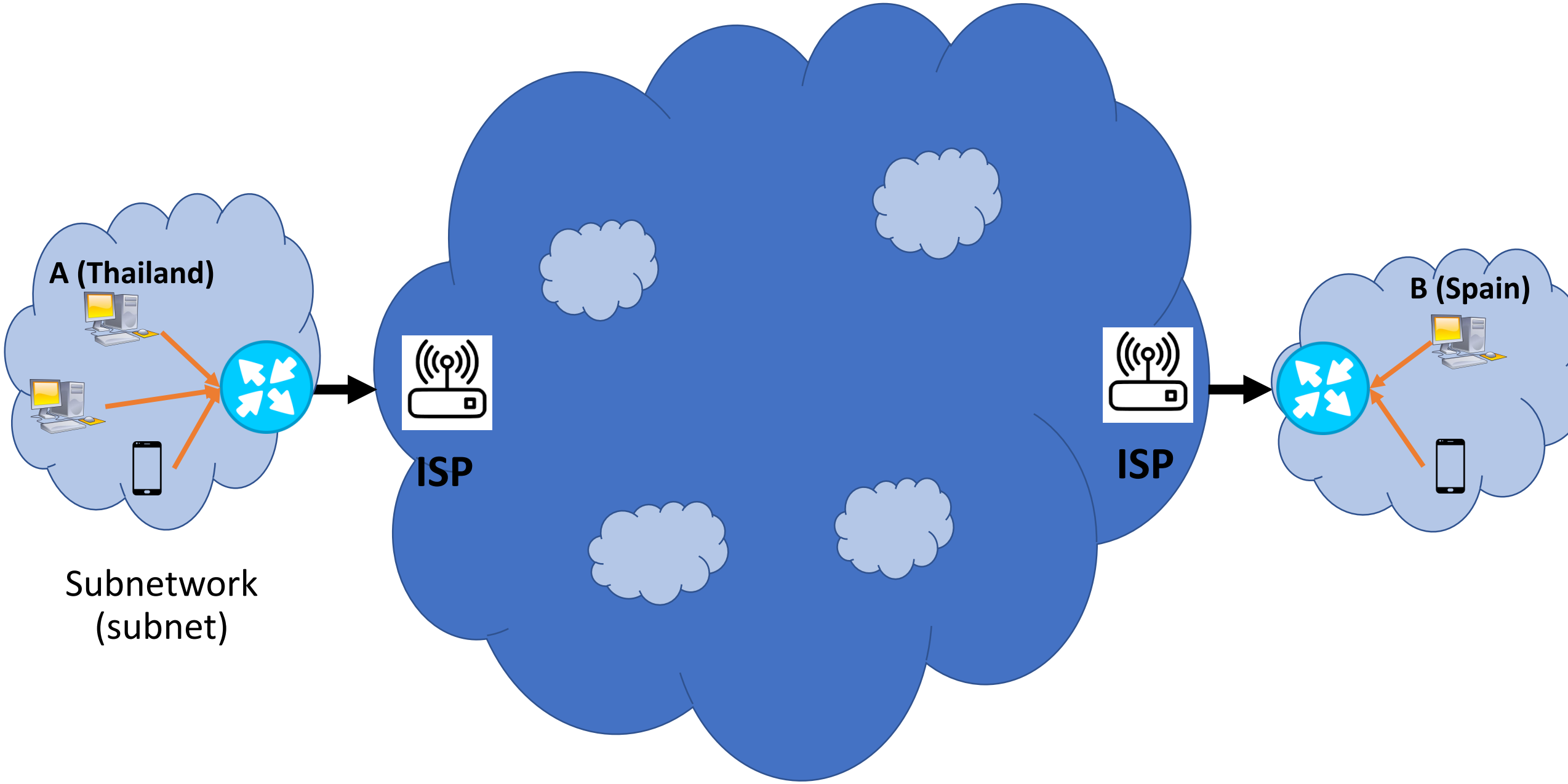
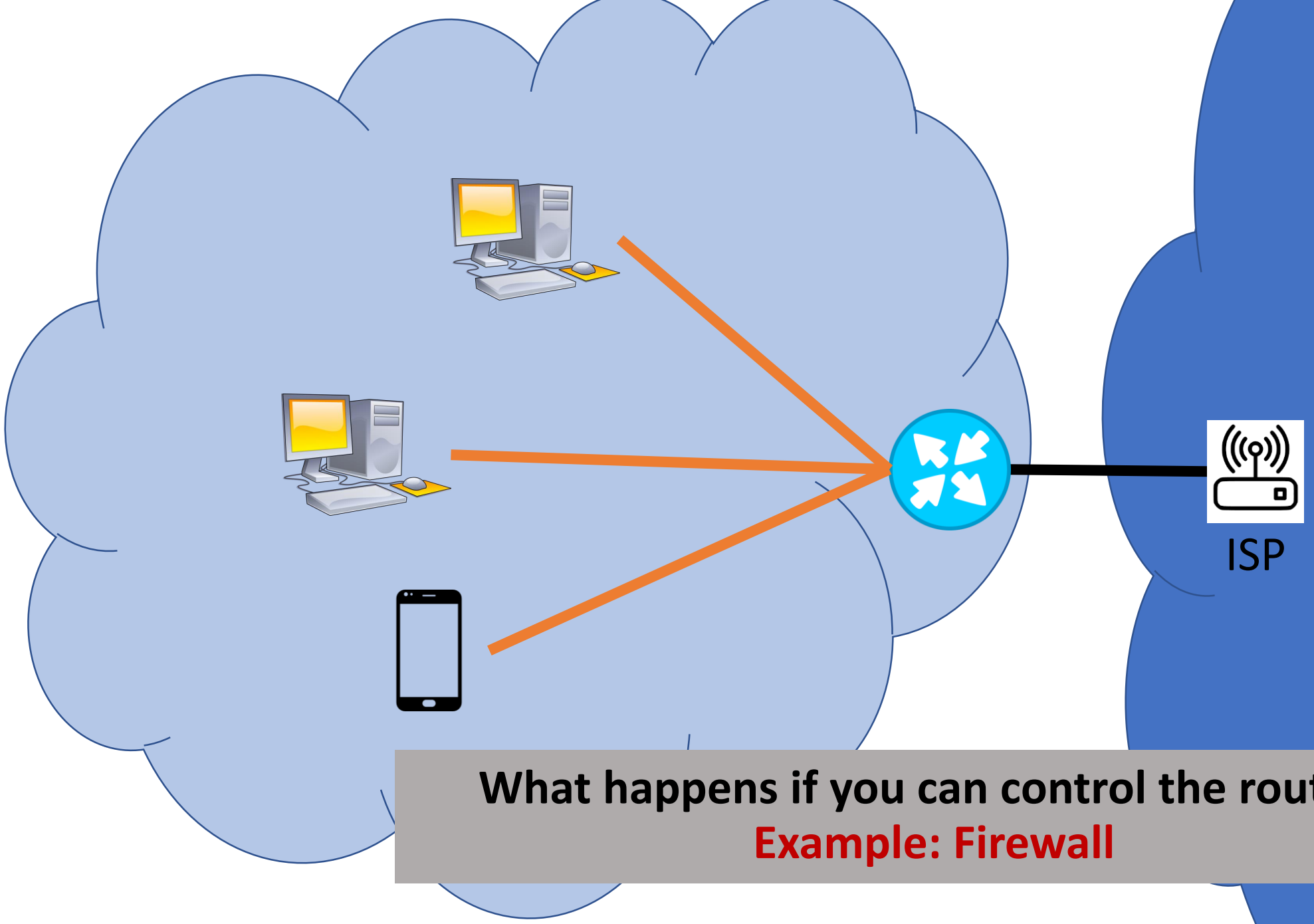
(Spain)


A (Thailand)
ISP
ISP
B (Spain)
Subnetwork
(subnet)

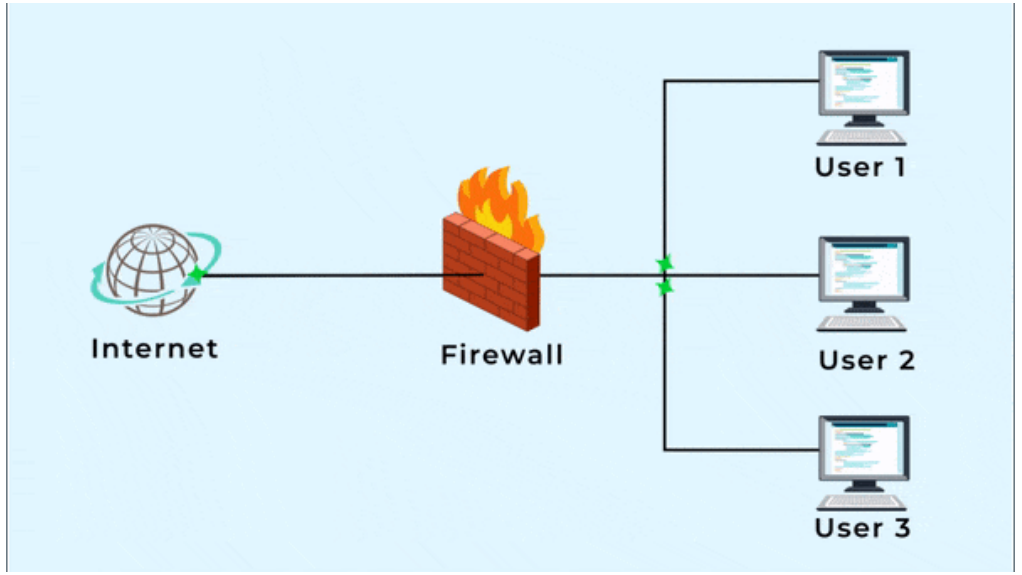


What happens if you can control the router?

Example: Firewall

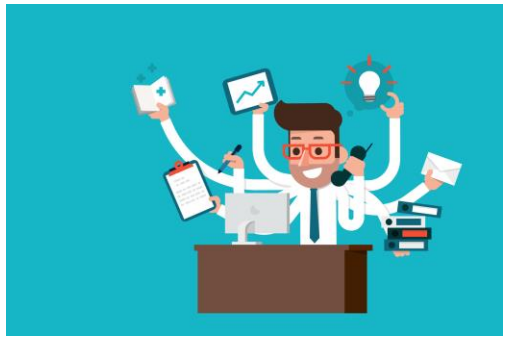
Firewall

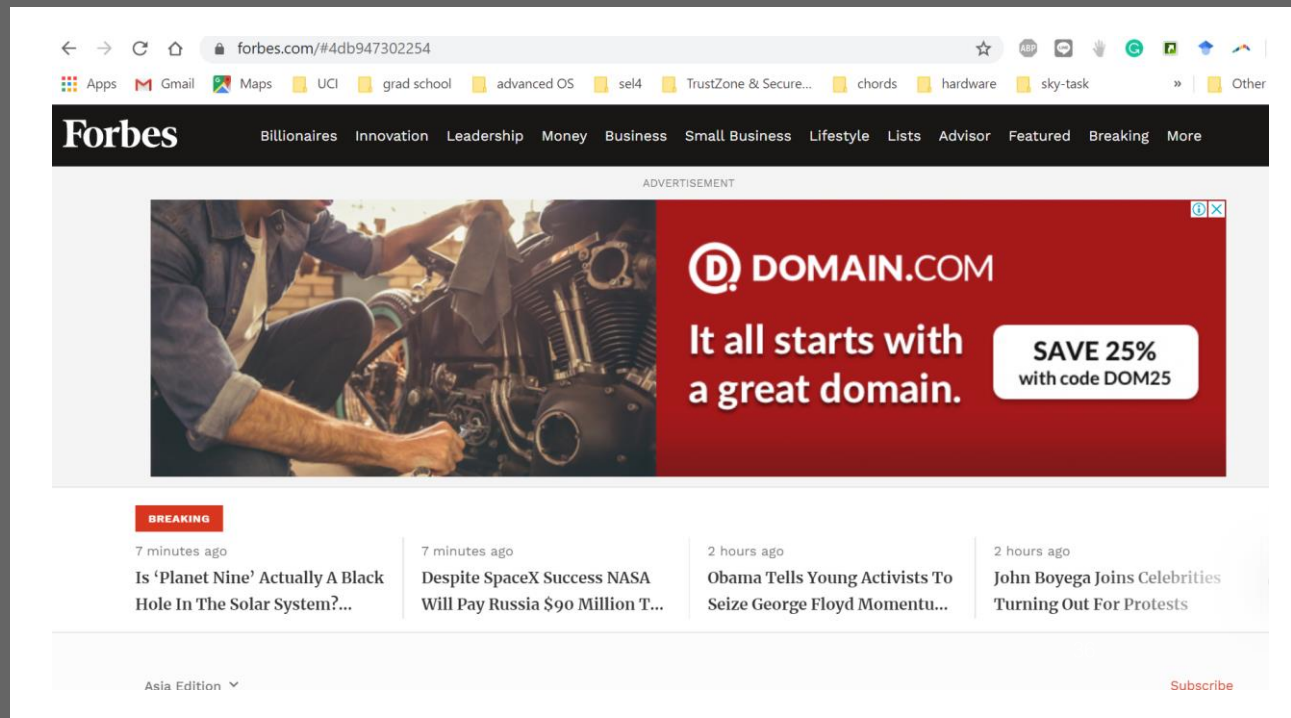
- Routers usually contains firewall software
- Monitor incoming and outgoing messages (traffic)
- Firewall can drop messages based on user-defined policies
- Examples: drop all outgoing messages whose destination is www.facebook.com



Why dropping messages?

- Prevent attacks
- Children protection
- Block ads
- Prevent outsider to access internal resources
- Block social media websites
- Etc.





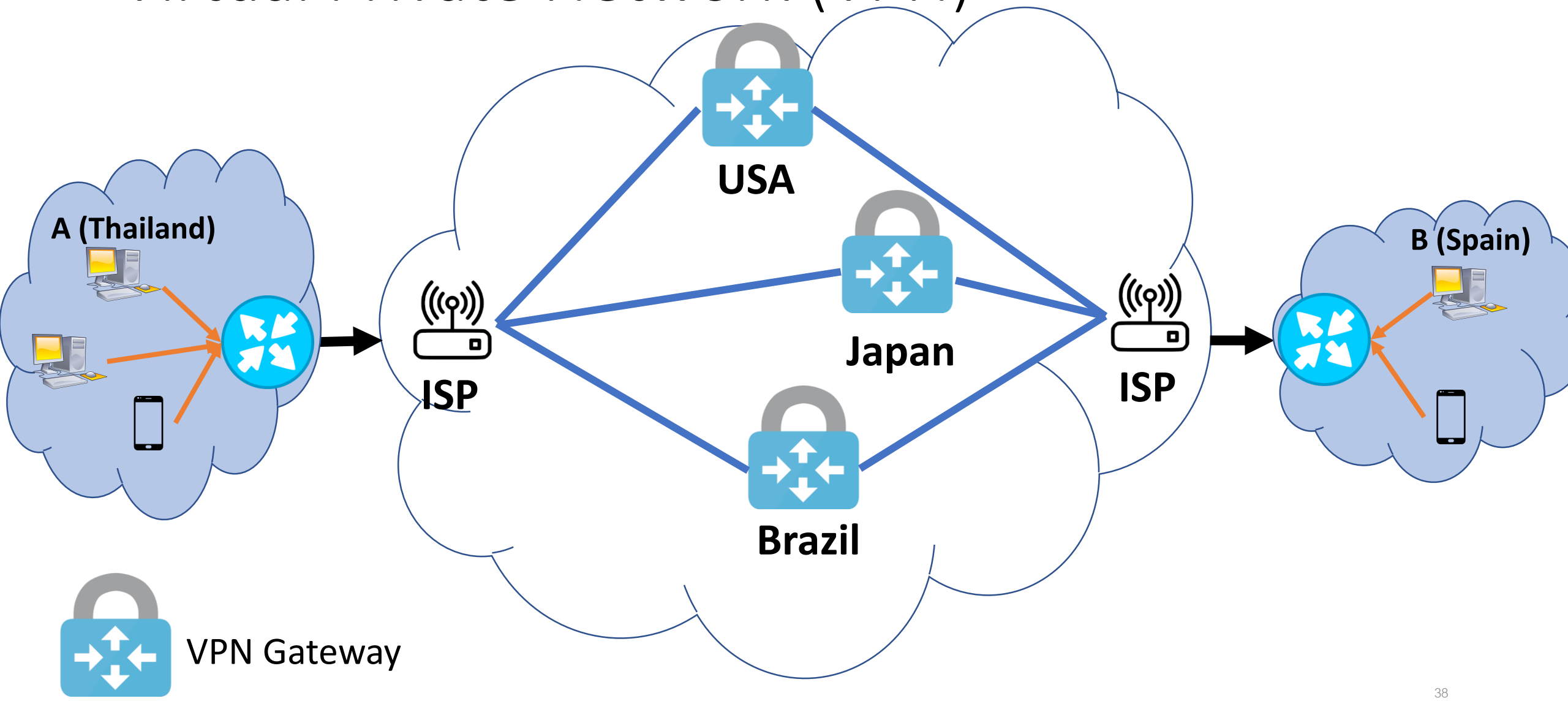
What if you cannot control the router?

Is there any way to avoid the router (or ISP) from dropping your messages?

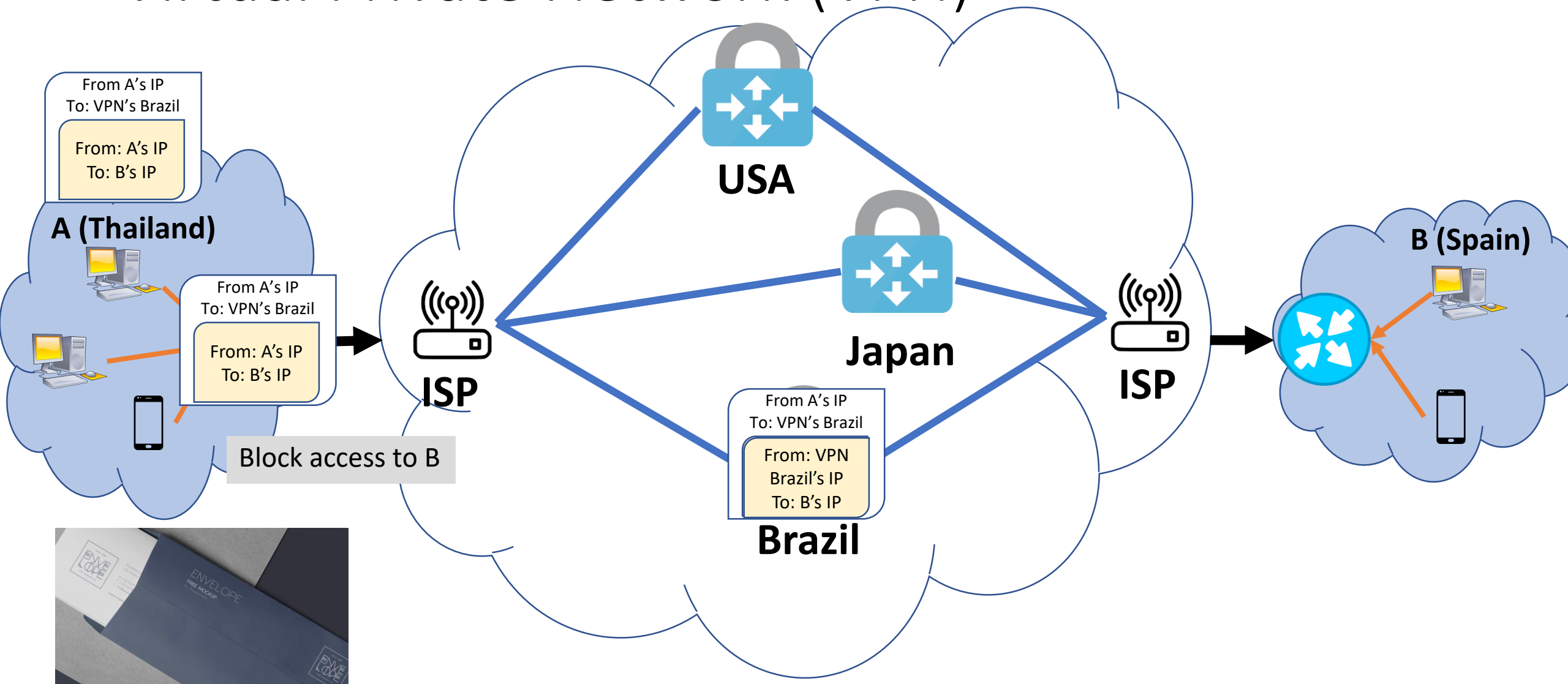
OR

How can you access www.google.com in China?

Virtual Private Network (VPN)



Virtual Private Network (VPN)



Advantages of VPN

Allow users to access certain websites that are normally blocked by router/ISP

Allow users to view geographically limited content

Anonymity: Destination doesn’t know your identity

Disadvantages of VPN

Trustworthiness of VPN Providers

- Do not keep records
- Strong message encryption (or sealing)

Easy to detect by ISP/routers

- Always connect to the same IP address
- Messages are always encrypted (or sealed)

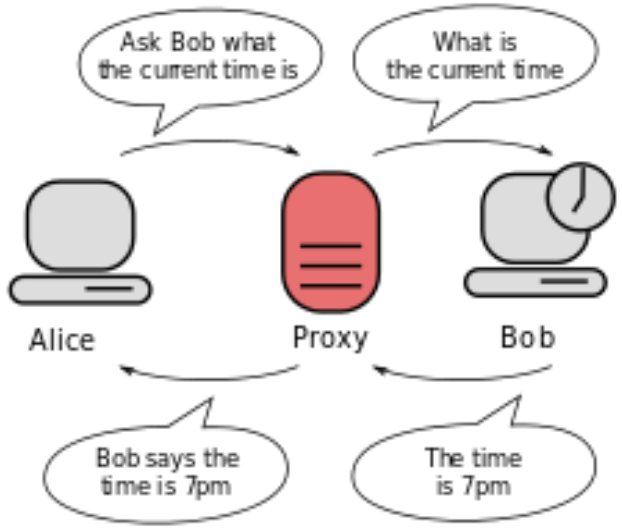
Could slow down Internet connections

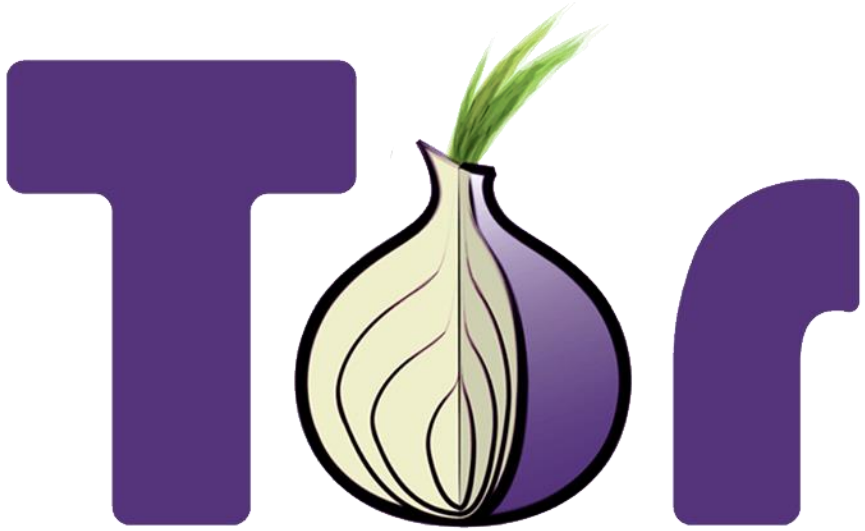
Trustworthy VPN Service is usually NOT free

Alternatives to VPN

(for avoid website blocking + hide your IP address)

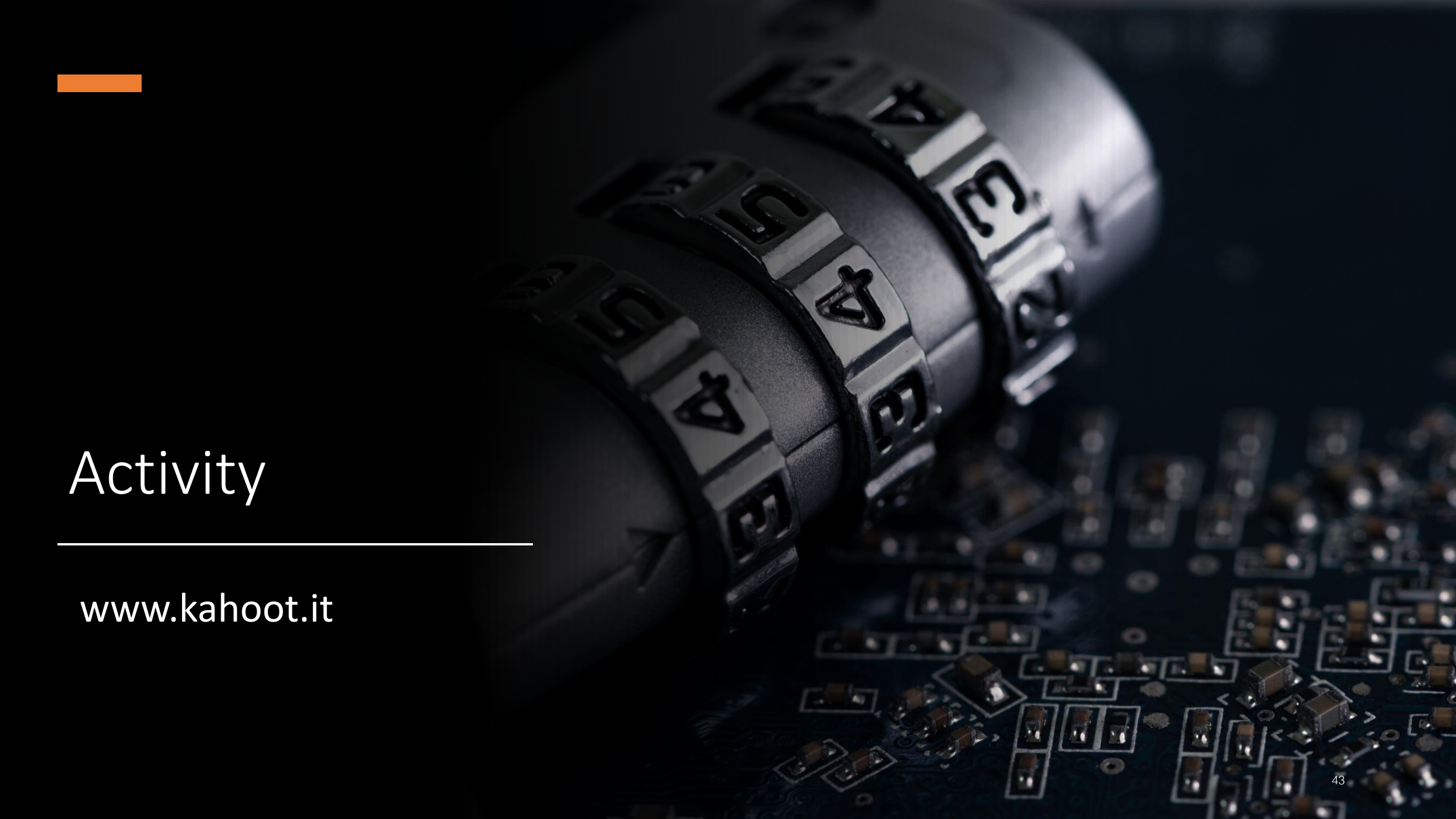
- Proxy Server – a middle man between you and a website (without encryption)
  - Con: Need to trust proxy servers, less secure than VPN
- The Onion Routing (TOR) – (roughly speaking) VPN with more than 1 gateway
  - Pro: Trust no one (unless TOR nodes collude)
  - Con: Slower than VPN
  - https://www.torproject.org/download/





Activity

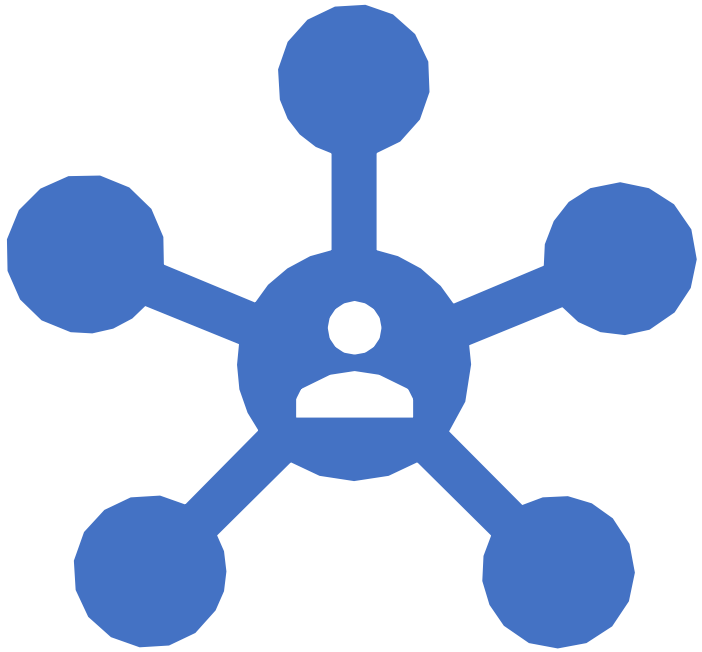
www.kahoot.it



Checking whether the website is down:

https://downforeveryoneorjustme.com/

Down (Unavailable) vs Blocked by router/gateway

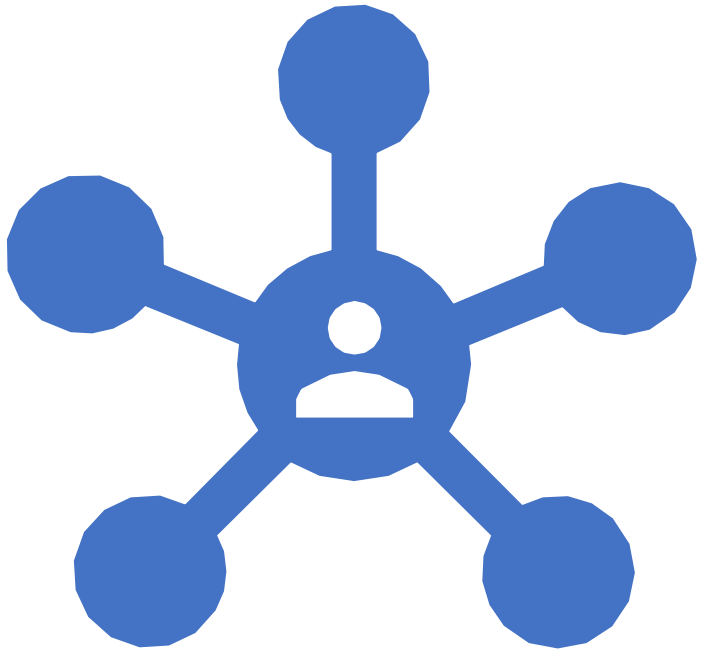


Internet is also a computer network

- A group of computers
- **Communication medium/link**
- Communication protocol

Link Type

- Sender and Receive need to connect with a wired cable or wireless link.
- Wired
  - Twisted pairs <= e.g., telephone line, LAN cable
  - Coaxial cable <= e.g., cable, cable modem
  - Fiber optic <= e.g., the Internet
- Wireless
  - 3G, 4G, 5G
  - Wi-Fi
  - etc.

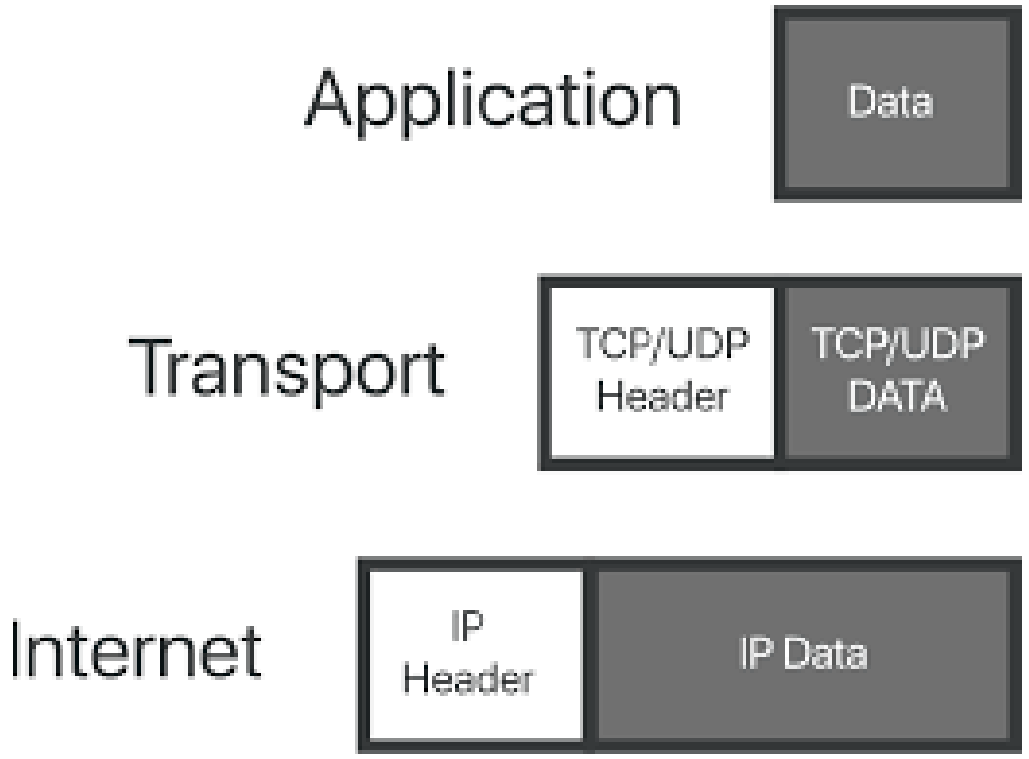


Internet is also a computer network

- A group of computers
- Communication medium/link
- **Communication protocol**

Protocol

- Internet Protocol (IP): header (source IP + dest IP) and payload (data)
- Transmission Control Protocol (TCP): IP where IP Data = TCP packet
- User Datagram Protocol (UDP): IP where IP Data = UDP packet
- etc.



Task (10-minute): Research online

- What is “bandwidth” in the context of computer networks?
- What is the minimum (or average) bandwidth to watch videos on video streaming websites, e.g., YouTube, Bilibili? 500Kbps
- What is the minimum (or average) bandwidth to use voice application to call your friend, e.g., Line voice calling, WeChat voice calling? 100Kbps
- Between video streaming apps and voice apps, which one requires more bandwidth? Why?

Recap

- ISP/router has control of all messages, including blocking specific websites/resources on the Internet
- Ways to avoid traffic blocking: VPN, TOR, Proxy Server, etc.
- Links: wired vs wireless
- Protocol: language used by computers to communicate
- Bandwidth

Homework:
5-min presentation next Thursday in class

Find a case study where Internet-of-things (IoT) has impacts on a specific social application:

- Manufacturing, healthcare, business, agriculture, education, transportation etc.

Suggested Topics to include:

1. What are “things” (small devices) in Internet-of-things in this case study?
2. Summarize how IoT is used in this case study
3. Show (with concrete evidence) the impact of IoT in this case study,
   - e.g., if the impact is an increase in company’s performance, you can show by reporting the company’s profits before and after IoT is used
4. Apply what you have learned from the impact of IoT in your case study to other scenarios.

Where to find a case study?

- Online/Internet: News, blog, websites
- Personal experiences: interview your family's business, your friend's business, etc.
- If it's safe to go outside: go outside to interview a small/medium-sized enterprise (e.g., coffee shops, restaurants, etc.)

Make sure to cite the source where you obtain a case study

Q/A