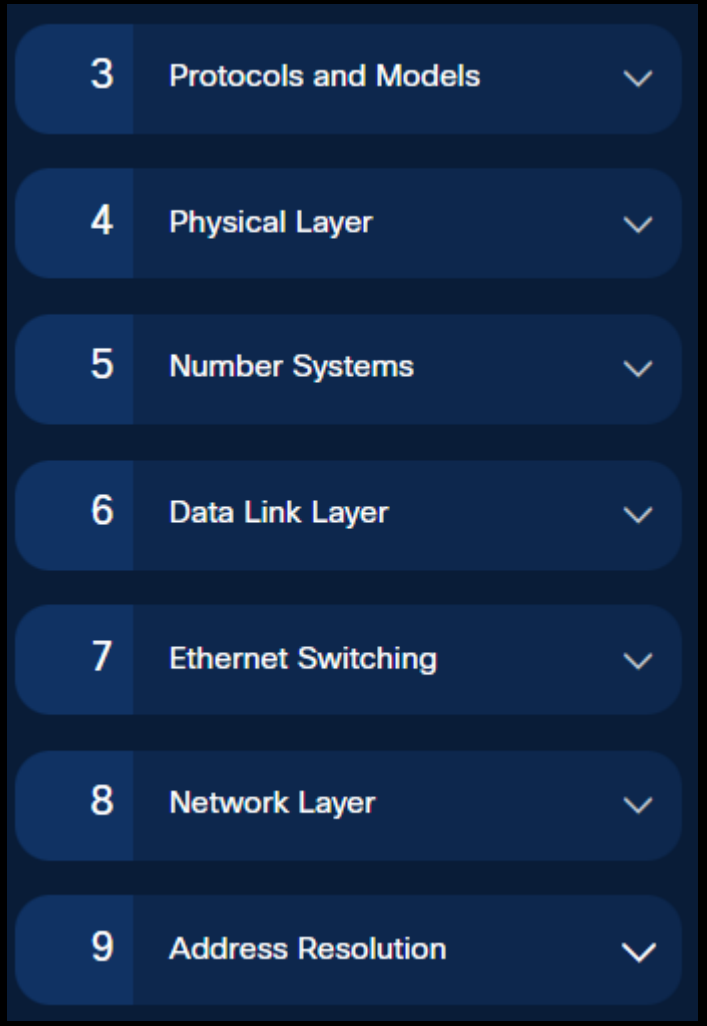
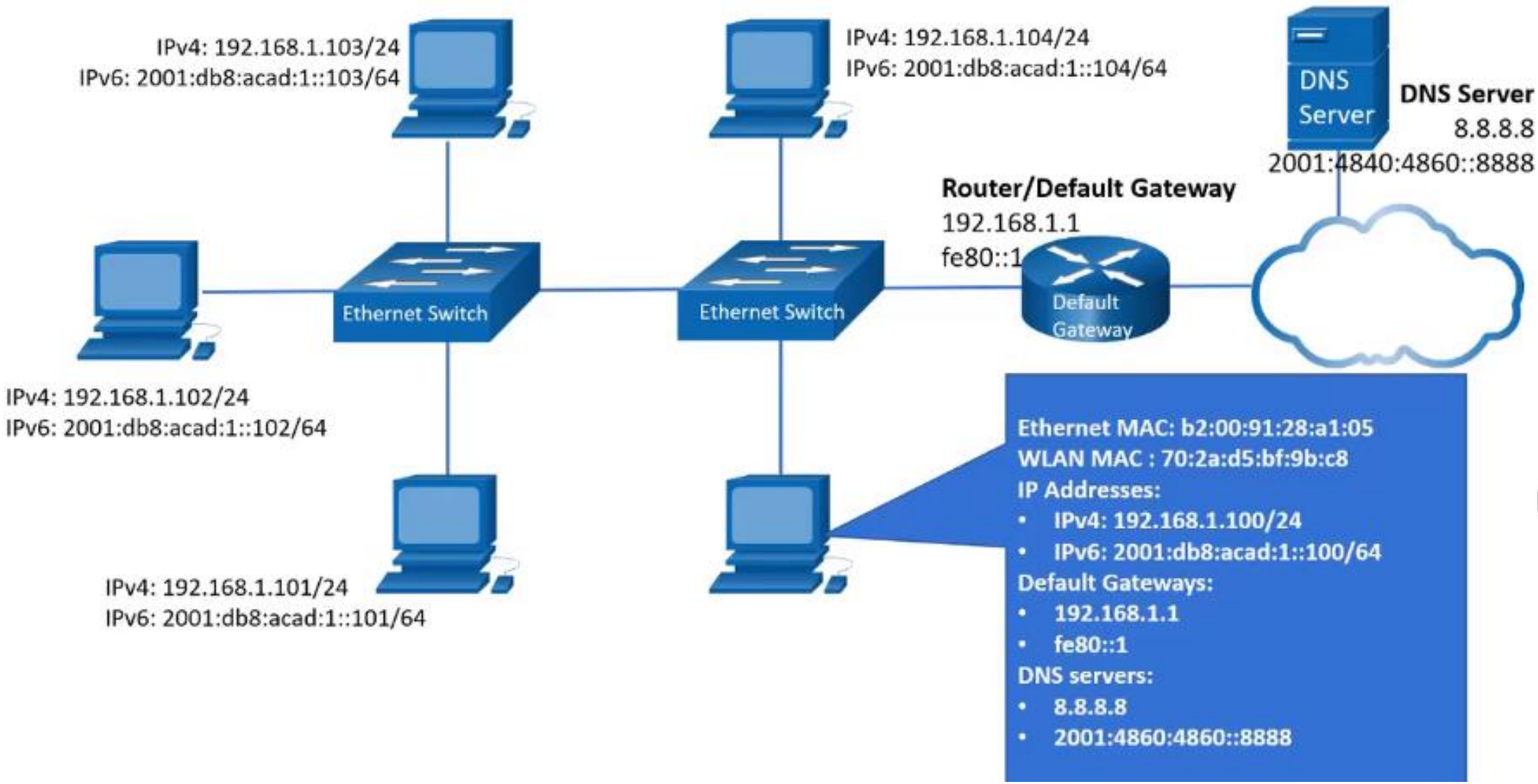
OSI model

https://www.netacad.com



How we "see" the network



This is how a device (computer, mobile phone, etc.) "sees" the network.
It doesn't.

- What is my addressing information? What network am I on?
- Is the destination device on my network or is it on another network?
- Where do I send information when the destination device is on a different network?
- Did the destination device receive the information I sent?
- Do I need to resend any information?

Osnove komunikacije

- Mreže se razlikuju po veličini, obliku i funkciji. Mogu biti složeni kao uređaji povezani preko interneta ili jednostavni kao dva računala izravno povezana jedno s drugim jednim kabelom, i bilo što između.

- Međutim, jednostavno postojanje žičane ili bežične fizičke veze između krajnjih uređaja nije dovoljno za omogućavanje komunikacije. Da bi došlo do komunikacije, uređaji moraju znati "kako" komunicirati.

- Ljudi razmjenjuju ideje koristeći mnogo različitih komunikacijskih metoda. Međutim, sve metode komunikacije imaju sljedeća tri zajednička elementa:

    1. Izvor poruke (pošiljatelj) – izvori poruke su ljudi ili elektronički uređaji koji trebaju poslati poruku drugim osobama ili uređajima.
    2. Odredište poruke (primatelj) – Odredište prima poruku i tumači je.
    3. Kanal - Sastoji se od medija koji osigurava put kojim poruka putuje od izvora do odredišta.

- Slanje poruke, bilo putem komunikacije licem u lice ili putem mreže, regulirano je pravilima koja se nazivaju protokoli. Ovi protokoli su specifični za vrstu komunikacijske metode koja se koristi.
- U našoj svakodnevnoj osobnoj komunikaciji, pravila koja koristimo za komunikaciju putem jednog medija, poput telefonskog poziva, nisu nužno ista kao pravila za korištenje drugog medija, kao što je slanje pisma.

Pravila komunikacije

- Prije međusobnog komuniciranja, pojedinci moraju koristiti utvrđena pravila ili dogovore za upravljanje razgovorom. Razmotrite ovu poruku na primjer:

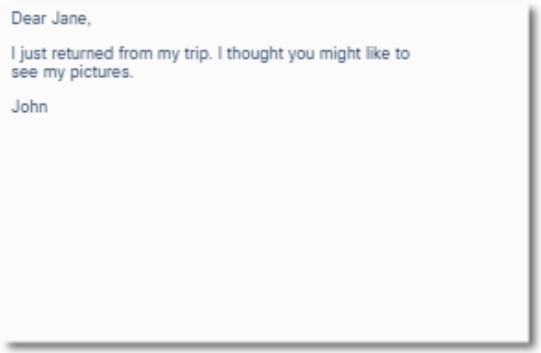
  German Coastguard We are Sinking/ What are you Thinking About
  https://youtu.be/xacdDrylrek?si=_rUAEYEjub4XI4xj

  When a Frenchman calls an Indian Call Center : The iRabbit
  https://youtu.be/DxxAwDHgQhE?si=J2Hfo4rh3CuoSxsS

Protokoli moraju uzeti u obzir sljedeće zahtjeve za uspješnu isporuku poruke koju primatelj razumije:

- Identificirani pošiljatelj i primatelj (IP adrese, MAC adrese, TCP/UDP portovi)
- Zajednički jezik i gramatika (format poruke, način enkapsulacije, veličina poruke, enkripcija itd.)
- Brzina i vrijeme isporuke (sinkronizacija komunikacije-timing, minimalni zahtjevi npr. latencija, jitter, frame rate itd.)
- Zahtjevi za potvrdu ili potvrdu (vrsta komunikacije, pouzdana komunikacija vs. Nepouzdana, upravljanje greškama-error handling)

Pravila komunikacije

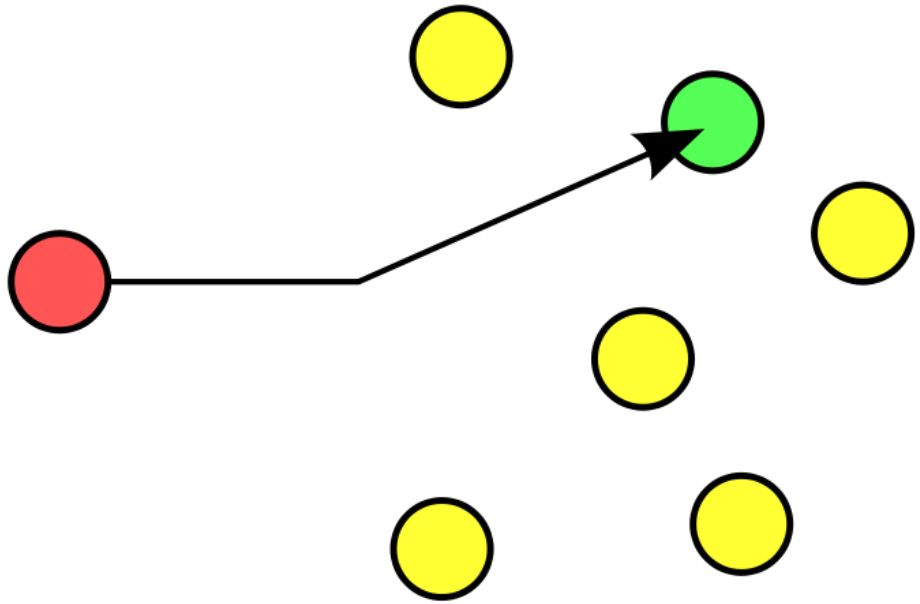


Recipient (destination) Location address	Sender (source) Location address	Salutation (start of message indicator)	Recipient (destination) identifier	Content of Letter (encapsulated data)	Sender (source) identifier	End of Frame (End of message indicator)
Envelope Addressing		Encapsulated Letter				
1400 Main Street Canton, Ohio 44203	4085 SE Pine Street Ocala, Florida 34471	Dear	Jane	I just returned from my trip. I thought you might like to see my pictures.	John	

Vrste komunikacije u mreži

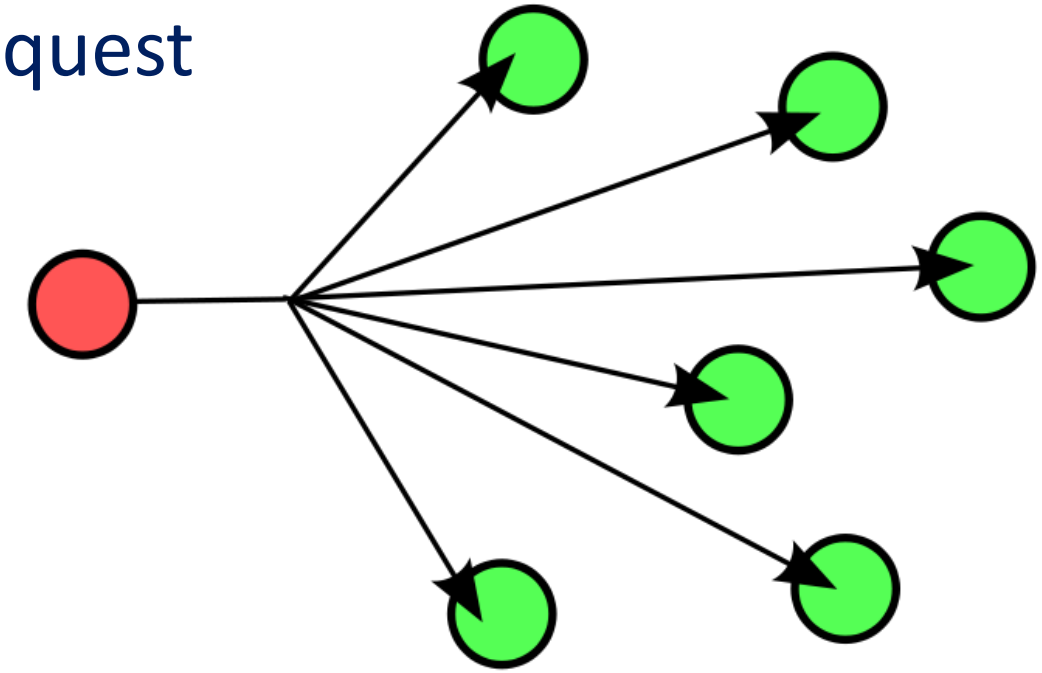
- **Unicast (jedan na jedan)**
  - Primjeri: Ping, uspostava TCP veze, ARP reply, telnet…

Src IP= 192.168.1.10 dst IP=192.168.3.30



Vrste komunikacije u mreži

- **Broadcast (jedan na sve)-zaustavlja se na L3 uređajima (Router/Usmjernik)**
  - Primjeri: DHCP discover, ARP request



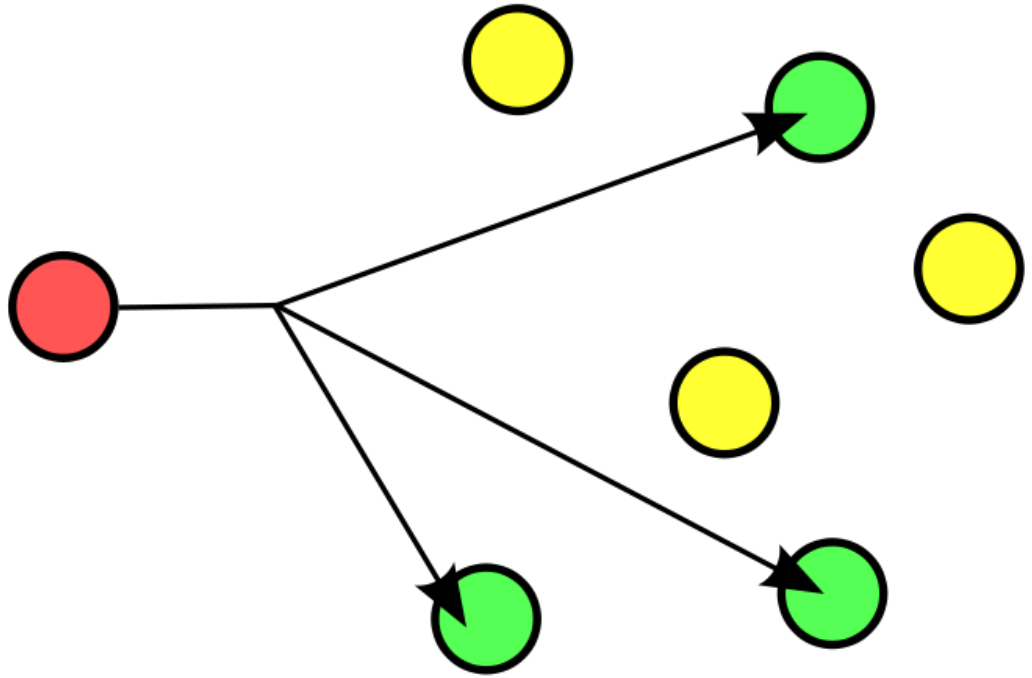
Src IP= 192.168.1.10 dst IP=192.168.1.255

L3 255. 255. 255. 255

```
Frame 74: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface 0
Ethernet II, Src: HonHaiPr_c9:be:b7 (9c:2a:70:c9:be:b7), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 172.20.67.87 (172.20.67.87), Dst: 255.255.255.255 (255.255.255.255)
User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)
Bootstrap Protocol
```

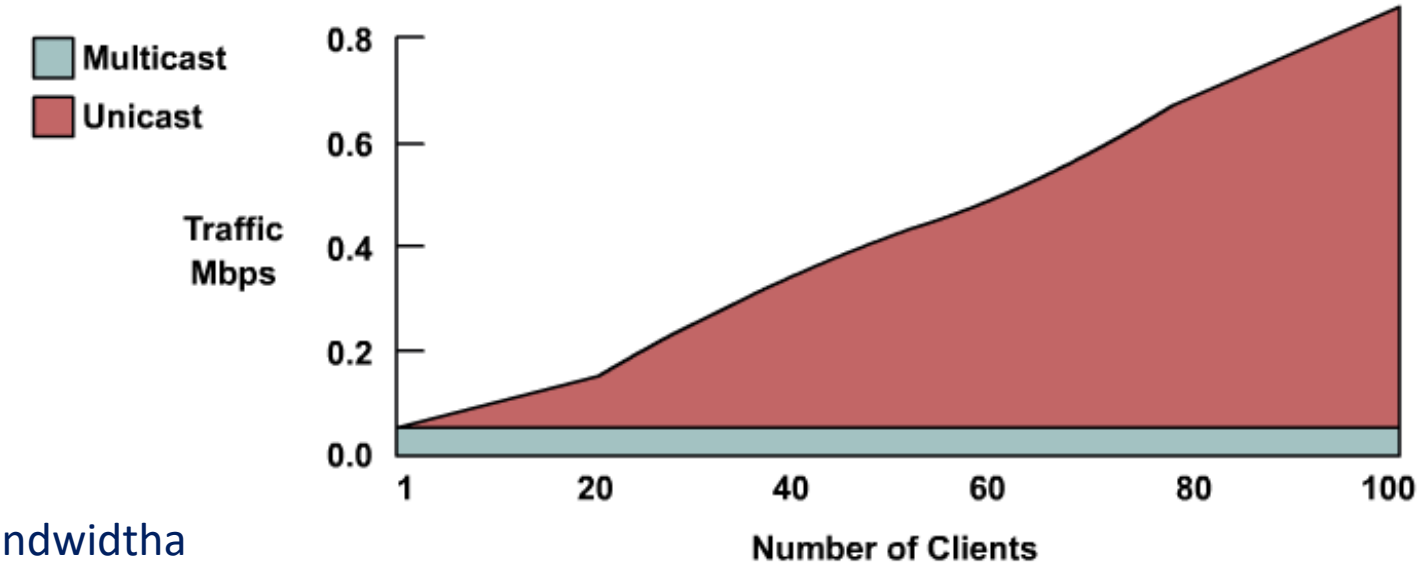
Vrste komunikacije u mreži

- **Multicast (jedan na grupu)-**uobičajeno zaustavlja se na L3 uređajima (Router/Usmjernik), osim ako ti uređaji nisu konfigurirani da propuštaju/usmjeravaju multicast promet, kao što je slučaj s IP TV prometom
- Primjeri: IP TV, protokoli za usmjeravanje prometa u mreži i drugi „infrastrukturni protokoli” (RIP, EIGRP, OSPF, HSRP, VRRP…)



- 224.0.0.0 do 224.0.0.255 Reserved for special “well-known” multicast addresses. se ne proslijeđuju dalje od linka
- 224.0.1.0-238.255.255.255 Globally-scoped (Internet-wide) multicast addresses.
- 239.0.0.0-239.255.255.255 Organization-Local Scope

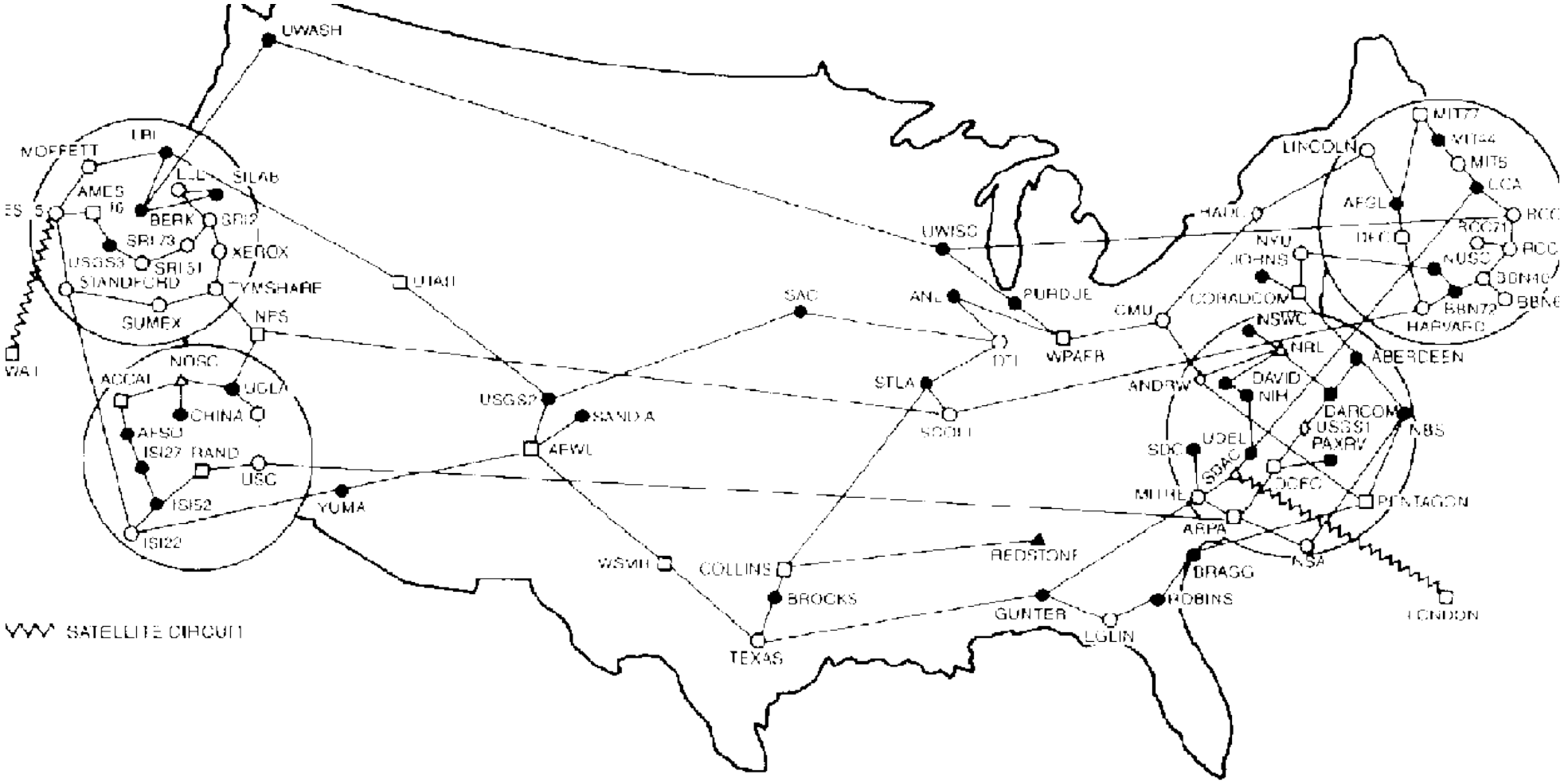
Prednosti multicast komunikacije

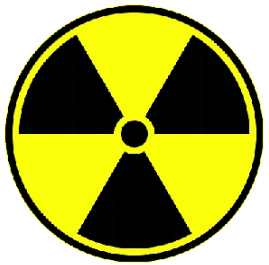


- Efikasnije korištenje Bandwidtha
  - ✓ mrežna propusnost je bolje iskorištena, višestruki tokovi podataka se zamjenjuju sa jednim
- Manje opterećenje Servera
  - ✓ Server ne mora za svakog klijenta slati poseban stream, što smanjuje trošenje resursa (CPU, RAM, Bandwidth....)
- Manje opterećenje mrežne opreme
  - ✓ manji broj paketa znači i manje prosljeđivanja i procesuiranja
- Omogućava efikasnije korištenje distribuiranih aplikacija
  - ✓ aplikacije i servisi koje su namijenjene većem broju korisnika nisu moguće u unicast izvedbi iz razloga što unicast nije skalabilan

?

Put prema Internetu-početak-telegraf-switchboard

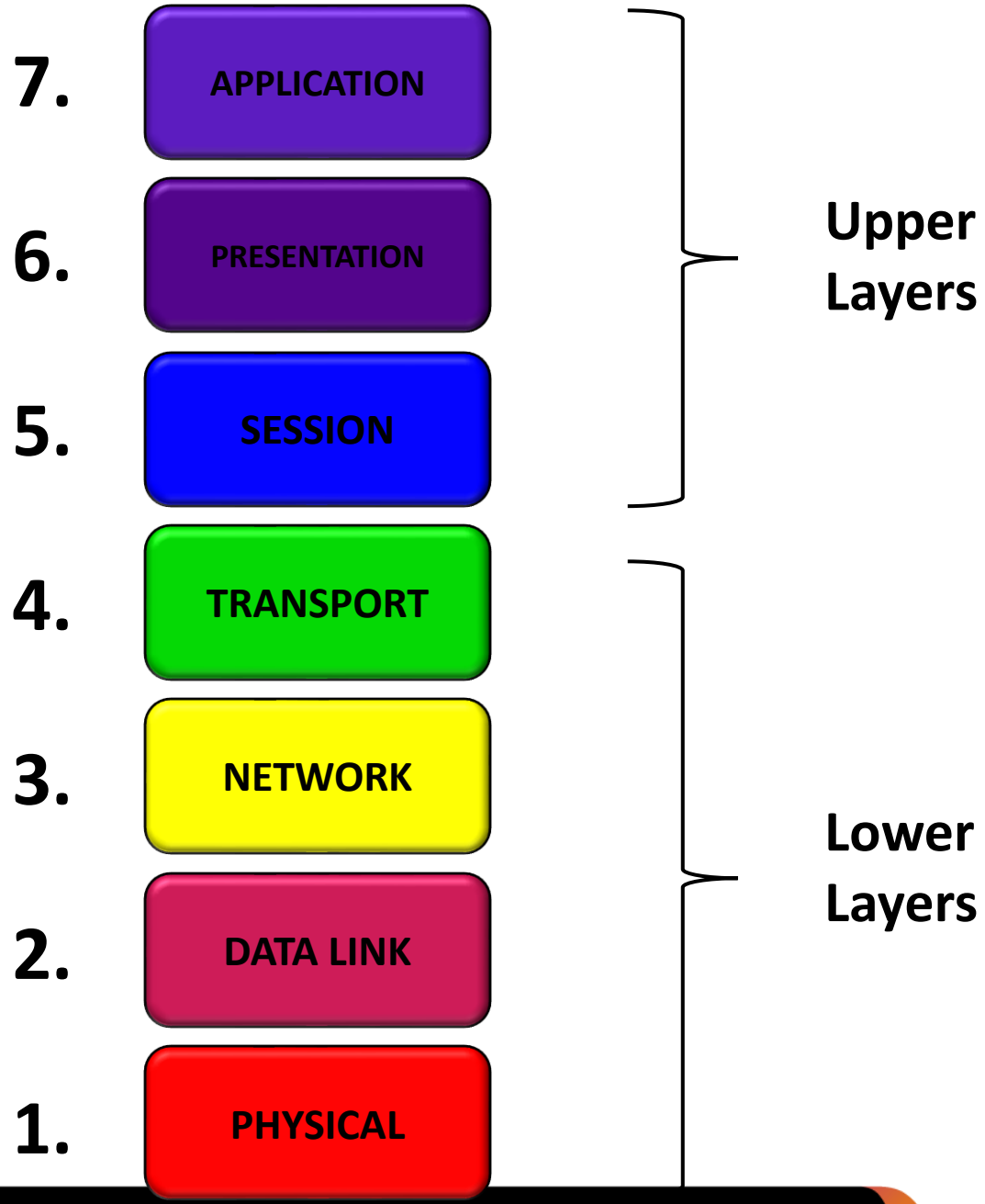





UNION CARBIDE
SIMPLY GREAT CHEMISTRY
MONSANTO
BIOTECHNOLOGY
innovation – collaboration – speed
IBM
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
FedEx
Express
LOCKHEED MARTIN
THE UNIVERSITY OF CALIFORNIA
UCLA
DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA
verizon
NASA
Massachusetts Institute of Technology
Macintosh
LIBRARY OF CONGRESS
U.S. DEPARTMENT OF HOMELAND SECURITY
FEMA

OSI model

Open
System
Interconnection
model



7. APPLICATION
6. PRESENTATION
5. SESSION
4. TRANSPORT
3. NETWORK
2. DATA LINK
1. PHYSICAL

- Procedure za prijenos podataka
- Veza između korisnika i računala
- Identifikacija partnera komunikacije
- Određivanje raspoloživih resursa
- Sinkronizacija komunikacije

7. APPLICATION

7. APPLICATION

6. PRESENTATION

5. SESSION

4. TRANSPORT

3. NETWORK

2. DATA LINK

1. PHYSICAL

- **Formatiranje podataka**
- **Kompresija**
- **Enkripcija i dekripcija**

6. PRESENTATION

.txt .doc .docx .jpg .png

Dođi kući na čaj od šipka.

≠

DoÄ‘i kuÄ‡i na ÄŤaj od Ĺˇipka

7. APPLICATION

6. PRESENTATION

5. SESSION

4. TRANSPORT

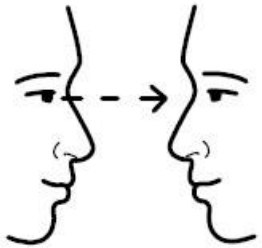
3. NETWORK

2. DATA LINK

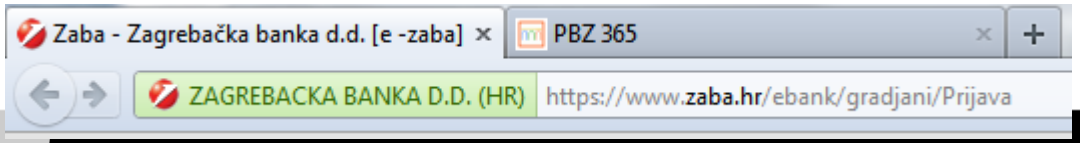
1. PHYSICAL

- **Uspostava komunikacije**
- **Održavanje komunikacije**
- **Zatvaranje komunikacije**

5. SESSION



BitTorrent™



7. APPLICATION

6. PRESENTATION

5. SESSION

4. TRANSPORT

3. NETWORK

2. DATA LINK

1. PHYSICAL

- **Pouzdanost komunikacije**
- **Kontrola protoka podataka**
- **Izbjegavanje zagušenja**

TCP – transmission control protocol

UDP – user datagram protocol

4. TRANSPORT

7. APPLICATION

6. PRESENTATION

5. SESSION

4. TRANSPORT

3. NETWORK

2. DATA LINK

1. PHYSICAL

• ROUTING

Internet Protocol (IPv4 i IPv6)

IP adresa: 192.168.0.11

3. NETWORK

ALGEBRA

7. APPLICATION

6. PRESENTATION

5. SESSION

4. TRANSPORT

3. NETWORK

2. DATA LINK

1. PHYSICAL

• SWITCHING

- **Kontrola pristupa mediju**
- **Kontrola grešaka…**

ETHERNET protocol

MAC sdresa 001C:001B:001A

2. DATA LINK

7. APPLICATION

6. PRESENTATION

5. SESSION

4. TRANSPORT

3. NETWORK

2. DATA LINK

1. PHYSICAL

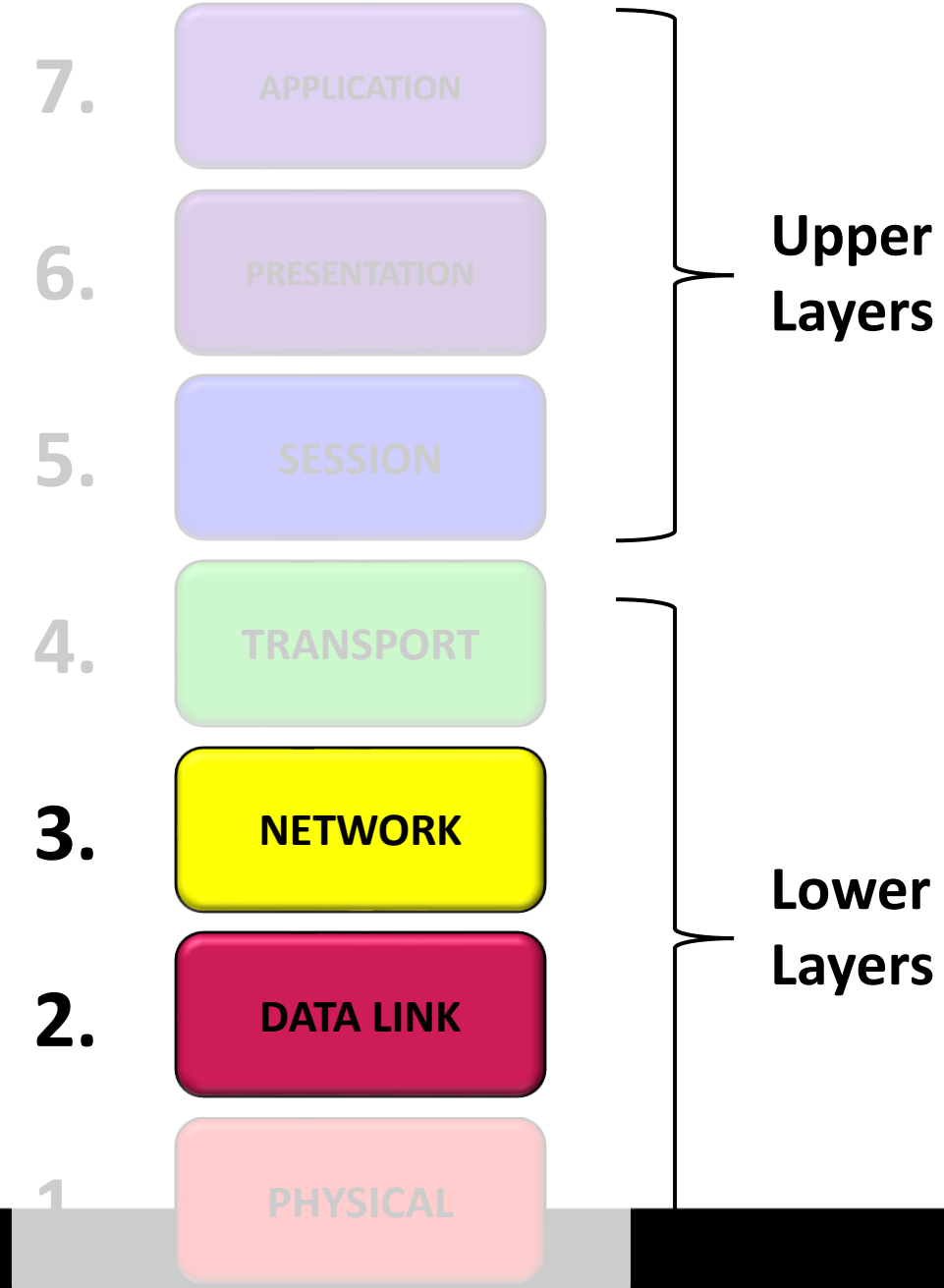
- Električni signali
- Kablovi
- Konektori

5 V 600 MHz 850 nm

1. **PHYSICAL**

OSI model

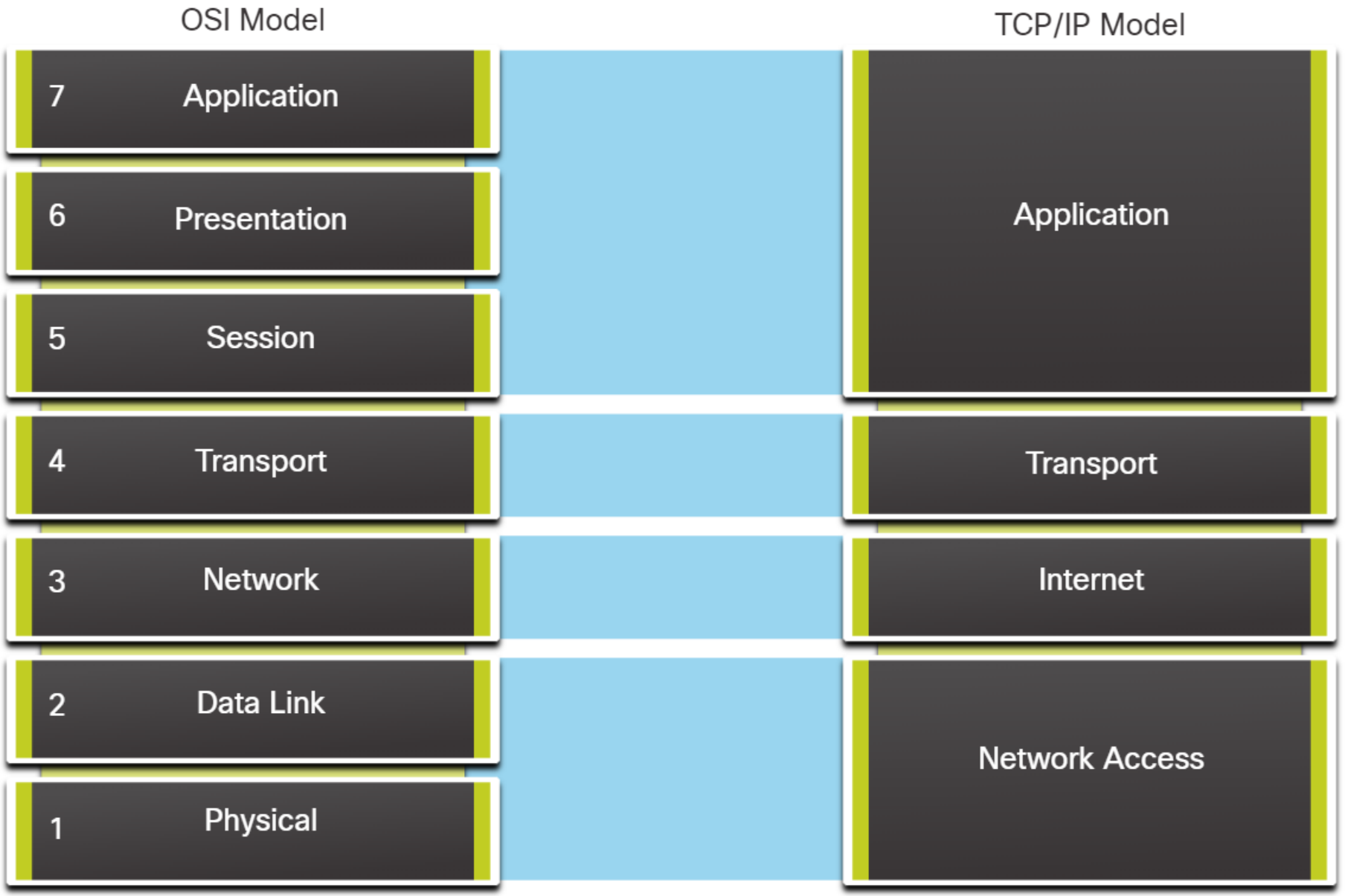
- Referenti model koji opisuje način na koji se odvija komunikacija između dva računala.



ROUTING • IP

SWITCHING • ETHERNET

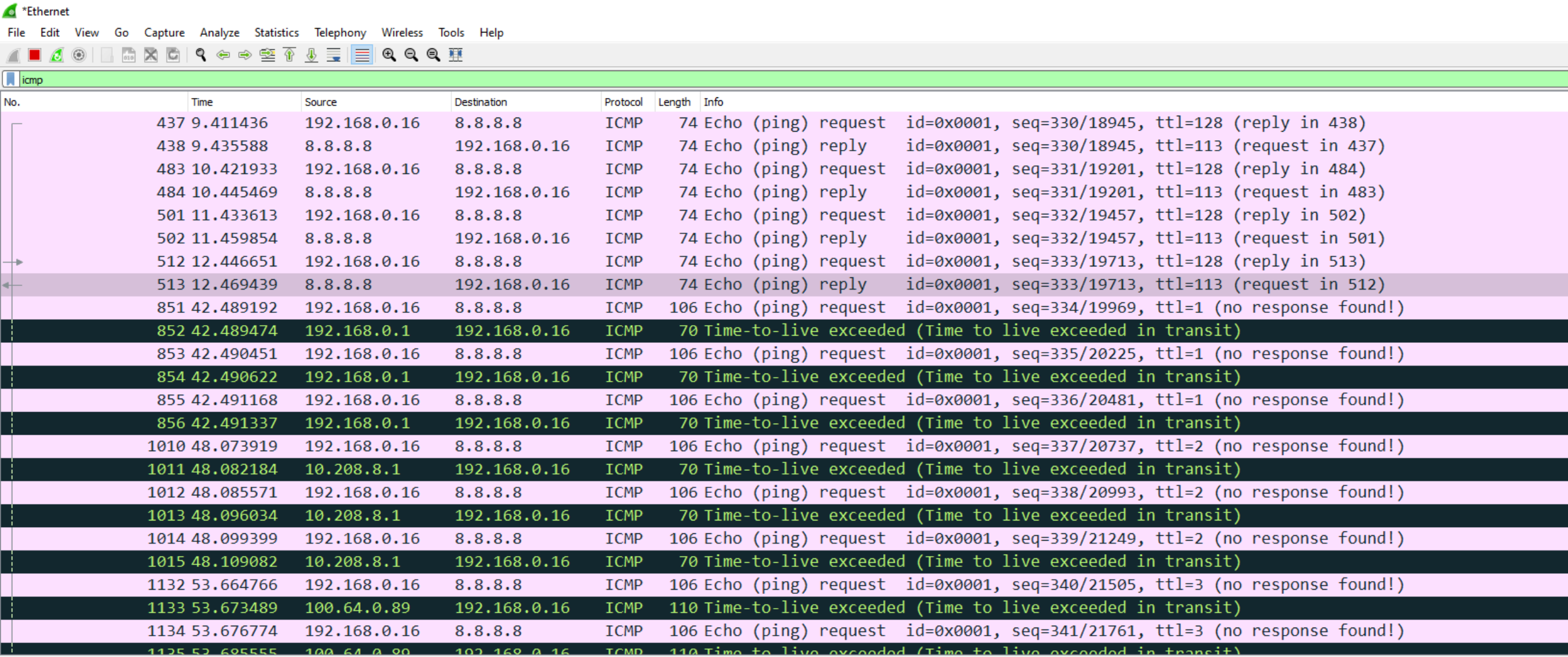
Please Do Not Throw Sausage Pizza Away ! !


OSI Model
TCP/IP Model
7 Application
6 Presentation
5 Session
4 Transport
3 Network
2 Data Link
1 Physical
Application
Transport
Internet
Network Access

CMD.EXE

Start  cmd.exe 

WIRESHARK


*Ethernet
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
No. Time Source Destination Protocol Length Info
437 9.411436 192.168.0.16 8.8.8.8 ICMP 74 Echo (ping) request id=0x0001, seq=330/18945, ttl=128 (reply in 438)
438 9.435588 8.8.8.8 192.168.0.16 ICMP 74 Echo (ping) reply id=0x0001, seq=330/18945, ttl=113 (request in 437)
483 10.421933 192.168.0.16 8.8.8.8 ICMP 74 Echo (ping) request id=0x0001, seq=331/19201, ttl=128 (reply in 484)
484 10.445469 8.8.8.8 192.168.0.16 ICMP 74 Echo (ping) reply id=0x0001, seq=331/19201, ttl=113 (request in 483)
501 11.433613 192.168.0.16 8.8.8.8 ICMP 74 Echo (ping) request id=0x0001, seq=332/19457, ttl=128 (reply in 502)
502 11.459854 8.8.8.8 192.168.0.16 ICMP 74 Echo (ping) reply id=0x0001, seq=332/19457, ttl=113 (request in 501)
512 12.446651 192.168.0.16 8.8.8.8 ICMP 74 Echo (ping) request id=0x0001, seq=333/19713, ttl=128 (reply in 513)
513 12.469439 8.8.8.8 192.168.0.16 ICMP 74 Echo (ping) reply id=0x0001, seq=333/19713, ttl=113 (request in 512)
851 42.489192 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=334/19969, ttl=1 (no response found!)
852 42.489474 192.168.0.1 192.168.0.16 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit)
853 42.490451 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=335/20225, ttl=1 (no response found!)
854 42.490622 192.168.0.1 192.168.0.16 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit)
855 42.491168 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=336/20481, ttl=1 (no response found!)
856 42.491337 192.168.0.1 192.168.0.16 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit)
1010 48.073919 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=337/20737, ttl=2 (no response found!)
1011 48.082184 10.208.8.1 192.168.0.16 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit)
1012 48.085571 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=338/20993, ttl=2 (no response found!)
1013 48.096034 10.208.8.1 192.168.0.16 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit)
1014 48.099399 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=339/21249, ttl=2 (no response found!)
1015 48.109082 10.208.8.1 192.168.0.16 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit)
1132 53.664766 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=340/21505, ttl=3 (no response found!)
1133 53.673489 100.64.0.89 192.168.0.16 ICMP 110 Time-to-live exceeded (Time to live exceeded in transit)
1134 53.676774 192.168.0.16 8.8.8.8 ICMP 106 Echo (ping) request id=0x0001, seq=341/21761, ttl=3 (no response found!)
Frame 513: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface \Device\NPF_{AD0DC399-0FDE-42A5-9E28-581B7FDE22A8}, id 0
Ethernet II, Src: HonHaiPr_94:10:53 (fc:01:7c:94:10:53), Dst: ASRockIn_92:09:2a (70:85:c2:92:09:2a)
Internet Protocol Version 4, Src: 8.8.8.8, Dst: 192.168.0.16
Internet Control Message Protocol

CMD.EXE-osnovne naredbe

- ipconfig
- ipconfig /all
- route print (netstat -r)
- arp -a
- telnet
- tracert
- ping
- netstat -a
- Nslookup
- ipconfig /flushdns
- ipconfig /release
- Ipconfig /renew

tracert

- Tracert 178.79.149.215
- Tracert -d 178.79.149.215
- Tracert -h 10 178.79.149.215
- Tracert -h 10 -d 178.79.149.215

telnet

- telnet 178.79.149.215 80

ping

- Ping -n 7 178.79.149.215
- Ping -a 178.79.149.215
- Ping -t 178.79.149.215
- Ping -l 1500 178.79.149.21
- Ping -w 10 178.79.149.215

Priprema za vježbu

What is OSI model (10 min)
https://www.cloudflare.com/learning/ddos/glossary/open-systems-interconnection-model-osi/

What is wireshark (5min)
https://www.wireshark.org/docs/wsug_html_chunked/ChapterIntroduction.html#ChIntroWhatIs

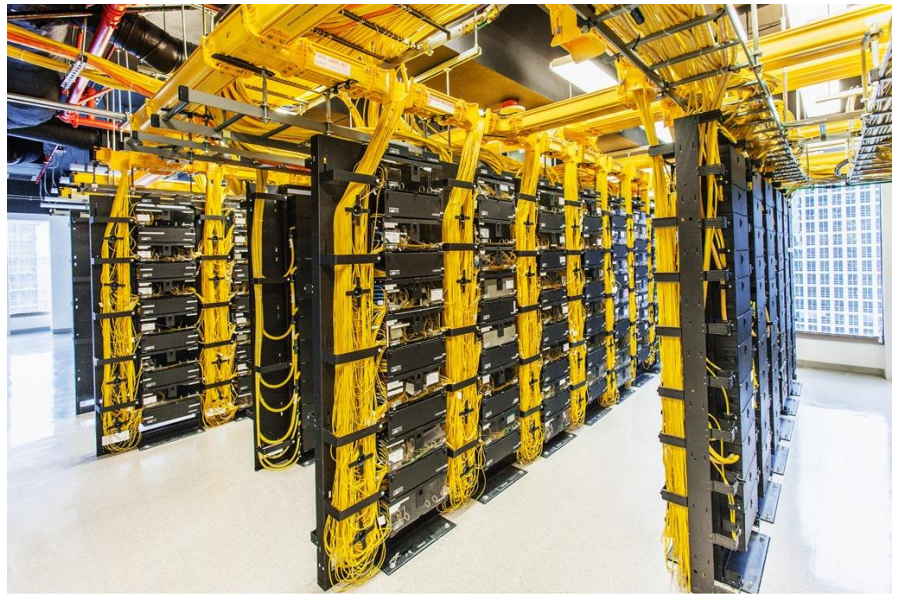
What is OSI Model? (9 min)

https://www.youtube.com/watch?v=Ilk7UXzV_Qc

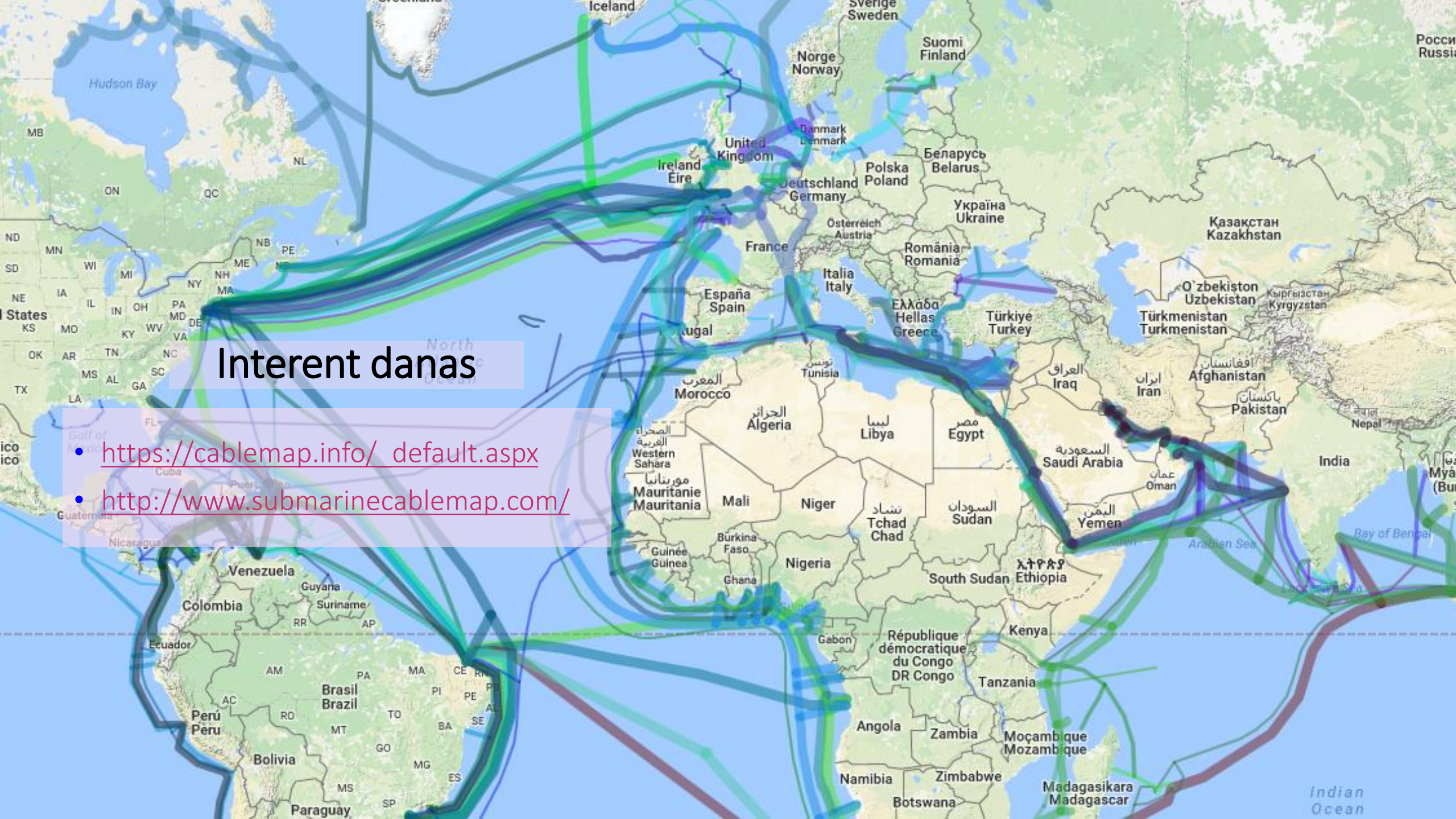
Wireshark Tutorial for Beginners (14 min)

https://www.youtube.com/watch?v=TkCSr30UojM

CIX (Croatian Internet exchange)



https://www.cix.hr/clanice/clanice



Interent danas

- https://cablemap.info/_default.aspx
- http://www.submarinecablemap.com/

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Hvala na pažnji!