

# Програмування-1

Лекція 17

Networking

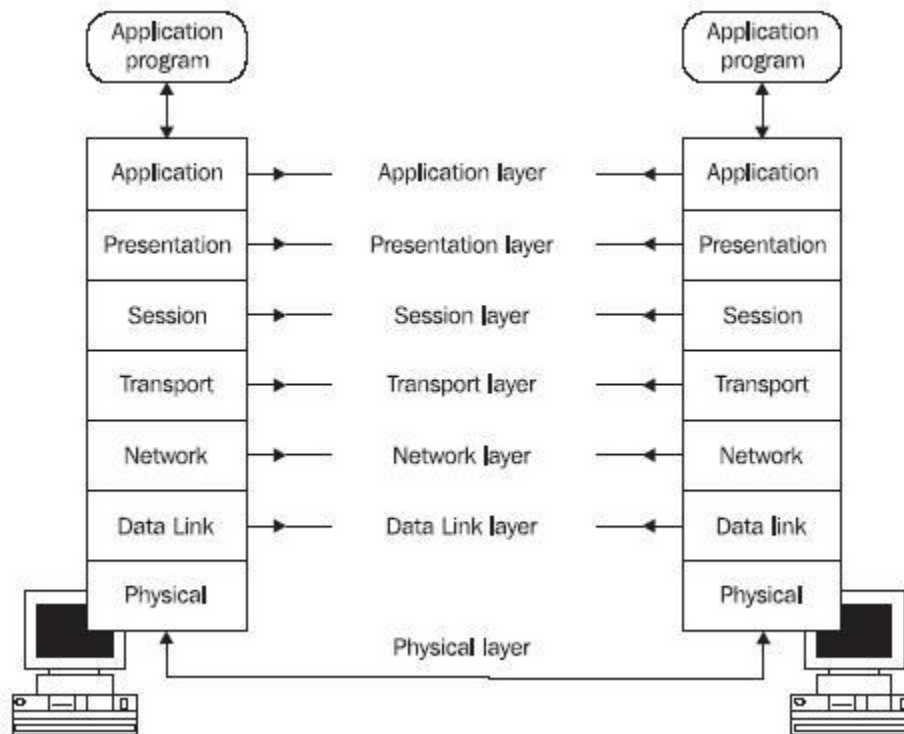
# Мережева модель OSI

- OSI model - Open Systems Interconnection model
- Базова еталонна модель взаємодії відкритих систем
- 7-рівнева модель

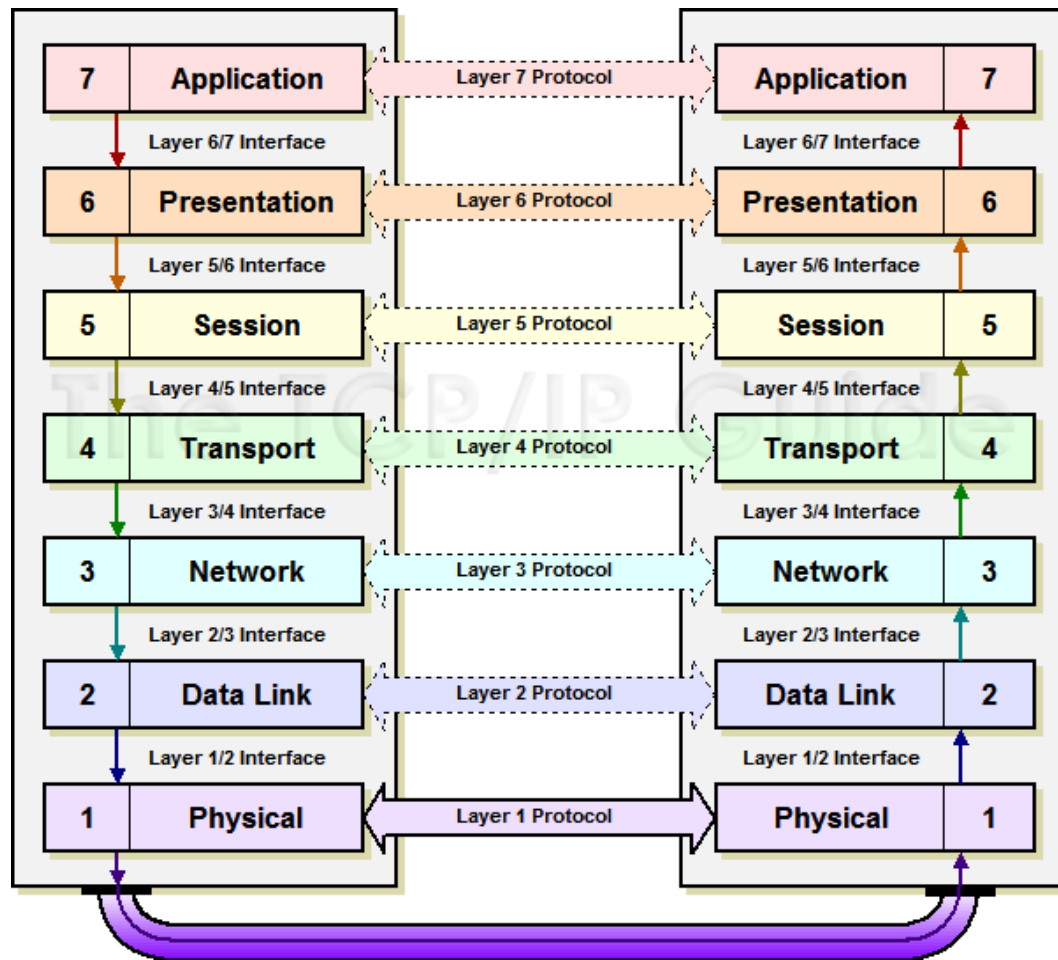
# Мережева модель OSI

Layer		Protocol data unit (PDU)	Function <sup>[3]</sup>
Host layers	7	<a href="#">Application</a>	High-level <a href="#">APIs</a> , including resource sharing, remote file access
	6	<a href="#">Presentation</a>	Translation of data between a networking service and an application; including <a href="#">character encoding</a> , <a href="#">data compression</a> and <a href="#">encryption/decryption</a>
	5	<a href="#">Session</a>	Managing communication <a href="#">sessions</a> , i.e. continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes
	4	<a href="#">Transport</a>	Reliable transmission of data segments between points on a network, including <a href="#">segmentation</a> , <a href="#">acknowledgement</a> and <a href="#">multiplexing</a>
Media layers	3	<a href="#">Network</a>	Structuring and managing a multi-node network, including <a href="#">addressing</a> , <a href="#">routing</a> and <a href="#">traffic control</a>
	2	<a href="#">Data link</a>	Reliable transmission of data frames between two nodes connected by a physical layer
	1	<a href="#">Physical</a>	Transmission and reception of raw bit streams over a physical medium

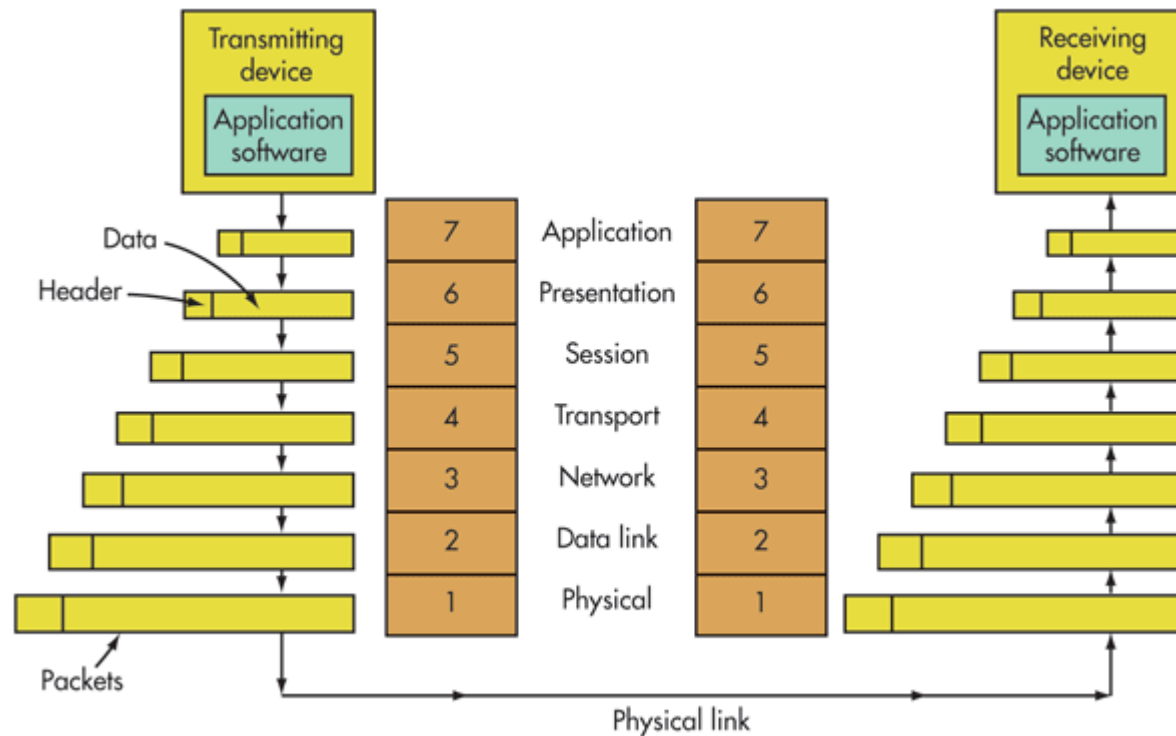
# Мережева модель OSI



# Protocol vs Interface



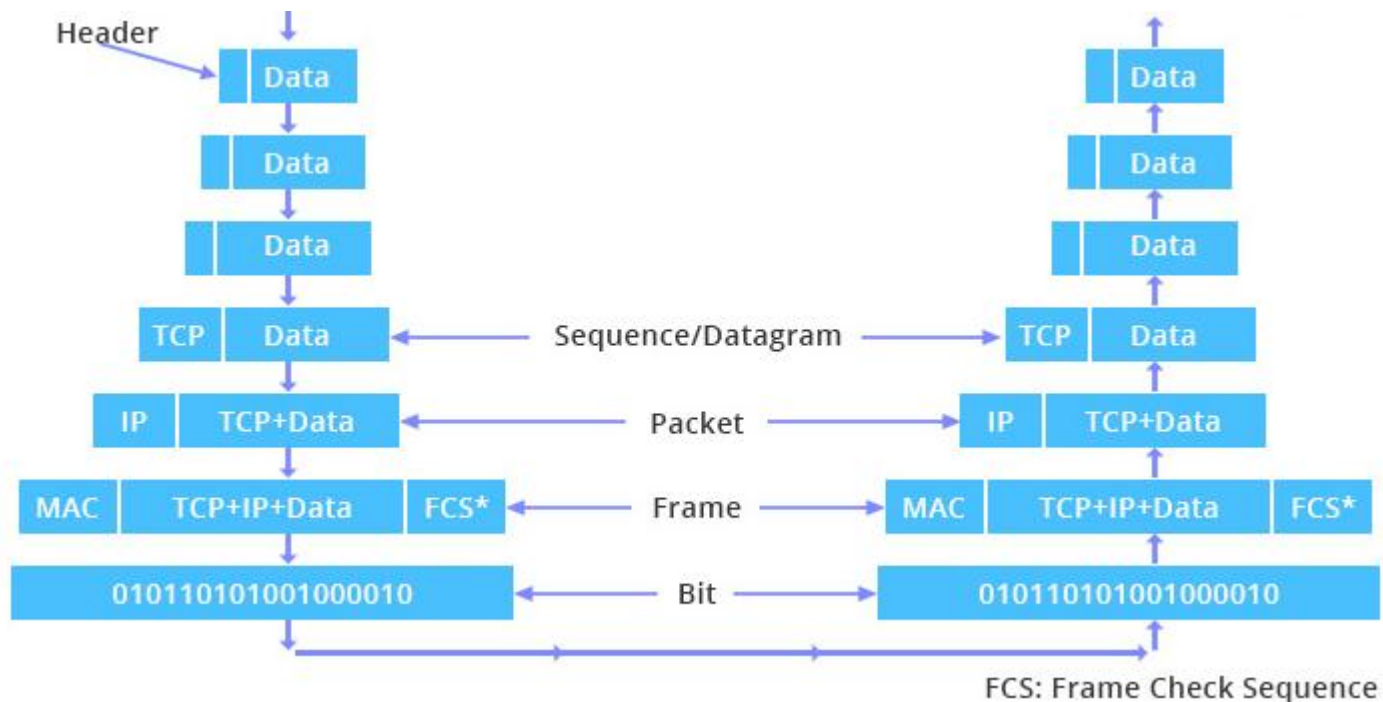
# Packet = Header + Data *[+Tail]*



# TCP/IP vs OSI

TCP/IP model	Protocols and services	OSI model
Application	HTTP, FTP, Telnet, NTP, DHCP, PING	Application
		Presentation
		Session
Transport	TCP, UDP	Transport
Network	IP, ARP, ICMP, IGMP	Network
Network Interface	Ethernet	Data Link
		Physical

# Packet = Header + Data *[+Tail]*



# Що потрібно знати про TCP/IP?

- IP
- DNS
- TCP / UDP
- Port
- NAT/PAT
- MAC
- Socket
- MTU
- ping, netstat, ipconfig

# IP

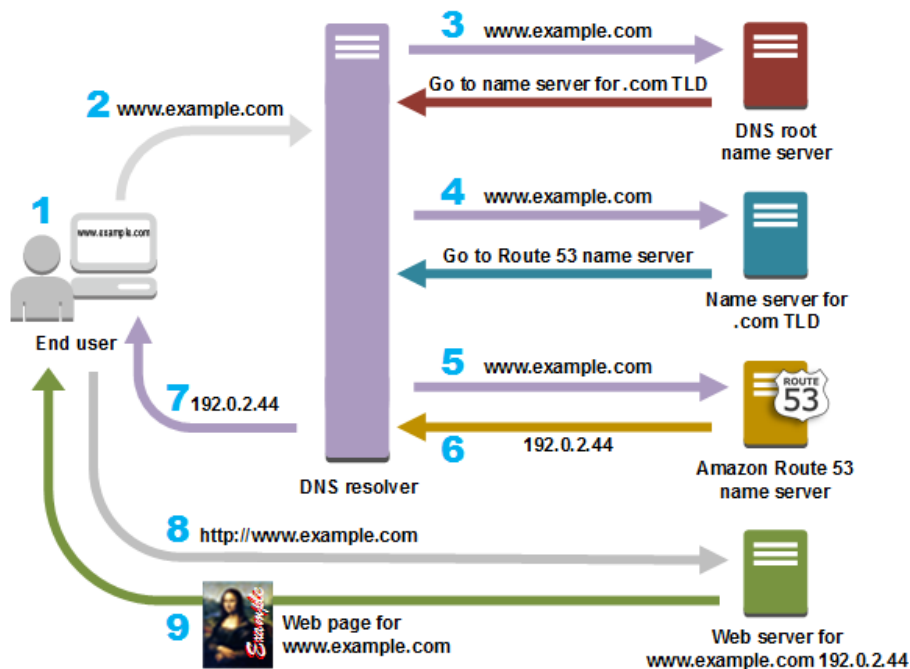
- IP – Internet Protocol
- Версії IP
  - IPv4 – 32-розрядна адреса
  - IPv6 – 128-розрядна адреса
- localhost, loopback, 127.0.0.1
  - Насправді: 127.0.0.1 – 127.255.255.254
- MTU – maximum transmission unit
  - Provider specific
  - Minimum (гарантований) MTU:
    - IPv4: 576 байт
    - IPv6: 1280 байт

# IP

- IP-адреса умовно складається з адреси мережі та адреси хоста у мережі
- Маска мережі
  - потрібна для того, щоб вказати, де адреса мережі, а де адреса хоста
$$\text{hostIP} \& \text{netMask} == \text{netIP}$$
  - у двійковому вигляді (32 розряди):
    - 11111....11110000...000
- 2 способи запису
  - XXX.XXX.XXX.XXX
  - /XX
- Приклад: 192.168.0.0 – 192.168.0.255
  - IP: 192.168.0.0 Mask: 255.255.255.0
  - IP: 192.168.0.0 / 24

# DNS

- DNS - Domain Name System
- “google.com” = “172.217.16.14”



# TCP vs UDP

Item	TCP	UDP
Stands For	Transmission Control Protocol	User Datagram Protocol
Protocol	Connection Oriented	Connectionless
Security	Makes Checks For Errors And Reporting	Makes Error Checking But No Reporting
Data Sending	Slower	Faster
Header Size	20 Bytes	8 Bytes
Segments	Acknowledgement	No Acknowledgement
Typical Applications	- Email	- VoIP

# TCP vs UDP



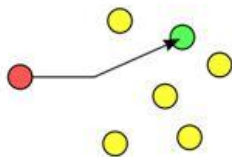
TCP

- **Slower but reliable transfers**
- **Typical applications:**
  - Email
  - Web browsing

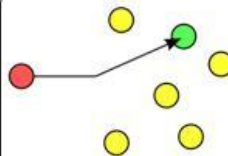


UDP

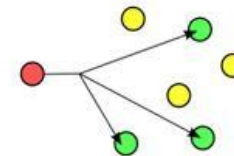
- **Fast but non-guaranteed transfers (“best effort”)**
- **Typical applications:**
  - VoIP
  - Music streaming



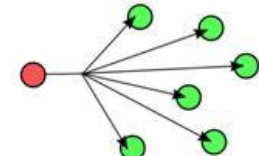
unicast



unicast



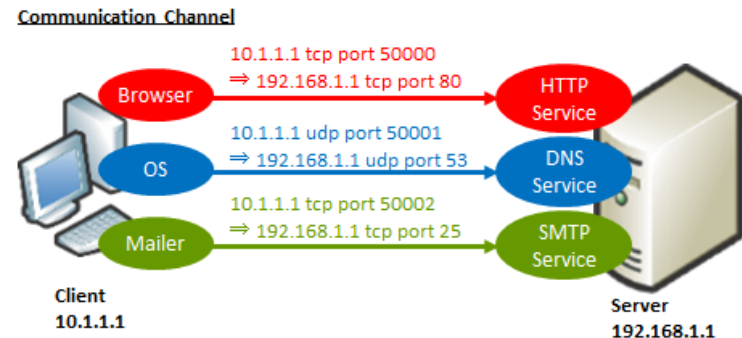
multicast



broadcast

# Порт

- На одному фізичному хості може бути кілька сервісів
  - Потрібна унікальна адреса
  - Порт – адреса сервісу на хості
- Порт: 0..65535
  - 0..1023 – system
  - 1024..49151 – registered
  - 49152.. 65535 – dynamic



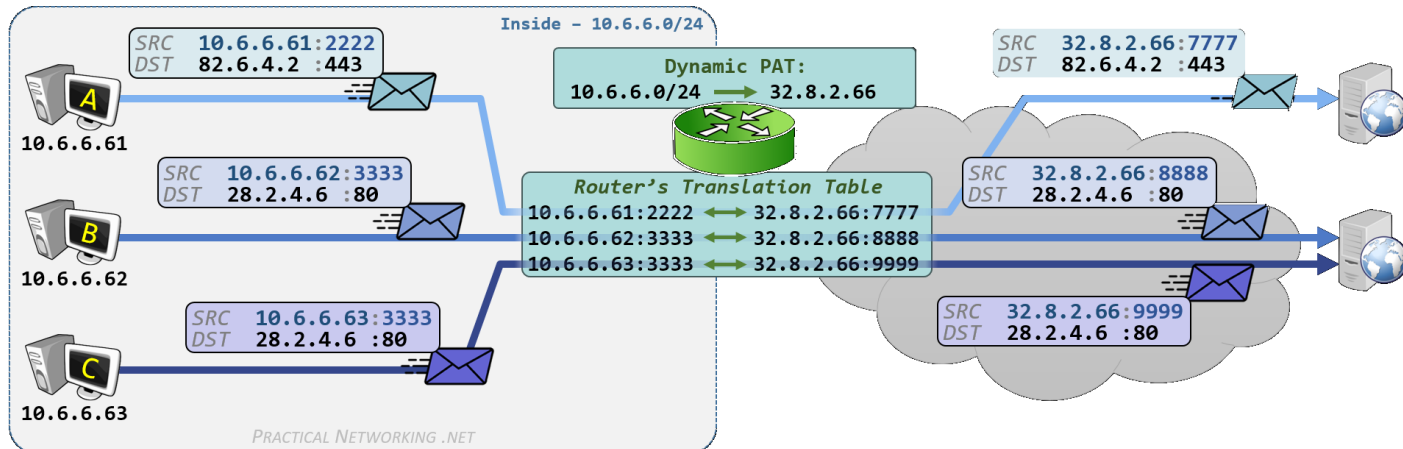
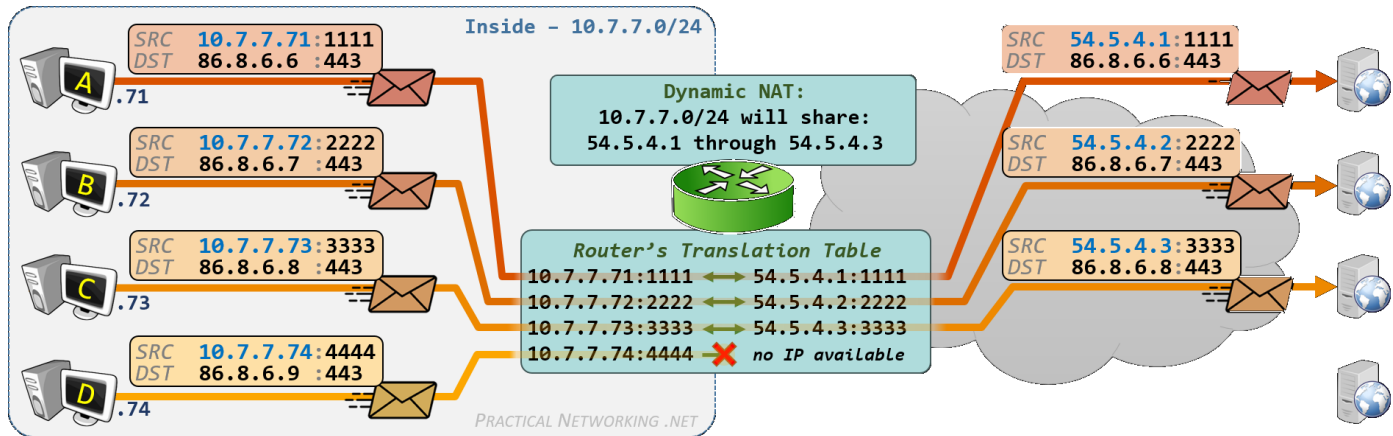
# Local address, NAT/PAT

- Local IPv4 addresses:

24-bit block	10.0.0.0 – 10.255.255.255	single class A network
20-bit block	172.16.0.0 – 172.31.255.255	16 contiguous class B networks
16-bit block	192.168.0.0 – 192.168.255.255	256 contiguous class C networks

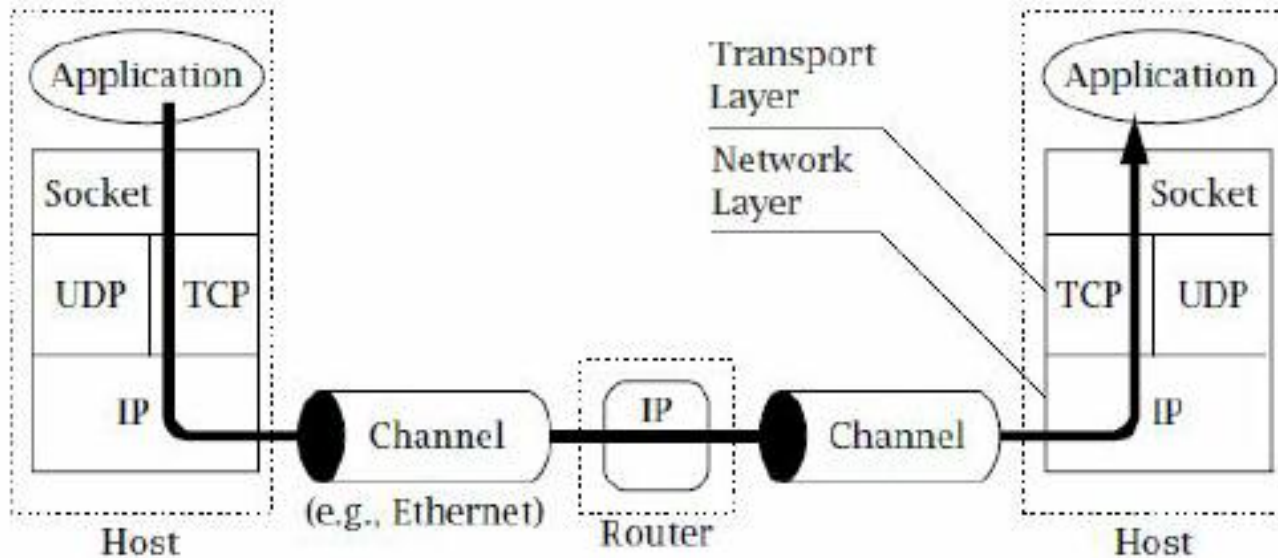
- NAT - Network Address Translation
- PAT - Port Address Translation

# NAT / PAT

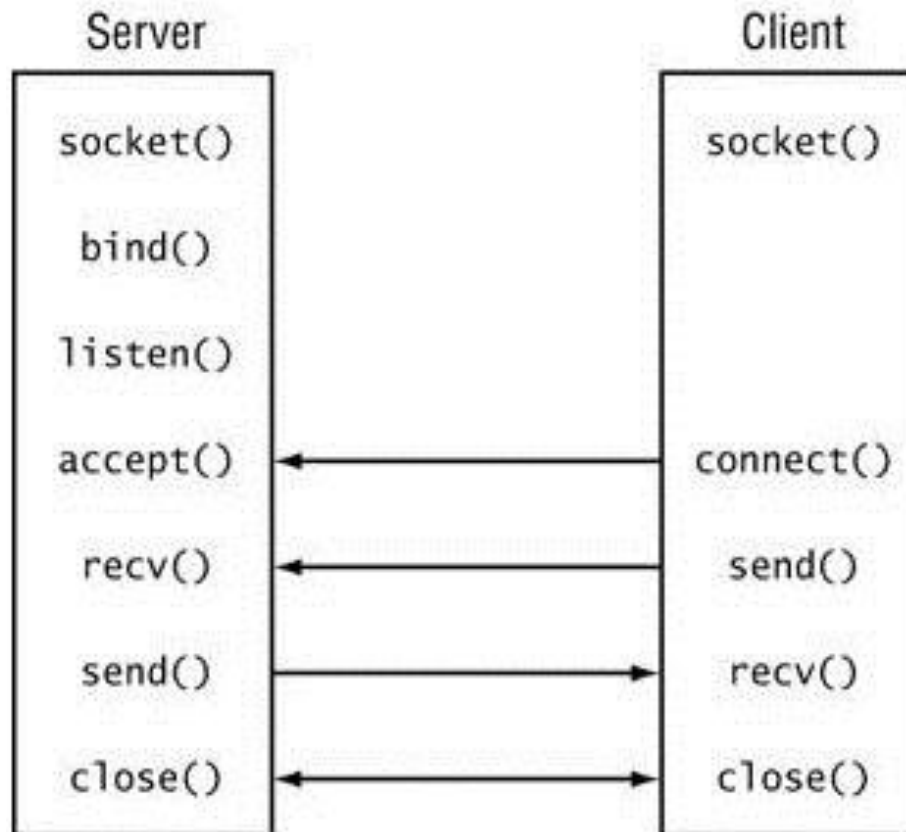


# Socket

- Socket – інтерфейс між додатком та TCP/IP



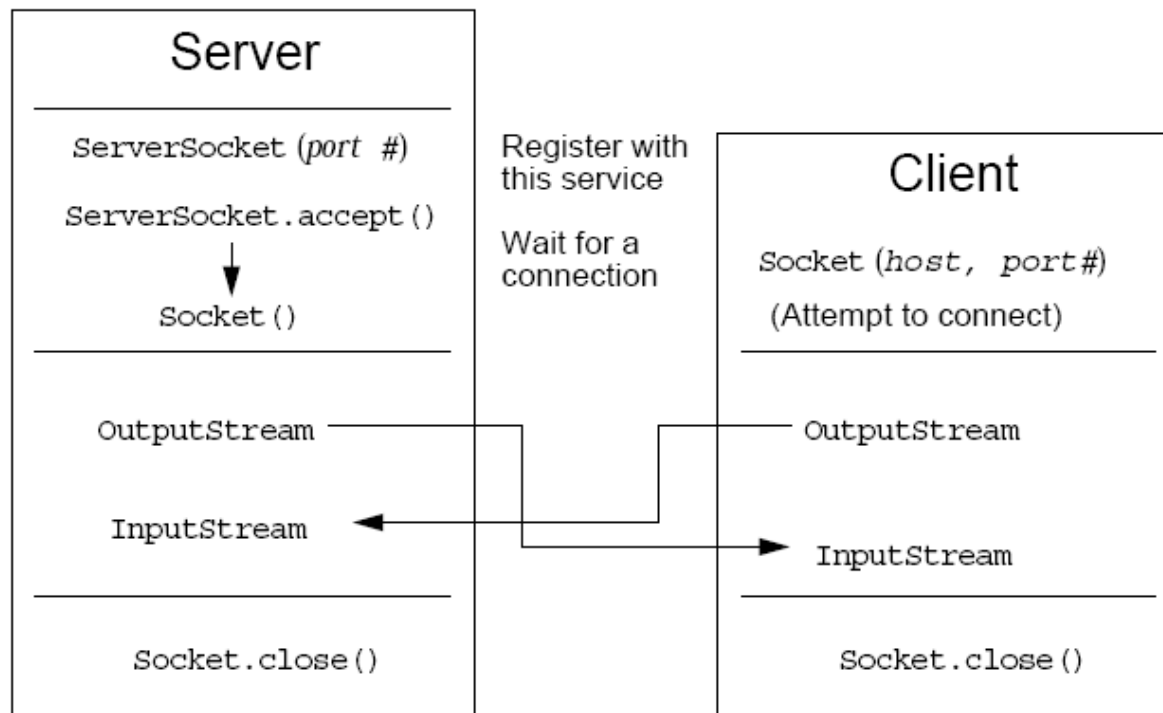
# Socket



# java.net

- Socket, ServerSocket - TCP
- DatagramSocket, DatagramPacket - UDP
- InetAddress, Inet4Address, Inet6Address
- InetSocketAddress

# Java TCP client/server



# Java TCP Server

```
import java.net.*;
import java.io.*;

public class SimpleServer {

    public static void main(String args[]) {
        ServerSocket serverSocket= null;

        try {
            serverSocket = new ServerSocket(5432);
        } catch (IOException e) {
            e.printStackTrace();
            return;
        }
    }
}
```

# Java TCP Server

```
while (true) {  
    try {  
        Socket clientSocket = serverSocket.accept();  
  
        OutputStream os = clientSocket.getOutputStream();  
        BufferedWriter bw = new BufferedWriter(  
            new OutputStreamWriter(os));  
  
        bw.write("Hello Net World!\n");  
  
        bw.close();  
        clientSocket.close();  
    } catch (IOException e) {  
        e.printStackTrace();  
    }  
}
```

# Java TCP Client

```
import java.net.*;
import java.io.*;

public class SimpleClient {
    public static void main(String args[]) {
        try {
            Socket socket = new Socket("127.0.0.1", 5432);
            InputStream is = socket.getInputStream();
            BufferedReader br = new BufferedReader(
                new InputStreamReader(is));
            System.out.println(br.readLine());
            br.close();
            socket.close();
        } catch (ConnectException connExc) {
            System.err.println("Could not connect.");
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```