



# IF2230 Jaringan Komputer

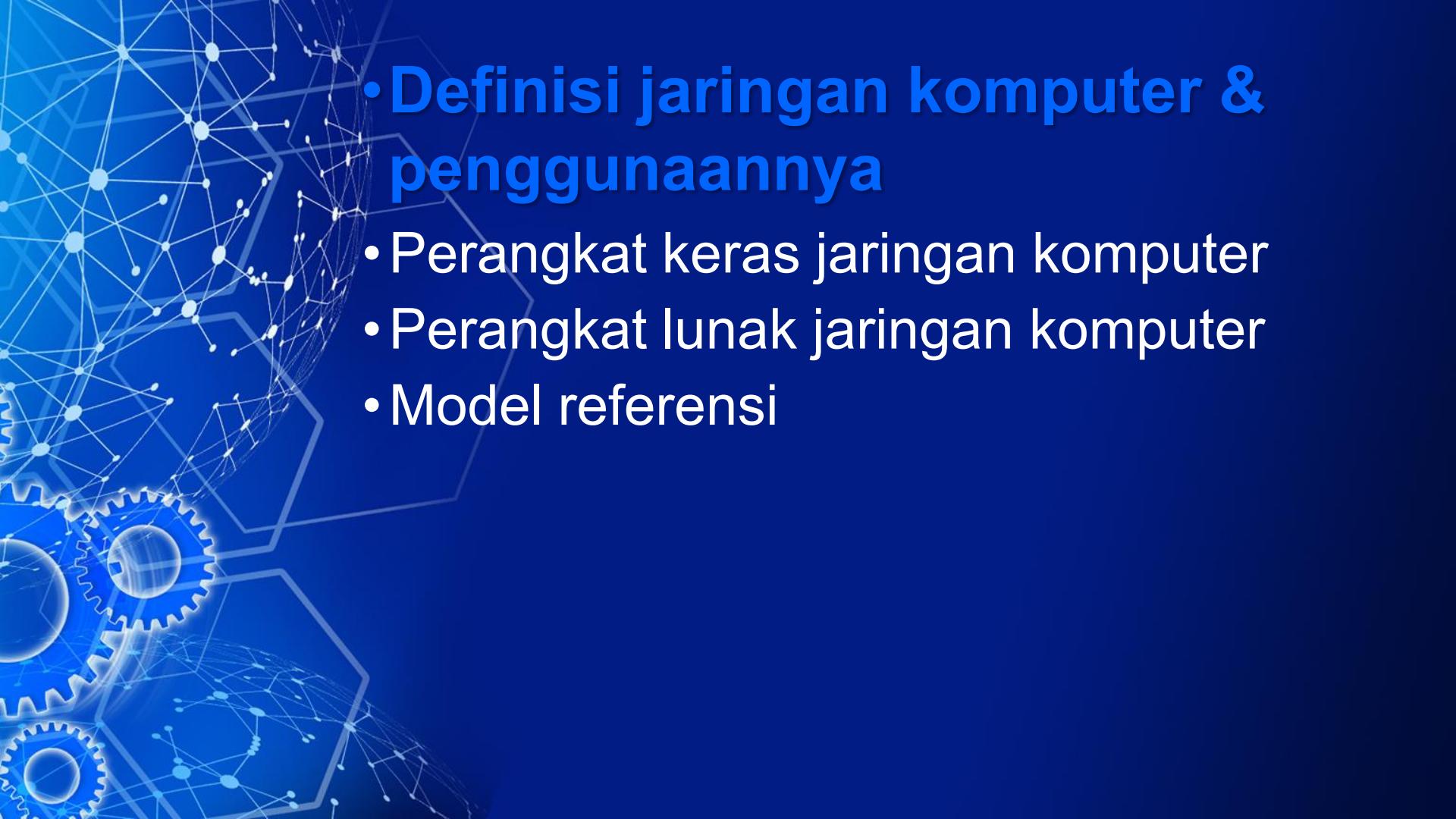
## Introduction

Robithoh Annur  
Andreas Bara Timur  
Monterico Adrian



# Pengantar jaringan komputer

- Definisi jaringan komputer & penggunaannya
- Perangkat keras jaringan komputer
- Perangkat lunak jaringan komputer
- Model referensi

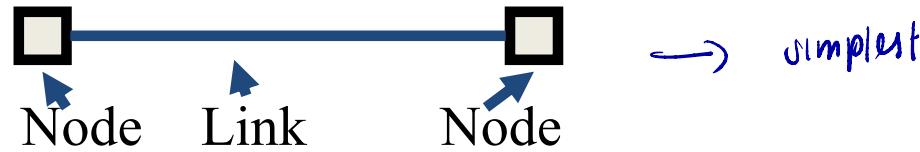
- 
- Definisi jaringan komputer & penggunaannya
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- 
- Collection of nodes and links that connect them
  - This is vague. Why? Consider different networks:
    - Internet
    - Andrew
    - Telephone
    - Your house
    - Others – sensor nets, cell phones, ...
  - Jaringan komputer: sekumpulan komputer yang terhubung dengan saluran komunikasi

# How to Draw a Network



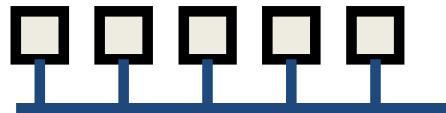
# Basic Building Block: Links



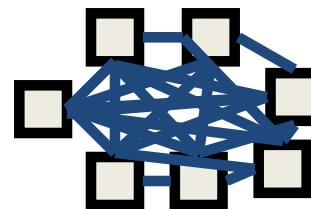
- Electrical questions
  - Voltage, frequency, ...
  - Wired or wireless?
- Link-layer issues: How to send data?
  - When to talk – can either side talk at once?
  - What to say – low-level format?
- Okay... what about more nodes?

# Basic Building Block: Links

- ... But what if we want more hosts?



One wire



Wires for everybody!

→ bertumbuh + berkembang

- Scalability?!

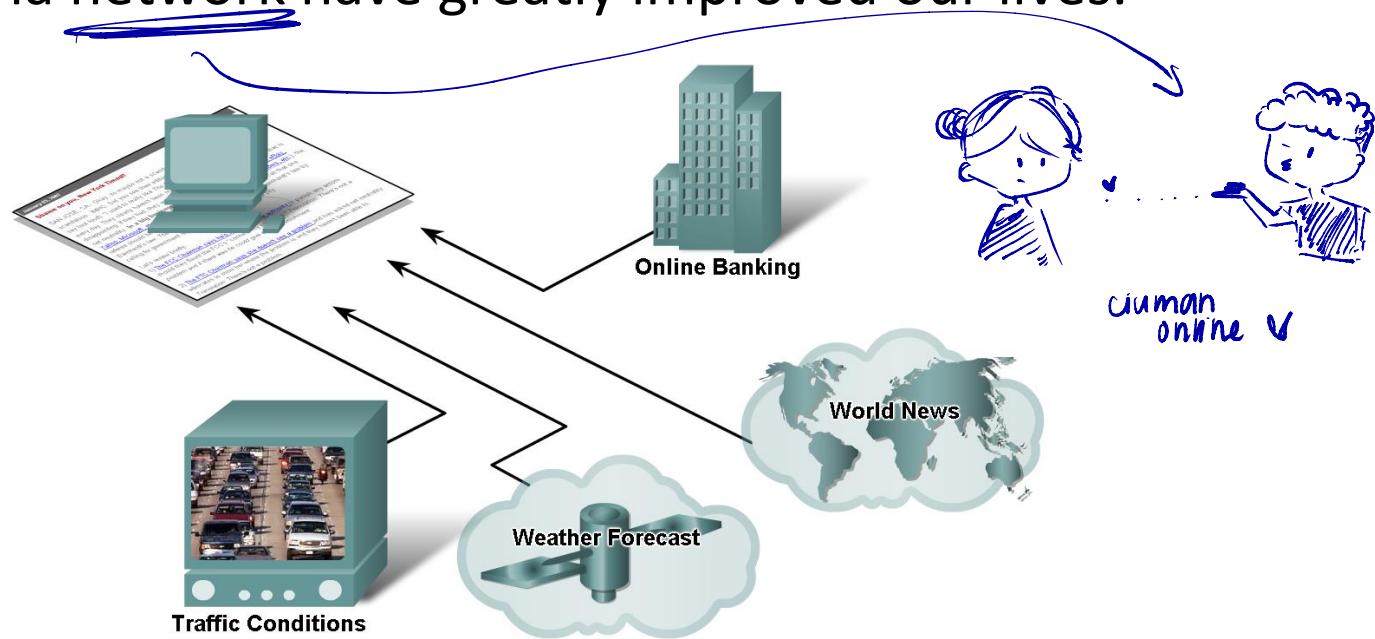
tapi

Kl sgt banyak jd ttp bisa collapse ^

how to connect?  
if we only have  
2 nodes,  
gd bisa byk  
linknya (?)

# How Networks Impact Daily Life

- The benefits of instantaneous communication via network have greatly improved our lives.



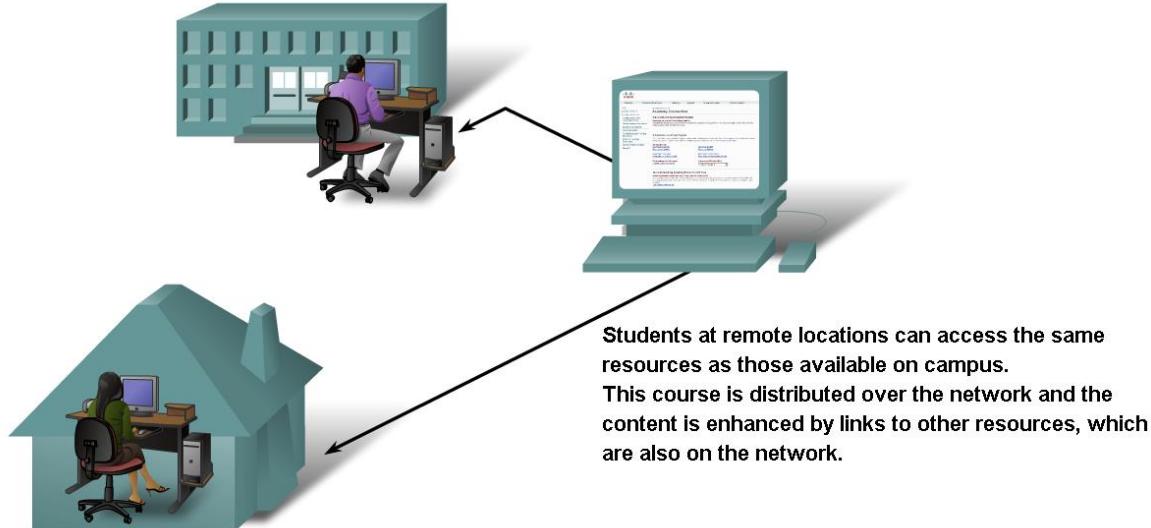
# How Networks Impact Daily Life

- Communication over a network has also greatly changed the way we work.



# How Networks Impact Daily Life

- and also changed the way we study....

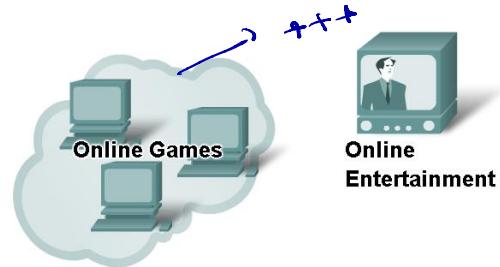


# How Networks Impact Daily Life

- the way we entertain ourselves....



## Online Interest Groups



## Online Entertainment



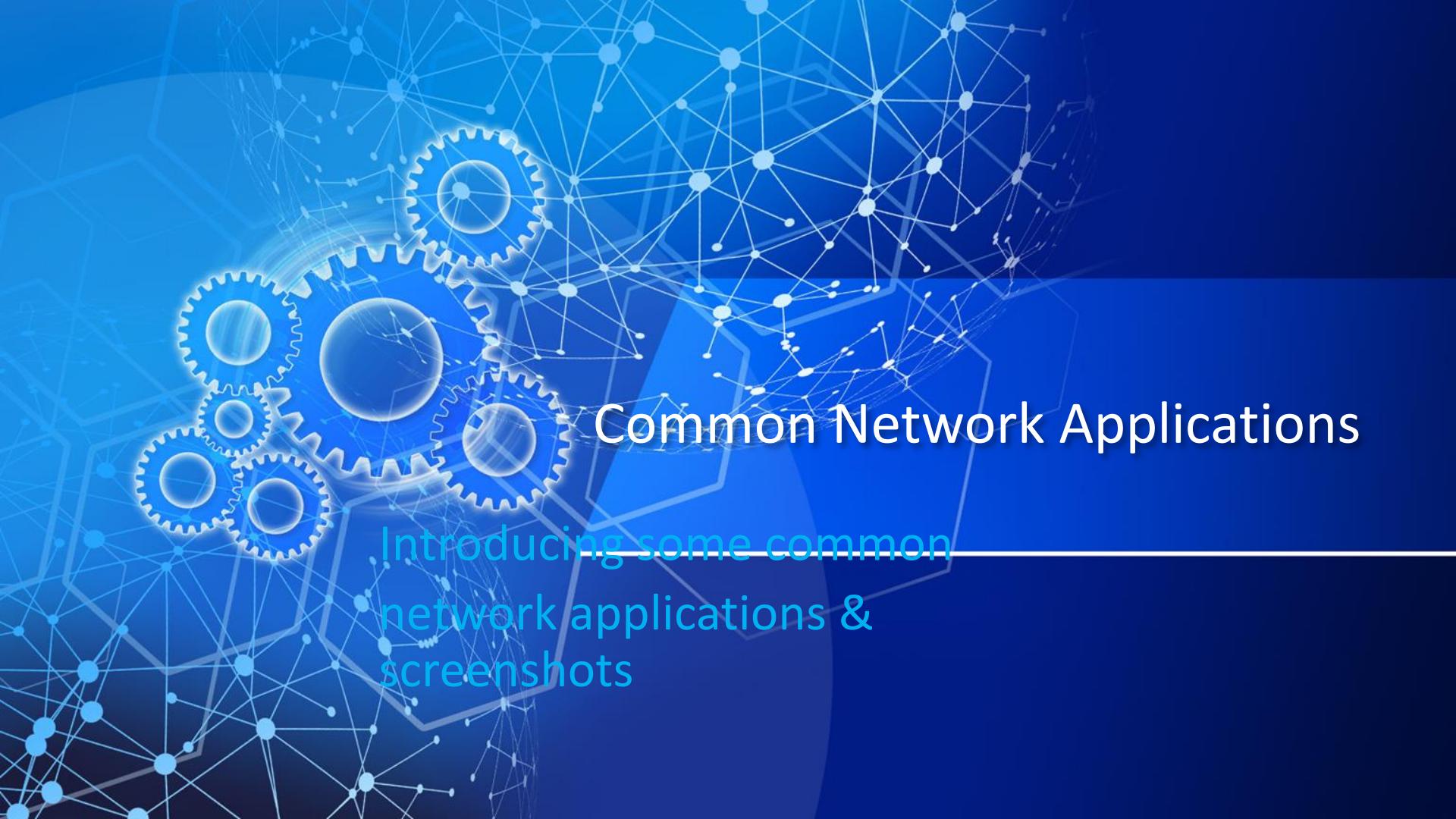
Online Travel



The onboard data network provides a range of services to airline personal seatback video systems.



## Instant Messaging

The background features a complex network of interconnected nodes and lines in shades of blue, resembling a digital or industrial gear system. A large, semi-transparent hexagonal shape is centered on the right side of the slide.

# Common Network Applications

Introducing some common  
network applications &  
screenshots



# Internet & Daily Life

- When you access the Internet, do you use the following applications?
  - Internet Explorer, Firefox
  - Google Mail, Hotmail, Yahoo Mail,
  - Yahoo Messenger, Skype, Whatsapp
  - Facebook, Google+, LinkedIn
  - Online Games (The Secret World, Final Fantasy XIV)
  - and others....
- Since these applications require the access to the Internet, we refer these applications as network applications.

SP yg  
m/n Pake  
dk

# Web Browser

- By definition:
  - A web browser is a network application for retrieving, presenting, and traversing information resources on the World Wide Web.
- The following network applications (web browsers) do the same thing as Internet Explorer:
  - Google Chrome
  - Mozilla Firefox
  - Netscape
  - Opera
  - Safari
  - Camino
  - Konqueror
  - and others....



Netscape 2.0  
is The browser that  
make the Internet  
or World Wide Web  
into a global  
phenomena back in  
1996.

# Other Web Browsers' Screenshots

Safari



Google Chrome



# Other Web Browsers' Screenshots

Firefox



Opera

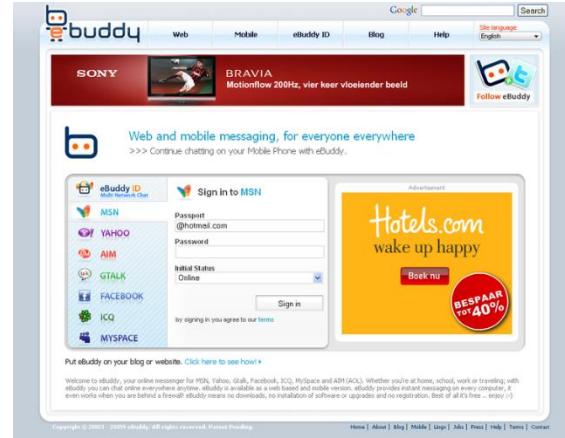
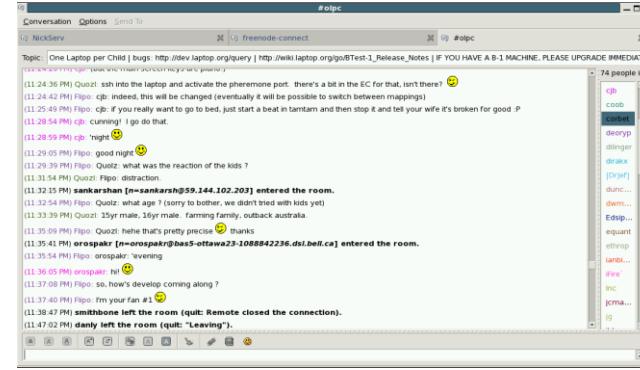
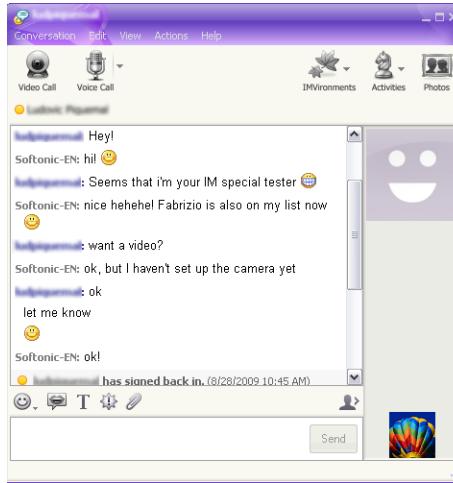


# Instant Messaging

- Another popular network application beside the web browsers is Instant Messaging.
- Instant messaging (IM) is a form of real-time direct text-based communication between two or more people using personal computers (PCs) or other devices.
  - More advanced instant messaging software also allow live voice or video calling.
- Some of the popular instant messaging software:
  - ICQ
  - Skype
  - Yahoo! Messenger
  - Facebook Messenger
  - Ebuddy
  - Line
  - WhatsApps



# Screenshots of Other Instant Massagers



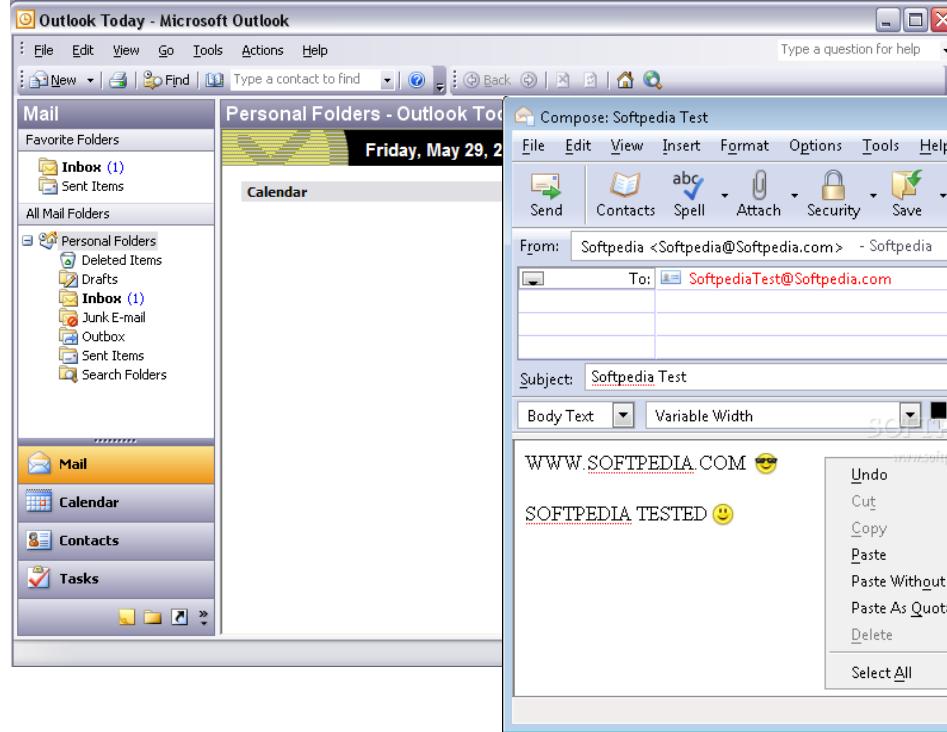


# Email

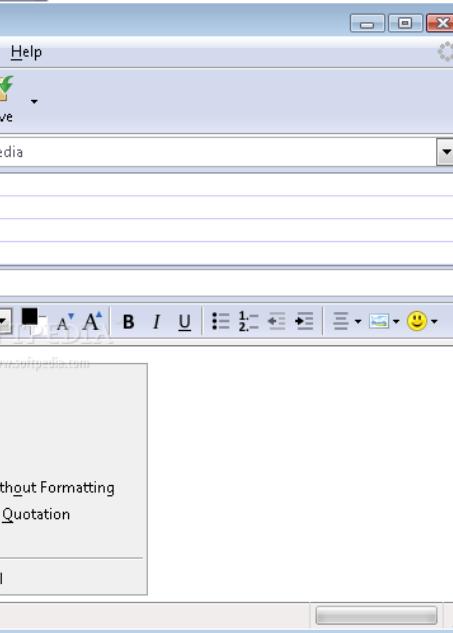
- For all business activities via the Internet, any network manager will tell you that the Email is the most important network application.
- Email remains as the oldest and still the most frequently used network communications in the Internet.

# Screenshots of Email Software

Microsoft's Outlook



Mozilla Thunderbird





# Other Network Applications

- Besides Web Browser, Instant Messaging & Email, there are other network applications that do:
  - File transfer
    - (Ws\_FTP, Free Download Manager)
  - Remote login
    - (PuTTY, Terra Term)
  - Accessing remote database
    - (SQuirreL SQL Client )
  - Internet Relay Chat
    - (mIRC)
  - and other ...



# Topik

Definisi jaringan komputer & penggunaannya  
**Perangkat keras jaringan komputer**  
Perangkat lunak jaringan komputer  
Model referensi



# Pengelompokan Jaringan

- Pengelompokan berdasarkan jenis transmisi:
  - Broadcast links
  - Point-to-point links
- Pengelompokan berdasarkan skala

| Interprocessor distance | Processors located in same | Example                   |
|-------------------------|----------------------------|---------------------------|
| 1 m                     | Square meter               | Personal area network     |
| 10 m                    | Room                       | Local area network        |
| 100 m                   | Building                   |                           |
| 1 km                    | Campus                     |                           |
| 10 km                   | City                       | Metropolitan area network |
| 100 km                  | Country                    |                           |
| 1000 km                 | Continent                  |                           |
| 10,000 km               | Planet                     | The Internet              |



# Personal area networks

- A PAN is a computer network that used for communication among computer devices, including telephones and personal digital assistants, in proximity to an individual's body
- Bluetooth, ZigBee

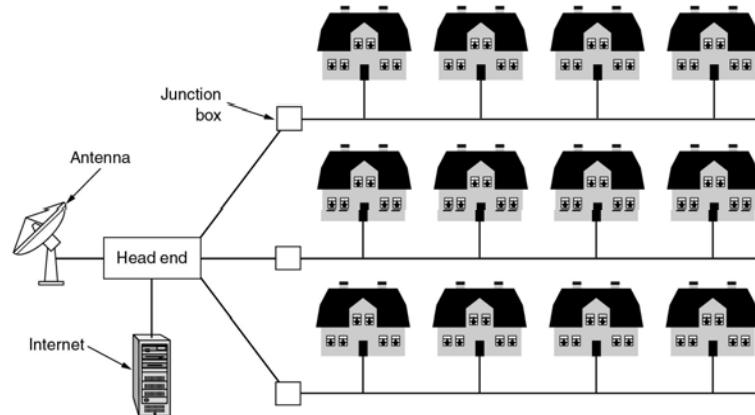
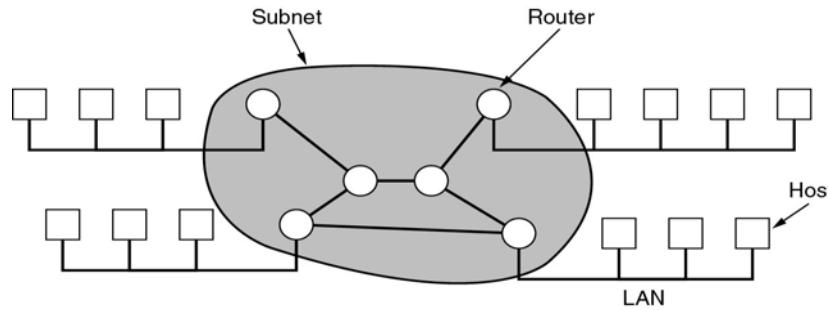


# Local area networks

- A LAN is a computer network covering a small physical area, like a home, office, or small groups of buildings, such as a school, or an airport.
- Menghubungkan komputer2 dengan peralatan lain (printer, data, files) untuk resource sharing
- Medium broadcast kabel:
  - Kecepatan awal 10 Mbps atau 100 Mbps. Teknologi terakhir mencapai 100 Gbps.
- Medium broadcast wireless (WLAN)
  - Kecepatan awal 11 Mbps, 54 Mbps. Teknologi terakhir mencapai 1.3Gbs.
- Standards:
  - <http://standards.ieee.org/getieee802/portfolio.html>

# Metropolitan Area Network

- A MAN is a large computer network that usually spans a city or a large area

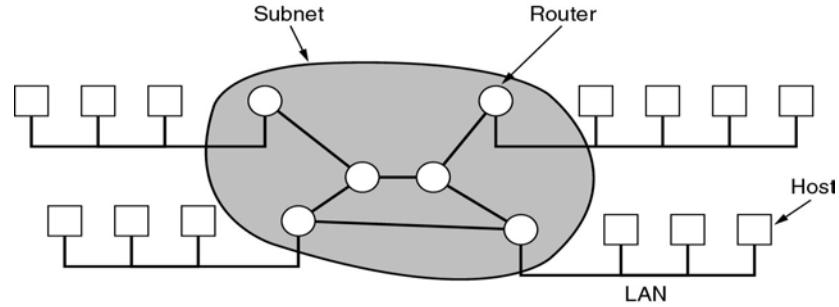


- Router: node/device/komputer yang menyediakan layanan komunikasi
- Subnet: kumpulan router (definisi umum). Subnet dapat pula berarti sekelompok node jaringan yang memiliki alamat IP awal sama.
- Relation between hosts on LANs and the subnet.

- A metropolitan area network based on cable TV.

# Wide Area Networks

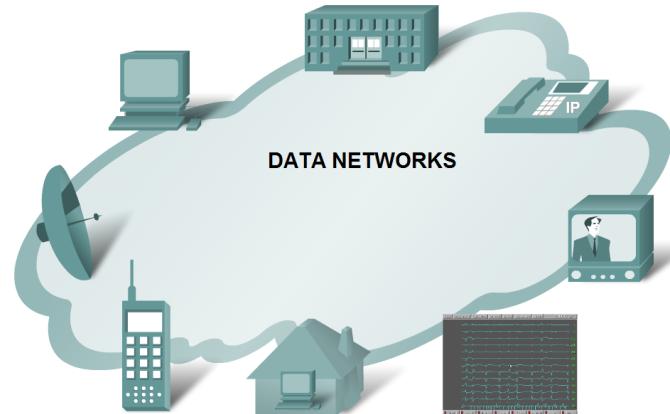
- A WAN is a computer network that covers a broad area (across metropolitan, regional, or national boundaries)
- Mencakup area geografis yang luas
- Umumnya terdiri atas banyak koneksi point-to-point
- Komputer/LAN terhubung dengan WAN melalui subnet
- Subnet dapat berbasis paket maupun circuit
  - Paket: pengguna berebut bandwidth yang ada
  - Circuit: pengguna memiliki jatah bandwidth tetap



- Router: node/device/komputer yang menyediakan layanan komunikasi
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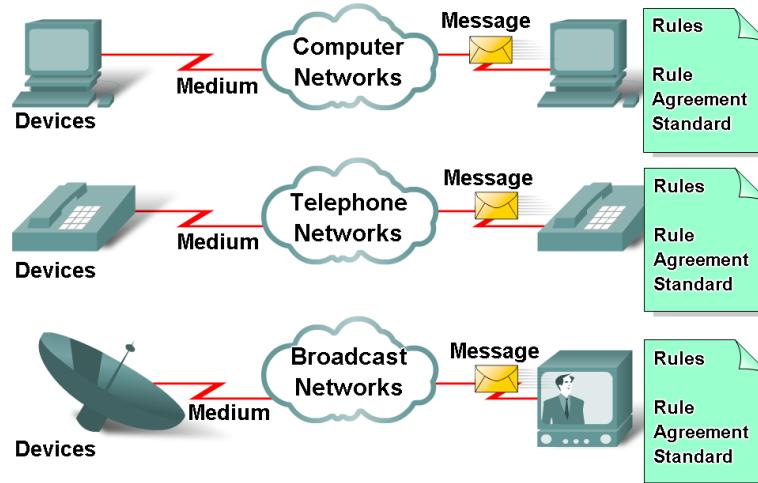
# Network as a Platform

- The function of a network is to serve as a platform for communications between end users.
- End users can be in the form of:
  - Servers & clients
  - Smart phones & other mobile devices
  - PCs and webcam



# Elements of a Network

- All networks have four basic elements in two categories:
  - Hardware: (i) Devices, (ii) Medium,
  - Software: (iii) Message, (iv) Rules/Agreement.



# Hardware: Devices & Medium

- Devices
  - will be explained in the later slides
- Medium
  - this is the channel over which a message travels
  - the following diagram shows some examples of a network medium

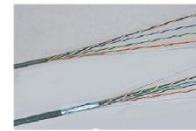
Network Media



Copper



Fiber Optics



Wireless





# Software: Message & Rules

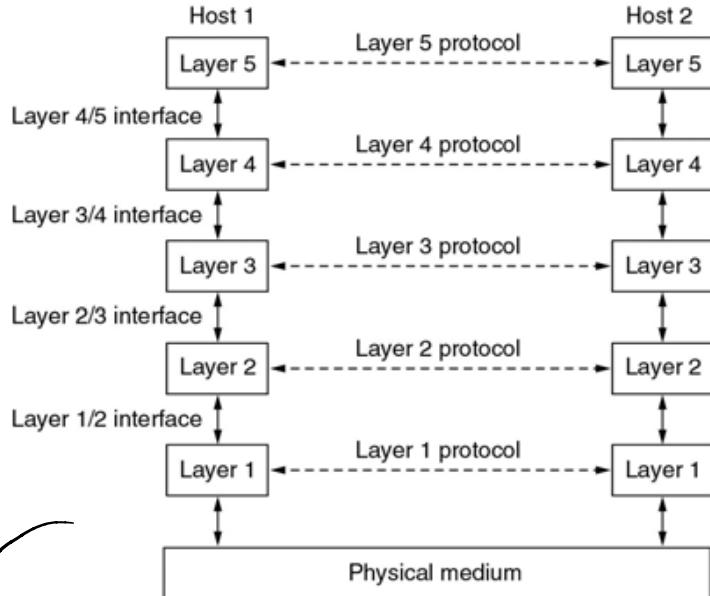
- Message:
  - Generic term that encompasses web pages, emails, instant messages, telephone calls, video, multimedia streaming, etc.
- Rules:
  - Addressing schemes (IP, MAC address, port numbers)
  - Protocols



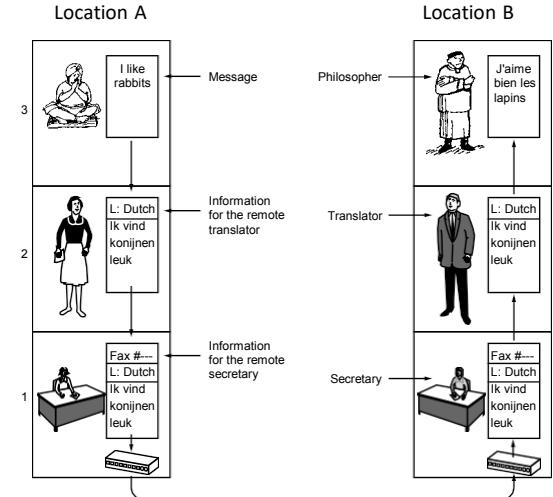
# Network Protocol

- Networks diorganisasikan ke dalam sederetan layer-layer
- Setiap layer memberikan layanan kepada layer di atasnya, dan menggunakan layanan dari layer di bawahnya.
- Layer N pada satu mesin berkomunikasi dengan layer N pada mesin lainnya (disebut sebagai peer), menggunakan aturan/protokol tertentu. Data dikirimkan melalui layer di bawahnya.
- Antarmuka antar layer yang bersebelahan mendefinisikan operasi primitif dan layanan yang disediakan

# Protocol Hierarchies



setiap layer punya fungsi nya masing<sup>2</sup>,  
tapi dia tetap harus serve layer  
diatasnya.



- The philosopher-translator-secretary architecture.

- Definisi jaringan komputer & penggunaannya
- Perangkat keras jaringan komputer
- Perangkat lunak jaringan komputer
- **Model referensi**



# Reference Models

- The OSI Reference Model
- The TCP/IP Reference Model
- A Comparison of OSI and TCP/IP
- A Critique of the OSI Model and Protocols
- A Critique of the TCP/IP Reference Model

# OSI Layered Model

- OSI was developed back in 1977, by International Organization for Standardization (ISO).
- OSI architecture has begun with two major components:
  - an abstract model of networking, with specific functions at each layer,
  - a set of specific protocols associated with a particular layer.

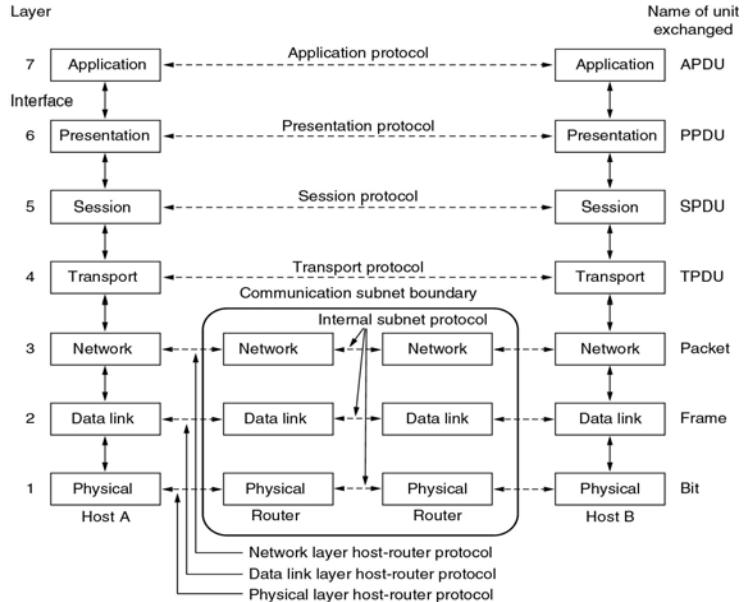
|              |           | OSI Model       |   |
|--------------|-----------|-----------------|---|
|              | Data unit | Layer           | Function                                  |
| Host layers  | Data      | 7. Application  | Network process to application            |
|              |           | 6. Presentation | Data representation and encryption        |
|              |           | 5. Session      | Interhost communication                   |
| Media layers | Segment   | 4. Transport    | End-to-end connections and reliability    |
|              | Packet    | 3. Network      | Path determination and logical addressing |
|              | Frame     | 2. Data Link    | Physical addressing                       |
|              | Bit       | 1. Physical     | Media, signal and binary transmission     |

(fokus ke  
basically  
the nodes  
)

masing ada yg  
speednya ... bits/s  
gitu berarti dan di  
physical

# The OSI Reference Model

- ISO menetapkan model Open Systems Interconnection untuk membantu pembangunan implementasi jaringan yang dapat berinteroperasi
- Aspek/masalah komunikasi dibagi menjadi 7 bagian yang lebih kecil, sehingga dapat lebih mudah dikelola, dengan membuat layer-layer





# OSI layer 1 – physical layer

- Layer 1 mengatur spesifikasi electrical, mechanical, procedural dan functional untuk:
  - Aktivasi sambungan fisik antar end systems
  - Pengelolaan sambungan fisik antar end systems
  - Deaktivasi sambungan fisik antar end systems
- Contoh:
  - Mengatur level tegangan
  - Timing sinyal
  - Data rate fisik
  - Jarak maksimum transmisi
  - konektor



# OSI layer 2 – data link layer

- Layer 2 menyediakan layanan transmisi data yang bebas dari error antar 2 node yang tersambung melalui physical layer
- Layer ini memecah data dari layer network menjadi frame-frame, dan mengirimkannya node lainnya yang kemudian menggabungkannya kembali. Layer ini menangani:
  - Frame acknowledgements
  - Error detection & correction
  - Flow control
  - Medium access



# OSI layer 3 – network layer

- Layer 3 mengontrol bagaimana sebuah paket dapat diteruskan dari komputer asal ke tujuan dalam sebuah jaringan. Layer ini mengatur:
  - Penentuan rute paket
  - Congestion control/pengendalian kemacetan
  - Informasi untuk accounting
  - Menangani masalah interkoneksi antara subnet yang heterogen (antar LAN & WAN yang menggunakan protokol yang beragam)



# OSI layer 4 – transport layer

- Layer 4 adalah layer end-to-end yang paling bawah antara aplikasi sumber dan tujuan
- Layer ini menyediakan end-to-end flow control, end-to-end error detection & correction, dan mungkin juga menyediakan congestion control tambahan



# OSI layer 5 – session layer

- Layer ini menyediakan
  - dialogue control:
    - Siapa giliran berbicara/mengirim data
  - Token management
    - Siapa yang memiliki akses ke resource bersama
  - Sinkronisasi data
    - Apa status terakhir sebelum link putus



# OSI layer 6 – presentation layer

- Berkaitan dengan sintaks dan semantik data yang dikirimkan (bukan lagi masalah transmisi data)
- Menyediakan abstraksi data yang seragam sehingga dapat digunakan untuk komunikasi data antar komputer yang heterogen

yg divent voice, text, images, etc



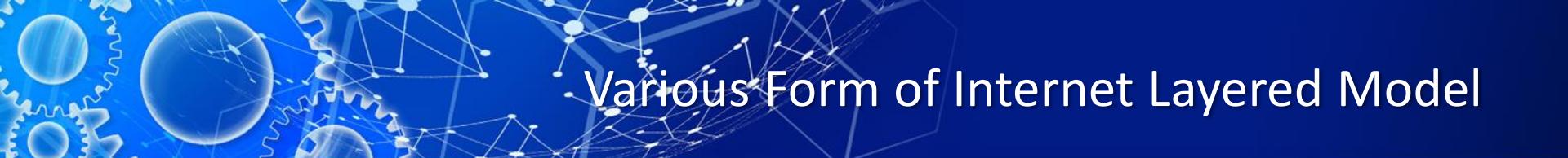
# OSI layer 7 – application layer

- Aplikasi yang menggunakan jaringan:
  - Network terminal/telnet
  - File transfer
  - E-mail
  - Newsgroup
  - Web
  - Directory lookup
  - Information retrieval/searching



# Terminologi OSI

- Elemen yang aktif dalam setiap layer disebut sebagai **entities** (dapat berupa hardware maupun software)
- Entities yang berada dalam layer yang sama pada mesin yang berbeda disebut sebagai peer entities. Data dikirim antar entities dalam satuan yang disebut sebagai **Protocol Data Units (PDU)**
- Entities pada layer N mengimplementasikan layanan yang digunakan layer N+1. Layer N disebut sebagai **service provider**, layer N+1 disebut sebagai **service user**.



# Various Form of Internet Layered Model

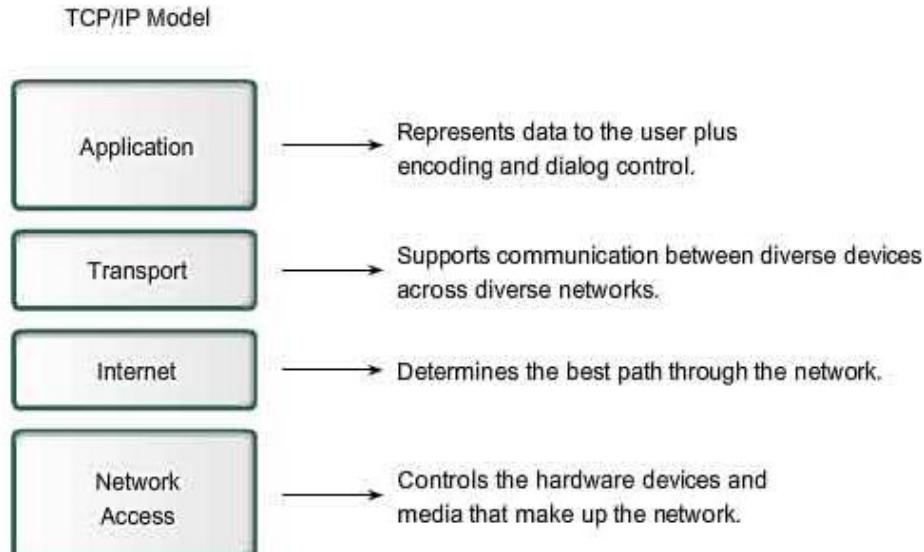
- The following table shows the layer model names and the number of layers of Internet model (or TCP/IP model) presented in the textbooks in today's university computer networking courses.

| Kurose <sup>[7]</sup> , Forouzan <sup>[8]</sup>        | Comer <sup>[9]</sup> , Kozierok <sup>[10]</sup> | Stallings <sup>[11]</sup> | Tanenbaum <sup>[12]</sup> | RFC 1122 <sup>[13]</sup> | Cisco Academy <sup>[13]</sup> |
|--|---|---------------------------|---------------------------|--------------------------|-------------------------------|
| Five layers  | Four+one layers                                 | Five layers               | Four layers               | Four layers              | Four layers                   |
| "Five-layer Internet model" or "TCP/IP protocol suite" | "TCP/IP 5-layer reference model"                | "TCP/IP model"            | "TCP/IP reference model"  | "Internet model"         | "Internet model"              |
| Application  | Application                                     | Application               | Application               | Application              | Application                   |
| Transport  | Transport                                       | Host-to-host or transport | Transport                 | Transport                | Transport                     |
| Network  | Internet  | Internet                  | Internet                  | Internet                 | Internetwork                  |
| Data link  | Data link (Network interface)                   | Network access            | Host-to-network           | Link                     | Network interface             |
| Physical   | (Hardware)                                      | Physical                  |                           |                          |                               |



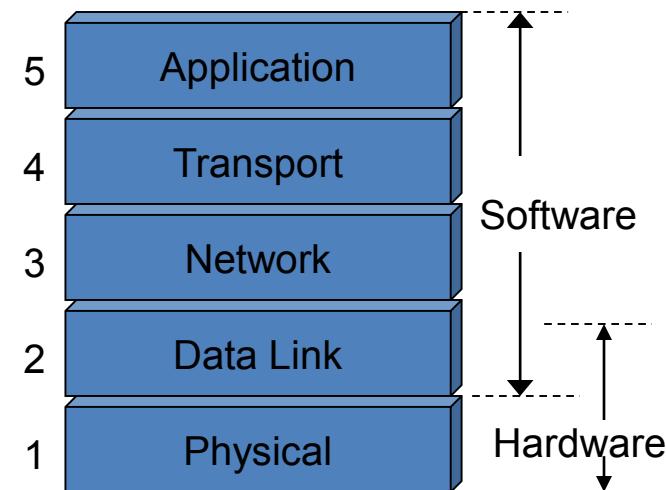
# TCP/IP Model

- Typical functions for each layer of TCP/IP model.



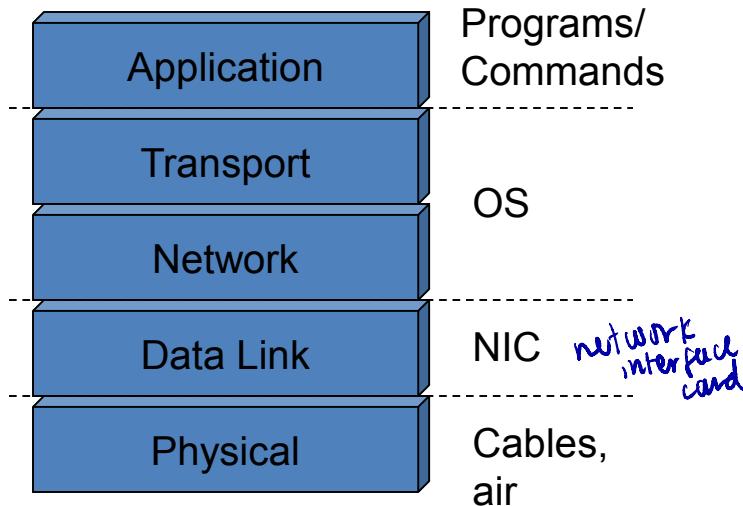
# Internet Layered Model

- There are 5 layer in Internet model.
  - Memorize this!!!
- Physical layer is called layer 1
- Application layer is called layer 5.
- First four layers deals mainly with software
- The physical layer (and data link layer) deals with hardware.



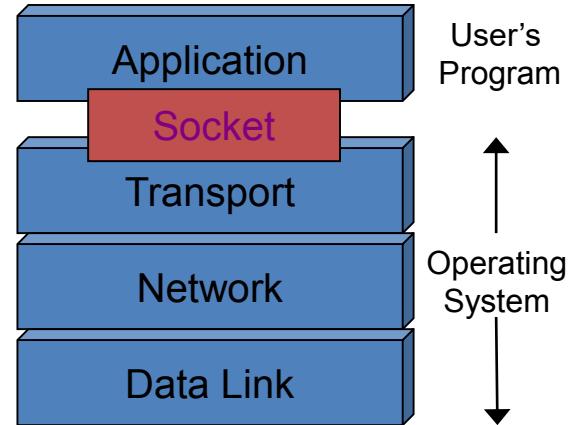
# Corresponding Layer in a Host

- For easy visualization of layered model in PC
- Layer 1 is made up of
  - Cables, transmission and reception of NIC
- Layer 2
  - Processing part of NIC
- Layer 3, 4, 5
  - CPU, RAM and hard disk



# TCP/IP Suite

- The TCP/IP protocol suite is the protocol architecture of the **Internet**
- The TCP/IP suite has four layers: **Application, Transport, Network, and Data Link Layer**
- End systems (hosts) implement all four layers. Gateways (Routers) only have the bottom two layers (Network and Data Link)





# Layered Architecture and Protocol

- Each layer has its own protocol
    - Application layer protocol: HTTP, FTP, DNS, DHCP...
    - Transport layer protocol: TCP, UDP
    - Network layer protocol: IP, ICMP, RIP....
    - Data Link layer protocol: ARP, *Ethernet*
  - The complexity of the communication task is reduced by using **multiple protocol layers**:
    - Each protocol is implemented independently
    - Each protocol is responsible for a specific subtask
    - Protocols are grouped in a hierarchy
  - A structured set of protocols is called a **communications architecture** or **protocol suite**.
- protocol for LAN (local)*



# IMPORTANT!!

- If you still don't understand protocol or layered architecture, at least remember the following:
  - Transport Layer gives port numbers
  - Network Layer gives IP address
  - Data Link Layer gives MAC address
- And, the “chunk” of data in
  - Transport Layer is called “segment”
  - Network Layer is called “packet”
  - Data Link Layer is called “frame”
  - Physical Layer is called “bits” or “bit streams”

# IMPORTANT: Protocols in Various layer

