



COMPUTER NETWORKING

ADVANCED NOTICE

NETWORK LAYERS

1. **Physical Layer** = Getting the letter into the “right form for the road”
2. **Data Link Layer** = Handling delivery inside your neighborhood
3. **Network Layer** = Choosing the route across different neighborhoods
4. **Transport Layer** = Ensuring the whole message arrives correctly
5. **Application Layer** = The service you actually use (web, email, chat)

PHYSICAL LAYER (Cables and Wi-Fi Signals)

What it does: Moves raw bits (0s and 1s) as electrical signals or radio waves.

Practical examples:

- Ethernet cable from your computer to a switch
- Wi-Fi radio sending data between your phone and a Wi-Fi router

TIP: If the Wi-Fi is disconnected or the cable is unplugged, everything above fails because the physical layer can’t carry data.

DATA LINK LAYER (Local Delivery: Switches and MAC Addresses)

What it does: Delivers data **within the same local network** (like your home or office). It uses **Media Access Control** addresses to decide where frames go.

Practical examples:

- Your laptop sends data to the correct device on the same Wi-Fi network

- A **switch** forwards data to the right port (instead of broadcasting to all devices)

ANALOGY: This layer is like “deliver inside the same building/neighborhood.”

NETWORK LAYER (Routing Between Networks: IP Address)

What it does: Sends data **between different networks** using **Internet Protocol** addressing. This is where **routing** happens.

Practical examples:

- Your home network sending data to a website server on the internet
- A **router** deciding the best next path toward the destination network using IP

Beginner analogy: This layer is like “choosing the road to reach another city.”

TRANSPORT LAYER (End-to-End Delivery: TCP and UDP)

What it does: Ensures the data gets delivered to the correct **application** on the destination device.

It adds reliability/ordering rules.

TCP (Transmission Control Protocol):

- Reliable delivery (re-sends lost parts)
- Ensures packets arrive in correct order

Practical TCP examples:

- Website loading (most web traffic uses TCP for reliable transfer)
- Email delivery

UDP (User Datagram Protocol):

- Faster, but does not guarantee delivery
- Packets may arrive out of order or be lost (no re-send)

Practical UDP examples:

- Live video calls / online gaming (speed is more important than perfect reliability)

ANALOGY: Transport layer is like “make sure the full message reaches the right person, with the right level of strictness.”

APPLICATION LAYER (Services You Use)

What it does: Provides the actual internet services to users. Protocols here define the “language” for each application.

Practical examples:

- **Web browsing** uses **Hypertext Transfer Protocol / Hypertext Transfer Protocol Secure**
- **Email** uses email protocols (not just one—depends on the system)
- **Chat** uses messaging protocols

ANALOGY: This is the “user experience layer”—websites, email, chat apps.

LEARNING PATH

Step 1: Learn what packets are

Practical meaning: When you send a file or open a website, the network **breaks it into packets** to send efficiently.

What to try:

- Open a webpage and imagine it as many small chunks being delivered.

Step 2: Understand IP addresses and ports

IP address (Internet Protocol address):

- Identifies the destination device (like “which house”)

Port:

- Identifies the destination application/service on that device (like “which room”)

Practical examples:

- Your computer needs an IP to reach the server.
- The server uses ports to know whether the traffic is for web, email, etc.

Step 3: Know the difference between a switch vs a router**Switch:**

- Connects devices in the same local network
- Uses local delivery (often based on Media Access Control)

Router:

- Connects different networks (local network to internet)
- Uses routing (based on Internet Protocol addressing)

Practical examples:

- A school lab switch connects all student PCs on the same LAN.
- The router connects the school LAN to the internet.

Step 4: Learn TCP vs UDP**TCP:**

- Reliability matters (re-send if something is lost)
- Used when “accuracy is more important than speed”

UDP:

- Speed matters more
- Used for real-time communication (where waiting would be worse)

Practical examples:

- Video calls and gaming often prefer UDP behavior.

- File downloads and web pages often prefer TCP behavior.

Step 5: Understand DNS and how websites load

DNS (Domain Name System):

- Translates a human-friendly name (like “example.com”) into an **Internet Protocol address**.

Practical flow when you type a website:

1. You type a domain name in your browser.
2. DNS resolves it to an IP address.
3. Your device connects to that IP address.
4. The website content is delivered (via the transport and application layers).

Beginner takeaway: DNS is like the internet’s “phonebook.”