CPE314 Data Communication and Computer Networks

Lecture 1: A Conceptual Preamble for the Entire Course

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Lecture Objectives

- Understand what **Data Communication** and **Computer Networks** really mean
- See how cellular systems evolved from a **data perspective**
- Identify where **computer networks and cellular networks overlap**
- Distinguish between **circuit switching and packet switching**
- Understand how **layered architecture unifies everything**
- Appreciate why this course matters in the **5G era in Pakistan**

Why Does This Course Exist?

A simple question

What happens when you press **Send** on WhatsApp?

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- How does data move?
- How does it reach the correct destination?
- What if something fails?

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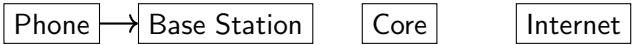
Key idea

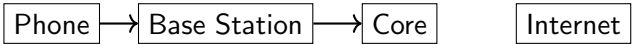
Software decides **WHAT**. Networks decide **WHETHER it works**.

Data Flow from Device to Internet



- Access Network (Physical + Link)

Data Flow from Device to Internet



- Access Network (Physical + Link)
- Core Routing (Network Layer)

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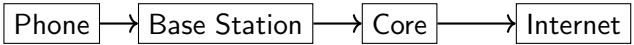

- Access Network (Physical + Link)
- Core Routing (Network Layer)
- End-to-End Delivery (Transport Layer)

From 1G to 5G — A Data-Centric View

Generation	Data Perspective
1G	Analog information
2G	Digital data
3G	Data rate limitations
4G	Packet-switched IP data
5G	Extreme performance requirements

Key insight

Generations changed because **data demands changed**.

Where Do Computer Networks Begin?

Distinction

- Communication systems move **bits**
- Computer networks connect **computers at scale**

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- Addressing
- Routing
- Congestion control
- Reliability
- Scalability

Communication engineering makes links possible.
Computer networking makes the Internet possible.

Data Communication vs Computer Networks

Data Communication

- Reliable transmission
- Error detection and correction
- Link-level focus

Computer Networks

- Scalable connectivity
- Routing and congestion
- End-to-end behavior

Important

You can have data communication without a network,
but you cannot have a computer network without data communication.

Circuit Switching vs Packet Switching

Circuit Switching

- Dedicated path
- Reserved resources
- Voice-centric

Packet Switching

- Shared resources
- Packets
- Scalable and efficient

Circuit switching serves conversations.
Packet switching serves networks.

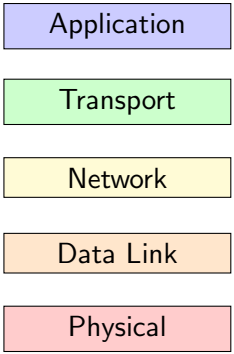
Cellular Networks in Pakistan: A Reality Check

- **2G**: Circuit-switched voice and SMS
- **3G**: Hybrid (voice + packet data)
- **4G/LTE**: Fully packet-switched
- **IP Multimedia Subsystem (IMS)**: Voice over packet networks
- **Circuit-Switched Fall Back (CSFB)**: Interworking with legacy systems

Key insight

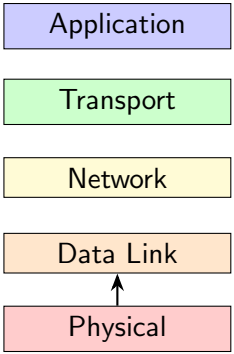
Networks evolve — users expect continuity.

Layered Architecture



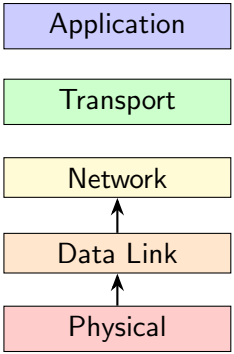
- Physical — How bits move

Layered Architecture



- Physical — How bits move
- Data Link — How neighbors talk

Layered Architecture



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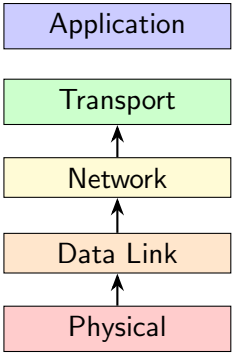
- Network — Where packets go

Layered Architecture



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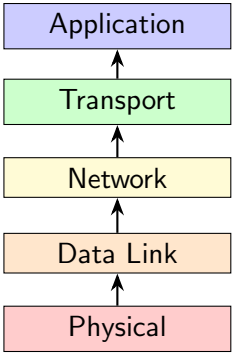
- Data Link — How neighbors talk
- Network — Where packets go
- Transport — How reliable / how fast

Layered Architecture



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- Network — Where packets go
- Transport — How reliable / how fast
- Application — What users want

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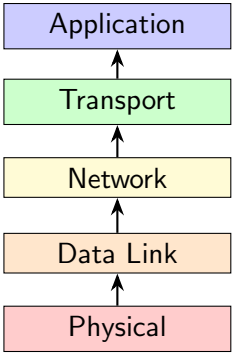

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Key Insight

Data Communication is the foundation; Computer Networks are built on top of it.

Why the Physical Layer Still Matters

- Bits must survive noise and interference
- Limited bandwidth affects performance
- Errors propagate upward

Key idea

Computer networks assume the physical layer exists —
data communication explains how it survives reality.

What This Course Is — and Is NOT

This course is NOT

- Antenna design
- RF engineering
- Heavy signal mathematics

This course IS

- Reliable data transfer
- Scalable connectivity
- Network behavior under load and failure

Analogy

We study traffic rules and routing — not how roads are built.

Final Takeaway

Data communication gives us the **foundation**.
Computer networks give us the **architecture**.
Cellular systems provide a **real-world application**.

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If you understand this course, you don't just use networks —
you understand **why they work**.