

# OSI Model vs TCP/IP Model: A Comparative Study

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**Abstract**—Computer networks rely on structured communication models to ensure reliable data transmission between devices. The OSI (Open Systems Interconnection) model and the TCP/IP (Transmission Control Protocol/Internet Protocol) model are two foundational networking models used to describe how data flows across a network. This research paper presents a detailed comparative study of the OSI and TCP/IP models, focusing on their architecture, layers, functionalities, advantages, limitations, and real-world applications. The study aims to provide a clear conceptual understanding for students and researchers in computer networks.

**Index Terms**—OSI Model, TCP/IP Model, Computer Networks, Network Layers, Protocols

## I. INTRODUCTION

With the rapid growth of the internet and communication technologies, standardized network models became essential for interoperability and efficient data exchange. Network models define rules and structures that guide communication between heterogeneous systems.

The OSI model was developed by ISO as a theoretical framework, while the TCP/IP model emerged as a practical implementation used in the Internet. Understanding the similarities and differences between these models is fundamental to learning computer networking.

## II. OVERVIEW OF THE OSI MODEL

### 2.1 Definition

The OSI (Open Systems Interconnection) model is a 7-layer conceptual model that standardizes the functions of a communication system.

### 2.2 OSI Layers and Functions

Layer No.	Layer Name	Function
7	Application	User interface, network services

6	Presentation	Data formatting, encryption
5	Session	Session management
4	Transport	Reliable data transfer
3	Network	Routing and addressing
2	Data Link	Error detection, framing
1	Physical	Transmission of raw bits

Diagram 1: OSI Model

Application  
 Presentation  
 Session  
 Transport  
 Network  
 Data Link  
 Physical

## III. OVERVIEW OF THE TCP/IP MODEL

### 3.1 Definition

The TCP/IP model is a 4-layer network model developed by DARPA and is the backbone of the Internet.

### 3.2 TCP/IP Layers and Functions

Layer	Function
Application	Network applications (HTTP, FTP, SMTP)
Transport	End-to-end communication (TCP, UDP)
Internet	Logical addressing and routing (IP)
Network Access	Physical transmission

Diagram 2: TCP/IP Model

Application  
 Transport  
 Internet  
 Network Access

IV. LAYER-WISE MAPPING OF OSI AND TCP/IP MODELS

OSI Model	TCP/IP Model
Application	Application
Presentation	Application
Session	Application
Transport	Transport
Network	Internet
Data Link	Network Access
Physical	Network Access

V. COMPARATIVE STUDY: OSI VS TCP/IP

Parameter	OSI Model	TCP/IP Model
Number of Layers	7	4
Developed By	ISO	DARPA
Nature	Theoretical	Practical
Protocol Dependency	Protocol-independent	Protocol-specific
Flexibility	Less flexible	Highly flexible
Usage	Educational	Real-world Internet

VI. ADVANTAGES AND LIMITATIONS

6.1 Advantages of OSI Model

- Clear layer separation
- Easy troubleshooting
- Ideal for learning and teaching

6.2 Limitations of OSI Model

- Complex structure
- Rarely implemented directly

6.3 Advantages of TCP/IP Model

- Highly reliable and scalable
- Widely implemented
- Supports internetworking

6.4 Limitations of TCP/IP Model

- Less clear layer separation
- No dedicated session and presentation layers

VII. REAL-WORLD APPLICATIONS

- Internet communication
- Email systems
- Web applications
- Cloud networking
- IoT communication

VIII. INTERACTIVE EXAMPLE

Scenario:

When you open a website:

- TCP/IP model ensures packet delivery via IP and TCP
- OSI model helps understand which layer handles encryption, routing, and display

This layered understanding improves network debugging and design.

IX. CONCLUSION

Both the OSI and TCP/IP models play vital roles in computer networking. The OSI model provides a clear conceptual framework, while the TCP/IP model offers a practical, real-world implementation. Understanding their comparison helps network professionals design, troubleshoot, and optimize communication systems effectively.

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