OSI Model vs TCP/IP Model

The OSI (Open Systems Interconnection) model and the TCP/IP (Transmission Control Protocol/Internet Protocol) model are two frameworks that explain how data moves in a network.

OSI Model (7 Layers)

The OSI model splits network communication into **7 layers**. Each layer has a specific job.

Layer 7: Application Layer

- **Job**: This is where programs interact with the network (like web browsers or email clients).
- **Examples**: HTTP (web browsing), FTP (file transfer), SMTP (email), DNS (domain names).
- **User Interaction**: This is where users interact with the network (e.g., sending an email or browsing a website).

Layer 6: Presentation Layer

- **Job**: This layer makes sure data is in the right format (like changing data into JSON or XML).
- **It also**: Handles encryption (like SSL/TLS) and compression.
- **Data Types**: Converts data into formats that the application layer can understand.
- **Example**: Compression of images or files before sending them.

Layer 5: Session Layer

- **Job**: Manages the conversation between two programs.
- **It handles**: Authentication (logging in) and session control.
- **Example**: When you log into a website, this layer keeps track of your session until you log out.
- **Protocols**: NetBIOS, PPTP.

Layer 4: Transport Layer

- **Job**: Makes sure data is delivered correctly to the right program.
- **Uses**: Ports (like port 80 for HTTP, port 443 for HTTPS).
- **Devices**: Routers, firewalls.
- **Data Type**: Segments.
    - **Segment Structure**:

```
| TCP Header | Data Payload |
```

- **Protocols**: TCP (reliable) and UDP (faster, but less reliable).
    - **TCP** manages flow control, error correction, and retransmission, and is more reliable.

- **UDP** is faster but doesn't guarantee data delivery.

Layer 3: Network Layer

- **Job**: Sends data from one device to another across different networks.
- **Uses**: IP addresses (like `192.168.3.1`).
- **Devices**: Routers.
- **Data Type**: Packet.
  - **Packet Structure**:

```
| IP Header | TCP Header | Data Payload |
```

- **Protocols**: IP (Internet Protocol).
  - **IP addresses** help route data from source to destination.

Layer 2: Data Link Layer

- **Job**: Moves data between devices on the same network and checks for errors.
- **Uses**: MAC addresses (unique addresses for devices).
  - MAC addresses are **48 bits long**.
  - The first **24 bits** identify the manufacturer, and the remaining **24 bits** are a unique identifier for the device.
- **Devices**: Switches, bridges.
- **Data Type**: Ethernet Frame.
  - **Ethernet Frame Structure**:

```
| Ethernet Header | IP Header | TCP Header | Data Payload | Ethernet
Trailer |
```

- **Example**: Ensures reliable data transfer between directly connected devices.

Layer 1: Physical Layer

- **Job**: Transmits raw data over physical cables or wireless signals.
- **Devices**: Network cables, routers, hubs, Wi-Fi.
- **No Addressing**: Deals with the physical connection, not addresses.

TCP/IP Model (4 Layers)

The TCP/IP model is simpler, with just **4 layers**.

Layer	OSI Equivalent Layers	What It Does

Layer	OSI Equivalent Layers	What It Does
Application	Application, Presentation, Session	Handles high-level protocols (HTTP, FTP, SMTP)
Transport	Transport	Ensures reliable delivery (TCP, UDP)
Internet	Network	Manages addressing and routing (IP, ICMP)
Link	Data Link, Physical	Handles the physical connection (Ethernet, Wi-Fi)

OSI Model vs TCP/IP Model

OSI Layer	OSI Layer Name	TCP/IP Layer	TCP/IP Layer Name
7	Application Layer	**4**	Application Layer
6	Presentation Layer		
5	Session Layer		
4	Transport Layer	**3**	Transport Layer
3	Network Layer	**2**	Internet Layer
2	Data Link Layer	**1**	Link Layer
1	Physical Layer		

Key Differences Between OSI and TCP/IP Models

Feature	OSI Model	TCP/IP Model
Number of Layers	7	4
Development	Made by ISO (a standard organization).	Made by the U.S. Department of Defense.
Layer Names	Physical, Data Link, Network, Transport, Session, Presentation, Application	Link, Internet, Transport, Application
Focus	A detailed, theoretical model.	A simpler, practical model used in real life.

Key Takeaways

- **OSI Model**: 7 layers, detailed, theoretical.
- **TCP/IP Model**: 4 layers, practical, used in real-world networking.
- Both models explain how data travels across networks.
- OSI is more detailed, while TCP/IP is easier and more commonly used.