

R&D DOCUMENT ON WORKING OF ALL THE LAYERS IN OSI MODEL

Prepared by: Piyush Kumar Dey

Intern, Celebal Technologies

Date: 08 June 2025

Abstract

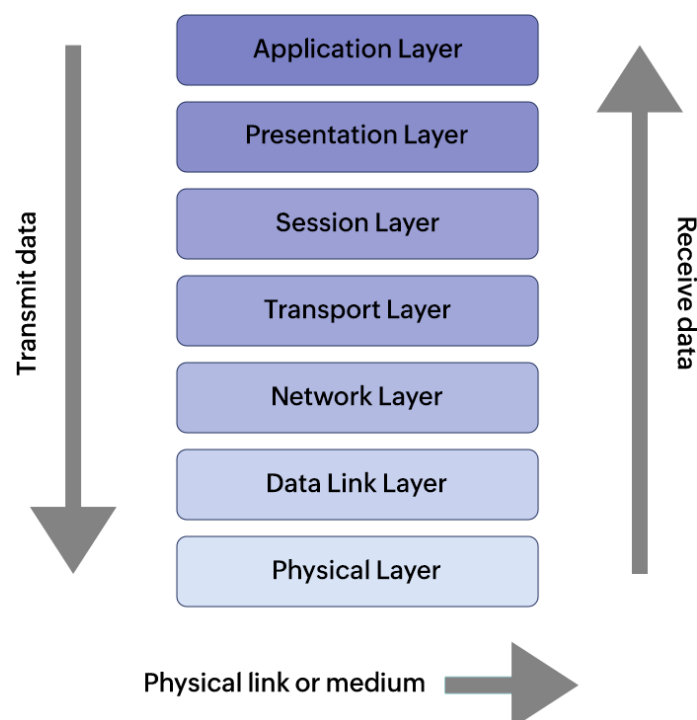
This research focuses on the OSI (Open Systems Interconnection) Model, which is a seven-step structure that describes how data moves through a network. The layers are **physical**, **data link**, **network**, **transport**, **session**, **presentation**, and **application**, where each performs a specific role in making sure information travels smoothly and correctly between devices.

The document also explores how these layers are used in cloud computing. It explains how data is split, passed through different devices like switches and routers, and safely put back together. It connects OSI layers with real tools such as firewalls, encryption, IAM, and virtual networks used in cloud platforms. The purpose is to understand how the OSI model helps build safe, strong, and efficient cloud systems.

1. Introduction

The OSI model is a basic concept that helps us understand how data moves between devices in a network. It is made up of seven layers: Physical, Data Link, Network, Transport, Session, Presentation, and Application. Each layer has its own job, and all of them work together to make sure data reaches its destination safely and correctly.

In cloud computing, the OSI model is very helpful because cloud services like virtual machines, storage, and firewalls all depend on different layers to work properly. By learning the OSI model, it becomes easier to plan, set up, and protect cloud systems. This report explains each layer in a simple way and shows how they are used in real cloud setups to keep everything running smoothly and securely.



2. Objective

This report mainly focuses on learning how the seven layers of the OSI model function and support the movement of data between two devices in a network. Each layer has its own task, and together they help in making sure that the data is sent and received in the right way without errors.

The document also aims to relate these OSI layers with common tools and services used in cloud computing. It explains how things like virtual networks, firewalls, data encryption, and user permissions are linked to specific layers. The goal is to make it easier to understand how the OSI model can be used to design secure and efficient cloud systems in real-life scenarios.

3. Overview of OSI Model

The OSI model is a way to understand how computers and devices communicate over a network. It breaks down the process into seven layers, each handling a specific part of the data transfer.

Starting from the bottom, the **Physical layer** deals with the actual hardware and signals used to send data. The **Data Link layer** ensures data is sent error-free between connected devices. The **Network layer** takes care of finding the best path for data to travel across networks.

The **Transport layer** makes sure data is delivered correctly and in order. The **Session layer** manages the connection between devices, keeping communication organized. The **Presentation layer** formats the data so it can be understood by the receiving device, like translating or encrypting it.

Finally, the **Application layer** is where users interact with the network, using software like web browsers or email clients. Each layer works with the others to make sure data moves smoothly and safely from one device to another.

4. Detailed Working of Each Layer

In this section, each layer of the OSI model with its working is described briefly and how the help in moving data across a network.

4.1 Physical layer

The Physical layer is the foundation where actual data travels as electrical or optical signals through cables, switches, and other hardware devices. It focuses on the physical connection and transmission of raw bits between devices.

This layer is responsible for defining things like voltage levels, cable types, and data rates. Without this layer, no physical link would exist to send or receive data.

4.2 Data link layer

The Data Link layer prepares data for transmission by organizing bits into frames and checking for errors during transfer. It also controls how devices on the same network identify each other using MAC addresses.

This layer ensures that data moves smoothly without mistakes on a local network. It also handles access control to avoid data collisions on shared media.

4.3 Network Layer

The Network layer decides the path data takes from the sender to the receiver across different networks. It uses logical addresses like IP addresses to route data through routers.

It helps in directing traffic on the internet, making sure data finds the best way to reach its destination even if networks are large or complex.

4.4 Transport Layer

The Transport layer breaks large data into smaller pieces called segments to send over the network. It also checks that all segments arrive correctly and in order, resending any that get lost.

Protocols like TCP provide reliable delivery, while UDP offers faster but less reliable transmission for applications like video streaming.

4.5 Session Layer

The Session layer manages and maintains the connection between two devices. It keeps communication open, allowing devices to exchange data in a structured way during a session.

4.6 Presentation Layer

The Presentation layer formats data so that the application layer can understand it. This includes converting data types, encrypting information for security, and compressing data to speed up transmission.

It acts like a translator and protector, making sure data is both readable and secure.

4.7 Application Layer

At the top, the Application layer lets users interact with the network through software like browsers and email programs. It provides the tools and protocols needed for common services such as HTTP and FTP.

This layer is where everything connects to the user, enabling things like web browsing, file sharing, and email communication.

5. Importance of OSI model in Cloud Infrastructure and Security

The OSI model is very useful in cloud computing because it helps explain how data moves and how different parts of a cloud system work together. Cloud infrastructure includes many components like virtual machines, storage, and networks, all of which rely on OSI layers to communicate properly.

Key roles of OSI layers in cloud security:

- Firewalls and routers work at the Network and Transport layers to control data flow and block threats.
- Encryption and data formatting happen at the Presentation layer to protect sensitive information.
- Access controls and user authentication are often handled in the Session and Application layers.

By understanding the OSI model, cloud engineers can design better security systems and apply the right tools at each layer to protect the network.

This layered structure also helps improve cloud system performance and makes managing networks easier. Each layer focuses on its specific job, which helps keep the whole system reliable and secure.

Overall, the OSI model is a valuable guide for building cloud networks that work efficiently and safely. The **Application layer** handles user authentication and permissions to ensure only authorized users can access cloud services.

6. Conclusion

The OSI model gives a clear way to understand how data moves through a network. It breaks communication into seven layers, each with a specific role, helping devices send and receive data correctly. In cloud computing, this model is very important because it shows how different parts of cloud systems work together and how security is applied at each step.

By knowing the OSI model, cloud engineers can design networks that are safe, reliable, and easy to manage. Each layer helps protect data and improve performance, making sure cloud services run smoothly. Overall, the OSI model is a useful tool for building strong and secure cloud networks.

References

- Forouzan, B. A. *Data Communications and Networking*.
- TechTarget. "OSI Model Definition."
- Oracle Cloud Infrastructure Documentation. "Understanding Network Security."
- Amazon Web Services (AWS). "Security in the Cloud."
- Geier, J. (2020). *Networking Fundamentals*.
- TutorialsPoint. "OSI Model Explained."