OSI from a Developer's Point of View in the Era of Cloud Computing

Technology, as we all know, continues to evolve and change. For decades, technologists have used the OSI Model as a frame of reference to troubleshoot network problems, evaluate security risks, and design new networks. Is the OSI model still relevant in the era of cloud computing?

Application solutions have changed from a single instance on a machine to client-server distributed solutions, to the web browser becoming the default client; it is now commonplace for applications to be cloud-hosted web-based solutions supported on every device. The best developers have always understood how their solutions perform across the OSI model. Understanding the impact and cost of resources, the required throughput of data, choosing the correct protocols, and effective communication with the security and infrastructure teams help developers design effective, low-cost, resilient solutions.

What is the OSI Model?

The Open Systems Interconnection (OSI) model is a conceptual model that describes how data communication works between computers. It divides data communication into seven layers, each performing a specific function. The OSI model is often used to troubleshoot network problems and to design and implement new networks. The OSI model is a valuable tool for understanding how data communication works.

Open Source Interconnection (OSI) 7 Layer Model

Layer	Application/Example		Central Device/Protocols			TCP/IP Model	DOD4 Model
Application (7) Serves as the method for users and application processes to access the network services	**End User Layer** - Provides measurable business value to a set of users Blogs, Wikis, CRMs, Email, Resource sharing, Remote file access and file transfer, Remote login, Remote printer access, Directory Services, Network Management, Database access		**User Applications** SMTP, FTP, HTTP, DNS, ODBC		GATEWAY	Application Layer	Process
Presentation (6) Formats the data to be presented to the Application Layer	**Syntax Layer** - Encrypt & Decrypt Character code translation, Data representation, Data compression, Data encryption, Character Set Translation		JPEG, EBDIC, TIFF, GIF, PICT				
Session (5) Allows session establishment between processes running on separate devices	**Synch & Send to logical ports** Dialog control, Synchronization, Abort handling, Session establishment, Maintenance and Termination, Session support - security, name recognition, logging, etc...		**Logical Ports** RPC, SQL, NFS, NetBIOS names				
Transport (4) Ensures that messages are delivered error-free, in sequence, and with no losses or duplication	**TCP** - Host to Host, Flow Control Connection establishment, Flow control, Error correction, Message segmentation, Message Acknowledgement, Message Traffic control, Session multiplexing	PACKET FILTERING	**Gateway, Relays, Proxies** TCP, SPX, UDP			Transport Layer	Host to Host
Network (3) Controls the operations of the subnet, deciding which physical path the data takes	**Packets** - "letter" contains IP Address Logical-physical address mapping, Routing, Subnet traffic control, Frame fragmentation, Encapsulation		**Routers** IP, IPX, ICMP		Can be used on all layers	Internet Layer	Internet
Data Link (2) Provides error-free transfer of data frames from one node to another over the physical layer	**Frames** - "envelopes" contains MAC address, End-to-end (NIC Card - Switch - NIC Card) Establishes and Terminates the logical link between nodes, Frame traffic control, Frame sequencing, Frame Error detection & correction, Media access control		**Switch Bridge WAP** PPP, SLIP	Land Based Layers		Network Access Layer	Network
Physical (1) Controls transmission and reception of the unstructured raw bit stream over the physical medium	**Physical structure** - Cables, hubs, etc... Electrical, Mechanical, Functional, Data Encoding, Physical medium attachment, Tramision technique, Physical medium transmission Bit & Volts		**Hub**				

(Burns, 2017)

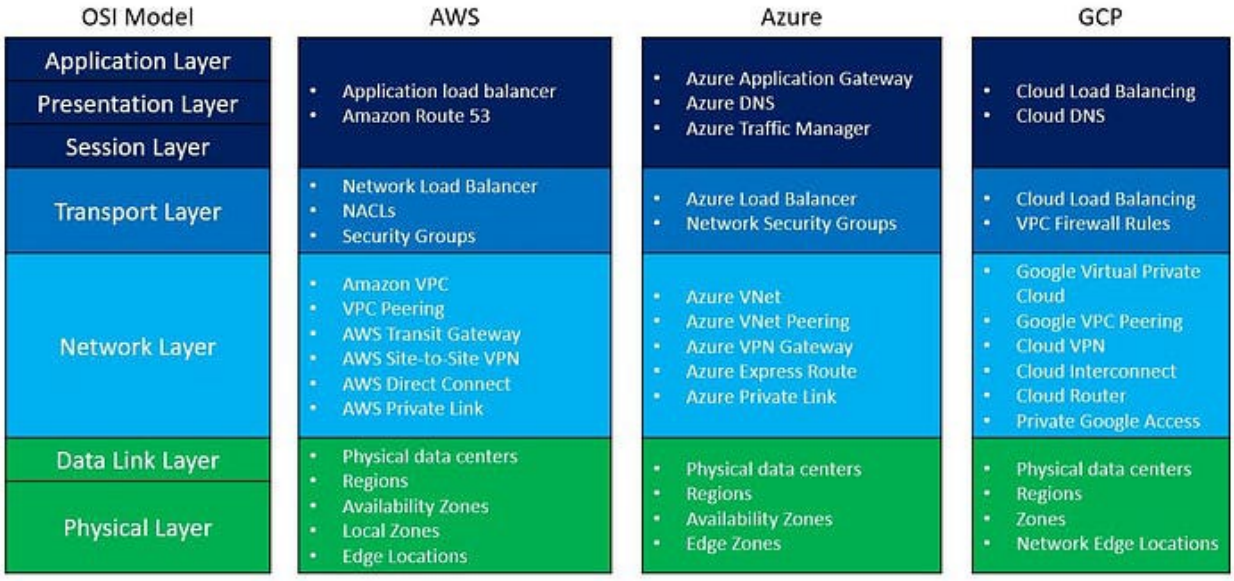
Here is a brief overview of the seven layers of the OSI model:

- Physical layer: The physical layer is responsible for the physical transmission of data between devices. This layer includes the physical cables, connectors, and other hardware used to connect devices.
- Data link layer: The data link layer is responsible for error detection and correction. This layer also provides flow control, ensuring data is transmitted promptly.
- Network layer: The network layer is responsible for routing data between devices on different networks. This layer also provides addressing, which allows devices to identify each other.
- Transport layer: The transport layer ensures data is delivered to the correct destination. This layer also provides flow control and error detection.

- Session layer: The session layer manages the communication between two devices. This layer provides for the establishment, maintenance, and termination of sessions.
- Presentation layer: The presentation layer is responsible for formatting data so the application layer can understand it. This layer also provides encryption and compression.
- Application layer: The application layer is the highest layer of the OSI model. It is responsible for providing services to the user. This layer includes email, web browsing, and file-sharing applications.

Mapping the OSI model to Cloud Services

The OSI model is not specific to any particular network technology. This makes it a valuable tool for understanding how data communication works in various environments, including the cloud. Developers should understand how cloud services relate to the OSI model to make informed decisions about using them. Below is a mapping of the OSI Model Layers and Cloud services:

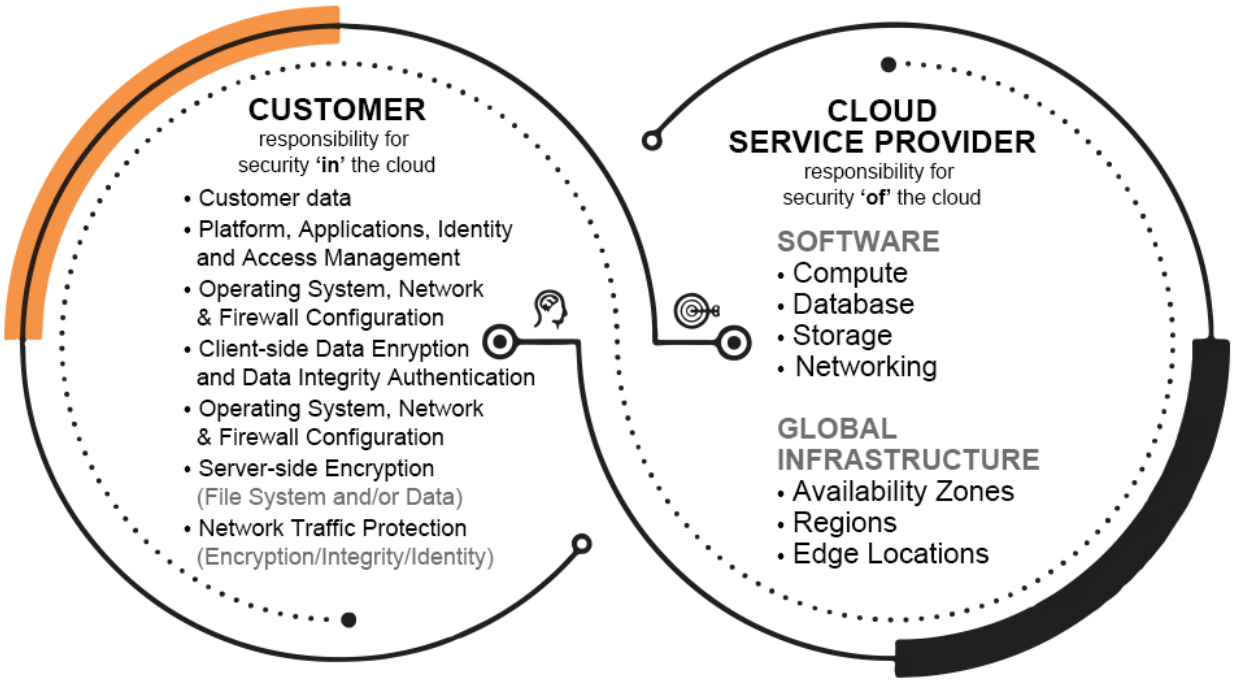


(Estrin, 2022)

Cloud services can be used at any layer of the OSI model. For example, a cloud storage service can be used at the physical layer to store data on remote servers. Here are a few uses cases:

- A cloud computing service can be used at the network layer to provide routing and forwarding services. A cloud database service can be used at the presentation layer to provide data formatting and encryption services.
- The OSI model can be used in the cloud to understand how data is transmitted between different cloud resources. For example, when a user sends an email from a cloud-based email client, the email must be transmitted to the cloud-based email server. The OSI model can be used to understand how email is transmitted between these two resources.
- The OSI model can also be used to troubleshoot network problems in the cloud. For example, if a user cannot access a cloud-based application, the OSI model can be used to identify the layer at which the problem is occurring. This information can then be used to troubleshoot the problem and resolve it.
- Developers should choose cloud services that are appropriate for the needs of their applications. For example, a cloud computing service that provides multiple redundant servers may be a good choice if an application requires high availability. A cloud database service that encrypts data at rest and in transit may be a good choice if an application requires strong security.

Another caveat to genuinely understanding the environment your code is running in is the Shared Responsibility Model inherent in all Cloud environments.



Source: https://www.horangi.com/horangipedia/what-is-the-shared-responsibility-model

Just as developers have always had to be able to communicate the requirements for their applications to their counterparts in Infrastructure and security teams, now we must also include the Cloud Service Provider in some of those discussions.

Cloud services can provide several benefits, including scalability, reliability, security, and cost-effectiveness. Developers should carefully consider the risks associated with cloud services, such as data loss, security breaches, and vendor lock-in. By understanding the OSI Model, developers can effectively communicate with the security and infrastructure teams to design effective, low-cost, resilient solutions that meet the solution's requirements.

Summary

The OSI model helps us understand how data communication works in the cloud. By understanding the different layers of the OSI model, you can troubleshoot network problems, design & implement new networks, and understand how data is transmitted between different cloud resources. In today's cloud-centric world, a developer's understanding of the OSI model is not only relevant but it's also necessary. By understanding the relationship between cloud services and the OSI model, developers can make informed decisions about using them to build better applications.

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