Discussion 1 The OSI model

Discussion Topic:

Professionals need to understand the OSI model. The OSI model is a conceptual model of how data travels from one PC to another. Explain how the OSI model aids in your understanding of networks. In addition, describe the pros and cons of the star and mesh topologies.

My Post:

Hello Class,

The Open Systems Interconnection (OSI) model is a standardized reference framework that describes how data flows in networks or how networked devices communicate with each other. In 1977 the International Organization for Standardization (ISO) developed OSI to standardize the interoperability of multivendor communications systems into one cohesive model (uCertify, 2019 a). The OSI Model is a reference model, it is not a reverence model (Wallace, 2020). In other words, the model does not need to be revered as a framework where every network component or device must neatly fit. However, it can be used as a tool to explain and understand where different network components or devices reside. This makes the model very useful for diagnosing and fixing network issues as it helps isolate problems within its different layers.

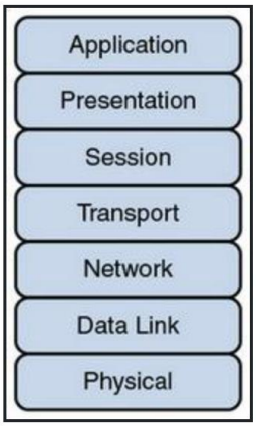
The OSI model is composed of seven layers:

- Layer 1: The physical layer
- Layer 2: The data link layer
- Layer 3: The network layer
- Layer 4: The transport layer
- Layer 5: The session layer
- Layer 6: The presentation layer
- Layer 7: The application layer

Note that the application layer is the last in the OSI queue, as it is the closest to the user. However, graphically the layers are usually represented as a stack, bottom-up, as illustrated in Figure 1.

Figure 1

OSI Layers

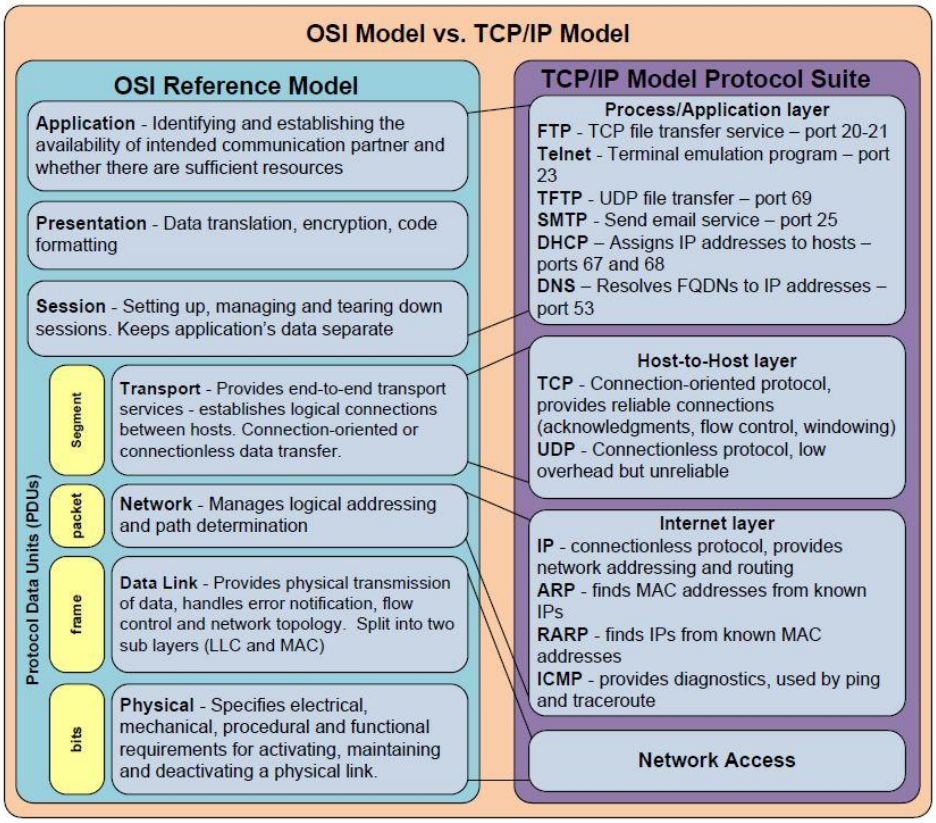


Note: From "The OSI reference model. *CompTIA Network+ Pearson N10-007*", Figure 2.2, by uCertify. (2019 a).

Each layer represents a different network functionality as shown in Figure 2.

Figure 2

OSI vs. TCP/IP



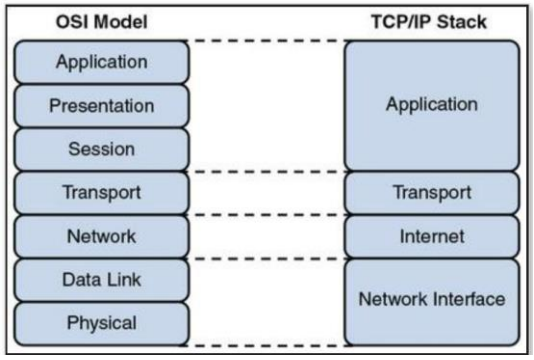
Note: From "Objective 1.01 Explain, compare, and contrast the OSI layers" by vWannabe (n.d.).

In Figure 2, the OSI stack is compared to the TCP/IP stack model, which is a reference model based on the TCP/IP protocol suite. The TCP/IP model is used to describe communications on the Internet and

simplifies the OSI layers into four categories which are Network Interface (Network access layer), Internet (Internet layer), Transport (Host-to-Host layer), and Application (Process/Application layer) see Figure 3.

Figure 3

OSI and TCP/IP



Note: From “The OSI reference model. CompTIA Network+ Pearson N10-007”, Figure 2.15, by uCertify. (2019 a).

The TCP/IP layers map to the OSI layers as follows:

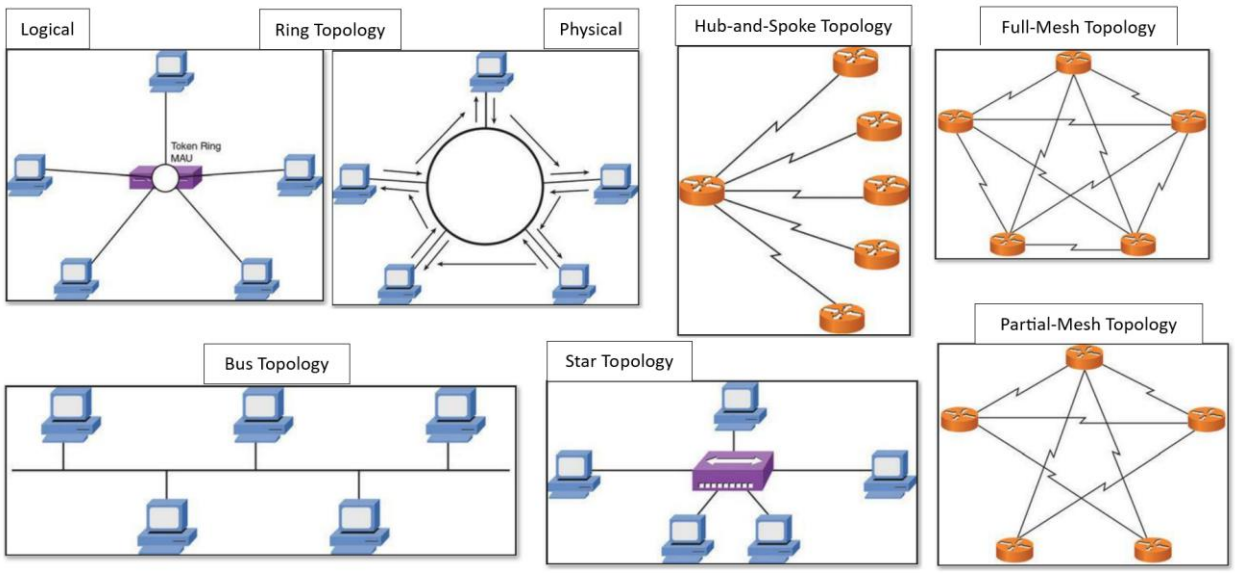
- Network Interface: Combines the physical and data link layers of the OSI model.
- Internet: Corresponds to the network layer of the OSI model.
- Transport: Maps directly to the transport layer of the OSI model.
- Application: Consolidates the session, presentation, and application layers of the OSI model.

As shown above, for me, the OSI model is a great tool for understanding network systems and diagnosing issues. When connected to the TCP/IP model, it provides practical insights into troubleshooting and understanding Internet systems, which is where most of today's networks operate.

Another important concept to understand is network topology. Topology classifies the arrangement of devices and connections within a network, either physically (physical topology) or logically (logical topology). Below is an illustration of the most common topologies:

Figure 4

Network Topologies



Note: From "Lesson 1: Computer Network Fundamentals. *CompTIA Network+ Pearson N10-007*," various Figures, by uCertify (2019 b). Modify.

The table below describes the characteristics, advantages, and limitations of various topologies.

Table 1

Network Topologies

Topology	Description	Benefits	Drawbacks
Bus Topology	Devices connect to a single cable (bus).	Requires less cable; simple to install.	Single point of failure; limited scalability; troubleshooting is difficult.
Ring Topology	Devices connect in a closed loop, and data flows in one direction.	Reduces contention; dual rings add fault tolerance.	A single break disrupts the entire network (in single-ring setups); scalability limitations.
Star Topology	All devices connect to a central hub or switch.	Fault isolation is easy; cable breaks affect only the connected device.	Requires more cable; the central hub or switch is a single point of failure.
Hub-and-Spoke	WAN topology with remote sites connecting to a central hub.	Cost-effective compared to full-mesh; easier to add new sites.	Suboptimal routes; the central hub is a single point of failure.
Full-Mesh Topology	Every site connects directly to every other site.	Optimal routes; high fault tolerance; easy troubleshooting.	Expensive and complex; adding new sites increases the number of required links exponentially.
Partial-Mesh	Selectively connects sites with high traffic, avoiding a full-mesh connection for all sites.	Balances cost and performance; more redundancy than hub-and-spoke.	Less redundant than full-mesh; more costly than hub-and-spoke.

Ad Hoc (Wireless)	Devices communicate directly without a central access point.	Simple setup; useful for temporary or mobile networks.	Limited range and scalability; less secure and reliable.
Infrastructure	Wireless devices communicate through a central access point, such as a wireless router.	Centralized management; supports a larger number of devices.	Dependent on access point; potential bottlenecks.
Mesh (Wireless)	Specialized nodes relay data in a wireless network.	Provides wide coverage and redundancy; scalable.	More complex setup; susceptible to interference and environmental challenges.

Note: Data from "Lesson 1: Computer Network Fundamentals. *CompTIA Network+ Pearson N10-007*" by uCertify (2019 b).

As shown in Table 1, each topology has its pros and cons depending on the needs, budget, and future goals of a business. One topology may be more suitable than another. Below, Table 2 is a comparison between Star and Generic Mesh Topologies, that showcases their advantages, disadvantages, and the types of business applications or use cases they are best suited for.

Table 2

Comparison of Star and Generic Mesh Topologies

Aspect	Star Topology	Mesh Topology
Structure	Centralized: All devices connect to a central hub or switch.	Decentralized: Devices connect directly to some or all other devices.
Fault Tolerance	Limited: A central hub failure disables the entire network.	High: Multiple redundant paths ensure communication even during link failures.
Scalability	Moderate: Adding devices requires additional ports on the switch/router and cables.	Partial Mesh: Scalable with selective links; Full Mesh: Poor scalability due to exponential connections.
Performance	High: Direct communication with the switch/router reduces collisions and latency.	Very High: Direct connections between devices enable optimal and efficient routing.
Installation Cost	Moderate: Requires more cables compared to bus or ring but less than mesh.	High: Full mesh demands extensive cabling; partial mesh balances cost with performance.
Complexity	Low: Easy to design, configure, and maintain.	High: Full mesh is complex to design, configure, and manage; partial mesh simplifies this.
Reliability	Moderate: Depends on the central router or switch; other device failures don't impact the entire network.	High: Redundancy ensures reliable operation even with multiple link or device failures.

Use Cases	Small-to-medium businesses, home networks, LANs with limited devices.	Critical systems, large enterprise networks, data centers, and IoT networks requiring fault tolerance.

Note: Data from "Lesson 1: Computer Network Fundamentals. *CompTIA Network+ Pearson N10-007*" by uCertify (2019 b).

As shown in Table 2 a star topology is better suited for Small-to-medium businesses due to its low cost as mesh topology is better suited for large enterprise networks, data centers, and IoT networks that require fault tolerance.

-Alex

References:

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