A Comparison of the OSI and TCP/IP Models

Background

Network protocols act as a common language for devices on a network, ensuring communication despite differences. They dictate how data is formatted, sent, and received. These protocols often come in layers, with each layer handling a specific task. Two key models showcase this layered approach: TCP/IP (four layers) and OSI (seven layers). TCP/IP forms the internet's foundation, while OSI provides a conceptual framework [1].

A vital concept is encapsulation. As data travels through layers, it gets wrapped with additional information (headers) specific to each layer. At the destination, this data is decapsulated, with each layer removing its header to reveal the original data [1]. Network protocols and layered architectures are fundamental for reliable network communication. Protocols provide a common language, and layers offer a structured approach to data transmission. Together, they enable seamless information exchange across vast networks.

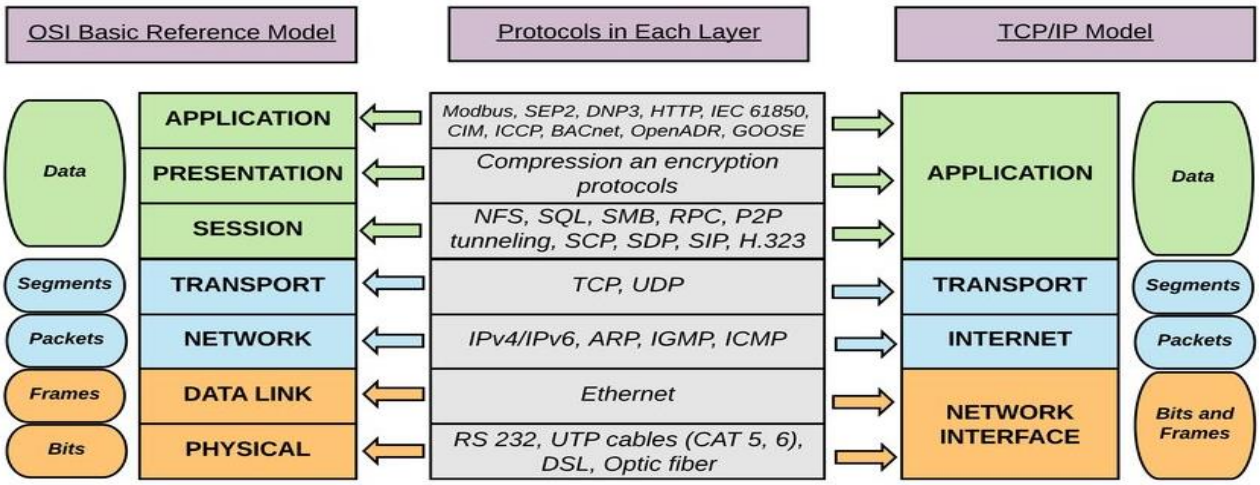

Figure 1:The logical mapping between OSI basic reference model and the TCP/IP model [2]

The Open Systems Interconnection (OSI) Model: This conceptual model serves as a reference framework, consisting of seven layers [3]:

1. Physical Layer: Deals with the physical transmission of data bits over a network medium.
2. Data Link Layer: Focuses on error-free data transmission on a single network link.
3. Network Layer: It handles routing and addressing data packets.
4. Transport Layer: Provides reliable data transfer services between applications.

5. Session Layer: Establishes, manages, and terminates communication sessions between applications.
6. Presentation Layer: Ensures data format compatibility between communicating applications.
7. Application Layer: Provides network services to applications.

The Transmission Control Protocol/Internet Protocol (TCP/IP) Model: This widely used model consists of four distinct layers [3]:

1. Network Access Layer: Manages physical data transmission over network media like cables or wireless connections. This layer is a combination of the Physical and Data Link layer of the OSI model.
2. Internet Layer: Handles routing and addressing data packets across networks. This layer corresponds to the Network layer of the OSI Model.
3. Transport Layer: Responsible for reliable data transfer between applications on different devices. Does not provide assurance delivery of packets because TCP is reliable while UDP is unreliable.
4. Application Layer: Defines protocols for user applications like web browsing and email. When the Application, Presentation, and Sessions layers of the OSI model are combined, they perform similar functions as the Application layer of the TCP/IP model.

Parameter	**OSI Model**	**TCP/IP Model**
Flow Control	The transport layer carries out flow control, sending data at a rate that matches the connection speed of the receiving device.	The transport layer is also responsible for flow control which ensures the receiving device can handle data rate.
Routing	OSI uses the network layer to define the routing standards and protocols.	TCP/IP uses the internet layer to define the routing standards and protocols.
Error Correction	Each layer of OSI architecture detects and handles error.	TCP/IP, transport layer handles all error detection and recovery.
Reliability	Considered less reliable.	Considered more reliable.
Protocol replacement	Protocols are easy to replace	Protocols are not easy to replace

Approach type	OSI follows a vertical approach.	TCP/IP follows a horizontal approach.
Service type	In the OSI model, the network layer provides connection-oriented and connectionless services.	In the TCP/IP model, the network layer provides only connectionless service.
Minimum header size	The minimum size of the OSI header is 5 bytes.	The minimum header size is 20 bytes.

Table 1: The differences between OSI model vs TCP/IP model [1] [3].

Conclusion

This research focused on the comparison of the OSI and TCP/IP models by analyzing the strengths and weaknesses of each layer and how they handle specific functionalities. The OSI model offers a theoretical framework for understanding network communication. However, the TCP/IP model is more practical and widely used in actual network implementations. While TCP/IP lacks some functionalities of OSI, it prioritizes simplicity and efficiency.

References

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[2] A. Sundararajan, A. Chavan, D. Saleem and A. I. Sarwat, "A Survey of Protocol-Level Challenges and Solutions for Distributed Energy Resource Cyber-Physical Security," *Energies,* 2018.

[3] A. Singh, "OSI vs TCP/IP Model: What’s the Difference?," Shiksha Online, India, 2024.