Research & Development Document: Functionality and Working of the TCP/IP Model

**1. Introduction**

The TCP/IP model, which stands for Transmission Control Protocol/Internet Protocol, is the basic framework for organizing and standardizing data communication across networks, including the Internet. It explains how data should be packetized, addressed, transmitted, routed, and received. This document describes the structure and operation of the TCP/IP model, compares it to the OSI model, and summarizes their functional differences and similarities.

**2. Overview of the TCP/IP Model**

Developed in the 1970s by DARPA, the TCP/IP model was created as a strong and scalable communication protocol stack for connecting computers over different networks. The model has four layers:

A. Network Access Layer

• Combines OSI's Physical and Data Link Layers.

• Manages hardware addressing and defines protocols for delivering data over physical media.

• Includes technologies like Ethernet, Wi-Fi, ARP, and others.

B. Internet Layer

• Matches OSI’s Network Layer.

• Responsible for logical addressing and routing using protocols like IP (IPv4/IPv6), ICMP, and ARP.

C. Transport Layer

• Corresponds to OSI’s Transport Layer.

• Ensures end-to-end communication, reliability, and data flow control.

• Key protocols: TCP (reliable, connection-oriented) and UDP (unreliable, connectionless).

D. Application Layer

• Combines OSI's Session, Presentation, and Application layers.

• Provides services for end-users and application interfaces.

• Protocols include HTTP, FTP, SMTP, DNS, and others.

**3. OSI vs. TCP/IP Model**

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| --- | --- | --- |
| Feature | OSI Model | TCP/IP Model |
| Layers | 7 | 4 |
| Developed By | ISO | DARPA (U.S. DoD) |
| Approach | Prescriptive (what should be done) | Descriptive (what is done) |
| Usage | Mostly theoretical, standard reference | Practical implementation basis for the Internet |
| Layer Names | Physical, Data Link, Network, Transport, Session, Presentation, Application | Network Access, Internet, Transport, Application |
| Protocol Definition | Protocols are tightly specified for each layer | Protocols are loosely defined, implementation-based |

* **Graphical Comparison of Layers**

|  |  |
| --- | --- |
| OSI Model | TCP/IP Model |
| Application | Application |
| Presentation |  |
| Session |  |
| Transport | Transport |
| Network | Internet |
| Data Link | Network Access |
| Physical | Network Access |

**4. Summary of Functionalities by Layer (TCP/IP)**

• Application Layer: Interacts with software applications to implement communication components. Handles data encoding, user authentication, and session management.

• Transport Layer: Manages error correction, flow control, and connection setup (TCP/UDP).

• Internet Layer: Manages logical addressing (IP), routing, and packet delivery across networks.

• Network Access Layer: Deals with physical connections, device drivers, and protocols needed for packet transmission.

**5. Conclusion**

The TCP/IP model offers a straightforward and practical approach for designing communication networks that work together. While the OSI model serves as a theoretical reference, TCP/IP is the model used in today’s Internet and networking technologies. Understanding both models is useful for troubleshooting, protocol design, and network engineering.

**6. References**

• Cisco CCNA Gold Bootcamp

• ISO OSI Model Documentation