

### Network Protocols

| Protocol | Port    | Description                                                                                                  |
|----------|---------|--------------------------------------------------------------------------------------------------------------|
| SSH      | 22      | Secure Shell protocol used for secure remote access and file transfer.                                       |
| FTP      | 20/21   | File Transfer Protocol used for transferring files between computers.                                        |
| SMTP     | 25      | Simple Mail Transfer Protocol used for sending email messages between servers.                               |
| DNS      | 53      | Domain Name System protocol used for translating domain names into IP addresses.                             |
| DHCP     | 67/68   | Dynamic Host Configuration Protocol used for assigning IP addresses to devices on a network.                 |
| HTTP     | 80      | Hypertext Transfer Protocol used for web browsing.                                                           |
| POP3     | 110     | Post Office Protocol (ver. 3) used for retrieving email messages from a mail server.                         |
| IMAP     | 143     | Internet Message Access Protocol used for retrieving email messages and managing mailboxes on a mail server. |
| SNMP     | 161/162 | Simple Network Management Protocol used for managing and monitoring network devices.                         |
| HTTPS    | 443     | HTTP over SSL/TLS encrypted protocol for secure web browsing.                                                |
| TCP      | -       | Transmission Control Protocol used for establishing reliable connections between devices on a network.       |
| UDP      | -       | User Datagram Protocol used for establishing unreliable connections between devices on a network.            |
| ICMP     | -       | Internet Control Message Protocol used for error reporting and diagnostic messages.                          |
| ARP      | -       | Address Resolution Protocol used for mapping IP addresses to MAC addresses.                                  |

### OSI Model

| Layer                                                                                                 | Name         | Protocol Data Unit (PDU) | Protocols                            |
|-------------------------------------------------------------------------------------------------------|--------------|--------------------------|--------------------------------------|
| 7                                                                                                     | Application  | Data                     | HTTP, FTP, SSH, DNS                  |
| Provides user interfaces and support for services such as email, file transfer, and network printing. |              |                          |                                      |
| 6                                                                                                     | Presentation | Data                     | SSL, SSH, IMAP, MPEG, JPEG           |
| Formats and encrypts data for transmission.                                                           |              |                          |                                      |
| 5                                                                                                     | Session      | Data                     | APIs, Sockets                        |
| Manages connections between applications.                                                             |              |                          |                                      |
| 4                                                                                                     | Transport    | Segment                  | TCP, UDP                             |
| Provides reliable, end-to-end data delivery and error recovery.                                       |              |                          |                                      |
| 3                                                                                                     | Network      | Packet                   | IP, ICMP, IPSec, IGMP                |
| Determines the best path for data transmission and performs logical addressing.                       |              |                          |                                      |
| 2                                                                                                     | Data Link    | Frame                    | Ethernet, PPP, Switch                |
| Transfers data between network devices and manages physical addressing.                               |              |                          |                                      |
| 1                                                                                                     | Physical     | Bit                      | Fiber, Access Points, Copper Cabling |



### OSI Model (cont)

Defines physical specifications for network hardware and cabling.

### TCP/IP Model

| Layer                                                                                               | Name         | Protocol Data Unit (PDU) |
|-----------------------------------------------------------------------------------------------------|--------------|--------------------------|
| 4                                                                                                   | Application  | Data                     |
| Provides network services to end-user applications, such as email, file transfer, and web browsing. |              |                          |
| 3                                                                                                   | Transport    | Segment                  |
| Provides reliable, end-to-end data delivery and error recovery.                                     |              |                          |
| 2                                                                                                   | Internet     | Packet                   |
| Determines the best path for data transmission and performs logical addressing.                     |              |                          |
| 1                                                                                                   | Network Link | Frame                    |
| Transfers data between network devices and manages physical addressing.                             |              |                          |

### Network Topologies

| Network Topology | Description                                                                                                                                                                                          |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bus Topology     | A single cable connects all devices in a linear sequence. Each device communicates with the others through the cable. If the cable fails, the entire network goes down.                              |
| Star Topology    | All devices are connected to a central hub or switch. If a cable fails, only the device connected to that cable is affected.                                                                         |
| Ring Topology    | Devices are connected in a circular loop. Each device communicates with the device next to it, and messages travel around the loop in one direction. If a cable fails, the entire network goes down. |
| Mesh Topology    | Each device is connected to every other device in the network. This provides redundancy and fault tolerance, but requires more cabling than other topologies.                                        |
| Tree Topology    | Also known as a hierarchical topology, devices are organized in a hierarchical structure with multiple levels. This provides scalability and fault tolerance, but can be complex to manage.          |
| Hybrid Topology  | A combination of two or more different topologies. This provides the benefits of each topology, but can be more complex to manage.                                                                   |

### Network Classes

| Class   | Range of IP Adresses         | Default Subnet Mask |
|---------|------------------------------|---------------------|
| Class A | 1.0.0.0 to 126.255.255.255   | 255.0.0.0           |
| Class B | 128.0.0.0 to 191.255.255.255 | 255.255.0.0         |
| Class C | 192.0.0.0 to 223.255.255.255 | 255.255.255.0       |
| Class D | 224.0.0.0 to 239.255.255.255 | N/A                 |
| Class E | 240.0.0.0 to 255.255.255.255 | N/A                 |



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### Subnetting

| Subnet Mask     | CIDR | Usable IPs | Network Address | Broadcast Address |
|-----------------|------|------------|-----------------|-------------------|
| 255.255.255.128 | /25  | 126        | 192.168.1.0     | 192.168.1.127     |
| 255.255.255.192 | /26  | 62         | 192.168.1.0     | 192.168.1.63      |
| 255.255.255.224 | /27  | 30         | 192.168.1.0     | 192.168.1.31      |
| 255.255.255.240 | /28  | 14         | 192.168.1.0     | 192.168.1.15      |
| 255.255.255.248 | /29  | 6          | 192.168.1.0     | 192.168.1.7       |
| 255.255.255.252 | /30  | 2          | 192.168.1.0     | 192.168.1.3       |

### Network Cables - Copper

| Cable Type | Max Data Transfer Speed | Max Operating Lengths |
|------------|-------------------------|-----------------------|
| CAT5       | 100 Mbps                | 100 Meters            |
| CAT5e      | 1 Gbps                  | 100 Meters            |
| CAT6       | 10 Gbps                 | 55 Meters             |
| CAT6a      | 10 Gbps                 | 100 Meters            |
| CAT7       | 10 Gbps                 | 100 Meters            |
| CAT8       | 40 Gbps                 | 30 Meters             |

### Network Cables - Fiber

| Cable Type          | Max Data Transfer Speed | Max Operating Lengths | Typical Use                                               |
|---------------------|-------------------------|-----------------------|-----------------------------------------------------------|
| OM1 - Orange Jacket | 10 Gbps                 | 33 Meters             | 100 Mbps Ethernet                                         |
| OM2 - Orange Jacket | 10 Gbps                 | 82 Meters             | 1 Gbps Ethernet                                           |
| OM3 - Aqua Jacket   | 10 Gbps                 | 300 Meters            | 10 Gbps Ethernet                                          |
| OM4 - Aqua Jacket   | 10 Gbps                 | 400 Meters            | 100 Gbps at 150 Meters                                    |
| OM5 - Green Jacket  | 10 Gbps                 | 400 Meters            | Improvements on OM4.                                      |
| OS1 - Yellow Jacket | 100 Gbps                | 10 Kilometers         | Single mode fiber for connecting indoor nodes.            |
| OS2 - Yellow Jacket | 100 Gbps                | 200 Kilometers        | Single mode fiber for connecting infrastructure outdoors. |

### IEEE 802

| IEEE 802 Standard | Description                                        |
|-------------------|----------------------------------------------------|
| 802.1Q            | Virtual LAN (VLAN) tagging standard.               |
| 802.1X            | Port-based network access control (PNAC) standard. |
| 802.2             | Logical link control (LLC) layer protocol.         |
| 802.3             | Ethernet standard.                                 |
| 802.3ab           | Gigabit Ethernet standard.                         |
| 802.3ae           | 10 Gigabit Ethernet standard.                      |
| 802.3af           | Power over Ethernet (PoE) standard.                |



### IEEE 802 (cont)

|          |                                                                                            |
|----------|--------------------------------------------------------------------------------------------|
| 802.3at  | PoE+ standard.                                                                             |
| 802.3bt  | 4-pair PoE standard.                                                                       |
| 802.11   | Wireless LAN (WLAN) standard.                                                              |
| 802.11a  | WLAN standard operating in the 5 GHz frequency band.                                       |
| 802.11b  | WLAN standard operating in the 2.4 GHz frequency band.                                     |
| 802.11g  | WLAN standard operating in the 2.4 GHz frequency band with higher data rates than 802.11b. |
| 802.11n  | WLAN standard with improved speed and range.                                               |
| 802.11ac | WLAN standard with even higher speed and range than 802.11n.                               |
| 802.11ax | WLAN standard designed for high-density environments with many devices.                    |
| 802.15   | Wireless personal area network (WPAN) standard.                                            |
| 802.15.4 | Low-rate WPAN standard used in Zigbee and other mesh networking protocols.                 |
| 802.16   | Broadband Wireless Access (BWA) standard.                                                  |
| 802.22   | Wireless regional area network (WRAN) standard for long-range, rural broadband.            |



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