

# CHAPTER 2

## Networking Basics

TESTOUT NETWORK PRO



# Networking Overview



# Key Terms

- ❖ Internet Protocol address (IP address)
- ❖ Subnet address
- ❖ Local area network (LAN)
- ❖ Metropolitan area network (MAN)
- ❖ Wide area network (WAN)
- ❖ Software-defined wide area network (SDWAN)
- ❖ Multipoint Generic Routing Encapsulation (mGRE)
- ❖ Internet

# Key Terms

- ❖ Intranet
- ❖ Extranet
- ❖ Topology
- ❖ Terminator

# Key Definitions

- ❖ **Internet Protocol address (IP address):** An address that identifies the network and host address assigned to a device.
- ❖ **Subnet address:** The portion of the IP address that identifies the network the device is assigned to.
- ❖ **Local area network (LAN):** A group of computers and associated devices that share a common communications line or wireless link, typically to a server.
- ❖ **Metropolitan area network (MAN):** Computer users and resources within a geographic area the size of a metropolitan area that are connected.

# Key Definitions

- ❖ **Wide area network (WAN):** A network that connects several LANs. WANs are often limited to a corporation or an organization but are sometimes accessible to the public.
- ❖ **Software-defined wide area network (SDWAN):** A WAN that uses software to control connectivity.
- ❖ **Multipoint Generic Routing Encapsulation (mGRE):** A tunnel interface.
- ❖ **Internet:** A collection of many networks owned by many entities that share information and communicate together.
- ❖ **Intranet:** A local or restricted communications network, especially a private network created using World Wide Web software.

# Key Definitions

- ❖ **Extranet:** An intranet that can be partially accessed by authorized outside users, enabling businesses to exchange information over the internet securely.
- ❖ **Topology:** The term used to describe how devices are connected and how messages flow from device to device. The physical topology describes the way the network is wired. The logical topology describes the way messages are sent.
- ❖ **Terminator:** A device that is connected to absorb signals and prevent them from reflecting repeatedly back and forth on the cable. Terminators are used with bus topology.

# Introduction to Networking



# Introduction to Networking

## Network Components

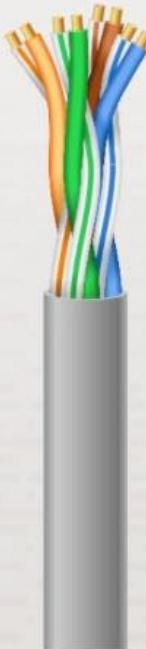


## Nodes/Hosts



# Introduction to Networking

## Connecting Media



Twisted Pair

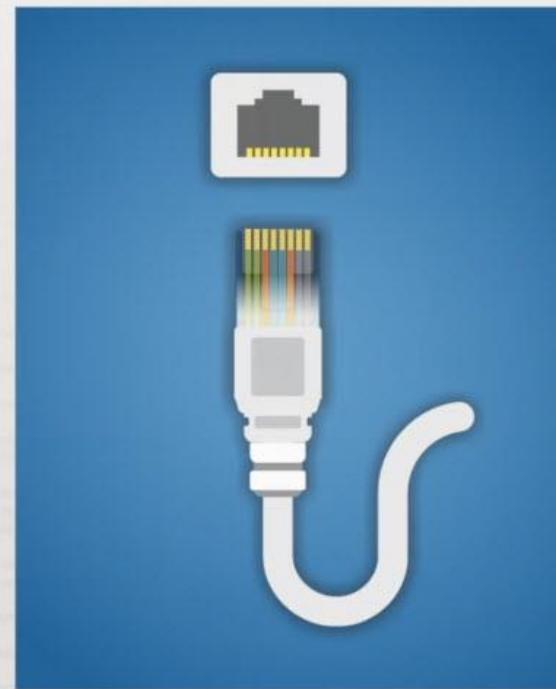


Fiber Optic



# Introduction to Networking

## Network Interface

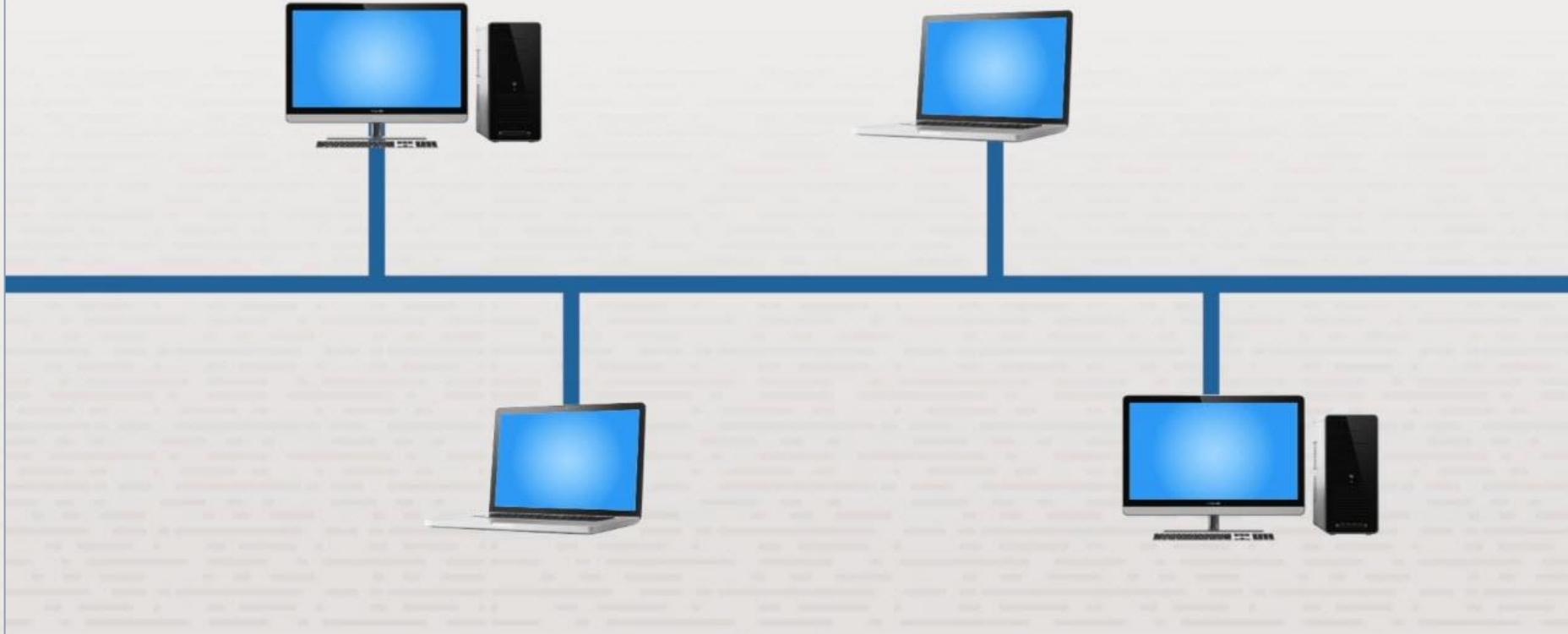


# Network Protocols

- ❖ Define how data is formatted
- ❖ Communicate between computers

# Introduction to Networking

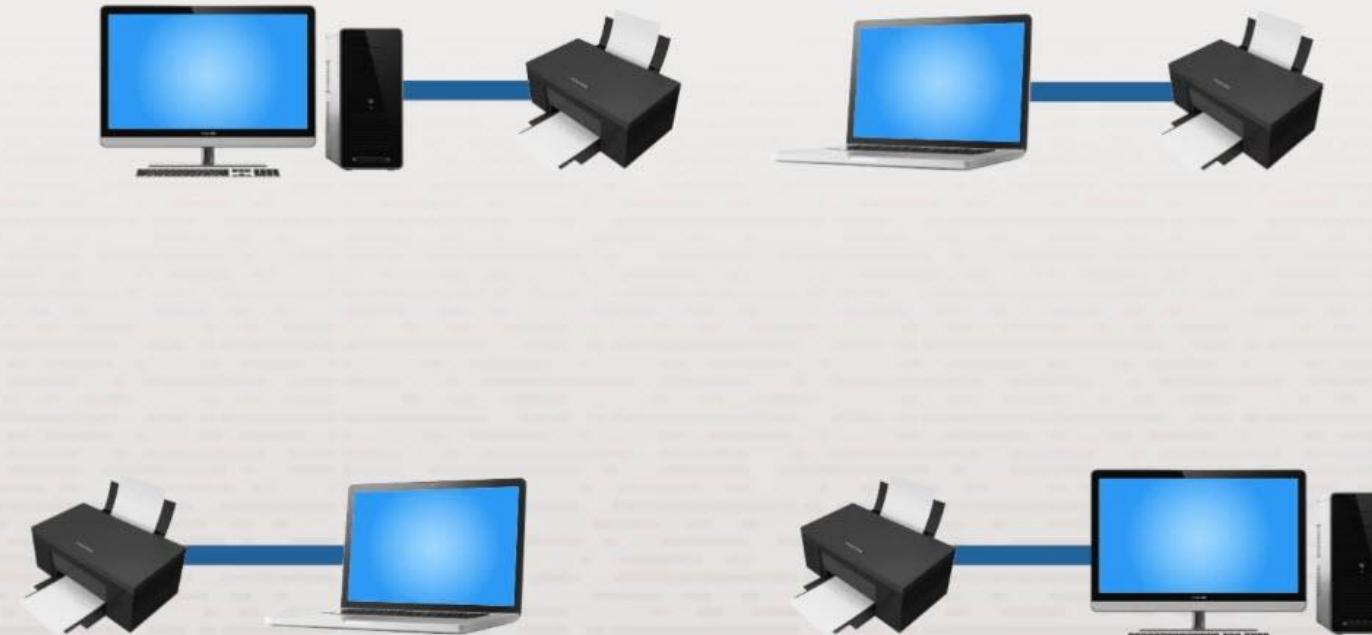
## Networks Share Peripherals



# Introduction to Networking

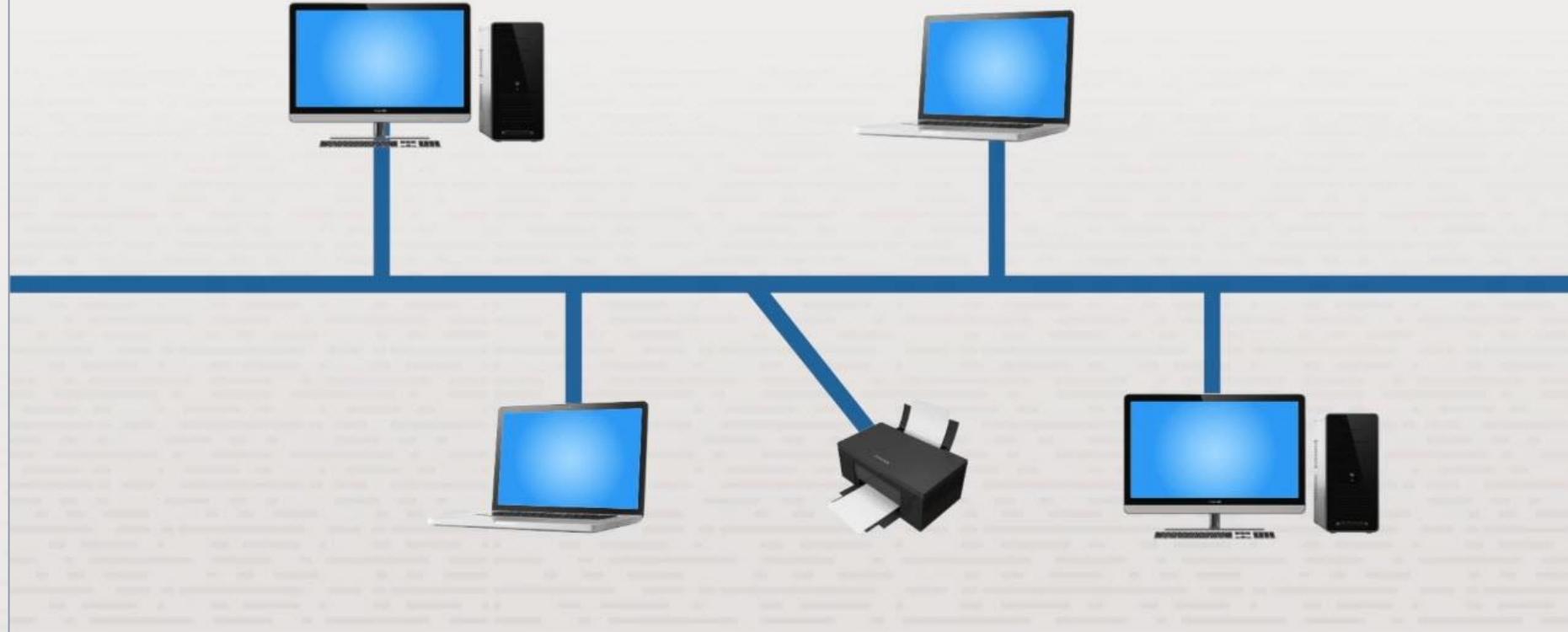
## Networks Share Peripherals

Without a Network



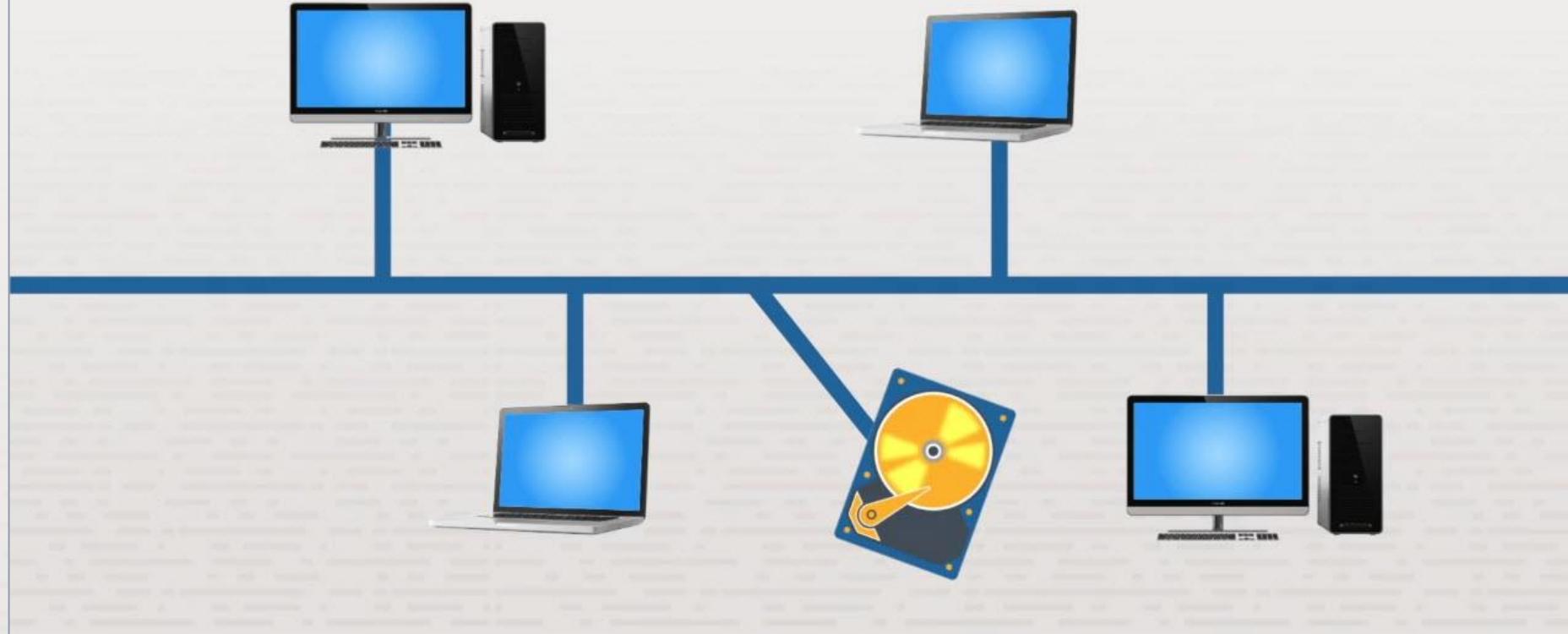
# Introduction to Networking

## Networks Share Peripherals



# Introduction to Networking

## Networks Share Peripherals



# Introduction to Networking

## Networks Share Peripherals



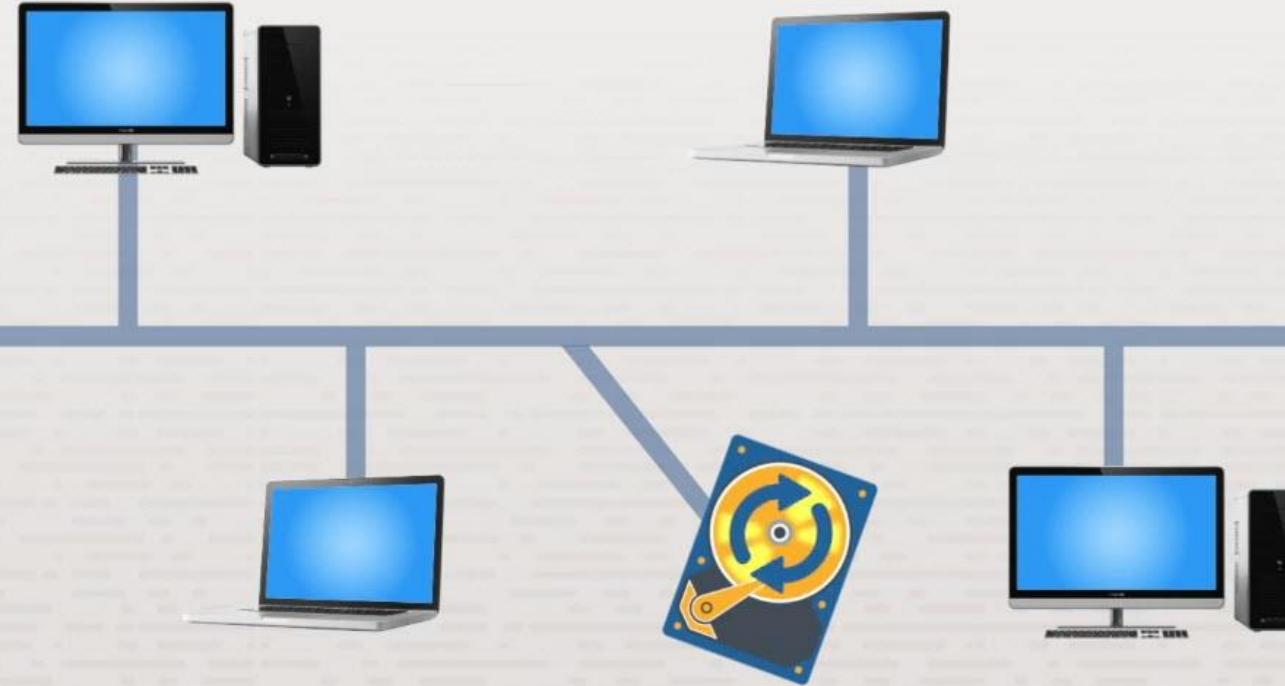
# Introduction to Networking

## Networks Share Peripherals



# Introduction to Networking

## Networks Share Peripherals



# Network Benefits

- ❖ File sharing
- ❖ Email
- ❖ Instant messaging
- ❖ Social media
- ❖ Workflow management
- ❖ VoIP
- ❖ Websites
- ❖ Webcast

# Summary

- ❖ Computer network
- ❖ Devices
- ❖ Connecting medium
- ❖ Network interface
- ❖ Network protocols
- ❖ Saving time and money

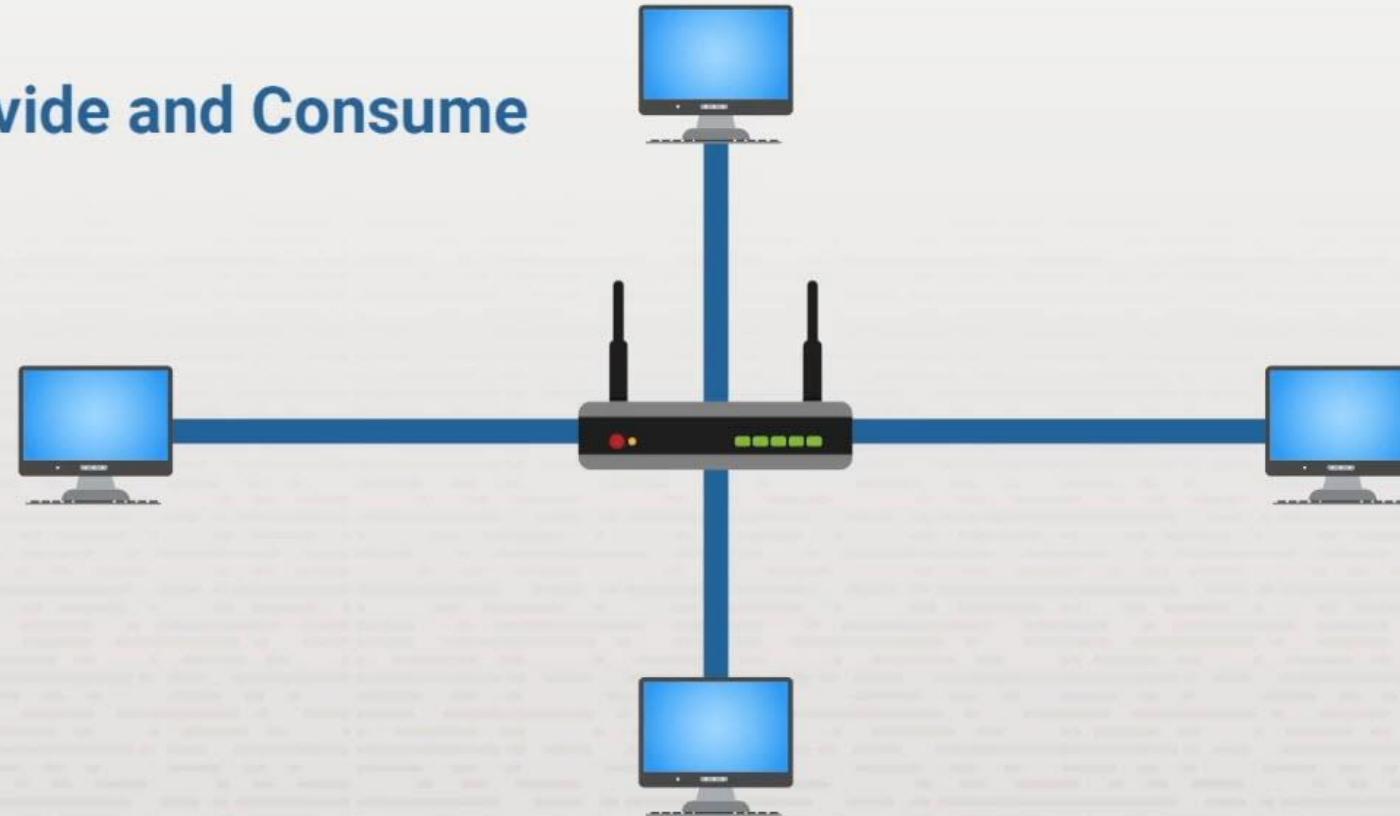
# Network Types



# Network Types

## Peer-to-Peer Network

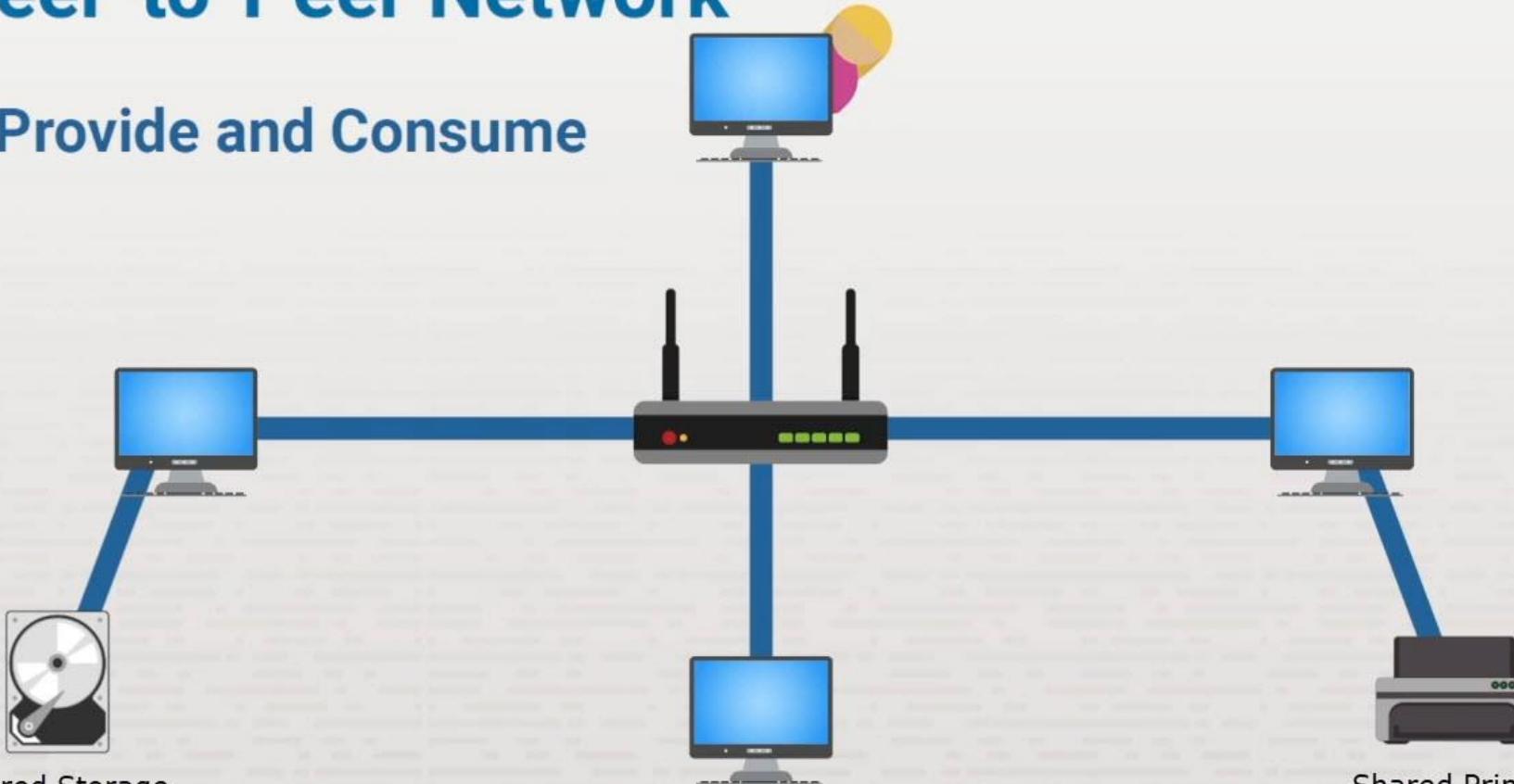
Provide and Consume



# Network Types

## Peer-to-Peer Network

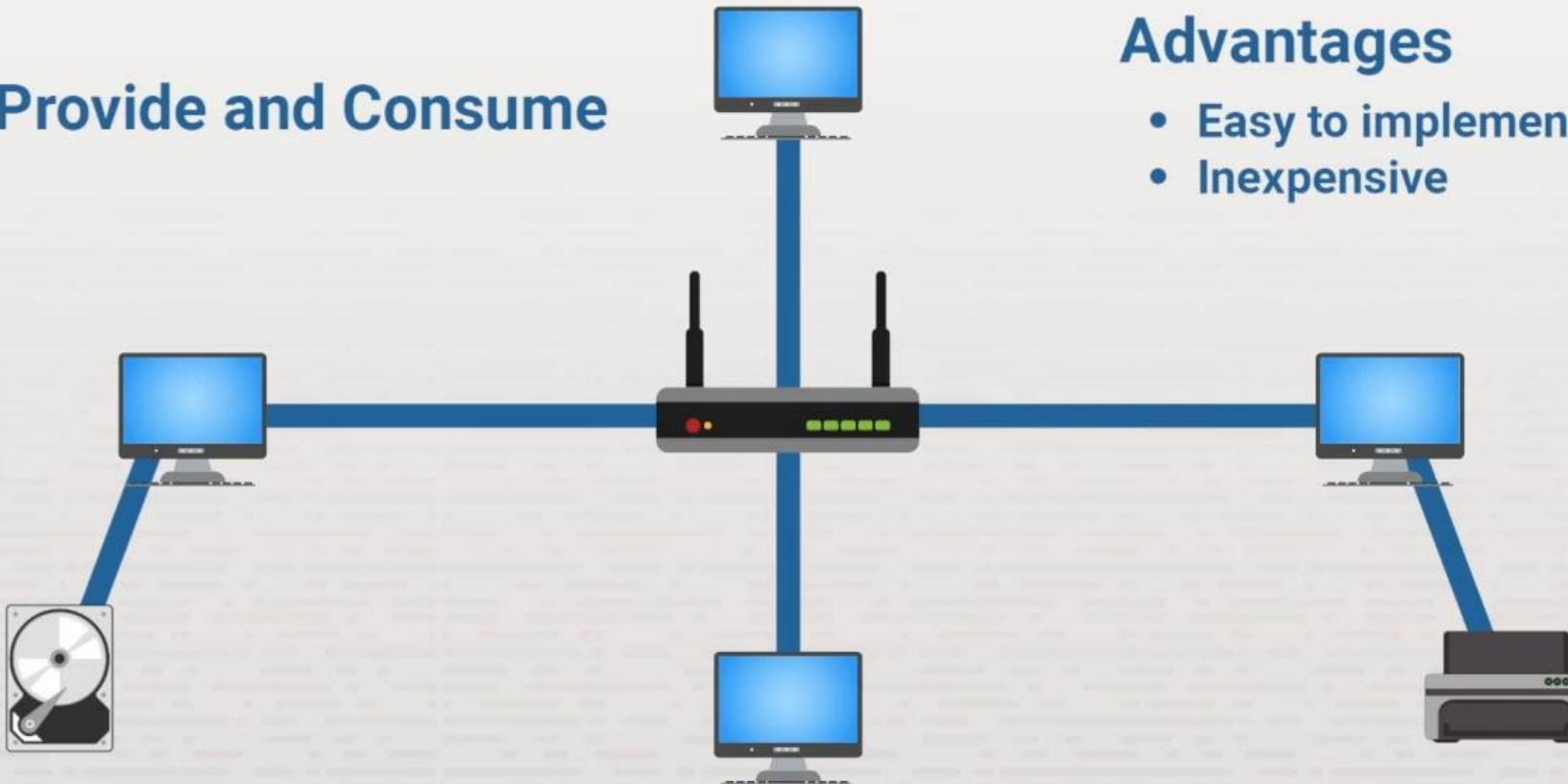
Provide and Consume



# Network Types

## Peer-to-Peer Network

Provide and Consume



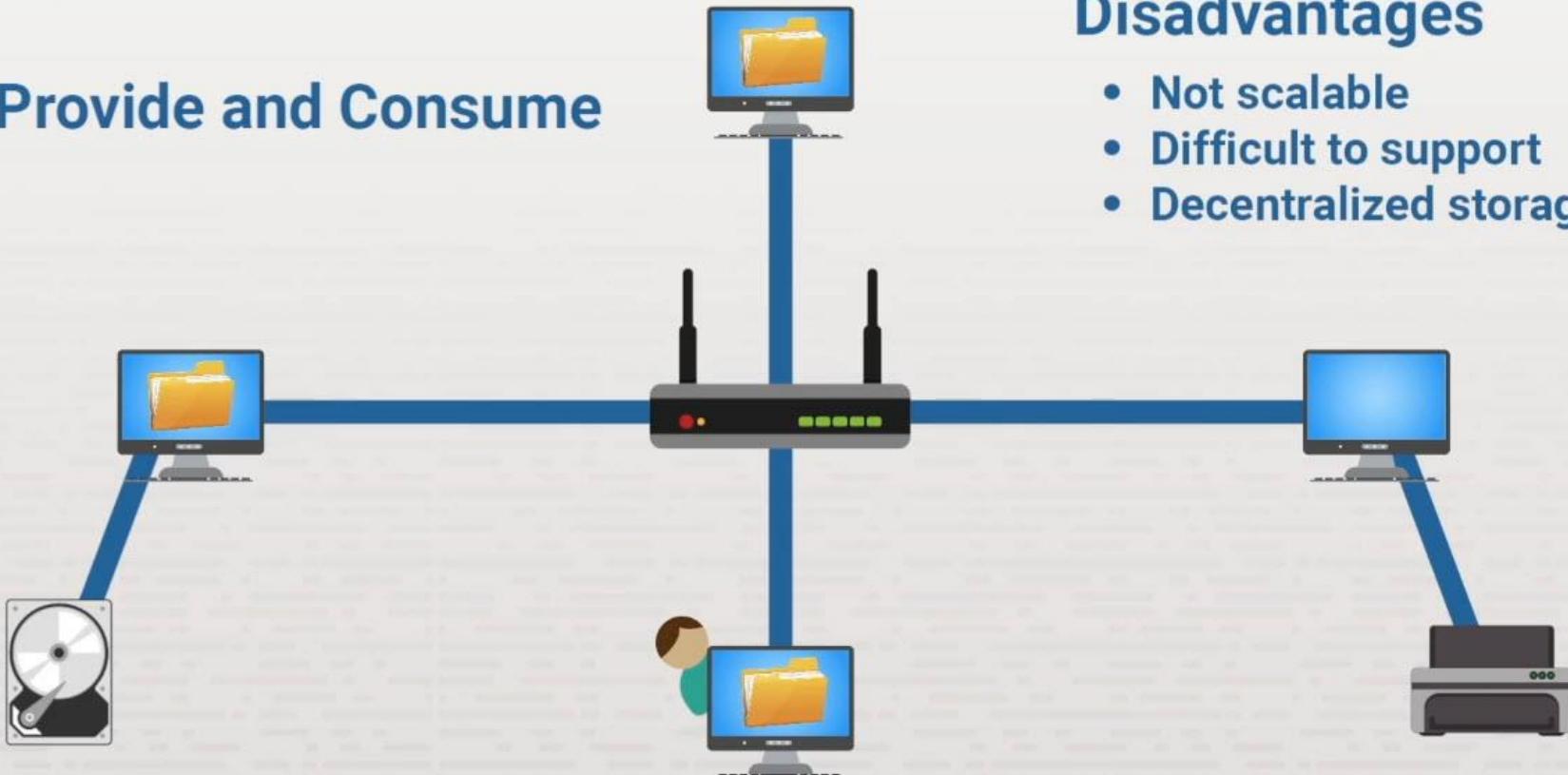
### Advantages

- Easy to implement
- Inexpensive

# Network Types

## Peer-to-Peer Network

Provide and Consume



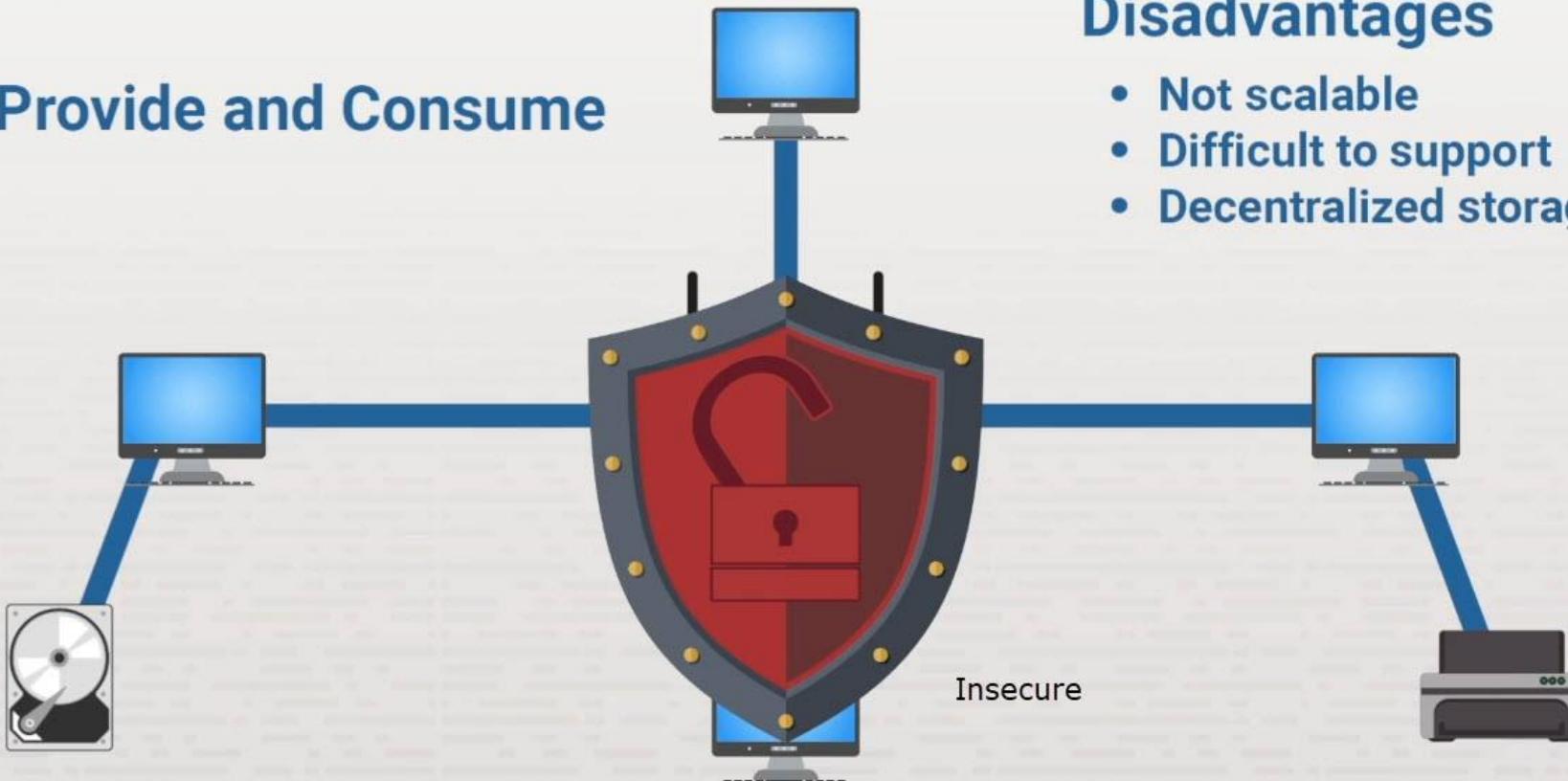
### Disadvantages

- Not scalable
- Difficult to support
- Decentralized storage

# Network Types

## Peer-to-Peer Network

Provide and Consume



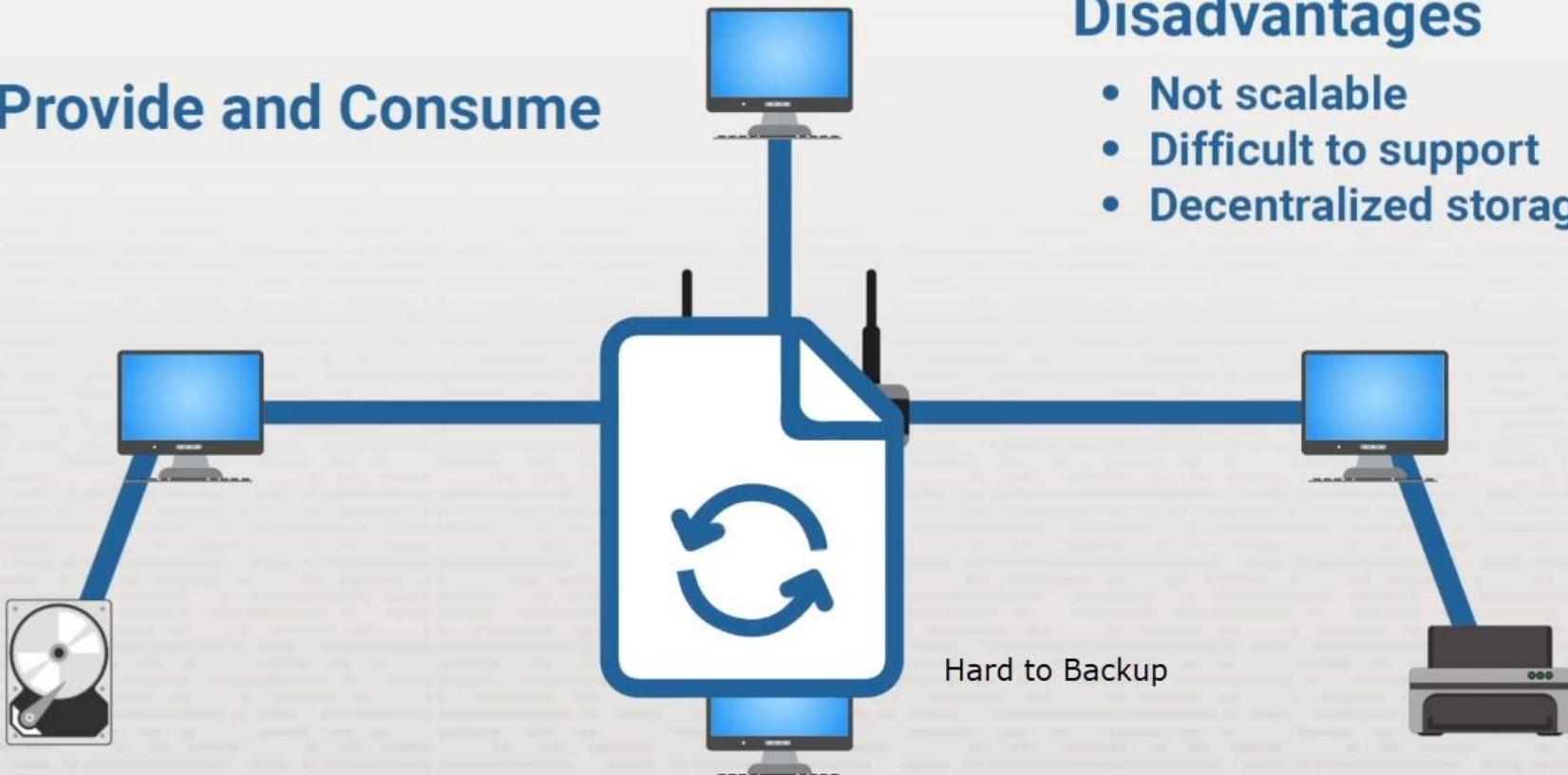
### Disadvantages

- Not scalable
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# Network Types

## Peer-to-Peer Network

Provide and Consume



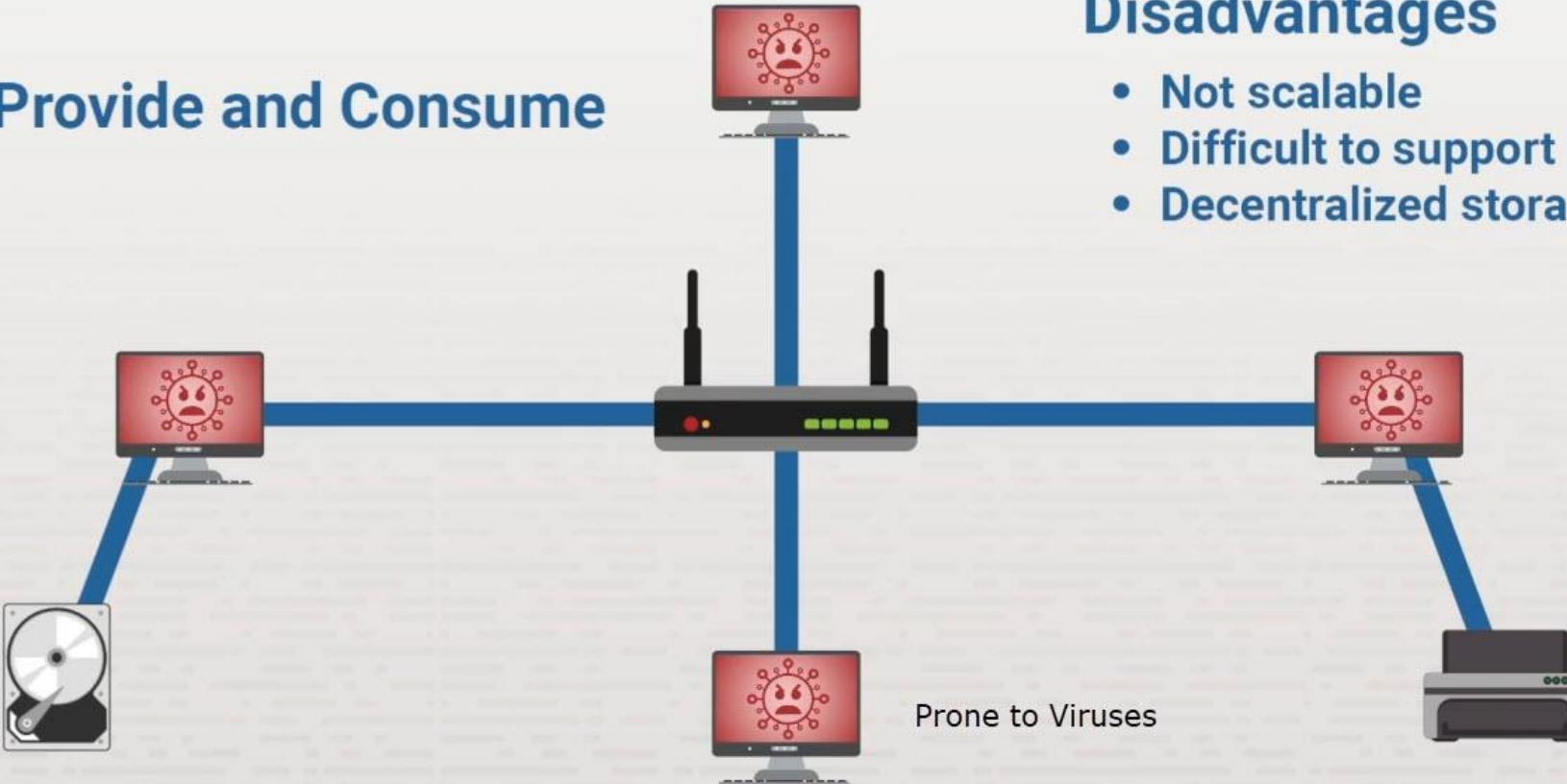
### Disadvantages

- Not scalable
- Difficult to support
- Decentralized storage

# Network Types

# Peer-to-Peer Network

## Provide and Consume



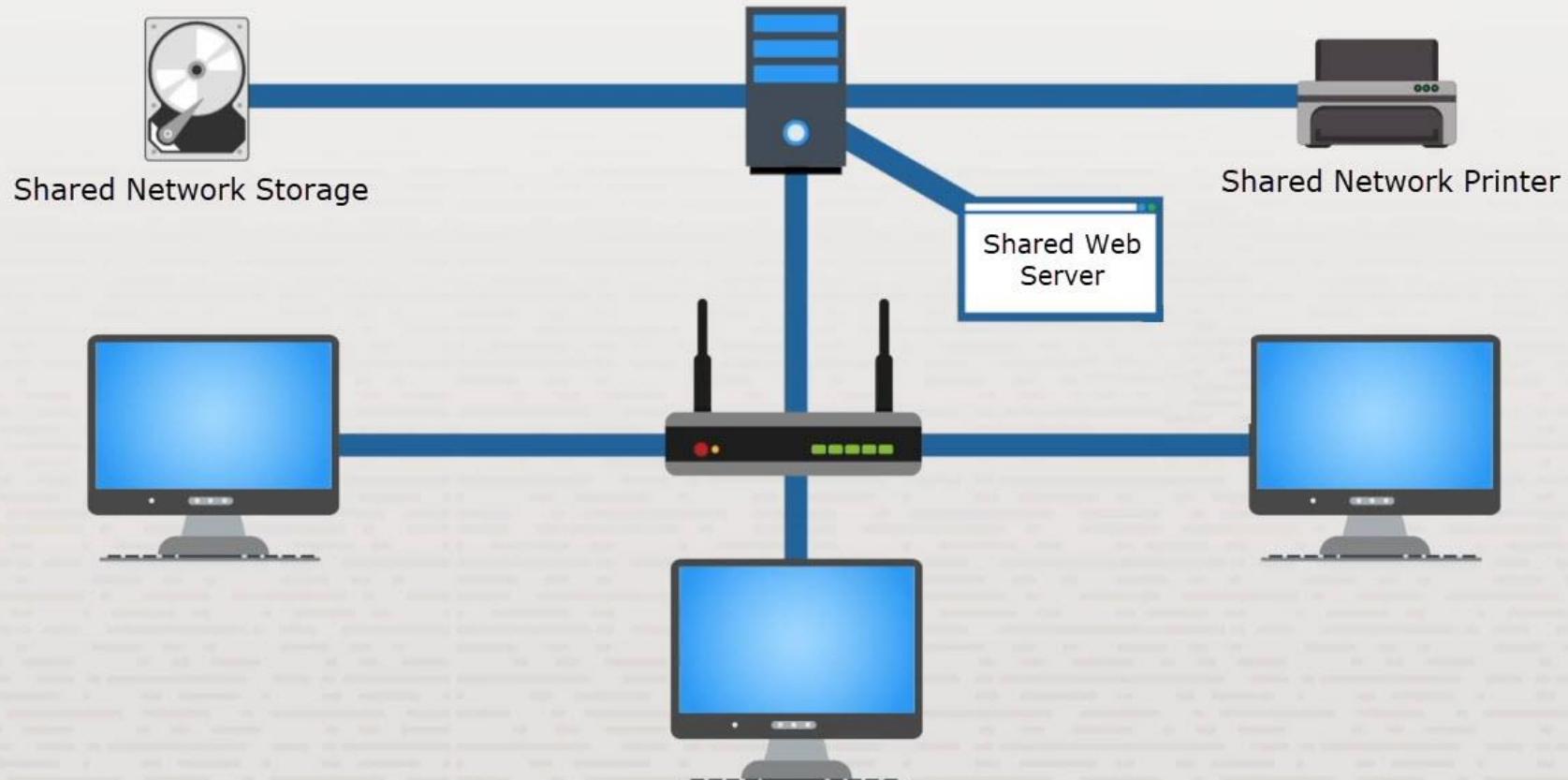
## Disadvantages

- Not scalable
  - Difficult to support
  - Decentralized storage

## Prone to Viruses

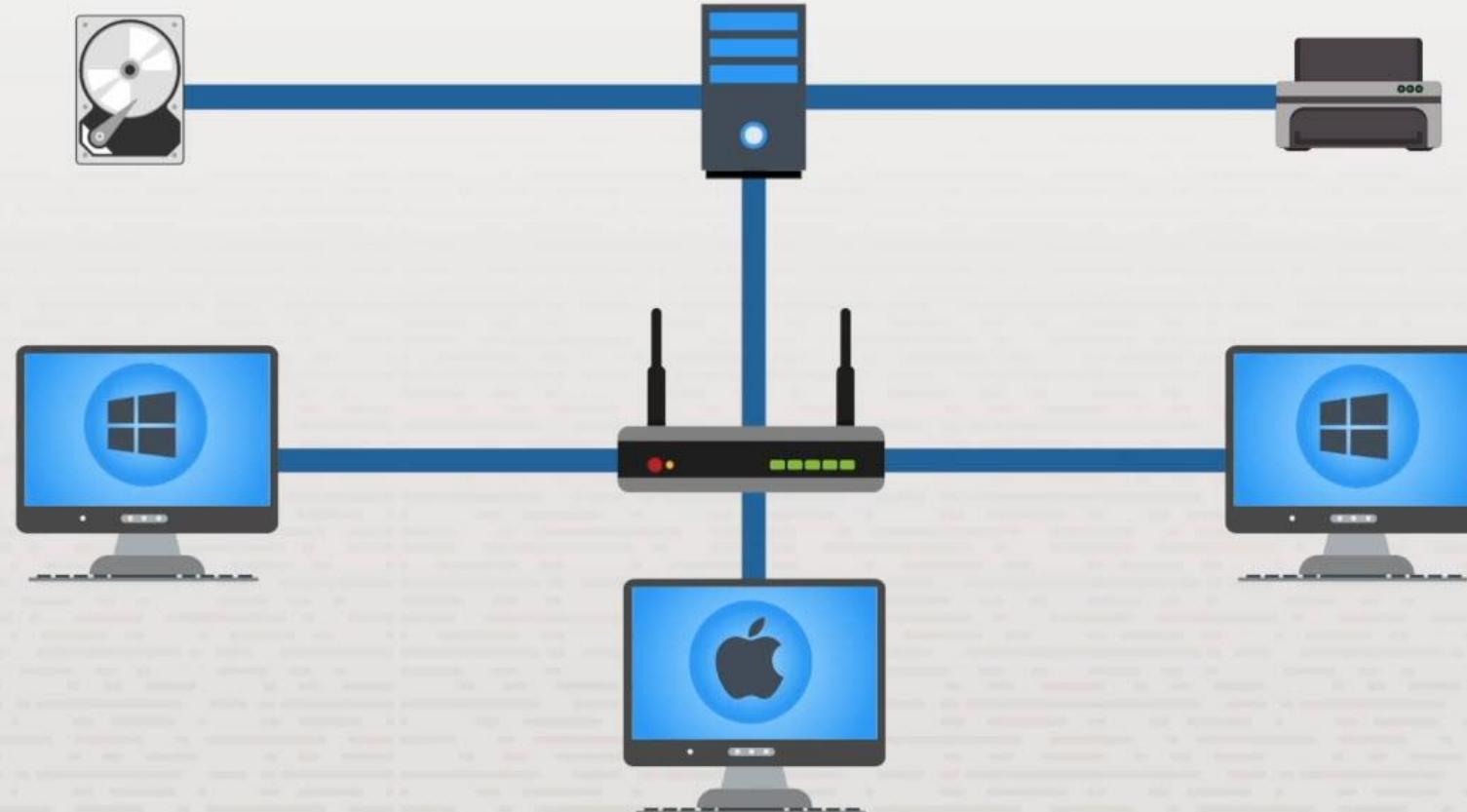
# Network Types

## Client-Server Network



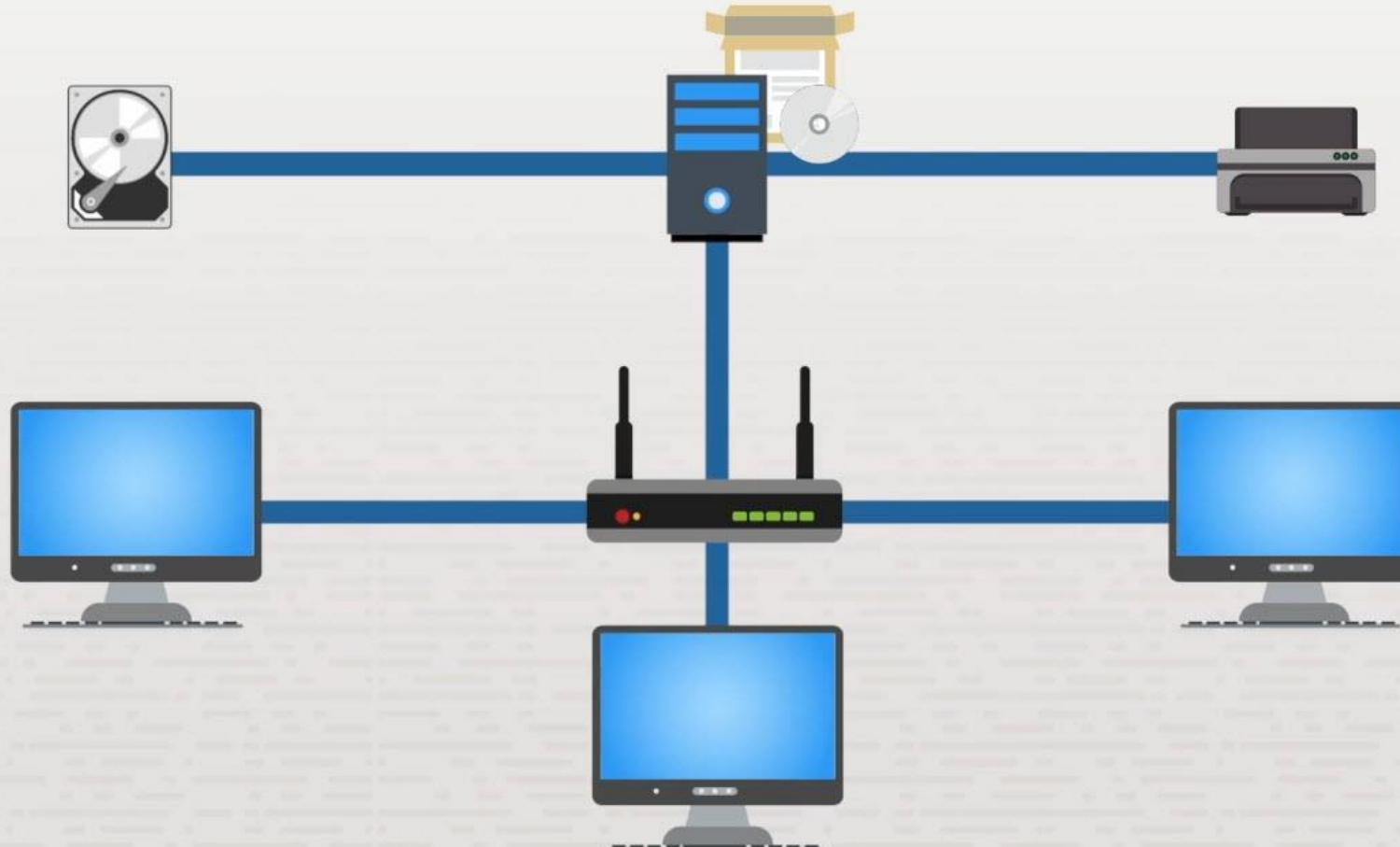
# Network Types

## Client-Server Network



# Network Types

## Client-Server Network



# Client-Server Network Advantages

- ❖ Very scalable
- ❖ Easier to support
- ❖ Data protection

# Client-Server Network Disadvantages

- ❖ Expensive
- ❖ Advanced planning required

# Networking Terms



# Networking Terms

## Addressing



732

Oak Street



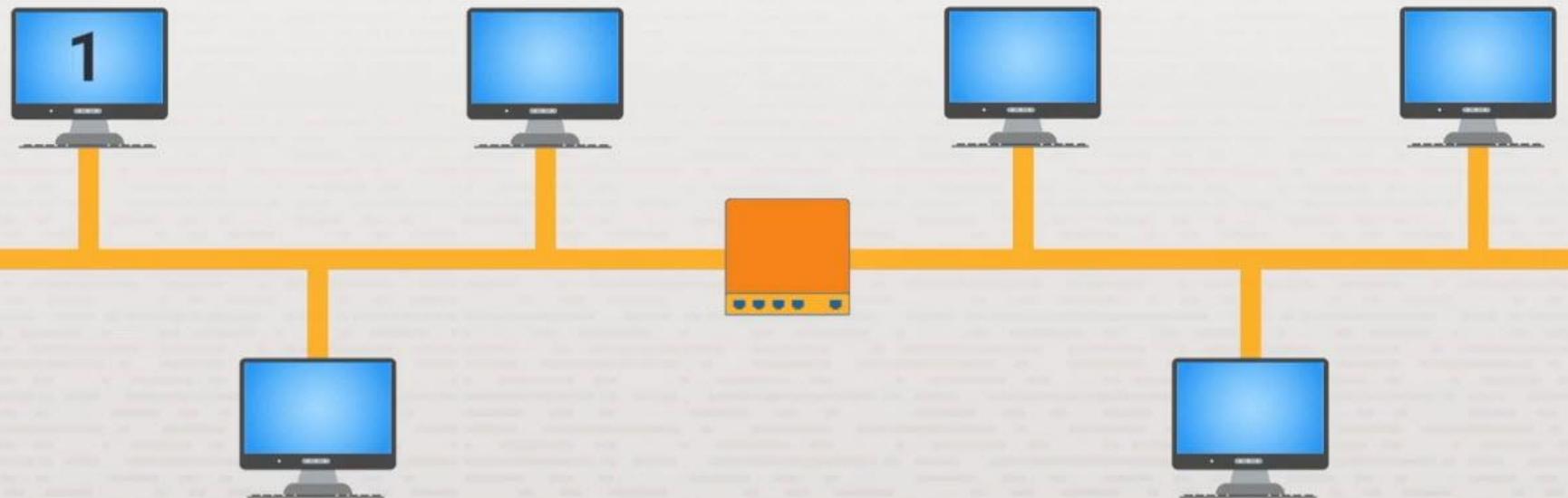
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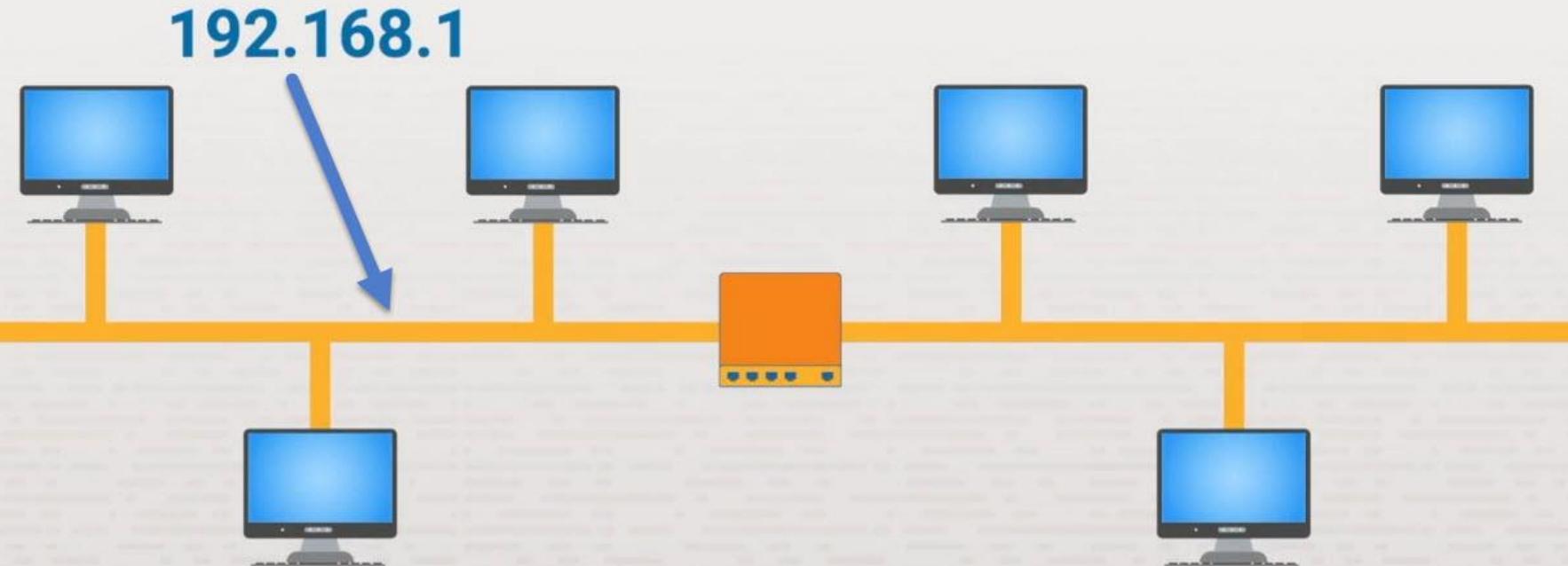
# Networking Terms

## Network Addressing

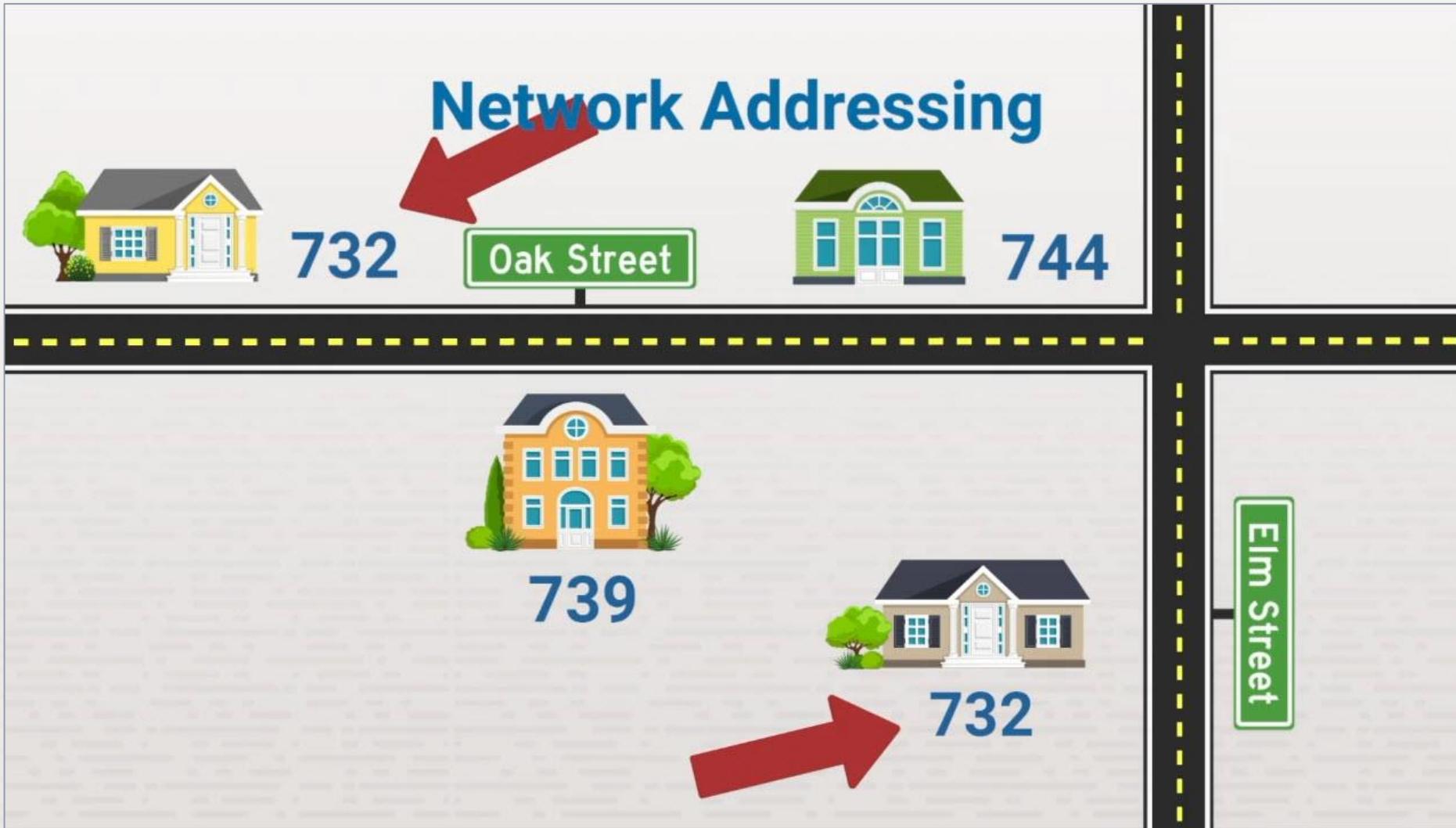


# Networking Terms

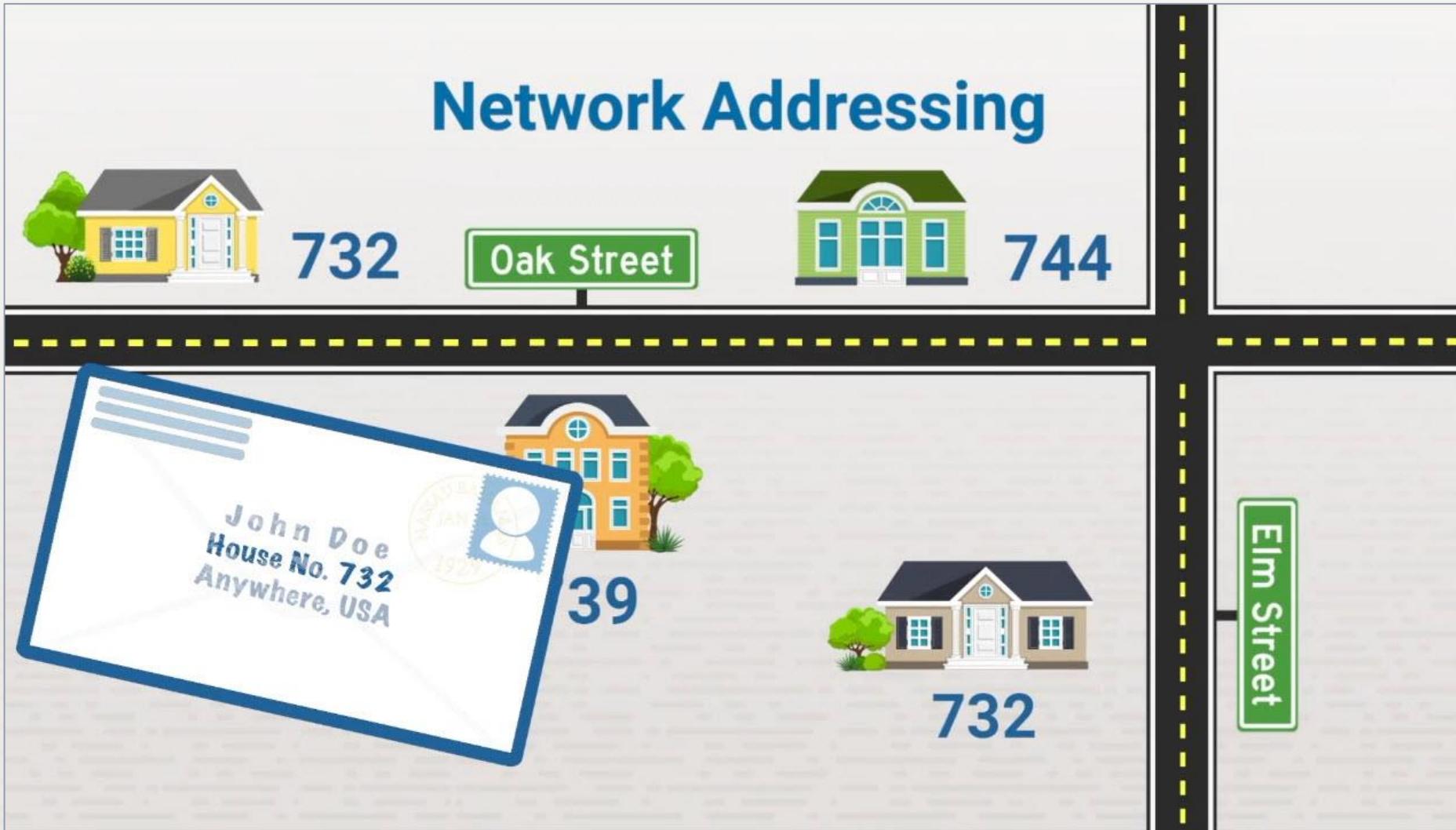
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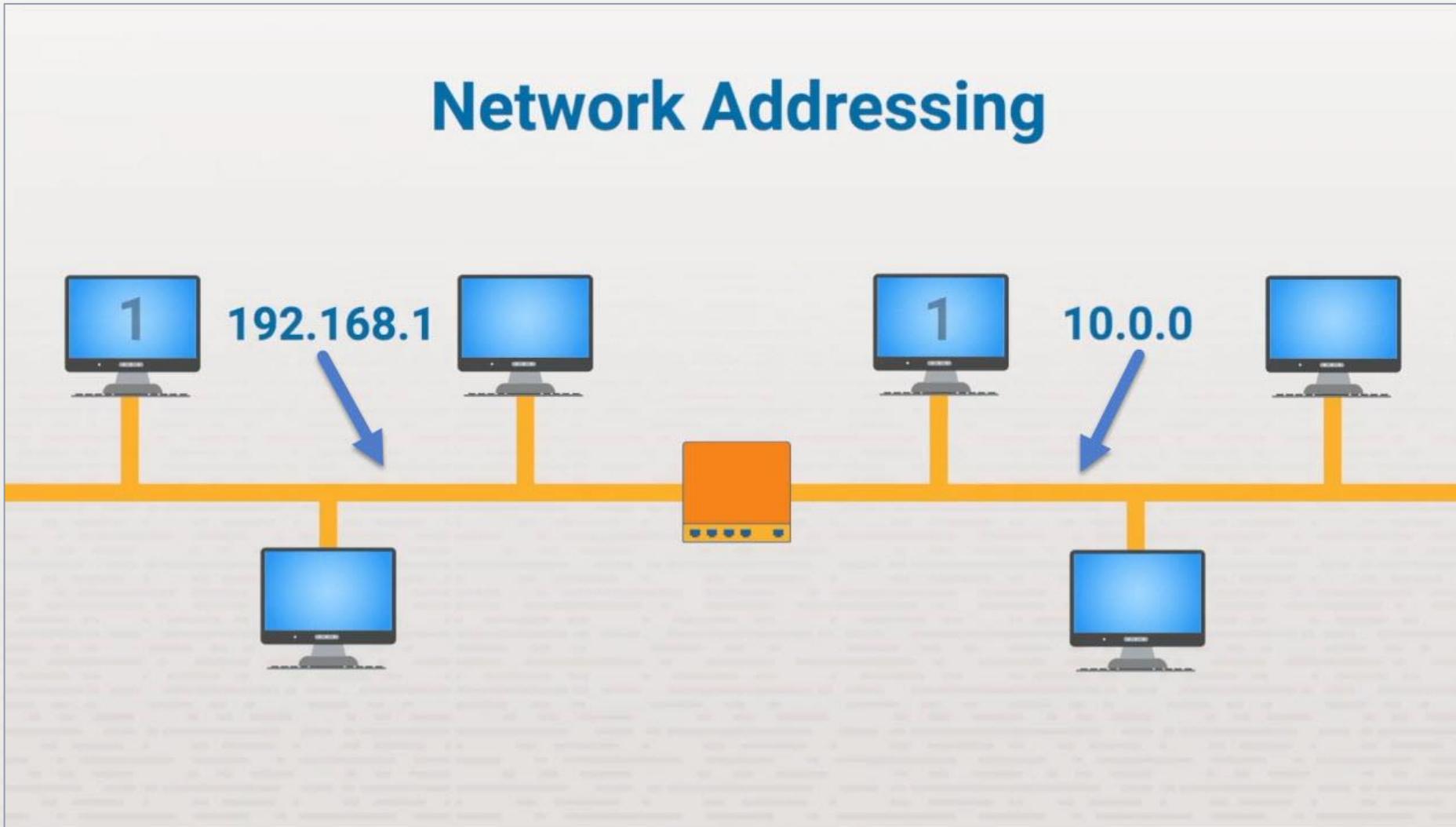
# Networking Terms



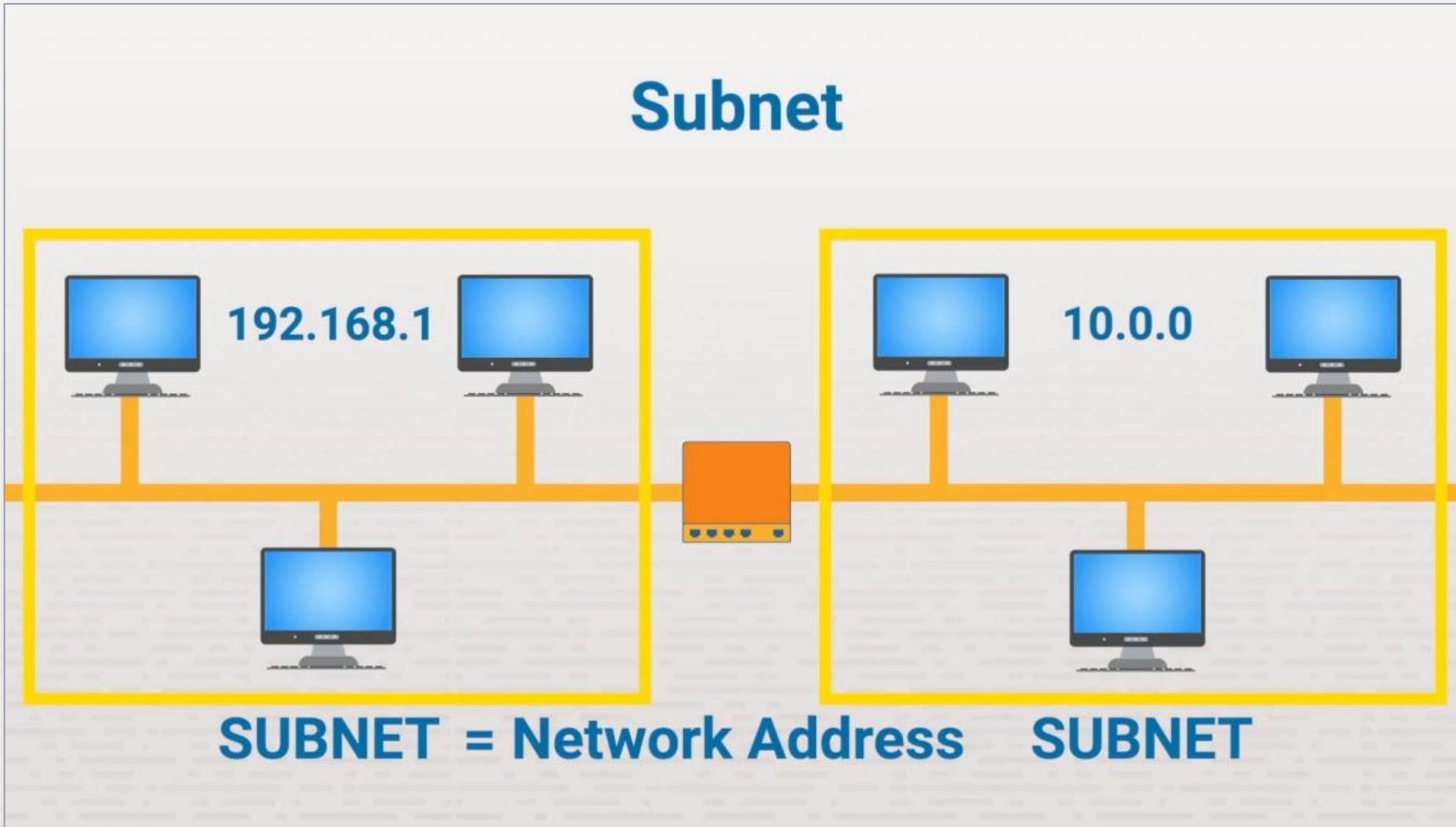
# Networking Terms



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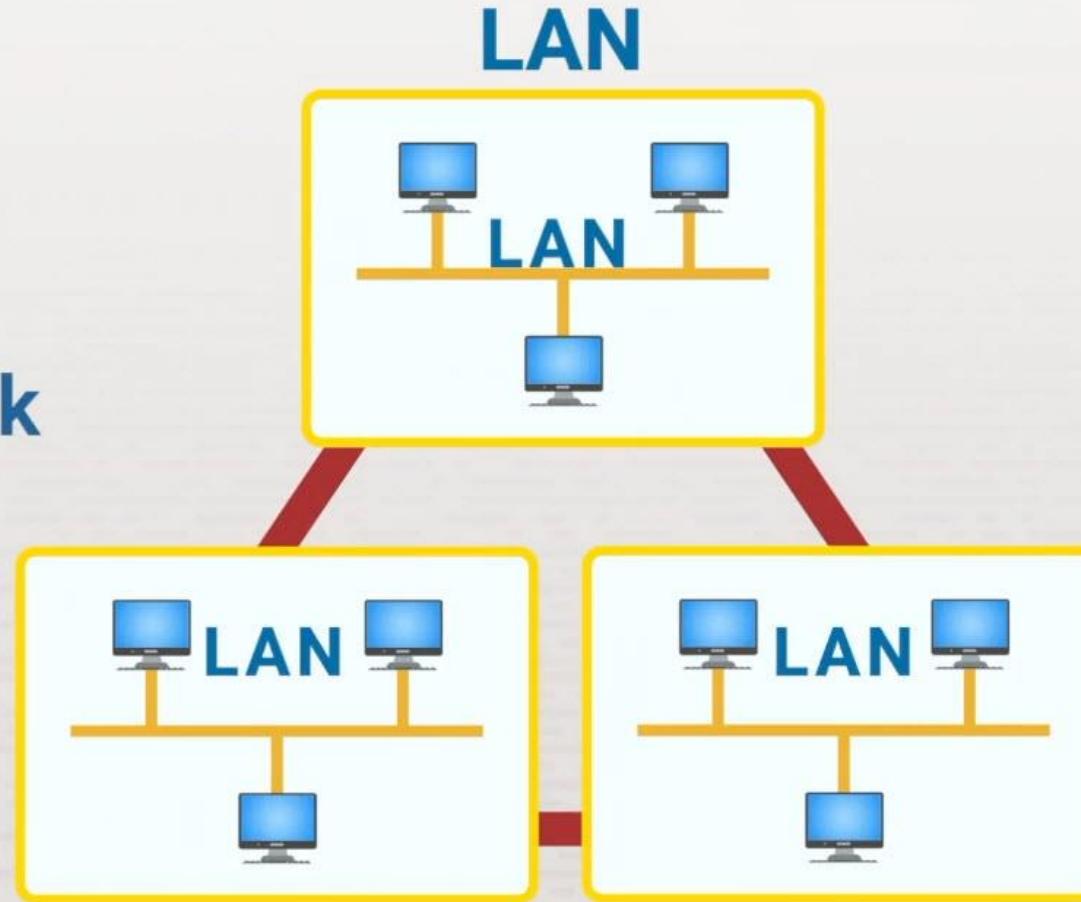


# Networking Terms



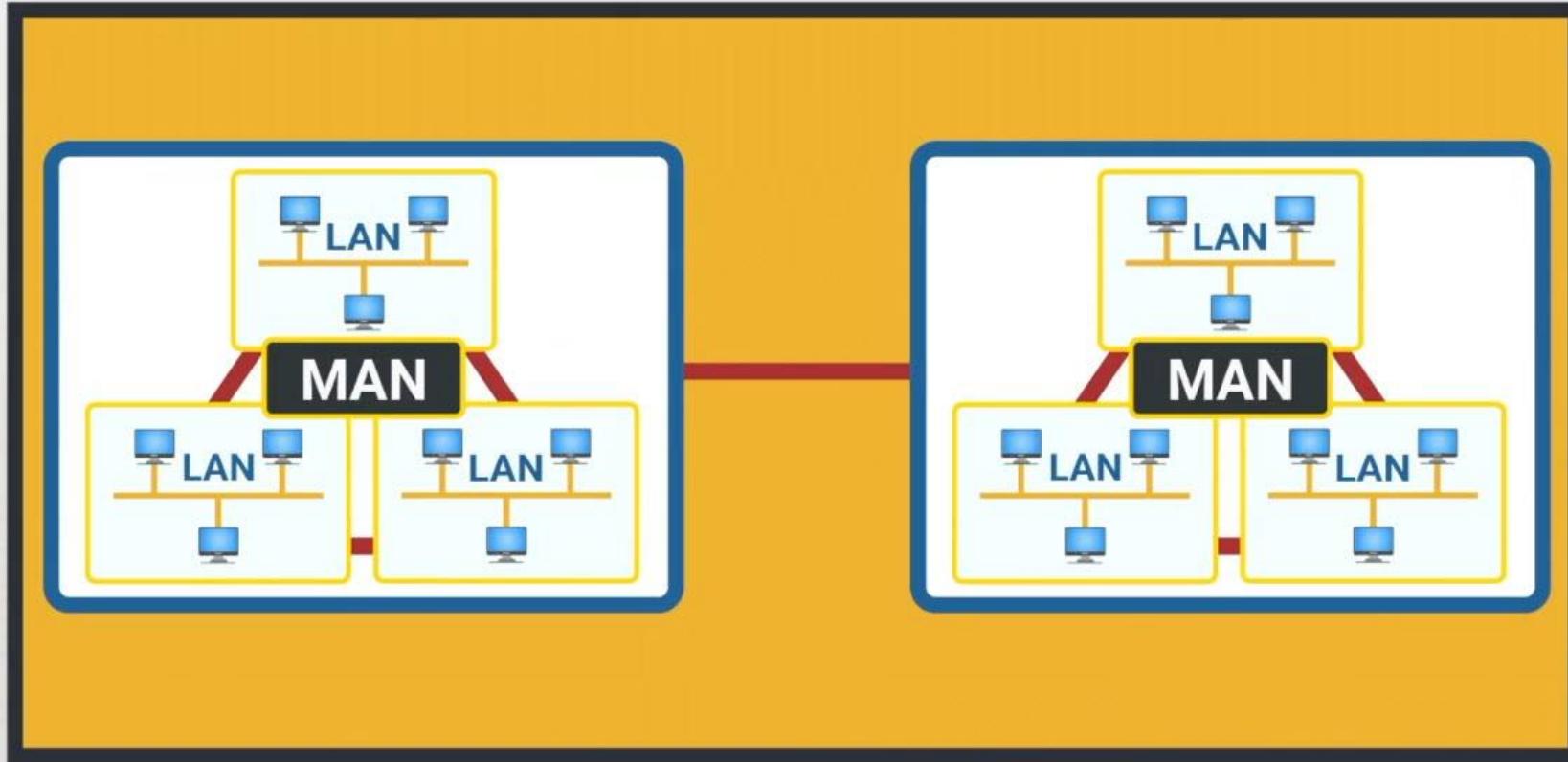
# Networking Terms

Local  
Area  
Network



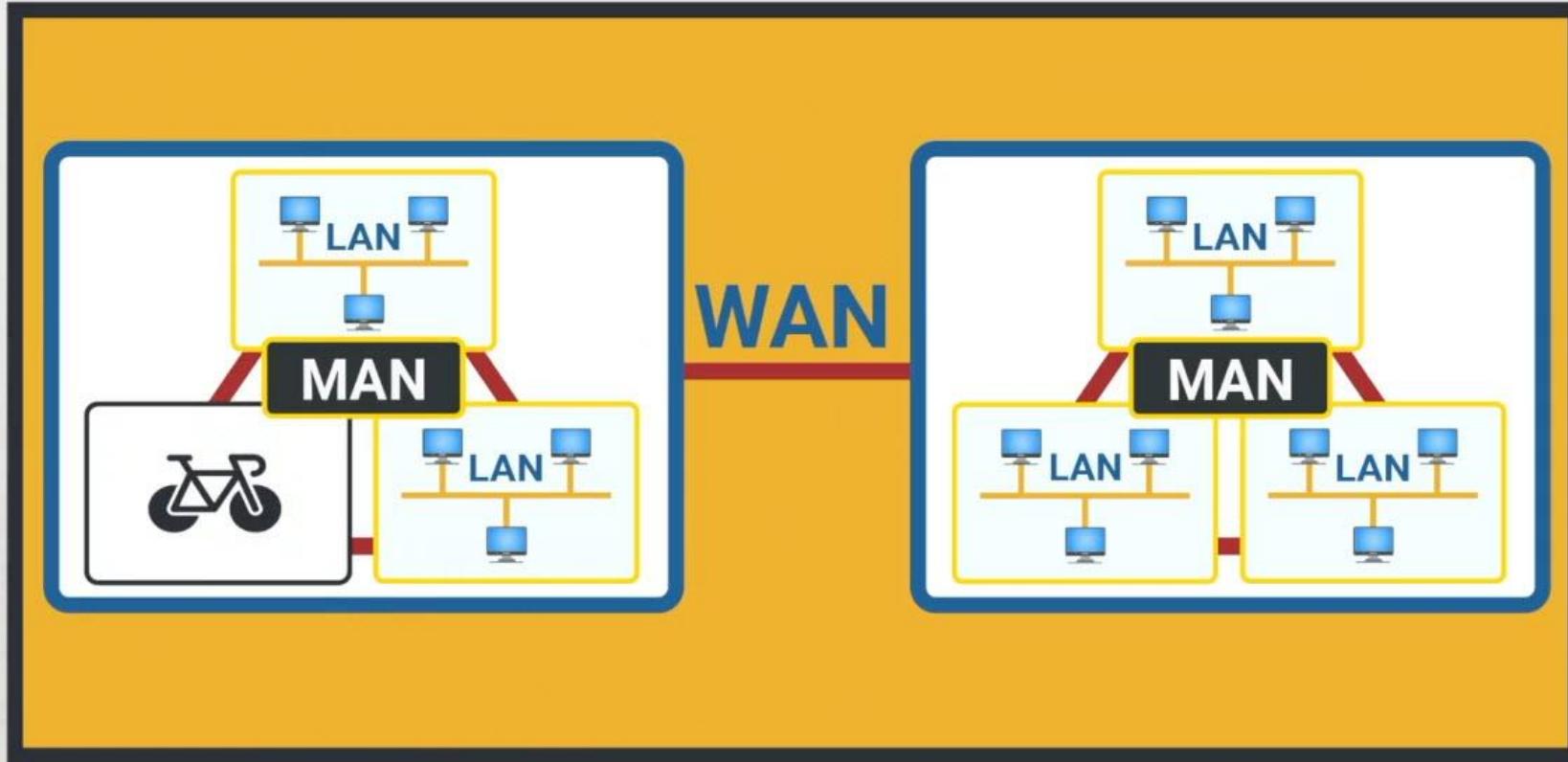
# Networking Terms

## MAN and WAN



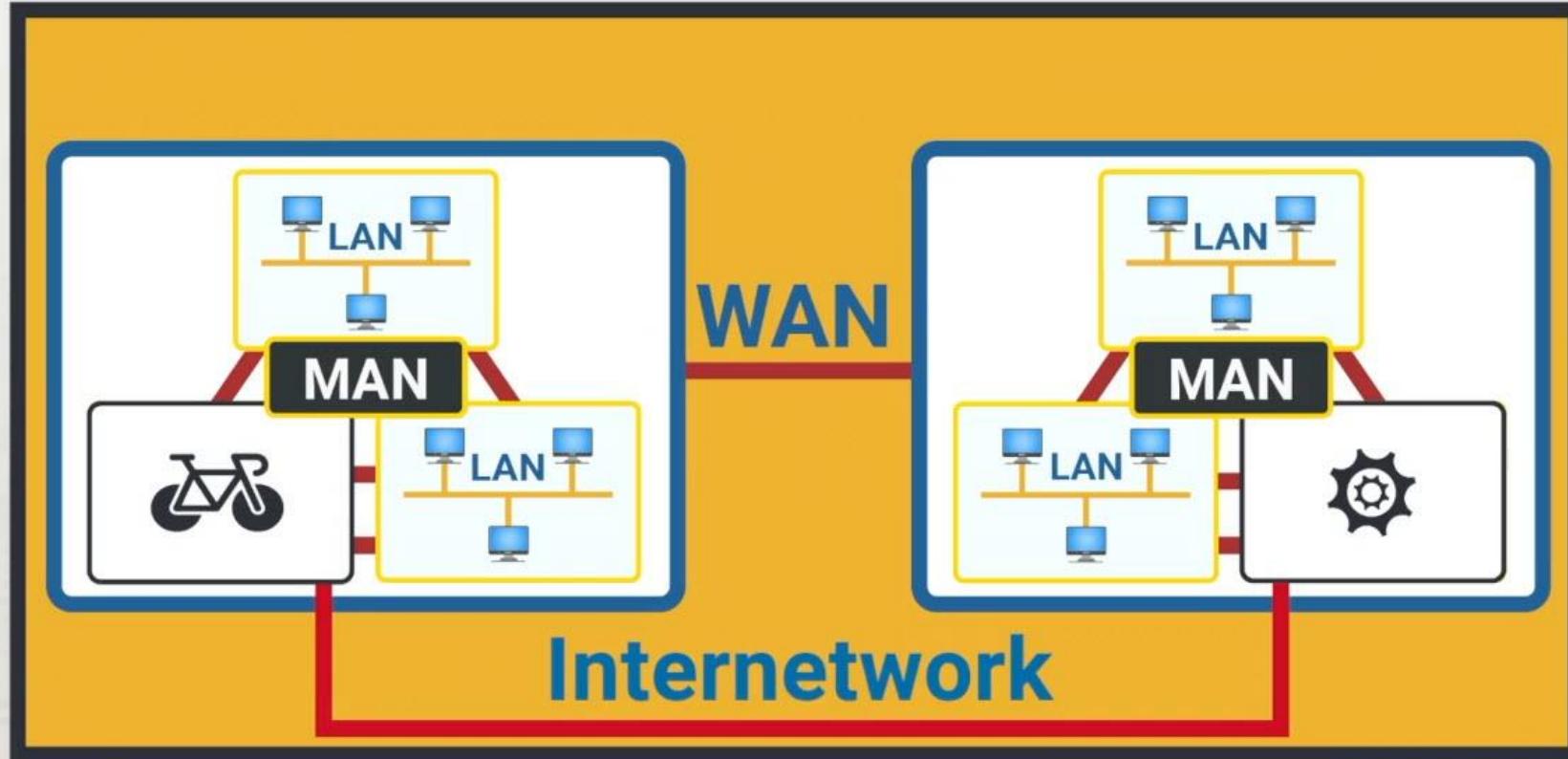
# Networking Terms

## Network and Internetwork

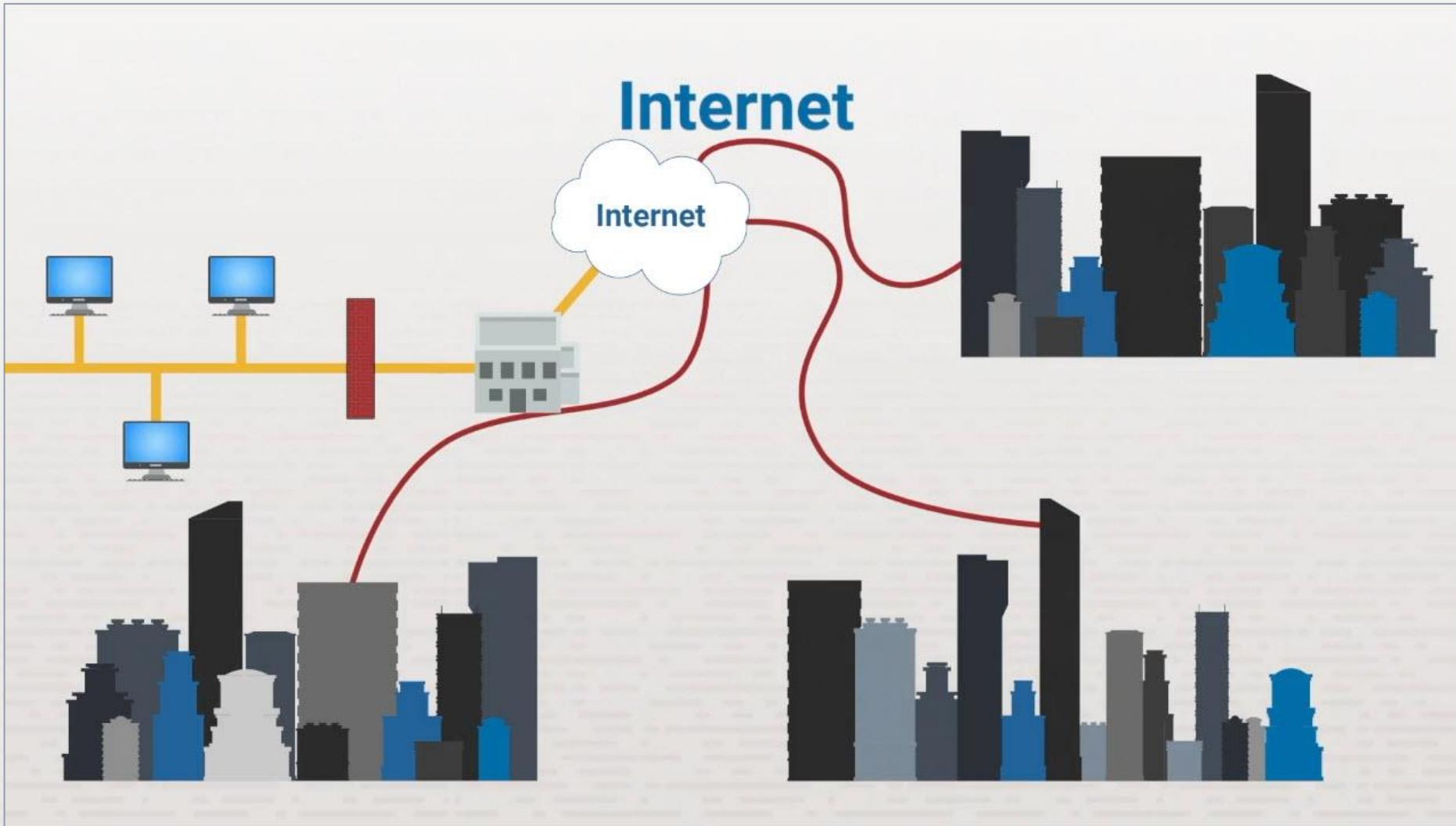


# Networking Terms

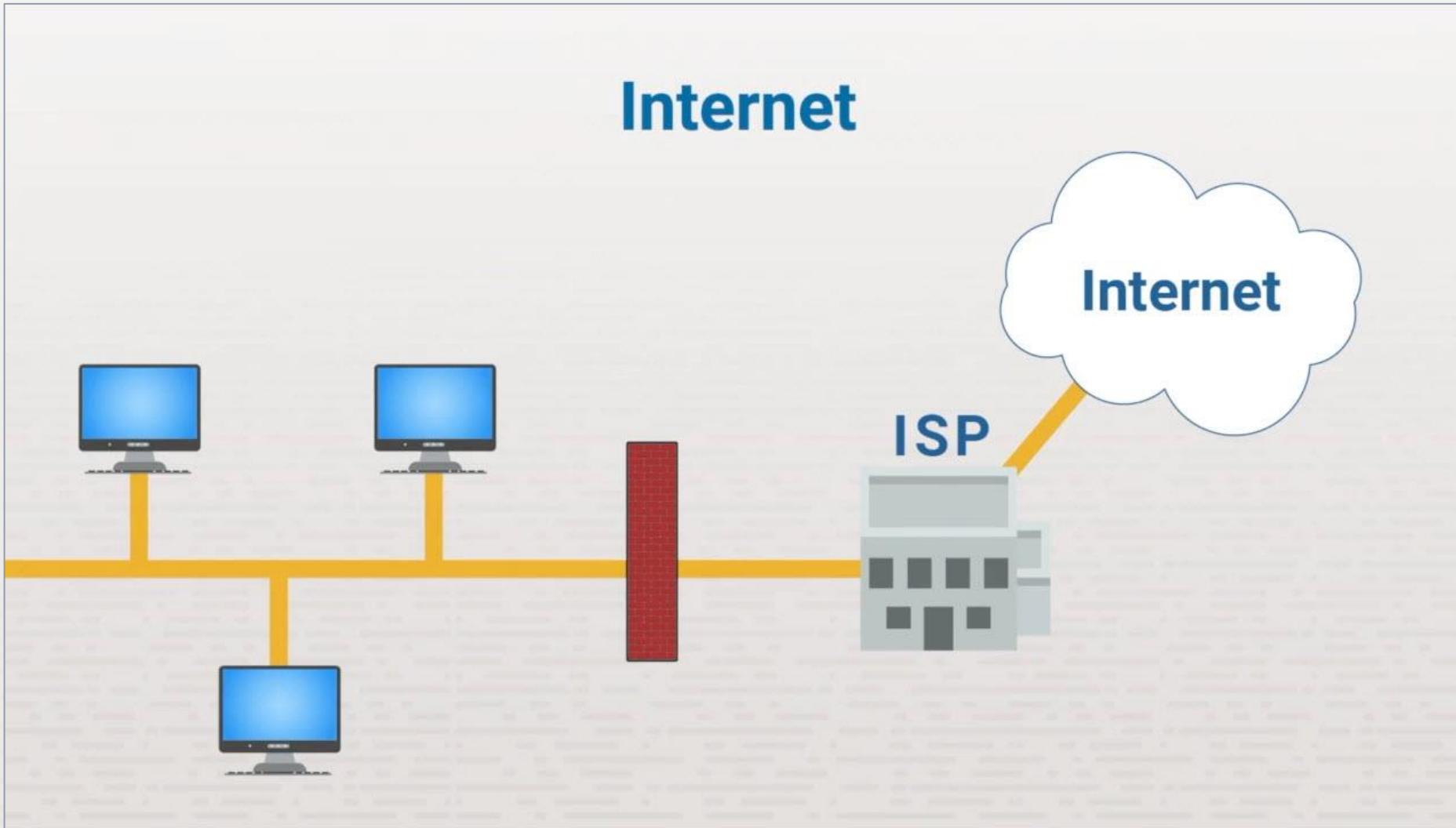
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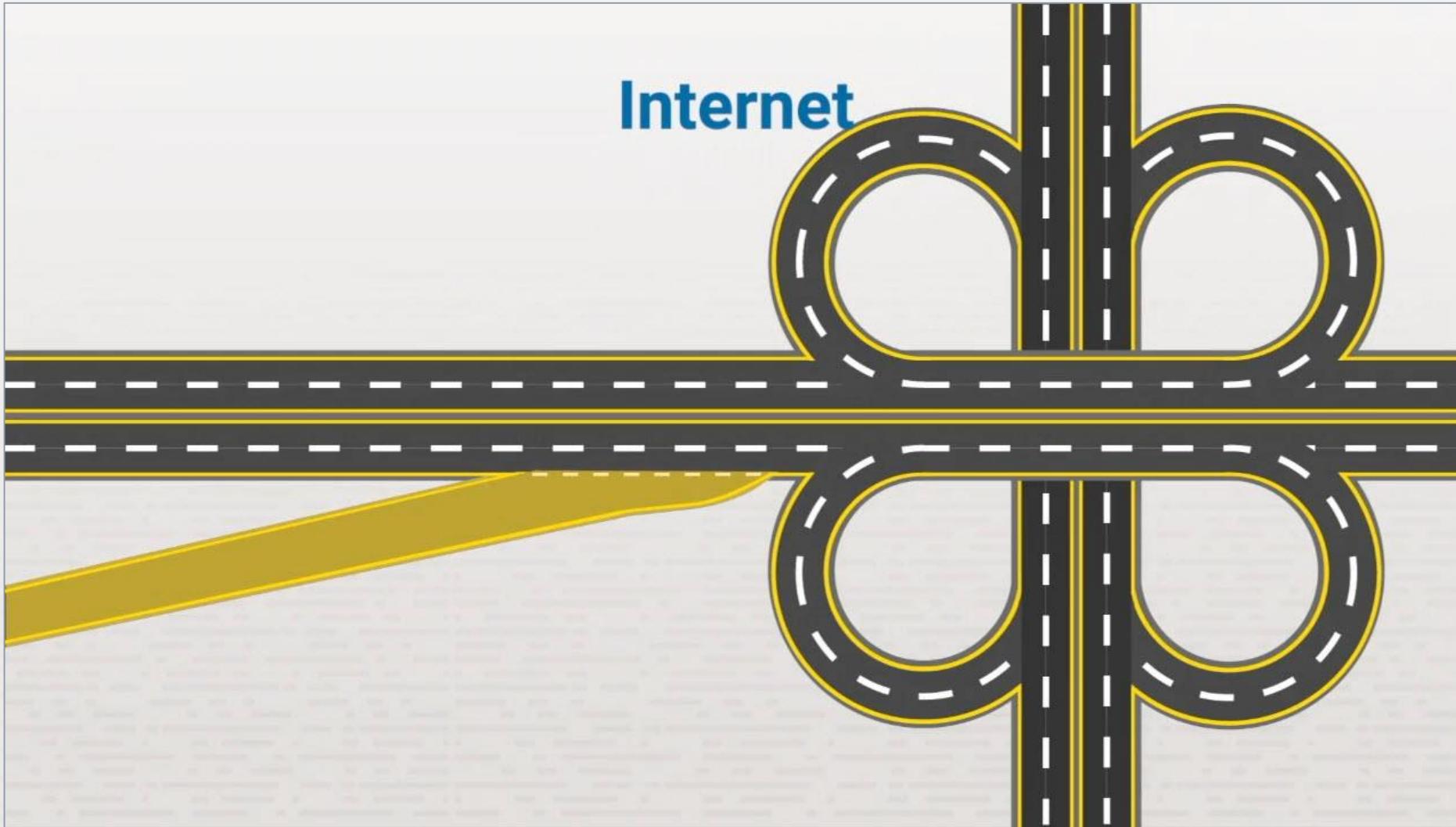
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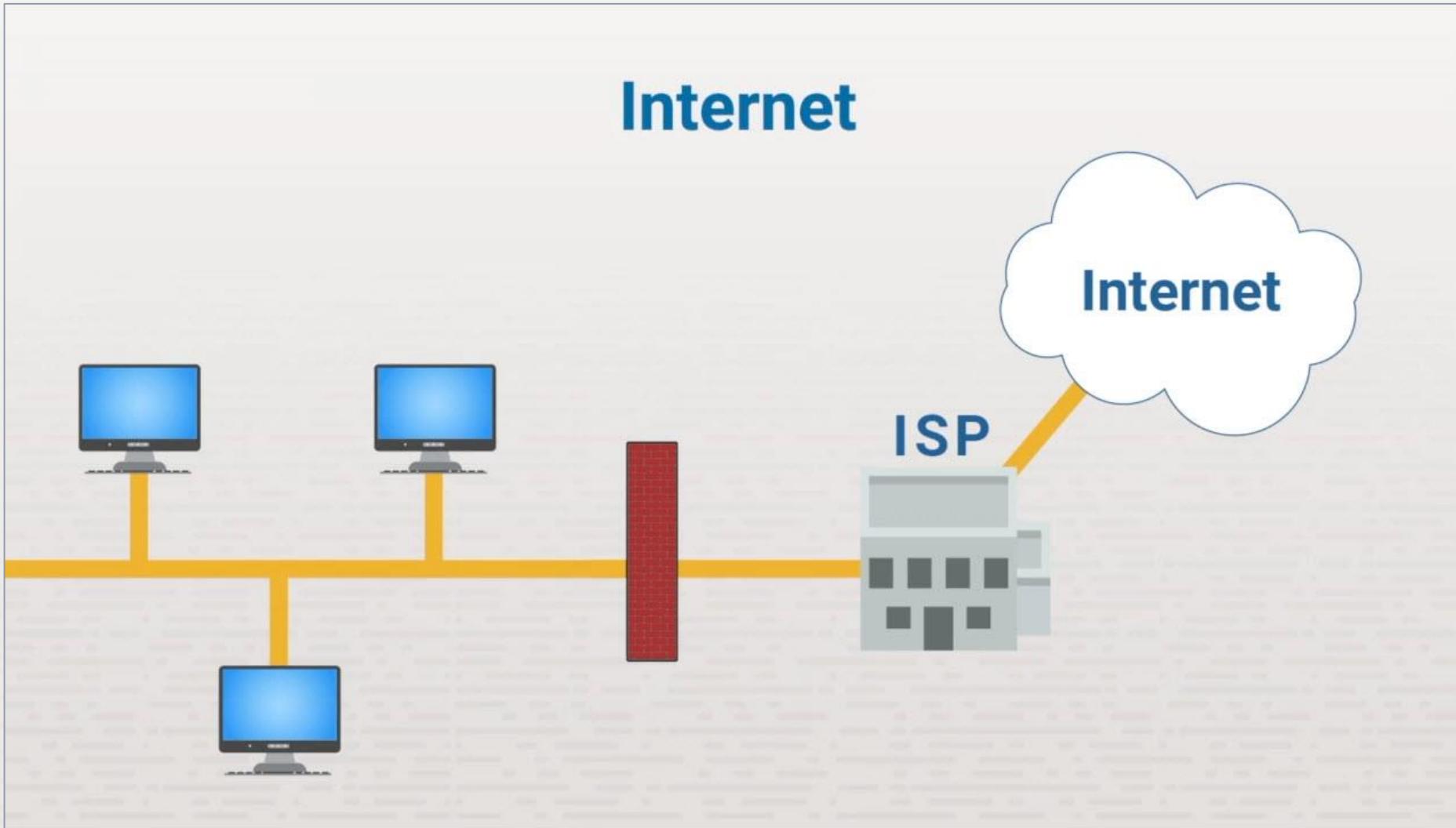
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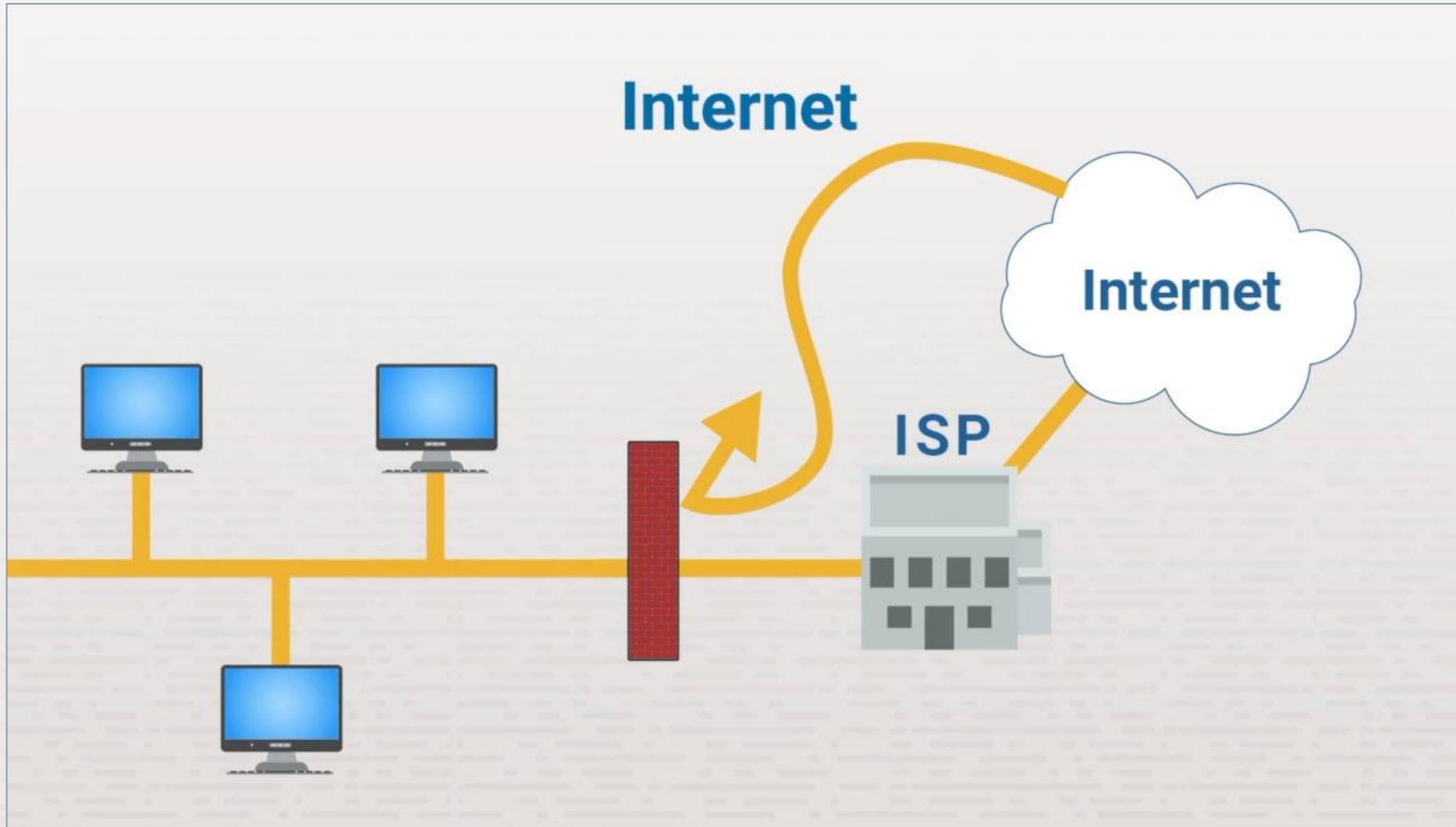
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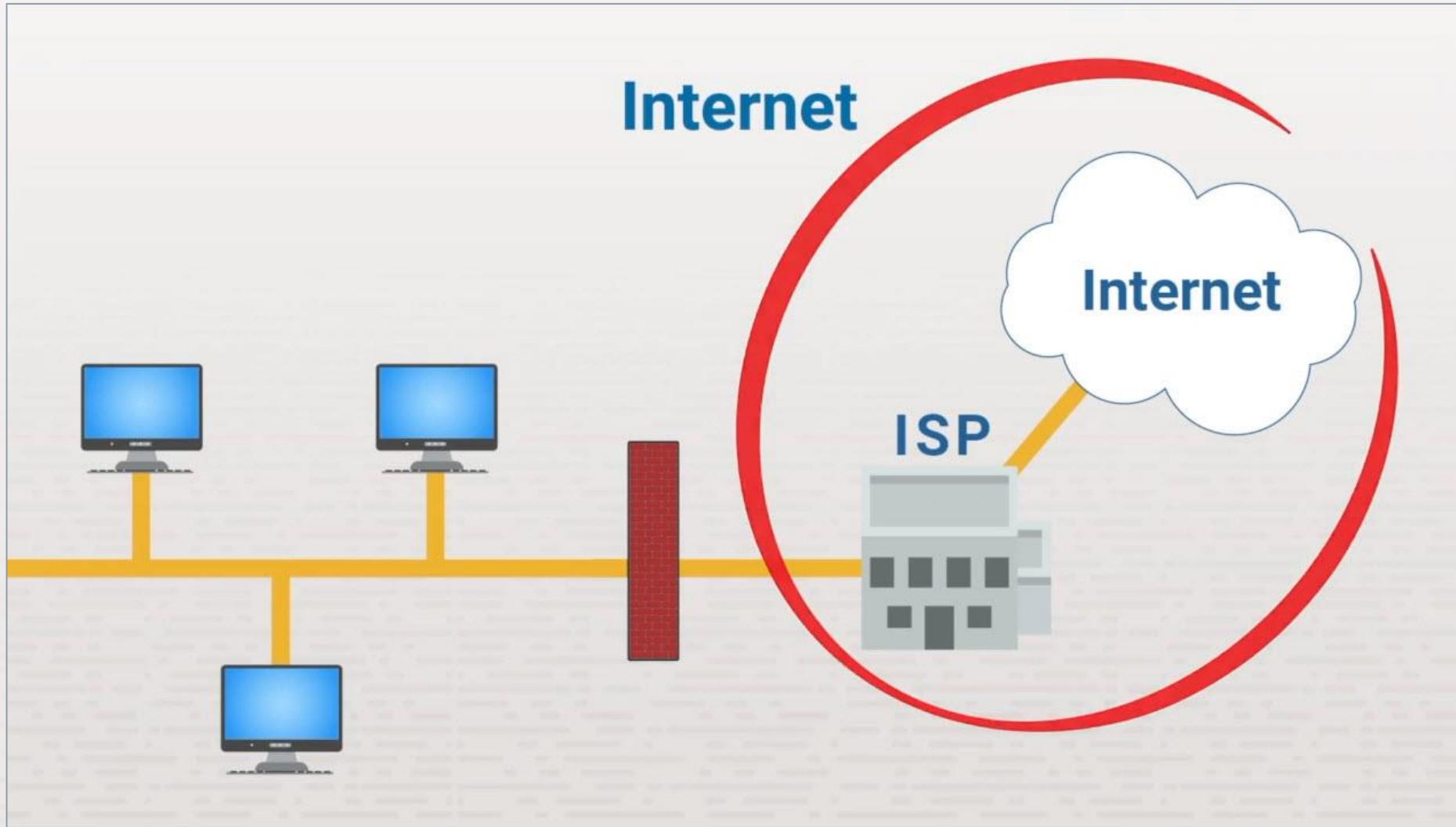
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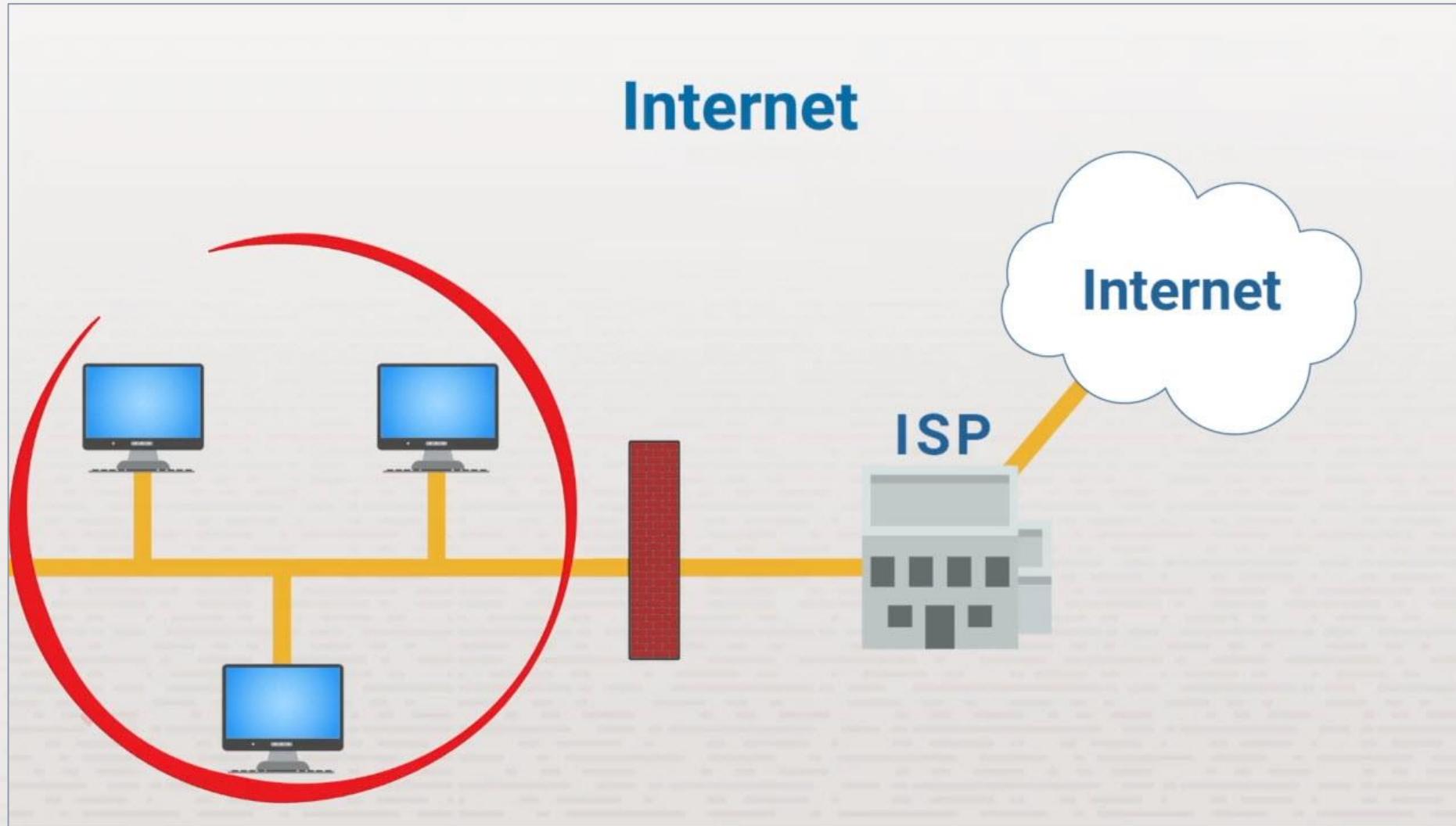
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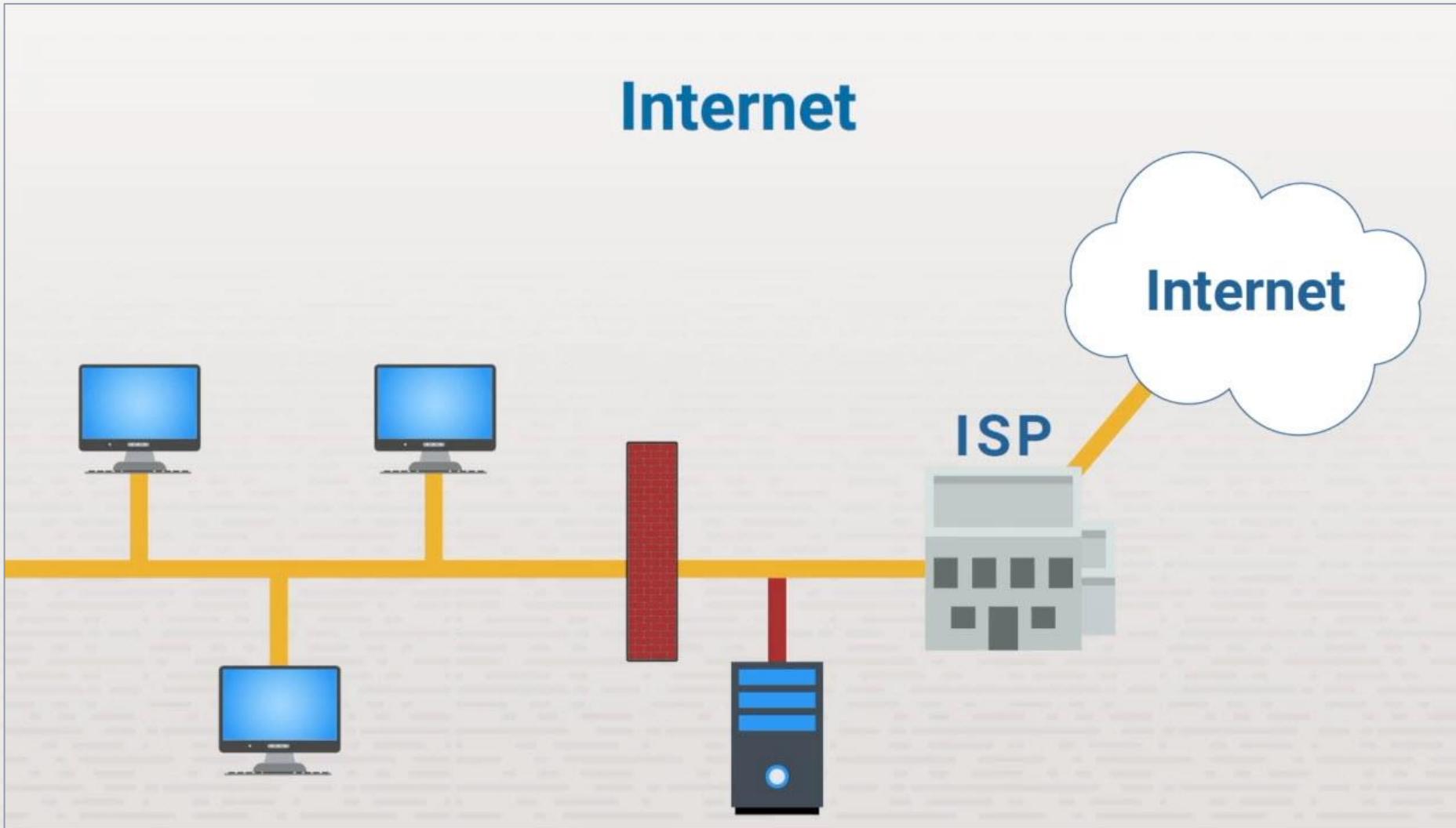
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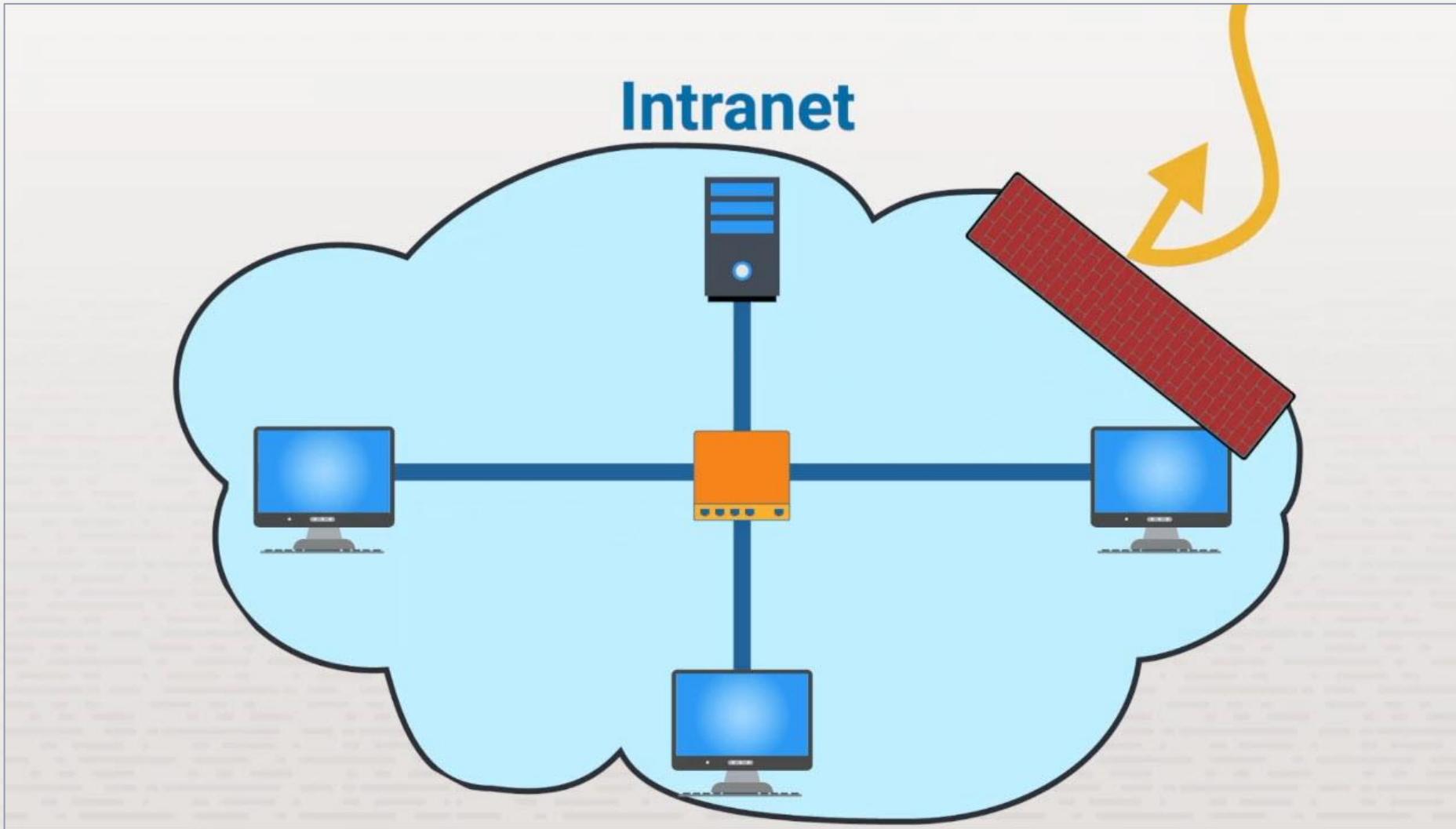
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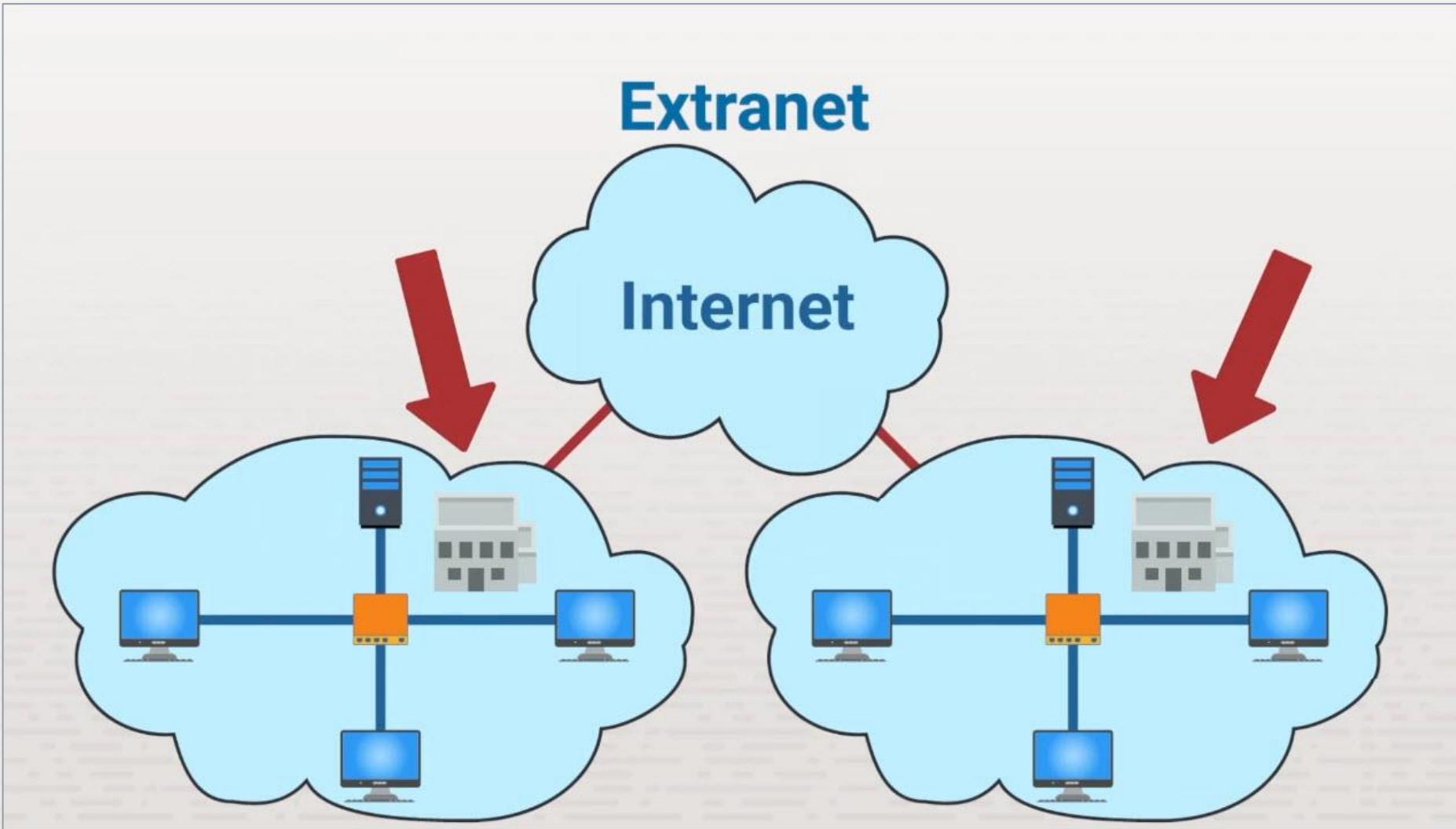
# Networking Terms



# Networking Terms



# Networking Terms



# Summary

- ❖ Addressing
- ❖ LANs
- ❖ MANs
- ❖ WANs
- ❖ Internet
- ❖ Intranet
- ❖ Extranet

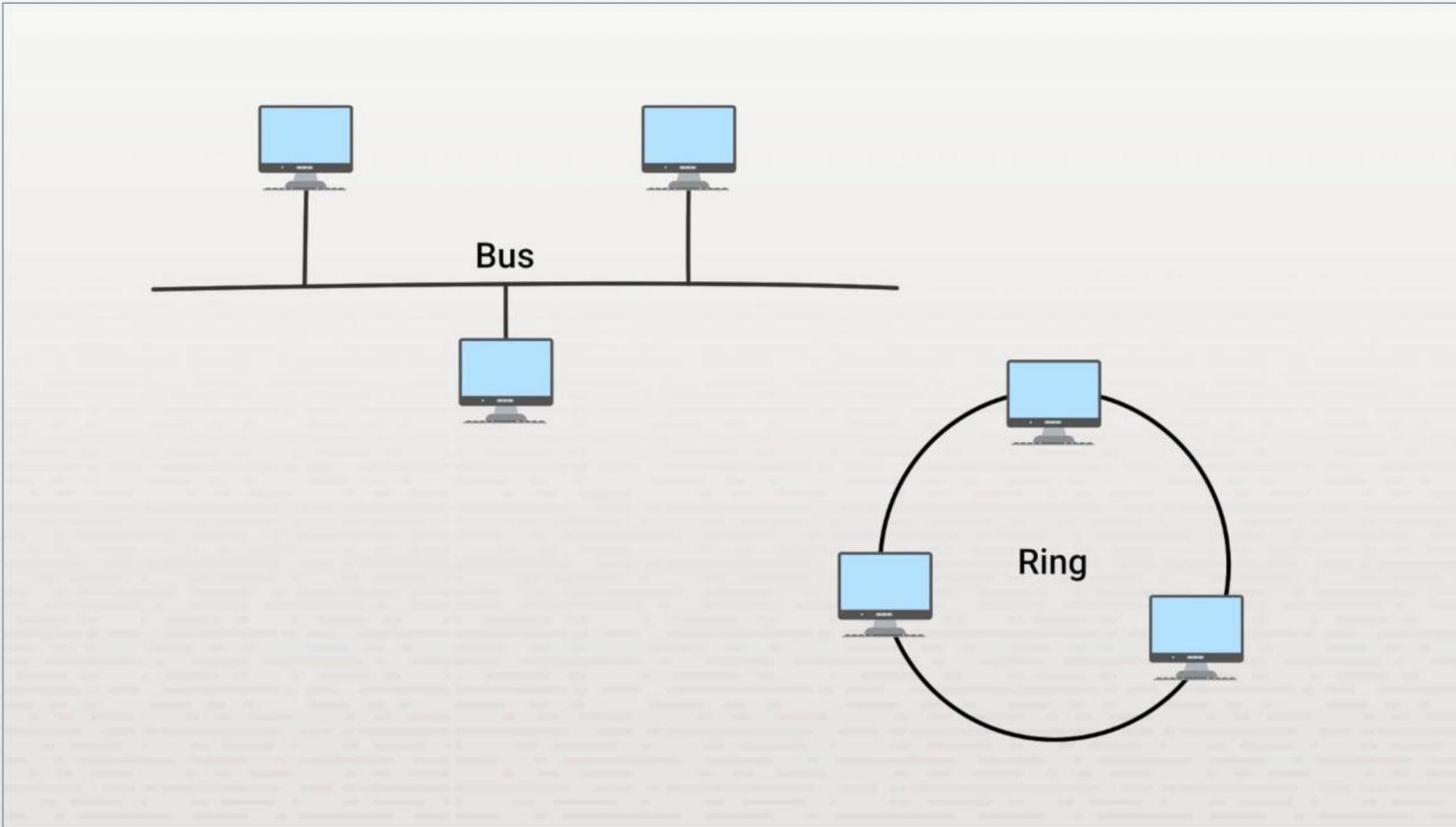
# Network Topologies



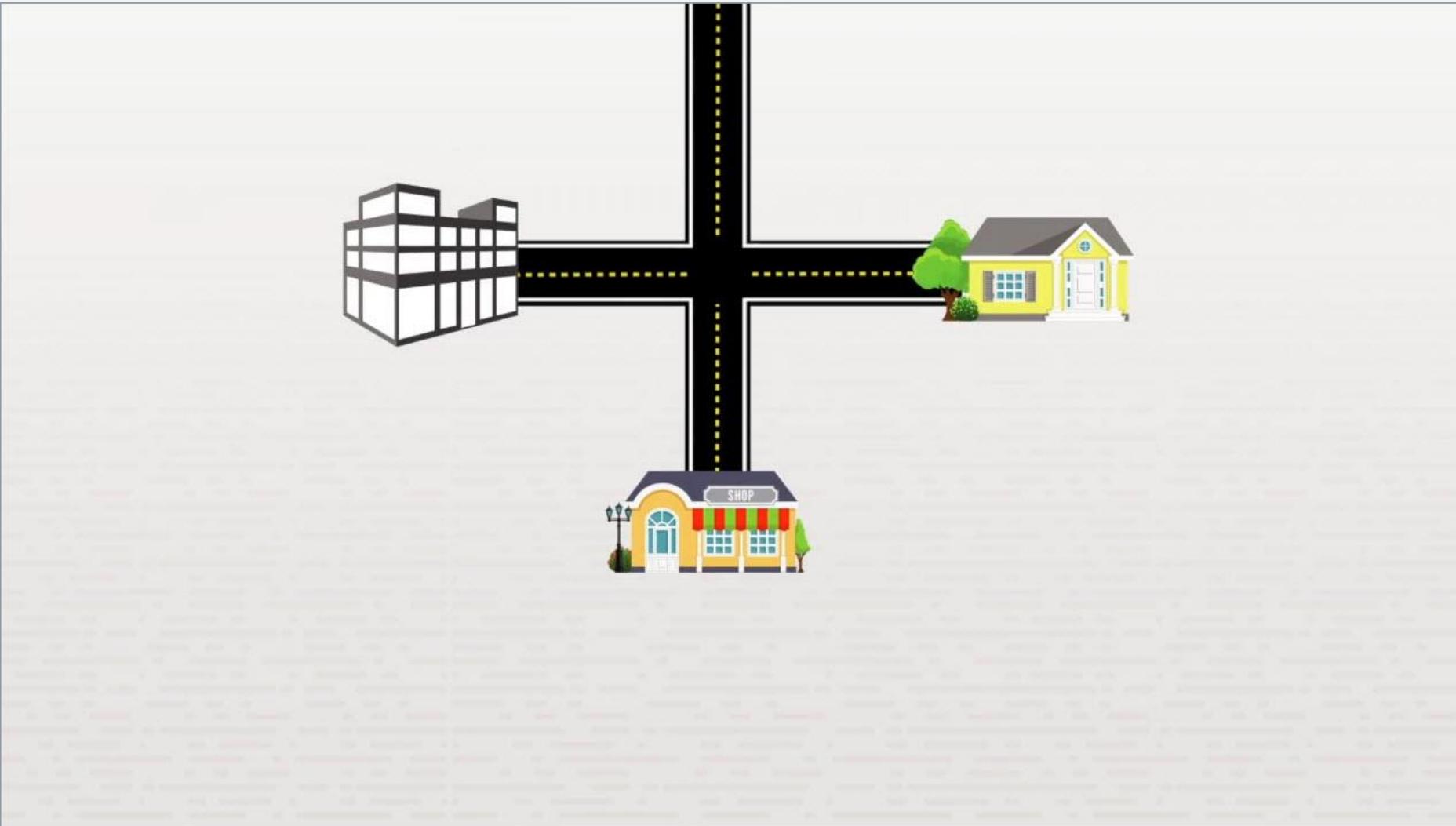
# Network Topologies

- ❖ Physical
- ❖ Logical

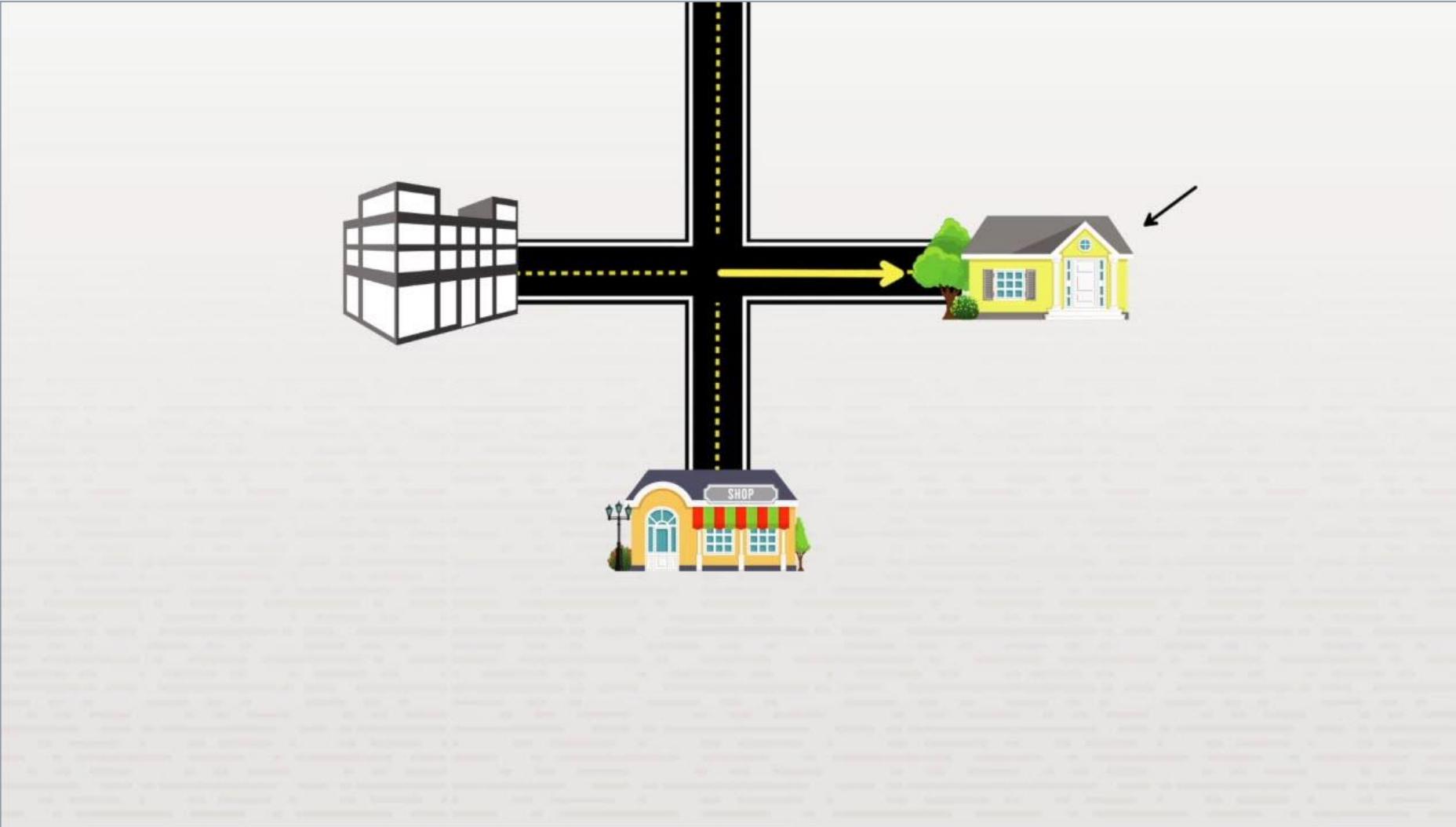
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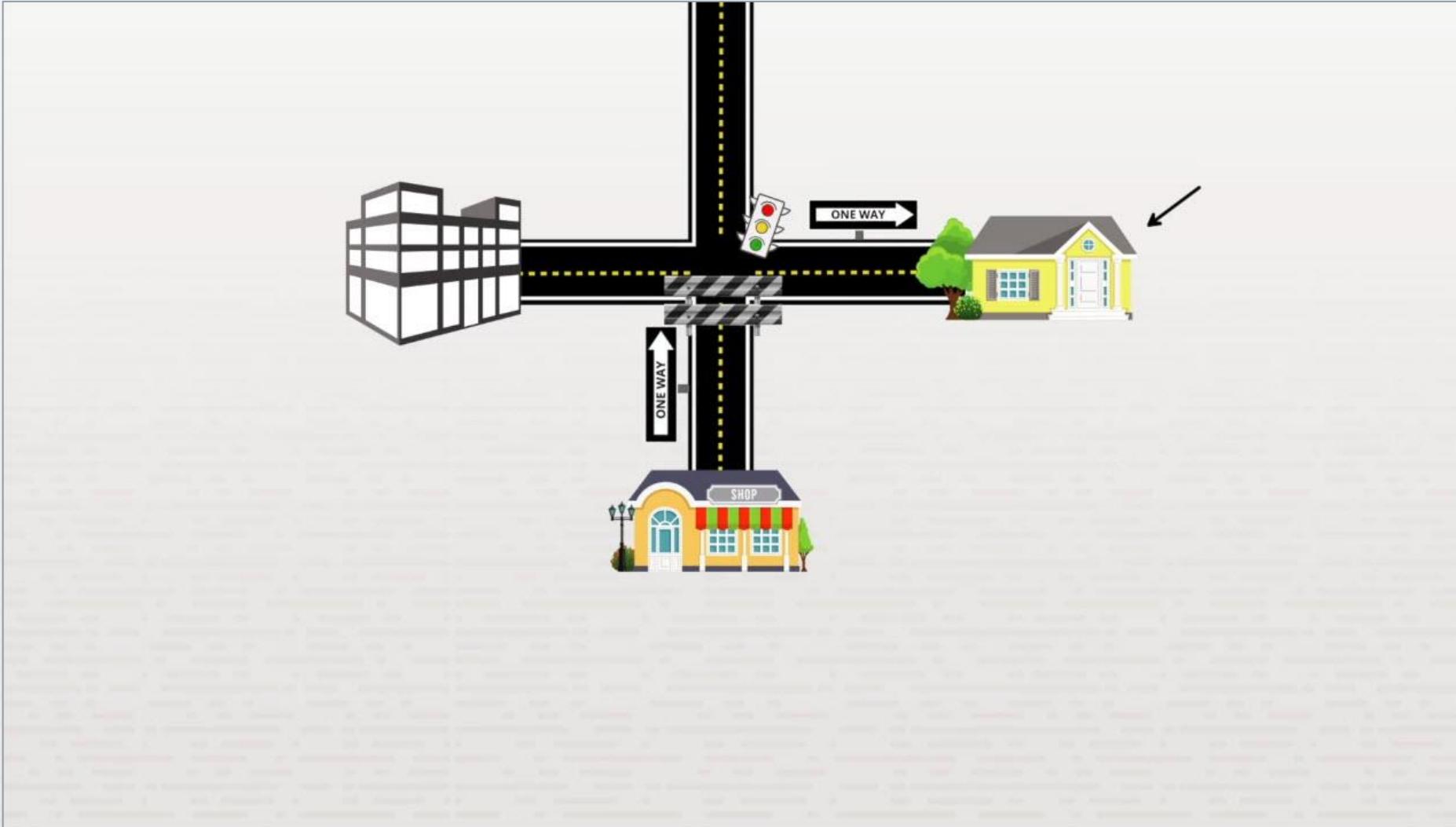
# Network Topologies



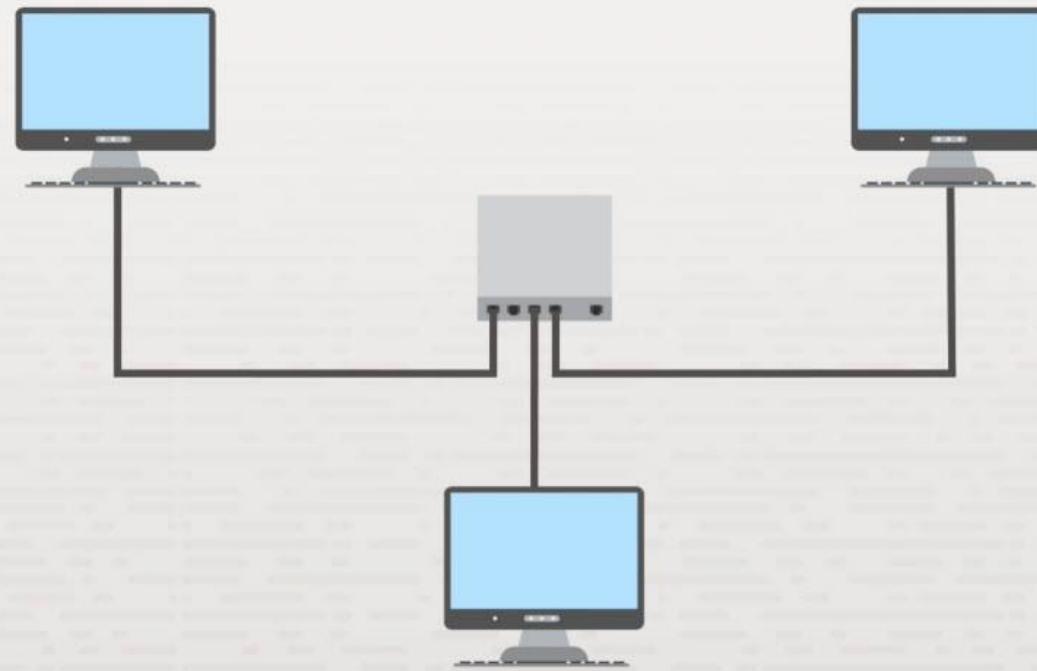
# Network Topologies



# Network Topologies



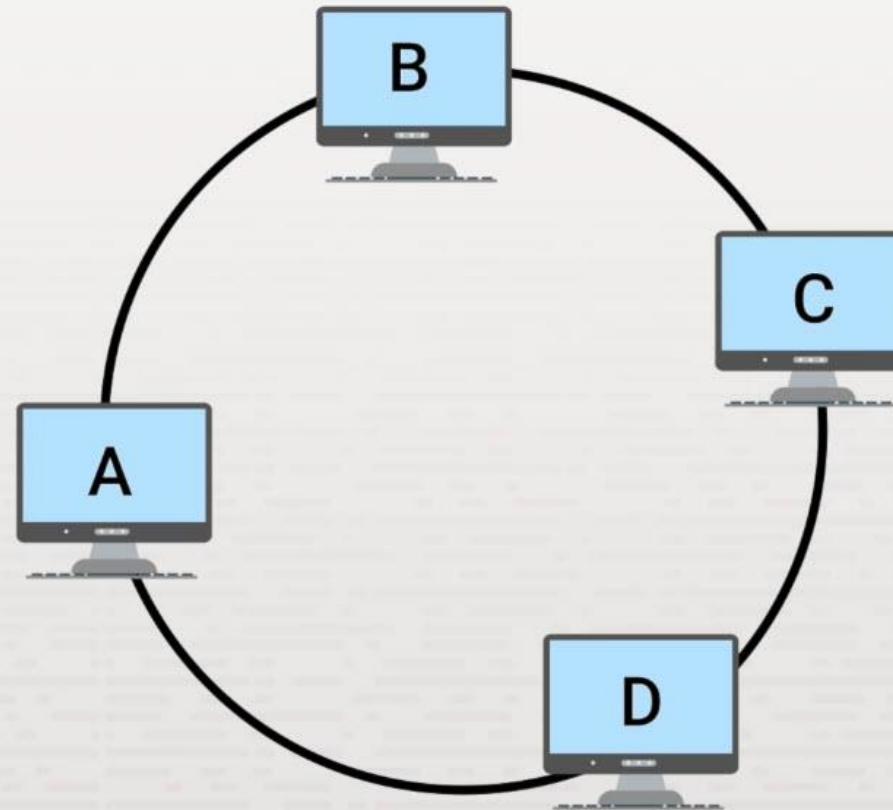
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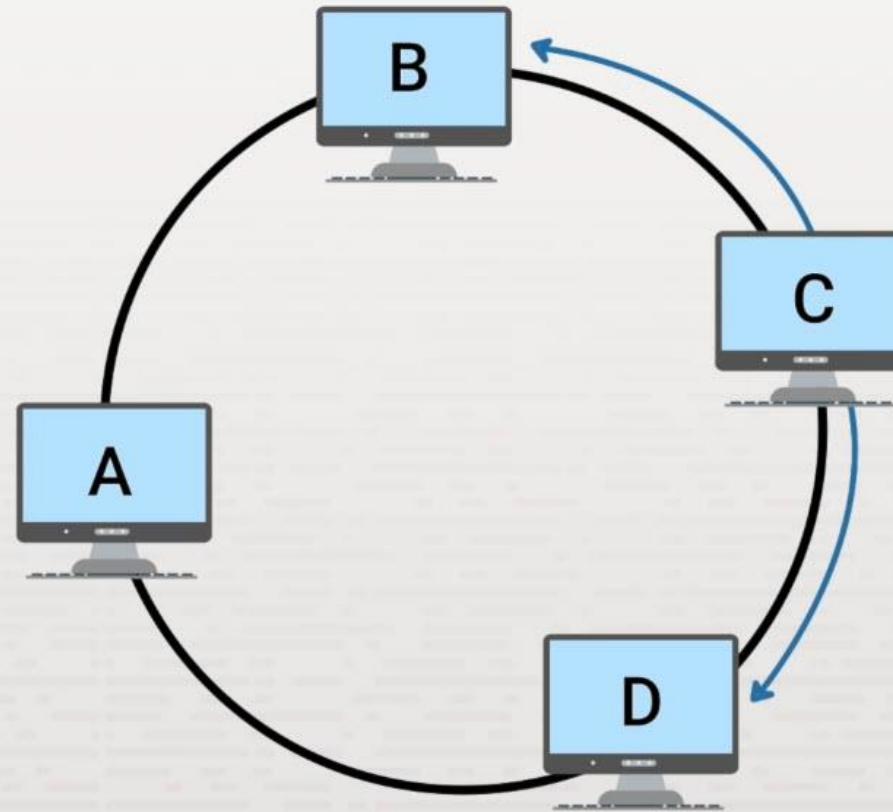
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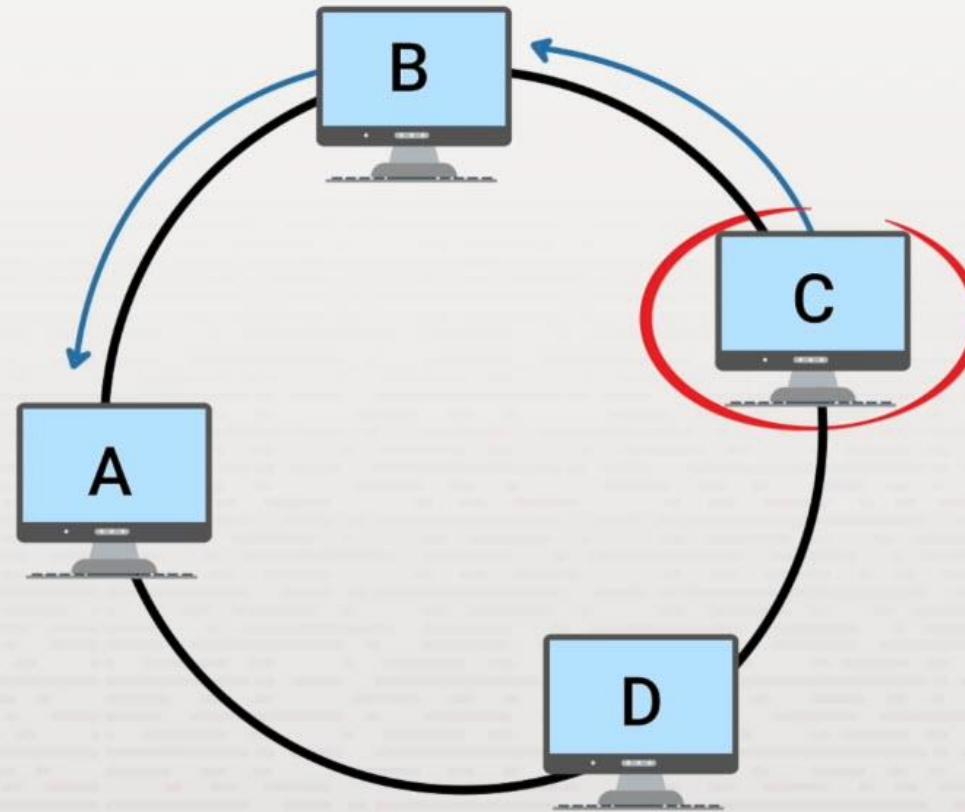
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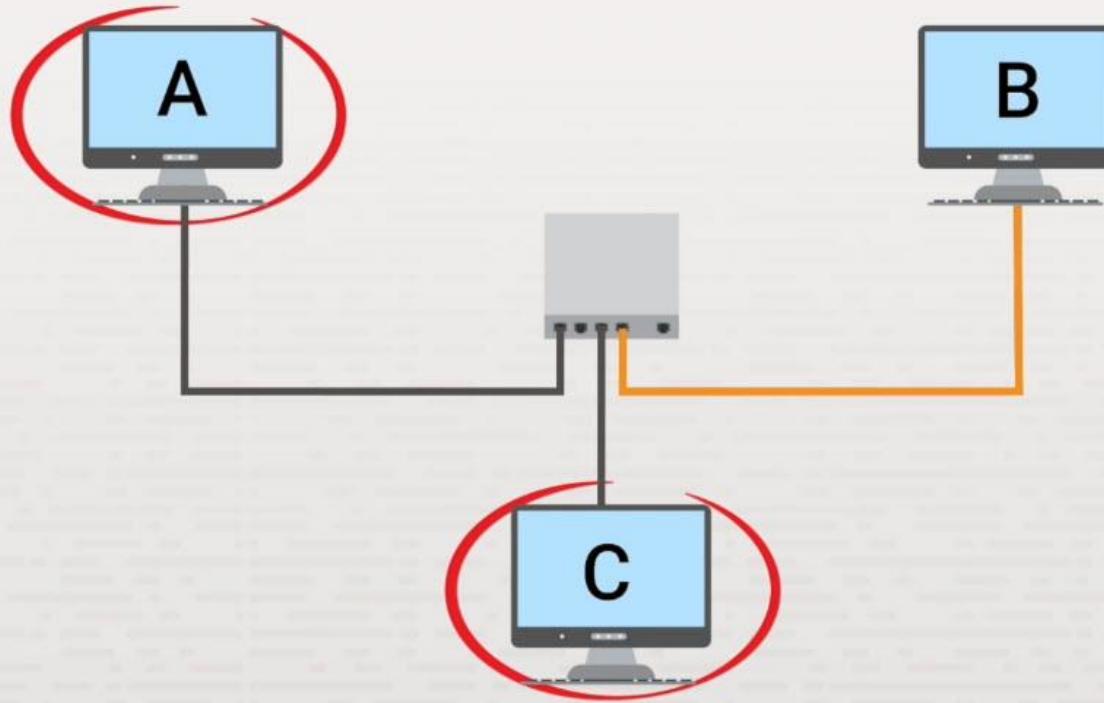
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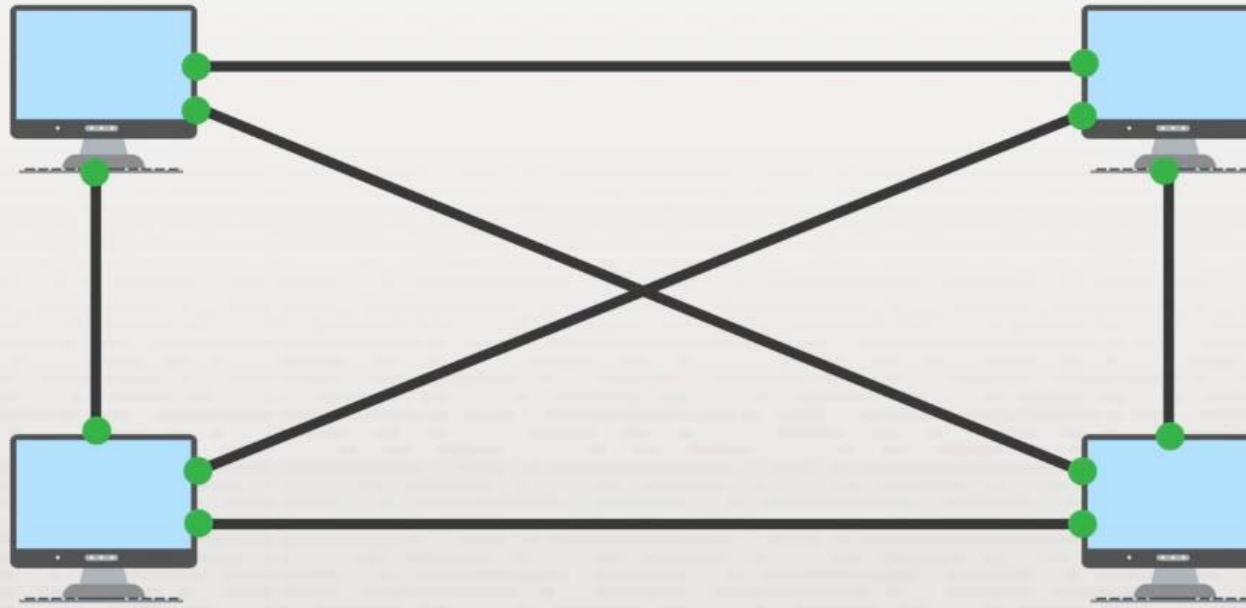
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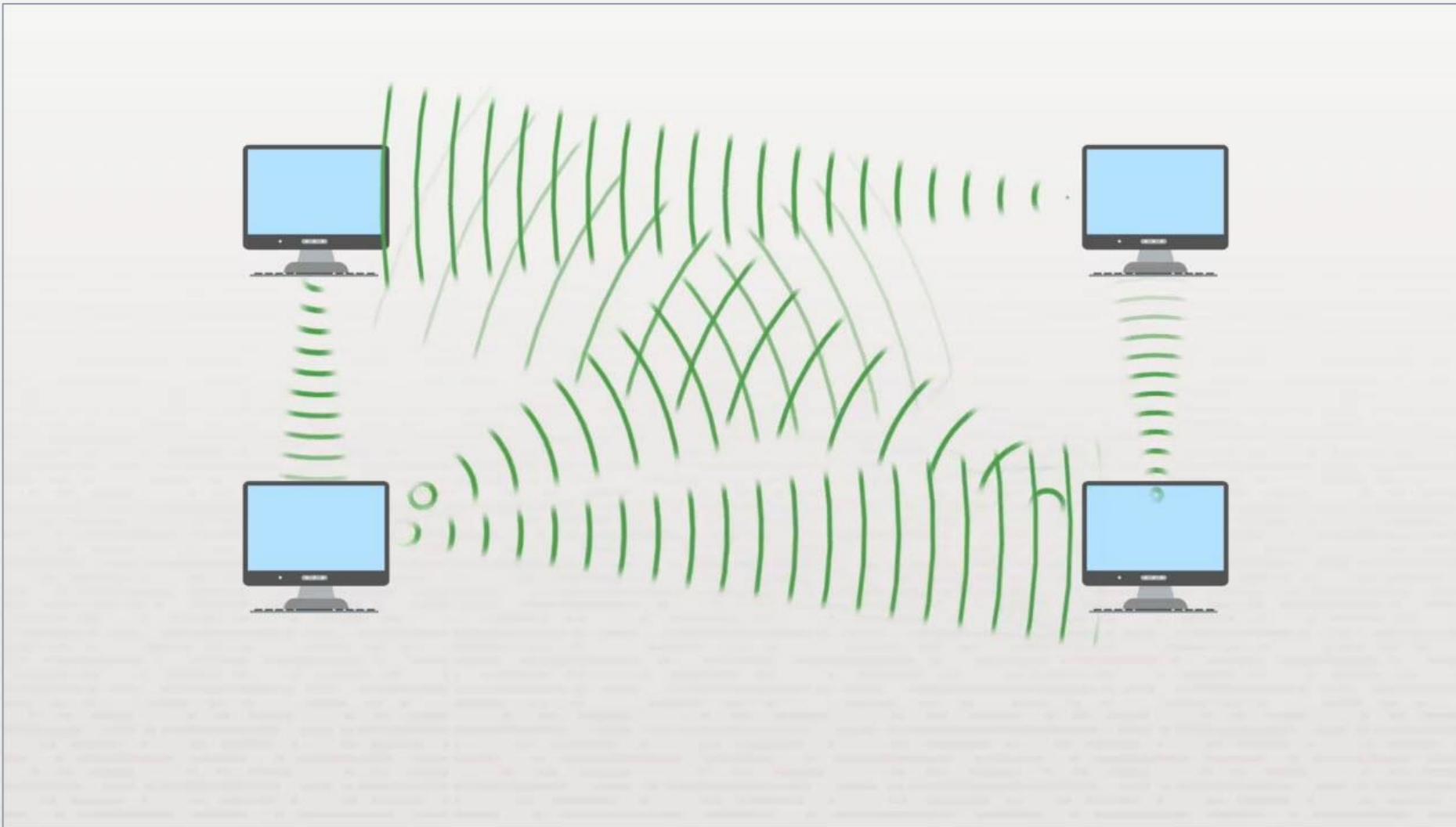
# Network Topologies



# Network Topologies



# Network Topologies



# Summary

- ❖ Physical network topology
- ❖ Logical network topology

# Class Discussion

- ❖ Why are protocols important for networking?
- ❖ What are the advantages of a client-server network as compared to a peer-to-peer network?
- ❖ What is defined by the logical topology?
- ❖ How does the logical topology differ from the physical topology?
- ❖ Why can a single physical topology support multiple logical topologies?
- ❖ Why is a physical mesh topology normally an impractical solution?

# OSI Model and Data Encapsulation



# Key Terms

- ❖ Open Systems Interconnection (OSI) Model

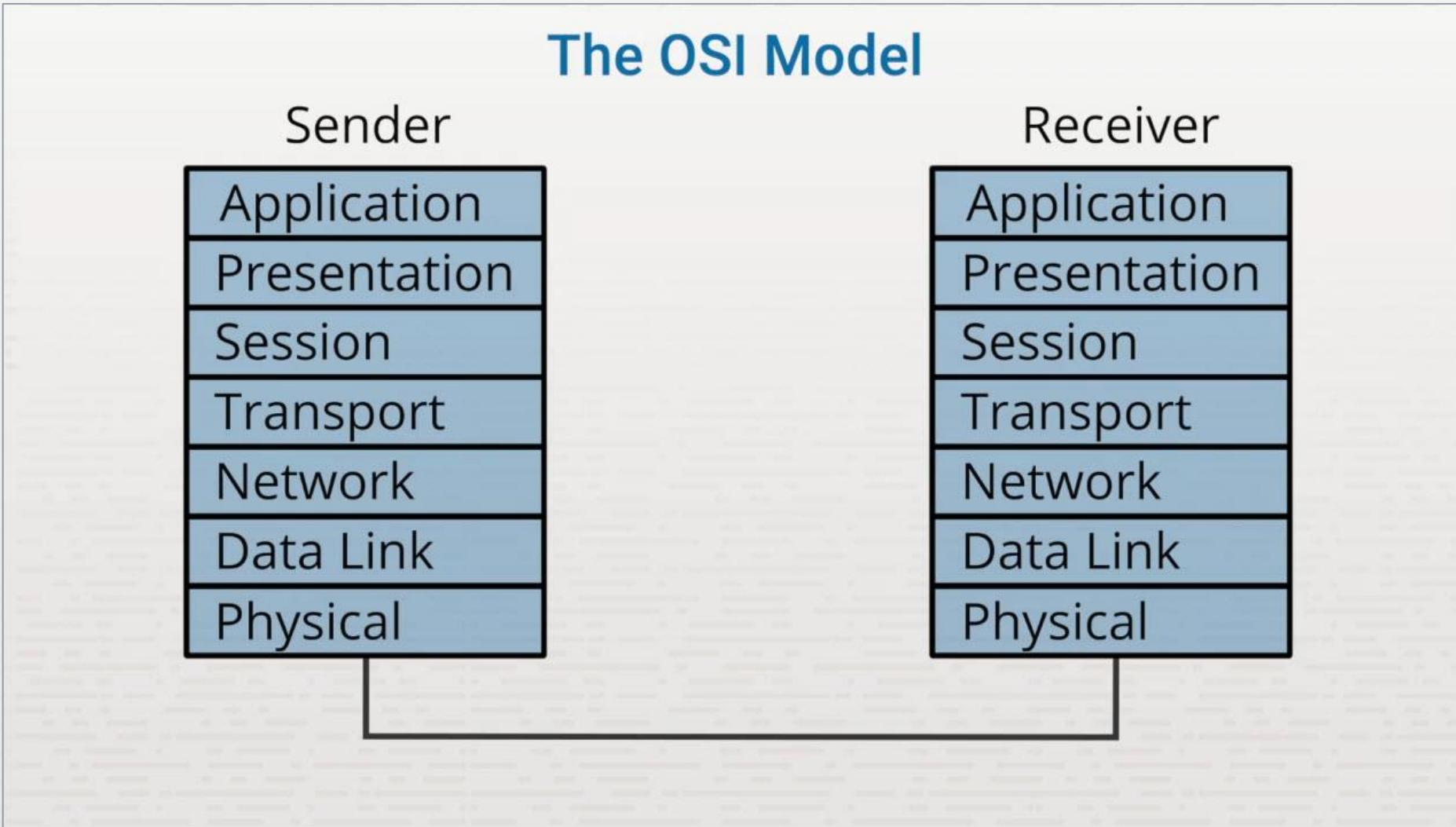
# Key Definitions

- ❖ **Open Systems Interconnection (OSI) Model:** A reference model for how applications communicate over a network without regard to its underlying internal structure and technology.

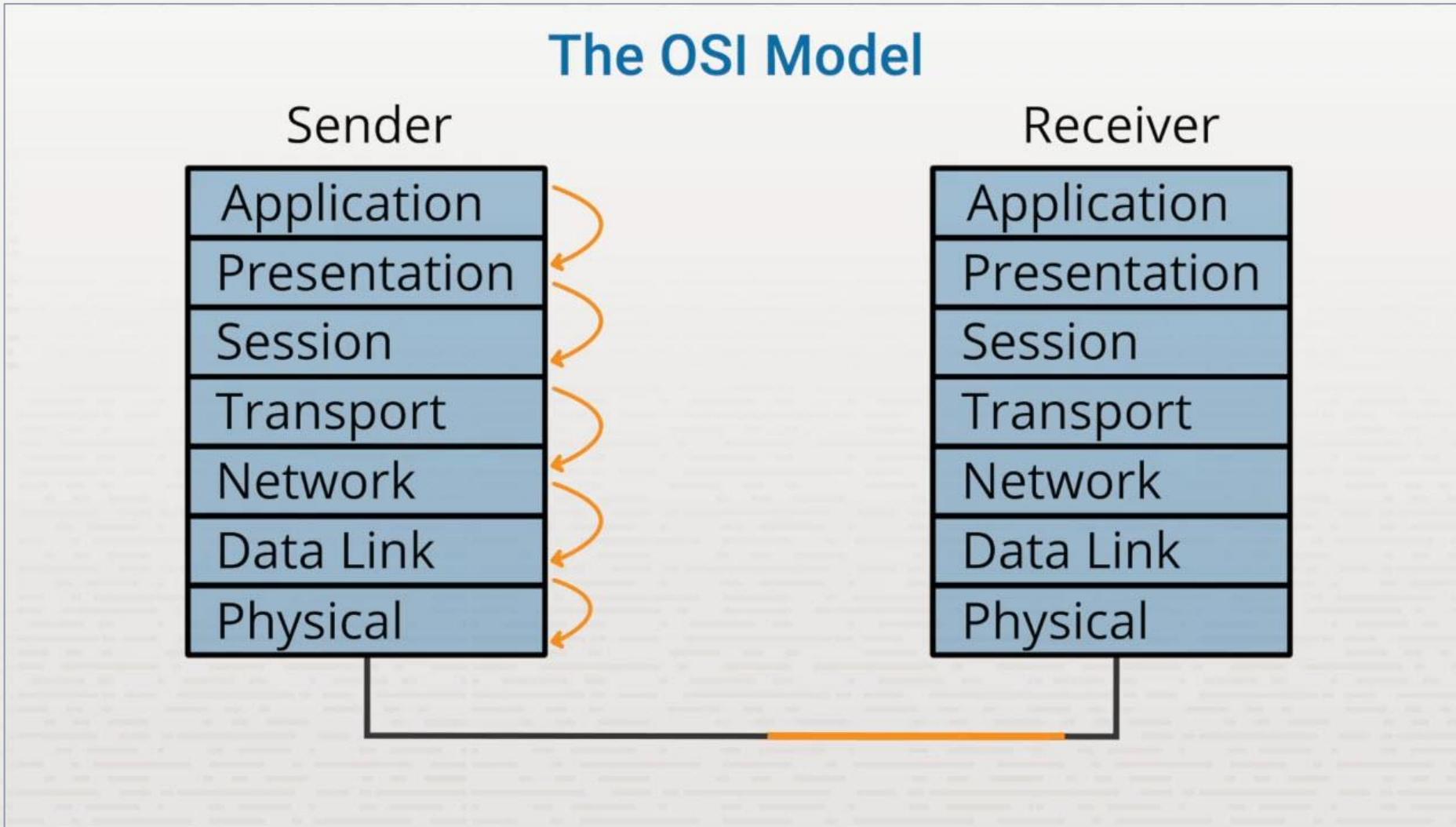
# The OSI Model



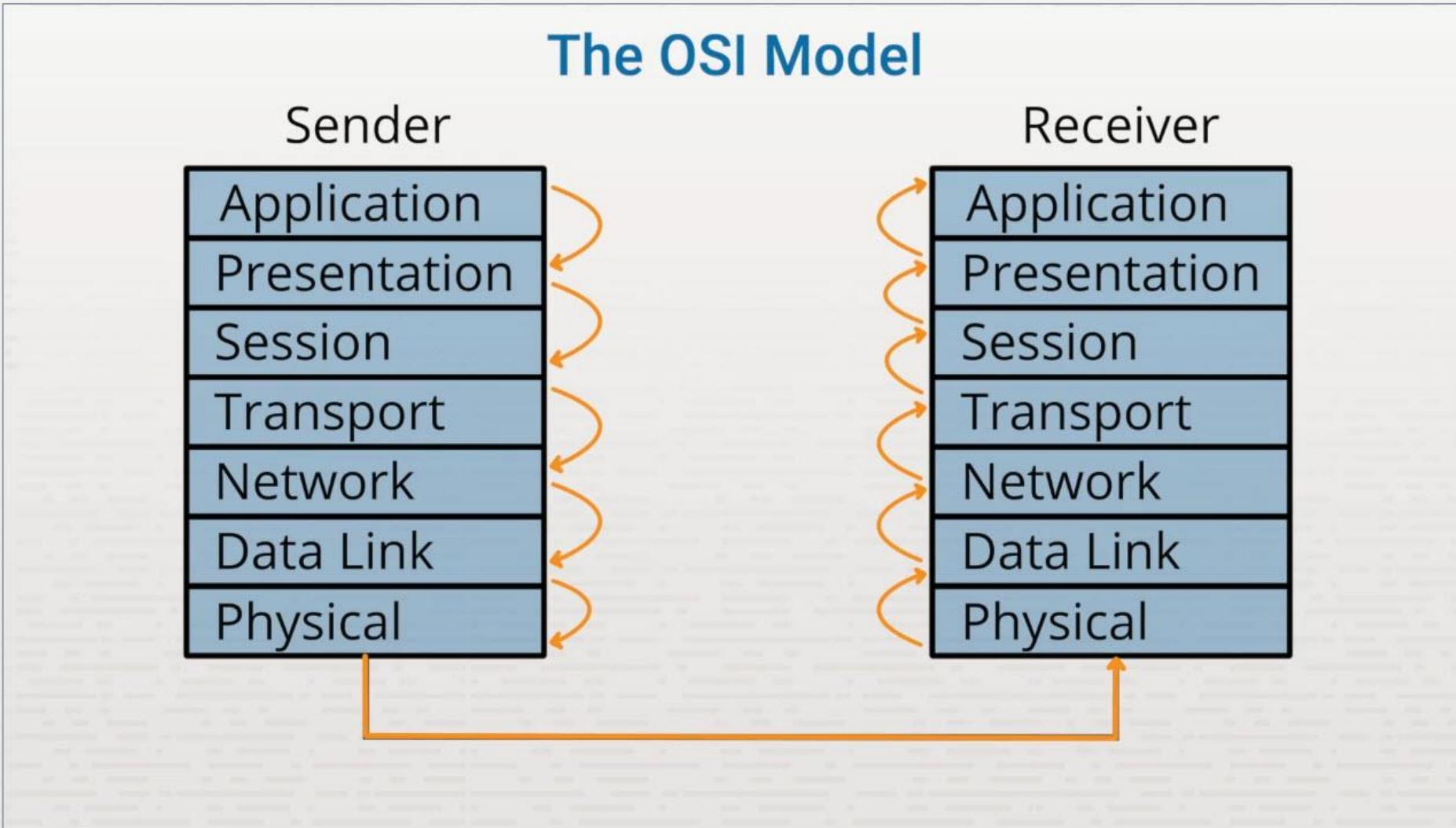
# The OSI Model



# The OSI Model

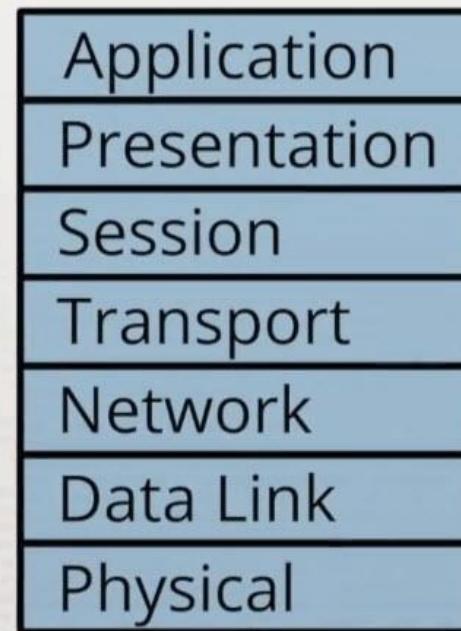


# The OSI Model



# The OSI Model

## The OSI Model

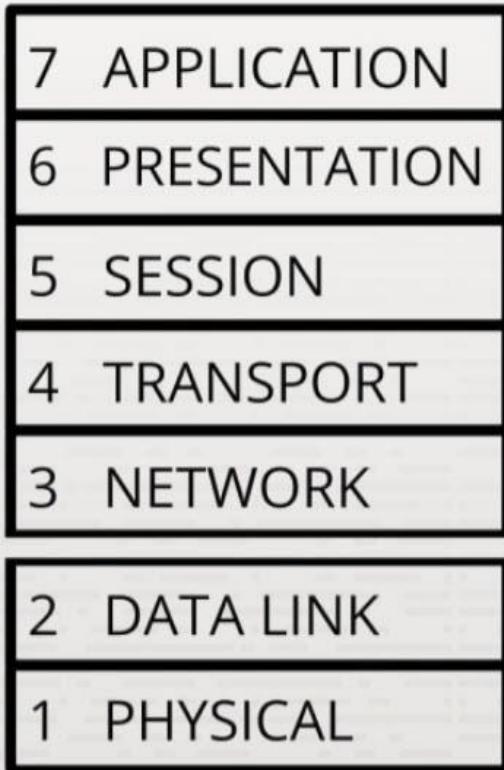


# OSI Model Layers

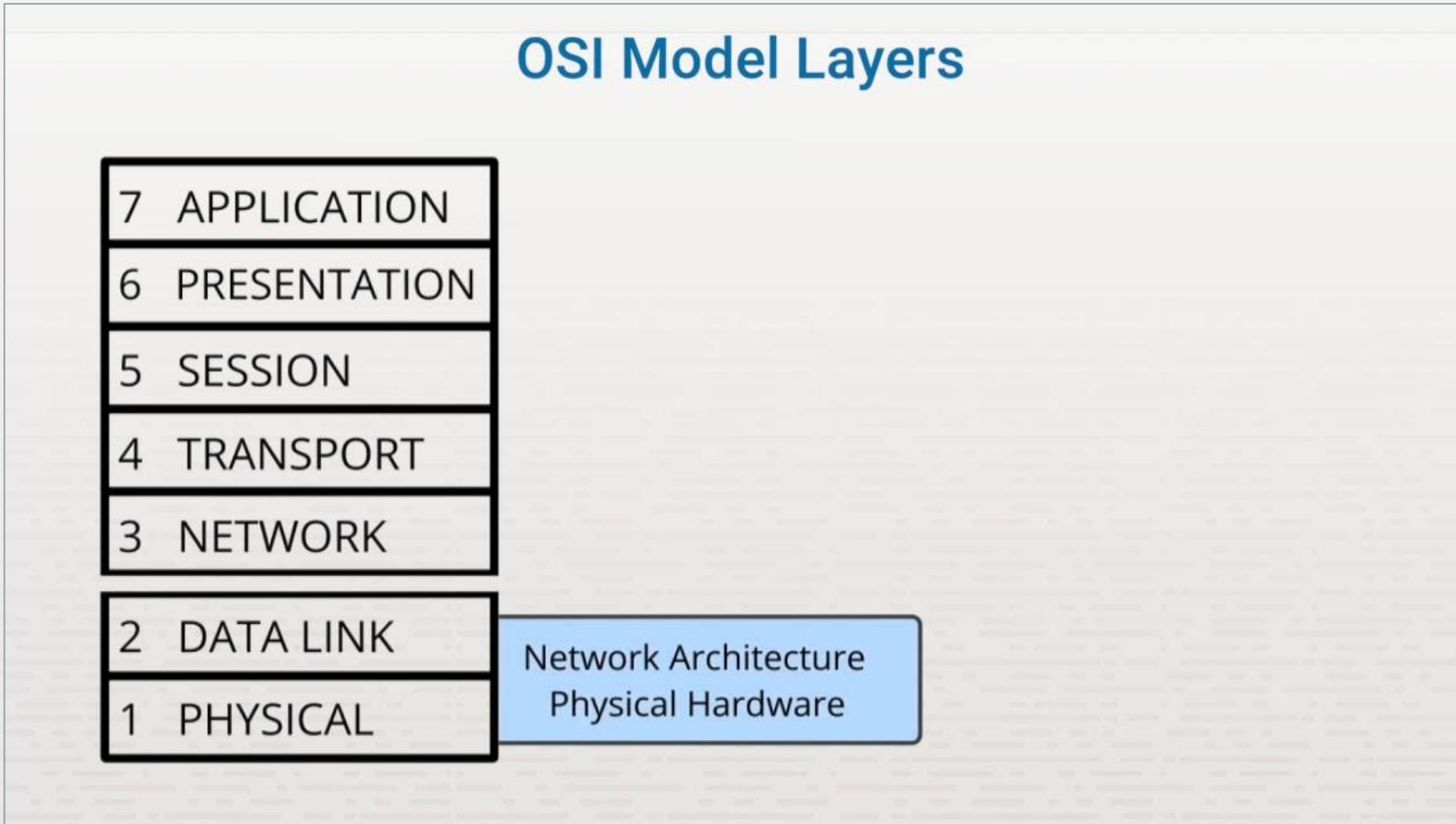


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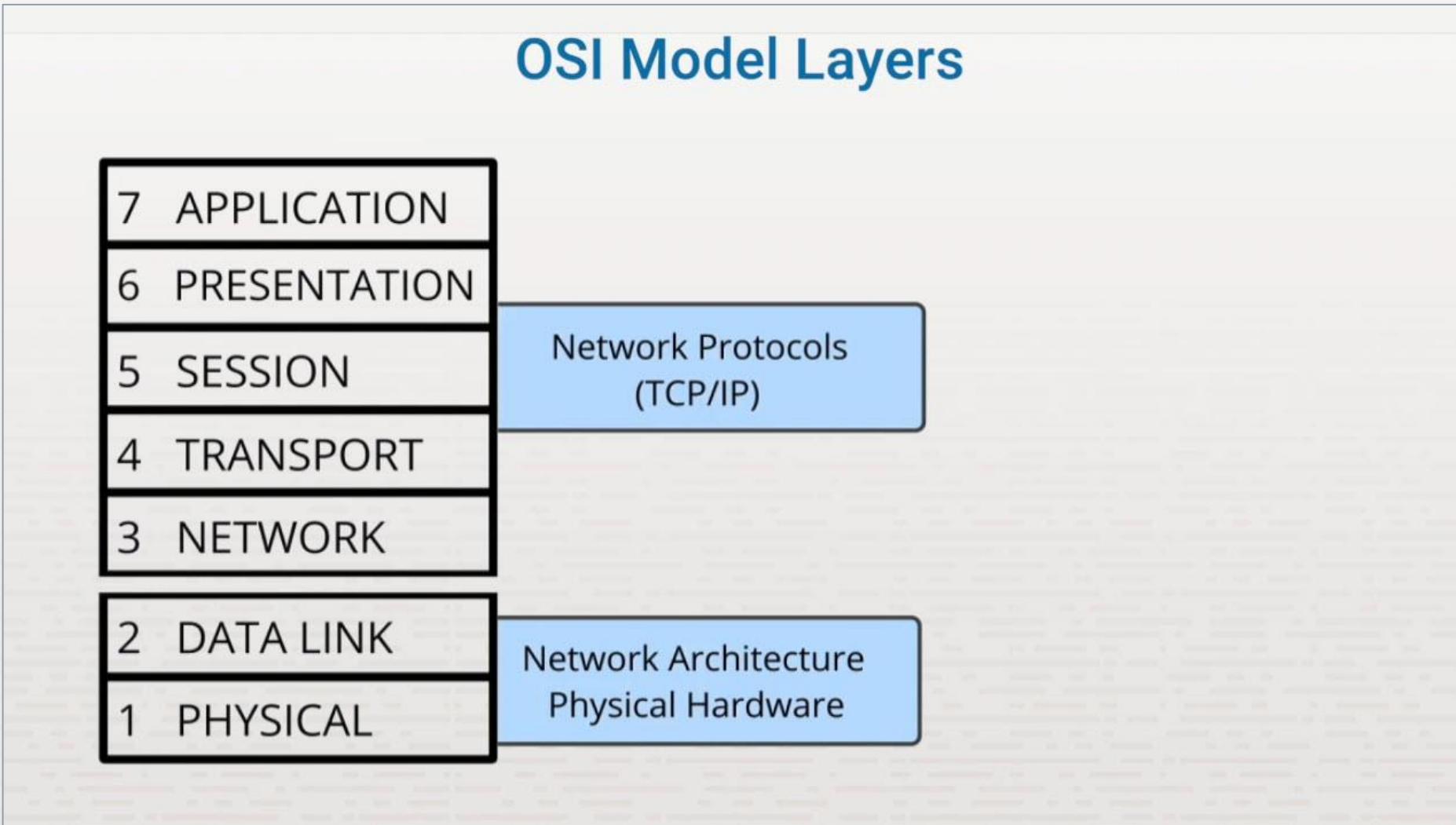
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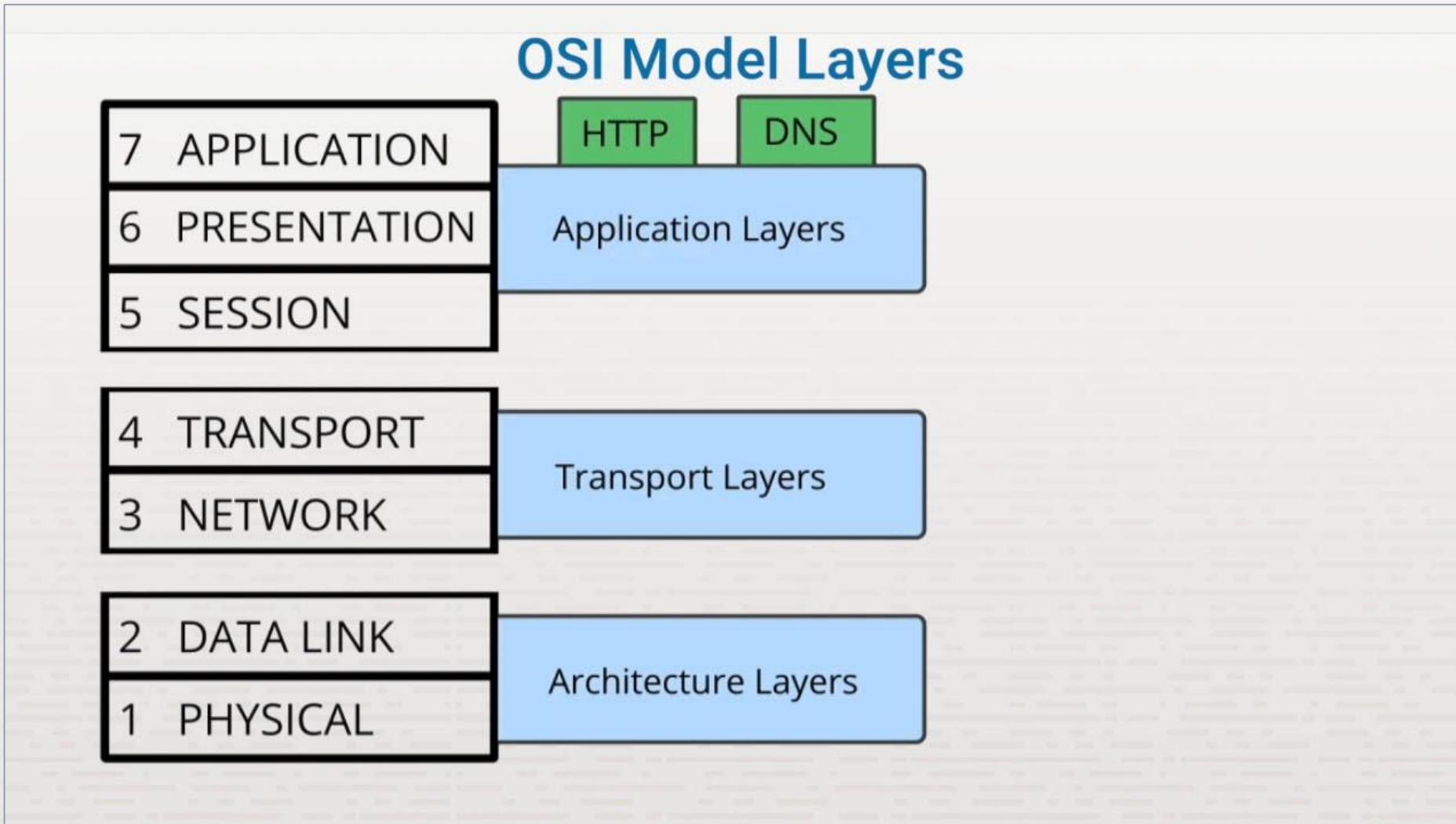
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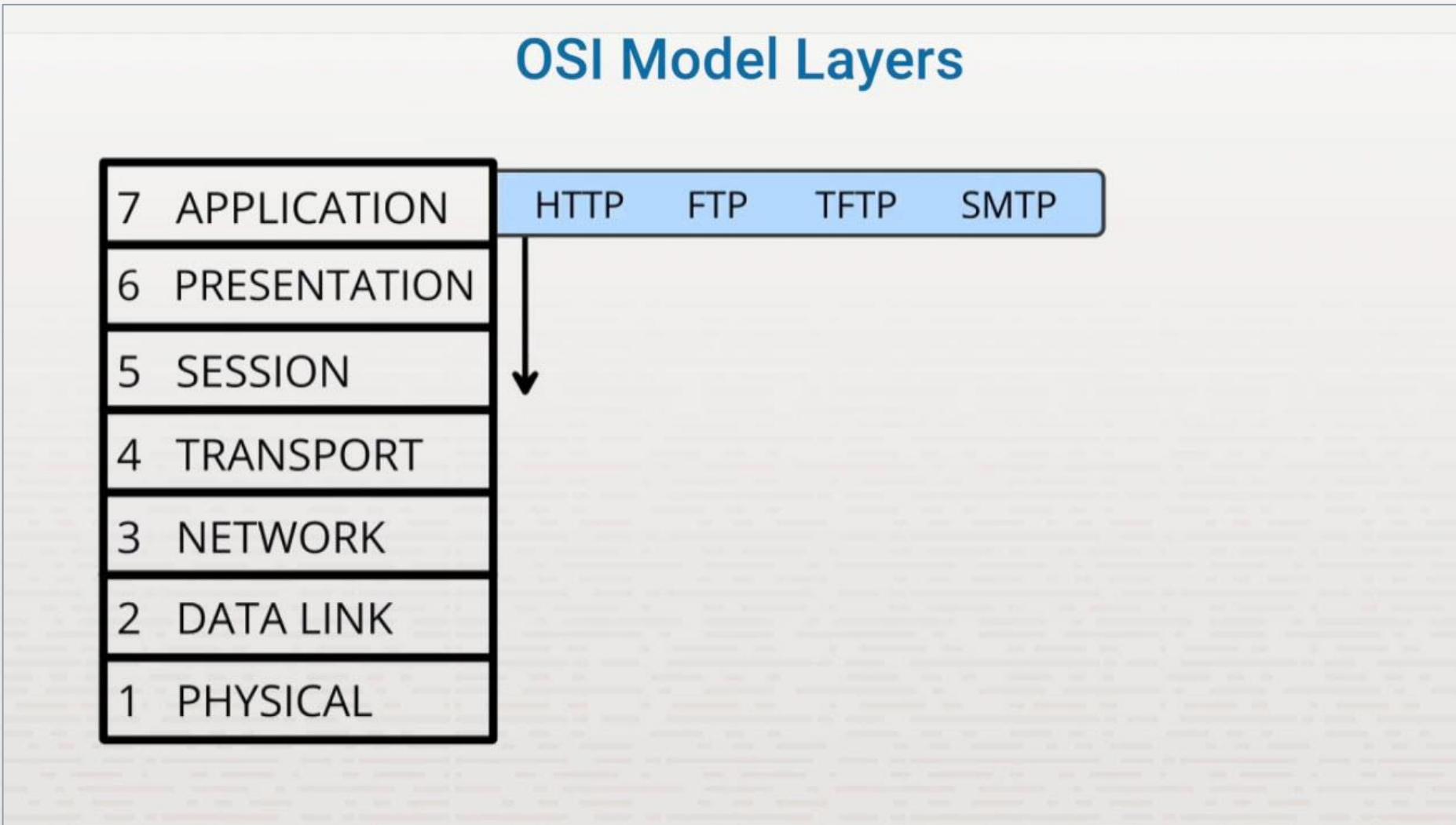
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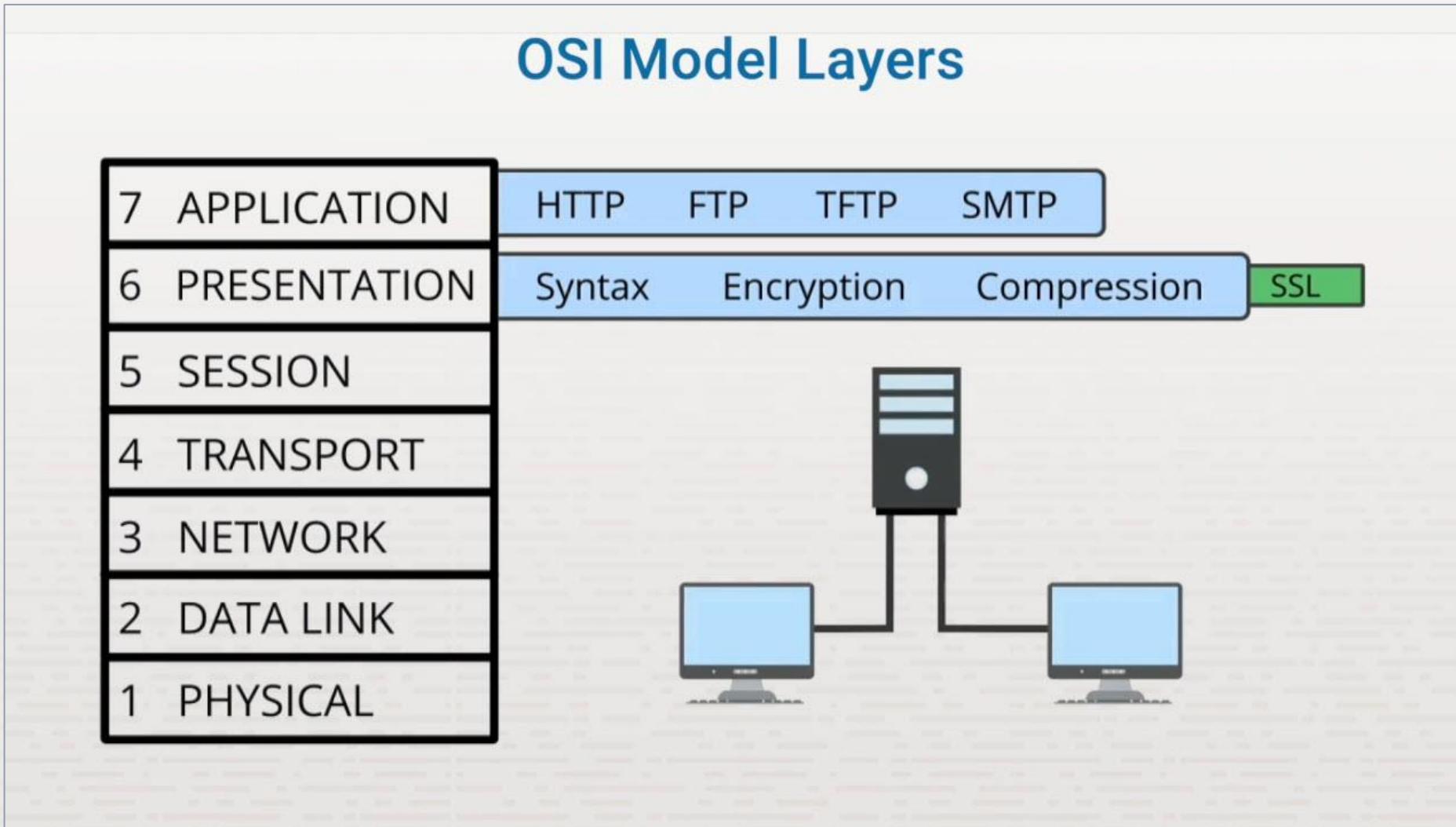
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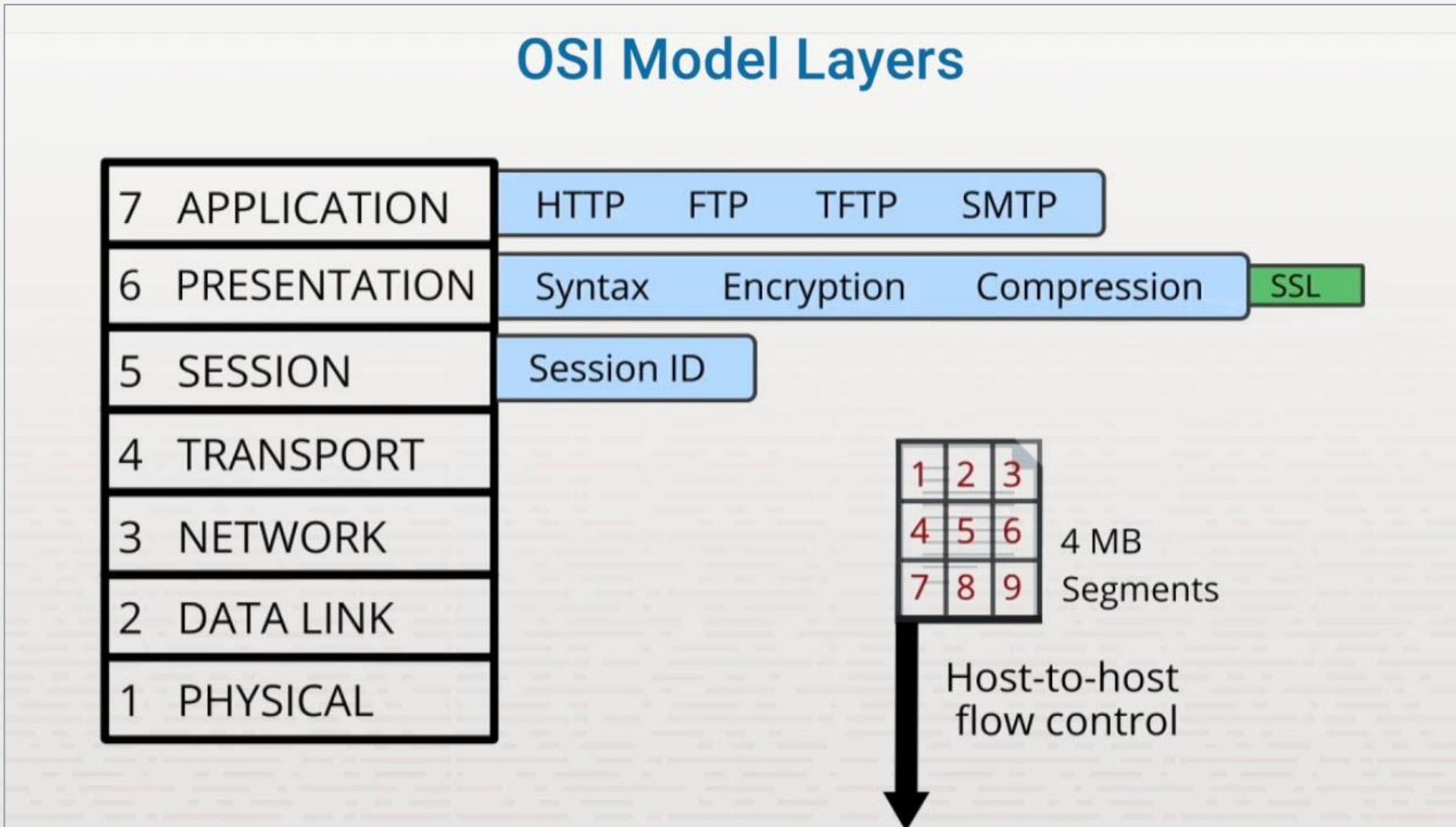
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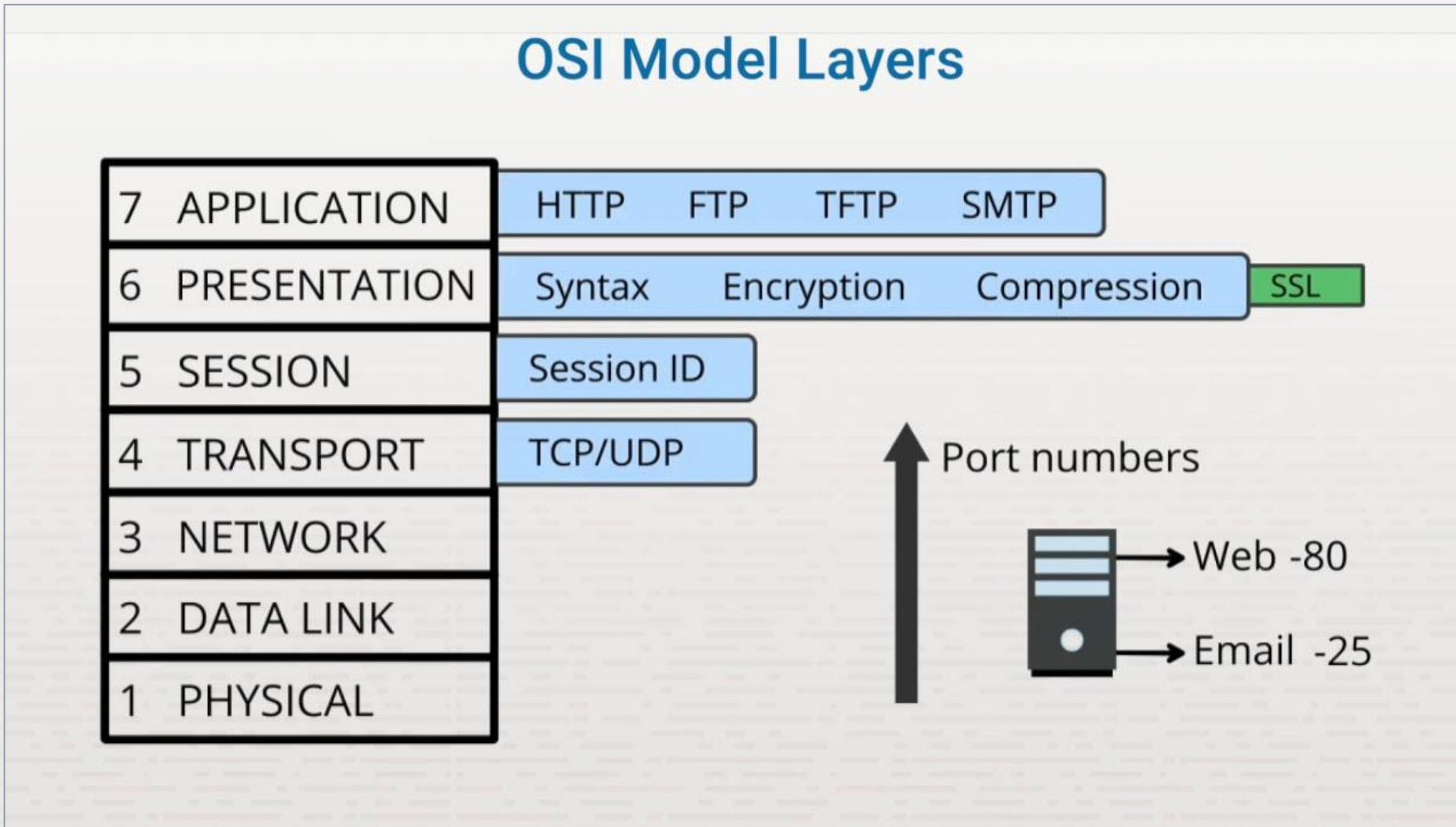
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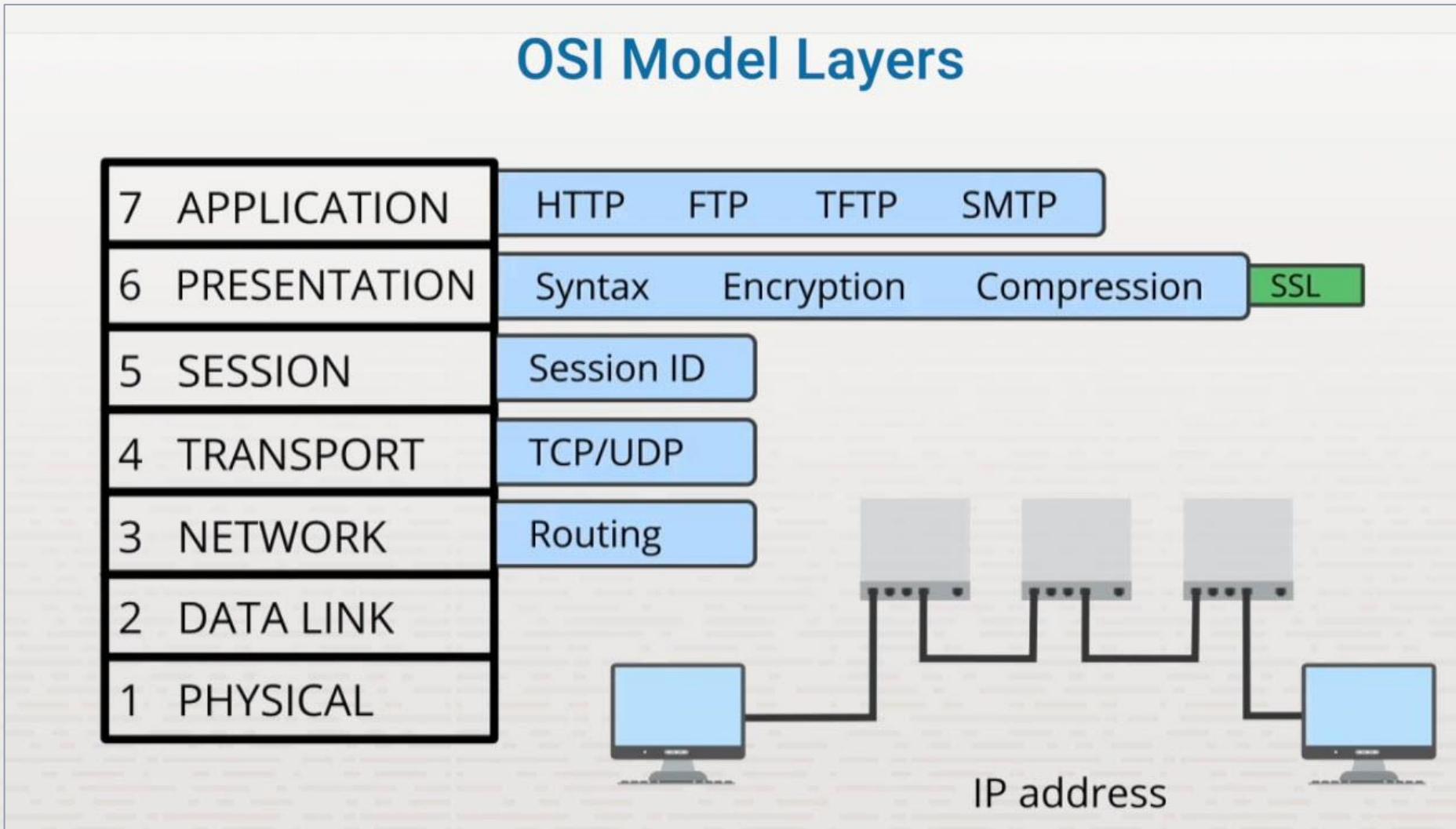
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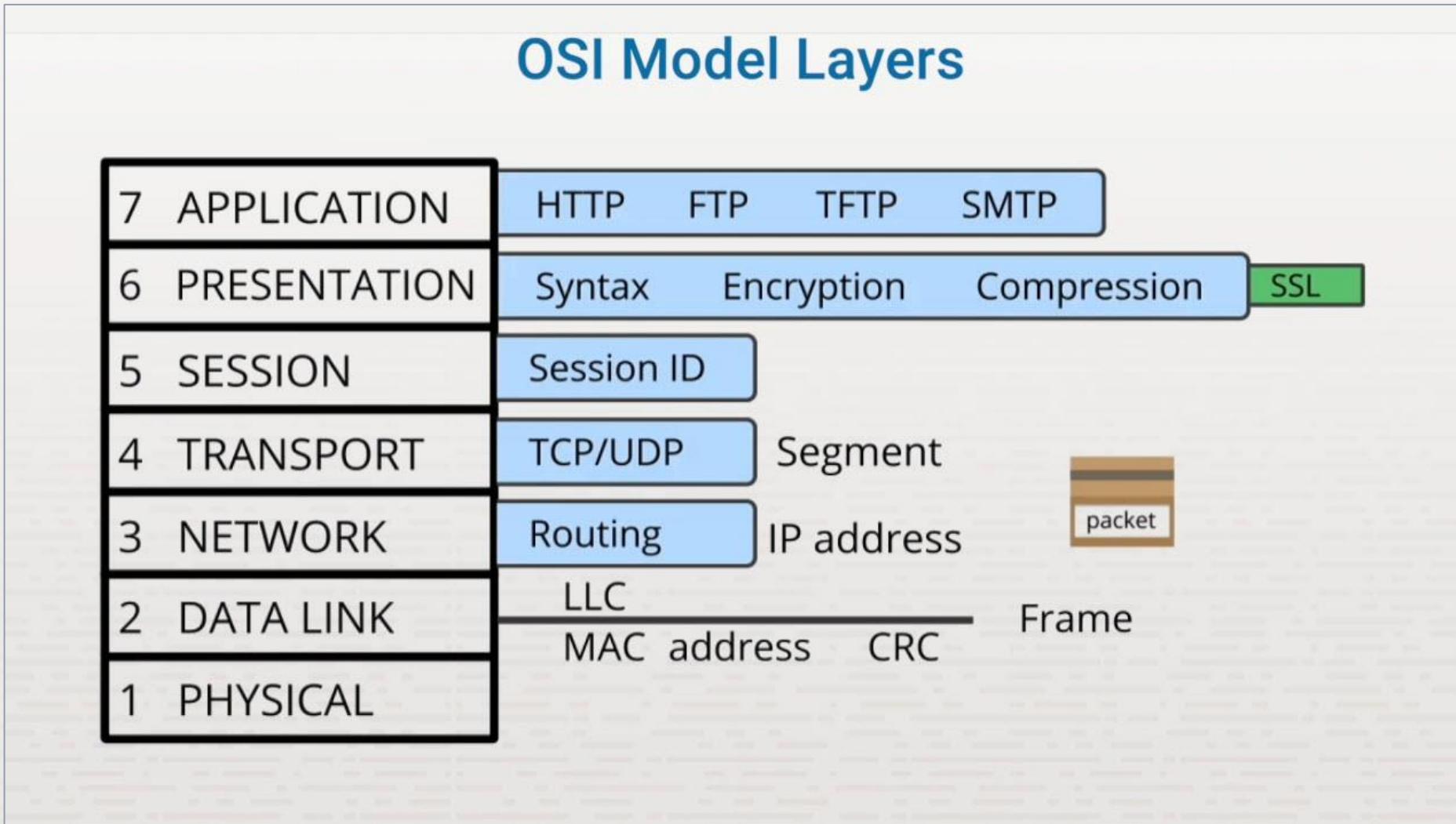
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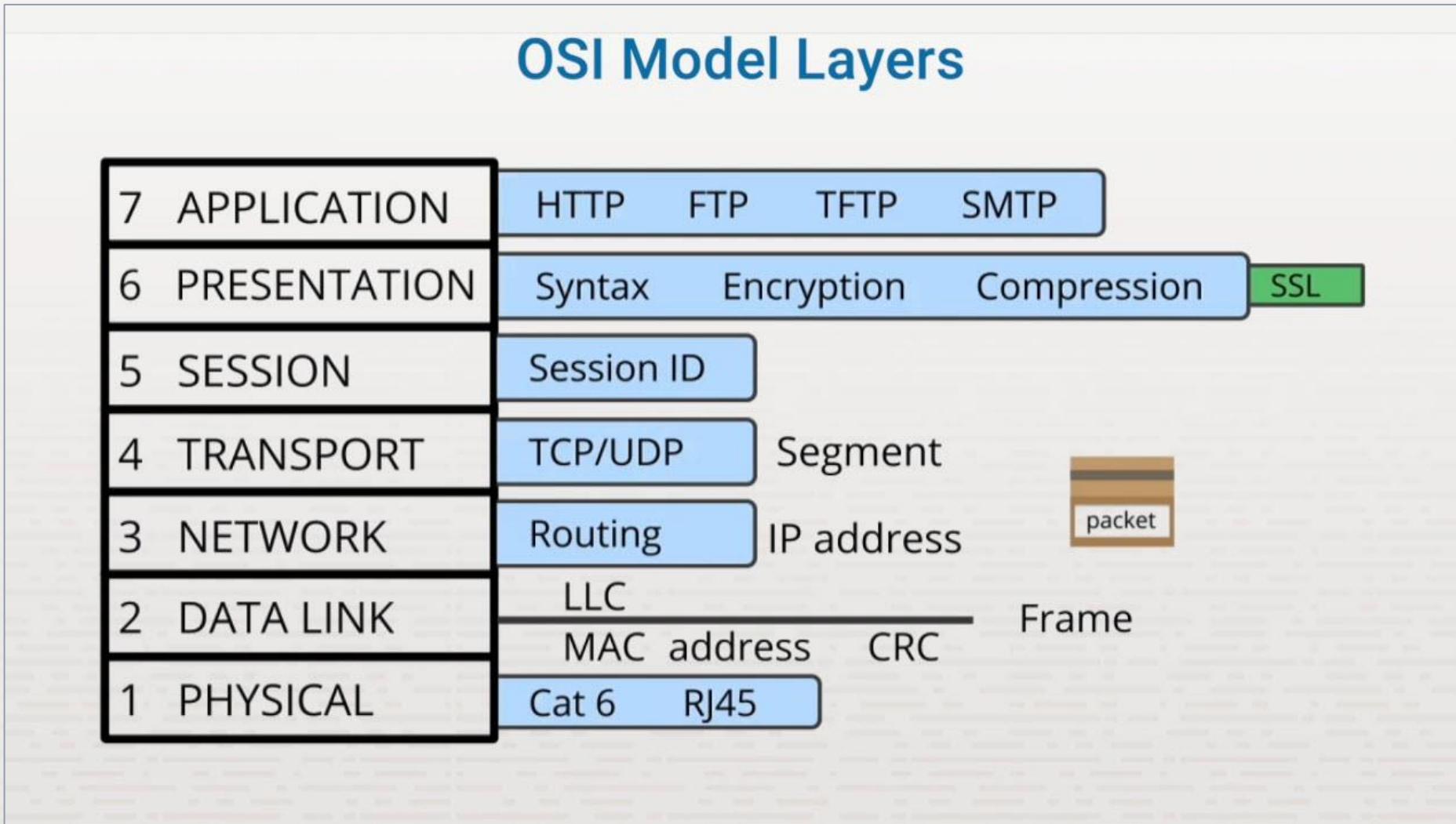
# OSI Model Layers



# OSI Model Layers



# OSI Model Layers



# Summary

- ❖ Different ways to group the OSI model layers
- ❖ Each layer's responsibility

# OSI Model Communications



# OSI Model Communications

## OSI Model Communications



# OSI Model Communications

## OSI Model Communications

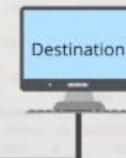


# OSI Model Communications

## OSI Model Communications



Encryption



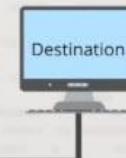
# OSI Model Communications

## OSI Model Communications

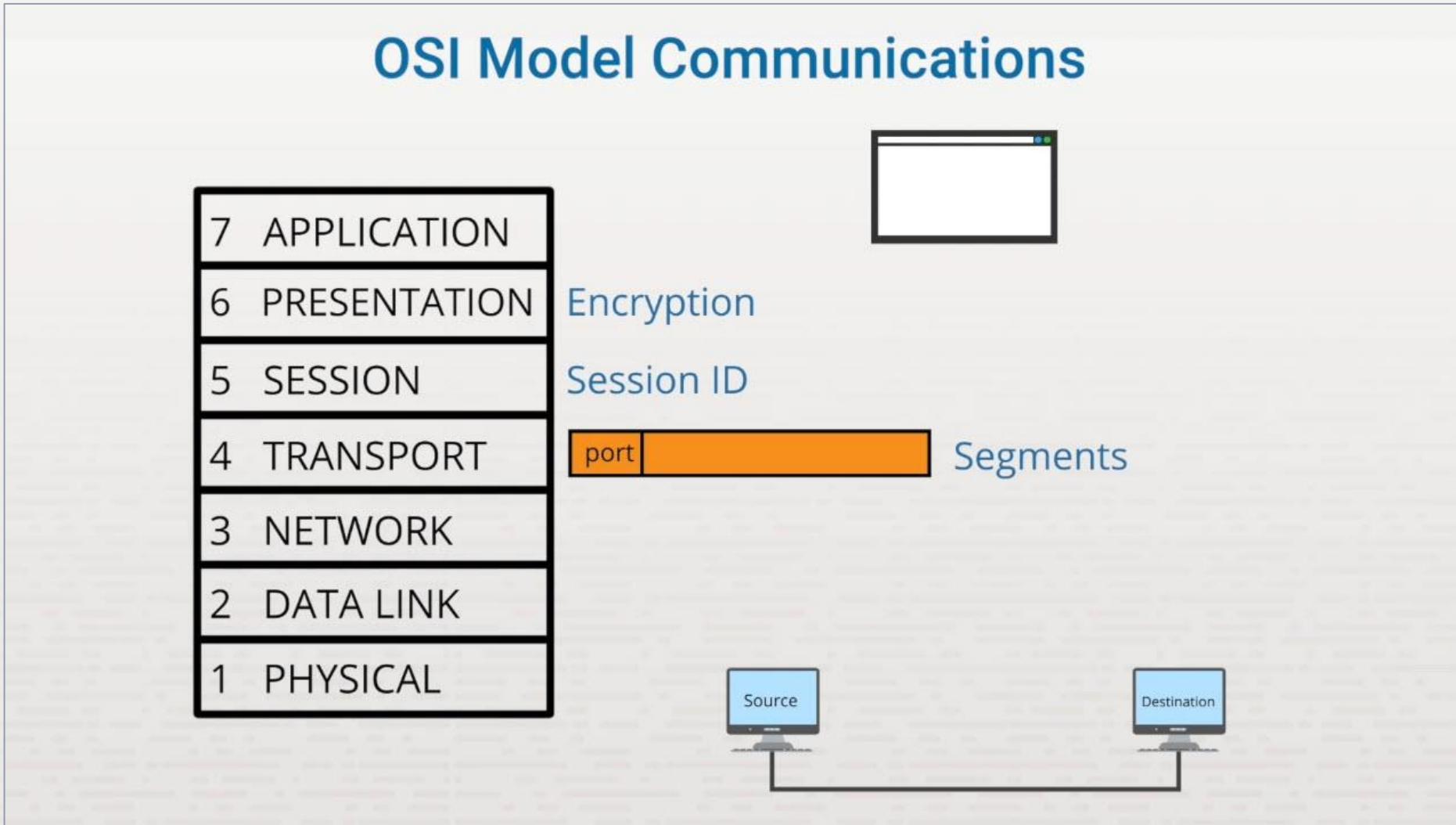


Encryption

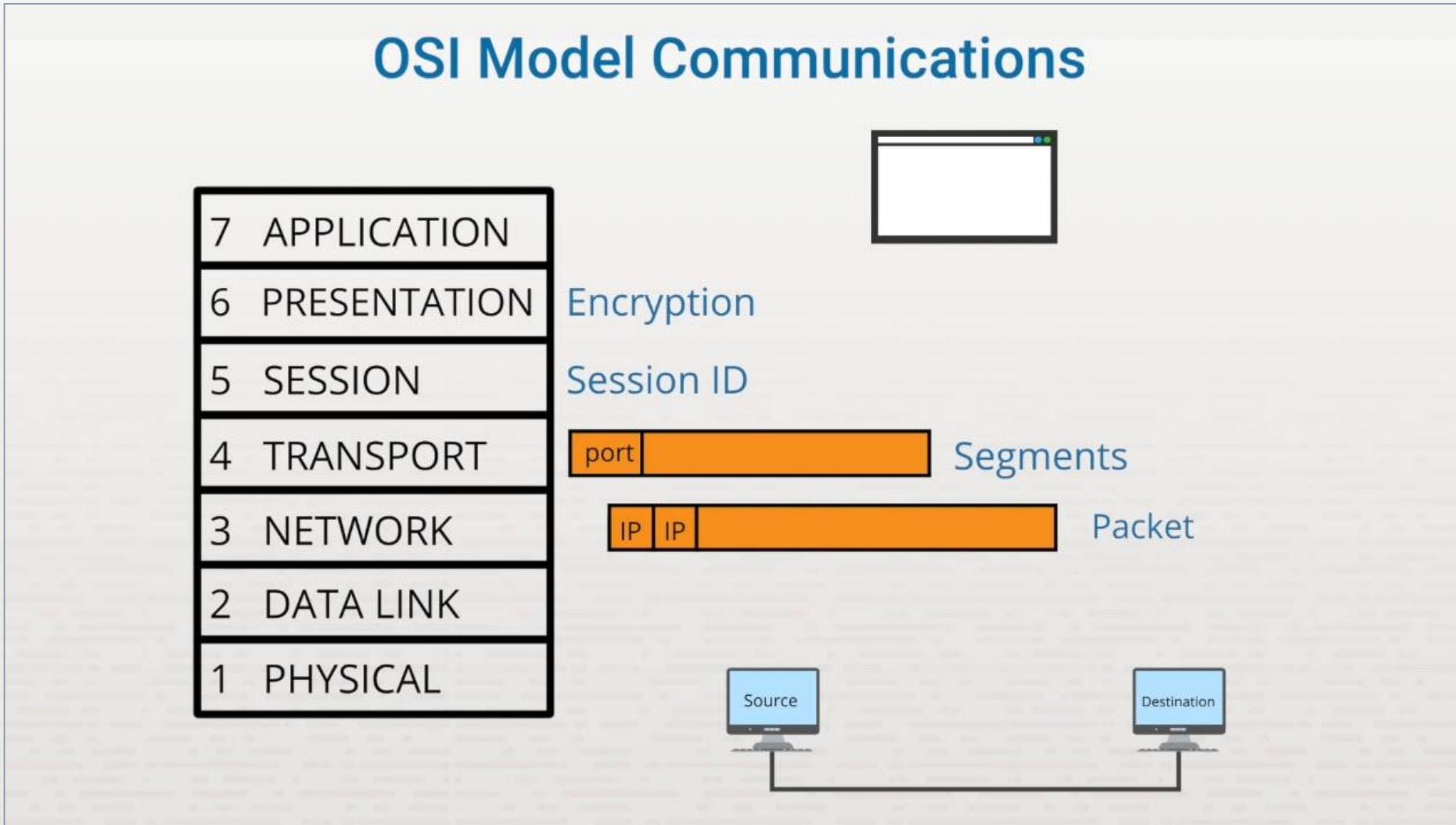
Session ID



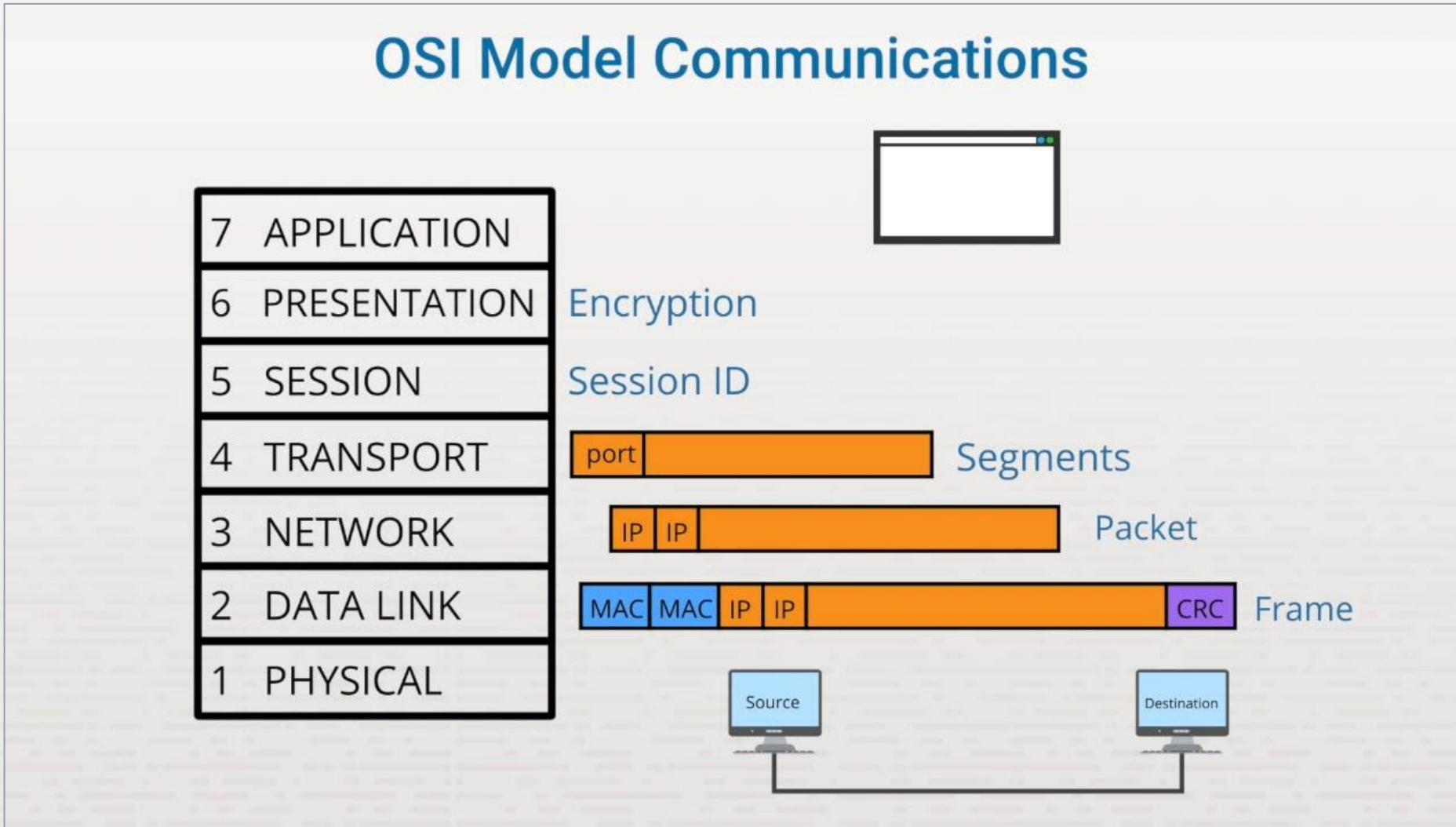
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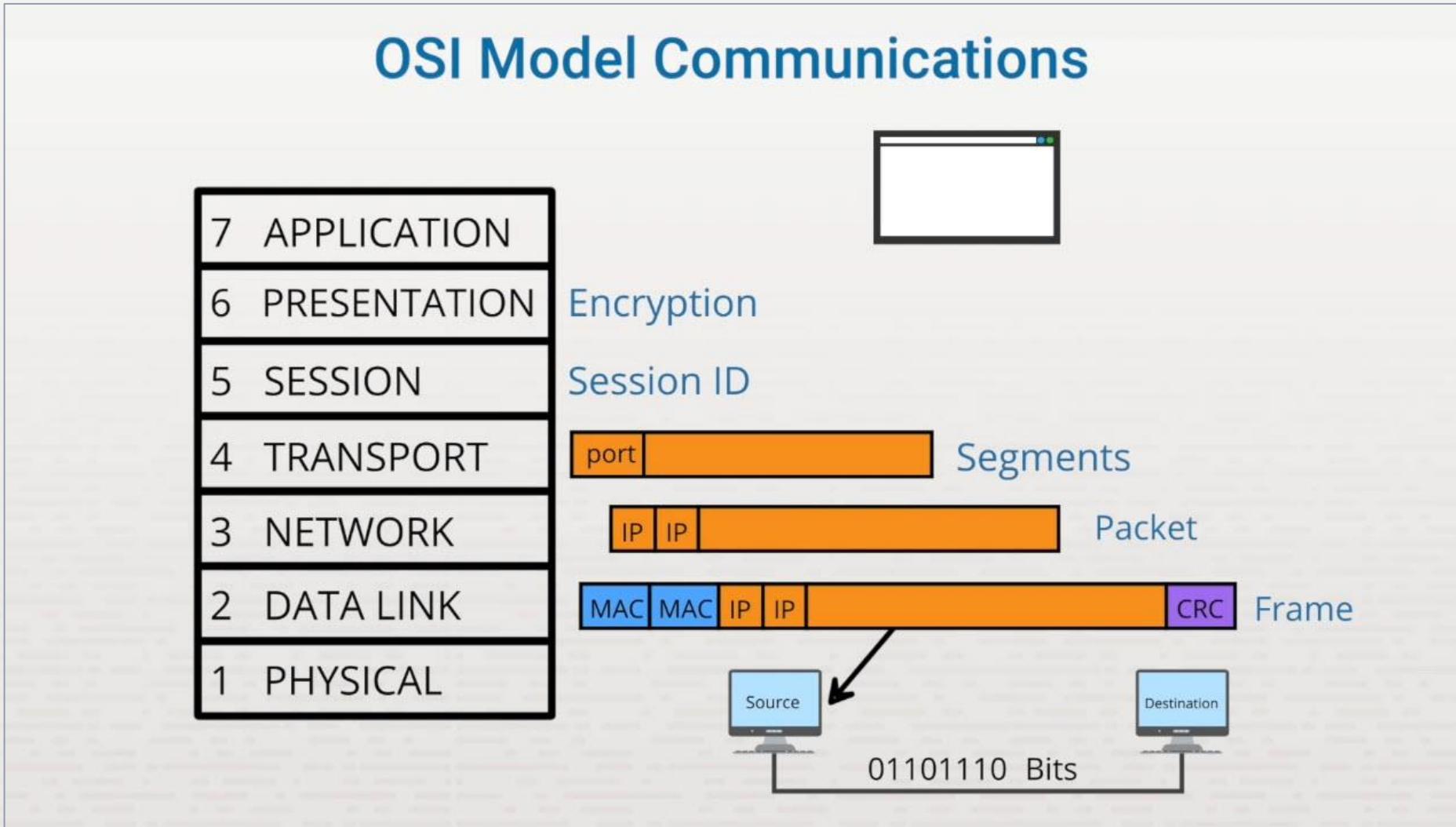
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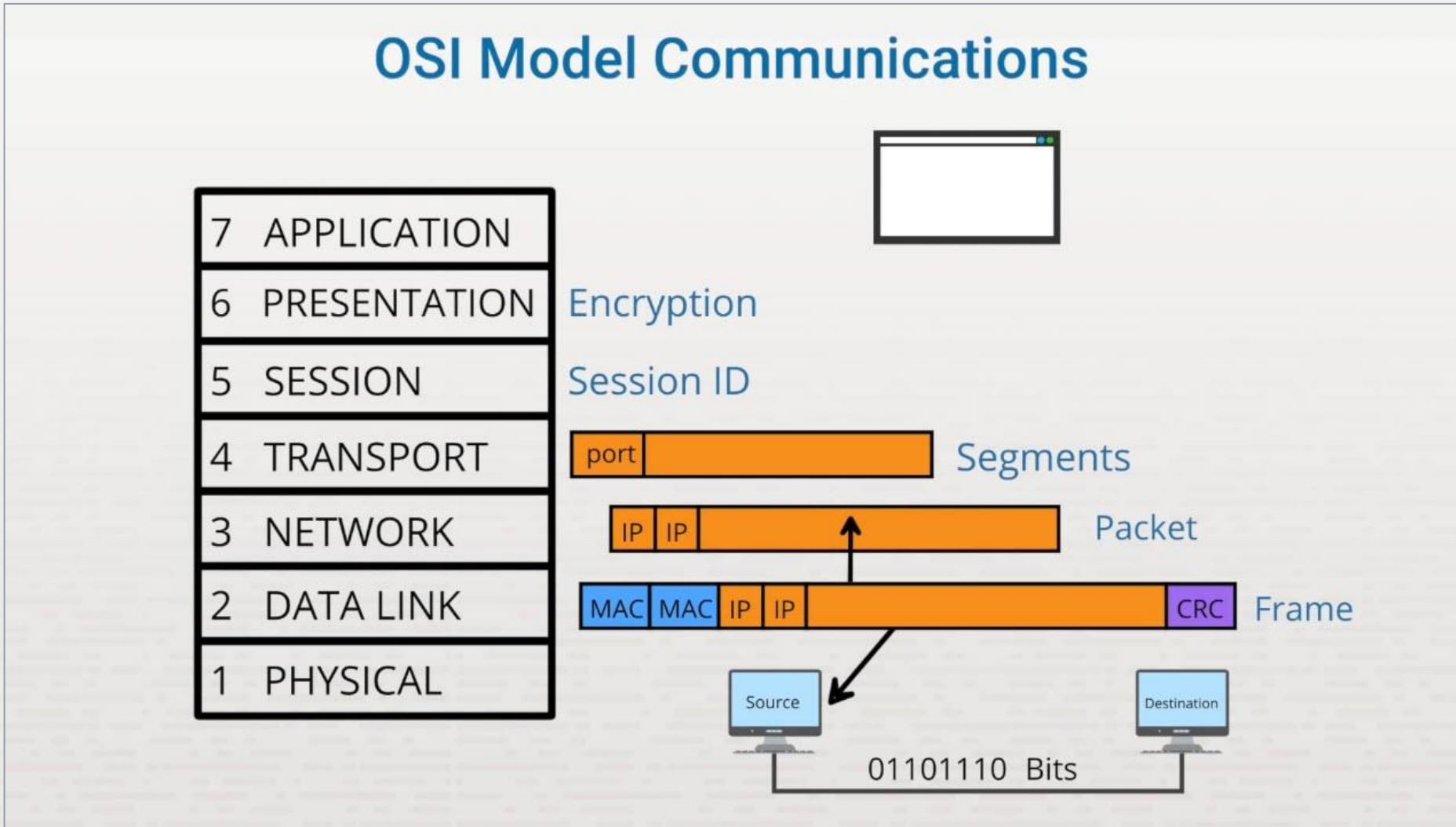
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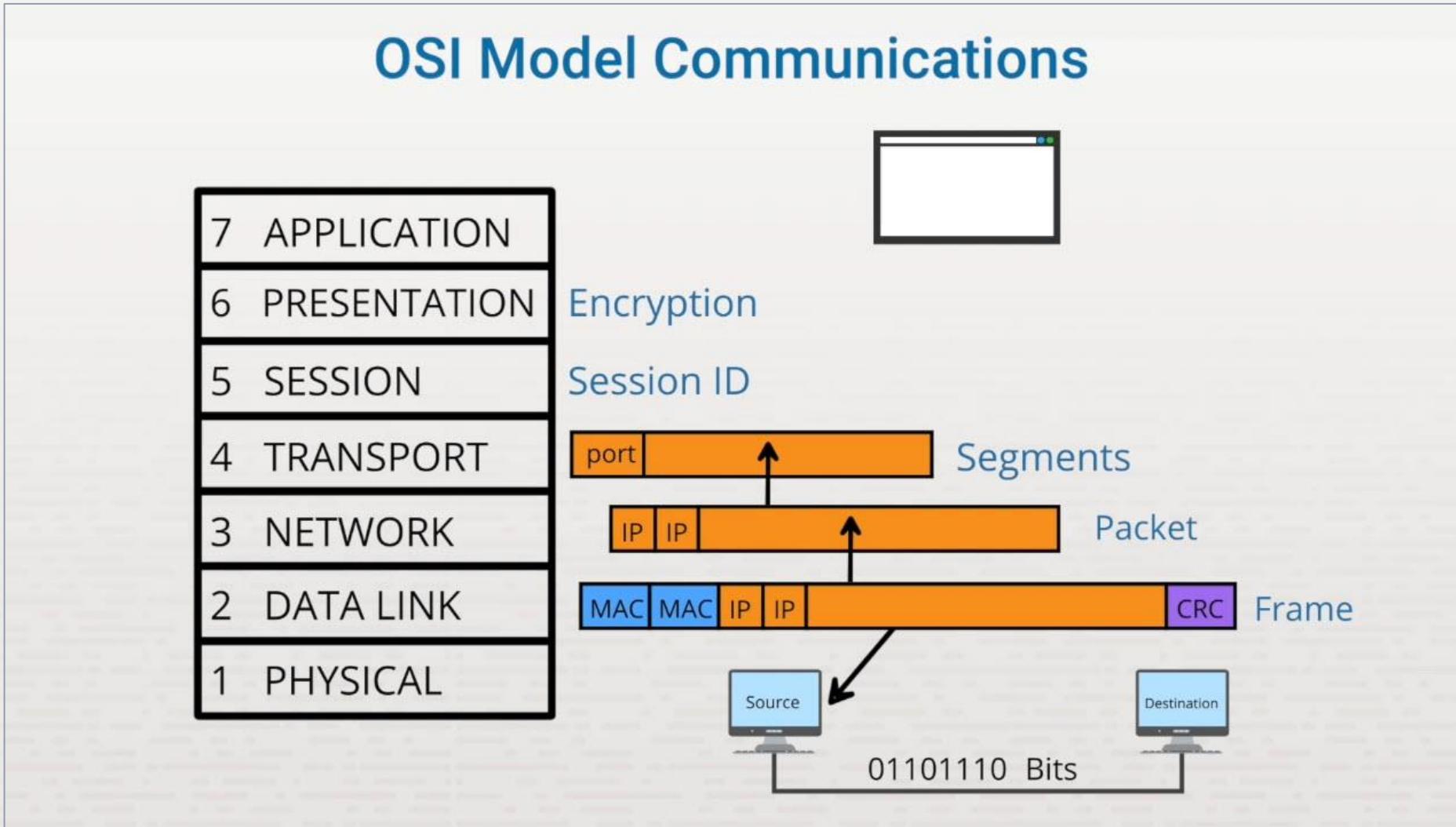
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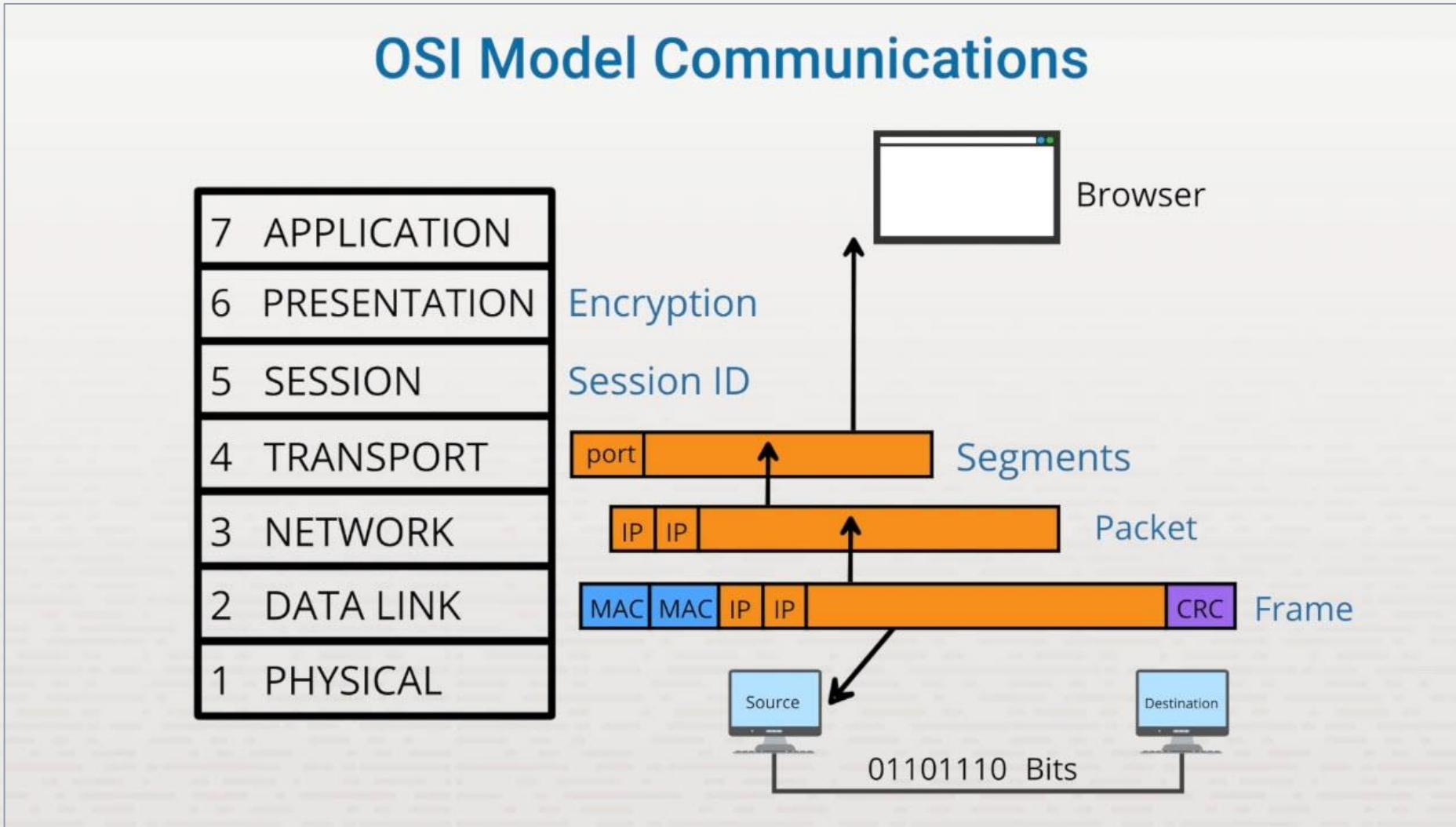
# OSI Model Communications



# OSI Model Communications



# OSI Model Communications



# Summary

- ❖ How the OSI model is used to talk to devices

# Class Discussion

- ❖ What is the OSI model? Why is it important for understanding networking?
- ❖ What are the advantages of using a theoretical model to describe networking?
- ❖ What is the name of Layer 3 in the OSI model? Layer 5?
- ❖ Which OSI model layers typically correspond to the network architecture?
- ❖ How does the session ID differ from the port number?
- ❖ Which OSI model layer would you find a frame at?
- ❖ What is the difference between connectionless and connection-oriented services?

# Data Encapsulation



# Key Terms

- ❖ Transmission Control Protocol (TCP)
- ❖ Address Resolution Protocol (ARP)
- ❖ Maximum transmission unit (MTU)

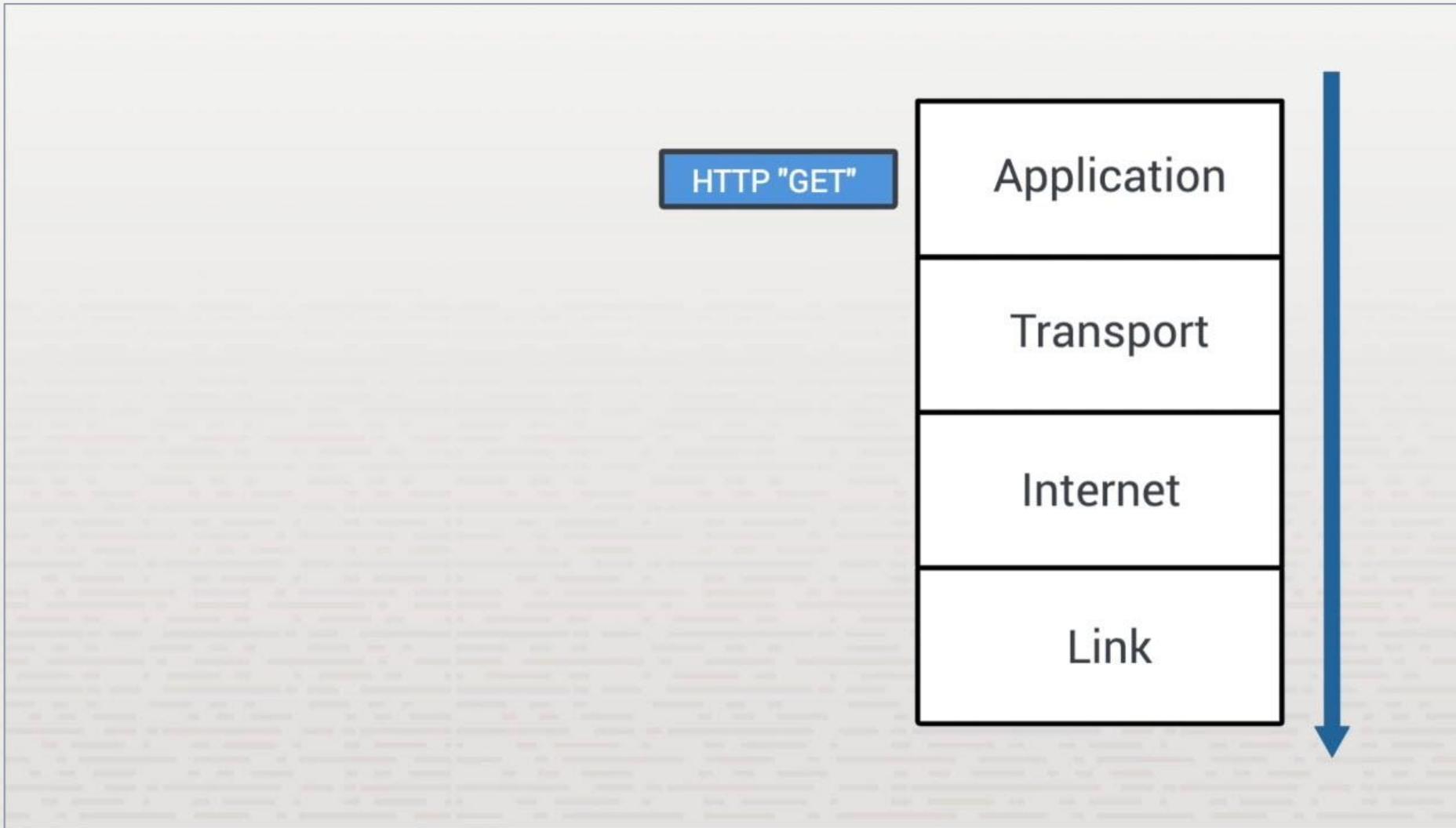
# Key Definitions

- ❖ **Transmission Control Protocol (TCP):** TCP is one of the main internet protocols. It allows computing devices and application devices to exchange messages over a network.
- ❖ **Address Resolution Protocol (ARP):** ARP is used to determine the MAC address of the host using the destination IP address.
- ❖ **Maximum transmission unit (MTU):** MTU is the largest size data unit that can be transmitted through the network.

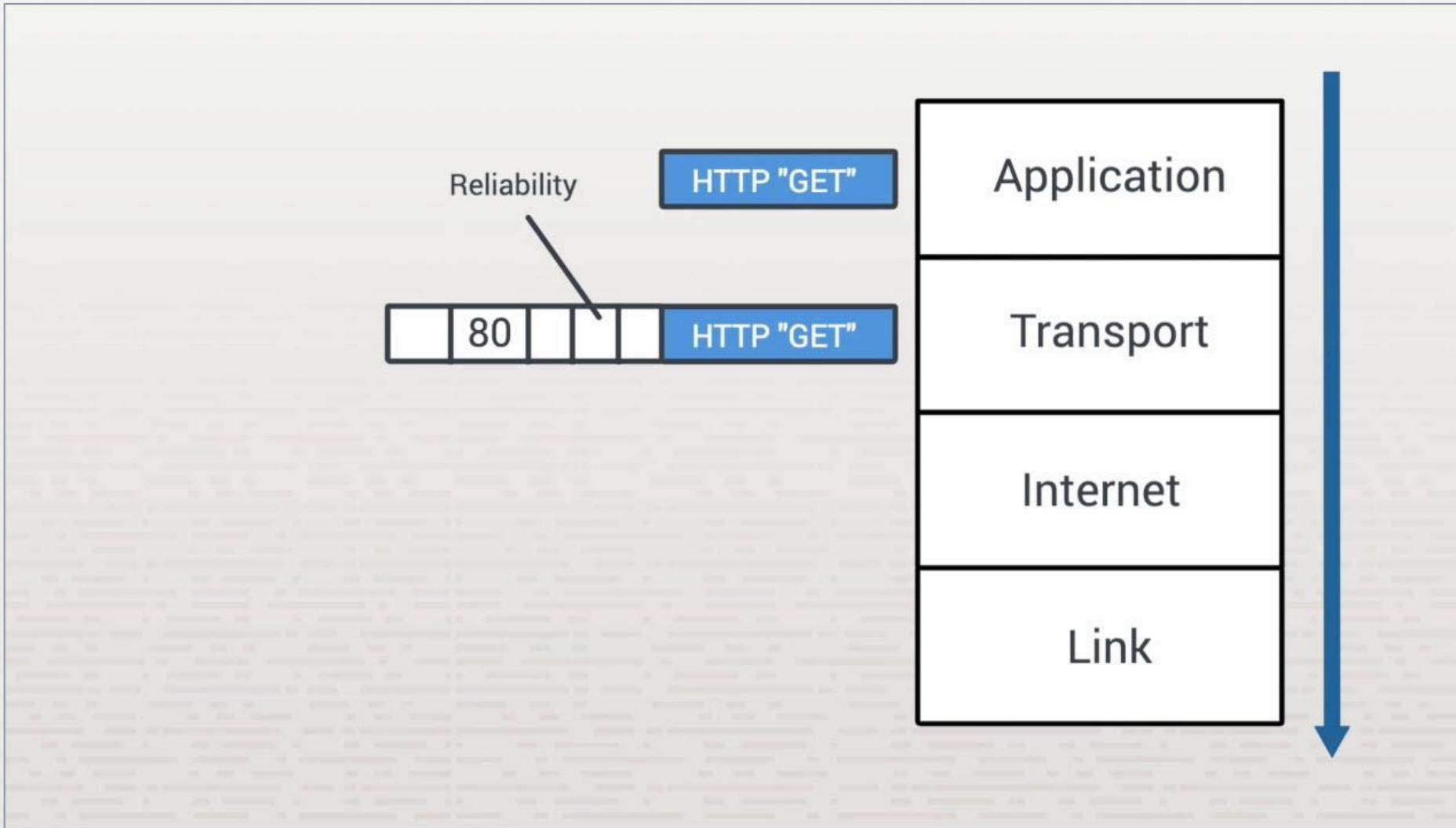
# Data Encapsulation



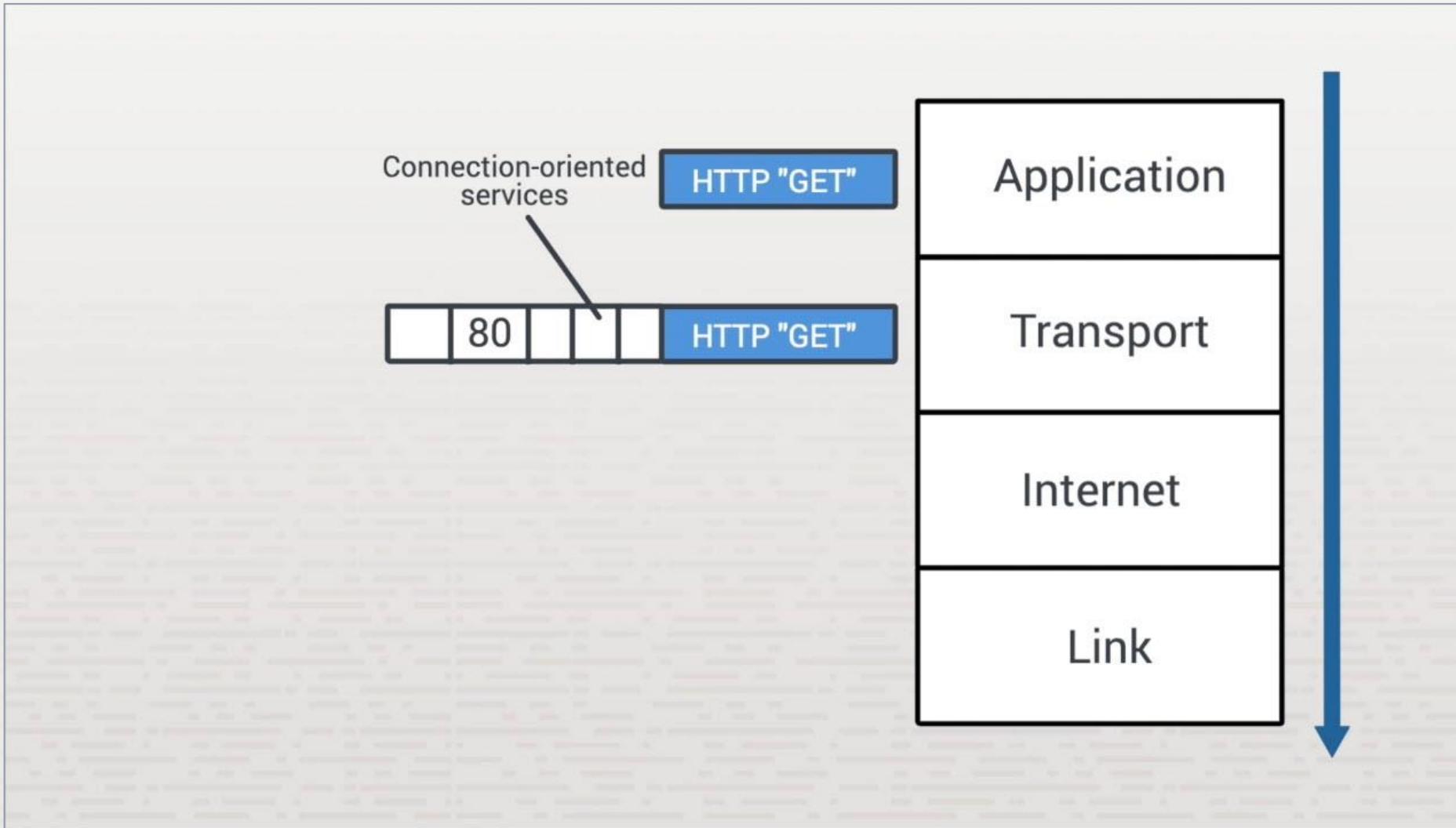
# Data Encapsulation



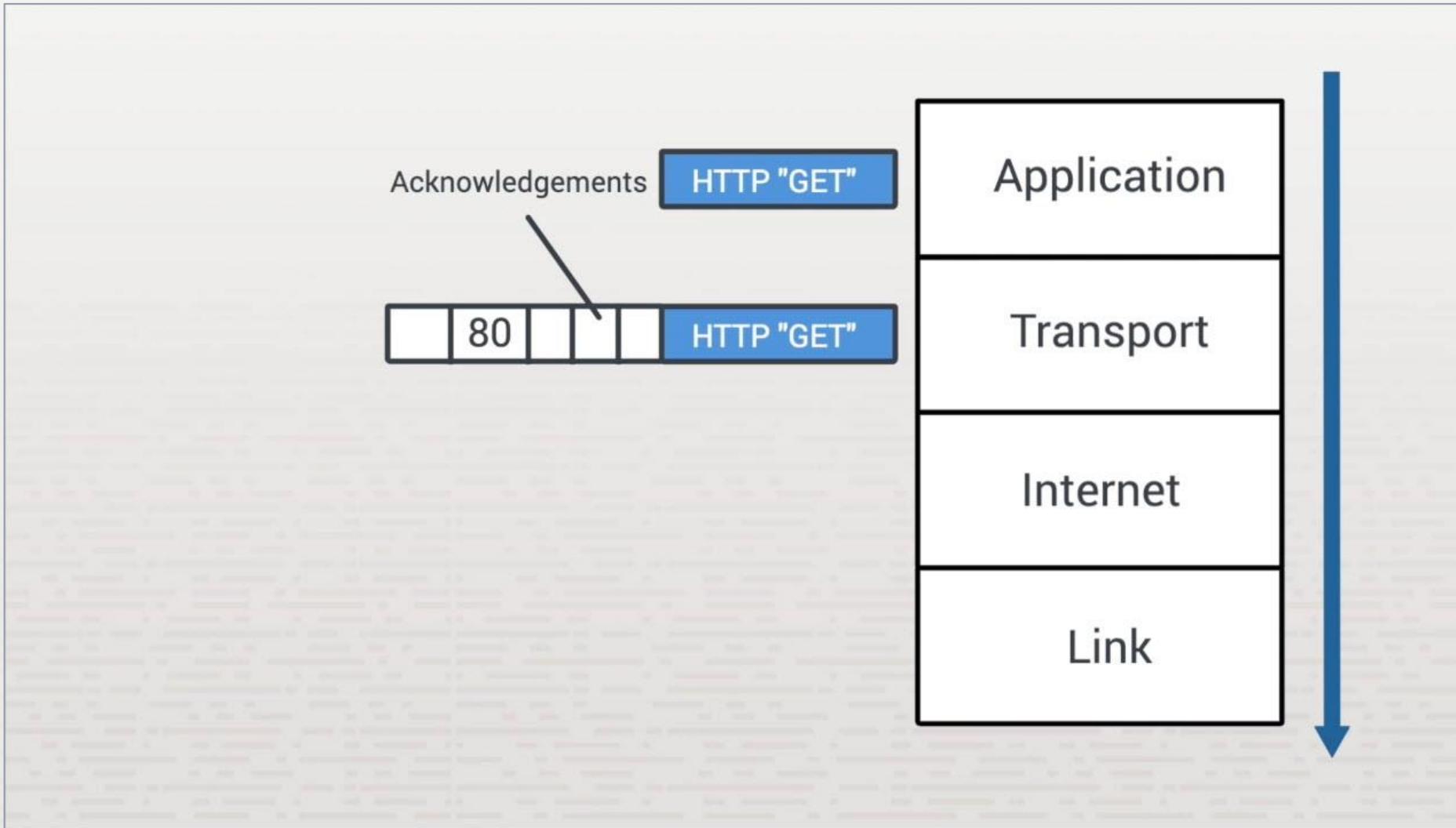
# Data Encapsulation



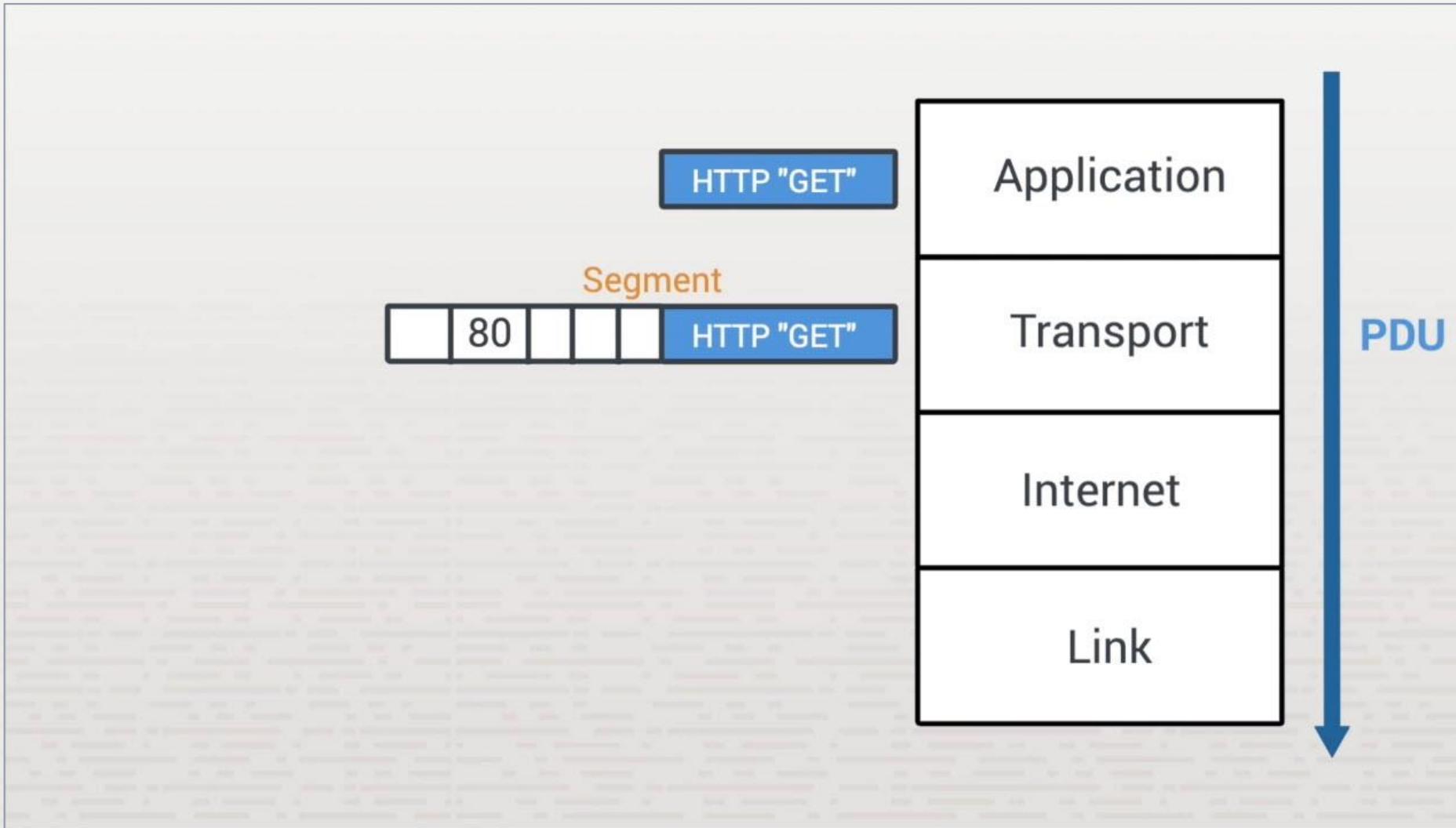
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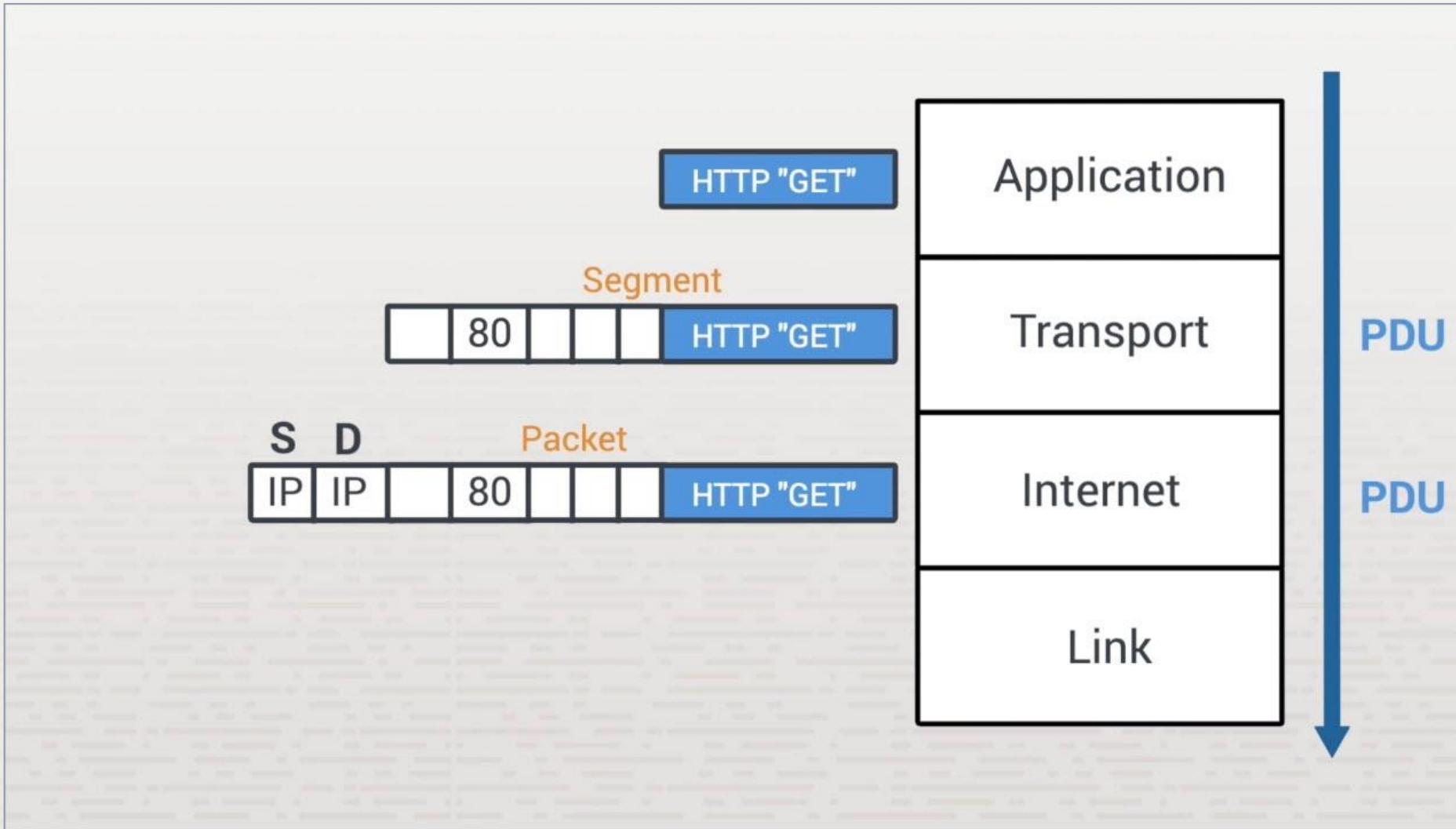
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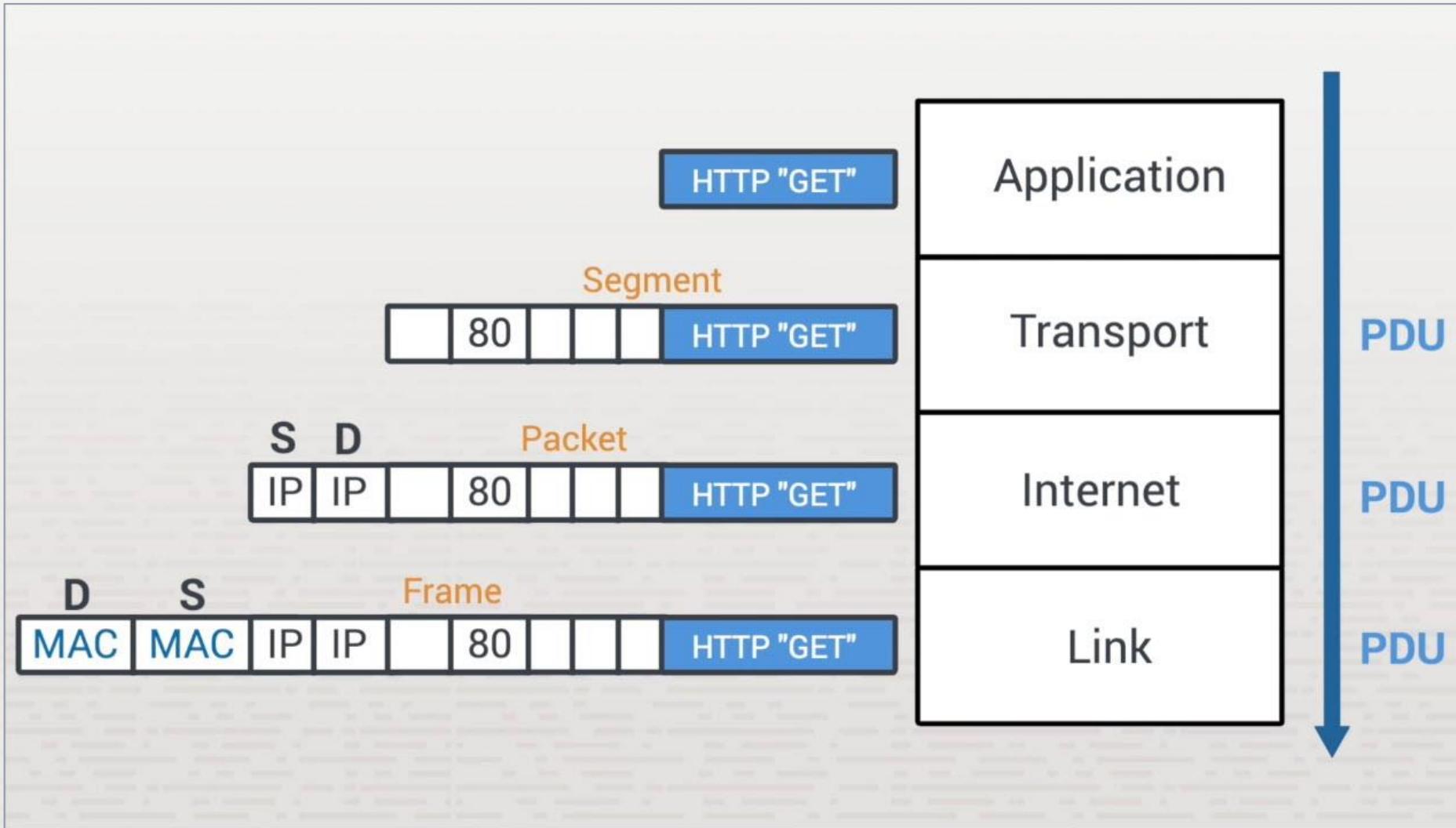
# Data Encapsulation



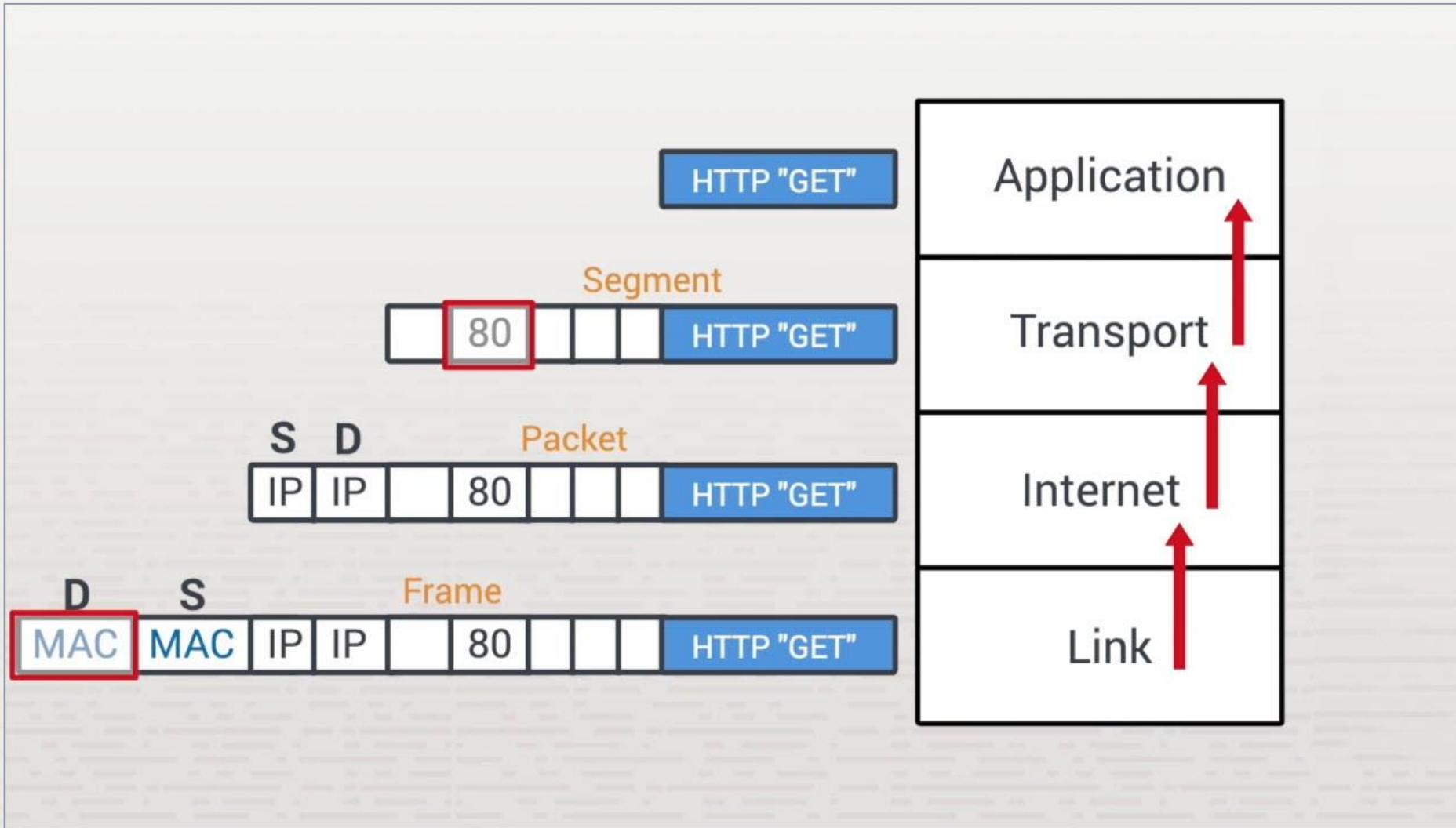
# Data Encapsulation



# Data Encapsulation



# Data Encapsulation



# Encapsulation

- ❖ Encapsulate - top to bottom
- ❖ De-encapsulate - bottom to top

# Summary

- ❖ TCP/IP:
  - ❖ Organizes
  - ❖ Formats
  - ❖ Prepares data
  - ❖ Encapsulates
  - ❖ De-encapsulates

# Address Resolution Protocol (ARP)

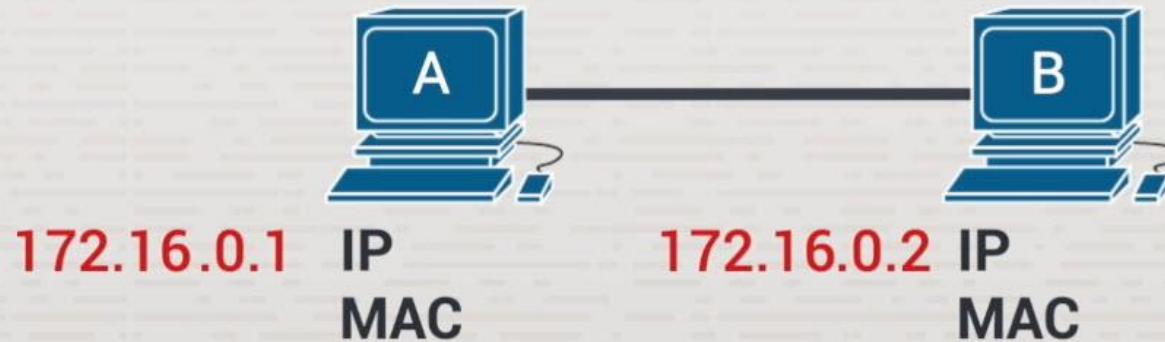


# Address Resolution Protocol (ARP)

## Address Resolution Protocol (ARP)

172.16.0.1 IP

00-02-42-EF-IA-01 MAC



# Address Resolution Protocol (ARP)

## Address Resolution Protocol (ARP)

172.16.0.1      IP

00-02-42-EF-IA-01      MAC



# Address Resolution Protocol (ARP)

## Address Resolution Protocol (ARP)

172.16.0.1      IP

00-02-42-EF-IA-01      MAC

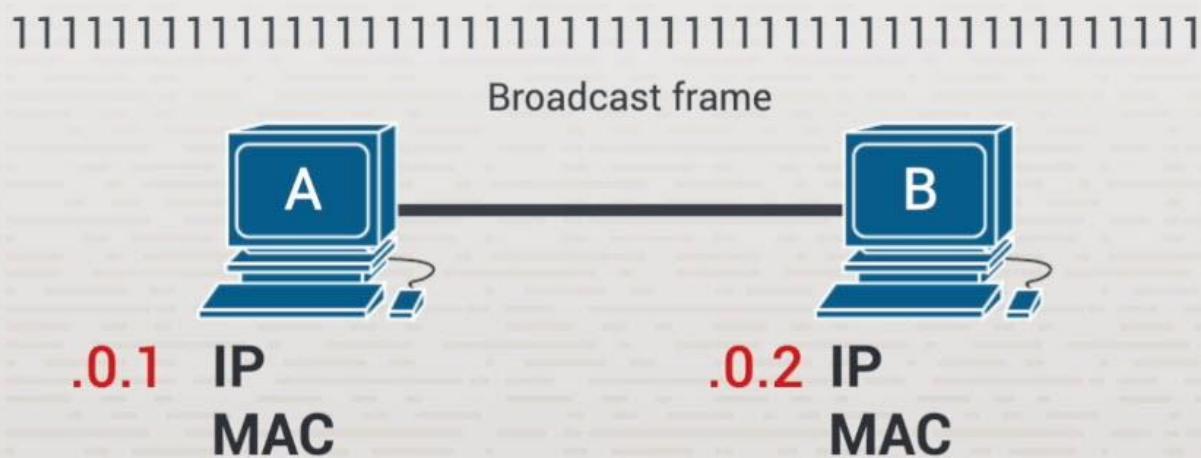


# Address Resolution Protocol (ARP)

# Address Resolution Protocol (ARP)

172.16.0.1 IP

00-02-42-EF-IA-01 **MAC**

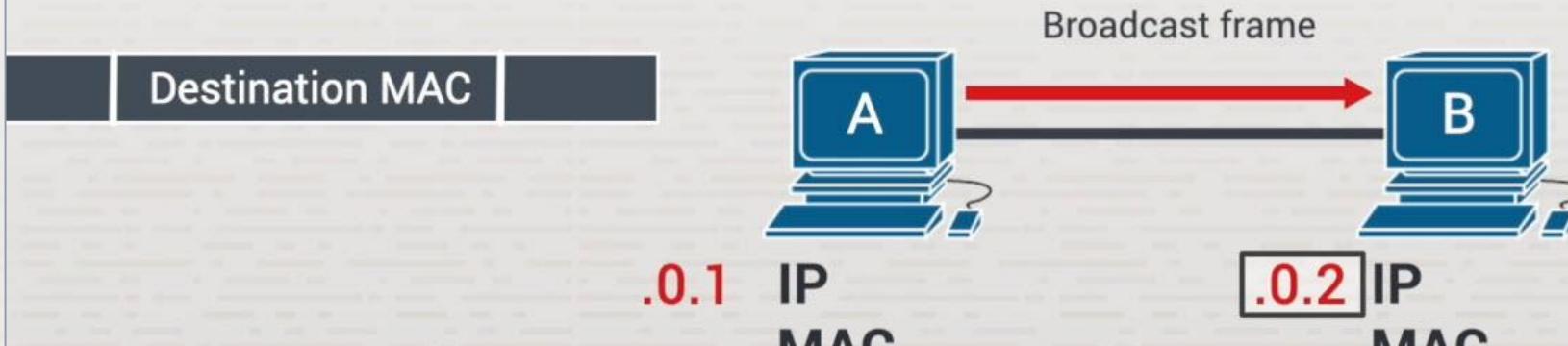


# Address Resolution Protocol (ARP)

## Address Resolution Protocol (ARP)

172.16.0.1 IP

00-02-42-EF-IA-01 MAC

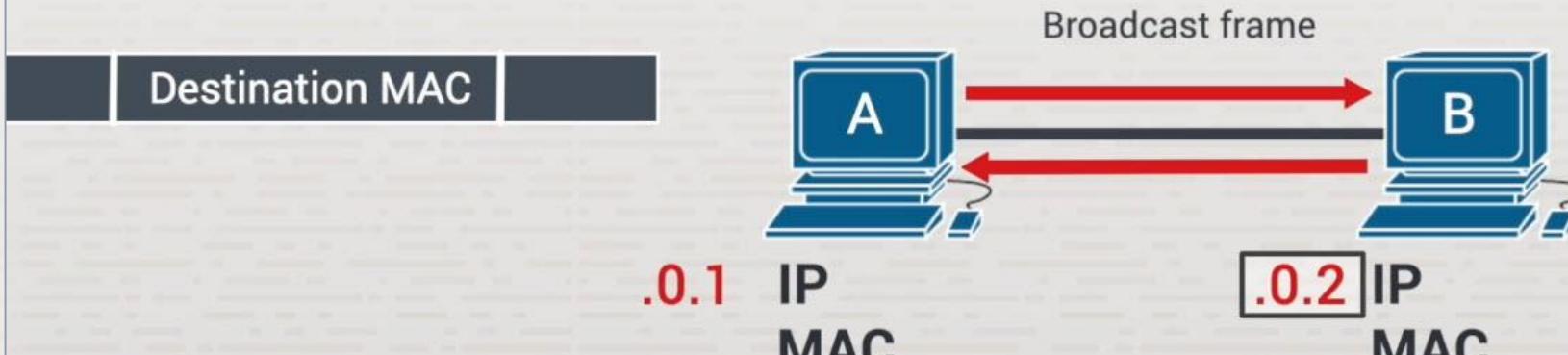


# Address Resolution Protocol (ARP)

## Address Resolution Protocol (ARP)

172.16.0.1 IP

00-02-42-EF-IA-01 MAC

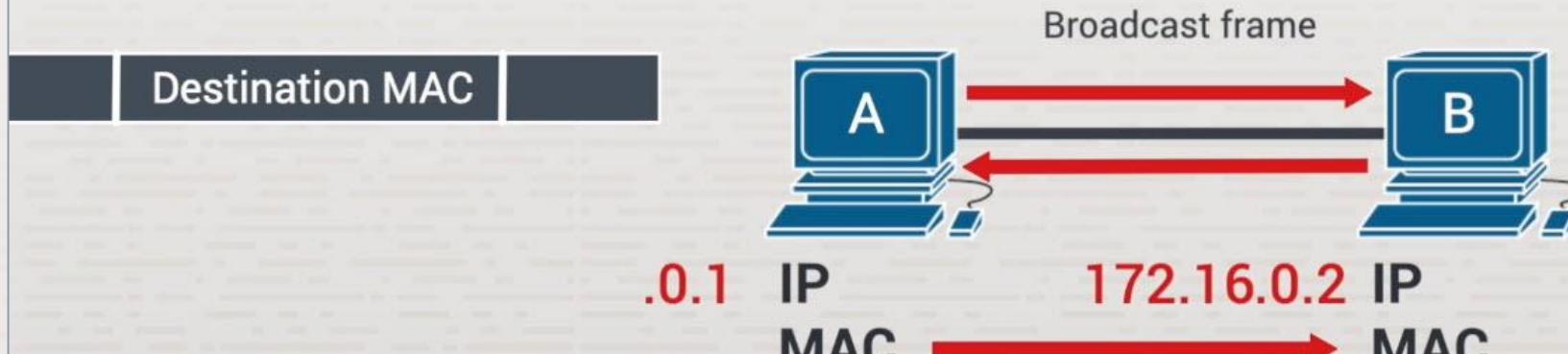


# Address Resolution Protocol (ARP)

## Address Resolution Protocol (ARP)

172.16.0.1 IP

00-02-42-EF-IA-01 MAC



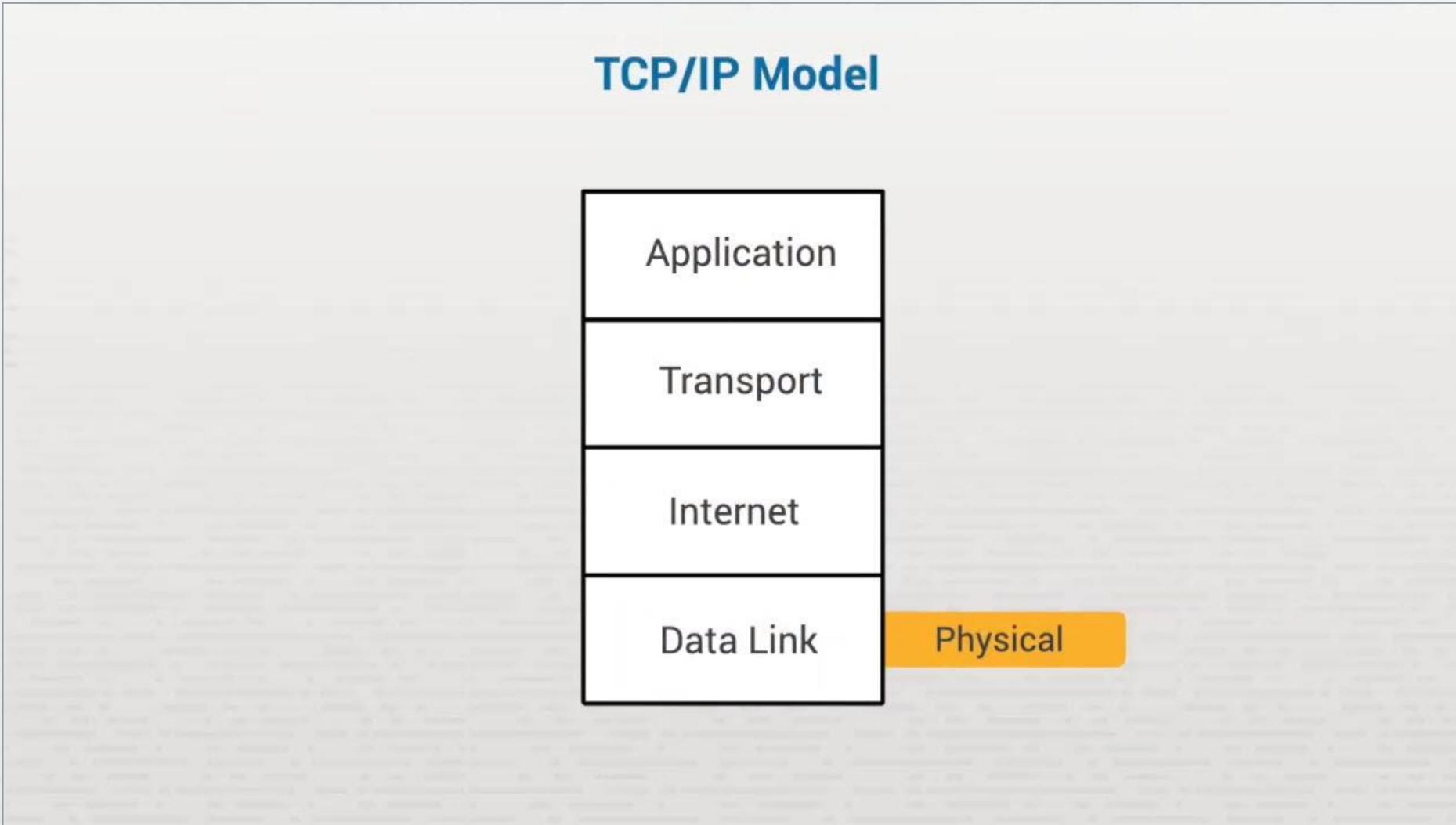
# Summary

- ❖ Discovers MAC addresses
- ❖ Sends broadcast requests
- ❖ Replies as unicast

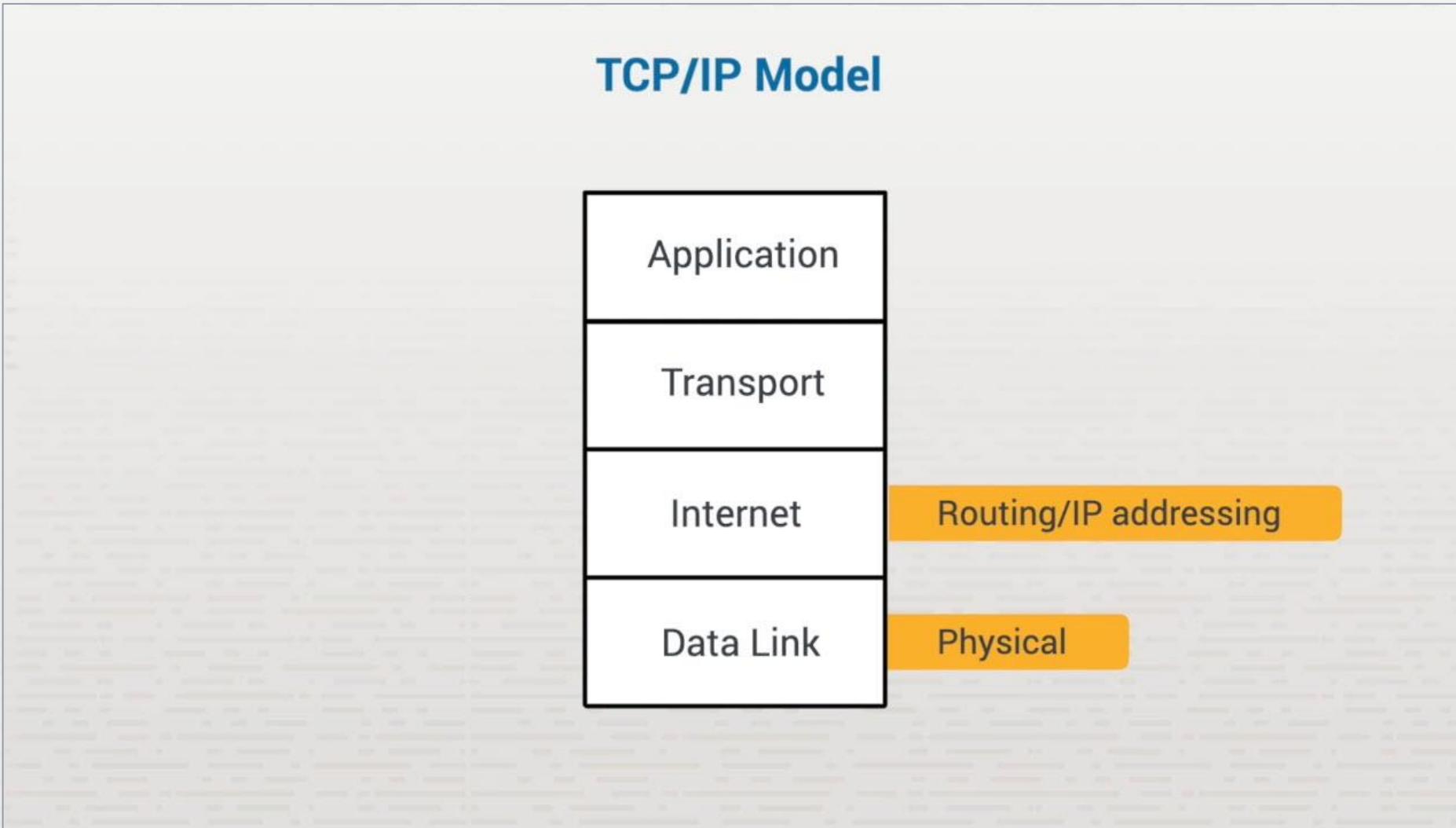
# Packets and Frames



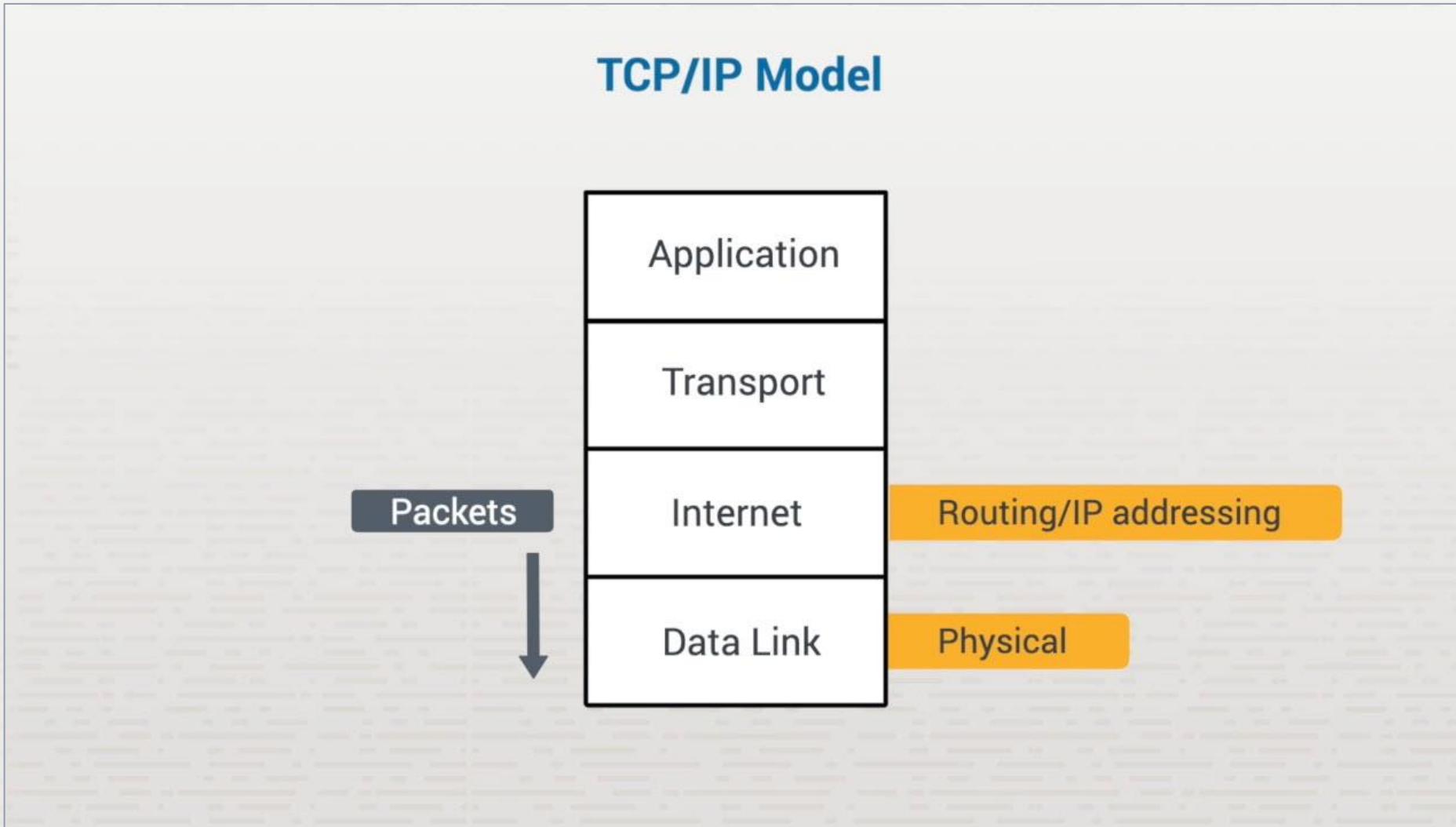
# Packets and Frames



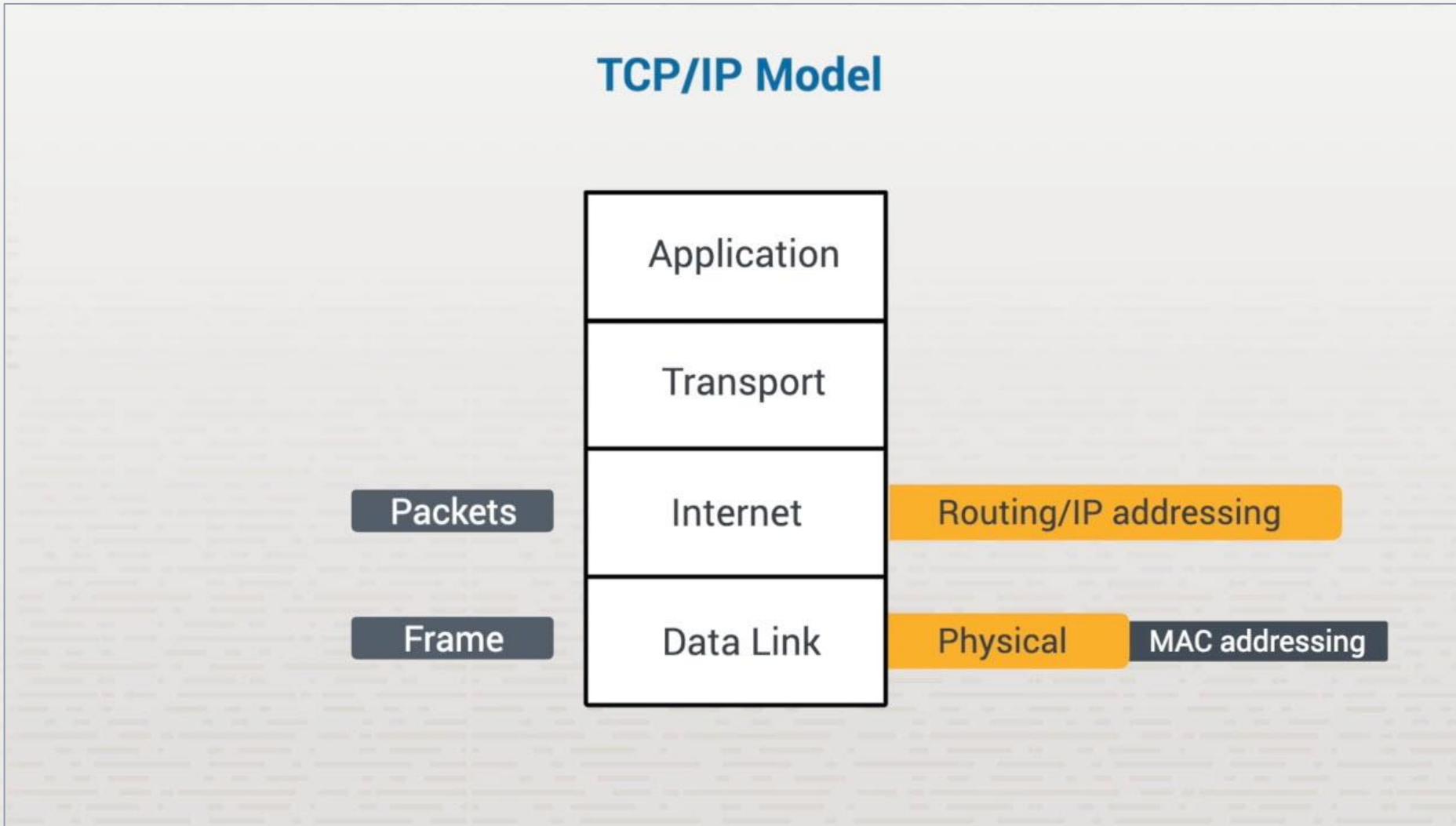
# packets and frames



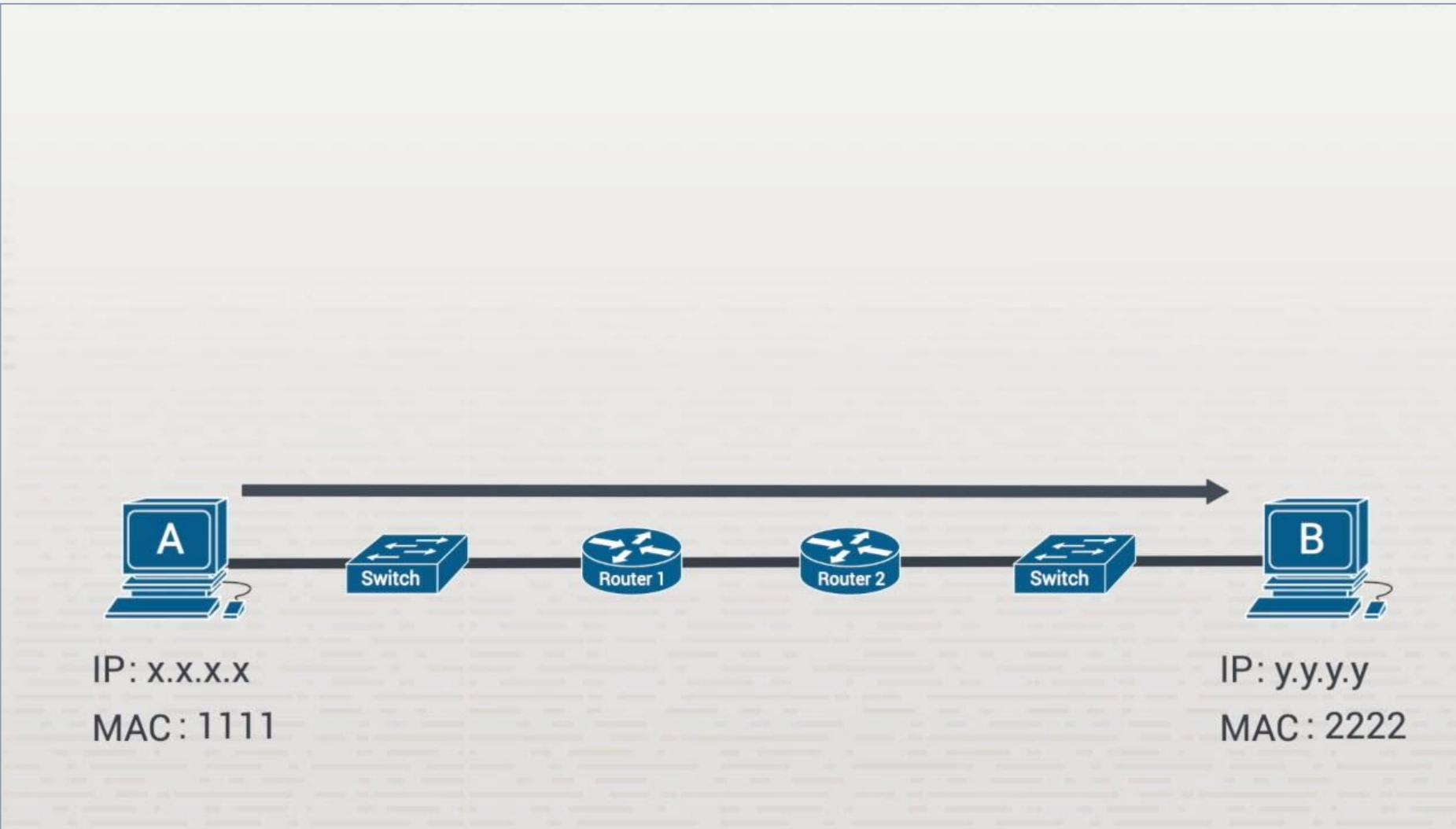
# Packets and Frames



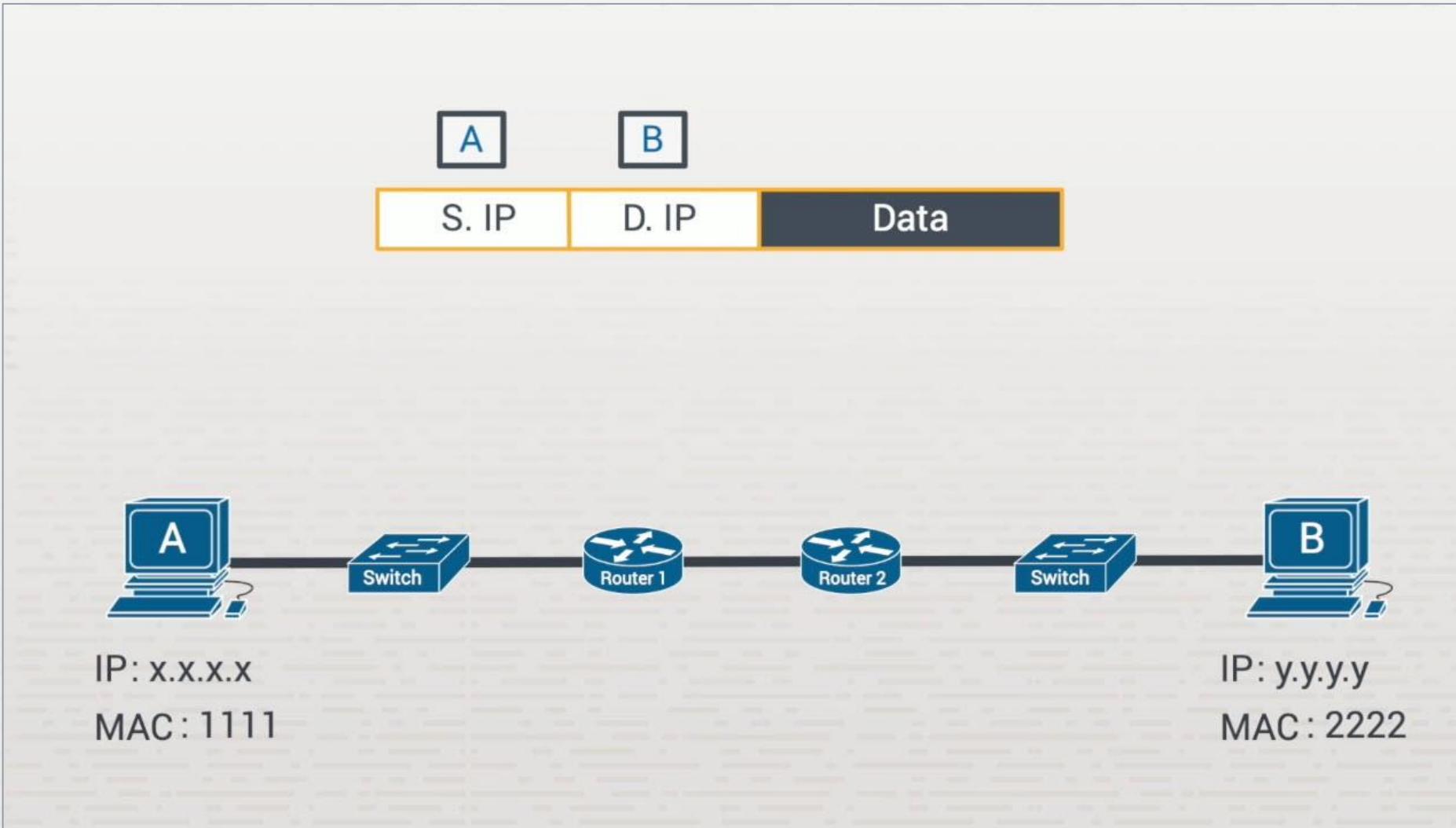
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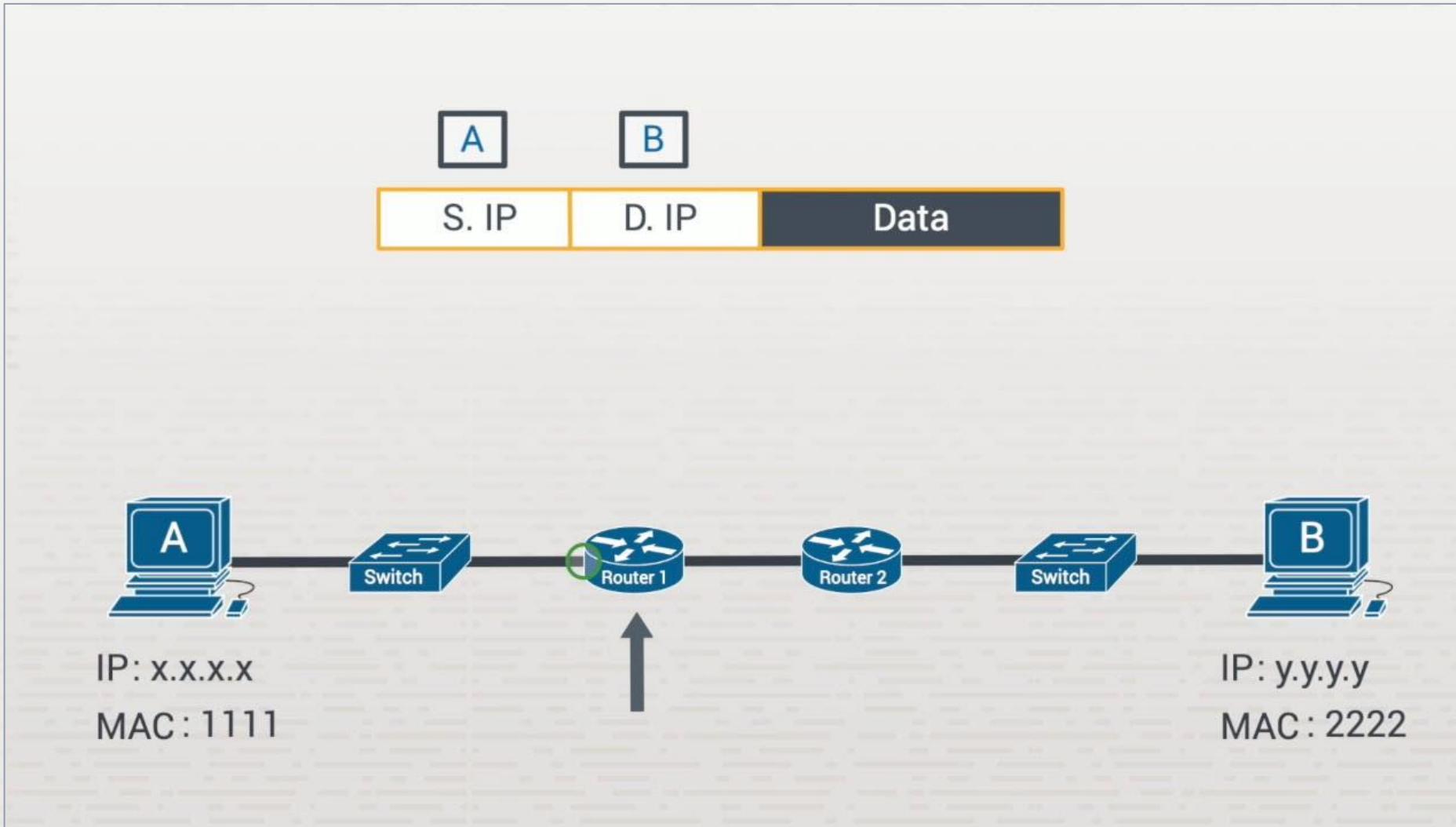
# Packets and Frames



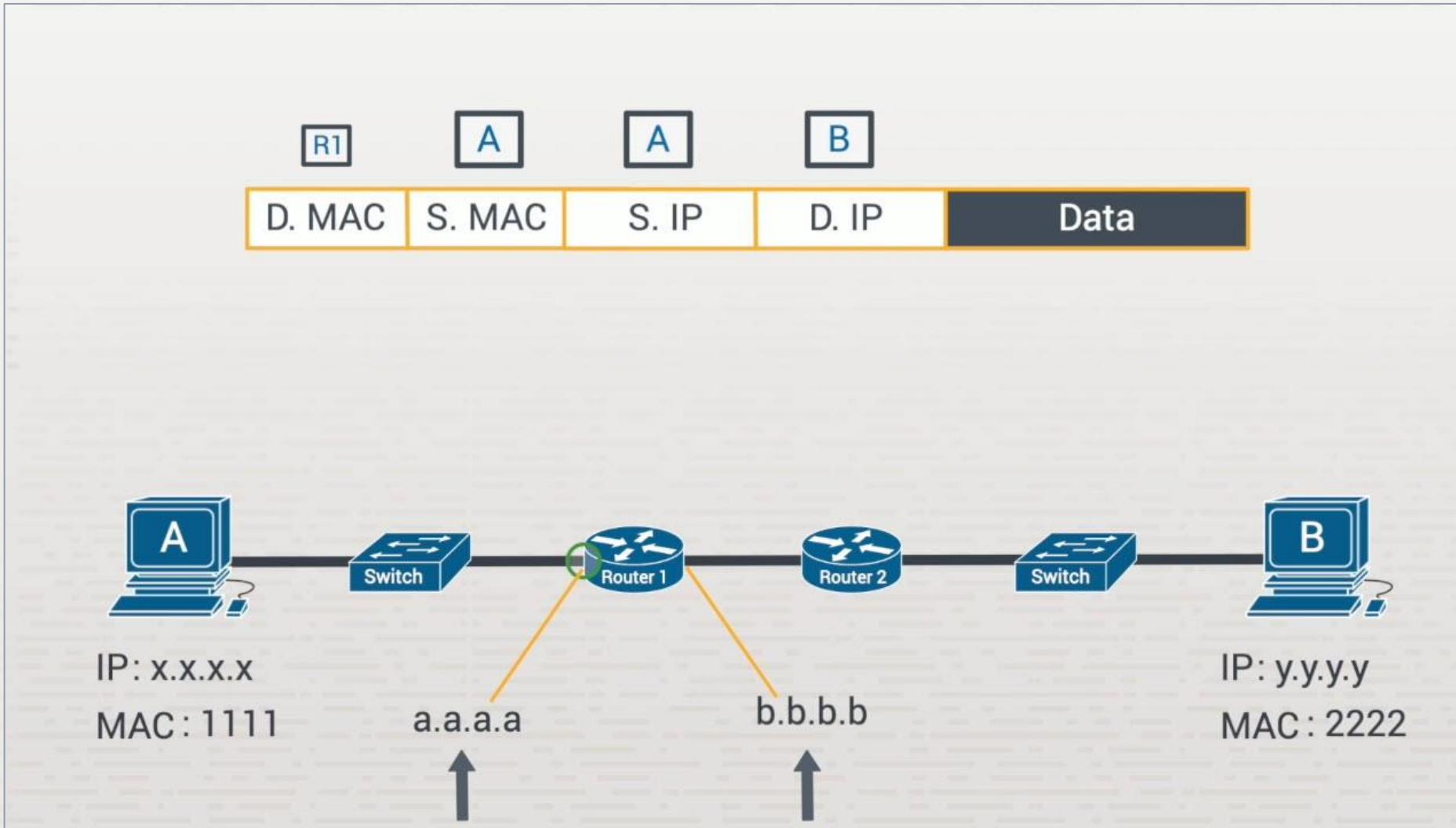
# packets and frames



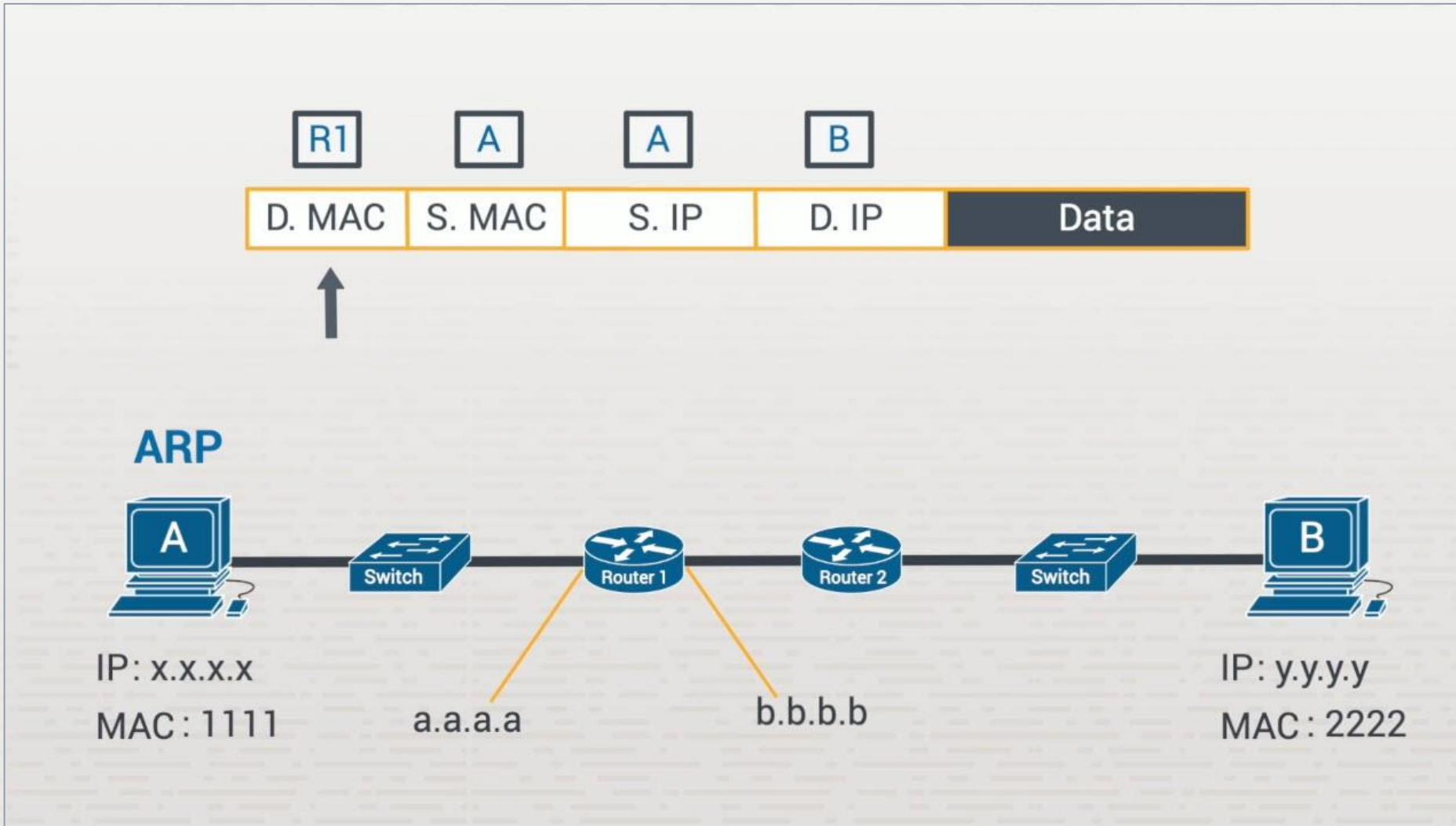
# packets and frames



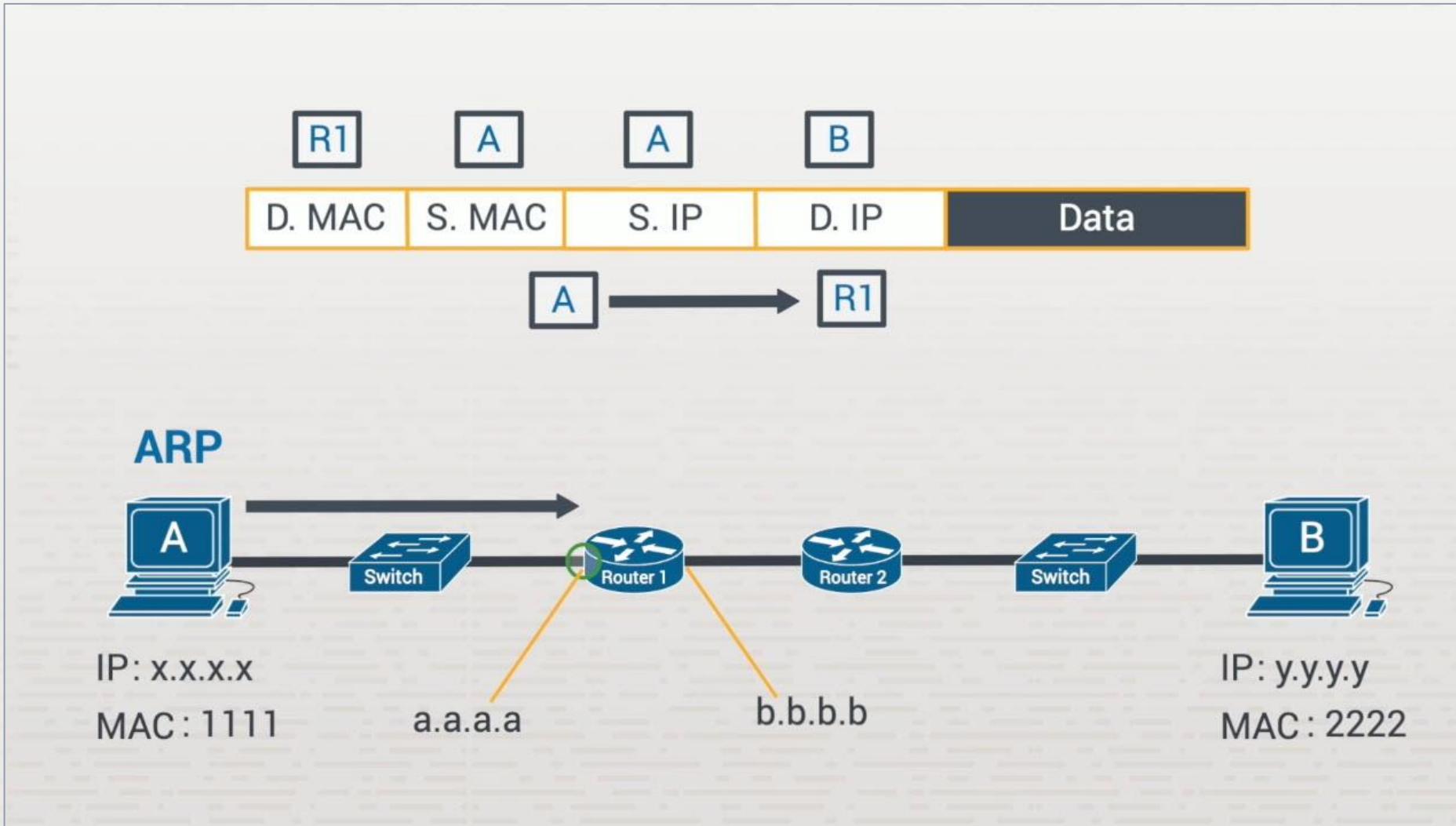
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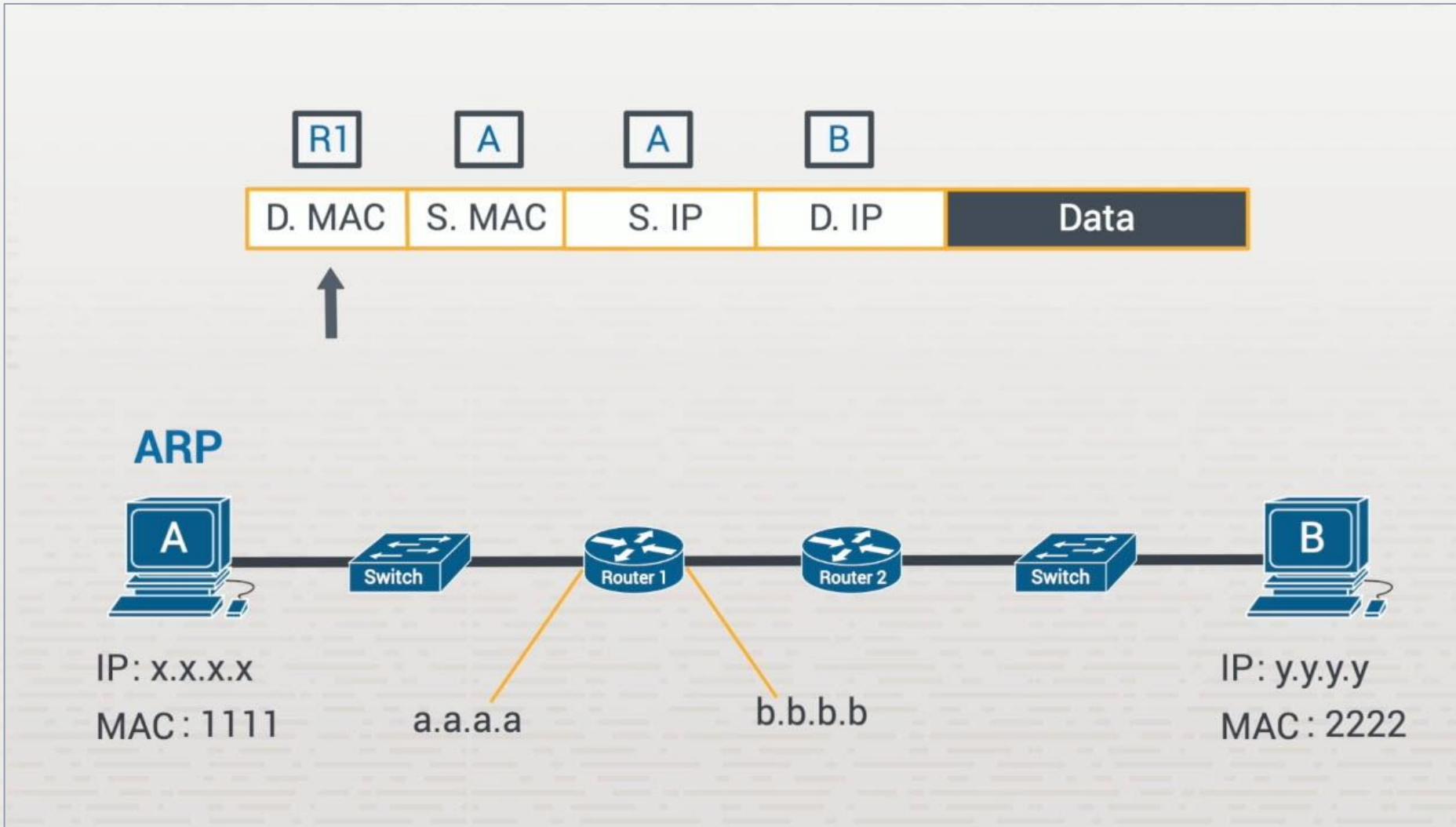
# packets and frames



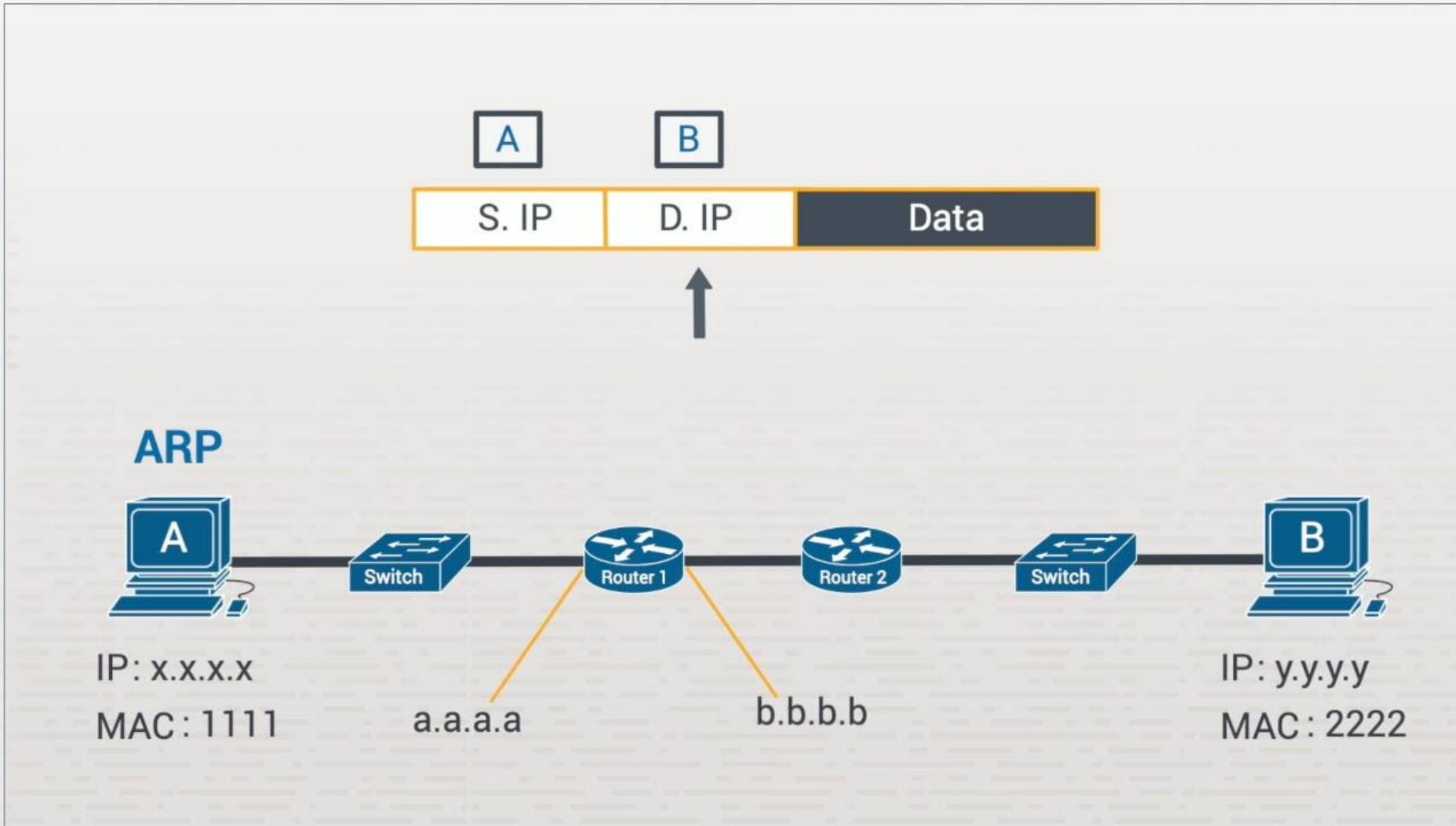
# packets and frames



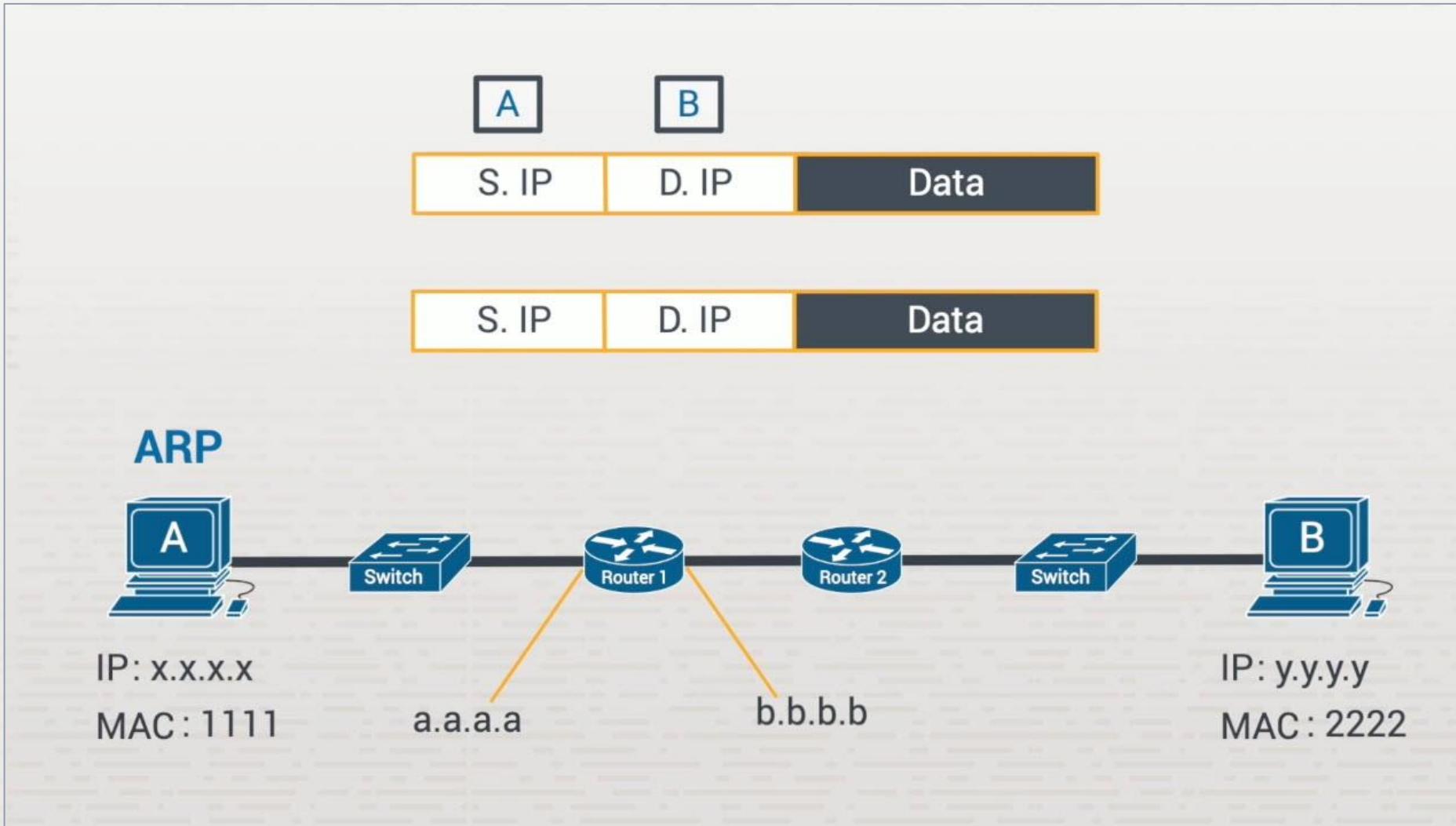
# packets and frames



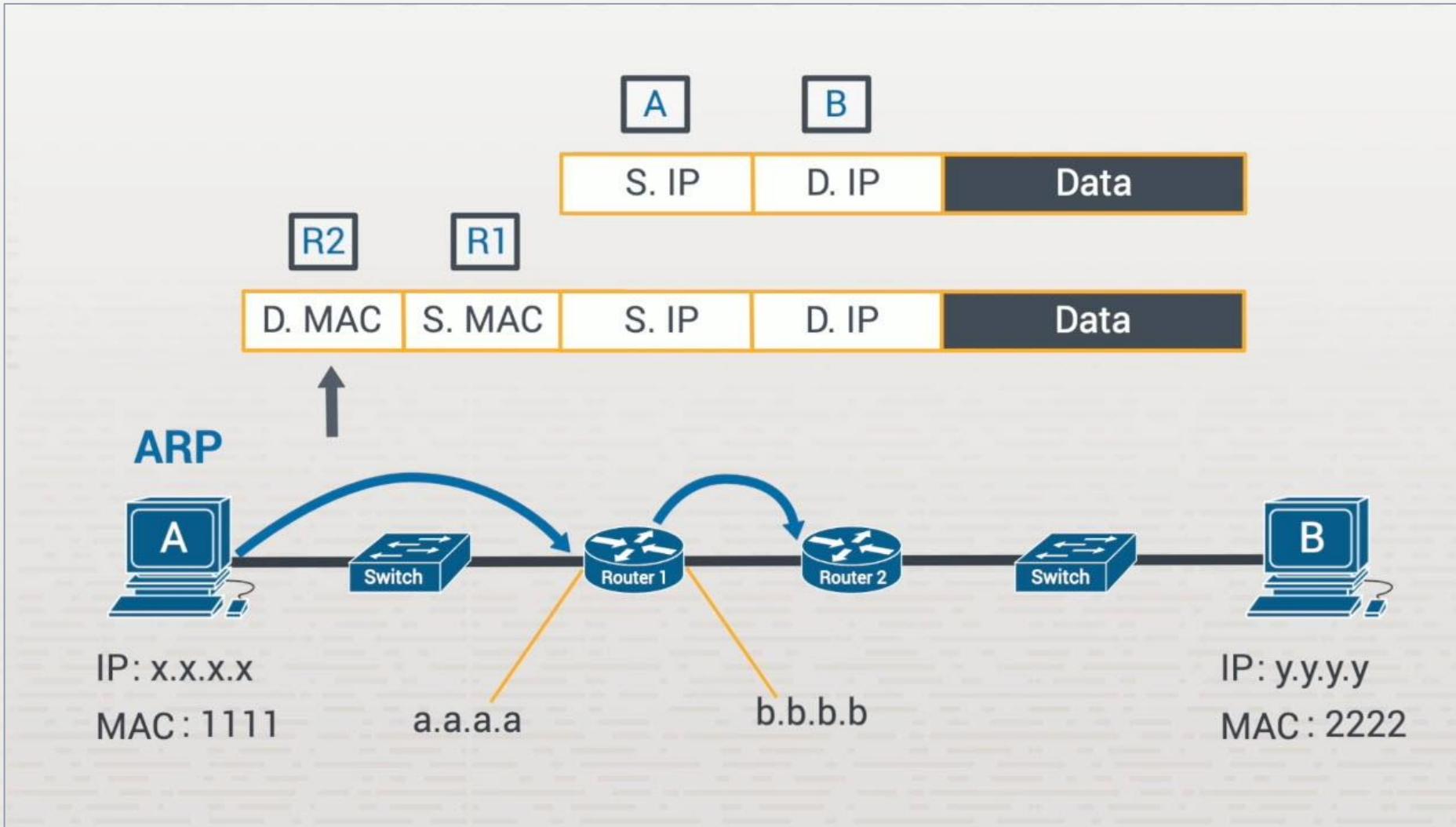
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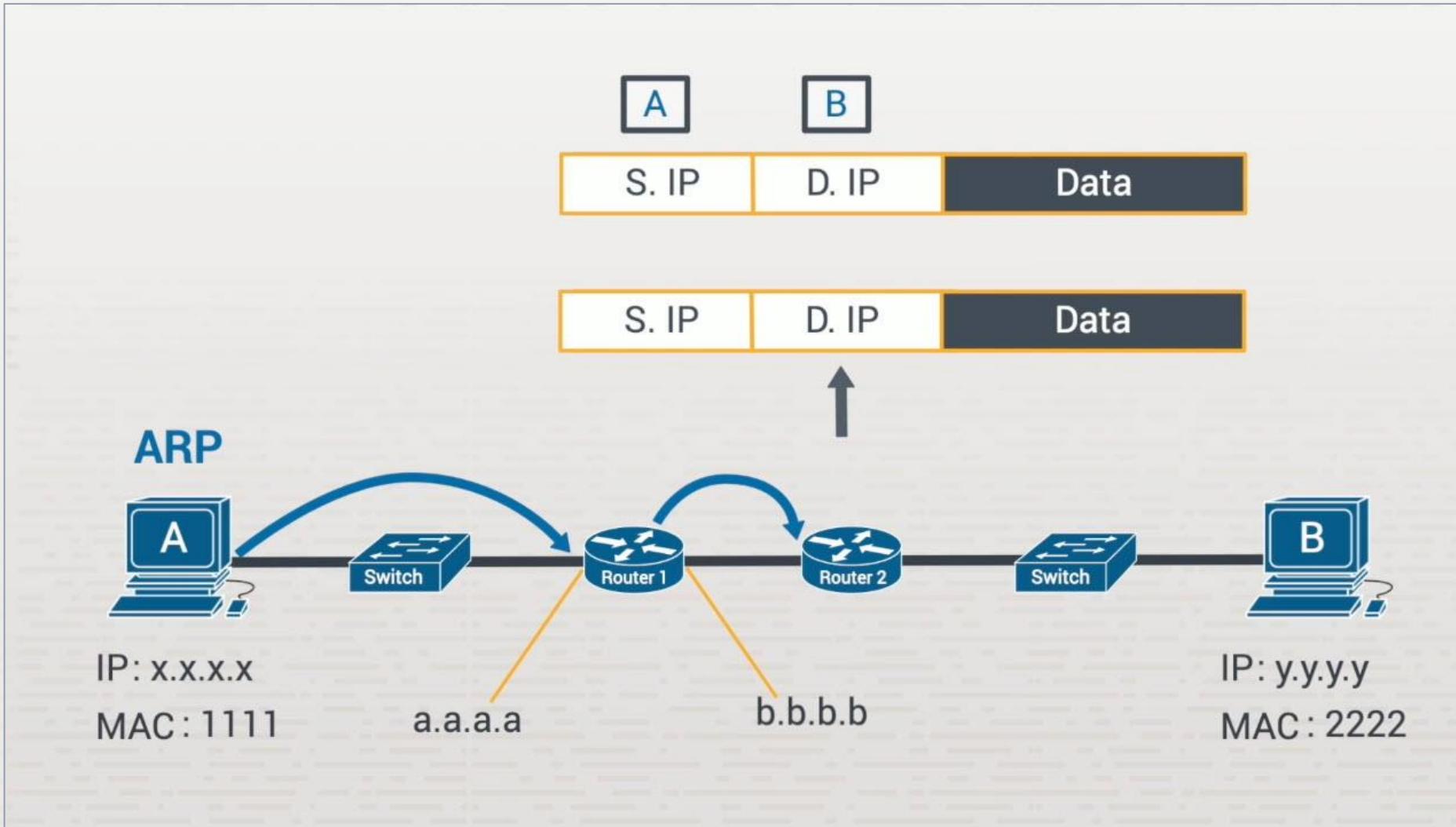
# packets and frames



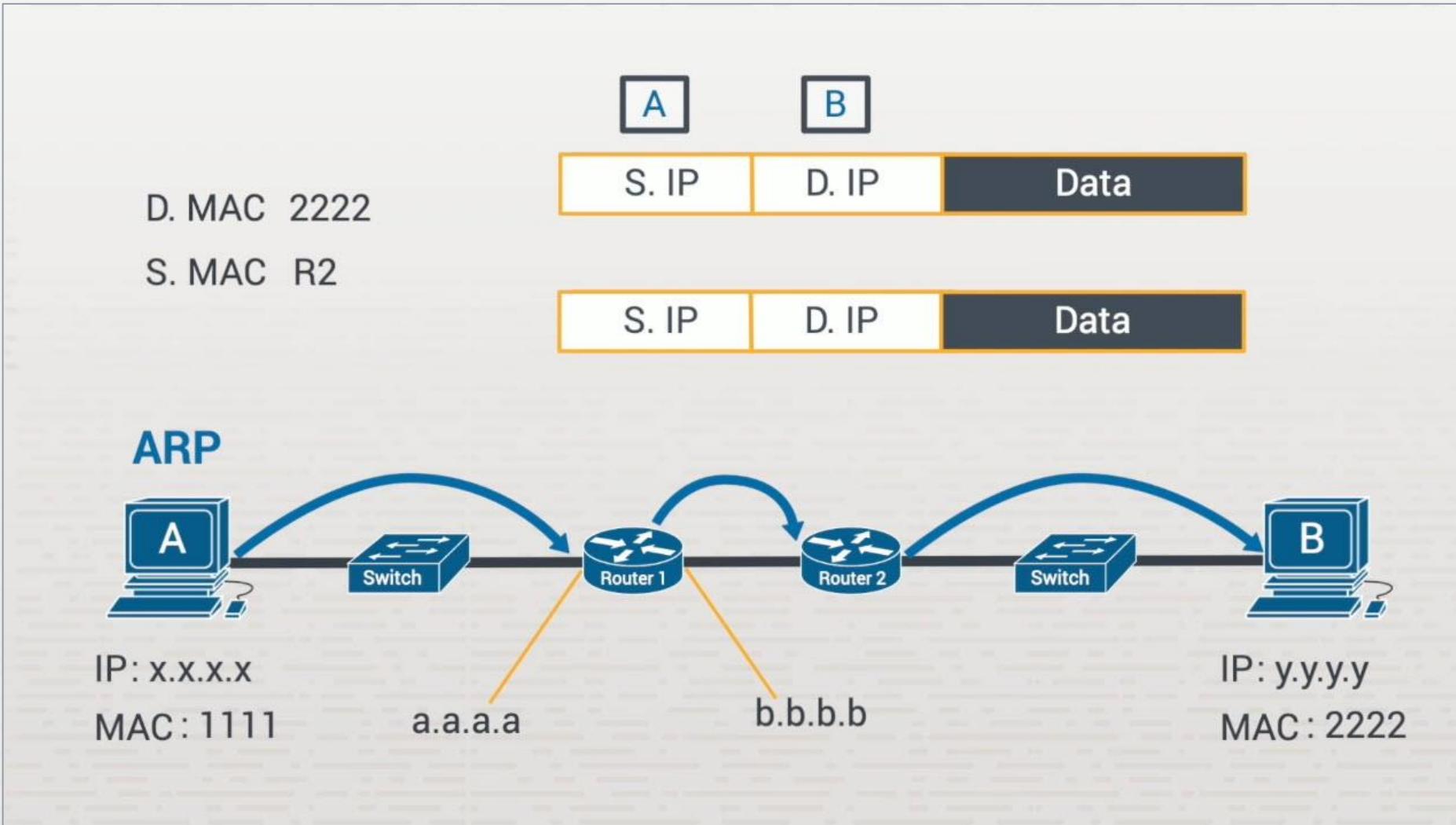
# packets and frames



# packets and frames



# packets and frames



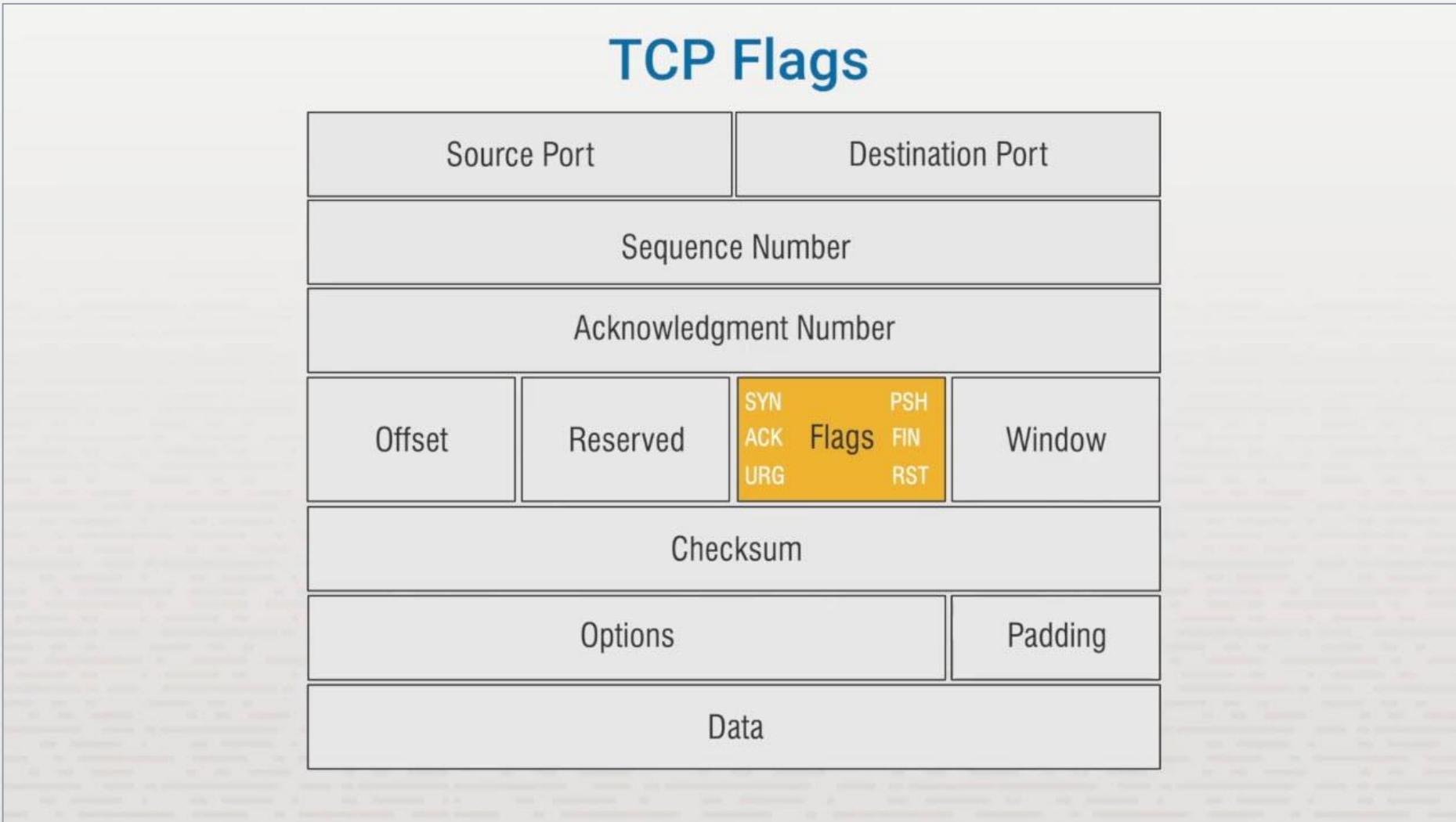
# Summary

- ❖ Packets built
- ❖ Frames encapsulated

# Three-Way Handshake and TCP Flags

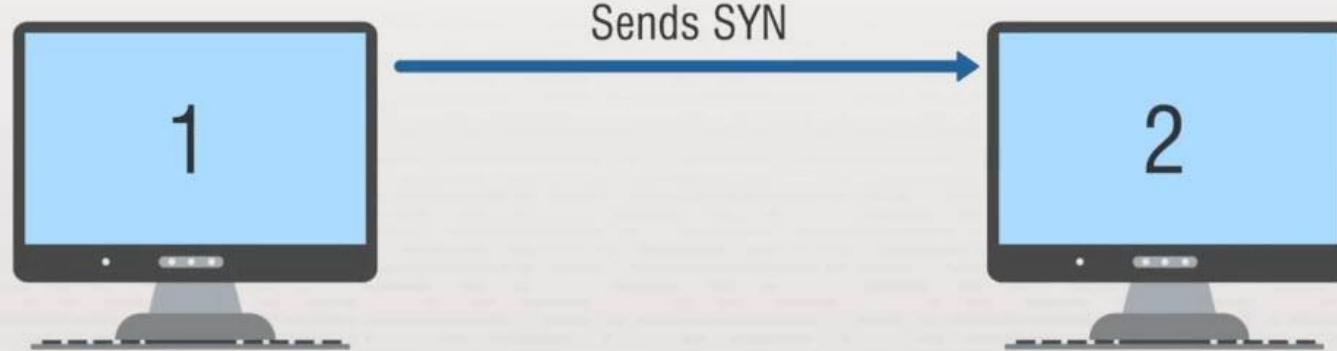


# Three-Way Handshake and TCP Flags



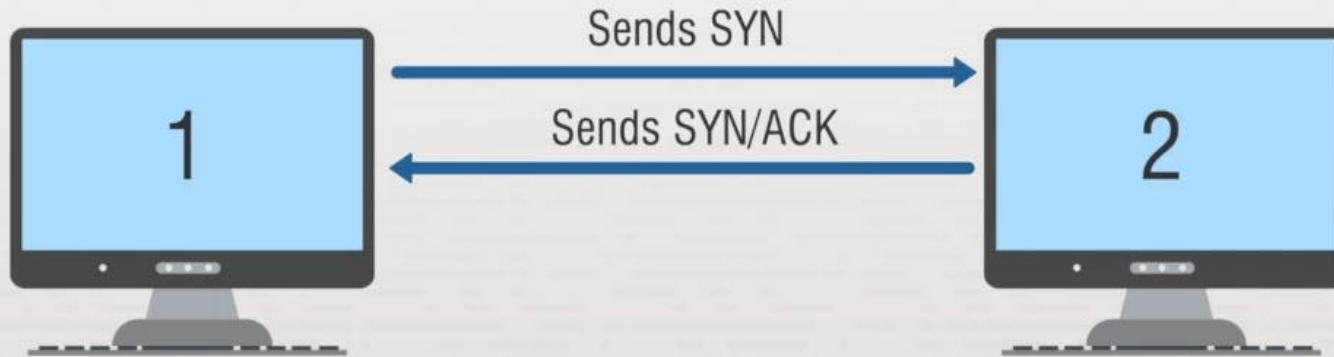
# Three-Way Handshake and TCP Flags

## Three-Way Handshake



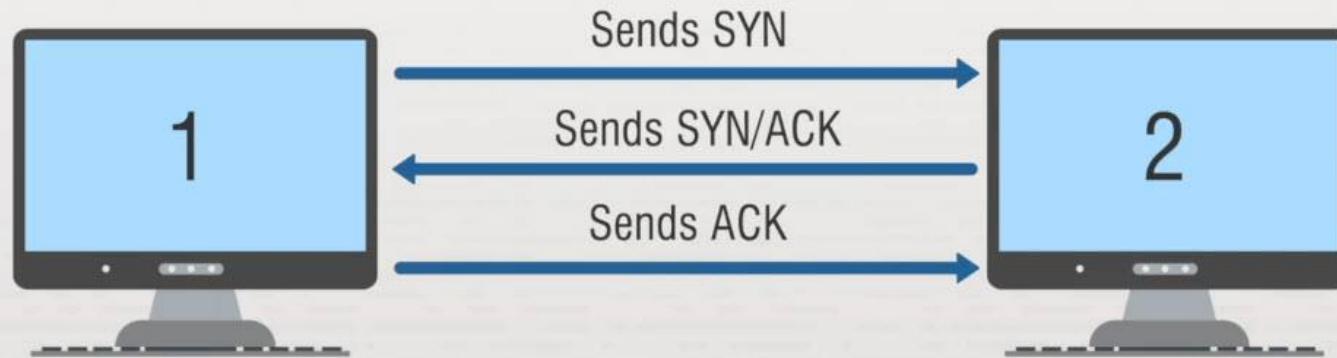
# Three-Way Handshake and TCP Flags

## Three-Way Handshake



# Three-Way Handshake and TCP Flags

## Three-Way Handshake



# Three-Way Handshake and TCP Flags



# Three-Way Handshake and TCP Flags

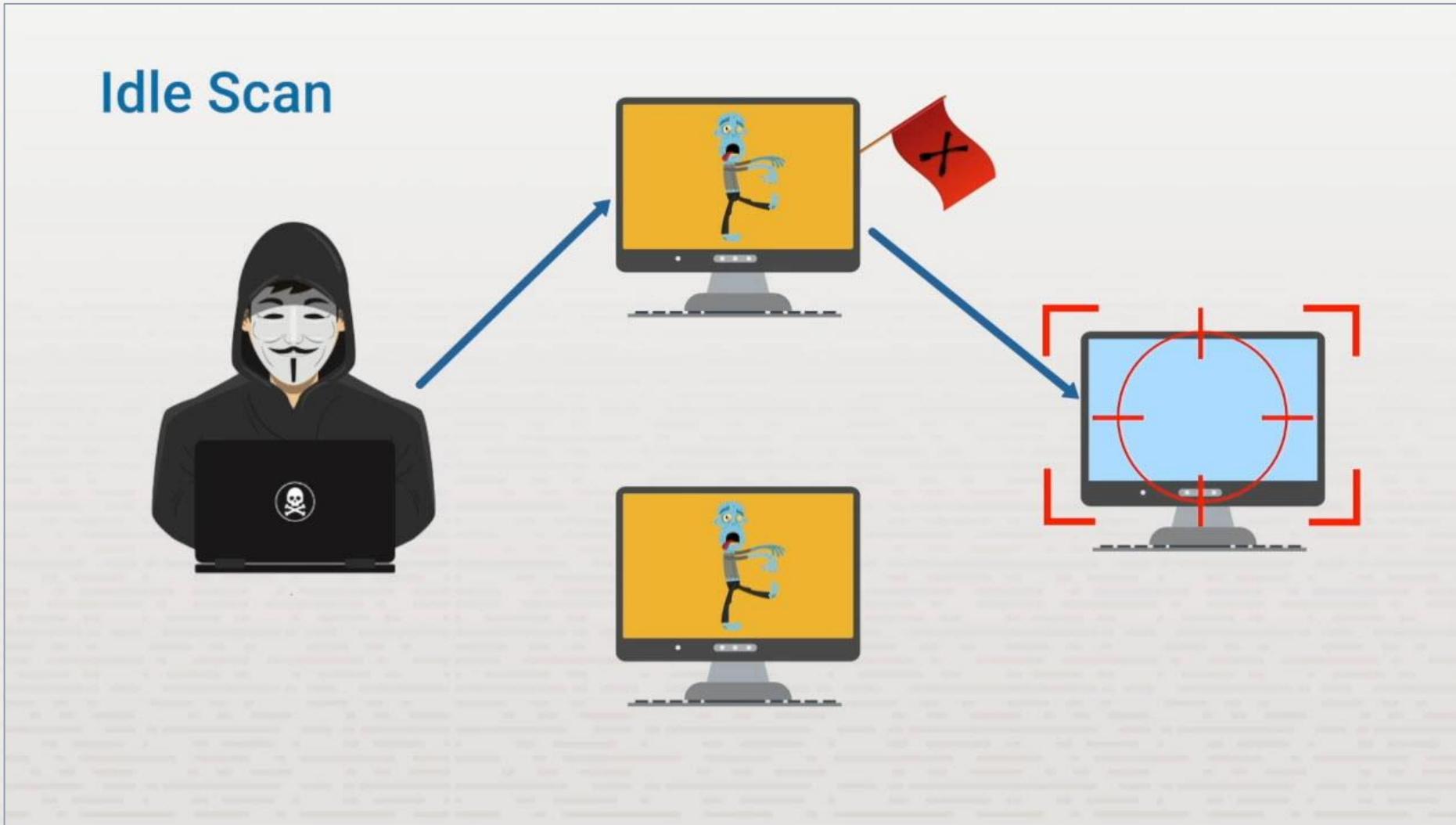


# Three-Way Handshake and TCP Flags

Xmas Tree Scan



# Three-Way Handshake and TCP Flags



# Summary

- ❖ Three-way handshakes
- ❖ TCP flags
- ❖ Open scan
- ❖ Stealth scan
- ❖ Xmas tree scan
- ❖ Idle scan

# Class Discussion

- ❖ How does data encapsulation facilitate data transmission?
- ❖ What are the TCP/IP encapsulation process steps on a sending host?
- ❖ What are the TCP/IP de-encapsulation process steps?
- ❖ What are TCP flags?
- ❖ How do packets and frames work?

# Network Protocols



# Section Skill Overview

- ❖ Explore network services

# Key Terms

- ❖ Protocol
- ❖ Internet Protocol Suite

# Key Definitions

- ❖ **Protocol:** A protocol is a set of standards for communication between network hosts.
- ❖ **Internet Protocol suite:** The Internet Protocol suite (frequently referred to as TCP/IP) is a conceptual model and set of communications protocols used on the internet and similar computer networks. The foundational protocols in this suite are Transmission Control Protocol (TCP) and Internet Protocol (IP).

# TCP/IP Protocols



# TCP/IP Protocols

## TCP/IP Protocol Suite

Transmission Control Protocol (TCP) → Connection-oriented

User Datagram Protocol (UDP) → Connectionless

---

Hypertext Transfer Protocol (HTTP) (HTTPS)

Secure Socket Layer (SSL)

Transport Layer Security (TLS)



# TCP/IP Protocols

File Transfer Protocol (FTP)

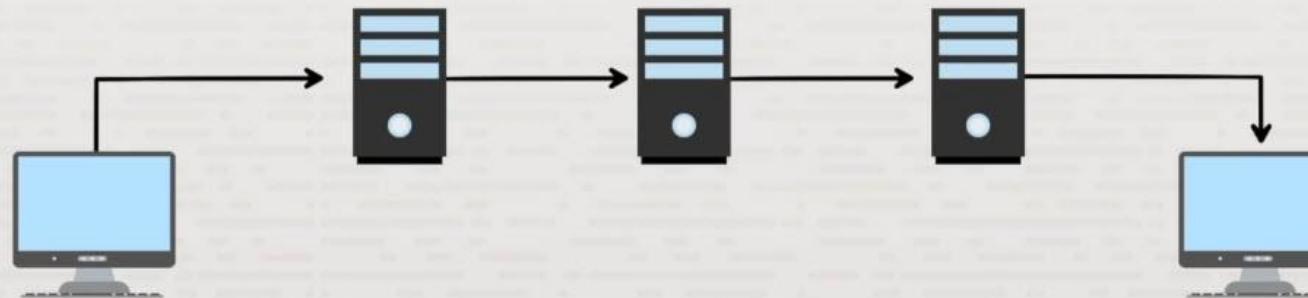
Trivial File Transfer Protocol (TFTP)

Secure File Transfer Protocol (SFTP)

Secure Copy Protocol (SCP)

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Simple Mail Transfer Protocol (SMTP)



# TCP/IP Protocols

File Transfer Protocol (FTP)

Trivial File Transfer Protocol (TFTP)

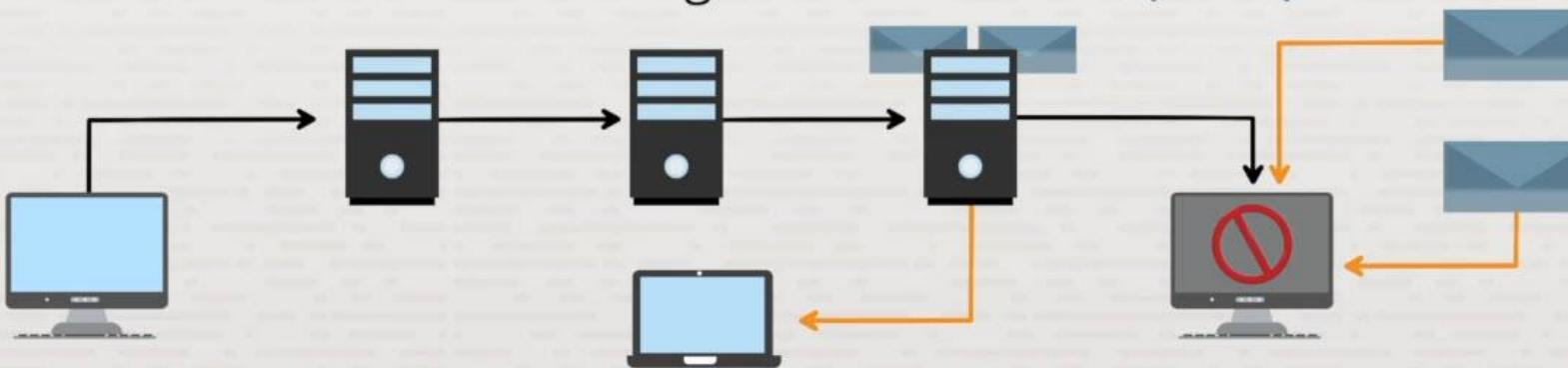
Secure File Transfer Protocol (SFTP)

Secure Copy Protocol (SCP)

Simple Mail Transfer Protocol (SMTP)

Post Office Protocol v3 (POP3)

Internet Message Access Protocol (IMAP)



# TCP/IP Protocols

Dynamic Host Configuration Protocol (DHCP)

Domain Name System (DNS) TCP and UDP



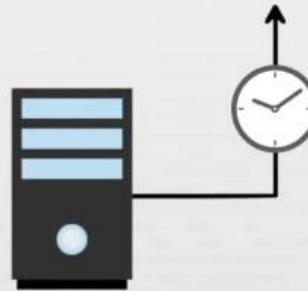
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# TCP/IP Protocols

Dynamic Host Configuration Protocol ([DHCP](#))

Domain Name System (DNS) [TCP](#) and [UDP](#)

Network Time Protocol ([NTP](#))



# TCP/IP Protocols

Dynamic Host Configuration Protocol ([DHCP](#))

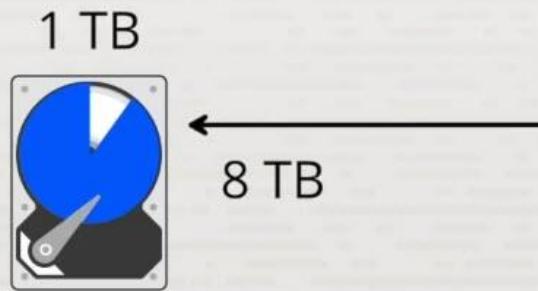
Domain Name System (DNS) [TCP](#) and [UDP](#)

Network Time Protocol ([NTP](#))

Lightweight Directory Access Protocol (LDAP) [TCP](#) and [UDP](#)

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Simple Network Management Protocol ([SNMP](#))



# TCP/IP Protocols

Dynamic Host Configuration Protocol ([DHCP](#))

Domain Name System (DNS) [TCP](#) and [UDP](#)

Network Time Protocol ([NTP](#))

Lightweight Directory Access Protocol (LDAP) [TCP](#) and [UDP](#)

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Simple Network Management Protocol ([SNMP](#))

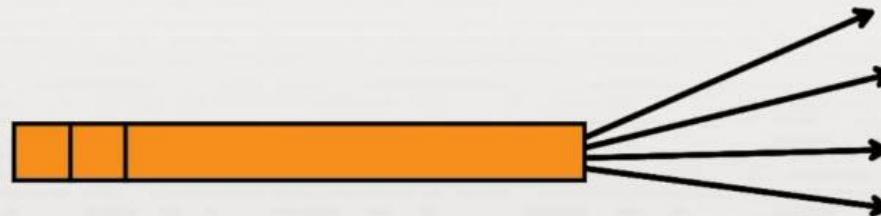
[TELNET](#)

[Secure Shell \(SSH\)](#)

# TCP/IP Protocols

Internet Control Message Protocol (ICMP)

Internet Group Management Protocol (IGMP)



# Summary

- ❖ Commonly used protocols in the TCP/IP protocol suite

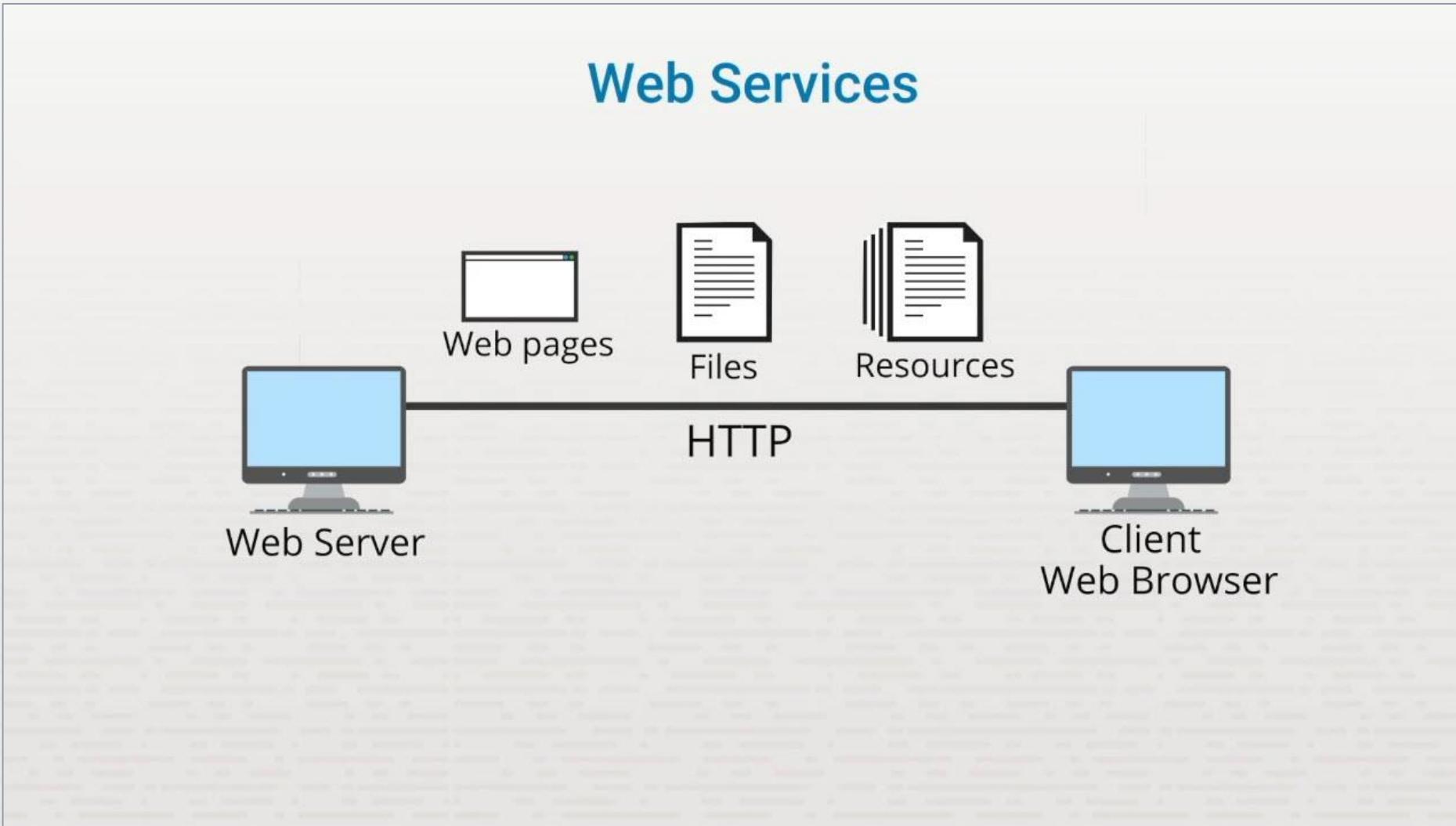
# Common Network Services



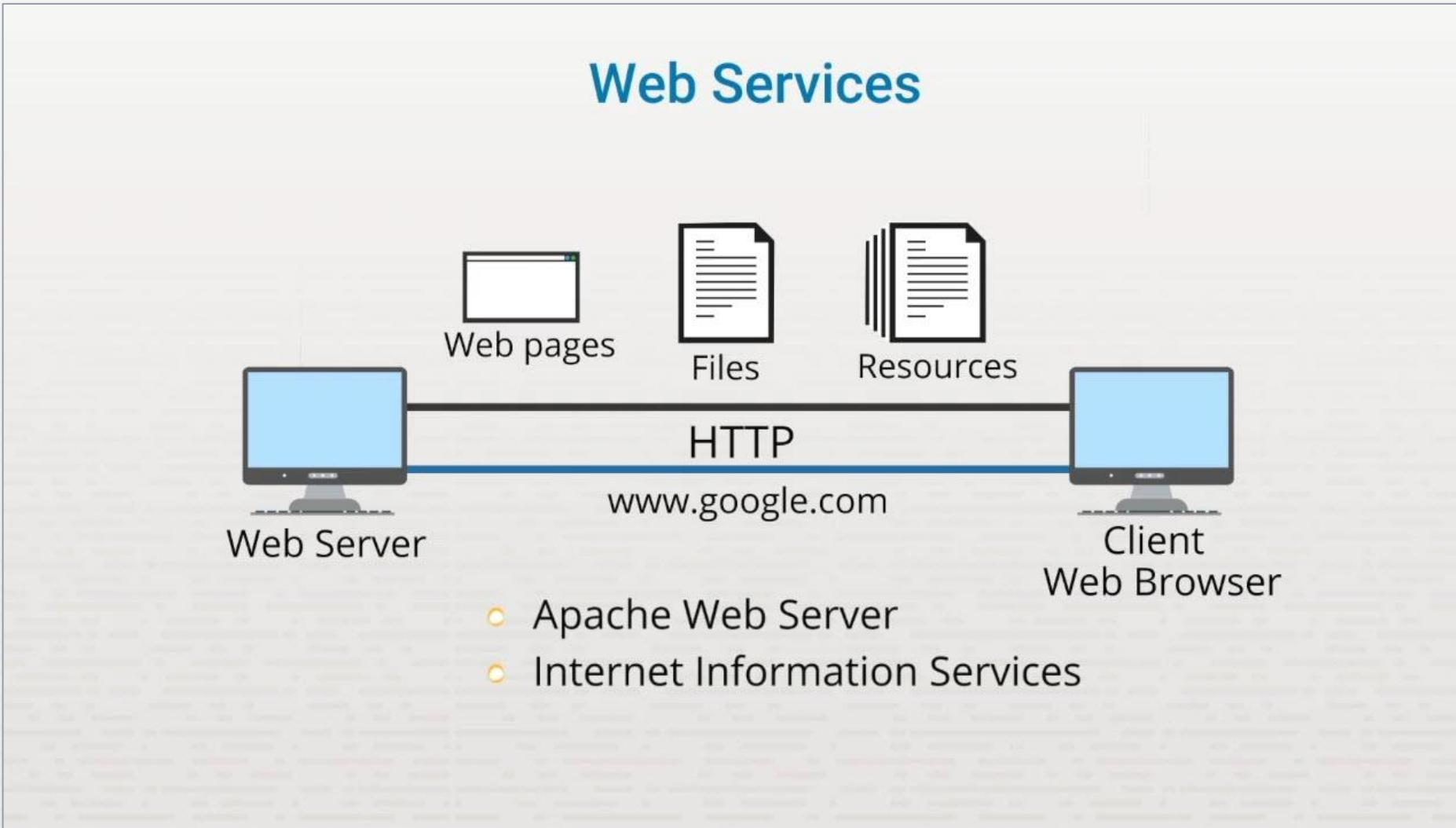
# What Is a Server?

- ❖ Physical computer
- ❖ Specific network service

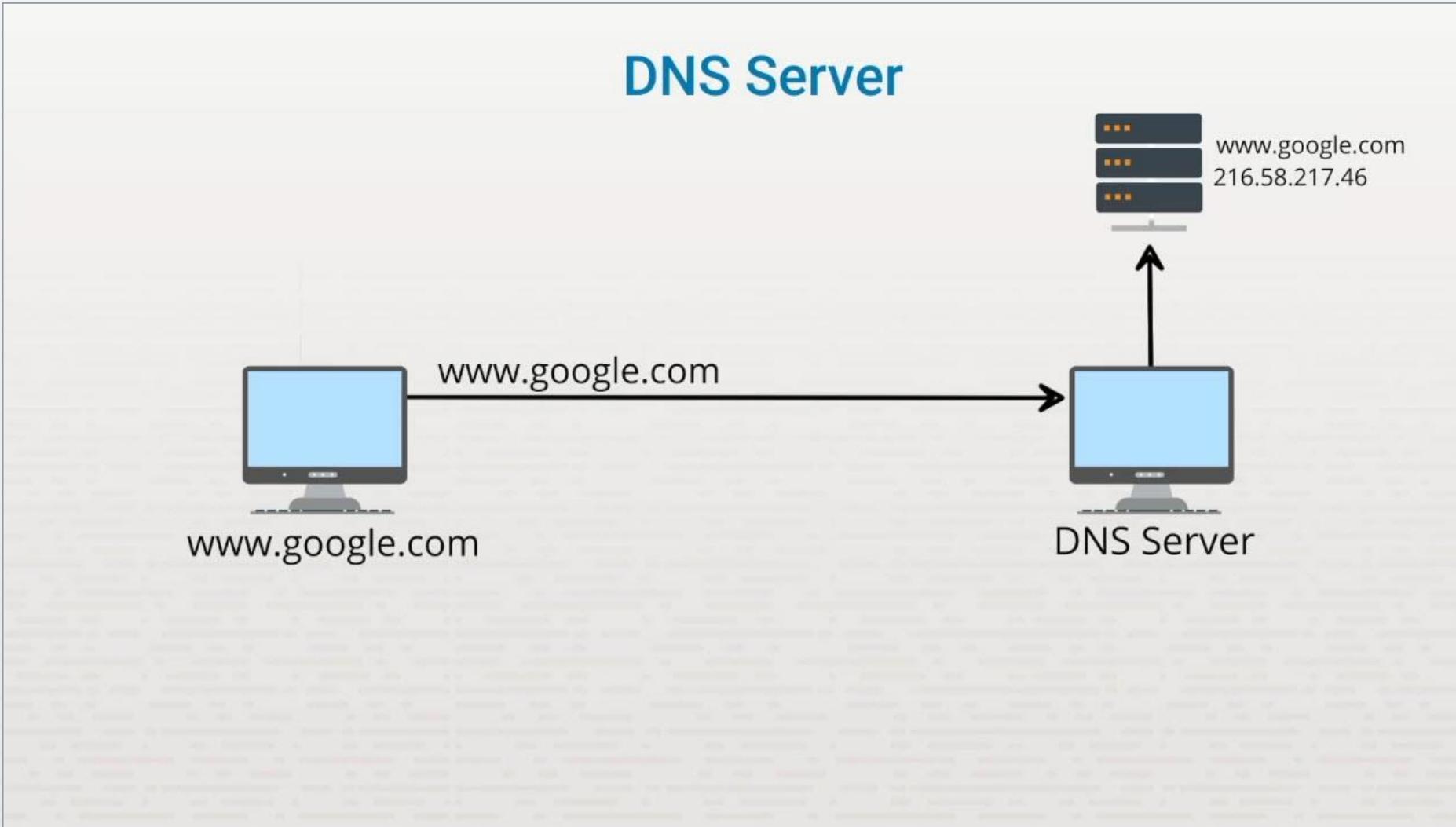
# Common Network Services



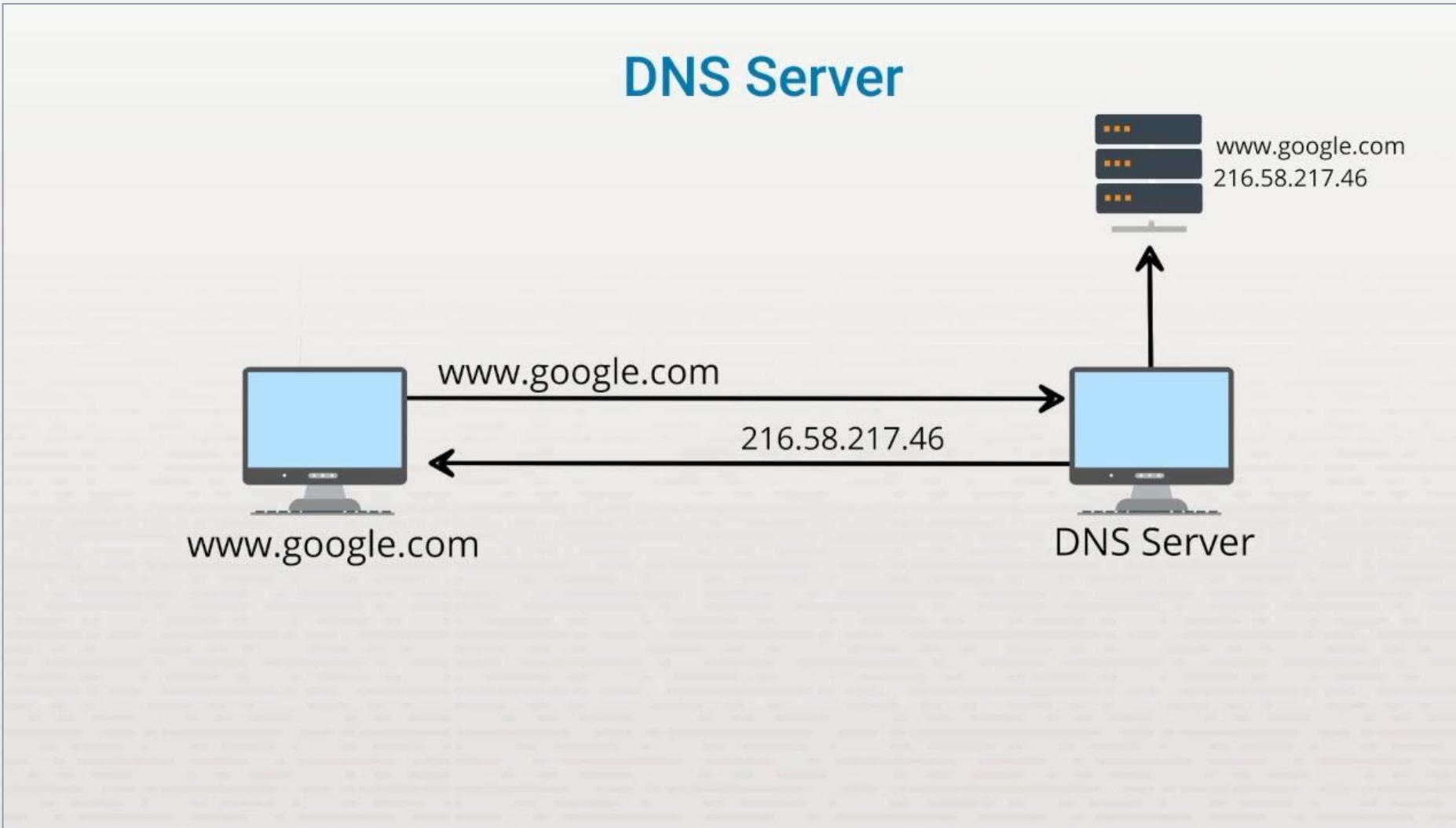
# Common Network Services



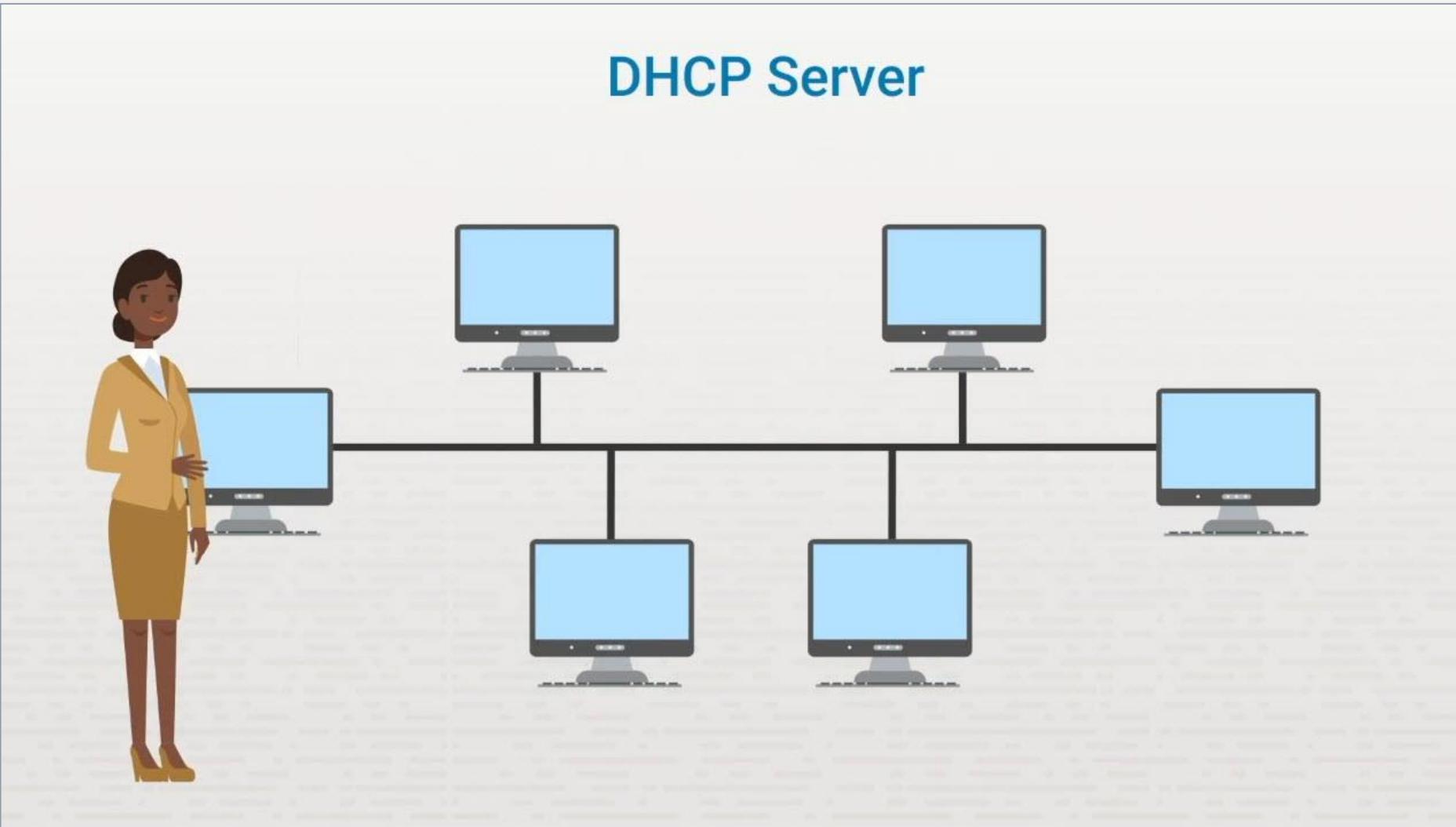
# Common Network Services



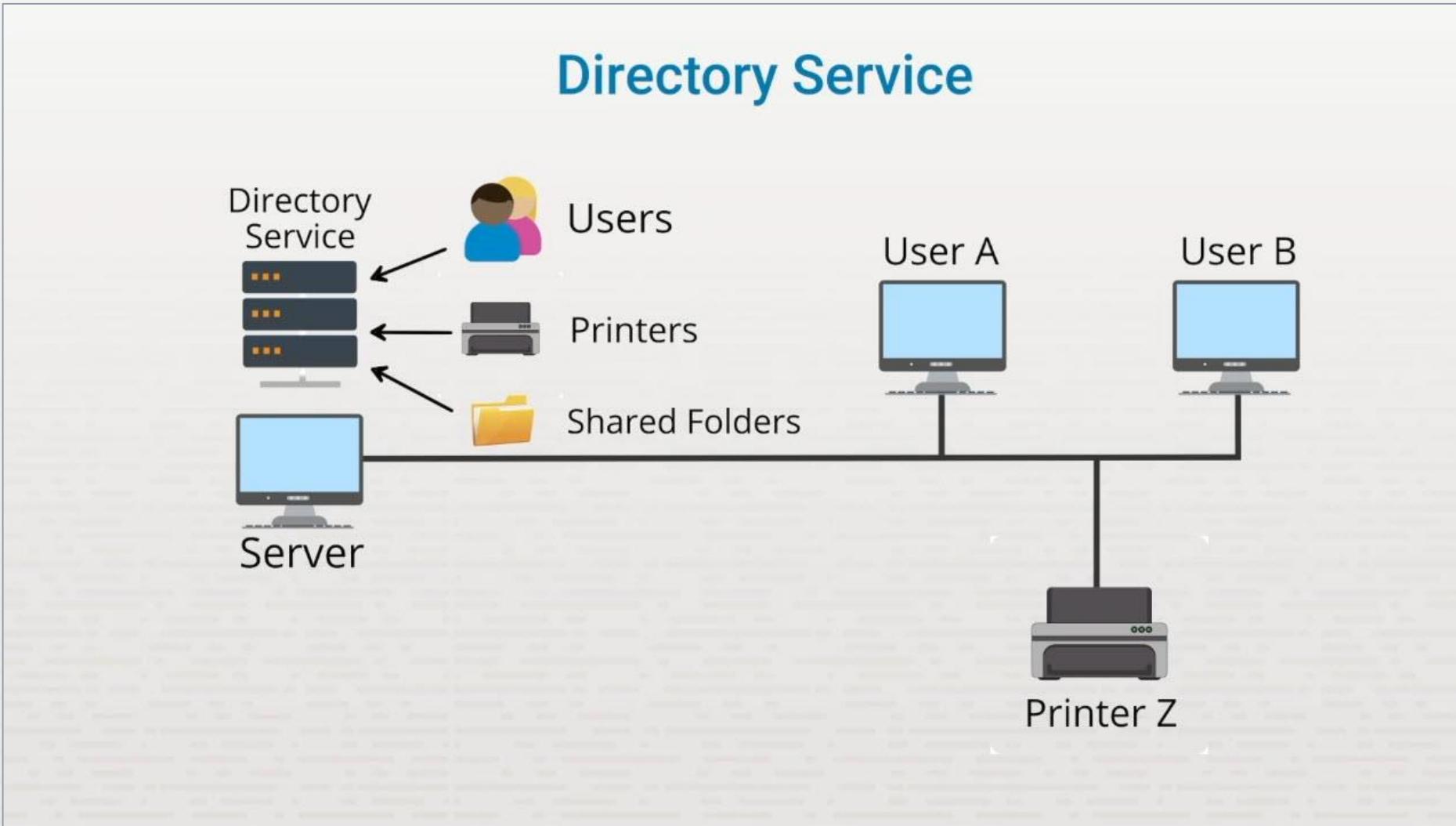
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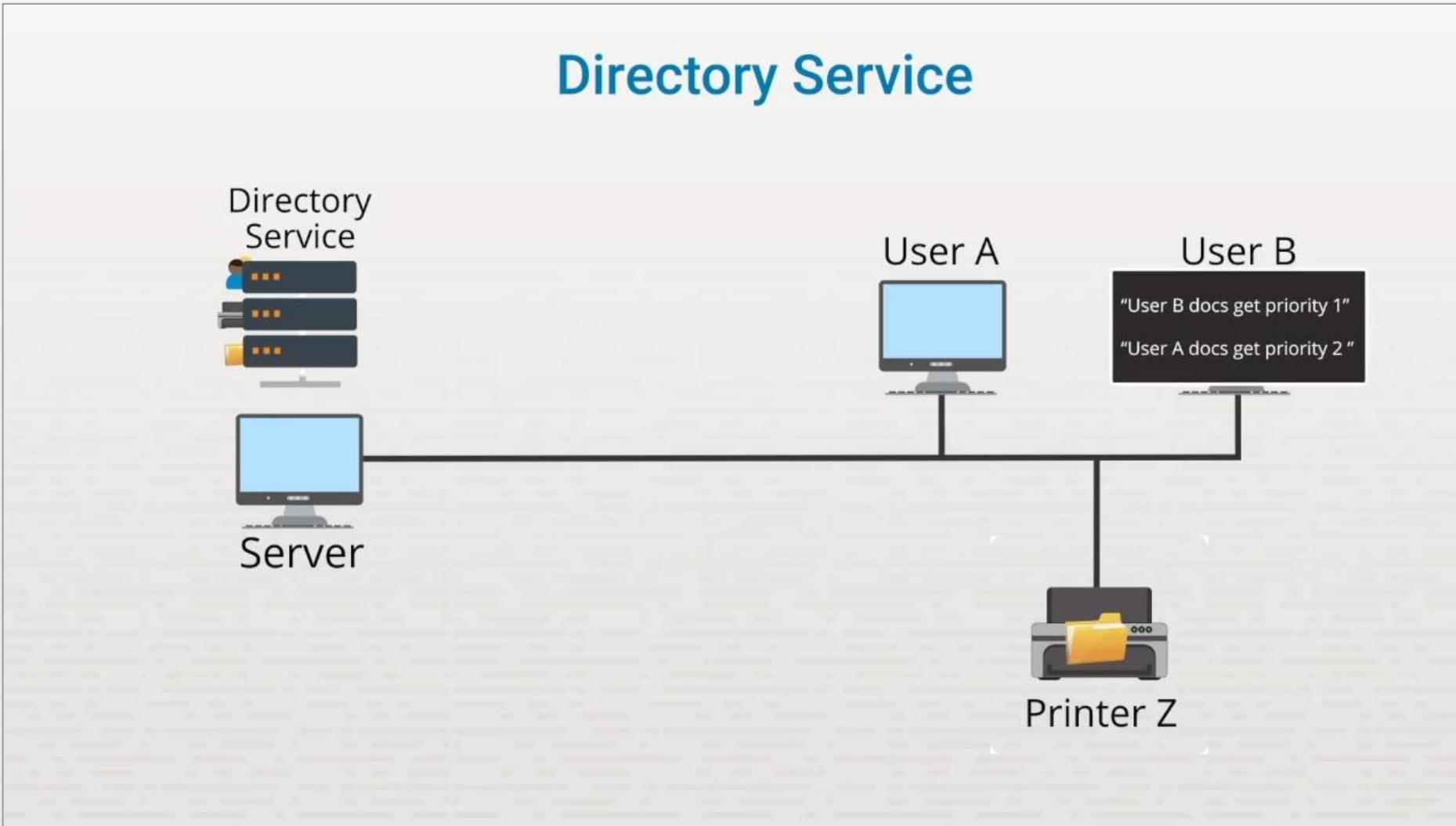
# Common Network Services



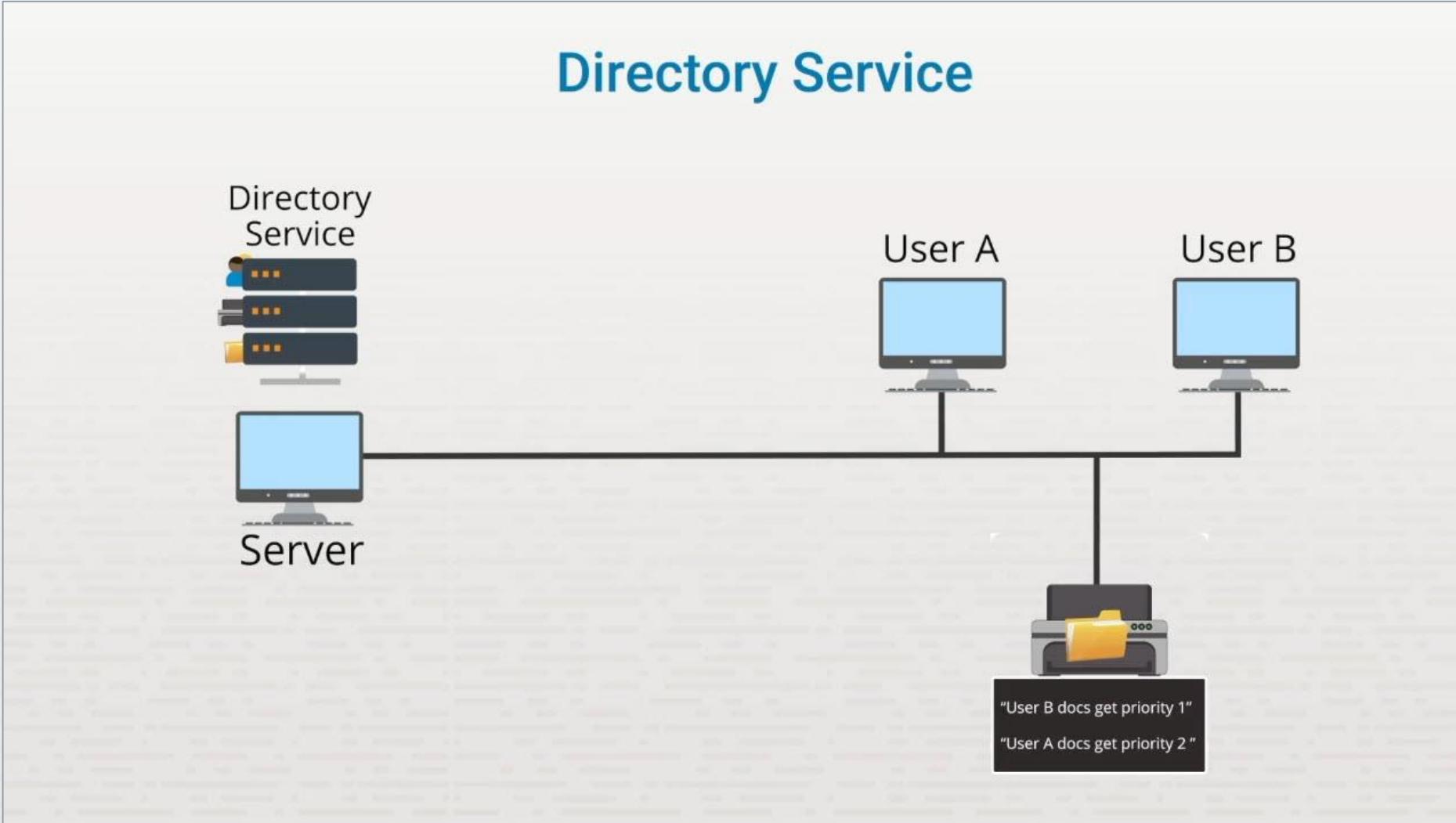
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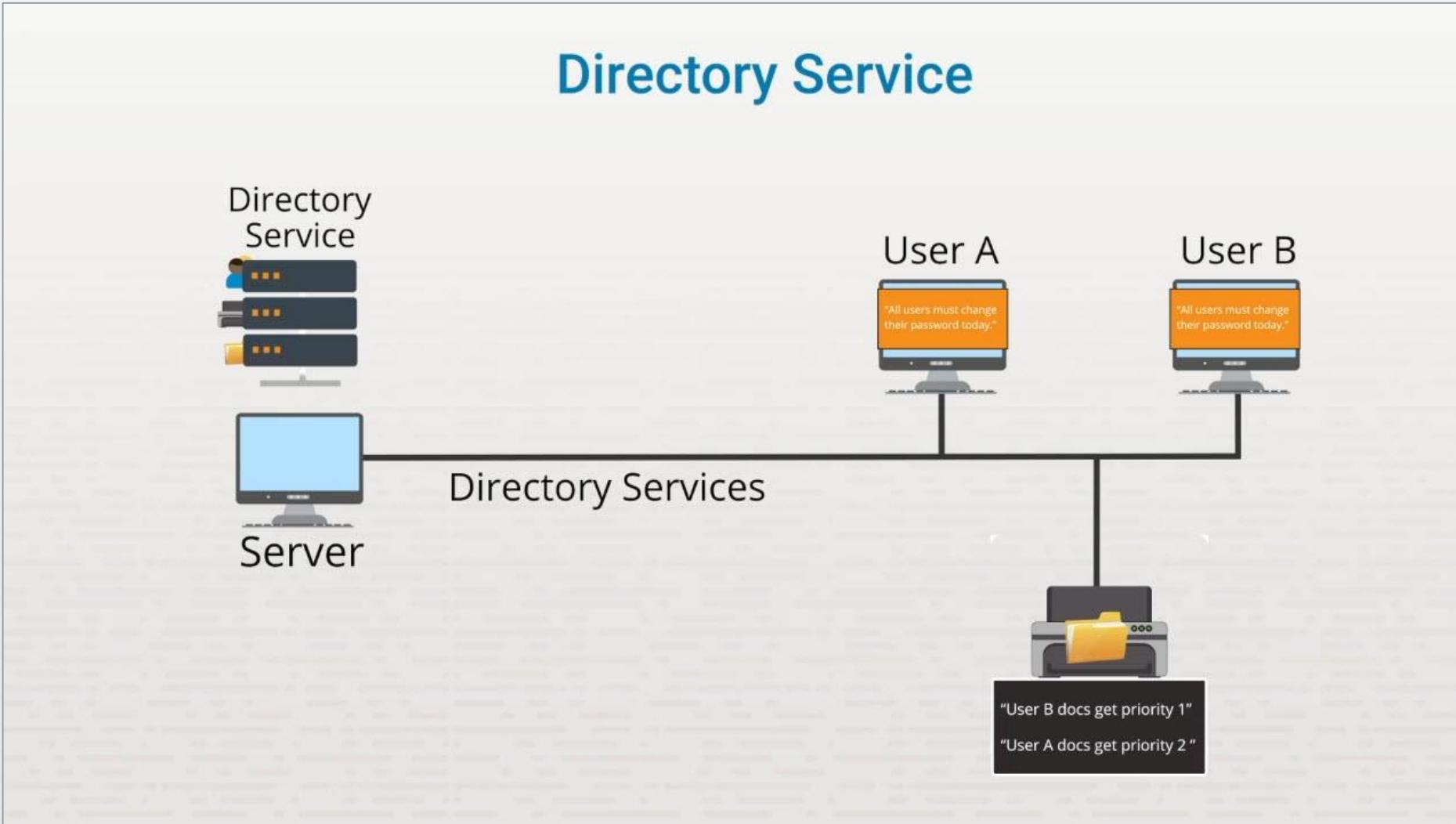
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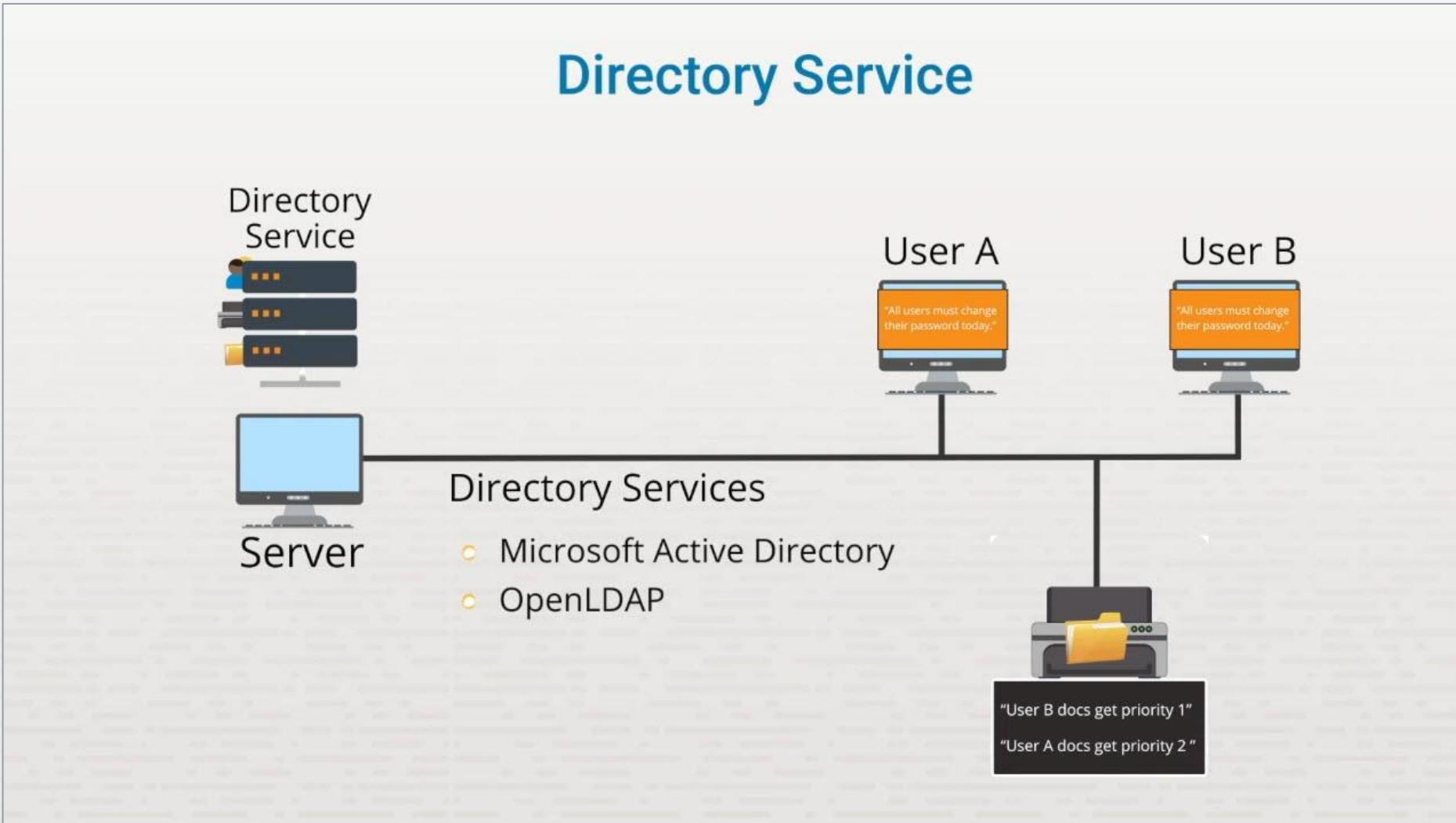
# Common Network Services



# Common Network Services

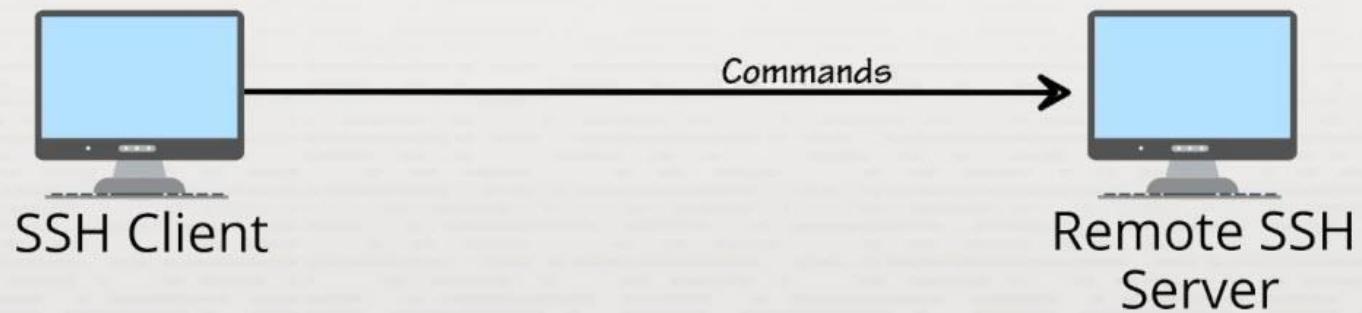


# Common Network Services

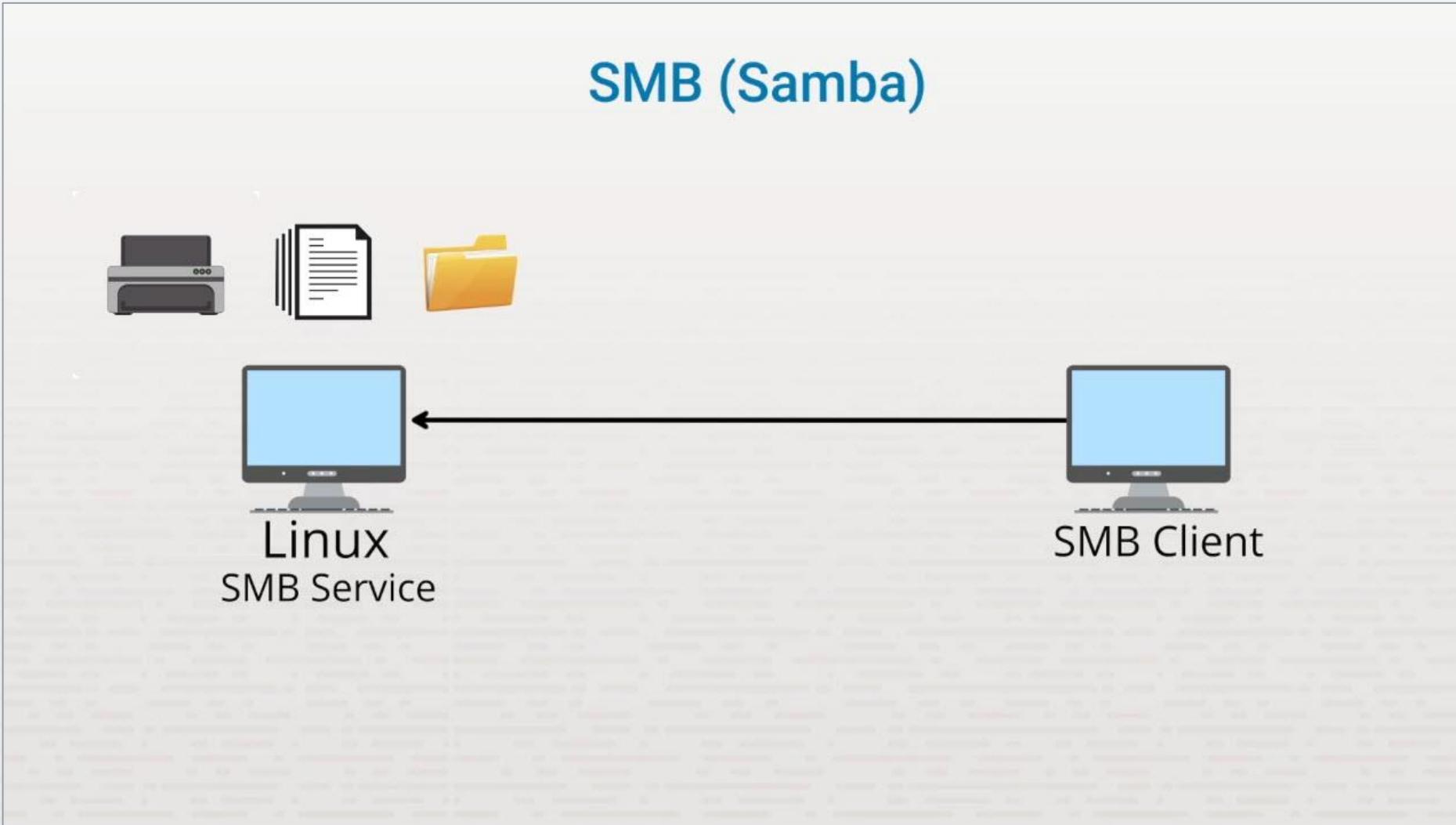


# Common Network Services

## Secure Shell (SSH)



# Common Network Services



# Summary

- ❖ Web servers
- ❖ DNS
- ❖ DHCP
- ❖ Directory services
- ❖ SSH
- ❖ SMB

# Class Discussion

- ❖ How does a protocol suite differ from a protocol?
- ❖ How does TCP differ from UDP?
- ❖ What are the differences between the three email protocols (IMAP4, POP3, and SMTP)?
- ❖ How does SSH differ from Telnet? How does HTTPS differ from HTTP?