BELL RINGER

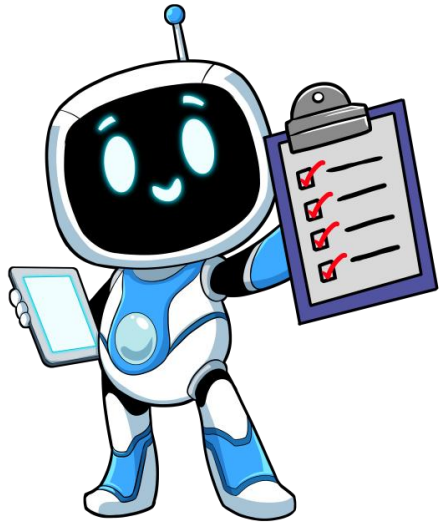
# Warm up your A+ networking memory.

*5 minutes. Write your answers in your notebook before the bell.*

1. What is the difference between TCP (Transmission Control Protocol) and UDP at a high level?

2. An IP (Internet Protocol) address identifies what?

3. True or false: a switch and a router do the same job.

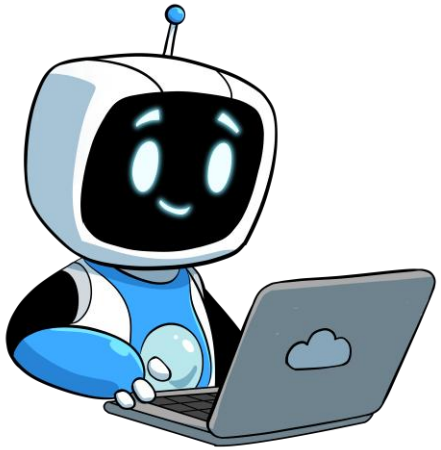


# OSI Model Fundamentals

Network+ (N10-009) · Objective 1.1

*OSI = Open Systems Interconnection. The 7-layer framework every Net+ tech learns by heart.*

*50 minutes · One class period*



WHY THIS MATTERS

# In a real NOC, the first question is always "what layer?"

*NOC = network operations center. The team that watches networks 24/7.*

| Layer 1 | Layer 2 | Layer 3 | Layer 7 |
| --- | --- | --- | --- |
| **Cable unplugged** | **Switch port misconfigured** | **Wrong subnet** | **Web app down** |

**The payoff**

Students who memorize the 7 OSI layers cold can troubleshoot like a senior tech on day one of their first networking job. Once you know the layer, you know which tool to grab and which team to escalate to.

TODAY'S PATH

# What you'll know in 50 minutes.

1. The 7 layers in order, top to bottom and bottom to top
2. The PDU (protocol data unit) at each layer: bits, frame, packet, segment, data
3. Which devices and protocols live at which layer (switch=L2, router=L3, etc.)
4. How to use OSI as a checklist when something breaks
5. A mnemonic so you never lose the order again

*Section 1*

# The 7 layers

Top to bottom. Cable to app.

LAYER 7

# Application

*The layer you actually see and touch.*

**Analogy**

Writing a letter. You are the user. Your words are the message.

**PDU (protocol data unit)**

**Data**

**Common protocols**

HTTP (Hypertext Transfer Protocol), HTTPS, FTP, SMTP, DNS

**Real-world example**

Web browser, email client (Outlook, Gmail), file transfer app

LAYER 6

# Presentation

*Translation and encryption between app and network.*

**Analogy**

Translating the letter into a language the recipient speaks. Or sealing it in code.

**PDU (protocol data unit)**

**Data**

**Common protocols**

TLS (Transport Layer Security), SSL (older version of TLS), JPEG, ASCII

**Real-world example**

HTTPS encryption, image file format conversion

LAYER 5

# Session

*Starts, manages, and ends conversations between devices.*

**Analogy**

A phone call. The ring, the "hello," the conversation, the "goodbye," the hang-up.

**PDU (protocol data unit)**

**Data**

**Common protocols**

NetBIOS, RPC (Remote Procedure Call)

**Real-world example**

A login session staying alive while you click around an app

LAYER 4

# Transport

*Reliable delivery and port numbers.*

**Analogy**

The post office. They guarantee delivery and know which mailbox to drop the letter in.

**PDU (protocol data unit)**

**Segment (TCP) or Datagram (UDP (User Datagram Protocol))**

**Common protocols**

TCP (Transmission Control Protocol), UDP (User Datagram Protocol)

**Real-world example**

Port 443 carries HTTPS web traffic. Port 53 carries DNS lookups.

LAYER 3

# Network

*Logical addressing and routing between networks.*

**Analogy**

The street address on an envelope. Routers read it to decide which truck and which road.

**PDU (protocol data unit)**

**Packet**

**Common protocols**

IP (Internet Protocol), ICMP (Internet Control Message Protocol, behind ping)

**Real-world example**

A router forwards a packet from your office network to Google by reading its IP address.

LAYER 2

# Data Link

*Frames and MAC (media access control) addresses inside one local network.*

**Analogy**

The mail carrier on your street, who knows exactly which house each letter goes to.

**PDU (protocol data unit)**

**Frame**

**Common protocols**

Ethernet, ARP (Address Resolution Protocol)

**Real-world example**

A switch forwards a frame to the right computer by reading its MAC (media access control) address.

LAYER 1

# Physical

*Bits on a wire. Signal in the air.*

**Analogy**

The road the mail truck drives on. The wire the bits run through.

**PDU (protocol data unit)**

**Bits**

**Common protocols**

(no protocols; this is the physical medium itself)

**Real-world example**

Copper Ethernet cable, fiber optic, radio waves (WiFi), satellite link

MEMORIZE THIS TABLE

# All 7 layers, one slide.

| Layer | Name | PDU | Common protocols | Example device |
|---|---|---|---|---|
| 7 | **Application** | Data | HTTP/HTTPS, FTP, SMTP, DNS | Web browser |
| 6 | **Presentation** | Data | TLS, SSL, JPEG | HTTPS encryption |
| 5 | **Session** | Data | NetBIOS, RPC | Login session |
| 4 | **Transport** | Segment / Datagram | TCP, UDP | Port 443 |
| 3 | **Network** | Packet | IP, ICMP | Router |
| 2 | **Data Link** | Frame | Ethernet, ARP | Switch |
| 1 | **Physical** | Bits | (physical medium) | Cable / fiber / radio |

TWO MODELS, ONE INTERNET

# OSI vs TCP/IP

*OSI = 7 layers (the teaching model). TCP/IP = 4 layers (what the real internet uses).*

## OSI (7 layers)

| | |
|---|---|
| 7 | Application |
| 6 | Presentation |
| 5 | Session |
| 4 | Transport |
| 3 | Network |
| 2 | Data Link |
| 1 | Physical |

## TCP/IP (4 layers)

**Application**

*maps to OSI 5, 6, 7*

**Transport**

*maps to OSI 4*

**Internet**

*maps to OSI 3*

**Link**

*maps to OSI 1 and 2*

## ENCAPSULATION

# Each layer wraps the next one in a header.

*Send: add headers going down. Receive: strip them going up.*

| | |
|---|---|
| **App data** | **= Data** |
| **+ TCP header (Layer 4)** | **= Segment** |
| **+ IP header (Layer 3)** | **= Packet** |
| **+ Ethernet header (Layer 2)** | **= Frame** |
| **+ Physical signal (Layer 1)** | **= Bits** |

*Sender goes DOWN the stack.  Receiver goes UP and unwraps.*

*Section 2*

# PDUs + troubleshooting

Use the model when something breaks.

PDU STACK

# Memorize the PDU names in order.

*PDU = protocol data unit. The name for "the thing being sent" at each layer.*


**Bottom of stack to top: Bits, Frame, Packet, Segment or Datagram, Data.**

COMMON MISTAKES

# Three traps the test (and your boss) will catch.

## Mixing up the PDUs

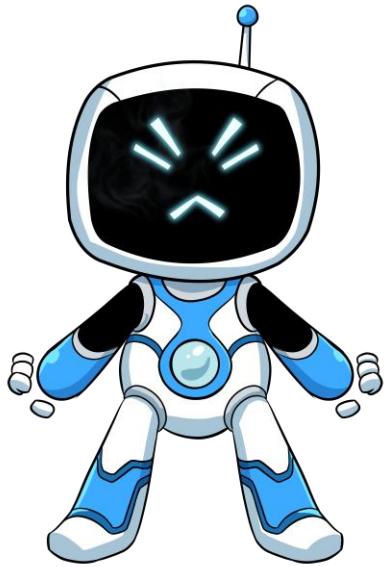
A "packet" is Layer 3 (IP). A "frame" is Layer 2 (Ethernet). They are not the same thing. Memorize the PDU stack.

## Confusing OSI with TCP/IP

OSI has 7 layers. TCP/IP has 4 layers. They are different models. Know which one the question is asking about.

## Putting devices at the wrong layer

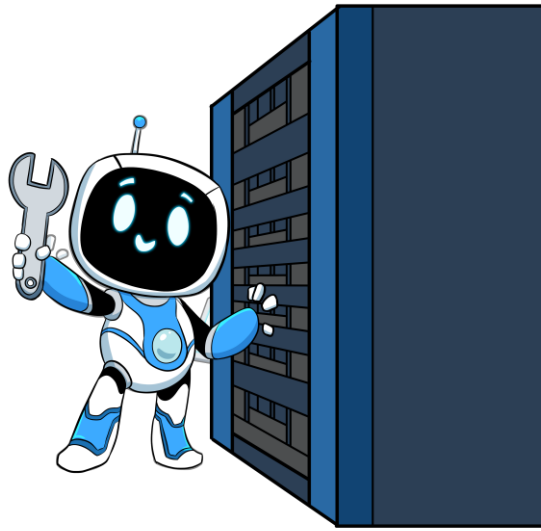
A standard switch is Layer 2 (forwards by MAC address). A standard router is Layer 3 (forwards by IP address). Do not swap them.



## TROUBLESHOOTING BY LAYER

# When something breaks, start at Layer 1 and work up.

| Layer | Common symptom | First tool to grab |
|---|---|---|
| 1 | No link light. Cable damaged. WiFi signal dead. | Eyes. Cable tester. Swap the cable. |
| 2 | Switch port "err-disabled." MAC address flapping. | Switch console. show interface status. |
| 3 | Can ping by IP but not by name. Wrong subnet. | ipconfig (Windows), ifconfig (Linux), ping, tracert. |
| 4 | App times out. Port blocked by firewall. | telnet to port. nmap. Firewall log. |
| 5 | Login session drops mid-task. | App session log. Auth server log. |
| 6 | Certificate warning. HTTPS handshake fails. | Browser dev tools. Cert chain check. |
| 7 | Web app shows 500 error. Email bounces. | Web browser. App logs. Email headers. |



THE MNEMONIC

# Please Do Not Throw Sausage Pizza Away.

*Bottom up: Layer 1 to Layer 7. Memorize once, never lose it.*

| P | D | N | T | S | P | A |
|---|---|---|---|---|---|---|
| **Physical** | **Data Link** | **Network** | **Transport** | **Session** | **Presentation** | **Application** |
| Layer 1 | Layer 2 | Layer 3 | Layer 4 | Layer 5 | Layer 6 | Layer 7 |

*Drill: say it forwards, then backwards, until it sticks.*

ASSIGNMENT 2 PREVIEW

# The Help Desk Ticket

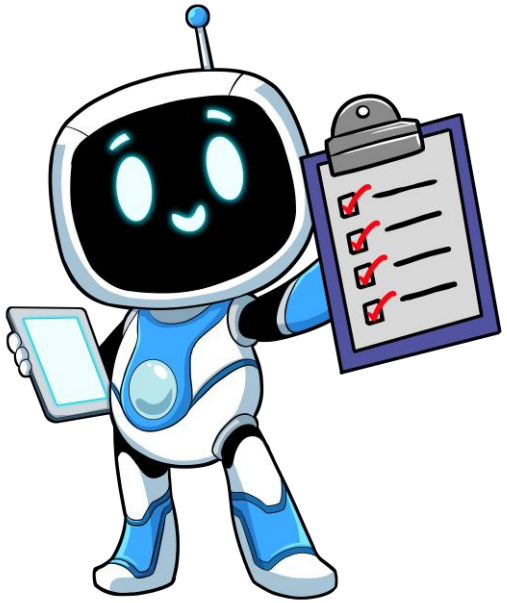
*Use OSI as a checklist on a real ticket.*

TICKET #N-0042

**User report:**

*"My computer keeps disconnecting from the internet for like 30 seconds, then it comes back. Started yesterday. Same WiFi as always. Restarted my laptop twice."*

**Your job: walk the OSI checklist and find the root cause.**



*Section 3*

# Bringing it together

Five takeaways and what comes next.

TAKE THESE WITH YOU

# 5 things to remember.

1. The OSI model has 7 layers, bottom to top: Physical, Data Link, Network, Transport, Session, Presentation, Application.
2. The PDU stack: Bits (L1), Frame (L2), Packet (L3), Segment or Datagram (L4), Data (L5-7).
3. Switch lives at Layer 2 (MAC addresses). Router lives at Layer 3 (IP addresses). Firewall can span Layer 3 to Layer 7.
4. When something breaks, start at Layer 1 and work up. Most problems are in L1, L2, or L3.
5. Please Do Not Throw Sausage Pizza Away. Drill the mnemonic. The order matters.

TOMORROW

# TCP/IP deep dive.

*How the 7 OSI layers compress into the 4 layers that actually run the internet.*

**Tomorrow's lesson covers:**

- The 4 layers of TCP/IP: Link, Internet, Transport, Application
- How the OSI mapping breaks down in real protocol stacks
- Why the IETF chose 4 layers and what they merged
- When techs use OSI language vs TCP/IP language in real tickets

EXIT TICKET

# Three quick prompts. Before you go.

*Write on a notecard and hand in on the way out.*

1. Name the 7 OSI layers in order.
2. What PDU is at Layer 3?
3. Which layer would you check first if a cable looked damaged?