OSI Models & TCP-IP Suite

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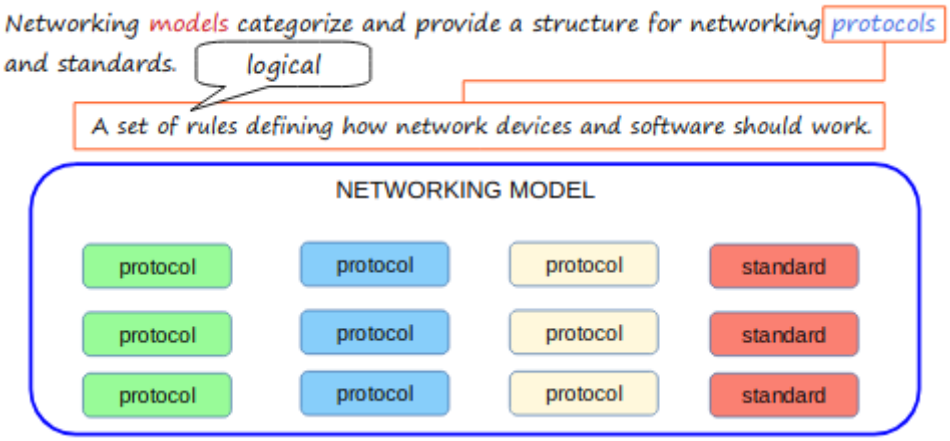
We will cover the **OSI Model** & the **TCP-IP Suit**e, how they are used in the networking environment.

What is a networking model?



The different colours represent different categories of protocols & standards

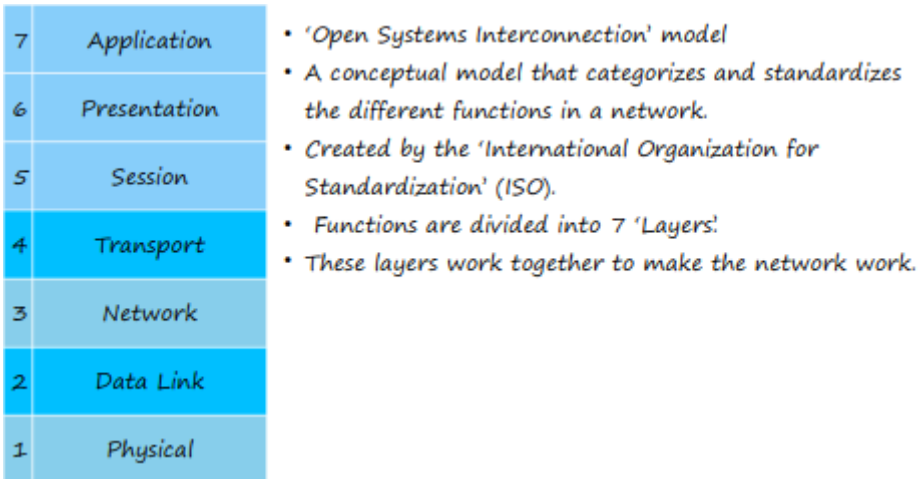
The **different categories of protocols & standards help define things** like the *structure & usage of IP addresses, and physical details like electrical voltage when used on copper cables when transmitting data*.

If we had no protocols & standards, different devices (like Dell & Apple) would not be able to communicate with each other - only devices from the same manufacturer. **It is the protocols & standards that allow communication between devices on different networks**.

OSI Model

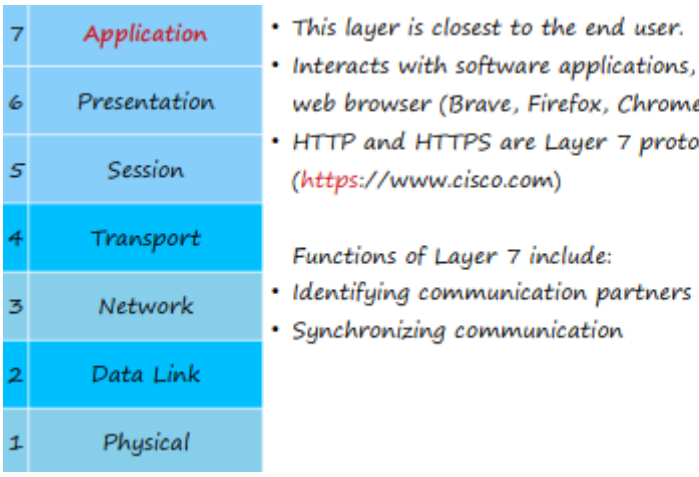
The OSI Model is used to standardise network communications. *Although it is not in used today, networking engineers refer to the model today*. The OSI Model is broken down into **7 layers** of protocols & standards.

7 Layers of the OSI Model



When we **send data**, it passes through the **application (Layer 7)** then **works its way down** to the **physical layer (Layer 1)**; for the end host **receiving** the data it passes through the **physical layer (Layer 1)** then **works it's way up** to the **application layer (Layer 7)**.

Application Layer

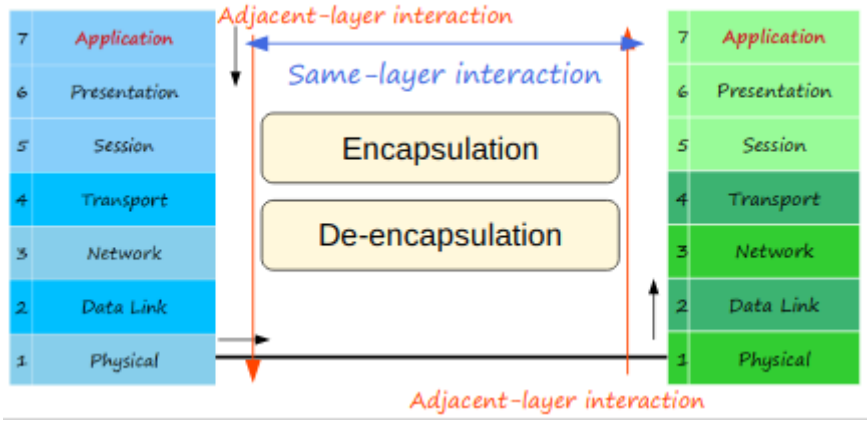


Application definition

The application layer **interacts with software applications that has a communication component** like a web browser. *Layer 7 only focuses on the protocols to interact with the application, not the application itself.*

When we send data, as the data passes through the layers, **each layer adds some information about the data being sent**. By the time the raw data is sent through Layer 1, it is **encapsulated** with data from the rest of the layers. **This is encapsulation**. *By the time the data is sent through Layer 1 it is*

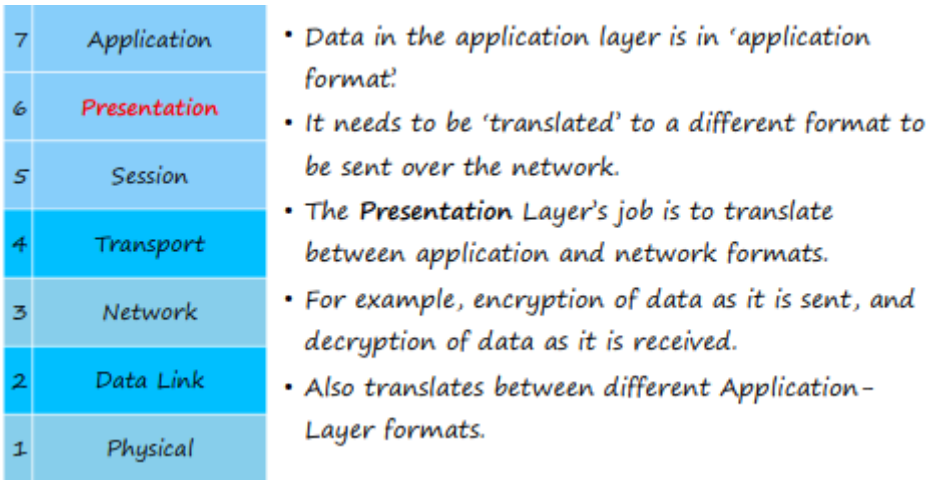
sent through as electrical signals on a wire.



When the data passes to the machine receiving it, it enters Layer 1 as electrical signals and the data is **de-encapsulated** by the time it reaches the receiver's application (Layer 7). **De-encapsulation is the opposite process of encapsulation**, where it strips off data at each layer before reaching its final destination.

This communication between the two different application layers is known as same-layer injection. This allows the application to perform its functions described in the Application definition image.

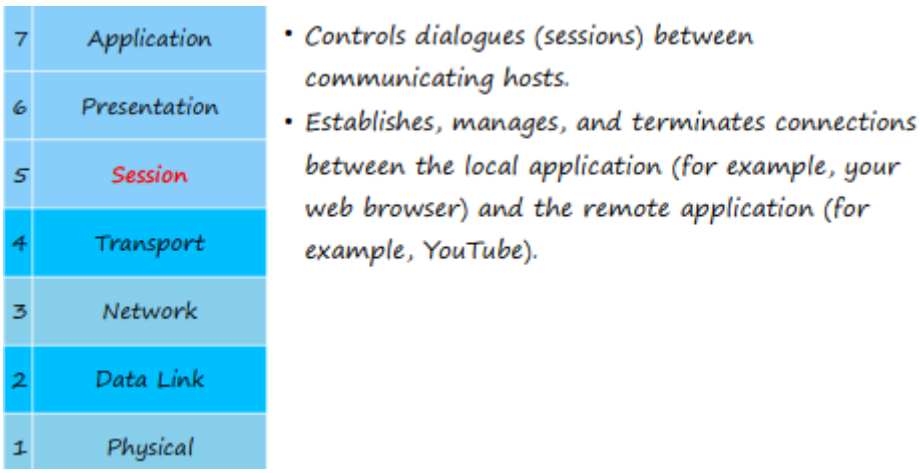
Presentation Layer



Presentation definition

The presentation layer **translates the data to the appropriate format for the end host to understand**.

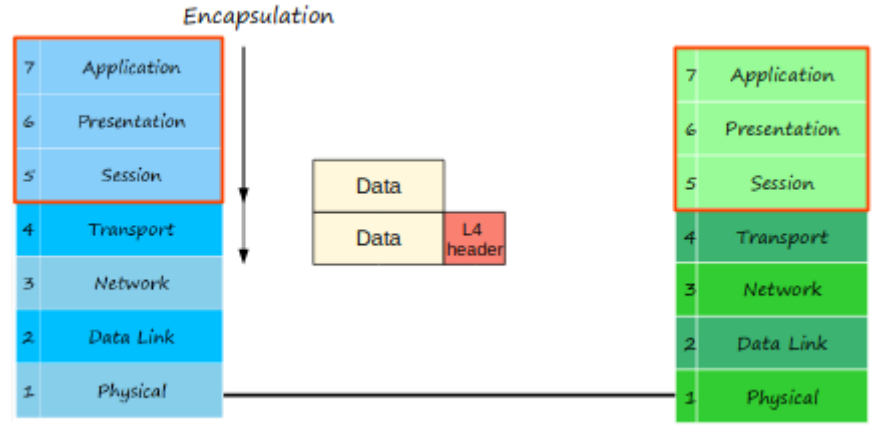
Session Layer



Session definition

The session management allows platforms to **accommodate for continuous traffic** (loads of people using their platform).

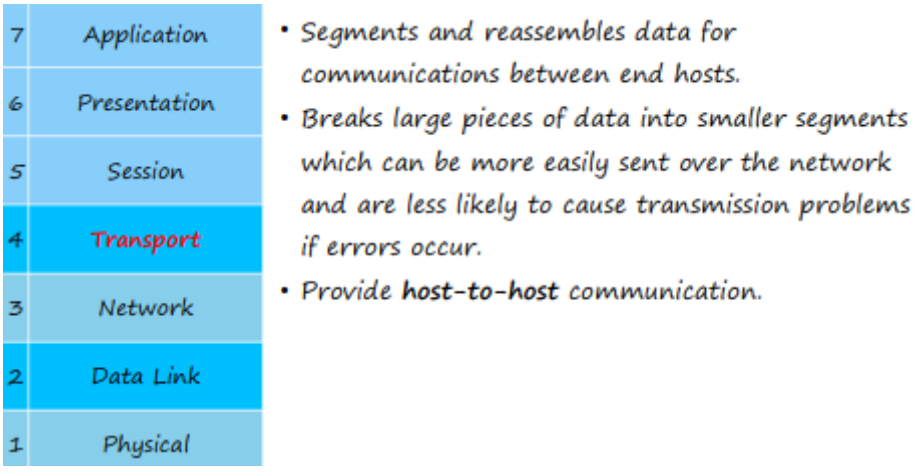
Top Three Layers



Data being sent to the bottom 4 layers

Data at the top 3 layers is sent to the lower 4 layers. **The bottom 4 layers actually do the work of the network**. As part of the encapsulation, when the data is received at the transport layer (Layer 4), **a header is attached before sending the data to the next layer down**.

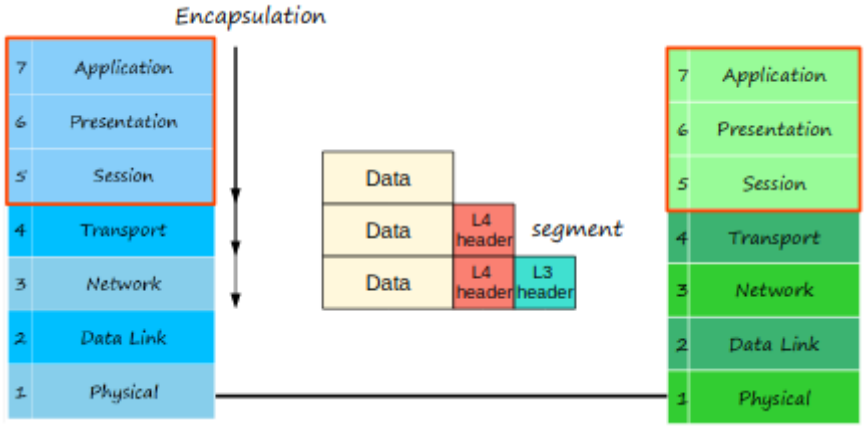
Transport Layer



Transport definition

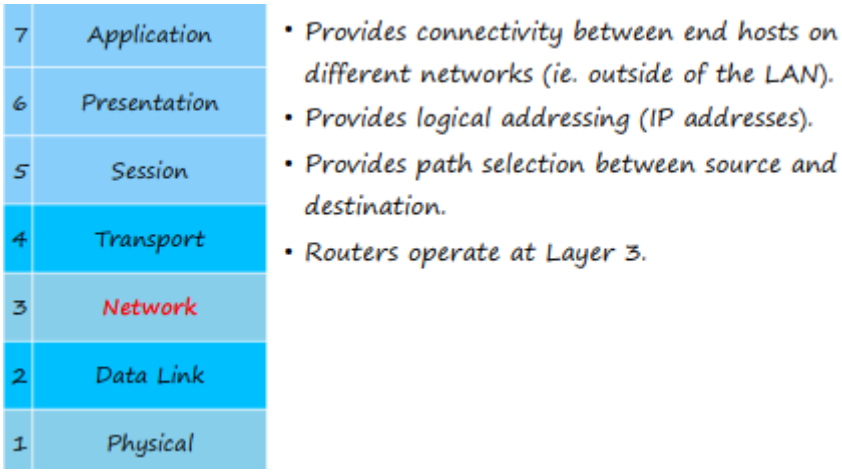
If data being sent is in one big unit and an error occurs, then the end host would not receive the message, video, page, etc. But if the data is transported into **segments** and there is an error, **it will only be applied to that segment** - *meaning the rest of the data could be sent & received*. **Host-to-host is also known as end-to-end communication**; Layer 4 also provides **process-to-process** communication for applications.

Segments



When Layer 4 receives the data, it attaches a **Layer 4 header** to the data, this is called a **segment**. *The segment is then sent to the network layer (Layer 3)*.

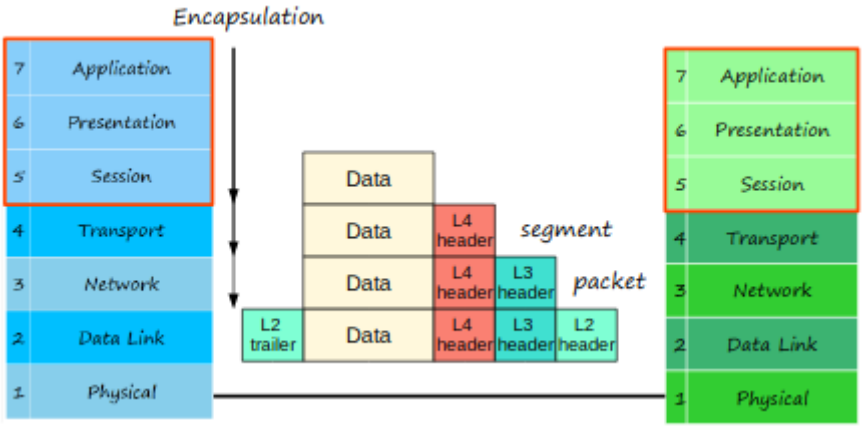
Network Layer



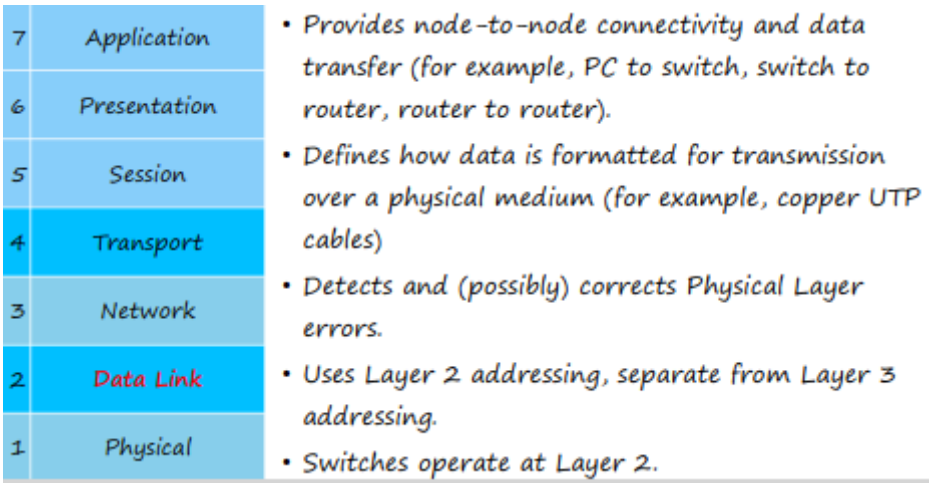
Network definition

Often there are many paths to navigate around a network, **Layer 3 provides the best path selection** - think of it as Waze or Google Maps of the OSI Model! When Layer 3 receives the segment, *the network layer attaches a **Layer 3 header** to the segment*. This is called a **packet**; *the packet is then sent to the data link layer (Layer 2)*.

Packets



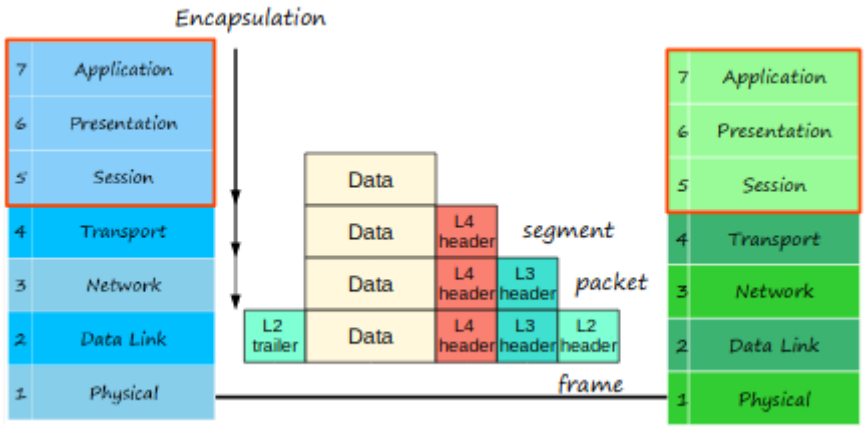
Data Link



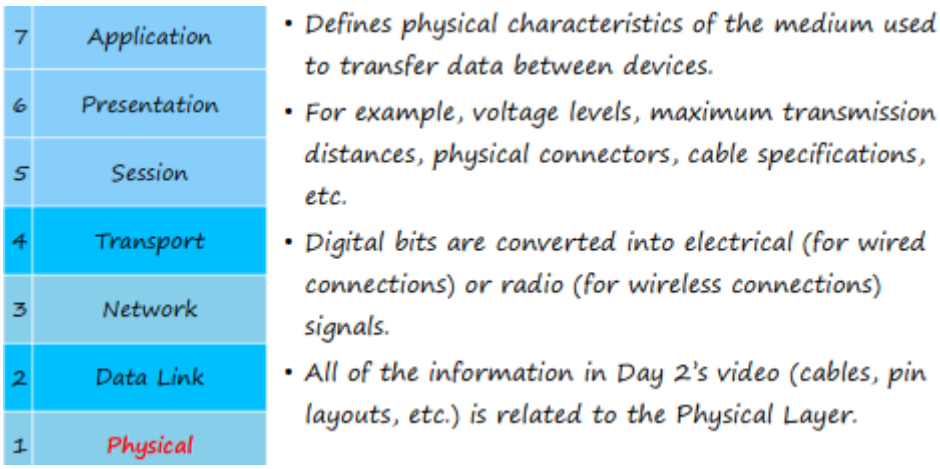
Data link definition

In Layer 2, switches look at the *destination's* ***Layer 2 Address*** to **determine where to send the data**. *The address system used in* ***Layer 2*** ***(the MAC address)*** *is different from the system used in* ***Layer 3*** ***(the IP address)***. When the packet is received in layer 2, *the data link attaches a* ***Layer 2 header and trailer*** *to the packet* - this is called a **frame**. *The frame is then sent to the physical layer (Layer 1).*

Frame



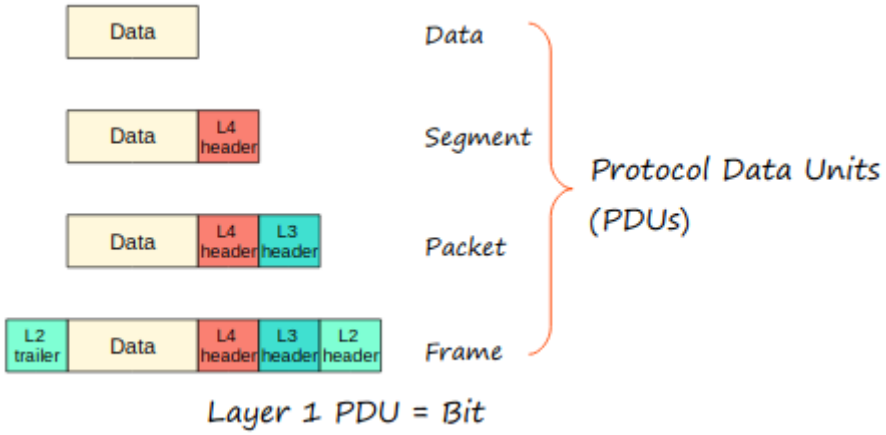
Physical Layer



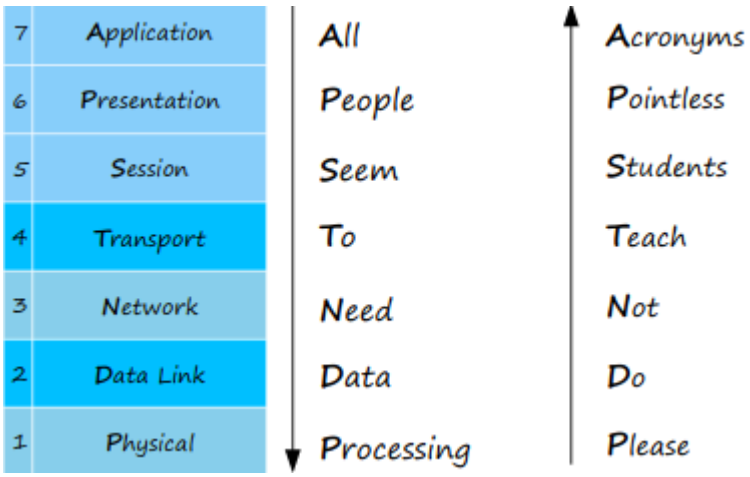
Physical definition

Once the frame is received by the client, the client's machine will de-encapsulate the data at each layer to view the data.

OSI Model - Protocol Data Units (PDUs)



Acronyms for the OSI Model



Use these acronyms to remember the OSI Model

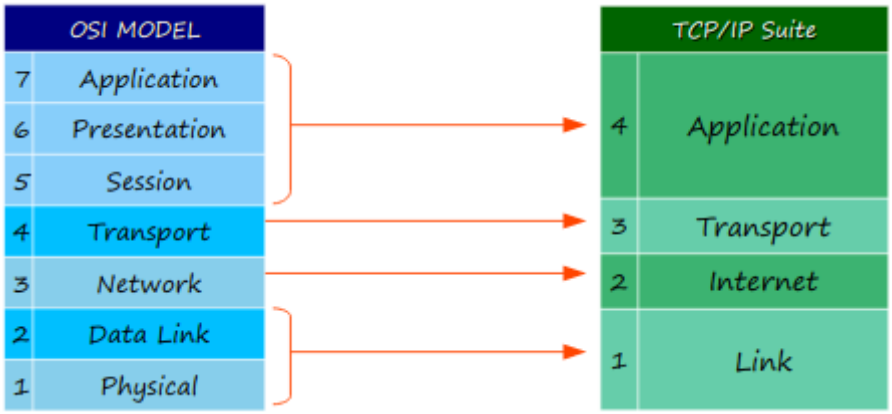
TCP-IP Suite

- Conceptual model and set of communications protocols used in the Internet and other networks.
- Known as TCP/IP because those are two of the foundational protocols in the suite.
- Developed by the United States Department of Defense through DARPA (Defense Advanced Research Projects Agency)
- Similar structure to the OSI Model, but with fewer layers.
- This is the model actually in use in modern networks.
- NOTE: The OSI model still influences how network engineers think and talk about networks.

TCP-IP Suite definition

It's very important that you learn and understand the OSI Model because it is referred to even when using the TCP-IP model.

OSI vs TCP-IP

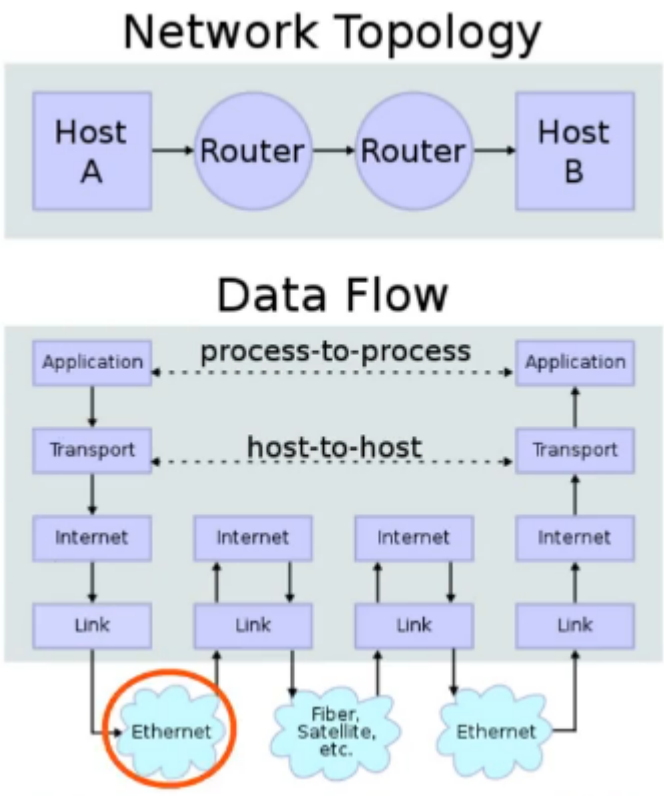


Comparisons between the two models

If you are working on a TCP-IP model and **someone refers to a layer**, they are **referencing a OSI Model layer**. You may come across another model which is structured differently.

RFC 1122, Internet STD 3 (1989)	Cisco Academy[31]	Kurose,[32] Forouzan[33]	Comer,[34] Kozierok[35]	Stallings[36]	Tanenbaum[37]	Arpanet Reference Model (RFC 871)	OSI model
Four layers	*Four layers*	*Five layers*	*Four+one layers*	*Five layers*	*Five layers*	*Three layers*	*Seven layers*
"Internet model"	"Internet model"	"Five-layer Internet model" or "TCP/IP protocol suite"	"TCP/IP 5-layer reference model"	"TCP/IP model"	"TCP/IP 5-layer reference model"	"Arpanet reference model"	OSI model
Application	Application	Application	Application	Application	Application	Application/Process	Application
							Presentation
							Session
Transport	Transport	Transport	Transport	Host-to-host or transport	Transport	Host-to-host	Transport
Internet	Internetwork	Network	Internet	Internet	Internet		Network
Link	Network interface	Data link	Data link (Network interface)	Network access	Data link	Network interface	Data link
		Physical	(Hardware)	Physical	Physical		Physical

Same model with different names



Connection between two end hosts with their own routers. Host A is the server while Host B is the client.

When Host A sends data to Host B, it goes through the encapsulation process as the data travels down to the Link layer. Connection to the internet without WiFi means you would have to use an Ethernet cable; **the router is referenced by the Ethernet symbol**. The router will look for the **layer 3 IP address** within the packet so it knows where to send the data to. The router de-encapsulates the data to figure out where to send it via its transport address; **only when that is done a frame is created to send to the client**. This could be done by fibre-optics, satellite, etc, then the client will de-encapsulate

the data by doing the same process (reversed). The data is sent through Layer 2 via the MAC address while Layer 1 is the way the data is sent - cables, fibre-optics, WiFi etc.

REMEMBER !!

• Network engineers only focus from the **transport** layer to the **physical** layer **(Layers 4 - 1)**.