The OSI and TCP/IP Model

Welcome to the ITFreeTraining video on the OSI Model. This video will look at the OSI model and in particular, how it relates to the internet protocol.

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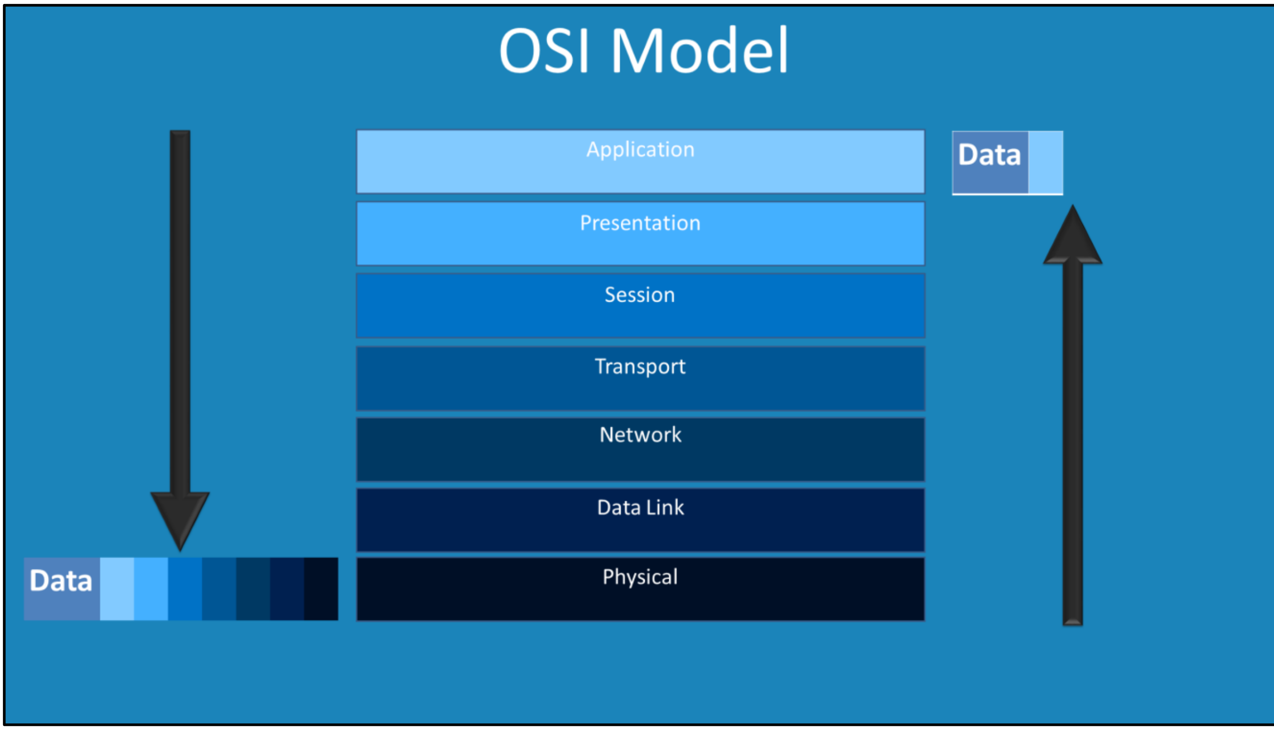

OSI Model

0:13 – The OSI was first developed in the 1980s. It is a conceptual model aimed at standardizing network communication. The model was not implemented in its entirety, but it is still referenced today. The OSI model has 7 different layers. Each layer is directly linked to the layer above and below it, if a layer exists. As data travels down the OSI model, each layer adds additional information. This continues until it reaches the last layer. It is then transmitted across the network. Once the other side receives the data, the process is reversed. You can see how each layer requires the layer or layers adjacent to it. Also it is not possible to skip a layer. All communication either starts at the top layer or is received at the bottom layer.

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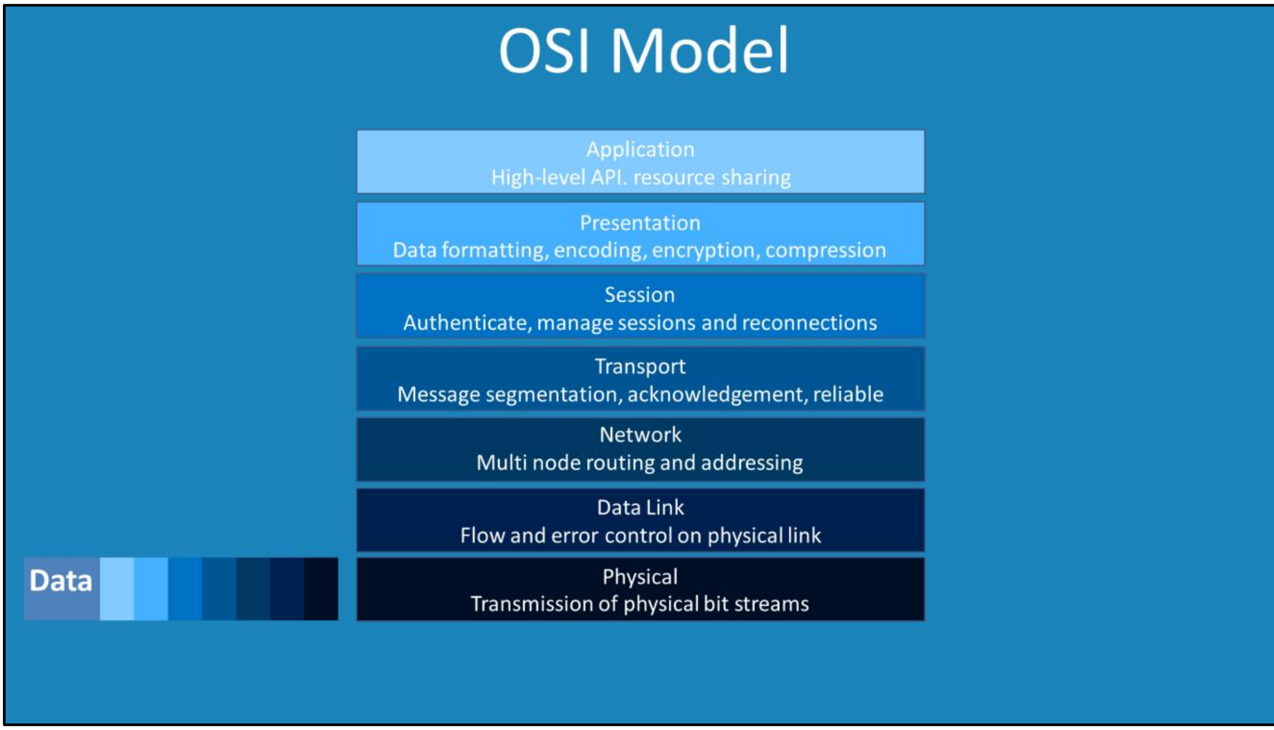

OSI Model

At the top, is the application layer. This layer provides the application programming interface. The next layer, presentation, is responsible for data formatting. This includes encoding, encryption and compression. The next layer, session, is responsible for connecting and reconnection of the network if it is lost. This also includes authentication of the connection. The next layer, transport, manages packet size and the resending of data if it was lost or corrupted. The following layer, network, routes data between different nodes in the network. The second to last layer, data link, is responsible for flow and error control. For example, ensuring more data is not sent out then the local network can handle. The last layer, physical, communicates directly with the network and is responsible for transmitting data on the network. As stated, the OSI model is a conceptual model and not directly implemented in modern networking, but is referenced from time to time.

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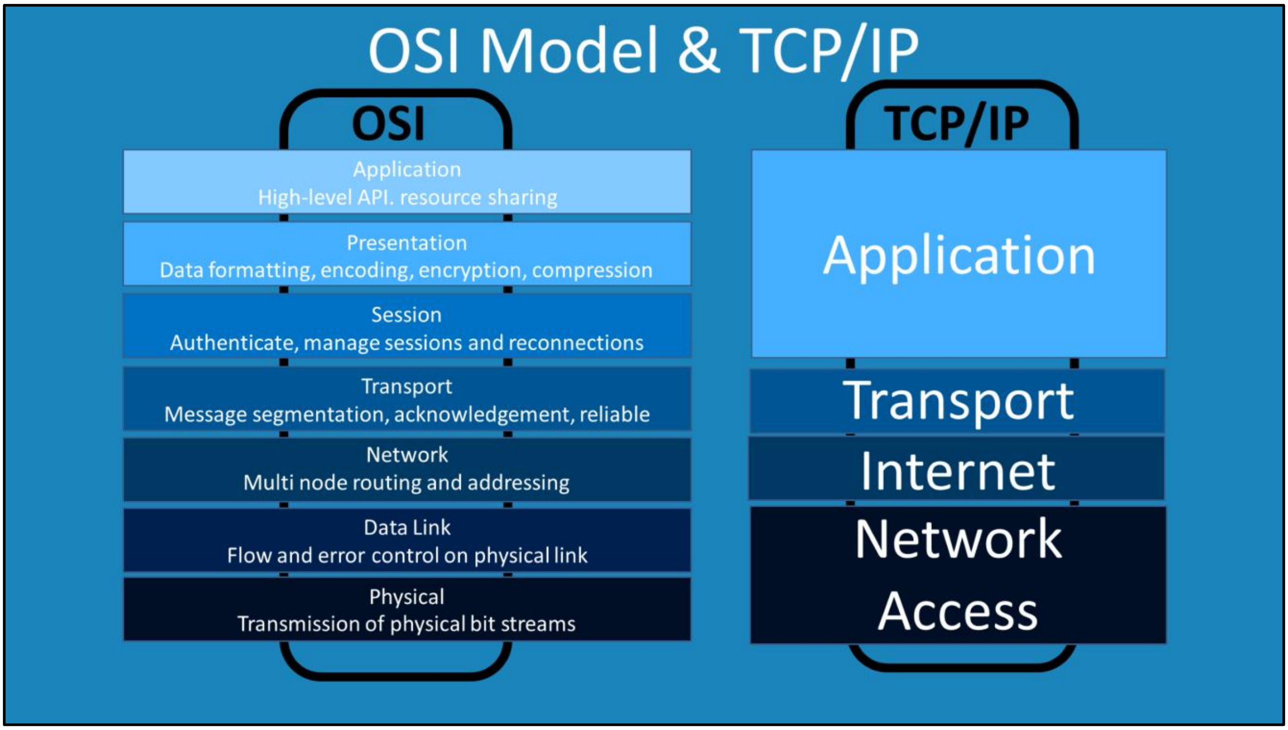

OSI Model & TCP/IP

2:20 – To demonstrate this, I will now compare it to the TCP/IP model. TCP stands for Transmission Control Protocol and IP as we know stands for Internet Protocol. A number of protocols are used to make internet communication possible. These protocols were grouped together under the name TCP/IP. Nowadays you don't hear this name so much, generally you will hear just IPv4 or IPv6 but it is still valid. As you can see, TCP/IP has 4 different layers as opposed to the 7 layers of the OSI model. It is shown as an exact fit, however in reality it does not fit the OSI model exactly. The application layer maps to the first and third layers of the OSI model. Transport is a direct 1 to 1 mapping. The internet layer maps directly to the network layer and the last two layers of the OSI model map to the network access layer.

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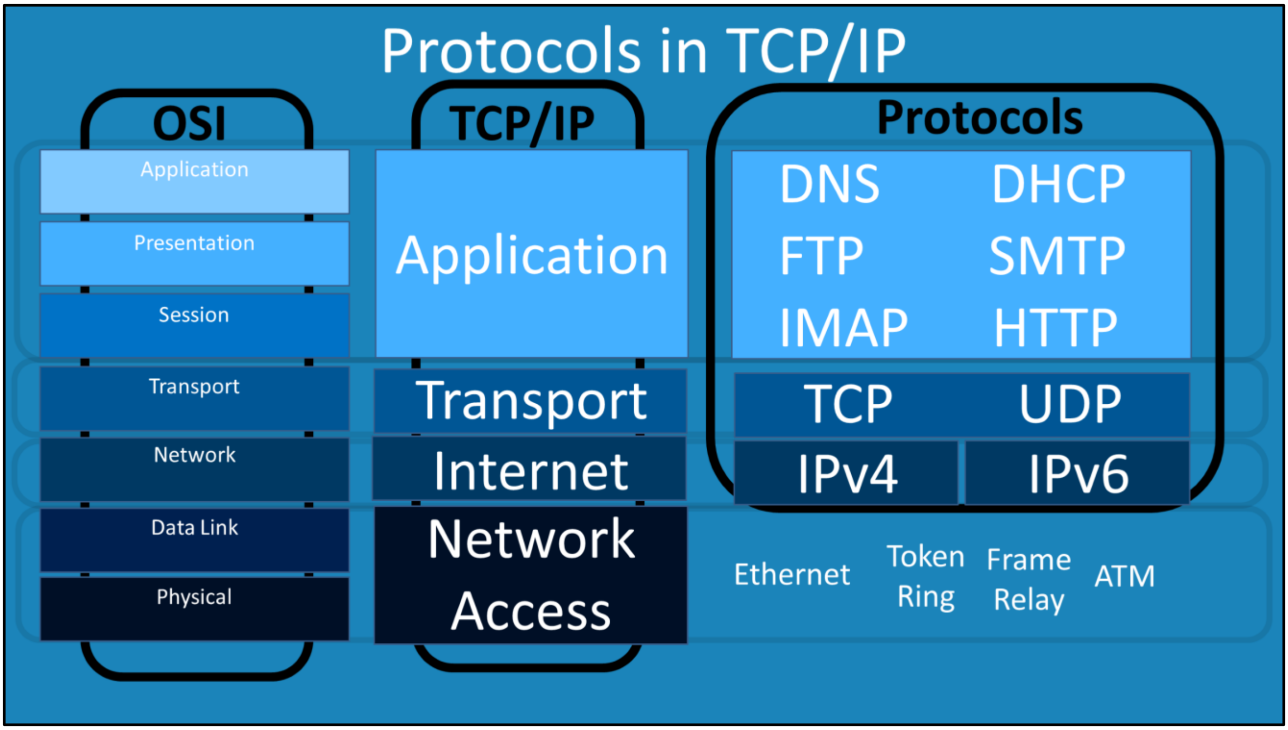

Protocols in TCP/IP

3:25 – Even though there are only 4 layers, each layer can be broken down further. As seen here, at the application layer there are a number of different protocols. You can see how software will generally use protocols to access services on the internet. The protocols themselves will access the transport layer. At this layer, there is a choice of TCP and UDP. TCP stands for Transmission Control Protocol. TCP gives reliable transmissions. If a packet is lost in transmission, the protocol will notice it has not arrived and request a resend. In contrast, UDP, which stands for User Datagram Protocol, is unreliable transmission. If a packet goes missing in transit, it is not resent. Think of UDP like mailing a letter. Once you mail the letter, you have no idea if it will arrive at its destination. The next layer determines if IPv4 or IPv6 is used. At the bottom is the device driver which communicates with the network. The most common type is Ethernet, however any other network devices are supported. You can see how TCP/IP is very modular. This makes it easy to add additional protocols and add additional hardware when they're developed. I will now have a look at how the OSI model may get referenced today.

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Layer 1 Device

- Physical (Transmission of physical bit streams)
  - Repeaters
  - Media convertors

Layer 1 Device

4:45 – The first device I will look at is a Layer 1 device. Remember that the OSI model refers to the first layer as physical and controls the transmissions at the bit level. Examples of Layer 1 devices are repeaters and media converters. A repeater essentially extends the limits of the network by boosting or recreating the network signal. A media convertor like the one shown, converts a particular network type to a different type. In this case, the media convertor converts a fibre signal to an Ethernet signal. Layer 1 devices are very simple devices.

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Layer 2 Device

5:25 – The next layer I will look at is the data link layer. This performs flow and error control on the physical link. Examples of these are switches and bridges. Switches, like the one shown, allow multiple devices to be connected together on the same network. They differ from Layer 1 devices in that they can perform some management of that data that goes through them. For example, if a packet is sent to the switch, the packet will only be sent to the port that contains the devices that packet is destined for. Layer 1 devices in contrast simply repeat the data that comes in from one port and replicates it out to the other ports. A bridge is a Layer 2 device that connects two networks together. For example, connects wireless to wired networks. It is different from a media convertor in that it inspects data before sending it. For example, data that does not need to be sent to the wireless won't be. In contrast, a Layer 1 device will repeat everything that is transmitted to it.

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Layer 3 Device

- Network (Multi node routing and addressing)
  - Routers
  - Switch that supports routing

Layer 3 Device

6:29 – Next I will look at Layer 3 devices. These devices work on the network layer of the OSI model. Layer 3 devices have the ability to route traffic between networks. So routers are considered a Layer 3 device. Also certain switches have the ability to support routing. Shown here is an example of such a switch. It looks just like a regular switch except it has routing ability. The advantage of using such a device is, since the routing is performed in hardware, it is quite fast.

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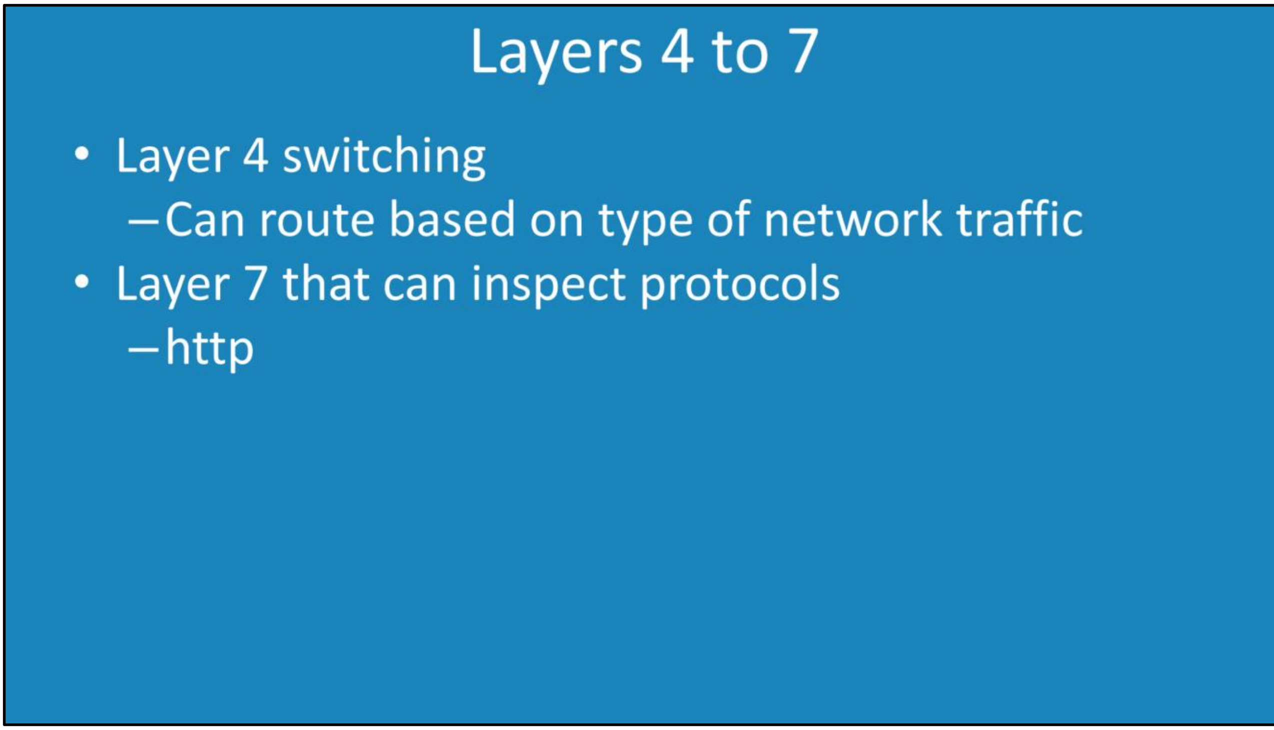

Layers 4 to 7
7:02 – The last layers that I will look at are 4 to 7. Usually hardware manufacturers don't sell devices marketed under these layers. Which device fits in which layer tends to get a bit blurry. Devices that are considered Layer 4 switching, tend to be Layer 3 switching devices with more features. The term Layer 4 switching does not tend to get used that much. Essentially that means the devices can route traffic based on what type of traffic it is. In many cases, this is used to prioritize certain traffic over other traffic. For example, routing web traffic before video traffic. Layer 7 devices tend to be devices that can inspect protocols. For example, they can inspect HTTP. For example, some firewalls are considered Layer 7 devices because they can inspect packets at the protocol level for certain types of attacks. Most applications work at Layer 7, for example, an email server. As I said, devices don't tend to be marketed using these levels so it is more about having an understanding of which level the device may fit best.

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References
"OSI model" https://en.wikipedia.org/wiki/OSI_model
"Internet protocol suite" https://en.wikipedia.org/wiki/Internet_protocol_suite

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