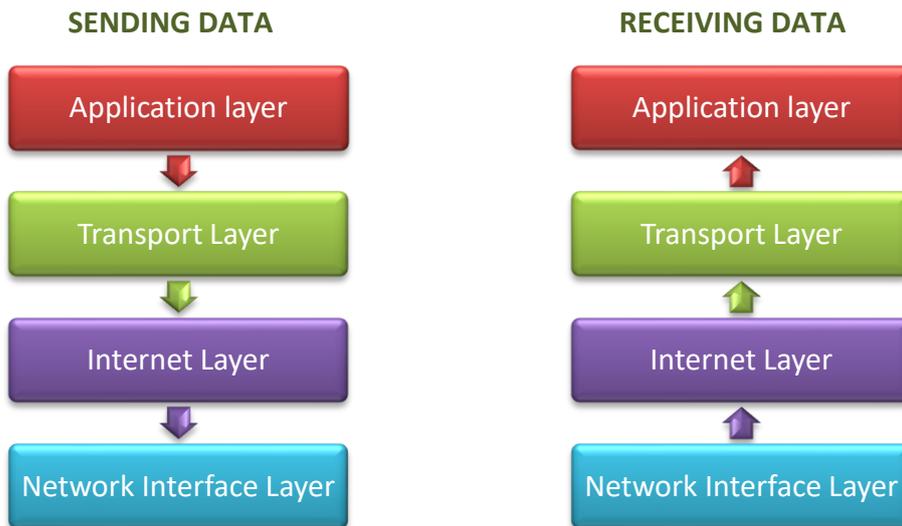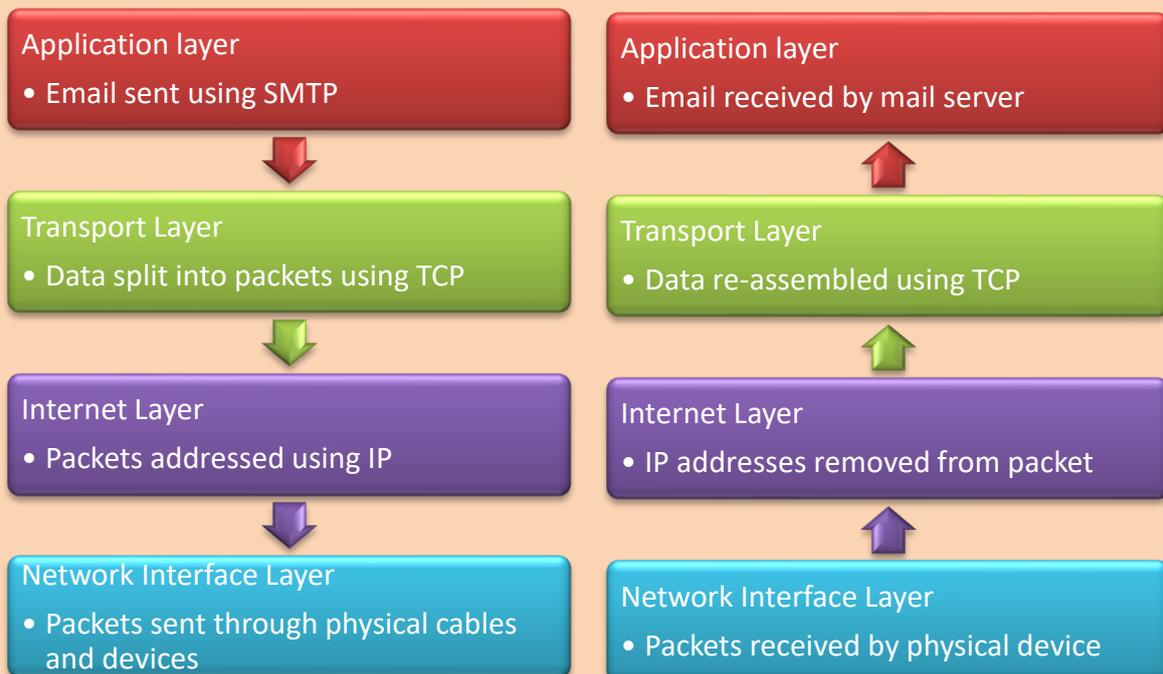## 3) Concept of layers

The TCP/IP family of protocols is divided into 4 layers. Each layer is a separate abstraction of communication. This means that when defining protocols in one layer, the other layers can be ignored. This enables hardware and software manufacturers to be able to adapt a protocol at one layer without affecting another layer because each layer performs a separate function.

Data being sent passes down the stack of layers and then back up the stack of layers to be received.

SENDING DATA   **RECEIVING DATA**

| Application layer |
| Transport Layer |
| Internet Layer |
| Network Interface Layer |

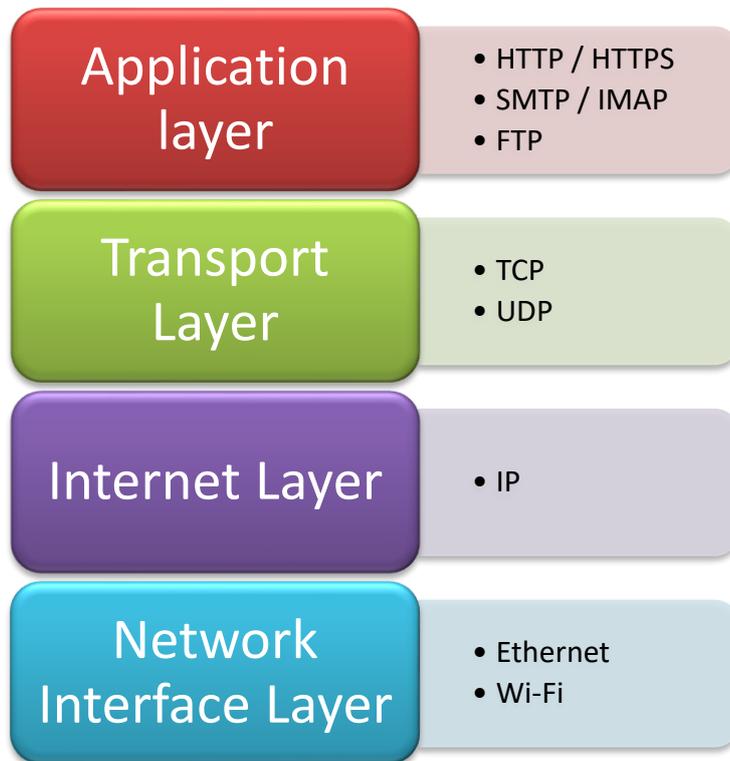| Application layer |
| Transport Layer |
| Internet Layer |
| Network Interface Layer |

Example – TCP/IP stack

An email is sent using the SMTP protocol in the application layer. The data is then split into packets as part of the TCP protocol at the transport layer. Each packet then receives source and destination IP addresses at the internet layer. The packets are then sent through cables (or wireless) and physical devices at the network interface layer.

Application layer
• Email sent using SMTP

Transport Layer
• Data split into packets using TCP

Internet Layer
• Packets addressed using IP

Network Interface Layer
• Packets sent through physical cables and devices

Application layer
• Email received by mail server

Transport Layer
• Data re-assembled using TCP

Internet Layer
• IP addresses removed from packet

Network Interface Layer
• Packets received by physical device

When each packet reaches its destination, it is received by the device with the destination IP address using the IP protocol at the internet layer. The TCP protocol then re-assembles the data at the transport layer and the email message is received by a mail server at the application layer.

Different protocols belong to different levels of the TCP/IP model as shown below:

Application layer	• HTTP / HTTPS • SMTP / IMAP • FTP
Transport Layer	• TCP • UDP
Internet Layer	• IP
Network Interface Layer	• Ethernet • Wi-Fi

Video

Watch http://tiny.cc/tcpipmodel about how the TCP/IP model works similar to a postal service. Note that the network interface layer is referred to as the link the video.

Watch http://tiny.cc/tcpipstack about how the TCP/IP stack works.

Application layer

The application layer contains all the protocols related to applications. This includes web browsers using HTTP and HTTPS, email clients using SMTP and IMAP and file transfer applications using FTP. Data is then sent to the transport layer to be transported.

Example – jigsaw puzzle

In the second video above, the example given was about sending a jigsaw puzzle that has been completed.

Transport layer

The transport layer contains protocols that relate to transporting data. This includes TCP and UDP. These protocols do not need to know what application the data came from. They are only concerned with transporting the data. The TCP protocol splits data into packets which are then sent to the internet layer to be addressed.

Example – jigsaw pieces

In the second video above, the example given was about the postal worker sending each jigsaw piece separately.
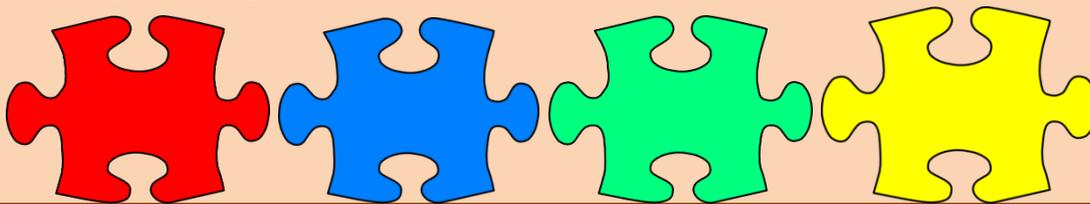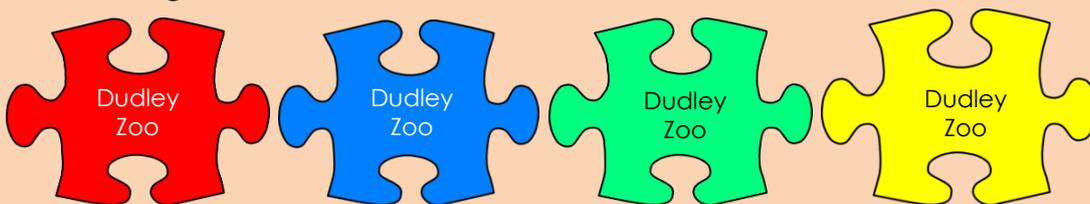
Internet layer

At the network layer, the IP protocol adds the source and destination IP addresses to each packet so they can be delivered to the correct destination. The internet layer also deals with routing each packet on its way to its destination. The packets are then passed onto the network interface layer for delivery to the destination.

Example – addressing jigsaw pieces

In the second video above, the example given showed how each jigsaw piece would be given an address to be delivered to.
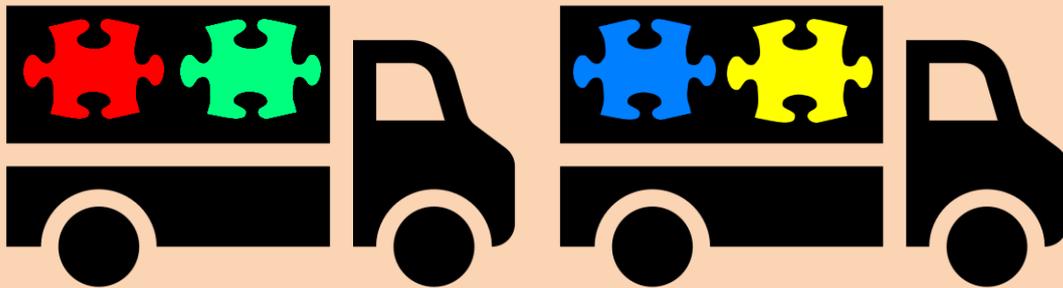
Note: *you may sometimes see this being called the Network Layer, but the proper term is Internet Layer.*

Network interface layer

At the network interface layer, data is transmitted through cables (or wirelessly) and physical devices. Wi-Fi protocols deal with sending data wirelessly and Ethernet protocols deal with sending data through cables and physical devices. The network interface layer defines the rules for sending data using signals as bits. Network interface controllers (NICs) belong to this layer.

Example – delivering jigsaw pieces

In the second video above, the example given showed how each jigsaw piece would be put into a truck to be delivered to the destination.

Note: you may sometimes see this being called the data link layer, but the proper term is Network Interface Layer to avoid confusion.

Questions – follow me

1) a)   Draw lines to connect each protocol to the correct layer in the 4 layer TCP/IP model.   [4]

         Application layer   TCP
         Transport layer   Wi-Fi
         Internet layer   IMAP
         Network interface layer   IP

     b)   Which layer deals with the transmission of data using cables?   [1]
        A   Application layer
        B   Transport layer
        C   Internet layer
        D   Network interface layer

     c)   Which layer does the UDP protocol belong to?   [1]
        A   Application layer
        B   Transport layer
        C   Internet layer
        D   Network interface layer

2) a)   State **one** function of the transport layer.   [1]
     b)   State **two** functions of the internet layer.   [1]

3)   Give **two** reasons why layers are used.   [2]