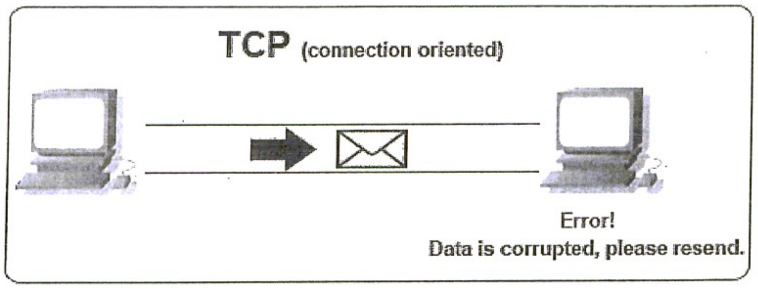
Transport Layer

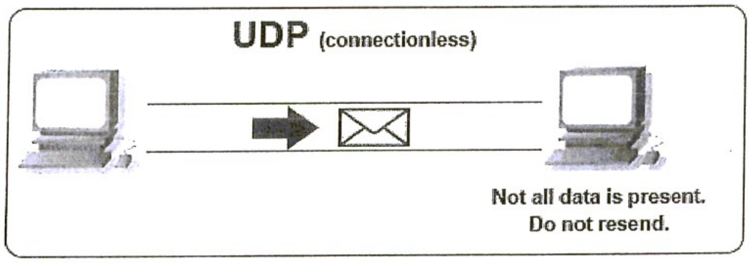
In the previous section we took a look at the Internet Layer. We took apart the IP header information, reviewed IP addresses and routing information, and briefly discussed ARP technologies.

Next in line we have the Transport layer- the layer responsible for actually getting the data packets to a specific location. When we receive email, we want to open it with our email program- not anything else. So how does a computer know exactly where to route data to appropriate programs, all while dealing with multiple connections?

The Difference between TCP and UDP

There are two protocols that are primarily used to transport data: TCP and UDP. TCP stands for transmission control protocol. It is the more common of the two, since it allows for much more error checking functionality and stability. UDP, or User Datagram Protocol, lacks extensive error checking- but is considered to be much faster than TCP as a result.



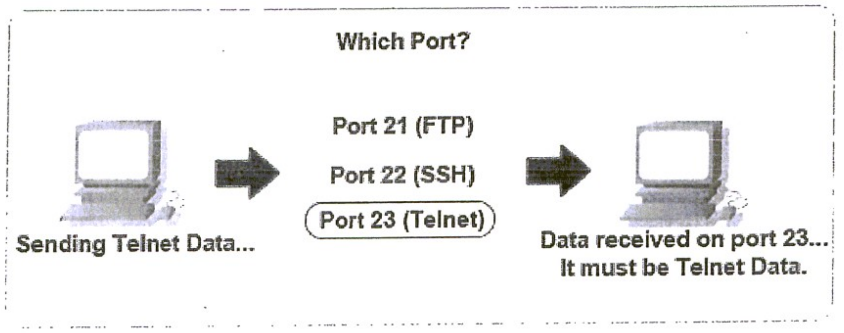


ince TCP guarantees the delivery of data over a network we call it a connection-oriented rotocol. If in the event that data isn't sent correctly, the sending computer will be otified and will resend the information. This is compared to UDP, which doesn't require hat data has been received correctly. Likewise, we call UDP a connectionless protocol.

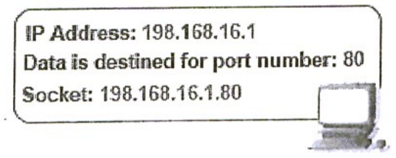
How Do Transport Protocols Work?

We mentioned earlier that a transport protocol can have simultaneous connections to a computer- yet the receiving computer still knows where each data packet should be sent. This is accomplished through ports and sockets.

A port is simply an internal address that acts as a pathway to control data flow. Since we need each port to be specific to a certain application, there are thousands of ports for use. If you are using the internet, for instance, data is being routed through TCP port 80. This port is called the HTTP port. Ports that have specific purposes (such as the HTTP port) are also known as well-known ports. (And in case you were wondering, there are over 65,535 ports to experiment with.)



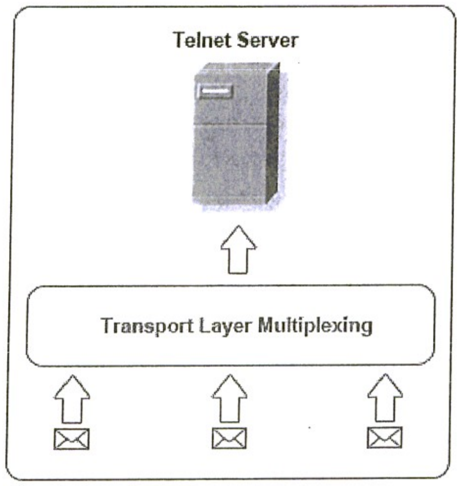
So now we know two things. First, the IP address is used to route the data to a specific computer. Next, the port number is used to tell the receiving computer what kind of application should handle it. But to actually accomplish both of these tasks, we use what is called a socket. A socket is simply an address formed by using the IP address and then tacking on the port number at the end.



Practical Uses of the Socket

So what good is a socket? For one thing, multiplexing and demultiplexing is made possible. When you are running multiple programs that are communicating with other computers, you are making use of both of these technologies.

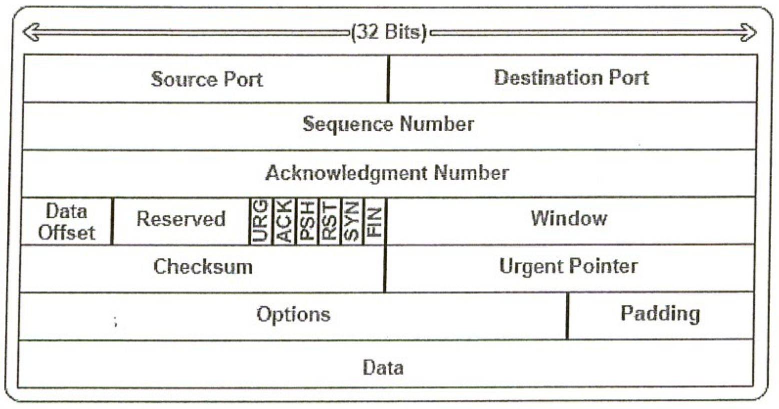
Let's look at a practical example. You are running a telnet server in which multiple computers are connected to. Each computer uses a socket address to tell the server which computer and which port the data is coming from. If each computer broadcasted at the same time, there may be a jam at the transport layer. We use multiplexing in this case to combine all incoming data into one stream.



Demultiplexing is very similar to multiplexing, except that it works in reverse. Instead of taking multiple streams of input data and outputting a single stream of data, demultiplexing involves receiving a single stream of input and delivering it to multiple outputs. This is handy for separating multiplexed signals. You may see demultiplexing referred to as "Demuxing."

The Anatomy of a TCP Segment

So now we know how data is routed, but what is the data made up of? As we learned in previous sections, we call the data at the Transport level of the TCP protocol a segment.



TCP Segments Explained

- **1. Source Port -** A 16-bit field that specifies which port number the data segment originated from on the source machine.
- **2. Destination Port -** A 16-bit field that specifies which port number the data segment is destined for on the receiving machine.
- **3. Sequence Number -** A 32-bit field that specifies which sequence number the particular segment of information is assigned. The sequence number is used to number packets of information so that they may be counted on the receiving side- guaranteeing a successful and complete delivery of information.
- **4. Acknowledgment Number -** A 32 bit field that specifies whether or not a segment was received correctly. The acknowledgment number is always one higher than the sequence number, since the receiving computer is expecting the next segment.
- **5. Data Offset –** A 4-bit field that tells the receiving computer how long the header is, and where the data actually begins.
- **6. Reserved -** A 6-bit field that is reserved for future use. Currently this field is represented as all zeroes. In the future, it may be likely that TCP will make use of this space for some reason or another.
- **7. URG -** A 1-bit control flag that stands for urgent. If the value is 1, the information is urgent and should be dealt with accordingly.
- **8. ACK -** A 1-bit control flag that, if set to 1, indicates that the Acknowledgment Number field is significant.
- **9. PSH -** A 1-bit control flag that stands for push. If set to 1, all the information sent so far is sent to the receiving application.
- **10. RST -** 1-bit control flag that stands for reset. If set to 1, the connection is reset.