TCP

* In May 1974 the IEEE published a paper containing details on sharing resources using packet switching among the nodes. The central control component in this was the TCP or Transmission Control Protocol which would provide connection-oriented links and datagram services between hosts.
* TCP is a very complex protocol, and although a lot of enhancements have been made/proposed over the years, its basic operation has not been altered. There are a few RFCs that relate to TCP:
* RFC675 (1974): Definition of TCP
* RFC793 (1981): IPv4 in relation to TCP
* RFC1122 (1989): Clarified a number of TCP protocol implementation requirements.
* RFC2581 (2001): Congestion Control
* RFC2009 (2009): Congestion Control
* Programmers interact with TCP via sockets, and there’s a separate socket for each connection as it’s all 1-to-1. The client and server operate differently when setting up a connection. The server is bound to an address and waits for a connection to start, whilst the client actively seeks out a connection with the server. If the connection drops, exceptions are thrown.
* TCP runs inside the Operating System.
* TCP is a Layer 4 (Transport Layer) protocol that maintains RELIABLE connections between, manages efficient packaging and transmission of network traffic, and distinguishes programs from each other on the computer using port numbers.. It does all this because of its main features:
* Virtual Circuits: TCP connections are like live, two-way connections between hosts.
* Reliability: TCP guarantees delivery of data.
* Performance Optimisation: Includes mechanisms to modify transmission variables depending on network conditions.
* TCP uses a Finite State Machine (FSM) at each end of the connection (each socket). This is implemented in software within the OS. TCP exchanges events between the two ends to drive state transitions.
* The events are bit flags which are set (or not) in the TCP header.
* An FSM is a mathematical model of computation. It’s an abstract machine that can be one of a finite number of states at a given time. The FSM can change its state in response to some external inputs (transition). An FSM is defined by a list of its states, its initial state, and the conditions for each transition.
* Graphical user interface, application

  Description automatically generatedThe TCP header looks like this:
* A screenshot of a computer

  Description automatically generatedThe 6 different flag bits in the TCP header are:
* TCP uses the Three-way Handshake in order to establish and terminate connections with other hosts. Three messages are exchanged in a segment, and there’s one for creating a connection and one for terminating:
* The Synchronisation (SYN) segment is used to describe messages which create a connection.
* The Finish (FIN) segment is used to describe messages which close a connection.
* The Synchronisation Three-way Handshake looks like this:

Graphical user interface, application

Description automatically generated

* And the Finish Three-way Handshake looks like this:

Graphical user interface, application

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