4. The transport layer

4.1 The port number

One of the most important information contained in the header of a segment are the destination and the source port numbers.

The port numbers are necessary to identify the application to which a data unit belongs to.

The port number is a 16-bit number, so it can have the decimal values 0 to 65535 (=2^{16}-1). The first 1024 port numbers (0-1023) are the so called *well known port numbers*. They are used to identify the *server applications* as these port numbers have to be "well known" to the client applications.

application (protocol)	port number
web server (http)	80
web server (https)	443
FTP (ftp)	20 & 21
Email (pop3)	110
Email (imap)	143
Email (smtp)	25

Each server application receives always the same port number.

The operating system of a host is assigning one of the *other port numbers* to each *client application*. The range of dynamic port numbers is logically (1024 - 65535).

Each client application receives dynamically a different port number.

4.2 TCP and UDP

The two most common protocols used on the transport layer are TCP and UDP.

4.2.1 TCP

The TCP protocol adds a 24 bytes header to the data unit. The structure of the TCP header is:

Bit 0 **Bit 15**	**Bit 16** **Bit 31**
Source Port (16)	Destination Port (16)
Sequence Number (32)	
Acknowledgement Number (32)	
Header Length (4) Reserved (6) Code Bits (6)	Window(16)
Checksum (16)	Urgent(16)
Options (0 or 32, if any)	
Data	

24 bytes

The sequence and acknowledgement number allow checking if all the segments of a transmission session have reached the destination. This assures the reliability of the communication.

The windows size is the number of bytes that the sender of the TCP segment is able to receive into its buffer. This technique is called flow control.

The checksum allows detecting transmission errors.

Usually a TCP segment contains 1500 bytes of data. If many errors occur during a transmission, it can be useful to reduce the number of data bytes. Among others this can be done with the option bits. This technique is called dynamic window sizing (do not confuse the window size).

4.2.2 UDP

The UDP protocol adds a 8 bytes header to the data unit. The structure of the UDP header is:

Bit 0 **Bit 15**	**Bit 16** **Bit 31**	
Source Port (16)	Destination Port (16)	8 bytes
Length (16)	Checksum (16)	
Data		

The length field specifies the number of bytes contained in the whole segment (incl. header).

4.2.3 TCP versus UDP

The only but important advantage of UDP versus TCP is that the quantity of header information is lower. Thus the percentage of data bits within a UDP transmission is higher than with TCP. This leads to a higher net transmission speed.

TCP however allows a reliable and error free transmission.

In most applications the correctness of the transmission is more important than the speed. This is why most applications use the TCP protocol. Applications that typically use UDP are so called streaming applications like:

- video streaming
- audio streaming (i.e. voice over IP)