

7.7.1 IPv4 Datagram Format

Now that we have described the general layout of an IP datagram, we can look at the contents in more detail. Figure 7.3 shows the arrangement of fields in an IPv4 datagram. The next paragraphs discuss some of the header fields; later sections on fragmentation and options cover remaining fields.

0	4	8	16	19	24	31
VERS	HLEN	SERVICE TYPE	TOTAL LENGTH			
IDENTIFICATION			FLAGS	FRAGMENT OFFSET		
TIME TO LIVE		PROTOCOL	HEADER CHECKSUM			
SOURCE IP ADDRESS						
DESTINATION IP ADDRESS						
IP OPTIONS (IF ANY)					PADDING	
PAYLOAD ...						

Figure 7.3 Format of an IPv4 datagram, the basic unit of transfer in a TCP/IP internet.

Because an internet is virtual, the contents and format are not constrained by network hardware. For example, the first 4-bit field in a datagram (*VERS*) contains the version of the IP protocol that was used to create the datagram. Thus, for IPv4, the version field contains the value 4. The field is used to verify that the sender, receiver, and any routers in between them agree on the format of the datagram. All IP software is required to check the version field before processing a datagram to ensure it matches the format the software expects. We will see that although the IPv6 datagram header differs from the IPv4 header, IPv6 also uses the first four bits for a version number, making it possible for a router or host computer to distinguish between the two versions. In general, a computer will reject any datagram if the computer does not have software to handle the version specified in the datagram. Doing so prevents computers from misinterpreting datagram contents or applying an outdated format.

The header length field (*HLEN*), also 4 bits, gives the datagram header length measured in 32-bit words. As we will see, all fields in the header have fixed length except for the *IP OPTIONS* and corresponding *PADDING* fields. The most common datagram header, which contains no options and no padding, measures 20 octets and has a header length field equal to 5.

The *TOTAL LENGTH* field gives the length of the IP datagram measured in octets, including octets in the header and payload. The size of the payload area can be computed by subtracting the length of the header (four times *HLEN*) from the *TOTAL LENGTH*. Because the *TOTAL LENGTH* field is 16 bits long, the maximum possible