LS Type	Meaning
1	Router link
2	Network link
3	Summary link (IP network)
4	Summary link (link to border router)
5	External link (link to another site)

Field *LINK ID* gives an identification for the link (which can be the IP address of a router or a network, depending on the link type).

Field *LS AGE* helps order messages — it gives the time in seconds since the link was established. Field *ADVERTISING ROUTER* specifies the address of the router advertising this link, and *LINK SEQUENCE NUMBER* contains an integer generated by that router to ensure that messages are not missed or received out of order. Field *LINK CHECKSUM* provides further assurance that the link information has not been corrupted.

14.13.3 OSPFv2 Link-Status Request Message Format

After exchanging database description messages with a neighbor, a router has an initial description of the network. However, a router may discover that parts of its database are out of date. To request that the neighbor supply updated information, the router sends a *link-status request* message. The message lists specific links for which information is needed, as shown in Figure 14.12. The neighbor responds with the most current information it has about the links in the request message. The three fields shown in the figure are repeated for each link about which status is requested. More than one request message may be needed if the list of requests is long.

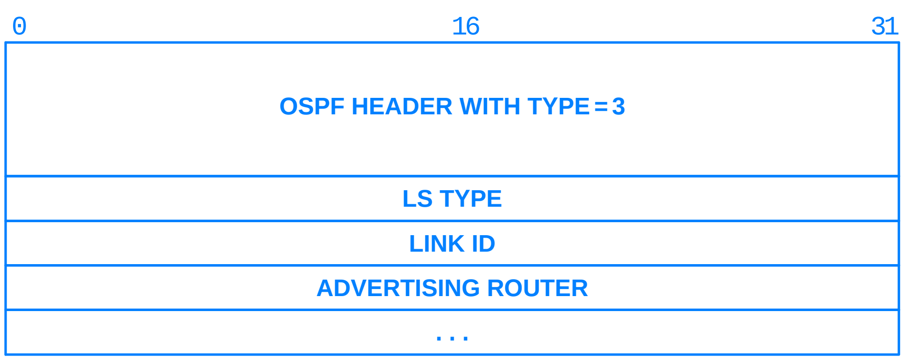

Figure 14.12 OSPFv2 *link-status request* message format. A router sends the message to a neighbor to request current information about a specific set of links.

14.13.4 OSPFv2 Link-Status Update Message Format

Because OSPF uses a link-state algorithm, routers must broadcast messages that specify the status of attached links and networks when the routing software boots, whenever the status changes, or in response to a request from another router. To increase reliability, OSPF routers broadcast status periodically, even if it has not changed; the period is set to 30 minutes. The status is carried in a type *4* OSPFv2 message that is named a *Link State update*. Each update message consists of a count of Link State advertisements followed by a list of the advertisements. Figure 14.13 shows the format of link-status update messages.

In the figure, each *link-state advertisement* (*LSA*) has a format that specifies information about the network being advertised. Figure 14.14 shows the format of the link-state advertisement. The values used in each field are the same as in the database description message.

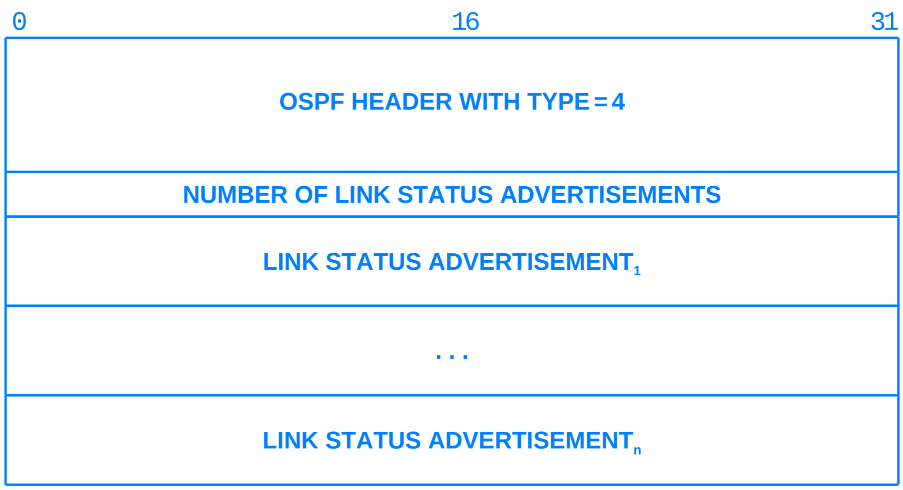

Figure 14.13 OSPFv2 *link-state update* message format. A router sends such a message to broadcast information about its directly connected links to all other routers.

0	16	31
LS AGE	OPTIONS	LS TYPE
LINK ID		
ADVERTISING ROUTER		
LINK SEQUENCE NUMBER		
LINK CHECKSUM	LS LENGTH	

Figure 14.14 The format of an OSPFv2 *link-state advertisement* used in a several messages.

Following the link-status advertisement header comes one of four possible formats to describe the links from a router to a given area, the links from a router to a specific network, the links from a router to the physical networks that constitute a single, subnetted IP network (see Chapter 5), or the links from a router to networks at other sites. In all cases, the *LS TYPE* field in the link-status advertisement header specifies which of the formats has been used. Thus, a router that receives a link-status update message knows exactly which of the described destinations lie inside the site and which are external.

14.14 Changes In OSPFv3 To Support IPv6

Although the basics of OSPF remain the same in version 3, many details have changed. The protocol still uses the link-state approach†. All addressing has been removed from the basic protocol, making it protocol-independent. In particular, OSPF originally used a 32-bit IPv4 address to identify a router; OSPFv2 and OSPFv3 use a 32-bit *router ID*. Similarly, area identifiers remain at 32 bits, but are not related to IPv4 addresses (even though dotted decimal is used to express them). OSPFv3 honors IPv6 routing scopes: link-local, area-wide, and AS-wide, meaning that broadcasts will not be propagated beyond the intended set of recipients. OSPFv3 allows independent *instances* of OSPF to run on a set of routers and networks at the same time. Each instance has a unique ID, and packets carry the instance ID. For example, it would be possible to have an instance propagating IPv6 routing information while another instance propagates MPLS routing information. Finally, OSPFv3 removes all authentication from individual messages, and instead, relies on the IPv6 authentication header.

The most significant change between OSPFv2 and OSPFv3 arises from the message formats, which all change. There are two motivations. First, messages must be changed to accommodate IPv6 addresses. Second, because IPv6 addresses are much larger, the designers decided that merely replacing each occurrence of an IPv4 address with an IPv6 address would make messages too large. Therefore, whenever possible,

†Unfortunately, the terminology has become somewhat ambiguous because IPv6 uses the term *link* in place of *IP subnet* (to permit multiple IPv6 prefixes to be assigned to a given network). In most cases, the IPv6 concept and OSPFv3 concept align, but the distinction can be important in special cases.

OSPFv3 minimizes the number of IPv6 addresses carried in a message and substitutes 32-bit identifiers for any identifier that does not need to be an IPv6 address.

14.14.1 OSPFv3 Message Formats

Each OSPFv3 message begins with a fixed, 16-octet header. Figure 14.15 illustrates the format.

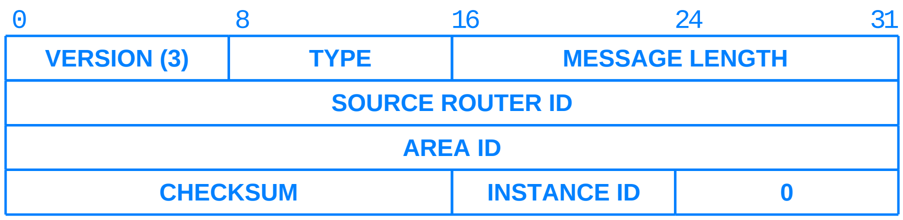

Figure 14.15 The fixed 16-octet OSPFv3 header that appears in each message.

Note that the version number occupies the first octet, exactly as in OSPFv2. Therefore, OSPFv3 messages can be sent using the same *NEXT HEADER* value as OSPFv2 with no ambiguity. Also note that the fixed header is smaller than the OSPFv2 header because authentication information has been removed.

14.14.2 OSPFv3 Hello Message Format

The OSPFv3 *hello* message helps illustrate the basic change from IPv4 addressing to 32-bit identifiers. The goal is to keep the packet size small while separating the protocol from IPv4. As Figure 14.16 illustrates, readers should compare the version 3 format to the version 2 format shown on page 306.