Enabling Mobility in IPv6 Networks

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INTRODUCTION

With the explosive growth in Internet usage over the last decade, the need for a larger address space is unavoidable, since all the addresses in IPv4 are nearly fully occupied. IPv6 (Deering & Hinden, 1998), with 128-bit addresses compared to IPv4 with 32-bit addresses and other advantages (like auto-configuration and IP mobility), can overcome many of the problems that IPv4 had before.

One of the requirements for the modern Internet is IP mobility support. In IPv4, a special router is needed to act as a foreign agent in the visited/foreign network and the need of a network element in the home network known as a home agent for a mobile host. IPv6 does away with the need for the foreign agent and operates in any location without any special support from a local router. Route optimization is inherent in IPv6, and this feature eliminates the triangle-routing (routing through the home agent) problem that exists in IPv4. IPv6 enjoys many network optimizations that are already built in within IPv6.

IP MOBILITY

IP mobility can be defined as referring to situations where there is a change in a node's IP address due to a change of its attachment point within the Internet topology (Soliman, 2004). This change may be caused by physical moment, such as someone moving her computer from one room to another or someone sitting in a moving vehicle that traverses different links. IP mobility can also occur due to change in the topology, which causes a node to change its address. Mobile IPv6 is a suite of protocols for IPv6 nodes to handle IP mobility.

Mobile IPv6 allows an IPv6 host to leave its home subnet while transparently maintaining all its connections and remaining reachable to the rest of the Internet. The use of IP in wireless technologies, such as local area networks (LANs; e.g., IEEE 802.11a, b, and g) to wide area networks (WANs; e.g., 3G), makes mobility in wireless devices an interesting research field. The popularity of wireless technologies allows users (hosts) to move freely within large geographical areas, but requires good support for mobility. Mobile IPv6 is the more prominent solution for mobility for IP wireless devices (Samad & Ishak, 2004). We will first review some relevant features of IPv6 before explaining how Mobile IPv6 works.

RELEVANT FEATURES OF IPV6

IPv6 specification was already defined in RFC 2460 (Deering & Hinden, 1998). Figures 1 and 2 show the header comparison between IPv4 and IPv6 headers. These include the header format, extension headers, and their processing fields. As can be seen in the figures, only the IPv6 header contains the minimum amounts of information necessary for IPv6 hosts to communicates with each other. The IPv6 packet header is much simpler than the IPv4 one. It is now a fixed size with no optional fields. Options in IPv4 are replaced by an IPv6

Figure 1. IPv4 header

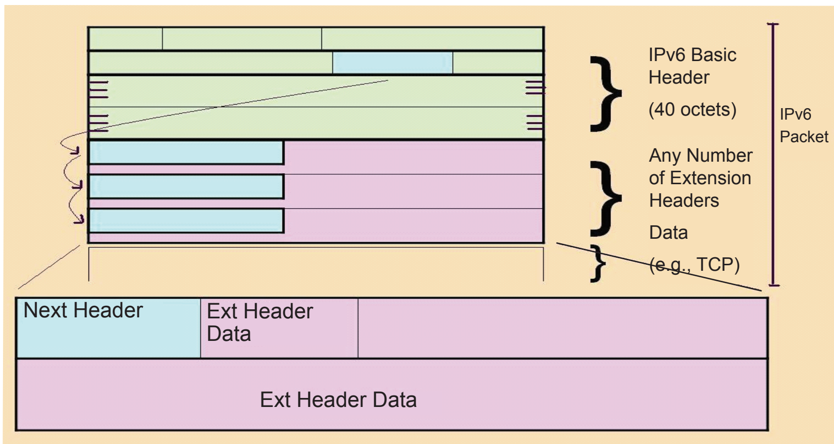
8 bits		8 bits		8 bits	8 bits
version	IHL	type of service		total length	
identification				flags	fragment offset
TTL		protocol		header checksum	
source address (32 bits)					
destination address (32 bits)					
options					padding

Figure 2. IPv6 header

8 bits 8 bits 8 bits 8 bits

version	traffic class	flow label		
payload length			next header	hop limit
source address (128 bits)				
destination address (128 bits)				

Figure 3. Extension header



extension header (will be explained later), which includes additional parameters for hosts or routers to receive IPv6 packets. An extension header in IPv6 may contain one or more extension headers when necessary for the processing of such a packet (Deering & Hinden, 1998).

The IPv6 header removes some of the fields that were previously included in the IPv4, and added new fields. It has been slimmed down to the necessary minimum header compression, which now has 8 fields, compare to the previous 13 fields in IPv4. The following sections explain further some of these design choices.

Extension Header

Mobile IPv6 has an optional header called *extension header*. IPv6 extension headers are defined to encode certain options that are needed for processing of the IPv6 packet and its subsequent packets. Encoding options must minimize the amount of time needed in order to classify the header and forward the packet on the correct route. The benefits of extension headers can be best explained when comparing them to option fields in IPv4 headers. Consider the router receiving an IPv4 packet including one or more options. The router would first determine that the packet is carrying IP options. The next step is the router must parse or classify the IP header to find out which options require processing by the router itself, as opposed to processing by the ultimate receiver of the packet. The process of parsing this header and its options takes some time and can reduce efficiency.

Routing Header

IPv6 defines a fixed size 40-bytes header and extension header for additional options. The routing header includes addresses of nodes that must be in the path taken by a packet on its way to its ultimate destination. Thus, the routing header is a form of source routing and can be used to make sure the packet goes to certain nodes/addresses on its way to its ultimate destination. It also allows routing to certain special-purpose routers for special reasons (e.g., mobility support).

Hop-by-Hop Options Header

As the name implies, this header includes options that need to be processed by every node (routers) along the packet's delivery path. It specifies delivery parameters at each hop on the way to the destination. Some of the fields in this type of header are used to alert a router to things like multicast

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