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Internet Protocol, Version 6 (IPv6) Specification

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Abstract

This document specifies version 6 of the Internet Protocol (IPv6), also sometimes referred to as IP Next Generation or IPng.

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1. Introduction

IP version 6 (IPv6) is a new version of the Internet Protocol, designed as the successor to IP version 4 (IPv4) [RFC-791]. The changes from IPv4 to IPv6 fall primarily into the following categories:

- Expanded Addressing Capabilities

  IPv6 increases the IP address size from 32 bits to 128 bits, to support more levels of addressing hierarchy, a much greater number of addressable nodes, and simpler auto-configuration of addresses. The scalability of multicast routing is improved by adding a "scope" field to multicast addresses. And a new type of address called an "anycast address" is defined, used to send a packet to any one of a group of nodes.

- Header Format Simplification

  Some IPv4 header fields have been dropped or made optional, to reduce the common-case processing cost of packet handling and to limit the bandwidth cost of the IPv6 header.

- Improved Support for Extensions and Options

  Changes in the way IP header options are encoded allows for more efficient forwarding, less stringent limits on the length of options, and greater flexibility for introducing new options in the future.

- Flow Labeling Capability

  A new capability is added to enable the labeling of packets belonging to particular traffic "flows" for which the sender requests special handling, such as non-default quality of service or "real-time" service.

o Authentication and Privacy Capabilities

Extensions to support authentication, data integrity, and (optional) data confidentiality are specified for IPv6.

This document specifies the basic IPv6 header and the initially-defined IPv6 extension headers and options. It also discusses packet size issues, the semantics of flow labels and traffic classes, and the effects of IPv6 on upper-layer protocols. The format and semantics of IPv6 addresses are specified separately in [ADDRARCH]. The IPv6 version of ICMP, which all IPv6 implementations are required to include, is specified in [ICMPv6].

2. Terminology

node - a device that implements IPv6.

router - a node that forwards IPv6 packets not explicitly addressed to itself. [See Note below].

host - any node that is not a router. [See Note below].

upper layer - a protocol layer immediately above IPv6. Examples are transport protocols such as TCP and UDP, control protocols such as ICMP, routing protocols such as OSPF, and internet or lower-layer protocols being "tunneled" over (i.e., encapsulated in) IPv6 such as IPX, AppleTalk, or IPv6 itself.

link - a communication facility or medium over which nodes can communicate at the link layer, i.e., the layer immediately below IPv6. Examples are Ethernets (simple or bridged); PPP links; X.25, Frame Relay, or ATM networks; and internet (or higher) layer "tunnels", such as tunnels over IPv4 or IPv6 itself.

neighbors - nodes attached to the same link.

interface - a node’s attachment to a link.

address - an IPv6-layer identifier for an interface or a set of interfaces.

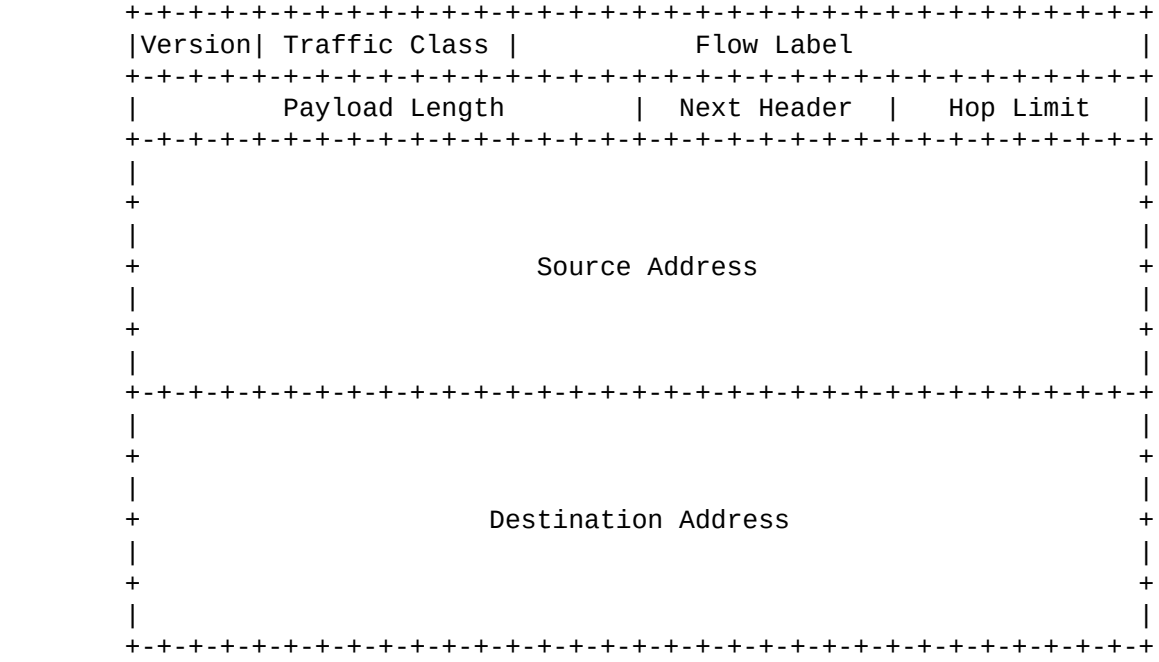
packet - an IPv6 header plus payload.

link MTU - the maximum transmission unit, i.e., maximum packet size in octets, that can be conveyed over a link.

path MTU - the minimum link MTU of all the links in a path between a source node and a destination node.

Note: it is possible, though unusual, for a device with multiple interfaces to be configured to forward non-self-destined packets arriving from some set (fewer than all) of its interfaces, and to discard non-self-destined packets arriving from its other interfaces. Such a device must obey the protocol requirements for routers when receiving packets from, and interacting with neighbors over, the former (forwarding) interfaces. It must obey the protocol requirements for hosts when receiving packets from, and interacting with neighbors over, the latter (non-forwarding) interfaces.

3. IPv6 Header Format



Version 4-bit Internet Protocol version number = 6.

Traffic Class 8-bit traffic class field. See section 7.

Flow Label 20-bit flow label. See section 6.

Payload Length 16-bit unsigned integer. Length of the IPv6 payload, i.e., the rest of the packet following this IPv6 header, in octets. (Note that any

	extension headers [section 4] present are considered part of the payload, i.e., included in the length count.)
Next Header	8-bit selector. Identifies the type of header immediately following the IPv6 header. Uses the same values as the IPv4 Protocol field [RFC-1700 et seq.].
Hop Limit	8-bit unsigned integer. Decremented by 1 by each node that forwards the packet. The packet is discarded if Hop Limit is decremented to zero.
Source Address	128-bit address of the originator of the packet. See [ADDRARCH].
Destination Address	128-bit address of the intended recipient of the packet (possibly not the ultimate recipient, if a Routing header is present). See [ADDRARCH] and section 4.4.

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