

IPv6 Introduction

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SOI-ASIA OW 2004

Agenda

- Problems of IPv4
- IPv6 Features
- IPv6 Addressing
- Packet Format
- ICMPv6
- Neighbor Discovery
- Multicast Listener Discovery

Problems of IPv4

- Exhaustion of IPv4 addresses
 - 32-bit turns out to be not enough
 - Will be exhausted in 2008(?)
- Routing table explosion
 - No effective route aggregation
 - 130k entries before aggregation; 95k after
- Proliferation of NAT
 - Networks don't have enough address space
 - Private IP address + NAT for connectivity

IPv6 Features

- Larger address space (128 bits)
- New header format
- Efficient and hierarchical addressing and routing infrastructure
- Built-in security
- Better support for QoS
- Extensibility

IPv6 Address Types

- Unicast
 - Single interface
- Multicast
 - Set of interfaces
 - Packets delivered to all interfaces
- Anycast
 - Set of interfaces
 - Packets delivered to one (the nearest) interface

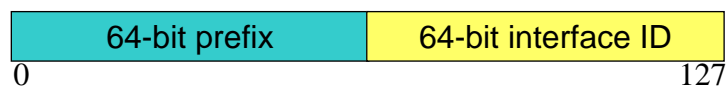
Address Notation

- 128 bit written as 8 blocks of 16-bits in hexadecimal separated by colon
1234:5678:90AB:0:0:5678:0:CDEF
- Blocks of 0 may be shortened with double colon (::) ; only one :: is allowed
1234:5678:90AB::5678:0:CDEF
1234:5678:90AB:0:0:5678::CDEF
1234:5678:90AB::5678::CDEF ✘

Address Type Identification

Type	Binary	IPv6 Notation
Unspecified	000...0 (128bits)	::/128
Loopback	000...1 (128bits)	::1/128
Multicast	11111111	FF00::/8
Link-local unicast	1111111010	FE80::/10
Site-local unicast	1111111011	FEC0::/10
Global unicast	(everything else)	

Unicast Address Format



- Low 64 bits are prefix
- High 64 bits are interface identifier

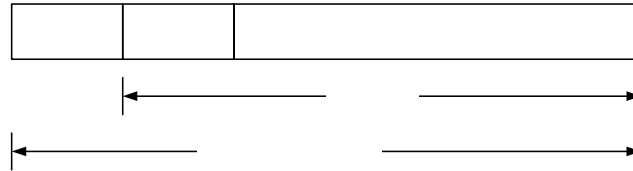
A Node's Address

- Loopback Address
- Link-local Address for each interface
- Additional Unicast and Anycast Addresses
- All-Nodes Multicast Addresses (ff02::1)
- Solicited-Node Multicast Addresses
- Multicast Address of groups it joined

A Router's Address

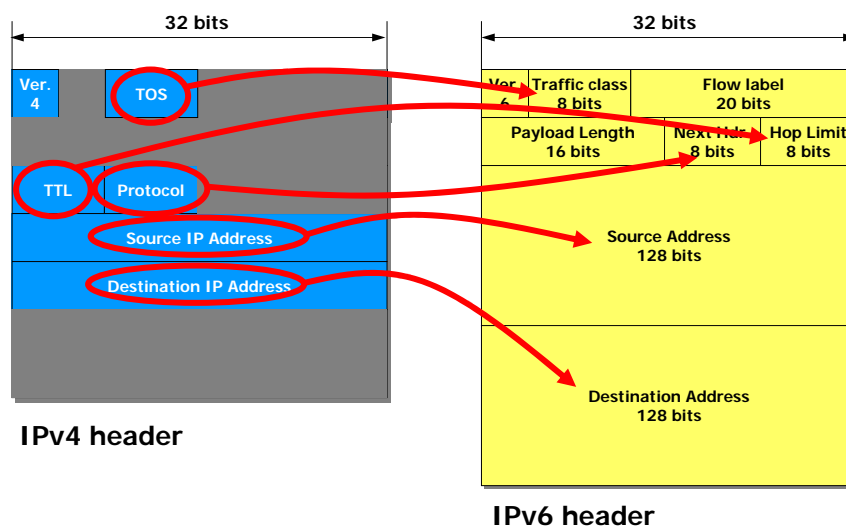
- A node's address
- Subnet-Router Anycast Address
- All other Anycast Address
- All-Router Multicast Addresses (ff02::2)

Packet Format



- Packet = IPv6 header + Payload
- Payload = Extension header + PDU
- What follows after a header is identified by Next Header field

IPv4 vs IPv6 Header



IPv
Hea

ICMPv6

- IPv6 and extension headers are only for packet delivery
- ICMPv6 for handling errors
 - Destination Unreachable
 - Packet Too Big
 - Time Exceeded
 - Parameter Problem
- ICMPv6 for diagnostic and troubleshooting
 - Echo Request
 - Echo Reply

Neighbor Discovery

- Interactions between nodes on the same link
- Use ICMPv6 packets
- Messages:
 - Router Advertisement
 - Router Solicitation
 - Neighbor Advertisement
 - Neighbor Solicitation
 - Redirect

Multicast Listener Discovery

- Enable IPv6 router to discover the presence of multicast listener on its link.
- Use ICMPv6 packets
- Messages
 - Multicast Listener Query
 - Multicast Listener Report
 - Multicast Listener Done

LAB WORK

Exercise 1

LAB WORK

Exercise 2

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Exercise 3

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Exercise 4