Internet Protocol version 10 (IPv10)

❖ Introduction:

- Internet is the global wide network used for communication between hosts connected to it.
- These connected hosts (PCs, servers, routers, mobile devices, etc.) must have a global unique addresses to be able to communicate through the Internet and these unique addresses are defined in the Internet Protocol (IP).
- The first version of the Internet Protocol is IPv4.
- When IPv4 was developed in 1975, it was not expected that the number of connected hosts to the Internet reach a very huge number of hosts more than the IPv4 address space, also it was aimed to be used for experimental purposes in the beginning.
- IPv4 is (32-bits) address allowing approximately 3.4 billion unique IP addresses.

- A few years ago, with the massive increase of connected hosts to the Internet, IPv4 addresses started to run out.
- Three short-term solutions (CIDR, Private addressing, and NAT) were introduced in the mid-1990s but even with using these solutions, the IPv4 address space ran out in February, 2011 as announced by IANA, and in 2015, 4 out of 5 of the RIRs (such as RIPE NCC, APNIC, ARIN, and Lacnic) announced the depletion of the IPv4 address space, and AFRINIC expects its announcement of the IPv4 address space depletion in 2017.
- A long term solution (IPv6) was introduced to increase the address space used by the Internet Protocol and this was defined in the Internet Protocol version 6 (IPv6).

- IPv6 was developed in 1998 by the Internet Engineering Task Force (IETF).
- IPv6 is (128-bits) address and can support a huge number of unique IP addresses that is approximately equals to 2^{128} unique addresses.
- So, the need for IPv6 became a vital issue to be able to support the massive increase of connected hosts to the Internet after the IPv4 address space exhaustion.

- The migration from IPv4 to IPv6 became a necessary thing, but unfortunately, it would take decades for this full migration to be accomplished.

- More than 10 years have passed since IPv6 was developed, but no full migration happened till now and this would cause the Internet to be divided into two parts, as IPv4 still dominating on the Internet traffic and new Internet hosts will be assigned IPv6 addresses.
- So, the need for solutions to the IPv4 and IPv6 coexistence became an important issue in the migration process as we cannot wake up in the morning and find all IPv4 hosts are migrated to be IPv6 hosts, especially, as most enterprises' networks did not do this migration for creating a full IPv6 implementation.
- Also, the request for using IPv6 addresses in addition to the existing IPv4 addresses (IPv4/IPv6 Dual Stacks) in all enterprise networks did not achieve a large implementation that can make IPv6 the most dominated IP in the Internet as many people believe that they will not have benefits from just having a larger IP address bits and IPv4 satisfies their needs, also, not all enterprises' devices support IPv6 and also many people are afraid of the service outage that can be caused due to this migration.

- The recent solutions for IPv4 and IPv6 coexistence are:

a) IPv4/IPv6 Dual Stacks.
b) Tunneling.
c) NAT-PT and NAT64.

- The first solution: (IPv4/IPv6 Dual Stacks), allows both IPv4 and IPv6 to coexist by using both IPv4 and IPv6 addresses for "all hosts" at the same time, but this solution does not allows IPv4 hosts to communicate to IPv6 hosts and vice versa.

- The second solution: (Tunneling), allows IPv6 hosts to communicate to each other through an IPv4 network, but still does not allows IPv4 hosts to communicate to IPv6 hosts and vice versa.

- The third solution: (NAT-PT), allows IPv6 hosts to communicate to IPv4 hosts with only using hostnames and getting DNS involved in the communication process but this solution was inefficient because it does not allows communication using direct IP addresses, also the need for so much protocol translations of the source and destination IP

addresses made the solution complex and not applicable that's why it was moved to the "Historic" status in the RFC 2766. Also, NAT64 requires so much protocol translations and statically configured bindings, and also getting a DNS64 involved in the communication process.

❖ Internet Protocol version 10 (IPv10):

- IPv10 is the solution in this essay.
- It solves the issue of allowing IPv6 only hosts to communicate to IPv4 only hosts and vice versa in a simple and very efficient way, especially when the communication is done using both direct IP addresses and when using hostnames between IPv10 hosts, as there is no need for protocol translations or getting the DNS involved in the communication process more than its normal address resolution function.

- IPv10 allows hosts from two IP versions to be able to communicate, and this can be accomplished by having an IPv10 packet containing a mixture of IPv4 and IPv6 addresses in the same IP packet header.
- From here the name of IPv10 arises, as the IP packet can contain (IPv6 + IPv4) addresses in the same header.

❖ The advantages of using IPv10:

1) Introduces an efficient way of communication between IPv6 hosts and IPv4 hosts.

2) Allows IPv4 only hosts to exist and communicate with IPv6 only hosts even after the depletion of the IPv4 address space.

3) Adds flexibility when making a query sent to the DNS for hostname resolution as IPv4 and IPv6 hosts can communicate with IPv4 or IPv6 DNS servers and the DNS can reply

with any record it has (either an IPv6 record "Host AAAA record" or an IPv4 record "Host A record").

4) There is no need to think about migration as both IPv4 and IPv6 hosts can coexist and communicate to each other which will allow the usage of the address space of both IPv4 and IPv6 making the available number of connected hosts be bigger.

5) IPv10 support on all Internet connected hosts can be deployed in a very short time as there is no dependence on enterprise users and it is just a software development process in the NIC cards of all hosts to allow encapsulating both IPv4 and IPv6 in the same IP packet header.

6) Offers the four types of communication between hosts:

- IPv6 hosts to IPv4 hosts (6 to 4).
- IPv4 hosts to IPv6 hosts (4 to 6).
- IPv6 hosts to IPv6 hosts (6 to 6).
- IPv4 hosts to IPv4 hosts (4 to 4).
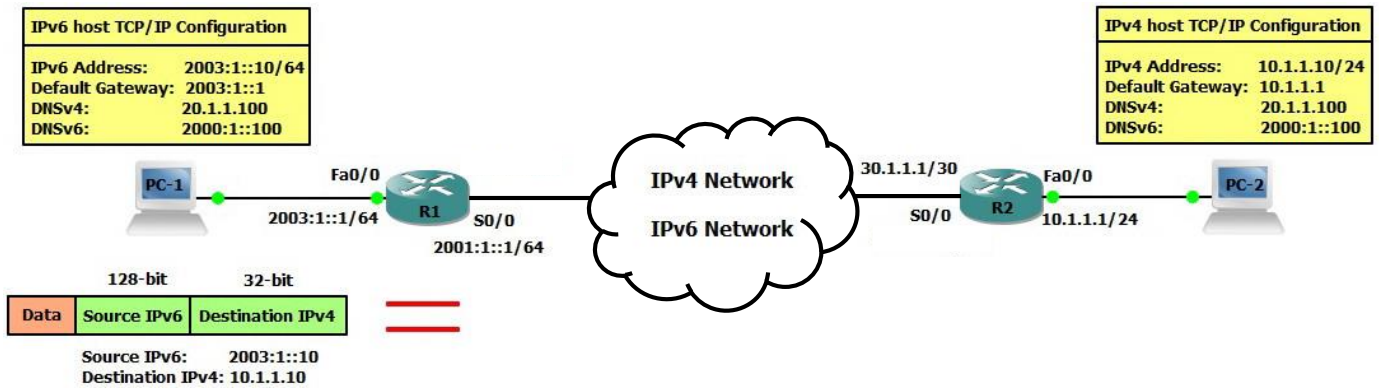
a) IPv10: IPv6 Host to IPv4 Host:

- IPv10 Packet ➔

- IPv10 TCP/IP Configuration ➔

IP Address:	IPv6 Address
Prefix Length:	Length
Default Gateway:	IPv6 Address (Optional)
DNS Addresses:	IPv6/IPv4 Addresses

- IPv10 Operation ➔
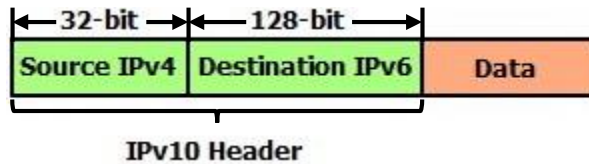

IPv10: IPv6 Host-to-IPv4 Host
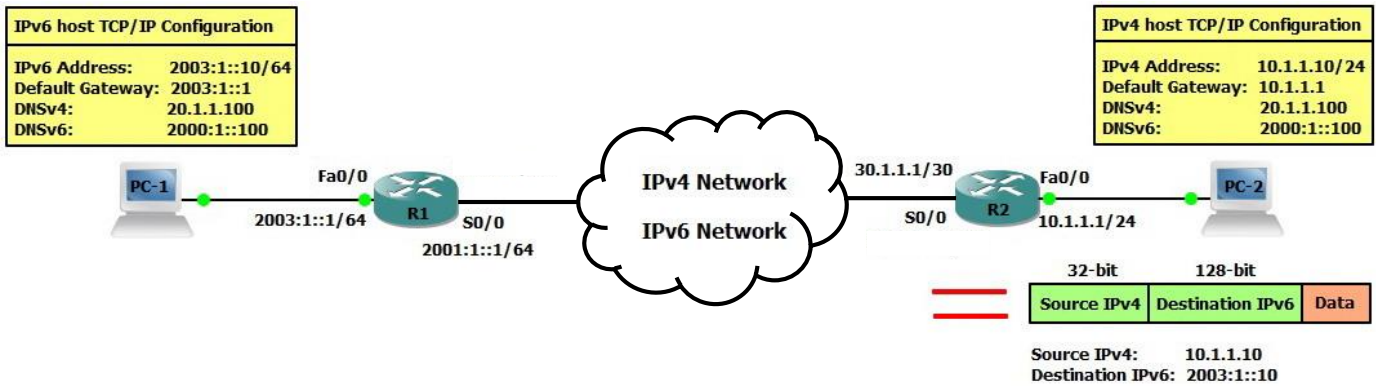
b) IPv10: IPv4 Host to IPv6 Host:

- IPv10 Packet ➔

- IPv10 TCP/IP Configuration ➔ IP Address: IPv4 Address
                                   Subnet Mask: Mask
                                   Default Gateway: IPv4 Address
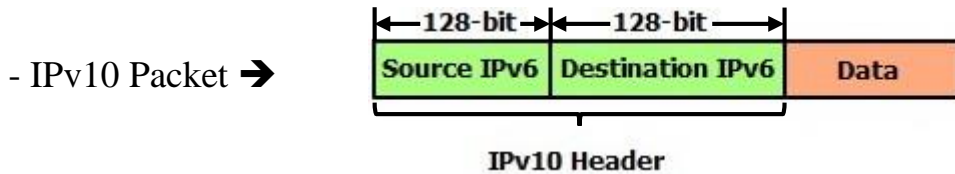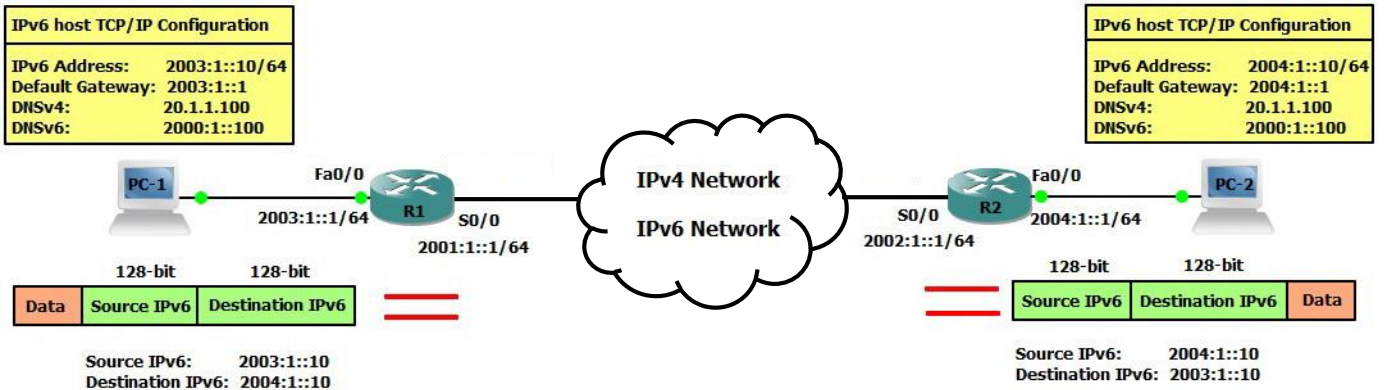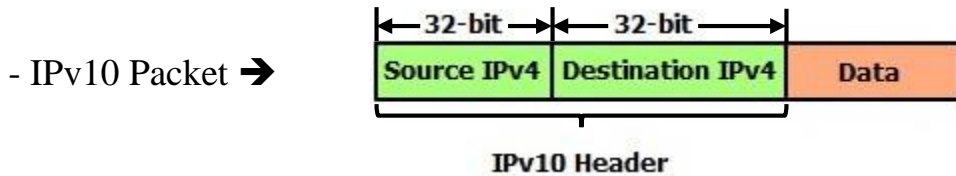   DNS Addresses: IPv6/IPv4 Addresses

- IPv10 Operation ➔

IPv10: IPv4 Host-to-IPv6 Host

c) IPv10: IPv6 Host to IPv6 Host:

- IPv10 Packet ➔

- IPv10 TCP/IP Configuration ➔
      IP Address: IPv6 Address
      Prefix Length: Length
      Default Gateway: IPv6 Address (Optional)
      DNS Addresses: IPv6/IPv4 Addresses

- IPv10 Operation ➔

IPv10: IPv6 Host-to-IPv6 Host
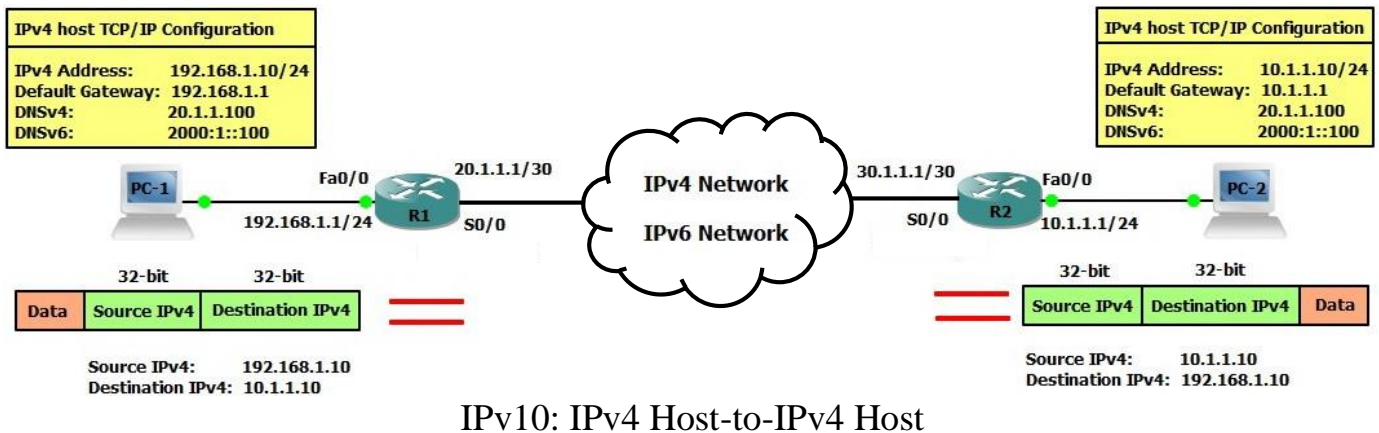
d) IPv10: IPv4 Host to IPv4 Host:

- IPv10 Packet ➔


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|← 32-bit →|← 32-bit →|
| Source IPv4 | Destination IPv4 | Data |
        IPv10 Header
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- IPv10 TCP/IP Configuration ➔   IP Address: IPv4 Address
                                   Subnet Mask: Mask
                                   Default Gateway: IPv4 Address
                                   DNS Addresses: IPv6/IPv4 Addresses

- IPv10 Operation ➔

IPv10: IPv4 Host-to-IPv4 Host
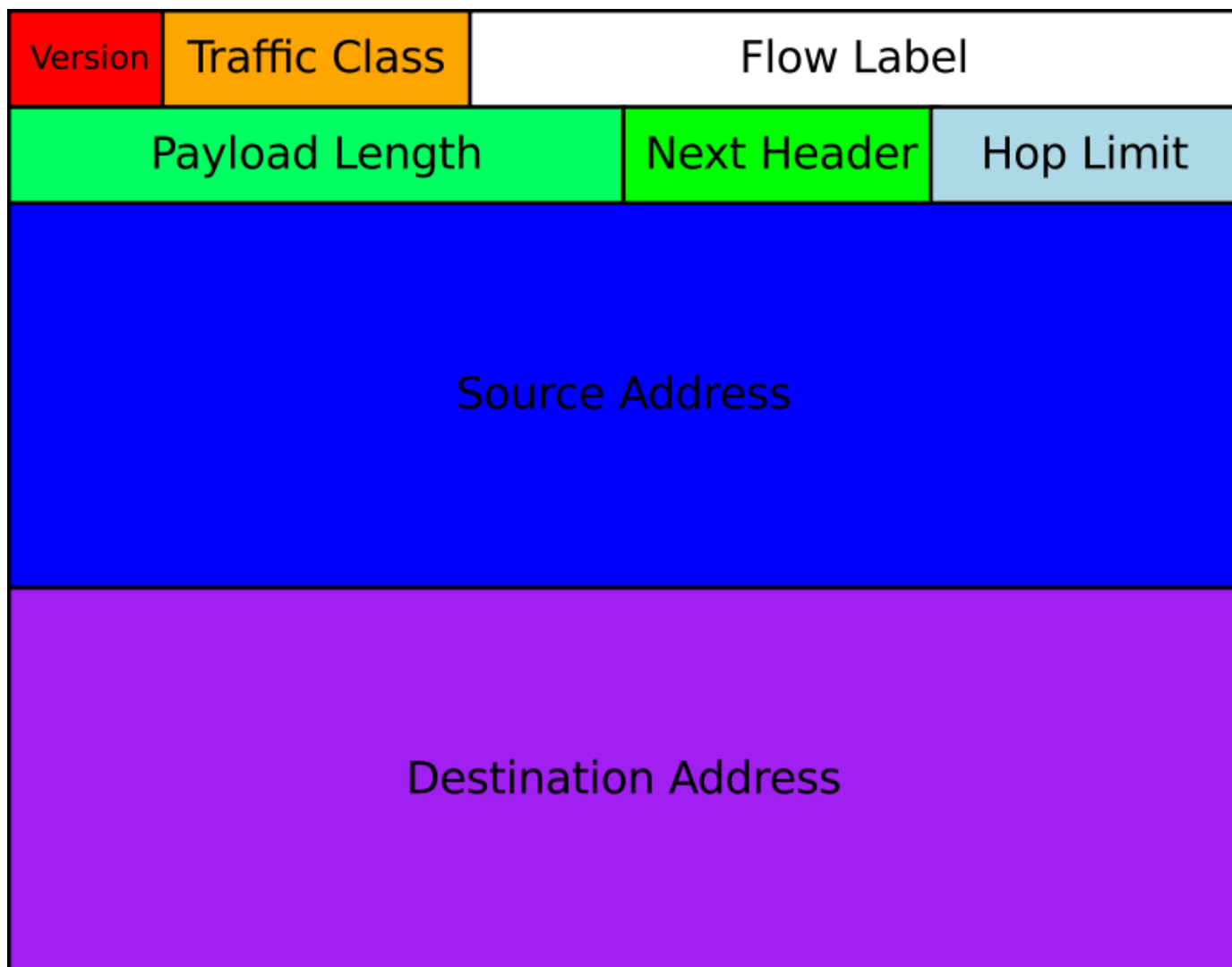
❖ IPv10 Packet Header:

- The following figure shows the IPv10 packet header which is almost the same as the IPv6 packet header:

Version	Traffic Class	Flow Label	
Payload Length		Next Header	Hop Limit
Source Address			
Destination Address			

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- Version (4-bits):

- 0100 ➔ IPv4 Packet (Source and destination addresses are IPv4).
- 0110 ➔ IPv6 Packet (Source and destination addresses are IPv6).
- 1010 ➔ IPv10 Packet (Source and destination addresses are IPv4/IPv6).
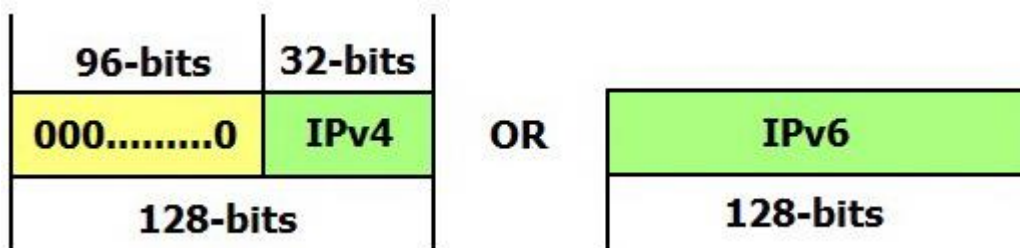
- Traffic class (8-bits).

- Flow Label (20-bits).
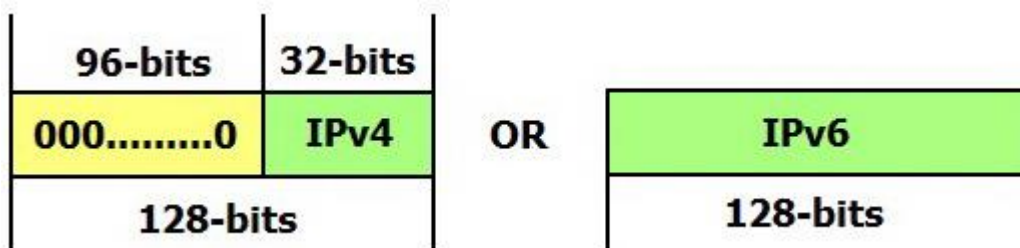
- Payload Length (16-bits).

- Next Header (8-bits).

- Hop Limit (8-bits).

- Source Address (128-bits):

- Destination Address (128-bits):

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