

# IPv6 Transition

# Introduction

- IPv4 and IPv6 are not interoperable.
- Until IPv6 completely supplants IPv4, which is not likely to happen in the foreseeable future, a number of so-called transition mechanisms are needed :
  - To enable IPv6-only hosts to reach IPv4 services.
  - To allow isolated IPv6 hosts and networks to reach the IPv6 Internet over the IPv4 infrastructure.

# Node Types

- IPv4-only node
  - Implements only IPv4 & is assigned IPv4 addresses
  - Doesn't support IPv6
- IPv6-only node
  - Implements only IPv6 & is assigned only IPv6 addresses.
  - Able to communicate with IPv6 only node & IPv6 enabled applications.
- IPv6/IPv4 node
  - Implements both IPv4 & IPv6 & is assigned both IPv4 & IPv6 addresses.

# IPv6 Transition Techniques

■ A wide range of techniques have been identified & implemented, basically falling into three categories:

## (1) Dual- Stack :

It allows IPv4 & IPv6 to coexist in the same device & network

## (2) Tunneling :

It allows IPv6 host to communicate over IPv4 infrastructure.

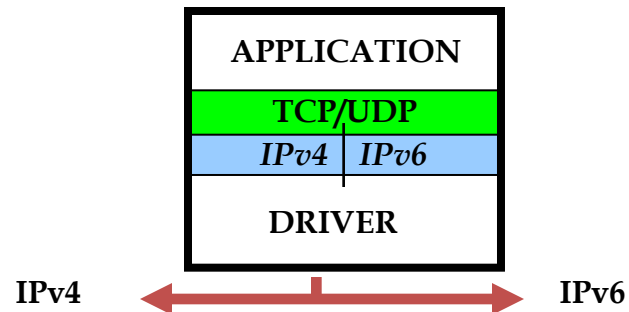
## (3) Translation :

It allows IPv6 only devices to communicate with IPv4 only devices

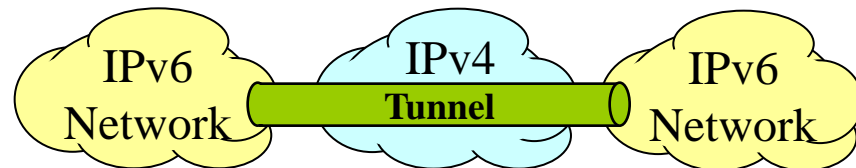
# Transition Mechanism

## ➤ Transition Options:

- Dual Stack



- IPv6-IPv4 Tunnel



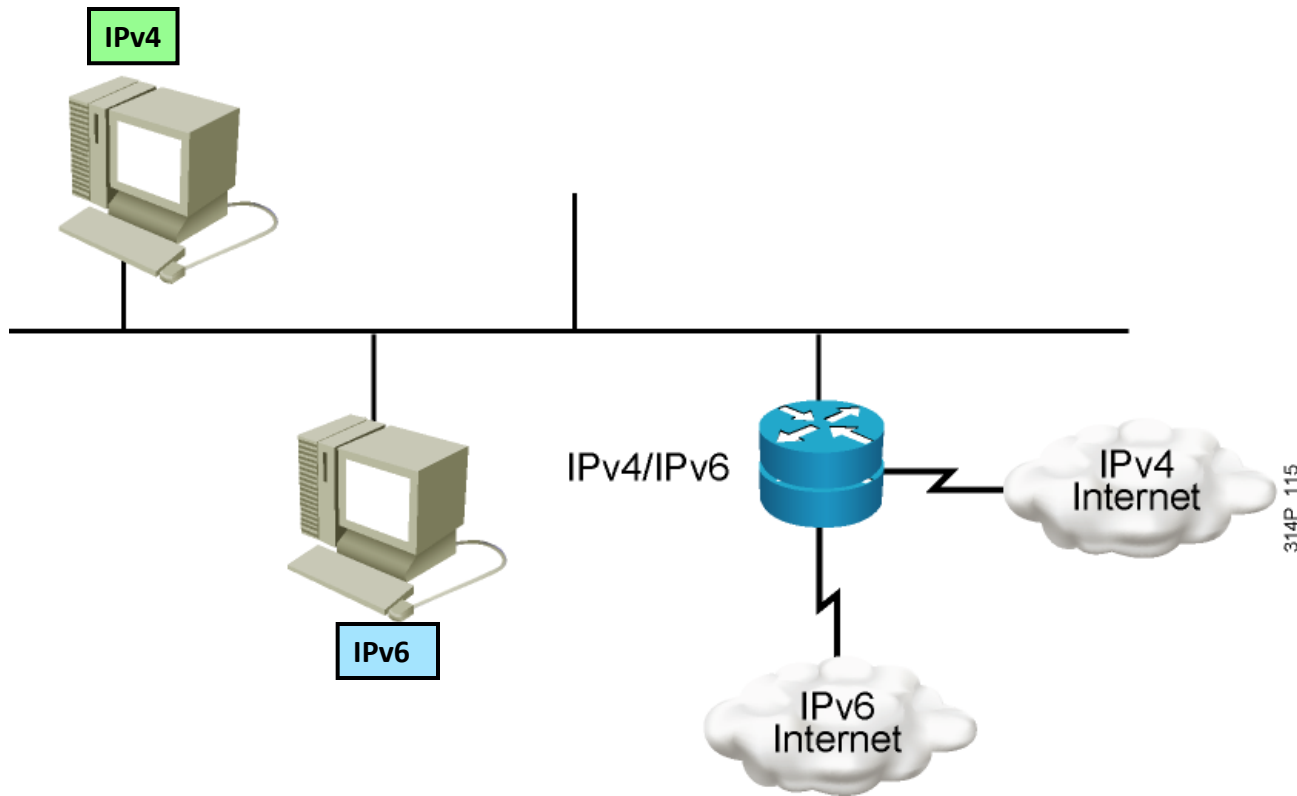
- Translation (IPv6- only to IPv4- only)



# Dual Stack

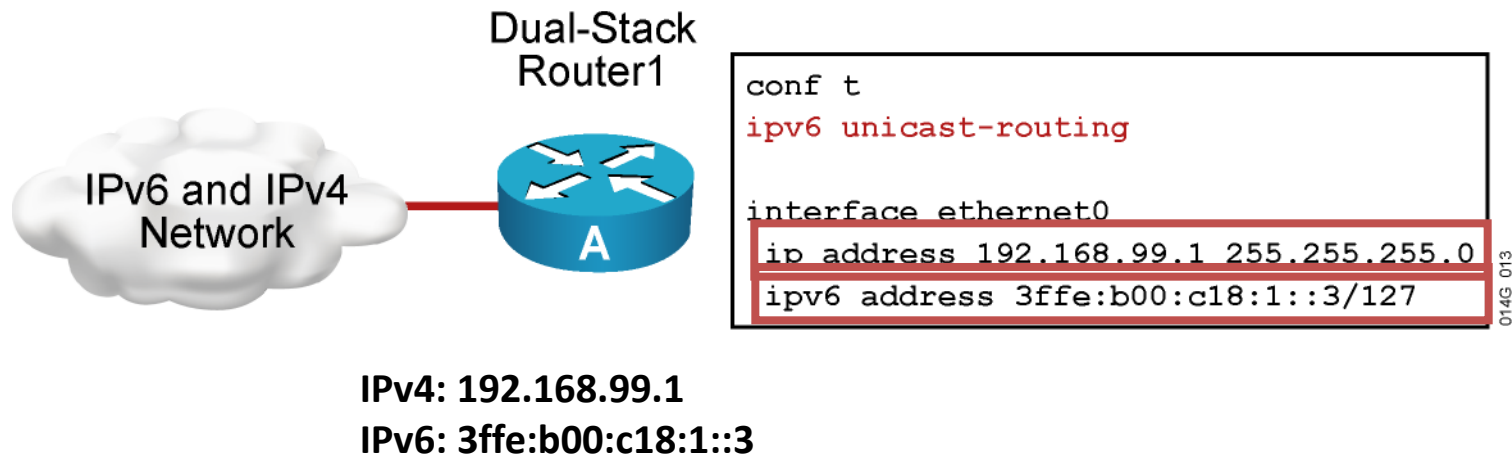
- Require network devices such as routers and end system running both IPv4 and IPv6 protocol stacks.
- ▣ If both the end stations support IPv6, they can communicate using IPv6; otherwise they will communicate using IPv4.
- ▣ This will allow both IPv4 and IPv6 to coexist and gradual transition from IPv4 to IPv6 can happen.

# Dual Stack Hosts and Network



Dual stack is an integration method in which a node has implementation and connectivity to both an IPv4 and IPv6 network.

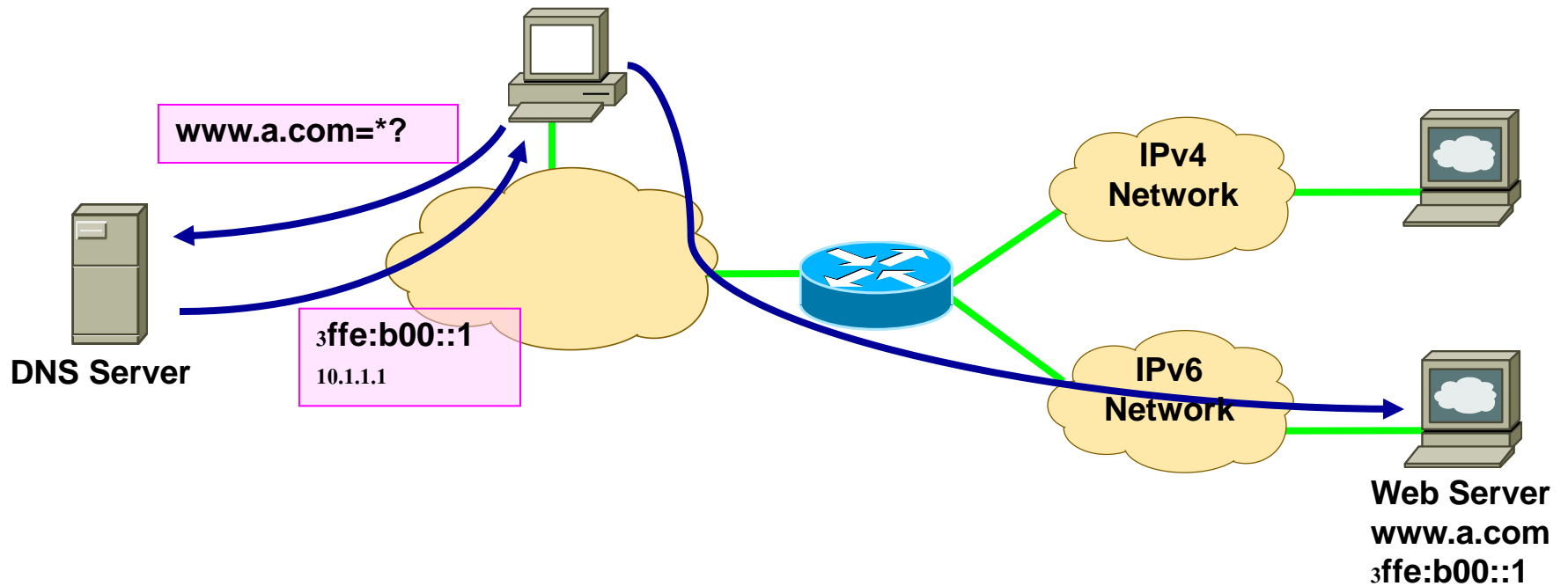
# Dual Stack Hosts and Network



When both IPv4 and IPv6 are configured on an interface, the interface is considered dual-stacked.



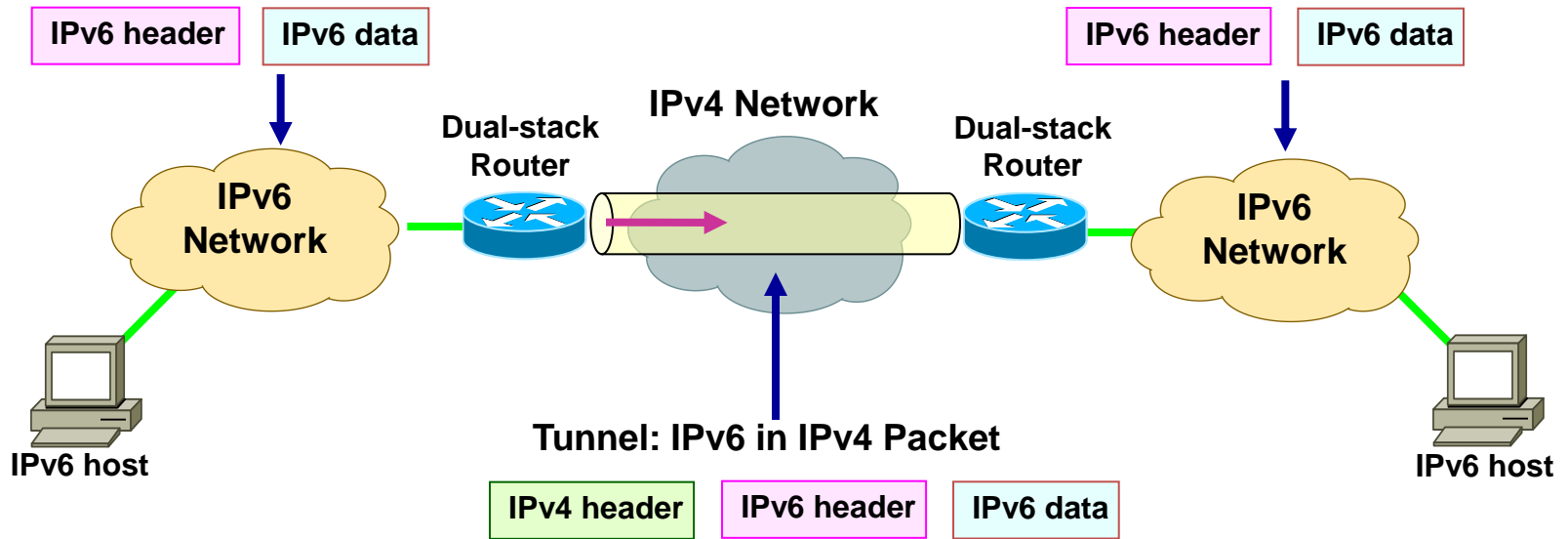
# IPv4-IPv6 Dual Stack Operation



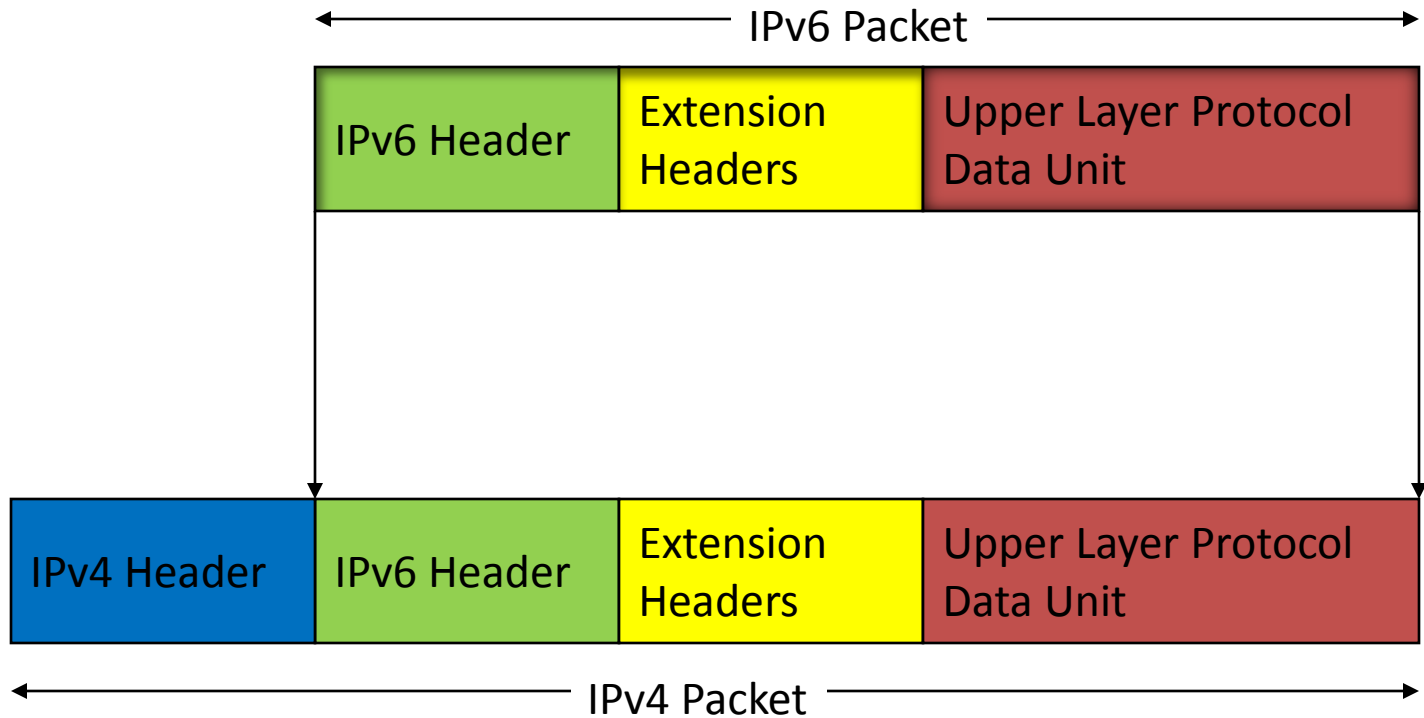
# Tunneling IPv6 via IPv4

- Tunneling encapsulates IPv6 traffic within IPv4 packets.
- Allows isolated IPv6 end system and routers to communicate without the need to upgrade the IPv4 infrastructure that exists between them.

# IPv6 over IPv4 Tunnels

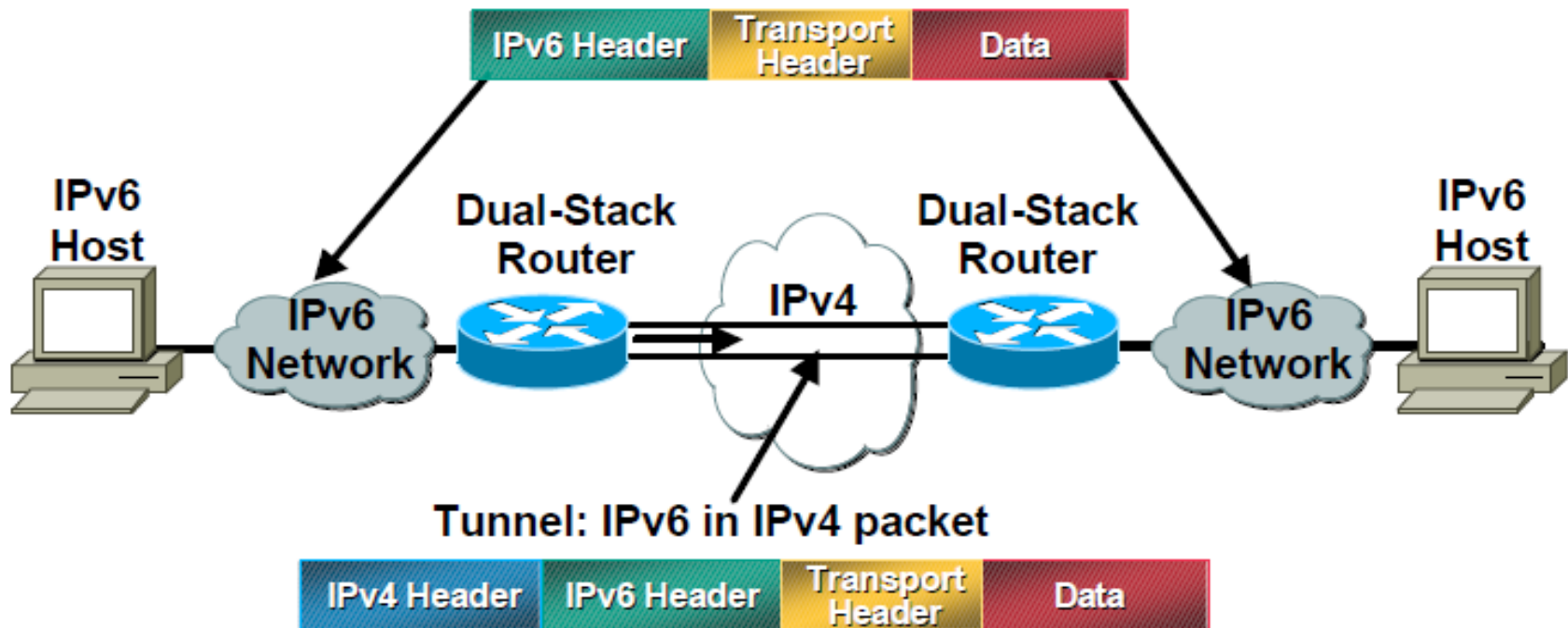


# Tunneling IP6 via IP4



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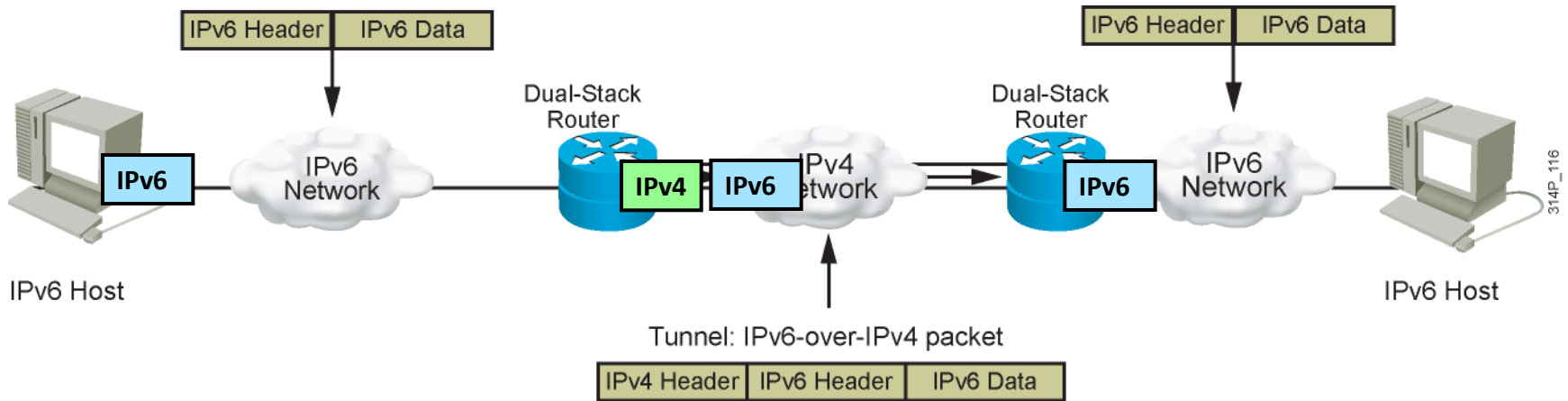
## Tunnel



# Packet Delivery over the tunnel

- **IPv6 node A sends packet to IPv6 node B**
  - Routed internally to router A
- **Router A sees destination network B is reachable over tunnel interface**
  - Encapsulates IPv6 packet in IPv4 packet(s)
  - Sends resulting IPv4 packet(s) to router B
  - Delivered over existing IPv4 Internet infrastructure
- **Router B decapsulates IPv6 packet from payload of received IPv4 packet**
  - Packet routed internally in network B to node B
  - Node B receives the IPv6 packet

# IPv6 Tunneling



Tunneling is an integration method in which an IPv6 packet is encapsulated within another protocol, such as IPv4. This method of encapsulation is IPv4.

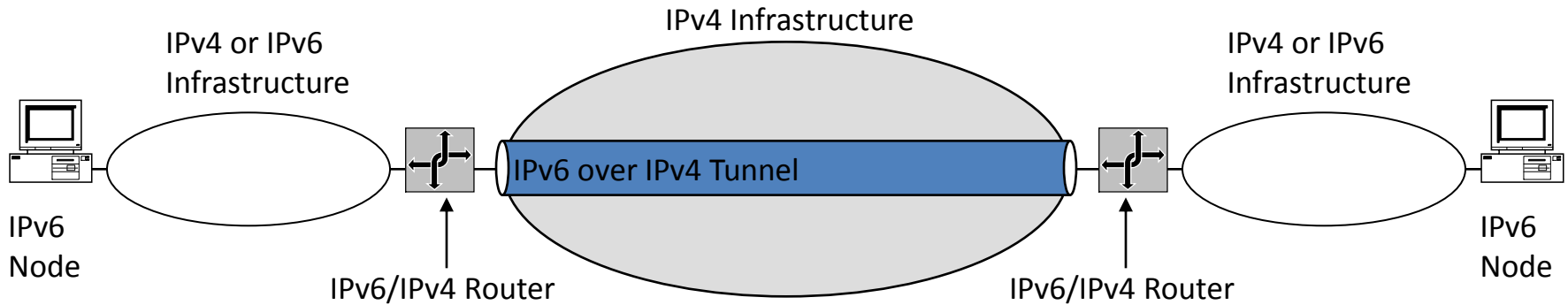
- Includes a 20-byte IPv4 header with no options and an IPv6 header and payload
- Requires dual-stack routers

# Tunneling Configurations

- Router-to-Router
- Host-to-Router and Router-to-Host
- Host-to-Host

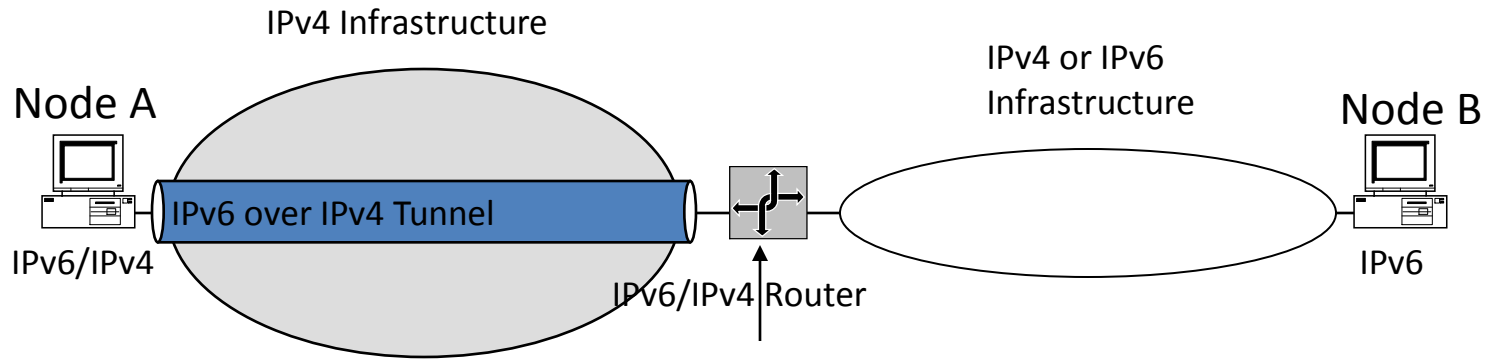


# Router-to-Router Tunneling



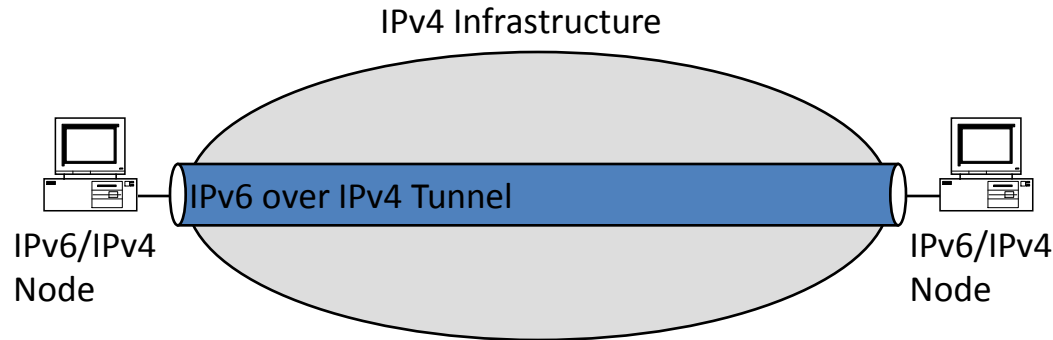
In the router-to-router tunneling configuration, two IPv6/IPv4 routers connect two IPv6-enabled infrastructures over an IPv4-only infrastructure

# Host-to-Router and Router-to-Host Tunneling



In the host-to-router tunneling configuration, an IPv6/IPv4 host that resides within an IPv4-only infrastructure uses an IPv6-over-IPv4 tunnel to reach an IPv6/IPv4 router.

# Host-to-Host Tunneling



In the host-to-host tunneling configuration, an IPv6/IPv4 node that resides within an IPv4 only infrastructure uses an IPv6-over-IPv4 tunnel to reach another IPv6/IPv4 node that resides within the same IPv4-only infrastructure.

# Tunneling IP6 via IP4

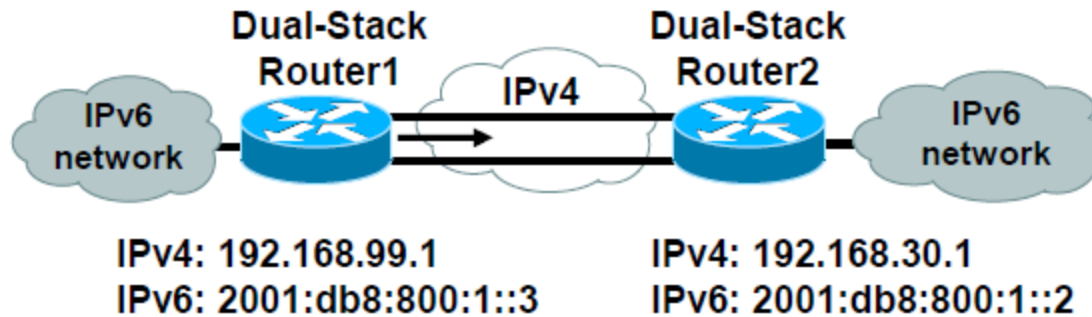
## Two Types of Tunneling

- Configured
- Automatic

# Tunneling IP6 via IP4

- Configured
  - Require manual configuration at both ends
  - Very easy to setup & configure
  - Good from a management prospective
  - Manual tunnel do not scale well as it requires separate tunnel configuration for each isolated IPv6 network destination

# Tunneling IPv6 via IPv4



```
router1#  
  
interface Tunnel0  
  ipv6 enable  
  ipv6 address 2001:db8:c18:1::3/127  
  tunnel source 192.168.99.1  
  tunnel destination 192.168.30.1  
  tunnel mode ipv6ip
```

```
router2#  
  
interface Tunnel0  
  ipv6 enable  
  ipv6 address 2001:db8:c18:1::2/127  
  tunnel source 192.168.30.1  
  tunnel destination 192.168.99.1  
  tunnel mode ipv6ip
```

## Configured

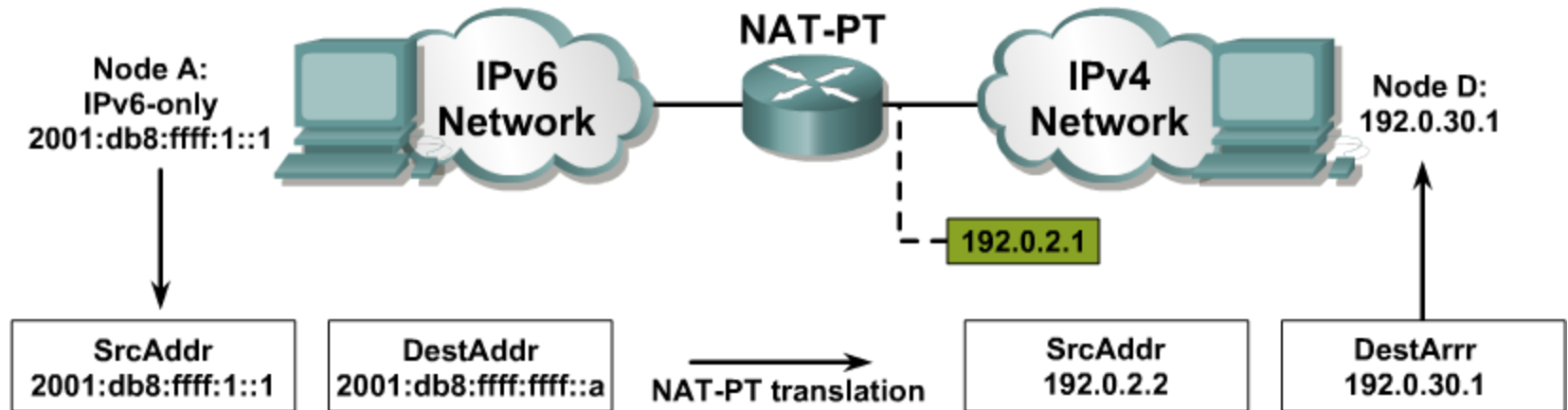
- ❏ A configured tunnels require manual configuration of the local & remote tunnel end points
- ❏ Dual stack end points
- ❏ Both IPv4 & IPv6 addresses configured at each end

# Tunneling IP6 via IP4

- Automatic Tunnel
  - ❑ An automatic tunnel is a tunnel that does not require manual configuration. Tunnel end points for automatic tunnel are determined by routing infrastructure (e.g. use of routes, tunnel interfaces, next hop address destination IPv6 addresses).
  - ❑ Tunnels created on demand without manual intervention

# IPv6-IPv4 Translation

☞ This allows communication between IPv4 only and IPv6 only end stations.

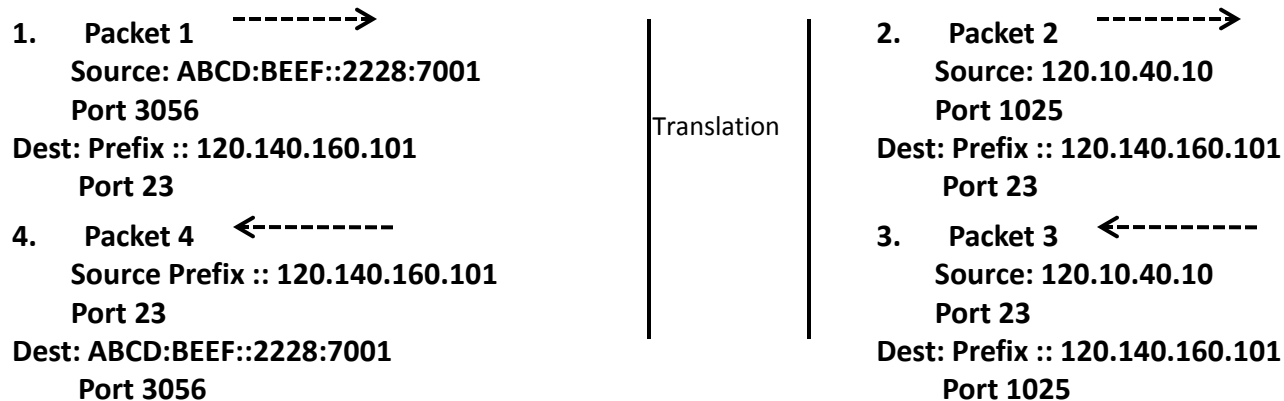
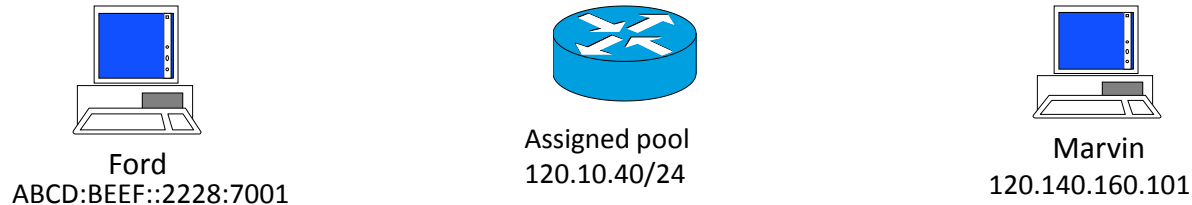


☞ The job of the translator is to translate IPv6 packets into IPv4 packets by doing address and port translation and vice versa.



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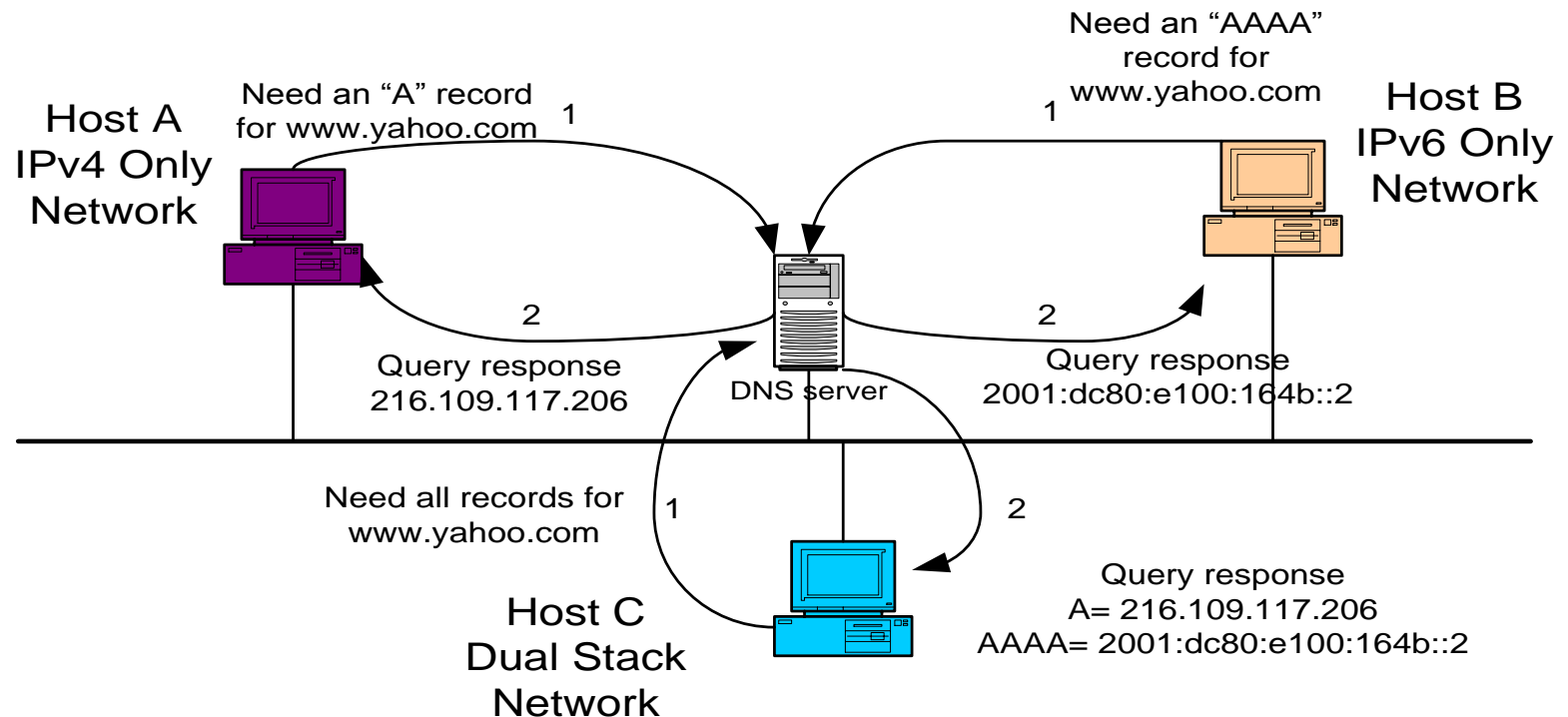
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# Naming Services

- DNS must be included in transition strategy
- Resolving Names:
  - IPv4 specifies “A” records
  - IPv6 specifies “AAAA” records
- Applications should be aware of both records

# Naming Services

## Querying DNS server



# Conclusion

- There are many IPv6 transition techniques available
  - No single ‘best’ solution
  - Transition plan is likely to be site-specific
- Recommended best practice :Dual-stack deployment
  - Natural path via procurement cycles.
  - Allows experience in IPv6 operation to be gained early.

Thanks