



# IPv6 on Cisco Fundamentals

# Instructor Introduction

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- CCIE Routing and Switching – 2007

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# Intended Audience

- » CCNA / CCNP Level experience with IPv4
- » Focus is on IPv6 on Cisco equipment, but a lot of the material covered is about general IPv6 for all platforms



# IPv6 on Cisco Fundamentals





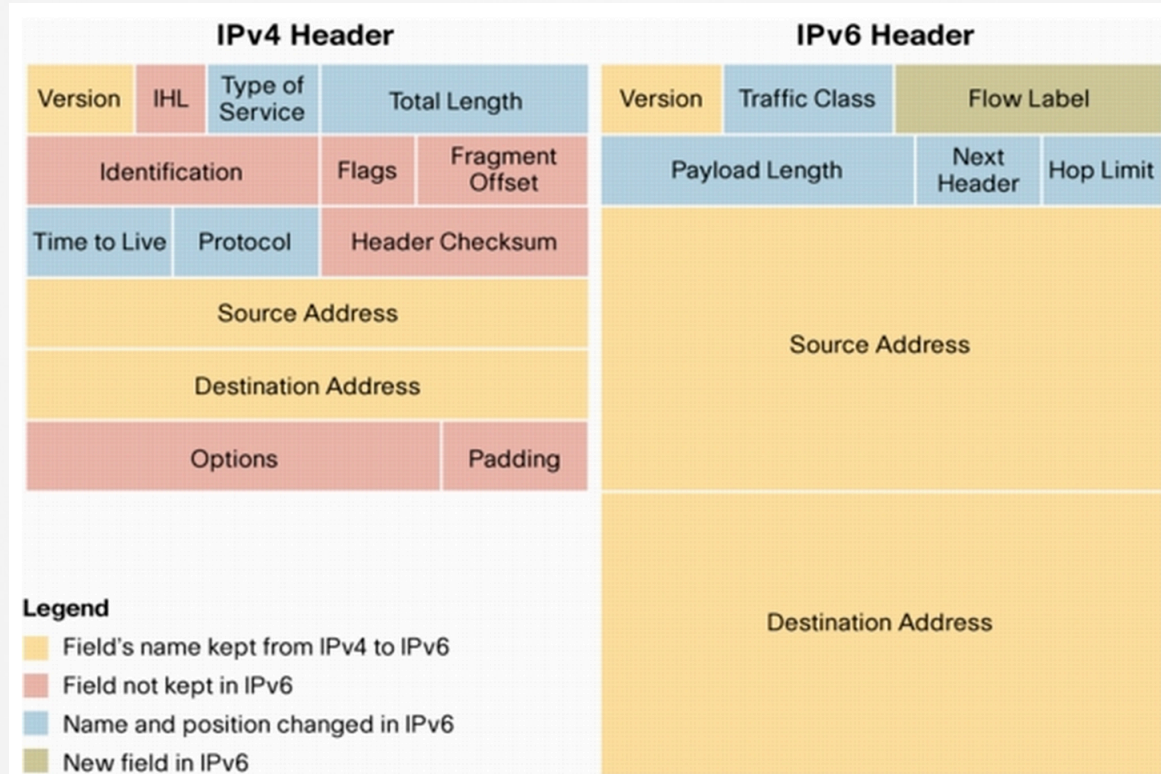
# Introduction to IPv6



# Why IPv6?

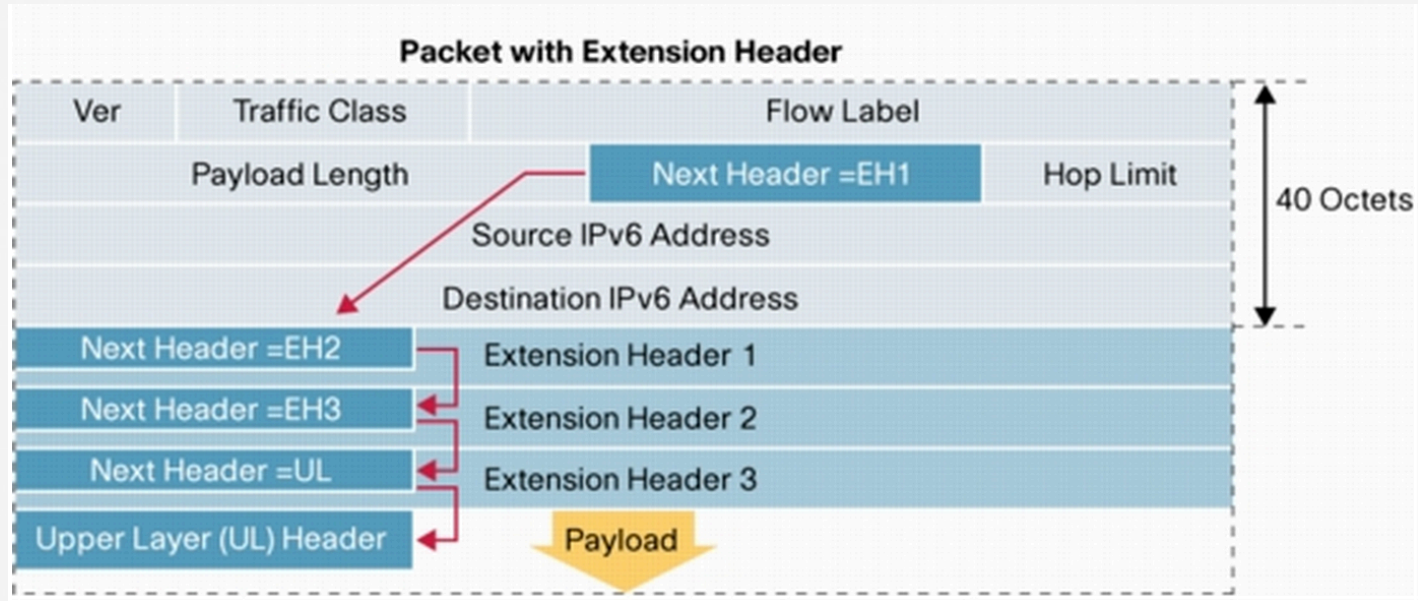
- » IPv4 only has  $2^{32}$  or ~3.4 Billion Addresses
- » After Classes, Multicast, reserved ranges etc.. There are far fewer usable
- » NAT has been a HUGE help, but ultimately is a crutch to get around limited addressing and breaks the end to end connectivity model
- » Broadcasts cause unnecessary CPU load

# IPv6 Simplified Header



# IPv6 Extension Headers

» Addressed in RFC 2460





# IPv6 Addressing

## » Uses 8 x 16 Bit Fields separated by a ':'

- This can cause confusion <http://2001:db8:100::10:8080>
- Needs to become [http://\[2001:db8:100::10\]:8080](http://[2001:db8:100::10]:8080)

## » 128bit Address

- $2^{128}$  ( $3.4 \times 10^{38}$  or 3 mnthe point Orlando
- 40 undecillion)

## » Leading Zeros can be dropped

- So 2001:0db8:0100::1 can be 2001:db8:100::1

# IPv6 Addressing

## » Consecutive fields of Zeros can be condensed to '::' once in an address

- 2001:db8:0:0:0:0:0:1 = 2001:db8::1
- 0:0:0:0:0:0:0:0 (Default) = ::
- 0:0:0:0:0:0:0:1 (Loopback) = ::1
- 2001:0:0:0:37:0:0:1 = 2001::37:0:0:1
  - CANNOT be 2001::37::1 – there would be no way of knowing WHERE the 37 actually belongs

# IPv6 Addressing

## » Address Types:

- Link-Local (fe80::/10)
- Global (IANA)
- Unique Local – RFC 4193 (fc00::/7)
  - Split into fc00::/8 and fd::/8

## » Communication Types:

- Unicast
- Multicast
- Anycast



# IPv6 Solicited Node Multicast

- » Since IPv6 does not support broadcast, there is no ARP
- » Neighbor Discovery (ND) is used instead of ARP
- » ND Messages use the Solicited Node Multicast Address

# IPv6 Solicited Node Multicast

- » This address is in the format
  - ff02::1:ff00:0/104
- » 'ff02' is a link local multicast in IPv6
- » This address is also used for Duplicate Address Detection (DAD)
- » The format leaves the last 24bits of the address to be unique per host

# IPv6 Solicited Node Multicast

- » A host with a IPv6 address of 2001::2aa:ff:fe28:9c5a would have the solicited node address of ff02::1:ff28:9c5a



# IPv6 Address Assignment

- » Static
- » Stateless Address Auto Configuration (SLAAC)
- » Stateless DHCPv6 (DHCPv6 Lite)
- » DHCPv6
- » DHCPv6 prefix delegation



# Introduction to IPv6





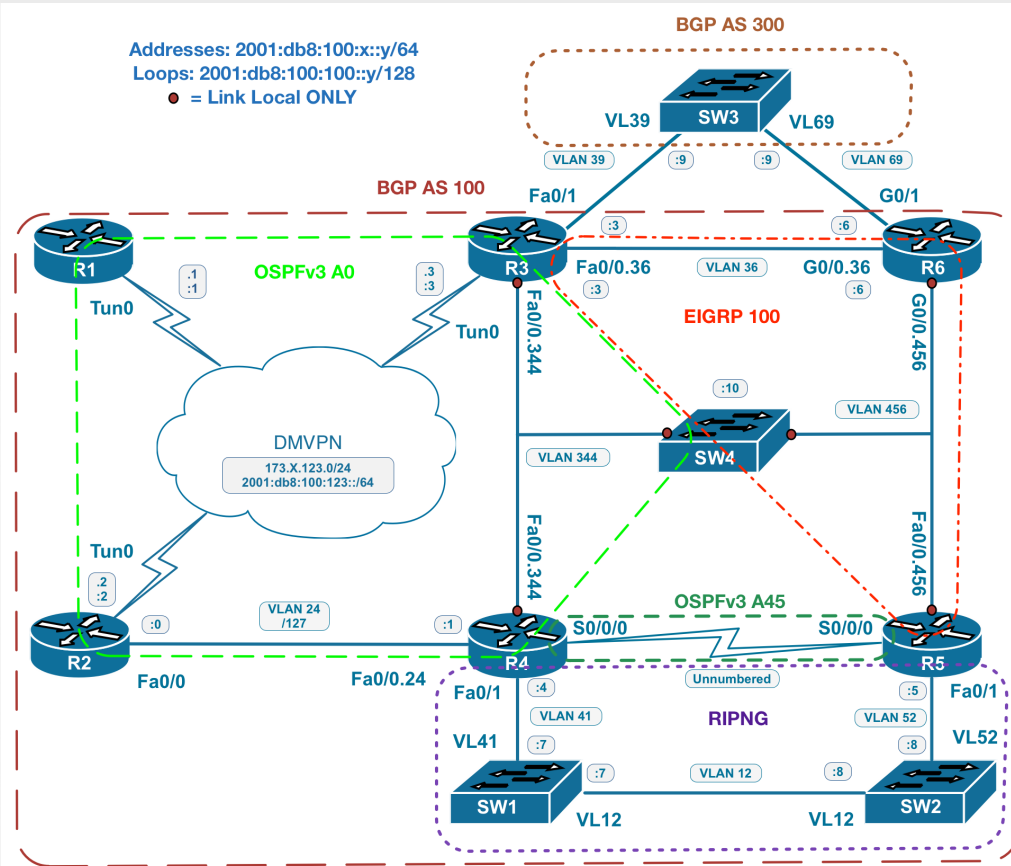
# IPv6 Address Configuration



# Manual Address Configuration



# IPv6 Base Topology



# IPv6 'Manual' Address Configuration

- » IPv6 enable
- » IPv6 link-local with automatic assignment
- » IPv6 link-local with static assignment
- » IPv6 global address using EUI-64
- » IPv6 global addressing using static assignment



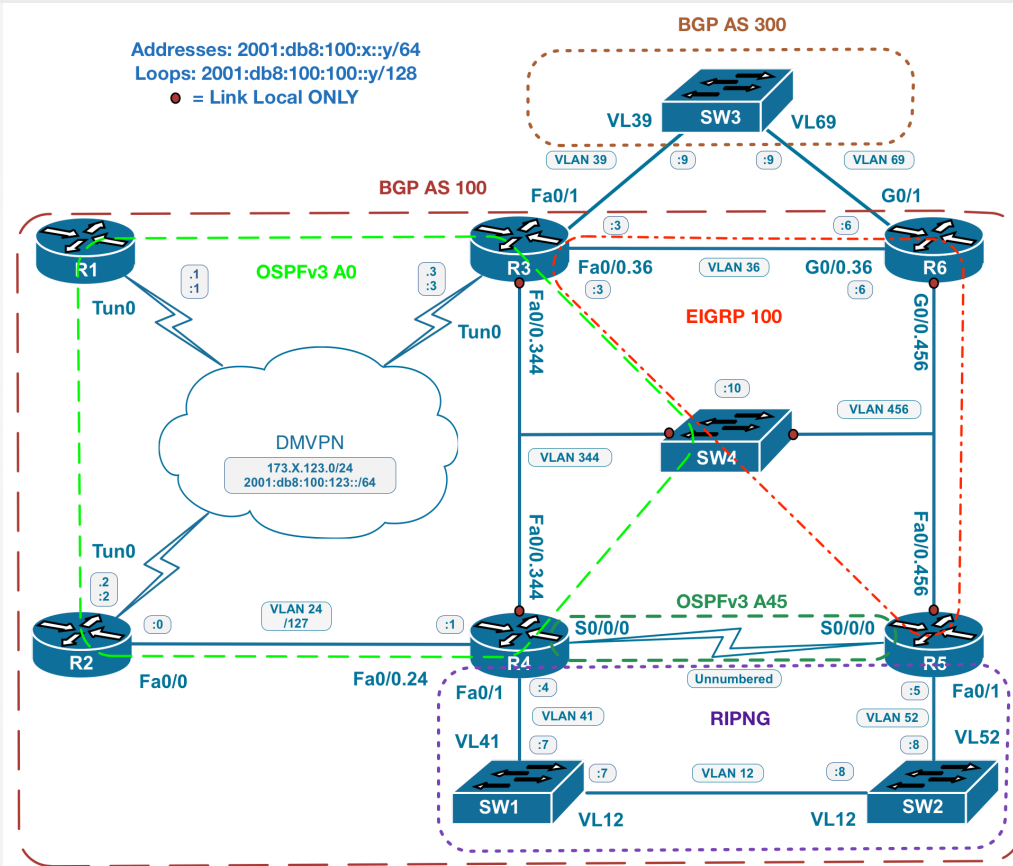
# Manual Address Configuration





# SLAAC Configuration

# IPv6 Base Topology



# IPv6 SLAAC

- » Configuring IPv6 router
- » Configuring IPv6 client device
- » Controlling host portion with link-local address





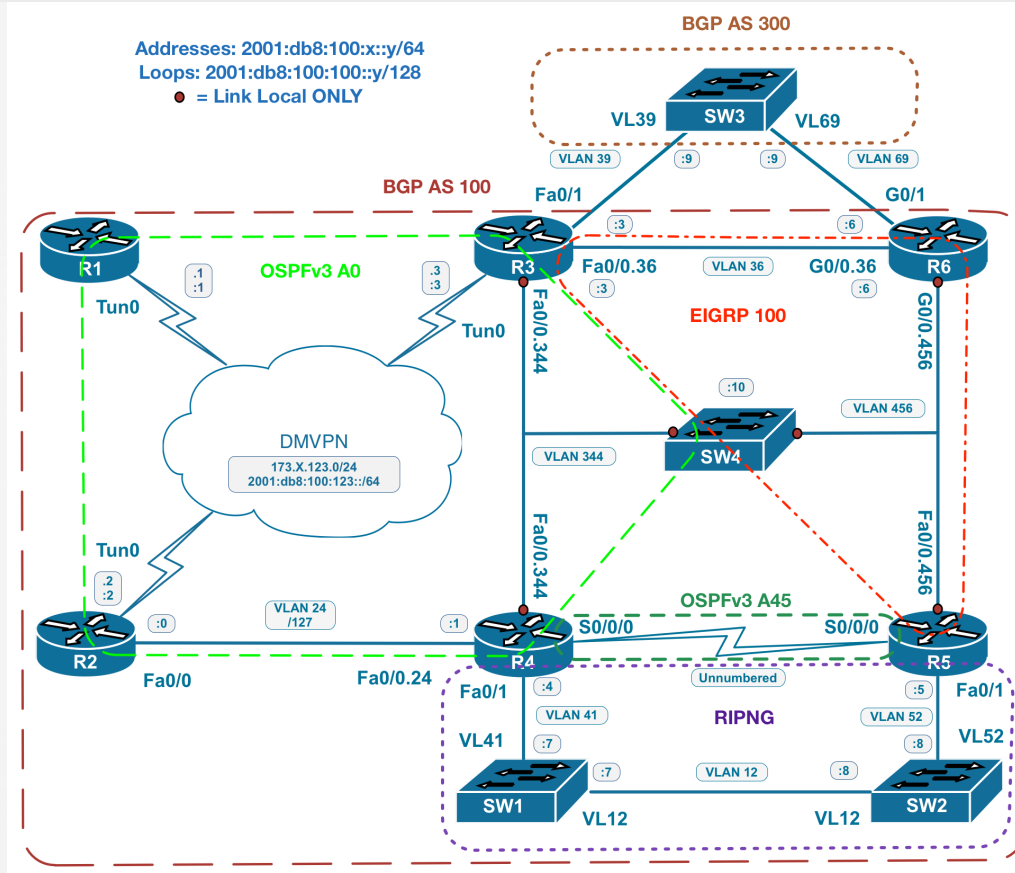
# SLAAC Configuration



# IPv6 Stateless DHCP Configuration



# IPv6 Base Topology



# IPv6 Stateless DHCPv6

- » Configuring IPv6 router DHCPv6 Scope
- » Configuring IPv6 Router Advertisement (RA)
- » Configuring IPv6 Host
- » Controlling host portion with link-local address



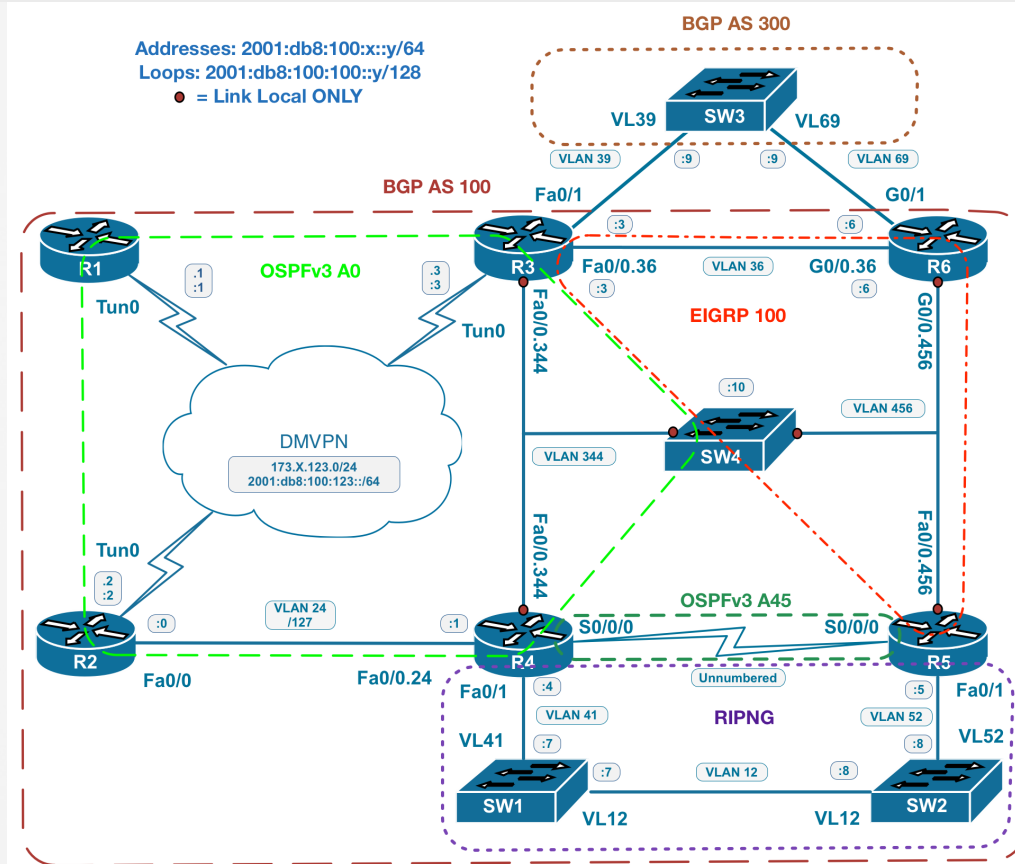
# IPv6 Stateless DHCP Configuration





# IPv6 DHCP Configuration

# IPv6 Base Topology



# IPv6 DHCPv6

- » Configuring IPv6 router DHCPv6 Scope
- » Configuring IPv6 Interface
- » Configuring DHCPv6 Client
- » Controlling host portion with link-local address





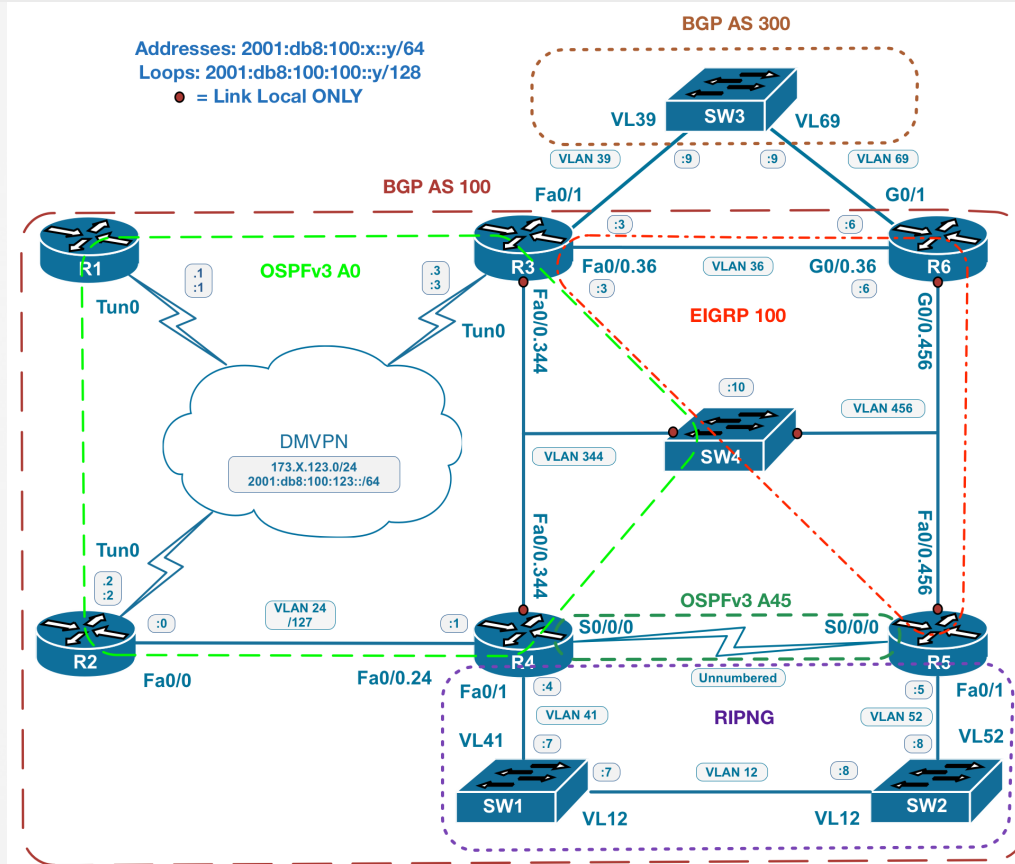
# IPv6 DHCP Configuration



# IPv6 DHCP Prefix Delegation Configuration



# IPv6 Base Topology



# IPv6 DHCPv6 Prefix Delegation

- » Configuring IPv6 router DHCPv6 Scope
- » Configuring IPv6 Interface
- » Configuring DHCPv6 Client
- » Controlling host portion with link-local address



# IPv6 DHCP Prefix Delegation Configuration





# IPv6 Address Configuration





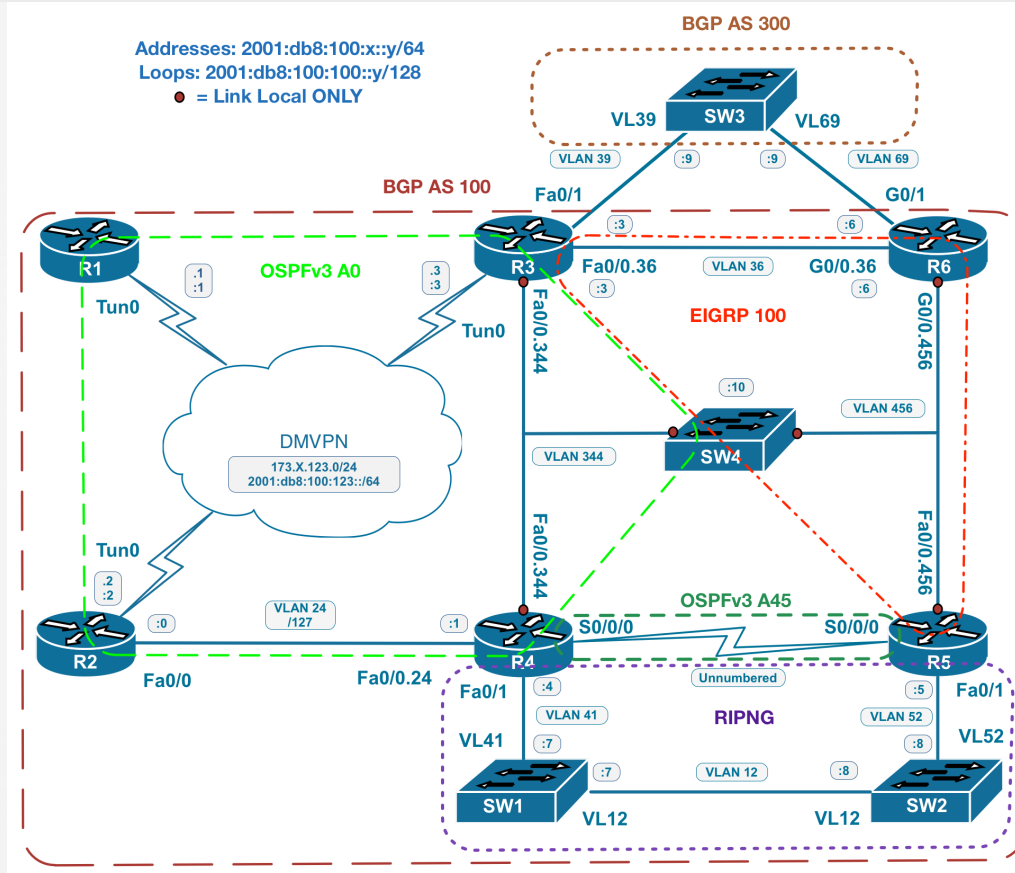
# IPv6 Routing Protocols



RIPng



# IPv6 Base Topology



# RIPng

- » RFC 2080
- » Runs over IPv6
- » Exchanges IPv6 Routes
- » Can run up to four instances on a router
- » Is named RIPng (Really RIPv2 for IPv6)





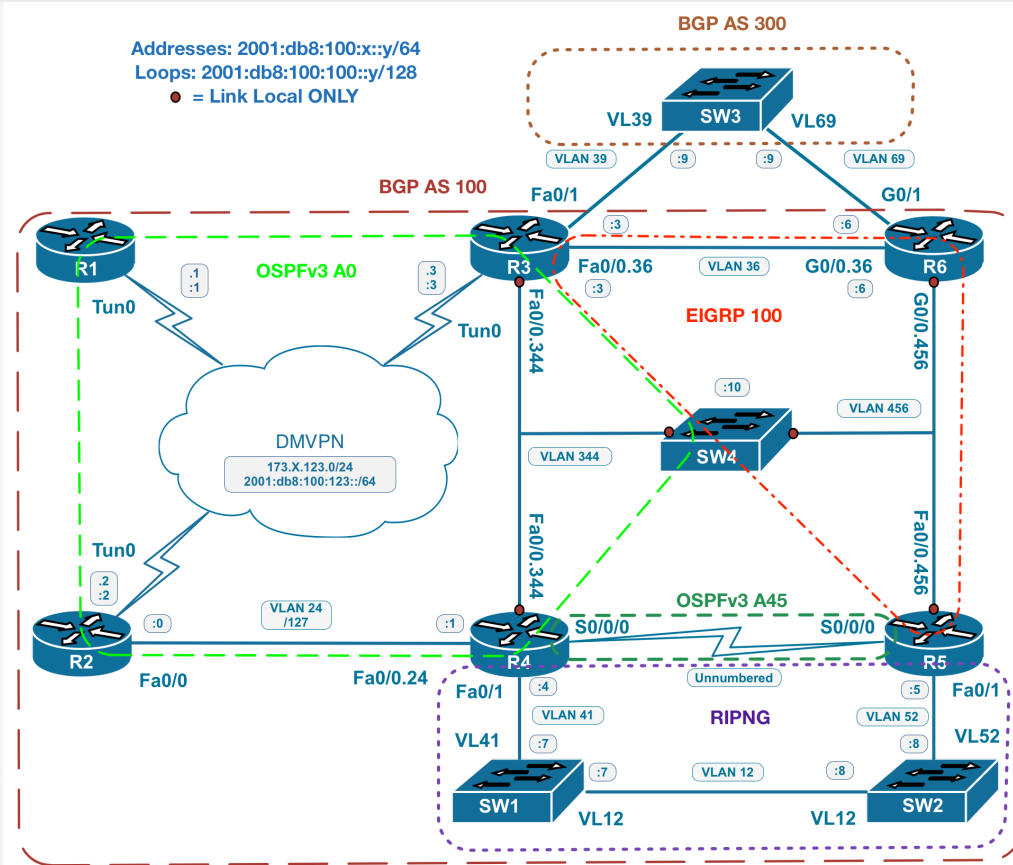
RIPng



# EIGRP



# IPv6 Base Topology



# EIGRP

- » Adds a new address family to EIGRP
- » Can be run in either Legacy or Named configuration
- » Can be run in a VRF only in named mode
- » Legacy mode requires creation of the global process
- » Named mode on be default on IPv6 Interfaces





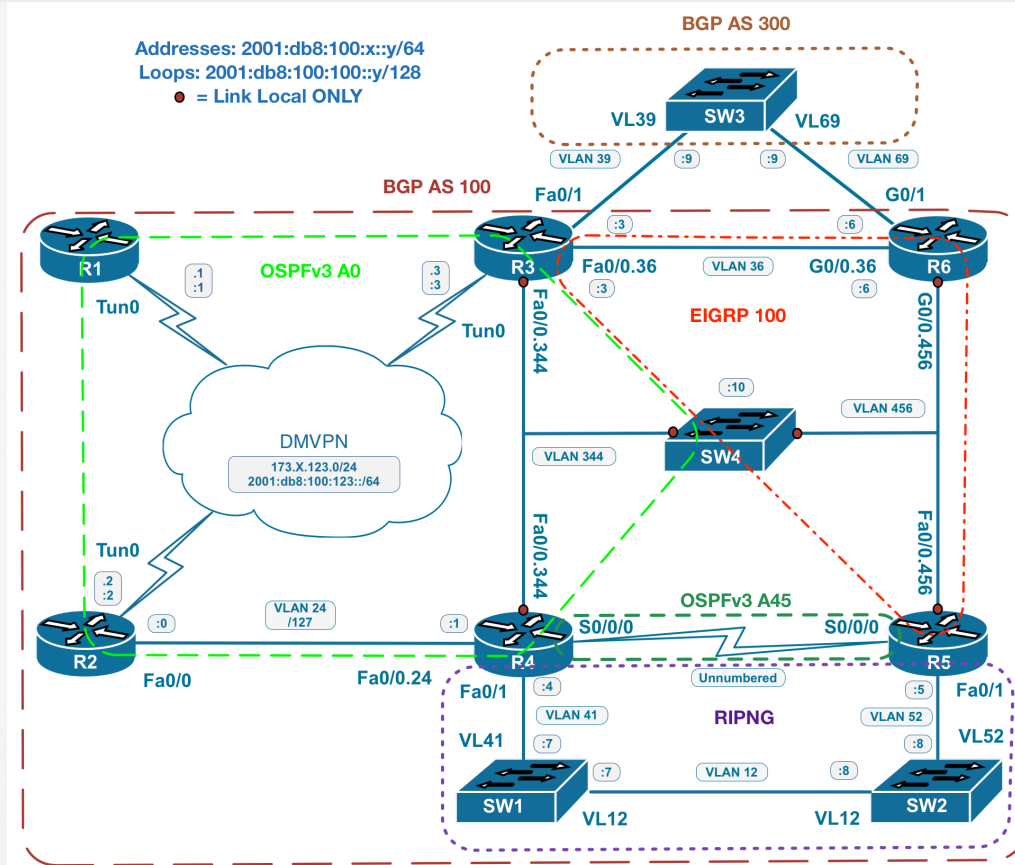
# EIGRP



# OSPF



# IPv6 Base Topology



# OSPFv3

- » Can be configured with legacy 'ipv6 router ospf x' – This cannot be used in a VRF
- » Newer syntax is 'router ospfv3 x' – This supports VRFs
- » New syntax also supports running IPv4 over OSPFv3 so only one routing protocol is needed – Still requires IPv6 for transport





# OSPF



# OSPF Database



# OSPFv3

## » Major changes to the OSPF database

- Separates Topology and prefix information
- Uses two new LSA types (8 and 9)





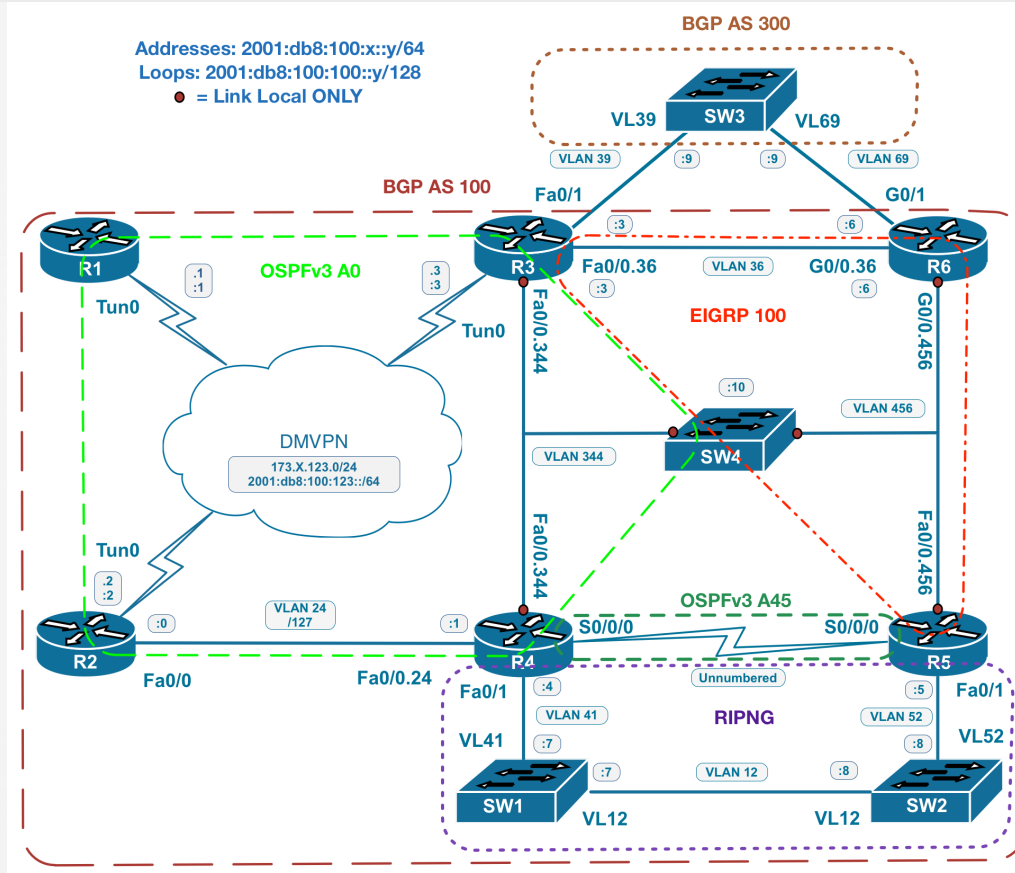
# OSPF Database



# BGP Address Families



# IPv6 Base Topology





# BGP

- » Adds a new address family to BGP
- » BGP can be running over IPv4 or IPv6 to exchange any address family
- » Next Hop issues need to be dealt with when running either IPv6 routes over a IPv4 session or visa versa



# BGP Address Families





# BGP IPv6 over IPv6





# BGP IPv6 over IPv4



# BGP IPv4 over IPv6

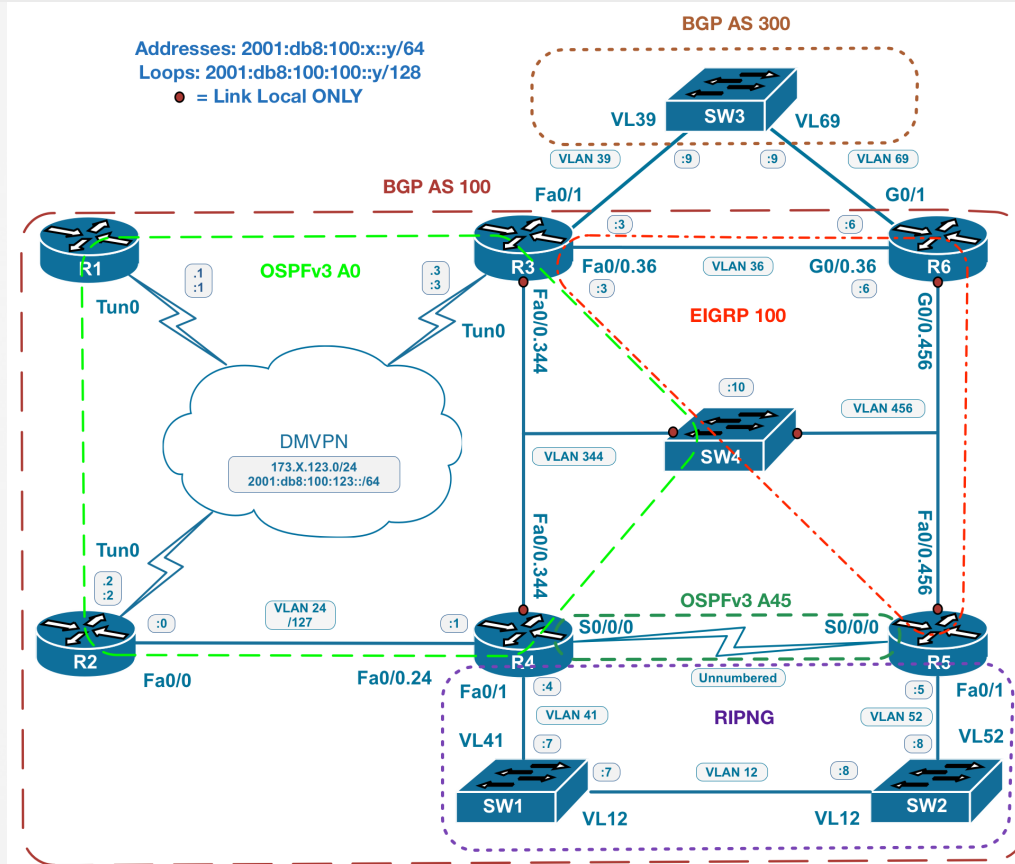




# Redistribution



# IPv6 Base Topology



# Redistribution

- » Fundamentally the same as IPv4 redistribution
- » Connected interfaces running the redistributed protocol are NOT automatically redistributed as they are by default in IPv4
- » RIPng exhibits a 'metric transparent' behavior when routes are redistributed



# Redistribution





# IPv6 Routing Protocols



# Transition Mechanisms





# Tunnels



# Tunnels

- » GRE
- » IPv6IP tunnels
- » 6to4 tunnels
- » ISATAP tunnels
- » MPLS
- » GRE Multipoint (DMVPN)



# Tunnels

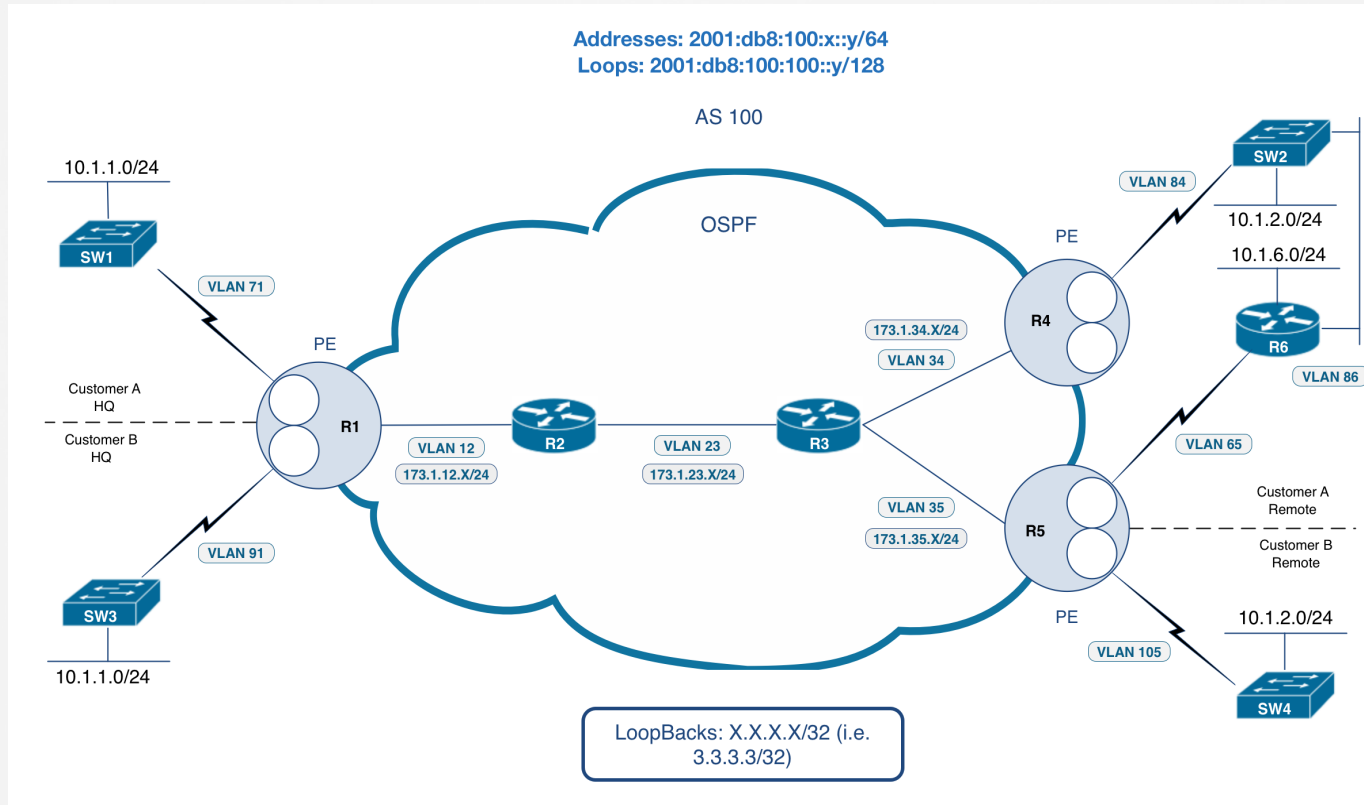




# GRE Tunnels



# IPv6 VPN Topology





# GRE Tunnels

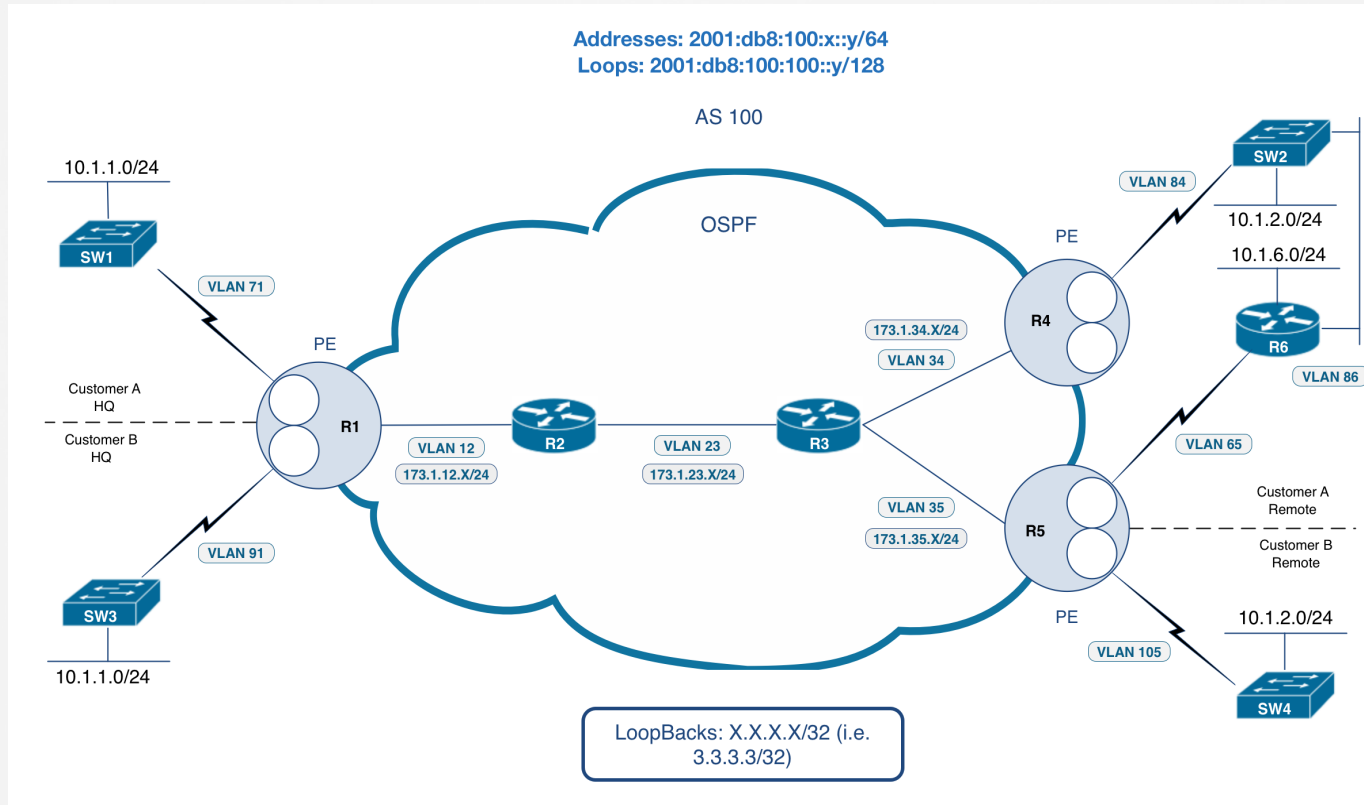




# IPv6IP Tunnels



# IPv6 VPN Topology





# IPv6IP Tunnels

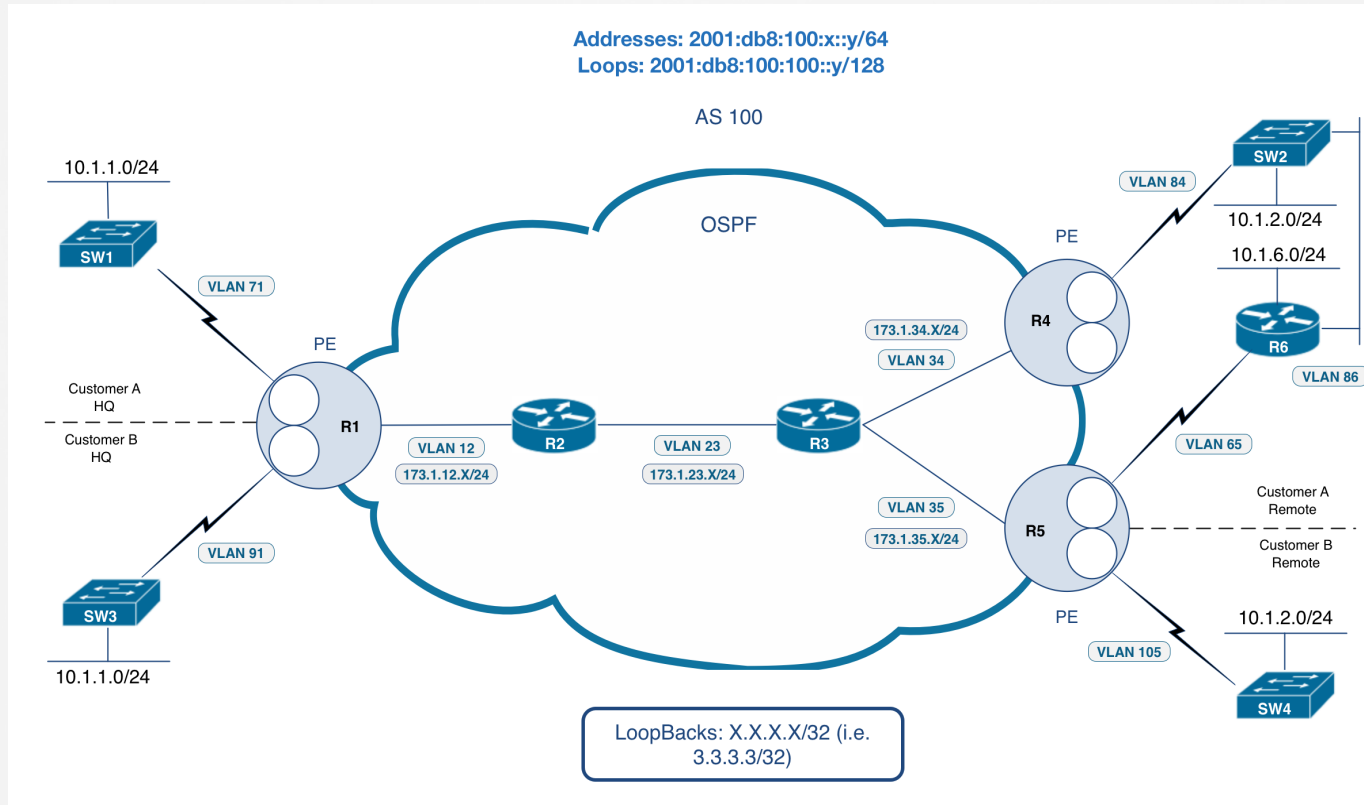




# 6to4 Tunnels



# IPv6 VPN Topology





# 6to4 Tunnels

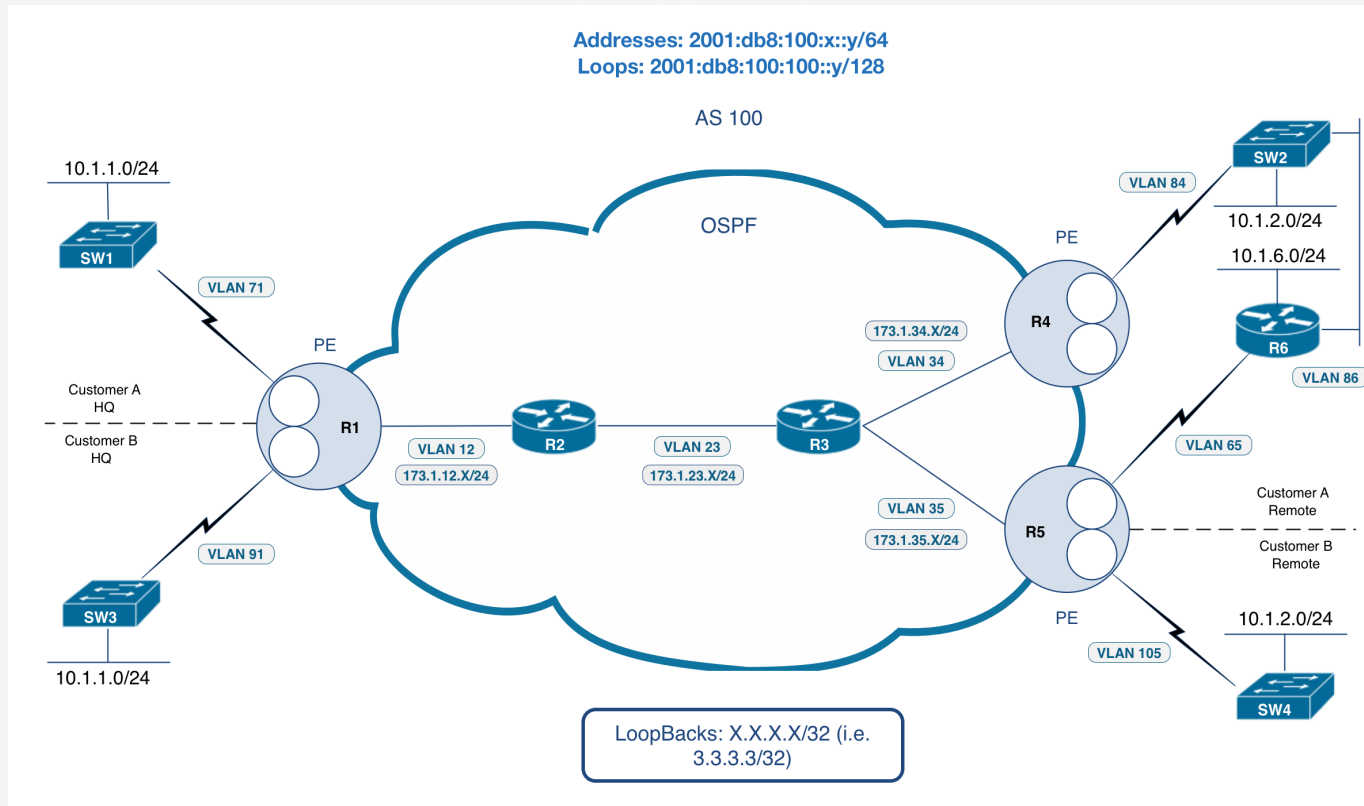




# ISATAP Tunnels



# IPv6 VPN Topology





# ISATAP Tunnels

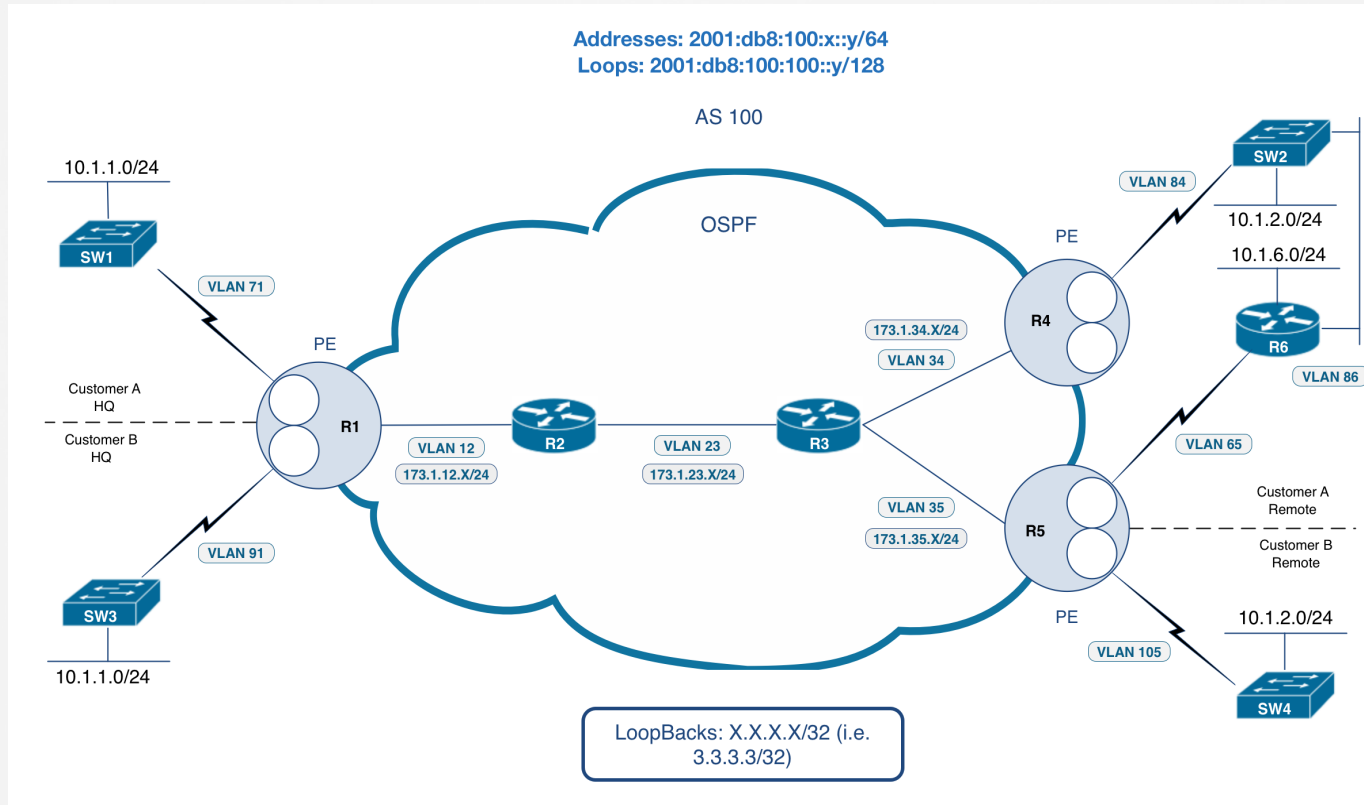




# DMVPN (GRE Multipoint Tunnels)



# IPv6 VPN Topology





# DMVPN (GRE Multipoint Tunnels)

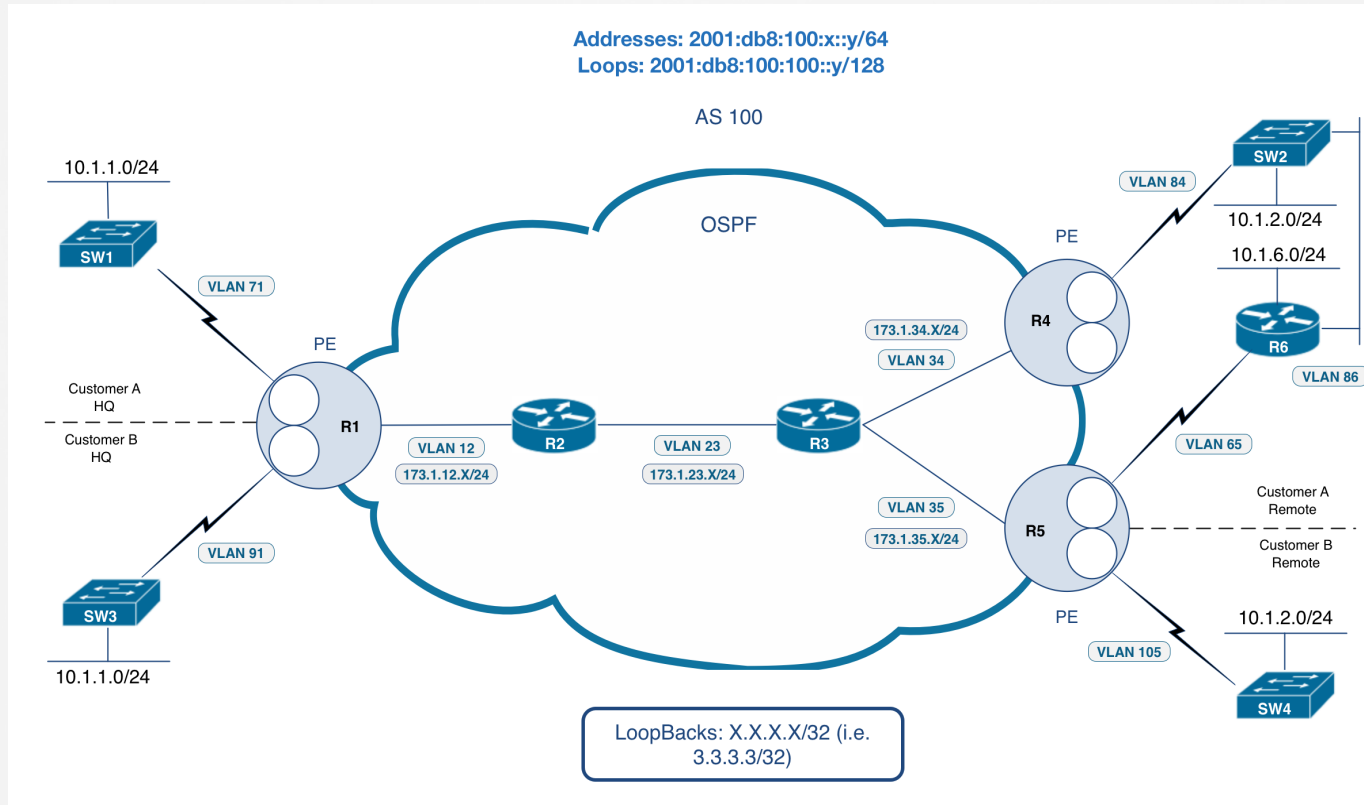




# MPLS 6PE



# IPv6 VPN Topology





# MPLS 6PE

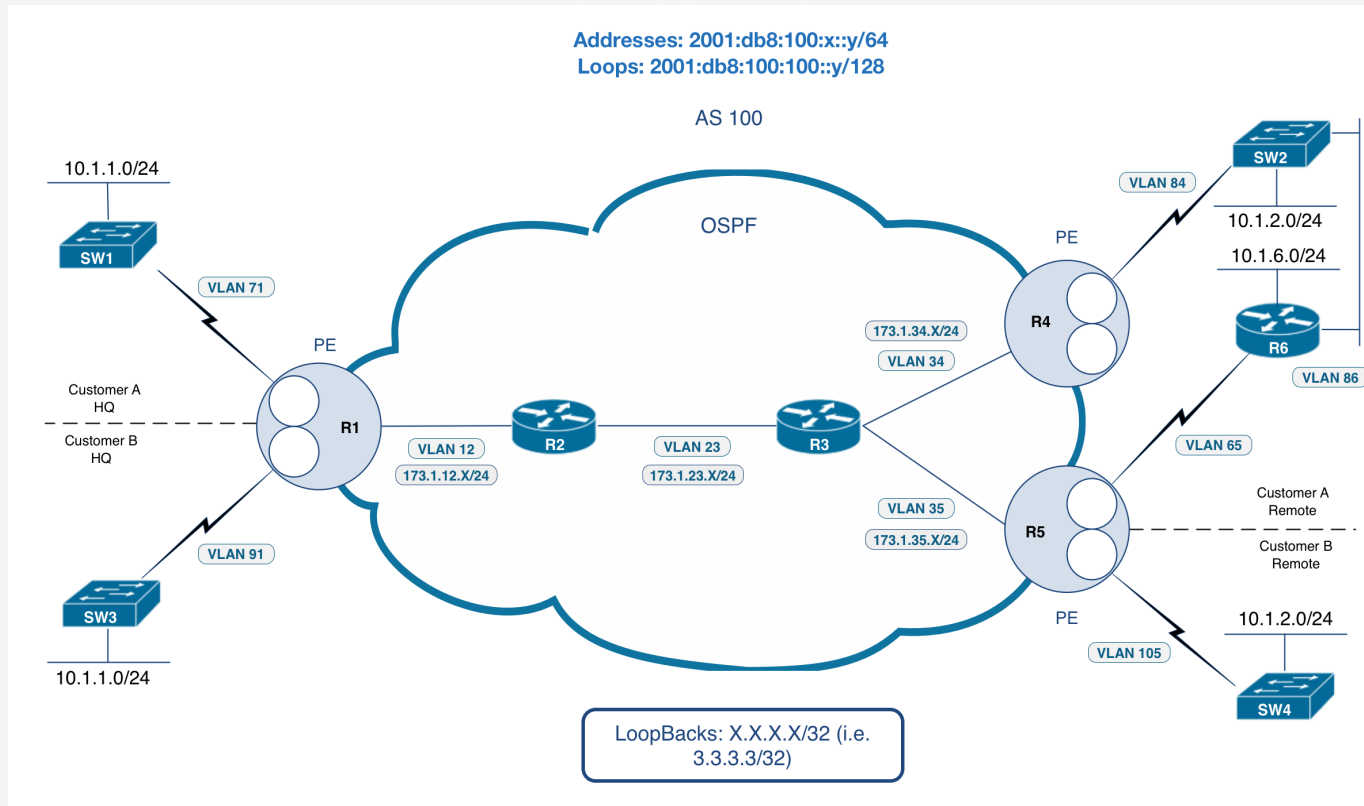




# MPLS 6VPE



# IPv6 VPN Topology





# MPLS 6VPE





# Dual Stack



# Dual Stack

- » Simple run both IPv4 and IPv6 at the same time on all devices
- » Both infrastructures are completely isolated
- » You are basically running two networks



# Dual Stack





# Transition Mechanisms