IPv6 on Cisco Fundamentals

Instructor Introduction

- **David Smith, CCIE #19125**
  - CCIE Routing and Switching – 2007

dsmith@ine.com

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

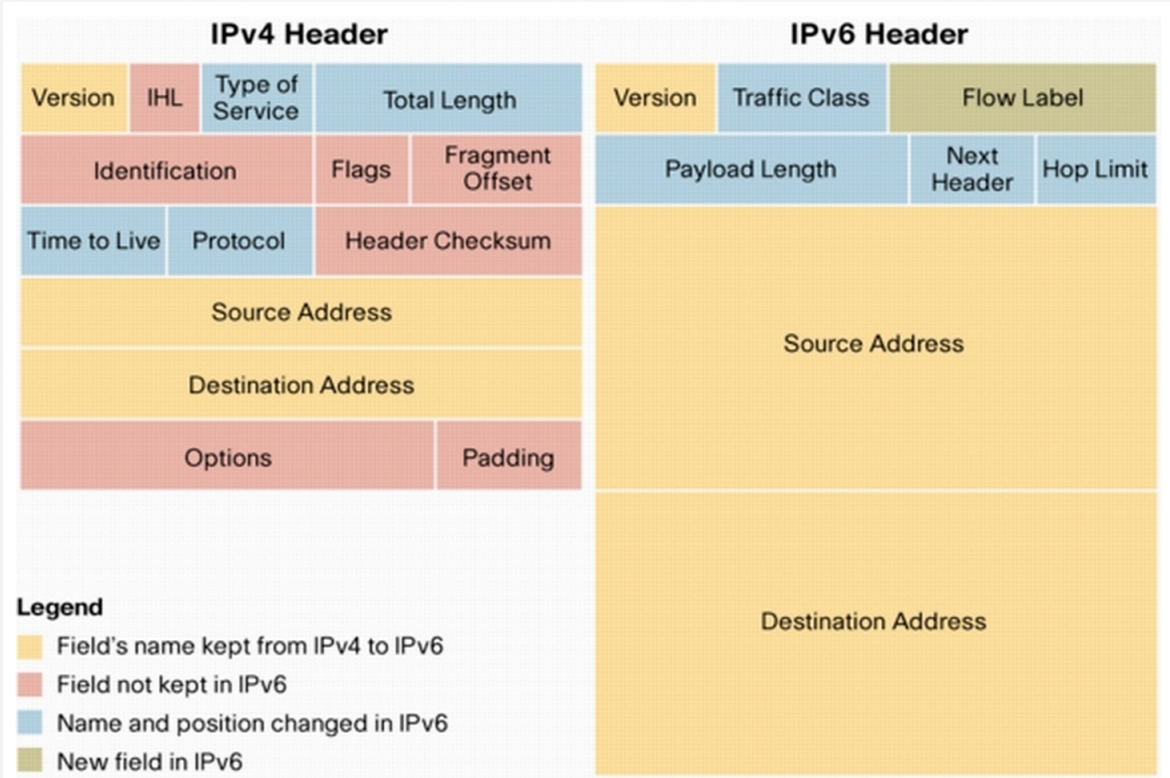
IPv6 on Cisco Fundamentals

Introduction to IPv6

Why IPv6?

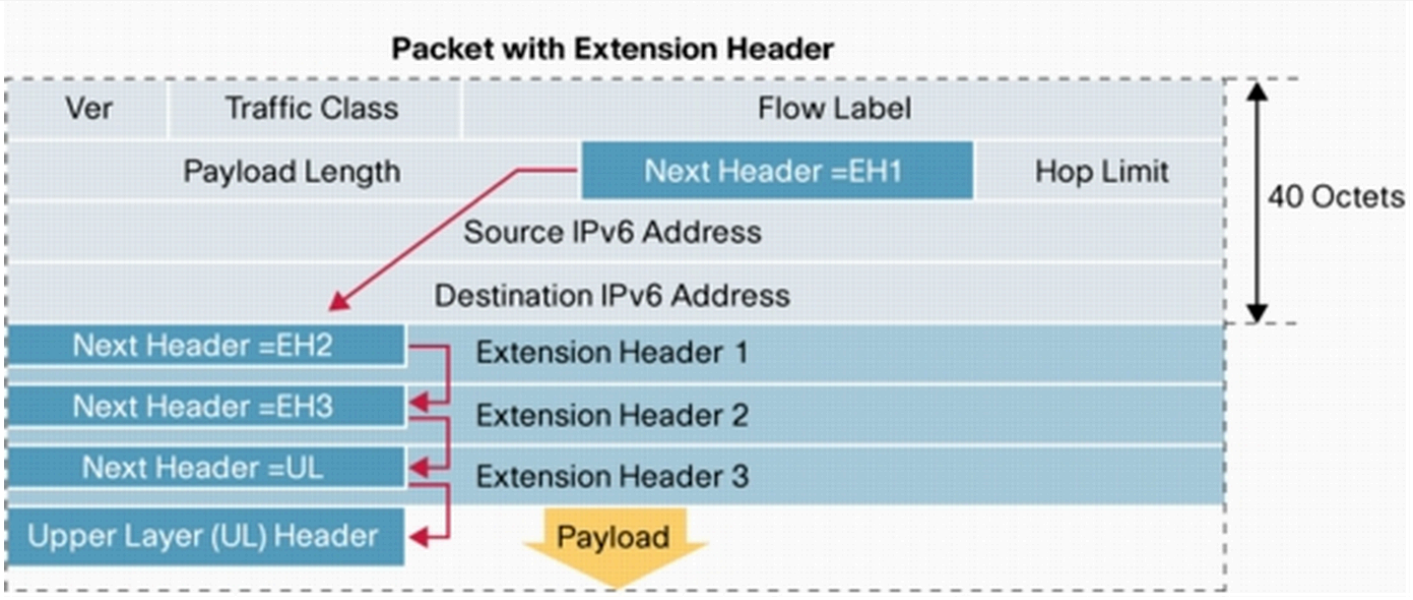
- IPv4 only has 2^32 or ~3.4 Billion Addresses
- After Classes, Multicast, reserved ranges etc.. There are far fewer usable
- NAT has been a HUGE help, but ultimately is a crutch to get around limited addressing and breaks the end to end connectivity model
- Broadcasts cause unnecessary CPU load

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
- 128bit Address
  - 2^128 (3.4 x 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

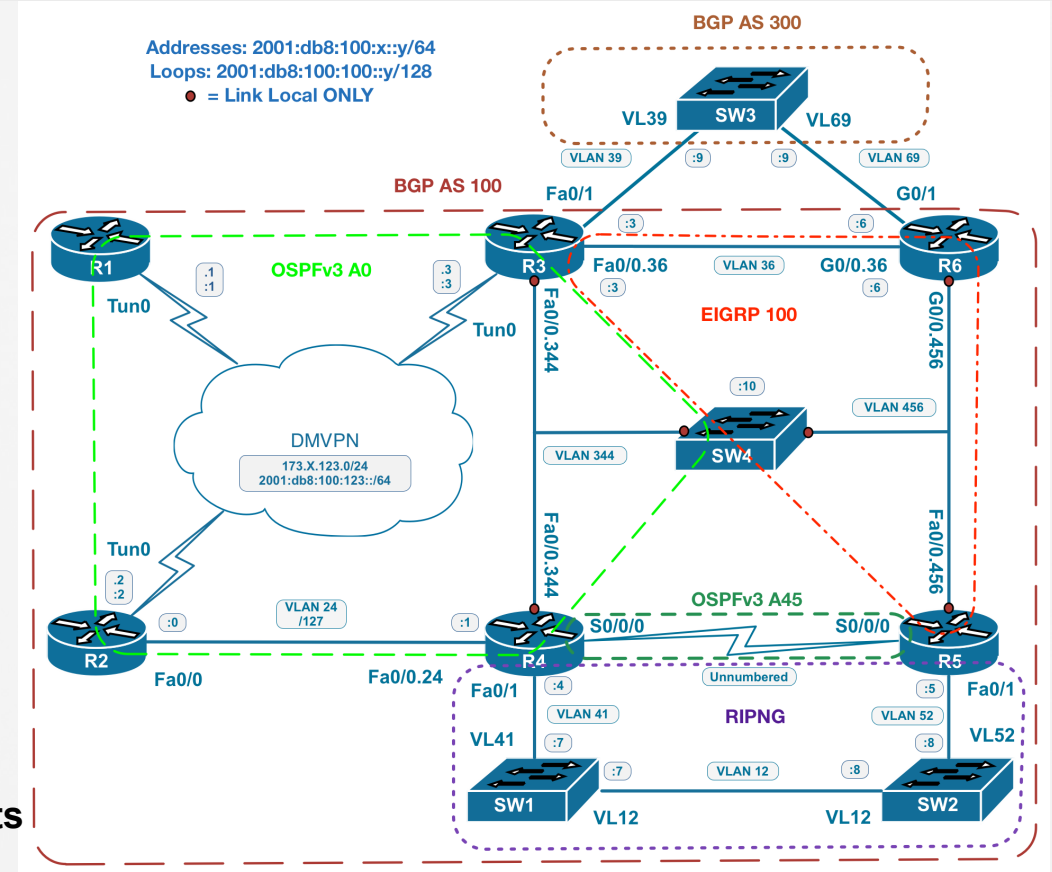
- Static
- Stateless Address Auto Configuration (SLAAC)
- Stateless DHCPv6 (DHCPv6 Lite)
- DHCPv6
- DHCPv6 prefix delegation

Introduction to IPv6

IPv6 Address Configuration

Manual Address Configuration

IPv6 Base Topology



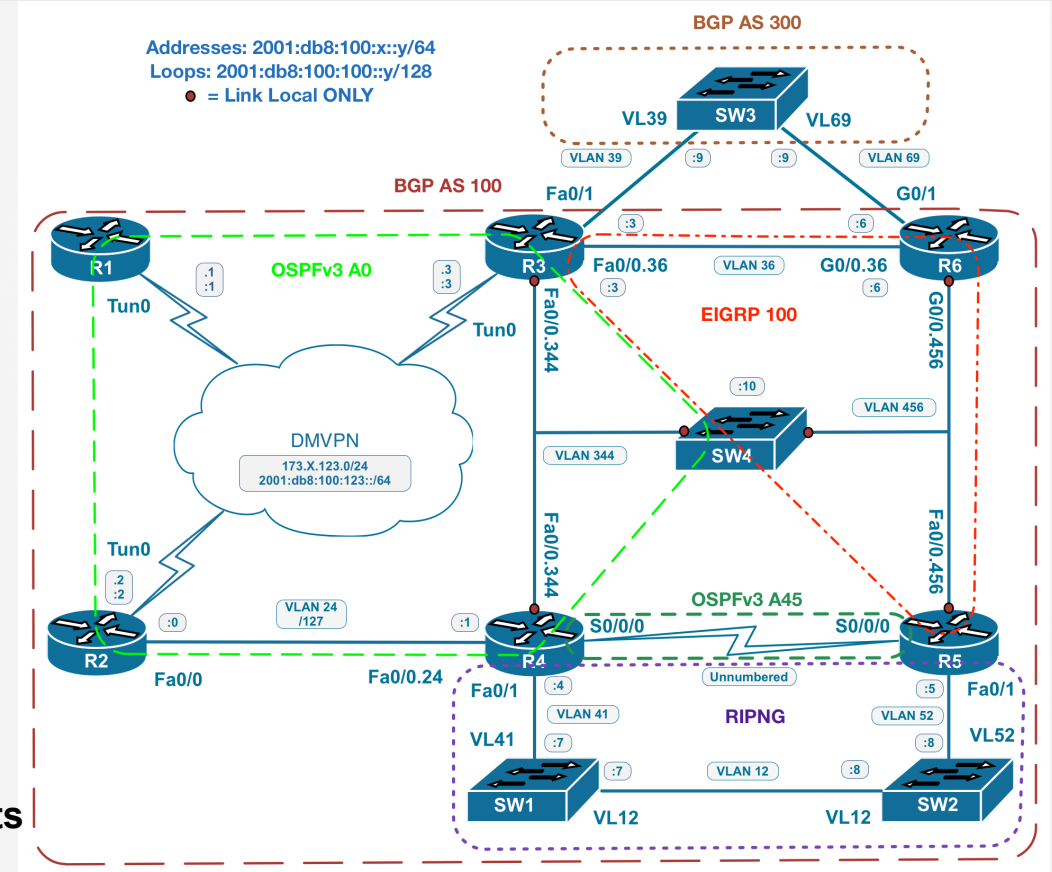
IPv6 'Manual' Address Configuration

- 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



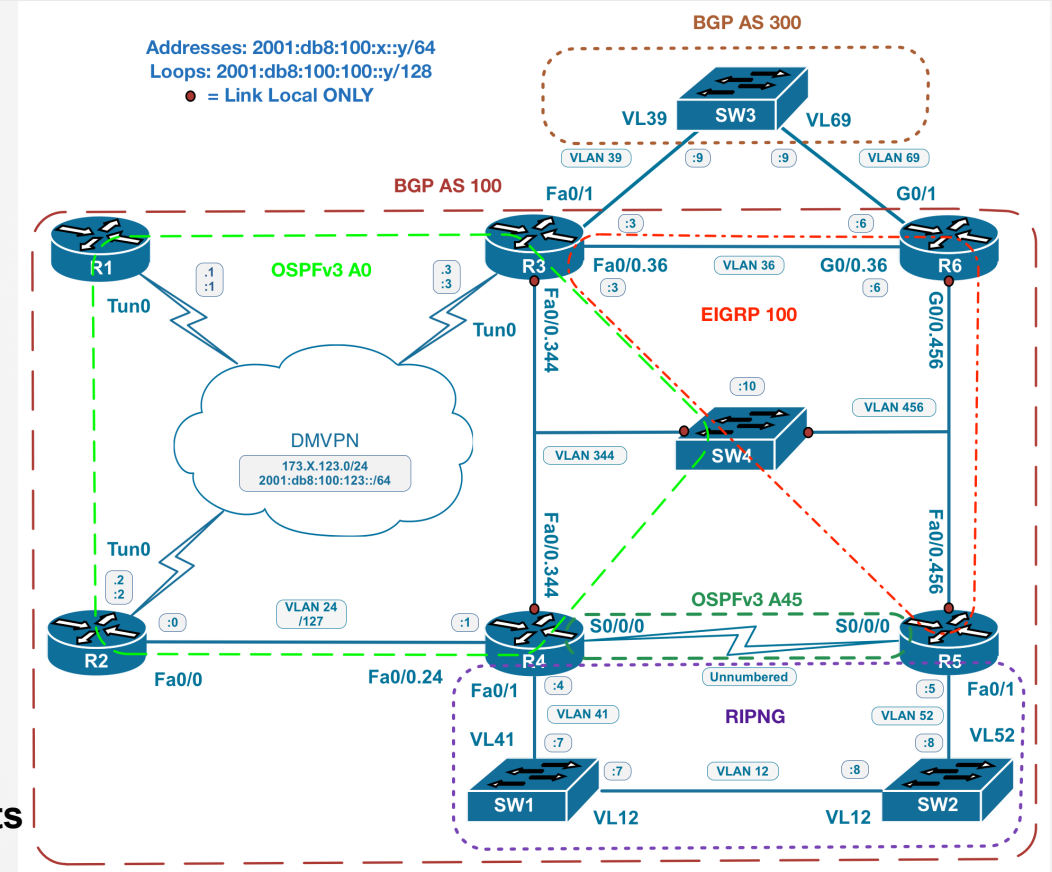
IPv6 SLAAC

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

SLAAC Configuration

IPv6 Stateless DHCP Configuration

IPv6 Base Topology



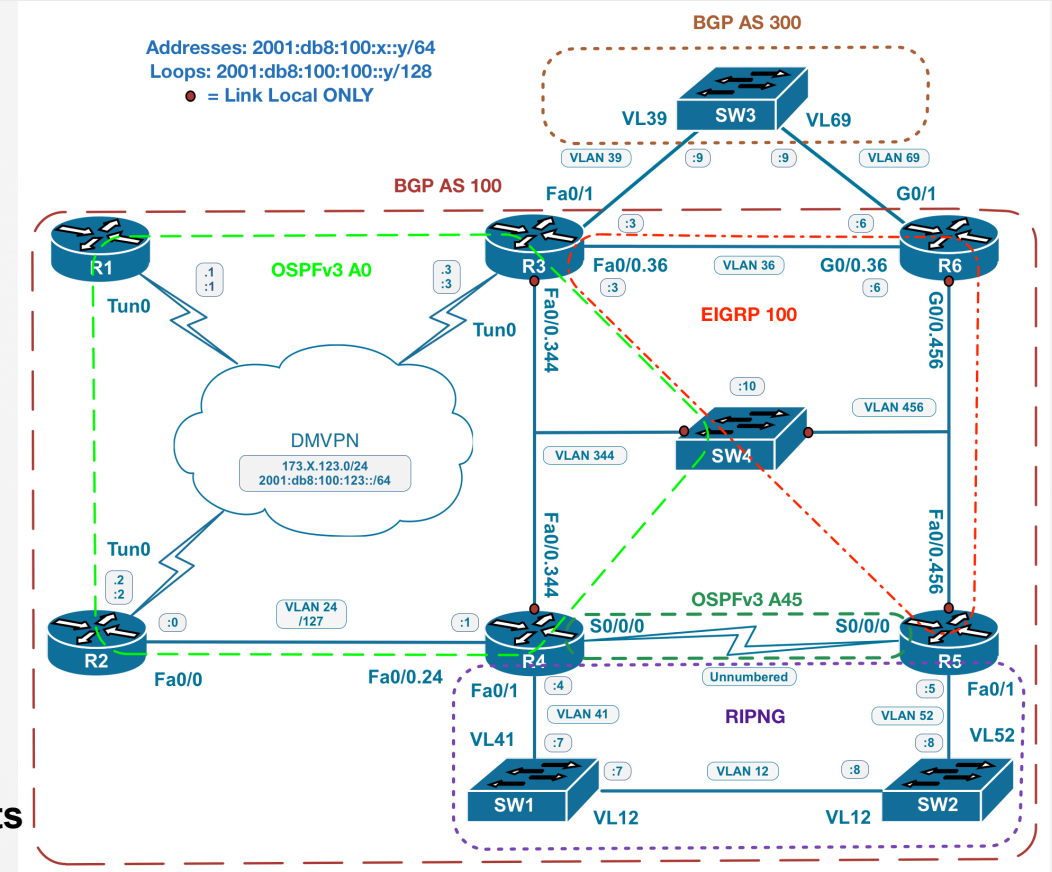
IPv6 Stateless DHCPv6

- 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



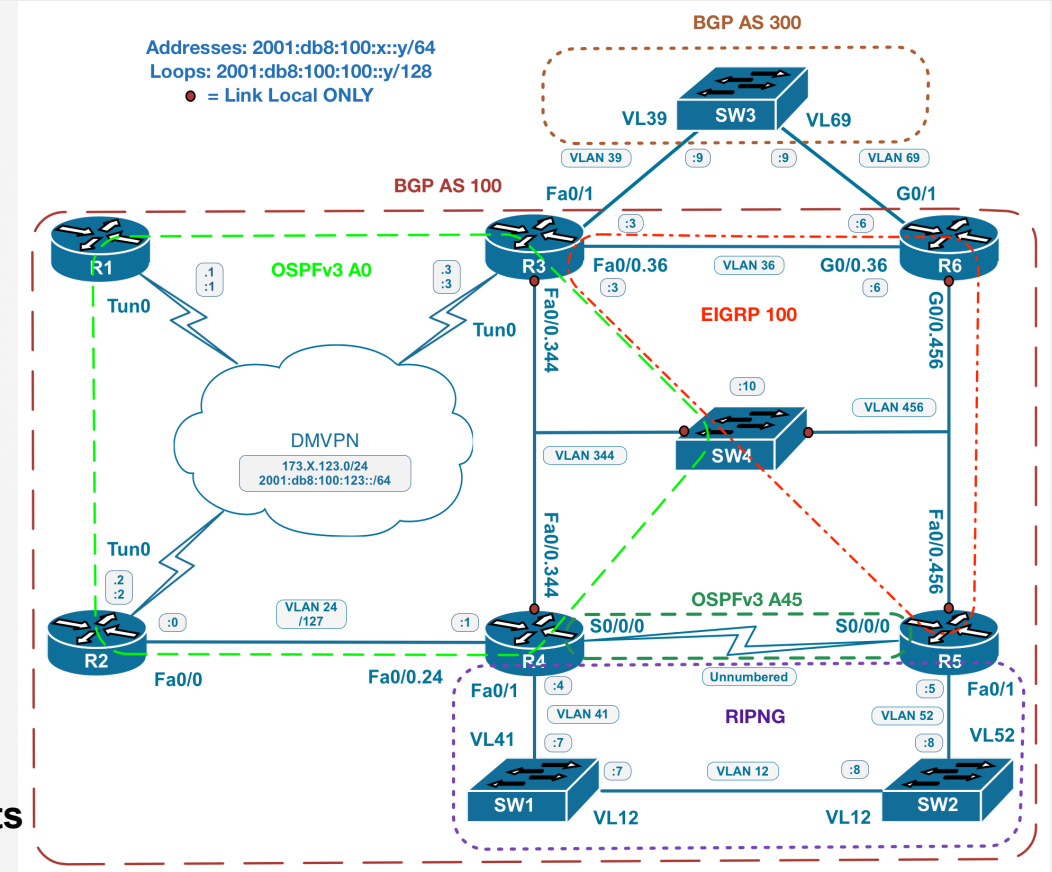
IPv6 DHCPv6

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

IPv6 DHCP Configuration

IPv6 DHCP Prefix Deligation Configuration

IPv6 Base Topology



IPv6 DHCPv6 Prefix Deligation

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- Controlling host portion with link-local address

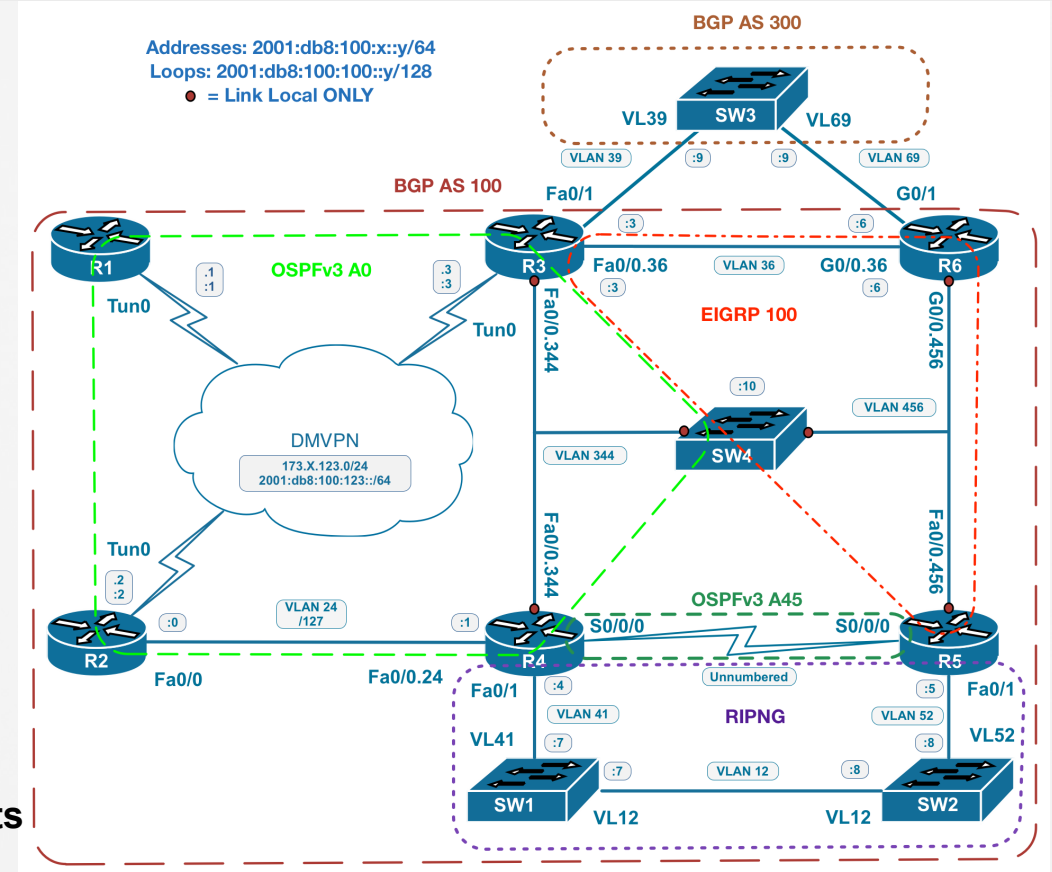
IPv6 DHCP Prefix Deligation Configuration

IPv6 Address Configuration

IPv6 Routing Protocols

RIPng

IPv6 Base Topology



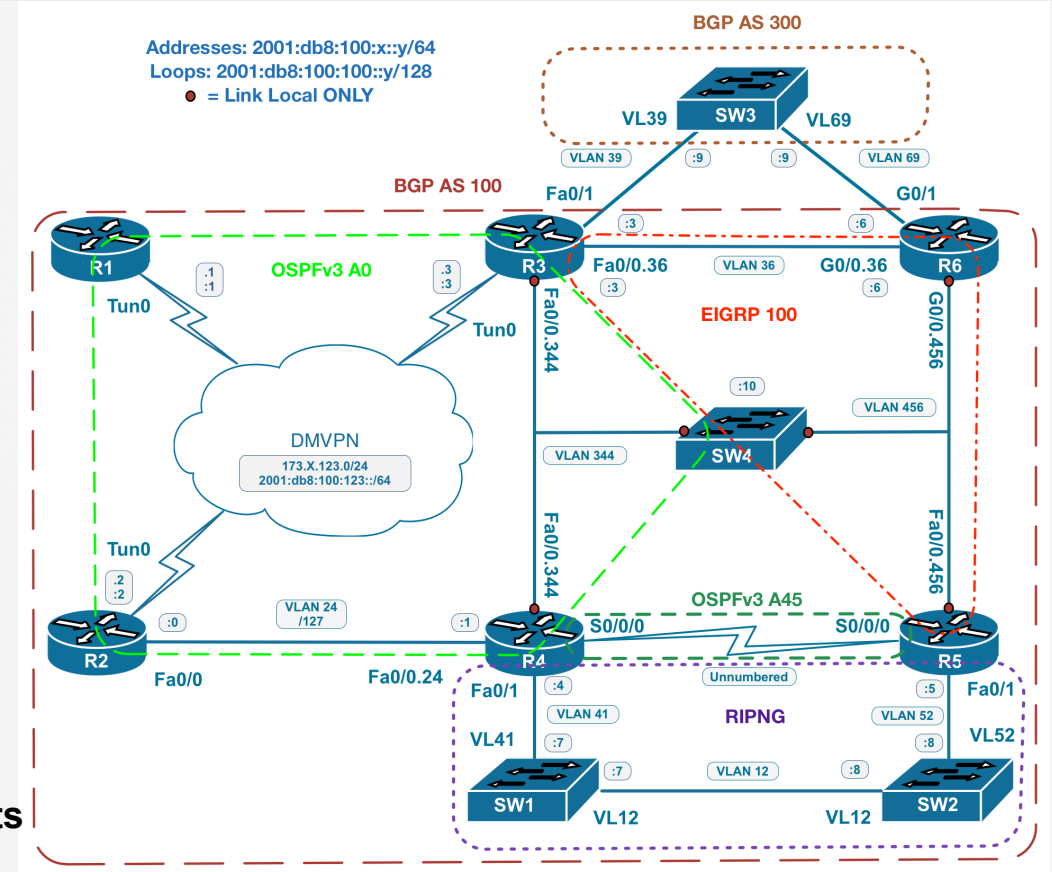
RIPng

- 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



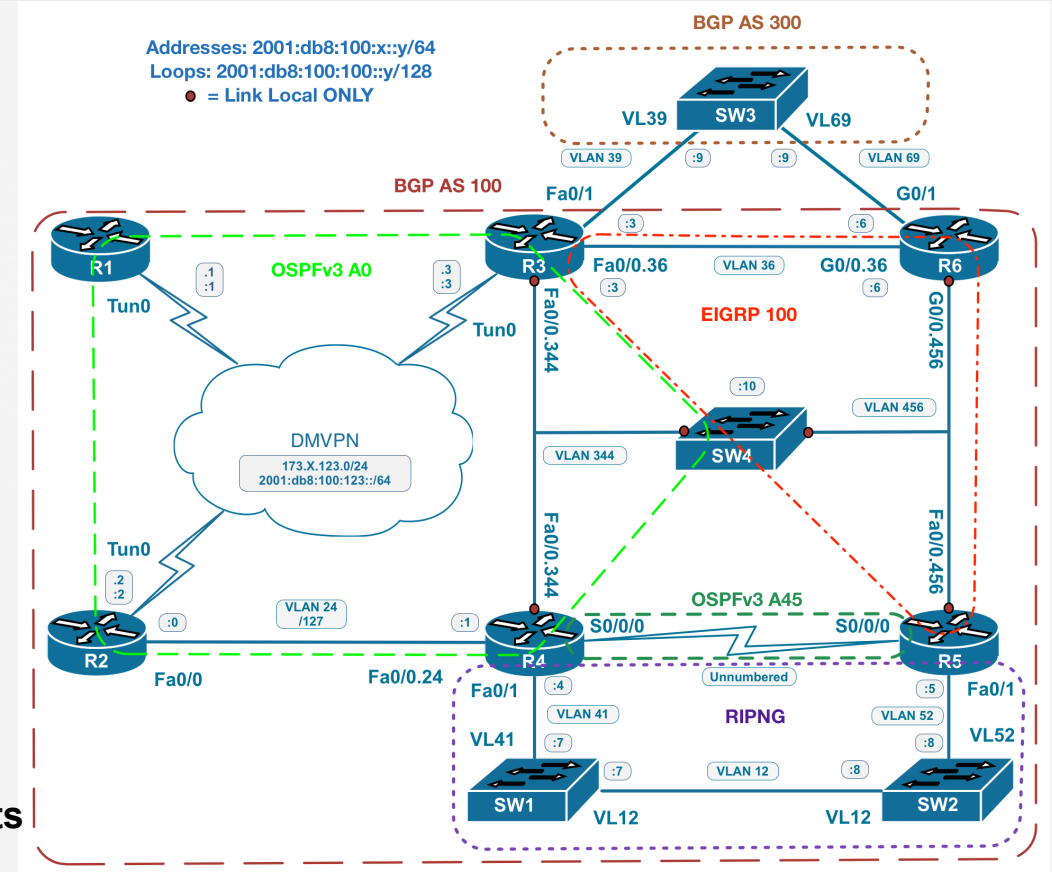
EIGRP

- 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

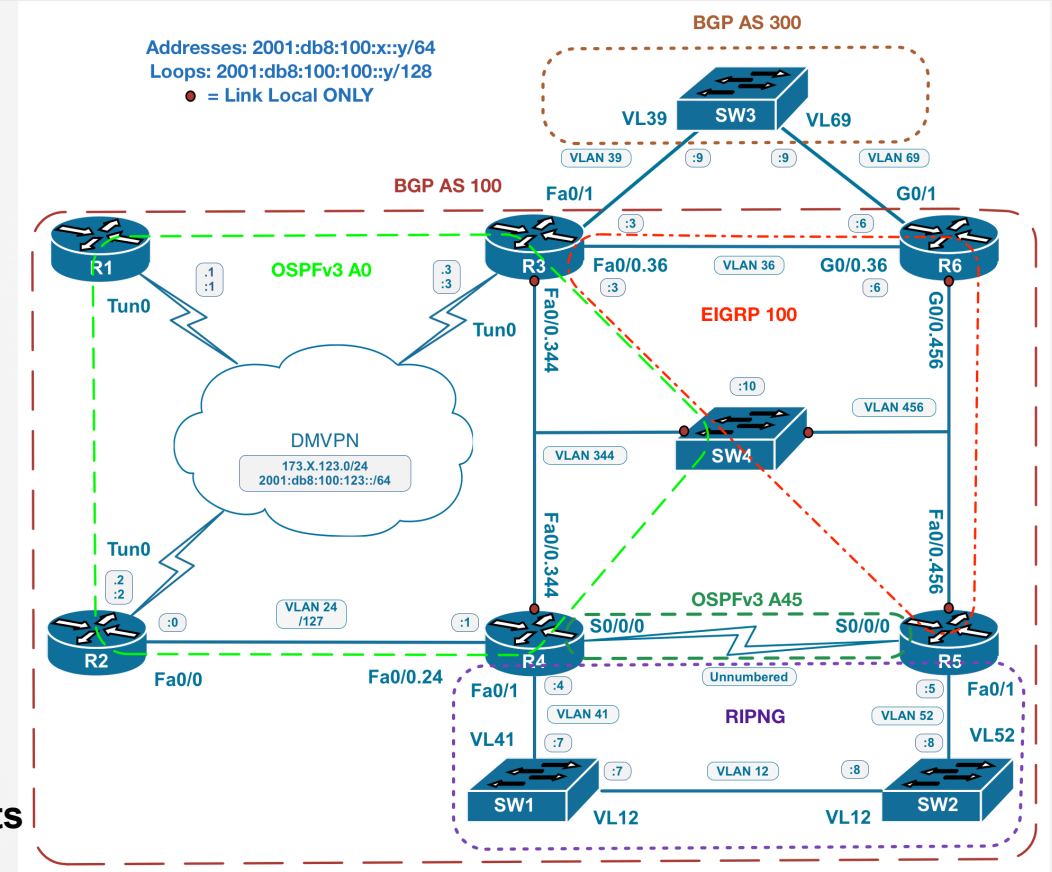
OSPFv3

- 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

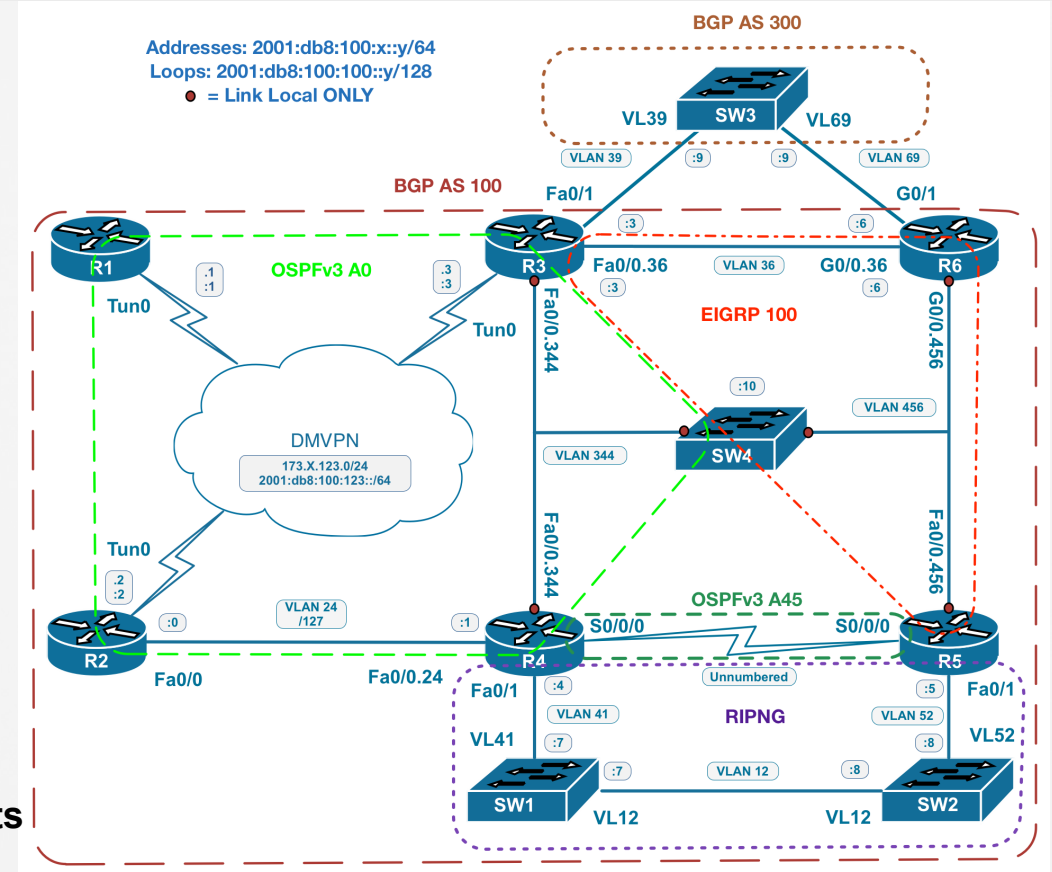
BGP IPv6 over IPv6

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

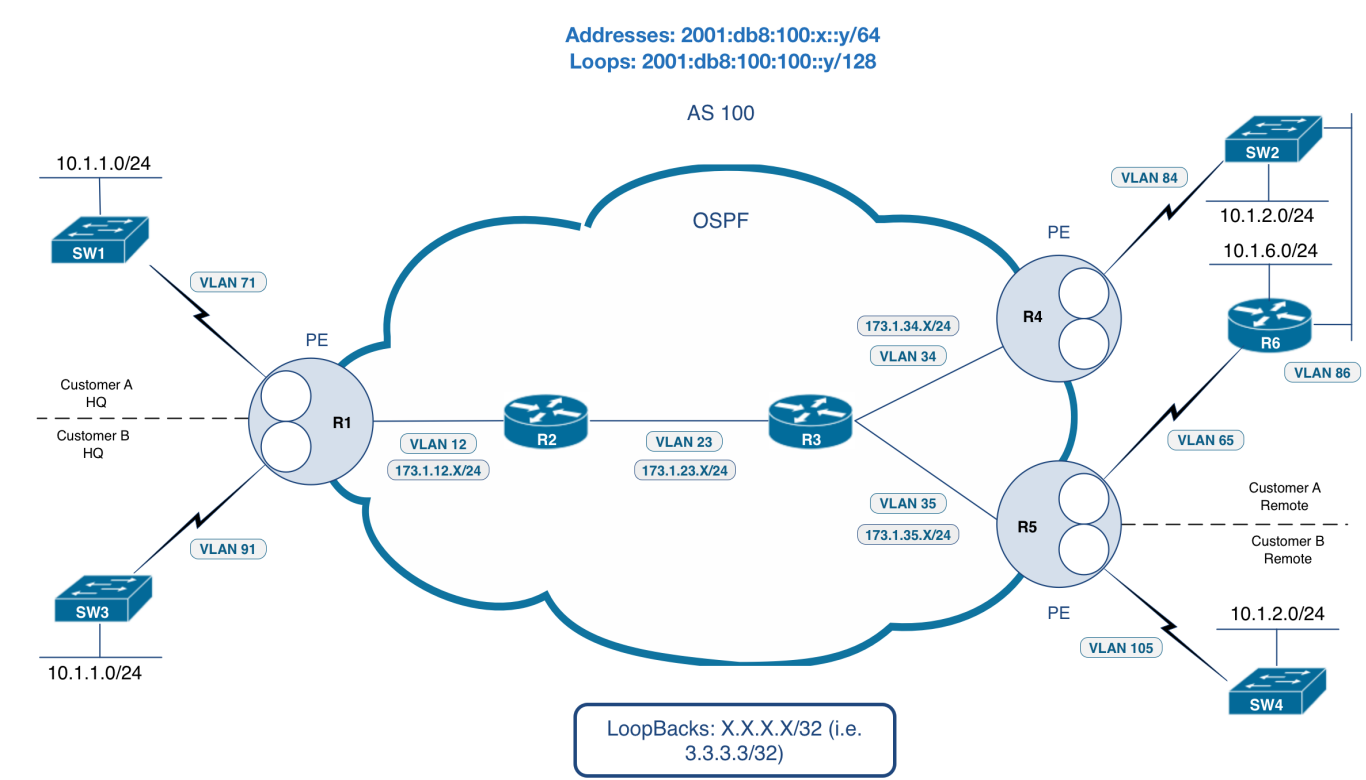
Tunnels

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

Tunnels

GRE Tunnels

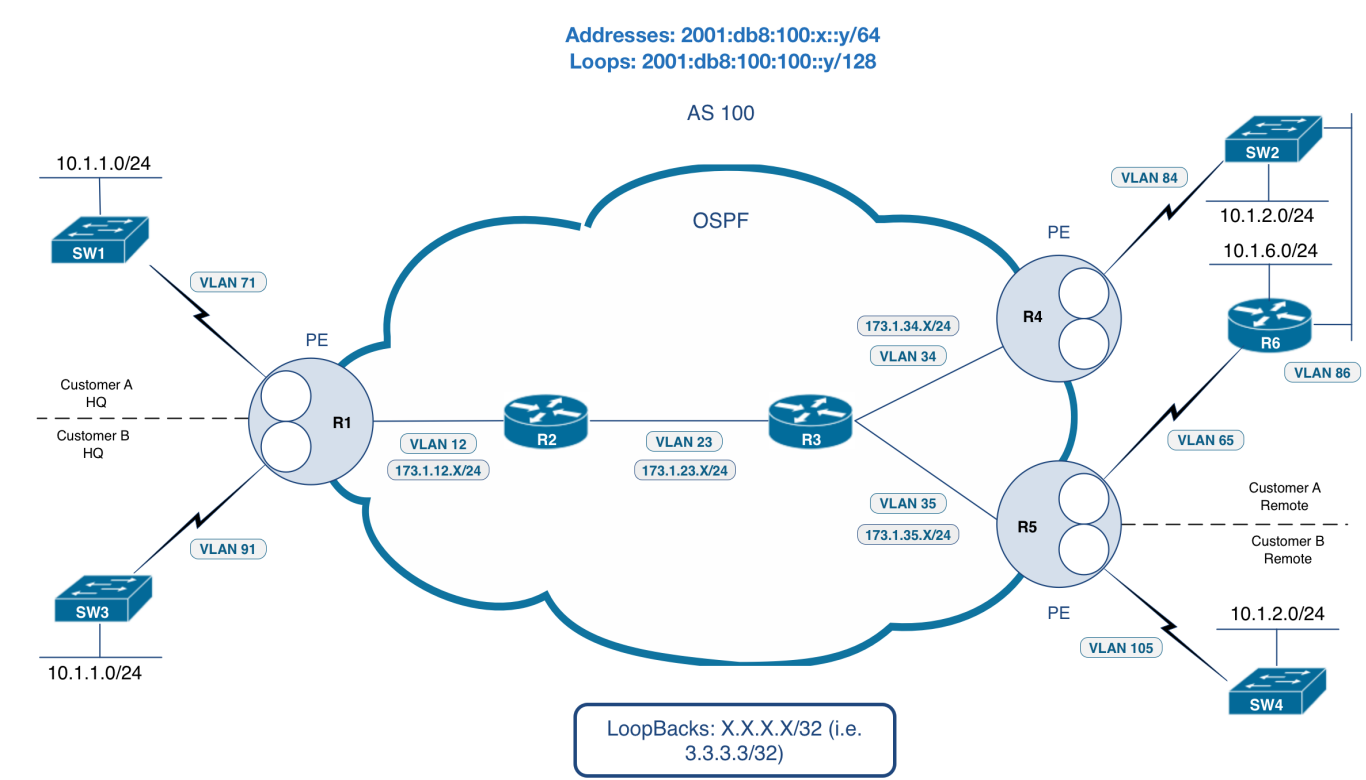
IPv6 VPN Topology



GRE Tunnels

IPv6IP Tunnels

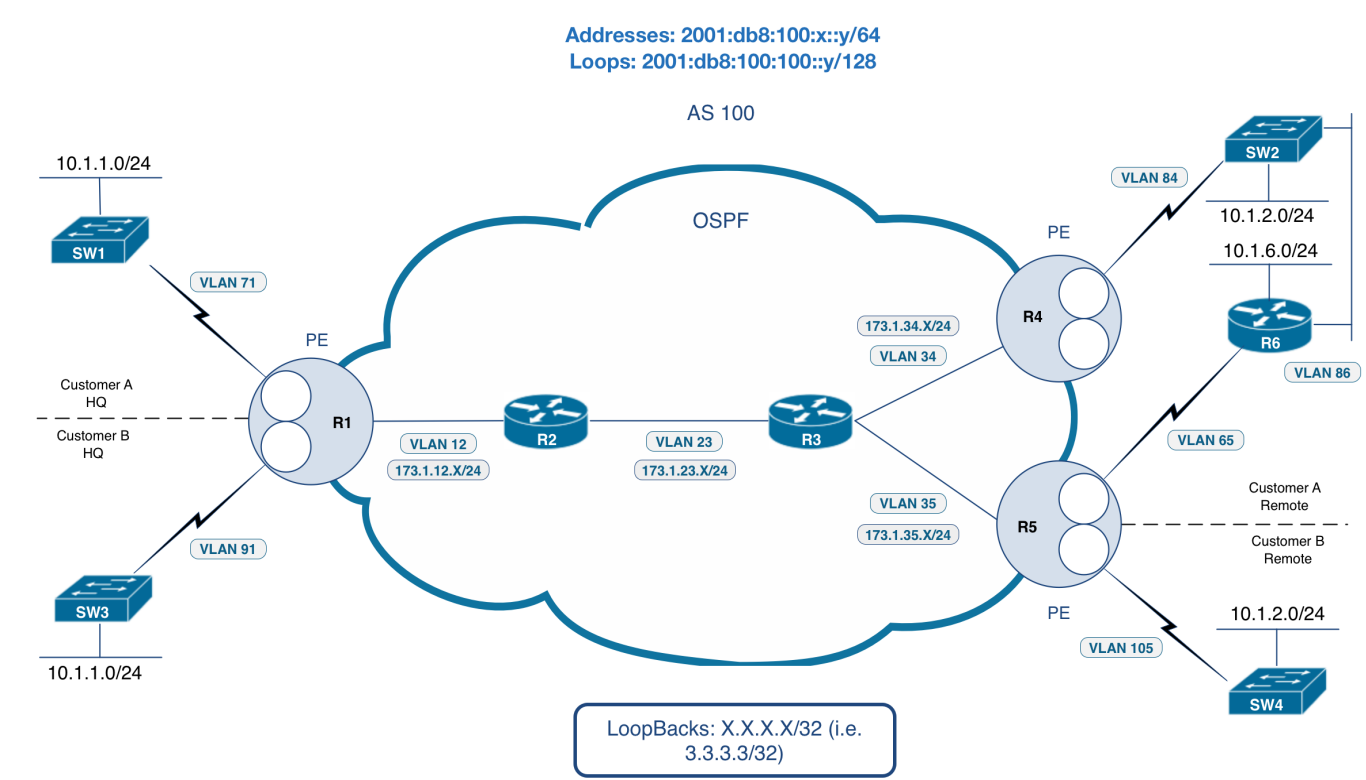
IPv6 VPN Topology



IPv6IP Tunnels

6to4 Tunnels

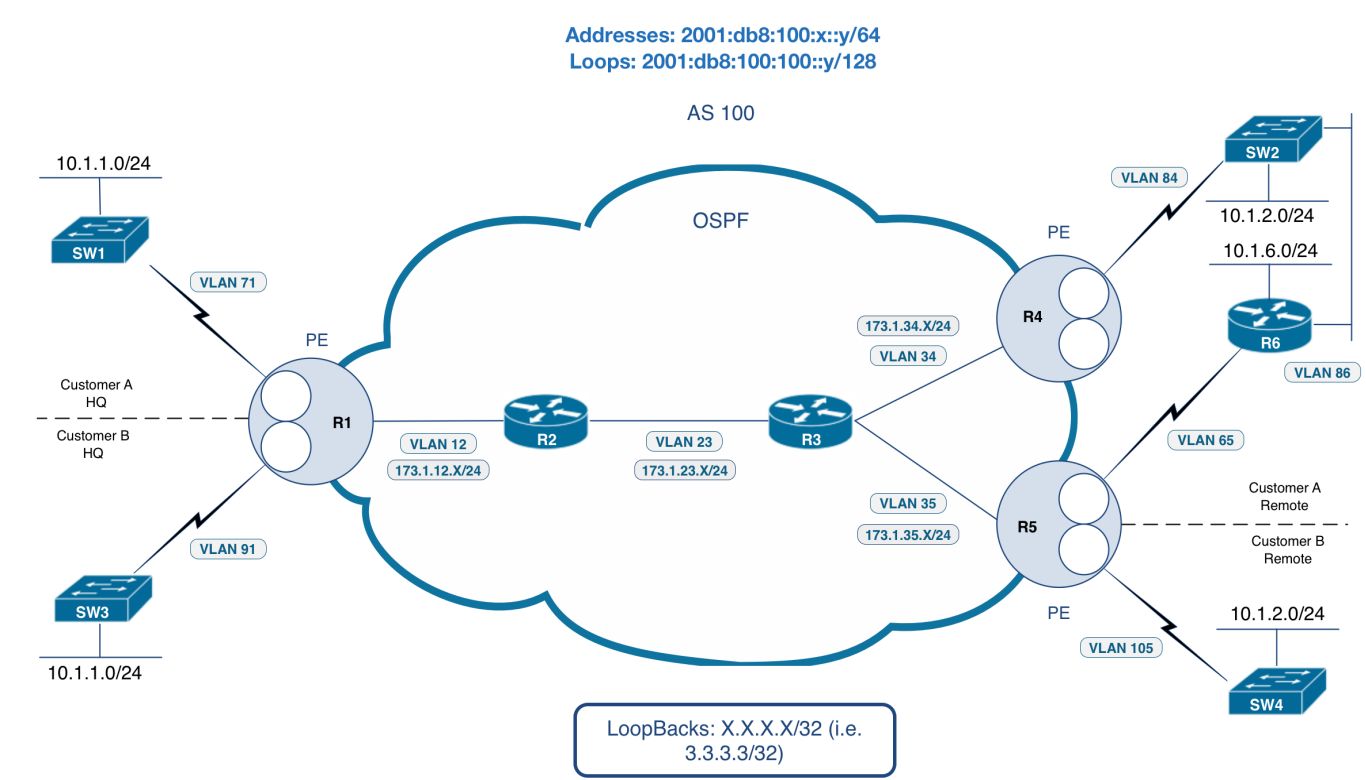
IPv6 VPN Topology



6to4 Tunnels

ISATAP Tunnels

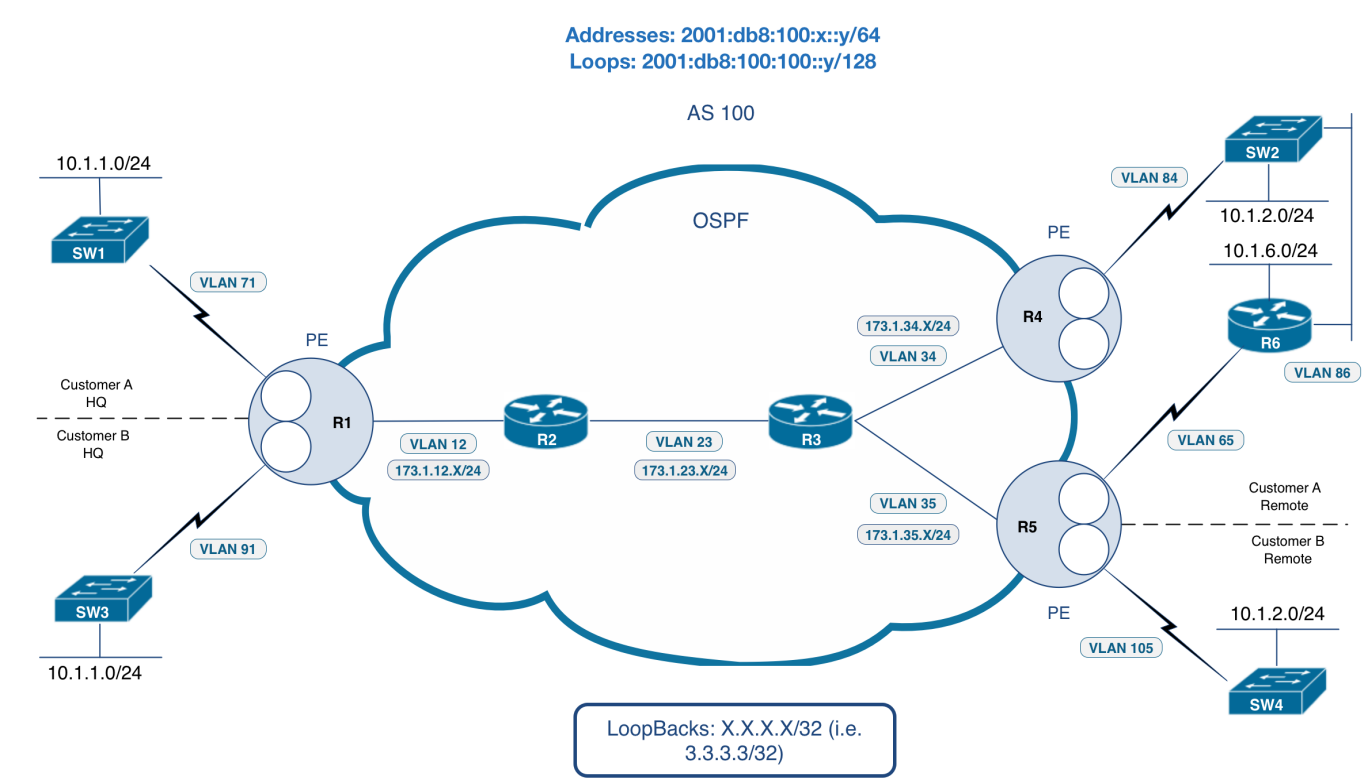
IPv6 VPN Topology



ISATAP Tunnels

DMVPN
(GRE Multipoint Tunnels)

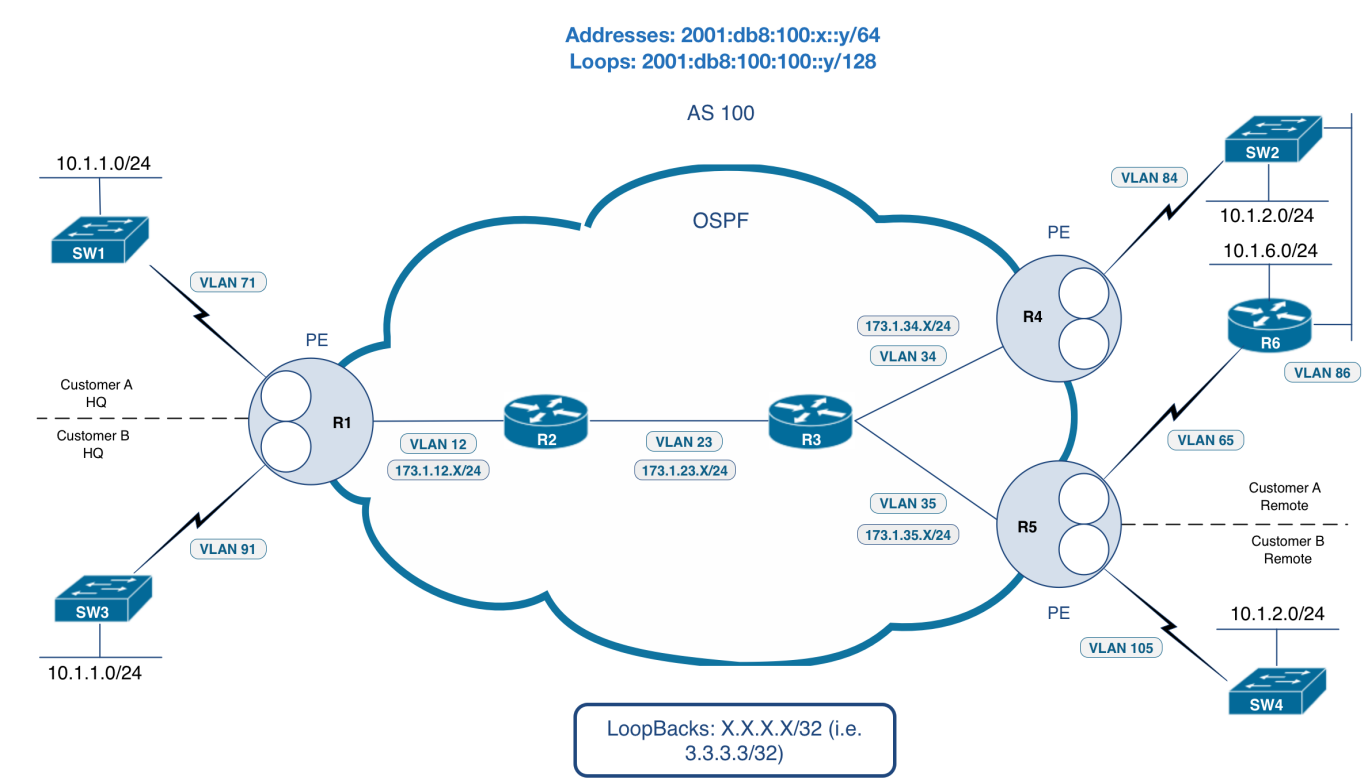
IPv6 VPN Topology



DMVPN
(GRE Multipoint Tunnels)

MPLS 6PE

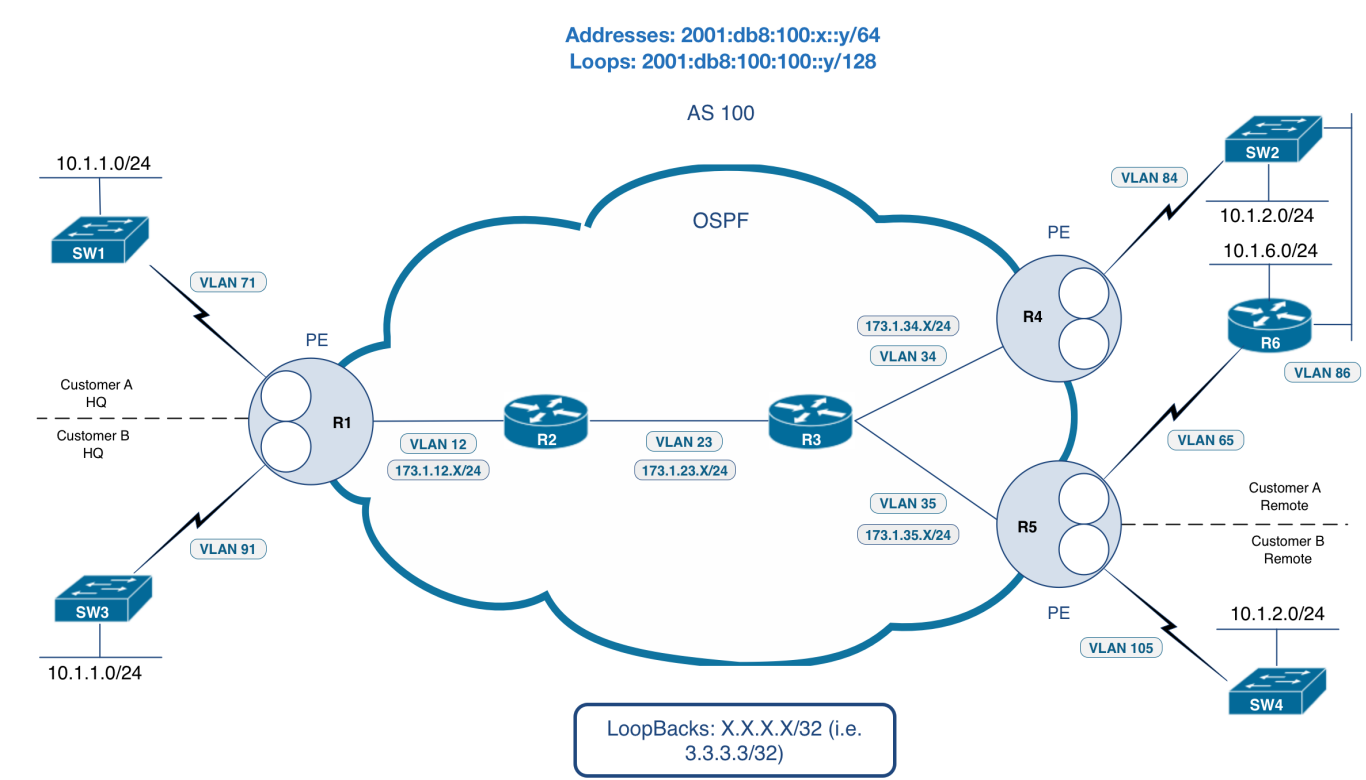
IPv6 VPN Topology



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