Routing Protocols

Internal and External Routing

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Agenda

Static routing

Gateway Redundancy

- VRRP

Internal Routing

- RIPng
- IS-IS
- OSPFv3

External Routing

- Multiprotocol BGP

Static Routes

Static route configuration syntax is the same as in IPv4

Except Prefix and next-hop are IPv6

- IPv4 static route:
- ip route *[ipv4_prefix][ipv4_address_mask][ipv4_if_address]*
- IPv6 static route:
- ipv6 route *[ipv6_prefix/prefix_length][ipv6_if_address]*

ipv6 route ::/0 FastEthernet1/40 FE80::206:2AFF:FE58:7820

Static Routes

It is not recommended to use a global unicast address as a next-hop addresss

ICMPv6 redirect messages will not work if used

- RFC 2461:
  - A router must be able to determine the link-local address of each of its neighboring routers in order to ensure that the target address of a Redirect message identifies the neighbor router by its link-local address.

VRRP

IETF: Version 3

- RFC5798, March 2010
- Based on VRRPv2 for IPv4
- Election protocol

Usage of «virtual» addresses

- Which are used by/configured on hosts
- One of the existent VRRP routers is elected as «MASTER»

IPv6 Multicast Address

- Assigned by IANA = FF02::12

VRRP

Advantage of using VRRP on IPv4:

- Higher-availability default path without requiring configuration of dynamic routing or router discovery protocols on every end-host.

Advantage of using VRRP on IPv6:

- Quicker switchover to Backup routers than can be obtained with standard IPv6 Neighbor Discovery mechanisms.

RIPng

Same as IPv4

- Based on RIPv2
- Distance vector, max. 15 hop, split-horizon, …

It's an IPv6 only protocol

- In a dual-stack environment, running RIP, you'll need RIP (IPv4) and RIPng (IPv6)

IPv6 related functionality

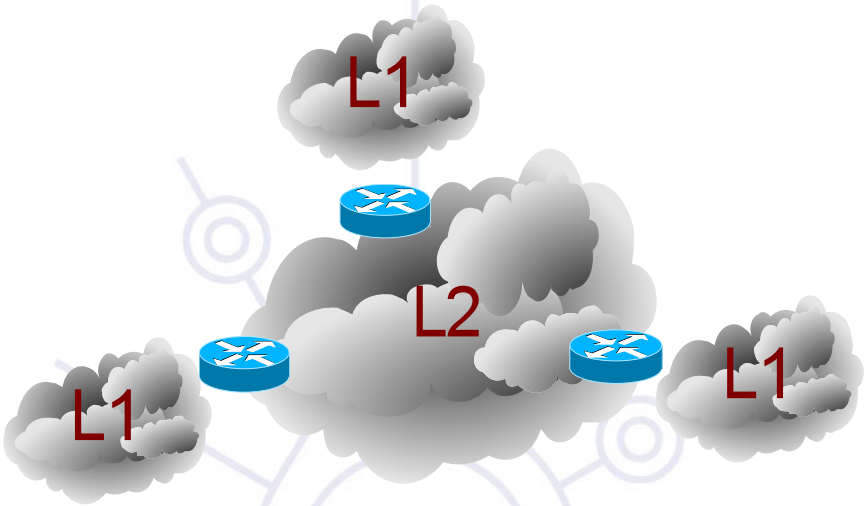
- Uses IPv6 for transport
- IPv6 prefix, next-hop IPv6 address
- For RIP updates, uses multicast address FF02::9

ISISv6

OSI Protocol

Based on two levels

- L2 = Backbone
- L1 = Stub
- L2L1= interconnect L2 and L1



Runs on top of CNLS

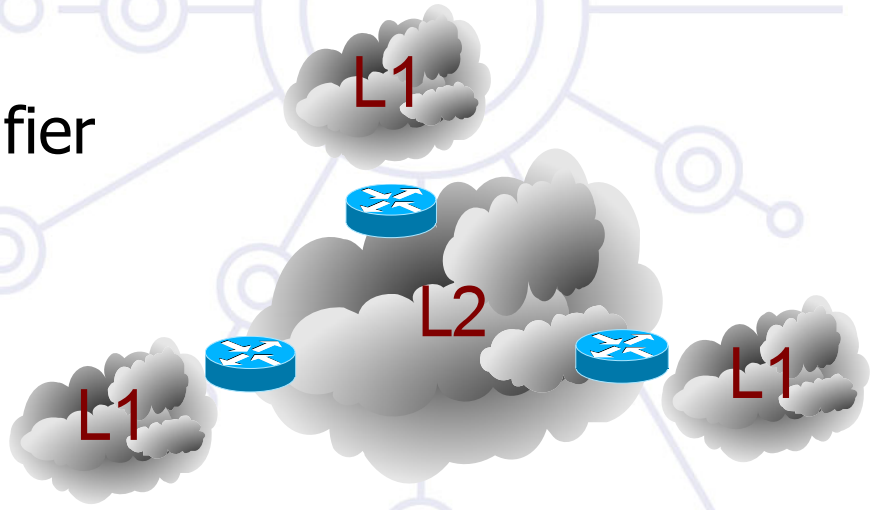
- Each IS device still sends out LSP (Link State Packets)
- Send information via TLV's (Tag/Length/ values)
- Neighborship process is unchanged

Major operation remains unchanged

ISISv6 #2

Updated features:

- Two new Tag/Length/Values (TLV) for IPv6
  - IPv6 Reachability
  - IPv6 Interface Address
- New network Layer Identifier
  - IPv6 NLPID



OSPFv3

OSPFv3 = OSPF for IPv6

Based on OSPFv2

Topology of an area is invisible from outside the area

- LSA flooding is bounded by area
- SPF calculation is performed separately for each area

All areas must have a connection to the backbone

OSPFv3

OSPFv3 is an IPv6-only protocol

- In a dual-stack environment, running OSPF, you'll need OSPFv2 (IPv4) and OSPFv3 (IPv6)
- Work-in-progress about extensible mechanisms to enable OSPFv3 with different address families support

Updated Features

- Runs directly over IPv6
- Distributes IPv6 prefixes
- New LSA types
- Uses Multicast addresses
  - ALLSPFRouters (FF02::5)
  - ALLDRouters (FF02::6)

Multiprotocol BGP

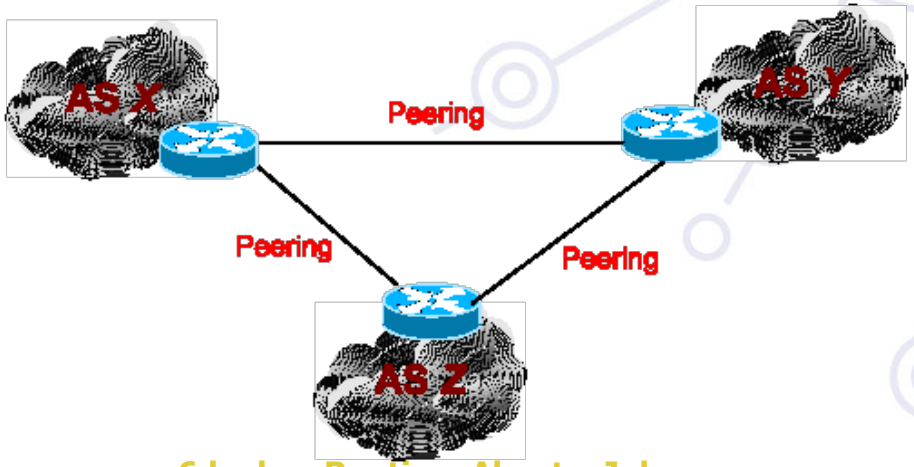
Exterior Gateway Protocol

Connect separate routing domains that contain independent routing policies (and AS numbers)

Carries sequences of AS numbers, indicating path (for each route)

Supports the same features and functionality as IPv4 BGP

Multiple addresses families: IPv4, IPv6, unicast, multicast



Multiprotocol BGP

BGP4 carries only 3 types of information wich is truly IPv4 specific:

- NLRI in the UPDATE message contains an IPv4 prefix
- NEXT_HOP attribute in the UPDATE message contains an IPv4 address
- BGP ID in AGGREGATOR attribute

Multiprotocol BGP

RFC 4760 defines multi-protocols extensions for BGP4

- this makes BGP4 available for other network layer protocols (IPv6, MPLS…)
- New BGP4 attributes:
  - MP_REACH_NLRI
  - MP_UNREACH_NLRI
- Protocol Independent NEXT_HOP attribute
- Protocol Independent NLRI attribute

Conclusions

All major routing protocols have stable IPv6 Support, and no major differences with IPv4

In a dual-stack environment, running OSPF, you'll need OSPFv2 (IPv4) and OSPFv3 (IPv6). It may change in a near future.

In a dual-stack environment, running RIP, you'll need RIPv1/RIPv2 (IPv4) and RIPng (IPv6)

Questions?

Extra Slides

EIGRPv6

Distance Vector with some Link State features (Advanced Distance Vector)

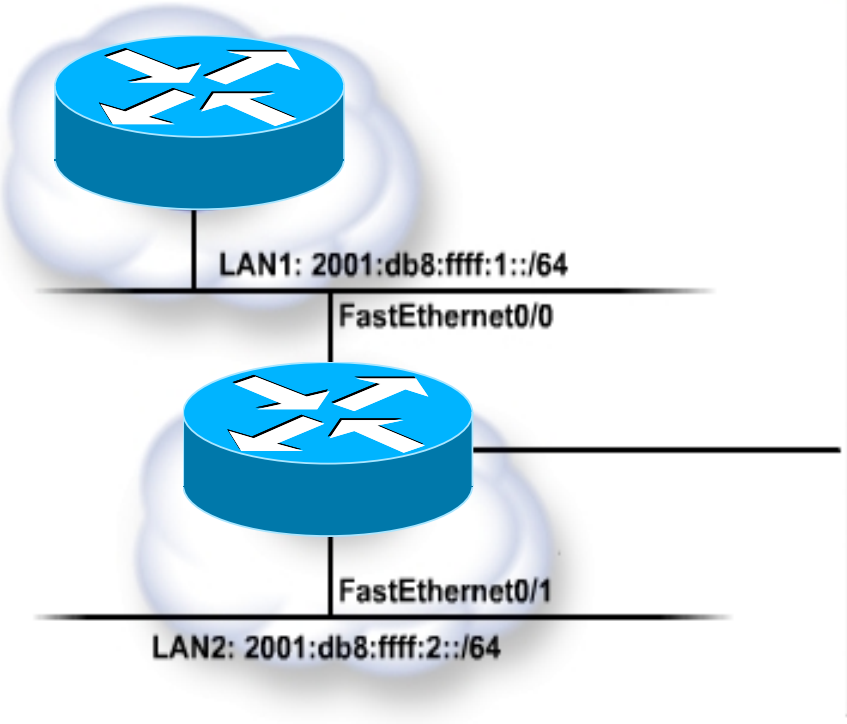
Multi-protocol

- EIGRP has a protocol dependent module for IPV4, IPX, Appletalk, and IPv6

Easy to configure

Fast convergence

Example



Console

File Edit View Call Transfer

```
RouterC#
…
interface FastEthernet0/0
 ipv6 address 2001:db8:ffff:1::c/64
 ipv6 eigrp 301

Interface FastEthernet0/1
 ipv6 address 2001:db8:ffff:2::c/64
 ipv6 eigrp 301

ipv6 router eigrp 301
 router-id 11.12.30.1
 no shut
```

Routing (on systems)

There is always an IPv4 and an IPv6 routing context in every system.

OS	IPv4	IPv6
Cisco (IOS)	**show ip route**	**show ipv6 route**
WinXP	**route print**	**netsh interface ipv6 show route**
Linux	**/sbin/route**	**/sbin/route –A inet6**
*BSD	**netstat -rn**	**netstat –rn –f inet6**

Routing Stats (IPv6 vs. IPv4, globally)

(11/09/2008)	IPv6	IPv4
ROUTES	**1505**	**281136**
AGGREGATED ROUTES	**1400 (93,02%)**	**170595 (60,68%)**
AUTONOMOUS SYSTEMS	**1131**	**29345**

source: www.cidr-report.org

Routing Stats (IPv6 vs. IPv4, globally)

(13/07/2011)	IPv6	IPv4
ROUTES	**6734**	**366636**
AGGREGATED ROUTES	**5732 (85.12%)**	**215630 (58.81%)**
AUTONOMOUS SYSTEMS	**4379**	**38272**

➔ 11%

source: www.cidr-report.org