



6DEPLOY

Equipment Configuration: Routers

6DEPLOY. IPv6 Deployment and Support

Routing Equipment

Cisco

Juniper

6WIND

Hitachi

Huawei

FreeBSD

Debian

Windows

Quagga



CISCO



Cisco IOS IPv6 Roadmap

**IOS
upgrade
=
Free IPv6**

IOS Release	Market Target
Phase I	Early Adopter Deployment
Phase II	Production Backbone Deployment
Phase III	Enhanced IPv6 Services

**IPv6 features are supported in these Cisco IOS Release trains:
12.0S, 12.2T, 12.2S, 12.3, 12.3T, 12.4, 12.4T and beyond**

Cisco – basics

Enable IPv6 on an interface

```
interface xxxxx  
  ipv6 enable
```

Configure an address

```
interface xxxxx  
  ipv6 address X:X:X:X::X/<0-128> (general address)  
  ipv6 address X:X:X:X::X (link-local address)  
  ipv6 address autoconfig (auto-configuration)
```

Example: LAN Interface

```
interface Ethernet0/0  
  ip address 192.168.1.254 255.255.255.0  
  ipv6 address 2001:DB8:123:1::2/64
```

Cisco – tunnel (1)

Configure an IPv6 in IPv4 tunnel

```
interface tunnel x
  tunnel source interface
  tunnel destination X.X.X.X
  ipv6 address X:X:X:X::X/<0-128>
  tunnel mode ipv6ip (for direct tunneling)
  tunnel mode gre ip (for gre encapsulation)
```

Cisco – tunnel (2)

Configure an IPv6 in IPv6 tunnel

```
interface tunnel x
  tunnel source interface
  tunnel destination X:X:X:X::X
  ipv6 address X:X:X:X::X/<0-128>
  tunnel mode ipv6 (for direct tunneling)
  tunnel mode gre ipv6 (for gre encapsulation)
```

Cisco – routing

Enable IPv6 routing

```
ipv6 unicast-routing
```

Configure static routes

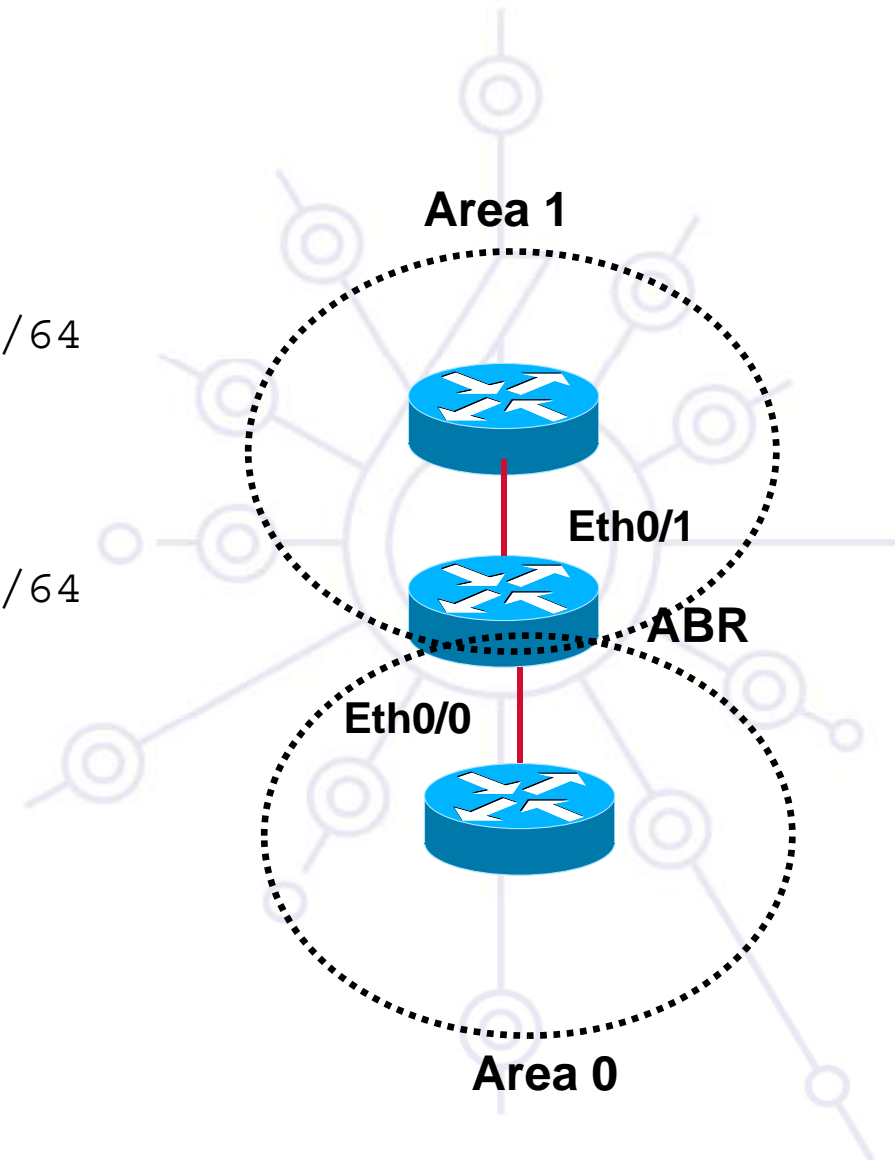
```
ipv6 route prefix/prefixlen next hop
```

```
Example: ipv6 route ::/0 2001:DB8:10A:1001::1
```



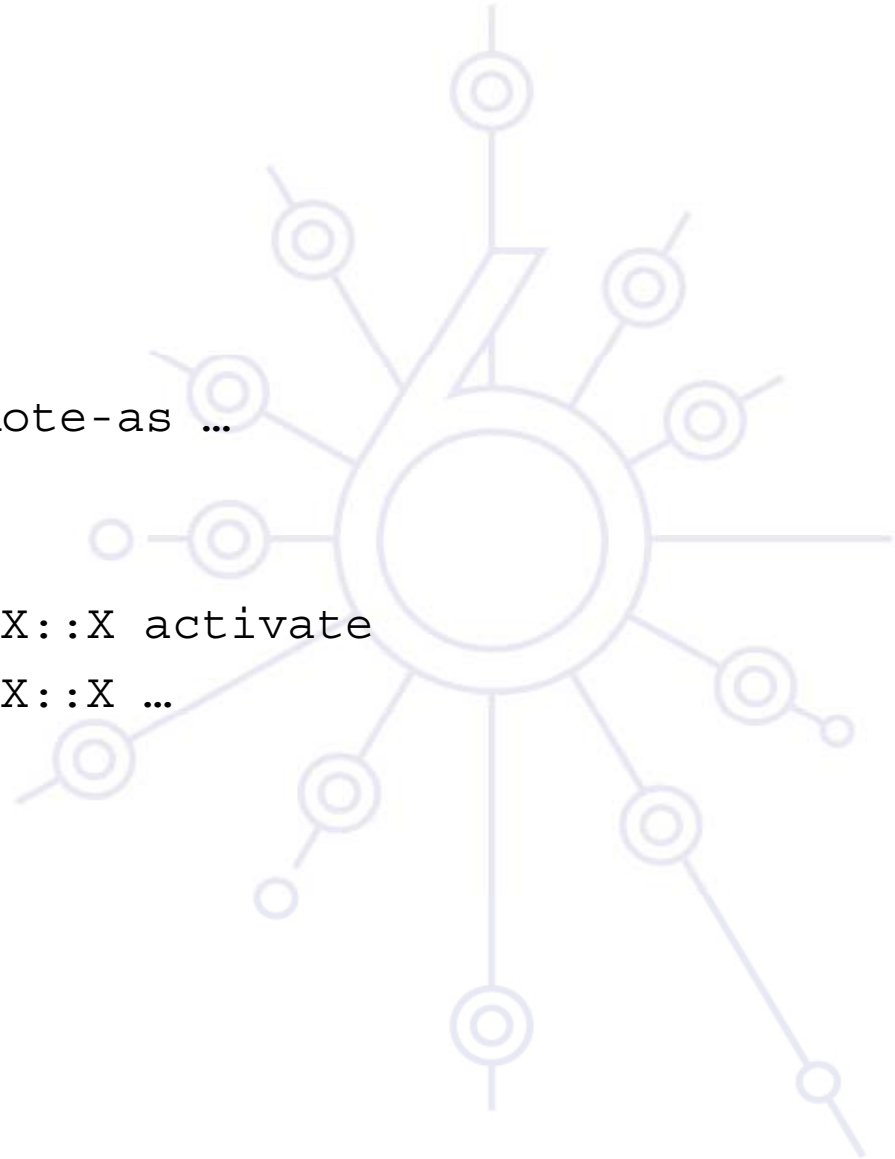
Cisco – OSPFv3

```
interface Ethernet0/0
ipv6 address 2001:DB8:1:1::1/64
ipv6 ospf 1 area 0
!
interface Ethernet0/1
ipv6 address 2001:DB8:1:2::2/64
ipv6 ospf 1 area 1
!
ipv6 router ospf 1
router-id 2.2.2.2
```



Cisco – BGP

```
no bgp4 default unicast
bgp router-id a.b.d.f
router bgp xxxx
  neighbor X:X:X:X::X remote-as ...
  neighbor X:X:X:X::X ...
    address-family ipv6
      neighbor X:X:X:X::X activate
      neighbor X:X:X:X::X ...
  network 2001:DB8::/32
  no synchronization
exit address-family
```



Cisco – routing policy filtering

```
ipv6 prefix-list bgp-in-ipv6 seq 5 deny ::/0
```

-> **Means filter ::/0 exactly**

```
ipv6 prefix-list bgp-in-ipv6 seq 10 deny 3ffe::/16 le 128
```

```
ipv6 prefix-list bgp-in-ipv6 seq 15 deny 2001:DB8::/32 le  
128
```

```
ipv6 prefix-list bgp-in-ipv6 seq 20 permit 2001::/32
```

```
ipv6 prefix-list bgp-in-ipv6 seq 25 deny 2001::/32 le 128
```

```
ipv6 prefix-list bgp-in-ipv6 seq 30 permit 2002::/16
```

```
ipv6 prefix-list bgp-in-ipv6 seq 35 deny 2002::/16 le 128
```

-> **Means every prefix matching 2001::/32 except 2001::/32 le 128**

```
ipv6 prefix-list bgp-in-ipv6 seq 40 permit 2001:4000::/18  
ge 32 le 32
```

```
ipv6 prefix-list bgp-in-ipv6 seq 45 permit 2001::/16 ge 32  
le 35
```

-> **Means every 2001::/16 derived prefix, with length between 32 and 35**

Cisco – ACLs

ACL

```
ipv6 access-list vty-ipv6
  permit tcp 2001:DB8:0:401::/64 any eq telnet
  deny ipv6 any any log-input
```

Applying an ACL to an interface

```
ipv6 traffic-filter <acl_name> in | out
```

Restricting access to the router

```
ipv6 access-class <acl_name> in | out
```

Applying an ACL to filter debug traffic

```
debug ipv6 packet [access-list <acl name>]
[detail]
```

Cisco – show commands

```
show bgp
```

```
show bgp ipv6 unicast/multicast/all summary
```

```
show bgp ipv6 neigh <addr> routes
```

```
show bgp ipv6 neigh <addr> advertised-routes
```

```
show bgp ipv6 neigh <addr> received-routes
```

```
show ipv6 route
```

```
show ipv6 interface
```

```
show ipv6 neighbors
```

JUNIPER



Juniper – IPv6 support (1)

No Special code, uniform on all platform Addressing and forwarding

- H/W forwarding
- Addressing (link, global, Neighbor discovery)
- Stateless autoconfiguration

Routing

- BGP4+, IS-IS, OSPFv3, RIPng, Static

Operation

- telnet, ssh, ping traceroute, ICMPv6
- H/W based firewall filter
- uRPF check

Deployment

- Dualstack, configured tunnel, L3 MPLS VPN

Juniper – IPv6 support (2)

**IPv6 Multicast: BGP, PIMv2 with RP support, SSM
EBGP peering with linklocal address**

IPv6 over MPLS

IPv6 flow monitoring

**IPv6 features are supported in these JUNOS
Releases: 5.x, 6.x and 7.x**

Juniper – basics

Interface configuration

```
interfaces {
  name of interface {
    unit x {
      family inet {
        address X.X.X.X/prefixlength;
      }
      family iso {
        address Y.Y.Y.Y.Y.Y;
      }
      family inet6 {
        address Z:Z:Z:Z::Z/prefixlength;
      }
    }
  }
}
```

Cannot autoconfigure the router interfaces

Juniper – tunnels

Router Advertisements (stateless autoconfiguration)

```
protocols {
  router-advertisement {
    interface interface-name {
      prefix IPv6_prefix::/prefix_length;
    }
  }
}

Configure tunnel (with Tunnel PIC)
interface {
  ip-x/x/x {
    tunnel {
      source ipv4 source address;
      destination ipv4_destination_address;
    }
    family inet6 {
      address ipv6_address_in_tunnel/prefixlength
    }
  }
  gr-x/y/z {
    unit 0 {...}
  }
}
```

Juniper – static routing

Static routes

```
routing-options {  
  rib inet6.0 { -> Means IPv6 unicast routing table  
    static {  
      route IPv6_prefix next-hop IPv6_address;  
    }  
  }  
}
```

```
routing-options {  
  rib inet6.0 {  
    static {  
      route IPv6_prefix discard; -> Useful to  
originate a network  
    }  
  }  
}
```

Juniper – OSPFv3

```
protocols {
  ospf3 {
    preference 20;
    area 0.0.0.0 {
      interface ge-0/3/0.808 {
        metric 100;
      }
      interface lo0.0 {
        passive;
      }
    }
  }
}
```



Juniper – BGP

```
protocols {
  bgp {
    local-as local_AS_number;
    group EBGP_peers {
      type external;
      family inet6 {
        (any | multicast | unicast) }
      neighbor neighbor_IPv6_address;
      peer-as distant AS number;
      import in-PS;
      export out-PS; }
  }
}
```

Juniper – routing policy filtering

Policy statements

```
policy-statement in-PS {
  term from outside accept {
    from {
      route-filter 3ffe::/16 orlonger;
      route-filter ::/8 orlonger;
      route-filter 2001:DB8::/32 orlonger;
      route-filter 2001::/32 exact next
    }
    policy;

    route-filter 2001::/31 longer;
    route-filter 2002::/16 exact next
  }
  policy;

  route-filter 2002::/16 longer;
  route-filter ::/0 upto /48 next policy; }
  then {
    accept; }
  then reject; }
```

Juniper – show commands

```
show bgp summary  
show route advert bgp <addr>  
show route rece bgp <addr>  
show route table inet6.0 (terse)  
show interfaces  
show ipv6 neighbors
```



6WIND



6WIND – basics

Interface Configuration

Enter Ethernet Private Interface Context

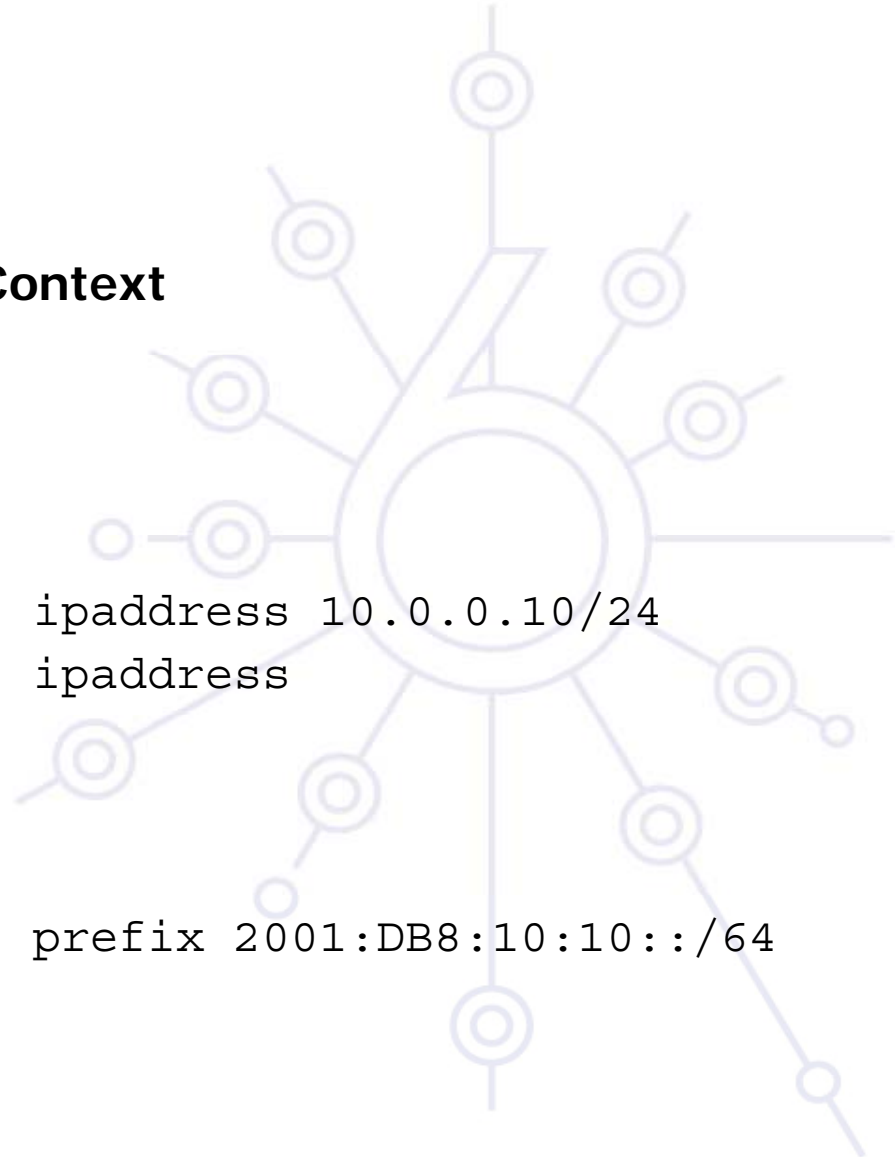
```
hurricane{myconfig} eth0 0  
hurricane{myconfig-eth0_0}
```

Set IP Address

```
hurricane{myconfig-eth0_0} ipaddress 10.0.0.10/24  
hurricane{myconfig-eth0_0} ipaddress  
2001:DB8:10::beef/48
```

Advertise an IPv6 prefix

```
hurricane{myconfig-eth0_0} prefix 2001:DB8:10:10::/64
```



6WIND – tunnels (1)

Migration configuration

Enter Migration Context

```
hurricane{myconfig} mig
hurricane{myconfig-mig}
```

Create 6in4 interface

```
hurricane{myconfig-mig} 6in4 0 1.1.1.10 1.1.1.20
2001:DB8::10 2001:DB8::20
```

Create 4in6 interface

```
hurricane{myconfig-mig} 4in6 0 2001:DB8::10
2001:DB8::20 1.1.1.10 1.1.1.20
```

Create 6to4 interface

```
hurricane{myconfig-mig} 6to4 1.1.1.10
```

6WIND – tunnels (2)

Create ISATAP interface

```
hurricane{myconfig-mig} isatap router 0 10.0.0.10  
hurricane{myconfig-mig} isatap_prefix 0  
2002:101:10a::/64
```

Create DSTM interface

```
hurricane{myconfig-mig} dstm eth0 0
```

6WIND – static routing

Routing configuration

Enter Routing Context

```
hurricane{myconfig} rtg
hurricane{myconfig-rtg}
```

Set IP default route

```
hurricane{myconfig-rtg} ipv4_defaultroute 1.1.1.20
hurricane{myconfig-rtg} ipv6_defaultroute 2001:DB8:1::20
```

Set static route

```
hurricane{myconfig-rtg} route 30.0.0.0/24 3.3.3.30
hurricane{myconfig-rtg} route 2001:DB8:1::/48
2001:DB8:3::30
```

6WIND – RIPng

Dynamic Routing Configuration RIP

Enter Dynamic Routing Context

```
hurricane{myconfig-rtg} dynamic
hurricane{myconfig-rtg-dynamic}
```

Activate RIP Routing Process

```
hurricane{myconfig-rtg-dynamic} router rip
hurricane{myconfig-rtg-dynamic-router-rip} network
1.1.1.0/24
hurricane{myconfig-rtg-dynamic-router-rip} network
3.3.3.0/24
hurricane{myconfig-rtg-dynamic-router-rip} redistribute
connected
```

6WIND – BGP

Dynamic Routing Configuration BGP4+

Enter Dynamic Routing Context

```
hurricane{myconfig-rtg} dynamic
hurricane{myconfig-rtg-dynamic}
```

Activate BGP4+ Routing Process

```
hurricane{myconfig-rtg-dynamic} router bgp 10
hurricane{myconfig-rtg-dynamic-router-bgp} neighbor
2001:DB8:2::20 remote-as 20
hurricane{myconfig-rtg-dynamic-router-bgp} neighbor
2001:DB8:3::30 remote-as 30
hurricane{myconfig-rtg-dynamic-router-bgp} address-family ipv6
hurricane{myconfig-rtg-dynamic-router-bgp-v6} neighbor
2001:DB8:2::20 activate
hurricane{myconfig-rtg-dynamic-router-bgp-v6} neighbor
2001:DB8:2::20 activate
hurricane{myconfig-rtg-dynamic-router-bgp-v6} redistribute
connected
```

HITACHI



Hitachi – basics

IPv6 features supported in these Hitachi OS releases: 06-xx, 07-xx, and 08-xx

Enable IPv6

Enabled by default in Hitachi OS IPv6 images

Add an IPv6 address on an interface

```
config ip interface-name IPv6-address/prefix-length
```

Delete an IPv6 address on an interface

```
config delete ip interface-name IPv6-address
```


Hitachi – tunnel

Tunnel

```
tunnel tunnel-name local-ipv4-address remote remote-  
ipv4-address
```

```
ip tunnel-name local-ipv6-address/prefix-length  
destination_ip_address remote-ipv6-address connect_type  
point
```

Configure a static default route via the tunnel

```
static 0::/0 gateway tunnel-remote-ipv6-address
```

Hitachi – RA autoconfiguration

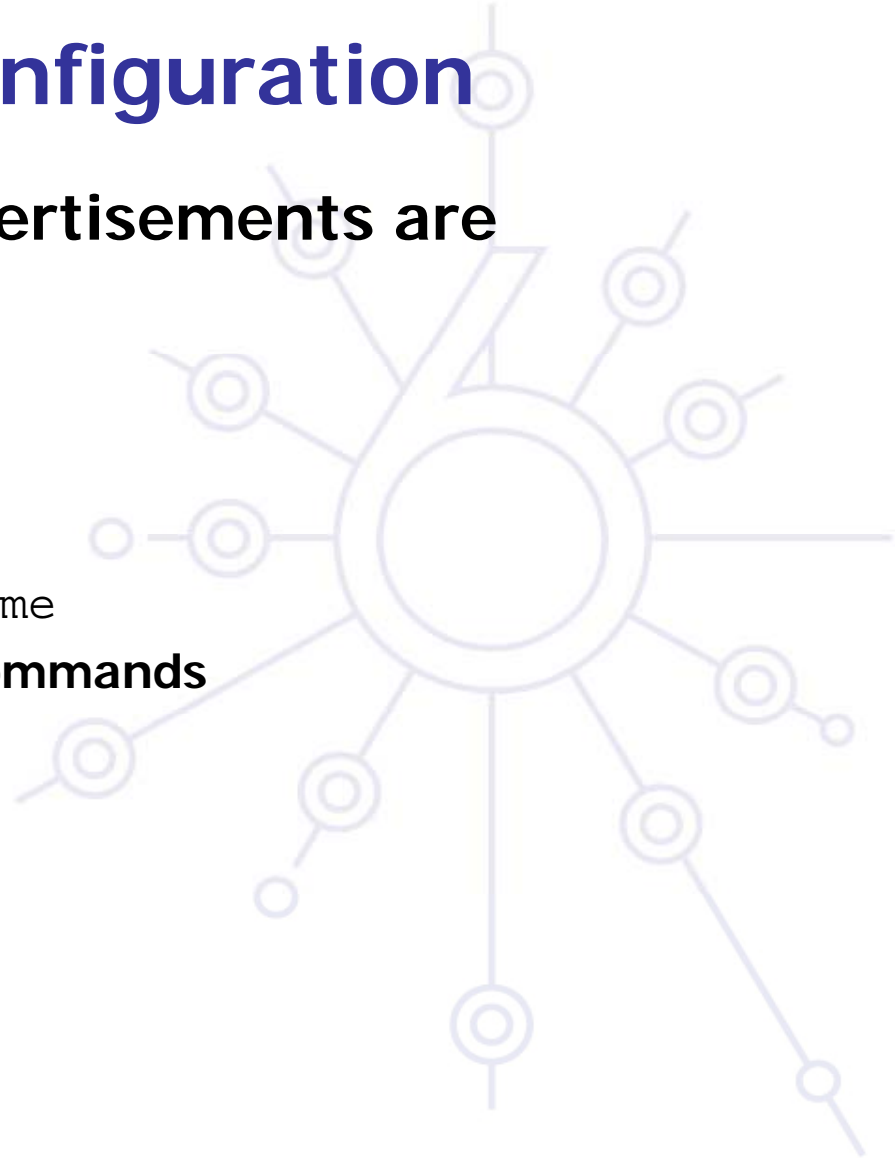
By default the router advertisements are suppressed

RA autoconfiguration

```
config ra yes
```

```
ra interface interface-name
```

More control with options of ra commands



HUAWEI



Huawei – basics

IPv6 features supported since this Huawei Quidway OS release: VRP5

Enable IPv6

Execute ipv6 command

Add an IPv6 address on an interface

```
config interface type number  
ipv6 address IPv6-address prefix-length
```

Delete an IPv6 address on an interface

```
config interface type number  
undo ipv6 address IPv6-address prefix-length
```

Huawei – tunnel

Tunnel

```
interface Tunnel name
ipv6 address local-ipv6-address prefix-length
 tunnel-protocol ipv6-ipv4
 source local-ipv4-address
 destination remote-ipv4-address
undo shutdown
```

Configure a static default route via the tunnel

```
ipv6 route-static 0::/0 tunnel-remote-ipv6-address
```

Huawei – RA autoconfiguration

By default the router advertisements are suppressed

RA autoconfiguration

Use `ipv6 nd ra halt`, to suppress a router to send RA

Use `undo ipv6 nd ra halt`, to cancel the configuration

More control with options of `ipv6 nd` commands

FREEBSD



FreeBSD – basics

Enable IPv6

```
ipv6_enable="YES" in /etc/rc.conf file
```

Autoconfiguration is automatically done while the gateway function is off

Enable IPv6 forwarding

```
ipv6_gateway_enable="YES" in rc.conf file
```

Add an IPv6 address on an interface

```
ifconfig interface inet6 X:X:X:X::X prefixlen 64
```


FreeBSD – tunnel

Configure an IPv6 in IPv4 tunnel

```
ifconfig gif1 create
ifconfig gif1 inet6 @IPv6 source @IPv6 dest prefixlen
128
gifconfig gif1 inet @IPv4_source @IPv4_dest
ifconfig gif1 up
```

Configure an IPv6 in IPv6 tunnel

```
ifconfig gif1 create
ifconfig gif1 inet6 @IPv6 source @IPv6 dest prefixlen
128
gifconfig gif1 inet6 @IPv6_source @IPv6_dest
ifconfig gif1 up
```

FreeBSD – static routing

Configure a static route

- **Default route**

```
route add -inet6 default fe80::route add -inet6 default X:X:X:X::X (if global address)
```

- **Others**

```
route add -inet6 X:X:X:X:: -prefixlen YY X:X:X:X::X  
route add -inet6 X:X:X:X:: -prefixlen YY  
fe80::
```

%interface notation

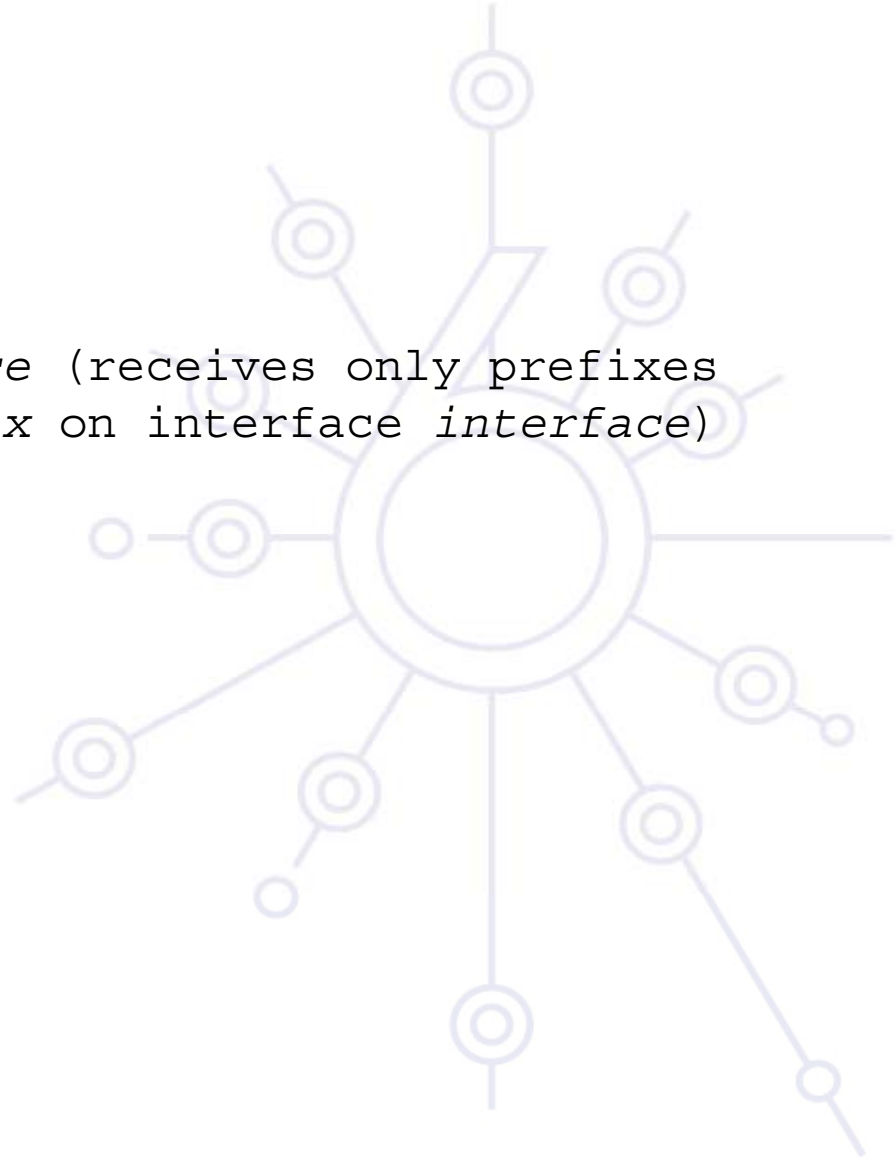
If link-local address, need to specify on which interface the address is available

FreeBSD – RIPng

RIPng: route6d daemon

```
route6d
```

```
-L IPv6 prefix, interface (receives only prefixes  
derived from IPv6_prefix on interface interface)
```



FreeBSD – BGP

BGP: bgpd daemon

Better to use Quagga BGP daemon



DEBIAN



Debian – basics

Enable IPv6

- Put "ipv6" in "/etc/modules"
- Edit "/etc/network/interfaces" :

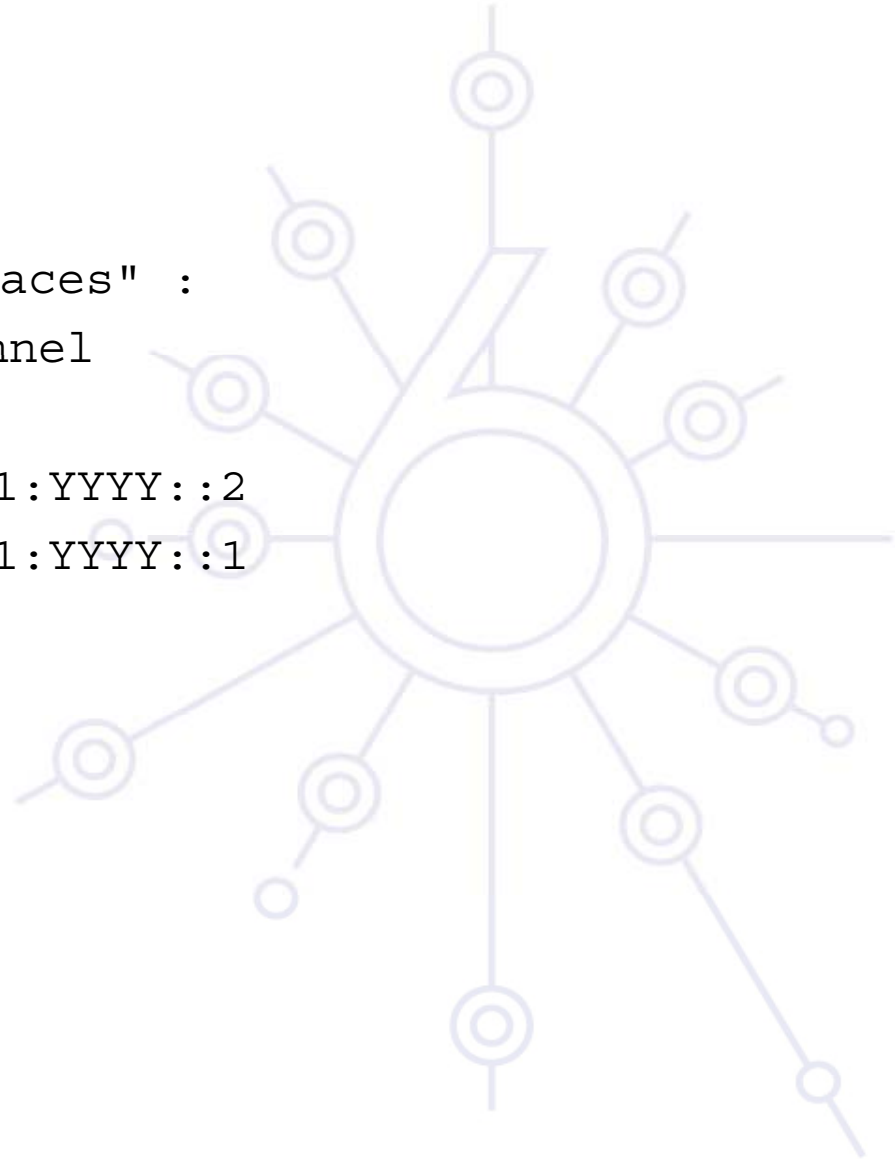
```
iface eth0 inet6 static
    address 2001:XXXX:YYYY:ZZZZ::1
    netmask 64
```

Further information:

<http://people.debian.org/~csmall/ipv6/>

Debian – tunnel

```
Edit "/etc/network/interfaces" :  
    iface tun0 inet6 v4tunnel  
        endpoint A.B.C.D  
        address 2001:XXXX:1:YYYY::2  
        gateway 2001:XXXX:1:YYYY::1  
        netmask 64
```



Debian – RA autoconfiguration

```
Add in "/etc/radvd.conf" :  
interface eth0  
{  
    AdvSendAdvert on;  
    AdvLinkMTU 1472;  
    prefix 2001:XXXX:YYYY:ZZZZ:/64  
    {  
        AdvOnLink on;  
        AdvPreferredLifetime 3600;  
        AdvValidLifetime 7200;  
    };  
};
```


WINDOWS XP



Windows XP – basics (1)

Enable IPv6

`ipv6 install` in a dos window

Autoconfiguration is then performed

Display IPv6 interfaces

`ipv6 if`

Display IPv6 routes

`ipv6 rt`



Windows XP – basics (2)

Add a static route

```
ipv6 rtu prefix ifindex[/address] [life valid[/pref]]  
[preference P] [publish] [age] [spl Site Prefix Size]
```

Anonymous addresses

```
ipv6 gpu UseAnonymousAddresses no
```

« User-friendly » IPv6 configuration

```
netsh in a dos window  
> interface ipv6
```

QUAGGA



Quagga

Cisco like commands

RIPng, BGP, OSPF, etc. available

<http://www.quagga.net/>



Questions?

6DEPLOY Project Web Site:

<http://www.6deploy.eu>

