

# IPv6 router configuration

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IPv6DISSemination and Exploitation

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6DISS IPv6 workshop 2005 South Africa

IPv6DISSemination and Exploitation

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*Equipment Configuration  
routers*



## Equipment Configuration

- CISCO
- JUNIPER
- 6WIND
- FreeBSD
- Debian
- Microsoft (Windows XP)
- Zebra



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## Cisco IOS Roadmap:

IOS Release	Market Target
<b>Phase I</b> IOS 12.2(5)T 12.2(14)S Done	Early Adopter Deployment
<b>Phase II</b> Done	Production Backbone Deployment
<b>Phase III</b> ongoing	Enhanced IPv6 Services

IOS  
upgrade  
=  
Free IPv6



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## Cisco IOS IPv6 Phase I

- IPv6 unicast routing
- ICMPv6 support
- IPv6 ND
- Static ND entry
- SLAAC
- Path MTU discovery
- CEF
- RIPng
- Static Route
- IS-IS (only SP images)
- BGP4+
- Basic ACLs
- IPv6 in IPv4 tunnel
- 6to4 tunnel
- Ethernet
- ATM
- FDDI
- Frame-Relay
- PPP/HDLC
- VLAN

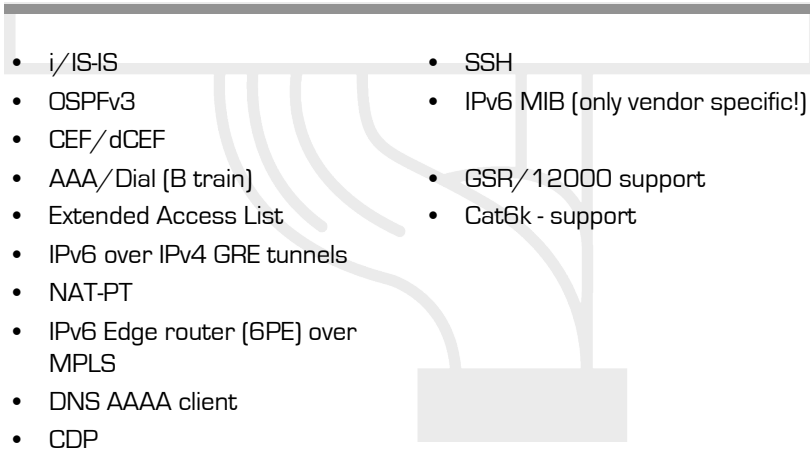


## Phase 1 supported platforms

- Cisco IOS 12.2T
  - Cisco 800 series routers
  - Cisco 1400 series routers
  - Cisco 1600 series routers
  - Cisco 1700 series routers
  - Cisco 2500 series routers (12.2(4)T only)
  - Cisco 2600 series routers
  - Cisco 3600 series routers
  - Cisco 4500/4700 series routers (12.2(2)T only)
  - Cisco 7100 series routers
  - Cisco 7200 series routers
  - Cisco 7500 series routers
- Cisco IOS 12.0ST
  - Cisco 12000 series routers
- Cisco IOS 12.2S
  - Cisco 7200 series routers
  - Cisco 7500 series routers
  - Cisco 7600 series routers (limited release)
  - Catalyst 6500 series (limited release)
- Cisco IOS 12.2B
  - Cisco 7400 series routers
- Cisco IPv6 EFT only
  - AS5300, 5400

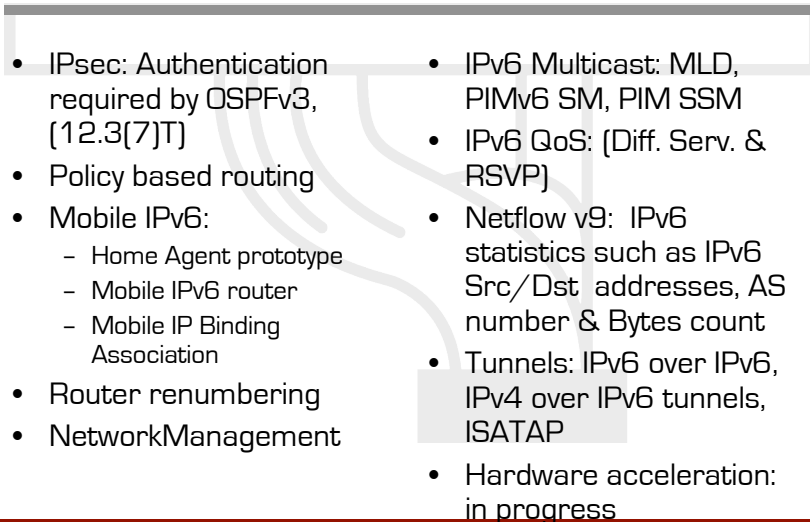


## Cisco IOS IPv6 Phase II

- 
- i/IS-IS
  - OSPFv3
  - CEF/dCEF
  - AAA/Dial (B train)
  - Extended Access List
  - IPv6 over IPv4 GRE tunnels
  - NAT-PT
  - IPv6 Edge router (6PE) over MPLS
  - DNS AAAA client
  - CDP
  - SSH
  - IPv6 MIB (only vendor specific!)
  - GSR/12000 support
  - Cat6k - support



## Cisco IOS IPv6 Phase III

- 
- IPsec: Authentication required by OSPFv3, (12.3(7)T)
  - Policy based routing
  - Mobile IPv6:
    - Home Agent prototype
    - Mobile IPv6 router
    - Mobile IP Binding Association
  - Router renumbering
  - NetworkManagement
  - IPv6 Multicast: MLD, PIMv6 SM, PIM SSM
  - IPv6 QoS: (Diff. Serv. & RSVP)
  - Netflow v9: IPv6 statistics such as IPv6 Src/Dst addresses, AS number & Bytes count
  - Tunnels: IPv6 over IPv6, IPv4 over IPv6 tunnels, ISATAP
  - Hardware acceleration: in progress



## Cisco IOS IPv6 Phase III/2

- Additional encapsulation: IPv6 over DPT, Cable and DSL
- DHCPv6: stateless, prefix delegation and relay
- Multicast IPv6: BGP, Scope, BSR
- SNMP: over IPv6
- IOS Firewall
- Future enhancements:
  - EIGRP
  - Mobile ACL extensions - done
  - HSRPv6
  - Mobile IPv6 extensions



## Cisco 12000 series router IPv6

### IPv6 Basics

- ICMPv6
- ND – including static entries
- Stateless Auto-config.
- ACL
- MIBs, SSH, Telnet
- DNS, TFTP

### Routing protocols

- RIPng, IS-IS for IPv6, OSPFv3, MP-BGP4

### IPv6 Tunnels

- distributed on Line cards or Tunnel Card

### Switching

- dCEFv6
- 6PE (IPv6 over MPLS)

### Feature set on 12.0(25)S

CY03

### IPv6 Hardware Assistance

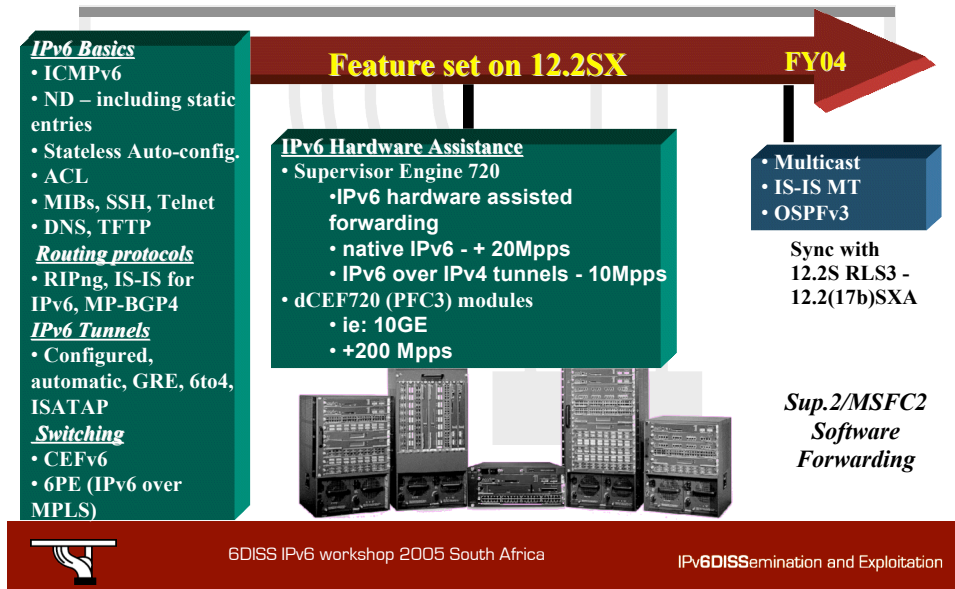
- Engine 3 Line Cards
- 4 x GE
- ATM OC-12
- POS OC-3, OC-12, OC-48
- Standard & Extended ACL
- Including simultaneous IPv6 Option Headers & UDP/TCP port parsing
- IPv6 Provider Edge (6PE) over MPLS
- up to 3.8Mpps per LC

- Multicast
- IS-IS MT

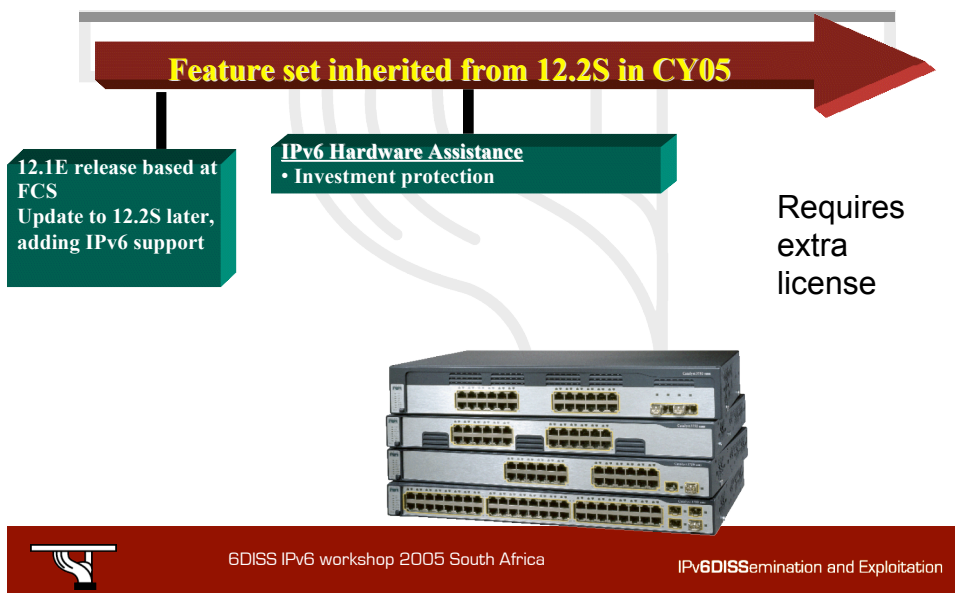
26S



## Cisco 7600/Cat. 6500 series IPv6



## Cisco Catalyst 3750 Series Switches



## CISCO configuration - 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)
```

- e.g. LAN Interface

```
interface Ethernet0/0
  ip address 192.168.1.254 255.255.255.0
  ipv6 address 2001:db8:123:1::2/64
```



## CISCO configuration - tunnel

- 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 configuration – tunnel2

- 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 configuration - routing

- Enable IPv6 routing  
`ipv6 unicast-routing`
- Configure static routes  
`ipv6 route prefix/prefixlen next_hop`  
Ex: `ipv6 route ::/0 2001:db8:10a:1001::1`

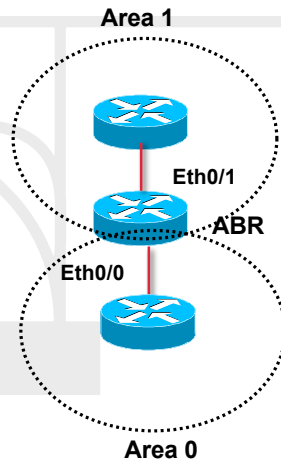


## Cisco configuration – OSPFv3

```

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 configuration - BGP

- BGP configuration
 

```

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 configuration – policy filtering

- Routing policy filtering

```

ipv6 prefix-list bgp-in-6net seq 5 deny ::/0
  -> Means filter ::/0 exactly
ipv6 prefix-list bgp-in-6net seq 10 deny 3FFE:300::/24 le 28
ipv6 prefix-list bgp-in-6net seq 15 deny 2001:db8::/35 le 41
ipv6 prefix-list bgp-in-6net seq 20 permit 2002::/16
ipv6 prefix-list bgp-in-6net seq 25 permit 3FFE::/17 ge 24 le 24
ipv6 prefix-list bgp-in-6net seq 30 permit 3FFE:8000::/17 ge 28 le 28
  -> Means every prefix matching 3FFE:8000::/17 with length 28
ipv6 prefix-list bgp-in-6net seq 35 permit 3FFE:4000::/18 ge 32 le 32
ipv6 prefix-list bgp-in-6net seq 40 permit 2001::/16 ge 32 le 35
  -> Means every 2001::/16 derived prefix, with length between 32 and 35

```



## Cisco configuration - 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`



## Cisco references

- [http://www.cisco.com/en/US/products/ps6553/products\\_ios\\_technology\\_home.html](http://www.cisco.com/en/US/products/ps6553/products_ios_technology_home.html)



## Juniper IPv6 support - now

- No Special code, uniform on all platform
- Addressing and forwarding
  - H/W forwarding
  - Addressing (link, global, Neighbour 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 - now+future

- IPv6 Multicast: BGP, PIMv2 support with RP support, SSM (now)
- EBGP peering with linklocal address - simplification for IPv6 IX (now)
- IPv6 over MPLS (now)
- IPv6 flow monitoring



## Juniper configuration - 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;
      }
      family inet6 {
        address Z:Z:Z:Z::Z/prefixlength;
      }
    }
  }
}

```

- Cannot autoconfigure the router interfaces



## Juniper configuration - tunnels

- Router advertisements (stateless autoconf)

```

protocols {
  router-advertisement {
    interface interface-name {
      prefix IPv6_prefix::/prefix_length;
    }
  }
}
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 configuration – 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 configuration - OSPFv3

```

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

```



## Juniper configuration - BGP

- BGP configuration

```

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 configuration – policy routing

- Policy statements

```

policy-statement in-PS {
  term from_outside_accept {
    from {
      route-filter 2002::16 exact;
      route-filter 3FFE::17 prefix-length-range /24-/24;
      route-filter 3FFE:8000::17 prefix-length-range /28-
/28;
      route-filter 3FFE:4000::18 prefix-length-range /32-
/32;
      route-filter 2000::3 prefix-length-range /16-/16;
      route-filter 2001::16 prefix-length-range /29-/35; }
    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

### 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 3ffe:10::beef/48
```

- Advertise an IPv6 prefix

```
hurricane{myconfig-eth0_0} prefix 3ffe:10::beef:f00d::/64
```



## 6WIND (2)

### 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
3ffe:1::10 3ffe:1::20
```
- Create 4in6 interface
 

```
hurricane{myconfig-mig} 4in6 0 3ffe:1::10 3ffe:1::20
1.1.1.10 1.1.1.20
```
- Create 6to4 interface
 

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



## 6WIND (3)

### Migration configuration

- 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 (4)

### Static 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 3ffe:1::20
```

- Set static route

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



## 6WIND (5)

### 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 (6)

### 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 3ffe:1::20
remote-as 20
hurricane{myconfig-rtg-dynamic-router-bgp} neighbor 3ffe:3::30
remote-as 30
hurricane{myconfig-rtg-dynamic-router-bgp} address-family ipv6
hurricane{myconfig-rtg-dynamic-router-bgp-v6} neighbor 3ffe:1::20
activate
hurricane{myconfig-rtg-dynamic-router-bgp-v6} neighbor 3ffe:3::30
activate
hurricane{myconfig-rtg-dynamic-router-bgp-v6} redistribute
connected
```



## FreeBSD

- 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 (2)

- 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 (3)

- Configure a static route

- Default route

```
route add -inet6 default fe80::X:X:X:X%interface
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::X:X:X:X%interface
```

- %*interface* notation

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



## FreeBSD (4)

- RIPng: route6d daemon

```
route6d
```

```
-L IPv6_prefix,interface [receives only prefixes derived  
from IPv6_prefix on interface interface]
```



## FreeBSD (5)

- BGP: bgpd daemon
- Better to use Zebra BGP daemon



## Debian

- Main URL:  
<http://people.debian.org/~csmall/ipv6/>
- Enable IPv6
  - Put "ipv6" in "/etc/modules"
  - Edit "/etc/network/interfaces" :

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



## Debian (2)

- Tunnel configuration
  - 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 (3)

- RA configuration on a Debian router

– Add in "/etc/radvd.conf":

```
interface eth0
{
  AdvSendAdvert on;
  AdvLinkMTU 1472;
  prefix 2001:XXXX:YYYY:ZZZZ:/64
  {
    AdvOnLink on;
    AdvPreferredLifetime 3600;
    AdvValidLifetime 7200;
  };
};
```



## Microsoft (Windows XP)

- Enable IPv6

`ipv6 install` in a dos window

- Auto-configuration is then performed

- Display IPv6 interfaces

`ipv6 if`

- Display IPv6 routes

`ipv6 rt`





## Microsoft (Windows XP) (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
```



## Zebra

- Cisco like commands
- BGP, RIPng, OSPF available

