



6DEPLOY

**Equipment Configuration:
Hosts**

6DEPLOY. IPv6 Deployment and Support

IPv6 Support – Hosts Operating Systems

Vendor	Versions supporting IPv6	More Information
Apple	MAC OS X 10.2	http://developer.apple.com/macosx/
BSD	FreeBSD 4.0 OpenBSD 2.7, NetBSD 1.5 BSD/OS 4.2	http://www.kame.net/
HP / Compaq	HP-UX 11i, Tru64 UNIX V5.1, OpenVMS V5.1	http://docs.hp.com/en/5990-7247/index.html
IBM	z/OS Rel. 1.4, AIX 4.3, OS/390 V2R6 eNCS	http://www-01.ibm.com/software/info/ipv6/compliance.jsp
Linux	Red Hat 6.2, Mandrake 8.0, SuSE 7.1, Debian 2.2	http://www.bieringer.de/linux/IPv6/status/IPv6+Linux-status-distributions.html
Microsoft	Windows 7, Windows Vista, XP, Server 2003, Server 2008, CE .NET, Mobile	http://www.microsoft.com/ipv6/
Novell	Netware 6.1	http://www.novell.com/documentation/oes2/ntwk_ipv6_nw/index.html?page=/documentation/oes2/ntwk_ipv6_nw/data/ai4x21f.html
Sun	Solaris 8, 9 and 10	http://docs.sun.com/app/docs/doc/817-0573?l=en

General purpose and embedded OSs supporting IPv6 <http://www.ipv6tf.org/index.php?page=guide/organizations/vendors/oss>

Host Equipment

Windows

BSD

Linux

Solaris

Mac OS X



WINDOWS



IPv6 on Windows

Full support

- Windows 7, Vista, XP SP1 and later
- Windows Server 2003 and 2008

Technology preview

- Windows XP with no SP
- Windows 2000 (no compatible with SP2 or later)

Developer Edition

- Windows NT 4.0 (source was available)

No official support but third party products available

- Windows 95/98/ME

Supported features:

- autoconfiguration, IPv4 tunnel, 6to4 tunnel, 6to4 relay, IPSec (manual keying)

IPv6 in Windows 7

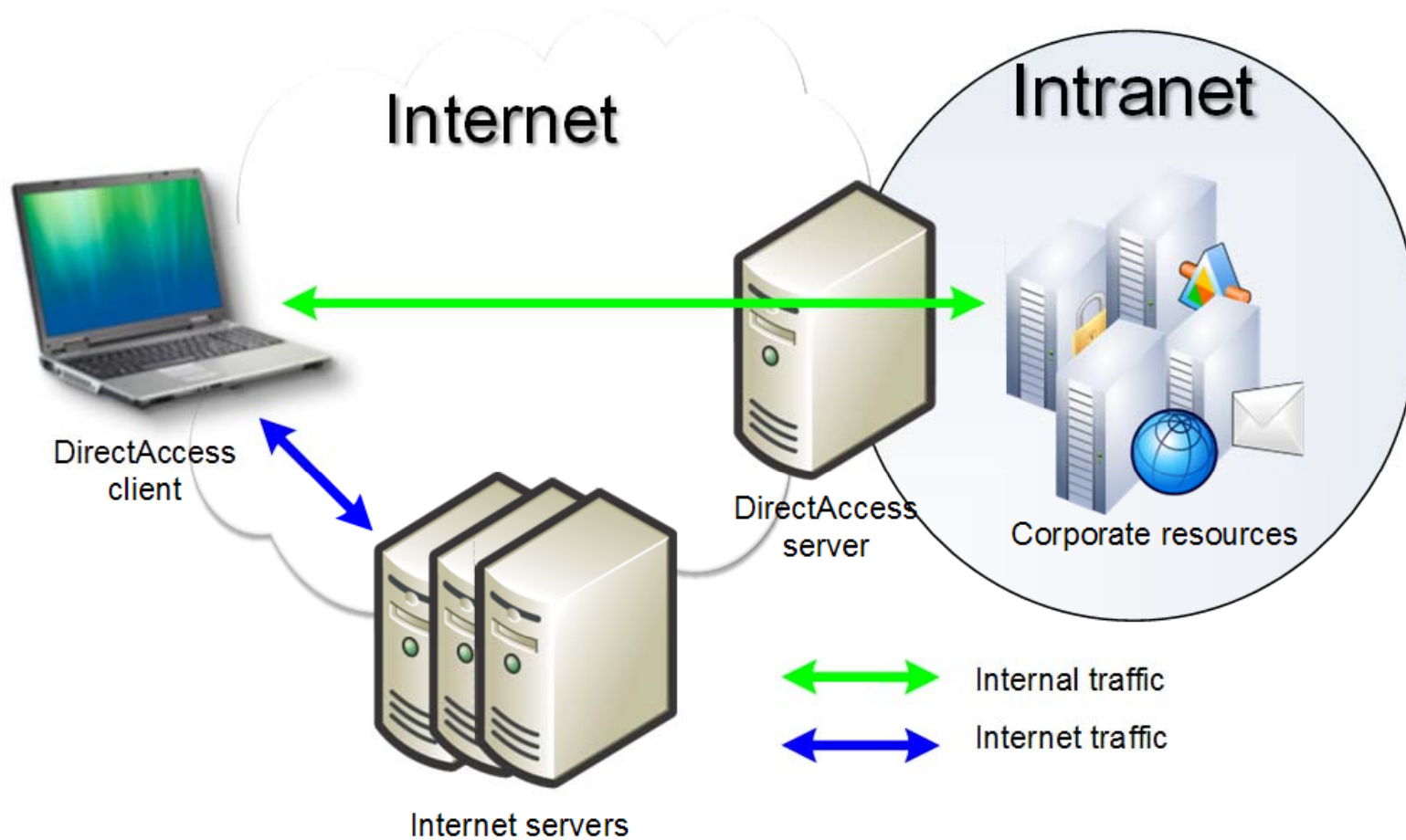
IPv6 is enabled by default

It supports: IPsec, MLDv2, DHCPv6, Teredo

New Features

- IP-HTTPS (IP over secure HTTP)
 - allows for a secure IPv6 tunnel to be established using a secure HTTP connection
- DirectAccess
 - give mobile users seamless access to corporate networks without a need to VPN.
 - it uses IPv6 over IPsec
 - Client on Windows 7 or Server 2008 – Server on Server2008
- MIPv6 support - Correspondent Node (CN) capability but not Return Routability (Route Optimization).
- A Windows 7 computer will communicate with a Mobile Node (MN) through its Home Address (HoA) through the Home Agent (HA).

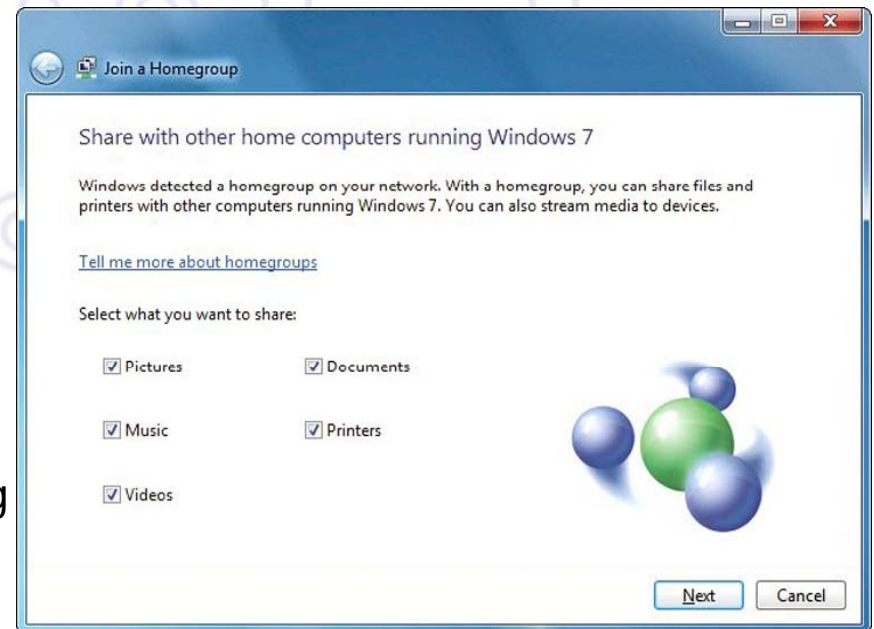
IPv6 in Windows 7 – Direct Access



IPv6 in Windows 7 – Home Group

HomeGroup:

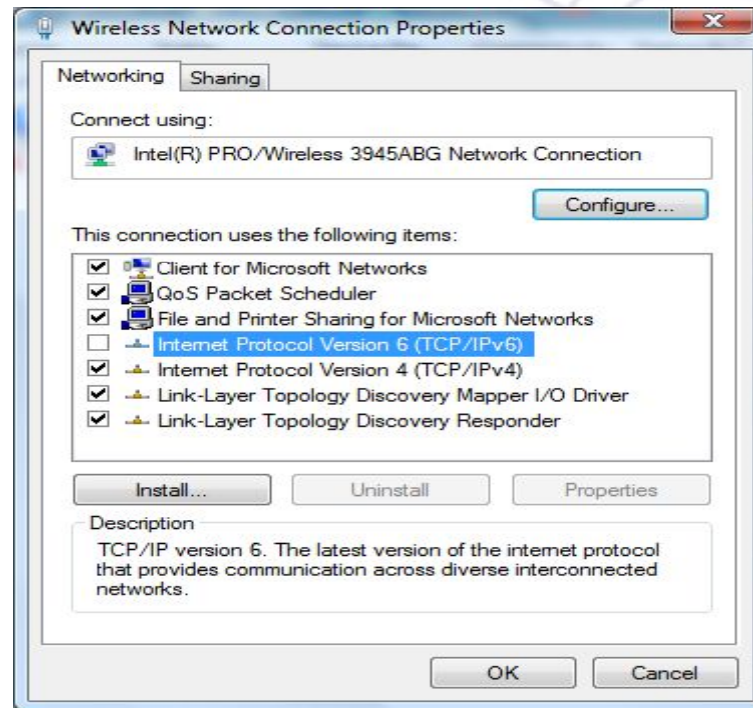
- a new way for computers on home networks to associate with each other and to let family members share documents, pictures, music, videos, and printers.
- relies on IPv6 connectivity and the Windows Peer-to-Peer Networking Platform
- Peer Name Resolution Protocol
PNRP is a distributed name resolution protocol allowing Internet hosts to publish "peer names" and corresponding IPv6 addresses and optionally other information. Other hosts can then resolve the peer name, retrieve the corresponding addresses and other information, and establish peer-to-peer connections.



IPv6 in Windows 7 - Installation

Installed by default

Use of the Network Connections folder > properties of the connection > clear the check box next to the TCP/IPv6 component



IPv6 in Windows Vista

IPv6 is enabled by default

It not only supports the basic functionalities as in previous versions (i.e. Windows XP and 2003) but also new advanced features such as

- Dual IP layer architecture Installed and enabled by default
- Graphical user interface (GUI)-based configuration
- Full Support for IPsec
- MLDv2
- DNS messages over IPv6
- LLMNR (Link Local Multicast Name Resolution)
- Literal IPv6 addresses in URLs
- Support for ipv6-literal.net names
- IPv6 over PPP
- DHCPv6

Windows Vista configuration (1)

- **Automatic address configuration**

1. Stateless address autoconfiguration with IPv6 RA
2. Stateful address autoconfiguration with DHCPv6

- **Manual address configuration**

1. The GUI of the properties of TCP/IPv6 component
2. Commands in the netsh interface ipv6 context

```
netsh interface ipv6 add address interface_name  
ipv6_address
```

- **Address selection configuration**

- RFC3484 provides a standardized method to choose source and destination IPv6 addresses with which to attempt connections

 1. A destination address selection algorithm to sort the list of possible destination addresses in order of preference
 2. A source address selection algorithm to choose the best source address to use with a destination address

Windows Vista configuration (2)

Unlike XP, IPv6 in Vista cannot be uninstalled

To disable IPv6 on a specific connection

- Network Connections folder > properties of the connection > clear the check box next to the TCP/IPv6 component
- This method disables IPv6 on your LAN interfaces and connections
- But does not disable IPv6 on tunnel interfaces or the IPv6 loopback interface

To selectively disable IPv6 components and configure behaviors

- Create and configure the following registry value (DWORD type)
`HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\tcpip6\Parameters\DisabledComponents`
DisabledComponents is set to 0 by default

IPv6 in Windows XP

Not installed by default, and installation varies on service packs

SP1 additions:

- vendor support
- GUI installation
- configuration via netsh command

SP2 additions

- Teredo client
- host-specific relay support
- IPv6 firewall

IPv6 installation in Windows XP

No service packs

- type `ipv6 install` from the command prompt

SP1

- install protocol "Microsoft IPv6 Developer Edition" from Connection Properties window

SP2

- install protocol "Microsoft TCP/IP version 6" from Connection Properties window

Windows XP configuration (1)

Command for IPv6 configuration

- ipv6 (will be discontinued, not present in Windows Server 2003)
- netsh interface ipv6

Autoconfiguration is working

- netsh interface ipv6 4
- interface 1 - loopback
- interface 2 - ISATAP
- interface 3 - 6to4 interface
- interface 4... – real network interfaces
- interface 5 – Teredo interface

Windows XP configuration (2)

Set manual address

- netsh ipv6 interface {add|set} address [interface=] <interface> [address=] <address>
- <interface> - interface name or index
- <address> - address in IPv6 format

Deleting manual address

- netsh ipv6 interface delete address [interface=] <interface> [address=] <address>

Windows XP configuration (3)

Set/remove static IPv6 route

- netsh ipv6 interface {add|set|delete} route
[prefix=]<prefix>/<length>
[interface=]<interface> [[nexthop=] <address>]

Applications

- ipconfig, netstat, ping6, tracert6, pathping
- All Wininet.dll based applications
 - ftp, telnet, IExplorer,

Windows 2003 server

- netsh interface ipv6 (only!)
- file/print sharing-et (site-local) supported over IPv6
- IIS and media server

Windows XP configuration (4)

Neighbor cache

- netsh interface ipv6 show neighbors (ipv6 nc)

IPv6 routing table

- netsh interface ipv6 show routes (ipv6 rt)

Reconfiguration

- netsh interface ipv6 renew (ipv6 renew)

Address selection policy

- netsh interface ipv6 show prefixpolicy
- netsh interface ipv6 set prefixpolicy
[prefix=]<prefix>/<length>
[precedence=]precedence [label=]label

What Windows cannot do with IPv6

DNS messages over IPv6

- not for Windows XP, but Windows Vista and Server 2003 can, there is a builtin proxy for it

IPv6 support for file and print sharing

- Windows 2003 can

IPv6 support for the WinInet, IPHelper, and DCOM APIs

Windows XP configuration (4)

IPSec

- ipsec6 sp/sa/s/l
- No ESP support by default

.NET

- IPv6 support, but IPv6 literal address does not work

IPv6 firewall support after SP2 or Advanced networking pack

IPv6 teredo support after SP2 or Advanced networking pack

Further information: <http://www.microsoft.com/ipv6/>

Windows XP configuration (5)

Windows XP ICF – same rules for IPv4 and IPv6

- Show configuration:
 - netsh firewall show globalport
 - netsh firewall show adapter
- Set configuration
 - set globalport [port#=enable|disable] [name=name] [protocol=tcp|udp]
 - set adapter [name] [icmp type#=enable|disable] [port port#=enable|disable [name=name] [protocol=tcp|udp]] [ignoreglobalport port#=enable|disable] [name=name] [protocol=tcp|udp]] [filtering=enable|disable]
 - set logging [filelocation=<location>] [filesize=integer] [droppedpackets=enable|disable] [successfulconnections=enable|disable]

After SP2

- in the firewall you can configure Path MTU discovery support
- per process configuration possible

Further information:

<http://www.microsoft.com/technet/community/columns/cableguy/cg0104.msp>

Windows XP/.Net/Vista configuration (netsh)

Configure an IPv6 in IPv4 tunnel

- `netsh interface ipv6 add v6v4tunnel Name [Your IPv4 Endpoint] [Server IPv4 Endpoint]`
- `netsh interface ipv6 add address Name [Your IPv6 Endpoint]`

Configure a default route

- `netsh interface ipv6 add route 0::/0 Name publish=yes`

Configure a static route

- `netsh interface ipv6 add route [Tunnel Prefix]/[Prefix Length] Name`

Allow ICMP ping

- Windows XP SP1 and lower
 - `netsh firewall set adapter Name icmp all=enable`
- Windows XP SP2 and up, 2003 and Vista
 - `netsh firewall set icmpsetting Name enable all`

BSD



IPv6 on *BSD

Supported

- autoconfiguration, IPv4 tunnel, 6to4, MLDv1, IPSec, Jumbogram, ICMP mode information query, privacy extension

**Available since FreeBSD 4.0, OpenBSD 2.7,
NetBSD 1.5**

KAME extension

- NAT-PT, DHCPv6, PIM-(S)SM, multicast DNS, EDNS resolver, ISATAP (not any more), anycast (integrated)

FreeBSD configuration (1)

Installation: not necessary, the default kernel has it

The installer asking for IPv6 support

- `ipv6_enable="yes"` in `/etc/rc.conf`
- Autoconfiguration is working
- `ifconfig -a`

FreeBSD configuration (2)

Manual address configuration

- `ipv6_prefix_fxp0="2001:DB8:1:2"`
- `ipv6_ifconfig_fxp0="2001:DB8:1:2::1 prefixlen 64"`
- `then /etc/netstart`
- `or ifconfig`

Neighbor cache

- `ndp -a`

Routing table

- `route/netstat`

FreeBSD configuration (3)

Configuration of further addresses

```
- ipv6_ifconfig_if0_alias0="fec0:0:0:5::2/64"
```

What about if you don't have IPv6 connectivity

- ip6addrctl(8) program – according RFC3484 you can adjust default address selection

```
#preferip4connection_policy
```

#Prefix	Precedence	Label
::1/128	50	0
::/0	40	1
2002::/16	30	2
::/96	20	3
::ffff:0:0/96	100	4

FreeBSD configuration (4)

Reconfiguration

- `rtsol fxp0`

Applications

- ping6, traceroute6, ftp, telnet, r* commands, sendmail, apache, Mozilla, proftpd, OpenSSH, LPD, NFS/YP (FreeBSD 5.0 tól), courier-imap, irc, openldap, tftp, tcpdump, inn, tin

Further information

- <http://www.freebsd.org>
- <http://www.kame.net>
- <http://ipv6.niif.hu/m/FAQ>

FreeBSD configuration (5)

Configure an IPv6 in IPv4 tunnel

- `ifconfig gif1 create`
- `ifconfig gif1 tunnel @IPv4_source @IPv4_dest`
- `ifconfig gif1 inet6 @IPv6_address up`

Configure an IPv6 in IPv6 tunnel

- `ifconfig gif1 create`
- `ifconfig gif1 tunnel @IPv6_source @IPv6_dest`
- `ifconfig gif1 inet6 @IPv6_address up`

FreeBSD configuration (6)

Configure a static route

- Default route

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

%interface notation

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

FreeBSD configuration (7)

Router advertisement: /etc/rtaadvd.conf

```
default:\
    :chlim#64:raflags#0:rltime#1800:rttime#0:retrans#0:\
    :pinfocflags="la":vlttime#2592000:pltime#604800:mtu#auto:
```

- `ef0:\`
`:addr="2001:DB8:ffff:1000::":prefixlen#64:tc=default:`

FreeBSD configuration (8)

RIPng: route6d daemon

route6d

-L *IPv6_prefix, interface* (receives only prefixes derived from *IPv6_prefix* on interface *interface*)

-N *interface* (do not receive and advertise routes on interface)

-O *IPv6_prefix, interface* (advertise only on interface the IPv6 prefix)

BGP: bgpd daemon

Better to use Zebra/Quagga BGP daemon

LINUX



IPv6 on Linux

Supported

- autoconfiguration, IPv4 tunnel, 6to4
- since Kernel 2.2.x recommended at least 2.4.8

USAGI patch (mostly included in 2.6.x series)

- Node information query, anycast, ISATAP, privacy extension, IPsec, applications, bug-fix, mobile IP

General Linux configuration (1)

Kernel compile options

- `CONFIG_IPv6=m/y`
- If the IPv6 module is loaded, file `/proc/net/if_inet6` should be present
- IPv6 module can be loaded by `modprobe ipv6`

Autoconfiguration supported

- `ifconfig`

General Linux configuration (2)

Address configuration

- `ifconfig <interface> inet6 add <ipv6address>/<prefixlength>`

Neighbor cache

- `ip -6 neigh show`

IPv6 routing table

- `route -A inet6/netstat`

Red Hat configuration (1)

Enabling Global IPv6 support

/etc/sysconfig/network file:

```
NETWORKING_IPV6="yes"
```

Enabling IPv6 support on a particular interface

/etc/sysconfig/network-scripts/ifcfg-eth0 file:

```
IPV6INIT="yes"
```

Configuring IPv6 interface address

/etc/sysconfig/network-scripts/ifcfg-eth0 file:

```
IPV6ADDR="2001:DB8:20::291D:6A83/48"
```

Default route configuration

/etc/sysconfig/static-routes-ipv6 file:

```
eth0 ::/0 2001:DB8:20::922:A678
```

Red Hat configuration (2)

Applications

- ping6, traceroute6, tcpdump, tracepath6, apache, bind, imap (xinetd), sendmail, openssh, telnet, ftp, mozilla, lynx, wget, kde, xchat, etc.

Further information

- <http://www.bieringer.de/linux/IPv6>
- <http://www.linux-ipv6.org/>

Fedora configuration (1)

**(Fedora Core 2 only) append to
/etc/sysconfig/network:**

- NETWORKING_IPV6=yes
- IPV6_DEFAULTDEV="your exit device e.g. tun6to4"

**(Fedora Core 1 only) append to
/etc/sysconfig/network**

- NETWORKING_IPV6=yes
- IPV6_GATEWAYDEV="your exit device e.g. tun6to4"

**6to4 gateway- append to
/etc/sysconfig/network-scripts/ifcfg-eth0**

- IPV6INIT=yes
- IPV6TO4INIT=yes

Debian configuration (1)

Enabling IPv6

You should put "ipv6" in "/etc/modules"

Address configuration

"/etc/network/interfaces" :

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

Further information

<http://wiki.debian.org/DebianIPv6>

Debian configuration (2)

Configure an IPv6 in IPv4 tunnel

"/etc/network/interfaces" :

```
iface tun0 inet6 v4tunnel
    endpoint A.B.C.D
    address 2001:DB8:1:YYYY::2
    gateway 2001:DB8:1:YYYY::1
    netmask 64
```

Debian configuration (3)

RA configuration on Debian router

"/etc/radvd.conf" :

```
interface eth0
```

```
{
```

```
  AdvSendAdvert on;
```

```
  AdvLinkMTU 1500;
```

```
  prefix 2001:XXXX:YYYY:ZZZZ:/64 {
```

```
    AdvOnLink on;
```

```
    AdvPreferredLifetime 3600;
```

```
    AdvValidLifetime 7200;
```

```
  };
```

```
};
```

Debian configuration (4)

Configuration on Debian router

```
net.ipv6.conf.all.autoconf = 0
net.ipv6.conf.all.accept_ra = 0
net.ipv6.conf.all.accept_redirects = 0
net.ipv6.conf.all.forwarding = 1
net.ipv6.conf.all.router_solicitations = 0
```

Firewalls

```
iptables -I INPUT -j ACCEPT --proto 41
```

Multiple IPv4 addresses in Debian

```
auto eth0
```

```
iface eth0 inet static
```

```
address 192.168.1.42
```

```
netmask 255.255.255.0
```

```
broadcast 192.168.1.255
```

```
gateway 192.168.1.1
```

```
auto eth0:0
```

```
iface eth0:0 inet static
```

```
address 192.168.1.41
```

```
netmask 255.255.255.0
```

```
broadcast 192.168.1.255
```

```
auto eth0:1
```

```
iface eth0:1 inet static
```

```
address 192.168.1.44
```

```
netmask 255.255.255.0
```

```
broadcast 192.168.1.255
```



Multiple IPv6 addresses in Debian

```
# IPv6 address for eth0:
```

```
iface eth0 inet6 static
```

```
address 2001:41d0:1:3c3::1
```

```
netmask 64
```

```
gateway 2001:41d0:1:3ff:ff:ff:ff:ff
```

```
up /sbin/ifconfig eth0 inet6 add 2001:41d0:1:3c3::2
```

```
down /sbin/ifconfig eth0 inet6 del 001:41d0:1:3c3::2
```

This will assign a second IPv6 address to the eth0 interface when it goes up, and removes it when down.

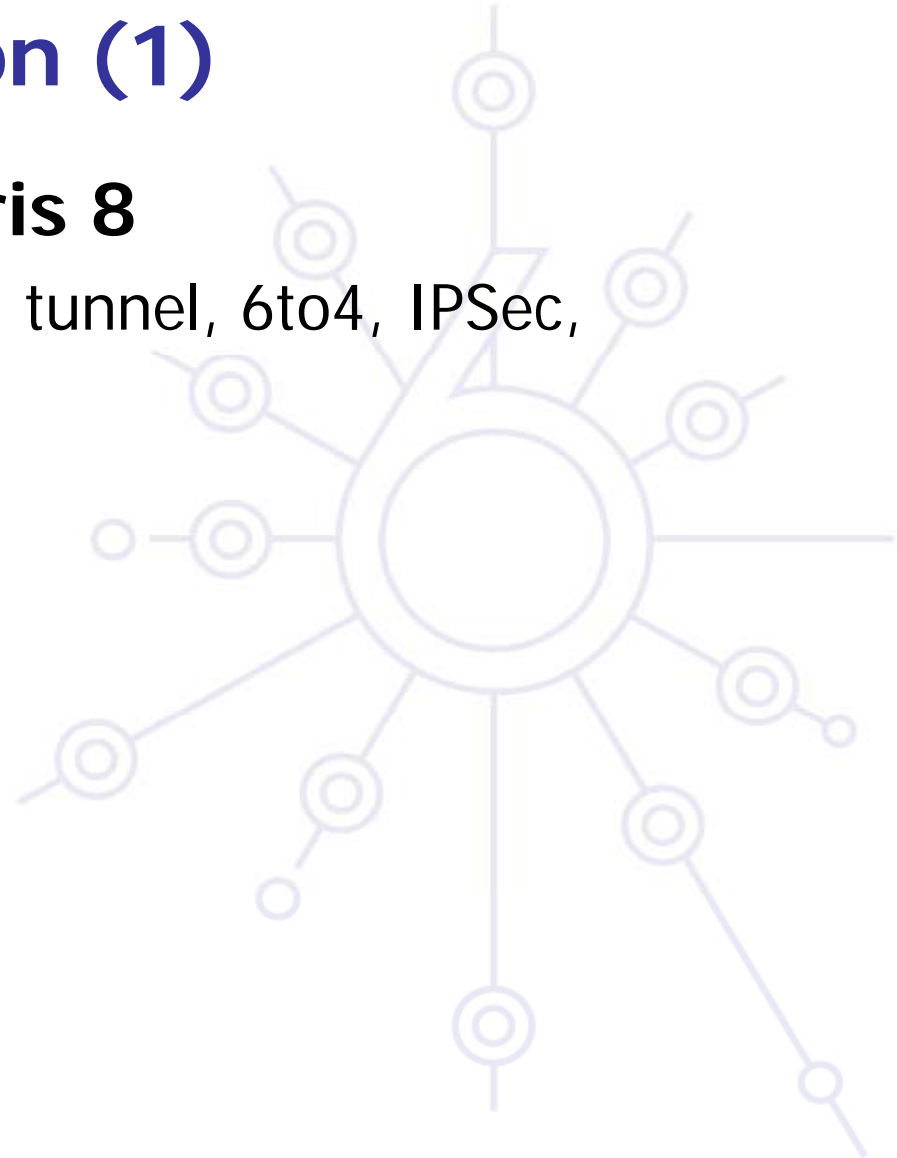
SOLARIS



Solaris configuration (1)

Supported since Solaris 8

- autoconfiguration, IPv4 tunnel, 6to4, IPsec, applications



Solaris configuration (2)

Autoconfiguration

```
existing "/etc/hostname6.<intf>"
```

Static address configuration

```
"/etc/hostname6.<intf>" :
```

```
addif 2001:DB8:1:2::100 up
```

Static name ↔ IPv6 address resolution:

```
in /etc/inet/ipnodes
```

DNS resolution should be enabled

```
/etc/nsswitch.conf
```

```
ipnodes: files dns
```


MAC OS X



Mac OS X configuration (1)

Supported since Mac OS X 10.2 (since Darwin kernel version 6)

- autoconfiguration, IPv4 tunnel, 6to4, IPSec, applications, Apple Filing Protocol (since AFP version 3.1)
- Rendez-vous point supports IPv6
- Basically – what you can expect from *BSD

Mac OS X configuration (2)

Enabled by ip6config command

`ip6config` command interface

- commands:
 - `start-v6` – enable IPv6 on given (all) interface
 - `stop-v6` – disable IPv6 on given (all) interface
 - `start-stf` – enable IPv6 as defined in `/etc/6to4.conf`
 - `start-rtadvd` – start router advertisement daemon and enable IPv6 packet forwarding between interfaces
- `ip6` – enable disable per interface

Autoconfiguration

enabled by default

Questions?

6DEPLOY Project Web Site:

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

