



IPv6 for Linux and z/VM

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In other words: Your mileage may vary. “It Depends.”
Results not typical. Actual mileage will probably be less.
Use only as directed. Do not fold, spindle, or mutilate. Not to be taken on an empty stomach. Refrigerate after opening.

In all cases, *“If you can't measure it, I'm just not interested.”*

Internet Protocol Version 6



World IPv6 Day

- 2011-June-8

World IPv6 Launch

- 2012-June-6

Internet Protocol Version 6

What really is IPv6 and why should we do it?

Where to get IPv6 connectivity?

What systems can talk IPv6?

How does one enable Ipv6?

- on Linux
- on z/VM

Now what??

- IPv6-specific Resources

What happened to IPv5?

Experimental

- Internet Stream Protocol

Not really called IPv5

Protocol header says “5”

Internet Protocol Version 6

Ports do not change (TCP, UDP)

Funny syntax ... [2604:8800:12b::d]

“beyond mind boggling” addressability

External infrastructure (now)

Consumer internet (immediate)

Internal infrastructure

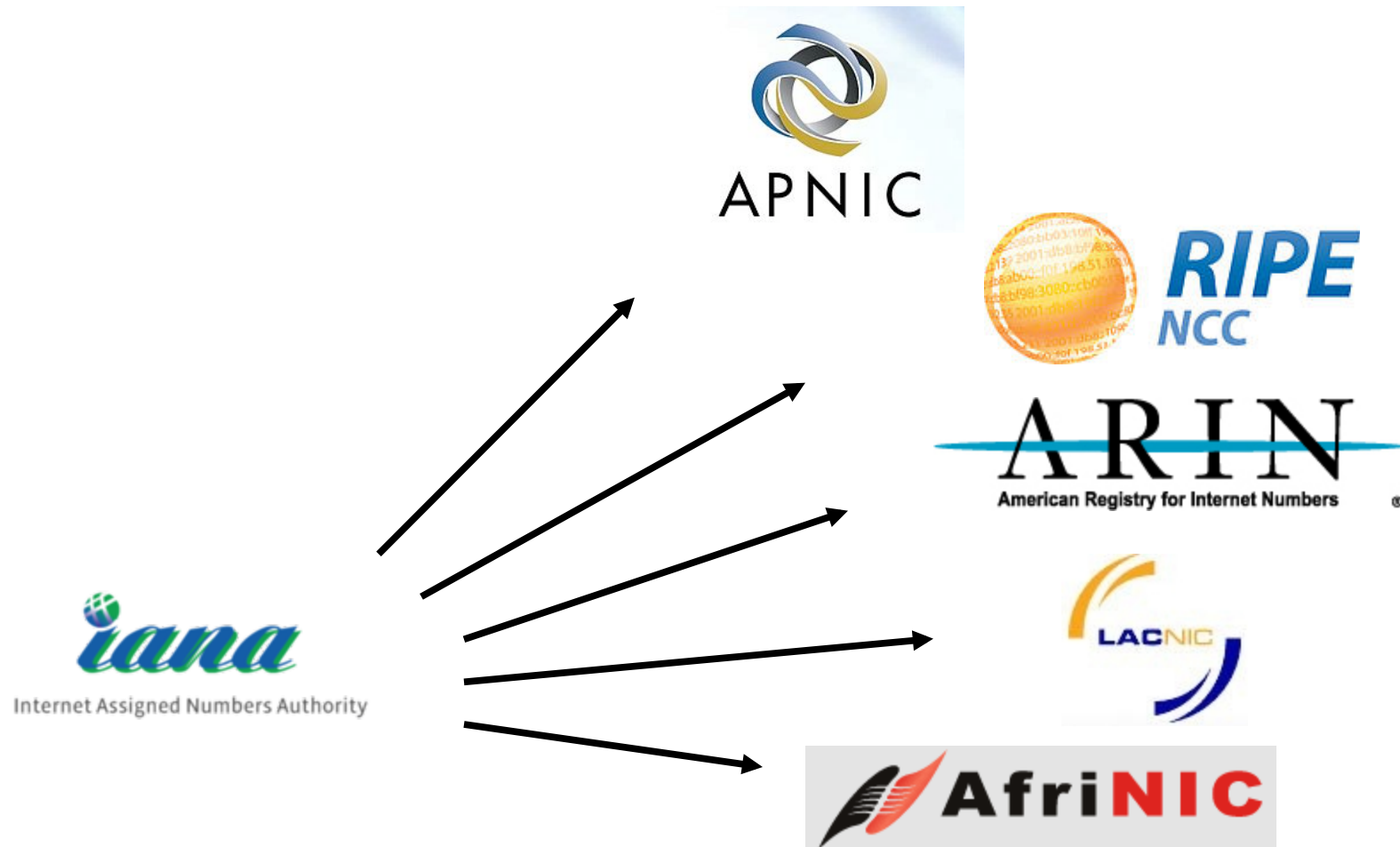
V4 turns vestigial

IPv6 for Linux and z/VM

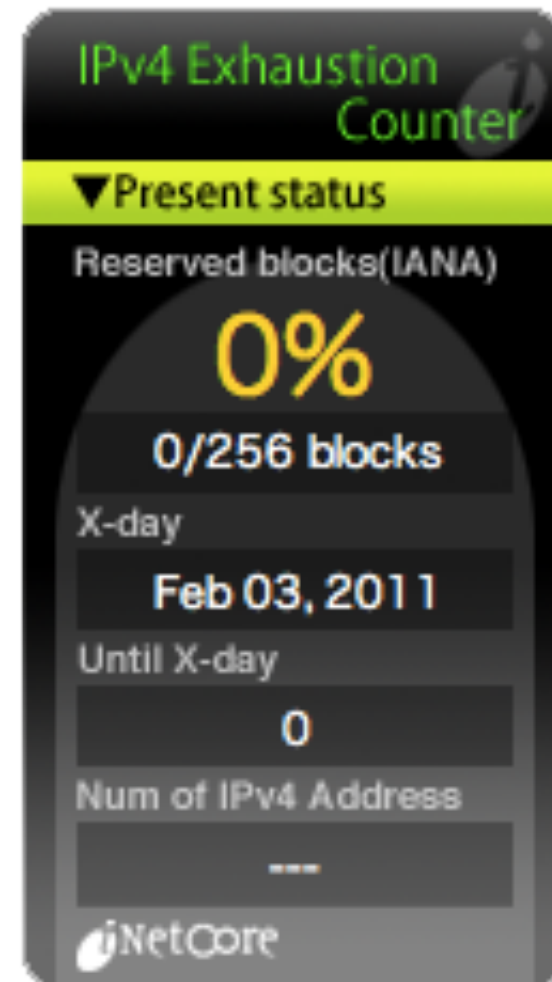
This is a personal odyssey
NOT talking about router config
NOT detailing app upgrades
NOT giving you the fire-and-brimstone

If IPv6 is a big yawn,
that's kind of the point!

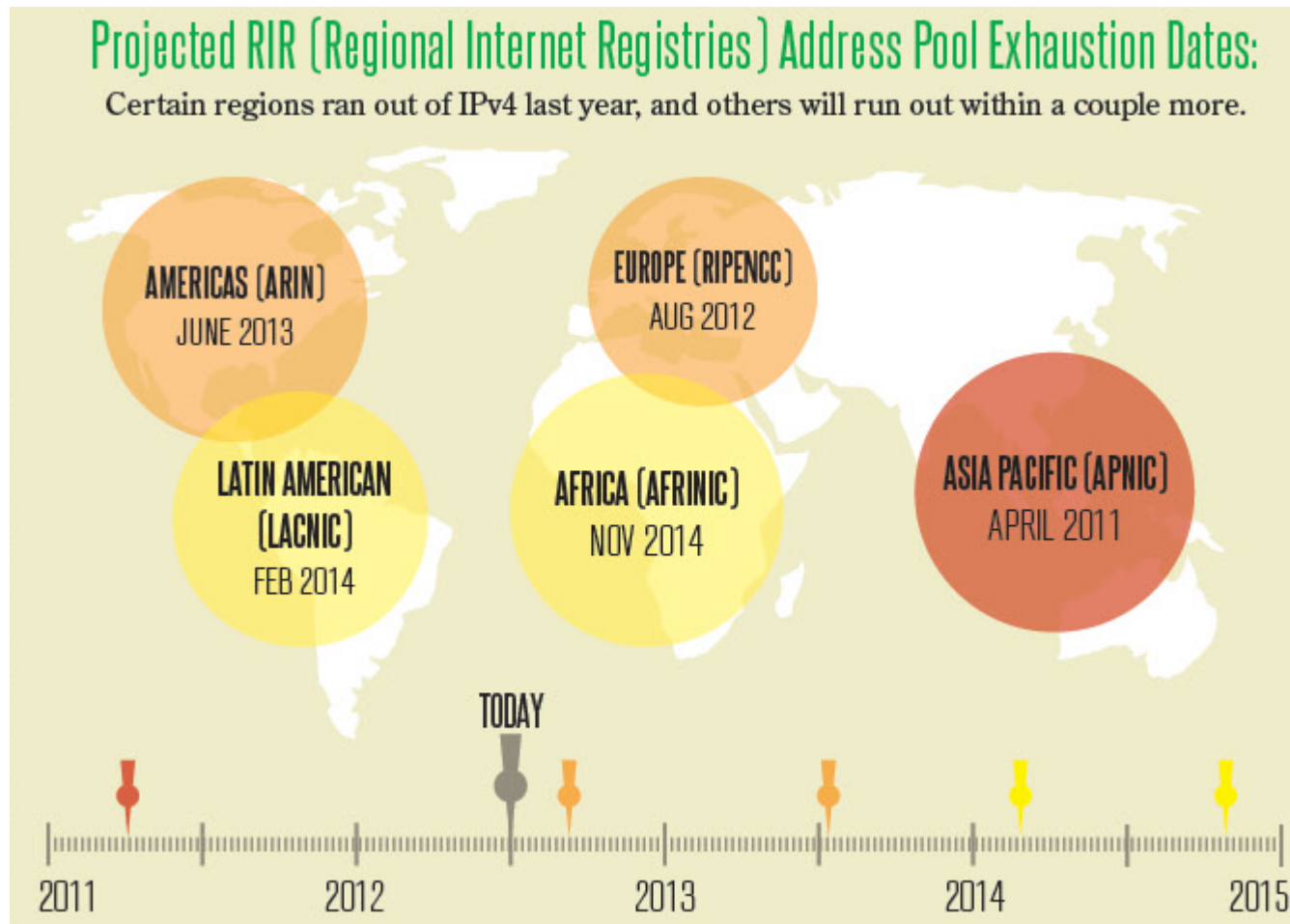
IPv4 Exhaustion



IPv4 Exhaustion



IPv4 Exhaustion



IPv4 Exhaustion

Microsoft pays Nortel \$7.5 million for IPv4 addresses

Bankrupt Nortel finds a buyer for 666K of its legacy IPv4 addresses, raising questions if the IPv4 black/grey market has arrived.

By [Microsoft Subnet](#) on Thu, 03/24/11 - 3:35pm.



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6 people recommend this. Be the first of your friends.

Microsoft this week offered to pay Nortel \$7.5 million for 666,624 legacy IPv4 addresses. The sale is pending approval by U.S. Bankruptcy Court for the District of Delaware as part of Nortel's Chapter 11 bankruptcy.

It doesn't sound exactly like the [black market for IPv4 address](#) that industry experts have been warning us about for years. But then again, it could be the start of one. This sale is reportedly the first publicly disclosed [large-scale sale of IPv4 addresses](#) since ICANN announced they had run out of address blocks, says Kevin Murphy from Domain Incite. And if the court approves the sale on April 26, these 666K-plus addresses will selling for a decent chunk of change, too. (Those who oppose the sale, have until April 4 to file their objections). [[Court documents: PDF](#)].

Microsoft will pay \$11.25 per address. That's more than the going rate for to register a .com domain name, which these days can be had for as little as \$7.50.



IPv4 Exhaustion

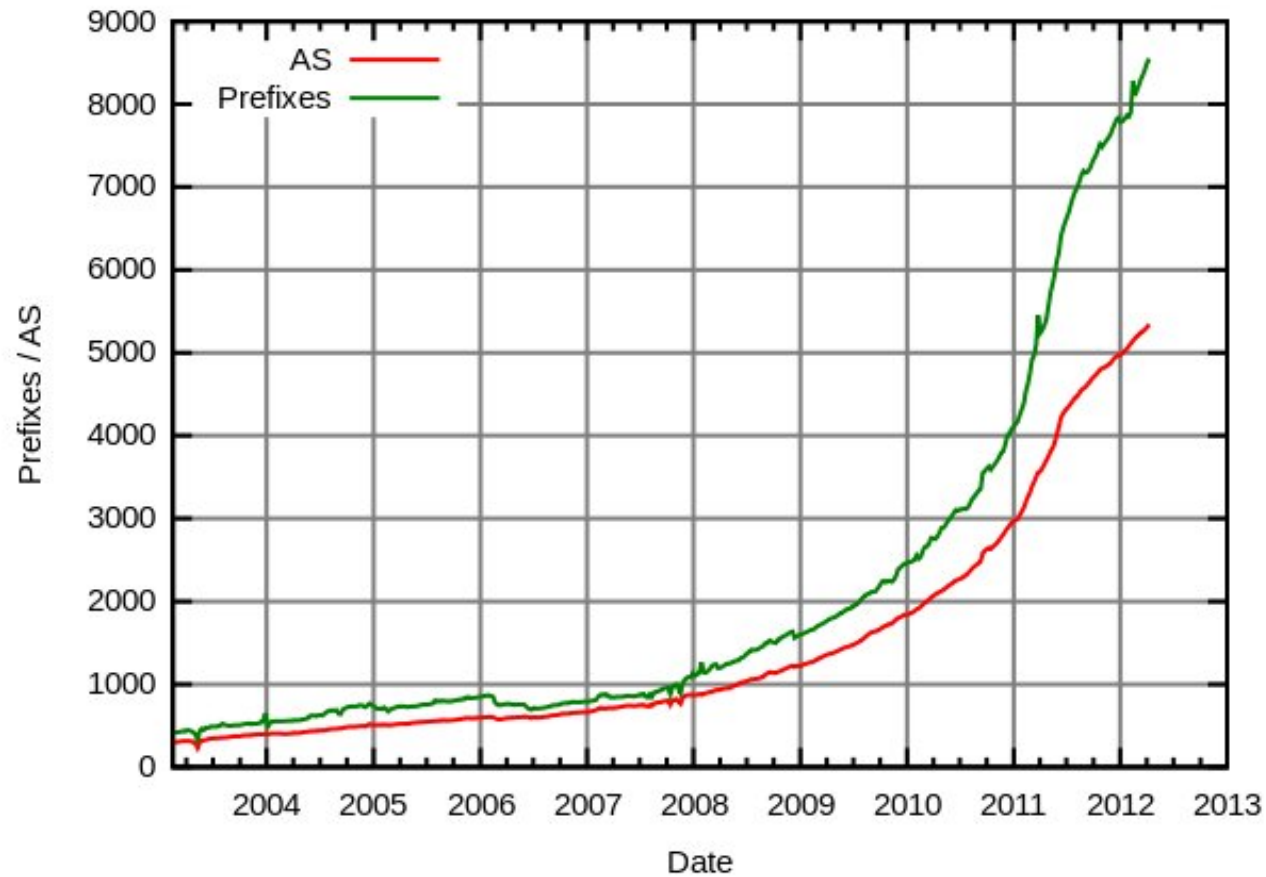
2011 IPv6 infrastructure 11%

2011 price for IP v4 address: \$11.25

(something special about number 11?)

IPv6 Deployment

IPv6 prefixes and AS



US Gov/Mil Committed



Core support since 2008

Many, many tests

Apps, systems, devices



Residential IPv6



Littleton, Colorado
Pleasanton, California
... other markets



What's My IP Address?

Will report your IPv4 or IPv6 address:

`http://icanhazip.com/`

`http://www.sixxs.net/`

`http://ipv6.he.net/`






`http://test-ipv6.com/`

Reachable only via IPv6:

`http://zechariah.casita.net/`

Test your IPv6 connectivity.

Summary Tests Run Technical Info Share Results / Contact

-  Your IPv4 address on the public Internet appears to be 173.88.116.60
-  Your IPv6 address on the public Internet appears to be 2604:8800:12b::5f
Your IPv6 service appears to be: uschi03.sixxs.net cymru
-  The [World IPv6 Launch](#) day is June 6th, 2012. **Good news!** Your current browser, on this com expected to keep working after the Launch. [\[more info\]](#)
-  Congratulations! You appear to have both IPv4 and IPv6 Internet working. If a publisher public using IPv6. Your browser prefers IPv6 over IPv4 when given the choice (this is the expected o
-  Your DNS server (possibly run by your ISP) appears to have IPv6 Internet access.

Your readiness scores

10/10 for your IPv4 stability and readiness, when publishers offer both IPv4 and IPv6

10/10 for your IPv6 stability and readiness, when publishers are forced to go IPv6 only

IPv6 Tunnel Brokers

SixXS

Hurricane Electric

Gogo6

regionals



IPv6 Tunnel Brokers

SixXS = Six Access
AICCU



```
/etc/aiccu.conf
```

```
username aaaa-SIXXS
```

```
password sayitnot
```

```
protocol tic
```

```
server tic.sixxs.net
```

```
tunnel_id T73837
```

IPv6 Tunnel Brokers

Hurricane Electric

Example configurations

Worked for Linux/390

Worked for Linux 2.2 '486



IPv6 for Linux, VM, and ...

AIX

Solaris - from 8 onward

Windows - XP, Vista, 7

Mac OS X

NetBSD

OpenBSD

FreeBSD - stable from 4.4 onward

HP-UX

IPv6 for Linux, VM, and ...

NETGEAR
SMARTWIZARD™
router manager
N300 Wireless Router model WNR2000v2

Select Language:
English
Apply

- Router Upgrade
- Advanced
 - Wireless Settings
 - Wireless Repeating Function
 - Port Forwarding / Port Triggering
 - WAN Setup
 - LAN Setup
 - QoS Setup
 - Dynamic DNS
 - Static Routes
 - Remote Management
 - UPnP
 - IPv6
 - Traffic Meter
- Web Support
 - Knowledge Base
 - Documentation
- Logout

WAN Setup

☐ Disable Port Scan and DoS Protection

☒ Default DMZ Server . . .

☒ Respond to Ping on Internet Port

MTU Size(in bytes)

NAT Filtering ☒ Secured ☐ Open

☐ Disable SIP ALG

Apply Cancel

WAN Setup Help

Using this page, you can set up a Default DMZ Server and allow the router to respond to a 'ping' from the internet. Both of these options have security issues, so use them carefully.

Disable Port Scan and DoS Protection - The DoS Protection protects your LAN against Denial of Service attacks. This should only be disabled in special circumstances.

Default DMZ Server

Specifying a Default DMZ Server allows you to set up a computer or server that is available to anyone on the Internet for services that you haven't defined. There are security issues with doing this, so only do this if you're willing to risk open access. If you do not assign a Default DMZ Server, the router discards any incoming service requests which are undefined.

To assign a computer or server to be a DMZ server:

1. Click the *Default DMZ Server* check box
2. Type the IP address for that server.
3. Click **Apply**.

Respond To Ping On Internet Port

If you want the Router to respond to a 'Ping' from the Internet, click this check box. This can be used as a diagnostic tool. Again, like the DMZ server, this can be a security problem. You shouldn't check this box unless you have a specific reason to do so.

Disable IGMP Proxying

IPv6 for Linux, VM, and ...

NETGEAR
SMARTWIZARD™ router manager
N300 Wireless Router model WNR2000v2

Select Language:
English
Apply

IPv6

Internet Connection Type: Disabled

Apply Cancel

IPv6 Help

The IPv6 pages allow you to configure and check the status of your IPv6 Internet connection.

Internet Connection Type

Select the IPv6 connection type you want to use, which should be provided by your ISP. If your ISP does not provide a specific IPv6 connection, you can select "6to4 Tunnel". If you are not clear about the IPv6 connection, you can select "Auto Detect" and let the router decide the proper type for you.

If your ISP explicitly indicates that your IPv6 connection is not DHCP, PPPoE, or Fixed IP, or your ISP indicates it is IPv6 auto config, you may select "Pass Through".

The default setting is "Disabled", which turns off the IPv6 function.

To Save/Cancel Changes or See the Current IPv6 Status

Click **Apply** to save the new settings to the router.
Click **Cancel** to discard any unsaved changes.
Click **Status Refresh** to update the page and see the information about the current IPv6 connection.

disabled by default, try 6to4

IPv6 for Linux - Fedora

To the file ...

`/etc/sysconfig/network-scripts/ifcfg-eth0`

Add the lines ...

`IPV6INIT=yes`

`IPV6_AUTOCONF=no`

`IPV6ADDR=2604:8800:12b::25/48`

`IPV6_DEFROUTE=yes`

`IPV6_FAILURE_FATAL=no`

IPv6 for Linux - SLES

To the file ...

`/etc/sysconfig/network/ifcfg-eth-id-macaddr`

Add the lines ...

`LABEL_0='0'`

`IPADDR_0='2604:8800:12b::23'`

`PREFIXLEN_0='48'`

IPv6 for Linux ... any Linux

```
La Casita Linux
easton login: rmt
Password:
easton:~$ uname -a
Linux easton 2.2.25 #7 Tue Aug 3 08:53:03 CDT 2004 i486 unknown
easton:~$ free
              total        used        free      shared    buffers     cached
Mem:          18448        18124          324        12528        7312        4652
-/+ buffers/cache:          6160        12288
Swap:          27208             0         27208
easton:~$ cd / ; exec ssh 2604:8800:12b::b
Password:
Last login: Fri Jun 24 13:28:10 2011 from sirsanta-1-pt.tunnel.tserv9.chi1.ipv6.
he.net
Jeremiah brought God's word: "the plans I have for you".
rmt@jeremiah:~$> uname -a
Linux jeremiah 2.6.16.46-0.12-xen #1 SMP Thu May 17 14:00:09 UTC 2007 i686 athlon
i386 GNU/Linux
rmt@jeremiah:~$> who am i
rmt          pts/1            2011-06-24 13:29 (sirsanta-1-pt.tunnel.tserv9.chi1.ipv6.he
.net)
rmt@jeremiah:~$> _
```

Since z/VM 5.1

'ping' and 'telnet' in z/VM 5.4

Remember “ENABLEIPV6”

Home address /64 and /128 only

No (known) tunneling ability

IPv6 for z/VM

```
DEVICE  ETHDEV  OSD  0200  NONROUTER  AUTORESTART
LINK    ETH0    QDIOETHERNET  ETHDEV  ENABLEIPV6
```

HOME

```
192.168.5.43      255.255.255.0    ETH0
2001:1938:81:209::2b/64    ETH0
```

GATEWAY

```
DEFAULTNET      192.168.5.20      ETH0    8992
DEFAULTNET6     2001:1938:81:8209::1    ETH0    8992
```

Stateless Autoconfig Considered Harmful
(use DHCPv6 or static instead)

Your “real address” is visible
(reduced anonymity; Rick sez “good!”)

IPv6 was first used by hackers
(using V6 address as a covert channel)

Use static addrs and use DNS

SLAY Radio - Internet Radio

```
#!/bin/sh
#http://www.slayradio.org/
cd /tmp
title SlayRadio IPv6
curl -s http://relayipv6.slayradio.org:8000/
\
| madplay -o cdda:- - \
| aplay -f cdr
```



Fréquence 3 - Internet Radio

```
#!/bin/sh
#http://www.frequence3.fr/
cd /tmp
title Frequency3 IPv6
curl -s http://stream.ipv6.frequence3.net:19000/frequence3
\
| madplay -o cdda:- - \
| aplay -f cdr
```



Absolute Radio - Internet Radio

```
#!/bin/sh
#http://www.absoluteradio.co.uk/
cd /tmp
title Absolute Radio IPv6 Classic Rock
curl -s http://icecast-ipv6.as34763.net:80/vc128.mp3 \
| madplay -o cdda:- - \
| aplay -f cdr
```



A Personal Odyssey

What I use:

SSH

port tunnels

VNC

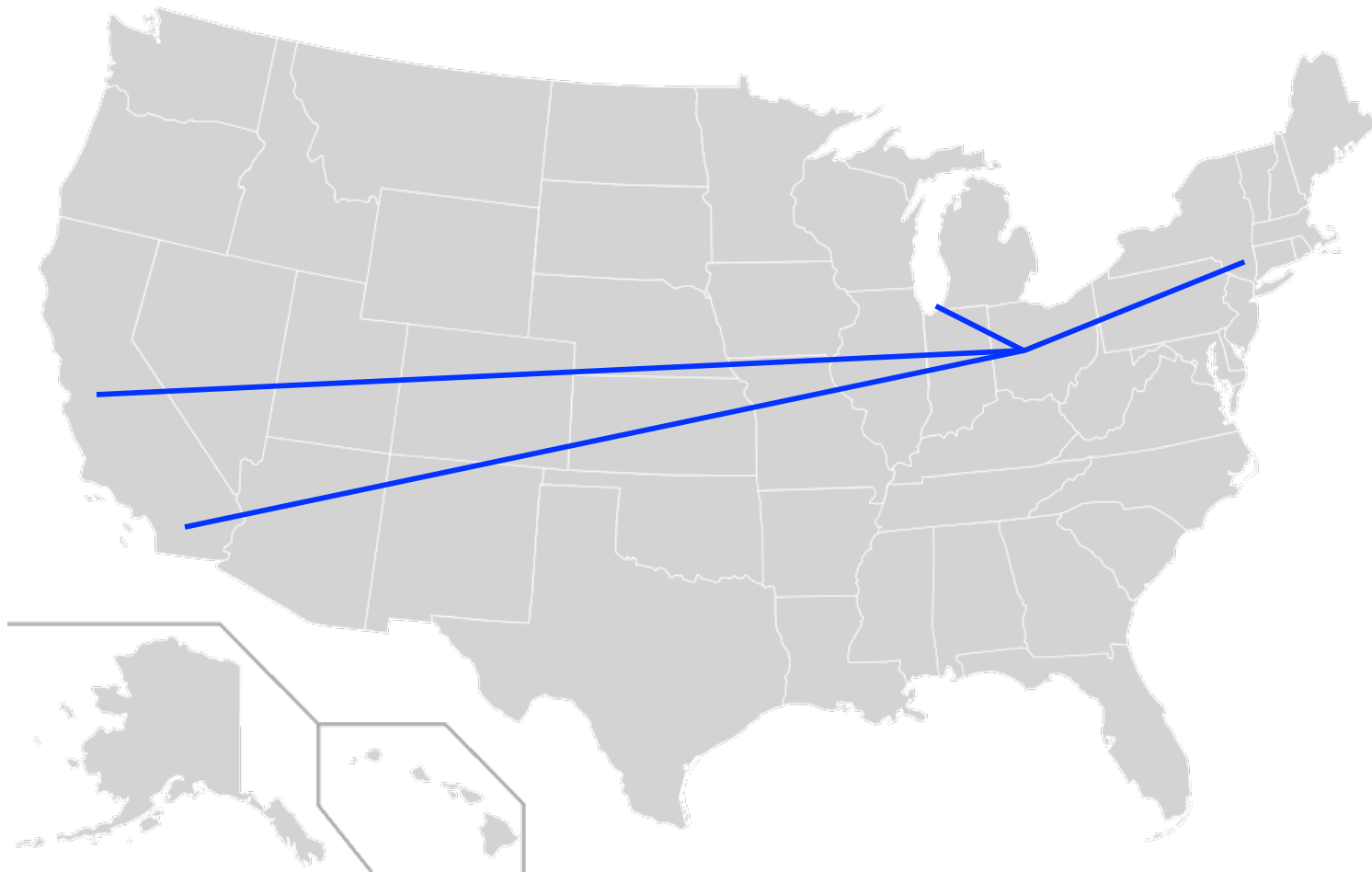
my own DNS

automation!

Tried to connect with 6bone



The Small World of casita.net



`/var/named/master/casita.net`

`/var/named/master/192.168.29`

`/var/named/master/2604:8800:12b`

“internal” DNS has complete domain

“external” DNS has partial

IPv4 PTR records valid internally (v4 NAT)

IPv6 PTRs meaningful everywhere

Forward - DNS at Casita.Net

\$TTL 4H

@ IN SOA @ root@casita.net. (2011071300 7200 3600 3600000 86400)

IN A 192.168.29.1

IN AAAA 2604:8800:12b::b

IN NS jeremiah.casita.net.

main IN A 192.168.29.1

jeremiah IN A 192.168.29.11

jeremiah IN AAAA 2604:8800:12b::b

nehemiah IN A 192.168.29.12

nehemiah IN AAAA 2604:8800:12b::c

culdesac IN A 192.168.29.26

culdesac IN AAAA 2604:8800:12b::1a

IPv4 Reverse - DNS at Casita.Net

\$TTL 4H

\$ORIGIN 29.168.192.IN-ADDR.ARPA.

@ IN SOA @ root@casita.net. (
2008063000 21600 3600 3600000 86400)

IN NS jeremiah.casita.net.

11 IN PTR jeremiah.casita.net.

12 IN PTR nehemiah.casita.net.

26 IN PTR culdesac.casita.net.

IPv6 Reverse - DNS at Casita.Net

\$TTL 4H

```
$ORIGIN b.2.1.0.0.0.8.8.4.0.6.2.ip6.arpa.
```

[illegible]

```
IN      NS      jeremiah.casita.net.
```

```
b.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0 IN PTR jeremiah.casita.net.
```

```
c.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0 IN PTR nehemiah.casita.net.
```

```
a.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0 IN PTR culdesac.casita.net.
```

A way of life since '95

RFC 1918 (formerly RFC 1597)

Not just packets, but stateful

Port swizzling, pain for (eg) SIP

Lack of uniqueness

Looked for NAT in V6 ... but ... then ...

<http://www.youtube.com/watch?v=v26BA1fWBm8>

NIST SP 800-119

“... can actually defeat certain aspects of the design intent of IPv4”

- network layer end-to-end security
- peer-to-peer (host-to-host connectivity)
- and interoperability

The era of IPv6 is upon us.

The world is not ending.

The era of IPv4 *has* ended.

There are challenges.

This is manifestly doable.

Welcome to the 21st century.