

# A short primer on IPv6

-or-

“I have an IPv6 address,  
now what?”

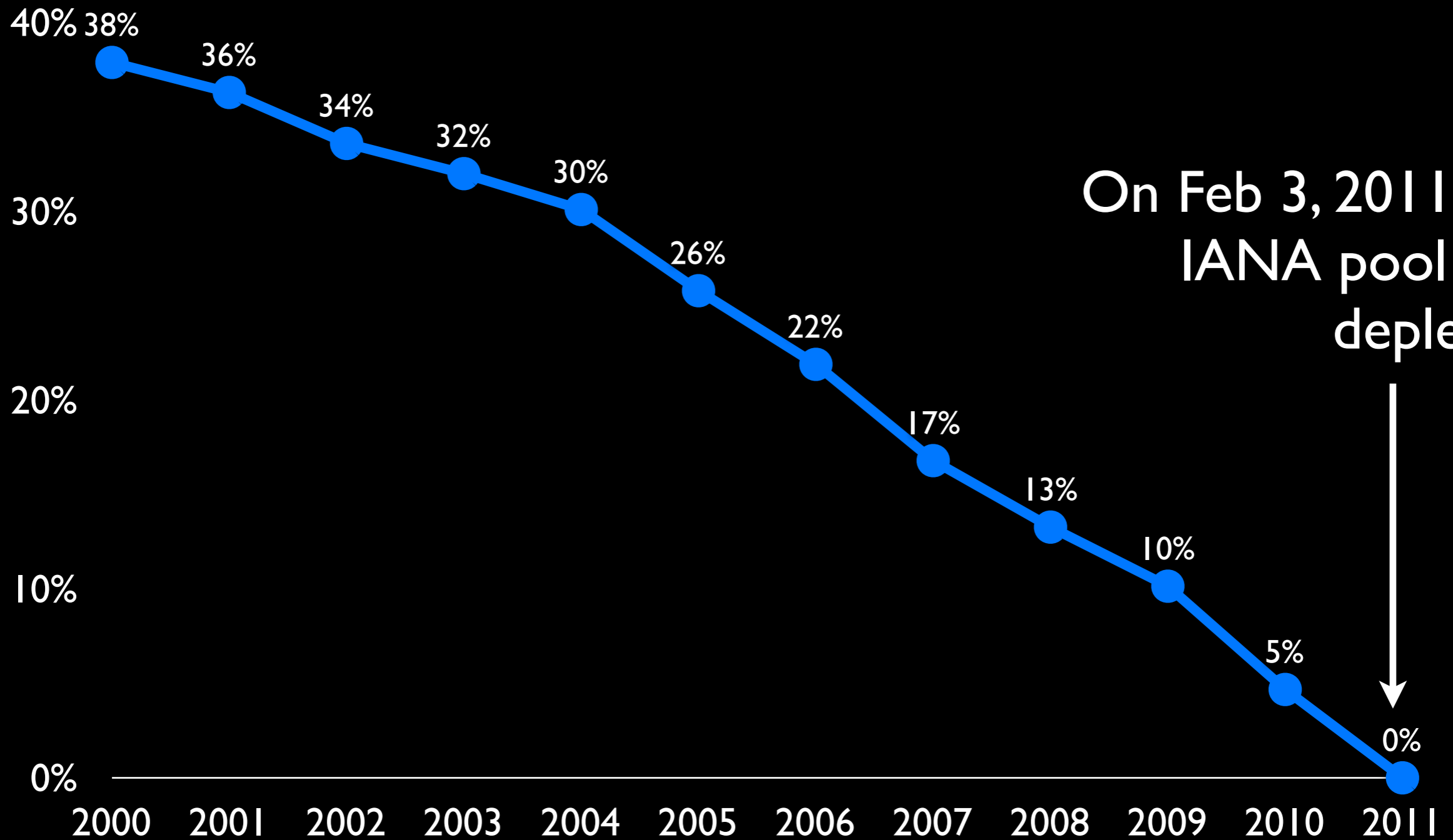
Derek Morr

Sr. Systems Programmer  
ITS Emerging Technologies  
derekmorr@psu.edu

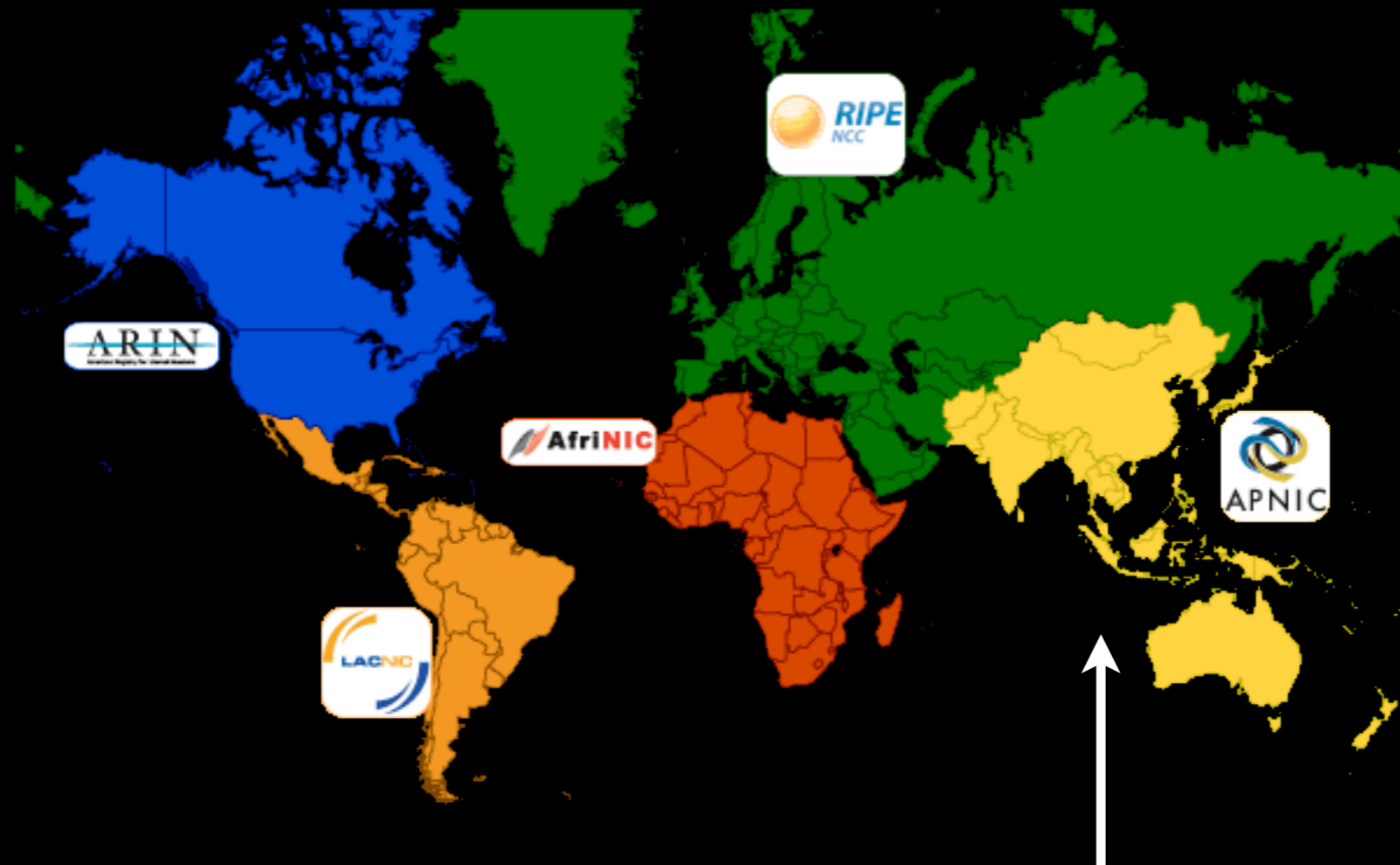
# Overview

- Quick Sales Pitch
- Status of IPv6 at Penn State
- Basics of IPv6
- How to configure IPv6 on OS X Server

# Remaining IPv4 Space



# Regional Internet Registries



April 15, 2011, APNIC reached Stage Three exhaustion. You'll only get crumbs now.

# Recent v6 News

- NIST calls for IPv6 in smart grids - January 2010
- T-Mobile has an IPv6-only trial - July 2010
- Federal gov't IPv6 mandate - September 2010
- Verizon enables IPv6 on LTE - December 2010
- Comcast deploys first native IPv6 cable modems in Colorado - January 2011
- World IPv6 Day - June 8, 2011

# IPv6 Status at Penn State

- The Integrated Backbone supports IPv6 at line speed
- Our upstream provider has native IPv6
  - from multiple providers
- Firewall and redundancy services support IPv6
- PI space from ARIN (2610:8::/32)
- DNS, NTP, TSM, carroll, wikispaces, etc support IPv6
  - Kerberos and AD coming by summer 2011
- Google IPv6 program participant

# My one slide about clients



OS X 10.6.5



Firefox 4



Android 2.2



Opera 10.65

**Please upgrade to (at least) these versions to fix various IPv6 bugs.**

# An IPv6 address

2610:0008:7800:001b:0000:0000:0000:0099



26 | 0:0008:7800:00 | b:0000:0000:0000:0099

26 | 0:8:7800: | b:0:0:0:99

26 | 0:0008:7800:00 | b:0000:0000:0000:0099

26 | 0:8:7800: | b:0:0:0:99

26 | 0:8:7800: | b::99

# Public Addresses

Public:

IPv4: 128.118.25.3

IPv6:

Taken out of 2000::/3

e.g. 2610:8:7800:1b::99

\$ host wikispaces.psu.edu

wikispaces.psu.edu has address 146.186.26.96

wikispaces.psu.edu has IPv6 address 2610:8:7800:1b::99

# Private Addresses

## IPv4:

- 10/8, 172.16/12, 192.168/16
- Reused across organizations

## IPv6:

- Unique Local Addresses (ULA)
- Each organization gets its own prefix
- fc00::/7
- Penn State's: FD0B:7CDB:AEFD::/48

# Link-local Addresses

## IPv4:

- 169.254/16
- Usually indicate that something broke

## IPv6:

- fe80::/10
- Every active interface **always** has a link-local
- Automatically generated by the OS
- Based on MAC address
- Should not be nameserved (except by mdns)
- Open Terminal and see for yourself

```
$ ifconfig enl
enl: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
ether 00:1e:c2:c0:52:e3
inet6 fe80::21e:c2ff:fec0:52e3%enl prefixlen 64 scopeid 0x5
inet 10.0.1.4 netmask 0xffffffff broadcast 10.0.1.255
media: autoselect
status: active
```

# Types of Addresses

Public	128.118.25.3	2000::/3 2001:db8::4:AF1
Private	10/8 172.16/12 192.168/16	fc00::/7 FD0B:7CDB:AEFD::/48
Link-local	169.254.x.y	fe80::/16 fe80::21e:c2ff:fec0:52e3
Loopback	127.0.0.1	::1
Unspecified	0.0.0.0	::

```
$ whois -a 2610:8::
```

```
OrgName: The Pennsylvania State University
```

```
OrgID: PSU-2
```

```
Address: 105 USB 2
```

```
City: University Park
```

```
StateProv: PA
```

```
PostalCode: 16802
```

```
Country: US
```

```
NetRange: 2610:0008:0000:0000:0000:0000:0000:0000 -
```

```
2610:0008:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF
```

```
CIDR: 2610:0008:0000:0000:0000:0000:0000:0000/32
```

```
NetName: PSU-IB
```

```
NetHandle: NET6-2610-8-1
```

```
Parent: NET6-2610-1
```

```
NetType: Direct Allocation
```

```
NameServer: OTC2.PSU.EDU
```

```
NameServer: ISENGARD.CSE.PSU.EDU
```

```
Comment:
```

```
RegDate: 2006-01-13
```

```
Updated: 2006-01-13
```



# A typical dual-stack server:

link-local IPv6

public IPv6

public IPv4

```
$ ifconfig en0
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1280
ether 00:16:cb:ae:aa:b8
inet6 fe80::216:cbff:feae:aab8%en0 prefixlen 64 scopeid 0x6
inet6 2610:8:6c00:a::217 prefixlen 64
inet 146.186.110.217 netmask 0xffffffc0 broadcast 146.186.110.255
media: autoselect (1000baseT <full-duplex,flow-control>)
status: active
```

2610:8:6c00:a::217

/64 for end-user  
networks

2610:8:

6c00:a:

:217

Assigned to  
Penn State by  
ARIN

Managed by you

Subnet ID  
assigned by TNS

# Bracket syntax

Apache virtual host:

Don't forget the brackets!

```
<VirtualHost 146.186.xxx.yyy [2001:db8:19:1b::f00] >  
    ServerName foo.bar.com  
    DocumentRoot /var/www/html
```

Others:

```
scp foo.txt [2001:db8:19:1b::f00]:/tmp
```

```
curl -LO http://[2001:db8:19:1b::f00]/somefile.txt
```

# But not always

Apache virtual host:

```
Listen [2001:db8:19:1b::f00]:80
```

```
<VirtualHost 146.186.xxx.yyy [2001:db8:19:1b::f00] >  
  ServerName foo.bar.com  
  DocumentRoot /var/www/html
```

But **not** here:

```
<Directory /foo>  
  Order Deny, Allow  
  Deny from all  
  Allow from 2610:8::/32  
</Directory>
```

# But not always

```
scp foo.txt [2001:db8:19:1b::f00] : /tmp
```

But **not** here:

```
ssh user@2001:db8:19:1b::f00
```

Supports IPv6 out of the box

Supports IPv6 with edits

No IPv6 support

AFP

Address Book

DHCP

Jabber

DNS

FTP\*

Open Directory

iCal

MySQL

Remote Desktop

Mail

NAT

SSH

Netboot

Software Update

NFS

Web

Quicktime Streaming

SMB

VPN

Server Admin doesn't support IPv6 addresses



# How does DNS work?

# BIND Configuration

/etc/named.conf:

```
options {  
    listen-on { any; };  
    listen-on-v6 { any; };  
};  
  
controls {  
    inet 127.0.0.1 port 54 allow { any; }  
    inet ::1 port 54 allow { any; }  
    keys { "rndc-key"; };  
};
```

# Forward DNS

## zone file:

\$TTL 6h

```
@    IN      SOA      et1.et-test.psu.edu.  hostmaster.et-test.psu.edu.  (  
    2008080200      ; serial  
    1h              ; refresh  
    30m             ; retry  
    14d             ; expiration  
    1h )           ; minimum    NS             et1.et-test.psu.edu.  
    NS             et2.et-test.psu.edu.www  IN      A       128.118.27.7  
    IN AAAA      2610:8:6800:1::7
```

# Reverse DNS

- IPv6 is rooted in ip6.arpa.
- Take your /64, reverse it, strip colons and separate with periods:
  - 2610:8:6800:1::/64
  - 1.0.0.0. 0.0.8.6. 8.0.0.0. 0.1.6.2 .ip6.arpa.
  - 1.0.0.0.0.0.8.6.8.0.0.0.0.1.6.2.ip6.arpa.



# ACLs

- Penn State requires that recursive DNS only be available to Penn State IPs
- Add 2610:8::/32, FD0B:7CDB:AEFD::/48 to your DNS recursive ACL

# Firewalls

- You have to set rules twice:
  - once for IPv4
  - once for IPv6
- Don't block all ICMPv6 packets

# WebAccess

WebAccess checks IP(v4) addresses by default. It doesn't support IPv6. Disable IP address checking:

```
CosignCheckIP never
```



# Don't forget about

- ACLs
- monitoring
- log analysis

# Recommendations

- Start now.
- Treat IPv6 as production, even if it isn't.
- Put IPv6 on your servers. Put it on *your* desktop. Complain if it breaks.
- Audit and test.

<http://wikispaces.psu.edu/display/ipv6>

Apple IPv6 mailing list:

<http://lists.apple.com/mailman/listinfo/ipv6-dev>

<http://www.personal.psu.edu/dvm105/blogs/ipv6>