An update on IPv6 in FreeBSD

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Agenda

1. FreeBSD and World IPv6 Day.

2. "IPv6-only" validation work.

3. IPv6 in FreeBSD 9.

FreeBSD and World IPv6 Day

What did we do?

- Created FreeBSD and PC-BSD v6-only snapshots.

- Created web pages.

- Had an IRC channel #freebsd-w6d.

- Did not sleep though were not too excited anymore after an hour or two.

FreeBSD The Power To Serve

Home | About | Get FreeBSD | Documentation | Community | Develop

- » Developers
- » Developer's Handbook
- » Porter's Handbook
- » Source code repositories
- » Release Engineering
- » Platforms
- » Project Ideas
- » Contributing

IPv6 in FreeBSD

Category Navigation

- IPv6 in FreeBSD
- IPv6-only
- World IPv6 Day
  - www stats

Introduction

FreeBSD has shipped tightly integrated IPv6 support first release to include "out-of-the-box" IPv6 support. development in the FreeBSD community, including pa

Latest news

- **August 3, 2011**: 9.0-BETA1 IPv6-only snapsh see IPv6Only wiki page.
- **June 9, 2011**: Thanks to everyone having joi (unspectacular) statistics of www.freebsd.org after the event for you.
- **June 7, 2011**: New set of IPv6-only snapshot nameserver support in rtsol(8) and rtsold(8), here and find download links and netinstall do
- **June 6, 2011**: The FreeBSD Foundation and i support the efforts of World IPv6 Day to accel release and find more information on FreeBSD
- **June 6, 2011**: New set of IPv6-only snapshot and find download links here.
- **June 6, 2011**: Hiroki Sato commits RFC 6106 Configuration" (RDNSS and DNSSL) support.

IPv6 in FreeBSD

FreeBSD is a widely used, open source operating syst for decades of research, as well as a reference imple FreeBSD first shipped IPv6 support in March 2000 as

IPv6 and the FreeBSD Project

The FreeBSD Project has been an early adopter and help of the community, we have been serving release FreeBSD's website, mailing lists, and developer infras

FreeBSD is used by critical Internet infrastructure suc of the world's busiest and most reliable web sites as for the best IPv6 support. To read more about some their products, see the FreeBSD Foundation Testimoni

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- » Developers
- » Developer's Handbook
- » Porter's Handbook
- » Source code repositories
- » Release Engineering
- » Platforms
- » Project Ideas
- » Contributing

FreeBSD and World IPv6 Day

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- IPv6-only
- World IPv6 Day
  - www stats

About World IPv6 Day

While Internet Protocol version 6 is in fact more than 15 years old, World IPv6 Day, a 24 hour test flight day on **8 June 2011** has motivated a lot of different organizations to get ready for IPv6, or improve their already existent IPv6 support. Major content providers will enable IPv6 for their websites that day, network operators and hosting companies have been working to provide IPv6 to their customers and operating system vendors like FreeBSD have been improving IPv6 support. You can find more information about World IPv6 Day on The Internet Society's web page www.worldipv6day.org.

You and FreeBSD on World IPv6 Day

What is special about that day for FreeBSD you might wonder? Indeed, with the help of the community, FreeBSD has been serving releases on IPv6 since 2003. We have our major infrastructure like www.freebsd.org IPv6 enabled since 2007. FreeBSD itself has been supporting IPv6 since the 4.0 Release for over a decade now, using the KAME based reference implementation.

Nonetheless there are things we can do during that day:

- help promoting IPv6.
  During the day there might be a lot more IPv6 users suddenly, and some people are expecting significantly more traffic. A lot of FreeBSD servers are out there actively using IPv6, some people have put FreeBSD into their networking products, but only few tell us. We would love to hear about your FreeBSD IPv6 experiences on World IPv6 Day.
- help you in case of problems.
  Obviously if you will run into problems you might want help immediately for the one day test flight. We will more closely monitor the FreeBSD networking mailing list, as well as being around on IRC in #freebsd-w6d on EFNet to answer your questions. In case you will file an IPv6 related bug report, you may want to tag it with [ip6].
- working on improving your IPv6 experience.
  As we get your questions and feedback we will take notes to further improve IPv6 support in FreeBSD. There might not be an immediate change but rest assured that your feedback will not be lost.

Join us for World IPv6 Day, spread the word, to help improving IPv6 support in FreeBSD even further!
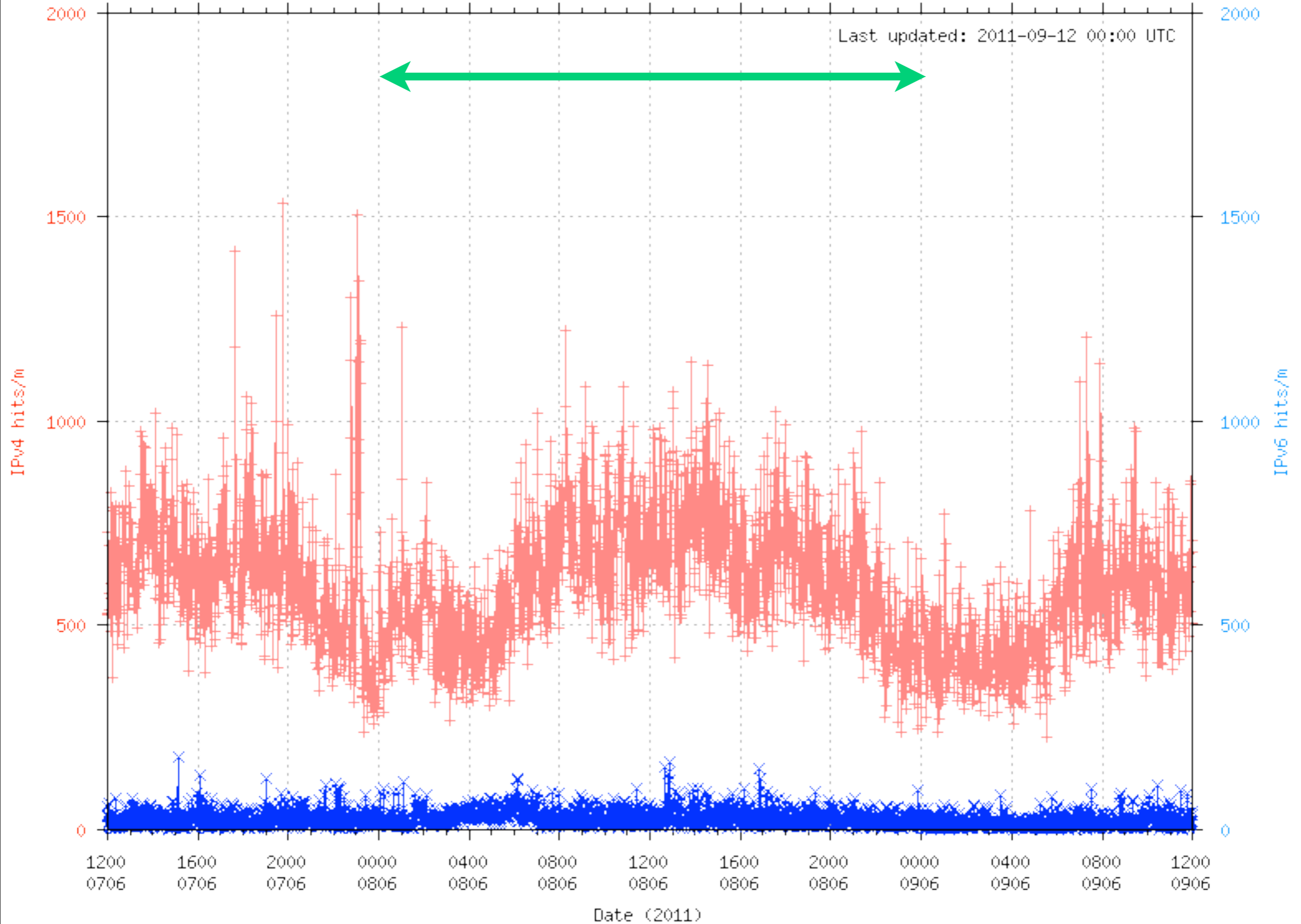
FAQ

What is this IPv6 thing?

Please see the chapter on IPv6 in the FreeBSD Handbook for an explanation.

Do you provide IPv6 connectivity?

FreeBSD is an operating system, not an Internet Service Provider. There are multiple ways to connect to an IPv6 network with FreeBSD however:

www.freebsd.org/ipv6
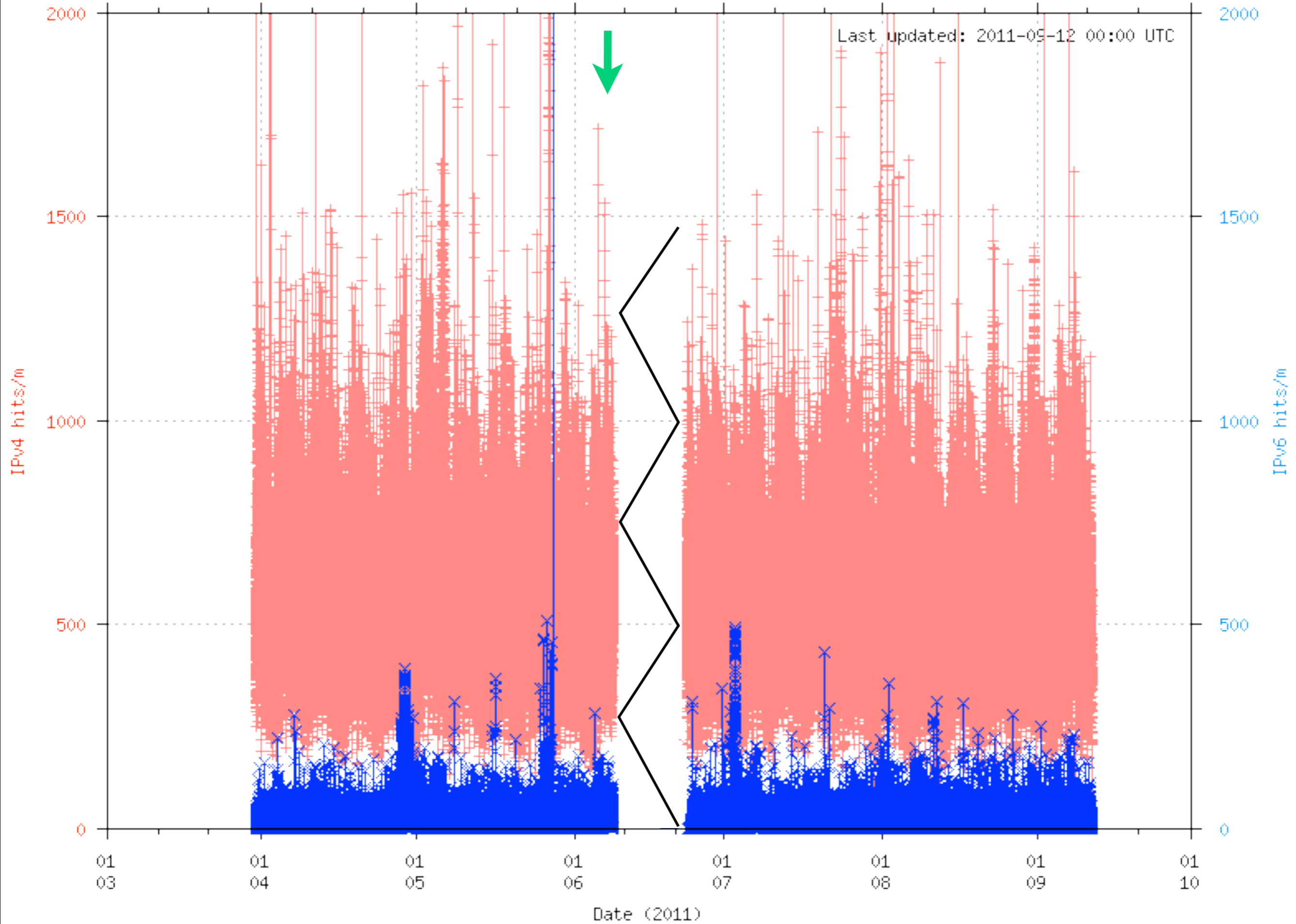
IPv4 and IPv6 hits on www.freebsd.org

Last updated: 2011-09-12 00:00 UTC

IPv6 hits on www.freebsd.org

Last updated: 2011-09-12 00:00 UTC
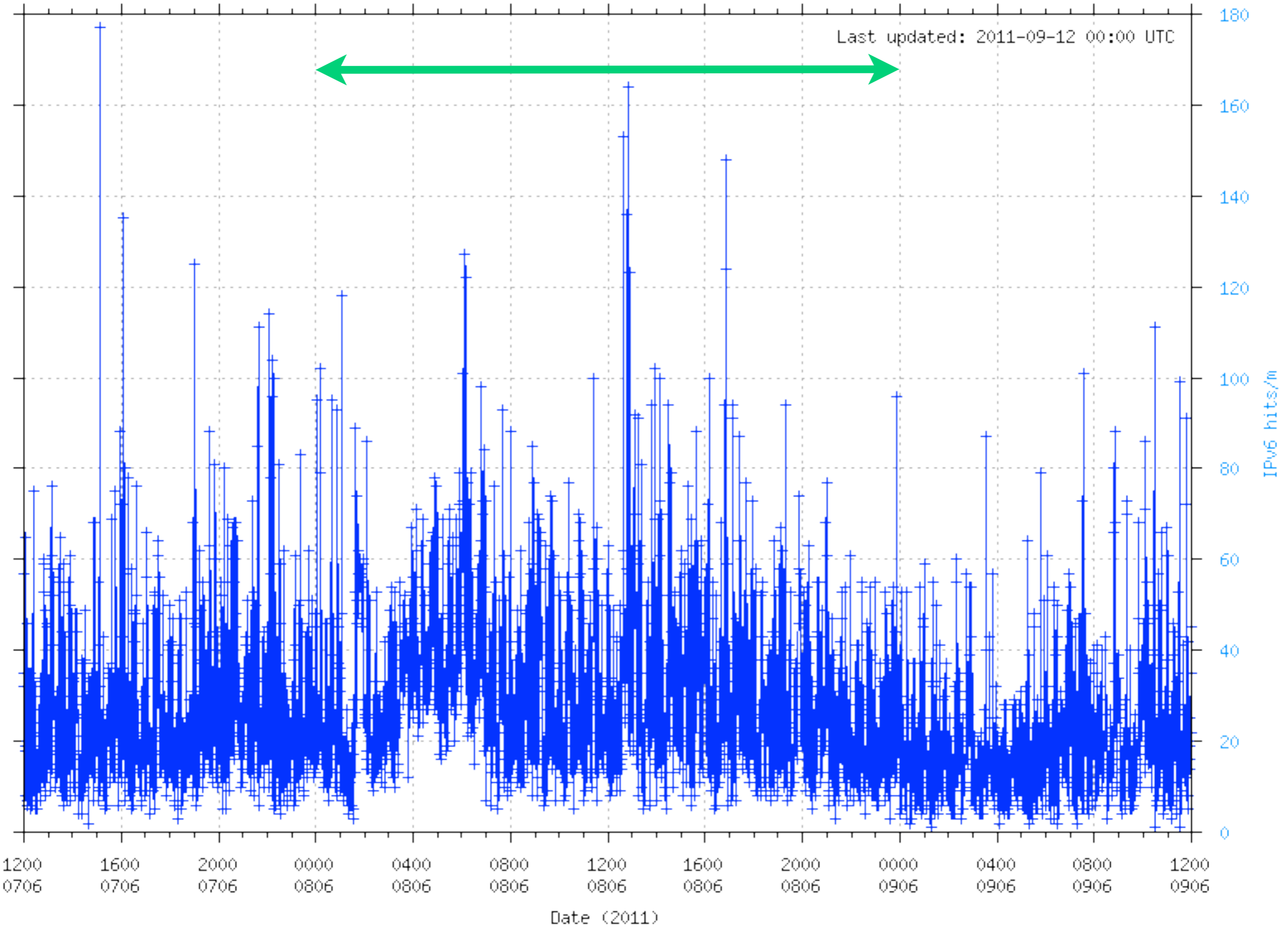
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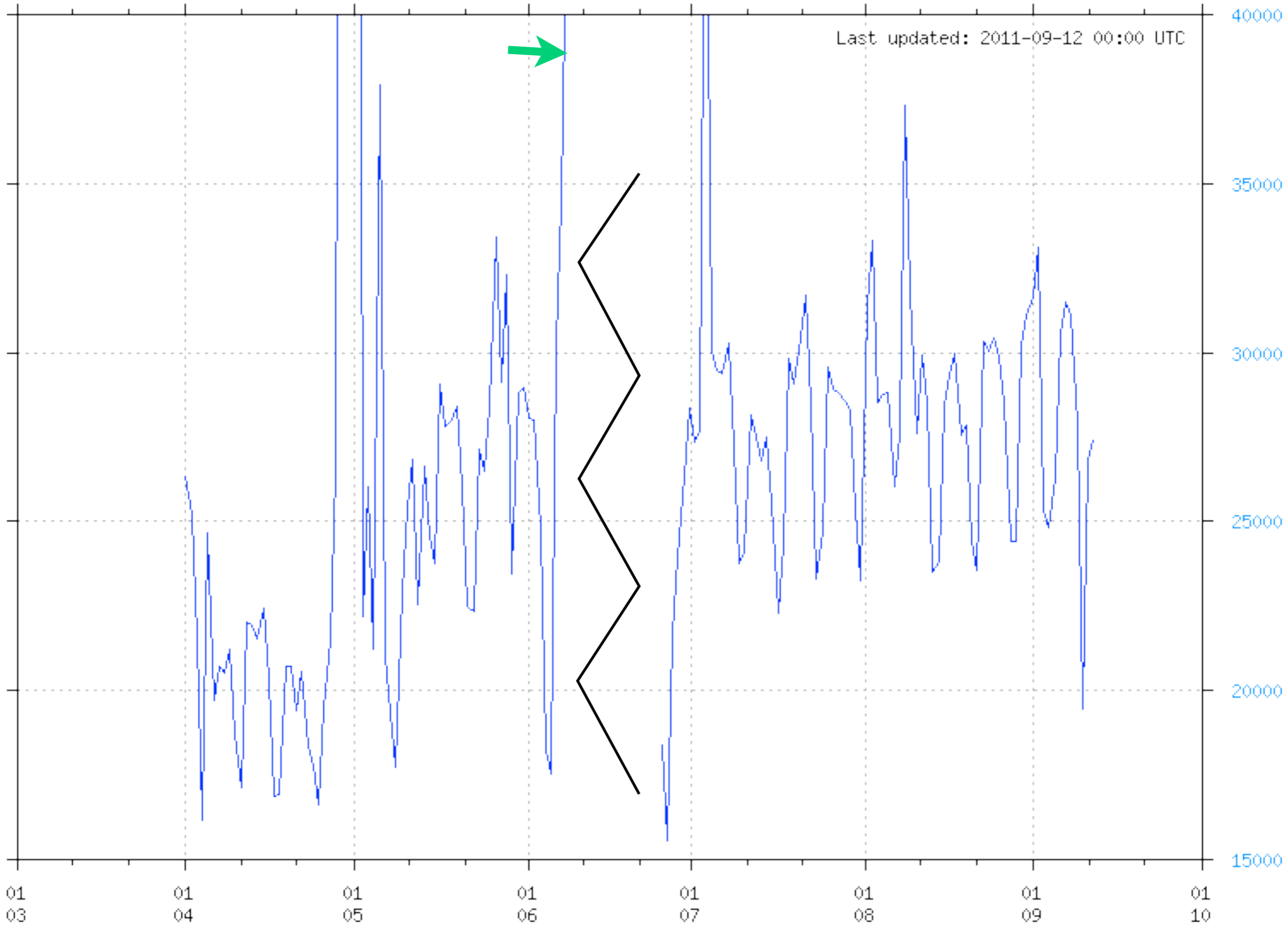
IPv6 hits/d

Date (2011)

What happened?

- Nice day on IRC.

- 2 questions on filtering IPv6 frags (pf, ipfw).

- Question on RFC 4941 privacy extensions.

- One possibly IPv6 related 7.4 panic.

- Question on v4-mapped addresses and traceroute6. We drop v4-mapped addresses from the wire early. Some MPLS networks tend to send them.

What happened?

- IPv6-only snapshots had downloads.

- ... lots where by IPv4.

- Mirrors in DE and JP.

- http://www.freebsd.org/ipv6/ipv6only.html

- http://www.pcbsd.org/IPv6

- Press Release, hit NANOG.

"IPv6-only"*(*)*
validation work

(*) no-INET or no-IPv4 support

What about IPv6-Only Services?

Is an IPv6-only service a viable option today?

Not really.

 – Only ~4% of the existing client base would successfully connect to an IPv6-only service

51

Stacking it Up - Experimental Observations on the operation of Dual Stack Services
Geoff Huston, APNIC, http://labs.apnic.net/, RIPE 62

Why am I am talking about this now then?

*"If you are not part of the solution,
you are part of the problem."*
(Donn Lee, APNIC32)

Reasons

- It's interesting and fun (and pesky ;-)

- The top100 websites seem a boring target to a developer and skype is not the world.

- Someone had an idea for April Fools' Day.

- Two *errnos* are not the same error.

- It will be too late for feature parity in another 15 years.

Reasons (cont.ed)

- Internet Service Providers.

- Mobile.

- Inter-Company connects and road runners / tele workers (VPN connections).

- Web Hosters.

- Management overhead.

- Trying to be ready and not late.

What is "ipv6-only"?

- ## Kernel without INET support:
  ```
  include GENERIC
  ident GENERIC-IPV6ONLY
  makeoptions MKMODULESENV+="WITHOUT_INET_SUPPORT="
  nooptions INET
  nodevice gre
  ```

- ## src.conf(5) options:
  ```
  WITHOUT_INET=
  WITHOUT_INET_SUPPORT=
  ```

- ## feature_present(3):
  ```
  kern.features.inet: 1
  kern.features.inet6: 1
  ```

IPv6-only user space

- Few user space utilities that can compile out IPv4 specific support. More utilities that just work in a no-IPv4-support environment.

- FreeBSD 9 bsdinstall and pc-sysinstall.

- ifconfig and improved rc(1) framework.

- jls.

- (Patches for) ftp.

FreeBSD Installer

+-------------------Network Configuration------------------+
| Please select a network interface to configure: |
| +--+ |
| | em0   Intel(R) PRO/1000 Legacy Network Connection 1.0.3 | |
| | plip0 PLIP network interface | |
| +--+ |
| |
| < OK >   <Cancel> |
+--+

FreeBSD Installer

+---Network Configuration---+
| Would you like to |
| configure IPv6 for this |
| interface? |
+---------------------------+
| < Yes >   < No > |
+---------------------------+

```
FreeBSD Installer
--------------------------------------------------------------------------

        +--Network Configuration---+
        |-Network Configuration----+
        | Would you like to try    |
        | stateless address        |
        | autoconfiguration        |
        | (SLAAC)?                  |
        |                           |
        |   < Yes >      < No  >    |
FreeBSD Installer
--------------------------------------------------------------------------


        +------------------Network Configuration------------------+
        | Resovler Configuration                                  |
        |                                                         |
        | +-----------------------------------------------------+ |
        | |Search          example.net                          | |
        | |IPv6 DNS #1      2001:db8::1                          | |
        | |IPv6 DNS #2      2001:db8::2                          | |
        | +-----------------------------------------------------+ |
        |                                                         |
        |            <  OK  >              <Cancel>               |
        |                                                         |
        +---------------------------------------------------------+

em0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> metric 0 mtu 1500
        options=9b<RXCSUM,TXCSUM,VLAN_MTU,VLAN_HWTAGGING,VLAN_HWCSUM>
        ether 00:0c:29:0e:31:f2
        inet6 fe80::20c:29ff:fe0e:31f2%em0 prefixlen 64 scopeid 0x2
        inet6 2001:db8::20c:29ff:fe0e:31f2 prefixlen 64 autoconf
        nd6 options=23<PERFORMNUD,ACCEPT_RTADV,AUTO_LINKLOCAL>
        media: Ethernet autoselect (1000baseT <full-duplex>)
        status: active
plip0: flags=8810<POINTOPOINT,SIMPLEX,MULTICAST> metric 0 mtu 1500
        nd6 options=29<PERFORMNUD,IFDISABLED,AUTO_LINKLOCAL>
lo0: flags=8049<UP,LOOPBACK,RUNNING,MULTICAST> metric 0 mtu 16384
        options=3<RXCSUM,TXCSUM>
        inet6 ::1 prefixlen 128
        inet6 fe80::1%lo0 prefixlen 64 scopeid 0x4
        nd6 options=21<PERFORMNUD,AUTO_LINKLOCAL>
```

"ipv6-only" problems

- Software not working with IPv6 at all.

- Software working on Dual-Stack (DS) with IPv4 addresses but not on IPv6-only.

- Software working on DS without IPv4 addresses but not on IPv6-only.

- Software giving confusing error messages on IPv6-only.

Not working with v6 or working in DS with v4

- Samples:
  cvsupd, cvs pserver, openssl s_client, bsnmpclient, ..

- Problems:

  - `gethostbyname()` is a bad idea.

  - bsnmpclient.c actually uses `getaddrinfo()`, but:
    `hints.ai_family = AF_INET;`

Working in Dual-Stack without v4 addresses

- Sample: ftp client

- Problem: `AF_INET` socket call to get socket buffer size on start:

```
/*
 * Get the default socket buffer sizes if we don't already have them.
 * It doesn't matter which socket we do this to, because on the first
 * call no socket buffer sizes will have been modified, so we are
 * guaranteed to get the system defaults.
 */
s = socket(AF_INET, SOCK_STREAM, 0);
if (s == -1)
        err(1, "Can't create socket to determine default socket sizes");
```

Confusing error messages on v6-only

- Sample:

```
%host people.freebsd.org
people.freebsd.org is an alias for freefall.freebsd.org.
freefall.freebsd.org has address 69.147.83.40
freefall.freebsd.org has IPv6 address 2001:4f8:fff6::28
...
```

- Problem:

```
%fetch http://people.freebsd.org/~bz/example.diff
fetch: ... : Protocol not supported
```

- But:

```
%fetch -6 http://people.freebsd.org/~bz/example.diff
fetch: ... : Operation not permitted
```

What has improved?

- (new) NFS seems to work on only IPv6.

- pjd fixed High Available STorage daemon.

- bsdinstall now works with IPv6(-only).

- ifconfig problem was relaxed for rescue.

- ntp noise was fixed.

- A couple of more fixes (base and ports) to come after the release cycle.

Infrastructure

- Dedicated machines for building i386 and amd64.

- Dedicated machine for distributing.

- Pondering freebsd-update support for future.

How to test or use?

- You can start just removing your IPv4 addresses but it will be a different experience.

- Use jails.

- Use virtual or dedicated machines and a real no-INET kernel.

➡ Test the FreeBSD base system, test ports and other 3rd party software.
Test your own software.

How to get? Feedback?

- Compile yourself.

- We provide information and snapshots:
  - http://www.freebsd.org/ipv6/
  - http://wiki.freebsd.org/IPv6Only
  - *http://noinet.nyi.freebsd.org/*

➡Report success or problems.

➡Send patches.
  - e.g. gethostbyname() sweep on the tree.
  - Test ports & submit changes (upstream).

IPv6 in FreeBSD 9

Some new features in FreeBSD 9.0

- Lots of general improvements.

- Secure Neighbor Discovery (SeND).
  Kernel hooks and private socket to
  intercept/re-inject packets.
  net-mgmt/send version 0.3 port.

- ipfw fwd ipv6 support.
  Allows IPv6 captive portal, transparent
  proxying, ... on v6. IPv6 policy routing.

rtadvd(8) / rtsold(8)

- Massively cleaned up and improved.

- Fixed RFC 4191 Route Info.

- RFC 6106 IPv6 Router Advertisement Options for DNS Configuration (RDNSS, DNSSL) support.

rtadvd(8)

- "noifprefix" option
  (RAs without prefix possible).

- SIGHUP to reload config.

- Improved handling of dynamic interfaces.

- Can start with non-existent interfaces.

- rtadvctl(8).

rtsold(8)

- Update resolv.conf(5) `nameserver` and `search` list using resolvconf(8) script (-R option).

- Possible to use and accept RAs even when IPv6 forwarding is enabled (-F option).

- Used by installer to learn information automatically if available
(as we do with DHCP for IPv4).

ifconfig(8) options (in 8.x)

- ifconfig inet6 ...., show up in nd6: line.

- accept_rtadv, -accept_rtadv

- defaultif, -defaultif

- ifdisabled, -ifdisabled

- nud, -nud

- prefer_source, -prefer_source

ifconfig(8) options (new in 9.0)

- no_radr, -no_radr:
  Add routers learnt from RAs to default router list or not. Defaults from `net.inet6.ip6.no_radr` **sysctl**.

- auto_linklocal, -auto_linklocal:
  Create link-local addresses when interface becomes available. Defaults from `net.inet6.ip6.auto_linklocal` **sysctl**.

more IPv6 sysctls of interest.

- net.inet6.ip6.use_tempaddr
  net.inet6.ip6.prefer_tempaddr:
  Control RFC 4941 Privacy Extensions.

- net.inet6.ip6.rfc6204w3:
  IPv6 Customer Edge Router Requirements,
  accept default router list when forwarding.

- net.inet6.ip6.norbit_raif:
  Suppress R-Bit in NA when accepting RAs
  on same interface even when forwarding.

rc.conf options

- A lot more fine-grained.

- Some backward compatibility in place.

- `ipv6_enable="YES"` is gone!

- `ipv6_activate_all_interfaces="NO"`
  If there is no `_ipv6=".."` config,
  the interface will stay disabled for IPv6.
  Set to `"YES"` to restore historic default on.

rc.conf options (cont.ed)

- Use `inet6` for configuring IPv6!
  `ifconfig_IF_ipv6=`**`"inet6`** `2001:db8::1/64"`

- Add more addresses (aliases) using:
  `ifconfig_IF_alias0=`**`"inet6`** `2001:db8::2/128"`
  This is the normal alias<N> configuration and can be mixed with IPv4.

rc.conf options (cont.ed)

- `ipv6_privacy="NO"`
  Set to `"YES"` to use and prefer RFC 4941 privacy addresses with SLAAC.

- `ipv6_ipv4mapping="NO"`
  Set to `"YES"` to enable support for v4-mapped v6 addresses (`::ffff:a.b.c.d`).

  If you use Java, you want to read:
  http://diario.behrens.de/2008/10/12/java_and_ipv6_on_bsd.html

rc.conf options (cont.ed)

- `ip6addrctl_policy="AUTO"`

  `ipv4_prefer`: IPv4 preferred

  `ipv6_prefer`: IPv6 preferred

  `AUTO`: try `/etc/ip6addrctl.conf`, if not exists, depending on `ipv6_activate_all_interfaces`: if `"YES"` prefer IPv6 else prefer IPv4.

- `ipv6_cpe_wanif="NO"`
  Set to interface name to set interface flags and sysctls correctly. Per IF options if set override.

Interface configuration

- You usually do not want to accept RAs on your internal interfaces of the router where you advertise yourself or on servers when only doing static configuration. On 9 usually no need for:
  `ifconfig_IF_ipv6="inet6 ... `**`-accept_rtadv`**`"`

- Double check on 8.x or add .. if needed:
  `ipv6_ifconfig_IF="inet6 ... `**`-accept_rtadv`**`"`

Summary

- Greatly improved and more fine-grained controllable for a lot more use cases at costs of backward compatibility.

- Most things now work with a single knob, out of the box, and as expected.

- Still ahead on industry with e.g. RFC 6106 support by default.

- Downstream projects like PC-BSD and pfsense support most/all as well with upcoming versions.

Outlook

- Outstanding 6rd patch.

- Outstanding NAT64 integration with pf.

- Carp and IPv6 rtadvd support.

- "ipv6-only" changes continue.
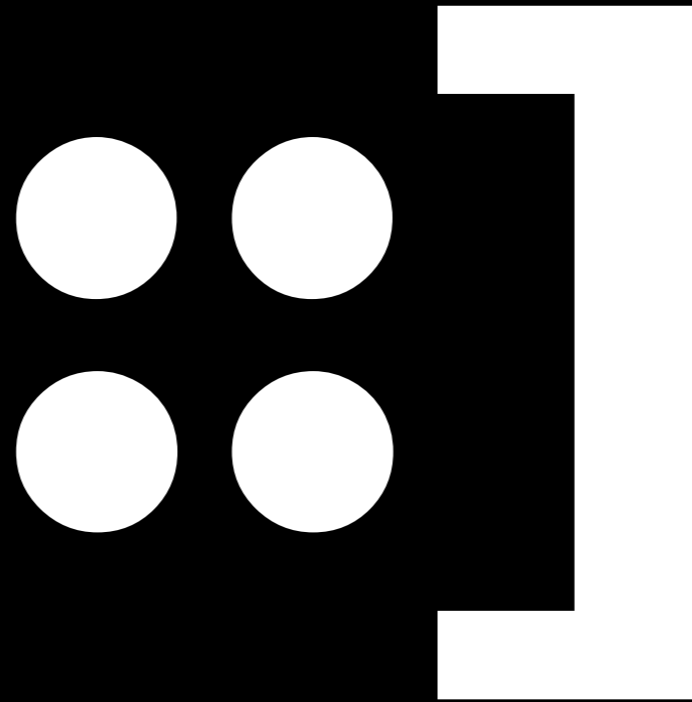
- More feature parity where missing.

Outlook (cont.ed)

• Pondering DHCPv6 integration.

• IPv6 performance.

• IPv6 compliance.

• Call for documentation improvements.

Questions?

Feedback:
bz@FreeBSD.org

Thanks and happy IPv6ing!

(IPv6 smiley)