Leading the way to the future of the Internet via IPv6

SuperHappyDevHouse 30 – 01/31/2009

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Company Snapshot

One of the largest and most reliable Internet Backbone, Colocation, and hosting companies in the world. And the #1 provider of IPv6 connectivity.

1. Colocation

2. Dedicated Servers

3. Web Hosting

4. IP Transit
Web Hosting

Speed with Reliability

Hurricane Electric is the Most Reliable Hosting Company in August 2008

Ranking by Failed Requests and Connection time,
August 1st – 31st 2008

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>OS</th>
<th>Outage h:mm:ss</th>
<th>Failed Req%</th>
<th>DNS</th>
<th>Connect</th>
<th>First byte</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><a href="http://www.iea.net">www.iea.net</a></td>
<td>Linux</td>
<td>0.00 0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.001</td>
<td>0.055</td>
<td>0.111 0.15+</td>
</tr>
<tr>
<td>2</td>
<td>DataPipe</td>
<td>unknown</td>
<td>0.00 0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>0.001</td>
<td>0.014</td>
<td>0.029 0.045</td>
</tr>
<tr>
<td>3</td>
<td><a href="http://www.godaddy.com">www.godaddy.com</a></td>
<td>WindowsServer 2003</td>
<td>0.00 0.01</td>
<td>0.01</td>
<td>0.05</td>
<td>0.041</td>
<td>0.264</td>
<td>0.264 0.264</td>
</tr>
<tr>
<td>4</td>
<td>IMeU</td>
<td>unknown</td>
<td>0.00 0.01</td>
<td>0.01</td>
<td>0.03</td>
<td>0.044</td>
<td>0.237</td>
<td>0.333 0.383</td>
</tr>
<tr>
<td>5</td>
<td>New York Internet</td>
<td>FreeBSD</td>
<td>0.00 0.01</td>
<td>0.01</td>
<td>0.00</td>
<td>0.047</td>
<td>0.096</td>
<td>0.096 0.245</td>
</tr>
<tr>
<td>6</td>
<td><a href="http://www.swishmail.com">www.swishmail.com</a></td>
<td>unknown</td>
<td>0.00 0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.061</td>
<td>0.123</td>
<td>0.123 0.340</td>
</tr>
<tr>
<td>7</td>
<td><a href="http://www.web.com">www.web.com</a></td>
<td>Windows 2000</td>
<td>0.00 0.01</td>
<td>0.01</td>
<td>0.11</td>
<td>0.074</td>
<td>0.185</td>
<td>0.185 0.21</td>
</tr>
<tr>
<td>8</td>
<td>Hosting4Less</td>
<td>Linux</td>
<td>0.00 0.01</td>
<td>0.01</td>
<td>0.07</td>
<td>0.080</td>
<td>0.164</td>
<td>0.164 0.365</td>
</tr>
<tr>
<td>9</td>
<td><a href="http://www.datasync.com">www.datasync.com</a></td>
<td>Linux</td>
<td>0.00 0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.050</td>
<td>0.116</td>
<td>0.116 0.167</td>
</tr>
<tr>
<td>10</td>
<td>Verio</td>
<td>Linux</td>
<td>0.00 0.02</td>
<td>0.01</td>
<td>0.07</td>
<td>0.076</td>
<td>0.152</td>
<td>0.152 0.152</td>
</tr>
</tbody>
</table>
Current IPv4

Core Problem:

The eventual exhaustion of the IPv4 address space

The current version of IP, IP version 4 (IPv4), defines a 32-bit address which means that there are only $2^{32}$ (4,294,967,296) IPv4 addresses available.

Although this seems like a large number of addresses, the finite number of IP addresses is already reaching its limit and will be exhausted by the year 2011.
Current IPv4

As a result, public IPv4 addresses have become relatively scarce, forcing many users and some organizations to use a NAT to map a single public IPv4 address to multiple private IPv4 addresses.

Although NATs promote reuse of the private address space, they violate the fundamental design principle of the original Internet that all nodes have a unique, globally reachable address, preventing true end-to-end connectivity for all types of networking applications.

Additionally, the rising prominence of Internet-connected devices and appliances ensures that the public IPv4 address space will eventually be depleted.
To address these and other concerns, the Internet Engineering Task Force (IETF) has developed a suite of protocols and standards known as IP version 6 (IPv6).

IPv6 has a number of improvements and simplifications when compared to IPv4. The primary difference is that IPv6 uses 128 bit addresses as compared to the 32 bit addresses used with IPv4.

This means that there are more available IP addresses using IPv6 than are available with IPv4 alone.

IPv4: 4,294,967,296 IP addresses.
IPv6: 18,446,744,073,709,551,616 IP addresses in a single /64 allocation.
Understanding IPv6

/8 (Class A)

IPv4

bit #

0 1 7 8 31

Network Number
Host Number

IPv6

/16 (Class B)

bit #

0 1 2 15 16 31

Network Number
Host Number

/24 (Class C)

bit #

0 1 2 3 23 24 31

Network Number
Host Number

64 bits

Network Part
(Not using manual configuration or DHCPv6)

Host Part
(Not using manual configuration or DHCPv6)
Understanding IPv6

A significant difference in IPv6:

IPv4: 4 blocks of 8 bits separated by a ‘.’ (Ex: 216.218.186.2)

IPv6: 8 blocks of 16 bits separated by a ‘:’ (Ex: 2001:470:0:76::2)

or


(Notice that leading zeros are removed and that ‘::’ can be used only once to represent consecutive zero’s)
Understanding IPv6

IPv6 availability depends on your Service Provider, either at home or for work. In a dual-stack environment, IPv4 and IPv6 co-exist along the same connection and don't require any special kind of connection. If dual-stack is not available, you might find yourself using an IP tunneling product or service to bring IPv6 connectivity to you.

Many Operating System platforms have native IPv6 support:
- Linux, BSD (Free, Open, Net) & MacOSX have had IPv6 support enabled for years
- Windows 2000/2003/XP – had to have it installed optionally
- Vista and Windows 2008 – have native IPv6 support enabled by default
Checking for IPv6 support

Windows XP (SP3)

Linux (Ubuntu 8.10)

(Must use Windows XP SP3 for most recent IPv6 tools such as ‘netsh’)
Installing IPv6 (Windows XP Example)

```
C:\Documents and Settings\Admin>ipv6 install
Installing... Succeeded.
```

```
C:\Documents and Settings\Admin>netsh interface ipv6 show Interface
```

```
Interface 6: Wireless Network Connection
Addr Type  DAD State  Valid Life  Pref. Life  Address
Link       Preferred  infinite  infinite  fe80::221:ff:fe64:ada3
```

```
Connection Name: Wireless Network Connection
GUID: {0971C888-4C2D-4549-AE9A-1C3C9F241944}
State: Connected
Metric: 0
Link MTU: 1500 bytes
Current Hop Limit: 128
Reachable Time: 21s
Base Reachable Time: 30s
Retransmission Interval: 1s
DAD Transmits: 1
DNS Suffix: gateway.2wire.net
Firewall: disabled
Site Prefix Length: 48 bits
Zone ID for Link: 6
Zone ID for Site: 1
Uses Neighbor Discovery: Yes
Sends Router Advertisements: No
Forwards Packets: No
Link-Layer Address: 60-21-00-64-ad-a3
```
Hurricane Electric’s IPv6 Certification

- Prove that you have basic IPv6 knowledge
- Prove that you have IPv6 connectivity and a IPv6 web server
- Prove that you have a working IPv6 email address
- Prove that you have working reverse IPv6 DNS
- Prove that you have name servers with IPv6 addresses that can respond to queries via IPv6

http://ipv6.he.net/certification/
Hurricane Electric’s IPv6 Certification

**Enthusiast**

Congratulations you NeWb! Let’s get you on to being an Enthusiast as quick as possible. Let’s certify that you have the basics of IPv6 setup. To complete this test you will need:

- An IPv6 capable desktop
- An IPv6 capable website/webserver
- The Domain you provide below will be used in future DNS tests.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Generate a User Code</td>
<td>sn2bgcwgxf</td>
</tr>
<tr>
<td>2</td>
<td>Tell us what your IPv6 website is, FQDN please</td>
<td><a href="http://nahmed.corp.he.net">http://nahmed.corp.he.net</a></td>
</tr>
<tr>
<td>3</td>
<td>We will test grabbing the file:</td>
<td><a href="http://nahmed.corp.he.net/sn2bgcwgxf.txt">http://nahmed.corp.he.net/sn2bgcwgxf.txt</a></td>
</tr>
<tr>
<td>4</td>
<td>Schedule the test:</td>
<td><a href="#">Test It!</a></td>
</tr>
</tbody>
</table>
Congratulations, your an IPv6 Enthusiast! As we all know the next step after getting your website online is to make it so you can receive email via IPv6. What you will need is:

- An IPv6 enabled mail system
- If you have "Greylisting" enabled: either whitelist ipv6@he.net or you will have to send, wait for your greylister timer to expire and then reset and send again. We are working on a better solution to this issue.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Generate a New User Code</td>
<td><a href="#">Generate It!</a></td>
</tr>
<tr>
<td>2</td>
<td>Tell us what your IPv6 capable email address is (Including the Domain):</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Schedule a test, we will email you your new User Code</td>
<td><a href="#">Send It!</a></td>
</tr>
<tr>
<td>4</td>
<td>Tell us what the code was:</td>
<td></td>
</tr>
</tbody>
</table>

![Certificate of Completion](certificate.png)
Hurricane Electric’s IPv6 Certification

Professional

Congratulations, you’re an IPv6 Administrator! As we all know, the next step after getting your IPv6 Email working is to setup Reverse DNS for the mail servers’ IP. What you will need is:

- An IPv6 enabled mail system, with working RDN3.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if your mail server has working rDNS</td>
<td></td>
</tr>
</tbody>
</table>

Certificate of Completion

gopher
hereby awarded the rank of
Professional
Hurricane Electric
IPv6 Certification
TunnelBroker – Tunneling of IPv6 packets through an IPv4 Network
Hurricane Electric’s IPv6 Tunnel Broker

Hurricane Electric’s free tunnel broker service enables you to reach the IPv6 Internet by tunneling over existing IPv4 connections from your IPv6 enabled host or router to one of Hurricane Electric’s IPv6 routers.

http://tunnelbroker.net

**Tunnelbroker Login**

- Username: [Blank]
- Password: [Blank]

**Hurricane Electric Free IPv6 Tunnel Broker**

**IPv6 Tunnel Broker**

Check out our new [usage stats]! And then hit up our new [Forums]!
Hurricane Electric’s IPv6 Tunnel Broker

Setup Regular IPv6 Tunnel

You currently have 0 of 4 allowed tunnels configured.

- If you are trying to reclaim a tunnel simply enter your last IPv4 address here. If you have any issues please email ipv6@he.net.
- If you have an official ASN and wish to setup a full BGP feed Please use This Form instead.

IPv4 endpoint
(your side of the tunnel)
(You are viewing from IP: 76.35.200.156):

- Fremont, CA USA [ 72.52.104.74 ]
- New York, NY USA [ 203.61.161.14 ]
- London, UK [ 216.66.80.26 ]
- Dallas, TX USA [ 216.218.224.42 ]
- Chicago, IL USA [ 209.51.181.2 ]
- Paris, France [ 216.66.84.42 ]
- Amsterdam, NL [ 216.66.04.46 ]
- Miami, FL USA [ 203.51.161.58 ]
- Ashburn, VA USA [ 216.66.22.2 ]
- Seattle, WA USA [ 216.218.226.238 ]
- Los Angeles, CA USA [ 66.220.18.42 ]
- Hong Kong [ 216.218.221.6 ]
- Toronto, ON Canada [ 216.66.38.58 ]

Which Server Is Closest to you?:

Submit
Hurricane Electric’s IPv6 Tunnel Broker

Account Menu
Click For Main Page
Update Info
Logout

User Functions
Combine Tunnels
Create Regular Tunnel
Create BGP Tunnel

Setup Regular IPv6 Tunnel

CREATE
2846|72.52.104.74|75.36.200.156|2001:470:1f04:b1e::1|2001:470:1f04:b1e::2|2001:470:1f05:b1e::1

O.K.: Your tunnel has been allocated

Your tunnel has been allocated and created. The endpoints and tunnel server information can be found under **Tunnel Details**. This page will also have examples to help you get the tunnel up and running on your system.
# Hurricane Electric's IPv6 Tunnel Broker

## Account Menu
- Click For Main Page
- Update Info
- Logout

## User Functions
- Combine Tunnels
- Create Regular Tunnel
- Create BGP Tunnel

## Tunnel Details

<table>
<thead>
<tr>
<th>Account: gopher</th>
<th>Tunnel Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Claim Code:</strong></td>
<td>No Code Available</td>
</tr>
<tr>
<td><strong>Global Tunnel ID:</strong></td>
<td>22030</td>
</tr>
<tr>
<td><strong>Local Tunnel ID:</strong></td>
<td>2646</td>
</tr>
</tbody>
</table>

| **Server IPv4 address:** | 72.52.104.74 |
| **Server IPv6 address:** | 2001:470:104:51e::1/64 |
| **Client IPv4 address:** | 75.36.200.186 |
| **Client IPv6 address:** | 2001:470:104:de:2646 |

| **Routed IPv4:** | Allocate |
| **Routed IPv6:** | 2001:470:104:51e::1/64 |
| **RDNS Delegation NS1:** | none |
| **RDNS Delegation NS2:** | none |
| **RDNS Delegation NS3:** | none |

| **ASIN:** | none |
| **Registration Date:** | Thu, Jan 22, 2009 |

## Example OS Configurations (Windows, Linux, etc.):

The configurations provided are only example configurations and may be different depending on the version OS or tools you are using. If you have any issues getting your tunnel to work please contact us at ipv6@he.net and we will be happy to assist you.
## Hurricane Electric’s IPv6 Tunnel Broker

### Tunnel Details

<table>
<thead>
<tr>
<th>Account: gopher</th>
<th>Delete Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claim Code: No Code Available</td>
<td></td>
</tr>
<tr>
<td>Global Tunnel ID: 22080</td>
<td></td>
</tr>
<tr>
<td>Local Tunnel ID: 2846</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Server IPv4 address: 72.52.104.74</td>
<td></td>
</tr>
<tr>
<td>Server IPv6 address: 2001:470:1104:b1e::1/64</td>
<td></td>
</tr>
<tr>
<td>Client IPv4 address: 75.36.200.156</td>
<td></td>
</tr>
<tr>
<td>Client IPv6 address: 2001:470:1104:b1c::6/64</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Routed 4/64:</td>
<td>Allocate 2001:470:1105:b1e::/64</td>
</tr>
<tr>
<td>RDNSS Delegation NS1:</td>
<td>none</td>
</tr>
<tr>
<td>RDNSS Delegation NS2:</td>
<td>none</td>
</tr>
<tr>
<td>RDNSS Delegation NS3:</td>
<td>none</td>
</tr>
<tr>
<td>ASN:</td>
<td>none</td>
</tr>
<tr>
<td>Registration Date: Thu, Jan 22, 2009</td>
<td></td>
</tr>
</tbody>
</table>

### Example OS Configurations (Windows, Linux, etc.):

- **Vista/2008**

Copy and Paste the following into a command window:

```plaintext
netsh interface ipv6 add v6tunnel IP6Tunnel 2001:470:1104:b1e::1 75.36.200.156 72.52.104.74
netsh interface ipv6 add address IP6Tunnel 2001:470:1104:b1e::2
netsh interface ipv6 add route 10 IP6Tunnel 2001:470:1104:b1e::1
```

1/31/2009

Hurricane Electric
Hurricane Electric’s IPv6 Tunnel Broker

Alex Broque – Hurricane Electric Network Engineer and co-developer of the Tunnelbroker provides a tutorial via YouTube video. (TunnelBroker software has since been updated)

http://www.youtube.com/watch?v=4o7sk97mItM

Tunnelbroker.net - Setting up an IPv6 tunnel
Q&A

Contact:

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Tech Engineer / Developer
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Fremont, CA 94539, USA
http://he.net/
lahmed@he.net


For all questions regarding IPv6 Certification or the HE TunnelBroker contact IPv6@he.net