



2013 North American
IPv6 Summit
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Troubleshooting Dual-Protocol Networks and Systems

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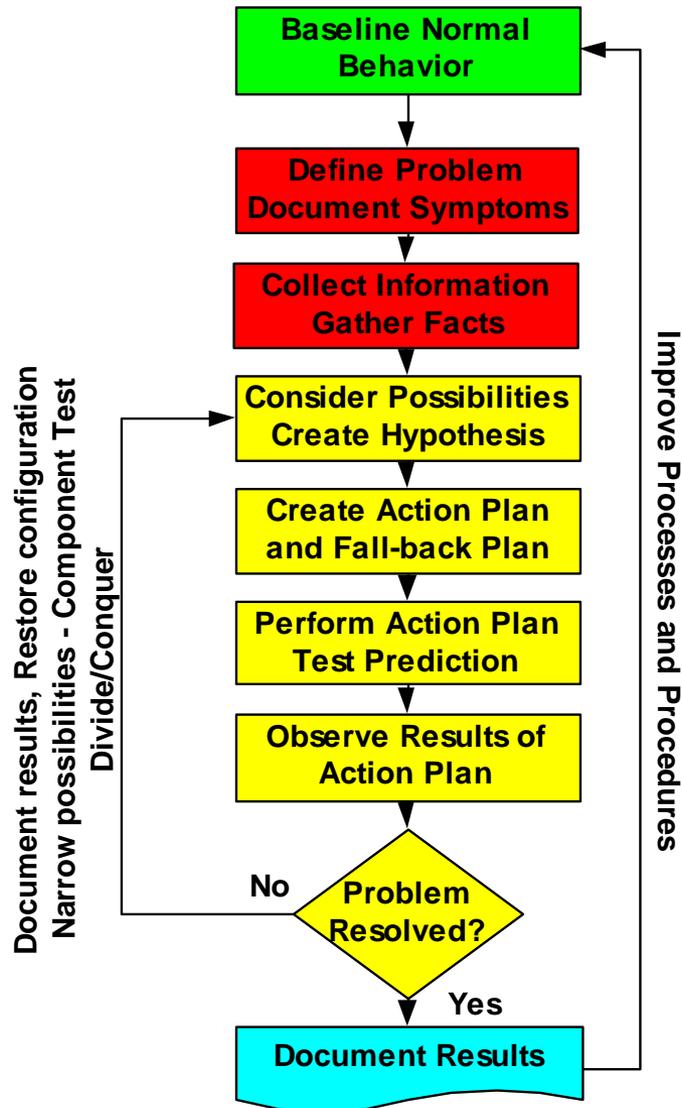
CCIE #5133, CISSP #4610



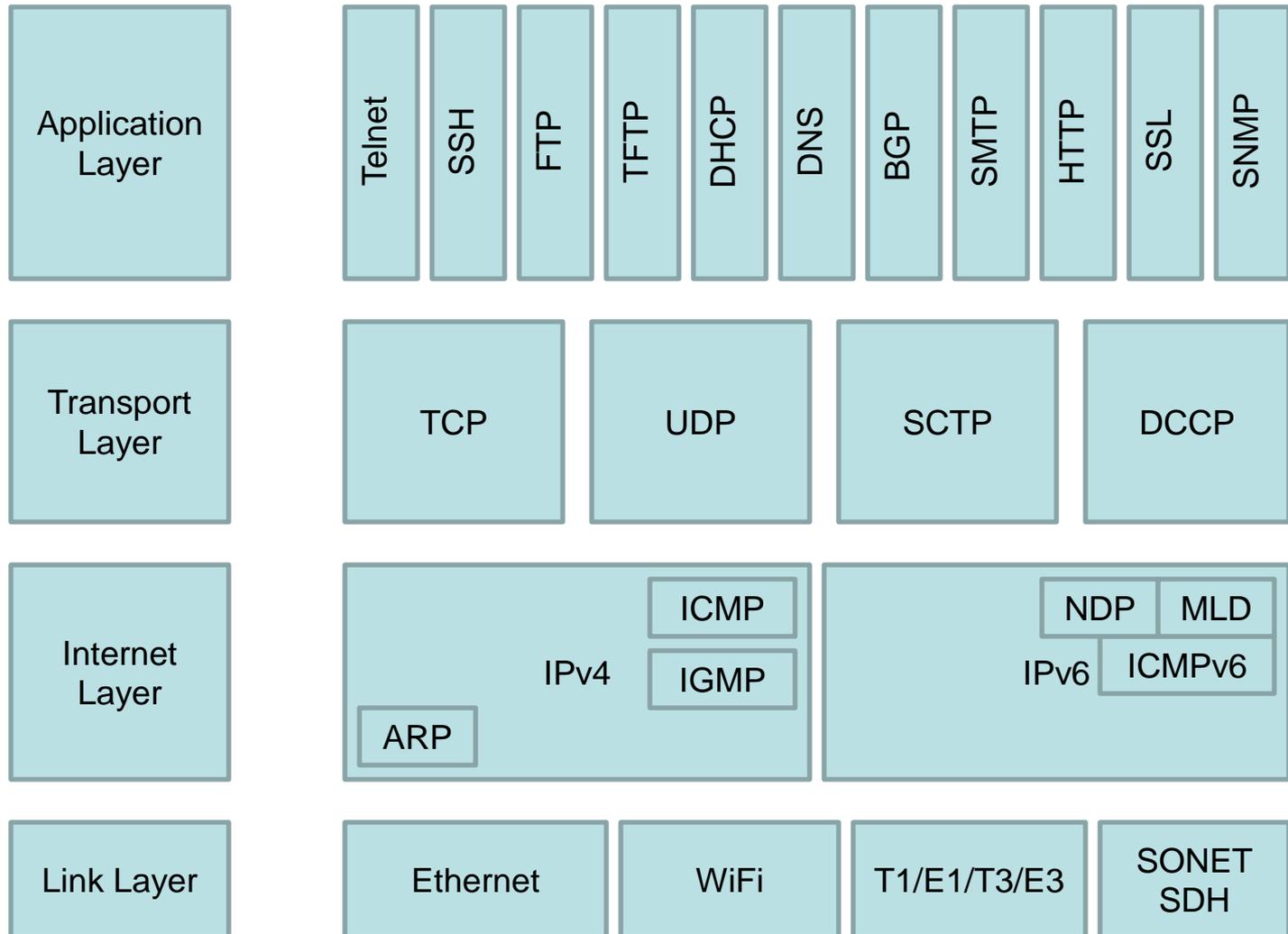
Improving Troubleshooting

- The cost of downtime can be significant, depending on the nature of your business, intangible negative reputation and customer dissatisfaction.
- Having good troubleshooting practices can help reduce MTTR, thus improving availability.
- Using a scientific troubleshooting methodology helps troubleshoot multi-part problems (like those in a dual-protocol environment).
- Network and system configurations will be changing quickly as IPv6 is deployed as change introduces more problems.
- You need to be able to troubleshoot IPv6-related problems even if you have not fully deployed IPv6.

Scientific Troubleshooting Methodology



TCP/IP_{v6} Troubleshooting



Node-to-Node Communications

- For two nodes to communicate they must support one common protocol
- An IPv4-only node cannot communicate with an IPv6-only node

	IPv4-Only	Dual Protocol	IPv6-Only
IPv4-Only	Yes (IPv4)	Yes (IPv4)	No
Dual Protocol	Yes (IPv4)	Yes (IPv6, IPv4)	Yes (IPv6)
IPv6-Only	No	Yes (IPv6)	Yes (IPv6)

Check TCP/IP Host Configuration

- Check that the IP address is correct
 - ifconfig, ipconfig, show ipv6 interface
- Does the host use DHCPv6?
- Check the host's default gateway
 - netstat -rn, route print
- Check DNS
 - Test forward and reverse lookups
 - Check that your resolver is good
 - Check which servers are authoritative for a domain (NS)
 - nslookup, host, dig, whois
 - Test with a protocol analyzer and inspect payload of DNS-replies
 - Consider cache poisoning as a possibility

Router Solicitations and Advertisements



Nodes send RSs (Type 133)
On bootup when they can't wait
200 seconds for the next RA

Source: FE80::/10
Link-Local address of Node
Destination: FF02::2 (all routers)

Data: Query to send RA

Routers send RAs (Type 134)
Every 200 seconds or
Responding to an RS message

Source: FE80::/10
Link-Local address of Router
Destination: FF02::1 (all nodes)

Data: Options, subnet prefix,
lifetime, autoconfig flags (M&O bits)



Host IPv6 Addresses

- IPv6 nodes can have their addresses configured automatically or configured statically in various ways.
- Manually entered addresses are prone to error.
- Verify IPv6 addresses on both end hosts
 - Link-Local, GUA, ULA, etc.
- Verify IPv6 default gateway
 - Link-local next-hop address
 - Or
 - Global address for next-hop address

Neighbor Discovery Protocol (NDP)

- NDP is the IPv6 equivalent of IPv4's ARP
- Check the IPv6 Neighbor Cache (like the ARP cache) to verify mapping of IPv6 address to Layer-2 address (e.g. Ethernet MAC address)
 - Windows: `netsh interface ipv6 show neighbors`
 - Linux: `ip neighbor show`
 - BSD: `ndp -a`
 - Solaris: `netstat -p -f inet6`
 - Cisco routers: `show ipv6 neighbors [statistics], show ipv6 routers`
- Even though two systems have each other in their neighbor cache, they may not be able to communicate on the local LAN

Neighbor Solicitations and Advertisements



Nodes send NSs (Type 135)
When sending IPv6 packet to
Another node

Source: Unicast IPv6 Address
Destination: Solicited Node
Multicast Address
FF02::1:FFAA:BBCC

Data: Target link-layer address
Query: What is your link-layer
address?

Routers send NAs (Type 136)
Responding to an NS message

Source: Unicast IPv6 Address
Destination: Unicast Address of
Requestor or FF02::1 (all nodes)

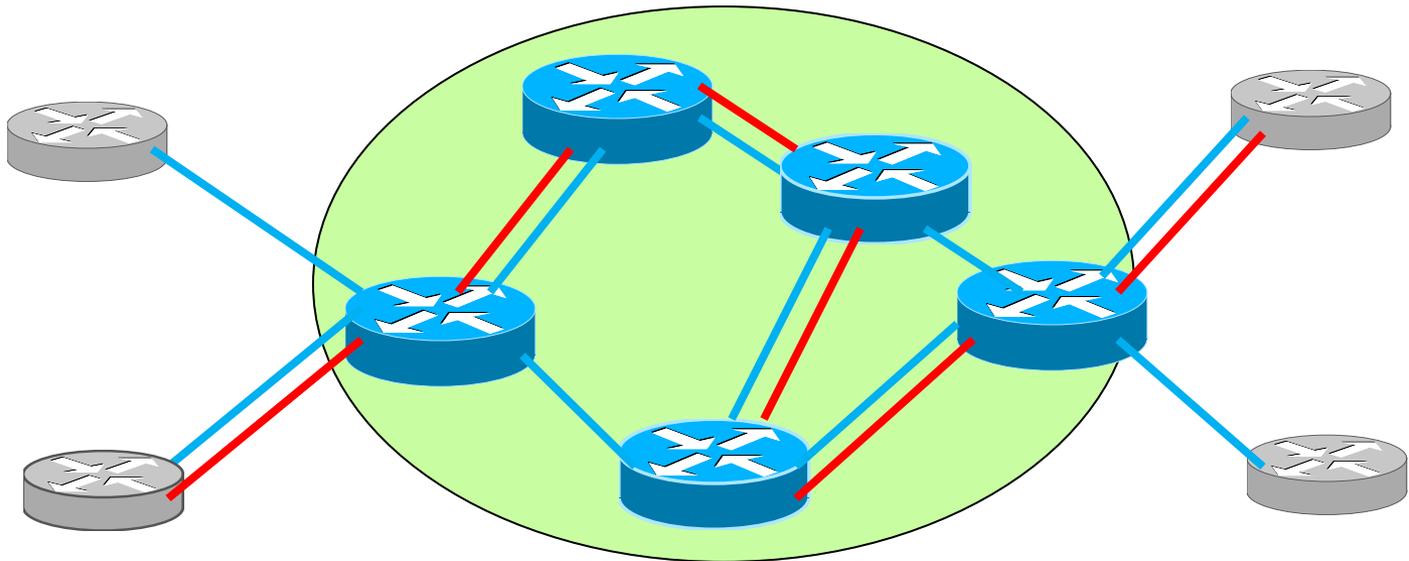
Data: R/S/O Flags, Target's Link-
layer address
Response: Here is my IPv6 and
link-layer address.

End-to-End Troubleshooting

- Ping (ping6) (by name, by IP addr, in both directions, specify source address, 1500-byte MTU)
 - Linux: `ping6 -I eth0 fe80::1`
 - Windows: `ping fe80::1%12`
 - Cisco: `ping fe80::1%GigabitEthernet0/0`
 - `ping -I 1500 2001:db8:dead:c0de::1`
- Traceroute (traceroute6), tracert
- Tcptraceroute6 (www.remlab.net/ndisc6/)
- Microsoft `C:\>pathping -6 2001:db8:11::1`
- `mtr -r6 www.rmv6tf.org c100` (www.bitwizard.nl/mtr/)
- Pchar, pathchar, iperf, jperf
- Netcat (`nc -6`), telnet, ssh, nmap `-6 -sT 2001:db8::1`

IPv4/IPv6 Topology Differences

- The IPv6 path through a network may not be the same as the IPv4 path – they may not be congruent
- Only a subset of the infrastructure may use IPv6 so IPv6 traffic may take a less optimal route than IPv4 traffic
- ISP IPv6 peering may not be as complete as their IPv4 peering



IPv6 Internet Routing

- BGP Looking glasses can be used to troubleshoot IPv6 Internet routing problems
- The looking glasses are routers or systems that are BGP-peered to other backbone routers – you can log into these and check the status of routes, ping, traceroute, etc.

BGP Looking Glasses for IPv4/IPv6, Traceroute & BGP Route Servers

Related Reading
Global Internet Exchange Points

Related Software Tools
BGP Software Tools & Scripts

Always handy:
Cisco BGP Features Roadmap
Cisco IOS BGP Commands
JunOS BGP Configuration Guidelines
JunOS BGP Configuration Statements
Quagga Routing Documentation
Zebra Routing Documentation
Understanding IP Addressing
RIPE NCC ASN32 FAQ
IPv4 Netmask Table
IPv4 CIDR Prefix Sizes
RFC Archive

CC	Region	BGP Looking Glass website	ISP / ISP website	IPv4	IPv6	ASN / RR
ASIA	Asia	Qwest Asia Looking Glass	qwest.net	✓	✗	AS209 A
EURO	Europe	Claranet International Looking Glass	clara.net	✓	✓	AS9426 R
EURO	Europe	KPN International Looking Glass	kpn.com	✓	✓	AS286 R
FIRO	Finland	linxTelecom Looking Glass	linxtelecom.net	✓	✓	AS3327 R

LOOKinGlass.org

IPv6-ENABLED SITES

Sort by: AS Number

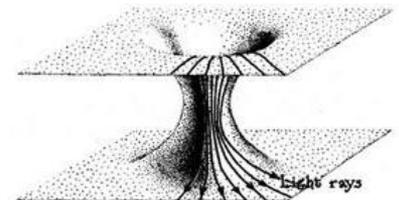
IPv4 Continent
 IX flag Country
 Routes City
 Output Style Comments
 Revision date

Save values

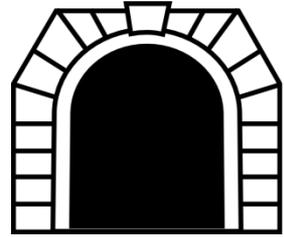
AS.Num	Link Name	IPv4	IX	Routes	Output Style	Continent	Country	City	Comments	Revision Date
AS286	KPN/Qwest	+		Full	Cisco	Europe	Netherlands		KPN Eurorings	25.06.2010
AS513	CERN	+		Full	Cisco	Europe	Switzerland	Geneva	European Organization for Nuclear Research	25.06.2010
AS553	BelVue	+		Full	Cisco	Europe	Germany	Stuttgart		25.06.2010
AS559	SWITCH			Full		Europe	Switzerland			Never
AS766	RedIRIS	+		Small	Cisco	Europe	Spain	Madrid	Spanish National R&D Network	15.11.2008
AS768	JANET	+		Small	Cisco, Juniper	Europe	United Kingdom	London	Some routers with private as num.	15.11.2008

Troubleshooting IPv6 Tunnels

- Tunnels are more difficult to troubleshoot than native IPv6 connectivity
- 6-in-4 tunnels converge on IPv4 routing topology
 - How does the tunnel sit on top of the IPv4 Layer-3 topology?
 - If your IPv4 connectivity is faulty then your IPv6 connectivity will be faulty
- Tunnels can add latency (non-optimal traffic paths)
 - What if you live in NY and your IPv6 tunnel goes to LA?
- Encapsulation/Decapsulation of IPv6/IPv4 packets in a tunnel can add jitter/processing overhead



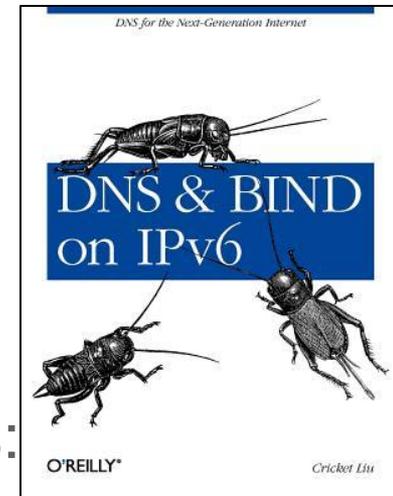
Troubleshooting IPv6 Tunnels



- Manually-configured tunnels can be misconfigured
- Automatic tunnels can fail too if relays are misconfigured (6to4 Relay, Teredo Relay, ISATAP router)
 - Look for packets that use 2002::/16 (6to4) or 2001::/32 (Teredo) addresses or have IPv6 /64 prefix followed by “0000:5EFE” followed by 32-bits of IPv4 address (ISATAP)
- Hosts using tunnels may also suffer from CPU overhead if network stack is not optimized

Check DNS Resolution

- We need to verify that DNS resolutions are indicating the correct IP version address to connect
- Different tools to check DNS resolution
 - `nslookup www.rmv6tf.org -querytype=aaaa`
 - `nslookup`
 - `set type=AAAA`
 - `dig @4.2.2.2 www.rmv6tf.org -t aaaa`
 - `host www.rmv6tf.org`
- The Google Public DNS IPv4 addresses:
 - 8.8.8.8 , 8.8.4.4
- The Google Public DNS IPv6 addresses:
 - 2001:4860:4860::8888 , 2001:4860:4860::8844
- Hurricane Electric Whitelisted DNS server
 - `ordns.he.net` (2001:470:20::2, 74.82.42.42)



IPv6 Packet Capture

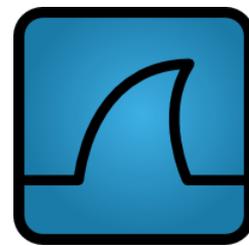
- There are many different options of IPv6-capable protocol analyzers
 - These tools may require WinPcap or Libpcap
 - Wireshark, www.wireshark.org
 - TCPDump, www.tcpdump.org
 - Network Instruments Observer, www.netinst.com
 - NetScout nGenius Probes and Sniffer (Network General), www.netscout.com
 - WildPackets OmniPeek, www.wildpackets.com
 - Microsoft Network Monitor, <http://blogs.technet.com/b/netmon/>

Other Protocol Analyzer Vendors

- Other protocol analyzers
- Hardware
 - Agilent (HP Test and Measurements Division) NetMatrix, Advisor
 - Spirent (Acquisition of many companies)
 - Acterna (TTC, Wandel & Goltermann DA-30c, ...)
 - Cisco Network Analysis Module (NAM)
- Software:
 - Shomiti – Surveyor 4.1 – Now Finisar
 - Network Instruments Observer
 - Fluke Networks OptiView

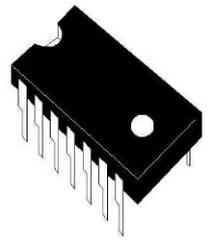


Wireshark and IPv6



- When you capture traffic, you can perform a basic display filter “ipv6”
- After you captured the traffic then you can use capture filters
 - eth.type == 0x86dd
 - ipv6
 - host 2001:db8:11::1 && icmpv6.type == 128
 - ip proto 41
 - ipv6 and not ip proto 41
 - ipv6.addr == 2001:db8:11::1
 - ipv6.dst == 2001:db8:11::1 && tcp.port == 80
 - ipv6.src == 2001:db8:11::1

IPv6 Performance



- Some older devices may not handle IPv6 forwarding in hardware
- Software-based forwarding may cause increased CPU utilization on routers even with moderate amount of IPv6
- This results in packet loss which leads to retransmissions which leads to application issues
- We want to gather performance statistics for each hop in the end-to-end path
- Identify the device that may be contributing to slowness or creating a bottleneck, then look at the status of that device and its counters



Cisco NBAR2

- Network-Based Application Recognition (NBAR) was re-architected to work with the Service Control Engine (SCE) in ISR-G2 and ASR1K routers
- NBAR2 can classify IPv6 packets, and tunneled packets
 - NBAR2 Protocols:
 - ipv6-frag, ipv6-icmp, ipv6inip, ipv6-nonxt, ipv6-opts, ipv6-route, isatap-ipv6-tunneled, ayiya-ipv6-tunneled, sixtofour-ipv6-tunneled, teredo-ipv6-tunneled

IPv6 Service Level Agreements (SLA)

- IP SLA allows a router to perform monitoring of services or systems using active traffic monitoring and this feature is also supported for IPv6
- The following Cisco IOS IP SLAs are supported for IPv6 (ICMP, TCP Connection, UDP Connection, UDP Jitter operation)

```
#conf t
track 150 ip sla 150
exit
ip sla 150
icmp-echo 2001:DB8:11::6 source-ip 2001:DB8:4444::4444
ip sla schedule 150 life forever start-time now
end
#show track 150
#show ip sla statistics
```



Web Browser IPv6 Support

- Most web browsers now support IPv6
 - How to tell if your browser made a v4 or v6 connection?
 - `http://[2001:DB8:1003::F]:8080/index.html`
 - ShowIP add-on for Firefox
 - Other plug-ins and add-ons are available for various browsers
- Otherwise you will have to browse by IPv6 address or IPv4 or IPv6 name
- You may need to use a protocol analyzer to make absolutely sure what IP version was used to make the connection

SixOrNot Firefox Add-On

Firefox

Rocky Mountain IPv6 Taskforce

www.rmv6tf.org

Google

Rocky Mountain IPv6 Task Force

HOME ABOUT EVENTS

North American IPv6

Remote

6	(1)	www.rmv6tf.org	2001:470:0:109::42a0:b04e	[Hide]
4	(3)	widgets.twimg.com	93.184.216.139	
6	(1)	connect.facebook.net	2600:1406:3:1:8400::eed	[+2]
4	(1)	capitola.amerinoc.com	216.17.111.5	
6	(63)	rmv6tf.org	2001:470:0:109::42a0:b04e	[+1]
6	(1)	fonts.googleapis.com	2607:f8b0:4001:c02::5f	[+1]
6	(4)	www.google-analytics.com	2607:f8b0:400f:801::1007	[+12]
4	(2)	dtym7iokkjlif.cloudfront.net	216.137.39.35	[+7]
6	(1)	static.ak.facebook.com	2001:559:0:52::6011:6ca1	[+3]
6	(1)	s-static.ak.facebook.com	2600:1406:3:1:8100::236	[+2]
4	(2)	search.twitter.com	199.59.148.84	[+2]
6	(1)	www.facebook.com	2a03:2880:10:cf01:face:b00c:0:4	[+2]
4	(24)	a0.twimg.com	93.184.216.169	
6	(1)	profile.ak.fbcdn.net	2001:559:0:52::b854:b732	[+3]
6	(2)	static.ak.fbcdn.net	2001:559:0:52::6011:6ca3	[+3]
4	(3)	d.shareaholic.com	107.22.208.177	
4	(1)	i.w55c.net	216.38.163.155	[+1]
4	(2)	ib.adnxs.com	68.67.151.173	[+7]

Open Settings

Goto Sixornot website

APRIL 17-19, 2013 DENVER, COLORADO

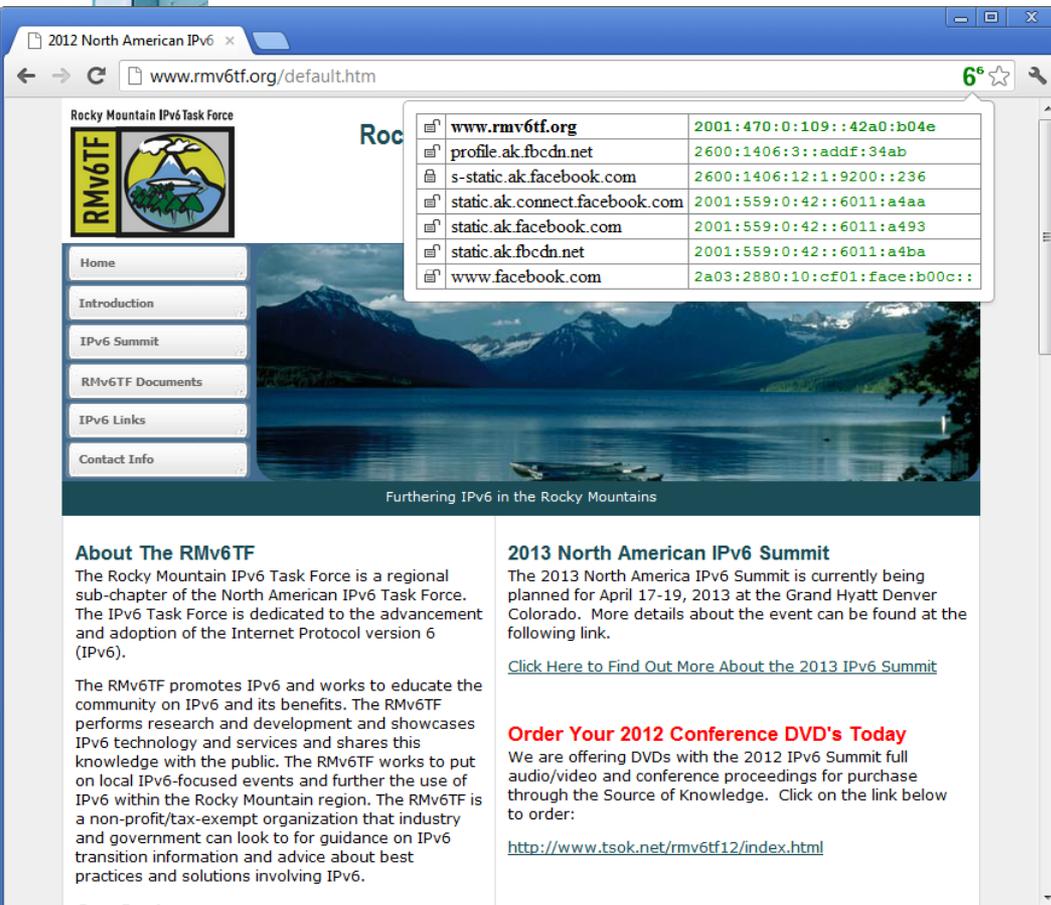
IPvFox Firefox Add-On

The screenshot shows a Firefox browser window with the address bar at `www.rmv6tf.org`. The IPvFox add-on is active, displaying a list of IP addresses for various domains. The website content includes the Rocky Mountain IPv6 Taskforce logo, navigation links (HOME, ABOUT, MEMBERSHIP, CONFERENCE DVD), and a banner for the Summit 2013 event in Denver, Colorado, from April 17-19, 2013.

Domain	IP Address
http://www.rmv6tf.org	2001:470:0:109::42a0:b04e
http://widgets.twimg.com	93.184.216.139
http://connect.facebook.net	2600:1406:3:1:8400::eed
http://capitola.amerinoc.com	216.17.111.5
http://rmv6tf.org	2001:470:0:109::42a0:b04e
http://fonts.googleapis.com	2607:f8b0:4001:c02::5f
http://www.google-analytics.com	2607:f8b0:400f:801::1007
http://dtym7iokkjilif.cloudfront.net	216.137.39.35
http://static.ak.facebook.com	2001:559:0:52::6011:6ca1
https://s-static.ak.facebook.com	2600:1406:3:1:8100::236
http://search.twitter.com	199.59.148.84
http://www.facebook.com	2a03:2880:10:cf01:face:b00c:0:4
http://a0.twimg.com	93.184.216.169
http://profile.ak.fbcdn.net	2001:559:0:52::b854:b732
http://static.ak.fbcdn.net	2001:559:0:52::6011:6ca3
http://d.shareaholic.com	107.22.208.177
http://i.w55c.net	216.38.163.155
http://ib.adnxs.com	68.67.151.173

IPvFoo for Google Chrome

- Summarizes IPv4, IPv6, and HTTPS information for all connections made by the current webpage



2012 North American IPv6 x

www.rmv6tf.org/default.htm 6★

Rocky Mountain IPv6 Task Force

Home

Introduction

IPv6 Summit

RMv6TF Documents

IPv6 Links

Contact Info

Furthering IPv6 in the Rocky Mountains

About The RMv6TF
The Rocky Mountain IPv6 Task Force is a regional sub-chapter of the North American IPv6 Task Force. The IPv6 Task Force is dedicated to the advancement and adoption of the Internet Protocol version 6 (IPv6).

The RMv6TF promotes IPv6 and works to educate the community on IPv6 and its benefits. The RMv6TF performs research and development and showcases IPv6 technology and services and shares this knowledge with the public. The RMv6TF works to put on local IPv6-focused events and further the use of IPv6 within the Rocky Mountain region. The RMv6TF is a non-profit/tax-exempt organization that industry and government can look to for guidance on IPv6 transition information and advice about best practices and solutions involving IPv6.

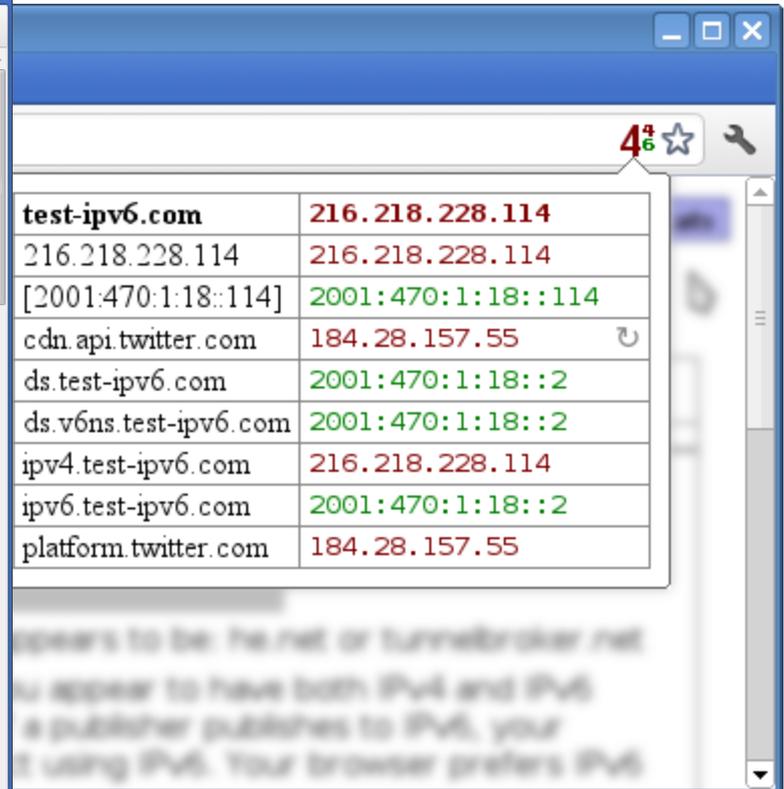
2013 North American IPv6 Summit
The 2013 North America IPv6 Summit is currently being planned for April 17-19, 2013 at the Grand Hyatt Denver Colorado. More details about the event can be found at the following link.

[Click Here to Find Out More About the 2013 IPv6 Summit](#)

Order Your 2012 Conference DVD's Today
We are offering DVDs with the 2012 IPv6 Summit full audio/video and conference proceedings for purchase through the Source of Knowledge. Click on the link below to order:

<http://www.tsok.net/rmv6tf12/index.html>

www.rmv6tf.org	2001:470:0:109::42a0:b04e
profile.ak.fbcdn.net	2600:1406:3::addf:34ab
s-static.ak.facebook.com	2600:1406:12:1:9200::236
static.ak.connect.facebook.com	2001:559:0:42::6011:a4aa
static.ak.facebook.com	2001:559:0:42::6011:a493
static.ak.fbcdn.net	2001:559:0:42::6011:a4ba
www.facebook.com	2a03:2880:10:cf01:face:b00c::



4★

test-ipv6.com	216.218.228.114
216.218.228.114	216.218.228.114
[2001:470:1:18::114]	2001:470:1:18::114
cdn.api.twitter.com	184.28.157.55
ds.test-ipv6.com	2001:470:1:18::2
ds.v6ns.test-ipv6.com	2001:470:1:18::2
ipv4.test-ipv6.com	216.218.228.114
ipv6.test-ipv6.com	2001:470:1:18::2
platform.twitter.com	184.28.157.55

appears to be: he.net or tunnelbroker.net
you appear to have both IPv4 and IPv6
a publisher publishes to IPv6, your
using IPv6. Your browser prefers IPv6

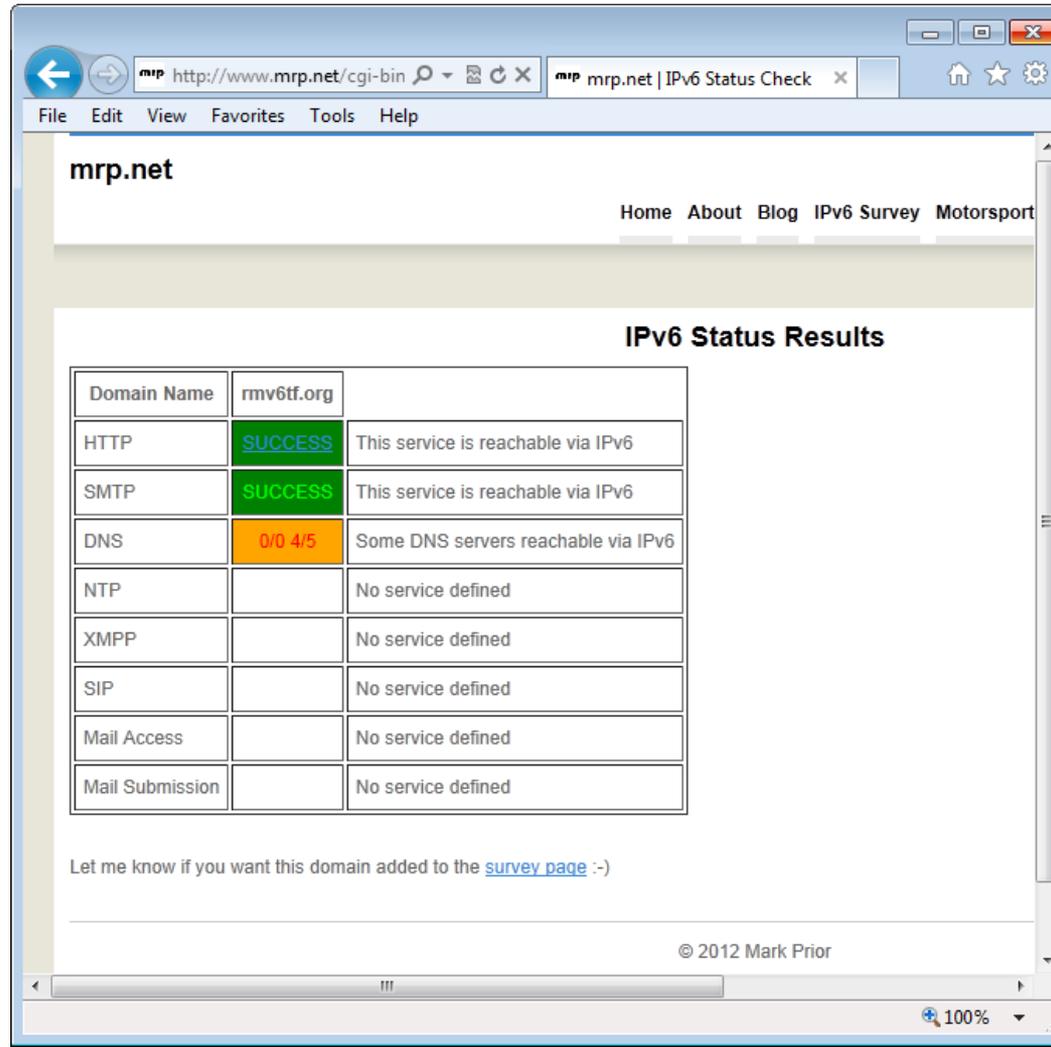
WGET



- GNU Wget is a free software package for retrieving files using HTTP, HTTPS and FTP
- IPv6-capable non-interactive command-line tool runs on UNIX-OSs and Microsoft Windows
- ```
[root@fez ~]# wget -6 www.rmv6tf.org
```
- ```
--2013-01-22 17:58:43-- http://www.rmv6tf.org/
```
- ```
Resolving www.rmv6tf.org... 2001:470:0:109::42a0:b04e
```
- ```
Connecting to
```
- ```
www.rmv6tf.org|2001:470:0:109::42a0:b04e|:80... connected.
```
- ```
HTTP request sent, awaiting response... 200 OK
```
- ```
Length: unspecified [text/html]
```
- ```
Saving to: `index.html`
```
- ```
[<=>] 42,599
```
- ```
175K/s in 0.2s
```
- ```
2013-01-22 17:58:44 (175 KB/s) - `index.html' saved
```
- ```
[42599]
```
- ```
[root@fez ~]# wget -6 --no-check-certificate
```
- ```
https://www.rmv6tf.org
```

Test IPv6 From the Internet

- <http://www.mrp.net/cgi-bin/ipv6-status.cgi>



The screenshot shows a web browser window with the address bar displaying `http://www.mrp.net/cgi-bin/ipv6-status.cgi`. The page title is "mrp.net | IPv6 Status Check". The main content area displays "IPv6 Status Results" for the domain "rmv6tf.org".

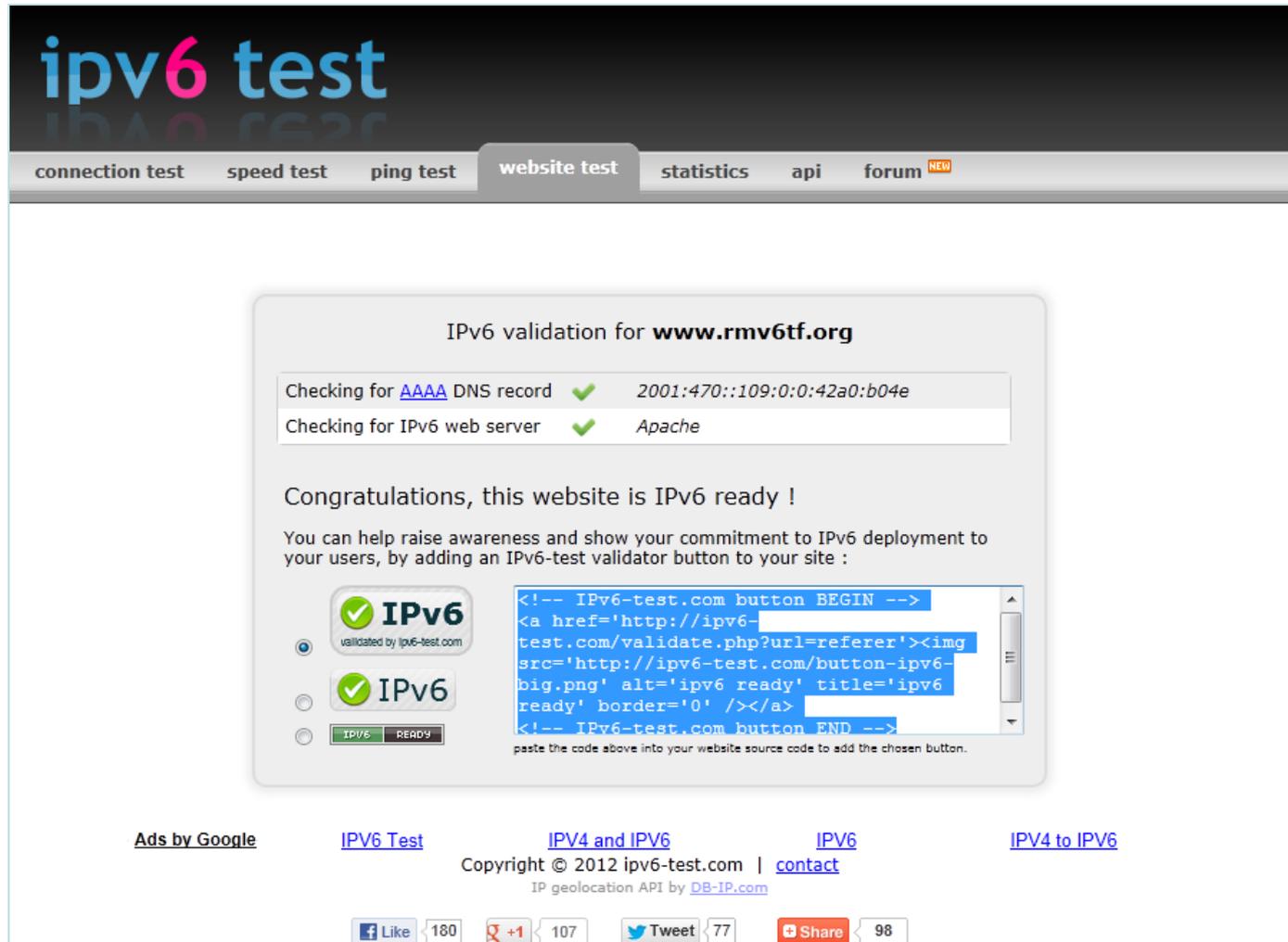
Domain Name	rmv6tf.org	
HTTP	SUCCESS	This service is reachable via IPv6
SMTP	SUCCESS	This service is reachable via IPv6
DNS	0/0 4/5	Some DNS servers reachable via IPv6
NTP		No service defined
XMPP		No service defined
SIP		No service defined
Mail Access		No service defined
Mail Submission		No service defined

Let me know if you want this domain added to the [survey page](#) :-)

© 2012 Mark Prior

Test IPv6 From the Internet

- <http://ipv6-test.com/validate.php>



The screenshot shows the IPv6 test website interface. At the top, there's a navigation bar with links for 'connection test', 'speed test', 'ping test', 'website test' (which is active), 'statistics', 'api', and 'forum'. Below the navigation bar, the main content area displays the results of an IPv6 validation for the website **www.rmv6tf.org**.

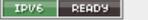
The validation results are as follows:

- Checking for [AAAA](#) DNS record: 2001:470::109:0:0:42a0:b04e
- Checking for IPv6 web server: Apache

Congratulations, this website is IPv6 ready !

You can help raise awareness and show your commitment to IPv6 deployment to your users, by adding an IPv6-test validator button to your site :

Three button options are shown:

- 
- 
- 

A code block shows the HTML code for the selected button:

```
<!-- IPv6-test.com button BEGIN -->
<a href='http://ipv6-
test.com/validate.php?url=referer'><img
src='http://ipv6-test.com/button-ipv6-
big.png' alt='ipv6 ready' title='ipv6
ready' border='0' /></a>
<!-- IPv6-test.com button END -->
```

paste the code above into your website source code to add the chosen button.

At the bottom of the page, there are several links and social media widgets:

- Ads by Google
- [IPv6 Test](#)
- [IPv4 and IPv6](#)
- [IPv6](#)
- [IPv4 to IPv6](#)
- Copyright © 2012 [ipv6-test.com](#) | [contact](#)
- IP geolocation API by [DB-IP.com](#)
- Social media widgets: Like (180), +1 (107), Tweet (77), Share (98)

IPv6-Capable Web Monitoring

- Services that monitor your IPv6 web site
 - Keynote Internet Testing Environment (KITE)
 - keynote.com
 - Gomez (now Compuware Application Performance Management (APM))
 - <http://www.compuware.com/application-performance-management/>
- Other web monitoring services do not seem to have any IPv6 capabilities



Test Network Load



- To test end-to-end network performance you will need tools that load a network with IPv6 traffic. This could be synthetic or real traffic.
- You can test the performance of your IPv6 Internet link with these services:
 - <http://ipv6.speedtest.premieronline.net> (Premier Communications - US)
 - <http://www.burst.net/speeds.shtml> (Burst.net - US)
 - <http://ipv6-speedtest.net> (UK)
 - <http://speedtest6.com> (Japan)

Iperf

- Iperf is an open-source network throughput performance utility that can generate IPv4 or IPv6 TCP or UDP packets between a client and server
- Iperf was created by the Distributed Applications Support Team (DAST) at the National Laboratory for Applied Network Research (NLANR).
 - On Server:
 - `iperf -s -p 5001 -V`
 - On Client:
 - `iperf -c 2001:db8:22::100 -P 1 -i 1 -p 5001 -V -f k -t 10 -T 1`
- Jperf (xjperf) 2.0.2 is a Google Code project java-based front end to Iperf that is IPv6-capable

JPerf

JPerf 2.0.2 - Network performance measurement graphical tool

JPerf

Iperf command: `bin/iperf.exe -c 2001:db8:22:0:851d:34a1:faa5:b4f1 -P 1 -i 1 -p 5001 -V -fk -t 10 -T 1`

Choose iPerf Mode: Client Server

Server address: `:0:851d:34a1:faa5:b4f1` Port: `5,001`

Parallel Streams: `1`

Listen Port: `5,001` Client Limit

Num Connections: `0`

test port: `5,001`

Representative File:

Print MSS

Transport layer options

Choose the protocol to use

TCP

Buffer Length: `2` MBytes

TCP Window Size: `56` KBytes

Max Segment Size: `1` KBytes

TCP No Delay

UDP

UDP Bandwidth: `1` MBytes/sec

UDP Buffer Size: `41` KBytes

UDP Packet Size: `1,500` Bytes

IP layer options

TTL: `1`

Type of Service: `None`

Bind to Host:

IPv6

Bandwidth Mon, 23 May 2011 15:52:41

Time (sec)	Bandwidth (Kbits/sec)
1	45000
2	37000
3	38000
4	37000
5	37000
6	37000
7	37000
8	37000
9	38000
10	37000

#156: [38869.00Kbits/s]

Output

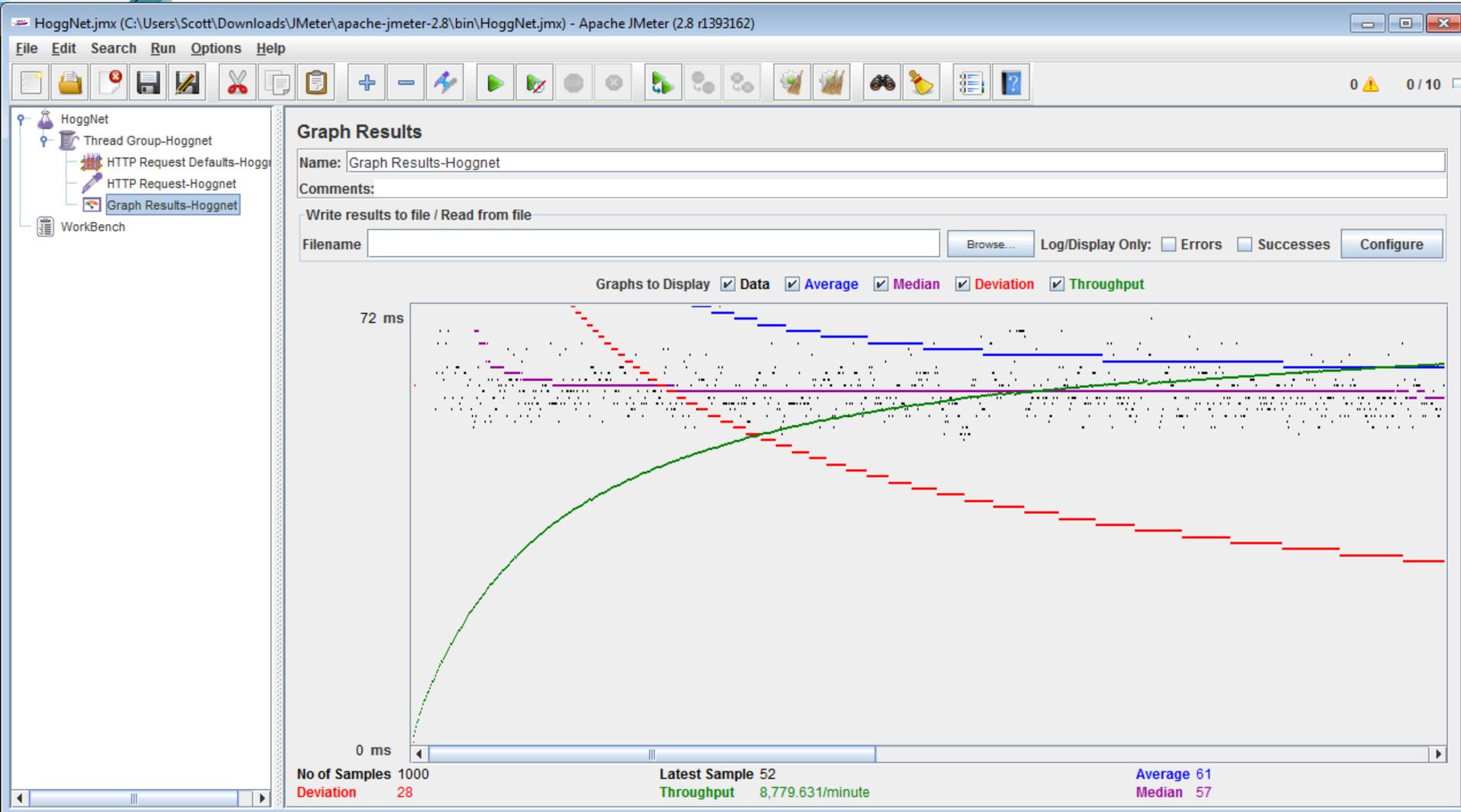
```
bin/iperf.exe -c 2001:db8:22:0:851d:34a1:faa5:b4f1 -P 1 -i 1 -p 5001 -V -fk -t 10 -T 1
-----
Client connecting to 2001:db8:22:0:851d:34a1:faa5:b4f1, TCP port 5001
TCP window size: 8.00 KByte (default)
-----
[156] local 2001:db8:11:0:2473:dda6:de7b:f6f4 port 33814 connected with 2001:db8:22:0:851d:34a1:faa5:b4f1
[ ID] Interval      Transfer      Bandwidth
[156] 0.0- 1.0 sec  5736 KBytes  46989 Kbits/sec
[156] 1.0- 2.0 sec  4552 KBytes  37290 Kbits/sec
[156] 2.0- 3.0 sec  4720 KBytes  38666 Kbits/sec
[156] 3.0- 4.0 sec  4616 KBytes  37814 Kbits/sec
[156] 4.0- 5.0 sec  4624 KBytes  37880 Kbits/sec
```

Clear Output on each Iperf Run

Apache JMeter

- JMeter is a simple open-source Java app designed to load test functional behavior and measure performance of web and other applications
- Download Jmeter 2.8 to a directory, unzip
- Run bin/Jmeter.bat
- Created a Threat Group with HTTP Request Defaults for `www.hoggn.net.com`, HTTP Request for `/`, Graph Results
- Changed bin/system.properties files to:
 - `java.net.preferIPv4Stack=false`
 - `java.net.preferIPv6Addresses=true`

Jmeter Results – IPv6



Check Your IPv6 Address



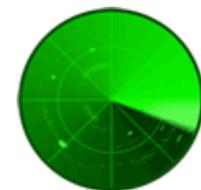
- <http://whatismyv6.com>, <http://ipv6.whatismyv6.com>, <http://whatismyipv6address.com>, <http://ip6.me> (for mobile devices)
- <http://whatsmyipv6.org>
- <http://www.myipv6address.com>
- <http://www.v6address.com> ([v4address.com](http://www.v4address.com))
- <http://ip6tools.com>, <http://www.my-ip6.com>
- <http://www.runningipv6.net/what-is-my-ipv6-address.php>
- <http://www.ipv6chicken.com> (uses large MTU size)
 - <http://www.ipchicken.com>

Check Your IPv6 Connectivity



- <http://www.kame.net>
- <http://6to4test7.runningipv6.net>
- <http://test-ipv6.comcast.net>
- <http://test-ipv6.com>
- <http://ipv6-test.com>
- <http://onlyv6.com> (IPv6-only web site)
- <http://www.traceroute6.net>
- <http://s.a.ak6i.net/a1/results/demo.html> (Akamai AK6I IPv6 Connectivity check)
- <http://ipv6eyechart.ripe.net> (RIPE's dual-stack connectivity chart)

Port Scan Yourself



- Tim's Free Online IPv6 Port Scanner (Firewall Tester)
 - <http://ipv6.chappell-family.com/ipv6tcptest/index.php>
 - <http://ipv6.chappell-family.com/timswiki/index.php5/IPv6>
- SubnetOnline.com Online Port Scanner IPv6
 - <http://www.subnetonline.com/pages/ipv6-network-tools/online-ipv6-port-scanner.php>
- Qualys FreeScan
 - <https://freescan.qualys.com>
- L'Altro Mondo Free Online Opensource IPv6 TCP Port Scanner
 - <http://laltromondo.dynalias.net/~ipv6/>
- VikingScan - Portscan your IP for Free!
 - <http://miniscan6.vikingscan.org>
- <http://www.scanipv6.com> free IPv6-capable nmap scanner

IPv6 and PMTUD

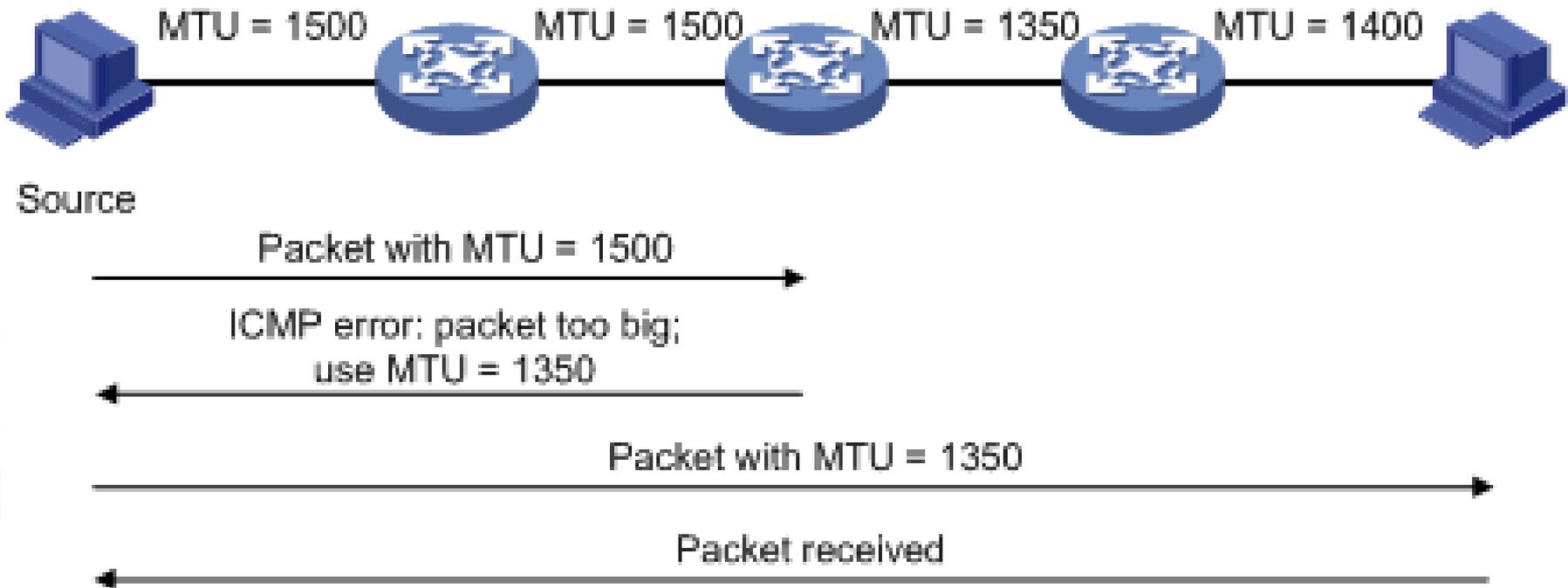
- IPv6 routers do not perform fragmentation of IPv6 packets (Minimum IPv6 Link MTU=1280 bytes)
 - Routers drop the packet and send back ICMPv6 Packet Too Big message (Type 2) to the source
- Hosts must perform Path MTU Discovery (PMTUD) and reduce packet size and cache new size
- Fragmentation Extension Header will be added to fragmented packets (next-header 44)
- Tunnels are pervasive for IPv6, tunnel overhead reduces effective MTU, PMTUD needed more frequently with IPv6 networks due to tunnel usage
- Firewalls should not filter PMTUD messages, if they do, then PMTUD will not work

IPv6 and PMTUD (Cont.)

- Many applications today do not perform PMTUD properly and this will need to change with the introduction of IPv6 (most web servers set DF=1)
- Application may complete initial connection (smaller packets) then hang when larger data is sent by server
- Turning down TCP Maximum Segment Size (MSS) to 1220 bytes only works for TCP, but may not work in all cases
- Turning down interface MTU to 1280 bytes is far less than ideal, someday we will want jumbo frames

IPv6 and PMTUD (Cont.)

- You can test PMTUD with ping
- `ping -I 1500 2001:DB8:DEAD:C0DE::1`
- `netsh int ipv6 show destinationcache`

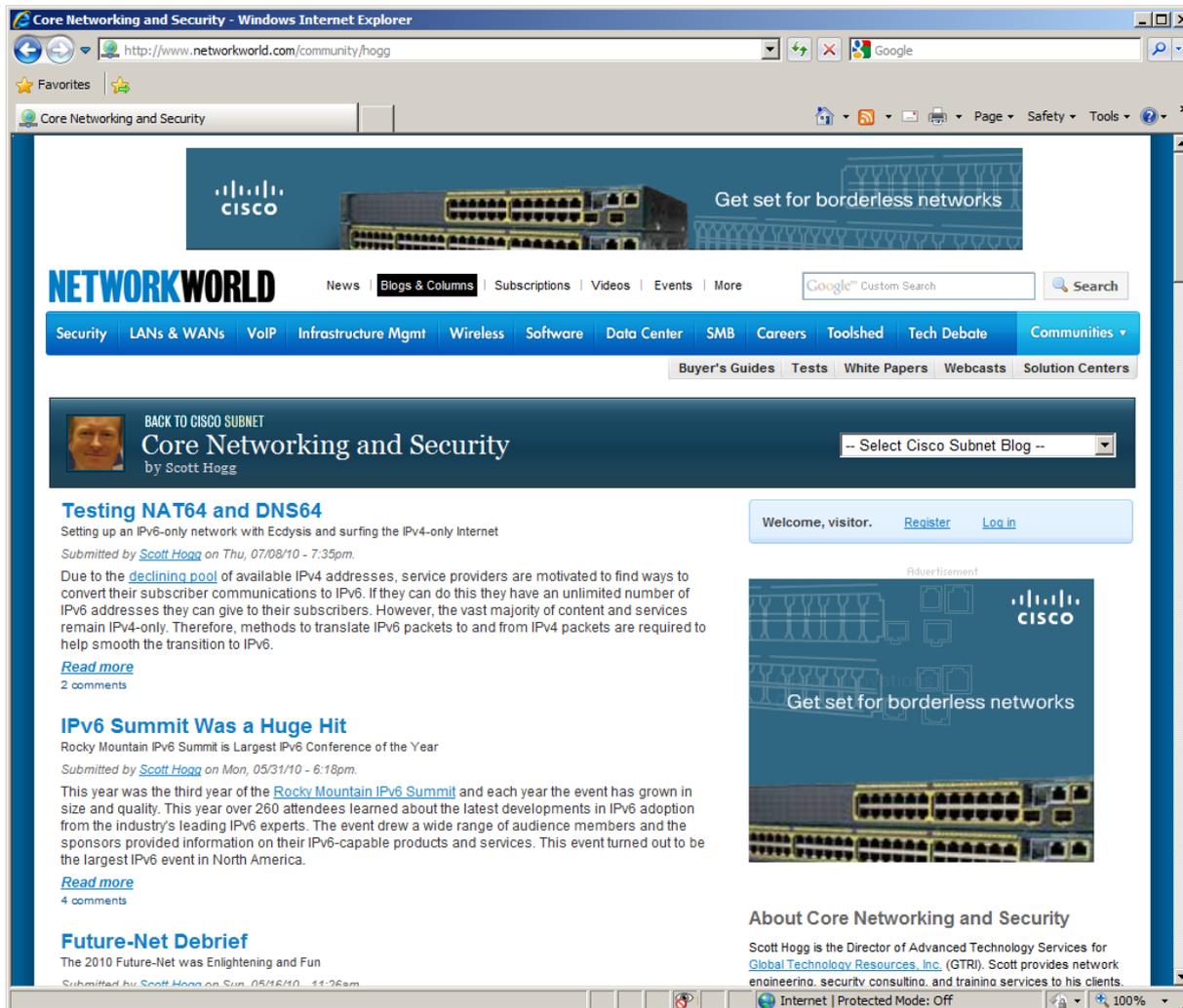


The Bottom Line

- ◆ ***Use good methodology***
- ◆ ***Document actions and results***
- ◆ ***Leverage all tools to gather information***
- ◆ ***Use protocol analyzer to help troubleshoot problems***
- ◆ ***Understand protocols you are troubleshooting***

NetworkWorld Blog

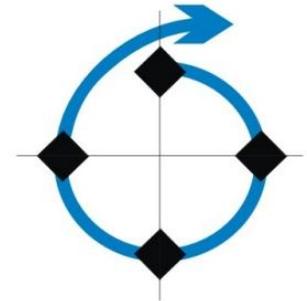
<http://www.networkworld.com/community/hogg>



The screenshot shows a Windows Internet Explorer browser window displaying the NetworkWorld blog page. The address bar shows the URL <http://www.networkworld.com/community/hogg>. The page features a Cisco advertisement at the top with the text "Get set for borderless networks". Below the advertisement is the NetworkWorld logo and a navigation menu with categories such as Security, LANs & WANs, VoIP, Infrastructure Mgmt, Wireless, Software, Data Center, SMB, Careers, Toolshed, Tech Debate, and Communities. A search bar is also present. The main content area displays a list of blog posts by Scott Hogg, including "Testing NAT64 and DNS64", "IPv6 Summit Was a Huge Hit", and "Future-Net Debrief". Each post includes a brief description, submission date, and a "Read more" link. A sidebar on the right contains a "Welcome, visitor" message with "Register" and "Log in" links, and an "About Core Networking and Security" section.

GTRI's IPv6 Transition Services

- **IPv6 Inventory**
 - Documentation of your current inventory and determination of IPv6 compatibility
 - Data gathering expertise (manual, data calls, automated utilities)
 - Cisco and GTRI automated tools
 - Inventory data aggregation and review
- **IPv6 Training**
 - Education for your teams to help them learn IPv6 technologies
 - Classroom and hands-on training
- **IPv6 Impact Analysis**
 - IPv6 Risk Assessment using OMB's own Risk Analysis Methodology
 - Custom-tailored transition planning for your IPv6 migration, tied to your enterprise architecture
- **IPv6 Application Assessment**
 - Software assessments leveraging COTS tools and our extensive experience
 - Review of your operating system constraints for IPv6 adoption
- **IPv6 Experimentation and Testing**
 - Systems testing in our IPv6 lab (DNS, routing, security, applications)
- **IPv6 Deployment**
 - Deployment of dual-stack and other IPv6 transition techniques
 - Dual Stack DNS servers and IPv6 security deployment



Question and Answer

Q:

&

A:

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