

**Sent:** Fri, 25 Jan 2013 09:52:04 -0500  
**From:** "Mitchell, Stu" <stu\_mitchell@ios.doi.gov>  
**To:** fedv6-deploy@nist.gov  
**Subject:** [fedv6-deploy] Fwd: Power Points for Tomorrow  
[IPv6 Troubleshooting - 2013-01-25.pdf](#)  
[ATT00001.txt](#)

FYI - slides for today's Tech Meeting.  
Stu

----- Forwarded message -----

**From:** **Scott Hogg** <[SHogg@gtri.com](mailto:SHogg@gtri.com)>  
**Date:** Thu, Jan 24, 2013 at 10:06 PM  
**Subject:** RE: Power Points for Tomorrow  
**To:** John Lee <[john@internetassociatesllc.com](mailto:john@internetassociatesllc.com)>  
**Cc:** Stu Mitchell <[stu\\_mitchell@ios.doi.gov](mailto:stu_mitchell@ios.doi.gov)>, "[Mark.Busby@usdoj.gov](mailto:Mark.Busby@usdoj.gov)"  
<[Mark.Busby@usdoj.gov](mailto:Mark.Busby@usdoj.gov)>

Here is the PDF of the PPT that I will cover tomorrow.

Please distribute this to the attendees.

--

**Scott Hogg**

.....  
Director of Technology Solutions  
CCIE #5133, CISSP #4610  
**[Global Technology Resources, Inc.](#)**  
990 S. Broadway Suite 400  
Denver, CO 80209  
**c:** [REDACTED]  
**f:** 303-455-8808  
**e:** [SHogg@GTRI.com](mailto:SHogg@GTRI.com)

P6/b(6)

---

**From:** John Lee [mailto:[john@internetassociatesllc.com](mailto:john@internetassociatesllc.com)]  
**Sent:** Thursday, January 24, 2013 6:48 PM  
**To:** Scott Hogg  
**Cc:** Stu Mitchell; [Mark.Busby@usdoj.gov](mailto:Mark.Busby@usdoj.gov)  
**Subject:** Power Points for Tomorrow

Scott,

If you could send us the power points Stu or I will send it to the group as some do not have access to the webinar but dial in to the conference call.

Thanks for all of the effort.

John L. Lee

CTO, Internet Associates, LLC

O- 770-495-0953

C- [REDACTED] - - - - - [REDACTED] P6/b(6)

[www.internetassociatesllc.com](http://www.internetassociatesllc.com)

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Stu2



# **U.S. FEDERAL IPV6 TASK FORCE JANUARY 25, 2013**

## **TROUBLESHOOTING DUAL-PROTOCOL NETWORKS AND SYSTEMS**

**Scott Hogg**

GTRI - Director of Technology Solutions

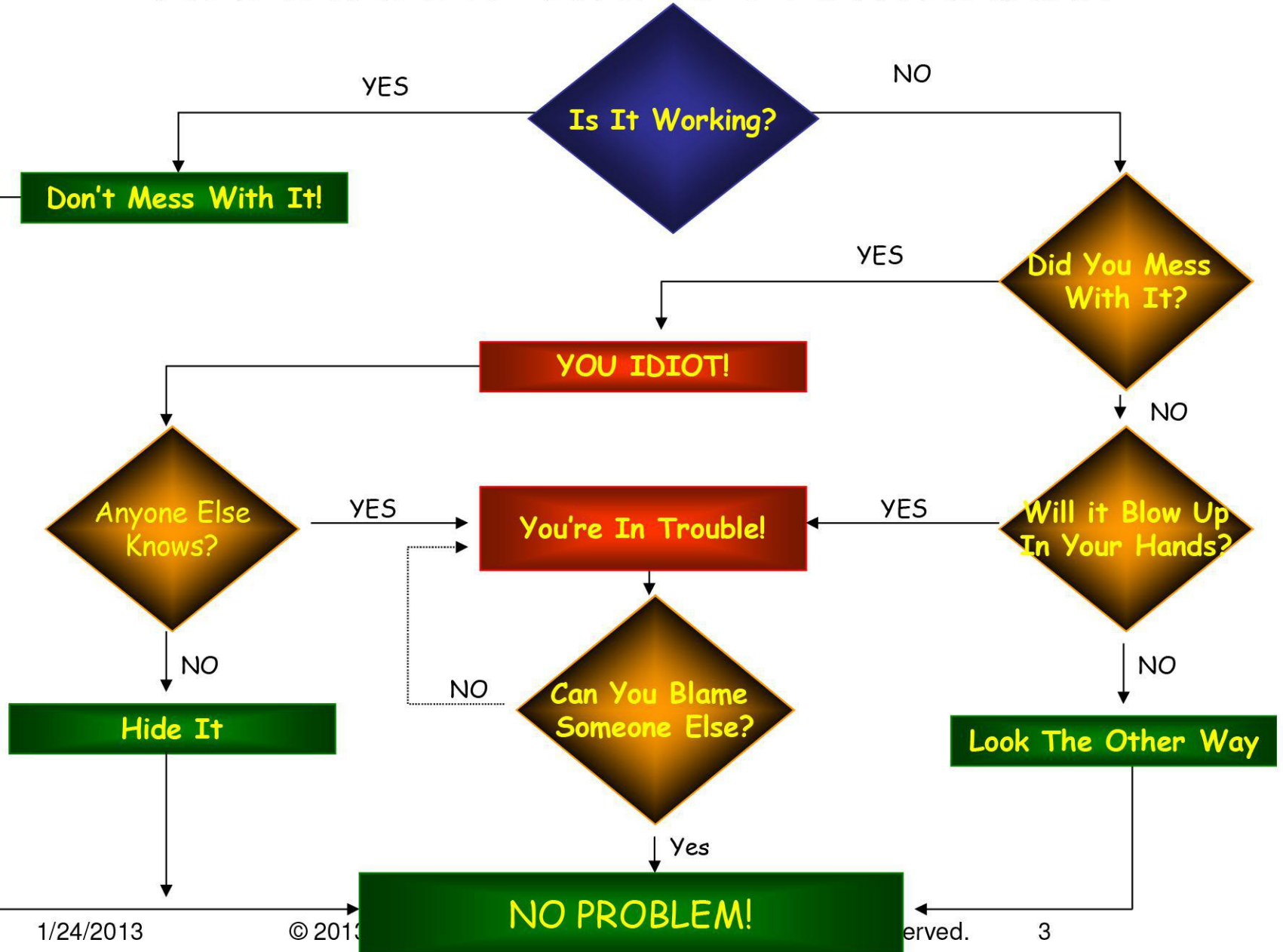
CCIE #5133, CISSP #4610



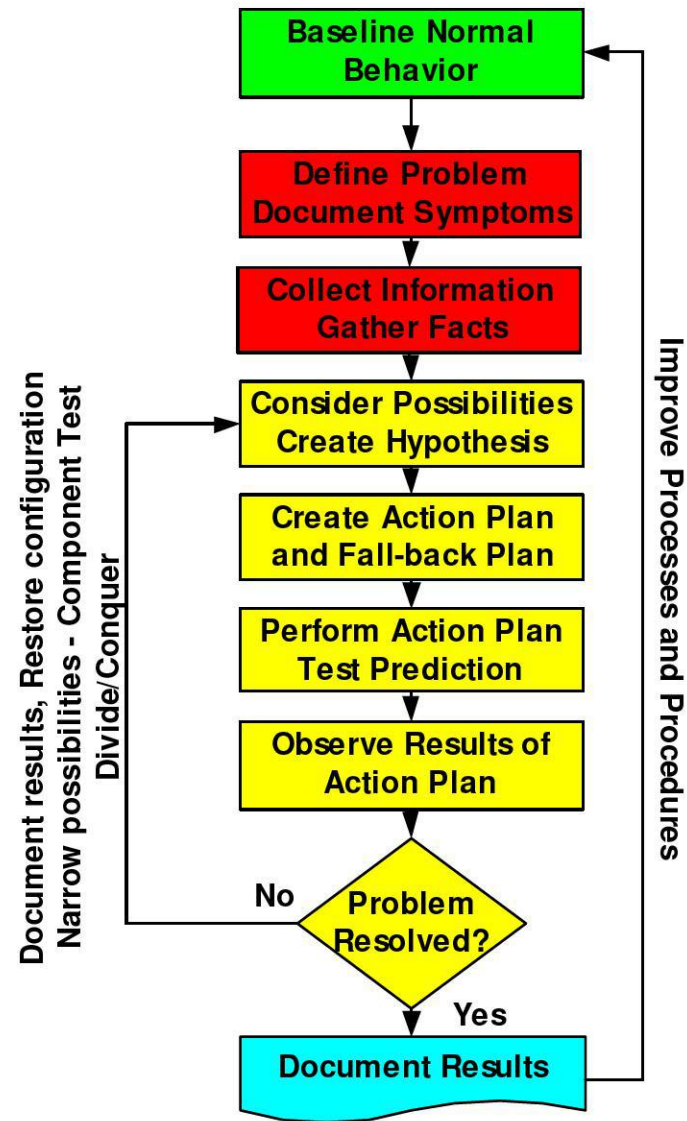
## IMPROVING TROUBLESHOOTING

- 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.

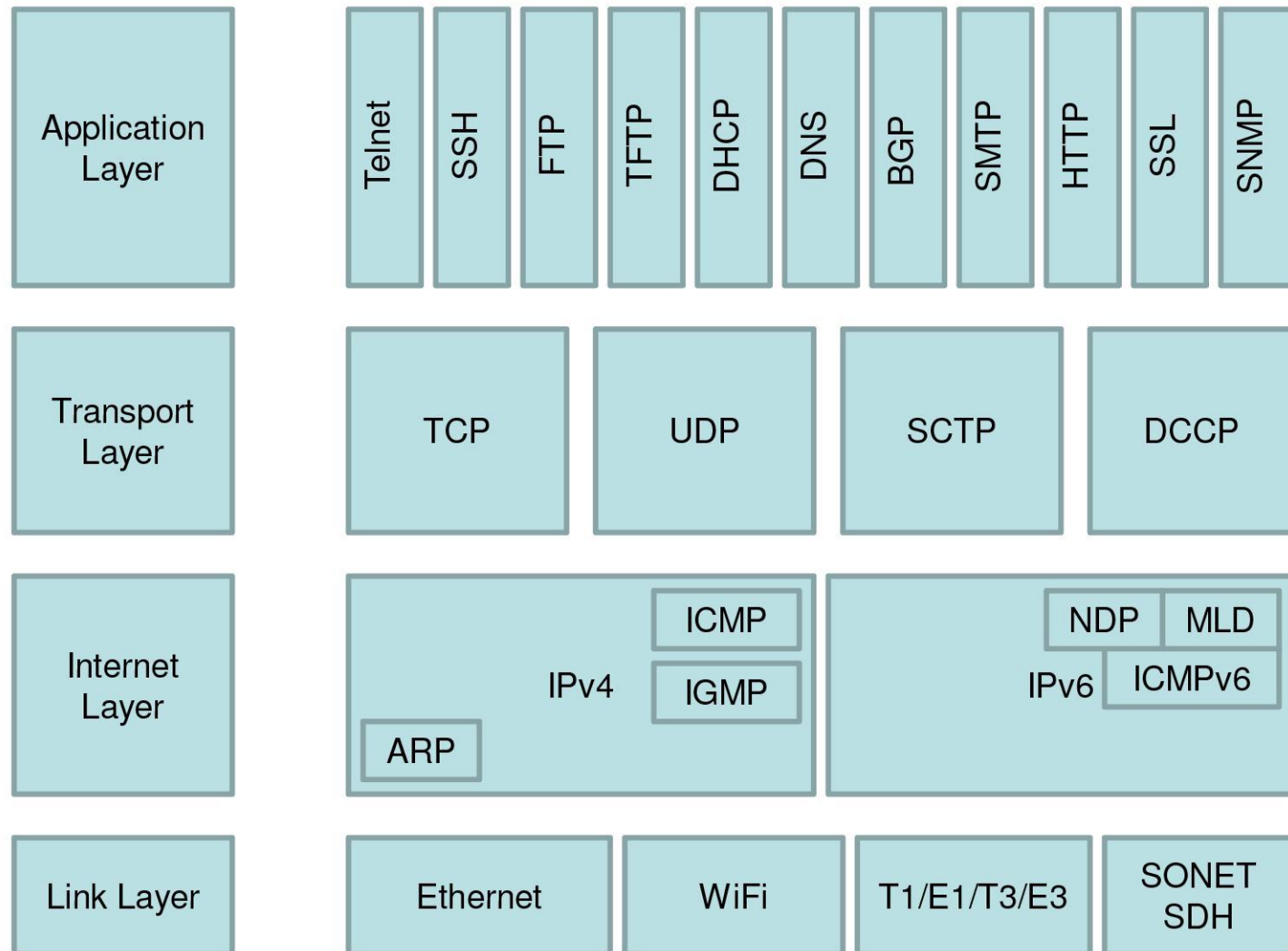
# COMMONLY USED FLOWCHART



# SCIENTIFIC TROUBLESHOOTING METHODOLOGY



# TCP/IPv6 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.

# ICMPv6

- More powerful than ICMPv4
- ICMPv6 uses IPv6 extension header # 58 (RFC 2463)

Type	Description
------	-------------

1	Destination Unreachable
---	-------------------------

2	Packet too Big
---	----------------

3	Time exceeded
---	---------------

4	Parameter problem
---	-------------------

128	Echo Request
-----	--------------

129	Echo Reply
-----	------------

130	Multicast Listener Query – sent to ff02::1 (all nodes)
-----	--

131	Multicast Listener Report
-----	---------------------------

132	Multicast Listener Done – sent to ff02::2 (all routers)
-----	---

133	Router Solicitation (RS) – sent to ff01::2 (all routers)
-----	--

134	Router Advertisement (RA) – sent to ff01::1 (all nodes)
-----	---

135	Neighbor Solicitation (NS) – sent to ff02:0:0:0:0:1:ff00::/104
-----	--

136	Neighbor Advertisement (NA)
-----	-----------------------------

137	Redirect message
-----	------------------

PING

MLD

Prefix  
Advertisement

Router  
Redirection

ARP  
Replacement

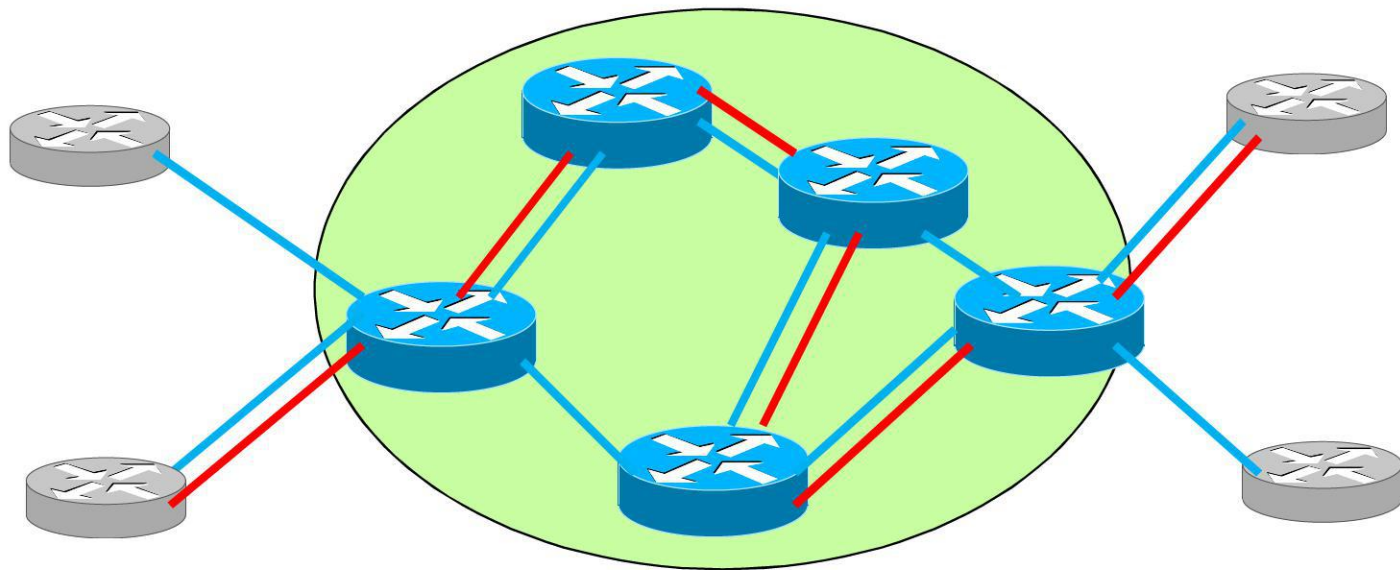


## END-TO-END TROUBLESHOOTING

- 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/](http://www.remlab.net/ndisc6/))
- Microsoft `C:\>pathping -6 2001:db8:11::1`
- `mtr -r6 www.rmv6tf.org c100` ([www.bitwizzard.nl/mtr/](http://www.bitwizzard.nl/mtr/))
- `Pchar`, `pathchar`, `iperf`, `jperf`
- Netcat (`nc -6`), `telnet`, `ssh`, `nmap -6 -sT 2001:db8::1`

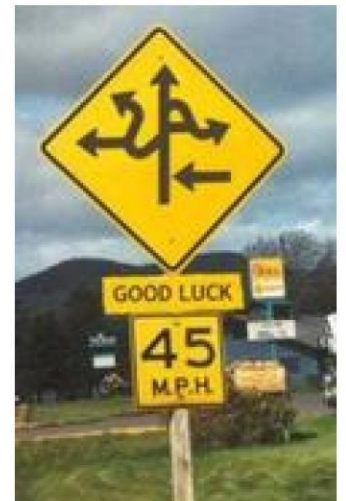
# IPv4/IPv6 TOPOLOGY DIFFERENCES

- 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



# ROUTING TABLE PROBLEMS

- Routing protocol table and forwarding table
  - “Show ip route” vs. “show ip ospf route”
  - Inactive or flapping routes
  - Check routing table and routing metrics for specific routes – check in both directions
  - Clear out specific route or entire routing table and let it build again – last resort
  - Check route summarization and redistribution
  - Administrative distance (believability/favorability)
  - Equal-cost load balancing
- Asymmetrical routing
  - Open jaw routes
  - Black hole routes



# 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

**Infoblox**

Think you can handle IPv6?

**Take the online challenge now & win an iPad.**

**REGISTER NOW**

**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

**Troubleshooting IP Routing Protocols**

Zahar Aziz, Johnnie Liu, Abe Marley, Faraz Shamim, Johnnie Liu

**CC - Region**

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	Clarent International Looking Glass	clarent.net	✓	AS9426 R
EURO	Europe	KPN International Looking Glass	kpn.com	✓	AS266 R
EURO	Europe	Linx Telecom Looking Glass	linxtelecom.net	✓	AS3322 R

**LOOKinGlass.org**

**IPv6-ENABLED SITES**

Sort by: **AS Number**

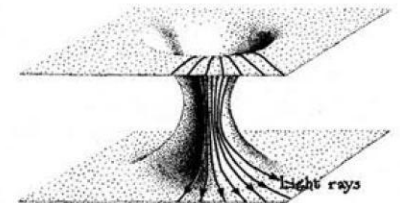
☒ IPv4 ☒ Continent  
☒ IX flag ☒ Country  
☒ Routes ☒ City  
☒ Output Style ☒ Comments  
☒ Revision date

**Save values**

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

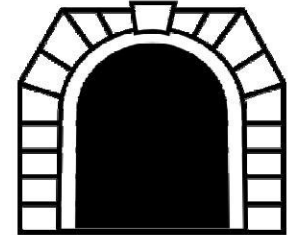
# TROUBLESHOOTING IPV6 TUNNELS

- 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



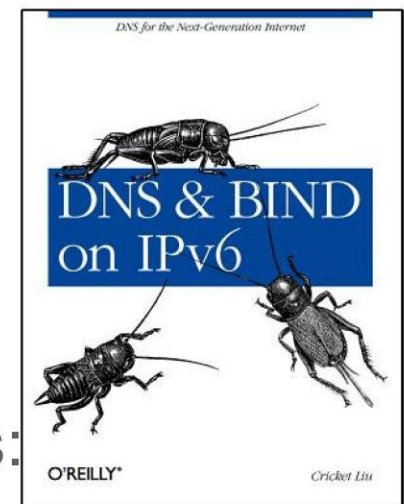
## TROUBLESHOOTING IPV6 TUNNELS

- 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

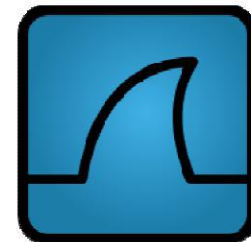
- There are many different options of IPv6-capable protocol analyzers
  - These tools may require WinPcap or Libpcap
  - Wireshark, [www.wireshark.org](http://www.wireshark.org)
  - TCPDump, [www.tcpdump.org](http://www.tcpdump.org)
  - Network Instruments Observer, [www.netinst.com](http://www.netinst.com)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

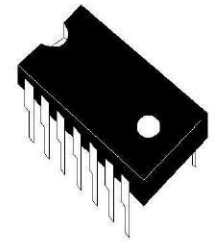


## WIRESHARK AND IPV6



- 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, ayia-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)

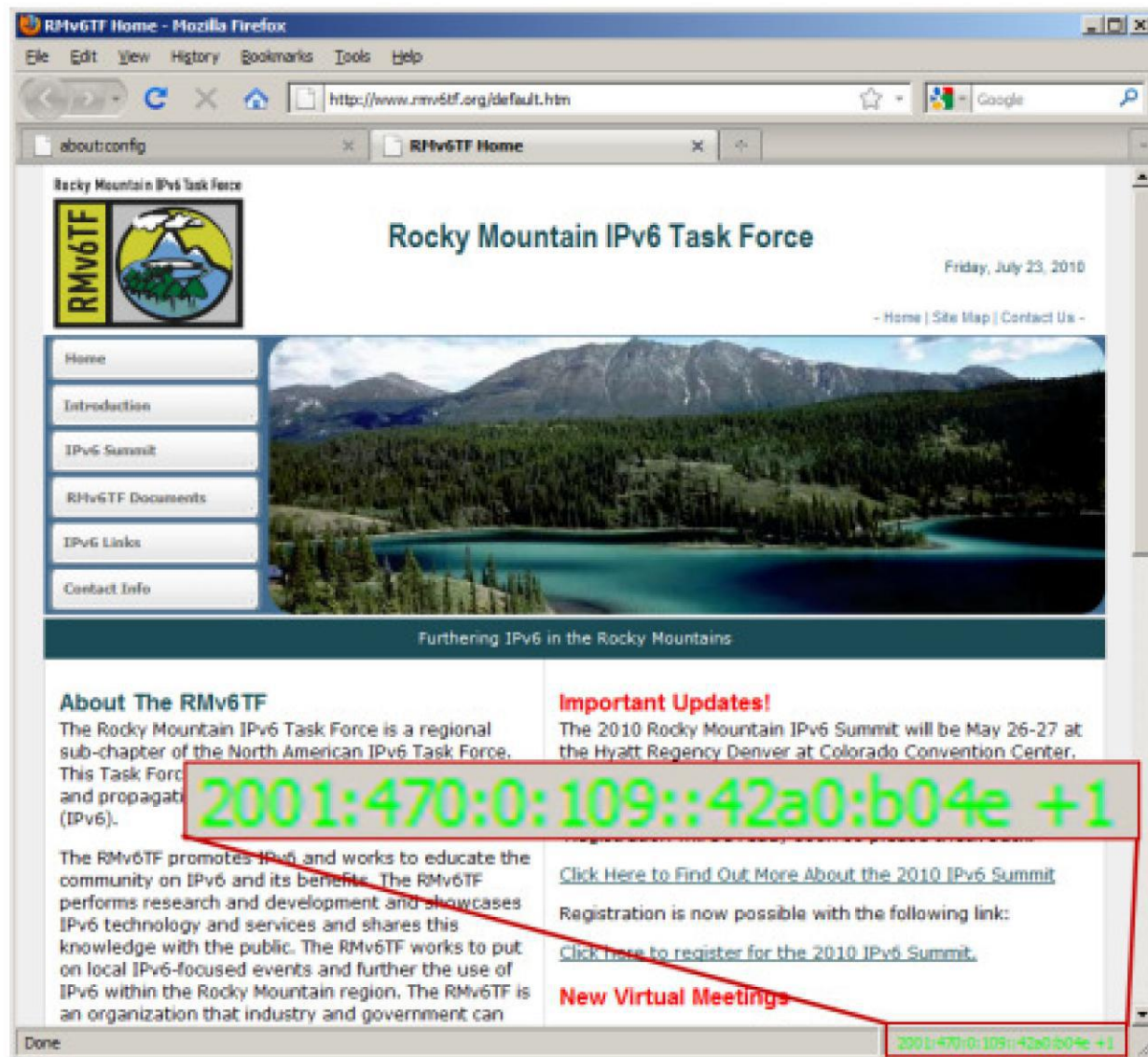
```
#conf t
track 150 ip sla 150
exit
ip sla 150
icmp-echo 2001:DB8:11::6 source-ip 2001:DB8:4444::4444
ip sla schedule 150 life forever start-time now
end
#show track 150
#show ip sla statistics
```



## WEB BROWSER IPV6 SUPPORT

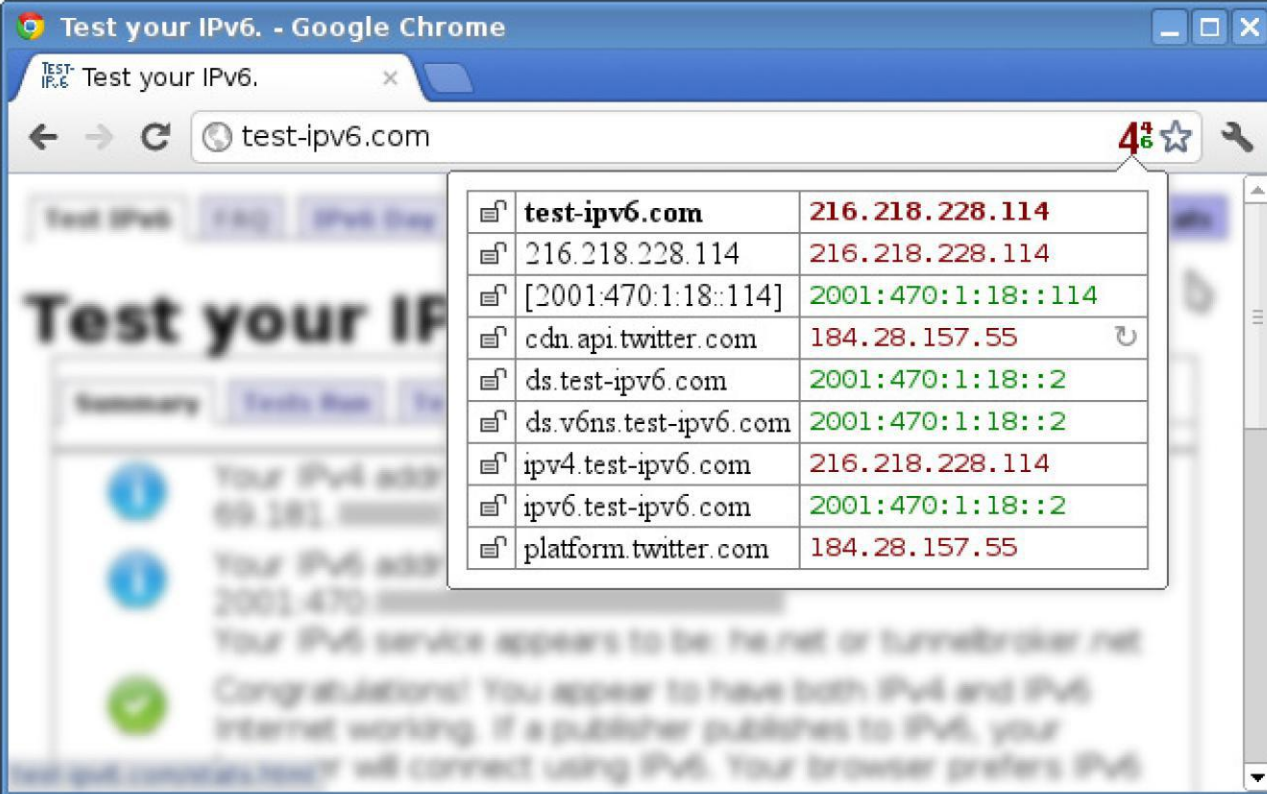
- Most web browsers now support IPv6
  - How to tell if your browser made a v4 or v6 connection?
  - [http://\[2001:DB8:1003::F\]:8080/index.html](http://[2001:DB8:1003::F]:8080/index.html)
  - ShowIP add-on for Firefox
  - Other plug-ins and add-ons are available for various browsers
- Otherwise you 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

# WEB BROWSER SUPPORT



# IPVFOO FOR GOOGLE CHROME

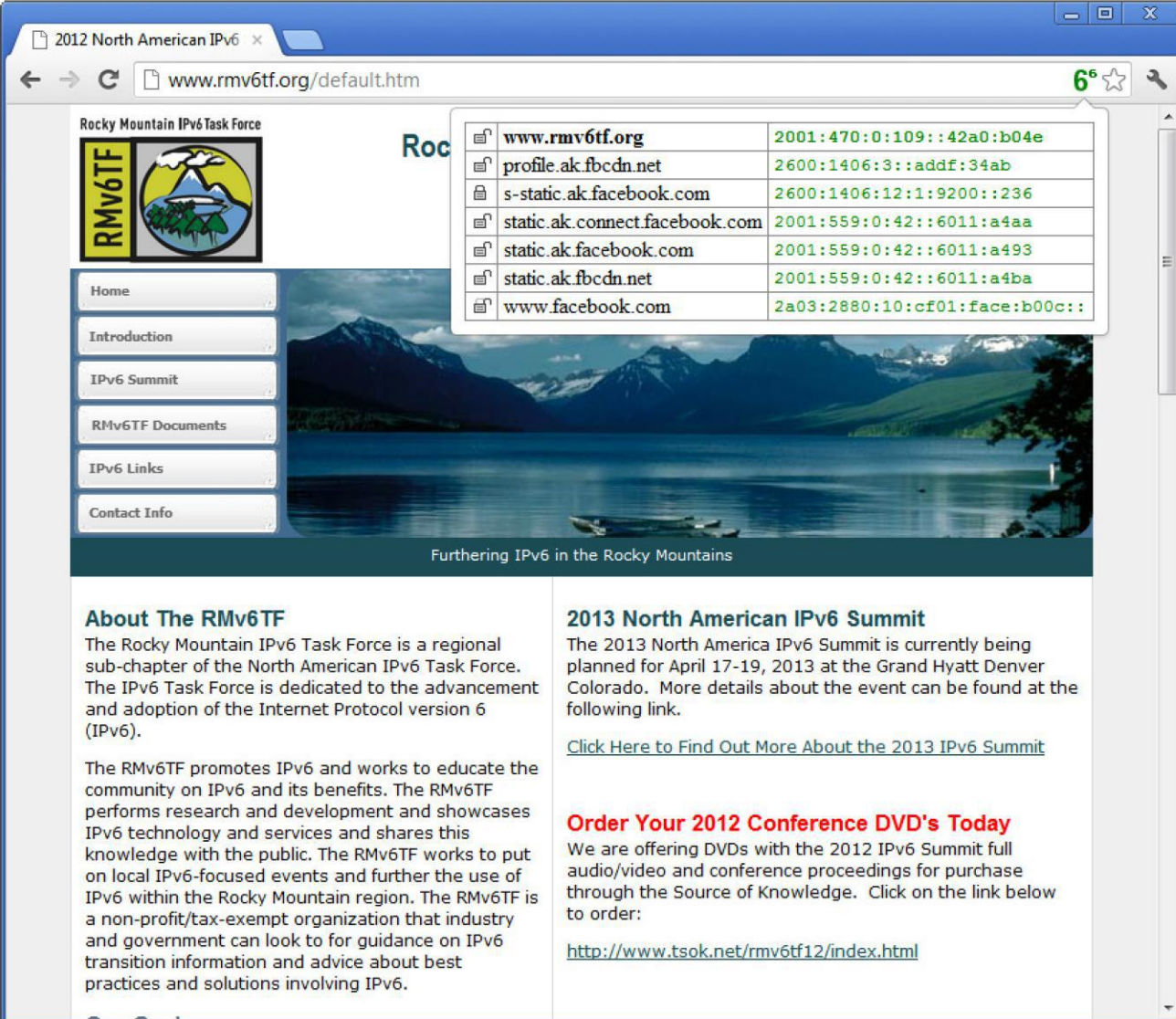
- Summarizes IPv4, IPv6, and HTTPS information for all connections made by the current webpage



The screenshot shows a Google Chrome browser window titled "Test your IPv6. - Google Chrome". The address bar shows "test-ipv6.com". The page content includes a "Test your IP" section with a "Summary" tab selected. A table is displayed, listing various connections and their corresponding IPv4 and IPv6 addresses. The table has three columns: a small icon, the domain name, and the IP address. The IP addresses are color-coded: red for IPv4 and green for IPv6.

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

# IPvFoo for Google Chrome



The screenshot shows a Google Chrome browser window with the address bar displaying `www.rmv6tf.org/default.htm`. The website is the Rocky Mountain IPv6 Task Force (RMv6TF) homepage, featuring a navigation menu on the left and a main content area with a mountain landscape image. An IPvFoo extension popup is open, showing a table of IPv6 addresses for various domains.

Domain	IPv6 Address
<code>www.rmv6tf.org</code>	<code>2001:470:0:109::42a0:b04e</code>
<code>profile.ak.fbcdn.net</code>	<code>2600:1406:3::addf:34ab</code>
<code>s-static.ak.facebook.com</code>	<code>2600:1406:12:1:9200::236</code>
<code>static.ak.connect.facebook.com</code>	<code>2001:559:0:42::6011:a4aa</code>
<code>static.ak.facebook.com</code>	<code>2001:559:0:42::6011:a493</code>
<code>static.ak.fbcdn.net</code>	<code>2001:559:0:42::6011:a4ba</code>
<code>www.facebook.com</code>	<code>2a03:2880:10:cf01:face:b00c::</code>

The website content includes sections for "About The RMv6TF", "2013 North American IPv6 Summit", and "Order Your 2012 Conference DVD's Today".

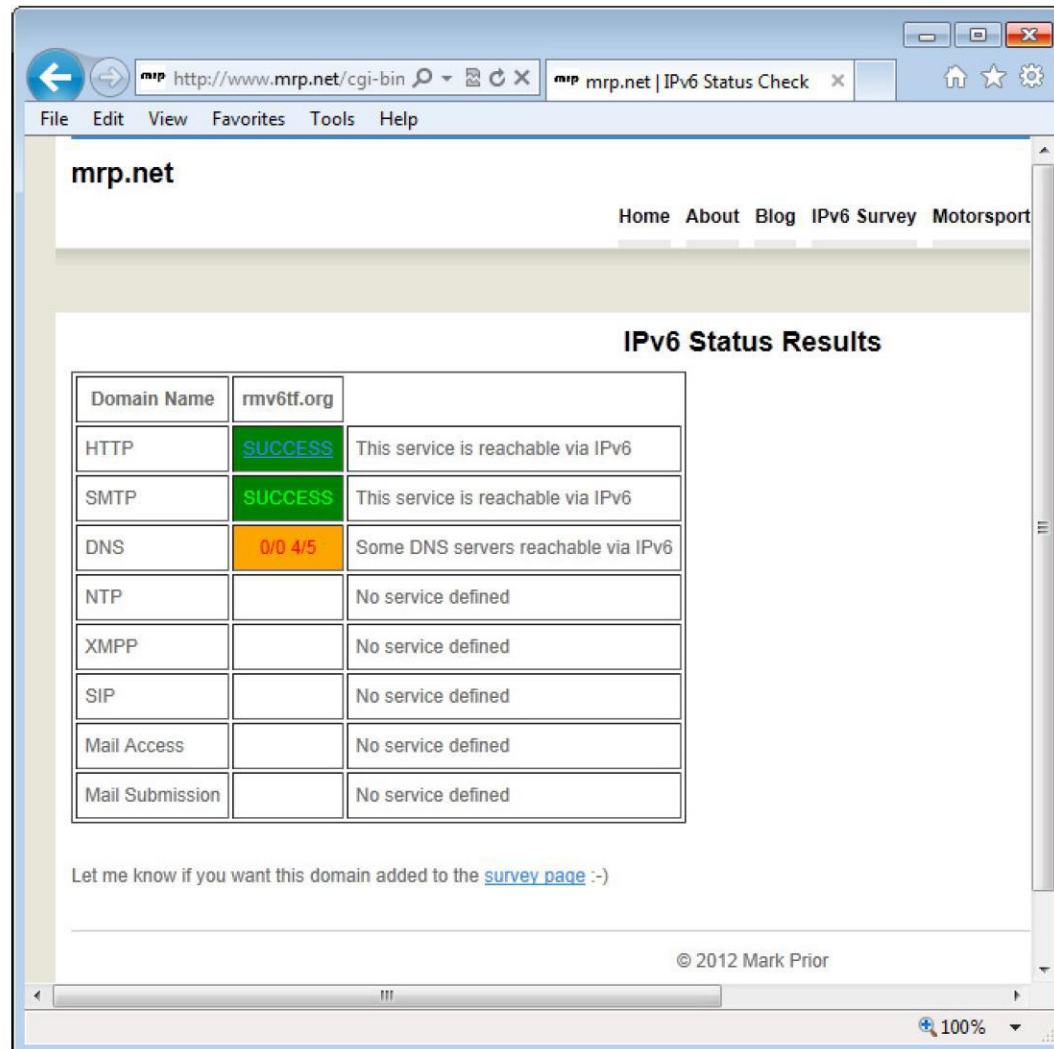
# WGET



- 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 is titled "IPv6 Status Results" and contains a table with the following data:

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

Below the table, there is a text input field and a link: "Let me know if you want this domain added to the [survey page](#) :-)". The footer of the page reads "© 2012 Mark Prior".

# TEST IPV6 FROM THE INTERNET

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



The screenshot shows the 'ipv6 test' website interface. The header has a navigation bar with links: connection test, speed test, ping test, website test (active), statistics, api, and forum. The main content area displays the results of an IPv6 validation for the website **www.rmv6tf.org**.

IPv6 validation for **www.rmv6tf.org**

Checking for <a href="#">AAAA</a> 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 :

☒ 

☐ 



☐ 

```
<!-- 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, there are links for 'Ads by Google', 'IPv6 Test', 'IPv4 and IPv6', 'IPv6', and 'IPv4 to IPv6'. The footer includes copyright information: 'Copyright © 2012 ipv6-test.com | [contact](#)' and 'IP geolocation API by [DB-IP.com](#)'. Social media sharing buttons for Facebook (Like 180), Google+ (+1 107), Twitter (Tweet 77), and YouTube (Share 98) are also present.

# 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

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: `2001:db8:22:0:851d: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

Kbits (avg)

Time (sec)

#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

Save Clear now ☐ Clear Output on each Iperf Run

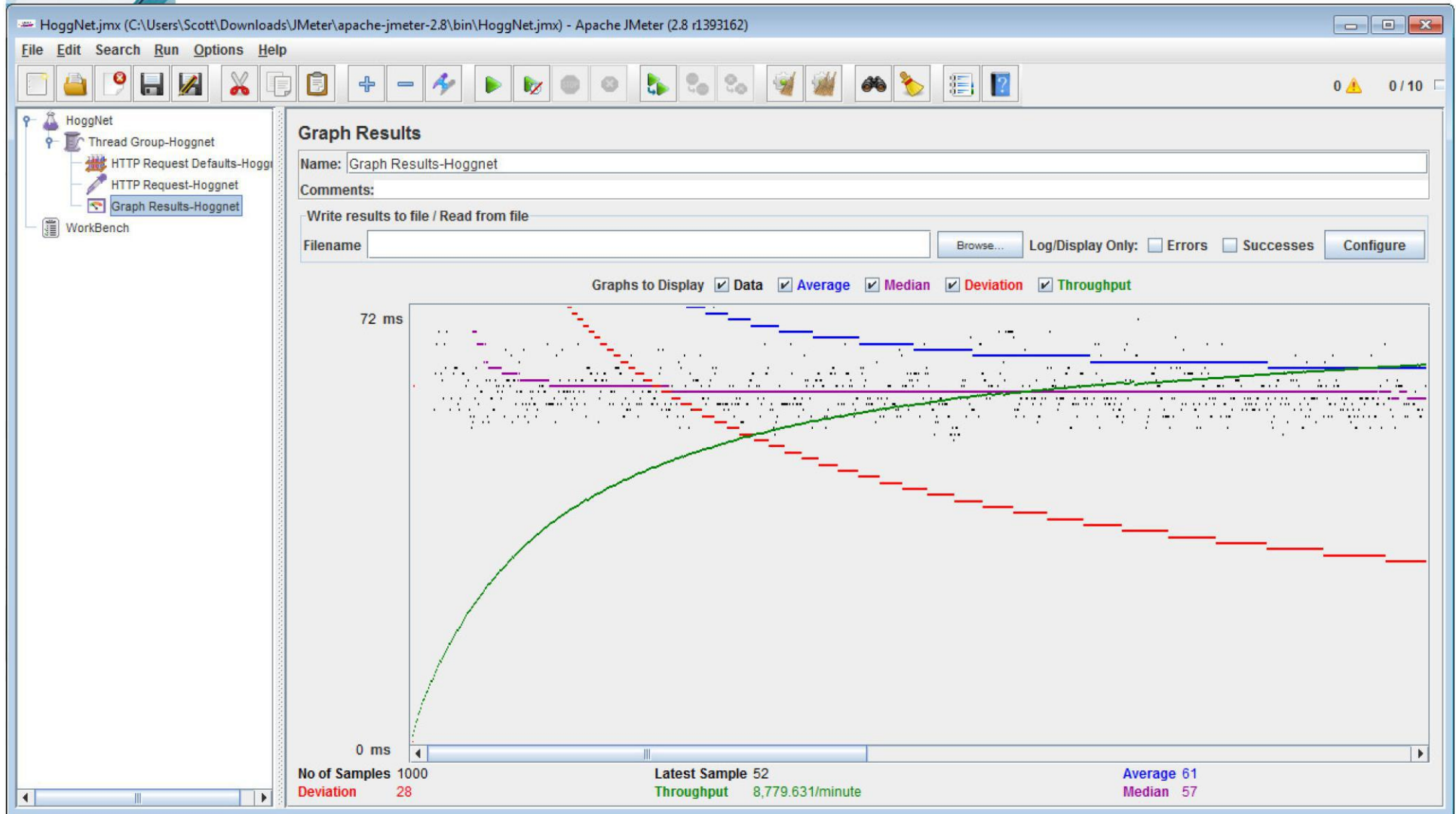


# APACHE JMeter



- 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.hoggnet.com](http://www.hoggnet.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



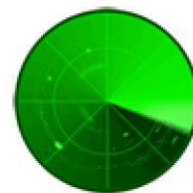
- <http://whatismyv6.com>, <http://ipv6.whatismyv6.com>, <http://whatismyipv6address.com>, <http://ip6.me> (for mobile devices)
- <http://whatsmyipv6.org>
- <http://www.myipv6address.com>
- <http://www.v6address.com> ([v4address.com](http://www.v4address.com))
- <http://ip6tools.com>, <http://www.my-ip6.com>
- <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

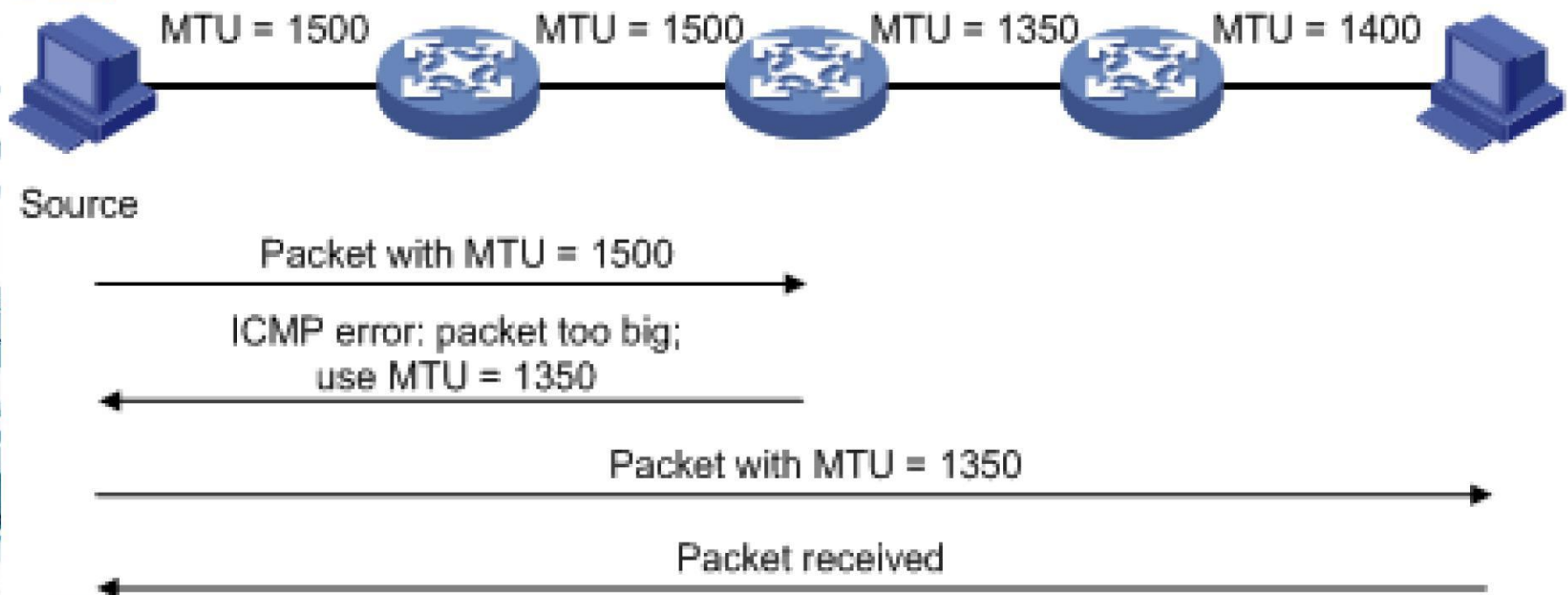


## IPv6 AND PMTUD (CONT.)

- 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 -l 1500 2001:DB8:DEAD:C0DE::1`
- `netsh int ipv6 show destinationcache`





## THE BOTTOM LINE

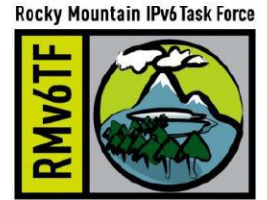
- ◆ *Use good methodology*
- ◆ *Document actions and results*
- ◆ *Leverage all tools to gather information*
- ◆ *Use protocol analyzer to help troubleshoot problems*
- ◆ *Understand protocols you are troubleshooting*



## BE AN IPV6 SUPER SLEUTH

- ♦ *Sherlock Holmes, Quincy, Colombo, Matlock, Angela Lansbury, Hercule Poirot, Miss Marple, Sam Spade*
- ♦ *Start at the scene of the crime*
- ♦ *Find evidence, pay attention to details*
- ♦ *Follow leads even if they're weak*
- ♦ *Dig deeper, use forensic techniques*
- ♦ *Never give up the IPv6 quest!*

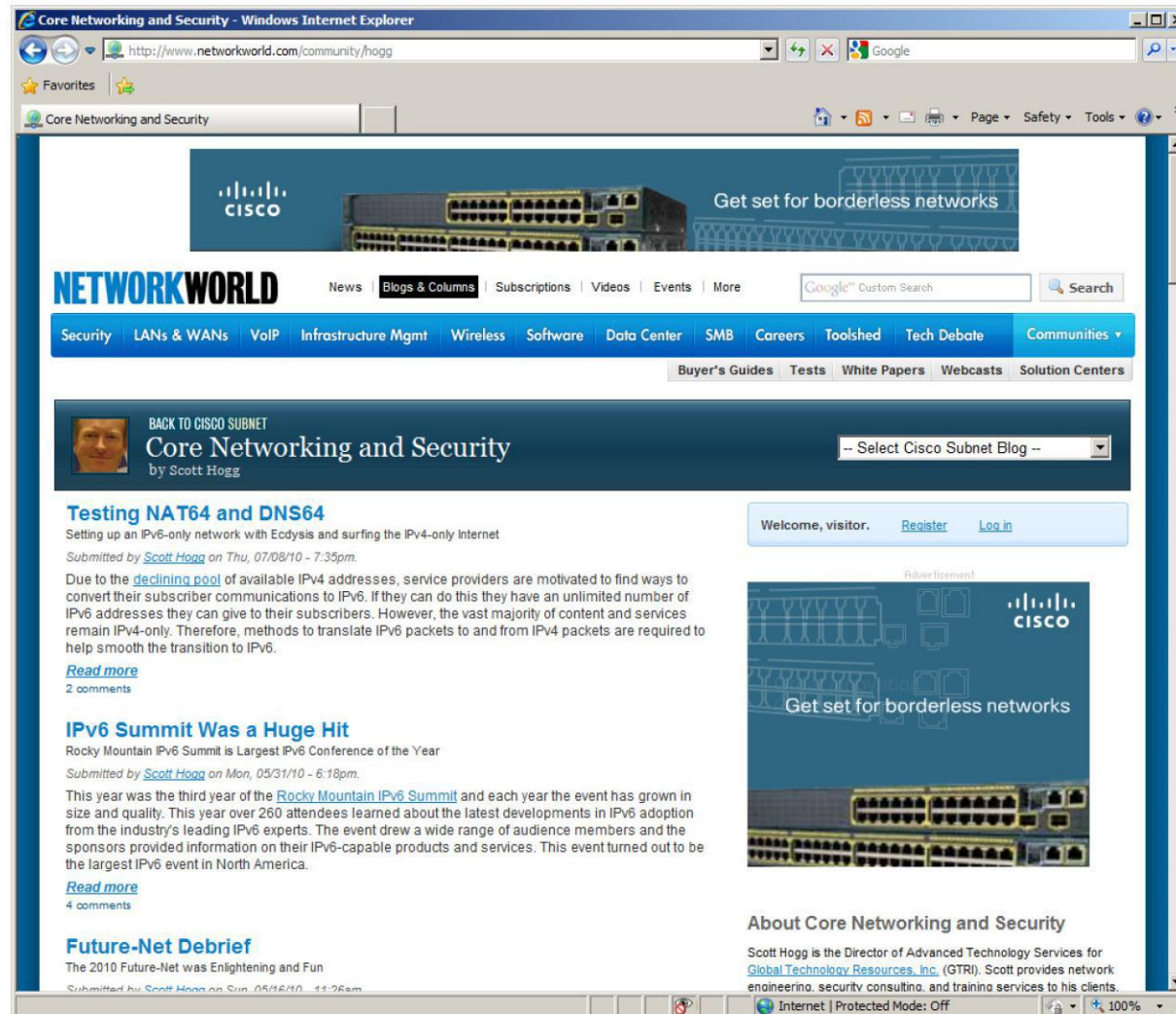
# ROCKY MOUNTAIN IPv6 TASK FORCE



- Regional “chapter” of North American IPv6 Task Force and, therefore, the IPv6 Forum
- Our Charter
  - Provide Education on IPv6 and its benefits
  - Promotion of IPv6 technology
  - Research and Development and showcase IPv6 technology and services
  - Put on local IPv6-focused events
  - Work to further the use of IPv6 with a regional focus
- 2013 North American IPv6 Summit
  - April 17-19, 2013 – Denver, Colorado
  - Download presentations from first 5 years of events
  - [www.RMv6TF.org](http://www.RMv6TF.org)

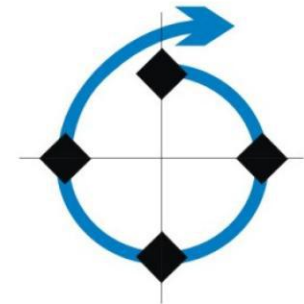
# NETWORKWORLD BLOG

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



# 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



# IPv6 SECURITY BOOK DRAWING

- Send an e-mail me to be entered into a drawing for one of three copies of “*IPv6 Security*”, by Scott Hogg and Eric Vyncke.

Send e-mail to:  
[shogg@gtri.com](mailto:shogg@gtri.com)

Drawing will take place on Monday  
1/28/13 at 5PM MDT

ISBN-10: 1-58705-594-5  
ISBN-13: 978-1-58705-594-2



# QUESTION AND ANSWER

**Q:**

**&**

**A:**

SHogg@GTRI.com  
Scott@HoggNet.com

Mobile:  - - -  P6/b(6)

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fedv6-deploy mailing list

fedv6-deploy@nist.gov

<https://email.nist.gov/mailman/listinfo/fedv6-deploy>