IPv6 Migration - Why do I care anyway?

WELCOME

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KeyOptions

MacSysAdmin 2012

A RECAP FROM LAST YEAR....

AUDIENCE PARTICIPATION TIME!!!

What was the 3rd bullet point in slide number 4?

THE STORY SO FAR.....

Let’s get on the same page

The End Is Nigh!!!

NO MORE ALLOCATION
OF IPv4 addresses!

IPv4 Addressing - 32 Bit

- IPv4 address: 192.168.1.10 IPv4 address:
- Four bytes
- 2^32 total addresses
- 2^32 total addresses - 4 billion
- Are you kidding?

IPv6 Addresses - 128 Bit

- IPv6 address
- 2001:05c0:1000:000b:0000:0000:0000:66fb
- Omitting unnecessary zeroes; - 2001:5c0:1000:b::66fb
- Eight fields, each 16 bits long 4 hexadecimal characters
- 2^128 total addresses

So What Is 2^{128} ?

340 undecillion, 282 decillion, 366 noncillion,

920 octillion, 938 septillion, 463 sexillion,

374 quintillion, 607 trillion, 431 billion,

768 million, 211 thousand, 456

And So What.....

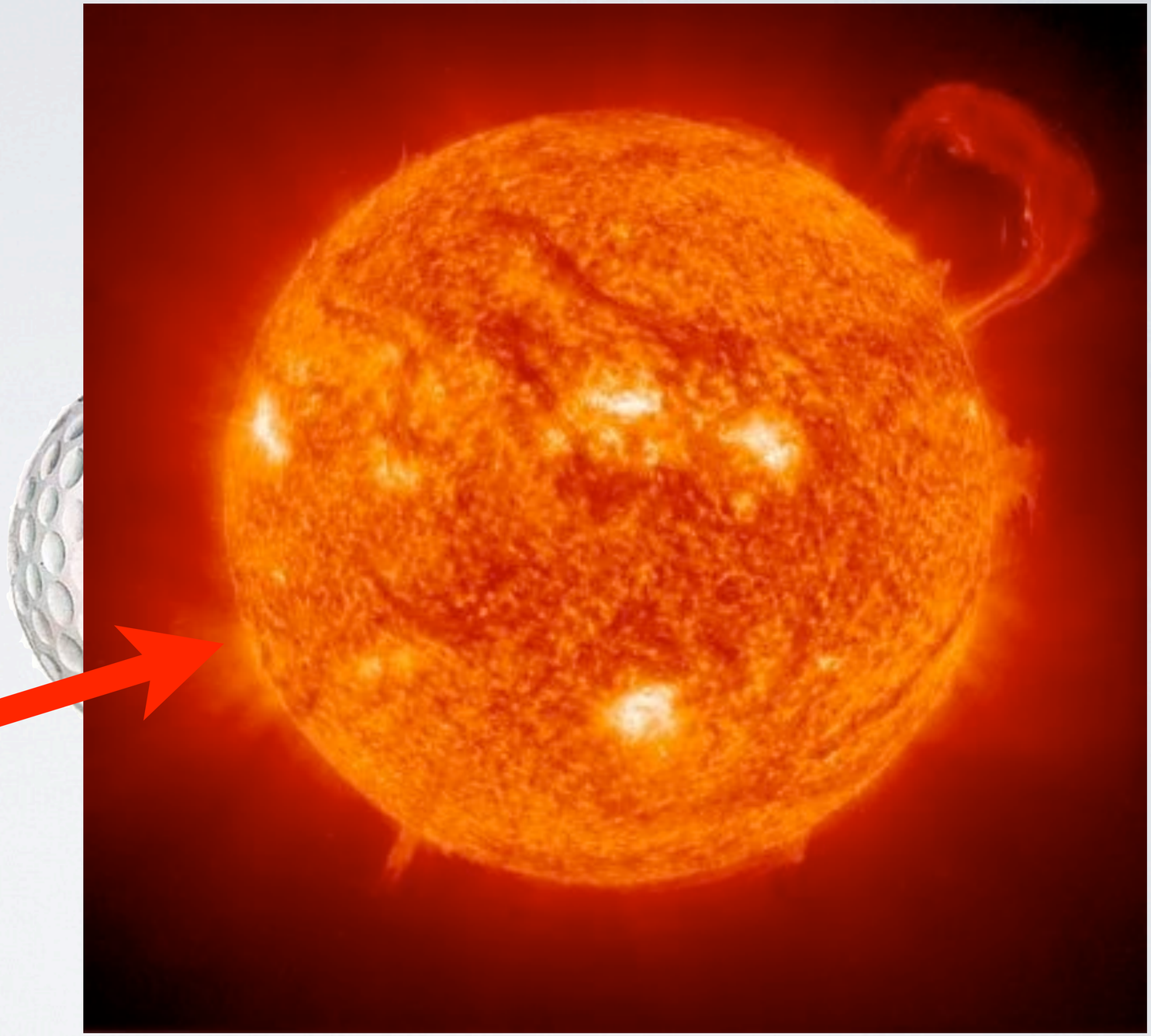
2^128/(2^33 x 2^64) - Assume remove the 64-bit address for the MAC address.

2,147,483,648 IPv6 addresses each!!

2 billion, 147 million, 483 thousand and 648

1.1.1.1 - 254.254.254.254

NOT TO SCALE



IPv4 & IPv6 - The Bottom Line

- We've run out of IPv4 address space
- IPv6 must be adopted for continued Internet growth
- IPv6 is not backwards compatible with IPv4
- We must maintain IPv4 and IPv6 simultaneously for many years
- IPv6 deployment has begun

So What Does It REALLY Give Us?

- Larger address space for global reachability and scalability
- Simplified header for routing efficiency and performance
- Deeper hierarchy and policies for network architecture flexibility
- Efficient support for routing and route aggregation

So What Does It REALLY Give Us?

- Serverless autoconfiguration, easier renumbering, multihoming, and improved plug and play support
- Security with mandatory IP Security (IPSec) support for all IPv6 devices
- Improved support for Mobile IP and mobile computing devices (direct-path)
- Enhanced multicast support with increased addresses and efficient mechanisms

IPv6 is the ONLY future technology that will allow for the growth and deployment of mobile devices and Consumer VoIP

ADDRESSING

Address Notation - Pure IPv6

An IPv6 address has 128 bits, or 16 bytes:

2001:DB8:0000:0000:0202:B3FF:FE1E:8329

This can be abbreviated to:

2001:DB8:0:0:202:B3FF:FE1E:8329

or this:

2001:DB8::202:B3FF:FE1E:8329

Prefix Notation

- Prefix notation in the form
  - **IPv6 address / Prefix Length**

Start with this: 2001:DB8:0000:0056:0000:ABCD:EF12:1234/64

Short Version: 2001:DB8::56/64

Uncompress: 2001:DB8:0000:0000:0000:0000:0000:0056

What it should be: 2001:DB8:0:56::/64

Address Notation - Mixed

In networks where there is both IPv4 and IPv6, the address notation can be set as follows:

IPv4 address of 192.168.0.2

Can be represented as

0:0:0:0:0:0:192.168.0.2 or ::192.168.0.2

or more correctly

::C0AB:2

IPV6 And DNS

Your IPv4 DNS is

```
demo.com.   IN MX 10    Sydney.demo.com.
demo.com.  IN   MX   10  Melbourne.demo.com.
Sydney.demo.com.  IN A 4.2.2.1
Melbourne.demo.com.    IN A 8.8.8.8
```

IPv6 DNS Becomes

```
demo.com.   IN MX 10    Sydney.demo.com.
demo.com.  IN   MX   10  Melbourne.demo.com.
Sydney.demo.com.  IN A 4.2.2.1
Sydney.demo.com.  IN AAAA  2001:db8:10:133::1
Melbourne.demo.com.    IN A 8.8.8.8
Melbourne.demo.com.    IN AAAA  2001:db8:10:133::2
```

TRANSITION MECHANISMS

	Key user / Primary use	Benefits	Limitations	Requirements
IPv6 over IPv4 Tunnels	Service provider wanting to offer initial IPv6 service. Enterprise wanting to interconnect IPv6 domains or link to remote IPv6 networks.	Can demonstrate demand for IPv6 for minimal investment. Easy to implement over existing IPv4 infrastructures. Low cost, low risk.	Complex management and diagnostics due to the independence of the tunnel and link topologies.	Access to IPv4 through dual-stack router with IPv4 and IPv6 addresses. Access to IPv6 DNS.
IPv6 over Dedicated Data Links	Service provider WANs or metropolitan area networks (MANs) deploying ATM, Frame Relay, or dWDM.	Can provide end-to-end IPv6 with no impact on the IPv4 traffic and revenue.	Lack of IPv6-specific hardware acceleration and support for IPv6 network management in currently deployed hardware.	Access to the WAN through dual-stack router with IPv4 and IPv6 addresses. Access to IPv6 DNS.
IPv6 over MPLS Backbones	Mobile or greenfield service providers, or current regional service providers deploying MPLS.	Integrates IPv6 over MPLS, thus no hardware or software upgrades required to the core.	Implementation required to run MPLS. High management overhead.	Minimum changes to the customer edge (CE) or provider edge (PE) routers, depending on the technique.
IPv6 Using Dual-Stack Backbones	Small enterprise networks.	Easy to implement for small campus networks with a mixture of IPv4 and IPv6 applications.	Complex dual management of routing protocols. Major upgrade for large networks.	All routers are dual-stack with IPv4 and IPv6 addresses. Access to IPv6 DNS. Enough memory for both IPv4 and IPv6 routing tables.

Deployment Issues

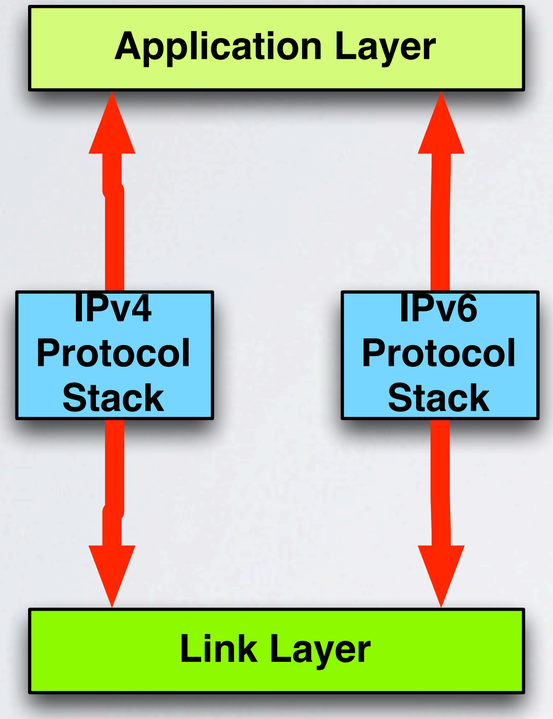
- Uncertain risk to network operators
- Unclear benefits of IPv6 to network operators
- Lack of IPv6 or no “killer apps”
- Lack of technical knowledge
- Lack of public awareness

So What Are Your Choices?

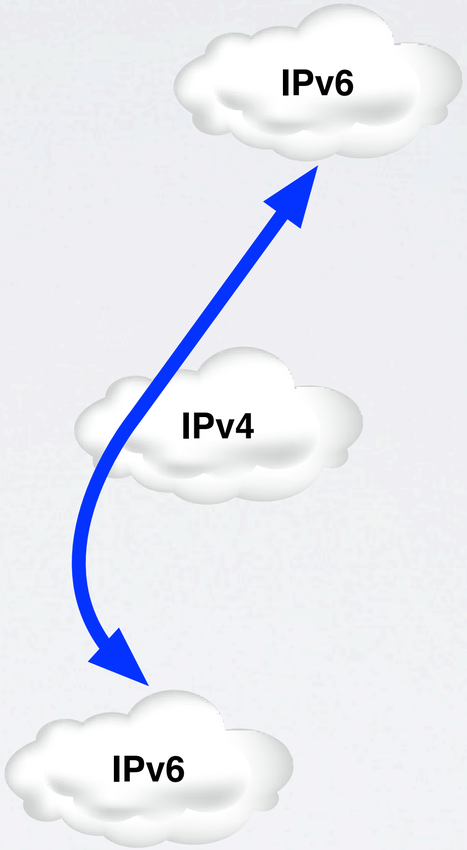
- Ignore IPv6: Stay on IPv4-only
- Gateways: Devices that convert IPv6 to IPv4
- Tunnel IPv6 over IPv4
- Dual-Stack: IPv4 and IPv6 together
- Nirvana: IPv6-only

THE 3 BASIC STRATEGIES

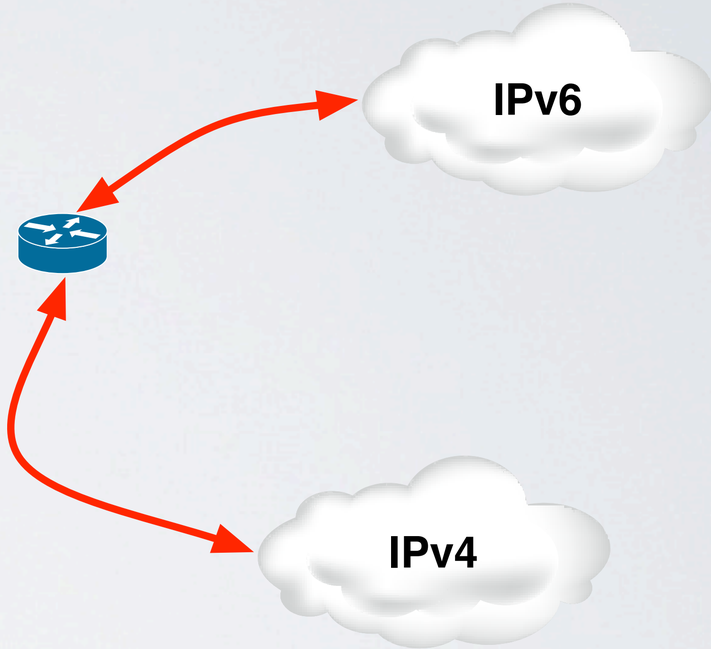
3 Basic Strategies



Dual Stack

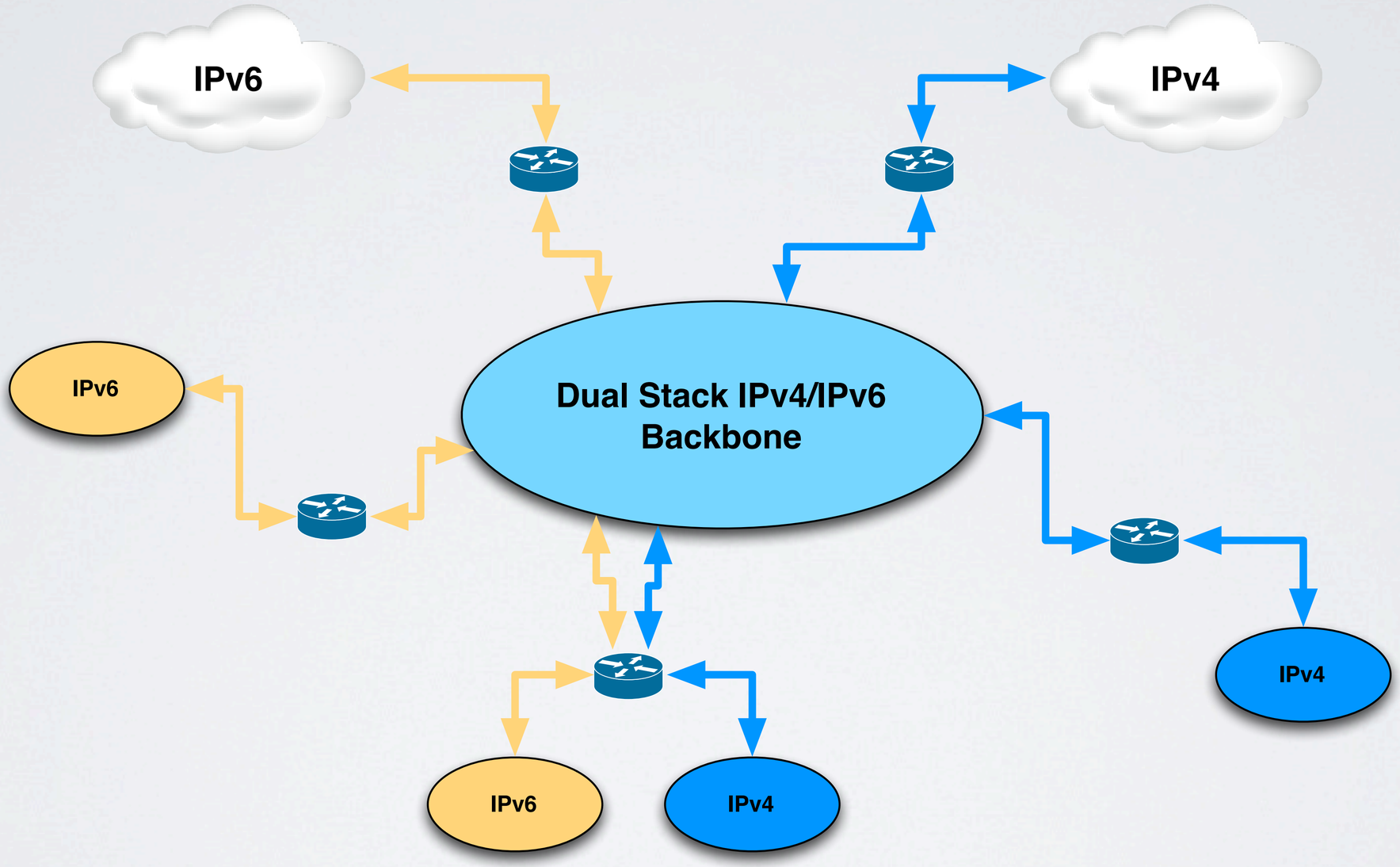


Tunnelling



Translation

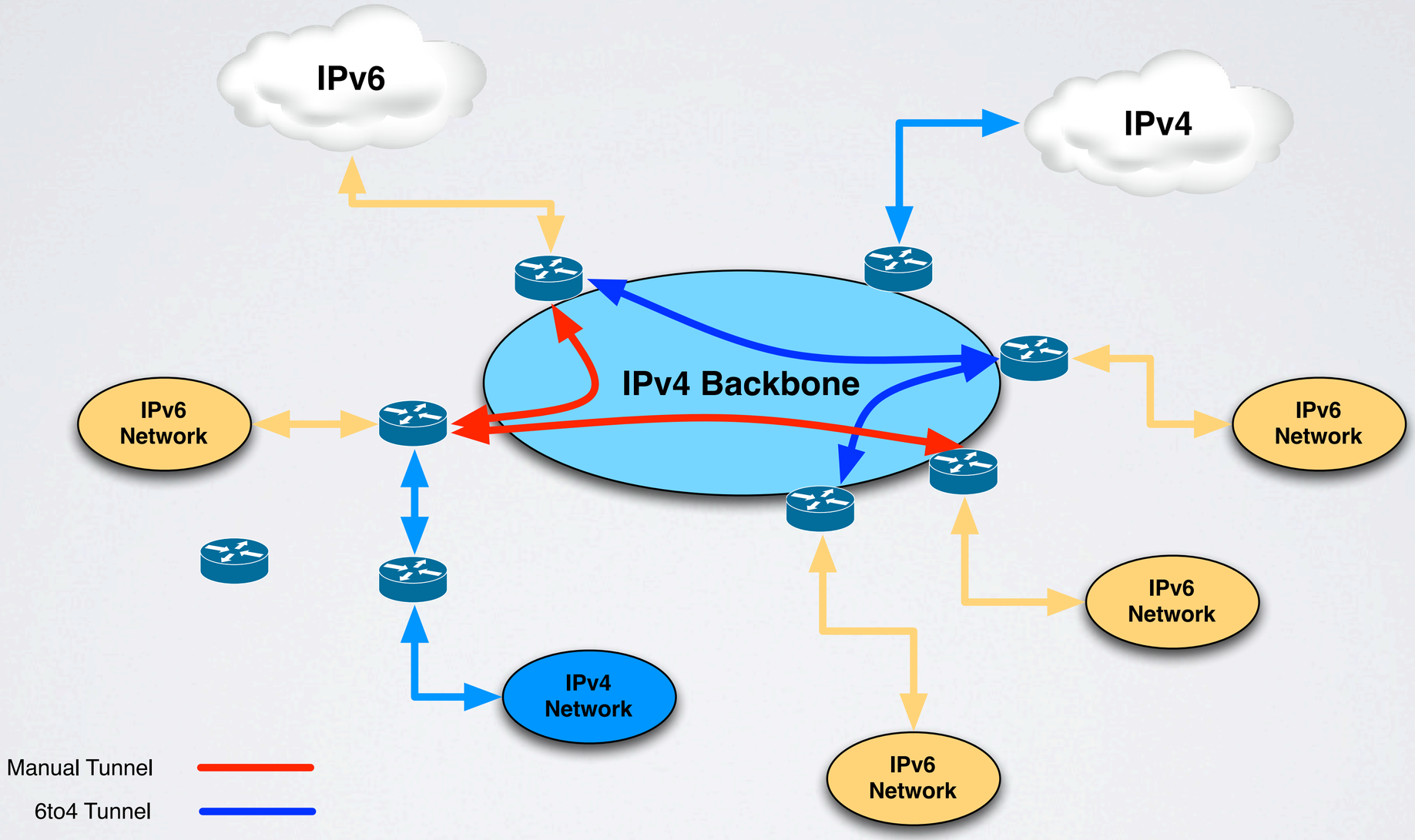
Dual Stack



Dual Stack

Pros	Cons
• Same topology as an IPv4 Network • Easy deployment	• Requires IPv6 capabilities that match the IPv4 capabilities • Older routers may have limited IPv6 features • Older routers may foward IPv6 in software

IPv6 Tunnels



IPv6 Tunnelling

Pros	Cons
• No changes needed to the core network • IPv6 is only enabled on the routers as needed to deliver services.	• Different topology as the IPv4 network • Management complexity • Scalability limits with large number of tunnels • Limited end-to-end IPv6 support

IPv6 Tunnels

- Fast and easy to set up
- Not the best for security or performance
- Free IPv4-to-IPv6 Tunnels
  - Gogo6.com
  - Sixxs.net
  - Tunnelbroker.com

Teredo / Miredo

- Provides IPv6 connectivity behind NATs
- Done by tunnelling IPv6 within UDP
- Teredo (Miredo) is specified in RFC 4380
- Teredo IPv6 service Prefix : 2001:0000: / 32

DEMO

IPV4 TO IPV6 MIGRATION

What Drives Migration?

- IPv4 address depletion
- Lack of IPv4's scalability
- Mobile IPv6 - End-to-end network model
- Applications such as VoIP and video that require good end-to-end networks
- IPv6 capabilities are present on most networks
- New protocols ease network administration

THE MOBILE TGV IS HERE!!

So What??

Without IPv6 Mobility of the future is simply not going to work.

NAT is not the Answer

IPv6 Success Example

- Beijing Olympics
- Every device ran on IPv6
  - Cameras, sensors, in taxis to ease congestion
- Everything could talk to Everything!!!!

SUCCESSFUL STRATEGIES

Successful Strategies

- Upgrade EVERYTHING!!! - The Shotgun approach!
- Work from the outside in
- Concentrate on one thing

Upgrade EVERYTHING!!

Doomed to Fail!!!

Work From The Outside In.

- Start at the edge of your network - Get that right
- Nearly all modern operating systems support IPV6

Concentrate On One Thing

- One successful small things is much is much better for management
- Get quick wins to gain confidence.

MAKE A PLAN!!!!!!

5W's

Who - is it for
What - is it for
Why - are you doing it
When - will it be done by
Where - will it be done
How - will it be achieved

6P's

Prior
Preparation
Planning
Prevents
Poor
Performance

SO WHAT STRATEGIES CAN WE USE?

A Strategy

- Define a methodology
- Develop MileStones
- Develop a test methodology
- Training
- Cost and Risk Analysis
- Back-out plan

Components Of An IPv6 Transition

- Identify the strategic business objectives
- Identify transition priorities
- Identify the transition activities
- Work out some transition milestones
- What is the transition criteria for legacy, upgraded, and new capabilities

Components Of An IPv6 Transition

- Define technical strategy and selection of transition mechanisms to support IPv4/IPv6 interoperability
- Define management and assignment of resources for transition
- What is the maintenance of interoperability and security during transition
- Determine the use of IPv6 standards and products
- What will be the continued support for IPv4 infrastructure during and after IPv6 network deployment

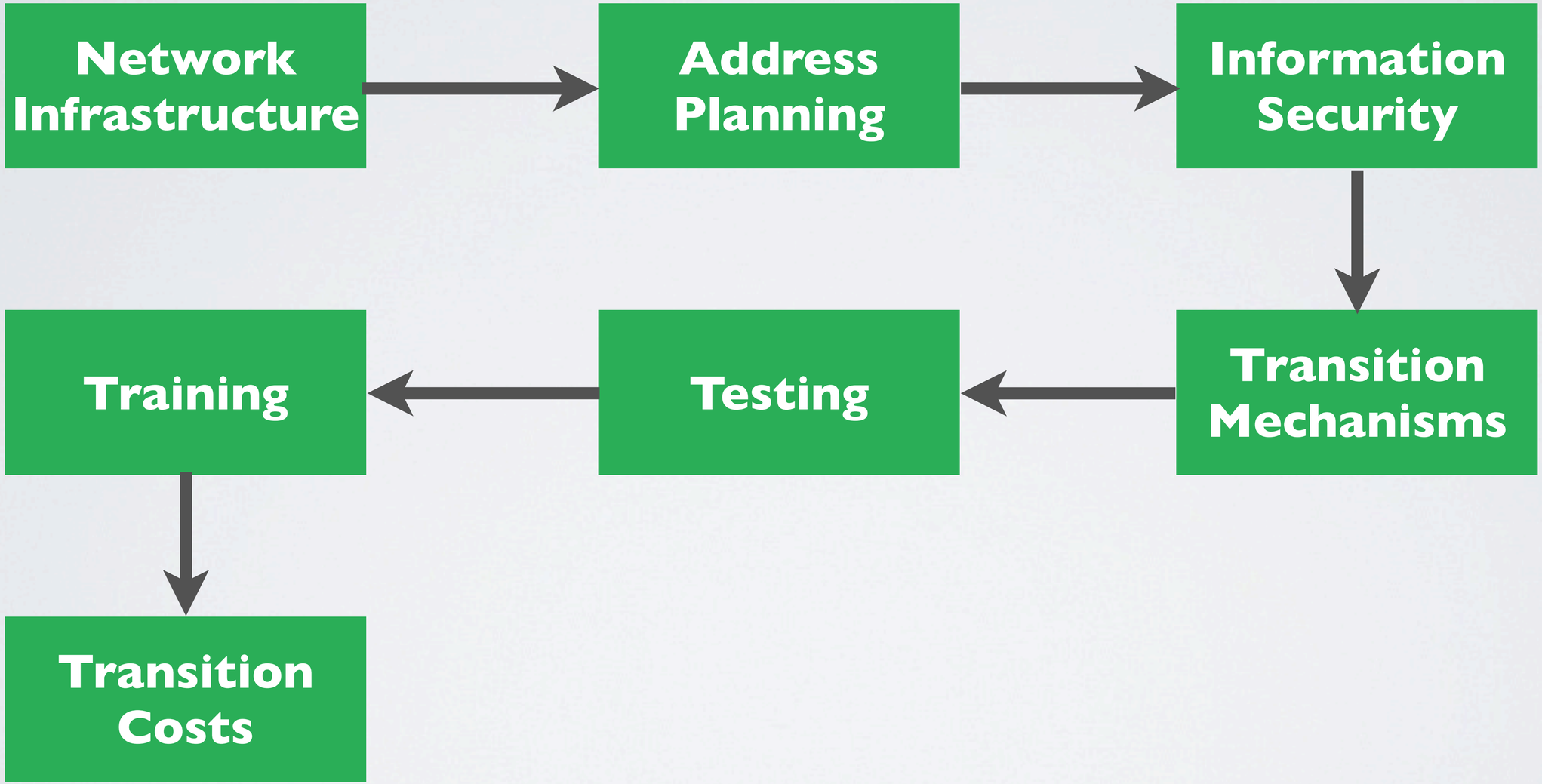
Components Of An IPv6 Transition

- Application migration
- What are the costs not covered by technology refresh
- What are the acquisition and procurement issues
- Determine training needs
- What is the testing plan

Components Of An IPv6 Transition

- Transition governance
  - Policy
  - Roles and responsibilities
  - Management structure
  - Performance measurement
  - Reporting

Best Practice For A Transition Plan



SO WHAT IS THE REAL STATUS OF IPV6 AROUND THE GLOBE?

RESOURCES

RFC's

Mobile IPv6 RFC 3775
RFC 2117 (documents router alert option)
RFC 2676 (documents QoS routing mechanisms)
RFC 2460 - Internet Protocol, Version 6 (IPv6) Specification

Cool Sites

http://www.subnetonline.com/pages/subnet-calculators/ipv4-to-ipv6-converter.php

http://www.potaroo.net/

http://www.mrp.net/IPv6_Survey.html

http://ipv6.he.net

http://www.sixxs.net

http://bgp.he.net/

IPv6 Resources

Pv6 Intelligence
http://ipv6int.net/systems/mac_os_x-ipv6.html

Derek Morr's *Living with IPv6* blog
http://www.personal.psu.edu/dvm105/blogs/ipv6/

SIXXS
http://www.sixxs.net/wiki/SixXS_Wiki

ARIN IPv6 Wiki
http://whois.arin.net/index.php/Main_Page

IPv4/IPv6: The Bottom Line
http:// arin.net/knowledge/v4-v6.html
http://www.teamarin.net

http://www.kame.net

Theres is no Plan B: Why the IPv4-to-IPv6 transition will be ugly:
http://arstechnica.com/business/news/2010/09/there-is-no-plan-b-why-the-ipv4-to-ipv6-transition-will-be-ugly.ars

Hurricance Electric:
http://ipv6.he.net

Teredo Overview
http://technet.microsoft.com/en-us/library/bb457011.aspx

Miredo:
http://www.remlab.net/miredo/

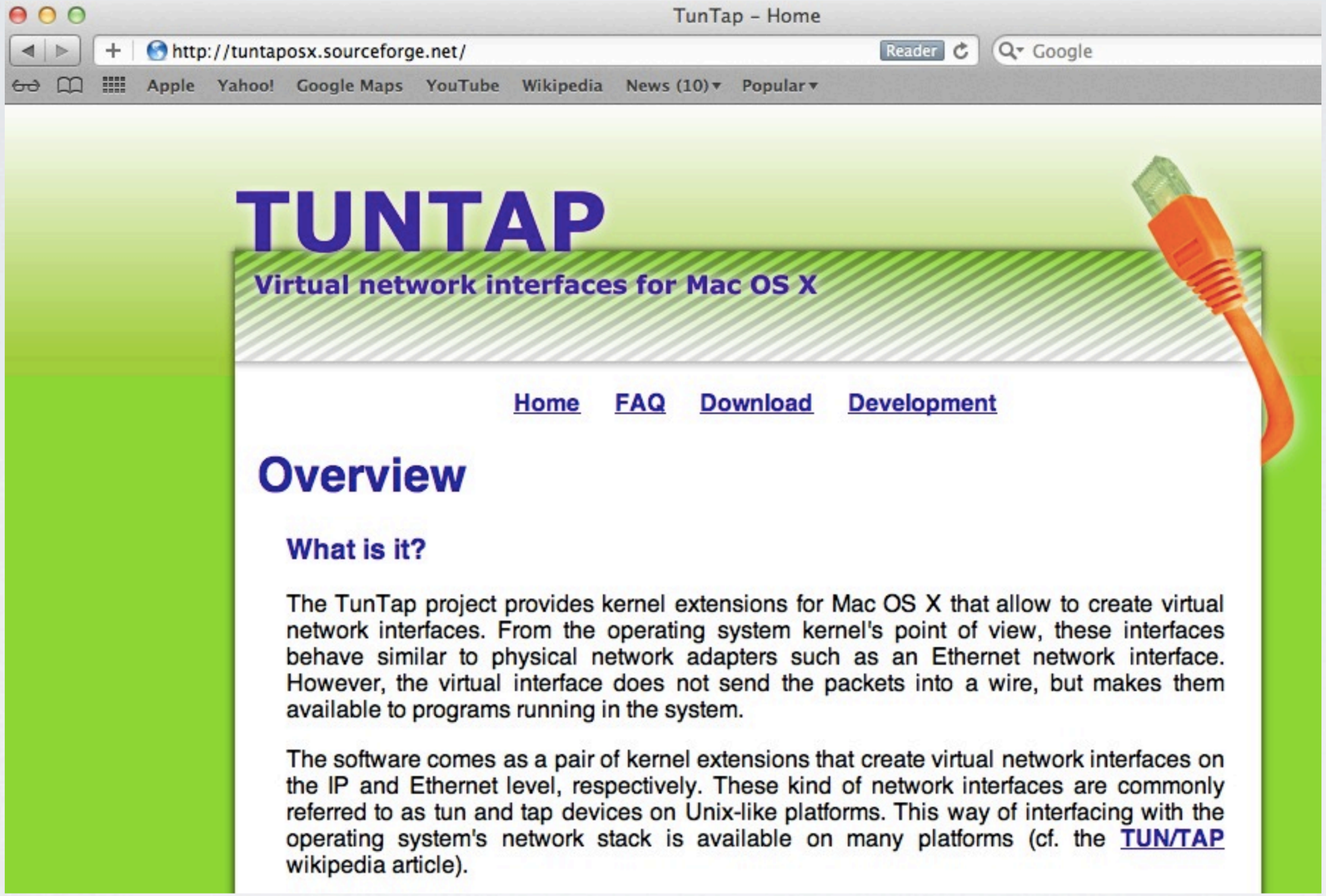
THANK YOU

SLIDES NOT USED

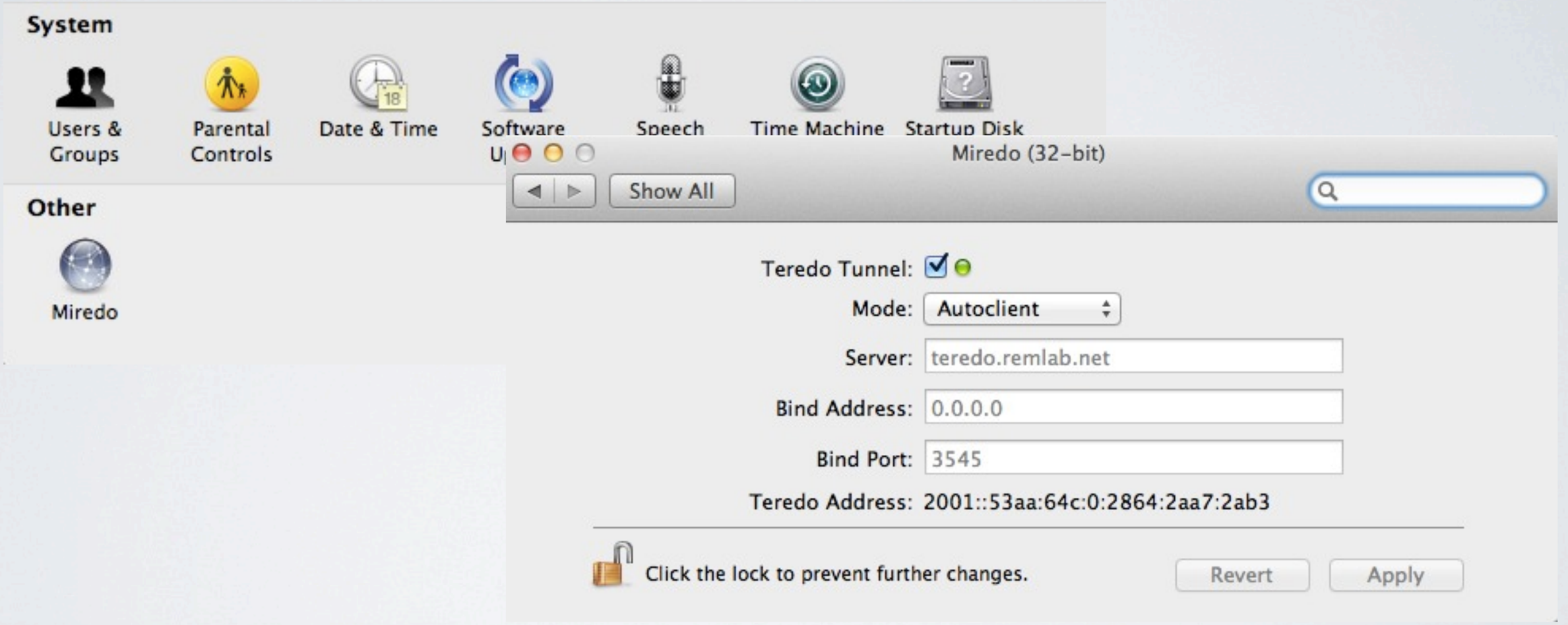
HERE’S SOMETHING I PREPARED EARLIER....

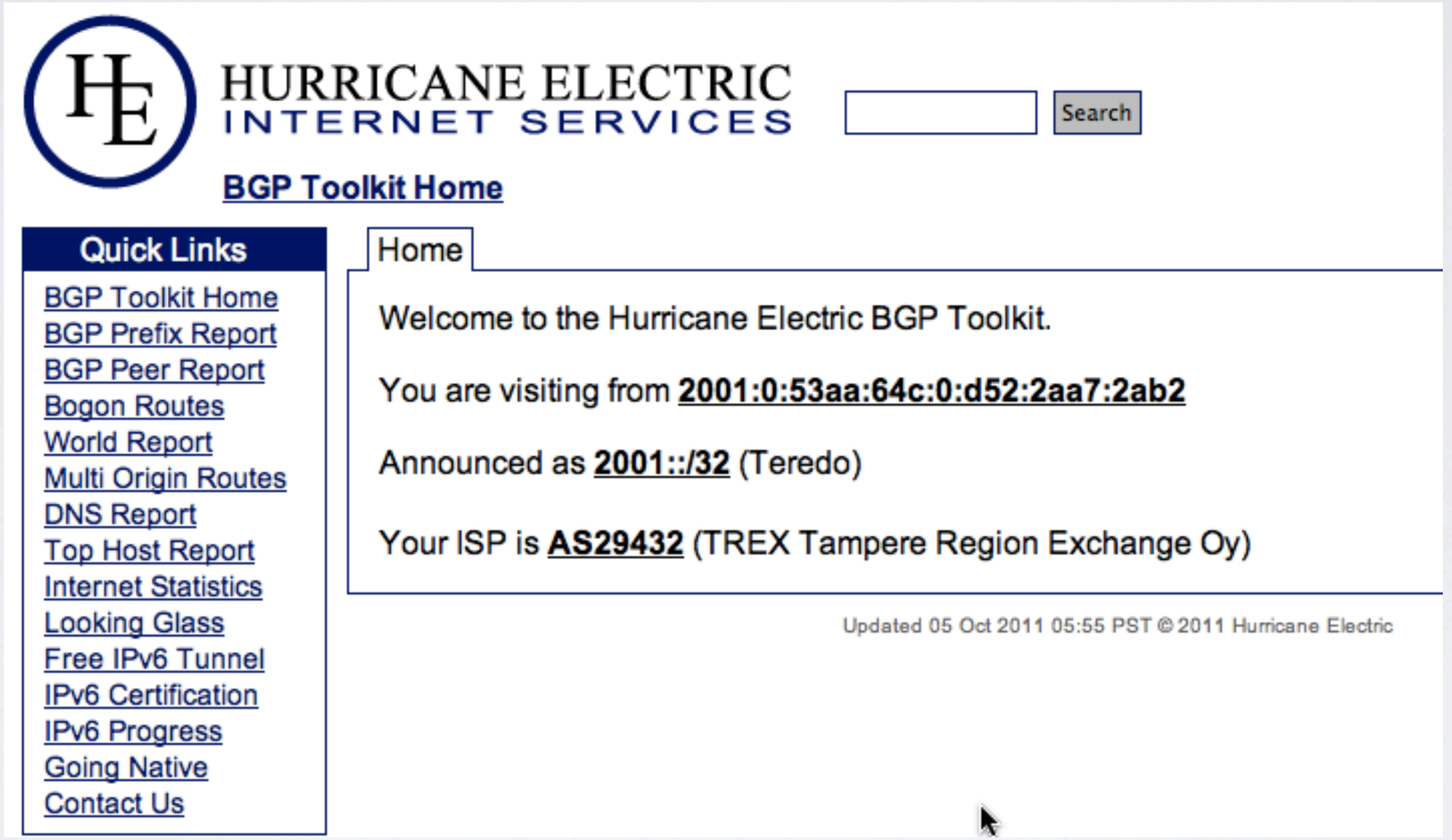
Deepdarc - Teredo For OSX

TUNTAP - Fixes 32-bit Problem

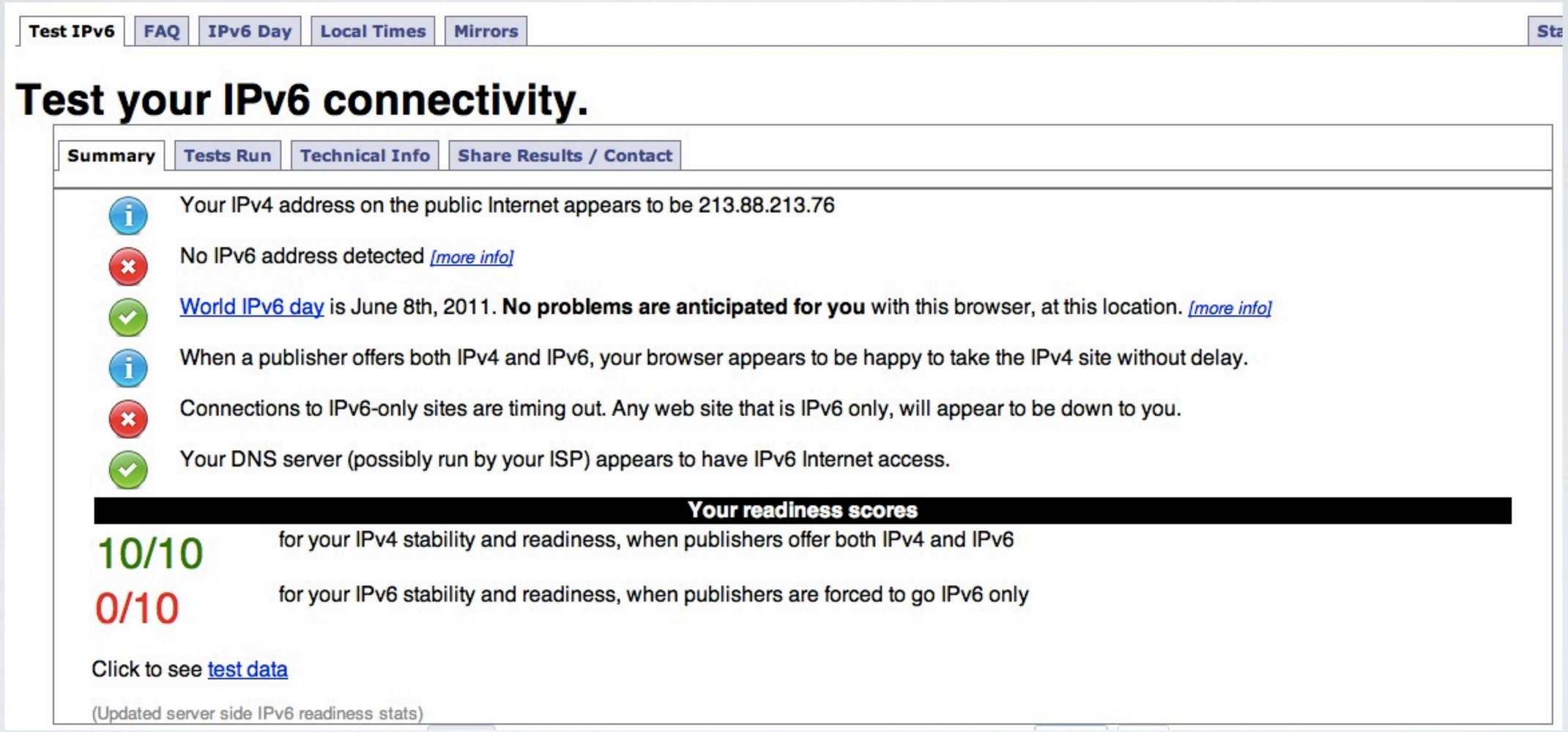


Miredo For OSX

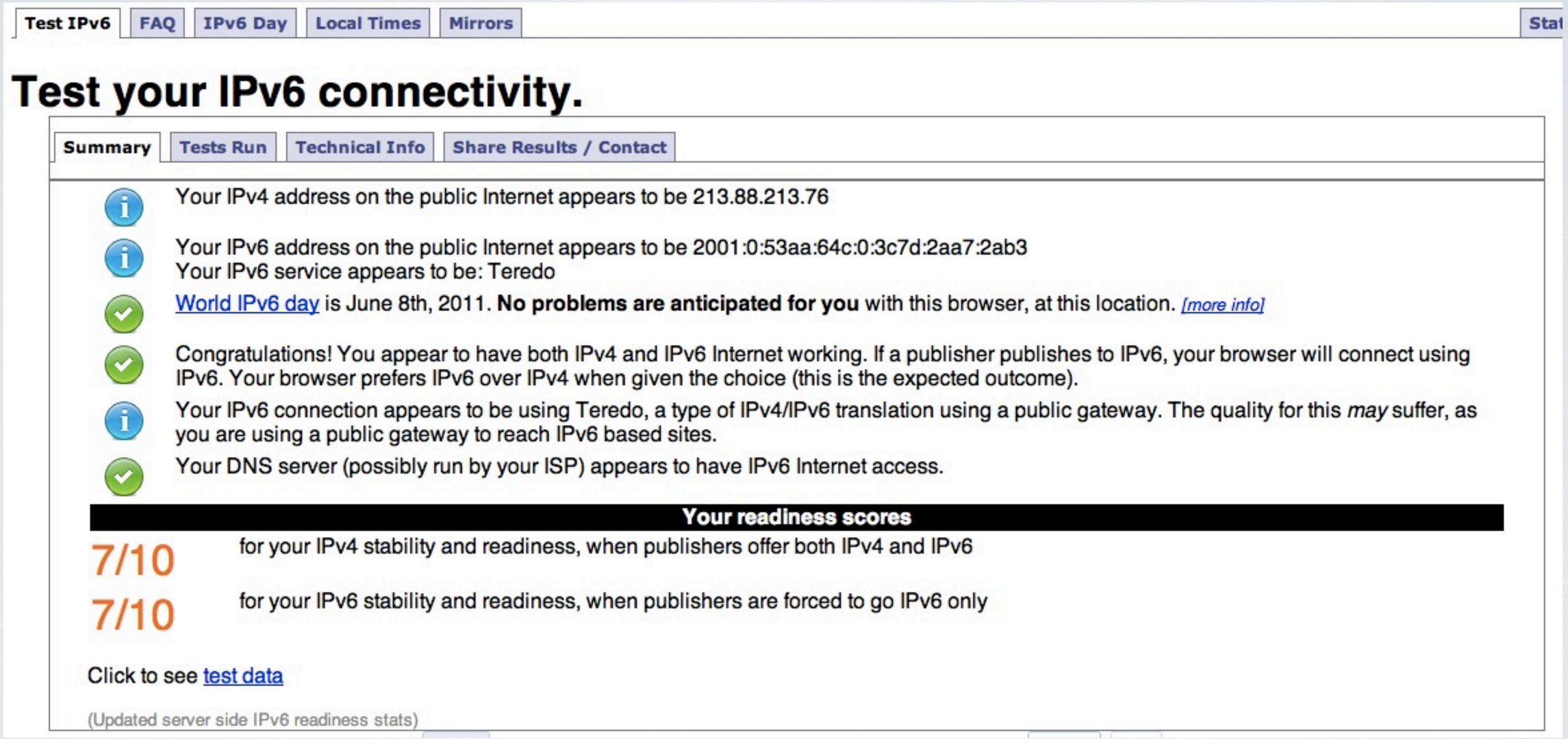



HURRICANE ELECTRIC
INTERNET SERVICES
Search
BGP Toolkit Home
Quick Links
BGP Toolkit Home
BGP Prefix Report
BGP Peer Report
Bogon Routes
World Report
Multi Origin Routes
DNS Report
Top Host Report
Internet Statistics
Looking Glass
Free IPv6 Tunnel
IPv6 Certification
IPv6 Progress
Going Native
Contact Us
Home
Welcome to the Hurricane Electric BGP Toolkit.
You are visiting from 2001:0:53aa:64c:0:d52:2aa7:2ab2
Announced as 2001::/32 (Teredo)
Your ISP is AS29432 (TREX Tampere Region Exchange Oy)
Updated 05 Oct 2011 05:55 PST © 2011 Hurricane Electric

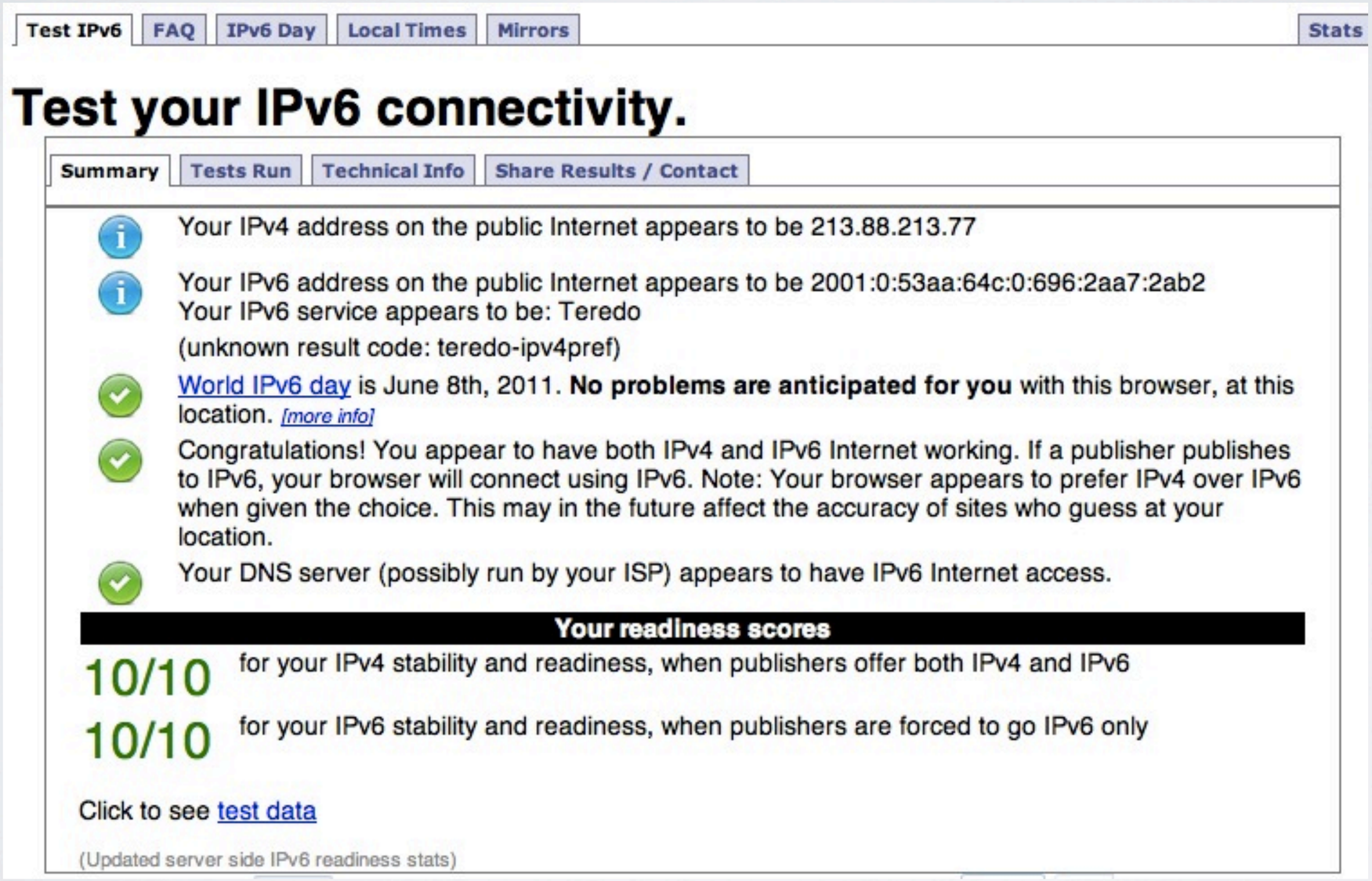
IPV4 Test 10.6.8

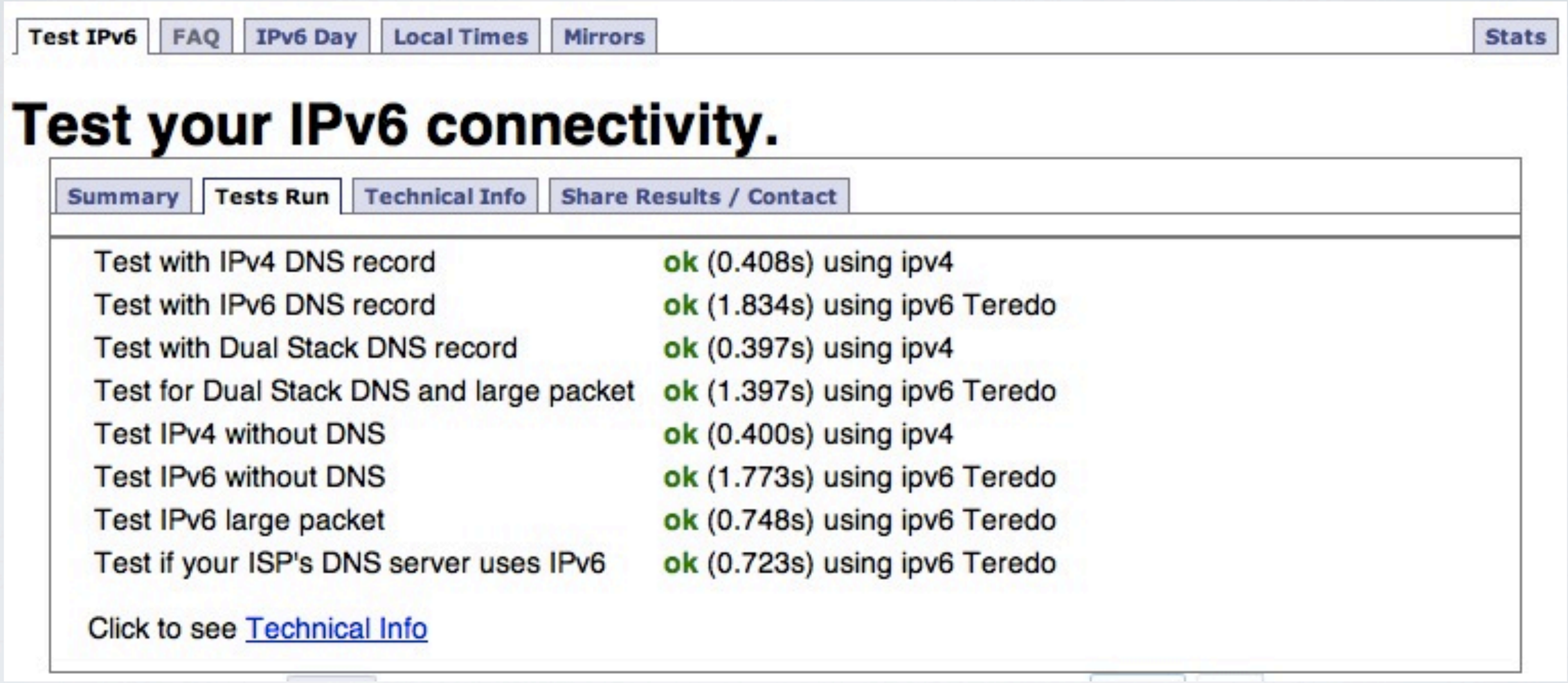


IPv6 Test 10.6.8



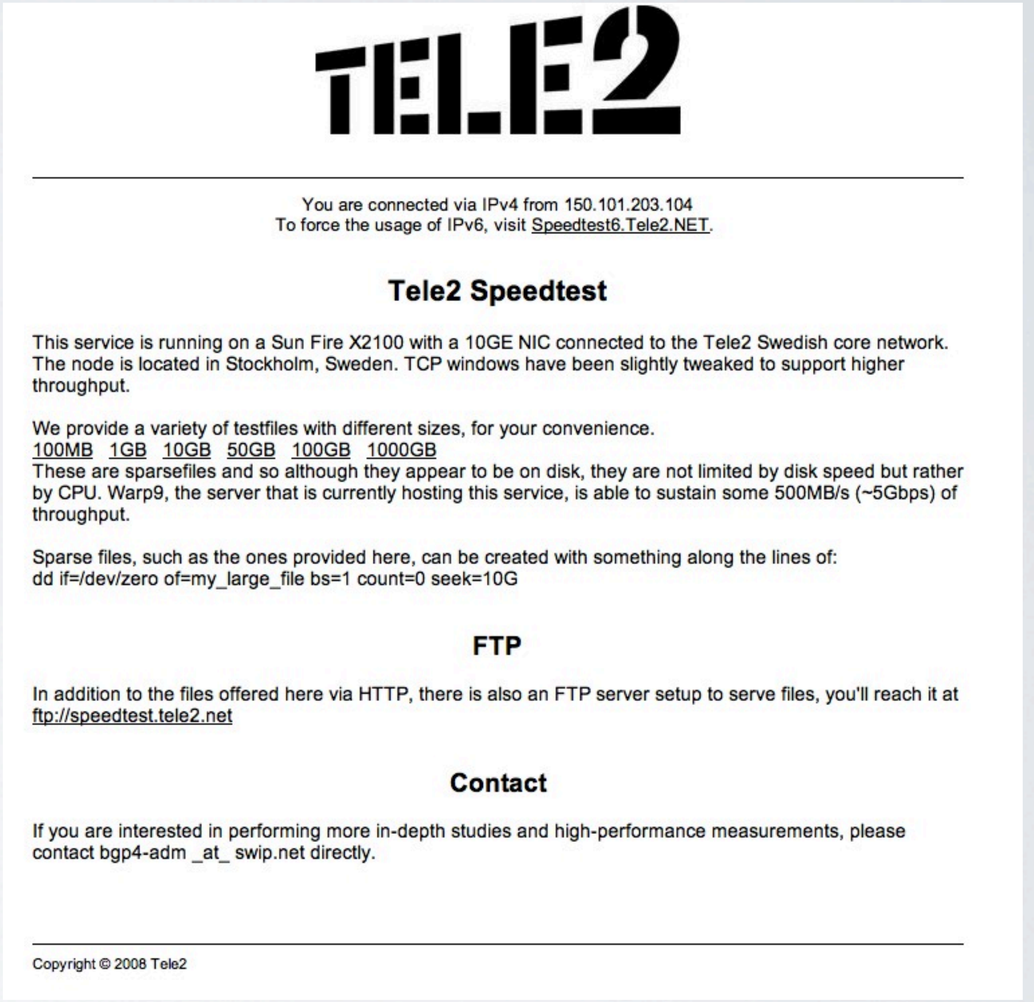
Test IPv6 10.7.1




Test IPv6
FAQ
IPv6 Day
Local Times
Mirrors
Stats
Test your IPv6 connectivity.
Summary
Tests Run
Technical Info
Share Results / Contact
Test with IPv4 DNS record ok (0.408s) using ipv4
Test with IPv6 DNS record ok (1.834s) using ipv6 Teredo
Test with Dual Stack DNS record ok (0.397s) using ipv4
Test for Dual Stack DNS and large packet ok (1.397s) using ipv6 Teredo
Test IPv4 without DNS ok (0.400s) using ipv4
Test IPv6 without DNS ok (1.773s) using ipv6 Teredo
Test IPv6 large packet ok (0.748s) using ipv6 Teredo
Test if your ISP's DNS server uses IPv6 ok (0.723s) using ipv6 Teredo
Click to see Technical Info

Performance Testing

- Don’t get funky, just use HTTP or FTP file transfers.
- Use WireShark to Monitor
- Example http://speedtest.tele2.net -
- Operated bt Tele2 Sverige AB



TELE2

You are connected via IPv4 from 150.101.203.104
To force the usage of IPv6, visit Speedtest6.Tele2.NET.

Tele2 Speedtest

This service is running on a Sun Fire X2100 with a 10GE NIC connected to the Tele2 Swedish core network. The node is located in Stockholm, Sweden. TCP windows have been slightly tweaked to support higher throughput.

We provide a variety of testfiles with different sizes, for your convenience.
100MB 1GB 10GB 50GB 100GB 1000GB
These are sparsefiles and so although they appear to be on disk, they are not limited by disk speed but rather by CPU. Warp9, the server that is currently hosting this service, is able to sustain some 500MB/s (~5Gbps) of throughput.

Sparse files, such as the ones provided here, can be created with something along the lines of:
dd if=/dev/zero of=my_large_file bs=1 count=0 seek=10G

FTP

In addition to the files offered here via HTTP, there is also an FTP server setup to serve files, you'll reach it at ftp://speedtest.tele2.net

Contact

If you are interested in performing more in-depth studies and high-performance measurements, please contact bgp4-adm _at_ swip.net directly.

So.....

- http://www.mrp.net/IPv6_Survey.html
- Looks at 5 things
  - Web servers accessible via IPv6
  - Email deliverable via IPv6
  - DNS names servers accessible via IPv6
  - NTP service accessibe by IPV6
  - Jabber service accessibel via IPv6

- Dual stack
- IPv6 tunnelling
- Manual tunnels
- Automatic 6to4 tunnels
- IPv6 provider edge router (6PE)
- Topology types