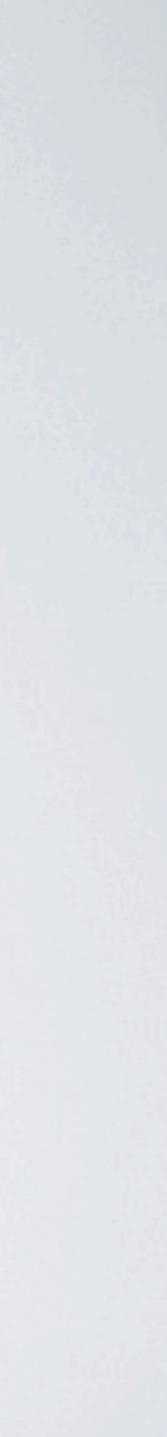
IPv6 Migration - Why do I care anyway?



MacSysAdmin 2012

WELCOME **Rick Wylie KeyOptions**



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

- 2¹28 total addresses

• Omitting unnecessary zeroes; - 2001:5c0:1000:b::66fb • Eight fields, each 16 bits long 4 hexadecimal characters



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.....

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

2 billion, 147 million, 483 thousand and 648

$2^{128}/(2^{33} \times 2^{64})$ - Assume remove the 64-bit address for the MAC address.

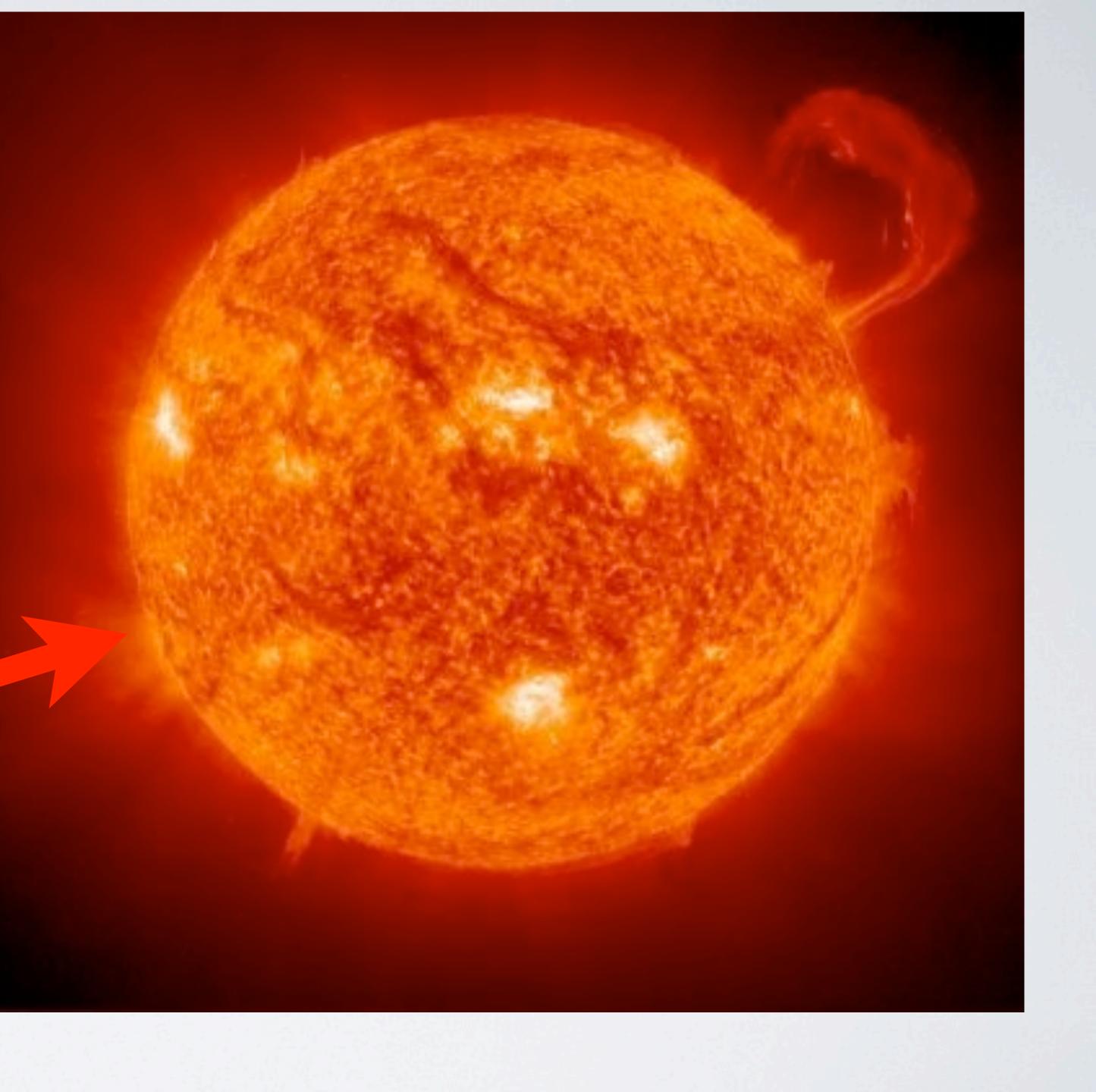


I.I.I.I - 254.254.254.254









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 VolP



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:DB8:0000:0000:0000:0000:0000:00056

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



Address Notation - Mixed

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

::COAB:2

In networks where there is both IPv4 and IPv6, the address notation can



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 A8.8.8.8

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 A8.8.8.8

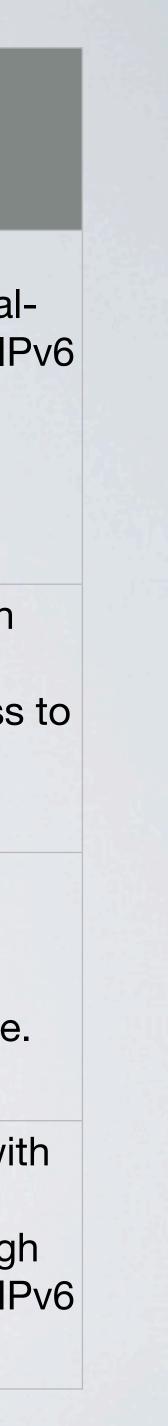
```
Melbourne.demo.com. IN AAAA 2001:db8:10:133::2
```



TRANSITION MECHANISMS



Key user / Primary use	Benefits	Limitations	Requirements
	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 IP addresses. Access to IPv6 DNS.
Service provider WANs or metropolitan area networks (MANs) deploying ATM, Frame Relay, or dWDM.		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 IPv6 DNS.
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.
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 IP routing tables.
	Service provider wanting to offer initial IPv6 service. Enterprise wanting to interconnect IPv6 domains or link to remote IPv6 networks. Service provider WANs or metropolitan area networks (MANs) deploying ATM, Frame Relay, or dWDM. Mobile or greenfield service providers, or current regional service providers deploying MPLS. Small enterprise	 Service provider wanting to offer initial IPv6 service. Enterprise wanting to interconnect IPv6 domains or link to remote IPv6 networks. Service provider WANs or metropolitan area networks (MANs) deploying ATM, Frame Relay, or dWDM. Mobile or greenfield service providers, or current regional service providers, or software upgrades required to the core. Small enterprise networks. Can demonstrate demand for IPv6 for minimal investment. Easy to implement over existing IPv4 infrastructures. Low cost, low risk. Can provide end-to-end IPv6 with no impact on the IPv4 traffic and revenue. Mobile or greenfield service providers, or current regional service providers deploying MPLS. Small enterprise networks. 	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.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.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.Small enterprise networks.Easy to implement for small campus networks with a mixture of IPv4Complex dual management or software upgrades required to the core.



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

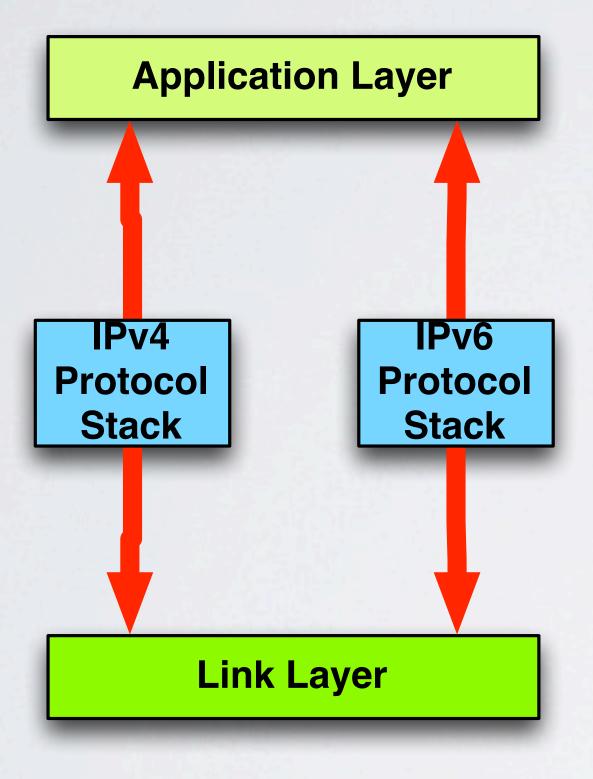




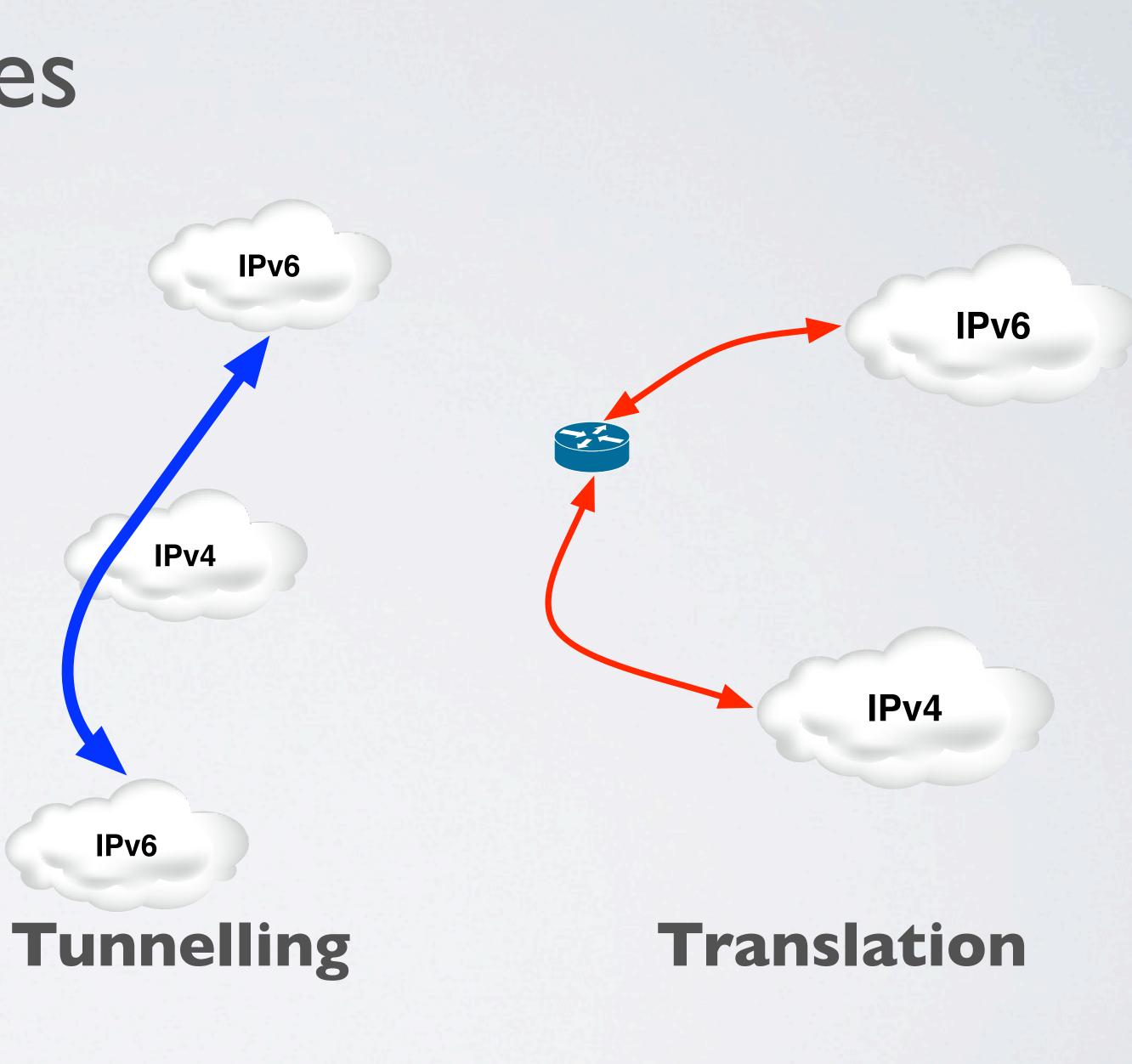
THE 3 BASIC STRATEGIES



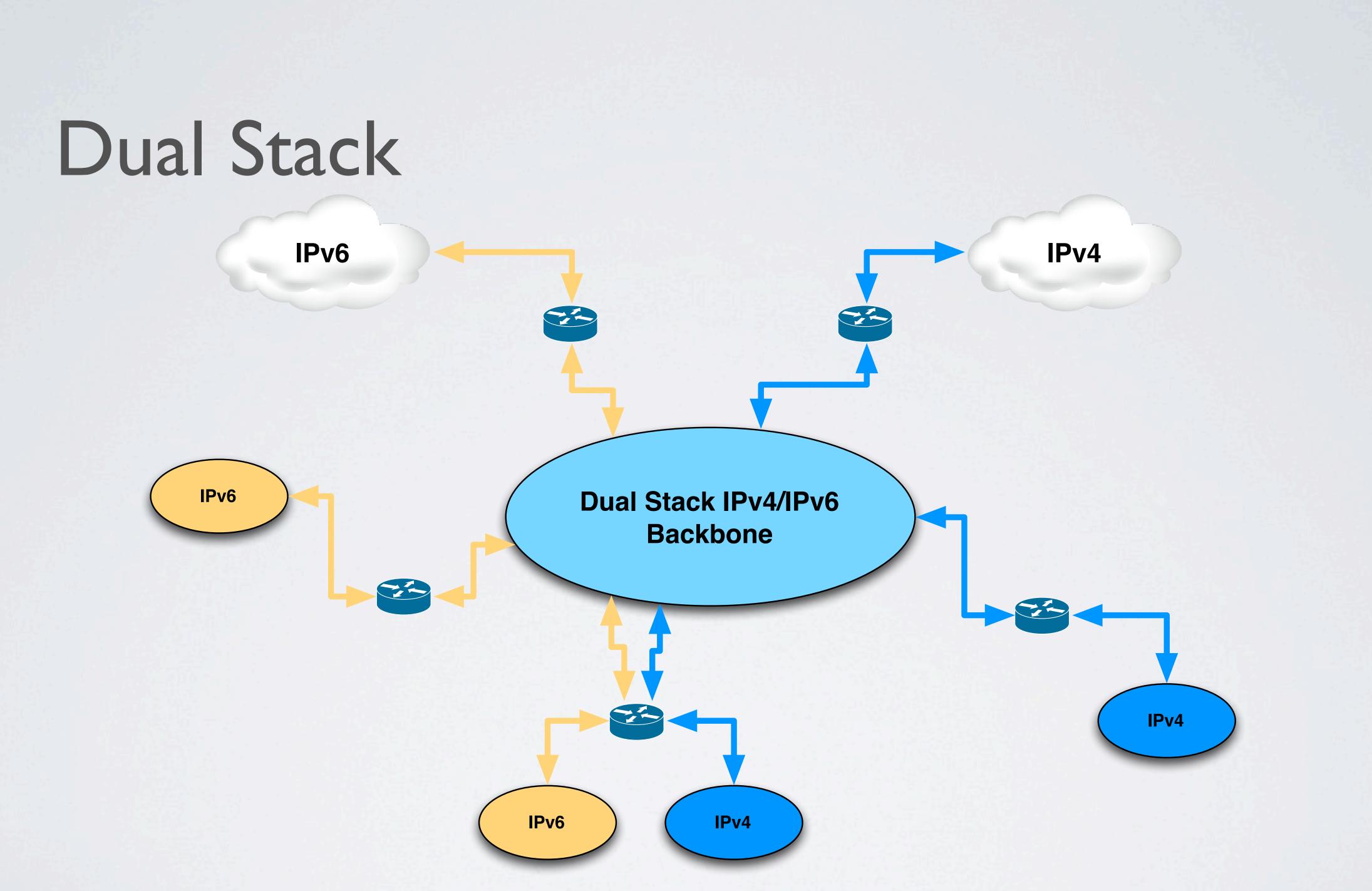
3 Basic Strategies



Dual Stack









Dual Stack

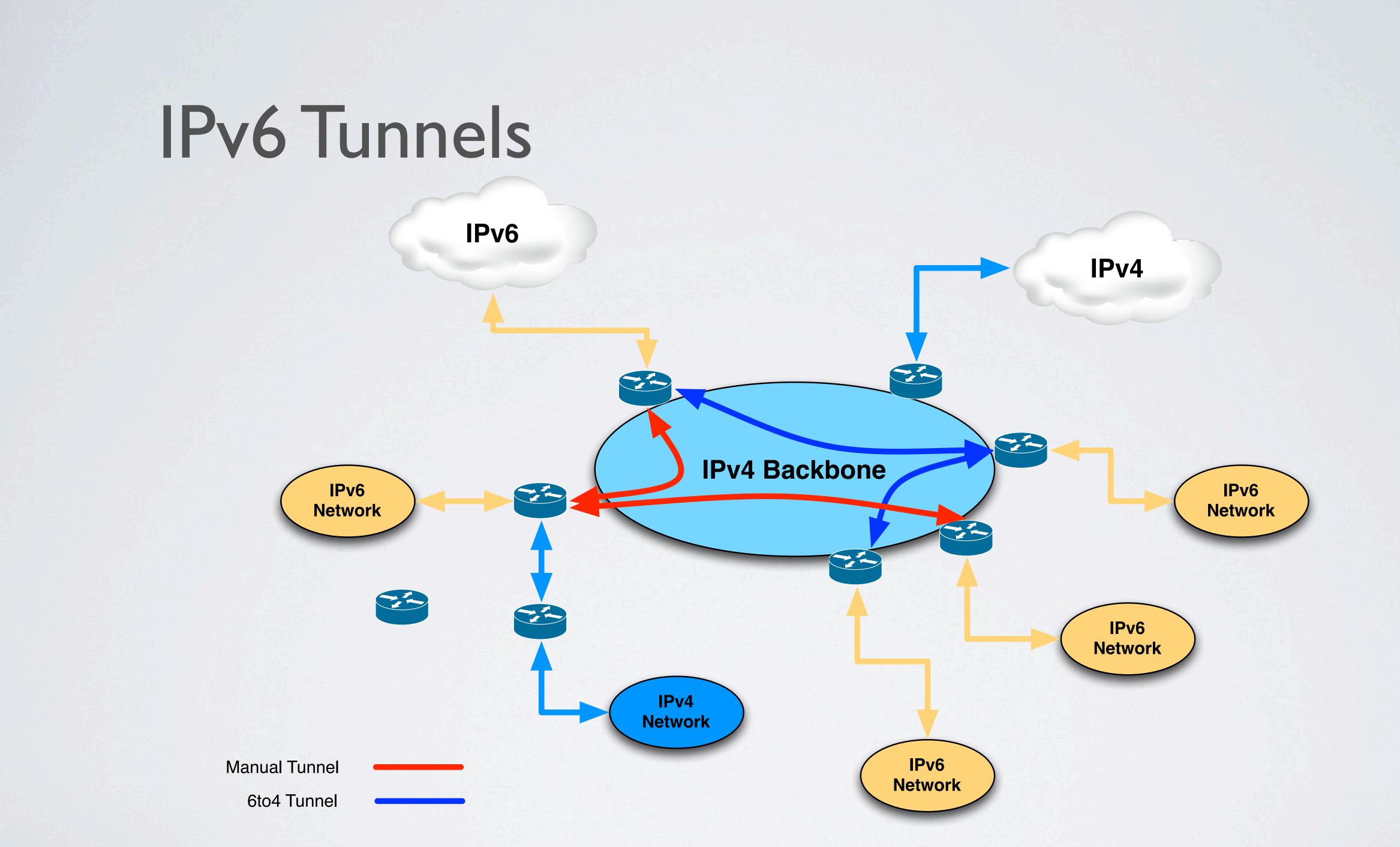
Pros

- Same topology as an IPv4 Network
- Easy deployment

Cons

- Requires IPv6 capabilities that match the IPv4 capabilities
- Older routers may have limited IPv6 features
- Older routers may foward IPv6 in software







IPv6 Tunnelling

Pros

- No changes needed to the core network
- IPv6 is only enabled on the routers as needed to deliver services.

Cons

- Different topology as the IPv4 network
- Management complexity
- Scalability limits with large number of tunnels
- Limited end-to-end IPv6 support



IPv6 Tunnels

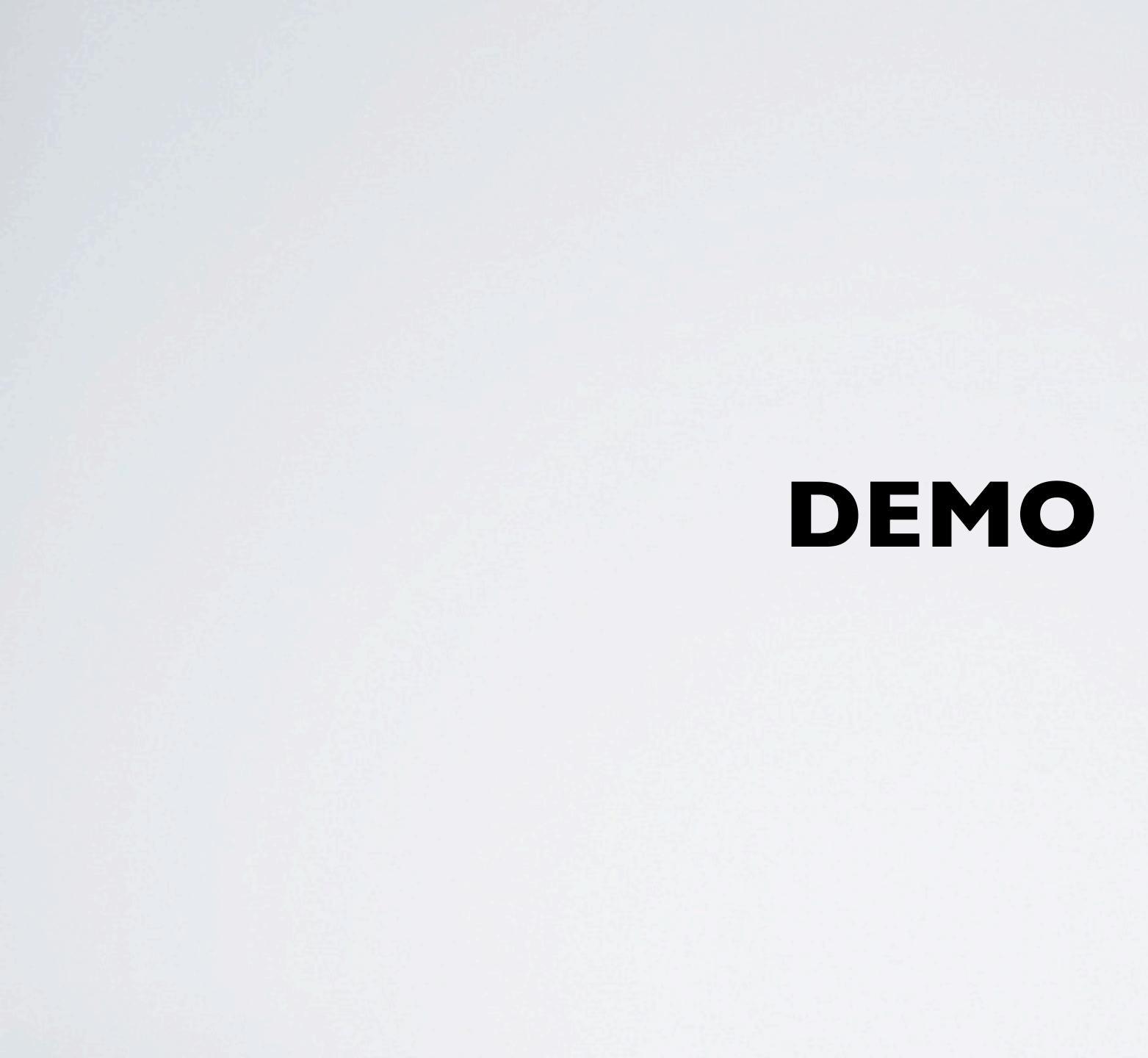
- Fast and easy to set up
- Not the best for security or performance
- Free IPv4-to-IPv6 Tunnels
 - Gogo6.com
 - Sixxs.net
 - Tunnelbroker.com



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







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

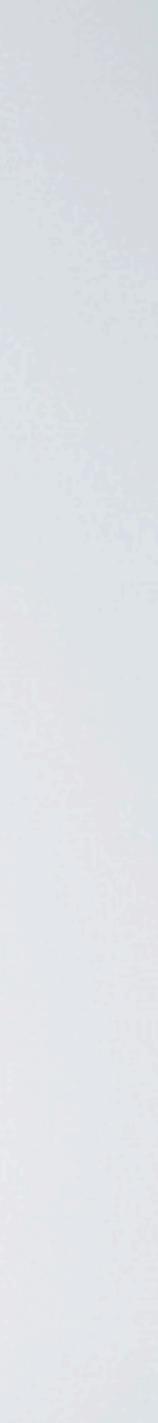




IPv6 Success Example

- 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.



MAKEA 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



- 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



- Define technical strategy and selection of transition mechanisms to support IPv4/IPv6 interoperability
- Define management and assignment of resources for transition
- during transition
- Determine the use of IPv6 standards and products
- during and after IPv6 network deployment

•What is the maintenance of interoperability and security

• What will be the continued support for IPv4 infrastructure



- 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

vered by technology refresh nd procurement issues



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



Best Practice For A Transition Plan

Network Infrastructure





Transition Costs

Address Planning

Information Security

Transition Mechanisms



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





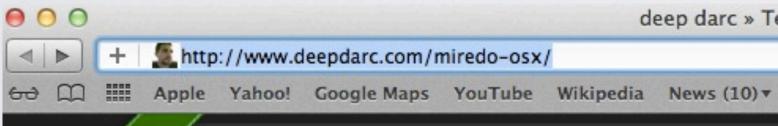




HERE'S SOMETHING I PREPARED EARLIER....



Deepdarc - Teredo For OSX



deep darc deep and darc stuff

FortmeonCith

Teredo for MacOS X

Wednesday, February 21, 2007 by darco Posted in Apple, Projects, IPv6

As some of you may know, I've been playing around with IPv6 quite a bit lately. One specific IPv6 technology which has gotten me quite excited is the Teredo automatic tunneling protocol. Teredo allows you to obtain a globally routable IPv6 address when you only have access to the IPv4 internet, even if you are behind a NAT router¹!

Support for the Teredo protocol is actually in WindowsXP, but it is disabled by default. However, that has changed for Windows Vistawhere IPv6 and Teredo are enabled by default². This is important because this means that relatively soon, widespread deployment of IPv6 will become a reality. This is great for Windows users, but what about

other platforms?

Miredo is an open-source (GPL) user-space teredo implementation for linux and BSD. Someone went thru the effort to get miredo to work on MacOS X, but setting it up is not something your average joe can accomplish. What is needed is an installer package.

Well, that's exactly what I'm putting together. I'm releasing a prerelease version of the package today for early-adopters and power-users. You just download it, install it, and you should have IPv6 connectivity. It's that simple!

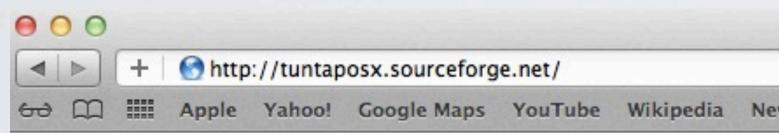
Prerelease 2

Download Here: Miredo Installer for MacOS X (Universal), and source code

Fe	eredo for Mac	OS X					
		Reader (2 Q-	Google			
	Popular v						
						Search	
		A	bout	Contact	Login	Projects	



TUNTAP - Fixes 3





Home FAQ

Overview

What is it?

The TunTap project provides kernel extensions for Mac OS X that allow to create virtual network interfaces. From the operating system kernel's point of view, these interfaces behave similar to physical network adapters such as an Ethernet network interface. However, the virtual interface does not send the packets into a wire, but makes them available to programs running in the system.

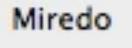
The software comes as a pair of kernel extensions that create virtual network interfaces on the IP and Ethernet level, respectively. These kind of network interfaces are commonly referred to as tun and tap devices on Unix-like platforms. This way of interfacing with the operating system's network stack is available on many platforms (cf. the <u>TUN/TAP</u> wikipedia article).

2	2-bi	t Problem
Т	unTap - Home	
		Reader 🖒 🔍 Google
ws (1	0) • Popular •	
_		
	Mac OS X	
Q	Download	Development



Miredo For OSX





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(2)	2		
Time Machine S	tartup Disk Miredo (32-bit)		
]		Q	
Teredo Tunnel:			
release runner.			
	Autoclient ‡		
Mode:	Autoclient \$ teredo.remlab.net		
Mode:	teredo.remlab.net		
Mode: Server:	teredo.remlab.net		



HURRICANE ELECTRIC

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)

Search

Updated 05 Oct 2011 05:55 PST © 2011 Hurricane Electric

×.



IPV4 Test 10.6.8

est your I	Pv6 connectivity.				
Summary Tests	Run Technical Info Share Results / Contact				
1 Your I	r IPv4 address on the public Internet appears to be 213 Pv6 address detected [more info] d IPv6 day is June 8th, 2011. No problems are anticip				
<u> </u>					
World					
(i) When	a publisher offers both IPv4 and IPv6, your browser a ections to IPv6-only sites are timing out. Any web site				
<u> </u>					
<u> </u>	Your DNS server (possibly run by your ISP) appears to ha				
	You				
10/10	for your IPv4 stability and readiness, when publis				
0/10	for your IPv6 stability and readiness, when public				
Click to see test	t data				
(Updated server sid	de IPv6 readiness stats)				

3.88.213.76

pated for you with this browser, at this location. [more info]

appears to be happy to take the IPv4 site without delay.

that is IPv6 only, will appear to be down to you.

/e IPv6 Internet access.

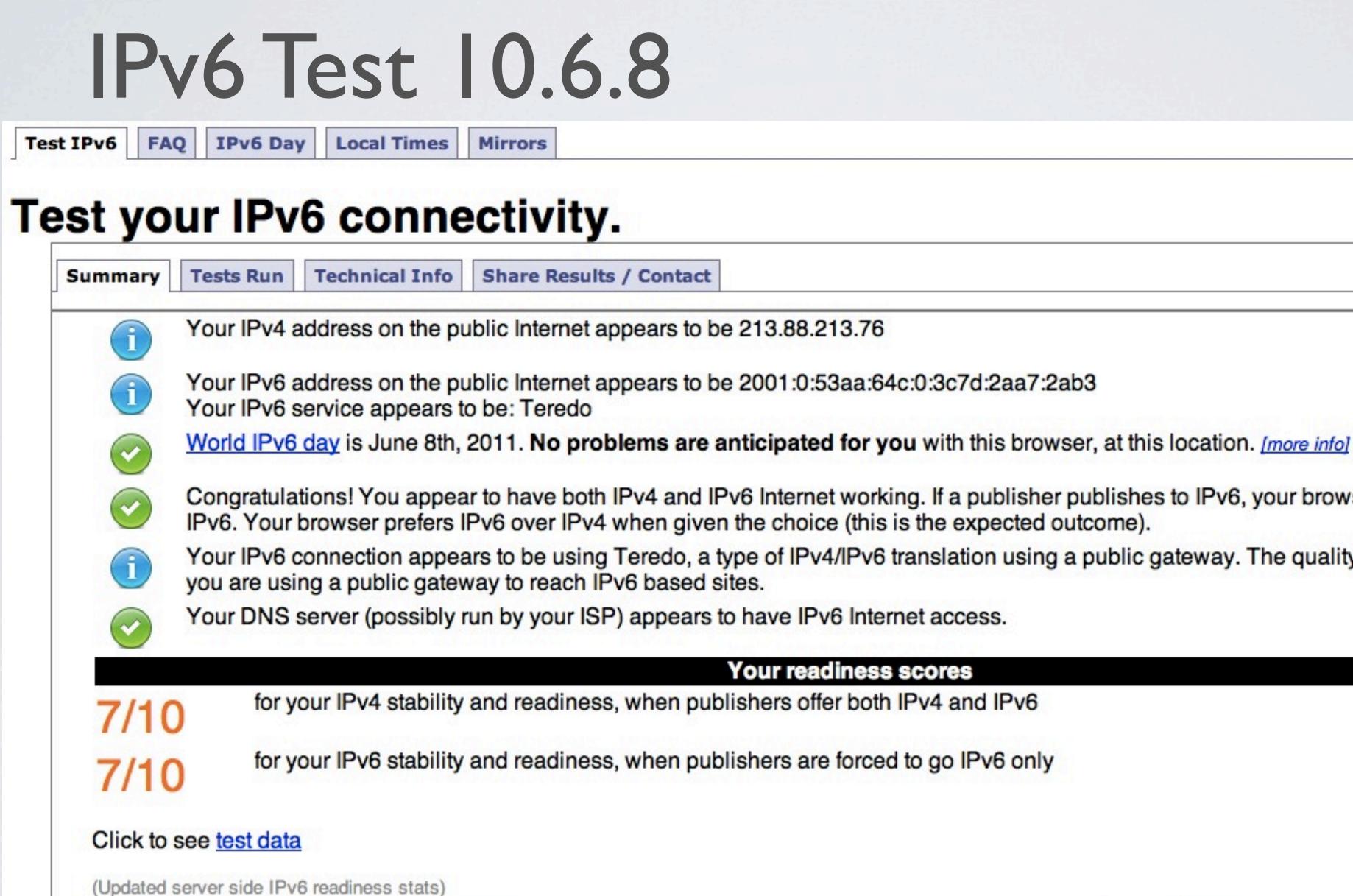
r readiness scores

shers offer both IPv4 and IPv6

shers are forced to go IPv6 only

Sta







Congratulations! You appear to have both IPv4 and IPv6 Internet working. If a publisher publishes to IPv6, your browser will connect using

Your IPv6 connection appears to be using Teredo, a type of IPv4/IPv6 translation using a public gateway. The quality for this may suffer, as

Your readiness scores

Test IPv6 10.7.1

Test IPv6 FAQ IPv6 Day Local Times Mirrors

Test your IPv6 connectivity.

Summary Tests Run Technical Info Share Results / Contact

i i

Your IPv6 address on the public Internet appears to be 2001:0:53aa:64c:0:696:2aa7:2ab2 Your IPv6 service appears to be: Teredo

(unknown result code: teredo-ipv4pref)



World IPv6 day is June 8th, 2011. No problems are anticipated for you with this browser, at this location. [more info]



Congratulations! You appear to have both IPv4 and IPv6 Internet working. If a publisher publishes to IPv6, your browser will connect using IPv6. Note: Your browser appears to prefer IPv4 over IPv6 when given the choice. This may in the future affect the accuracy of sites who guess at your location.

Your DNS server (possibly run by your ISP) appears to have IPv6 Internet access.

Your readiness scores

for your IPv4 stability and readiness, when publishers offer both IPv4 and IPv6 10/10

for your IPv6 stability and readiness, when publishers are forced to go IPv6 only 10/10

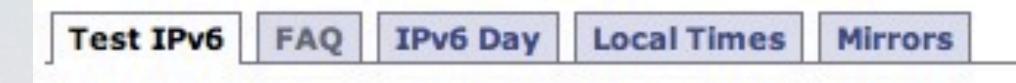
Click to see test data

(Updated server side IPv6 readiness stats)

Your IPv4 address on the public Internet appears to be 213.88.213.77



Stats



Test your IPv6 connectivity.

Tests Run Technical Info Share Results / Contact Summary 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 <u>http://speedtest.tele2.net</u> -
- Operated bt Tele2 Sverige AB

TELE 2

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.

Copyright @ 2008 Tele2



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

