IPv6: Myth and Reality

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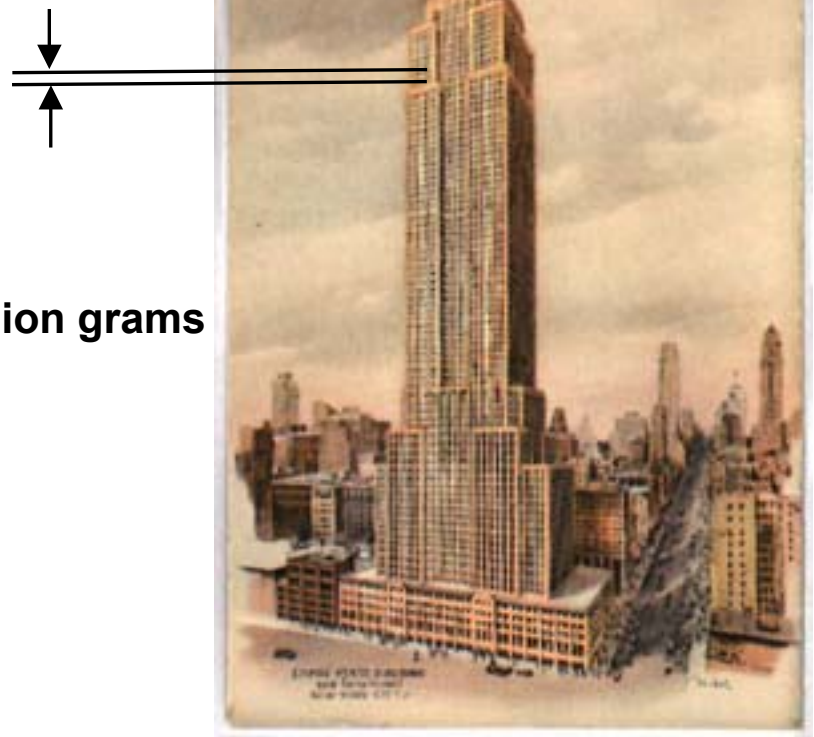
IPv6 Overview

- **Increased address space**
  - 128 bits = 340 trillion trillion trillion addresses
  - (2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456)
  - = 67 billion billion addresses per cm^2 of the planet's surface

If an IPv4 Address Weighed 1 Gram…

IPv4 = 1/76th weight of Empire State Building



Empire State Bldg. = 365,000 tons* = 328.5 billion grams

* http://www.gibnet.org/heavy.htm

$$\frac{32.85e+10}{2^{32}} = 76.48$$

If an IPv6 Address Weighed 1 Gram…

IPv6 address space =

X 56.7 billion

Earth = 6.00e+24 kg*

* http://www.howstuffworks.com/question30.htm

$$\frac{2^{128}}{6.00e+27} = 56,713,727,820$$

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- **Hierarchical address architecture**
  - Improved address aggregation
- **More efficient header architecture**
  - Improved routing efficiency, in some cases
- **Neighbor discovery and autoconfiguration**
  - Improved operational efficiency
  - Easier network changes and renumbering
  - Simpler network applications (Mobile IP)
- **Integrated security features**

Myth

We do not need IPv6.

The Internet is working just fine without it.

Reality

- **IPv4 addresses are becoming increasingly scarce**
  - North America: 74% of allotted addresses
  - Europe: 17% of allotted addresses
  - Asia: 9% of allotted addresses

Source: Wired.com

- **A little arithmetic:**
  - Population of People's Republic of China = 1.3 billion
  - Usable global IPv4 addresses = 3.7 billion
  - ~65% of global IPv4 addresses already allotted
  - Remaining 35% (1.3 billion) could be depleted by this single country!

Reality

- **70% of Fortune 1000 companies use NAT***
- **But…**
  - NAT breaks globally unique address model
  - NAT breaks address stability
  - NAT breaks the Peer-to-Peer model
  - NAT breaks some security and QoS applications
  - NAT introduces hidden costs (applications and operations)
  - NAT inhibits development of new applications

*Source: Center for Next Generation Internet (NGI.org)

Reality

- **Security? What security?**
  - 70% of WiFi access points run without encryption
  - 86% of consumers keep sensitive health, financial, or personal information on their computers*
  - 91% of users have spyware on their home computers*
  - Very few users understand security risks and how to alleviate them
  - NAT is *not* a security solution
  - Modern firewalls look like Swiss Cheese
- **IPv6 offers the opportunity for true end-to-end security**

*Source: National Cyber Security Alliance

Reality

- **Stability on the Internet is terrible**
  - Primary cause is a long history of poor IPv4 multihoming practices
- **IPv6 offers the opportunity of implementing and enforcing intelligent multihoming**

Myth

IPv6 needs a “killer app”

Reality

- **We need enough addresses for the applications we already have**
- **Adoption of IPv6 will precede the advent of new kinds of applications**
- **Elimination of NAT creates a fertile environment for innovation**

The Fertile Field:
Peer-to-Peer Networking

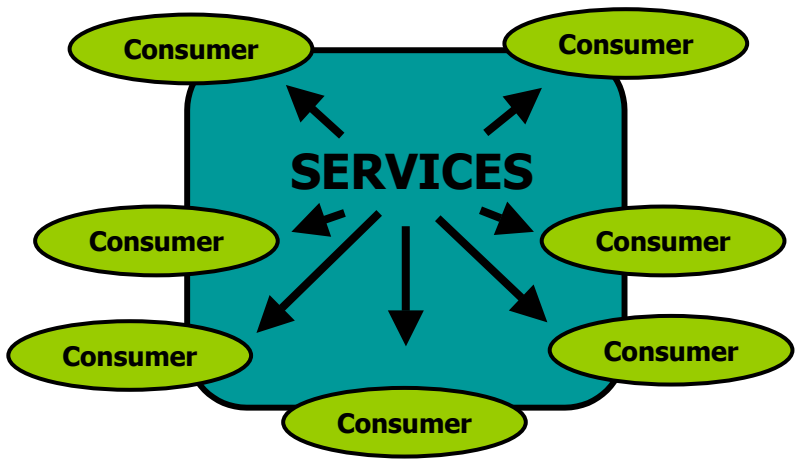
P2P: The sharing of computer resources and services by direct exchange between systems.*

*** P2P Working Group**

…this is one of the characteristics of the early Internet

What Happened?

- **The Internet has evolved into a "Services in the Middle" model**
- **Information and services flow primarily toward the user**
- **Contributing factors:**
  - Commercial interests
  - Legacy of low-powered PCs
  - NAT breaks network transparency



The Lessons of Napster

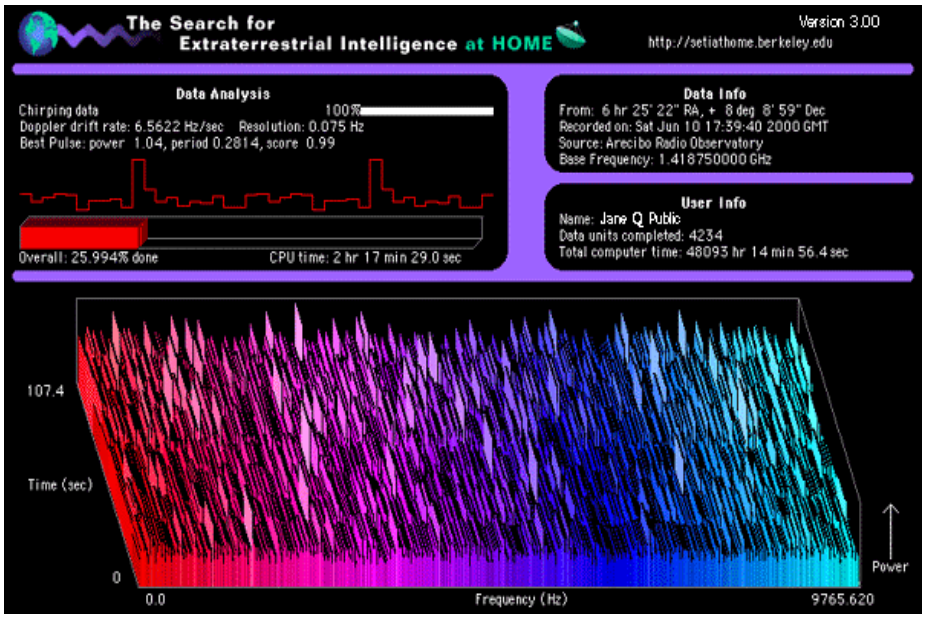
- **User driven**
- **Intelligent application of client/server and peer-to-peer**
- **Simple model made unnecessarily complex by dynamic IP issues**

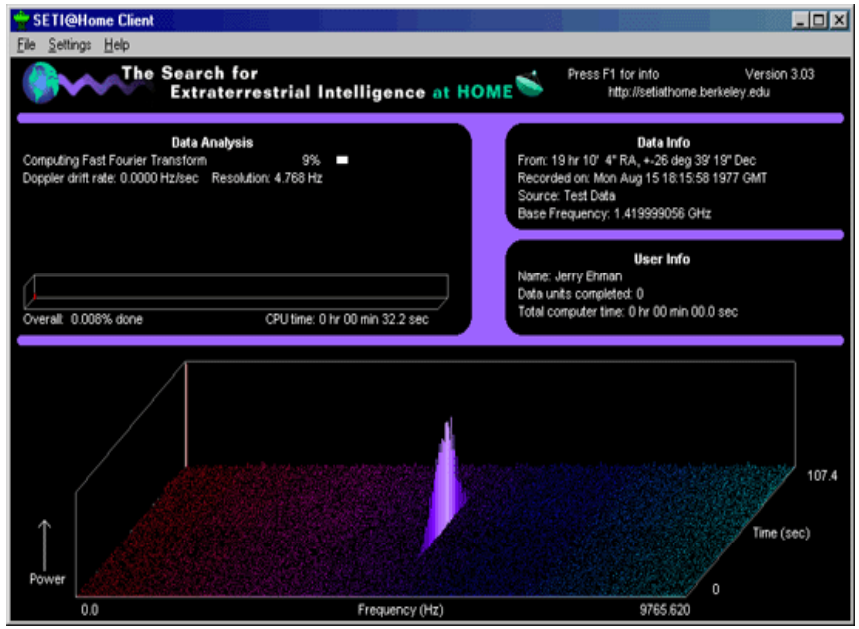
Death of Napster ≠ Death of P2P

- **Content sharing**
  - Napster was a wake-up call
  - Kazaa
  - Morpheus, FreeNet, Grokster, Gnutella, many more…
- **Distributed data processing**
  - SETI@home
  - Folding@home
  - Popular Power
  - United Devices
- **Distributed applications**
  - Black-hat hackers already appr

SETI@home:
The Power of Distributed Processing

- **1 work unit = 3.1 trillion floating-point operations**
- **700,000 work units performed per day = 20 TFLOPS**
- **~2X speed of fastest current supercomputer**
- **< 1% the cost of the fastest current supercomputer**





The New P2P Paradigm

- **P2P applications can be:**
  - Fully P2P
  - P2P and client-server
  - Fully server based
- **If P2P can be fully server based, what does P2P really mean?**

P2P: A group of nodes actively participating in the computing process

- **Peer machines can be both clients and servers**
- **Users are both consumers and producers**

"The network is the computer" --Sun Microsystems

Myth

Adoption of IPv6 means turning off IPv4 first

Reality

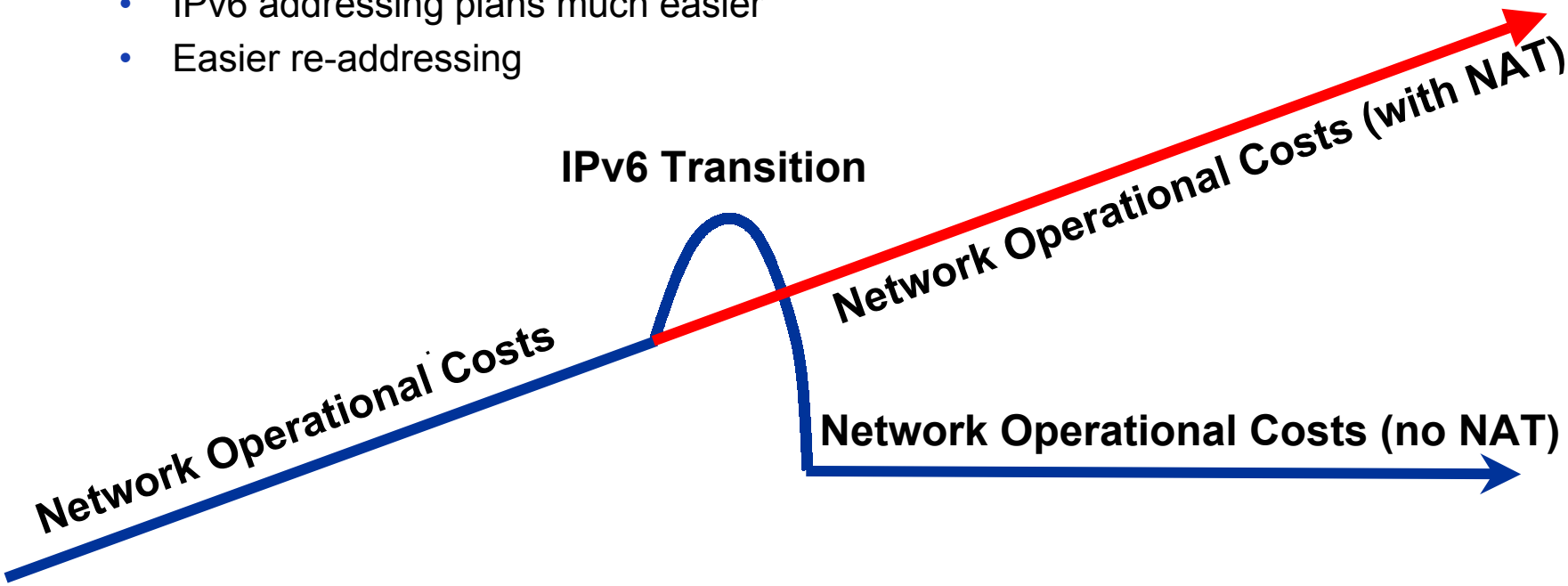
- **Transition to IPv6 will be incremental and cautious**
- **IPv6 is designed to coexist with IPv4**

Myth

Transition to IPv6 will be complicated and expensive

Reality

- **It doesn't have to be**
- **IPv6 will be operationally cheaper**
  - No NAT = cheaper operations, cheaper applications
  - IPv6 addresses easier to acquire
  - IPv6 addressing plans much easier
  - Easier re-addressing



Myth

There is not yet enough vendor support for IPv6

Reality

- **Operating systems supporting IPv6:**

  Microsoft, Apple, Solaris, Linux, BSD, HP-UX, AIX, SCO, Solaris…

- **Routing platforms supporting IPv6:**

  6Wind, Cisco, Fujitsu, Hitachi, IPInfusion, Juniper, NEC, Nortel, Zebra…

- **IPv6 applications and utilities:**

  Chat, DNS, firewalls, FTP, games, IPSec, Java, mail, monitoring, videoconferencing, web servers…

  (See www.ipv6forum.org for details)

Myth

There are too many issues still to be solved

Reality

- **A rich suite of transition tools are available**
  - Dual stacks
  - Tunnels
    - Configured
    - Automatic
  - Translators
    - Network Layer
    - Transport Layer
    - Application Layer

Call to Action

- **IPv6 is imperative for the continued evolution of network services**
- **IPv6 is happening now!**
- **Clue density of the semi-informed must be raised**

Thank You

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