



e-Nations, The Internet for All

An IPv6 Business Case

Axel Clauberg

Sr. Manager, Consulting Engineering

Cisco Systems EMEA

clauberg@cisco.com

**This presentation is based on the paper
“e-Nations, The Internet for All, An IPv6 Business Case” by
Patrick Grossetête, Sr. Product Manager IPv6, Cisco Systems
Jim Bound, HP Fellow, Hewlett Packard
Tony Hain, Technical Leader, Cisco Systems**

http://www.nav6tf.org/RIR_eNations/e-Nations.pdf

Agenda

- **Global Internet Success**
- **A look at the numbers**
- **How to sustain Internet Growth ?**
- **Conclusion**

IPv6 Drivers—IP Convergence

Cisco.com

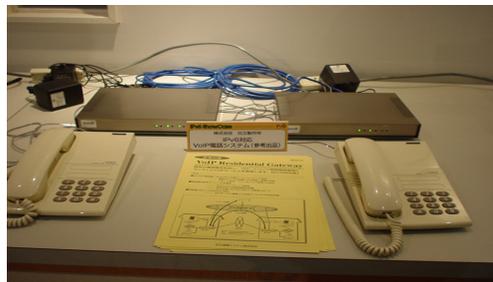
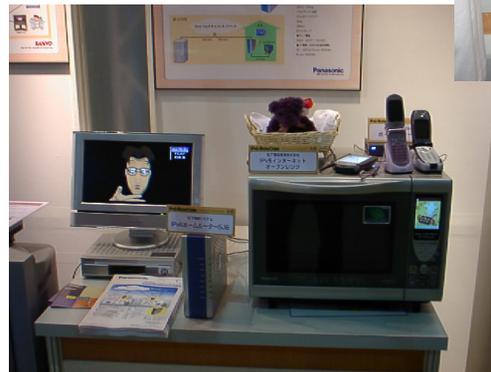
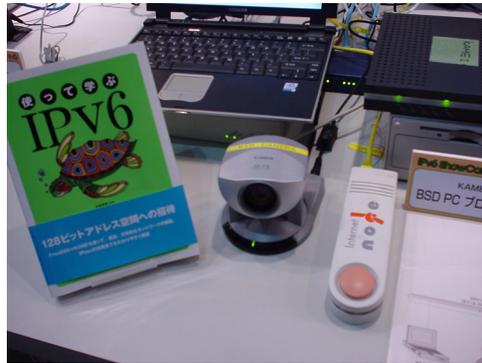


Millions of new devices becoming IP aware, not just PCs.

A Need for increased addressing and “plug and play” networking !

Explosion of New Internet Appliances

Cisco.com



Source: N+I Tokyo, July 2002

“In 2005, all Sony products will be IPv6-enabled”

Mario Tokoro

Corporate Executive Vice President,

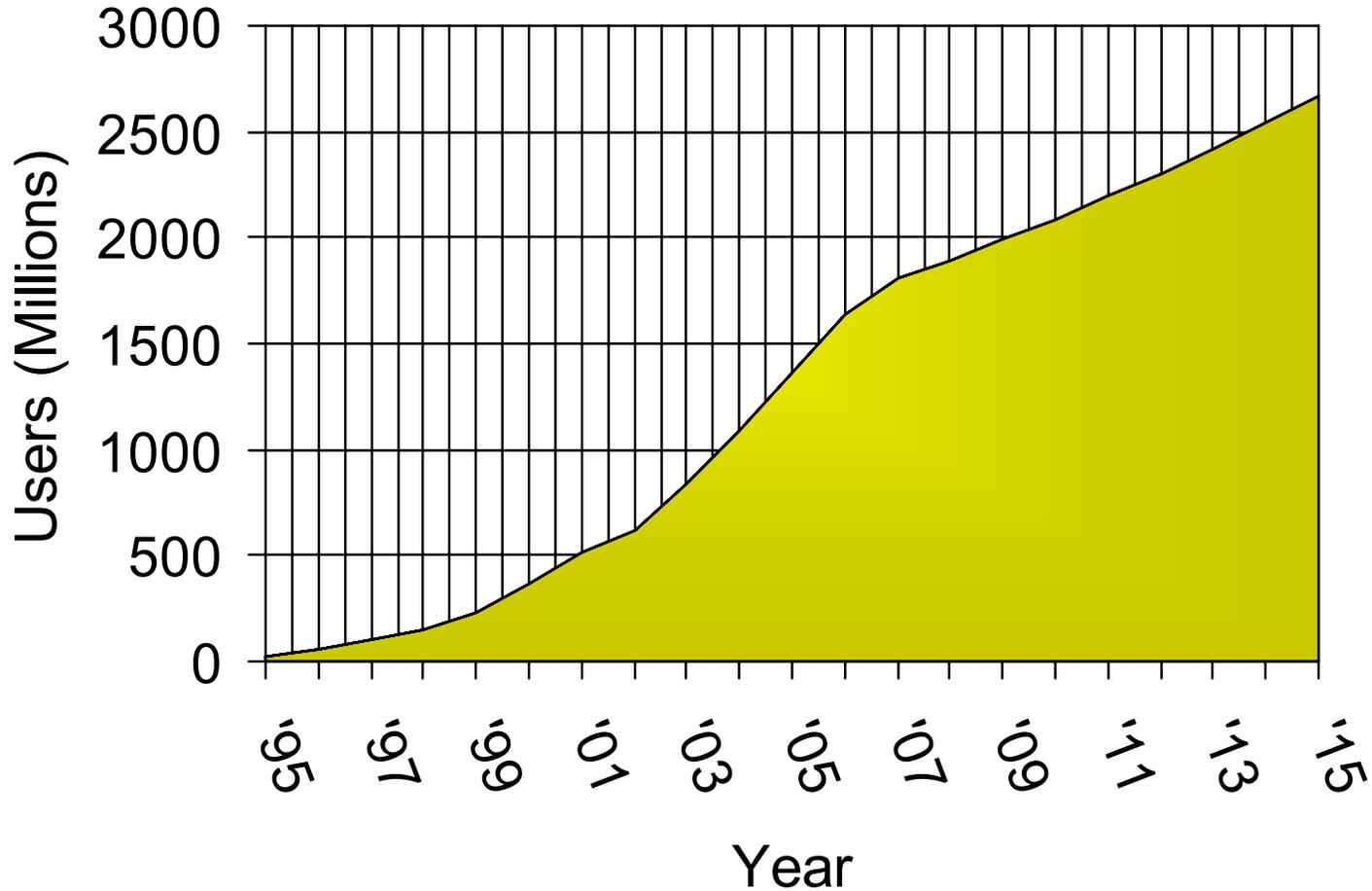
Co-CTO and President of Network & Software Technology

Centre at Sony Corporation

February 12th, 2003

<http://www.ipv6style.jp/en/interviews/20030212/index.shtml>

Internet User Trends



Source: Nua Internet Surveys + vgc projections

IPv4 Address Allocation History

1981 - IPv4 protocol published

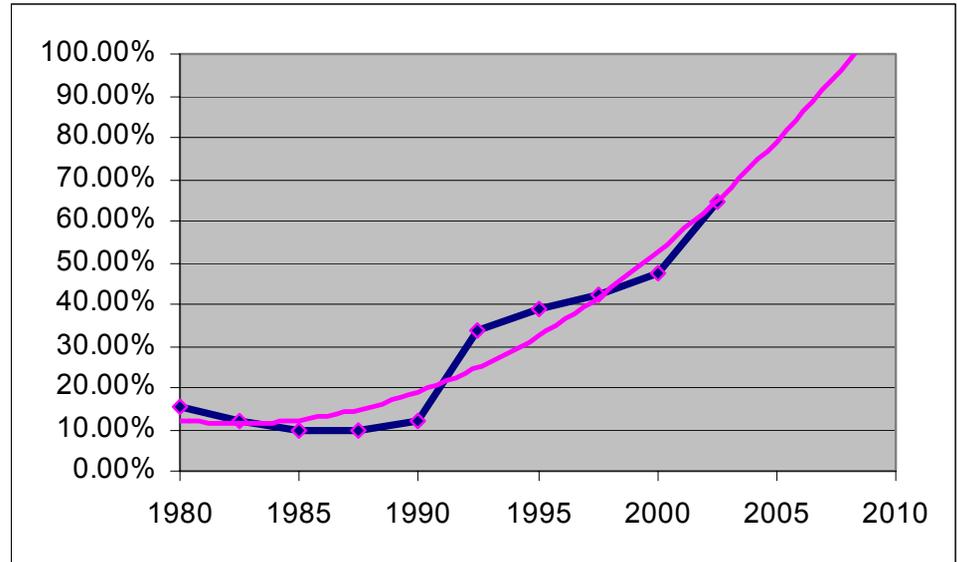
1985 ~ 1/16 of total space

1990 ~ 1/8 of total space

1995 ~ 1/3 of total space

2000 ~ 1/2 of total space

2003 ~ 2/3 of total space



- **This despite increasingly intense conservation efforts**

PPP / DHCP address sharing

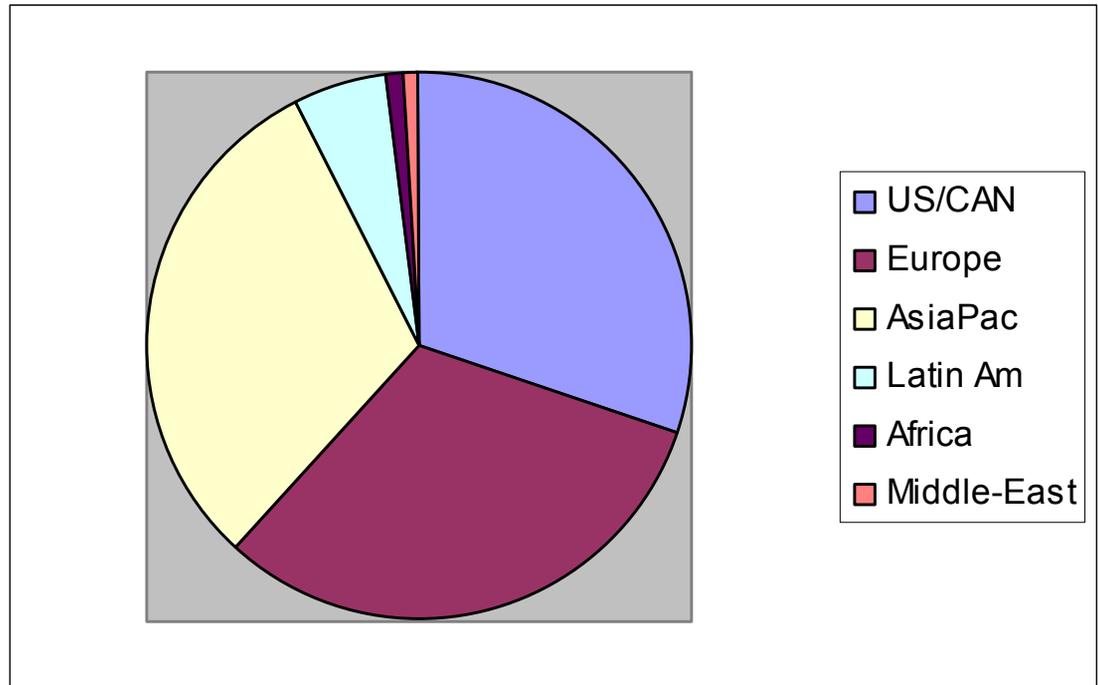
CIDR (classless inter-domain routing)

NAT (network address translation)

plus some address reclamation

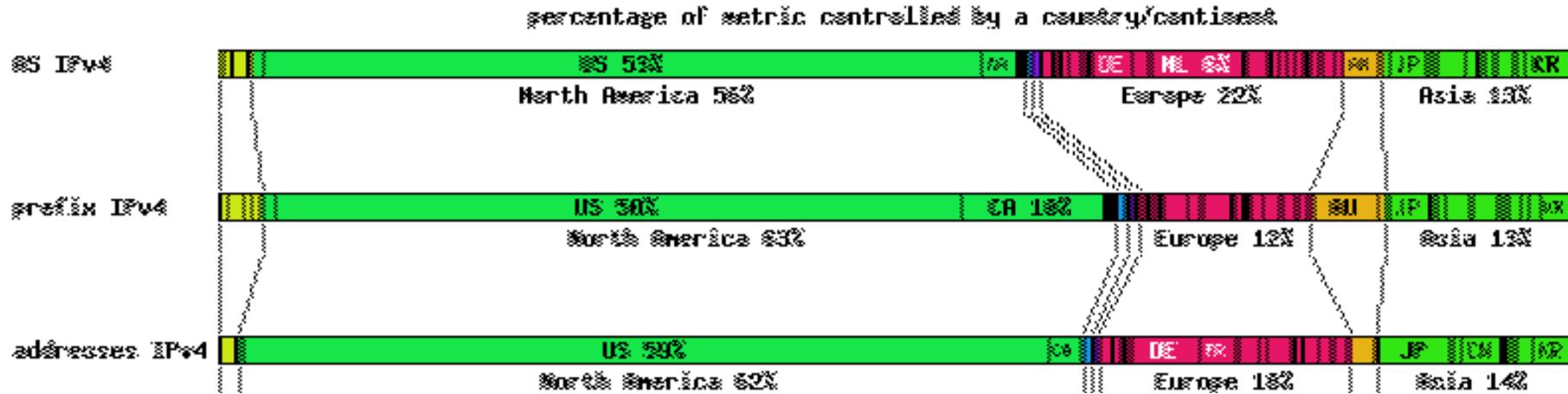
Users on the Internet – Sept 2002

- **CAN/US - 182.67M**
 - **Europe - 190.92M**
 - **Asia/Pac - 187.24M**
 - **Latin Am - 33.35M**
 - **Africa - 6.31M**
 - **Mid-east - 5.12M**
-
- **Total - 605.6 M**



(Source www.nua.ie)

IPv4 address and prefix distribution by region



Source: <http://www.caida.org/analysis/geopolitical/bgp2country/ipv6.xml>

How to sustain growth ?

- **Internet Population**
 - ~600M users in Q4 CY2002, ~950M by end of CY 2004
- **Mobile Industry**
 - Currently 1.2 Billion subscribers
- **How to address the future Worldwide population?**
 - Current population ~ 6.3 Billion (UN 2002 revision report)
 - Expected growth to ~ 9 Billion by 2050
- **Emerging Internet countries need address space**
 - China uses nearly 2 /8 blocks (11/2002), ~20 /8 needed if every student (320M) has to get an IP address
- **Mass Market ?**
 - Only 36 out of 208 countries exceed 20% user penetration (4 close)
 - 139 countries forced to use NAT !

IPv6 Drivers—Network's Architecture

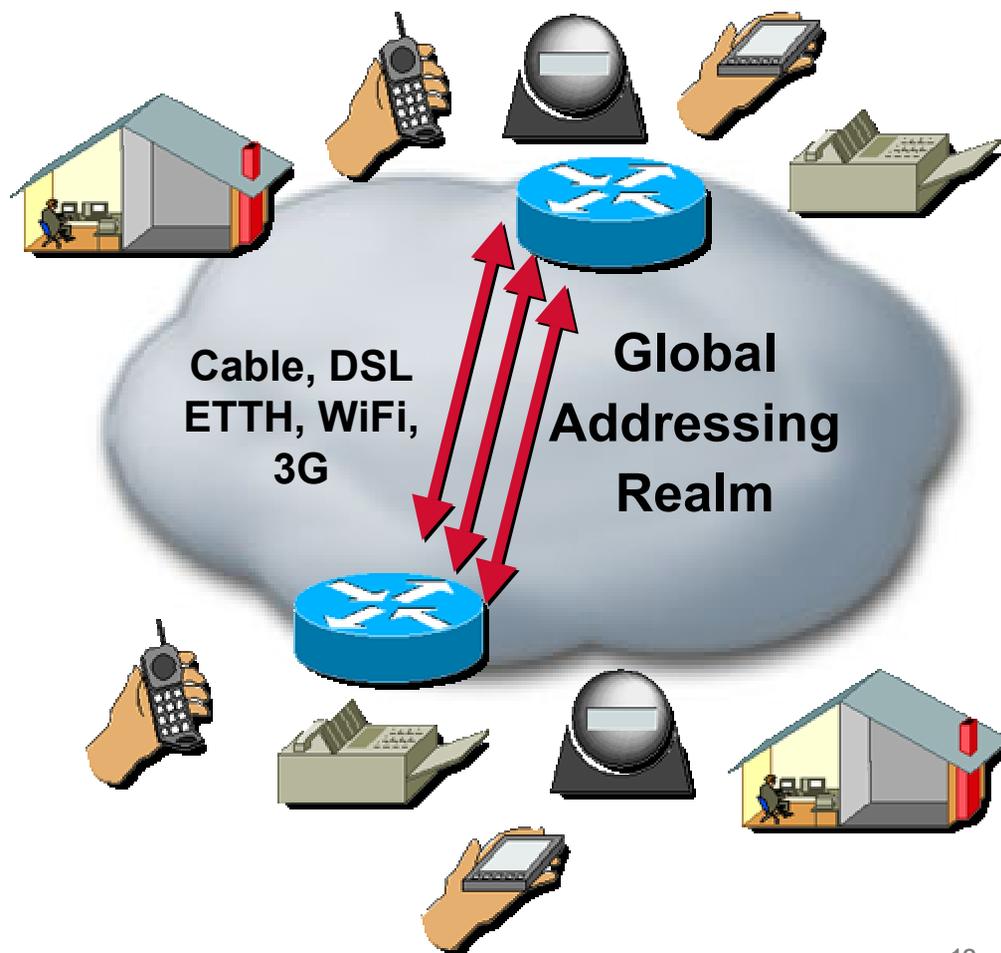
“Always-on” technologies enable new application environments

- Today, Network Address Translation (NAT) and application-layer gateways connect disparate networks

Internet started with end-to-end connectivity for any application

- Peer-to-peer or server-to-client applications mean global addresses

IP telephony, fax, video
Mobility
Distributed gaming
Remote monitoring
Instant messaging



Host-Density (HD) Ratio – RFC3194

- **Measure the efficiency of address allocation**
- **Values between 0 and 1, usually expressed in percentages**

$$\text{HD} = \frac{\text{LOG (number of allocated objects)}}{\text{LOG (max number of allocatable objects)}}$$

0 just one allocation

1 one object allocated to each available address

- **US Telephone System**
 - 9.2 Digits HD = 87% (linear quotient 10%)**
 - 10 Digits HD = 80% (linear quotient 3.2%)**
- **Theoretical limit of 32-bit address space: ~ 4 Billion**
- **Practical limit of 32-bit address space: ~ 250 Million**

How many addresses ?

- **Expectation is that users will need 1 to 5 IP addresses**
PC, Phone, Car, Internet-enabled Home Appliances
- **Very painful HD ratio 90% assumed, reasonable would be 80%**
- **20% penetration**
- **Only 5 countries would have enough address space to support 5 addresses per user !**

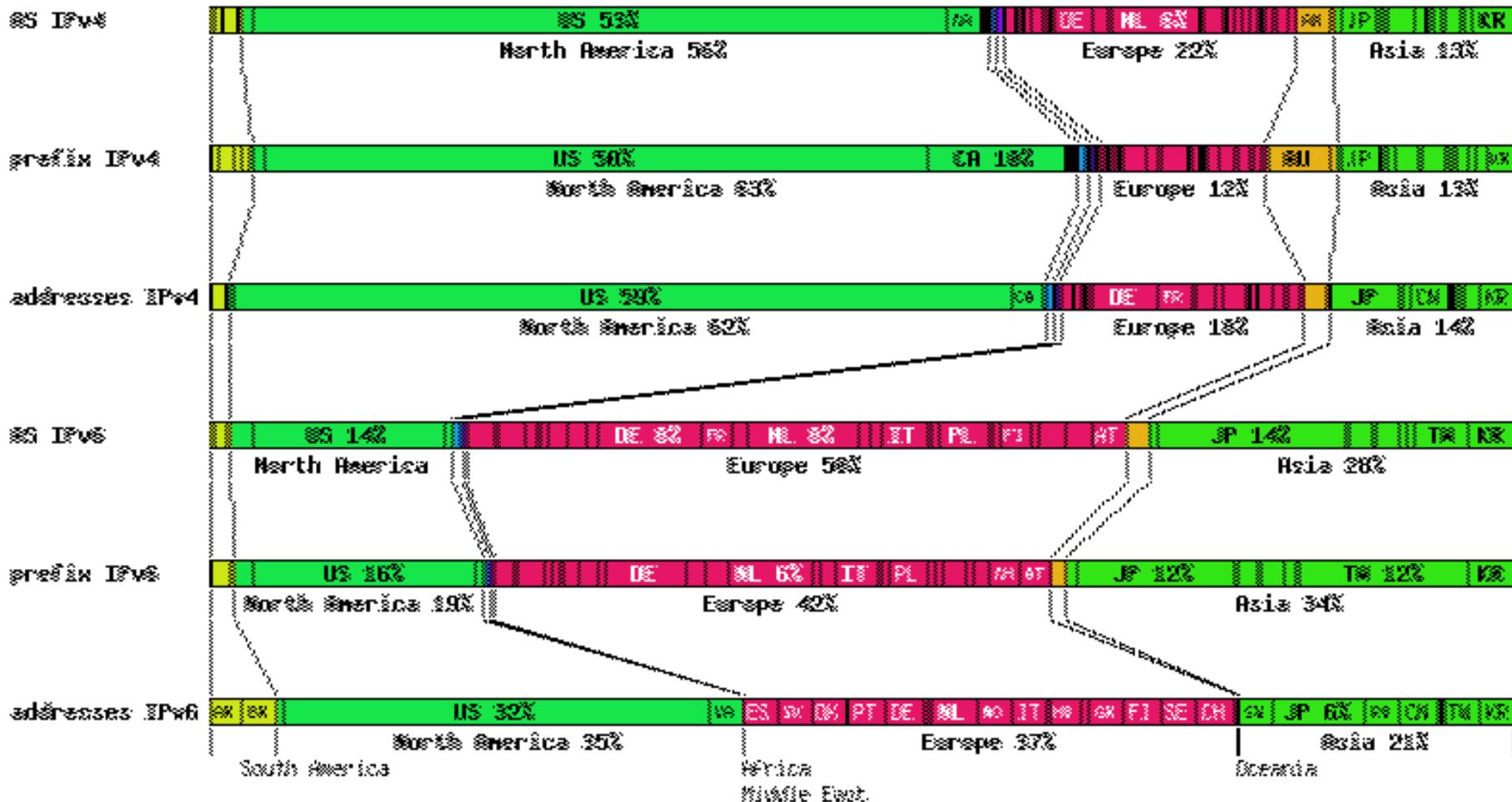
| | /8 for 20% penetration , 1 address per user | /8 for 20% penetration, 5 addresses per user |
|------------|------------------------------------------------|-------------------------------------------------|
| China | 116.5 | 779.7 |
| India | 105.5 | 637.8 |
| Global | 413 | 2763 |
| IPv4 limit | 221 | |

Conclusion

- **The success of the Internet is built on an open and global model**
- **Internet economy is a reality that smoothly reaches all nations worldwide**
- **None want to be isolated**
- **Even less developed countries see IP as a chance to improve their economy and education**
- **Even though currently in its infancy, only IPv6 with its 128-bit address space is able to sustain the growth of the Internet to enable a **global e-Nation****
- **It will take several years to achieve, but we need to start NOW !**

IPv4 and IPv6 address and prefix distribution by region

percentage of metric controlled by a country/continent



Source: <http://www.caida.org/analysis/geopolitical/bgp2country/ipv6.xml>

Pointers

- **IPv6 Forum**

<http://www.ipv6forum.com>

- **IPv6 Task Force**

<http://www.ipv6tf.org>

- **Vendor Sites**

[**http://www.cisco.com/go/ipv6**](http://www.cisco.com/go/ipv6)

CISCO SYSTEMS

