



# IPv6 Impacts on Telecommunications and the Broadband Internet

Michael Biber

Managing Director  
Asia Pacific Networx Pty Limited

Convenor  
IPv6 Forum Australia

[mbiber@apnetworx.com.au](mailto:mbiber@apnetworx.com.au)



# Acknowledgments

- IPv6 Forum
  - <http://www.ipv6forum.org>
- IETF
  - [www.ietf.org](http://www.ietf.org)
- SIP Forum
  - [www.sipforum.org](http://www.sipforum.org)
- OSA/Parlay
  - [www.parlay.org](http://www.parlay.org)
- Geoff Huston – Telstra
  - <http://www.telstra.net/ops/bgp>
- AARNet IPv6 John Barlow
  - <http://www.aarnet.edu.au/rd/advanced-internet-workshops/aiw02-2/contact.html>





# Contact Information



Convenor: Michael Biber

IPv6 Forum Australia

PO Box 347

Enmore NSW 2042 Australia

Ph: +61 2 9519 0030 Fx: +61 2 9519 0933 Mb:  
0412 058 808

Em: [ipv6forum@apnetworx.com.au](mailto:ipv6forum@apnetworx.com.au)

W3: <http://www.apnetworx.com.au>



# The IP-over-everything Internet

- Always-on devices
  - ADSL, cable modems... games consoles...
- Voice and data convergence
  - mobile IP telephony – VoIP, UMTS and beyond
  - compare cellular ownership to Internet hosts
- Mobile ad-hoc computing
  - wireless devices/PDAs (e.g. 802.11),
  - Bluetooth...
- Need UNIQUE address space as a tech enabler
  - 100 IP addresses per person or household?



# The Pervasive Internet

- Pervasive IP-based computing
  - palmtop, wearable, household, in-car,...
- Smart Buildings
  - pervasive information fabric
  - embedded IP devices
  - shared mobile, wireless work
- Smart Homes
- Smart Cars

**....Millions of IP Addresses!**



# Notations of IPv6 Addresses

- 128 bit is represented as:
  - 8 integers (16-bit) separated by colons
    - each integer is represented by 4 hex digits

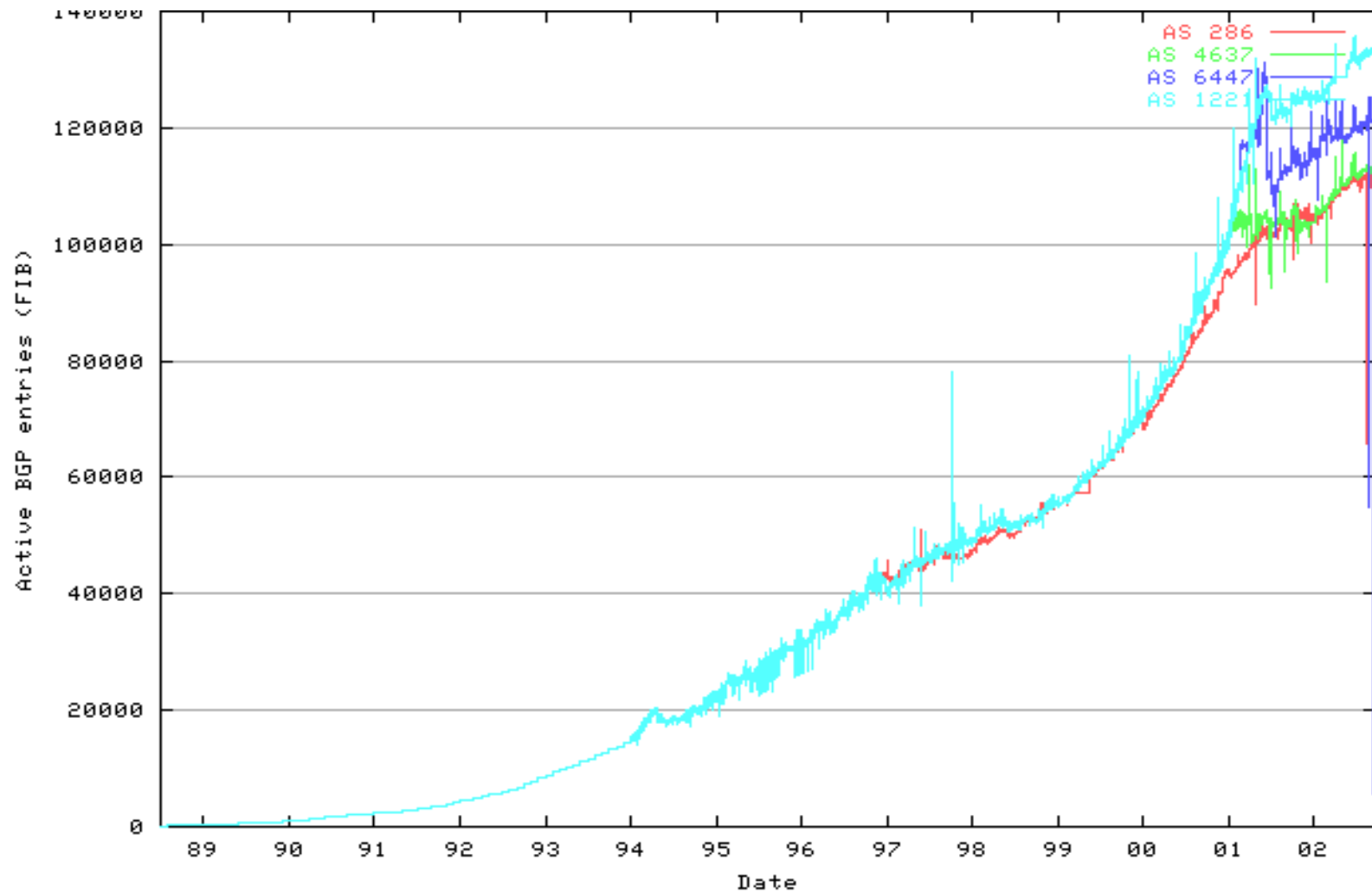
Example:

fe80:0000:0000:0000:0200:e8ff:fe4e:0000



# BGP Table Data -Active BGP entries

Report last updated at Wed, 18 Sep 2002 16:1:5 UTC+1000

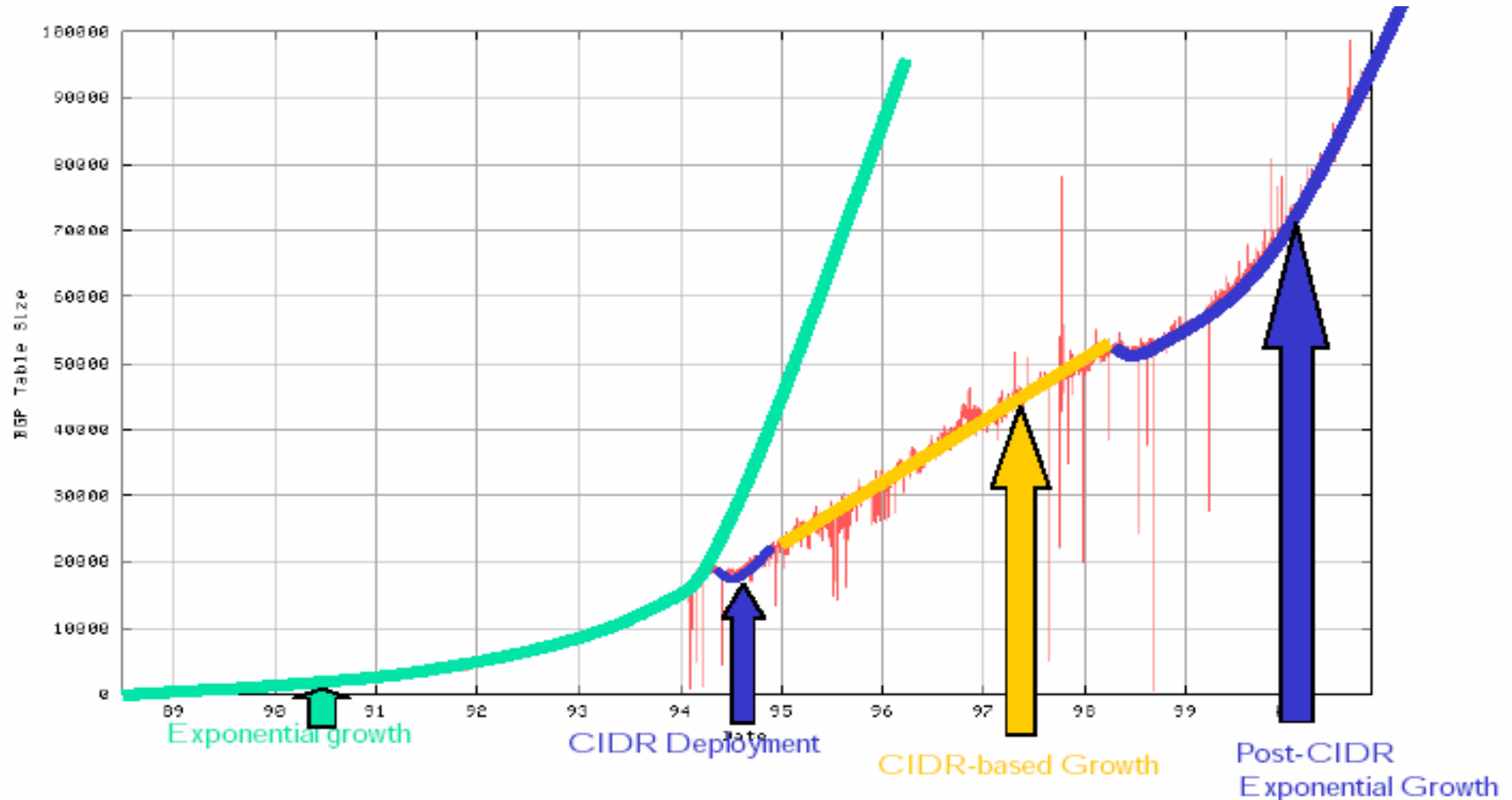


Source: <http://bgp.potaroo.net/>



# Route Table Consolidation

## - Short term solution



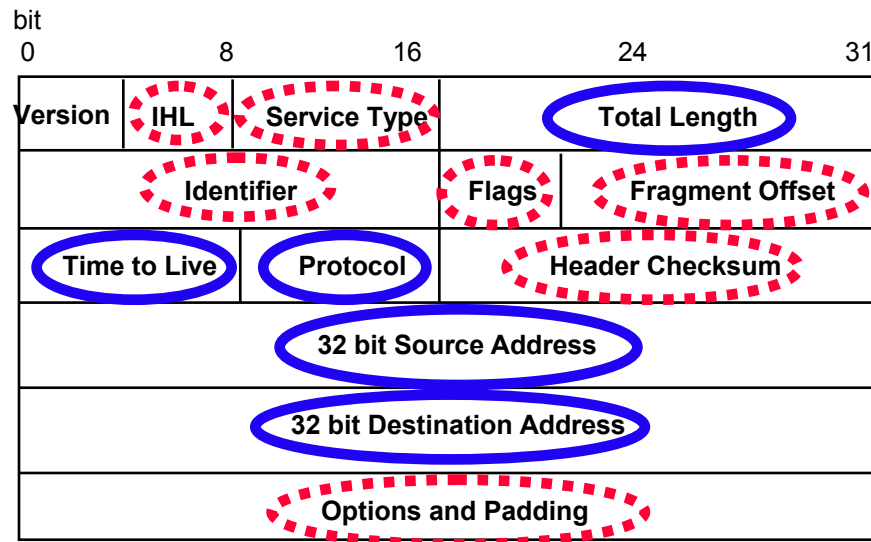


# IPv6 Design Philosophy

- Recognizable yet simplified header format
- Reduce common-case processing cost of packet handling
- Keep bandwidth overhead low in spite of increased size of the address
- Flexible and extensible support for option headers
- Design optimised for 64-bit architecture
  - Headers are 64-bit aligned



# IPv6 Header – Comparison with IPv4

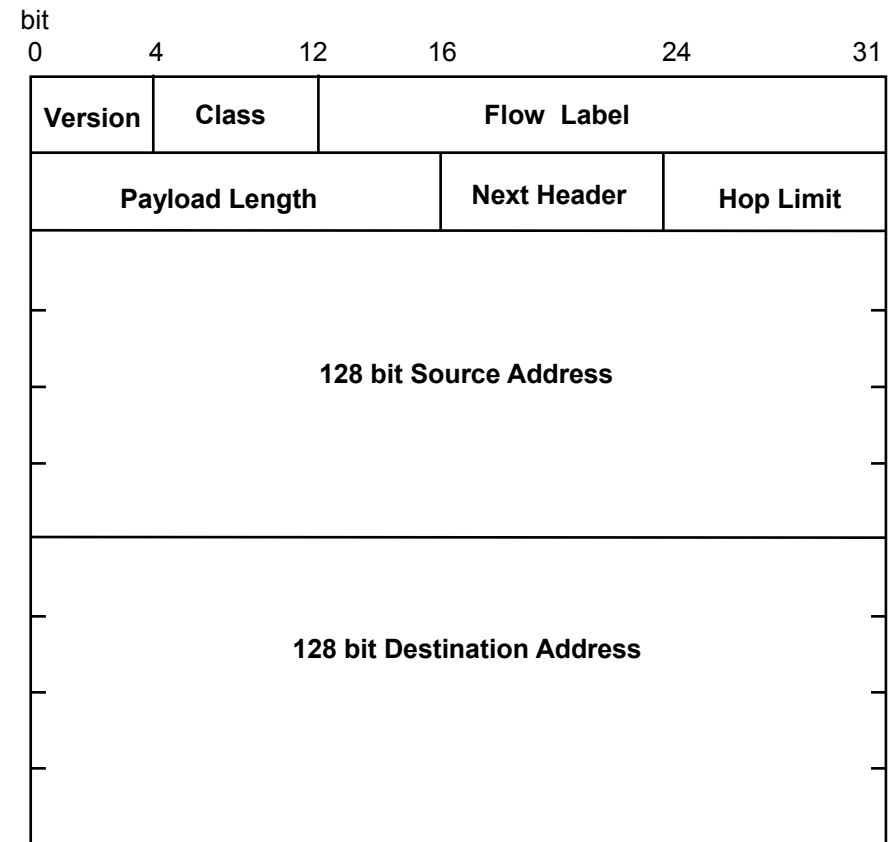


## IPv4 Header

20 octets, 12 fields, including 3 flag bits  
+ fixed max number of options

Changed

Removed

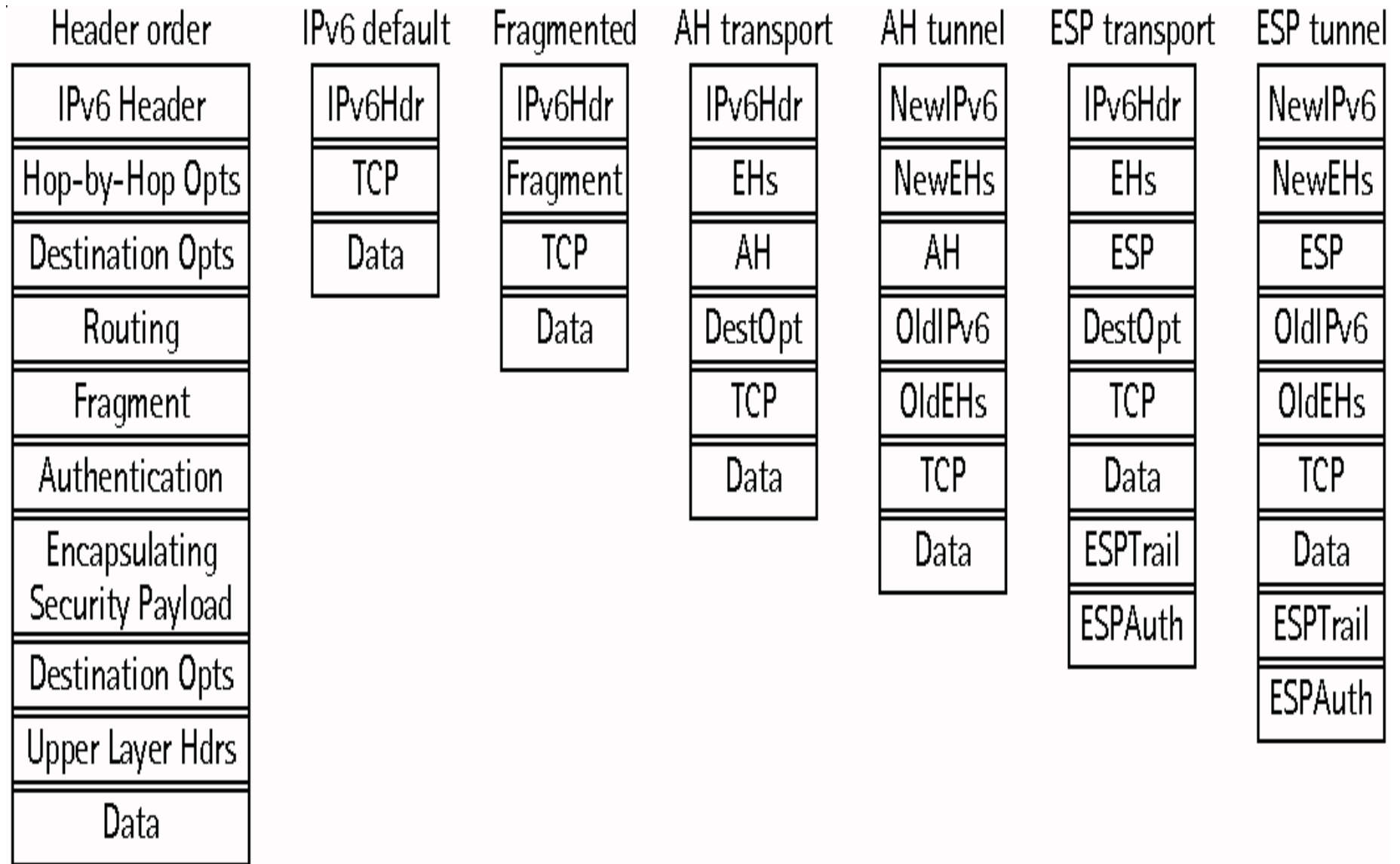


## IPv6 Header

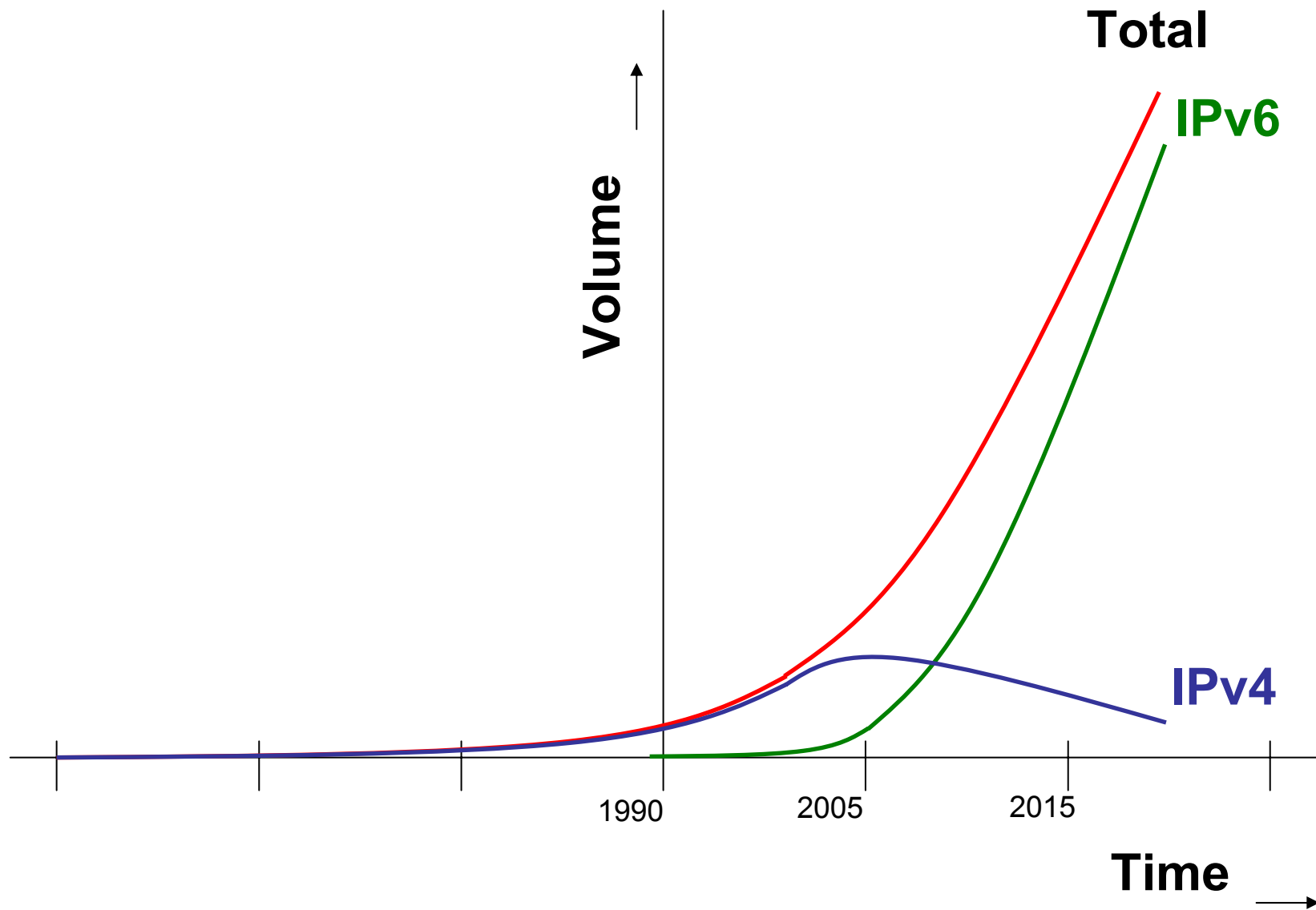
40 octets, 8 fields  
+ Unlimited Chained Extension (options) Header



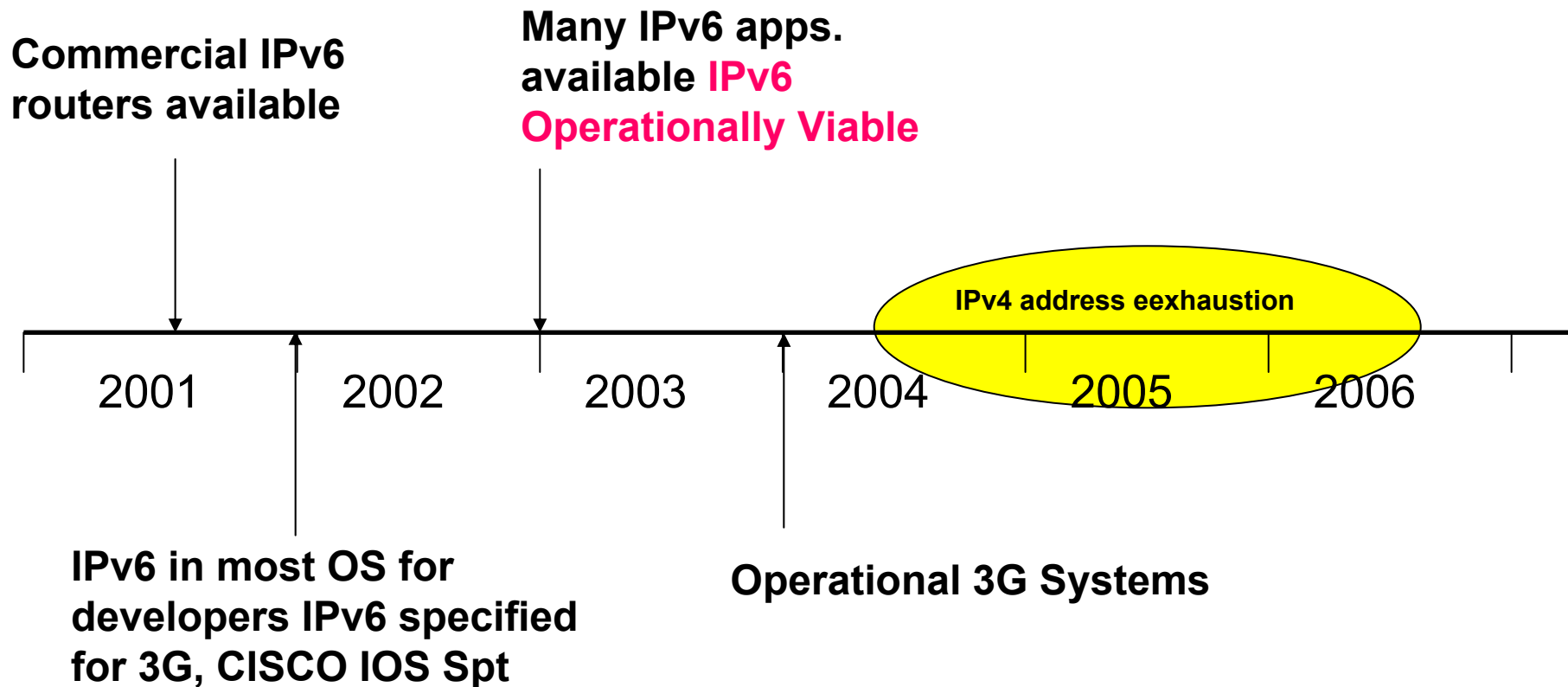
# IPv6 Extension Headers



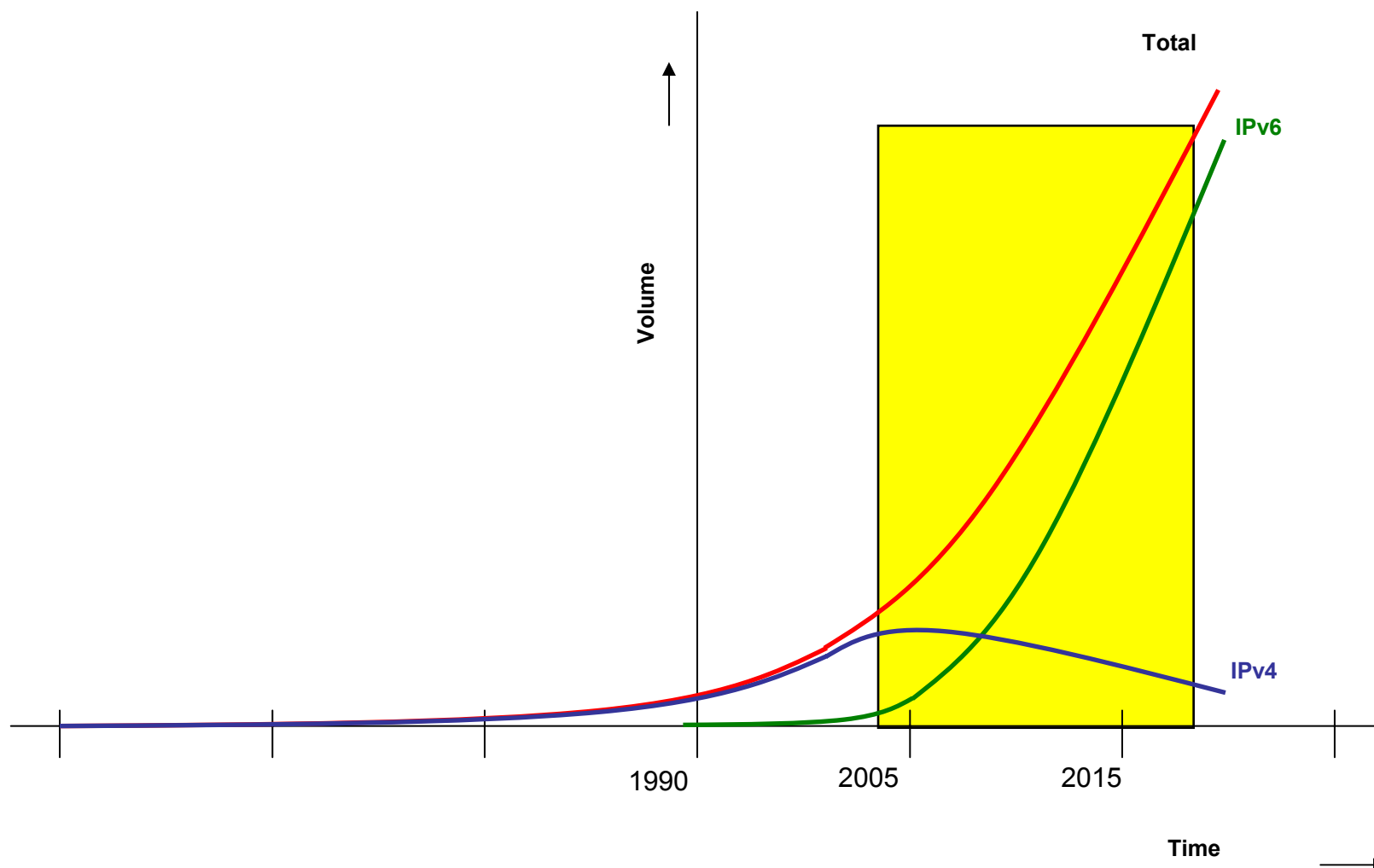
# IPv6 Position



# IPv6 Timeline

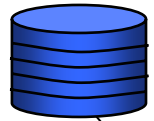


# Interworking Required



# Internet Access and Border

## End User Wireline



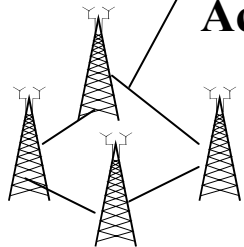
Access Node



Border Node



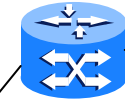
Access Node



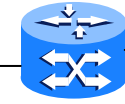
## End User Wireless

## Application Services

Access Nodes



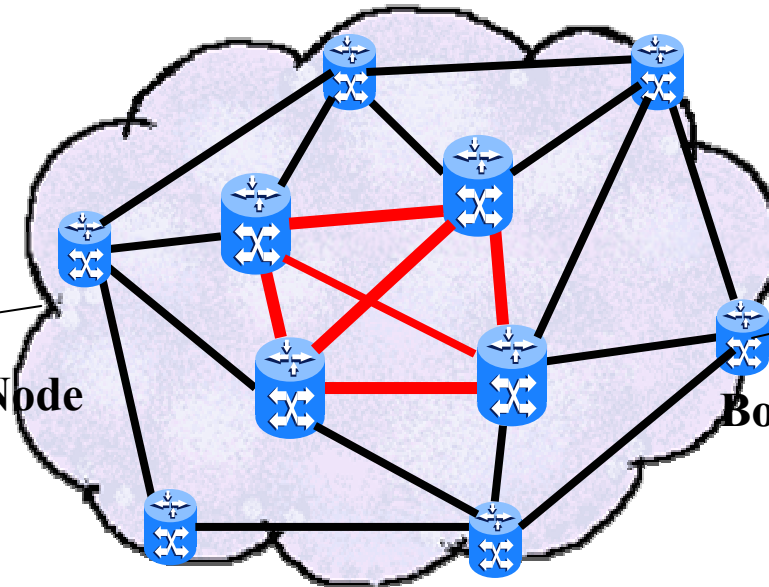
Voice Services



Video Services



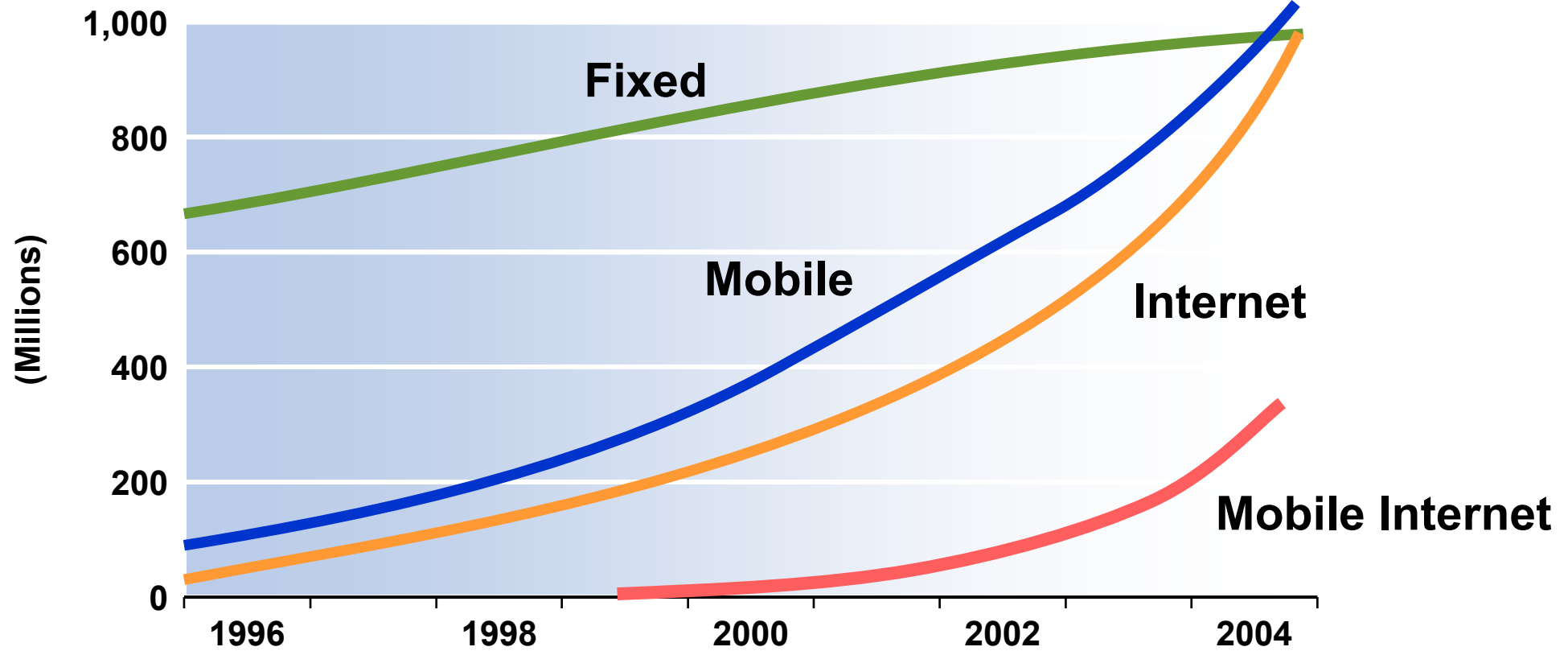
Gaming Services



Internet Edge and Core



# Mobile Internet: in 4 years the size of 10 years GSM

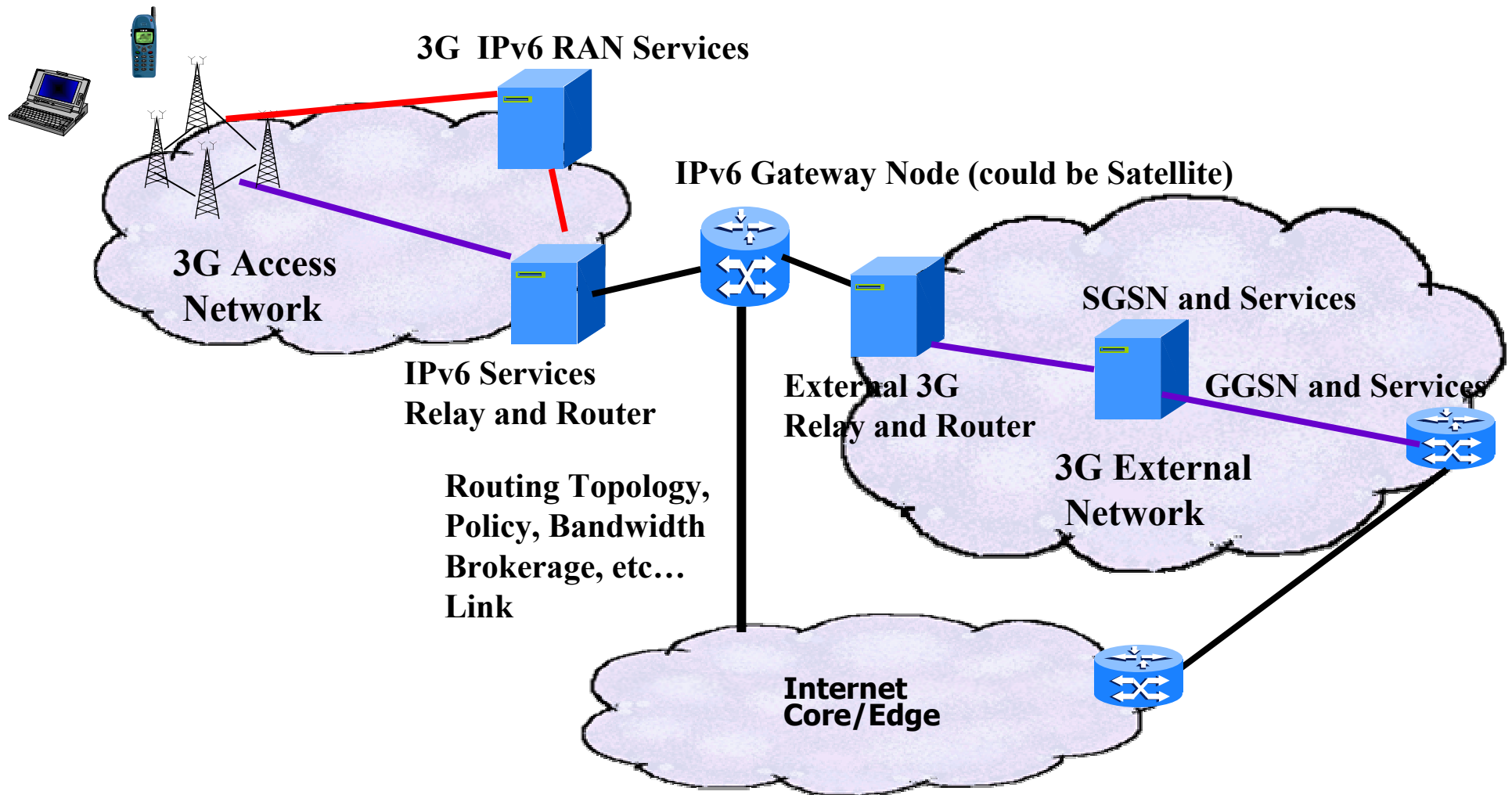


Source: Ericsson 2000





# A 3G Deployment Example



# IPv6 auto-configuration

- Network prefix advertised
  - via Router Advertisement on local network
- Stateless auto-configuration
  - append 48-bit MAC address with 'fffe' in middle
  - includes duplicate address detection
  - can find services via IPv6 multicast
  - if prefix changes, host can reconfigure
  - IP registered via Dynamic DNS

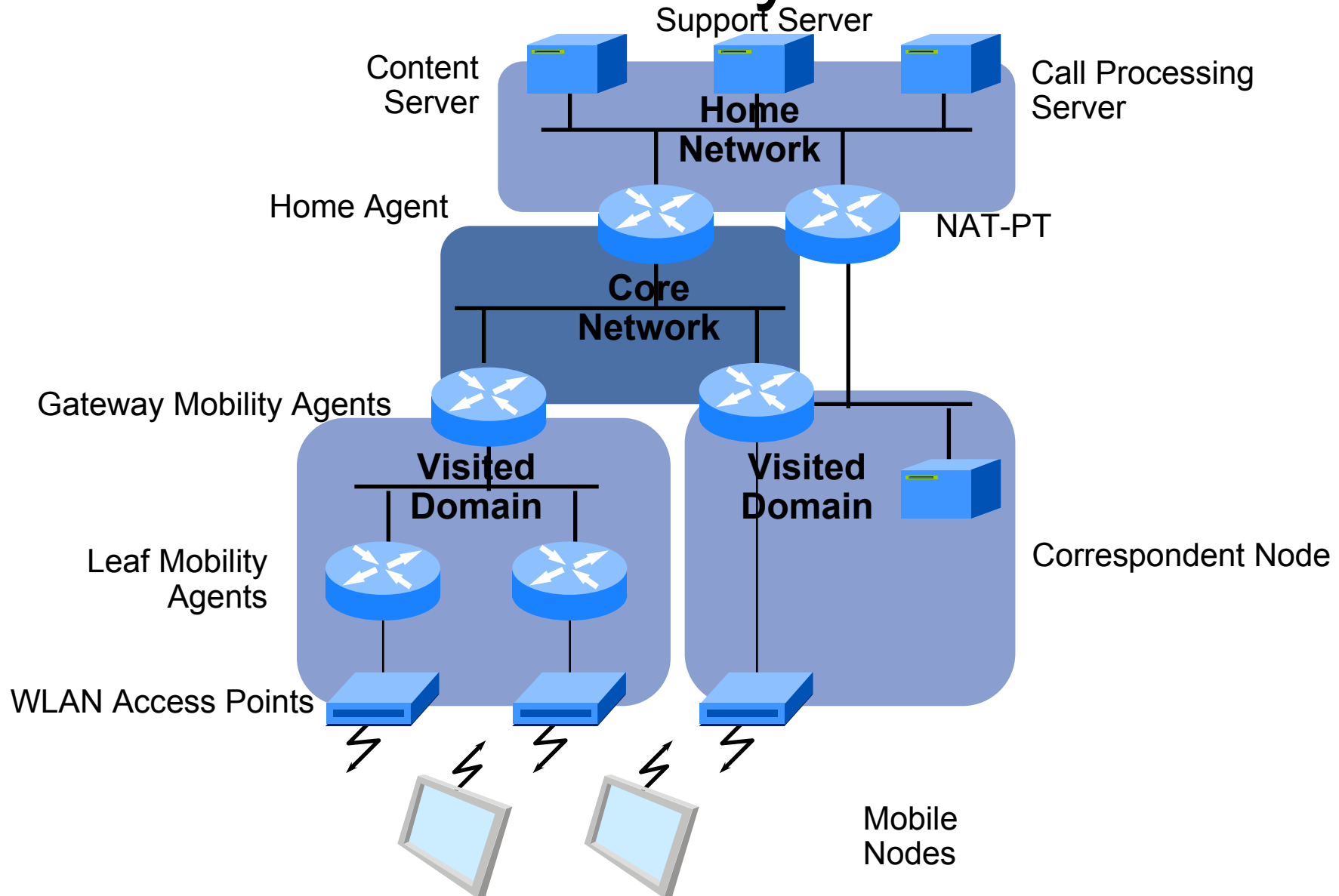


# Auto-configuration benefits

- Reduced management overhead
  - devices generate their own IPv6 configuration
  - no IP address clashes, extensible subnets
- Ability to change ISP more easily
  - router advertisements, router renumbering
- Ability to deploy anywhere
  - may need secure auto-configuration
- Improves IP mobility
  - minimises the need for a foreign agent interaction



# IPv6 Mobility Features



# Australia Status

- 6Bone operations through Trumpet etc. 1996
- UeCOMM deploys IPv6 with Ericsson core 2000
- Connect.com registered as TLA, begins to allocate IPv6 Addresses - 2001
- NTT announces trial launch 18/9/2002
  - Trail to operate from 1/10/2002 to 30/6/2003



# Australia Status

- Hitachi 1<sup>st</sup> vendor to offer IPv6 Router in Oz
- IPv6 Web Sites -http<sub>v6</sub>  
(not Web sites about IPv6):
  - <http://shag.ipv6.bl.echidna.id.au/>
    - Experimental private IPv6 Router
  - <http://www.sharks.org.au/>
    - Ice Hockey Club web page
  - <http://vortex.ipv6.intercode.com.au/>
    - This site has some links to other sites and a traceroute server
- IPv6 in most OS now
  - CISCO IOS, WindowsXP, FreeBSD, Linux, MACOS, PS2 etc.

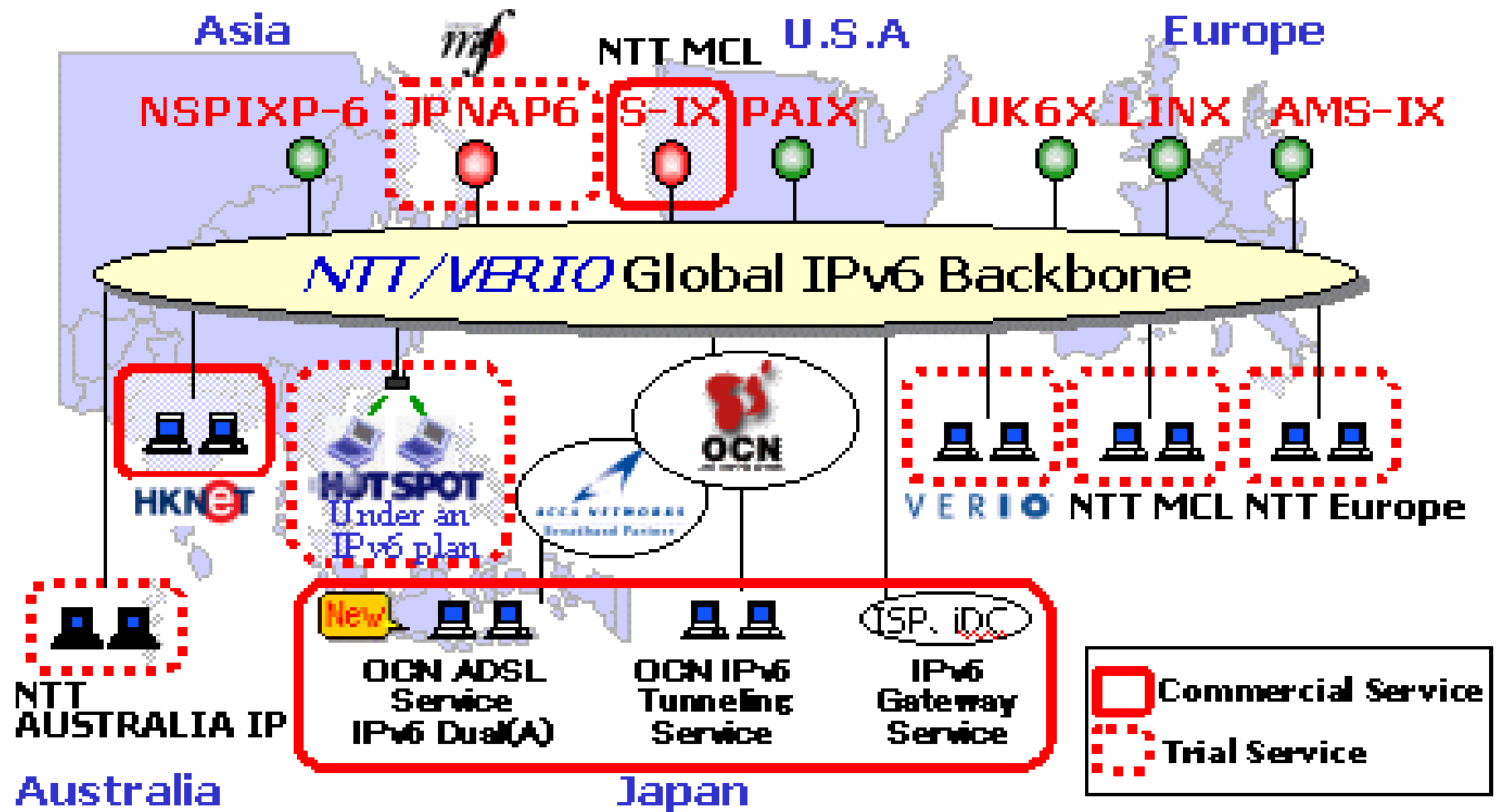


# IPv6 through AARNet

- Initially tunneling IPv6 into an AARNet router and tunneling on to IPv6 researchers networks. In time this will move to native IPv6 routing.
- Overseas feed - peering with Abilene (noc@abilene.iu.edu, AS11537 and the Internet2 IPv6 working groups pages) and APAN-JP (AS7660) and Euro6IX (Jordi Palet info@euro6ix.net).
- Australian backbone - tunneled through the AARNet "lattice" boxes (Dell PCs running RedHat linux).



# NTT in Australia



Source: [http://www.v6.ntt.net/globe/index\\_e.html](http://www.v6.ntt.net/globe/index_e.html)





# What is the Internet used for today ?

- Email –the ‘Killer Application’ ?
- Web Browsing
- Applications Transactions
- Video on Demand
- Video conferencing/ Voice over IP
- Peer to Peer computing –e.g. Napster, Morpheous
- Distributed games

## What will the Internet be used for tomorrow ?

## Exactly the same...but faster!



# Plus...with IPv6...

- More Peer to Peer applications support
- MobileIP and IP Roaming
- Routable Addresses used everywhere...
  - Because SECURITY is inherent
- Converged access on multifunction terminals
- Granular Management, Billing and AAA
- SCALE and ATOMISATION

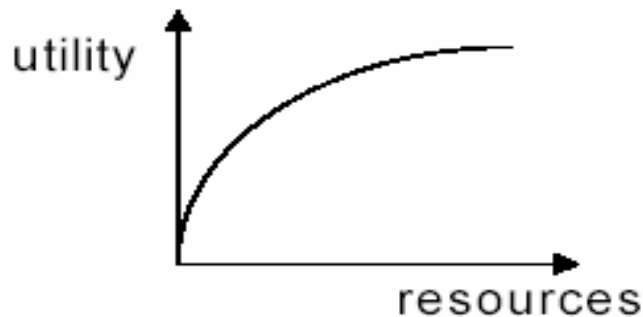


# Utility and Bandwidth

## Utility Curve == Price Elasticity

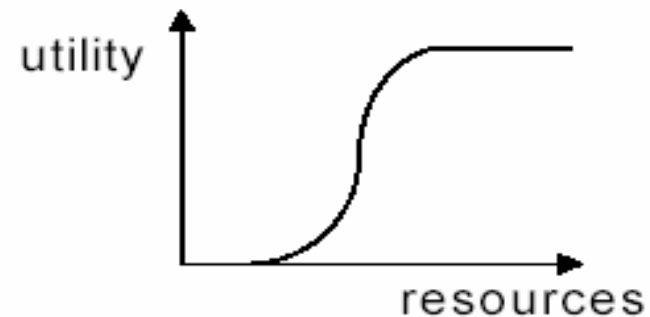
Utility per unit resource i.e. bandwidth

### Elastic Applications:



e.g. WWW, ftp, file transfers, email,  
on-line transactions

### Inelastic Applications:



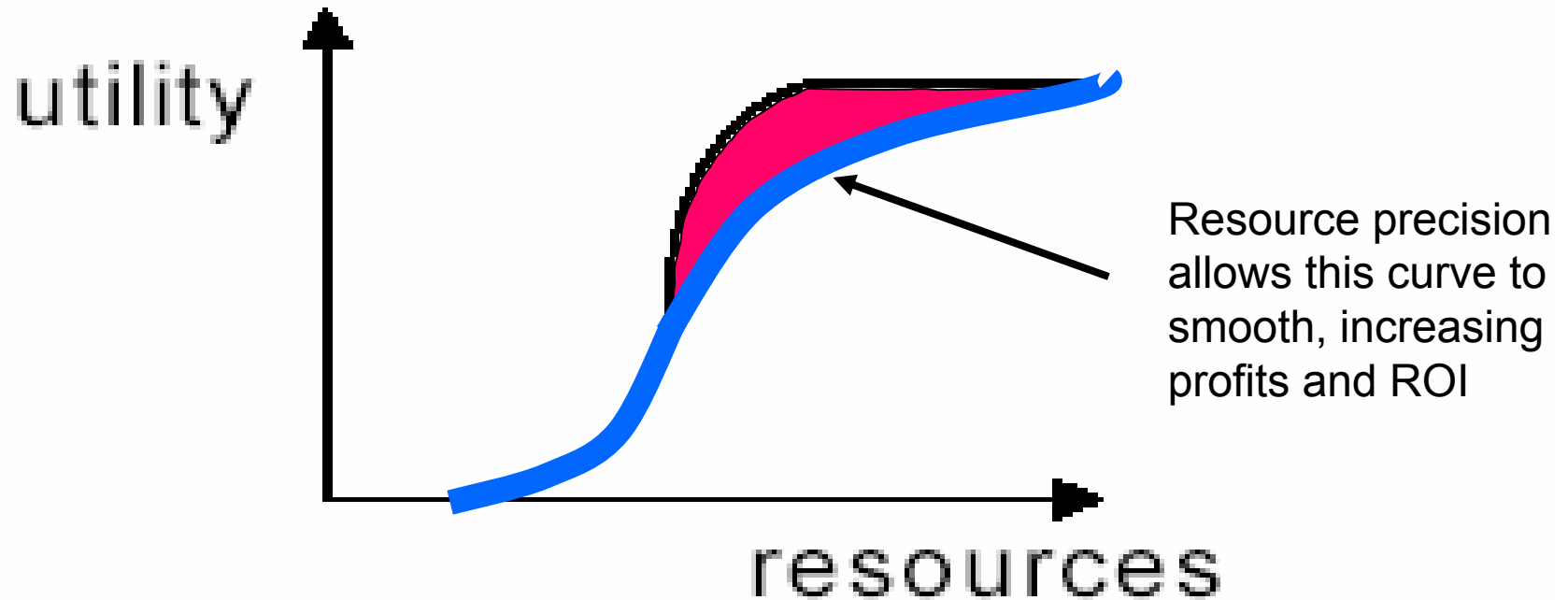
e.g. video, audio, conferencing,  
gaming

**The Internet == Elastic + Inelastic**



# IPv6 Granularity

## Inelastic Applications:



# AAA Terminology-RFC2977

- **Accounting**  
The act of collecting information on resource usage for the purpose of trend analysis, auditing, billing, or cost allocation.
- **Authentication**  
The act of verifying a claimed identity, in the form of a pre-existing label from a mutually known name space, as the originator of a message (message authentication) or as the end-point of a channel (entity authentication).
- **Administration**  
Management of operational resources, from planning through provisioning to end of service.
- **AAA Diameter** base protocol is intended to provide a AAA framework for Mobile-IP, NASREQ and ROAMOPS.
- 3<sup>rd</sup> party **API** interfacing... e.g., for 3GPP via Parlay/OSA

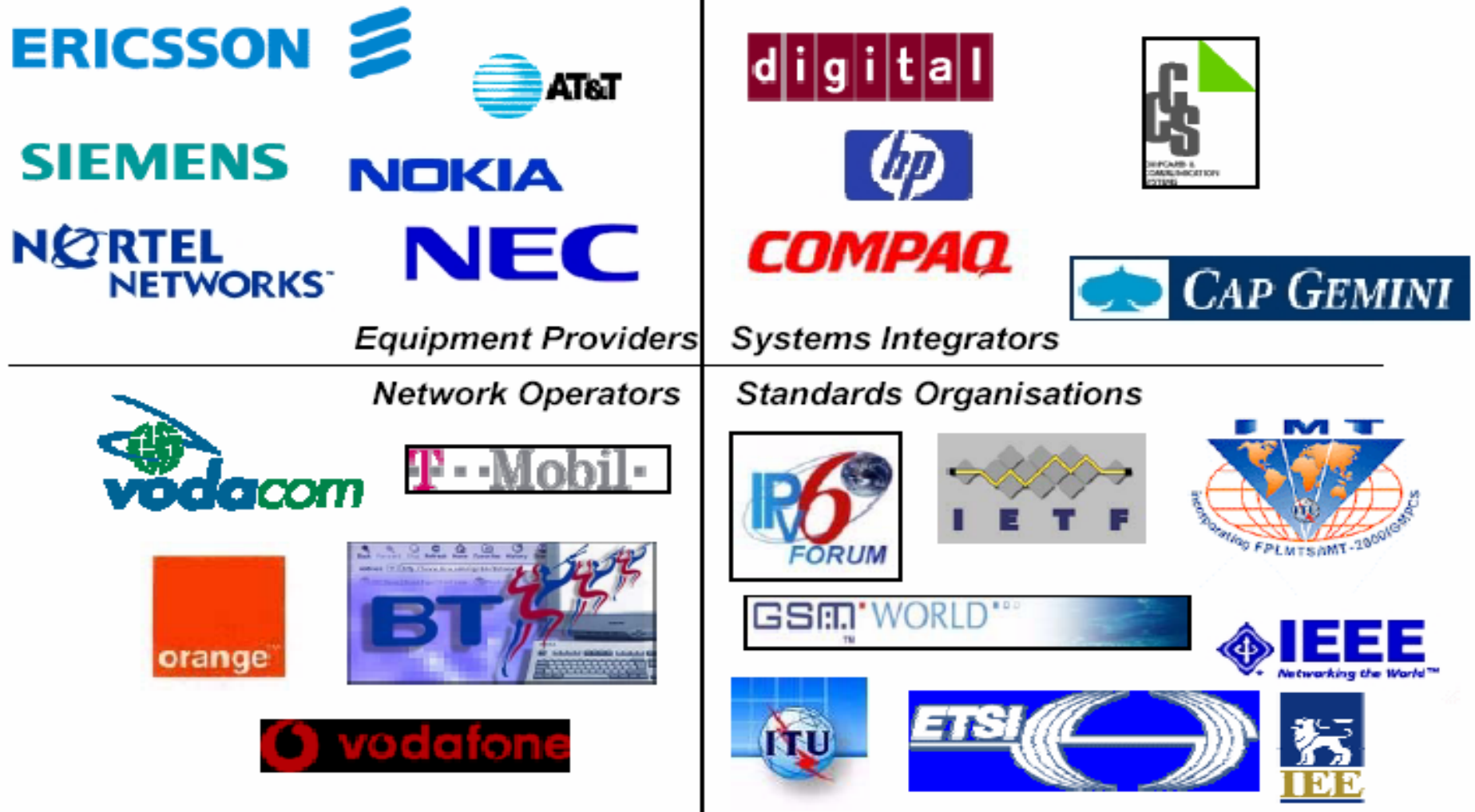


# Charging Models for Internet Usage

- Metered charging
- Usage based pricing
- Fixed Price
- Paris-Metro Packet charging
- Edge pricing
- Other Models
  - Smart Markets
  - Expected capacity
  - Fair pricing
  - Quota based charging
  - Fair Allocation



# IPv6 Billing: Complex Interactions



Source: After [http://www.comp.lancs.ac.uk/computing/users/cushniej/papers/2\\_year\\_report.pdf](http://www.comp.lancs.ac.uk/computing/users/cushniej/papers/2_year_report.pdf)

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# Some Charging Conclusions

- **Internet Charging**
  - Here and now –very relevant
- **Data Capture**
  - Potentially enormous amounts of data
  - Reducing data into information is vital
    - Aggregation & Correlation –the key
- **Charging Models**
  - Combination models may be more suitable
  - Metering using standard protocols is required
    - e.g. Diameter, IPexport, SNMP etc.
  - Direct charging for content/services needs to be addressed

**IPv6  
Facilitated!**

**IPv6  
Facilitated!**





# AARnet Internet2 IPv6 Workshops

- **Sydney 1/2 October 2002**
- **Brisbane 15/16 October 2002**
- **Adelaide 29/30 October 2002**

**Email:** [internetworkshop@aar.net.edu.au](mailto:internetworkshop@aar.net.edu.au)

**Post:**           **Workshop Organiser**  
                  **AARNet Pty Ltd**  
                  **83 Chelford Street**  
                  **Alderley Qld 4051**

**Fax:**           **07 3311 5605**

**W3:**

<http://www.aar.net.edu.au/rd/advanced-internet-workshops/aiw02-2/index.html>



# Crystal Ball Gazing

Consultancy, East & Partners is holding a complimentary briefing, panel discussion and lunch on:

- ***The Future of Telecommunications in Australia: Where to Now?***
  - From 12:30pm to 3:00pm, October 3, Wentworth Hotel, Phillips St, Sydney.
  - Participants will include Shadow Treasurer Bob McMullan, ATUG MD Rosemary Sinclair, Brad Scott from Salomon Smith Barney and industry analysts.
  - To register, call Brett Williamson (02) 9004 7855 or email [brett.w@east.com.au](mailto:brett.w@east.com.au)



# IPv6 Forum Australia

- Part of the *OneWorld IPv6 Forum* that includes, the US, Europe, China, Taiwan, Japan, Malaysia, India and Korea
- Call for Industry Meeting in November '02 to gauge interest in participating
- Email [ipv6@apnetworx.com.au](mailto:ipv6@apnetworx.com.au) for more information



**Thanks for your attention**  
**Any questions?**

Michael Biber

<http://www.apnetworx.com.au>

[mbiber@apnetworx.com.au](mailto:mbiber@apnetworx.com.au)

