

Service provider planning for the IPv6 Internet

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Ross Chandler

Network Architect

IP Network Strategy Group

Status of IPv6 in Eircom

- Connected to 6BONE in 2002
 - Got IPv6 allocation from RIPE NCC in 2003
 - Providing IPv6 over IPv4 tunnel access to customers with a static IPv4
 - Anycast 6to4 Relay also (RFC 3068)
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- Next slide review of IPv4 allocations in Ireland

IPv4 allocations to Ireland

- Estimate of numbers of IP addresses allocated to Ireland based on routing advertisements at Irish peering point INEX

Network	IPv4 addresses 000s
HEANET	1,766
Eircom	954
Imagine	452
BT Ireland	413
Vodafone Ireland	150
Magnet	110
SMART	102
Clearwire	32
Others	400
Total	4,379

- ComReg Quarterly report December 2008
 - Estimated 59% of households have broadband
 - 25.9% of population have broadband (19.7% non-mobile)

IPv4 allocations to Ireland

- Continuing with Business as Usual
 - We would need at least twice as many IPv4s as we already have
 - appears unsustainable

- Next slide
 - What's being proposed to deal in the short term with the impending exhaustion of IPv4

RIR IPv4 “end-of-life” policy proposals

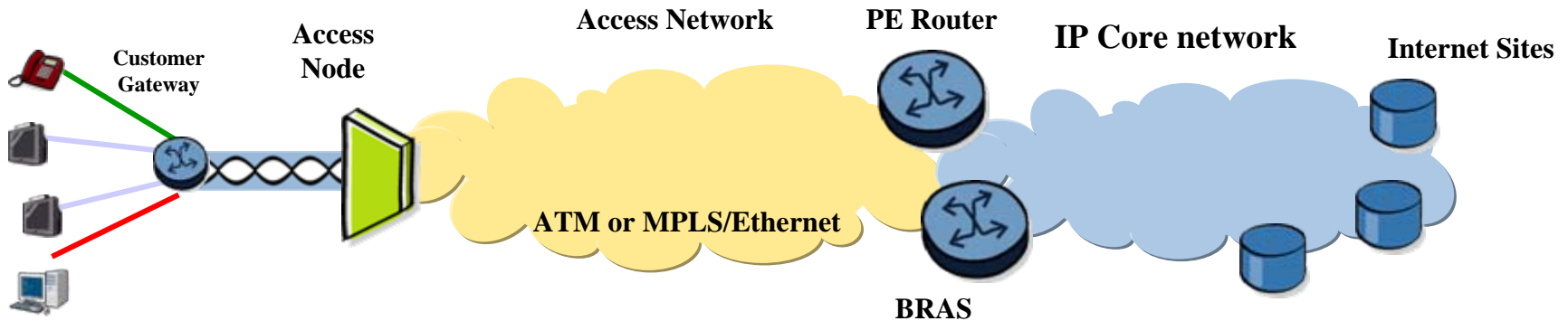
- RIPE - Final /8 (“Global policy for the allocation of the remaining IPv4 address space”)
 - New and existing LIRs will only be given the minimum allocation even if their requests justifies more
- RIPE -Ensuring efficient use of historical IPv4 resources
 - About 50% were made before existing RIR rules
 - Most are in the ARIN region
 - LIRs must document and justify use of historical that were obtained prior to existence of RIPE NCC. E.g 159.134.0.0/16
- ARIN - Liberalising transfer of IPv4 address space between holders
 - “True ownership” of blocks
 - Incentives to return addresses
 - This would help to reflect extra costs of continuing with IPv4
- Good article on IPv4 exhaustion in recent Internet Protocol Journal (Vol11, Num 3)
 - by Geoff Huston

Running out of IPv4 before IPv6 is fully deployed

- The original dual stack strategy for managing the transition will not work
 - It was to gradually introduce IPv6 until every host has an IPv4 and a IPv6 address
 - And then turn off IPv4
- Impending IPv4 exhaustion starting to focus minds
- Measures that were previously *verboden* being considered
 - **Provider NAT**
 - cost and complexity added to service provider network
 - not yet widely supported by vendors
 - **IPv4 <--> IPv6 protocol translation NAT**
 - standards work in progress (IETF BEHAVE working group)
 - unlikely to be widely deployed at the start of IPv4 exhaustion
 - e.g. Chinese IVI
- Next slide: IPv6 looks inevitable so where in SP network do we put it

Typical Fixed Line Access Architecture

- Typical structure
 - CPE, Access Node, Aggregation Network, IP service edge devices, Core
 - Agg, Edge and Core can all be running a common IGP



Putting IPv6 in the service provider network

- It can be incrementally added
- IPv6 multicast services don't have to be supported initially
 - Commercial IPTV services are all IPv4 multicast
- IPv6 deployment in SP core is relatively easy
 - 6PE (IPv6 with MPLS labels) is an easy way to quickly get it over the core without having to complicate operations by much
 - It works very much like MPLS IPv4 VPNs
- Edge/Aggregation access networks
 - This is the most difficult place in the SP network to deploy it
 - ISP IPv6 Deployment Scenarios in Broadband Access Networks RFC4779
- Customer premises
 - Vendors need to provide cheap IPv6 capable routers for residential use

Requirements for customer & provider routers

- CPE Router LAN facing customer
 - Public IPv4 subnet
 - Private IPv4 subnet
 - IPv6 subnet
- CPE functionality
 - Ordinary NAT
 - IPv4/IPv6 dual stacked
 - IPv6 over IPv4 tunnels
 - IPv4 over IPv6 tunnel (used where no IPv4 on access link)
- CPE Router access link to service provider
 - PPP and/or DHCPv4/v6 dynamic assignment of pooled addresses
 - Private IP on WAN link
 - IPv6 on WAN link
- PE Provider Edge router
 - Provider NAT - not yet widely implemented by equipment vendors
 - Protocol translation NAT - still a work in progress

Pros/Cons of different types of CPE

CPE Model	Pro/Con
Res/SME + IPv6 tunneled to home gateway	Not scalable to large IPv6 traffic levels
IPv6 Res/SME Public IPv4	IPv4 exhaustion
IPv6 Res/SME Private IPv4	One or Two layers of NAT
Comcast Proposal	Only one layer of NAT
IPv4 only Res/SME + provider translation	Provider doing it all. Not future proofed.
IPv6 only	Best suited to restricted networks

The End

- Any questions or feedback

Customer Premises Equipment & Access network

Customer Gateway Type	CPE LAN addr			CPE Functions					CPE WAN addr			Provider edge	
	public IPv4	private IPv4	IPv6	Conventional NAT	IPv4/IPv6 translation NAT	IPv6 over IPv4 tunnel	Dual Stack	IPv4 over IPv6 tunnel	PPPoE/DHCP pool addr	Private IPv4	Native IPv6 on link	Provider NAT	IPv4/IPv6 translation
Current Business cust	✓	✗	✓	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗
IPv4 only residential/SME	✓	✓	✗	✓	✗	✗	✗	✗	✓	✗	✗	✗	✗
Res/SME + Tunneled IPv6	✗	✓	✓	✓	✗	✓	✓	✗	✓	✗	✗	✗	✗
IPv6 Res/SME Public IPv4	✗	✓	✓	✓	✗	✗	✓	✗	✓	✗	✓	✗	✗
IPv6 Res/SME Private IPv4	✗	✓	✓	✓	✗	✗	✓	✗	✓	✓	✓	✓	✗
Comcast Proposal	✗	✓	✓	✗	✗	✗	✓	✓	✓	n/a	✓	✓	✗
IPv4 only Res/SME + provider translation	✗	✓	✗	✓	✗	✗	✗	✗	✓	✓	✓	✓	✓
IPv6 only	✗	✗	✓	✗	✗	✗	✗	✗	✓	✗	✓	✗	✓