IPv4 shortage and CERN

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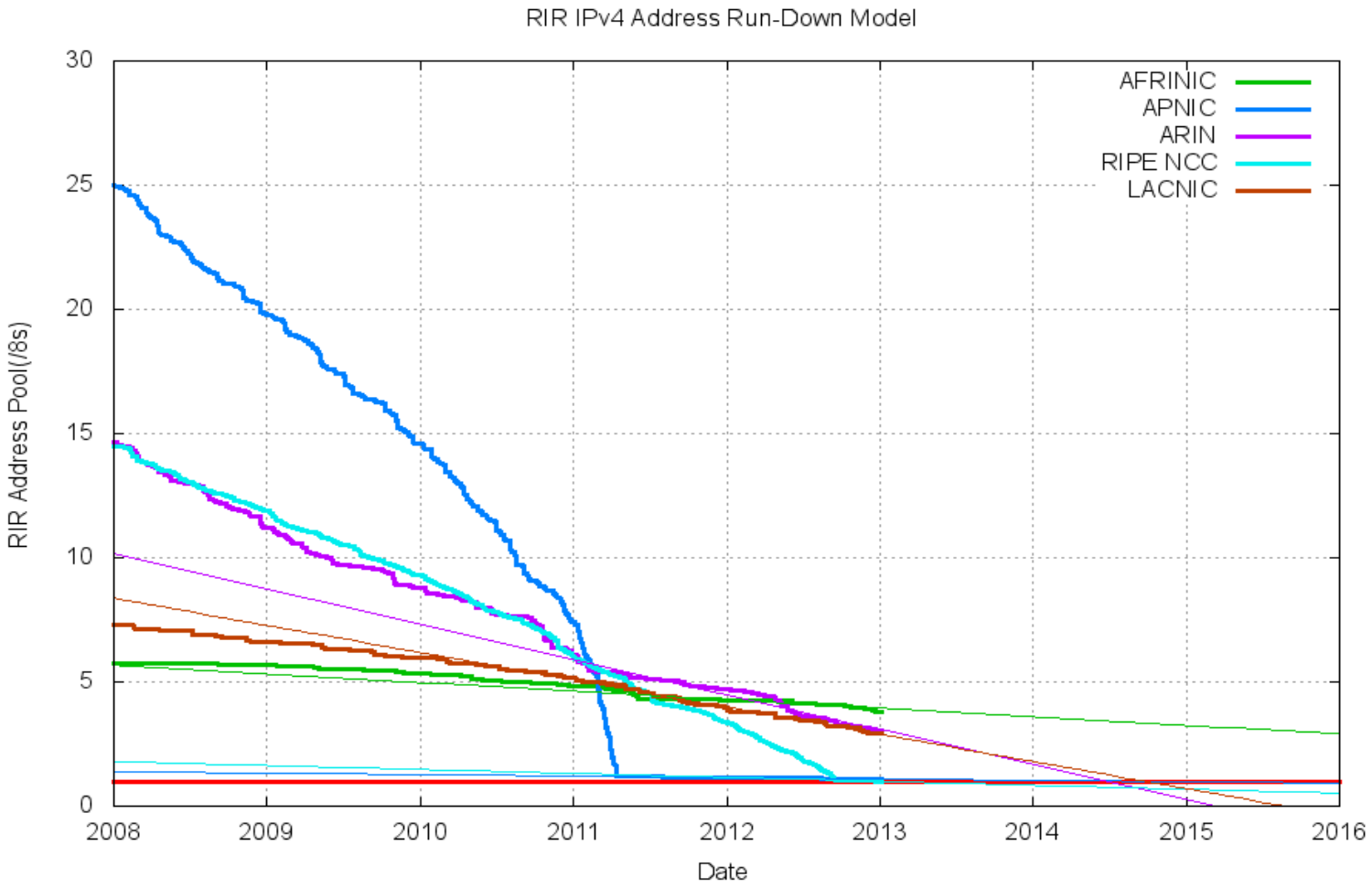
Summary

- IPv4 shortage
- IPv4 and IPv6 coexistence
- Tunnels and Translations
- CERN strategy
- Conclusions

IPv4 shortage

IPv4 exhaustion predictions



http://www.potaroo.net/tools/ipv4/

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IPv4 exhaustion status

IANA Unallocated Address Pool Exhaustion:
03-Feb-2011

Projected RIR Address Pool Exhaustion Dates and remaining /8s (16M blocks):

APNIC:	19-Apr-2011 (actual)	0.8938
RIPE NCC:	14-Sep-2012 (actual)	0.9462
ARIN:	07-Jun-2014	3.0049
LACNIC:	23-Sep-2014	2.8778
AFRINIC:	27-Feb-2021	3.8043

[as of 7th of January 2013]

http://www.potaroo.net/tools/ipv4/

CERN IPv4 addresses status

128.141.0.0/16 (64K) - GPN dynamic addresses (~65% used)
128.142.0.0/16 (64K) - LCG servers in the CC (~40% used)
137.138.0.0/16 (64K) - GPN static addresses (~92% used)
188.184.0.0/16 (64K) - GPN static addresses (~5% used)
188.185.0.0/16 (64K) - Wigner datacentre
194.12.128.0/18 (16K) - Network infrastructure (~35% used)

[as of 7th of January 2013]

Allocation of 188.184.0.0/16 started in October 2012: **5% allocated in only 2 months**

CERN can ask only for one additional /22 (1K)

IPv4 and IPv6 coexistence

Incompatible headers

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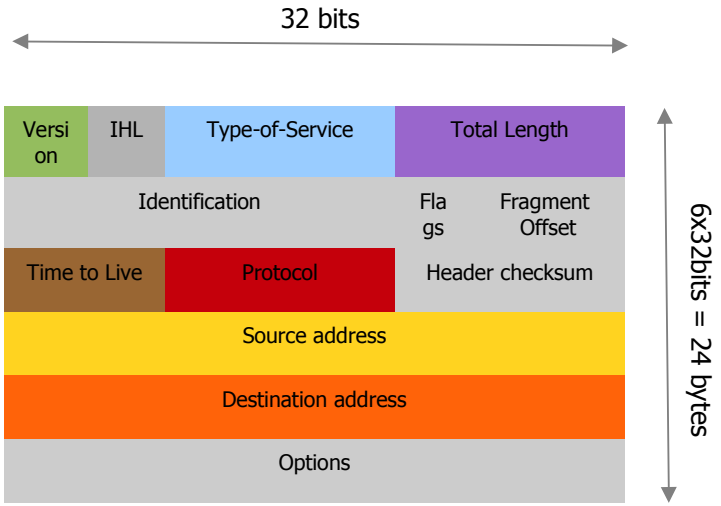
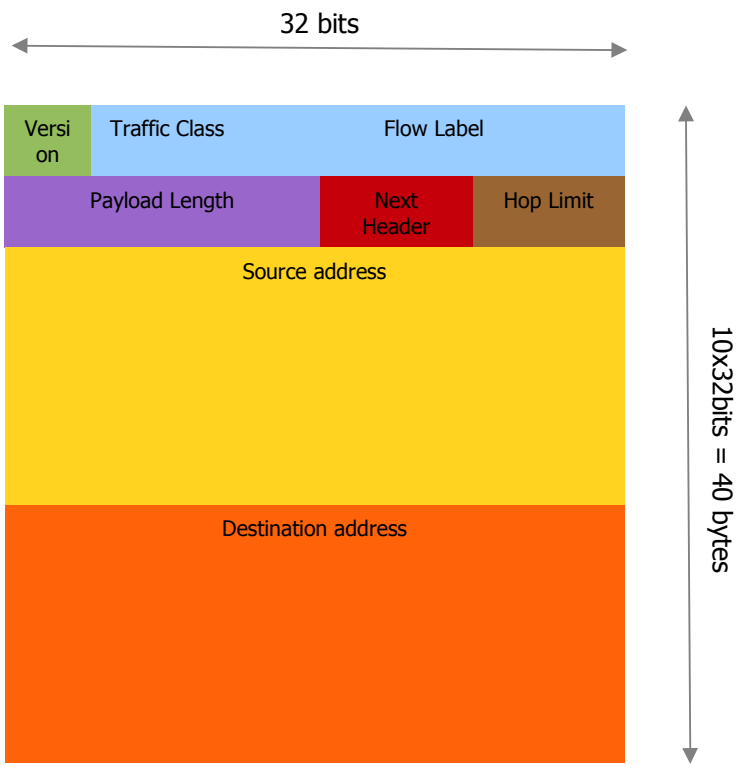
IPv4 header

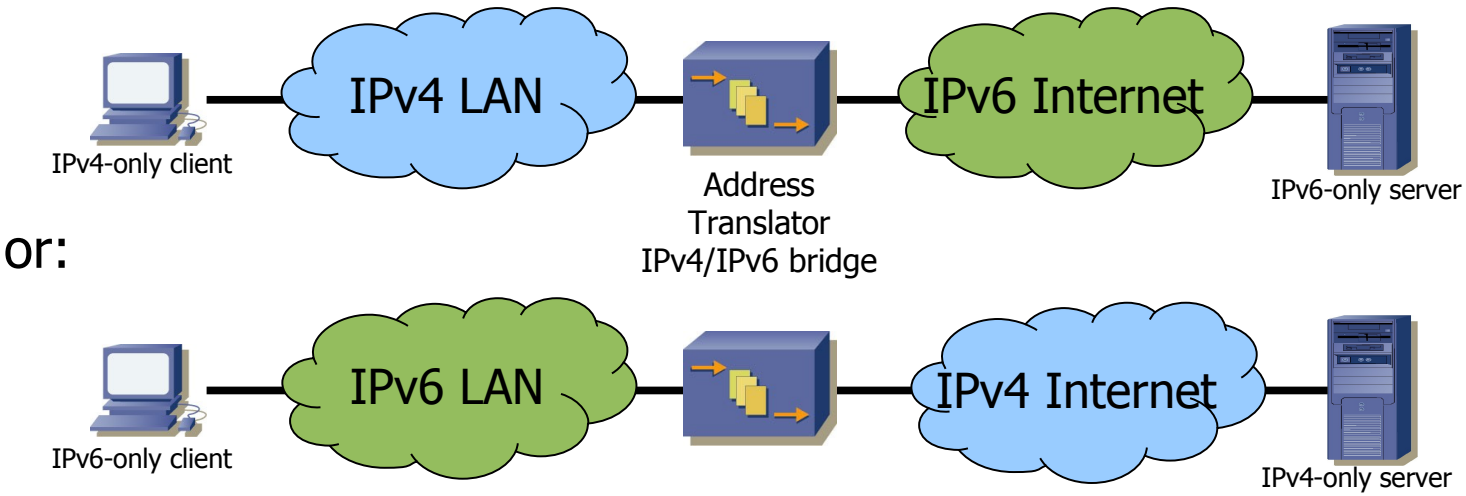


IPv6 header

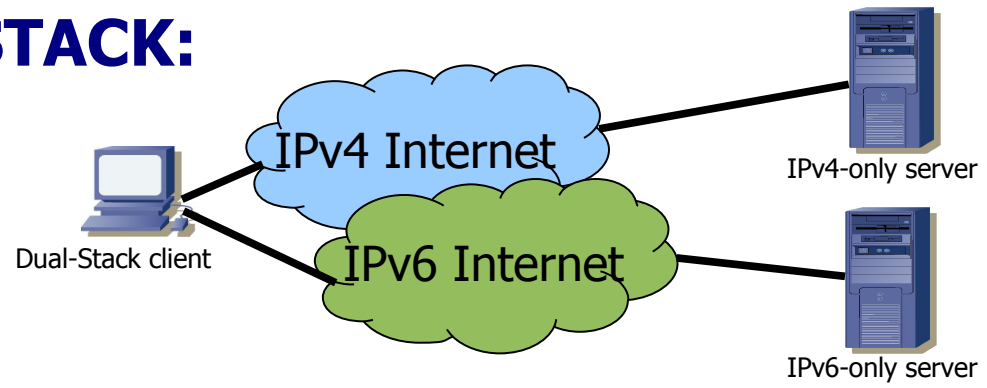


Co-existence strategies

Several NAT/Tunneling options:



DUAL-STACK:



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Pros and Cons

Tunnelings:

+ rapid deployment (few changes)
+ cheap
- limited performance/doesn't scale well
- missing some protocol features

Dual-stack:

+ best performance
+ full features
+ scale well / long term solution
- re-configuration of all devices
- expensive

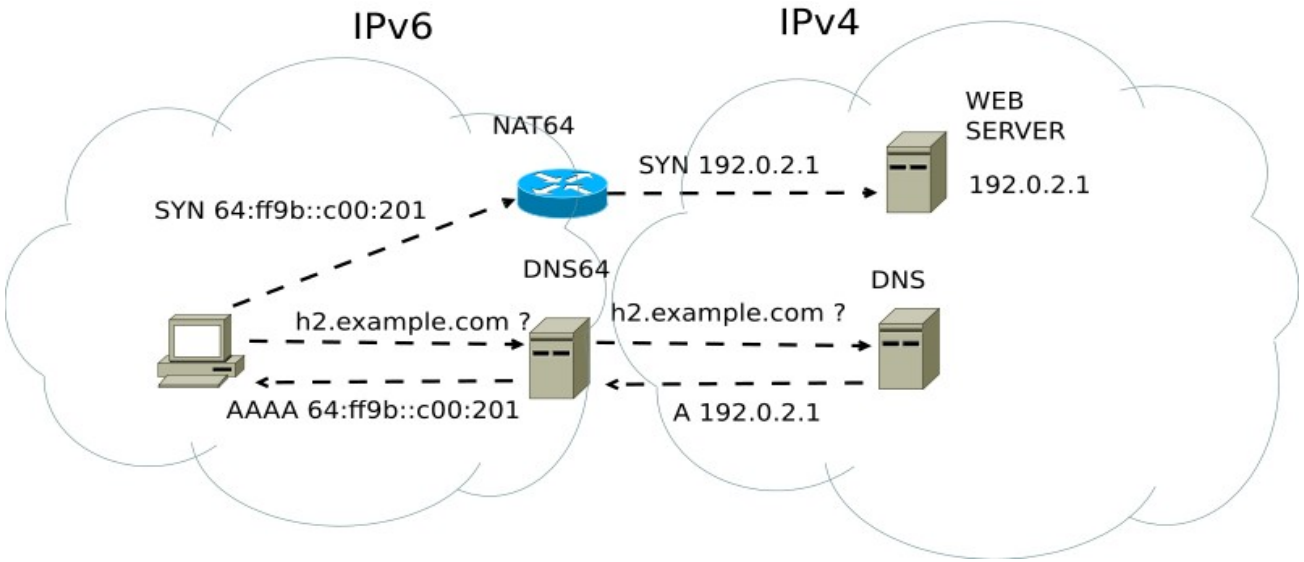
Tunnel and Translation protocols

NAT64

NAT64 allows IPv6-only clients to reach IPv4-only servers.

In general, NAT64 is designed to be used when the communications are initiated by IPv6 hosts. Static address mapping exists to allow the reverse.

The v4-v6 bridge/NAT device works in conjunction with a special DNS server that converts v4 addresses in local v6 ones.



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SIIT

Stateless IP/ICMP Translation (SIIT) allows communications between an IPv4 host and an IPv6 host by translating the packet headers.

Good for bidirectional reachability

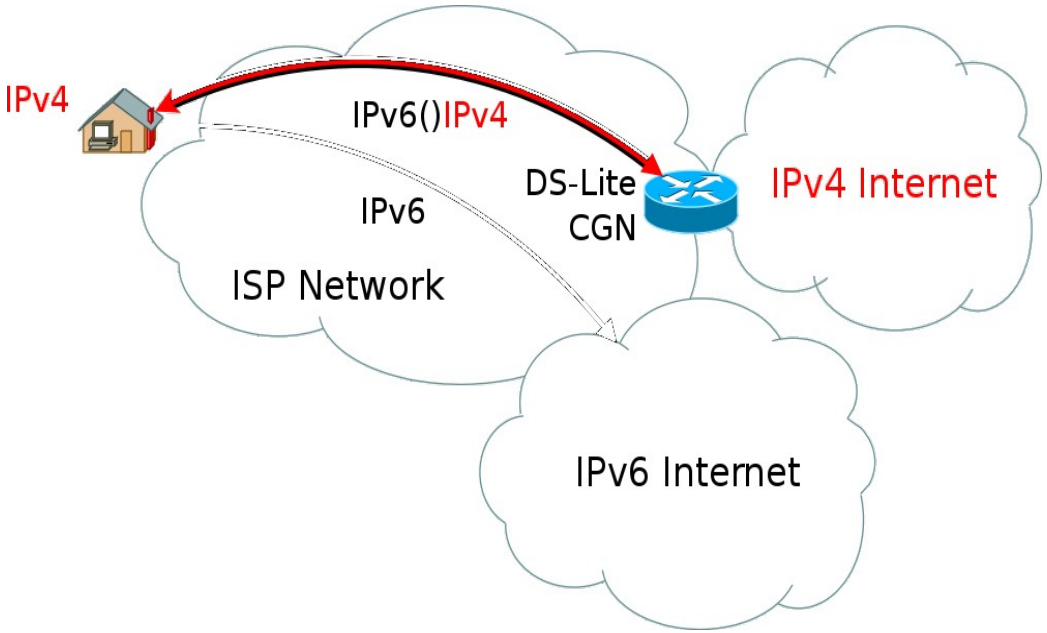
It maps one v4-address to one v6-address

DS-Lite (Dual Stack lite)

DS-Lite allows communications between IPv4 hosts in IPv4 islands. IPv4 clients uses private IPv4 addresses.

IPv4 client packets are encapsulated into IPv6 packets when crossing the IPV6-only ISP backbone.

IPv4 packets are decapsulated and NATed by special DS-Lite CGN devices (Carrier Grade NAT), then routed to the IPv4 Internet.

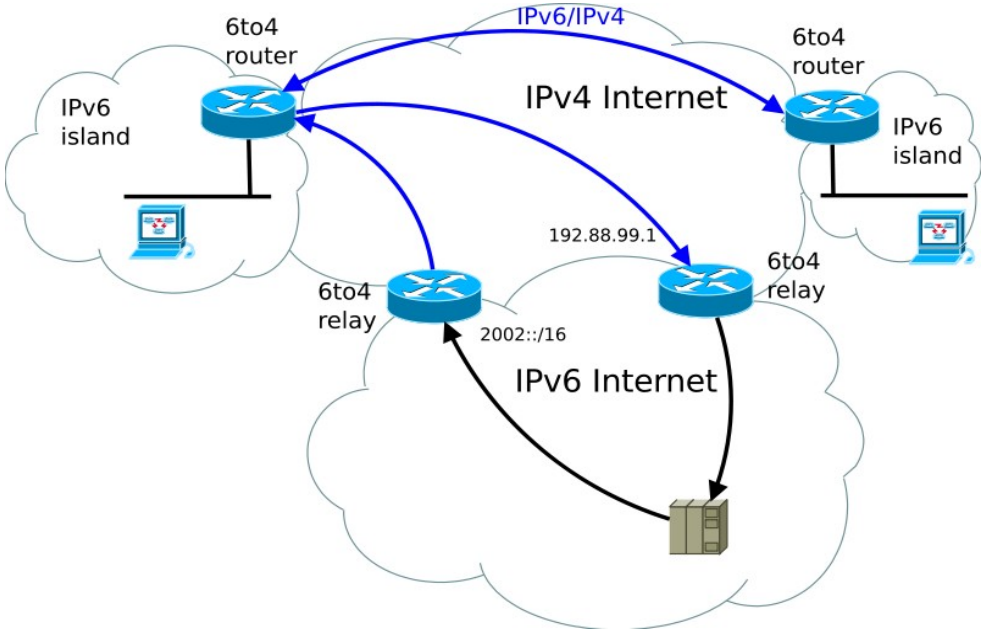


6to4

6to4 allows communications between IPv6 hosts in IPv6 islands.

IPv6 packets are encapsulated into IPv4 packets when crossing the IPv4 Internet.

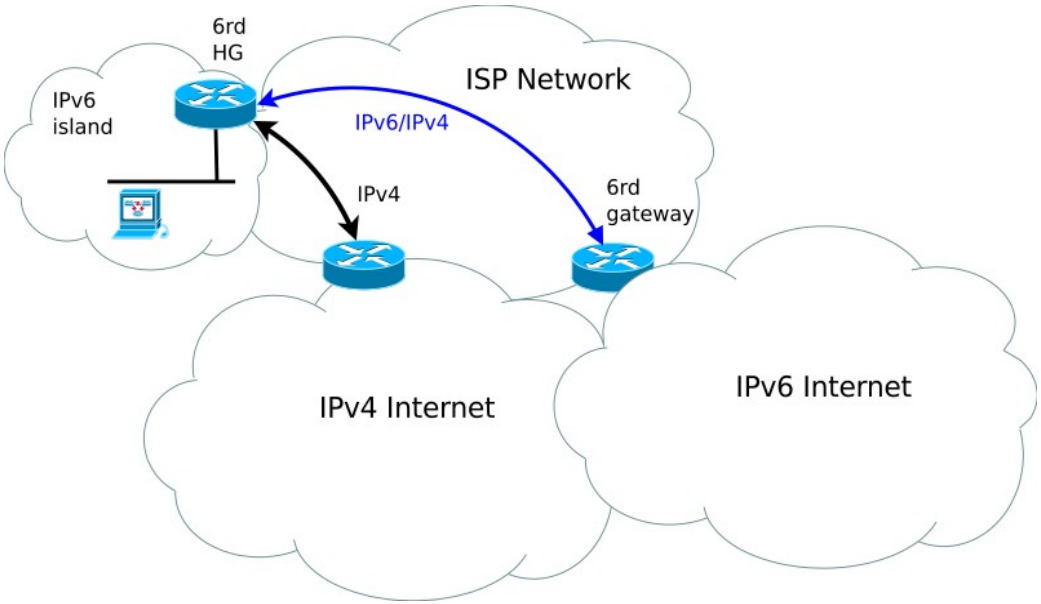
IPv6 encapsulated packets are exchanged between well-known 6to4 routers and relay.



6rd (Rapid Deployment)

Derived from 6to4 but designed to operates entirely within the end-user's ISP's network, to avoid problems due to misconfigured 6to4 routers.

Developed and currently used by Free.fr for their ADSL customers.



4rd

4rd is a mechanism to facilitate IPv4 residual deployment across IPv6 networks.

It is the reverse of 6rd.

Teredo

Teredo allows IPv4-only clients to reach IPv6 only servers by establishing IPv4 tunnels to well-known Teredo relays

Similar to 6to4 but with more limitations.

MAP

MAP allows IPv4 communication between IPv4 islands. Similar to DS-lite + CGN but with the NAT functions delegated to the CPE device (customer router)

Still an IETF draft.

CERN strategy

IPv6 Service Description

- **Dual Stack**
- One IPv6 address assigned to every IPv4 one
- Identical performance as IPv4, no degradation
- Common provisioning tools for IPv4 and IPv6
- Same network services portfolio as IPv4
- Common security policies for IPv4 and IPv6

IPv6 deployment plan

- Testing of network devices: *completed* — 2011Q2
- IPv6 Testbed for CERN users: *available* — 2011Q3
- New LANDB schema: *in production* — 2021Q1
- Addressing plan in LANDB: *in production* — 2012Q1
- Provisioning tools (cfmgr and csdbweb): *almost done*
- Network configuration: *on going*
- Network services (DNS, DHCPv6...): *on going*
- User interfaces (webreq): *on going* — Today
- User training
- IPv6 Service ready for production in 2013 — 2013Q2

IPv4 shortage at CERN

Current VMs adoption plan may cause IPv4 depletion during 2014

Then:

A) IPv6-only VMs

or

B) VMs with private IPv4 addresses

A) IPv6-only VMs

+ Unlimited number of VMs
- Several applications don't run over IPv6 (PXE, AFS, ...)
- Very few remote sites have IPv6
+ Will push IPv6 adoption in the WLCG community

NAT64 or SIIT may be used:

http://tools.ietf.org/html/draft-anderson-siit-dc-00

B) private IPv4 addresses

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+ Works flawlessly inside CERN domain
- Needs NAT to reach not-CERN IPv4-only hosts:
  - may not work fairly with some application
  - still need public IPv4 addresses for external services
  - reduced performance

Conclusions

Conclusions

- IPv4 shortage will soon hit CERN

- Applications will have to live either with private ipv4 addresses or ipv6-only stacks

- Use of IPv6 in the WLCG have to start as soon as possible

More information:

http://cern.ch/ipv6