# Panel: IPv6 Transition and Address Family Translation

**Dave Ward Moderator**

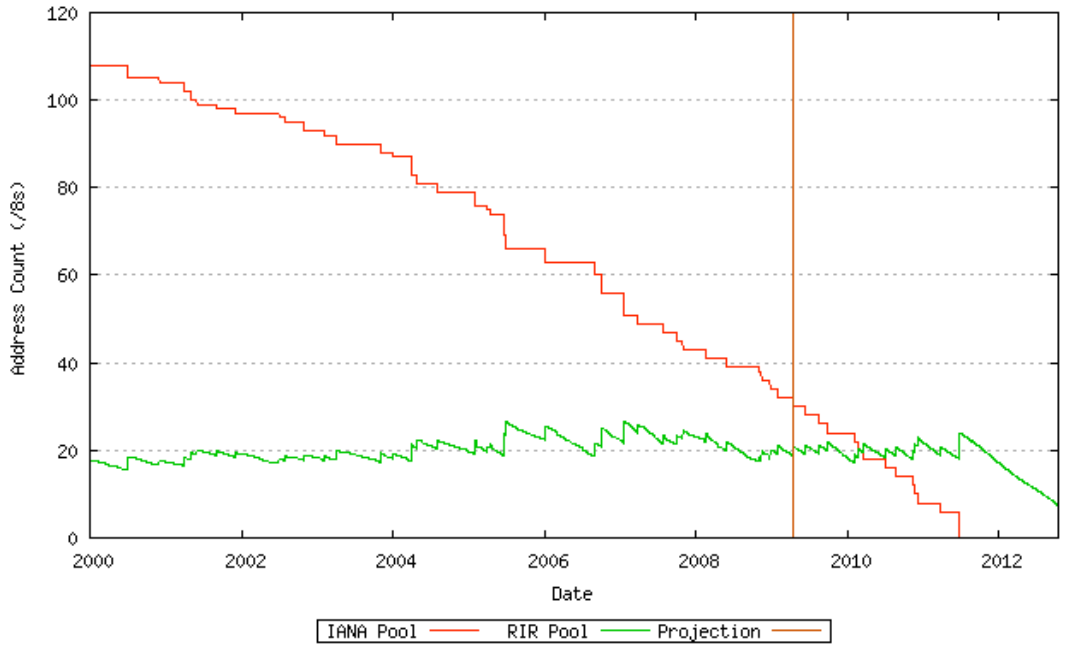
**Lixia Zhang, Suzanne Woolf, Alain Durand, Chris Chase**

**June 2009**

# Problem Statement

- 1st Order is IPv4 Address Run-Out

  Impacts business sustainability and growth




- 2nd Order is Pragmatic IPv6 Transition Strategy

  How does SP move from IPv4 to IPv6?

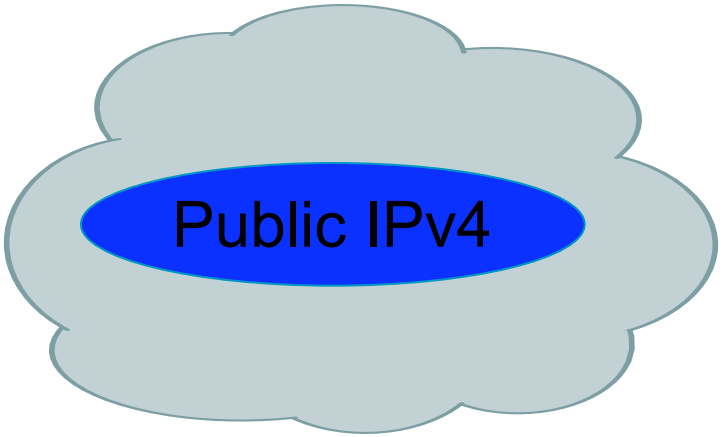
# Some Challenges to IPv6 Deployment

- Everyone waited too long
  - All necessary pieces not built/working
- Existing Transition Mechanisms are not workable on large scale
  - NAT-PT has been deprecated (RFC4966)
  - Dual-Stack (RFC4213) all the way thru the network not viable
- ***"Vast regions of the Internet, even reaching into the home, are and will remain IPv4-only for up to two decades"***
- ***".. The lack of real backwards compatibility for IPv4 was the single critical failure .."*** - Leslie Daigle, Chief Internet Technology Officer for the Internet Society, IETF74

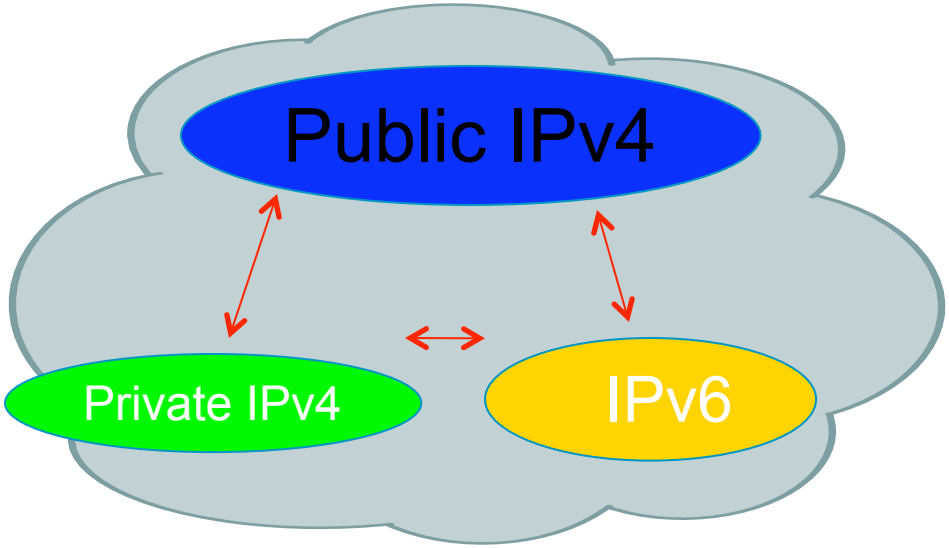
# Challenges to IPv6 Deployment

- IPv6 upgrades require CAPEX/OPEX investment
- Backend processes including provisioning, management and billing are not IPv6-enabled
- Standards required for interoperable devices/software not completed or just recently released
  - Big issue in access networks (CMTS, DSLAM, home gateways, etc)
- Must keep rolling out subscribers and customers
- New devices/market are IPv6 only (e.g. Sensor networking)
  - How to connect to public IPv4 Internet?

# Challenges – Address Families and the Internet




- Internet Today
  - One IP address family today

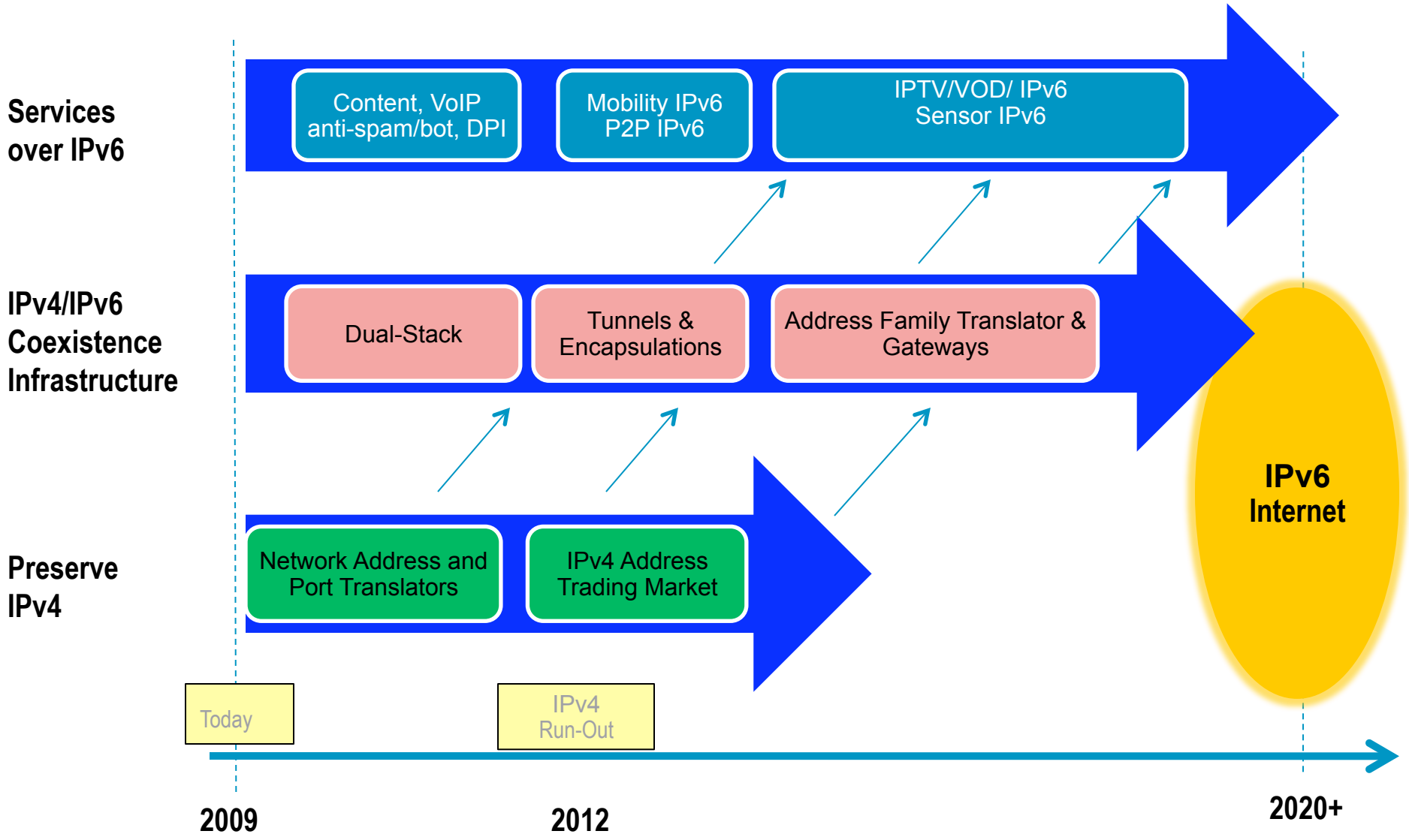



- Internet Tomorrow
  - 3 x IP address families
  - And they must talk to one another

# Challenges – IPv6 Killer App

- Conventional wisdom says there is NO Killer-App for IPv6
  - Functional equivalent to IPv4 except has bigger address space
- But in fact there is are IPv6 Killer-Apps …
- During the first phase the ***Public IPv4 Address*** is the critical app
  - Run-out forces Internet to act
  - Private IPv4 can relieve run-out pressure but is NOT the long term answer
  - Is it possible to use imminent public IPv4 address run-out to incent customers to move to IPv6?
- The second is applications. IPv6 may drive a new application service cost structure.

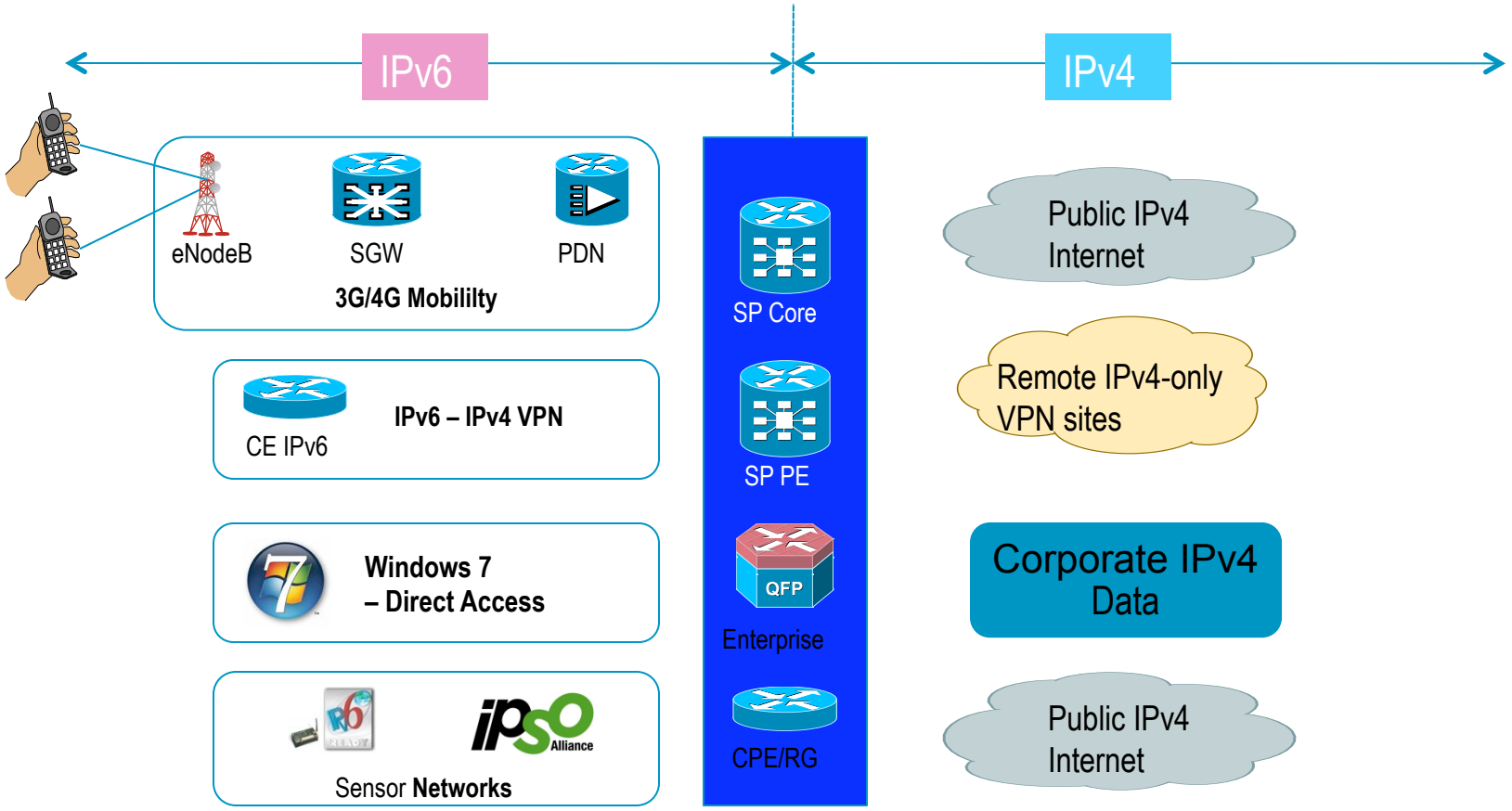
# Technology Buckets



# Address Family Translation confusion

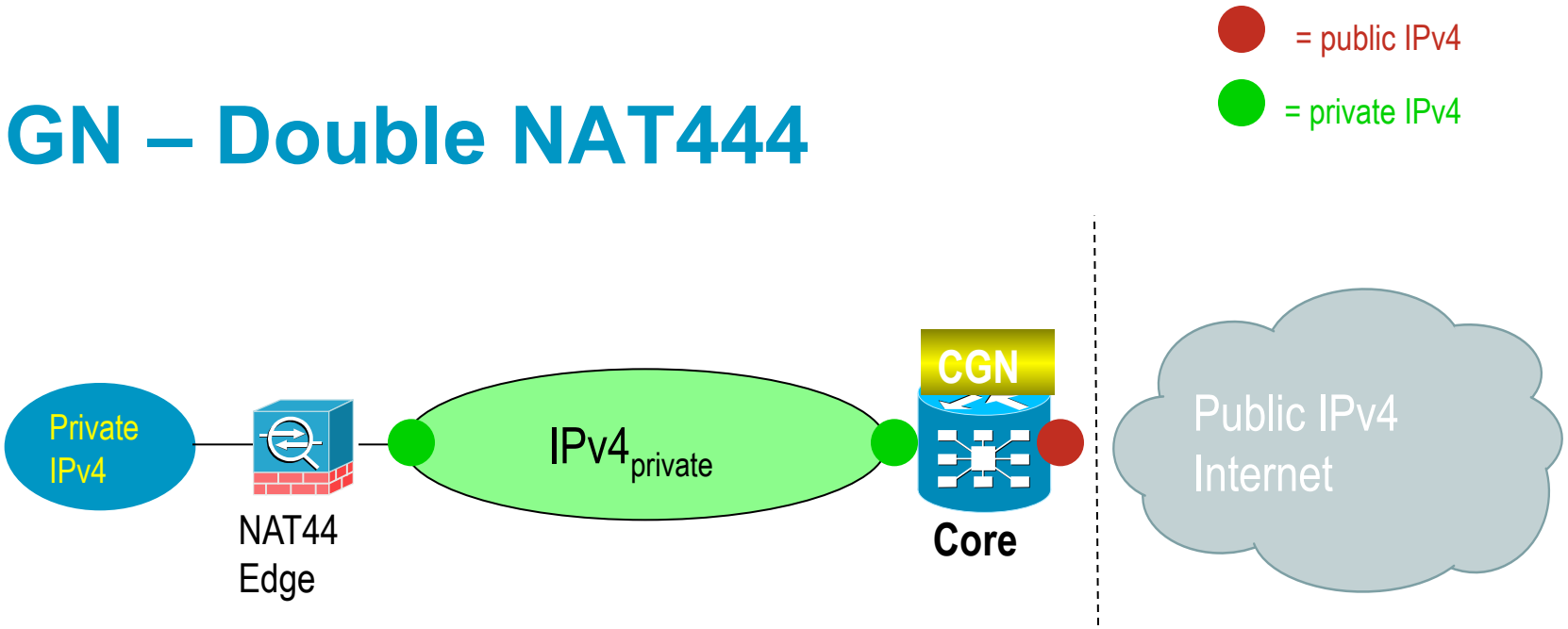
- RFC 2766 - “Network Address Translator – Protocol Translator”
- NAT-PT Issues
  - DNS query/response creates NAT state
  - breaks applications with IP address in payload
  - breaks security protocols (IPsec and DNSsec)
  - breaks IP multicast
- CGN (Carrier Grade NAT) – TLA for catch-all functionality
  - Tunnel concentrator
  - Translates IPv4 <-> IPv6
  - Translates IPv4 public <->IPv4 private

# Viable AFT Use-Cases



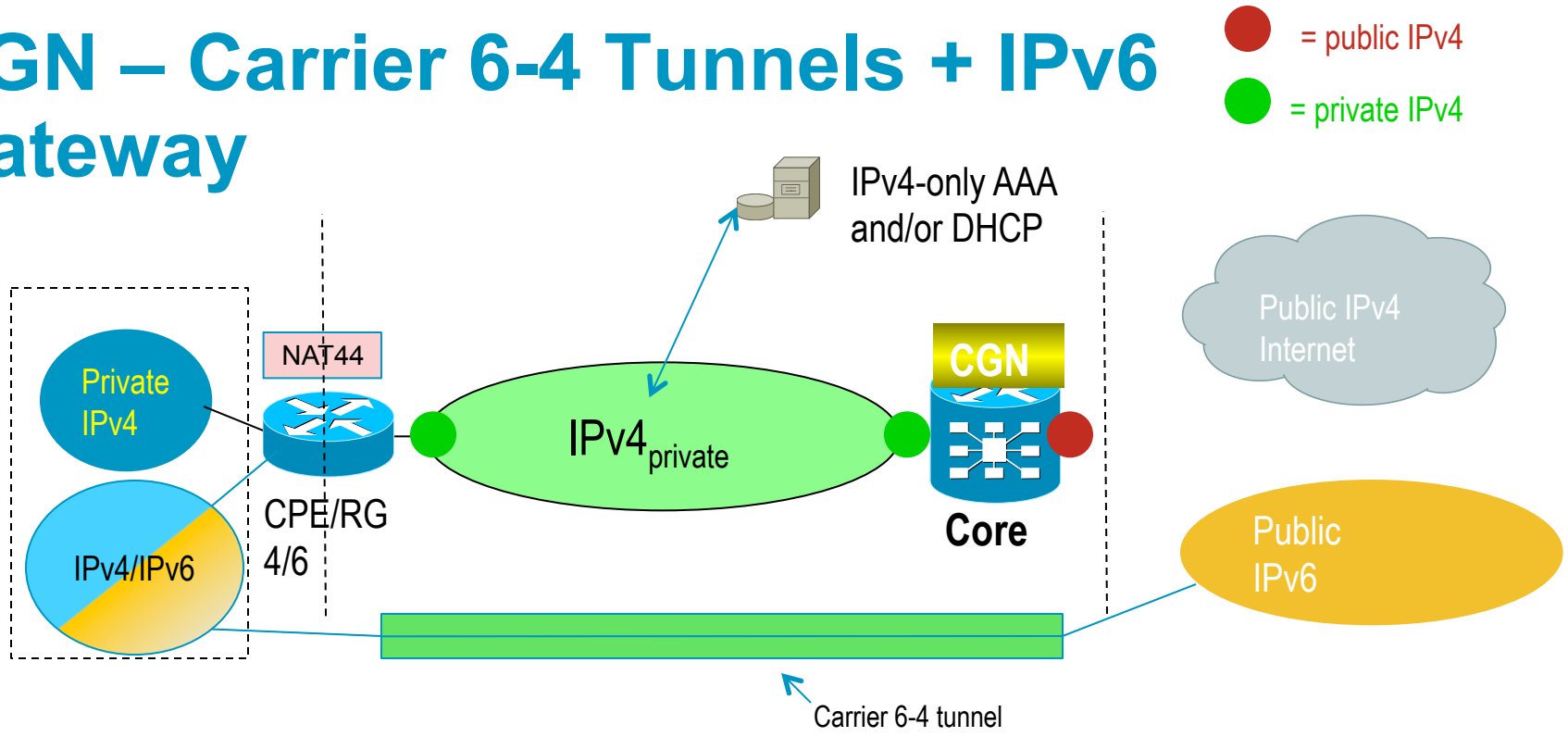

- AFT will run on different nodes in the network

# CGN – Double NAT444



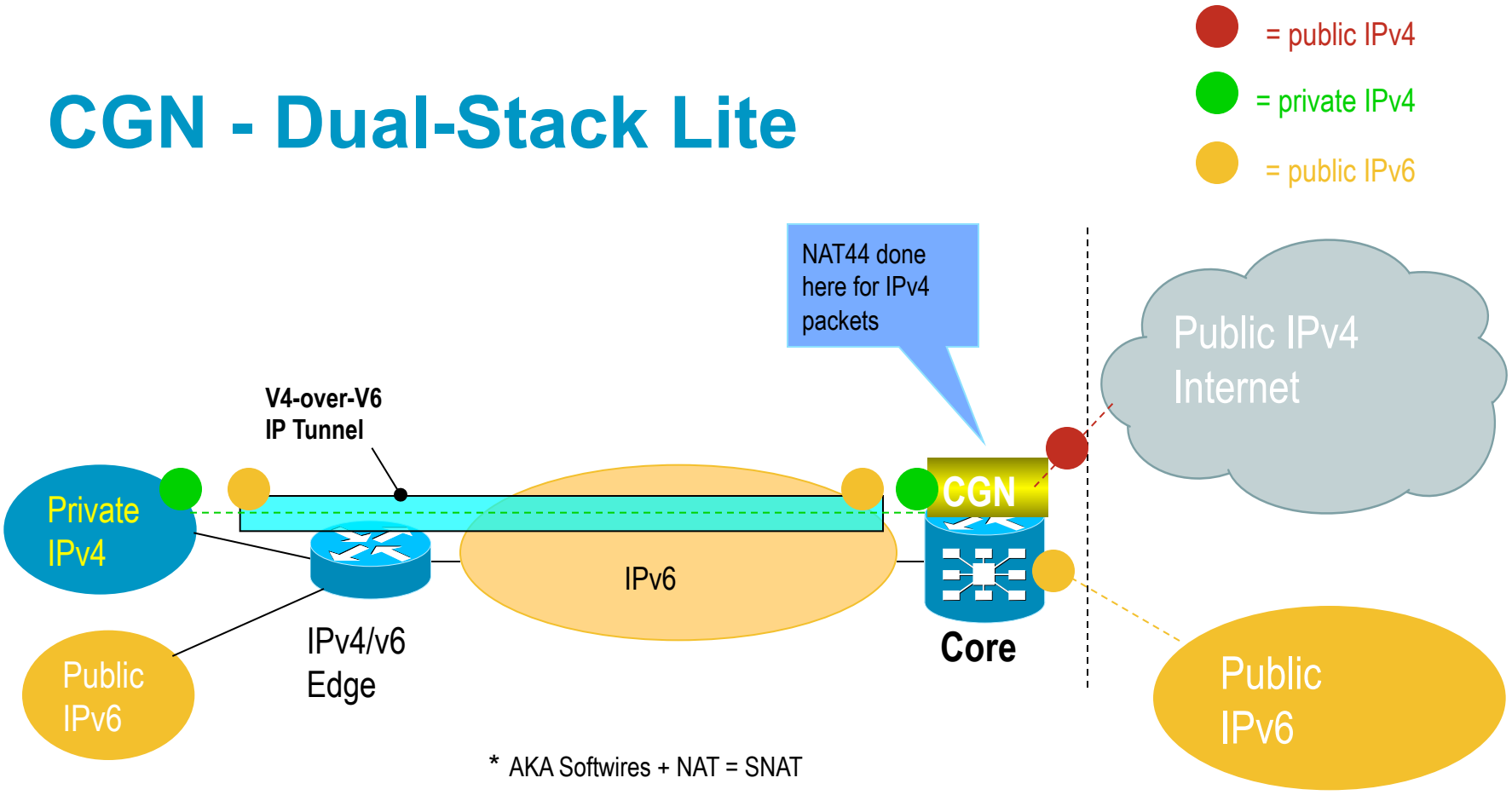

- CGN does NAT44 or O(large number) of private IPv4 end-points
- No need for IPv6 anywhere
- Challenges related to scale, performance, logging, subscriber interaction, etc.

# CGN – Carrier 6-4 Tunnels + IPv6 Gateway



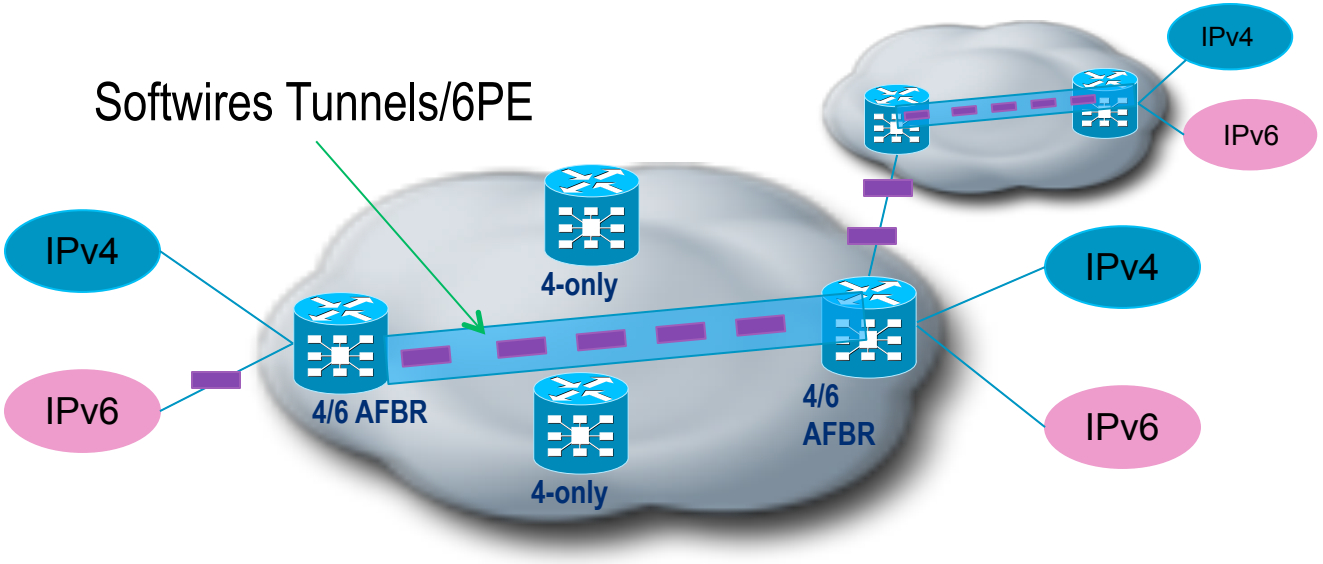

- No change to IPv4-based access infrastructure
- IPv6 prefix derived from IPv4 address; RG and CGN perform automatic IPv6/IPv4 encap/decap
- CGN become IPv6 Gateway to IPv6 Internet
- Simple, stateless, automatic IPv6-in-IPv4 encap and decap function on CPE/RG

# CGN - Dual-Stack Lite




- Employs softwire 4over6 tunnels plus CGN-NAT44 to support private IPv4 connectivity to public IPv4 Internet
- IPv6 hosts use native IPv6 routing to public IPv6 Internet

# Connecting islands across core




- Dual-stack edge routers use BGP to establish mesh of softwire/6PE tunnels to transport IPv6 packets in IPv4
  - Inter-AS is supported; Inverse of IPv4 tunneled thru IPv6 is supported
  - Same principle as 6VPE except  customer traffic is global (not VPN)

# Reality of Infrastructure and Connectivity

- **Problem:** Public IPv4 Address Run-Out by 2011/2012
  Must continue to rollout Subscribers and Enterprise services
- **Result:** Creation of large private IPv4 (and later IPv6) "islands" needing to connect to the public IPv4 Internet
- Carrier-Grade NAT (CGN) – Tunnel concentrator
  *Address Family Versatile: Routing, Tunnel Termination and Translation (protocol, address, port)*