



IPv4 to IPv6 Transition Alternatives

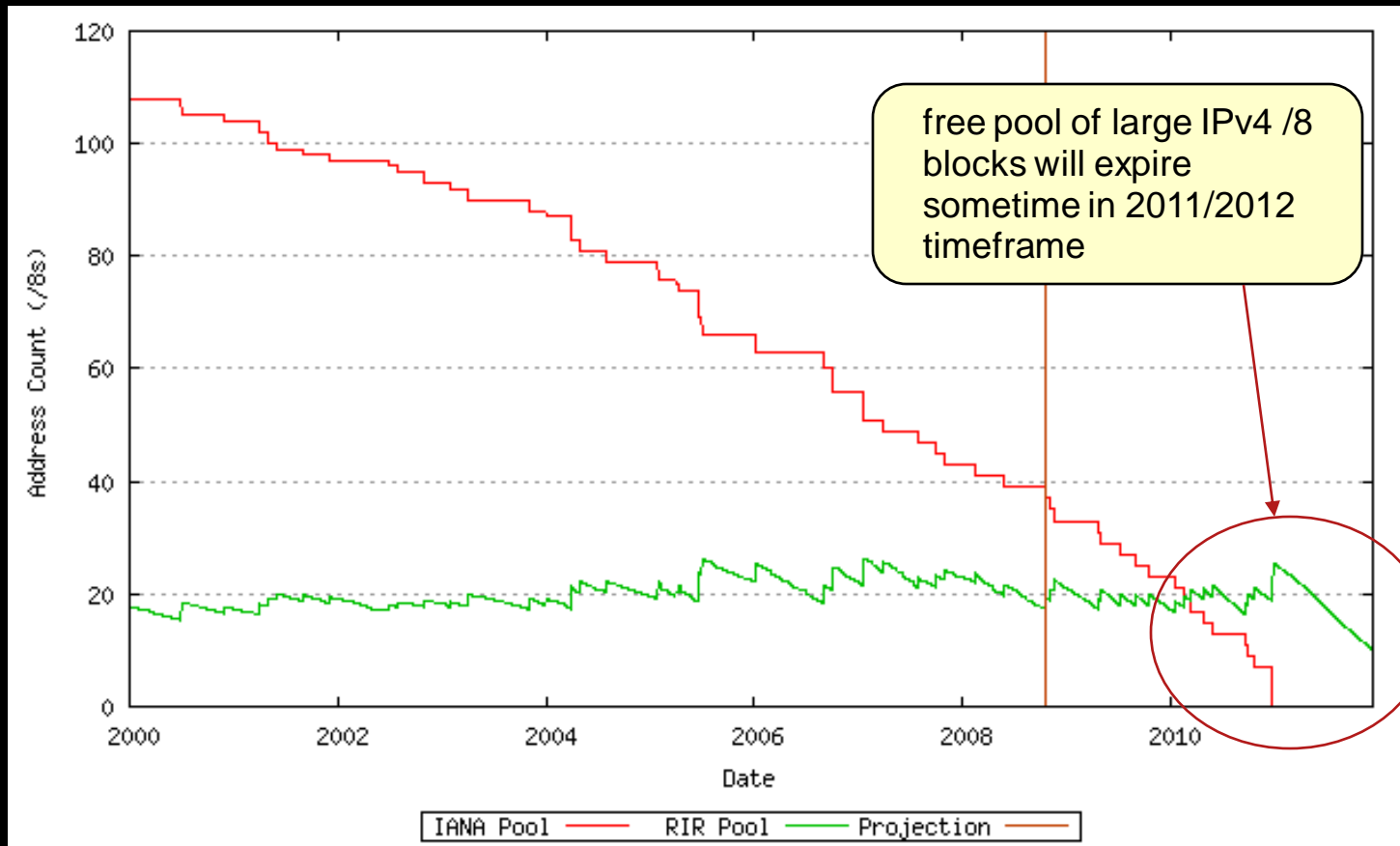


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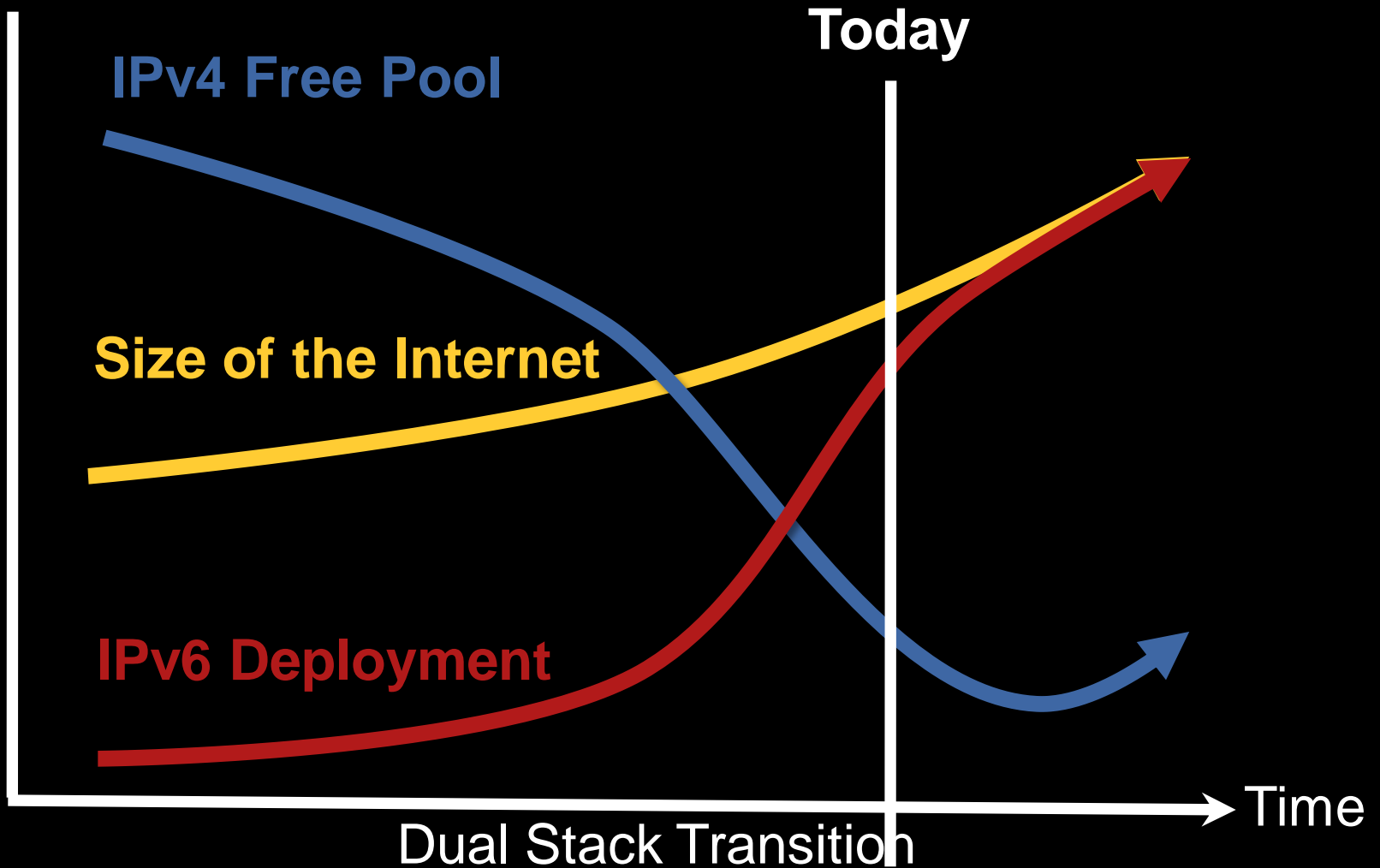
GTER27 – June 2009

IPv4 Address Completion (Run-Out)

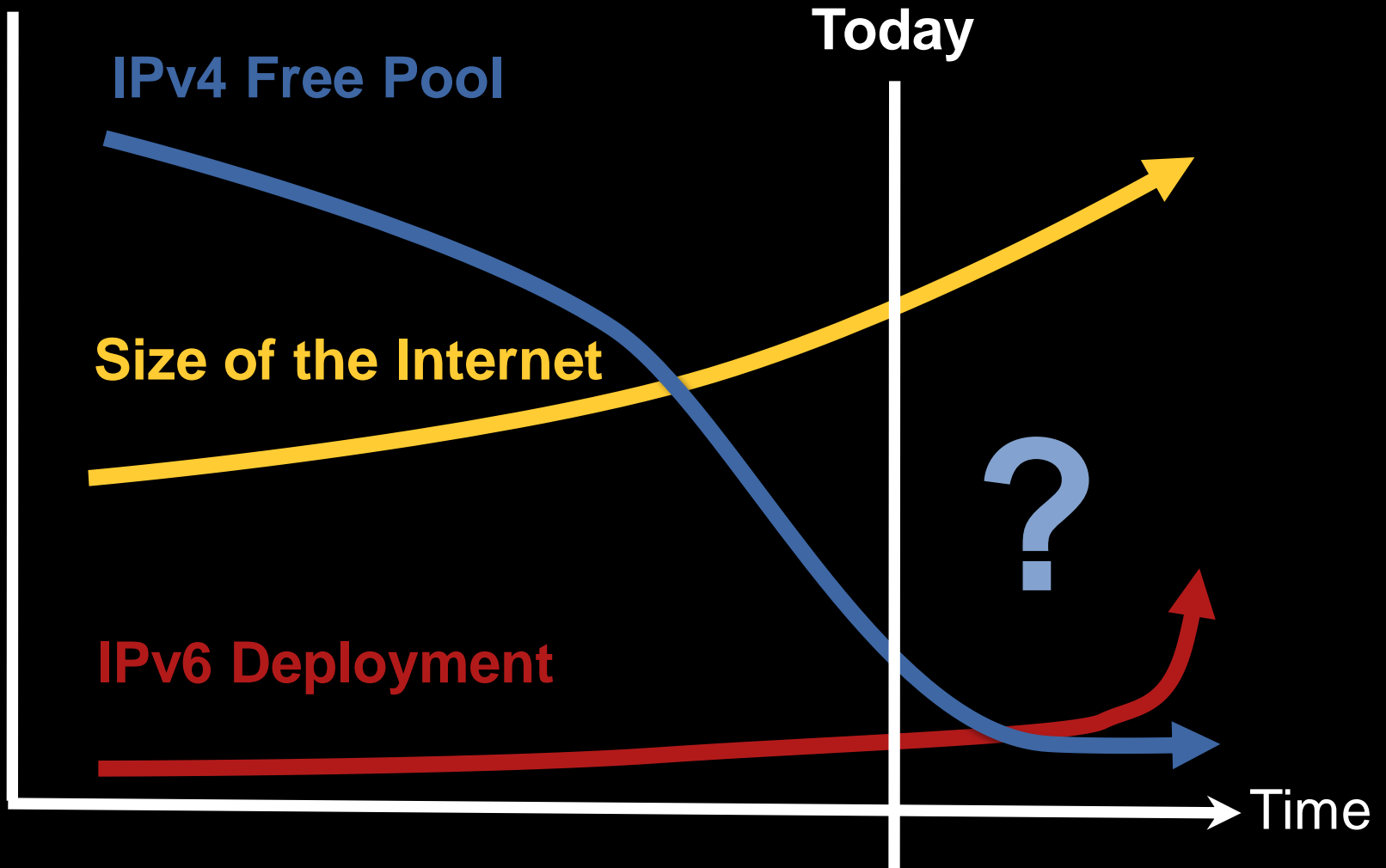


- see <http://www.potaroo.net/tools/ipv4/index.html> for more details

The Plan



The Reality



Impact of IPv4 Run-Out on Service Providers

- Difficult to add/support new IPv4 customers
- May find smaller IPv4 address blocks but this will
 - Increase routing table bloat
 - Increase opex
- Difficult to plan for Next-Gen IP Services like mobility (LTE/4G) and sensor networks
- Business Continuity compacted
- Clearly **IPv6** with its almost infinite address space **is the long-term answer** but ...

We May Need Some Alternatives

- Support private IPv4 connectivity to public IPv4 Internet post-IPv4 Address Completion
- Facilitate IPv6 Transition
 - Make it possible for IPv6-only hosts to talk to IPv4-only hosts
- Where IPv6 is deployed governments are or about to mandate that IPv6 subscribers have access to the wider internet as there are significant complaints

Other Facts During Transition

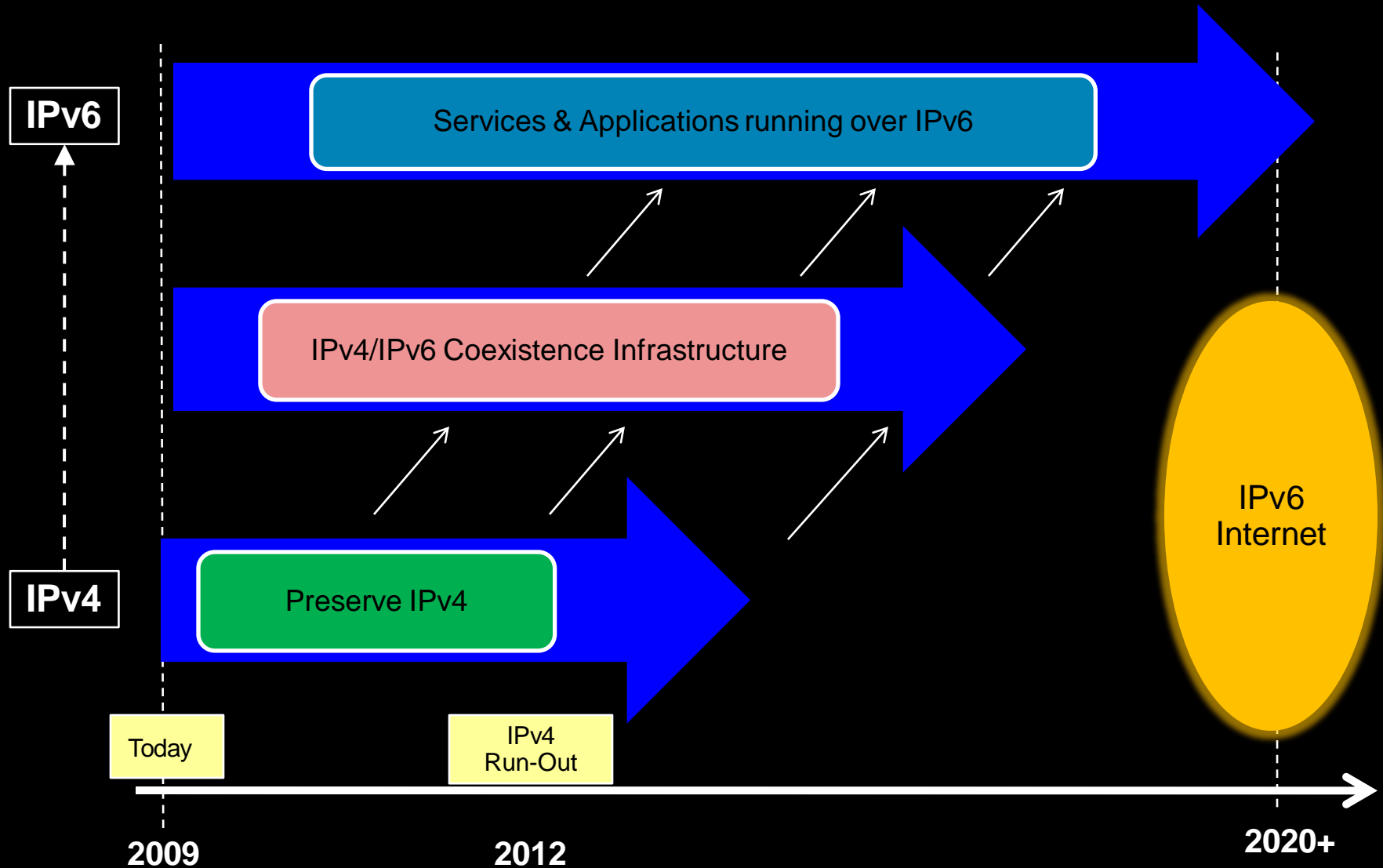
- Wider de-aggregation of IPv4 space
 - Allocated blocks and complete usage are two very different things
- Those with a large amount of IPv4 space may want to trade or lease space to providers and enterprises needing more public addresses
- We are working to create a prefix validation scheme in BGP
 - The certificate database (aka leasing company) will be provided by RIRs
 - There will be an increase in routing table (IPv4) and FIB size
 - This validation scheme enables the “IPv4 address trading market”

* source: draft-wing-nat-pt-replacement-comparison

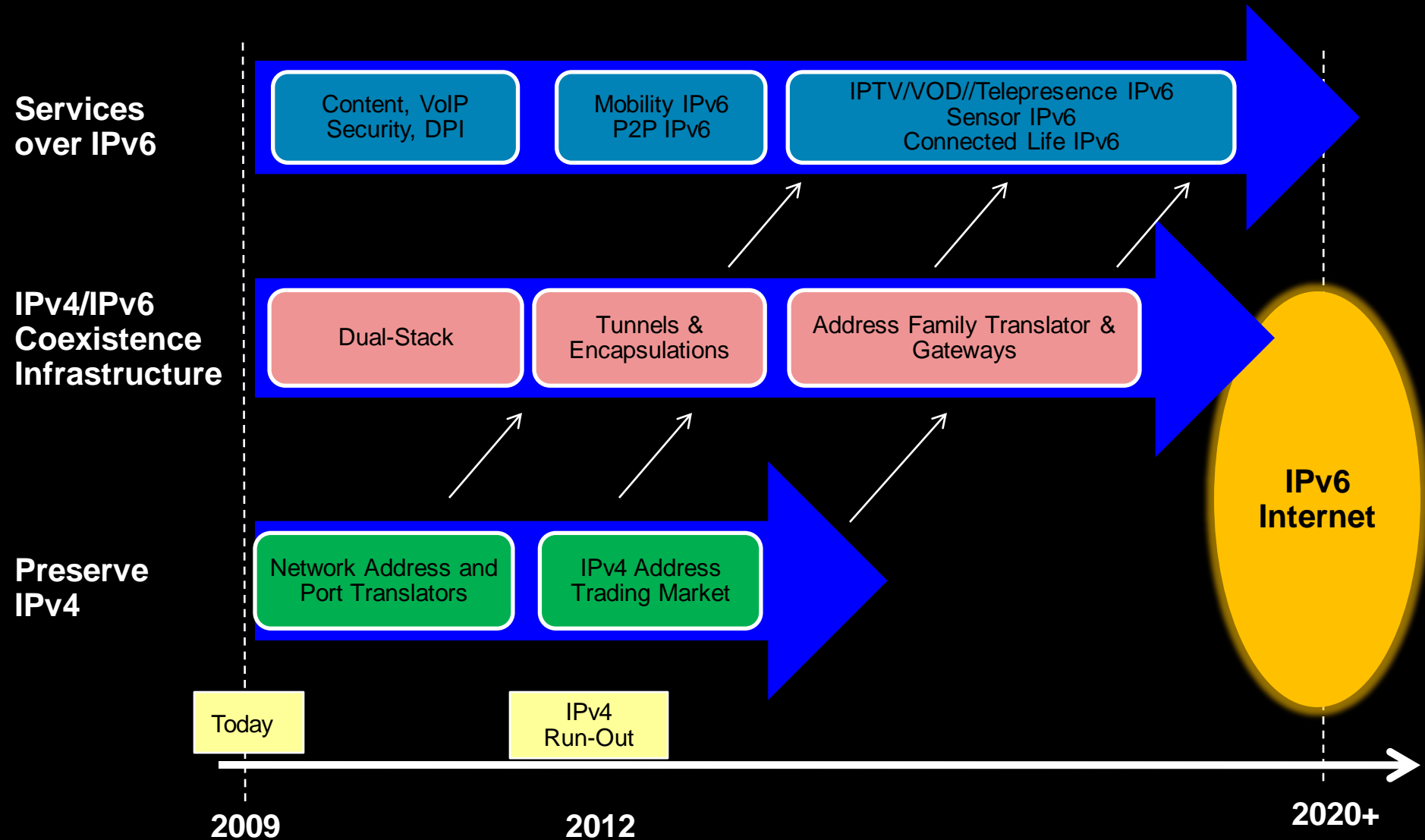
We Need a Phased Approach

- Native IPv6 Internet is years away
- IPv4 Run-Out is here now
- Entering a period of IPv4/IPv6 Coexistence
- Legacy (IPv4) and new (IPv6) apps and services can only function over an IPv4/IPv6 Coexistence Infrastructure
 - They will likely need more time to implement dual-stack and/or native IPv6
- Thus we need tools, methods, products and solutions that
 - Help address IPv4 run-out
 - Offer incremental means to build out IPv4/IPv6 coexistence infrastructure
- Not one size fits all

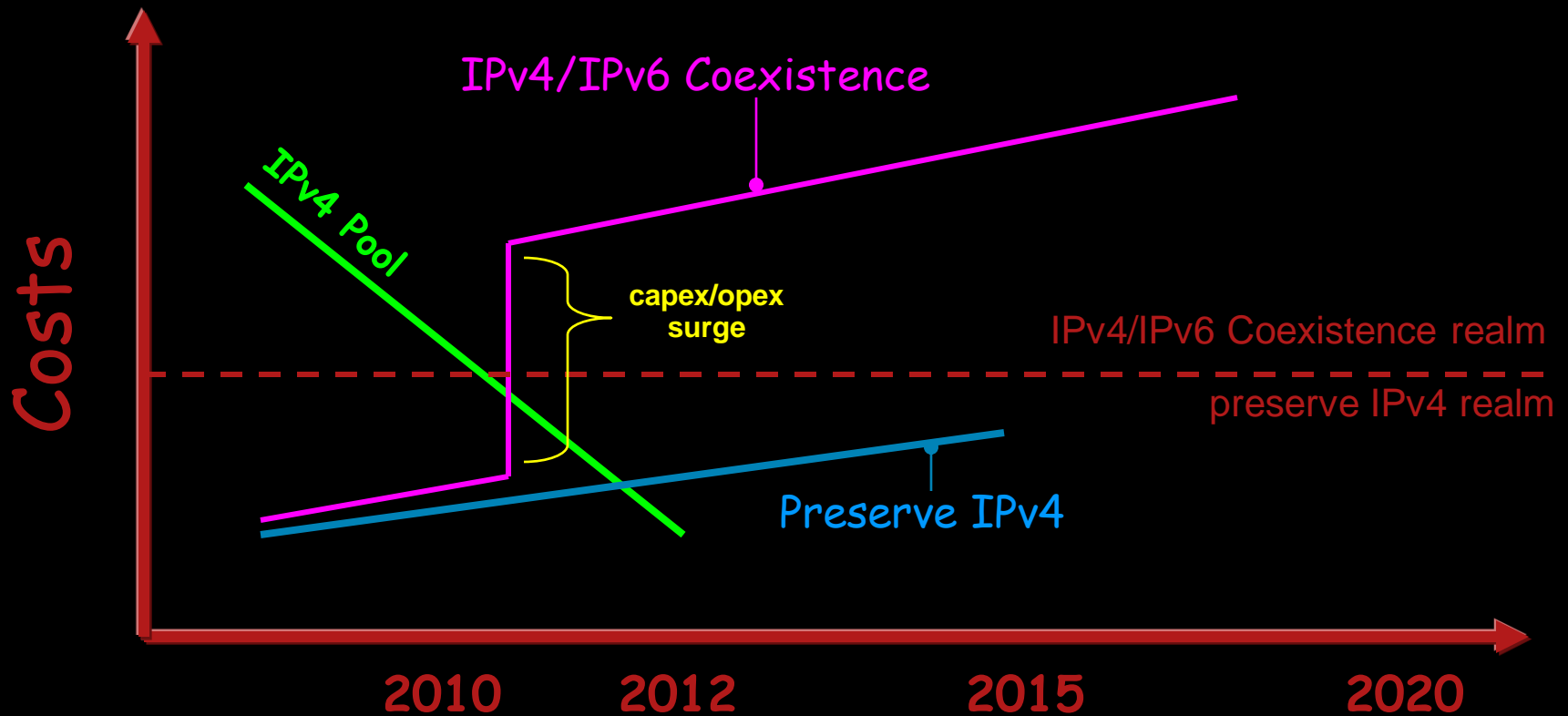
“346”: A 3 Tier Transition Framework for Moving from IPv4 to IPv6



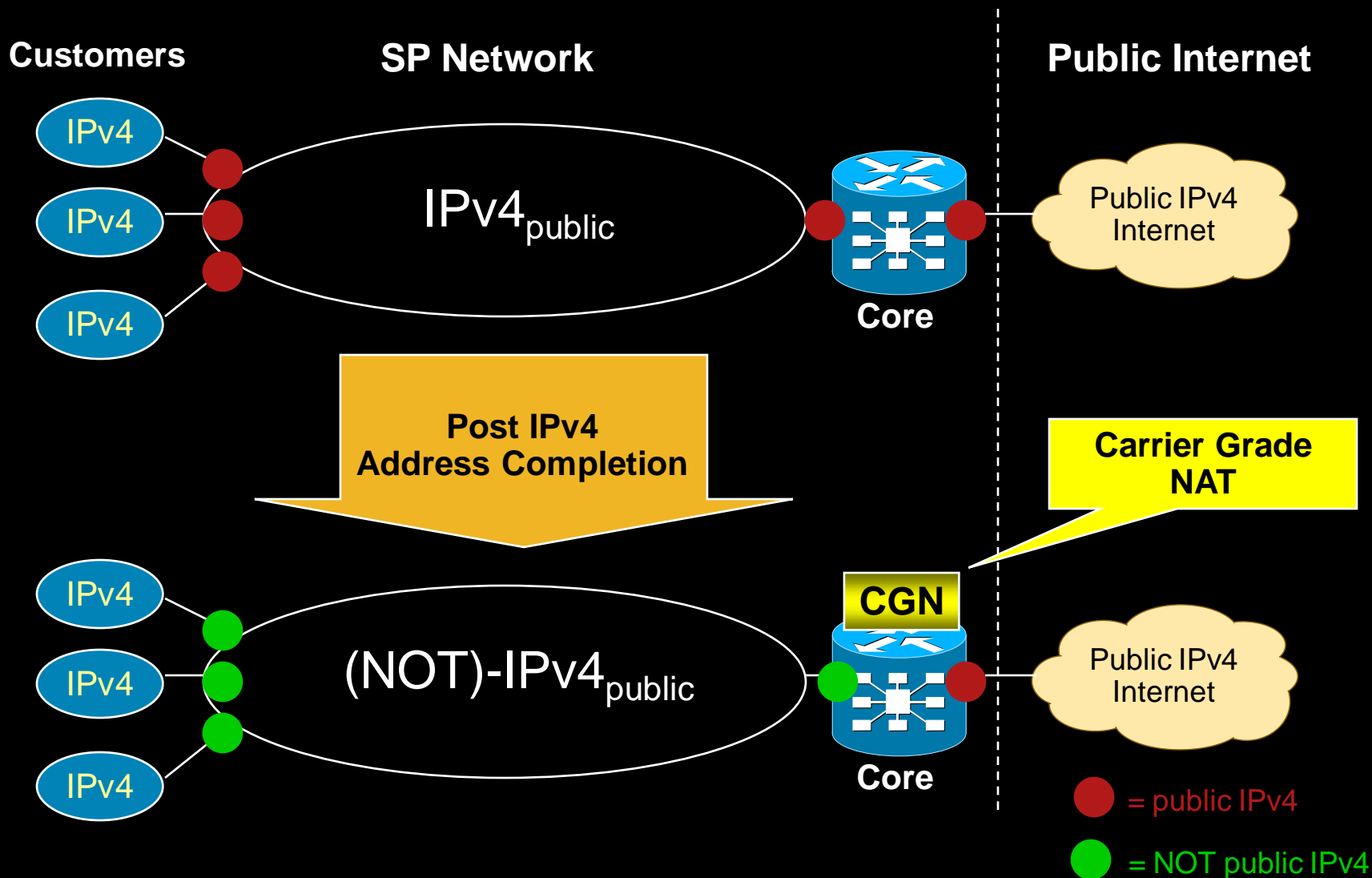
346 Technology Buckets



Another View of Preserve IPv4: *Avoid IPv6 Capex/Opex Surge*



One Strategy for Dealing with the IPv4 Address Run-Out Problem



What is a Carrier Grade NAT?

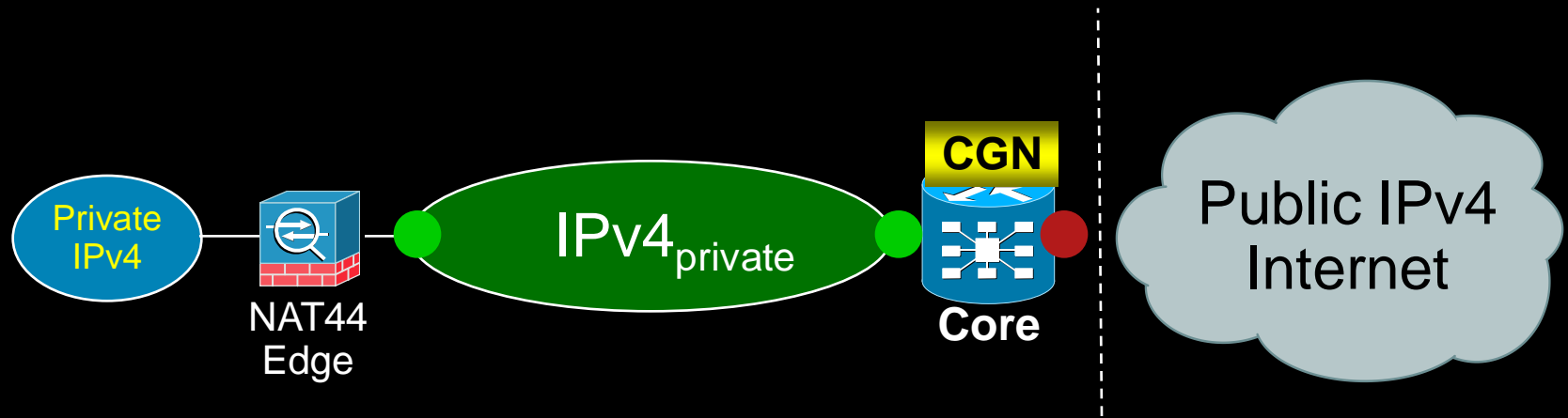
- ***“..A NAT or NAPT device used by many subscribers, where 'many' would be on the order of dozens to hundreds of thousands of subscribers. This might NAT between any combination of IPv4 and IPv6..”****
 - O(20M) translations (sessions)
 - O(Thousands) private IP addresses (depending on sessions per user)
 - O(10Gb/sec) Performance – Full Duplex
 - Scenarios
 - Double NAT444
 - Dual-Stack Lite
 - NAT/AFT (for IPv4 and IPv6 translation)
 - IPv6 Gateway
 - CGN Bypass (route around NAT)
 - Must be Carrier-Grade in Scale and Performance
- * source: draft-wing-nat-pt-replacement-comparison

IETF Standards: IPv6 Transition

- BEHAVE Working Group
 - Translating IPv6 to IPv4, IPv4 to IPv6
 - Differences between NAT-PT and new BEHAVE work
- SOFTWARE Working Group
 - Tunneling to an IPv4/IPv4 NAT

CGN – Double NAT44

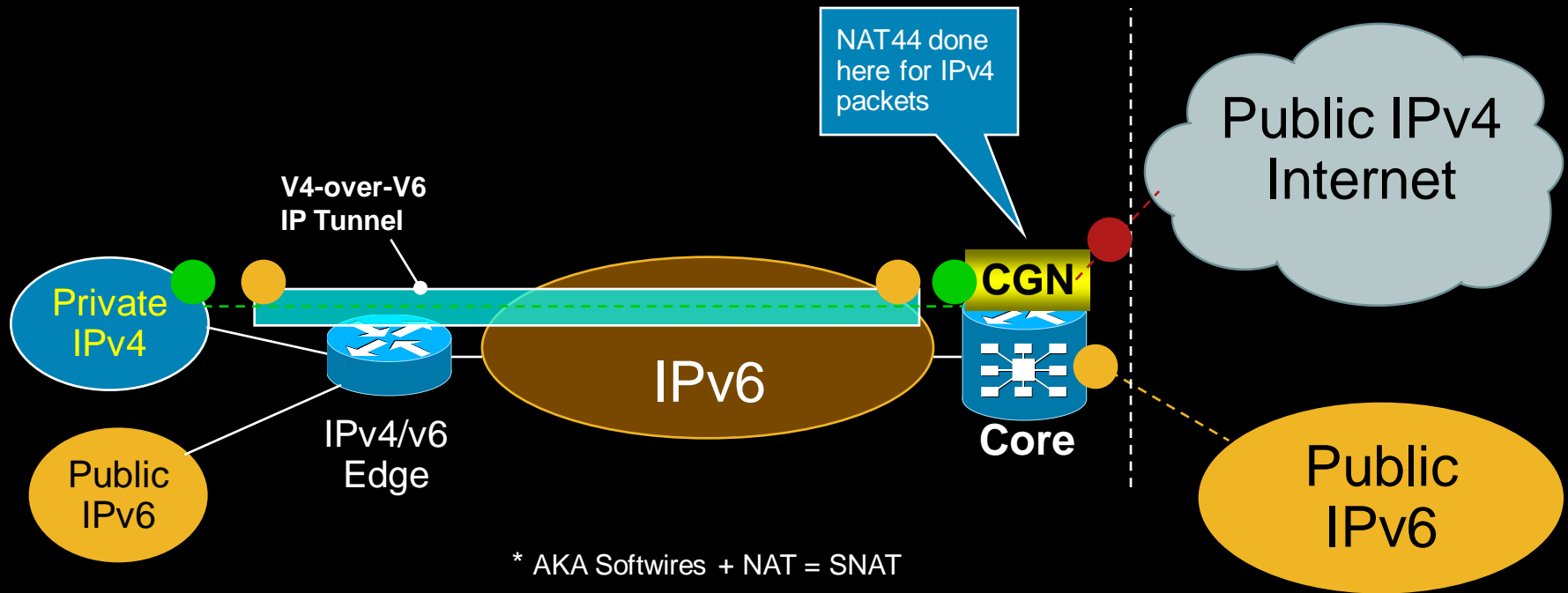
● = public IPv4
● = private IPv4



- 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 - Dual-Stack Lite

- = public IPv4
- = private IPv4
- = public IPv6



- 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

Comparing Both Solutions

- Similarities

 - both resolve IPv4 Run-Out

 - both employ NAT44 on CGN (IPv4_{private}-to-IPv4_{public})

 - both designed primarily to ensure continued private IPv4 connectivity to public IPv4 Internet

- Differences

 - Double NAT444 is exclusively IPv4, no IPv6

 - Double NAT444 can support 1918, 1918bis or even class E 240 space if IETF decides it is needed

 - D-S-L requires dual-stack CPE and CGN

 - D-S-L requires IPv4-over-IPv6 tunnels

 - D-S-L requires IPv6 connectivity from customer to CGN

 - D-S-L enables dual-stack or IPv6-only host to connect to native IPv6 Internet

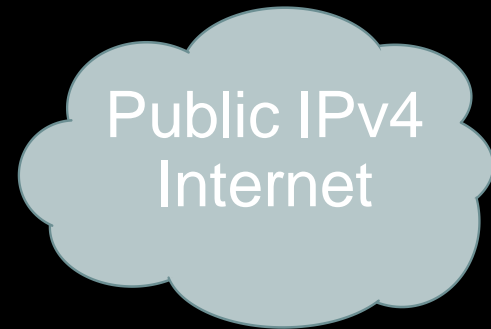
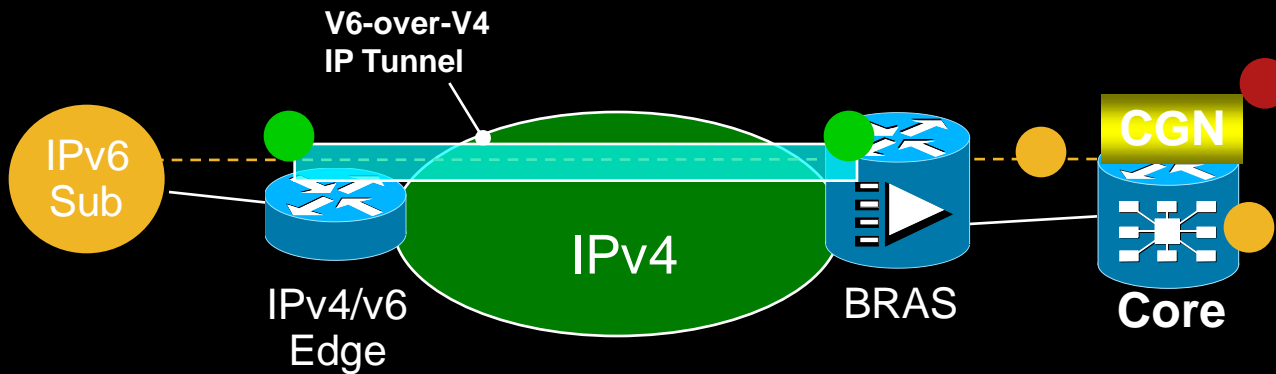
What about NAT Protocol Translation between IPv4 and IPv6?

- NAT-PT originally designated as IPv6 Transition solution (RFC2766)
- Deprecated in RFC4966 due to multiple issues
- IETF BEHAVE WG currently tackling NAT-PTbis solution(s)
 - draft-wing-nat-pt-replacement-comparison
 - <http://trac.tools.ietf.org/area/int/trac/wiki/v4v6interim>
- NAT-PTbis will be supported in a market determined phasing
- **Also referred to as NAT64**
 - Very few cases for NAT46 and this is under investigation at standards bodies

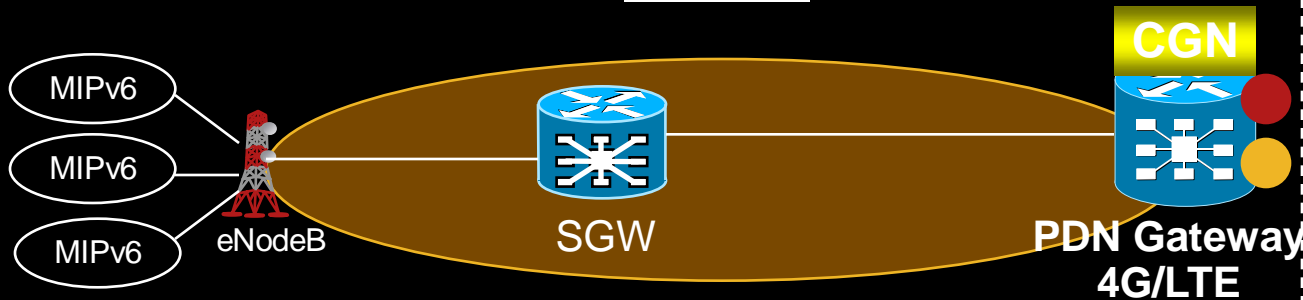
CGN Use-Cases employing NAT64

- = public IPv4
- = private IPv4
- = public IPv6

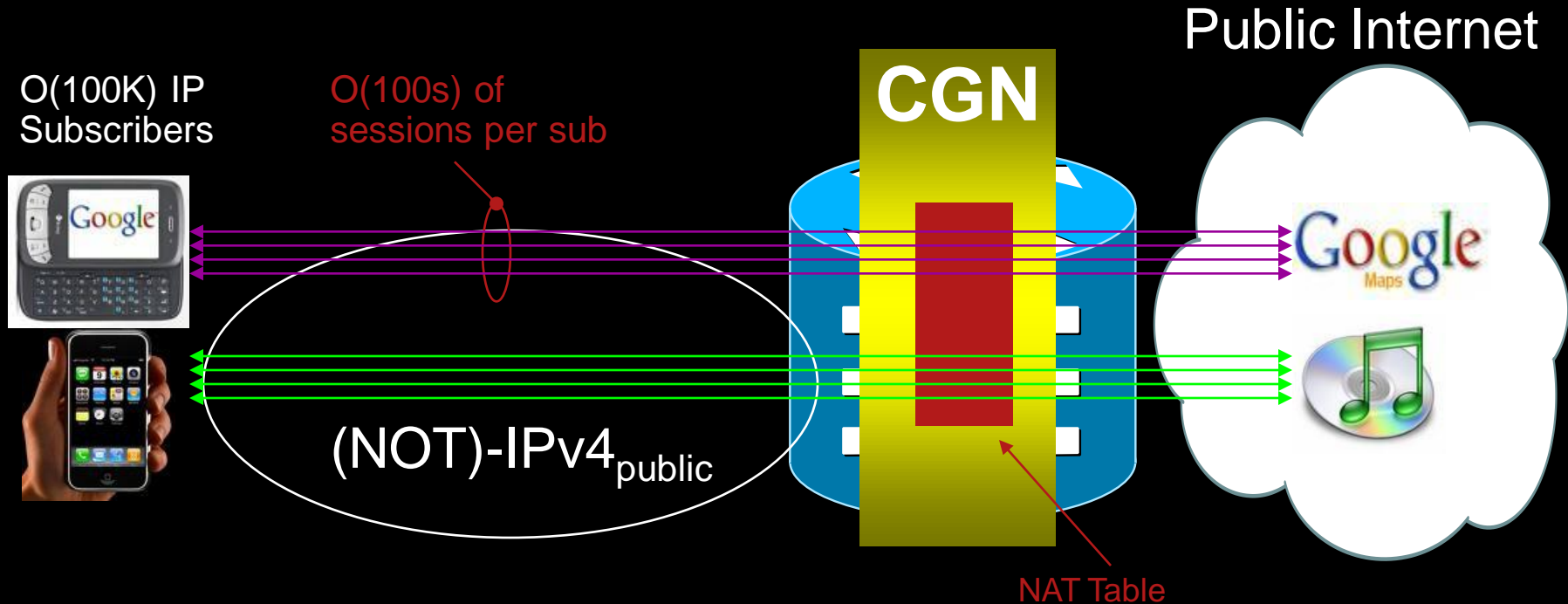
Tunnel + NAT64



4G/LTE



Why is NAT translation table so big in CGN?



- Many new applications employ AJAX TCP methods by opening hundreds of parallel connections
 - each connection/session creates state in CGN
 - so $O(100K) \text{ subs} \times O(100s \text{ of sessions per sub}) = O(10s \text{ of Millions})$ of Session States

What about ALGs on CGN?

- We would prefer not to do any ALG. Why?

“.. Note: Placing application awareness (i.e., ALG) in the CGN will cause bug fixes and new features to be delayed by development, testing, and deployment. To prevent such delays, application awareness should be placed elsewhere (e.g., in the CPE router or in the end host)...”*

- Additional ALG Thoughts:

SIP – done on S/BC which is separate from CGN

Active FTP – can do that on CGN

others - FFS

* source: draft-wing-nat-pt-replacement-comparison

Additional Considerations

Port Forwarding	<p>Needed to operate Internet Server from private home network</p> <ul style="list-style-type: none">▪ Use web portal to request and provision static NAT binding on CGN
External Logging	<p>Idea would be to log NAT bindings</p> <ul style="list-style-type: none">▪ Log size could be large (e.g. O(10G-100G) per day)▪ Will use NF9 bulk/batch approach to spool to external NF collectors
DynDNS	<p>Different methods for updating DynDNS server with public IP address:port</p>
P2P Applications	<p>Use techniques described in RFC5128</p>

References

- Huston, G., “The Changing Foundation of the Internet: Confronting IPv4 Address Exhaustion”, Internet Protocol Journal, Vol. 11, No. 3, Sept. 2008
- draft-ietf-softwire-mesh-framework
- draft-ietf-softwire-dual-stack-lite-00
- draft-arkko-townsley-coexistence
- draft-baker-behave-v4v6-framework
- draft-wing-nat-pt-replacement-comparison

