



IPv6 Deployment and Trials in OTE

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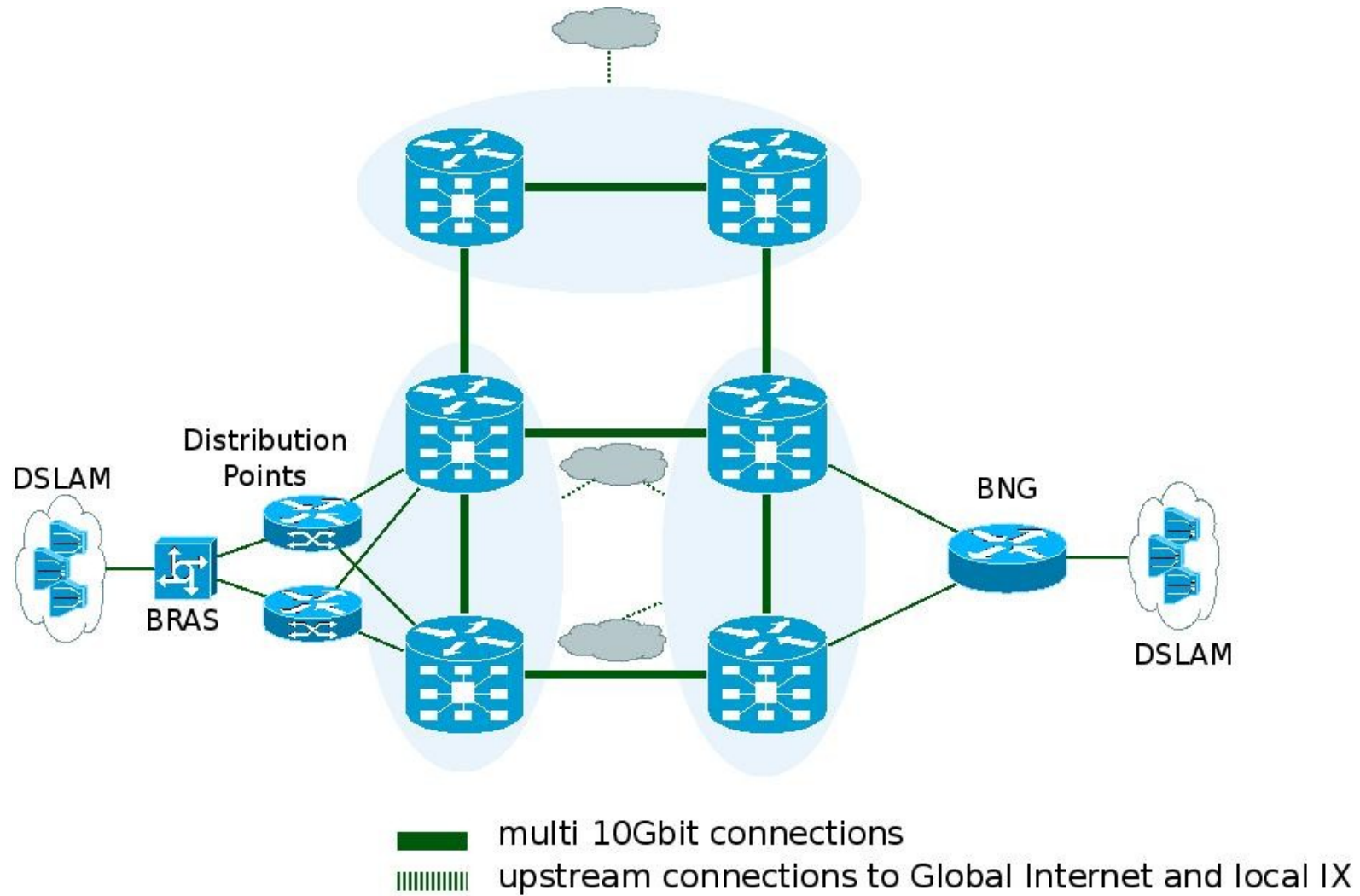
The Company

- Largest Greek ISP/Telco (incumbent)
- 1.3M Broadband (xDSL) subscribers
- IP Telephony over xDSL(just launched)
- 380k TV (IP/SAT) subscribers
- 230 Gbps (peak) internet traffic
- Internet Access for Business
- VPNs

IPv6 History

- 2004 - PoC Lab
- 2008 - 1st addressing plan
- 2009 - Working group formed
- 2009 – IP core/aggregation/BGP Peerings dual-stacked
- 2010 – Internal LAC/LNS PPP trials
- 2011 – Internal BRAS PPP Trials
- 2013 - „Commercial“ launch for BRAS users
- 2013 – final(?) Addressing Plan laid out

High-level network diagram



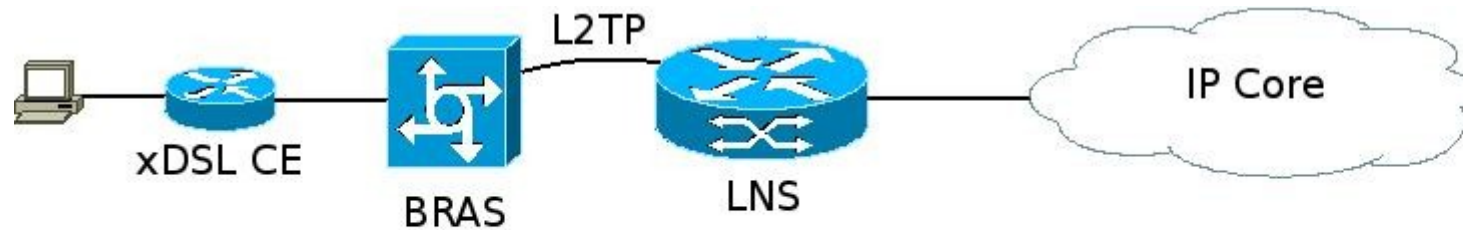
Dual-Stack in the Network

- Dual-stack core → edge
- IGP of choice: IS-IS (contiguous L2)
- BGP Peerings w/ upstream and local IX
- (i)BGP mesh between FIRT routers
- Aggregation layer followed shortly after

PPPoE Trials LNS (internal)

- @ipv6ote.gr tunnelled to IPv6 LNS
- Dual stack session
- /56 for CE LAN (through DHCPv6-PD)
- /128 for CE WAN (through PPP/SLAAC)
- Internet Services (DNS, HTTP)
- Peak concurrent users: ~100

PPPoE Trials LNS (internal)



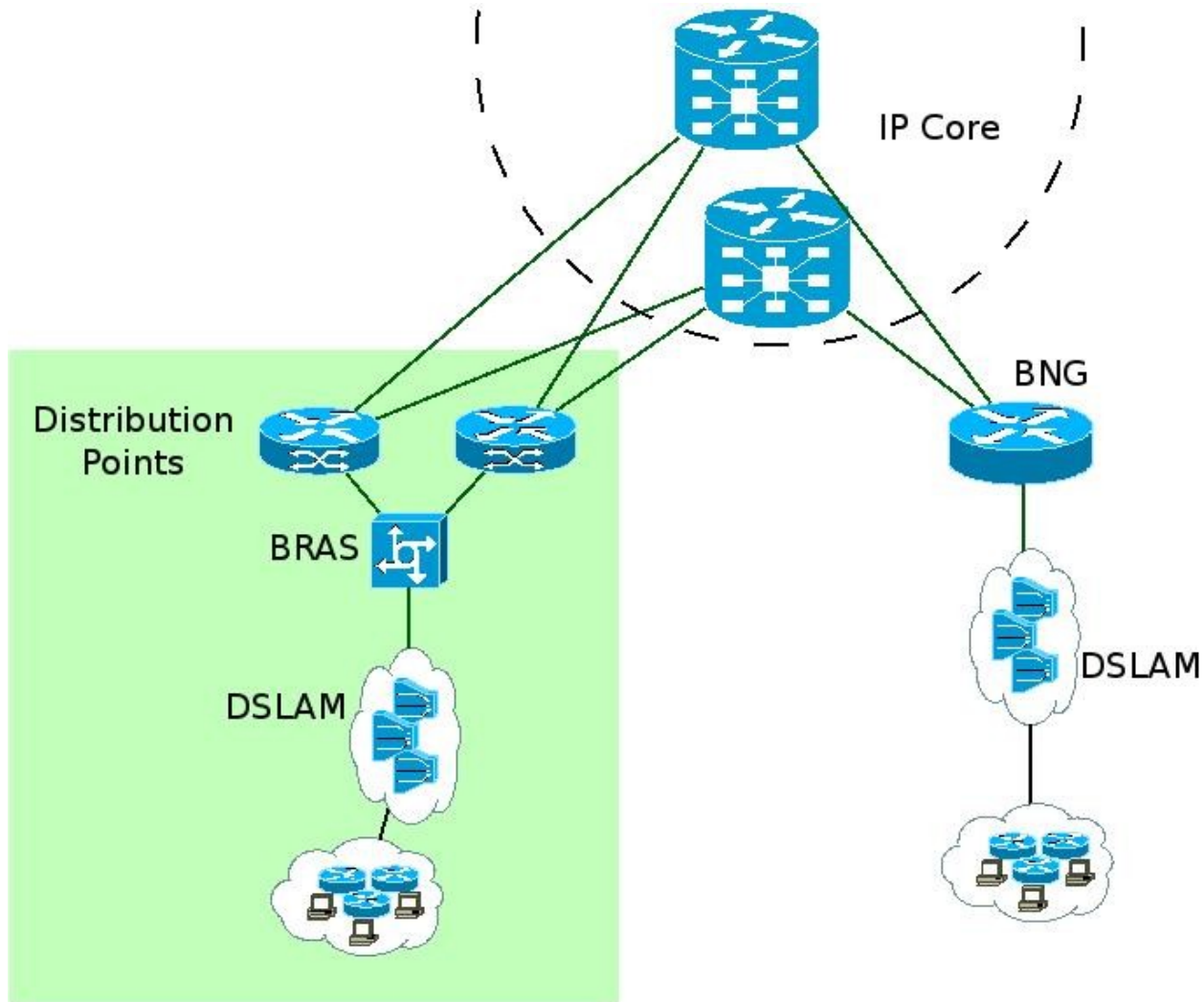
PPPoE Trials LNS (static)

- Static /56 assigned to user (RADIUS)
- No reverse DNS support
- Peak Concurrent users: ~30

BRAS Trials

- Normal PPP termination @ (test) BRAS
- /56 for CE LAN (through DHCPv6-PD)
- /128 for CE WAN (through NDP)

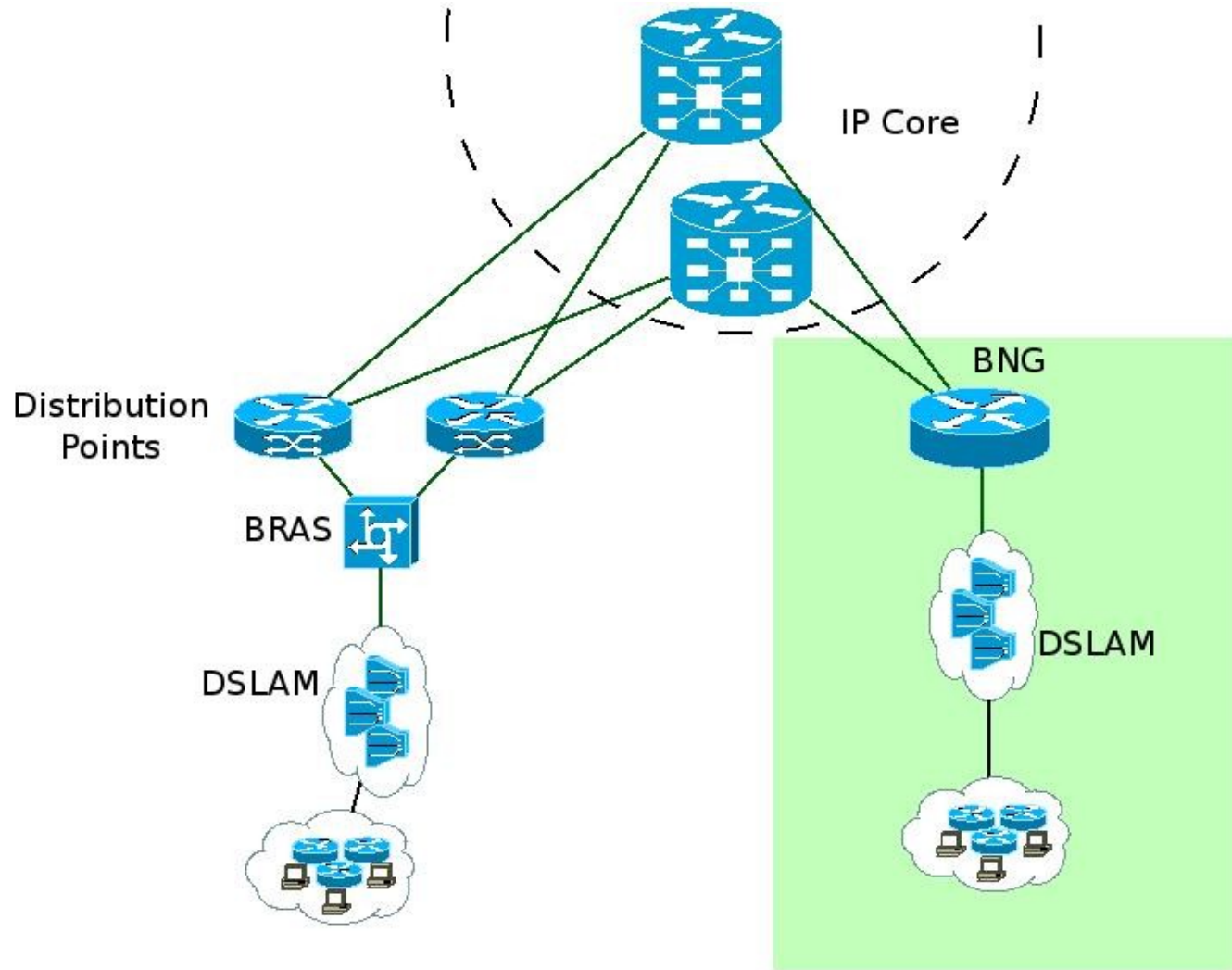
BRAS Trials



BNG Trials

- Normal PPP termination @ (test) BNG
- /56 for CE LAN (through DHCPv6-PD)
- /64 for CE WAN (through NDP)

BNG Trials



Commercial IPv6 (BRAS-BNG)

- No real issues w/ BRAS
- BNGs deployment was delayed (bug fixes, testing)
- BNG deployment is still ongoing
- 90% of CPEs are IPv6 (DS) capable
- IPv6 enabled via TR069 in batches
- Many CPE bugs encountered
- Every new CPE or BNG bug was a step backwards

Commercial IPv6 (BRAS-BNG) - Future

- No dynamic flavor
- Static /56 valid in the same PoP
- RDNS support
 - Considerations discussed in draft-howard-isp-ip6rdns
 - Custom (internally developed) solution will be deployed [subject of a different presentation when completed]
- „Default permit“ security policy opt-in

Commercial IPv6 (business)

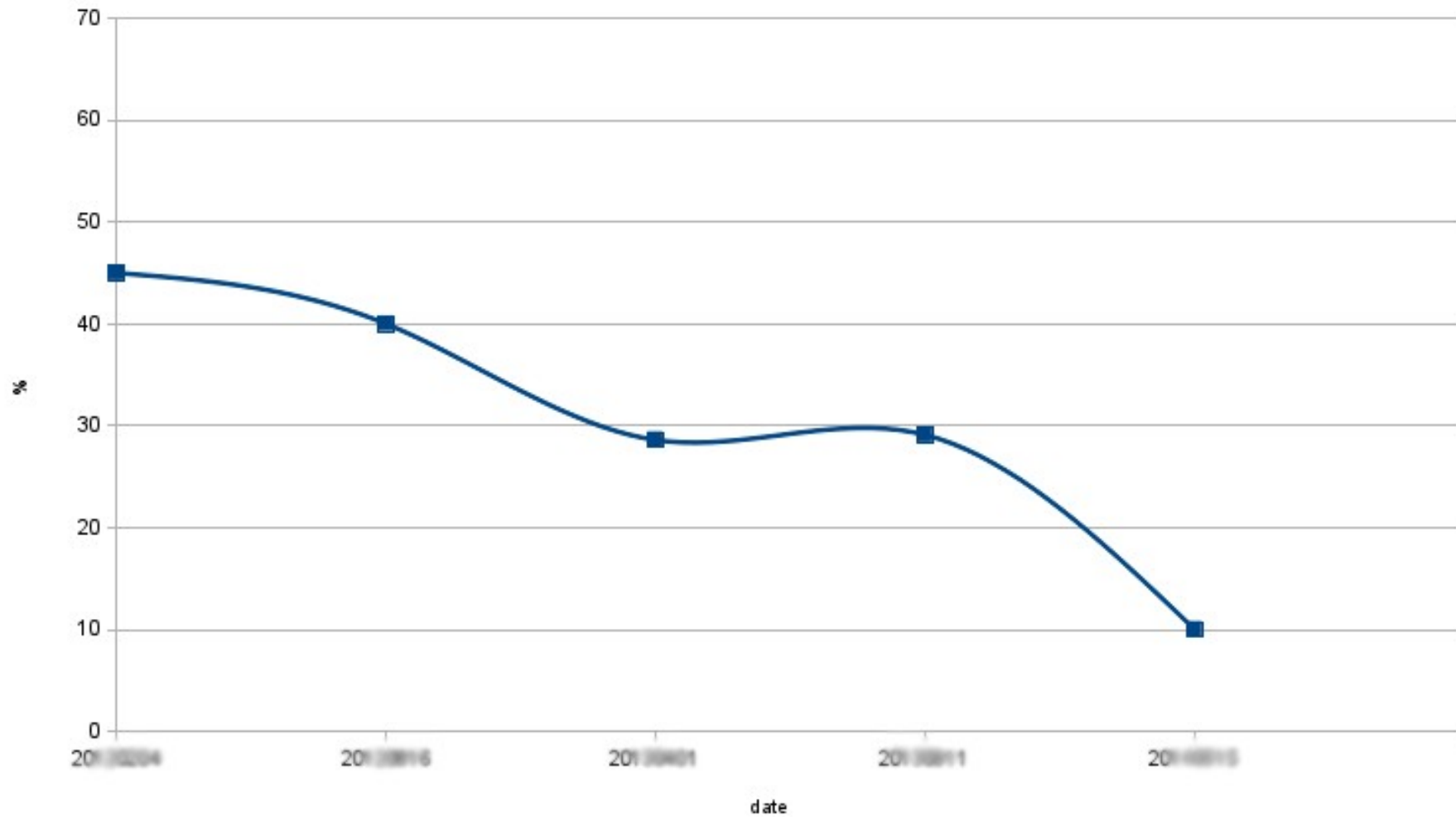
- Provide a single /56 upto multiple /48s
- Support for static/dynamic protocol (BGP)
- Deploy 1st multihomed customer in 2016

Services

- DNS Resolver (anycast) Infrastructure already DS
- Public FTP service
- DNS authoritative service (Q1 2016)
- VoBB (in trials)
- TR069 (Eo2015)
- Web hosting (Eo2015)
- Email (Q1 2016)

IPv4 Exhaustion

Percentage of Available IPv4 Space



IPv4 Exhaustion & IPv6-only

- No easy way to mitigate
- IPv4 space defragmentation (effort vs gain)
- IPv4 address transfer (too expensive)
- CGN (last resort)
- ...
- native IPv6 network already in place
- Take advantage of IPv4 sunsetting

IPv4 Exhaustion & IPv6-only

- Various transition methods considered
- MAP and LW4o6 seemed the most promising
- Both take advantage of IPv4 sunsetting
- Both stateless (or „less stateful“)
- Standardized in the IETF
- CPE dev/ment required

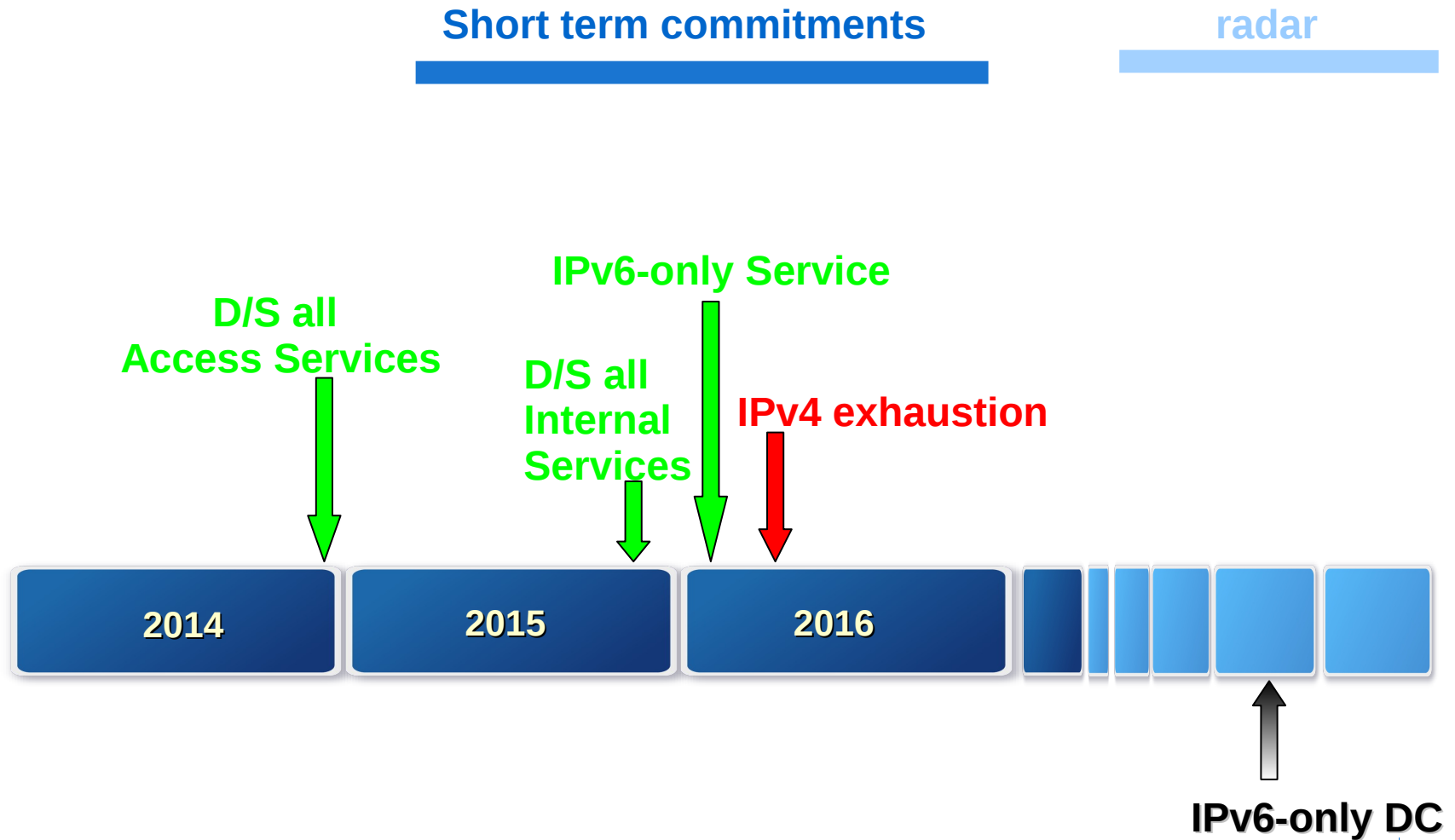
IPv4 Exhaustion & IPv6-only - MAP

- MAP seemed like a good fit in our network
- No new equipment needed in infrastructure
- MAP's deterministic nature
- Preliminary Tests were successful
- Tested BRs: (virtual) Cisco ASR1k and ASR9k
- CPEs used: latest OpenWRT image

IPv4 Exhaustion & IPv6-only - LW4o6

- LW4o6 was the method of choice finally
- Provisioning seems simpler (to understand)
- DT's involvement was key factor
- Service Launch (provisional): Q12016

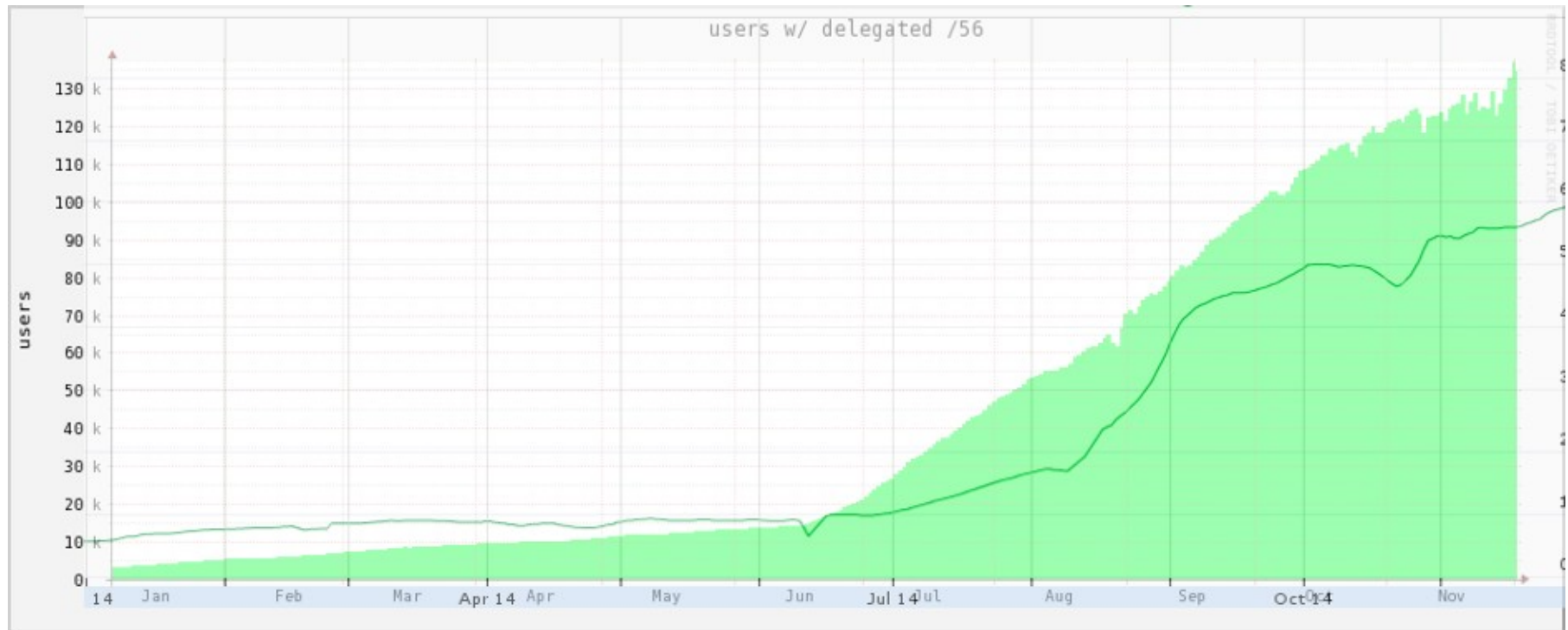
IPv4 Exhaustion & IPv6-only



Leftover Issues

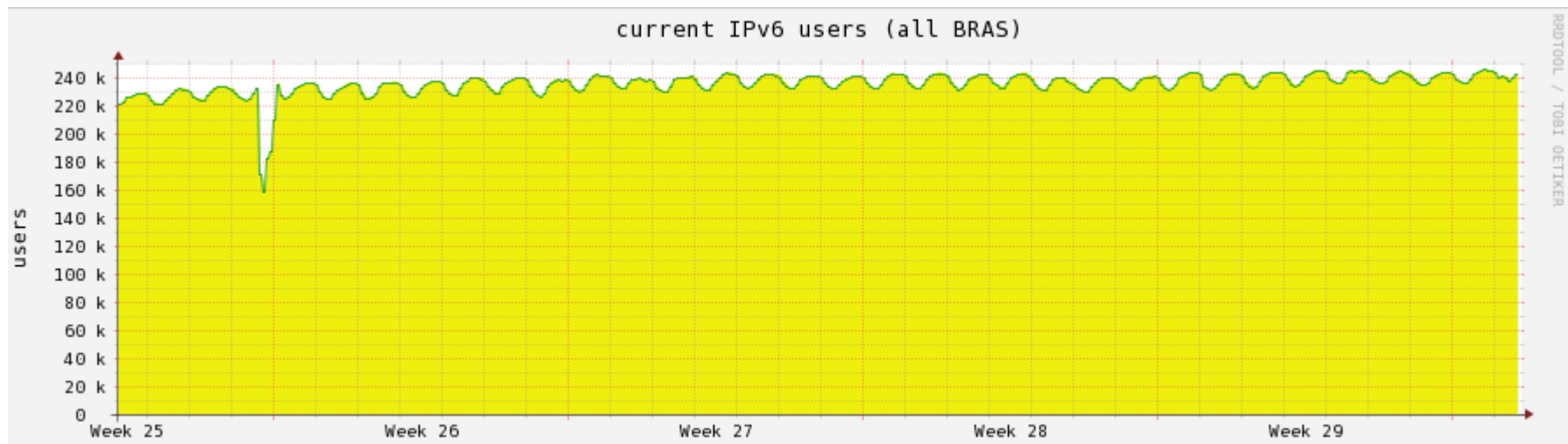
- CPE is still #1 issue (many, many bugs)
- Security not being treated equally
- Big boxes that handle IPv6 in s/w
- EH handling
- Silly bugs in Carrier-Grade Boxes
- IPv6-related issues go unnoticed in D/S environments
- IT dept provisioning systems

Stats



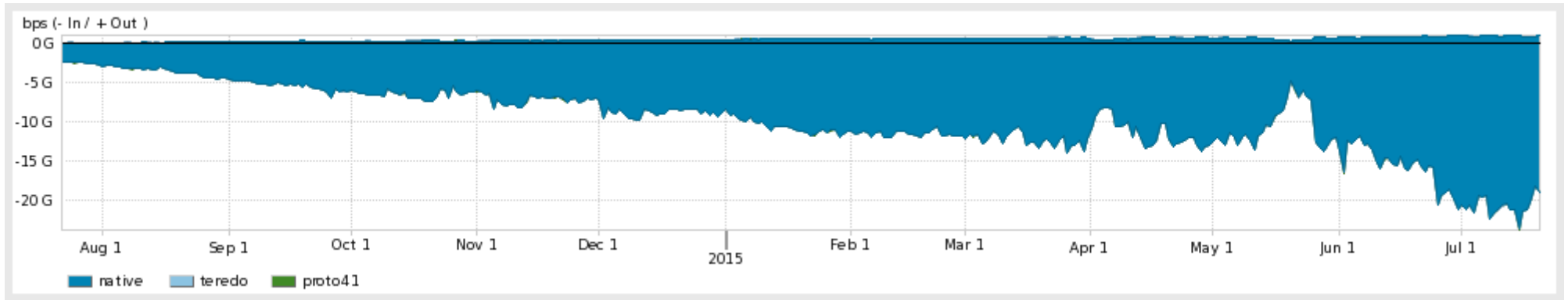
- OTE IPv6 users vs Greece's total IPv6 users (source:6lab.cisco.com)
(Units are irrelevant but timeframes really match)

Stats



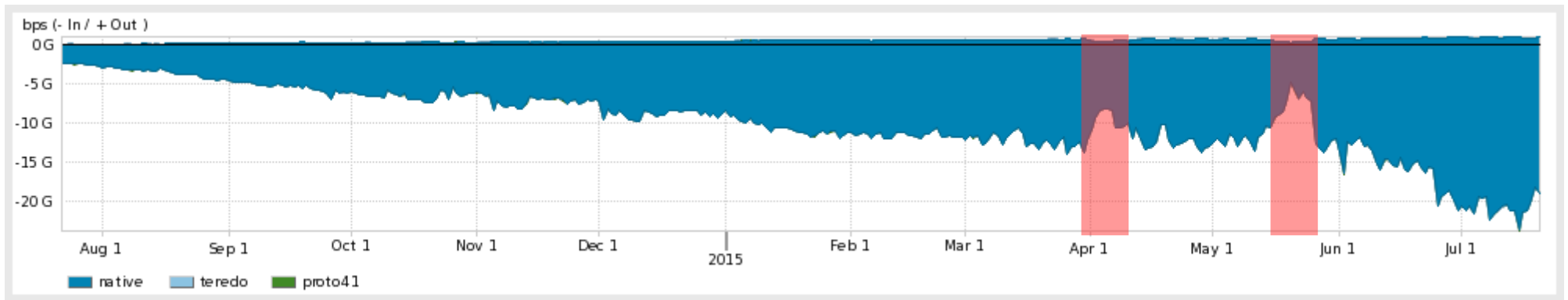
- ~20% of total broadband userbase is Dual-Stack
- (expected) ~50% by end of 2015

Stats



- ~10% of total traffic is Ipv6
- Mostly Google-related (youtube)
- Traffic from Akamai's local clusters also significant

Stats



- ~10% of total traffic is Ipv6
- Mostly Google-related (youtube)
- Traffic from Akamai's local clusters also significant
- Apr and May traffic decreases due to software bugs in border routers

thank you :)

Reference Presentations

- DNS Anycast Implementation:

<https://www.grnog.gr/wp-content/uploads/sites/7/2015/06/kzorba-dns-anycast-grnog-1.pdf>

- IPv6 Addressing Plan:

<https://ripe67.ripe.net/presentations/222-ripe67-yanodd-ipv6-addressing.pdf>

- CPE issues & IPv6 brokenness:

<https://ripe65.ripe.net/presentations/139-ripe65-yanodd-ote-depl-w6l.pdf>