IPv6 deployment (challenges) for mobile

George Manousakis

Network Engineer

gmanousak@cosmote.gr
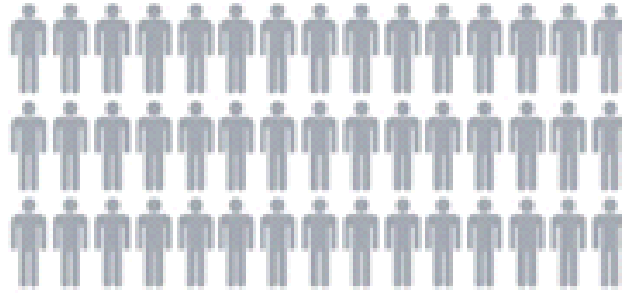
COSMOTE
our world is you

**Since 2015
common brand name
for all services
(fixed/mobile/b2b/etc)**

OTE
GROUP OF COMPANIES

Who we are

~21000
employees in
3 countries

OTE
GROUP OF COMPANIES

Fixed & Mobile telephony

Broadband access

TV

ICT

Services for operators

Who we are

Leader in SE Europe

GREECE
No1 Fixed, Mobile, TV
ROMANIA
No1 Fixed
No3 Mobile
No2 TV
ALBANIA
No2 Mobile

REVENUE

ROMANIA 25%
ALBANIA 2%
GREECE 73%
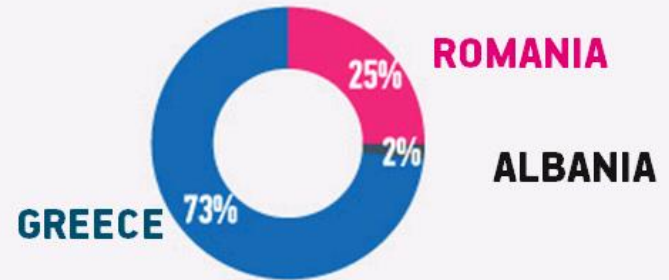
DEUTSCHE TELEKOM
Group member

OTE group shareholders

10% GREEK STATE
50% STOCK MARKET
40% DEUTSCHE TELEKOM

Challenge #1

"The need for IPv6"

The need for IPv6

During 2010 discussions for the need of IPv6 started but:

- **No commercial drive**
- **No vendor push towards IPv6**
- **No service differentiation (speed, latency, features, etc)**
- **No actions from competition**

On the other hand:

- **Public IPv4 shortage & RIPE policy for last /8**
- **Mobile subscribers increasing rapidly (doubling each year)**
- **Avoid short living CAPEX investment (CGN)**
- **Private address space chaos within 10 NATCOs & NT/IT**
- **Optimal support for new services (VoLTE/IoT)**
- **Regulatory compliance**

The need for IPv6

IPv6 deployment started to cover technology driven needs
=> project with lowest priority and risk

If something went wrong affecting other projects or (even worse) live service
=> could jeopardize the existence of the project.

Studying the demand for deployment early:

- Adjust the requirements for new infrastructure
- Spread the preparation / upgrades etc over a larger period of time
- Allow engineers to gain awareness of the new reality without rush
- Optimize the network architecture
  - Faster implementation of new services
  - More efficient O&M
  - Increase scalability and reliability
  - Reduce complexity and thus decrease costs

Challenge #2

"Dual stack or IPv6 only"

Dual stack or IPv6 only

IPv6 was introduced in 3GPP standards in release 99 (1999)

IPv4v6 was introduced in release 9 (2010)

Dual stack (over IPv4v6 single bearer) because:

- **No prerequisites from other departments (IT/VAS/TV/etc)**

$\Rightarrow$ **minimizing the risk for business critical applications/portals/etc**

- **One time re-provisioning covers all future needs (v4 only, v6 only, v4v6)**

- **Support from terminals with no differentiations**

- **Support all outbound ROAMING subscribers in Greece**

- **An emergency de-provisioning mechanism put in place to fall back to IPv4 only**

Challenge #3

"FEMTO cells over xDSL"

FEMTO cells over xDSL

Mobile services date back to 1998 => no green field environment

During 2011 "femtocells" introduced to deliver 3G service over aDSL,
(but development of the platform stopped)

IPv4v6 was not supported over this RAN environment:
So Customer Care & Commercial were involved
=> the issue was not ranked as critical to stop the v6 deployment

After going live with dual stack some more cases failed:
Corporate environment with no wifi coverage (not the usual case)
=> the de-provisioning fallback mechanism to IPv4 only was triggered
(still no change in the terminal, even if the customer gets only IPv4)

Challenge #4

"VoLTE & VoWiFi"

VoLTE & VoWiFi

VoLTE & VoWiFi => 2017 launched commercially

Native terminal support (no external applications)

ePC & IP design teams proposed as optimal (& scalable) design:
- **IPv4v6 PDN type for APN "ims" in the subscription platform (HSS)**
- **IPv6 only configuration on PGW**
- **PCSCF provided over PGW should be IPv6 only**

In theory everything should work fine

=> and so it did (at the beginning)

=> and then more and more devices came to the lab for testing … …

VoLTE & VoWiFi

The problem:

In the VoLTE call the device:

1. was asking for v4v6 "ims" connection
2. network was falling back to IPv6 only
3. connection/registration/initiation/call ✓

But call handover from VoLTE to VoWiFi ✗

VoLTE & VoWiFi

VoWiFi/LTE Mobility - Handover

CISCO
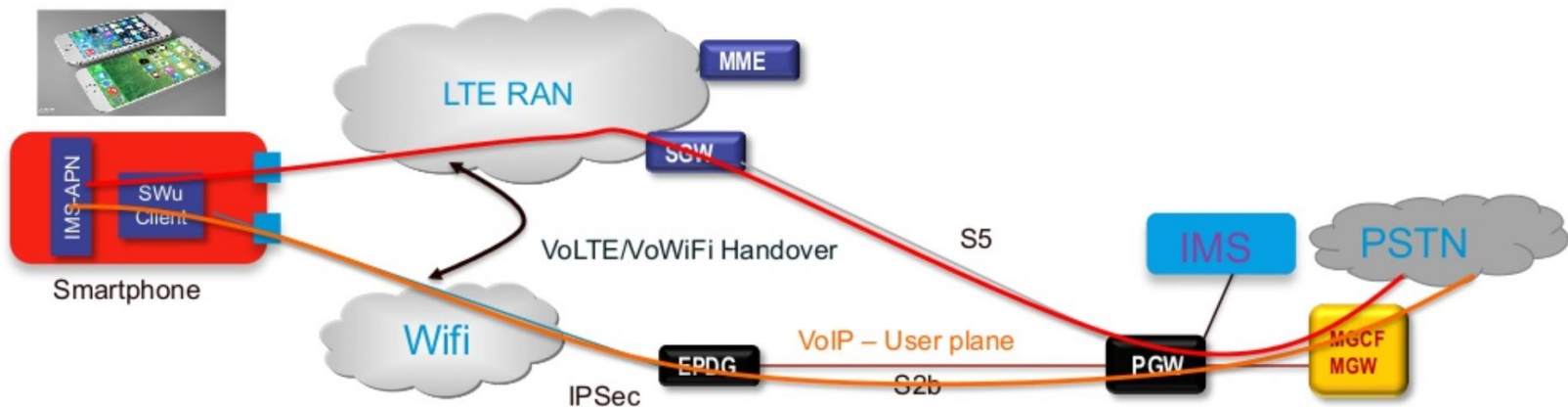
But call handover from VoLTE to VoWiFi ✗

4. the device was asking from EPDG to take over a v4v6 call

5. but PGW had v6 only connection

=> inconsistency => call dropped => PROBLEM

VoLTE & VoWiFi

Proposed solutions:

1. force the vendor to fix the firmware
2. force all the vendors providing IPv6 only configuration for APN "ims"
3. make "ims" APN dual stack on the ePC

The 3rd solution was chosen:

- **faster**
- **easier**
- **but… ugly : IPv6 only service approach => wiped out in a blink of an eye**

At least:

- **service delivered on time**
- **the choice of v4v6 profile in the subscription paid off**
- **0.0.0.0/8 was used for IPv4 pool since it's completely useless**
- **compatibility with future to come devices with v4v6 pre-configured**

Challenge #5

"ROAMING"

ROAMING

Subscribers must seamlessly roam between HOME and VISITING networks.
(but…while roaming, some infrastructure belongs to different organizations)

IPv4v6 support was new for handsets & provisioning systems but:

- **Mobile networks are upgraded very often to support new features**
- **Outbound Roaming**
  - **All our roaming partners were asked to test several APN configurations**
    - **Some strange feedback came back**
    - **In general there were no issues**
    - **A couple of networks had problems (only to prove the validity of tests)**
  - **Problems are easier to be dealt with**
- **Inbound Roaming**
- **=> v4 only, v6 only, v4v6 supported**
- **IPv6 go live was delayed as much as possible**

ROAMING

so the decision was:

dual stack service only for devices that differentiate home & roaming profile:

- **HOME settings: IPv4v6**
- **ROAMING settings: IPv4 only**

after two years of live dual stack service

=> NO issues were reported regarding ROAMING

Challenge #6

"User equipment"

User equipment

User equipment is not easily controlled by the mobile operator

- **Users may use whatever device they like=> diversity of settings**
- **Operators have usually limited leverage to enforce policies or new features to UE vendors (especially when there is no service differentiation)**

Some vendors provided the devices' settings unlocked

But the two biggest had to approve the changes => that took time

=> further delay (went hand in hand with ROAMING delay)

Current status

Current status

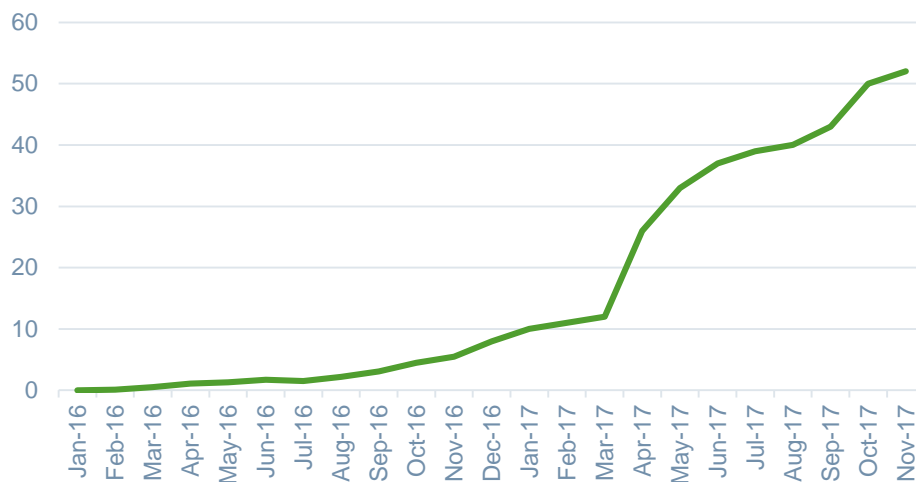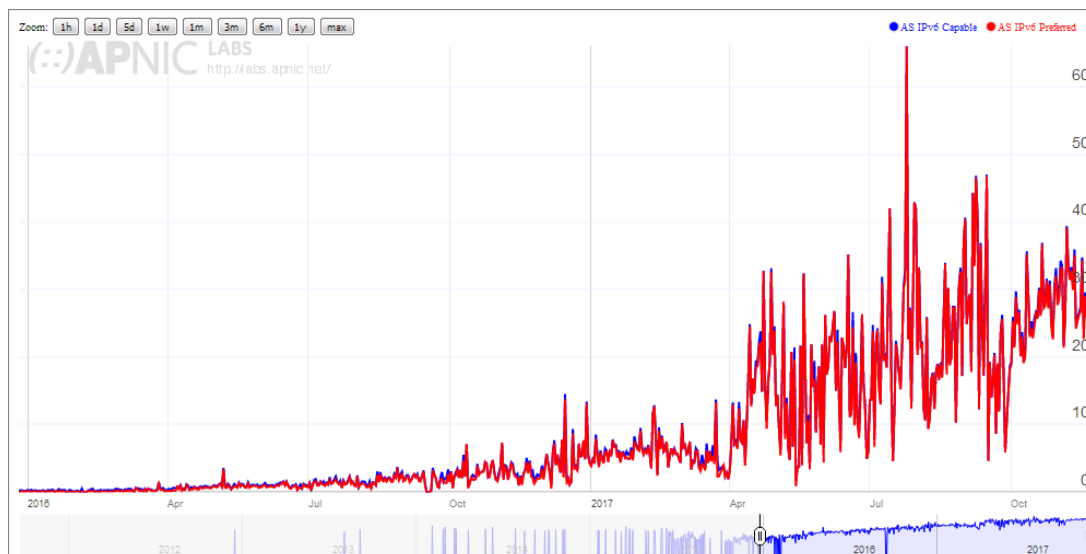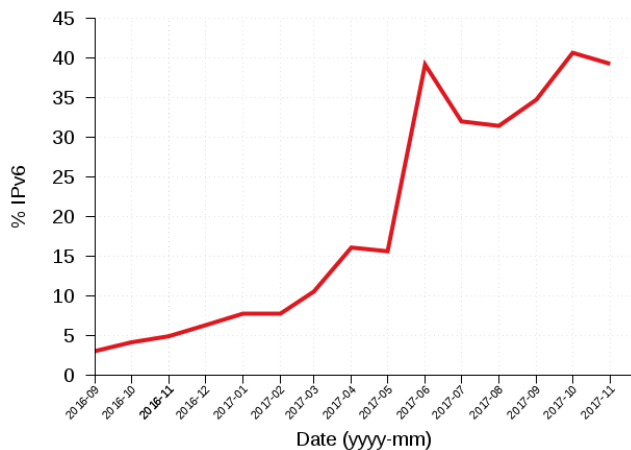**Mass market internet service is dual stack since August 2016:**

Current status
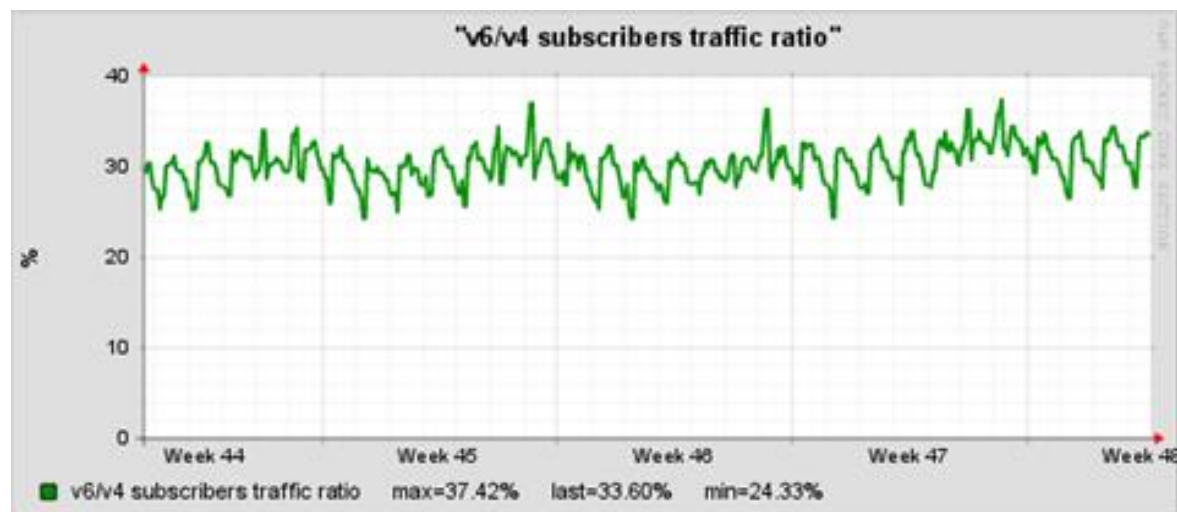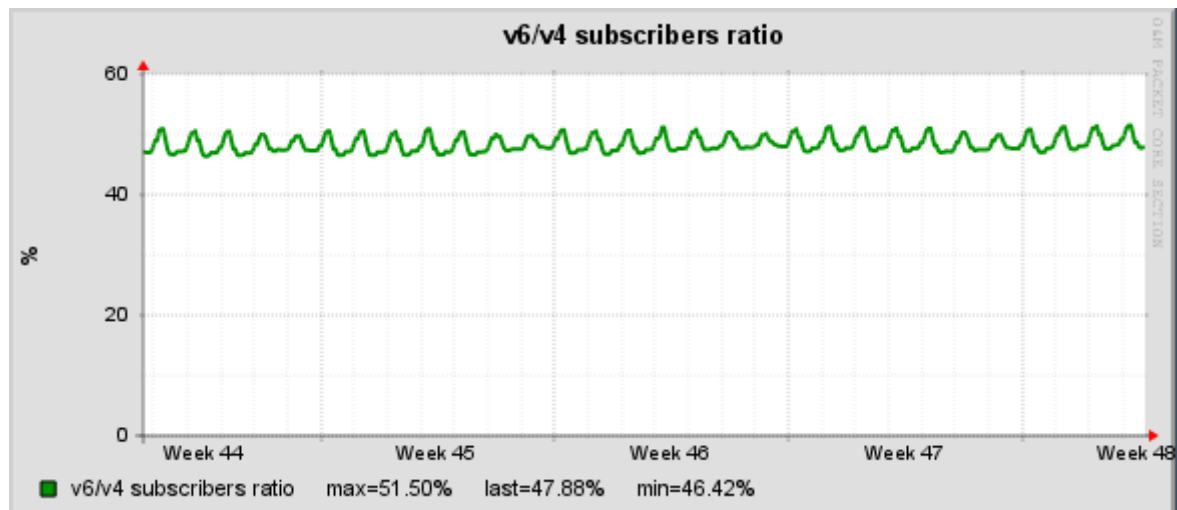
Current status

v6/v4 subscriber ratio

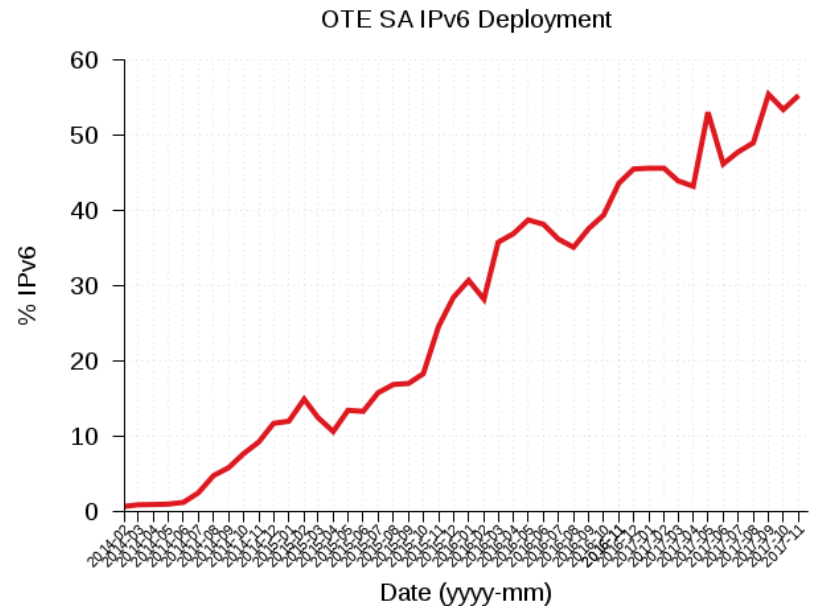Cosmote Mobile Telecommunications S.A IPv6 Deployment

Fixed

Fixed

When mobile started studying IPv6

Fixed was way ahead!! => pilot for aDSL users

- **Currently ~ 40% of traffic is IPv6**
- **CGN solution was installed (to deal with public IPv4 shortage)**
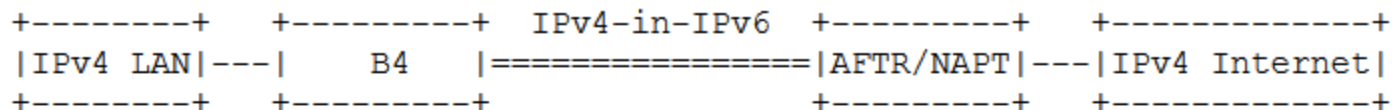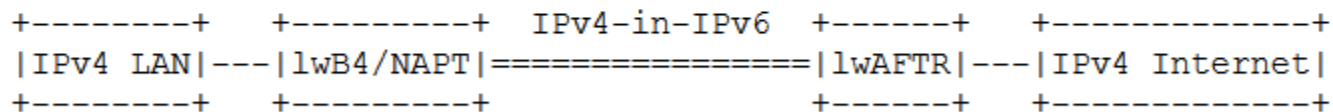
$\Rightarrow$ **now this is being replaced by a IPv6 only solution**

OTE SA IPv6 Deployment

Fixed

The IPv6 only solution chosen is based on "*Lightweight 4over6*" (RFC7596)

Lightweight 4over6 Architecture

```
+--------+    +---------+   IPv4-in-IPv6  +---------+    +------------+
|IPv4 LAN|---|    B4   |================|AFTR/NAPT|---|IPv4 Internet|
+--------+    +---------+                 +---------+    +------------+
           DS-Lite NAPT model: all state in the AFTR


+--------+    +---------+   IPv4-in-IPv6  +------+    +------------+
|IPv4 LAN|---|lwB4/NAPT|================|lwAFTR|---|IPv4 Internet|
+--------+    +---------+                 +------+    +------------+
                    lw4o6 NAPT model:
        subscriber state in the lwAFTR, NAPT state in the lwB4
```

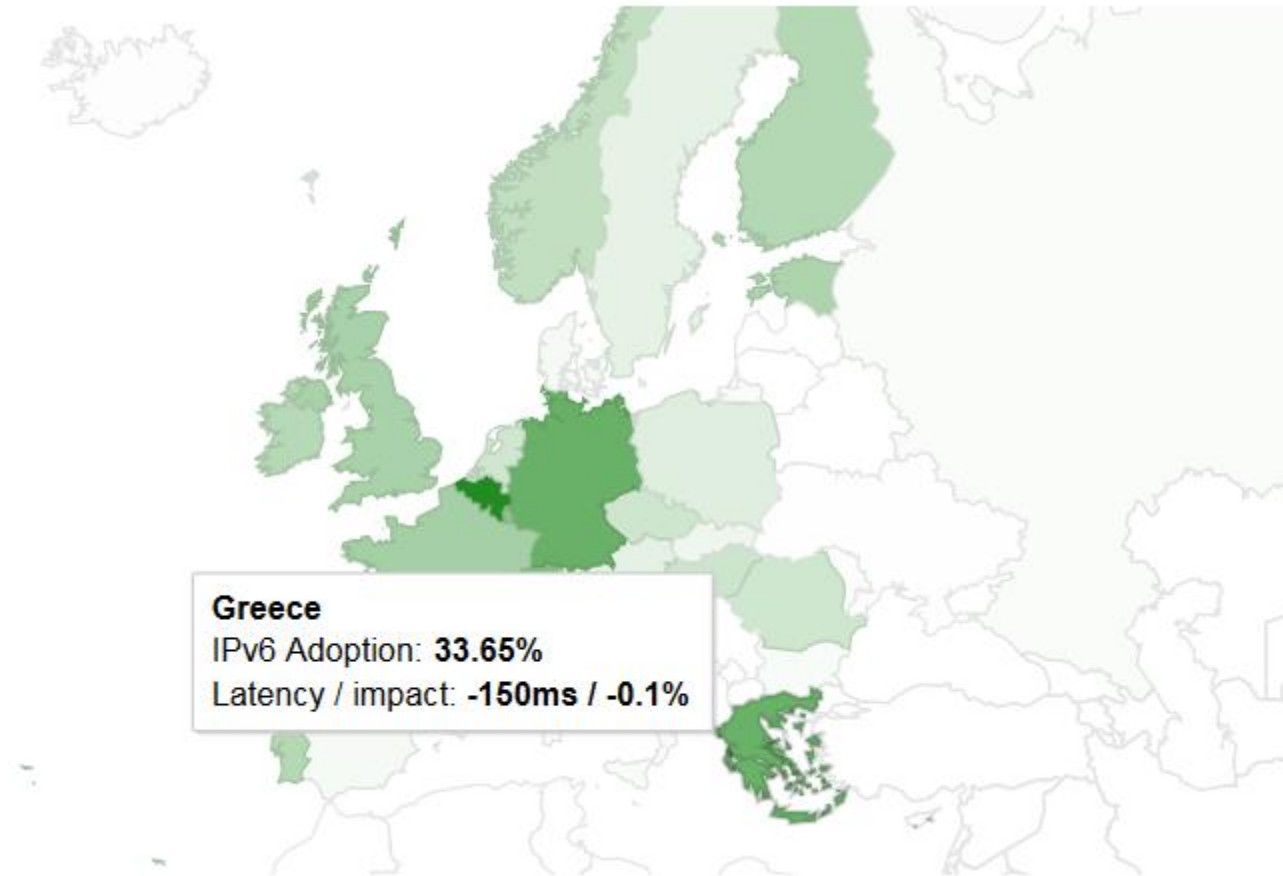⇒ **is an extension to the DS-Lite Architecture decentralizing NAT function**

Country status

Country status

Greece
IPv6 Adoption: **33.65%**
Latency / impact: **-150ms / -0.1%**

Questions