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RIPE 67
ATHENS / GREECE

Moving on…
IPv6, DS-Lite & PCP

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IP Engineering – Forthnet

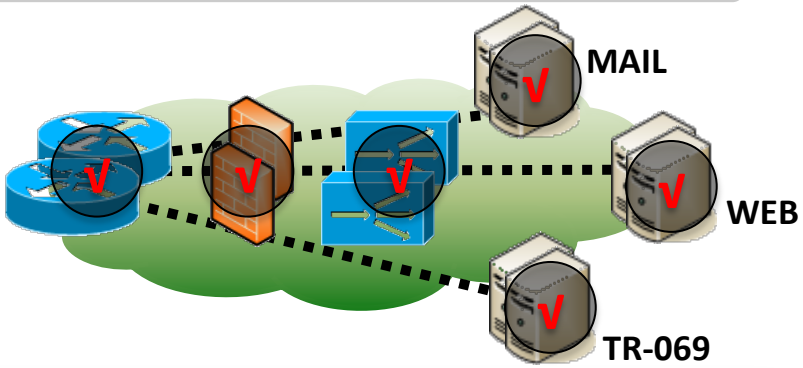
17-10-2013

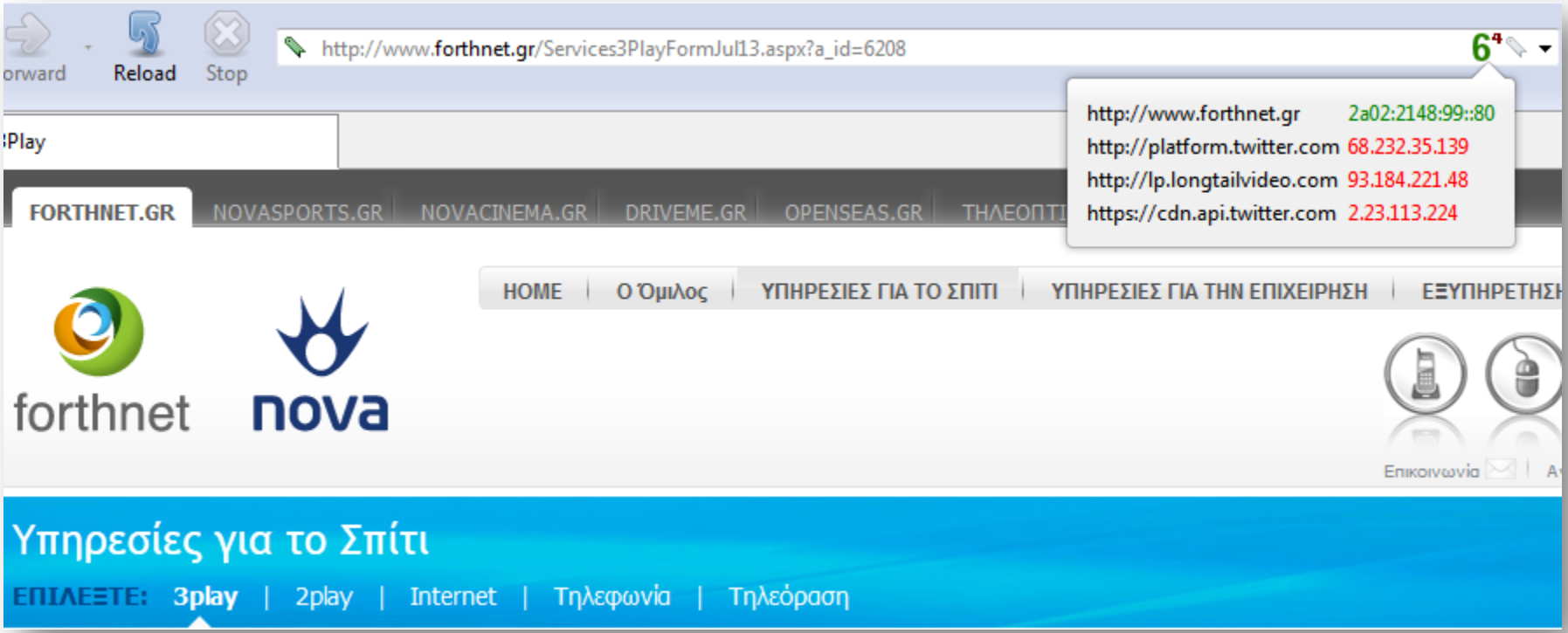
IPv6

IPv6 in www.forthnet.gr

…in just a few hours…

- Reserve IPv6 prefixes
- Configure IPv6 prefixes
- Update IPv6 filters
- Update DNS





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Statistics

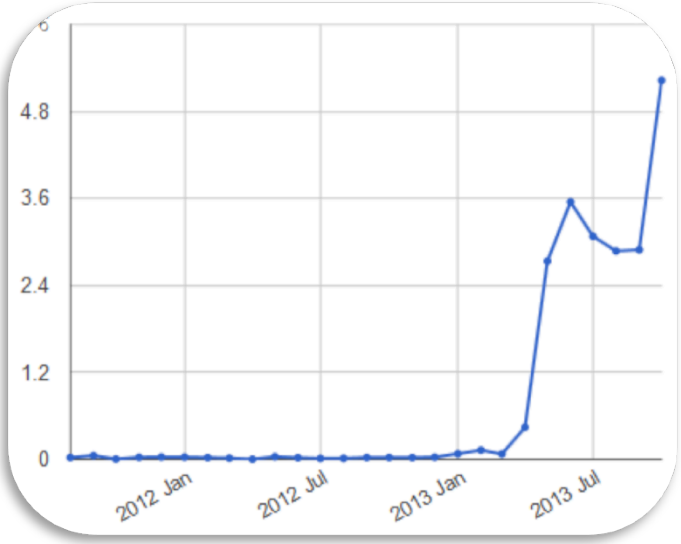
IPv6

IPv6 measurements

RIPE: 4,8%

APNIC: 5%

Access (last 6 months)	Access (last month)	Content	LIR
3.7 %	4.8 %		FORTHnet SA



W6L: 2,35%

Participating Network	ASN(s)	IPv6 deployment
Forthnet	1241	2.35%

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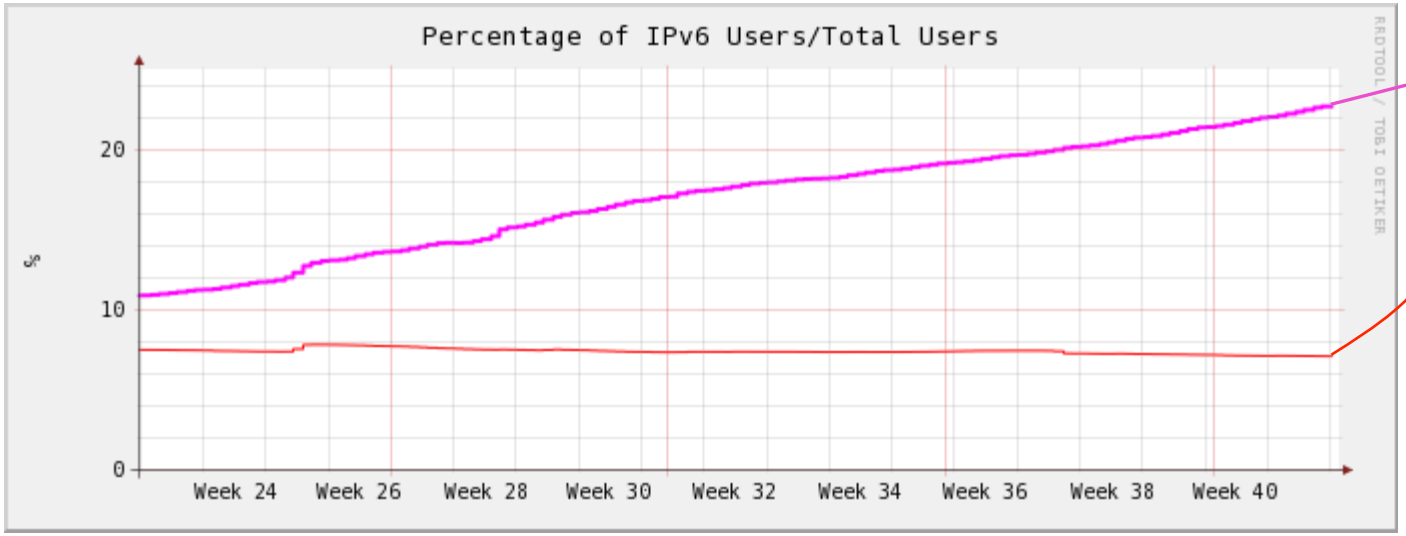
IPv6

IPv6 subscribers

More than **10%** of subscribers could access the internet over IPv6 in **June**

Almost **23%** of subscribers should access the internet over IPv6 in **October**



in 2014

But only **8%** can actually do it
Why?

A wrong default value in the latest firmware of one of our CPEs

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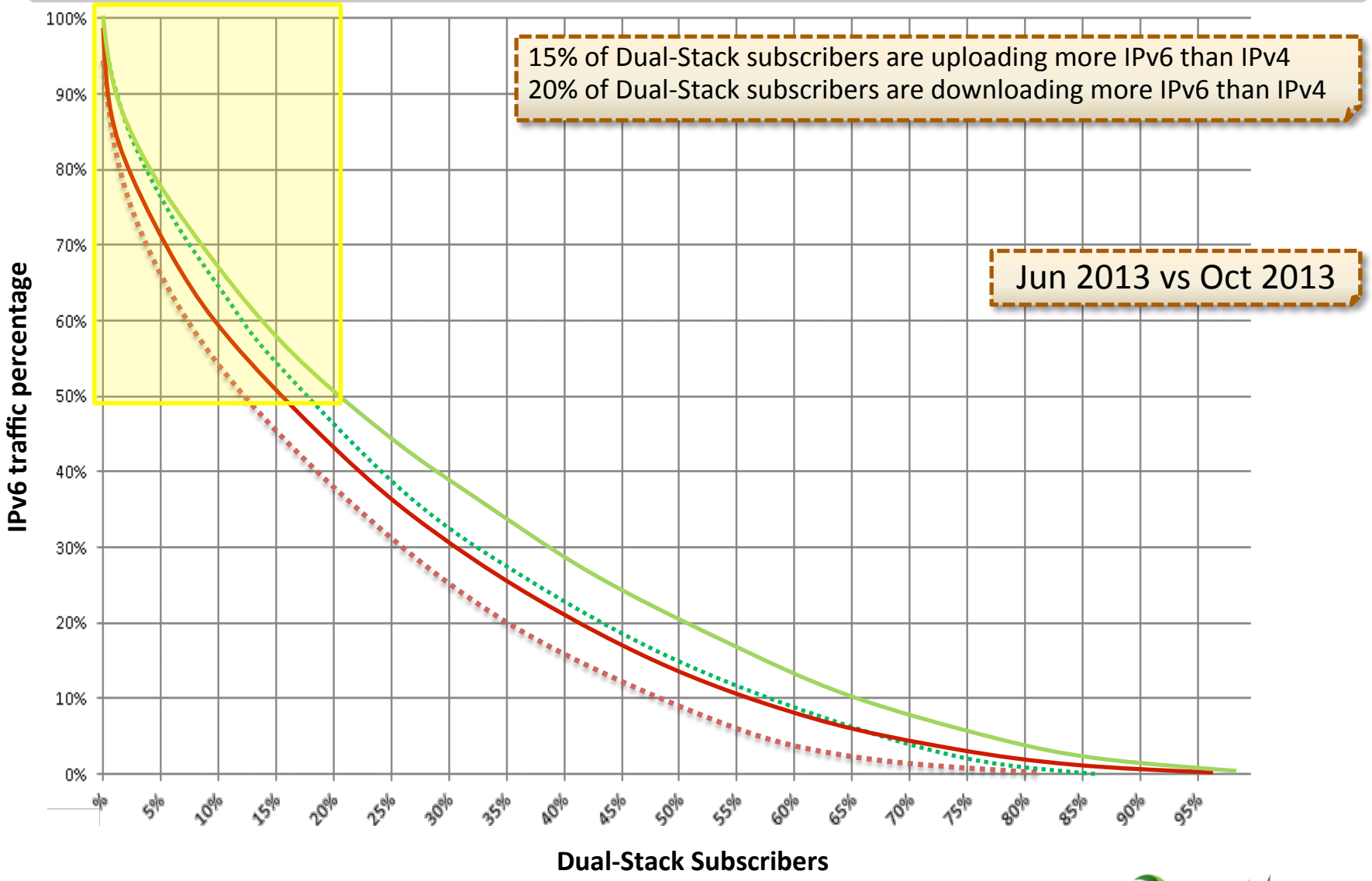
IPv6

IPv6 traffic vs IPv4 traffic



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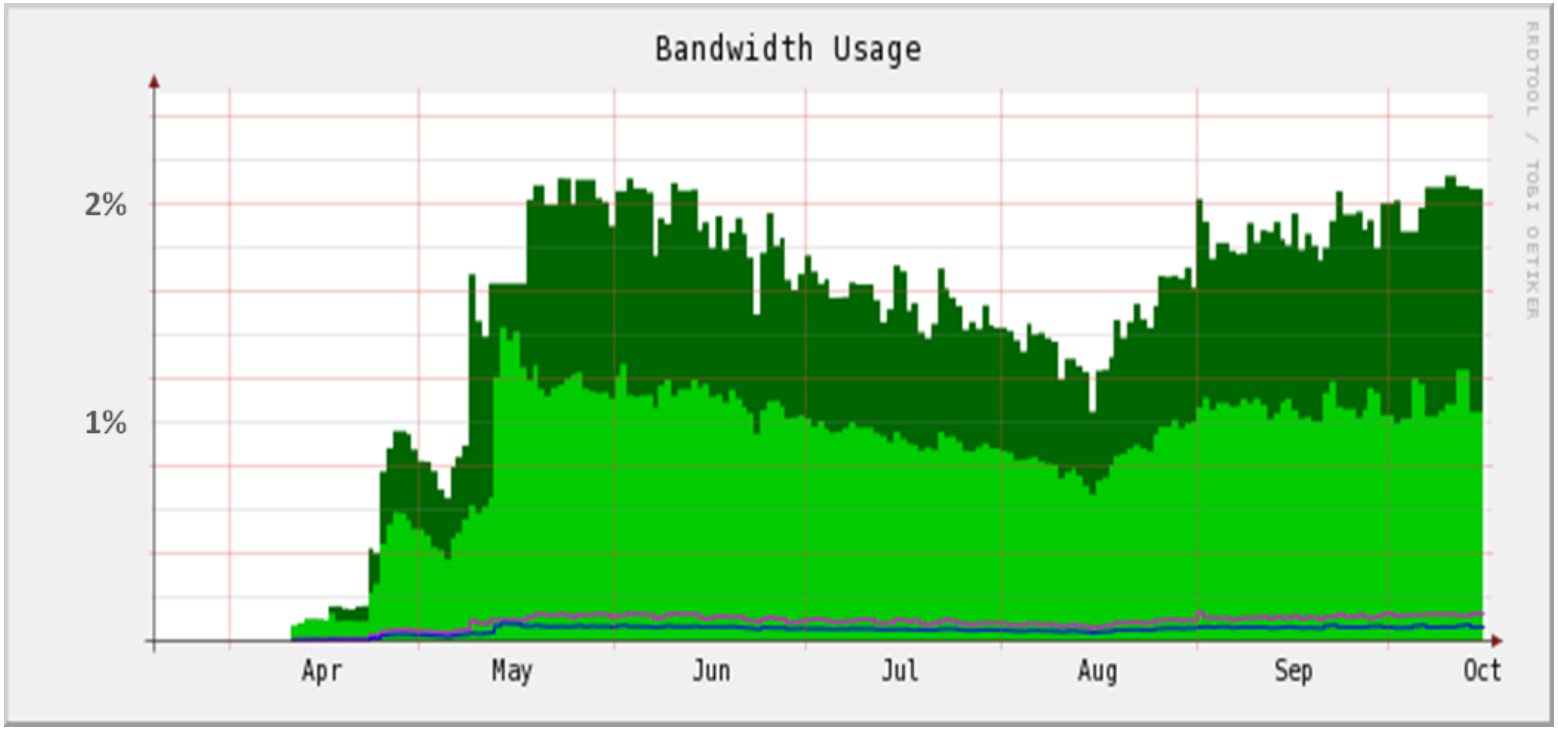
IPv6

IPv6 traffic

Almost **2%** of our traffic is over IPv6



We expect that to reach **6%** in 2014

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IPv6 in CPEs

- 5 CPEs with Dual-Stack (6 firmwares avg)
- 5 CPEs with DS-Lite (3 firmwares avg)
- 1 CPE with PCP (5 firmwares avg)

Most common problems

- DHCPv6-PD not working
- Passing DNS info to clients
- Non-optimal MTU

IPv4 Address Depletion

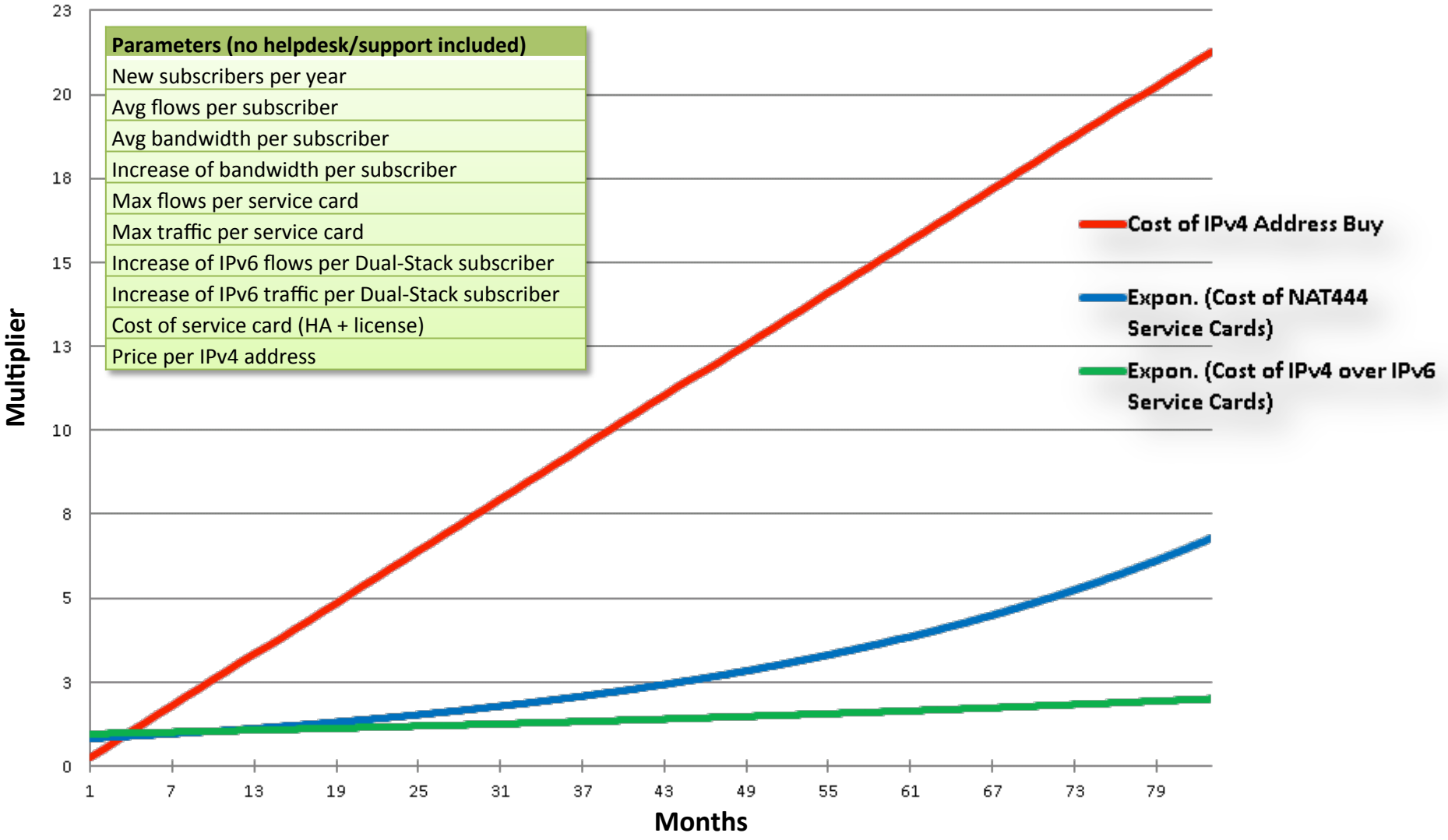
DS-Lite

Migrating from Decentralized IPv4 Assignment to Centralized

- Currently each BRAS has its own IPv4 local pool (distributed model)
- There exist 5 BRAS clusters (to become 3 soon), each one with an overflow BRAS
- Due to BRAS clustering, only the overflow BRAS has underutilization of its local IPv4 address pool
- A migration is underway in order to move distributed pools from overflow BRAS of all clusters to a centralized DHCPv4 server
- Routing de-aggregation will be minimal
- An **extension** of **a few months** is expected for the IPv4 depletion date

DS-Lite

NAT444 vs DS-Lite Cost



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DS-Lite in Forthnet

DS-Lite (Dual-Stack Lite) is a well-known **IPv6 transition technology**, while at the same time offers a **solution for the depletion of IPv4 addresses**.

The underlying architecture of the DS-Lite uses only IPv6 communication between the provider and the subscriber's CPE, while retaining the IPv4 (or dual-stack) subscriber devices as they are.

The main reasons for selecting DS-Lite for Forthnet's network are:

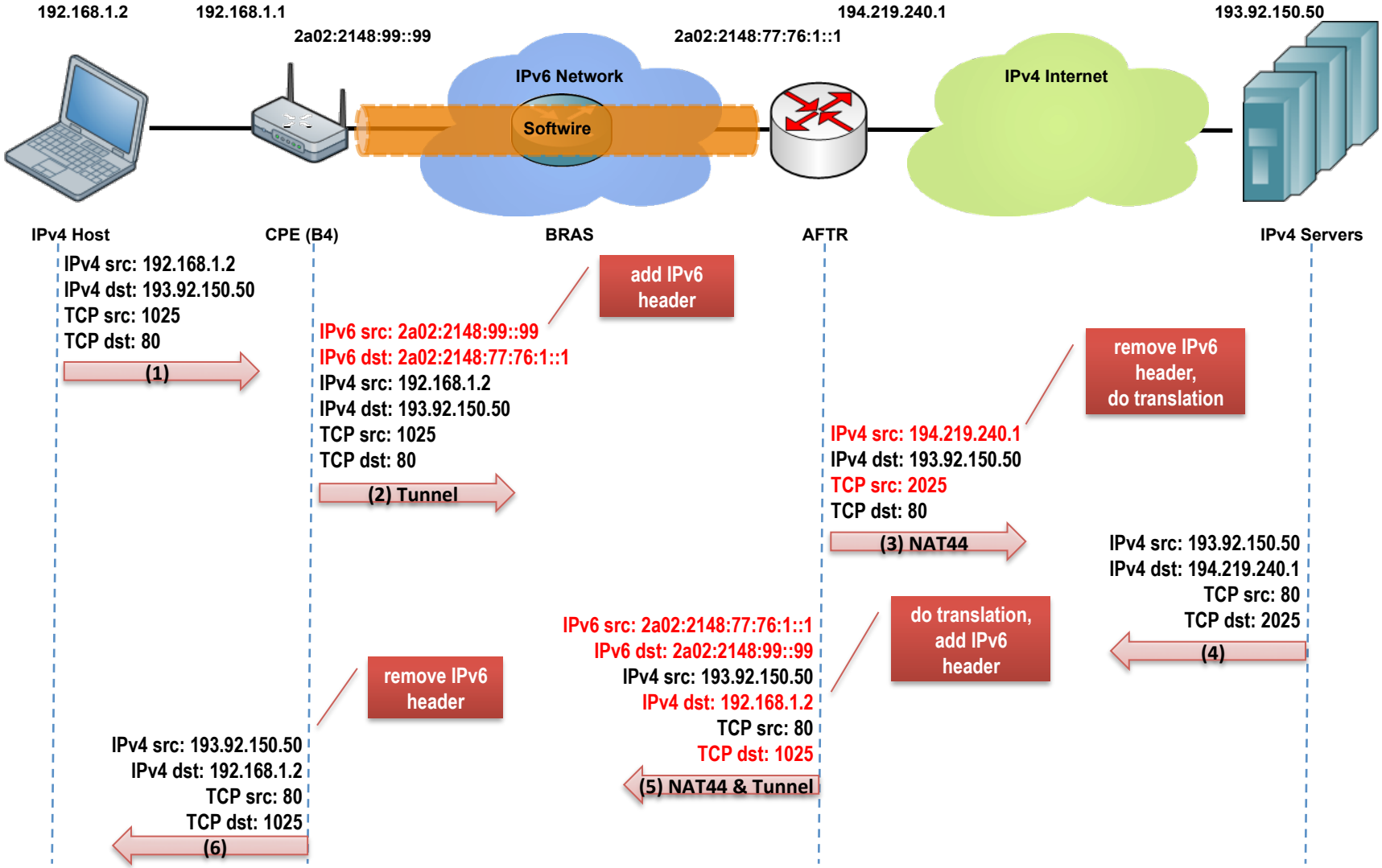
- the **mature** technology
- the **easy** implementation and provisioning
- **the use of IPv6 as its basis**

It is considered a technology solution with a relatively limited lifetime, since as IPv6 content/traffic increases, the need for communication via IPv4 will gradually decrease.

A public pilot is active in Forthnet's network since 1-Apr-2013.

Forthnet & DS-Lite

DS-Lite Operation



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Current Logging Parameters

- Date/Time
- Reporting device identifier
- Subscriber identifier (Username/Circuit-ID)
- IPv4 address/network
- WAN IPv6 Prefix (used for correlation with the new logging parameters)
- LAN IPv6 Prefix

Logging Parameters

New Logging Parameters

Dst IPv4 Address is not required/ recommended due to privacy issues
Dst owner should keep track of source ports

- Reporting device type (Optional)
- Reporting device identifier (Optional/Mandatory per case)
- Subscriber identifier (Mandatory)
- External IPv4 address (Mandatory)
- External port or ICMP identifier (Mandatory)
- Protocol identifier (Optional/Mandatory per case)
- Internal port or ICMP identifier (Optional/Mandatory per case)
- Internal address of the source of the packet (Optional/Mandatory per case)

- efficient
- customized
- requires collector
- requires extra application

IPFIX

- readable
- searchable
- reduced performance
- larger volume

SYSLOG

SYSLOG could be used on a back-end device processing IPFIX records in real-time

Sample output from AFTR

Original Message	Stored Message		
2013 Sep 14 19:19:17.698 aftr-kln-01_re0 (FPC Slot 2, PIC Slot 0) 2013-09-14 16:19:17 {DSLITE-SERVICE-SET}[FWNAT]: ASP_SFW_**CREATE**_ACCEPT_FLOW: **proto 6 (TCP)** application: tcp, xe-0/1/0.0:**192.168.1.5:65412** -> **111.111.111.111:80**, creating forward or watch flow ; source address and port translate to **194.219.240.52:1886** ;Softwire **2a02:2148:100:301:f53a:a74a:1c28:a36f**->2a02:2148:77:76:1:0:0:1	**Field**	**Original Value**	**Final Value**
	Date/Time	2013 Sep 14 19:19:17	19:19:17
	Action	Create/Delete	C/D
	Protocol	TCP	6
	Src Int IPv4 Address	192.168.1.5	-
	Src Int IPv4 Port	65412	-
	Src Ext IPv4 Address	194.219.240.52	194.219.240.52
	Src Ext IPv4 Port	1886	1886
	Dst IPv4 Address	-	-
	Dst IPv4 Port	-	-
	Src IPv6 Address	2a02:2148:100:301:f53a:a74a:1c28:a36f	2a02:2148:100:301
	Total Bytes	114	56
2013 Sep 14 19:29:19.537 aftr-kln-01_re0 (FPC Slot 2, PIC Slot 0) 2013-09-14 16:29:19 {DSLITE-SERVICE-SET}[FWNAT]: ASP_SFW_**DELETE**_FLOW: **proto 6 (TCP)** application: any, (null)(null)**192.168.1.5:65412** -> **111.111.111.111:80**, deleting forward or watch flow ; source address and port translate to **194.219.240.52:1886** ;Softwire **2a02:2148:100:301:f53a:a74a:1c28:a36f**->2a02:2148:77:76:1:0:0:1			

Date is not required, because it's embedded in each log filename
Dst IPv4 Address is not required/recommended (Dst owner should keep track of source ports too)
Further decrease can be accomplished by omitting some delimiters, prefixes and the Delete/Release actions

Logging Volume Calculations

An average subscriber generates 27k connections per 24 hours (assuming not idle)
An bittorent user makes 27k connections per hour! 1/5 of these are unique…

Logging messages can have a length of 114 bytes or 56 bytes if optimized

- 27k x 114 = 3,1 MB logs per user per day
- 27k x 56 = 1,5 MB logs per user per day if optimized

A CGN can serve at least 32k subscribers

- 32k x 3,1 MB = 99 GB per day, aka 3,0 TB per month
- 32k x 1,5 MB = 48 GB per day, aka **1,4 TB per month** if optimized

Assumptions

- No compression is happening
  - Can provide 1/10 smaller size
  - Makes searching harder and slower
- No traffic is switched over to IPv6
  - IPv6 traffic is currently 2% of IPv4, showing exponential increase
  - New IPv4 subscribers are added every day

Sample output from AFTR (PBA+PCP)

Original Message

2013 Sep 19 10:08:10.850 aftr-kln-01_re0 (FPC Slot 8, PIC Slot 0)
2013-09-19 07:08:10 [FWNAT]:ASP_NAT_PORT_BLOCK_**ALLOC**:
2a02:2149:ff01:6869:7c84:6829:ca04:f3cd ->
194.219.240.252:5120-6143

2013 Sep 19 09:58:48.602 aftr-kln-01_re0 (FPC Slot 8, PIC Slot 0)
2013-09-19 06:58:48 {TEST-PCP-SERVICE-SET}
[FWNAT]:ASP_PCP_NAT_MAP_**CREATE**:
2a02:2149:ff01:6869:7c84:6829:ca04:f3cd 192.168.1.2:48000 ->
194.219.240.252:48000

2013 Sep 19 10:50:59.933 aftr-kln-01_re0 (FPC Slot 8, PIC Slot 0)
2013-09-19 07:50:59 [FWNAT]:ASP_NAT_PORT_BLOCK_**RELEASE**:
2a02:2149:ff01:6869:7c84:6829:ca04:f3cd ->
194.219.240.252:3072-4095 0x523aa078

2013 Sep 19 10:58:48.924 aftr-kln-01_re0 (FPC Slot 8, PIC Slot 0)
2013-09-19 07:58:48 {TEST-PCP-SERVICE-SET}
[FWNAT]:ASP_PCP_NAT_MAP_**DELETE**:
2a02:2149:ff01:6869:7c84:6829:ca04:f3cd 192.168.1.2:48000 ->
194.219.240.252:48000

Stored Message

Field	Original Value	Final Value
Date/Time	2013 Sep 19 10:08:10	10:08:10
Action	Create/Delete Allocate/Release	C/D/A/R
Protocol	?	?
Src Int IPv4 Address	192.168.1.2	-
Src Int IPv4 Port	48000	-
Src Ext IPv4 Address	194.219.240.52	194.219.240.52
Src Ext IPv4 Port Range	48000 5120-6143	48000 5120-6143
Dst IPv4 Address	-	-
Dst IPv4 Port	-	-
Src IPv6 Address	2a02:2149:ff01:6869: 7c84:6829:ca04:f3cd	2a02:2149:ff01:6869
Total Bytes	124	62

Date is not required, because it's embedded in each log filename
Dst IPv4 Address is not required/recommended (Dst owner should keep track of source ports too)
Further decrease can be accomplished by omitting some delimiters, prefixes and the Delete/Release actions

PBA Logging Volume Calculations

An average subscriber makes 60 block allocations per 24 hours (assuming not idle)
An bittorent user makes 80 block allocations per 24 hours. Very little difference…

Logging messages can have a length of 124 bytes or 62 bytes if optimized

- ❑ 60 x 124 = 7 KB logs per user per day
- ❑ 60 x 62 = 3,7 KB logs per user per day if optimized

A CGN can serve at least 32k subscribers

- ❑ 32k x 7 KB = 238 MB per day, aka 7 GB per month
- ❑ 32k x 3,7 KB = 119 MB per day, aka **3,5 GB per month** if optimized

Outcomes & Comments

- ❑ No compression needed
- ❑ No optimization needed
- ❑ Little dependency on IPv6 traffic switchover
- ❑ PCP mappings make very little difference
- ❑ Depending on port block size and timeout, further optimization can be achieved

Next steps regarding IPv4 depletion

- ❑ Focus on technologies that lead to logging per port-set (natx4-log-reduction, deterministic-cgn, etc.)
- ❑ Evaluate Lw4over6 (move NAT from AFTR to B4)
- ❑ Evaluate other stateless solutions like MAP (still lacking CPE vendor interest)
- ❑ Implement automatic correlation of BRAS radius acct records with AFTR NAT mapping logs, unless RFC 6736 gets implemented first

Migrating customers to native **IPv6** is always **top priority**

PCP

PCP

About

PCP

- ❑ Port Control Protocol
- ❑ RFC 6887
- ❑ Server & Client/Proxy
- ❑ UPnP IGD-PCP Interworking Function

PCP might become an all-around protocol for signaling (like BGP)

PCP main objective

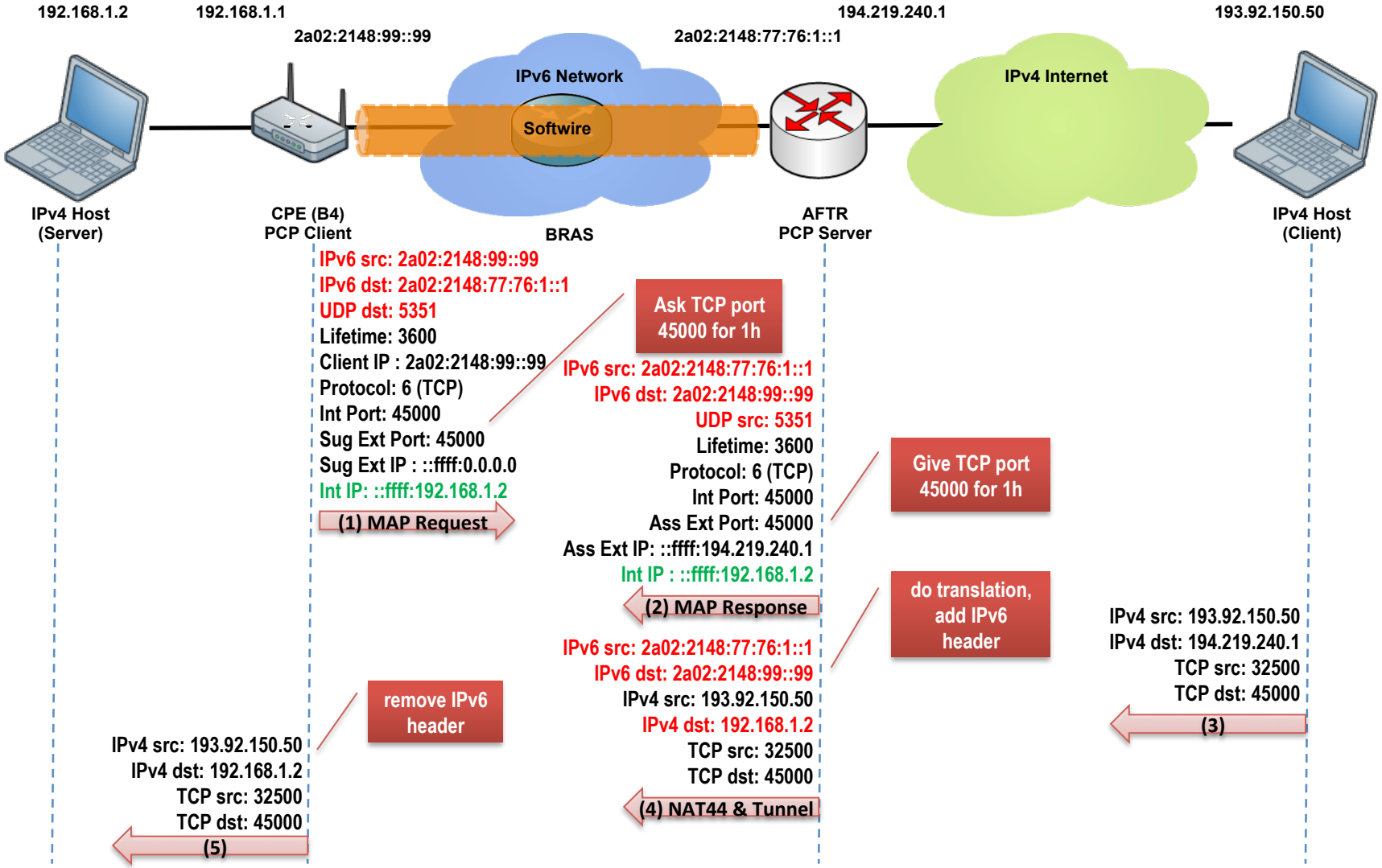
- ❑ Enable subscriber applications to receive incoming connections in coordination with an ISP NAT/Firewall device
- ❑ Enable an explicit communication between CPE/applications and the ISP NAT/ Firewall device, instead of using NAT traversal techniques (STUN/TURN/ICE)
- ❑ Good potential to become the “carrier-grade” evolution of UPnP and NAT-PMP

PCP & DS-Lite

- ❑ In plain mode, B4 element acts as PCP-client or PCP-proxy for IPv4 clients behind it and will send requests for PCP mappings using the THIRD_PARTY option

PCP

PCP & DS-Lite Operation



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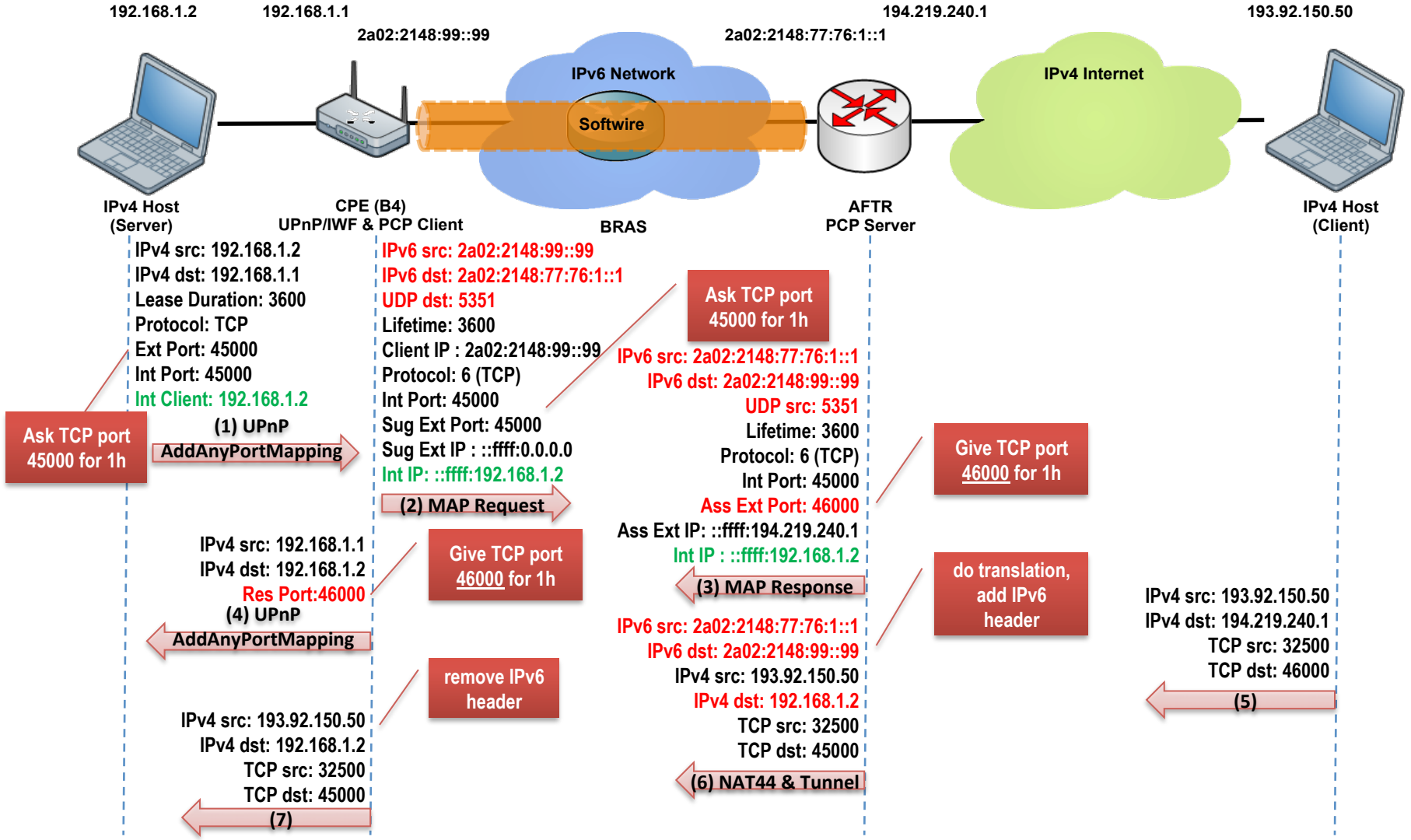
PCP

PCP/UPnP & DS-Lite Operation



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PCP

Custom CPE page for tests

Common Request Header					
Version:	2	R: 0	Opcode:	1	Reserved
Requested Lifetime:				3600	
PCP Client's IP address:				2a02:2149:ff02:ca4b:f520:adfa:894:1b99	
ANNOUNCE MAP PEER Opcode Request					
Protocol:	6	Reserved			
Internal Port:	50007	Suggested External Port:		50007	
Suggested External IP address:				::ffff:0.0.0.0	
Option(s)					
Option Code:	1	Reserved	Option Length:	16	
Data:		::ffff:192.168.1.2			
Add an Option	Delete	Filter option?			

A custom page was created on the CPE in order to start experimenting with PCP

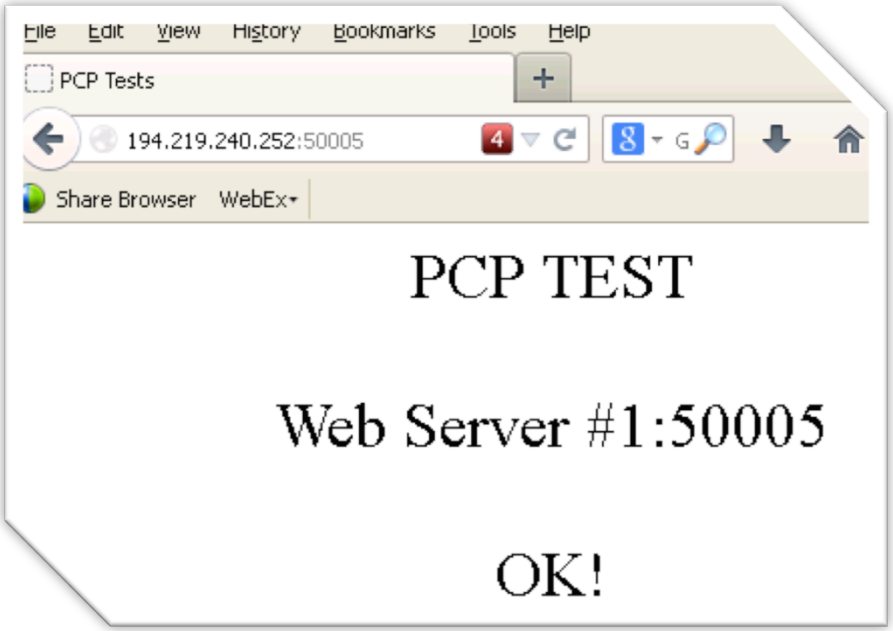
PCP

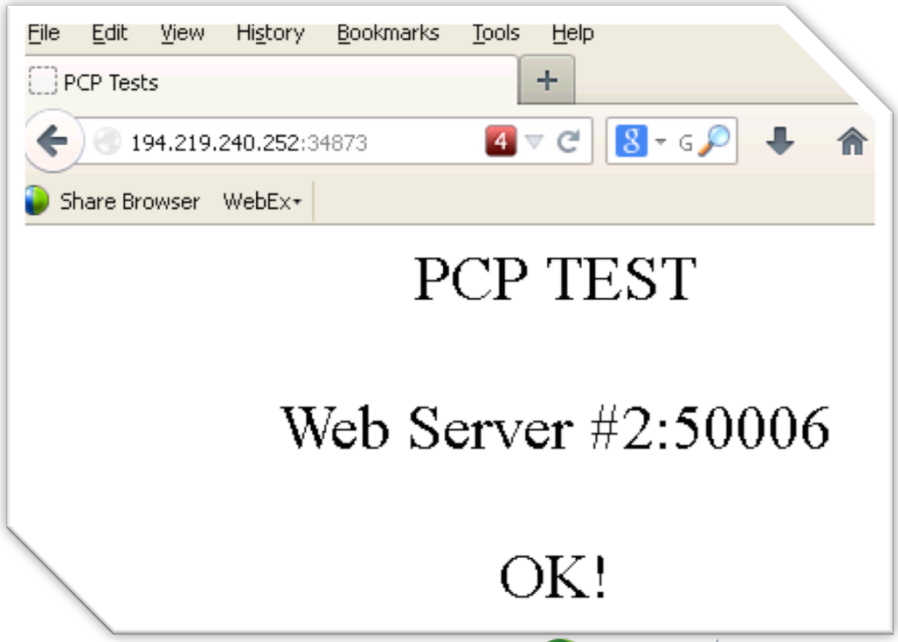
Tests

Create a NAT port-forwarding entry for a web server on internal port 50005

Create a NAT port-forwarding entry for a web server on internal port 50006

Protocol	Internal IP Address	Internet Port	External IP Address	External Port	Lifetime	Created by
TCP	192.168.1.2	50005	194.219.240.252	50005	Infinite	User
TCP	192.168.1.2	50006	194.219.240.252	34873	Infinite	User





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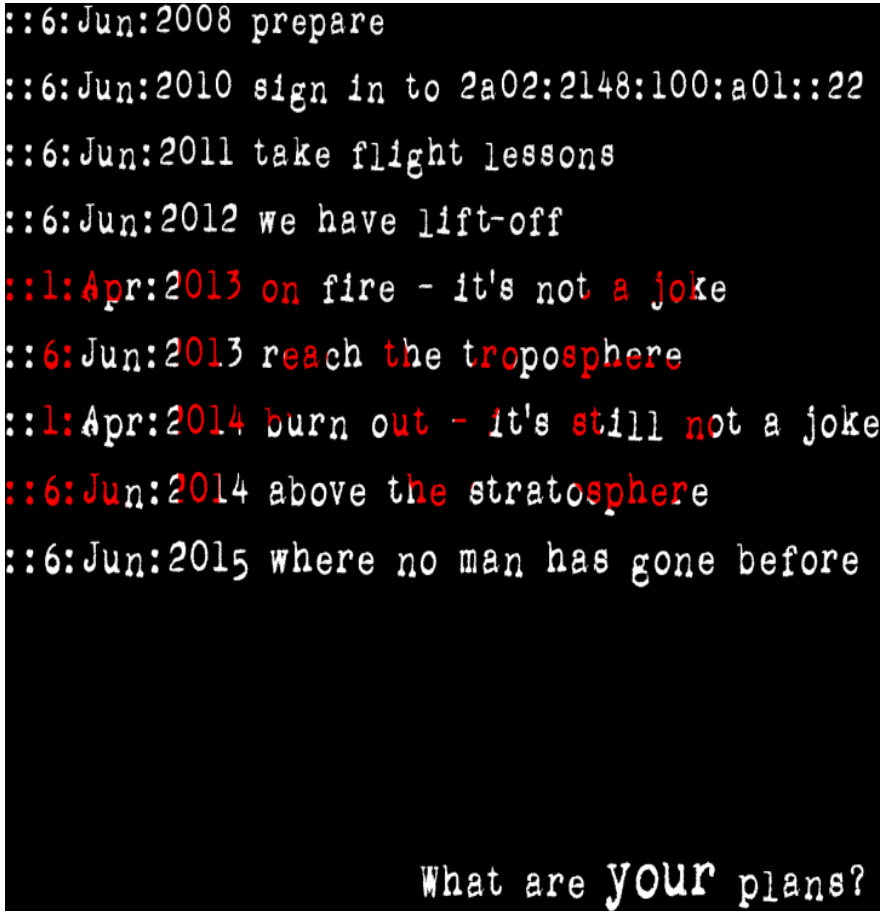
Implementation issues

- Many PCP servers seem to be stuck at draft versions (RFC out from April)
- Support mostly for MAP opcode
- Main focus on PCP client and PCP/UPnP-IGD IWF functionality
- PCP proxy not preferred (any apps out there?)
- PREFER_FAILURE by default on
- Many bugs with lifetimes and timeouts

Still a lot to be done in PCP

Nevertheless,
DS-Lite and PCP work!



- ❑ IPv6 internal tests
- ❑ /29 from RIPE & ipv6.forthnet.gr
- ❑ IPv6 pilot (W6D)
- ❑ IPv6 production (W6L)
- ❑ IPv6 production & DS-Lite pilot
- ❑ 10% of subscribers use IPv6
- ❑ DS-Lite & PCP production
- ❑ 30% of subscribers use IPv6
- ❑ ?

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Thank you!

Q & A