SWISS IPv6 COUNCIL

AWK GROUP

Consulting
Engineering
Project Management

Swiss IPv6 Council
NAT64 Day 2019 @ AWK

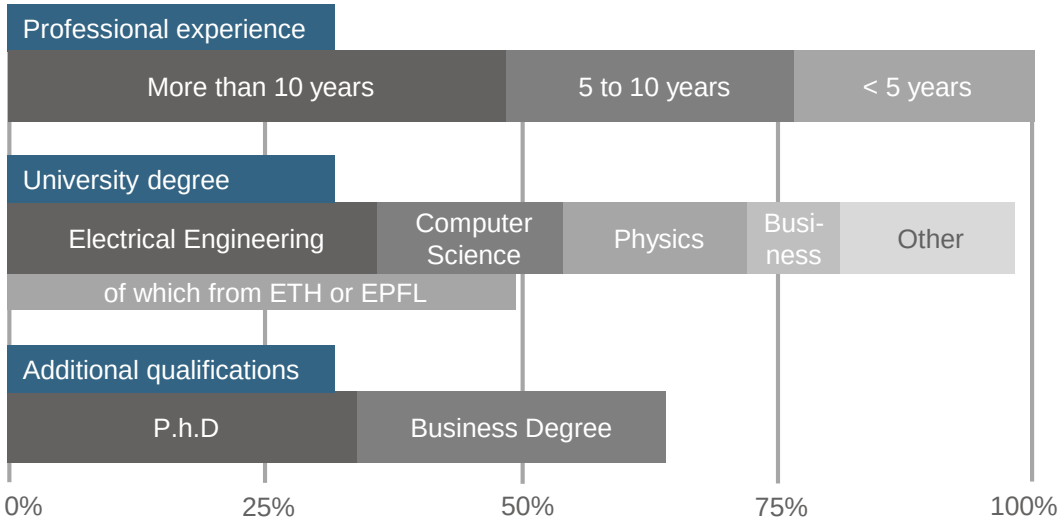
Digicomp, 20 Mai 2019

Gabriel Müller, Principal Consultant

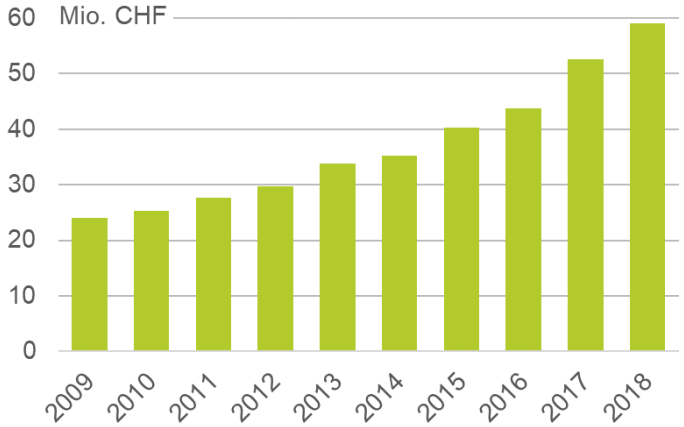
Facts and Figures

Activity	Consulting, engineering und project management for information technology and digital transformation
Founded in	1986
Employees	Over 300 staff
Clients	Over 400
Projects	Over 4‘000
Site Locations	Zurich, Berne, Basle, Lausanne

Qualification of our Consultants



Turnover



Partners of AWK

From left to right:
Christian Mauz
Andreas Gumann
Oliver Spiess
Ralph Tonezzer
Oliver Vaterlaus (CEO)
Roger Mosimann
André Arrigoni
Adrian Wägli

Content

Motivation

“the proof of the pudding is in the eating”

Can we do it ?

How complex is the setup ?

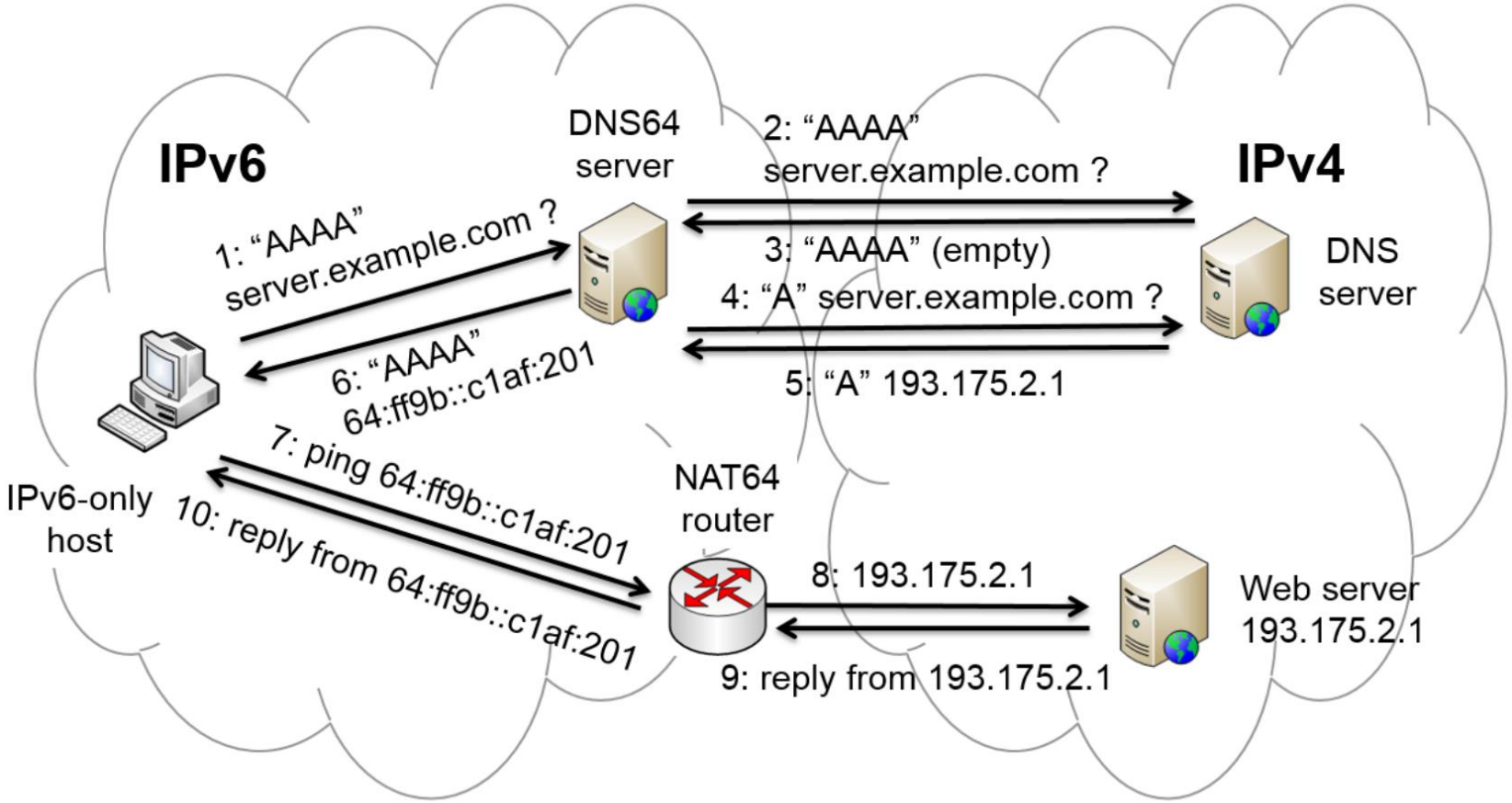
Alternative to dual stack setup ?

Source: www.kisspng.com

NAT64 / DNS64 Recap

Enable IPv6-only clients to access IPv4 content:

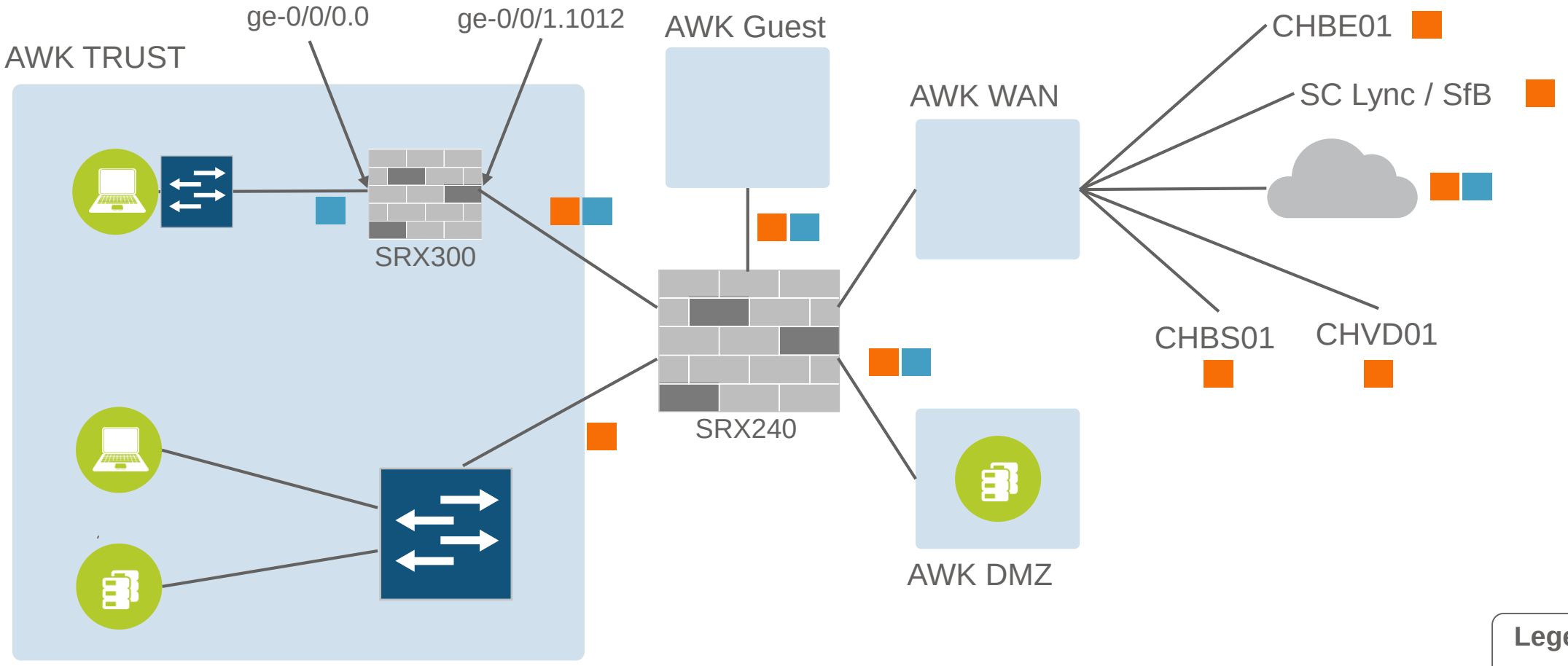
- Based on DNS response modifications
- If no AAAA exists, an AAAA response with prefix 66:ff9B::/96 is created and returned to client → DNS64
- Client then initiates an IPv6 connection to this IPv6 address, the NAT64 router does IPv6 to IPv4 translation → NAT64



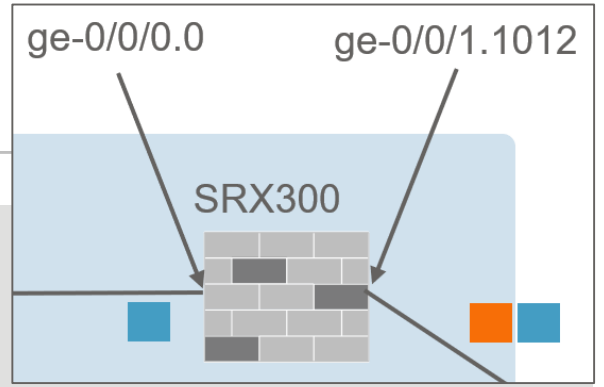
Source: www.researchgate.net

Content

Test setup – the big picture



Technical details




```
// Interface Configuration
// IPv6 client network
set interfaces ge-0/0/0 unit 0 family inet6 address 2001:1702:6:6::10/64
set interfaces ge-0/0/0 unit 0 family inet6 address fe80::6:0:0:10/64
// Dualstack transport network
set interfaces ge-0/0/1 vlan-tagging
set interfaces ge-0/0/1 unit 1012 vlan-id 1012
set interfaces ge-0/0/1 unit 1012 family inet address 10.1.241.30/24
set interfaces ge-0/0/1 unit 1012 family inet6 address 2001:1702:6:1012::30/64
set interfaces ge-0/0/1 unit 1012 family inet6 address fe80::1012:0:0:30/64
// NAT64
set security nat static rule-set NAT64 from zone Clients-IPv6
set security nat static rule-set NAT64 rule NAT64_INET match destination-address 64:ff9b::/96
set security nat static rule-set NAT64 rule NAT64_INET then static-nat inet
// NAT46
set security nat static rule-set NAT46 from zone Transport-IPv4
set security nat static rule-set NAT46 rule NAT46_Pool match source-address 0.0.0.0/0
set security nat static rule-set NAT46 rule NAT46_Pool match destination-address 192.168.21.128/25
set security nat static rule-set NAT46 rule NAT46_Pool then static-nat prefix 2001:1702:6:6::80/121
// DNS64
< nothing > // using dns doctoring feature of Junos, enabled by default
```

IMPORTANT

The packet destination IP is not same as source IP version, drop it

Technical details – stateless vs. stateful NAT64

In our test setup we use stateless / static NAT64

- Any idea why?

Stateless NAT64	Stateful NAT64
1:1 translation	1:N translation
No conservation of IPv4 address	Conserves IPv4 address
Assures end-to-end address transparency and scalability	Uses address overloading, hence lacks in end-to-end address transparency
No state or bindings created on the translation	State or bindings are created on every unique translation
Requires IPv4-translatable IPv6 addresses assignment	No requirement on the nature of IPv6 address assignment
Requires either manual or DHCPv6 based address assignment for IPv6 hosts	Free to choose any mode of IPv6 address assignment viz. Manual, DHCPv6, SLAAC

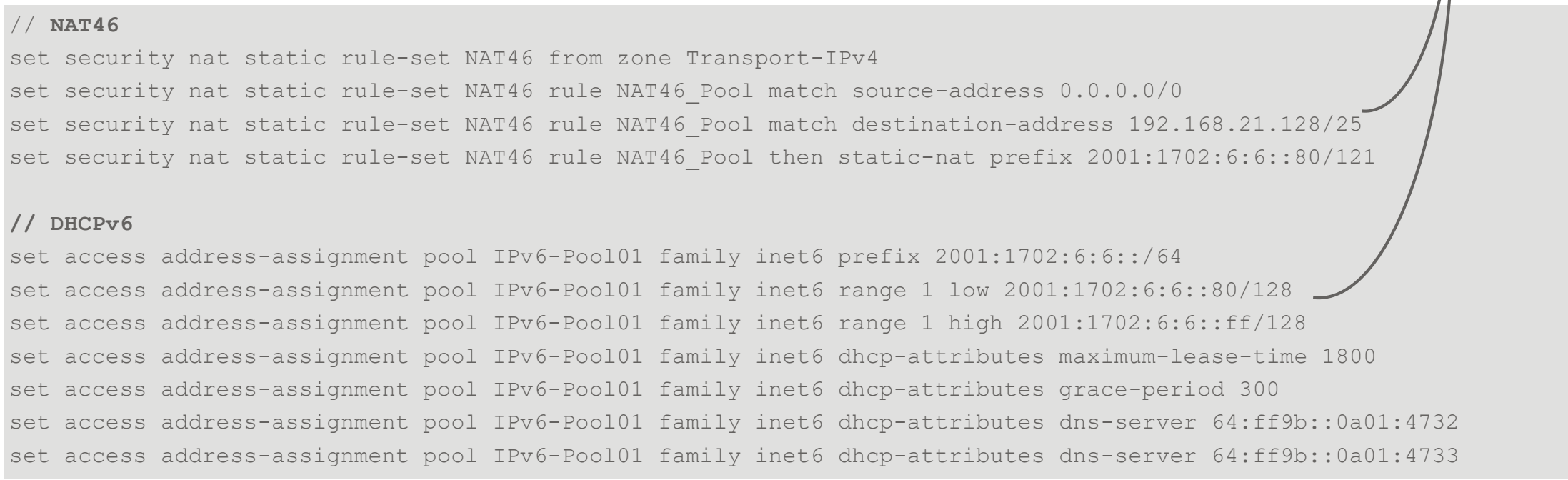
Source: Cisco IOS Advanced Webinars, NAT64 Technology: NAT64, IPv6 Branch Functionality

Addressing

```
2001:1702:6:6::80 <-> 192.168.21.128
2001:1702:6:6::81 <-> 192.168.21.129
2001:1702:6:6::82 <-> 192.168.21.130
…
2001:1702:6:6::ff <-> 192.168.21.255
```

Using DHCPv6

- **Any idea why?**
- **Motivation: Creating a 1to1 relationship / enabling bi-directional traffic**



```
// NAT46
set security nat static rule-set NAT46 from zone Transport-IPv4
set security nat static rule-set NAT46 rule NAT46_Pool match source-address 0.0.0.0/0
set security nat static rule-set NAT46 rule NAT46_Pool match destination-address 192.168.21.128/25
set security nat static rule-set NAT46 rule NAT46_Pool then static-nat prefix 2001:1702:6:6::80/121

// DHCPv6
set access address-assignment pool IPv6-Pool01 family inet6 prefix 2001:1702:6:6::/64
set access address-assignment pool IPv6-Pool01 family inet6 range 1 low 2001:1702:6:6::80/128
set access address-assignment pool IPv6-Pool01 family inet6 range 1 high 2001:1702:6:6::ff/128
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes maximum-lease-time 1800
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes grace-period 300
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes dns-server 64:ff9b::0a01:4732
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes dns-server 64:ff9b::0a01:4733
```

Technical details – the beauty of static NAT @ Junos

```
// ICMP ping example
C:\Users\Mug>ping 64:ff9b::10.1.71.50
Ping wird ausgeführt für 64:ff9b::a01:4732 mit 32 Bytes Daten:
Antwort von 64:ff9b::a01:4732: Zeit=1ms
Antwort von 64:ff9b::a01:4732: Zeit=1ms

// SRX trace

// Initial packet received
RT: ge-0/0/0.0:2001:1702:6:6:0:0:0:8c/8->64:ff9b:0:0:0:0:a01:4732/1,58, icmp 128/0 <root-logical-system>
// NAT64 - changing destination IP
RT: packet 2001:1702:6:6:0:0:0:8c->64:ff9b:0:0:0:0:a01:4732 dst is translated to 10.1.71.50
// Routing and policy lookup
RT: routed (x_dst_ip 10.1.71.50) from Clients-IPv6 (ge-0/0/0.0 in 0) to ge-0/0/1.1012, Next-hop:…
RT: Policy lkup: vsys 0 zone(6:Clients-IPv6) -> zone(7:Transport-IPv4) scope:0
RT:              2001:1702:6:6:0:0:0:8c/32768 -> 10.1.71.50/19490 proto 58
// NAT64 - changing source IP - using reversed NAT46 configuration
RT: reverse mip xlate 2001:1702:6:6:0:0:0:8c/8 -> 192.168.21.140/8 (on ge-0/0/1.1012)
```

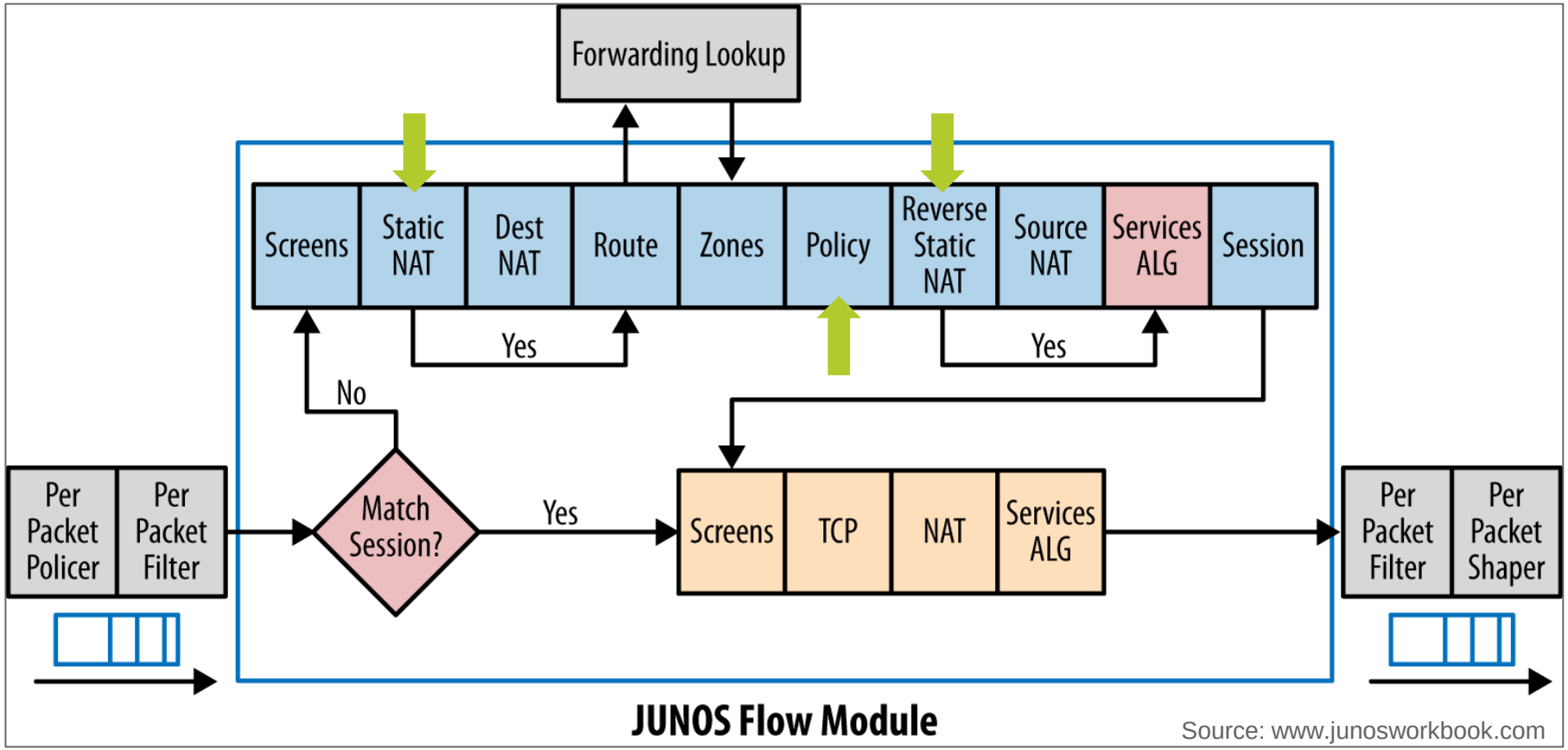
```
match source-address 2001:1702:6:6::80/121
Then static-net prefix 192.168.21.128/25
```

```
match destination-address 192.168.21.128/25
then static-nat prefix 2001:1702:6:6::80/121
```

Technical details – remark

Junos flow processing

- In which regard is this important ?



Source: www.junosworkbook.com

Technical details – Junos dns doctoring feature

```
// DNS querry for entry with non-existing AAAA record
C:\Users\Mug>nslookup -type=aaaa tagi.ch
Server:  UnKnown
Address:  64:ff9b::a01:4732

Nicht autorisierende Antwort:
```

DNS querry - client perspective

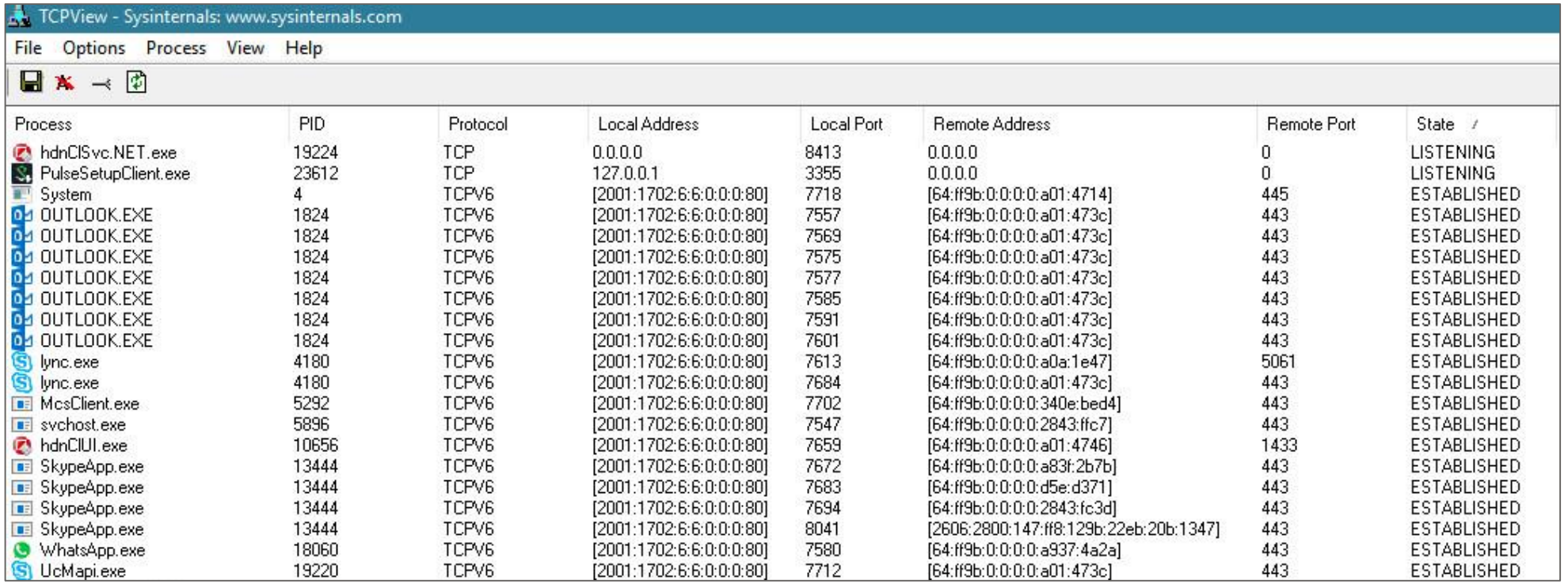
No.	Time	Source	Destination	Length	Protocol	Info
1	0.000000	2001:1702:6:6::8c	64:ff9b::a01:4732	87	DNS	Standard query 0x0003 AAAA tagi.ch
2	0.002142	64:ff9b::a01:4732	2001:1702:6:6::8c	123	DNS	Standard query response 0x0003 AAAA tagi.ch AAAA 64:ff9b::97fc:a7e

```
// SRX trace
RT: Receive an A response from V4 server to V6 client
RT: The response for the duplicate A query
RT: Translating A response to AAAA response
RT: DNS All RRs Offset Start Update
RT: ***************name_size = 2
RT: Find the total sum = 0 RRs might need to be modified
RT: Modify offset from (12) to (25)
RT: Translating A response(151.252.10.126) to AAAA response(64:ff9b:0:0:0:0:97fc:a7e)
RT: Reinject the dup jbuf from A to AAAA
RT: Success to xlate reply from A to AAAA
```

Test Methodology

Validation / fault finding done by

- Testing application
- Windows log
- Wireshark
- TCPview



Process	PID	Protocol	Local Address	Local Port	Remote Address	Remote Port	State
hdnCISvc.NET.exe	19224	TCP	0.0.0.0	8413	0.0.0.0	0	LISTENING
PulseSetupClient.exe	23612	TCP	127.0.0.1	3355	0.0.0.0	0	LISTENING
System	4	TCPV6	[2001:1702:6:6:0:0:0:80]	7718	[64:ff9b:0:0:0:0:a01:4714]	445	ESTABLISHED
OUTLOOK.EXE	1824	TCPV6	[2001:1702:6:6:0:0:0:80]	7557	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
OUTLOOK.EXE	1824	TCPV6	[2001:1702:6:6:0:0:0:80]	7569	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
OUTLOOK.EXE	1824	TCPV6	[2001:1702:6:6:0:0:0:80]	7575	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
OUTLOOK.EXE	1824	TCPV6	[2001:1702:6:6:0:0:0:80]	7577	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
OUTLOOK.EXE	1824	TCPV6	[2001:1702:6:6:0:0:0:80]	7585	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
OUTLOOK.EXE	1824	TCPV6	[2001:1702:6:6:0:0:0:80]	7591	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
OUTLOOK.EXE	1824	TCPV6	[2001:1702:6:6:0:0:0:80]	7601	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
lync.exe	4180	TCPV6	[2001:1702:6:6:0:0:0:80]	7613	[64:ff9b:0:0:0:0:a0a:1e47]	5061	ESTABLISHED
lync.exe	4180	TCPV6	[2001:1702:6:6:0:0:0:80]	7684	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED
McsClient.exe	5292	TCPV6	[2001:1702:6:6:0:0:0:80]	7702	[64:ff9b:0:0:0:0:340e:bed4]	443	ESTABLISHED
svchost.exe	5896	TCPV6	[2001:1702:6:6:0:0:0:80]	7547	[64:ff9b:0:0:0:0:2843:ffc7]	443	ESTABLISHED
hdnCIUI.exe	10656	TCPV6	[2001:1702:6:6:0:0:0:80]	7659	[64:ff9b:0:0:0:0:a01:4746]	1433	ESTABLISHED
SkypeApp.exe	13444	TCPV6	[2001:1702:6:6:0:0:0:80]	7672	[64:ff9b:0:0:0:0:a83f:2b7b]	443	ESTABLISHED
SkypeApp.exe	13444	TCPV6	[2001:1702:6:6:0:0:0:80]	7683	[64:ff9b:0:0:0:0:d5e:d371]	443	ESTABLISHED
SkypeApp.exe	13444	TCPV6	[2001:1702:6:6:0:0:0:80]	7694	[64:ff9b:0:0:0:0:2843:fc3d]	443	ESTABLISHED
SkypeApp.exe	13444	TCPV6	[2001:1702:6:6:0:0:0:80]	8041	[2606:2800:147:ff8:129b:22eb:20b:1347]	443	ESTABLISHED
WhatsApp.exe	18060	TCPV6	[2001:1702:6:6:0:0:0:80]	7580	[64:ff9b:0:0:0:0:a937:4a2a]	443	ESTABLISHED
UcMapi.exe	19220	TCPV6	[2001:1702:6:6:0:0:0:80]	7712	[64:ff9b:0:0:0:0:a01:473c]	443	ESTABLISHED

Content

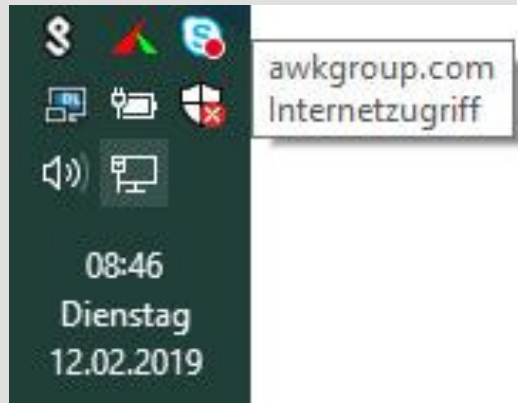
Introduction

Conditions:

- AWK clients in IPv6-only network segment
- Within the trust zone, access to all internal IPv4 resources
- Access to the IPv4 and IPv6 internet
- Focus on AWK internal applications as well as on applications used by consultants within projects

Basics

```
// IP Configuratin Client (DHCPv6)
Ethernet-Adapter Ethernet:

   Verbindungsspezifisches DNS-Suffix:
   Beschreibung. . . . . . . . . . . : Intel(R) Ethernet Connection (4) I219-V
   Physische Adresse . . . . . . . . : 54-E1-AD-1B-6E-33
   DHCP aktiviert. . . . . . . . . . : Ja
   Autokonfiguration aktiviert . . . : Ja
   IPv6-Adresse. . . . . . . . . . . : 2001:1702:6:6::80(Bevorzugt)
   Lease erhalten. . . . . . . . . . : Donnerstag, 31. Januar 2019 07:27:23
   Lease läuft ab. . . . . . . . . . : Freitag, 1. Februar 2019 07:27:22
   Verbindungslokale IPv6-Adresse  . : fe80::9878:6afa:d5d5:a16d%2(Bevorzugt)
   IPv4-Adresse (Auto. Konfiguration): 169.254.161.109(Bevorzugt)
   Subnetzmaske  . . . . . . . . . . : 255.255.0.0
   Standardgateway . . . . . . . . . : fe80::6:0:0:10%2
   DHCPv6-IAID . . . . . . . . . . . : 39117229
   DHCPv6-Client-DUID. . . . . . . . : 00-01-00-01-22-1D-D1-29-54-E1-AD-1B-6E-33
   DNS-Server  . . . . . . . . . . . : 64:ff9b::a01:4732
                                       64:ff9b::a01:4733
   NetBIOS über TCP/IP . . . . . . . : Deaktiviert
```



Basics

```
// Routing Table Client
IPv4-Routentabelle
===========================================================================
Aktive Routen:
     Netzwerkziel    Netzwerkmaske          Gateway    Schnittstelle Metrik
        127.0.0.0        255.0.0.0   Auf Verbindung         127.0.0.1    331
        127.0.0.1  255.255.255.255   Auf Verbindung         127.0.0.1    331
// … only directly connected networks (virtual box, etc.)
//   no IPv4 default route

IPv6-Routentabelle
===========================================================================
Aktive Routen:
 If Metrik Netzwerkziel              Gateway
  2    261 ::/0                     fe80::6:0:0:10
  1    331 ::1/128                  Auf Verbindung
  2    261 2001:1702:6:6::/64       Auf Verbindung
  2    261 2001:1702:6:6::80/128    Auf Verbindung
 22    281 fe80::/64                Auf Verbindung
// …
===========================================================================
```

Basics

```
// Further Information
C:\Users\Mug>netsh interface ipv6 show interface

Idx     Met         MTU          State                Name
---  ----------  ----------  ------------  ---------------------------
  1          75  4294967295  connected     Loopback Pseudo-Interface 1
…
 28          25        1500  connected     Ethernet 19


C:\Users\Mug>netsh int ipv6 show int 28

Parameter für die Schnittstelle "Ethernet 19"
------------------------------------------------------------
…
Standortpräfixlänge                    : 64
…
Angekündigte Routerlebensdauer         : 1800 Sekunden      // Router Lifetime
…
```

Basics

```
// Router Perspective
mug2@SRX300-T2019> show dhcpv6 server binding
Prefix                  Session Id  Expires  State    Interface    Client DUID
2001:1702:6:6::86/128   7           86358    BOUND    ge-0/0/0.0   LL_TIME0x1-0x1fa9321e-54:ee:75:…
2001:1702:6:6::80/128   1           81466    BOUND    ge-0/0/0.0   LL_TIME0x1-0x221dd129-54:e1:ad:…
…

mug2@SRX300-T2019> show security flow session nat
Session ID: 2573, Policy name: 000_AllowAll/4, Timeout: 1394, Valid
  In: 2001:1702:6:6::81/52603 --> 64:ff9b::a27d:1285/443;tcp, Conn Tag: 0x0, If: ge-0/0/0.0, Pkts: 116, Bytes: 72289,
  Out: 162.125.18.133/443 --> 192.168.21.129/52603;tcp, Conn Tag: 0x0, If: ge-0/0/1.1012, Pkts: 181, Bytes: 27069,

Session ID: 4164, Policy name: 000_AllowAll/4, Timeout: 1388, Valid
  In: 2001:1702:6:6::81/53284 --> 64:ff9b::a27d:1285/443;tcp, Conn Tag: 0x0, If: ge-0/0/0.0, Pkts: 92, Bytes: 50602,
  Out: 162.125.18.133/443 --> 192.168.21.129/53284;tcp, Conn Tag: 0x0, If: ge-0/0/1.1012, Pkts: 145, Bytes: 22545,

Session ID: 5124, Policy name: 000_AllowAll/4, Timeout: 298, Valid
  In: 2001:1702:6:6::82/49611 --> 64:ff9b::2843:fe24/443;tcp, Conn Tag: 0x0, If: ge-0/0/0.0, Pkts: 16, Bytes: 3322,
  Out: 40.67.254.36/443 --> 192.168.21.130/49611;tcp, Conn Tag: 0x0, If: ge-0/0/1.1012, Pkts: 14, Bytes: 5212,

…
```

Basics – Findings – nslookup and ping

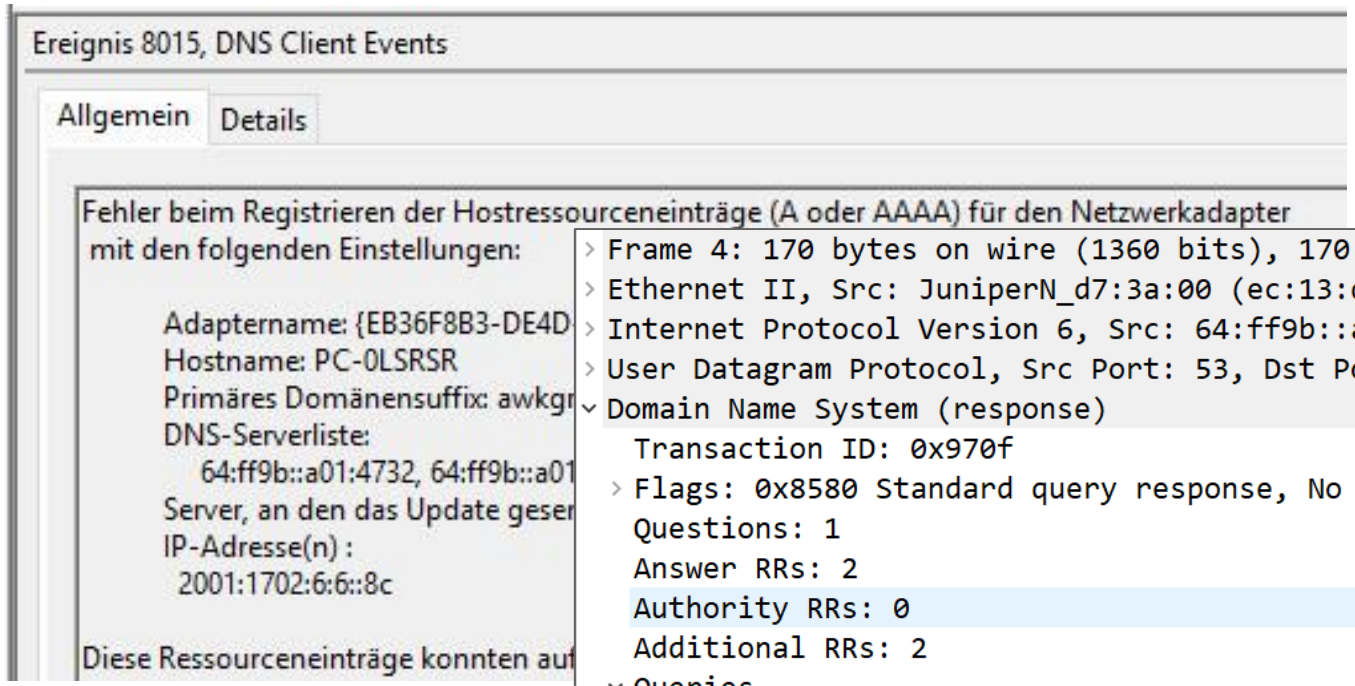
```
// nslookup and ping
mug@T420s:~$ nslookup ps10.awkgroup.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   ps10.awkgroup.com
Address: 10.1.71.55
Name:   ps10.awkgroup.com
Address: 64:ff9b::a01:4737

mug@T420s:~$ ping ps10.awkgroup.com
PING ps10.awkgroup.com(64:ff9b::a01:4737 (64:ff9b::a01:4737)) 56 data bytes
64 bytes from 64:ff9b::a01:4737 (64:ff9b::a01:4737): icmp_seq=1 ttl=125 time=1.28 ms
64 bytes from 64:ff9b::a01:4737 (64:ff9b::a01:4737): icmp_seq=2 ttl=125 time=1.15 ms
^C
--- ps10.awkgroup.com ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 1.156/1.218/1.280/0.062 ms
mug@T420s:~$
```

Tip:

You can also use IPv4 address notation:

`ping 64:ff9b::10.1.71.55`

Basics – Findings – DNS registration



Process

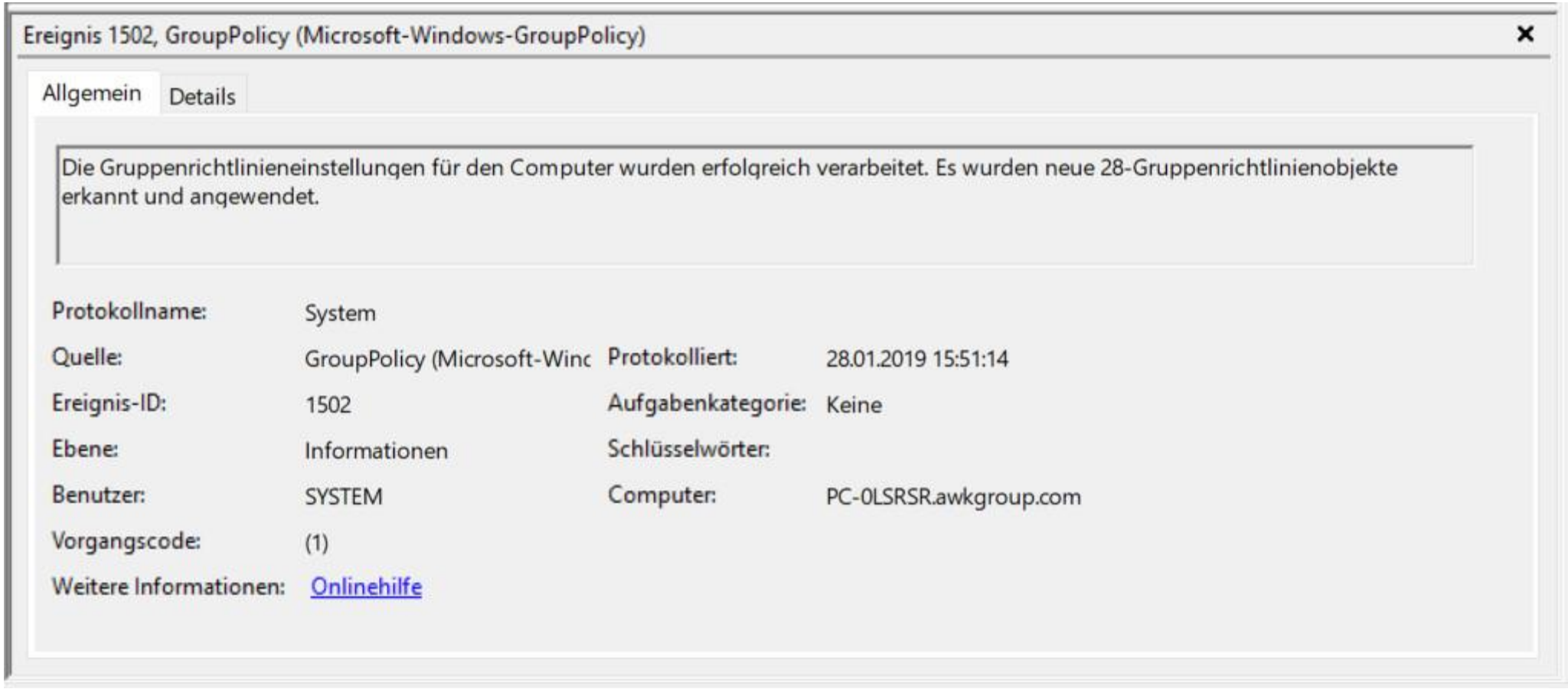
- Client sending SOA query for <pc-name><domain>
- Response is SOA record

```
> Frame 4: 170 bytes on wire (1360 bits), 170 bytes captured (1360 bits) on interface 0
> Ethernet II, Src: JuniperN_d7:3a:00 (ec:13:db:d7:3a:00), Dst: LcfcHefe_1b:6e:33 (54:e1:ad:1b:6e:33)
> Internet Protocol Version 6, Src: 64:ff9b::a01:4732, Dst: 2001:1702:6:6::80
> User Datagram Protocol, Src Port: 53, Dst Port: 52354
v Domain Name System (response)
    Transaction ID: 0x970f
  > Flags: 0x8580 Standard query response, No error
    Questions: 1
    Answer RRs: 2
    Authority RRs: 0
    Additional RRs: 2
  v Queries
    > awkgroup.com: type NS, class IN
  v Answers
    > awkgroup.com: type NS, class IN, ns ad11.awkgroup.com
    > awkgroup.com: type NS, class IN, ns ad10.awkgroup.com
  v Additional records
    > ad11.awkgroup.com: type A, class IN, addr 10.1.71.51
    > ad10.awkgroup.com: type A, class IN, addr 10.1.71.50
    [Request In: 3]
    [Time: 0.001710000 seconds]
```

Here it breaks – no re-writing by dns doctoring feature

This is what you can configure on the SRX , the DNS64 is a standard RFC and you can find it in the following link: https://tools.ietf.org/html/rfc6147

Basics – Findings – GPO processing



Basics – Findings – ntp

Basics – Findings – default GW

Windows 10 client looses default GW information after 1 hour

```
Ethernet-Adapter Ethernet:

   Verbindungsspezifisches DNS-Suffix:
   Beschreibung. . . . . . . . . . . : Intel(R) Ethernet Connection (4) I219-V
   Physische Adresse . . . . . . . . : 54-E1-AD-1B-6E-33
   DHCP aktiviert. . . . . . . . . . : Ja
   Autokonfiguration aktiviert . . . : Ja
   IPv6-Adresse. . . . . . . . . . . : 2001:1702:6:6::80(Bevorzugt)
   Lease erhalten. . . . . . . . . . : Donnerstag, 31. Januar 2019 07:27:22
   Lease läuft ab. . . . . . . . . . : Freitag, 1. Februar 2019 07:27:21
   Verbindungslokale IPv6-Adresse  . : fe80::9878:6afa:d5d5:a16d%2(Bevorzugt)
   IPv4-Adresse (Auto. Konfiguration): 169.254.161.109(Bevorzugt)
   Subnetzmaske  . . . . . . . . . . : 255.255.0.0
   Standardgateway . . . . . . . . . :
   DHCPv6-IAID . . . . . . . . . . . : 39117229
   DHCPv6-Client-DUID. . . . . . . . : 00-01-00-01-22-1D-D1-29-54-E1-AD-1B-6E-33
   DNS-Server  . . . . . . . . . . . : 64:ff9b::a01:4732
                                       64:ff9b::a01:4733
   NetBIOS über TCP/IP . . . . . . . : Deaktiviert
```

Update

- Used wrong fe80 address: fe80::6:0:0:0:10/64 (should be fe80::6:0:0:10/64)
- Once fixed, gw information is no longer lost

Findings – AWK internal – various

Working

- File Access (network drives)
- Sharepoint
- RDP (mstsc.exe)
- Skype for Business
  - PTSN -> IPv6 client
  - IPv6 client -> PTSN
  - IPv4 client -> IPv6 client - Video Call
  - IPv6 client -> IPv4 client - Video Call
- Printing (sending job to print server)
- Abacus (ERP) (java based)
- Outlook
- Citrix Netscaler RDP

Findings – AWK internal – various

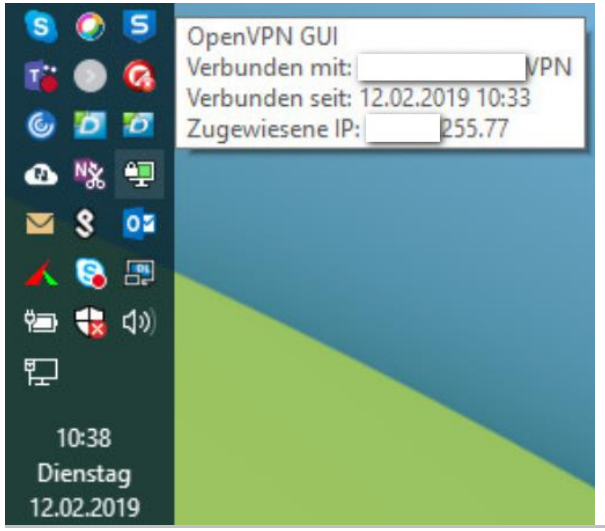
Not Working

- Microsoft Teams
  - IPv6 client -> IPv4 client - Video Call ☑
  - IPv4 client -> IPv6 client - Video Call ☒
- Swisscom Storebox

Finding – AWK external – various

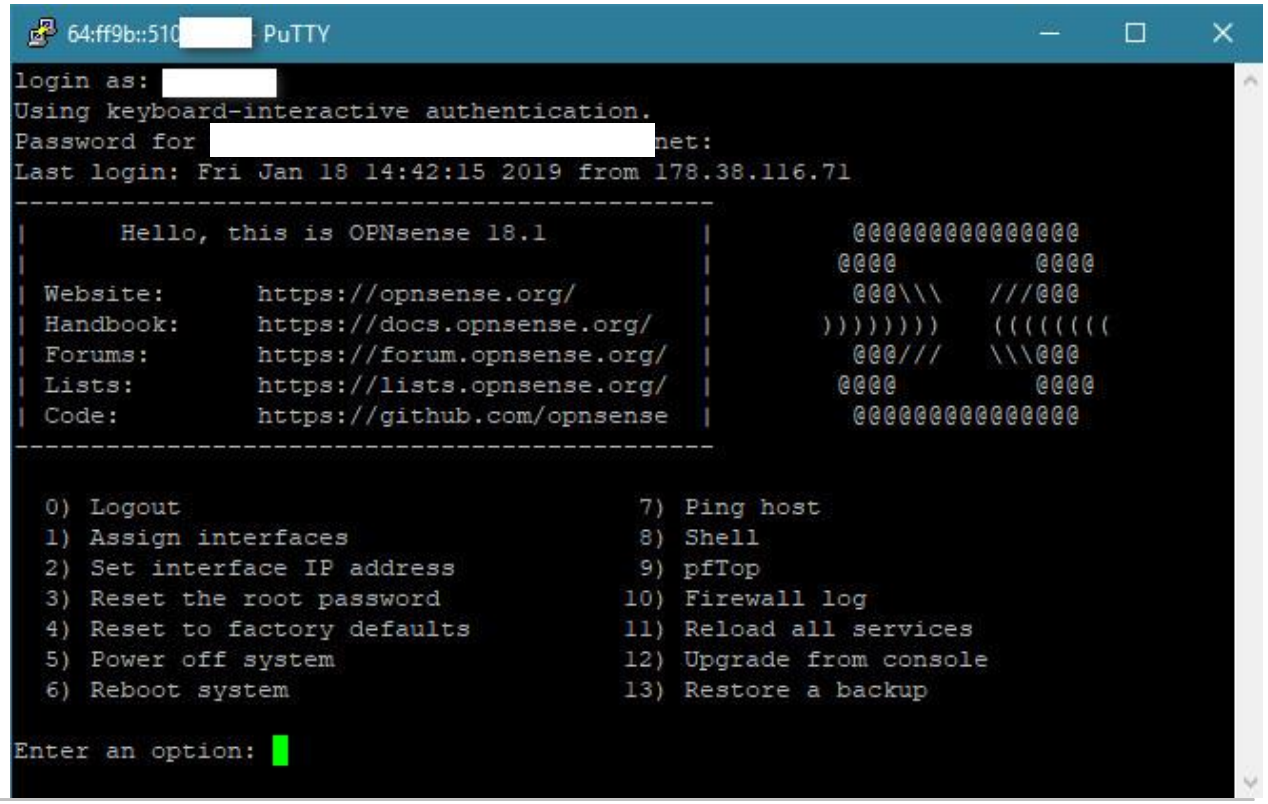
Working

- OpenVPN
- SSH
- Skype
- Speedtest (web based)
- google drive
- Whatsapp desktop app



Using FQDN in configuration

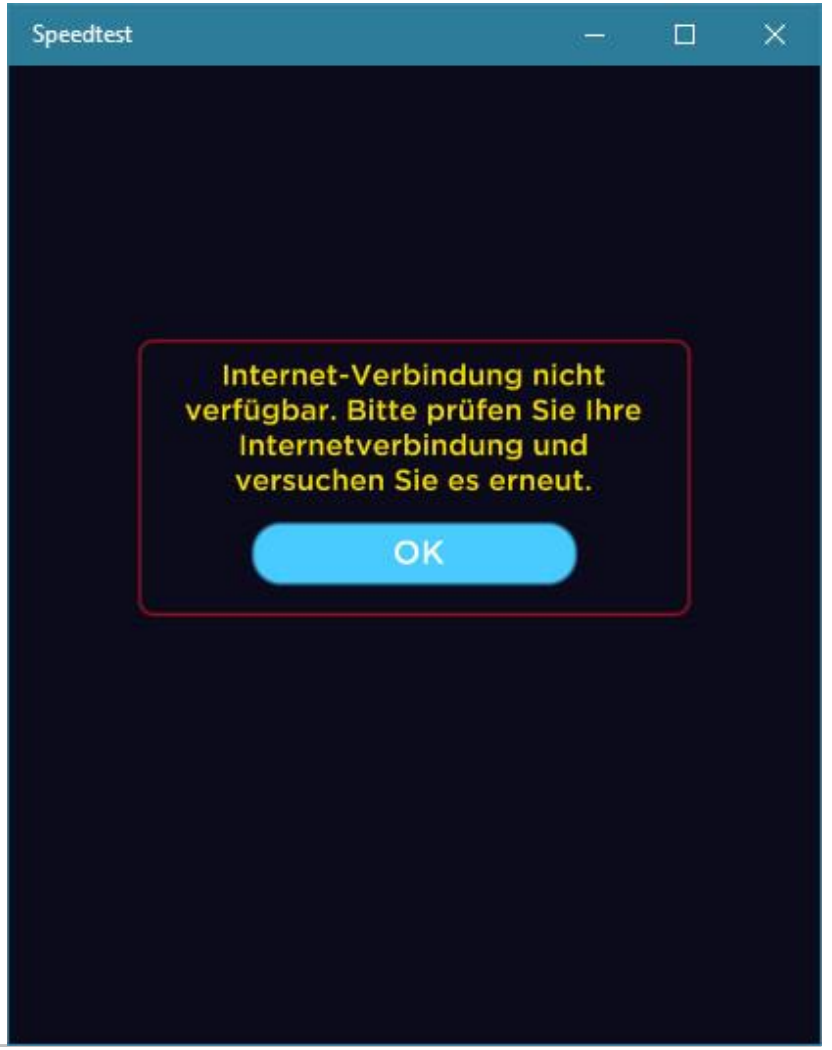
Using `64:ff9b::<IPv4 address>`



Findings – AWK external – various

Not working

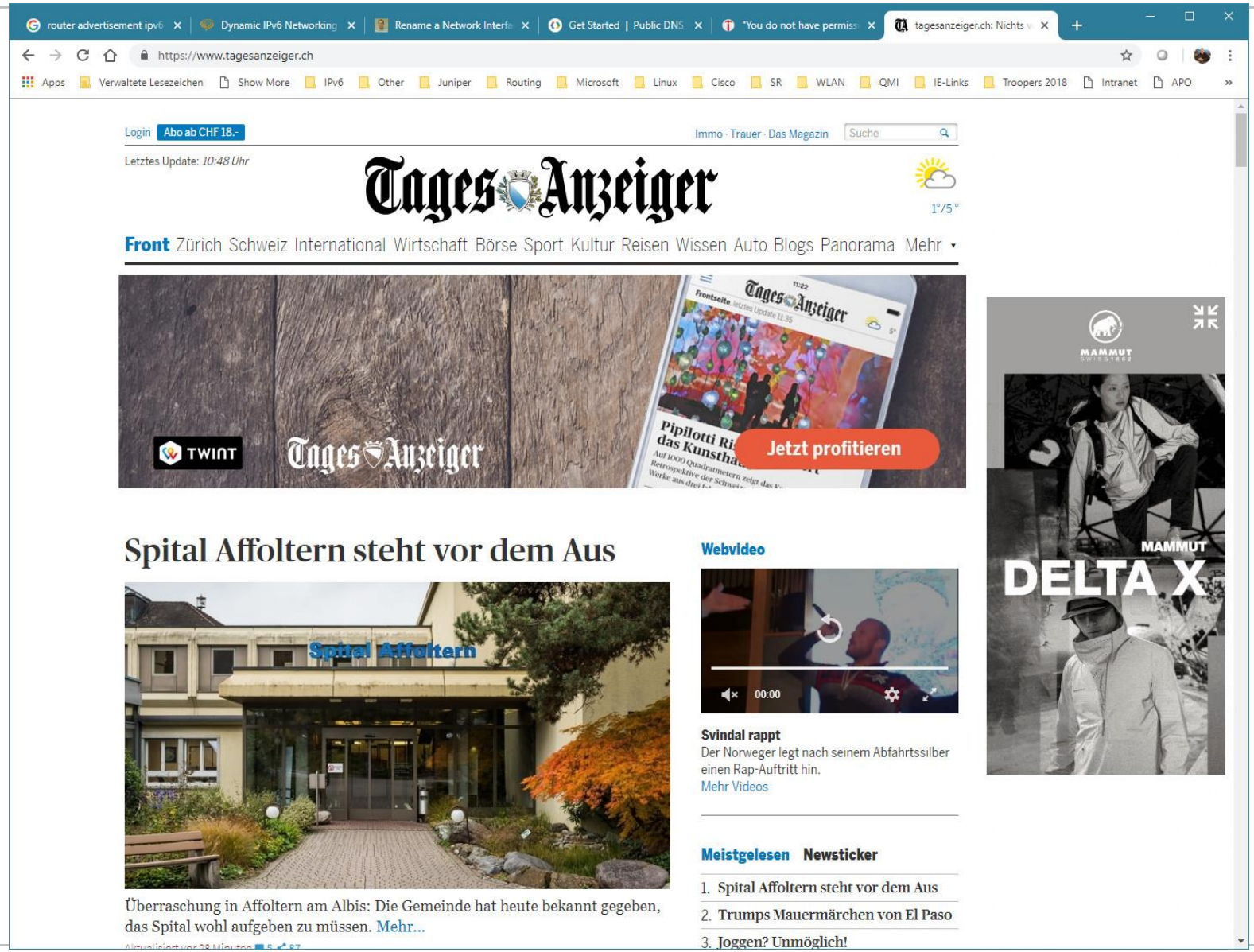
- Speedtest (app)
- Vmware Horizon (both, web-based and local application)



Findings – Other

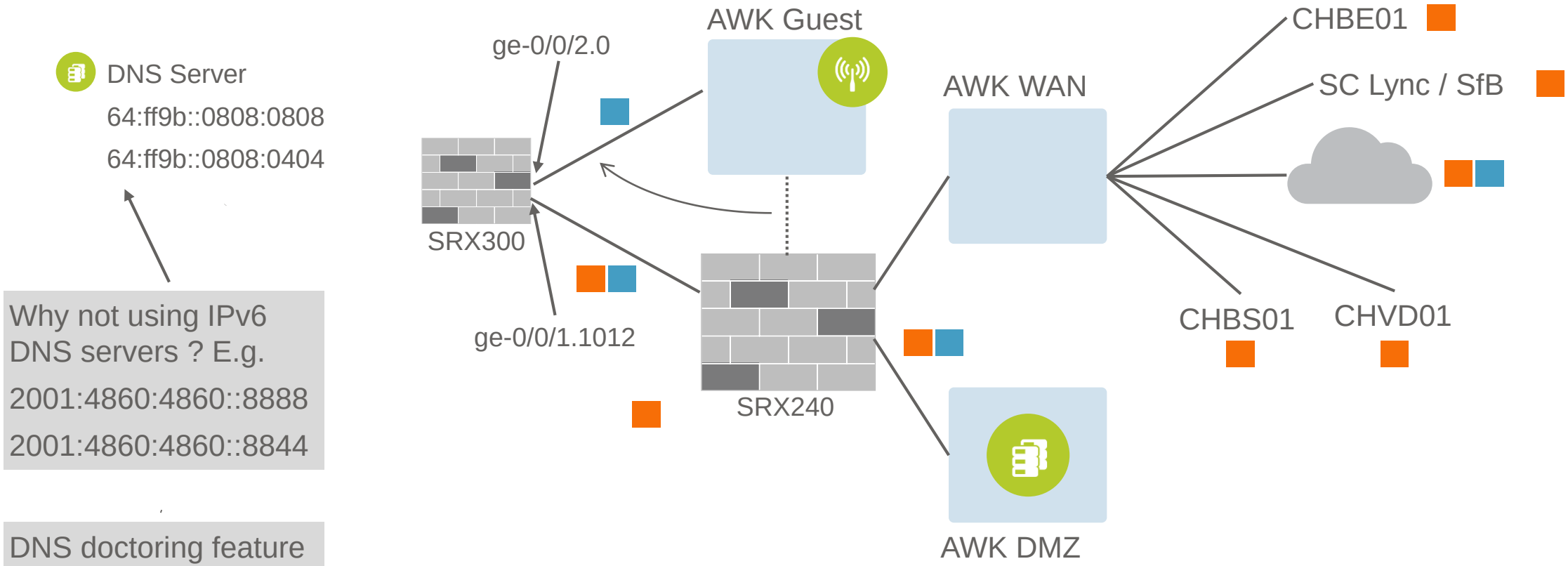
Problematic

- IPv6 not properly working
- Why ?
- No fallback to IPv4 (happy eyeballs, etc.)



Content

Test setup – the big picture (WLAN)



SRX Configuration

```
// Interface Configuration
// IPv6 client network (WLAN)
set interfaces ge-0/0/2 unit 0 family inet6 address 2001:1702:6:7::10/64
set interfaces ge-0/0/2 unit 0 family inet6 address fe80::7:0:0:10/64
// NAT64
set security nat source rule-set NAT64-2 to zone Transport-IPv4
set security nat source rule-set NAT64-2 rule NAT64_Source match source-address 2001:1702:6:7::/64
set security nat source rule-set NAT64-2 rule NAT64_Source match destination-address 0.0.0.0/0
set security nat source rule-set NAT64-2 rule NAT64_Source then source-nat interface
// NAT46
< empty / none >
// DNS64
< nothing > // using dns doctoring feature of Junos, enabled by default
// SLAAC (including RDNSS) & DHCPv6
set protocols router-advertisement interface ge-0/0/2.0 managed-configuration
set protocols router-advertisement interface ge-0/0/2.0 dns-server-address 64:ff9b::0808:0808
set protocols router-advertisement interface ge-0/0/2.0 dns-server-address 64:ff9b::0808:0404
set protocols router-advertisement interface ge-0/0/2.0 prefix 2001:1702:6:7::/64
…
set access address-assignment pool IPv6-Pool02 family inet6 dhcp-attributes dns-server 64:ff9b::0808:0808
set access address-assignment pool IPv6-Pool02 family inet6 dhcp-attributes dns-server 64:ff9b::0808:0404
```

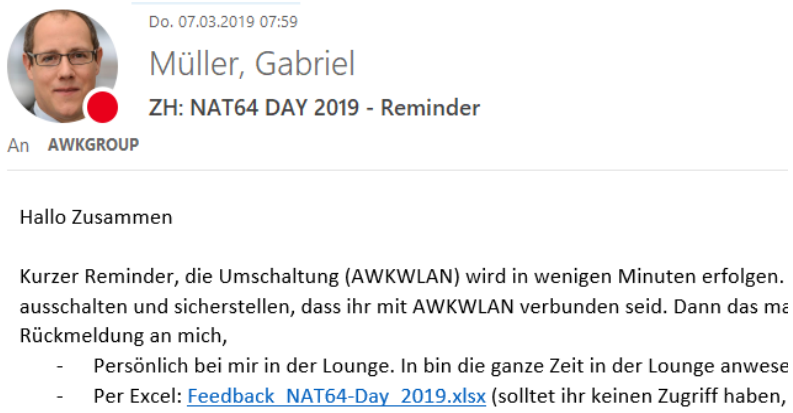
NAT64 Day @AWK

Preparation

- Configuration of SRX
- Testing with Android mobile
- Testing with iOS mobile
- Testing with Ubuntu PC

Communication

- Email sent 1 week in advance
- Reminder sent 1 day in advance
- Information sent before activation
- Information sent at end of day



Do. 07.03.2019 07:59

Müller, Gabriel

ZH: NAT64 DAY 2019 - Reminder

An **AWKGROUP**

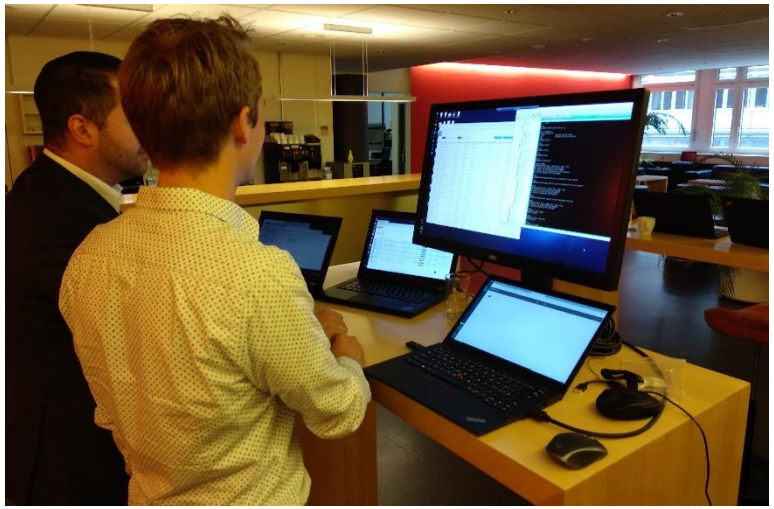
Hallo Zusammen

Kurzer Reminder, die Umschaltung (AWKWLAN) wird in wenigen Minuten erfolgen.
ausschalten und sicherstellen, dass ihr mit AWKWLAN verbunden seid. Dann das ma
Rückmeldung an mich,

- Persönlich bei mir in der Lounge. In bin die ganze Zeit in der Lounge anwese
- Per Excel: Feedback_NAT64-Day_2019.xlsx (solltet ihr keinen Zugriff haben,

NAT64 Day

- Switched to NAT64 at 08:00
- Presence in lounge
- Switched back to normal at 11:00



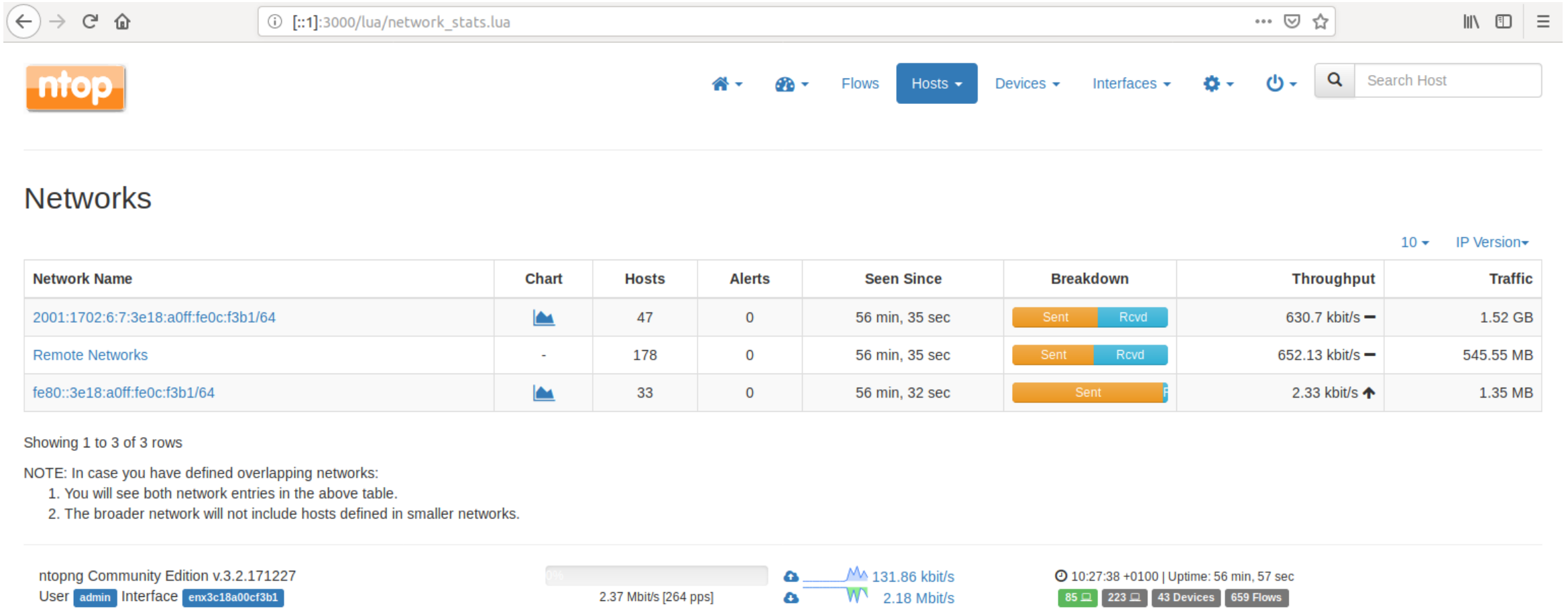
NAT64 Day @AWK – Monitoring

Basic monitoring

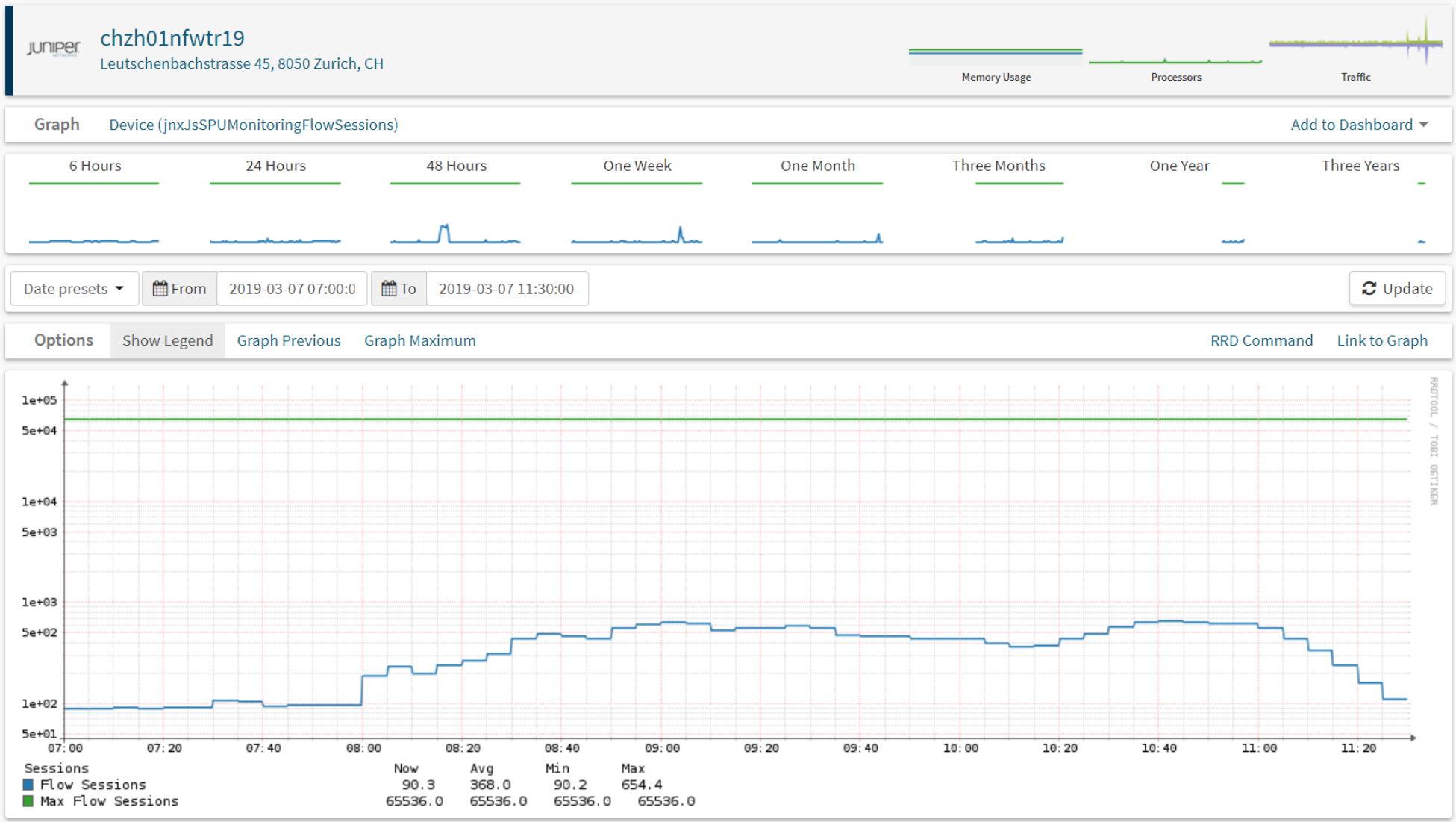
- On SRX
- Using ntopng
- Observium

```
mug@SRX300-T2019> show ipv6 neighbours
IPv6 Address                  Linklayer Address  State       Exp Rtr Secure Interface
2001:1702:6:7:480:13d2:24b3:c64   40:9c:28:5a:xx:xx  stale       366 no  no      ge-0/0/2.0
2001:1702:6:7:548:51cd:288b:482b  98:00:c6:27:xx:xx  stale       53  no  no      ge-0/0/2.0
2001:1702:6:7:6b1:67ff:fe2a:xxxx  04:b1:67:2a:xx:xx  stale       488 no  no      ge-0/0/2.0
…
fe80::4e66:41ff:fefc:xxxx         4c:66:41:fc:xx:xx  stale       141 no  no      ge-0/0/2.0
fe80::740c:8fb3:29b1:8981         24:18:1d:f3:xx:xx  stale       947 no  no      ge-0/0/2.0
fe80::8ef5:a3ff:fe82:xxxx         8c:f5:a3:82:xx:xx  stale       22  no  no      ge-0/0/2.0
fe80::8ef5:a3ff:fe82:xxxx         8c:f5:a3:82:xx:xx  stale       167 no  no      ge-0/0/2.0
fe80::b6cd:27ff:fea1:xxxx         b4:cd:27:a1:xx:xx  stale       777 no  no      ge-0/0/2.0
…
```

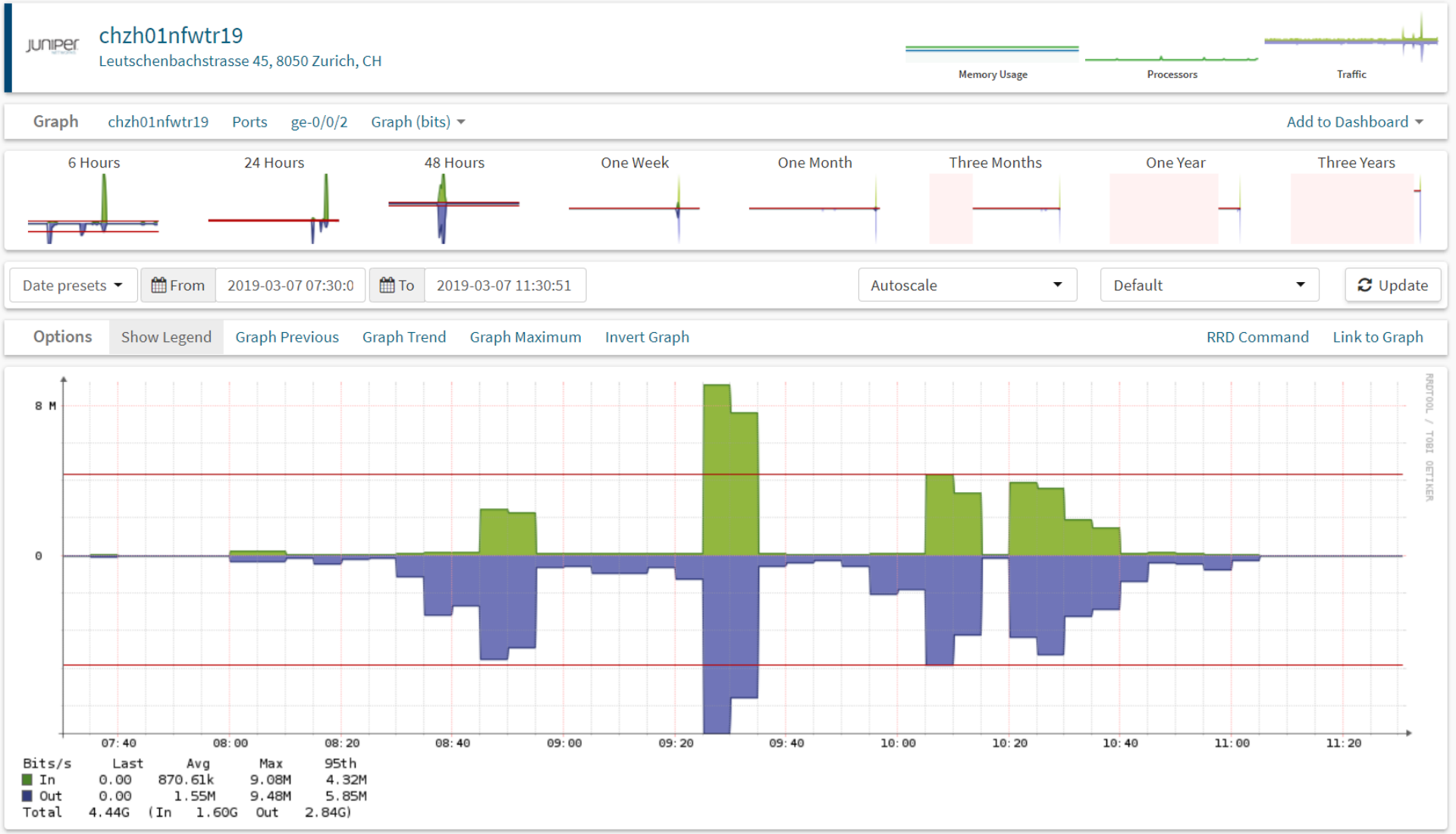
NAT64 Day @AWK – Monitoring



NAT64 Day @AWK – Monitoring



NAT64 Day @AWK – Monitoring



NAT64 Day @AWK – Results

Biggest hassle with Window 10 laptops

- Were not able to configure an IPv6 address // most probably due to wrong configured fe80 address

Flapping internet / spontaneous disconnects

- Reported by 2 users (both Android (version 6 and 9)

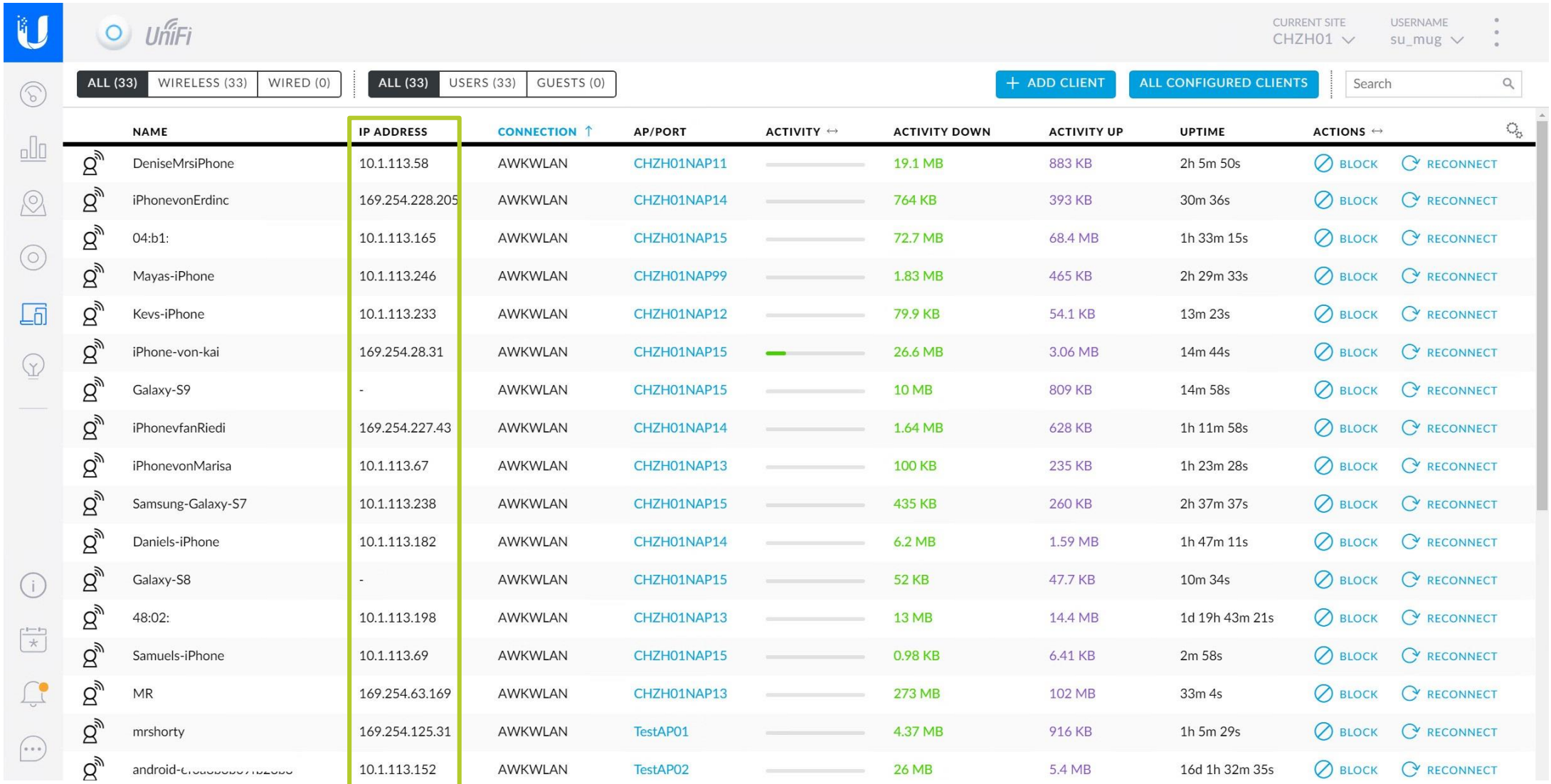
Other than that only very little problems detected

- Revolut app: Verification SMS not received

NAT64 Day @AWK – Results

1: SMS validation not working

Unifi – No IPv6 support



NAME	IP ADDRESS	CONNECTION	AP/PORT	ACTIVITY	ACTIVITY DOWN	ACTIVITY UP	UPTIME	ACTIONS
DeniseMrsiPhone	10.1.113.58	AWKWLAN	CHZH01NAP11		19.1 MB	883 KB	2h 5m 50s	BLOCK RECONNECT
iPhonevonErdinc	169.254.228.205	AWKWLAN	CHZH01NAP14		764 KB	393 KB	30m 36s	BLOCK RECONNECT
04:b1:	10.1.113.165	AWKWLAN	CHZH01NAP15		72.7 MB	68.4 MB	1h 33m 15s	BLOCK RECONNECT
Mayas-iPhone	10.1.113.246	AWKWLAN	CHZH01NAP99		1.83 MB	465 KB	2h 29m 33s	BLOCK RECONNECT
Kevs-iPhone	10.1.113.233	AWKWLAN	CHZH01NAP12		79.9 KB	54.1 KB	13m 23s	BLOCK RECONNECT
iPhone-von-kai	169.254.28.31	AWKWLAN	CHZH01NAP15		26.6 MB	3.06 MB	14m 44s	BLOCK RECONNECT
Galaxy-S9	-	AWKWLAN	CHZH01NAP15		10 MB	809 KB	14m 58s	BLOCK RECONNECT
iPhonevfanRiedi	169.254.227.43	AWKWLAN	CHZH01NAP14		1.64 MB	628 KB	1h 11m 58s	BLOCK RECONNECT
iPhonevonMarisa	10.1.113.67	AWKWLAN	CHZH01NAP13		100 KB	235 KB	1h 23m 28s	BLOCK RECONNECT
Samsung-Galaxy-S7	10.1.113.238	AWKWLAN	CHZH01NAP15		435 KB	260 KB	2h 37m 37s	BLOCK RECONNECT
Daniels-iPhone	10.1.113.182	AWKWLAN	CHZH01NAP14		6.2 MB	1.59 MB	1h 47m 11s	BLOCK RECONNECT
Galaxy-S8	-	AWKWLAN	CHZH01NAP15		52 KB	47.7 KB	10m 34s	BLOCK RECONNECT
48:02:	10.1.113.198	AWKWLAN	CHZH01NAP13		13 MB	14.4 MB	1d 19h 43m 21s	BLOCK RECONNECT
Samuels-iPhone	10.1.113.69	AWKWLAN	CHZH01NAP15		0.98 KB	6.41 KB	2m 58s	BLOCK RECONNECT
MR	169.254.63.169	AWKWLAN	CHZH01NAP13		273 MB	102 MB	33m 4s	BLOCK RECONNECT
mrshorty	169.254.125.31	AWKWLAN	TestAP01		4.37 MB	916 KB	1h 5m 29s	BLOCK RECONNECT
android-[redacted]	10.1.113.152	AWKWLAN	TestAP02		26 MB	5.4 MB	16d 1h 32m 35s	BLOCK RECONNECT

M and O flags – IPv6 address configuration

Managed Address Configuration flag (M)

- instructs the host to use a configuration protocol to obtain stateful addresses

Other Stateful Configuration flag (O)

- instructs the host to use a configuration protocol to obtain other configuration settings

Flag states	Theoretical client behavior
M = 0 O = 0	Client shall use information contained in router advertisements to configure network interface. No DHCPv6 service available
M = 1 O = 0	Client shall use DHCPv6 protocol to configure IPv6 addresses on interface. For all other information router advertisement information should be used.
M = 0 O = 1	Client shall use DHCPv6 only for other configuration information, and using router advertisements for address configuration (> stateless DHCPv6)
M = 1 O = 1	Client shall use DHCPv6 for IPv6 address configuration and other configuration settings (> stateful DHCPv6)

M and O flags – Juniper SRX300

```
Example: M and O set (1)
set protocols router-advertisement interface ge-0/0/2.0 managed-configuration
set protocols router-advertisement interface ge-0/0/2.0 other-stateful-configuration
```

Looking at RA message sent by SRX

```
Example: M and O set (1)
root@T420s:/home/mug# tcpdump -vvvv -ttt  icmp6 and 'ip6[40] = 134'
tcpdump: listening on enp0s25, link-type EN10MB (Ethernet), capture size 262144 bytes
 00:00:00.000000 IP6 (hlim 255, next-header ICMPv6 (58) payload length: 96) _gateway > ip6-allnodes:
[icmp6 sum ok] ICMP6, router advertisement, length 96
        hop limit 64, Flags [managed, other stateful], pref medium, router lifetime 180s, …
          source link-address option (1), length 8 (1): ec:13:db:d7:3a:02
            0x0000:  ec13 dbd7 3a02
          rdnss option (25), length 40 (5):  lifetime 1800s, addr: 64:ff9b::808:808 addr: 64:ff9b::…
            0x0000:  0000 0000 0708 0064 ff9b 0000 0000 0000
            0x0010:  0000 0808 0808 0064 ff9b 0000 0000 0000
            0x0020:  0000 0808 0404
          prefix info option (3), length 32 (4): 2001:1702:6:7::/64, Flags [onlink, auto], valid time …
            0x0000:  40c0 0027 8d00 0009 3a80 0000 0000 2001
            0x0010:  1702 0006 0007 0000 0000 0000 0000
```

M and O flags – Some more testing

- Used wrong fe80 address: fe80::7:0:0:0:10/64 (should be fe80::7:0:0:10/64)
- DHCPv6 server needed reset as well

< LAN >
< WLAN >

Flag states	DHCPv6 enabled	Windows 10 10.0 (Build 10240)	Windows 10 1709 (Build 16299.431)	Ubuntu 18.04.1 LTS	Mac OS X 10.10.5
M = 0 O = 0	No	SLAAC – no gw No IP addr. configured	SLAAC – OK No IP addr. configured	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 0 O = 0	Yes	SLAAC – no DNS DHCPv6 - OK	SLAAC – OK No IP addr. configured	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 0	No	SLAAC – NO DNS SLAAC – NO DNS	SLAAC – OK SLAAC – NO DNS	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 0	Yes	SLAAC – NO DNS DHCPv6 - OK	DHCPv6 – OK No IP addr. configured	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK SLAAC – OK
M = 0 O = 1	No	SLAAC – NO DNS SLAAC – NO DNS	SLAAC – NO DNS SLAAC – NO DNS	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 0 O = 1	Yes	SLAAC – NO DNS SLAAC – OK	SLAAC – OK No IP addr. configured	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 1	No	SLAAC – NO DNS SLAAC – NO DNS	SLAAC – OK No IP addr. configured	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 1	Yes	SLAAC – NO DNS SLAAC – OK	DHCPv6 – OK SLAAC – OK	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK SLAAC - OK

M and O flags – Some more testing (rev. 2 – after fixing wrong fe80 address)

< LAN >
< WLAN >

Flag states	DHCPv6 enabled	Windows 10 10.0 (Build 10240)	Windows 10 1709 (Build 16299.431)	Ubuntu 18.04.1 LTS	Mac OS X 10.10.5
M = 0 O = 0	No	SLAAC – no DNS SLAAC – no DNS	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 0 O = 0	Yes	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK DHCPv6 – OK	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 0	No	SLAAC – no DNS SLAAC – no DNS	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 0	Yes	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK SLAAC – OK
M = 0 O = 1	No	SLAAC – no DNS SLAAC – no DNS	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 0 O = 1	Yes	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK DHCPv6 – OK	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 1	No	SLAAC – no DNS SLAAC – no DNS	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK	SLAAC – OK SLAAC – OK
M = 1 O = 1	Yes	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK DHCPv6 – OK	DHCPv6 – OK SLAAC - OK

Content

Summary

Getting it up and running was fast and easy

- Most time consuming: Planning and preparations
- DNS doctoring feature ‘build-in’, no additional DNS server required

Test Results

- Within our TRUST zone (internal network)
- Much better than expected
- Nevertheless not an option due to missing support for key features

Test Results (other)

- Again, much better than expected
- Most challenging seems to be address assignment / configuration on Windows // no longer valid

Discussion

IPv6-only setup less complex ?

- **really?**
- **At least for IPv4 traffic you will see both (v6/v4) depending on network segment you are looking at**
- **So for me it looks more and more like you should first**
  - Enable your server infrastructure / internal resources dualstack (or IPv6-only with dualstack GW)
  - (optional) Create IPv6 ‘islands’
  - Then switch clients to IPv6 only with NAT64 / DNS64 for accessing external IPv4 resource

- **By tendency, the more content is available native via IPv6 the better / easier you can move the client site to an IPv6-only network**
- **Your opinion**

Challenges

1. AWK VPN
2. Android IPv4 URL

Content

Complete configuration SRX300

```
set version 15.1X49-D45
set system host-name SRX300-T2019
set system root-authentication encrypted-password …
set system login class read-only-local permissions snmp
set system login user mug uid 2000
set system login user mug class super-user
set system login user mug authentication encrypted-password …
set system services ssh
set system services dns forwarders 10.1.71.50
set system services dns dns-proxy interface ge-0/0/0.0
set system services dns dns-proxy interface ge-0/0/2.0  // added after NAT64 Day
set system services dhcp-local-server dhcpv6 overrides interface-client-limit 200
set system services dhcp-local-server dhcpv6 group IPv6-Group01 interface ge-0/0/0.0
set system services dhcp-local-server dhcpv6 group IPv6-Group02 interface ge-0/0/2.0 // added after NAT64 Day
set security alg traceoptions file DebugDNS
set security forwarding-options family inet6 mode flow-based
set security nat source rule-set NAT64-2 from zone Clients-IPv6
set security nat source rule-set NAT64-2 to zone Transport-IPv4
set security nat source rule-set NAT64-2 rule NAT64_Source match source-address 2001:1702:6:7::/64
set security nat source rule-set NAT64-2 rule NAT64_Source match destination-address 0.0.0.0/0
set security nat source rule-set NAT64-2 rule NAT64_Source then source-nat interface
set security nat static rule-set NAT64 from zone Clients-IPv6
set security nat static rule-set NAT64 rule NAT64_INET match destination-address 64:ff9b::/96
set security nat static rule-set NAT64 rule NAT64_INET then static-nat inet
```

Complete configuration SRX300 (continued)

```
set security nat static rule-set NAT46 from zone Transport-IPv4
set security nat static rule-set NAT46 rule NAT46_Pool match source-address 0.0.0.0/0
set security nat static rule-set NAT46 rule NAT46_Pool match destination-address 192.168.21.128/25
set security nat static rule-set NAT46 rule NAT46_Pool then static-nat prefix 2001:1702:6:6::80/121
set security policies from-zone Clients-IPv6 to-zone Transport-IPv4 policy 000_AllowAll match source-address any
set security policies from-zone Clients-IPv6 to-zone Transport-IPv4 policy 000_AllowAll match destination-address any
set security policies from-zone Clients-IPv6 to-zone Transport-IPv4 policy 000_AllowAll match application any
set security policies from-zone Clients-IPv6 to-zone Transport-IPv4 policy 000_AllowAll then permit
set security policies from-zone Transport-IPv4 to-zone Clients-IPv6 policy 000_AllowAny match source-address any
set security policies from-zone Transport-IPv4 to-zone Clients-IPv6 policy 000_AllowAny match destination-address any
set security policies from-zone Transport-IPv4 to-zone Clients-IPv6 policy 000_AllowAny match application any
set security policies from-zone Transport-IPv4 to-zone Clients-IPv6 policy 000_AllowAny then permit
set security traceoptions file DebugDNS
set security zones security-zone Clients-IPv6 interfaces ge-0/0/0.0 host-inbound-traffic system-services all
set security zones security-zone Clients-IPv6 interfaces ge-0/0/2.0 host-inbound-traffic system-services all
set security zones security-zone Transport-IPv4 interfaces ge-0/0/1.1012 host-inbound-traffic system-services all
set security zones security-zone MGMT interfaces ge-0/0/1.1111 host-inbound-traffic system-services all
set interfaces ge-0/0/0 unit 0 family inet6 address 2001:1702:6:6::10/64
set interfaces ge-0/0/0 unit 0 family inet6 address fe80::6:0:0:10/64
set interfaces ge-0/0/1 vlan-tagging
set interfaces ge-0/0/1 unit 1012 vlan-id 1012
set interfaces ge-0/0/1 unit 1012 family inet address 10.1.241.30/24
set interfaces ge-0/0/1 unit 1012 family inet6 address 2001:1702:6:1012::30/64
```

Complete configuration SRX300 (continued)

```
set interfaces ge-0/0/1 unit 1012 family inet6 address 2001:1702:6:1012::30/64
set interfaces ge-0/0/1 unit 1012 family inet6 address fe80::1012:0:0:30/64
set interfaces ge-0/0/1 unit 1111 vlan-id 1111
set interfaces ge-0/0/1 unit 1111 family inet address 10.1.224.30/24
set interfaces ge-0/0/2 unit 0 family inet6 address 2001:1702:6:7::10/64
set interfaces ge-0/0/2 unit 0 family inet6 address fe80::7:0:0:10/64
set interfaces lo0 unit 0 family inet address 192.168.21.254/32
set snmp location CHZH01
set snmp contact "Gabriel Mueller <gabriel.mueller@awk.ch>"
set snmp community … authorization read-only
set snmp community … clients 10.1.233.0/24
set routing-options rib inet6.0 static route ::/0 next-hop 2001:1702:6:1012::10
set routing-options static route 0.0.0.0/0 next-hop 10.1.241.10
set routing-options static route 10.1.233.0/24 next-hop 10.1.224.10
set protocols router-advertisement interface ge-0/0/0.0 max-advertisement-interval 60
set protocols router-advertisement interface ge-0/0/0.0 min-advertisement-interval 5
set protocols router-advertisement interface ge-0/0/0.0 managed-configuration
set protocols router-advertisement interface ge-0/0/0.0 other-stateful-configuration
set protocols router-advertisement interface ge-0/0/0.0 prefix 2001:1702:6:6::/64 no-autonomous
set protocols router-advertisement interface ge-0/0/0.0 prefix ::/0 valid-lifetime 36001
set protocols router-advertisement interface ge-0/0/0.0 prefix ::/0 preferred-lifetime 36000
set protocols router-advertisement interface ge-0/0/0.0 prefix ::/0 no-autonomous
```

Complete configuration SRX300 (continued)

```
set protocols router-advertisement interface ge-0/0/2.0 max-advertisement-interval 60
set protocols router-advertisement interface ge-0/0/2.0 min-advertisement-interval 5
set protocols router-advertisement interface ge-0/0/2.0 other-stateful-configuration
set protocols router-advertisement interface ge-0/0/2.0 dns-server-address 64:ff9b::0808:0808
set protocols router-advertisement interface ge-0/0/2.0 dns-server-address 64:ff9b::0808:0404
set protocols router-advertisement interface ge-0/0/2.0 prefix 2001:1702:6:7::/64
set access address-assignment pool IPv6-Pool01 family inet6 prefix 2001:1702:6:6::/64
set access address-assignment pool IPv6-Pool01 family inet6 range 1 low 2001:1702:6:6::80/128
set access address-assignment pool IPv6-Pool01 family inet6 range 1 high 2001:1702:6:6::ff/128
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes maximum-lease-time 1800
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes grace-period 300
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes dns-server 64:ff9b::0a01:4732
set access address-assignment pool IPv6-Pool01 family inet6 dhcp-attributes dns-server 64:ff9b::0a01:4733
set access address-assignment pool IPv6-Pool02 family inet6 prefix 2001:1702:6:7::/64
set access address-assignment pool IPv6-Pool02 family inet6 range 1 low 2001:1702:6:7::20/128
set access address-assignment pool IPv6-Pool02 family inet6 range 1 high 2001:1702:6:7::ff:ff/128
set access address-assignment pool IPv6-Pool02 family inet6 dhcp-attributes maximum-lease-time 36000
set access address-assignment pool IPv6-Pool02 family inet6 dhcp-attributes grace-period 3600
set access address-assignment pool IPv6-Pool02 family inet6 dhcp-attributes dns-server 64:ff9b::0808:0808
set access address-assignment pool IPv6-Pool02 family inet6 dhcp-attributes dns-server 64:ff9b::0808:0404
```

Links / References

RFC 6052 - IPv6 Addressing of IPv4/IPv6 Translators