

Routing Security @ Claranet

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claranet

Background

- Established 1996 as an ISP in the United Kingdom
- 2000+ person company, UK, FR, DE, NL, ES, PT, IT, BR
- Managed Services Provider (MSP) which are essentially ISP services that we manage for customers.
- Own our own Network Infrastructure in Europe





About me

- Network Engineer for 20+ years
- Infrastructure Manager at Claranet Technology Group
- Arbiter for the RIPE NCC
- Regular RIPE meeting + WG participant
- IETF contributor

Outbound Security

- We adhere to MANRS (<http://www.manrs.org/>), meaning that we:
 - Filter our outbound BGP announcements
 - Practise anti-spoofing in the data plane, doing source validation for outbound traffic
 - Maintain globally accessible, up-to-date contact information
 - Publish our routing data globally, allowing others to validate what we do

Publishing and maintaining contact data

<https://as8426.peeringdb.com>

If you take anything away from this talk, it's to make sure that if, you have an autonomous system, and you peer it with others, on the Internet, that you ***should*** register it on peeringdb.com

The screenshot shows the PeeringDB profile for AS8426, Claranet. The page is divided into several sections:

- Organization:** Claranet, with details like company website, primary ASN (8426), IRR Record (AS-CLARANET), and various URLs.
- Public Peering Exchange Points:** A table listing various IXPs and their associated IP addresses and speeds.
- Private Peering Facilities:** A table listing facilities like Digital Realty Amsterdam and London.
- Contact Information:** A table with roles (NOC, Policy), names (peerops, peering), and contact details (phone, email).

Exchange	ASN	IPv4	IPv6	Speed
AMG-IX	8426	80.249.208.82	2001:79b:1::a500:8426:1	10G
AMG-IX	8426	80.249.209.228	2001:79b:1::a500:8426:2	10G
CATNIX	8426	193.242.98.131	2001:79b:2a:0:2:1:0:8426	1G
DE-CIX Frankfurt	8426	80.81.192.88	2001:79b::20ea:0:1	10G
DE-CIX Frankfurt	8426	80.81.193.88	2001:79b::20ea:0:2	10G
DE-CIX Madrid	8426	185.1.68.28	2001:79b:a0::20ea:0:1	1G
Equinix Paris	8426	195.42.144.30	2001:79b:43::8426:1	10G
France-IX Paris	8426	37.49.236.60	2001:79b:54::60	10G
France-IX Paris	8426	37.49.236.61	2001:79b:54::61	10G
GigaPIX LAN1	8426	193.136.250.50	2001:79b:ac1::5	10G
GigaPIX LAN2	8426	193.136.251.5	2001:79b:ac2::5	10G
IXManchester	8426	195.66.244.17	2001:79b:4:2::20ea:1	1G
LINX LON1	8426	195.68.224.88	2001:79b:4::20ea:1	20G
LINX LON2	8426	195.68.236.88	2001:79b:4:1::20ea:1	10G

Facility	ASN	Country	City
Digital Realty Amsterdam (Science Park)	8426	Netherlands	Amsterdam
Digital Realty London (Sovereign House)	8426	United Kingdom	London
Digital Realty London (West Drayton)	8426	United Kingdom	West Drayton, Middlesex

Role	Name	Phone	E-Mail
NOC	peerops		peerops@clara.net
Policy	peering		peering@clara.net

Publishing our routing data

- All valid announcements published in RIPPEDB IRR
 - Policies published in AS8426 AUT-NUM
 - Route origins represented by AS-CLARANET macro.
- ROAs published for all prefixes we maintain
 - We use RIPE NCC managed RPKI (point and click)

AUT-NUM specifies your policy

We generate ours automatically from our records of customers and peers
(others use it to generate config, we use it to publish)

Doing this is not as important / relevant today.

```
$ whois -h whois.ripe.net -- -T aut-num -Br AS8426

aut-num:      AS8426
as-name:      CLARANET-AS
descr:        ClaraNET LTD
descr:        Global Autonomous System
remarks:
remarks:      *****
remarks:      * The list below is generated automatically *
remarks:      *****
remarks:
remarks:      AS5615 (PEER) - TISNL-BACKBONE Green ISP B.V.
mp-import:    afi ipv4.unicast from AS5615 80.249.208.115 at 80.249.208.82 accept AS5615
mp-export:    afi ipv4.unicast to AS5615 80.249.208.115 at 80.249.208.82 announce AS-CLARANET
mp-import:    afi ipv4.unicast from AS5615 80.249.208.78 at 80.249.208.82 accept AS5615
mp-export:    afi ipv4.unicast to AS5615 80.249.208.78 at 80.249.208.82 announce AS-CLARANET
mp-import:    afi ipv4.unicast from AS5615 80.249.208.78 at 80.249.209.228 accept AS5615
mp-export:    afi ipv4.unicast to AS5615 80.249.208.78 at 80.249.209.228 announce AS-CLARANET
mp-import:    afi ipv4.unicast from AS5615 80.249.208.115 at 80.249.209.228 accept AS5615
mp-export:    afi ipv4.unicast to AS5615 80.249.208.115 at 80.249.209.228 announce AS-CLARANET
mp-import:    afi ipv4.unicast from AS5615 195.69.144.78 at 195.69.144.82 accept AS5615
mp-export:    afi ipv4.unicast to AS5615 195.69.144.78 at 195.69.144.82 announce AS-CLARANET
mp-import:    afi ipv4.unicast from AS5615 195.69.144.115 at 195.69.144.82 accept AS5615
mp-export:    afi ipv4.unicast to AS5615 195.69.144.115 at 195.69.144.82 announce AS-CLARANET
remarks:      AS5631 (CUSTOMER) - VITAL-GROUP VITAL-GROUP UK Network
mp-import:    afi ipv4.unicast from AS5631 accept AS5631
mp-export:    afi ipv4.unicast to AS5631 announce ANY
remarks:      AS6067 (PEER) - ONYX Onyx Internet
mp-import:    afi ipv4.unicast from AS6067 195.66.224.35 at 195.66.224.66 accept AS-ONYX
mp-export:    afi ipv4.unicast to AS6067 195.66.224.35 at 195.66.224.66 announce AS-CLARANET
mp-import:    afi ipv4.unicast from AS6067 195.66.236.35 at 195.66.236.66 accept AS-ONYX
mp-export:    afi ipv4.unicast to AS6067 195.66.236.35 at 195.66.236.66 announce AS-CLARANET

<snip>
```

AS-SET (macro) more important

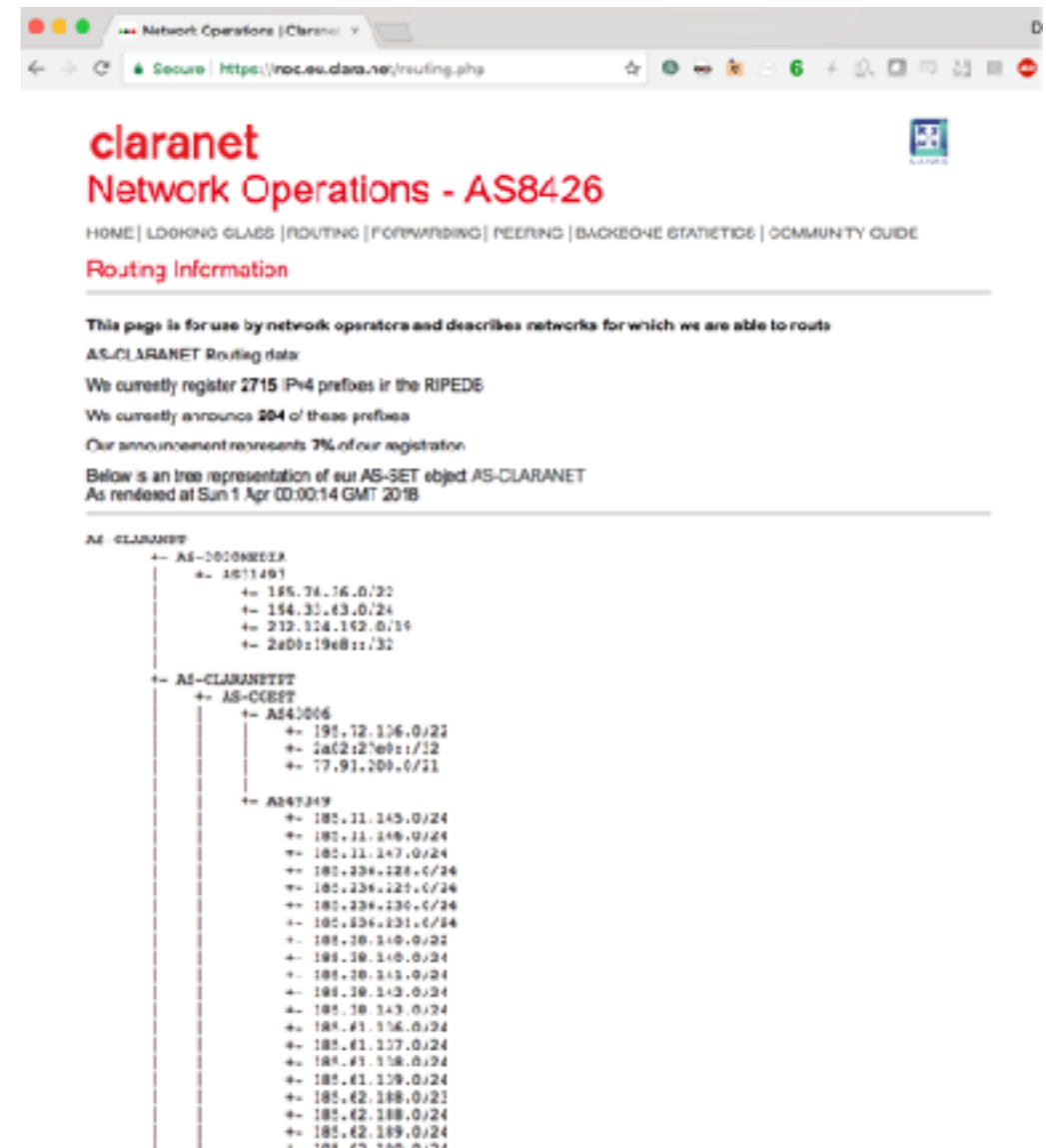
This we generate again automatically, from our customer database

You should keep this up to date at the top level

```
$ whois -h whois.ripe.net -- -T as-set -Br AS-CLARANET
```

```
as-set:      AS-CLARANET
descr:      ASes routed by Claranet
members:    AS-CLARANETPT
members:    AS8426
members:    AS-2020MEDIA
members:    AS-CONTINENT8
members:    AS-DIADEMYS
members:    AS-DOMICILIUM
members:    AS-LUMINET
members:    AS-MOREA
members:    AS-NOMINET
members:    AS-NORTENET
members:    AS-OXYMIUM
members:    AS-RUNISO
members:    AS-TYPHON
members:    AS-WEL-TRANSIT
members:    AS12583
members:    AS12628
members:    AS12680
members:    AS15489
members:    AS15622
members:    AS15722
members:    AS15734
```

```
<snip>
```



The screenshot shows a web browser window with the URL `https://noc.es.claranet.net/routing.php`. The page title is "claranet Network Operations - AS8426". The navigation menu includes links for HOME, LOOKING GLASS, ROUTING, FORWARDING, PEERING, BACKBONE STATISTICS, and COMMUNITY GUIDE. The main content area is titled "Routing Information" and contains the following text:

This page is for use by network operators and describes networks for which we are able to route

AS-CLARANET Routing data

We currently register 2715 IPv4 prefixes in the RIPv6

We currently announce 204 of these prefixes

Our announcement represents 7% of our registration

Below is an tree representation of our AS-SET object AS-CLARANET
As rendered at Sun 1 Apr 00:00:14 GMT 2018

The tree representation shows the following structure:

```
AS-CLARANET
├── AS-DOCOMOEEA
│   ├── AS11491
│   │   ├── 185.34.36.0/22
│   │   ├── 154.33.43.0/24
│   │   ├── 212.124.142.0/16
│   │   └── 2a09:1948::/32
│   └── AS-CLARANETPT
│       ├── AS-OCCEET
│       │   ├── AS42066
│       │   │   ├── 195.12.106.0/22
│       │   │   ├── 2a02:27e0::/12
│       │   │   └── 77.91.200.0/21
│       │   └── AS24349
│       │       ├── 182.11.143.0/24
│       │       ├── 182.11.146.0/24
│       │       ├── 182.11.147.0/24
│       │       ├── 182.136.128.0/24
│       │       ├── 182.136.129.0/24
│       │       ├── 182.136.130.0/24
│       │       ├── 182.136.131.0/24
│       │       ├── 188.20.140.0/22
│       │       ├── 188.20.140.0/24
│       │       ├── 188.20.143.0/24
│       │       ├── 188.20.143.0/24
│       │       ├── 188.20.143.0/24
│       │       ├── 188.20.143.0/24
│       │       ├── 188.41.156.0/24
│       │       ├── 188.41.157.0/24
│       │       ├── 188.41.158.0/24
│       │       ├── 188.41.159.0/24
│       │       ├── 188.42.188.0/22
│       │       ├── 188.42.188.0/24
│       │       ├── 188.42.189.0/24
│       │       └── 188.42.189.0/24
```

Keeping the levels below up to date is another challenge...

Publish ROAs for everything you originate
We are using RIPE NCC hosted RPKI
So ROAs exist for everything in the LIR

RPKI Dashboard 41 CERTIFIED RESOURCES ALERTS ARE SENT TO 1 ADDRESS

43 BGP Announcements 43 Valid 0 Invalid 0 Unknown **47 ROAs** 47 OK 0 Causing problems

BGP Announcements **Route Origin Authorisations (ROAs)** History

Create ROAs for selected BGP Announcements Valid Invalid Unknown

<input type="checkbox"/>	Origin AS	Prefix	Current Status	
<input type="checkbox"/>	AS8426	130.193.80.0/20	VALID	
<input type="checkbox"/>	AS8426	176.52.208.0/21	VALID	
<input type="checkbox"/>	AS8426	185.39.232.0/23	VALID	
<input type="checkbox"/>	AS8426	185.77.172.0/22	VALID	
<input type="checkbox"/>	AS8426	185.77.200.0/22	VALID	
<input type="checkbox"/>	AS8426	185.77.64.0/22	VALID	
<input type="checkbox"/>	AS8426	185.77.72.0/22	VALID	
<input type="checkbox"/>	AS8426	185.77.72.0/23	VALID	
<input type="checkbox"/>	AS8426	185.77.80.0/22	VALID	
<input type="checkbox"/>	AS8426	194.112.32.0/19	VALID	

Automation of outbound prefix filters

Takes data from evaluation of our AS-MACRO

Commits > 2b489e9e

Commit 2b489e9e authored 8 week ago Browse files Options ▾

committed by [redacted].py on [redacted].clara.net

parent 2d447fa5 taster

No related merge requests found

Showing 4 changed files with 8 additions and 8 deletions Hide whitespace changes inline Side-by-side

▼ bogons-prefixes/bogons4-pfx-out-ios.txt View file @ 2b489e9e

<pre> 1 no ip prefix-list AS-CLARANET 2 3 - ! Created by [redacted].py on [redacted].clara.net at 15-03-2018 15:14:44 UTC 4 ip prefix-list AS-CLARANET permit 5.159.48.0/21 5 ip prefix-list AS-CLARANET permit 5.206.224.0/21 6 ip prefix-list AS-CLARANET permit 5.206.224.0/21 ge 24 le 24 ... @@ -407,7 +407,7 @@ ip prefix-list AS-CLARANET permit 195.167.176.0/20 le 21 407 ip prefix-list AS-CLARANET permit 195.167.176.0/20 le 21 408 ip prefix-list AS-CLARANET permit 195.178.96.0/19 409 ip prefix-list AS-CLARANET permit 195.178.169.0/24 410 - ip prefix-list AS-CLARANET permit 195.191.216.0/24 411 ip prefix-list AS-CLARANET permit 195.208.252.0/23 412 ip prefix-list AS-CLARANET permit 195.211.164.0/23 413 ip prefix-list AS-CLARANET permit 195.216.0.0/19 ... </pre>	<pre> 1 no ip prefix-list AS-CLARANET 2 3 + ! Created by [redacted].py on [redacted].clara.net at 28-03-2018 01:11:02 UTC 4 ip prefix-list AS-CLARANET permit 5.159.48.0/21 5 ip prefix-list AS-CLARANET permit 5.206.224.0/21 6 ip prefix-list AS-CLARANET permit 5.206.224.0/21 ge 24 le 24 ... @@ -407,7 +407,7 @@ ip prefix-list AS-CLARANET permit 195.167.176.0/20 le 21 407 ip prefix-list AS-CLARANET permit 195.167.176.0/20 le 21 408 ip prefix-list AS-CLARANET permit 195.178.96.0/19 409 ip prefix-list AS-CLARANET permit 195.178.169.0/24 410 + ip prefix-list AS-CLARANET permit 195.191.216.0/23 ge 24 le 24 411 ip prefix-list AS-CLARANET permit 195.208.252.0/23 412 ip prefix-list AS-CLARANET permit 195.211.164.0/23 413 ip prefix-list AS-CLARANET permit 195.216.0.0/19 ... </pre>
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▼ bogons-prefixes/bogons46-pfx-out-ios_xr.txt View file @ 2b489e9e

<pre> 1 prefix-set AS-CLARANET 2 - # Created by [redacted].py on [redacted].clara.net at 15-03-2018 15:14:44 UTC 3 5.159.48.0/21, 4 5.206.224.0/21, 5 5.206.224.0/21 ge 24 le 24, ... @@ -406,7 +406,7 @@ prefix-set AS-CLARANET 406 195.167.176.0/20 le 21, 407 195.178.96.0/19, 408 195.178.169.0/24, 409 - 195.191.216.0/24, 410 195.208.252.0/23, 411 195.211.164.0/23, 412 195.216.0.0/19, ... </pre>	<pre> 1 prefix-set AS-CLARANET 2 + # Created by [redacted].py on [redacted].clara.net at 28-03-2018 01:11:02 UTC 3 5.159.48.0/21, 4 5.206.224.0/21, 5 5.206.224.0/21 ge 24 le 24, ... @@ -406,7 +406,7 @@ prefix-set AS-CLARANET 406 195.167.176.0/20 le 21, 407 195.178.96.0/19, 408 195.178.169.0/24, 409 + 195.191.216.0/23 ge 24 le 24, 410 195.208.252.0/23, 411 195.211.164.0/23, 412 195.216.0.0/19, ... </pre>
--	--

Plenty of open source tools to do this for you (Example : bgpq3, <https://github.com/snar/bgpq3>)

```
$ bgpq3 -3 -4 -A -1 AS-CLARANET -P -S RIPE AS-CLARANET
no ip prefix-list AS-CLARANET
ip prefix-list AS-CLARANET permit 5.159.40.0/21
ip prefix-list AS-CLARANET permit 5.206.224.0/21
ip prefix-list AS-CLARANET permit 5.206.224.0/21 ge 24 le 24
ip prefix-list AS-CLARANET permit 12.111.223.0/24
ip prefix-list AS-CLARANET permit 12.175.119.0/24
ip prefix-list AS-CLARANET permit 23.207.64.0/19 ge 20 le 20
ip prefix-list AS-CLARANET permit 31.3.136.0/21
ip prefix-list AS-CLARANET permit 31.3.137.0/24
ip prefix-list AS-CLARANET permit 31.3.139.0/24
ip prefix-list AS-CLARANET permit 31.172.240.0/20
ip prefix-list AS-CLARANET permit 37.44.8.0/21
ip prefix-list AS-CLARANET permit 37.220.96.0/21
ip prefix-list AS-CLARANET permit 41.222.104.0/21 ge 22 le 22
ip prefix-list AS-CLARANET permit 41.222.104.0/23 le 24
ip prefix-list AS-CLARANET permit 41.222.108.0/23 ge 24 le 24
ip prefix-list AS-CLARANET permit 41.222.110.0/23 le 24
ip prefix-list AS-CLARANET permit 43.228.128.0/22 ge 24 le 24
ip prefix-list AS-CLARANET permit 43.242.240.0/22 ge 24 le 24
ip prefix-list AS-CLARANET permit 45.60.0.0/16 ge 17 le 17
ip prefix-list AS-CLARANET permit 45.60.0.0/16 ge 24 le 24
ip prefix-list AS-CLARANET permit 45.64.64.0/22 ge 24 le 24
ip prefix-list AS-CLARANET permit 45.223.0.0/16
ip prefix-list AS-CLARANET permit 46.18.128.0/21
ip prefix-list AS-CLARANET permit 46.231.112.0/21
ip prefix-list AS-CLARANET permit 46.245.208.0/21
ip prefix-list AS-CLARANET permit 62.24.0.0/19
ip prefix-list AS-CLARANET permit 62.80.0.0/18
ip prefix-list AS-CLARANET permit 62.128.107.0/24
ip prefix-list AS-CLARANET permit 62.173.64.0/18
ip prefix-list AS-CLARANET permit 62.176.128.0/19
ip prefix-list AS-CLARANET permit 62.197.0.0/19
ip prefix-list AS-CLARANET permit 62.231.128.0/19
ip prefix-list AS-CLARANET permit 62.240.224.0/19
ip prefix-list AS-CLARANET permit 64.199.226.0/24
ip prefix-list AS-CLARANET permit 77.91.200.0/21
ip prefix-list AS-CLARANET permit 78.24.208.0/21
ip prefix-list AS-CLARANET permit 78.24.208.0/22 le 24
ip prefix-list AS-CLARANET permit 78.24.212.0/22
ip prefix-list AS-CLARANET permit 78.24.212.0/23 le 24
ip prefix-list AS-CLARANET permit 78.40.32.0/21
```

<snip>

Customer route filtering

- Customers speaking BGP should be filtered inbound
- We capture AUT-NUM or AS-SET at provision time
- Automatically build filters in the same way

```
ip prefix-list AS-CUSTOMER permit 212.22.254.0/23 ge 24 le 24
ip prefix-list AS-CUSTOMER permit 212.28.0.0/19 ge 20 le 20
ip prefix-list AS-CUSTOMER permit 212.43.192.0/18
ip prefix-list AS-CUSTOMER permit 212.49.192.0/18
ip prefix-list AS-CUSTOMER permit 212.54.140.0/24
ip prefix-list AS-CUSTOMER permit 212.57.64.0/19
ip prefix-list AS-CUSTOMER permit 212.61.0.0/16
ip prefix-list AS-CUSTOMER permit 212.66.0.0/19
ip prefix-list AS-CUSTOMER permit 212.82.224.0/19
ip prefix-list AS-CUSTOMER permit 212.124.192.0/19
ip prefix-list AS-CUSTOMER permit 212.125.64.0/19
ip prefix-list AS-CUSTOMER permit 212.126.128.0/19
ip prefix-list AS-CUSTOMER permit 212.169.0.0/18
ip prefix-list AS-CUSTOMER permit 212.188.128.0/17
ip prefix-list AS-CUSTOMER permit 213.2.0.0/16
```

Anti Spoofing (Customer packet filtering)

- BCP38 strict uRPF or ACL on all single homed customers.

```
!
interface GigabitEthernet0/0/0/0.101
  description Non-core: Some customer [London - 1000 Mbps - Primary]:Telco:1234567890:ZZZ001
  bandwidth 1024000
  ipv4 address 192.0.2.1 255.255.255.0
  ipv4 verify unicast source reachable-via rx
  ipv4 unreachable disable
  encapsulation dot1q 101
!
```

- Multi-homed customers are subject to ACL only.
- ACLs automatically generated by the same automation
- This can be done at customer or internetwork interface

Anti Spoofing

CAIDA Spoofer project
<https://spoofer.caida.org>

Go check your ASN now!

The screenshot shows the CAIDA Spoofer project website. The page title is "Recent tests". The CAIDA logo and name are visible at the top. The navigation menu includes: HOME, RESEARCH, DATA, TOOLS, INTERACTIVE, PUBLICATIONS, WORKSHOPS, PROJECTS, FUNDING. There is a search bar and links for DONATE and CONTACT US. The main content area is titled "Recent tests" and contains a navigation bar with links: | Spoofer Project Page | Download | FAQ |. Below this is a "Data:" section with links: Stats Summary, Recent Tests, Remediation, Results by AS, Results by Country, Results by Provider, Results by Traceroute. A "Result filters:" section allows filtering by AS numbers or (partial) names (8426), Country codes, and checkboxes for "Exclude NAT" and "Only show non-remediated spoofing". A "Spoof status key" table explains the colors used in the results table. The main table lists test sessions with columns: Session, Timestamp (UTC), Client IP Block, ASN, Country, NAT, Spoof Private, Spoof Routable, Adjacency Spoofing, and Results.

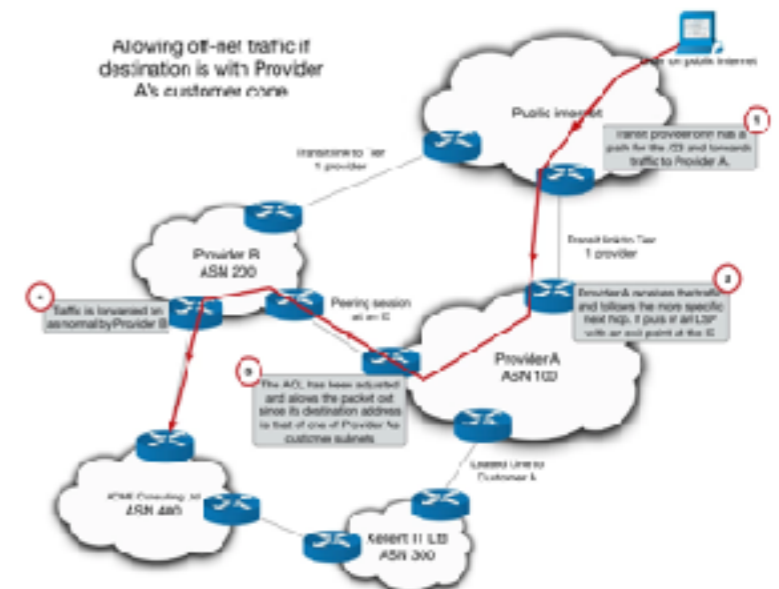
Session	Timestamp (UTC)	Client IP Block	ASN	Country	NAT	Spoof Private	Spoof Routable	Adjacency Spoofing	Results
438077	2018-04-02 07:33:57	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	blocked	blocked	none	Report
434314	2018-03-28 16:08:46	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	blocked	blocked	none	Report
434310	2018-03-28 16:04:23	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	blocked	blocked	none	Report
434005	2018-03-28 08:26:12	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	blocked	blocked	none	Report
431858	2018-03-22 07:25:40	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	blocked	blocked	none	Report
431363	2018-03-21 14:10:21	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	unknown	unknown	none	Report
431286	2018-03-21 11:50:33	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	blocked	blocked	none	Report
431256	2018-03-21 10:41:00	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	unknown	unknown	none	Report
429956	2018-03-19 11:38:07	212.61.12.x/24	8426 (CLARANET-AS)	nld (Netherlands)	yes	blocked	blocked	none	Report
353410	2017-11-14 11:18:24	212.188.254.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	blocked	blocked	none	Report
350177	2017-11-08 22:12:17	212.188.254.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes				Report
		2001:a88:d5xx::/40	8426 (CLARANET-AS)	gbr (United Kingdom)	no	blocked	blocked	/32	
345756	2017-11-01 20:13:38	212.188.254.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	blocked	blocked	none	Report
		2001:a88:d5xx::/40	8426 (CLARANET-AS)	gbr (United Kingdom)	no	blocked	blocked	/32	
290077	2017-08-18 18:08:45	80.168.113.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	rewritten	rewritten	none	Report
293830	2017-08-10 02:46:32	195.157.65.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	unknown	unknown	none	Report
292944	2017-08-09 02:57:58	195.157.65.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	unknown	unknown	none	Report
258524	2017-06-27 17:02:43	89.206.239.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	unknown	unknown	none	Report
248057	2017-06-14 22:43:09	213.165.152.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	unknown	unknown	none	Report
245200	2017-06-11 19:46:47	213.165.152.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	unknown	unknown	none	Report
234849	2017-05-30 16:44:34	213.165.152.x/24	8426 (CLARANET-AS)	gbr (United Kingdom)	yes	unknown	unknown	none	Report

Peer inbound filtering

- Route filtering via IXP filtering route-server a quick win
 - But you need to find one (example, AMS-IX RS)
- If you have bilateral sessions, this is harder
 - You can generate per peer filters, presuming AS-SET is published
 - Argument against peering with somebody who doesn't do this
 - AS-SET also needs to be valid, and preferably clean and not excessive size
 - Scale issue on the peering edge with all of these filters.
- Also, if you rely on upstream providers, specific route filtering of these is likely impossible.
- General solution is usually to permit everything by default and deny BOGON (private and reserved) or known bad networks: - <https://www.team-cymru.com/bogon-reference.html>
 - You can do this for routes, and also for packets, even on shared media.
 - Don't forget to also deny your own prefixes / packets (unless you really need to accept them)

Policy Violations

- Policy violations occur usually when:
 - Multiple parties have genuine announcements
 - Traffic flows against policy
- Usually announcements cause forwarding conflict
- These can only be detected automatically by good telemetry (Netflow, sFlow) and analysis, this is what happens in our case.
- Can be resolved technically, politically or commercially
 - Partition of function at the edge helps here.



Questions?

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