HURRICANE ELECTRIC
INTERNET SERVICES

Peering Security

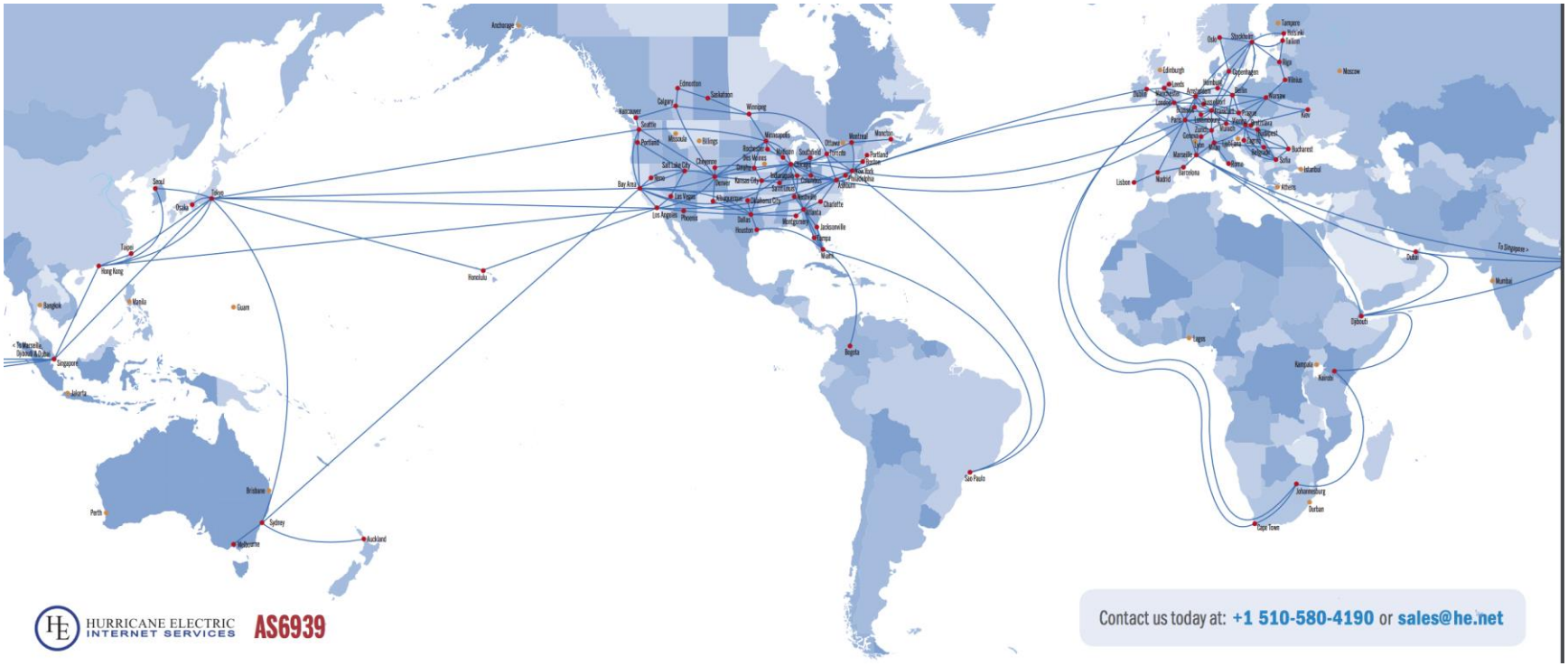
RONOG
Bucharest 2019

Walt Wollny, Director Interconnection Strategy
Hurricane Electric AS6939

Who is Walt Wollny?

- Hurricane Electric AS6939 – 4 years
  - Director Interconnection Strategy – supporting the network to reach to over 44 counties and over 229 Internet Exchanges. Focus on Global connectivity.
- Amazon AS16509 – 4 years
  - Developed IP Transit and Peering on five continents.
  - Primary focus on Japan, Singapore, Hong Kong, India, Taiwan, Philippines, Australia.
  - Over 62 new CDN sites.
- Microsoft AS8075 – 13 years
  - Developed IP Transit and Peering on four continents.
  - Primary focus on US, EU and South America.

Hurricane Electric Backbone



The Most Peering Exchanges

HURRICANE ELECTRIC INTERNET SERVICES

Search

Internet Exchange Report

Quick Links

- BGP Toolkit Home
- BGP Prefix Report
- BGP Peer Report
- Exchange Report
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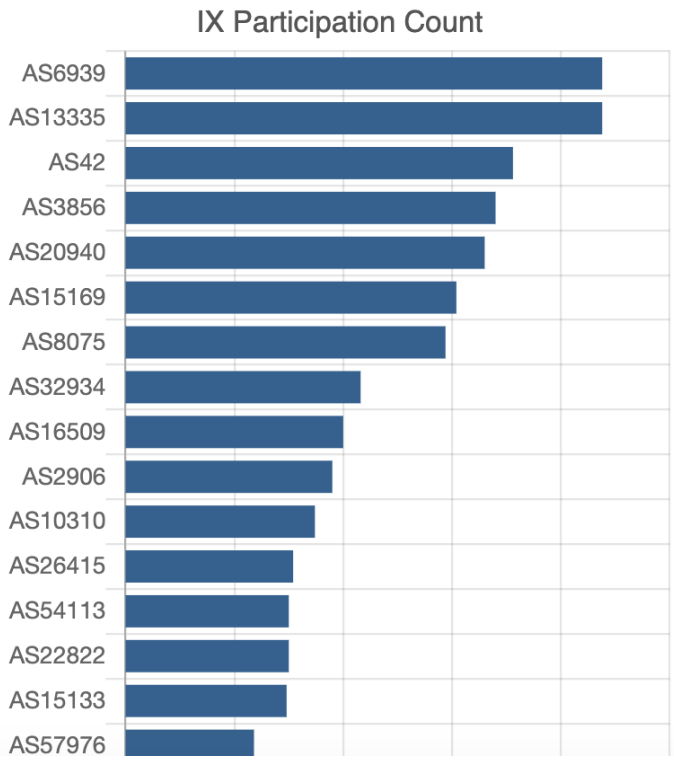
- DNS Report
- Top Host Report
- Internet Statistics
- Looking Glass
- Network Tools App
- Free IPv6 Tunnel
- IPv6 Certification
- IPv6 Progress
- Going Native
- Contact Us

Internet Exchanges | Exchange Participants

IX Participation Count

ASN	Name	IXes
AS6939	Hurricane Electric LLC	219
AS13335	Cloudflare, Inc.	219
AS42	WoodyNet	178
AS3856	Packet Clearing House	170
AS20940	Akamai International B.V.	165
AS15169	Google LLC	152
AS8075	Microsoft Corporation	147
AS32934	Facebook, Inc.	108
AS16509	Amazon.com, Inc.	100
AS2906	Netflix Streaming Services Inc.	95
AS10310	Oath Holdings Inc.	87
AS26415	VeriSign Global Registry Services	77
AS54113	Fastly	75
AS22822	Limelight Networks, Inc.	75
AS15133	EdgeCast Networks, Inc. d/b/a Verizon Digital Media Services	74



Why So Many Peering Exchanges?

Why So Many Peering Exchanges?

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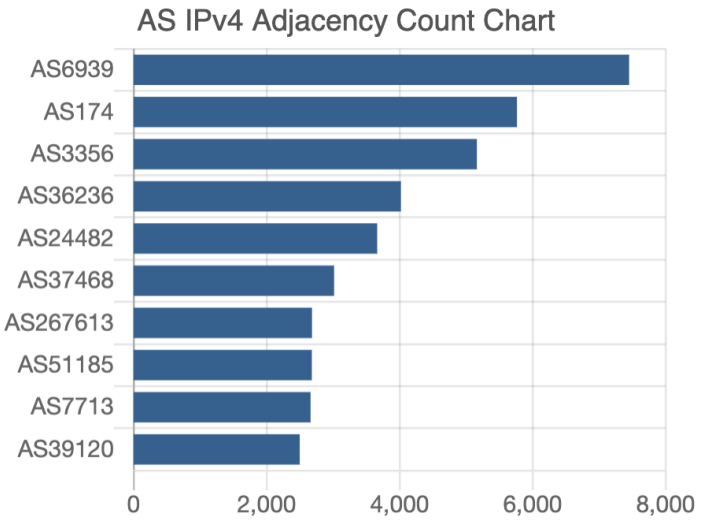
- IPv6 Progress

Adjacencies | Adjacency History | Prefixes | Prefix History | IPv4 Addresses Originated

IPv4 Adjacencies

ASN	Name	Count
AS6939	Hurricane Electric LLC	7,452
AS174	Cogent Communications	5,765
AS3356	Level 3 Parent, LLC	5,162
AS36236	NetActuate, Inc	4,020
AS24482	SG.GS	3,663
AS37468	Angola Cables	3,015
AS267613	ELETRONET S.A.	2,683
AS51185	Onecom Global Communications LTD	2,680
AS7713	PT Telekomunikasi Indonesia	2,661
AS39120	Convergenze S.p.A.	2,498



Before we start…..

We all live in glass houses..

Offer to help and drop that rock….

What does security have to do with Peering?

A lot. Now.

Security was an afterthought, but it has become **critically** important with the increase of BGP hijacks

Some of the basics...

Basics

- Best defenses for your network?
  - Logical Port Security
  - IXP Subnet Security
  - Routing Security
  - http://routing.he.net/

Logical Port Security

- Many IXPs will post their recommended port configuration (HKIX, AMS-IX, etc).
- Don’t just connect an interface with a default configuration to an IX Port!
- Services like Proxy-ARP will disrupt the IX as well as degrade your own network.
- Most IXs allow only unicast traffic. (IPv6 multicast neighbor discovery packets are an exception.0

Logical Port Security

- Apply ACL's to your interfaces—don't forget to configure both IPv4 and IPv6 ACLs!
- The SIX (Seattle Internet Exchange) has a great example here.
- Your IX port is an exposed piece of your network.
- Hundreds of other networks are directly connected.
- Remove this security risk!

Logical Port Security

- Why do we care?

AMS-IX

Ticket: 341134
Subject: Instability on AMS-IX
Status: closed
Opened: 2017-06-20 16:04:56 +0200
Type: unscheduled
Scope: AMS-IX NL
Start: 2017-06-20 15:20:00 +0200
CLOSED 2017-06-21 16:54:10 +0200:

Total impact time – 1 hour 34 mins

Root cause human error

The instability was caused due to a hardware issue on the customer's NIC and due to proxy-arp being enabled after the port passed the testing phase and was moved to production.

BBIX Tokyo

Occurred time: 2018/5/16 17:28 JST
Corresponded time: 2018/5/16 17:48 JST
Recovered time: 2018/5/16 18:10 JST
Affected area: BBIX Tokyo IX service

Total impact time – 39 mins

Root cause human error

Arp proxy response(= proxy arp) became effective when we changed the subnet mask on our monitoring router

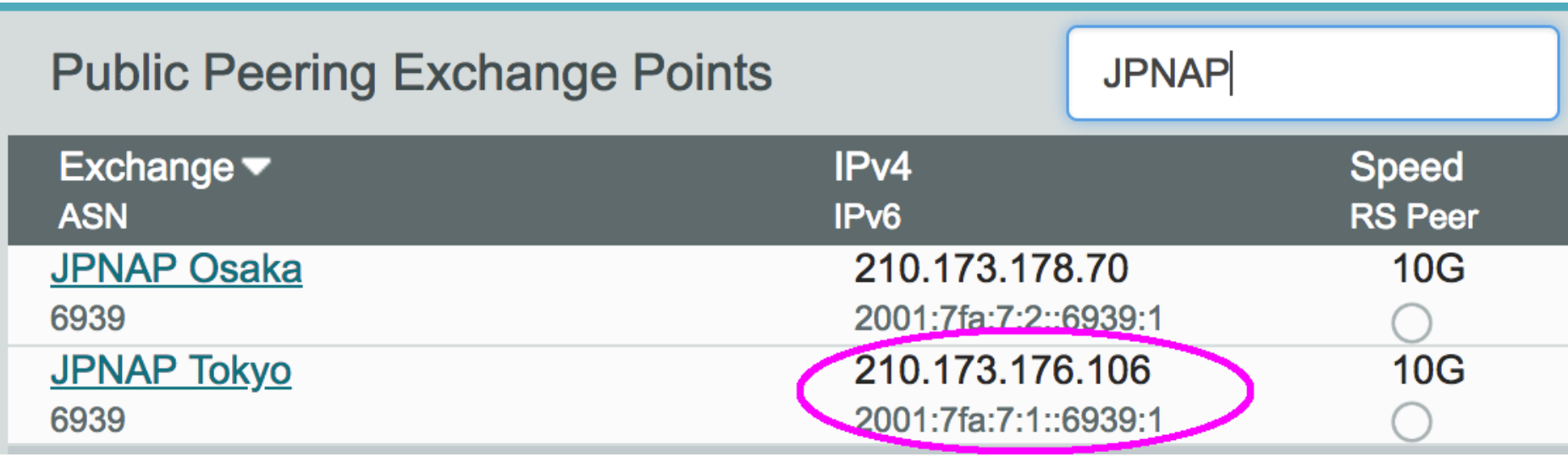
IXP Subnet

- Your IX Port is a target for DDoS Attacks!
- Applying the best security practices will help limit the exposure.

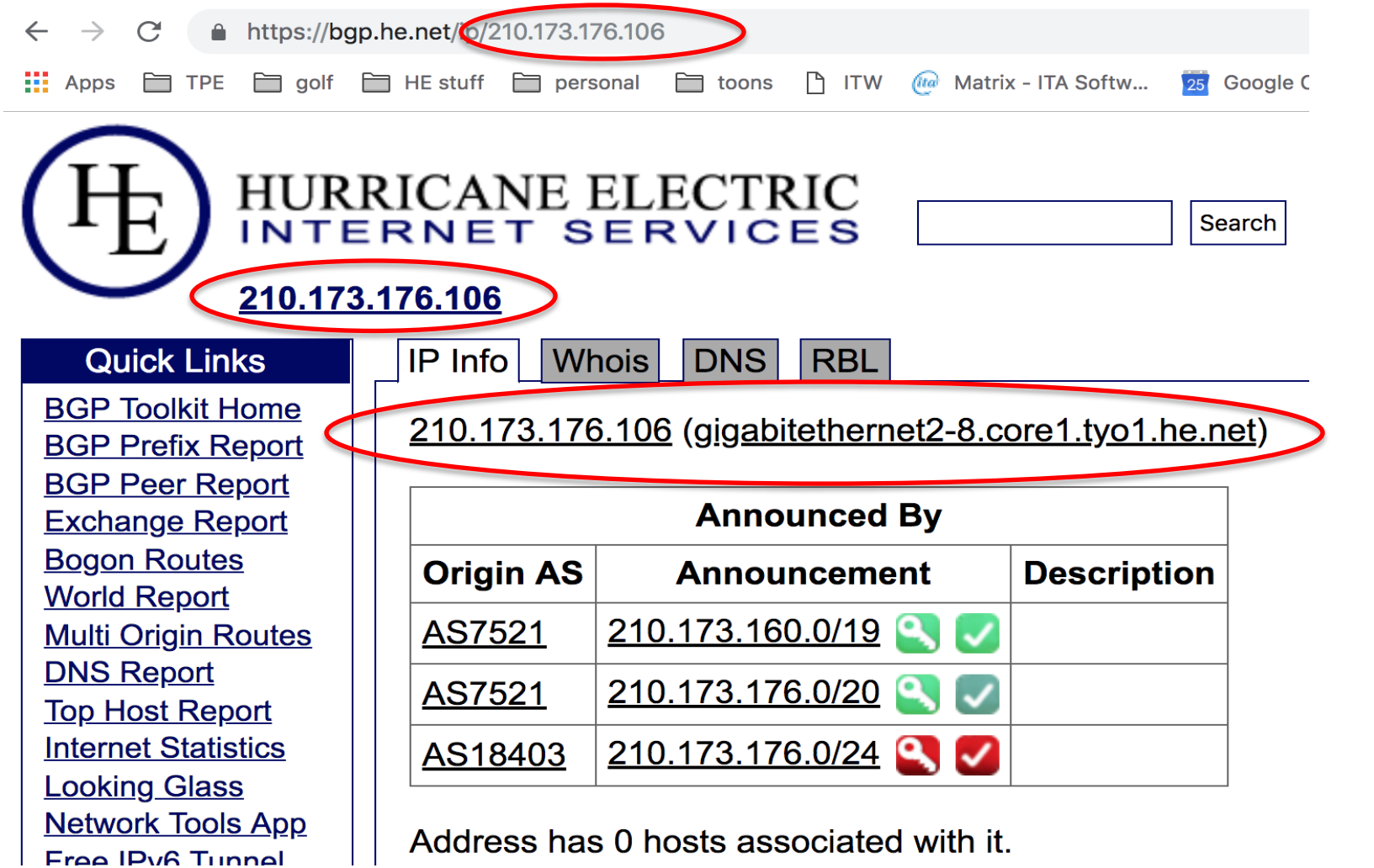
IXP Subnet

- The IXP is responsible for protecting the infrastructure.
- The IX LAN is not your IP space and should not be routed.
- Checking this...

IXP Subnet


Public Peering Exchange Points
JPNAP
Exchange
ASN
IPv4
IPv6
Speed
RS Peer
JPNAP Osaka
6939
210.173.178.70
2001:7fa:7:2::6939:1
10G
JPNAP Tokyo
6939
210.173.176.106
2001:7fa:7:1::6939:1
10G

IXP Subnet


https://bgp.he.net/ip/210.173.176.106
Apps
TPE
golf
HE stuff
personal
toons
ITW
Matrix - ITA Softw...
Google C
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210.173.176.106
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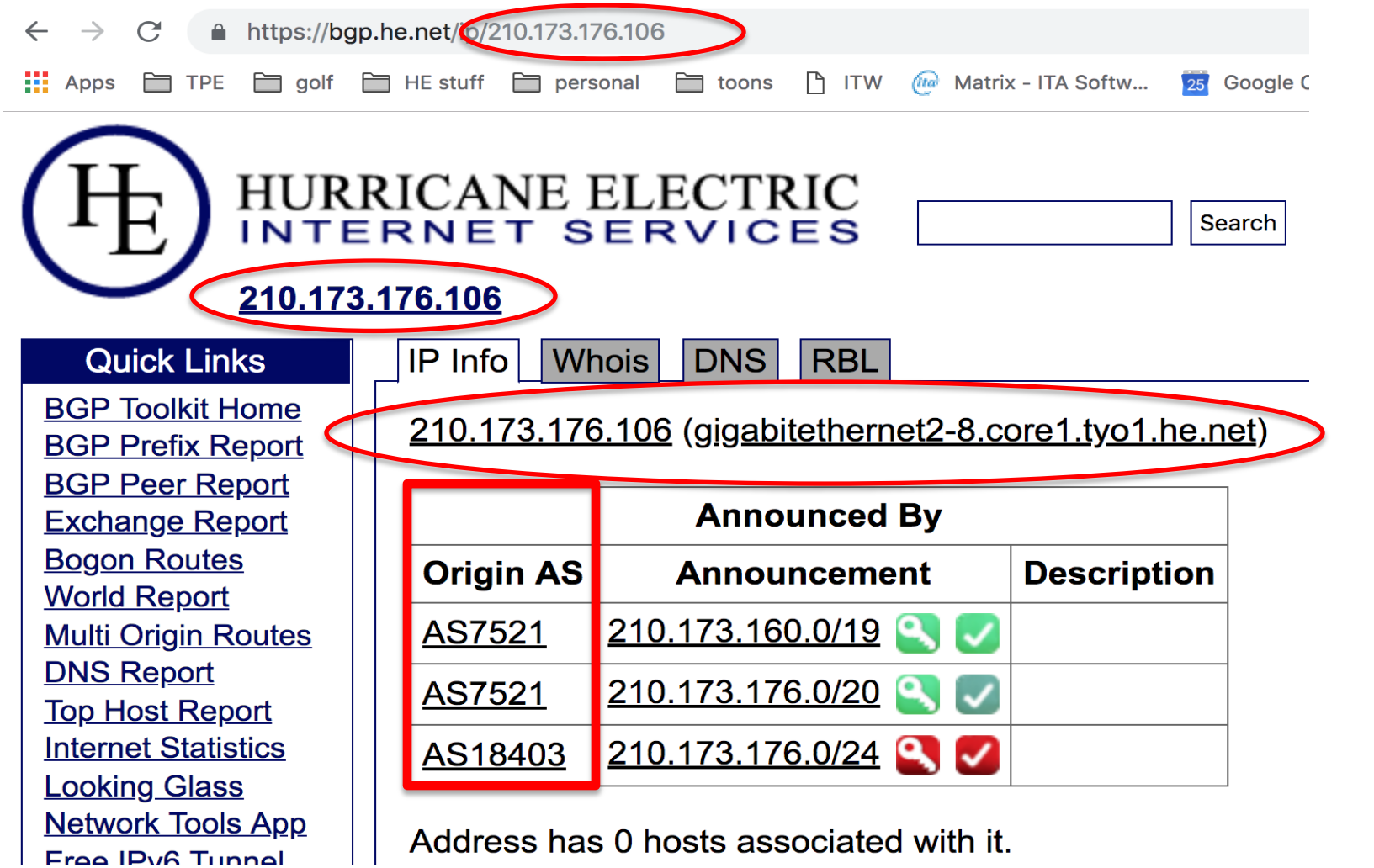
Network Tools App
IP Info
Whois
DNS
RBL
210.173.176.106 (gigabitethernet2-8.core1.tyo1.he.net)
Announced By
Origin AS
Announcement
Description
AS7521
210.173.160.0/19
AS7521
210.173.176.0/20
AS18403
210.173.176.0/24
Address has 0 hosts associated with it.

IXP Subnet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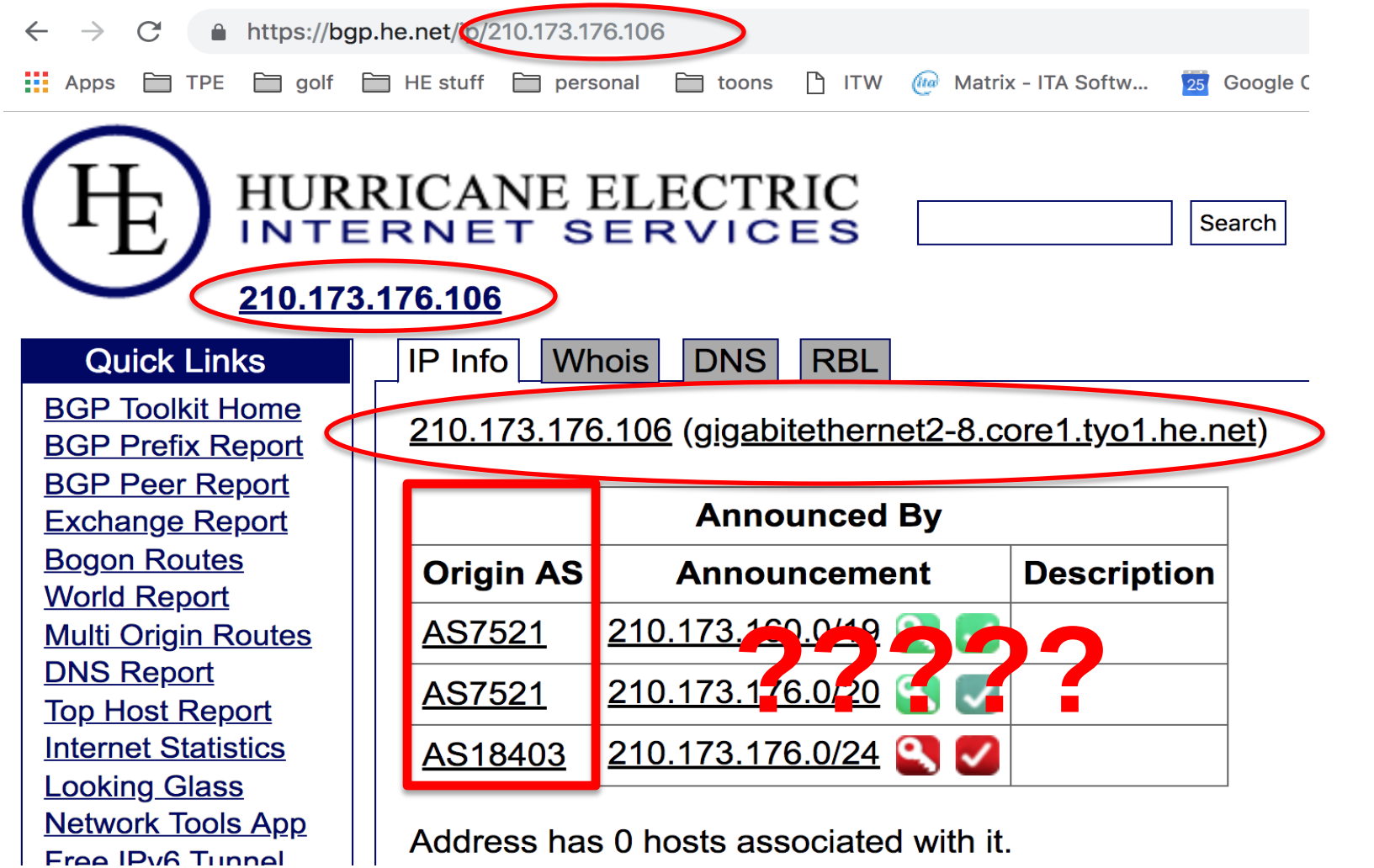
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AS18403
210.173.176.0/24
????
Address has 0 hosts associated with it.

IXP Subnet

- The IX LAN is not your IP space and should not be routed.

- Some of the smaller guys

IXP Subnet

Europe

CC	Exchange	Speed	IPv4	IPv6
	VIX	2x10GE	193.203.0.185	2001:7f8:30:0:2:1:0:6939
	BNIX	2x10GE	194.53.172.33	2001:7f8:26::a500:6939:1
	B-IX Balkans	10GE	217.174.157.31	2001:7f8:8e::31
	BIX.BG	2x10GE	193.169.198.70	2001:7f8:58::1b1b:0:1
	NetIX	10GE	193.218.0.89	2001:67c:29f0::6939:1
	MegaIX Sofia	10GE	91.212.235.55	2001:7f8:9f::a:6939:1
	T-CIX Bulgaria	10GE	185.1.40.26	2001:7f8:98::26
	CIXP	10GE	192.65.185.143	2001:7f8:1c:24a::1b1b:1

IXP Subnet

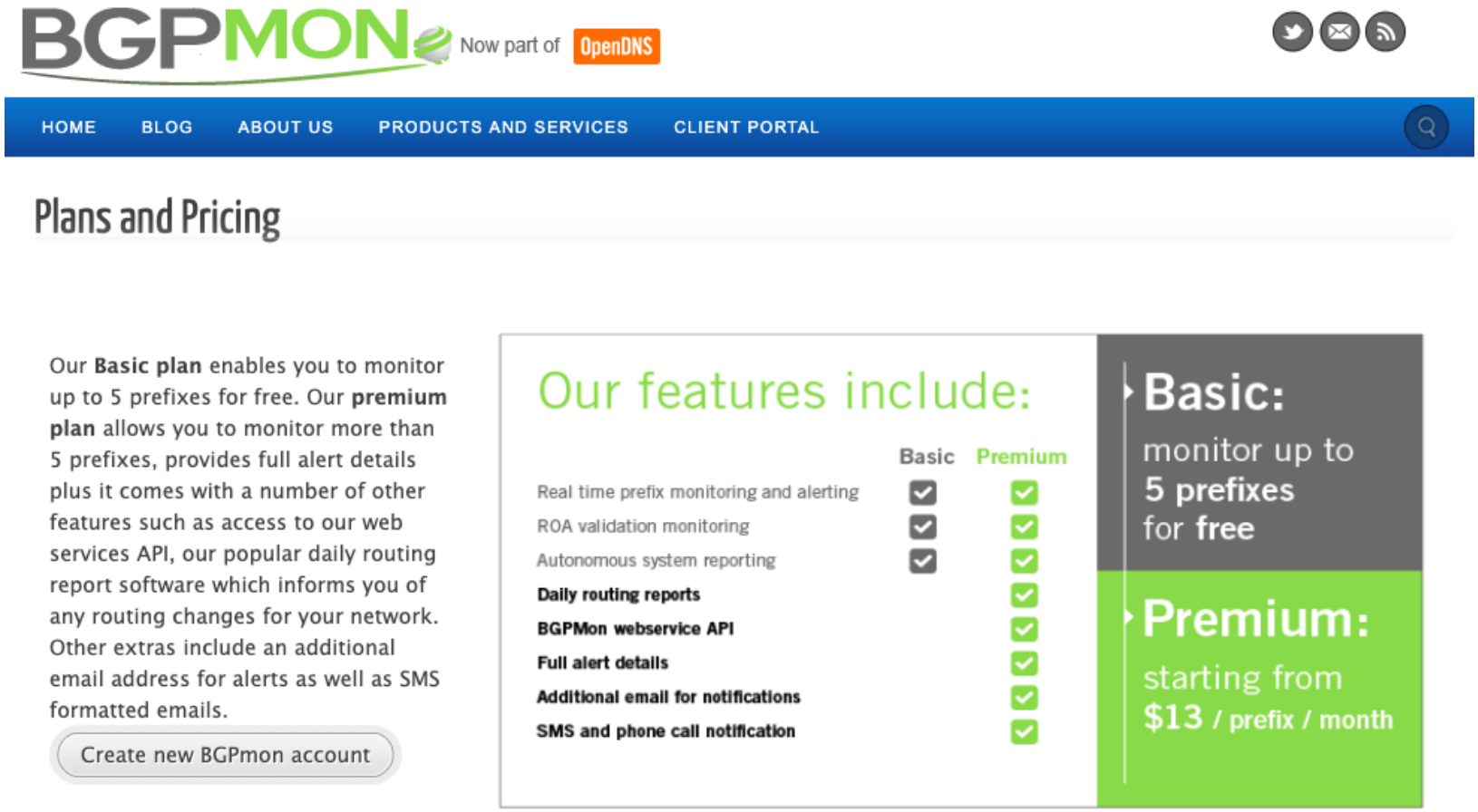
- Some of the big ones…..

IXP Subnet

Europe

CC	Exchange	Speed	IPv4	IPv6
DE	CIX Frankfurt	2x100GE	80.81.192.172	2001:7f8::1b1b:0:1
	France-IX Paris	2x10GE	37.49.236.10	2001:7f8:54::10
	AMS-IX	2x100GE	80.249.209.150	2001:7f8:1::a500:6939:1
	LINX	100GE	195.66.224.21	2001:7f8:4:0::1b1b:1
	MSK-IX Moscow	2x100GE	195.208.210.40	2001:7f8:20:101::210:40
	NL-IX	3x10GE	193.239.116.14	2001:7f8:13::a500:6939:1

IXP Subnet



This product is now end of life in March 2020

BGPmon.net Notification

BGPmon Alert

Sent: Wednesday, January 30, 2019 at 11:08 AM

To: info@seattleix.net

You received this email because you are subscribed to BGPmon.net.
For more details about these updates please visit:
https://portal.bgpmon.net/myalerts.php

==========

Possible Prefix Hijack (Code: 10)

==========

Your prefix:	206.81.80.0/22:
Update time:	2019-01-29 21:55 (UTC)
Detected by #peers:	1
Detected prefix:	206.81.80.0/23
Announced by:	AS10310 (YAHOO-1 - Yahoo!, US)
Upstream AS:	AS29467 (LUXNETWORK Network Service Provider in Luxembourg, LU)
ASpath:	60983 29467 10310
Alert details:	https://portal.bgpmon.net/alerts.php?details&alert_id=86973730
Mark as false alert:	https://portal.bgpmon.net/fp.php?aid=86973730

---

*for questions regarding the change code or other question, please see:
https://portal.bgpmon.net/faq.php

Latest BGPmon news: http://bgpmon.net/blog/

* Popular Destinations rerouted to Russia
* Todayâ€™s BGP leak in Brazil
* BGP leak causing Internet outages in Japan and beyond.

BGPMON Replacement

https://mailman.nanog.org/pipermail/nanog/2019-August/102672.html

Thanks to Job & Massimo @NTT Ltd

This product is now end of life in March 2020

IXP Subnet

Why do we care?

IXP Subnet

The DDoS That Almost Broke the Internet

Cloudflare March 2013 ~120Gbps attack on LINX

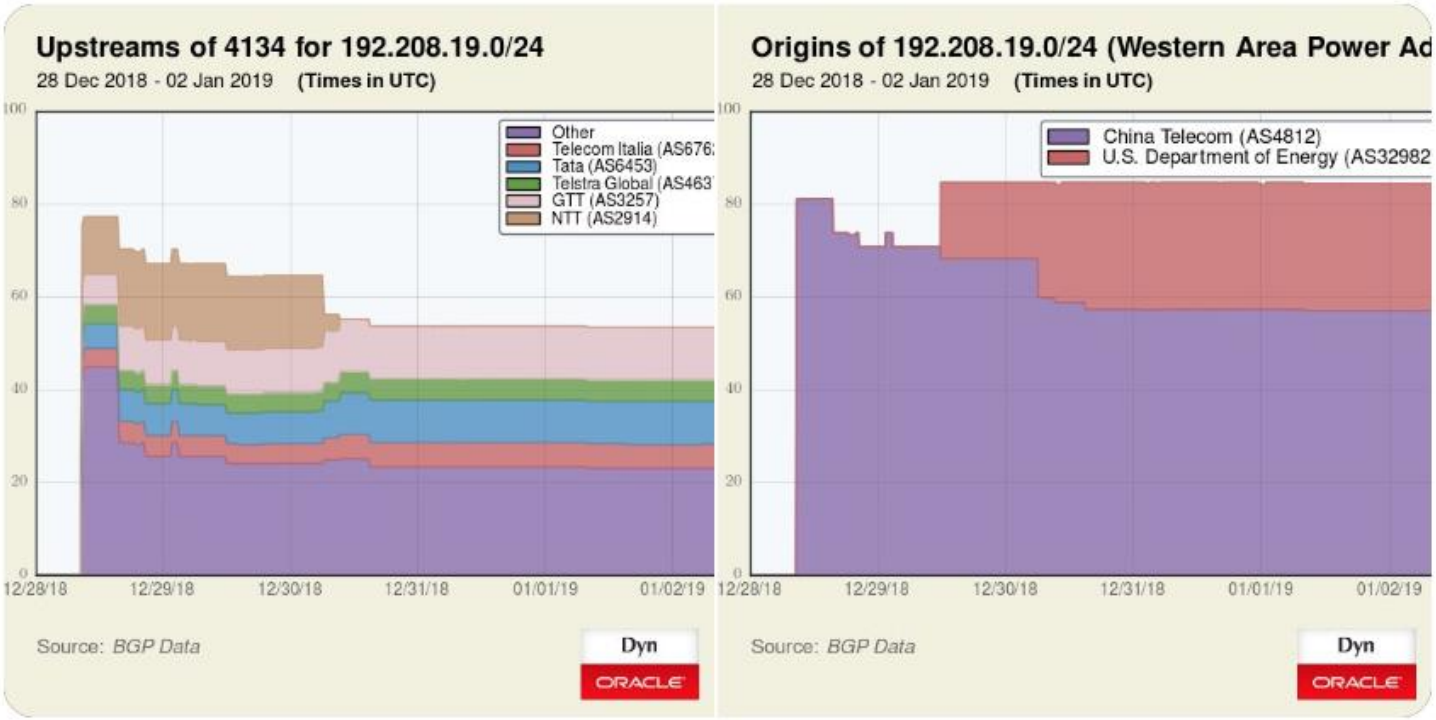
Basics - Routing Security

You must filter your peers.

- Most networks don't filter their peers.
- This is negligent behavior.

Routing Security: Why it matters

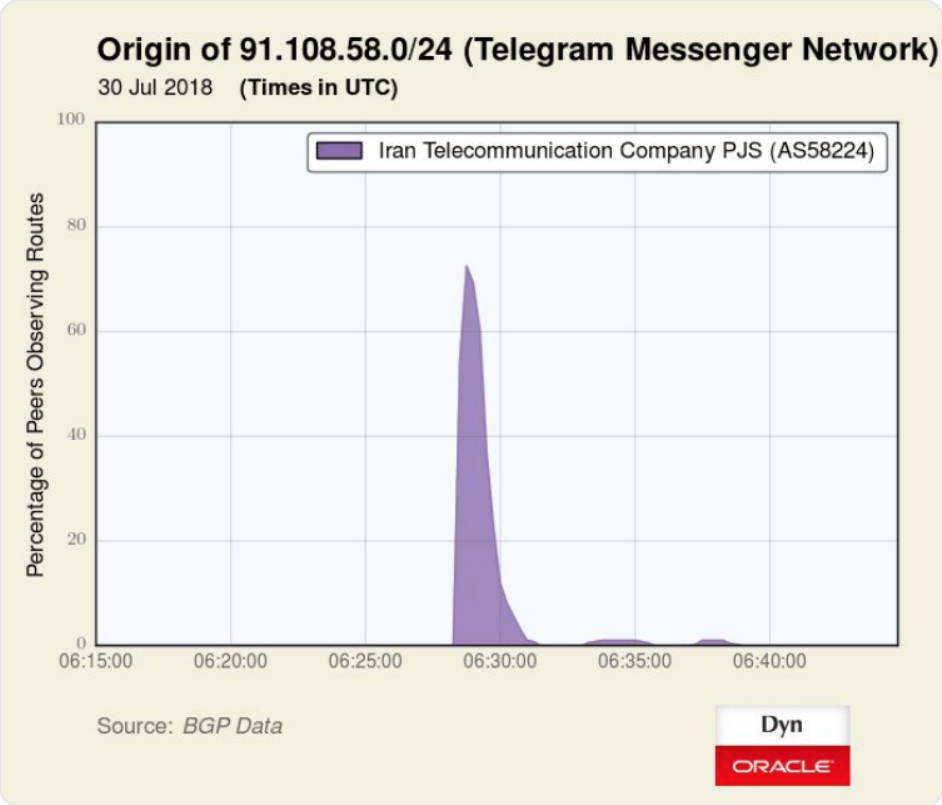
On 28 December 2018 China Telecom hijacked a US Department of Energy prefix (192.208.19.0/24) and did not correct the problem for 6 days.



InternetIntelligence
@InternetIntel

Follow

At 06:28 UTC earlier today (30-Jul), an Iranian state telecom network briefly leaked over 100 prefixes. Most were Iranian networks, but the leak also included 10 prefixes of popular messaging app @telegram (8 were more-specifics).



7:45 AM - 30 Jul 2018

https://bgpstream.com

- Every day there are several hijacks and leaks

Possible Hijack	*Expected Origin AS:* COMCAST-7922 - Comcast Cable Communications, LLC, US (AS 7922) *Detected Origin AS:* LIVEPERSON-ASN, IL (AS 49794)	2019-08-21 14:20:14		More detail
Possible Hijack	*Expected Origin AS:* ADAPT-AS, GB (AS 24867) *Detected Origin AS:* LEVEL3 - Level 3 Parent, LLC, US (AS 3356)	2019-08-21 14:20:14		More detail
Possible Hijack	*Expected Origin AS:* GLBB-JP GLBB Japan KK, JP (AS 55900) *Detected Origin AS:* MULTIDATA-ID-AP PT Multidata Rancana Prima, ID (AS 58552)	2019-08-21 12:57:31		More detail
Outage	Fundação Carlos Chagas Filho de Amparo a Pesquisa, BR (AS 2715)	2019-08-21 12:42:00	2019-08-21 12:54:00	More detail
Outage	Assoc do Inst Nac de Matematica Pura e Aplicada, BR (AS 262829)	2019-08-21 12:42:00	2019-08-21 12:54:00	More detail
Possible Hijack	*Expected Origin AS:* LASVEGASNET-AS - LasVegas.Net LLC, US (AS 27501) *Detected Origin AS:* LIQUID-AS, GB (AS 30844)	2019-08-21 10:48:30		More detail
Possible Hijack	*Expected Origin AS:* LASVEGASNET-AS - LasVegas.Net LLC, US (AS 27501) *Detected Origin AS:* LIQUID-AS, GB (AS 30844)	2019-08-21 10:48:30		More detail

Basics - Routing Security

I know we can do better

Basics - Routing Security

You must filter your peers!

Basics - Routing Security

- Routing security is important in two directions:
  - The routes you receive
  - The routes you announce

- Starting with the routes you receive...

Basics - Routing Security

- The routes you receive can be filtered in a few ways:
  - Prefix Count
  - AS-Path
  - Prefix list
  - RPKI

Basics - Routing Security

- Prefix Count

Consider tightening up the limits
with bgp neighbor restart/graceful

Basics - Routing Security

AS-Path

BBIX peer 各位 (Dear BBIX peering partners,)

さくらインターネット(AS9371)の津田です。
いつもお世話になっております。

弊社から広報しておりますAS Pathに変更が御座います。
AS Pathでのフィルタ設定が御座います場合、設定変更をお願い致します。

AS name: SAKURA-C
AS set: AS-SAKURA
AS number: 9371

▼追加するAS Path(IPv4)
^(9371_)+(2519_)+(9354_)+(10001_)+$
^(9371_)+(9370_)+(2519_)+(9354_)+(10001_)+$

Basics - Routing Security

Prefix list per neighbor

```
ip prefix-list AS57660 permit 37.26.208.0/20
ip prefix-list AS57660 permit 185.67.16.0/22
ip prefix-list AS57660 permit 212.67.48.0/20
```

Basics - Routing Security

RPKI

Basics - Routing Security

Building filters does not have to be hard. You can script it yourself or use a tool like bgpq3. Here is an example using bgpq3 to generate a prefix list for a Juniper router:

```
walt@staff:~$ bgpq3 -J4l AS57660-IN AS57660
policy-options {
replace:
 prefix-list AS57660-IN {
    37.26.208.0/20;
    185.67.16.0/22;
    212.67.48.0/20;
 }
}
walt@staff:~$
```

IXPs using RPKI

- AMS-IX
- DE-CIX
- France-IX
- LINX
- LONAP
- Over 58 IXP today and more coming!

- **Downside is that not all networks peer on route servers**

- http://peering.exposed/

http://routing.he.net

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ROUTE FILTERING HOME ALGORITHM

AS13335

ASN	STATUS	PEERINGDB_IRR	EXTRACTED_V4	EXTRACTED_V6	OK_V4	OK_V6	SOURCE
13335	explicit	AS-CLOUDFLARE			AS-CLOUDFLARE	AS-CLOUDFLARE	peeringdb

FILTERS

AF	AS-SET NAME	IRR STATUS	IRR BUILT	IRR LINES	PREFIXES RECEIVED	FILTER BUILT	FILTER LINES	POLICY	REASONS	FILTER
4	AS-CLOUDFLARE	good	May 20 2019 13:20:28	1381	600	May 21 2019 13:19:06	600	DISPLAY	DISPLAY	DISPLAY
6	AS-CLOUDFLARE	good	May 20 2019 13:20:36	1026	224	May 21 2019 13:19:10	224	DISPLAY	DISPLAY	DISPLAY

PREFIX LISTS

AF	ROUTER	NAME	STATUS	CHECKED	EXISTING_LINES	VERIFIED	EXISTING	DELTA	LOG
4	core1.akl1.he.net	prefix-filter-as13335	updated	May 21 2019 14:28:29	606	May 21 2019 14:28:36	DISPLAY	DISPLAY	DISPLAY

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ROUTE FILTERING HOME ALGORITHM

AS13335

ASN	STATUS	PEERINGDB_IRR	EXTRACTED_V4	EXTRACTED_V6	OK_V4	OK_V6	SOURCE
13335	explicit	AS-CLOUDFLARE			AS-CLOUDFLARE	AS-CLOUDFLARE	peeringdb

FILTERS

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ROUTE FILTERING HOME ALGORITHM

AS13335

ASN	STATUS	PEERINGDB_IRR	EXTRACTED_V4	EXTRACTED_V6	OK_V4	OK_V6	SOURCE
13335	explicit	AS-CLOUDFLARE			AS-CLOUDFLARE	AS-CLOUDFLARE	peeringdb

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AS13335

ASN	STATUS	PEERINGDB_IRR	EXTRACTED_V4	EXTRACTED_V6	OK_V4	OK_V6	SOURCE
13335	explicit	AS-CLOUDFLARE			AS-CLOUDFLARE	AS-CLOUDFLARE	peeringdb

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4	core1.akl1.he.net	prefix-filter-as13335	updated	May 21 2019 14:28:29	606	May 21 2019 14:28:36	DISPLAY	DISPLAY	DISPLAY

SESSIONS

295 sessions.

SESSION STATUS IS NON REALTIME, DATA IN TABLE IS DELAYED APPROXIMATELY 24 HOURS

IP	ROUTER	STATUS	ACCEPTED	FILTERED	RECEIVED	RCVD STATUS	RCVD UPDATED	RCVD ACCEPTED	RCVD FILTERED
103.16.102.93	core1.sin1.he.net	ESTAB	0	266	DISPLAY	good	October 20 2018 01:52:05	0	266
103.231.152.33	core1.sin1.he.net	ESTAB	270	0	DISPLAY	good	October 18 2018 18:39:16	270	0
103.246.232.134	core1.osa1.he.net	ESTAB	255	0	DISPLAY	good	September 17 2018 00:07:52	255	0

```
SSH@core1.ams1.he.net>terminal length 0
sh ip bgp nei 185.1.32.22 received-routes
       There are 262 received routes from neighbor 185.1.32.22
Searching for matching routes, use ^C to quit...
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       E:EBGP H:HISTORY I:IBGP L:LOCAL M:MULTIPATH m:NOT-INSTALLED-MULTIPATH
       S:SUPPRESSED F:FILTERED s:STALE x:BEST-EXTERNAL
       Prefix              Next Hop        MED        LocPrf     Weight Status
1      1.0.0.0/24          185.1.32.22                100        0      ME
         AS_PATH: 13335
2      1.1.1.0/24          185.1.32.22                100        0      ME
         AS_PATH: 13335
3      23.227.63.0/24      185.1.32.22                100        0      ME
         AS_PATH: 13335
4      64.68.192.0/24      185.1.32.22                100        0      ME
         AS_PATH: 13335
5      66.235.200.0/24     185.1.32.22                100        0      EF
         AS_PATH: 13335
6      104.16.0.0/12       185.1.32.22                100        0      ME
         AS_PATH: 13335
7      104.16.0.0/20       185.1.32.22                100        0      ME
```

```
SSH@core1.ams1.he.net>terminal length 0
sh ip bgp nei 185.1.32.22 received-routes
       There are 262 received routes from neighbor 185.1.32.22
Searching for matching routes, use ^C to quit...
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       E:EBGP H:HISTORY I:IBGP L:LOCAL M:MULTIPATH m:NOT-INSTALLED-MULTIPATH
       S:SUPPRESSED F:FILTERED s:STALE x:BEST-EXTERNAL
       Prefix              Next Hop        MED         LocPrf      Weight Status
1      1.0.0.0/24          185.1.32.22                 100         0      ME
         AS_PATH: 13335
2      1.1.1.0/24          185.1.32.22                 100         0      ME
         AS_PATH: 13335
3      23.227.63.0/24      185.1.32.22                 100         0      ME
         AS_PATH: 13335
4      64.68.192.0/24      185.1.32.22                 100         0      ME
         AS_PATH: 13335
5      66.235.200.0/24     185.1.32.22                 100         0      EF
         AS_PATH: 13335
6      104.16.0.0/12       185.1.32.22                 100         0      ME
         AS_PATH: 13335
7      104.16.0.0/20       185.1.32.22                 100         0      ME
```

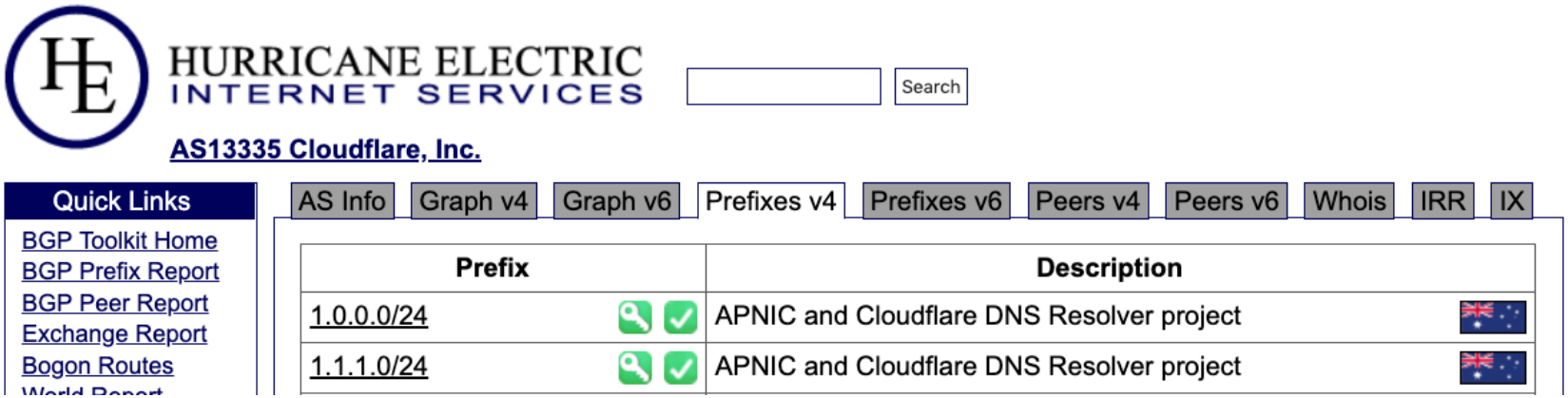
```
Toms-MacBook-Pro-38:Downloads tom$ whois -h whois.radb.net 66.235.200.0
route:      66.235.200.0/24
descr:      CMI  (Customer Route)
origin:     AS38082
mnt-by:     MAINT-AS58453
changed:    qas_support@cmi.chinamobile.com 20180906
source:     RADB

route:      66.235.200.0/24
descr:      CMI IP Transit
origin:     AS38082
admin-c:    MAINT-CMI-INT-HK
tech-c:     MAINT-CMI-INT-HK
mnt-by:     MAINT-CMI-INT-HK
changed:    qas_support@cmi.chinamobile.com 20180906
source:     NTTCOM
```

Hurricane Electric Route Filtering Algorithm

- Read more here
  http://routing.he.net/algorithm.html

- Example:
- xx.7.224.0/24,rejected,does not strictly match IRR policy or RIR handles
- xx.10.254.0/23,accepted,strictly matched IRR policy
- xx.17.248.0/24,accepted,strictly matched IRR policy
- xx.26.36.0/22,rejected,does not strictly match IRR policy or RIR handles
- xx.26.39.0/24,rejected,does not strictly match IRR policy or RIR handles

Update your ROA/IRR



ROA Signed and Valid

ROA Signed and Invalid

IRR Valid

IRR Match - Parent Entry Found

IRR Invalid

Resources

- https://www.seattleix.net/faq
- https://twitter.com/bgpstream/status/1078584924364595202?lang=en
- https://bgp.he.net
- https://routing.he.net
- https://github.com/snar/bgpq3
- https://bgpmon.net/
- https://bgpstream.com/
- https://bgpmon.net/
- http://peering.exposed/

HURRICANE ELECTRIC
INTERNET SERVICES

Thanks!

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