The impact of an RPKI validator in Bangladesh and Lessons Learned

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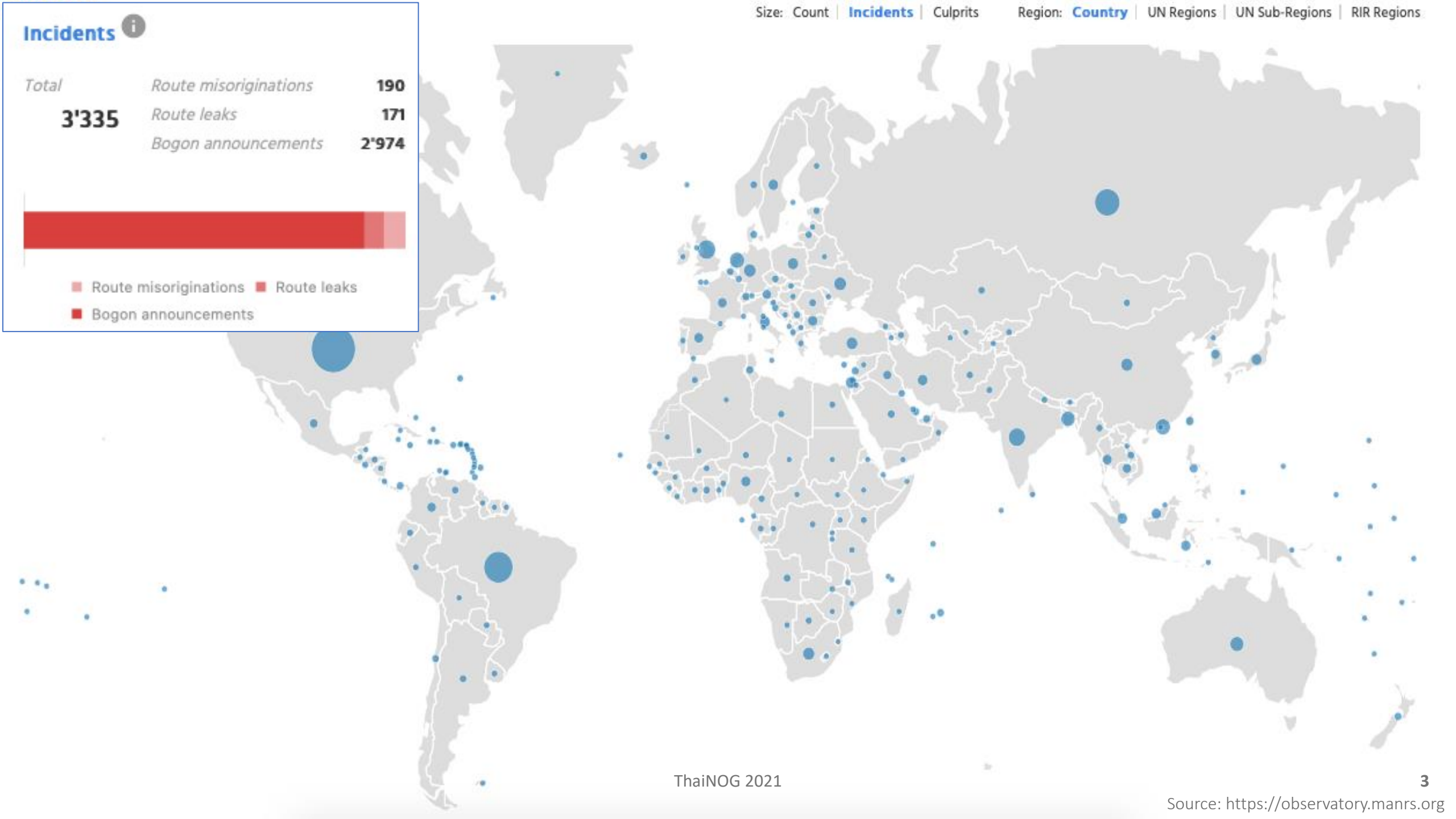
#ThaiNOG
May 14, 2021

Image source: Internet

Starting with some routing incidents…



Source: https://observatory.manrs.org

- A Prefix is announced by both AS 134599 and AS 133957 (might be unintentional)
- Either AS cloud be closest to different geographic locations
- Legitimate traffic might get blackholed

	Announced By
Origin AS	Announcement
AS134599	45.118.70.0/24 ✅
AS133957	45.118.70.0/24 ✅

```
route-views>show ip bgp 45.118.70.0/24 | i 133957
  3277 3267 174 58601 138197 138197 138197 138197 138197 133957
  24441 3491 3491 3257 58601 138197 138197 138197 138197 138197 133957
  3561 209 174 58601 138197 138197 138197 138197 138197 133957
  20912 174 58601 138197 138197 138197 138197 138197 133957
  852 174 58601 138197 138197 138197 138197 138197 133957
  101 101 174 58601 138197 138197 138197 138197 138197 133957
  3267 174 58601 138197 138197 138197 138197 138197 133957
  3303 3257 58601 138197 138197 138197 138197 138197 133957
  54728 20130 23352 3257 58601 138197 138197 138197 138197 138197 133957
```

```
route-views>show ip bgp 45.118.70.0/24 | i 134599
  8283 6762 132602 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599 134599
  6939 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599 134599
  7018 2914 132602 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599 134599
  1403 1299 2914 132602 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599
  1403 1299 2914 132602 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599
  1351 6939 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599
  286 6762 132602 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599 134599
  57866 6762 132602 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599 134599
  4826 58717 135341 135341 135341 135341 134599 134599 134599 134599 134599 134599 134599 134599 134599 134599
```

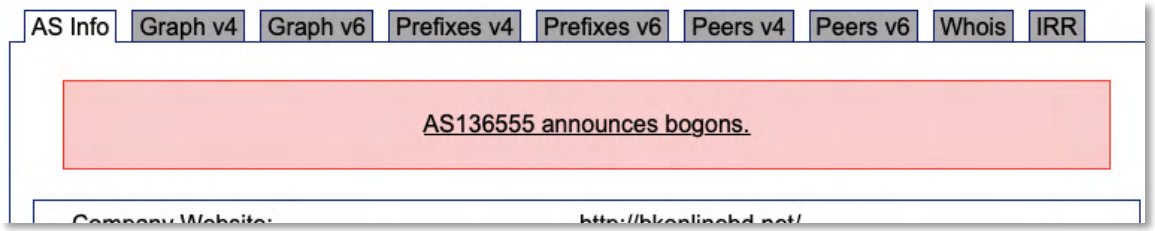
- Issue informed to the IP owner.
- They removed one announcement
- Created ROA for valid ASN
- Valid announcement visible in the global routing table

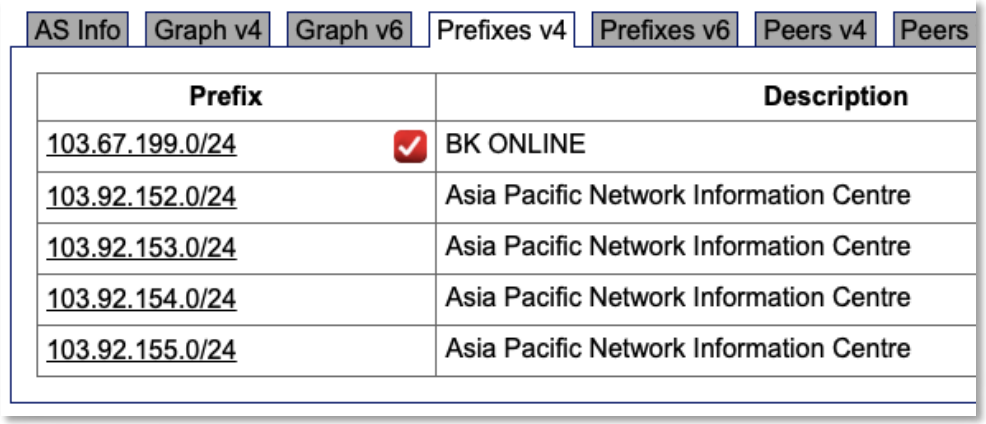
	Announced By
Origin AS	Announcement
AS133957	45.118.70.0/24

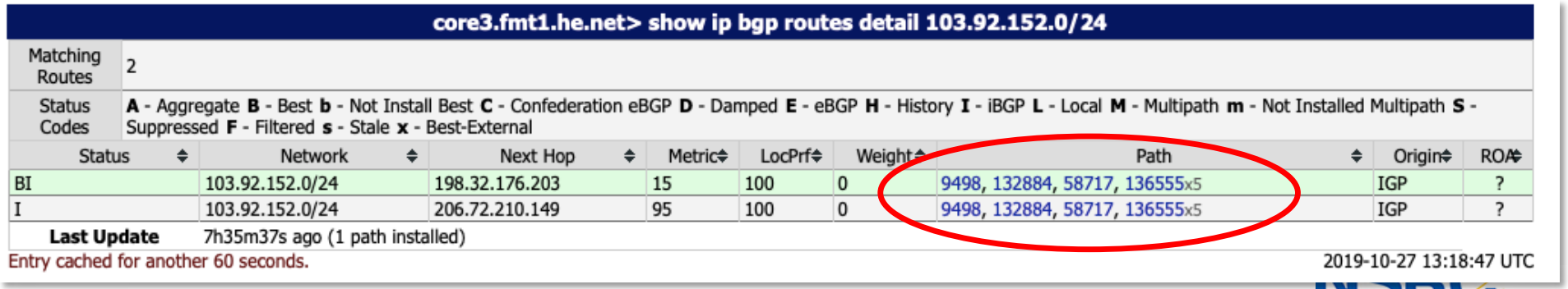
```
route-views>show ip bgp 45.118.70.0/24 | i 133957
  3277 3267 174 58601 138197 138197 138197 138197 138197 133957
  24441 3491 3491 3257 58601 138197 138197 138197 138197 138197 133957
  3561 209 174 58601 138197 138197 138197 138197 138197 133957
  20912 174 58601 138197 138197 138197 138197 138197 133957
  852 174 58601 138197 138197 138197 138197 138197 133957
  101 101 174 58601 138197 138197 138197 138197 138197 133957
  3267 174 58601 138197 138197 138197 138197 138197 133957
  3303 3257 58601 138197 138197 138197 138197 138197 133957
  54728 20130 23352 3257 58601 138197 138197 138197 138197 138197 133957
```

```
route-views>sho ip bgp 45.118.70.0/24 | i 134599
route-views>
```

- Client AS didn’t update APNIC membership
- Shouldn’t have valid prefix allocation with revoked membership
- Transit still announces client’s prefixes
- Prefixes marked as BOGON in global routing table







- The issue has been informed to the transit provider
- Then, they dropped it
- The announcement was removed from global table
- Later on, the AS got membership renewed and has its allocated prefixes back for use

```
route-views>show ip bgp 103.92.152.0/24
% Network not in table
route-views>show ip bgp 103.92.153.0/24
% Network not in table
route-views>show ip bgp 103.92.154.0/24
% Network not in table
route-views>show ip bgp 103.92.155.0/24
% Network not in table
```

Prefix	
103.67.199.0/24	BK ONLINE
103.92.152.0/24	BK ONLINE
103.92.153.0/24	BK ONLINE
103.92.154.0/24	BK ONLINE
103.92.155.0/24	BK ONLINE

- 103.204.210.0/24 was delegated by AS 64075 to AS 137842
- AS 137842 announced the prefix
- AS 64075 is also announcing its delegated prefixes as AS 137842 (AS Hijack)
- It's upstream accepting it and further announcing it globally
- The issue has been informed to them and got fixed

	Announced By
Origin AS	**Announcement**
AS137842	103.204.210.0/24
AS64075	103.204.210.0/24

AS137842 MH ONLINE

nks
Home
Report
eport
eport
es
t
Routes

AS Info | Graph v4 | Prefixes v4 | Peers v4 | Whois | IRR

Rank	Description
1	BDCOM
2	CIRCLE NETWORK BANGLADESH

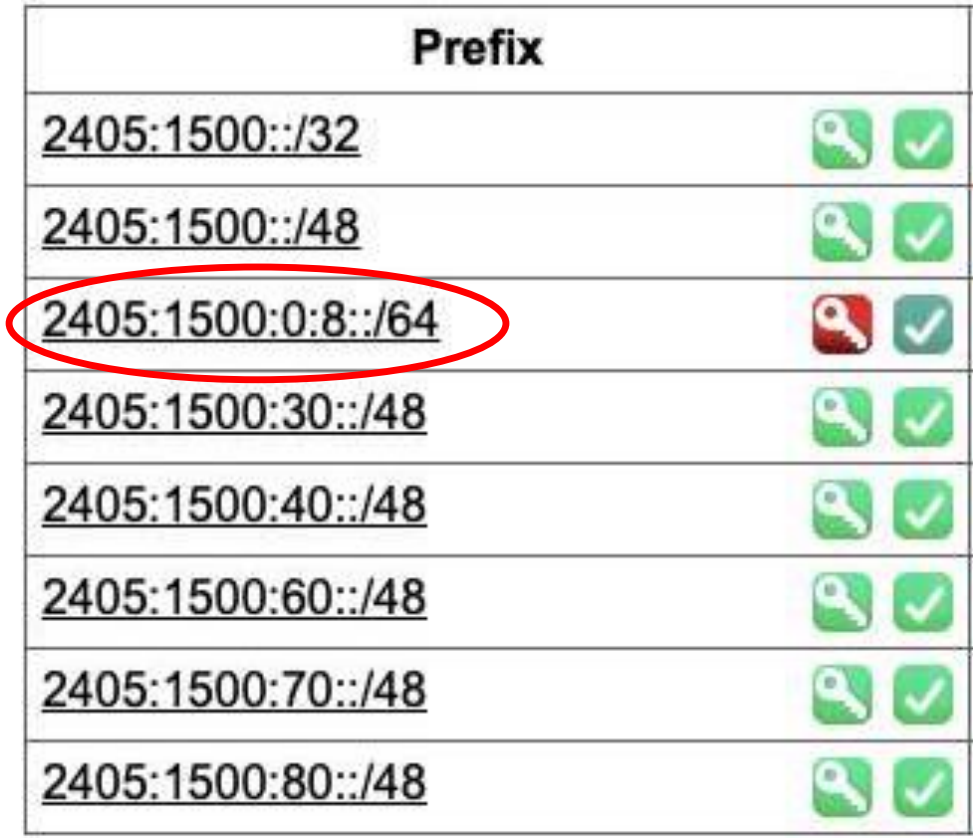
core1.sin1.he.net> show ip bgp routes detail 202.181.16.0/24

Matching Routes	10
Status Codes	**A** - Aggregate **B** - Best **b** - Not Install Best **C** - Confederation 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

Status	Network	Next Hop	Metric	LocPrf	Weight	Path	Origin	ROA
BEx	202.181.16.0/24	74.82.51.74	0	140	0	132602, 10075, 134371, 137842	IGP	
E	202.181.16.0/24	27.111.228.140	0	100	0	10075, 134371, 137842	IGP	
E	202.181.16.0/24	27.111.228.140	0	100	0	10075, 134371, 137842	IGP	
E	202.181.16.0/24	27.111.228.140	0	100	0	10075, 134371, 137842	IGP	
E	202.181.16.0/24	27.111.228.40	0	100	0	9498, 10075, 134371, 137842	IGP	
E	202.181.16.0/24	27.111.229.76	0	100	0	132602, 10075, 134371, 137842	IGP	
E	202.181.16.0/24	65.49.109.182	0	100	0	9498, 10075, 134371, 137842	IGP	
E	202.181.16.0/24	27.111.228.111	0	100	0	6762, 132602, 10075, 134371, 137842	IGP	
E	202.181.16.0/24	74.82.48.70	0	100	0	3491, 9498, 10075, 134371, 137842	IGP	
E	202.181.16.0/24	216.218.221.142	0	100	0	4637, 9498, 10075, 134371, 137842	IGP	

Last Update 4d5h31m58s ago (1 path installed)
Entry cached for another 60 seconds.
2019-10-24 13:20:23 UTC

- A /64 IPv6 prefix announced in global routing table
- Most specific announcement in global table is /48
- A /64 should never be in global routing table



Prefix
2405:1500::/32
2405:1500::/48
2405:1500:0:8::/64
2405:1500:30::/48
2405:1500:40::/48
2405:1500:60::/48
2405:1500:70::/48
2405:1500:80::/48

- The issue was informed to the AS
- The announcement has been removed

Prefix
2405:1500::/32
2405:1500::/48
2405:1500:30::/48
2405:1500:40::/48
2405:1500:60::/48
2405:1500:70::/48
2405:1500:80::/48

Somebody is announcing non-routable prefixes in the global BGP table.

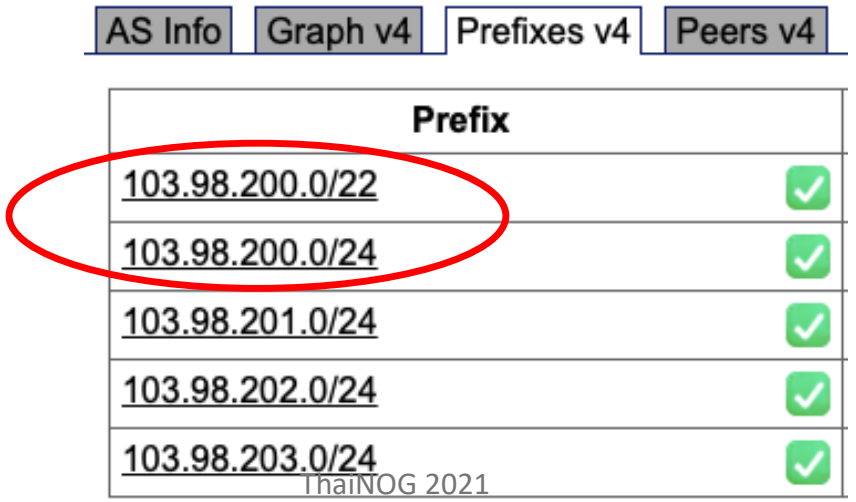
Prefix
103.82.232.0/24
103.96.230.0/23
103.96.232.0/24
123.253.228.0/22
172.18.3.0/24

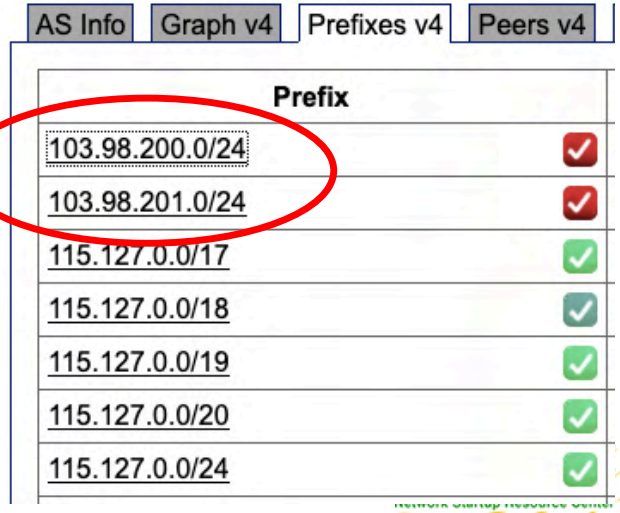
Prefix
103.82.232.0/24
103.96.230.0/23
103.96.232.0/24
123.253.228.0/22

The announcement has been removed once the issue was informed to them

- AS 136909 used to take transit via AS 24342 using static routing.
- AS 24342 announced prefixes of AS 136909 in global BGP table on their behalf.
- Later, AS 136909 stated doing BGP but AS 24342 still didn't stop the announcement.

```
route-views>sh ip bgp 103.98.200.0/24 | i 24342
  49788 12552 4637 9498 58601 24342 24342 24342 24342 24342 24342 24342
  3303 2914 58601 24342 24342 24342 24342 24342 24342
  3561 209 3356 2914 58601 24342 24342 24342 24342 24342 24342
  3267 3356 2914 58601 24342 24342 24342 24342 24342 24342
  24441 3491 3491 9498 58601 24342 24342 24342 24342 24342 24342
  3277 3267 3356 2914 58601 24342 24342 24342 24342 24342 24342
  20912 174 9498 58601 24342 24342 24342 24342 24342 24342
  852 3491 9498 58601 24342 24342 24342 24342 24342 24342
  6939 58601 24342 24342 24342 24342 24342 24342
  101 101 11164 7473 9498 58601 24342 24342 24342 24342 24342 24342
  1351 6939 58601 24342 24342 24342 24342 24342 24342
  54728 20130 6939 58601 24342 24342 24342 24342 24342 24342
  3257 7473 9498 58601 24342 24342 24342 24342 24342 24342
  3333 1273 2914 58601 24342 24342 24342 24342 24342 24342
  6079 4637 9498 58601 24342 24342 24342 24342 24342 24342
  701 2914 58601 24342 24342 24342 24342 24342 24342
  1239 2914 58601 24342 24342 24342 24342 24342 24342
  3549 3356 6453 58601 24342 24342 24342 24342 24342 24342
  1221 4637 9498 58601 24342 24342 24342 24342 24342 24342
  4901 6079 4637 9498 58601 24342 24342 24342 24342 24342 24342
  4826 1221 4637 9498 58601 24342 24342 24342 24342 24342 24342
  53767 174 174 9498 58601 24342 24342 24342 24342 24342 24342
  2497 2914 58601 24342 24342 24342 24342 24342 24342
```





- AS 24342 has been informed to stop announcing client's prefixes
- Client AS 136909 has signed their prefixes
- Issue resolved.

```
route-views>show ip bgp 103.98.200.0/24 | i 24342
  7660 2516 6453 58601 24342 24342 24342 136909
  286 6453 58601 24342 24342 24342 136909
  852 3491 9498 58601 24342 24342 24342 136909
  6079 4637 9498 58601 24342 24342 24342 136909
  1351 9498 58601 24342 24342 24342 136909
  54728 20130 6939 58601 24342 24342 24342 136909
  3333 1257 6453 58601 24342 24342 24342 136909
  3267 6461 7473 17494 58601 24342 24342 24342 136909
  1403 6453 58601 24342 24342 24342 136909
  1403 6453 58601 24342 24342 24342 136909
  8283 6453 58601 24342 24342 24342 136909
  57866 6461 7473 17494 58601 24342 24342 24342 136909
  49788 12552 9498 58601 24342 24342 24342 136909
  3277 3267 6461 7473 17494 58601 24342 24342 24342 136909
```

AS Info | Graph v4 | Prefixes v4 | Peers v4

Prefix
103.98.200.0/22
103.98.200.0/24
103.98.201.0/24
103.98.202.0/24
103.98.203.0/24

AS Info | Graph v4 | Prefixes v4 | Peers v4 | Whois

Prefix
115.127.0.0/17
115.127.0.0/18
115.127.0.0/19
115.127.0.0/20
115.127.0.0/24
115.127.1.0/24
115.127.2.0/24
115.127.3.0/24
115.127.4.0/24

- AS 136901 got an allocation of /22.
- They announce part of its prefix (not the whole), e.g. /23 is announced but the other /23 is not.
- Opportunists can try to use the unannounced /23 for unauthorized activities.

Prefix	
103.98.64.0/24	✅
103.98.65.0/24	✅

```
awal@Awals-MacBook-Air ~> whois -h whois.radb.net 103.98.64.0/22
route:          103.98.64.0/22
origin:         AS136901
```

- AS 137515 announced BCC's prefix 103.48.17.0/24 to BDIX (Prefix hijack)
- Important government services became unavailable to the citizens
- Costs our time to fix.

AS Info | Graph v4 | Graph v6 | Prefixes v4 | Prefixes v6 | Peers v4 | Peers v6 | Whois | IRR

Prefix	Description
43.229.12.0/22	Bangladesh Computer Council
43.229.15.0/24	Bangladesh Computer Council
103.48.16.0/22	Bangladesh Computer Council
114.130.54.0/23	Bangladesh Computer Council
114.130.116.0/22	Bangladesh Computer Council
180.211.213.0/24	Bangladesh Computer Council

```
inet.0: 801403 destinations, 6284521 routes (787268 active, 0 holddown, 3604693 hidden)
+ = Active Route, - = Last Active, * = Both

103.48.17.0/24      *[BGP/170] 00:01:34, localpref 100
                       AS path: 132602 56032 137515 I, validation-state: unverified
                     > to 103.16.155.45 via et-0/0/1.517
                     [BGP/170] 00:01:13, localpref 100
                       AS path: 132602 56032 137515 I, validation-state: unverified
                     > to 103.16.155.41 via et-0/0/2.520
                     [BGP/170] 00:01:34, localpref 100
                       AS path: 132602 56032 137515 I, validation-state: unverified
                     > to 163.47.83.29 via et-0/0/3.73
```

What they reply about it? Funny but they really did

- We mistakenly announced the prefix
- We do not manually check our clients' APNIC membership status
- The client is very trustworthy, so we never required to check their announcements
- We don't do prefix or AS filtering for our clients
- Forgot to stop announcing the prefix after it's delegated to another AS

Image source: Internet

How we ensure the routing hygiene manually?

Nightmare…

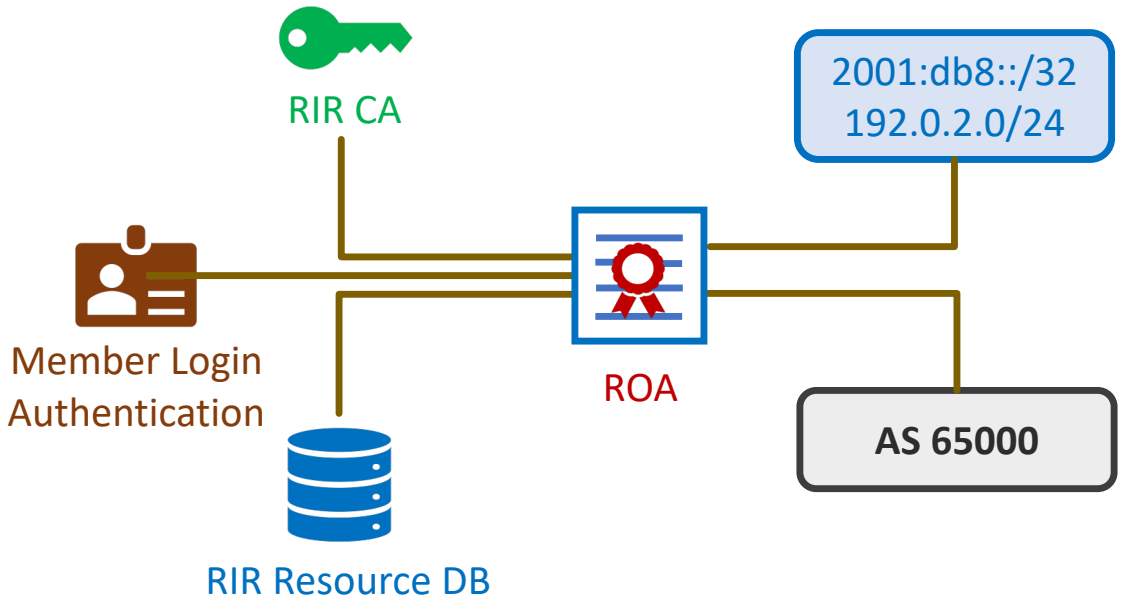
Image source: Internet

Image source: Internet

RPKI is about 2 things: ROA and ROV

1 Signing prefixes

a.k.a. creating ROAs



Route	Origin AS	ROA status	Whois status
103.48.16.0/22	AS63932	✓	✓
2401:ED80::/32	AS63932	✓	✓
43.229.12.0/22	AS63932	✓	✓
43.229.15.0/24	AS63932	✓	✓

RPKI is about 2 things: ROA and ROV

2 Validating ROAs

a.k.a doing ROV


```
RPKI server is 172.20.22.4, port 3323
RPKI current state: Established, Age: 01m46s
  Local host: 172.19.19.1, Local port: 60462
  Remote host: 172.20.22.4, Remote port: 3323
Refresh time : 900
Aging time : 1800
Session ID : 59791
Serial number : 10
Session Statistics:
  IPv4 record : 98101
  IPv6 record : 16506
```

```
RPKI validation codes: V - valid, I - invalid, N - not-found

Total Number of Routes: 1005452
      Network            NextHop                MED

*>   V 1.0.0.0/24        103.9.114.161
*    V                   114.130.31.5
*>   N 1.0.4.0/22        103.9.114.161
*>   N 1.0.4.0/24        103.9.114.161
*>   N 1.0.5.0/24        103.9.114.161
*>   N 1.0.6.0/24        103.9.114.161
*>   N 1.0.7.0/24        103.9.114.161
*>   N 1.0.16.0/24       103.9.114.161
*>   N 1.0.64.0/18       103.9.114.161
```

Why Create ROA?

	Announced By
Origin AS	Announcement
AS134599	45.118.70.0/24
AS133957	45.118.70.0/24

To ensure the authenticity of your IP resources and help others verify it if requires

So that your IP resources are not knowingly or unknowingly used or abused by anyone

Why Deploy ROV?

To build and maintain a secure and trustworthy global routing infrastructure

To validate BGP routes and identify the authorized originator of the prefix

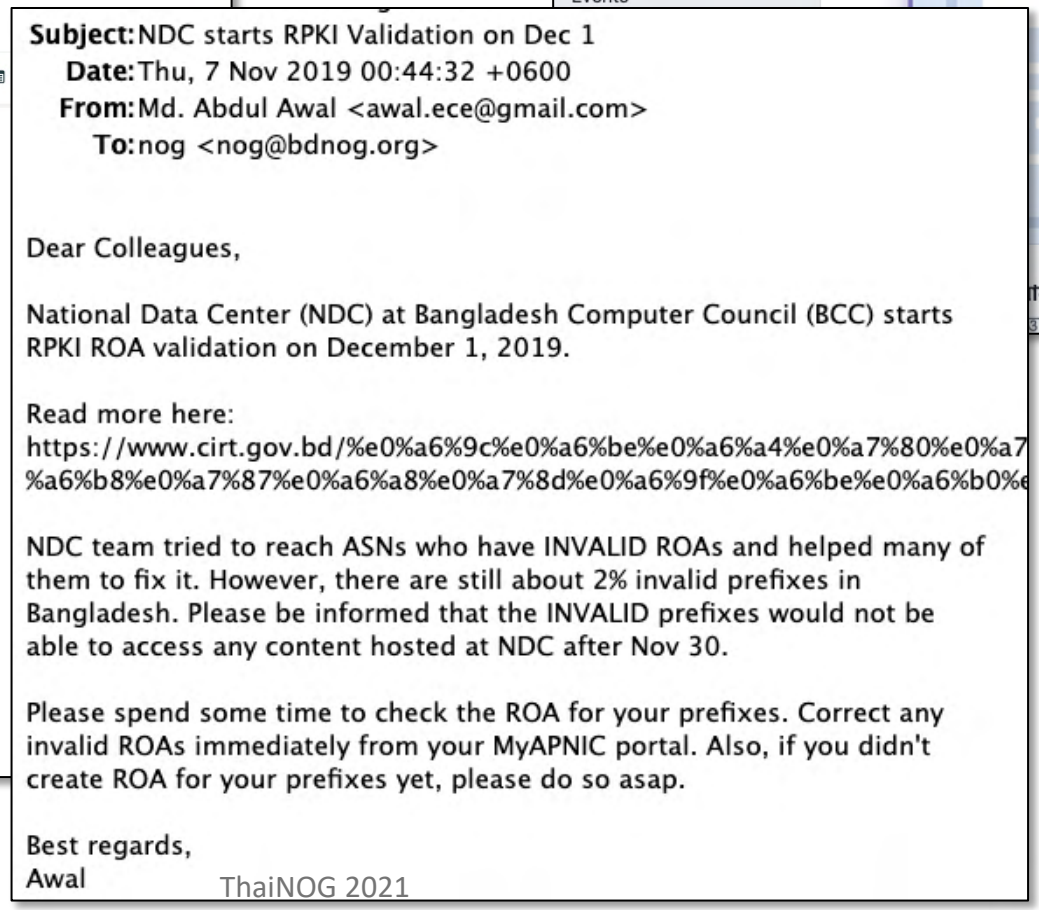
Image source: Internet

RPKI Validation in NDC and subsequent impact

RPKI Validation at National Data Center

- NDC declared to drop invalids since Dec 1, 2019
- Bangladesh has more than 800 active ASN
- BD ROA stats in Sep 2019:
  - Valid – 29%
  - Unknown – 69%
  - Invalid – 2%
- Need to find out ASNs who are getting impact
  - BD ASNs are easy to reach for obvious reason
  - How about the global ASNs?

Awareness Before the ROV



Awareness Before the ROV

- We helped others to create and/or fix their ROAs
  - LEAs, Police, Special forces
  - Govt. Organizations
  - IXPs
  - Banks and Financial Organizations
  - Transit providers
  - ISPs
  - Data Centers

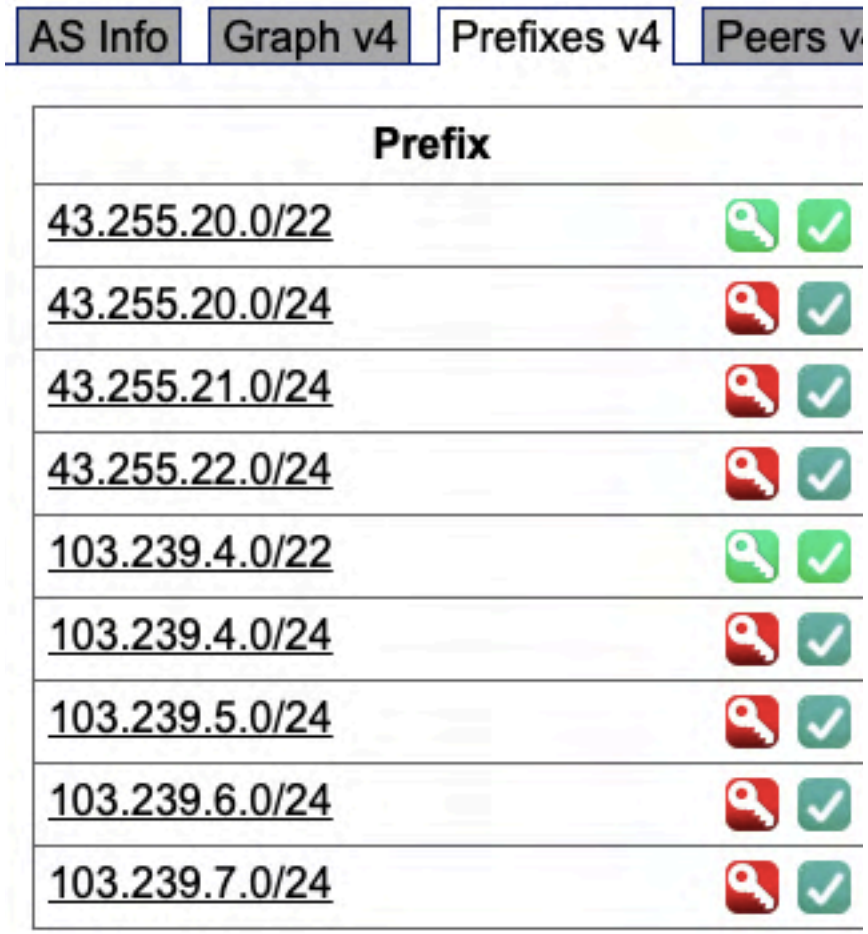
The impact of awareness campaign

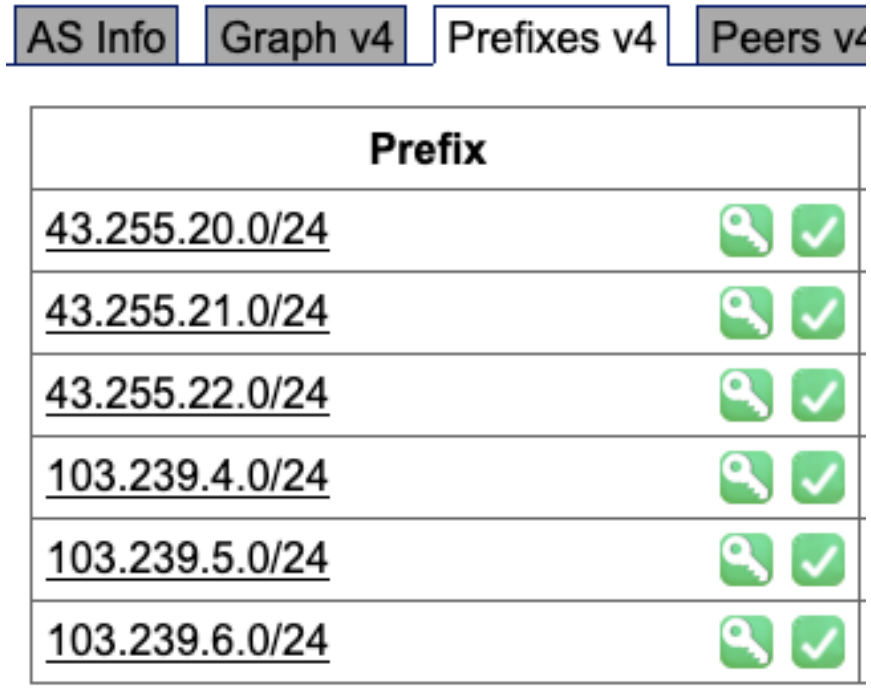
Prefix
123.49.0.0/18
123.49.14.0/24
123.49.16.0/20
123.49.29.0/24
123.49.30.0/24
123.49.31.0/24
123.49.47.0/24
180.211.128.0/17
180.211.201.0/24
180.211.214.0/24
180.211.215.0/24
203.112.192.0/19
203.112.194.0/24
209.58.24.0/24

Prefix
123.49.0.0/18
123.49.14.0/24
123.49.16.0/20
123.49.29.0/24
123.49.30.0/24
123.49.31.0/24
123.49.47.0/24
180.211.128.0/17
180.211.201.0/24
180.211.214.0/24
180.211.215.0/24
203.112.192.0/19
203.112.194.0/24

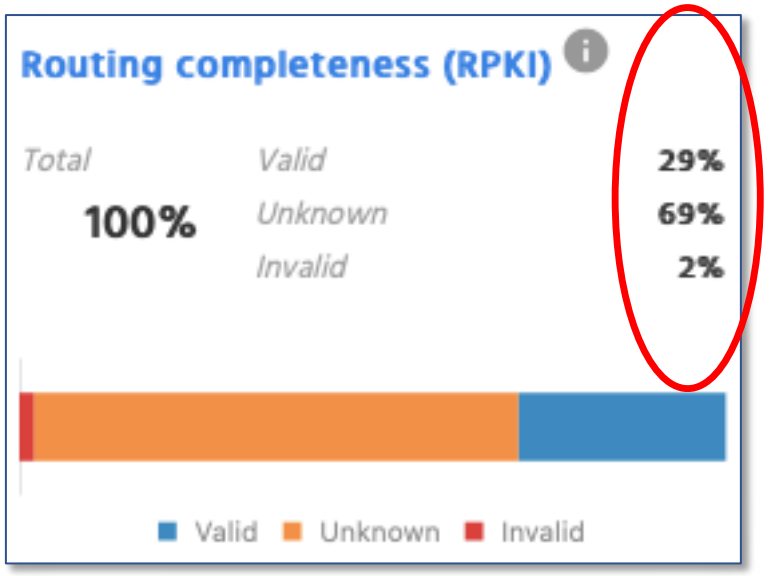
Source: https://bgp.he.net

The impact of awareness campaign

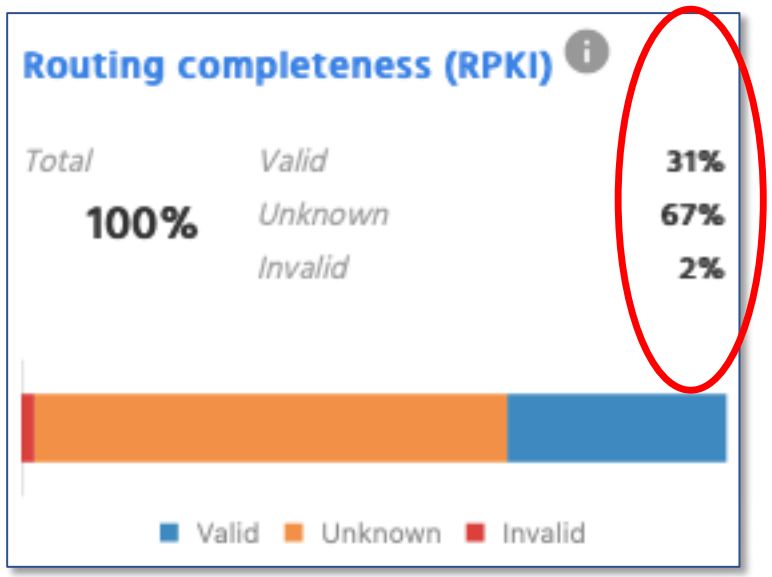




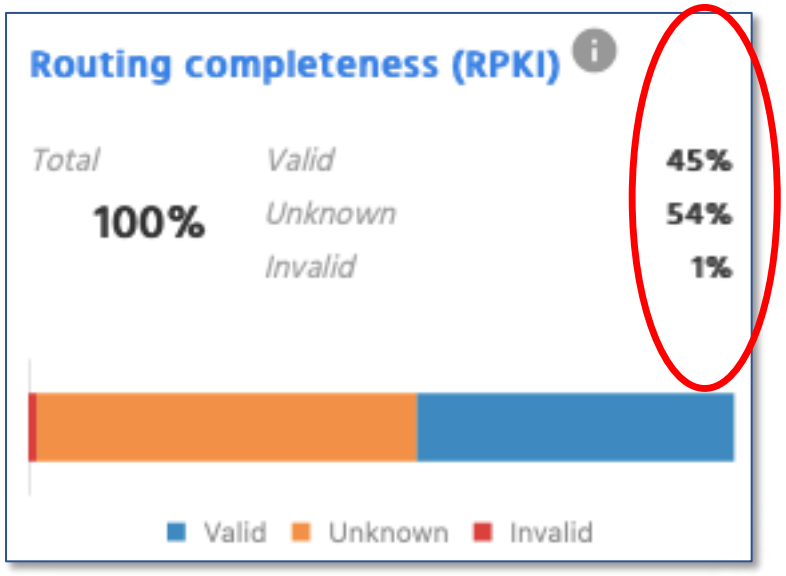
The impact of awareness campaign



Sep 2019



Oct 2019

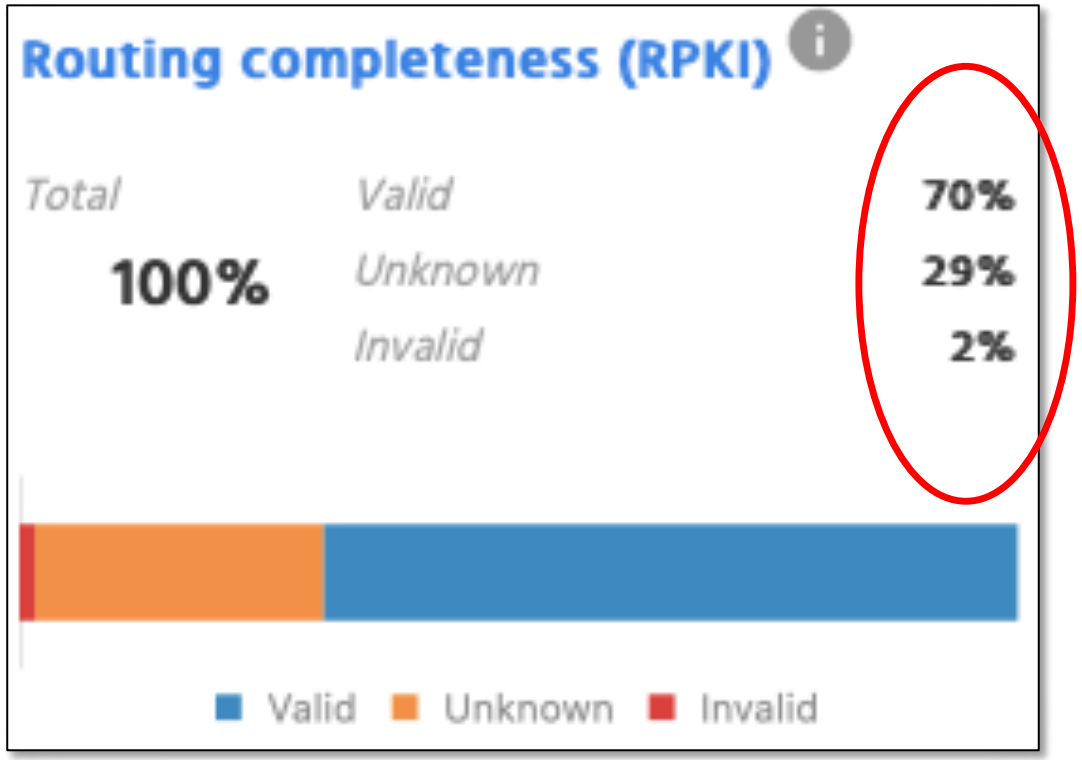


Nov 2019

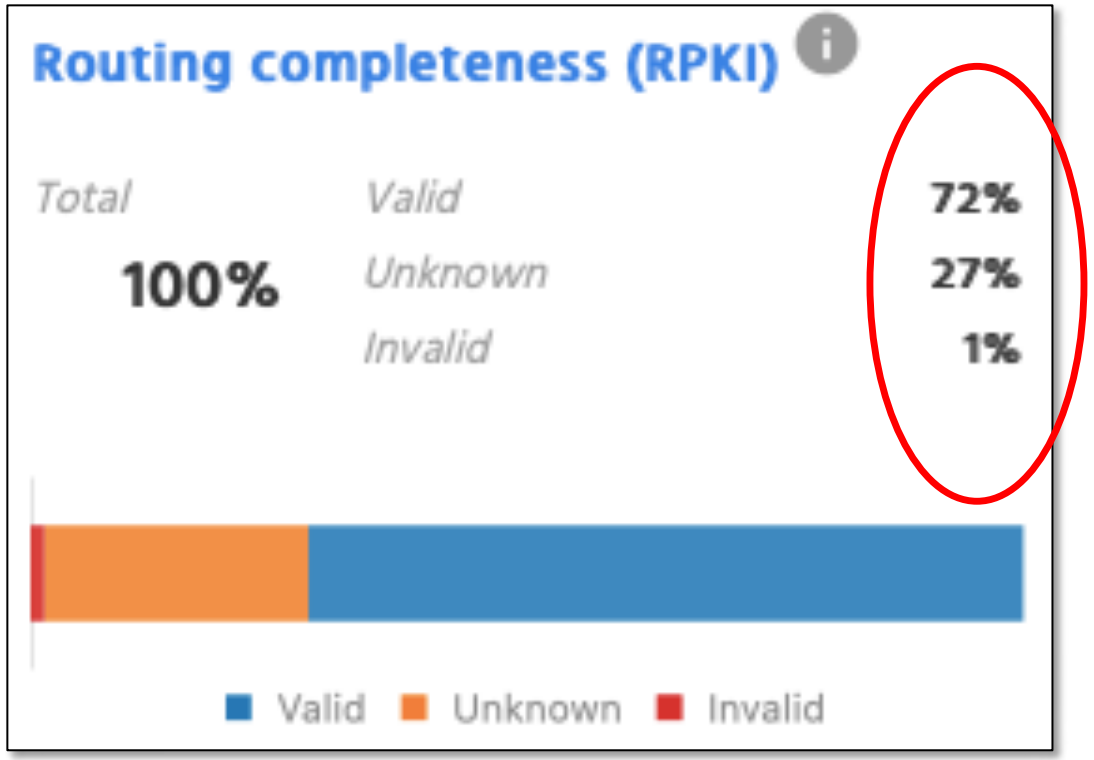
Source: https://observatory.manrs.org

And, finally NDC drops invalids since Dec 1, 2019

The impact of awareness campaign



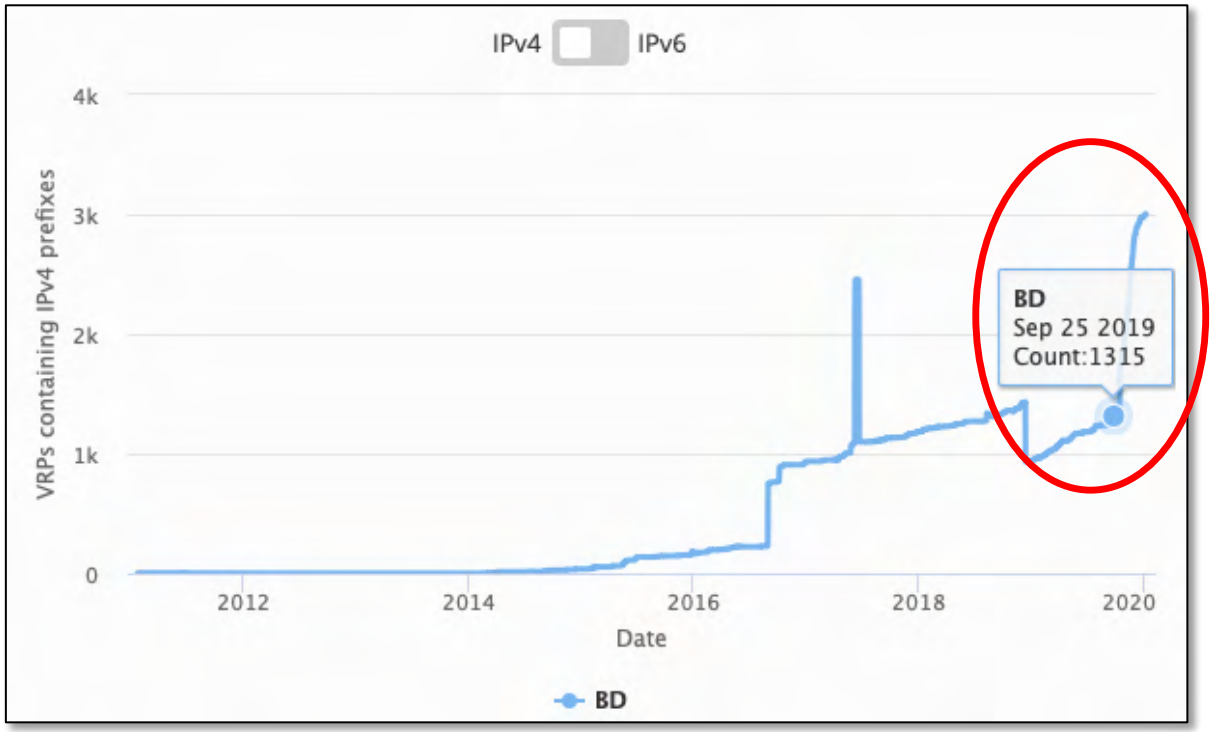
Dec 2019

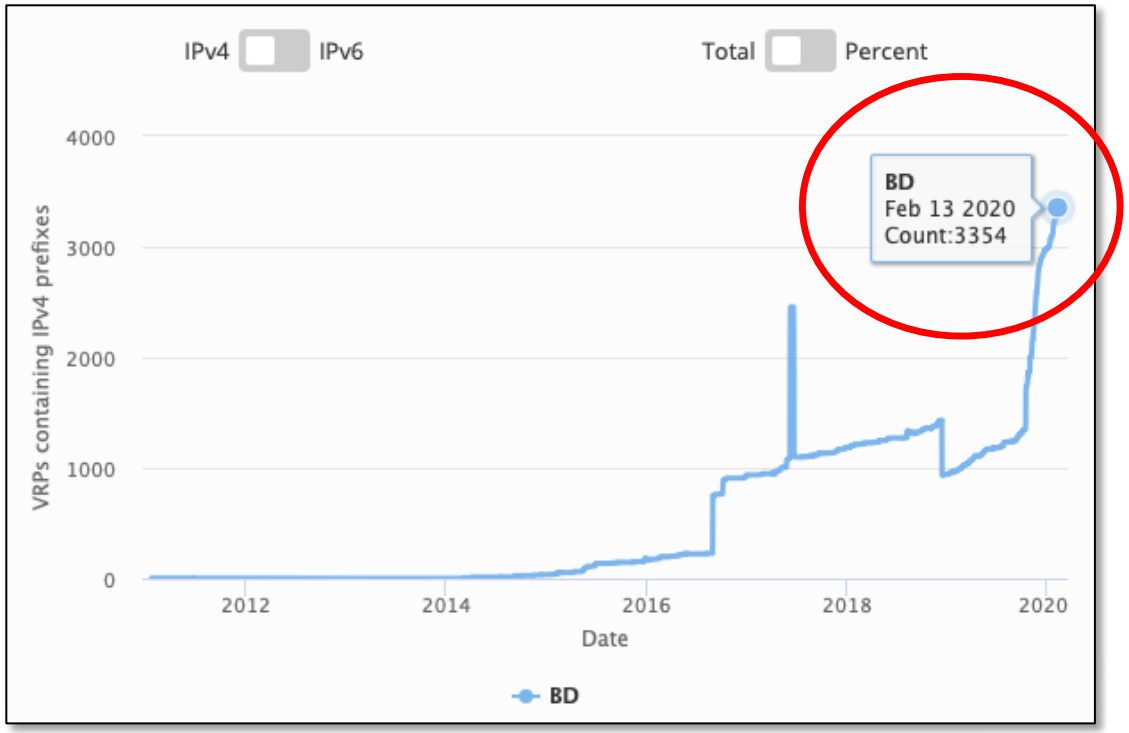


Jan 2020

Source: https://observatory.manrs.org

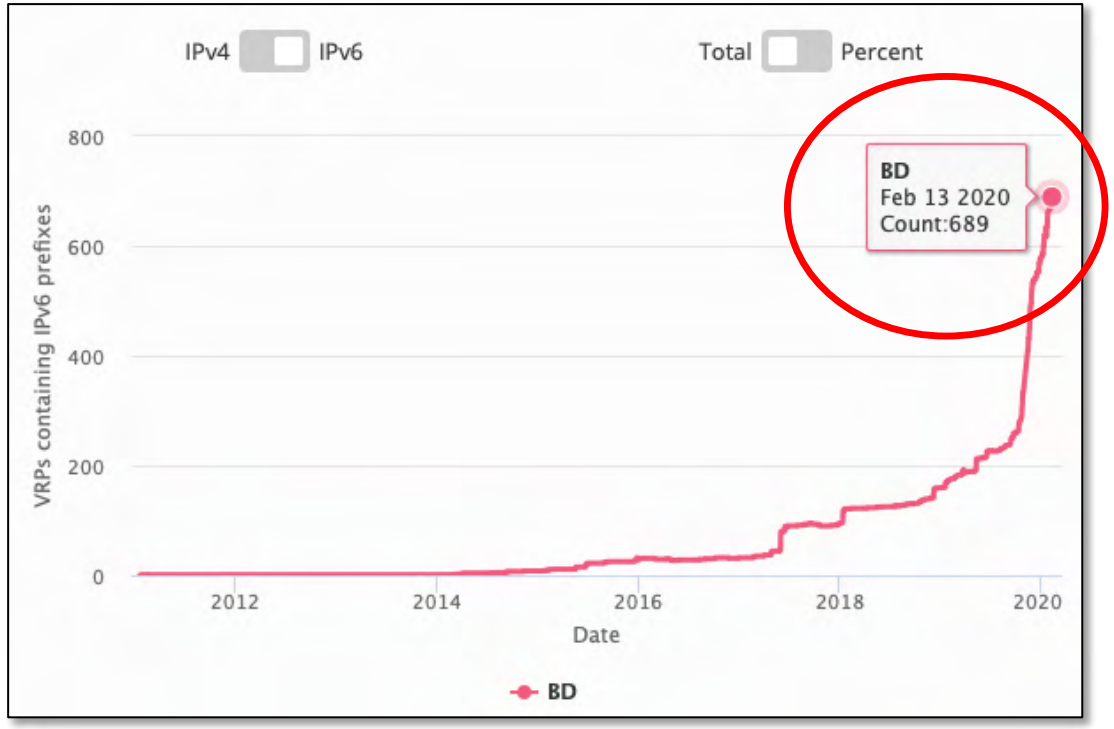
The impact of awareness campaign





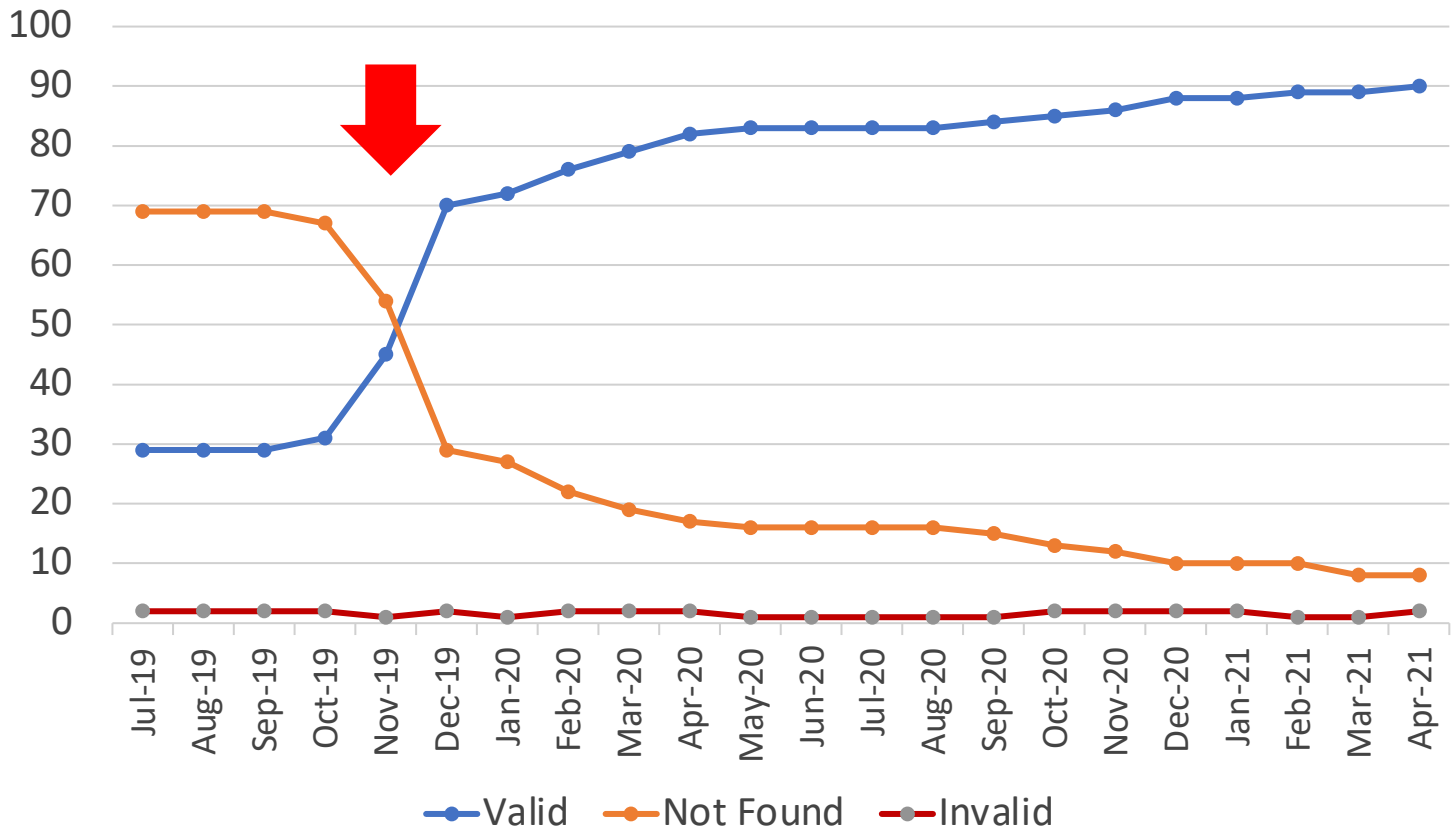
Source: https://stat.ripe.net/BD#tabId=routing

The impact of awareness campaign



Source: https://stat.ripe.net/BD#tabId=routing

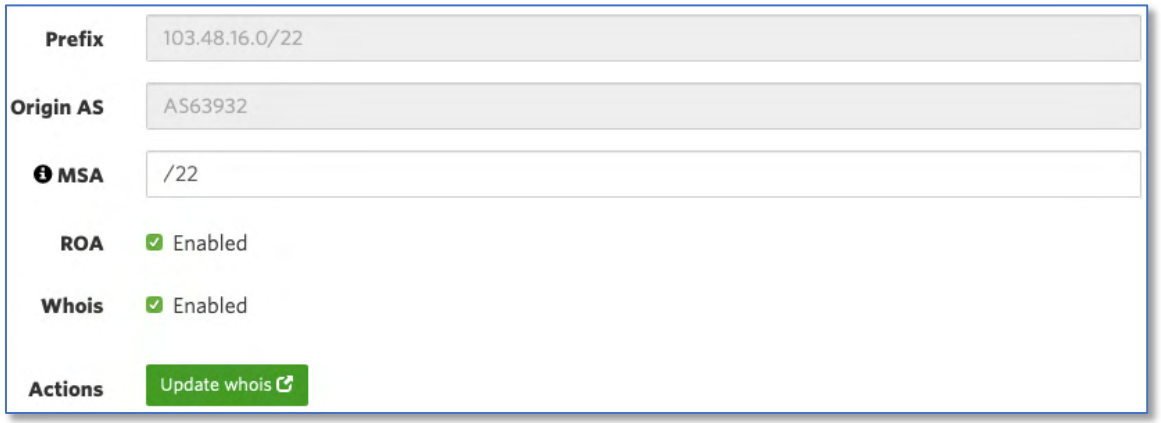
RPKI ROA Adoption in BD



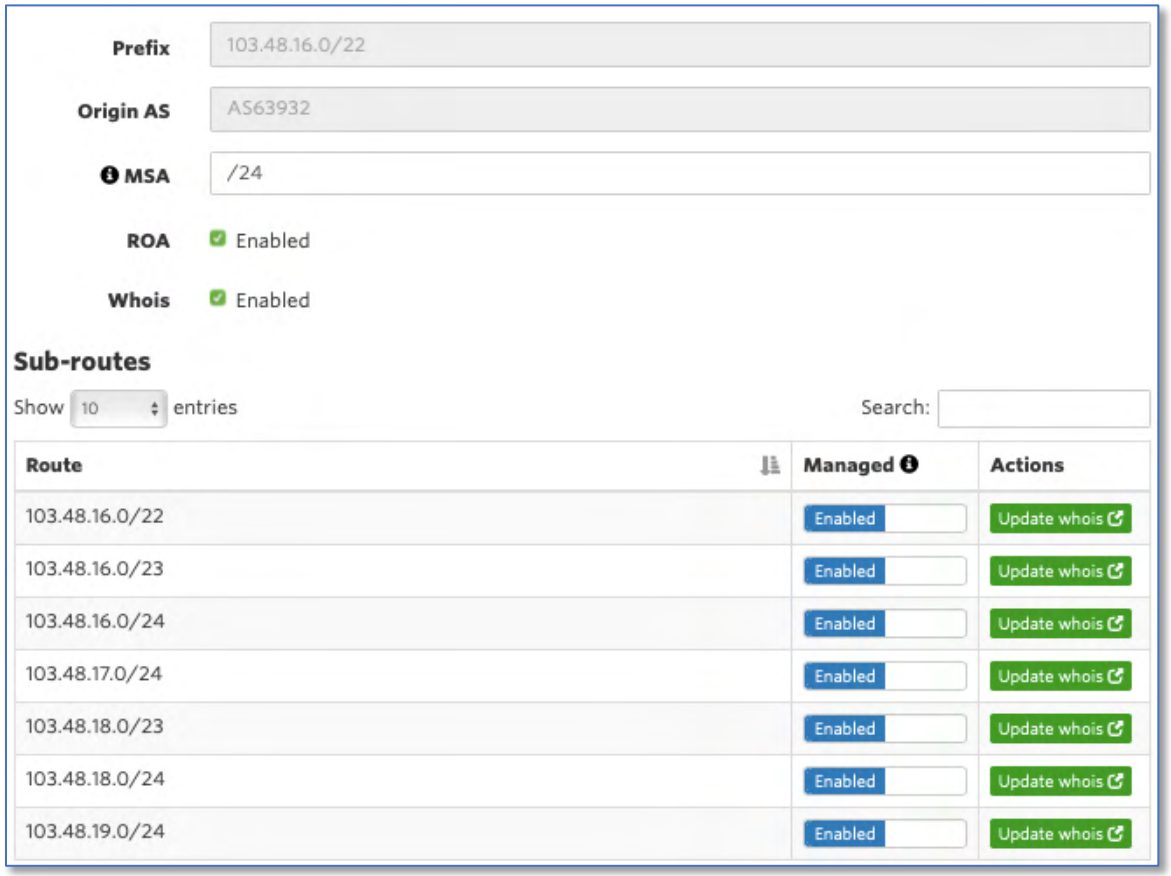
Source: https://observatory.manrs.org

Considerations about ROA and ROV

Creating ROA



VS



- Not a good idea to create ROAs up to /24 if not announced in BGP
- Better to create ROAs for specific prefixes that are announced in BGP

Creating ROA

```
awal@Awals-MacBook-Air ~> whois -h whois.bgpmon.net " --roa 17494 103.110.212.0/22"
0 - Valid
-----------------------
ROA Details
-----------------------
Origin ASN:       AS17494
Not valid Before: 2019-11-12 05:41:59
Not valid After:  2020-10-31 00:00:00  Expires in 323d5h27m43s
Trust Anchor:     rpki.apnic.net
Prefixes:         2407:5000:88::/48 (max length /48)
                  203.112.192.0/19 (max length /24)
                  2407:5000::/32 (max length /40)
                  103.110.212.0/22 (max length /24)
                  123.49.0.0/18 (max length /24)
                  180.211.128.0/17 (max length /24)
awal@Awals-MacBook-Air ~> whois -h whois.bgpmon.net " --roa 45588 103.110.212.0/22"
2 - Not Valid: Invalid Origin ASN, expected 17494
```

VS

```
awal@Awals-MacBook-Air ~> whois -h whois.bgpmon.net " --roa 17494 123.49.0.0/18"
0 - Valid
-----------------------
ROA Details
-----------------------
Origin ASN:       AS17494
Not valid Before: 2019-11-12 05:41:59
Not valid After:  2020-10-31 00:00:00  Expires in 323d5h31m22s
Trust Anchor:     rpki.apnic.net
Prefixes:         2407:5000:88::/48 (max length /48)
                  203.112.192.0/19 (max length /24)
                  2407:5000::/32 (max length /40)
                  103.110.212.0/22 (max length /24)
                  123.49.0.0/18 (max length /24)
                  180.211.128.0/17 (max length /24)
awal@Awals-MacBook-Air ~> whois -h whois.bgpmon.net " --roa 45588 123.49.0.0/18"
0 - Valid
-----------------------
ROA Details
-----------------------
Origin ASN:       AS45588
Not valid Before: 2019-11-12 05:42:00
Not valid After:  2020-10-31 00:00:00  Expires in 323d5h31m13s
Trust Anchor:     rpki.apnic.net
Prefixes:         123.49.0.0/18 (max length /24)
                  2407:5000:88::/48 (max length /48)
                  2407:5000::/32 (max length /40)
                  180.211.128.0/17 (max length /24)
                  203.112.192.0/19 (max length /24)
```

You may sign same prefix with multiple ASNs but do if you really really have to

Doing ROV

		Network	NextHop
*>	I	45.123.40.0/23	103.125.54.54
*>	I	103.63.158.0/23	103.125.54.54
*>	I	103.73.104.0/22	103.125.54.73
*	I	103.73.105.0/24	103.125.54.73
*	I	103.73.106.0/24	103.125.54.73
*	I	103.73.107.0/24	103.125.54.73
*>	I	103.87.249.0/24	103.125.54.54
*	I	103.88.234.0/24	103.125.54.54
*	I	103.114.39.0/24	103.125.54.53
*	I	103.121.60.0/24	103.125.54.54
*>	I	103.123.168.0/24	103.125.54.54
*	I	103.123.169.0/24	103.125.54.54
*>	I	103.126.20.0/22	103.125.54.54
*>	I	103.126.20.0/23	103.125.54.54
*>	I	103.126.22.0/23	103.125.54.54
*	I	103.130.114.0/24	103.125.54.54
*	I	103.133.201.0/24	103.125.54.73
*	I	103.134.56.0/24	103.125.54.54
*	I	103.134.57.0/24	103.125.54.54

VS

		Network	NextHop
	I	45.123.40.0/23	103.125.54.54
	I	103.63.158.0/23	103.125.54.54
	I	103.73.104.0/22	103.125.54.73
	I	103.73.105.0/24	103.125.54.73
	I	103.73.106.0/24	103.125.54.73
	I	103.73.107.0/24	103.125.54.73
	I	103.87.249.0/24	103.125.54.54
	I	103.88.234.0/24	103.125.54.54
	I	103.114.39.0/24	103.125.54.53
	I	103.121.60.0/24	103.125.54.54
	I	103.123.168.0/24	103.125.54.54
	I	103.123.169.0/24	103.125.54.54
	I	103.126.20.0/22	103.125.54.54
	I	103.126.20.0/23	103.125.54.54
	I	103.126.22.0/23	103.125.54.54
	I	103.130.114.0/24	103.125.54.54
	I	103.133.201.0/24	103.125.54.73
	I	103.134.56.0/24	103.125.54.54
	I	103.134.57.0/24	103.125.54.54

Validation without dropping RPKI Invalids

Validation with dropping RPKI Invalids

ROA for Small ISPs and Enterprises

- Have own Internet resources?
  - Creating ROA is straightforward using RIR's resource management portal
- Got assignment for LIR?
  - Have public ASN?
    - Ask the LIR to create ROA with your ASN and verify
  - Don't have public ASN?
    - Ask the LIR to create ROA for the assigned prefix and verify

ROV for Small ISPs and Enterprises

- Have BGP with transits and peers?
  - Receive full routes from neighbors?
    - Implementing ROV using validator cache is straightforward
  - Receive partial routes with default from neighbors?
    - Ask transits to do ROV for you
    - Implement ROV using validator cache to validate peer and IX routes
  - Receive only the default route
    - ROV wouldn't fit, however, you may ask transits to do ROV on their network ☺
- Have static routing with transits?
  - ROV wouldn't fit, however, you may ask transits to do ROV on their network

Still thinking why we need ROA and ROV?

- Check the issues discussed in first couple slides
- Reduce the opportunity of routing incidents, prefix hijacks, route leaks, DDoS, outages
- You wouldn’t want to be a target of those incidents
- Help improve global routing infrastructure security
- Help each other to maintain routing hygiene
- We are engineers working hard to make Internet better, remember?

We all can help improve global routing security

- Create/fix ROAs for your prefixes
- If you are a transit provider, ask you clients to do the same
- If you're receiving BGP full route, implement ROV
- Share this among other colleagues in the community
- Help others fix their ROAs

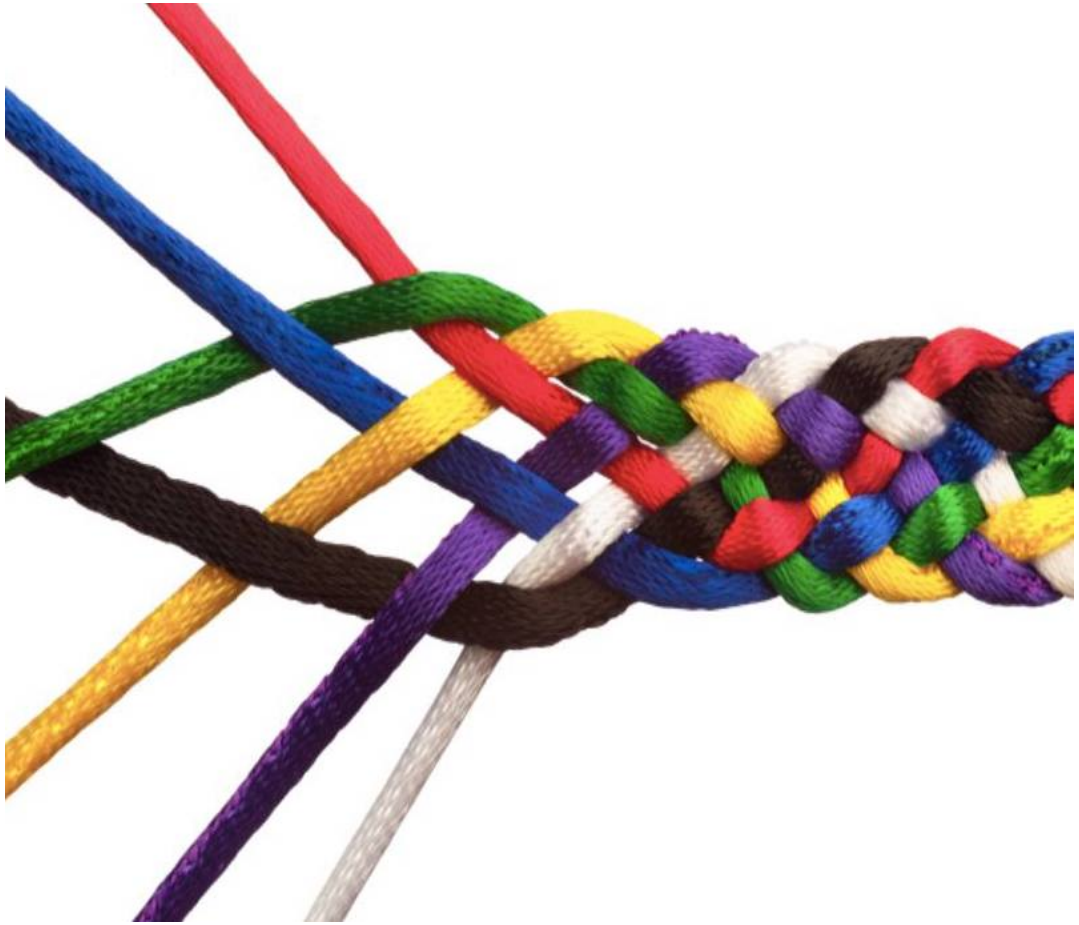


Image source: Internet

Let's check your own ASN

- Go to https://bgp.he.net , search for your AS number and check v4 and v6 prefixes

Or,

- Use whois on unix terminal:

`whois -h whois.bgpmon.net " --roa ASN Prefix"`

- If you find issues with ROA, please fix it

https://blog.apnic.net/2019/09/11/how-to-creating-rpki-roas-in-myapnic/

HURRICANE ELECTRIC INTERNET SERVICES

63932 Search

AS63932 Bangladesh Computer Council

AS Info | Graph v4 | Graph v6 | Prefixes v4 | Prefixes v6 | Peers v4 | Peers v6

Prefix	Description
43.229.12.0/22	Bangladesh Computer Council
43.229.15.0/24	Bangladesh Computer Council
103.48.16.0/22	Bangladesh Computer Council
114.130.54.0/23	Bangladesh Computer Council
114.130.116.0/22	Bangladesh Computer Council
180.211.213.0/24	Bangladesh Computer Council

```
awal@Awals-MacBook-Air ~> whois -h whois.bgpmon.net " --roa 63932 103.48.16.0/22"
0 - Valid
-----------------------
ROA Details
-----------------------
Origin ASN:       AS63932
Not valid Before: 2019-12-06 18:22:35
Not valid After:  2021-01-31 00:00:00  Expires in 1y55d2h39m25.6000000014901s
Trust Anchor:     rpki.apnic.net
Prefixes:         103.48.16.0/22 (max length /22)
                  43.229.12.0/22 (max length /22)
                  2401:ed80::/32 (max length /32)
                  43.229.15.0/24 (max length /24)
```

References

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9. https://www.apnic.net/wp-content/uploads/2017/12/ROUTE_MANAGEMENT_GUIDE.pdf
10. https://www.cirt.gov.bd/জাতীয়-ডাটা-সেন্টারে-আরপি/

Questions?