The impact of an RPKI validator in Bangladesh and Lessons Learned

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Starting with some routing incidents...







- 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	Announcer	nent				
AS1345	99 4	5.118.70.0/24					
AS1339	<u>57</u> 4	5.118.70.0/24	 ✓ 				

oute-views>show ip bap 45.118.70.0/24 i 133957 138197 138197 138197 138197 133957 3277 38197 138197 138197 138197 138197 138197 138197 3561 133957 138197 138197 138197 138197 138197 133957 852 174 58601 138197 138197 138197 138197 138197 138197 133957 138197 138197 133957 101 101 174 58601 138197 138197 138197 174 58601 3267 138197 138197 138197 133957 138197 138197 138197 133957 3257 58601 138197 138197 138197 138197 58601 138197 138197 138197 138197 138197 133957

route-views>show ip bap 45.118.70.0/24 134599 134599 134599 134599 134599 8283 6762 132602 35341 135341 135341 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 134599 134599 134599 134599 134599 135341 1403 1299 58717 135341 135341 1599 1599 1403 1299 1351 6939 134599 134599 134599 286 6762 132602 58717 134599 134599 134599 57866 6762 132602 58717 135341 135341 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						

134599

route-views>show ip bqp 45.118.70.0/24 |/i 3277 3267 174 58601 138197 138197 138197 138197 138197 138957 138197 138197 138197 138197 133957 133957 138197 133957 58601 138197 138197 138197 138197 852 174 58601 138197 138197 138197 138197 138197 138197 133957 101 174 58601 138197 138197 138197 138197 138197 133957 101 3267 174 58601 138197 138197 138197 138197 138197 133957 3303 3257 58601 138197 138197 138197 138197 138197 138197 133957 58601 138197 138197 138197 138197 138197 13395 3257

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

S Info Graph v4	Graph v6	Prefixes v4	Prefixes v6	Peers v4	Peers v6	Whois	IRR
		AS13655	5 announces t	ogons.			
Company Waheit			http://hks	nEachd act			

Prefix	Description				
103.67.199.0/24	BK ONLINE				
103.92.152.0/24	Asia Pacific Network Information Centre				
103.92.153.0/24	Asia Pacific Network Information Centre				
103.92.154.0/24	Asia Pacific Network Information Centre				
103.92.155.0/24	Asia Pacific Network Information Centre				

Matching Routes	2													
Status Codes	A - Agg Suppres	regate B - Best b - N sed F - Filtered s - S	iot Install Be tale x - Best	st C - Confederat t-External	tion et	BGP D - Da	mped E - el	BGP H - Hist	ory I - i	BGP L - Local N	- Multipath m	n - Not Installe	d Multipath S	•
		Network	•	Next Hop	•	Metrico	LocPrf®	Weight Φ			Path		Origin	ROA
Statu	IS 0	The strive is												
Statu	is o	103.92.152.0/24	198	8.32.176.203		15	100	0	9498,	132884, 58717,	136555x5		IGP	?
Statu 1	IS 0	103.92.152.0/24 103.92.152.0/24	198	8.32.176.203		15 95	100 100	0	9498, 9498,	132884, 58717, 132884, 58717,	136555x5 136555x5		IGP IGP	?





- 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

tome			
teport	Rank	Description	
eport eport	1	BDCOM	
15	2	CIRCLE NETWORK BANGLADESH	

			1.0	core1.sin1.h	e.net	> show	ip bgp r	outes de	tail 202.181.16.0/24			
Matching Routes	10											
Status Codes	A - Age Suppre	gregate B - Best b ssed F - Filtered s	- Not Install I - Stale x - Be	Best C - Confed est-External	eration	eBGP D	Damped I	E - eBGP H	- History I - IBGP L - Local M - Multipath m - Not	Installed N	lultipath \$	
Statu	5 0	Network		Next Hop		Metrid	LocPr®	Weighte	Path		Origine	ROA
BEx		202.181.16.0/24	74.8	2.51.74		0	140	0	132602, 10075, 134371, 137842		1GP	0
E .		202.181.16.0/24	27.1	11.228.140		0	100	0	10075, 134371, 137842		IGP	0
E		202.181.16.0/24	27.1	11.228.140		0	100	0	19075, 134371, 137842		1GP	0
ε		202.181.16.0/24	27.1	11.228.140		0	100	0	10075, 134371, 137842		1GP	0
ε		202.181.16.0/24	27.1	11.228.40	3	0	100	0	9498, 10075, 134371, 137842		1GP	0
ε		202.181.16.0/24	27.1	11.229.76		0	100	0	132602, 10075, 134371, 137842		1GP	0
E.		202.181.16.0/24	65.4	9.109.182		0	100	0	9498, 10075, 134371, 137842		1GP	0
E		202.181.16.0/24	27.1	11.228.111		0	100	0	6762, 132602, 10075, 134371, 137842		1GP	0



- 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	8.
2405:1500::/48	9.
2405:1500:0:8::/64	S 🗸
2405:1500:30::/48	8
2405:1500:40::/48	8.
2405:1500:60::/48	8
2405:1500:70::/48	8
2405:1500:80::/48	8



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

Prefix	
2405:1500::/32	S 🔊
2405:1500::/48	S 🗸
2405:1500:30::/48	8
2405:1500:40::/48	S 🗸
2405:1500:60::/48	S 🗸
2405:1500:70::/48	S 🗸
2405:1500:80::/48	S 🗸







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 started doing BGP but AS 24342 still didn't stop the announcement.

oute-views>sh ip bap 103.98.200.0/24 | 342 24342 24342 49788 12552 4637 9498 58601 24342 24342 24342 2 3303 2914 58601 24342 24342 24342 24342 24342 24342 24342 3561 209 3356 2914 58601 24342 24342 24342 2434 24342 24342 3267 3356 2914 58601 24342 24342 24342 24342 24 42 24342 9498 58601 24342 24342 24342 24 42 24342 24342 3277 3267 3356 2914 58601 24342 24342 24342 24342 24342 24342 20912 174 9498 58601 24342 24342 24342 24342 24342 24342 58601 24342 24342 24342 24342 24342 24342 24342 58601 24342 24342 24342 24342 11164 7473 9498 58601 24342 24342 24342 24342 24342 24342 1351 6939 58601 24342 24342 24342 24342 24342 24342 58601 24342 24342 24342 24342 24342 24342 9498 58601 24342 24342 24342 24342 24342 24342 24342 3333 1273 2914 58601 24342 24342 24342 24342 24342 24342 9498 58601 24342 24342 24342 24342 24342 24342 58601 24342 24342 24342 24342 58601 24342 24342 24342 24342 24342 24342 3356 6453 58601 24342 24342 24342 24342 24342 24342 9498 58601 24342 24342 24342 24342 24342 24342 58601 24342 24342 24342 24342 174 174 9498 58601 24342 24342 24342 24342 24342 24342 2497 2914 58601 24342 24342 24342 24342 24342 24342 24342

AS Info Graph v4 Prefixes v4 Peers v4		AS Info Graph v4 Prefixes v4 Peers v4	
Prefix		Prefix	
103 98 200 0/22	· (103.98.200.0/24	
		103.98.201.0/24	
<u>103.98.200.0/24</u>		115.127.0.0/17	
103.98.201.0/24		115.127.0.0/18	
	·	115.127.0.0/19	
103.98.202.0/24		115.127.0.0/20	l
103.98.203.0/24		115.127.0.0/24	

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

oute-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 2 <mark>4342 136909</mark>
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	2
103.98.200.0/24	2
103.98.201.0/24	🕙 🔽
103.98.202.0/24	2
103.98.203.0/24	🔍 🔽

Pr	refix
115.127.0.0/17	🔍 🜌
115.127.0.0/18	S 🖉
115.127.0.0/19	2
115.127.0.0/20	S 🖉
115.127.0.0/24	S 🛛
115.127.1.0/24	S 🖉
115.127.2.0/24	80
115.127.3.0/24	2.0

AS Info Graph v4 Prefixes v4 Peers v4 Whois



- 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.



awal@Awals-MacBo	ook-Air ~	> whois	-h	whois.radb.net	103.98.64.0/22
route:	103.98.6	4.0/22			
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.

Prefix		Description		
43.229.12.0/22	S 🗸	Bangladesh Computer Council		
43.229.15.0/24	8.0	Bangladesh Computer Council		
103.48.16.0/22	8.0	Bangladesh Computer Council		
114.130.54.0/23	80	Bangladesh Computer Council		
114.130.116.0/22	2.	Bangladesh Computer Council		
180.211.213.0/24		Bangladesh Computer Council		





How we ensure the routing hygiene manually?

Nightmare...













RPKI is about 2 things: ROA and ROV



Prefix	2401ED80:/32	
Origin AS	A563932	
O MSA	/32	
ROA	C Enabled	
Whois	C Enabled	
Actions	Update whois 🕑	
		Cancel Submit

Route II	Origin AS	11	ROA status 0	Whois status O
103.48.16.0/22	A\$63932		0	0
2401:ED80::/32	A\$63932		0	0
43.229.12.0/22	A563932		0	0
43.229.15.0/24	A563932		0	0



RPKI is about 2 things: ROA and ROV



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?



#SGNOG8

Awareness Before

areness Before 1	the ROV	BDNOG : Bangladesh Network Operators Group Ø Public group About Discussion	Mohammad A O Admin - 1 hr বাংলামেশ কম্পিউটার কাউ ভারিখ যেকে আরপিকেআট হিফিল্লাসমূহের রোখা ভুল সেন্টারের কোন কনটেন্ট আ National Data Center validation on Dec 1, 2h correct/create if requi	bdul Awal shared a link. নিদলের অধীনস্থ জাতীয় ভাটা দেন্টারে আগায়ী ১ কিনেম্বর ২০১৯ t ভেলিভেশন শুরু হক্ষে। এর ফলে যেসব ইন্টারনেট বা ইন্দজালিত সেইসব আইপি এপ্লেস থেকে আতীয় ভাটা Is এক্সেস করা যাবে না। at Bangladesh Computer Council starts RPKI ROA 019. Please check the ROA for your prefixes and red.
GGD e-GOV CIRT	€880235006801 (]	Announcements Members Events	1	DDKI
এরাবেরে আরপিকেআই ডশন শুরু	Subject: NDC starts RPKI Validation on D Date: Thu, 7 Nov 2019 00:44:32 +06 From: Md. Abdul Awal <awal.ece@gm To: nog <nog@bdnog.org> Dear Colleagues, National Data Center (NDC) at Banglades RPKI ROA validation on December 1, 202</nog@bdnog.org></awal.ece@gm 	ec 1 00 ail.com> th Computer Council 19.	(BCC) starts	রিপিকেআই ভেলিডেশন শুরু হর প্রতি আনাদের মৃত প্রতিকার্তির অংশ হিসেবে বাংলাদেশ_
র দিরাপত্তার প্রতি আন্যাদন দৃহ প্রতিক্রতির আশে হিসেবে বাংলাদেশ কম্পিউটার কাউন্দিলের জলীপস্থ রে আগায়ী ১ ভিসেশ্বর ২০১৬ তারিব ঘোক আরশিকেআই ভেলিডেশন শুরু রাজ্য। এর বাংল যেনব দৃদ্বারে রোআ ভুল বা ইনভালিডে সেইসর প্রিতিক্সসমূহক জানীয় ভানি সেন্টারের রাউটারসমূহ আর হাংগ	Read more here: https://www.cirt.gov.bd/%e0%a6%9c%e0 %a6%b8%e0%a7%87%e0%a6%a8%e0%a7%	%a6%be%e0%a6%a4% 8d%e0%a6%9f%e0%a6	e0%a7%80%e0%a7 %be%e0%a6%b0%	
র উপলব্ধি করবের ৫ যোকান পেটএরার্ক অপ্যারটির রা টপ্টারপেট সার্ভিন প্রোভাটভার এর যদি কোন প্রিচিজেরে রোজা ভুল বা হোল দেইসর আটপি এড্রেস থেকে জার্টীয় জারী দেশটারের কোন কনটেন্ট আর এপ্রেল করা যাবে শা। PKU) এবং রোআ (ROA) কি ? ৪ ইপফ্লেষ্ট্রাকচার বা আবন্দিকআই হল এক ধরসের কাঠানো হার মাধ্যাম কটার পেটএরে প্রোটাকল ইয়েরোপী বিশ্বন টপটারদেটী আইন্টিং অবকাঠানোকে দিরাপদ সন্দর।	NDC team tried to reach ASNs who have them to fix it. However, there are still at Bangladesh. Please be informed that the able to access any content hosted at ND Please spend some time to check the RC invalid ROAs immediately from your My/ create ROA for your prefixes yet, please	INVALID ROAs and ho out 2% invalid prefixes INVALID prefixes wo C after Nov 30. A for your prefixes. C NPNIC portal. Also, if do so asap.	elped many of es in uld not be Correct any you didn't	

জাতীয় ডাটা সেন্টারে আরপিকেআই ভেলিডেশন শুরু

লেট হয়কে ২ সহাঁৱাৰ পিৰাপহাৰ প্ৰতি আন্দাদৰ দৃহ প্ৰতিক্ৰাতিৰ অংশ হিসেবে বাংলাদেশ ৰুম্পিউটাৰে ৰাটপিনলৰ অস্তীপন্থ রাজীর ভাটা দেশীয়ে আগামী ১ ভিনেমর ২০১৬ তারির লোক আরশিকেআই ভেলিডেশন শুরু রাজ। এর বাল দেনর वेगेताओं शिविकामपुरात ताचा जुल वा देनजालिक (मरेमर शिविकामपुराक कातीर कति (मनेतारह तावेग्रेतमपुर व्यात शंहन 0.024 401

কারা এর প্রতিকিয়া উপলব্ধি করবেঃ

রাংলাদেশসম বিশ্বের যোকান লেটএরার্ক অপোরেটর বা টিন্টারনেট সার্ভিস প্রোভাইডার এর যদি কোন প্রিচিজের রোঝা ভুল বা ইপরালিত ব্যাক তাহলে নেইসর আইপি এয়েস বেকে ভার্তীয় জটা দেশীয়ের কোন কনটেন্ট আর. এক্সেন করা যাবে গা

আরশিকেআই (RPHI) এবং প্রোঝা (ROA) জি ?

HOME

রিসোর্স পারলিক কি ইপফ্রাষ্ট্রাকচার বা আরপ্যিকারাই হল এক ধরসের কটোমো হার মারামে কটার পেটিএর প্রোটাকল (विकिभि) तब प्रत्न विद्युदाणी दिशत ऐनीवान्सी साउँगिः प्यटकार्यतपाल निराणन मश्चर।



Best regards, Awal



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

INIVERSITY OF OREGON



Prefix	
123.49.0.0/18	8
123.49.14.0/24	🔍 🔽
123.49.16.0/20	2
123.49.29.0/24	3
123.49.30.0/24	2
123.49.31.0/24	2
123.49.47.0/24	2
180.211.128.0/17	8
180.211.201.0/24	S. 🗸
180.211.214.0/24	S
180.211.215.0/24	🔍 🔽
203.112.192.0/19	
203.112.194.0/24	9
209.58.24.0/24	

Prefix	
123.49.0.0/18	8
123.49.14.0/24	2
123.49.16.0/20	3
123.49.29.0/24	9
123.49.30.0/24	9
123.49.31.0/24	8
123.49.47.0/24	🕙 🔽
180.211.128.0/17	8
180.211.201.0/24	8
180.211.214.0/24	9
180.211.215.0/24	9
203.112.192.0/19	9
203.112.194.0/24	8.



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AS Info Graph v4 Prefixes v4	Peers v
Prefix	
43.255.20.0/22	🔍 🔽
43.255.20.0/24	🔍 🔽
43.255.21.0/24	🔍 🔽
43.255.22.0/24	<u>s</u>
103.239.4.0/22	🔍 🔽
103.239.4.0/24	🔍 🔽
103.239.5.0/24	2
103.239.6.0/24	2
103.239.7.0/24	S. 🗸

AS Info	Graph v4	Prefixes v4	Peers v4
	Pre	efix	
43.255.2	20.0/24		9
43.255.2	21.0/24		9
43.255.2	22.0/24		8
103.239	.4.0/24		9
103.239	.5.0/24		2
103.239	.6.0/24		S 🗸



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And, finally NDC drops invalids since Dec 1, 2019











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





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RPKI ROA Adoption in BD



Source: https://observatory.manrs.org



Considerations about ROA and ROV





Creating ROA

Prefix	103.48.16.0/22	
Origin AS	A563932	
O MSA	/22)
ROA	C Enabled	
Whois	C Enabled	
Actions	Update whois 🖒	

- 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

Prefix	103.48.16.0/22			
Origin AS	A\$63932			
O MSA	/24			
ROA	C Enabled			
Whois	Enabled			
Sub-routes				
Show 10 \$ er	tries	Search		
Route	n	Managed 0	Actions	
103.48.16.0/22		Enabled	Update whois 🖒	
103.48.16.0/23		Enabled	Update whois 🕑	
		-	Designation and balling (PC	
103.48.16.0/24		Enabled	oposite willow Q	
103.48.16.0/24		Enabled	Update whois C	
103.48.16.0/24 103.48.17.0/24 103.48.18.0/23		Enabled Enabled Enabled	Update whois C	
103.48.16.0/24 103.48.17.0/24 103.48.18.0/23 103.48.18.0/24		Enabled Enabled Enabled Enabled	Update whois C Update whois C Update whois C	



Creating ROA

awal@Awals-MacBoo 0 - Valid	k-Air -> whois -h whois.bgpmon.net "roa 17494 103.110.212.0/22"	
ROA Details		5
Origin ASN: Not valid Before: Not valid After: Trust Anchor: Prefixes:	AS17494 2019-11-12 05:41:59 2020-10-31 00:00:00 Expires in 323d5h27m43s rpki.apnic.net 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-MacBoo	k-Air -> whois -h whois.bapmon.net roa 45588 103.110.212.0/22"	
2 - Not Valid: In	valid Origin ASN, expected 17494	

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

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



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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
*	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



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VS

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?



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- National Science Foundation (NSF)
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- Internet Society
 - Partnership in the global efforts towards improving routing security





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Questions?



