

IPv6 and RPKI Status Updates

Presented by Makito Lay for VNIX-NOG 2025

Nha Trang, Vietnam

17 October 2025

About Me



- **Makito Lay**

- Network Analyst / Technical Trainer @ APNIC
- Volunteering:
 - TWNOG Multi-Stakeholder Group Member
 - KHNOG Executive Committee Member
- Experiences:
 - 18 years in ISP and Telecom industry
 - MikroTik Certified Trainer
 - Ex-programmer
- Certifications: CCIE # 47682, JNCIP-SP, MTCINE...etc.
- Areas of Interest: BGP, MPLS, IPv6, Coding & Databases



Agenda



- **Internet Protocol version 6 (IPv6)**
 - IPv6 Status in Asia / South-Eastern Asia / Vietnam
 - Common Challenges
 - IPv6 Deployment Planning
- **Resource Public Key Infrastructure (RPKI)**
 - RPKI Status in Asia / South-Eastern Asia / Vietnam
 - Recommendations for RPKI
 - Autonomous System Provider Authorisation (ASPA)

IPv6 and RPKI Status Updates

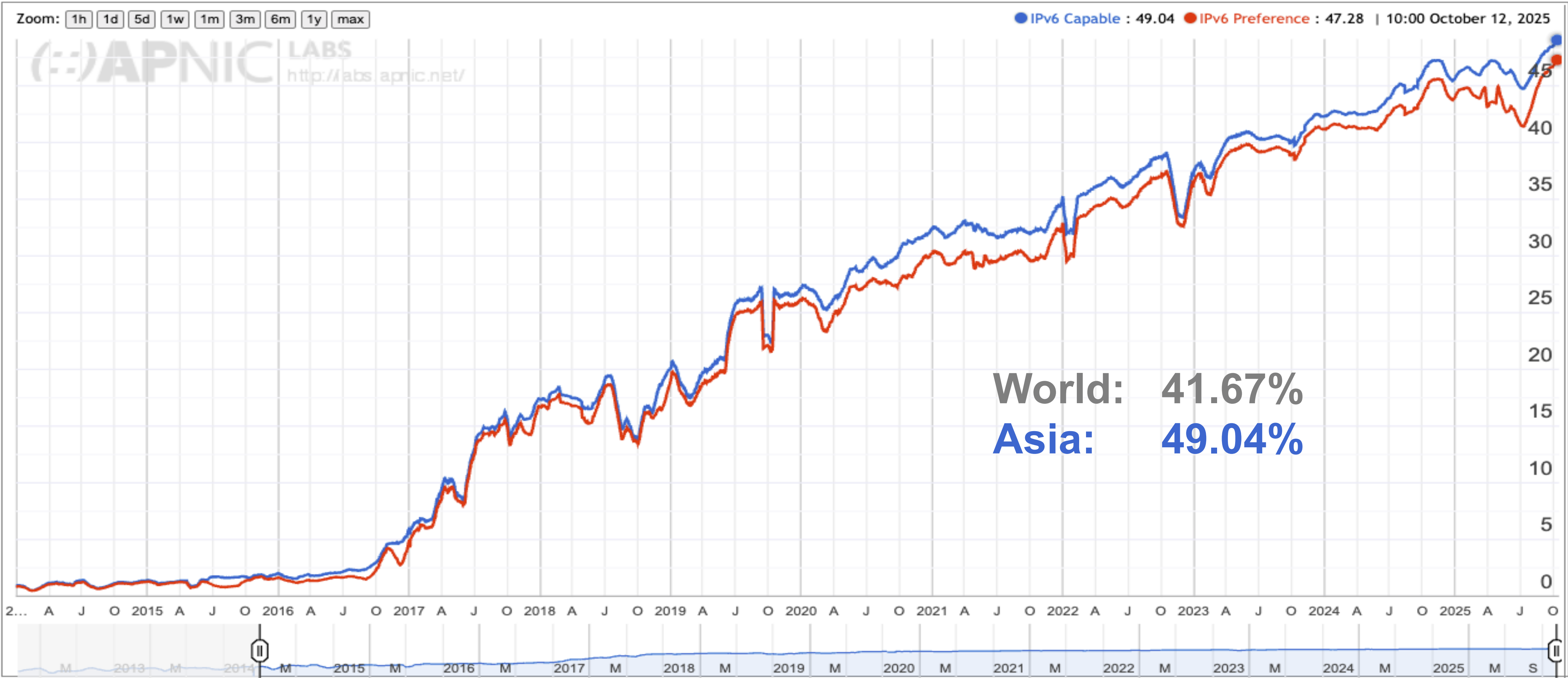
Internet Protocol version 6 (IPv6)

Why IPv6?



- Not enough IPv4 to support growing demands.
 - More people on the planet than IPv4 addresses
 - Each person may have multiple devices
- IPv4 is running out.
 - Organisations will soon be unable to apply for new IPv4 addresses
 - Need to lease or buy (USD 40–60 per address) from others
- For routers, it is more efficient to forward IPv6 than IPv4.
- IPv6 provides end-to-end connectivity.
 - No Network Address Translation (NAT)

IPv6 Status in Asia



Source: <https://stats.labs.apnic.net/ipv6/XD> (13 Oct 2025)

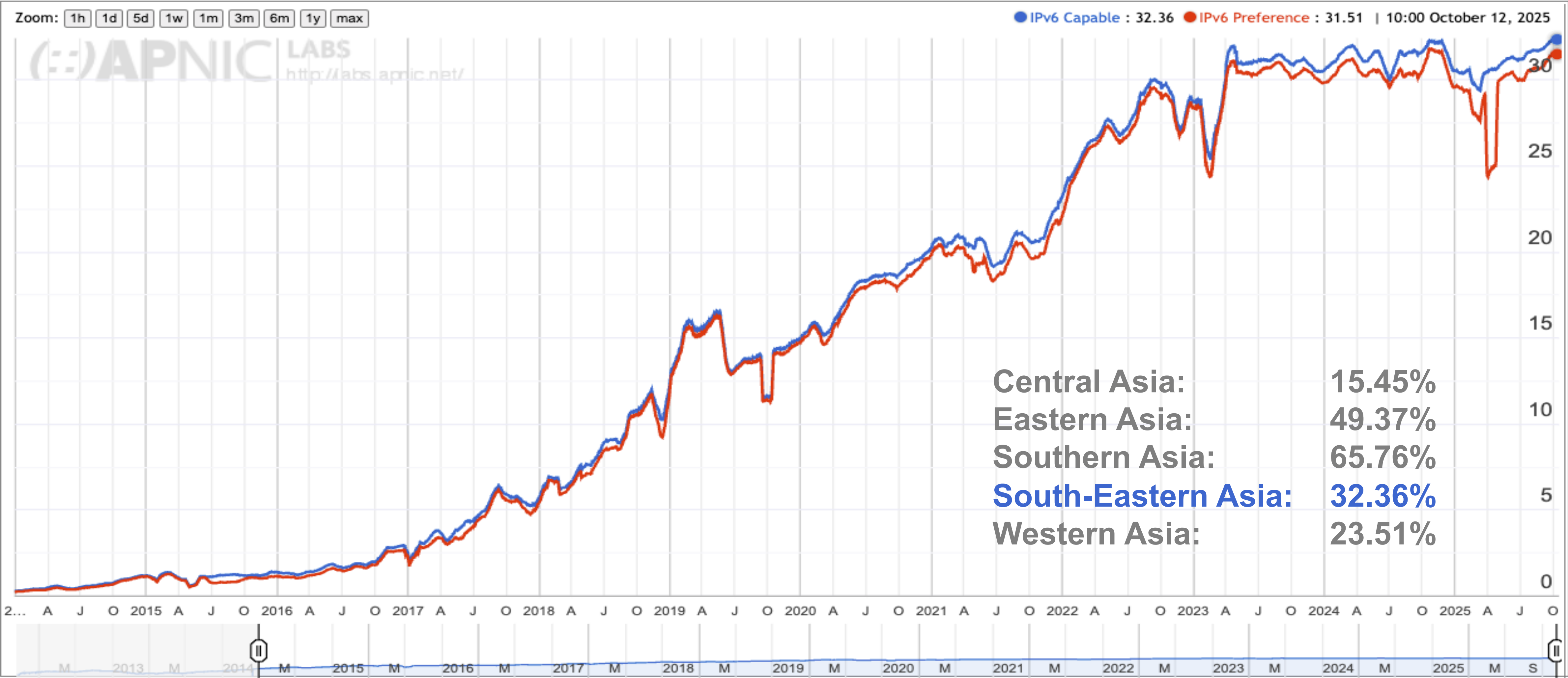
IPv6 Status in Asia



CC	Country	IPv6 Capable ▼	IPv6 Preferred	Samples	Weight	Weighted Samples
IN	India, Southern Asia, Asia	77.88%	77.15%	150,453,352	0.93	139,882,955
MY	Malaysia, South-Eastern Asia, Asia	70.58%	68.89%	9,337,933	0.71	6,625,402
SA	Saudi Arabia, Western Asia, Asia	69.51%	66.65%	6,100,474	1.27	7,767,856
IL	Israel, Western Asia, Asia	62.18%	57.52%	2,892,630	0.6	1,749,630
VN	Vietnam, South-Eastern Asia, Asia	61.28%	59.55%	15,596,312	0.82	12,738,293
JP	Japan, Eastern Asia, Asia	59.15%	55.61%	43,405,004	0.62	26,768,057
TW	Taiwan, Eastern Asia, Asia	57.96%	52.11%	6,411,045	0.97	6,202,025
LK	Sri Lanka, Southern Asia, Asia	56.08%	54.78%	1,421,027	1.35	1,919,540
NP	Nepal, Southern Asia, Asia	55.38%	54.07%	2,749,327	0.62	1,710,063
AE	United Arab Emirates, Western Asia, Asia	51.23%	49.76%	1,547,390	1.51	2,343,004
TH	Thailand, South-Eastern Asia, Asia	50.74%	49.58%	11,777,701	0.91	10,675,897
CN	China, Eastern Asia, Asia	49.40%	46.44%	43,034,710	4.55	195,787,901
MO	Macao Special Administrative Region of China, Eastern Asia, Asia	43.25%	42.54%	891,515	0.15	134,756
MN	Mongolia, Eastern Asia, Asia	42.94%	41.76%	924,443	0.21	197,375
QA	Qatar, Western Asia, Asia	37.59%	30.46%	787,922	0.85	673,658
KR	Republic of Korea, Eastern Asia, Asia	31.09%	30.14%	10,793,762	1.12	12,107,287
BT	Bhutan, Southern Asia, Asia	30.99%	30.24%	133,582	0.78	104,302
KW	Kuwait, Western Asia, Asia	28.17%	26.03%	1,160,879	1.07	1,240,532
KZ	Kazakhstan, Central Asia, Asia	24.54%	23.50%	7,257,763	0.5	3,599,819
OM	Oman, Western Asia, Asia	23.62%	22.68%	1,010,992	1.03	1,044,318

Source: <https://stats.labs.apnic.net/ipv6/XD> (13 Oct 2025)

IPv6 Status in South-Eastern Asia



Source: <https://stats.labs.apnic.net/ipv6/XU> (13 Oct 2025)

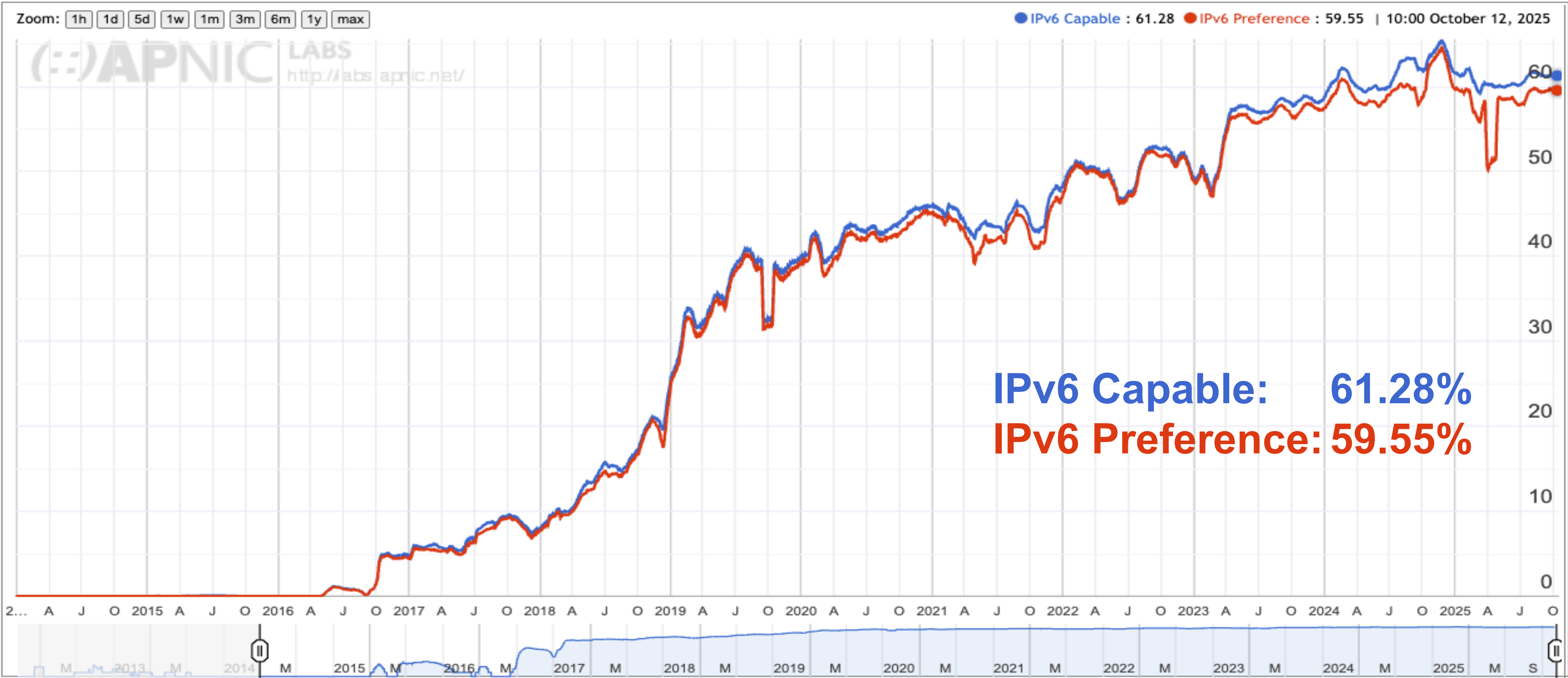
IPv6 Status in South-Eastern Asia



CC	Country	IPv6 Capable ▼	IPv6 Preferred	Samples	Weight	Weighted Samples
MY	Malaysia, South-Eastern Asia, Asia	70.58%	68.89%	9,337,933	0.71	6,625,402
VN	Vietnam, South-Eastern Asia, Asia	61.28%	59.55%	15,596,312	0.82	12,738,293
TH	Thailand, South-Eastern Asia, Asia	50.74%	49.58%	11,777,701	0.91	10,675,897
PH	Philippines, South-Eastern Asia, Asia	19.82%	19.28%	18,765,848	0.92	17,352,646
ID	Indonesia, South-Eastern Asia, Asia	18.32%	17.91%	44,418,192	0.62	27,733,979
SG	Singapore, South-Eastern Asia, Asia	16.23%	13.64%	2,826,329	0.43	1,214,570
MM	Myanmar, South-Eastern Asia, Asia	9.18%	8.90%	579,574	8.82	5,112,665
TL	Timor-Leste, South-Eastern Asia, Asia	2.76%	2.70%	78,787	1.26	98,923
KH	Cambodia, South-Eastern Asia, Asia	0.30%	0.29%	1,346,219	1.24	1,670,036
BN	Brunei Darussalam, South-Eastern Asia, Asia	0.14%	0.13%	229,216	0.51	116,543
LA	Lao People's Democratic Republic, South-Eastern Asia, Asia	0.08%	0.08%	403,194	1.38	554,858

Source: <https://stats.labs.apnic.net/ipv6/XU> (13 Oct 2025)

IPv6 Status in Vietnam



Source: <https://stats.labs.apnic.net/ipv6/VN> (13 Oct 2025)

IPv6 Status in Vietnam



ASN	AS Name	IPv6 Capable ▼	IPv6 Preferred	Samples
AS54113	FASTLY	100.00%	96.23%	106
AS36183	AKAMAI-AS	99.40%	97.08%	1,165
AS13335	CLOUDFLARENET	98.28%	96.05%	97,976
AS7643	VNPT-AS-VN Vietnam Posts and Telecommunications VNPT	81.67%	79.05%	420
AS131429	MOBIFONE-AS-VN MOBIFONE Corporation	77.69%	74.73%	727,642
AS18403	FPT-AS-AP FPT Telecom Company	67.78%	66.12%	2,784,715
AS7552	VIETEL-AS-AP Viettel Group	65.69%	63.99%	6,132,450
AS24086	VIETTEL-AS-VN Viettel Corporation	59.87%	58.38%	361,421
AS45899	VNPT-AS-VN VNPT Corp	53.13%	51.43%	5,107,931
AS135932	VNDATA-AS-VN Viet Storage Technology Joint Stock Company	36.94%	8.96%	1,451
AS56141	DSP-AS-VN Danang ICT Infrastructure Development Center	23.29%	22.60%	292
AS45543	SCTV-AS-VN SaiGon Tourist cable Televition Company	19.88%	19.42%	213,048
AS135921	MAXSERVER-AS-VN Maxserver Company Limited	18.77%	11.77%	1,758
AS45557	VNTT-AS-VN Vietnam Technology and Telecommunication JSC	18.31%	16.97%	7,002
AS149107	TRUMVPS-VN TRUMVPS COMPANY LIMITED	9.43%	1.89%	53
AS150895	EZTECH-VN EZ TECHNOLOGY COMPANY LIMITED	9.17%	0.92%	109
AS45903	CMCTELECOM-VN CMC Telecom Infrastructure Company	6.45%	5.69%	16,361
AS38732	CMCTELECOM-VN CMC Telecom Infrastructure Company	6.25%	6.25%	64
AS9009	M247	5.60%	5.60%	125
AS24088	HTCHCMC-AS-VN Hanoi Telecom Joint Stock Company - HCMC Branch	5.40%	4.48%	13,548

Source: <https://stats.labs.apnic.net/ipv6/VN> (13 Oct 2025)

IPv6 Status in Vietnam



- Encouraging adoption level.
 - Peak at 65.35% in November 2024
 - Relatively stable over the past two years
- Consistent growth in line with global trend.
- Major operators (VPNT, Mobifone, FPT, Viettel) are key contributors, with IPv6 Capable rates of 53.13% to 81.67%.
 - It would be insightful to identify any barriers preventing further growth
- **Next step: IPv6-only by 2032.**

Common Challenges



- Legacy network upgrade?
 - Equipment may not support IPv6
- New skills required?
 - Not sure how to do
- Concerns on security?
 - All users will be using public addresses
- Still have enough IPv4 addresses? 😊
- Have money to lease or buy IPv4 addresses? 😊

IPv6 Deployment Planning



- IPv4 will not last forever, the cost of running IPv4 is getting higher.
 - IPv4 address prices
 - Carrier Grade NAT (CGN) equipment costs
- Steps for IPv6 deployment:
 - Network assessment
 - Network optimisation
 - Applying for IPv6 address space
 - IPv6 addressing plan
 - IPv6 deployment
 - Seeking IPv6 Transit services
 - Enabling IPv6 for customers

Need Help in IPv6?



General Information

IPv6@APNIC

<https://www.apnic.net/community/ipv6/>

APNIC Help Centre

<https://help.apnic.net/s>

Funding

Information Society Innovation Fund (ISIF Asia)

IPv6 Deployment Grants

USD 30,000 to 250,000 available

<https://apnic.foundation/isif-asia/apply-for-funding/>

Technical Discussions

APNIC Technical Assistance

<https://academy.apnic.net/technical-assistance>

Training Resources

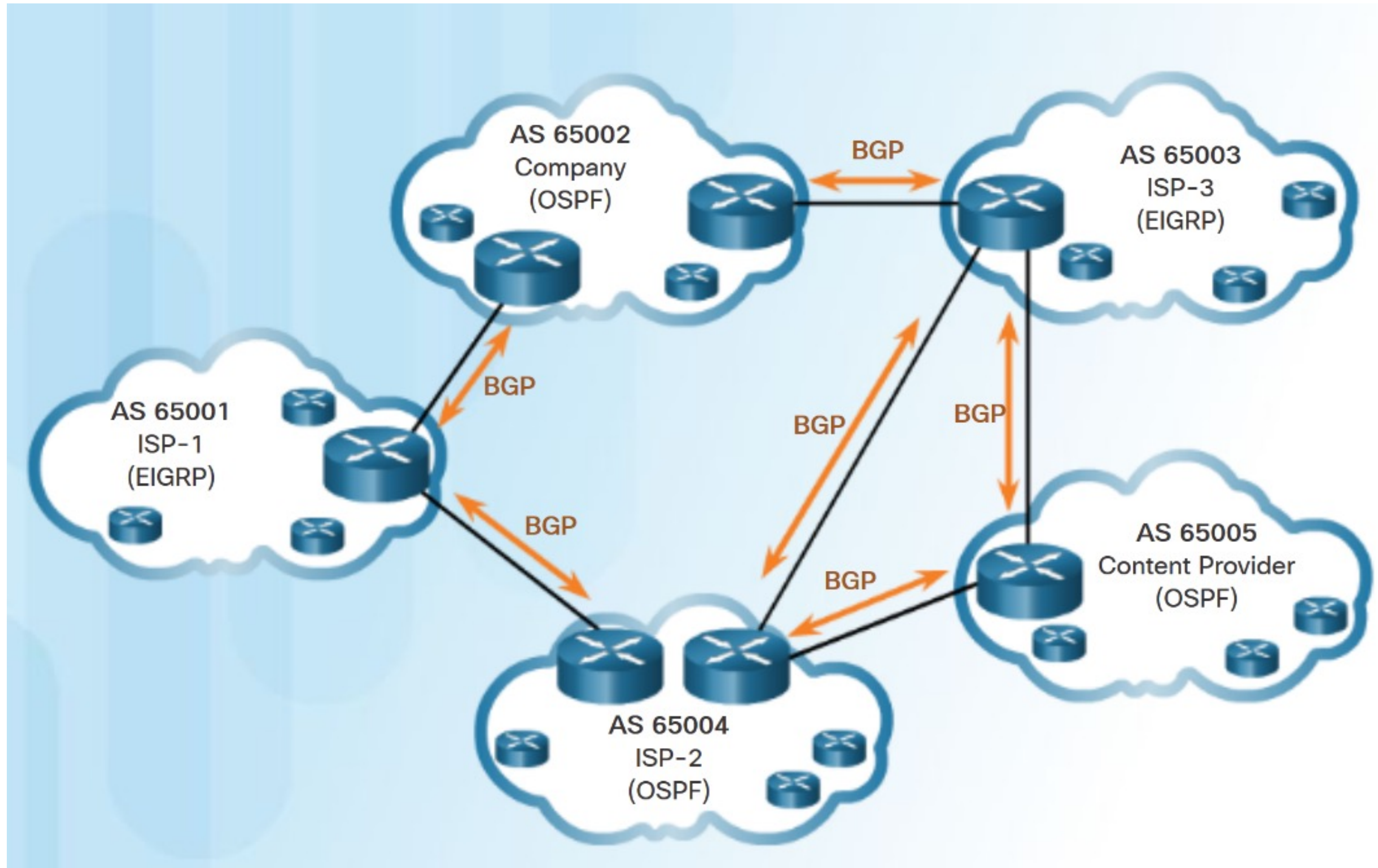
APNIC Academy

<https://academy.apnic.net>

IPv6 and RPKI Status Updates

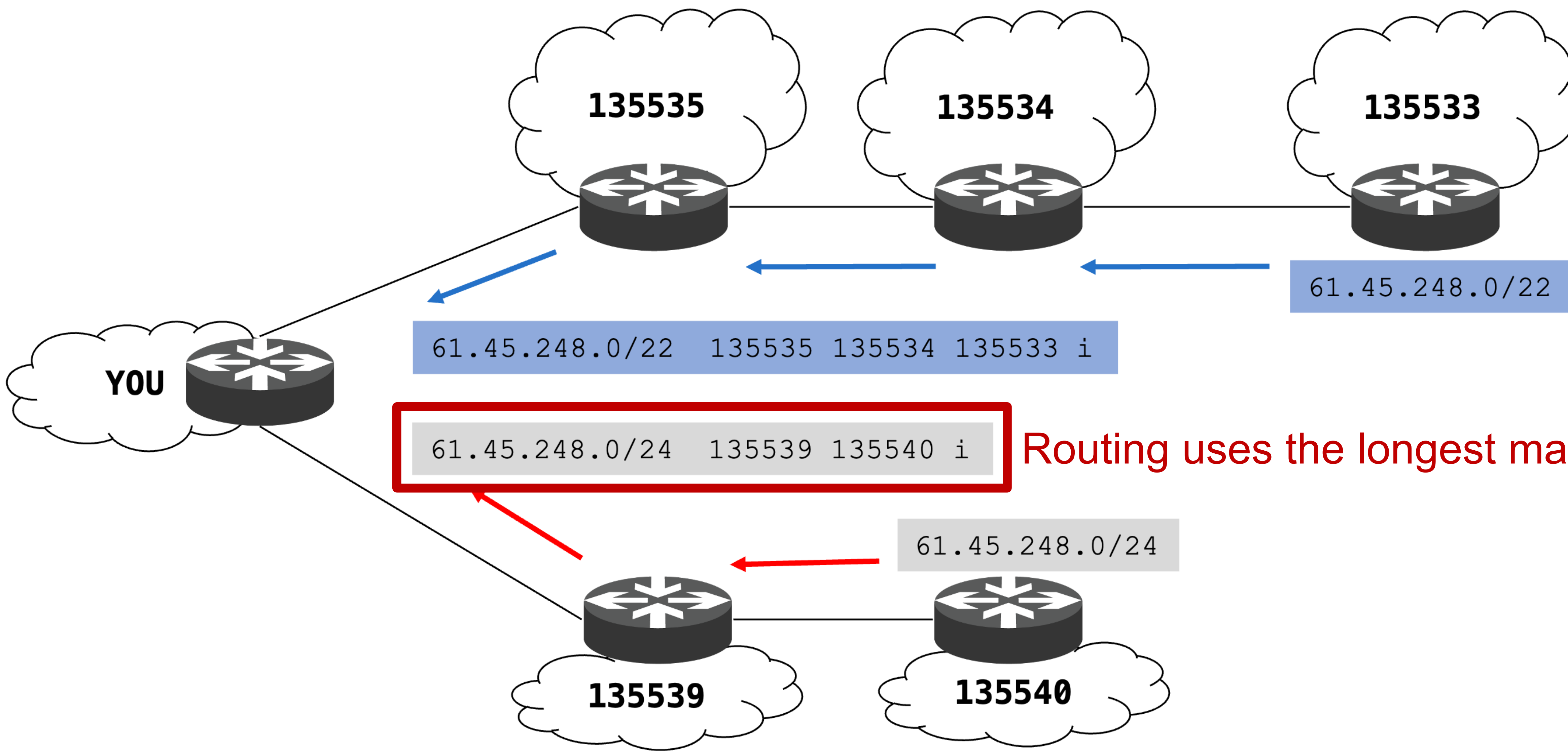
Resource Public Key Infrastructure (RPKI)

Internet Routing

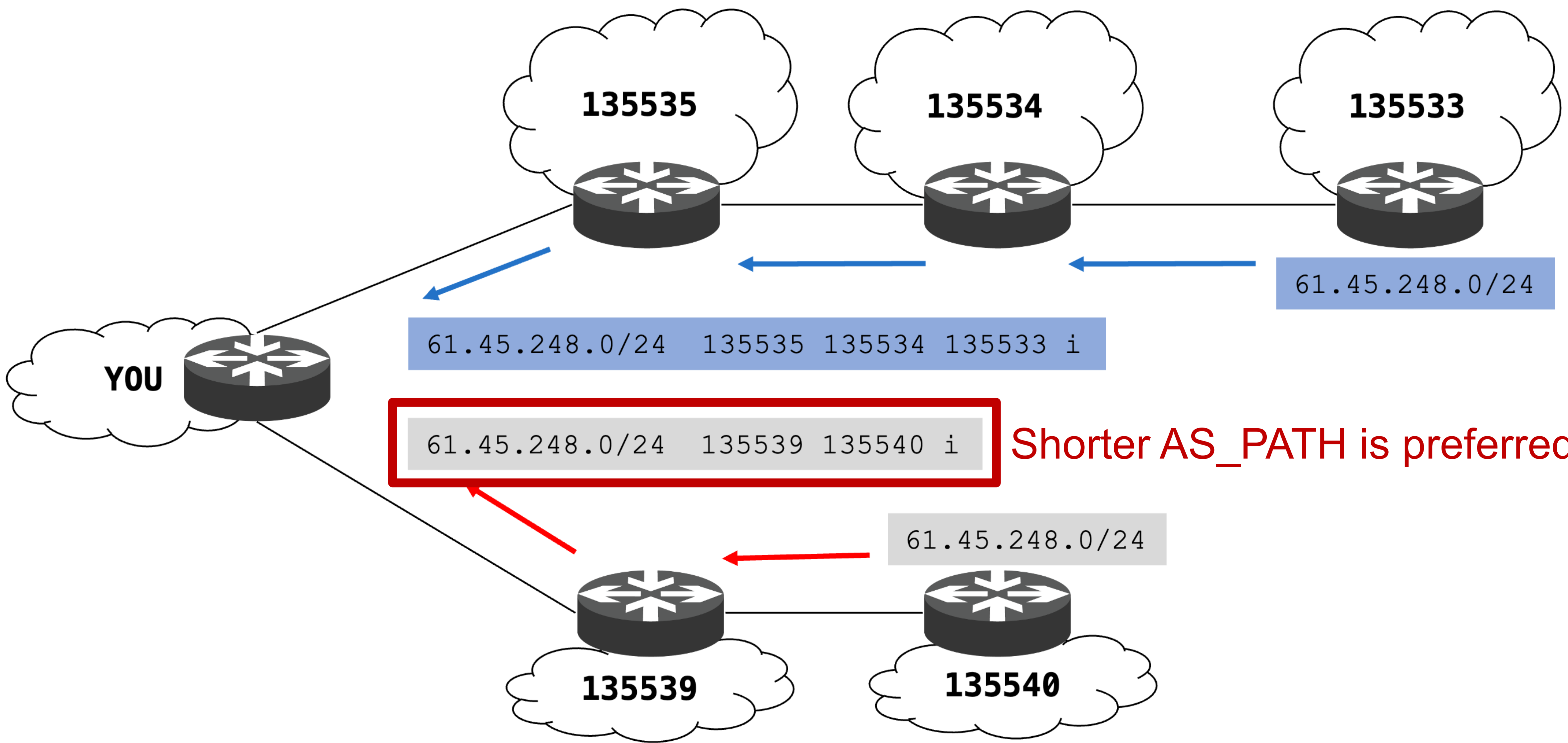


Source: Screenshot taken from “3.5.3.4 Packet Tracer - Configure and Verify eBGP.pka”
example from Connecting Networks Cisco Networking Academy course

Internet Routing



Internet Routing



BGP Hijack



- Announcing a more specific path.
- Announcing an address space that is owned by someone else.



Source: Williams, R. (2015). street signs being stolen [Image].
https://media.apnarm.net.au/media/images/2015/02/06/IQT_06-02-2015_NEWS_05_STOLENSIGNS1_t1880.jpg

What is RPKI?



- Resource Public Key Infrastructure.

Route Origin Authorisation (ROA)

Resource holders permit specific AS to originate their prefixes

Route Origin Validation (ROV)

Other networks check whether the received prefixes are originated by the permitted AS

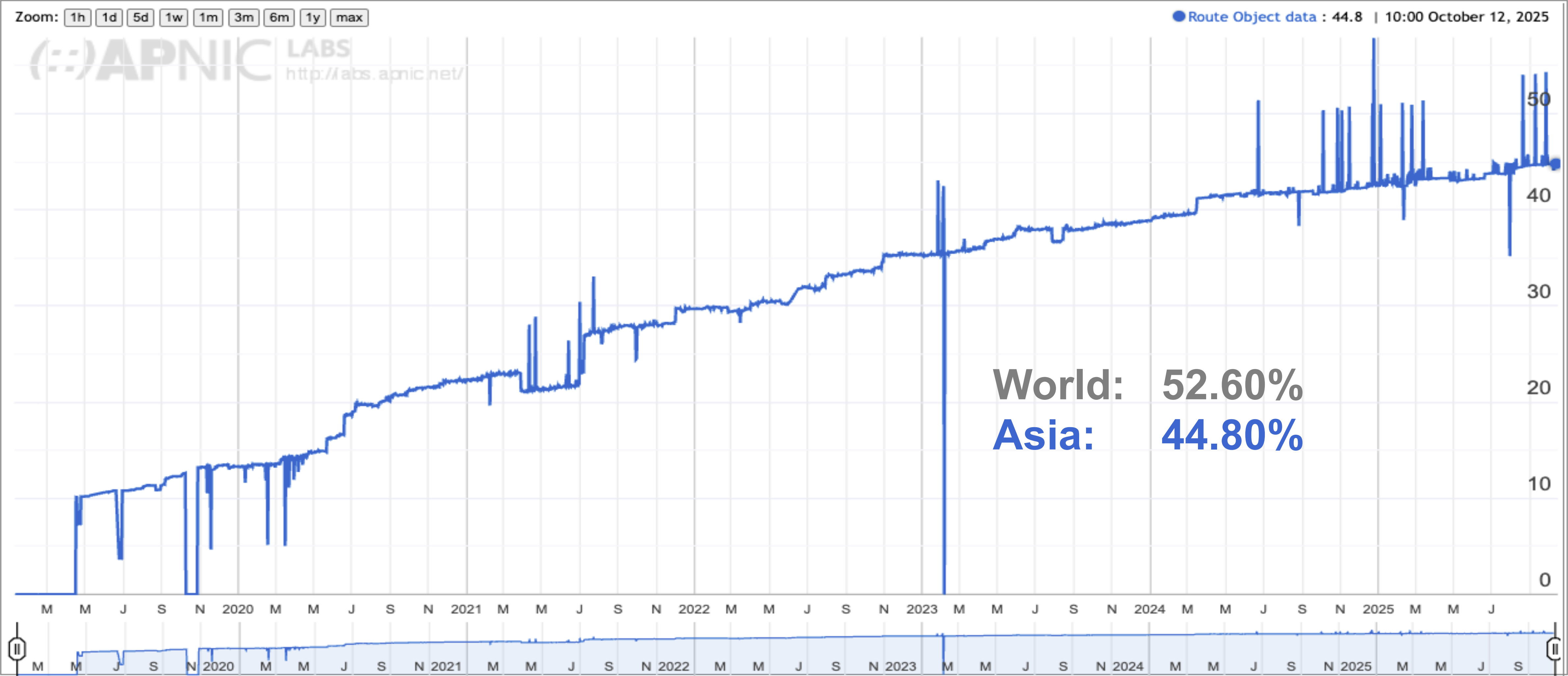
- For mitigating BGP route leaks and hijacks.
- ROA and ROV are done cryptographically.
 - Resource holders use private key to sign authorisations
 - Other networks use public key to validate the signatures

Route Origin Authorisation (ROA)



- To be done by resource holder:
 - Creating ROA for prefixes belong to own address space
 - Prefix
 - Origin AS
 - Max. Length
 - Also known as “Most Specific Announcement (MSA)”
 - APNIC members can create ROA in MyAPNIC portal
 - APNIC Help Centre: ROA objects
 - <https://help.apnic.net/s/article/roa-objects>
 - Route Management – Guide to manage your routes and (RPKI) ROA
 - <https://www.apnic.net/wp-content/uploads/2017/01/route-roa-management-guide.pdf>
 - How to Create ROAs in MyAPNIC
 - <https://www.youtube.com/watch?v=NLG2siznuu4>

ROA Signing in Asia



Source: <https://stats.labs.apnic.net/roa/XD> (13 Oct 2025)

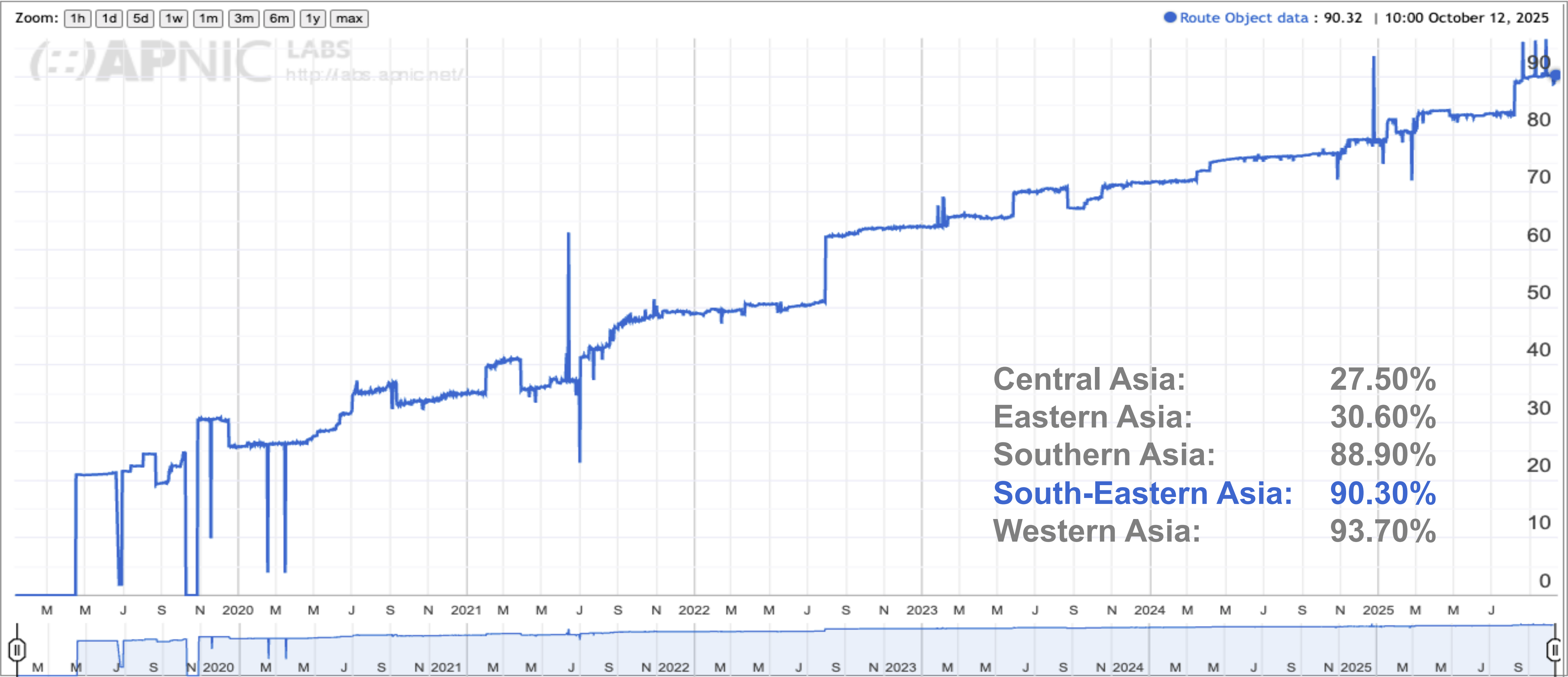
ROA Signing in Asia



Code	Region	V4 Valid	Pc ▼	V4 Invalid	Pc	V4 Unknwn	Pc	V4 Total Addr	V6 Valid	Pc	V6 Invalid	Pc	V6 Unknwn	Pc
MV	Maldives, Southern Asia, Asia	94,208	99.2%	0	0.0%	768	0.8%	94,976	1	100.0%	0	0.0%	0	0.0%
BT	Bhutan, Southern Asia, Asia	48,896	98.5%	0	0.0%	768	1.5%	49,664	11	100.0%	0	0.0%	0	0.0%
LB	Lebanon, Western Asia, Asia	533,504	98.5%	0	0.0%	8,192	1.5%	541,696	80	98.8%	0	0.0%	1	1.2%
VN	Vietnam, South-Eastern Asia, Asia	16,047,384	98.4%	29,672	0.2%	229,376	1.4%	16,306,432	29	65.9%	0	0.0%	14	31.8%
BD	Bangladesh, Southern Asia, Asia	1,867,464	98.3%	8,504	0.4%	23,808	1.3%	1,899,776	223	96.1%	2	0.9%	6	2.6%
IR	Iran (Islamic Republic of), Southern Asia, Asia	10,002,735	98.0%	33,489	0.3%	169,216	1.7%	10,205,440	729	94.9%	0	0.0%	39	5.1%
SA	Saudi Arabia, Western Asia, Asia	10,523,085	98.0%	9,523	0.1%	210,688	2.0%	10,743,296	87	75.0%	0	0.0%	28	24.1%
IQ	Iraq, Western Asia, Asia	736,509	97.9%	2,051	0.3%	13,824	1.8%	752,384	79	96.3%	0	0.0%	3	3.7%
TR	Turkey, Western Asia, Asia	15,758,834	97.5%	10,254	0.1%	395,776	2.4%	16,164,864	1,123	92.7%	38	3.1%	51	4.2%
NP	Nepal, Southern Asia, Asia	571,392	97.3%	768	0.1%	15,104	2.6%	587,264	40	93.0%	0	0.0%	3	7.0%
MN	Mongolia, Eastern Asia, Asia	164,828	96.4%	292	0.2%	5,888	3.4%	171,008	17	100.0%	0	0.0%	0	0.0%
PH	Philippines, South-Eastern Asia, Asia	6,213,183	95.9%	17,449	0.3%	249,087	3.8%	6,479,719	86	88.7%	0	0.0%	10	10.3%
PK	Pakistan, Southern Asia, Asia	5,065,401	95.7%	87,052	1.6%	140,048	2.6%	5,292,501	36	87.8%	0	0.0%	4	9.8%
IL	Israel, Western Asia, Asia	8,232,735	95.2%	2,785	0.0%	414,976	4.8%	8,650,496	305	94.4%	0	0.0%	18	5.6%
AE	United Arab Emirates, Western Asia, Asia	5,196,811	95.1%	174,581	3.2%	94,720	1.7%	5,466,112	2,949	91.2%	9	0.3%	274	8.5%
TW	Taiwan, Eastern Asia, Asia	32,771,340	95.1%	1,418,612	4.1%	272,128	0.8%	34,462,080	952	97.8%	4	0.4%	16	1.6%
MY	Malaysia, South-Eastern Asia, Asia	6,856,183	95.0%	6,411	0.1%	353,280	4.9%	7,215,874	52	75.4%	0	0.0%	17	24.6%
OM	Oman, Western Asia, Asia	975,988	94.3%	13,708	1.3%	45,312	4.4%	1,035,008	10	40.0%	0	0.0%	15	60.0%
YE	Yemen, Western Asia, Asia	222,208	94.3%	1,024	0.4%	12,288	5.2%	235,520	8	50.0%	0	0.0%	8	50.0%
LA	Lao People's Democratic Republic, South-Eastern Asia, Asia	86,528	92.9%	0	0.0%	6,656	7.1%	93,184	4	57.1%	0	0.0%	3	42.9%

Source: <https://stats.labs.apnic.net/roa/XD> (13 Oct 2025)

ROA Signing in South-Eastern Asia



Source: <https://stats.labs.apnic.net/roa/XU> (13 Oct 2025)

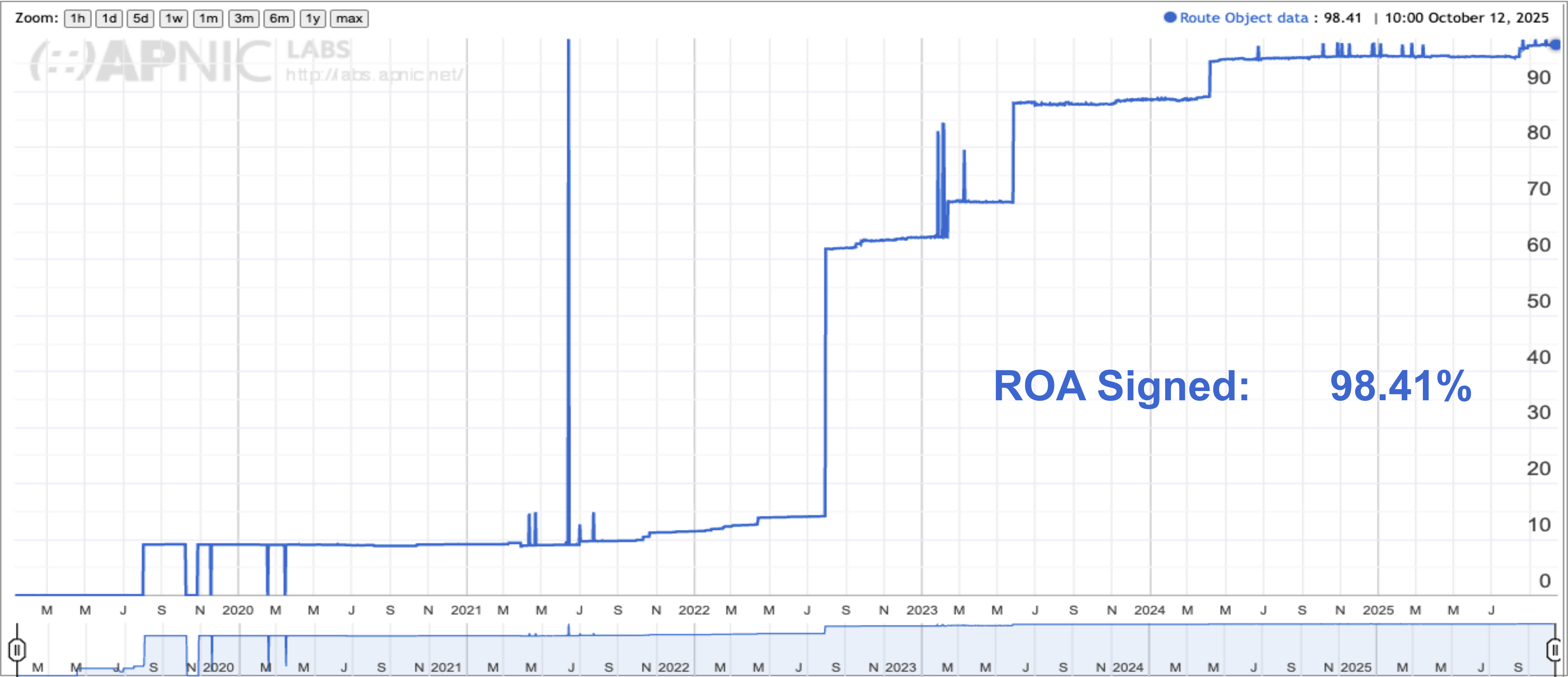
ROA Signing in South-Eastern Asia



Code	Region	V4 Valid	Pc ▼	V4 Invalid	Pc	V4 Unknwn	Pc	V4 Total Addrs	V6 Valid	Pc	V6 Invalid	Pc	V6 Unknwn	Pc
VN	Vietnam, South-Eastern Asia, Asia	16,047,384	98.4%	29,672	0.2%	229,376	1.4%	16,306,432	29	65.9%	0	0.0%	14	31.8%
PH	Philippines, South-Eastern Asia, Asia	6,213,183	95.9%	17,449	0.3%	249,087	3.8%	6,479,719	86	88.7%	0	0.0%	10	10.3%
MY	Malaysia, South-Eastern Asia, Asia	6,856,183	95.0%	6,411	0.1%	353,280	4.9%	7,215,874	52	75.4%	0	0.0%	17	24.6%
LA	Lao People's Democratic Republic, South-Eastern Asia, Asia	86,528	92.9%	0	0.0%	6,656	7.1%	93,184	4	57.1%	0	0.0%	3	42.9%
MM	Myanmar, South-Eastern Asia, Asia	193,792	89.9%	1,024	0.5%	20,736	9.6%	215,552	17	100.0%	0	0.0%	0	0.0%
SG	Singapore, South-Eastern Asia, Asia	14,155,845	89.0%	37,437	0.2%	1,707,144	10.7%	15,900,426	126	75.4%	0	0.0%	41	24.6%
ID	Indonesia, South-Eastern Asia, Asia	16,913,257	88.9%	39,575	0.2%	2,074,368	10.9%	19,027,200	240	80.8%	0	0.0%	57	19.2%
KH	Cambodia, South-Eastern Asia, Asia	419,838	88.7%	770	0.2%	52,480	11.1%	473,088	19	82.6%	0	0.0%	4	17.4%
TH	Thailand, South-Eastern Asia, Asia	7,060,969	74.7%	42,519	0.4%	2,350,592	24.9%	9,454,080	43	63.2%	0	0.0%	24	35.3%
TL	Timor-Leste, South-Eastern Asia, Asia	15,360	67.4%	1,024	4.5%	6,400	28.1%	22,784	1	50.0%	0	0.0%	1	50.0%
BN	Brunei Darussalam, South-Eastern Asia, Asia	71,936	48.5%	0	0.0%	76,288	51.5%	148,224	0	0.0%	0	0.0%	0	0.0%

Source: <https://stats.labs.apnic.net/roa/XU> (13 Oct 2025)

ROA Signing in Vietnam



Source: <https://stats.labs.apnic.net/roa/VN> (13 Oct 2025)

ROA Signing in Vietnam



AS	AS Name	V4 Valid	Pc ▼	V4 Invalid	Pc	V4 Unknwn	Pc	V4 Total Addrs	V6 Valid	Pc	V6 Invalid	Pc	V6 Unknwn	Pc
AS984	OWS-NETWORK	6,144	100.0%	0	0.0%	0	0.0%	6,144	0	0.0%	0	0.0%	0	0.0%
AS3491	CONSOLE-CONNECT-ASN	256	100.0%	0	0.0%	0	0.0%	256	0	0.0%	0	0.0%	0	0.0%
AS4637	ASN-TELSTRA-GLOBAL Telstra Global	256	100.0%	0	0.0%	0	0.0%	256	0	0.0%	0	0.0%	0	0.0%
AS5065	BUNNY-COMMUNICATIONS-GLOBAL	1,024	100.0%	0	0.0%	0	0.0%	1,024	0	0.0%	0	0.0%	0	0.0%
AS7602	SPT-AS-VN Sai gon Postel Corporation	75,754	100.0%	0	0.0%	0	0.0%	75,754	0	0.0%	0	0.0%	0	0.0%
AS9304	HUTCHISON-AS-AP HGC Global Communications Limited	2,816	100.0%	0	0.0%	0	0.0%	2,816	0	0.0%	0	0.0%	0	0.0%
AS13150	CATON	256	100.0%	0	0.0%	0	0.0%	256	0	0.0%	0	0.0%	0	0.0%
AS13335	CLOUDFLARENET	1,280	100.0%	0	0.0%	0	0.0%	1,280	0	0.0%	0	0.0%	0	0.0%
AS14593	SPACEX-STARLINK	1,024	100.0%	0	0.0%	0	0.0%	1,024	0	0.0%	0	0.0%	0	0.0%
AS16509	AMAZON-02	768	100.0%	0	0.0%	0	0.0%	768	0	0.0%	0	0.0%	0	0.0%
AS17497	LGHL-AS-AP Liasail Global Hongkong Limited	256	100.0%	0	0.0%	0	0.0%	256	0	0.0%	0	0.0%	0	0.0%
AS20648	TMN-SA	256	100.0%	0	0.0%	0	0.0%	256	0	0.0%	0	0.0%	0	0.0%
AS21211	PENKI-AS LT-01115, Vilnius	1,024	100.0%	0	0.0%	0	0.0%	1,024	0	0.0%	0	0.0%	0	0.0%
AS23899	VNIX-AS-VN Vietnam Internet network information center VNNIC	1,024	100.0%	0	0.0%	0	0.0%	1,024	0	0.0%	0	0.0%	0	0.0%
AS23902	VNNIC-AS-VN Vietnam Internet network information center VNNIC	2,048	100.0%	0	0.0%	0	0.0%	2,048	0	0.0%	0	0.0%	0	0.0%
AS23962	VNIX-AS-VN Vietnam Internet Network Information Center	1,024	100.0%	0	0.0%	0	0.0%	1,024	0	0.0%	0	0.0%	0	0.0%
AS24066	VNNIC-AS-VN Vietnam Internet Network Information Center	2,048	100.0%	0	0.0%	0	0.0%	2,048	0	0.0%	0	0.0%	0	0.0%
AS24086	VIETTEL-AS-VN Viettel Corporation	470,016	100.0%	0	0.0%	0	0.0%	470,016	0	0.0%	0	0.0%	0	0.0%
AS24088	HTCHCMC-AS-VN Hanoi Telecom Joint Stock Company - HCMC Branch	20,992	100.0%	0	0.0%	0	0.0%	20,992	0	0.0%	0	0.0%	0	0.0%
AS24089	VNNIC-AS-AP Vietnam Internet Network Information Center	1,024	100.0%	0	0.0%	0	0.0%	1,024	0	0.0%	0	0.0%	0	0.0%

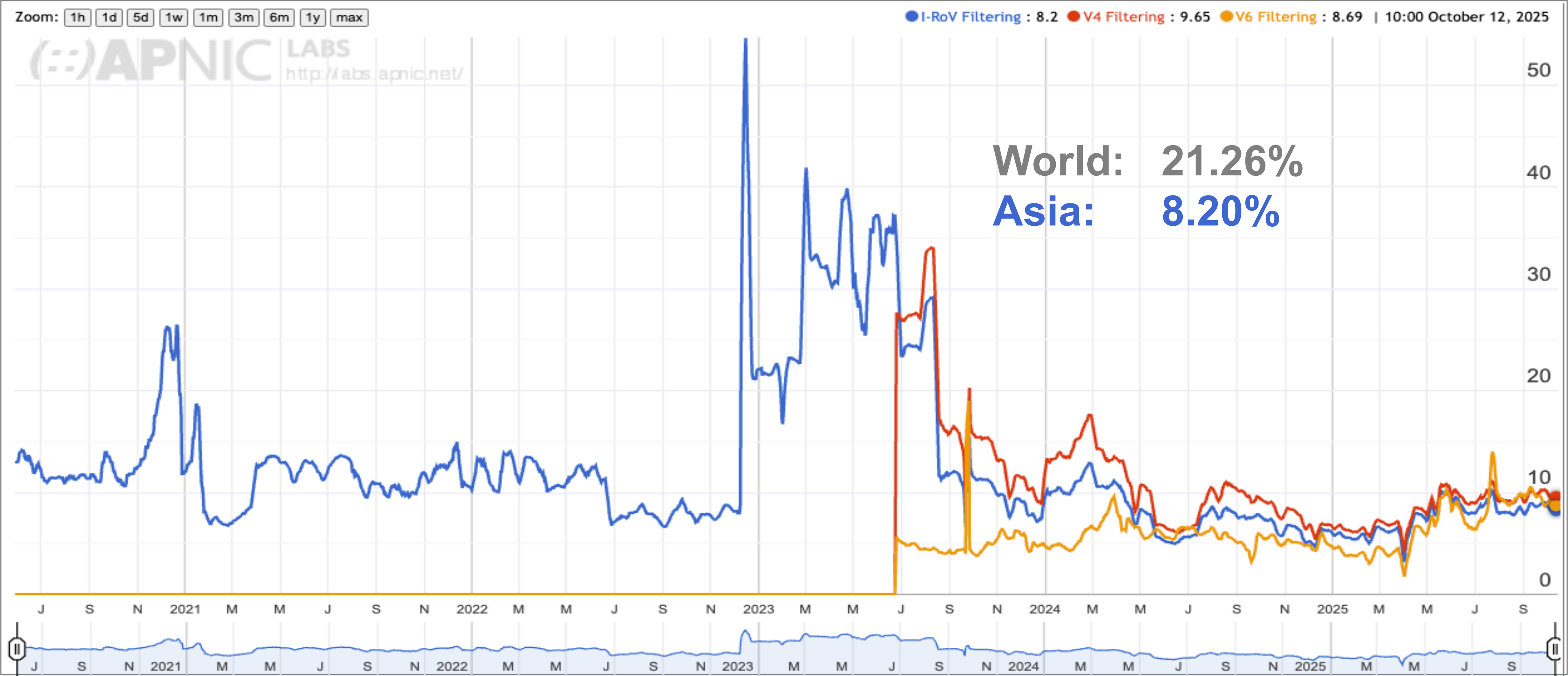
Source: <https://stats.labs.apnic.net/roa/VN> (13 Oct 2025)

Route Origin Validation (ROV)



- Should be done by all networks on the Internet:
 - Setting up RPKI Validators
 - Configuring Border Routers to validate received prefixes
 - **VALID**
 - ROA exists, both prefix length and origin AS match with the record
 - **INVALID**
 - ROA exists, but prefix length or/and origin AS mismatch with the record
 - **UNKNOWN / NOT FOUND**
 - ROA does not exist
 - Implementing routing policies based on validation state
 - Prefer **VALID** over **UNKNOWN** over **INVALID**; or
 - Drop **INVALID**

ROV Filtering in Asia



Source: <https://stats.labs.apnic.net/rpki/XD> (13 Oct 2025)

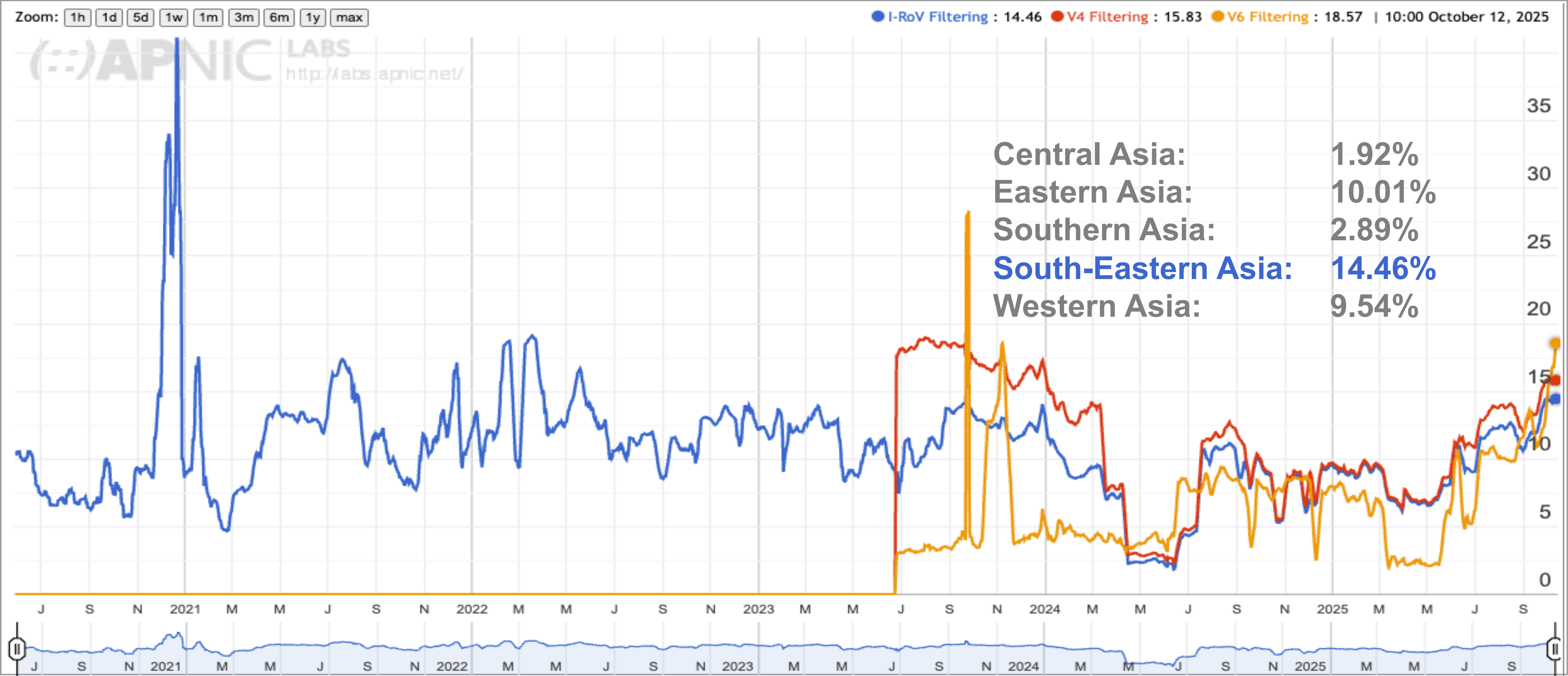
ROV Filtering in Asia



Code	Region	RPKI Validates ▼	Samples	Weight	Weighted Samples	V4 Validates	V4 Count	V6 Validates	V6 Count
TM	Turkmenistan, Central Asia, Asia	84.13%	334	10	38,757	84.13%	334	100.00%	1
MM	Myanmar, South-Eastern Asia, Asia	61.67%	41,133	10	467,791	65.12%	41,133	36.26%	2,551
SY	Syrian Arab Republic, Western Asia, Asia	57.00%	125,217	1.7	212,383	57.00%	125,217	85.71%	231
LB	Lebanon, Western Asia, Asia	55.29%	204,638	0.45	92,065	55.29%	204,638	95.35%	624
TW	Taiwan, Eastern Asia, Asia	44.33%	620,439	0.92	568,775	73.73%	620,439	22.72%	355,759
BT	Bhutan, Southern Asia, Asia	37.12%	14,141	0.69	9,815	37.54%	14,141	27.59%	4,791
CY	Cyprus, Western Asia, Asia	35.61%	37,800	0.66	24,825	35.62%	37,800	99.00%	6,013
JP	Japan, Eastern Asia, Asia	28.33%	3,547,415	0.68	2,423,975	28.99%	3,547,415	28.57%	2,080,195
IR	Iran (Islamic Republic of), Southern Asia, Asia	27.43%	60,214	10	1,438,133	31.89%	60,214	27.18%	8,704
MN	Mongolia, Eastern Asia, Asia	24.97%	80,398	0.25	19,703	25.04%	80,398	2.11%	33,338
HK	Hong Kong Special Administrative Region of China, Eastern Asia, Asia	22.29%	494,754	0.31	154,077	22.54%	494,754	34.62%	34,862
ID	Indonesia, South-Eastern Asia, Asia	21.48%	3,930,139	0.65	2,563,460	21.66%	3,930,139	24.45%	699,243
MY	Malaysia, South-Eastern Asia, Asia	18.48%	830,014	0.8	662,657	31.37%	830,014	32.98%	588,892
PS	State of Palestine, Western Asia, Asia	18.38%	83,489	1.06	88,690	18.39%	83,489	72.13%	61
VN	Vietnam, South-Eastern Asia, Asia	18.23%	1,415,863	0.85	1,204,666	18.37%	1,415,863	20.02%	869,376
PK	Pakistan, Southern Asia, Asia	14.61%	1,885,821	0.48	900,899	17.72%	1,885,821	15.31%	442,554
AM	Armenia, Western Asia, Asia	14.09%	86,776	0.55	47,931	14.10%	86,776	36.01%	7,312
SG	Singapore, South-Eastern Asia, Asia	12.89%	266,395	0.44	117,581	13.08%	266,395	10.39%	40,086
GE	Georgia, Western Asia, Asia	11.04%	88,913	0.63	55,667	11.23%	88,913	1.47%	12,277
AF	Afghanistan, Southern Asia, Asia	9.41%	89,117	1.48	132,033	9.42%	89,117	99.73%	4,052

Source: <https://stats.labs.apnic.net/rpki/XD> (13 Oct 2025)

ROV Filtering in South-Eastern Asia



Source: <https://stats.labs.apnic.net/rpki/XU> (13 Oct 2025)

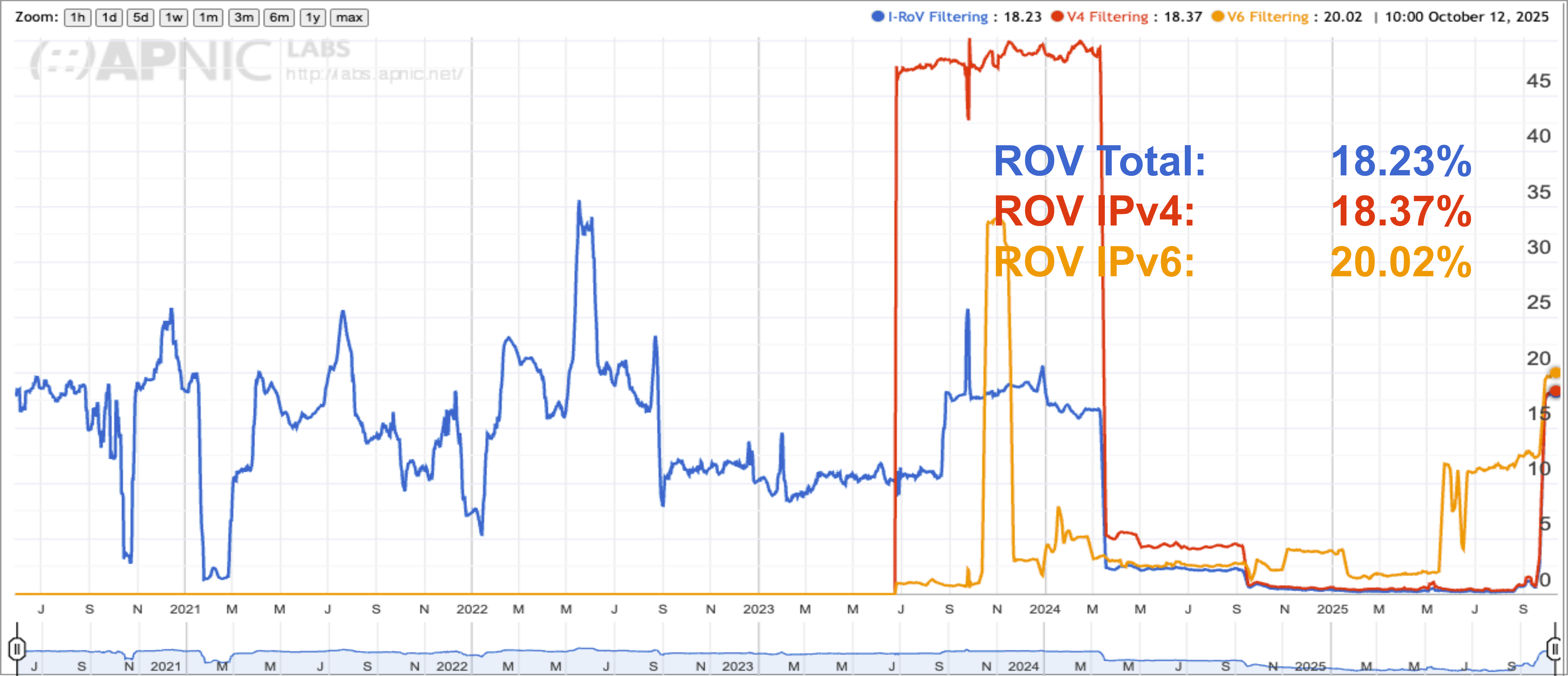
ROV Filtering in South-Eastern Asia



Code	Region	RPKI Validates ▼	Samples	Weight	Weighted Samples	V4 Validates	V4 Count	V6 Validates	V6 Count
MM	Myanmar, South-Eastern Asia, Asia	61.67%	41,133	10	467,791	65.12%	41,133	36.26%	2,551
ID	Indonesia, South-Eastern Asia, Asia	21.48%	3,930,139	0.65	2,563,460	21.66%	3,930,139	24.45%	699,243
MY	Malaysia, South-Eastern Asia, Asia	18.48%	830,014	0.8	662,657	31.37%	830,014	32.98%	588,892
VN	Vietnam, South-Eastern Asia, Asia	18.23%	1,415,863	0.85	1,204,666	18.37%	1,415,863	20.02%	869,376
SG	Singapore, South-Eastern Asia, Asia	12.89%	266,395	0.44	117,581	13.08%	266,395	10.39%	40,086
TL	Timor-Leste, South-Eastern Asia, Asia	0.92%	8,564	1.12	9,602	0.92%	8,564	0.90%	221
PH	Philippines, South-Eastern Asia, Asia	0.73%	1,514,049	1.16	1,760,025	1.11%	1,514,049	4.29%	292,061
KH	Cambodia, South-Eastern Asia, Asia	0.65%	117,322	1.33	156,293	0.65%	117,322	94.49%	272
BN	Brunei Darussalam, South-Eastern Asia, Asia	0.36%	19,977	0.56	11,139	0.36%	19,977	63.64%	22
LA	Lao People's Democratic Republic, South-Eastern Asia, Asia	0.34%	34,614	1.56	53,944	0.34%	34,614	100.00%	7
TH	Thailand, South-Eastern Asia, Asia	0.32%	1,023,662	0.98	998,244	0.51%	1,023,662	0.35%	517,899

Source: <https://stats.labs.apnic.net/rpki/XU> (13 Oct 2025)

ROV Filtering in Vietnam



Source: <https://stats.labs.apnic.net/rpki/VN> (13 Oct 2025)

ROV Filtering in Vietnam



ASN	AS Name	RPKI Validates ▼	Samples	V4 Validates	V4Count	V6 Validates	V6Count
AS135921	MAXSERVER-AS-VN Maxserver Company Limited	100.00%	180	100.00%	180	100.00%	56
AS135967	BKNS-AS-VN Bach Kim Network solutions Join stock company	100.00%	181	100.00%	181	100.00%	2
AS151858	INTERDIGI-VN INTERDIGI JOINT STOCK COMPANY	100.00%	127	100.00%	127	0.00%	0
AS149089	CLOUDFLY-VN CLOUDFLY CORPORATION	100.00%	76	100.00%	76	0.00%	0
AS13335	CLOUDFLARENET	99.73%	8,135	99.73%	8,135	99.83%	7,852
AS140825	HOSTINGVIET-AS-VN Thien Quang Digital technology joint stock company	99.64%	844	99.64%	844	0.00%	0
AS140815	HTTVSERVER-VN HTTVSERVER TECHNOLOGY COMPANY LIMITED	99.42%	172	99.42%	172	0.00%	0
AS18403	FPT-AS-AP FPT Telecom Company	99.18%	246,848	99.20%	246,848	99.50%	164,458
AS135918	DVS-AS-VN VIET DIGITAL TECHNOLOGY LIABILITY COMPANY	95.73%	655	95.73%	655	100.00%	8
AS135932	VNDATA-AS-VN Viet Storage Technology Joint Stock Company	86.19%	181	86.19%	181	100.00%	29
AS56150	VHOST-AS-VN Viet Solutions Services Trading Company Limited	33.87%	62	35.48%	62	0.00%	2
AS55309	MTT-AS-VN Minh Tu Telecom Limited Company	28.57%	77	28.57%	77	0.00%	0
AS63737	VIETSERVER-AS-VN VIETSERVER SERVICES TECHNOLOGY COMPANY LIMITED	21.35%	89	21.35%	89	0.00%	0
AS63741	DCNET-AS-VN DCNET TELECOM	12.90%	62	12.90%	62	0.00%	0
AS21859	ZEN-ECN	4.59%	109	4.59%	109	0.00%	0
AS45557	VNTT-AS-VN Vietnam Technology and Telecommunication JSC	4.37%	710	4.37%	710	98.10%	105
AS24173	NETNAM-AS-AP Netnam Company	2.28%	1,095	2.28%	1,095	0.00%	6
AS7602	SPT-AS-VN Sai gon Postel Corporation	1.47%	68	1.47%	68	0.00%	0
AS45903	CMCTELECOM-VN CMC Telecom Infrastructure Company	1.41%	1,485	1.41%	1,485	0.00%	37
AS24088	HTCHCMC-AS-VN Hanoi Telecom Joint Stock Company - HCMC Branch	0.74%	948	0.74%	948	6.56%	61

Source: <https://stats.labs.apnic.net/rpki/VN> (13 Oct 2025)

RPKI Status in Vietnam



- Impressive ROA signing rate (98.41%).
 - A leading example in Asia
- ROV filtering remains limited (18.23%).
 - Apart from FPT, major operators are not effectively doing validation
- **Next step: Enable ROV filtering.**
 - ROA permits a specific AS to originate a specific prefix
 - ROAs are created for other networks to perform ROV
 - The authorisation is meaningless if no one validates it
 - All networks should eventually implement ROV

Major Networks Dropping INVALID



ASN	Name	Source
1221	Telstra	https://lists.ausnog.net/pipermail/ausnog/2020-July/044367.html
4637		https://www.zdnet.com/article/telstra-to-roll-out-rpki-routing-security-from-june-2020/
1239	Sprint / T-Mobile	https://www.sprint.net/policies/bgp-aggregation-and-filtering
1299	Telia	https://www.teliacarrier.com/Our-Network/BGP-Routing/Routing-Security.html
2497	IIJ	https://www.ij.ad.jp/en/dev/iir/pdf/iir
2914	NTT	https://www.gin.ntt.net/support/policy/rr.cfm#RPKI
3356	Level3	https://twitter.com/lumentechco/status/1374035675742412800
4826	Vocus	https://blog.apnic.net/2021/05/13/vocus-rpki-implementation/
6939	Hurricane Electric	https://mailman.nanog.org/pipermail/nanog/2020-June/108277.html
7018	AT&T	https://mailman.nanog.org/pipermail/nanog/2019-February/099501.html
7922	Comcast	https://corporate.comcast.com/stories/improved-bgp-routing-security-adds-another-layer-of-protection-to-network
9002	RETN	https://twitter.com/RETNnet/status/1333735456408793089
16509	Amazon	https://aws.amazon.com/blogs/networking-and-content-delivery/how-aws-is-helping-to-secure-internet-routing/
37100	Seacom	https://www.ripe.net/participate/mail/forum/routing-wg/PDZIMzAzMzhhlWVhOTAtnZlxOC1IMzi0LTBjZjMyOGI1Y2NkM0BzZWJb20ubXU+
...		

Source: <https://weitongli.com/publications/papers/li-2023-rov.pdf> (24 Oct 2023)

Recommendations for RPKI



- Create ROAs for all your prefixes.
 - Origin AS and Max. Length must match actual BGP announcements
 - Ensure ROAs are up-to-date upon sub-assignments
 - Multiple ROAs with different Origin ASes for Anycast prefixes
 - For networks using leased IPv4 address space, request your lease provider to create relevant ROAs
 - Regardless whether the address space is in APNIC region
- Advise your customers and peers to sign their prefixes.
 - Unlike Internet Routing Registry (IRR), ROA cannot be proxy-registered
- Monitor whether your network is announcing INVALID.

Recommendations for RPKI



- Implement ROV in your network.
 - Employ at least two RPKI Validators for redundancy purpose
 - Ensure consistency across all RPKI Validators
 - Establish and secure RPKI-to-Router (RTR) sessions
 - Update routing policies to support ROV
 - Set LOCAL_PREF based on validation state, or drop INVALID (preferred)
 - Use BGP Communities to propagate validation state (optional)
 - For Internet Transit, receive full routing table and drop default route

Autonomous System Provider Authorisation (ASPA)

- New routing security mechanism based on RPKI.
- Extends RPKI's protection to include AS_PATH validation.
- ROV validates who is authorised to originate a prefix.
 - Verifies origin ASNs using ROA objects
 - Detects prefixes originated by unauthorised ASNs
- ASPA validates how a prefix is propagated through ASes.
 - Verifies provider-customer relationships using ASPA objects
 - Detects unauthorised prefix propagation
 - Leaking Internet prefixes received from Provider 1 to Provider 2
 - Leaking Internet prefixes to peers
 - Leaking peer prefixes to other peers or upstream providers

Autonomous System Provider Authorisation (ASPA)

- Recent Development of ASPA:
 - IETF:
 - draft-ietf-sidrops-aspa-verification-23
 - <https://datatracker.ietf.org/doc/draft-ietf-sidrops-aspa-verification/>
 - MANRS:
 - Estimating the Timeline for ASPA Deployment
 - <https://manrs.org/2023/05/estimating-the-timeline-for-aspa-deployment/>
 - APNIC Blog:
 - RPKI's 2024 year in review
 - <https://blog.apnic.net/2025/01/28/rpkis-2024-year-in-review/>
 - Advancing RPKI: NRO RPKI Program in 2025 for trust, transparency, and user experience
 - <https://blog.apnic.net/2025/08/25/advancing-rpki-nro-rpki-program-2025/>

Need Help in RPKI?



General Information

APNIC RPKI Page

<https://www.apnic.net/community/security/resource-certification/>

APNIC Help Centre

<https://help.apnic.net/s>

Technical Discussions

APNIC Technical Assistance

<https://academy.apnic.net/technical-assistance>

Training Resources

APNIC Academy

<https://academy.apnic.net>

Online Courses:

- ☐ [RPKI Deployment](#)
- ☐ [RPKI Deployment Status: 2022 in Review](#)
- ☐ [Historical Resource Management and the Benefits of RPKI](#)
- ☐ [Hosted vs. Delegated RPKI](#)
- ☐ [Demystifying AS0](#)
- ☐ [How to set up Router/OS 7 and ROV](#)

Virtual Labs:

- ☐ [RPKI Deployment Lab](#)

Thank you for your attention!

Contact Me

- ❑ E-mail: makito.lay@apnic.net
- ❑ LinkedIn: <https://www.linkedin.com/in/ogawamakito>

