IETF 125

Source Address Validation Deployment Status

draft-wang-sav-deployment-status-02

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https://datatracker.ietf.org/doc/draft-wang-sav-deployment-status/

Draft Updates Since Draft-00

- Category
  - ✓ From ***standard*** to ***information***
- Measuring methods
  - ✓ Added ***KI3 SAV-T*** as an additional example for client-based measurement methods
- Measuring Results
  - ✓ Updated global measurement results to ***January 2026*** data
  - ✓ Provided ***in-depth analysis*** of MANRS impact on SAV deployment

Deployment Status - Global Picture

- In January 2026, we used various methods to measure SAV deployment in the Internet
  - ✓ **66.6% of the tested IPv4 and 80.5% of the tested IPv6 ASes lack any ISAV deployment**
  - ✓ **Partial ISAV deployment is observed in 29.6% of IPv4 and 15.1% of IPv6 ASes, suggesting that ISAV is selectively deployed, for example at access-facing interfaces.**
  - ✓ **11.0% of IPv4 ASes and 11.2% of IPv4 /24 prefixes demonstrate complete OSAV deployment**

Category	IPv4 ASNs	IPv6 ASNs
Deployed	1,465 (3.9%)	352 (4.4%)
Not Deployed	25,319 (66.6%)	6,490 (80.5%)
Partially Deployed	11,255 (29.6%)	1,217 (15.1%)

ISAV deployment status across ASes

Category	IPv4 Prefixes	IPv6 Prefixes
Deployed	189,321 (24.4%)	48,864 (12.6%)
Not Deployed	539,649 (69.7%)	277,610 (71.7%)
Partially Deployed	45,626 (5.9%)	60,944 (15.7%)

ISAV deployment status across prefixes

Category	IPv4 ASNs	IPv6 ASNs
Deployed	290 (11.0%)	387 (80.5%)
Not Deployed	2,272 (85.8%)	62 (12.9%)
Partially Deployed	86 (3.2%)	32 (6.7%)

OSAV deployment status across ASes

Category	IPv4 Prefixes	IPv6 Prefixes
Deployed	795 (11.2%)	2,904 (96.0%)
Not deployed	6,211 (87.7%)	112 (3.7%)
Partially Deployed	73 (1.0%)	10 (0.3%)

OSAV deployment status across prefixes

Deployment Status - Global Picture

- The prefix length of /16-/24 dominates OSAV deployment (67.71%)
  - ✓ corresponding to common IPv4 allocation units for ASes.
  - ✓ This distribution is consistent with OSAV being predominantly deployed at AS border routers, where filtering is typically performed using aggregated address blocks, rather than at access-facing routers that would require finer grained prefix filtering.
- 44.48% of networks filter inbound spoofing packets at /29-/30 granularity
  - ✓ This pattern suggests that ISAV is predominantly deployed at
  - ✓ access-facing interfaces, where fine-grained prefix filtering is operationally feasible.

anularity	Percenta
/8	0.00
/9	0.00
/10	0.62
/11	0.00
/12	2.48
/13	0.62
/14	0.62
/15	4.35
/16	17.39
/17	5.59
/18	3.73
/19	5.59
/20	5.59
/21	3.11
/22	9.32
/23	5.59
/24	11.80
/25	4.35
/26	4.35
/27	2.48
/28	4.35
/29	4.97
/30	2.48
/31	0.62

OSAV filtering granularity (IPv4)

anularity	Percenta
/8	0.50
/9	2.26
/10	5.31
/11	4.86
/12	4.57
/13	3.58
/14	3.64
/15	7.41
/16	2.59
/17	2.67
/18	2.09
/19	1.57
/20	1.16
/21	2.28
/22	1.45
/23	2.73
/24	1.47
/25	1.02
/26	1.27
/27	1.31
/28	1.78
/29	24.53
/30	19.95

ISAV filtering granularity (IPv4)

Deployment Status - Global Picture

- 96.28% of the tested IP addresses deploy OSAV within 2 hops from the endpoints

Hop	Percentage
1	87.55 %
2	8.73 %
3	1.21 %
4	0.61 %
5	0.61 %
6	0.52 %
7	0.52 %
8	0.17 %
9	0.09 %
10	0.00 %

OSAV filtering depth (IPv4)

Deployment Status - Deployment in Countries/Regions

- Canada, China, and the United States exhibit relatively higher OSAV deployment ratios,while India, Bangladesh, and Ecuador show limited observable OSAV deployment. Brazil also exhibits relatively low OSAV deployment ratios with 2,210 prefixes tested.
- ISAV deployment remains limited in most regions; however, South Korea and Egypt stand out as notable exceptions with substantially higher ISAV deployment ratios.

Country	OSAV Tested Prefixes	OSAV Deployment Ratio
CA	114	50.0%
CN	130	43.1%
US	339	41.6%
CZ	61	26.2%
ES	43	23.3%
PL	59	20.3%
TR	213	19.7%
MX	36	19.4%
IT	119	9.2%
RU	74	5.4%
PK	98	5.1%
ZA	65	4.6%
BR	2,210	3.7%
ID	382	3.4%
NG	36	2.8%
AR	216	1.9%
PA	77	1.3%
IN	1,276	1.2%
BD	584	0.0%
EC	71	0.0%

OSAV deployment

Country	ISAV Tested Prefixes	ISAV Deployment Ratio
KR	45,709	73.9%
EG	9,923	71.4%
TW	11,757	68.6%
VN	9,101	55.5%
PL	12,921	53.3%
FR	14,123	43.8%
DE	17,631	27.3%
US	180,683	24.7%
CA	9,507	23.8%
BR	26,366	22.7%
GB	10,883	18.7%
RU	45,055	15.7%
AU	11,022	14.3%
JP	23,134	12.5%
IT	15,400	10.5%
IN	16,891	7.1%
CN	96,451	5.9%
ID	13,797	5.4%
MX	11,193	4.7%
DZ	11,093	0.9%

ISAV deployment

Deployment Status - Comparison between ISAV and OSAV

- For OSAV, a smaller number of ASes, such as DigitalOcean (AS14061) and China Telecom (AS4134), demonstrate high OSAV deployment ratios across their tested /24 prefixes.
- For ISAV, several large providers, including Chunghwa Telecom (AS3462), SK Broadband (AS9318), Korea Telecom (AS4766), Telecom Egypt (AS8452), Charter Communications (AS10796, AS20115), and Comcast Cable Communications (AS7922), exhibit high deployment ratios.

ASN	OSAV Tested Prefixes	OSAV Deployment Ratio
14061	37	100.0%
4134	42	83.3%
17995	67	77.6%
9121	31	51.6%
15924	88	20.5%
52965	31	3.2%
52468	75	1.3%
150008	101	0.0%
23956	54	0.0%
395582	51	0.0%
58495	45	0.0%
52419	43	0.0%
34984	42	0.0%
52444	38	0.0%
18002	36	0.0%
45804	35	0.0%
18229	34	0.0%
58678	32	0.0%
52426	32	0.0%
37403	29	0.0%

OSAV deployment

ASN	ISAV Tested Prefixes	ISAV Deployment Ratio
3462	8,462	93.3%
9318	7,537	91.8%
4766	26,312	90.3%
8452	6,523	84.3%
10796	6,809	60.3%
7922	9,071	59.7%
20115	10,434	56.8%
209	8,514	9.9%
7018	6,559	9.3%
12389	9,557	8.7%
4812	6,052	7.4%
16509	8,371	6.1%
3269	7,196	5.9%
4134	23,992	5.9%
4713	6,972	5.4%
4837	23,663	4.0%
8151	7,988	1.7%
36947	11,064	0.9%
749	9,636	0.0%
45090	7,000	0.0%

ISAV deployment

Impact of MANRS on OSAV Deployment

- To examine the relationship between MANRS participation and the deployment of SAV, we analyze measurement results for both OSAV and ISAV deployments.
- For OSAV, MANRS-participating ASes exhibit a substantially higher proportion of *Deployed* networks compared to non-MANRS ASes (37.5% versus 10.1%). In contrast, the *Not Deployed* state is significantly more prevalent among non-MANRS ASes (86.3%) than among MANRS ASes (51.9%).
- A chi-squared test suggests that **MANRS participation and OSAV deployment status are not independent.**

	Deployed	Partially Deployed	Not Deployed
MANRS	117 (37.5%)	33 (10.6%)	162 (51.9%)
Non-MANRS	314 (10.1%)	113 (3.6%)	2,694 (86.3%)

Impact of MANRS on ISAV Deployment

- For ISAV, MANRS ASes show higher proportions of *Deployed* and *Partially Deployed* networks, while non-MANRS ASes are more likely to be classified as *Not Deployed*.
- The chi-squared test for ISAV also indicates a statistically significant association between MANRS participation and ISAV deployment status.

- These results indicate a strong statistical association between MANRS participation and the observed deployment of SAV mechanisms in both OSAV and ISAV scenarios.
- While this analysis does not establish causality, the measurements consistently show that ASes participating in MANRS are more likely to deploy SAV than those that do not.

	Deployed	Partially Deployed	Not Deployed
MANRS	124 (18.6%)	339 (50.7%)	205 (30.7%)
Non-MANRS	2,902 (12.1%)	9,561 (39.8%)	11,565 (48.1%)

Measuring SAV deployment with SAV-T

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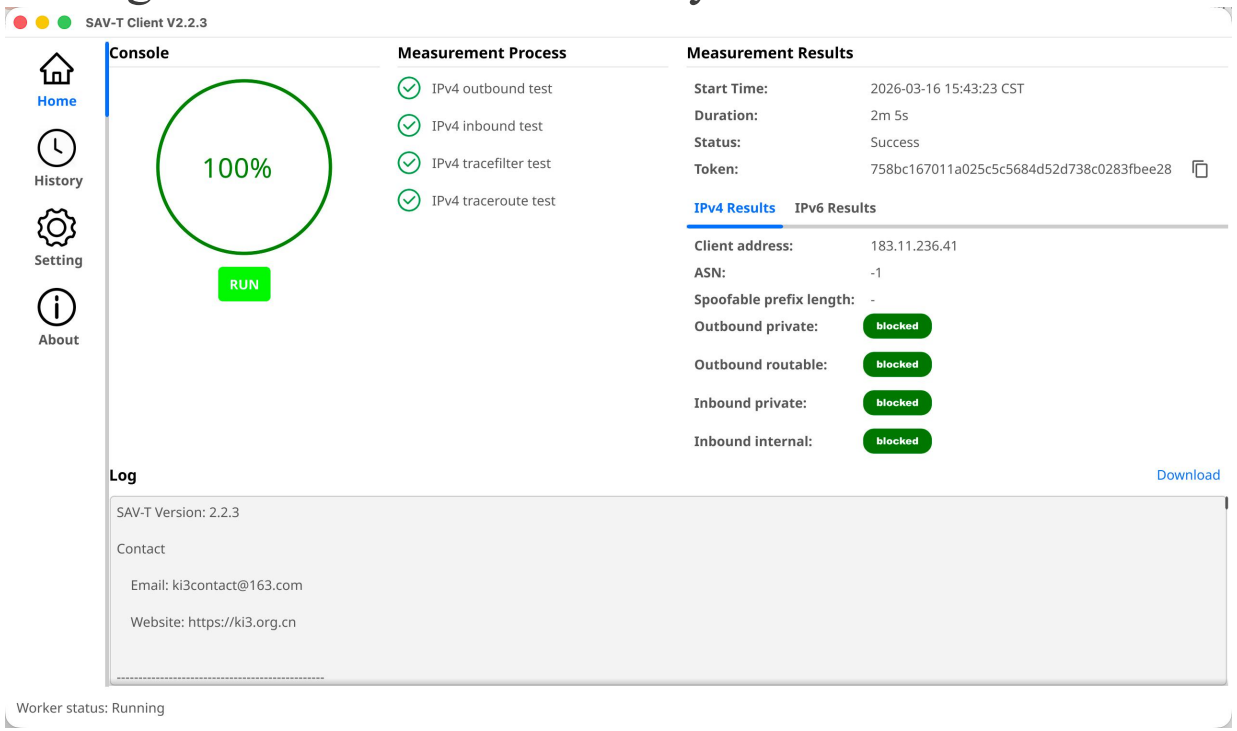
March 19, 2026

What is SAV-T

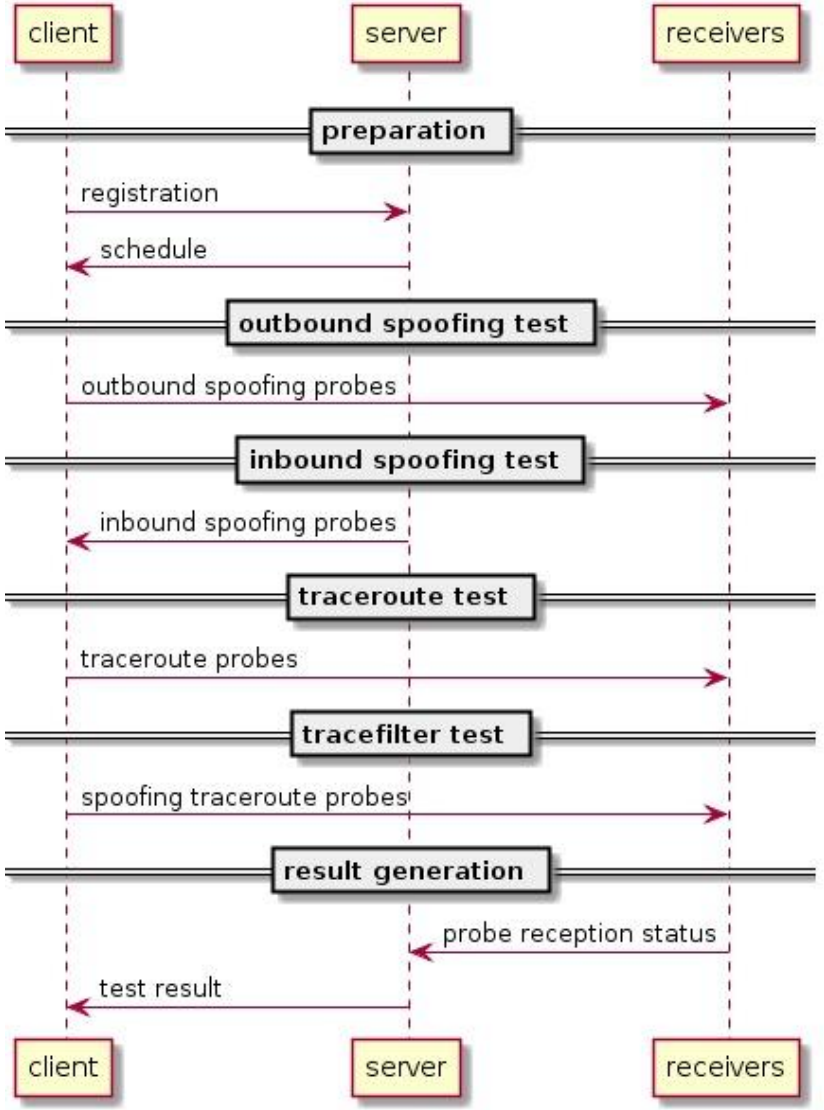
- SAV-T is a platform for testing and disclosing deployment data of source address validation
  - ✓For testing, SAV-T client is easy to install and runs on one click.
  - ✓For disclosing, SAV-T collects users' testing data for research use only and discloses data with users' permission.
- SAV-T can test
  - ✓private & routable
  - ✓inbound & outbound
  - ✓IPv4 & IPv6
  - ✓spoofable prefix length



How does SAV-T work

- SAV-T controls three characters: **client**, **server** and **receivers**.

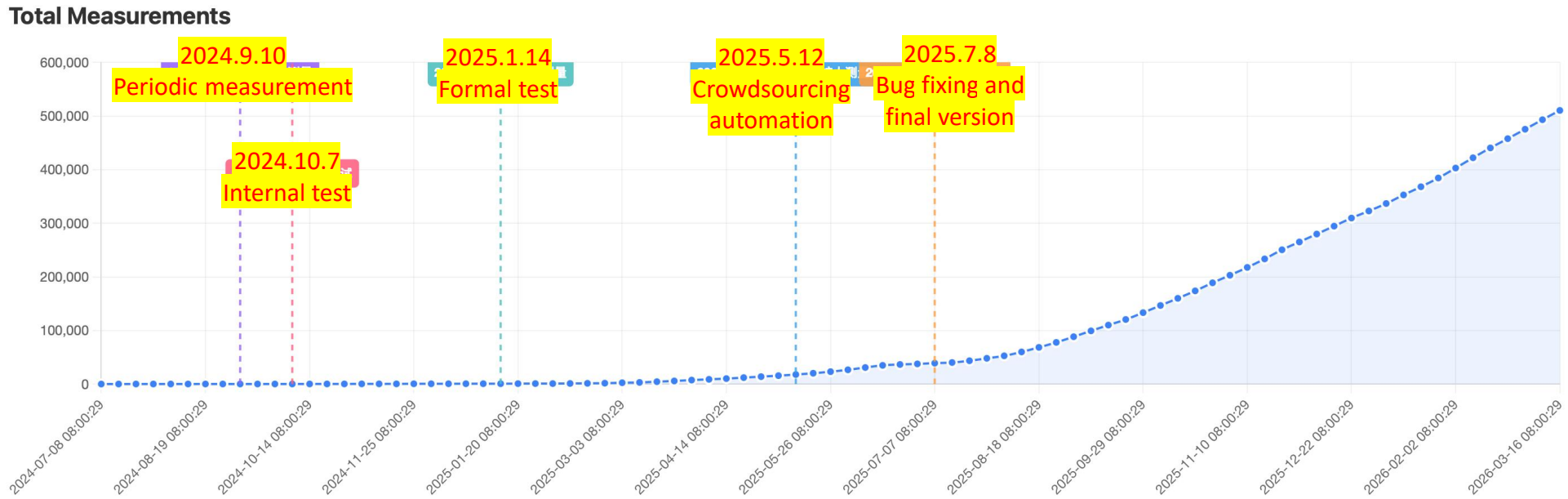
1. **Client** registers a new measurement routine in **server**.
2. **Server** sends the schedule (which addresses to spoof) to **client**.
3. **Client** sends packets sourced with scheduled addresses to **receivers**. (**outbound spoofing test**)
4. **Server** sends spoofed packets sourced with address that is in the same network with **client**. (**inbound spoofing test**)
5. **Client** sends traceroute probes to **receivers**. (**traceroute test**)
6. **Client** sends tracefilter probes to **receivers**. (**tracefilter test**)
7. **Receivers** return the probe reception status to **server**.
8. **Server** returns test result to **client**.



How we promote SAV-T

Crowdsourcing

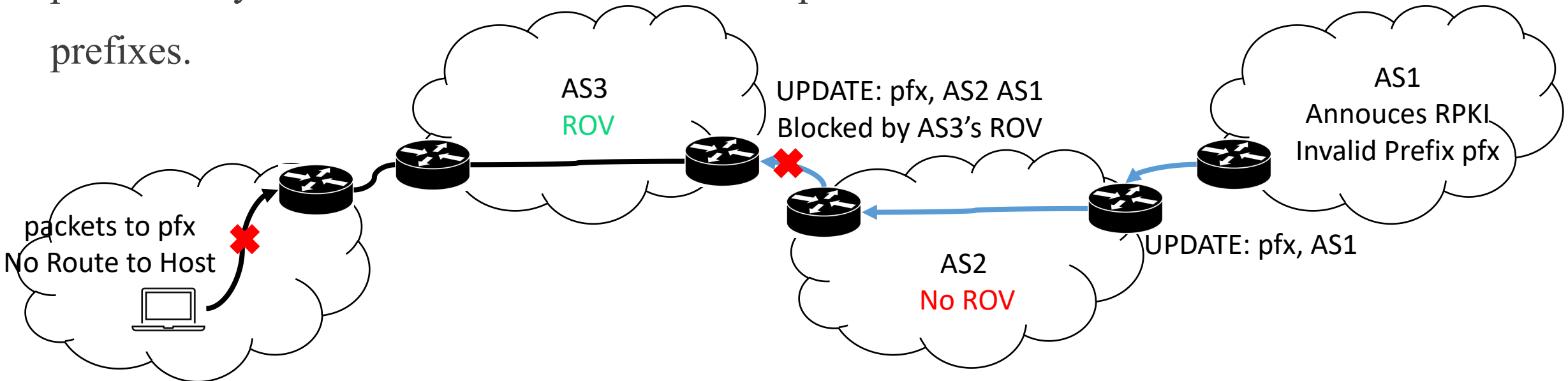
- ✓We pay workers on Prolific to test more networks.
- ✓We automate the whole process and make large scale measurements by crowdsourcing much easier.
- ✓We paid 8.9k workers and **tested 1,955 ASes**, covering **35k IPv4 /24 networks** and **4k IPv6 /40 networks**.



The # measurements done by SAV-T. Yellow line is when we started crowdsourcing.

ROV Measurement on SAV-T

- SAV-T is basically a framework for ping and traceroute. The server gives commands and the client executes the measurements.
- ROV measurement tests whether the network is under the protection of ROV.
- The client sends several traceroute probes to RPKI invalid prefixes. A network is not protected by ROV if the client can receive responses from active hosts in RPKI invalid prefixes.



- Thanks for your listening!
- You can download and test SAV-T on our website: https://ki3.org.cn/#/sav-t
- SAV-T is open-sourced at https://github.com/KI3-Team/savt-client
- Email: wangshuai@zgclab.edu.cn, lirf@mail.zgclab.edu.cn

SAV-T Website

SAV-T GitHub Repo