@Benjojo12 / ben@benjojo.co.uk / $whois as206924

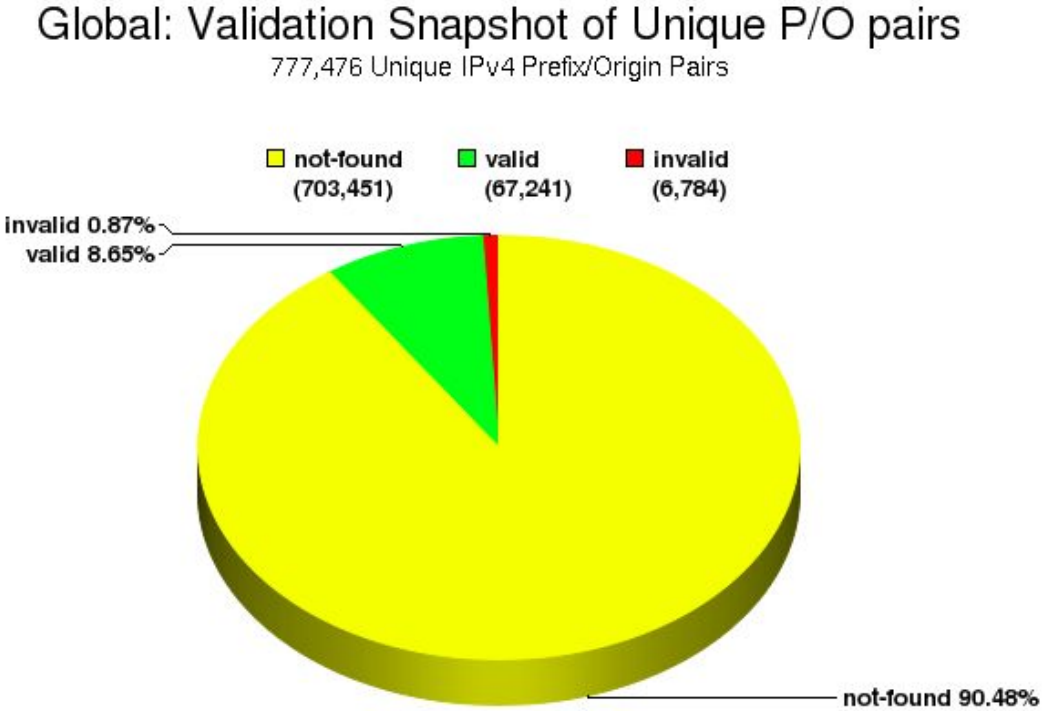
Measuring RPKI Adoption

using the ✨data-plane✨

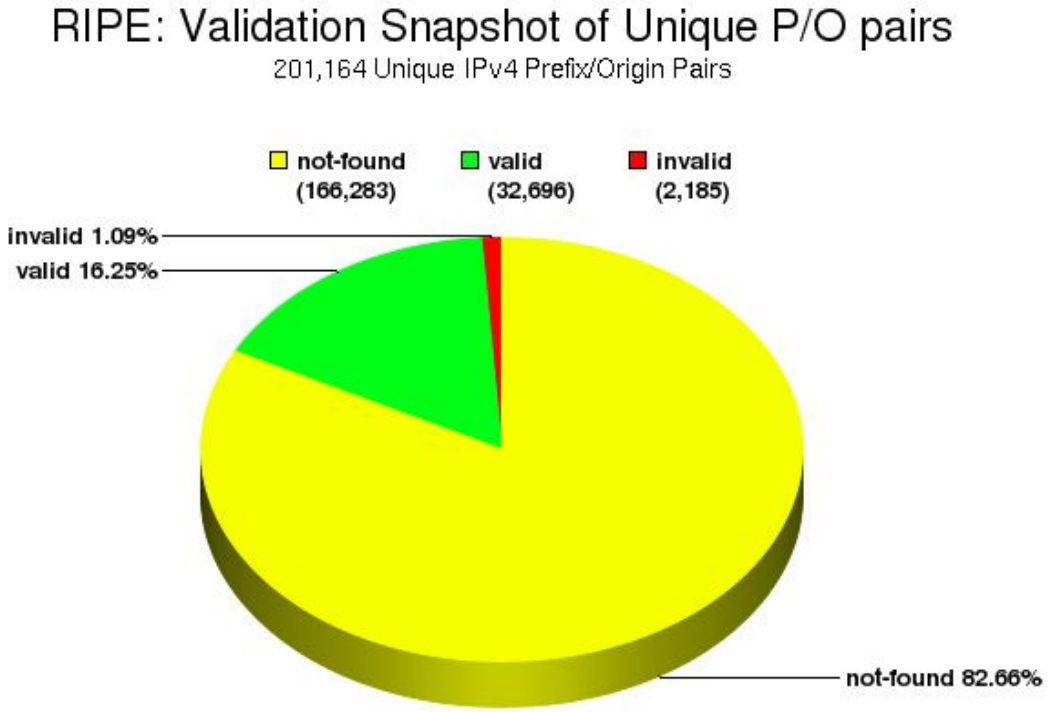
Ben Cartwright-Cox

dac3cda3f35eb6f2ff99d5ed174d6204

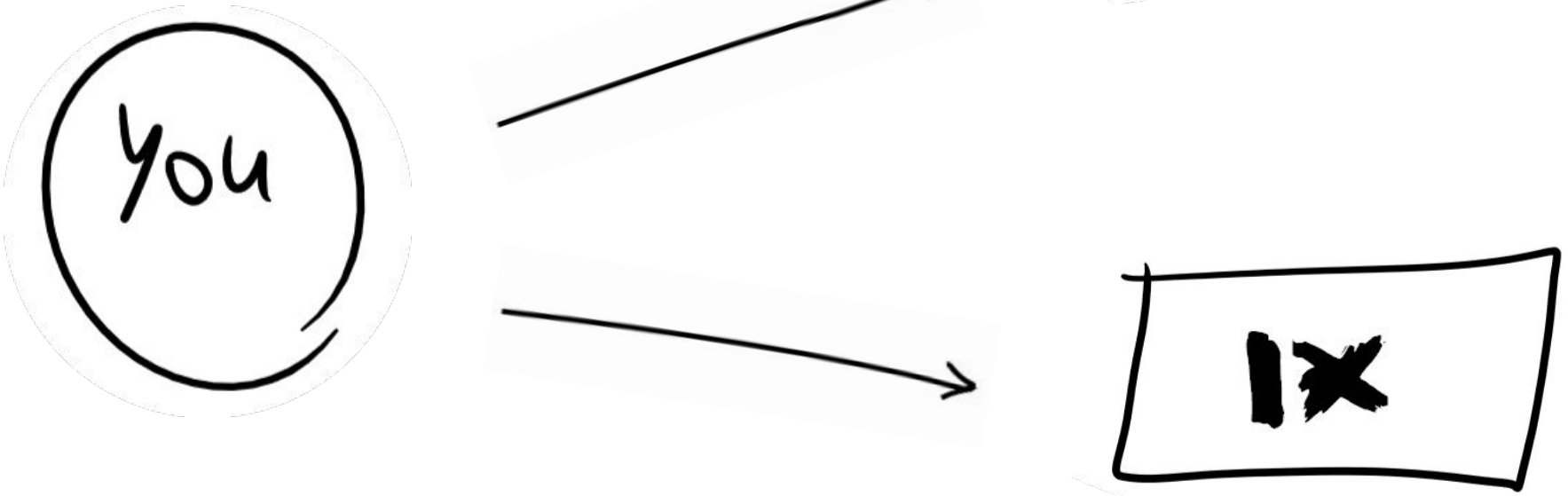
RPKI adoption is growing

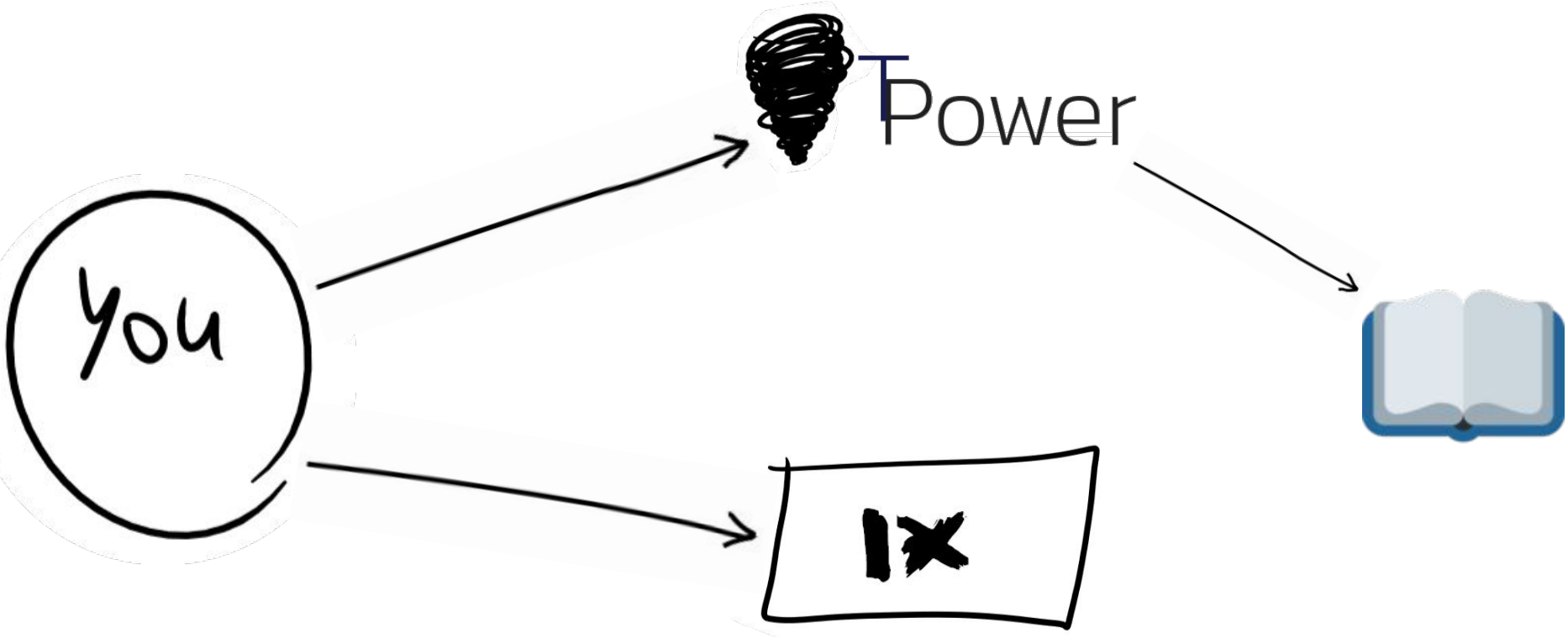


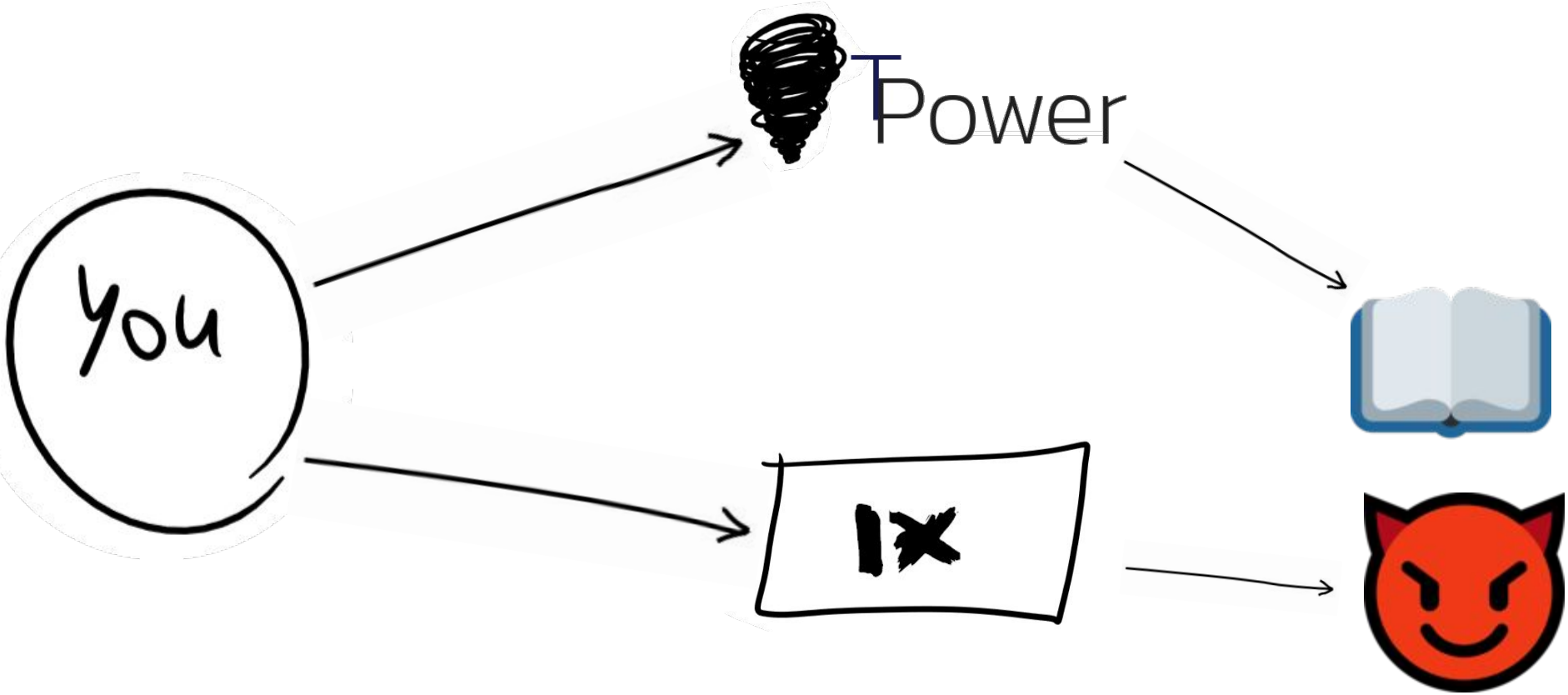
Even better in RIPE

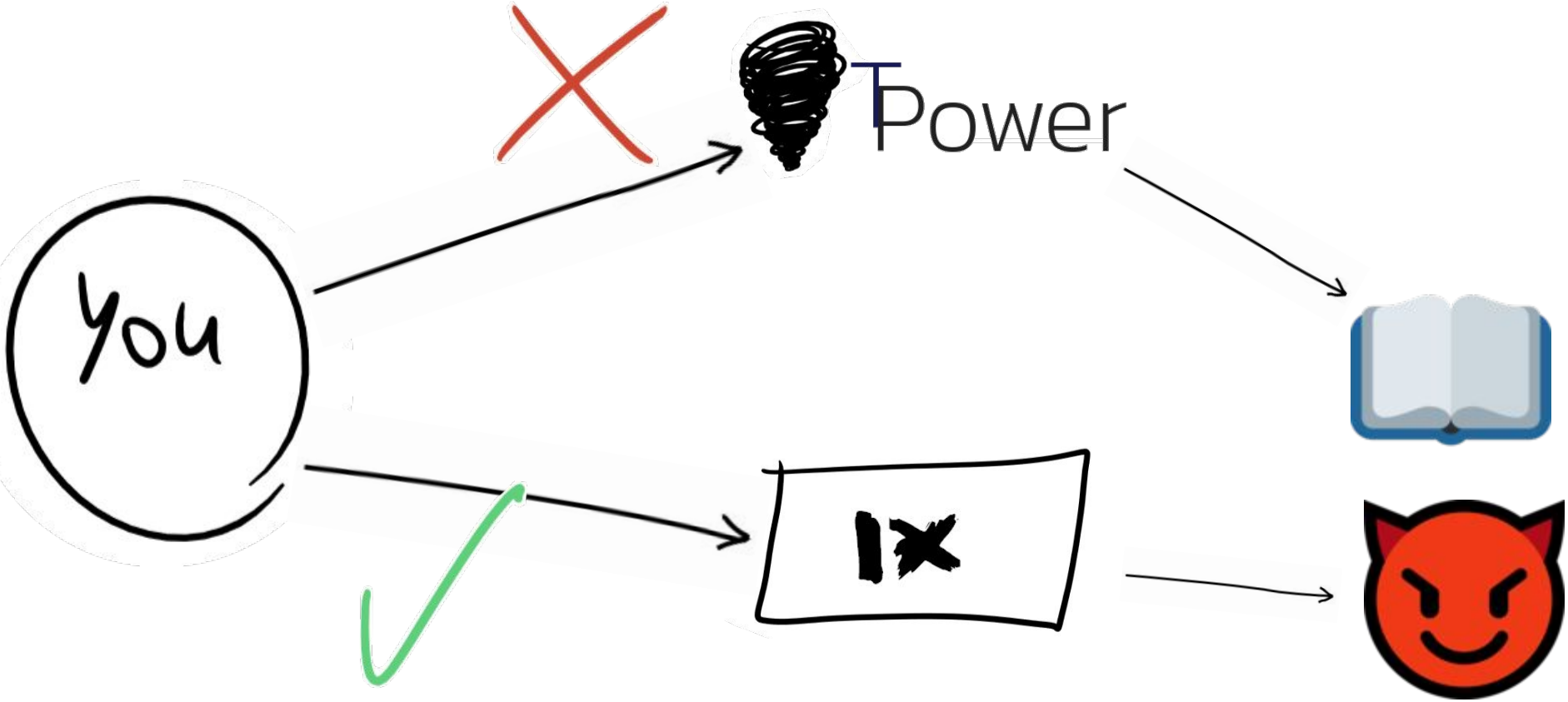


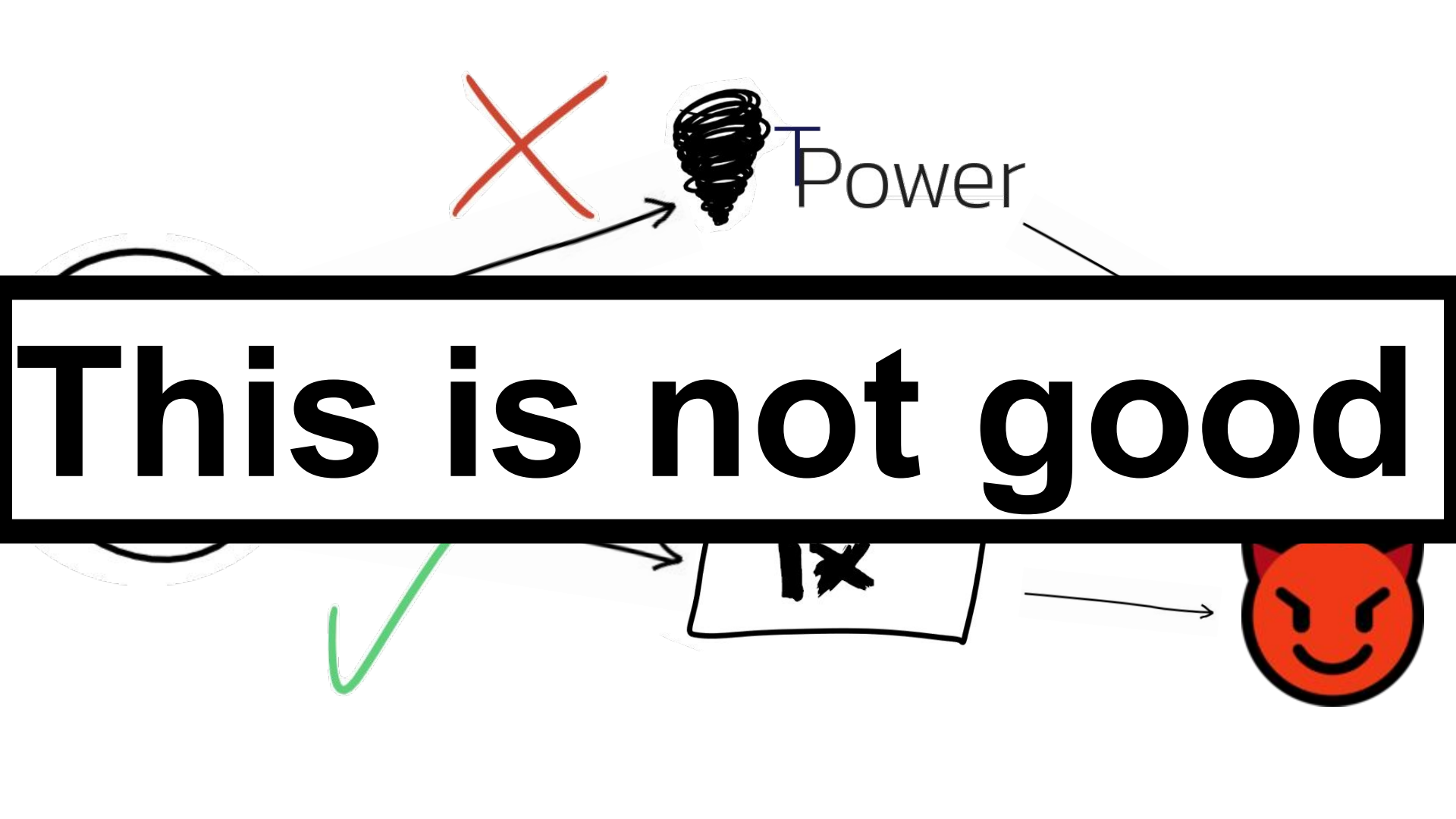
NIST RPKI Monitor 2018-08-26

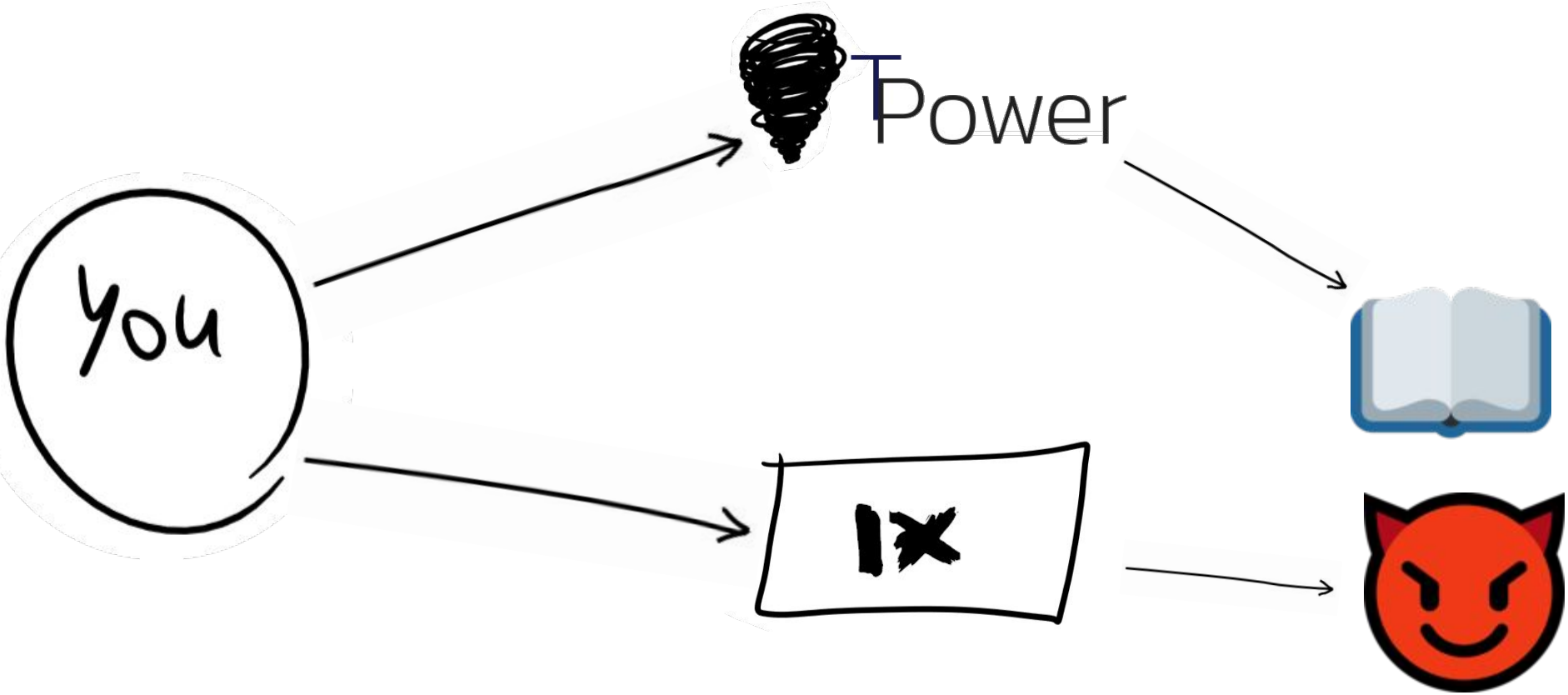

You
TPower
IX

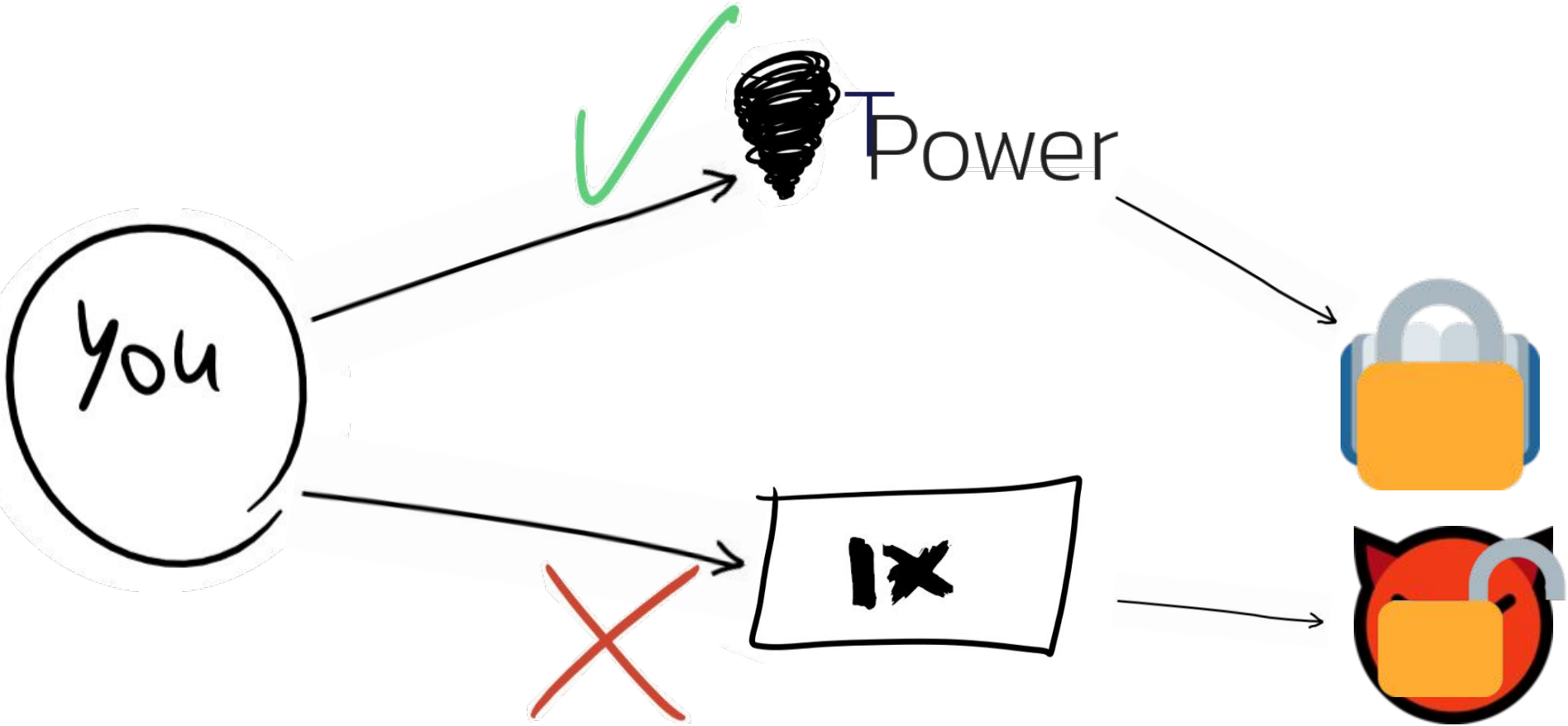

Power
You
IX

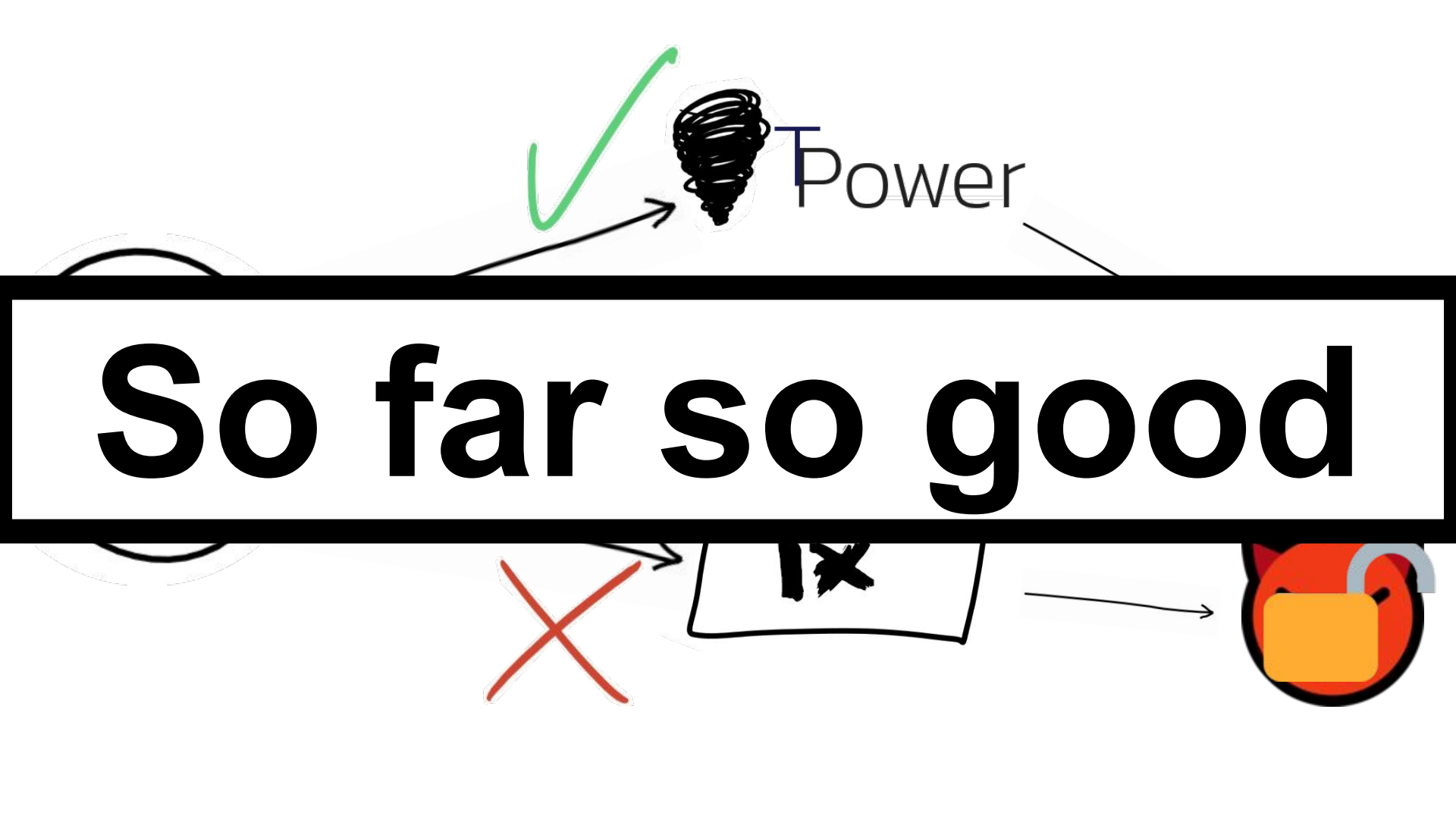

Power
You
IX

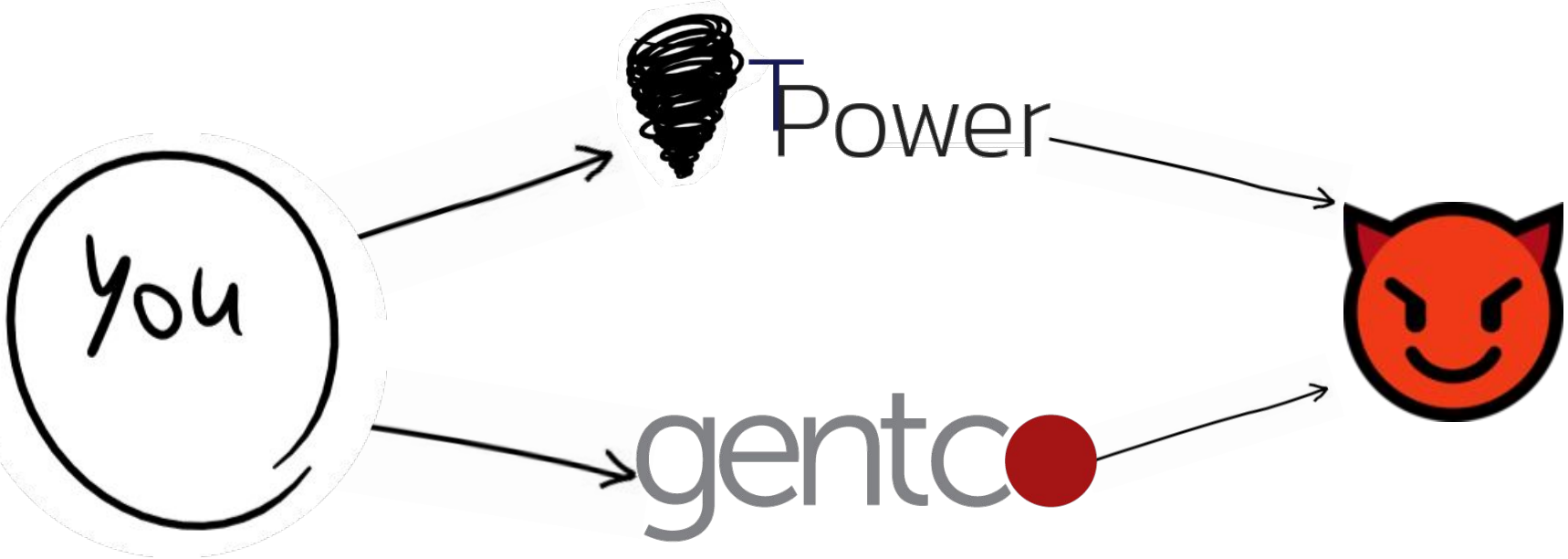

Power
you
IX

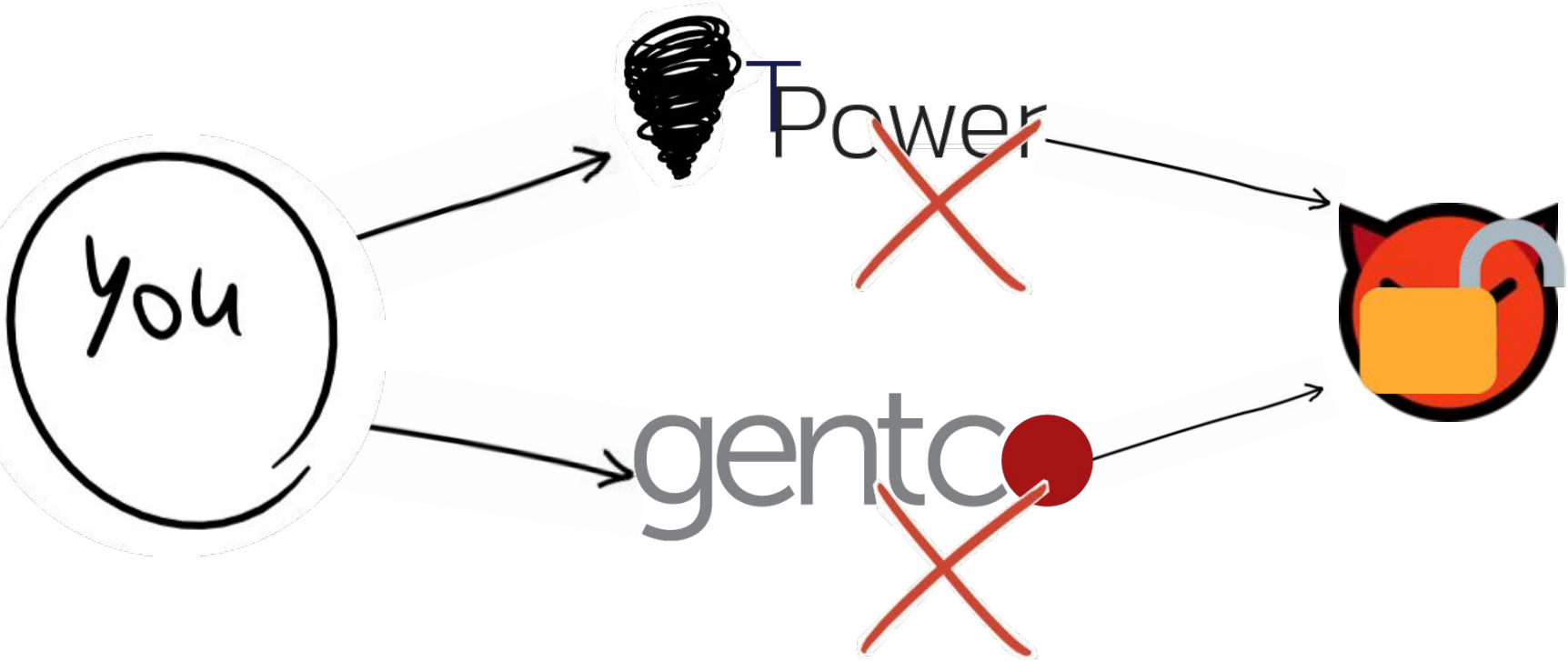

Power
This is not good

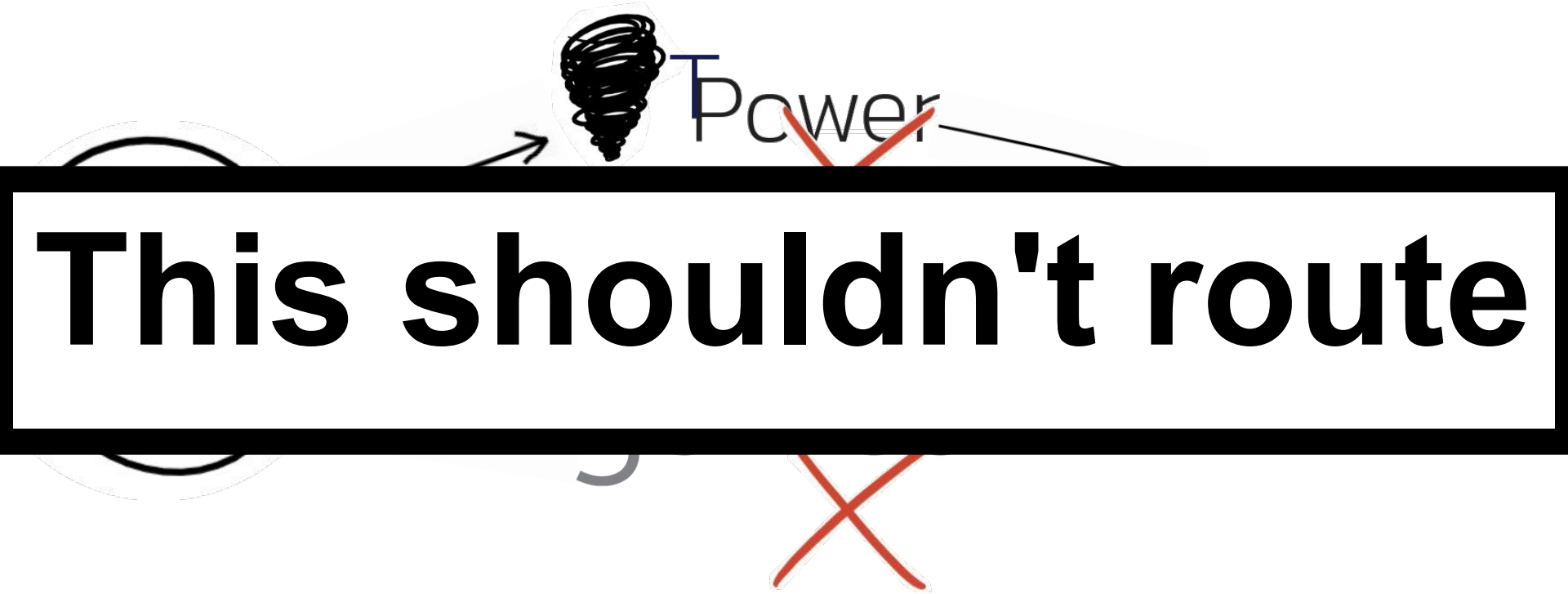

Power
You
IX


Power
You
IX

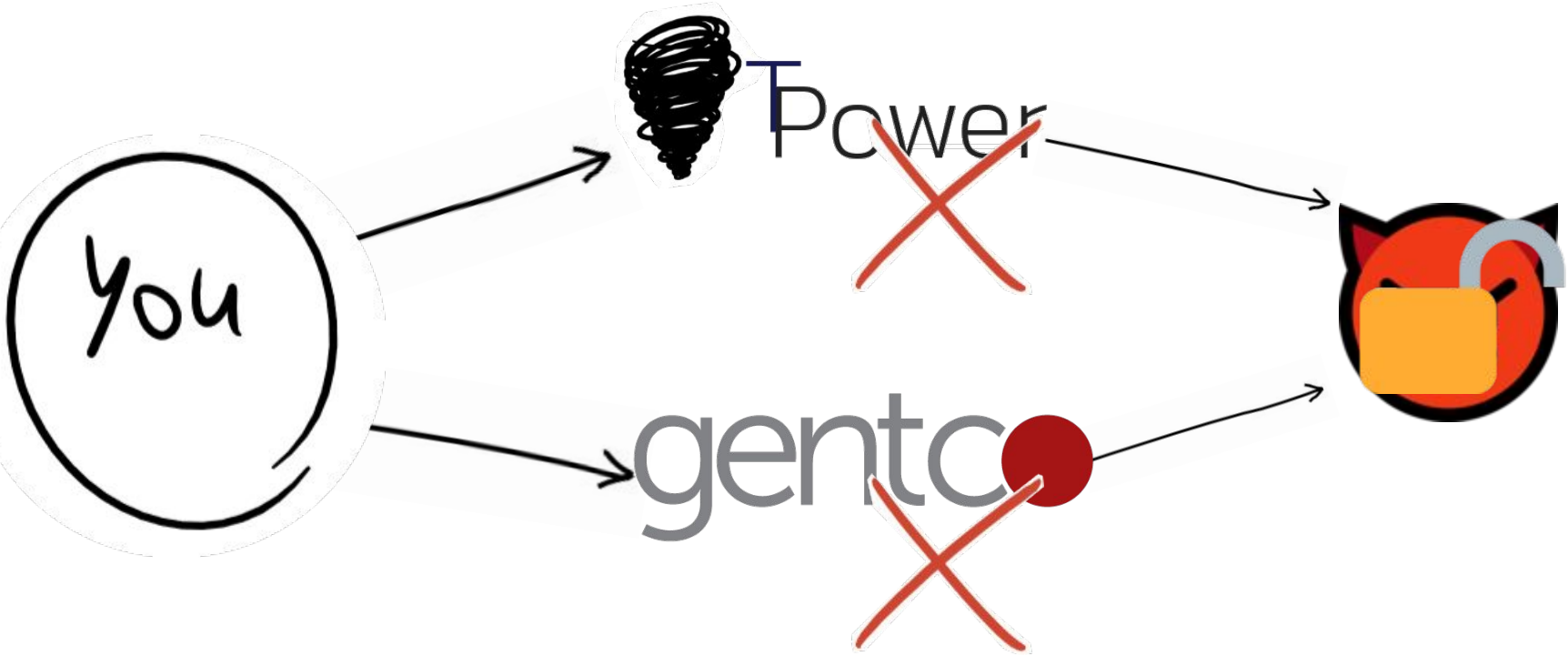

Power
So far so good

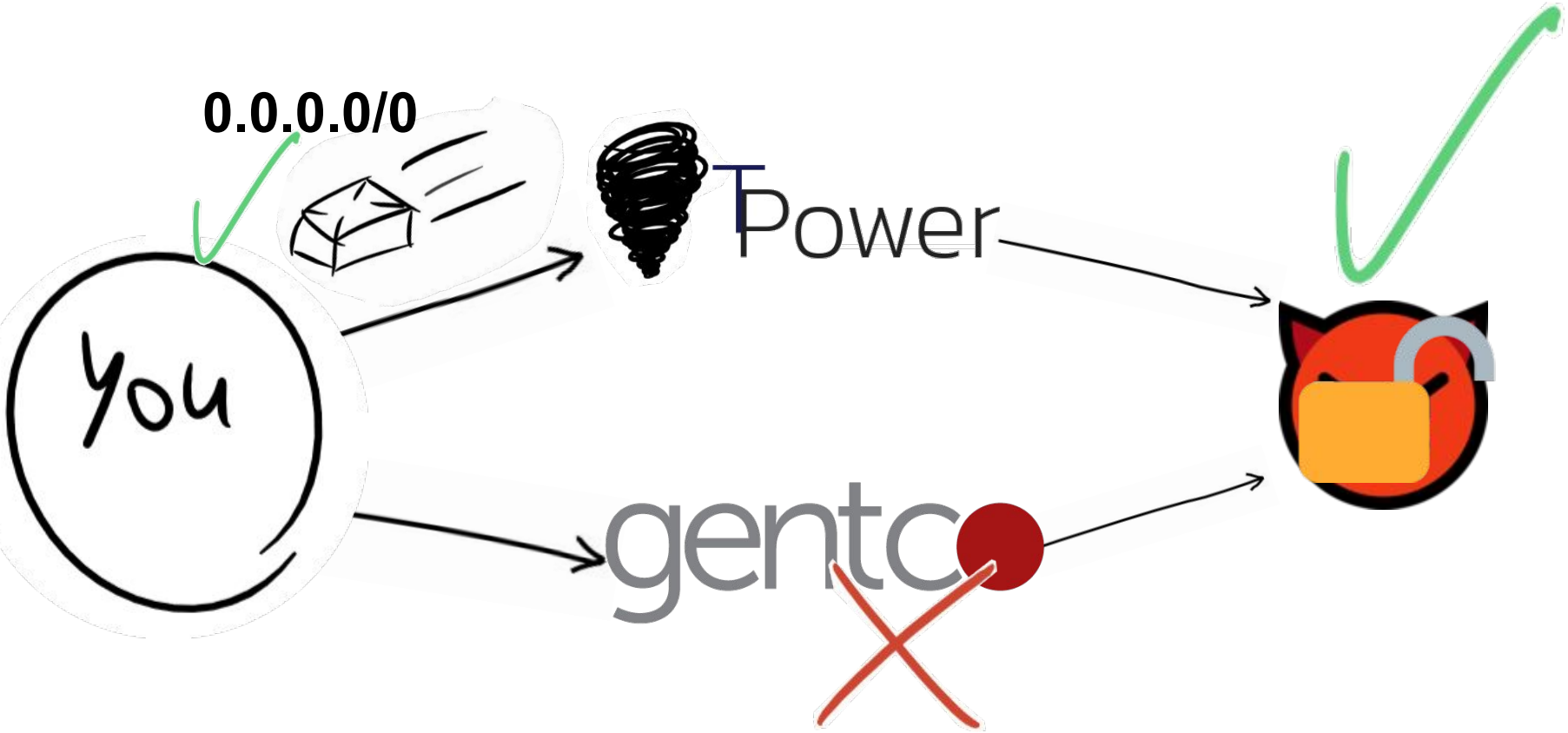

You
TPower
gentco

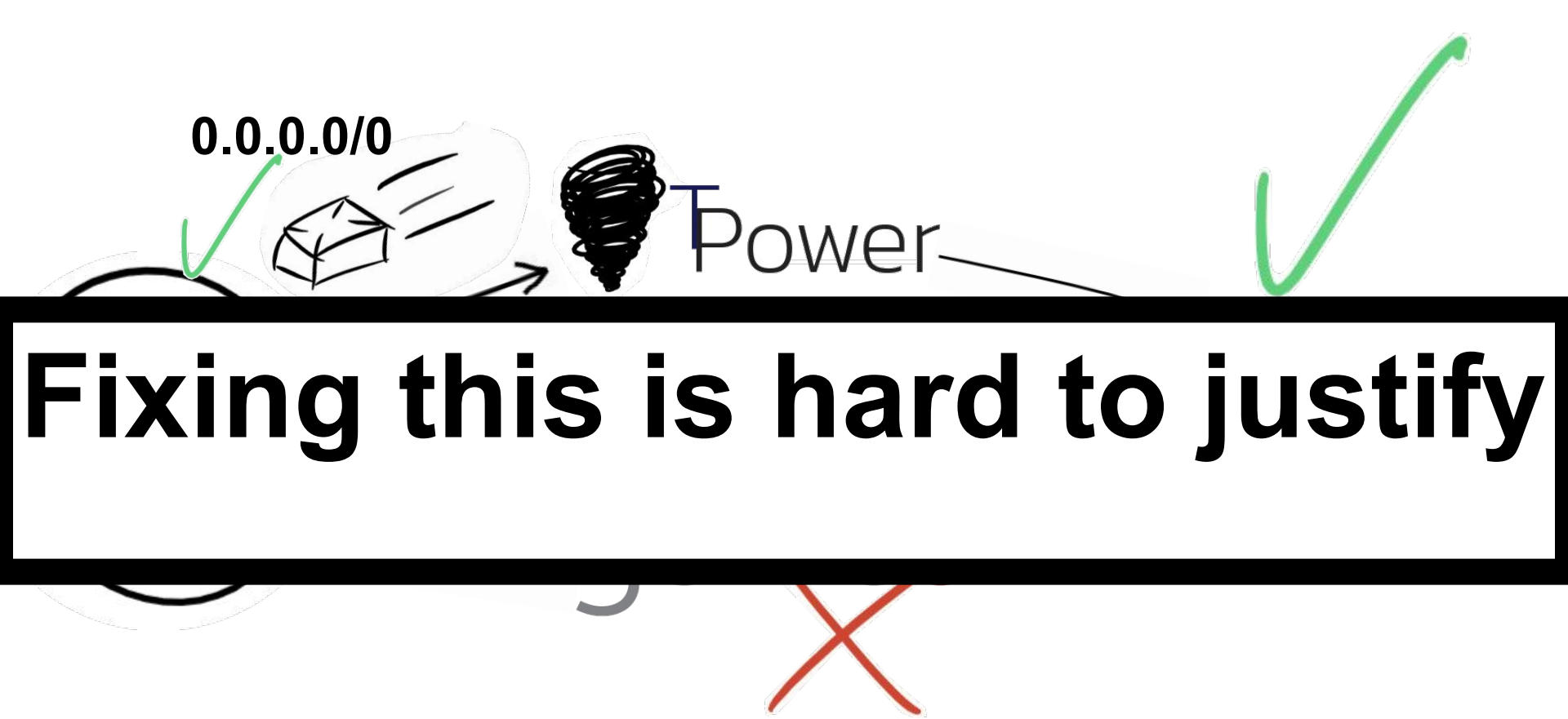

You
TPower
gentoo



This shouldn't route


You
Power
gentoo


0.0.0.0/0
You
Power
gentoo

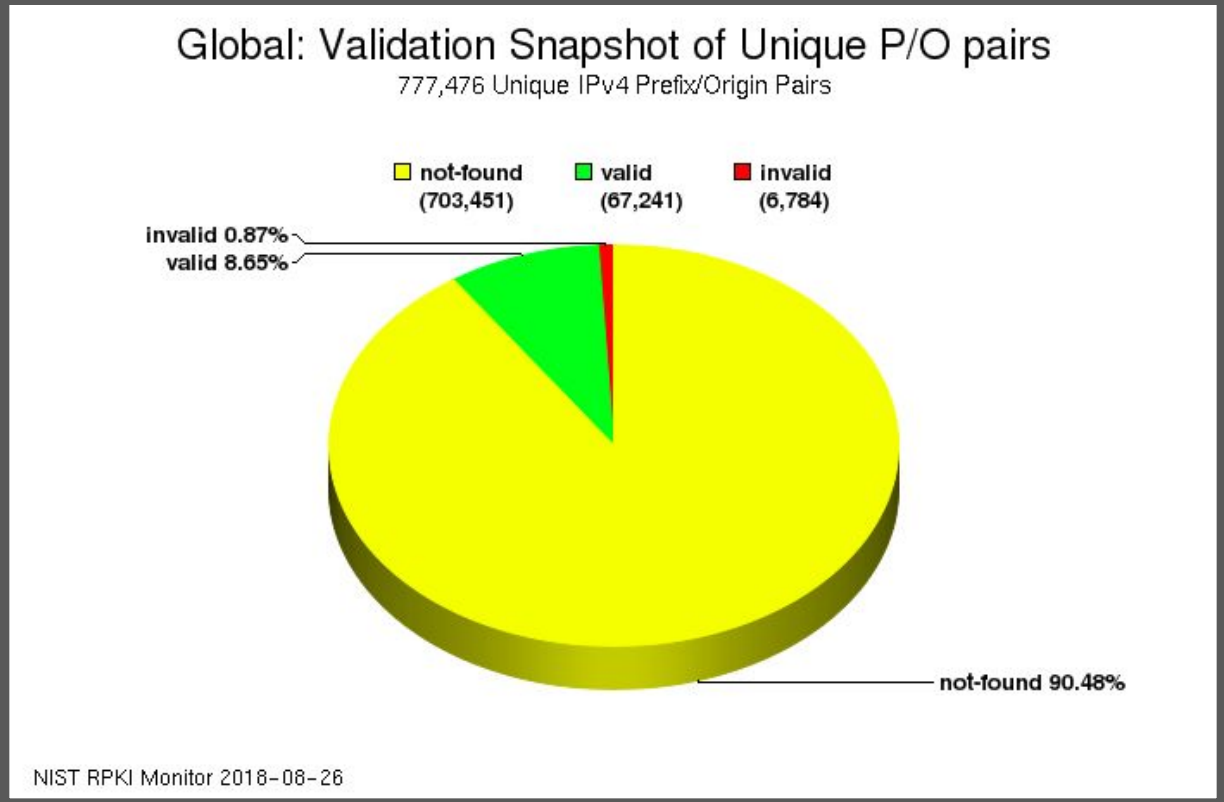


Fixing this is hard to justify

0.0.0.0/0

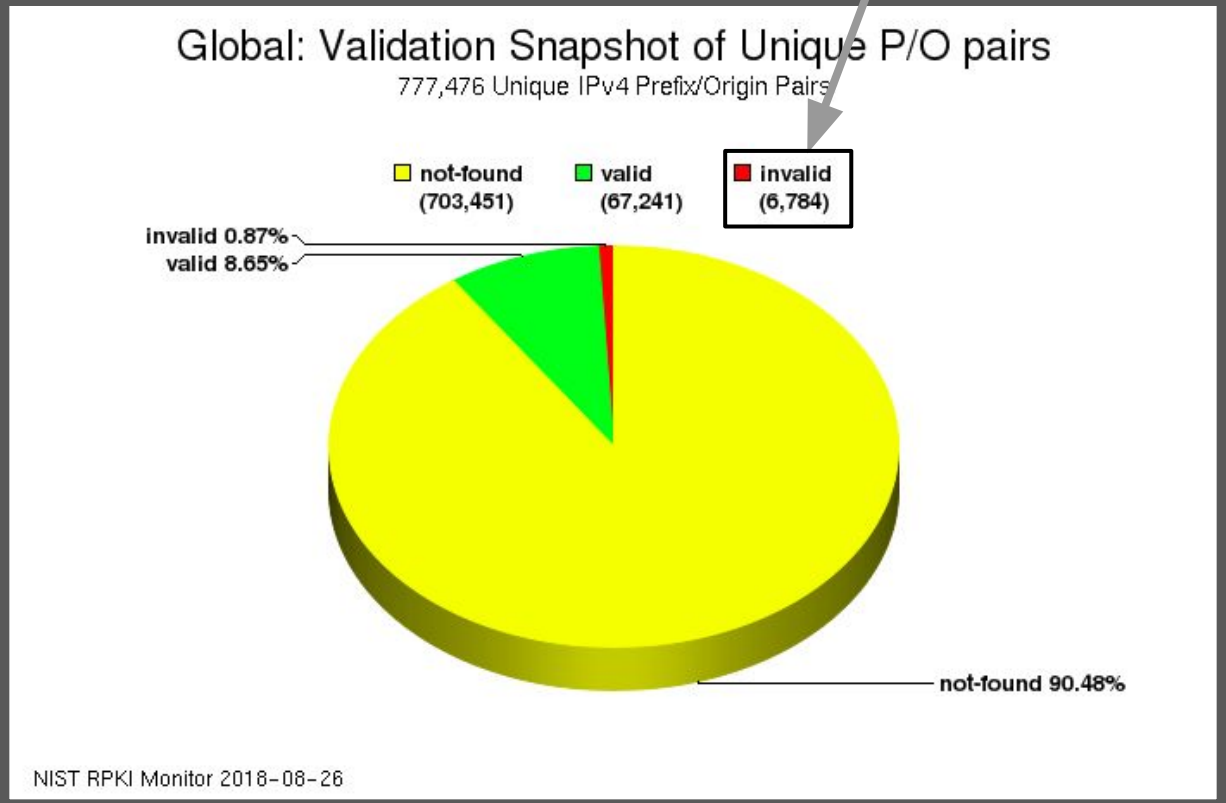
Fixin

stify



This is still a lot of traffic

0.0.0.0/0

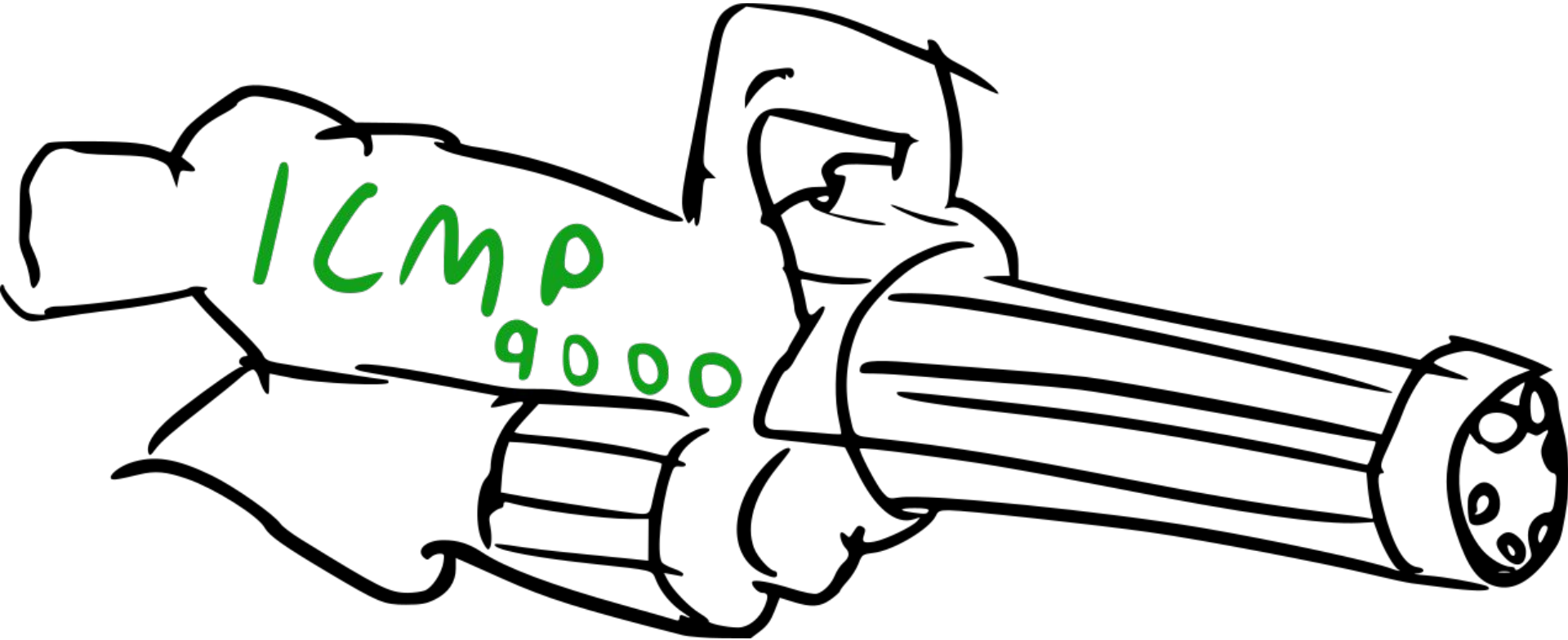


Assumptions

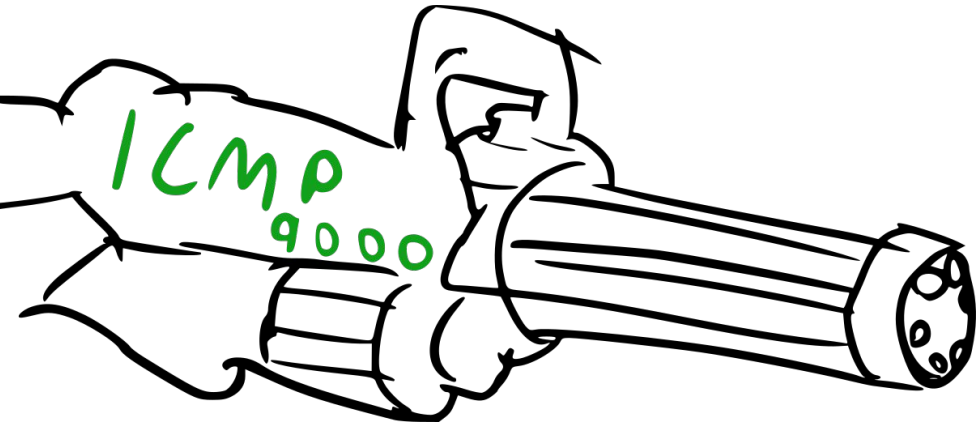
- Lots of people have default routes

- Lots of people are signing but not validating

Testing rig



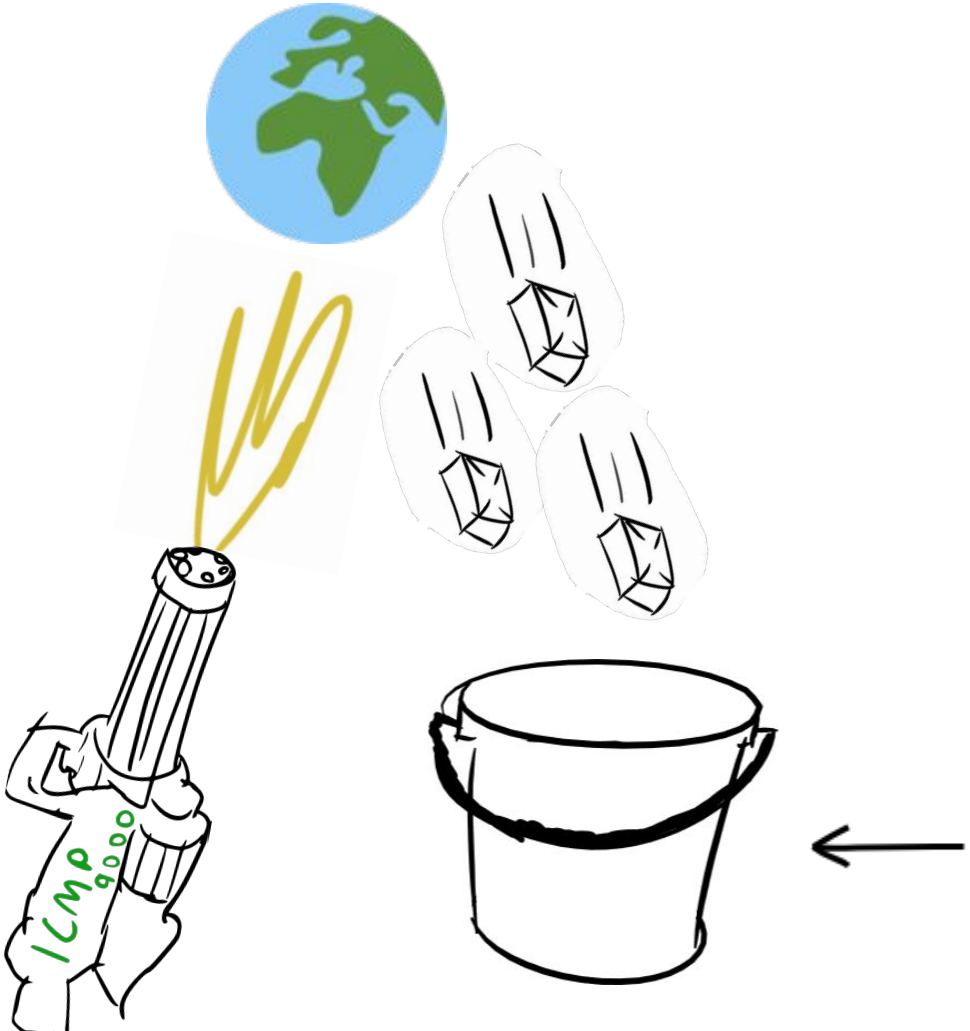
Testing rig



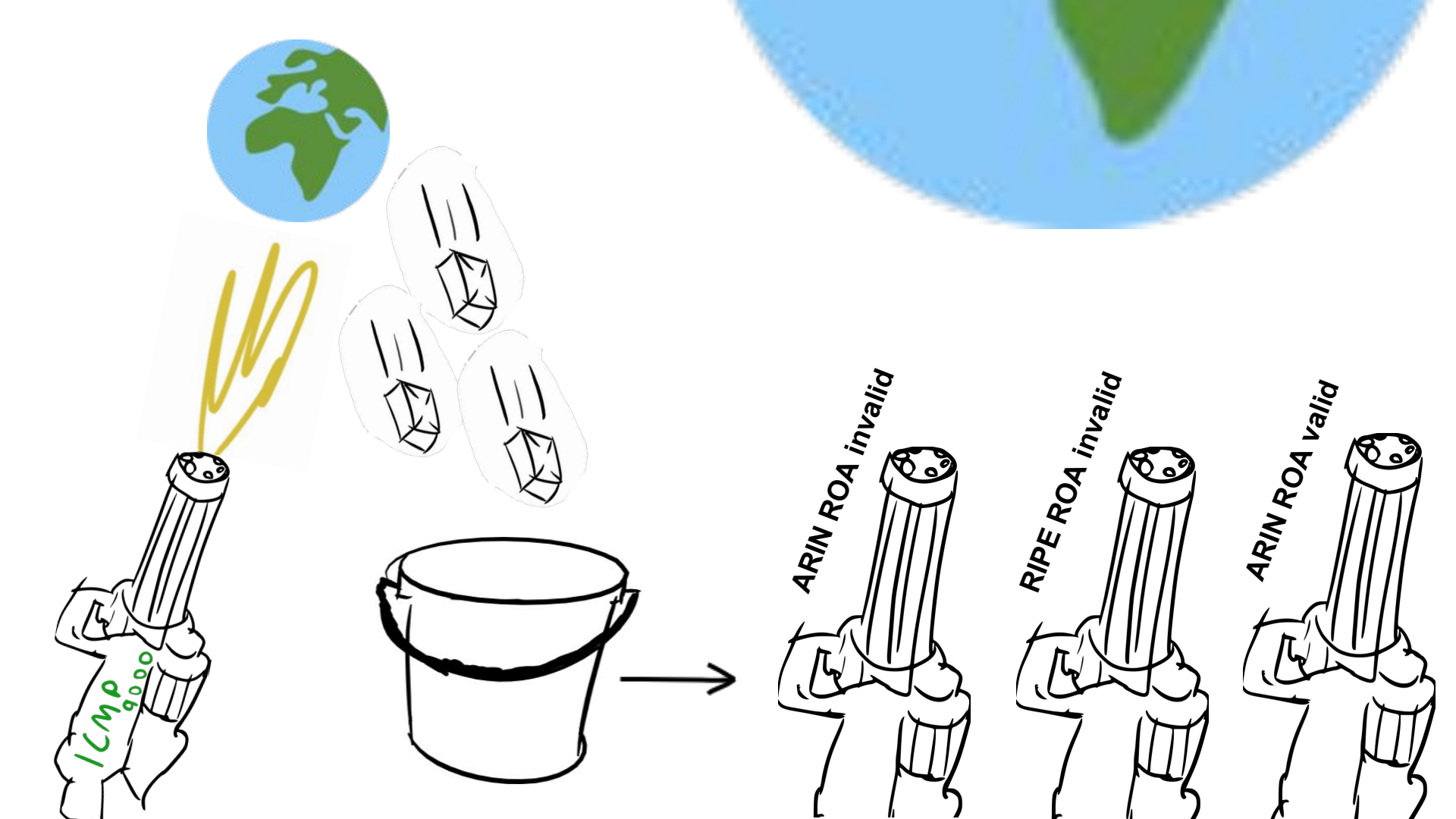
+

Prefix	Descrip
36.0.4.0/22	Nepal R&E Network
194.32.71.0/24	NTT Europe Limited
202.13.72.0/24	
209.24.0.0/24	NTT America, Inc.
209.24.1.0/24	NTT America, Inc.


ICMP
9000



All 0.0.0.0/0 responses collected


ICMP
9000
ARIN ROA invalid
RIPE ROA invalid
ARIN ROA valid

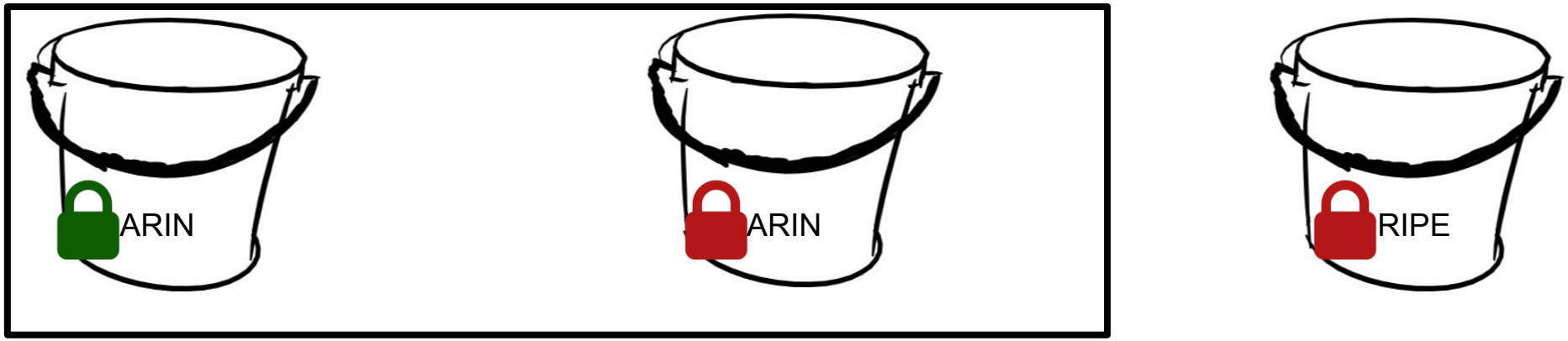
What means what?

IF

IF

Then they are validating and dropping(!) 🎉

IF



Then they are using a popular ROA validator setup with defaults

IF

Then they are not validating anything

Wait, what?!

Not all ROA's are equal?

TRUST ANCHOR LOCATOR (TAL)

Using RPKI Routing as a Relying Party

To act as an RPKI relying party and retrieve data from ARIN's RPKI database, entities should use an RPKI Validator and ARIN's Trust Anchor Locator (TAL).The TAL contains both the location of ARIN's repository and ARIN's public key, which is used to cryptographically verify that ARIN has signed the artifacts within ARIN's repository. RPKI validators can then verify the certificates and ROAs within the repository.

Follow these steps:

1. Download a validation tool, such as the RIPE NCC RPKI Validator. (You can also use other validators such as that from Dragon Research or RPSTIR.)
2. If using the RIPE NCC RPKI Validator, it contains the TALs from these individual IRRs: AFRINIC, APNIC, LACNIC, and RIPE NCC. It doesn't include the ARIN TAL. Download the ARIN TAL (linked below; choose RIPE NCC RPKI Validator format).
3. Transfer the TAL to your routing policy engine using one of the following methods:
    a. Direct transfer to the router using RTR protocol
    b. Transfer using custom scripts and the REST API
    c. Transfer as RPSL objects

ARIN recommends reading RFC 6810: The Resource Public Key Infrastructure (RPKI) to Router Protocol to learn more about transferring RPKI information to routers.

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Sad.

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Total counts

130 Mil

130 Mil

128.2 Mil

130 Mil

128.3 Mil

128.2 Mil

130 Mil

128.3 Mil

128.2 Mil

127.9 Mil

128.1 Mil

128.1 Mil

	A	B	C	D	E	F	G	H	I	J	K
1	ASN	ValidCount	RIPEDrop	ARINDrop	APNICDrop	JPNICDrop	AFRINICDrop	RIPE Drop	ARIN Drop	APNIC Drop	Avg Drop
2	7922	10289320	9334	6900	12487	11274	8992	0.09%	0.07%	0.12%	0.09%
3	4837	7520898	106698	106045	106794	106274	106184	1.42%	1.41%	1.42%	1.42%
4	4134	4779337	114900	113710	115107	115906	115871	2.40%	2.38%	2.41%	2.40%
5	4766	4741475	325310	297007	330537	336565	352058	6.86%	6.26%	6.97%	6.70%
6	701	3164794	1958	1768	2720	2406	1871	0.06%	0.06%	0.09%	0.07%
7	3352	2362607	8536	8414	8611	8665	8564	0.36%	0.36%	0.36%	0.36%
8	3209	2360741	3685	3646	3816	3737	3658	0.16%	0.15%	0.16%	0.16%
9	16625	2027586	840	786	795	804	807	0.04%	0.04%	0.04%	0.04%
10	8151	2006432	3885	3549	5304	4582	6488	0.19%	0.18%	0.26%	0.21%
11	3269	1840483	238580	216617	272729	257630	282159	12.96%	11.77%	14.82%	13.18%
12	17858	1808266	2907	2769	4405	2894	2733	0.16%	0.15%	0.24%	0.19%
13	5607	1776741	996	983	1051	1025	1014	0.06%	0.06%	0.06%	0.06%
14	12322	1753291	9883	7744	52911	20688	84993	0.56%	0.44%	3.02%	1.34%
15	209	1644035	3828	3060	4148	4014	3498	0.23%	0.19%	0.25%	0.22%
16	17676	1639674	17368	17245	17529	17410	17467	1.06%	1.05%	1.07%	1.06%
17	3320	1483790	18337	18023	18978	18607	18172	1.24%	1.21%	1.28%	1.24%
18	9318	1378972	4334	4198	4126	4321	4270	0.31%	0.30%	0.30%	0.31%
19	5650	1338350	2478	2313	2874	2734	2399	0.19%	0.17%	0.21%	0.19%
20	7552	1035178	14809	14794	14884	15026	15089	1.43%	1.43%	1.44%	1.43%
21	20940	1016381	310	337	309	329	312	0.03%	0.03%	0.03%	0.03%
22	20001	961039	1175	1003	1305	1223	1186	0.12%	0.10%	0.14%	0.12%
23	20115	932778	1128	773	1685	1434	1069	0.12%	0.08%	0.18%	0.13%
24	33363	860905	1248	1141	1418	1400	1231	0.14%	0.13%	0.16%	0.15%
25	10796	842801	1074	860	1452	1283	1223	0.13%	0.10%	0.17%	0.13%
26	6830	827339	1271	1230	1601	1479	1441	0.15%	0.15%	0.19%	0.17%
27	37963	827212	1375	1394	1412	1368	1376	0.17%	0.17%	0.17%	0.17%
28	3303	791892	537	540	669	582	557	0.07%	0.07%	0.08%	0.07%
29	7018	785962	3034	2172	4650	4033	2841	0.39%	0.28%	0.59%	0.42%
30	11427	785444	991	773	1354	1201	1218	0.13%	0.10%	0.17%	0.13%
31	12389	778859	18760	18567	18828	18729	19125	2.41%	2.38%	2.42%	2.40%
32	6805	711005	20462	19761	21018	20556	20984	2.88%	2.78%	2.96%	2.87%
33	12479	708492	3136	3190	3200	3230	3149	0.44%	0.45%	0.45%	0.45%
34	5089	708183	377	389	432	461	381	0.05%	0.05%	0.06%	0.06%
35	6848	663548	487	452	515	535	499	0.07%	0.07%	0.08%	0.07%
36	26615	610225	32655	32599	33184	33071	33042	5.35%	5.34%	5.44%	5.38%
37	16509	595528	990	962	1095	1055	1036	0.17%	0.16%	0.18%	0.17%
38	15557	590092	1298	1299	1329	1337	1287	0.22%	0.22%	0.23%	0.22%
39	11426	582395	893	837	1068	1011	902	0.15%	0.14%	0.18%	0.16%

AS57598
AS15426
AS34968
AS35470
AS34762
AS28878
AS39647
AS8455
AS21155
AS197902
AS24679
AS20559
AS8608
AS200831
AS30870
AS29028
AS24586
AS34756
AS8312
AS202955
AS201975
AS41480
AS201290
AS39637
AS8587
AS50554
AS61349
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AS59980
AS24730
AS60820
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AS28747
AS34215
AS42812
AS48729
AS199456
AS60950
AS202016
AS61429
AS35027
AS21073
AS41153
AS49627
AS61147
AS42585
AS15703
AS15879
AS35260
AS62353
AS202947
AS34141
AS41960
AS20495
AS52144
AS42755

	A	B	C	D	E	F	G	H	I	J	K
1	ASN	ValidCount	RIPEDrop	ARINDrop	APNICDrop	JPNICDrop	AFRINICDrop	RIPE Drop	ARIN Drop	APNIC Drop	Avg Drop
2	57598	43826	43826	43826	43826	43826	0	100.00%	100.00%	100.00%	100.00%
3	15426	12658	12658	12658	12658	12658	2	100.00%	100.00%	100.00%	100.00%
4	34968	9562	9562	9562	9562	9562	1	100.00%	100.00%	100.00%	100.00%
5	35470	7408	7408	7408	7408	7408	0	100.00%	100.00%	100.00%	100.00%
6	34762	7148	7148	7148	7148	7148	1	100.00%	100.00%	100.00%	100.00%
7	28878	3559	3559	3559	3559	3559	0	100.00%	100.00%	100.00%	100.00%
8	39647	3462	3462	3462	3462	3462	0	100.00%	100.00%	100.00%	100.00%
9	8455	2169	2169	2169	2169	2169	1	100.00%	100.00%	100.00%	100.00%
10	21155	1863	1863	1863	1863	1863	0	100.00%	100.00%	100.00%	100.00%
11	197902	1821	1821	1821	1821	1821	0	100.00%	100.00%	100.00%	100.00%
12	24679	1716	1716	1716	1716	1716	2	100.00%	100.00%	100.00%	100.00%
13	20559	1702	1702	1702	1702	1702	2	100.00%	100.00%	100.00%	100.00%
14	8608	1220	1220	1220	1220	1220	0	100.00%	100.00%	100.00%	100.00%
15	200831	879	879	879	879	879	0	100.00%	100.00%	100.00%	100.00%
16	30870	864	864	864	864	864	0	100.00%	100.00%	100.00%	100.00%
17	29028	849	849	849	849	849	0	100.00%	100.00%	100.00%	100.00%
18	24586	613	613	613	613	613	0	100.00%	100.00%	100.00%	100.00%
19	34756	599	599	599	599	599	0	100.00%	100.00%	100.00%	100.00%
20	8312	495	495	495	495	495	0	100.00%	100.00%	100.00%	100.00%
21	202955	486	486	486	486	486	0	100.00%	100.00%	100.00%	100.00%
22	201975	449	449	449	449	449	0	100.00%	100.00%	100.00%	100.00%
23	41480	423	423	423	423	423	0	100.00%	100.00%	100.00%	100.00%
24	201290	415	415	415	415	415	0	100.00%	100.00%	100.00%	100.00%
25	39637	389	389	389	389	389	0	100.00%	100.00%	100.00%	100.00%
26	8587	384	384	384	384	384	0	100.00%	100.00%	100.00%	100.00%
27	50554	348	348	348	348	348	0	100.00%	100.00%	100.00%	100.00%
28	61349	338	338	338	338	338	0	100.00%	100.00%	100.00%	100.00%
29	58075	334	334	334	334	334	0	100.00%	100.00%	100.00%	100.00%
30	59980	230	230	230	230	230	0	100.00%	100.00%	100.00%	100.00%
31	24730	212	212	212	212	212	0	100.00%	100.00%	100.00%	100.00%
32	60820	185	185	185	185	185	0	100.00%	100.00%	100.00%	100.00%
33	202916	185	185	185	185	185	8	100.00%	100.00%	100.00%	100.00%
34	28747	178	178	178	178	178	0	100.00%	100.00%	100.00%	100.00%
35	34215	171	171	171	171	171	0	100.00%	100.00%	100.00%	100.00%
36	42812	166	166	166	166	166	0	100.00%	100.00%	100.00%	100.00%
37	48729	160	160	160	160	160	0	100.00%	100.00%	100.00%	100.00%
38	199456	152	152	152	152	152	0	100.00%	100.00%	100.00%	100.00%
39	60950	146	146	146	146	146	0	100.00%	100.00%	100.00%	100.00%

57598	MD	ripencc	SHA-AS, MD
15426	NL	ripencc	XENOSITE Amsterdam, NL
34968	NL	ripencc	IUNXI, NL
35470	NL	ripencc	XL-AS, NL
34762	BE	ripencc	COMBELL-AS, BE
28878	NL	ripencc	SIGNET-AS, NL
39647	NL	ripencc	REDHOSTING-AS, NL
8455	NL	ripencc	ATOM86-AS ATOM86, NL
21155	NL	ripencc	ASN-PROSERVE Amsterdam, NL
197902	NL	ripencc	HOSTNET, NL
24679	DE	ripencc	SSERV-AS, DE
20559	NL	ripencc	FUNDAMENTS-AS, NL
8608	NL	ripencc	QINIP Esprit Telecom B.V., NL
200831	NL	ripencc	MIHOSNET, NL
30870	NL	ripencc	TRANS-IX-AS Trans-iX, NL
29028	NL	ripencc	COMPUKOS-AS, NL
24586	NL	ripencc	NL-INTERMAX B.V., NL
34756	NL	ripencc	ASN-GVRH, NL
8312	NL	ripencc	ZYLON-AS, NL
202955	NL	ripencc	IAHOSTER, NL
201975	NL	ripencc	UNISCAPEB IT-Services & Hosting, NL
41480	NL	ripencc	SYSTEMEC-AS, NL
201290	NL	ripencc	BLACKGATE, NL
39637	NL	ripencc	NETLOGICS-AS, NL
8587	NL	ripencc	INFRACOM-AS, NL
50554	NL	ripencc	NCBV-BACKBONE, NL
61349	NL	ripencc	MAXITEL, NL
58075	NL	ripencc	X2COM, NL
59980	NL	ripencc	MIJNDOMEIN, NL
24730	NL	ripencc	ASN-NETHOLDING, NL
60820	NL	ripencc	WIFI4ALL-AS, NL
202916	NL	ripencc	IPS, NL
28747	BE	ripencc	EASYHOST-COLO-AS, BE
34215	NL	ripencc	ATINET, NL
42812	NL	ripencc	DT-IT, NL
48729	NL	ripencc	O4S-AS, NL
199456	GB	ripencc	VLDTECH-ASN, GB
60950	NL	ripencc	CLOUDNL-AS, NL
202016	NL	ripencc	DOMINOICT, NL
61429	NL	ripencc	AS-CASTOR, NL
35027	NL	ripencc	ASN-SEVENP, NL
21073	NL	ripencc	ZORANET-AS Amsterdam, NL
41153	NL	ripencc	GNTEL-AS, NL
49627	NL	ripencc	SPEAKUP, NL
61147	NL	ripencc	CALLHOSTED-AS Callhosted NL
42585	NL	ripencc	NETWORKING4ALL, NL
15703	NL	ripencc	TRUESERVER-AS TrueServer BV, NL
15879	NL	ripencc	KPN-INTERNEDSERVICES, NL
35260	NL	ripencc	IU-NET, NL
62353	NL	ripencc	ASN-DATAPLACE, NL
202947	NL	ripencc	Multi ICT B.V., Almere, NL
34141	NL	ripencc	IN2IP-AS, NL
41960	NL	ripencc	NEXTPERTISE Nextpertise, NL
20495	NL	ripencc	WEDARE wd6.NET B.V, NL
52144	NL	ripencc	NOTUBIZ, NL
42755	NL	ripencc	DATAFIBER, NL

57598	MD	ripencc	SHA-AS, MD
15426	NL	ripencc	XENOSITE Amsterdam, NL
34968	NL	ripencc	IUNXI, NL
35470	NL	ripencc	XL-AS, NL
34762	BE	ripencc	COMBELL-AS, BE
28878	NL	ripencc	SIGNET-AS, NL
39647	NL	ripencc	REDHOSTING-AS, NL
8455	NL	ripencc	ATOM86-AS ATOM86, NL
21155	NL	ripencc	ASN-PROSERVE Amsterdam, NL
197902	NL	ripencc	HOSTNET, NL
24679	DE	ripencc	SSERV-AS, DE
20559	NL	ripencc	FUNDAMENTS-AS, NL
8608	NL	ripencc	QINIP Esprit Telecom B.V., NL
200831	NL	ripencc	MIHOSNET, NL
30870	NL	ripencc	TRANS-IX-AS Trans-iX, NL
29028	NL	ripencc	COMPUKOS-AS, NL
24586	NL	ripencc	NL-INTERMAX B.V., NL
34756	NL	ripencc	ASN-GVRH, NL
8312	NL	ripencc	ZYLON-AS, NL
202955	NL	ripencc	IAHOSTER, NL
201975	NL	ripencc	UNISCAPEB IT-Services & Hosting, NL
41480	NL	ripencc	SYSTEMEC-AS, NL
201290	NL	ripencc	BLACKGATE, NL
39637	NL	ripencc	NETLOGICS-AS, NL
8587	NL	ripencc	INFRACOM-AS, NL
50554	NL	ripencc	NCBV-BACKBONE, NL
61349	NL	ripencc	MAXITEL, NL
58075	NL	ripencc	X2COM, NL
59980	NL	ripencc	MIJNDOMEIN, NL
24730	NL	ripencc	ASN-NETHOLDING, NL
60820	NL	ripencc	WIFI4ALL-AS, NL
202916	NL	ripencc	IPS, NL
28747	BE	ripencc	EASYHOST-COLO-AS, BE
34215	NL	ripencc	ATINET, NL
42812	NL	ripencc	DT-IT, NL
48729	NL	ripencc	O4S-AS, NL
199456	GB	ripencc	VLDTECH-ASN, GB
60950	NL	ripencc	CLOUDNL-AS, NL
202016	NL	ripencc	DOMINOICT, NL
61429	NL	ripencc	AS-CASTOR, NL
35027	NL	ripencc	ASN-SEVENP, NL
21073	NL	ripencc	ZORANET-AS Amsterdam, NL
41153	NL	ripencc	GNTEL-AS, NL
49627	NL	ripencc	SPEAKUP, NL
61147	NL	ripencc	CALLHOSTED-AS Callhosted NL
42585	NL	ripencc	NETWORKING4ALL, NL
15703	NL	ripencc	TRUESERVER-AS TrueServer BV, NL
15879	NL	ripencc	KPN-INTERNEDSERVICES, NL
35260	NL	ripencc	IU-NET, NL
62353	NL	ripencc	ASN-DATAPLACE, NL
202947	NL	ripencc	Multi ICT B.V., Almere, NL
34141	NL	ripencc	IN2IP-AS, NL
41960	NL	ripencc	NEXTPERTISE Nextpertise, NL
20495	NL	ripencc	WEDARE wd6.NET B.V, NL
52144	NL	ripencc	NOTUBIZ, NL
42755	NL	ripencc	DATAFIBER, NL

91%

3%

57598	MD	ripencc	SHA-AS, MD
15426	NL	ripencc	XENOSITE Amsterdam, NL
34968	NL	ripencc	IUNXI, NL
35470	NL	ripencc	XL-AS, NL
34762	BE	ripencc	COMBELL-AS, BE
28878	NL	ripencc	SIGNET-AS, NL
39647	NL	ripencc	REDHOSTING-AS, NL
8455	NL	ripencc	ATOM86-AS ATOM86, NL
21155	NL	ripencc	ASN-PROSERVE Amsterdam, NL
24730	NL	ripencc	ASN-NETHOLDING, NL
60820	NL	ripencc	WIFI4ALL-AS, NL
202916	NL	ripencc	IPS, NL
28747	BE	ripencc	EASYHOST-COLO-AS, BE
34215	NL	ripencc	ATINET, NL
42812	NL	ripencc	DT-IT, NL
48729	NL	ripencc	O4S-AS, NL
199456	GB	ripencc	VLDTECH-ASN, GB
60950	NL	ripencc	CLOUDNL-AS, NL

This amounts to a /15 protected

8587	NL	ripencc	INFRACOM-AS, NL
50554	NL	ripencc	NCBV-BACKBONE, NL
61349	NL	ripencc	MAXITEL, NL
58075	NL	ripencc	X2COM, NL
59980	NL	ripencc	MIJNDOMEIN, NL
20495	NL	ripencc	WEDARE Wd6.NET B.V, NL
52144	NL	ripencc	NOTUBIZ, NL
42755	NL	ripencc	DATAFIBER, NL

91%

3%

	A	B	C	D	E	F	G	H	I	J	K
1	ASN	ValidCount	RIPEDrop	ARINDrop	APNICDrop	JPNICDrop	AFRINICDrop	RIPE Drop	ARIN Drop	APNIC Drop	Avg Drop
60	8283	313	1	313	313	0	91	0.32%	100.00%	100.00%	66.77%
61	12306	2066	2066	3	2066	2066	395	100.00%	0.15%	100.00%	66.72%
62	30766	693	693	0	693	693	170	100.00%	0.00%	100.00%	66.67%
63	20755	351	351	0	351	351	71	100.00%	0.00%	100.00%	66.67%
64	16188	322	322	0	322	322	62	100.00%	0.00%	100.00%	66.67%
65	12822	147	147	0	147	147	40	100.00%	0.00%	100.00%	66.67%
66	393537	107	107	0	107	107	0	100.00%	0.00%	100.00%	66.67%
67	14348	899	894	9	894	894	6	99.44%	1.00%	99.44%	66.63%
68	54300	641	638	0	641	638	0	99.53%	0.00%	100.00%	66.51%
69	8315	2944	2937	0	2937	2937	663	99.76%	0.00%	99.76%	66.51%
70	22683	139	91	91	91	91	0	65.47%	65.47%	65.47%	65.47%
71	26967	933	903	0	903	903	1	96.78%	0.00%	96.78%	64.52%
72	18168	149	96	100	69	66	85	64.43%	67.11%	46.31%	59.28%
73	36081	579	481	2	481	481	1	83.07%	0.35%	83.07%	55.50%
74	10405	1814	975	901	1091	1053	1101	53.75%	49.67%	60.14%	54.52%
75	198106	462	234	242	275	249	272	50.65%	52.38%	59.52%	54.18%
76	19783	965	769	1	769	769	0	79.69%	0.10%	79.69%	53.16%
77	25899	3398	2515	12	2534	2524	23	74.01%	0.35%	74.57%	49.65%
78	50522	1738	837	836	842	838	1	48.16%	48.10%	48.45%	48.24%
79	34549	2627	1882	0	1882	1882	381	71.64%	0.00%	71.64%	47.76%
80	20504	243	115	115	115	115	1	47.33%	47.33%	47.33%	47.33%
81	25625	185	131	0	131	131	1	70.81%	0.00%	70.81%	47.21%
82	31487	1608	678	632	789	756	806	42.16%	39.30%	49.07%	43.51%
83	263034	2731	1019	956	1266	1153	1469	37.31%	35.01%	46.36%	39.56%
84	262806	703	270	258	303	276	302	38.41%	36.70%	43.10%	39.40%
85	36758	215	123	0	123	123	123	57.21%	0.00%	57.21%	38.14%
86	9178	161	60	60	60	61	0	37.27%	37.27%	37.27%	37.27%
87	265326	271	99	79	119	113	124	36.53%	29.15%	43.91%	36.53%
88	205124	439	148	153	160	135	143	33.71%	34.85%	36.45%	35.00%
89	46549	456	7	10	456	14	33	1.54%	2.19%	100.00%	34.58%
90	267218	168	51	61	62	53	53	30.36%	36.31%	36.90%	34.52%
91	19902	269	269	1	7	6	0	100.00%	0.37%	2.60%	34.32%
92	203187	303	99	53	156	123	174	32.67%	17.49%	51.49%	33.88%
93	1843	4589	38	37	4589	42	42	0.83%	0.81%	100.00%	33.88%
94	19530	3209	3115	59	84	3131	82	97.07%	1.84%	2.62%	33.84%
95	53298	203	0	0	203	0	0	0.00%	0.00%	100.00%	33.33%
96	11509	888	0	0	886	9	0	0.00%	0.00%	99.77%	33.26%
97	7837	197	0	0	196	0	0	0.00%	0.00%	99.49%	33.16%

But wait

What about those who take default routes?

--- 139.138.224.4 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 19887ms
rtt min/avg/max/mdev = 243.039/243.758/251.173/1.088 ms, pipe 2

Valid

Invalid

--- 139.138.224.4 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 19877ms
rtt min/avg/max/mdev = 245.384/246.097/248.497/0.608 ms, pipe 2

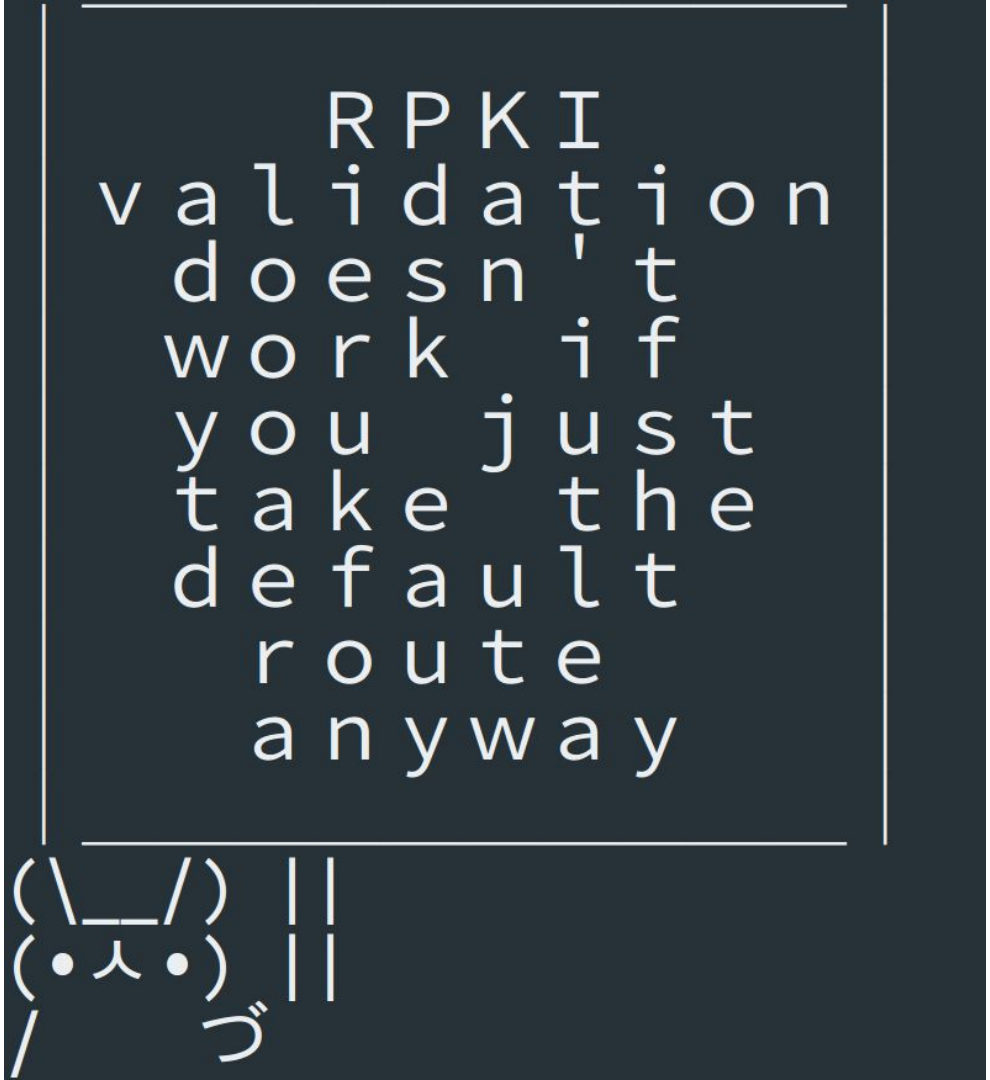
--- 139.138.224.4 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 19887ms
rtt min/avg/max/mdev = 243.039/243.758/251.173/1.088 ms, pipe 2

Valid

Reliably a 3ms~ difference

Invalid

--- 139.138.224.4 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 19877ms
rtt min/avg/max/mdev = 245.384/246.097/248.497/0.608 ms, pipe 2


RPKI
validation
doesn't
work if
you just
take the
default
route
anyway
(__/) ||
(•ㅅ•) ||
/ づ

But wait x 2

Maybe services do a better job?

BORDER GATEWAY PROTOCOL ATTACK —

Suspicious event hijacks Amazon traffi for 2 hours, steals cryptocurrency

Almost 1,300 addresses for Amazon Route 53 rerouted for two hours.

DAN GOODIN - 4/24/2018, 8:00 PM

BORDER GATEWAY PROTOCOL ATTACK —

Suspicious event hijacks Amazon traffi for 2 hours, steals cryptocurrency

Almost 1,300 addresses for Amazon Route 53 rerouted for two hours.

204.246.189.0/24	Amazon.com, Inc.	
205.251.192.0/23	Amazon.com, Inc.	
205.251.192.0/24	Amazon.com, Inc.	
205.251.193.0/24	Amazon.com, Inc.	
205.251.194.0/23	Amazon.com, Inc.	
205.251.194.0/24	Amazon.com, Inc.	
205.251.195.0/24	Amazon.com, Inc.	
205.251.196.0/23	Amazon.com, Inc.	
205.251.196.0/24	Amazon.com, Inc.	
205.251.197.0/24	Amazon.com, Inc.	
205.251.198.0/23	Amazon.com, Inc.	
205.251.198.0/24	Amazon.com, Inc.	
205.251.199.0/24	Amazon.com, Inc.	

Are you validating?

```
ben@eshwil:~$ dig ripe.playfeniks.com

ben@eshwil:~$ dig arin.playfeniks.com

ben@eshwil:~$ dig apnic.playfeniks.com

ben@eshwil:~$ dig jpnic.playfeniks.com
```

* These are likely not going to work that much longer after the talk

Try it??

```
[15:02:03] ben@metropolis:~$ dig @1.1.1.1 ripe.playfeniks.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> @1.1.1.1 ripe.playfeniks.com
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 25737
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1452
;; QUESTION SECTION:
;ripe.playfeniks.com.       IN   A

;; ANSWER SECTION:
ripe.playfeniks.com.    10193    IN   A    1.3.3.7

;; Query time: 1 msec
;; SERVER: 1.1.1.1#53(1.1.1.1)
;; WHEN: Thu Sep 06 15:02:11 BST 2018
;; MSG SIZE  rcvd: 64
```

```
[15:02:11] ben@metropolis:~$ dig @8.8.8.8 ripe.playfeniks.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> @8.8.8.8 ripe.playfeniks.com
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 30212
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
;ripe.playfeniks.com.       IN   A

;; ANSWER SECTION:
ripe.playfeniks.com.    20990    IN   A    1.3.3.7

;; Query time: 9 msec
;; SERVER: 8.8.8.8#53(8.8.8.8)
;; WHEN: Thu Sep 06 15:02:18 BST 2018
;; MSG SIZE  rcvd: 64
```

```
[15:02:18] ben@metropolis:~$ dig @9.9.9.9 ripe.playfeniks.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> @9.9.9.9 ripe.playfeniks.com
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 44713
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;ripe.playfeniks.com.       IN   A

;; ANSWER SECTION:
ripe.playfeniks.com.    43200    IN   A    1.3.3.7

;; Query time: 129 msec
;; SERVER: 9.9.9.9#53(9.9.9.9)
;; WHEN: Thu Sep 06 15:02:23 BST 2018
;; MSG SIZE  rcvd: 64
```

```
[15:02:23] ben@metropolis:~$ dig @80.80.80.80 ripe.playfeniks.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> @80.80.80.80 ripe.playfeniks.com
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 29235
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 2, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;ripe.playfeniks.com.       IN   A

;; ANSWER SECTION:
ripe.playfeniks.com.    604800    IN   A    1.3.3.7

;; Query time: 251 msec
;; SERVER: 80.80.80.80#53(80.80.80.80)
;; WHEN: Thu Sep 06 15:02:34 BST 2018
;; MSG SIZE  rcvd: 124
```

VALID ROA

General Information | Probes | Map | Results

Probe	ASN (IPv4)	ASN (IPv6)	Time (UTC)	Answer	Response Time
6058	2611	2611	2018-09-06 13:52	NOERROR	
6077	14061	14061	2018-09-06 13:52	NOERROR	
6088	43996	43996	2018-09-06 13:52	NOERROR	
6094	16004	16004	2018-09-06 13:52	NOERROR	
6095	14907	14907	2018-09-06 13:52	NOERROR	
6097	32244	32244	2018-09-06 13:52	NOERROR	57.808
6122	22300	22300	2018-09-06 13:52	NOERROR	64.374
6131	5404	5404	2018-09-06 13:52	NOERROR	
6137	3333	3333	2018-09-06 13:52	NOERROR	159.211
6155	30633	30633	2018-09-06 13:52	NOERROR	48.007
6166	680	680	2018-09-06 13:52	NOERROR	
6171	60574	60574	2018-09-06 13:52	NOERROR	
6196	4508	4508	2018-09-06 13:52	NOERROR	86.409
6242	8211	8211	2018-09-06 13:52	undefined	✖
6257	8560	8560	2018-09-06 13:52	NOERROR	83.795
6280	19255	19255	2018-09-06 13:52	NOERROR	38.511
6281	2200	2200	2018-09-06 13:52	NOERROR	197.
6309	39815	2614	2018-09-06 13:52	NOERROR	

excluding one probe, out of the 1k sample all worked

RIPE INVALID

General Information | Probes | Map | Results

Probe	ASN (IPv4)	ASN (IPv6)	Time (UTC)	Answer	Response Time
6058	2611	2611	2018-09-06 13:52	NOERROR	597.87
6077	14061	14061	2018-09-06 13:52	NOERROR	1806.34
6088	43996	43996	2018-09-06 13:52	NOERROR	814.00
6094	16004	16004	2018-09-06 13:52	NOERROR	237.592
6095	14907	14907	2018-09-06 13:52	NOERROR	423.893
6097	32244	32244	2018-09-06 13:52	NOERROR	401.948
6122	22300	22300	2018-09-06 13:52	NOERROR	62.984
6131	5404	5404	2018-09-06 13:52	NOERROR	637.24
6137	3333	3333	2018-09-06 13:52	NOERROR	152.399
6155	30633	30633	2018-09-06 13:52	NOERROR	46.535
6166	680	680	2018-09-06 13:52	NOERROR	249.735
6171	60574	60574	2018-09-06 13:52	NOERROR	431.726
6196	4508	4508	2018-09-06 13:52	NOERROR	86.384
6242	8211	8211	2018-09-06 13:52	undefined	✖
6257	8560	8560	2018-09-06 13:52	NOERROR	82.689
6280	19255	19255	2018-09-06 13:52	NOERROR	40.203
6281	2200	2200	2018-09-06 13:52	NOERROR	197.757
6309	39815	2614	2018-09-06 13:52	NOERROR	311.758
6323	206186	206186	2018-09-06 13:52	NOERROR	1070.8
6357	39138	39138	2018-09-06 13:52	NOERROR	149.622
6367	15133	15133	2018-09-06 13:52	NOERROR	1103.8

Lessons

Please, if you are going to do RPKI:

- Sign your prefixes
- **Validate your inbound prefixes**
- Consider not having your default route if you take a full table
- Configure your RPKI validator correctly (aka, add ARIN)

Shout outs

- Huge thanks to Job for the 10GBE server and the helping with prefixes
  - Even though later on a qemu limitation ment I could barely do 150mbps :(
- Nepal Research and Education Network (NREN)
  - For the APNIC prefix to test with
- Japan Network Information Center / PPP-EXP
  - For the JPNIC prefix
- NTT Communications
  - For the ARIN and RIPE prefix
- LARUS Cloud Service Ltd
  - For the AFRINIC prefix

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  - For the JPNIC prefix
- NTT Communications
  - For the ARIN and RIPE prefix
- LARUS Cloud Service Ltd
  - For the AFRINIC prefix

Questions? (if I have time)

@Benjojo12 / ben@benjojo.co.uk / $whois as206924

Links

https://docs.google.com/spreadsheets/d/14gwdinxXAq-G3XBqJOxQfsrMpmfDAgaRK0z05TBq6UY/edit

<- Spreadsheet

Raw Data ->

https://drive.google.com/drive/folders/1j9XoapFo4vO4DFZ2o2htopZgcJ0uL3_b?usp=sharing

Questions? (if I have time)