

How much “bad traffic” should I be seeing from each economy?

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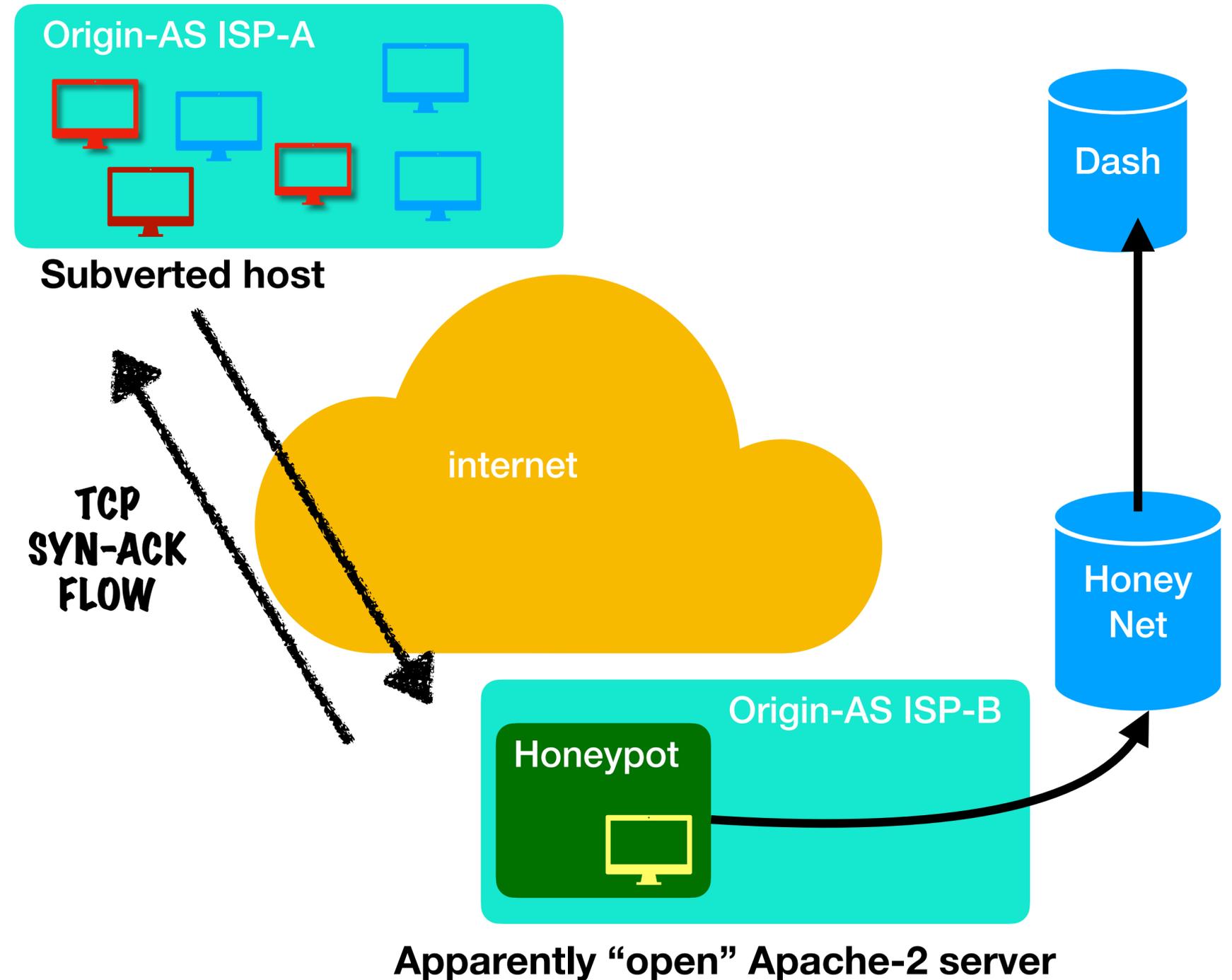
What is “bad traffic” - background

- APNIC runs an information service called “DASH”
- “**D**ashboard for **AS** number **H**ealth”
- It’s a report about honeynet-measured bad traffic origination from each AS
- *(we’re working on BGP health & RPKI / IRR misalignment as a feature for 2022 along with alerting as a service)*



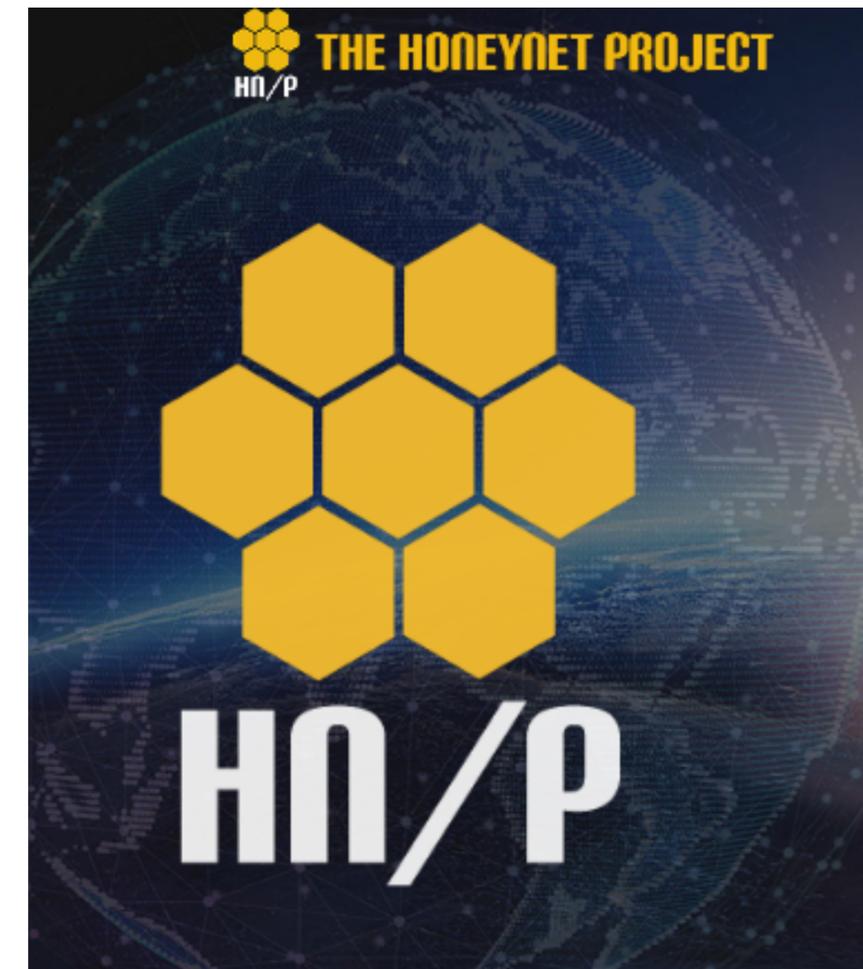
What is “bad traffic” - Subverted systems

- We believe we primarily detect subverted customer hosts
- Systems which have malware installed, and are being used as part of a “botnet” or otherwise as an attack source: probing to find other candidate systems to attack, and install malware on
- If these are not subverted hosts, since its TCP, it isn't hard to track them down. Its not spoofed-source



Honeynet?

- Honeypots are traps for attackers:
 - Run “attractive” port-80 (web), port-22 (SSH), port-53 (DNS) and like services -signal (falsely) they are unpatched for known CVE, or have rainbow-table guessable passwords, or are open-resolvers
 - Collect the 5-tuple {ip proto, src, srcport, dst, dstport} plus associated metadata
 - Share the information amongst the CERT & related community
 - 501c3 international non-profit security research organisation
 - Distributed worldwide



<https://honeynet.org>

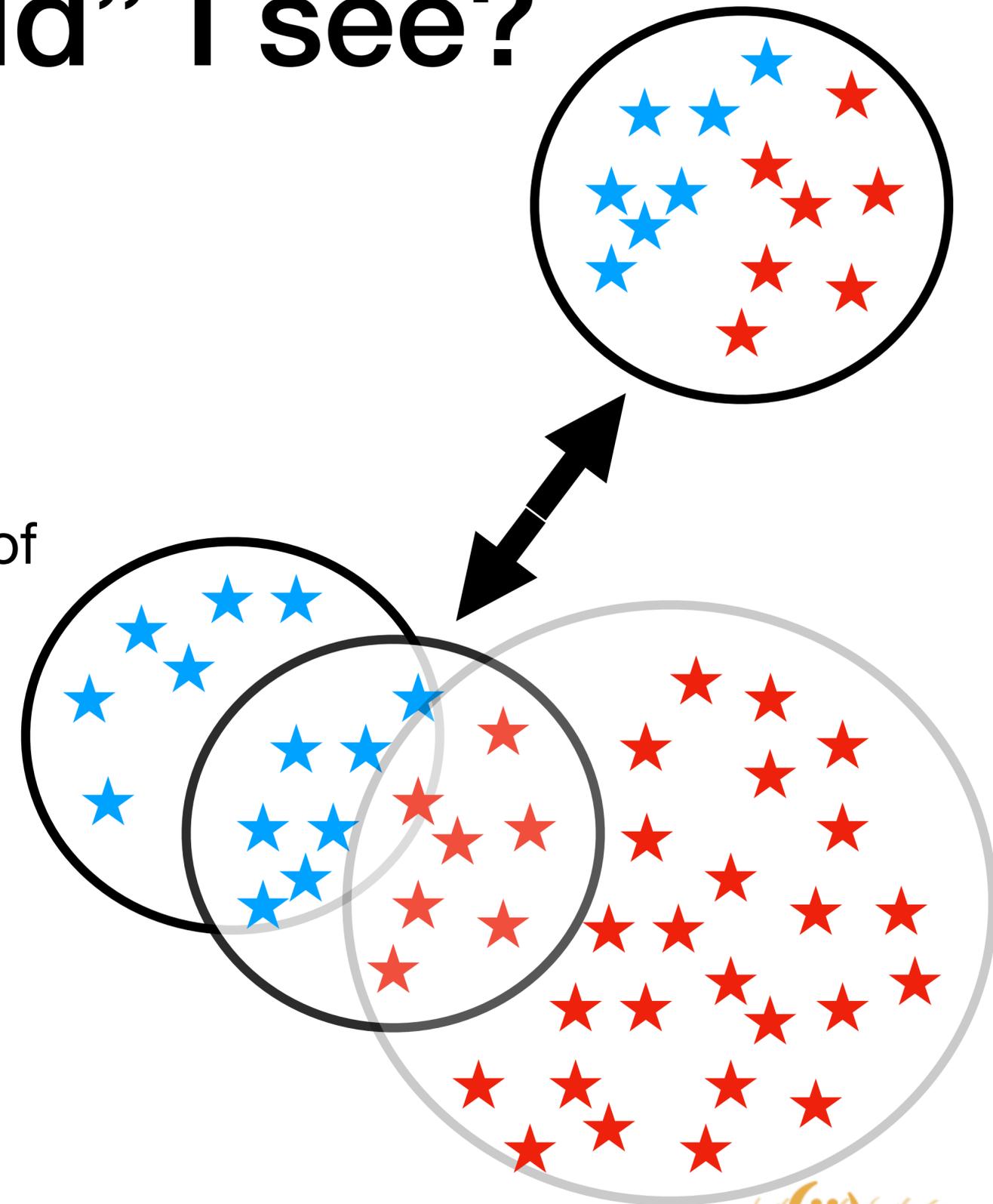
DASH has a honey net feed

- APNIC Security (Adli Wahid) has provided APNIC with a JSON feed of the honey net “hits”
- We “adorn” this via delegated-extended and BGP to add the origin-as (at time of hit) and registration information (economy, allocating RIR, custodian code)
- Our primary mission in DASH is to tell the delegate (and origin-AS) about the problem: we’re not in the “name and shame” business
- But, we do aggregate this up to the economy/region level for analysis

```
{  
  "direction": "inbound",  
  "protocol": "ip",  
  "ids_type": "network",  
  "timestamp": "2018-04-15T22:44:23.339555",  
  "vendor_product": "Cowrie",  
  "type": "cowrie.sessions",  
  "app": "cowrie",  
  "src_ip": "195.3.147.49",  
  "economy": "LV",  
  "RIR": "RIPE",  
  "custodian-code": "702bfdc7-58d1-48db-a50e-43be90c3e3ac",  
  "origin-AS": "AS41390"  
  "dest_port": 22,  
  "signature": "SSH session on cowrie honeypot",  
  "ssh_version": "SSH-2.0-PuTTY_Release_0.67",  
  "src_port": 40629,  
  "dest_ip": "192.168.1.1",  
  "sensor": "8ae6a710-16c2-11e8-a596-5600015f762a",  
  "transport": "tcp",  
  "severity": "high"  
}
```

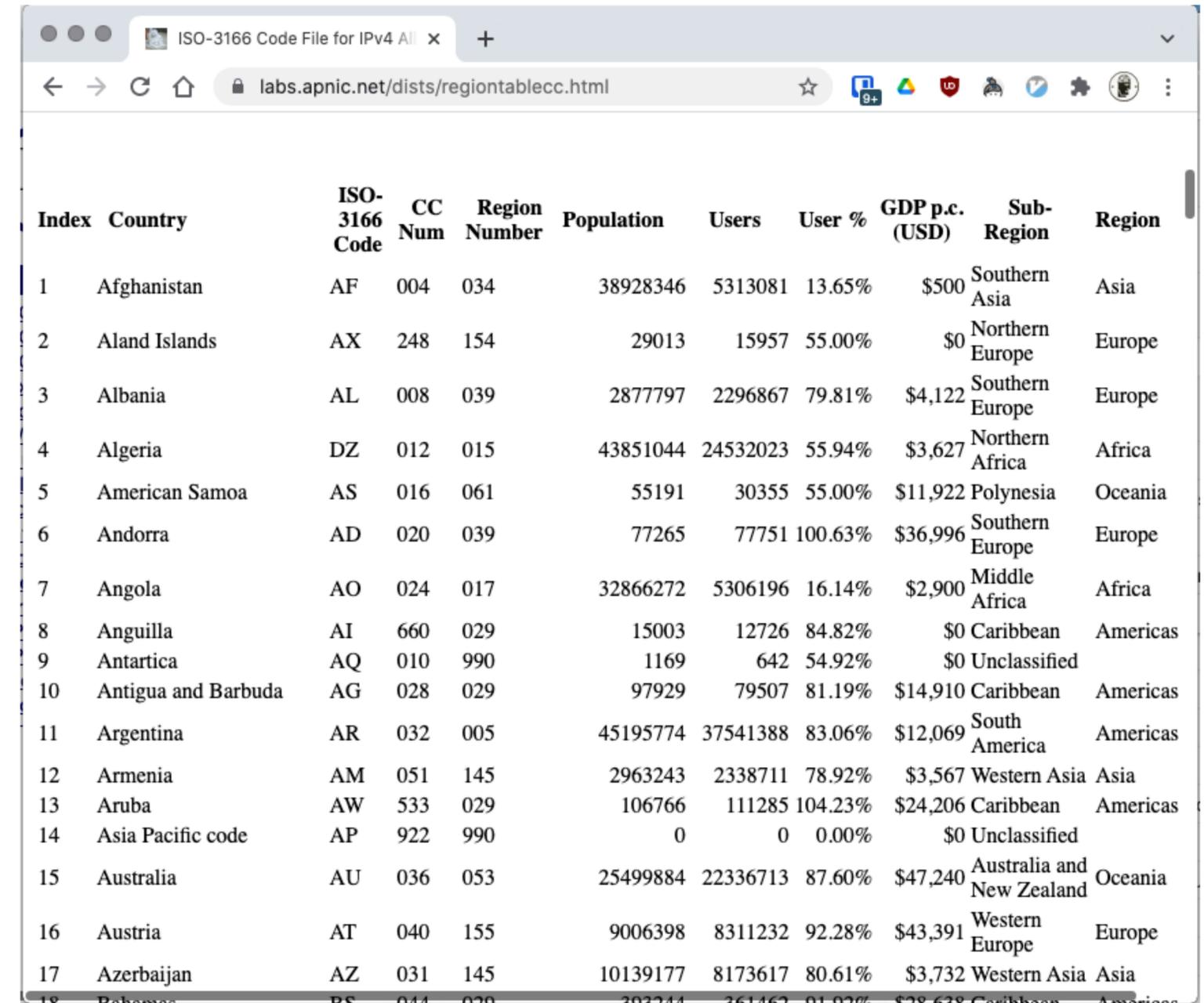
How much “should” I see?

- Imagine “bad traffic” as a problem is evenly distributed
- This means that on average, the amount of “hits” which are seen from any source will be a function of the size of the population online
- Therefore the volume of “bad traffic” hits per economy should be a function of the online population size
- ...Which we have in APNIC Labs as a model



The APNIC Labs population model

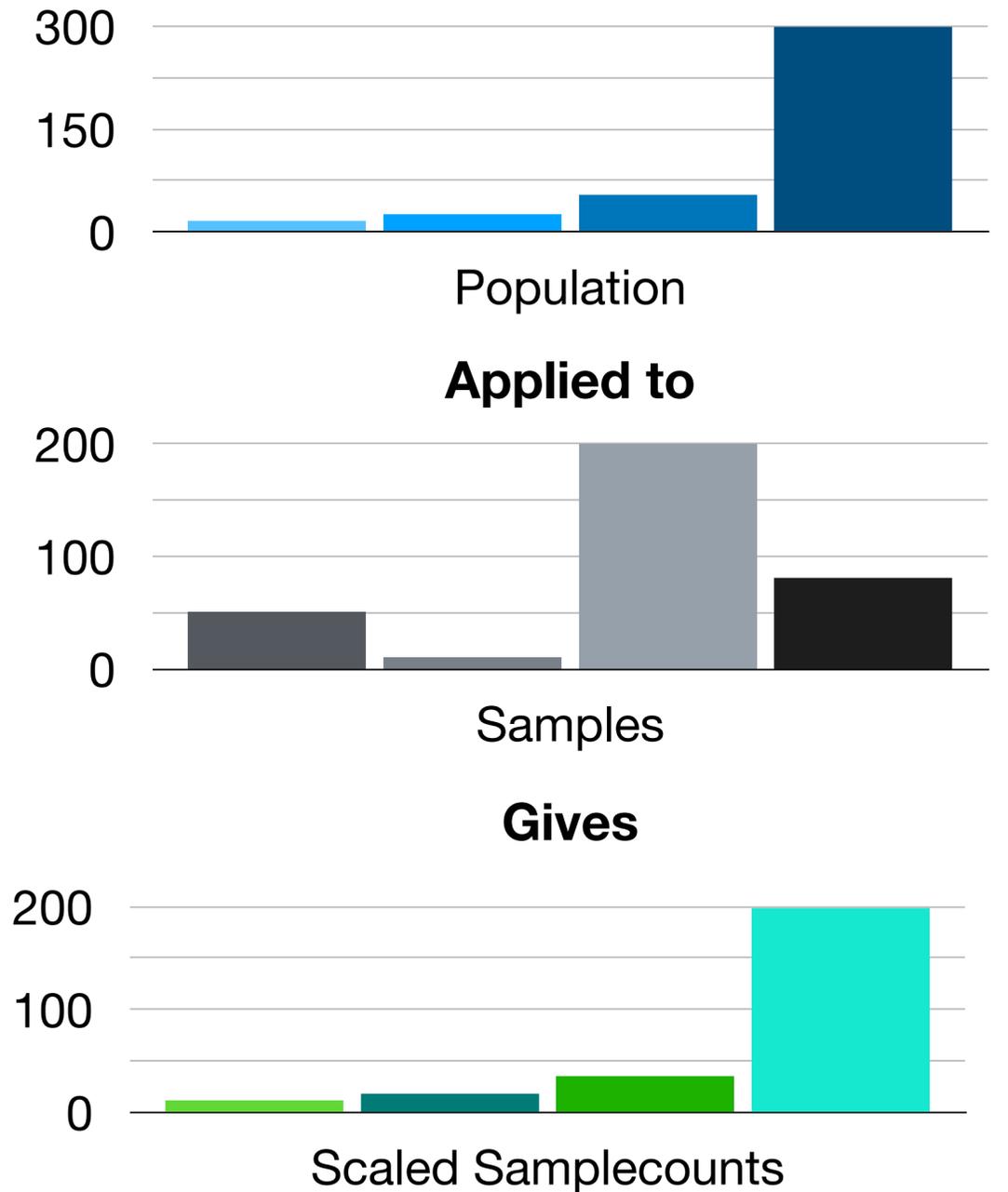
- APNIC Labs collates basic economy data from external sources and tabulates it online at
 - <https://labs.apnic.net/dists/regiontablecc.html>
- This is used for “weighting” data in labs 1x1 experiments



Index	Country	ISO-3166 Code	CC Num	Region Number	Population	Users	User %	GDP p.c. (USD)	Sub-Region	Region
1	Afghanistan	AF	004	034	38928346	5313081	13.65%	\$500	Southern Asia	Asia
2	Aland Islands	AX	248	154	29013	15957	55.00%	\$0	Northern Europe	Europe
3	Albania	AL	008	039	2877797	2296867	79.81%	\$4,122	Southern Europe	Europe
4	Algeria	DZ	012	015	43851044	24532023	55.94%	\$3,627	Northern Africa	Africa
5	American Samoa	AS	016	061	55191	30355	55.00%	\$11,922	Polynesia	Oceania
6	Andorra	AD	020	039	77265	77751	100.63%	\$36,996	Southern Europe	Europe
7	Angola	AO	024	017	32866272	5306196	16.14%	\$2,900	Middle Africa	Africa
8	Anguilla	AI	660	029	15003	12726	84.82%	\$0	Caribbean	Americas
9	Antartica	AQ	010	990	1169	642	54.92%	\$0	Unclassified	
10	Antigua and Barbuda	AG	028	029	97929	79507	81.19%	\$14,910	Caribbean	Americas
11	Argentina	AR	032	005	45195774	37541388	83.06%	\$12,069	South America	Americas
12	Armenia	AM	051	145	2963243	2338711	78.92%	\$3,567	Western Asia	Asia
13	Aruba	AW	533	029	106766	111285	104.23%	\$24,206	Caribbean	Americas
14	Asia Pacific code	AP	922	990	0	0	0.00%	\$0	Unclassified	
15	Australia	AU	036	053	25499884	22336713	87.60%	\$47,240	Australia and New Zealand	Oceania
16	Austria	AT	040	155	9006398	8311232	92.28%	\$43,391	Western Europe	Europe
17	Azerbaijan	AZ	031	145	10139177	8173617	80.61%	\$3,732	Western Asia	Asia

Weighting data

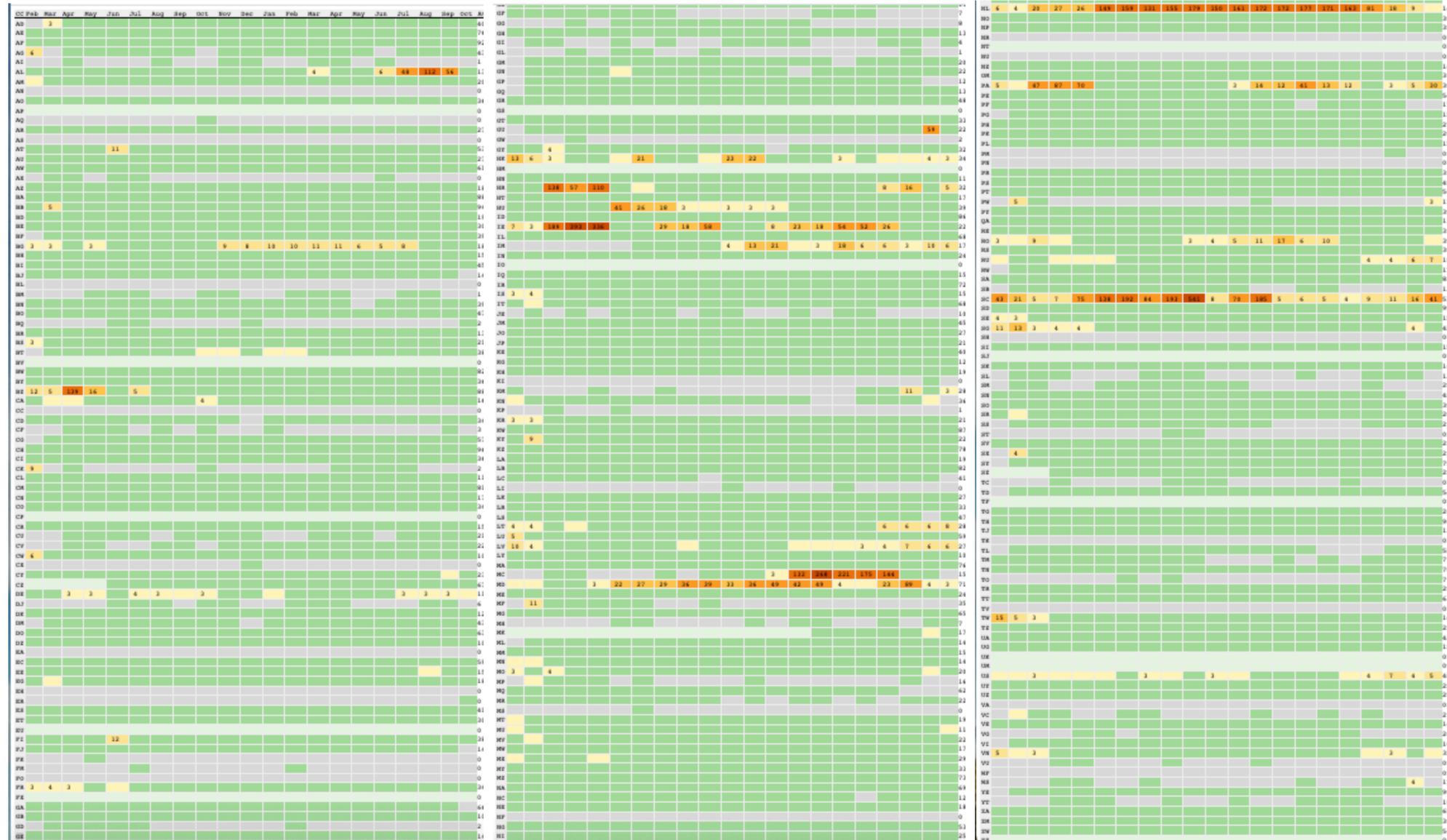
- Samples in labs 1x1 experiments do not distribute randomly by economy
- Within any AS or Economy, they are a reasonable insight into end-user capability per user
 - *If there was an external ground-truth to the ratio of end users per origin-AS, labs could apply it*
- Weights are applied to re-scale sample **counts** per economy, to use in totals for World, regions, or associated totals for discrete economies (eg RIPE membership, APNIC membership)
- Sample values as measured are un-affected, but can be “added” to scale with the real-world % of totals amongst economies



Applying weights to DASH data

- We don't want to produce sums/totals by region or from economies.
- We want to understand if the volume of honey net inputs per economy are in scale with the economy as a population of users.
- So: based on some count of hits per day seen, assuming random distribution per economy, what level of traffic per economy (by user population) **should** we have seen
- ...And how does this vary against the actual hit rate per economy?

The Results



The Results



The Results

The image shows a large grid of data, likely a calendar or schedule, with a blue overlay in the center containing the text "Thank You. Questions?". The grid is composed of many small cells, some of which are highlighted in yellow or orange. The text "Thank You. Questions?" is written in white on a blue background.

Ok. More seriously what's going on?

CC	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
AD		3																			
AE																					
AF																					
AG	6																				
AI																					
AL														4			6	48	112	56	

- This is a time series from Feb 2020 to October 2021
- Each row is an ISO3166 economy identified from the origin-as
- The cells show variance of count of the “hits” in this date, from the “ground truth” user population, as a ratio of world population. -The variance is “how many x “worse” this is.



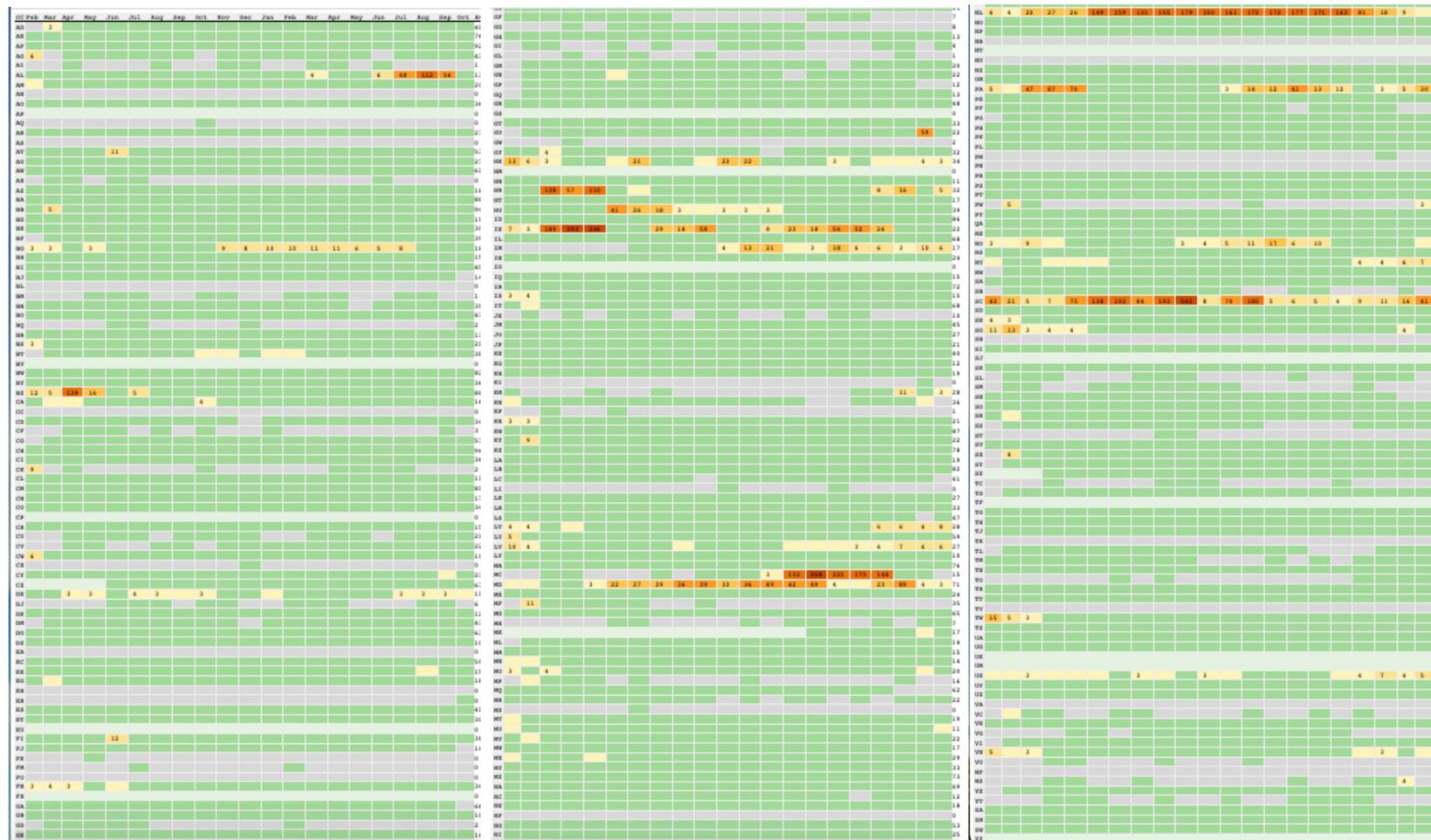
The Results: most economies do “OK”



- The graph is overwhelmingly “green”
- Most economies are at, or below their expected ratio against all samples seen worldwide
- *I didn't bother grading for goodness, some are better than others.*
- Most economies without samples are small economies.



The Results: for most economies, the problem is “intermittent”



- On bad months, its sustained sometimes beyond 1-2 months, but usually its dealt with at some point

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Is this evenly distributed?

- No. On this evidence, “goodness” distributes pretty evenly, but “badness” is spotty, and distributes differently in time, and location.
- The first proposition “follows the % of world population” doesn’t look like it holds.

The Results: What is going on in the Netherlands?

CC	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
NG																						
NI																						
NL	6	4	20	27	26	149	159	131	155	179	150	161	172	172	177	171	163	81	18	9		
NO																						
NP																						
NR																						

- Is this a persisting problem, or is the NL where the CERT/honeynet community typically run scanners from?
 - We think that there was some ramp-up and then long period, and then a process change of some kind.
 - The scale appears above and beyond that which would sail under the radar of the NL authorities, if this was a persisting problem



The Results: The problem sorted by intensity and scale

- This is an extract of the data, selected by the scale of the problem, to average intensity (so, it naturally promotes consistently above-scale sources)

CC	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	vAvg	vMax
NL	6	4	20	27	26	149	159	131	155	179	150	161	172	172	177	171	163	81	18	9		99	181
SC	43	21	5	7	75	138	192	84	193	541	8	70	185	5	6	5	4	9	11	16	41	76	540
IE	7	3	189	393	336			29	18	58			8	23	18	54	52	26				56	402
MC													3	132	268	221	175	144				44	273
MD					3	22	27	29	36	39	33	36	49	42	49	4		23	89	4	3	22	89
HR			138	57	110													8	16		5	16	147
PA	5		47	87	70							3	14	12	41	13	12		3	5	30	16	87
AL														4			6	48	112	56		10	112
BZ	12	5	139	16		5																8	140
HK	13	6	3				21				23	22				3				4	3	5	24
HU						41	26	18	3		3	3	3									5	42
IM											4	13	21		3	18	6	6	3	10	6	4	22
BG	3	3		3						9	8	10	10	11	11	6	5	8				4	11
RO	3		9							3	4	5	11	17	6	10						3	17
LV	10	4															3	4	7	6	6	3	10
GU																					59	3	59
US			3					3			3							4	7	4	5	2	7
SG	11	13	3	4	4															4		2	14
LT	4	4																6	6	6	8	2	8
RU																		4	4	6	7	2	7
DE			3	3		4	3		3									3	3	3		2	4
TW	15	5	3																			1	14
VN	5		3																3			1	5
FR	3	4	3																			1	4
KY		9																				1	9
KR	3	3																				1	4
BT																						1	2
FI					12																	1	12

CC	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	vAvg	vMax		
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BZ	12	5					139															8	140		
HK	13	6	3																	4	3	5	24		
HU																						5	42		
IM																						3	22		
BG	3	3																				4	11		
RO	3							9														3	17		
LV	10	4																		7	6	6	3	10	
GU																							3	59	
US																				7	4	5	2	7	
SG	11	13	3																		4		2	14	
LT	4	4																			6	6	8	2	8
RU																					4	6	7	2	7
DE																					3	3		2	4
TW	15	5	3																				1	14	
VN	5																				3		1	5	
FR	3	4	3																				1	4	
KY																							1	9	
KR	3	3																					1	4	
BT																							1	2	
FI																							1	12	

This is a CDF of about 80% Of the problem

CC	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	vAvg	vMax	
NL	6	4	20	27	26	149	159	131	155	179	150	161	172	172	177	171	163	81	18	9		99	181	
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BG	3	3																				4	11	
RO	3		9																			3	17	
LV	10	4																				7	10	
GU																							3	59
US			3																			7	7	
SG	11	13	3																			2	14	
LT	4	4																				6	8	
RU																						4	7	
DE			3																			3	4	
TW	15	5	3																				1	14
VN	5		3																			3	5	
FR	3	4	3																				1	4
KY		9																					1	9
KR	3	3																					1	4
BT																							1	2
FI					12																		1	12

This is a CDF of about 80% Of the problem
 It's a CDF of only 17% of the population of users

Classic 80/20 problem!

- It kind-of works out that 20% of the population (ok 17%) is causing 80% of the problem.

The Results: The problem sorted by real-world scale

- This is an extract of the data, selected by the scale of the economy, irrespective of intensity.

CC	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	vAvg	vMax	%world	%cumulative	
CN																						0	1	19.57	19.570	
IN																							0	0	14.49	34.058
US			3					3			3							4	7	4	5	2	7	5.84	39.903	
BR																							0	1	3.96	43.860
ID																							0	1	2.91	46.770
RU																		4	4	6	7	2	7	2.82	49.591	
JP																							0	0	2.63	52.216
MX																							0	3	2.18	54.394
PH																							0	0	1.76	56.149
DE			3	3		4	3		3									3	3	3		2	4	1.65	57.800	
TR																							0	1	1.54	59.339
GB																							0	1	1.53	60.870
NG																							0	0	1.53	62.397
IR																							0	1	1.52	63.920
IR																							0	1	1.29	65.209
VN	5		3																3			1	5	1.28	66.488	
EG																							0	2	1.27	67.758
FR	3	4	3																				1	4	1.21	68.965
KR	3	3																					1	4	1.10	70.068
TH																							0	1	1.01	71.075
ES																							0	1	0.90	71.979
IQ																							0	0	0.90	72.881
AR																							0	1	0.90	73.781
IT																							0	2	0.86	74.640
PK																							0	0	0.86	75.496
CA									4														1	4	0.85	76.344
ZA																							0	0	0.84	77.181
CO																							0	1	0.80	77.981
BD																							0	0	0.79	78.772
SA																							0	0	0.74	79.517
SA																							0	0	0.68	80.197
PL																							0	1	0.67	80.862
UA																							0	1	0.66	81.526
MY																							0	1	0.64	82.162
ET																							0	0	0.60	82.764
TW	15	5	3																				1	14	0.59	83.351

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This is a CDF of about 40% Of the problem

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ET																							0	0	0.60	82.764
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This is a CDF of about 40% Of the problem
 But.. it's about 78% of the CDF by user Population

wait.. $80 + 40 == 120\%$

- You can't add these two views, different sorting functions determined the "top set" in each case.
- (Some of the (few) heavy hitters in the first slide, are also in the second slide, by population, if not by intensity of effect)

Summary

- DASH is helping AS delegates understand their bad traffic effects, from a worldwide network of honeypots
- Viewed as an aggregate by economy and time, The “problem” of bad traffic is not evenly distributed.
 - By “size”, less than half the problem sources from the larger Internet economies (user population)
 - By “pain”, almost 80% of the problem sources from a list of around 30 economies, which represent less than 17% of the population
- There are some anomaly economies (NL?) which may be measurement artefacts or CERT scanning activity
 - Most economies seem to get a handle on the problem within a few months of a “peak event”

Summary

Thank you for listening!

Happy to take questions

(Can't easily show you inside DASH because its for delegates only: you need an APNIC login. Remember we're not doing "name and shame" at the delegate (AS holder) level)

Thank You

Complete Dataset by economy code, Feb 2020 - Oct 2021

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AD		3																				0	3	0.000	0.000	0.00	0.002	
AE																							0	1	0.000	0.001	0.23	0.236
AF																							0	1	0.000	0.001	0.13	0.367
AG	6																						0	7	0.000	0.000	0.00	0.369
AI																							0	0	0.000	0.000	0.00	0.369
AL														4			6	48	112	56			10	112	0.006	0.062	0.06	0.425
AM																							0	2	0.000	0.001	0.06	0.481
AN																							0	0	0.000	0.000	0.00	0.484
AO																							0	0	0.000	0.000	0.13	0.613
AP																							0	0	0.000	0.000	0.00	0.613
AQ																							0	0	0.000	0.000	0.00	0.613
AR																							0	1	0.002	0.009	0.90	1.516
AS																							0	0	0.000	0.000	0.00	1.517
AT					11																		1	11	0.001	0.021	0.20	1.714
AU																							0	1	0.001	0.004	0.52	2.237
AW																							0	1	0.000	0.000	0.00	2.240
AX																							0	1	0.000	0.000	0.00	2.240
AZ																							0	0	0.000	0.000	0.19	2.432
BA																							0	0	0.000	0.000	0.07	2.501
BB		5																					0	5	0.000	0.000	0.01	2.507
BD																							0	0	0.001	0.004	0.80	3.306
BE																							0	0	0.000	0.001	0.25	3.551
BF																							0	0	0.000	0.000	0.10	3.653
BG	3	3		3						9	8	10	10	11	11	6	5	8					4	11	0.005	0.013	0.12	3.769
BH																							0	1	0.000	0.000	0.04	3.808
BI																							0	1	0.000	0.000	0.02	3.826
BJ																							0	0	0.000	0.000	0.05	3.877
BL																							0	0	0.000	0.000	0.00	3.877
BM																							0	0	0.000	0.000	0.00	3.878
BN																							0	1	0.000	0.000	0.01	3.890
BO																							0	1	0.000	0.001	0.15	4.036
BQ																							0	0	0.000	0.000	0.00	4.036
BR																							0	1	0.008	0.052	3.96	7.993
BS	3																						0	3	0.000	0.000	0.01	8.002
BT																							1	2	0.000	0.000	0.01	8.012
BV																							0	0	0.000	0.000	0.00	8.012
BW																							0	1	0.000	0.000	0.03	8.038
BY																							0	1	0.000	0.001	0.18	8.220
BZ	12	5	139	16		5																	8	140	0.000	0.007	0.00	8.225
CA									4														1	4	0.005	0.035	0.86	9.080
CC																							0	0	0.000	0.000	0.00	9.080
CD																							0	0	0.000	0.000	0.30	9.377
CF																							0	0	0.000	0.000	0.01	9.382
CG																							0	0	0.000	0.000	0.01	9.395

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CH																				0	1	0.000	0.002	0.21	9.601
CI																				0	0	0.000	0.001	0.31	9.909
CK	9																			0	9	0.000	0.000	0.00	9.909
CL																				0	1	0.001	0.003	0.39	10.296
CM																				0	0	0.000	0.000	0.16	10.452
CN																				0	1	0.070	0.291	19.57	30.022
CO																				0	1	0.001	0.008	0.84	30.859
CP																				0	0	0.000	0.000	0.00	30.859
CR																				0	1	0.000	0.001	0.10	30.961
CU																				0	0	0.000	0.000	0.17	31.127
CV																				0	1	0.000	0.000	0.01	31.137
CW	6																			0	6	0.000	0.000	0.00	31.139
CX																				0	0	0.000	0.000	0.00	31.139
CY																				0	2	0.000	0.001	0.03	31.165
CZ																				0	1	0.000	0.002	0.21	31.371
DE			3	3		4	3			3										2	4	0.031	0.063	1.65	33.022
DJ																				0	0	0.000	0.000	0.03	33.050
DK																				0	0	0.000	0.000	0.13	33.182
DM																				0	1	0.000	0.000	0.00	33.183
DO																				0	1	0.000	0.001	0.19	33.371
DZ																				0	0	0.000	0.001	0.60	33.973
EA																				0	0	0.000	0.000	0.00	33.975
EC																				0	1	0.000	0.001	0.27	34.248
EE																				0	2	0.000	0.001	0.03	34.276
EG																				0	2	0.002	0.030	1.28	35.555
EH																				0	0	0.000	0.000	0.01	35.562
ER																				0	0	0.000	0.000	0.00	35.564
ES																				0	1	0.002	0.008	1.01	36.571
ET																				0	0	0.000	0.001	0.66	37.234
EU																				0	0	0.000	0.000	0.00	37.234
FI					12															1	12	0.001	0.013	0.11	37.348
FJ																				0	1	0.000	0.000	0.01	37.361
FK																				0	0	0.000	0.000	0.00	37.361
FM																				0	0	0.000	0.000	0.01	37.366
FO																				0	0	0.000	0.000	0.00	37.367
FR	3	4	3																	1	4	0.013	0.049	1.27	38.637
FX																				0	0	0.000	0.000	0.00	38.637
GA																				0	0	0.000	0.000	0.03	38.666
GB																				0	1	0.004	0.015	1.53	40.196
GD																				0	1	0.000	0.000	0.00	40.198
GE																				0	1	0.000	0.000	0.07	40.265
GF																				0	1	0.000	0.000	0.00	40.269
GG																				0	0	0.000	0.000	0.00	40.269
GH																				0	0	0.000	0.001	0.33	40.599
GI																				0	0	0.000	0.000	0.00	40.600
GL																				0	0	0.000	0.000	0.00	40.601

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GM																				0	1	0.000	0.000	0.01	40.614
GN																				0	2	0.000	0.001	0.05	40.660
GP																				0	1	0.000	0.000	0.01	40.665
GQ																				0	0	0.000	0.000	0.01	40.676
GR																				0	2	0.000	0.003	0.18	40.853
GS																				0	0	0.000	0.000	0.00	40.853
GT																				0	0	0.000	0.001	0.23	41.082
GU																				3	59	0.000	0.002	0.00	41.086
GW																				0	0	0.000	0.000	0.00	41.088
GY			4																	0	4	0.000	0.000	0.01	41.095
HK	13	6	3						21											5	24	0.009	0.040	0.17	41.260
HM																				0	0	0.000	0.000	0.00	41.260
HN																				0	0	0.000	0.000	0.09	41.346
HR			138	57	110															16	147	0.009	0.085	0.06	41.404
HT																				0	0	0.000	0.000	0.03	41.438
HU							41	26	18	3										5	42	0.008	0.074	0.18	41.613
ID																				0	1	0.004	0.016	2.91	44.523
IE	7	3	189	393	336															56	402	0.055	0.395	0.10	44.621
IL																				0	2	0.000	0.003	0.17	44.796
IM																				4	22	0.000	0.000	0.00	44.797
IN																				0	0	0.010	0.033	14.49	59.285
IO																				0	0	0.000	0.000	0.00	59.285
IQ																				0	0	0.000	0.000	0.90	60.189
IR																				0	1	0.003	0.009	1.52	61.713
IS	3	4																		0	4	0.000	0.000	0.01	61.721
IT																				0	2	0.003	0.016	0.90	62.621
JE																				0	0	0.000	0.000	0.00	62.623
JM																				0	1	0.000	0.000	0.04	62.662
JO																				0	1	0.000	0.001	0.18	62.842
JP																				0	0	0.001	0.007	2.63	65.468
KE																				0	0	0.000	0.001	0.25	65.715
KG																				0	0	0.000	0.000	0.07	65.787
KH																				0	1	0.001	0.002	0.17	65.960
KI																				0	0	0.000	0.000	0.00	65.960
KM																				1	11	0.000	0.000	0.00	65.962
KN																				0	2	0.000	0.000	0.00	65.963
KP																				0	0	0.000	0.000	0.00	65.964
KR	3	3																		1	4	0.010	0.042	1.21	67.172
KW																				0	0	0.000	0.000	0.13	67.300
KY			9																	1	9	0.000	0.000	0.00	67.302
KZ																				0	0	0.000	0.001	0.36	67.662
LA																				0	0	0.000	0.000	0.06	67.719
LB																				0	0	0.000	0.000	0.13	67.852
LC																				0	1	0.000	0.000	0.00	67.854
LI																				0	0	0.000	0.000	0.00	67.855
LK																				0	0	0.000	0.000	0.19	68.049

