



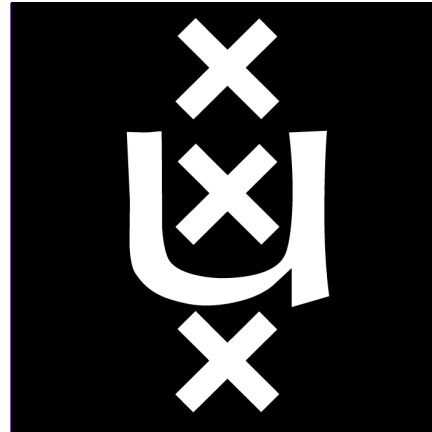
Authors:

Remy de Boer

<Remy.deBoer@os3.nl>

Javy de Koning

<Javy.deKoning@os3.nl>



BGP Origin Validation (RPKI)

+ What is RPKI?

- Designed to secure internet routing infrastructure
- Route origin validation
- Might be used for routing policies
- Certificates for proof of holdership

+ Why?

2
of
22

- BGP is currently a web of trust
- No validation or filtering can lead to outages
- Limit impact of misconfigurations
- Prevent Hijacking attempts

+ Research question

3
of
22

- *“How can we reliably determine which ASes are advertising invalid routes due to misconfigurations and how can we monitor this over the course of time?”*

+ Route Origin Authorization?

- Prefix
 - (145.96.0.0/15)
- Autonomous System Number
 - (1103)
- Maximum Length (optional)

+ Validation states

- Unknown
 - Announcement not covered by a ROA
- Invalid
 - Announcement covered by at least one ROA but no ROA matches
- Valid
 - Announcement covered AND matched by at least one ROA

+ Examples (1/3)

- Advertisement:
 - Prefix:
 - 195.169.0.0/16
 - AS number:
 - 1103
- ROA
 - Prefix:
 - 195.169.0.0/16
 - AS number:
 - 1103
 - Max length:
 - Not used (= 16)

+ Examples (2/3)

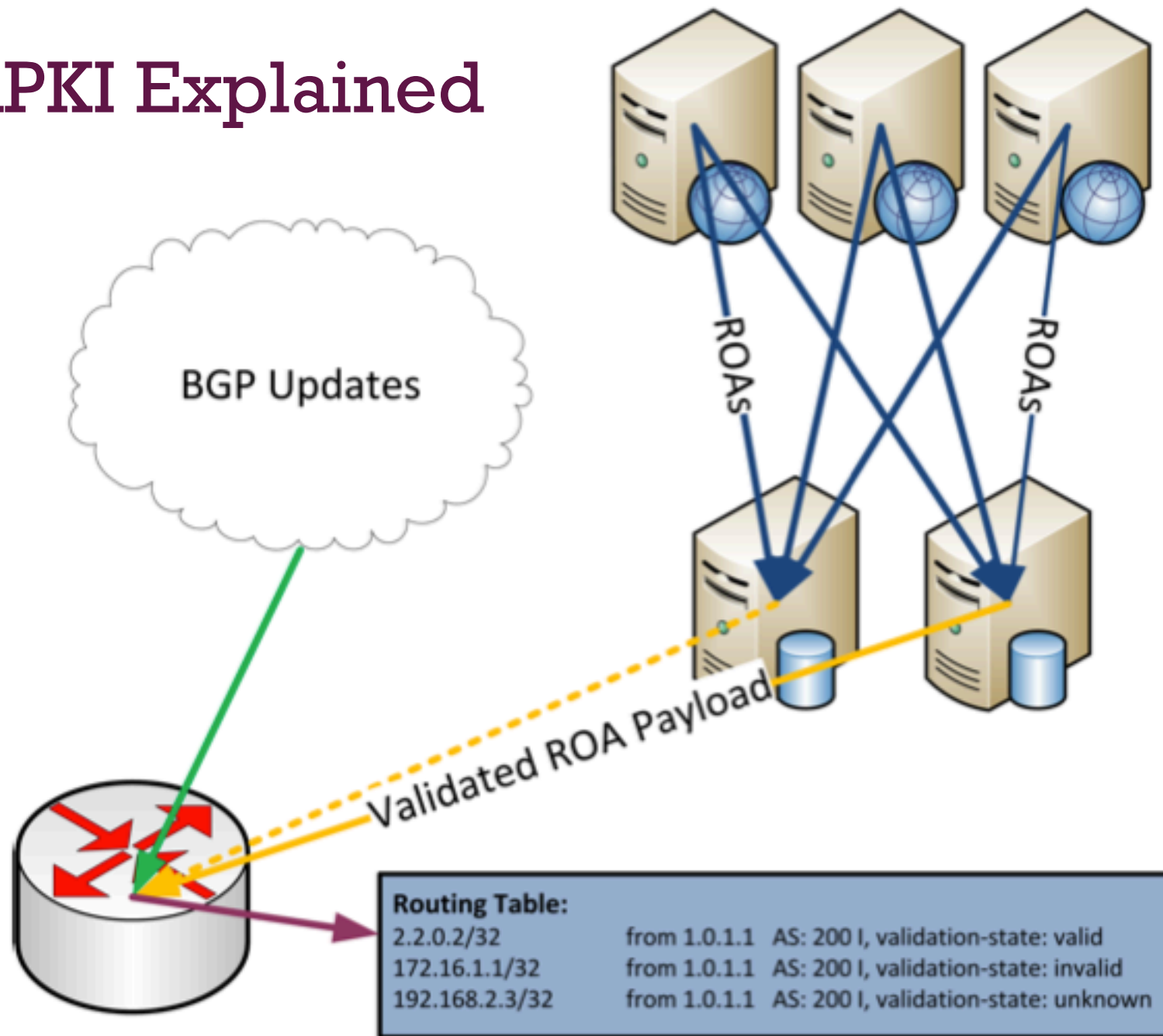
- Advertisement:
 - Prefix:
 - 181.50.0.0/22
 - AS number:
 - 10620
- ROA
 - Prefix:
 - 181.50.0.0/13
 - AS number:
 - 14080
 - Max length:
 - 24

+ Examples (3/3)

- Advertisement:
 - Prefix:
 - 193.48.122.0/24
 - AS number:
 - 1724
- ROA
 - Prefix:
 - 193.48.0.0/14
 - AS number:
 - 2200
 - Max length:
 - 14

+ RPKI Explained

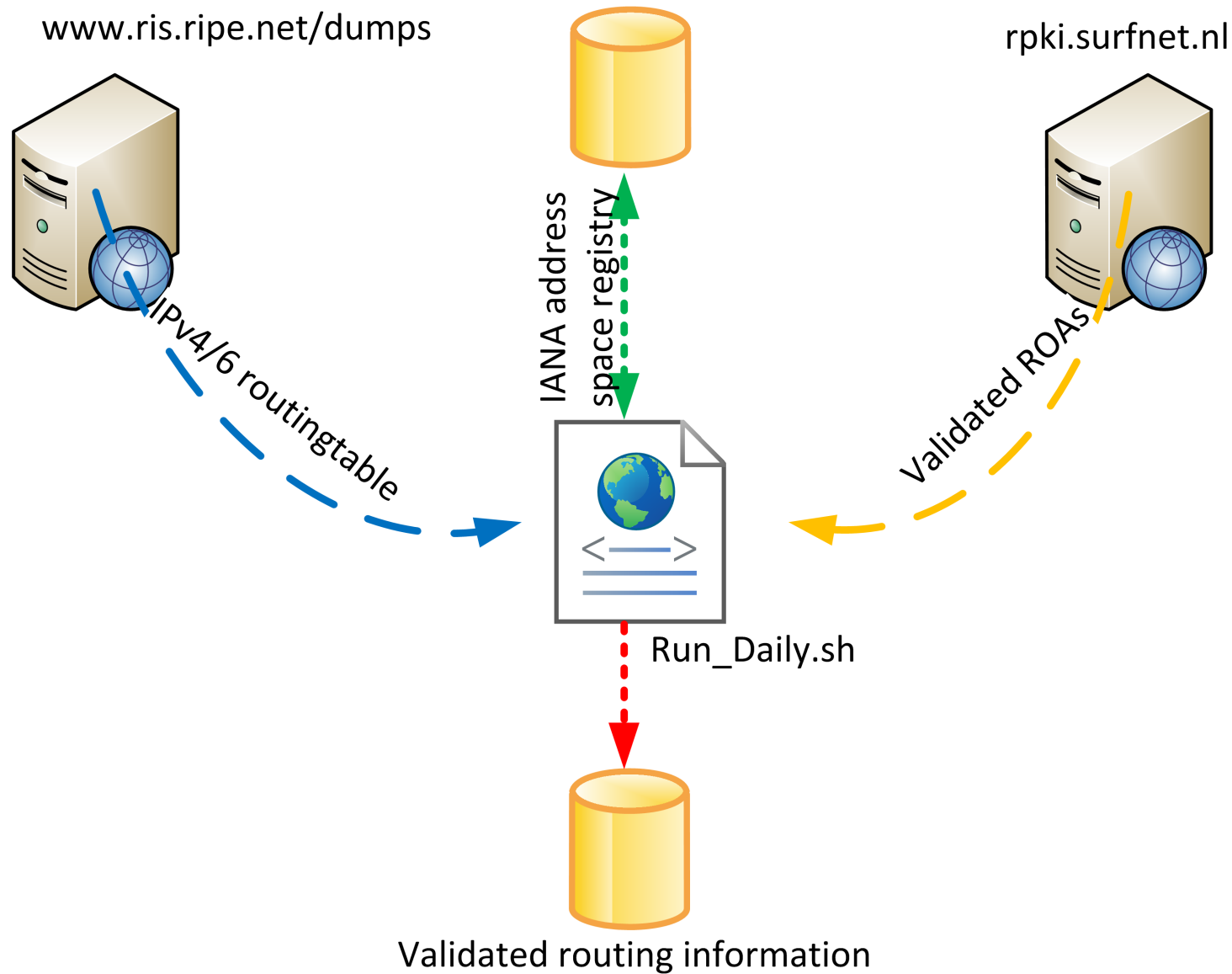
9
of
22



+ Tools used

- Python/PHP/MySQL/Google Chart
- Twitter bootstrap
- RIPE RPKI Validator
- RIPE Global routing table (RIS)
- IANA address space registry

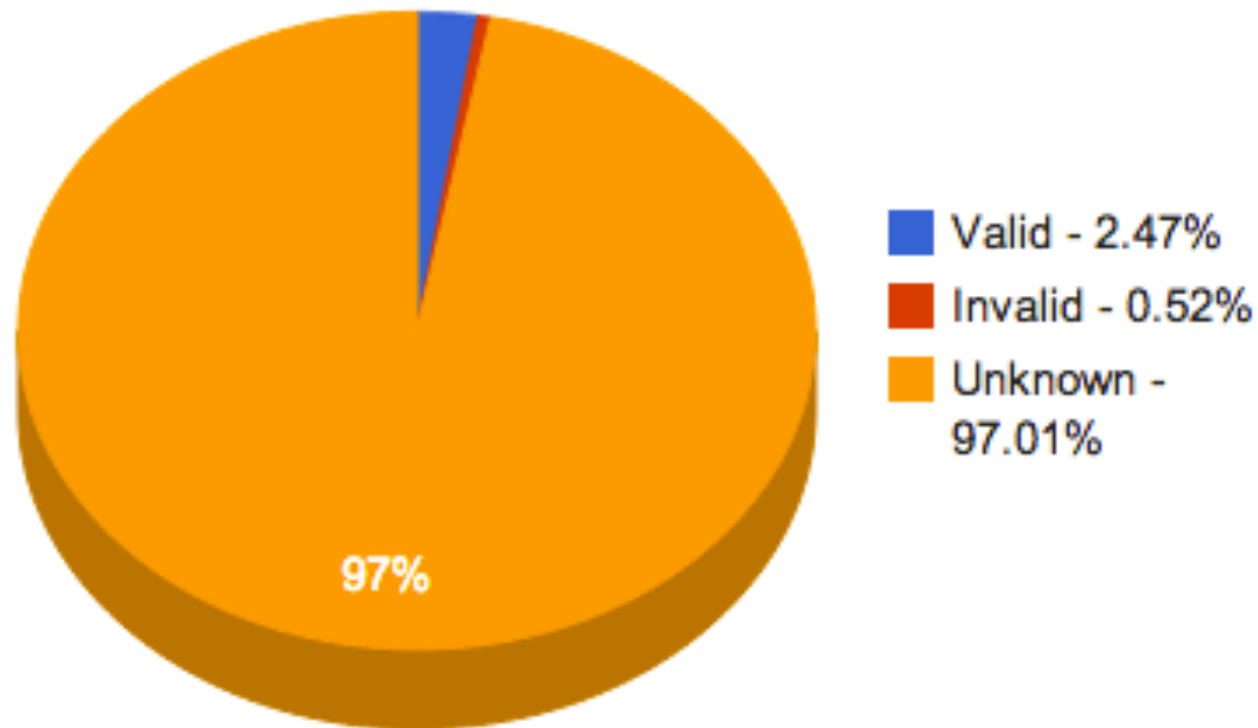
+ Data sources



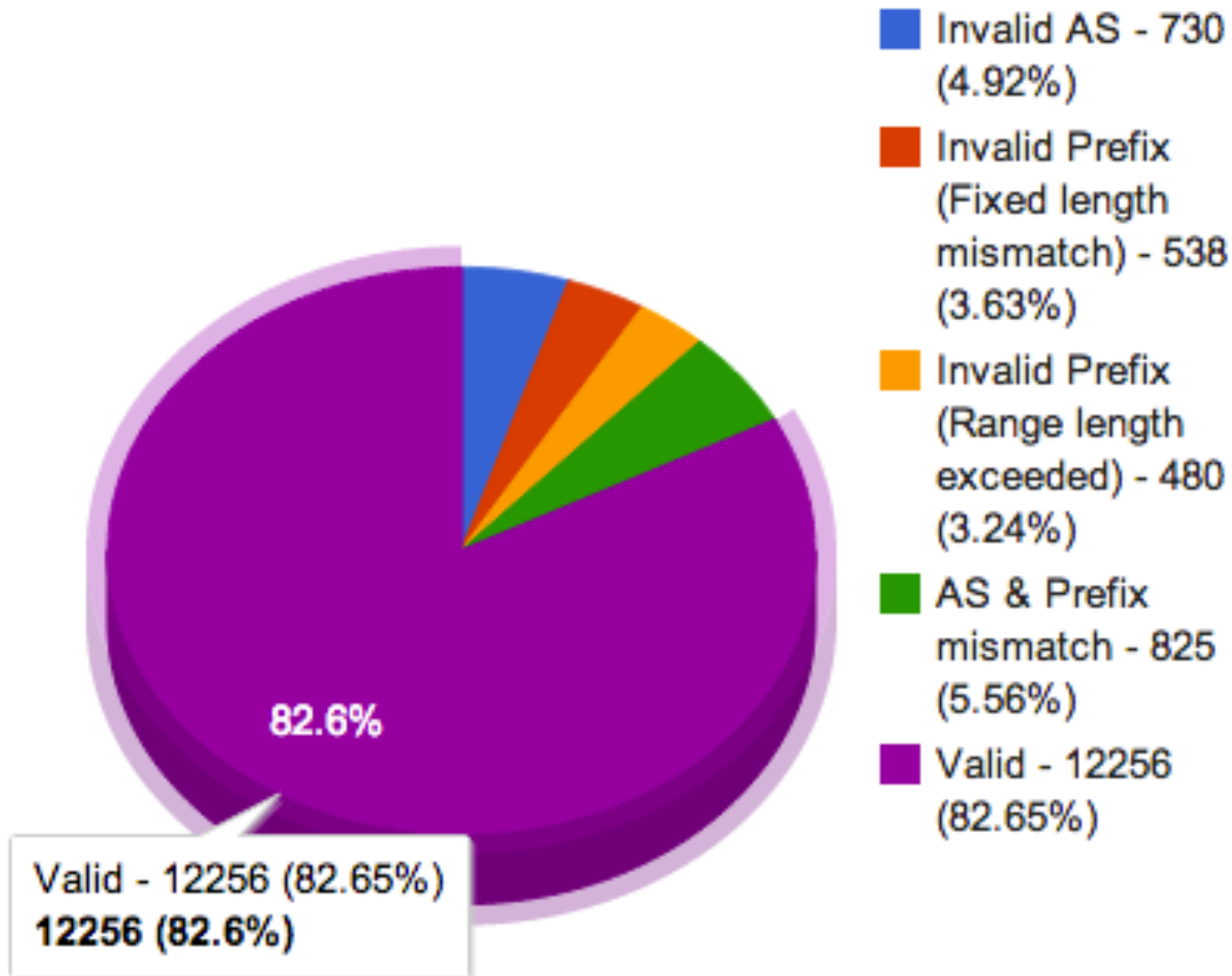
+ Measurements and Results

+ Global RPKI statistics

- 495838 prefixes in routing table (July 1st).
- Validation state for 14829 prefixes (2.99%).



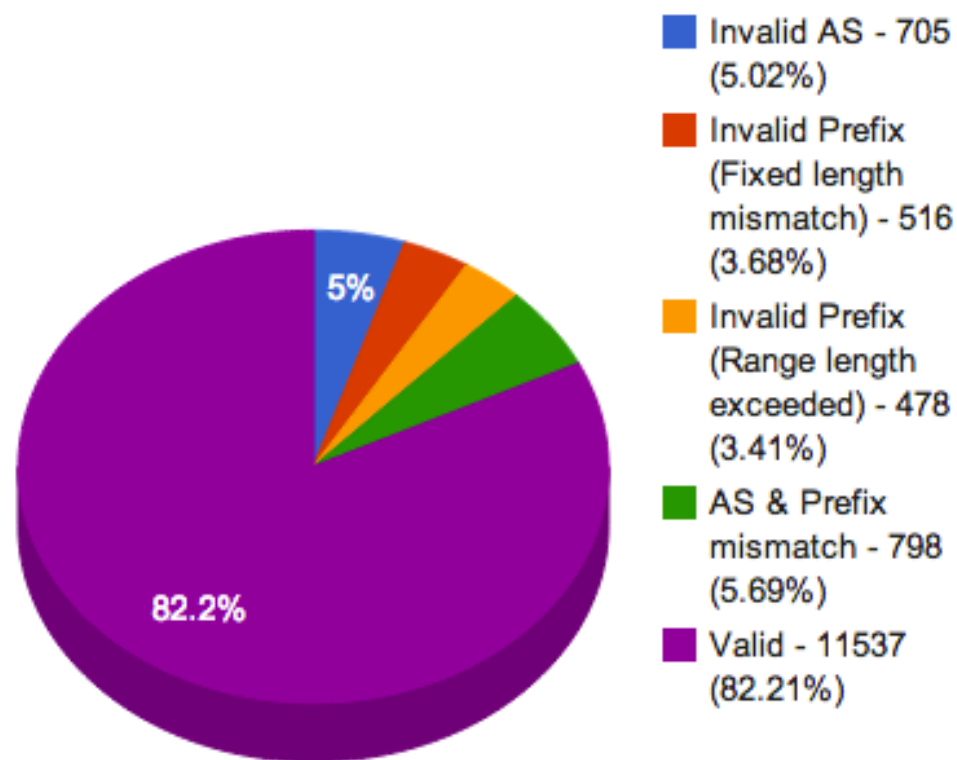
+ Distribution of invalids



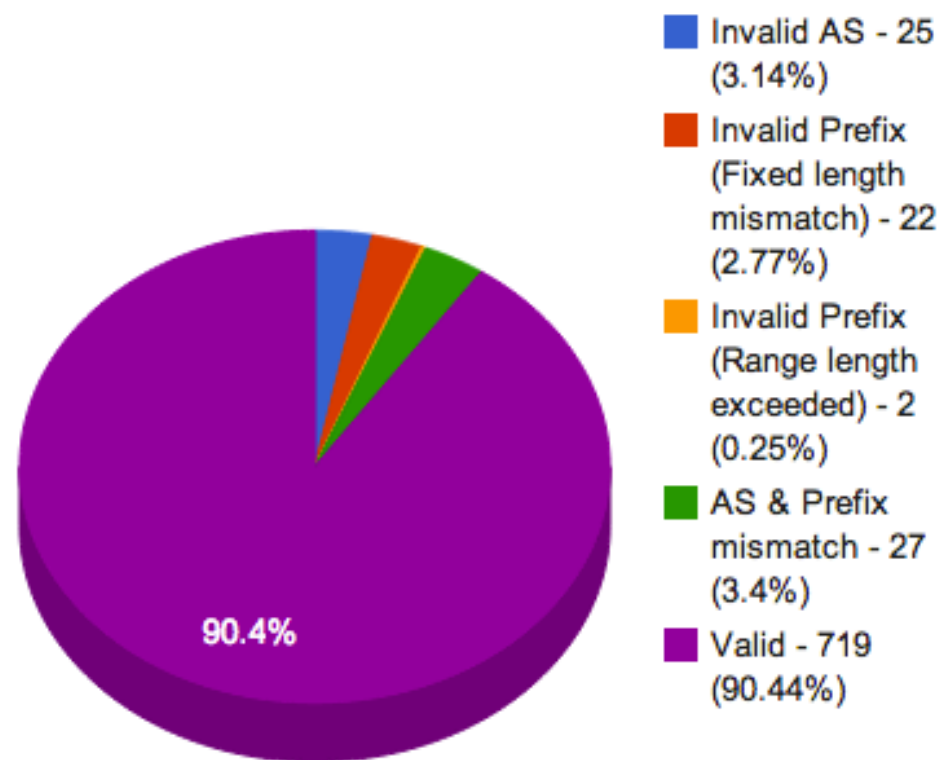
+ IPv4 vs IPv6

15
of
22

Distribution of RPKI prefixes for IPv4

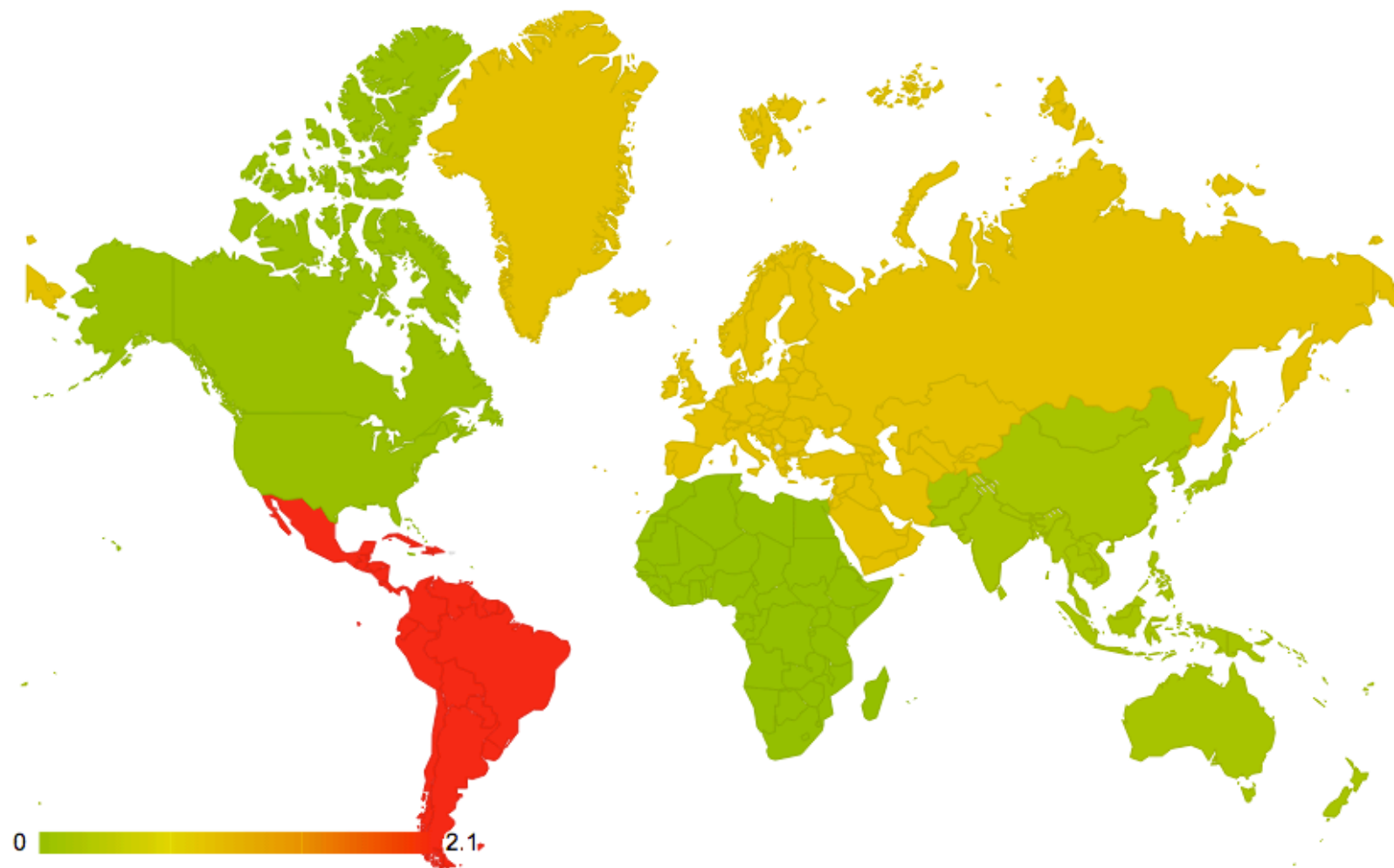


Distribution of RPKI prefixes for IPv6



+ Origin of invalids

16
of
22



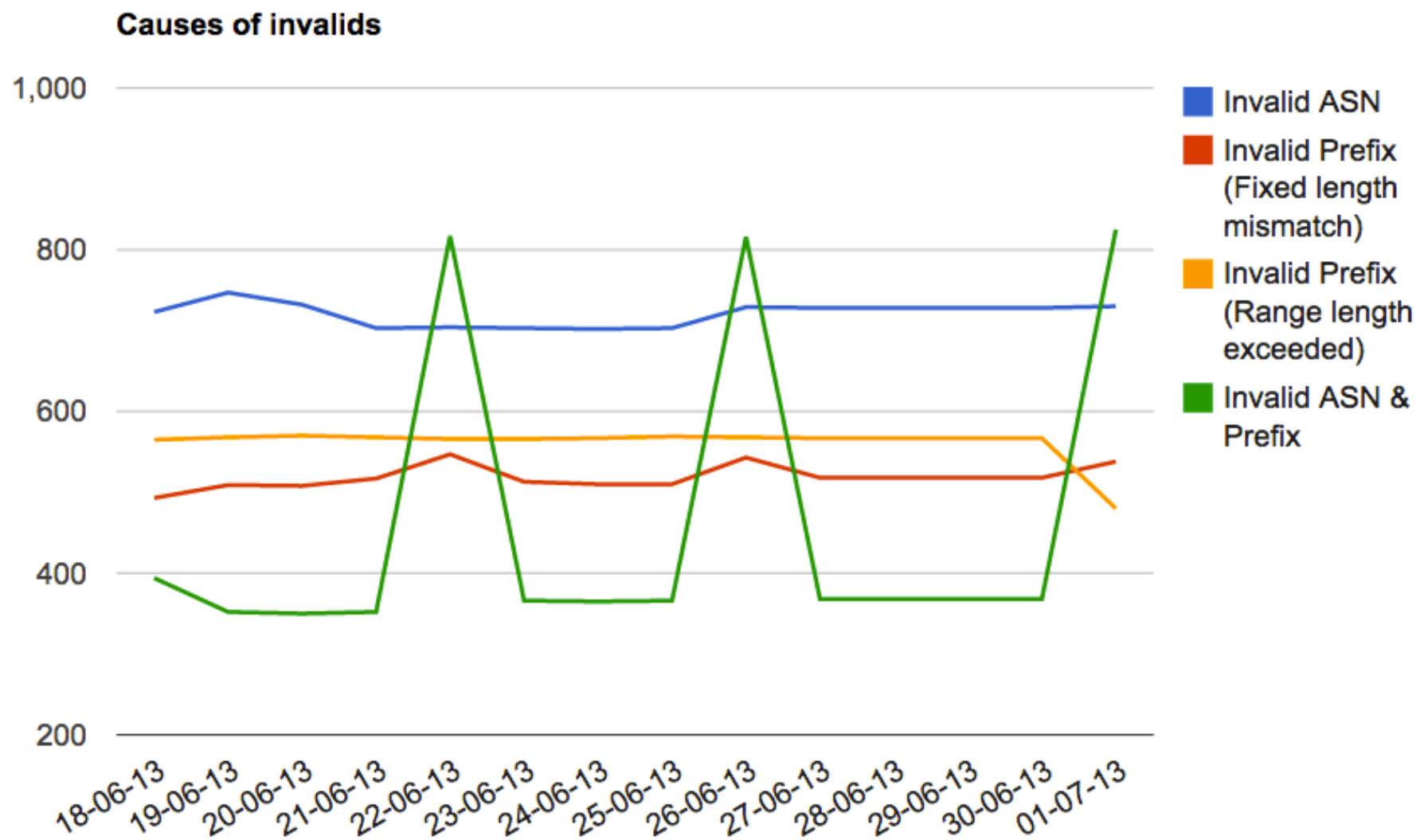
+ RIR Statistics

17
of
22

RIR	Total	Valid	Invalid	Unknown	RPKI Adoption Rate
AFRINIC	10839 (100%)	12 (0.11%)	0 (0%)	10827 (99.89%)	0.11%
APNIC	116379 (100%)	84 (0.07%)	212 (0.18%)	116083 (99.75%)	0.25%
ARIN	182009 (100%)	199 (0.11%)	30 (0.02%)	181780 (99.87%)	0.13%
LACNIC	56294 (100%)	5561 (9.88%)	1184 (2.1%)	49549 (88.02%)	11.98%
RIPE	128726 (100%)	6400 (4.97%)	1147 (0.89%)	121179 (94.14%)	5.86%

+ Monitoring over time

18
of
22



+ Weird stuff

01-07-2013		
ASN	count	
2065	92	
1942	82	
1724	66	
35104	64	
2457	62	
1937	39	
1945	33	
1723	32	
197890	17	
8649	16	

30-06-2013		
ASN	count	
35104	64	
8649	16	
197890	16	
2199	13	
2471	12	
27947	12	
24954	9	
27817	9	
197860	8	
9180	7	



Demo!!!

+ Conclusion

- Dashboard for operators and RIRs
- Distribution of invalids
- Insight in:
 - Configuration mistakes
 - Adoption rate RPKI
 - Detailed prefix information
- Daily stats monitoring

+ Future work

- Performance improvements
- Even more statistics
 - Data already available
- Extensible framework

+ Q&A

