

# APNIC Internet Measurements

The Internet from the users' point of view

João Damas  
APNIC Labs

# APNIC

One of 5 RIRs globally

IP resource stewardship

Training

Labs: measurements to inform Internet  
policy and development

# Why Measure?

Control plane  $\neq$  user reality

A network may enable a new feature but...

- Can the user actually use it?
- Would the user prefer to use that feature or something else?
- How does that feature behave for the user?

# Methodology

Ad-based • user-side • massive scale

Get the user to do some tests for us

Ads can have javascript

- Fetch a list of URLs from our server

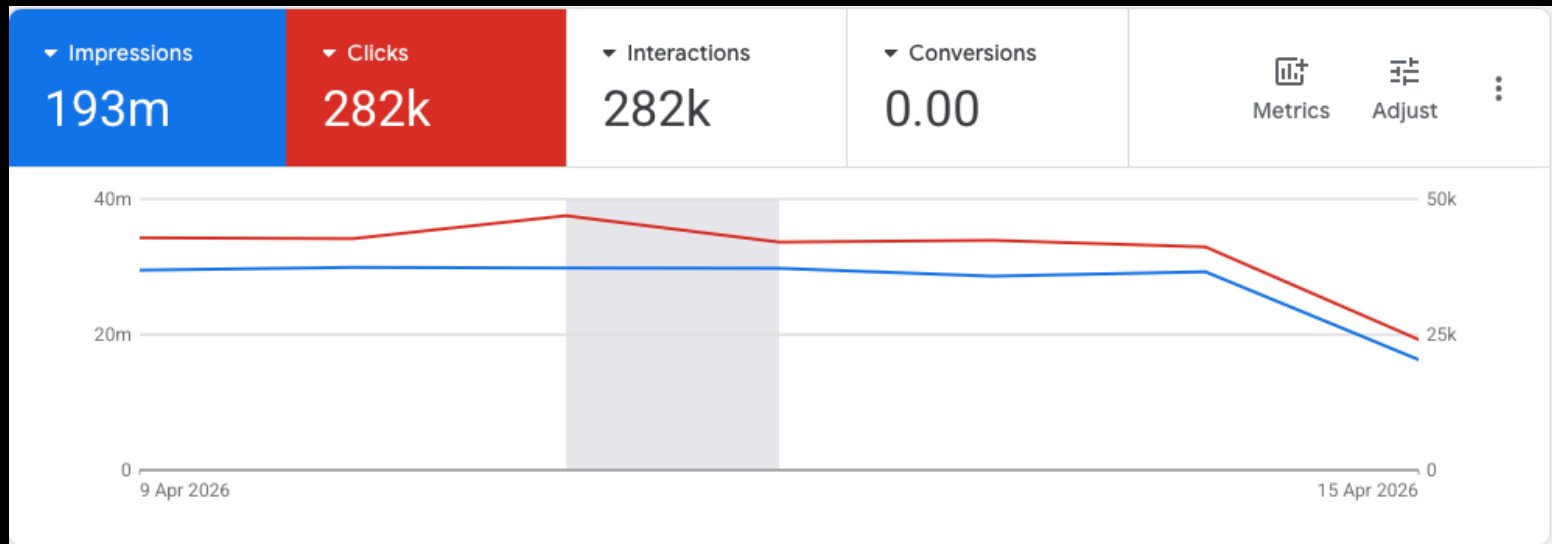
  - Unique URLs for each user

- Go through the list of provided URLs and fetch them

  - We control the DNS and web servers

# Scale

Millions of measurements/day



**What we see**

## IPv6 Measurements

- [IPv6 Uptake](#)
- [IPv6 Users per AS](#)
- [IPv6 Relative Performance](#)
- [IPv6 Fragmentation and Extension Header Drop Rates](#)

## BGP Measurements

- [RPKI RoV Drop-Invalid](#)
- [RPKI ROA Publication](#)

## IP Transport Measurements

- [QUIC \(HTTP/3\) Uptake](#)
- [Apple iCloud Private Relay Use](#)
- [ECN Use](#)

## DNS Measurements

- [DNSSEC Validation](#)
- [DNSSEC Signing](#)
- [DNS Resolver use](#)
- [Use of DOH and DOT](#)
- [Delegated and NXDomain Queries](#)
- [Use of HTTPS Query](#)
- [DNS QTYPEs](#)

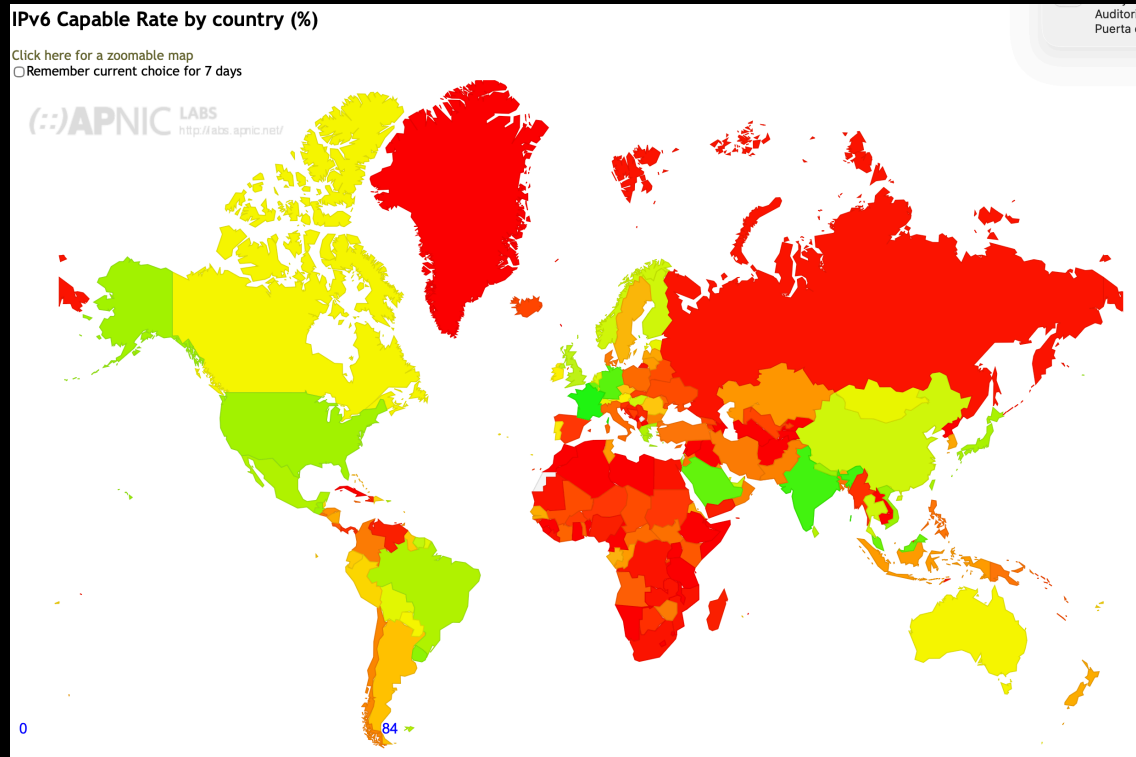
## Ad-based Measurements

- [Users per AS](#)
- [Ad Program Measurement Delivery Metrics](#)
- [Ad Impressions per Country](#)

<https://labs.apnic.net/measurements/>

# IPv6 uptake worldwide

~43% capability, ~41% preference

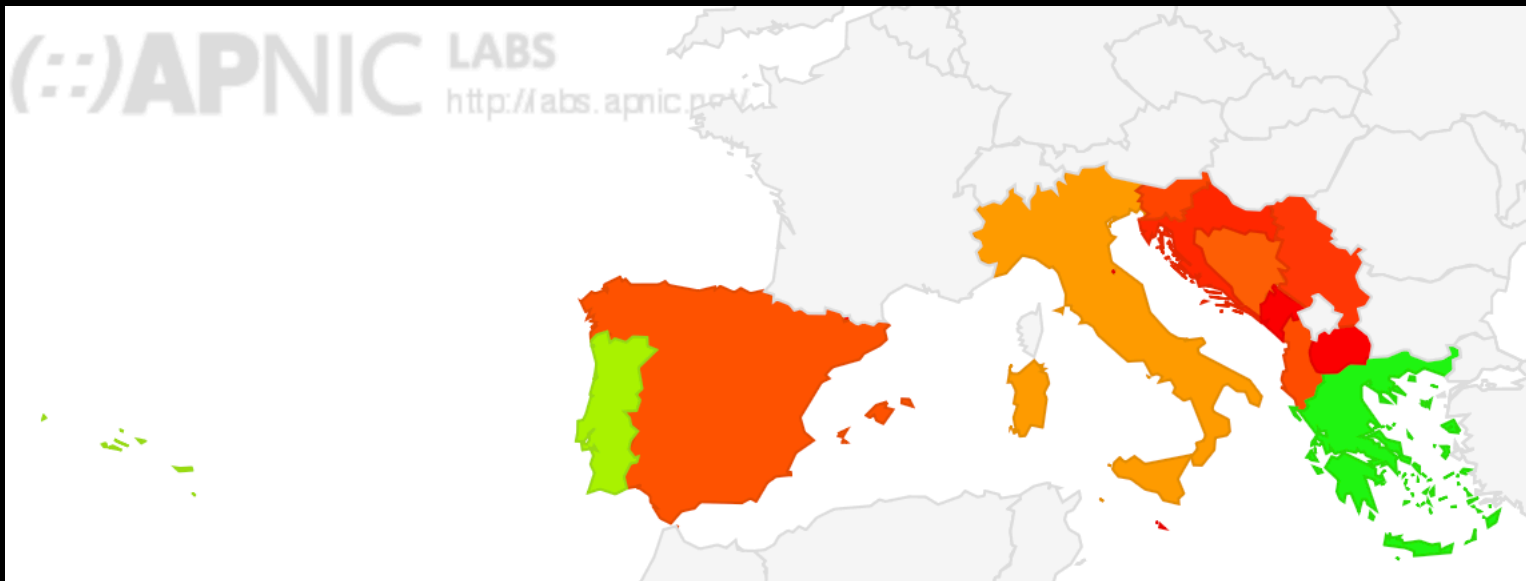


# IPv6 uptake Italia

**Europa:** ~36% capability, ~35% preference

**Italia:** ~19% capability, ~18% preference

(San Marino: 0.7%, 0.7%, Holy See: 0%)



# Italy

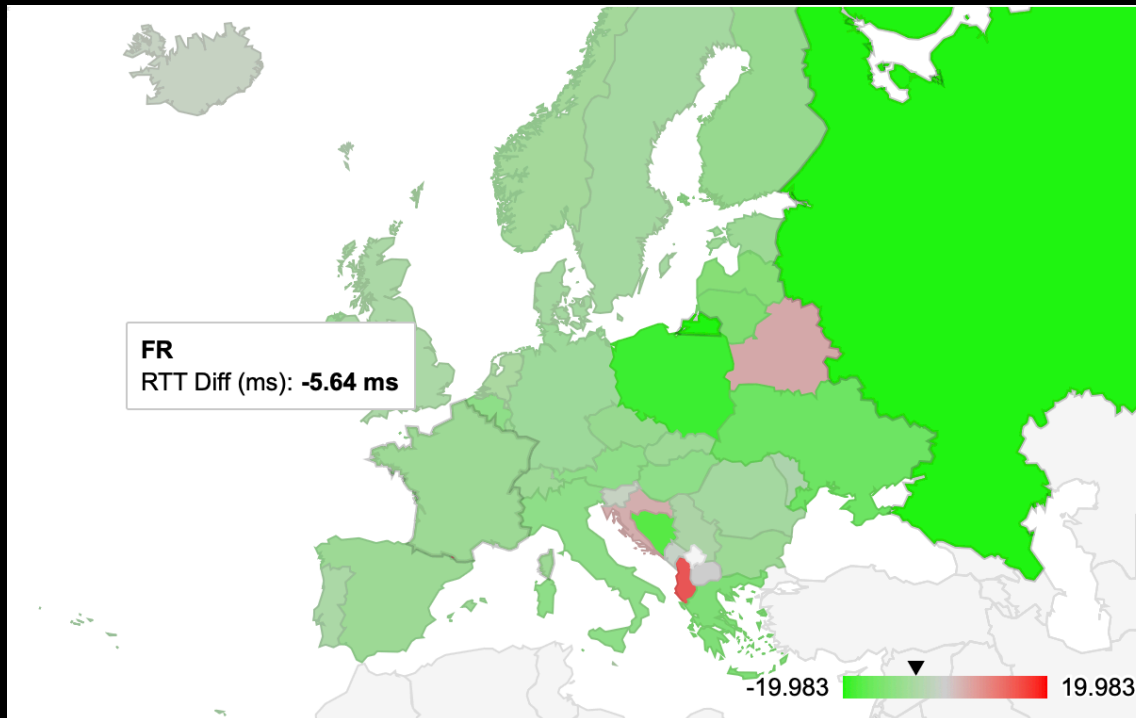
## Operator-driven deployment

ASN	AS Name	IPv6 Capable	IPv6 Preferred	Samples ▼
AS1267	ASN-WINDTRE IUNET	38.81%	37.96%	3,221,332
AS3269	ASN-IBSNAZ	0.29%	0.06%	3,076,213
AS30722	VODAFONE-IT-ASN	3.31%	3.15%	2,824,580
AS29447	TIF-AS Iliad Italia S.p.A	18.35%	18.11%	1,471,247
AS12874	FASTWEB	40.59%	38.83%	1,448,319
AS16232	ASN-TIM Service Provider	0.13%	0.08%	1,153,758
AS210278	SKYIT-BB	89.91%	89.12%	644,148
AS35612	NGI-AS	0.52%	0.09%	322,996
AS8612	TISCALI-	0.44%	0.25%	262,435
AS202098	AS_ENELENERGIA_	0.37%	0.06%	197,623
AS14593	SPACEX-STARLINK - Space Exploration Technologies Corporation	32.71%	31.99%	112,733

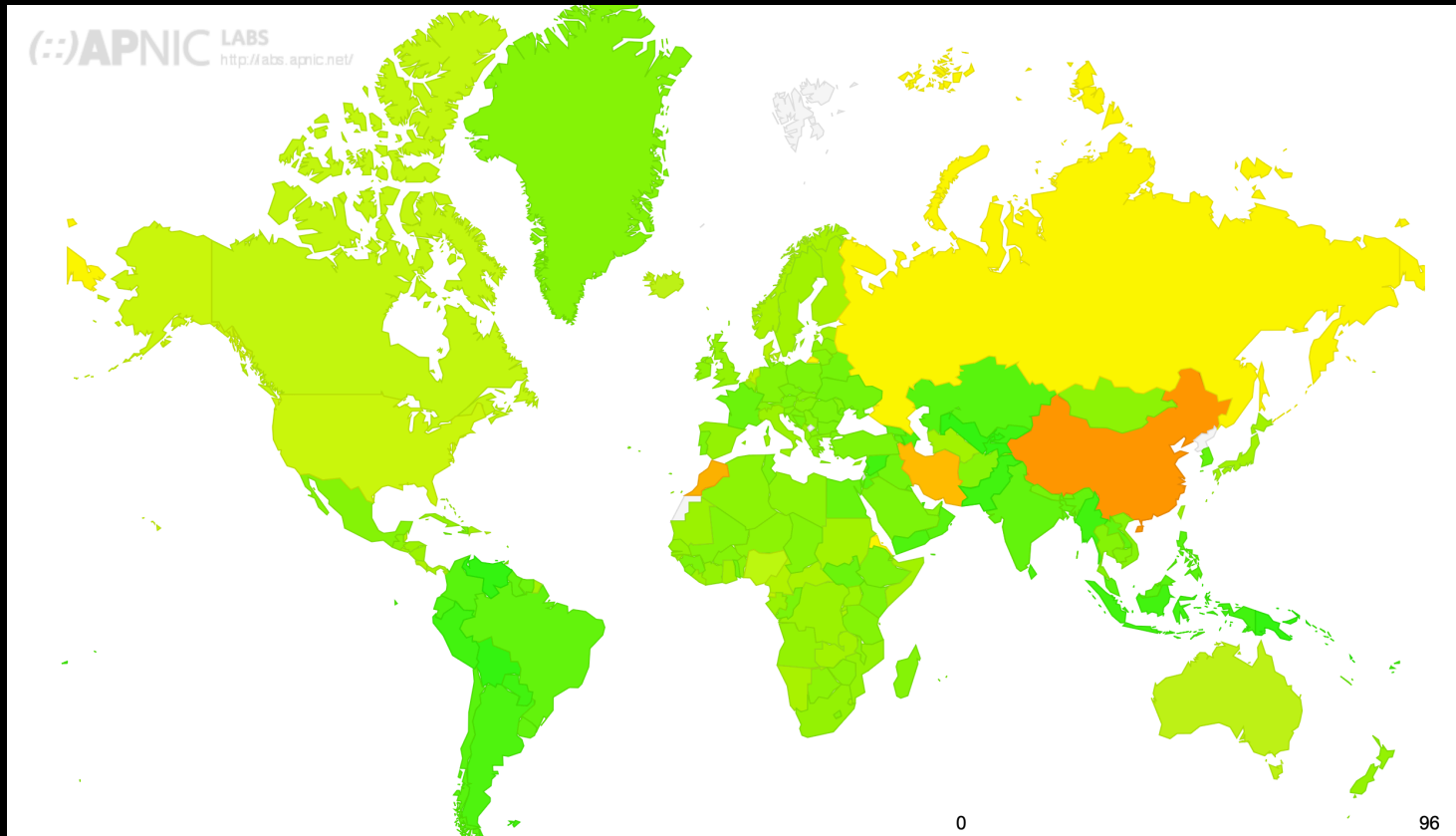
<https://stats.labs.apnic.net/ipv6/IT>

# Performance

IPv6  $\approx$  IPv4



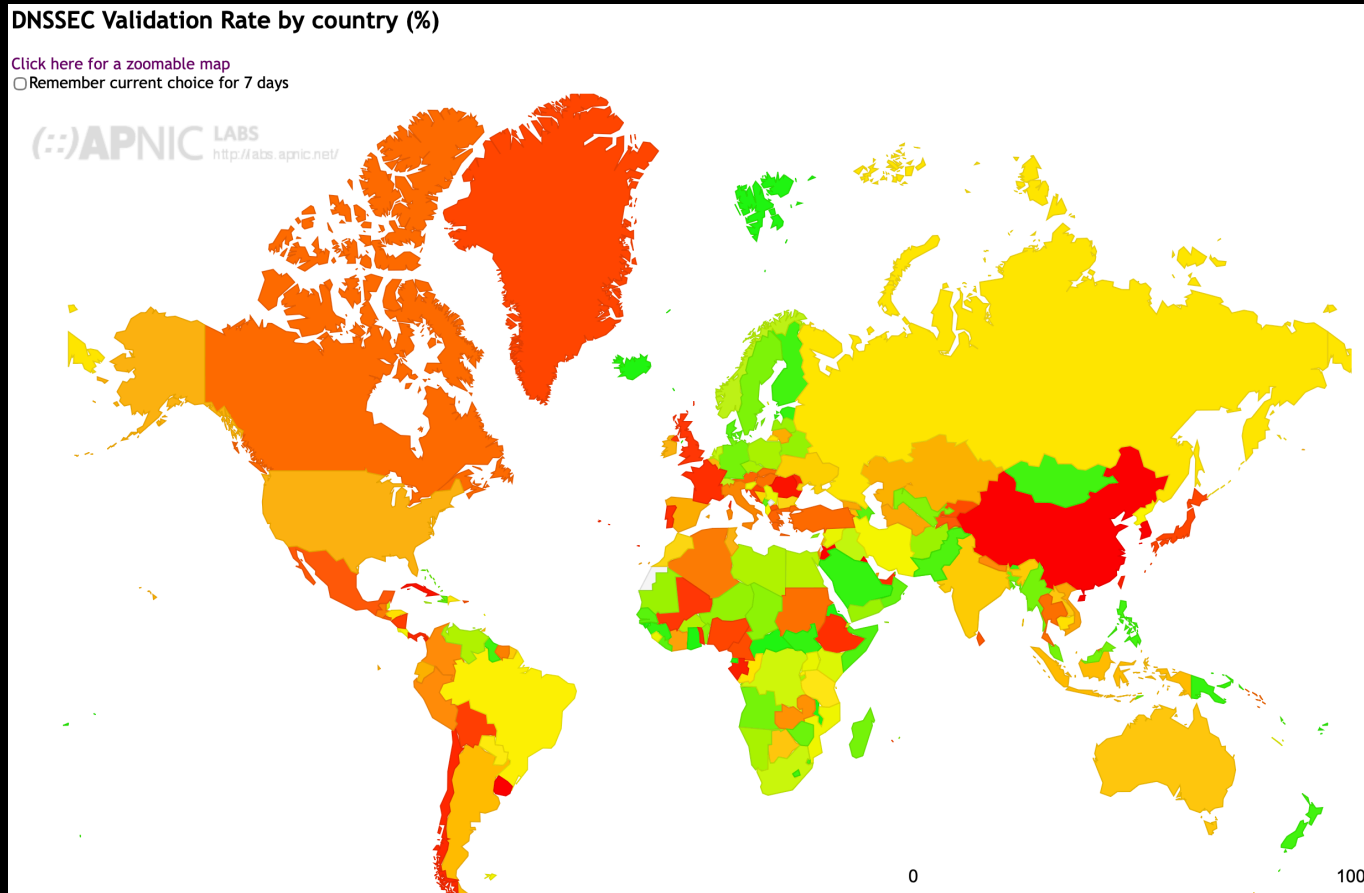
# QUIC adoption



# QUIC adoption

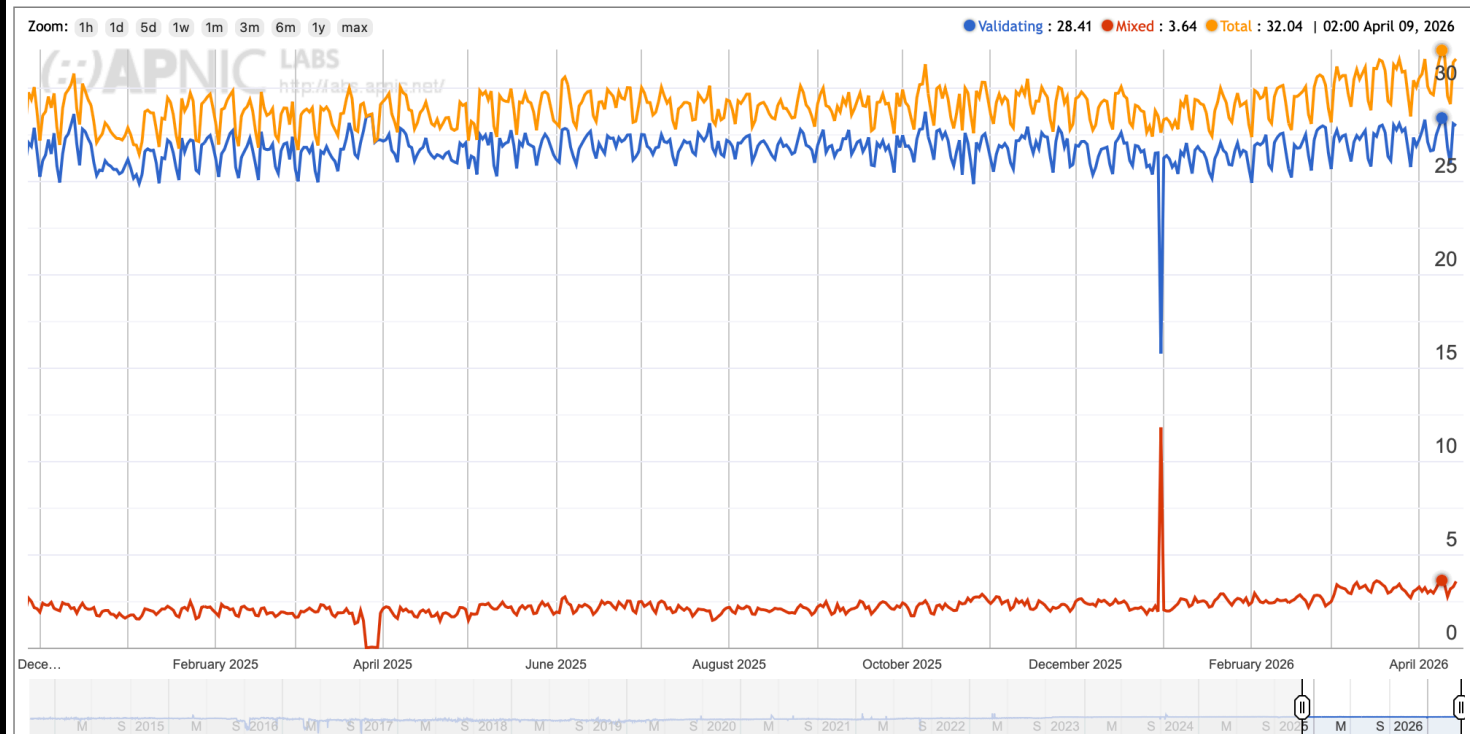
Code	Region	HTTP/3 on First Query	HTTP/3 on Second Query	Samples ▼
IN	India, Southern Asia, Asia	5.7%	80.9%	11,294,418
JP	Japan, Eastern Asia, Asia	24.6%	68.5%	7,378,400
US	United States of America, Northern America, Americas	34.6%	58.9%	6,755,795
CN	China, Eastern Asia, Asia	18.6%	29.3%	6,403,791
ID	Indonesia, South-Eastern Asia, Asia	5.8%	89.7%	4,716,952
MX	Mexico, Central America, Americas	13.2%	73.7%	4,337,464
BR	Brazil, South America, Americas	7.1%	82.6%	4,278,030
FR	France, Western Europe, Europe	27.1%	79.5%	2,834,006
CA	Canada, Northern America, Americas	32.0%	61.5%	2,803,398
VN	Vietnam, South-Eastern Asia, Asia	32.1%	73.9%	2,528,448

# DNSSEC



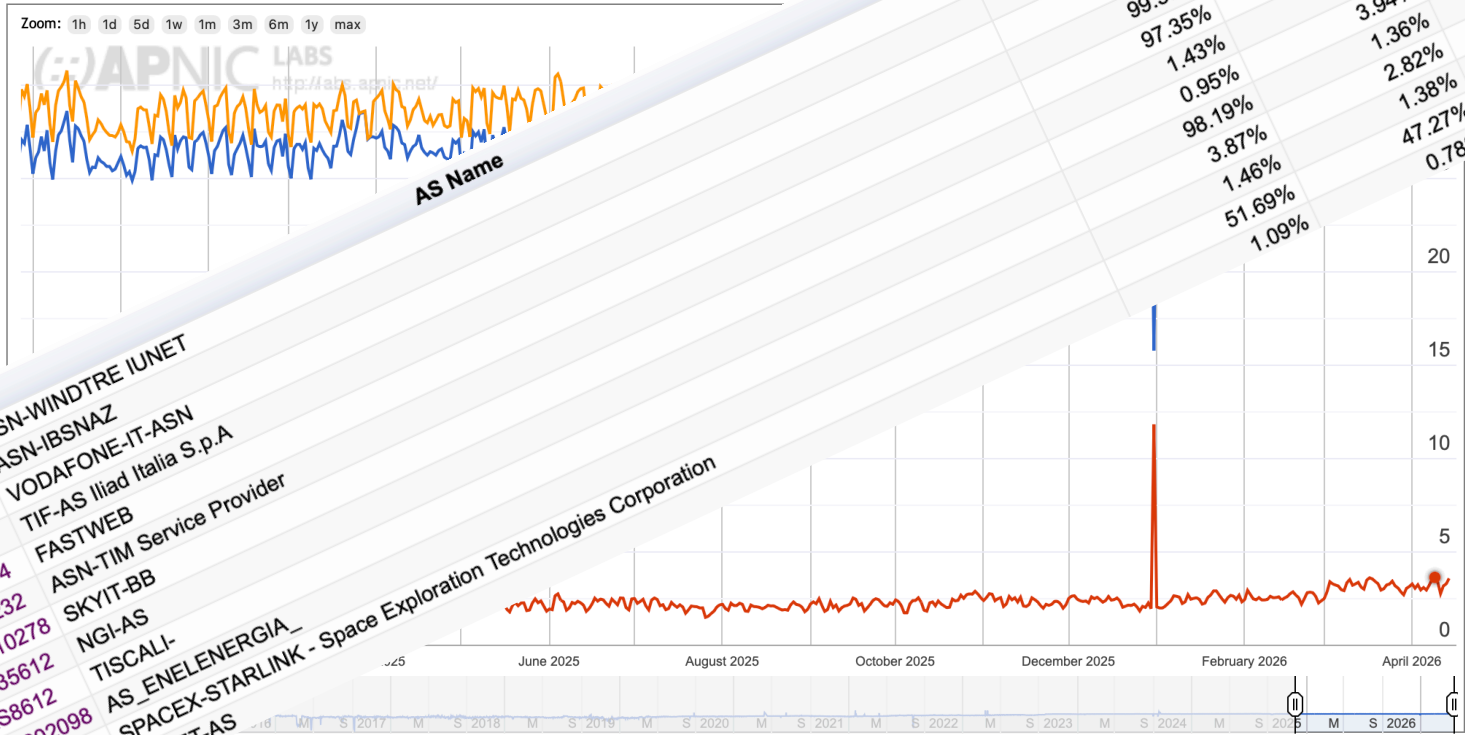
# DNSSEC Italia

## Use of DNSSEC Validation for Italy (IT)



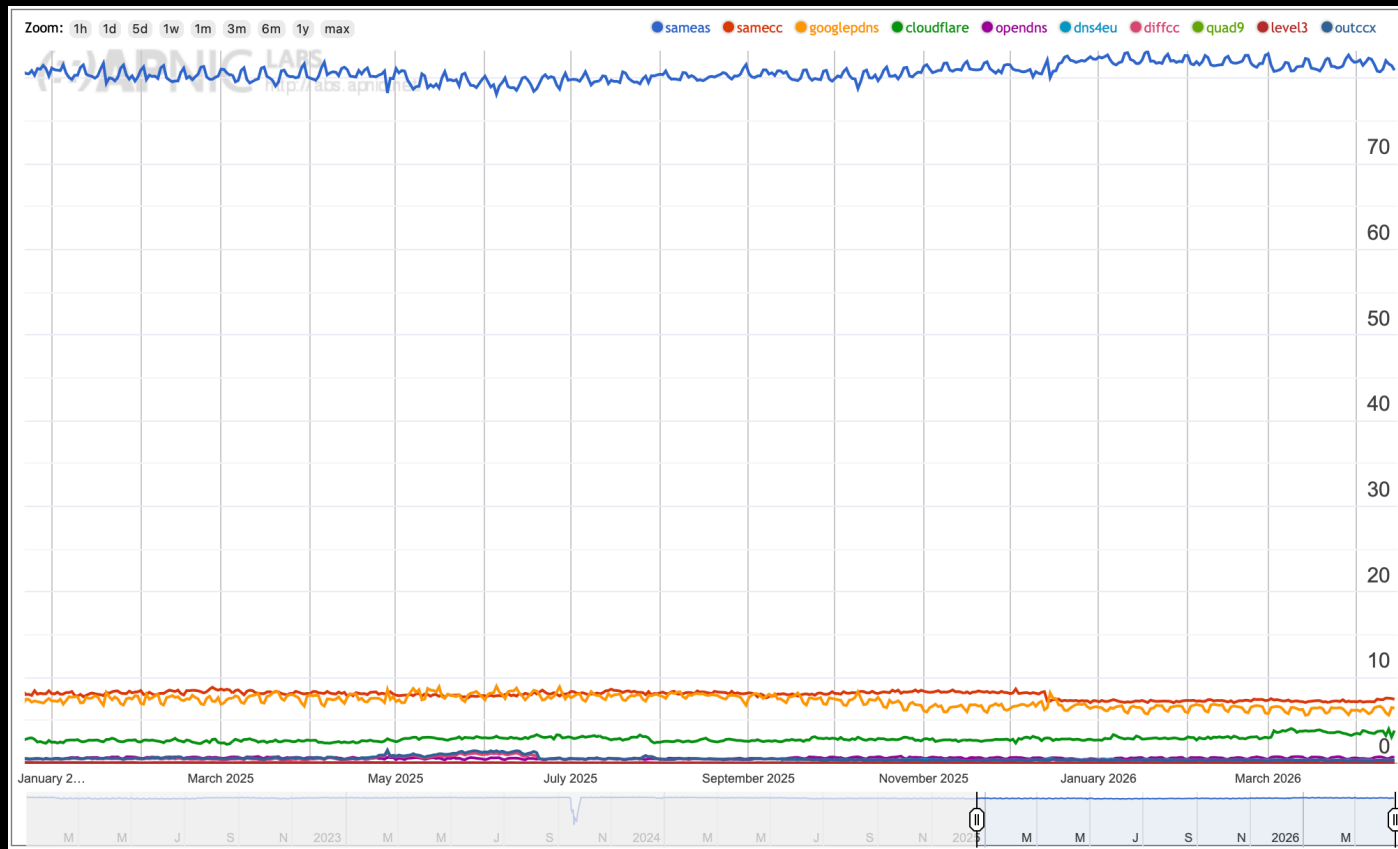
# DNSSEC Italia

## Use of DNSSEC Validation for Italy (IT)



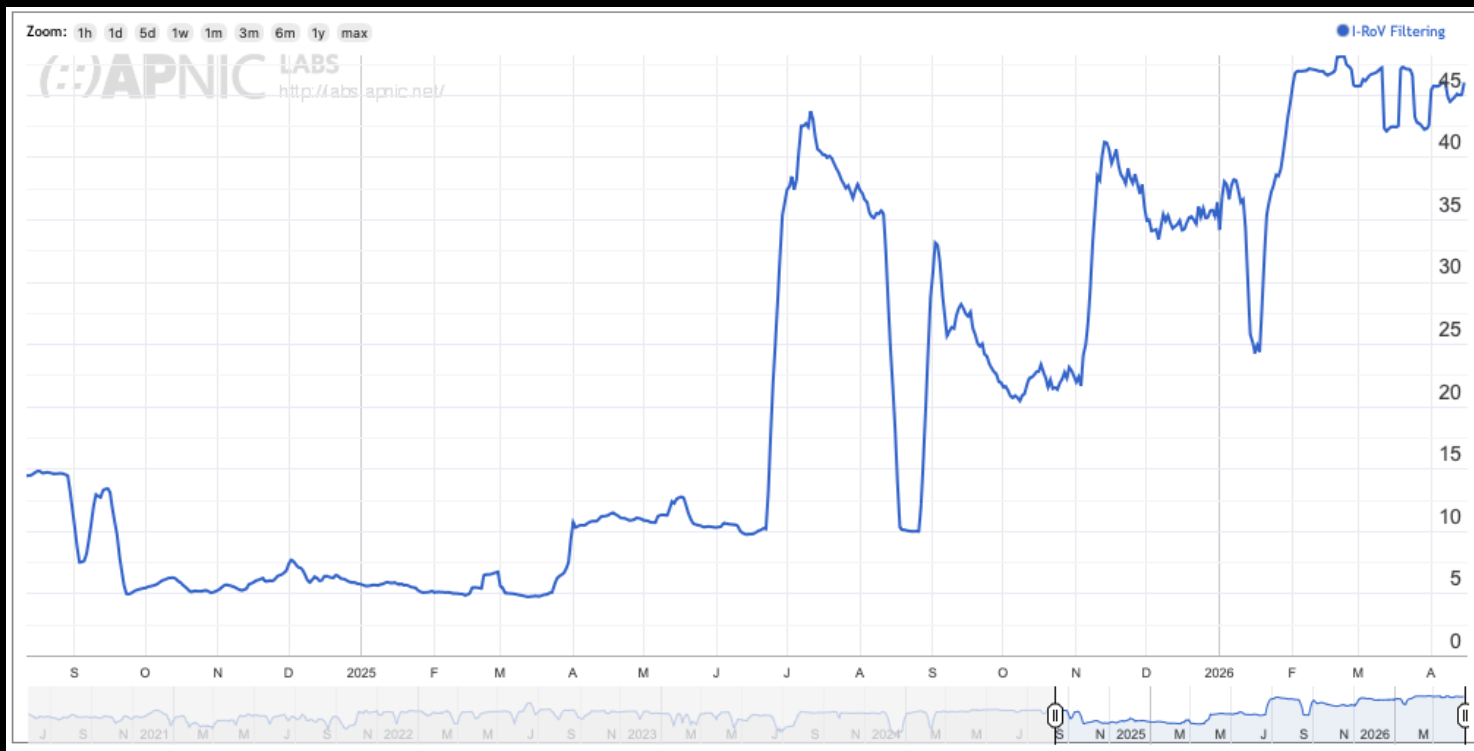
# DNS Trends

## Resolver centralisation

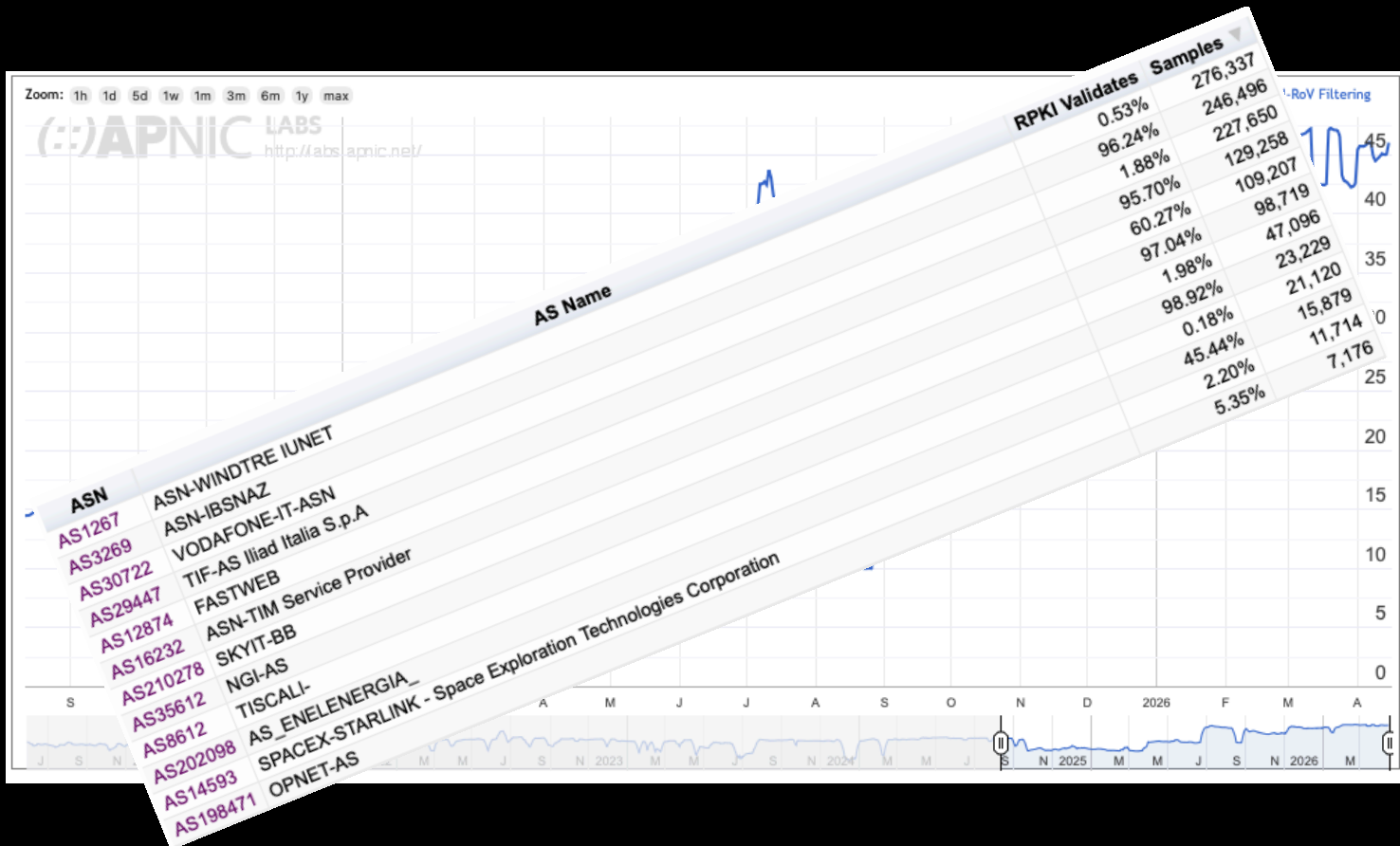




# RPKI ROA Validation



# RPKI ROA Validation



# Takeaway

Measure • Understand • Act

Beware of the difference between what the network can do and what users do

# Questions