RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Measuring Internet Technology Adoption in Central Asia

RPKI and IPv6 deployment to drive Internet development

Anastasiya Pak | RIPE NCC | 3 November 2026

What We Have Been Reporting On

- **Routing security**
  - **BGP Incidents** (GRIP)
  - **ROA** (IPv4, IPv6)
  - **ROV** (RoVista)
  - **ASPA -** new addition, authorises the provider relationship between ASes
  - ROA coverage for **government websites** (ROA coverage of IP addresses resolving to government domains)
- **IPv6**
  - IPv6 capability (percentage of ASNs routing at least one IPv6 prefix)
  - IPv6 adoption (reported by CDNs)

Routing Security

The Need for RPKI

- Internet routing determines how data packets get forwarded across the Internet
- Attackers or misconfigurations can redirect traffic, causing outages or data theft
    - **Example**: Google Japan (2017) Google accidentally leaked BGP prefixes resulting in a major outage, Telegram block attempt (2023) and more
- **Why RPKI?**
    - Prevents such incidents by cryptographically verifying the legitimacy of route announcements
    - Helps mitigate both accidental and malicious BGP misconfigurations



Enhancing Routing Security

- Used to validate the origin of BGP announcements
  - Is the originating ASN authorised to originate this particular prefix?

- Has (now) three parts:

  - **Route Origin Authorisation (ROA):** Defines which ASes are authorised to announce specific IP prefixes

  - **Route Origin Validation (ROV):** Validates routes based on ROAs, ensuring only legitimate routes are accepted

  - **Autonomous System Provider Authorisation (ASPA):** Helps mitigate routing incidents by enabling validation of (customer-to-provider) AS path relationships
    - labs.ripe.net/author/tim_bruijnzeels/aspa-in-the-rpki-dashboard-a-new-layer-of-routing-security/

Measuring ROV

- We used **RoVISTA** to analyse deployment of ROV
    - Scores ASes on the % of tested RPKI-invalid targets they cannot reach (suggests local or upstream ROV).
    - We classify an AS (or its upstream) as having implemented ROV if its score is greater than 0, indicating any level of ROV deployment
- **Collateral benefit**
    - We assessed ROV impact from the perspective of network centrality, utilising **AS Hegemony**, which measures the centrality of autonomous systems within a country
    - Measures the common transit networks to a local AS and how much this AS relies on these transit networks based on BGP data. Values range between 0 and 1 and indicate the fraction of paths crossing a node.

IPv6 Adoption

IPv6 Capability

- We calculated (IPv6 capability) the percentage of ASes in each country that announce both IPv4 and IPv6 addresses, as well as those that announce only IPv6, compared to those that announce only IPv4
    - IPv6 capability indicates that addresses are being routed, this does not equate to adoption
    - IPv6 capability should be viewed as an initial step toward broader adoption

Central Asia: Reporting to drive change

Reporting to Drive Change









- Since our regional forum CAPIF kicked off, we have been reporting on technology adoption in the region
- Presenting our measurements consistently helped us drive change - engagement with governments and major telecom operators
- It led to positive dynamics in technology adoption in the region, especially RPKI

Kazakhstan



113 (+9) RIPE NCC members

257 (+29) ASNs

12,858 (+184) allocated IPv4 (/24s)

541 (+80) IPv6 (/32s)

IPv6

- **IPv6 Capability** 23% → 27%
- **Facebook** 19% → 20%
- **Google** 21% → 21%
- **Akamai** 19% → 22%

RPKI

- **ROA (IPv4)** 13% → 79%
- **ROA (IPv6)** 16% → 24%
- **ASPA (Jan 2026 - Sep 2026)** 2% → 4.3%

Gov resources

- **ROA (IPv4)** 46% → 69%

BGP incidents

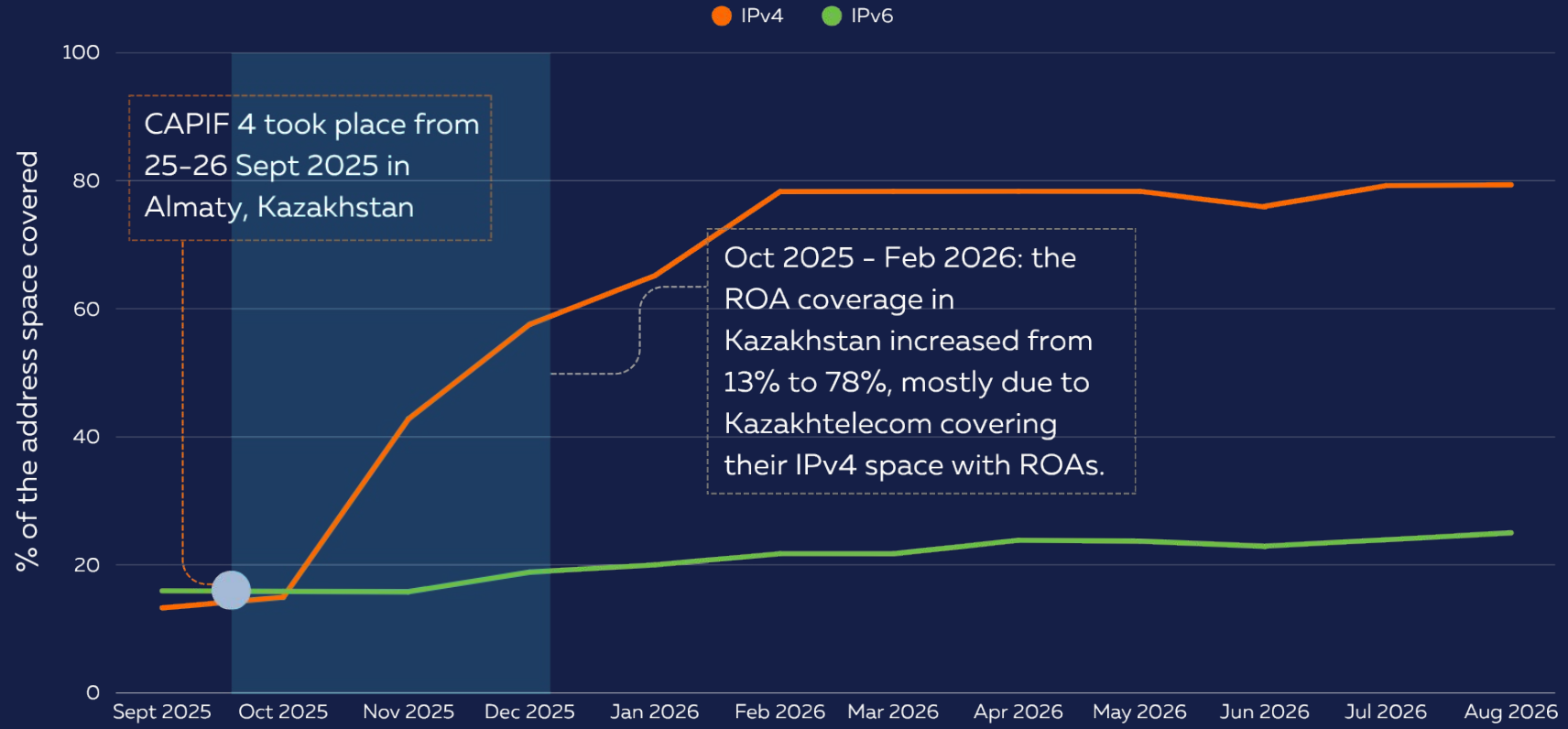
- **In country** 46 → 121

Steady growth amidst solid development
(data from Sept 2025 - Aug 2026. Source: RIPE NCC)

Data from Sept 2025 to Aug 2026

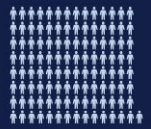
- ROA coverage for IPv4 space increased from approximately 13% in September 2025 to nearly 80% in September 2026
- Kazakhstan continues to lead in IPv6 adoption

Kazakhstan’s ROA Coverage (Sept 2025 - Sept 2026)



Kazakhstan

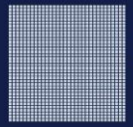




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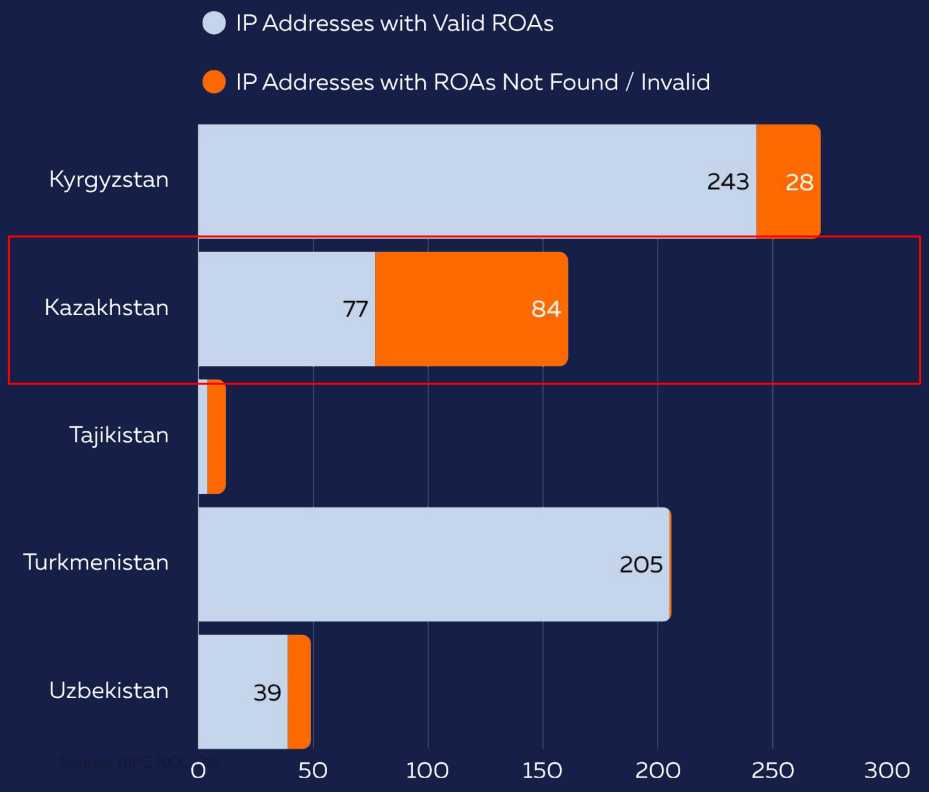
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Steady growth amidst solid development
(data from Sept 2025 - Aug 2026. Source: RIPE NCC)

Data from Sept 2025 to Aug 2026

- Operators protect government resources as well
- Supports the collaboration between government and operators

ROA Coverage for Government Domains - Sept 2025



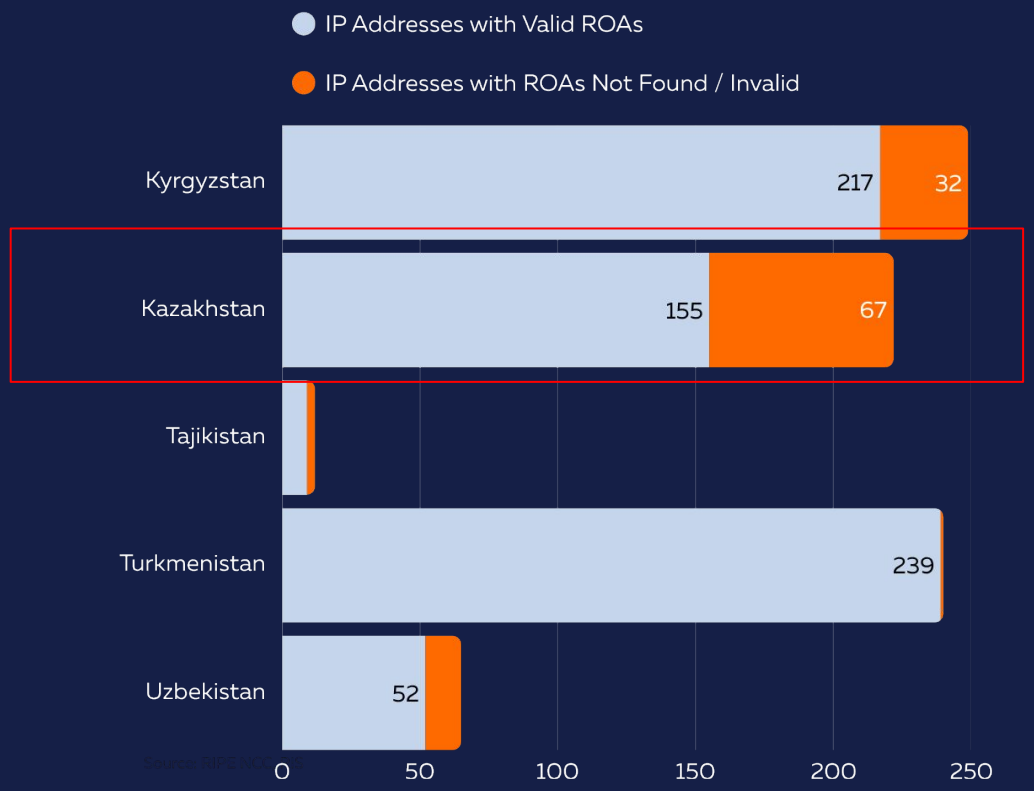
The methodology involves extracting BGP routing data from RIS and then validating against RIPE NCC's RPKI Validator, categorising each prefix as follows:

Valid: IP addresses covered by an RPKI-Valid route announcement.
Invalid: IP addresses covered by an RPKI-Invalid route announcement.
NotFound: IP addresses covered by a route announcement in the NotFound state.

IP addresses that fell under Invalid or Not-Found prefixes, and were not concurrently covered by a more specific Valid ROA, were classified as being associated with IP addresses under RPKI Invalid or Not-Found prefixes.

Note: To compile a list of government institutions we used Certificate Transparency (CT) logs. The list might be non-exhaustive, and some domains might not have been analysed.

ROA Coverage for Government Domains - Sept 2026



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Tajikistan



32 (+6) RIPE NCC members

41 (+5) ASNs

280 (+4) allocated IPv4 (/24s)

140 (+40) IPv6 (/32s)

IPv6

- **IPv6 Capability** 19% → 24%
- **Facebook** 0% → 2%
- **Google** 0% → 1%
- **Akamai** 0% → 2%

RPKI

- **ROA (IPv4)** 31% → 40%
- **ROA (IPv6)** 9% → 25%
- **ASPA (Jan 2026 - Sep 2026)** 0% → 4.9%

Gov resources

- **ROA (IPv4)** 36% → 75%

BGP incidents

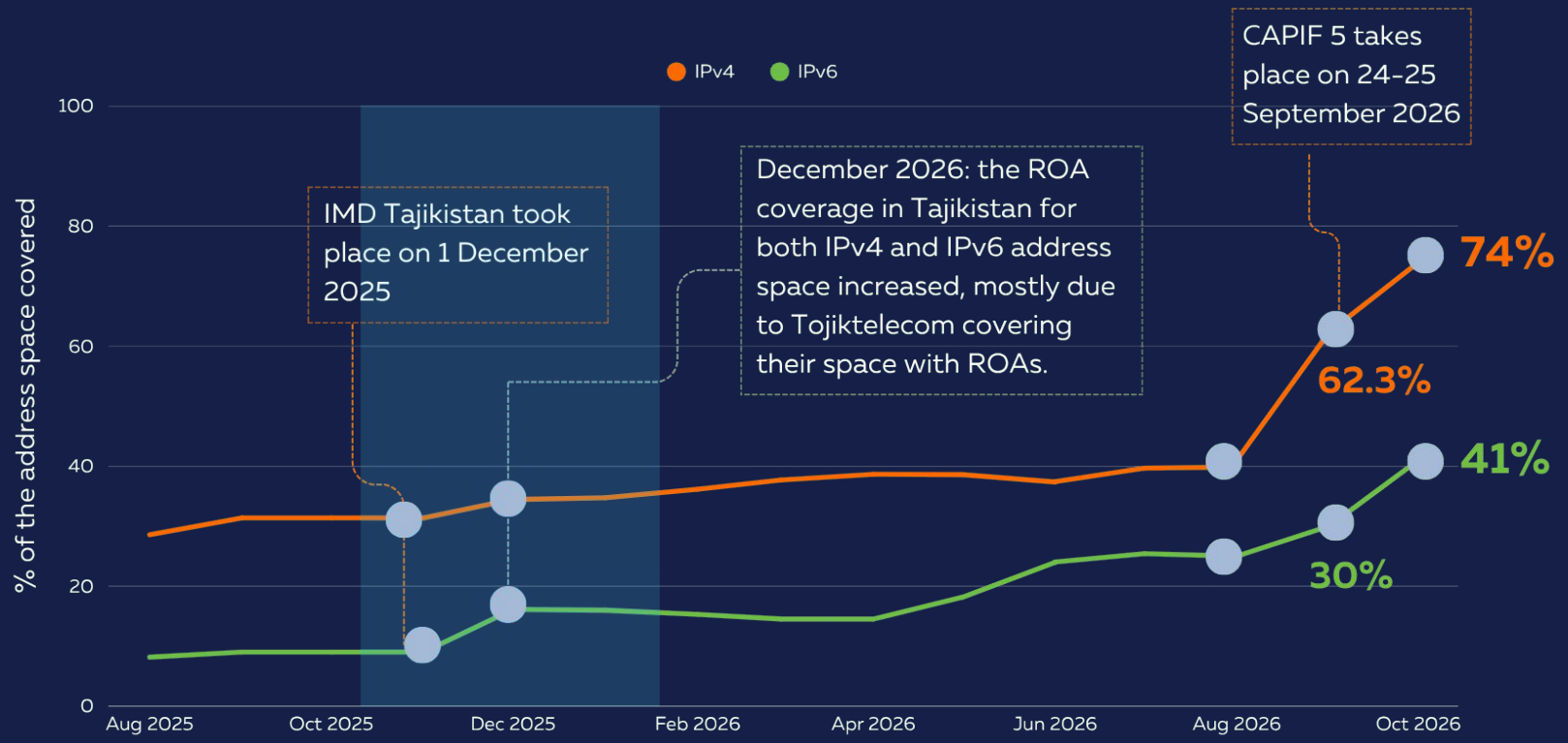
- **In country** 6 → 1

Strong growth with solid development

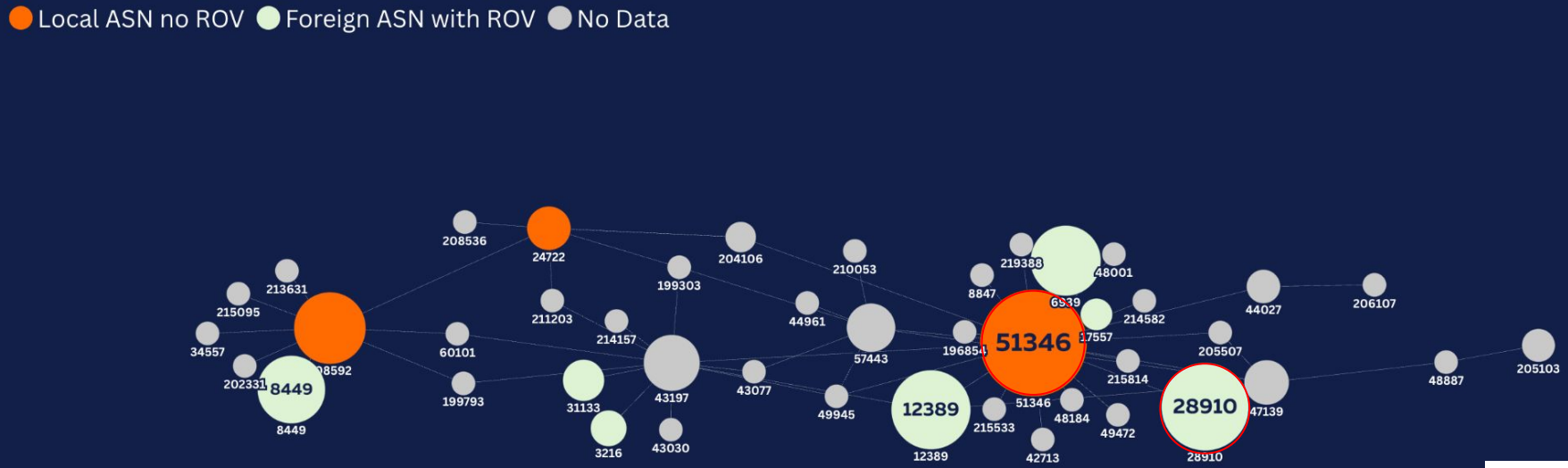
Data from Sep 2025 - Aug 2026, RIPE NCC, various sources

- ASPA uptake is growing
- IPv6 ROA coverage growth (and yesterday, more operators signed ROAs!)
- Stronger protection of government domains with ROA

Tajikistan’s ROA Coverage



Tajikistan’s Interconnectivity Map



- Implementing RPKI by Tojiktelecom is important for the country’s routing
- Next step is validation
- Peering with Uzbektelecom - regional development

Sources: AS Hegemony, RoVista

Scan to view the interactive visualisation

Kyrgyzstan



33 (+3) RIPE NCC members

68 (+4) ASNs

1,002 (+45) allocated IPv4 (/24s)

128 (+24) IPv6 (/32s)

IPv6

- **IPv6 Capability** 17% → 21%
- **Facebook** 2% → 1%
- **Google** 2% → 2%
- **Akamai** 2.4% → 1.5%

RPKI

- **ROA (IPv4)** 89% → 86%
- **ROA (IPv6)** 42% → 42%
- **ASPA (Jan 2026 - Sep 2026)** 0% → 1.5%

Gov resources

- **ROA (IPv4)** 90% → 87%

BGP incidents

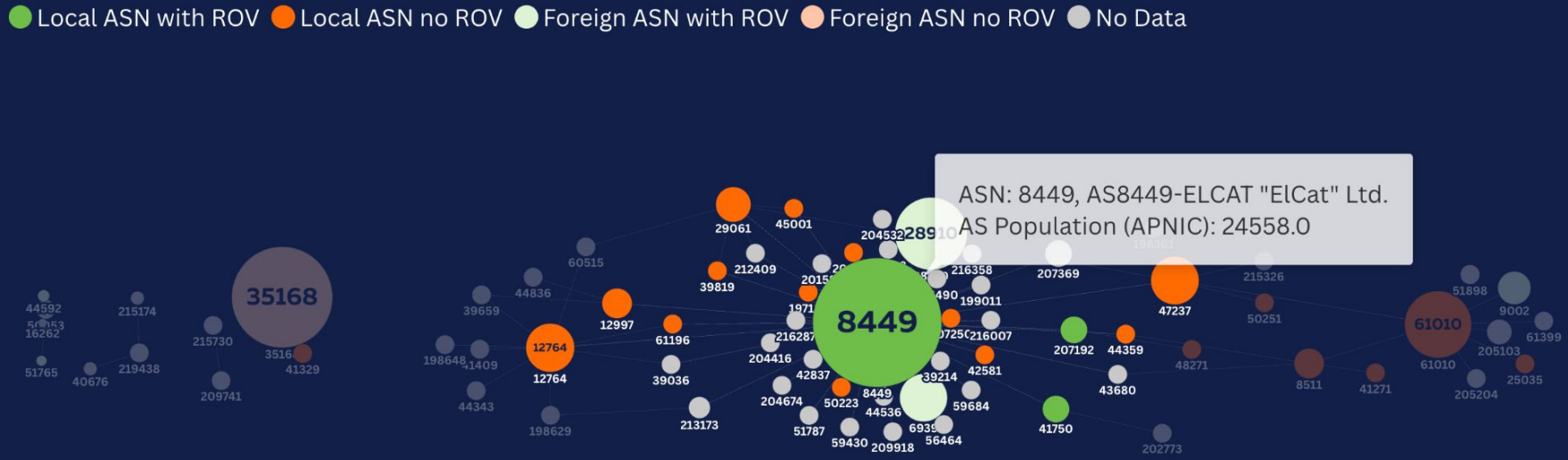
- **In country** 3 → 30

Mixed development over steady growth

Data from Sep 2025 - Aug 2026, RIPE NCC

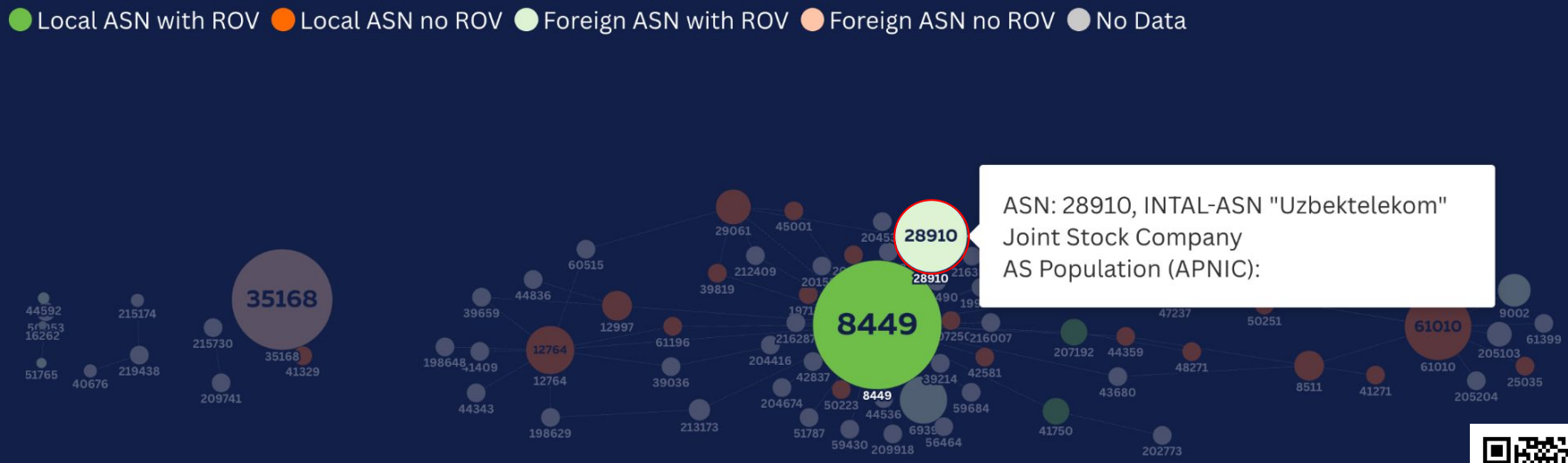
- Slight increase in IPv6 capability (the readiness of networks to use IPv6) since last year
- IPv6 adoption remains very low
- Interesting changes in Kyrgyzstan’s routing landscape

Kyrgyzstan’s Interconnectivity Map



Sources: AS Hegemony, RoVista

Kyrgyzstan’s Interconnectivity Map



Sources: AS Hegemony, RoVista

Scan to view the interactive visualisation

Turkmenistan



3 (+0) RIPE NCC members

7 (-1) ASNs

87 (+0) allocated IPv4 (/24s)

16 (+0) IPv6 (/32s)

IPv6

- **IPv6 Capability** 14% → 14%
- **Facebook** 0% → 0%
- **Google** 0% → 0%
- **Akamai** 0% → 0%

RPKI

- **ROA (IPv4)** 94% → 94%
- **ROA (IPv6)** 100% → 100%
- **ASPA (Jan 2026 - Sep 2026)** 0% → 0%

Gov resources

- **ROA (IPv4)** 100% → 100%

BGP incidents

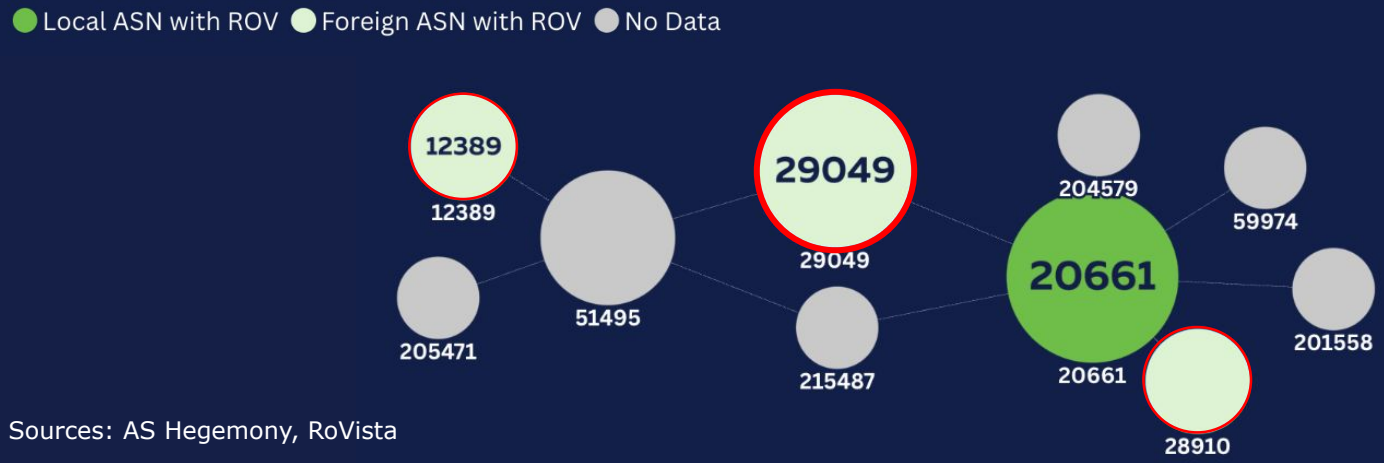
- **In country** 0 → 0

No change

Data from Sep 2025 - Aug 2026, RIPE NCC, various sources

- No changes since last year
- Strong routing security practices
- Turkmentelecom maintains a dominant role in national and international connectivity

Turkmenistan



Sources: AS Hegemony, RoVista

- Turkmentelecom (AS20661), Delta (AS29049), Rostelecom (AS12389), and Uztelecom (AS28910), or their upstream providers, are now all deploying ROV
- Less centrality for Rostelecom, Delta is more prominent, peering with Uztelecom - optimised peering strategies

Uzbekistan



58 (+3) RIPE NCC members

75 (+40) ASNs

1,191 (+80) allocated IPv4 (/24s)

267 (+16) IPv6 (/32s)

IPv6

- **IPv6 Capability** 15% → 15%
- **Facebook** 15% → 13%
- **Google** 11% → 11%
- **Akamai** 15% → 15%

RPKI

- **ROA (IPv4)** 68% → 70%
- **ROA (IPv6)** 12% → 15%
- **ASPA (Jan 2026 - Sep 2026)** 0% → 3.9%

Gov resources

- **ROA (IPv4)** 80% → 80%

BGP incidents

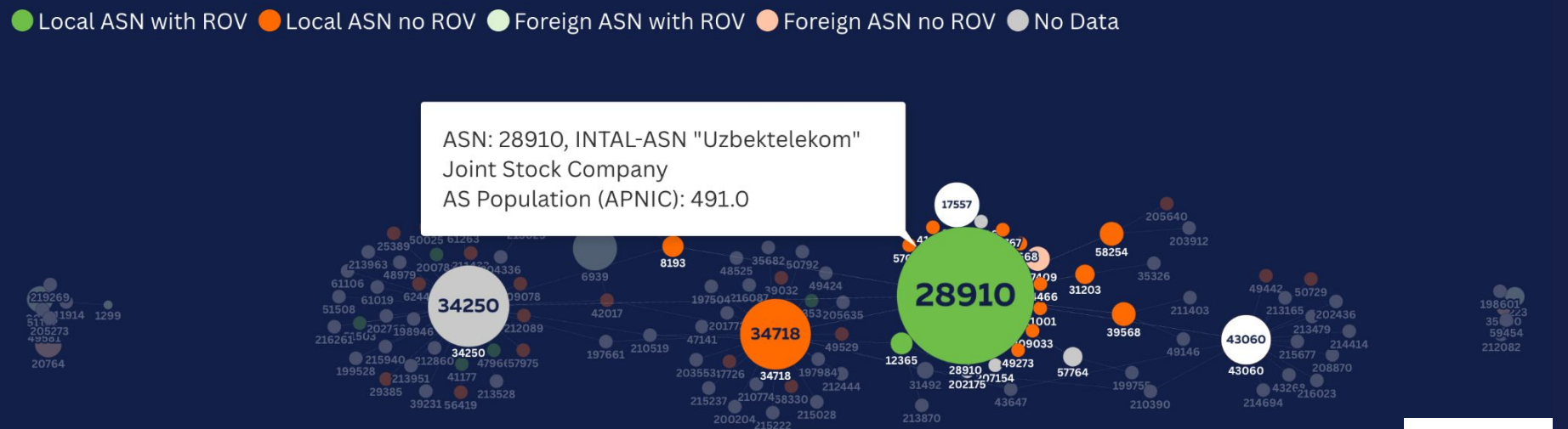
- **In country** 7 → 29

Mixed development over steady growth

Data from Sep 2025 - Aug 2026, RIPE NCC, various sources

- Growth in ASNs and allocated resources
- High ROA coverage for government domains
- ROV deployment by Uzbektelecom as seen by RoVista
- IPv6 - no growth in adoption

Uzbekistan’s Interconnectivity Map



Sources: AS Hegemony, RoVista

Scan to view the interactive visualisation

Conclusions

- **Routing security has made some of the strongest gains**
  - Kazakhstan’s increase in IPv4 ROA coverage stands out
  - ROV deployment by Uzbektelecom is particularly significant given the network’s central role both within Uzbekistan and for neighbouring networks
  - Government-domain coverage is strongest in Turkmenistan and Kyrgyzstan
- **IPv6 remains the clearest area for improvement**
  - Some IPv6 adoption remains concentrated in Kazakhstan and Uzbekistan
  - Capability has improved in places, but actual adoption remains low across much of the region

Learn How the Internet in Central Asia Has Evolved

Find the sources and read the report on RIPE Labs!

Original report on labs.ripe.net

Статья на русском языке



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THANK YOU!