

Enhancing Routing Security with RPKI

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Transformation

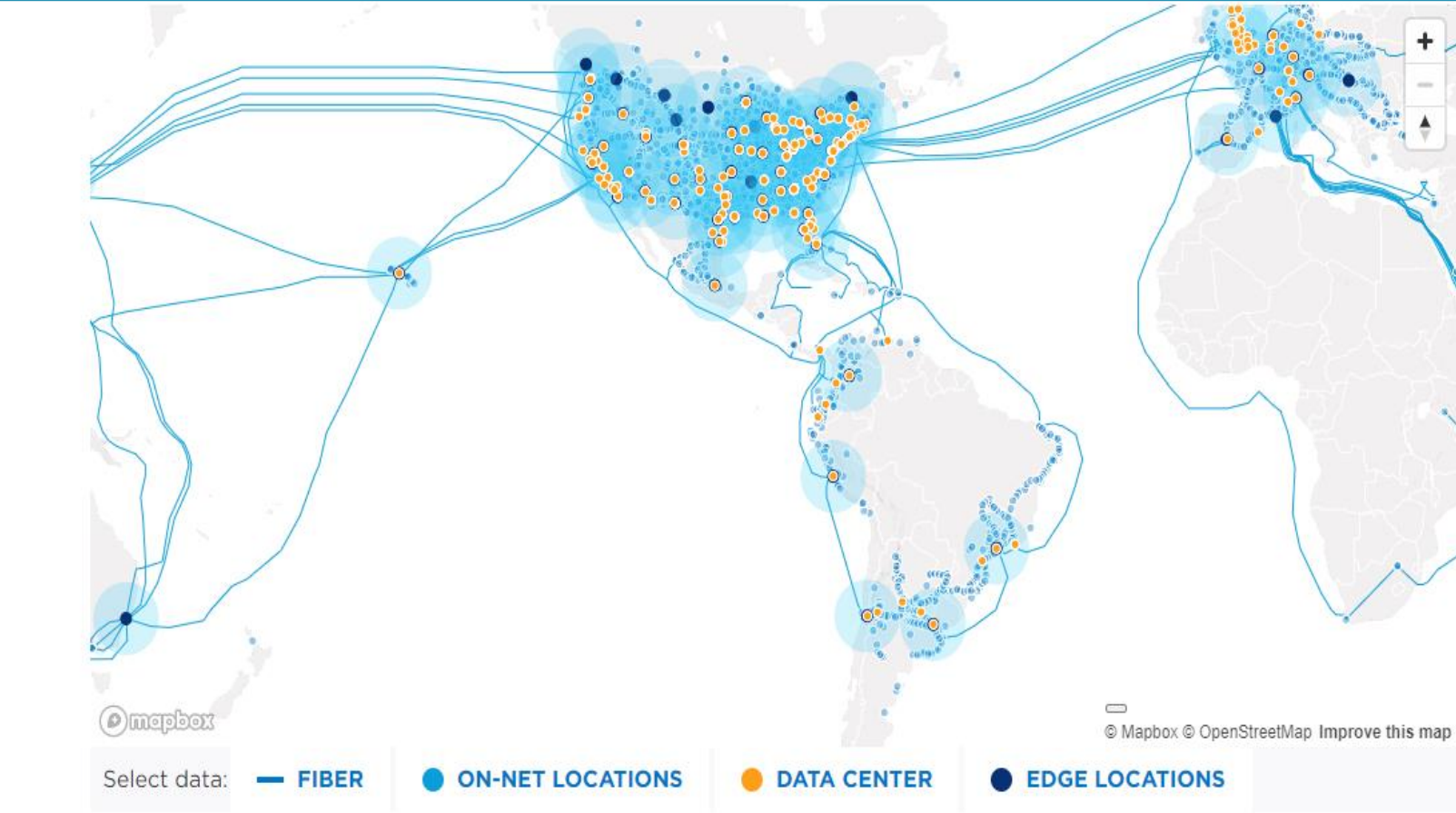
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“If you do not change direction, you may end up where you are heading.” —Lao Tzu

Lumen's Expansive Global Network

- 450,000 Global Route Miles of Fiber – Wrapping the Earth 18 Times
- 150,000 On-Net Buildings
- We have over 314,000 IP Devices
- Voice Traffic: 25 Billion+ Minutes Of Use per Month



Lumen Network Rank



AS Ranking	AS #	Organization	ASN %
1	3356	Level 3 Parent, LLC	43.82%
26	3549	Level 3 Parent, LLC	2.52%
36	209	CenturyLink	1.69%

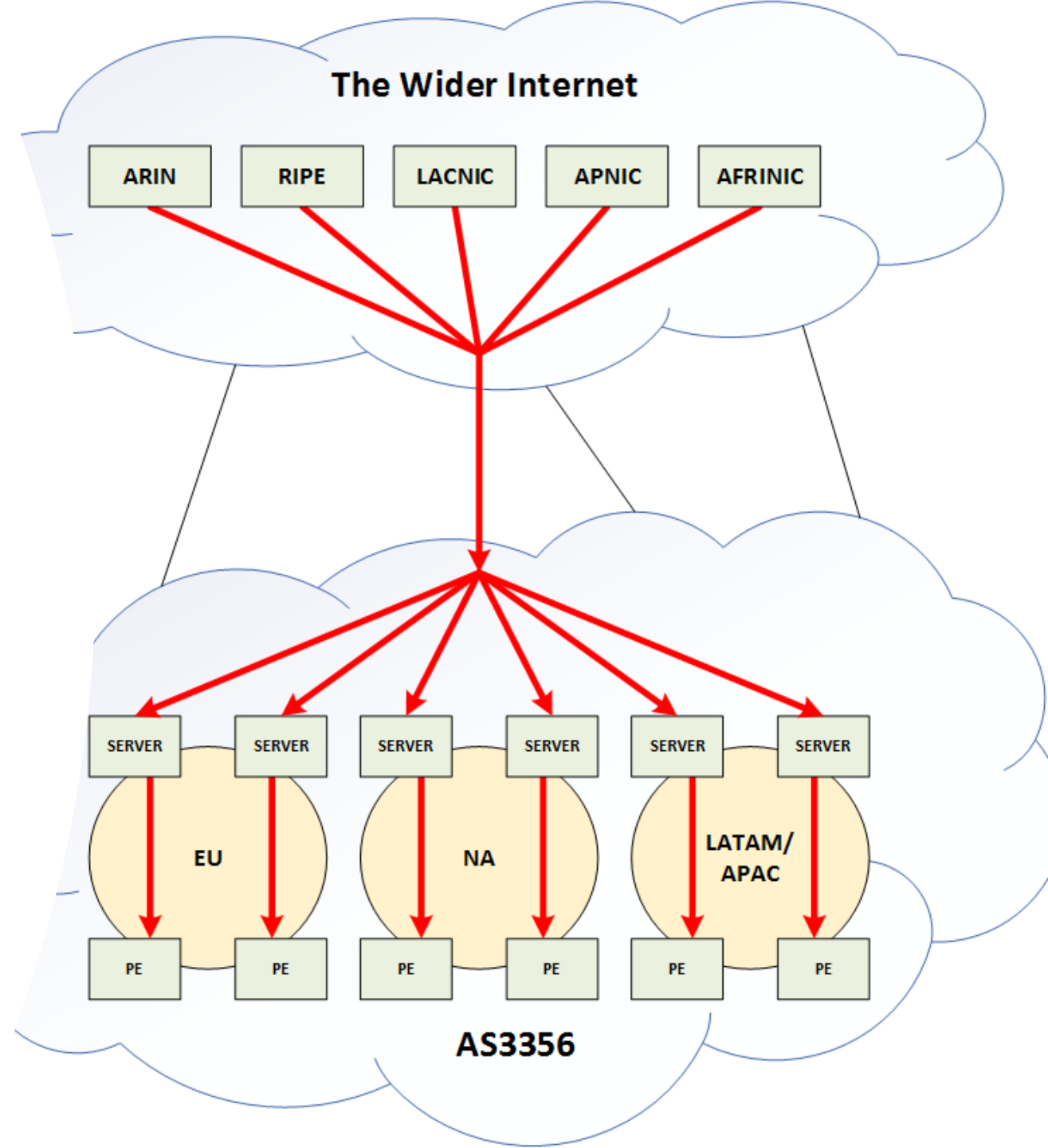
Lumen Network Size



- We provide communications in 60 countries and all continents
- We own Autonomous System Number 1 (ASN1)
- Ranked #1 in IP Services – 3356 = Largest ranked AS
- Ranked #1 in Ethernet – Largest provider on the Planet

What is Resource Public Key Infrastructure (RPKI) and Why Does it Matter?

- A voluntary framework to secure internet routing infrastructure and prevent BGP route hijacking
- RPKI verifies that a specific system is authorized to use its stated IP prefixes
- IP service providers can use RPKI to validate IP route announcements
- Stops some leaks due to misconfiguration and the most basic route hijacks due to human error
- RPKI does not stop the vast majority of *malicious* hijacks



RPKI Deployment Challenges and Lessons Learned

- Business Case Justification
- RPKI Software Flaws
- Hardware and Software Upgrades
- Validation Server Implementation
- Customer communications
- Other
 - Increased load on routing platforms
 - Developing routing policy
 - Support and training
 - Trust in Regional Internet Registries

Successful RPKI Deployment Benefits the Internet Community

- The complexity of RPKI deployment over Lumen's enormous global network required careful planning
- Final implementation was successfully completed due to Lumen's careful approach
- Many customers benefited from being able to correct invalid Route Origin Authorizations and reclaim hijacked IP ranges
- RPKI deployment is a worthwhile effort we hope that other ISPs can learn from our experience and together we can protect global users of the Internet

