



RIPE NCC
RIPE NETWORK COORDINATION CENTER

Root DNS-servers

Anycast and Ukraine

Alex Semenyaka | December 2025 | UADOM

RIPE NCC: Regional Internet Registry





Regional Internet registry

- Registration of Internet numerical resources
 - IPv4
 - IPv6
 - ASN
- RPKI Trusted Anchor
- RIPE Database
- LIR Portal

Secretariat of the RIPE Community

- Technical support for RIPE working groups
- Organization of regional and country community meetings
- Learning and Development

R&D and delivery of Information Services

- **K-root server**
- AuthDNS
- RIPE NCC Internet Country Reports
- RIPE Tools
 - RIPE Atlas
 - RIPE RIS
 - RIPEStat

Operators of the DNS root servers

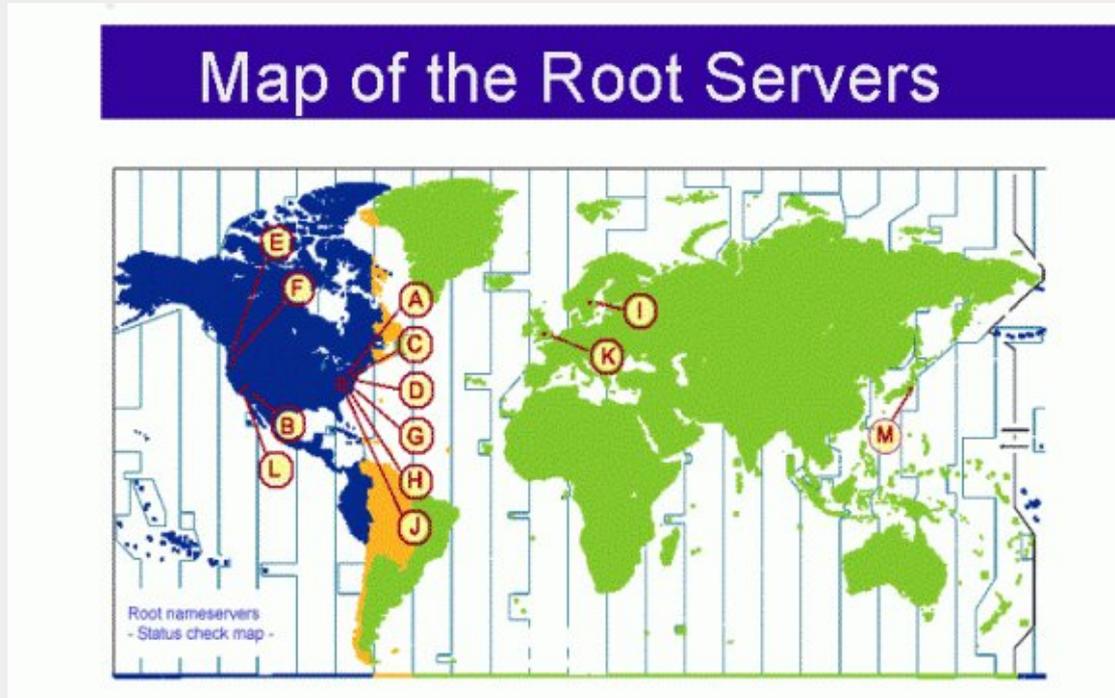


“A Letter”	IP-addresses	Managing organisation
a.root-servers.net	198.41.0.4, 2001:503:ba3e::2:30	VeriSign, Inc.
b.root-servers.net	199.9.14.201, 2001:500:200::b	University of Southern California (ISI)
c.root-servers.net	192.33.4.12, 2001:500:2::c	Cogent Communications
d.root-servers.net	199.7.91.13, 2001:500:2d::d	University of Maryland
e.root-servers.net	192.203.230.10, 2001:500:a8::e	NASA (Ames Research Center)
f.root-servers.net	192.5.5.241, 2001:500:2f::f	Internet Systems Consortium, Inc.
g.root-servers.net	192.112.36.4, 2001:500:12::d0d	US Department of Defense (NIC)
h.root-servers.net	198.97.190.53, 2001:500:1::53	US Army (Research Lab)
i.root-servers.net	192.36.148.17, 2001:7fe::53	Netnod
j.root-servers.net	192.58.128.30, 2001:503:c27::2:30	VeriSign, Inc.
k.root-servers.net	193.0.14.129, 2001:7fd::1	RIPE NCC
l.root-servers.net	199.7.83.42, 2001:500:9f::42	ICANN
m.root-servers.net	202.12.27.33, 2001:dc3::35	WIDE Project

Root Server locations



Sometimes one can find such a map...



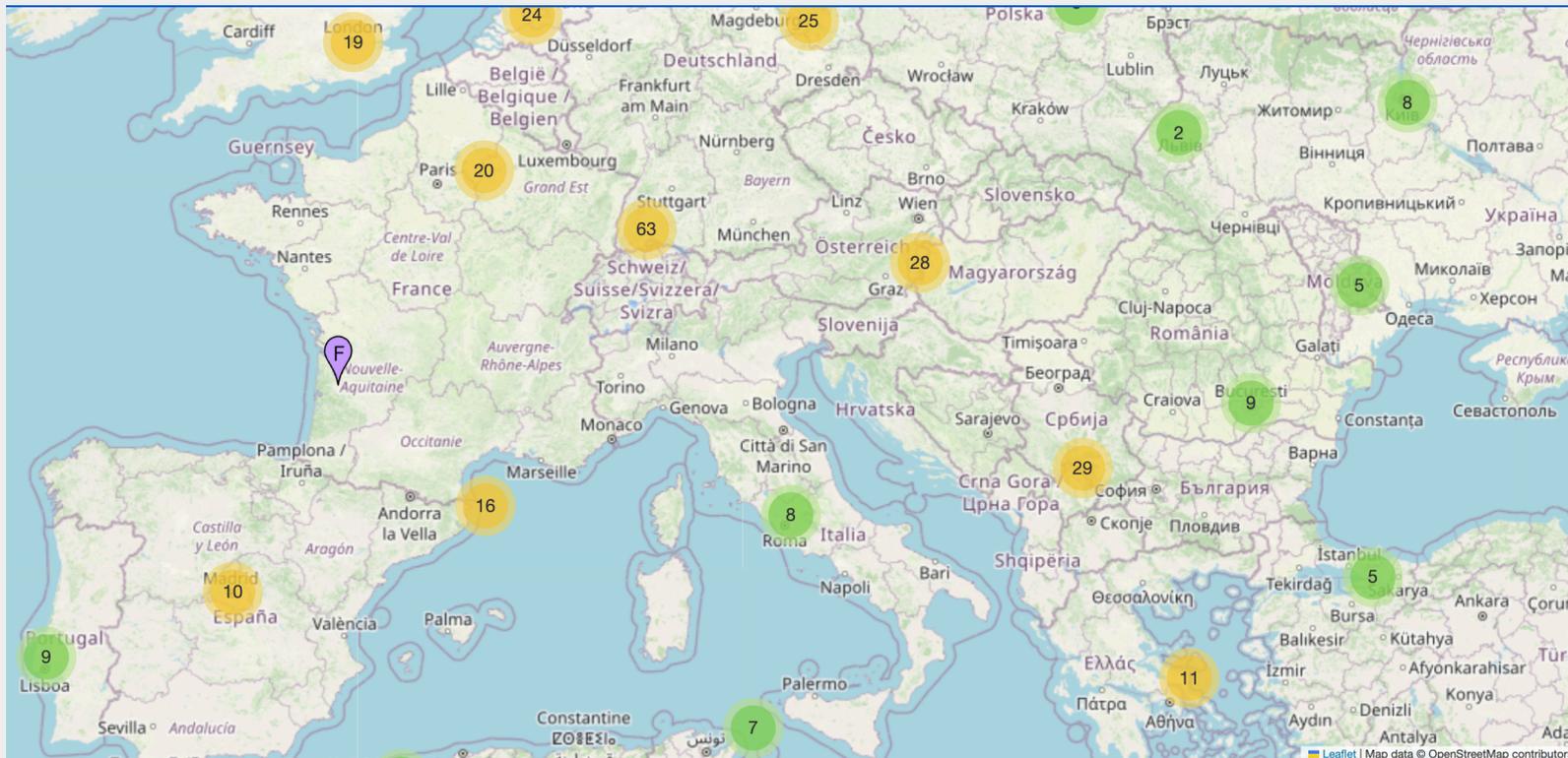
- This is not where the root servers are located
- This is where the organizations that operate them are located

And where are the servers themselves?



As of 2025-11-30T18:29:06Z, the root server system consists of 1952 instances operated by the 12 independent root server operators.

Europe



K-root in the world (2017)



How is it possible?



Each operator has many servers

- **These servers share:**
 - IPv4 and IPv6 addresses
 - Autonomous System Number
- **But they separate servers that operate independently**



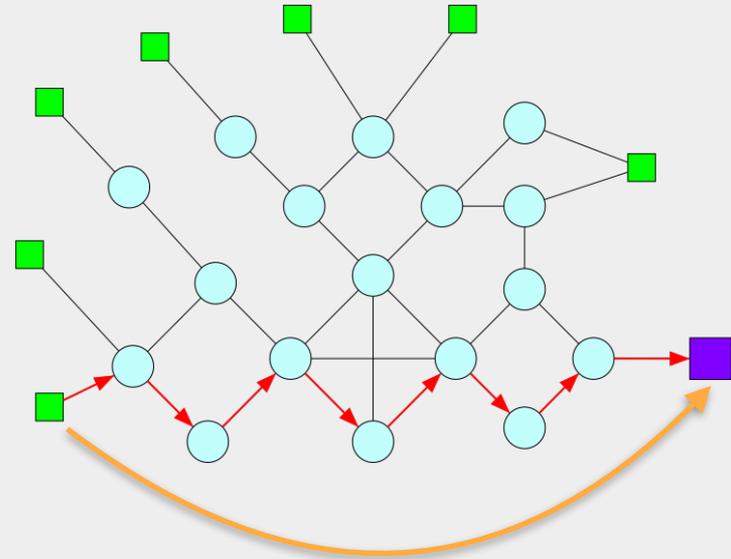
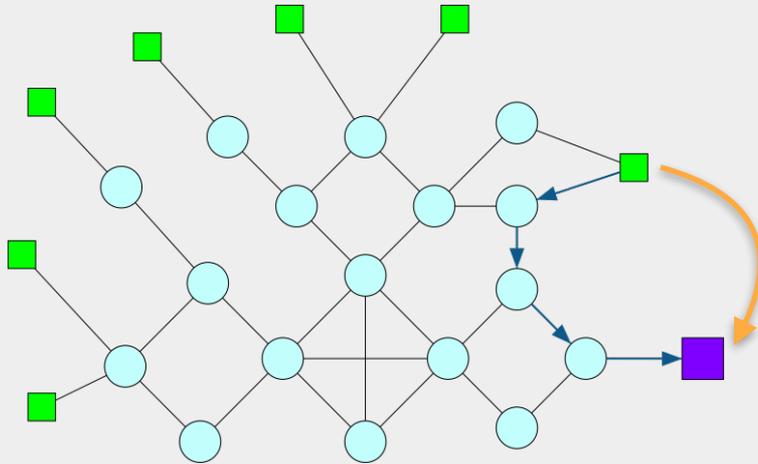
A tricky feature of the routing technology

- Usually we deal with the *unicast* traffic
 - One sender, one receiver
- Sometimes we use the *multicast* traffic
 - One sender, one many receivers
- Now we switch to the *anycast* traffic
 - One sender, one receiver, but one of many equal ones



Unicast traffic

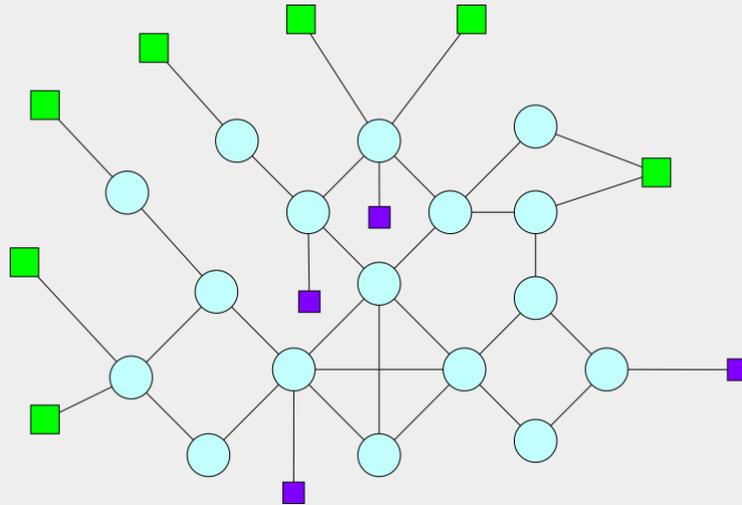
- Every time the *routing protocol* is responsible for finding the best way to the receiver(s)
 - Sometimes it is short, sometimes



BGP Anycast



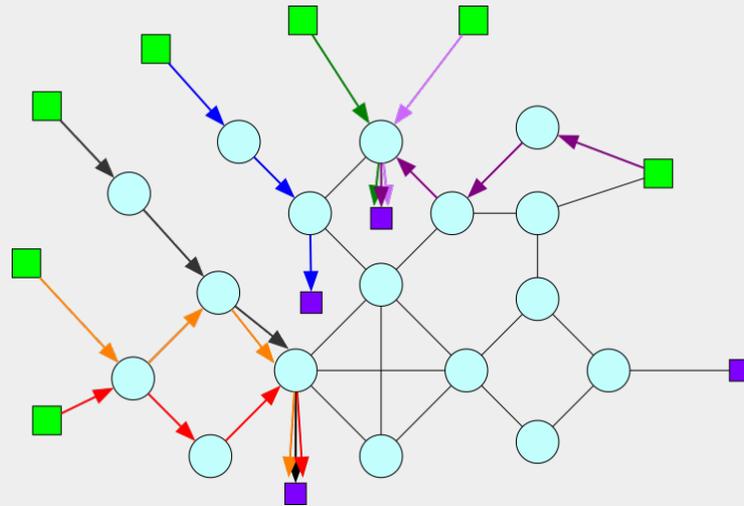
- **But we can make many identical recipient nodes in the global network**
 - **Let the BGP protocol choose which one is closer (according to its criteria)**



BGP Anycast



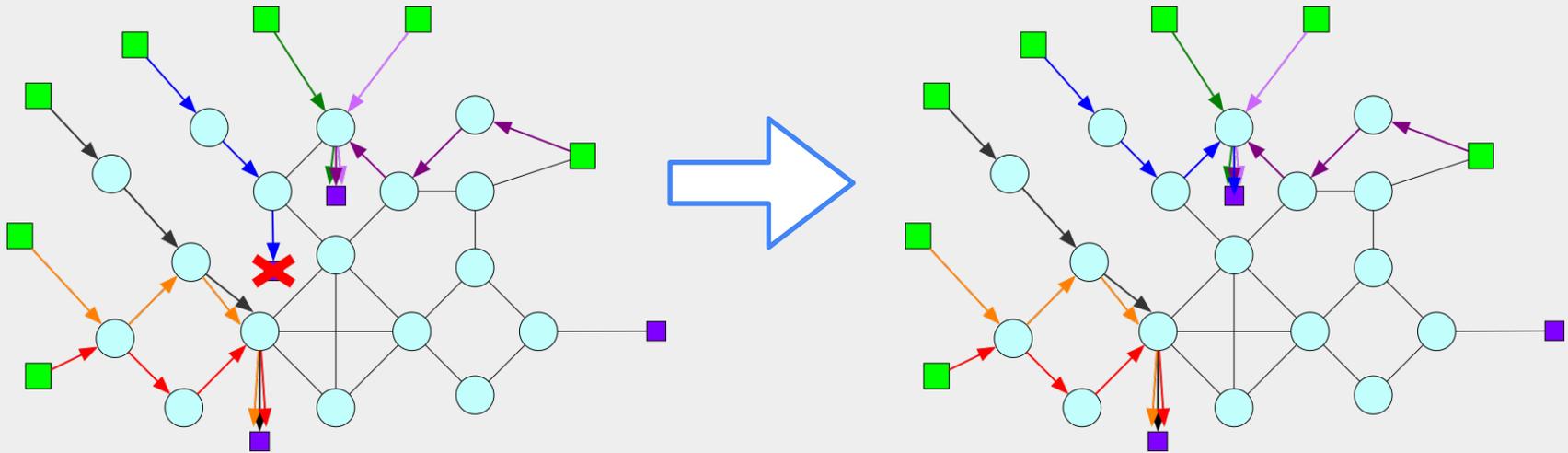
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 - Let the BGP protocol choose which one is closer (according to its criteria)



BGP Anycast: a faulty node



- We received free load balancing
- And service restoration in case of failure code



A silver bullet?



Uh...not exactly

- **Achieving 80% efficiency in the anycast operation is incredibly simple**
- **Achieving 100% efficiency in the anycast operation is incredibly hard**

- **The trick lies in the words “BGP criteria”**
- **BGP was never designed to make everyone work the same way**
- **It was designed to allow everyone to work in their own way**
 - **BGP appears when money is translated into the routers' language**

Simple example



Cold and hot potato principle

- **Some operators try to transfer transit customer traffic outside as quickly as possible**
 - hot potato routing
- **Others, on the contrary, drag it as far as possible across their network**
 - cold potato routing
- **(And BGP settings are responsible for this)**



On the map



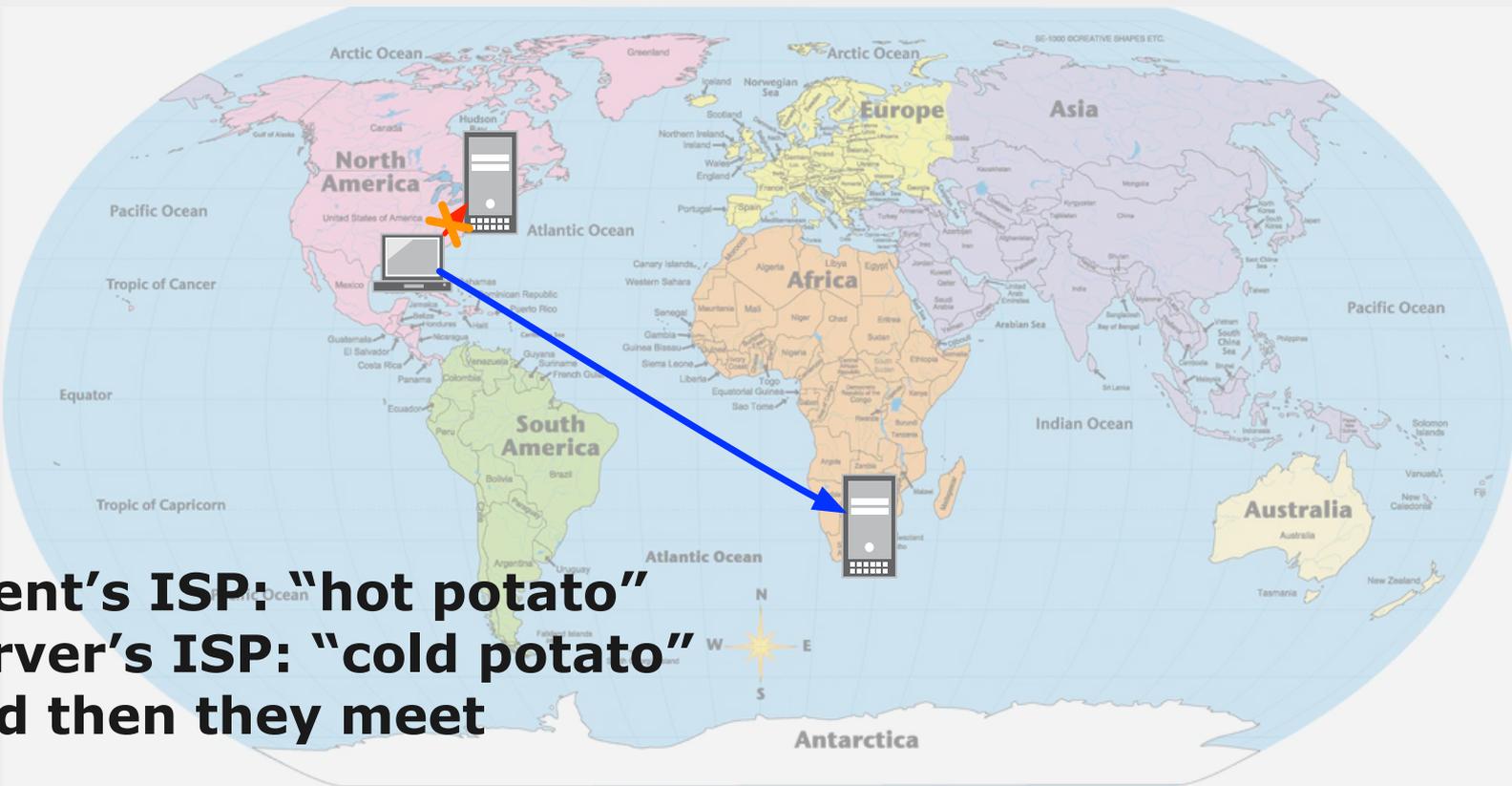
On the map



On the map



On the map



Client's ISP: "hot potato"
Server's ISP: "cold potato"
And then they meet



And what to do?

Countermeasures

- Many small servers are better than one powerful server
- Natural localization points: traffic exchange points
- Monitoring the operation of Anycast nodes and calculating anomalies
 - RIPE Atlas measurement system

Ukraine

- In 2025 two Ukrainian IXP applied and got their K-Root nodes
- Currently being developed - a joint program with Hostmaster for installing DNS servers on other IXPs.
- Installation of new RIPE Atlas probes to monitor the situation
 - Contact me for new probes



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THANK YOU!