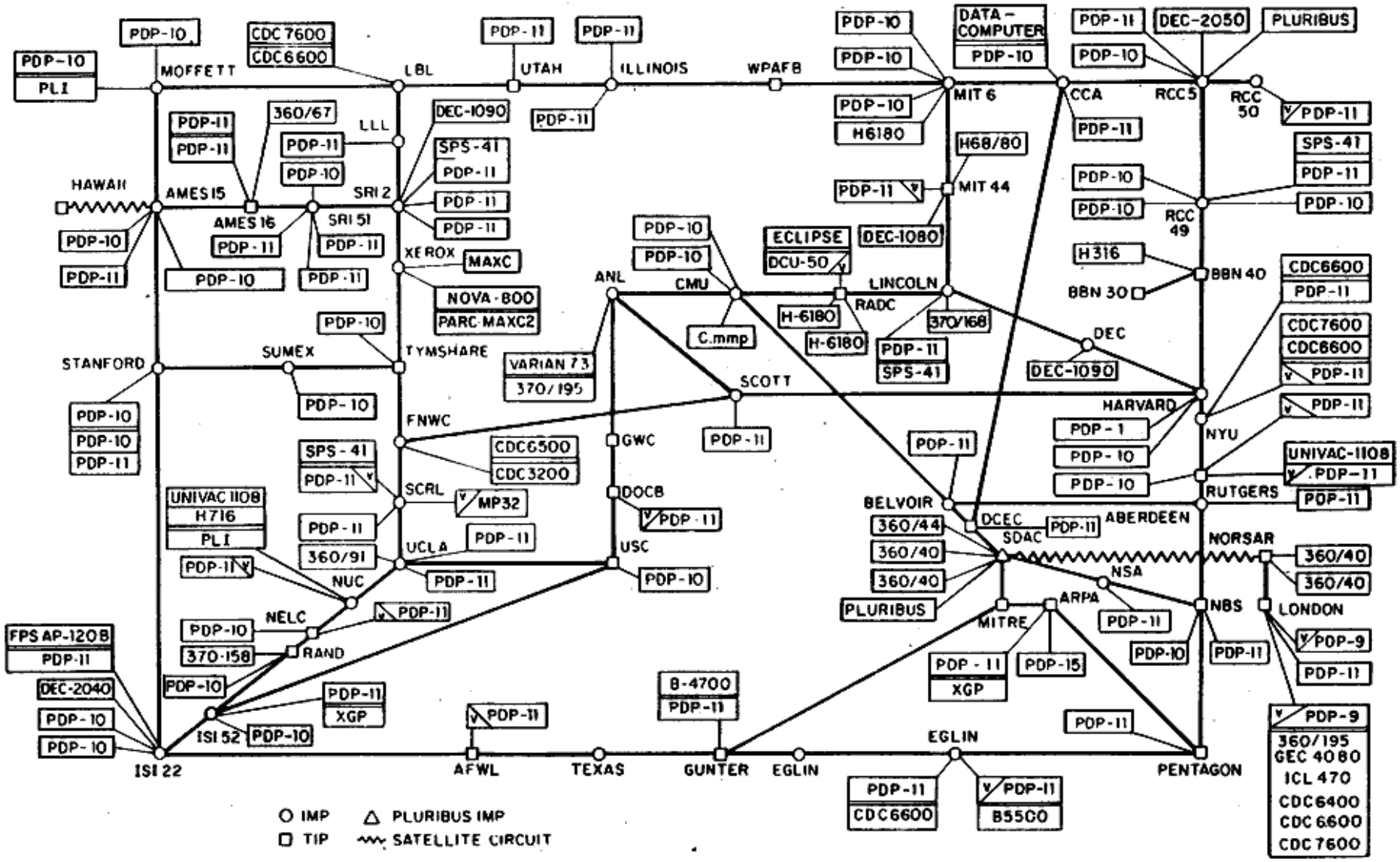
The Root Server System

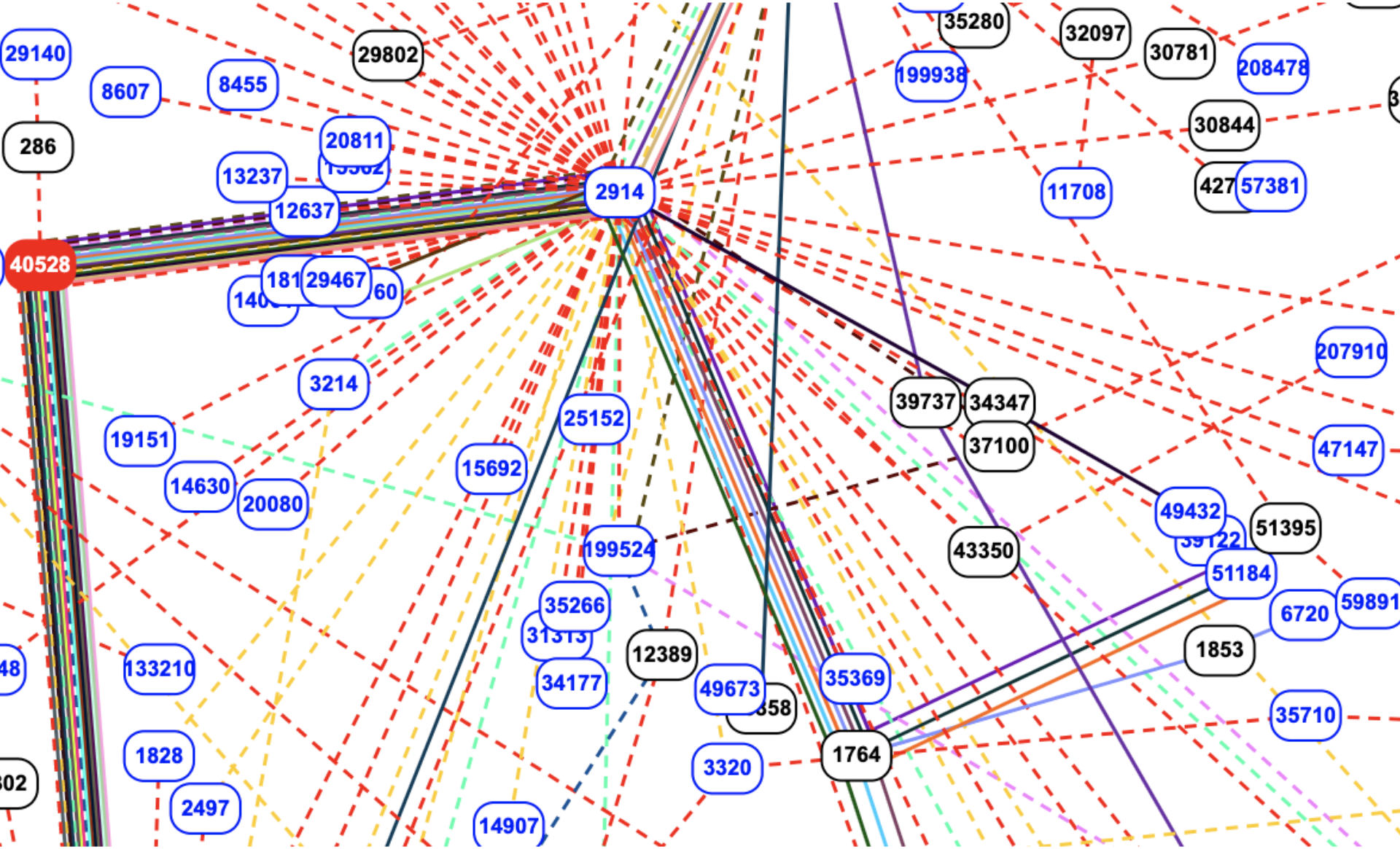
A view from Romania, and a little bit about some changes in governance

David Huberman
ICANN's Office of the CTO

ARPANET in March 1977 (via Wikipedia)



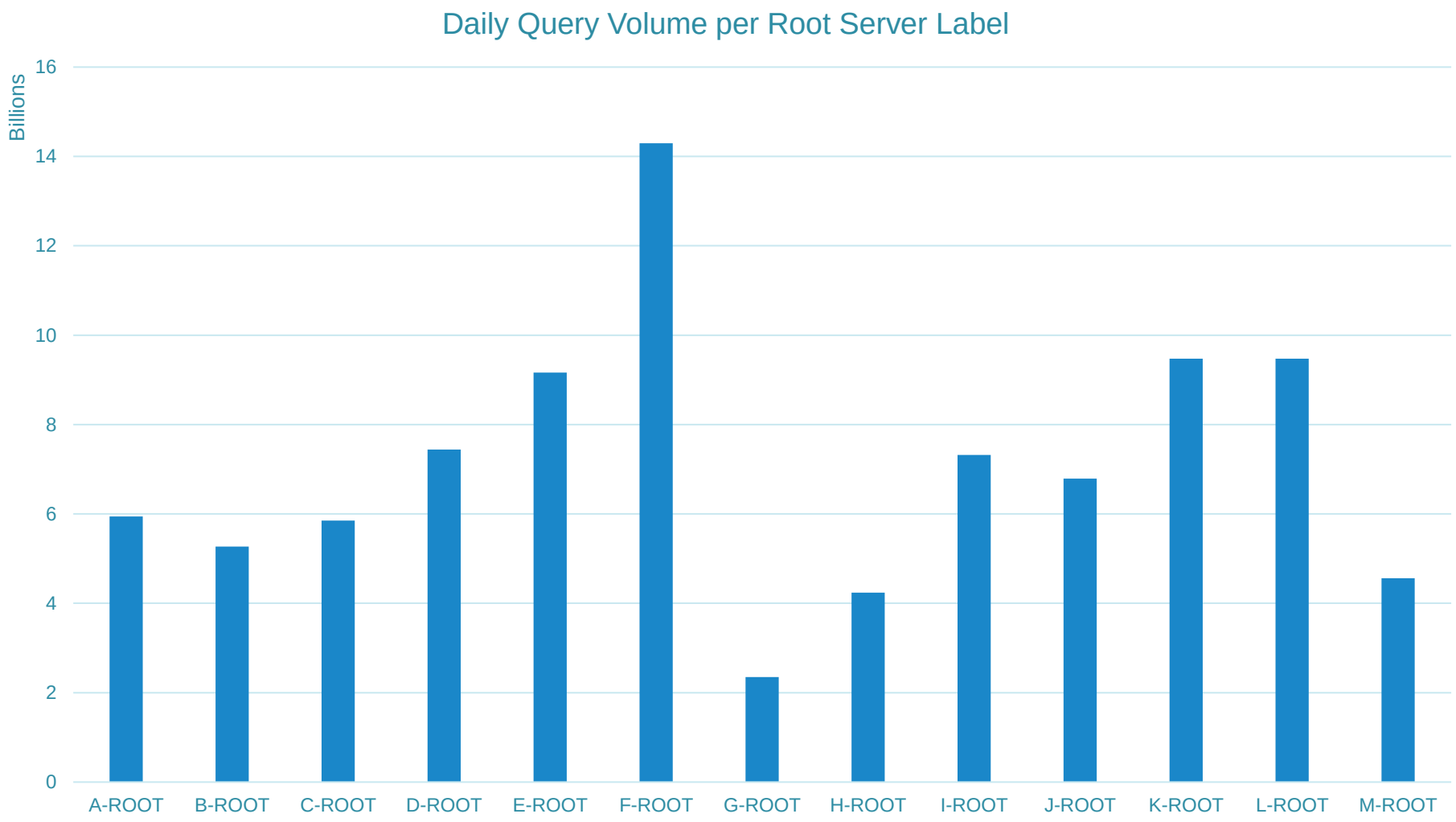
1980s: Introduction of BGP & DNS



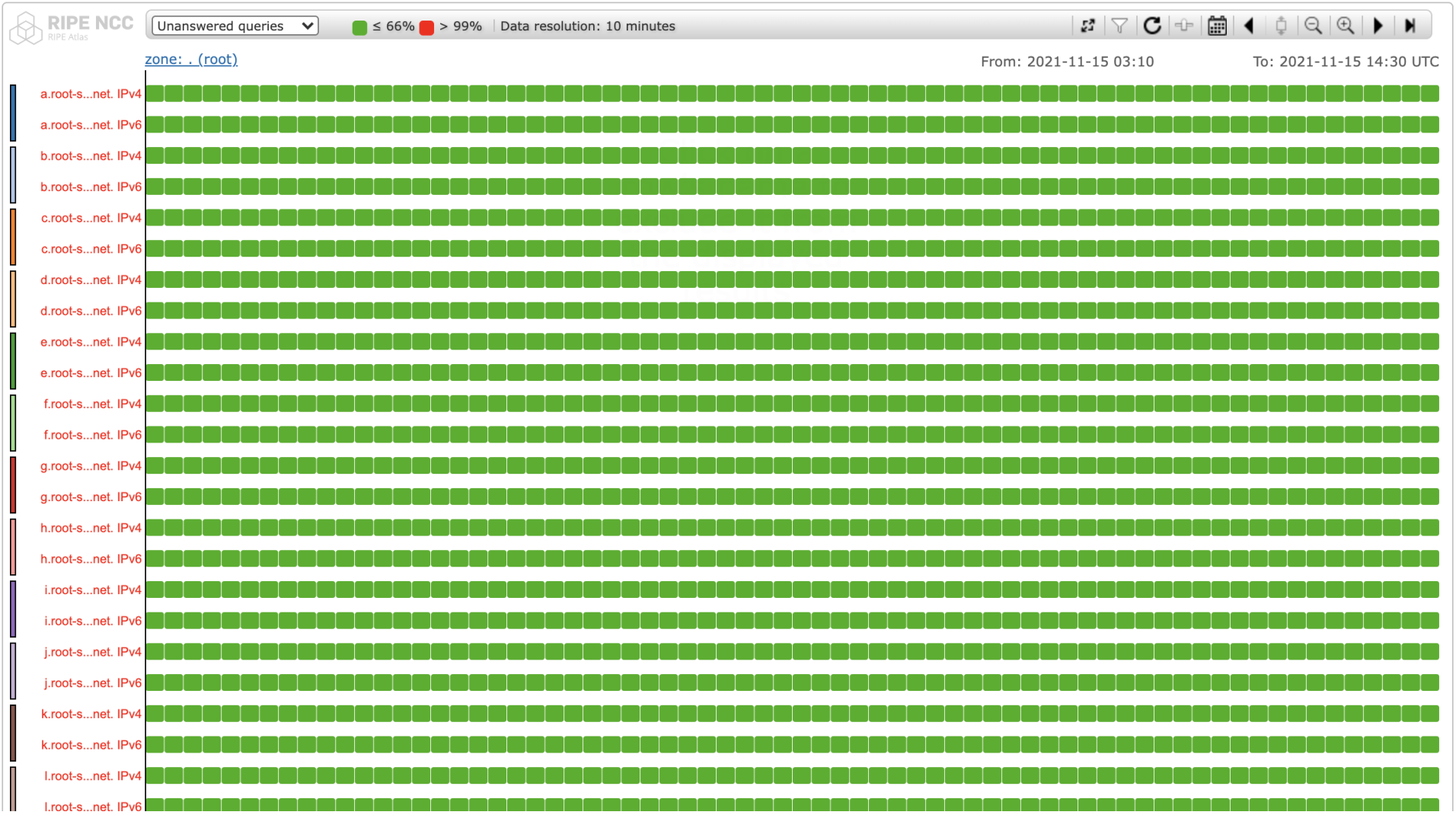
DNS

www.ronog.ro.

Over 90 Billion Queries Daily



Real-time Monitoring of the Root Server System



1983

RFC 882:
DOMAIN NAMES - CONCEPTS and FACILITIES

1984

First root server established at University of Southern California's Information Sciences Institute (USC ISI)

1985

Four root servers:
two on each U.S. coast

1987

Seven root servers:
SRI – ISI – RPI – U. of Maryland –
U.S. Air Force – NASA – U.S. Army

1991

NORDU.NET replaces U.S. Air Force

https://**labs.ripe.net**/author/liman/celebrating-30-years-of-europes-first-root-name-server/

1993

Nine root servers:
InterNIC and ISC are added

1997

13 Root Servers

The Root Server System Today

- 13 labels: A through M
- 26 IP addresses (13 IPv4, 13 IPv6)
- Operated by 12 Root Server Operators
- Assigned to 1,551* instances thanks to anycast routing
- The root zone servers answer over 90 billion queries every day

** This number fluctuates daily as instances are turned-up and down due to maintenance, reachability, upgrades, etc.*

Root Server Operators

A: Verisign

B: USC ISI

C: Cogent

D: University of Maryland

E: NASA - AMES

F: ISC

G: U.S. DoD

H: U.S. Army Research Lab

I: Netnod

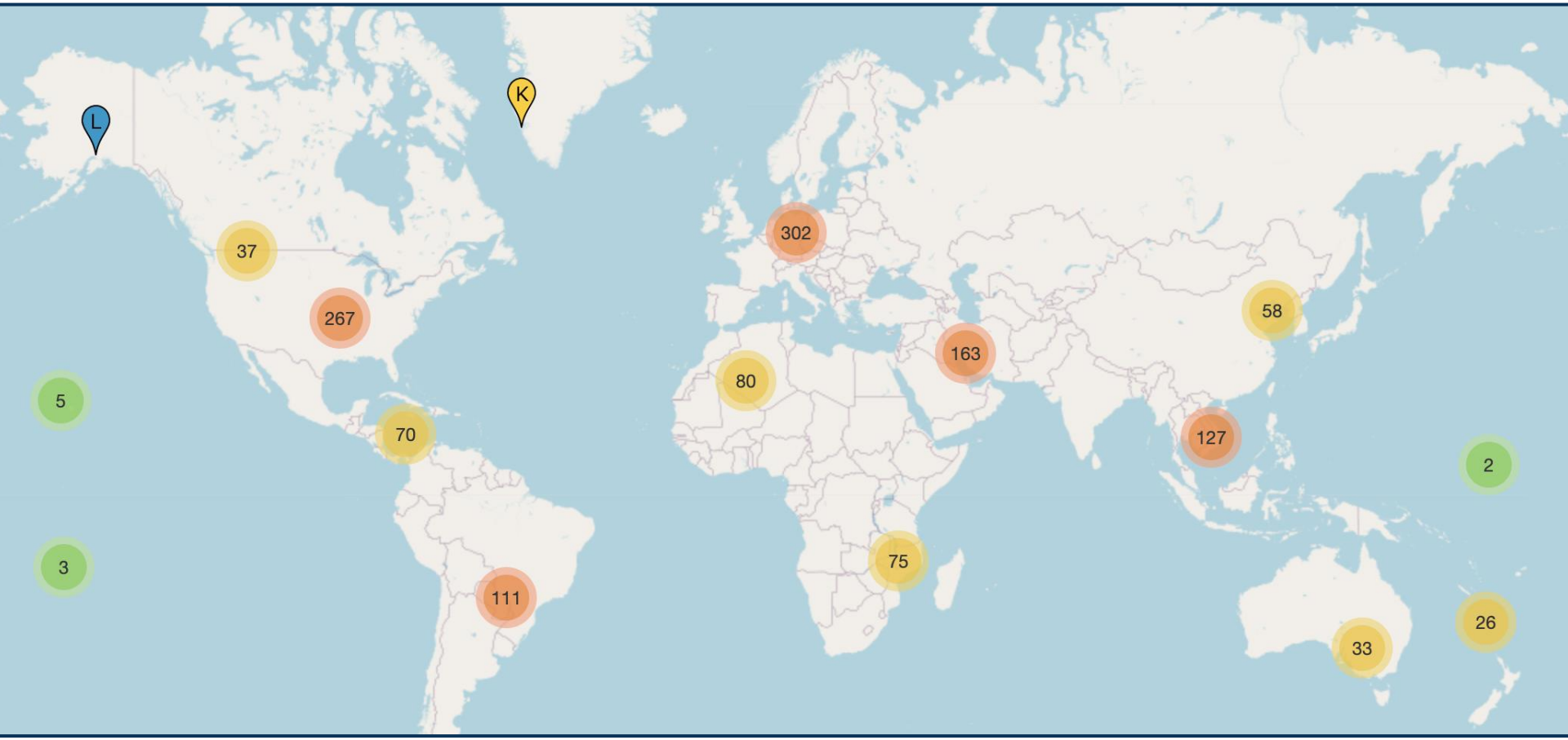
J: Verisign

K: RIPE NCC

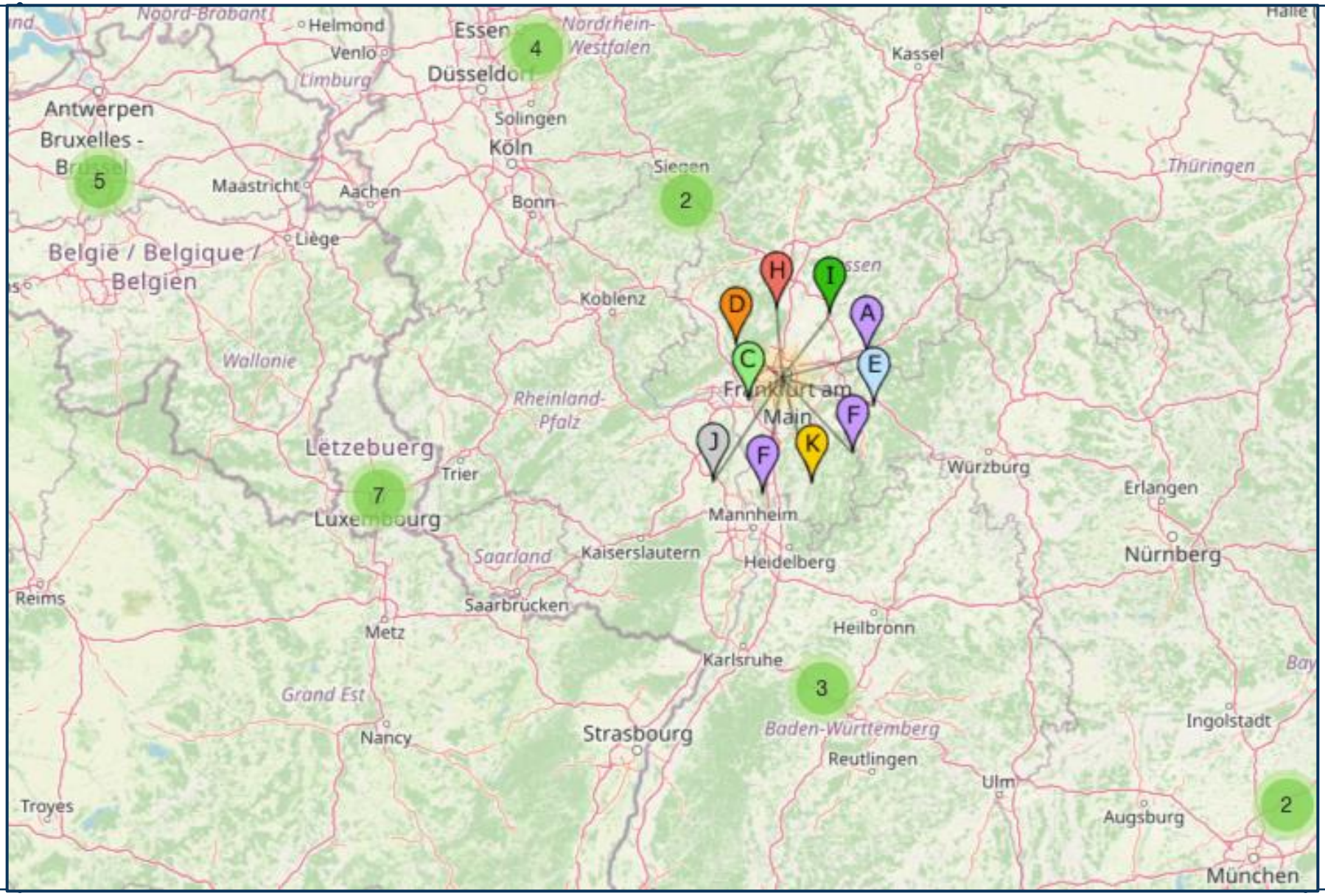
L: ICANN

M: WIDE

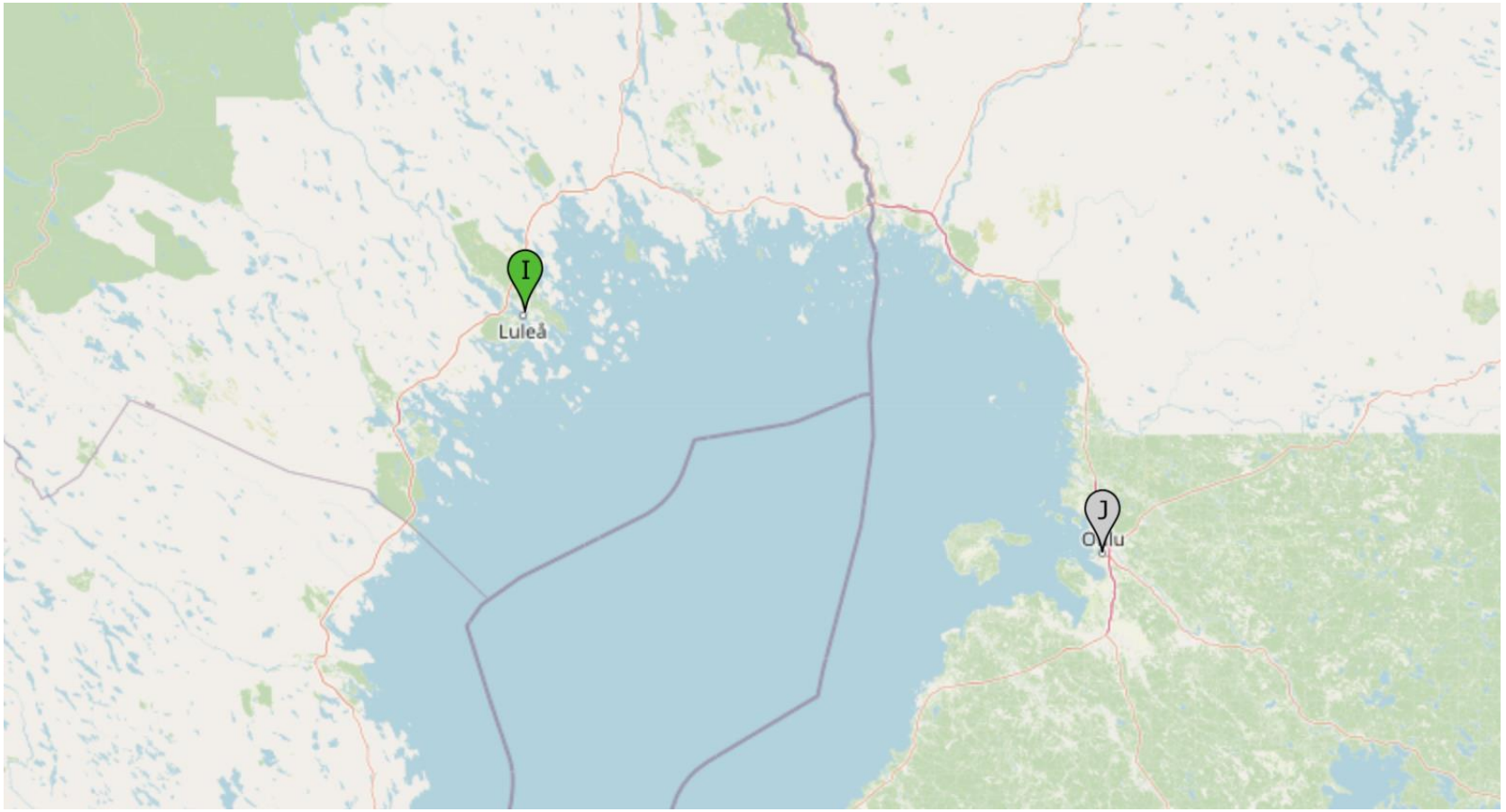
1,551 Root Server Instances Around the World



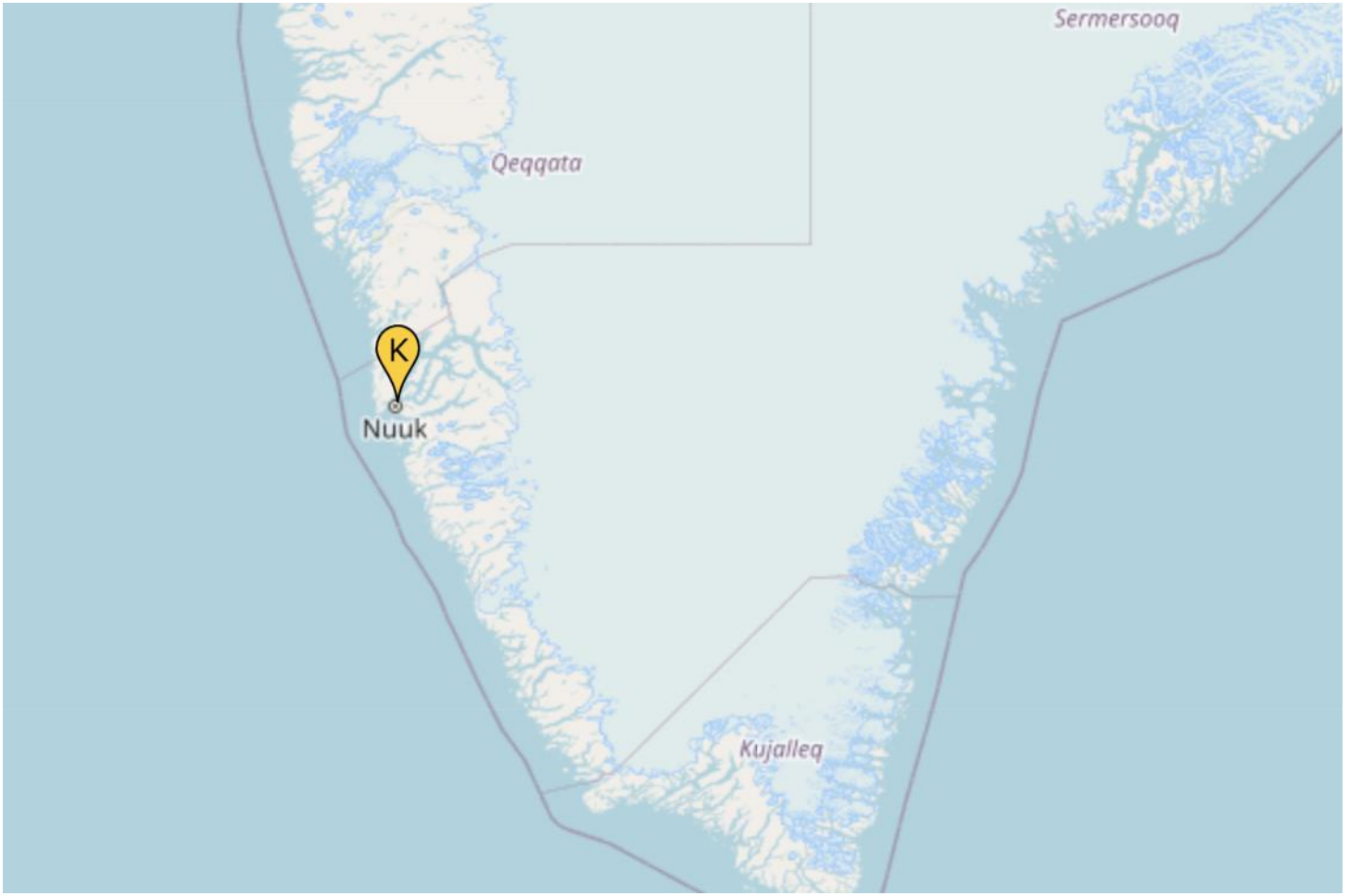
Instances are Often Found in Major Cities



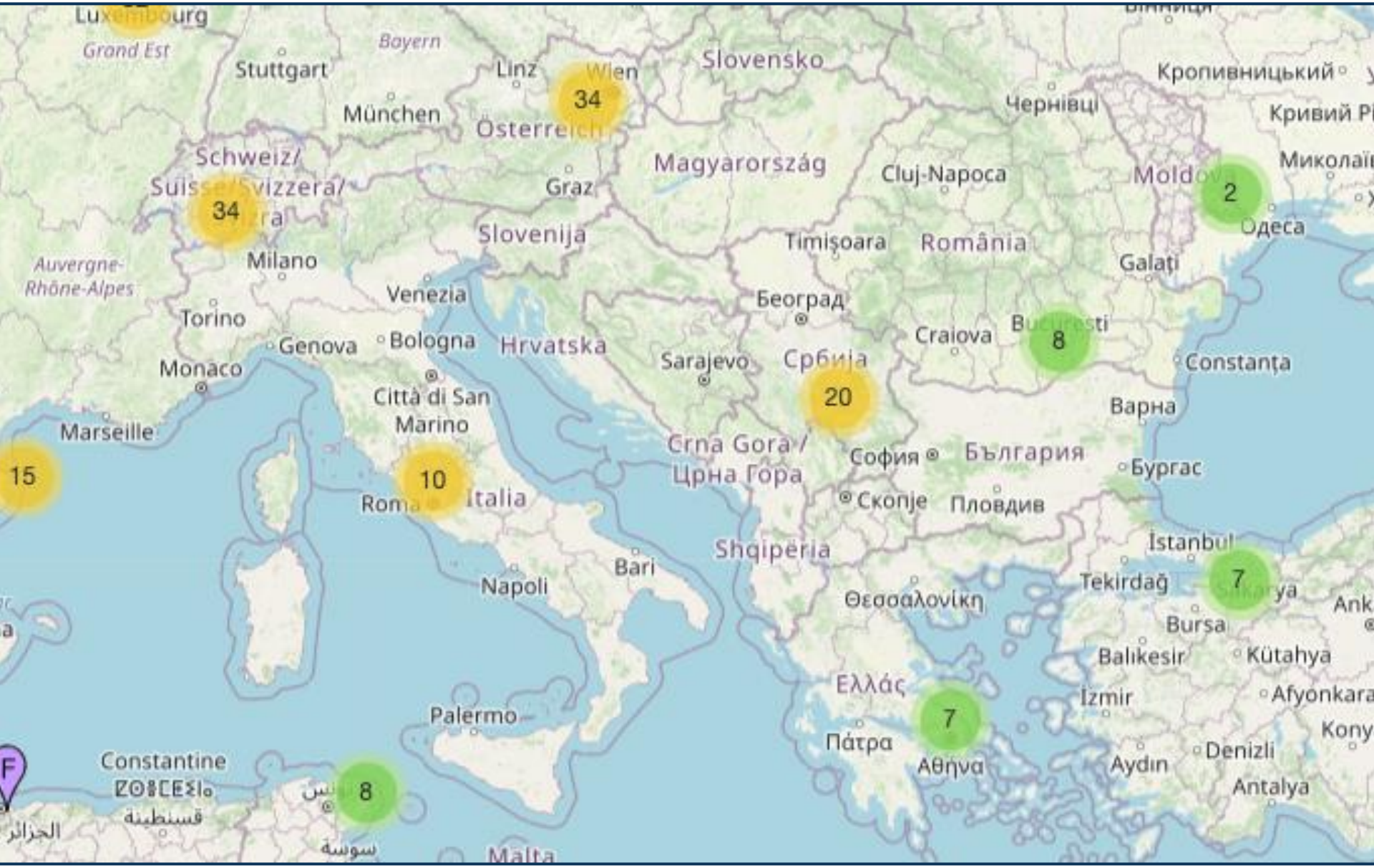
But Also Sometimes Not



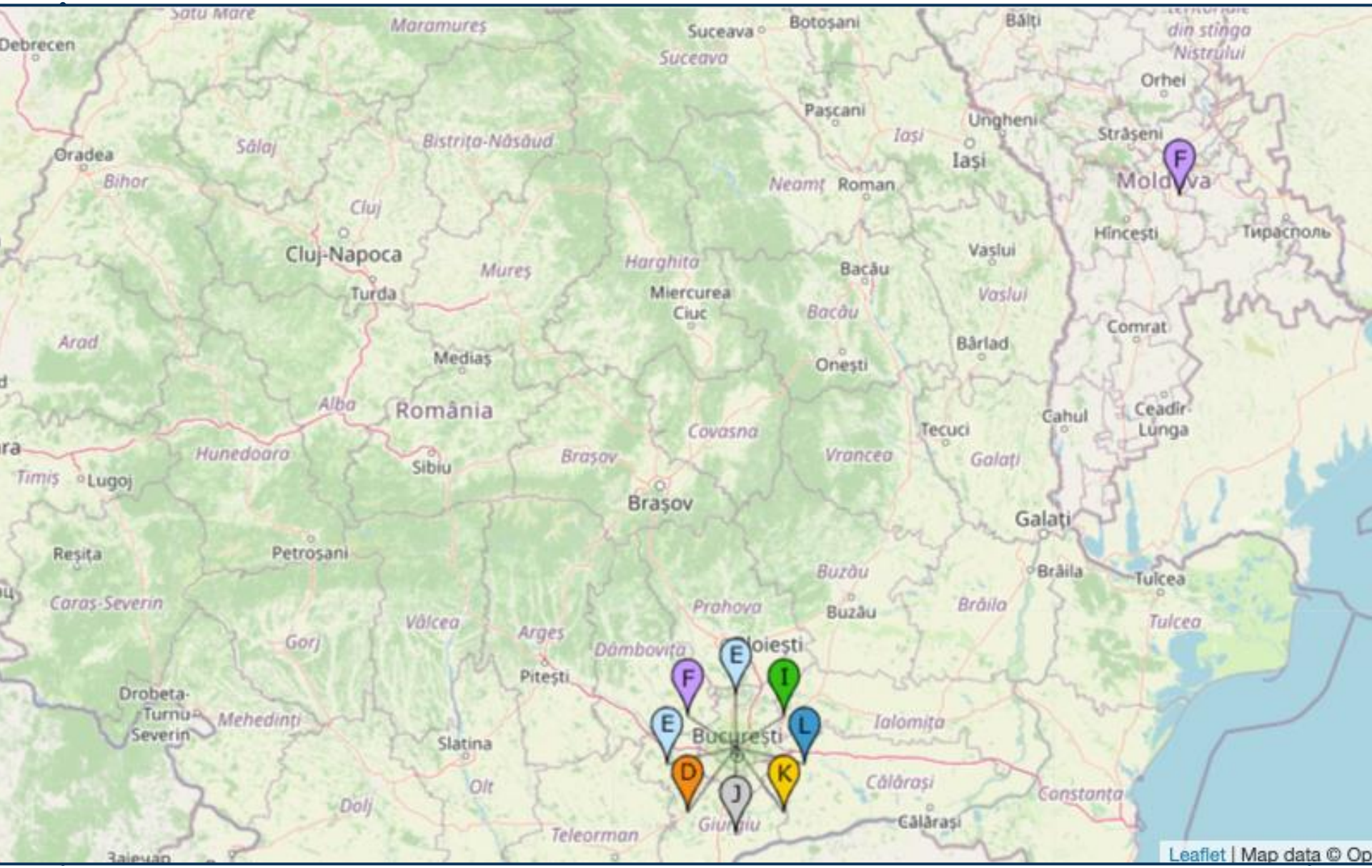
Nuuk (population 17k; 56k in Greenland)



Southeastern Europe



Romania


Debrecen
Satu Mare
Maramureș
Suceava
Botoșani
Bălți
din stînga Nistrului
Orhei
Pașcani
Ungheni
Iași
Strășeni
Oradea
Sălaj
Bistrița-Năsăud
Bihor
Neamț
Roman
Moldova
Cluj
Cluj-Napoca
Hîncești
Тирасполь
Vaslui
Mureș
Harghita
Bacău
Turda
Miercurea Ciuc
Arad
Comrat
Bârlad
Mediaș
Onești
Alba
România
Cahul
Ceadîr-Lunga
Tecuci
Covasna
Hunedoara
Brașov
Vrancea
Galați
Timiș
Lugoj
Sibiu
Brașov
Galați
Reșița
Petroșani
Buzău
Brăila
Tulcea
Caraș-Severin
Prahova
Buzău
Brăila
Tulcea
Vâlcea
Argeș
Gorj
Dâmbovița
Pitești
Drobeta-Turnu Severin
Mehedinți
București
Ialomița
Slatina
Olt
Călărași
Constanța
Dolj
Teleorman
Giurgiu
Călărași
F
E
I
F
E
L
D
J
K
Leaflet | Map data © Op

Recursive Resolvers in Romania

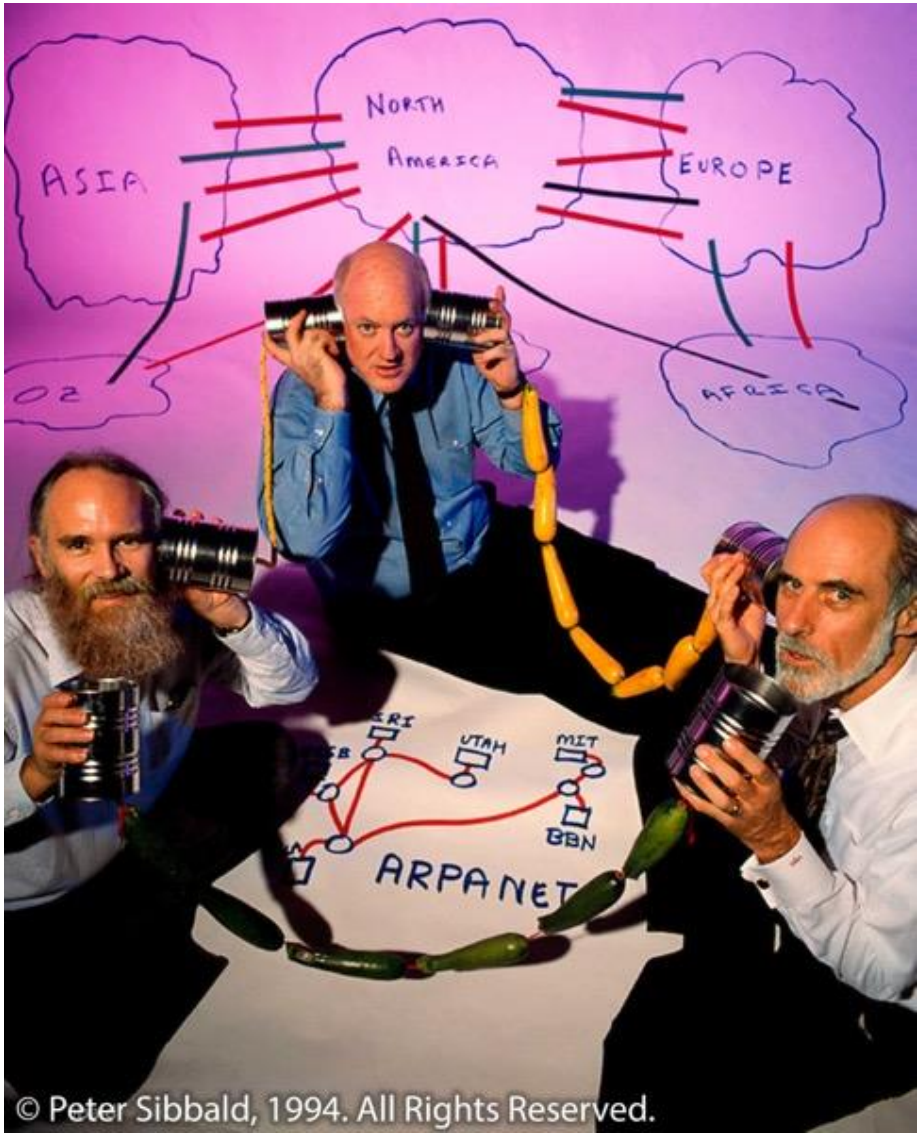
Country Code	ASN	sameas	samecc	diffcc	allprsvrs
RO	AS12302	97.01	0.11	0.27	2.63
	AS2614	29.93	1	0.74	69.77
	AS31313	70	1.94	0.98	27.7
	AS35725		99.08	0.04	0.89
	AS39425	81.25			18.75
	AS39737	60.71	5.95	2.8	34.54
	AS41496	81.1			18.9
	AS44679	98.84		0.84	1.38
	AS48161	94.09	0.18	0.38	5.55
	AS50887	69.8			30.2

Management of the Root Server System

1,551 instances around the world, with responsibility shared by 12 organizations. That prompts questions:

- It's a critical part of Internet infrastructure, so how is it regulated and governed?
- It sounds expensive (it is!). Who pays for it?

Informal Governance



- This 14-year history evolved without any formal governance structures.
- A small group of DNS technical experts discussed and debated change on mailing lists and at in-person conferences.
- Over time, a natural leader emerged: Jon Postel
- After assigning the 13th root server to WIDE in Japan, Jon Postel died on October 16, 1996
- Following Jon's death, there was **no system and no processes** in place to add, replace, or remove root server operators

So, What Do We Have?

- Today the governance activities for the root server system are centered around two groups:
  - ICANN's Root Server System Advisory Committee (RSSAC)
  - Root Operators Meetings (Root-Ops)
- But Root-Ops is not really governance. It is more about technical coordination. It is a closed group with informal meetings.

So, What Do We Have?

- RSSAC is closer to a governance body:
  - Organized within the bylaws of a formal governance organization, ICANN
  - It advises the ICANN community and Board on matters relating to the operation, administration, security, and integrity of the root server system
- But it is only a governance body to the extent that the root server operator members agree both to participate and to abide by decisions. The ICANN community, and the ICANN Board, have no leverage over the root server operators.

Oh! And By The Way . . .

. . . nobody pays a root server operator to provide root service!

The 12 root server operators provide root service as a public benefit, even though it can cost millions of dollars each year to provide root service.

Evolving Governance

- In June 2018, the RSSAC published a document entitled:
  - “A Proposed Governance Model for the DNS Root Server System”
- It was the RSSAC’s attempt to model who should govern the root server system, and how it should evolve in times of need
- The initial model the RSSAC envisaged solved five challenges:
  - Setting the system’s strategy, architecture, and policy
  - Measuring and monitoring performance
  - Financial considerations
  - How to add, replace, or remove root server operators
  - A secretariat function to coordinate everything

Governance Working Group

- The **Root Server System Governance Working Group** (**RSS GWG**) has been formed and is now actively working on realizing the details of the RSSAC's vision
- The GWG has to publish detailed and concrete recommendations for the five functions and do so in a way that respects community norms and is acceptable to a diverse group of stakeholders, including the root server operators who are currently not subject to formal governance
- The GWG also needs to develop an approach that fits into the overall ICANN ecosystem with minimal disruption

https://go.icann.org/rssgwgworkspace

Questions?

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