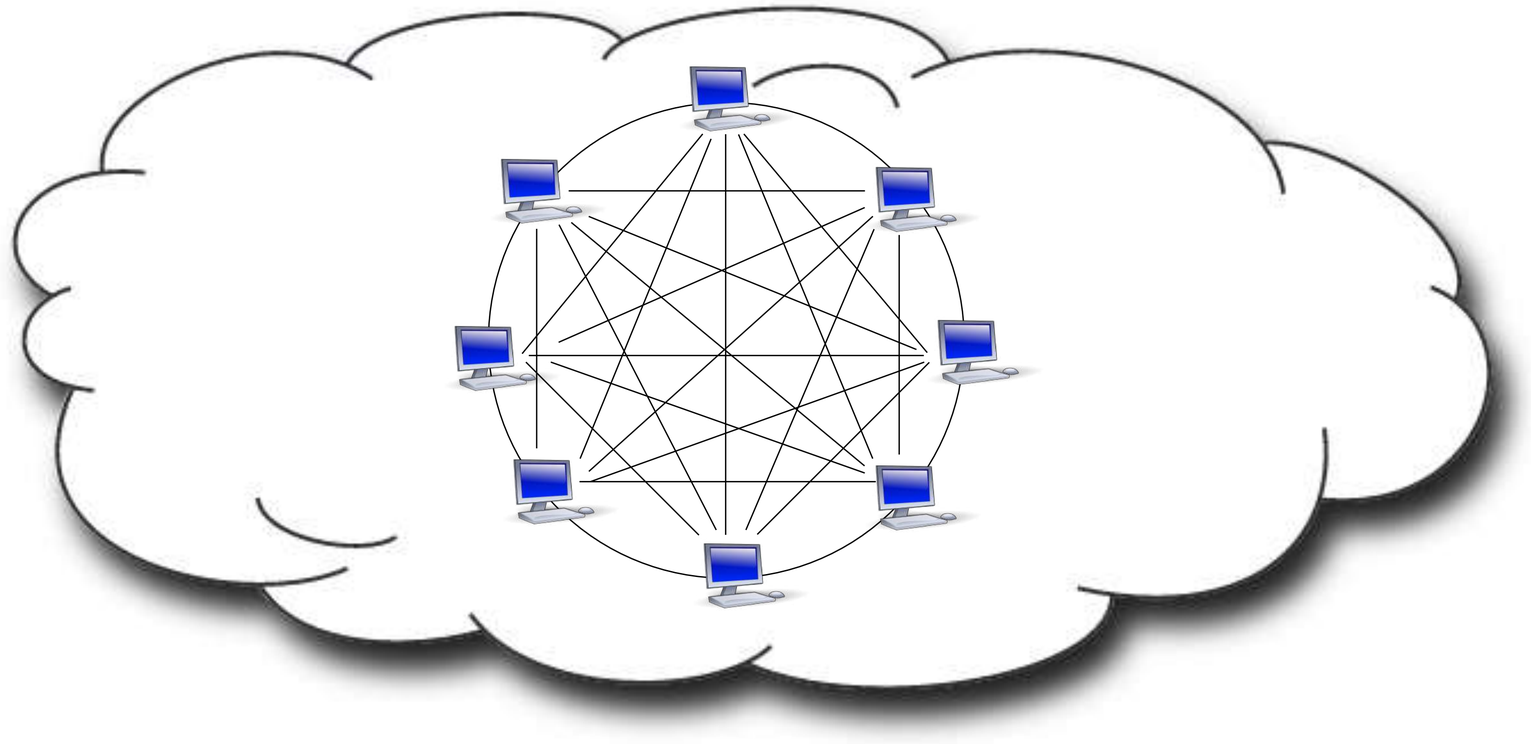
RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Introduction to Internet Infrastructure: The RIR System, the RIPE Community, and the RIPE NCC

Gergana Petrova | 27 May 2024

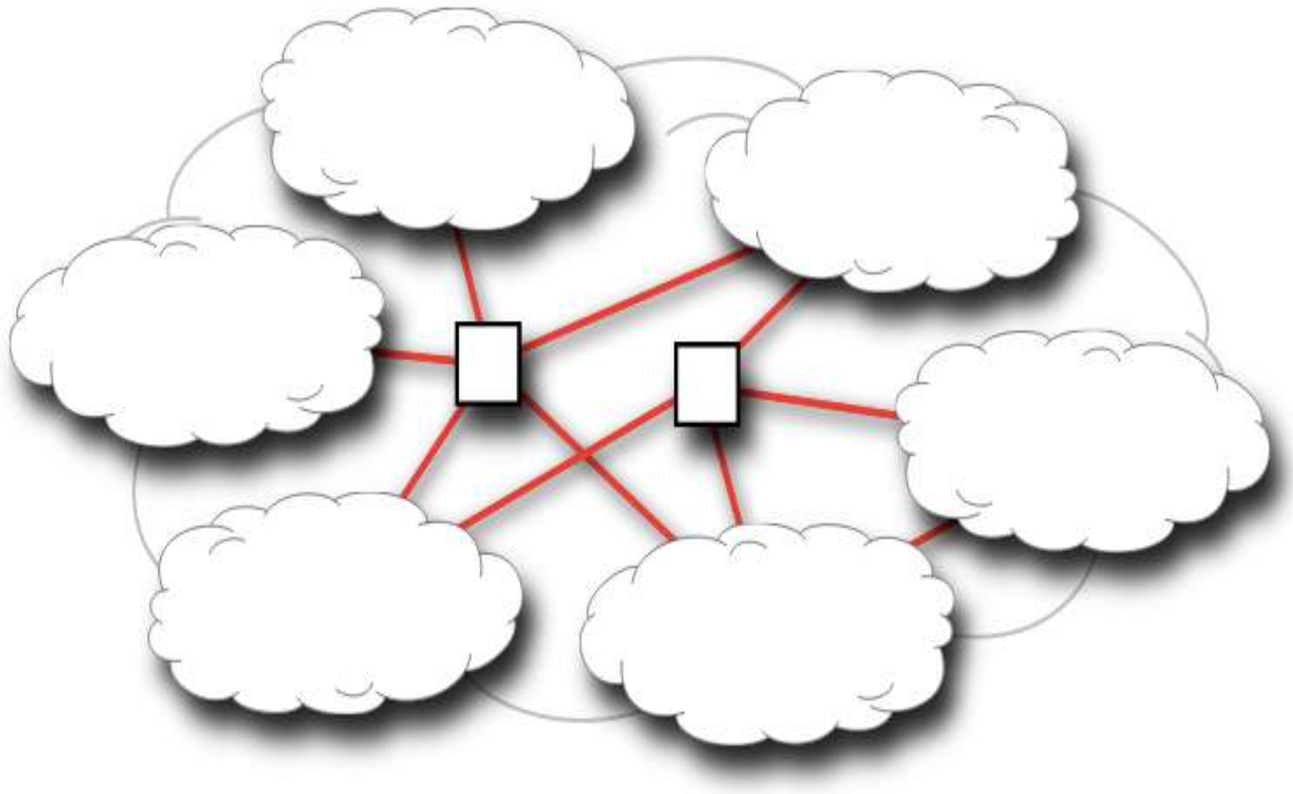
What is the Internet?

- Autonomous System (AS)
- The Internet has more than 70,000 interconnected ASs

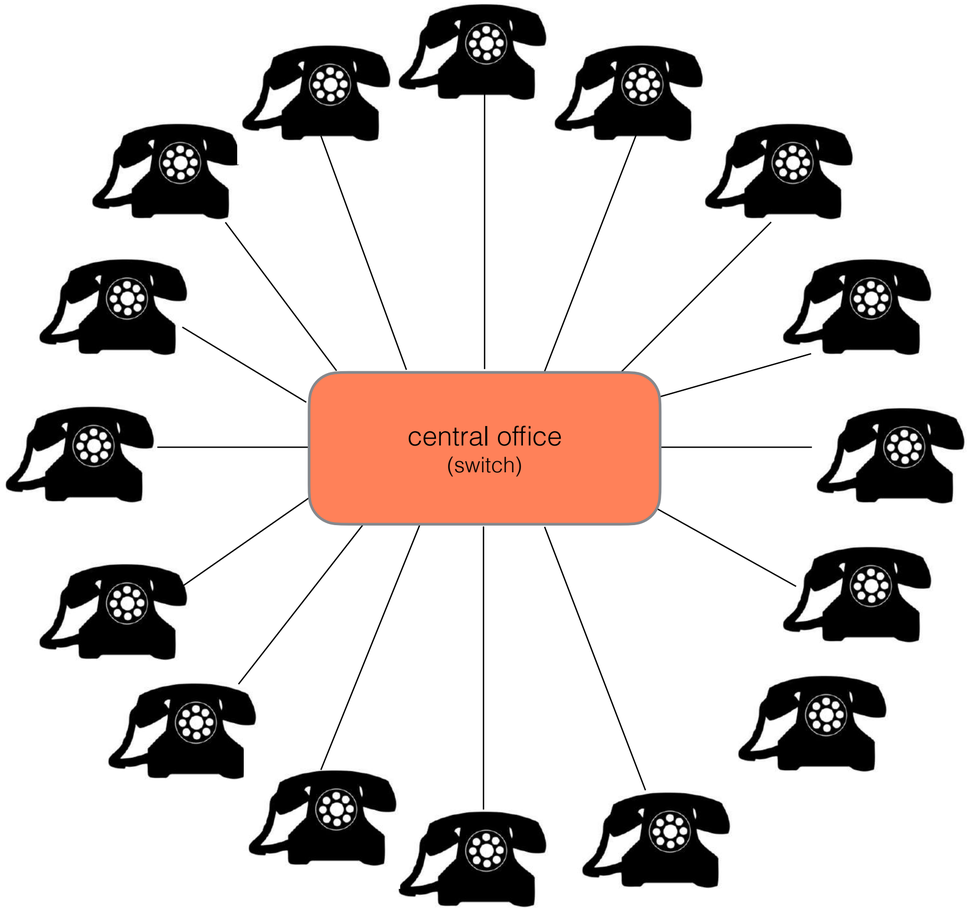


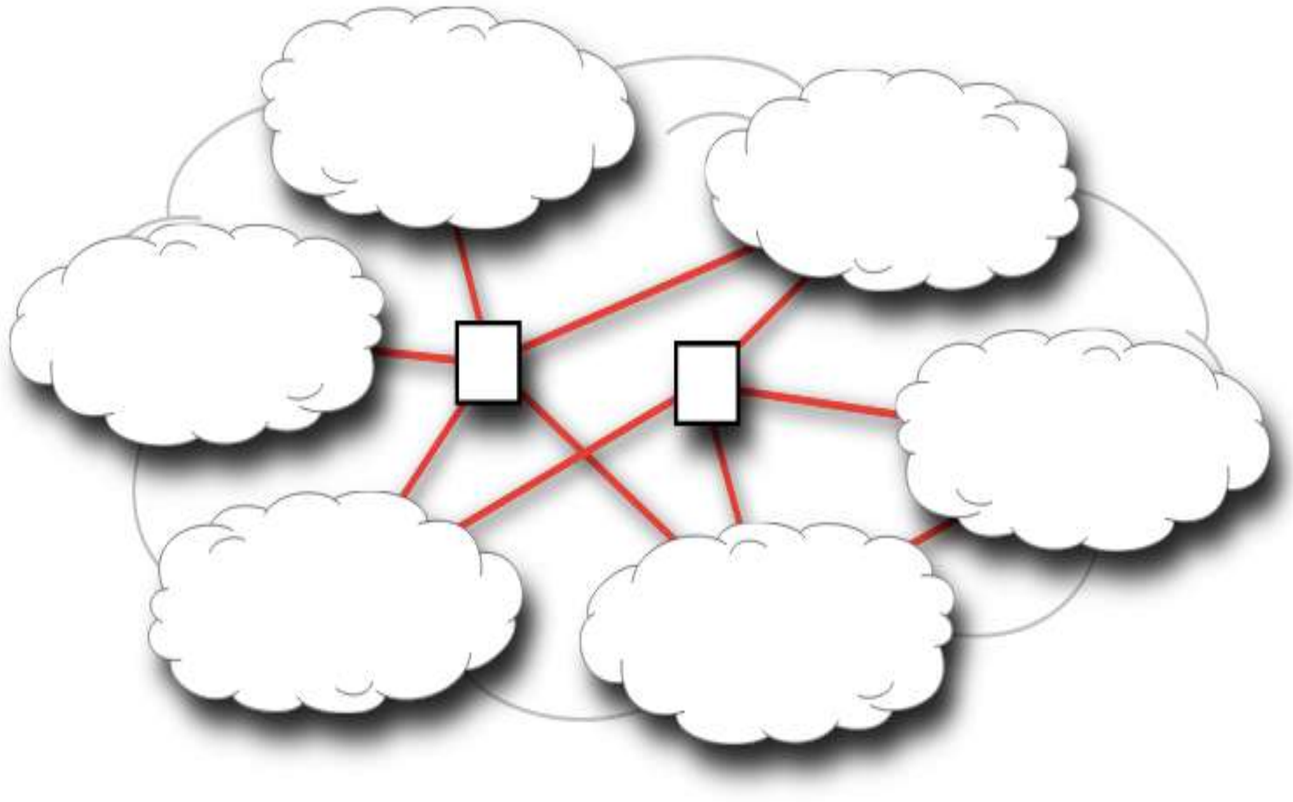
What is the Internet?

- The Internet is a network of interconnected networks
- TCP/IP is the standard of communication between all computers on this network
- IP = Internet Protocol



Unlike the phone system, the Internet is decentralised





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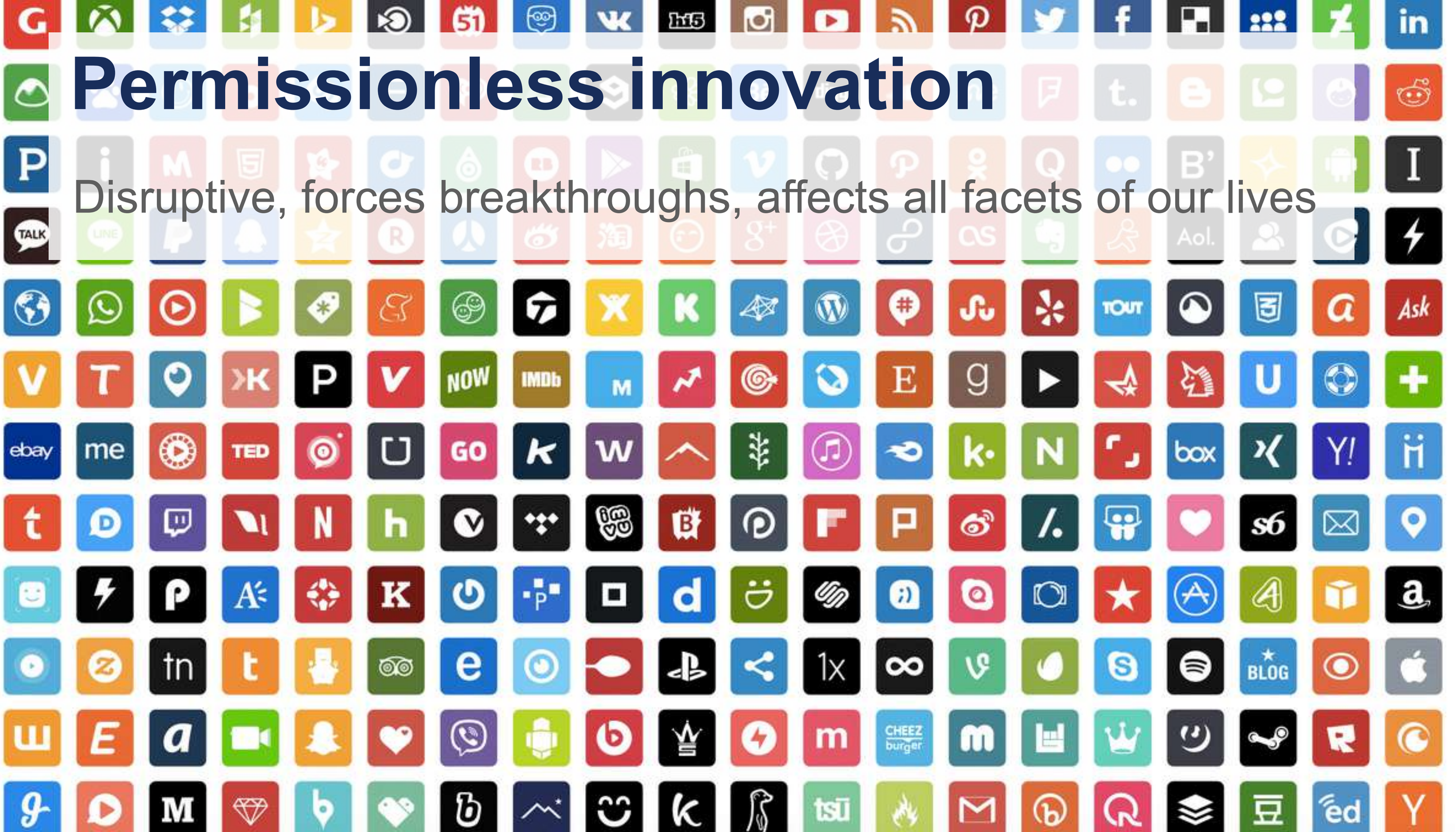
Permissionless innovation

Disruptive, forces breakthroughs, affects all facets of our lives



Standardising organisations

The Internet Engineering Task Force

- Develop and promote voluntary Internet standards
- Open standards organisation, with no formal membership
- Rough consensus and running code

World Wide Web Consortium

- Develop open standards to ensure the long-term growth of the Web

Internet Corporation for Assigned Names and Numbers

- Global forum for developing policies for coordination of some of the Internet's core technical elements
- Coordinate the Internet Assigned Numbers Authority (IANA) functions:
  - management of the address and routing parameter area (ARPA) top-level domain
  - administration of certain responsibilities of generic (gTLD) and country code (ccTLD) Top-Level Domains
  - the allocation of Internet numbering resources

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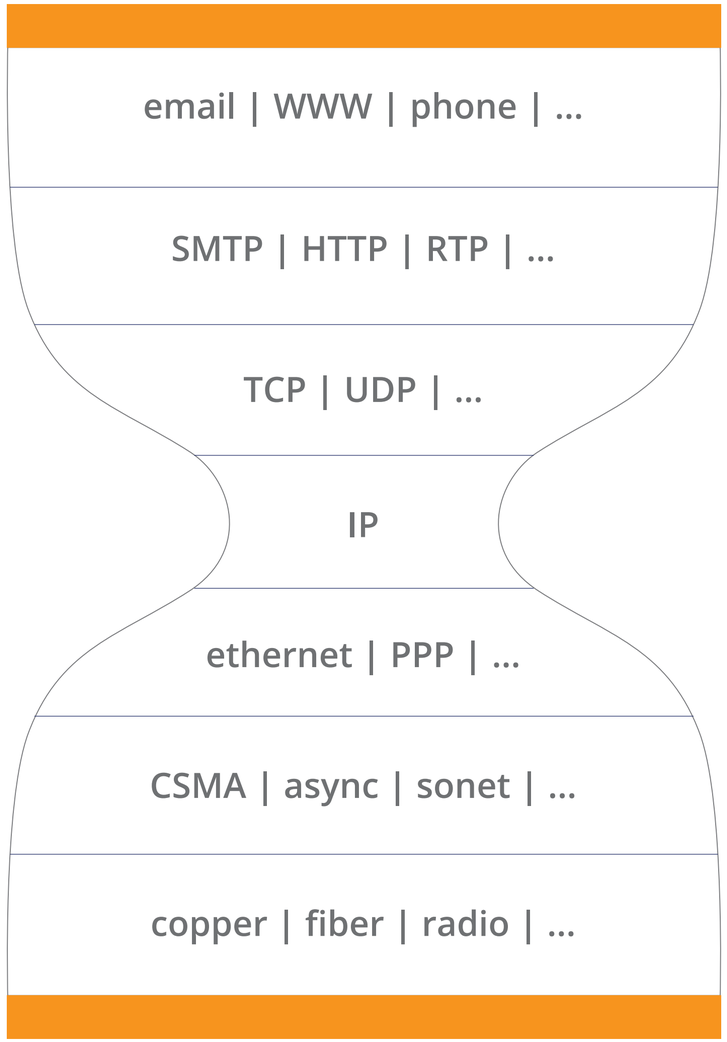
Numbers

The Internet Layers



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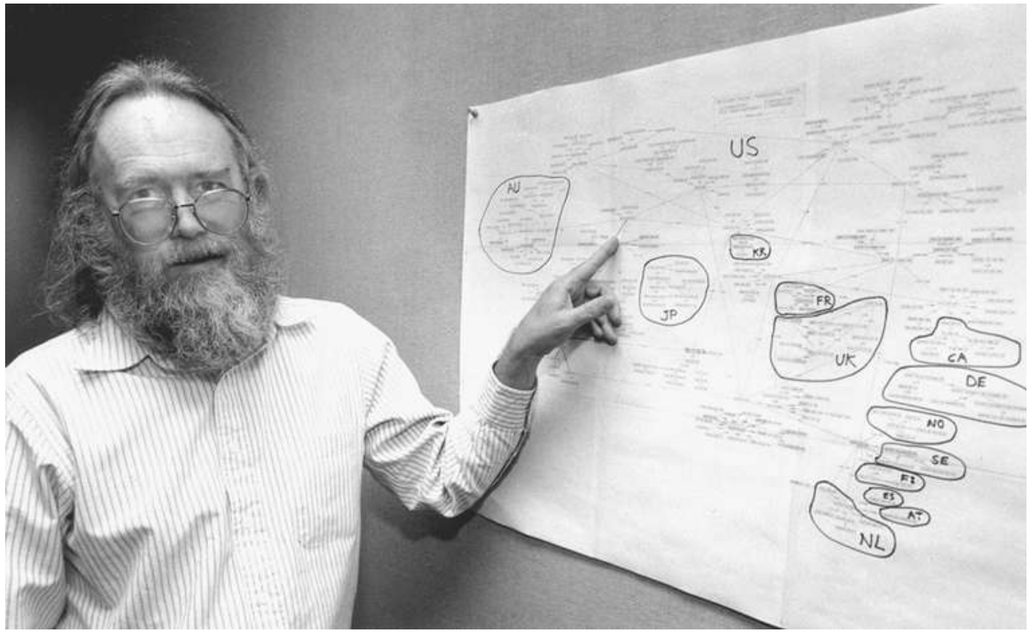
Internet Protocol (IP) Address

- It needs to be globally unique
- It is an address, not an identity
  - Represents a location in a network
  - If you move, your address is likely to change

- IPv4 e.g. 192.0.2.17 (32 bits)
- IPv6 e.g. 2001:db8:0:1234:0:567:8:1 (128 bits)

How to make sure IPs are unique?

- We need a coordinator



Jon Postel
(1943-1998)
“The Internet Assigned Numbers Authority (IANA)”

Where are the RIRs?

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What is RIPE NCC?

- RIPE Network Coordination Centre
- Established in 1992
- Independent, not-for-profit, membership organisation
- One of the five RIRs (Regional Internet Registry)
- Serving Europe, the Middle East, parts of Central Asia
- Around 190 staff based in Amsterdam and Dubai

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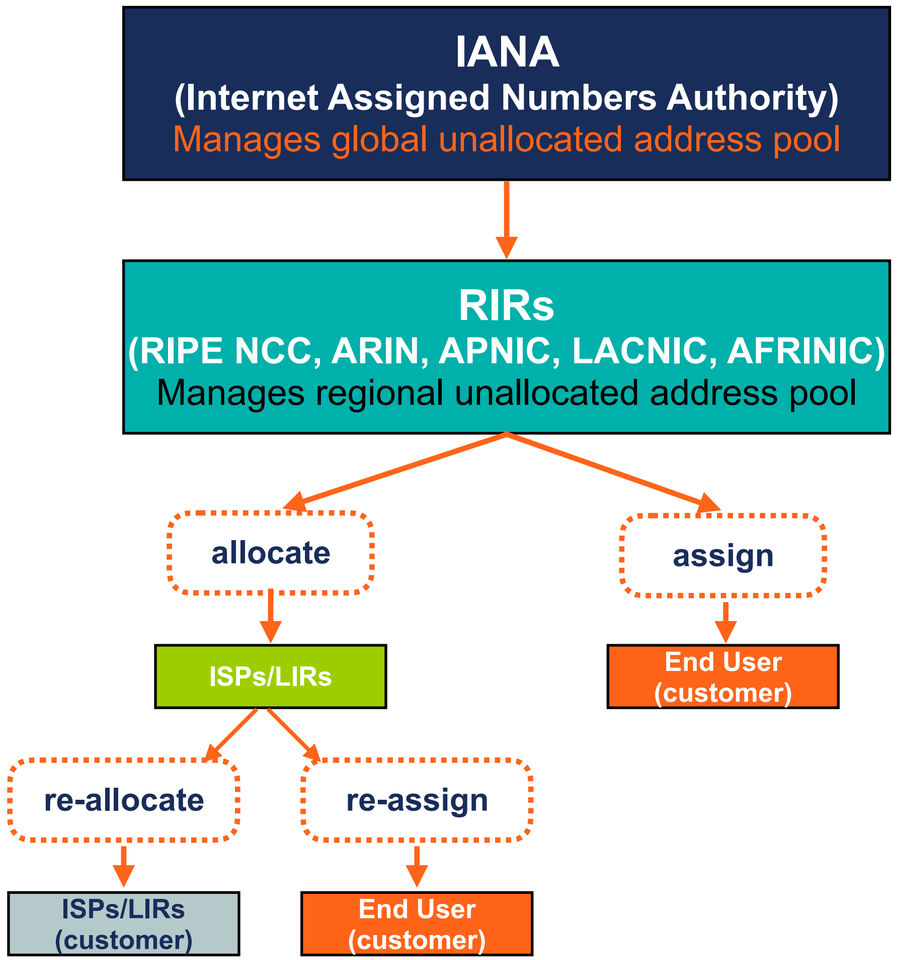
What is an RIR?

- A Regional Internet Registry (RIR) manages the allocation and registration of Internet number resources in a particular region of the world and maintains a unique registry of all IP numbers issued.
- Number resources include:
  - IP addresses (IPv4 and IPv6)
  - Autonomous System (AS) Numbers

Core RIPE NCC Functions

- Receive large IP address blocks from IANA
  - Distribute those in smaller blocks to its members
  - Publish and maintain a list of who has which block
  - Implement the rules (policies) set by the RIPE community
- Support the infrastructure of the Internet through technical coordination
- Provide services for the benefit of the Internet community at large



What is in the RIPE Database?

- Registration information about
  - IP addresses and AS Numbers issued by the RIPE NCC
  - IP addresses and AS Numbers issued prior to the establishment of the RIRs (legacy space)
  - Original registration date
  - Organisations that hold these resources (ORGs)
  - Points of Contact for resources or organisations (POCs)
  - Customer reassignment information (from ISPs to their customers)
  - Referential information to the authoritative RIR

www.metu.edu.tr
144.122.145.153

Responsible organisation: Middle East Technical University
Abuse contact info: abuse@metu.edu.tr

```
inetnum:        144.122.0.0 - 144.122.255.255
netname:        METU-NET
descr:          Middle East Technical University(METU)
descr:          Computer Center
descr:          Ankara
country:        TR
org:            ORG-METU1-RIPE
admin-c:        MH4497-RIPE
tech-c:         MH4497-RIPE
status:         LEGACY
mnt-by:         AS1967-MNT
mnt-domains:    AS1967-MNT
mnt-irt:        irt-METU-NET
created:        2002-03-04T13:03:43Z
last-modified:  2019-12-04T13:09:45Z
source:         RIPE
```

What is not in the RIPE Database?

- Domain names
- Certain customer reassignments
  - Example: private residence
- Accurate geographic location of the network or end user customer

What is the RIPE community?

- Réseaux IP Européens
- Established in 1989
- Open, inclusive, bottom-up, transparent
- Responsible for making policy, sharing information and best practices
- RIPE structures:
  - Working groups
  - Mailing lists
  - RIPE Meetings

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The RIPE community

- Join the mailing list!
  - https://www.ripe.net/mailman/listinfo/ripe-list/
- Public archives
- Work is structured around:
  - Working Groups (WGs)
  - Task Forces (TFs)

Working Groups

- Address Policy
- Anti-Abuse
- Connect
- Cooperation
- Database
- DNS
- IPv6
- Measurements & Tools (MAT)
- Open Source
- The Internet of Things (IoT)
- RIPE NCC Services
- Routing

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RIPE Chair Team

- The role of the RIPE Chair is to ensure the smooth functioning of the RIPE community
- There is a RIPE Chair and Vice Chair:
  - Mirjam Kühne, RIPE Chair
  - Niall O’Reilly, RIPE Vice Chair

RIPE Policy Development

- Process described in document ripe-642
- Decisions based on mailing list discussion
  - Face to face meetings help
- Rough Consensus
  - Properly address all concerns and objections
  - Work out differences
  - No voting or counting

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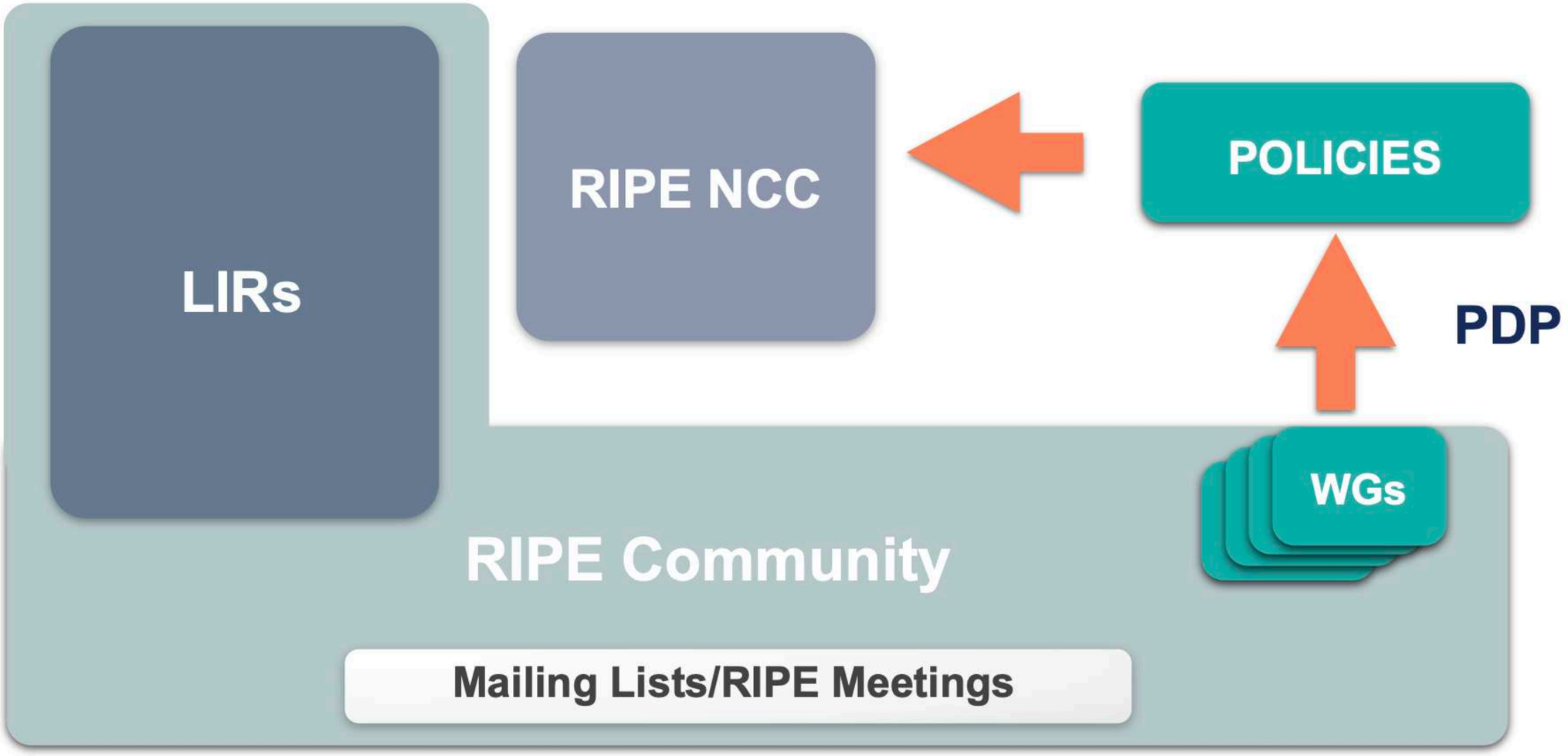
The Bottom Up Model



Benefits of a Regional Approach

- We are very close to our users (stakeholders)
  - Easier communication
  - Easier to maintain accurate registry
- Policies can adapt to regional differences
  - Different stages of Internet development
  - Different priorities amongst stakeholders
- Overlap exists between community members
  - All policy development is open to everyone
  - No requirement to be from inside the region

Participate in the PDP

- Stay up-to-date with new policies
- Sign up for the Policy Announce mailing list
  - https://www.ripe.net/mailman/listinfo/policy-announce/
- Join in discussions about policy proposals
  - https://www.ripe.net/community/wg/
- Propose a new policy

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Who does what?

- The RIPE community
  - Creates and discusses proposals
  - Seeks consensus
- RIPE Working Group (WG) chairs
  - Accept proposals
  - Chair the discussions
  - Decide if consensus has been reached
- The RIPE NCC
  - Acts as the secretariat to support the process
  - Publishes policy documents and implements them

What is a RIPE Meeting

- Five-day event where ISPs, network operators and other interested parties gather to
  - Discuss **policies and procedures** to allocate IP addresses and ASNs
  - **Discuss** current technical and policy issues
  - **Share** experiences, latest developments and best common practices
  - **Network** with peers
- Usually held twice a year

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Join us onsite or online for RIPE 89

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Online Learning

- Online Webinars: ripe.net/support/training/webinars/webinar-recordings
- RIPE Academy: academy.ripe.net

Internet Governance

Learn how the Internet is governed and how you can be part of the process!

BGP Security

BGP is vulnerable. Analyse the threats to BGP and learn about the recommended security measures to protect your network against accidental and malicious misconfigurations.

IPv6 Security

Keep your IPv6 network secure. Learn to design a high-level strategy to protect your IPv6 infrastructure against common threats.

IPv6 Fundamentals

Get started with IPv6. You will learn how IPv6 addresses work, how to subnet, best-practices and IPv6-related RFCs among other topics.

RIPE Database

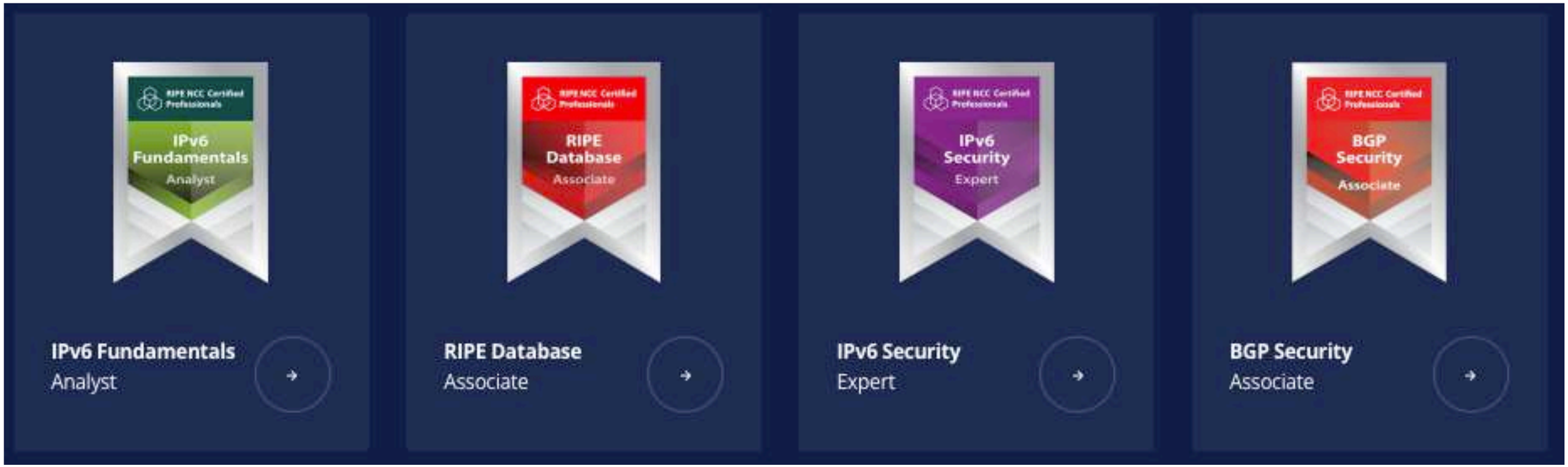
Learn how the RIPE Database works. Practise querying, creating and updating objects. Understand database best-practices and more.

Microlearnings

Learn about the mechanisms that make the Internet work.

Online Learning

- RIPE NCC Certified Professionals: ripe.net/support/certified-professionals
- Write to exams@ripe.net if interested



IPv4 and IPv6

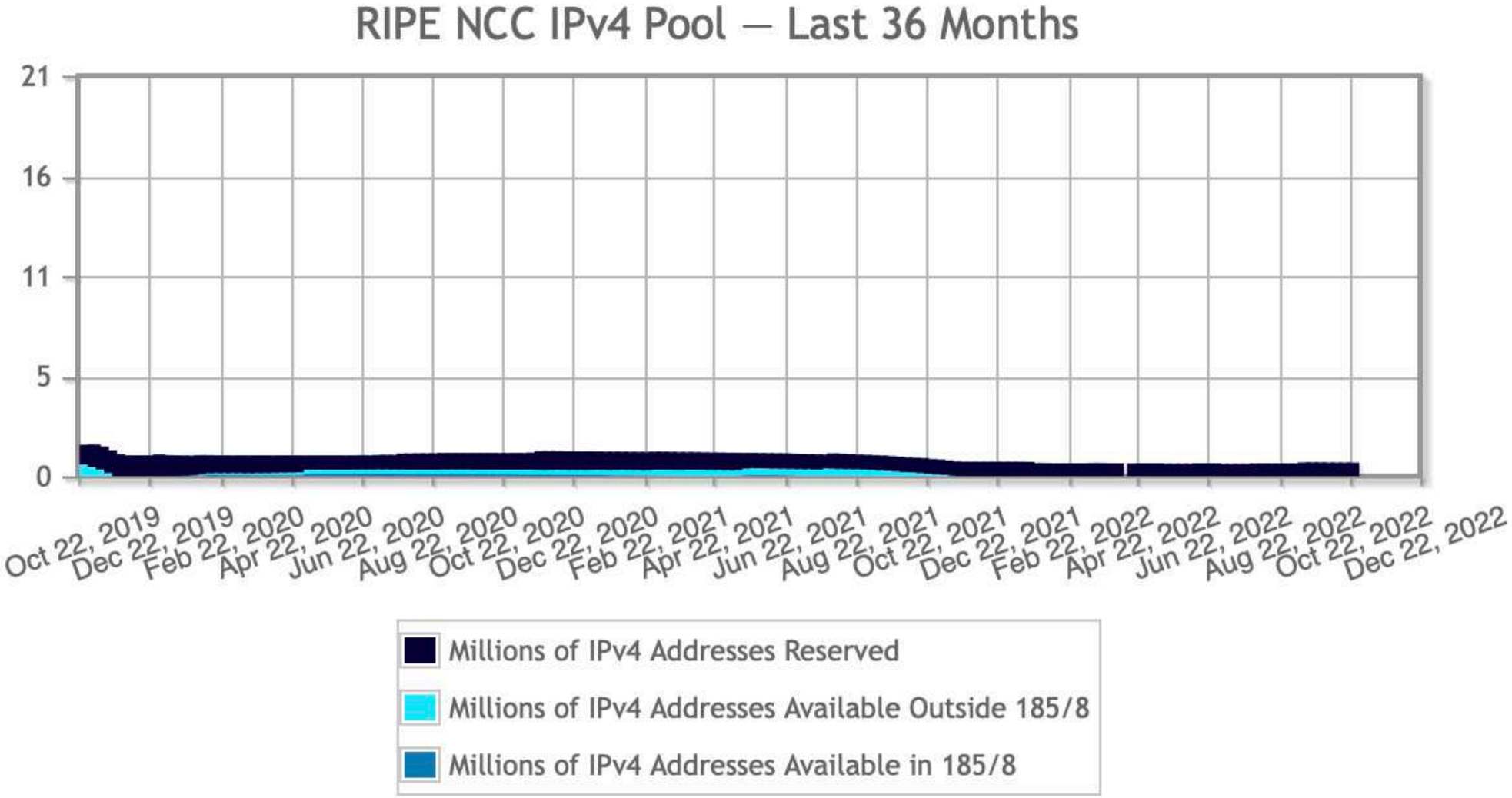
Internet Protocol (IP) Address

- The currently used IPv4 only has 4.2 billion addresses
- IPv6 functions the same as IPv4
  - “Same cardboard box, slightly bigger label on it”
- Address is 128 bits long (IPv4 uses 32 bits)
  - 2^128 addresses available
  - 340282366920938463463374607431768211456 options
- Example:
  - IPv4: 192.0.2.53
  - IPv6: 2001:0db8:582:ae33::29

IPv6 and IPv4 are not interoperable

- Design feature, not a bug; easier to deploy
- You can use both protocols at the same time on the same network without interference
- You can “retrofit” IPv6 onto existing networks without breaking or removing IPv4
- Computers which have both can choose to use either IPv4 or IPv6

RIPE NCC’s IPv4 Address Pool



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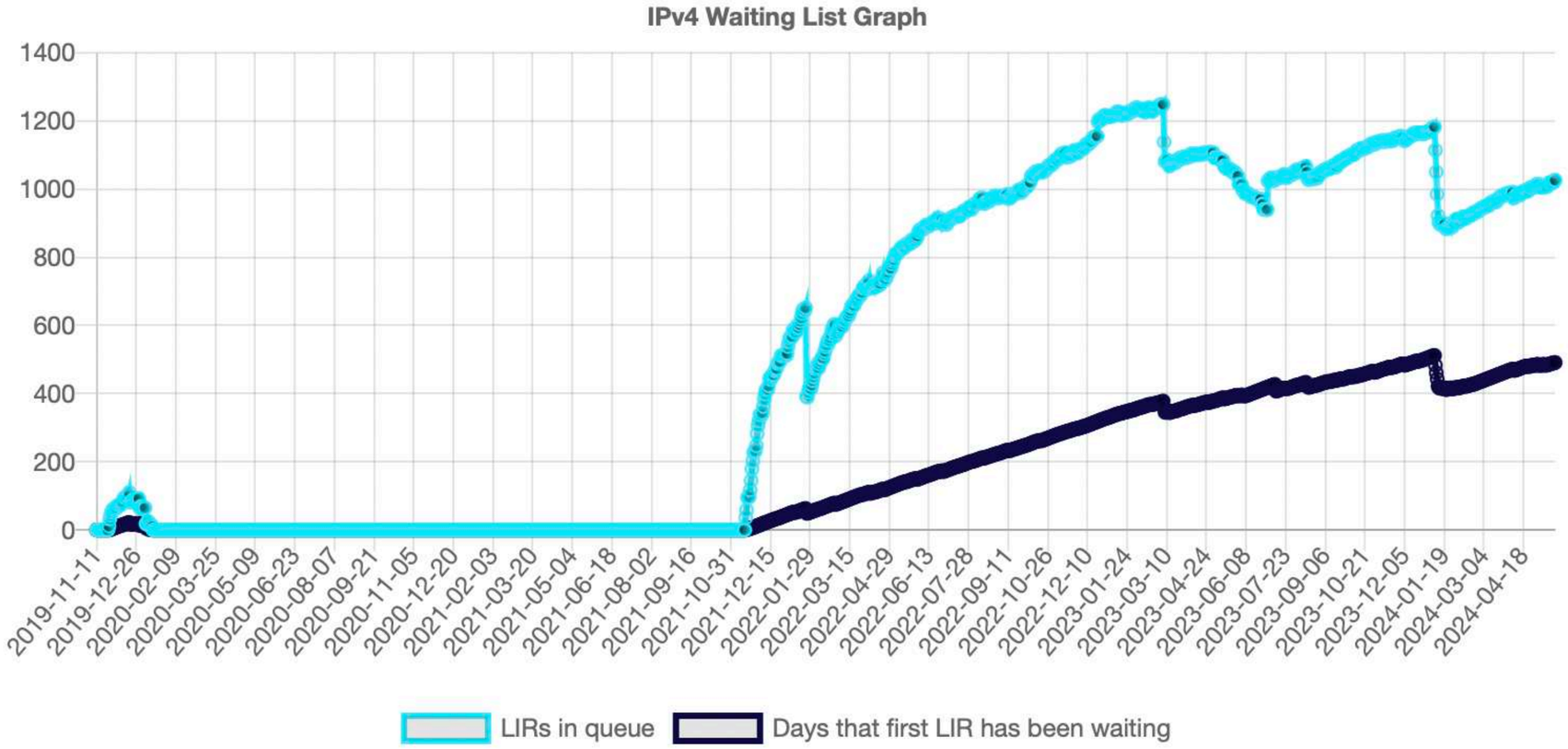
Still Recovering Some IPv4 bits

- From organisations that have gone out of business
- From closed LIR accounts
- From networks that return addresses they no longer need

The Waiting List

- LIRs that have submitted an IPv4 request can see their position on the waiting list in the LIR Portal



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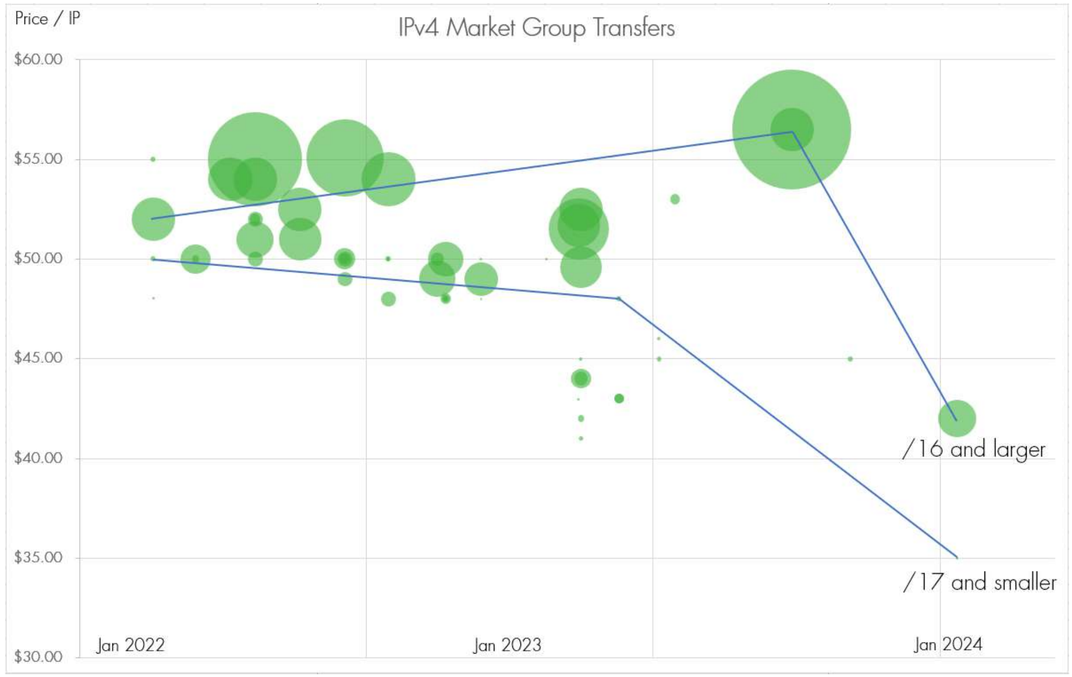
The Waiting List

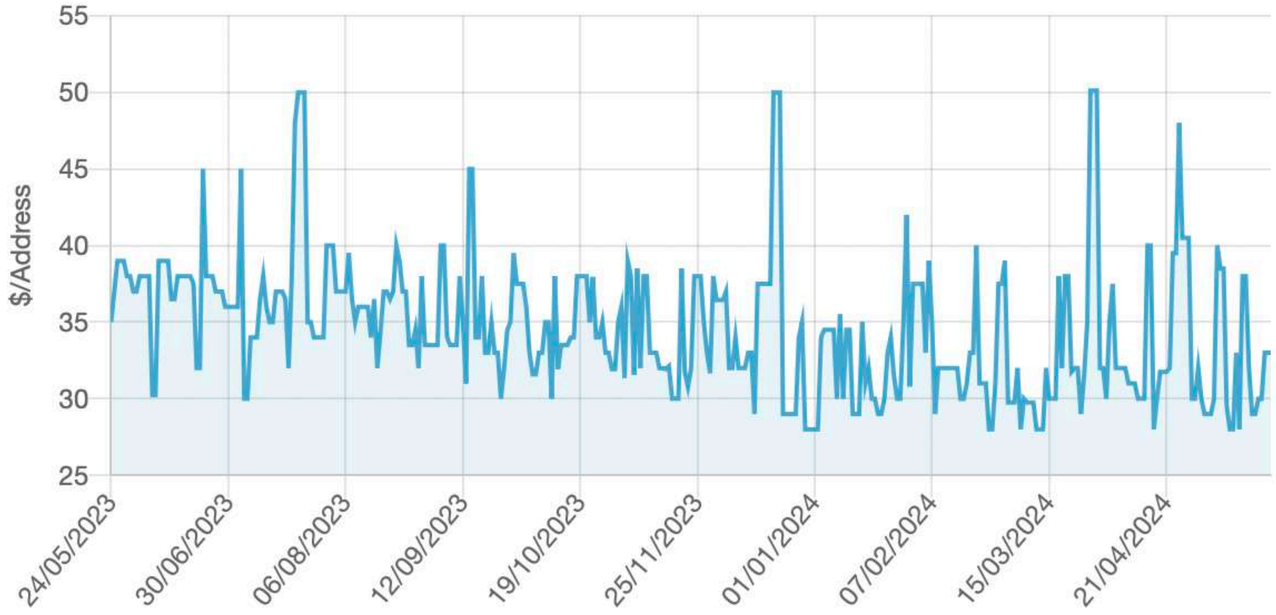
Only LIRs that have never received an IPv4 allocation from the RIPE NCC (of any size) may request addresses from the waiting list, and they are only eligible to receive a single /24 allocation.

That’s 256 addresses…

IPv4 Transfer Market

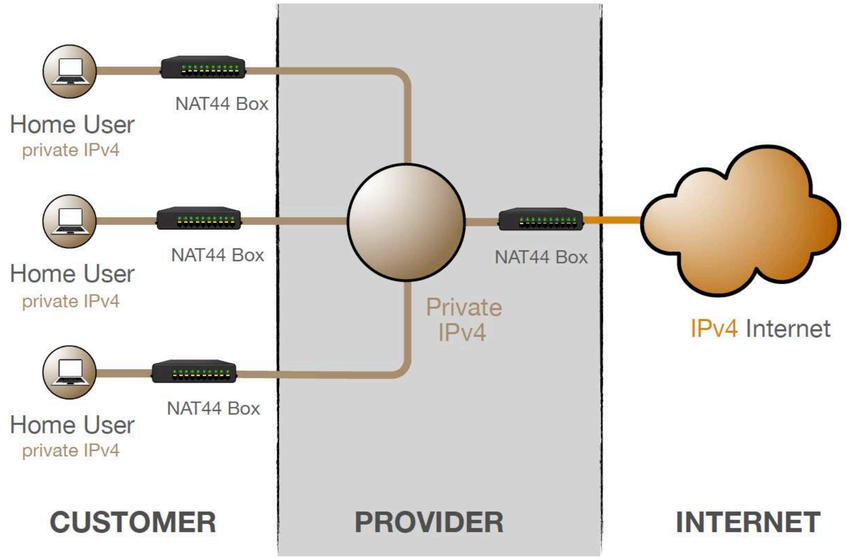
- $35-$55 depending on the size of the block
- Increase of demand
- Big blocks are becoming scarce



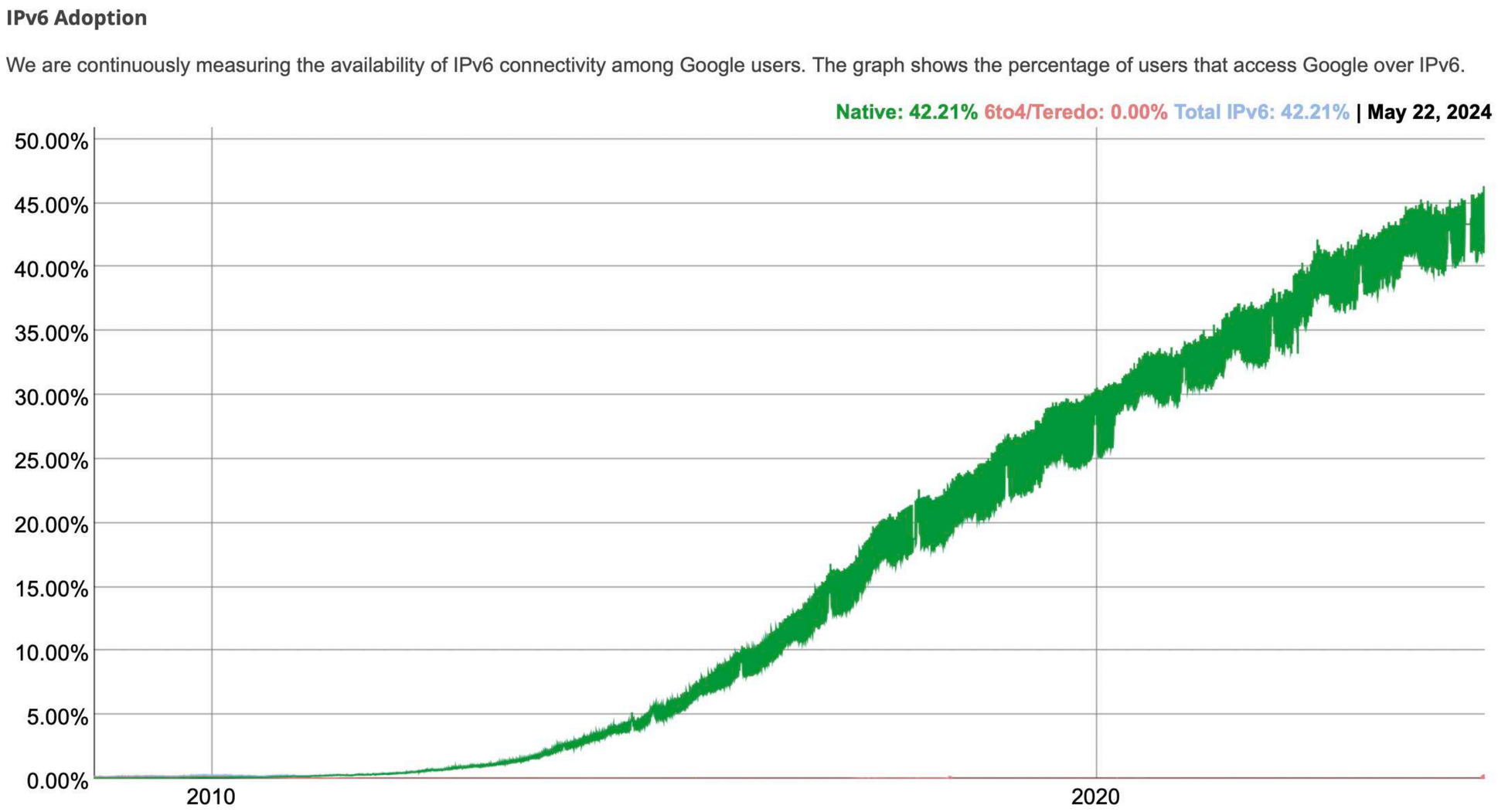


Network Address Translation (NAT)

- Instead of one IPv4 address per customer
  - Share a single IPv4 address with multiple customers
  - Internal addresses only have to be unique locally
  - Common amongst mobile network operators
- However:
  - Breaks the end-to-end connectivity model of the Internet
  - Inhibitor to “permissionless innovation”
  - NATs are expensive to scale
  - Difficult for law enforcement to identify people behind IPs



IPv6 Adoption



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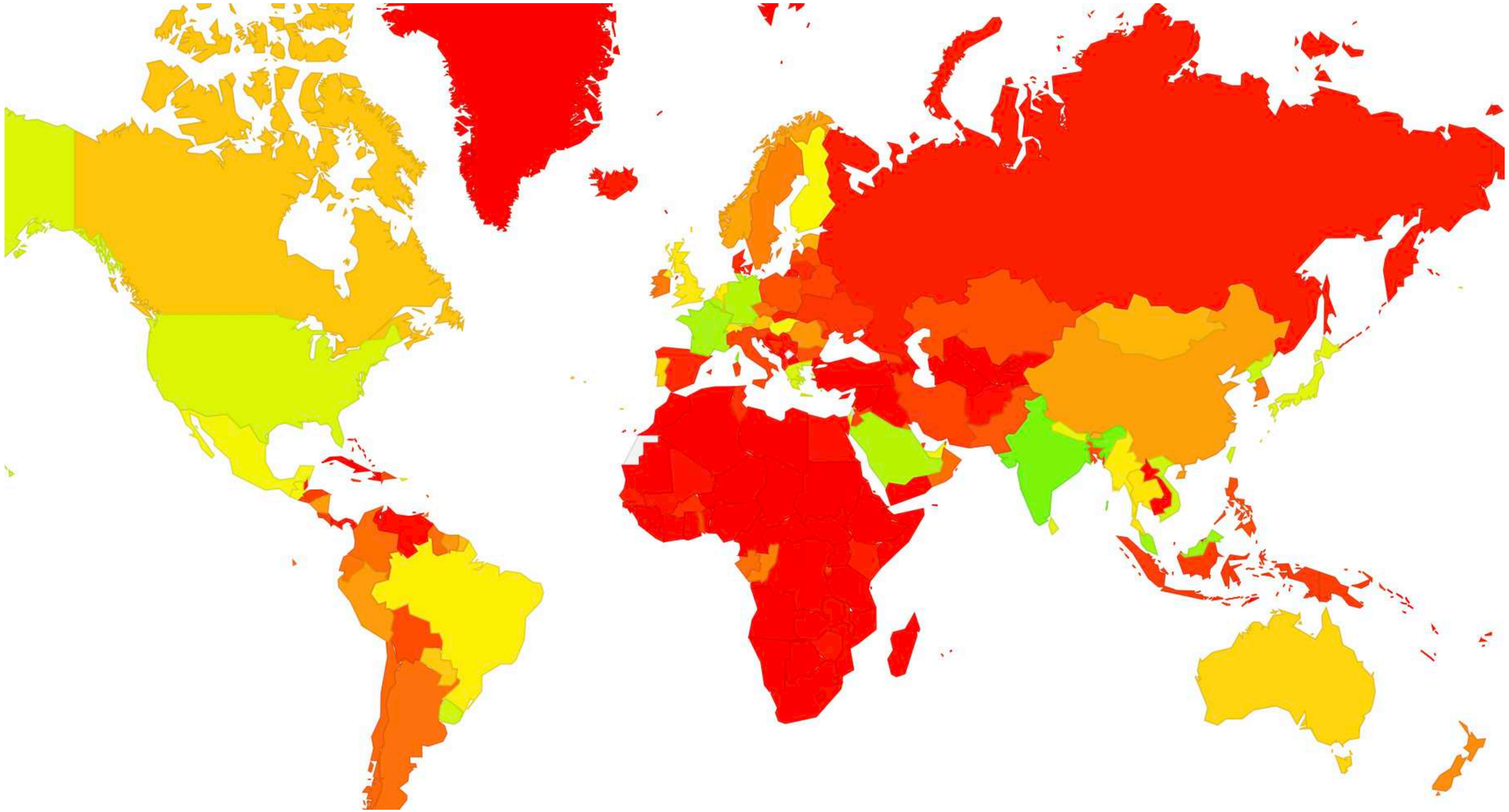
IPv6 Adoption



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Top countries

CC	Country	IPv6 Capable	IPv6 Preferred
IN	India, Southern Asia, Asia	79.56%	78.82%
MY	Malaysia, South-Eastern Asia, Asia	70.87%	67.42%
FR	France, Western Europe, Europe	68.18%	67.80%
BE	Belgium, Western Europe, Europe	66.94%	66.42%
DE	Germany, Western Europe, Europe	65.92%	65.39%
SA	Saudi Arabia, Western Asia, Asia	65.84%	64.72%
VN	Vietnam, South-Eastern Asia, Asia	60.11%	58.15%
UY	Uruguay, South America, Americas	59.88%	59.72%
TW	Taiwan, Eastern Asia, Asia	58.86%	49.46%
GR	Greece, Southern Europe, Europe	57.80%	57.58%

Why the hold up?

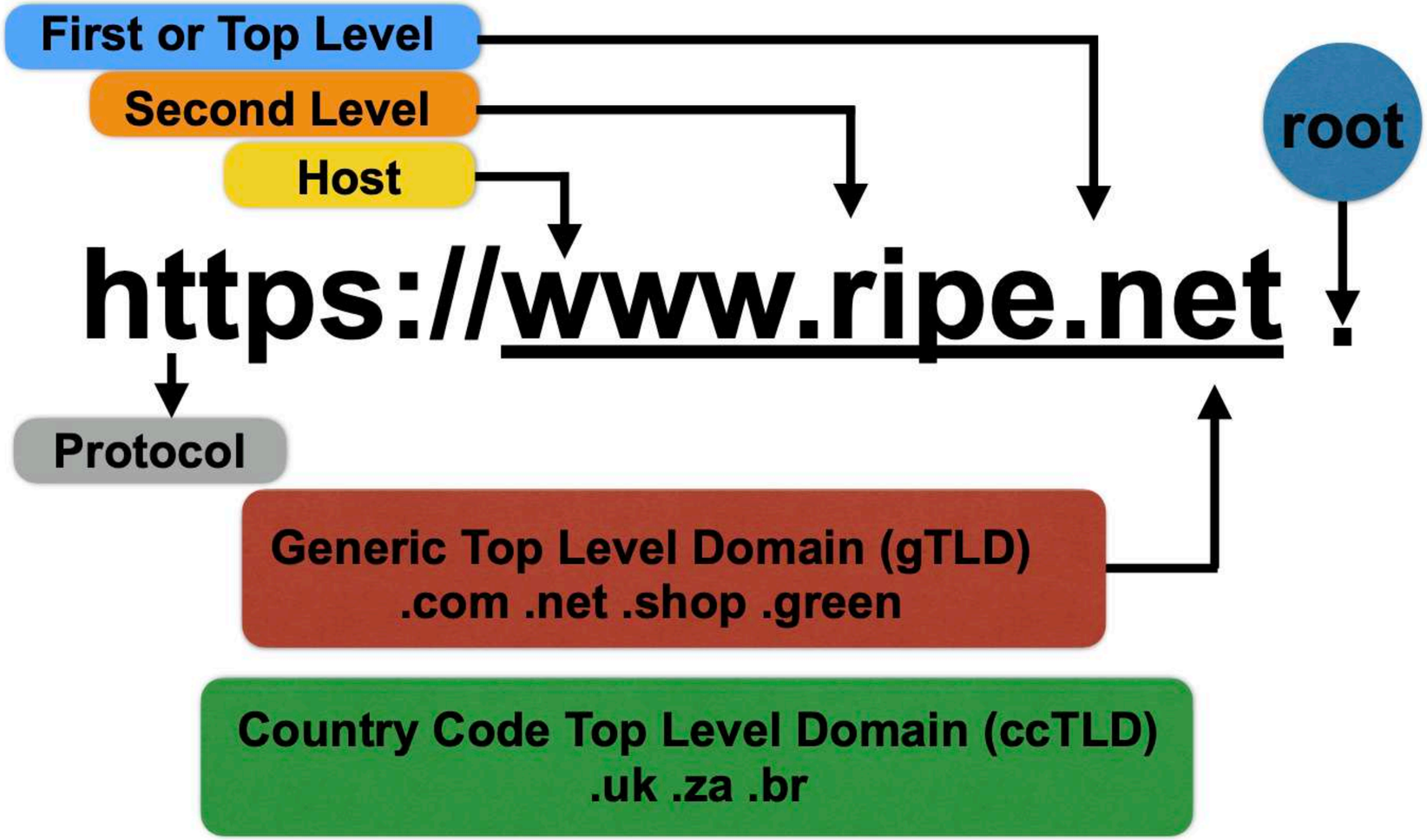
- “We still have enough” or “We use NAT”
- Old equipment
- Lack of expertise
- Lack of management buy-in
- A lof of content is still on IPv4
- Wait until bugs and errors have been solved
- Wait until best practises have been developed

Names

What is DNS?

- People can’t remember numbers, so we use names
  - Uniform Resource Locator (URL)
- DNS
  - A naming system for computers, services and other resources
  - Translates the easy-to-remember domain names to the numerical IP addresses
  - Hierarchical and decentralised

The Anatomy of a Domain



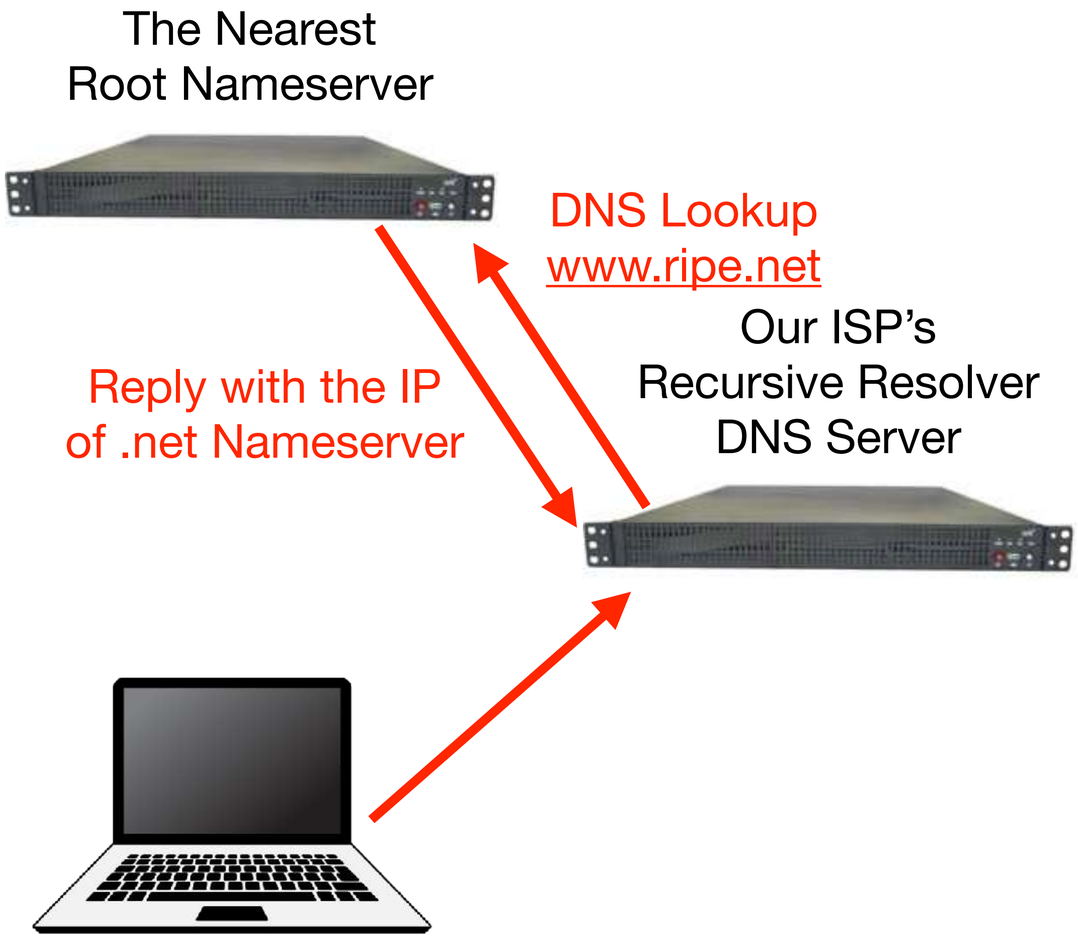
How does DNS work?

The Nearest
Root Nameserver

Our ISP’s
Recursive Resolver
DNS Server

Domain Name Lookup
to resolve www.ripe.net

How does DNS work?



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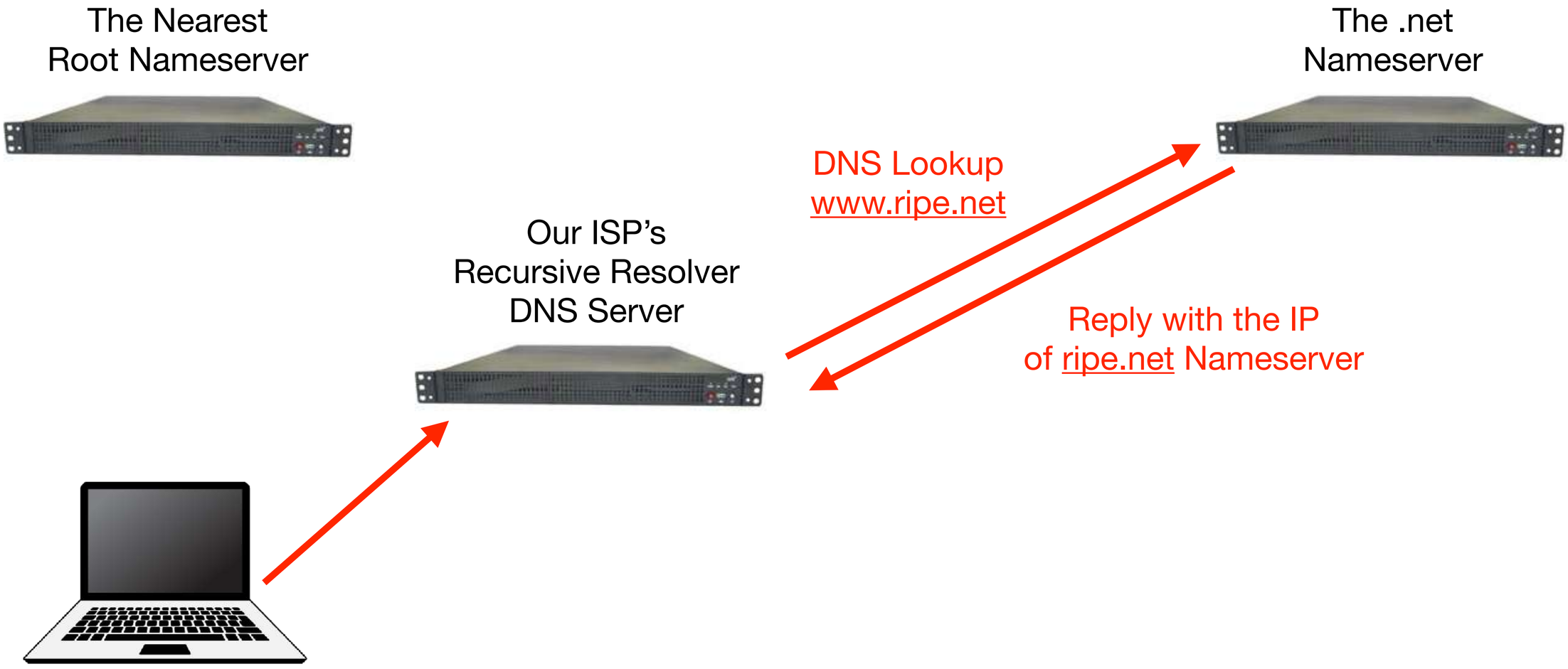

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How does DNS work?

The Nearest
Root Nameserver

The .net
Nameserver

Our ISP's
Recursive Resolver
DNS Server

DNS Lookup
www.ripe.net

Reply with the IP
of www.ripe.net

The ripe.net
Nameserver

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How does DNS work?

The Nearest
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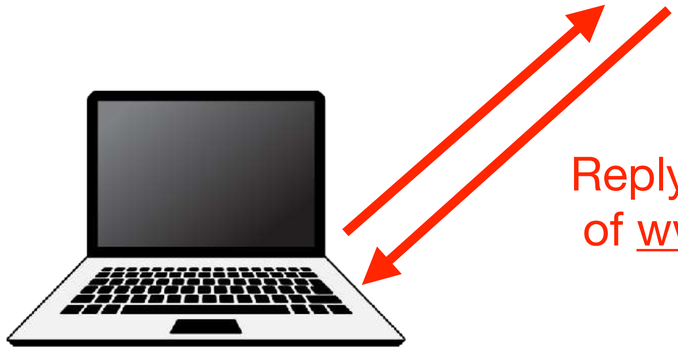

Reply with the IP
of www.ripe.net

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How does DNS work?

The Nearest
Root Nameserver

The .net
Nameserver

Our ISP's
Recursive Resolver
DNS Server

The ripe.net
Nameserver

WWW
Host

HTTPS request to web server by IP address

HTTPS reply to content of web page

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Root Server Instances

The 13 root name servers are operated by 12 independent organisations.

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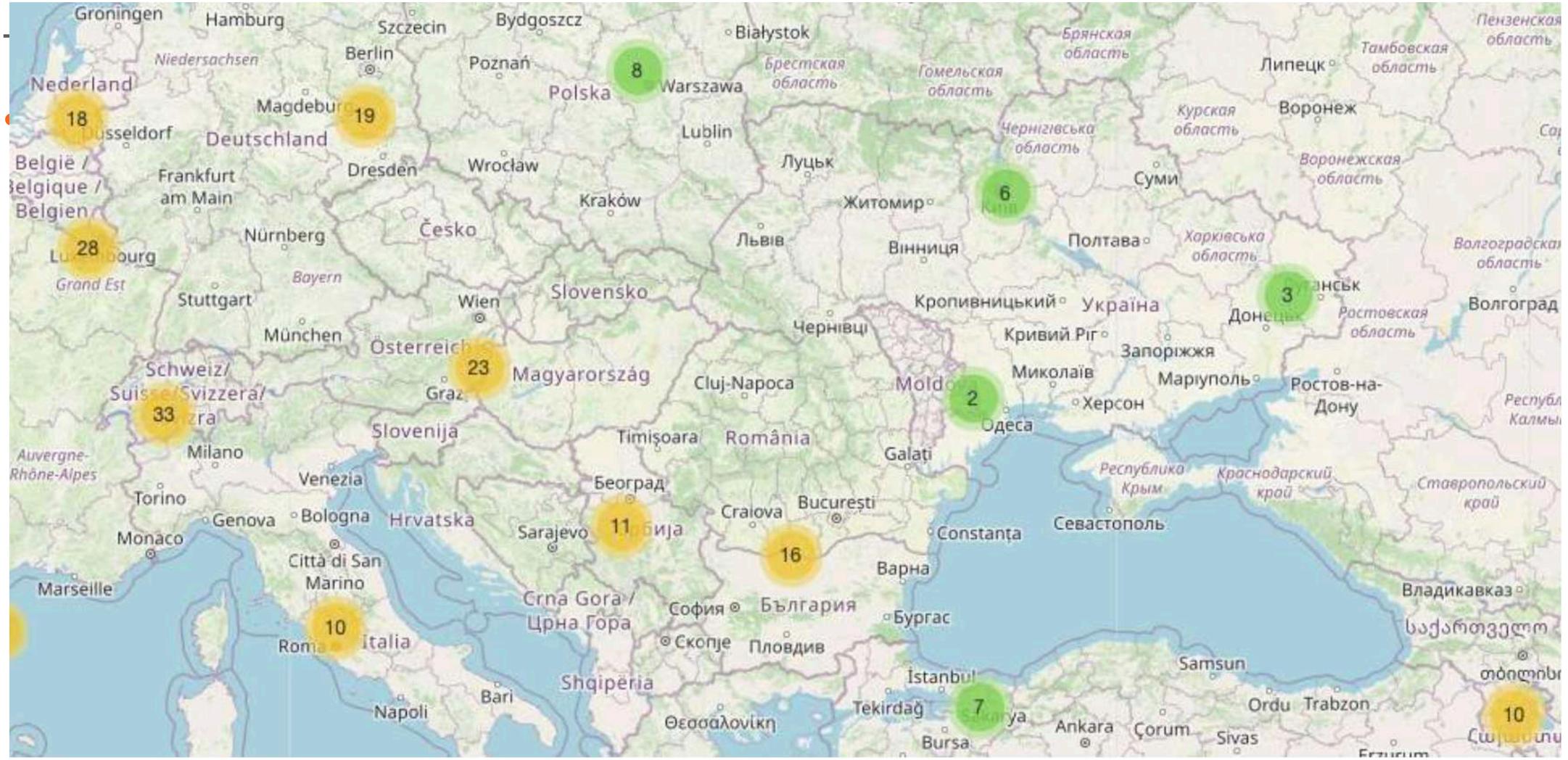
Root Server Instances



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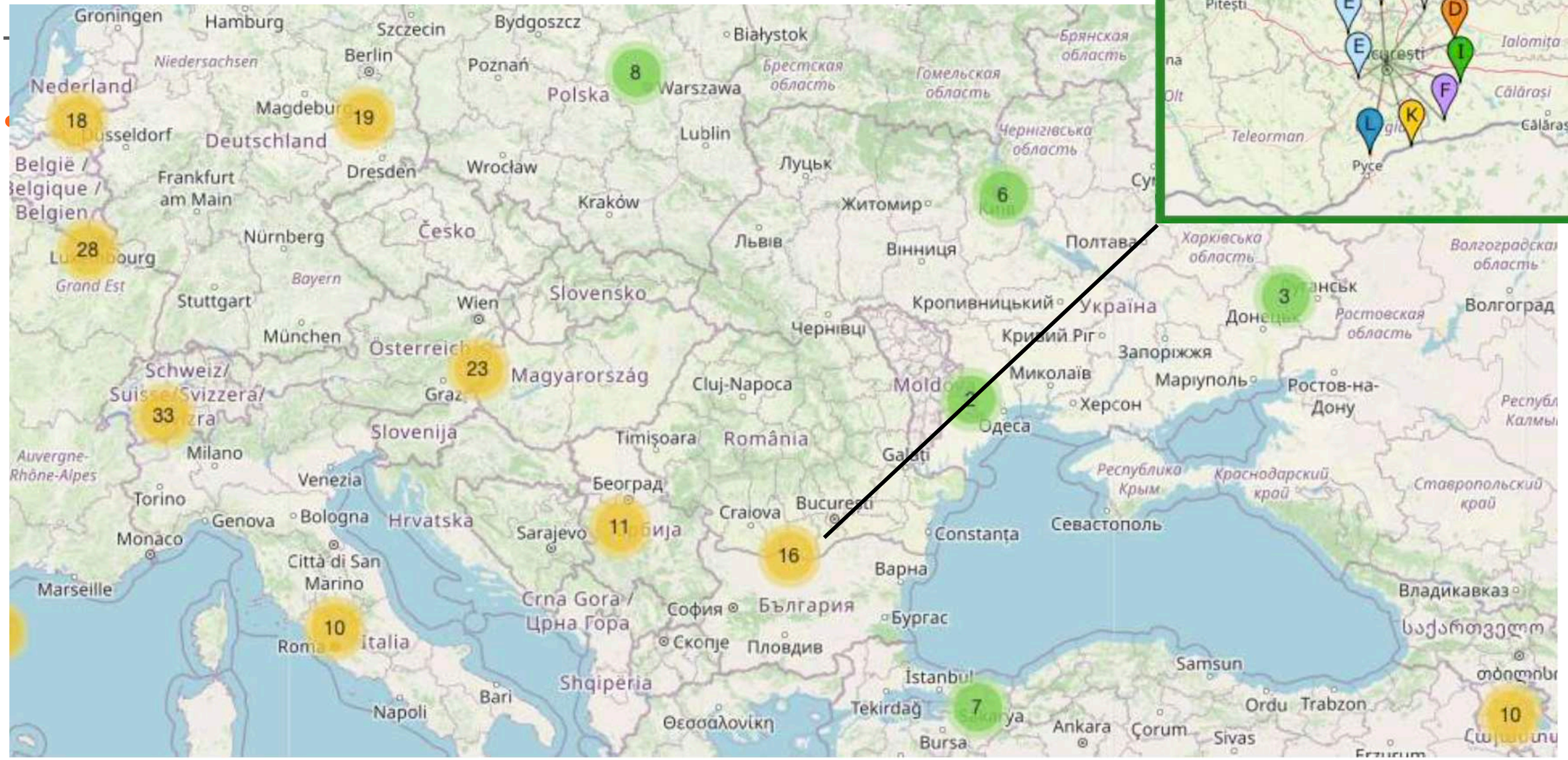
Root Server Instances



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More resources

ccTLDs and online content explained:

- https://www.centr.org/education/cctld-registry.html (scroll down)
- By CENTR (Council of European National Top-Level Domain Registries)

Regulation

Regional Approaches

- The EU supports the multistakeholder approach
  - But: recent push for digital autonomy
- The Middle East and Russia have the traditional top-down mentality
  - But: have eagerly included us in their meetings and participated in our roundtables
- South East Europe and Central Asia follow neighbouring big players
  - We work to build relationships and nurture their communities

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Example 2020: NewIP

- Chinese (Huawei) proposal for an alternative, hierarchical (top-down) architecture of the Internet
- Aims to give control to the core of the network instead of leaving it to the end points
- Eventually could replace TCP/IP
- End to the open, distributed model, end to permissionless innovation

Example 2020: NewIP

Internet Community and IETF not interested to standardise

They took it to the ITU

Opportunity to change the governance and put states in control

We submitted a formal contribution, we did not agree

Alerted friendly member states about the risks

A large number of countries agreed and saw the risks

They grouped together via CEPT, UK built large coalition

Industry, GSMA and ETNO joined to show benefit of multi-stakeholder model

The joined effort put the discussion to rest (for now)

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Questions

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