AIORI 3

FDP - Part 1

To conduct annual skill development workshops and hackathons that strengthen India's internet infrastructure resilience and build a self-reliant supply chain of technical talent, limiting the country's exposure to externalities.

- AIORI Team

INDIA INTERNET FOUNDATION

Advanced Internet Operations Research in India

Agenda

Time	Span	Agenda
19:30 - 19:45	15 mins	Inaugural Session
19:45 - 20:30	45 mins	- The Internet Way of Networking - Internet Architecture & Ecosystem - Core Internet Protocols - Internet Standards & Governance - Internet Operations - Introduction to Internet Measurement - Performance, Edge Computing & Availability - Internet Security & Operational Best Practices
20:30 - 20:45	15 mins	- Measurement Platforms - AIORI Showcasing - AIORI Tools & Platform Overview
20:45 - 21:00	15 mins	Question Answering Session

The Flow

History

Internet Architecture

Infrastructure

Governance

Aiori

History

1960s

Advanced Research Projects Agency

A universal network for sharing computer resources

Packet Switching

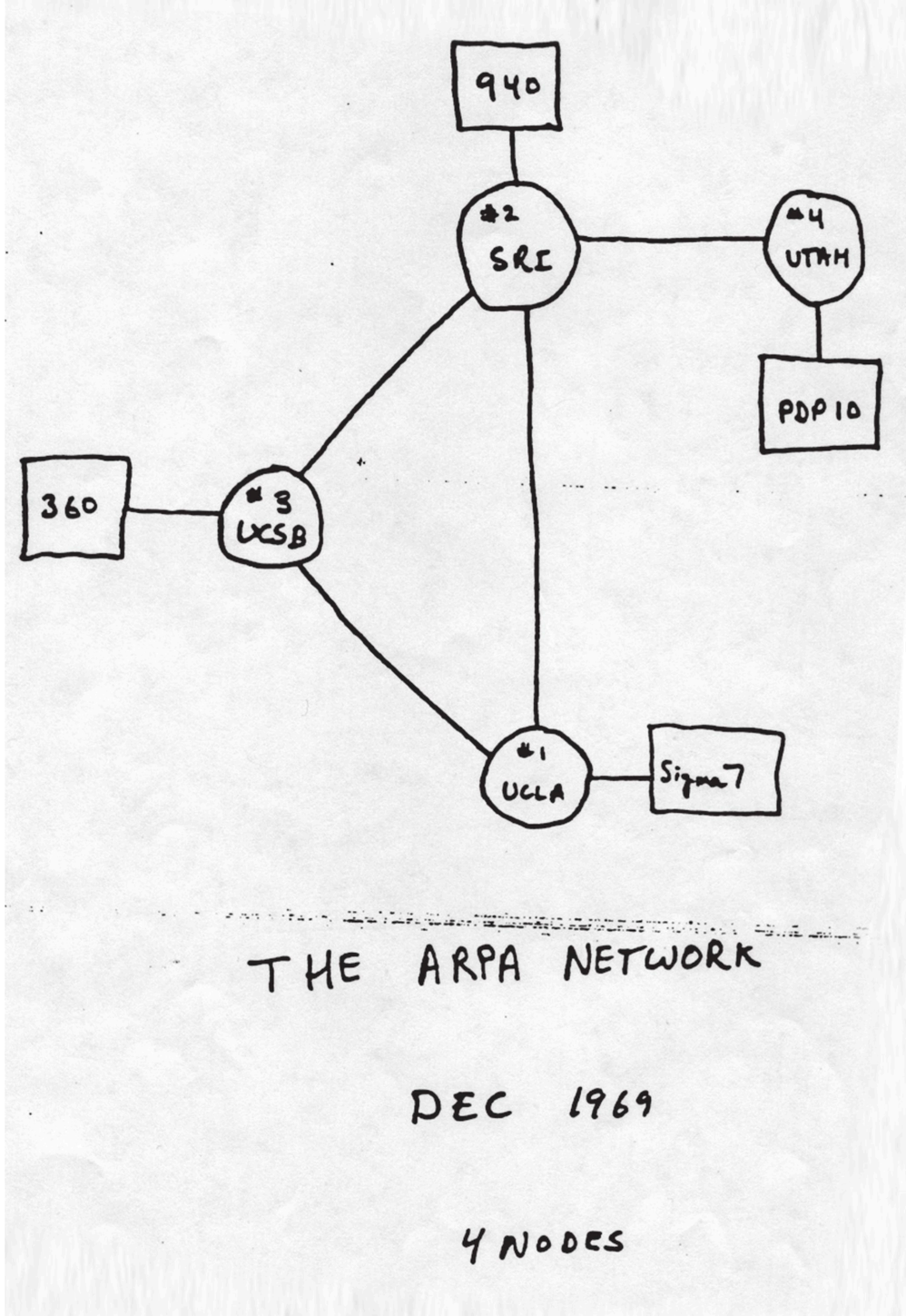
Circuit Switching

1970s

A sketch of the ARPANET in December 1969.

The nodes 1-4, and computers:

- SDS Sigma 7 at UCLA
- SDS 940 at Stanford Research Institute (SRI)
- IBM 360/75 at UCSB
- PDP-10 at University of Utah



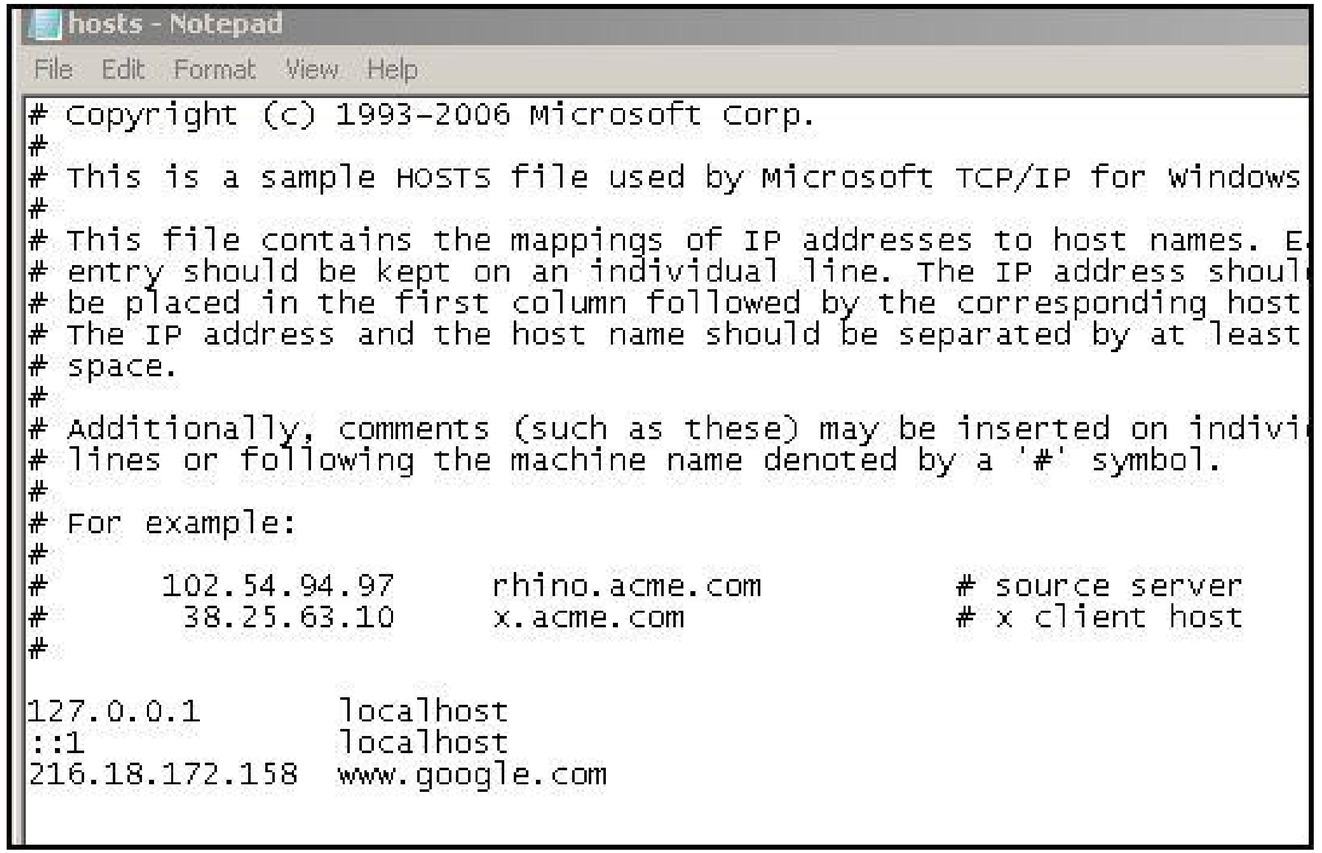
1970s

Vint Cerf and Bob Kahn, published their research on **inter-net**working in 1974 in Internet Experiment Note

TCP / IP

HOSTS.TXT

Stanford Research Institute manually maintained a HOSTS.TXT to map IP to Hostnames

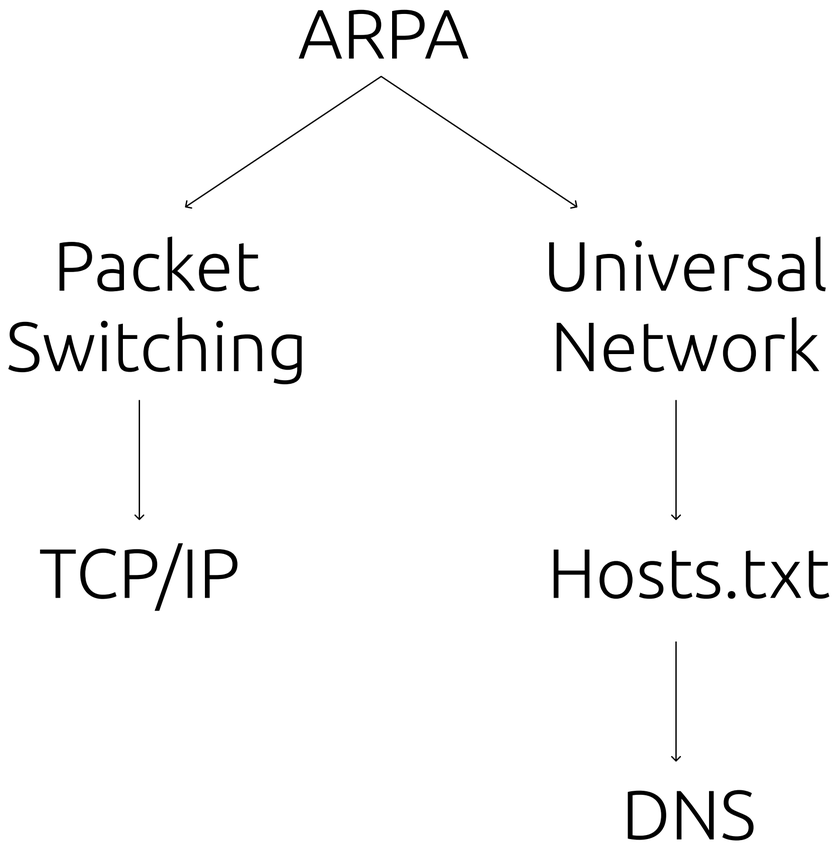


1980s

By 1980s, it became the hosts.txt file became a huge flatfile, becoming a bottleneck.

In 1983, Jon Postel asked Paul Mockapetris to find a compromise between 5 possible alternatives.

DNS



~~History~~

Internet Architecture

Infrastructure

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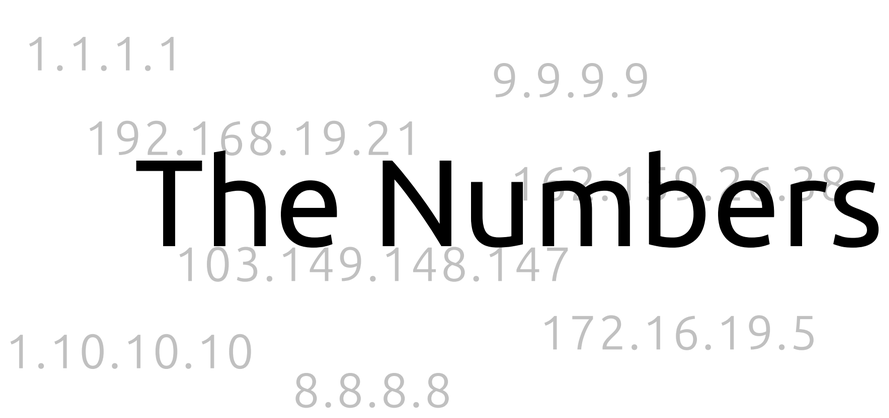
Aiori

Internet Architecture

Internet


1.1.1.1
9.9.9.9
192.168.19.21
The Numbers
103.149.148.147
1.10.10.10
172.16.19.5
8.8.8.8


bank.in
iana.org
net
darkwall.co.in
example.com
The Names
com
us-east-1.console.aws.amazon.com
en.wikipedia.org
google.com

Internet - Names & Numbers

1.1.1.1

9.9.9.9

192.168.19.21

162.159.26.38

103.149.148.147

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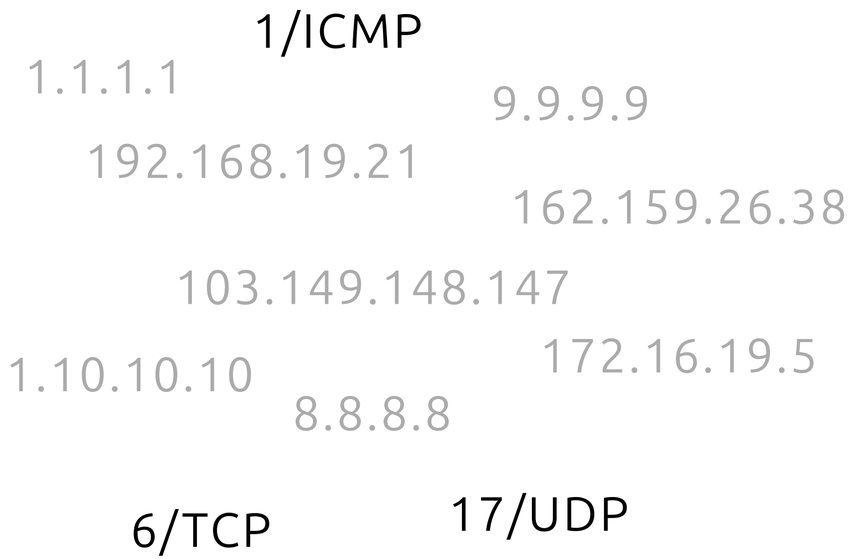
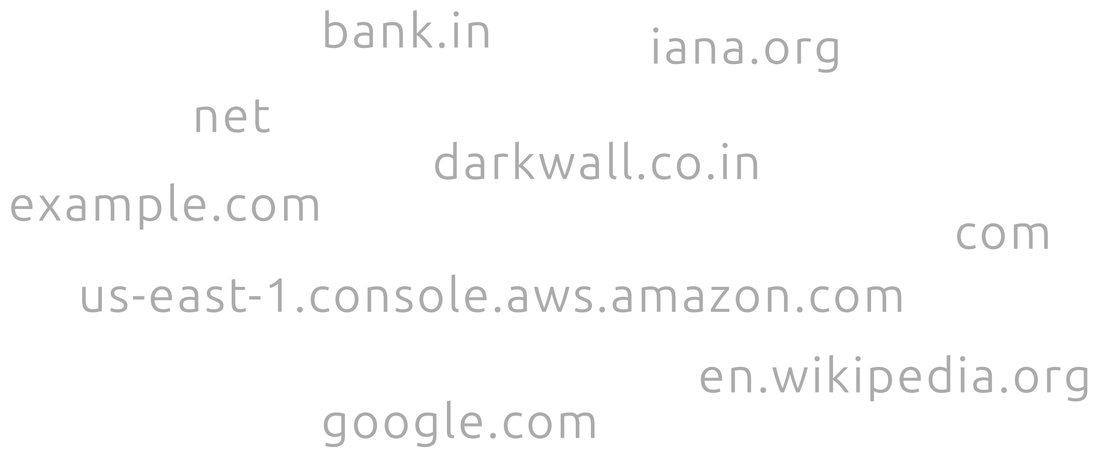
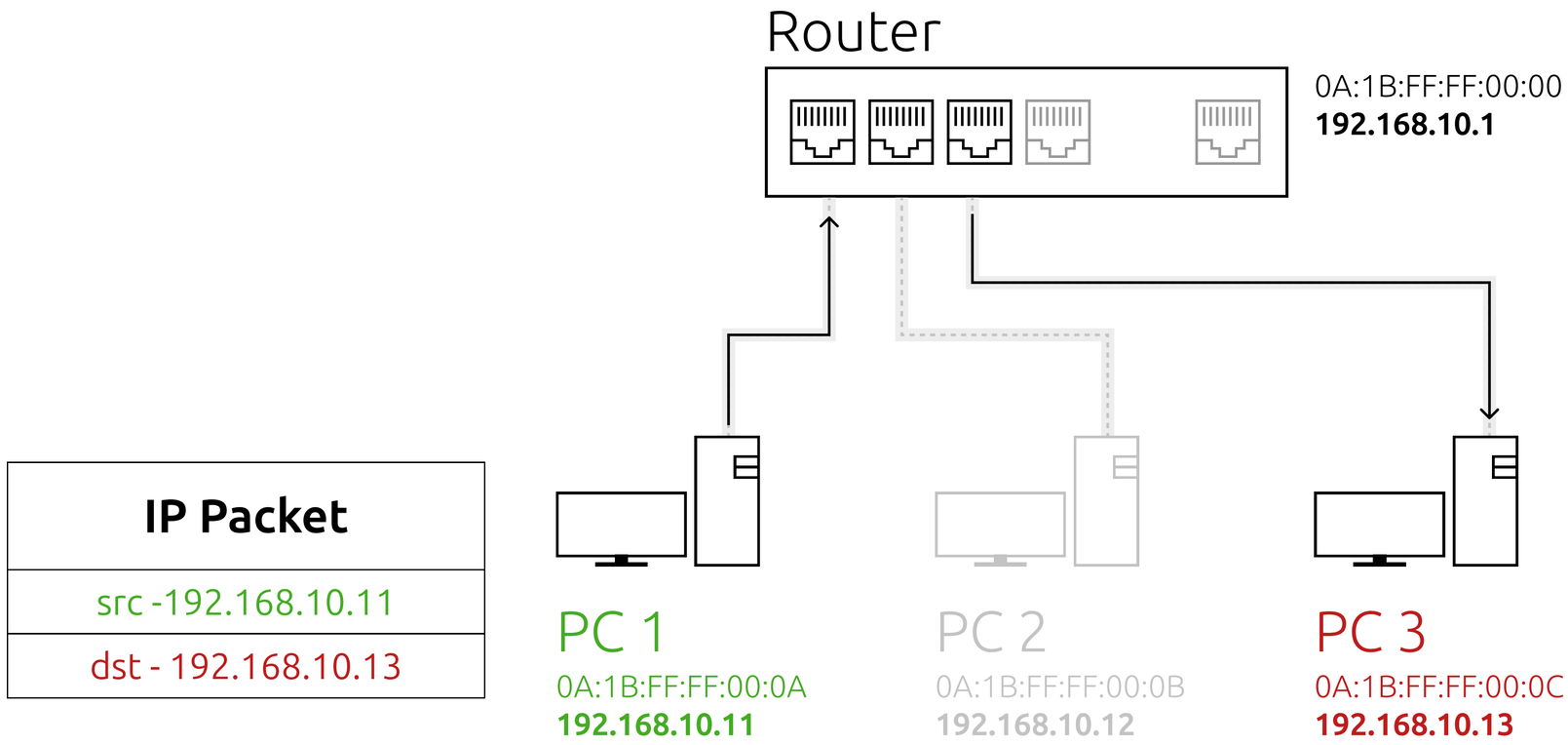
Internet - Names & Numbers

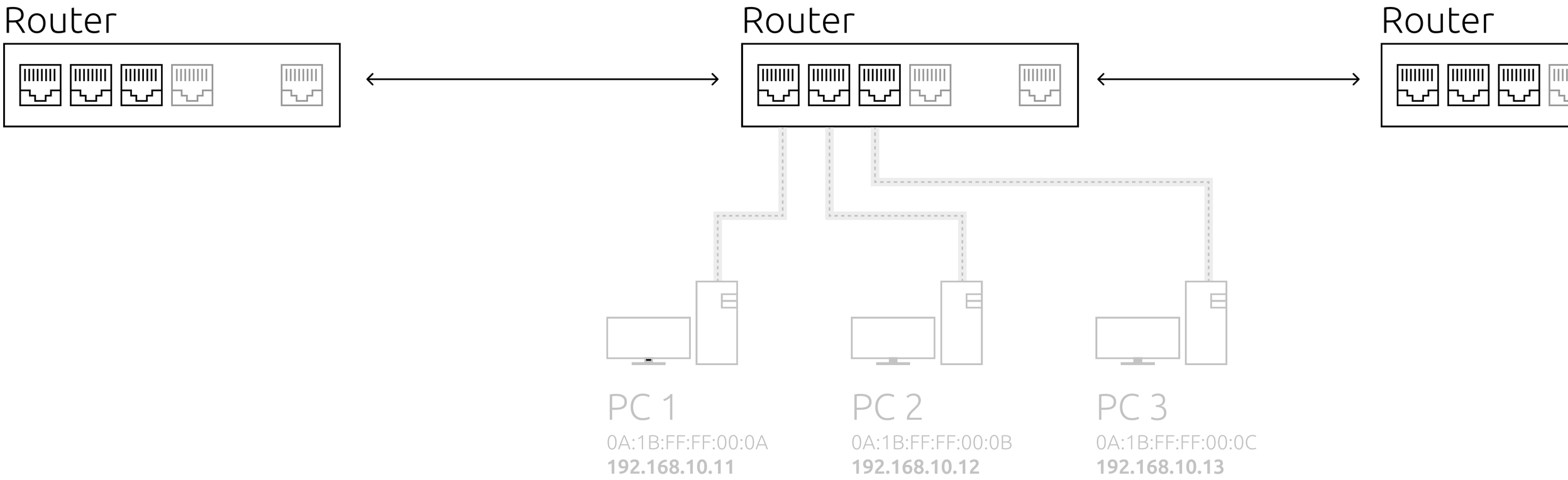




Internet - IP Address & Local Network



Internet - IP Address & Local Network



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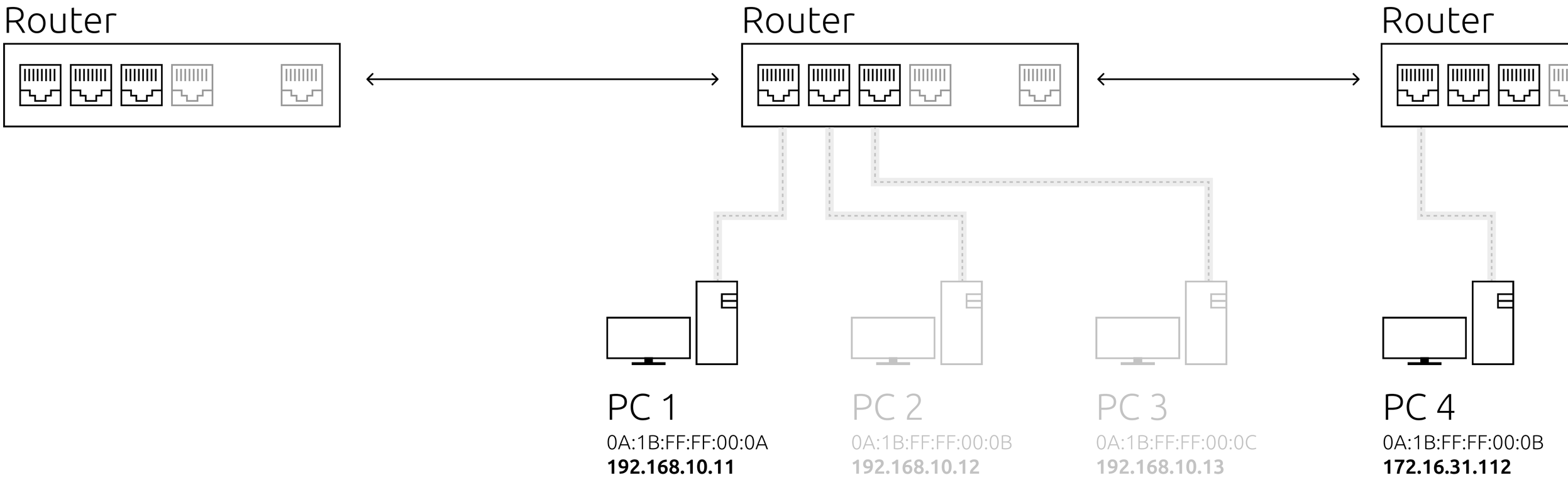
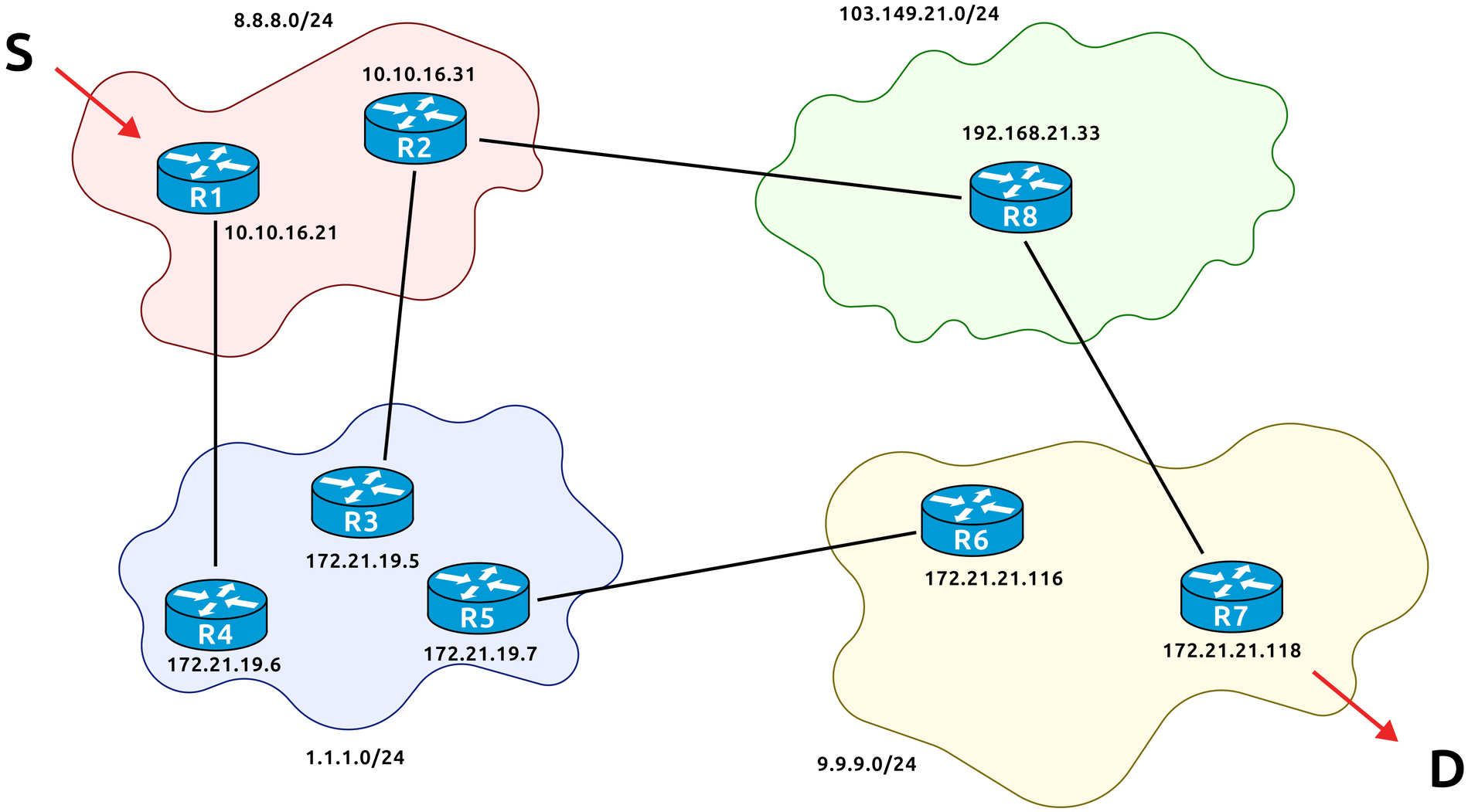
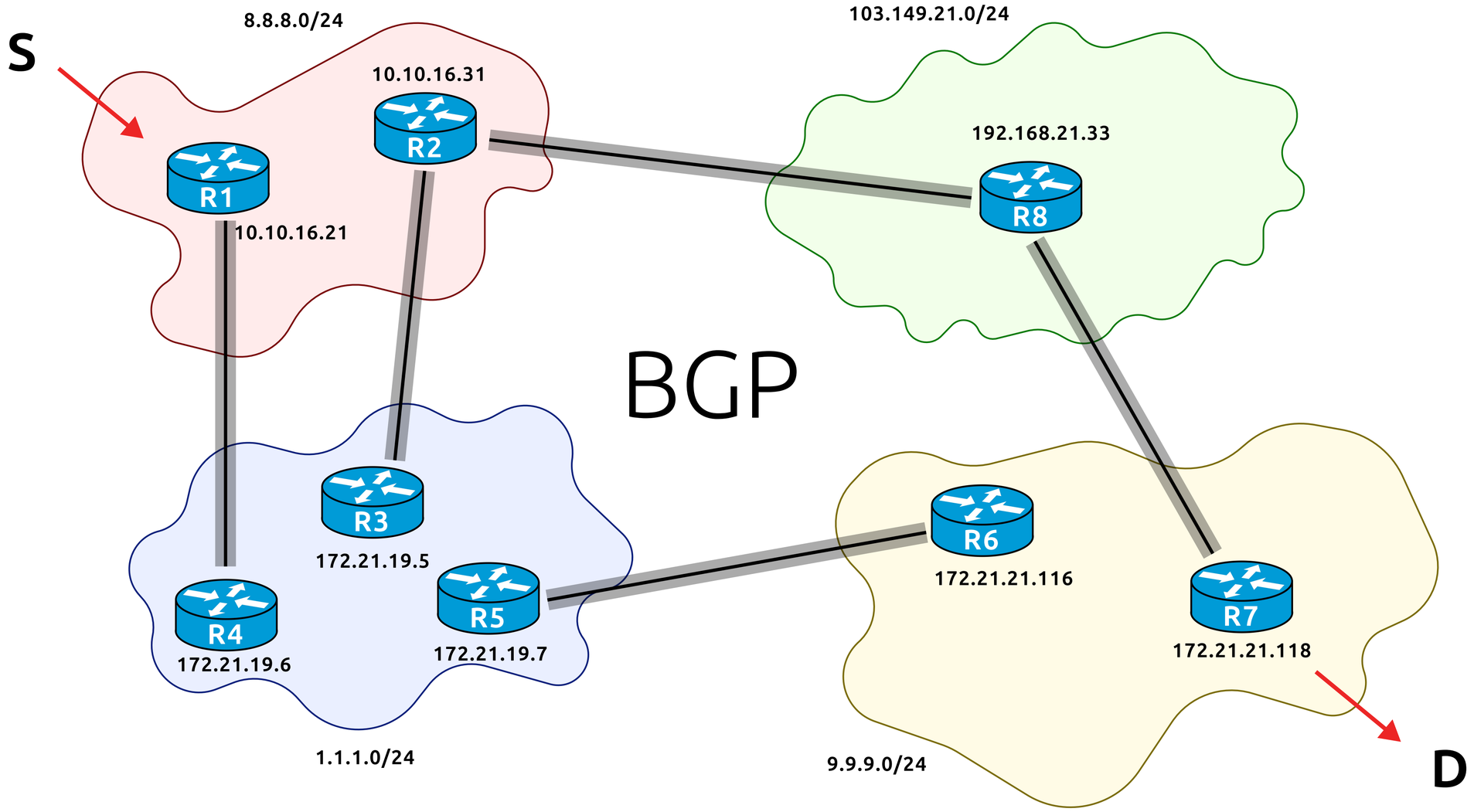


Internet - IP Routes



Internet - IP Routes



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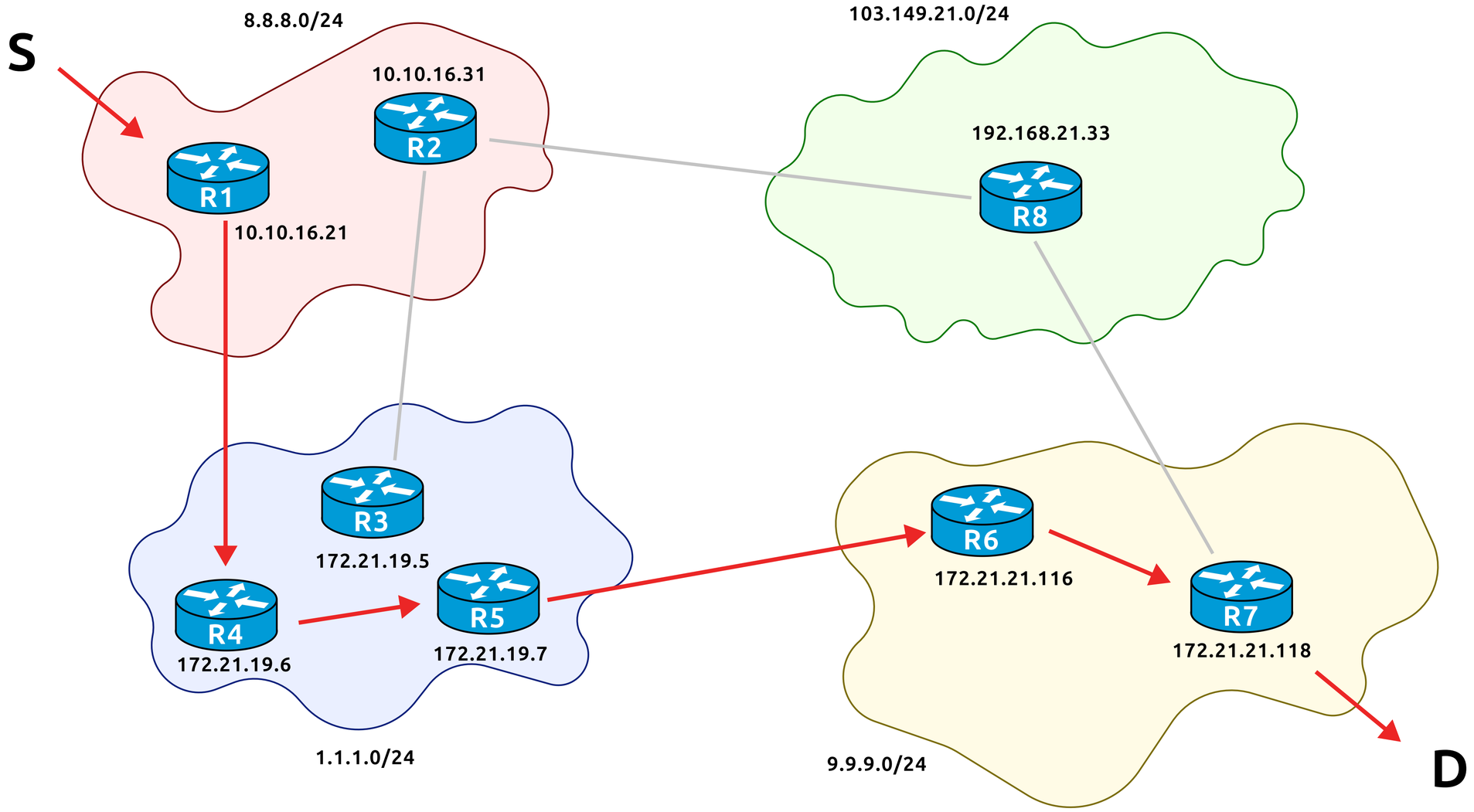
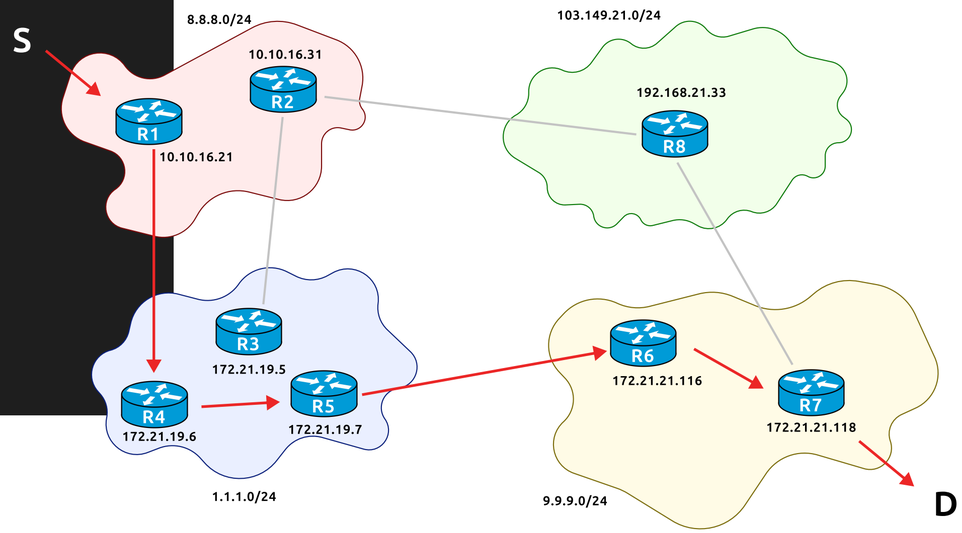
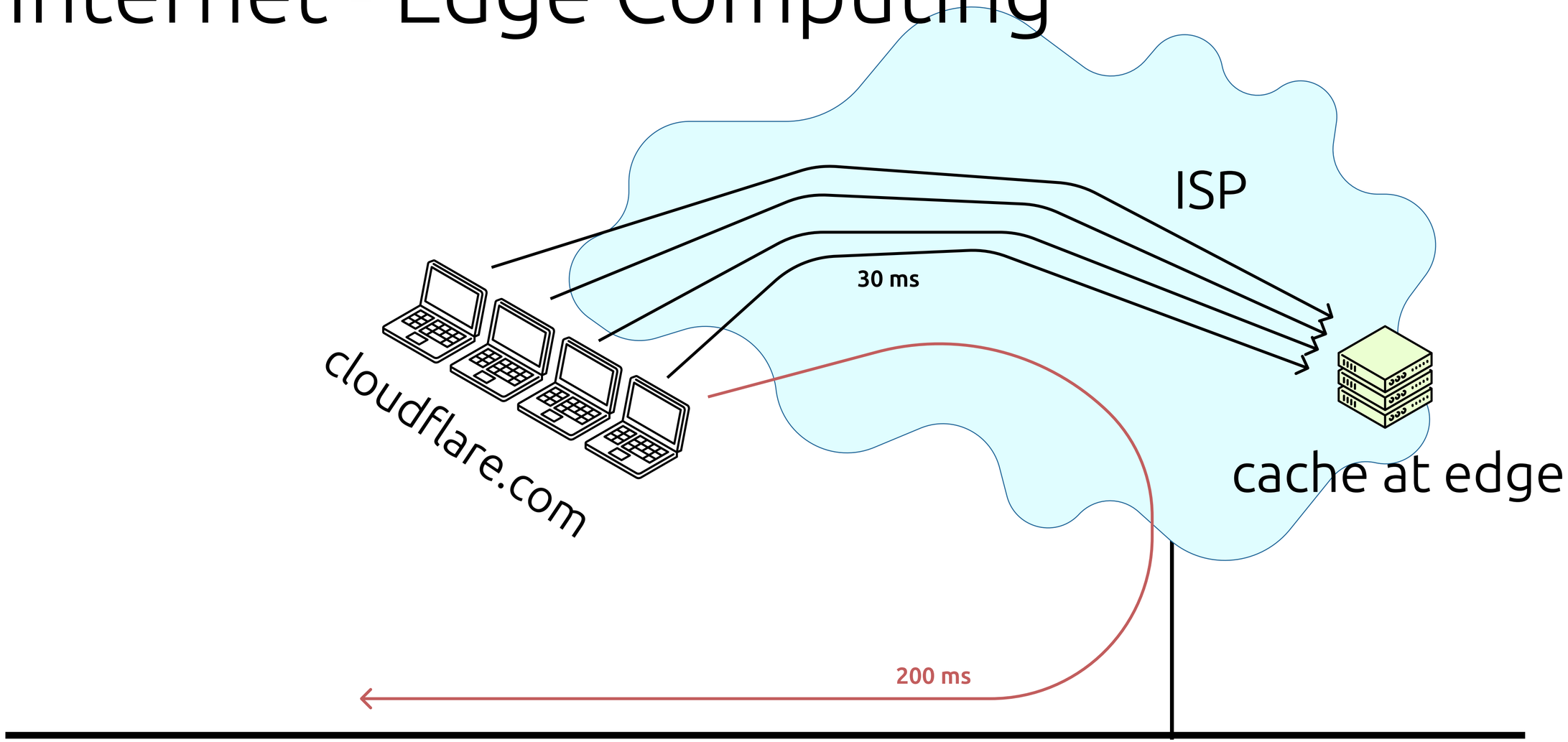


Internet - IP Routes

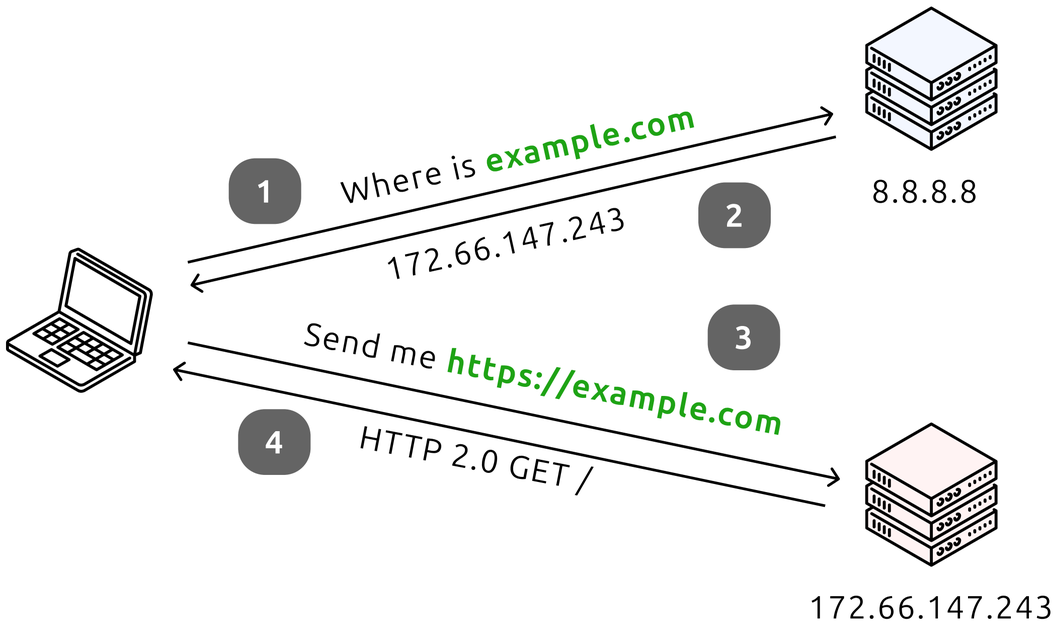
```
andrew@Arnavs-MacBook-Air ~ % traceroute 142.250.183.142
traceroute to 142.250.183.142 (142.250.183.142), 64 hops max, 52 byte packets
 1  192.168.10.1 (192.168.10.1)  23.632 ms  4.842 ms  7.045 ms
 2  192.168.19.1 (192.168.19.1)  29.041 ms  4.950 ms  24.033 ms
 3  203.193.130.153 (203.193.130.153)  3.713 ms  3.636 ms  3.540 ms
 4  * 14.140.119.241.static-kolkata.vsnl.net.in (14.140.119.241)  9.685 ms *
 5  * * *
 6  115.113.165.98.static-mumbai.vsnl.net.in (115.113.165.98)  46.128 ms  40.843 ms  41.304 ms
 7  * * *
 8  192.178.86.244 (192.178.86.244)  43.011 ms
    142.250.214.112 (142.250.214.112)  45.355 ms
    142.250.208.148 (142.250.208.148)  42.270 ms
 9  192.178.110.248 (192.178.110.248)  39.808 ms
    192.178.110.208 (192.178.110.208)  63.583 ms
    142.250.226.134 (142.250.226.134)  39.348 ms
10  192.178.254.229 (192.178.254.229)  44.795 ms *
    192.178.254.225 (192.178.254.225)  44.305 ms
11  142.251.252.94 (142.251.252.94)  65.495 ms
    172.253.64.226 (172.253.64.226)  72.872 ms
    142.251.241.166 (142.251.241.166)  64.593 ms
12  142.251.50.59 (142.251.50.59)  59.893 ms  75.154 ms
    142.250.208.231 (142.250.208.231)  64.237 ms
13  172.253.73.29 (172.253.73.29)  72.206 ms  74.861 ms
    172.253.73.35 (172.253.73.35)  73.918 ms
14  lcmaaa-ba-in-f14.1e100.net (142.250.183.142)  71.137 ms  74.909 ms  66.407 ms
```

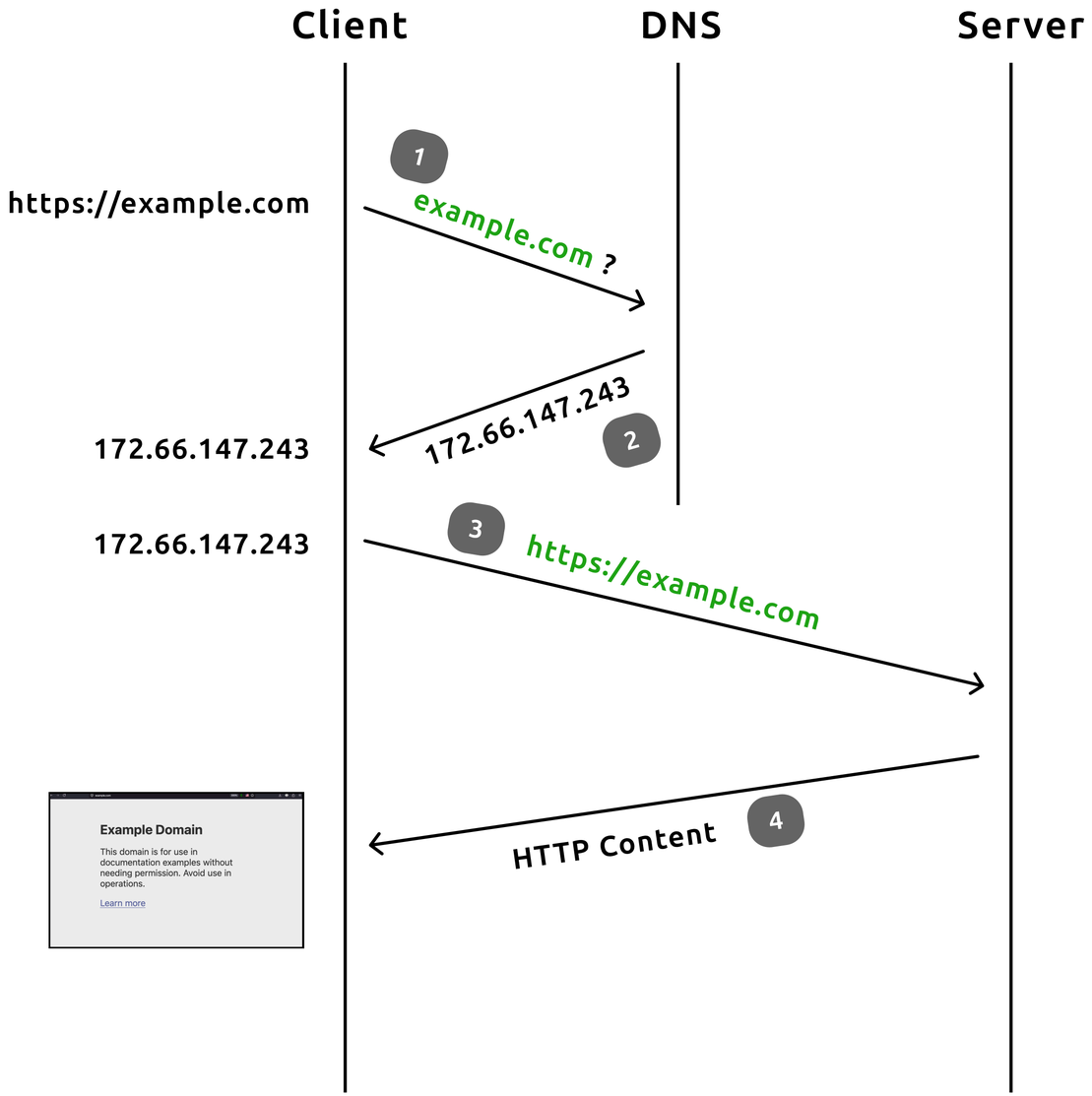


Internet - Edge Computing

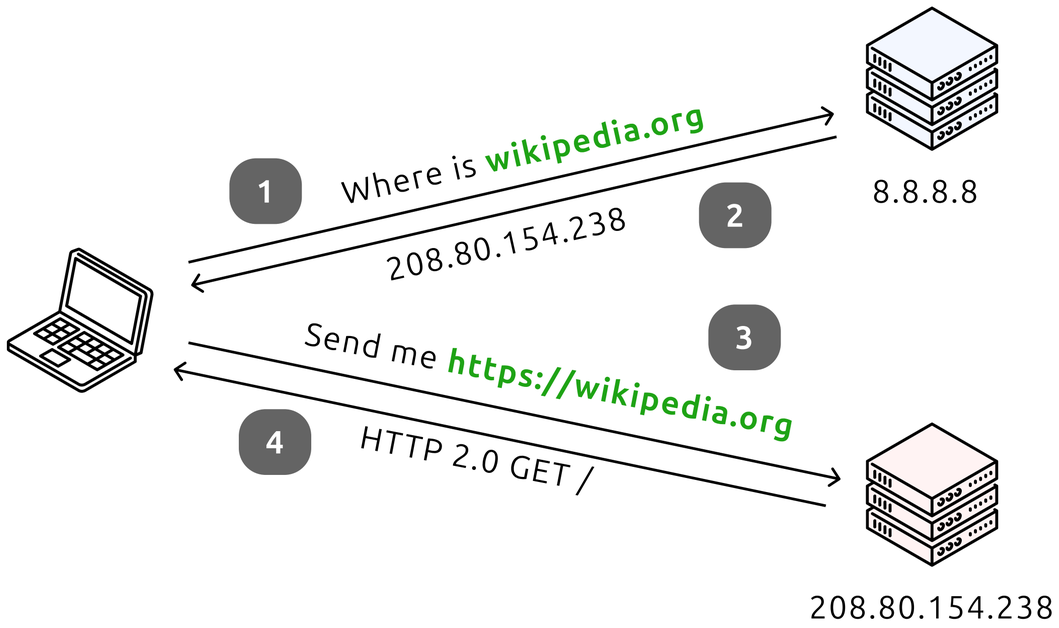


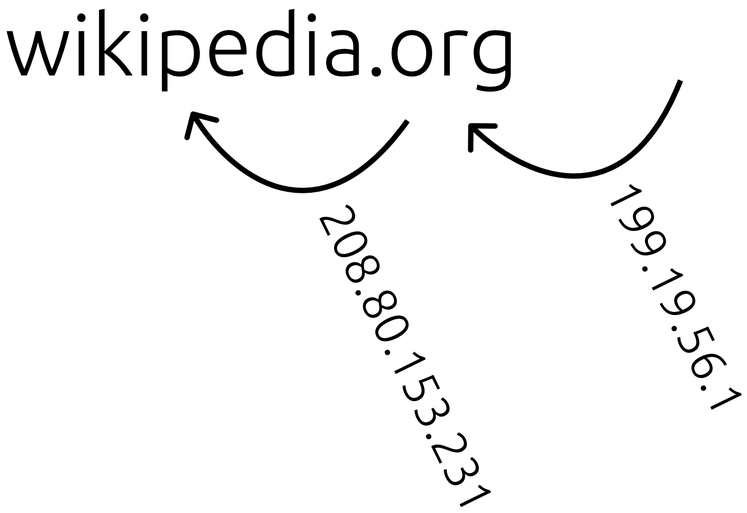
Internet - DNS



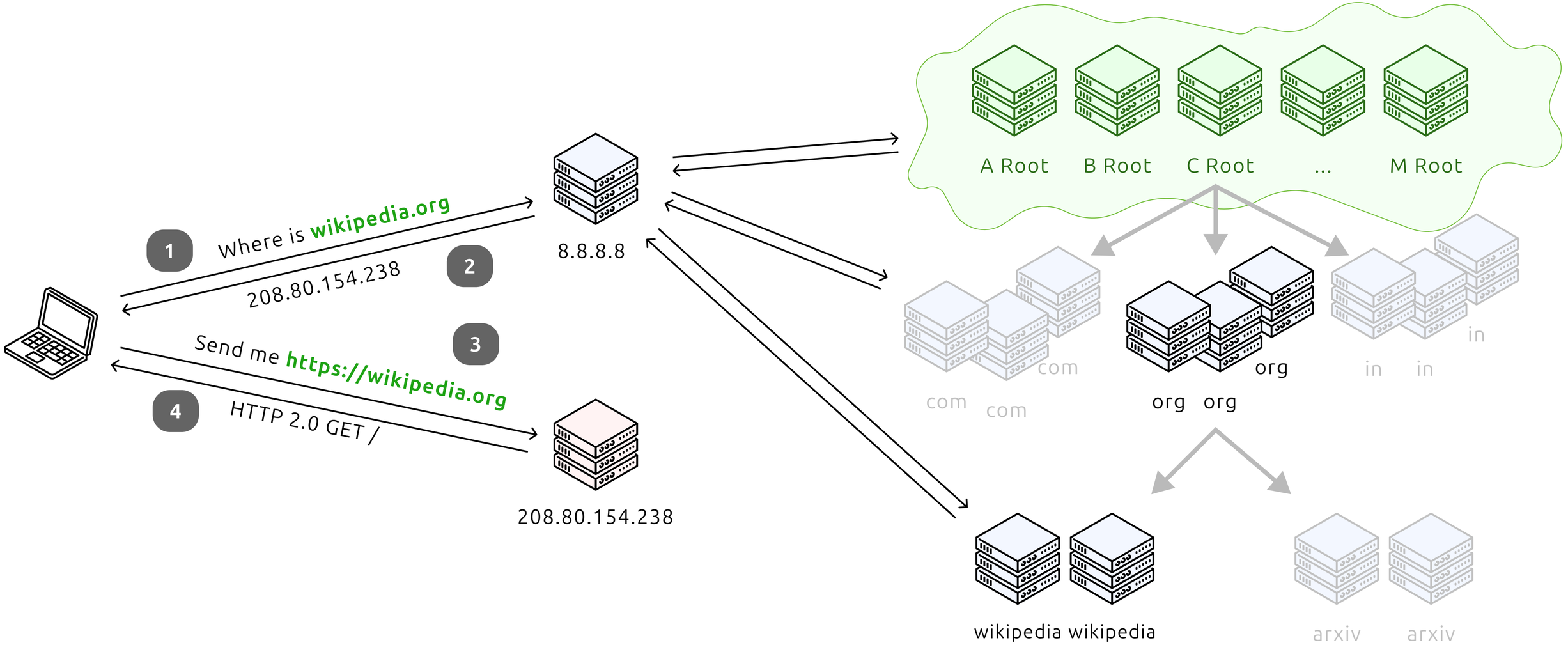


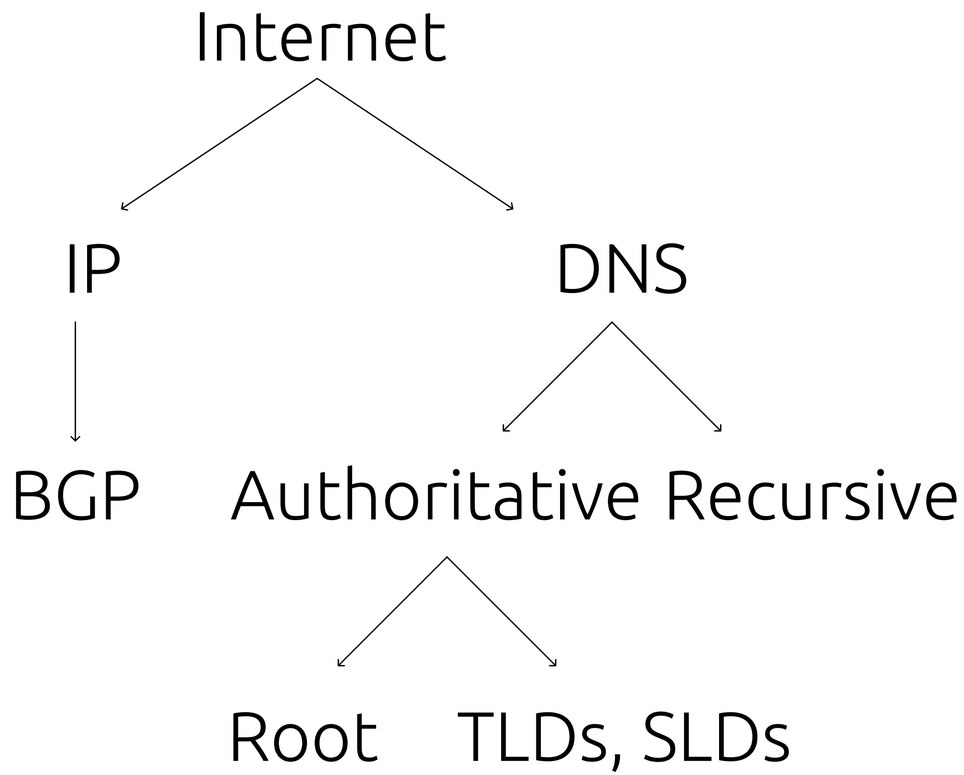
Internet - DNS





Internet - DNS





~~History~~

~~Internet Architecture~~

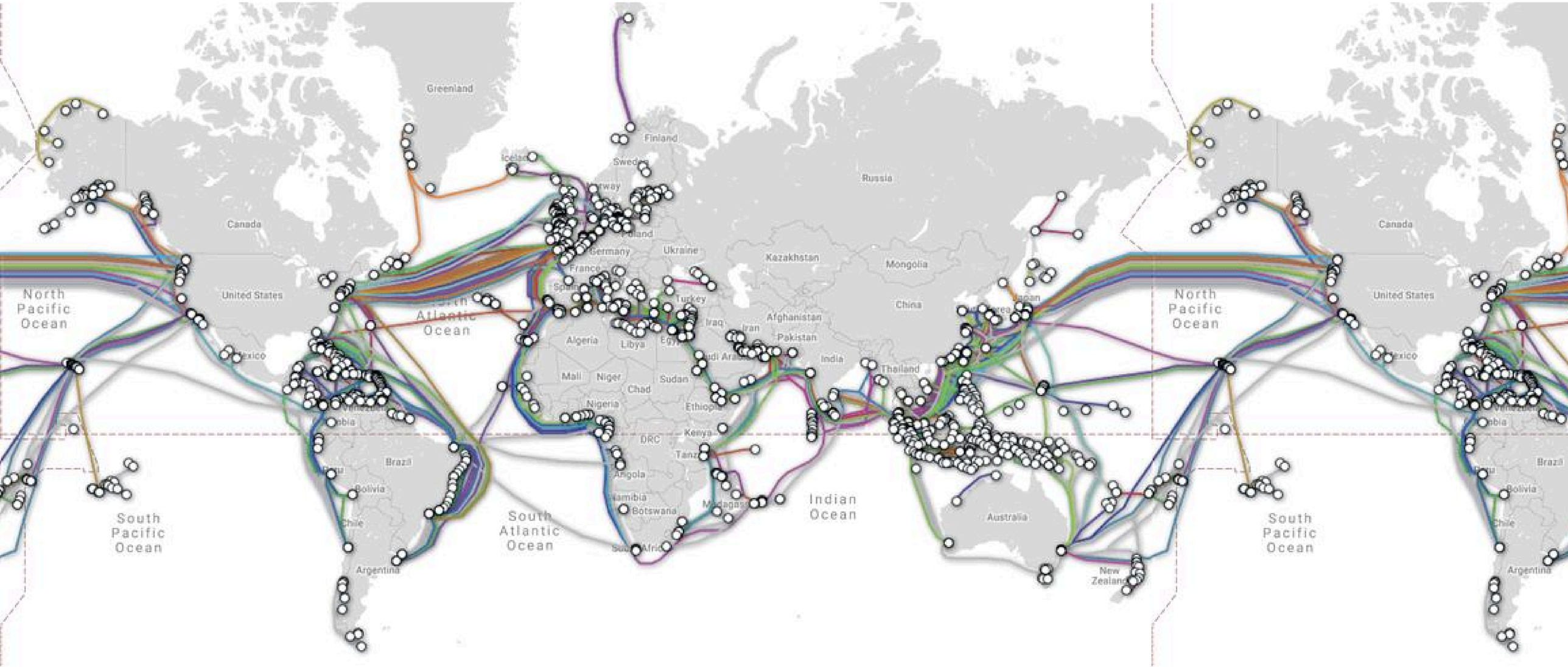
Infrastructure

Governance

Aiori

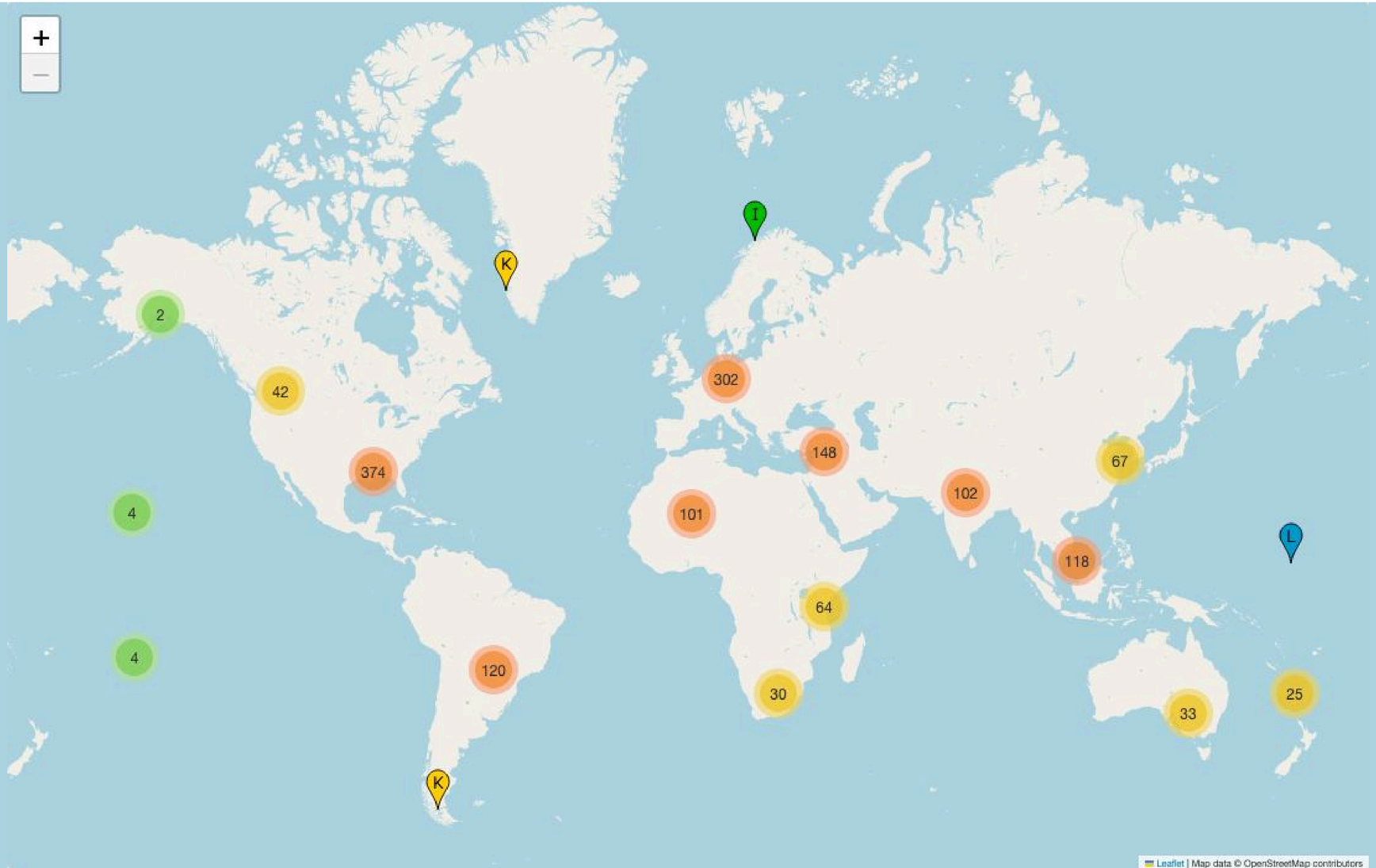
Infrastructure & Security

Infrastructure - Submarine



Infrastructure - Root Servers

- Root Server Copies
- Anycast



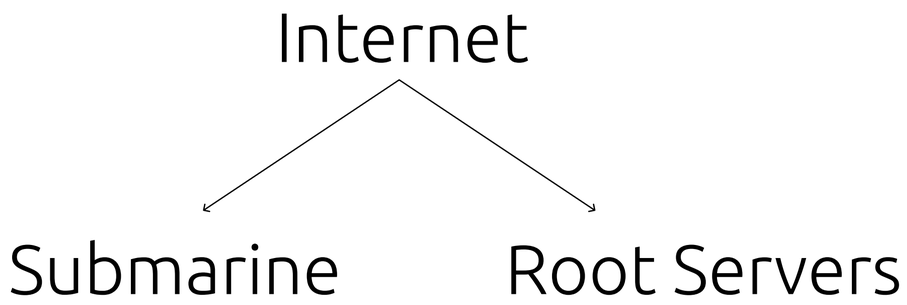
Internet Security

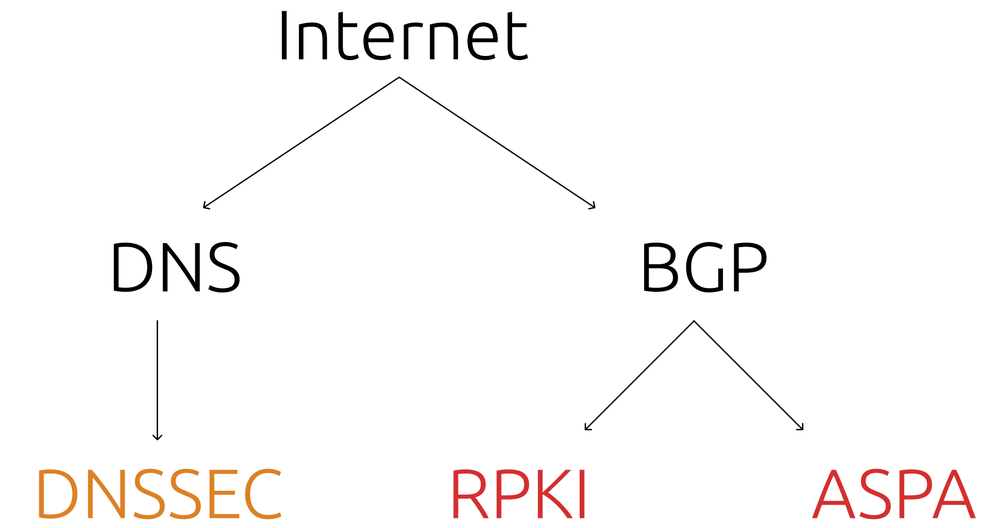
TLS [RFC4346, RFC5246, RFC8446]

SSL [RFC6101]

RPKI [RFC8210]

DNSSEC [RFC9364]





~~History~~

~~Internet Architecture~~

~~Infrastructure~~

Governance

Aiori

Governance

Governance

Governance

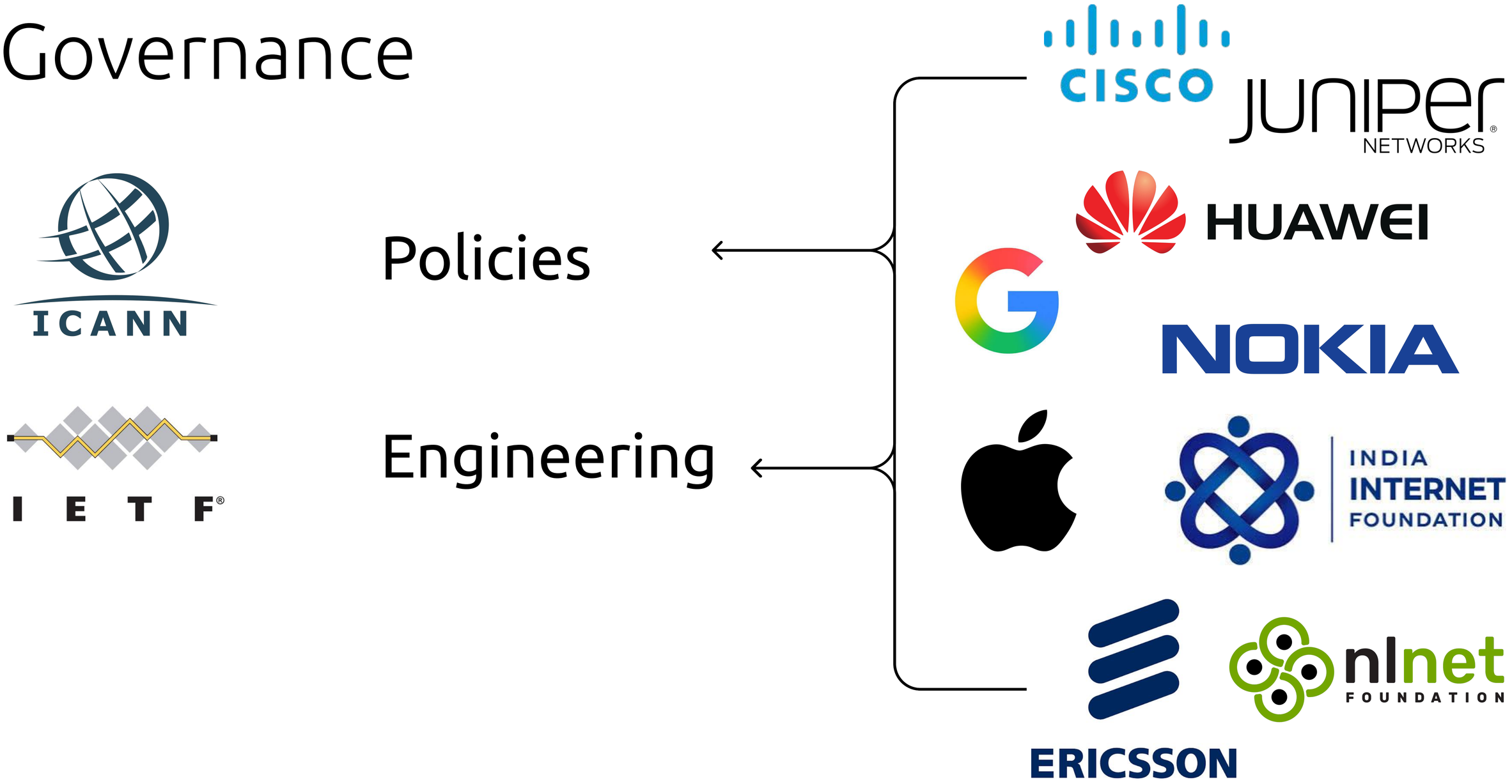
Internet Society

ICANN — Policies

IETF — Engineering

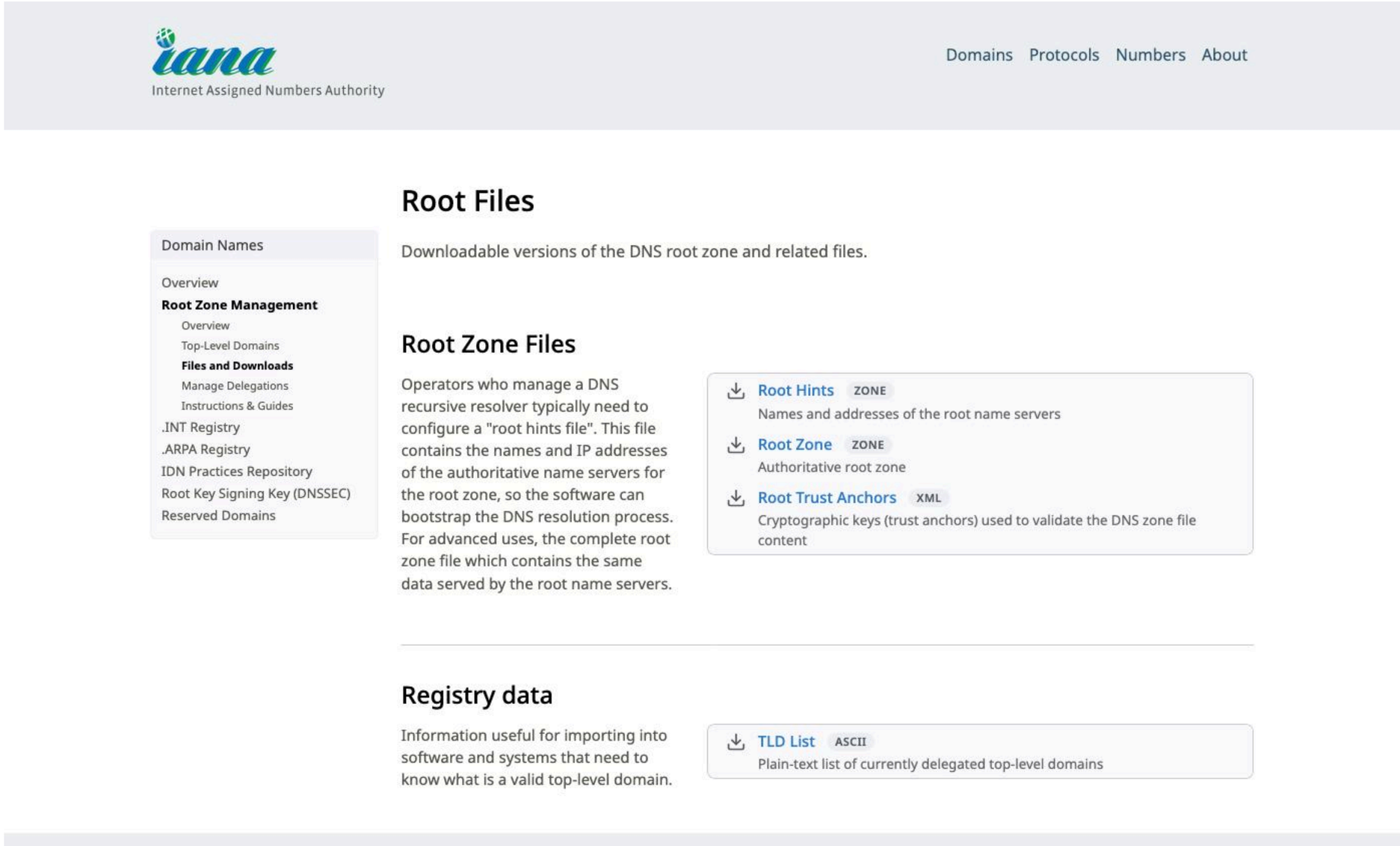
iana — Registry

Governance


ICANN
IETF
Policies
Engineering
CISCO
JUNIPER NETWORKS
HUAWEI
NOKIA
INDIA INTERNET FOUNDATION
ERICSSON
nlnet FOUNDATION

Governance

Maintaining Registry for DNS



Governance

Maintaining Registry for Protocol Numbers

(Type of Payload)

Decimal	Keyword	Protocol	IPv6 Extension Header	Reference
0	HOPOPT	IPv6 Hop-by-Hop Option	Y	[RFC8200]
1	ICMP	Internet Control Message		[RFC792]
2	IGMP	Internet Group Management		[RFC1112]
3	GGP	Gateway-to-Gateway		[RFC823]
4	IPv4	IPv4 encapsulation		[RFC2003]
5	ST	Stream		[RFC1190][RFC1819]
6	TCP	Transmission Control		[RFC9293]
7	CBT	CBT		[Tony_Ballardie]
8	EGP	Exterior Gateway Protocol		[RFC888][David_Mills]
9	IGP	any private interior gateway (used by Cisco for their IGRP)		[Internet_Assigned_Numbers_Authority]
10	BBN-RCC-MON	BBN RCC Monitoring		[Steve_Chipman]
11	NVP-II	Network Voice Protocol		[RFC741][Steve_Casner]
12	PUP	PUP		[Boggs, D., J. Shoch, E. Taft, and R. Metcalfe, "PUP: An Internetwork Architecture", XEROX Palo Alto in IEEE Transactions on Communication, Volume COM-28, Number 4, April 1980.][[XEROX]]
13	ARGUS (deprecated)	ARGUS		[Robert_W_Scheifler]
14	EMCON	EMCON		[Bich_Nguyen]
15	XNET	Cross Net Debugger		[Haverty, J., "XNET Formats for Internet Protocol Version 4", IEN 158, October 1980.][Jack_Haverty]
16	CHAOS	Chaos		[J_Noel_Chiappa]
17	UDP	User Datagram		[RFC768][Jon_Postel]
18	MUX	Multiplexing		[Cohen, D. and J. Postel, "Multiplexing Protocol", IEN 90, USC/Information Sciences Institute, May 1
19	DCN-MEAS	DCN Measurement Subsystems		[David_Mills]

Governance

Internet Protocol - RIRs

(Regional Internet Registry)

Number Resources

We are responsible for global coordination of the Internet Protocol addressing systems, as well as the Autonomous System Numbers used for routing Internet traffic.

Currently there are two types of Internet Protocol (IP) addresses in active use: IP version 4 (IPv4) and IP version 6 (IPv6). IPv4 was initially deployed on 1 January 1983 and is still the most commonly used version. IPv4 addresses are 32-bit numbers often expressed as 4 octets in "dotted decimal" notation (for example, *192.0.2.53*). Deployment of the IPv6 protocol began in 1999. IPv6 addresses are 128-bit numbers and are conventionally expressed using hexadecimal strings (for example, *2001:0db8:582:ae33::29*).

Both IPv4 and IPv6 addresses are generally assigned in a hierarchical manner. Users are assigned IP addresses by Internet service providers (ISPs). ISPs obtain allocations of IP addresses from a local Internet registry (LIR) or National Internet Registry (NIR), or from their appropriate Regional Internet Registry (RIR):

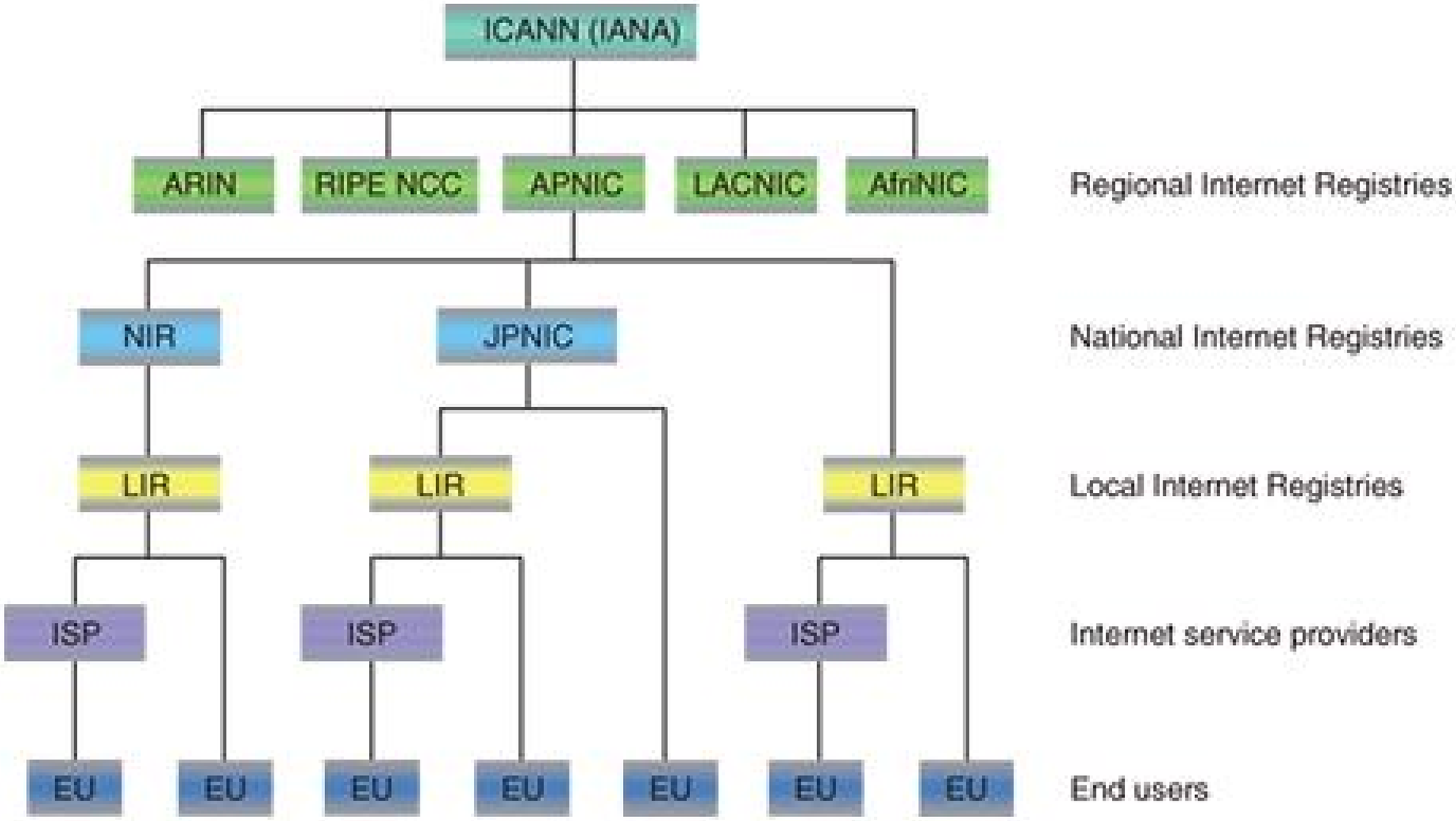
Registry	Area Covered
AFRINIC	Africa Region
APNIC	Asia/Pacific Region
ARIN	Canada, USA, and some Caribbean Islands
LACNIC	Latin America and some Caribbean Islands
RIPE NCC	Europe, the Middle East, and Central Asia

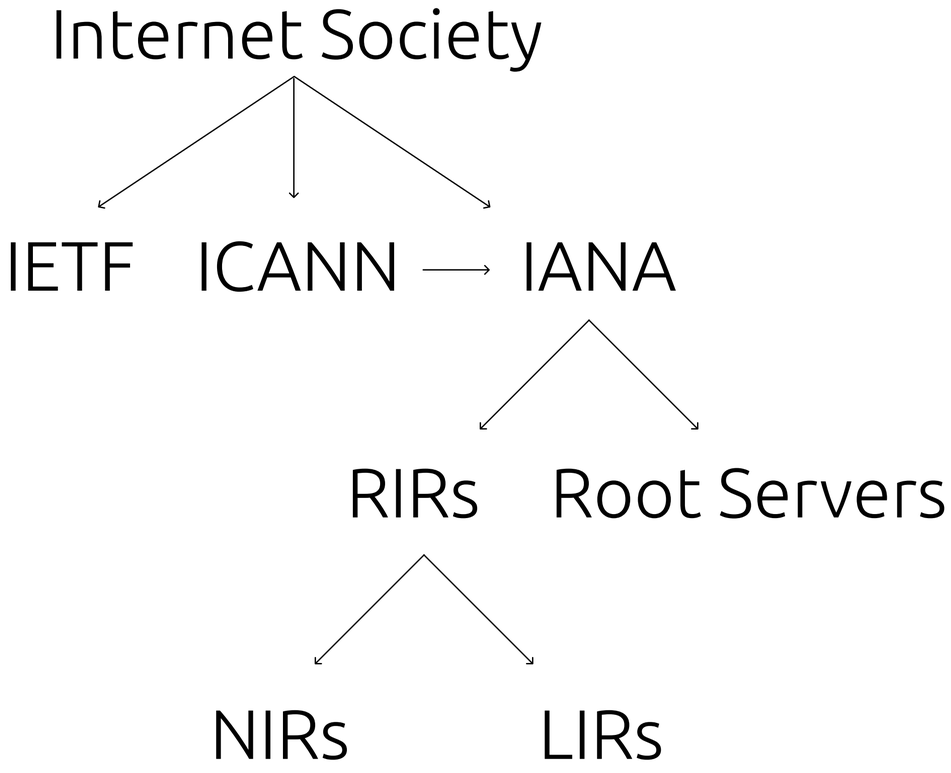
Our primary role for IP addresses is to allocate pools of unallocated addresses to the RIRs according to their needs as described by global policy and to document protocol assignments made by the IETF. When an RIR requires more IP addresses for allocation or assignment within its region, we make an additional allocation to the RIR. We do not make allocations directly to ISPs or end users except in specific circumstances, such as allocations of multicast addresses or other protocol specific needs.

Governance

Registry	Area Covered
AFRINIC	Africa Region
APNIC	Asia/Pacific Region
ARIN	Canada, USA, and some Caribbean Islands
LACNIC	Latin America and some Caribbean Islands
RIPE NCC	Europe, the Middle East, and Central Asia

Operational





~~History~~

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~~Governance~~

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AIORI

Research

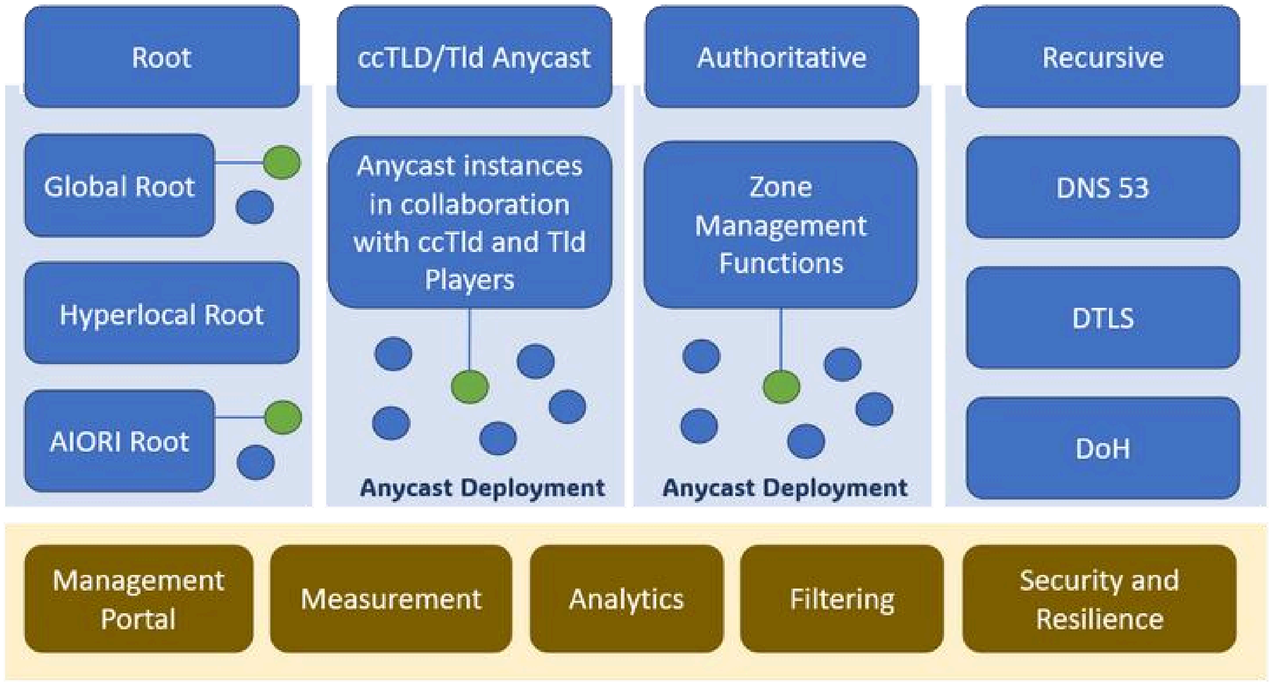
- Internet Infrastructure
- Measurement & Analysis

Internet Infrastructure

Resillient DNS Implementations

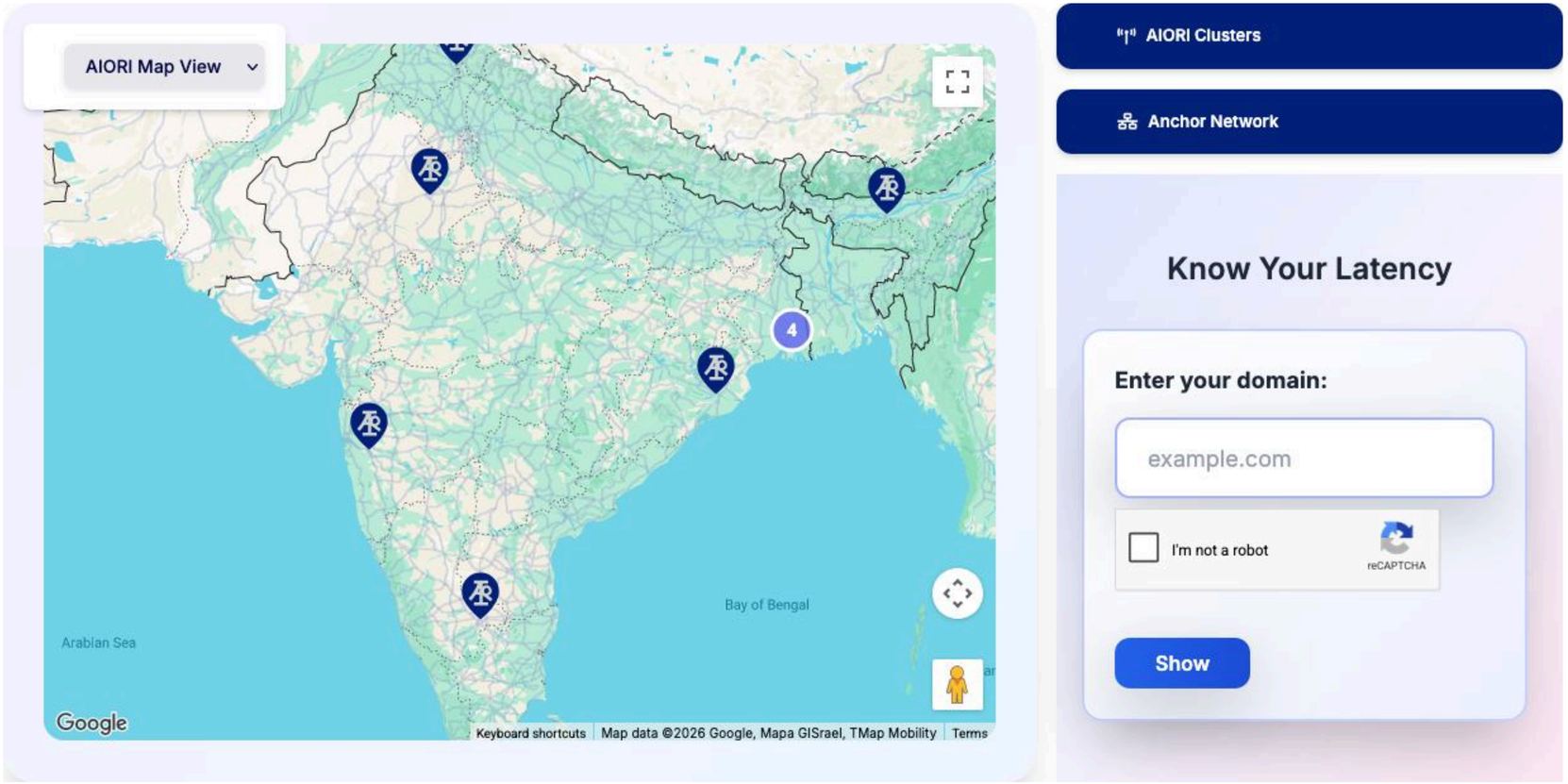
Post Quantum Cryptography

IP Geolocation



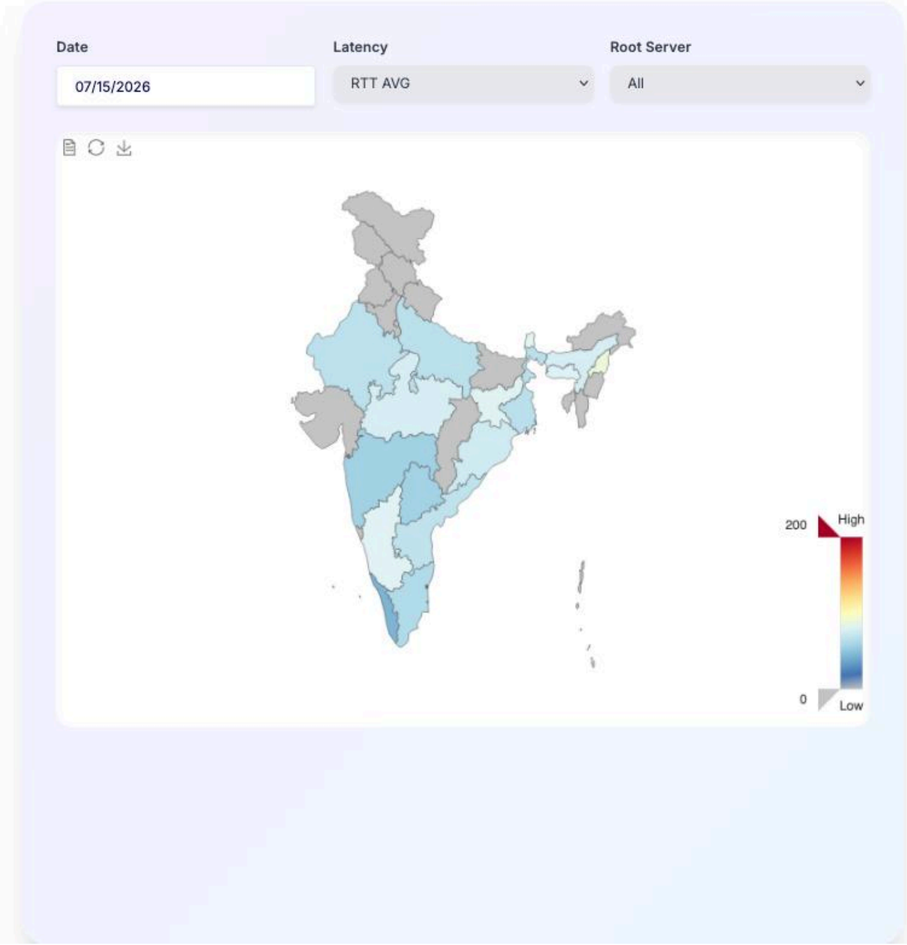
Measurement & Analysis

Measurement & Analysis



Measurement & Analysis

Root Server Query Latency in India



Show Search:

State	Latency
Kerala	44
Maharashtra	57
Telangana	57
Chandigarh	63
Tamil Nadu	63
Uttar Pradesh	66
West Bengal	66
Rajasthan	67
Andhra Pradesh	68
Odisha	74
Assam	76
Madhya Pradesh	76
Meghalaya	79
Karnataka	80
Jharkhand	81
Sikkim	84
Nagaland	89

Previous 1 Next

aiori.in

History

Internet Architecture

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Aiori

We Saw

History plays an important role in understanding the current Internet.

Internet Architecture and how it started, and what ot looks like.

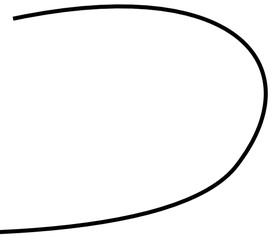
History

Internet Architecture

Infrastructure

Governance

Aiori



We Saw

Infrastructure is necessary to connect my PC to a Wikipedia or Google.

Planetary scale communication and Phone book

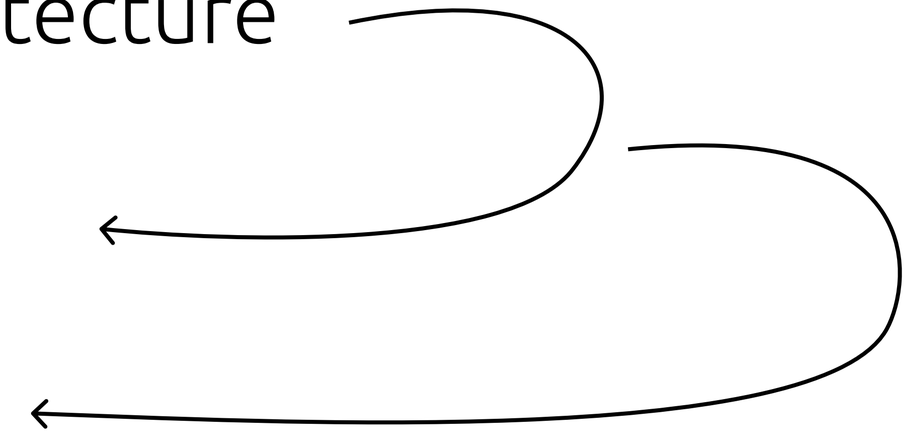
History

Internet Architecture

Infrastructure

Governance

Aiori



We Saw

Governance is necessary to manage and maintain a planetary scale communication and Phone book

Next Session

What needs to be done in the Student Workshop

- How the internet functions
- AIORI overview (what the platform does + platform tools)
- What we measure (how we are measuring)
- Benefits of these measurements
- Student workshop activities (what students will do)

What needs to be done in the Student Workshop

Learn AIORI and its purpose (platform overview)

- Understand what AIORI is and how the platform supports measurement driven troubleshooting
- See what “anchors” mean and why defined starting points matters

What needs to be done in the Student Workshop

Learn AIORI and its purpose (platform overview)

Demonstrate what AIORI measures (Latency, DNS, etc)

- Explain and observe: Latency (experience impact)
- Explain and observe: DNS query behavior (name resolution delays)
- Explain and observe: Traceroute (route/path indicators)

What needs to be done in the Student Workshop

Learn AIORI and its purpose (platform overview)

Demonstrate what AIORI measures (Latency, DNS, etc)

Analyze & Identify “where the delay is originating”

- DNS resolution time
- Routing/path-related delays
- Decide the next actions based on the evidence