

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



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

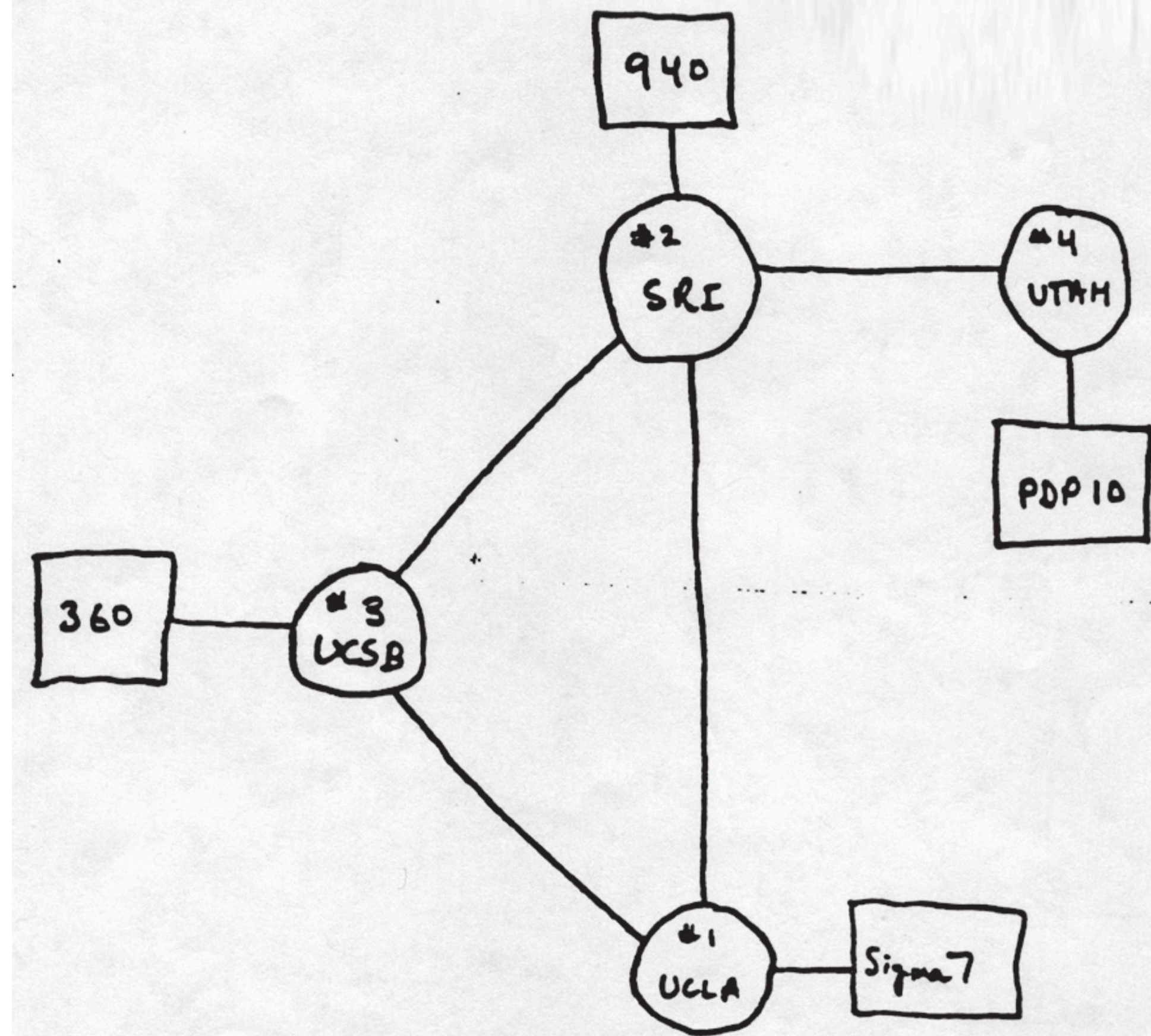


1970s

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



THE ARPA NETWORK

DEC 1969

4 NODES

1970s

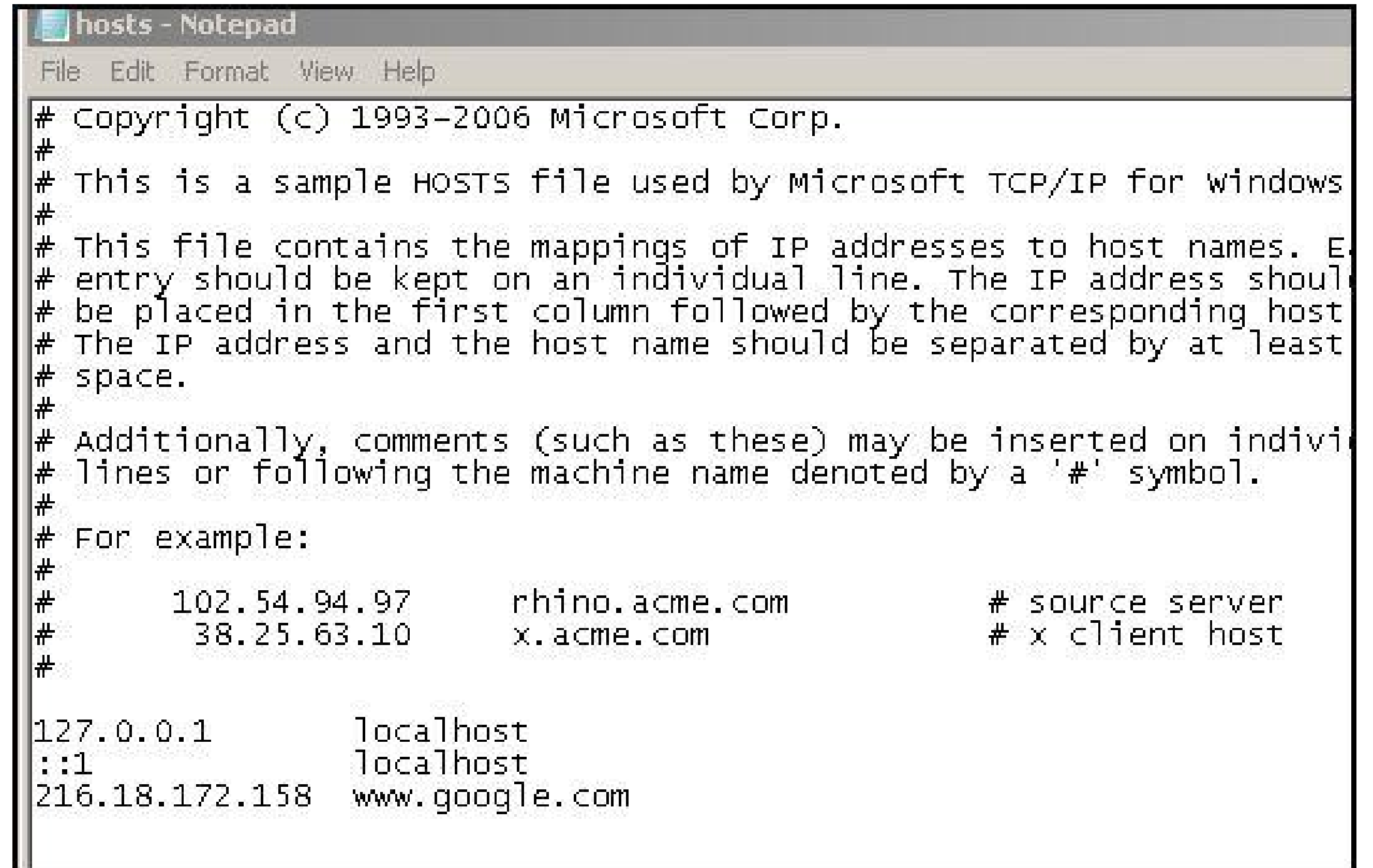
Vint Cerf and Bob Kahn, published their research on **inter-net**working in 1974 in Internet Experiment Note



TCP / IP

HOSTS.TXT

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



```
hosts - Notepad
File Edit Format View Help
# Copyright (c) 1993-2006 Microsoft Corp.
#
# This is a sample HOSTS file used by Microsoft TCP/IP for Windows.
#
# This file contains the mappings of IP addresses to host names. Each
# entry should be kept on an individual line. The IP address should
# be placed in the first column followed by the corresponding host
# name. The IP address and the host name should be separated by at least
# one space.
#
# Additionally, comments (such as these) may be inserted on individual
# lines or following the machine name denoted by a '#' symbol.
#
# For example:
#
#       102.54.94.97       rhino.acme.com          # source server
#       38.25.63.10       x.acme.com              # x client host
#
127.0.0.1          localhost
::1               localhost
216.18.172.158     www.google.com
```

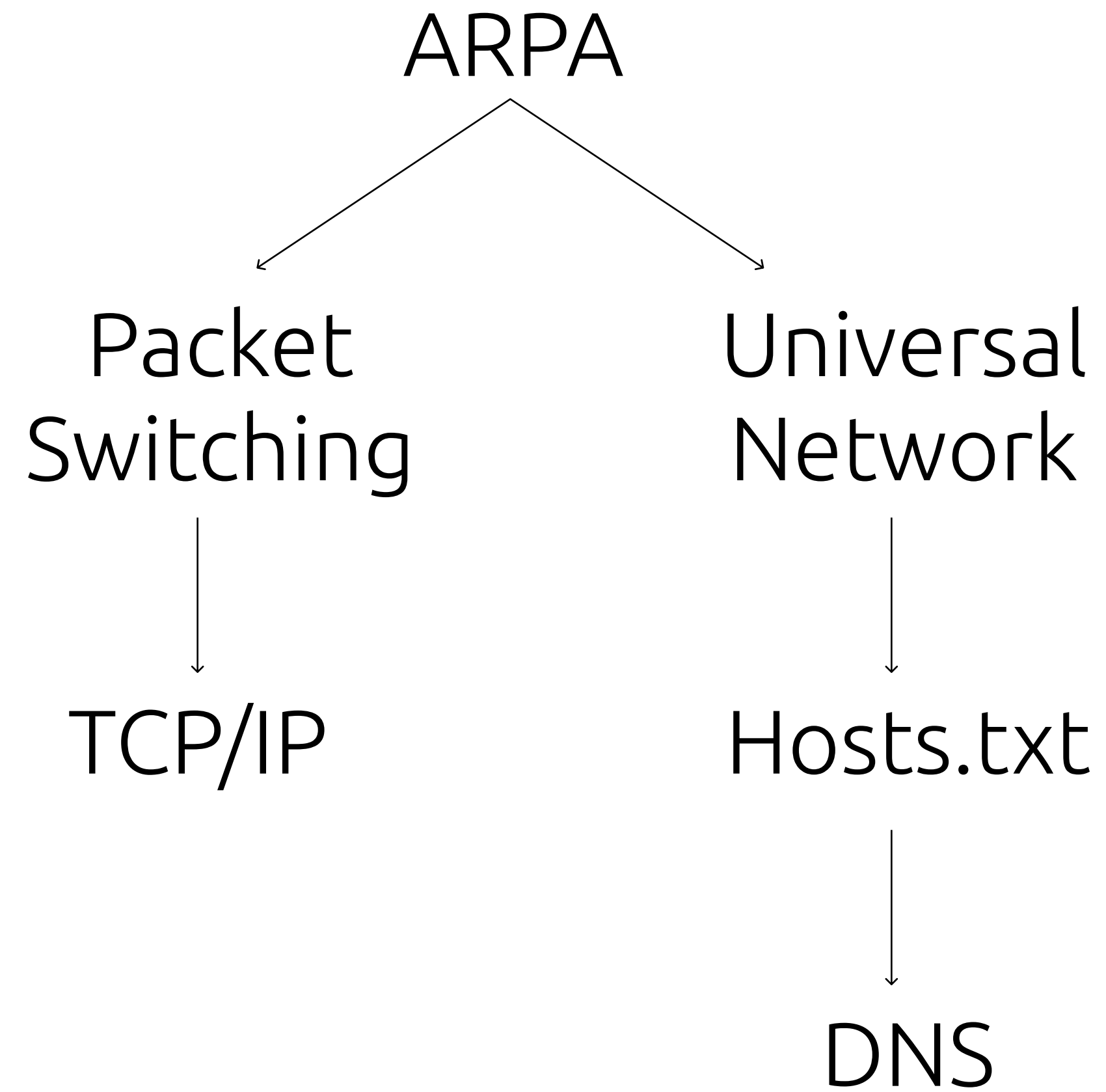

1980s

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

Governance

Aiori

Internet Architecture

Internet

1.1.1.1
9.9.9.9
192.168.19.21
163.159.26.38
103.149.148.147
1.10.10.10
8.8.8.8
172.16.19.5

The Numbers

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

The Names

Internet - Names & Numbers

1.1.1.1 9.9.9.9 bank.in iana.org

192.168.19.21 net darkwall.co.in

162.159.26.38 example.com com

103.149.148.147 us-east-1.console.aws.amazon.com

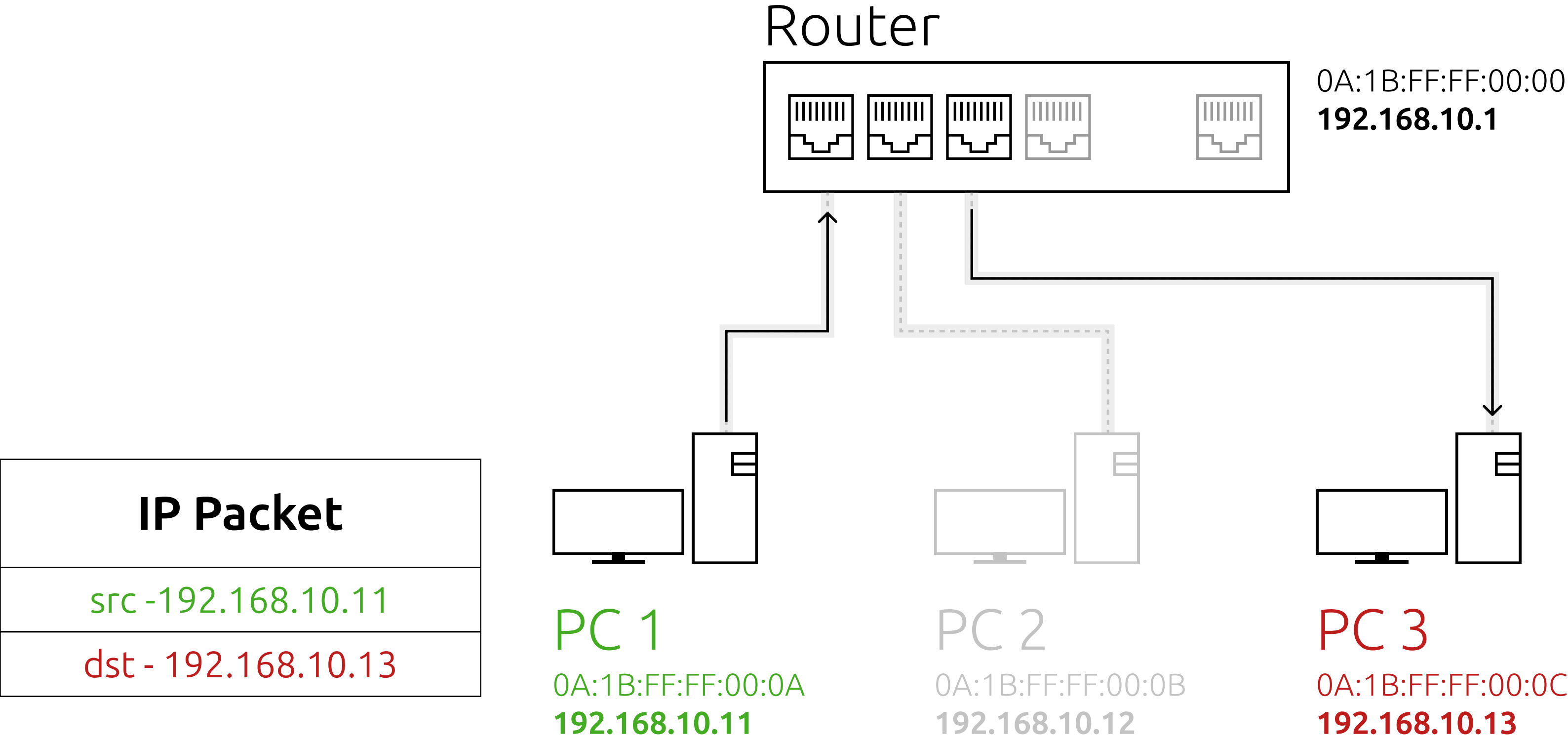
1.10.10.10 172.16.19.5 google.com en.wikipedia.org

8.8.8.8

Internet - Names & Numbers

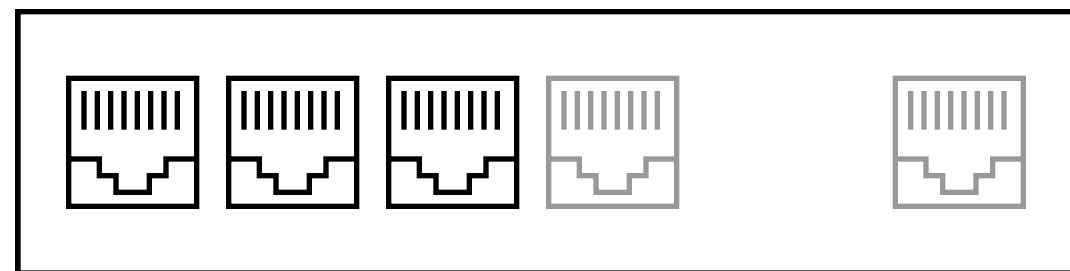


Internet - IP Address & Local Network

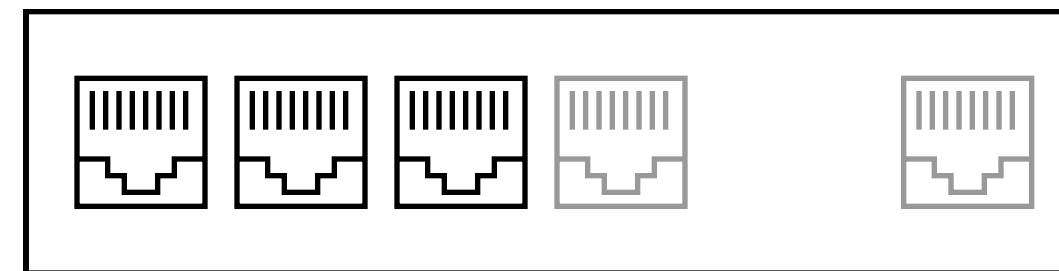


Internet - IP Address & Local Network

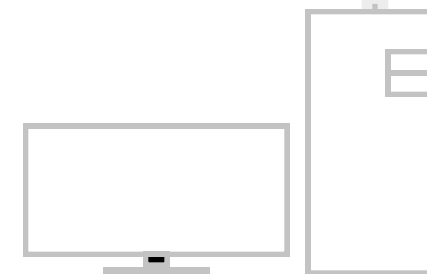
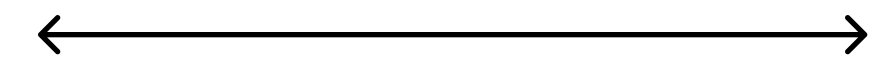
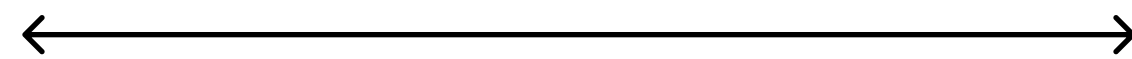
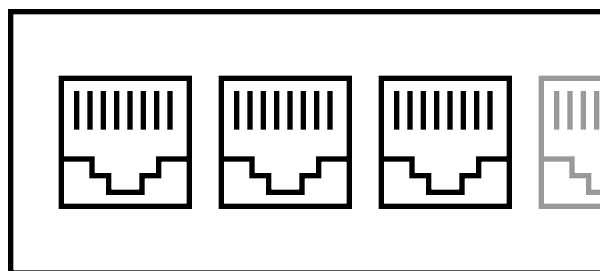
Router



Router

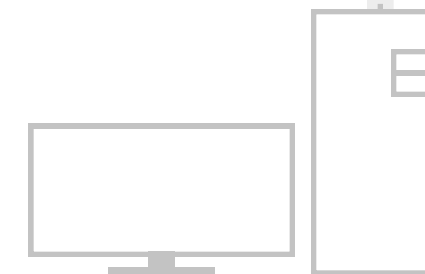


Router



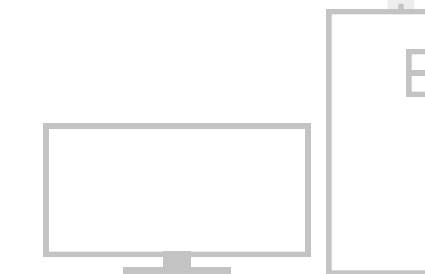
PC 1

0A:1B:FF:FF:00:0A
192.168.10.11



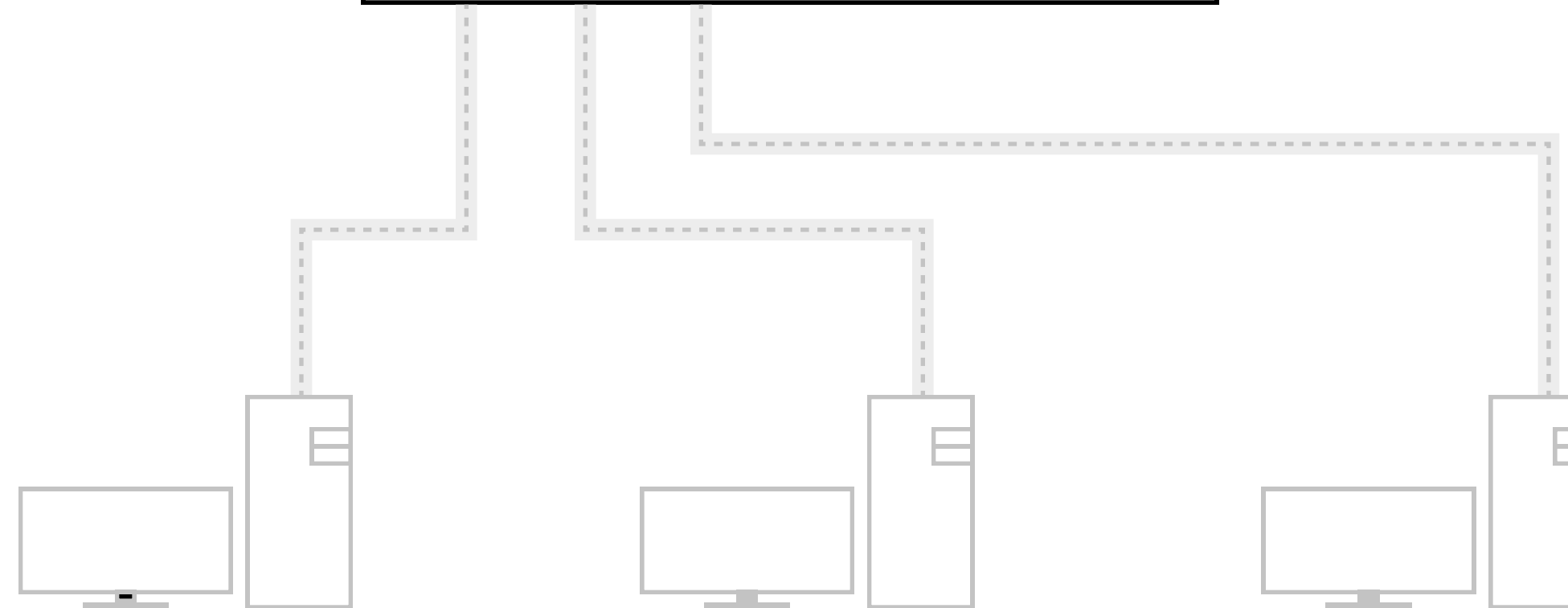
PC 2

0A:1B:FF:FF:00:0B
192.168.10.12



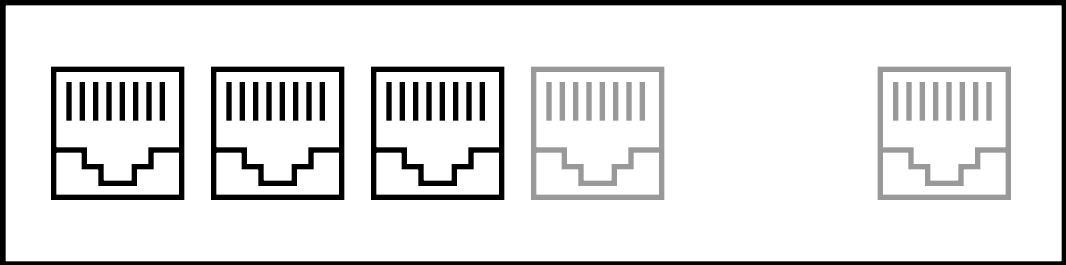
PC 3

0A:1B:FF:FF:00:0C
192.168.10.13

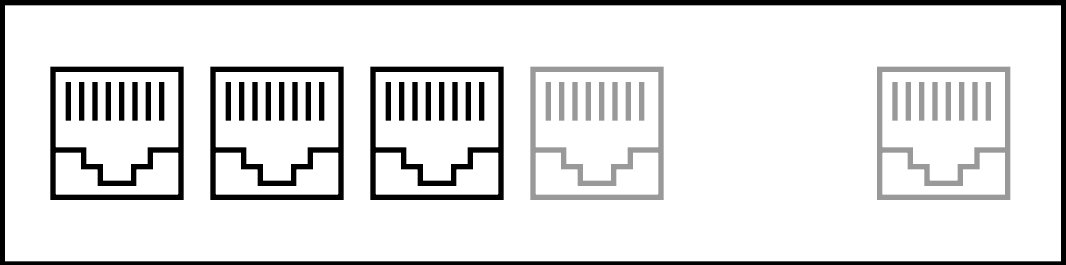


Internet - IP Address & Local Network

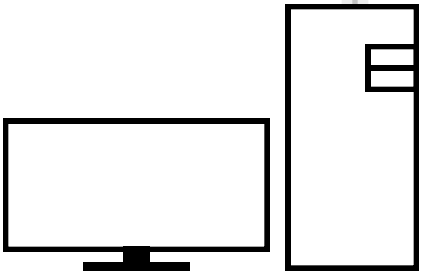
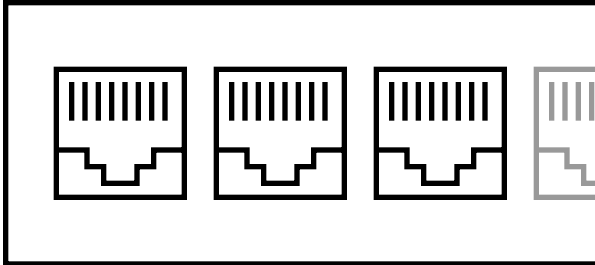
Router



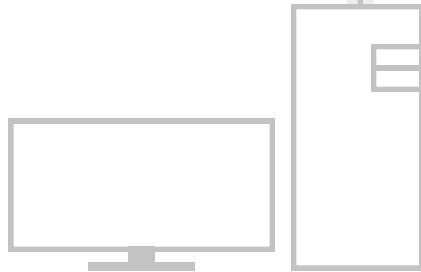
Router



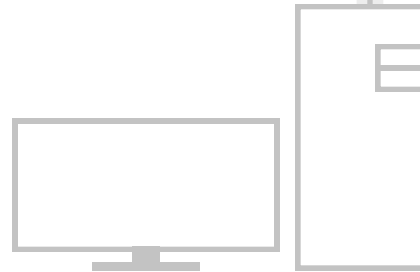
Router



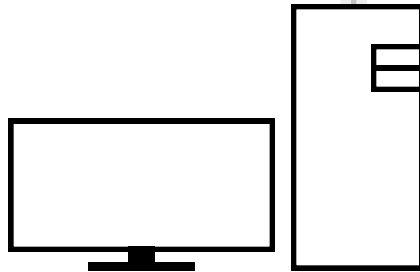
PC 1
0A:1B:FF:FF:00:0A
192.168.10.11



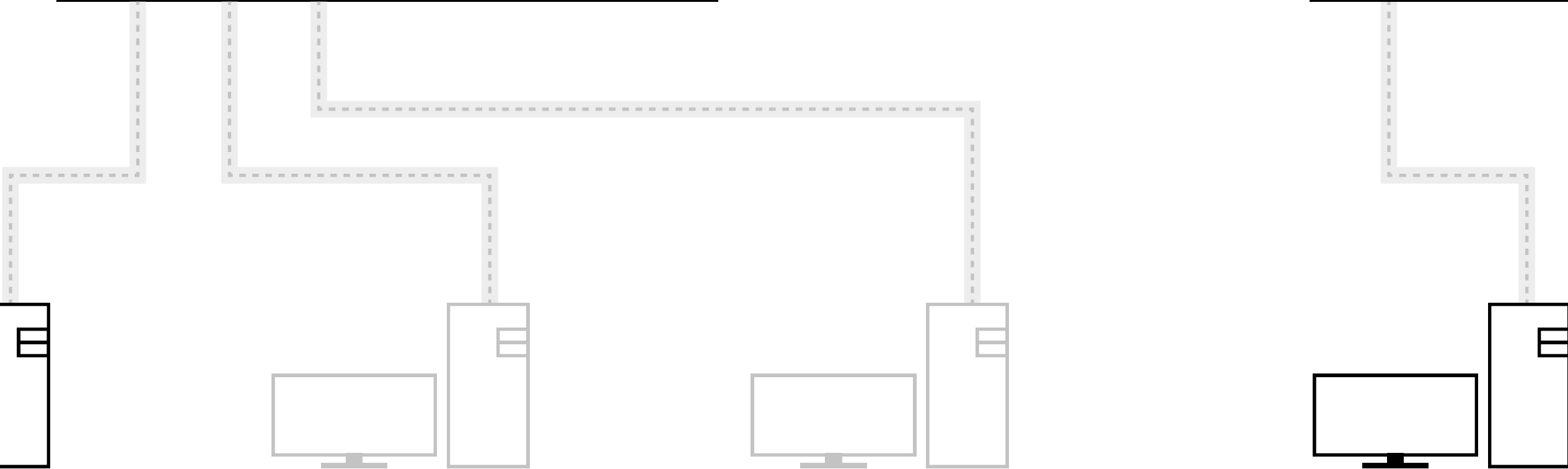
PC 2
0A:1B:FF:FF:00:0B
192.168.10.12



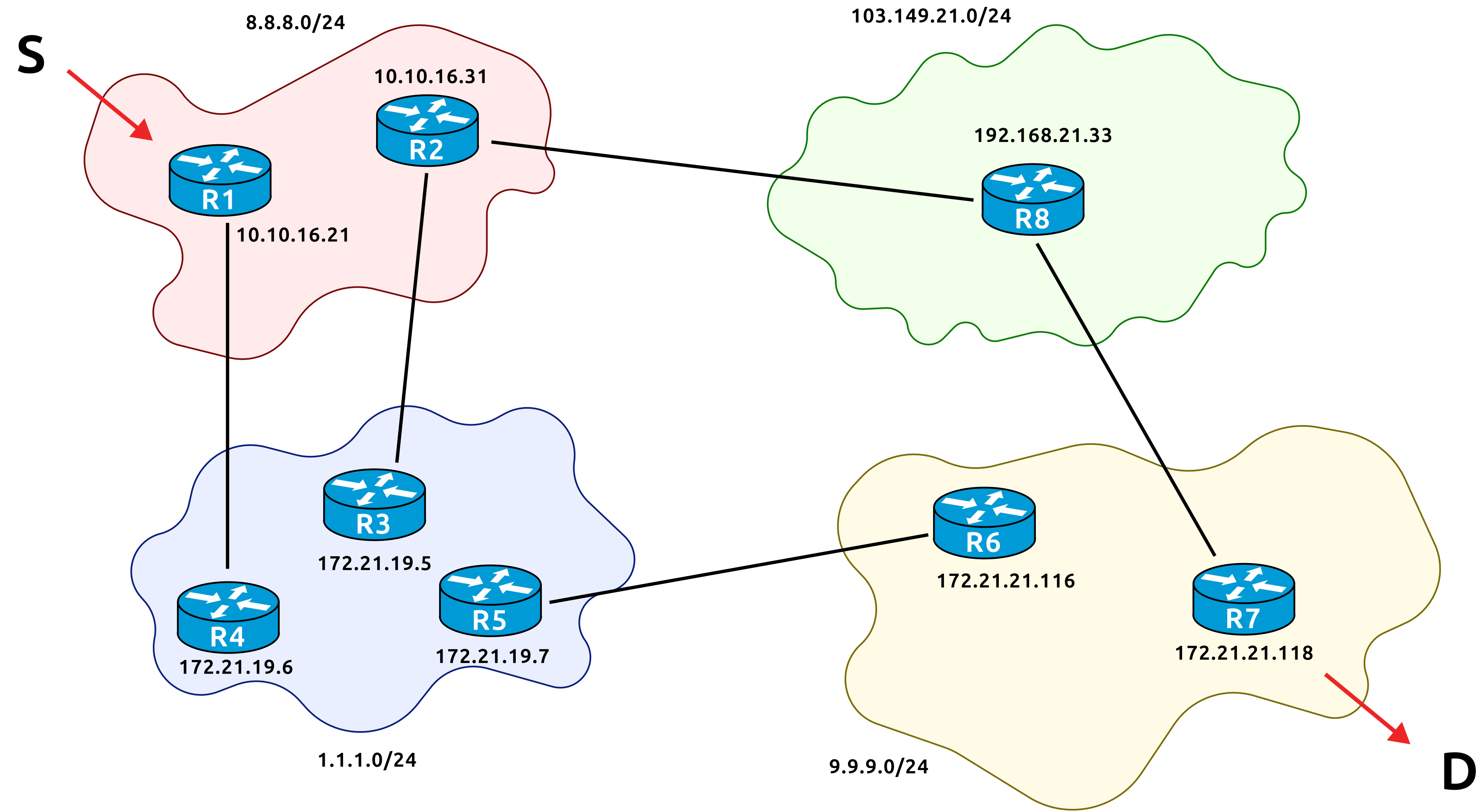
PC 3
0A:1B:FF:FF:00:0C
192.168.10.13



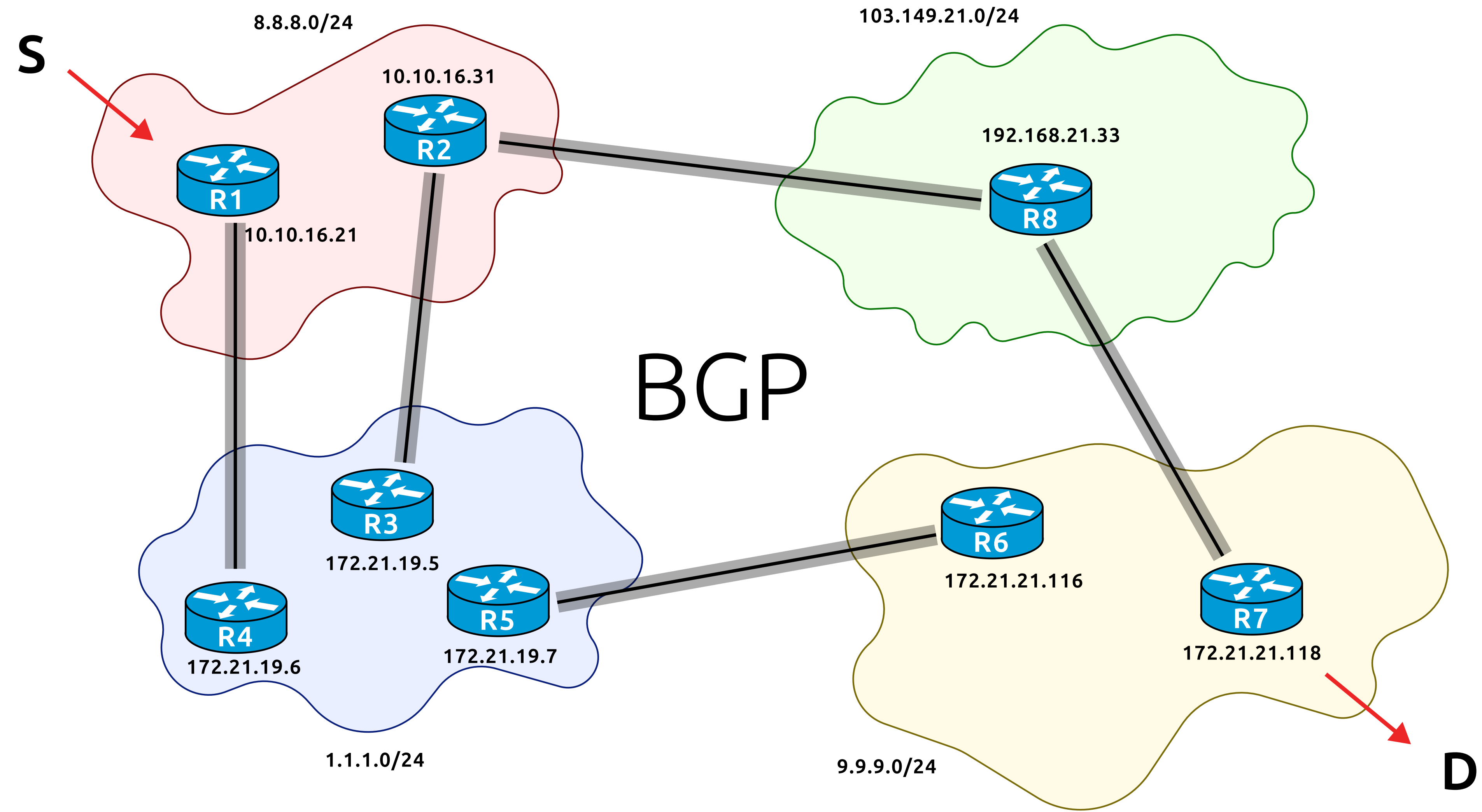
PC 4
0A:1B:FF:FF:00:0B
172.16.31.112



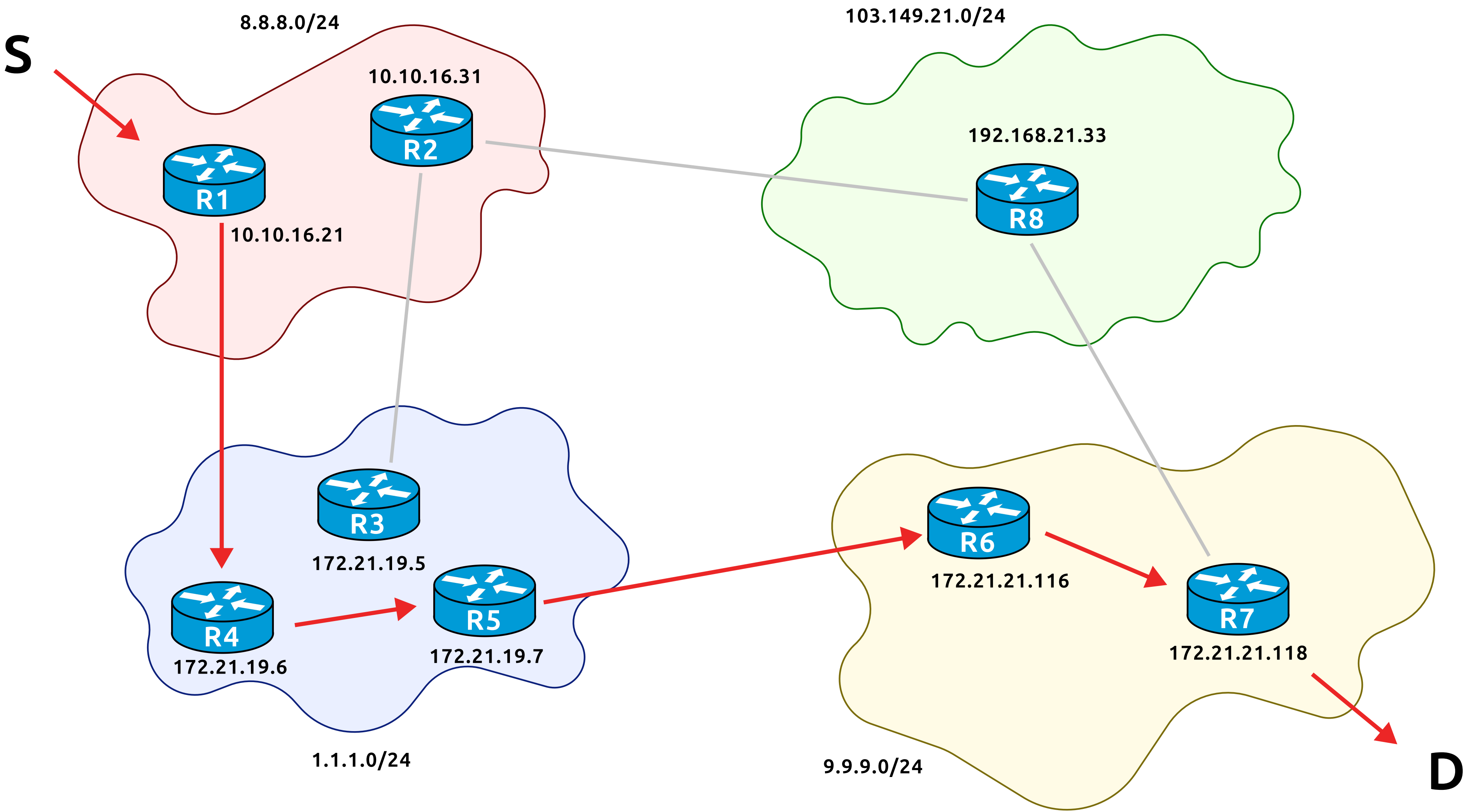
Internet - IP Routes



Internet - IP Routes

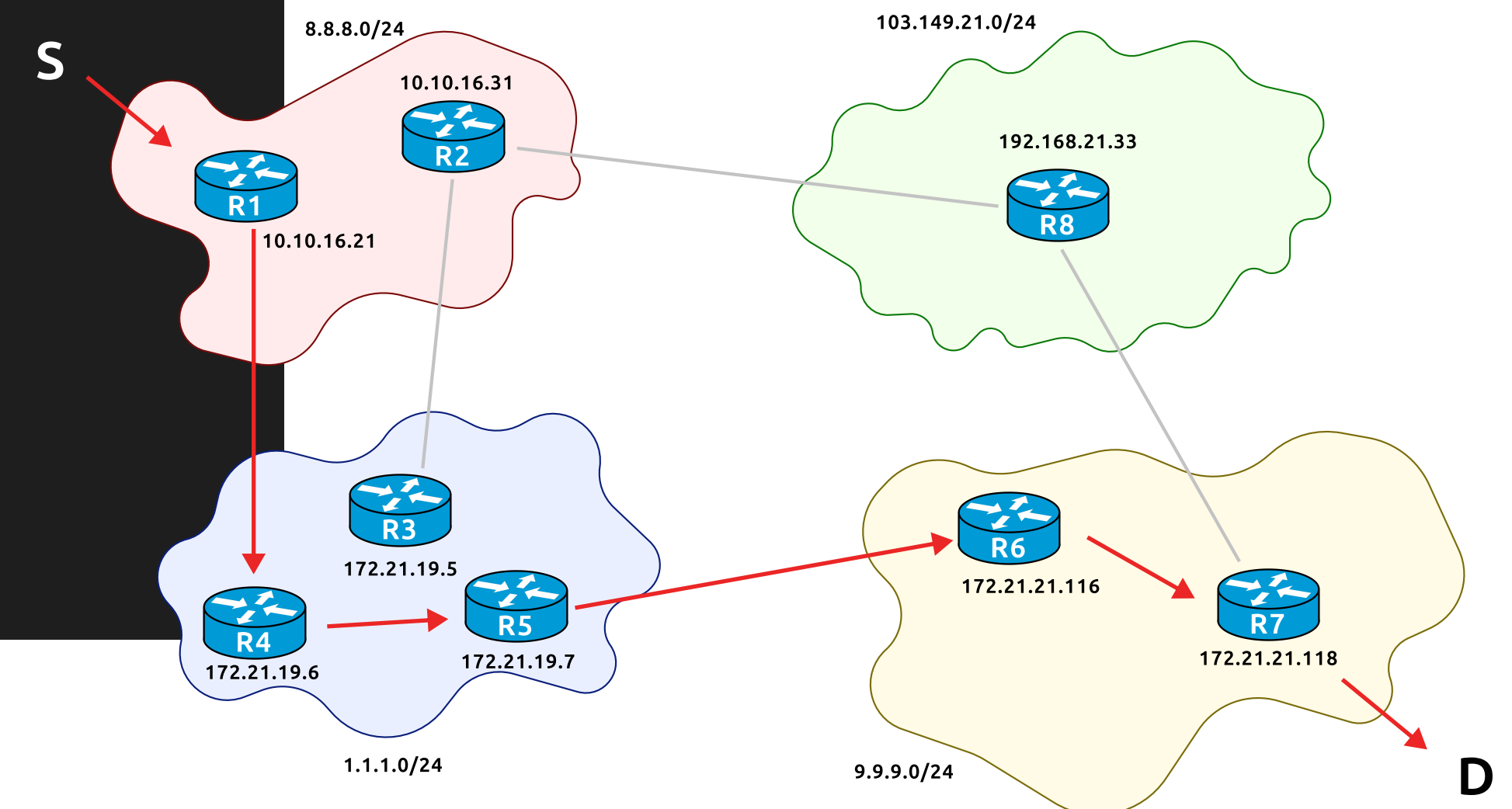


Internet - IP Routes

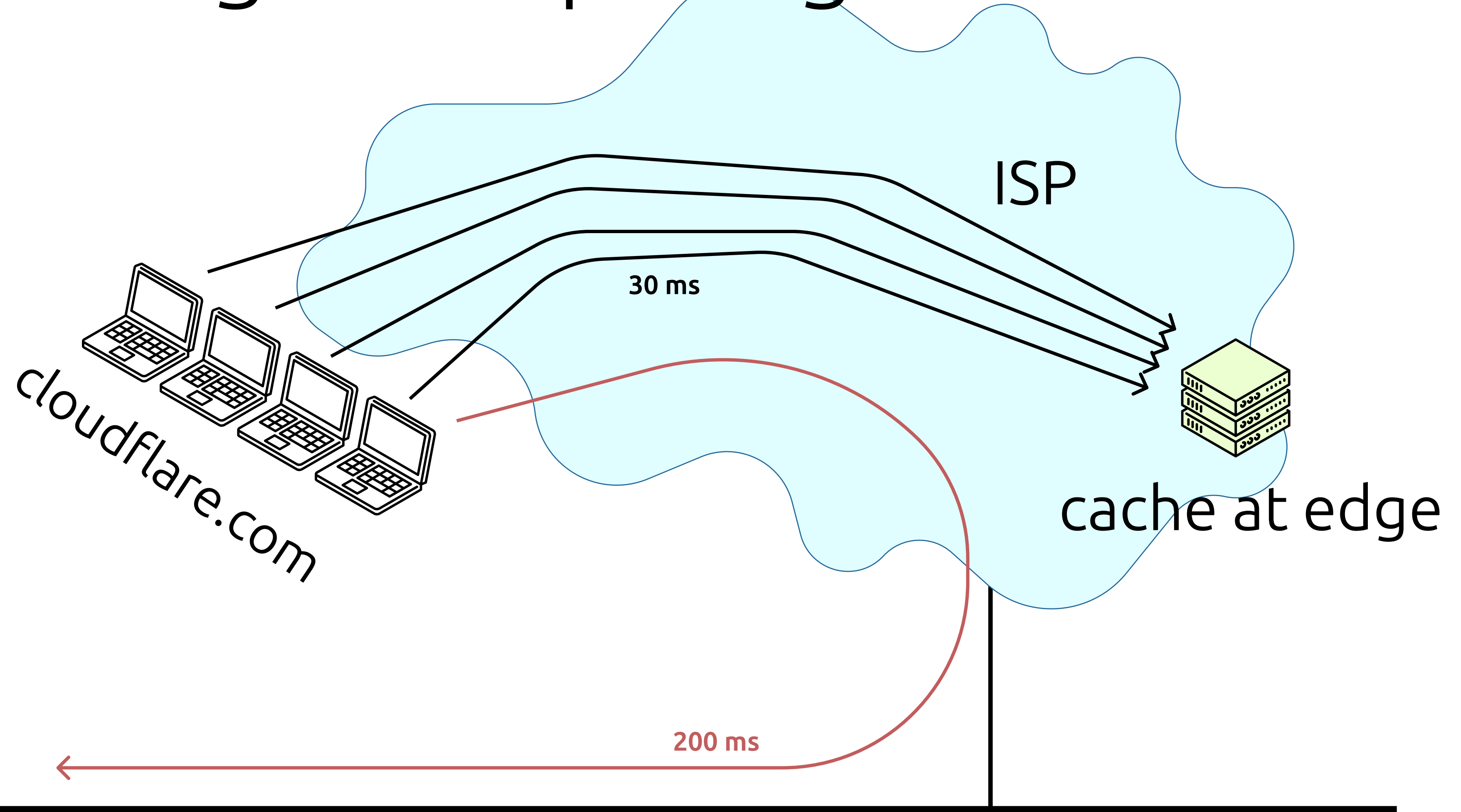


Internet - IP Routes

```
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
```

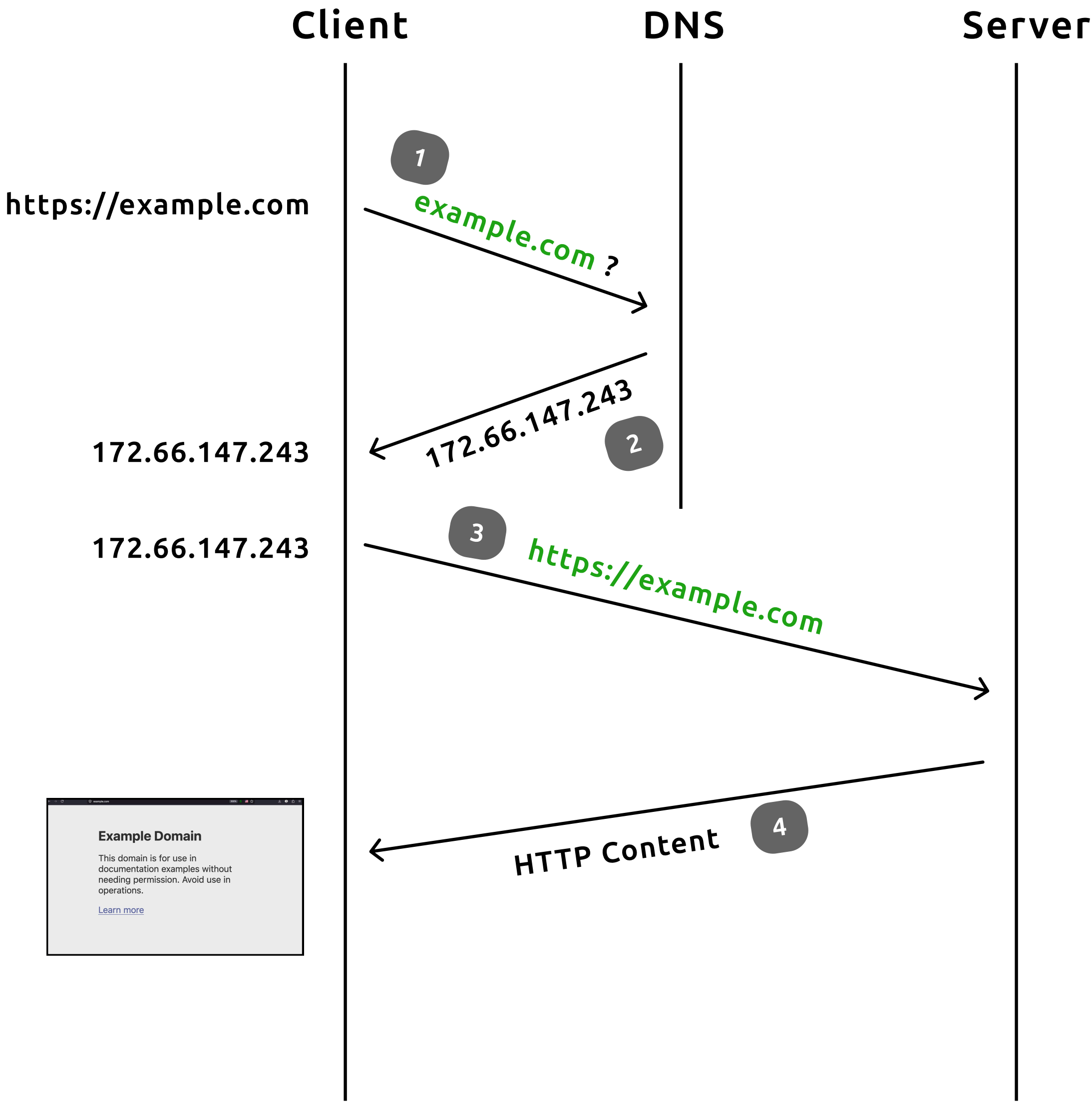
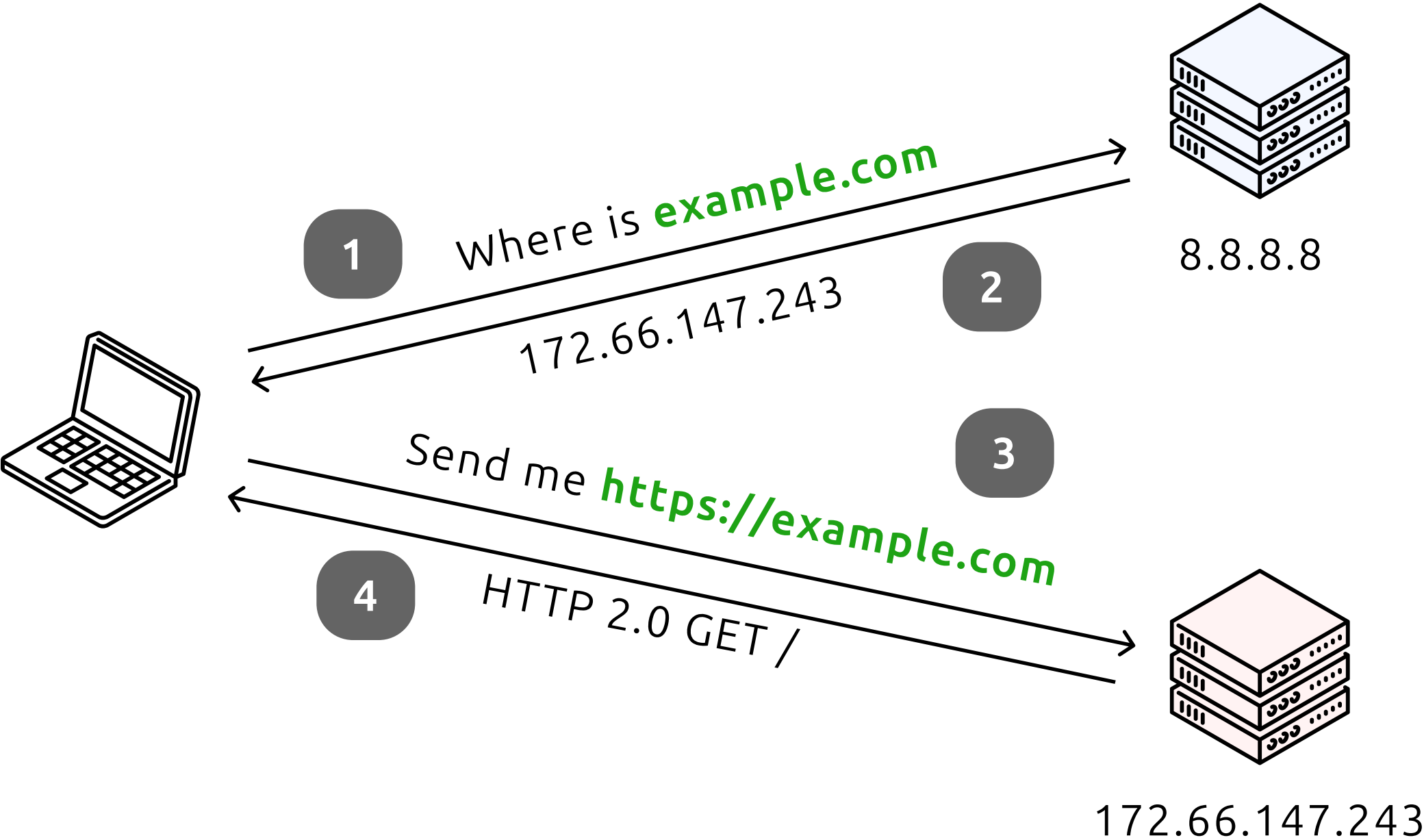


Internet - Edge Computing

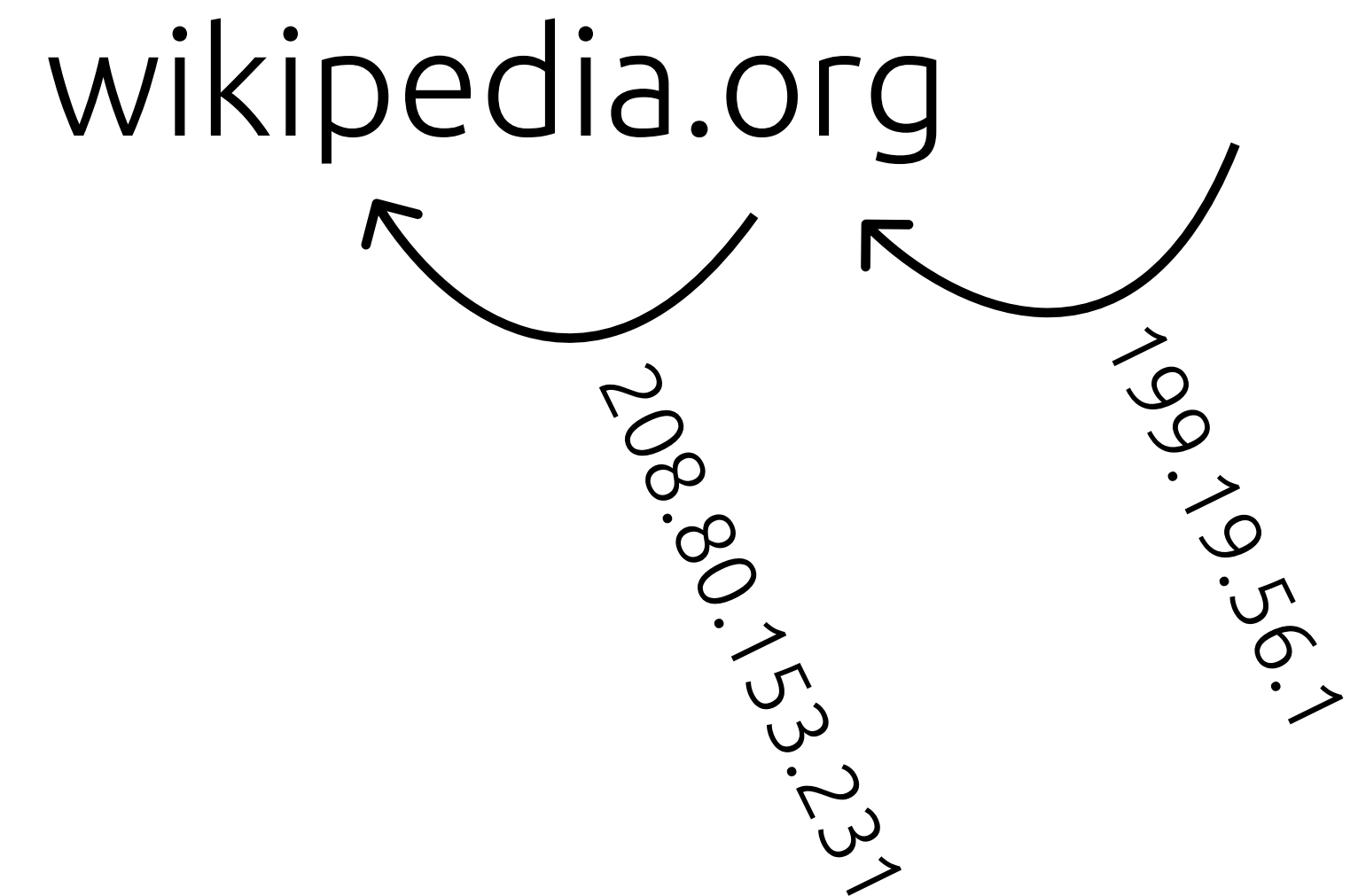
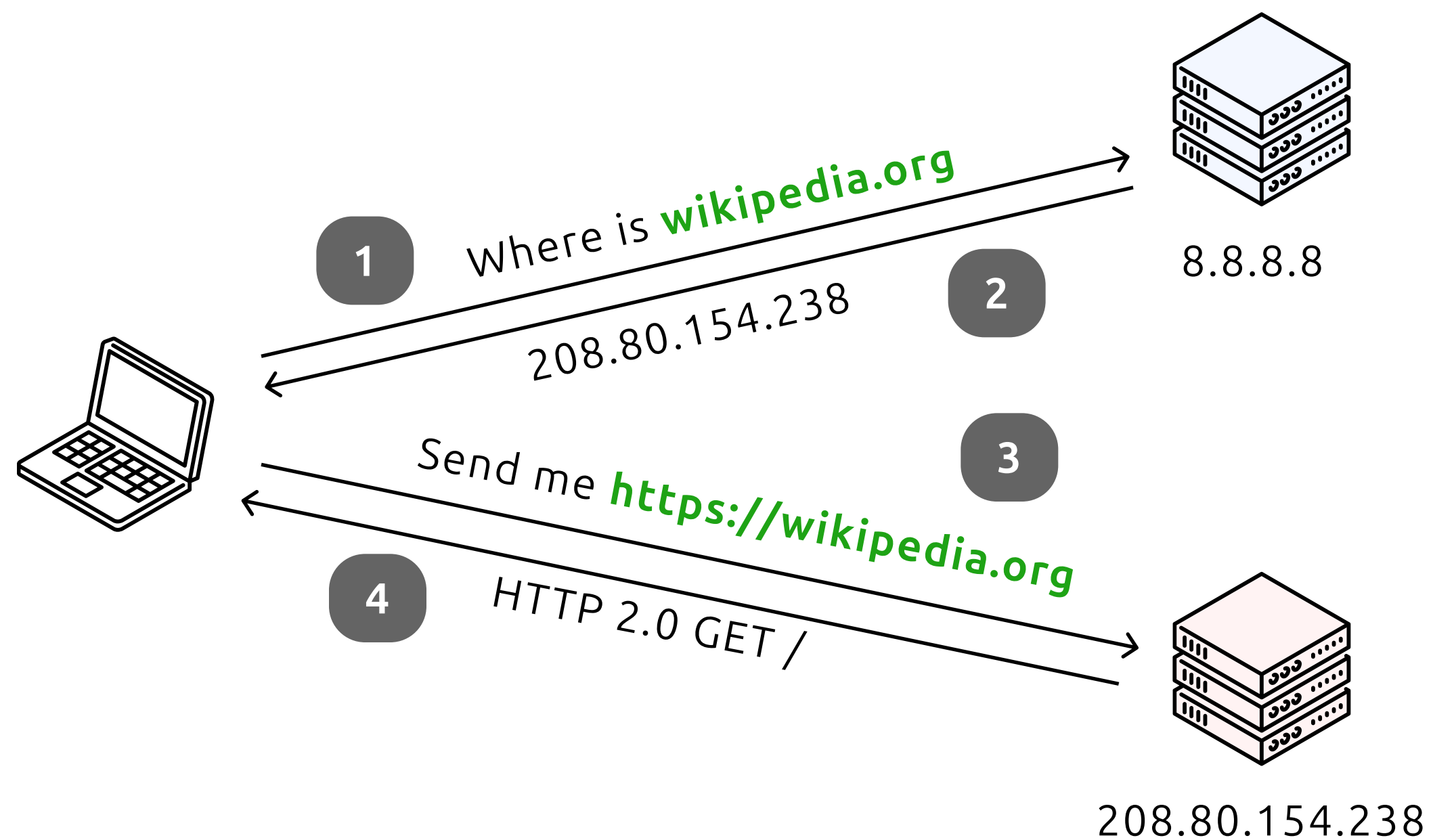


Internet

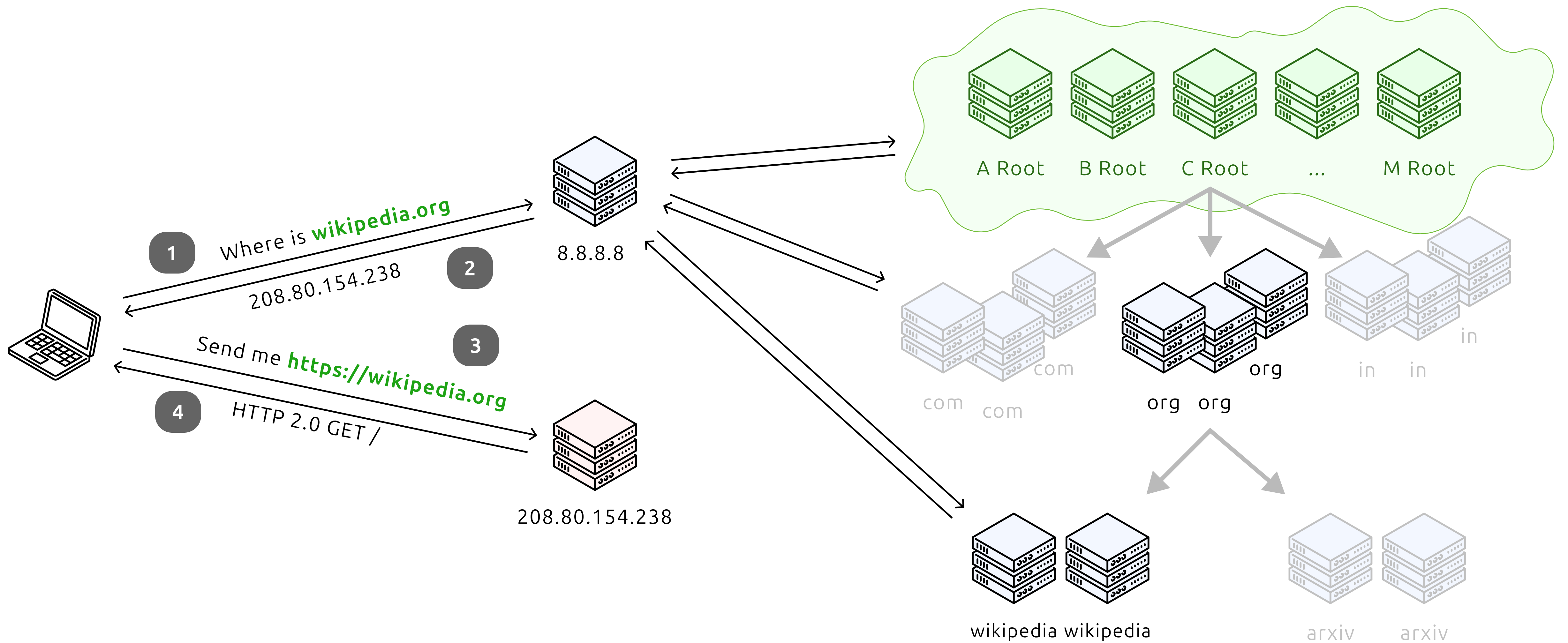
Internet - DNS

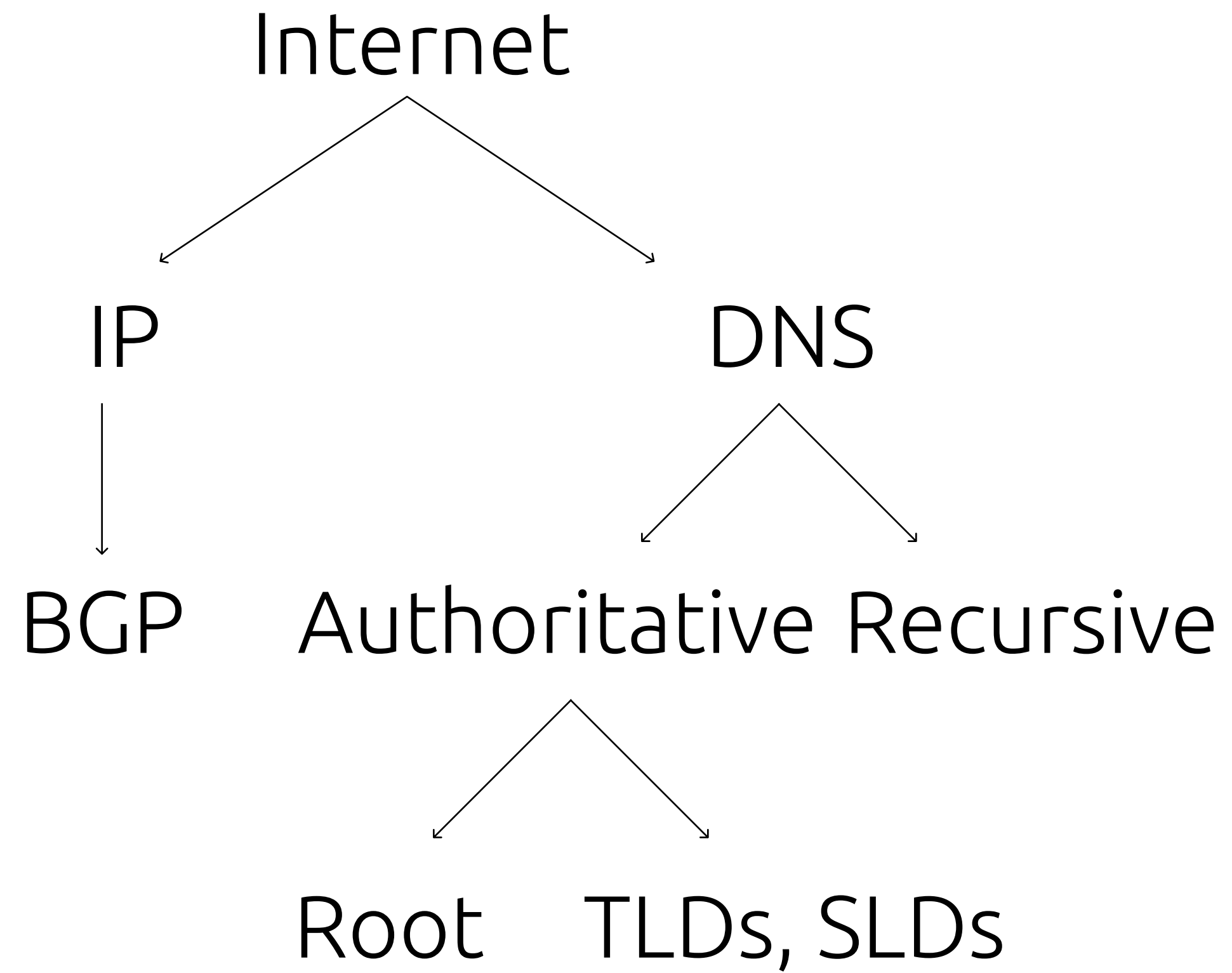


Internet - DNS



Internet - DNS





~~History~~

~~Internet Architecture~~

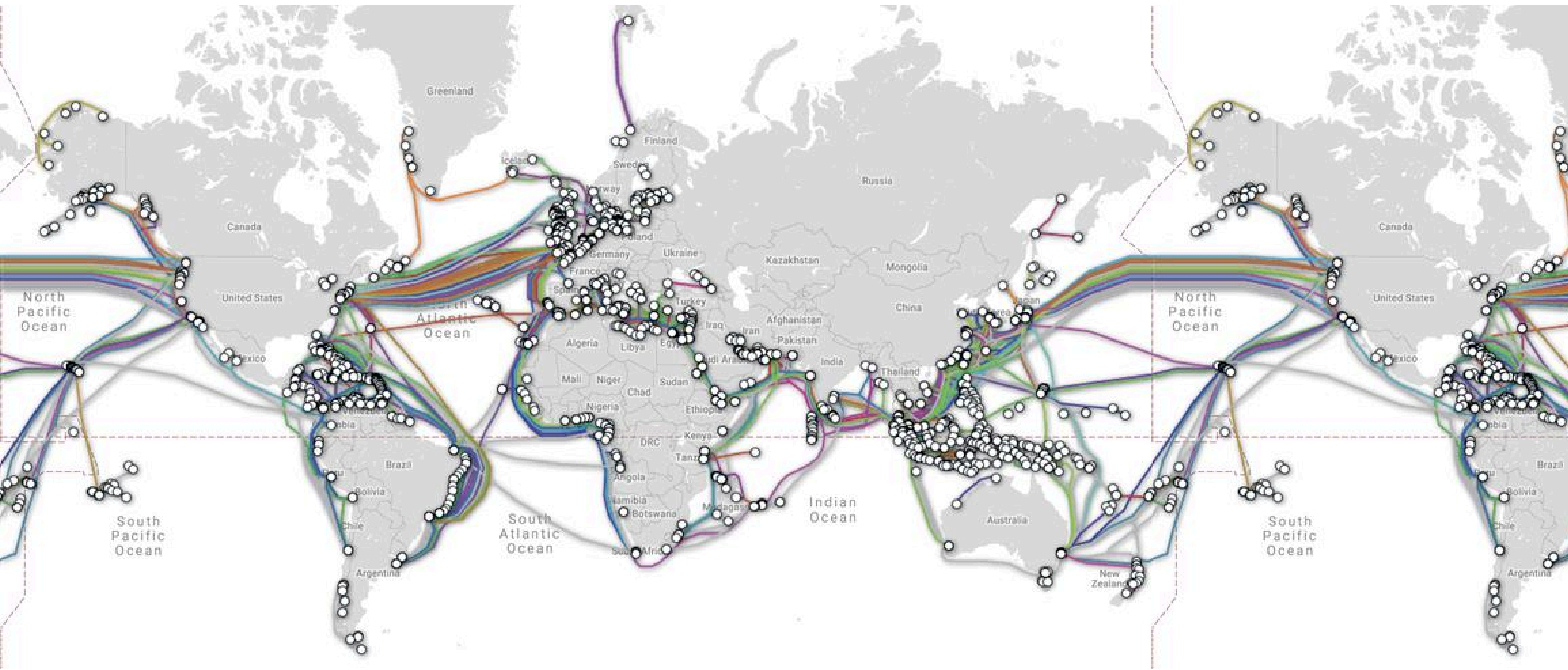
Infrastructure

Governance

Aiori

Infrastructure & Security

Infrastructure - Submarine



Infrastructure - Root Servers

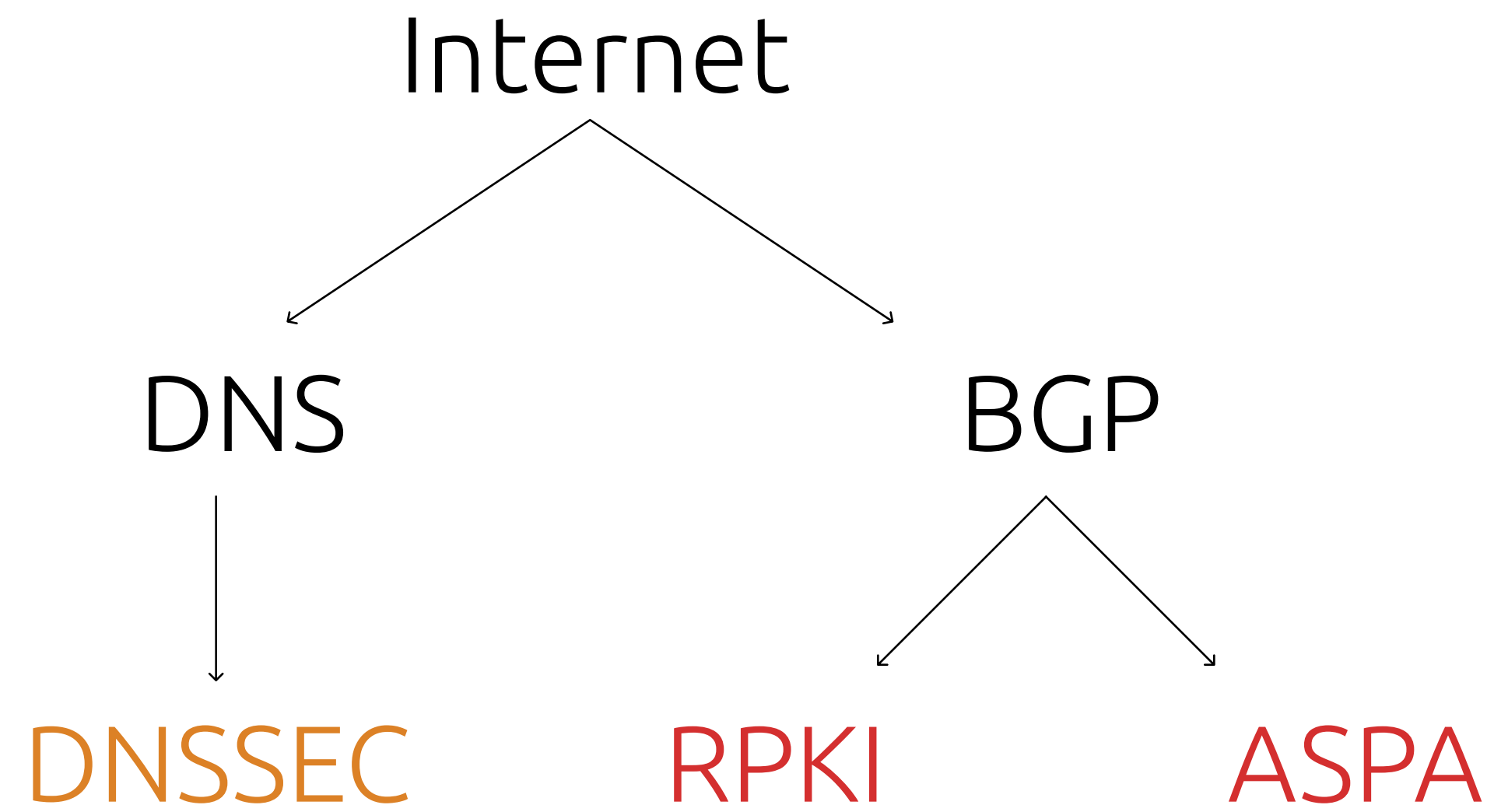
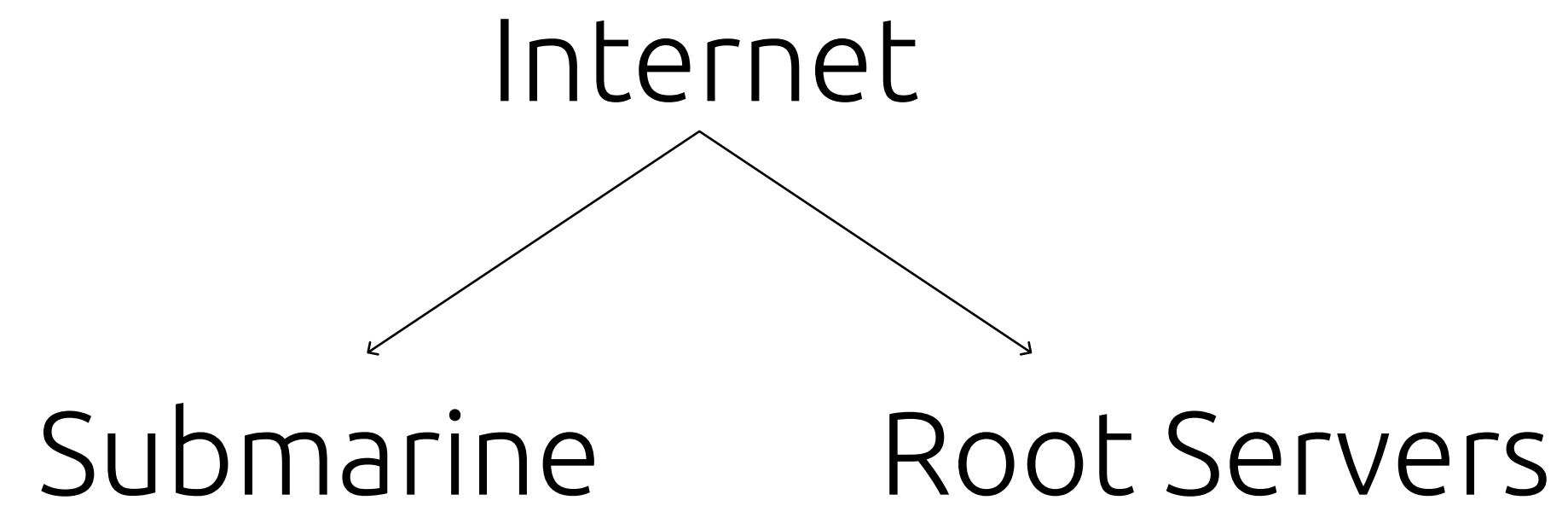


Internet Security

TLS [RFC4346, RFC5246, RFC8446]

SSL [RFC6101] RPKI [RFC8210]

DNSSEC [RFC9364]



~~History~~

~~Internet Architecture~~

~~Infrastructure~~

Governance

Aiori

Governance

Governance



Governance



Policies

Engineering

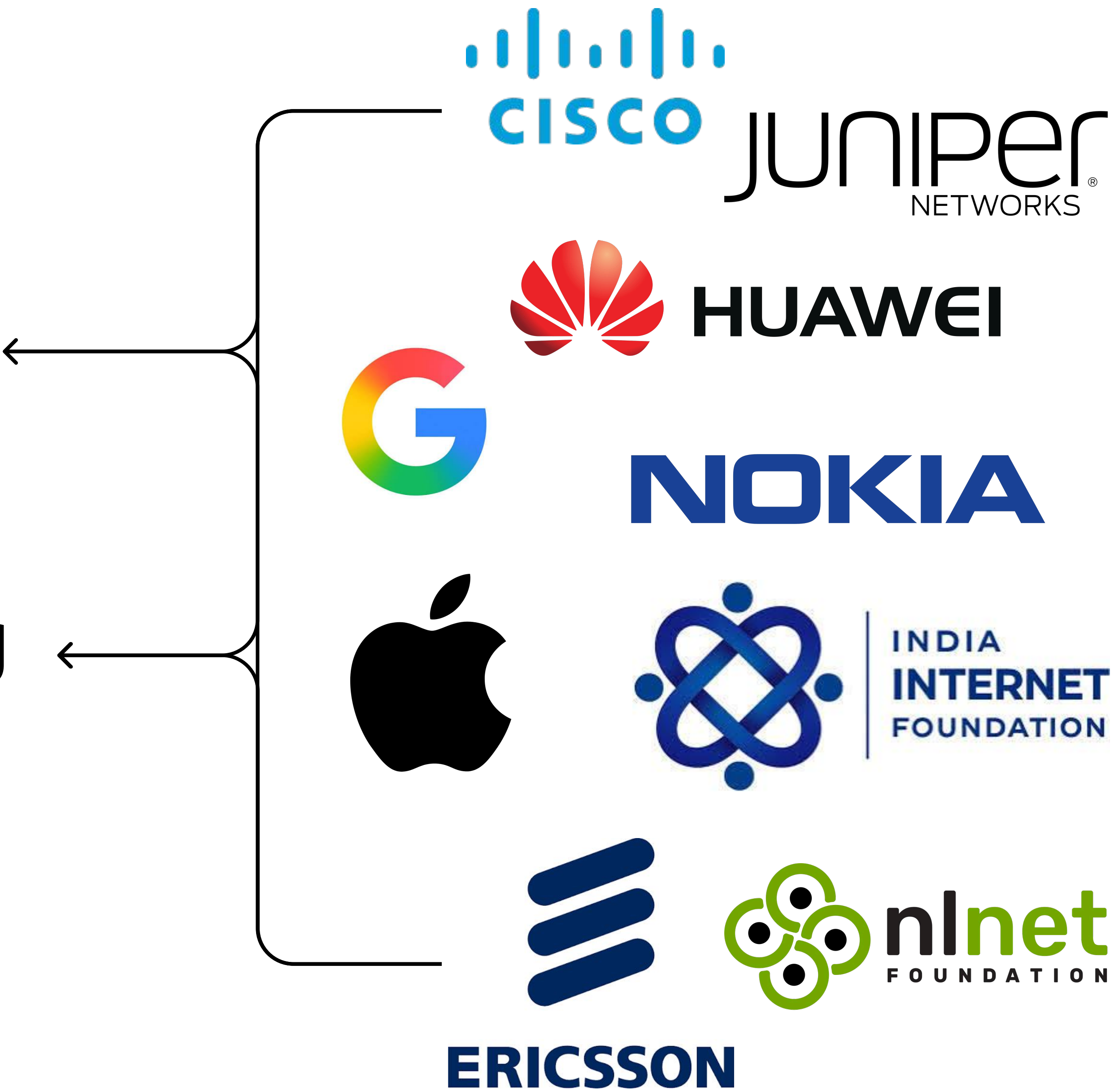
Registry

Governance



Policies

Engineering



Governance



Maintaining Registry for DNS



[Domains](#) [Protocols](#) [Numbers](#) [About](#)

Domain Names
Overview
Root Zone Management
Overview
Top-Level Domains
Files and Downloads
Manage Delegations
Instructions & Guides
.INT Registry
.ARPA Registry
IDN Practices Repository
Root Key Signing Key (DNSSEC)
Reserved Domains

Root Files

Downloadable versions of the DNS root zone and related files.

Root Zone Files

Operators who manage a DNS recursive resolver typically need to configure a "root hints file". This file contains the names and IP addresses of the authoritative name servers for the root zone, so the software can bootstrap the DNS resolution process. For advanced uses, the complete root zone file which contains the same data served by the root name servers.

↓	Root Hints	ZONE	Names and addresses of the root name servers
↓	Root Zone	ZONE	Authoritative root zone
↓	Root Trust Anchors	XML	Cryptographic keys (trust anchors) used to validate the DNS zone file content

Registry data

Information useful for importing into software and systems that need to know what is a valid top-level domain.

↓	TLD List	ASCII	Plain-text list of currently delegated top-level domains
---	--------------------------	-------	--

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 1970.]
19	DCN-MEAS	DCN Measurement Subsystems		[David Mills]

Governance



Internet Protocol - RIRs

(Regional Internet Registry)

Number Resources

Overview

RIR Allocation Data

- Overview
 - IPv6 (AFRINIC)
 - IPv6 (APNIC)
 - IPv6 (ARIN)
 - IPv6 (LACNIC)
 - IPv6 (RIPE NCC)
 - ASN (AFRINIC)
 - ASN (APNIC)
 - ASN (ARIN)
 - ASN (LACNIC)
 - ASN (RIPE NCC)
- #### Abuse Issues
- Overview
 - Questions and Answers

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

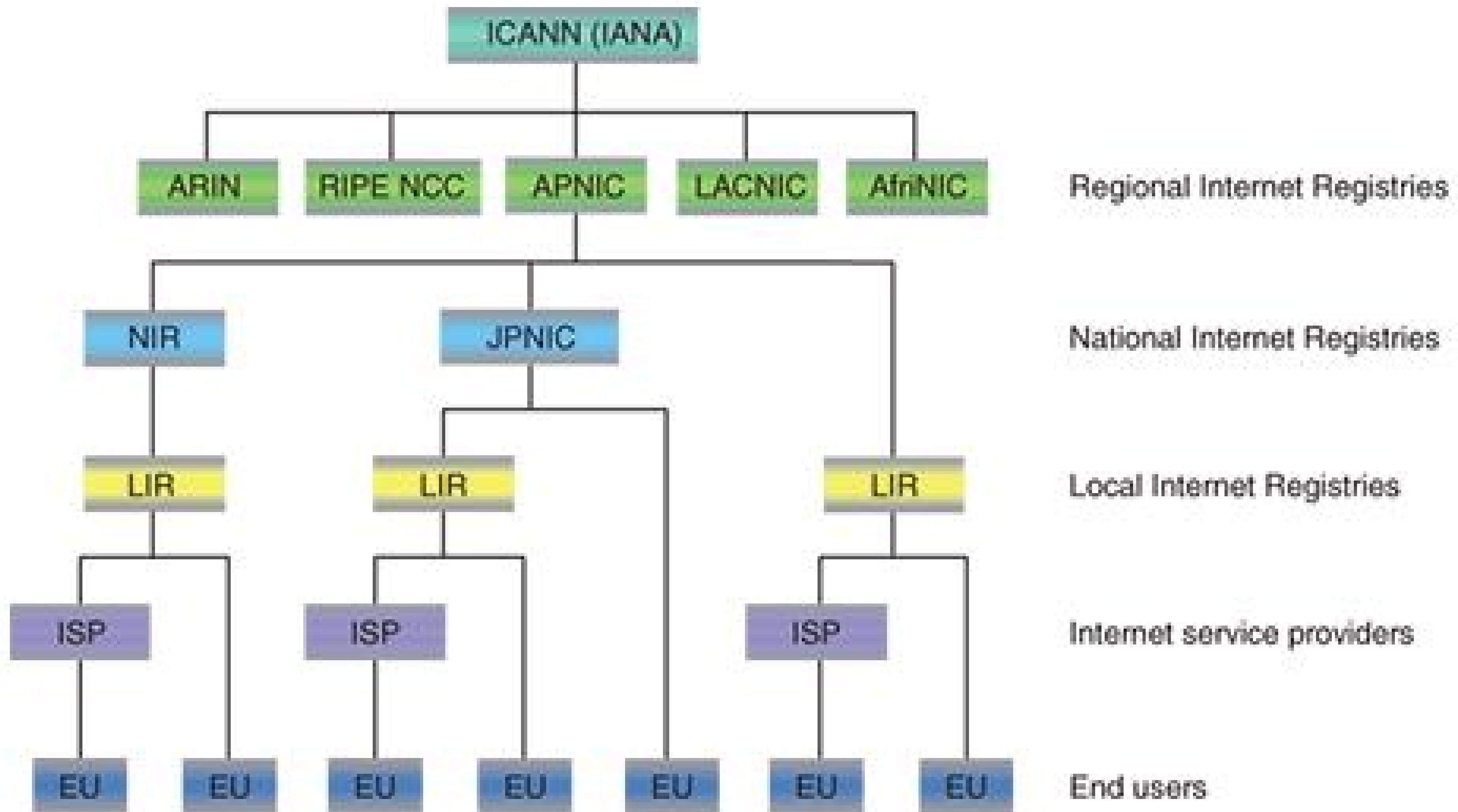
Our primary role for IP addresses is to allocate pools of unallocated addresses to the RIRs according to their needs as described by [global policy](#) and to document protocol assignments made by the [IETF](#). When an RIR requires more IP addresses for allocation or assignment within its region, we 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.

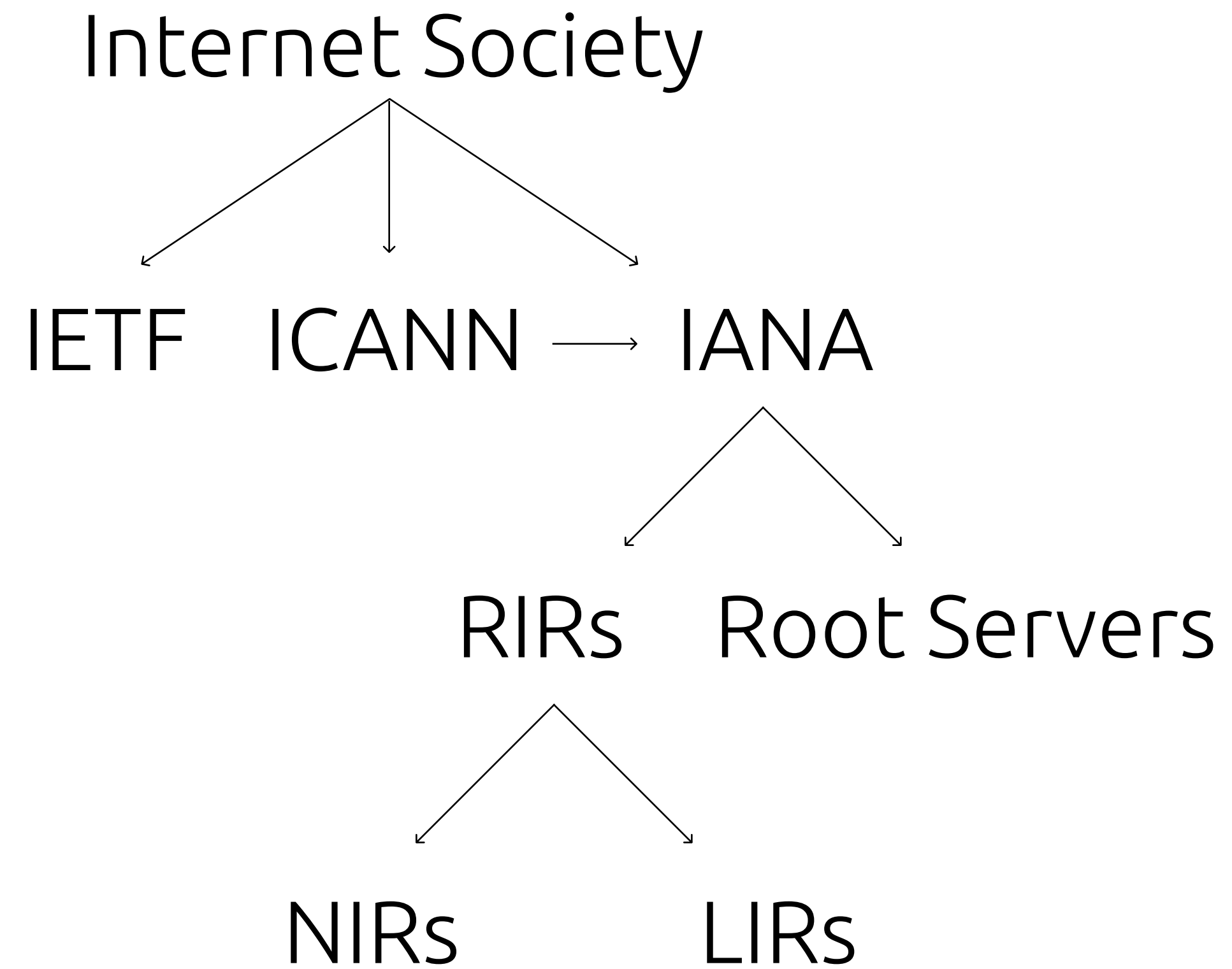
Governance



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~~

~~Internet Architecture~~

~~Infrastructure~~

~~Governance~~

Aiori

AIORI

Research

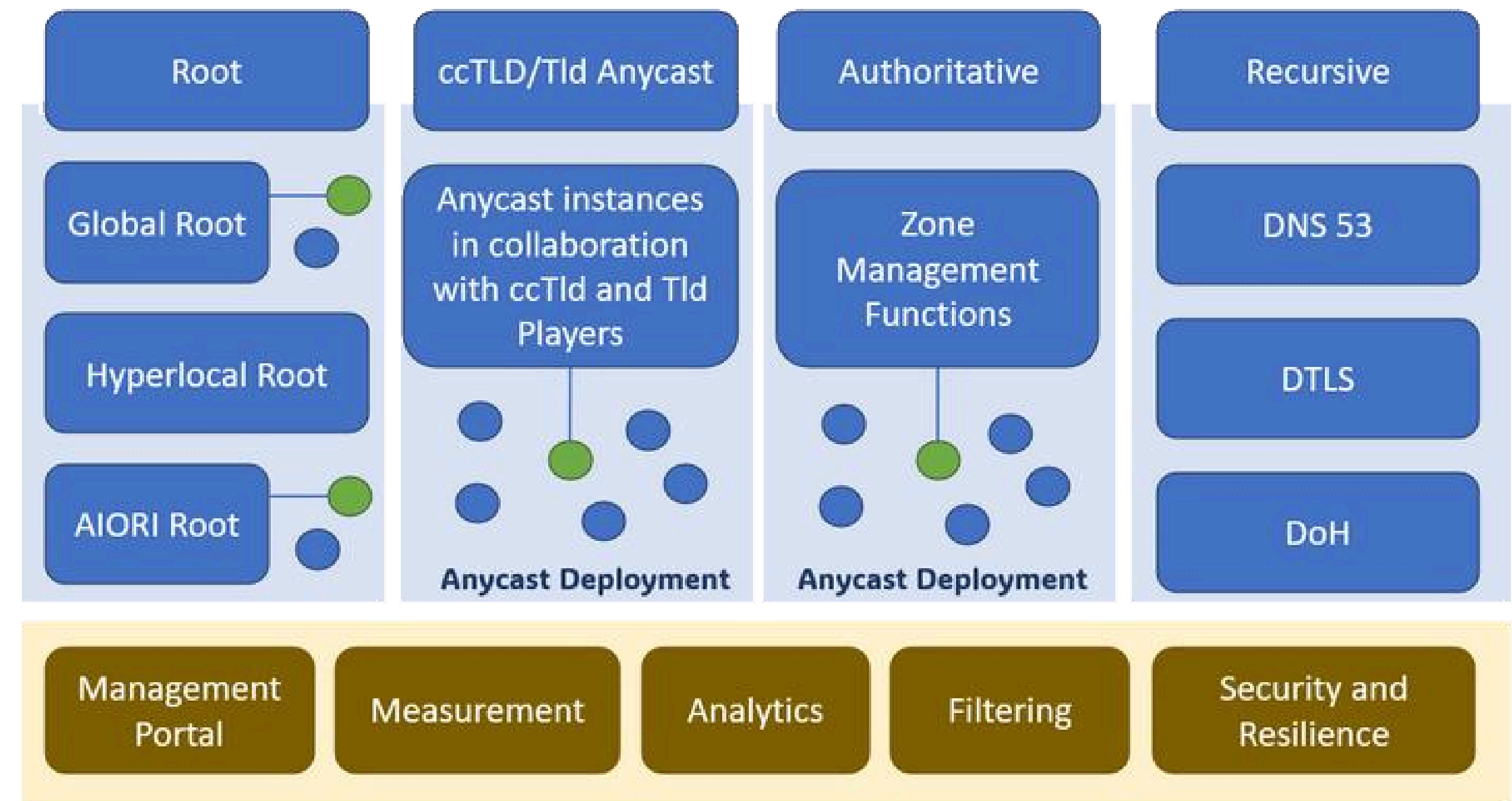
- Internet Infrastructure
- Measurement & Analysis

Internet Infrastructure

Resilient DNS
Implementations

Post Quantum
Cryptography

IP Geolocation

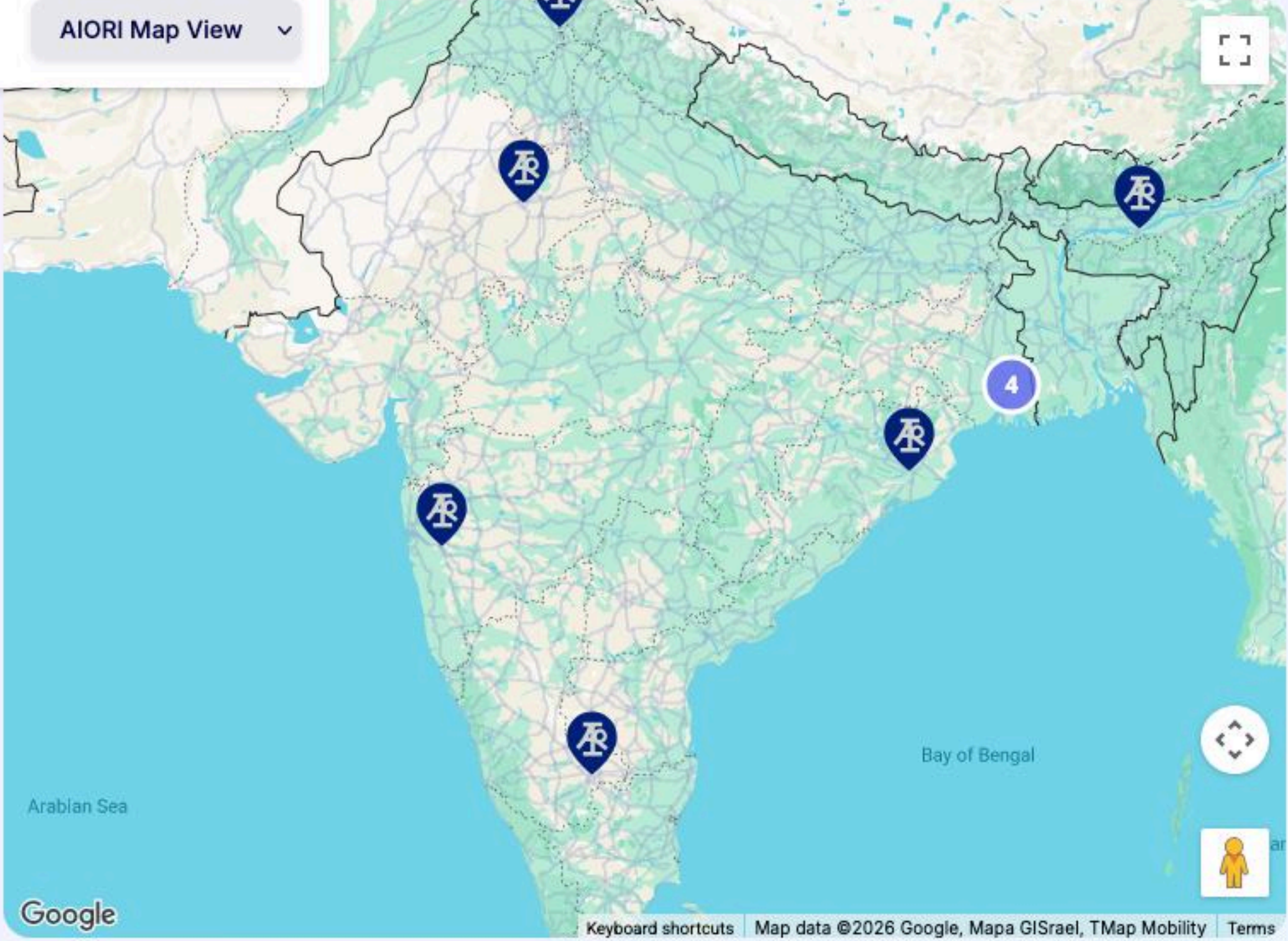


Measurement & Analysis



Measurement & Analysis

AIORI Map View



Arabic Sea

Bay of Bengal

Google

Keyboard shortcuts | Map data ©2026 Google, Mapa GISrael, TMap Mobility | Terms

AIORI Clusters

Anchor Network

Know Your Latency

Enter your domain:

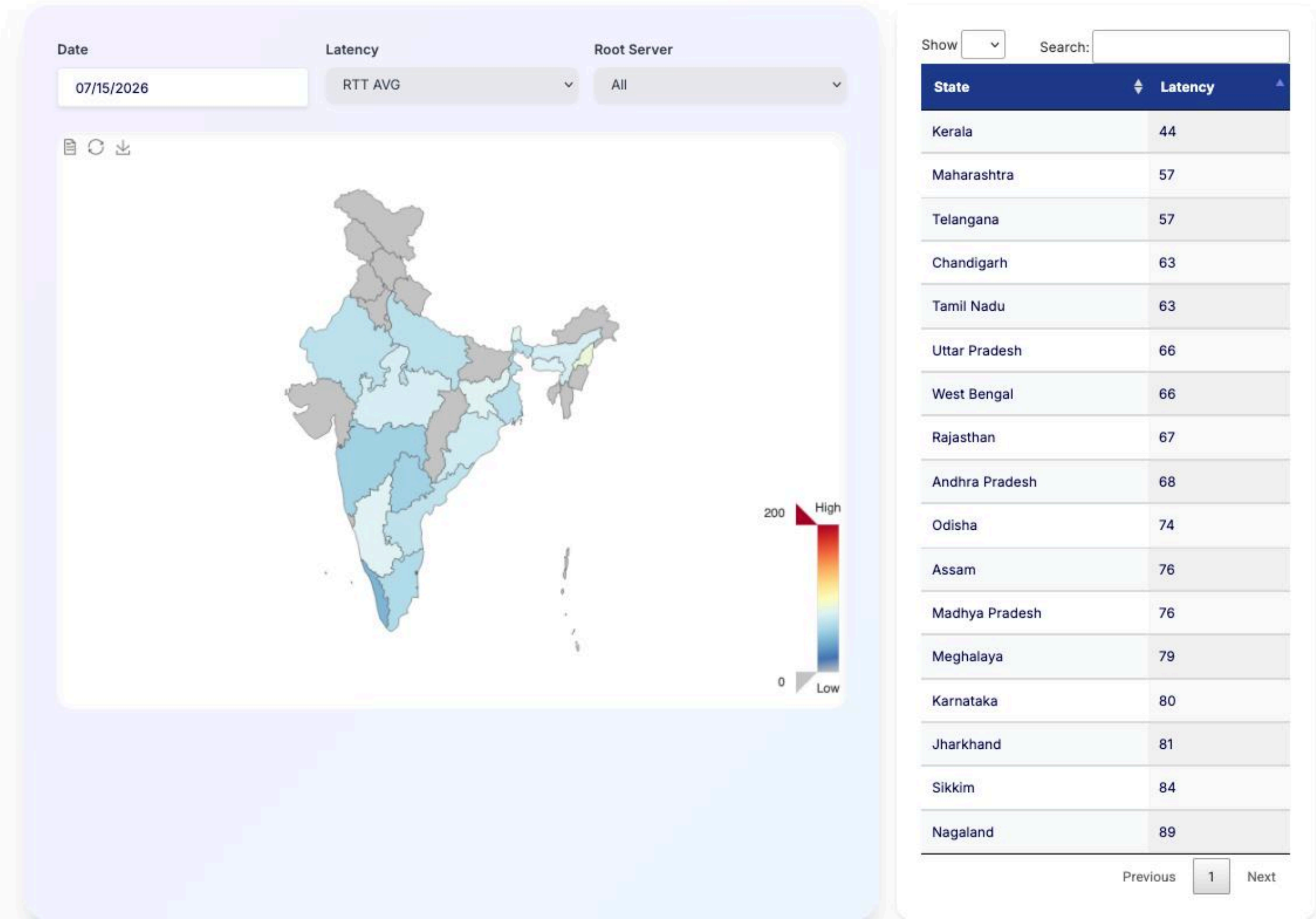
example.com

☐ I'm not a robot 

Show

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
Infrastructure
Governance
Aiori

We Saw

History plays an important role in understanding the current Internet.

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

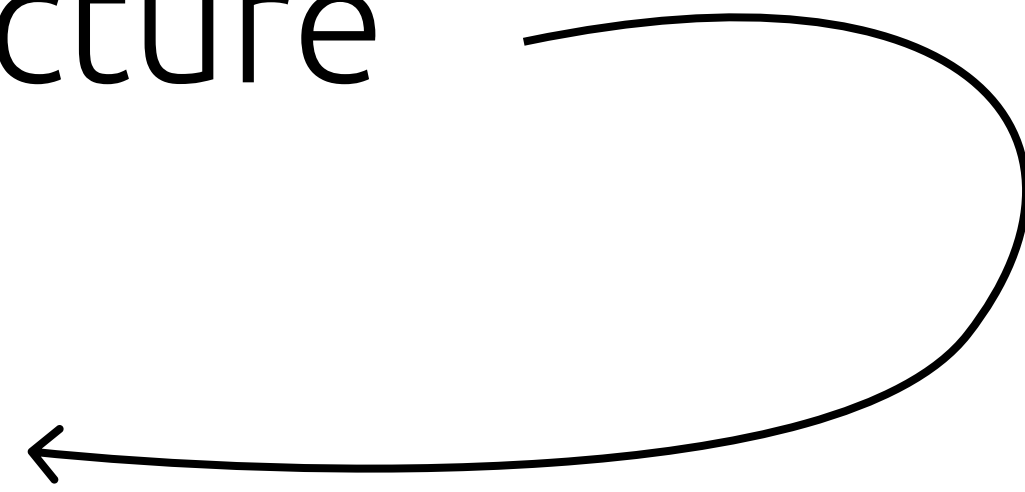
History

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

We Saw

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

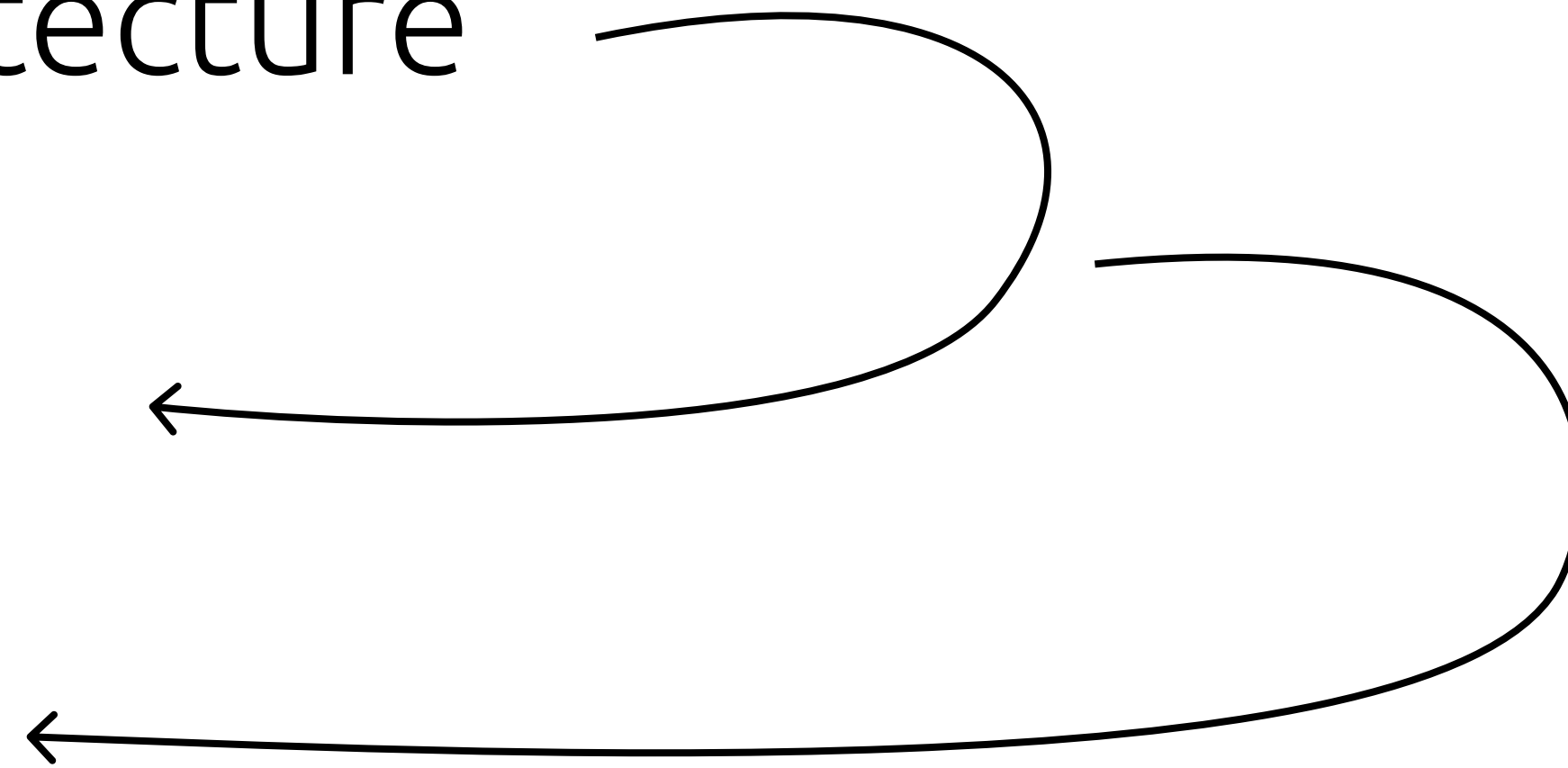
History

Internet Architecture

Infrastructure

Governance

Aiori



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