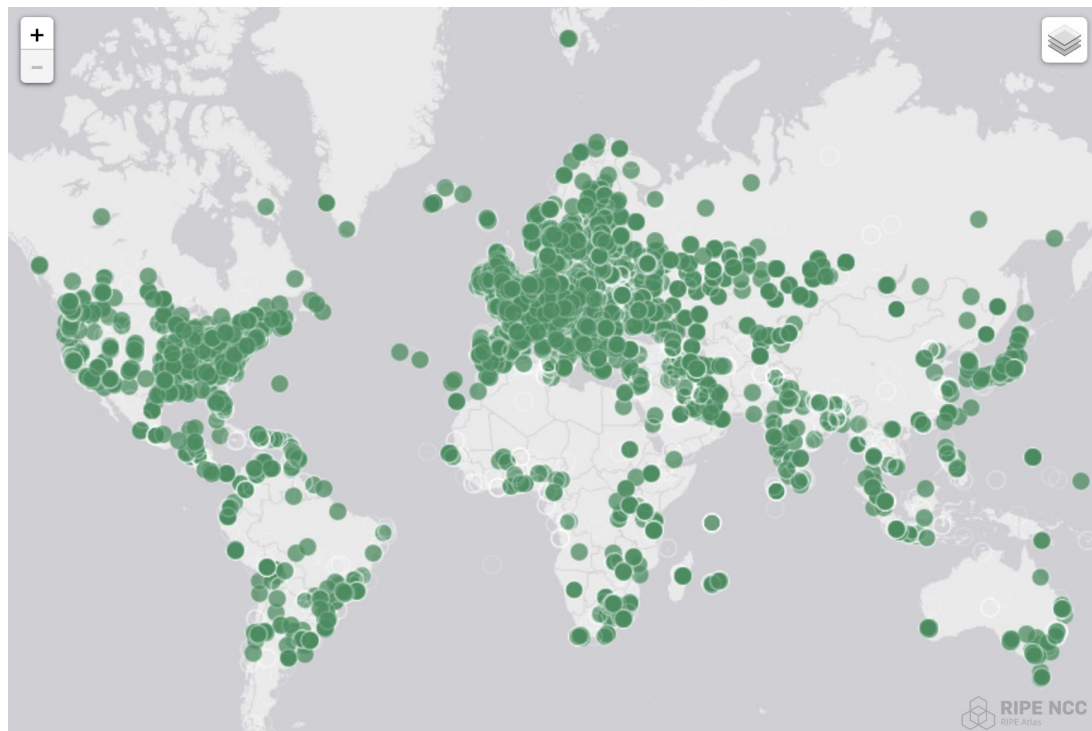


Analysing global CDN performance using **RIPE Atlas**

Emir Beganović
RIPE SEE 8
Sarajevo, April 2019.

RIPE Atlas introduction

largest Internet measurement network ever made



RIPE Atlas features

- 10k probes
- Mutual usage
- Credits
- User-defined measurements
- Web UI & API

Coverage

IPv4 ASNs covered - 3602 (5.627%)

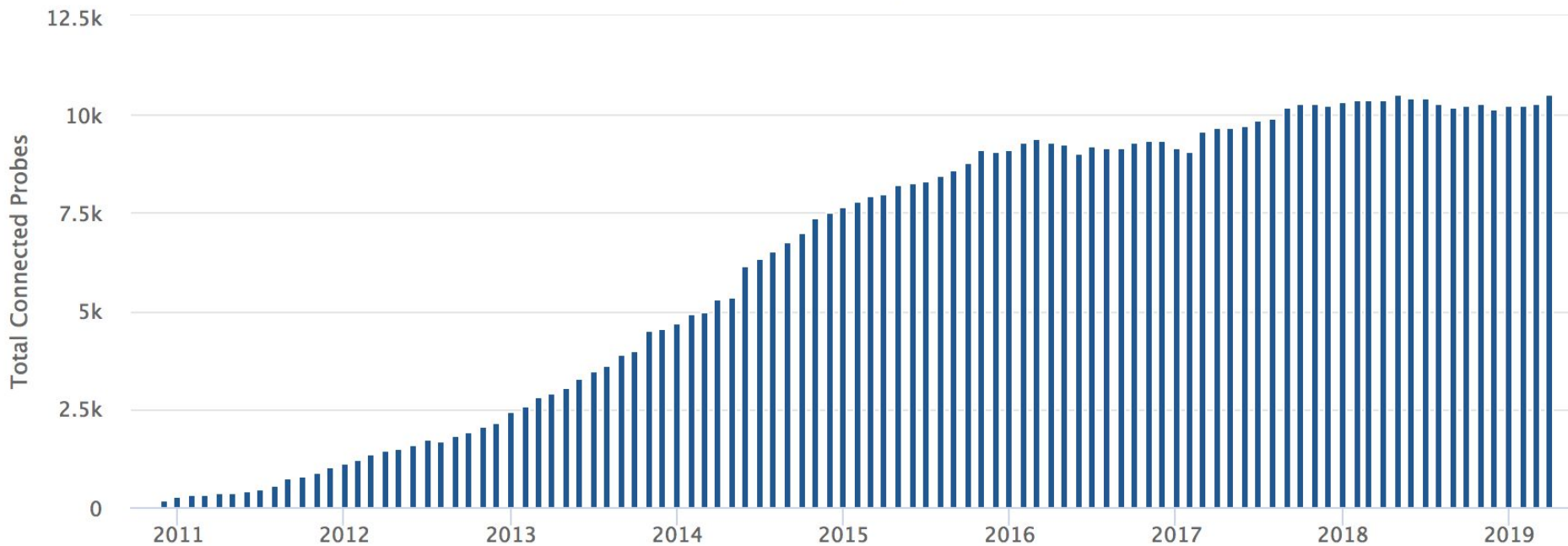
IPv6 ASNs covered - 1446 (8.617%)

Number of countries covered - 182 (92.857%)

Statistics

Probes

The number of connected probes



Statistics

Connected: 10484

Disconnected: 1640

Abandoned: 11560

RIPE Atlas web UI

- Simple web wizard
- Costs summary

Create a New Measurement

Step 1 Definitions

▼ Ping measurement to www.google.com

Target:

An IP address or hostname

Address Family*:

Packets:

Size:

Description:

Interval:

How often this should be done (seconds between samples). Note that this value is ignored for one-off measurements.

Tags

A list of comma separated tags

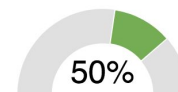
Resolve on Probe:
Force the probe to do DNS resolution

[Advanced Options](#)

+ Ping + Traceroute + DNS + SSL + HTTP + NTP

Costs summary

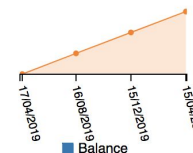
Daily cost: 10800 credits



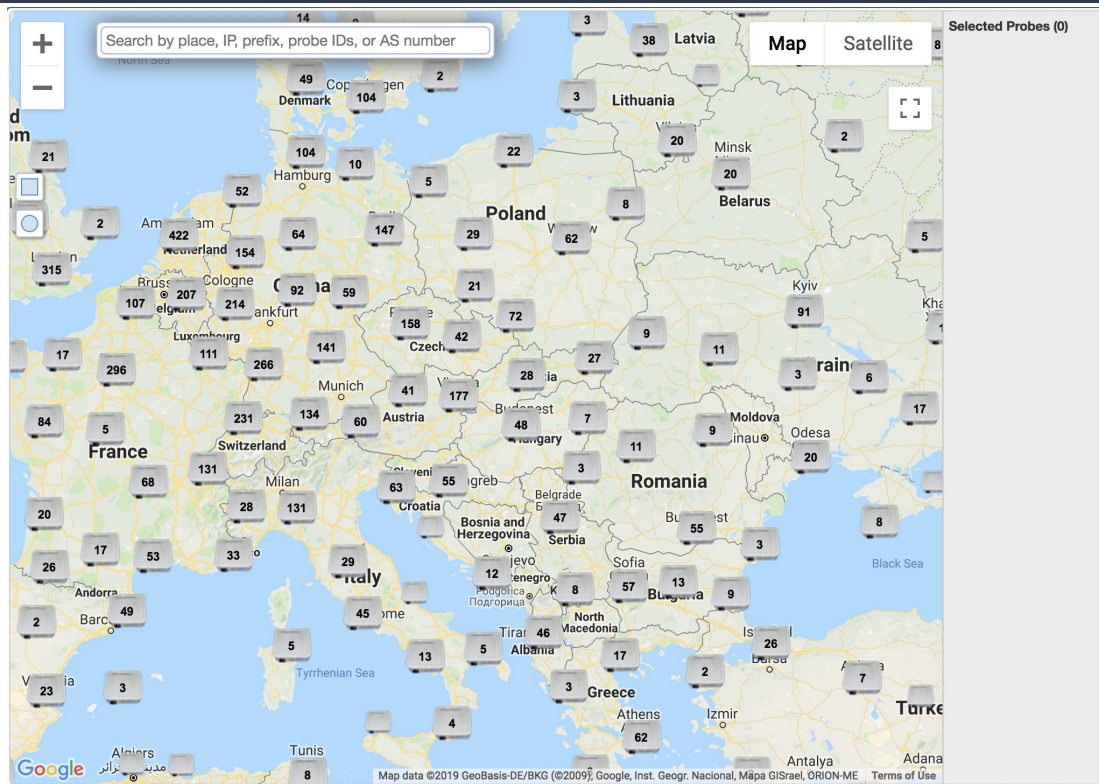
This measurement would cost 50.0% of your daily income

The new cost of all your measurements would be 170.6% of your daily income

You will not run out of credits in a year



RIPE Atlas web UI



Create your selection

In this panel you can manually create a probe selection. If you need more help or you want to visualize where the probes are, please use the wizard selection.

Type (mandatory)

asn

Autonomous System Number (mandatory)

9146

Number of probes (mandatory)

50

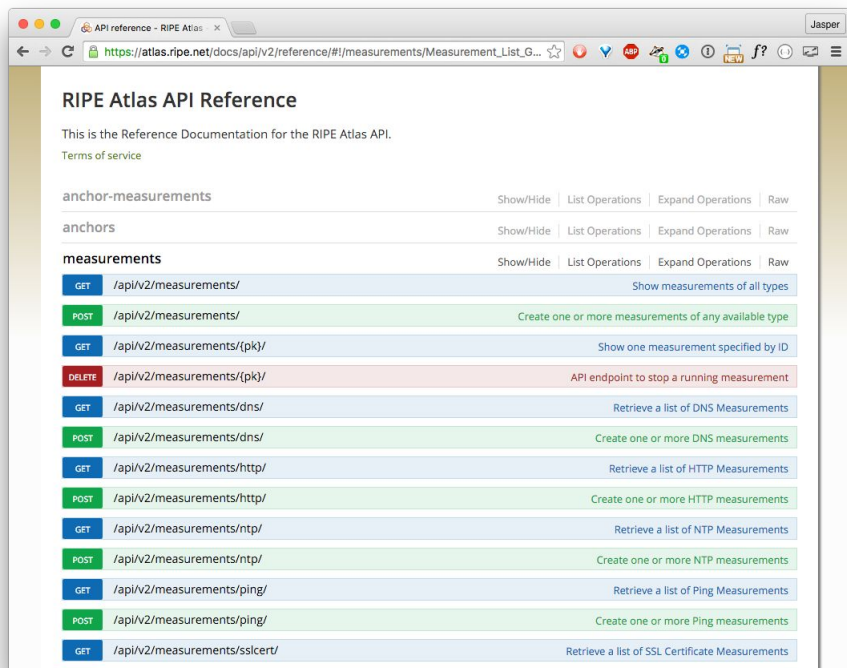
Include tags

Exclude tags

Cancel

Add

RIPE Atlas API



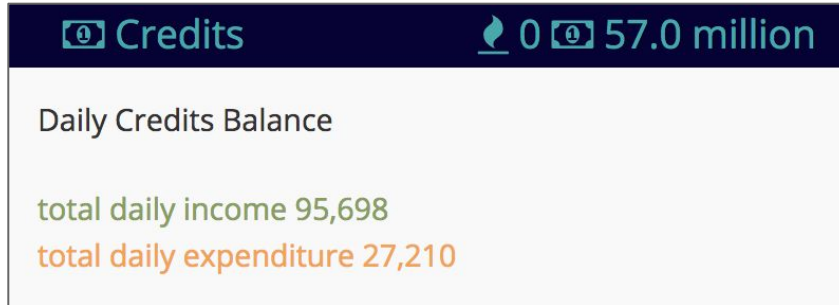
The screenshot shows a web browser window with the URL `https://atlas.ripe.net/docs/api/v2/reference/#/measurements/Measurement_List_G...`. The page title is "RIPE Atlas API Reference". Below the title, there is a sub-header "RIPE Atlas API Reference" and a paragraph: "This is the Reference Documentation for the RIPE Atlas API." followed by a link for "Terms of service". The main content is a list of API endpoints categorized into "anchor-measurements", "anchors", and "measurements". Each category has a "Show/Hide", "List Operations", "Expand Operations", and "Raw" link. The "measurements" section lists various endpoints with their HTTP methods and descriptions:

Method	Endpoint	Description
GET	/api/v2/measurements/	Show measurements of all types
POST	/api/v2/measurements/	Create one or more measurements of any available type
GET	/api/v2/measurements/{pk}/	Show one measurement specified by ID
DELETE	/api/v2/measurements/{pk}/	API endpoint to stop a running measurement
GET	/api/v2/measurements/dns/	Retrieve a list of DNS Measurements
POST	/api/v2/measurements/dns/	Create one or more DNS measurements
GET	/api/v2/measurements/http/	Retrieve a list of HTTP Measurements
POST	/api/v2/measurements/http/	Create one or more HTTP measurements
GET	/api/v2/measurements/ntp/	Retrieve a list of NTP Measurements
POST	/api/v2/measurements/ntp/	Create one or more NTP measurements
GET	/api/v2/measurements/ping/	Retrieve a list of Ping Measurements
POST	/api/v2/measurements/ping/	Create one or more Ping measurements
GET	/api/v2/measurements/sslcert/	Retrieve a list of SSL Certificate Measurements

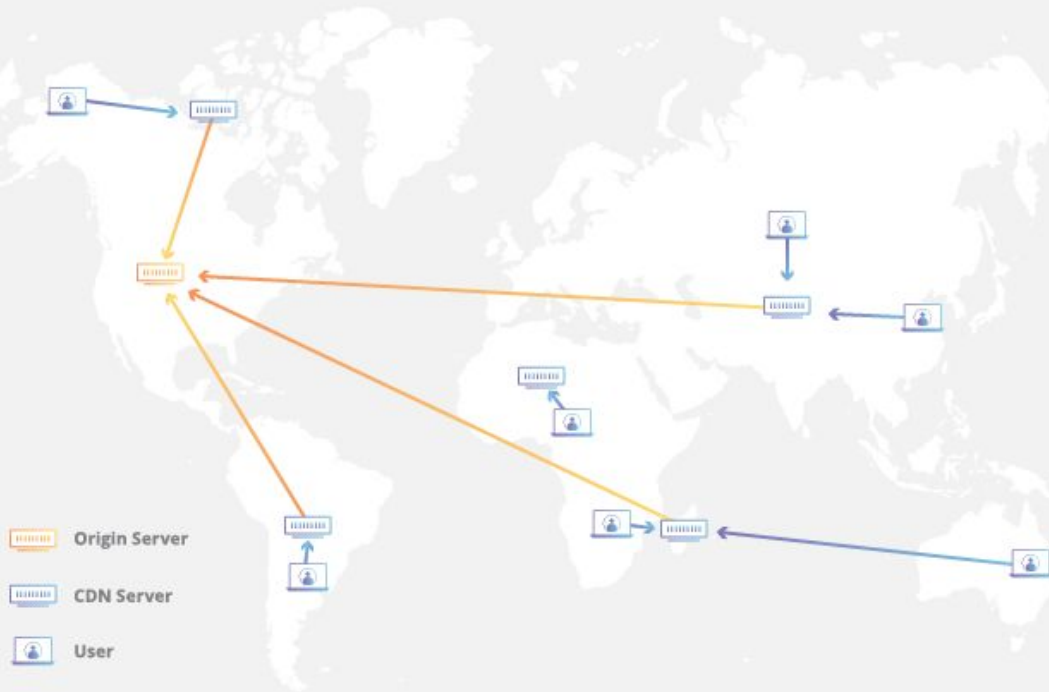
```
{  
  "definitions": [  
    {  
      "target": "www.google.ba",  
      "af": 4,  
      "timeout": 4000,  
      "description": "Traceroute to Google",  
      "protocol": "ICMP",  
      "resolve_on_probe": true,  
      "packets": 3,  
    }  
  ]  
}
```

Background

- Atlas probe up since 2014
- Analysis for private and public use



CDNs



- Faster load time
- Offloading traffic costs
- Ensure traffic spikes
- Caching

Why analyse CDN performance?

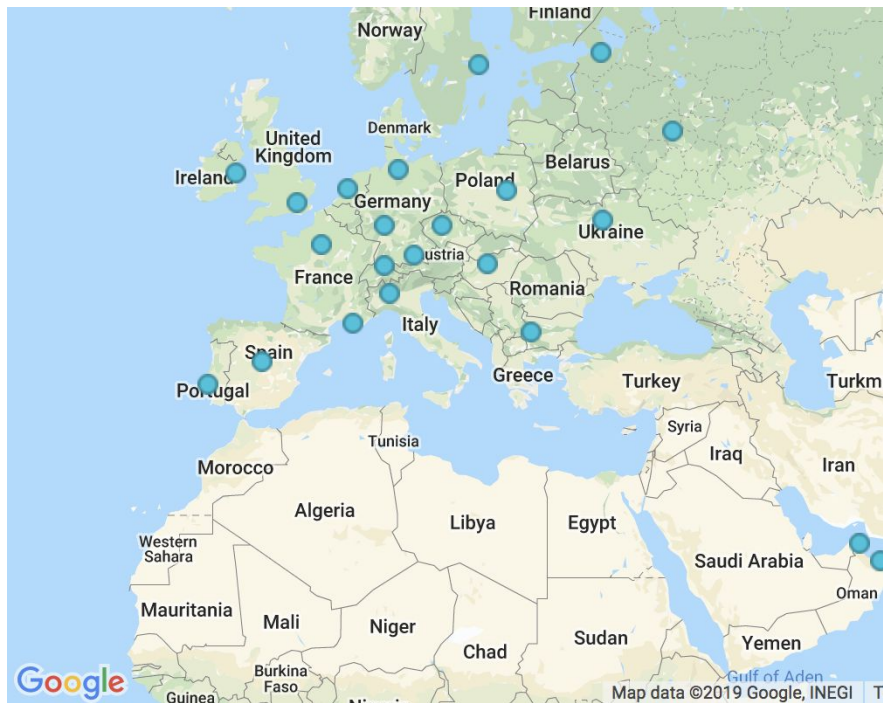
- 9/10 of top 10 websites in BiH use a CDN
- Most popular services in the country: heavy CDN based
 - Facebook/Instagram, Youtube, Netflix, etc.
- Picking up a CDN for a new project
- Get a global overview of the best CDN for particular country, region, continent or **globally**

Methodology

1. Define a list of CDNs to analyse:

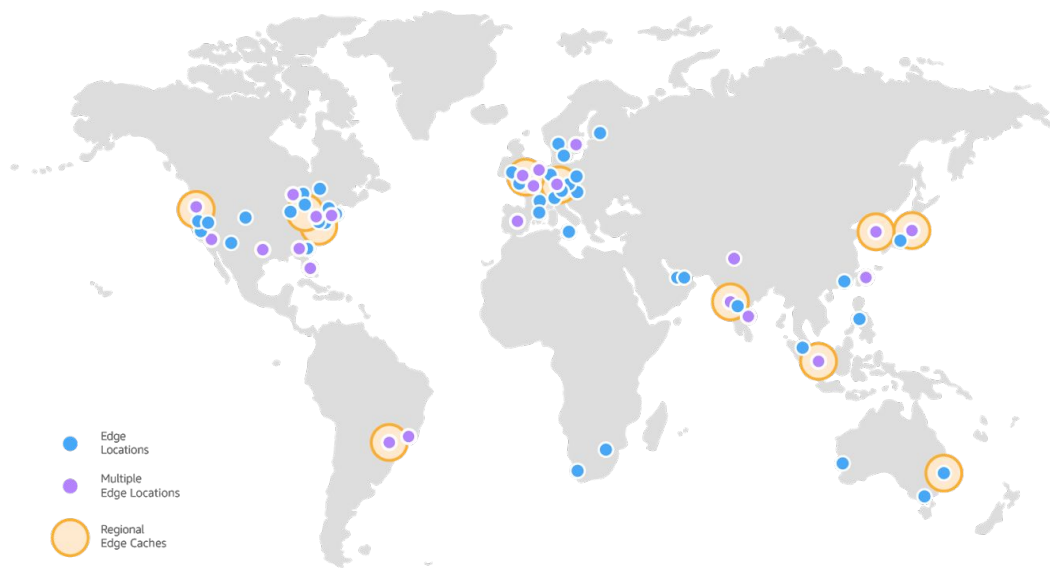
- Akamai
- AWS Cloudfront
- Azure
- Cloudflare
- Google Cloud
- Fastly
- Cachefly

Google Cloud CDN



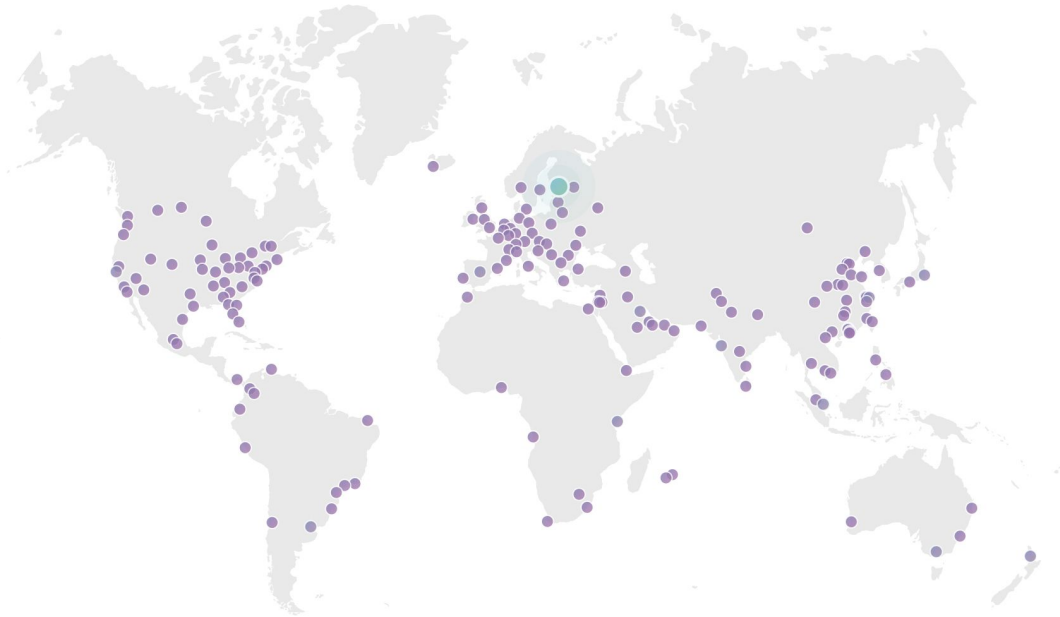
- Edge Points of Presence
- Can be used for Storage & LB

AWS Cloudfront



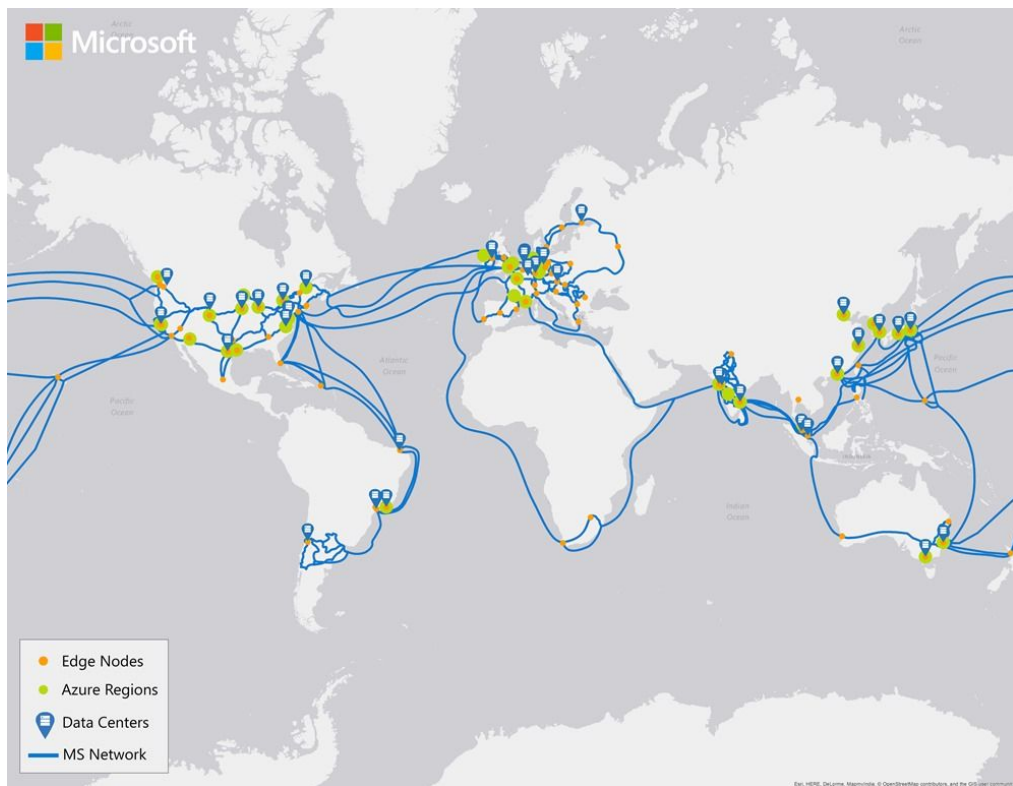
- 166 POPs
 - 155 Edge locations
 - 11 Regional Edge Caches
- 29 countries

Cloudflare



- 175 POPs
- BiH: most popular

Microsoft Azure



- 129 POPs

Cachefly



Methodology

2. Creating measurements using RIPE Atlas API

- Small script, written in Go
- For each 2-digit ISO country code & CDN combination
 - Create a 3-packet ping measurement, up to 50 probes

Methodology

2. Creating measurements using RIPE Atlas API

- 3-packet ping measurement

```
var CDNProviders = []CDN{
    {Name: "akamai", Destination: "www.fifa.com"},
    {Name: "azure", Destination: "contoso.azureedge.net"},
    {Name: "cachefly", Destination: "web1.cachefly.net"},
    {Name: "cloudflare", Destination: "1.1.1.1"},
    {Name: "googlecloud", Destination: "130.211.37.1"},
    {Name: "cloudfront", Destination: "d7uri8nf7uskq.cloudfront.net"},
    {Name: "fastly", Destination: "www.fastly.com"},
}
```

Methodology

2. Creating measurements using RIPE Atlas API

- Using only working probes tagged as:
 - `system-ipv4-capable`
 - `system-ipv4-works`
 - `system-resolves-a-correctly`
- Consume the API response, save created measurement IDs































Methodology

2. Creating measurements using RIPE Atlas API

- Issue: Throttling on RIPE Atlas side of 100 concurrent measurements and up to 1 million credits daily
- Issue: some requests failed - not all countries represented

Methodology

Measurement results

Probe	ASN (IPv4)	ASN (IPv6)		Time (UTC)	RTT	Packet Loss
25089	42571		 	2019-03-17 14:14	 2.685	0.0%
33688	202632		 	2019-03-17 14:14	 10.452	0.0%
6366	8670		 	2019-03-17 14:14	 13.487	0.0%
33680	8670	8670	 	2019-03-17 14:14	 13.841	0.0%
24750	8670		 	2019-03-17 14:14	 14.353	0.0%
1244	42560		 	2019-03-17 14:14	 17.599	0.0%
14628	42560		 	2019-03-17 14:14	 25.908	0.0%
22970	16178		 	2019-03-17 14:14	 26.294	0.0%
51134	25144		 	2019-03-17 14:14	 29.654	0.0%
33681	35567		 	2019-03-17 14:14	 53.304	0.0%

Methodology

3. Parsing API responses

- Wait until API limits are lifted & repeat
- Fetching all measurement results after they're done

```
[  
  - {  
    af: 4,  
    avg: 73.4259346667,  
    dst_addr: "1.1.1.1",  
    dst_name: "1.1.1.1",  
    dup: 0,  
    from: "77.77.192.120",  
    fw: 4790,  
    group_id: 20236449,  
    lts: 159,  
    max: 185.128741,  
    min: 17.549572,  
    msm_id: 20236449,  
    msm_name: "Ping",  
    prb_id: 1244,  
    proto: "ICMP",  
    rcvd: 3,  
    - result: [  
      - {  
        rtt: 185.128741  
      },  
      - {  
        rtt: 17.599491  
      },  
      - {  
        rtt: 17.549572  
      }  
    ],  
    sent: 3,  
    size: 48,  
    src_addr: "77.77.192.120",  
    step: null,  
    stored_timestamp: 1552832072,  
    timestamp: 1552832054,  
    ttl: 54,  
    type: "ping"  
  },  
]
```

Methodology

3. Parsing API responses

- Storing measurements in format akamai/BA.json
- Parsing JSON, using **avg** field for average RTT from the results

Methodology

4. Creating final result set

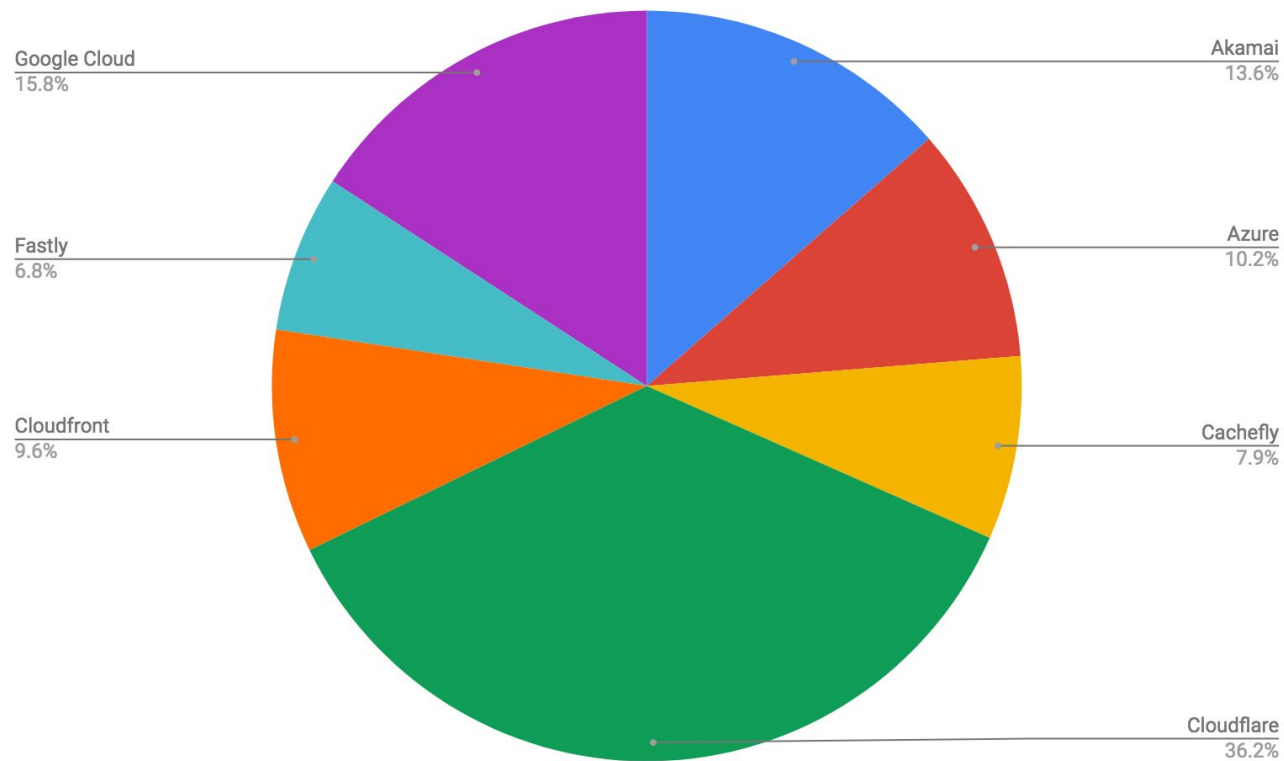
- Saving the calculated average RTT for each measurement to final DB
- Deriving a result set in format: ISO2 country code, fastest CDN, average RTT

~50.000

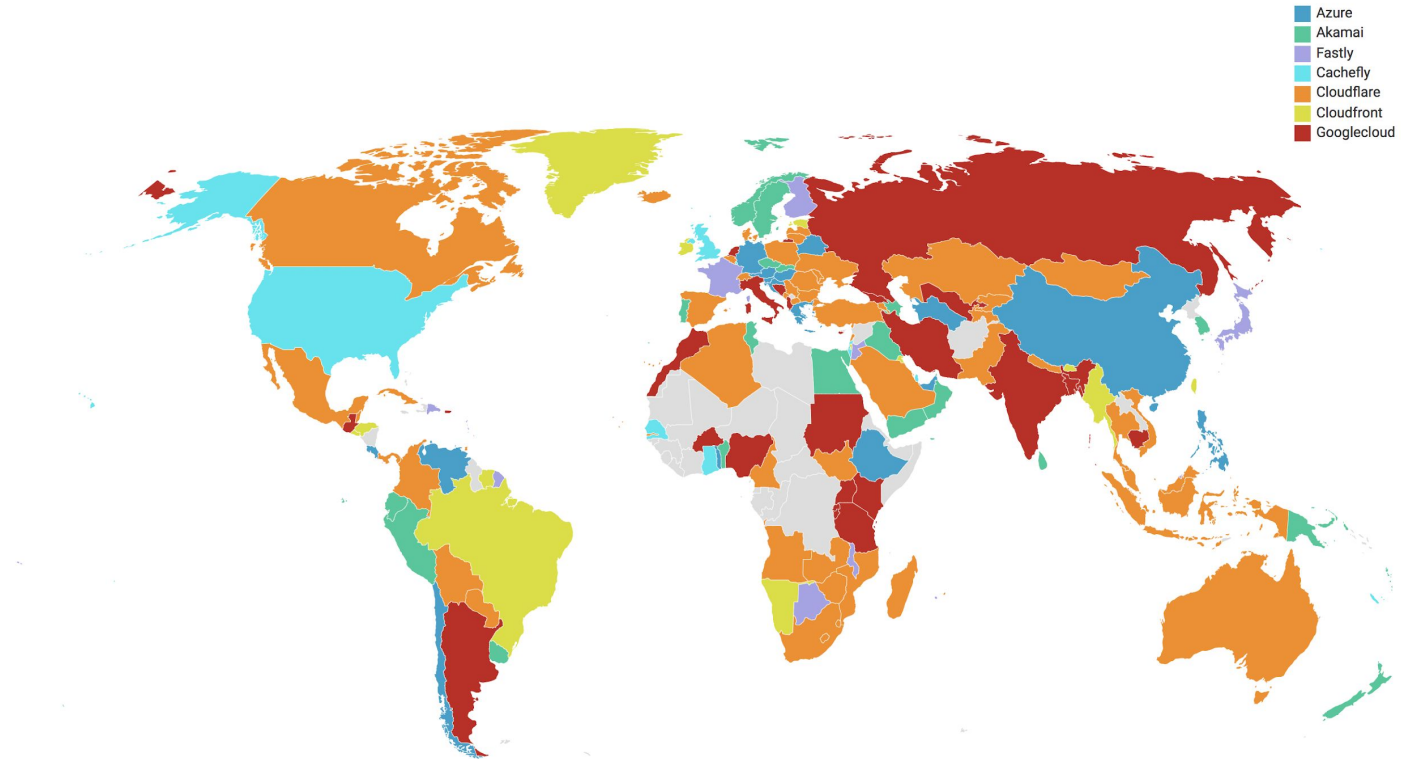
credits well spent

Results

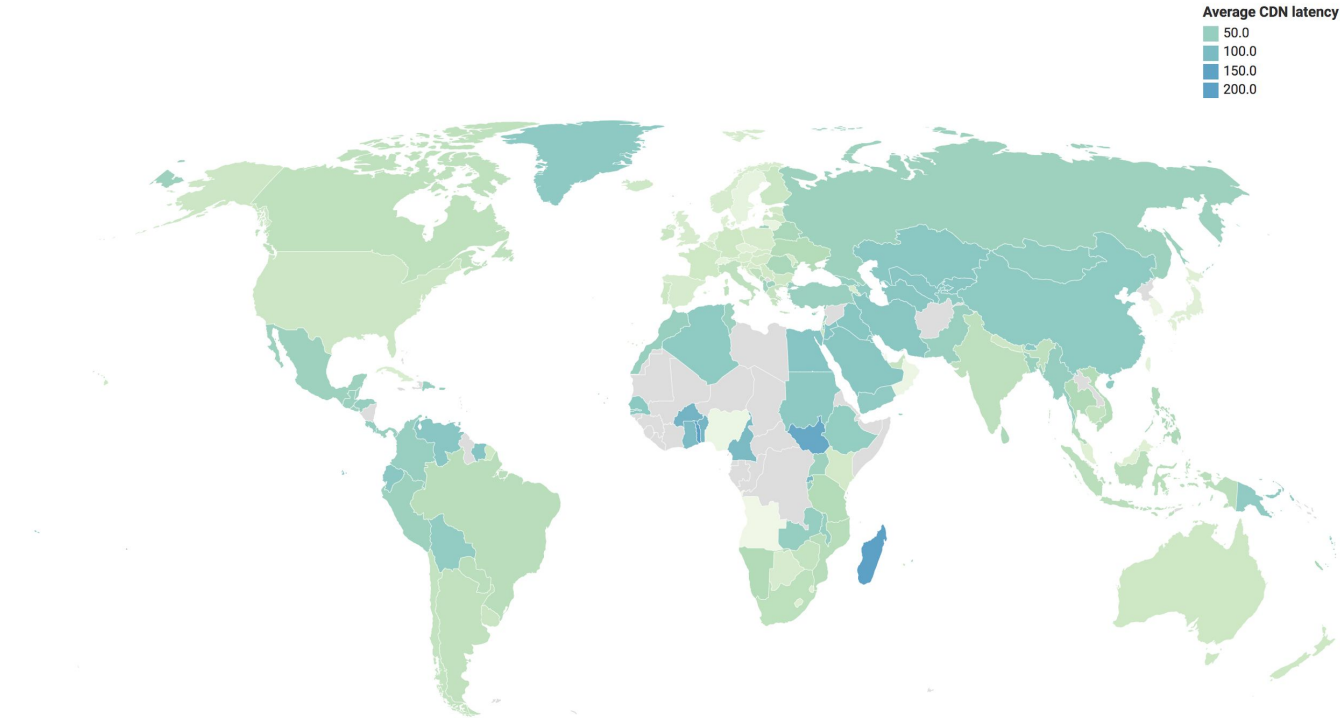
Fastest in most countries: Cloudflare



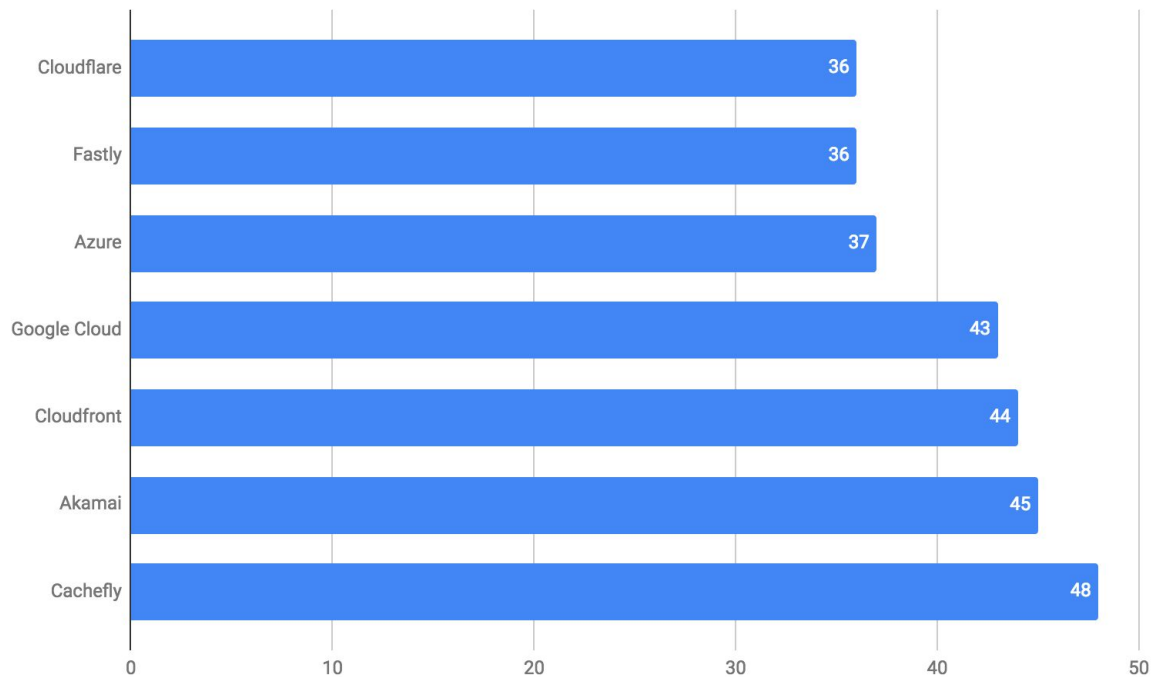
Distribution of fastest CDNs on a world map



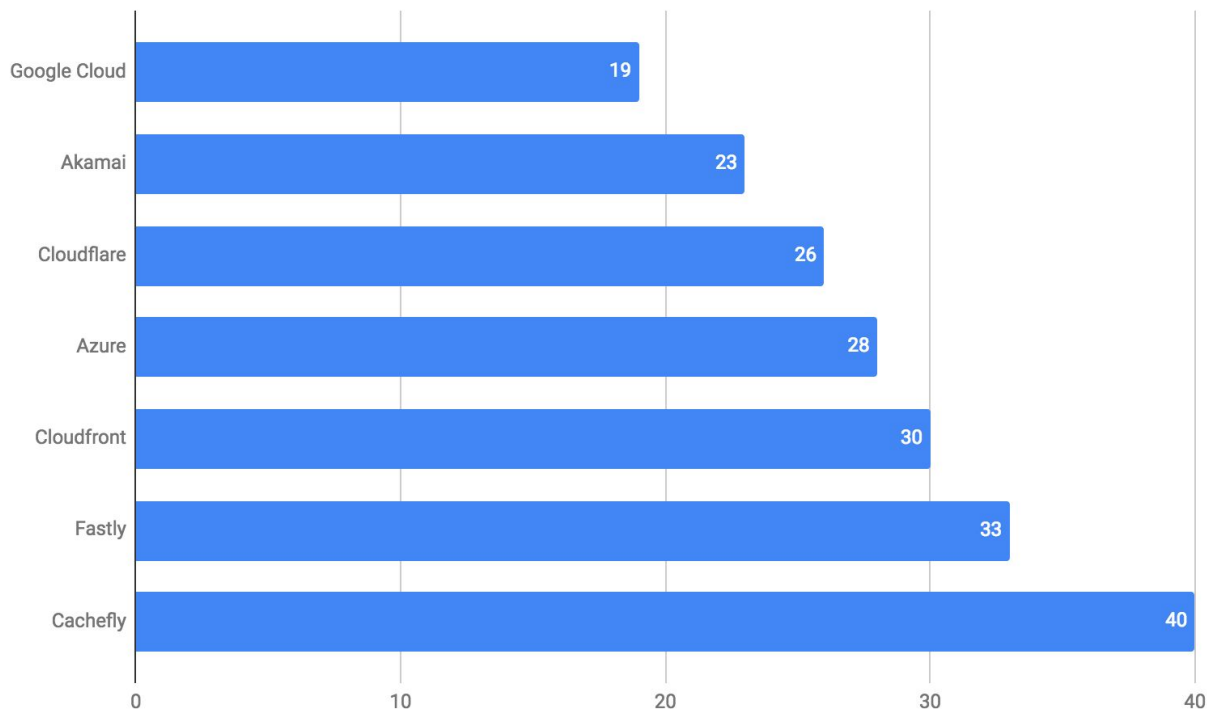
Average CDN latency



Average CDN latency, worldwide



Average CDN latency, Bosnia and Herzegovina



Conclusions

- Cloudflare: best geographical spread
- Akamai: most POPs, peering privately within ISPs, best for Africa & Asia
- Google Cloud: different routing based on network tier (standard vs premium = peering vs transit)
- Azure: choice between Verizon, Akamai, Microsoft

Questions?

Thank you