RIPE NCC
RIPE NETWORK COORDINATION CENTRE

OpenIPmap
Geolocating Internet Infra-Structure with Inference Engines and Crowdsourcing

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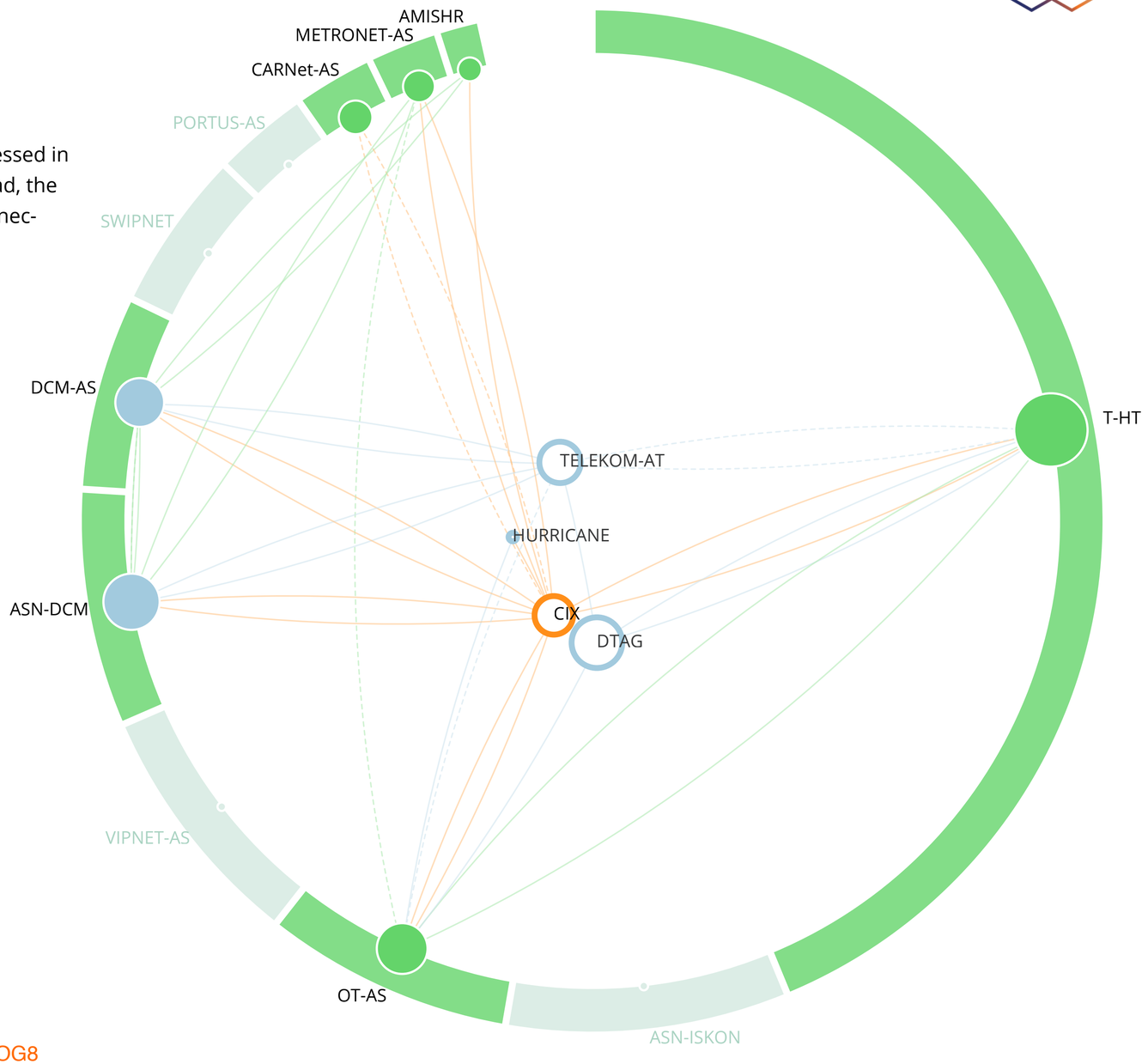
But now for something completely different first

Sketches of the Peer-to-Peer Fabric of a Country

The quality of end-user connections are often expressed in download speeds towards content providers. Instead, the sketches presented here focus on peer-to-peer connections in a country.

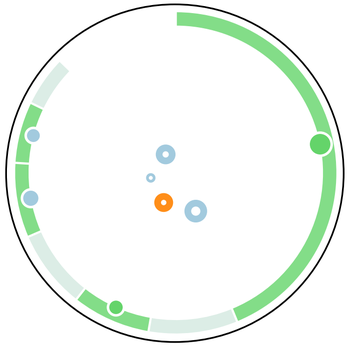
The sketches explore the different ways in which end-users are interconnected within the same country: the peer-to-peer fabric. Each sketch represents a snapshot of this fabric at a single given point in time. They try to put a number on the amount of different ways the networks interconnect their users.

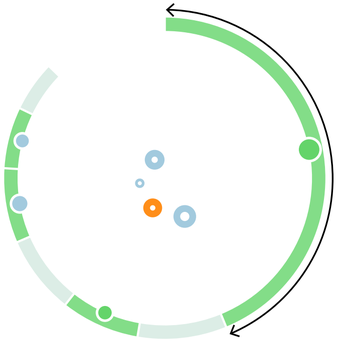
These sketches are created with active measurements from the RIPE Atlas measurement platform, datasets from RIPEstat, AS-to-ORG datasets from CAIDA and a dataset from APNIC that estimates the percentage of end-users in each network.



Sketches of the Peer-to-Peer Fabric of a Country

The full circle represents 100% of the end-users in a country.

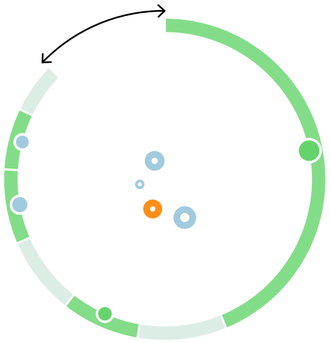




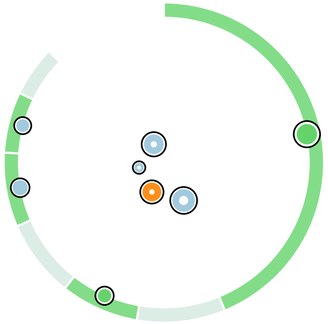
Each network that provides connectivity to more than 1% of the end-users is represented by a colored circle segment. The length of the arc of the segment represents the percentage of the end-users in a country.

The darker green denotes an network for which we have peer-to-peer data. The lighter green color denotes networks for which we don't have peer-to-peer data.

The open part of the circle represents the sum of all ASes that provide connectivity to less than 1% of the end-users in a country.



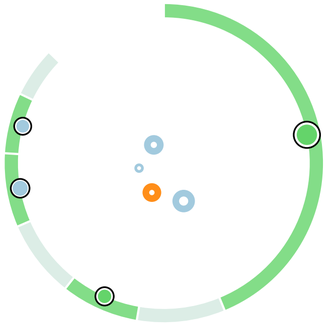
Sketches of the Peer-to-Peer Fabric of a Country



Each ring or circle represents the percentage of the peer-to-peer fabric in a country that passes through this point.

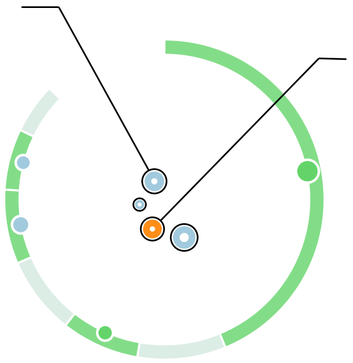
The color of the circle or ring denotes the type of location.

A blue circle on the outer ring represents a network that both serves end-users and provides transit to others end-user networks within the country.



A green circle on the outer ring represents a network that (mainly) serves end-users.

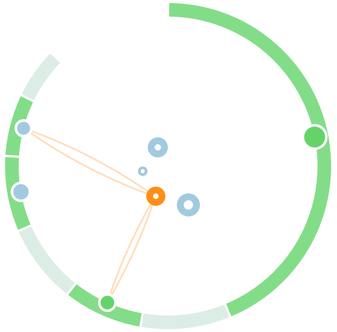
A blue circle in the interior indicates a transit network or an IXP that is external to this country.

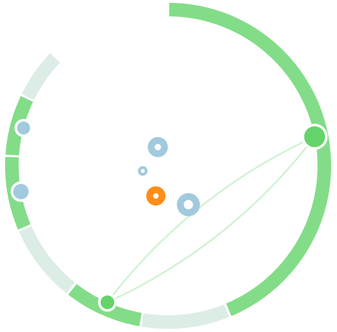


An orange circle in the interior indicates an IXP identified with this country.

Sketches of the Peer-to-Peer Fabric of a Country

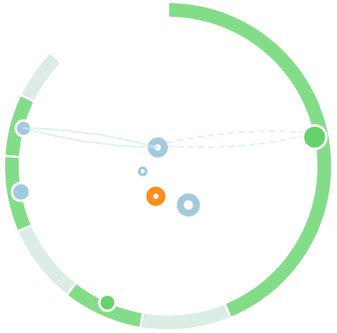
Orange lines indicate that two end-user networks are connected through an IXP.





Green lines indicate that two end-user networks are directly connected.

Blue lines indicate two end-user networks are connected through a transit network.



Dotted lines of any color indicate that we cannot fully map this path.

Peer-to-Peer Fabric

country

Denmark

snapshot date

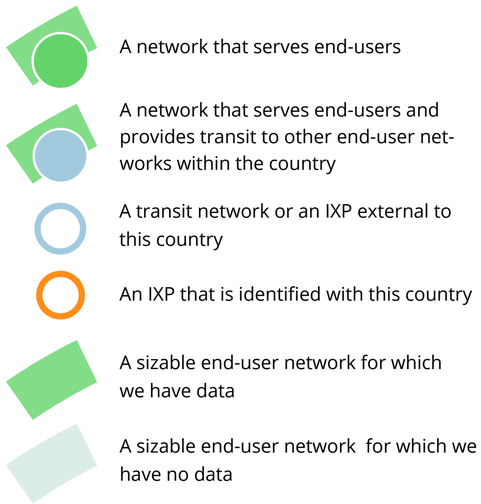
1 March 2018

github

https://github.com/emileaben/ixp-country-jedi/

url

http://sg-pub.ripe.net/ixp-country-jedi/dk/2018/03/01



A network that serves end-users

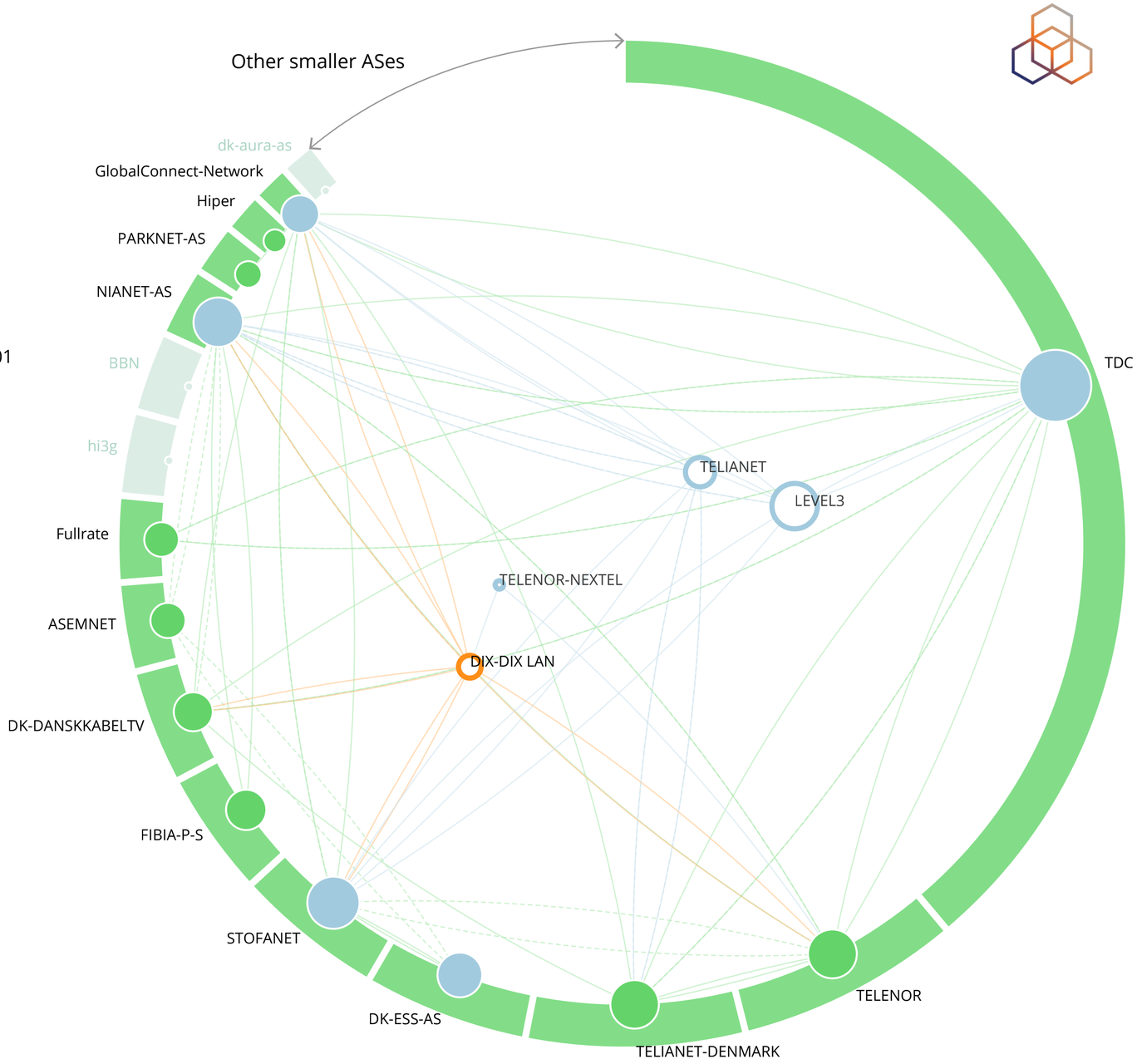
A network that serves end-users and provides transit to other end-user networks within the country

A transit network or an IXP external to this country

An IXP that is identified with this country

A sizable end-user network for which we have data

A sizable end-user network for which we have no data



Peer-to-Peer Fabric

country

Southern Korea

snapshot date

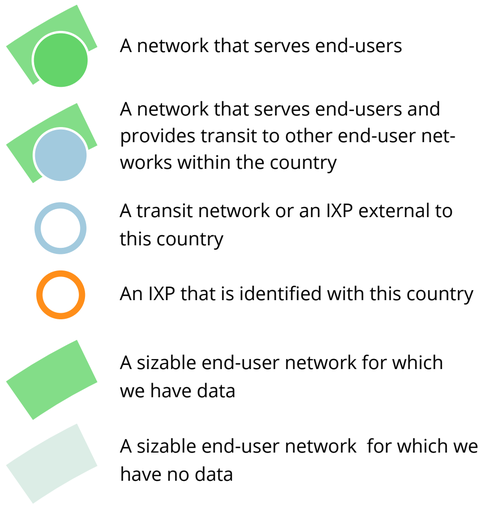
1 March 2018

github

https://github.com/emileaben/ixp-country-jedi/

url

http://sg-pub.ripe.net/ixp-country-jedi/dk/2018/03/01



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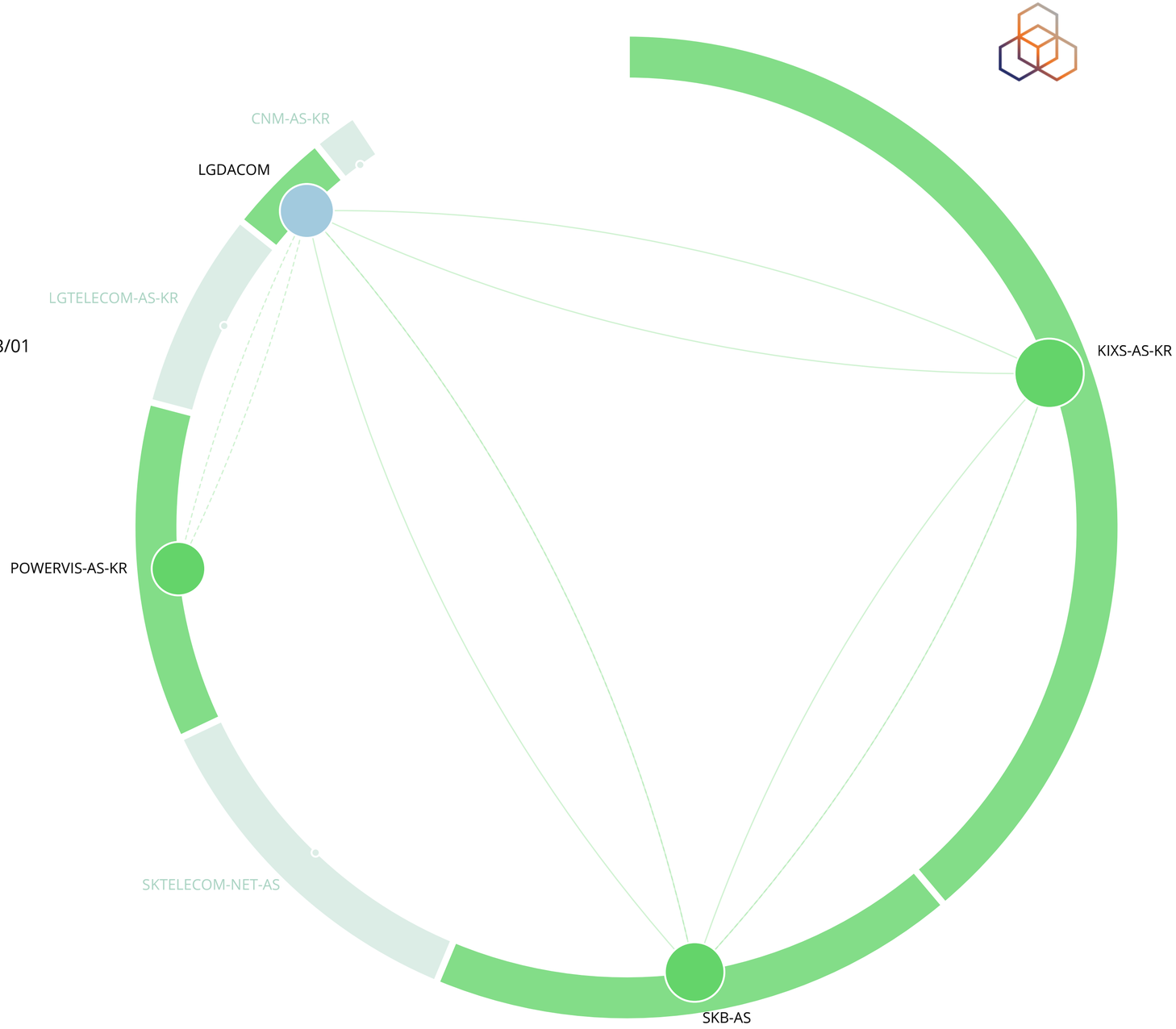

Peer-to-Peer Fabric

country

Ireland

snapshot date

1 March 2018

github

https://github.com/emileaben/ixp-country-jedi/

url

http://sg-pub.ripe.net/ixp-country-jedi/dk/2018/03/01

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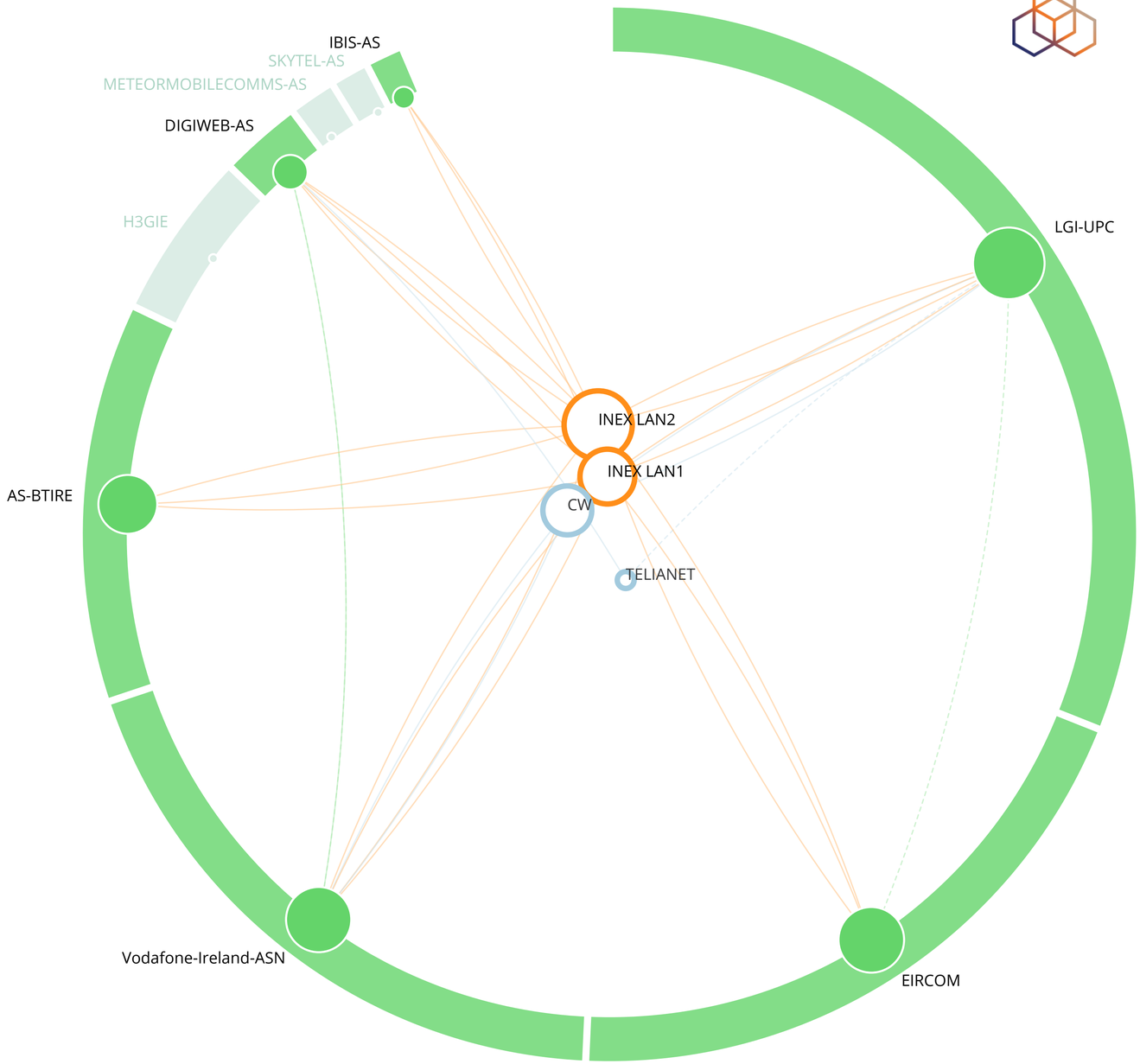


Peer-to-Peer Fabric

country

USA

snapshot date

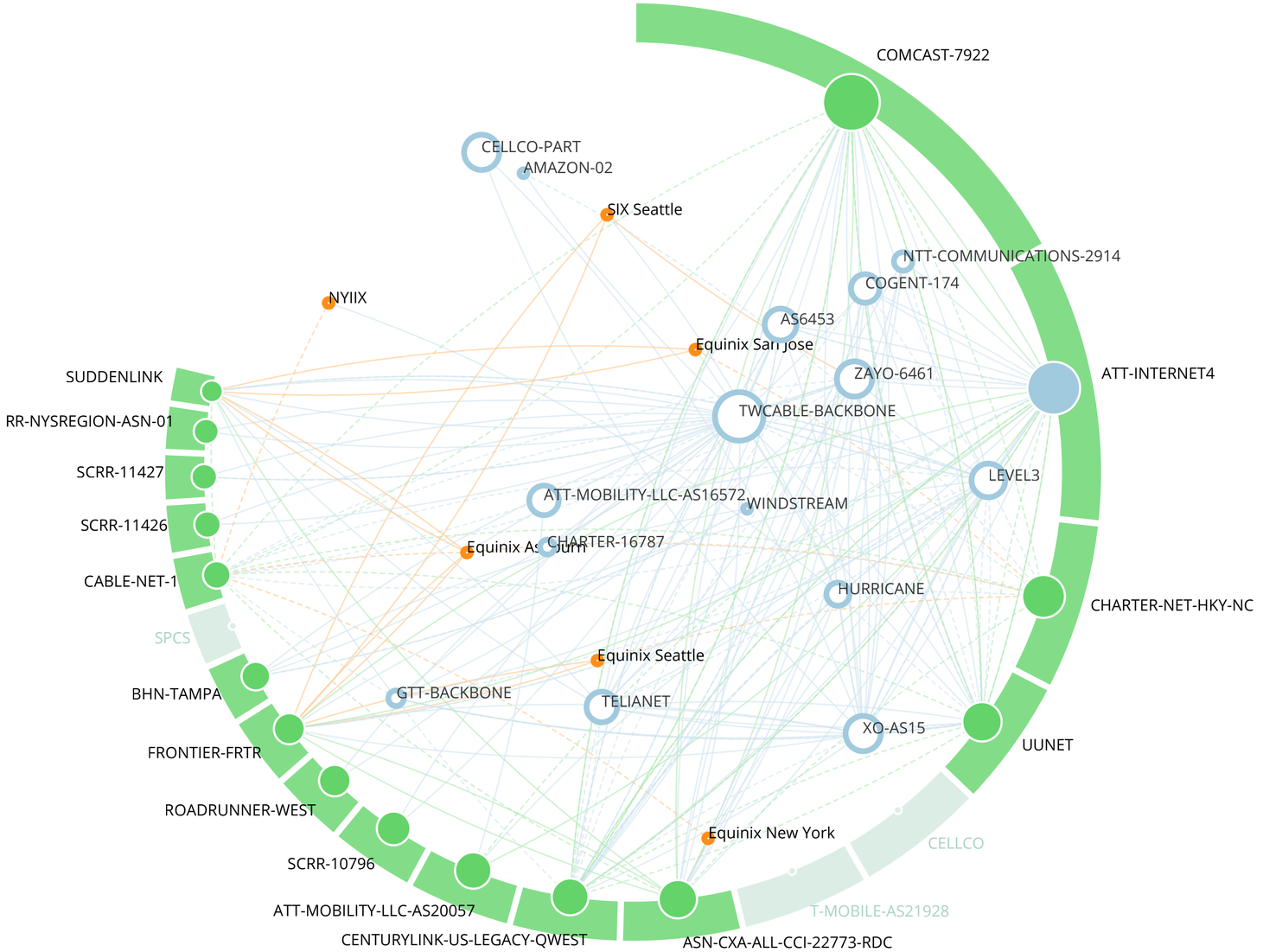
1 March 2018

github

https://github.com/emileaben/ixp-country-jedi/

url

http://sg-pub.ripe.net/ixp-country-jedi/dk/2018/03/01



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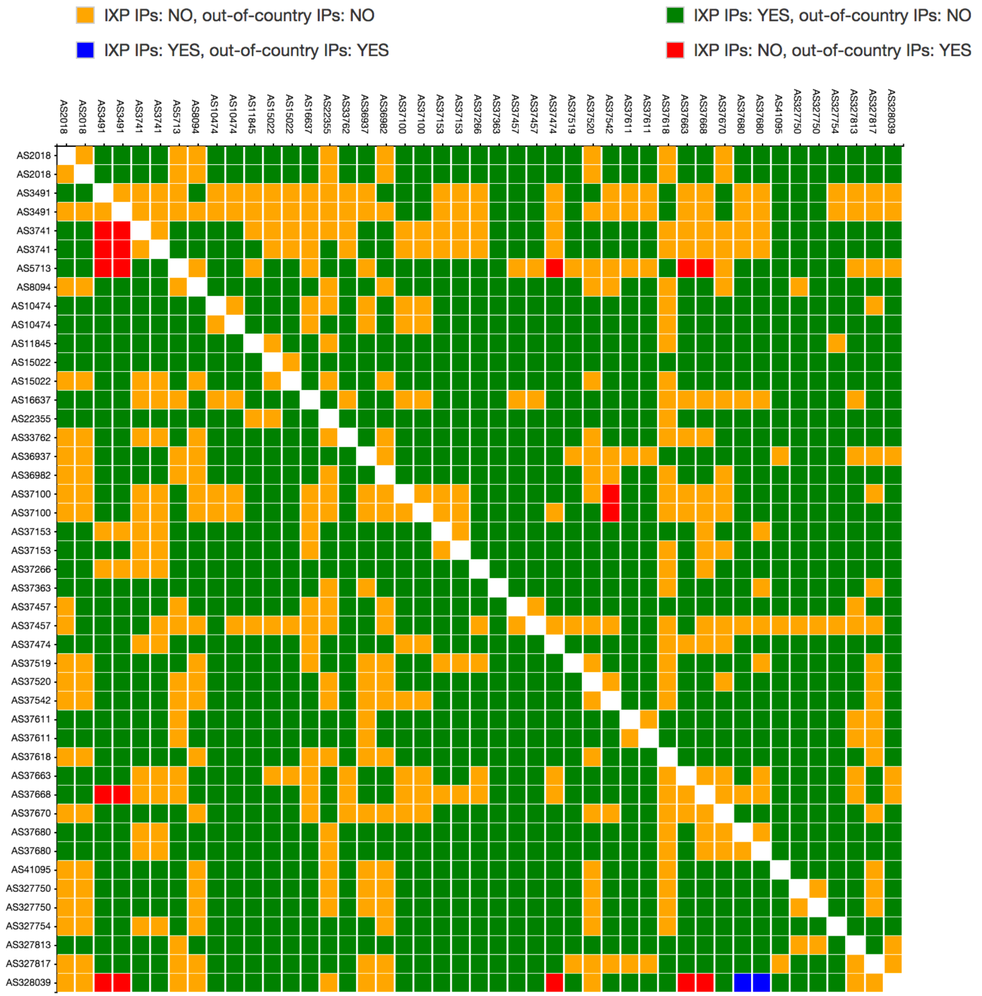
Why Geolocation of infra-structure?

Why?

Analyse & Optimise Paths

Analyse Paths



Why?

Coherence of Geo Information

Geolocation in the RIPE Database

“Please be aware that this information may not be picked up by geolocation providers.”

…

“Please be aware that geolocation information is added by the resource holders in the RIPE Database and the RIPE NCC does not verify this information.”

The problem of Geolocation

Geolocation is hard

Different Research Approaches

- Triangulation a.k.a. trilateration
- Reverse DNS based location inference
- ‘Administrative’ analyses
- Verification/falsification procedures

Commercial Offerings

- Tend to concentrate on end user IP Addresses
- Opaque Methodology
- IPv6 address space largely ignored

Our Integration Attempt

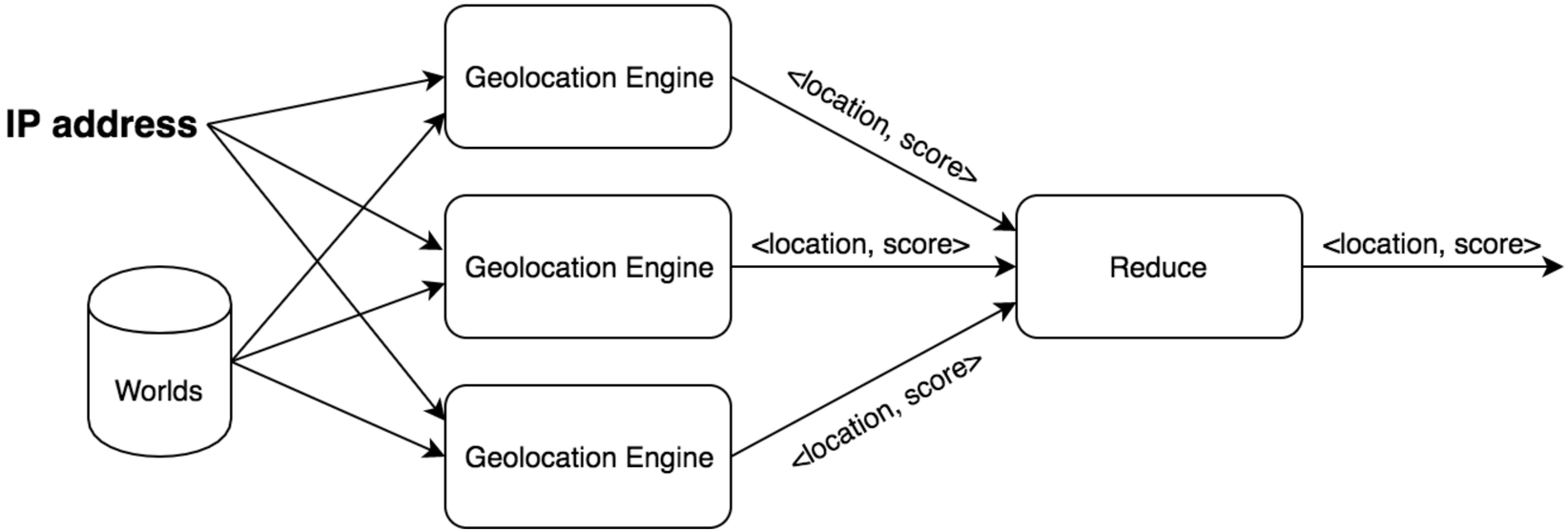
inference engines and crowdsourcing

Accumulate Research Efforts as Inference Engines

Inference Engines

- Each of them is applicable only in some cases
- Each of them has a score factor
- Complete transparency about the inference methodology

Inference Engines



geolocation API

https://openipmap.ripe.net


```
[
  {
    "url": "/locate",
    "description": "Geolocation service. It provides geolocation according to a set of passive and active geolocation approaches"
  },
  {
    "url": "/worlds",
    "description": "Worlds dataset, providing standard geolocation format to all other services"
  },
  {
    "url": "/crowdsource",
    "description": "Geolocation service based on crowdsourced information."
  },
  {
    "url": "/peeringdb",
    "description": "PeeringDB interface for geolocation purposes."
  },
  {
    "url": "/triangulation",
    "description": "Active geolocation service based on latency triangulation."
  },
  {
    "url": "/anycast",
    "description": "Anycast geolocation service based on active measurements"
  }
]
```

openipmap.ripe.net/api/locate/83.163.50.165/best


```
{
  "location": {
    "score": 145,
    "countryCodeAlpha3": "NLD",
    "countryCodeAlpha2": "NL",
    "cityPopulation": 147590,
    "stateAnsiCode": "07",
    "pointGeometry": "0101000020E61000005C72DC291D8C12401B81785DBF304A40",
    "cityNameAscii": "Haarlem",
    "stateIsoCode": "NL-07",
    "countryName": "Netherlands",
    "stateName": "North Holland",
    "longitude": 4.63683,
    "geonameId": 2755003,
    "latitude": 52.38084,
    "cityName": "Haarlem",
    "type": "city",
    "id": "HAARLEM-NL-07-U173CX8KTBR196ECJF92"
  },
  "meta": {
    "distribution": {
      "version": "17.9.18.1"
    },
    "service": {
      "version": "0.0.1"
    },
    "request": {
      "params": {
        "ip": "83.163.50.165"
      },
      "query": {}
    }
  }
}
```

openipmap.ripe.net/api/locate/83.163.50.165/partials


```
{
  "partials": [
    {
      "engine": "probeslocation",
      "description": "Probes location suggestor - based on user setting",
      "scoreFactor": 10,
      "locations": [ … ] // 1 item
    },
    {
      "engine": "anycastparistech",
      "description": "Anycast engine - Paristech dataset",
      "scoreFactor": 10,
      "locations": []
    },
    {
      "engine": "crowdsourced",
      "description": "Crowdsourced engine",
      "scoreFactor": 9,
      "locations": []
    },
    {
      "engine": "triangulation",
      "description": "Triangulation engine (if empty try in 3 minutes, triangulation requires time)",
      "scoreFactor": 5,
      "locations": [ … ] // 20 items
    }
  ],
  "meta": {
    "distribution": {
      "version": "17.9.18.1"
    },
    "service": {
      "version": "0.0.1"
    },
```

/locate - Active geolocation

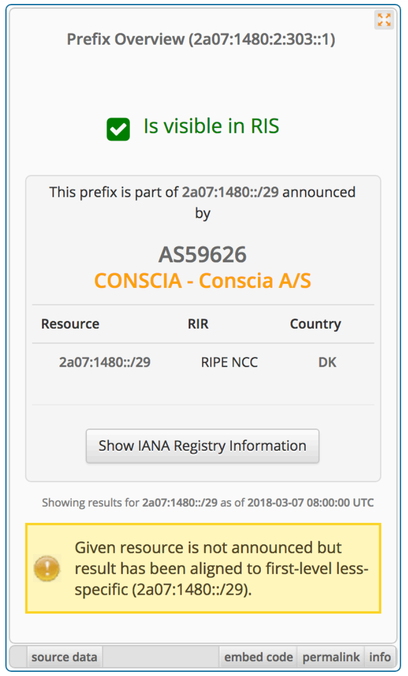
If the IP has not been measured yet, a new Ping measurement starts

- Peering DB data and BGP data are used to reduce the locations probed
- Score based on RTT, only RTT <10ms are considered
- PeeringDB facilities and population boost the score
- A list of possible locations will be returned
- We are working on it! (Contributions are welcome!)

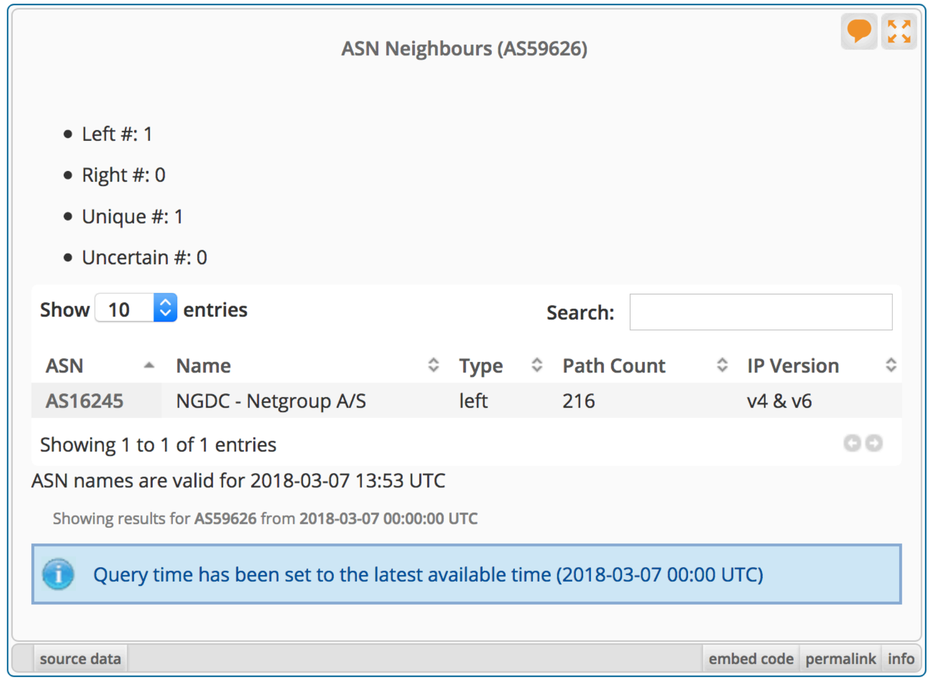
let’s geolocate 2a07:1480:2:303::1

First step: get a set of ASes that are related to this IP address

AS59626



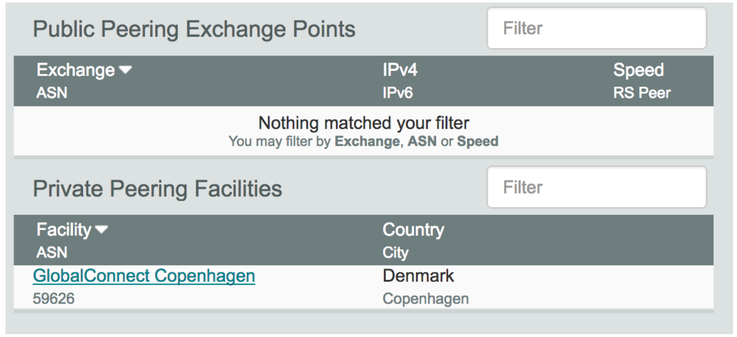
AS16245



let’s geolocate 2a07:1480:2:303::1

Second step: get a set of geographic locations related with these ASes

AS59626



Public Peering Exchange Points

Filter

Exchange ASN	IPv4 IPv6	Speed RS Peer

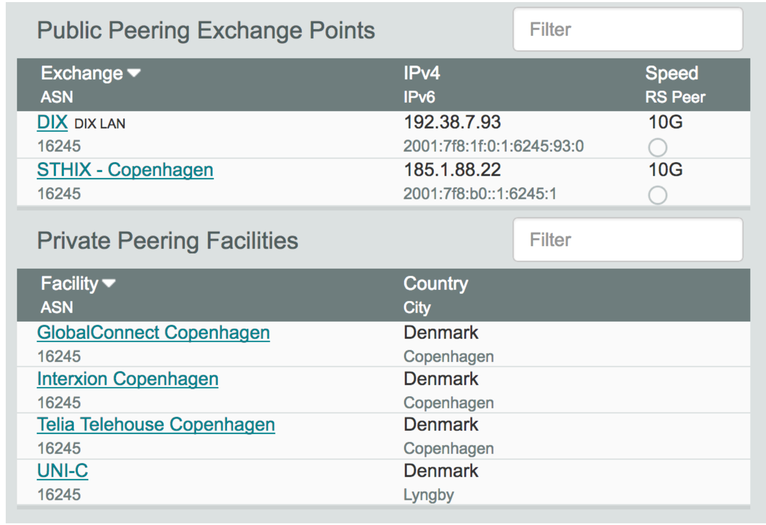
Nothing matched your filter
You may filter by **Exchange**, **ASN** or **Speed**

Private Peering Facilities

Filter

Facility ASN	Country City
GlobalConnect Copenhagen 59626	Denmark Copenhagen

AS16245



Public Peering Exchange Points

Filter

Exchange ASN	IPv4 IPv6	Speed RS Peer
DIX DIX LAN 16245	192.38.7.93 2001:7f8:1f:0:1:6245:93:0	10G
STHIX - Copenhagen 16245	185.1.88.22 2001:7f8:b0::1:6245:1	10G

Private Peering Facilities

Filter

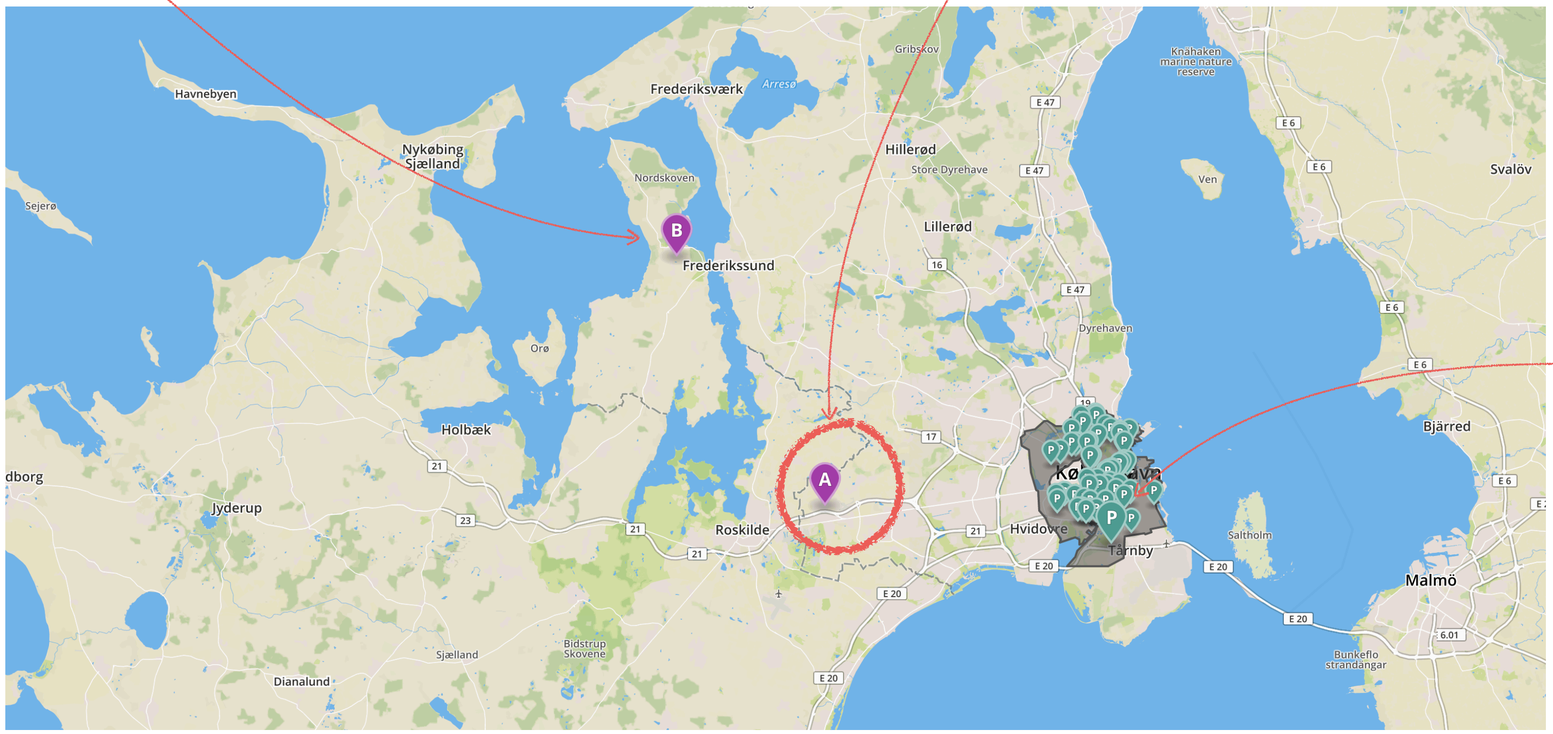
Facility ASN	Country City
GlobalConnect Copenhagen 16245	Denmark Copenhagen
Interxion Copenhagen 16245	Denmark Copenhagen
Telia Telehouse Copenhagen 16245	Denmark Copenhagen
UNI-C 16245	Denmark Lyngby

let’s geolocate 2a07:1480:2:303::1

Third step: run ping measurements on RIPE Atlas probes within these ASes and these locations.

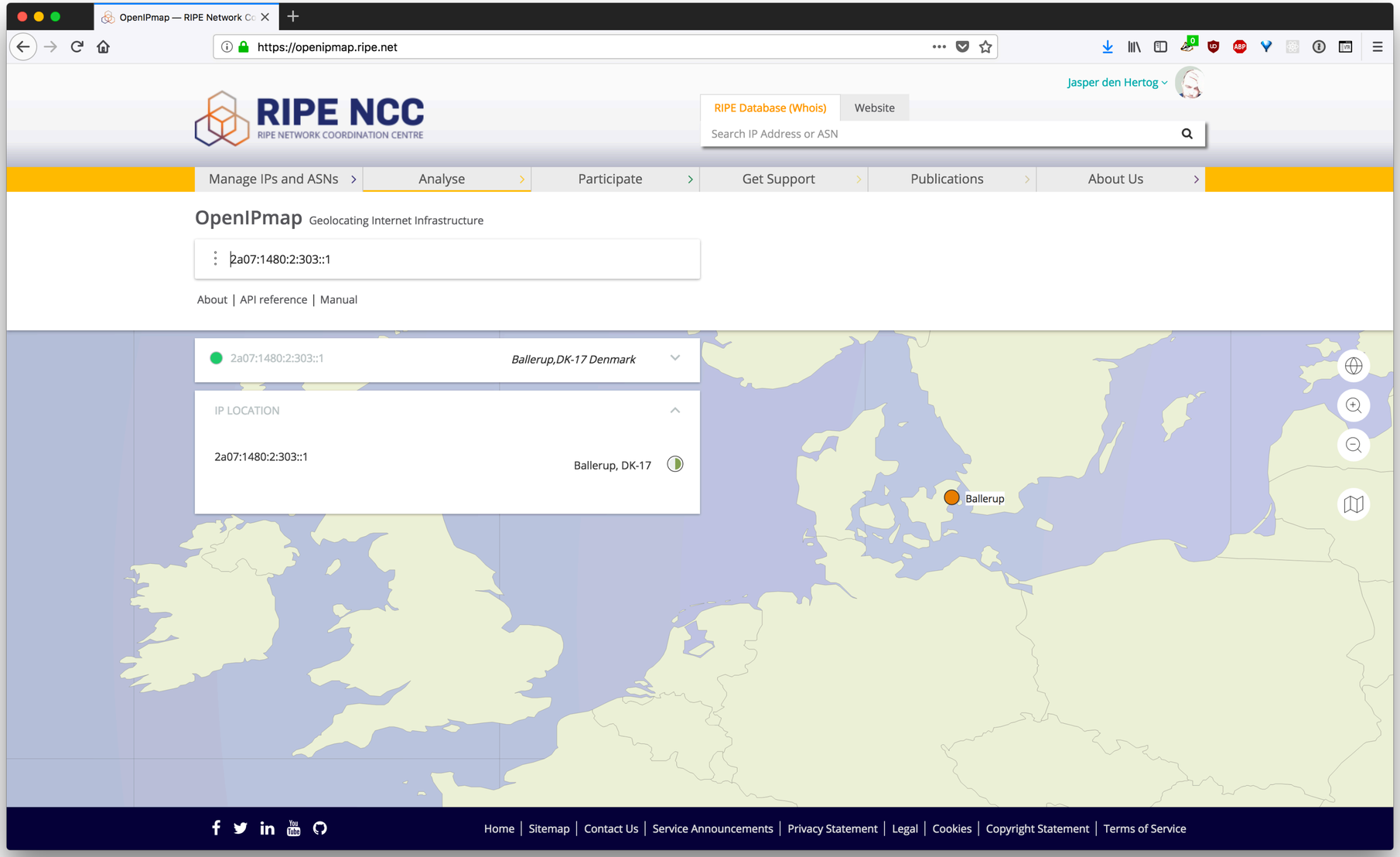
AS59626 (6,4ms)

AS16245 (2.1ms!)



from location (6,4ms)

let’s geolocate 2a07:1480:2:303::1



Crowdsourcing with OpenIPmap

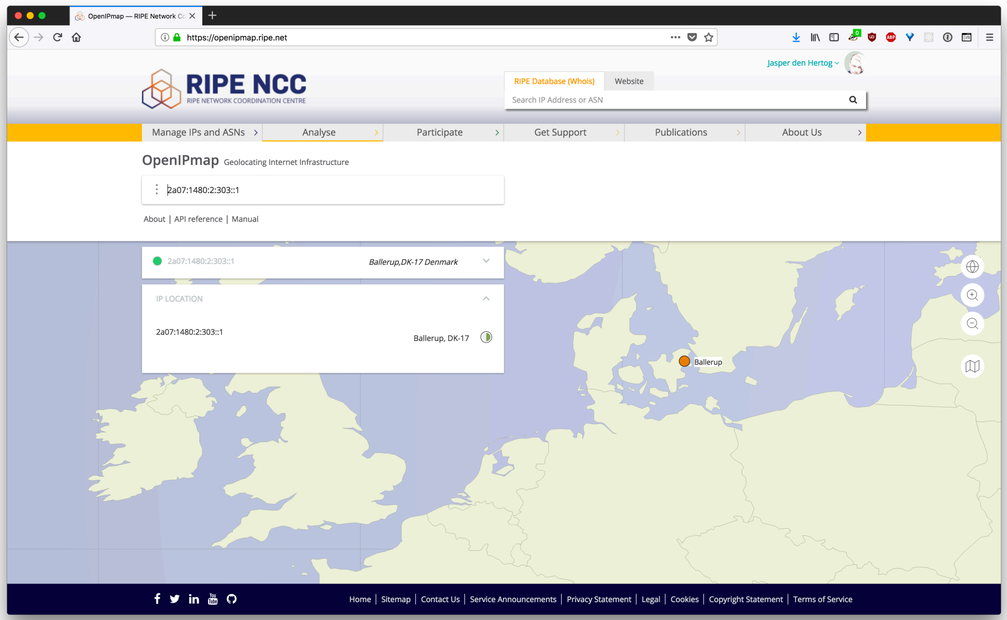
Web UI: put stuff on a map

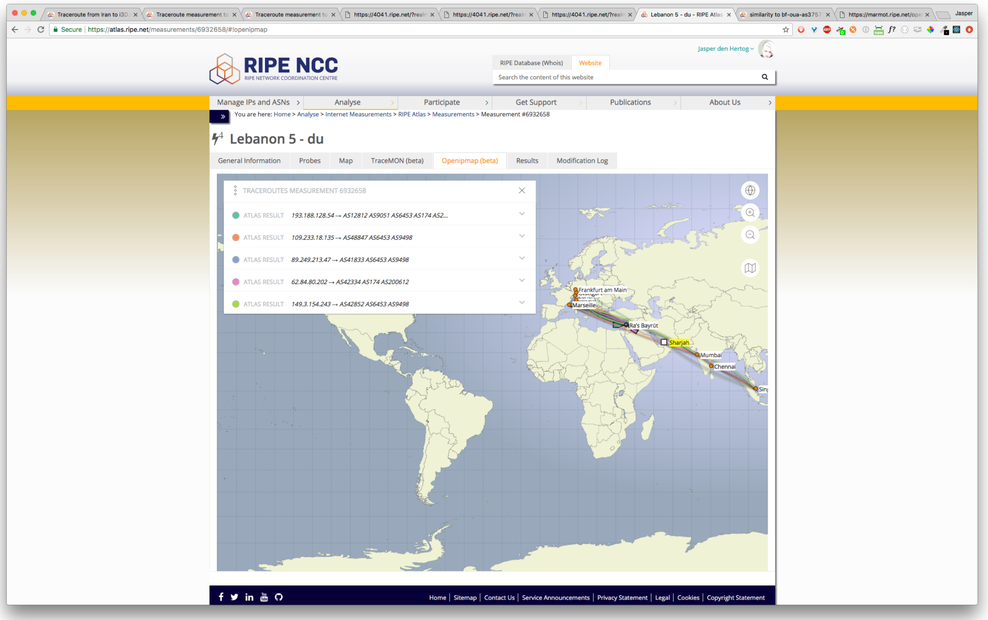
- Make sense of RTTs in one glimpse
- Understand network relationships among countries
- Verify geographical optimisation policies
- Crowdsource IP addresses to geolocation

…actually we have two interfaces

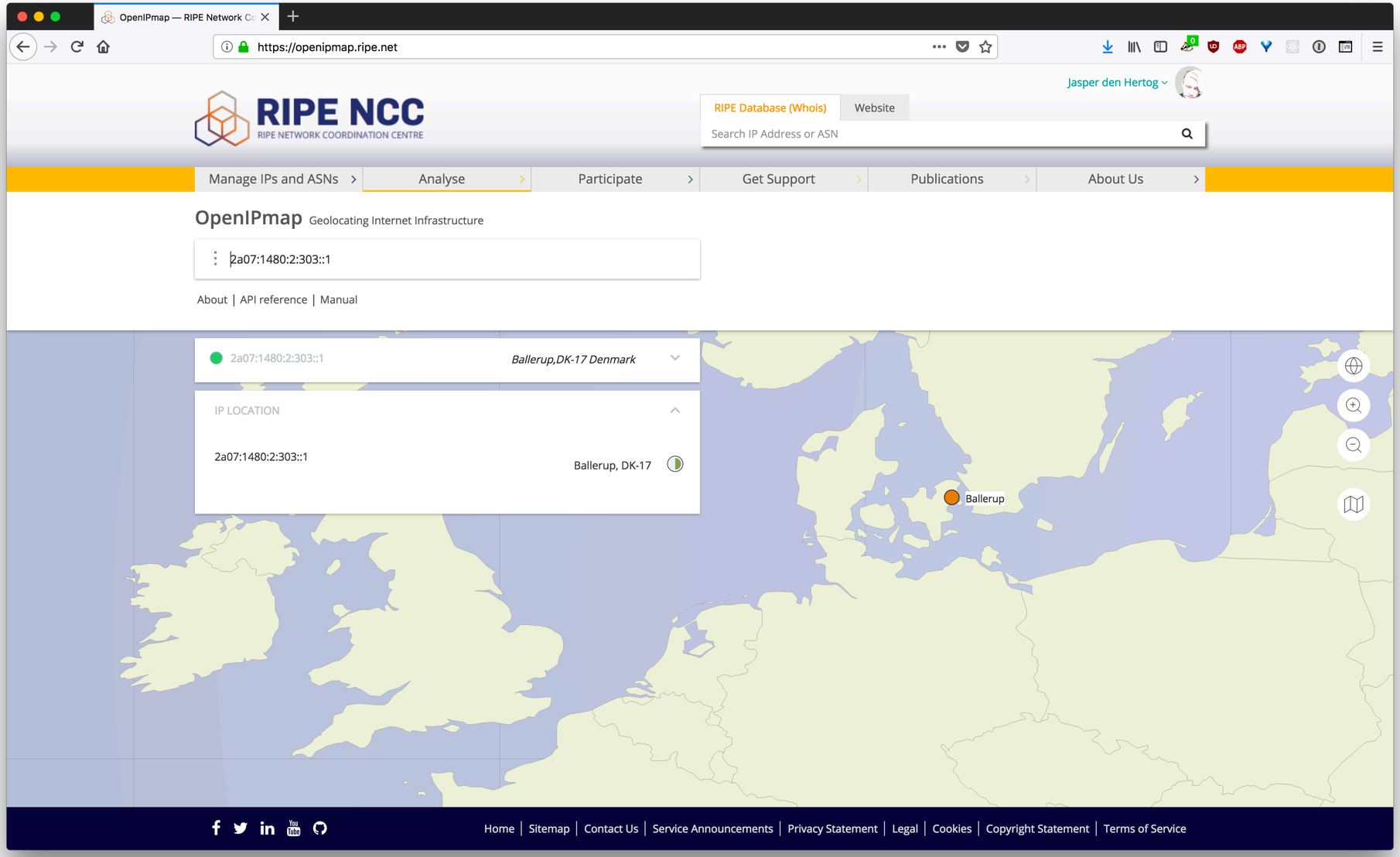
https://openipmap.ripe.net

https://atlas.ripe.net/measurements/<TRACEROUTEMSM>



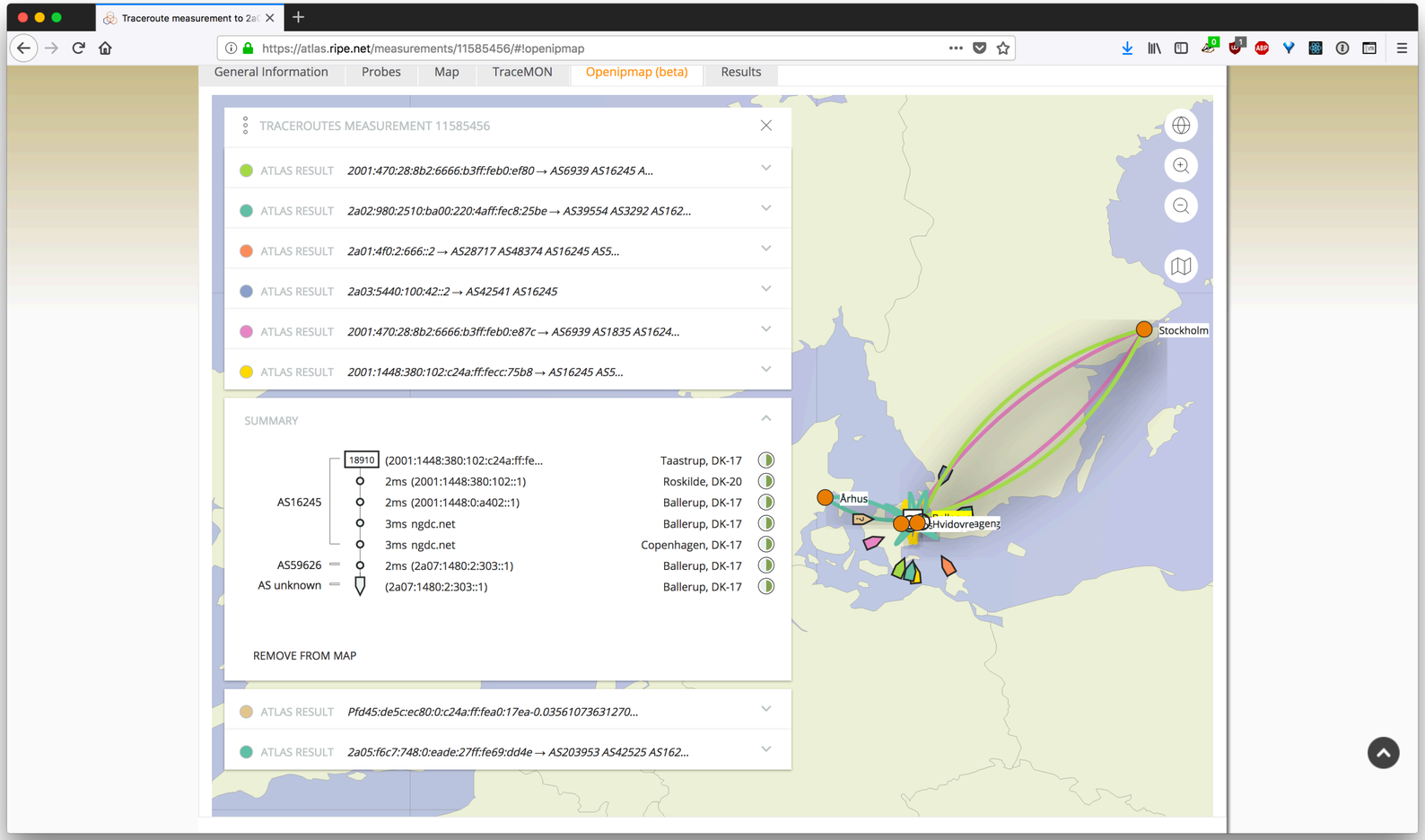


The first one we already saw…

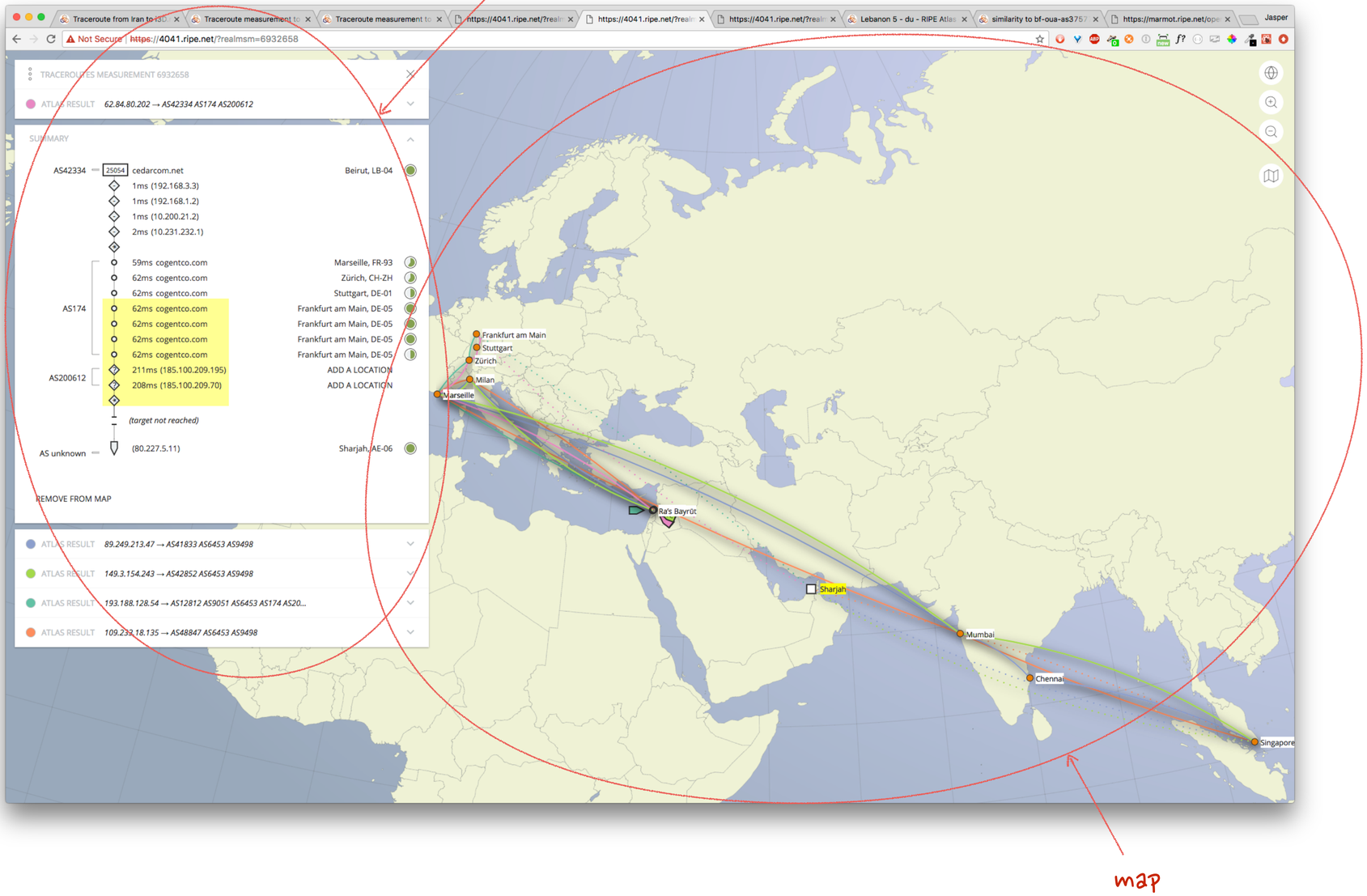


The second shows traceroutes

https://atlas.ripe.net/measurements/11585456/#!openipmap



elements

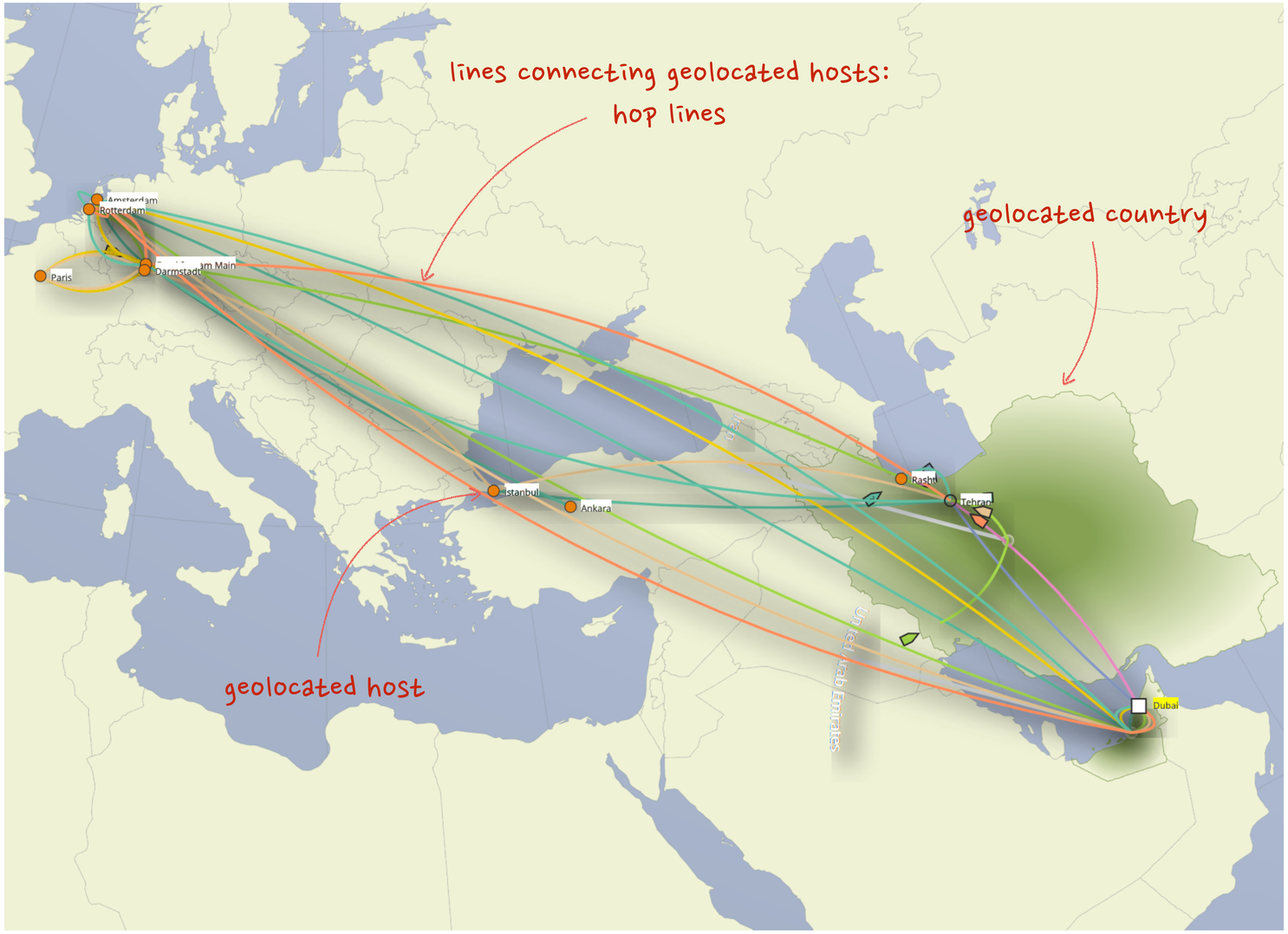

sidebar
Not Secure | https://4041.ripe.net/?realmsm=6932658
TRACEROUTES MEASUREMENT 6932658
ATLAS RESULT 62.84.80.202 → AS42334 AS174 AS200612
SUMMARY
AS42334 25054 cedarcom.net Beirut, LB-04
1ms (192.168.3.3)
1ms (192.168.1.2)
1ms (10.200.21.2)
2ms (10.231.232.1)
AS174
59ms cogentco.com Marseille, FR-93
62ms cogentco.com Zürich, CH-ZH
62ms cogentco.com Stuttgart, DE-01
62ms cogentco.com Frankfurt am Main, DE-05
62ms cogentco.com Frankfurt am Main, DE-05
62ms cogentco.com Frankfurt am Main, DE-05
62ms cogentco.com Frankfurt am Main, DE-05
AS200612
211ms (185.100.209.195) ADD A LOCATION
208ms (185.100.209.70) ADD A LOCATION
(target not reached)
AS unknown (80.227.5.11) Sharjah, AE-06
REMOVE FROM MAP
ATLAS RESULT 89.249.213.47 → AS41833 AS6453 AS9498
ATLAS RESULT 149.3.154.243 → AS42852 AS6453 AS9498
ATLAS RESULT 193.188.128.54 → AS12812 AS9051 AS6453 AS174 AS20...
ATLAS RESULT 109.232.18.135 → AS48847 AS6453 AS9498
Frankfurt am Main
Stuttgart
Zürich
Milan
Marseille
Ra's Bayrūt
Sharjah
Mumbai
Chennai
Singapore
map

sidebar

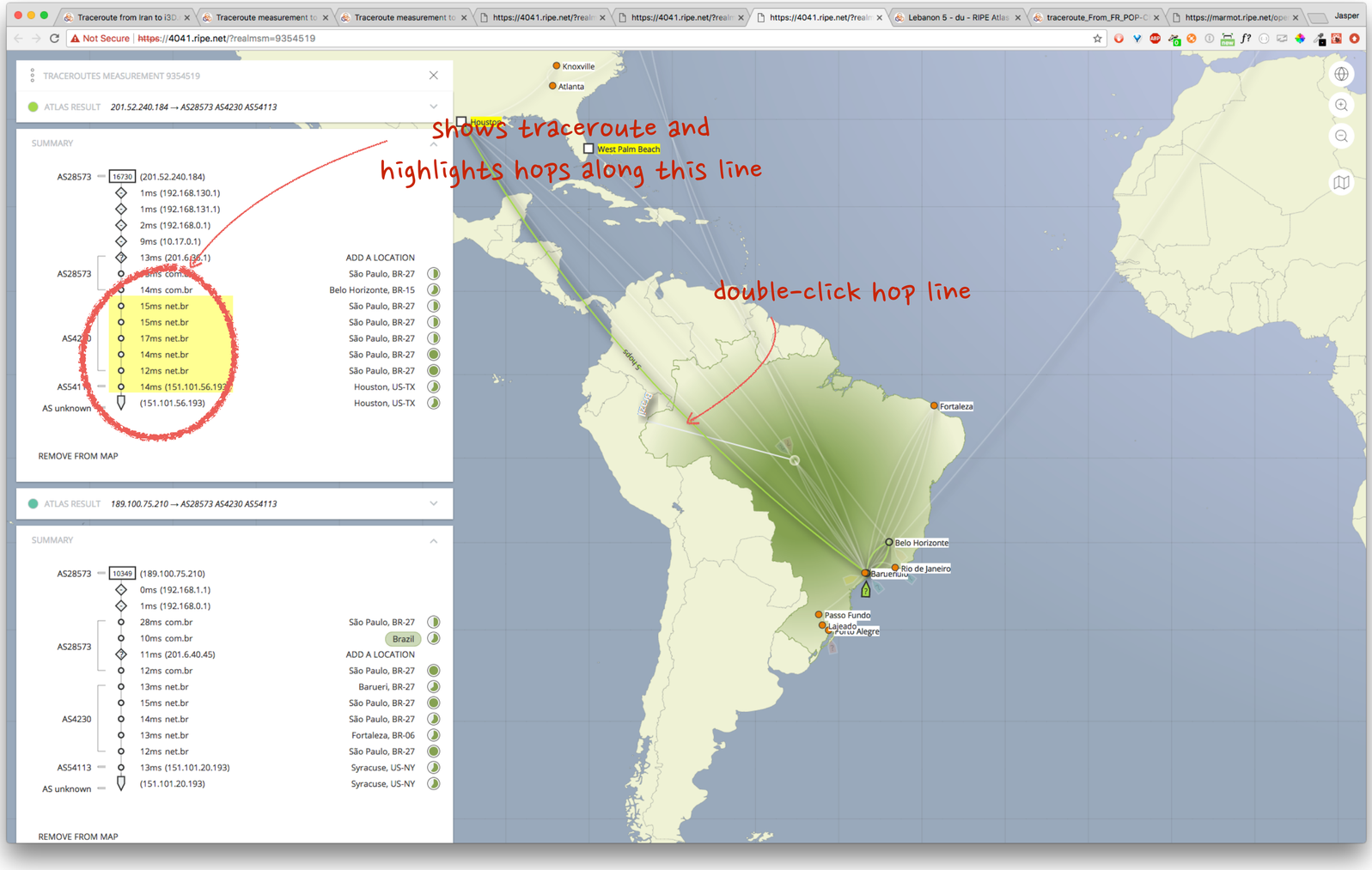
hops with enriched info

Geographical information

map

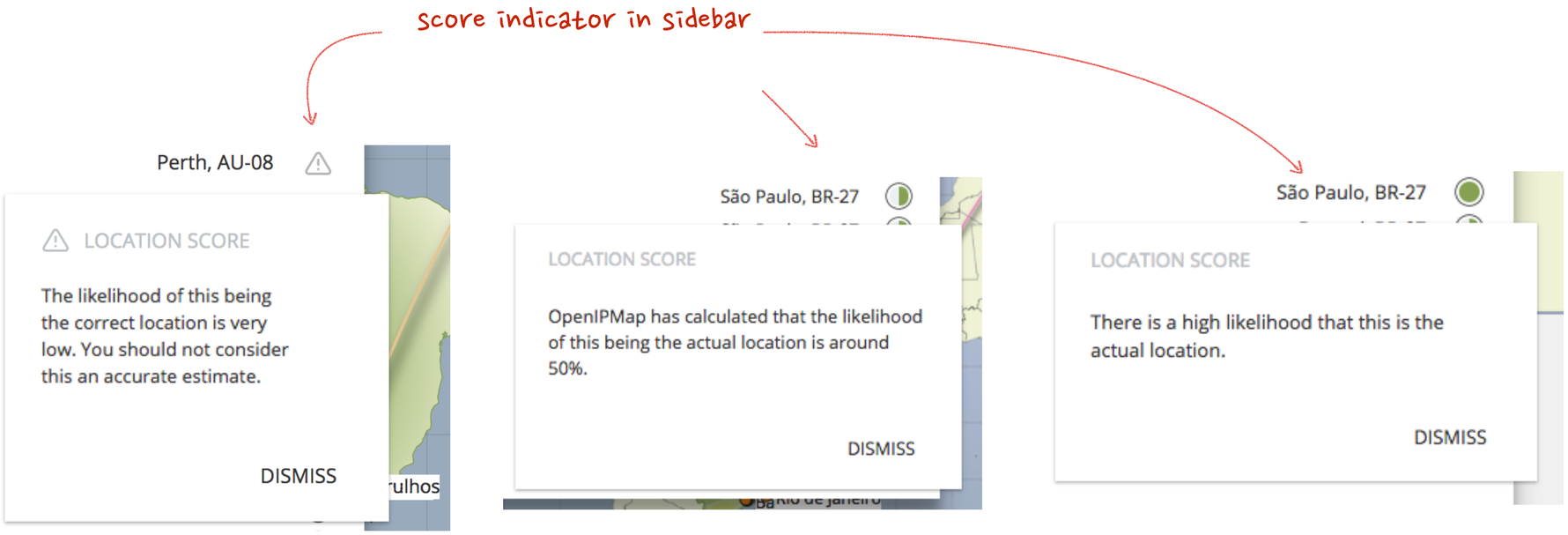

lines connecting geolocated hosts:
hop lines
geolocated country
geolocated host
Amsterdam
Rotterdam
Paris
Darmstadt
Istanbul
Ankara
Rasht
Tehran
Dubai

interaction sidebar and map

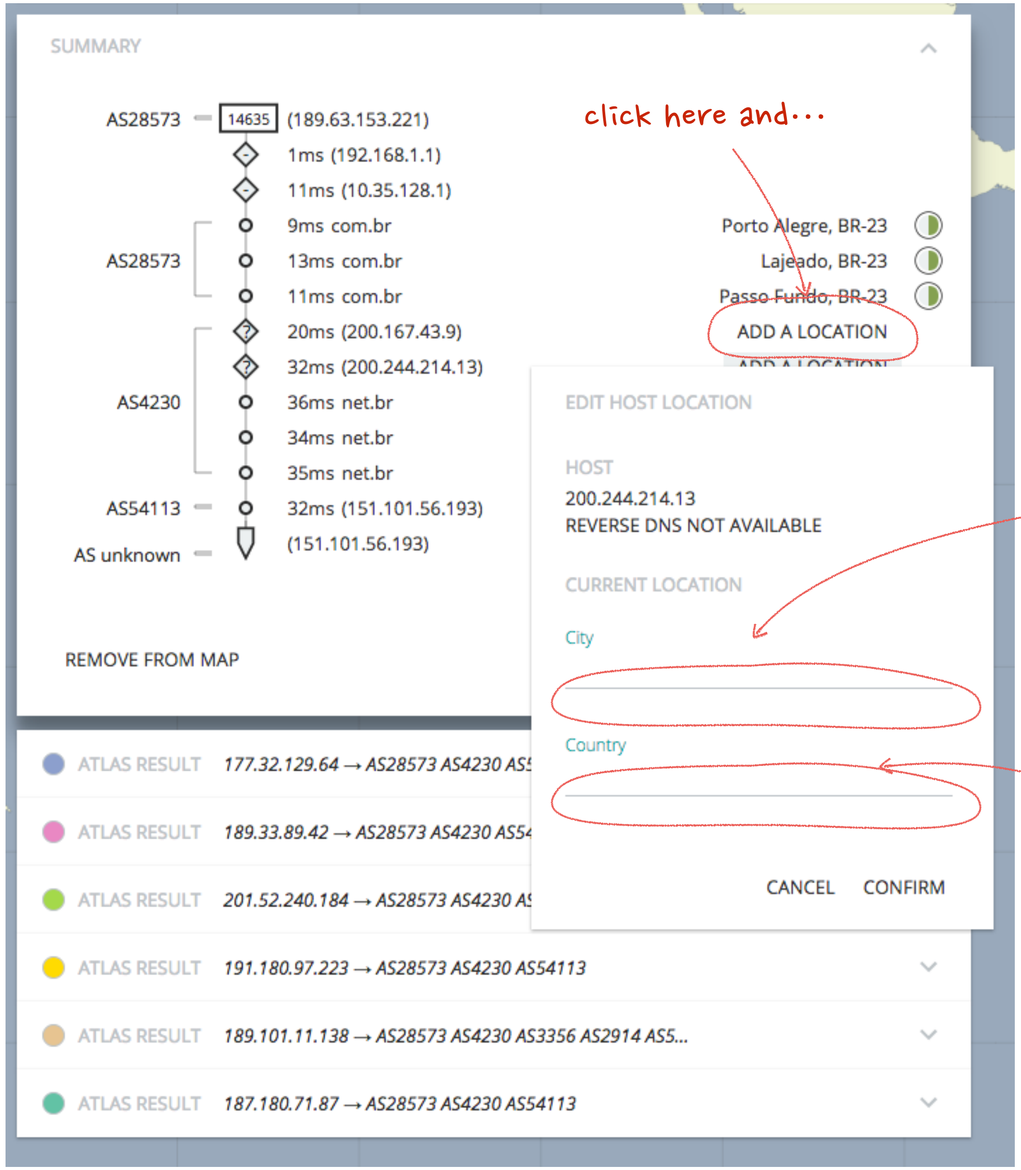


to each traceroute its own line

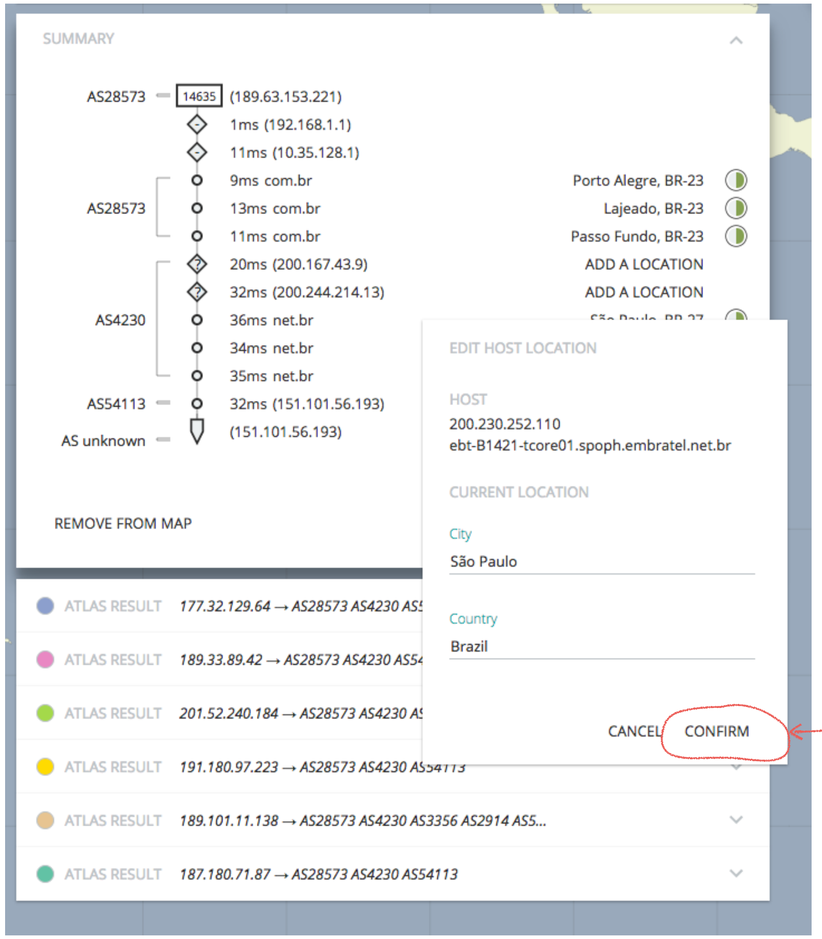
data doubt: scores for locations



crowdsource: add locations

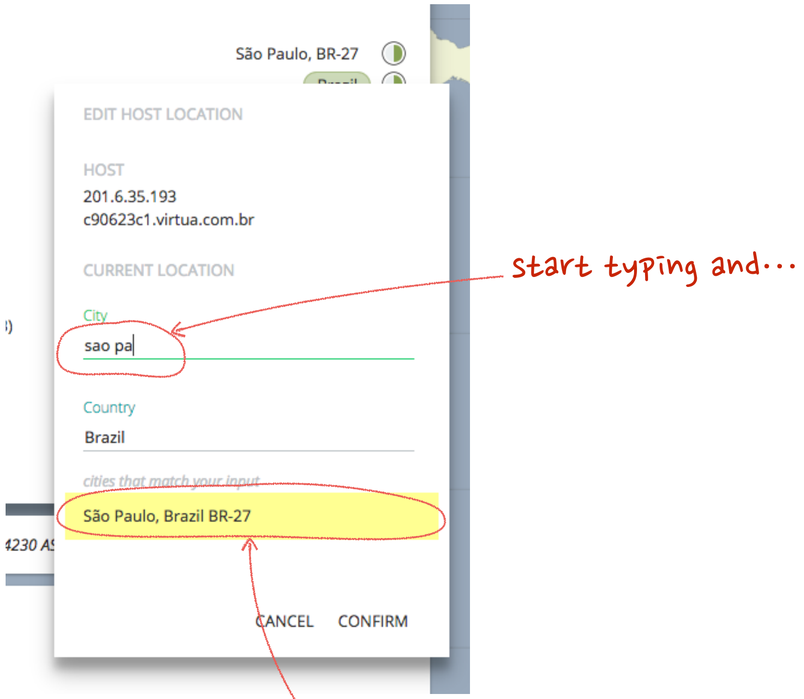


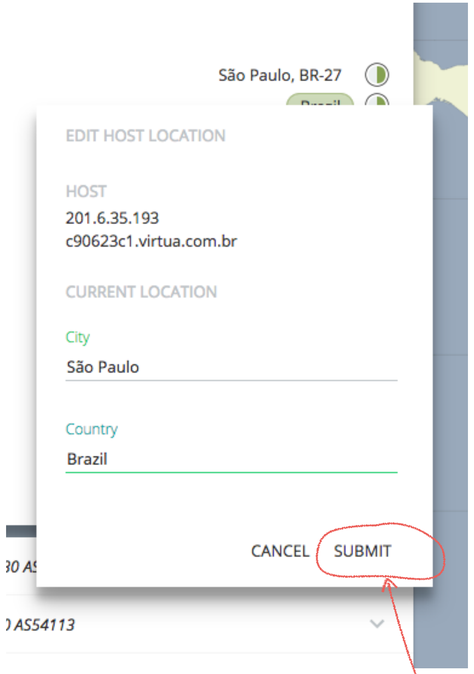
confirm and boost location score



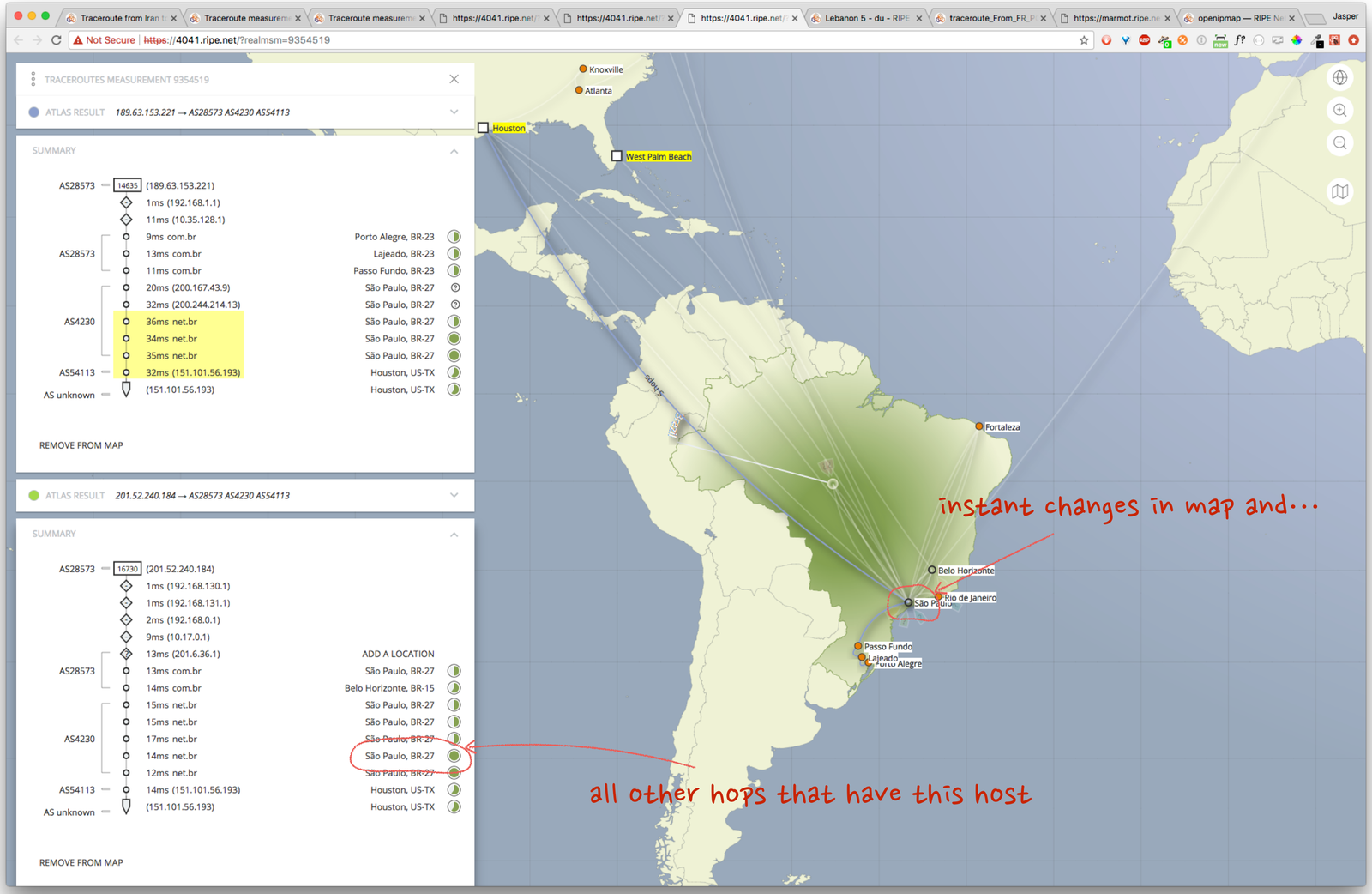
boost the score for this location

Change and improve locations





Change and improve

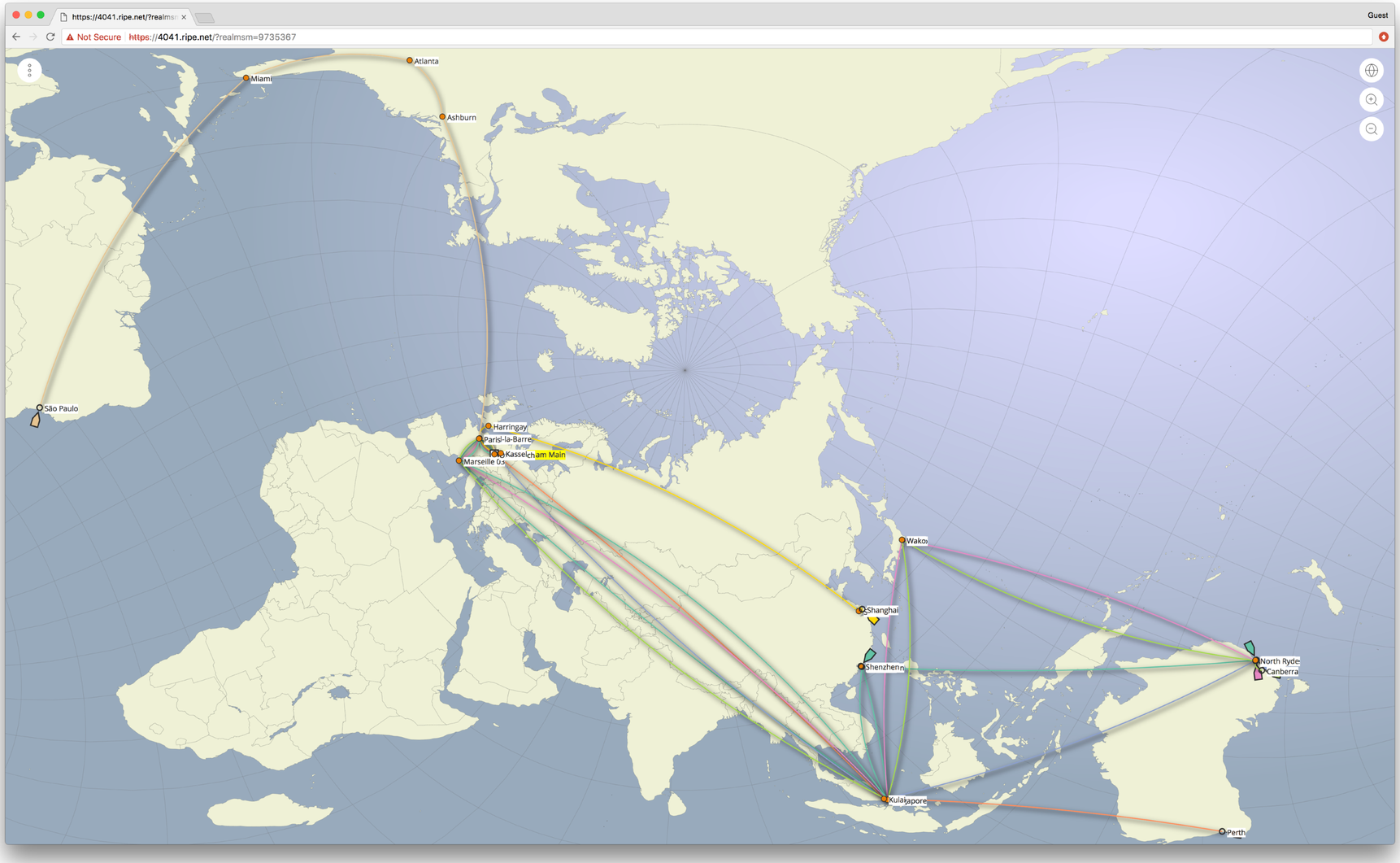


Future Work

New Inference Engines

- Increase research collaborations
- Integrate RIR data
- Reverse DNS engine
- Attempt to separate infra-structure IP addresses from end-user IP addresses
- Automated IP address discovery (IPv6!)

https://openipmap.ripe.net



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