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

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 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

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
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

country
Southern Korea

snapshot date
1 March 2018

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

url
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Peer-to-Peer Fabric

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
Peer-to-Peer Fabric

country
USA

snapshot date
1 March 2018

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

url
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Jasper den Hertog | 9 March 2018 | DKNOG8
Why Geolocation of infra-structure?
Why?

Analyse & Optimise 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

```json
{
  "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": "/crowdsourced",
  "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-U173CX8KTBR196ECAFJ92"
  },
  "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

```json
{  "partials": [    {"engine": "probeslocation", "description": "Probes location suggestor - based on user settings", "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": "17.8.18.1" },    "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

AS16245
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)
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
Geographical information

hops with enriched info
interaction sidebar and map
to each traceroute its own line
data doubt: scores for locations

- Perth, AU-08
  - Location Score: The likelihood of this being the correct location is very low. You should not consider this an accurate estimate.
- São Paulo, BR-27
  - Location Score: OpenIPMap has calculated that the likelihood of this being the actual location is around 50%.
- São Paulo, BR-27
  - Location Score: There is a high likelihood that this is the actual location.
crowdsourcing: add locations

- Click here and...
- Start typing a city or...
- A country
confirm and boost location score

boost the score for this location
Change and improve locations

start typing and...

...choose a new or more specific location and...

now you can submit!
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!)
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