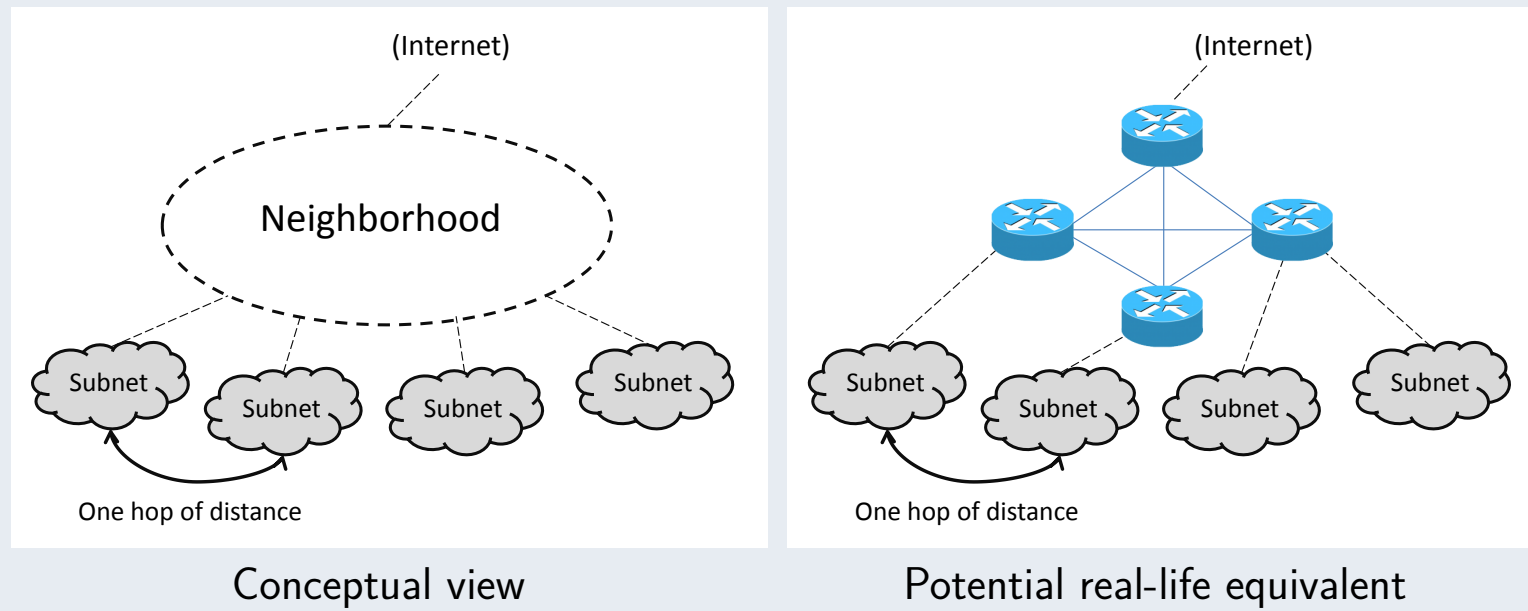


## Summary

A *subnet* is a set of devices which share a same connection medium. Built upon ExploreNET, a subnet discovery tool, TreeNET maps a target domain at several levels, using the subnets as a basis.

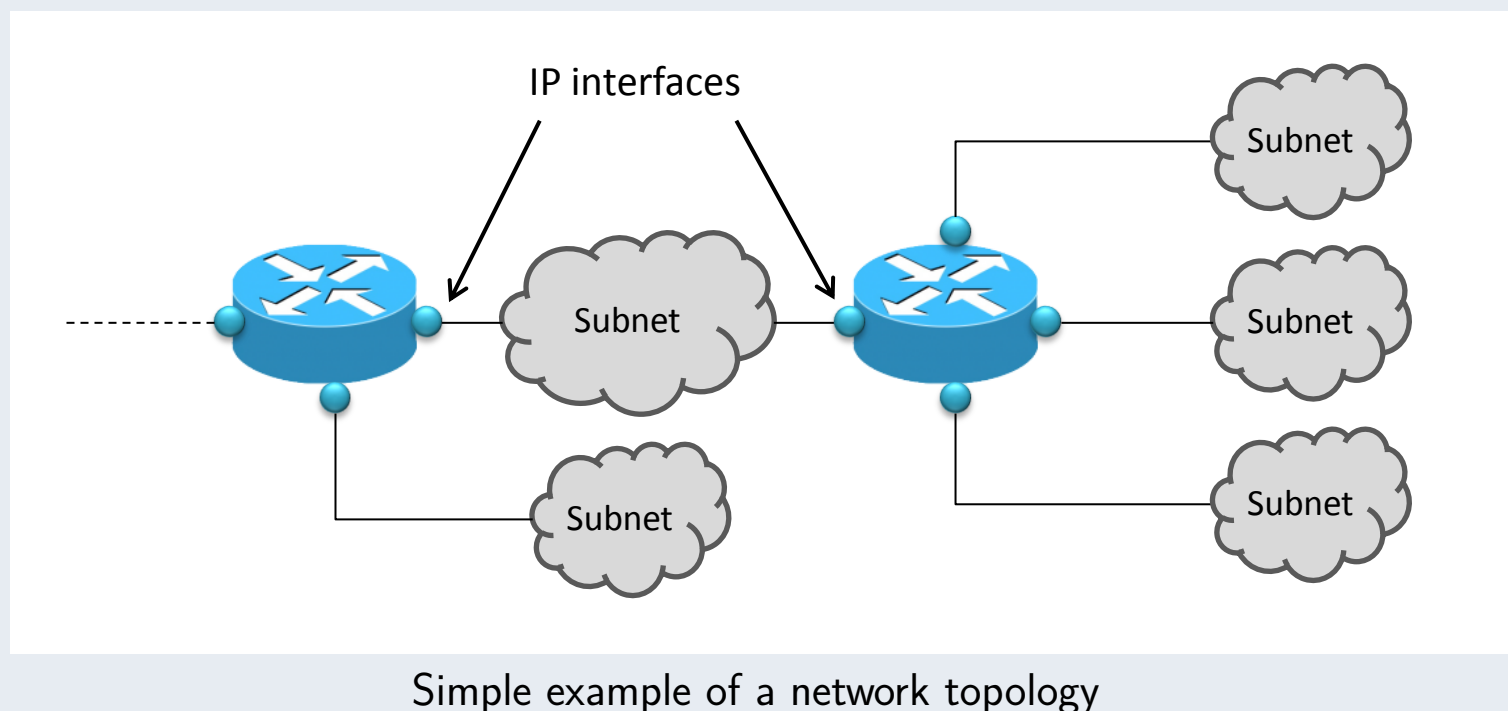
## Locating subnets with the neighborhood concept

To map a network on the basis of its subnets, TreeNET relies on the notion of *neighborhood*: a location in a computer network bordered by a set of subnets which are at most one hop away from each other.

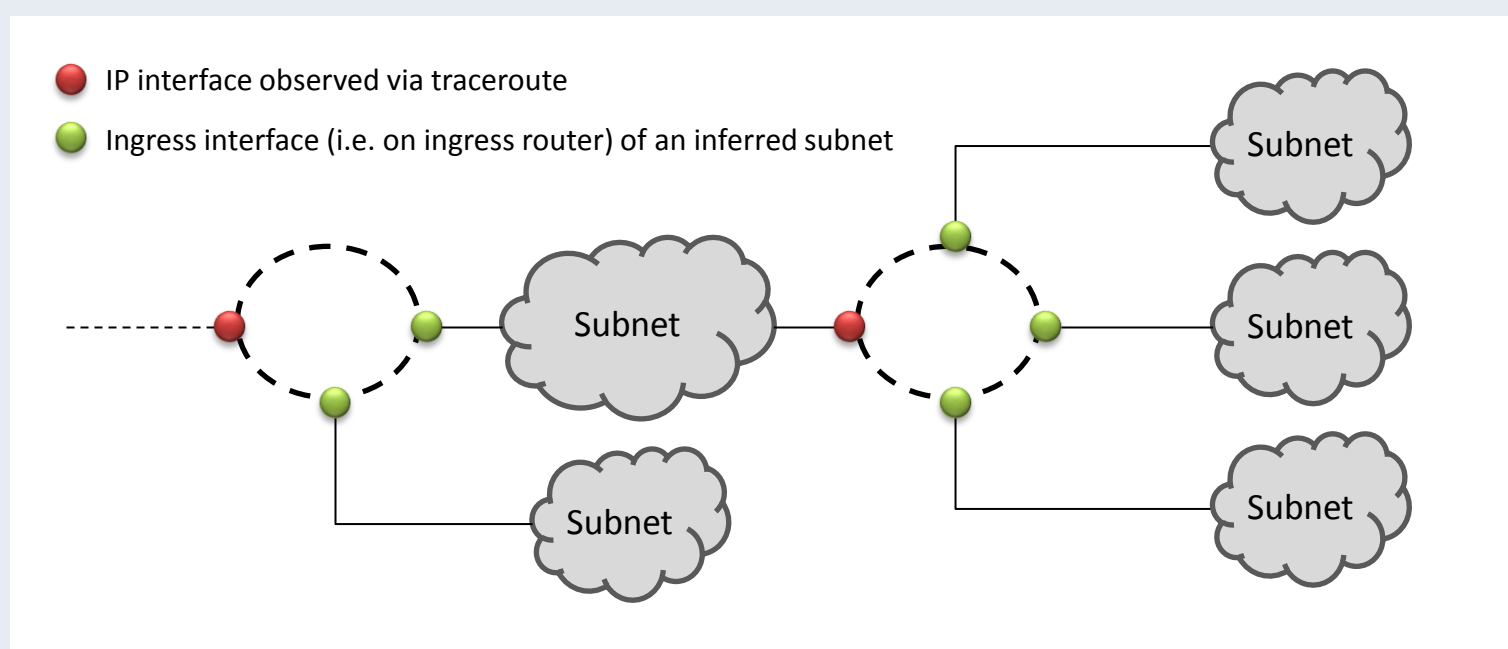


## Discovering neighborhoods

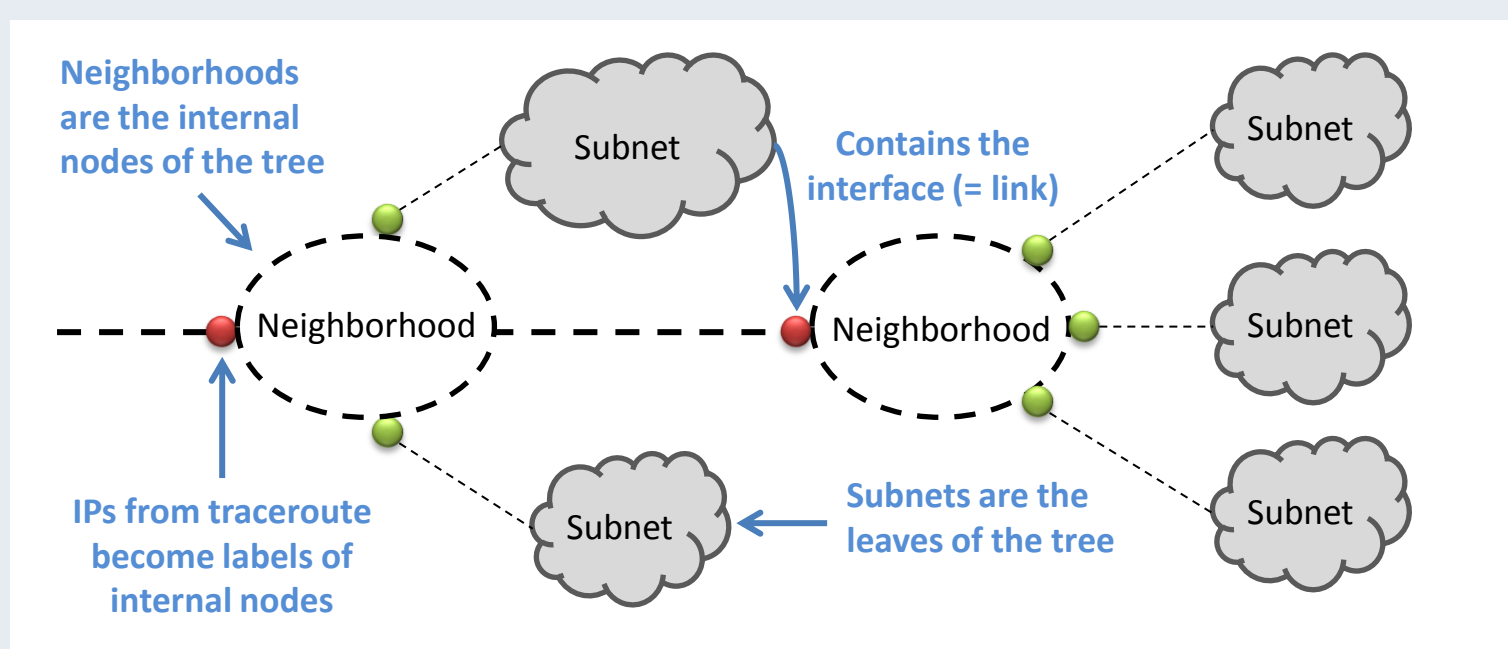
TreeNET conducts traceroute measurement towards each inferred subnet and builds a tree-like structure with the collected routes. The tree (*network tree*) reveals the neighborhoods.



Simple example of a network topology



As seen through traceroute and subnet inference

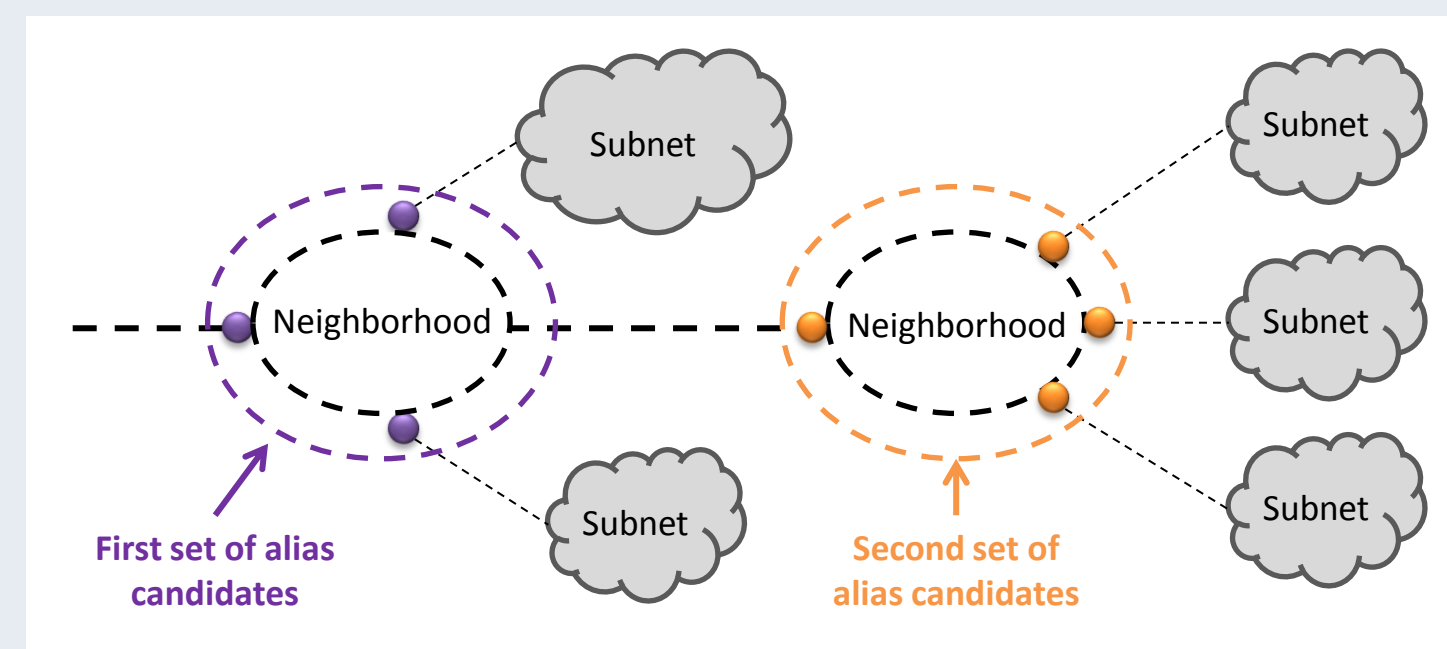


As a network tree built by TreeNET

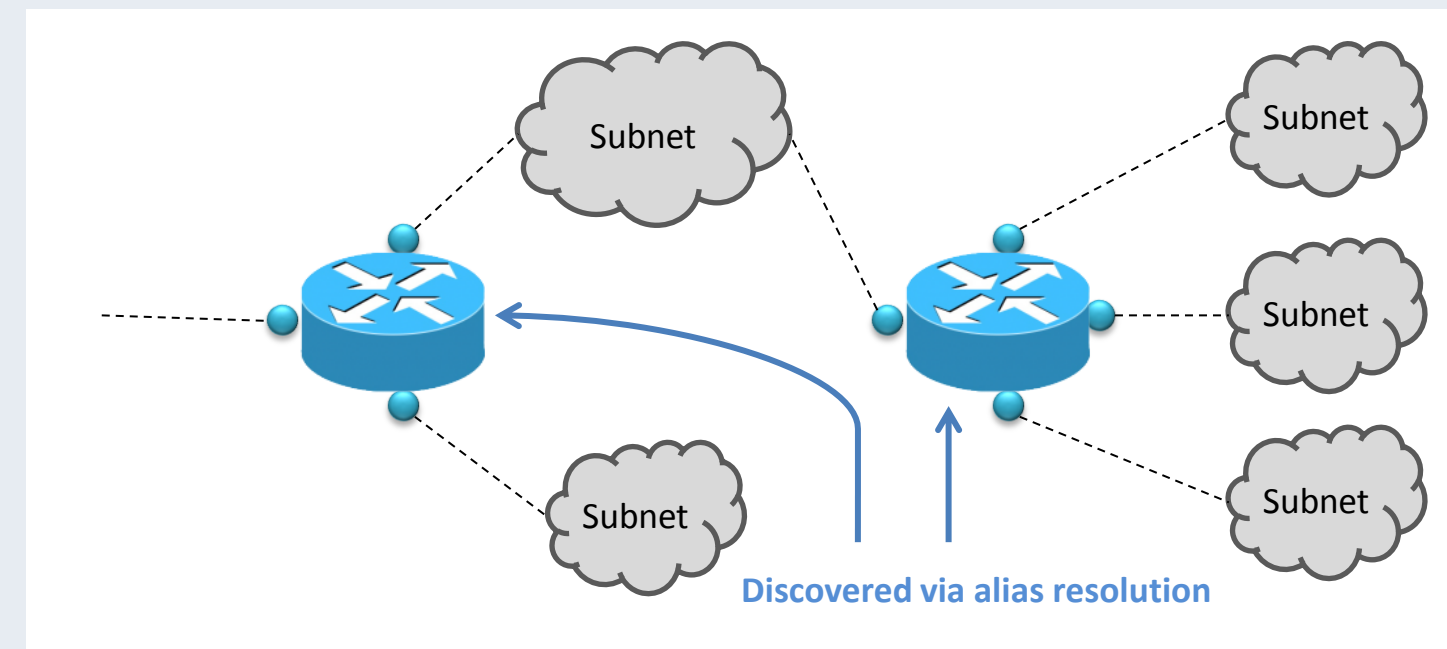
## Alias resolution (1)

The traceroute hops and the ingress interfaces of the inferred subnets can be aliased. Discovering neighborhoods is therefore a way to break down the search space into several smaller sets of *alias candidates*. For each neighborhood, TreeNET sends additional probes towards the alias candidates to fingerprint them. These fingerprints are a way to select the most suited state-of-the-art alias resolution technique.

## Alias resolution (2)



Space search reduction in order to conduct alias resolution



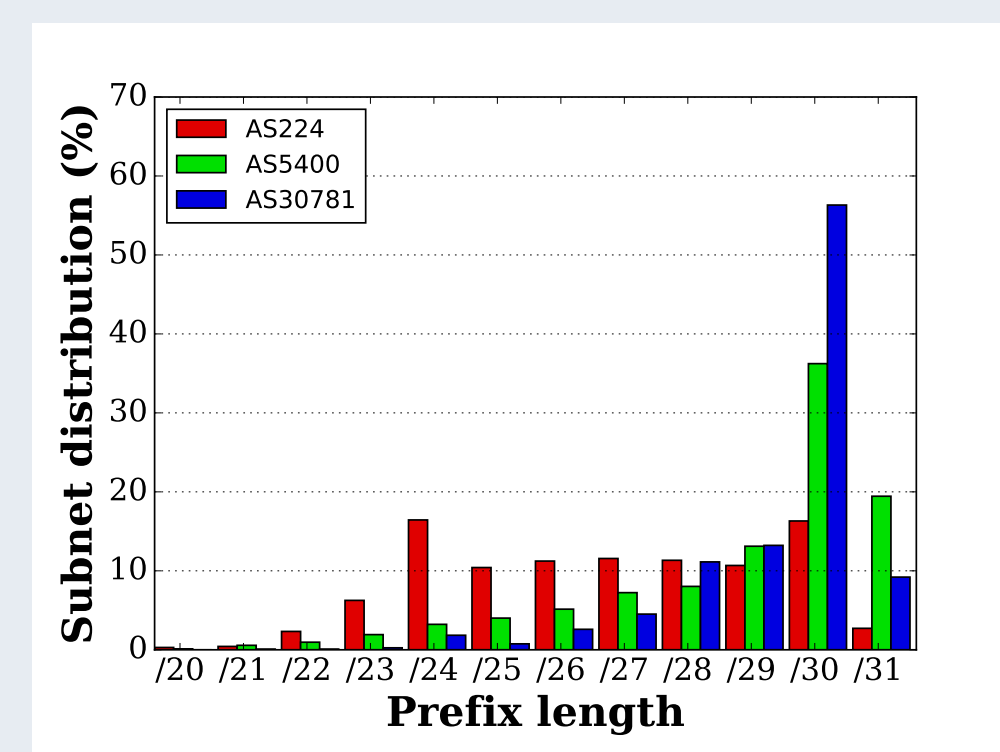
Interpretation of the fully processed network tree

## Validation

TreeNET is currently able to discover accurately around 90% of the visible subnets of a groundtruth network (/16 IPv4 prefix) and infer aliases with a precision of 98%, a true positive rate above 80% and a false positive rate below 0,5%. The false negative rate is a consequence of traceroute anomalies, leading to incomplete neighborhoods.

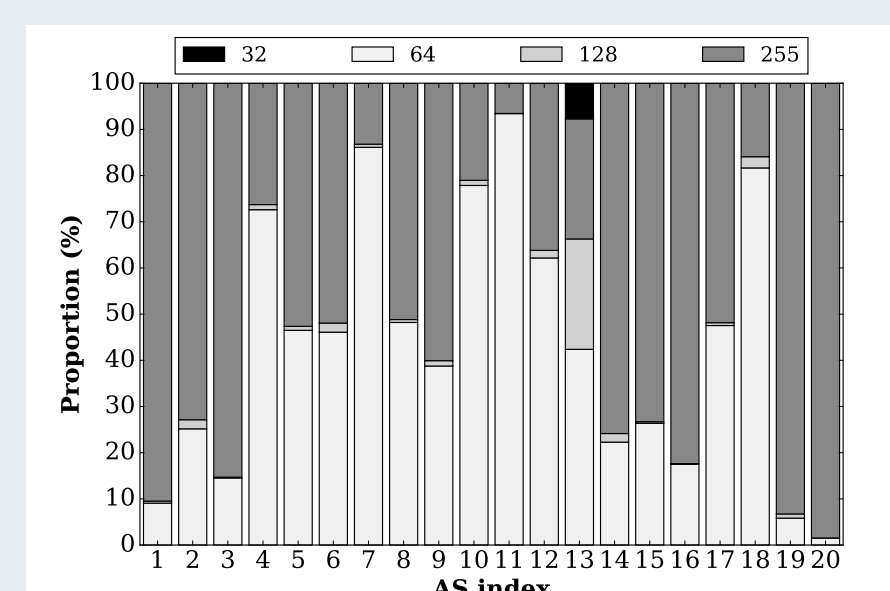
## Observations from the PlanetLab testbed

Early measurements (November 2015) showed that the spread of subnet prefixes can vary a lot from one AS to another.

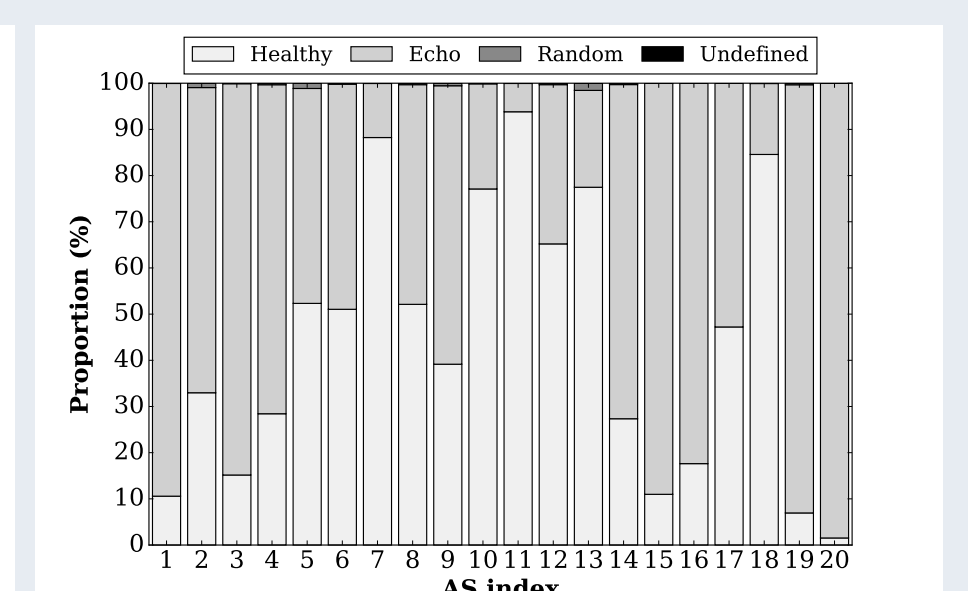


Spread of subnet prefixes

Using data collected towards 20 different Autonomous Systems (ASes), we discovered that some properties of the fingerprinted IPs correlated with each other (figures based on datasets collected on April 14<sup>th</sup>, 2017).



Spread of the initial TTL value of replies



Spread of the IP-ID behavior of fingerprinted IPs

## Publications

*TreeNET: discovering and connecting subnets*  
 J.-F. Grailet, F. Tarissan and B. Donnet (TMA 2016)

*Towards a renewed alias resolution with space search reduction and IP fingerprinting*  
 J.-F. Grailet and B. Donnet (TMA 2017)

## Software and datasets

TreeNET is freely available on GitHub (<https://github.com/JefGrailet/treenet>), along with datasets collected from the PlanetLab testbed. It is exclusively available for IPv4.