Worldwide Measurements Using the Power of Ripe Atlas

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***Abstract*—**

I. Introduction

Goals

- understand the diversity of mobile and fixed Internet access across the globe
- understand impact of last-mile access
- routing paths from ISP clients to cloud providers
- the potential for offloading computations to compute devices closer to the users
- operational difference/similarities between LEO satellite connections and traditional WiFi or mobile connectivity.

II. Experiment Design

A. Probe Selection

Choosing the right probes for network measurement is crucial to obtaining accurate and representative data. Probes should be distributed over all continents and countries, over cities and rural areas as well as over multiple network types and Internet Service Providers (ISPs) to ensure that a comprehensive and representative view of internet performance can be obtained. Our probe selection is based on the probe information data as of $2023-02-07$. Having this information we need to set criteria for pre-filter them. We need our selected probes to be active (exclude probes having another status than *connected*). Furthermore, we don't want them to be located in a datacenter (exclude all probes having the tag *datacenter*, *datacentre*, *aws*, *gcp*). The result is a selection which was active at the day of starting the measurements. The last mile of a connection might have a significant effect on the overall latency. We differ between four different last mile alternatives: cellular, home WiFi, Ethernet and satellite. For each of them we define criteria to filter probes. See Table 1 for an overview on filtering criteria.

1) Cellular: Probes, connected via cellular radio must use one of the established mobile internet technologies from 3G to 5g. As there exist devices which are routers receiving internet connection by a cellular module, we explicitly exclude them.

2) Home WiFi: Home WiFis can be of various different kinds. From most common variant of a router connected by a wire to devices by the ISP connected by cellular setting up a WiFi hotspot in e.g. rural areas, where no cable infrastructure is available. However, we require them to be related to a home WiFi, sparing out public WiFi hotspots.

	cellular	home wifi	satellite	ethernet
Tag (obl.)	–	*home*	*starlink*	*home*
Tag (any)	*3g*, *4g*, *lte*, *5g*, *mobile*	*wi-fi*, *wireless*, *system-wifi*, *fixed-wireless*, *wireless-isp*	–	*fibre*, *cable*, *ftth*
Tag (exclude)	*dsl*, *vdsl*, *vdsl2*, *adsl*	–	–	–
Filter	–	–	$ASN14593$	distance (min)
# Probes	168	122	63	290

Fig. 1. Probe Filter Criteria

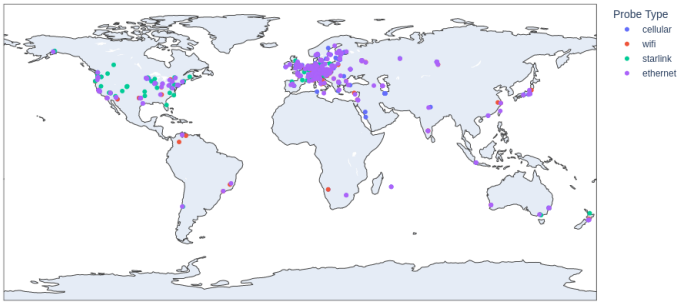

Fig. 2. Map of Probe Selection

3) Satellite: Internet connection via satellite is mainly represented by Starlink, a low earth orbit (LEO) system. Probes connected to Starlink can be easily identified by Starlink's autonomous system number 14593.

4) Ethernet: For comparison to cellular and home WiFi, we select one probe for each cellular and WiFi probe connected via Ethernet which minimizes geographical distance. Additionally it should be related to a home network.

Using these criteria, we found a total of 643 probes spread across the earth as shown in Figure 2. From the map we can observe big differences in distribution of probes. The major part, almost 70% is located in Europe, rather in its norther part. Second most probes with 18% are located in North America, having more than half of the total satellite probes. On the last

place is Africa, hosting only 1% of all probes. This leads to a highly unbalanced distribution of probes between Europe and North America, and the remaining continents. Taking this as basis, we regard these differences in the following analysis.

B. Datacenter Selection

Which datacenters did we select and why?

C. Route Selection

- mapping from probes to datacenters

D. Measurement Techniques

- (paris) traceroutes - pings

III. Analysis

IV. Conclusion

References