Response Times from Latin America and the Caribbean to the LACTLD Anycast DNS Cloud

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Introduction

Within the framework of the analyses conducted by LACNIC to determine the status of Internet security, stability, and resilience in Latin America and the Caribbean, it is evident that there is a need to focus on the Domain Name System (DNS), one of the key building blocks that support the operation of the Internet.

To do so, it is essential to analyze the different aspects of the DNS system, from both the recursive and the authoritative point of view and, in the latter case, at different levels of the DNS hierarchy.

An initial study conducted in 2019[1] focused on the health of DNS root servers, the first level in this hierarchy. The 2019 study analyzed the response times from each Latin American and Caribbean country to each of the root servers using regular and constant measurements.

For the second stage, the decision was made to analyze the next level in the DNS hierarchy, i.e., top level domains (TLD), especially those corresponding to countries in our region.

The LACTLD anycast cloud,[2] a platform developed by the Latin American and Caribbean ccTLD Association which brings together various ccTLDs, can be used for this purpose. This initiative offers its members a collaborative infrastructure that currently comprises 14 nodes in different countries across the region (see Annex A). These are exact copies that account for a total of 15 ccTLDs and critical infrastructure zones (see Annex B).

The number of countries that have joined this platform makes it an attractive target for a DNS analysis. Good response times from each country to the LACTLD anycast cloud reflect a more stable, resilient and secure Internet in the region.

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[1] Root server measurements website: https://rsstats.labs.lacnic.net/
[2] LACTLD Anycast Project website: https://anycast.lactld.org

Purpose

To analyze response times from different countries in the LAC region to the LACTLD anycast cloud.

The name of LACTLD's anycast cloud is *a.lactld.org* and, thanks to anycast technology, it is enough to direct queries to one of the corresponding IP addresses.[3] The cloud node 'closest' to the origin will be the one to respond.

This cloud serves each of the 15 countries that use the LACTLD anycast service for their ccTLDs, so the response time to *a.lactld.org* is the same for any of these ccTLDs.

Methodology

Just as the 2019 root server study, this research used the probes of the RIPE Atlas project[4] hosted by volunteers in the different countries of the region. DNS queries were sent from these probes to the LACTLD anycast DNS cloud and the response times were recorded.

At the time of the study, there were approximately 1200 probes in the region, with various penetration depending on each country (see Annex C). More than 500 operational probes participated in each monthly measurement.

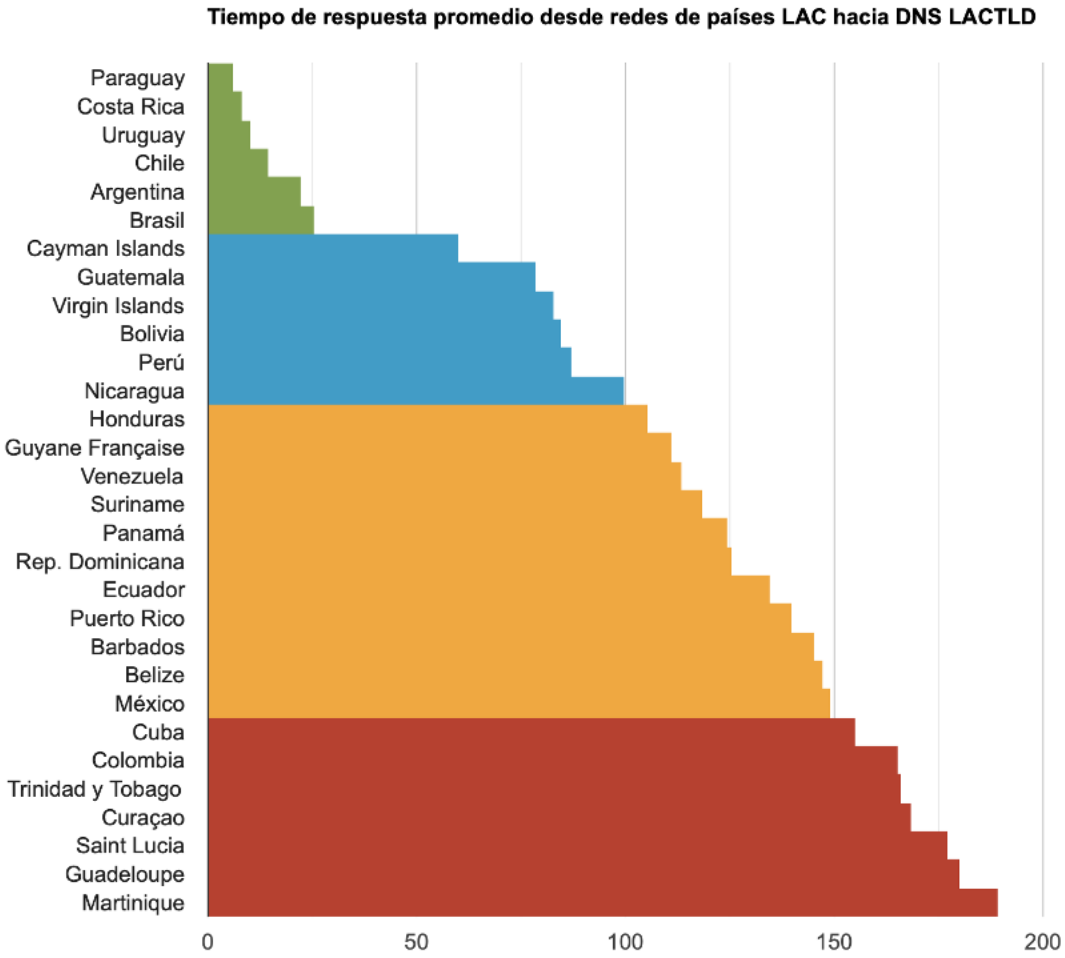
Monthly analyses were conducted by sending DNS queries from each probe every 13 hours during a one-week period. This allowed covering a variety of hours and days of the week and then averaging individual response times to take into account potential delays and temporary outages.

The data was then analyzed to produce representative charts and maps.

[3] IPv4 200.0.68.10 and IPv6 2801:14:a000::10
[4] https://atlas.ripe.net

Initial Findings

After the first six months of data collection, we identified four clusters with very different average response times.



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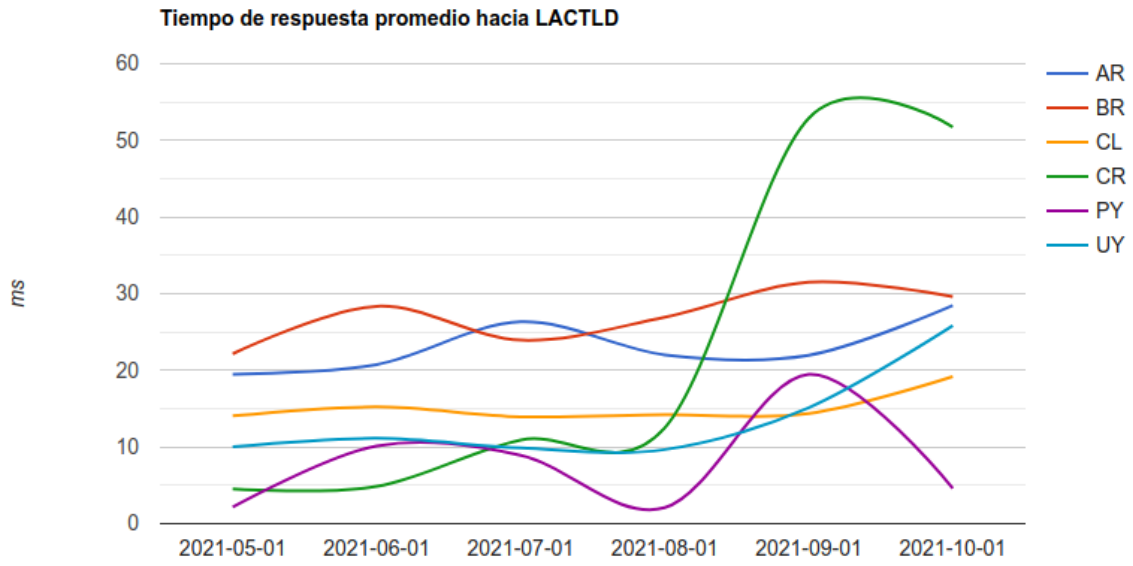
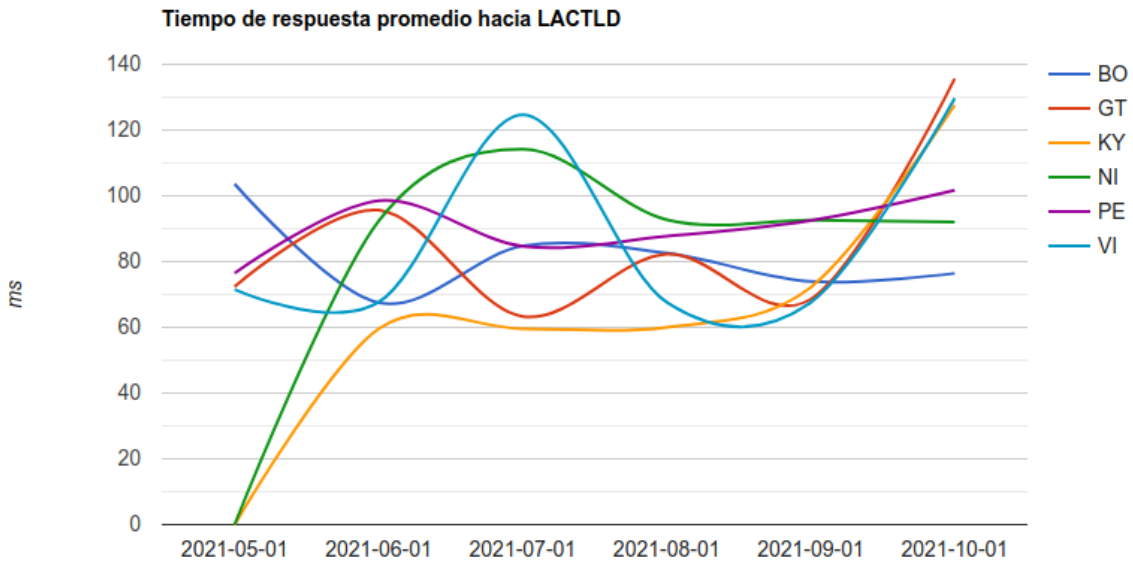
On the one hand, a group of countries with response times lower than 25 milliseconds (ms), quite a good number as this represents an ideal response time for any DNS service. Most of these countries are part of the southern cone of the Latin America, with the exception of Costa Rica, which hosts a node precisely at its CRIX Internet exchange point which, thanks to its optimal interconnection status, makes it possible to make the most of this replica. Uruguay, Brazil, Argentina, and Chile also benefit from the nodes present in each of these countries.



A second group comprises the countries with response times from 50 to 100 ms, quite an acceptable number if they have no local copies and must access copies located in other territories. In this group, Peru stands out because it does not have a good average response time despite having a local copy, which may be evidence of internal routing issues that are forcing access to nodes outside the country instead of their own.



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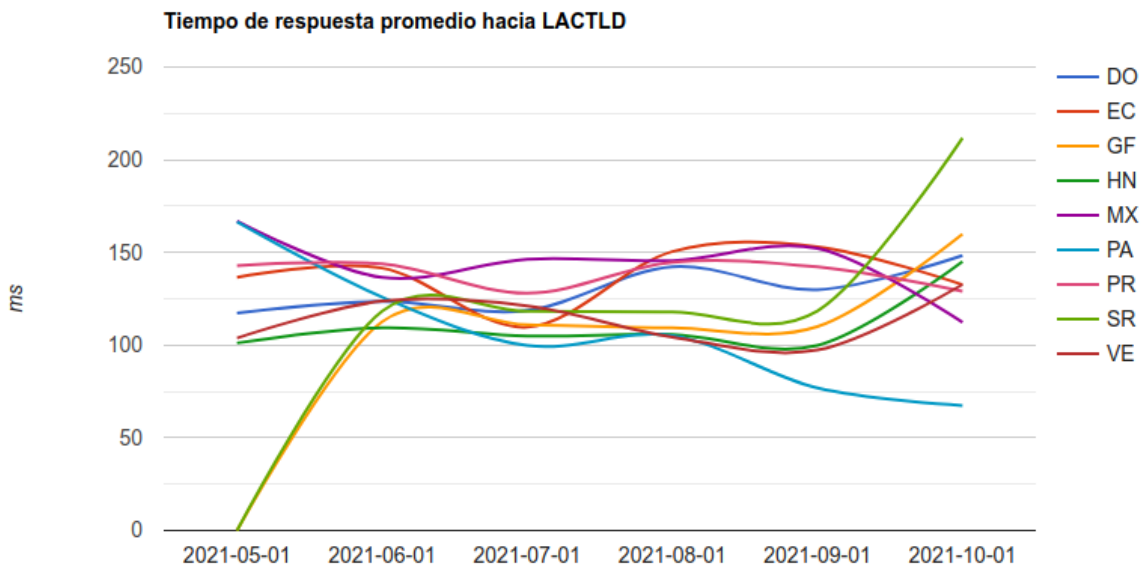
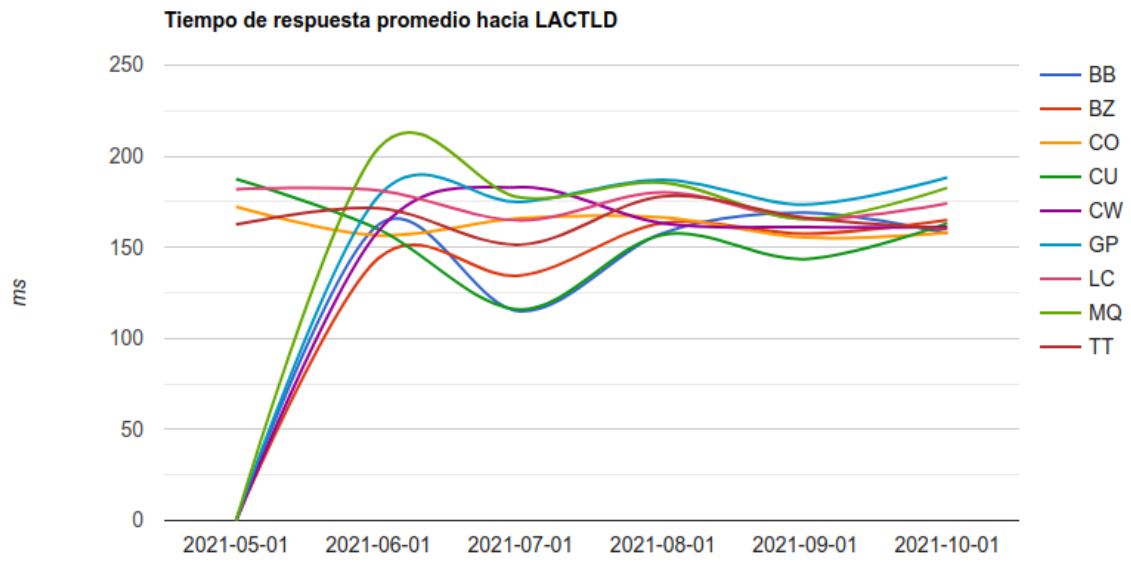
The third group comprises countries where response times have already exceed 100 ms, a number that causes concern as this may cause name resolution delays. Installing local nodes would immediately result in improved response times.

Mexico is another special case: although there is a local node in the country, responses come from more geographically and topologically distant nodes. This would suggest that the local node is not well interconnected with the rest of the country.

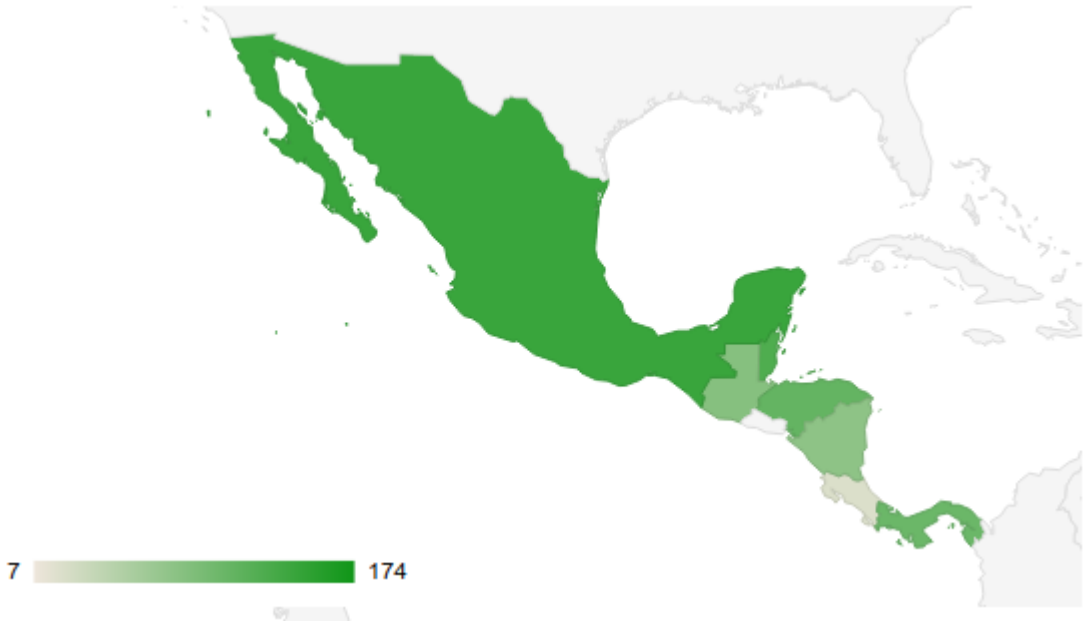


Finally, there is a group of seven countries with response times in excess of 150 ms. In these cases, timeouts might be considered to solve domain name issues.

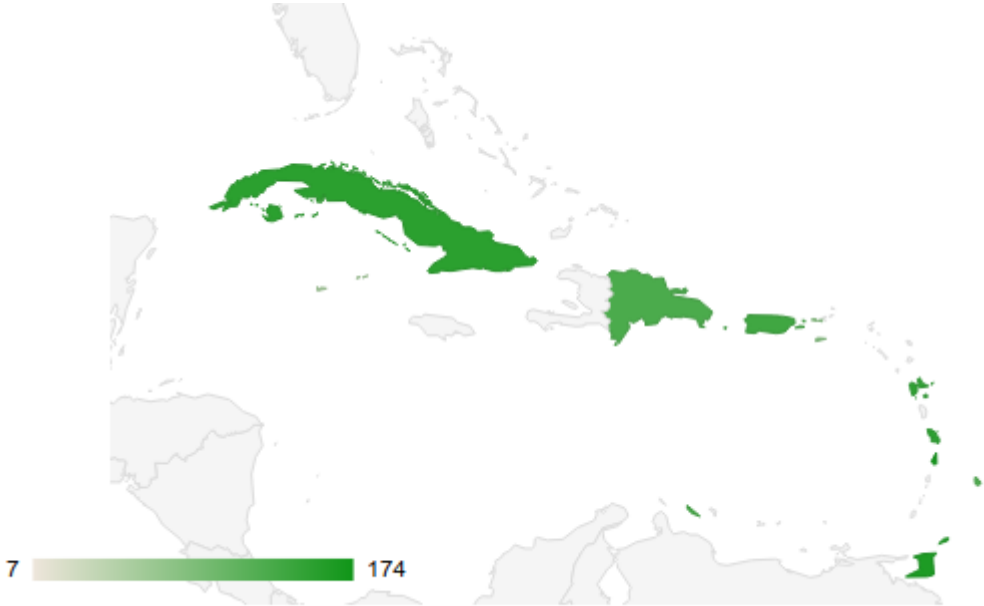


The study allowed us to create maps for each subregion. Each country's response times were represented by different colors. Lighter shades represent lower response times and consequently a better user experience, while darker shades represent longer response times and a poorer user experience.

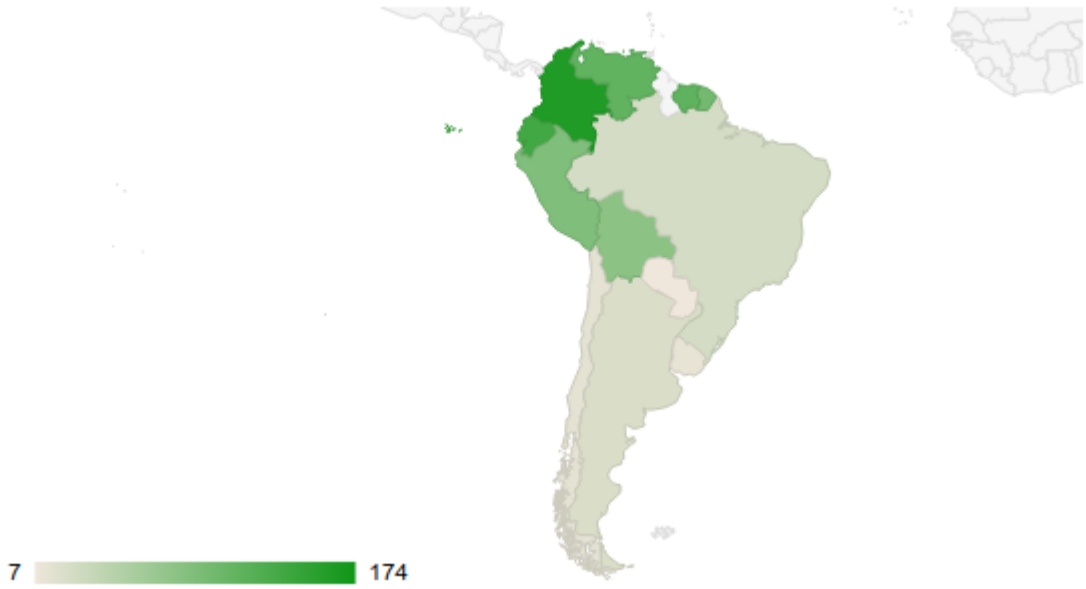
Central America and Mexico



The Caribbean



South America



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Conclusions

The results of the first semester showed locations with an excellent service towards LACTLD anycast cloud member countries and others with room for improvement. This improvement might be achieved by installing new cloud nodes, or by solving internal connectivity issues in case of not reaching the local node .

Reasonably low query times for the domains of each country build towards good Internet quality. The LACTLD cloud project provides an improved geographical distribution of the name servers of the countries whose zones it hosts.

This study analyzed these response times from different measurement points in each country. This project also offers continuous reporting, so the connection of a new node or any changes to network routing engineering will provide evidence of the potential improvements that may be achieved.

Historical results and monthly updates are published on the https://nsstats.labs.lacnic.net/ website.

Annex A: Nodes in the LACTLD Anycast Cloud

At the time of reporting, the LACTLD anycast cloud comprised 14 nodes or replicas, hosted by the following organizations and installed in the following cities:

- NIC Argentina, Buenos Aires, Argentina
- NIC Brasil, Sao Paulo, Brazil
- NIC Chile, Santiago, Chile
- CRIX, San José, Costa Rica
- NIC.cz, Prague, Czech Republic
- NIC Mexico, Monterrey, Mexico, and Dallas, USA
- NIC Paraguay, Asunción, Paraguay
- Blacknight, Carlow, Irlanda
- Buenos Aires, Argentina
- IXP.GT, Guatemala City, Guatemala
- LACNIC, Montevideo, Uruguay
- Perú IX, Lima, Peru

Annex B: Countries and Zones in the LACTLD Anycast Cloud

At the time of reporting, in each of its nodes, the LACTLD anycast cloud included the following country code zones and critical infrastructure:

- .ai, Anguilla
- .cr, Costa Rica
- .do, Dominican Republic
- .ec, Ecuador
- .gp, Guadeloupe
- .gt, Guatemala
- .gy, Guyana
- .hn, Honduras
- .pe, Peru
- .pr, Puerto Rico
- .py, Paraguay
- .sv, El Salvador
- .tt, Trinidad and Tobago
- .uy, Uruguay
- .ve, Venezuela
- LACNIC reverse IP zones

Annex C: RIPE Atlas Probes in the Region

The probes used as the origin of the measurements in this study are part of the RIPE Atlas project, a collaborative effort by volunteers who host devices or servers that perform joint measurements.

A map showing the regional RIPE Atlas network coverage can be found at: https://atlas.ripe.net/results/maps/network-coverage/

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The percentage of probes per country can also be viewed: