DE CIX

STUDY

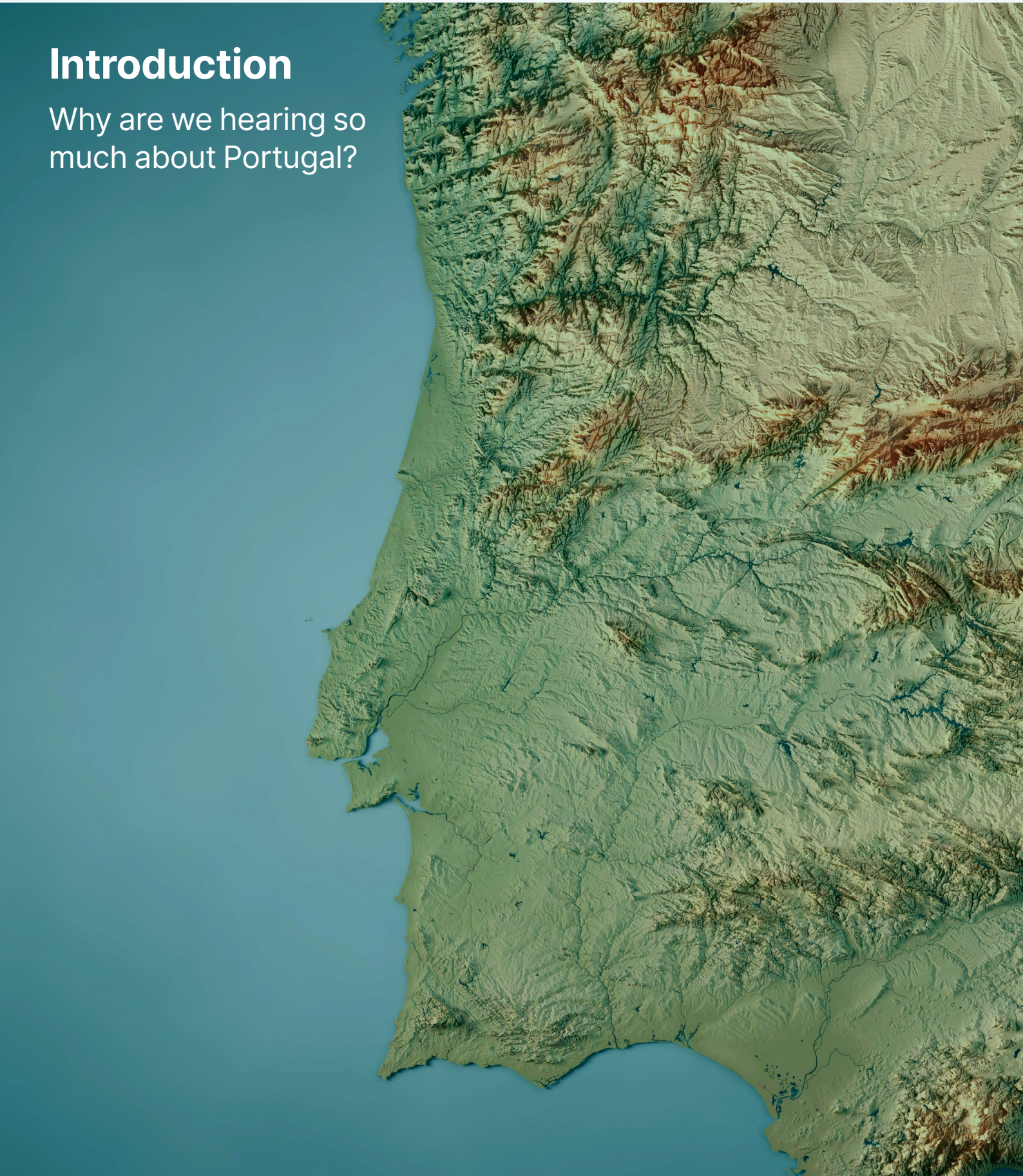
Portugal: a global interconnection hub, a gateway to Europe, a gateway to the world

Study by Serge Radovcic, Paul Rendek

Contents

Introduction

Why are we hearing so much about Portugal?



Portugal has been highlighted as a destination of opportunity for business investment, education, lifestyle, and leisure. Reported growth rates in these segments together with a favorable fiscal investment and regulatory environment all seem to support this. With European countries racing to advance their digital footprint, a closer look into Portugal's digital infrastructure development reveals a country positioned to become a new global interconnection hub for Internet data flows.

Global interconnection hubs manage international traffic flows to a country or region and provide a transit zone function for routing international traffic. This has multiple impacts on the connectivity of the region, among them a reduction in the price of connectivity, an increase in the local availability of content, an economic boost through the construction and operation of more local data centers, an increase in the resilience and robustness of Internet connectivity, and a reduction in latency. This last element in particular has been coined the "new currency", as many current and future digital services and applications are dependent on fast reaction times, and therefore low-latency connectivity.

Identifying elements common to prominent and thriving interconnection hubs provides a benchmark for assessing the position of Portugal in current and future international and intercontinental Internet data flows. This paper examines the developments in this area over the period 2016 to early 2024 and reveals what progress Portugal is making towards parity with other globally recognized hubs.

In addition to fundamental business investment and infrastructure, three points stand out at global interconnection hubs:

1. an established Internet Exchange (IX) achieving globally competitive roundtrip times and keeping locally destined traffic local,
2. a distributed and diverse interconnection ecosystem of both local and international network providers and data center operators, and
3. the ability to offer redundancy, resiliency, and options that are becoming paramount to serving different market segments and network needs.

From a geographical standpoint, Portugal occupies a pivotal position in the contemporary global Internet landscape. Serving as an ideal nexus for connectivity, it seamlessly links other regions of the world to Europe, and reciprocally facilitates efficient access for Europeans to the rest of the globe, potentially minimizing all round-trip times. One could argue that Portugal is ideally placed at the center of the Internet connectivity world.

Keeping in mind Portugal's strategic geographical position, this paper will examine what this means in terms of real proximity to developed and emerging markets in terms of latency and data traffic flow, and what is happening to secure the country's position among other global interconnection hubs. The analysis below provides evidence that Portugal can provide a viable alternative to the historical FLAPS (Frankfurt, London, Amsterdam, Paris, Stockholm) interconnection powerhouse locations. The paper demonstrates that the interconnection market has taken steps in developing a complementary ecosystem in the country, encouraging greater diversity, and increasing options for redundancy and resiliency. However, the potential for expanding interconnections and data flows from both developed and emerging markets has yet to be fully exploited.

In essence, Portugal is a country well-positioned not only as a complementary interconnection hub to cater for the well-established international traffic flows to or through Europe, but also as part of the regional development on the Iberian Peninsula as a potential game changer in this context.

A brief look at Portugal's Internet infrastructure progress: What has improved in recent years?

The period investigated in this paper, 2016 to 2024, was chosen to encapsulate all recent changes on the IX market in the country. Although an existing strong local IX, GigaPIX, has been present in the market for close to 30 years, keeping local traffic local and ensuring low latency for these data flows, after 2016 new IX players entered and transformed the market in Portugal, bringing greater diversity and redundancy, and strengthening the interconnection ecosystem.

A brief look at some characteristics supporting the foundations for a robust interconnection ecosystem highlight some of the significant changes since 2016. They show that Portugal has been taking strides to match the infrastructure expansion of other leading European regions.

With Portugal's fast-growing and dynamic tech sector, continuing investment in Internet infrastructure is vital to attract foreign players and energize the market. An increase in infrastructure capacity and a decrease in costs for businesses and end-users is a strategic balancing act.

↓ **Figure. 1**
Development of characteristics supporting the foundations for a robust interconnection ecosystem in Portugal, 2016-2023

	2016 / 2023	Evolution ↑↓
Average price per megabit per month EUR	0.82 / 0.65	**21% cheaper**
Median 10 Gbps IP Transit Prices	0.75 / 0.26	**65% cheaper**
Fiber to the Home (FTTH)	N/A / 71%	
Average Internet Connection Speed (fixed)	12.6 / 119	**+844%**
Average Internet Connection Speed – Global Ranking	37 → 22	**up by 15 ranks**
Number of ASNs being publicly routed	69 / 109	**+58%**
% of registered ASNs being publicly routed	77% / 90%	**+17%**
Number of IXPs in Country	2 / 4	**+100%**
Total IXP Traffic in Lisbon (Gbps)	35 / 180	**+414%**
Number of data centers in country (vs. in Lisbon)	N/A / 33 (20)	

In terms of domestic infrastructure investments, seven European countries have exceeded 50% penetration of Fiber to the Home / Building (FTTH/B) connectivity by 2023. These countries were, in descending order, Iceland, Spain, Portugal, Sweden, Norway, Romania, and France. Placed third in Europe, Portugal shines with a FTTH/B penetration rate of 71.1%. Later in this report, we will take a closer look at terrestrial connectivity, specifically between Portugal and the rest of Europe, as well as sub-sea cross-continental connectivity.

Connectivity costs is a central benchmark applied in the competitive market for both international and national data. From 2016 to early 2024, Portugal has seen a 20% decrease in average price per megabit per month to consumers. During the same period, it has experienced an even sharper decrease in transit prices, with the median price for 10 Gigabits per second (Gbit/s) of IP transit dropping an impressive 65% to 0.26 EUR cents. This reduction in prices can be seen as a direct positive impact of Portugal's status as a promising global interconnection hub, with significant growth in international networks and other digital infrastructure in the period 2016 to 2024. With prices in 2023 at 0.25 EUR cents in Spain and 0.22 EUR cents in Germany, Portugal is well positioned in comparison with other competitive markets.

Internet connectivity speeds are an element affected positively by a robust interconnection hub. From 2016 to early 2024, Portugal witnessed a surge in the average Internet connection speed, rising from 12.6 Mbps to 119 Mbps, an increase of 844%. This has moved Portugal up 15 places in the global ranking of average Internet connection speed, from position 37 to 22.

Data center availability is critical for networks seeking their next potential point of presence in a market. At the beginning of 2024, Portugal has 33 data centers, of which 20 are in or in the vicinity of Lisbon. A site in Covilhã, Portugal boasts one of the world's largest data centers. In addition to this, there are plans for a data center powered by 100% green energy as part of the unique Sines data center project. If the project is completed as planned, it will be the largest renewable energy data center site in Europe. These developments are all aimed at managing the ever-growing demand for both data storage and transmission. Unfortunately, reliable reporting of the number of data centers in Portugal does not date back to 2016, therefore providing no baseline for growth in the data center market.

Healthy interconnection markets generally also witness an increase in the public announcements of Autonomous System Numbers (ASNs), or networks. Portugal saw a 58% increase in the number of publicly routed ASNs from 2016 to 2024, and 90% of the ASNs registered were announced.

Finally, a solid and resilient connectivity infrastructure and an abundance of data centers allows for the emergence of a diverse Internet Exchange ecosystem. From 2016 to 2024 the number of IXs in operation in Portugal doubled, bringing the total to four IXs offering services at various data centers for a diversity of ASNs. A closer look at the IX ecosystem and more detailed information on ASN growth can be found on page 22 of this report.

Portugal, a global connectivity hub ready for the future

From a geographical standpoint, Portugal occupies a pivotal position in the contemporary global Internet landscape. Serving as an ideal nexus for connectivity, it seamlessly links other regions of the world to Europe, and reciprocally facilitates efficient access for Europeans to the rest of the globe, potentially minimizing all round-trip times. One could argue that Portugal is ideally placed at the center of the Internet connectivity world.

Given that minimizing the distance that data needs to travel is essential for keeping latency as low as possible, geographical location is decisive for not only local data exchange, but also international and cross-continental traffic flows. Using Portugal's capital city Lisbon as a focal point of reference, insightful comparisons can be drawn to other prominent cities worldwide in terms of their proximity to major global centers. This allows for an analysis of geographical positioning and connectivity in relation to several of the world's key urban hubs.

By conducting an analysis of a selection of important cities worldwide located at points of cross-continental data flows and measuring their distances 'as the crow flies' to key economic and population centers on five continents, it becomes evident that Lisbon occupies a strategically advantageous geographical position. The table provided below (Fig. 2) illustrates the individual flight kilometers between the five global economic and population centers chosen, these representing Europe, North America, South America, Asia, and Africa respectively, and relevant or potential Internet interconnection hubs. Cumulatively, Lisbon boasts the lowest total kilometers among the hubs explored, with the most favorable average distances.

	London	New York	Rio	Hong Kong	Johannesburg	TOTAL	AVERAGE
Cape Town	9,671	12,565	3,767	11,873	1,262	39,138	7,828
Dubai	5,481	11,014	11,859	5,946	6,429	40,729	8,146
Forteleza	8,497	7,153	793	17,349	7,203	40,995	8,199
Lagos	5,017	8,475	6,025	11,840	4,504	35,861	7,172
Lisbon	**1,583**	**5,422**	**7,716**	**11,027**	**8,188**	**33,936**	**6,787**
Los Angeles	8,754	3,936	10,140	11,652	16,674	51,156	10,231
Miami	7,123	1,757	6,720	14,452	12,945	42,997	8,599
Singapore	10,858	15,339	15,724	2,587	8,658	53,166	10,633
Tokyo	9,561	10,849	18,566	2,882	13,540	55,398	11,080
Global Average	7,394	8,501	9,034	9,956	8,823	43,708	8,742

↑ **Figure. 2**
Flight distances from various global digital hubs to other major cities

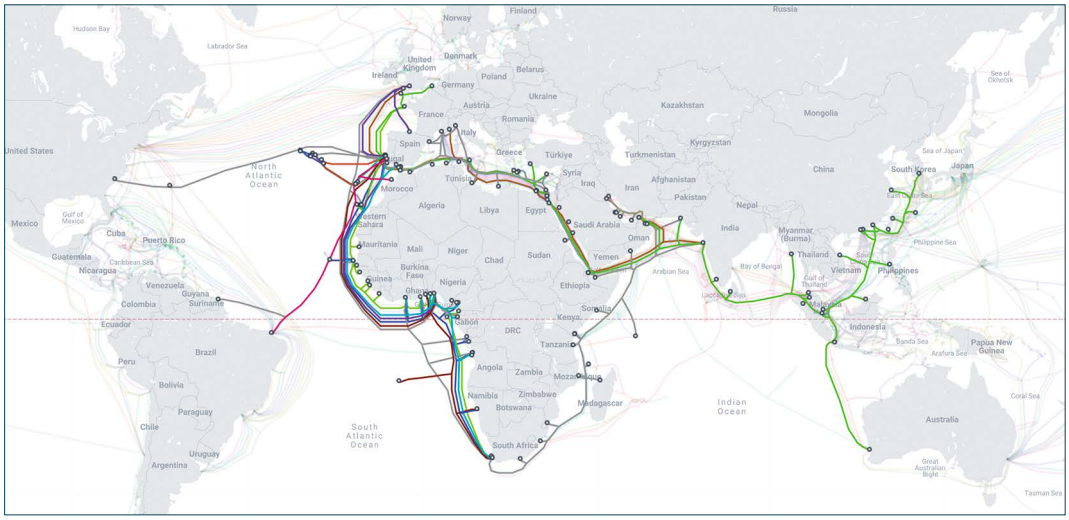
While other prominent European digital hubs like Frankfurt, Amsterdam, and Paris have historically played crucial roles in connecting Europe with the Americas through their links to transatlantic routes, and potentially share a comparable geographical advantage in achieving similar average distances to the five major economic and population centers outlined in the table above, Lisbon stands out by featuring direct submarine cable links across the Atlantic to South America, and soon it will establish direct connections to the East Coast of the USA.

Portugal showcases its strategic location with remarkably short distances, providing convenient access to Europe, Africa, and, notably, favorable proximity to both North and South America. The visualization in Figure 3 of flight paths from Lisbon to other global cities illustrates Lisbon's positioning as a formidable gateway for traversing the Atlantic Ocean.

← **Figure. 3**
Visualization of flight paths from Lisbon to other major cities on each continent

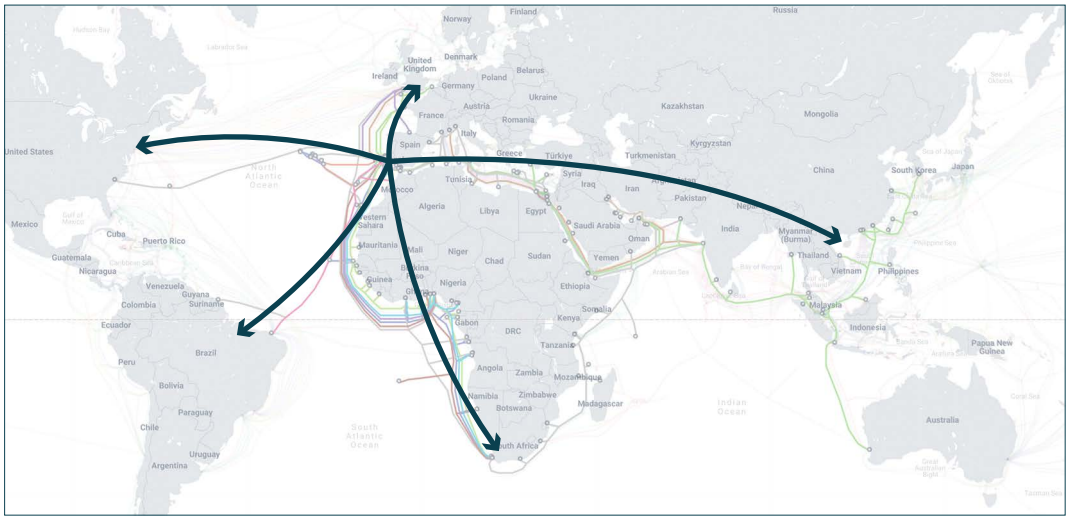
As mentioned earlier, several other European cities also enjoy a geographical advantage akin to Portugal concerning distances to other parts of the world. What distinguishes Portugal is the extensive network of submarine cables capitalizing on these favorable distances (see Figure 4), resulting in a unique potential for a global interconnection hub.

By 2026, it is anticipated that submarine cable initiatives landing in Portugal will extend to 115 cable landing stations worldwide (Figure 4), establishing direct cable connections with no fewer than 60 countries across five continents and extending as far as Australia.



← **Figure. 4**
TeleGeography submarine cable map showing cable links connecting Portugal to the world

By superimposing the maps illustrating, on the one hand, the existing and future global network of submarine cables landing in Portugal and, on the other hand, the flight paths between Lisbon and major cities worldwide (Figure 5), the rationale behind designating Portugal as a global interconnection hub becomes increasingly evident. Naturally, in many cases the flight path is shorter than the cable routes, however this overview attempts to depict the relatively close relationship between the two.



← **Figure. 5**
Superimposition of TeleGeography submarine cable map and flight path map from Lisbon to major cities on each continent

Enhancing Portugal's distinction as a global interconnection hub is the strategic placement of its cable landing stations at five separate locations on the mainland. The country has managed to foster a truly distributed interconnected infrastructure spanning multiple cities along its expansive Atlantic coastline. This dispersion fortifies overall Internet diversity and robustness, providing redundancy and resiliency against potential disruptions.

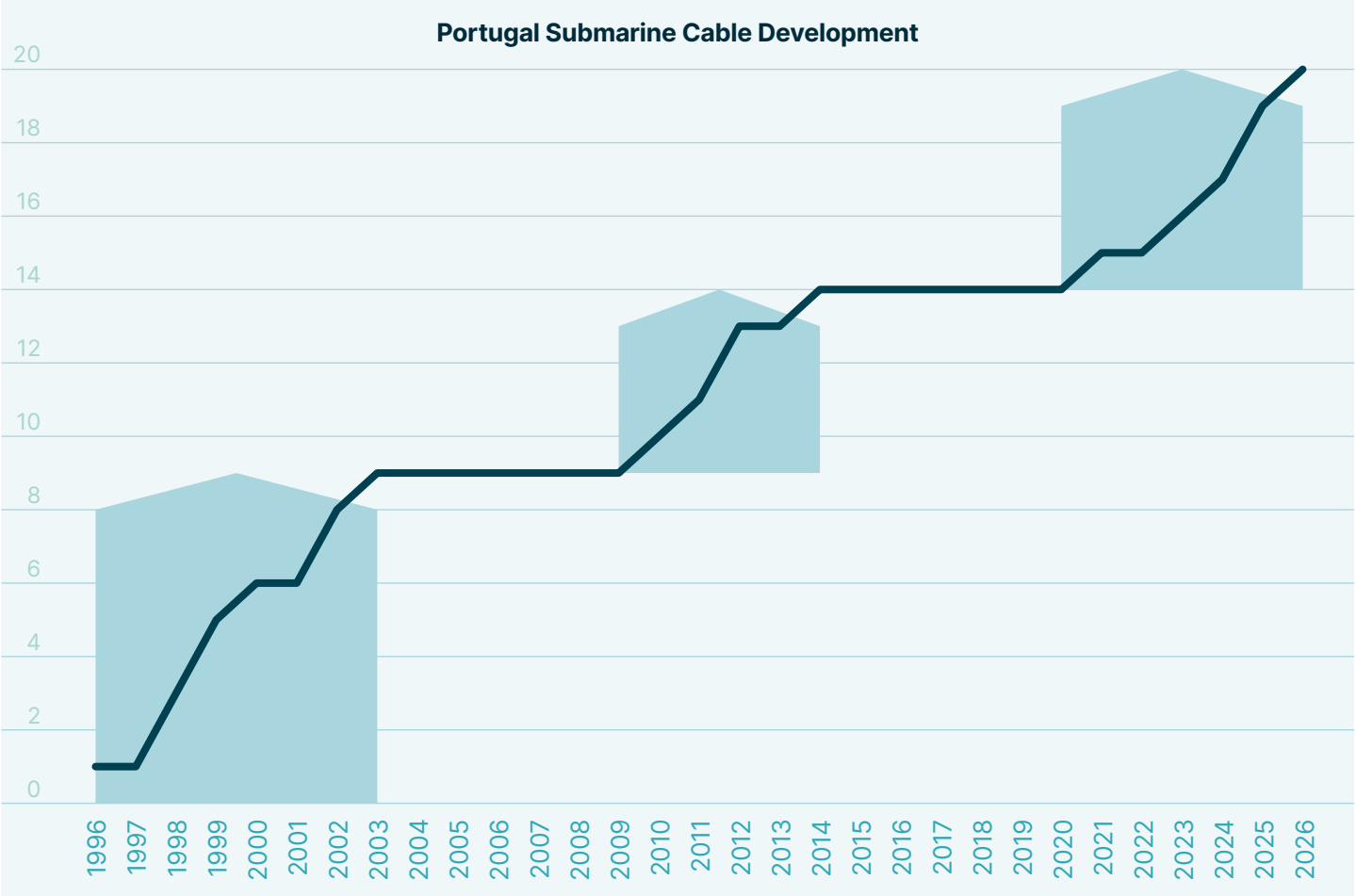
What sets Portugal apart even more distinctly from other countries is that the four main international cable landing stations and Portugal's three main Internet Exchanges (IXs) in Lisbon are all within a radius of just 100 kilometers, creating a uniquely concentrated and interconnected network infrastructure.

Portugal's rich history of submarine cables dates back to the late 1990s, when it witnessed the deployment of its initial three cables connecting various parts of its coastline, and the establishment of the first link to the Azores Islands, which also included landings at seven points on the

island group. By as early as 2002, Portugal had successfully established submarine cable connections to key locations such as Spain, the United Kingdom, Belgium, France, Mediterranean destinations, North Africa, West Africa, South Africa, the Middle East, and extensive parts of Asia, as well as a link to Australia. Six out of the eight submarine cable initiatives were solely owned and operated by Portugal Telecom, which was government-owned at the time. Additionally, Portugal played a role as part owners in two other intercontinental cable initiatives.

After a dynamic period of establishing an extensive network of connections from 1996 to 2003, there was an interlude in submarine cable development for the subsequent six years. From 2009 to 2012, renewed efforts led to an additional connection with France and, notably, the introduction of three distinct submarine cable initiatives linking to multiple West African countries. Two of these initiatives extended their reach to the shores of South Africa, thereby reinforcing connectivity between the two continents.

↓ **Figure. 6a**
Development of submarine cables landing in Portugal since 1996



While the period from 2012 to 2020 witnessed yet another pause in new cable initiatives, with just one cable being developed within the Azores Island group, the drought was broken in 2021 with the establishment of an unprecedented link between Europe and South America through the new EllaLink initiative connecting Portugal to Brazil. Following this milestone, 2023 marked the introduction of another significant link between Portugal, the west coast of Africa, and South Africa, thereby reinforcing and enhancing the Africa-Europe connectivity ecosystem. Looking ahead to the years 2024 to 2026, we anticipate further diversification of cable routes from Portugal, including additional connections to other European countries, North Africa, and the Middle East. Notably, a direct link to the east coast of the USA is expected to be launched in 2026.

↓ **Figure. 6b**
List of submarine cables landing in Portugal

#	Name	Year Est.	Length (Km)	Owners	Continents
1	BUGIO	1996	73	Portugal	Europe (Portugal)
2	Azores Fiber Optic System (AFOS)	1998	1,100	Portugal	Europe (Portugal)
3	Sagres	1998	302	Portugal	Europe (Portugal)
4	Columbus-III Azores-Portugal	1999	1,500	Portugal	Europe (Portugal)
5	SeaMeWe-3	1999	39,000	Portugal/ Foreign	Africa, Asia, Europe
6	Continente-Madeira	2000	1,179	Portugal	Europe (Portugal)
7	SAT-3/WASC	2002	14,350	Portugal/ Foreign	Africa
8	Tata TGN-Western Europe	2002	3,578	Foreign	Europe
9	CAM Ring	2003	1,120	Portugal	Europe (Portugal)
10	MainOne	2010	7,000	Foreign	Africa
11	Europe India Gateway (EIG)	2011	15,000	Portugal/ Foreign	Africa, Asia, Europe
12	Africa Coast to Europe (ACE)	2012	17,000	Foreign	Africa, Europe
13	West Africa Cable System (WACS)	2012	14,530	Portugal/ Foreign	Africa
14	Flores-Corvo Cable System	2014	685	Portugal	Europe (Portugal)
15	EllaLink	2021	6,200	Portugal/ Foreign	South America, Africa
16	Equiano	2023	15,000	Foreign	Africa
17	2Africa	2024	45,000	Foreign	Africa, Asia, Europe
18	Medusa Submarine Cable System	2025	8,760	Foreign	Africa, Europe
19	Olisipo	2025	110	Portugal/ Foreign	Europe (Portugal)
20	Nuvem	2026	6,500	Foreign	North America

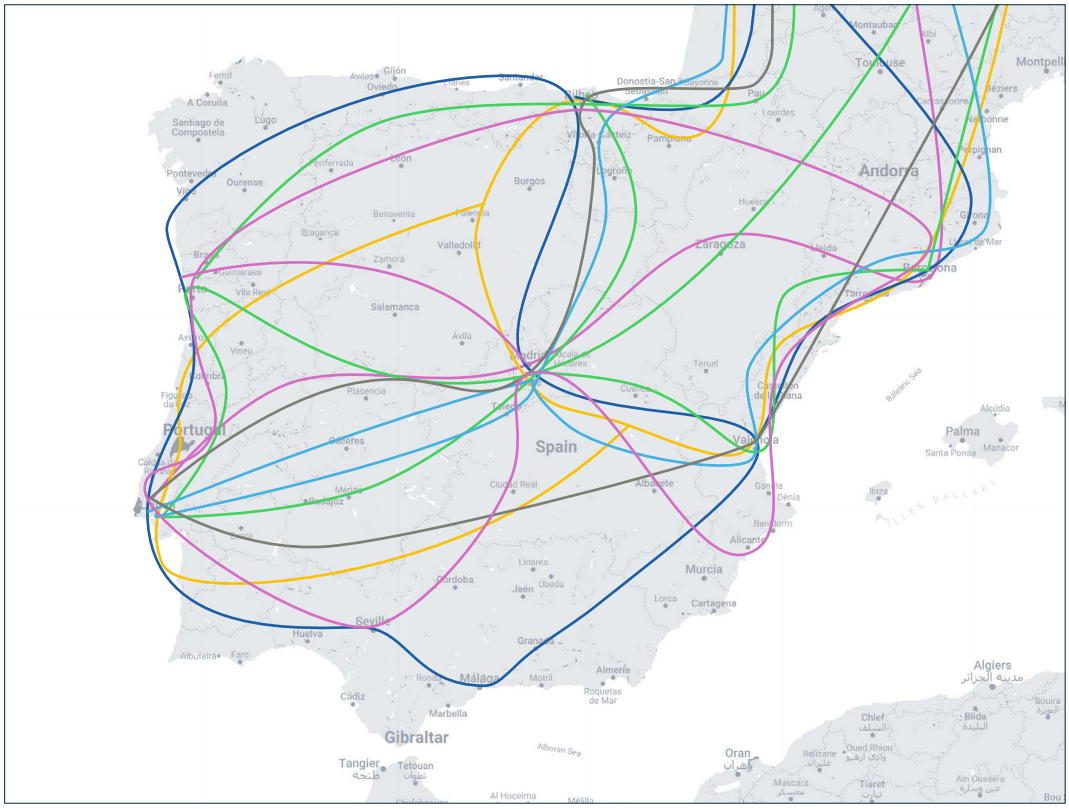
Portugal's Exclusive Economic Zone (EEZ), which includes the Azores and Madeira, is the EU's largest and stands as the 10th largest globally, covering over 1.7 million square kilometers. With its vast expanse and a high concentration of submarine cables, somewhere between 10% to 15% of all global cables traverse this region.

So, the submarine links look impressive, but how about the terrestrial links?

Portugal's position as an aggregation point for intercontinental Internet data flows is evident, with its extensive submarine cable network connecting Portugal to the global Internet ecosystem. In addition, the significant number of terrestrial links connecting Portugal to the rest of mainland Europe are also indicative of its growing status as a global interconnection hub.

Examination of some of the main predominantly European Internet backbone providers (see Figure 7 below) reveals a minimum of 12 links between Portugal and Spain. Notably, most of these links extend not only to other parts of Spain, but also reach further into France and beyond. This forms a robust network of terrestrial cables capable of facilitating connections for both Europe and other continents and capitalizing on the array of submarine cables landing in Portugal.

The combination of diverse submarine cable landing points coupled with investments from approximately ten major backbone Internet providers in terrestrial links to Portugal reinforces the country's pivotal role as a distinctive crossroads for global Internet connectivity. Moreover, this provides additional resilient and redundant pathways for Internet users and offers options for network operators.



← **Figure. 7**
Schematic overview of the main international terrestrial links between Portugal and Spain

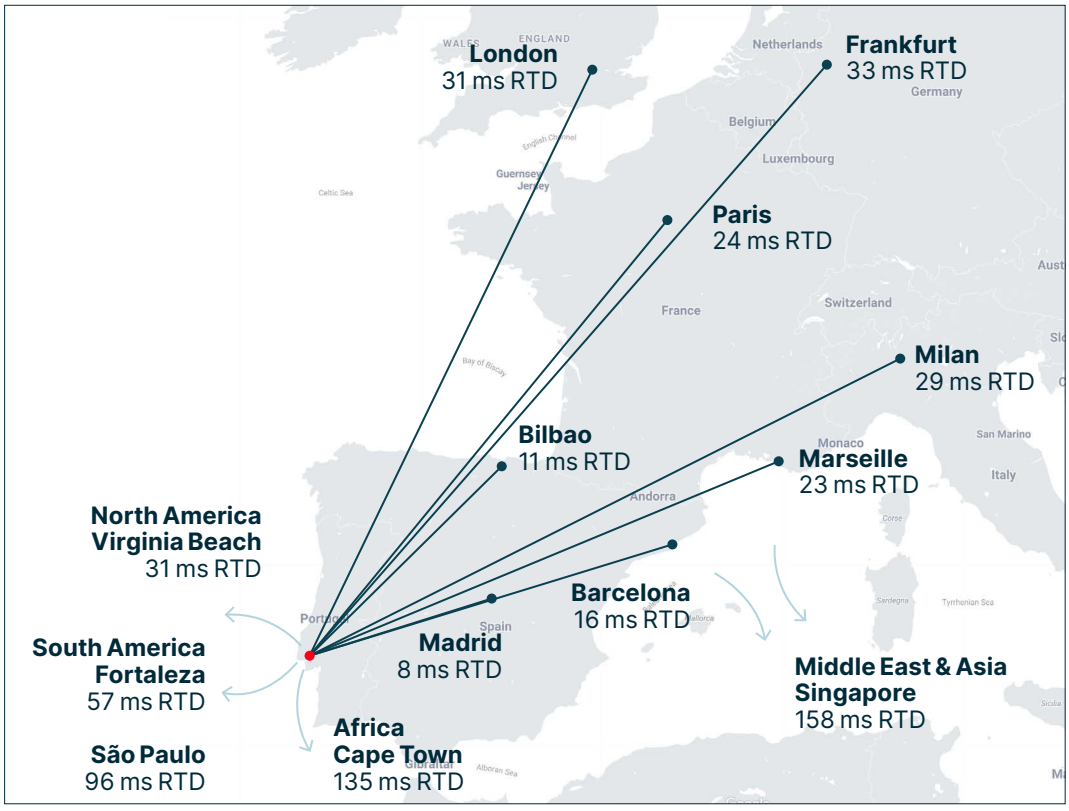
What does this all mean for latency?

Considering the strategic geographical location of Portugal in global Internet connectivity, the substantial presence of intercontinental submarine cables landing on its shores, the extensive network of international terrestrial cables, and the noteworthy high penetration rates of Fiber-to-the-Home (FTTH), it comes as no surprise that the country achieves impressive average results when measuring round trip times for Internet latency.

A series of tests performed making use of the RIPE Atlas Internet measurement network tools (https://atlas.ripe.net/) revealed that end users in and around Lisbon could, on average, achieve a latency of approximately 9ms when connecting to destinations in Madrid. For destinations a bit farther away, such as Barcelona and Marseilles, the latency was measured at around 18ms. Additionally, end users in Lisbon were found to reach FLAPS destination targets within 17-24ms, depending on the Internet service provider carrying the traffic.

In the evaluation of intercontinental destinations, tests employing RIPE Atlas probes showcased impressive results for Lisbon-based latency. Responses to Casablanca in Africa averaged 16ms, while Lagos registered around 40ms, and Johannesburg demonstrated a relatively low latency of 80ms, (around 10ms less than Johannesburg to London). Heading west across the Atlantic, Washington DC targets were reached in 60ms, Miami in 70ms, and Fortaleza in 90ms. It is worth noting that the observed latency to Fortaleza suggests that the test probes are unlikely to have leveraged the direct submarine link between Portugal and Brazil. If they had, significantly lower times would have been expected, potentially around 60ms, a latency difference of approximately 30%. Turning our focus to the Middle East, specifically Dubai, our tests indicated a latency of approximately 70ms, while Singapore was reached in around 140ms.

Portugese international connectivity (non-exhaustive)



← **Figure. 8**
Latency map from Portuguese end users to other global destinations

An interconnection ecosystem contributing to network density and increased data gravity in southern Europe

An examination of Portugal's local Internet Exchange (IX) ecosystem reveals an evolution paralleling that of many European markets. Initially rooted in an academic environment, the IX function emerged with a primary goal of efficient routing, ensuring that locally destined traffic remains within the local network and thus minimizing latency.

In addition to fundamental business investment and infrastructure, three points stand out at global interconnection hubs:

1. an established Internet Exchange achieving globally competitive roundtrip times and keeping locally destined traffic local,
2. a distributed and diverse IX ecosystem of both local and international network providers and data center operators, and
3. the ability to offer redundancy, resiliency, and options that are becoming paramount to serving different market segments and network needs.

Let's take a closer look at the emergence of a complementary interconnection ecosystem in Portugal.

Collectively, the total number of ASNs connected to the Portuguese peering ecosystem exceeds 120, spread across three main IXs, all based in Lisbon. This network density within the Lisbon metropolitan area, which has grown significantly in the last five years due to the establishment of new IXs, offers redundancy and increased resiliency, and will attract further networks to arrive in the country and take advantage of the growing data gravity in Portugal in the future.

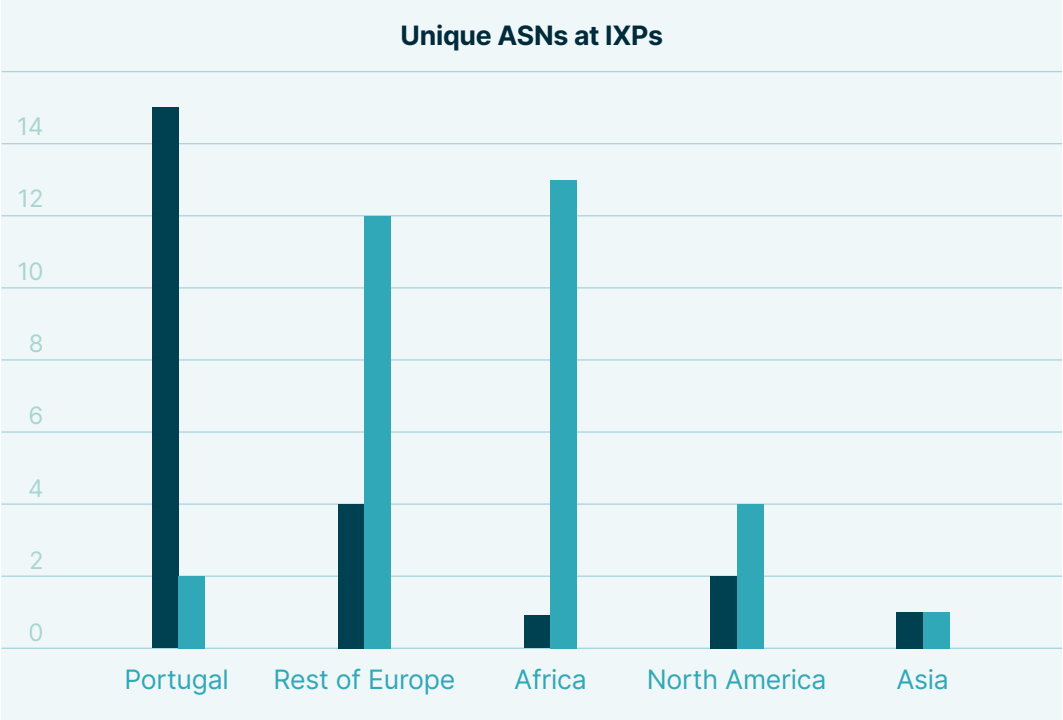
Prior to 2019, Gigabit Portuguese Internet eXchange (GigaPIX) was the only IX operator located in Portugal providing IP interconnection. GigaPIX was established in 1995 and has a strong customer base of 55 mainly local ASNs (as of May 2024). Alongside its operations in Lisbon, GigaPIX also operates a very small IX in Porto, which will not feature in this discussion.

A second Lisbon-based IX, Equinix Lisbon, was established in 2018. Equinix arrived in Portugal in 2017, with the purchase of Itconic, a leading data center, connectivity, and cloud infrastructure solutions provider on the Iberian Peninsula. Equinix Lisbon has enriched the interconnection ecosystem by attracting international players. At the time of writing, the number of ASNs publicly confirmed to be connecting to Equinix Lisbon amounted to around 20.

DE-CIX, a world leader in operating IXs, entered the Portuguese market in 2019, fostering an increasingly distributed IX ecosystem. Drawing on its global reach and with an already strong presence in Spain, the company took the opportunity to develop its European interconnection ecosystem further into Southern Europe. In May 2024, the IX had 60 connected networks and another four in the process of connecting.

↓ **Figure. 9a**
Origin of ASNs at IXs in Portugal

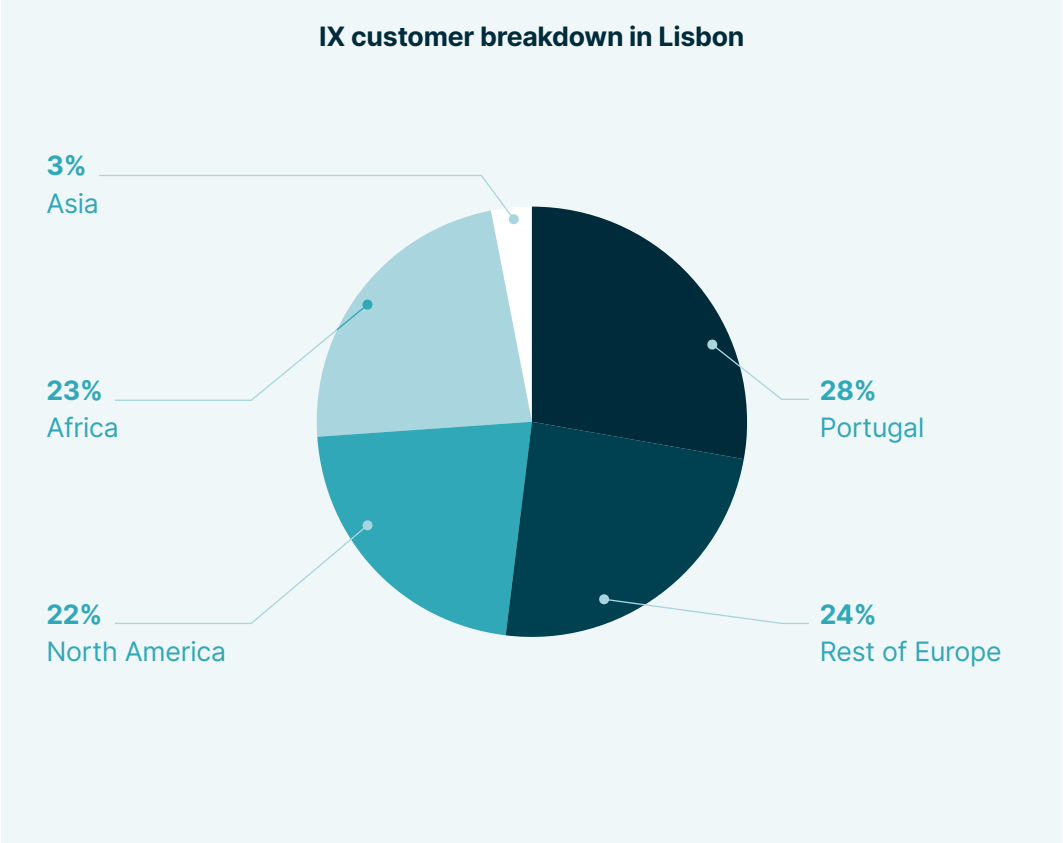
	Portugal	Rest of Europe	Africa	North America	Asia	TOTAL
Total Unique ASNs	23	19	19	18	2	81
Unique at GIGAPIX	15	4	1	2	1	23
Unique at DE-CIX LIS	2	12	13	4	1	32
ASNs at both IXPs	6	3	5	12	0	26



← **Figure. 9b**
Geographic uniqueness of ASNs connected to GIGAPIX and DE-CIX Lisbon as of February 2024

A comparison of the two larger IXs in Portugal and the origin of their connected networks provides interesting insights into contrasts between the different IX players on the market. The graph above (Figure 9b) shows the origin of ASNs uniquely located at either DE-CIX Lisbon or GigaPIX. This graph reveals that GigaPIX hosts the largest concentration of local Portuguese networks in addition to some unique ASNs from elsewhere in Europe and, to a lesser extent, other parts of the world. At the same time, it illustrates that unique ASNs present at DE-CIX Lisbon are predominantly from other European countries, Africa, and North America, bringing together networks of diverse origins and enabling network density in Lisbon. In addition, the number of (non-unique) networks connected to both IXs (Figure 9a) is a testament to the demand for redundancy within the interconnection ecosystem of Lisbon.

DE-CIX Lisbon has clearly brought international players to Portugal, helping to create shorter paths for larger international data networks. Greater instances of ASNs from other European countries, Africa, and North America translate to closer proximity to international markets, including emerging markets.



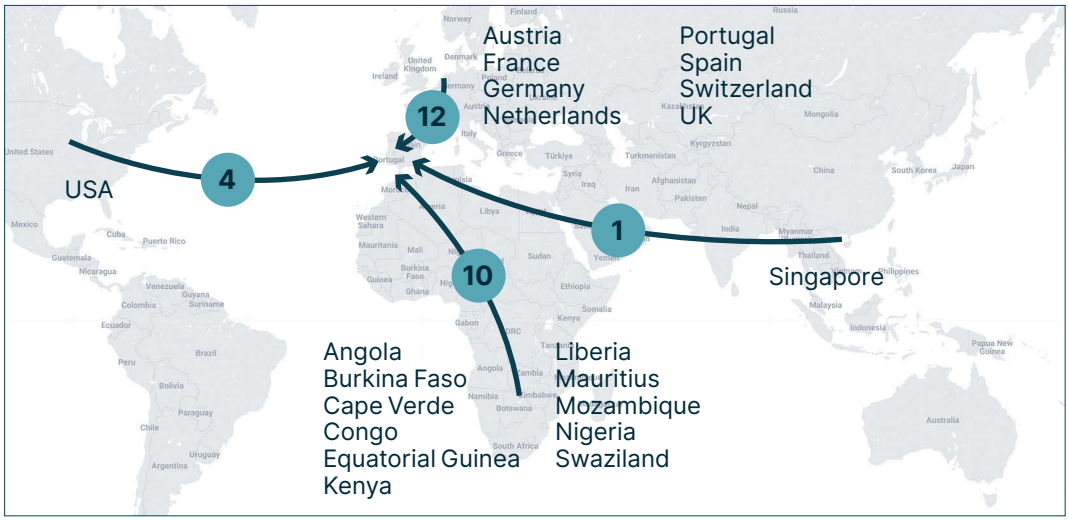
← **Figure. 10**
The country of origin of the ASNs present at GIGAPIX and DE-CIX Lisbon

The establishment and growth of DE-CIX Lisbon has introduced a spectrum of international players to Portugal. As shown in Figure 10 above, the customer segments at Lisbon's two larger IXs are well-distributed, encompassing both local and international participants. This balanced and diverse interconnection ecosystem sets the stage for future prosperity.

← **Figure. 11**
The continental diversity of customers connected to DE-CIX Lisbon as of February 2024

The presence of DE-CIX Lisbon has facilitated the entry of numerous international players into the Portuguese IX ecosystem, including a diverse international customer base, with networks originating in particular from Africa, many parts of Europe, and North America, as shown in Figure 11 above.

DE-CIX Lisbon: A Magnet for International Networks



← **Figure. 12**
Geographic origins of unique ASNs that are present at DE-CIX Lisbon

Lisbon provides an alternative to the historical FLAPS hubs

The presence of DE-CIX Lisbon, GigaPIX, and Equinix Lisbon exemplifies a distributed and complementary IX ecosystem with various players enriching this market. This not only creates an opportunity for redundancy and resiliency, but offers options that can satisfy different market segments, allowing tailored offers for individual needs.

The interconnection market has taken complementary steps in developing the ecosystem, but the potential for expanding interconnections and data flow from both developed and emerging markets is yet to be fully exploited.

The emergence of international players brought by DE-CIX continues to make this location more sought after and a predestined European gateway for West African and South American networks and beyond.

Are international traffic flows making use of Portugal yet?

The essential infrastructure in Lisbon, encompassing global submarine cable landing points, an extensive terrestrial network, well-established local and international Internet Exchanges, and more than 20 data centers, is firmly established. The question remains: Are network operators worldwide actively leveraging these attributes, or are there still components missing or areas that may require further development?

One determinant for the choice of a destination for international traffic is the availability of desired content and services. Presently, this is commonly delivered through content delivery networks (CDNs) like Akamai, CDN77, Cloudflare, Fastly, etc., or cloud service providers such as AWS, Google, Microsoft Azure, etc. Although several CDNs have established a presence in Portugal either through an Internet Exchange (IX) or a point of presence elsewhere in the country, cloud service providers have yet to establish a substantial presence within the country, beyond their IX participation. As of the time of writing, a notable exception is Google Cloud, which has a cloud on-ramp located in Lisbon.

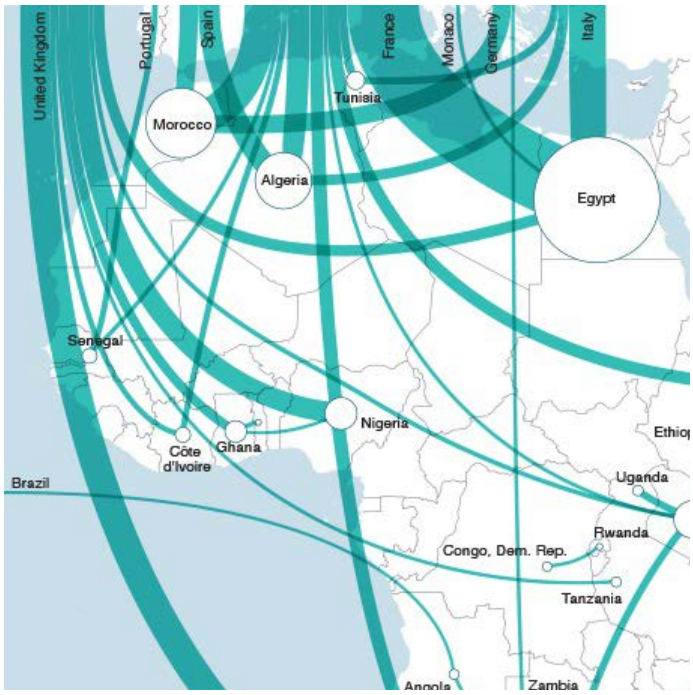
Considering this, the implication is that African networks seeking content and services may explore alternative routes and destinations. It is notable that many African networks opt for routes leading to France, Italy, or the UK. Despite the potential for slightly higher latency, particularly in the case of the UK, the decision is influenced by international transit prices and the availability of the most required content in those locations. At present, this could be a more favorable alternative than routing through Portugal.

TeleGeography reports (https://www2.telegeography.com/) reveal that African bandwidth has surged consistently at the remarkable rate of over 40% annually over the past four years, outpacing the global average of just over 30%. Projections indicate that this robust growth trend is expected to persist for around the next five years.

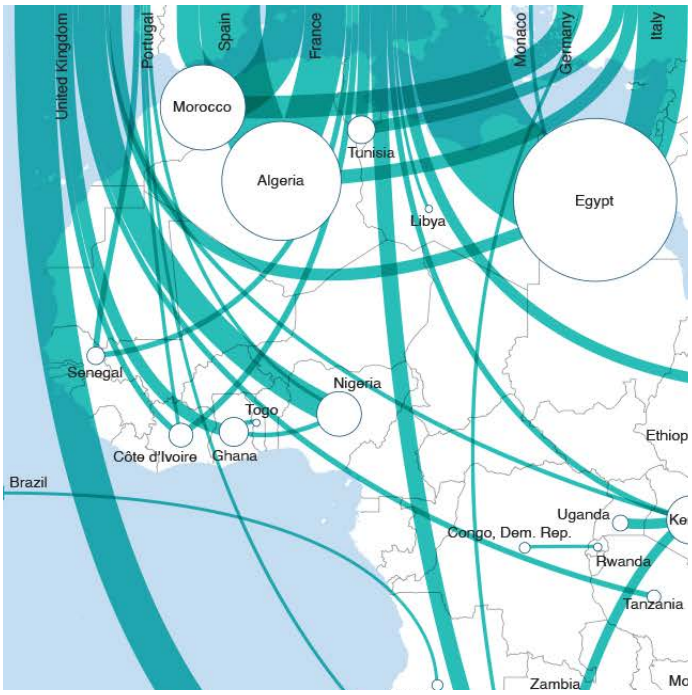
Diving deeper into the traffic dynamics between Africa and Europe, it becomes evident that a significant portion follows routes from Egypt to France/Italy. Meanwhile, other African regions tend to channel traffic through France, Spain, or the UK. According to TeleGeography surveys in 2022 (Figure 13a), only a minimal amount of traffic seems to flow directly from Africa to Portugal, primarily originating from Senegal. However, by 2023, the same TeleGeography Survey (Figure 13b) indicates not only

an increase in the volume of traffic from Africa to Portugal but also a simultaneous diversification of the originating points in Africa.

While the international traffic routes between Africa and Europe have historically held significance, it is worthy of note that traffic between the two continents is actually reducing despite the sizable and growing number of Internet users in Africa. This can be attributed, in part, to the diminishing gap between international transit prices and local or intra-Africa transit prices. Additionally, the maturity of the Africa-wide peering ecosystem plays a role, coupled with the fact that Africans tend to access a sizable portion of their content locally, exhibiting a reduced inclination to seek content outside of the continent. This pattern is more evident in sub-Saharan Africa when compared to North African countries.



↑ **Figure. 13a**
TeleGeography survey of African Internet traffic flows in 2022



↑ **Figure. 13b**
TeleGeography survey of African Internet traffic flows in 2023

How does Portugal's future look?

A rich Internet Exchange and peering ecosystem, sub-sea cable landings, a robust terrestrial network connecting Portugal to the rest of Europe, and a growing data center scene: These are all necessary ingredients in the recipe for creating a global interconnection hub.

Portugal has cultivated an ideal and relatively competitive ecosystem. Now, it is time for operators and other stakeholders to seize this opportunity.

How is Portugal going to capitalize on the infrastructure and position that it has created? Initiatives need to be identified that can make greater use of the Ellalink sub-sea cable for the Portuguese ICT marketplace and beyond. The speed, redundancy, and resiliency of this link offers an advantage that can stimulate the market.

Positioned within the broader digital and interconnection hub network of southern Europe, Portugal offers an excellent solution for redundancy and resiliency. Instead of working in isolation, Portugal should continue to ensure that it remains part of the larger regional digital hub that is emerging in the south of the continent. The question remains: What role will Portugal play in this larger space?

Portugal is one component of the larger regional digital hub of the Iberian Peninsula. It can perform well as a secondary hub within this region. Capitalizing on strengths of nearby locations, collaboration with Spain and even France would be a logical step, fostering what could potentially be a regional mega-hub on the Iberian Peninsula.

Portugal may lack the larger economic and population numbers of most FLAPS market locations, but what it does offer is a world class global interconnection hub capable of managing international traffic flows destined for Europe or acting as a transit zone for more efficient routing of international data flows. This makes it a location that cannot be overlooked by networks seeking a location closer to emerging markets or a new vantage point to tackle latency, hailed as the new currency for the future of Internet data flow dominance.

The entrance into Portugal at the end of the last decade of a new generation of IXs, in the form of DE-CIX Lisbon and Equinix Lisbon, has significantly influenced the interconnection ecosystem by attracting international players. While traditional Portuguese IXs have effectively

kept local traffic within the country, DE-CIX recognized the potential to enhance this ecosystem by leveraging its global reach to entice global players to Tier 2 locations, in keeping with the trend of moving closer to the edge, as opposed to concentrating only on the more established FLAPS locations. This symbiotic ecosystem has proven to be mutually beneficial.

This progressive and complementary approach serves as a model that can be emulated in other countries and regions.

Supporting sources

Distance calculator for flight path measurements: https://www.distance.to/

RIPE Atlas Measurement Network tool for latency measurements: https://atlas.ripe.net/

RIPEstat information services for address resource information: https://stat.ripe.net/

Broadband statistics: http://www.oecd.org/sti/broadband/broadband-statistics

Internet Penetration statistics: https://www.theglobaleconomy.com/Spain/Internet_subscribers/

Broadband pricing statistics: https://www.cable.co.uk/broadband/worldwide-pricing/2022/broadband_price_comparison_data.xlsx

Transit Pricing Data: https://global-internet-map-2021.telegeography.com/

Average connection speed statistics: https://wisevoter.com/country-rankings/internet-speed-by-country/

Submarine Cable data: https://www.submarinecablemap.com/

Registered RIPE NCC LIR data: https://stat.ripe.net/special/country-report/lirs/pt

IXP Data information: https://www.pch.net

PeeringDB - IXP connected participant information: https://www.peeringdb.com

DE-CIX Lisbon information: https://www.de-cix.net/en/locations/lisbon/

GigaPIX Lisbon information: https://gigapix.pt/en/index/

Equinix Lisbon information: https://www.equinix.com/

Lisbon Datacenter information: https://www.colliers.com/en-es/research/data-centers-snapshot--h1-2023

Portugal Datacenter information: https://datacentercatalog.com/portugal

Portugal Datacenter information: https://www.datacentermap.com/portugal/

ASN Path data: https://jedi.ripe.net/latest/PT/rttmesh/index.html

FTTH Council Europe: https://www.ftthcouncil.eu/knowledge-centre/all-publications-and-assets

State of the Internet Reports: https://www.akamai.com/site/en/documents/state-of-the-internet/q4-2016-state-of-the-internet-connectivity-report.pdf

Digital Economy and Society Index (DESI) 2022: https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2022

Publication details

Authors: Serge Radovcic, Paul Rendek

Date of publication: May 2024

Publisher: DE-CIX Group AG

CEO/Geschäftsführer/V.i.s.d.P.: Ivaylo Ivanov

Registered office: Lichtstr. 43i, 50825 Cologne

Board of Directors: Ivaylo Ivanov (Chair), Dr. Thomas King, Christian Reuter, Sebastian Seifert

Supervisory Board: Felix Höger (Chair), Klaus Landefeld, Harald A. Summa, Rudolf van Megen

Trade registry: District court (Amtsgericht) Cologne, HRB 92808

Tax-ID Number: 217/5721/1291

VAT-ID Number: DE315990412

DE CIX

About DE-CIX

As the leading Internet Exchange operator and interconnection provider, we help companies to realize new opportunities and future-proof their connectivity needs to manage growing data volumes and new applications. From easy and secure cloud connection to creating interconnection ecosystems, we make interconnection easy. Anywhere.

Find out more at de-cix.net.

Contact us

Phone: +49 69 1730902-12
Email: sales@de-cix.net