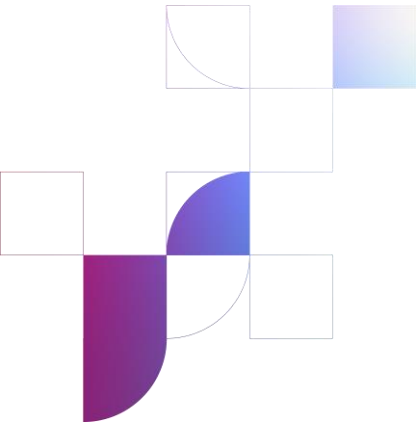
BEREC
Body of European Regulators for Electronic Communications

BoR (25) 171

BEREC Report on domestic submarine cables connectivity in Europe



04 December, 2025

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Executive summary

Domestic submarine fibre optic cable networks, which are part of the global international electronic communication network (ECN) infrastructure, are crucial to the global economy. They play a key role in maintaining a robust global network infrastructure that supports the seamless functioning of the internet and electronic communication services (ECS), essential for, among others, scientific cooperation, territorial cohesion and digital inclusiveness.

In order to have a better overview of the domestic submarine cable systems ensuring communication services in Europe and the main purpose of their deployment, BEREC collected information from its members[1], through a dedicated questionnaire. This work is particularly relevant to support the mapping of existing and planned submarine cable infrastructures under the EU's 2025 Action Plan on Cable Security and the 2024 Commission Recommendation on Secure and Resilient Submarine Cable Infrastructures.

The data received and collected shows that there is a total of 27 countries with direct access to sea of which only 15 have segments of submarine cables connecting national cable landing stations (CLS). These 15 countries have in total 323 domestic submarine cables in operation, with lengths that varies between less than 1 km, for submarine cables connecting ends on straits or very close islands, to more than 1,500 km in the case of the cable that connects Azores to mainland Portugal, the Canary Islands to mainland Spain, or the submarine cables connecting French overseas territories to mainland France. Most of the submarine cable segments are deployed in the Mediterranean Sea (around 41%) and in the Atlantic Ocean (38%), while almost 16% of the segments are deployed in the Baltic Sea.

The large majority of the submarine cables corresponds to purely domestic submarine cables (with all landing stations in the same country), while only 12% of them are part of an international cable system. Moreover, almost a third of the submarine cable systems are between 10 and 25 years old. However, 14% of the submarine cable systems started operating over 35 years ago, which may impact the capacity of submarine cable systems in the near future.

The report highlights that in certain situations, public funding may be needed to ensure the connectivity of the national territories, as the business models may not allow the private sector to recover investments. In fact, nearly a fifth of the domestic submarine cables analysed in this report benefitted from public funding. Therefore, public funding instruments, such as the Connecting Europe Facility, are vital for assuring connectivity goals associated with submarine cable deployment and security, as well as the renewal of existing aging submarine cables.

[1] https://www.berec.europa.eu/en/berec-members

The report also highlights the following:

- A large majority of submarine cables is deployed by ECN operators acting at the retail level and using submarine cables for their own network connections and operations. Notwithstanding, they also, in most cases, offer wholesale connectivity to others, either through leased lines or rental of dark fibre.

- Wholesale-only ("independent") providers' main motivation to deploy is to provide trunk communications services or to rent dark fibre to other actors. This is the case for companies focused on the business of operation of submarine cables, as well as the case of public/State initiatives aimed at developing their territory. These cases correspond to nearly 20% of the submarine cable segments for which information was collected.

After briefly presenting the legal framework applicable to domestic submarine cables, the report provides detailed information on the ex-ante economic regulatory treatment of submarine cables in the different BEREC member countries. In this context, the report shows that six NRAs (Croatia, France, Greece, Iceland, Portugal and Spain) have carried out a market analysis regarding or including domestic submarine cables leading to regulation of submarine cables with designation of an operator with significant market power (SMP). Over these six NRAs who regulate or have regulated submarine cables, four of them (Croatia, Greece, Iceland, Portugal) are still regulating this market, whereas the other two (France and Spain) stopped regulating it, respectively in 2017 and 2024.

Different regulatory approaches have been applied: four NRAs (Greece, Iceland, Portugal and Spain) regulate or have regulated this market through market 14 of the 2003 European Recommendation on Relevant Markets (hereafter "the Recommendation"), one NRA (France) has done it through market 4 of the 2014 Recommendation and the last one (Croatia) has done it through both market 14 of the 2003 Recommendation and market 4 of the 2014 Recommendation. Moreover, different remedies were adopted. Two countries considered other forms of regulation: in France, prior to its regulation through market analysis starting in 2006, guidelines specifying the conditions under which it might be required to apply the legal provisions relating to access to submarine cable systems were adopted, while in Italy, the NRA, in July 2025, assessed the economic conditions for wholesale access to submarine cables subject to public funds[2]. Apart from the NRAs still regulating submarine cables, three NRAs (France, Malta and Spain) monitor the evolution and trends of this specific market.

To give more detail on the economic regulation adopted where domestic submarine cables have recently been or are still regulated, BEREC provides a deeper analysis of three case studies focusing on Iceland, Spain and Portugal.

[2] Delibera 181/25/CONS | Agcom.

Finally, several NRAs identified as the most relevant the following challenges and emerging trends: the security, reliability and redundancy of the connections provided through submarine cables, the replacement of current submarine cable systems as the end of their lifecycle is approaching and the need for very high investments, especially when submarine cables serve remote areas or coastal villages sparsely populated, where investment is not justified based on future revenues.

In this context, it is key to monitor the evolution of effective competition in the long term, which requires precise data/information from different stakeholders. To this end, NRAs should be able to collect information relating to submarine cables from both public and private entities (owners like ECN operators or big tech companies, suppliers, among others).

1. Introduction

Submarine cables are key for international connectivity of Europe, as well as national connectivity for insular regions in several countries and for the development and cohesion of national territories outside continental Europe (e.g. archipelagos).

This report provides an overview of the domestic submarine cables in BEREC member countries, the main purpose for their deployment, the *ex-ante* economic regulatory regime adopted in each country and its evolution, and it identifies some potential challenges and emerging trends for domestic cable systems.

The report is organised as follows: Chapter 1 lays out the introduction to the report, Chapter 2 provides a general overview of domestic submarine cable systems that ensure communications services, distinguishing between purely domestic submarine cable connections and the domestic segments of international cable systems within the BEREC member countries, and characterising their age, financing models and other relevant attributes. Chapter 3 outlines the applicable legal framework. Chapter 4 reviews the historical and current economic regulatory approaches to domestic submarine cables. Chapter 5 presents selected case studies, offering a more detailed analysis of regulation and regulatory measures adopted in some countries to specific submarine cables, and the reasoning for the remedies imposed. Chapter 6 identifies the main challenges and emerging trends, and the main conclusions of the report are presented in Chapter 7.

For this report, BEREC circulated a detailed questionnaire to the National Regulatory Authorities (NRAs), organised in two sections: Section 1, aimed at collecting information on these submarine cables, and Section 2 on *ex-ante* economic regulation for submarine routes. NRAs from 28 countries[3] answered the questionnaire between 27 February and 25 March 2025: five of them (Austria, Czech Republic, Hungary, Poland and Slovenia) reported that their countries have no domestic submarine cables (in the first three cases because they do not have any access to the sea), 14 NRAs[4] answered to both sections, the NRA from Denmark only answered to Section 1 and gave a general input on the topics questioned in Section 2, NRAs from eight different countries[5] provided answers only to Section 2. Many answers were classified as confidential and therefore the figures presented in this report give a global, aggregated overview. For the NRAs that did not answer the questionnaire, some data was

[3] Austria, Belgium, Bulgaria, Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, Montenegro, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia, Spain and Turkey.
[4] From Belgium, Estonia, France, Greece, Iceland, Lithuania, Malta, Montenegro, Netherlands, Norway, Portugal, Romania, Spain and Turkey.
[5] The NRAs from Bulgaria, Cyprus, Croatia, Finland, Ireland, Italy, Latvia and Slovakia.

collected from public sources, as Telegeography. Finally, this report also includes the contributions, comments and insights gathered during the public consultation on its draft[6].

For the purpose of this report, a domestic submarine cable is any cable/branch that ensures communications services at least between two points within the same country. Thus, if a segment of an international submarine cable lands at least twice in a country, that specific segment was considered as part of a domestic submarine cable.

It should be noted that, in recent years, BEREC has already analysed several topics related to submarine cables, under different contributions, such as:

- BEREC Report on the entry of large content and application providers into the markets for electronic communications networks and services[7];
- BEREC Report on the general authorisation and related frameworks for international submarine connectivity[8];
- BEREC Workshop on international submarine connectivity in the EU (21 September 2023)[9];
- The BEREC Cyber Security resilience workshop, in November 2024, in which the message that “resilience planning for extreme weather conditions and cyber threats requires clear security strategies and comprehensive frameworks, and should consider digital infrastructure robustness, power backup, redundancy, and supply chain dependencies” received strong support;
- The BEREC workshop, on 9 December 2025, on “Submarine cable connectivity: competition & market dynamics, ex-ante economic regulation and future challenges” with speakers representing international regulatory networks (like REGULATEL, EMERG and ITU) and relevant stakeholders, to share knowledge and experience and to discuss the submarine cables’ market competition and

[6] The draft BEREC Report on submarine cables connectivity in Europe (BoR (25) 85) was opened to public consultation from 11 June to 11 July. BEREC Report on the outcome of the Public consultation on the draft BEREC Report on submarine cables connectivity in Europe (BoR (25) 111) explains how these contributions were integrated in the current report. See BoR (25) 170, available at https://www.berec.europa.eu/en/all-documents/berec/reports/berec-report-on-the-outcome-of-the-public-consultation-on-the-draft-berec-report-on-submarine-cables-connectivity-in-europe .

[7] BEREC report BoR (24) 139, available at https://www.berec.europa.eu/en/all-documents/berec/reports/berec-report-on-the-entry-of-large-content-and-application-providers-into-the-markets-for-electronic-communications-networks-and-services.

[8] BEREC report BoR (24) 85 https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-the-general-authorisation-and-related-frameworks-for-international-submarine-connectivity.

[9] https://www.berec.europa.eu/en/events/berec-workshop-on-international-submarine-connectivity-in-the-eu.

dynamics, the ex-ante economic regulatory regime applied, as well as the main emerging and future challenges[10].

This report is also particularly relevant to support the mapping of existing and planned submarine cable infrastructures under the EU's 2025 Action Plan on Cable Security[11] and the 2024 Commission Recommendation on Secure and Resilient Submarine Cable Infrastructures[12]. On 23 October 2025 the European Commission published a Report on Security and Resilience of EU Submarine Cable Infrastructures which maps the EU submarine cable infrastructure, detailing risk assessments and stress tests[13] and announced progress made on boosting the security and resilience of Europe's critical submarine cable infrastructure, under the EU Action Plan on Cable Security.

2. Overview of the domestic submarine cables in Europe

This section presents submarine cables that are used or can be used for national connections within BEREC member countries, that is segments of submarine cables that connect at least two landing points in the same country.

In the questionnaire sent to all BEREC members, NRAs were requested to provide information on all the connections (being segments of domestic cables or segments of an international cable connecting two national points). The questionnaire was also sent to landlocked countries just in case there was any sub-fluvial submarine cable, although none of them were reported.

There is a total of 27 countries within BEREC with direct access to sea[14]. These can be an island or an archipelago, form part of the coast in the continental territory, or be mainly continental with islands and/or archipelagos.

According to Telegeography and the data sent by BEREC members, only 15 countries have segments of submarine cables connecting national cable landing stations[15]. BEREC received

[10] Agenda available at https://www.berec.europa.eu/en/events/berec-public-workshop-on-submarine-cable-connectivity-competition-market-dynamics-ex-ante-economic-regulation-and-future-challenges?language_content_entity=en.

[11] Joint Communication to the European Parliament and the Council, EU Action Plan on Cable Security, JOIN/2025/9 final.

[12] Commission Recommendation (EU) 2024/779 of 26 February 2024 on Secure and Resilient Submarine Cable Infrastructures, OJ L, 2024/779, 8.3.202.

[13] See https://digital-strategy.ec.europa.eu/en/library/report-security-and-resilience-eu-submarine-cable-infrastructures.

[14] Albania, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Ukraine.

[15] It is important to note that although many international cables land in Europe, the present report is only focused on domestic connections.

data on national existing cables/segments from 12 of these 15 countries[16]. The other three countries could not provide the information, due to confidentiality or other reasons.

Since submarine cables are critical infrastructure and some data was considered confidential by some BEREC members, information on cable landing stations or other specific aspects of each submarine cable are not provided in the report, but it is an aggregated view on the situation in Europe.

2.1. Length of the submarine cable systems

The length of domestic segments of submarine cables varies a lot depending on the distance between the submarine CLS located at each end of the cable. For those segments for which the length is known, the median length is around 62 km, but it varies between less than 1 km, for submarine cables connecting ends on straits or very close islands, to more than 1,500 km, in the cases of the cables connecting the Azores archipelago to mainland Portugal, the Canary Islands to mainland Spain, or even more in the case of submarine cables connecting French overseas territories to mainland France.

Table 1. Segment length in kms

Minimum segment length	Median segment length	Maximum segment length
0,27	62,00	1.836,00

Source: BEREC

Interestingly, BEREC found that submarine cables are being used in short distances (e.g. less than 20 km), where microwave links could possibly be used, but the high capacity and reliability of the fibre optics in submarine cables requests the deployment and use of submarine cables instead. It is also interesting to note that in cases where topology is complex, submarine cables are also used as an alternative to terrestrial fibre, as it is the case of coastal cities in the Norwegian fjords.

2.2. Characterization of the submarine cable systems

In total, BEREC collected data on 366 domestic segments of submarine cables using the information provided by NRAs or publicly available on Telegeography. Of those 366 segments, as shown in the next table, 43 are still not in operation, being either planned or currently under deployment.

[16] Denmark, Estonia, France, Greece, Iceland, Lithuania, Malta, Netherlands, Norway, Portugal, Spain and Turkey.

Table 2. Status of reported domestic submarine cable segments

Operational state	Number of submarine cables
In Operation	323
Planned	30
Under Deployment	13
Total	**366**

Source: BEREC

Table 3 shows the location distribution of domestic submarine cables. As expected, most of the submarine cable segments are deployed in the Mediterranean Sea (around 41%) or the Atlantic Ocean (38%). Almost 16% of the segments are deployed in the Baltic Sea[17] and just less than 2% of submarine cables are in the Black Sea and in the Bosporus strait. The remaining segments considered, located in other seas[18], refer to less than 1% of the total number of European submarine cables.

Table 3. Location of reported submarine cable segments

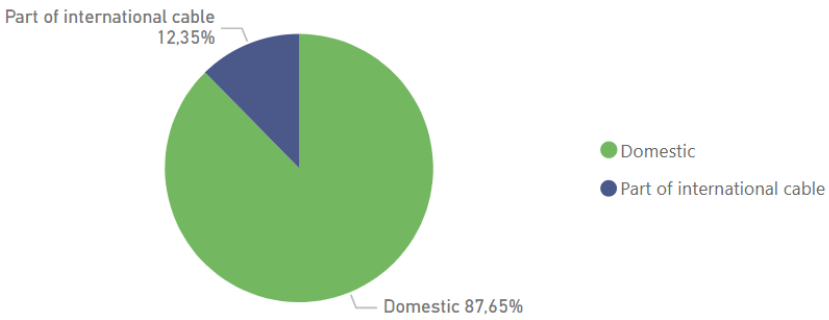
Mediterranean Sea	40,82%
Atlantic Ocean	37,53%
Baltic Sea	15,62%
Caribbean Sea	3,84%
Black Sea and Bosphorus strait	1,64%
Other	0,55%

Source: BEREC

As depicted in Figure 1, a large majority of the different submarine cable systems corresponds to purely domestic submarine cables (with all CLS in the same country), and only 12% of them are part of an international cable system.

[17] Including the Gulf of Bothnia.
[18] Mainly Caribbean Sea, but also in the Indic Ocean.

Figure 1. Types of submarine cable system



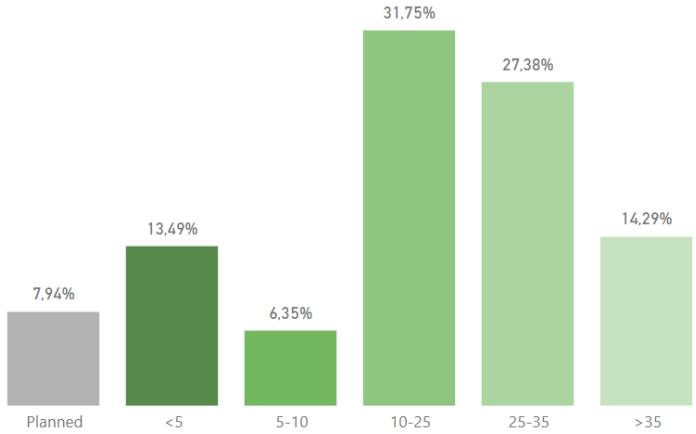
Source: BEREC

As shown in Figure 2, almost a third of the different considered submarine cable systems (taking into account different systems instead of each separate segment) are between 10 and 25 years old. While approximately 13% of the segments entered into service over the last five years and around 8% of the total number of different considered systems are currently under deployment or still being planned, 14% of the different submarine cable systems started operating over 35 years ago.

Although such information was not collected, generally, newer submarine cables support a large number of fibres (24 or even more pairs) that, combined with modern modulation techniques, as the DWDM[19], allow for a very relevant increase of capacity compared to older submarine cables. The need for replacing the submarine cables can therefore also be justified by such considerations.

[19] DWDM – Dense Wavelength Division Multiplexing.

Figure 2. Age of reported submarine cable systems



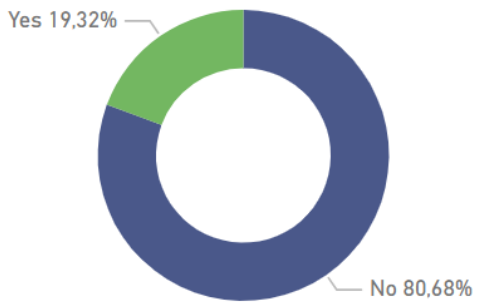
Source: BEREC

2.3. Other relevant aspects

In certain situations, such as deploying submarine cables to connect insular territories with the mainland, or to connect islands in archipelagos (typically small islands to large islands that are the ones that connect to the mainland), public funding may be needed to ensure the connectivity of these territories, as the business models may not allow the private sector to recover investments.

Hence, public funding instruments such as the Connecting Europe Facility (CEF) are vital for assuring connectivity goals associated with submarine cable development and deployment. This has been the case of nearly a fifth of the domestic different submarine cable systems considered, which, as shown in the next figure, benefitted from several sources of public funding. Renewal of the existing aging submarine cables may also require further public funding.

Figure 3. Public funding to submarine cable systems



Source: BEREC

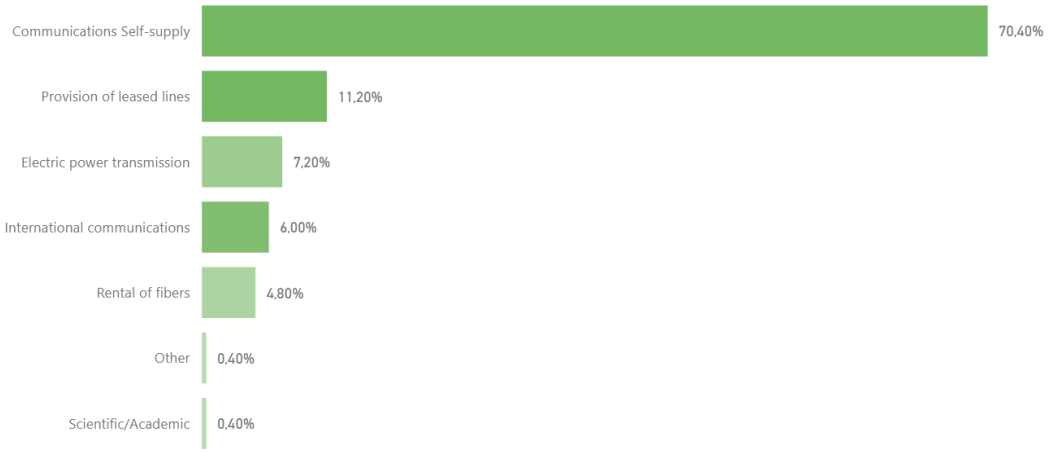
BEREC also collected information about the primary use of submarine cables, signalling the main motivation for their deployment. As can be seen below, a large majority of submarine cables were deployed by ECN operators acting at the retail level and using submarine cables for their own network connections and operations, notwithstanding that they also, in most cases, offer wholesale connectivity to others, either through leased lines or rental of dark fibre.

Wholesale-only ("independent") providers' main motivation is to provide trunk communications services or to rent dark fibre to other actors. This is the case for companies focused on the business of operation of submarine cables, as well as the case of public/State initiatives aimed at developing their territory. These cases correspond to nearly 20% of the submarine cable segments for which information was collected.

It is interesting to note that the use of the submarine cables to carry electric power is mentioned in very few cases. In general, powerlines are also equipped with fibres that can be used to carry electronic communication services. Still, as the main purpose of the companies owning submarine cables is power transmission, and they use the fibres for internal control signals, only in certain cases the utilities companies use the submarine cable to provide ECS to other operators, as it implies operating active equipment and managing communication services beyond their core business models. However, part of the fibres can also be rented to third parties, which does happen in some cases. Renting of fibres not in use by utilities companies can allow for capacity provision to ECN operators, lowering costs of connecting territories.

Over 70% of different cable systems were reported to be used for communications self-supply, with remaining primary uses focused on the provision of leased lines and power transmission.

Figure 4. Primary uses of submarine cable systems



Source: BEREC

3. The legal framework

Given that submarine cables are typically intended to function across national borders, initial efforts to develop a regulatory framework for them took place at the international level.

The application of international law to submarine cables began with the International Convention for the Protection of Submarine Telegraph Cables in 1884. In the 20th century, the Geneva Convention on the High Seas, the Convention on the Continental Shelf, both in 1958 and the United Nations Convention on the Law of the Sea, in 1982, defined the regime of maritime spaces (including that inherent to the Territorial Sea, the Exclusive Economic Zone (EEZ), the Continental Shelf and the High Seas) as well as the exercise of the various freedoms that may conflict with the powers of States. As a result of nine years of negotiations involving 160 sovereign states, the 1982 United Nations Convention on the Law of the Sea (UNCLOS) – commonly referred to as LOSC – was adopted as the global constitution of the oceans. To date, 170 parties, including the European Union, adhere to it.[20]

LOSC codifies nine core regulatory pillars, including a dedicated framework on submarine technologies. Among its key provisions, it grants all states the freedom to lay submarine cables on the continental shelf and within the Exclusive Economic Zone (EEZ) of coastal states, without requiring prior consent. However, coastal states retain the right to prescribe the course of pipelines and to take reasonable measures for resource exploration and marine environmental protection.

While LOSC provides a foundational framework for the governance of submarine cables, experts increasingly point to the need for its modernisation to address contemporary technological, environmental, and geopolitical challenges in the deployment and protection of submarine cable systems.

Building on the foundational legal framework and BEREC's mandate, this Report focuses exclusively on ECN/ECS operational scale and does not include reference to cybersecurity, environmental of other fundamental dedicated pieces of legislation applicable to submarine cables.

In Europe, the European Electronic Communications Code (EECC) provides a harmonised legal and regulatory framework, containing a general authorisation regime that sets out the rights and obligations of ECN and ECS providers also applicable when submarine cable systems are deployed to provide connectivity services[21].

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[20] Cfr. United Nations Treaty Collection, in https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en

[21] Please note that within the scope of the cybersecurity strategy, Directive (EU) number 2016/1148 of the European Parliament and of the Council of 6 July 2016 (NIS1 Directive) was approved to strengthen the resilience of European cyberspace. Subsequently, Directive (EU) 2022/2555 of the European Parliament and of the Council

Most of the rights and obligations under the EECC apply exclusively to publicly available ECN and ECS, which may include certain submarine cable infrastructures when they offer public connectivity services.

Where national legislation on ECN/ECS of Member States applies to submarine cable systems, the provider of ECN/ECS may be[22]:

1. subject to prior notification to a competent authority and subsequently be included in a national list of providers (articles 12 (1), 12 (3), 12 (4) of the EECC). This is despite the requirements for the installation and operation of submarine cable systems set out by national legislation in other sectors different from the EC sector, such as environmental protection, cultural heritage protection, maritime resources planning and management and urban and territory planning and management;

2. granted rights in the field of the installation of facilities (articles 15(1)(b), 43(1) of the EECC);

3. granted rights and subject to obligations in the field of access and interconnection (articles 15(2)(a), 15(1) of the EECC).

4. as provided in Title II of the EECC, competent authorities may impose obligations to undertakings designated as having significant market power (SMP) on a specific market and, under certain conditions, to other undertakings providing ECS;

5. subject to administrative charges and fees (articles 16(1)(a) and 42) of the EECC).

With regard to point 4 above, NRAs, in the context of a market analysis, may impose obligations on the operators with SMP: i) on the markets identified in the Recommendation on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in force[23], or, ii) when the market is not listed in the Recommendation, if the three-criteria test is fulfilled.

It is precisely in this context that remedies were imposed on domestic submarine cables by some NRAs as ex-ante regulation (see chapter 4); some were adopted under market 14 (i.e., “wholesale trunk segments of leased lines”, see reference to “domestic terrestrial leased lines” in the chapter below), during the period when the 2003 Recommendation on relevant markets was still in effect. Following the entry into force of the revised Recommendation in 2014, some NRAs applied remedies to submarine cables under Market 4 (“Wholesale high-quality access

of 14 December 2022 (NIS2 Directive) was published, extending the scope of the previous one and adding the new sectors to the list of so-called "critical sectors", and transferred the security provisions in Articles 40 and 41 of the EECC to the NIS2 Directive.

[22] Cfr. BEREC Report on the general authorisation and related frameworks for international submarine connectivity of 6 June 2024.

[23] Please note that the last one is the Recommendation (EU) 2020/2245 of 18 December 2020, in accordance with Directive (EU) 2018/1972 of the European Parliament and of the Council establishing the European Electronic Communications Code, available at: eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020H2245.

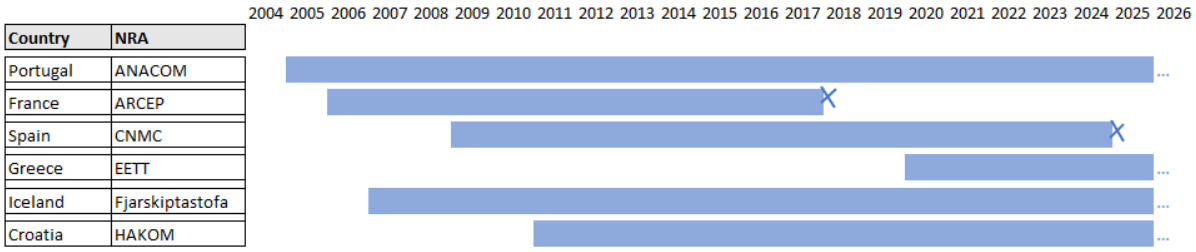
provided at a fixed location"), while others continued to rely on the Market 14 definition, having conducted the necessary three-criteria test.

4. The *ex-ante* economic regulatory treatment of submarine cables

Six NRAs (Croatia, France, Greece, Iceland, Portugal, and Spain) have carried out a market analysis regarding or including domestic submarine cables leading to regulation of submarine cables with designation of an operator with SMP, whereas 22 NRAs[24] who responded to the questionnaire have not. Of these 22, five countries do not have any domestic submarine cables as some of those do not have any access to the sea[25].

Of these six NRAs who regulated or have regulated submarine cables, four of them (Croatia, Greece, Iceland, Portugal) are still regulating this market, whereas the other two (France and Spain) stopped regulating it in their last market analysis, respectively in 2017 and 2024. Nevertheless, not all domestic submarine cables are regulated: in fact, according to the information provided by the NRAs, only 138 out of 160 domestic submarine cables in operation are regulated.

Figure 5. Timeline of economic regulation by country



Source: BEREC

Different regulatory approaches have been applied: four NRAs (Greece, Iceland, Portugal and Spain) regulate or have regulated this market through market 14 of the 2003 European Recommendation on Relevant Markets (hereafter "the Recommendation"), one NRA (France) has done it through market 4 of the 2014 Recommendation and the last one (Croatia) has done it through both market 14 of the 2003 Recommendation and market 4 of the 2014 Recommendation.

In terms of the market definition, three NRAs (Croatia, Greece and Iceland) consider that the submarine cables are included in a national market also comprising terrestrial routes, whereas

[24] Netherlands, Italy, Portugal, Romania, France, Belgium, Germany, Turkey, Spain, Ireland, Bulgaria, Denmark, Greece, Montenegro, Croatia, Iceland, Malta, Cyprus, Lithuania, Latvia, Slovakia, Finland.
[25] Austria, Czech Republic, Hungary and Slovenia.

the other three NRAs (France, Portugal and Spain) consider or have considered this market as not national. France explained that the market definition is an aggregation of routes in six specific geographical zones[26]. Spain defined each route as a specific market. Portugal defined the routes that belong to CAM[27] and inter-island system jointly in the same market. In Portugal, no geographical segmentation was in place before 2016.

In terms of barriers to access the capacity on domestic submarine cables, the main entry barrier identified by NRAs concerns economic aspects, as it was explicitly identified by five NRAs (Portugal, France, Spain, Croatia and Iceland). Two NRAs (Portugal and Spain) emphasise the non-replicability of the infrastructure due to the lack of economies of scale on small territories. One NRA (France) also found legal or administrative barriers as competition law to remedy possible problems was considered inadequate on its own.

NRAs have imposed remedies on different matters.

Three NRAs (Portugal, Spain and France[28]) impose or have imposed remedies specific to submarine cables[29]:

- These three NRAs impose or have imposed remedies such as access, reference offer, transparency, non-discrimination and price control;
- One NRA (Portugal) also imposes account separation;
- And two NRAs (Portugal, France) impose or have imposed remedies in relation to financial reporting.

Three NRAs (Croatia, Iceland and Greece) consider that the remedies that apply to domestic terrestrial leased lines in market 4 or 14 apply also to the islands connected with submarine cables.

- These three NRAs impose remedies in relation to access, reference offer, transparency, non-discrimination and account separation;
- Two NRAs (Croatia and Iceland) impose financial reporting.

In terms of any other forms of regulation, one NRA (France), prior to its regulation through market analysis starting in 2006, adopted in 1997 guidelines[30] specifying the conditions under

[26] Two different SMP operators were identified.
[27] Mainland-Azores-Madeira (CAM).
[28] While two NRAs (Portugal and Spain) consider or have considered that access to the CLS is combined with the access to submarine capacity, one NRA (France) made the distinction between the two obligations: one SMP (GCN) had obligations on both submarine capacity and CLS, whereas the other (Orange) had obligations only on access to CLS.
[29] These remedies do not apply to all domestic submarine cables referred in Section 2 of this document.
[30] Available at https://www.arcep.fr/uploads/tx_gsavis/97-455.pdf.

which it might be required to apply the legal provisions relating to access to submarine cable systems. The NRA also settled a dispute in 2004.

Apart from the NRAs still regulating submarine cables, three NRAs (France, Malta and Spain) monitor the evolution and trends of this specific market.

5. Case studies

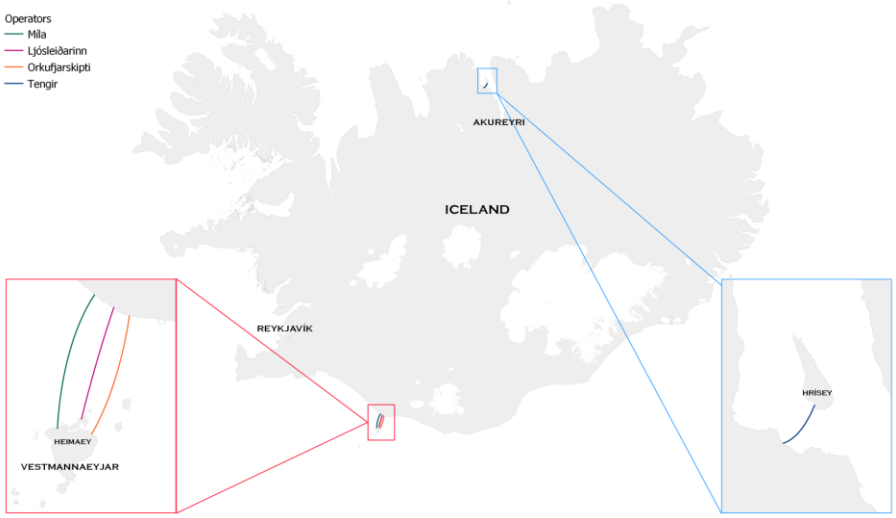
5.1. Iceland

Domestic telecommunications submarine cables in Iceland have been subject to regulatory obligations since 2007, following the conclusion of the first market analysis of the wholesale trunk segment market (market 14/2003). At that time, the market was divided into two geographic segments: the capital region on the one hand, and the rest of the country on the other. Siminn, the former incumbent, along with Míla – a subsidiary established to manage network operations of Siminn – were designated as having SMP and were consequently subject to regulatory obligations. A subsequent market review was conducted in 2015, which defined the entire country as a single geographic market, with Míla, being the sole SMP operator.

These analyses did not place a particular focus on domestic submarine cables, and no specific discussion was dedicated to them. However, maps and descriptions of networks falling within the market definition clearly include domestic submarine cables. Obligations have been applied to domestic submarine cables in the same manner as to other domestic trunk lines.

Islands belonging to Iceland are generally in close proximity to the mainland, with few being inhabited and typically with very small populations. The largest island settlement is in Vestmannaeyjar, home to just under 5,000 inhabitants. This island is currently relatively well connected by more than one provider. Given this context, competitive concerns regarding domestic submarine cables have not been a major focus of discussion. However, issues concerning security and redundancy have received more attention. Competition concerns are more pronounced in relation to international submarine cables, where market failure has led to all major submarine cables from Iceland being state-owned.

Figure 6. Submarine cables in Iceland



Source: ECOI

Following the market analyses, a full set of obligations was imposed under the former regulatory framework on all trunk lines of the SMP operator, including domestic submarine cables and associated facilities such as landing stations.

Cost orientation obligations are based on total cost of Míla's whole trunk network and submarine cable costs are not analysed separately.

No disputes specifically concerning access to domestic submarine cables were reported.

Currently, preparations are underway for a new market analysis, and it is likely that the geographic definition of the market will move away from viewing the country as a single market. Instead, the market may be defined based on specific routes between locations in the trunk network. It remains uncertain what impact this will have on the regulatory obligations related to domestic submarine cables or whether SMP designation will apply to the relevant specific segments of the geographic market.

5.2. Spain

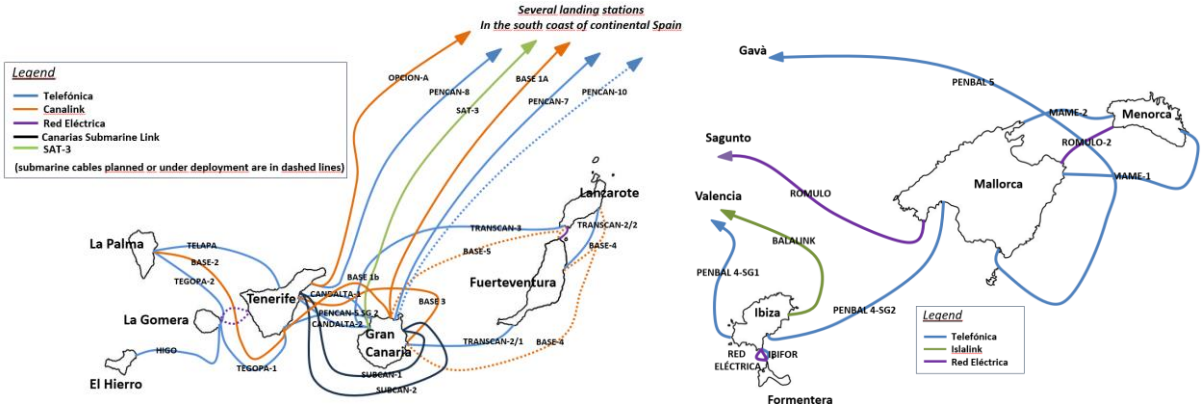
Around 7.5% of the Spanish population lives in one of the two archipelagos in Spain (Canary and Balearic Islands) or in two cities in the northern coast of Africa (Ceuta and Melilla), comprising nearly 3,6 million of inhabitants. For these citizens, submarine connections are key, as all the communications for all operators and services, being fixed and mobiles, residential business or administrations, depend on the transmission of data via them to connect to peninsular Spain.

Although initially the market for the trunk segments of leased lines both terrestrial and submarine was regulated at a national level, in 2009, the Spanish regulator limited regulation of submarine routes connecting islands in both archipelagos and in Ceuta and Melilla, considering each of these routes a separate market. At that time, most of the submarine routes were covered just by the former incumbent, Telefónica, and there was a need to regulate access to Telefonica's submarine cables to ensure that all operators could access to its capacity and at cost-oriented prices. The cost model was applied separately to each route based on data on CAPEX, OPEX and capacity used in a similar way as in Portugal.

In further market analysis reviews, part of the routes was de-regulated based on the deployment of new submarine cables (for example, the route connecting the Canary Islands with the mainland was deregulated in 2013 when a new submarine cable from an alternative operator was deployed).

In the market review of 2018, just nine submarine routes were regulated and in the recent market analysis from July 2024, all submarine routes were deregulated, as for most of them there were alternative submarine cables deployed on being deployed. The submarine cables in the Canary and Balearic Islands are shown in the next figure.

Figure 7. Submarine cables in the Canary and Balearic Islands



Source: CNMC

Although most of the routes connect small islands with low population, along time new alternative submarine cables have appeared. These new cables are not deployed by traditional operators acting as competitors to Telefónica in the retail market, but other actors as:

1) the power transit company (Red Electrica, in purple in the diagram), that have deployed power cables equipped with optic fibres that can be used by telco operators contracting leased lines and/or renting fibres;

2) a public company owned by the government of Tenerife, Canalink (marked in Orange), that has deployed several cables in the Canary Islands and is deploying

some new submarine cables in the archipelago. Canalink has benefited from EU funding for deploying a new ring connecting three islands (Gran Canaria, Lanzarote and Fuerteventura) and is opting for funding for an additional ring connecting the smaller island in the Canary Islands;

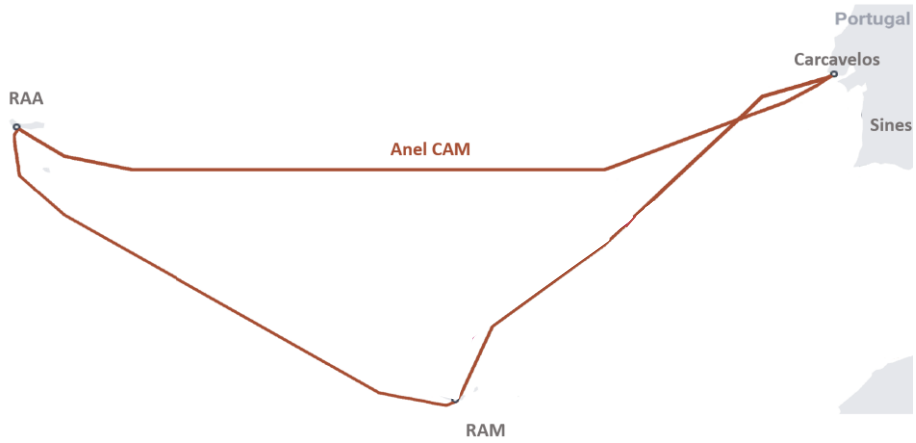
3) there are also some private companies deploying cables such as Islalink in Balearic Islands (green), CSC connecting the major islands in Canary Islands (Gran Canaria and Tenerife), as well as cables to carry international traffic as “Dos Continentes”, owned by GTD in Ceuta, that is also being used for domestic traffic.

5.3. Portugal

ANACOM’s experience with submarine cable economic regulation was conducted on the cable systems connecting 1) Portugal’s mainland and its two archipelagos, the Azores and Madeira 2) and the different islands in the Azores. These regions have been connected through submarine cables since the first connection through telegraphic cables in 1893 between mainland Portugal and the island of Horta in Azores.

The current operating CAM fibre optic ring system is owned by the former incumbent[31], which started operating in 1999 and is expected to be substituted by 2027.

Figure 8. Portuguese CAM ring



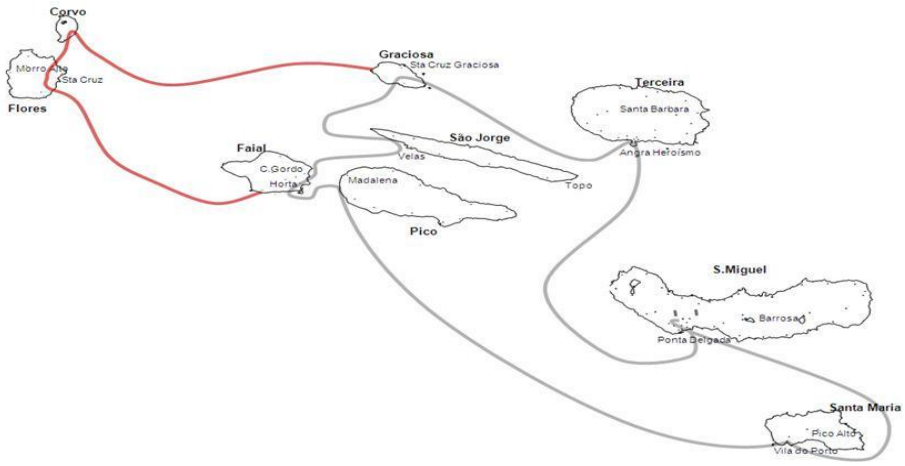
Source: Telegeography and ANACOM

Connecting the islands in the Azores, there are two other systems of submarine cables. The oldest one, a ring connecting the easternmost islands, and also approaching its economic end of life, is owned by MEO. The other one, owned by Fibroglobal, was installed in 2012 to support a state aid project (public tender launched in 2009) to serve rural areas with VHCN, a

[31] In Portugal, the PT, currently named Altice Portugal, owns MEO and, since 2022, a majority of Fibroglobal.

necessary means to provide high-speed connectivity to the westernmost islands in Azores. In 2022, Altice Portugal acquired Fibroglobal.

Figure 9. Azores Inter-islands system



Source: ANACOM

ANACOM started its regulation based on the Commission's Relevant Markets Recommendation in 2005, applying it to all routes based on existing domestic submarine cable systems. The wholesale product was originally based only on traditional lines but, from 2010 started to include Ethernet lines.

Price controls were applied, from 2005 to 2010, regarding traditional leased lines and between 2010 and 2016 for Ethernet leased lines, with a retail-minus approach, which subsequently transferred to a cost-orientation principle, applied to traditional lines from 2010. This was applied to terrestrial and non-terrestrial leased lines, in general, until the 2016 market analysis.

In 2015, new cost accounting data provided clear evidence to ANACOM that wholesale prices for leased lines based on domestic submarine cable routes were set at an excessive level, which led to the extension of the cost-orientation rule for Ethernet leased lines as well, allowing a price reduction of over 80% for wholesale clients, following an urgent decision.

Subsequently, the 2016 market analysis introduced the obligation for ANACOM to annually review the prices of circuits based on CAM and Inter-islands systems. The price reviews were to be based on a methodology which summed all relevant costs (i.e. CAPEX, OPEX, commercial and billing costs, common costs), dividing them by the occupied capacity of the relevant systems, resulting in a cost per Gbps. This cost was then compared to the price per Gbps and, if appropriate, a price reduction was ordered to comply with cost-orientation.

From the most recent round of market reviews, at the end of 2023, ANACOM concluded for the maintenance of SMP by MEO in the CAM and the eastern Azorean islands routes, finding out it was still the only provider of backbone connectivity, and that there was no competitive pressure from alternative operators for those routes. Importantly, Fibroglobal's routes connecting the westernmost Azores islands were also included in the relevant market. Given

its acquisition by Altice Portugal in 2022 and the historical evidence of access restriction on the lines supported on the cable system, Fibroglobal was also found to have SMP as part of the Altice Portugal group.

All remedies for Ethernet leased lines were maintained (extending to Fibroglobal's routes), and, due to a lack of demand, the provision of traditional lines was removed from the existing CAM and Azores Inter-islands reference offer. Additionally, ANACOM committed to reviewing the market once the new CAM ring was ready for service.

Based on the terms set on the market analysis, some changes were applied to the price review methodology, namely: instead of the capacity in use at the end of the year, Altice Portugal was now to provide information on the annual average capacity in use; traffic rerouting was to be applied to all clients automatically in case of failure of one of the branches of the CAM ring, with the inclusion of relevant costs for the price review; the price applicable to 10 Gbps should reflect Altice Portugal's savings in providing 10 Gbps circuits relative to providing 1 Gbps circuits.

These modifications have been applied in the latest draft decision, which considered both expected changes in costs and demand for the whole period until the end of 2026, when the new CAM system is expected to start operating, and also the predicted additional costs associated with the retirement of the current CAM system. This led to projected price reductions between 5% and 24.4% for CAM circuits and between 10.7% and 65.1% for Inter-islands circuits.

6. Potential challenges and future trends

Several NRAs identified in the response to the questionnaire as most relevant challenges the security, reliability and redundancy of the connections provided through submarine cables, the replacement of current submarine cable systems as the end of their lifecycle is approaching and the need for very high investments, especially when submarine cables serve remote areas or sparsely populated coastal villages, where investment is not justified based on future revenues.

Other NRAs also pointed out that it is key to monitor the evolution of effective competition in the long term, which requires precise data/information from different stakeholders. To this end, it is necessary to explicitly allow NRAs to collect information relating to submarine cables from both public and private entities (owners like telecom operators or big tech companies, suppliers, etc.).

6.1. Security, reliability and redundancy of the connections

Providing reliable connections with no degradation of service, even in case a particular cable is damaged, is essential, namely in very sensitive political contexts and hybrid warfare, with

an increased potential of cable sabotage. This may call for stricter physical and logical resilience requirements and cost-efficiency, which may be necessary for attracting multiple retail telecom operators or providers from other economic areas (like power) to peripherical regions.

On security, based on input received from stakeholders, BEREC considers that it is important to enhance security at critical points in the terrestrial segment on elements such as manholes, beach landing stations, and Cable Landing Stations. Another key aspect also raised by stakeholders is the need to ensure that there are enough vessels to repair submarine cables in a timely manner, and in case that the private initiative cannot cover the associated costs, it would be worth analysing the case for participation of the public initiative to ensure that Europe is ready to act quickly when there is problem needing intervention in the sea.

Fibre exchange agreements are a good practice to increase reliability in any case. For example, in the Balearic Islands it can be observed that two different operators exchange fibres in their submarine cables, which allows for ensure redundancy and increased resilience.

Additionally, the security of submarine cables at the EU level must be addressed at a multinational level, as the challenges posed by threats such as hybrid warfare in recent years require that various stakeholders – governments, industry, and academia – collaborate to enhance the resilience of these critical infrastructures. It is crucial to align the incentives of these stakeholders to achieve this common goal.

Science Monitoring And Reliable Telecommunications (SMART) submarine cables can play an important role in enhancing security, reliability, and redundancy. Equipped with sensors, these cables enable real-time monitoring of the health and status of the connections, ensuring early detection of potential issues. This capability is vital for maintaining uninterrupted services, particularly for critical infrastructure that depends on robust data transmission. By integrating artificial intelligence and machine learning, SMART cables can predict and prevent failures, thereby offering a more secure and reliable communication network.

6.2. The replacement of current submarine cable systems

From a political and economic perspective, when the end of the submarine cable life cycle approaches, it is important to ensure territorial continuity and that these links can continue to be maintained, namely if there are no alternatives to provide ECS in that area.

In this context, the renewal of current submarine cable systems and subsequent transfers of capacity by wholesale clients often require regulatory analysis. Indeed, the conditions offered by the new submarine cable(s) provider(s) may need to be assessed: not only the prices offered for each capacity, and the terms and conditions associated (including the ones related to redundancy), but also if they meet the conditions conducive to the entry of other operators/competitors that enable a wider range of consumer choices (the analysis done

before the submarine cable replacement is very similar to the one that is done during market analysis and the usual monitoring).

In addition, further clarification on whether the new cable(s) can be subject to ex ante market regulation may also be necessary, in case the new one is the sole infrastructure that allows retail operators to compete in remote and sparsely populated areas.

6.3. The need for high investments

Deploying submarine cables is always very expensive and typically for the connection of territories with low population (small islands or enclaves) there is no business case justifying pure private investment. That implies that as submarine cables will age, most probably it will be necessary to resort to, at least partially, public funding for these deployments, as they are critical for the connected territories and to guarantee that the concerned populations will not be left out from the increased connectivity conditions observed in the rest of the country (as in the case of Azores archipelago). Furthermore, to ensure that communications services continue to be provided without discontinuity, it is also important to strengthen the security and resilience of submarine cables, through actions in a whole resilience cycle approach, which may call for public funding plans, such as previewed in EU Action Plan on Cable Security.

In parallel, it is important to boost new investments to ensure that the European domestic and international submarine cable infrastructure is secure and resilient.

It is important to note that new investments would also enhance competition in this segment of communication markets. For example, in some countries, the entry of players from other areas in the field of electronic communications occurred: on some Spanish islands, there are already some electric cables equipped with fibres to provide communication services and on one of the Portuguese islands, a utilities group also runs a company that deployed a dedicated submarine cable for communications services. These utilities companies' providers are in some cases renting fibres to third parties and not providing leased lines, but still, it can make a difference in terms of competition at the retail level for ECS.

Lastly, some of the latest cables are equipped with sensors to measure temperature, movement of tectonic plates and monitor the marine fauna and flora, among others. The investment on these SMART submarine cables is crucial to obtain trends on heating, but also to detect in advance tsunamis and earthquakes.

In this context, specific plans and financing mechanisms may be key to leverage territorial cohesion, digital inclusiveness, security, investment and strengthening the EU's capabilities in submarine cable connectivity.

7. Summary and conclusions

The report gives an overview of the domestic submarine cable systems ensuring communications services in BEREC members, presents their regulatory treatment and identifies some major emerging trends.

As for the overview of the domestic cable systems: only 15 out of the 27 countries with direct access to sea, have segments of submarine cables connecting national CLS. Most of the submarine cable segments are deployed in the Mediterranean Sea (around 41%) and in the Atlantic Ocean (38%), while almost 16% of the segments are deployed in the Baltic Sea. The large majority of the submarine cables corresponds to purely domestic submarine cables (with all CLS in the same country), while only 12% of them are part of an international cable system. A large majority of submarine cables were deployed by ECN operators acting at the retail level and using submarine cables for their own network connections and operations, notwithstanding they also, in most cases, offer wholesale connectivity to others, either through leased lines or rental of dark fibre. Moreover, almost a third of the submarine cable systems are between 10 and 25 years old.

Concerning the ex-ante economic regulatory treatment of submarine cables by BEREC members, the report shows that six NRAs (Croatia, France, Greece, Iceland, Portugal, and Spain) have carried out a market analysis regarding or including domestic submarine cables leading to regulation of submarine cables with designation of an SMP operator. Over these six NRAs who regulate or have regulated submarine cables, four of them (Croatia, Greece, Iceland, Portugal) are still regulating this market, whereas the other two (France and Spain) stopped regulating it, respectively in 2017 and 2024.

Finally, several NRAs identified as the following most relevant challenges and emerging trends: the security, reliability and redundancy of the connections provided through submarine cables, the replacement of current submarine cable systems as the end of their lifecycle is approaching and the need for very high investments, especially when submarine cables serve remote areas or coastal villages sparsely populated, where investment is not justified based on future revenues.

In this context, it is key to monitor the evolution of effective competition in the long term, which requires precise data/information from different stakeholders. To this end, NRAs should be able to collect information relating to submarine cables from both public and private entities (owners like telecom operators or big tech companies, suppliers, among others).